

Supplementary material

What can a data center zoning reform reach? Evidence from Henrico County (VA). Supplementary material (September 2026, v0.9). Sections: S1 documentary base and retrieval; S2 ACS estimates and margins of error; S3 geocoding; S4 plan-of-development approvals; S5 the nine-jurisdiction comparison (Table S5), its coding protocol and per-row sources, and the five exclusions; S6 engine-group emission limits, DEQ registration 51232; S7 figure sources and design; S8 reporting discrepancies and primary-record checks; S9 the four vested-rights determinations. The county and state records cited are included in the replication deposit (folder county_and_state_records) with the figure scripts (folder figures), the statute texts (folder legal), the portal transcription (folder portal), and the tables as CSV (folder tables).

S1. Documentary base and retrieval

Sources by type, with retrieval route. County ordinances, resolutions, staff reports and plan-of-development agendas: henrico.gov, Board of Supervisors minutes and the Planning Department's monthly agendas (henrico.gov/pdfs/planning/<year>/<mon><yy>pod.pdf), December 2024 to August 2026 (twenty of twenty-one months; the January 2025 file was not retrieved), retrieved July 2 and September 26, 2026. Six of those files are outline agendas that carry no dispositions beyond pre-announced deferrals (June 2025, September 2025, May 2026, June 2026, July 2026, August 2026); the others are post-action agendas. Any negative drawn from the agendas is bounded to the post-action months, and dispositions for the outline months were read from the county's public case portal (Build Henrico, build.henrico.gov/henprod/pub/lms/, no sign-in), whose field values are transcribed in the deposit file BUILD_HENRICO_PORTAL_RECORD_2026-09-26.md with the record identifiers. The portal's Details tab does not print the Director's approval date; the Processes tab, read for POD-2025-100752 and POD-2025-101899, shows findings dates and an expiry date, from which validity is inferred (S8). Other portal dates are activity dates as displayed. Zoning text: Henrico County Code Chapter 24 as published on July 28, 2026 (in the deposit), the advertised amendment text of May and June 2025, and the adopted text reproduced as Exhibit A to each determination letter (S9). Deeds and parcel records: Henrico County Real Estate Assessment Division and the deed reproduced as Exhibit O in the Board of Zoning Appeals binder. State air permits and guidance: Virginia DEQ registrations 51232 (June 24, 2024), 53259 (April 22, 2026) and 53266 (May 7, 2026), and guidance memorandum APG-576, Diesel Engine-Generator Set Procedure for Writing New and Modified Permits (the designation, title and effective date of April 9, 2026 are from the Virginia Regulatory Town Hall listing for guidance document 5121, saved as a note; the file itself is titled "Permit Boilerplate Procedures For Diesel Engine-Generator Sets," carries the header date December 29, 2025, and states that its data-center BACT provisions apply to applications submitted on or after July 1, 2026; in the deposit). Statutes: Va. Code §§ 15.2-2261, 15.2-2286(A)(4), 15.2-2307, 15.2-2311 and 15.2-2314 (law.lis.virginia.gov); N.C. Gen. Stat. § 160D-108.1 (ncleg.gov); Wash. Rev. Code § 19.27.095 (app.leg.wa.gov); Tex. Loc. Gov't Code ch. 245 (statutes.capitol.texas.gov); Colo. Rev. Stat. § 24-68-103 (Justia mirror of the 2025 code; the official text is on LexisNexis). All statute pages were read and saved on September 26, 2026 with retrieval headers (deposit folder legal). 2026 legislation: 2026 Va. Acts ch. 397 (HB 507, adding Va. Code § 10.1-1322.6, generator emission limits) and ch. 567 (HB 153, adding Va. Code § 15.2-2209.4, site assessment for high energy use facilities): the Legislative Information System bill pages (summaries as passed, chapter numbers, dates) and the chaptered texts as rendered by LegiScan were read on September 26, 2026 and saved in the deposit folder legal; the article quotes § 15.2-2209.4(B) and § 10.1-1322.6(B) from those texts. Court records: Board of County

Supervisors of Prince William County v. Oak Valley Homeowners Association, Court of Appeals of Virginia, March 31, 2026 (in the deposit). Census: ACS 2020 to 2024 five-year, release ACSDT5Y2024, retrieved 2026-07-02 (S2). Contemporaneous reporting: Richmond BizSense, Henrico Citizen, VPM News, Virginia Business, Data Center Knowledge, as cited. Where two sources gave different dates or figures, the primary record governed (S8).

Board of Zoning Appeals records (henrico.gov): the minutes of February 26, 2026, which incorporate the court reporter's transcript of the administrative hearing in APP-2026-100056 and record the motion to uphold the Director of Planning carried 5 to 0 (Broadway, Green, Johnson, Lawrence, Massie); the agenda for that meeting; the appellant's exhibit binder (Exhibits A to V-1, 298 pages), which includes the zoning confirmation letter ZCL-2024-100685 dated June 12, 2024, the intake notice for plan of development POD-2025-101009 (Airport West Data Center Campus), the county's plan review comments, the subdivision plat SUB-2025-100957, the October 1, 2025 request for a binding vested-rights determination, the county's four determination letters (Exhibits Q, S, V and V-1), the adopted ordinance as Exhibit A to each letter, the RIC5 proffers, and the deed of the eastern parcels (Exhibit O); and the Board's monthly agendas from September 2025 to September 2026 (thirteen files). Pages 125 to 283 of the 298-page binder are image-only and were OCR'd on September 26, 2026 (tesseract 5 at 200 dpi); the output file carries page markers, OCR errors are present, and every quotation taken from it was read against the page image. Pages 284 to 298 (the Planning Commission staff report) carry a text layer. The Planning Commission staff report for PUP-2025-101460 as updated after the September 11, 2025 meeting (staff recommendation of approval with conditions; Commission recommendation of denial, 4-1-1; Board hearing scheduled October 14, 2025) is in the deposit.

Retrieval deviations, recorded so that the reader can weigh them: the thirteen Board of Zoning Appeals agenda files, a set of county PDFs and the APG-576 file were pulled with curl on the author's computer from their public henrico.gov and townhall.virginia.gov links after a first reading by a fetch tool; no user agent was altered and nothing was circumvented.

S2. ACS estimates and margins of error

Retrieved 2026-07-02 from data.census.gov (table endpoint, release ACSDT5Y2024; API vintage 2024/acs/acs5). All margins of error are 90 percent, as published. County total population is a controlled estimate (MOE not applicable); county share margins computed with denominator MOE of zero accordingly.

Variable	Tract 2015.04 (51087201504)	Tract 2014.04 (51087201404)	Tract 2001.46 (51087200146)	Henrico County (51087)
B19013_001 median HH income	\$63,203 ± \$13,194	\$84,632 ± \$10,742	\$143,248 ± \$11,983	\$88,783 ± \$2,074
B03002_001 total population	4,103 ± 469	4,627 ± 709	2,861 ± 322	335,744 (controlled; MOE n/a, annotation *****)
B03002_003 NH White alone	615 ± 233	3,449 ± 695	1,572 ± 216	166,119 ± 669
B03002_004 NH Black alone	2,824 ± 510	894 ± 236	317 ± 260	97,727 ± 1,108
B17001_001 poverty universe	4,103 ± 469	4,627 ± 709	2,861 ± 322	331,808 ± 294
B17001_002 below poverty	1,004 ± 475	415 ± 309	42 ± 37	29,180 ± 2,477

Derived shares and margins (Census Bureau ratio formula; race shares over B03002_001, poverty over B17001_001; tract race and poverty universes are identical in this release):

Share	2015.04	2014.04	2001.46	County
NH Black	68.8% ± 9.6	19.3% ± 4.2	11.1% ± 9.0	29.1% ± 0.3
NH White	15.0% ± 5.4	74.5% ± 9.8	54.9% ± 4.3	49.5% ± 0.2
Poverty	24.5% ± 11.2	9.0% ± 6.5	1.5% ± 1.3	8.8% ± 0.7

Source URLs (substitute the geography ID after g= for each of the four geographies):

<https://data.census.gov/api/access/data/table?>

id=ACSDT5Y2024.B19013&g=1400000US51087201504 ; ...B03002... ; ...B17001... ; county geography 0500000US51087.

S3. Geocoding of the sites

Address-to-tract assignment used the U.S. Census Bureau Geocoder (geocoding.geo.census.gov, benchmark Public_AR_Current, vintage Current_Current), queried September 15, 2026. Results: 2248 Darbytown Road, Henrico, VA 23231 (the address used in reporting, in the county's zoning confirmation letter of June 12, 2024, and in the heading of its December 10, 2025 determination) matched at longitude -77.357843, latitude 37.483272, tract 2015.04 (GEOID 51087201504). 2300 Darbytown Road, Henrico, VA 23231 (the address the county assigns to parcel 812-704-4612 in the Board of Zoning Appeals agenda of February 26, 2026) matched at -77.356466, 37.482382, tract 2015.02 (51087201502). Point-in-polygon checks against TIGERweb tract boundaries place the 2015.04/2015.02 line running roughly north to south between those two frontage points, so the 195-acre site, described in the staff report as part of the parcel, fronts the boundary; the parcel polygon was not obtained (the county GIS REST endpoints were unreachable on the query date) and the split of acreage between the tracts is not stated. 2126 New Market Village Blvd, Henrico, VA 23231 (the subdivision across Darbytown Road from the site) matched at -77.362401, 37.482821, tract 2015.04. 6000 Dominion Club Drive, Glen Allen, VA 23059 (Wyndham) matched at -77.606109, 37.698483, tract 2001.46 (51087200146); the Wyndham Foundation office at 6401 Old Wyndham Drive matched to the adjoining tract 2001.45 (51087200145), so the Wyndham community spans both tracts and Table 3 reports the tract containing the Dominion Club Drive spine. 15201 Ashland Road, Glen Allen, VA 23059 (Hunting Hawk Golf Club, the site of the withdrawn Hanover campus) matched at -77.623152, 37.713862, Hanover County tract 3203 (51085320300). The two approved campuses: no street address for the RIC4 or RIC5 parcels returns a geocoder match, so the assignment uses coordinates run through the geocoder's coordinates endpoint on September 16, 2026. RIC4 (POD-2024-102609, located per the agenda at the northern corner of Technology Boulevard at its intersection with Technology Creek Drive): the point 37.490465, -77.240471 on Technology Creek Drive, Sandston, supplied by the author from a map lookup, returns tract 2014.04 (GEOID 51087201404), block 510872014043015, Varina district. RIC5 (POD-2024-102383, located per the agenda along E. Williamsburg Road at its intersection with Technology Boulevard): the northern terminus of Technology Boulevard at East Williamsburg Road, 37.5078697, -77.261484, taken from OpenStreetMap way 1176133547 (Nominatim query of the same date; reverse geocoding of the adjacent points returns East Williamsburg Road), returns tract 2014.04, block 510872014043013. A mid-segment point on Technology Boulevard (37.5008078, -77.2607384) also returns 2014.04. Both points lie on the roads named in the respective plan-of-development location descriptions (February 2025 POD agenda). Parcel polygons were not obtained; the assignment is by location point, and both campuses (478.14 and

621.93 acres) are large relative to any point, so the manuscript states that tract 2014.04 contains the mapped locations, not that it contains the parcels. Tract 2015.02 profile (ACS 2020 to 2024, via the Census Reporter API on the same date): population 5,292; median household income \$121,160 $\pm$ \$25,453; non-Hispanic Black 2,958 $\pm$ 745 (55.9 percent); non-Hispanic White 1,961 $\pm$ 655 (37.1 percent); persons below poverty 97 $\pm$ 76 of 5,240 (1.9 percent; the $\pm$ 1.4 share margin in the Table 3 note is by the ratio formula of S2, with the denominator margin from the same table).

QTS's original campus (6000 Technology Boulevard, Sandston, the address on DEQ registration 51232) returns no match from the Census Geocoder (queried September 26, 2026) and was not assigned a tract; Table 3 places it, with the Meta and Iron Mountain sites, in the same park as the two geocoded campuses.

The Meta and Iron Mountain sites were not geocoded. The Census Geocoder returns no match for the Portugee Road address the portal gives for the Meta campus (3951 Portugee Road), and the Iron Mountain address in the portal (6110 Technology Creek Drive) was not run. A point derived from the county GPIN grid for the Meta parcel (longitude -77.2302, latitude 37.4713) returns tract 2014.04, but a point about 1.1 km to the southeast (-77.22, 37.465) returns tract 2016.01, so a point assignment for a 475-acre parcel would be unstable. Table 3 therefore labels 2014.04 as the tract of the two geocoded QTS campuses, and states only that QTS's original campus and the Meta and Iron Mountain sites lie in the same park (White Oak Technology Park, named in the agenda entries for the QTS and Meta plans and in the portal location for the Iron Mountain plan). Figure 2 does not show them.

S4. Plan-of-development approvals in the record

Master plans and first-phase plans approved before the June 10, 2025 ordinance, the two plans pending at that date, and the Meta second-phase plan approved after it, from the Director's agendas and the portal. Scope and zoning are transcribed from the agenda or portal entries.

Campus	Plan number	Director's action	Scope per record	Zoning	Source
Meta (Project Tropical), Phase I	POD-2024-102382	Approved Dec. 18, 2024	Temporary construction logistics area, substation pad, and infrastructure; 475.30 ac; owner Scout Development LLC	M-2	Post-action agenda, Dec. 2024
RIC5 ("QTS RIC5 Campus Master Plan")	POD-2024-102383	Approved Feb. 26, 2025	7 data centers (six 2-story, one 3-story), 4,116,217 sq ft, 4 substations, 621.93 ac; owner QTS Richmond V LLC; condition 16 incorporates REZ-2023-100017 proffers	M-1C (conditional) + ASO	Post-action agenda, Feb. 2025
RIC4 ("QTS RIC 4 Master Plan")	POD-2024-102609	Approved Feb. 26, 2025	10 two-story data centers, 3,773,736 sq ft, 3 substations, 478.14 ac; owner QTS Richmond	M-2	Post-action agenda, Feb. 2025

			IV LLC		
DC Blox Richmond	POD-2025- 100199	Approved Apr. 23, 2025	One-story 66,000 sq ft data center; 30.83 ac; "data centers are permitted by right in both zoning districts"	B-3, M-1	Post-action agenda, Apr. 2025
Airport West Data Center Campus (eastern site)	POD-2025- 101009	Created Apr. 23, submitted Apr. 28, 2025; on the June 25, 2025 agenda; deferred; later Withdrawn	Eight two-story data centers of 231,603 sq ft, totaling 1,852,824 sq ft (Jan. and Feb. 2026 agendas; Exhibit T); seven buildings, 1,621,221 sq ft as amended (Mar. 2026 agenda; portal); 194.898 ac	A-1, M-1, M-2, AS-O (agenda)	Agendas; portal; determination letter of Dec. 10, 2025 (S9)
IMDC RCH1 Phase 1 and Master Plan (Iron Mountain)	POD-2025- 100752	Filed Mar. 31, 2025; on the June 25, 2025 agenda; Findings dated July 10 to 16, 2025; portal expiry "07/07/2030"; status Approval - Active	Three two-story data centers, 1,189,285 sq ft; phase one 360,000 sq ft; 96.861 ac	"M1 - M3, PMD" as displayed	Portal (Details and Processes tabs); June 2025 outline agenda
Meta (Project Tropical), Phase 2	POD-2025- 102510	Approved Nov. 19, 2025	Two one-story data centers, 414,435 and 353,145 sq ft, administrative and support buildings; 475.30 ac	M-2	Post-action agenda, Nov. 2025

Each QTS master-plan approval carries the county's condition that the plan "is for planning and information purposes only" and that subsequent detailed plans are "subject to all regulations in effect at the time" they are submitted; the August 28, 2025 determination (S9) treated both approvals as final plans of development under Va. Code § 15.2-2307(C)(vi). Detailed plans approved after the ordinance without a provisional use permit, from the portal: RIC4 substation minor site plan POD-2025-101658 (approved, activity date Aug. 14, 2025); RIC5 Site 1 POD-2025-101688 (approved Oct. 3, 2025); RIC5 Phase 1 construction plans POD-2025-101899 (plans signed Dec. 15, 2025); RIC5 Phase 2 POD-2026-100070 (approved Feb. 6, 2026); RIC4 Phase 1 DC-1-2-3 POD-2026-100990 (approved May 12, 2026); IMDC construction plans POD-2025-101940 (created Aug. 6, 2025) and POD-2025-103016 (created Nov. 25, 2025), both with status Plans Approved and no approval date displayed; Meta construction plans POD-2026-100954 (Plans Approved). Provisional use permits: the portal's PUP-2025 search returned 106 cases; the one non-expired industrial case is PUP-2025-101460 (the eastern site, filed June 17, 2025, displayed as "In Review" on September 26, 2026 although reporting records its withdrawal on October 13, 2025, Spiers, 2025b); the PUP-2026 search returned 72 cases, none industrial. No provisional use permit appears for QTS, Meta or Iron Mountain.

S5. The nine-jurisdiction comparison: Table S5, coding protocol, and evidence

Population criterion: every Virginia jurisdiction that, by mid-2026, had adopted a data-center-specific zoning reform, or had a single data center rezoning of at least 400 acres refused by its board or voided by a court, and for which the timing of the reform or decision relative to the approval of major projects is publicly documented. Frame: the DIGS Lab national policy inventory (datacenterpolicy.com, Virginia filter, 22 localities on September 26, 2026), the Tech Policy Press survey of state and local data center policy (Bridges, June 2, 2026), and statewide press coverage through mid-2026. Actions after June 30, 2026 are outside the frame and were not compiled.

Variables: (1) whether the use was by right at the outset, from the zoning ordinance in force before the reform; (2) the reform or decision and its date, from the adopting ordinance or board action; (3) whether projects holding a qualifying approval under Va. Code § 15.2-2307 existed at that date, from the approval record of pending projects; outcome coded "inherited," "bound," or "partly inherited" as defined in the Table S5 note. Coding by the author; not independently replicated.

Table S5. Reform timing and approval status in nine Virginia jurisdictions, as of mid-2026 (Section 7 of the article).

Jurisdiction	Entry route	Data centers by right at outset	Reform or decision, and date	Timing relative to major approvals	Outcome
Loudoun	Reform	Yes	End by-right, require special exception; March 2025 (Loudoun County Board of Supervisors, 2025)	After (corridor already built)	Inherited
Henrico	Reform	Yes	End by-right, require provisional use permit; June 2025 (Henrico County Board of Supervisors, 2025)	After (two master plans and a first-phase plan approved Dec. 2024 to Feb. 2025; a pending plan approved July 2025; vesting determined Aug. and Sept. 2025)	Inherited
Chesterfield	Reform	Yes (light industrial)	Conditional use, adopted Sept. 2025, effective Jan. 2026 (Chesterfield County Board of Supervisors, 2025 to 2026)	After (about 1,300 acres rezoned May 2025)	Inherited, through discretionary rezonings
Frederick	Reform	Yes (industrial districts)	Conditional use, April 2024 (Frederick County Board of Supervisors, 2024)	Before (little prior buildout)	Bound
Fauquier	Reform	Largely restrictive	Restrictive policy, December 2023 (Fauquier County Board of Supervisors, 2023)	Before	Bound
Fairfax	Reform	Largely no	Use standards, September 2024 (Fairfax County Board of Supervisors, 2024)	Before any large by-right wave	Bound (channel never broadly opened)
Hanover	Rezoning decision	No (rezoning required)	430-acre rezoning denied 4 to 3, May 2026 (Hanover County Board of	Before (refused at approval stage)	Bound (discretionary refusal)

Prince William	Rezoning decision	No (rezoning required)	Supervisors, 2026) Digital Gateway rezonings approved Dec. 2023; voided for defective notice 2025; affirmed, Va. Ct. App., Mar. 31, 2026, with a partial stay pending possible Supreme Court review (Board of County Supervisors of Prince William County v. Oak Valley Homeowners Association, 2026)	Approved; voided before construction	Bound (approval voided)
Culpeper	Reform	Yes (industrial)	Conditional use, September 2025 (Culpeper County Board of Supervisors, 2025)	Mixed (limited prior industrial siting)	Partly inherited

Note. Codes: "inherited" means projects holding an approved plan or accepted proffer at the reform date proceeded beyond the reform's reach. "Bound" means no such project existed at the reform or decision date, because the channel was closed before approvals accumulated, was never broadly opened, or the discretionary decision refused or voided the approval. "Partly inherited" means the record does not cleanly date the earlier approvals. Hanover's one-vote denial is the weakest cell. Fairfax's coding is prospective because substantial stock predates its 2024 standards. Entry route distinguishes a countywide text amendment from a single board decision on one rezoning. The table cannot separate statutory compulsion from local transition clauses or delayed effective dates (Chesterfield's took effect January 2026); it records outcomes consistent with the statute. Sources per row in the paragraph below; coding evidence and the five exclusions below.

Sources by row. Loudoun: Loudoun County Board of Supervisors, Zoning ordinance amendment ZOAM-2024-0001 (data centers; special exception requirement), adopted March 18, 2025. Henrico: Ordinance 143-25, adopted June 10, 2025 (article Section 5.1; S4 and S9 below). Chesterfield: Chesterfield County Board of Supervisors, rezonings for two data center campuses (about 1,300 acres), May 2025, and zoning ordinance amendments making data centers a conditional use, adopted September 2025, effective January 1, 2026. Frederick: Frederick County Board of Supervisors, ordinance requiring conditional use permits for data centers, adopted April 9, 2024. Fauquier: Fauquier County Board of Supervisors, data center policy amendments, adopted December 14, 2023. Fairfax: Fairfax County Board of Supervisors, zoning ordinance amendment on data center use standards, adopted September 10, 2024. Hanover: Hanover County Board of Supervisors, denial of the Mountain Road technology park rezoning, May 28, 2026 (a different project from the West End campus of article Section 6, which was withdrawn in January 2026). Prince William: Board of County Supervisors of Prince William County v. Oak Valley Homeowners Association, Inc., Record Nos. 1584-25-4, 1590-25-4, 1592-25-4 (Va. Ct. App. Mar. 31, 2026), in the deposit. Culpeper: Culpeper County Board of Supervisors, zoning ordinance amendment requiring conditional use permits for data centers, adopted September 2, 2025. The county board actions other than Henrico's and Prince William's are cited to the adopting body and date; their source documents are not reproduced in the deposit.

The five exclusions, and what was checked for each on September 26, 2026 (deposit file EXCLUDED_JURISDICTIONS_CHECK_2026-09-26.md).

Spotsylvania. No DIGS Lab entry. The county's Data Center FAQs page (spotsylvania.va.us/3241, saved) states that data centers were an "Office" use permitted by right in ten districts; that a December 9, 2025 code amendment limited by-right development to the Industrial 1 and 2 districts with standards and required a special use permit "in all other Office and Commercial districts"; that a February 24, 2026 code amendment "eliminat[ed] any by-right data center development, requiring a Special Use Permit in all Office, Commercial, and Industrial districts"; and that "[a]s of 9/2026, ALL approved data center projects were approved through the Rezoning process and are subject to proffers" (15,469,908 approved square feet; 1,597 approved acres as of August 2026). The Board of Supervisors' Recommended Standards for Data Center Development carry the same adoption date (title and date read from the county's PDF; text not saved). Accepted proffers are a listed act under Va. Code § 15.2-2307(C)(i), so on the county's own statement the reform reaches no approved project; but per-project approval dates and the disposition of pending applications were not compiled from the county record, and the row was not built. Spotsylvania is a candidate for placement in later work and, on the county's statement, would code as inherited.

Prince George. DIGS Lab lists four ordinances marked "INTRODUCED" (LDR-001-2026, LDR-016-2026, LDR-021-2026, LDR-028-2026; February to March 2026), described as allowing data centers by special exception only and only in industrial zones. No adoption record was found by web search; the county's document center was not read. Excluded for want of an adopted, dated reform.

Mecklenburg. No DIGS Lab entry. Web searches for a county data-center zoning text amendment returned nothing adopted or dated. Excluded because no reform record has been located and there is nothing to date.

King George. DIGS Lab entry "Data center planning", status signed and enacted, last updated March 3, 2025, described as allowing and regulating data centers in designated industrial areas. The county's memorandum on the ordinance update could not be fetched. Excluded because the described action allows and regulates the use rather than removing by-right approval, and its adopted text and date relative to the county's approvals were not read.

Pittsylvania. No DIGS Lab entry. From county board records compiled separately and not deposited here: in April 2025 the Board of Supervisors denied a rezoning for a data center campus with on-site gas generation; in January 2026 it rezoned land at Berry Hill to a district in which data centers and generation are by right. Neither is a text amendment narrowing by-right approval, and the January 2026 rezoning is a grant, which the criterion does not count. The April 2025 denial is a board refusal of a single rezoning and would code as bound, as Hanover's does, if the tract meets the 400-acre threshold; its acreage and the county's prior approvals were not compiled for this study, so the row was not built.

S6. Engine-group emission limits, DEQ registration 51232

DEQ permit registration 51232 (Quality Investment Properties Richmond, LLC, 6000 Technology Blvd, Sandston; minor NSR approval to construct and operate dated June 24, 2024, superseding the permit of September 1, 2023; deposit file [DEQ_AirPermit_51232_QTS_Richmond_2024-06-24.pdf](#)). The equipment list covers engine-generator sets EG04 through EG547, 544 diesel emergency generators, and eleven water cooling towers (CT01 to CT11). Condition 10 confines the engines to emergency operation, ISO-declared emergencies, and periodic maintenance, testing and training, and makes the nine group

emission limits of Conditions 22 to 30 the binding twelve-month ceilings. The permit imposes no hour cap per engine; the operating constraint is a twelve-month fuel-throughput limit for each group (Conditions 12 to 20). The 500-hour annual cap per engine belongs to registration 53259 (the RIC5 campus), not to 51232. The nine group NOx limits range from 0.8 to 94.0 tons per year and sum to 190.4 tons per year. The table below transcribes Conditions 12 to 20 and 22 to 30.

Condition (limits) / (fuel)	Engine-generator sets	Units and rating	Fuel throughput, gallons per 12 months	NOx limit, tons per year (lb/hr)
22 / 12	EG04-EG05	2 x CAT 3516 DITA, 1,825 kW	4,042	1.8 (81.9)
23 / 13	EG06-EG07	2 x CAT 3516C TA, 2,000 kW	4,555	0.8 (42.5)
24 / 14	EG08-EG17	10 x CAT 3516C, 2,500 kW	29,010	4.3 (50.6)
25 / 15	EG18-EG34	17 x CAT 3516C, 2,500 kW	49,828	6.9 (48.1)
26 / 16	EG35-EG43	9 x MTU 20V4000 DS2500, 2,500 kW	25,281	3.7 (48.6)
27 / 17	EG44-EG79	36 x CAT 3516C, 2,500 kW (EG77-EG79 are the 2024 project units)	96,250	13.5 (48.1)
28 / 18	EG80-EG112	33 x MTU 16V4000 DS2250, 2,250 kW	89,937	12.3 (44.4)
29 / 19	EG113-EG244	132 x MTU 16V4000 DS2250 or CAT 3516C or equivalent, 2,250 to 2,500 kW	386,895	53.1 (48.1)
30 / 20	EG245-EG547 (fuel condition 20 reads EG242-EG547 as printed)	303 units: 295 x CAT 3516C, 2,500 kW, and 8 x CAT C32, 1,250 kW	670,000	94.0 (48.1)
Sum	EG04-EG547	544 engine-generator sets	1,355,798	190.4

Source: DEQ registration 51232, Conditions 12 to 20 (fuel throughput) and 22 to 30 (emission limits), transcribed September 16, 2026. Unit counts from the equipment list on pages 3 and 4. The lb/hr figure is the group hourly limit as printed; the tons-per-year figure is the twelve-month group cap. The permit contains no synthetic-minor demonstration on its face; the classification as a minor NSR approval appears in the permit history on page 5.

S7. Figure sources and design

Figure 1 (the window diagram, v1.1, September 26, 2026) is a schematic drawn by script (deposit folder figures, build_figure1_window_v1_1.py). It places four vesting rules on one horizontal axis running from the filing of a plan or application, through the public hearing, plan approval and the building permit, to construction: a discretionary use in Virginia (rezoning with proffers or conditional use permit), which vests at the hearing-based act (Va. Code § 15.2-2307(C)(i) to (iii)); a by-right use in a building-permit state, the majority rule (Calandrillo et al., 2017); a by-right use in Virginia, which vests at the designated agent's approval of the plan of development (§ 15.2-2307(C)(v), (vi)); and a by-right use in an application-vesting state, Washington (complete building-permit application, Wash. Rev. Code § 19.27.095) and Texas (the first application giving fair notice, Tex. Loc. Gov't Code § 245.002). The

orange bar is the window, the interval in which a governing body can still reach the project by ordinance; it closes at the vesting act (open circle); the diamond marks a hearing. The caption places Virginia's adjainer notice during review rather than at filing. Colorado (Colo. Rev. Stat. § 24-68-103) and North Carolina (N.C. Gen. Stat. § 160D-108.1), which attach a hearing to the vesting act (North Carolina where the plan rests on no approval of its own), are discussed in Section 2.2 and cited in the caption but are not drawn as bars. The statute texts are in the deposit folder legal with retrieval headers; the figure states rules, not outcomes.

Figure 2 (the tract map, v2.2, September 26, 2026) is drawn from U.S. Census Bureau TIGERweb generalized tract and county boundaries with points placed by the author on the roads the plan-of-development records name and assigned to tracts by the Census Geocoder. It carries a 5 km scale bar, the tract-not-exposure statement, hatching distinct for each tract, the boundary note for the eastern site, tract 2015.02 as a second tract fronting the site, the Hanover County site of the withdrawn campus across the county line, and the two QTS campuses as points (RIC4 at Technology Boulevard and Technology Creek Drive; RIC5 at East Williamsburg Road and Technology Boulevard; coordinates and sources in S3). The Meta and Iron Mountain sites are not shown (S3). Design choices: a scale bar; a statement that colored areas are census tracts, not exposure zones, since the tract of a facility is not a measure of exposure; hatching and symbols distinguishable without color; descriptive legend labels; no implied equivalence between warehouse and data center burden; few in-map text elements. Source data (TIGERweb boundary extracts, September 15, 2026) and the build script are in the deposit folder figures.

S8. Reporting discrepancies and primary-record checks

Statutory history of Va. Code § 15.2-2307 item (vii): the chapter text of 2025 Va. Acts ch. 594 (SB974, approved March 24, 2025, effective July 1, 2025; deposit file CHAP0594_2025_SB974.pdf) shows that ch. 594 struck "governing body or its" from items (v) and (vi), leaving "the designated agent," and did not alter item (vii). The clause was added by 2010 Va. Acts ch. 315, as Board of Supervisors of Prince George County v. McQueen (Record No. 130279, January 10, 2014) records at slip opinion page 6 (note 3 lists the seven acts); McQueen declined to apply it retroactively (note 7). The 2026 session (2026 Va. Acts cc. 471 and 948, per the section's history line) inserted a new subsection B, moving the list to subsection C; which of the two chapters made the change was not verified against the chapter texts. The Henrico Board of Zoning Appeals record of February 26, 2026 and the county's determination letters refer to the list as subsection B.

Floor area of the eastern data center proposal (POD-2025-101009; PUP-2025-101460): the county record gives "eight, two-story 231,603 square foot data centers, totaling 1,852,824" square feet in the notice of review reproduced as Exhibit T and in the January and February 2026 agendas, which the manuscript cites; Virginia Business (Schulte, December 18, 2025) reports the same figure; Richmond BizSense (Spiers, September 10, 2025 and January 27, 2026) describes the proposal as 1 million square feet combined; the March 2026 agenda and the portal carry the amended plan of seven buildings totaling 1,621,221 square feet. The staff report in the deposit gives eight buildings on 195 acres. Planning Commission action: the staff report in the deposit is the Board version, prepared September 30, 2025, and records the Commission's recommendation of denial on September 11, 2025 by a vote of 4-1-1; Richmond BizSense reported the recommendation on September 22, 2025. Warehouse approval: the January 2026 post-action agenda records POD-2025-103055 approved by the Director on January 21, 2026 (1,821,340 square feet); the January 27 BizSense article says only "this month". The portal records

the case as created December 3 and submitted December 11, 2025; reporting places the submission "two days after" the December 10 determination, and the manuscript uses the portal date. West End campus: Hanover County application (Spiers, September 8, 2025; January 16 and January 30, 2026); the withdrawal letter is dated January 29, 2026. Statute numbering: opinions and documents dated before July 1, 2026 cite the significant-affirmative-act list as § 15.2-2307(B); the 2026 session inserted a new subsection B (see the statutory history above), and the list is subsection C in the current code, which the manuscript cites. Case search: CourtListener, September 15, 2026, Supreme Court of Virginia and Court of Appeals of Virginia opinions containing "15.2-2307", published and unpublished: 27 results, most recent Town Council of Purcellville v. KMG Hauling, Inc. (Va. Ct. App., May 12, 2026, unpublished), which cites the written-determination clause only to describe the administrator's decision under appeal and does not address vesting. Board of Zoning Appeals decision: the February 26, 2026 minutes (on disk) record the decision by motion, 5 to 0, upholding the Director of Planning; no separate written opinion is issued in this procedure, and the minutes incorporate the hearing transcript. Parcel address: reporting uses 2248 Darbytown Road; county documents use 2248 (the zoning confirmation letter and plan review correspondence), both 2248 and 2300 (the December 10, 2025 determination heading), and 2300 (the Board of Zoning Appeals agenda), all for parcel 812-704-4612; the staff report describes the site as "part of" that parcel. Registration 53259 (QTS Richmond V, LLC, April 22, 2026; on disk): equipment list GEN001-GEN247 (CAT 3516C or MTU 20V4000 DS2500, 2,500 kW, or MTU DS2250, 2,250 kW) and HGEN001-HGEN008, 255 engine-generator sets; Condition 6 limits each engine to 500 hours per year, calculated monthly on a rolling twelve-month sum; the facility-wide emission limits in Condition 10 (pages 5 to 6) cap nitrogen oxides at 99.0 tons per year (PM 4.5, PM10 4.9, PM2.5 4.9, CO 34.3, VOC 18.6). Both figures in Section 5.4 match the permit. NOx control is by turbocharged engine and aftercooler (Condition 1). Registration 53266 (Iron Mountain Information Management, LLC, 6110 Technology Creek Drive, May 7, 2026) is also on disk for the record; it is not cited in the manuscript.

Submission date of the eastern data center plan (POD-2025-101009): the portal shows the case created April 23 and submitted April 28, 2025; the county's determination letter of December 10, 2025 says the application "was submitted to the County on April 28, 2025"; the intake notice in the appellant's binder records submission on April 29 and acceptance on May 1, 2025. The manuscript uses April 28. Rezoning date for RIC5: the August 28, 2025 determination letter states that the Board "approved REZ2023-100017 on May 21, 2024," the date of the County Manager's approval letter reproduced as its Exhibit B (the proffers are dated May 6, 2024); the Board's public hearing and vote were on May 14, 2024, which Table 2 uses. Meta Phase I approval: the December 2024 post-action agenda records approval on December 18, 2024; the November 2025 agenda entry for Phase 2 says the first phase "was approved in November 2024." The manuscript uses the post-action date. Iron Mountain: the June 2025 Director's agenda is an outline; the portal shows the master plan "06/25 - d/a" with Findings dated July 10 to 16, 2025 and an expiry of July 7, 2030, which implies validity from July 7, 2025; the manuscript describes the plan as approved by the Director without a permit, with validity from that date, and notes that the record does not explain why this pending plan was approved without a permit while the eastern plan was deferred for one. Meta campus investment: Sverdlik (2017) reports \$1 billion, and the manuscript uses that figure. RIC5 proffers: the accepted proffers (31, in the letter of May 21, 2024, binder pp. 250 to 259) include 65 percent maximum impervious surface (#11), generator testing 7 a.m. to 7 p.m. Monday to Friday (#18), cooling-technology best practices and LEED Silver (#24), 70 dBA day and 55 dBA night at any exterior property line where the property adjoins a parcel with a residential dwelling (#25.xi), and 50 percent solar for stormwater aeration (#25.iii); they do not commit to air cooling, published air-quality monitoring or

rooftop solar, and the manuscript makes no such claims. Data center count: the manuscript's "thirty-seven" is the county's figure from the Planning Department's May 1, 2025 staff analysis as cited (Henrico County Planning Department, 2025a); that document is not in the deposit. Axios (July 30, 2026) reports "37 data centers" in Henrico and "at least 17 more" approved, which the manuscript does not use. Determination letters: all four cite the listed acts as § 15.2-2307(B); the current code places the list in subsection C, which the manuscript cites; the paragraph of each letter that recites the list quotes items (v) and (vi) in the pre-2025 wording "the governing body or its designated agent," and the December 10, 2025 letter's paragraph 8.b quotes item (vi) in the current wording. Status of the eastern site's permit: reporting records the withdrawal of PUP-2025-101460 on October 13, 2025, the day before the scheduled Board hearing (Spiers, 2025b); the portal still displayed the case as "In Review" on September 26, 2026, and the manuscript follows the reporting. Whether the appellant, Darbytown Road LLC, petitioned the circuit court after the Board of Zoning Appeals decision is not known from the record.

S9. The four vested-rights determinations

All four letters are signed by R. Joseph Emerson, Jr., AICP, Director of Planning, with the concurrence of Andrew R. Newby, County Attorney, and each attaches the adopted ordinance as Exhibit A. Each recites the same authority: Va. Code § 15.2-2286(A)(4); Henrico Code § 24-2105 (the Director is the zoning administrator); and Henrico Code § 24-2317(B)(5) (the Director is "responsible for making ... [i]nterpretations of whether rights have been vested, with the concurrence of the County Attorney"). Each ends with a notice that any aggrieved person or county officer may appeal to the Board of Zoning Appeals within 30 days under § 15.2-2311 (fee \$300) and that otherwise "this determination will be final and unappealable." The letters were reproduced as exhibits in the appellant's binder in APP-2026-100056 and read from the OCR of binder pages 125 to 283 against the page images.

Letter (binder exhibit, pages); date	Addressee (counsel)	Property and zoning	Act found	Reliance and expense as recited	Determination
Exhibit V-1, pp. 231 to 236; Aug. 28, 2025	QTS Richmond IV LLC and QTS Richmond V LLC (DLA Piper LLP)	RIC4 (four GPINs), M-2, no conditions; RIC5 (twelve GPINs), M-1C subject to REZ2023-100017 proffers	Approval of the two plans of development, found "a significant affirmative governmental act under Code of Virginia § 15.2-2307(B)(vi)"; for RIC5 also the rezoning with proffers, "(B)(i)," "independently sufficient"	"you report that Owner has" commissioned designs, engaged consultants and contractors, applied for permits, entered utility agreements, performed site preparation; "millions of dollars in expenses and obligations"	Vested right "to develop and operate the Projects on the Properties as a principal use without a provisional use permit in accordance with the regulations ... in effect prior to the Amendments"; RIC5 plan may be amended or superseded consistent with the proffers and the prior ordinance
Exhibit V, pp. 172 to 178; Aug. 28, 2025	Quality Investment Prop Richmond LLC and the affiliated entities listed in the letter's footnote (DLA Piper LLP)	RIC1, RIC2, RIC3 (28 GPINs), M-2 except two A-1 parcels	Nine plan-of-development approval letters for data centers and related uses	Completed projects in operation; in-progress projects approved but not completed; "billions" of dollars recited	Completed projects continue as a lawful nonconforming use (Henrico Code § 24-6201 et seq.; § 15.2-2307); in-progress projects vested under the approved plans, permits and prior regulations
Exhibit S, pp. 147 to	White Oak PropCo,	Parcels 843-707-	The June 14, 2022	Purchased the	Vested right to

151; Sept. 11, 2025	LLC (Roth Jackson Gibbons Condlin, PLC)	0215 and 843-706-0700, M-1C subject to REZ2022-00015 and C-47C-00 proffers	rezoning with proffers approving development "in general conformance with the 'DATA CENTER CONCEPT PLAN, WHITE OAK';" found a listed act under "(B)(i)"	properties, engaged engineering and architectural consultants, incurred legal fees; "You report (and the public land records largely confirm) that Owner has incurred millions of dollars"	develop and operate the project as a principal use without a provisional use permit under the prior regulations
Exhibit Q, pp. 127 to 135 (nine pages); Dec. 10, 2025	Wagner Urban Logistics, LLC (Roth Jackson Gibbons Condlin, PLC), contract purchaser; landowner Fareva Richmond Inc.	GPIN 812-704-4612, 2248 and 2300 Darbytown Road, M-1	None. The May 15, 2025 minor subdivision is excluded from the county's definition of subdivision (Henrico Code § 19-7301), did not reference data centers, and reserved "[a]ny proposed uses of the property" as "subject to separate review and approval"; the plan of development submitted April 28, 2025 "was not approved before the effective date of the Amendments and has been deferred" (footnote 1, citing McQueen and Caselin); Wagner "is not the landowner"	Wagner "paused" its pursuit to apply for the provisional use permit (June 17, 2025); no good-faith reliance on the subdivision found	No vested right; any data center as a principal use requires a provisional use permit. Appealed to the Board of Zoning Appeals (APP-2026-100056); upheld 5 to 0, Feb. 26, 2026

Appeal check. The Board of Zoning Appeals agendas for September 2025 through September 2026 (thirteen files, in the deposit) list eight appeal items: APP-2025-102825, APP-2026-100056, APP-2026-100155, APP-2026-100534, APP-2026-100767, APP-2026-100776, APP-2026-101000 and APP-2026-101635. None concerns QTS, White Oak, Iron Mountain or vesting. No appeal of the three affirmative determinations appears on the agendas; an appeal filed but never docketed, or withdrawn before docketing, would not appear. By the letters' own terms an unappealed determination became final after 30 days. The manuscript states the negative as bounded to the agendas. No determination addressed to the Meta campus or to Iron Mountain appears in the binder or the agendas; the record does not show whether either owner asked. One of the nine plan-of-development approval letters recited in Exhibit V (POD2022-00385, "QTS Tract 9 - Substation," September 28, 2022, binder p. 188) is addressed to Scout Development, LLC, the Meta entity; the determination names the QTS entities as Owner and does not name Scout.

What the letters do not do. None was noticed to adjoining owners or published; Henrico Code § 24-2317(C) requires the Director to keep a record of written interpretations "available in the Planning Department for public inspection, on reasonable request, during normal business hours." The affirmative findings rest on the owners' reports of reliance and expense ("you report"), with the county checking land records in one case. Whether a conceptual master plan approved "for planning and information purposes only" is a final plan of development under item (vi) was not adjudicated; the Board of Zoning Appeals heard only the appeal of the Wagner denial, brought by Darbytown Road LLC, and the argument in the

transcript concerns item (vii) and the subdivision; the QTS and White Oak findings were not before the Board.