Date of Meeting: February 16, 2022

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BOARD OF SUPERVISORS
TRANSPORTATION AND LAND USE COMMITTEE
ACTION ITEM

SUBJECT: **Loudoun County Data Center Land Study**

ELECTION DISTRICT: Countywide

CRITICAL ACTION DATE: At the pleasure of the Committee

STAFF CONTACTS: Buddy Rizer, Economic Development
Alex Gonski, Economic Development
James David, Planning and Zoning

PURPOSE: To present the findings and recommendations contained within a comprehensive review of the data center industry, including land suitability and availability for future development, to the Transportation and Land Use Committee (TLUC).

RECOMMENDATION: Staff recommends that the TLUC consider regulatory changes to prohibit data centers in the Route 7 corridor as part of the ongoing Zoning Ordinance Rewrite (ZO Rewrite) and evaluate future policy and regulatory changes to allow data centers in a new opportunity area identified as Dulles Cloud South in the southern part of the County.

BACKGROUND: Over the past 14 years, the Department of Economic Development (DED) has regularly studied and marketed available land inventory for future development, utilizing internal resources. However, the Loudoun County 2019 General Plan (2019 GP) has established a refined land use vision and developable land has become scarcer. To that end, DED determined that an in-depth and data driven resource was needed to both determine the appropriate and inappropriate places for data center development, and to quantify the future opportunity for the growth of this tax revenue vertical equity.

In November of 2020, DED began the process of selecting a contractor to conduct a data driven review of the remaining land parcels in Loudoun County, generally east of Route 15, outside of town boundaries, and predominantly in the suburban policy area. In March of 2021, DED contracted with ARUP USA, Inc. to complete the study. The Loudoun County Data Center Land Study, which integrates ARUP USA, Inc. study findings, staff findings, and topics for Committee discussion from both DED and the Department of Planning and Zoning (DPZ), is provided in Attachment 1.

Contained within the report are two topics for Committee discussion: prohibiting data centers in the Route 7 corridor and/or allowing data centers in a new opportunity area identified as Dulles Cloud South. The overarching goal of this report is to provide an in-depth analysis of land use constraints and market factors for data centers and land availability that will inform next steps in the implementation of the County's strategic goals for economic diversification.

ISSUES: Staff has identified several considerations for the TLUC: 1) consider the analysis in the Loudoun County Data Center Land Study (Attachment 1); 2) support creation of a zoning overlay district in the ZO Rewrite that prohibits data centers along the Route 7 corridor; and, 3) recommend the full Board of Supervisors (Board) direct staff to return to the TLUC with further research on impacts of allowing data centers in the area identified as Dulles Cloud South as well as a potential Comprehensive Plan Amendment (CPAM)/Zoning Ordinance Amendment (ZOAM) work plan.

These options available to the Board all necessitate a legislative process and will take time, further review, and approval before the impact would be realized by the County. The Route 7 corridor contains parcels governed by zoning districts where data center usage is allowed by-right; however, the designated 2019 GP Suburban Mixed Use Place Type does not envision data centers. The County cannot prohibit by-right data center development within the existing regulatory parameters, and market conditions have created a high level of interest in parcels in the corridor by data center developers and land holders. The data-driven study gave numerical values to various development elements critical to data center infrastructure, as described beginning on page 38 of the consultant report. These included electric utility access, water access and site suitability (flood hazards, wetlands, steep slopes, physical criteria, zoning, place type). Based primarily on the lack of electric utility access, the Route 7 corridor did not score well on the overall rankings leading to this recommendation.

On this topic, staff proposes the creation of an overlay district along Route 7 that modifies the list of allowed uses in the base zoning districts. The creation of this overlay district is within the scope of the adopted ZO Rewrite Resolution of Intent to Amend (ROIA) that states the Board's intention to establish new regulations as necessary to align the Revised 1993 Zoning Ordinance with the 2019 GP.[1] Staff has already started work through the ZO Rewrite process on a broader overlay district to implement the 2019 GP Suburban Mixed Use Place Type, maps have been created with the specific areas identified and evaluated, use standards suggested, and the preliminary work is already completed. Additional review and input would be needed to ensure regulatory compliance and evaluate and mitigate unintended consequences, but an approach specific to the areas discussed in the study would acknowledge the current land and market conditions as outlined in the report and go further in achieving the maximum number of the Board's stated strategic goals, while offering a long-term holistic solution. Staff recommends that the TLUC support an overlay district be incorporated into the ZO Rewrite process. Periodic updates will be provided to TLUC and the Planning Commission as part of the regular ZO Rewrite information items.

[1] November 16, 2021 Board Business Meeting Item 7 – Zoning Ordinance Rewrite ROIA

Figure 1Route 7 Corridor (Page 12 Attachment 1)

The second area of discussion involves a potential new area for data center development, identified by the data driven analysis, in an area south of Dulles International Airport and south of Braddock Road, referred to as Dulles Cloud South. While current demand is high and tax growth opportunity is immediate, this area is not under the same development pressure and timeline as is the Route 7 corridor. Generally, the 2019 GP already supports some industrial uses within the Transition Policy Area, however the specific areas identified in the study are currently envisioned for large lot residential uses. Should the TLUC have interest in considering this area, staff recommends additional research on changes to land use policies and regulations that would allow for data centers with the recommended enhanced use-standards, and a draft CPAM/ZOAM process including community engagement. These enhanced use-standards should acknowledge the change in zoning, provide tangible standards that are responsive to the unique nature of data centers over other industrial uses, while allowing for the execution of the County's larger strategic goals. Staff recommends working with the industry to more clearly identify these standards and returning to the TLUC with a work plan to include a full recommendation of the legislative amendments and use-standards and a feasible project timeline.

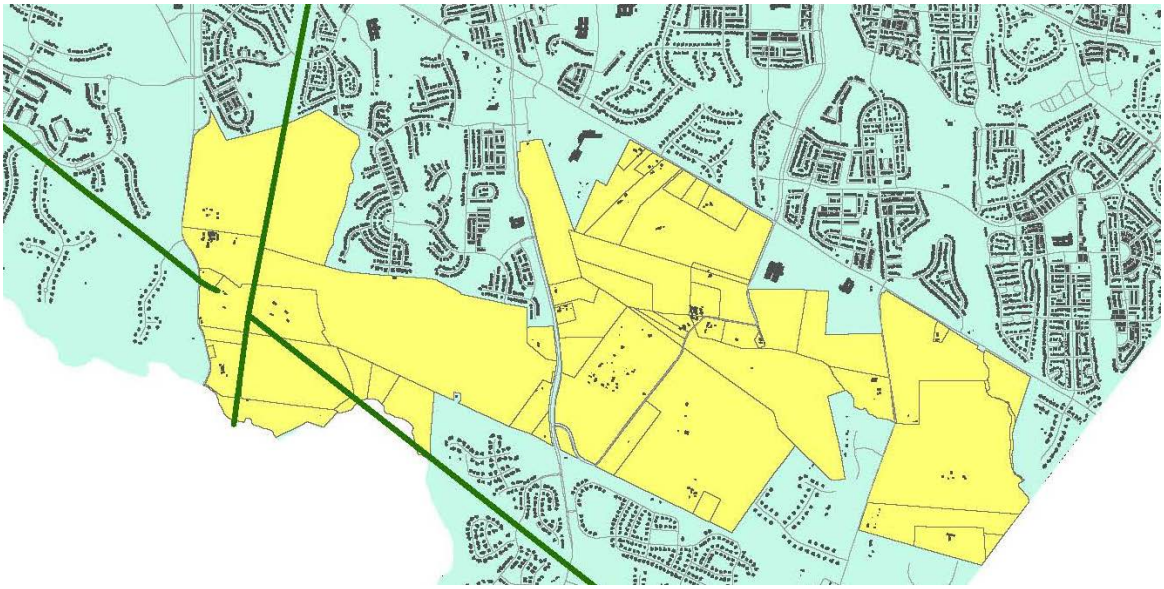


Figure 2 Area Referenced as Dulles Cloud South (Page 15 Attachment 1)

FISCAL IMPACT: At this time there is no fiscal impact associated with this Action Item. However, if the TLUC chooses to act on any of the recommendations within the report, further analysis will need to be conducted to determine the full fiscal impact.

ALTERNATIVES:

1. The TLUC could consider the creation of a zoning overlay district in the ZO Rewrite that prohibits data centers along the Route 7 corridor and recommend that the Board direct staff to return to the TLUC with further research on impacts of allowing data centers in the area identified as Dulles Cloud South, as well as a potential CPAM/ZOAM work plan.

2. The TLUC could consider the creation of a zoning overlay district in the ZO Rewrite that prohibits data centers along the Route 7 corridor and take no action on the Dulles Cloud South concept.

3. The TLUC could recommend that the Board direct staff to return to the TLUC with further research on impacts of allowing data centers in the area identified as Dulles Cloud South as well as a potential CPAM/ZOAM work plan and take no action on the conceptual Route 7 overlay to prohibit data centers.

4. The TLUC could take no action and direct staff how to proceed.

DRAFT MOTIONS:

1. I move that the Transportation and Land Use Committee recommend that the Board of Supervisors direct staff to return to the Transportation and Land Use Committee with further research on impacts of allowing data centers in the area identified as Dulles Cloud South as well as a potential CPAM/ZOAM work plan.

OR

2. I move an alternate motion.

ATTACHMENT:

1. Loudoun County Data Center Land Study

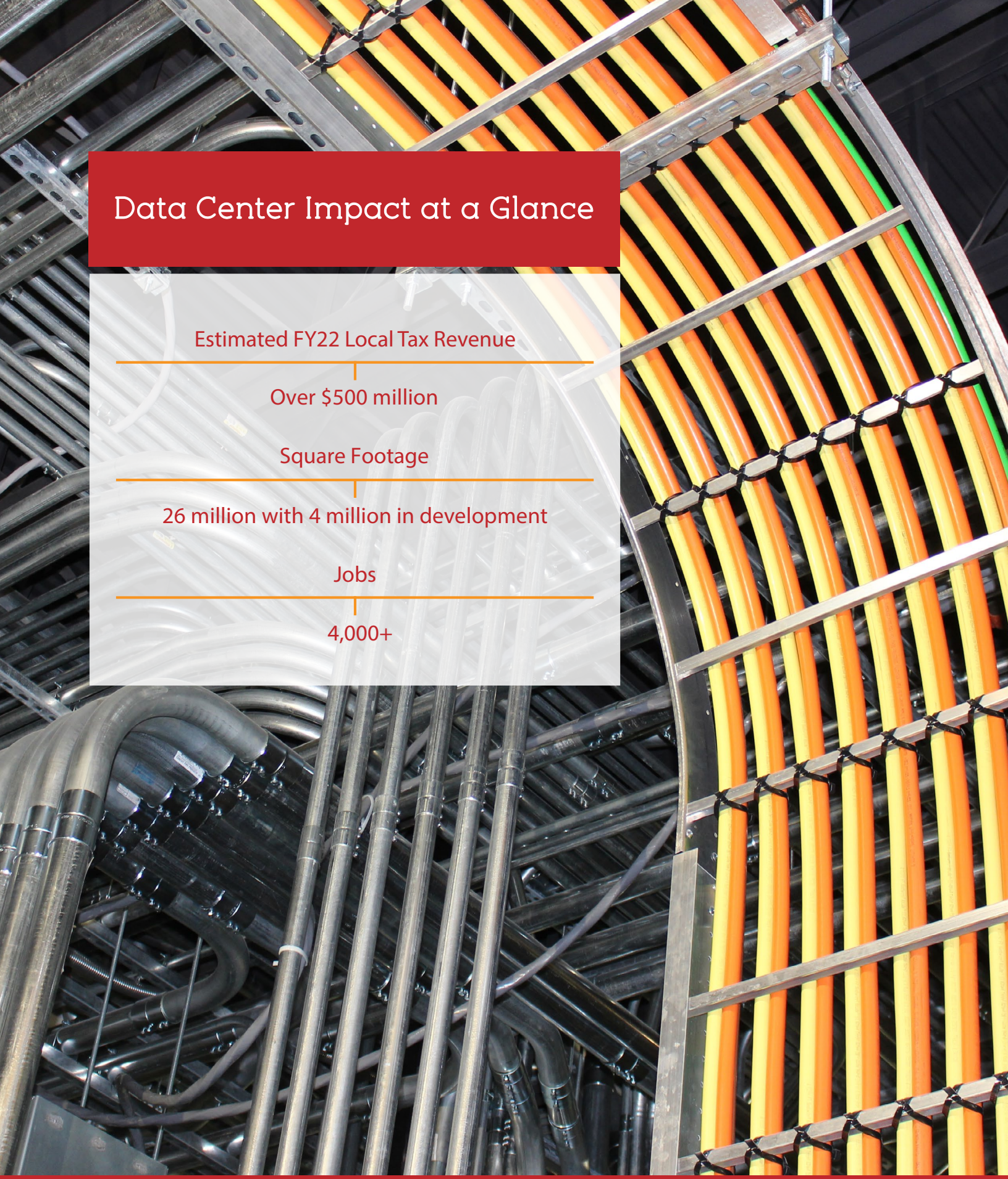
LOUDOUN VIRGINIA
ECONOMIC DEVELOPMENT

Loudoun Data Center Land Study

February 2022

biz.loudoun.gov

Attachment 1



Data Center Impact at a Glance

Estimated FY22 Local Tax Revenue

Over $500 million

Square Footage

26 million with 4 million in development

Jobs

4,000+

#LoudounPossible

Overview

Beginning in 2007, the Loudoun County Department of Economic Development (DED) created and implemented an aggressive data center business attraction strategy to build on established advantages and the anticipated need for digital infrastructure. The results have been transformative for Loudoun County, growing the commercial tax base and creating thousands of new jobs on the way to becoming the world's largest concentration of data centers. As of this writing, Loudoun is home to approximately 26 million square feet of data centers bringing in over a half of a billion dollars in annual tax revenue.

Over the past 14 years, DED has regularly studied and marketed available land inventory for future development utilizing internal resources. As developable land has become scarcer, and in the wake of the 2019 General Plan, DED determined that an in-depth and data driven resource was needed to both determine the appropriate places for data center development (and the identification of those areas not appropriate) and to quantify the future opportunity for the growth of this tax revenue vertical.

In November of 2020, DED began the process of selecting a contractor to conduct a data driven review of the remaining land parcels in Loudoun County, generally east of Route 15, outside of town boundaries and predominantly in the suburban policy area. In March of 2021, DED contracted with ARUP USA, Inc., a 75 year-old multinational professional services firm which provides design, engineering, architecture, planning, and advisory services across all aspects of the built environment, to complete the study. The attached report uses location criteria to determine the best locations for data center development. Utilizing this report, market trends, and feedback from both the data center and real estate industries, DED proposes two unlinked topics for the Board's consideration:

1. The county should take immediate action to limit the construction of data centers on Rt. 7. As shown on Map 1-A in red, there are multiple parcels along Rt. 7 that are permitted for data center by right even though there is no electrical infrastructure to support this development. DED has, by practice, worked with the data center industry to discourage development in this area. However, as land has become scarcer, DED recommends codifying restrictions on this development type.
2. The county should consider adding land shown on Map 1-A in yellow as data center land by right. This area, predominantly in what we have tentatively been calling "Dulles Cloud South", could potentially enable the development of more than 56 million square feet of data center space and mean over one billion dollars of tax revenue annually to Loudoun County. DED would recommend setting new restrictions on this land, such as requiring a commitment to 100 percent renewable energy to power the buildings, on-site renewable energy generation, the adoption of or preparation for new energy technologies, increased screening and open space requirements and contributions to the county's housing fund.

DED recognizes that there are multiple other factors that will need to be considered for the implementation of these recommendations, and that the path forward will require other legislative action, but feel that this data driven approach sets the table for a proactive and productive process by the County.

History

As recently described in the Revenue and Tax Policy Study conducted by PFM and presented to the Board as part of the revenue and tax policy report, the Internet and the World Wide Web had its origins in the 1960's due to the need for a global network of academic communication and information exchange between and among university scientists. Over the ensuing 30 years, this computer network expanded, became searchable, developed scalable communication protocols, and then achieved universal access with data transfer through telephone lines. By the mid-1990s Amazon, Yahoo and eBay all launched internet-based applications, as did Microsoft with its Internet Explorer browser as part of Windows 95. Interrupted briefly by the dot-com stock crash in 2000-2001, mobile Internet devices, smart phones and wireless handheld internet access all evolved during the early 2000s. The brief decades of development of a global, evolutionary, human communications network have led to exponentially increasing needs for data storage, access, processing and transmitting.

The emergence of the data center as both a business and an ecosystem had to outpace the growth of this technological evolution. In reviewing how this industry got to where it is today, it is helpful to understand what a data center is. A data center is a physical place to store and compute data. On a personal computer, there is only so much physical space to store information or run programs. To move beyond that limited capacity, information is stored externally to the specific device. Individuals may use a thumb drive, or an organization may have its own server that can be accessed by computers directly connected to it. However, as data storage needs changed and increased, managing that data has become cost prohibitive and requires specialized services to maintain outside the realm of the companies and organizations dependent upon that data. Data centers fill this need by holding the servers that store this data on behalf of their customers, which can be the owner of the data center itself or a business or government entity leasing space. Data centers house servers so that individual entities do not have to have that equipment at their own facility and do not carry the responsibility of maintaining that equipment or keeping it in an environment optimal to the machines (i.e., temperature controlled, secure, and with back-up power supplies to ensure continuous operation). The "cloud" is the interconnected ecosystem created by data centers that allows users to access data from an internet-based device instead of needing to access the server itself.

The growth in demand for data centers has occurred within a roughly twenty-year span. By the decade beginning in 2010, large facilities known as hyperscale data centers began being built to meet the vast and growing needs for data storage and processing. Users and generators of this level of data usage include household company names, including Amazon Web Services, Microsoft Azure/Office 365, Facebook, Alphabet's Google Cloud, IBM Cloud, Oracle Cloud, Apple, Alibaba, Yahoo, Uber, LinkedIn, and Dropbox. These cloud and data applications are being further expanded in the 2020s and are driven by the growth of e-commerce, wireless networks,

QTS' Ashburn-Shellhorn data center was one of the fastest built data centers ever built in Northern Virginia. QTS' commitment to speed and quality is strongly enriched by its partnership with Loudoun County as a part of the Loudoun County Fast Track program, providing QTS the ability to accelerate construction 67 days ahead of schedule.

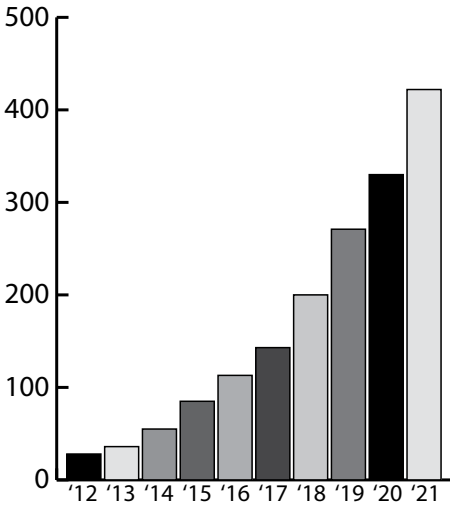
social media, streaming content, software as a service (SaaS), artificial intelligence (AI), machine learning, virtual reality, gaming, and machine-to-machine communication, also known as the Internet of Things (IoT). Our digital lives and digital security are stored in data centers throughout the world. Data centers are also used to drive personal experiences, such as driving directions and restaurant recommendations. The technological advancements of handheld devices, artificial intelligence, machine learning, and augmented reality have placed an ever-increasing demand on data center space leading to rapid data center development. While the previously discussed growth happened in several markets across this period, a few key areas saw increased activity for specific reasons.

Northern Virginia generally and Loudoun County specifically lead in this area of development. According to a Northern Virginia Technology Council report[1] dated January 2020, Northern Virginia has the largest data center market in the world. As measured in megawatts (MW) of power capacity, Northern Virginia has almost as much data center inventory as the 2nd-5th largest markets (Dallas-Fort Worth, Silicon Valley, Chicago, and Phoenix) combined. As of 2018, it is estimated that the regional data center industry provided approximately 14,644 direct full-time jobs (indirect: 45,290), $1.9B in direct employee pay and benefits (indirect: $3.5B), and $4.5B in direct economic output (indirect: $10.1B). Over the past decade, Loudoun County has emerged as the leader in data center development within the largest data center concentration in the country. Both technological and government tax policy helped support and create this important industrial concentration. Formed in 1992, one of the original net access points (NAP) called MAE-East formed in the Virginia market. As demand and technology advances increased, this original NAP was integrated into the Equinix internet exchange in Ashburn. The connectivity of this access point has helped maintain the data center development focus on Loudoun County.

In less than 10 years, from 2012-2021, data center space has increased more than four-fold in Loudoun County, from 5 million square feet of building space to over 26 million square feet during that time. During just 2019, there was a 60 percent increase in data center space from 14.7 million square feet to more than 23.5 million square feet. For comparison's sake, the county's current Zoning Ordinance completed in 1993 predates the bulk of this growth and the current rewrite process is looking at how to accommodate not just the data center industry, but the growth opportunities related to it with other business types in the context of industry growth far outpacing all other systems and processes to support it.

This incredible growth has brought opportunities and challenges to Loudoun. The opportunities have and will continue to include the business development, workforce, and tax revenue benefits of having this industry continue to choose Loudoun. As Loudoun works to diversify the types of businesses that make up the commercial tax base, the presence of the data

Estimated Equipment Tax Revenue from Data Centers



Estimated Total Tax Revenue from Data Centers

Tax Year	Total Revenue	% Change
2016	$148.23	
2017	187.01	26.2%
2018	255.59	36.7%
2019	345.80	35.3%
2020	431.92	24.9%

1 | https://www.nvtc.org/NVTC/Insights/Resource_Library_Docs/2020_NVTC_Data_Center_Report.aspx

center community and the infrastructure that goes with it is helping to attract companies across the IT industry including health IT, cybersecurity, AI, and unmanned systems; for each of these industries, data analysis and storage are key components to future growth. Many of these companies are small businesses and there is also an increasing number of minority-owned companies in these areas that will continue to enrich the commercial make-up of the County for years to come. Additionally, the growth of the data center industry benefits all residents by generating a significant amount of local tax revenue that supports quality schools, parks, public facilities, infrastructure, and lower residential tax rates. As provided in the revenue and tax policy report, the County's dependence on this industry has positive and negative effects that the County is actively working to balance while acknowledging that a measured and gradual process will be needed to retain the structural integrity of the County's commercial tax base and potential for future diversified growth. Finally, while data center buildings tend to have a defined boundary due to being secured facilities, once built they are a type of industrial development that compared to other types of industrial uses, results in very little traffic and relatively little impact on neighbors. This balance between the growth and opportunity of the data center industry in the last several years with the County's overall priorities required additional research and review.

2021 Data Center Study

To both quantify the opportunity for further growth in the data center cluster and limit growth in areas appropriate for development, DED retained ARUP USA. Inc.[2] to complete a formal review of land suitability. The attached study analyzes the County to better understand the locations that are most suitable for data center facilities based on the location of key utility infrastructure, physical characteristics, land use regulations, and other key suitability criteria. The study is also intended to identify areas where data center development is not desirable for the same reasons. However, land suitability and land development processes are only one factor in the business development process that has led Loudoun to be a critical leader in the data center industry. Beyond the data provided by ARUP, the purpose of this additional report and recommendation is to map out locations in eastern Loudoun County that best accommodate new data center development while achieving other goals, including the further diversification of Loudoun's economy by maintaining land availability for other commercial uses, the preservation of prime farmland, and minimizing impacts to residential areas. ARUP produced a portfolio of maps showing the location of key infrastructure and physical characteristics in addition to areas with current zoning or Place Types in the 2019 General Plan that allow for data centers. Staff analysis then reviewed market suitability to provide comprehensive maps that illustrate the recommendations provided herein.

Of primary concern in initiating this study from both land and market suitability is land availability and opportunity as it pertains to the County's

Data Center Industry Giving Back to the Community

2 | https://www.arup.com/

business diversification strategy. Loudoun County has a finite amount of land that supports commercial development per the 2019 General Plan, the zoning ordinance, and existing infrastructure. Loudoun is a strategically important location for the data center industry, due to the concentration of fiber infrastructure. However, almost all sites that can easily be developed as a data center have either already been developed or have been purchased by companies in the business of data center development. Remaining commercial land is now of critical concern for both supporting the important foundation created by the data center industry and in providing available opportunities for other business types. A careful review of this available land in the context of suitability for data center development shows where the industry still has opportunity that should be supported, and areas where, for any number of reasons, the County would be well-served in preserving that land for the important commercial business diversification strategy discussed above. The demand within the market will drive the extent to which private industry is willing to make additional investments to develop land in a way that makes sense for their business.

In FY22, data centers are expected to contribute more than $500 million in local tax revenue.

The ARUP study evaluated an area of eastern Loudoun County for "suitability" based on individual criteria, where suitability was defined as the relative feasibility or costs associated with data center development for that criterion at the level of each individual land parcel. The overlays for multiple criteria were then combined to produce composite suitability maps based on the physical characteristics and proximity to existing power and water infrastructure to which new development would connect. The study only evaluated the area of Loudoun County east of Route 15 and at no point were the Towns or the Rural Policy Area being considered for current or future data center development.

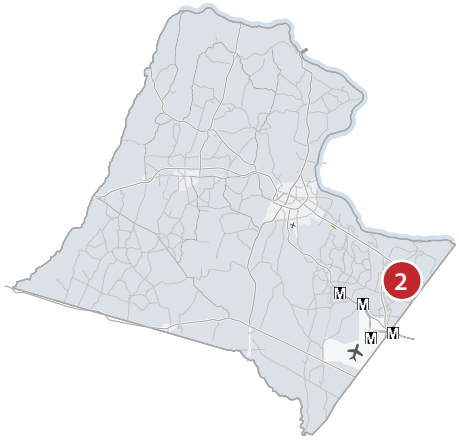
In addition to the overlays of the current zoning and the Place Types in the 2019 General Plan that allow for data centers, the map also highlights properties whose owners or broker representatives had communicated interest in marketing their properties for data center development. These properties are not necessarily suitable for development from the perspective of distance to existing power lines or allowed to have data centers under the current zoning, but existing zoning regulations allow for data center development and pressure continues to grow for these areas to develop at their maximum financial potential given the market demand. DED utilized the data-driven analysis from ARUP, considerations contained in the 2019 General Plan, the strategic goals of the Board and the diversification strategy discussed above, to create a map showing areas of interest for the Board to consider. Additionally, maps are included that highlight five key areas for closer review.

1. **Route 7 Corridor:** The Route 7 corridor is defined as the areas along the north and south sides of Route 7 between the eastern boundary of the Town of Leesburg and the Fairfax County boundary and contains several parcels that allow data center uses by right. However, the 2019 General Plan designates three Place Types along this corridor including Suburban Neighborhood, Suburban Compact Neighborhood and Suburban Mixed

The maps in this section are illustrative, please see the appendix for more detailed maps.

Use, none of which envision data centers as an allowable use. In addition to this land use conflict, access to adequate power connections pose a great challenge for data center uses along most of the Route 7 corridor. Major overhead transmission line extensions[3] would be necessary to provide sufficient power. Such extension and easement requirements would heavily impact existing suburban communities. Due to the 2019 General Plan land use recommendations and the negative impact of required power transmission line extensions, DED does not recommend that data center development be supported within the Route 7 corridor.

2. **Ridgetop Circle with Proximity to Route 7:** Ridgetop Circle, also referred to as Loudoun Tech Center, allows data center uses by right. However, the 2019 General Plan designates Loudoun Tech Center as a Suburban Mixed Use Place Type which does not envision data centers as an allowable use. Loudoun Tech Center is a prime location for flex/industrial buildings which are designed to be suitable for office, retail, and industrial uses. Flex space plays a critical role in providing space needed to support small businesses and economic diversity. Due to intense competition for land in Loudoun and the underlying financials triggered by the high prices paid by the data center industry, construction of new flex buildings has not kept pace with other growth in the county. DED recommends being cautious of data center development near Loudoun Tech Center for this reason.



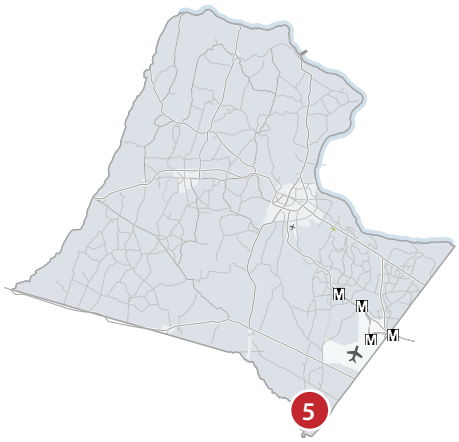
3. **28 North:** 28 North is defined as the area along Route 28 from Route 7, south to the Dulles Toll Road including parcels on either side in proximity to the corridor. This area has a mix of commercial uses including office, other industrial, and data centers, but data center construction outpaces the others in areas where data center development is allowed. The remaining parcels in this corridor are competing for limited space in an area where the infrastructure is ideal for data centers. Specifically, Paragon Park lot 3B is located at the northwest corner of Route 28 and the W&OD trail. The nearly 50-acre parcel allows data center uses by right. However, the 2019 General Plan designates this parcel as Suburban Mixed Use Place Type[4] which does not envision data centers as an allowable use. The parcel is adjacent to existing data centers to the north and west, a major power transmission line to the south and Route 28 to the east. Despite the parcel's 2019 General Plan land use conflict, given the land and market suitability, proximity to other data centers, and a limited market for other uses, it is ideally situated for data center development with respect to the surrounding uses and proximity to adequate power. Therefore, DED recommends that data center development be supported on this parcel.

3 | There are several miles in the corridor that would require a 100-foot easement width or more to meet the power needs of a new data center.

4 | While staff has not been directed to rezone areas within the Zoning Ordinance Rewrite, DED recommends the Board consider this exception for the areas discussed in the report as the most efficient way to accommodate the County's strategic goals in these areas while acknowledging land and market suitability.

4. **Southeast of Leesburg**: The area southeast of Leesburg contains parcels that are designated as one of six Place Types in the 2019 General Plan: Leesburg JLMA Industrial/Mineral Extraction, Transition Light Industrial, Transition Industrial/Mineral Extraction, Suburban Industrial/ Mineral Extraction all of which envision data centers as a Core Use; Leesburg JLMA Employment where data centers are envisioned as a Complimentary Use, and Suburban Employment where data centers are envisioned as a Conditional Use. DED recommends that data center development be supported in this area except for roughly 130 acres located within the Suburban Mixed Use Place Type where data centers are not envisioned as an allowable use despite the current zoning designation allowing data centers by right.

5. **South of Braddock (Dulles Cloud South):** The area south of Braddock Road contains parcels that are designated in the 2019 General Plan as Transition Large Lot Neighborhood Place Type where data centers are not envisioned as an allowable use. Despite the area's 2019 General Plan land use conflict, it is ideally situated for data center development with respect to the proximity to adequate power and significant contiguous undeveloped greenfield. Market trends indicate that the area is unlikely to stay in its current condition and the existing owners and potential users will be more willing to seek changes to current zoning to allow either housing or a commercial use[5]. While the 2019 General Plan considers residential development to be fiscally balanced, market demands indicate that this development could lead to a type of housing that will not add to the diversity of housing types needed in the County. Building anything other than single-family units with the maximum lot size and the highest market price attainable would be cost prohibitive to the private partners and detrimental to other strategic goals of the County also contained within the 2019 General Plan. Finally, because this area represents the remaining large parcels available within the County, allowing data center use would alleviate the pressure in other areas of the County with continued interest in data center development. Allowing data center use in this area while providing clear guidance where data center development would not be appropriate could reduce requests to redevelop existing commercial property in other areas where those property types are needed to continue the focus on diversifying the commercial tax base. To be considered for development, DED recommends that the following factors be considered:



    1. Open space requirements – Open space is an important factor for development in this area. For the Transition Policy Area – Large Lot Neighborhood place type that currently covers most of the area in yellow, the 2019 General Plan specifies: 50% of the site- Recreational, Agricultural, and/or Natural, Environmental, and Heritage. In the Bull Run policy subarea, 70% of a site shall be retained as open space.

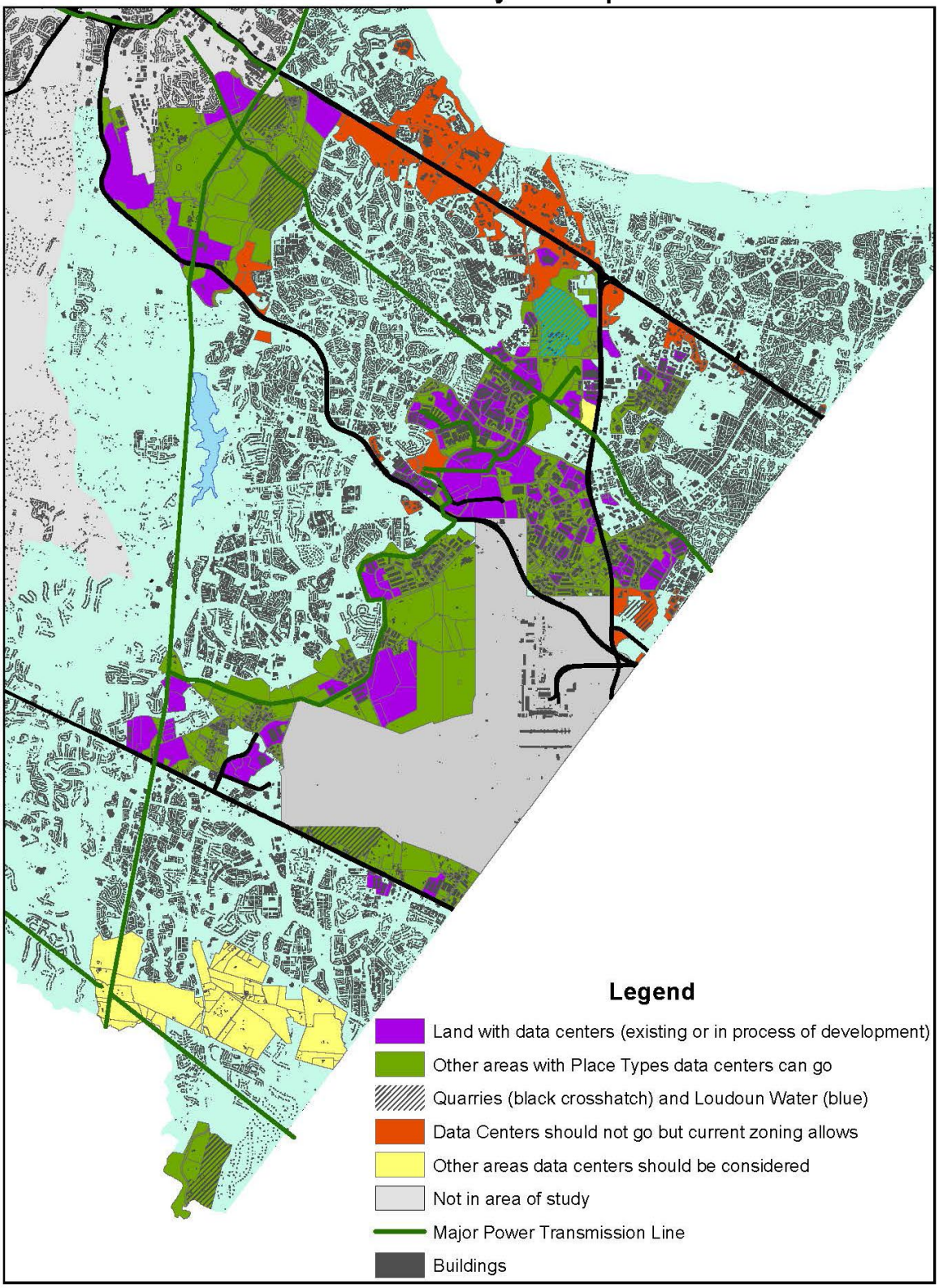
5 | As it currently stands, this area would require a rezoning to allow for commercial uses that would acknowledge that it is unaligned with the 2019 General Plan

2. Building height restrictions - The general plan refers to "stories" rather than "building heights" and states that buildings should be 1-3 stories. DED would recommend that stories be replaced by height and allow for a minimum of 60 feet to maximize development potential and tax revenue while maintaining a height where the visual impact of development on large sites can be mitigated through landscape screening and buffers.
3. Land for substations – the area in yellow included land with the existing substations at the intersection of the major transmission lines because they are within the overall area being recommended for consideration for data centers. The substations are within parcels owned by NOVEC (3.9 acres) and Dominion (193.1 acres).

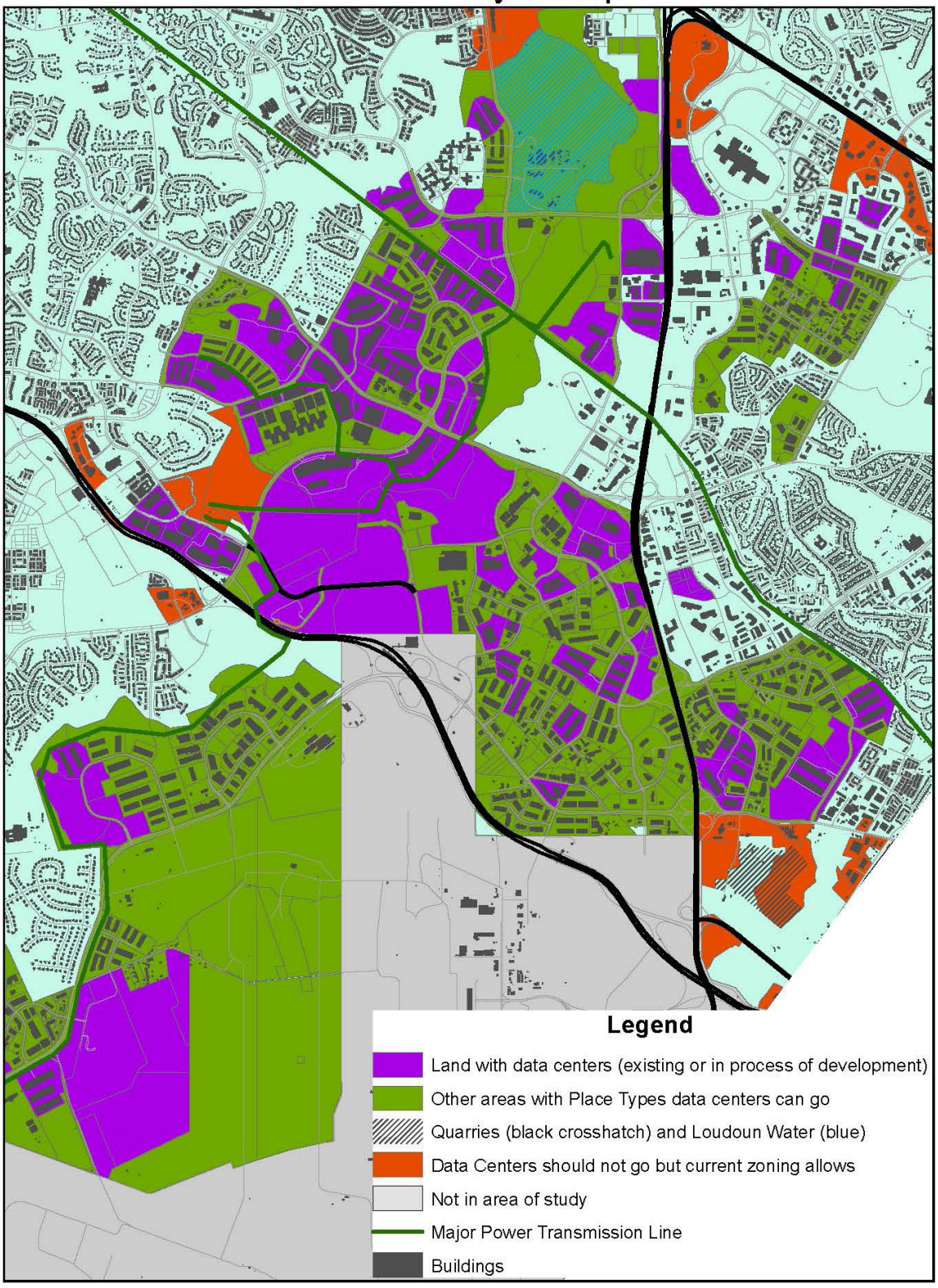
DED recommends the consideration of additional criteria for this area, which could include a commitment to 100 percent renewable energy to power the buildings, on-site renewable energy generation, the adoption of or preparation for new energy technologies, strong commitments to open space preservation, including increased screening and increased setback requirements to adjacent residential, and contributions to the county's housing fund. A commitment to new community amenities such as new public park should also be considered. All these recommendations would require additional vetting but would offer a balance to the market demand increasing pressure in other areas of the County, provide a creative mitigation strategy for allowing the use in this area, and add significant investment to the County to maintain fiscal sustainability while the County's diversification strategy continues to mature.

ATTACHMENT 1: MAPS 1-A THROUGH 1-D

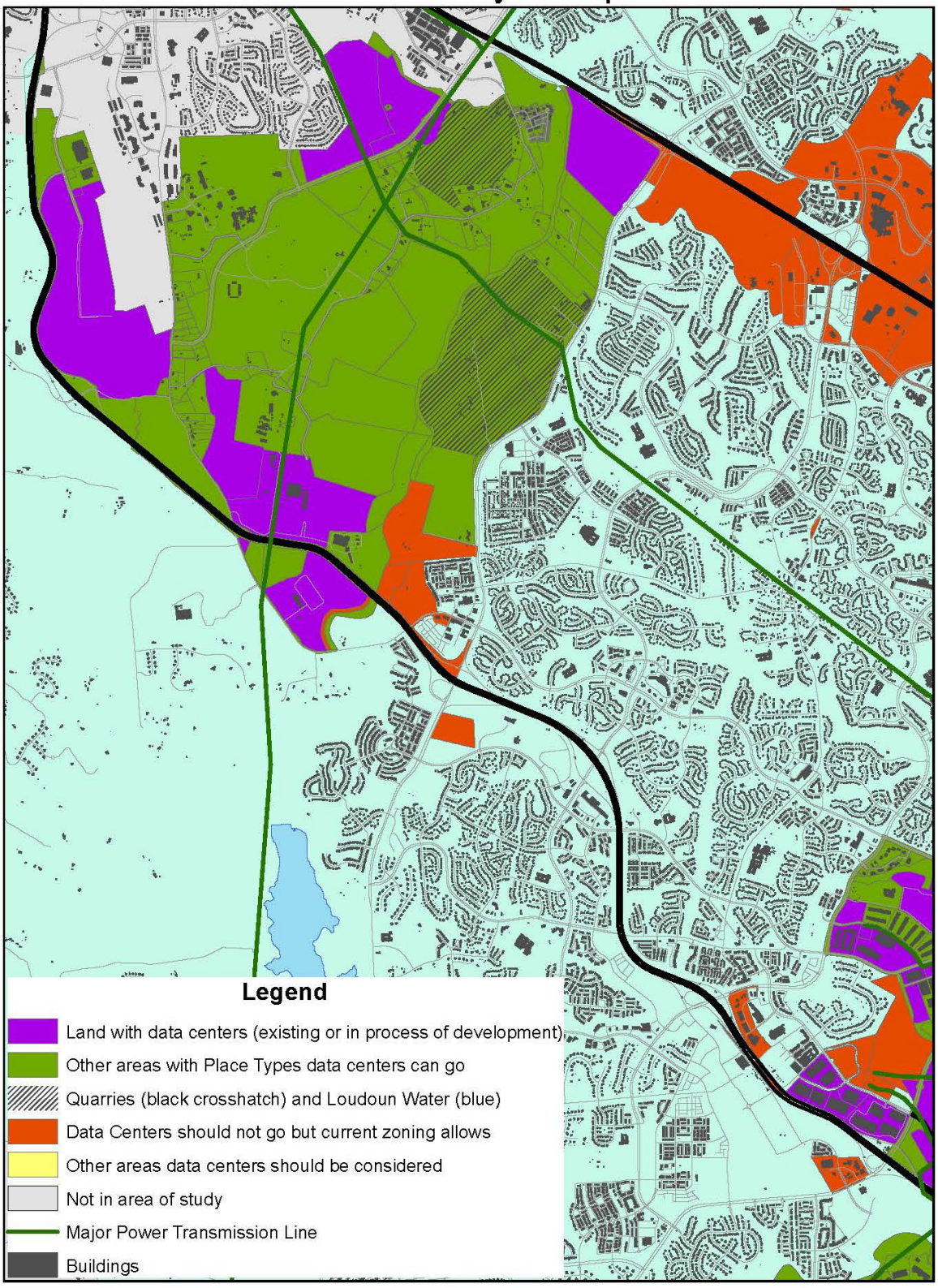
Data Center Land Use Study - Map 1A



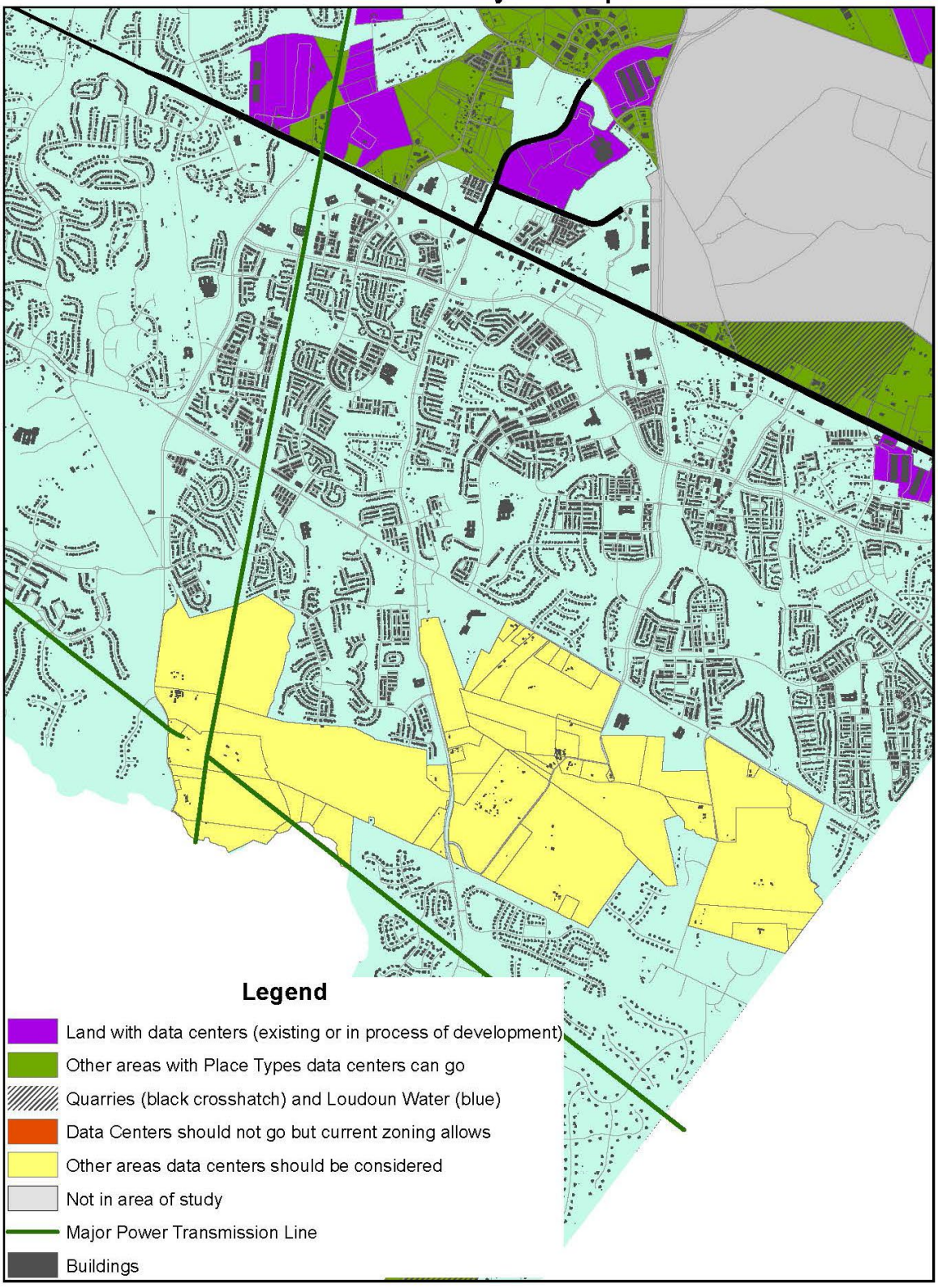
Data Center Land Use Study - Map 1B



Data Center Land Use Study - Map 1C



Data Center Land Use Study - Map 1D



LOUDOUN VIRGINIA
ECONOMIC DEVELOPMENT

ATTACHMENT 2: ARUP FINAL REPORT

Loudoun County Data Center Land Use Study

Final Report

October 2021

ARUP

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Image Source: Fairfax, Wikimedia

Introduction

Overview

Data Center Alley

Loudoun County, Virginia has the world's largest concentration of data centers, with more than 25 million SF in operation and another 4 million SF in development in the eastern portion of the County. Data centers are a high-performing industry that is a critical part of the infrastructure that supports the modern economy, a significant and growing source of employment and a significant generator of tax revenue.

Due to the unique nature of these types of facilities, data centers have specific infrastructure, utility and site development requirements, particularly around access to utilities.

Image source: Unsplash

Study Purpose

Strategically Balancing County Goals

Loudoun County stands to benefit from continued growth of the data center industry and is looking to map out locations that best accommodate new development while achieving other goals including preservation of prime farmland, maintaining land availability for other key uses, and minimizing impacts to residential areas.

In order to effectively manage the growth of the data center industry, the County desired to better understand the locations that are most suitable for these facilities based on the location of key utility infrastructure, physical characteristics, land use regulations and other key suitability criteria. The study is also intended to identify areas where data center development is not desirable.

Image source: Bob Mical | Flickr, CC license

Project Aim

Evaluating Suitable Locations for Data Centers

For this project, the County looked to accomplish the following:

- Provide a clear understanding of factors that make a site suitable for data center development
- Clearly articulate the County's preferred locations for data center development
- Identify areas where the County might look to discourage their growth in order to meet other policy goals

Image source: Unsplash

Project Approach

Project Approach

A Land Use Study on Future Data Centers Locations

Arup, a global engineering and consulting firm, was hired by the County to conduct this study. To help the County in achieving this goal, Arup was tasked with the following:

- Reviewing existing data sources from public data portals and sources provided by the County, including the location of current data center facilities, relevant future land use plans, zoning regulations showing where data centers are permitted as-of-right, and other key elements
- Meet with utility providers to communicate goals of the project and to help fill gaps on existing data sources
- Develop with the County suitability criteria for use in Arup's analysis

Suitability Methodology

Project Approach

Arup developed a six-step process for evaluating mapping layers, assessing constraints, weighing elements and creating final maps.

Opportunity Mapping ***Prioritization*** ***Final Output***

1. *Review all map layer input point and distances*
2. *Assess hard constraints*
3. *Add weight to each major category of opportunities*
4. *Assign score to each input*
5. *Review and iterate with County*
6. *Produce final maps and reporting*

Suitability Criteria

Project Approach

All elements evaluated as part of the suitability analysis were assigned a score from one through five. One is for elements that were understood to be *less suitable* and five is for elements that were *most suitable*.

Key Data Inputs

Data Inventory

Data Received*

- Parcels *(Loudoun Open Data)*
- Zoning *(Loudoun Open Data)*
- Steep slopes *(Loudoun GIS)*
- Predicted wetlands *(Loudoun GIS)*
- Water utility service areas *(Loudoun Water)*
- Utility electric substations and lines *(from OSM 3rd party)*
- Commercial building permits *(in Excel format)*
- DED Available Land Inventory *(Excel format)*
- Inventory of current data centers (Excel format)
- FiberMaps (images only – no indication of capacity)
- Property data tables (Assessors – table extract)
- Environmental Remediation
- Heritage sites
- List of properties with communication from owners and brokers about interest in data center development

*Data was received in April-May 2021

Data Unavailable

- Detailed fiber map

Suitability Evaluation Overview

Suitability Evaluation

Countywide Overview

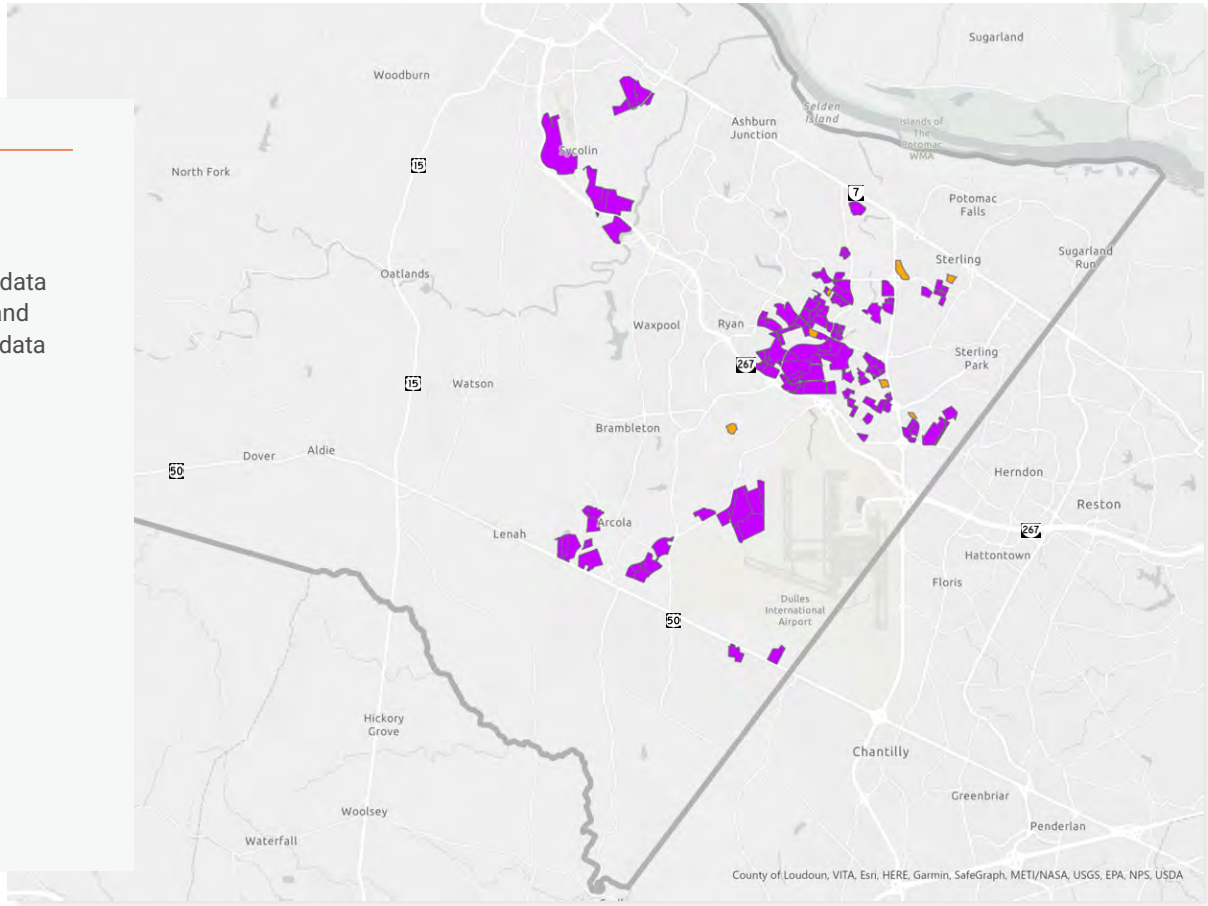
The area of study was limited to eastern Loudoun County. Land in the Rural Policy Area, the towns, and land at Dulles Airport (with the exception of airport land that has been marketed for data center development) is excluded from analysis.

Suitability Evaluation

Land with Existing Data Center Buildings

Loudoun County has over 90 land parcels with data center development based on building permit and assessment data. Some parcels have multiple data center buildings.

- Existing Data Centers *
- Additional Permitted Data Centers **
- County Boundary



* Parcel is shown as having data center in most recent assessment data
** Parcel is shown with building permit for data center according to Loudoun County permit data
*** The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Place Type Uses

The Loudoun County General Plan, adopted in 2019, defined key *Place Types* that guide the intent, form, character, and anticipated uses within policy area throughout the County. The General Plan envisions different types of uses within each place type:

- ***Core uses***, the most prevalent within a place type
- ***Complementary uses***, which support core uses
- ***Conditional uses***, which are to be considered on a case-by-case basis

Shown on the right are Place Types where data centers are permitted as core, complementary and conditional uses.

Data Centers as Core Use	GIS Label
Transition Industrial/Mineral Extraction	TRNIM
Suburban Industrial/Mineral Extraction	SUBIM
Urban Employment	URBEM
Leesburg JLMA Industrial/Mineral Extraction	LJMIM
Transition Light Industrial	TRNLI

Data Centers as Complementary Use	GIS Label
Leesburg JLMA Employment	LJLMEM

Data Centers as Conditional Use	GIS Label
Suburban Employment	SUBEM

Suitability Evaluation

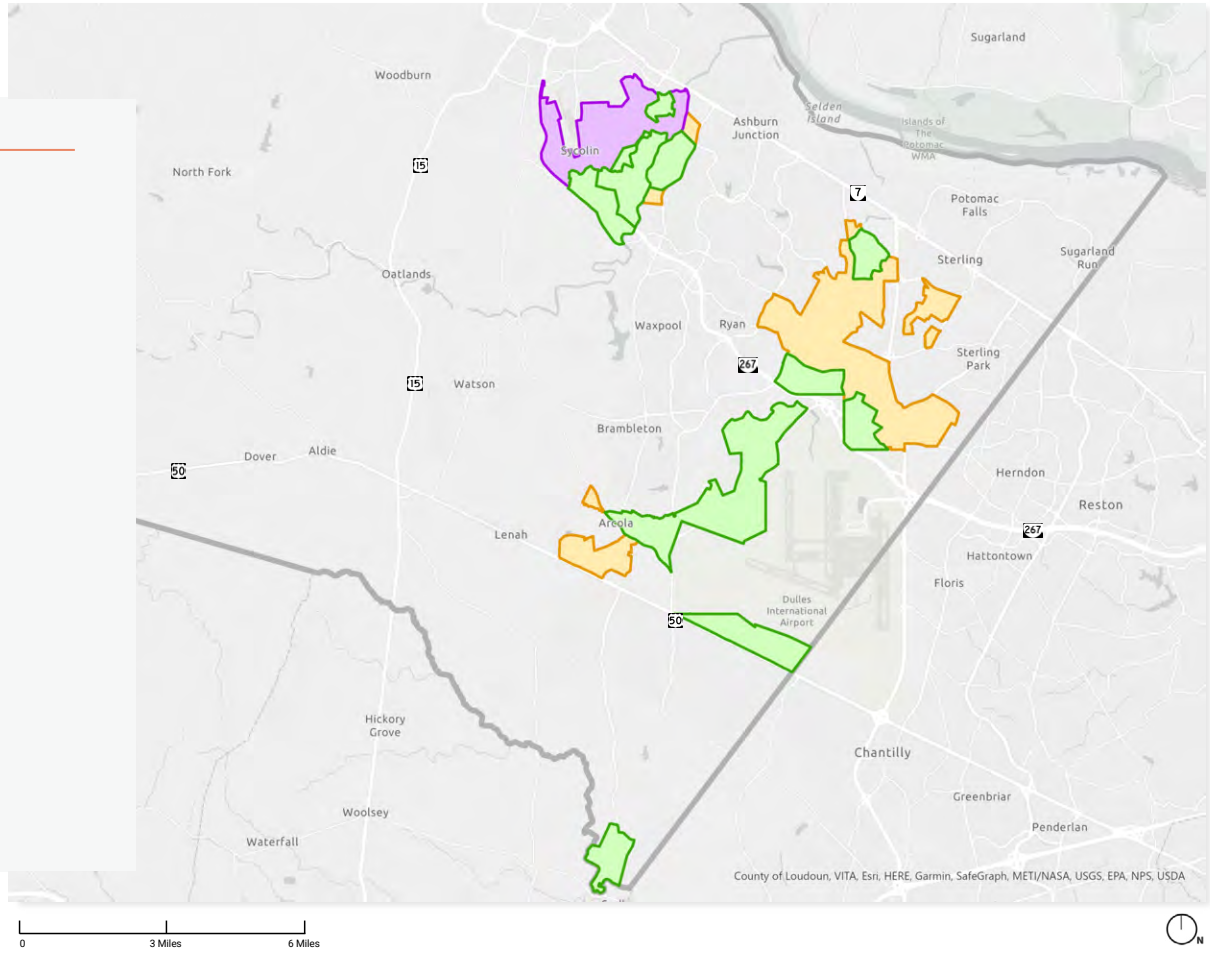
Place Type Uses

Core Use
TRNIM
SUBIM
URBEM
LJMIM
TRNLI

Complementary Use
LJLMEM

Conditional Use
SUBEM

County Boundary



Suitability Evaluation

Zoning-by-Right

Data centers are permitted by-right on land with certain identified zoning. This means that data centers are a permissible use in the zoning district and are not subject to special review and approval.

Data centers also exist in some areas with CLI zoning as they were permitted by right in CLI in the past, but new data center development is no longer permitted in CLI.

Data Centers Permitted By-Right	GIS Label
Planned Development-Research and Development Park	PDRDP
Planned Development-Office Park	PDOP
Planned Development-Industrial Park	PDIP
Planned Development-General Industrial	PDGI

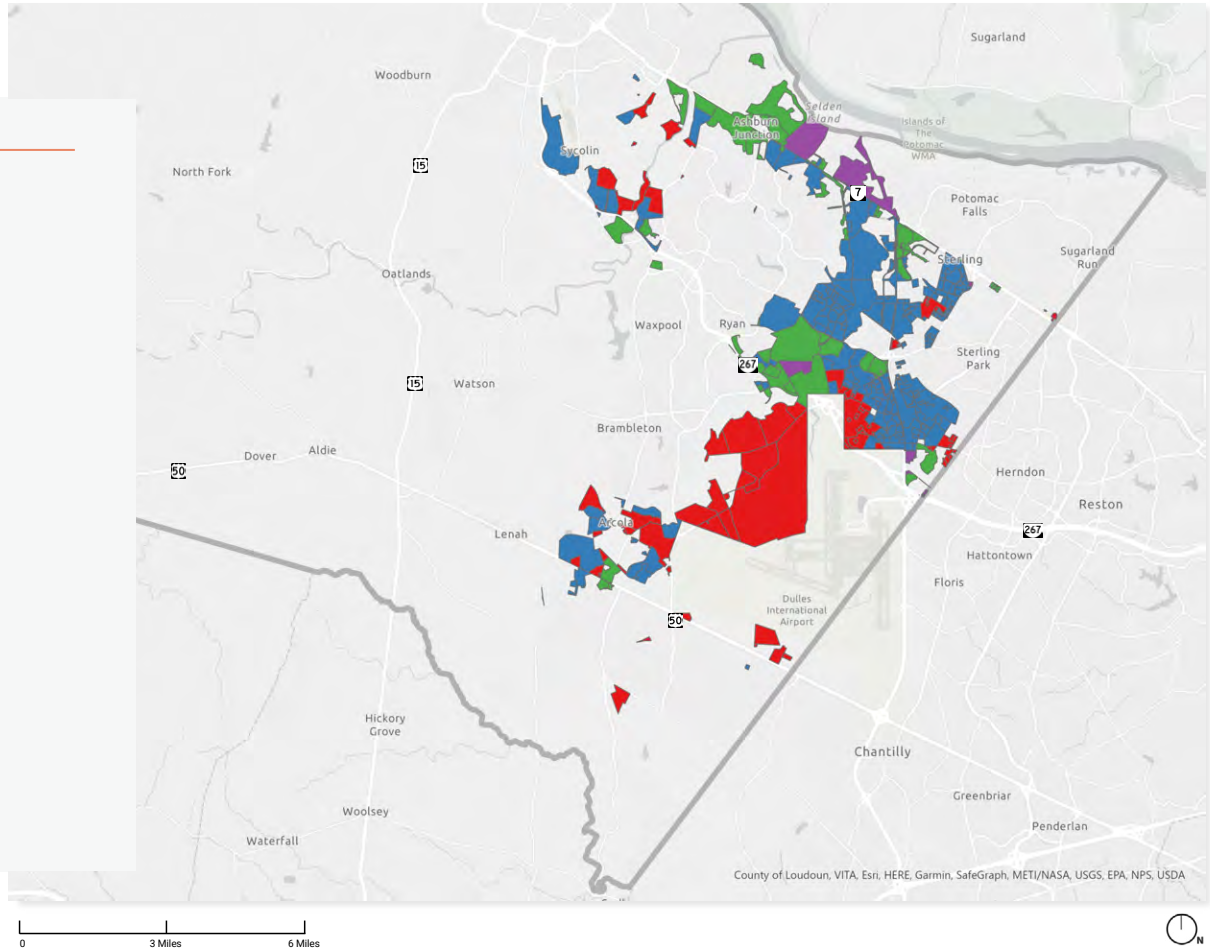
Data Centers Previously Permitted by-Right	GIS Label
Commercial/Light Industry	CLI

Suitability Evaluation

Zoning-by-Right

- PDRDP
- PDOP
- PDIP
- PDGI

County Boundary

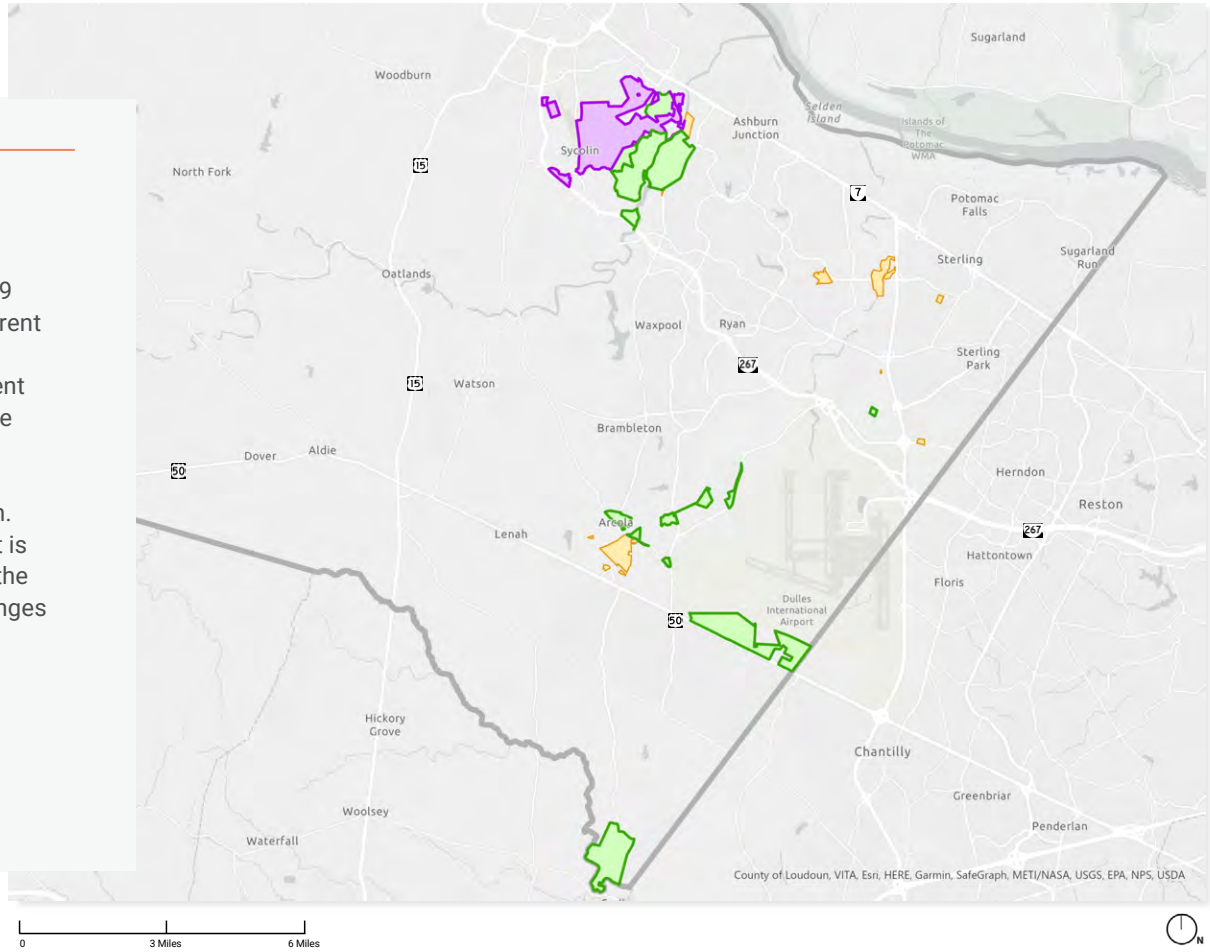


Suitability Evaluation

Suitable by Place Type without Current Zoning-by-Right

This map shows where Place Types in the 2019 General Plan allow for data centers but the current zoning does not. These areas may include opportunities for future data center development where the land is not already developed and the physical characteristics are suitable for development and are the extent of new opportunities per the vision of the General Plan. However, the amount of new development that is possible for many of these areas is limited by the presence of open pit quarries and other challenges related to physical characteristics of the land.

- Core Use
- Complementary Use
- Conditional Use
- County Boundary

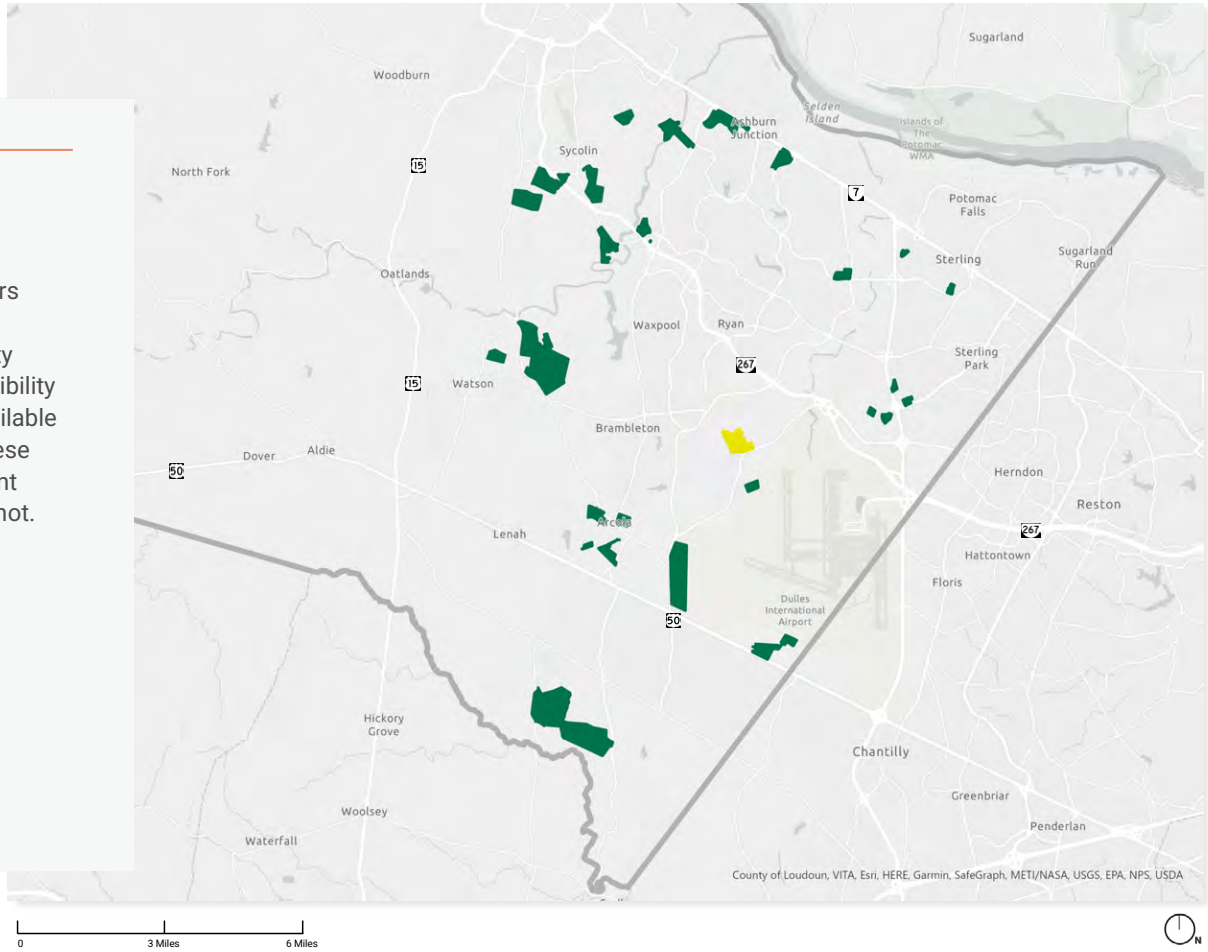


Suitability Evaluation

Interest in Feasibility or Marketing

This map shows properties without data centers where the property owner, broker, or other stakeholder has communicated with the County within the past few years to ask about the feasibility of data centers or about marketing land as available sites for data center development. Some of these areas already allow for data center development based on Place Types or zoning and some do not.

- Owner/broker communication and now owned by data center companies
- Owner/broker communication
- County Boundary



Utility Access Suitability

Suitability Evaluation

Electric Utility Access

Arup and the County met with representatives from Dominion Energy and NOVEC, the County's two electricity service providers. Neither provider was able to share detailed maps of the electrical grid infrastructure due to security rules, meaning that a detailed analysis of access to the electrical grid could not be included in Arup's analysis. However, locations of existing high voltage transmission lines were publicly available. Both providers cited challenges with creating additional transmission, and that proximity to existing power lines was generally advantageous for a site, as it required less new infrastructure. Arup used proximity within 1 mile of major transmission lines to show areas that are more suitable for this criteria. Adding new infrastructure beyond this distance increases the complexity of a project, whereas development on properties within that distance requires less new power transmission lines to support.

Image source: Dominion Energy

Suitability Evaluation

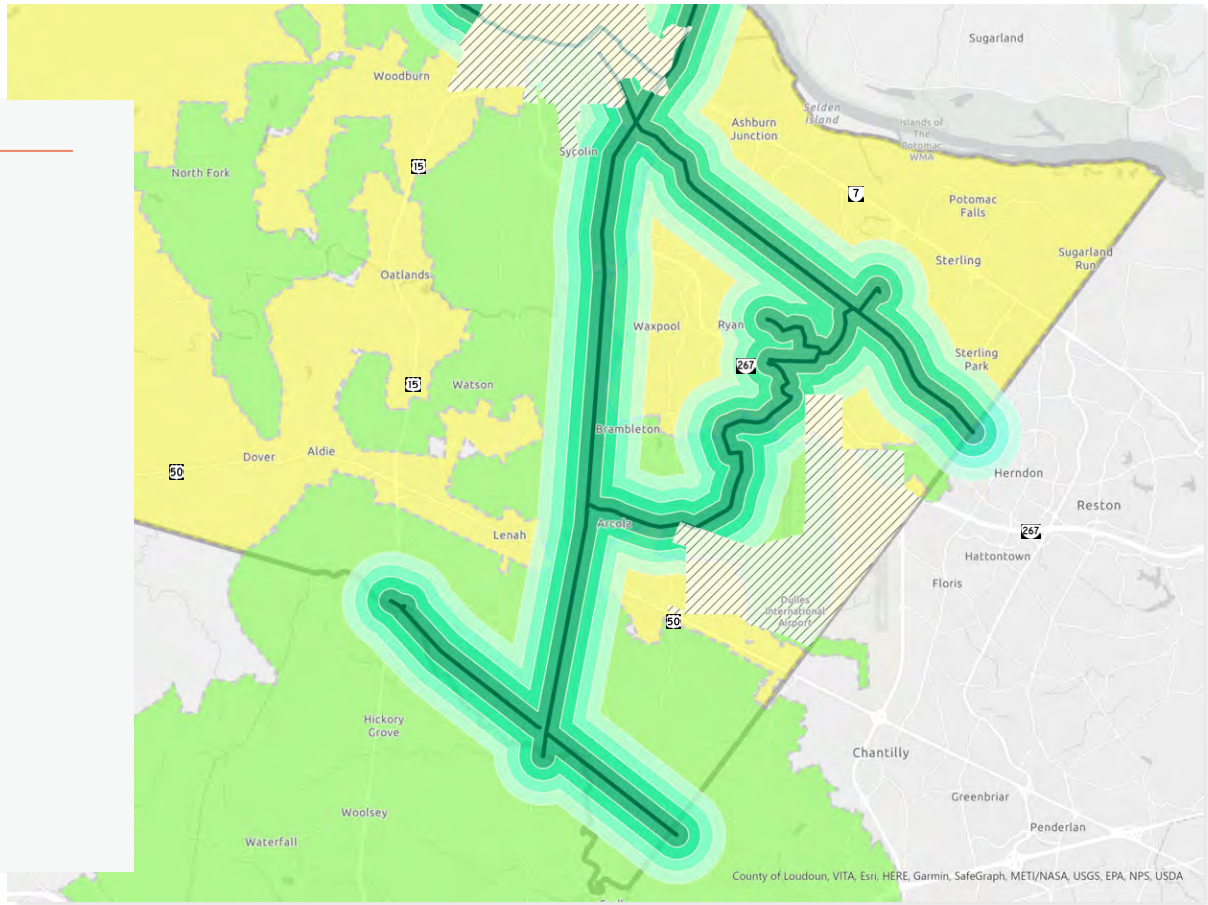
Electric Utility Access

Criteria *Distance from transmission line*	Score *Highest score is most suitable*
0.25 mile	10
0.5 mile	8
0.75 mile	6
1 mile	4
Other Areas	1

Electric Service Area

- DOMINION
- NOVEC

- Transmission Lines
- County Boundary
- Areas Not Included in Analysis *



* *The Rural Policy Area and incorporated towns are also not part of this study*

Suitability Evaluation

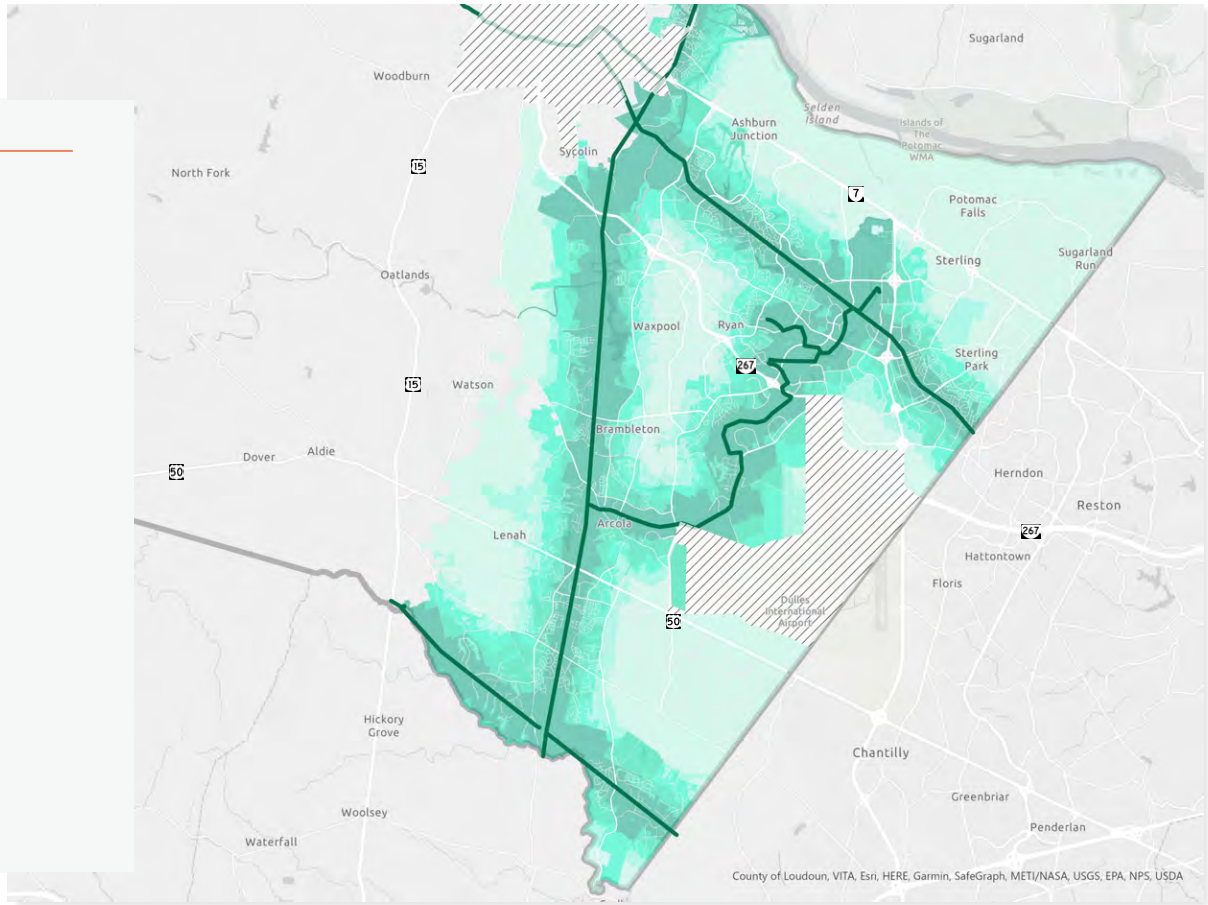
Electric Utility Access (Parcels)

Criteria *Distance from transmission line*	Score *Highest score is most suitable*
0.25 mile	10
0.5 mile	8
0.75 mile	6
1 mile	4
Other Areas	1

Transmission Lines

County Boundary

Areas Not Included in Analysis *



* *The Rural Policy Area and incorporated towns are also not part of this study*

Suitability Evaluation

Water Access

Arup and the County met with representatives from Loudoun Water, which provides water and wastewater services in eastern Loudoun County.

Similar to the electricity service providers, Loudoun Water was not able to provide detailed maps of the water infrastructure because of security rules. Some data about the water infrastructure is available via Open Street Map, and Loudoun Water publishes information about access to its reclaimed water system, which provides water that is safe for non-potable uses. Access to the reclaimed water is advantageous for data centers as this helps to lower the impact of their operations. In this analysis, Arup assigned a higher suitability score to parcels with access to reclaimed water.

Image source: Loudoun Water

Suitability Evaluation

Water Access

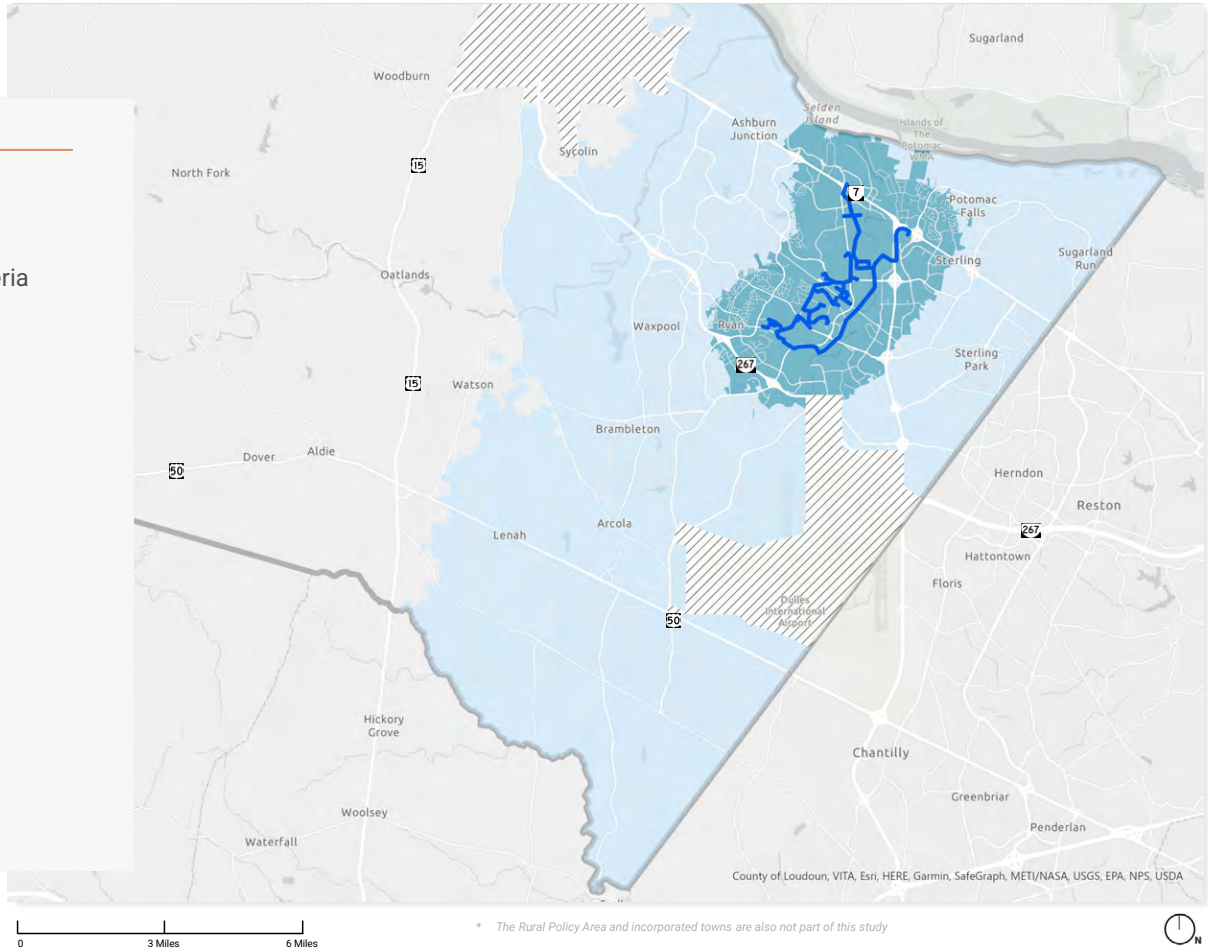
For the suitability evaluation, the following criteria were used:

Criteria	Score
Site with access to recycled system	5
Other areas served by Loudoun Water	3

Reclaimed Water Line

County Boundary

Areas Not Included in Analysis *



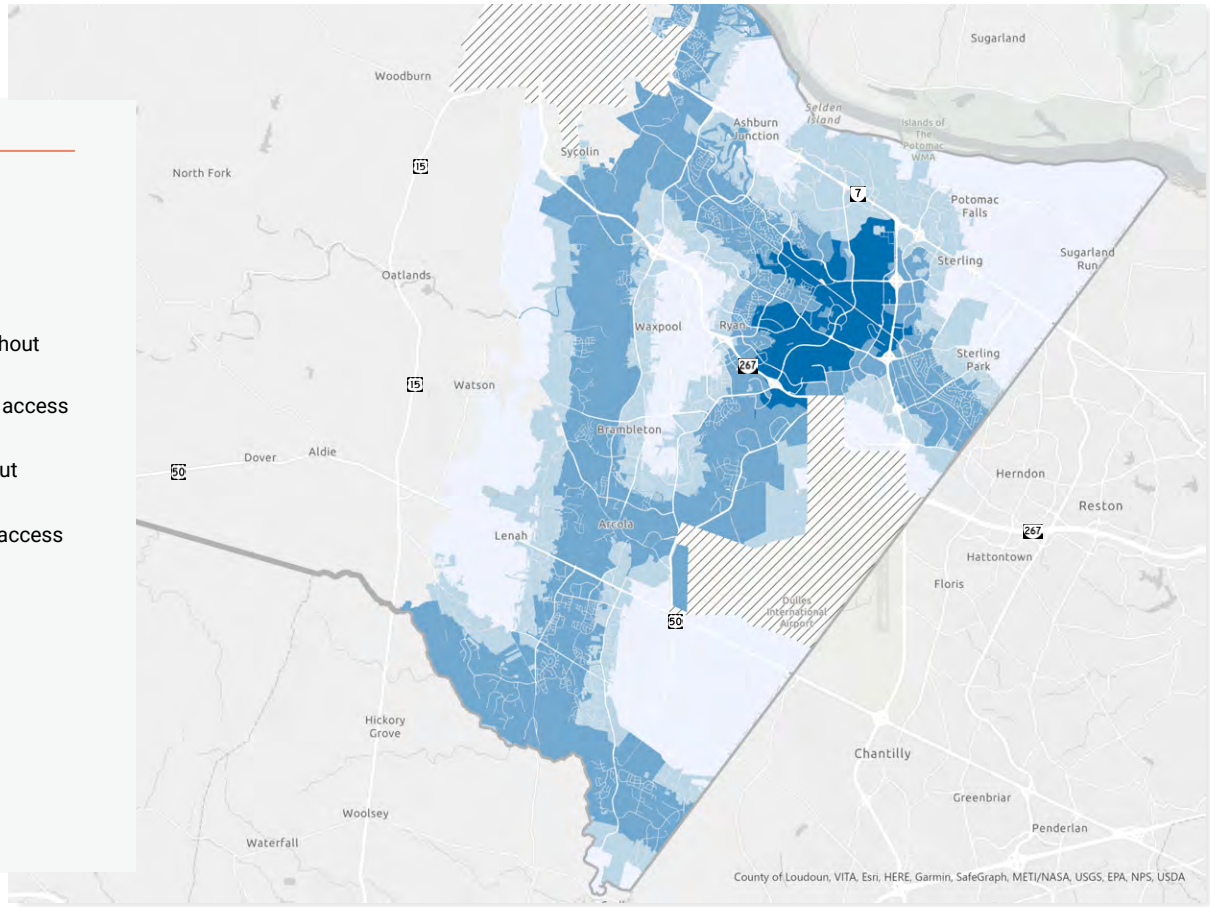
* The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Combined Utilities

- Outside of 1 mile of transmission line and without access to recycled water
- Within 1 mile of transmission line but without access to recycled water
- Within 1/2 mile of transmission line but without access to recycled water
- Within 1/4 mile of transmission line and with access to recycled water

- County Boundary
- Areas Not Included in Analysis *

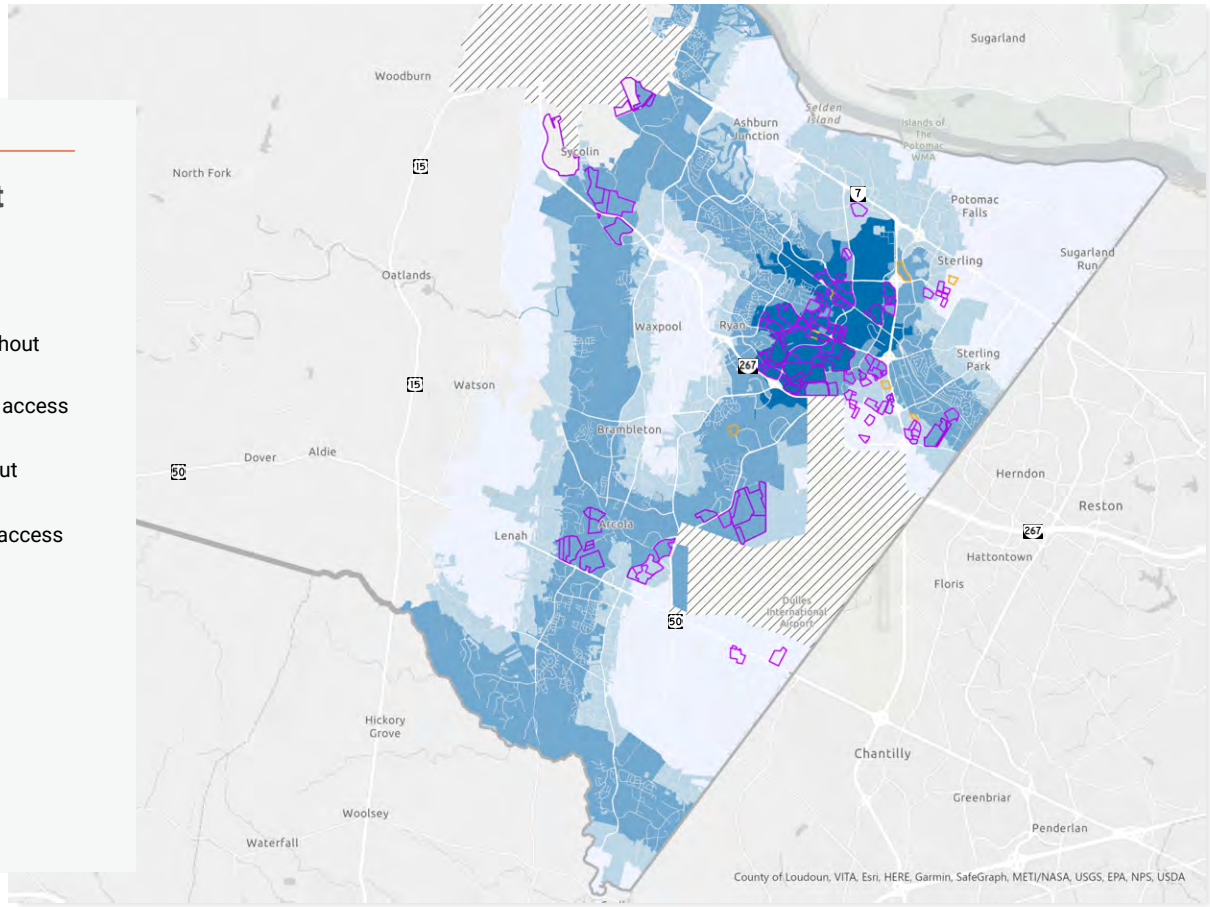


* The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Combined Utilities & Existing Built and Permitted Data Centers

- Outside of 1 mile of transmission line and without access to recycled water
- Within 1 mile of transmission line but without access to recycled water
- Within 1/2 mile of transmission line but without access to recycled water
- Within 1/4 mile of transmission line and with access to recycled water
- Existing Data Centers *
- Additional Permitted Data Centers **
- County Boundary
- Areas Not Included in Analysis *



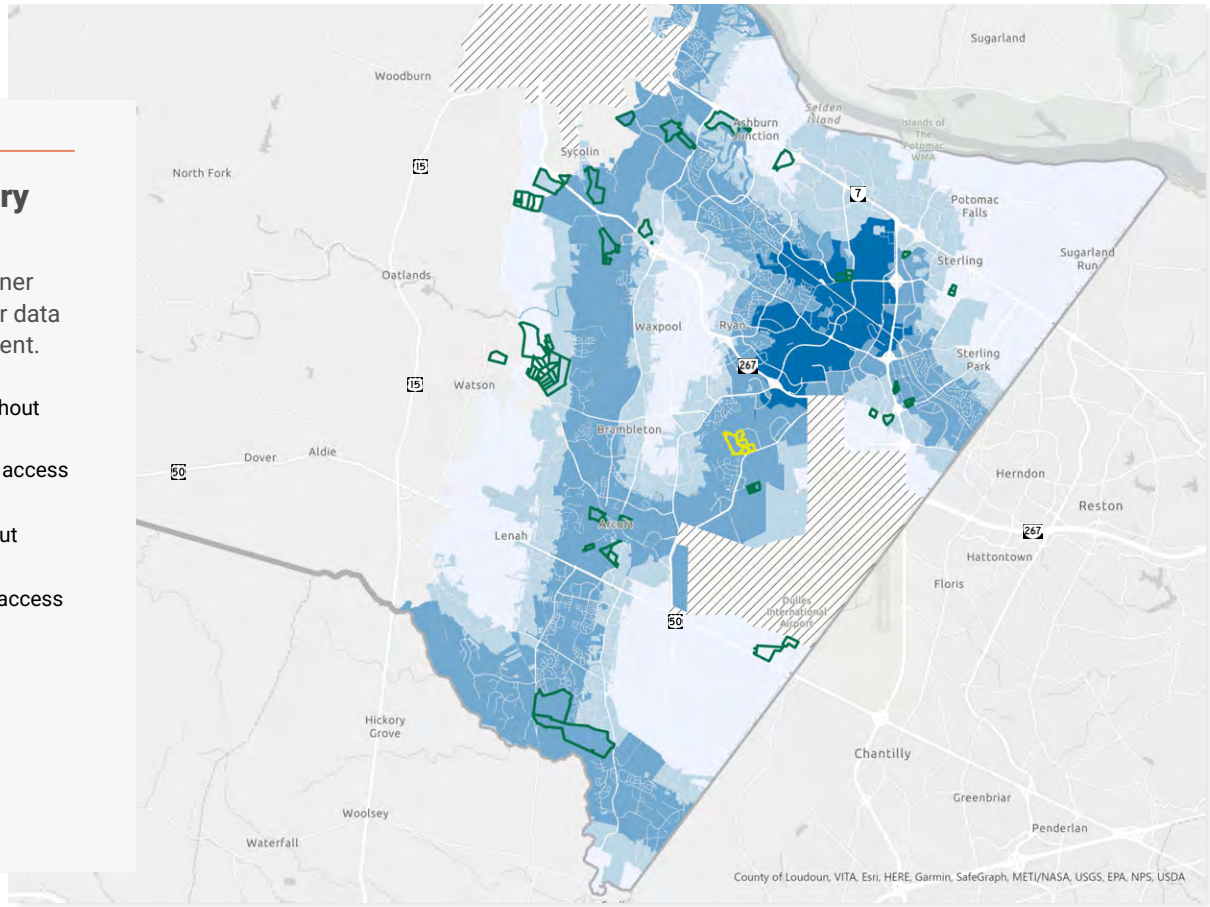
* Parcel is shown as having data center in most recent assessment data
** Parcel is shown with building permit for data center according to Loudoun County permit data
*** The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Combined Utilities & Land Inventory

With overlay of properties where owners or owner representatives have asked about feasibility for data centers or marketing for data center development.

- Outside of 1 mile of transmission line and without access to recycled water
- Within 1 mile of transmission line but without access to recycled water
- Within 1/2 mile of transmission line but without access to recycled water
- Within 1/4 mile of transmission line and with access to recycled water
- Owner Contacted
- Owner/broker communication and now owned by data center companies
- County Boundary
- Areas Not Included in Analysis *



* The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

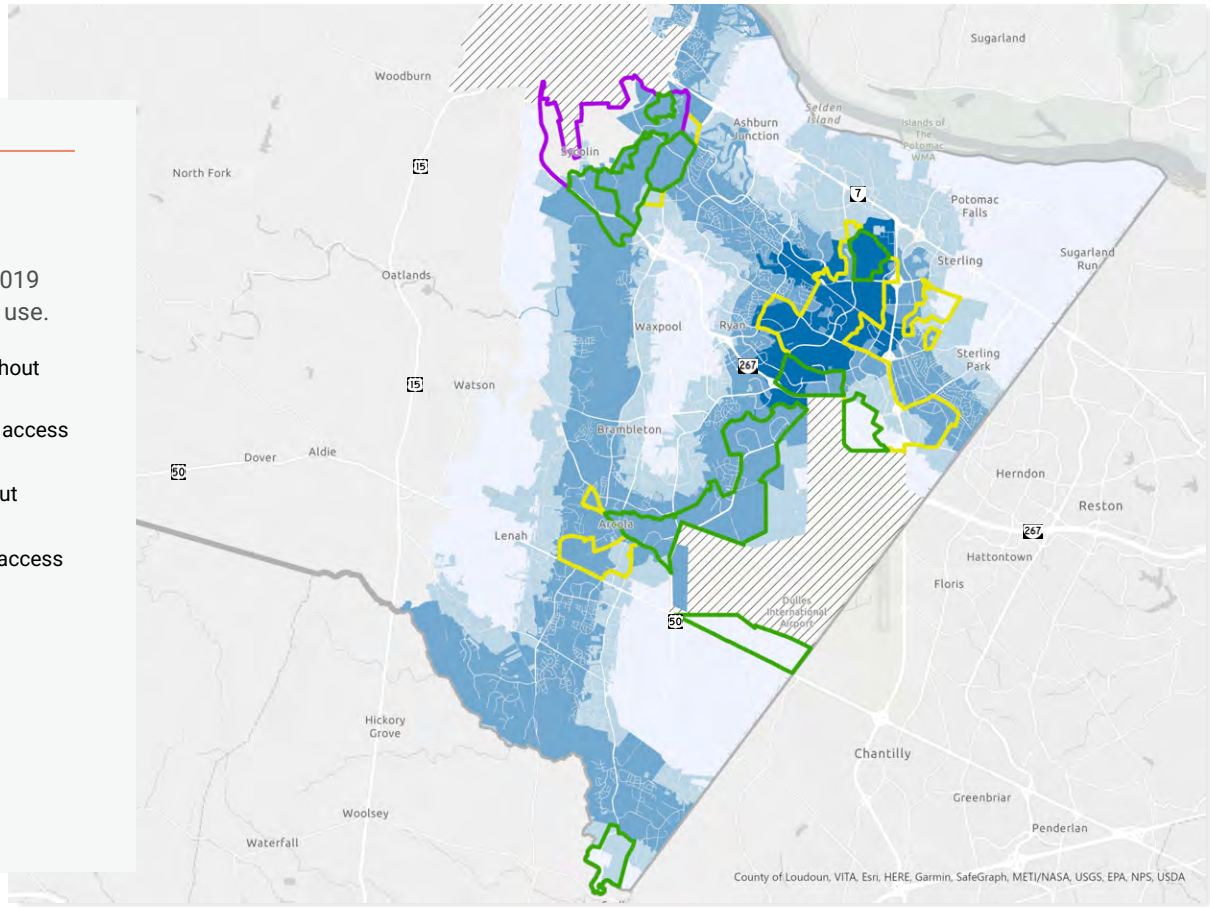
Combined Utilities & Place Types

With overlay of areas with Place Types in the 2019 General Plan that have data centers as a listed use.

- Outside of 1 mile of transmission line and without access to recycled water
- Within 1 mile of transmission line but without access to recycled water
- Within 1/2 mile of transmission line but without access to recycled water
- Within 1/4 mile of transmission line and with access to recycled water

- Core Use Place Type
- Complementary Use Place Type
- Conditional Use Place Type

- County Boundary
- Areas Not Included in Analysis *



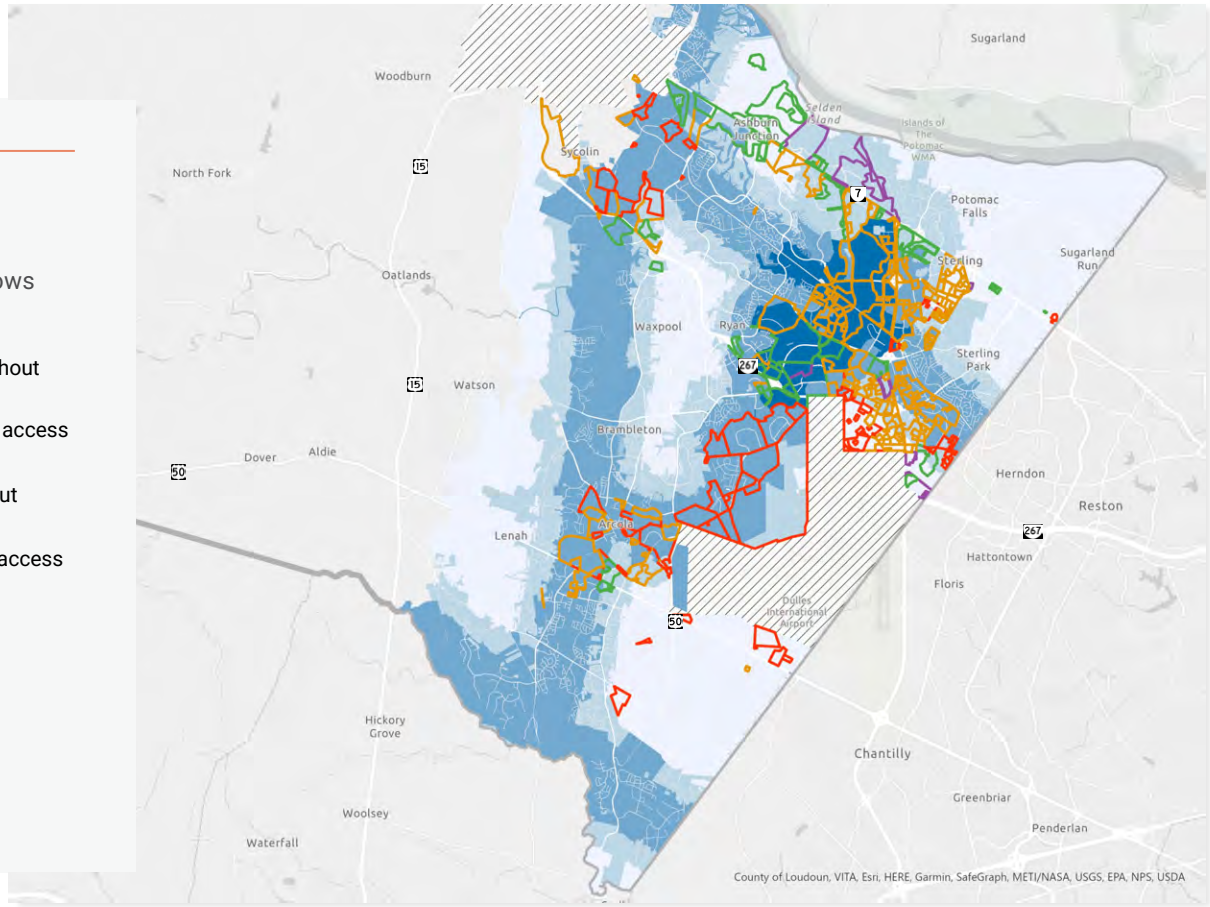
* The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Combined Utilities & Zoning

With overlay of areas where current zoning allows for data center development by right.

- Outside of 1 mile of transmission line and without access to recycled water
- Within 1 mile of transmission line but without access to recycled water
- Within 1/2 mile of transmission line but without access to recycled water
- Within 1/4 mile of transmission line and with access to recycled water
- PDRDP
- PDOP
- PDIP
- PDGI
- County Boundary
- Areas Not Included in Analysis *



* The Rural Policy Area and incorporated towns are also not part of this study

Physical Site Suitability

Suitability Criteria

Approach

All elements evaluated as part of the suitability analysis were assigned a score from one through five. One is for elements that were understood to be *less suitable* and five is for elements that were *most suitable*.

The physical criteria evaluated include floodplains, steep slopes, and wetlands.

Suitability Evaluation

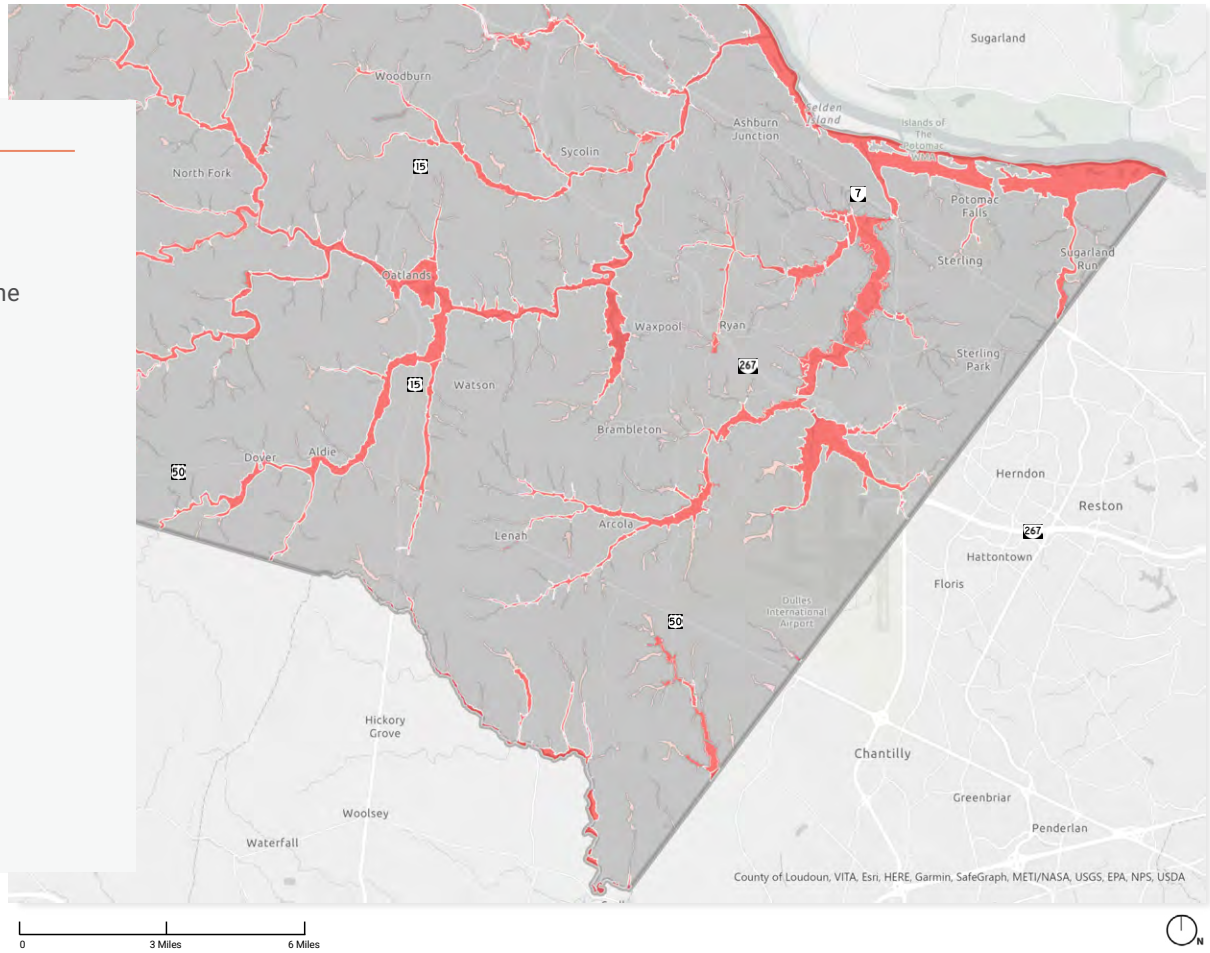
Flood Hazards

The flood hazards suitability evaluation used the FEMA flood plain map

High Flood Risk

Low Flood Risk

County Boundary



Suitability Evaluation

Flood Hazards

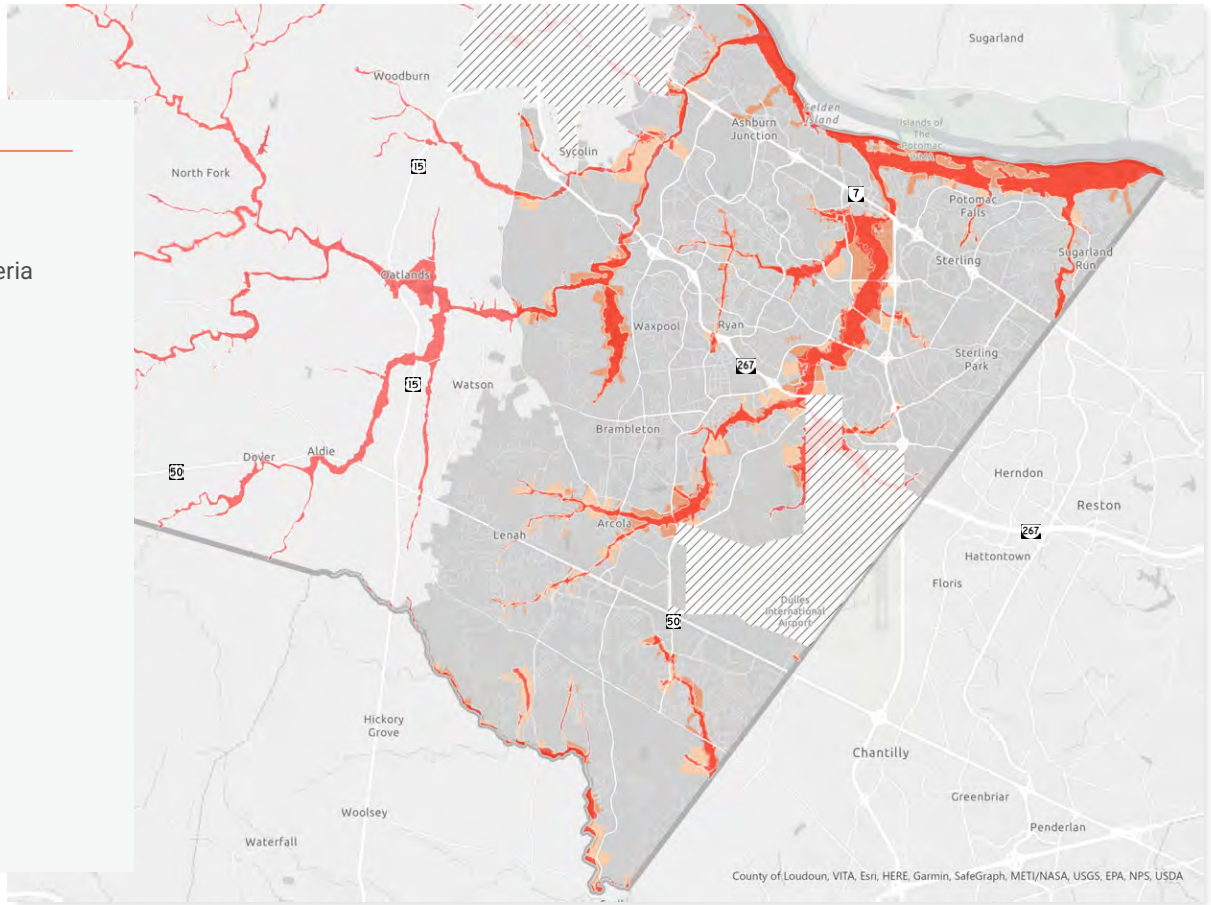
For the suitability evaluation, the following criteria were used:

Criteria	Score
Site not impacted or near floodplain	5
Site slightly impacted by flood plain	3
Site significantly impacted by floodplain	1

FEMA Flood Plain

County Boundary

Areas Not Included in Analysis *



* The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Wetlands and Steep Slopes Scoring Methodology

For both steep slope and wetlands, Arup used the following approach:

Steep Slopes

- High score means the parcel locates on relatively flat surface
- Low score means the parcel has a hilly terrain

Wetlands

- High score means the parcel has none or low percentage of wetlands
- Low score means the parcel locates within or largely covered by wetlands

With this method of scoring, some large parcels receive low scores while still having areas of developable land on the same parcel and may require further review on a case-by-case basis.

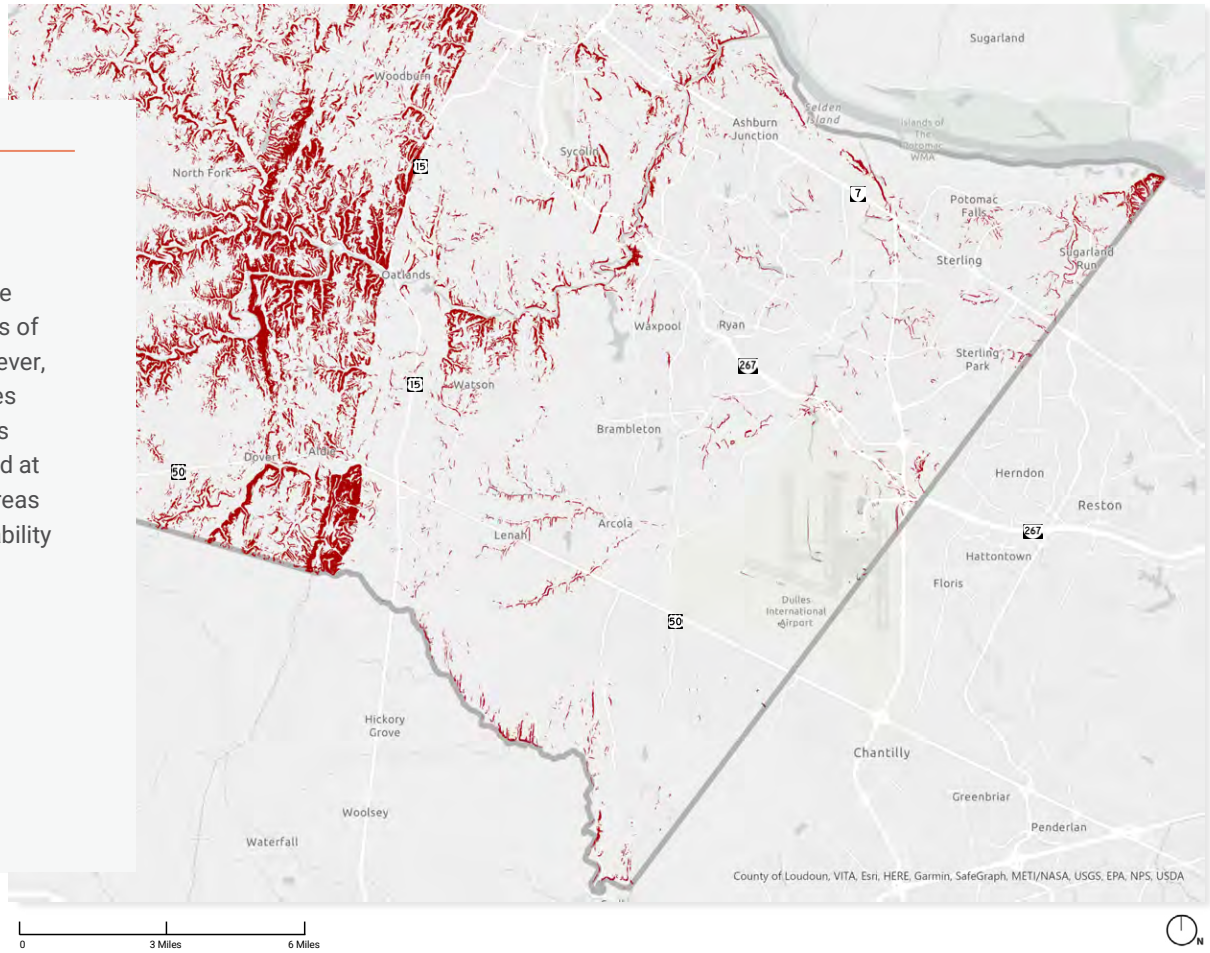
Suitability Evaluation

Steep Slopes

A steep slope is defined as an area with a slope greater than 15%. There are relatively few areas of steep slopes in eastern Loudoun County. However, the slopes data layer does not fully show slopes created by the open pit quarries south of Dulles Airport, southeast of the Town of Leesburg, and at the southernmost area of the County. These areas may need further review to determine the suitability of particular properties.

Slope

County Boundary



Suitability Evaluation

Steep Slopes

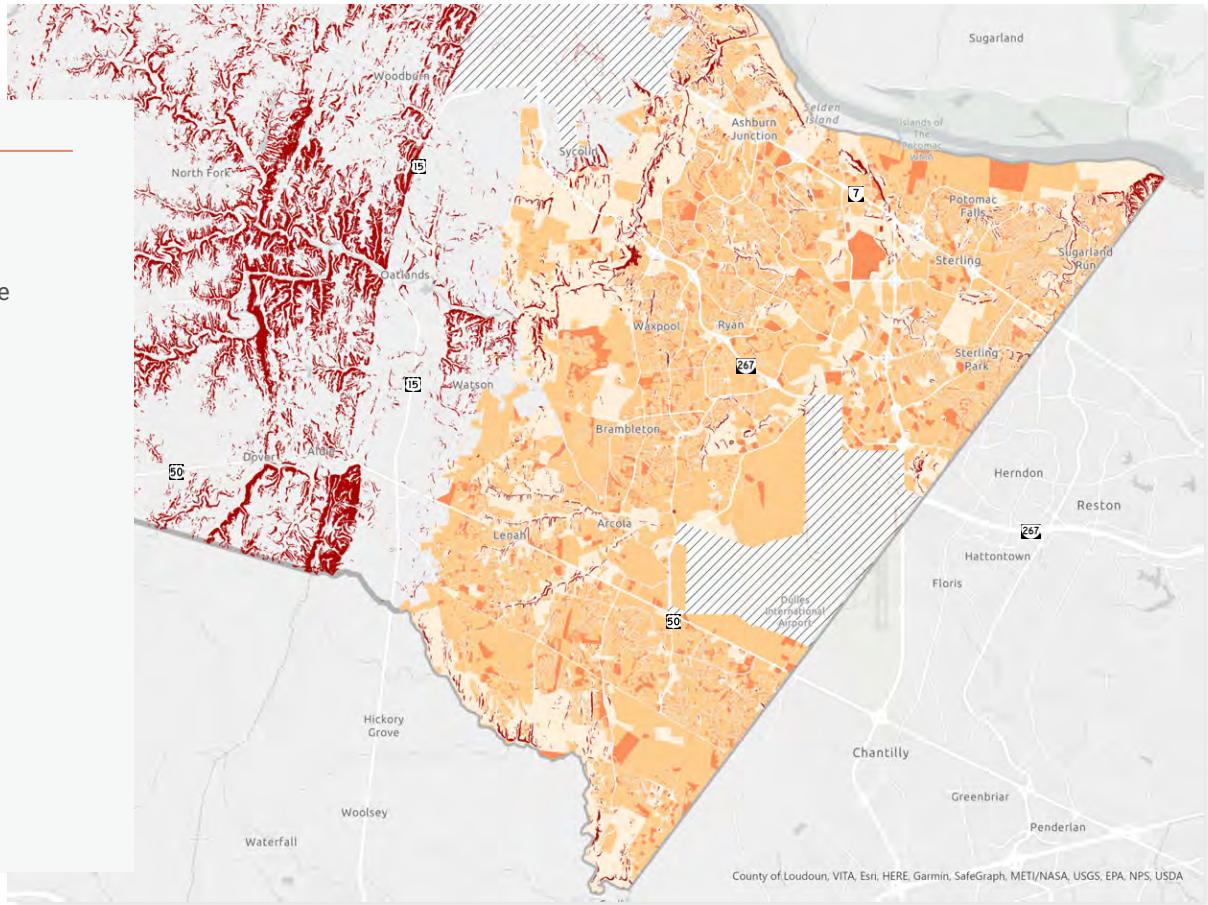
A steep slope is defined as an area with a slope greater than 15%.

Criteria	Score
More Suitable	5
Moderate Suitable	3
Less Suitable	1

Slope

County Boundary

Areas Not Included in Analysis *



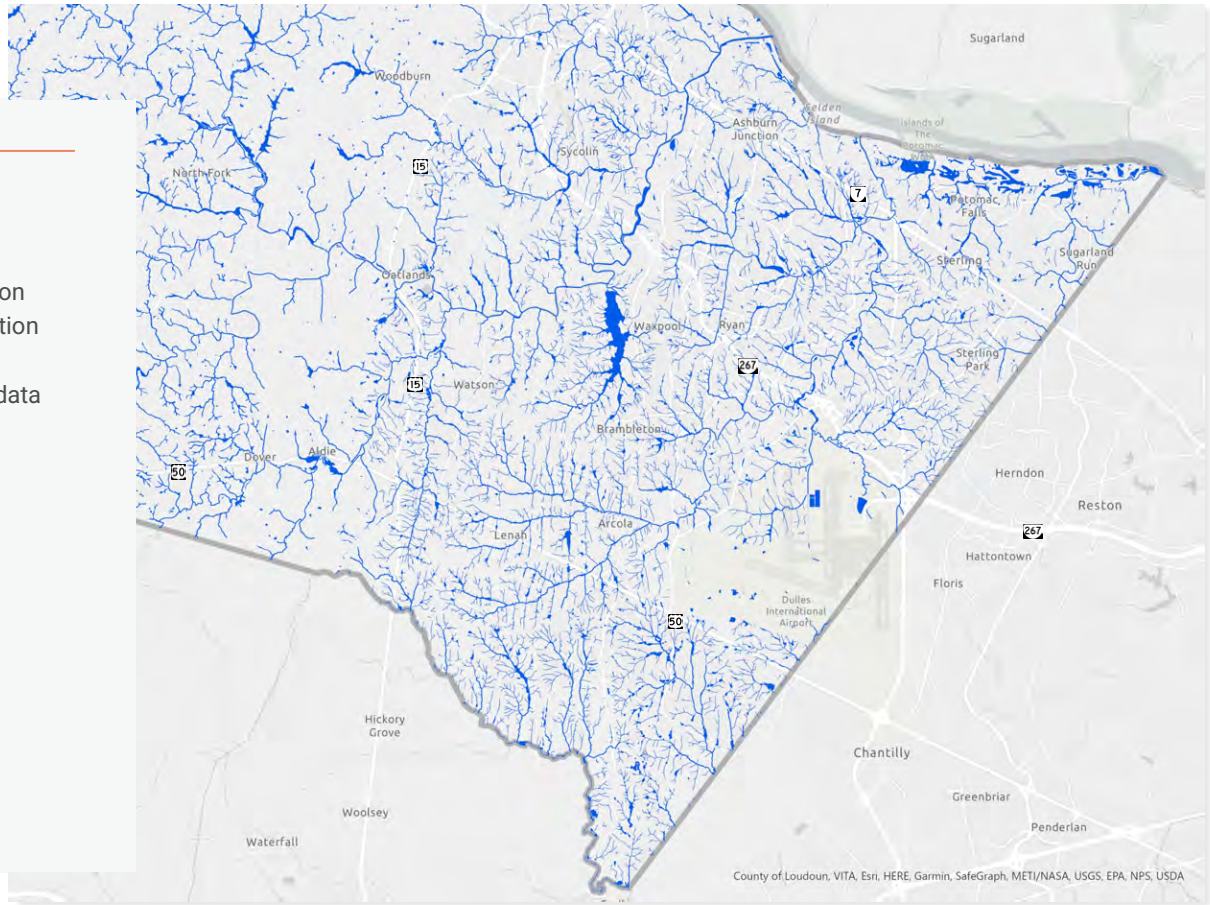
* The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Wetlands

The presence of wetlands impose restrictions on the amount of development and require mitigation where impacted by development. This map displays the predicted wetlands using the GIS data provided by Loudoun County.

- Predicted Wetlands
- County Boundary
- Areas Not Included in Analysis *



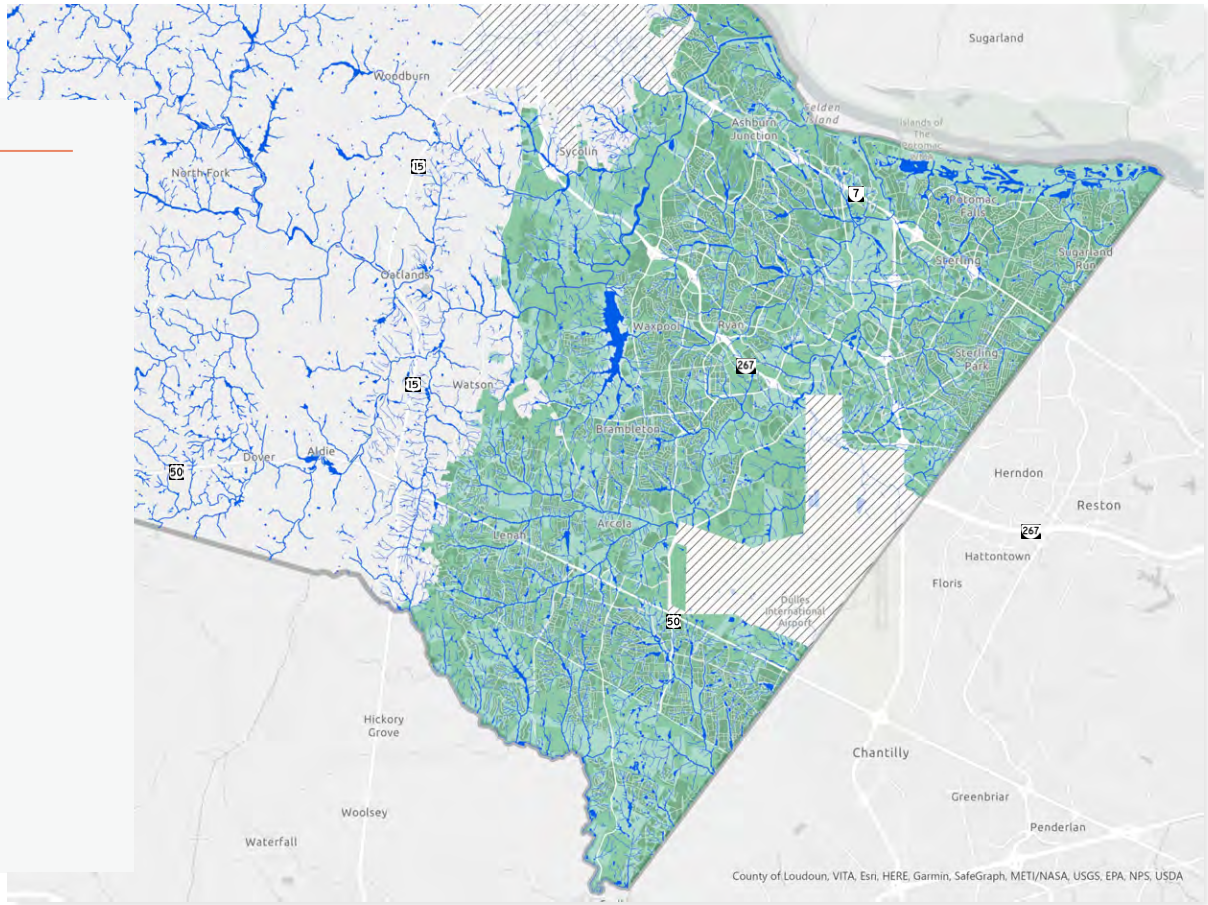
* The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Wetlands

Criteria	Score
More Suitable	5
	4
	3
	2
Less Suitable	1

- Predicted Wetlands
- County Boundary
- Areas Not Included in Analysis *



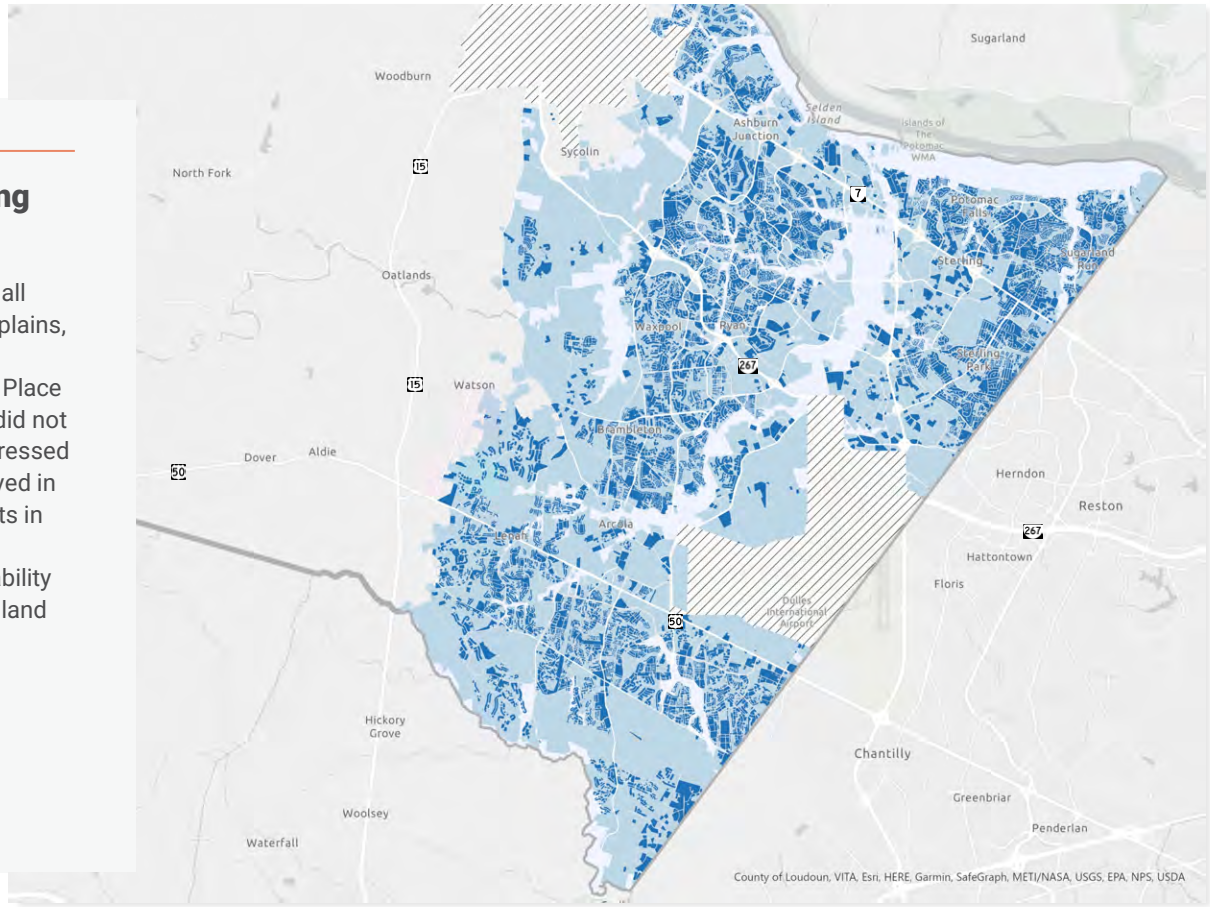
* The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Physical Criteria Suitability Ranking

Arup calculated a physical suitability score for all parcels using the criteria and scoring for floodplains, steep slopes, and wetlands noted on the corresponding maps in this study. The zoning, Place Types, and presence of existing development did not go into the calculation of this score and is addressed separately. All parcels were ranked and displayed in three categories. This method of scoring results in some large parcels with areas of less suitable physical characteristics receiving a lower suitability ranking while still having areas of developable land on the same parcel.

- Less Suitable
- More Suitable
- Suitable
- County Boundary
- Areas Not Included in Analysis *



* The Rural Policy Area and incorporated towns are also not part of this study

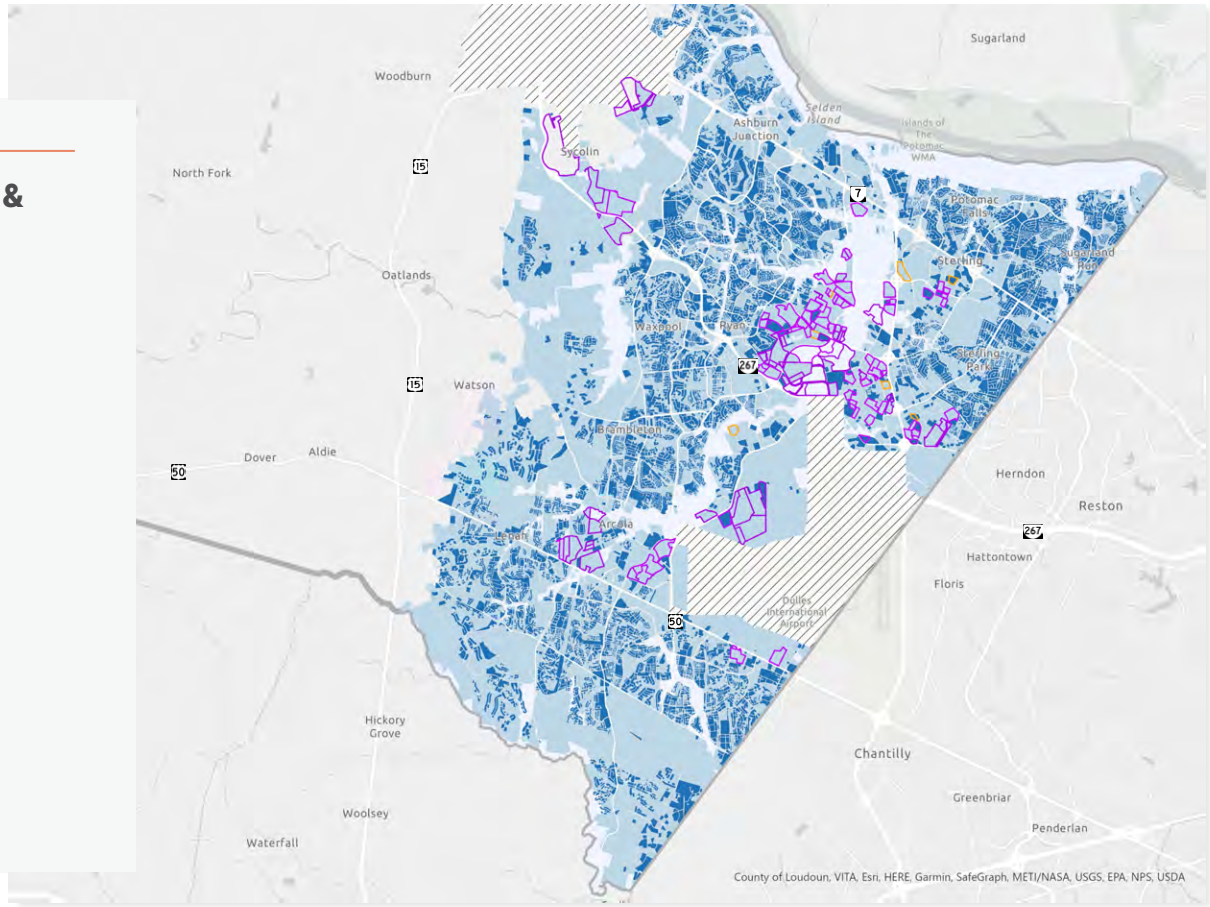
Suitability Evaluation

Physical Criteria Suitability Score & Existing Built and Permitted Data Centers

- Less Suitable
- Suitable
- More Suitable

- Existing Data Centers *
- Additional Permitted Data Centers **

- County Boundary
- Areas Not Included in Analysis *



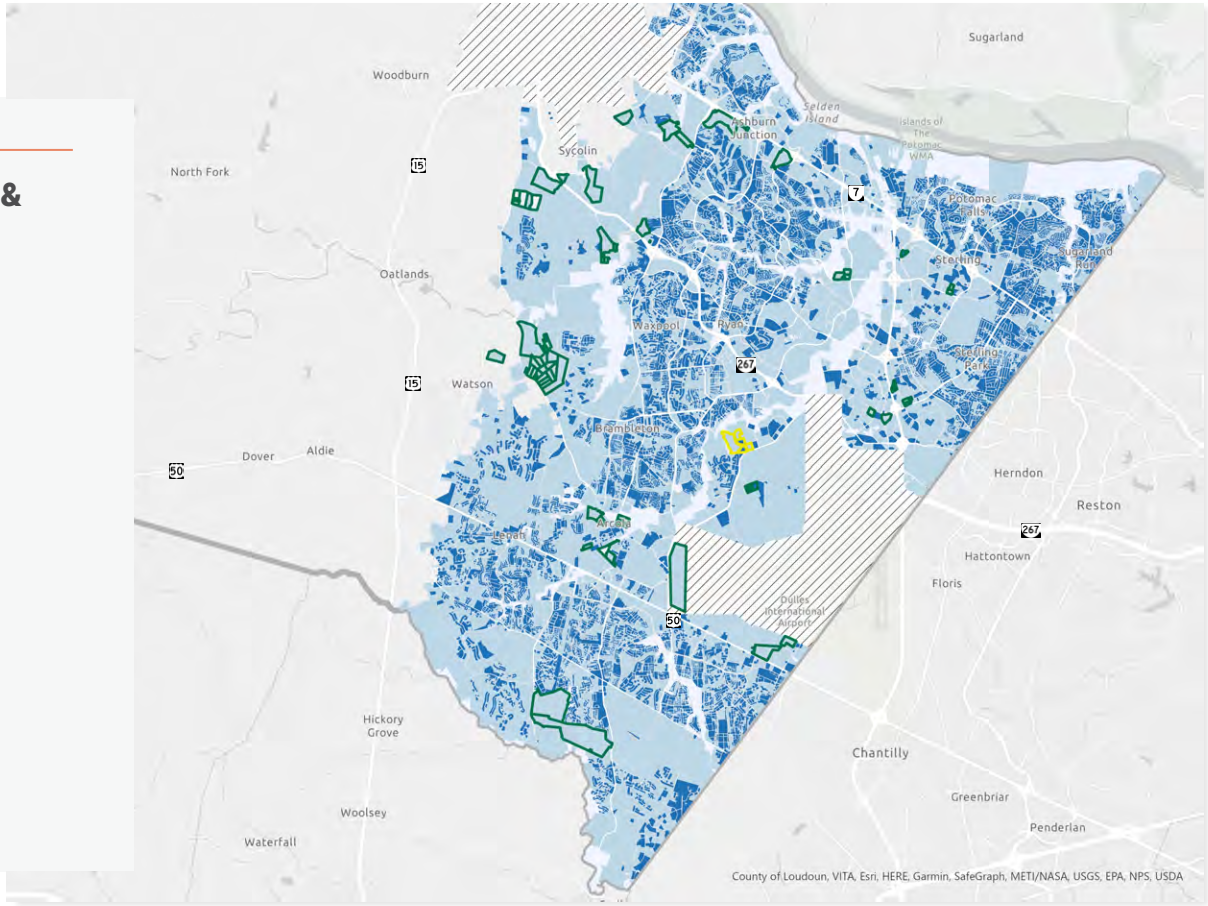
0 3 Miles 6 Miles

* Parcel is shown as having data center in most recent assessment data
** Parcel is shown with permits for data center according Loudoun County permit data
*** The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Physical Criteria Suitability Score & Land Inventory

- Less Suitable
- Suitable
- More Suitable
- Owner/broker communication
- Owner/broker communication and now owned by data center companies
- County Boundary
- Areas Not Included in Analysis *



* The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

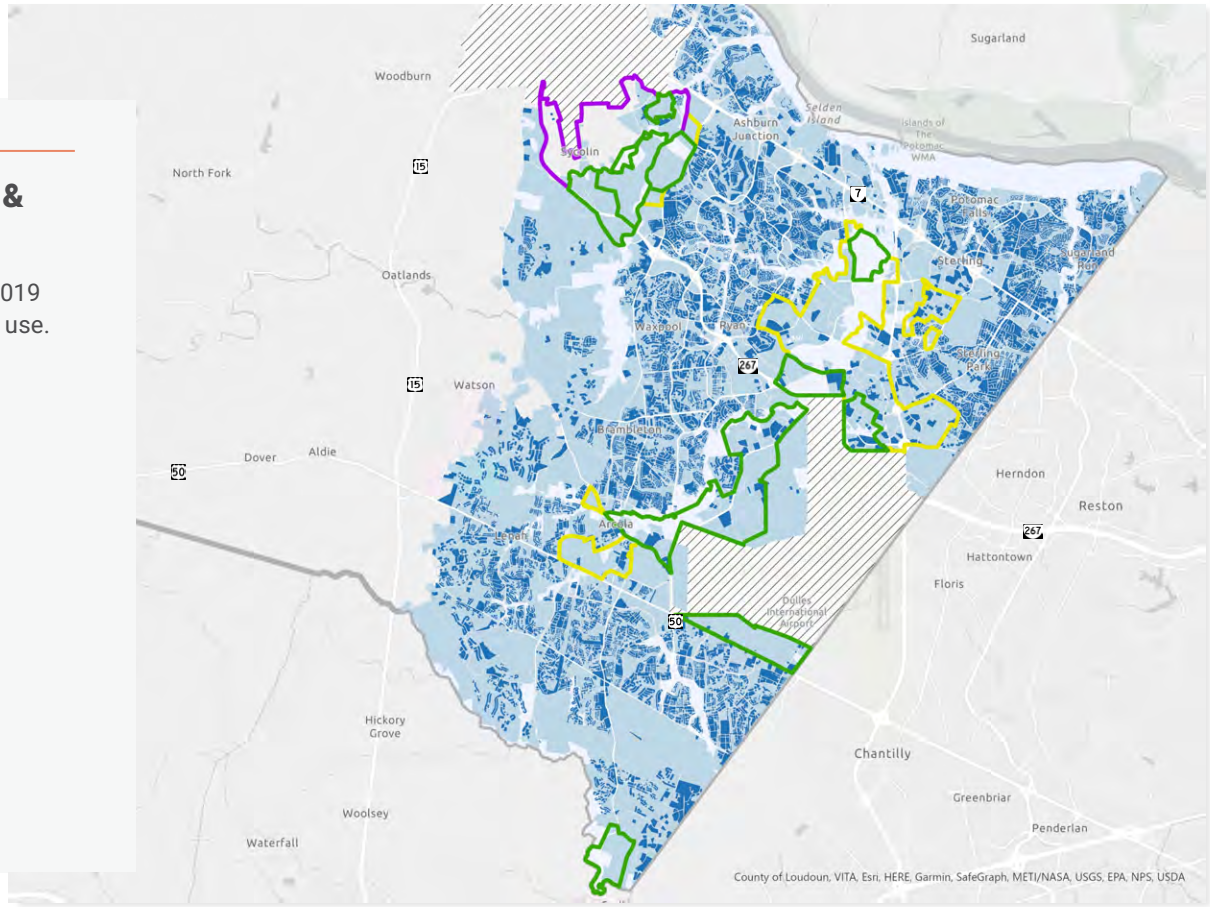
Physical Criteria Suitability Score & Place Types

With overlay of areas with Place Types in the 2019 General Plan that have data centers as a listed use.

- Less Suitable
- Suitable
- More Suitable

- Core Use Place Type
- Complementary Use Place Type
- Conditional Use Place Type

- County Boundary
- Areas Not Included in Analysis *



* *The Rural Policy Area and incorporated towns are also not part of this study*

Suitability Evaluation

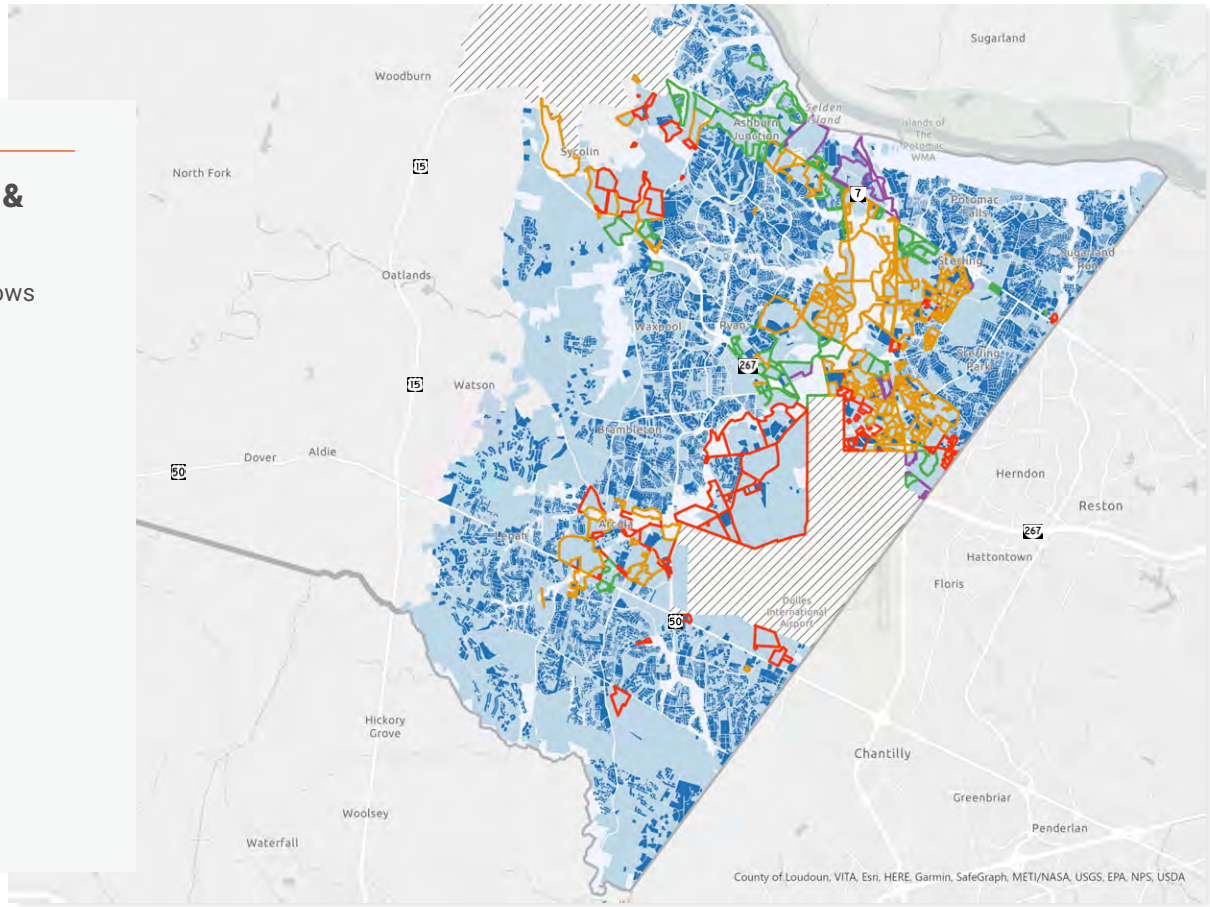
Physical Criteria Suitability Score & Zoning

With overlay of areas where current zoning allows for data center development by right.

- Less Suitable
- Suitable
- More Suitable

- PDRDP
- PDOP
- PDIP
- PDGI

- County Boundary
- Areas Not Included in Analysis *



* The Rural Policy Area and incorporated towns are also not part of this study

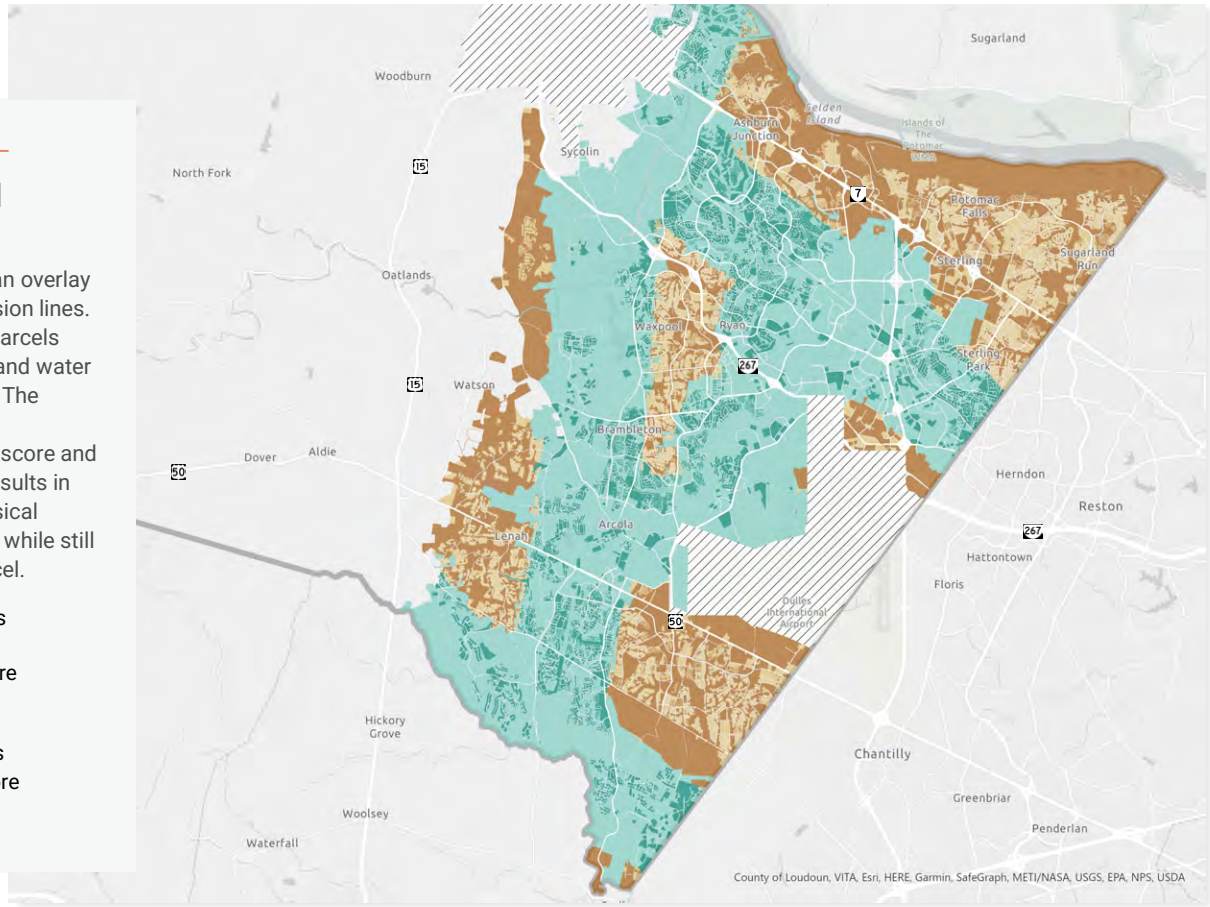
Combined Physical Suitability and Power

Suitability Evaluation

Combined Physical Suitability and Power Access

The map displays relative physical suitability with an overlay showing areas within 1 mile of the major transmission lines. Arup calculated a physical suitability score for all parcels using the criteria and scoring for access to power and water utilities, steep slopes, wetlands and flood hazards. The zoning, Place Types, and the presence of existing development did not go into the calculation of this score and is addressed separately. This method of scoring results in some large parcels with areas of less suitable physical characteristics receiving a lower suitability ranking while still having areas of developable land on the same parcel.

- Less suitable based on power access and less suitable based on physical site conditions
- Less suitable based on power access and more suitable based on physical site conditions
- More suitable based on power access and less suitable based on physical site conditions
- More suitable based on power access and more suitable based on physical site conditions
- Areas Not Included in Analysis *

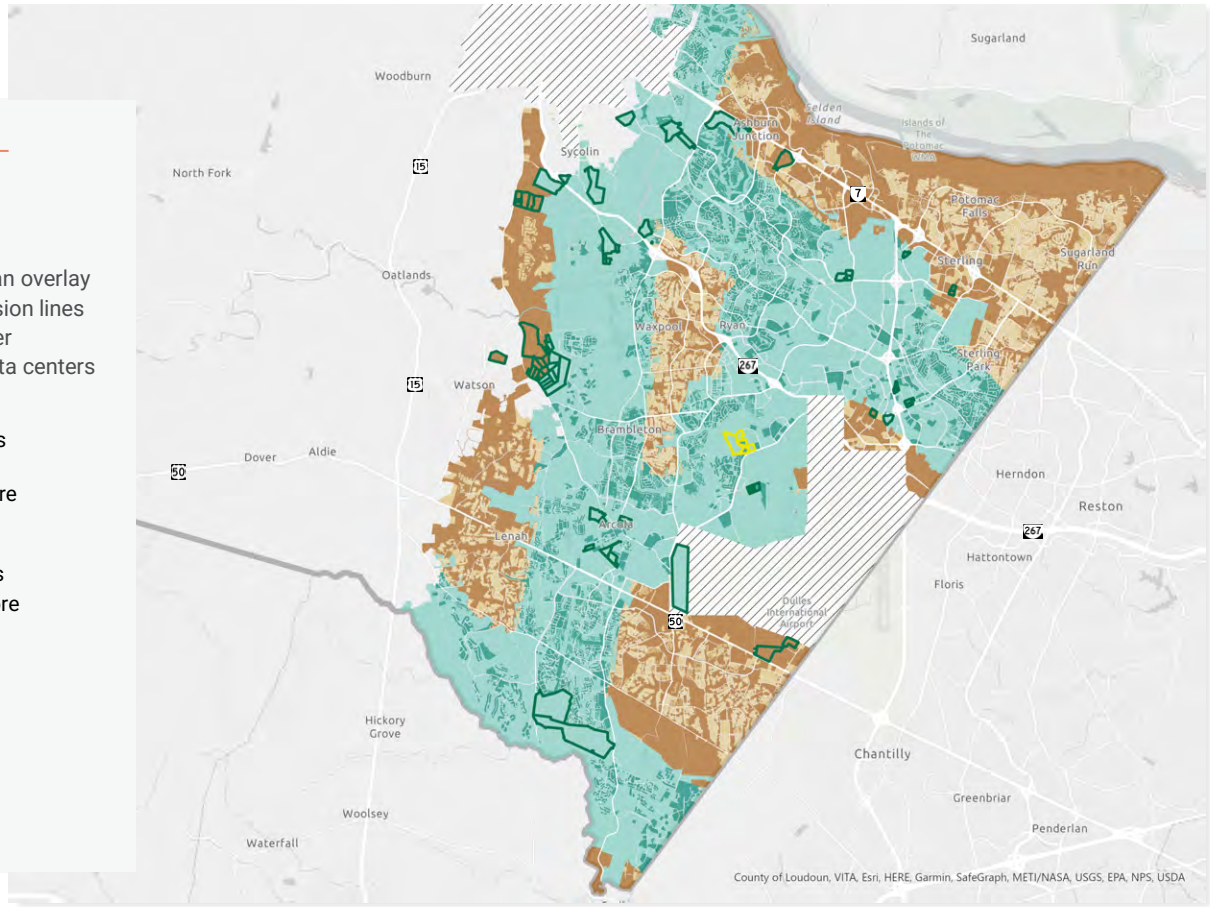


Suitability Evaluation

Combined Physical Suitability, Power, & Land Inventory

The map displays relative physical suitability with an overlay showing areas within 1 mile of the major transmission lines and an overlay of properties where owners or owner representatives have asked about feasibility for data centers or marketing for data center development.

- Less suitable based on power access and less suitable based on physical site conditions
- Less suitable based on power access and more suitable based on physical site conditions
- More suitable based on power access and less suitable based on physical site conditions
- More suitable based on power access and more suitable based on physical site conditions
- Owner/broker communication
- Owner/broker communication and now owned by data center companies
- County Boundary
- Areas Not Included in Analysis *



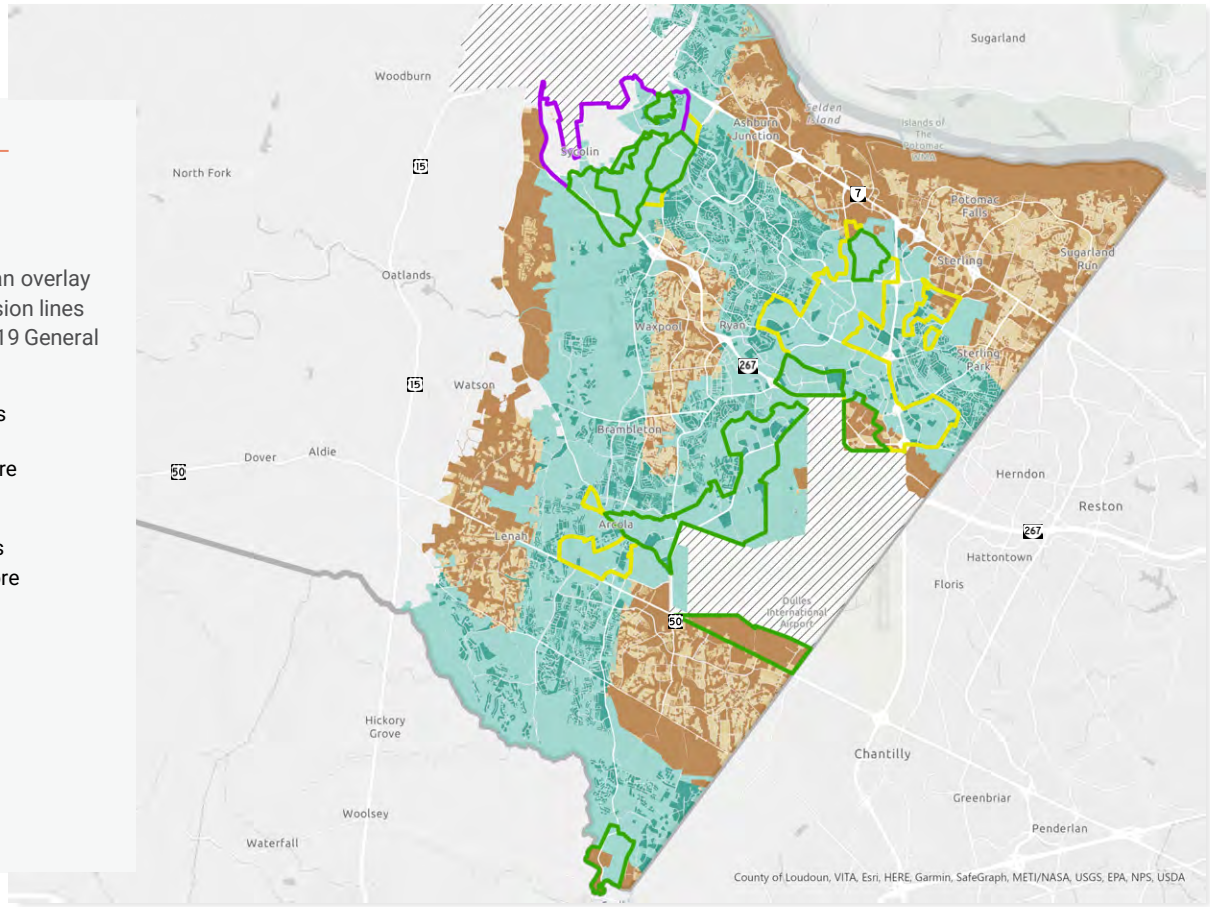
* The Rural Policy Area and incorporated towns are also not part of this study

Suitability Evaluation

Combined Physical Suitability, Power, & Place Types

The map displays relative physical suitability with an overlay showing areas within 1 mile of the major transmission lines and an overlay of areas with Place Types in the 2019 General Plan that have data centers as a listed use.

- Less suitable based on power access and less suitable based on physical site conditions
- Less suitable based on power access and more suitable based on physical site conditions
- More suitable based on power access and less suitable based on physical site conditions
- More suitable based on power access and more suitable based on physical site conditions
- Core Use Place Type
- Complementary Use Place Type
- Conditional Use Place Type
- County Boundary
- Areas Not Included in Analysis *



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Suitability Evaluation

Combined Physical Suitability, Power, & Zoning

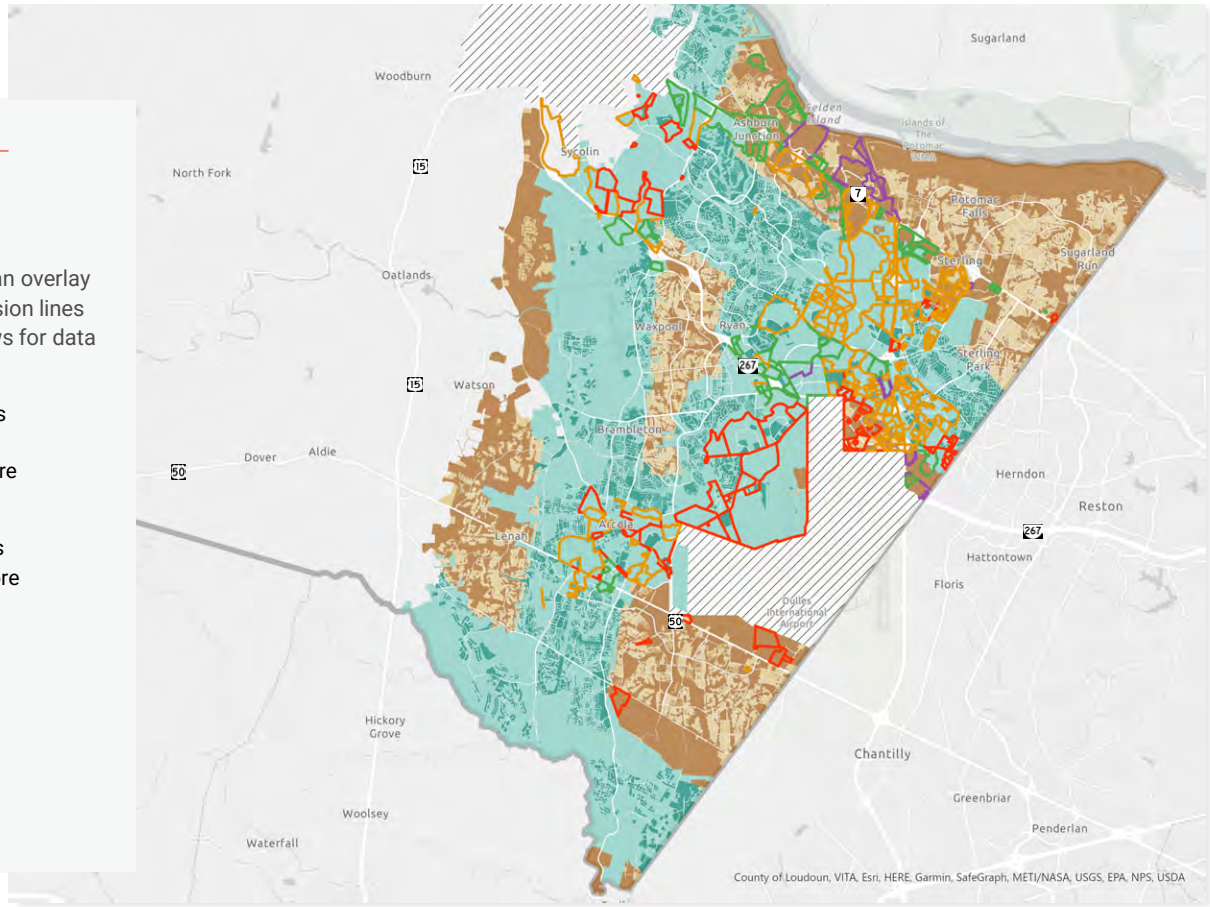
The map displays relative physical suitability with an overlay showing areas within 1 mile of the major transmission lines and an overlay of areas where current zoning allows for data center development by right.

- Less suitable based on power access and less suitable based on physical site conditions
- Less suitable based on power access and more suitable based on physical site conditions
- More suitable based on power access and less suitable based on physical site conditions
- More suitable based on power access and more suitable based on physical site conditions

PDRDP
PDOP
PDIP
PDGI

County Boundary

Areas Not Included in Analysis *



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Conclusion

Conclusion

Key Takeaways

Using the approach outlined in the document, Arup evaluated portions of the County for their suitability for data center development. The most suitable sites are located physically closer to existing high voltage transmission lines and have fewer site constraints such as being located in areas prone to flooding, sites with steep slopes, or in areas with wetlands.

The following pages provide additional information on the following locations:

- Remaining developable land in Loudoun County with current zoning and the General Plan Place Types and is suitable for data centers.
- Where there is remaining developable land in Loudoun County with current zoning that allows for data centers, but data center development would likely have more of an impact in terms of required new power infrastructure and the associated visual impacts that come with the new power infrastructure.
- The undeveloped area in the part of eastern Loudoun County covered by the study where there is remaining developable land that is the most reasonable opportunity for future data center development without current zoning or General Plan Place Types that allow for data centers.

Suitability Evaluation

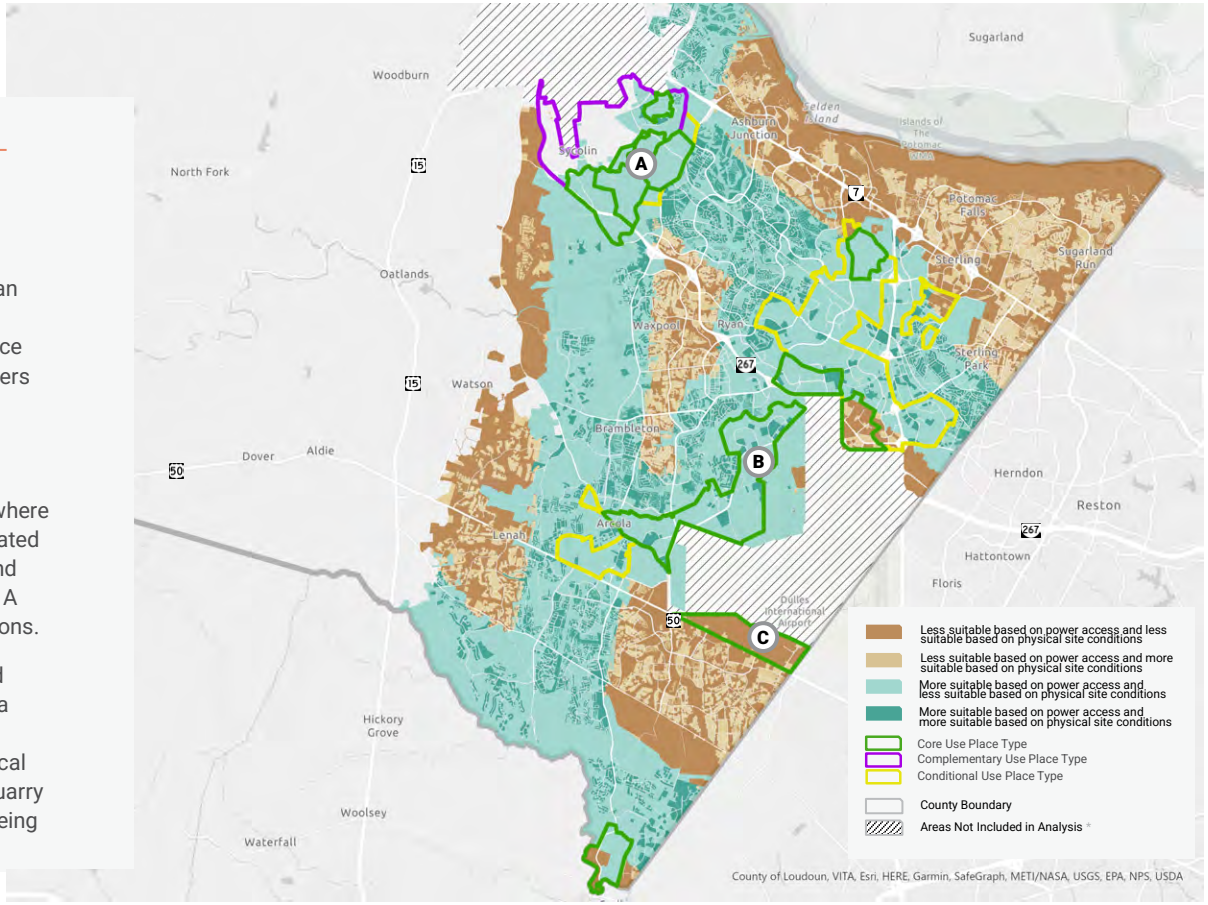
Combined Physical Suitability, Power, & Place Types

This map displays relative physical suitability with an overlay showing areas within 1 mile of the major transmission lines and an overlay of areas with Place Types in the 2019 General Plan that have data centers as a listed use.

Some areas to note include:

(A) (B) There are multiple areas with Place Types where data centers are a core use that were evaluated as more suitable based on power access and physical site constraints. The areas labeled A and B are examples of these types of locations.

(C) The land directly south of Dulles Airport and north of Route 50 has data center listed as a core use for the Place Type and is being developed for data centers where the physical site constraints related to being next to a quarry can be overcome. Power infrastructure is being extended and is not visible from Route 50.



* *The Rural Policy Area and incorporated towns are also not part of this study*

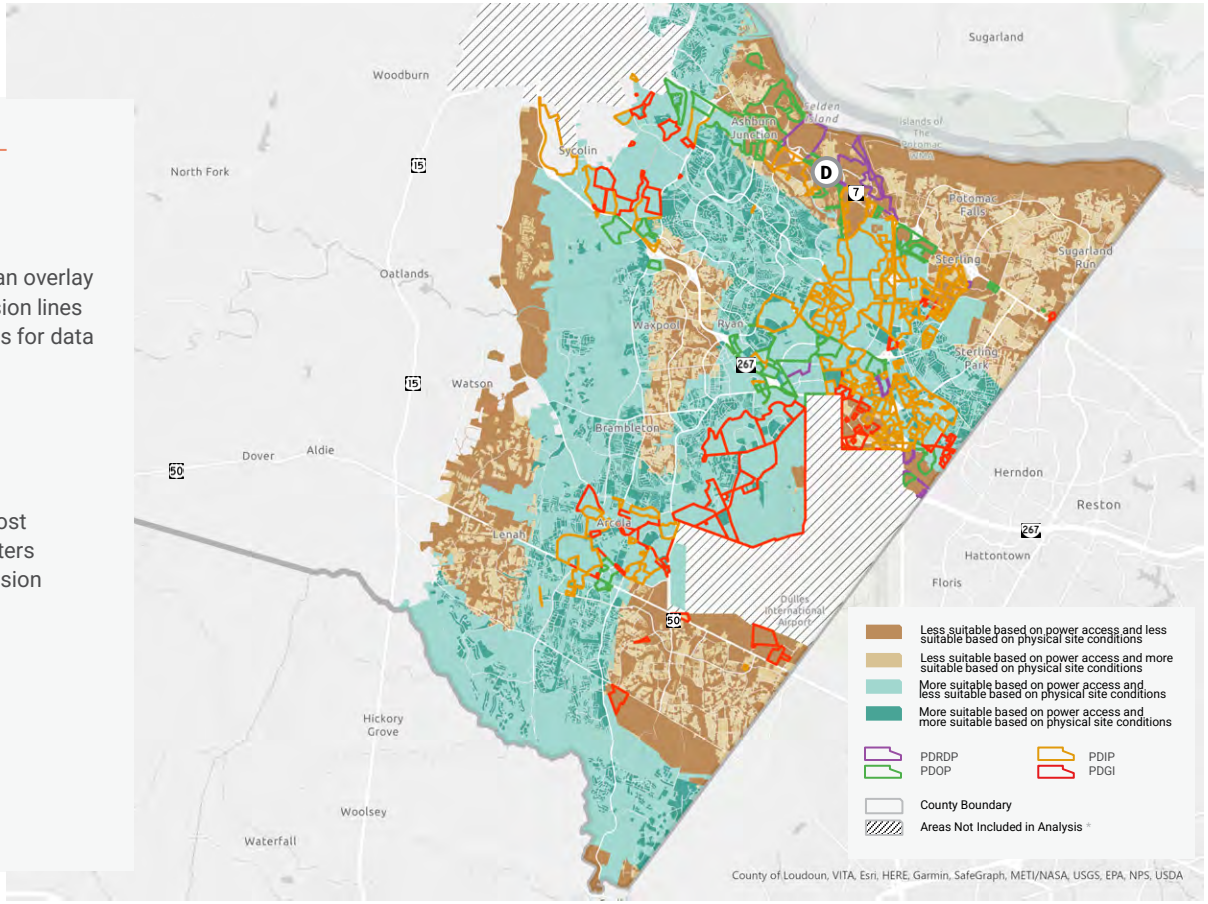
Suitability Evaluation

Combined Physical Suitability, Power, & Zoning

This map displays relative physical suitability with an overlay showing areas within 1 mile of the major transmission lines and an overlay of areas where current zoning allows for data center development by right.

Some areas to note include:

(D) There are areas along Route 7 where current zoning allows for data centers by right, but most areas of Route 7 are not suitable for data centers based on distance to existing power transmission lines and physical site conditions.



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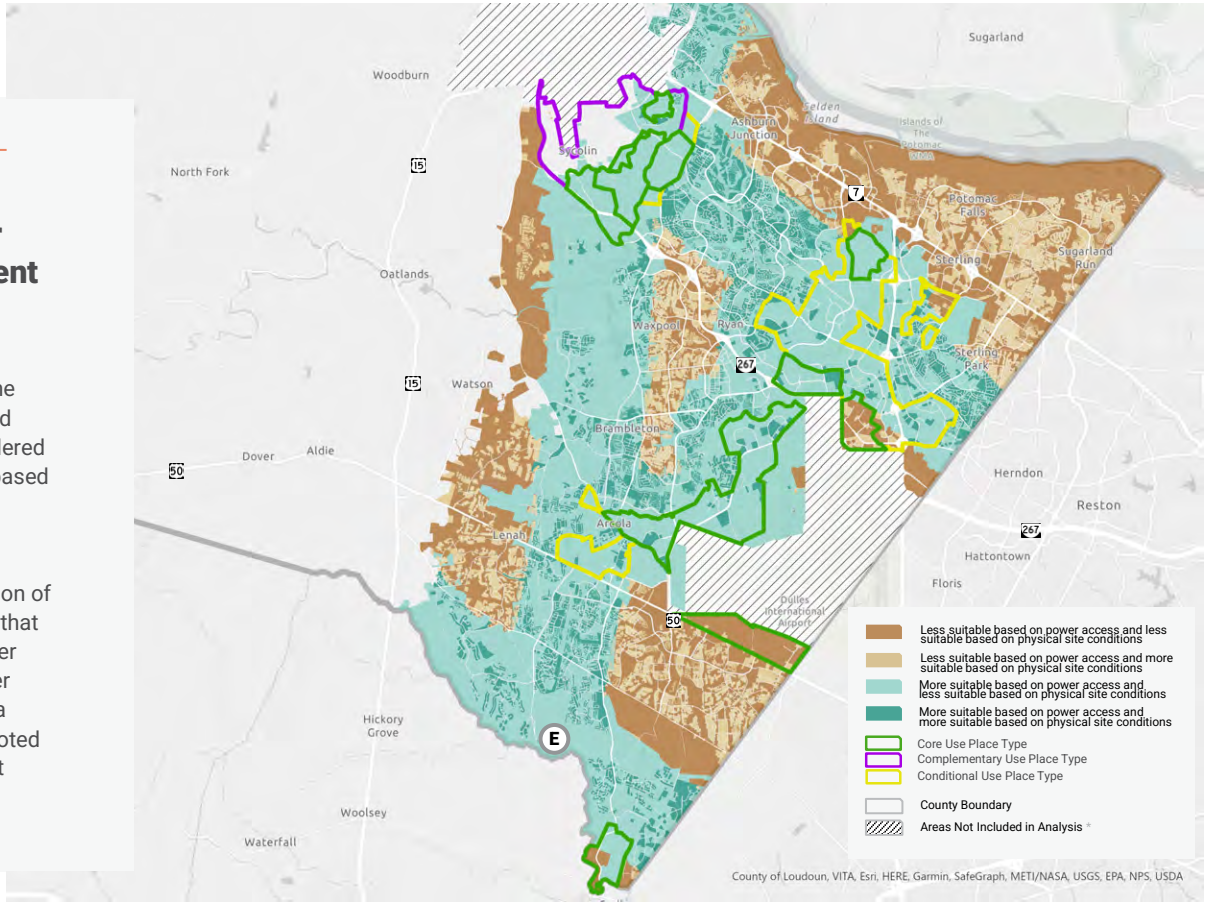
Suitability Evaluation

Combined Physical Suitability & Power and Place Types with Other Sites Most Suitable for Development

This map displays relative physical suitability with overlays showing areas within 1 mile of the major transmission lines and areas with Place Types in the 2019 General Plan that have data centers as a listed use. Other areas of the county that could be considered most suitable for future data center development based on the criteria reviewed are noted.

E There is a large area in the far southeast portion of the county 1-2 miles south of Braddock Road that lies next to the intersection of two major power transmission line corridors, has existing power substations, and is physically suitable for data centers. The properties in this area are also noted for having communication from owners about interest in opportunities for data center development.



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