DIODE

November 25, 2024

Gary Mitchell, Director of Community Development
10900 Courthouse Road
Charles City, VA 23030

RE: Rezoning, Special Use Permit & Comprehensive Plan Narrative

Dear Mr. Mitchell:

Roxbury Technology Park, LLC and Roxbury Technology Park II, LLC, through their affiliate Diode Ventures, LLC ("Diode"), are presenting the attached conditional rezoning application before the Charles City County Planning Commission and Board of Supervisors. The purpose of this application is to entitle the development of a future hyperscale data center campus with a special use permit supporting central utility facilities within the existing Roxbury Development Center.

Data centers play a crucial role in managing, processing, and storing the ever-increasing amount of data generated and consumed worldwide. As demand for data centers continues to rise, they are now being built in more diverse locations outside of major metropolitan areas. Charles City County is an ideal location for a data center, thanks to its ample land, overhead transmission lines, proximity to fiber networks, available workforce, and support of economic development as described in the 2014 Comprehensive Land Use Plan.

Diode's experience has shown that a hyperscale data center project can create around 1,200 skilled trades jobs during peak construction. This includes jobs such as electricians, HVAC technicians, plumbers, carpenters, and other tradespeople who are needed to construct the data center facility. We have also seen that a typical hyperscale data center project can create around 120 to 200 permanent jobs once the facility is operational. These jobs can include roles such as data center technicians, network engineers, maintenance staff, security personnel, administrative staff, and other positions required to operate and maintain the data center. While these employment metrics are ultimately dependent on the scale and complexity of the data center project, a community could see additional growth in demand and resources for other economic development such as retail, food service, shipping and logistics, and other ancillary services to support the data center and its professionals.

Diode is actively engaged in hearing concerns from county leaders and their constituents. We believe that this project, along with the necessary infrastructure improvements, offers a bright economic future in multiple ways including the creation of well-paying skilled jobs and broadening the community's tax base, while keeping the strain on public services, like schools, low.

A detailed narrative in support of the conditional rezoning application outlines how the proposed development will strive to comply with Charles City County's requirements. We welcome any questions associated with this application.

Regards,

Lindeon Davis

Lindeon S. Davis, Project Development Manager
Diode Ventures, LLC
DavisL@diodeventures.com

Rezoning, Special Use Permit & Comprehensive Plan Narrative

Date:	November 25, 2024
Applicant:	Roxbury Technology Park, LLC & Roxbury Technology Park II, LLC (together, the "Applicant")
Owner:	Please see **Exhibit A** (collectively, the "Owner")
Representative:	T. Preston Lloyd, Jr., Williams Mullen 200 South 10th Street Suite 1600 Richmond, VA 23219 Email: plloyd@williamsmullen.com Phone: (804) 420-6615
Project Name:	**Roxbury Technology Park** (the "Project")
Property:	Charles City County Tax Parcels 3-19, 3-20, 3-21, 3-30, and 7-140, consisting of approximately 515.23 acres, as surveyed and depicted in the attached **Exhibit B** (collectively, the "Property")
Request:	Conditional rezoning from a mix of Agricultural (A-1), Planned Development-Industrial Park (PD-IP), and Residential (R-1) to Light Industrial (M-1) for a future data center and a Special Use Permit for a central utility system in conjunction with a right-of-way greater than or equal to 30 feet in width to support the data center. (the "Request")

A. Application Overview

The Applicant and the Owner are requesting a conditional rezoning of the Property from a mix of Agricultural (A-1), Planned Development-Industrial Park (PD-IP), and Residential (R-1) zoning districts to the Light Industrial (M-1) zoning district, further described below in Table A-1, for the future development of a data center campus with a special use permit supporting central utility facilities, adjacent to the Roxbury Industrial Development Center.

Table A-1 Property Zoning Mix

Parcel Numbers	Acreage	Current Zoning	Proposed Zoning
3 19, 3-30	290.35 (as surveyed)	A-1, PD-IP	M-1
3 20	5.04 (as surveyed)	A-1	M-1
3 21	118.49 (as surveyed)	A-1	M-1
7 140	101.35 (as surveyed)	R-1	M-1

Below in Figure A-1 and Figure A-2 are visual illustrations of the proposed zoning classification change for the Property to support the Project.

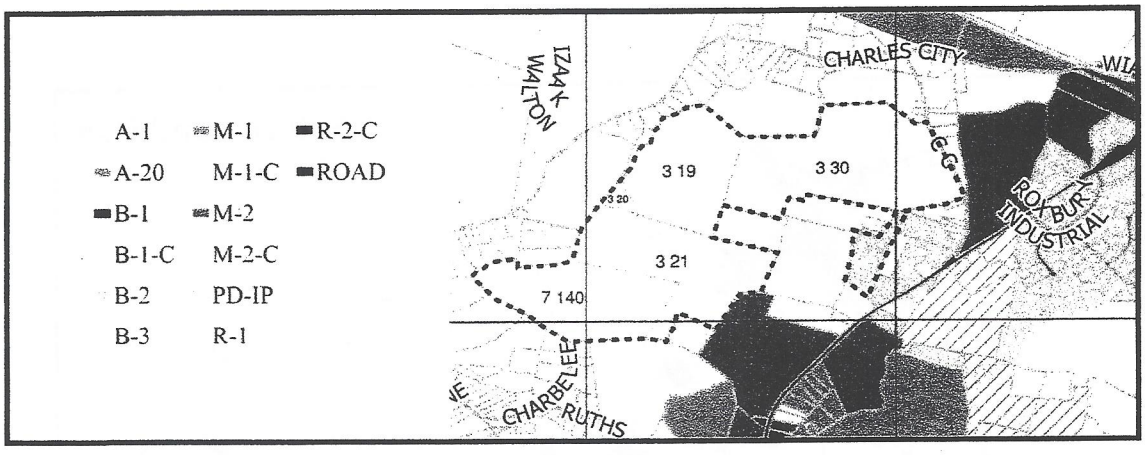


Figure A-1 Current Property Zoning Distribution per Official Zoning Map of Charles City County

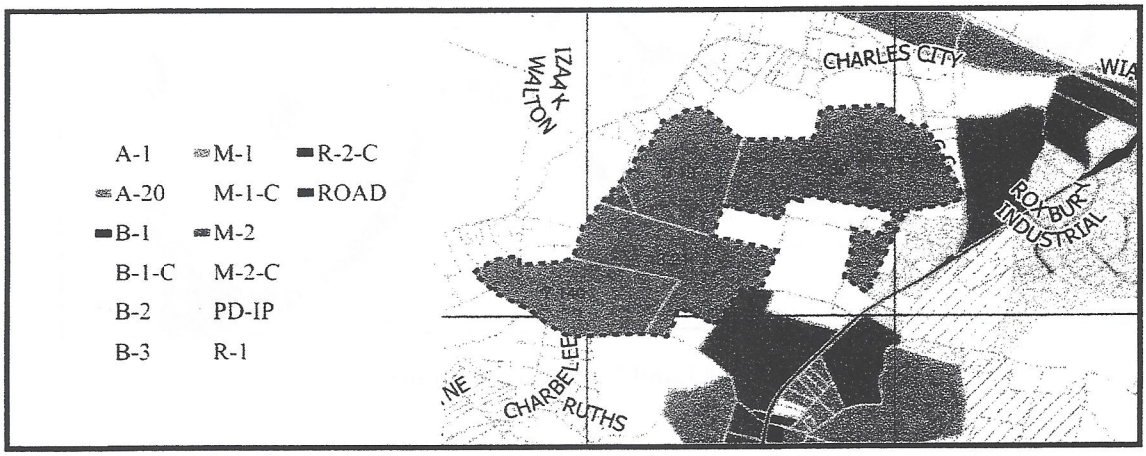


Figure A-2 Proposed Property Conditional Rezoning Distribution

Per the Charles City County Zoning Ordinance adopted March, 2006, as amended through August 1, 2024 (collectively the "Zoning Ordinance"), data centers are a by-right permitted use within the Light Industrial (M-1) zoning district. As shown in the 2014 Charles City County Comprehensive Land Use Plan (the "Comprehensive Plan"), Chapter 10 provides a Future Land Use Map, depicted below in Figure A-3. In Figure A-3, the Property to be conditionally rezoned lies within the bounds of one of only two development centers designated for future growth in the county, the Roxbury Development Center. Chapter 10 also states that "development within these areas encourages the blending of the new with the existing". Chapter 9 of the Comprehensive Plan, which lists its goals, objectives, and strategies, emphasizes the importance of maintaining a balance between new services, industrial growth, and the rural character of the county.

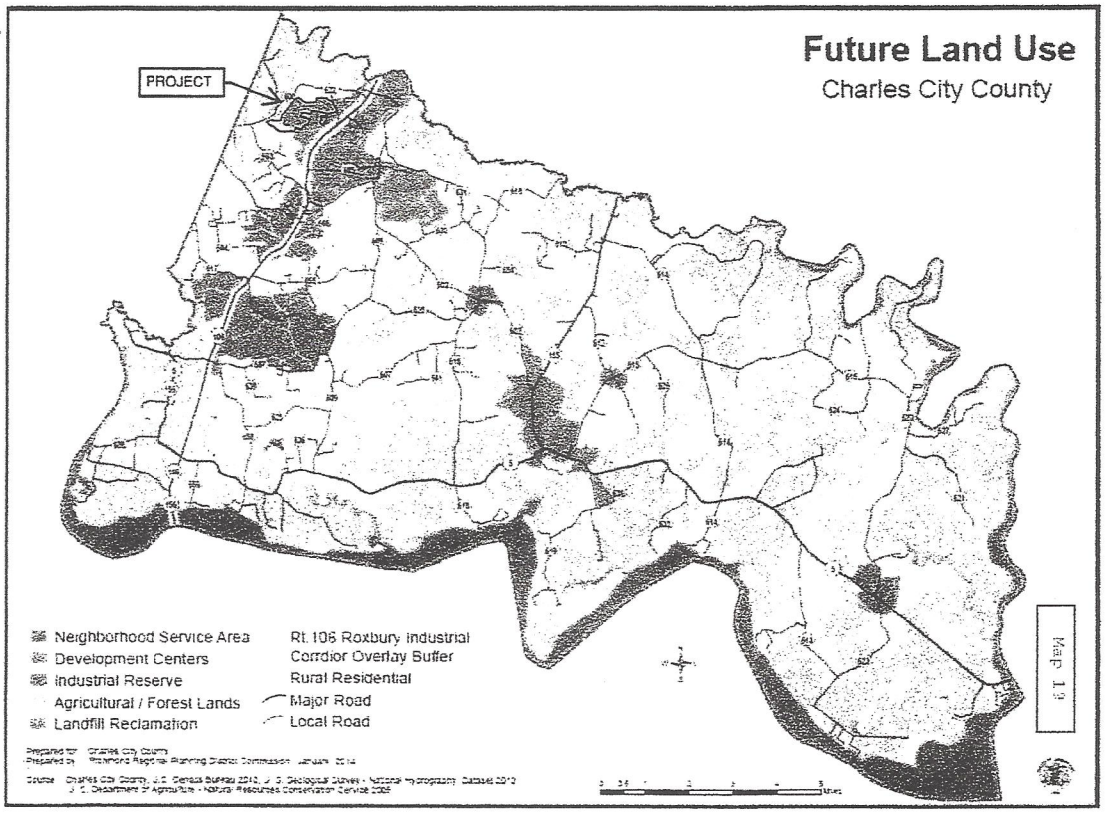


Figure A-3 Future Land Use Map for Property Area

Approval of the Request is consistent with Charles City County's goals for the Roxbury Development Center and will be contingent on approval by the county of a final, more definitive, site development plan that will be submitted by the Applicant at a later date.

B. Project Overview

The Project is located north of Charbelee Drive and Old Union Road, west of Roxbury Road, and bounded by Charles City Road to its west and north, in an unincorporated area southwest of Roxbury, Virginia within Charles City County. The Project is comprised of five (5) contiguous parcels of private land that collectively make up the Property. The Property is mainly forested in composition apart from the long-distance overhead transmission lines that bisect portions of the site and multiple areas of wetlands and streams found across the site, as generally shown in **Exhibit C**. The Property is vacant, with existing development limited to access roads/driveways throughout and the overhead transmission corridor. Currently, the Property is used for silviculture practices with recreational hunting at select times throughout the year.

The landscape surrounding the Property can be characterized as rural residential and agricultural with dense hardwood forests intermixed with forested wetlands and waterways. The Property is bordered on all sides by existing agricultural use and some industrial use interspersed. The Project is located near areas of commercial development, including a variety of businesses and facilities to the east and south along C C Road, Roxbury Road, and Chambers Road. Noteworthy businesses and industrial facilities include Chaney Enterprises Concrete Plant, Tire Recycling Solutions, Davis Autosports, Charles City Timber and Mat, Bruce Howard Contracting, Inc., the Charles City County Landfill, the Dominion Energy Chickahominy Substation, and the 85.60 acre industrial property owned by BHBH, LLC. The Project is expected to complement the existing development of industrial and commercial uses in the Roxbury area , while blending in a new "less intense" industrial use that strives to meet the goals of the Light Industrial (M-1) zoning district and the Comprehensive Plan, as discussed further below.

C. Criteria For Approval

1. **Does this request promote the public health, safety, convenience, and general welfare of the citizens of the County?**
   The Request will provide Charles City County with the opportunity to establish its first data center campus in one of the designated development centers per the Comprehensive Plan. This change is intended to be within the Light Industrial (M-1) zoning district, which is the least intensive industrial zoning district in the county per the Zoning Ordinance.

   The recently amended Zoning Ordinance authorizes "data center" as a permitted use within the Light Industrial (M-1), Heavy Industrial (M-2), and Planned Development-Industrial Park (PD-IP) zoning districts. While this allows for new industrial growth, the county government still retains its responsibility of reviewing each development request separately, taking into consideration its specific location, the site plan, and any possible effects it could have on the surrounding communities.

Data centers are good neighbors to communities in their immediate proximity for several key reasons:

i. Data center campuses typically require low levels of public services, such as police, fire, and EMS due to their high-security measures. This means that they should not negatively affect the crime rate or place a burden on emergency services.
ii. Data centers operate with a low employee count per square foot which allows for minimal expected impact on local traffic patterns and public facilities, including schools, libraries, and parks.
iii. Most data center developers use intentional campus style designs that can be built in ways that avoid and protect environmentally sensitive areas. Data centers are often designed to be set back from residential areas to reduce their visibility and blend into the surrounding landscape.

2. **Is the use in accordance with the goals, objectives, and strategies of the Comprehensive Plan?**

Yes, the proposed conditional rezoning of the Property to the Light Industrial (M-1) zone advances the goals, objectives, and strategies of the Comprehensive Plan.

The Project will encourage more robust economic communities by providing the local government with one of its first opportunities for a new industry that is in high demand (Comprehensive Plan Goal #1).

The Project can be designed in a way that is sensitive to the county's scenic integrity and quality of life, through master planning efforts that are consistent with local regulations and quality of life for the existing community (Comprehensive Plan Goal #2).

The Project is expected to have a low density of employees per square foot (minimal effect on traffic), to be designed in a campus-like setting with setbacks per the Zoning Ordinance, and to be a highly secure facility. For these reasons, the Project will preserve the county's rural heritage and quality of life (Comprehensive Plan Goal #4).

The development of the Project within the Roxbury Development Center on the Future Land Use Map will encourage ancillary industrial and tech businesses (Comprehensive Plan Goal #5).

Overall, the Project can help to achieve the Comprehensive Plan's objective of promoting public and private investment in development centers by attracting other businesses and generating tax revenue. The Project can also assist the county in meeting its goal of maintaining "30% of its tax base in commercial and industrial properties" as stated in Chapter 9 of the Comprehensive Plan, while providing new job opportunities and additional tax revenues.

3. **Is it compatible with the current surrounding uses, neighborhood, and the County in general?**

Yes. The Project expands the functionality of the existing Roxbury Development Center, while encouraging further private investment in the county. Below is a summary of the key effects of allowing the proposed and future data centers in the county:

Effects on adjacent properties –

The properties immediately adjacent to the Project are mostly larger, vacant and/or undeveloped lots that are 20 acres or greater in size. There are also a few smaller residential lots in the vicinity all located in agricultural districts. Initial siting efforts identified environmentally sensitive areas near the adjacent residential properties. These areas must be preserved and will form a natural buffer between the data center campus buildings and any adjacent residences.

Effects on the neighborhood –

The Project creates an extension of the Roxbury Industrial Center and is planned as such in the Comprehensive Plan. Data centers can attract additional businesses, encouraging new development in the Roxbury Industrial Center and Charles City County. While there are a limited number of rural residential homes in the area, the Project can be designed to have no or minimal visual or auditory impacts.

Effects on the county in general –

The tax revenue generated from the Project can help expand county resources and stimulate business and industry growth. During the construction phase, hundreds of skilled trade jobs may be created, providing an immediate economic boost that can last for 7-10+ years. Once the data centers are operational, they will employ approximately 30-50 full-time personnel per building.

Effects on public schools and other services –

The Project should not directly impact public schools. The tax revenue from a data center project can actually benefit the public school system and other public county services by providing additional tax revenue. Highly technical in security and design, data centers typically do not generate any increased volumes of calls to emergency responders.

Traffic –

The Project is not expected to have major traffic impacts as data centers do not typically cause a significant increase in traffic volume and flow. They are also usually located in industrial areas and are not open to the public. However, the construction of a new data center project can cause temporary increases in traffic during the construction phase. To mitigate these temporary impacts, best management practices will be used to monitor and manage the construction traffic.

To support this Request, the Applicant has included a traffic memorandum, which was prepared by Kimley Horn and dated November 21, 2024, titled "Roxbury Technology Park, LLC and Roxbury Technology Park II, LLC Trip Generation Analysis" attached as **Exhibit D** (the "Traffic Memo"). The Traffic Memo evaluated the anticipated site trips for the Project and determined that it will generate fewer daily trips than the threshold warranting the preparation of a traffic impact analysis ("TIA") under Virginia Department of Transportation (VDOT) guidelines. Per the VDOT Administrative Guidelines for the Traffic Impact Analysis Regulations, that threshold is 5,000 net new vehicle trips per day. From the two methods used within the Traffic Memo to assess the trips generated, it was identified that the Project would produce a maximum of 4,455 daily trips which is under the threshold for triggering the TIA.

Public Utilities –

Data centers require significant amounts of electricity and water to operate, including wastewater management. The Project is located near the Dominion Energy Chickahominy Substation and multiple transmission lines, ensuring ample electrical power supply. Water needs will be met via appropriate water supply source, with improvements to existing or new systems typically at the expense of the Project. The project is expected to utilize surface water provided from neighboring localities OR pulled directly from the James River, as the primary water source for data center cooling and consumption. Groundwater will NOT be used for data center cooling purposes, but minimal groundwater may be used for domestic and non-potable purposes, such as restrooms and kitchens. This limited use of groundwater will NOT impact the county's aquifer. The special use permit included in the Request will help to ensure that the necessary utilities can be provided to the site to support these needs.

Public Health –

The Project will be designed to operate with minimal environmental impact to the surrounding community. Data centers can be specifically constructed to reduce noise, dust, smoke, vibrations, and light pollution. The design of a data center includes features such as soundproofing, air filtration systems, downward lighting, and vibration dampening technologies, which reduce the noise, light, and vibrations generated by the equipment. All operations of a data center are completely enclosed within the building(s), which means that there is little to no impact on the surrounding community. Data centers are designed to operate in a controlled environment, with all equipment and processes contained within the building. This reduces the risk of any environmental impact, such as noise or dust pollution.

Hours of Operation –

Data centers operate 24 hours a day, 7 days a week, and 365 days a year. They are designed to provide continuous uptime and availability for the servers and other equipment that they house. Some data centers may have staff on-site around the clock, while others may have some degree of remote monitoring and support available to address any issues that may arise. Visitation and maintenance at data centers are infrequent and usually occur during regular business hours.

Environmental Impacts –

The Project will be designed to adhere to all federal, state, and local regulations as it pertains to environmentally sensitive lands, including, but not limited to, the county's Combined Water Protection Ordinance, Resource Protection Areas, floodplains and wetlands, endangered flora and fauna, and cultural resources. Environmental studies will be completed to assess the potential environmental impacts of the Project and identify measures that will be required to minimize or mitigate these impacts. These studies may include, but are not limited to, the following:

- **Environmental Site Assessment (ESA):** This study assesses the historical and current use of the site and identifies any potential environmental hazards, such as soil or groundwater contamination.
- **Cultural Resources Survey:** This survey may include a review of historical records, site inspections, and interviews with local experts and community members to identify and mitigate any potential impacts on cultural resources.
- **Geotechnical Study:** This study evaluates the soil and rock conditions at the proposed site, assesses the suitability of the site for development, and may evaluate the potential for soil erosion, landslides, or other geologic hazards.
- **Threatened and Endangered Species Survey:** This study identifies if there are any threatened or endangered species on the site and determines if any mitigation measures are required to protect them.
- **Wetland Delineation:** This study identifies the location and extent of wetlands on the site and determines if any permits or mitigation measures are required.
- **Acoustic Impact Study:** Acoustic impacts from the data center equipment and infrastructure have recently come into focus. These are handled via several studies: first, to identify baseline acoustic properties of the site, then later on, to inform the design of the data center(s) to minimize sound at the property boundary, and finally post-construction, to confirm that any sounds leaving the property are at a safe level.

Existing and Future development of the County –

Data centers are critical infrastructure necessary to store, analyze, and transmit data in an increasingly digital world. They support a wide range of businesses and the economy, both locally and globally. Data centers can help to promote Charles City County's strategic goals of encouraging industry and growth in a controlled way that respects the rural heritage of the county.

4. **Describe any existing zoning or conditional use permits and/or variances previously granted to this property.**
   There are no known existing zoning, conditional use permits, or variances previously granted to Parcels 3-19, 3-20, 3-21, 3-30 and 7-140.

D. Section 27-4 – Submittal Requirements

1. **A statement explaining the relationship of the development to the Comprehensive Plan.**
   The proposed conditional rezoning will advance the goals, objectives, and strategies of the Comprehensive Plan. The Project is in the area designated as the Roxbury Development Center on the Future Land Use Map. The goal of the Project is to develop a data center campus that will encourage economic growth in the county by attracting high levels of private investment. More details regarding the adherence to the Comprehensive Plan can be found in the section titled "Criteria for Approval" located above.

2. **A statement for presentation setting forth a maximum number of dwelling units or lots proposed for any residential development and the density and open space calculations where applicable.**
   No residential development is proposed in conjunction with the proposed conditional rezoning.

3. **A statement certifying that the proposed development conforms to the provisions of all applicable ordinances, regulations, and adopted standards. Any variance sought by the applicant shall be noted.**
   The requested conditional rezoning and special use permit described in Section A and depicted in Figures A-1 and A-2, is for the purpose of a future data center and associated utilities. The Applicant has no intention of deviating from this use other than including any required supporting facilities within good reason. Following conditional rezoning approval, the Applicant will develop detailed engineering and site plans that aim to preserve the rural history of the county. No variances are expected to be sought.

4. **A statement detailing any special amenities that are proposed.**
   No special amenities are proposed in conjunction with the proposed rezoning efforts and permits. Any future need for special amenities will be dependent on end user(s).

5. **A statement of public improvements both on and off site that are proposed for dedication and/or construction and an estimate of the timing for providing such improvements.**
   No on- or off-site improvements are proposed to be dedicated to the public at this time. All necessary on-site improvements being considered for the proposed data center campus, including, without limitation, public utility extensions, street widening, road/highway improvements, and their corresponding estimated timeline for completion, will be provided at the time of site plan review.

6. **A statement setting forth the proposed approximate development schedule.**
   While only conceptual, we anticipate the following development schedule for both proposed data center campuses contained in the Project:

   - Conditional rezoning and special use permit approval: 3 – 4 months
   - Detailed design and engineering: 8 – 12 months
   - Construction permitting approval: 4 – 6 months
   - Construction: 7 – 10+ years
   - Testing and commissioning: 6 – 12 months

   Ultimate construction phasing schedule and timeline will be contingent upon timelines for water infrastructure development and power delivery timelines set forth by the local utility provider. These details are still under active discussion.

7. **A site plan detailing the nature and location of any proffered conditions and those proposed circumstances that prompted the proffering of such conditions.**
   A scaled concept plan is shown in **Exhibit C** that shows the developable areas of the Project, with considerations to the Light Industrial M-1 setbacks per the Zoning Ordinance and environmental features including wetlands, streams, and RPA Buffers. The applicant is open to further discussions regarding the proposed concept plan and concerns that can be addressed within the conditions of this rezoning request.

8. **A signed Proffer Statement for both the applicant and owner.**
   The applicant is open to further discussions regarding the proposed rezoning and concerns that can be addressed within a future proffer statement.

EXHIBITS

A. List of Property Owners and Tax Parcel Numbers
B. "ALTA Survey - Tax Parcels 3-19, 3-20, 3-21, 3-30, and 7-140", titled "RTP ALTA SURVEY" dated August 16, 2024, and "RTP-II ALTA SURVEY" dated November 22, 2024, prepared by Survey and Mapping, LLC (SAM).
C. "General Development Plan", titled "Roxbury Technology Park General Development Plan", prepared by Hoefer Welker and dated November 21, 2024.
D. "Traffic Memo", titled "Roxbury Technology Park, LLC and Roxbury Technology Park II, LLC Trip Generation Analysis", prepared by Kimley Horn and dated November 21, 2024.

EXHIBIT A

List of Property Owners and Tax Parcel Numbers

Property Owner	Charles City County Tax Parcel Number
Andrea K. Greene, Trustee	3-19
Columbia Hill, LLC	3-20
Margaret P. Otey & Melvin R. Otey III	3-21
Andrea K. Greene, Trustee	3-30
Jonathan C. Kinney, Trustee	7-140

Kimley»Horn

MEMORANDUM

To: Sheri Adams
Deputy Zoning Administrator and Transportation Planner
Charles City County

From: Sarah Knox, P.E.
Katie Weatherton, E.I.T.
Kimley-Horn

Date: November 21, 2024

Subject: Roxbury Technology Park, LLC and Roxbury Technology Park II, LLC
Trip Generation Analysis

The following presents a trip generation analysis for the proposed data center at Roxbury Technology Park, LLC and Roxbury Technology Park II, LLC. This site is located in Charles City County, Virginia on parcels zoned A-1 (Agricultural District), PD-IP (Planned Development – Industrial Park), and R-1 (Residential District). A zoning application will be submitted to convert the existing parcels (plat numbers 3-19, 3-20, 3-21, 3-30, and 7-140) to M-1 (Light Industrial), to permit the construction of the data center land use. The properties are currently vacant and will be accessed along CC Road via Route 106. The following trip generation was prepared to demonstrate that the proposed development will generate fewer daily trips than the threshold warranting the preparation of a traffic impact study under Virginia Department of Transportation (VDOT) guidelines. Per the VDOT Administrative Guidelines for the Traffic Impact Analysis Regulations, that threshold is 5,000 net new vehicle trips per day.

Proposed Trip Generation Analysis

Weekday trip generation for the proposed land use was calculated using the average rates in the Institute of Transportation Engineers (ITE) *Trip Generation Manual, 11th Edition*. **Table 1** below shows that the proposed development will generate 4,455 daily trips, 495 AM peak hour trips, and 405 PM peak hour trips.

Table 1: Proposed Trip Generation (ITE Rates)

ITE Code	Land Use	Density		Daily	AM Peak Hour			PM Peak Hour		
					Total	Enter	Exit	Total	Enter	Exit
Proposed Development										
160	Data Center	4,500	1,000 SF	4,455	495	272	223	405	122	283

Weekday trip generation for the proposed land use was also calculated using rates presented in the Bowman memorandum titled *AWS Data Center Trip Generation Assessment*, dated March 15, 2023. This memorandum calculated data center trip generation rates for six existing data center campuses

in Virginia from January 2022 to January 2023. These rates have been accepted by VDOT as providing more accurate trip generation estimates for the data center land use. Based on these rates, **Table 2** below shows that the proposed development will generate 3,375 daily trips, 405 AM peak hour trips, and 135 PM peak hour trips.

Table 2: Proposed Trip Generation (Bowman-Collected Rates)

ITE Code	Land Use	Density		Daily	AM Peak Hour			PM Peak Hour		
					Total	Enter	Exit	Total	Enter	Exit
Proposed Development										
160	Data Center	4,500	1,000 SF	3,375	405	223	182	135	41	94

Trip generation rates for both the *ITE Trip Generation Manual* and the Bowman Study are provided in **Attachment 1**.

Both trip generation methods result in daily trip generation below the 5,000 daily trip threshold for a VDOT traffic impact study. Additionally, the anticipated peak hour trip generation potential of the proposed development represents approximately 14 percent of the capacity of the adjacent roadways. As such, it is not expected that additional traffic analyses are required.

ATTACHMENT 1

Table A-1: ITE Trip Generation Rates for Data Center Land Use

Period	Rate
Weekday	0.99
AM Peak Hour	0.11
PM Peak Hour	0.09

Source: ITE Trip Generation Manual, 11th Edition

Table A-2: Bowman Study Trip Generation Rates for Data Center Land Use

Period	Rate
Weekday	0.75
AM Peak Hour	0.09
PM Peak Hour	0.03

Source: AWS Data Center Trip Generation Assessment (Bowman), dated March 15, 2023

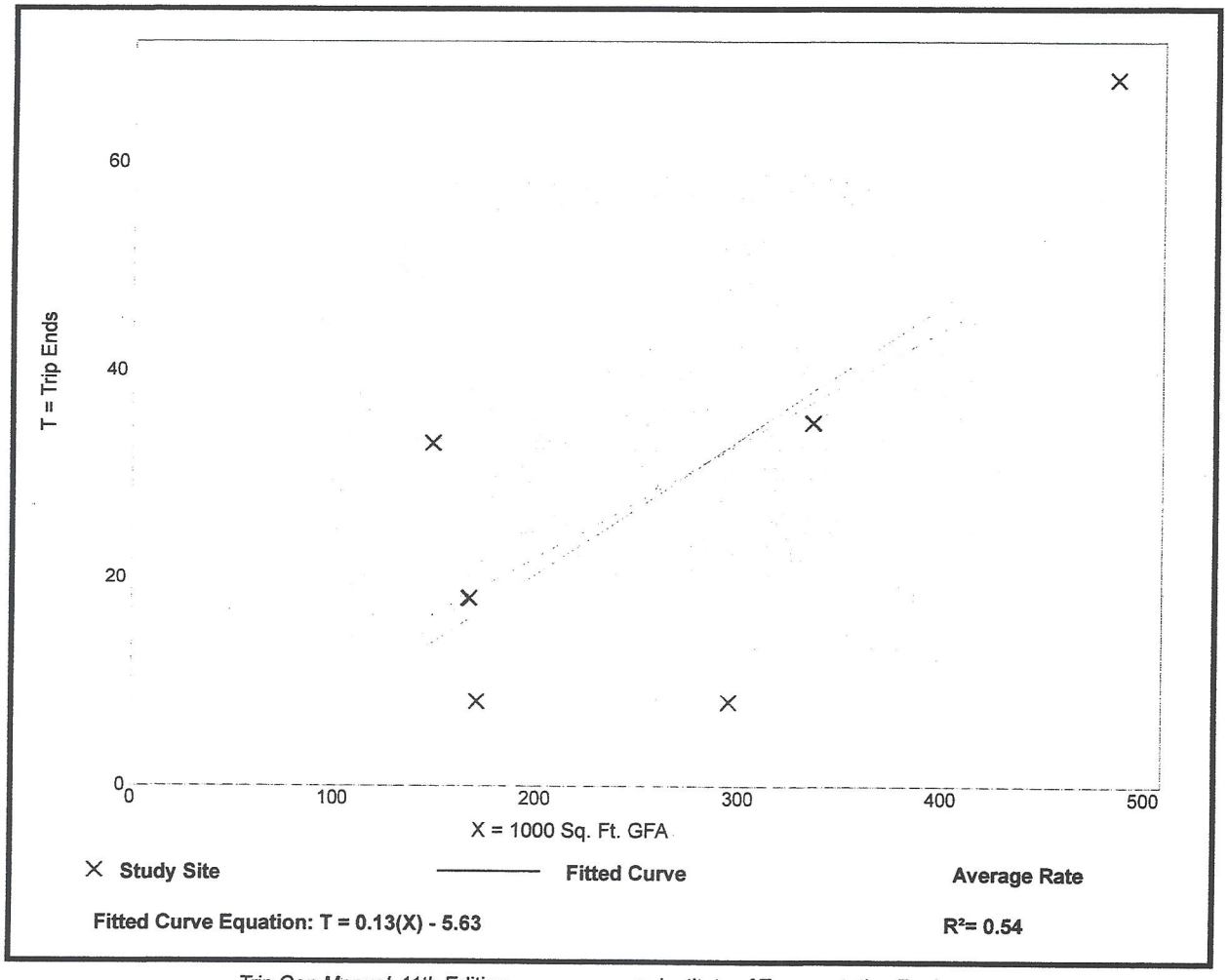
Data Center
(160)

Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 6
Avg. 1000 Sq. Ft. GFA: 267
Directional Distribution: 55% entering, 45% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
0.11	0.03 - 0.22	0.06

Data Plot and Equation



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Data Center
(160)

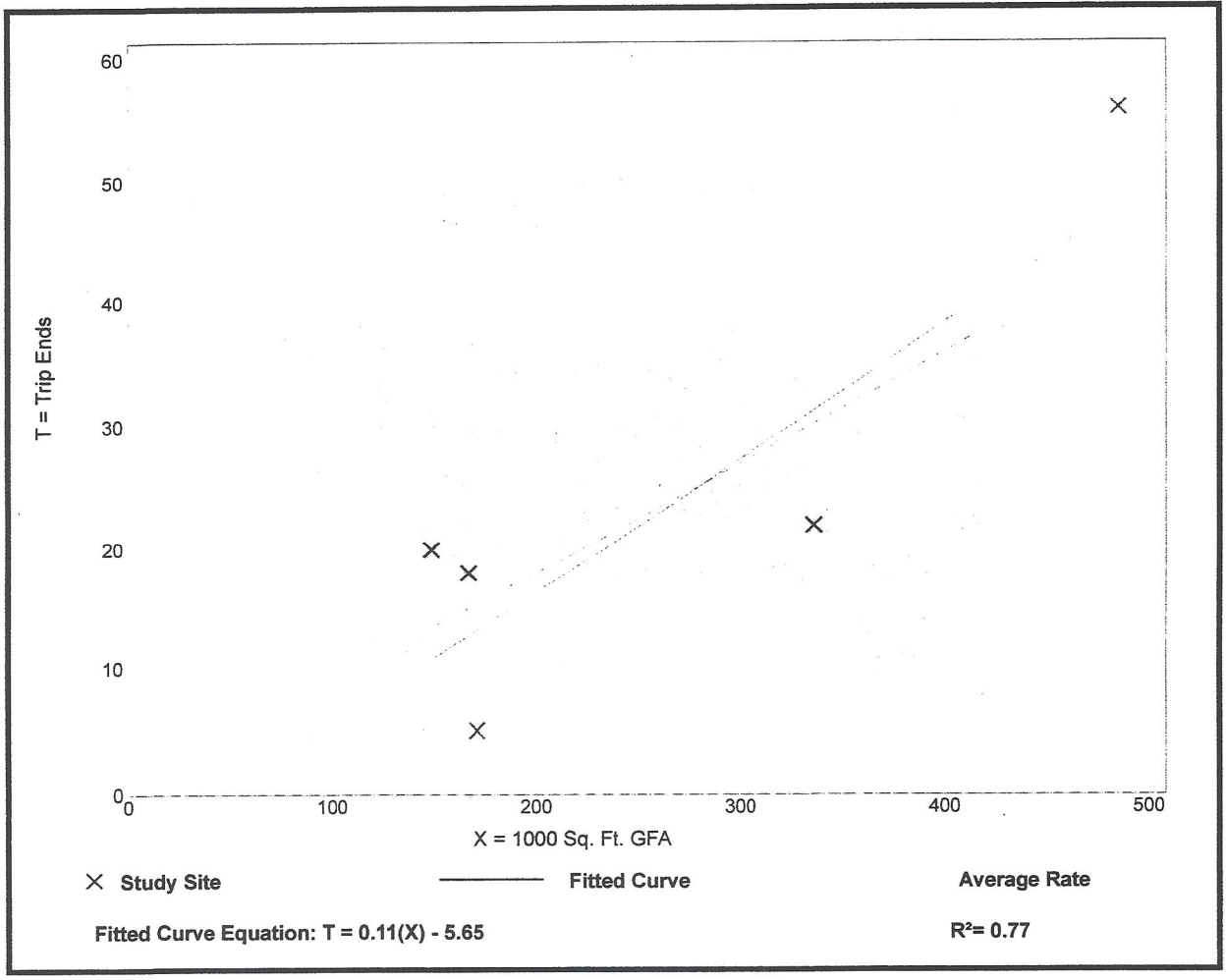
Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 5
Avg. 1000 Sq. Ft. GFA: 262
Directional Distribution: 30% entering, 70% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
0.09	0.03 - 0.13	0.04

Data Plot and Equation

Caution – Small Sample Size



Data Center
(160)

Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday**

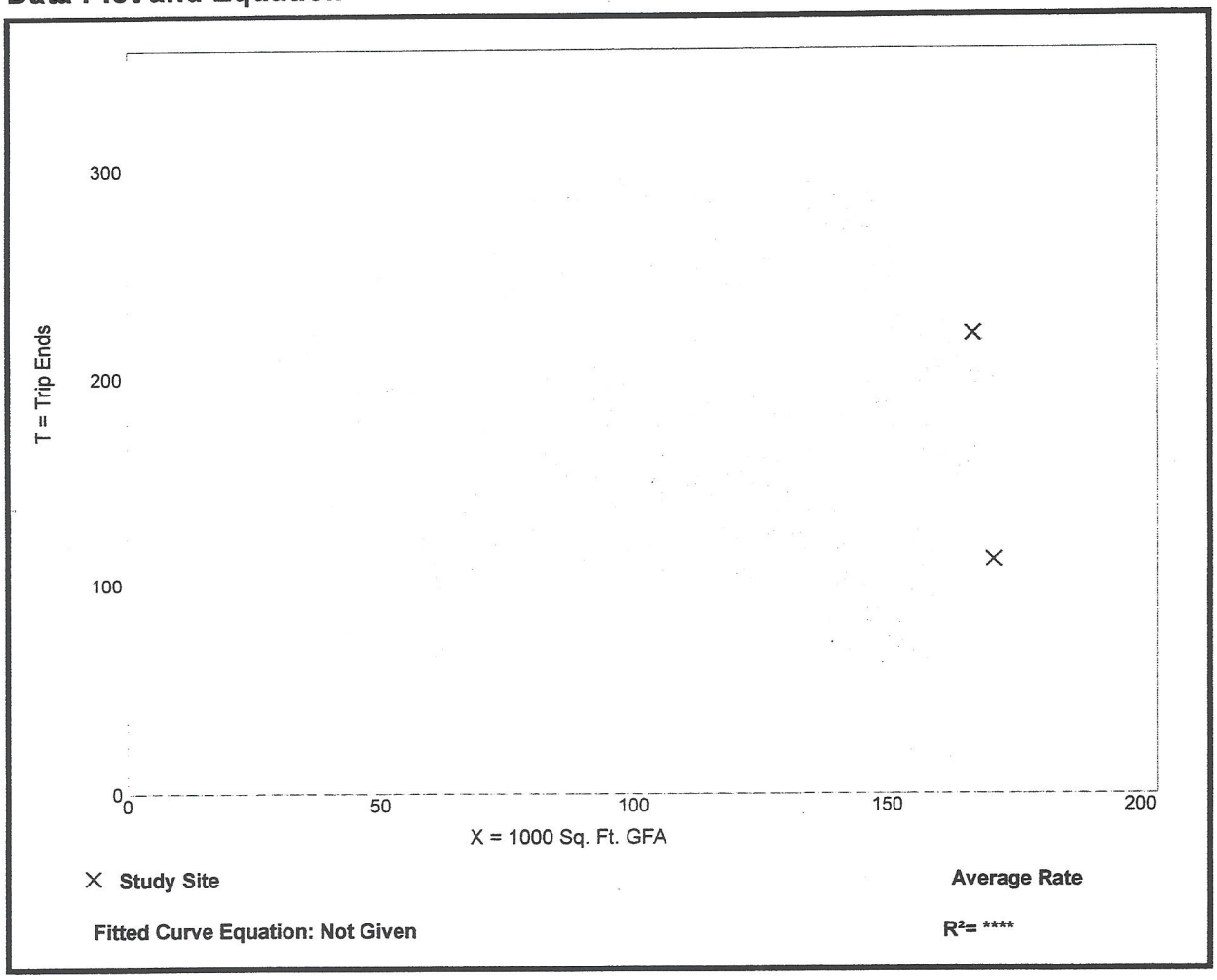
Setting/Location: **General Urban/Suburban**
Number of Studies: 2
Avg. 1000 Sq. Ft. GFA: 169
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
0.99	0.65 - 1.32	*

Data Plot and Equation

Caution – Small Sample Size



Trip Gen Manual, 11th Edition • Institute of Transportation Engineers

Bowman

Memorandum

To: Mr. Casey Frazier
Sr. Real Estate Development Manager
AWS Data Center Supply Solutions

From: Michael J. Young, P.E.

Date: 3/15/2023

Re: AWS Data Center Trip Generation Assessment

As requested, Bowman has prepared a trip generation assessment to determine the weighted average trip generation rate for Amazon Web Services (AWS) Data Centers located in the Commonwealth of Virginia. This evaluation was performed in accordance with the criteria and guidelines established in the Institute of Transportation Engineers (ITE) *Trip Generation Handbook, 3rd Edition.*

Background Information

AWS develops and constructs data centers throughout the country and the Commonwealth of Virginia. The data centers developed by AWS are highly specialized and modern facilities, and the evolving design of these facilities incorporate efficient operations and automated systems.

There are several data centers planned in Virginia by AWS and, as part of the development of these sites, traffic projections need to be developed to anticipate potential impacts.

The ITE *Trip Generation Manual, 11th Edition* includes such traffic projection information for data center sites. However, the trip generation rates from the Manual were developed based on two (2) surveyed sites for daily trips, six (6) surveyed sites for AM peak hour trips, and five (5) surveyed sites for PM peak hour trips. Due to the limited number of surveyed sites, the Trip Generation Manual offers the following disclaimer for this information:

> *"Caution should be used when applying trip generation rates for data centers, as the database contains a small number of sites with limited data on the number of tenants and employees."*

Data centers have a very small number of visitors, and the majority of trips are typically driven by employees or deliveries. Due to the technological advancements referenced above, data centers have become more efficient over time and rely on fewer on-site employees to operate.

The ITE Trip Generation Manual notes that the sites included were surveyed in the 2010s. Due to the aforementioned technological advancements, it is also likely that the traffic generation rates from the 2010s are no longer applicable to newer facilities.

Therefore, Bowman has prepared this trip generation assessment based on historical data of already established campuses with the following purposes:

1. To determine the average weekday, morning peak hour, and evening peak hour trip generation rates for a fully operational AWS Data Center. These average rates will be developed based on data from six (6) existing facilities, and will then be utilized throughout the planning process for future AWS Data Center developments in the Commonwealth of Virginia.

2. To compare these trip generation rates to the trip generation data documented in the ITE *Trip Generation Manual, 11th Edition.*

Methodology

The methodology utilized for this assessment was developed based on the criteria and guidelines included in the ITE *Trip Generation Handbook, 3rd Edition,* Chapter 9, "Use of Local Data to Estimate Trip Generation." Chapter 9 outlines the process for calculating the weighted average trip rate based on traffic data collected from existing facilities.

Chapter 9 also notes that trip generation data should be collected at a minimum of three (3) local sites, but that collecting data at five (5) or more sites is preferrable. Please note that, for the purposes of this evaluation, trip generation information from six (6) existing sites was evaluated.

Site Selection

For the purposes of this assessment, traffic data was collected from six (6) existing AWS Data Center campuses, all of which are located within the Commonwealth of Virginia. The sites surveyed are similar in both size and anticipated operations as the future data centers planned in Virginia by AWS.

Additional information regarding the building square footage and number of employees at each surveyed campus is as follows:

- Campus 1: 285,000 SF / 50 Employees
- Campus 2: 600,000 SF / 100 Employees
- Campus 3: 520,000 SF / 75 Employees
- Campus 4: 310,000 SF / 50 Employees
- Campus 5: 435,000 SF / 75 Employees
- Campus 6: 725,000 SF / 160 Employees

Trip Generation Data Collection

Cumulative trip data for each campus identified above was provided by AWS for the time period of January, 2022 to January, 2023. The AWS Data Centers are all secure facilities with historical data records, and the trip data provided to Bowman was extracted from the security card readers at each campus entrance.

The data center campuses surveyed included auxiliary spaces for site maintenance and support services which do not generate additional site trips. These auxiliary spaces vary in size from campus to campus, and therefore, the square footage of these areas was not included as part of the development of the trip generation rates for the actual data center buildings.

However, all existing site trips pertinent to the overall data center operations (including the auxiliary spaces) were included in the traffic data captured and evaluated in this memorandum.

Typical vehicle and heavy vehicle information was able to be included in this dataset, as the security gates at the facilities have separate card readers for trucks vs. passenger cars.

The trip data provided to Bowman was further refined to only include the card reader information recorded on an average weekday (Tuesday, Wednesday, or Thursday). The card reader information is timestamped, and therefore, the AM and PM peak hour trips for each campus were able to be extracted from the highest one-hour period of trips from 7:00 AM – 9:00 AM (AM peak), and from 4:00 PM – 6:00 PM (PM peak).

Data Summary and Evaluation

Based on the data provided, the existing trips per day for each surveyed campus were developed as shown in **Table 1.**

Table 1. Existing Campus Trips per Day

	No. of Average Weekdays Recorded Jan '22 - Jan '23		Total Recorded Daily Trips Jan '22 - Jan '23	Trips per Day			Total Recorded PM Peak Trips Jan '22 - Jan '23	PM Peak Hour Trips per Day
Campus 1	159	Car	39,272	246.99	4,360	27.42	1,583	9.96
		Truck	1,500	9.43	95	0.60	0	0.00
		TOTAL	**40,772**	**256.43**	**4,455**	**28.02**	**1,583**	**9.96**
Campus 2	159	Car	90,362	568.31	11,238	70.68	3,263	20.52
		Truck	2,026	12.74	198	1.25	7	0.04
		TOTAL	**92,388**	**581.06**	**11,436**	**71.92**	**3,270**	**20.57**
Campus 3	130	Car	41,442	318.78	5,867	45.13	1,930	14.85
		Truck	646	4.97	84	0.65	7	0.05
		TOTAL	**42,088**	**323.75**	**5,951**	**45.78**	**1,937**	**14.90**
Campus 4	159	Car	29,504	185.56	2,442	15.36	1,373	8.64
		Truck	3,984	25.06	195	1.23	60	0.38
		TOTAL	**33,488**	**210.62**	**2,637**	**16.58**	**1,433**	**9.01**
Campus 5	159	Car	45,538	286.40	6,309	39.68	1,863	11.72
		Truck	5,782	36.36	653	4.11	60	0.38
		TOTAL	**51,320**	**322.77**	**6,962**	**43.79**	**1,923**	**12.09**
Campus 6	130	Car	58,394	449.18	7,871	60.55	2,333	17.95
		Truck	2,324	17.88	285	2.19	50	0.38
		TOTAL	**60,718**	**467.06**	**8,156**	**62.74**	**2,383**	**18.33**

The campus-specific size and number of employees were then applied to these total trips to develop the average trips per 1,000 SF and the average trips per employee at each campus as shown in **Table 2.**

Table 2. Average Campus Trips per 1,000 SF and per Employee

	Square Footage (SF)	No. of Employees		Trips per Day	Daily Trips per 1,000 SF	Daily Trips per Employee				PM Peak Hour Trips per Day	PM Peak Hour Trips per 1,000 SF	PM Peak Hour Trips per Employee
Campus 1	285,000	50	Car	246.99	0.87	4.94	27.42	0.10	0.55	9.96	0.03	0.20
			Truck	9.43	0.03	0.19	0.60	0.00	0.01	0.00	0.00	0.00
			TOTAL	256.43	**0.90**	**5.13**	28.02	**0.10**	**0.56**	9.96	**0.03**	**0.20**
Campus 2	600,000	100	Car	568.31	0.95	5.68	70.68	0.12	0.71	20.52	0.03	0.21
			Truck	12.74	0.02	0.13	1.25	0.00	0.01	0.04	0.00	0.00
			TOTAL	581.06	**0.97**	**5.81**	71.92	**0.12**	**0.72**	20.57	**0.03**	**0.21**
Campus 3	520,000	75	Car	318.78	0.61	4.25	45.13	0.09	0.60	14.85	0.03	0.20
			Truck	4.97	0.01	0.07	0.65	0.00	0.01	0.05	0.00	0.00
			TOTAL	323.75	**0.62**	**4.32**	45.78	**0.09**	**0.61**	14.90	**0.03**	**0.20**
Campus 4	310,000	50	Car	185.56	0.60	3.71	15.36	0.05	0.31	8.64	0.03	0.17
			Truck	25.06	0.08	0.50	1.23	0.00	0.02	0.38	0.00	0.01
			TOTAL	210.62	**0.68**	**4.21**	16.58	**0.05**	**0.33**	9.01	**0.03**	**0.18**
Campus 5	435,000	75	Car	286.40	0.66	3.82	39.68	0.09	0.53	11.72	0.03	0.16
			Truck	36.36	0.08	0.48	4.11	0.01	0.05	0.38	0.00	0.01
			TOTAL	322.77	**0.74**	**4.30**	43.79	**0.10**	**0.58**	12.09	**0.03**	**0.16**
Campus 6	725,000	160	Car	449.18	0.62	2.81	60.55	0.08	0.38	17.95	0.02	0.11
			Truck	17.88	0.02	0.11	2.19	0.00	0.01	0.38	0.00	0.00
			TOTAL	467.06	**0.64**	**2.92**	62.74	**0.09**	**0.39**	18.33	**0.03**	**0.11**

The cumulative trip, square footage, and employee data across all six (6) campuses were then combined to develop the weighted average trip rates per the criteria in the ITE *Trip Generation Handbook, 3rd Edition.*

The weighted average trip generation rates are shown in **Table 3.**

Table 3. Weighted Average Trip Generation Rates

	Square Footage (SF)	No. of Employees		Trips per Day	Daily Trips per 1,000 SF	Daily Trips per Employee				PM Peak Hour Trips per Day	PM Peak Hour Trips per 1,000 SF	PM Peak Hour Trips per Employee
WEIGHTED AVERAGE	2,875,000	510	Car	2055.24	0.71	4.03	258.82	0.09	0.51	83.62	0.03	0.16
			Truck	106.44	0.04	0.21	10.01	0.00	0.02	1.24	0.00	0.00
			TOTAL	2161.68	**0.75**	**4.24**	268.83	**0.09**	**0.53**	84.86	**0.03**	**0.17**

Note: Values shown represent the cumulative data from all six (6) surveyed AWS campuses.

Data Comparison with ITE Trip Generation Manual

The average projected trip generation rates for the existing data centers shown in **Table 3** were then compared with the published rates from the ITE Trip Generation Manual for data centers (Land Use 160).

The ITE Trip Generation Manual does not include any employee information, and therefore, the comparison of rates was limited to building square footage only. The average rate comparison is shown in **Table 4.**

Table 4. Average Rate Comparison – ITE Trip Generation Manual vs. Existing Campus Data

Data Source	Weekday per 1,000 SF	AM Peak Hour per 1,000 SF	PM Peak Hour per 1,000 Sf
ITE Manual	0.99	0.11	0.09
Existing Campus Data	0.75	0.09	0.03
Existing Campus % of ITE Rate	**75.8%**	**81.8%**	**33.3%**

As shown in **Table 4,** the site-specific campus data indicates that the average trip rates for the AWS Data Centers are lower than those included in the ITE Trip Generation Manual.

PM Peak Hour of Generator Evaluation

Based on the data provided by AWS, the PM Peak Hour (highest one-hour period from 4:00 PM – 6:00 PM) trip generation rate shown in **Table 4** is 1/3 the size of both the ITE Manual PM Peak Hour trip generation rate, and the existing campus AM Peak Hour trip generation rate.

Upon review of the data provided by AWS, this PM Peak Hour trip generation rate appears to be a result of the campus operations being more intensive during times when the surrounding roadways are not as busy ("off-peak"). Therefore, through additional coordination with VDOT, it was requested that this memorandum also evaluate the PM Peak Hour of *Generator* for the existing data center campuses.

Instead of only evaluating the highest one-hour period from 4:00 PM – 6:00 PM, the "PM Peak Hour of Generator" is the most trip-intensive hour of a development for any time between 12:00 PM and 12:00 AM.

The trip data for each campus was combined into 15-minute intervals for this 12:00 PM – 12:00 AM timeframe in order to determine the PM Peak Hour of Generator for each campus. The results

of this evaluation indicate that the PM Peak Hour of Generator generally falls somewhere within the timeframe of 12:30 PM to 2:15 PM depending on the campus.

The existing PM Peak Hours of Generator and associated trips per day for each surveyed campus were developed and are included in **Table 5.** The campus-specific size and number of employees were then applied to these trips per day to develop the average PM Peak Hour of Generator trips per 1,000 SF and per employee at each campus.

Table 5. PM Peak Hour of Generator Existing Campus Trips per Day, per 1,000 SF, and per Employee

	No. of Average Weekdays Recorded Jan '22 - Jan '23	Observed PM Peak Hour of Generator	[illegible]	[illegible]	Trip Type	[illegible]	[illegible]	PM Peak Hour of Generator Trips per 1,000 SF	PM Peak Hour of Generator Trips per Employee
Campus 1	159	1:15 PM - 2:15 PM	285,000	50	Car	3,710	23.33	0.08	0.47
					Truck	229	1.44	0.01	0.03
					TOTAL	**3,939**	**24.77**	**0.09**	**0.50**
Campus 2	159	1:15 PM - 2:15 PM	600,000	100	Car	8,386	52.74	0.09	0.53
					Truck	162	1.02	0.00	0.01
					TOTAL	**8,548**	**53.76**	**0.09**	**0.54**
Campus 3	130	1:15 PM - 2:15 PM	520,000	75	Car	3,355	25.81	0.05	0.34
					Truck	62	0.48	0.00	0.01
					TOTAL	**3,417**	**26.28**	**0.05**	**0.35**
Campus 4	159	1:00 PM - 2:00 PM	310,000	50	Car	2,743	17.25	0.06	0.35
					Truck	536	3.37	0.01	0.07
					TOTAL	**3,279**	**20.62**	**0.07**	**0.41**
Campus 5	159	12:30 PM - 1:30 PM	435,000	75	Car	3,195	20.09	0.05	0.27
					Truck	524	3.30	0.01	0.04
					TOTAL	**3,719**	**23.39**	**0.05**	**0.31**
Campus 6	130	1:00 PM - 2:00 PM	725,000	160	Car	4,919	37.84	0.05	0.24
					Truck	262	2.02	0.00	0.01
					TOTAL	**5,181**	**39.85**	**0.05**	**0.25**

This information was then combined in **Table 6** to develop the weighted average PM Peak Hour of Generator trip rates per the criteria in the ITE *Trip Generation Handbook, 3rd Edition.*

Table 6. Weighted Average PM Peak Hour of Generator Trip Generation Rates

	Square Footage (SF)	No. of Employees	Trip Type	PM Peak Hour of Generator Trips per Day	PM Peak Hour of Generator Trips per 1,000 SF	PM Peak Hour of Generator Trips per Employee
WEIGHTED AVERAGE	2,875,000	510	Car	177.07	0.06	0.35
			Truck	11.62	0.00	0.02
			TOTAL	188.69	**0.07**	**0.37**

Note: Values shown represent the cumulative data from all six (6) surveyed AWS campuses.

As shown in **Table 6**, the calculated PM Peak Hour of Generator for the existing campuses currently generates an average of 0.07 trips per 1,000 SF and 0.37 trips per employee. These rates represent values that are over twice as intensive as those associated with the standard PM Peak Hour from 4:00 PM – 6:00 PM (0.03 trips per 1,000 SF and 0.17 trips per employee).

Conclusions

Based on the evaluation contained in this memorandum, the anticipated site trip rates associated with the AWS Data Centers are lower than those included in the ITE Trip Generation Manual.

The AWS rates appear to be a more appropriate estimation of future trips, as the rates from the Trip Generation Manual were developed based on a fewer number of surveyed sites. The Trip Generation Manual also only includes data from the 2010s, and the lower AWS trip generation rate is consistent with changes in the data center industry since then.

The average PM Peak Hour trip generation rate at the existing campuses is 1/3 the size of both the ITE Manual PM Peak Hour trip generation rate and the existing campus average AM Peak Hour trip generation rate. Therefore, VDOT requested an additional evaluation to determine the PM Peak Hour of Generator for the existing campuses.

Based on this evaluation, the PM Peak Hour of Generator for each campus generally falls somewhere within the timeframe of 12:30 PM to 2:15 PM, and the site trips during these timeframes are over twice as intensive as those associated with the standard PM Peak Hour from 4:00 PM – 6:00 PM.

Data centers have become more efficient and automated over this time, and typically require fewer on-site employees to operate. In coordination with VDOT, it has been determined that the square footage of each proposed campus should be used to project the anticipated site trips associated with each Data Center development.

As such, it is proposed to use the following rates throughout the planning process for future AWS Data Center developments in the Commonwealth of Virginia:

- **0.75 Daily Trips per 1,000 S.F.**
- **0.09 Morning Peak Hour Trips per 1,000 S.F.**
- **0.03 Evening Peak Hour Trips per 1,000 S.F.**