EXHIBIT 13

STATE OF NEW HAMPSHIRE

HILLSBOROUGH, SS.
SOUTHERN DISTRICT

SUPERIOR COURT

Docket No. 226-2022-CV-00181

MILES BROWN,
ELIZABETH CROOKER,
CHRISTINE FAJARDO,
KENT HACKMANN,
BILL HAY,
PRESCOTT HERZOG,
PALANA HUNT-HAWKINS,
MATT MOOSHIAN,
THERESA NORELLI,
NATALIE QUEVEDO, and
JAMES WARD,

v.

DAVID M. SCANLAN,
in his official capacity as the New Hampshire Secretary of State

AFFIDAVIT OF DR. JOWEI CHEN

I, Jowei Chen, being duly sworn, state as follows:

1. I am over the age of 18, have personal knowledge of the facts stated in this affidavit, and can competently testify to their truth.

2. Attached to this affidavit is an analysis of the recently enacted redistricting plans for the New Hampshire State Senate and New Hampshire Executive Council, as well as a current version of my curriculum vitae. I reserve the right to supplement the attached analyses in light of additional facts, testimony, and/or materials that may come to light.

Dated: 05/09/2022

Jowei Chen

Jowei Chen

State of Florida

County of Broward

This instrument was acknowledged before me this 9th day of May, 2022, by Jowei Chen.

PETA-GAYE ANDERSON
Notary Public - State of Florida
Commission # HH 102153
Expires on March 9, 2025

Notary Public

Peta-Gaye Anderson

My commission expires: 03/09/2025

Type of ID produced:TN State DRIVER LICENSE/MFA

Notarized online using audio-video communication

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EXPERT DECLARATION OF DR. JOWEI CHEN

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PART I: INTRODUCTION

I. Background and Qualifications

1. I am an Associate Professor in the Department of Political Science at the University of Michigan, Ann Arbor. I am also a Research Associate Professor at the Center for Political Studies of the Institute for Social Research at the University of Michigan and a Research Associate at the Spatial Social Science Laboratory at Stanford University. In 2007, I received a M.S. in Statistics from Stanford University, and in 2009, I received a Ph.D. in Political Science from Stanford University.

2. I have published academic papers on legislative districting and political geography in several political science journals, including The American Journal of Political Science and The American Political Science Review, and Election Law Journal. My academic areas of expertise include legislative elections, spatial statistics, geographic information systems (GIS) data, redistricting, racial politics, legislatures, and political geography. I have expertise in the use of computer simulations of legislative districting and in analyzing political geography, elections, and redistricting.

3. I have authored expert reports in the following redistricting court cases: *League of Women Voters of Florida v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2012); *Romo v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2013); *Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District & St. Louis County Board of Election Commissioners* (E.D. Mo. 2014); *Raleigh Wake Citizens Association v. Wake County Board of Elections* (E.D.N.C. 2015); *Brown v. Detzner* (N.D. Fla. 2015); *City of Greensboro v. Guilford County Board of Elections* (M.D.N.C. 2015); *Common Cause v. Rucho* (M.D.N.C 2016); *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (No. 261 M.D.

2017); *Georgia State Conference of the NAACP v. The State of Georgia* (N.D. Ga. 2017); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Whitford v. Gill* (W.D. Wis. 2018); *Common Cause v. Lewis* (N.C. Super. 2018); *Harper v. Lewis* (N.C. Super. 2019); *Baroody v. City of Quincy, Florida* (N.D. Fla. 2020*); McConchie v. Illinois State Board of Elections* (N.D. Ill. 2021); *Adams v. DeWine* (Ohio 2021); *Harper v. Hall* (N.C. Super. 2021); *Alonzo v. Schwab* (Wyandotte County D. Ct. 2022).

4. I have testified either at deposition or at trial in the following cases: *Romo v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2013); *Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District & St. Louis County Board of Election Commissioners* (E.D. Mo. 2014); *Raleigh Wake Citizens Association v. Wake County Board of Elections* (E.D.N.C. 2015); *City of Greensboro v. Guilford County Board of Elections* (M.D.N.C. 2015); *Common Cause v. Rucho* (M.D.N.C. 2016); *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (No. 261 M.D. 2017); *Georgia State Conference of the NAACP v. The State of Georgia* (N.D. Ga. 2017); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Whitford v. Gill* (W.D. Wis. 2018); *Common Cause v. Lewis* (N.C. Super. 2018); *Baroody v. City of Quincy, Florida* (N.D. Fla. 2020); *McConchie v. Illinois State Board of Elections* (N.D. Ill. 2021); *Harper v. Hall* (N.C. Super. 2021); *Alonzo v. Schwab* (Wyandotte County D. Ct. 2022).

5. I have been retained by Plaintiffs in the above-captioned matter. I am being compensated $550 per hour for my work in this case. My compensation is not contingent on the analysis or conclusions contained in this report.

6. Plaintiffs' counsel asked me to analyze Senate Bills 240 and 241, which respectively create districting plans for New Hampshire's State Senate and Executive Council

districts (the "Enacted Plans"), both of which were passed on April 21, 2022 by the New Hampshire General Court. Plaintiffs' counsel asked me to produce a set of computer-simulated plans for New Hampshire's State Senate and Executive Council districts by following non-partisan, traditional districting criteria, including the districting criteria specified in the New Hampshire State Constitution. Plaintiffs' counsel asked me to compare the district-level partisan attributes of the Enacted Plan to those of the computer-simulated plans and to identify any districts in the Enacted Plan that are partisan outliers.

II. Key Terms, Concepts, and Sources

7. Before describing the research, I conducted to analyze these questions, it is useful to first explain the following basic concepts and terms relating to redistricting, US Census data, and Census geography:

8. **Decennial Census P.L. 94-171 Redistricting Data**: After each decade's Census, the Bureau releases redistricting data summary files per Public Law (PL) 94-171 (the "PL 94-171 redistricting data"). These data files report each Census block's population count, and various racial and ethnic breakdowns of each block's population. The PL 94-171 redistricting data count the populations of various geographies and are used to calculate district populations in each state's redistricting processes. The 2020 decennial Census PL 94-171 redistricting data were released on August 12, 2021, and states use these data for the purpose of calculating the district-level populations of new legislative and congressional districting plans drawn during the current redistricting cycle.

9. **Census Blocks**: Census blocks are the lowest level of geography for which Decennial Census population counts are reported. For the 2020 Census, New Hampshire is divided into 31,948 Census blocks, the boundaries of which generally adhere to streets, railroad tracks, bodies of water, political boundaries, etc. States normally use Decennial Census

population counts at the Census block level to calculate the district-level populations of new legislative and congressional districting plans.

10. **New Hampshire Election Results**: After each statewide election, the New Hampshire Department of State reports each candidate's vote totals at the level of New Hampshire's city wards, towns, townships, grants, gores, and other unincorporated places. The Census Bureau generically refers to these geographic areas in New Hampshire as Voting Tabulation Districts (VTDs) because they are the geographic areas for which election vote counts are publicly reported. VTDs are different from state legislative districts, congressional districts, and Executive Council districts. However, it is the normal practice in New Hampshire to draw state legislative districts, congressional districts, and Executive Council districts by following VTD boundaries. In other words, VTDs are not split into multiple districts in New Hampshire's state legislative, congressional, and Executive Council districting plans.

11. Hence, New Hampshire's VTDs serve as the geographic organizing unit for administering elections and reporting election results. Each decade, the Census Bureau collects digitized maps depicting the geographic boundaries of New Hampshire's wards, municipalities, and other unincorporated places. The Census Bureau then publishes these VTD boundaries in the form of digitized Geographic Information System (GIS) maps. These digitized VTD maps are then used by map-drawers for the purpose of drawing new state legislative, congressional, and Executive Council districting plans.

12. It is also helpful to describe additional key terms that I use throughout, specifically regarding how to measure 1) compactness and 2) extreme partisan bias in a districting plan.

13. **Compactness**: Geographic compactness is a traditional districting principle, and the vast majority of the 50 US states require the drawing of geographically compact districts in state legislative or congressional maps.[1] The requirement of drawing compact districts is recognized as a "bulwark against gerrymandering."[2] In other words, redistricting scholars and practitioners recognize that relatively non-compact districts enable partisan gerrymandering. By drawing relatively non-compact districts, a mapdrawer is able to intentionally achieve more extreme partisan outcomes than if the mapdrawer had prioritized geographic compactness. Two commonly used metrics to measure compactness are the Polsby-Popper score and the Reock Score:[3]

a. *Polsby-Popper*: The Polsby-Popper score for each individual district is calculated as the ratio of the district's area to the area of a hypothetical circle whose circumference is identical to the length of the district's perimeter; thus, Polsby-Popper scores range from 0 to 1, and higher Polsby-Popper scores indicate greater district compactness.

b. *Reock*: Meanwhile, the Reock score for each individual district is calculated as the ratio of the district's area to the area of the smallest bounding circle that can be drawn to completely contain the district; thus, Reock scores range from 0 to 1, and higher Reock scores indicate more geographically compact districts.

[1] E.g., Michael McDonald., *The Predominance Test: A Judicially Manageable Compactness Standard for Redistricting*, Yale Law Journal Forum, Vol. 129: 18-43 (2019).
[2] Aaron Kaufman, Gary King, and Mayya Komisarchik, *How to Measure Legislative District Compactness If You Only Know It When You See It*, Vol. 65: 533-550 (2021).
[3] E.g., Stephen Ansolabehere and Maxwell Palmer. 2016. "A Two Hundred-Year Statistical History of the Gerrymander." Ohio State Law Journal Vol. 77: 741–762 (2016); Richard H. Pildes & Richard G. Niemi, Expressive Harms, "Bizarre Districts," and Voting Rights: Evaluating Election-District Appearances After Shaw v. Reno, Michigan Law Review Vol. 92, 483-587 (1993).

14. **Measures of Partisan Bias:** Three of the most common ways to measure partisan bias in a districting plan are Mean-Median Difference, Lopsided Margins, and Partisan Symmetry Based on Uniform Swing (often referred to as "partisan bias").

a. *Mean-Median Difference*: The mean-median difference is an accepted method that redistricting scholars commonly use to compare the relative partisan bias of different districting plans.[4] The mean-median difference for any given plan is calculated as the median district-level Republican vote share, minus the mean district-level Republican vote share. This measure of partisan bias is substantively important because it describes the degree of skew of a districting plan. A mean-median difference significantly higher than zero indicates that the median district in a plan is skewed more Republican than the plan's average district. A high mean-median difference for a plan would specifically indicate that the plan distributes voters across districts in such a way that most districts are more Republican than the average district, while relatively fewer districts are more Democratic than the average district. Such a skew would create a significant partisan advantage for Republicans by giving them stronger control over the median district in the Senate or Executive Council.

b. *The Lopsided Margins Measure*: Another measure of partisan bias in districting plans is the "lopsided margins" test.[5].The main insight captured by this measure is that a partisan-motivated map-drawer may attempt to intentionally pack the opposing party's voters into a small number of extreme districts that are won by a lopsided margin. Thus, for example, a map-drawer attempting to favor Party A may pack

[4] Michael D. McDonald and Robin E. Best. *Unfair Partisan Gerrymanders in Politics and Law: A Diagnostic Applied to Six Cases.* Election Law Journal: Rules, Politics, and Policy.Vol. 14. .312-330 (2015).
[5] Sam Wang, *Three Tests for Practical Evaluation of Partisan Gerrymandering*, Stanford Law Journal, Vol. 16: 1263-1321 (2016).

Party B's voters into a small number of districts that very heavily favor Party B. This packing would then allow Party A to win all the remaining districts with relatively smaller margins. This sort of partisan manipulation in districting would result in Party B winning its districts by extremely large margins, while Party A would win its districts by relatively small margins. Hence, the lopsided margins test is performed by calculating the difference between the average margin of victory in Republican-favoring districts and the average margin of victory in Democratic-favoring districts. A large difference between the two parties' average margins of victory would indicate that one party's voters are heavily packed into a small number of lopsided districts, while the other party's voters are spread across a larger number of districts won by relatively smaller margins.

c. *Partisan Symmetry Based on Uniform Swing*: Another common measure of partisan bias is based on the concept of partisan symmetry and asks the following question: Under a given districting plan and given a particular election-based measure of district partisanship, what share of seats would each party win in a hypothetical tied election (i.e., 50% vote share for each of two parties).[6] To approximate the district-level outcomes in a hypothetical tied election, one normally uses a uniform swing in order to simulate a tied statewide election. One then calculates whether each party would receive more than or less than 50% of the seats under this hypothetical tied election under a given districting plan. This particular measure is often referred to in the academic literature as "partisan bias." In order to avoid confusion with other measures of partisan bias

[6] Andrew Gelman, and Gary King. 1994. *A Unified Method of Evaluating Electoral Systems and Redistricting Plans.* American Journal of Political Science Vol. 38: 514-554 (1994); Andrew Gelman and Gary King. *Enhancing democracy through legislative redistricting.* American Political Science Review. Vol. 88: 541–559 (1994).

described in this report, I will refer to this measure as “Partisan Symmetry Based on Uniform Swing.”

III. The Use of Computer-Simulated Districting Plans

15. In conducting my academic research on legislative districting, partisan and racial gerrymandering, and electoral bias, I have developed various computer simulation programming techniques that allow me to produce a large number of nonpartisan districting plans that adhere to traditional districting criteria using US Census geographies as building blocks. This simulation process ignores all partisan and racial considerations when drawing districts. Instead, the computer simulations are programmed to draw districting plans following various traditional districting goals, such as equalizing population, preserving municipal boundaries, and pursuing geographic compactness. By randomly generating a large number of districting plans that closely adhere to these traditional districting criteria, I am able to assess an enacted plan drawn by a state legislature and determine whether partisan goals motivated the legislature to deviate from these traditional districting criteria. More specifically, by holding constant the application of nonpartisan, traditional districting criteria through the simulations, I am able to determine whether the enacted plan could have been the product of something other than partisan considerations. With respect to New Hampshire's 2022 Enacted Senate and Executive Council Plans, I determined that it could not.

16. I produced a set of 1,000 random computer-simulated plans for New Hampshire's Senate and Executive Council districts using a computer algorithm programmed to strictly follow nonpartisan, traditional districting criteria. These traditional districting criteria include the districting criteria enumerated in Article 26 of New Hampshire's State Constitution for legislative districting plans.

17. By randomly drawing districting plans with a process designed to strictly follow nonpartisan, traditional districting criteria, the computer simulation process gives us an indication of the range of districting plans that plausibly and likely emerge when map-drawers

are not motivated primarily by partisan goals. By comparing the Enacted Plan to the distribution of simulated plans with respect to partisan measurements, I am able to determine the extent to which a map-drawer's subordination of nonpartisan districting criteria, such as geographic compactness and preserving county and municipality boundaries, was motivated by partisan goals.

18. These computer simulation methods are widely used by academic scholars to analyze districting maps. For over a decade, political scientists have used such computer-simulated districting techniques to analyze the racial and partisan intent of legislative map-drawers.[7] In recent years, several courts have also relied upon computer simulations to assess partisan bias in enacted districting plans.[8]

[7] *E.g.*, Carmen Cirincione, Thomas A. Darling, Timothy G. O'Rourke. "Assessing South Carolina's 1990s Congressional Districting," Political Geography 19 (2000) 189–211; Jowei Chen, "The Impact of Political Geography on Wisconsin Redistricting: An Analysis of Wisconsin's Act 43 Assembly Districting Plan." Election Law Journal.

[8] *See, e.g.*, *League of Women Voters of Pa. v. Commonwealth*, 178 A. 3d 737, 818-21 (Pa. 2018); *Raleigh Wake Citizens Association v. Wake County Board of Elections*, 827 F.3d 333, 344-45 (4th Cir. 2016); *City of Greensboro v. Guilford County Board of Elections*, No. 1:15-CV-599, 2017 WL 1229736 (M.D.N.C. Apr 3, 2017); *Common Cause v. Rucho*, No. 1:16-CV-1164 (M.D.N.C. Jan 11, 2018); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Common Cause v. David Lewis* (N.C. Super. 2018); *Harper v. Hall* (N.C. Feb 14, 2022).

PART II: ANALYSIS OF 2022 THE SENATE PLAN

I. Redistricting Criteria

19. I programmed the computer algorithm to create 1,000 independent simulated plans adhering to the following five traditional districting criteria:

a. *Population Equality*: Because New Hampshire's 2020 Census population was 1,377,529, districts in every 24-member Senate plan have an ideal population of 57,397.04. The computer simulation algorithm populated each Senate districting plan such that each of the 24 districts has a population deviation of no more than +/-5%. In other words, the population of each simulated district is between 54,527.19 and 60,266.89. Additionally, the 2022 Enacted Senate Plan's "maximum population deviation,"[9] as measured by the sum of the population deviations of the most-populated district and the least-populated district, is 7.5%. Therefore, the computer algorithm similarly requires that every simulated Senate districting plan has a maximum population deviation of no greater than 7.5%.

b. *Contiguity*: The simulation algorithm required all Senate districts to be geographically contiguous, as required by Article 26 of the New Hampshire State Constitution.

c. *Avoiding Ward Splits*: Article 26 of the New Hampshire State Constitution prohibits the splitting of wards in the drawing of legislative district boundaries. Furthermore, both the 2022 Enacted Senate Plan and the 2012 Enacted Senate Plan avoid splitting wards. Therefore, the simulation algorithm also avoided splitting any wards.

d. *Avoiding Municipality Splits*: Article 26 of the New Hampshire State Constitution prohibits the splitting of towns and unincorporated places in the drawing of legislative district

[9] "Maximum population deviation is the sum of the percentage deviations from perfect population equality of the most- and least-populated districts. See *Chapman v. Meier*, 420 U. S. 1, 22 (1975). For example, if the largest district is 4.5% overpopulated, and the smallest district is 2.3% underpopulated, the map's maximum population deviation is 6.8%." *Evenwel v. Abbott* 136 S. Ct. 1120 (2016).

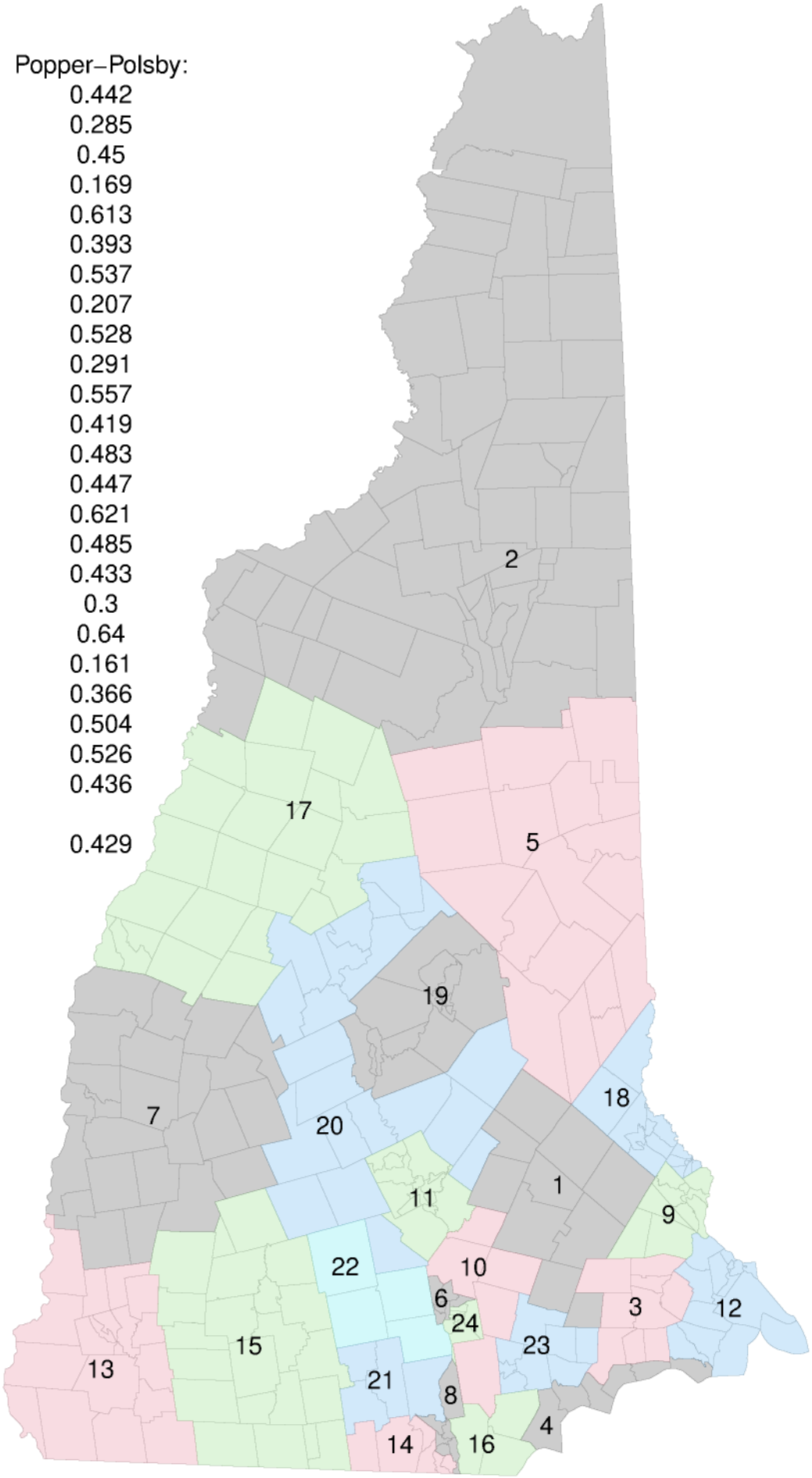
boundaries. Furthermore, the 2022 Enacted Senate Plan avoided splitting any of New Hampshire's cities, except for Manchester and Nashua, whose populations exceed the ideal Senate District population of 57,397. Therefore, the simulation algorithm avoided splitting any of New Hampshire's towns, townships, gores, and grants. The algorithm also avoided splitting any of New Hampshire's cities, except for Manchester and Nashua, which were always split into no more than two districts each.

e. *Geographic Compactness*: Geographic compactness is a traditional districting principle. The simulation algorithm prioritized the drawing of geographically compact districts whenever doing so does not violate any of the aforementioned criteria.

20. On the following page of this report, Map S-1 displays an example of one of the computer-simulated plans produced by the computer algorithm. The left portion of this Map also reports the population of each district and the compactness scores for each district.

Map S1: Example of a Computer−Simulated Senate Plan

District:	Population:	Reock:	Popper−Polsby:
1	57,528	0.562	0.442
2	57,227	0.385	0.285
3	57,270	0.503	0.45
4	59,121	0.114	0.169
5	56,388	0.541	0.613
6	57,874	0.348	0.393
7	57,295	0.664	0.537
8	58,442	0.245	0.207
9	57,266	0.38	0.528
10	55,363	0.406	0.291
11	59,412	0.527	0.557
12	56,532	0.447	0.419
13	57,530	0.491	0.483
14	55,339	0.333	0.447
15	56,012	0.554	0.621
16	55,433	0.517	0.485
17	59,166	0.485	0.433
18	55,551	0.353	0.3
19	59,147	0.571	0.64
20	58,161	0.465	0.161
21	57,100	0.437	0.366
22	57,099	0.365	0.504
23	59,503	0.518	0.526
24	57,770	0.433	0.436
Plan Average:	57,397.04	0.444	0.429

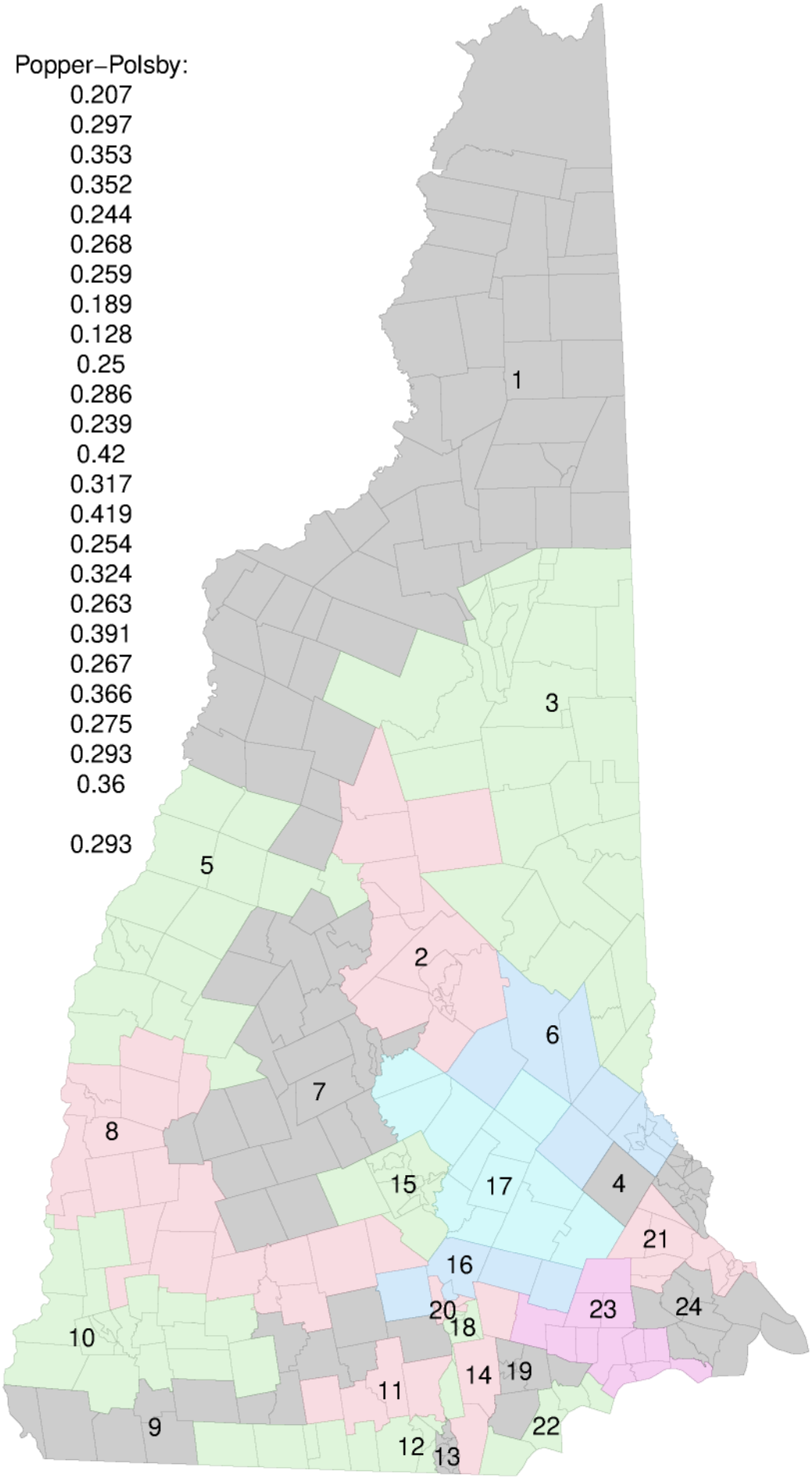


II. The Enacted Plan's Compliance with Traditional Districting Criteria

21. I assessed whether the 2022 Enacted Senate Plan complies with the five traditional districting criteria described above, and I describe my findings in this section. On the following page of this report, Map S-2 displays the boundaries of the 2022 Enacted Plan. The left portion of this Map also reports the population of each district and the compactness scores for each of the Enacted Plan's districts. I found that the Enacted Plan's districts do not violate geographic contiguity or population equality and do not split any wards. However, I also found that the Enacted Plan violates traditional districting principles in two ways. First, by comparing the 2022 Enacted Plan to the 1,000 computer-simulated plans, I found that the Enacted Plan is significantly less geographically compact than is reasonably possible. Second, the Enacted Plan unnecessarily splits Manchester into three separate districts. I describe these two findings below in detail.

Map S2: 2022 SB 240 Enacted Senate Plan

District:	Population:	Reock:	Popper−Polsby:
1	55,947	0.304	0.207
2	56,448	0.468	0.297
3	57,090	0.416	0.353
4	56,519	0.322	0.352
5	58,966	0.362	0.244
6	55,976	0.336	0.268
7	56,259	0.535	0.259
8	56,429	0.264	0.189
9	56,269	0.118	0.128
10	56,160	0.348	0.25
11	58,412	0.298	0.286
12	60,153	0.159	0.239
13	60,252	0.466	0.42
14	57,166	0.291	0.317
15	58,119	0.439	0.419
16	57,841	0.192	0.254
17	55,965	0.337	0.324
18	56,605	0.243	0.263
19	59,132	0.359	0.391
20	57,821	0.306	0.267
21	56,894	0.288	0.366
22	59,228	0.21	0.275
23	57,395	0.265	0.293
24	56,483	0.302	0.36
Plan Average:	57,397.04	0.318	0.293

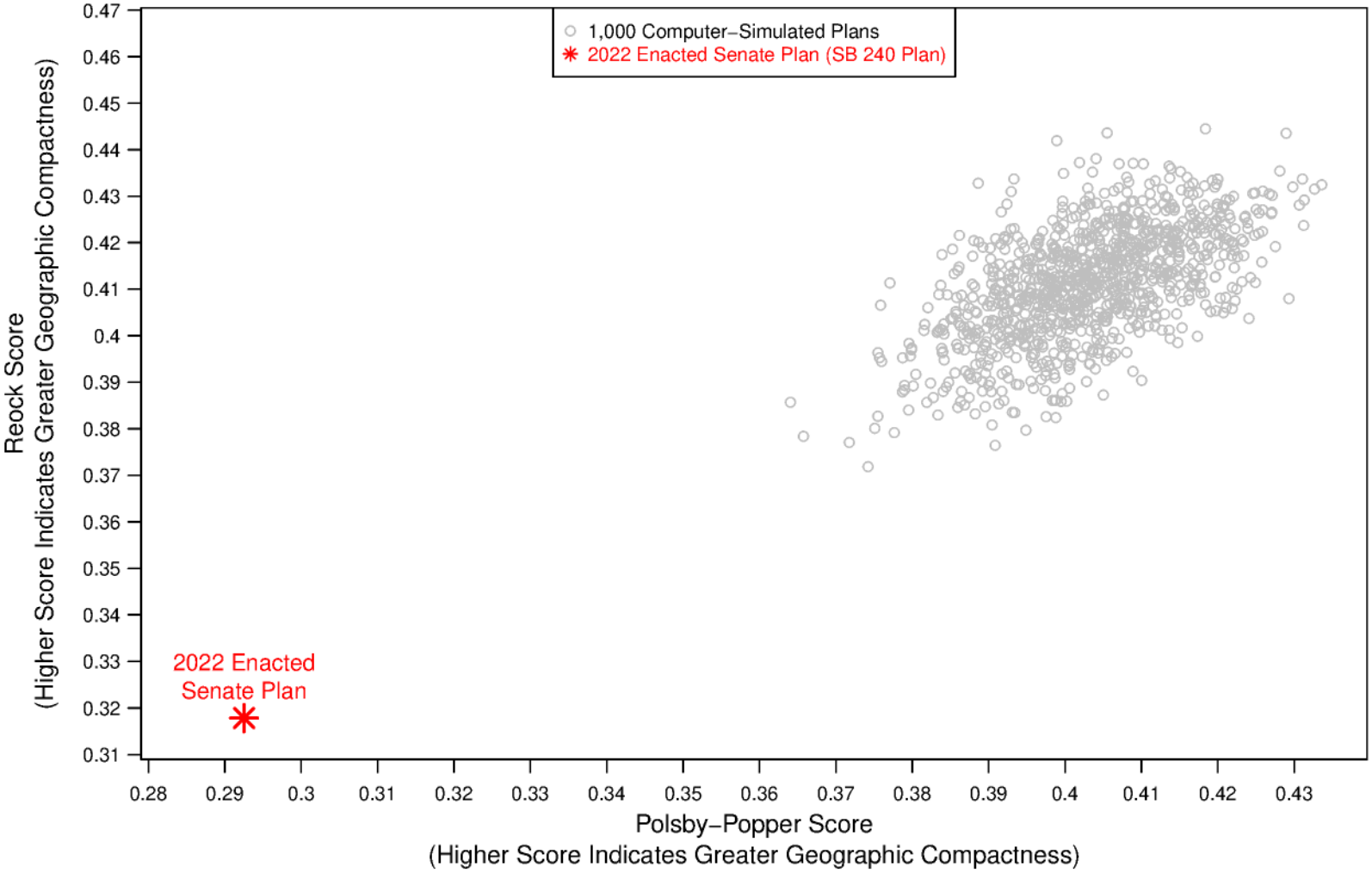


22. **Geographic Compactness of the Enacted Plan**: In evaluating whether the 2022 Enacted Plan was drawn in a manner that favors geographic compactness, it is useful to compare the compactness of the Enacted Plan and the 1,000 computer-simulated plans. The computer-simulated plans were produced by a computer algorithm adhering strictly to traditional districting criteria and ignoring any partisan considerations. Thus, the compactness scores of these computer-simulated plans illustrate the statistical range of compactness scores that could be reasonably expected to emerge from a districting process that solely seeks to follow traditional districting criteria while ignoring partisan considerations. I compare the compactness of the simulated plans and the Enacted Plan using two commonly-used measures of compactness in redistricting.

23. First, I calculate the average Polsby-Popper score of each plan's districts. As described in paragraph 14, Polsby-Popper scores range from 0 to 1, and higher Polsby-Popper scores indicate greater district compactness. The 2022 Enacted Plan has an average Polsby-Popper score of 0.293 across its 24 districts. As illustrated in Figure S-1, every single one of the 1,000 computer-simulated Senate plans in this report exhibits a significantly higher Polsby-Popper score than the Enacted Plan. In fact, the middle 50% of these 1,000 computer-simulated plans have an average Polsby-Popper score ranging from 0.395 to 0.411, and the most compact computer-simulated plan has a Polsby-Popper score of 0.434. Hence, it is clear that the Enacted Plan is significantly less compact, as measured by its Polsby-Popper score, than what could reasonably have been expected from a districting process adhering to the traditional districting principle of geographic compactness.

24. Second, I calculate the average Reock score of the districts within each plan. As described in paragraph 14, Reock scores range from 0 to 1, and higher Reock scores indicate more geographically compact districts. The 2022 Enacted Plan has an average Reock score of 0.318 across its 24 Senate districts. As illustrated in Figure S-1, every single one of the 1,000 computer-simulated Senate plans exhibits a significantly higher Reock score than the Enacted Plan. In fact, the middle 50% of these 1,000 computer-simulated plans have an average Reock score ranging from 0.403 to 0.420, and the most compact computer-simulated plan has a Reock score of 0.445. Hence, it is clear that the 2022 Enacted Plan is significantly less compact, as measured by its Reock score, than what could reasonably have been expected from a districting process adhering to the traditional districting principle of geographic compactness.

Figure S1: Comparison of 2022 Enacted Senate Plan to 1,000 Computer−Simulated Plans on Polsby−Popper and Reock Compactness Scores



25. **The Enacted Plan's Splitting of Manchester**: The Enacted Senate Plan splits Manchester into three Senate Districts: SD-16, SD-18, and SD-20. Splitting Manchester into three separate districts was unnecessary because Manchester's total population of 115,644 is nearly identical to two times the ideal district population of 57,397.04. Hence, Manchester could have easily been split into exactly two districts, rather than three. In fact, each of the 1,000 computer-simulated plans splits Manchester into exactly two districts without any over-population of districts, demonstrating that the Enacted Plan's splitting of Manchester into three districts was excessive and not necessary for producing equally populated districts.

III. Measuring the Partisanship of Districting Plans

26. I use actual election results from recent, statewide election races in New Hampshire to assess the partisan performance of the 2022 Enacted Plan and the computer-simulated plans analyzed in this report. Overlaying these past election results onto a districting plan enables me to calculate the Republican or Democratic share of the votes cast from within each district in the Enacted Plan and in each simulated plan. I am also able to count the total number of Republican and Democratic-leaning districts within each simulated plan and within the Enacted Plan. All of these calculations thus allow me to directly compare the partisanship of the Enacted Plan and the simulated plans. These partisan comparisons allow me to determine whether the partisanship of individual districts and the partisan distribution of seats in the Enacted Plan could reasonably have arisen from a non-partisan districting process adhering to traditional districting criteria. Past voting history in federal and statewide elections is a strong predictor of future voting history. Mapmakers thus can and do use past voting history to identify the class of voters, at a precinct-by-precinct level, who are likely to vote for Republican or Democratic candidates.

27. In general, the most reliable method of comparing the partisanship of different Senate districts within a state is to calculate the percentage of votes from these districts favoring Republican or Democratic candidates in recent, competitive statewide elections, such as the Presidential, Gubernatorial, Attorney General, and US Senate elections. Recent statewide elections provide the most reliable basis for comparisons of different precincts' partisan tendencies because in any statewide election, the anomalous candidate-specific effects that shape the election outcome are equally present in all precincts across the state. Statewide elections are thus a better basis for comparison than the results of Senate elections because the particular outcome of any Senate election may deviate from the long-term partisan voting trends of that

district, due to factors idiosyncratic to the district as currently constructed. Such factors can include the presence or absence of a quality challenger, anomalous differences between the candidates in campaign efforts or campaign finances, incumbency advantage, candidate scandals, and coattail effects.[10] Because these idiosyncratic factors would change if the district were drawn differently, it is particularly unsuitable to use election results from an existing district when comparing the partisanship of districts in a newly-enacted plan or a computer-simulated plan that would have different boundaries than those used in past Senate elections.

28. Moreover, statewide elections are also a more reliable indicator of a district's partisanship than partisan voter registration counts. Voter registration by party is a particularly unreliable method of comparing districts' partisan tendencies because many voters who consistently support candidates from one party nevertheless do not officially register with either major party, while others vote for candidates of one party while registering with a different party. As a result, based on my expertise and my experience studying redistricting practices across many states, I have observed that legislative map-drawers generally do not rely heavily on voter registration data in assessing the partisan performance of districts. I therefore use results from recent statewide elections in order to measure the partisanship of districts in the 2022 Enacted Plan and in the computer-simulated plans, as described below.

29. **The 2016-2020 Statewide Election Composite**: To measure the partisanship of all districts in the computer-simulated plans and the 2022 Enacted Plan, I used the results from every statewide general election contest for a political (non-judicial) office held in New Hampshire during 2016 to 2020. In other words, I used the results of the following seven

[10] E.g., Alan Abramowitz, Brad Alexander, and Matthew Gunning. "Incumbency, Redistricting, and the Decline of Competition in U.S. House Elections." *The Journal of Politics.* Vol. 68, No. 1 (February 2006): 75-88. Kenneth J. Meier, "Party Identification and Vote Choice: The Causal Relationship" Vol. 28, No. 3 (Sep., 1975):496-505.

elections: 2016 Governor, 2016 US President, 2016 US Senator, 2018 Governor, 2020 Governor, 2020 US President, and 2020 US Senator.

30. I obtained precinct-level results for these seven elections from the Redistricting Data Hub,[11] and I disaggregated these election results down to the census block level. I then aggregated these block-level election results to the district level within each computer-simulated plan and the Enacted Plan, and I calculated the number of districts within each plan that cast more votes for Republican than Democratic candidates. I used these calculations to measure the partisan performance of each simulated plan analyzed in this report and of the Enacted Plan. In other words, I looked at the census blocks that would comprise a particular district in a given simulation and, using the actual election results from those census blocks, I calculated whether voters in that simulated district collectively cast more votes for Republican or Democratic candidates in the 2016-2020 statewide election contests. I performed such calculations for each district under each simulated plan to measure the number of districts Democrats or Republicans would have won under that particular simulated districting map.

31. I refer to the aggregated election results from these seven statewide elections as the "2016-2020 Statewide Election Composite." For the 2022 Enacted Plan districts and for all districts in each of the 1,000 computer-simulated plans, I calculated the percentage of total two-party votes across these seven elections that were cast in favor of Republican candidates in order to measure the average Republican vote share of the district. This Republican vote share, as measured using the 2016-2020 Statewide Election Composite, simply reports the overall share of two-party votes cast in favor of Republican candidates in these seven recent statewide elections.

[11] https://redistrictingdatahub.org/state/new-hampshire/

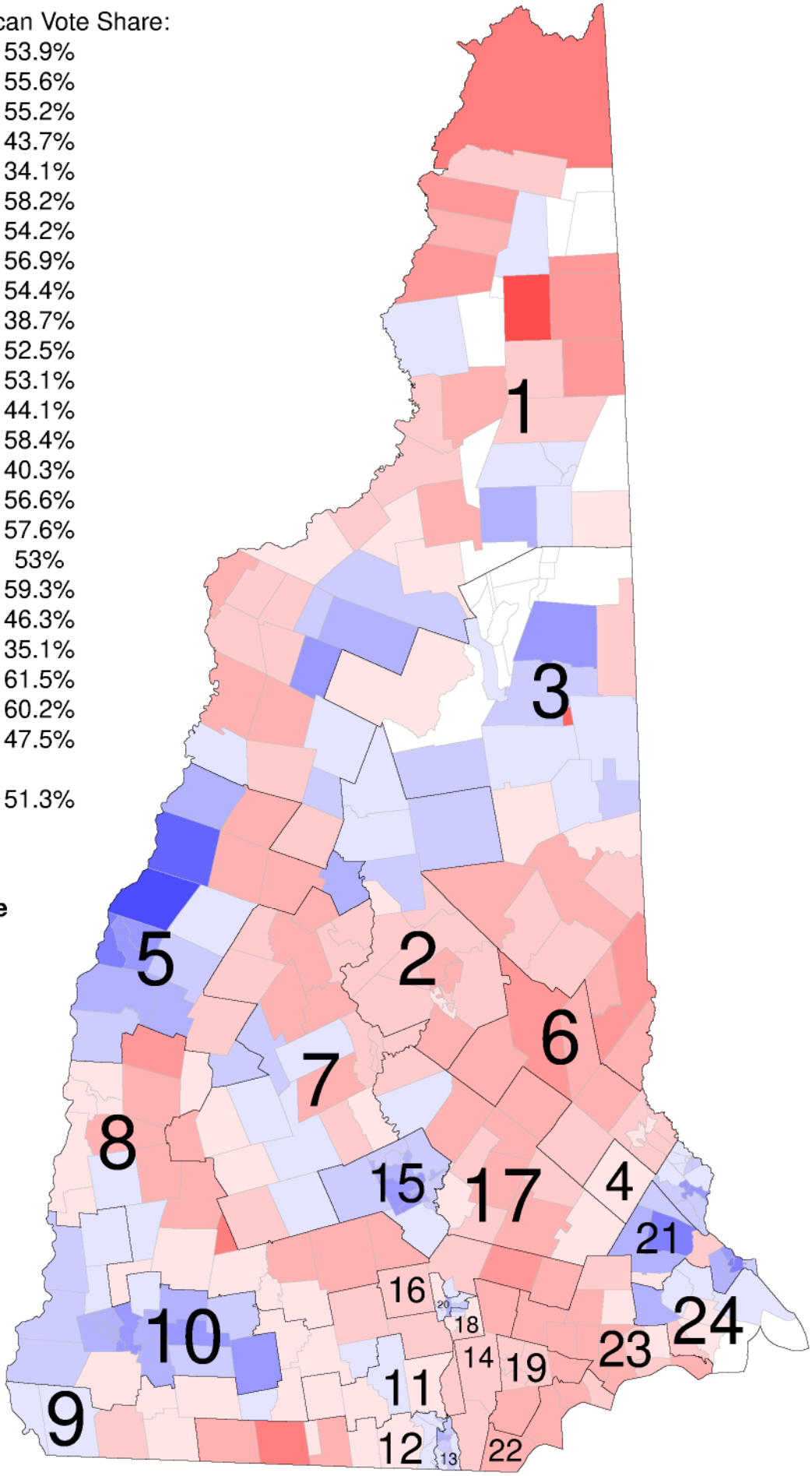
32. Map S-3 displays the Republican vote share, as measured using the Statewide Election Composite, of each ward, town, township, and unincorporated place in New Hampshire. In this map, Republican-favoring areas are shaded from dark red (most heavily Republican) to light red (least Republican), and Democratic-leaning areas are shaded from dark blue (most heavily Democratic) to light blue (least Democratic). Additionally, the district boundaries of the 2022 Enacted Senate Plan appear in black on this Map, and the table on the left side of this Map report the Republican vote share, measured using the Statewide Election Composite, of each Senate district in the Enacted Plan. At the end of this report, Appendix B contains a series of 24 maps, each of which zooms in on one of the individual districts in the 2022 Senate Plan.

Map S3: 2022 SB 240 Enacted Senate Plan

Number:	Population:	Republican Vote Share:
1	55,947	53.9%
2	56,448	55.6%
3	57,090	55.2%
4	56,519	43.7%
5	58,966	34.1%
6	55,976	58.2%
7	56,259	54.2%
8	56,429	56.9%
9	56,269	54.4%
10	56,160	38.7%
11	58,412	52.5%
12	60,153	53.1%
13	60,252	44.1%
14	57,166	58.4%
15	58,119	40.3%
16	57,841	56.6%
17	55,965	57.6%
18	56,605	53%
19	59,132	59.3%
20	57,821	46.3%
21	56,894	35.1%
22	59,228	61.5%
23	57,395	60.2%
24	56,483	47.5%
Plan Average:	57,397.04	51.3%

VTD–Level Republican Vote Share (Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



33. In the following section, I present district-level comparisons of the Enacted Plan and simulated plan districts in order to identify whether any individual districts in the Enacted Plan are partisan outliers. I also present plan-wide comparisons of the Enacted Plan and the simulated plans in order to identify the extent to which the Enacted Plan is a statistical outlier in terms of common measures of districting plan partisanship.

IV. District-Level and Plan-Wide Partisan Comparisons of the Enacted Plan and Simulated Plans

34. In this section, I present partisan comparisons of the 2022 Enacted Plan to the computer-simulated plans at both a district-by-district level as well as a plan-wide level using several common measures of districting plan partisanship. First, I compare the district-level Republican vote share of the Enacted Plan's districts and the districts in the computer-simulated plans. Next, I compare the number of Republican-favoring districts in the Enacted Plan and in the computer-simulated plans. Finally, I use some common measures of partisan bias to compare the Enacted Plan to the computer-simulated plans. Overall, I find that 16 of the 24 individual districts in the 2022 Enacted Plan are statistical outliers, exhibiting extreme partisan characteristics that are rarely or never observed in the computer-simulated plan districts drawn with strict adherence to non-partisan, traditional districting criteria. Moreover, I find that at the plan-wide level, the Enacted Plan creates a degree of partisan bias favoring Republicans that is more extreme than the vast majority of the computer-simulated plans. I describe these findings in detail below:

35. **Partisan Outlier Districts in the Enacted Plan**: In Figure S-2, I directly compare the partisan distribution of districts in the Enacted Plan to the partisan distribution of districts in the 1,000 computer-simulated plans. I first order the Enacted Plan's districts from the most to the least-Republican district, as measured by Republican vote share using the 2016-2020 Statewide Election Composite. The most-Republican district appears on the top row, and the least-Republican district appears on the bottom row. Next, I analyze each of the 1,000 computer-simulated plans and similarly order each simulated plan's districts from the most- to the least-Republican district. I then directly compare the most-Republican Enacted Plan district (SD-22) to the most-Republican simulated district from each of the 1,000 computer-simulated plans. In

other words, I compare one district from the Enacted Plan to 1,000 computer-simulated districts, and I compare these districts based on their Republican vote share. I then directly compare the second-most-Republican district in the Enacted Plan to the second-most-Republican district from each of the 1,000 simulated plans. I conduct the same comparison for each of the 24 districts in the Enacted Plan, comparing the Enacted Plan district to its computer-simulated counterparts from each of the 1,000 simulated plans.

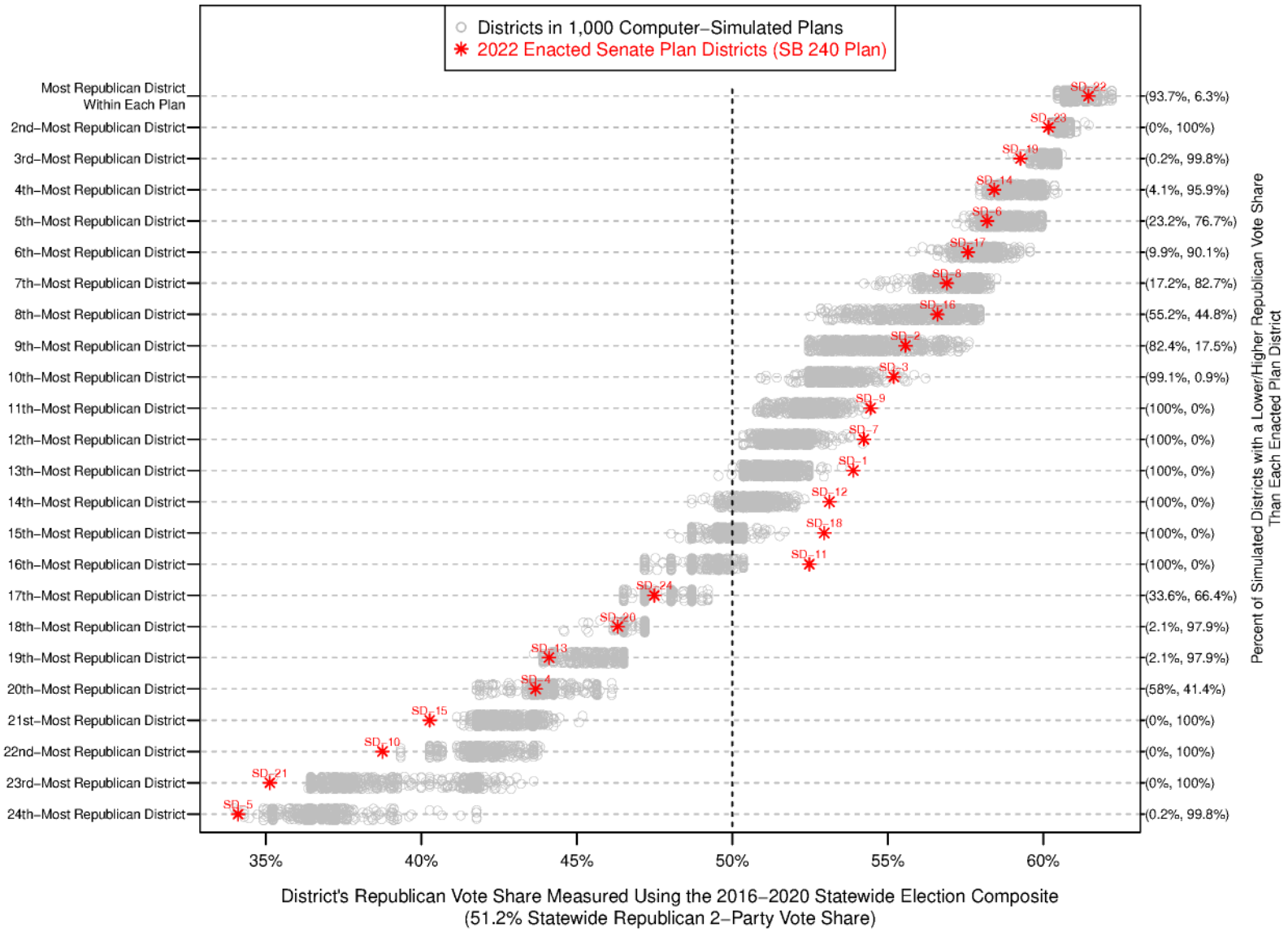
36. Thus, the top row of Figure S-2 directly compares the partisanship of the most-Republican Enacted Plan district (SD-22) to the partisanship of the most-Republican district from each of the 1,000 simulated plans. The two percentages in parentheses in the right margin of this Figure report the percentage of these 1,000 simulated districts that are less Republican than, and more Republican than, the Enacted Plan district. Similarly, the second row of this Figure compares the second-most-Republican district from each plan, the third row compares the third-most-Republican district from each plan, and so on until the 24th row compares the least-Republican district from each plan. In each row of this Figure, the Enacted Plan's district is depicted with a red star and labeled in red with its district number; meanwhile, the 1,000 computer-simulated districts are depicted with 1,000 gray circles on each row.

37. As Figure S-2 illustrates, the 10th-, 11th-, 12th-, 13th-, 14th-, 15th-, and 16th-most-Republican districts in the Enacted Plan (SD-3, SD-9, SD-7, SD-1, SD-12, SD-18, and SD-11) are more heavily Republican than over 99% of the corresponding districts in each of the 1,000 computer-simulated plans. In fact, 6 of these 7 districts are more heavily Republican than 100% of the corresponding simulated districts. These calculations are numerically reported in the right margin of the Figure. More than 99% of the computer-simulated counterpart districts would have been less favorable to Republicans than SD-3, SD-9, SD-7, SD-1, SD-12, SD-18,

and SD-11 in terms of partisanship: these districts exhibit Republican vote shares ranging from 52.5% to 55.2%, while the vast majority of corresponding districts in the computer-simulated plans would have exhibited a lower Republican vote share and would therefore have been more favorable to Democrats.

38. It is thus clear that districts SD-3, SD-9, SD-7, SD-1, SD-12, SD-18, and SD-11 crack Democratic voters by eliminating what would normally have been a more politically competitive or even Democratic-favoring district in nearly all the computer-simulated plans. The Republican vote share of these districts is higher than the corresponding districts in more than 99% of the computer-simulated plans (and for 6 of the 7 districts, higher than 100% of the plans). I therefore identify these districts as extreme partisan outliers when compared to each of their 1,000 computer-simulated counterparts, using a standard threshold test of 95% for statistical significance.

Figure S2: Comparison of 2022 Enacted Senate Plan Districts to 1,000 Computer−Simulated Plans' Districts



39. It is especially notable that these seven aforementioned Enacted Plan districts – SD-3, SD-9, SD-7, SD-1, SD-12, SD-18, and SD-11– were drawn to include more Republican voters than nearly all of their counterpart districts in the 1,000 computer-simulated plans. The "extra" Republican voters in these seven districts in the Enacted Plan had to come from other districts in the Enacted Plan.

40. Indeed, other rows in Figure S-2 confirm this precise effect. Figure S-2 reveals that the 2nd-, 3rd-, 4th-, 18th-, 19th-, 21st-, 22nd-, 23rd-, and 24th-most-Republican districts in the Enacted Plan (SD-23, SD-19, SD-14, SD-20, SD-13, SD-15, SD-10, SD-21, and SD-5) are less Republican than their corresponding districts in more than 95% of the computer-simulated plans. In fact, four of these nine districts are less Republican than their corresponding districts in 100% of the computer-simulated plans. The unnaturally low Republican vote share in districts SD-23, SD-19, and SD-14 (safe Republican districts), and in districts SD-20, SD-13, SD-15, SD-10, SD-21, and SD-5 (safe Democratic districts), allowed the Enacted Plan's districts SD-3, SD-9, SD-7, SD-1, SD-12, SD-18, and SD-11 to have higher Republican vote shares than nearly all of their computer-simulated counterpart districts, as illustrated in Figure S-2.

41. I therefore identify 16 districts in the Enacted Plan as partisan statistical outliers (SD-23, SD-19, SD-14, SD-20, SD-13, SD-15, SD-10, SD-21, SD-5, SD-3, SD-9, SD-7, SD-1, SD-12, SD-18, and SD-11). In the Enacted Plan, SD-5, SD-10, SD-13, SD-14, SD-15, SD-19, SD-20, SD-21, and SD-23 are significantly less Republican than over 95% of the corresponding districts in each of the 1,000 simulated plans, which allows districts SD-1, SD-3, SD-7, SD-9, SD-11, SD-12, and SD-18 to be more heavily Republican than over 99% of their counterpart computer-simulated plan districts. The net effect of these distortions is to create additional safe Republican districts in the 10th to 16th rows from the top of Figure S-2. These rows would have

had more politically competitive or Democratic-favoring districts under the vast majority of the computer-simulated plans. In order to create these additional safe Republican districts, the Enacted Plan decreased the Republican vote share in districts that would have already been either extremely safe Republican districts (2nd to 4th rows from the top of Figure S-2) or extremely safe Democratic districts (18th, 19th, and 21st to 24th rows from the top of Figure S-2).

42. Appendix A of this report contains seven additional figures (Figures A1 through A7) that each contain a similar analysis of the Enacted Plan districts and the computer-simulated plan districts. Each of these seven figures in the Appendix measures the partisanship of districts using one of the individual seven elections included in the 2016-2020 Statewide Election Composite. These seven figures generally demonstrate that the same extreme partisan outlier patterns observed in Figure S-2 are also present when district partisanship is measured using any one of the seven statewide elections held in New Hampshire during 2016-2020.

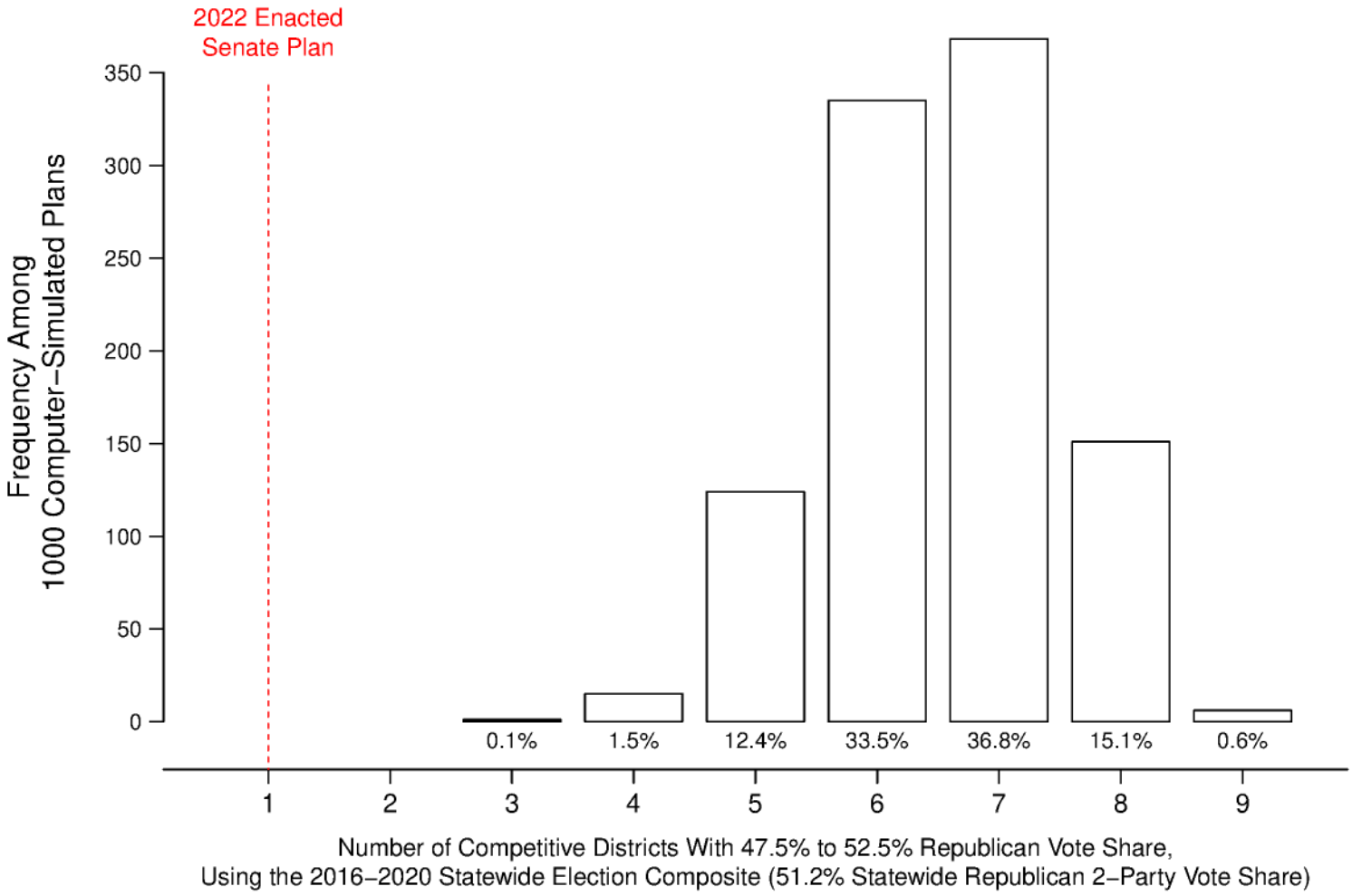
43. **Competitive Districts:** Collectively, the upper 16 rows in Figure S-2 illustrate that the Enacted Plan's 16 most-Republican districts exhibit a significantly narrower range of partisanship than is exhibited by the 16 most-Republican districts in each of the computer-simulated plans. Specifically, the Enacted Plan's 16 most-Republican districts all have Republican vote shares within the narrow range of 52.48% to 61.45%, while the districts in the bottom four rows are far more heavily Democratic than their computer-simulated counterpart districts in these rows.

44. This finding is noteworthy because, as Figure S-2 reveals, the 1,000 simulated plans frequently create districts with a Republican vote share very close to 50% - in other words, with nearly even numbers of Democratic and Republican voters. In Figure S-3, I label any districts with a Republican vote share between 47.5% and 52.5% as "competitive," and I

compare the number of competitive districts in the Enacted Plan to the number of competitive districts in each of the 1,000 simulated plans.

45. As Figure S-3 illustrates, the Enacted Plan's creation of only one competitive district (SD-11) is an extreme statistical outlier. None of the simulated plans created only one competitive district. Over 98% of the simulated plans create five to nine competitive districts, and the most common outcome among the simulations is seven competitive districts. Hence, the Enacted Plan is an extreme partisan outlier in terms of its near complete lack of competitive districts, and this outcome is clearly anomalous, given New Hampshire's political geography. In the 1,000 simulated plans created using a partisan-blind computer algorithm following traditional districting criteria, 27.2% of the Senate districts created by the simulations are politically competitive, with a Republican vote share between 47.5% and 52.5%. In other words, over one-fourth of the Senate districts created by the partisan-blind computer simulation algorithm are politically competitive. It is statistically impossible for a partisan-blind mapdrawing process in New Hampshire to produce a Senate map that, like the 2022 Enacted Plan, contains only one competitive district.

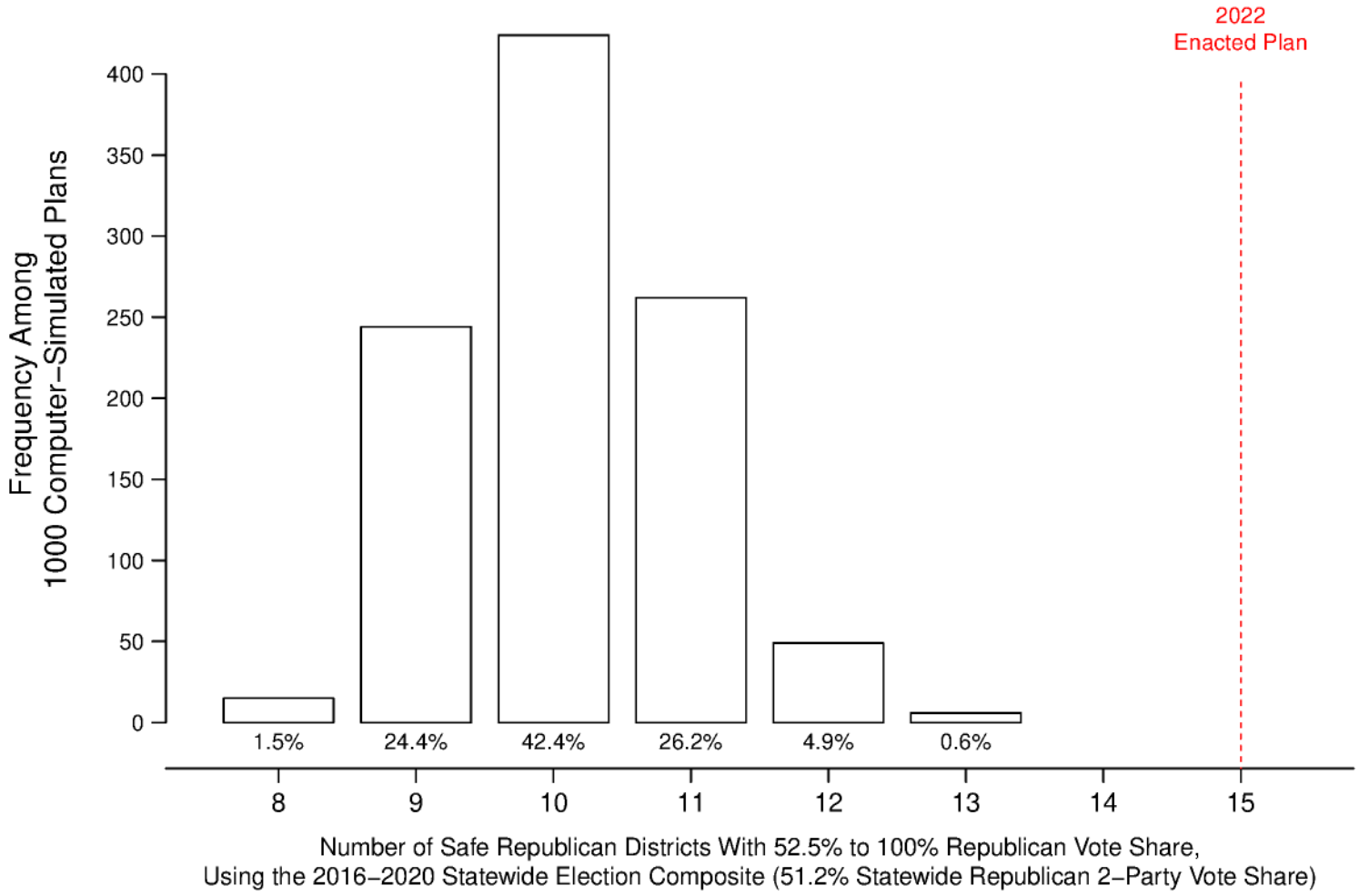
Figure S3:
Comparison of 2022 Enacted Senate Plan to 1,000 Computer–Simulated Plans



46. **Safe Republican Districts:** Rather than having multiple competitive districts, the 2022 Enacted Plan instead created 15 relatively safe Republican districts, each with a Republican vote share in the narrow range of 53.0% to 61.5%. Although such districts are not guaranteed to always elect Republicans, districts in this range are nevertheless relatively safer for Republicans than competitive districts with a 47.5% - 52.5% Republican vote share.

47. In Figure S-4, I therefore compare the number of districts with over a 52.5% Republican vote share in the Enacted Plan and in the 1,000 computer-simulated plans. As Figure S-4 illustrates, the Enacted Plan's creation of 15 Republican districts with over a 52.5% Republican vote share is an extreme statistical outlier. None of the 1,000 simulated plans ever contain 15 such safely Republican districts. The vast majority of the simulated plans contain between 9 and 12 such Republican districts, and no simulated plan contains more than 13. Hence, the Enacted Plan is clearly an extreme partisan outlier in terms of its peculiar focus on maximizing the number of relatively safe Republican districts with a Republican vote share of more than 52.5%. It did so to an extreme degree, creating more relatively safe Republican districts than were created in any of the 1,000 simulated plans using a partisan-blind computer algorithm that follows traditional districting principles.

Figure S4:
Comparison of 2022 Enacted Senate Plan to 1,000 Computer−Simulated Plans



48. **The Mean-Median Difference:** I also calculate each districting plan's mean-median difference. As described in paragraph 15, the mean-median difference for any given plan is calculated as the median district-level Republican vote share, minus the mean district-level Republican vote share. For any Senate districting plan, the mean is calculated as the average of the Republican vote shares in each of the 24 districts. The median, in turn, is the Republican vote share in the district where Republicans performed the middle-best, which is the district that Republicans would need to win in order to secure a majority of the Senate seats. For a Senate plan containing 24 districts, the median district is calculated as the average of the Republican vote share in the districts where Republicans performed the 12th- and 13th-best across the state.

49. Using the 2016-2020 Statewide Election Composite to measure partisanship, the districts in the 2022 Enacted Plan have a mean Republican vote share of 51.26%, while the median district has a Republican vote share of 54.06%. Thus, the Enacted Plan has a mean-median difference of +2.80%, indicating that the median district is skewed more Republican than the plan's average district. The mean-median difference thus indicates that the Enacted Plan distributes voters across districts in such a way that most districts are more Republican-leaning than the average New Hampshire Senate district, while Democratic voters are more heavily concentrated in a minority of the Enacted Plan's districts.

50. I perform this same mean-median difference calculation on all computer-simulated plans in order to determine whether this partisan skew in the median Senate districts could have resulted naturally from New Hampshire's political geography and the application of traditional districting principles. Figure S-5 compares the mean-median difference of the Enacted Plan to the mean-median difference for each the 1,000 computer-simulated plans.

51. Figure S-5 contains 1,000 gray circles, representing the 1,000 computer-simulated plans, as well as a red star, representing the 2022 Enacted Plan. The horizontal axis in this Figure measures the mean-median difference of the 2022 Enacted Plan and each simulated plan using the 2016-2020 Statewide Election Composite, while the vertical axis measures the average Polsby-Popper compactness score of the districts within each plan, with higher Polsby-Popper scores indicating more compact districts. Figure S-5 illustrates that the Enacted Plan's mean-median difference is +2.80%, indicating that the median district is skewed more Republican than the plan's average district. Figure S-5 further indicates that this difference is a statistical outlier compared to the 1,000 computer-simulated plans. None of the 1,000 simulated plans exhibit a mean-median difference higher than the Enacted Plan's mean-median difference of +2.80%. In fact, the middle 50% of the 1,000 computer-simulated plans have mean-median differences ranging from 0% to +0.76%, indicating a much smaller degree of skew in the median district than occurs under the 2022 Enacted Plan. These results confirm that the Enacted Plan exhibits a degree of pro-Republican partisan bias that cannot be explained by New Hampshire's voter geography or by strict adherence to traditional districting criteria.

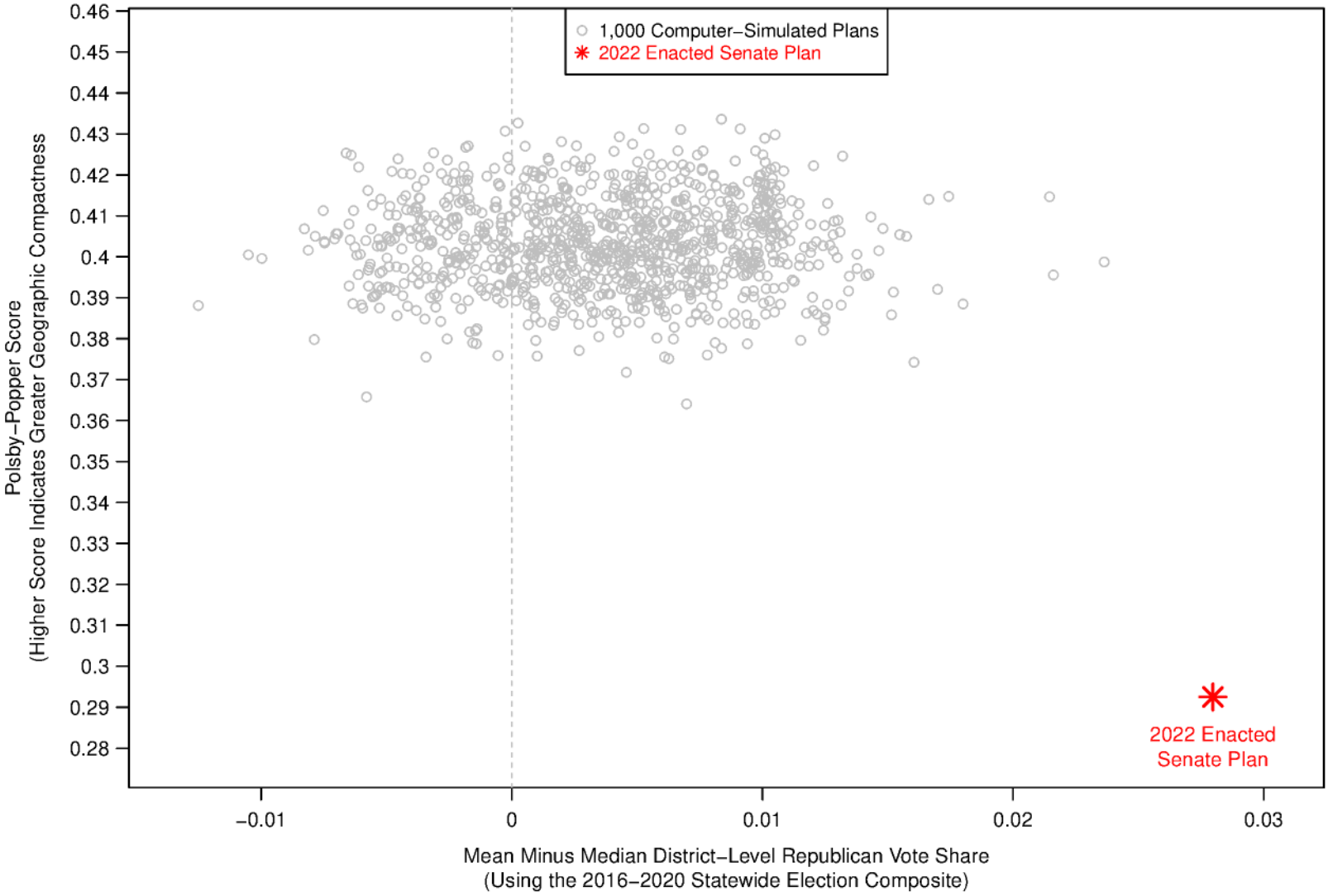
52. Figure S-5 also illustrates that the Enacted Plan is less geographically compact than every single one of the computer-simulated plans, as measured by each plan's average Polsby- Popper score. The simulated plans have Polsby-Popper scores ranging from 0.36 to 0.43. In fact, the middle 50% of these computer-simulated plans have Polsby-Popper scores ranging from 0.40 to 0.41. Meanwhile, the Enacted Plan exhibits a Polsby-Popper score of only 0.29, which is lower than all 1,000 of the computer-simulated plans. Hence, it is clear that the Enacted Plan did not seek to draw districts that were as geographically compact as reasonably possible.

Instead, the Enacted Plan subordinated geographic compactness, which enabled the Enacted Plan to create a partisan skew in New Hampshire's Senate districts favoring Republican candidates.

53. The consequence of the Enacted Plan's statistically extreme mean-median difference is that the Enacted Plan gives Republicans a far easier path to winning a majority of seats in the New Hampshire Senate. Using the 2016-2020 Statewide Election Composite, the Republicans' percentage of the statewide vote is 51.2%, while the 13th-most Republican Senate district (SD-1) has a Republican vote share of 53.9%. To win this 13th district (and thus guarantee control over 13 of the 24 Senate seats), Republicans would only need to win 47.3% of the statewide vote (51.2% minus 3.9%), assuming a uniform swing in vote share across all Senate districts. Moreover, the 16th-most Republican Senate district (SD-11) has a Republican vote share of 52.5%. Thus, Republicans would win a two-thirds supermajority of the Senate seats (16 of 24 districts) by winning just 48.7% of the statewide vote (51.2% minus 2.5%), assuming a uniform swing in vote share across all Senate districts.

54. By contrast, the 2022 Enacted Senate Plan gives Democrats a significantly more difficult path to winning a majority of New Hampshire's Senate seats. Using the 2016-2020 Statewide Election Composite, the Democrats' percentage of the statewide vote is 48.8%, while the 13th-most Democratic Senate district (SD-7) has a Republican vote share of 54.2%. To win this 13th district (and thus guarantee control over 13 of the 24 Senate seats), Democrats would have to win 53.0% of the statewide vote (48.8% plus 4.2%), assuming a uniform swing in vote share across all Senate districts. Hence, compared to Republicans, the Democrats would have to win a significantly higher share of the statewide vote in order to control a majority of the seats in the New Hampshire senate under the 2022 Enacted Senate Plan.

Figure S5: Comparison of 2022 Senate Enacted Plan to 1,000 Computer−Simulated Plans on Mean−Median Difference and Compactness



55. **The Lopsided Margins Measure**: As described in paragraph 15, another measure of partisan bias in districting plans is the "lopsided margins" test. The basic premise captured by this measure is that a partisan-motivated map-drawer may attempt to pack the opposing party's voters into a small number of extreme districts that are won by a lopsided margin. Hence, the lopsided margins test is performed by calculating the difference between the average margin of victory in Republican-favoring districts and the average margin of victory in Democratic-favoring districts. The 2022 Enacted Plan contains eight Democratic-favoring districts (SD-5, SD-21, SD-10, SD-15, SD-4, SD-13, SD-20, and SD-24), and these districts have an average Democratic vote share of 58.8%, as measured using the 2016-2020 Statewide Election Composite. By contrast, the Enacted Plan contains 16 Republican-favoring districts (SD-11, SD-18, SD-12, SD-1, SD-7, SD-9, SD-3, SD-2, SD-16, SD-8, SD-17, SD-6, SD-14, SD-19, SD-23, and SD-22), and these 16 districts have an average Republican vote share of 56.3%. Hence, the difference between the average Democratic margin of victory in Democratic-favoring districts and the average Republican margin of victory in Republican-favoring districts is +2.5%, which is calculated as 58.8% - 56.3%. I refer to this calculation of +2.5% as the Enacted Plan's lopsided margins measure.

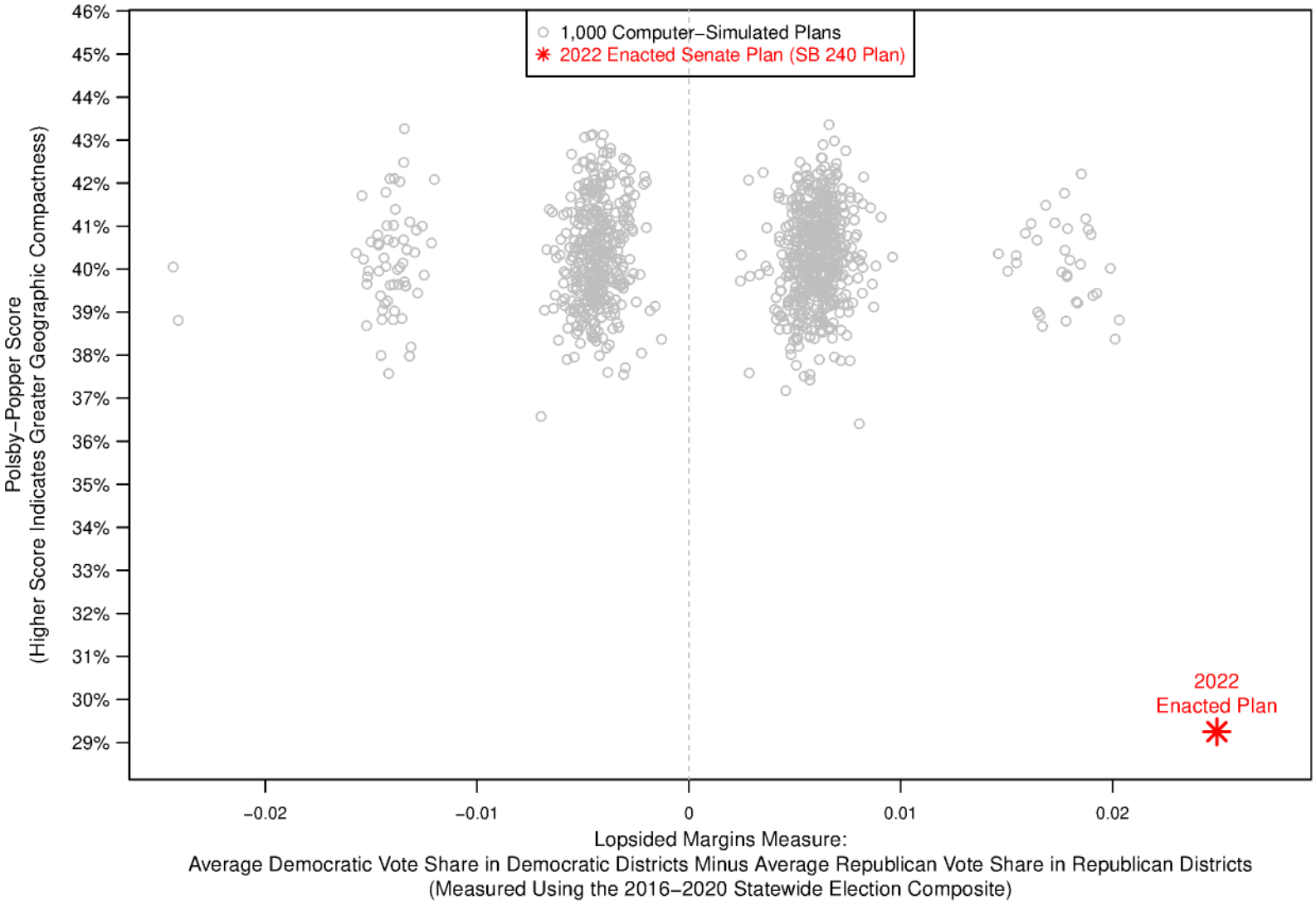
56. How does the 2.5% lopsided margins measure of the Enacted Plan compare to the same calculation for the 1,000 computer-simulated plans? Figure S-6 reports the lopsided margins calculations for the Enacted Plan and for the simulated plans. In Figure S-6, each plan is plotted along the horizontal axis according to its lopsided margins measure and along the vertical axis according to its Polsby-Popper score.

57. Figure S-6 reveals that the Enacted Plan's +2.5% lopsided margins measure is an extreme outlier compared to the lopsided margins measures of the 1,000 computer-simulated

plans. Every one of the simulated plans has a smaller lopsided margins measure than the Enacted Plan. Specifically, 100% of the simulated plans exhibit a smaller lopsided margins measure than the Enacted Plan does. In fact, 91.0% of the 1,000 simulated plans have a lopsided margins measure of between -1% to +1%, indicating a plan in which Democrats and Republicans win their respective districts by relatively similar average margins. This finding suggests that the vast majority of the time, a partisan-blind mapdrawing process adhering to traditional districting principles results in a Senate plan in which Democrats and Republicans win their respective districts by nearly the same average margins.

58. By contrast, the Enacted Plan's lopsided margins measure of +2.5% indicates that the Enacted Plan creates districts in which Democrats are packed tightly into their district, while the margin of victory in Republican districts is significantly smaller. The "lopsidedness" of the two parties' average margin of victory is extreme when compared to the computer-simulated plans. The finding that 100% of the simulated plans have a smaller lopsided margins measure indicates that the Enacted Plan's extreme packing of Democrats into a small number of Democratic-favoring districts was not simply the result of New Hampshire's political geography combined with adherence to traditional districting criteria.

Figure S6: Comparison of 2022 Enacted Senate Plan to 1,000 Computer−Simulated Plans on Lopsided Margins Measure and Compactness



59. **Partisan Symmetry Based on Uniform Swing**: Finally, as described in paragraph 15, another common measure of partisan bias is based on the concept of partisan symmetry and asks the following question: Under a given districting plan and given a particular election-based measure of district partisanship, what share of seats would each party win in a hypothetical tied election (i.e., 50% vote share for each of two parties). To approximate the district-level outcomes in a hypothetical tied election, one normally uses a uniform swing in order to simulate a tied statewide election. We then calculate whether each party would receive more than or less than 50% of the seats under this hypothetical tied election for a given districting plan. This particular measure is often referred to in the academic literature as "partisan bias." In order to avoid confusion with other measures of partisan bias described in this report, I will refer to this measure as "Partisan Symmetry Based on Uniform Swing."

60. Specifically, I use the 2016-2020 Statewide Election Composite to calculate the Partisan Symmetry measure for both the Enacted Plan and for the computer-simulated plans. The 2016-2020 Statewide Election Composite produces a statewide Republican vote share of 51.2%. Therefore, I use a uniform swing of -1.2% in order to estimate the partisanship of districts under a hypothetical tied election in which each party wins exactly 50% of the statewide vote. In other words, this uniform swing subtracts 1.2% from the Republican vote share in every district, both in the Enacted Plan and in all simulated plans.

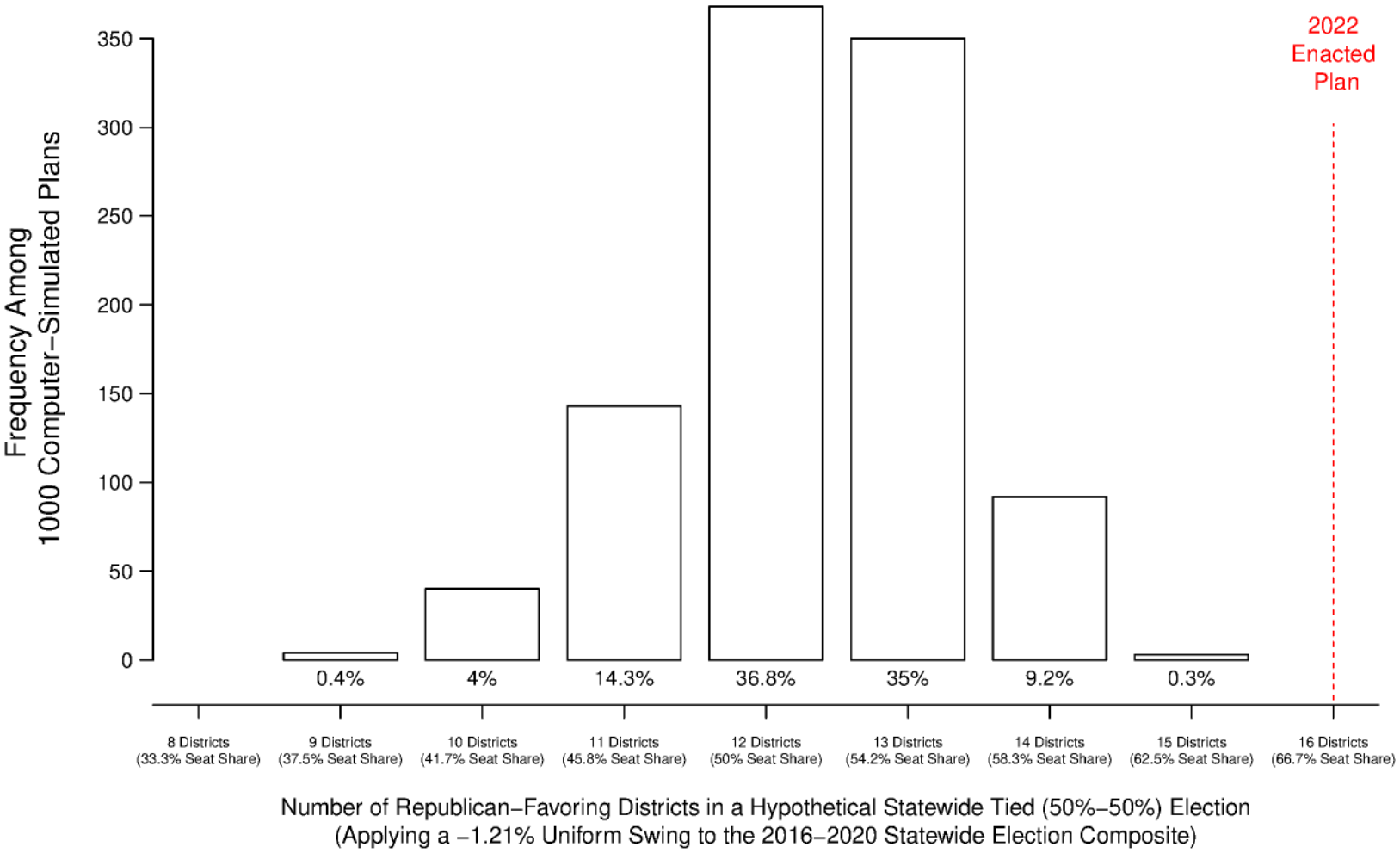
61. After applying this -1.2% uniform swing, I compare the number of Republican-favoring districts in the Enacted Plan and the simulated plans. In the Enacted Plan, 66.7% of the districts (16 out of 24) are Republican-favoring after applying the uniform swing. I then report the Republicans' seat share (66.7%) under this hypothetical tied election in Figure S-7 as the

"Partisan Symmetry Based on Uniform Swing" measure for the Enacted Plan. Figure S-7 also reports the calculations for all 1,000 simulated plans using this identical method.

62. Figure S-7 reveals 100% of the 1,000 simulated plans have a "Partisan Symmetry Based on Uniform Swing" measure that is closer to 50% than the Enacted Plan's measure. In fact, 36.8% of the simulated plans have a measure of exactly 50% (12 districts won by each party).

63. By contrast, the Enacted Plan's measure of 66.7% in Figure S-7 is a statistical outlier and is more favorable to Republicans than 100% of the simulated plans. Substantively, this 66.7% measure reflects the Enacted Plan's creation of a durable Republican majority for New Hampshire's Senate, such that even when Democrats win 50% of the statewide vote, Republicans will still be favored in 16 out of 24 (66.7%) of the Senate districts, and Democrats will only be favored in 8 out of the 24 (33.3%) districts.

Figure S7:
Comparison of 2022 Enacted Senate Plan to 1,000 Computer–Simulated Plans On Partisan Symmetry Based on Uniform Swing



V. Partisan Bias in the Enacted Plan's Population Deviations

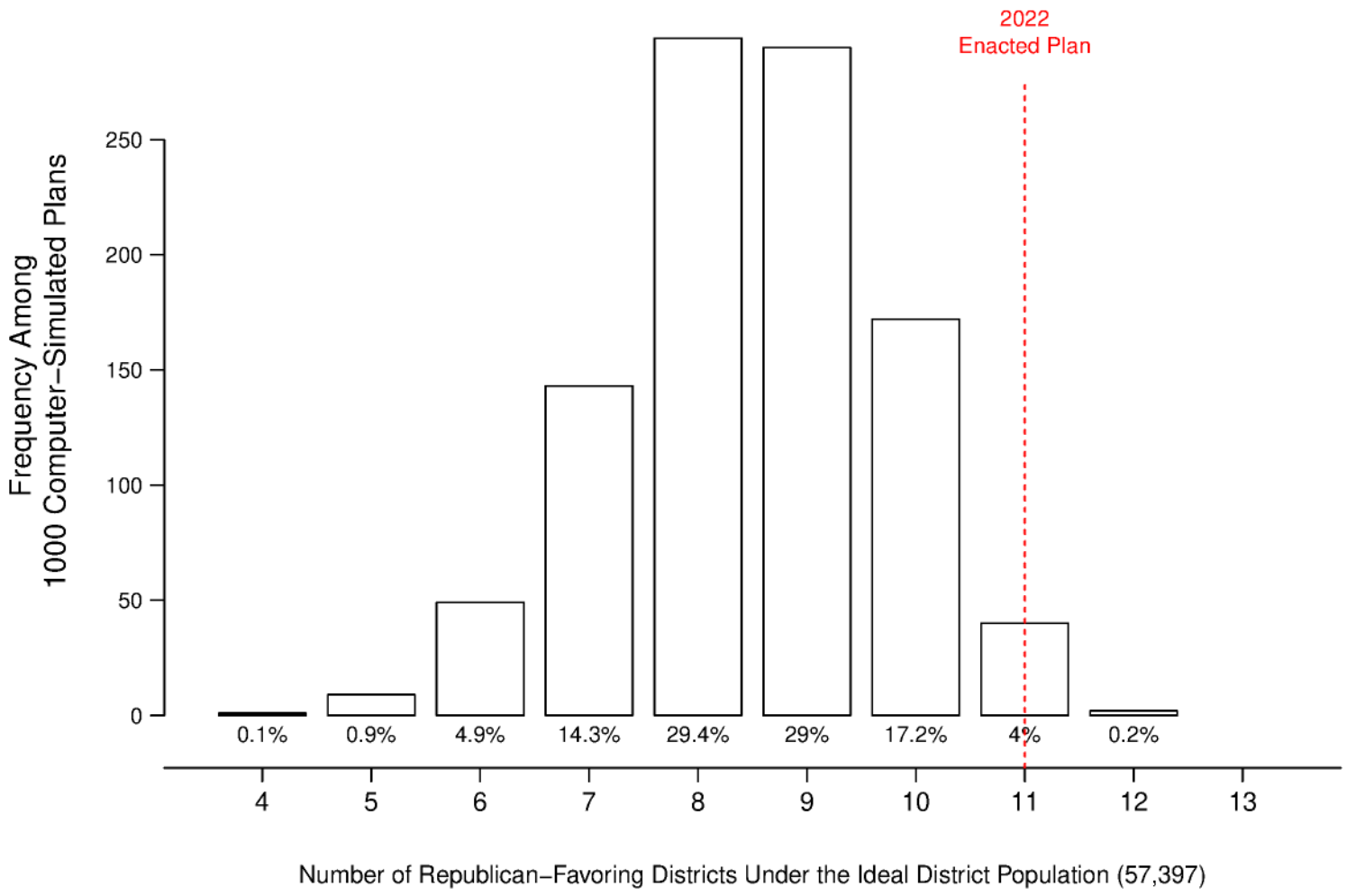
64. Although the 2022 Enacted Senate Plan's districts have population deviations under 5%, it is nevertheless still possible for such population deviations to exhibit a political bias. For example, suppose that a Senate plan is drawn such that the Republican-favoring districts are far more likely than the Democratic-favoring districts to be under-populated. Such a partisan pattern would have the overall effect of enhancing the voting strength of voters in the Republican districts while diluting the strength of voters in Democratic districts. I found that the 2022 Enacted Senate Plan exhibits precisely this pattern, and I found that the Enacted Plan's systematic under-population of Republican districts could not have plausibly emerged from a partisan-blind map-drawing process following traditional districting principles. I explain these findings in detail below.

65. To examine whether the population deviations in the 2022 Enacted Plan's districts exhibit a partisan pattern, I analyzed the population and the partisanship of every Senate district in the Enacted Plan and in each of the 1,000 computer-simulated plans. I categorized each district as under-populated if its population is less than the ideal district population of 57,397.04. I also categorized each district as Republican-favoring if it exhibits over a 50% Republican vote share, measured by the 2016-2020 Statewide Election Composite. Districts with under a 50% Republican vote share were categorized as Democratic-favoring. I then examined whether there was a partisan bias in the manner in which districts in the Enacted Plan were under-populated.

66. Figure S-8 reports the number of Republican-favoring districts that are under-populated, both in the Enacted Plan and in the 1,000 simulated plans. The computer simulation algorithm populated Senate districts in a partisan-blind manner, making no deliberate effort to either under-populate or over-populate Republican-favoring districts. The majority of the 1,000 simulated plans contain seven to ten under-populated Republican-favoring districts. The most

common outcome among the simulations was eight under-populated Republican-favoring districts. By contrast, the 2022 Enacted Senate Plan contains 11 under-populated Republican districts. This outcome is an extreme partisan outlier, exceeding the number of under-populated Republican districts in 95.8% of the 1,000 computer-simulated plans. It is thus clear that the Enacted Plan contains significantly more under-populated Republican districts than could be expected from a partisan-blind mapdrawing process that does not systematically favor one party over the other in the under-populating of districts.

Figure S8:
Comparison of 2022 Enacted Senate Plan to 1,000 Computer−Simulated Plans On Number of Republican−Favoring Districts that are Under−Populated



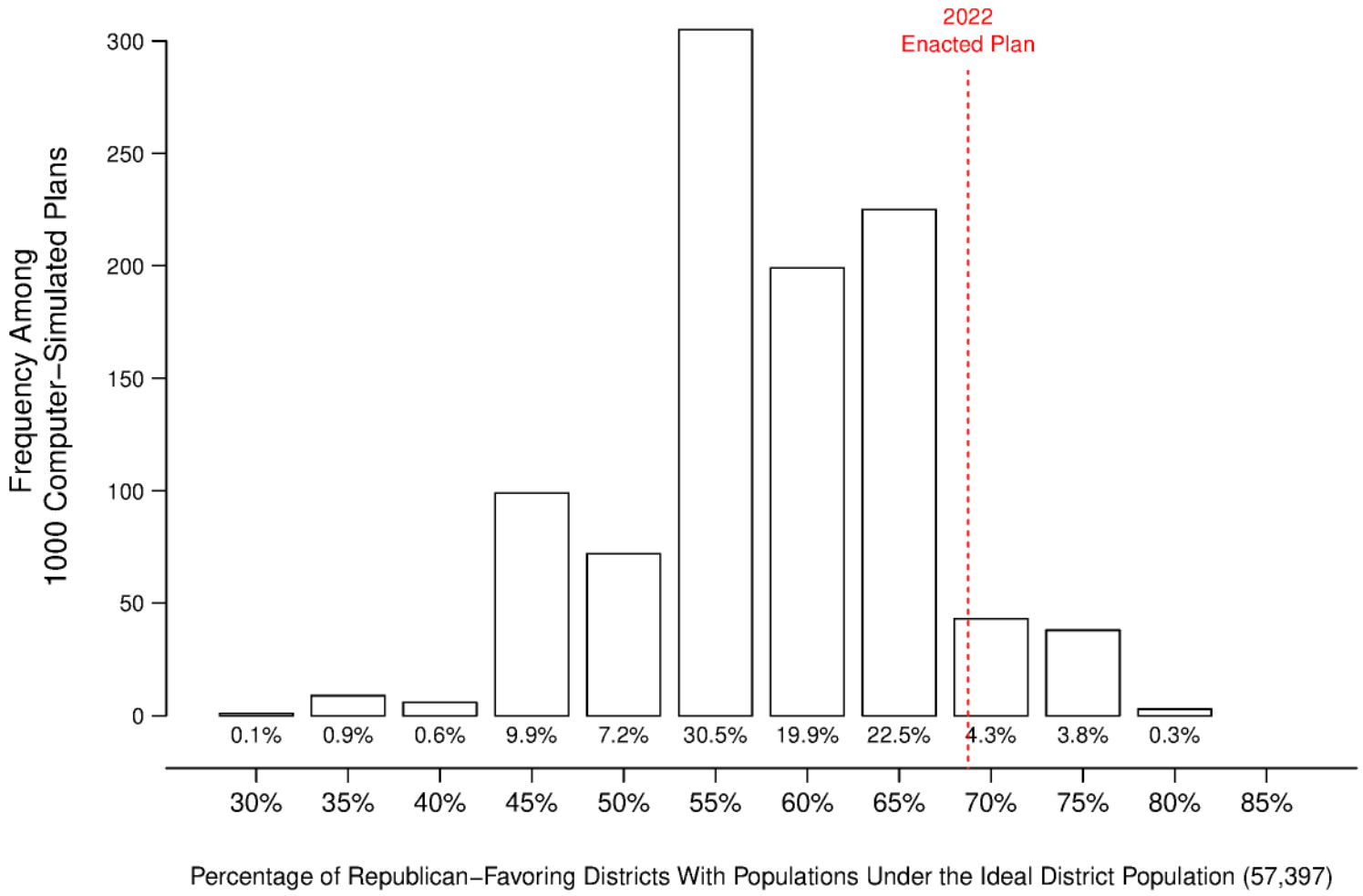
67. Figure S-9 demonstrates that the 2022 Enacted Senate Plan's extreme number of under-populated Republican districts is not merely a result of the Enacted Plan creating an unnaturally large number of Republican districts. The Enacted Plan contains a total of 16 Republican-favoring Senate districts, and 11 of these 16 districts (68.75%) are under-populated. Thus, only 5 of the 16 Republican-favoring districts (31.25%) are over-populated. Figure S-9 compares this outcome to the percentage of Republican-favoring districts that are under-populated within each of the 1,000 computer-simulated plans.

68. Figure S-9 illustrates that among the 1,000 computer-simulated plans, Republican districts are neither systematically under-populated nor over-populated. The majority of the simulations result in 35%-65% of the Republican-favoring districts being under-populated. The distribution of the 1,000 simulations illustrated in Figure S-9 suggests a logical outcome: When Senate plans are drawn using a partisan-blind computer algorithm that does not intentionally manipulate the populations of districts based on their partisanship, then approximately one-half of the Republican-favoring districts will be under-populated, and approximately one-half will be over-populated.

69. By contrast, the Enacted Plan's under-population of 68.75% (11 out of 16) of its Republican-favoring districts is more extreme than the vast majority of the simulations in Figure S-9. The Enacted Plan's under-population of 68.75% of its Republican districts is higher than in 91.6% of the computer-simulated plans. Hence, the degree to which the Enacted Plan under-populated its Republican districts is an outcome that rarely occurs under a mapdrawing process in which the relative populations of Republican and Democratic districts is not manipulated in a systematically partisan-biased manner.

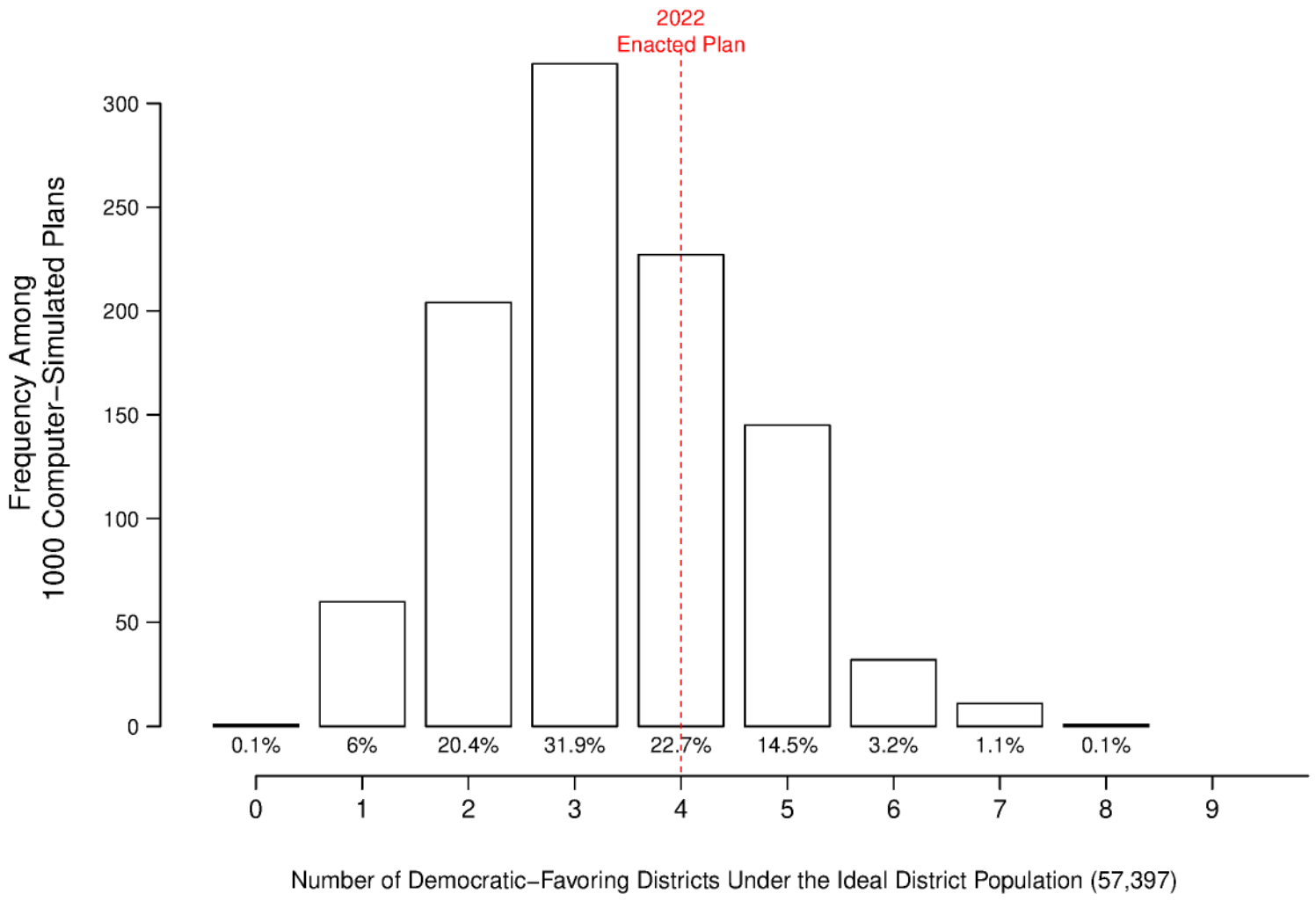
70. The 2022 Enacted Senate Plan's widespread under-populating of 68.75% of the Republican-favoring Senate districts has the effect of elevating the voting strength of Republican voters in these districts. Voters in under-populated Republican districts enjoy a relatively higher ratio of Senators-to-population, thus heightening their ability to influence the partisan composition of the New Hampshire's Senate.

Figure S9:
Comparison of 2022 Enacted Senate Plan to 1,000 Computer−Simulated Plans On Percentage of Republican−Favoring Districts that are Under−Populated



71. By contrast, voters in Democratic-favoring districts in the Enacted Plan do not enjoy this same elevated level of voting strength through the under-population of Senate districts. Figure S-10 illustrates that the Enacted Plan's pattern of under-populating districts did not extend to the Democratic-favoring Senate districts in the Plan. The Enacted Plan contains eight Democratic-favoring districts, among which four are under-populated and four are over-populated. Thus, unlike the Republican districts in the Enacted Plan, the Democratic-favoring districts were not systematically under-populated. This outcome of four under-populated Democratic-favoring districts is in line with the typical number of under-populated Democratic-favoring districts observed in the 1,000 computer-simulated plans, as illustrated in Figure S-10.

Figure S10:
Comparison of 2022 Enacted Senate Plan to 1,000 Computer−Simulated Plans
On Number of Democratic−Favoring Districts that are Under−Populated



72. In summary, the Enacted Plan systematically under-populates Republican Senate districts, but not Democratic Senate districts. The creation of 11 under-populated Republican Senate districts (68.75%) in the Enacted Plan is an extreme statistical outlier, higher than in 95.8% of the 1,000 computer-simulated plans. Overall, these population deviations elevate the voting strength of residents in the 11 out of 16 Republican districts that are under-populated. Meanwhile, the Democratic-favoring districts in the enacted Plan were not systematically under-populated in a similar manner.

VI. Conclusions Regarding Partisanship and Traditional Districting Criteria

73. The analyses described thus far in this report lead me to two main findings. First, the 2022 Enacted Plan failed to adhere to traditional districting principles, including geographic compactness and avoiding excessive municipality splits. The Enacted Plan is significantly less geographically compact than is reasonably possible under a districting process following traditional districting criteria, and the Enacted Plan also splits Manchester into more districts than is necessary

74. Second, I found that the 2022 Enacted Plan is an extreme partisan outlier when compared to computer-simulated plans produced by a process following traditional districting criteria. The Enacted Plan contains individual districts that are partisan outliers when compared to the simulated plans' individual districts, and, at a statewide level, the Enacted Plan creates a level of pro-Republican bias more extreme than 100% of the computer-simulated plans. The Enacted Plan created this extreme level of pro-Republican bias in part by systematically under-populating its Republican-favoring districts.

75. Based on these two main findings, I conclude that partisanship predominated in the drawing of the 2022 Enacted Plan and subordinated the traditional districting principles of geographic compactness and avoiding excessive municipality splits. Because the Enacted Plan fails to follow traditional districting principles and simultaneously creates an extreme level of partisan bias, I therefore conclude that the partisan bias of the Enacted Plan did not naturally arise by chance from a districting process adhering to traditional districting principles. Instead, I conclude that partisan goals predominated in the drawing of the Enacted Plan. By subordinating traditional districting principles, the New Hampshire General Court's Enacted Plan was able to achieve an extreme partisan outcome that would not have normally occurred under a partisan-neutral districting process following traditional districting principles.

VII. New Hampshire's Political Geography Did Not Cause the Enacted Plan's Extreme Partisan Bias

76. How does New Hampshire's political geography affect the partisan characteristics of the 2022 Enacted Plan? Democratic voters tend to be geographically concentrated in cities such as Manchester, Nashua, and Concord. As I have explained in my prior academic research,[12] these large urban clusters of Democratic voters, combined with the traditional districting principle of drawing geographically compact districts, can sometimes result in urban districts that "naturally" pack together Democratic voters, thus boosting the Republican vote share of other surrounding suburban and rural districts.

77. More importantly, my prior academic research explained how I can estimate the precise level of electoral bias in districting caused by a state's unique political geography: I programmed a computer algorithm that draws districting plans using New Hampshire's unique political geography, including the state's census population data and political subdivision boundaries. In this report, I have also programmed the algorithm to follow traditional districting criteria. I then analyzed the partisan characteristics of the simulated districting plans using New Hampshire's precinct-level voting data from past elections. Hence, the entire premise of conducting districting simulations is to fully account for New Hampshire's unique political geography and its political subdivision boundaries and to analyze how the state's political geography affects electoral bias in Senate districting.

78. This districting simulation analysis allowed me to identify the degree to which the electoral bias in New Hampshire's 2022 Enacted Senate Plan is caused by New Hampshire's

[12] Jowei Chen and Jonathan Rodden, 2013. "Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures" Quarterly Journal of Political Science, 8(3): 239-269; Jowei Chen and David Cottrell, 2016. "Evaluating Partisan Gains from Congressional Gerrymandering: Using Computer Simulations to Estimate the Effect of Gerrymandering in the U.S. House." Electoral Studies, Vol. 44, No. 4: 329-430.

political geography and how much is caused by the map-drawer's intentional efforts to favor one political party over the other. New Hampshire's natural political geography, combined with the application of traditional districting principles, almost never resulted in a simulated Senate plan containing 15 relatively safe Republican-favoring districts with over a 52.5% Republican vote share.

79. The 2022 Enacted Plan's creation of 15 relatively safe Republican-favoring districts clearly goes beyond any "natural" level of electoral bias caused by New Hampshire's political geography or the political composition of the state's voters. The Enacted Plan is a statistical outlier in terms of its partisan characteristics when compared to the 1,000 computer-simulated plans. The Enacted Plan creates more safely Republican-favoring districts with more than 52.5% Republican vote share than 100% of the simulated plans. This extreme, additional level of partisan bias in the 2022 Enacted Plan can be directly attributed to the map-drawer's clear efforts to favor the Republican Party. This additional level of partisan bias was not caused by New Hampshire's political geography.

PART III: ANALYSIS OF THE 2022 EXECUTIVE COUNCIL PLAN

I. Redistricting Criteria

80. I programmed the computer algorithm to create 1,000 independent simulated plans adhering to the following five traditional districting criteria:

a. *Population Equality*: Because New Hampshire's 2020 Census population was 1,377,529, districts in every five-member Executive Council plan have an ideal population of 275,505.8. In the 2022 Enacted Executive Council Plan, the district with the largest population deviation is District 3, which deviates from the ideal population by +2,382.2, or 0.86%. Accordingly, the computer simulation algorithm populated each Executive Council districting plan such that all five districts have a population deviation of no larger than 0.86%. Additionally, the Enacted Plan's "maximum population deviation,"[13] as measured by the sum of the population deviations of the most-populated district (District 3) and the least-populated district (District 2), is 1.26%. Therefore, the computer algorithm similarly requires that every simulated Executive Council districting plan has a maximum population deviation of no greater than 1.26%.

b. *Contiguity*: The simulation algorithm required all Executive Council districts to be geographically contiguous, as required by Articles 11 and 26 of the New Hampshire State Constitution.

c. *Avoiding Ward Splits*: Article 26 of the New Hampshire State Constitution prohibits the splitting of wards in the drawing of legislative district boundaries. Furthermore,

[13] "Maximum population deviation is the sum of the percentage deviations from perfect population equality of the most- and least-populated districts. See *Chapman v. Meier*, 420 U. S. 1, 22 (1975). For example, if the largest district is 4.5% overpopulated, and the smallest district is 2.3% underpopulated, the map's maximum population deviation is 6.8%." *Evenwel v. Abbott* 136 S. Ct. 1120 (2016).

both the 2022 Enacted Executive Council Plan and the 2012 Enacted Executive Council Plan avoid splitting wards. Therefore, the simulation algorithm also avoided splitting any wards.

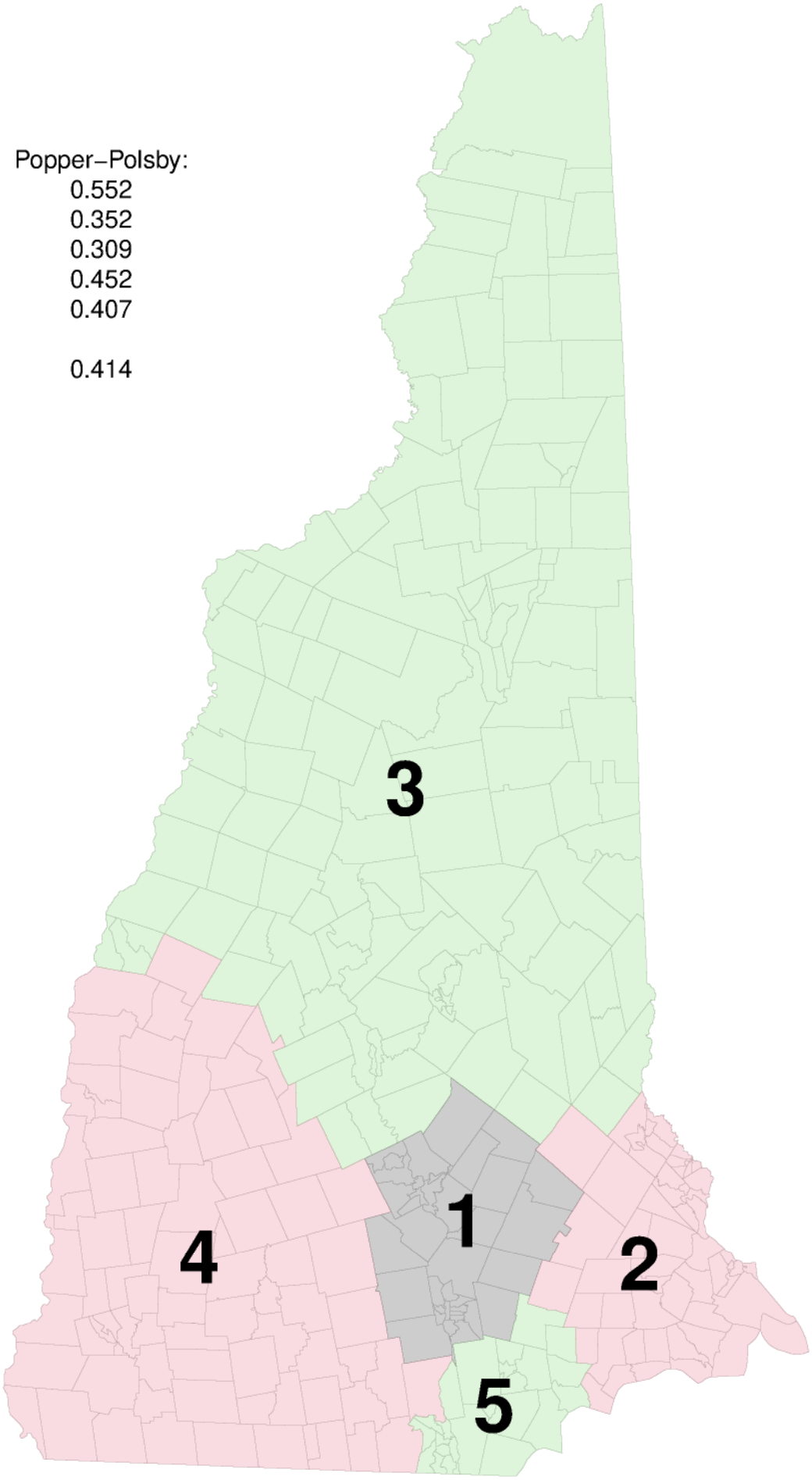
d. *Avoiding Municipality Splits*: Article 26 of the New Hampshire State Constitution prohibits the splitting of towns in the drawing of legislative district boundaries. Furthermore, both the 2022 Enacted Executive Council Plan and the 2012 Enacted Executive Council Plan avoid splitting municipalities. Therefore, the simulation algorithm avoided splitting any of New Hampshire's cities, towns, townships, gores, and grants. The population of every municipality and unincorporated place in New Hampshire is under 275,505.8, so prohibiting municipal splits does not conflict with the population equality requirement.

e. *Geographic Compactness*: The simulation algorithm prioritized the drawing of geographically compact districts whenever doing so did not violate any of the aforementioned criteria.

81. On the following page of this report, Map E-1 displays an example of one of the computer-simulated plans produced by the computer algorithm. The left portion of this Map also reports the population of each district and the compactness scores for each district.

Map E1: Example of a Computer−Simulated Senate Plan

District:	Population:	Reock:	Popper−Polsby:
1	276,143	0.639	0.552
2	275,976	0.442	0.352
3	275,461	0.426	0.309
4	276,619	0.567	0.452
5	273,330	0.48	0.407
Plan Average:	275,505.8	0.511	0.414

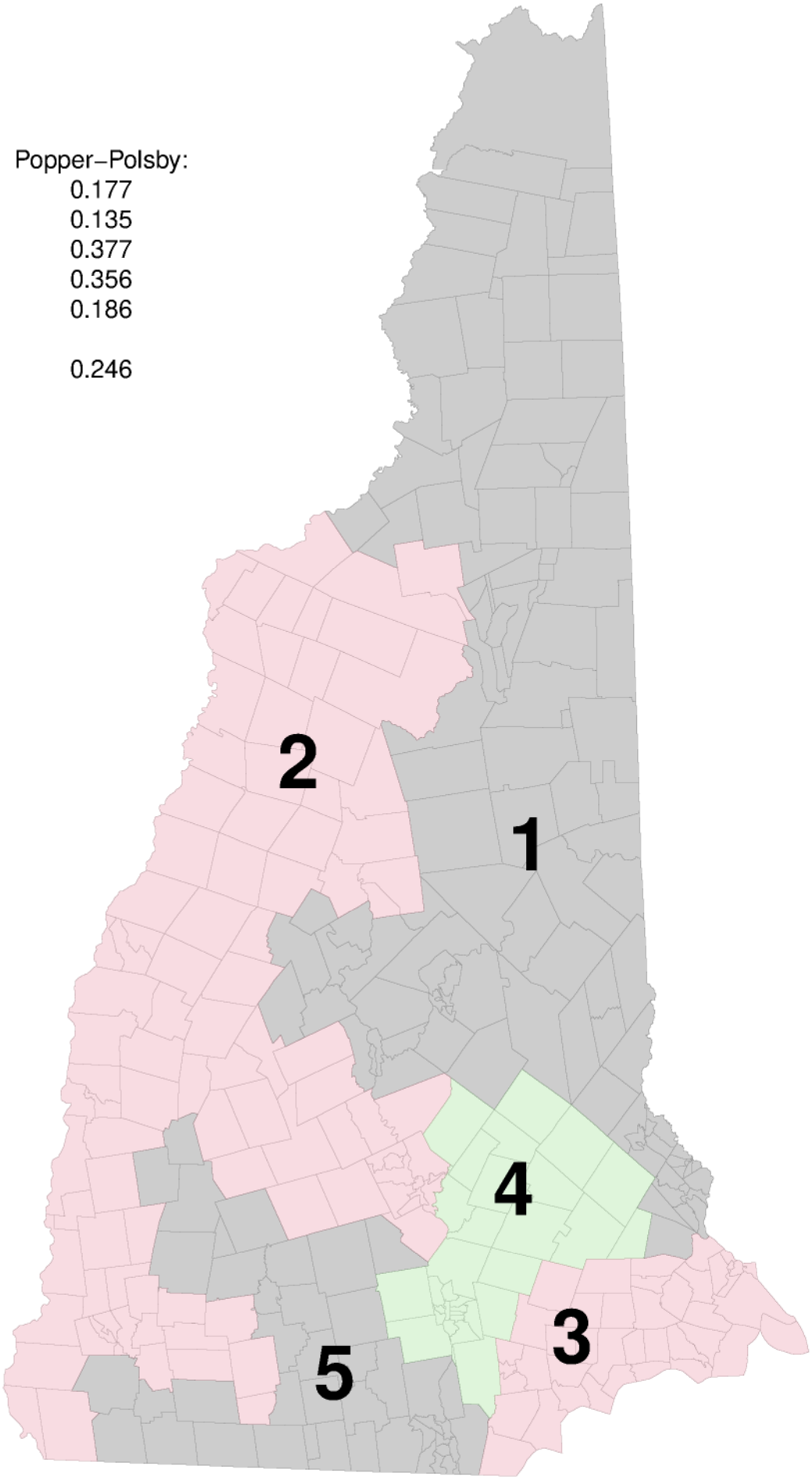


II. The Enacted Plan's Compliance with Traditional Districting Criteria

82. I assessed whether the 2022 Enacted Executive Council Plan complies with the five traditional districting criteria described above, and I describe my findings in this section. On the following page of this report, Map E-2 displays the boundaries of the 2022 Enacted Plan. The left portion of this Map also reports the population of each district and the compactness scores for each of the Enacted Plan's districts. Overall, I found that the Enacted Plan's districts do not deviate from the ideal district population by over 5%, nor do they violate contiguity or split any wards or municipalities.

Map E2: 2022 SB 241 Enacted Executive Council Plan

District:	Population:	Reock:	Popper−Polsby:
1	275,360	0.278	0.177
2	274,409	0.315	0.135
3	277,888	0.304	0.377
4	274,979	0.502	0.356
5	274,893	0.359	0.186
Plan Average:	275,505.8	0.351	0.246



83. However, by comparing the 2022 Enacted Plan to the 1,000 computer-simulated plans, I found that the Enacted Plan is significantly less geographically compact than is reasonably possible. I describe this finding below in detail.

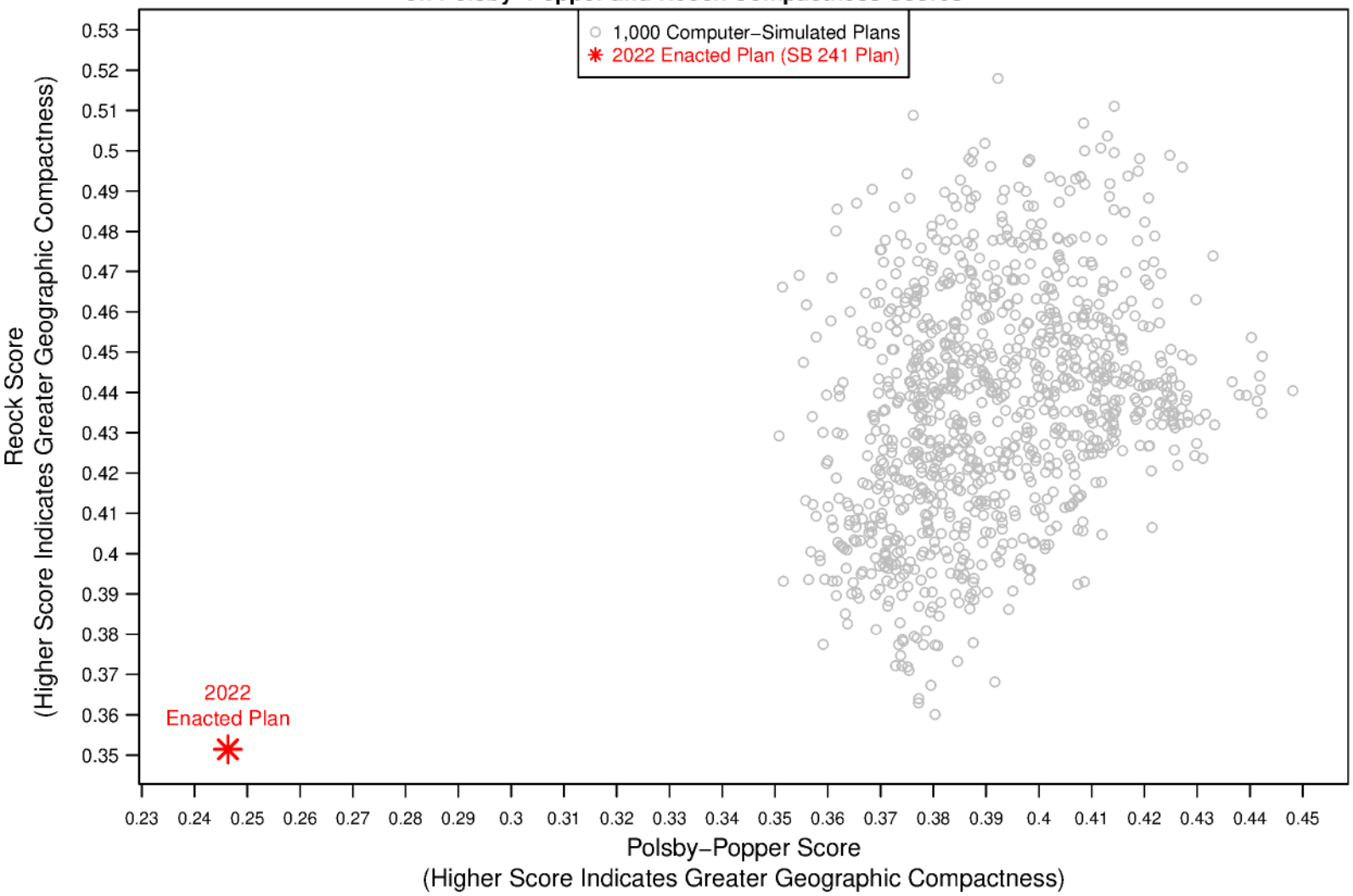
84. Measuring Geographic Compactness: In evaluating whether the 2022 Enacted Plan was drawn in a manner that favors geographic compactness, it is useful to compare the compactness of the Enacted Plan and the 1,000 computer-simulated plans. The computer-simulated plans were produced by a computer algorithm adhering strictly to traditional districting criteria and ignoring any partisan considerations. Thus, the compactness scores of these computer-simulated plans illustrate the statistical range of compactness scores that could be reasonably expected to emerge from a districting process that solely seeks to follow traditional districting criteria while ignoring partisan considerations. I compare the compactness of the simulated plans and the Enacted Plan using two commonly used measures of compactness in redistricting.

85. First, I calculate the average Polsby-Popper score of each plan's districts. As described in paragraph 14, Polsby-Popper scores range from 0 to 1, and higher Polsby-Popper scores indicate greater district compactness. The 2022 Enacted Plan has an average Polsby-Popper score of 0.246 across its five districts. As illustrated in Figure E-1, every single one of the 1,000 computer-simulated Executive Council plans in this report exhibits a significantly higher Polsby-Popper score than the Enacted Plan. In fact, the middle 50% of these 1,000 computer-simulated plans have an average Polsby-Popper score ranging from 0.377 to 0.405, and the most compact computer-simulated plan has a Polsby-Popper score of 0.448. Hence, it is clear that the Enacted Plan is significantly less compact, as measured by its Polsby-Popper score, than what

could reasonably have been expected from a districting process adhering to the traditional districting principle of geographic compactness.

86. Second, I calculate the average Reock score of the districts within each plan. As described in paragraph 14, Reock scores range from 0 to 1, and higher Reock scores indicate more geographically compact districts. The 2022 Enacted Plan has an average Reock score of 0.351 across its five Executive Council districts. As illustrated in Figure E-1, every single one of the 1,000 computer-simulated Executive Council plans exhibits a significantly higher Reock score than the Enacted Plan. In fact, the middle 50% of these 1,000 computer-simulated plans have an average Reock score ranging from 0.417 to 0.456, and the most compact computer-simulated plan has an Reock score of 0.440. Hence, it is clear that the 2022 Enacted Plan is significantly less compact, as measured by its Reock score, than what could reasonably have been expected from a districting process adhering to the traditional districting principle of geographic compactness.

Figure E1: Comparison of 2022 Enacted Executive Council Plan to 1,000 Computer−Simulated Plans on Polsby−Popper and Reock Compactness Scores



III. Measuring the Partisanship of Districting Plans

87. I use actual election results from recent, statewide election races in New Hampshire to assess the partisan performance of the 2022 Enacted Plan and the computer-simulated plans analyzed in this report. Overlaying these past election results onto a districting plan enables me to calculate the Republican or Democratic share of the votes cast from within each district in the Enacted Plan and in each simulated plan. I am also able to count the total number of Republican and Democratic-leaning districts within each simulated plan and within the Enacted Plan. All of these calculations thus allow me to directly compare the partisanship of the Enacted Plan and the simulated plans. These partisan comparisons allow me to determine whether the partisanship of individual districts and the partisan distribution of seats in the Enacted Plan could reasonably have arisen from a non-partisan districting process adhering to traditional districting criteria. Past voting history in federal and statewide elections is a strong predictor of future voting history. Mapmakers thus can and do use past voting history to identify the class of voters, at a precinct-by-precinct level, who are likely to vote for Republican or Democratic Executive Council candidates.

88. In general, the most reliable method of comparing the partisanship of different Executive Council districts within a state is to calculate the percentage of votes from these districts favoring Republican or Democratic candidates in recent, competitive statewide elections, such as the Presidential, Gubernatorial, Attorney General, and US Senate elections. Recent statewide elections provide the most reliable basis for comparisons of different precincts' partisan tendencies because in any statewide election, the anomalous candidate-specific effects that shape the election outcome are equally present in all precincts across the state. Statewide elections are thus a better basis for comparison than the results of Executive Council elections because the particular outcome of an Executive Council election may deviate from the long-term

partisan voting trends of that district, due to factors idiosyncratic to the district as currently constructed. Such factors can include the presence or absence of a quality challenger, anomalous differences between the candidates in campaign efforts or campaign finances, incumbency advantage, candidate scandals, and coattail effects.[14] Because these idiosyncratic factors would change if the district were drawn differently, it is particularly unsuitable to use election results from an existing district when comparing the partisanship of districts in a newly-enacted plan or a computer-simulated plan that would have different boundaries than those used in past council elections.

89. Moreover, statewide elections are also a more reliable indicator of a district's partisanship than partisan voter registration counts. Voter registration by party is a particularly unreliable method of comparing districts' partisan tendencies because many voters who consistently support candidates from one party nevertheless do not officially register with either major party, while others vote for candidates of one party while registering with a different party. As a result, based on my expertise and my experience studying redistricting practices across many states, I have observed that legislative map-drawers generally do not rely heavily on voter registration data in assessing the partisan performance of districts. I therefore use results from recent statewide elections in order to measure the partisanship of districts in the 2022 Enacted Plan and in the computer-simulated plans, as described below.

90. The 2016-2020 Statewide Election Composite: To measure the partisanship of all districts in the computer-simulated plans and the 2022 Enacted Plan, I used the results from every statewide general election contest for a political (non-judicial) office held in New

[14] E.g., Alan Abramowitz, Brad Alexander, and Matthew Gunning. "Incumbency, Redistricting, and the Decline of Competition in U.S. House Elections." *The Journal of Politics.* Vol. 68, No. 1 (February 2006): 75-88. Kenneth J. Meier, "Party Identification and Vote Choice: The Causal Relationship" Vol. 28, No. 3 (Sep., 1975):496-505.

Hampshire during 2016 to 2020. In other words, I used the results of the following seven elections: 2016 Governor, 2016 US President, 2016 US Senator, 2018 Governor, 2020 Governor, 2020 US President, and 2020 US Senator.

91. I obtained precinct-level results for these seven elections from the Redistricting Data Hub,[15] and I disaggregated these election results down to the census block level. I then aggregated these block-level election results to the district level within each computer-simulated plan and the Enacted Plan, and I calculated the number of districts within each plan that cast more votes for Republican than Democratic candidates. I used these calculations to measure the partisan performance of each simulated plan analyzed in this report and of the Enacted Plan. In other words, I looked at the census blocks that would comprise a particular district in a given simulation and, using the actual election results from those census blocks, I calculated whether voters in that simulated district collectively cast more votes for Republican or Democratic candidates in the 2016-2020 statewide election contests. I performed such calculations for each district under each simulated plan to measure the number of districts Democrats or Republicans would have won under that particular simulated districting map.

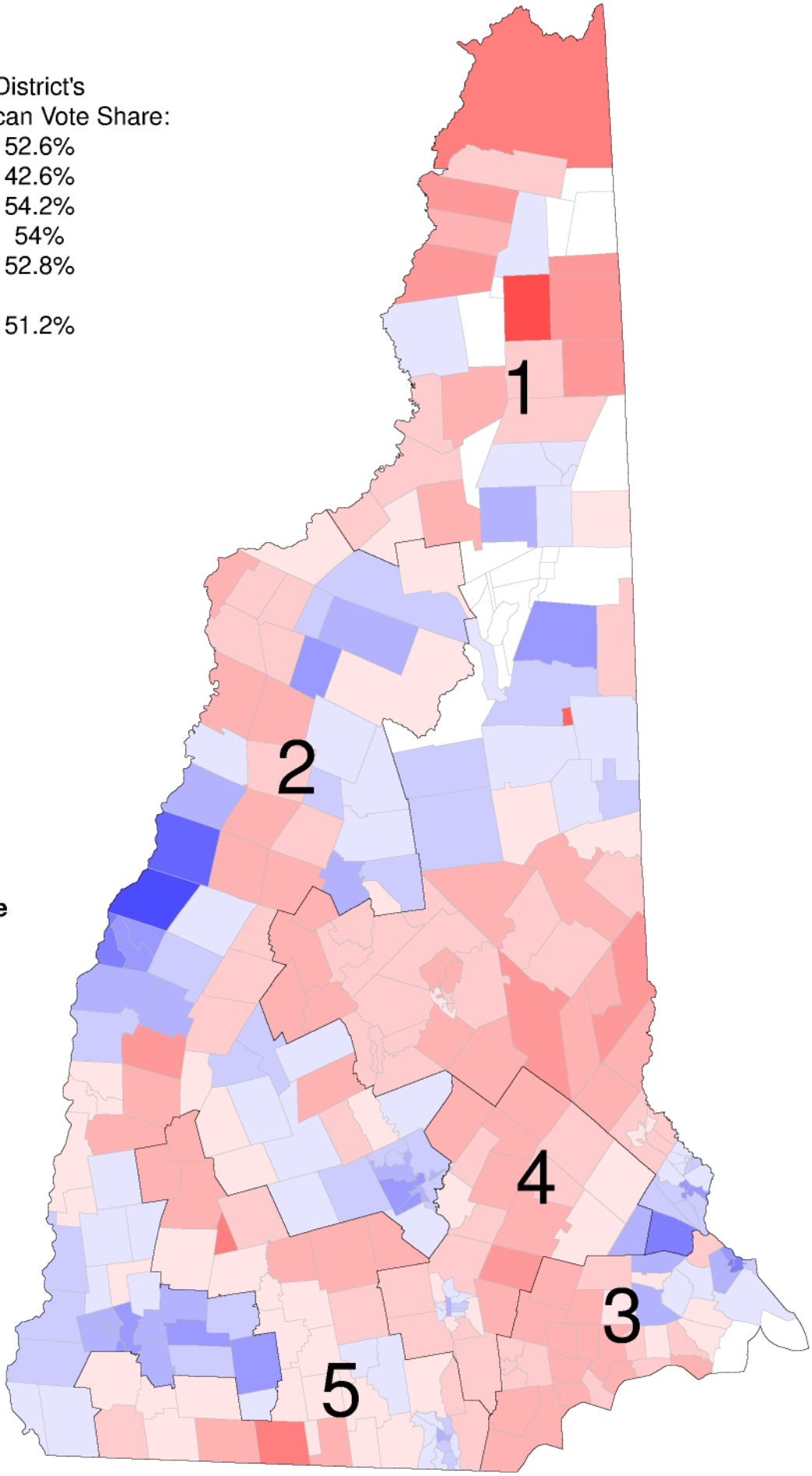
92. I refer to the aggregated election results from these seven statewide elections as the "2016-2020 Statewide Election Composite." For the 2022 Enacted Plan districts and for all districts in each of the 1,000 computer-simulated plans, I calculated the percentage of total two-party votes across these seven elections that were cast in favor of Republican candidates in order to measure the average Republican vote share of the district. This Republican vote share, as measured using the 2016-2020 Statewide Election Composite, simply reports the overall share of two-party votes cast in favor of Republican candidates in these seven recent statewide elections.

[15] https://redistrictingdatahub.org/state/new-hampshire/

93. Map E-3 displays the Republican vote share, as measured using the Statewide Election Composite, of each ward, town, township, and unincorporated place in New Hampshire. In this map, Republican-favoring areas are shaded from dark red (most heavily Republican) to light red (least Republican), and Democratic-leaning areas are shaded from dark blue (most heavily Democratic) to light blue (least Democratic). Additionally, the district boundaries of the 2022 Enacted Executive Council Plan appear in black on this Map, and the table on the left side of this Map report the Republican vote share, measured using the 2016-2020 Statewide Election Composite, of each Executive Council district in the Enacted Plan. At the end of this report, Appendix D contains a series of five maps, each of which zooms in on one of the individual districts in the 2022 Executive Council Plan.

Map E3: 2022 SB 241 Enacted Executive Council Plan

District Number:	District Population:	District's Republican Vote Share:
1	275,360	52.6%
2	274,409	42.6%
3	277,888	54.2%
4	274,979	54%
5	274,893	52.8%
Plan Average:	275,505.8	51.2%



VTD–Level Republican Vote Share (Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%

94. In the Appendix at the end of this report, Map E-4 uses a similar layout to display the boundaries of the 2012 Enacted Executive Council Plan. Map E-4 also reports the 2020 Census populations and the Republican vote share, measured using the 2016-2020 Statewide Election Composite, of each Executive Council district in the 2012 Plan.

95. In the following section, I present district-level comparisons of the Enacted Plan and simulated plan districts in order to identify whether any individual districts in the Enacted Plan are partisan outliers. I also present plan-wide comparisons of the Enacted Plan and the simulated plans in order to identify the extent to which the Enacted Plan is a statistical outlier in terms of common measures of districting plan partisanship.

IV. District-Level and Plan-Wide Partisan Comparisons Of the Enacted Plan and Simulated Plans

96. In this section, I present partisan comparisons of the 2022 Enacted Plan to the computer-simulated plans at both a district-by-district level as well as a plan-wide level using several common measures of districting plan partisanship. First, I compare the district-level Republican vote share of the Enacted Plan's districts and the districts in the computer-simulated plans. Next, I compare the number of Republican-favoring districts in the Enacted Plan and in the computer-simulated plans. Finally, I use some common measures of partisan bias to compare the Enacted Plan to the computer-simulated plans. Overall, I find that two of the five individual districts in the 2022 Enacted Plan are statistical outliers, exhibiting extreme partisan characteristics that are rarely or never observed in the computer-simulated plan districts drawn with strict adherence to non-partisan, traditional districting criteria. Moreover, I find that at the plan-wide level, the Enacted Plan creates a degree of partisan bias favoring Republicans that is more extreme than the vast majority of the computer-simulated plans. I describe these findings in detail below:

97. ***Partisan Outlier Districts in the Enacted Plan:*** In Figure E-2, I directly compare the partisan distribution of districts in the Enacted Plan to the partisan distribution of districts in the 1,000 computer-simulated plans. I first order the Enacted Plan's districts from the most to the least-Republican district, as measured by Republican vote share using the 2016-2020 Statewide Election Composite. The most-Republican district appears on the top row, and the least-Republican district appears on the bottom row. Next, I analyze each of the 1,000 computer-simulated plans and similarly order each simulated plan's districts from the most- to the least-Republican district. I then directly compare the most-Republican Enacted Plan district (District 3) to the most-Republican simulated district from each of the 1,000 computer-simulated plans. I

conduct the same comparison for each of the five districts in the Enacted Plan, comparing the Enacted Plan district to its computer-simulated counterparts from each of the 1,000 simulated plans.

98. Thus, the top row of Figure E-2 directly compares the partisanship of the most-Republican Enacted Plan district (District 3) to the partisanship of the most-Republican district from each of the 1,000 simulated plans. The two percentages in parentheses in the right margin of this Figure report the percentage of these 1,000 simulated districts that are less Republican than, and more Republican than, the Enacted Plan district. Similarly, the second row of this Figure compares the second-most-Republican district from each plan, the third row compares the third-most-Republican district from each plan, and so on. The fifth row compares the least-Republican district from each plan. In each row of this Figure, the Enacted Plan's district is depicted with a red star and labeled in red with its district number; meanwhile, the 1,000 computer-simulated districts are depicted with 1,000 gray circles on each row.

99. As the next-to-bottom row of Figure E-2 illustrates, the fourth-most-Republican district in the Enacted Plan (District 1) is more heavily Republican than 100% of the fourth-most -Republican districts in each of the 1,000 computer-simulated plans. This calculation is numerically reported in the right margin of the Figure. Every single one of the computer-simulated counterpart districts would have been less favorable to Republicans than District 1 in terms of partisanship: District 1 exhibits a Republican vote share of 52.6%, while all 1,000 of the most-Republican districts in the computer-simulated plans would have exhibited a lower Republican vote share and would therefore have been more favorable to Democrats.

100. It is thus clear that District 1 cracks Democratic voters by eliminating what would normally have been a more politically competitive or even Democratic-favoring district in all the

computer-simulated plans. The 52.6% Republican vote share of District 1 is higher than the fourth-most-Republican district in 100% of the computer-simulated plans. I therefore identify District 1 as an extreme partisan outlier when compared to its 1,000 computer-simulated counterparts, using a standard threshold test of 95% for statistical significance.

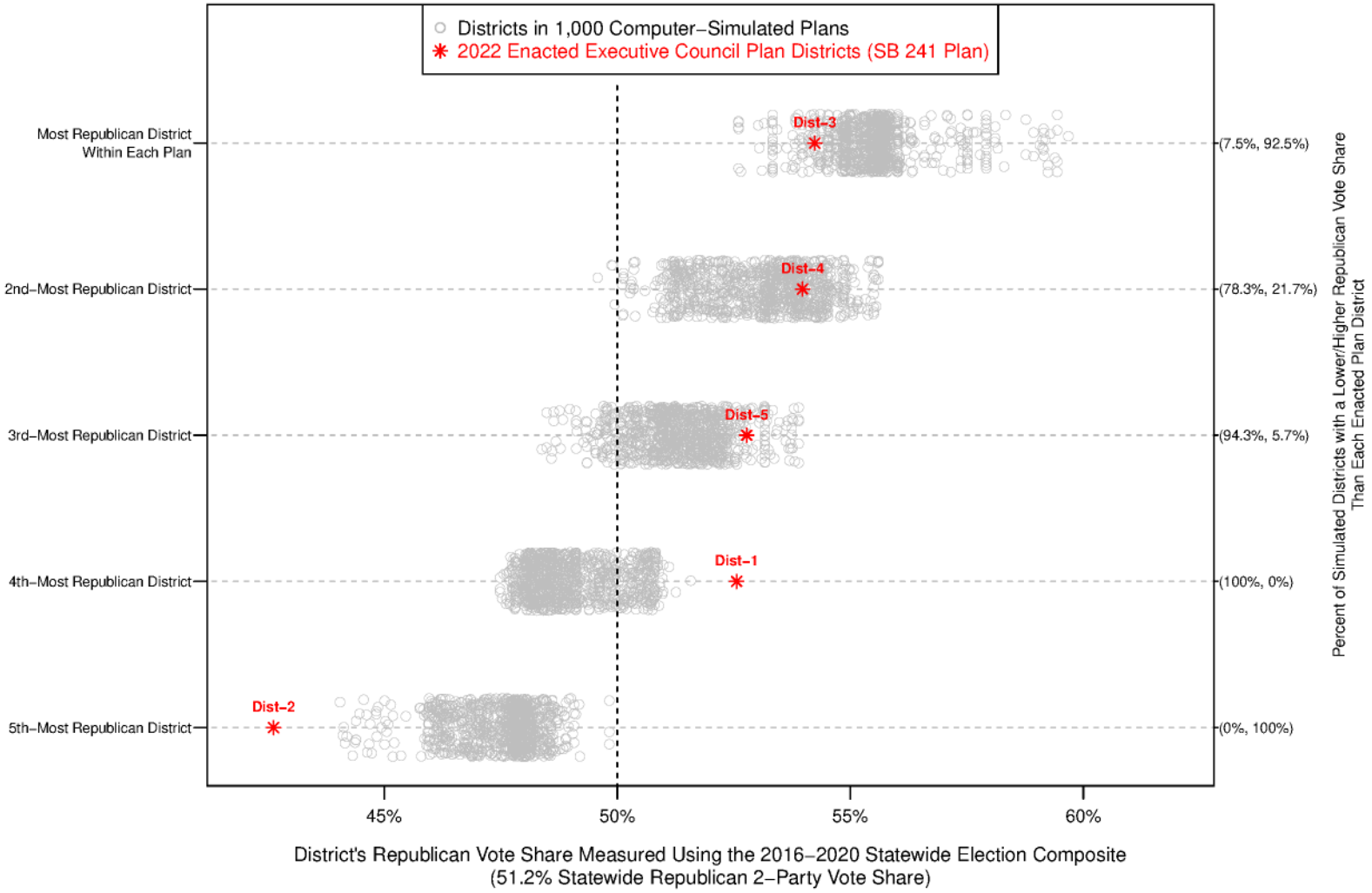
101. Similarly, the third row in Figure E-2 illustrates that the third-most-Republican district in the Enacted Plan (District 5) is more heavily Republican than 94.3% of the third-most-Republican districts in each of the 1,000 computer-simulated plans. Although this result falls just shy of the standard 95% threshold for statistical significance, it is nevertheless notable that 94.3% of the simulated plans' third-most-Republican district is more politically competitive than the Enacted Plan's District 5. The Enacted Plan's District 5 has a Republican vote share of 52.8% and is therefore more safely Republican than 94.3% of the simulated plan's third-most-Republican district. Under a partisan-blind mapdrawing process following traditional districting principle, this district would almost always have been more politically competitive or even slightly Democratic-leaning.

102. It is especially notable that these two aforementioned Enacted Plan districts – District 1 and District 5 – were drawn to include more Republican voters than almost all of their counterpart districts in the 1,000 computer-simulated plans in Figure E-2. These "extra" Republican voters in this district had to come from another district in the Enacted Plan.

103. Indeed, the bottom row in Figure E-2 confirms this precise effect. The bottom row of Figure E-2 compares the least-Republican district within the Enacted Plan and the 1,000 computer-simulated plans. Figure E-2 reveals that the least-Republican district in the Enacted Plan (District 2) is significantly less Republican than the least-Republican district in 100% of the computer-simulated plans. In most of the computer-simulated plans, this district has a

Republican vote share of 46% to 49%. But the Enacted Plan's District 2 has a Republican vote share of only 42.6%. This unnaturally low Republican vote share in District 2, already a safe Democratic district, allowed the Enacted Plan's District 1 to have a higher Republican vote share all of its computer-simulated counterpart districts, as illustrated in Figure E-2.

Figure E2: Comparison of 2022 Enacted Plan Districts to 1,000 Computer−Simulated Plans' Districts



104. I therefore identify two districts (District 1 and District 2) in the Enacted Plan as partisan statistical outliers, while a third district (District 5) is also nearly a statistical outlier. District 2 is significantly less Republican than 100% of the least-Republican districts in each of the 1,000 simulated plans, which allows District 1 to be more heavily Republican than all of its counterpart computer-simulated plan districts. Additionally, District 3 is significantly more Republican than 94.3% of the third-most-Republican districts in the 1,000 simulated plans. In other words, by packing Democratic voters into District 2, the Enacted Plan's mapdrawer was able to make both District 1 and District 5 more safely Republican than in nearly all of the computer-simulated plans drawn in a partisan-blind manner following traditional districting criteria.

105. Appendix C of this report contains seven additional figures (Figures C1 through C7) that each contain a similar analysis of the Enacted Plan districts and the computer- simulated plan districts. Each of these seven figures in the Appendix measures the partisanship of districts using one of the individual seven elections included in the 2016-2020 Statewide Election Composite. These seven figures generally demonstrate that the same extreme partisan outlier patterns observed in Figure E-2 are also present when district partisanship is measured using any one of the seven statewide elections held in New Hampshire during 2016-2020.

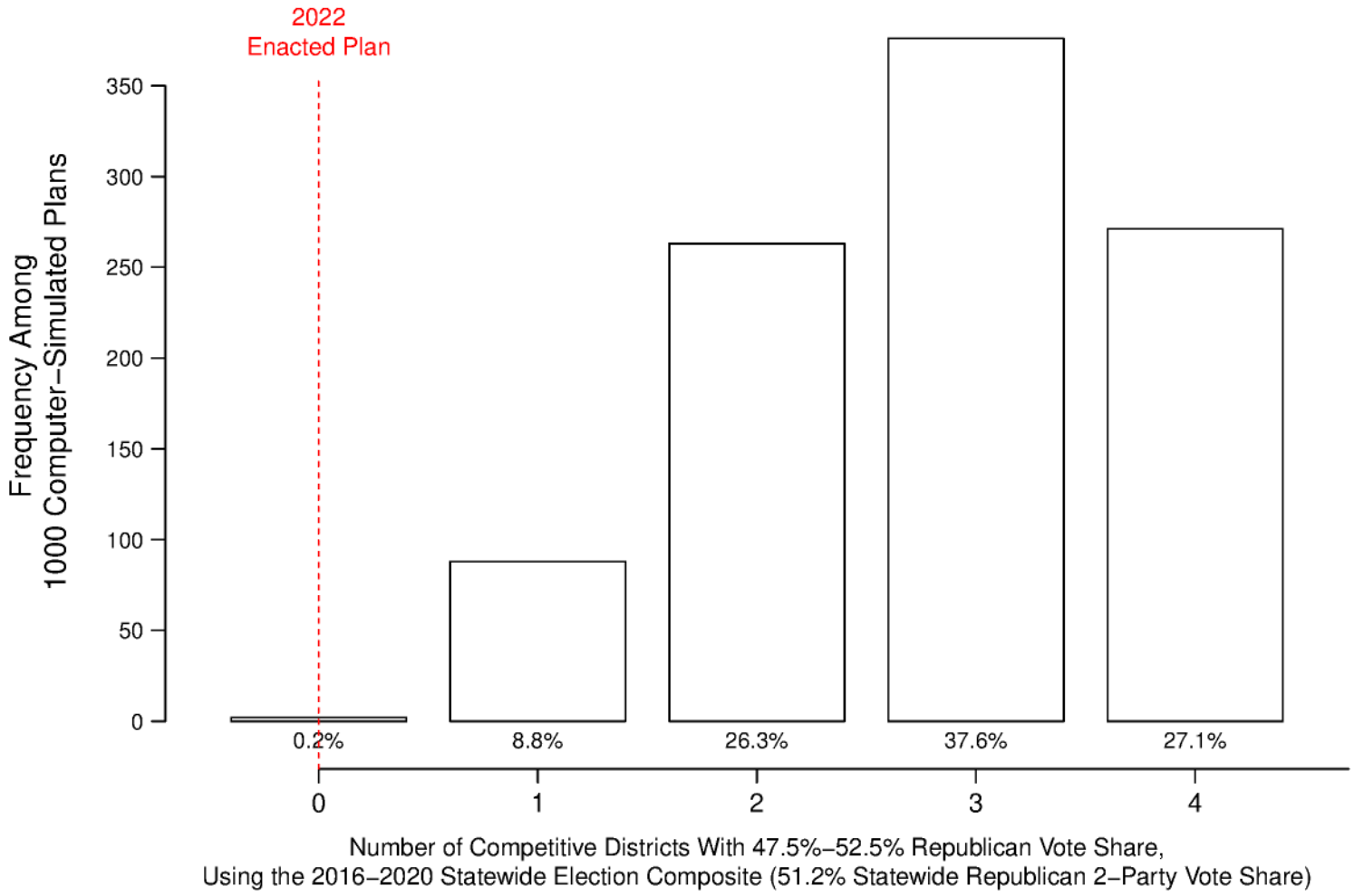
106. ***Competitive Districts:*** Collectively, the upper four rows in Figure E-2 illustrate that the Enacted Plan's four most-Republican districts exhibit a significantly narrower range of partisanship than is exhibited by the four most-Republican districts in each of the computer-simulated plans. Specifically, the Enacted Plan's four Republican-favoring districts all have Republican vote shares within the narrow range of 52.6% to 54.2%, while the one remaining

district (District 2) is very heavily Democratic. It is especially noteworthy that the Enacted Plan therefore has no districts containing nearly even numbers of Democrats and Republicans.

107. This finding is noteworthy because, as Figure E-2 reveals, the 1,000 simulated plans very frequently create districts with a Republican vote share very close to 50% - in other words, with nearly even numbers of Democratic and Republican voters. In Figure E-3, I label any districts with a Republican vote share between 47.5% and 52.5% as "competitive," and I compare the number of competitive districts in the Enacted Plan to the number of competitive districts in each of the 1,000 simulated plans.

108. As Figure E-3 illustrates, the Enacted Plan's creation of zero competitive districts is an extreme statistical outlier. Only 0.2% of the simulated plans (2 out of 1,000) similarly fail to create any competitive districts. 91% of the simulated plans create two to four competitive districts, and the most common outcome among the simulations is three competitive districts. Hence, the Enacted Plan is an extreme partisan outlier in terms of its complete lack of competitive districts, and this outcome is clearly anomalous, given New Hampshire's political geography. In the 1,000 simulated plans created using a partisan-blind computer algorithm following traditional districting criteria, more than half of the Executive Council districts created by the simulations are politically competitive, with a Republican vote share between 47.5% and 52.5%.

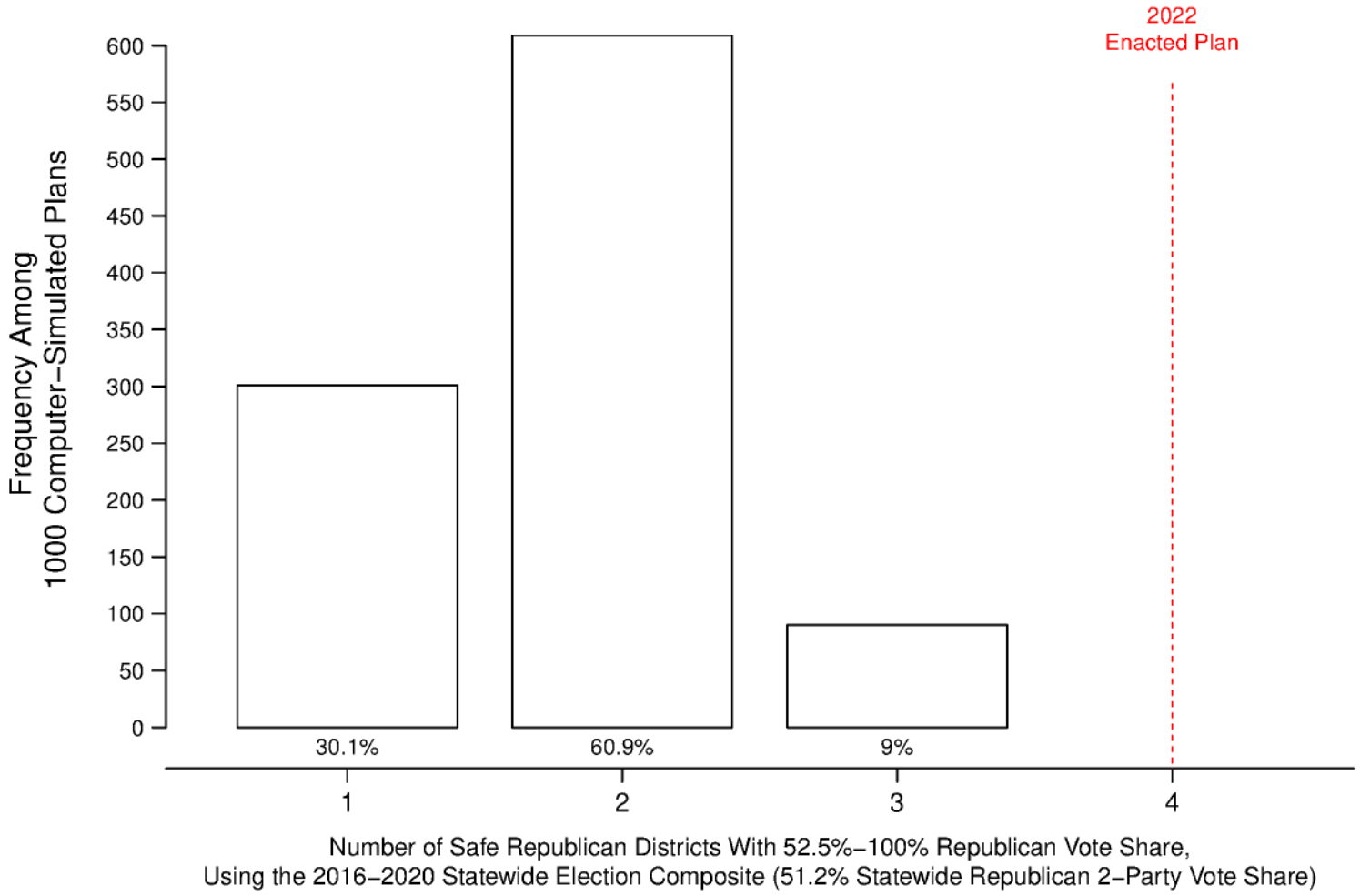
Figure E3:
Comparison of 2022 Enacted Executive Council Plan to 1,000 Computer−Simulated Plans



109. ***Safe Republican Districts:*** Rather than having competitive districts, the 2022 Enacted Plan instead created four relatively safe Republican districts, each with a Republican vote share in the narrow range of 52.6% to 54.2%. Although such districts are not guaranteed to always elect Republicans, districts in this range are nevertheless relatively safer for Republicans than competitive districts with a 47.5% - 52.5% Republican vote share.

110. In Figure E-4, I therefore compare the number of districts with over a 52.5% Republican vote share in the Enacted Plan and in the 1,000 computer-simulated plans. As Figure E-4 illustrates, the Enacted Plan's creation of four Republican districts with over a 52.5% Republican vote share is an extreme statistical outlier. None of the 1,000 simulated plans ever contain four such safely Republican districts. The vast majority of the simulated plans contain only one or two such Republican districts, and no simulated plan contains more than three. Hence, the Enacted Plan is clearly an extreme partisan outlier in terms of its peculiar focus on maximizing the number of relatively safe Republican districts with a Republican vote share of more than 52.5%. It did so to an extreme degree, creating more relatively safe Republican districts than in any of the 1,000 simulated plans generated using a partisan-blind computer algorithm that follows traditional districting principles.

Figure E4:
Comparison of 2022 Enacted Executive Council Plan to 1,000 Computer−Simulated Plans



111. ***The Mean-Median Difference:*** I also calculate each districting plan's mean-median difference, As described in paragraph 15, the mean-median difference for any given plan is calculated as the median district-level Republican vote share, minus the mean district-level Republican vote share. For any Executive Council districting plan, the mean is calculated as the average of the Republican vote shares in each of the five districts. The median, in turn, is the Republican vote share in the district where Republican performed the middle-best, which is the district that Republicans would need to win in order to secure a majority of the Executive Council seats. For an Executive Council plan containing five districts, the median district is calculated as the Republican vote share in the district where Republicans performed the 3rd-best across the state.

112. Using the 2016-2020 Statewide Election Composite to measure partisanship, the districts in the 2022 Enacted Plan have a mean Republican vote share of 51.24%, while the median district has a Republican vote share of 52.78%. Thus, the Enacted Plan has a mean-median difference of +1.54%, indicating that the median district is skewed more Republican than the plan's average district. The mean-median difference thus indicates that the Enacted Plan distributes voters across districts in such a way that most districts are more Republican-leaning than the average New Hampshire Executive Council district, while Democratic voters are more heavily concentrated in a minority of the Enacted Plan's districts.

113. I perform this same mean-median difference calculation on all computer-simulated plans in order to determine whether this partisan skew in the median Executive Council districts could have resulted naturally from New Hampshire's political geography and the application of traditional districting principles. Figure E-5 compares the mean-median

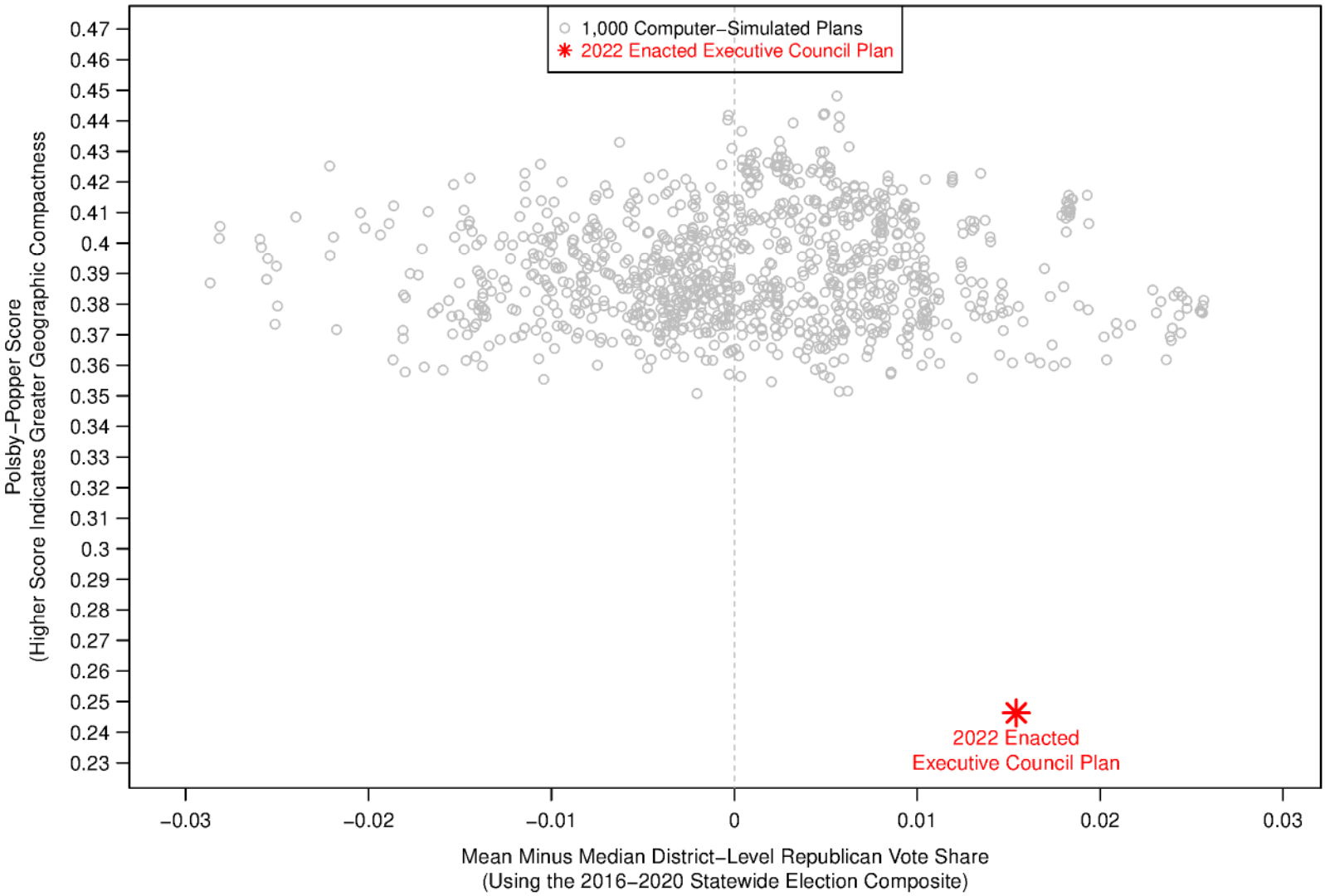
difference of the Enacted Plan to the mean-median difference for each the 1,000 computer-simulated plans.

114. Figure E-5 contains 1,000 gray circles, representing the 1,000 computer-simulated plans, as well as a red star, representing the 2022 Enacted Plan. The horizontal axis in this Figure measures the mean-median difference of the 2022 Enacted Plan and each simulated plan using the 2016-2020 Statewide Election Composite, while the vertical axis measures the average Polsby-Popper compactness score of the districts within each plan, with higher Polsby-Popper scores indicating more compact districts. Figure E-5 illustrates that the Enacted Plan's mean-median difference is +1.54%, indicating that the median district is skewed more Republican than the plan's average district. Figure E-5 further indicates that this mean-median difference is more extreme than nearly 95% of the mean-median differences exhibited by the 1,000 computer-simulated plans. Only 5.4% of the 1,000 simulated plans exhibit a mean-median difference higher than the Enacted Plan's mean-median difference of +1.54%. In fact, the middle 50% of the 1,000 computer-simulated plans have mean-median differences ranging from -0.46% to +0.67%, indicating a much smaller degree of skew in the median district than occurs under the 2022 Enacted Plan. These results indicate that the Enacted Plan exhibits a degree of pro-Republican partisan bias that likely cannot be explained by New Hampshire's voter geography or by strict adherence to traditional districting criteria.

115. Figure E-5 also illustrates that the Enacted Plan is less geographically compact than every single one of the computer-simulated plans, as measured by each plan's average Polsby-Popper score. The simulated plans have Polsby-Popper scores ranging from 0.35 to 0.45. In fact, the middle 50% of these computer-simulated plans have Polsby-Popper scores ranging from 0.38 to 0.41. Meanwhile, the Enacted Plan exhibits a Polsby-Popper score of only 0.25,

which is lower than all 1,000 of the computer-simulated plans. Hence, it is clear that the Enacted Plan did not seek to draw districts that were as geographically compact as reasonably possible. Instead, the Enacted Plan subordinated geographic compactness, which enabled the Enacted Plan to create a partisan skew in New Hampshire's Executive Council districts favoring Republican candidates.

Figure E5: Comparison of 2022 Enacted Executive Council Plan to 1,000 Computer−Simulated Plans on Mean−Median Difference and Compactness



116. The consequence of the Enacted Plan's mean-median difference is that the Enacted Plan gives Republicans a far easier path to winning a majority of seats on the New Hampshire Executive Council. Using the 2016-2020 Statewide Election Composite, the Republicans' percentage of the statewide vote is 51.2%, while median Executive Council district (District 5) has a Republican vote share of 52.8%. To win this median district (and thus guarantee control over three of the five Executive Council seats), Republicans would only need to win 48.4% of the statewide vote (51.2% minus 2.8%), assuming a uniform swing in vote share across all Executive Council districts.

117. By contrast, the 2022 Enacted Executive Council Plan gives Democrats a significantly more difficult path to winning a majority of New Hampshire's Executive Council seats. Using the 2016-2020 Statewide Election Composite, the Democrats' percentage of the statewide vote is 48.8%, while the median Executive Council district (District 5) has a Republican vote share of 52.8%. To win this median district (and thus guarantee control over three of the five Executive Council seats), Democrats would have to win a 51.6% of the statewide vote (48.8% plus 2.8%), assuming a uniform swing in vote share across all Executive Council districts. Hence, compared to Republicans, the Democrats would have to win a significantly higher share of the statewide vote in order to control a majority of the seats on the New Hampshire Executive Council under the 2022 Enacted Plan.

118. ***The Lopsided Margins Measure:*** As described in paragraph 15, the mean-median difference for any given plan is calculated as the median district-level Republican vote share, minus the mean district-level Republican vote share. The basic premise captured by this measure is that a partisan-motivated map-drawer may attempt to pack the opposing party's voters into a small number of extreme districts that are won by a lopsided margin. Thus, for example, a map-drawer attempting to favor Party A may pack Party B's voters into a small number of districts that very heavily favor Party B. This packing would then allow Party A to win all the remaining districts with relatively smaller margins. This sort of partisan manipulation in districting would result in Party B winning its districts by extremely large margins, while Party A would win its districts by relatively small margins.

119. Hence, the lopsided margins test is performed by calculating the difference between the average margin of victory in Republican-favoring districts and the average margin of victory in Democratic-favoring districts. The 2022 Enacted Plan contains one Democratic-favoring district (District 2), and this district has an average Democratic vote share of 57.4%, as measured using the 2016-2020 Statewide Election Composite. By contrast, the Enacted Plan contains four Republican-favoring districts (District 1, 3, 4, and 5), and these four districts have an average Republican vote share of 53.4%. Hence, the difference between the average Democratic margin of victory in Democratic-favoring districts and the average Republican margin of victory in Republican-favoring districts is +4.0%, which is calculated as 57.4% - 53.4%. I refer to this calculation of +4.0% as the Enacted Plan's lopsided margins measure.

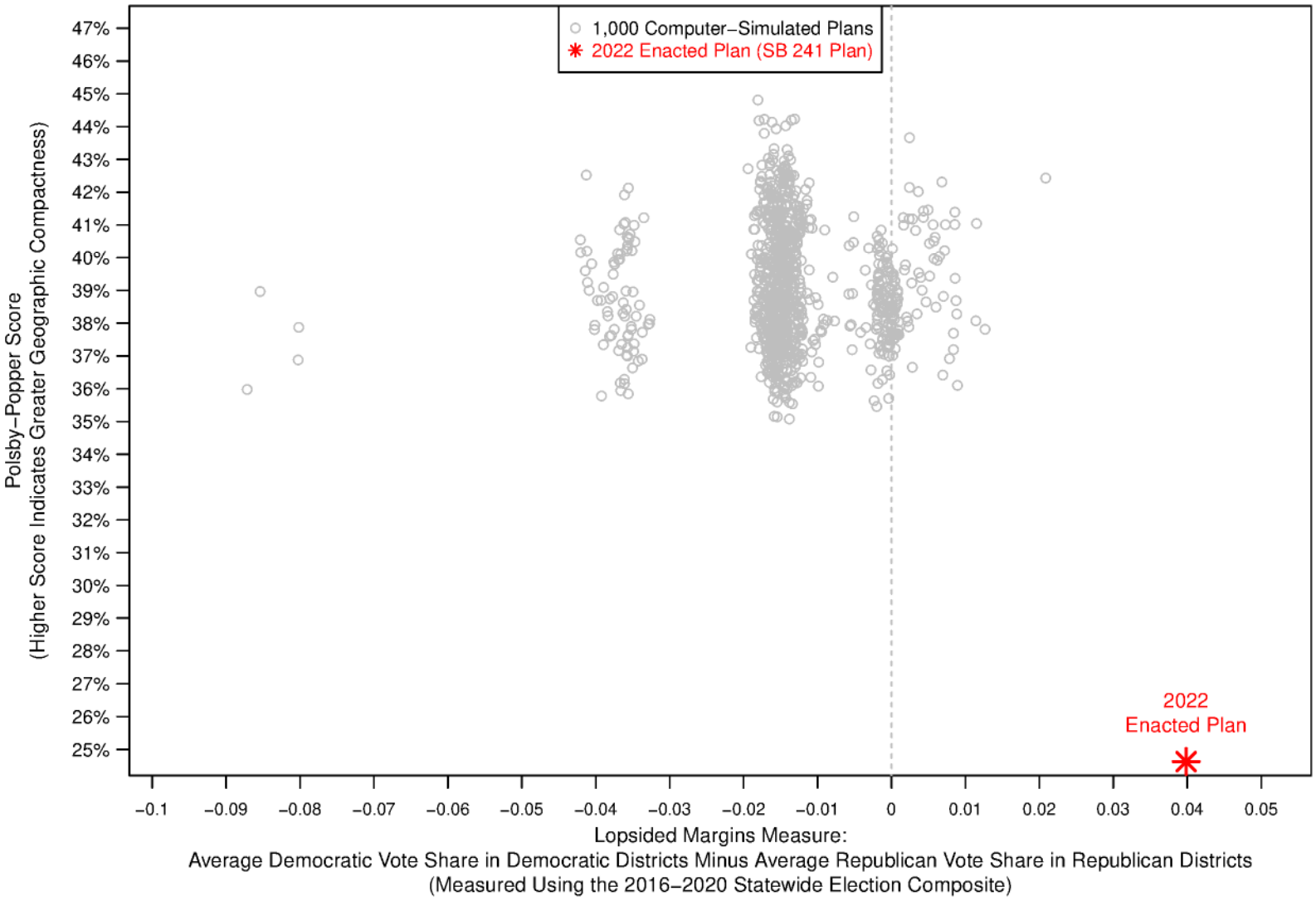
120. How does the 4.0% lopsided margins measure of the Enacted Plan compare to the same calculation for the 1,000 computer-simulated plans? Figure E-6 reports the lopsided margins calculations for the Enacted Plan and for the simulated plans. In Figure E-6, each plan is

plotted along the horizontal axis according to its lopsided margins measure and along the vertical axis according to its Polsby-Popper score.

121. Figure E-6 reveals that the Enacted Plan's +4.0% lopsided margins measure is an extreme outlier compared to the lopsided margins measures of the 1,000 computer-simulated plans. All 1,000 of the simulated plans have a smaller lopsided margins measure than the Enacted Plan. In fact, 91.8% of the 1,000 simulated plans have a lopsided margins measure of between -2.0% and +2.0%, indicating a plan in which Democrats and Republicans win their respective districts by relatively similar average margins.

122. By contrast, the Enacted Plan's lopsided margins measure of +4.0% indicates that the Enacted Plan creates districts in which Democrats are packed tightly into their district, while the margin of victory in Republican districts is significantly smaller. The "lopsidedness" of the two parties' average margin of victory is extreme when compared to the computer-simulated plans. The finding that all 1,000 simulated plans have a smaller lopsided margins measure indicates that the Enacted Plan's extreme packing of Democrats into a single Democratic-favoring district was not simply the result of New Hampshire's political geography, combined with adherence to traditional districting criteria.

Figure E6: Comparison of 2022 Enacted Executive Council Plan to 1,000 Computer−Simulated Plans on Lopsided Margins Measure and Compactness



123. ***Partisan Symmetry Based on Uniform Swing:*** Finally, as described in paragraph 15, another common measure of partisan bias is based on the concept of partisan symmetry and asks the following question: Under a given districting plan and given a particular election-based measure of district partisanship, what share of seats would each party win in a hypothetical tied election (i.e., 50% vote share for each of two parties). To approximate the district-level outcomes in a hypothetical tied election, one normally uses a uniform swing in order to simulate a tied statewide election. One then calculates whether each party would receive more than or less than 50% of the seats under this hypothetical tied election in a given districting plan. This particular measure is often referred to in the academic literature as "partisan bias." In order to avoid confusion with other measures of partisan bias described in this report, I will refer to this measure as "Partisan Symmetry Based on Uniform Swing."

124. Specifically, I use the 2016-2020 Statewide Election Composite to calculate the Partisan Symmetry measure for both the Enacted Plan and for the computer-simulated plans. The 2016-2020 Statewide Election Composite produces a statewide Republican vote share of 51.2%. Therefore, I use a uniform swing of -1.2% in order to estimate the partisanship of districts under a hypothetical tied election in which each party wins exactly 50% of the statewide vote. In other words, this uniform swing subtracts 1.2% from the Republican vote share in every district, both in the Enacted Plan and in all simulated plans.

125. After applying this -1.2% uniform swing, I compare the number of Republican-favoring districts in the Enacted Plan and the simulated plans. In the Enacted Plan, 80% of the districts (4 out of 5) are Republican-favoring after applying the uniform swing. I then report the Republicans' seat share (80%) under this hypothetical tied election in Figure E-7 as the "Partisan

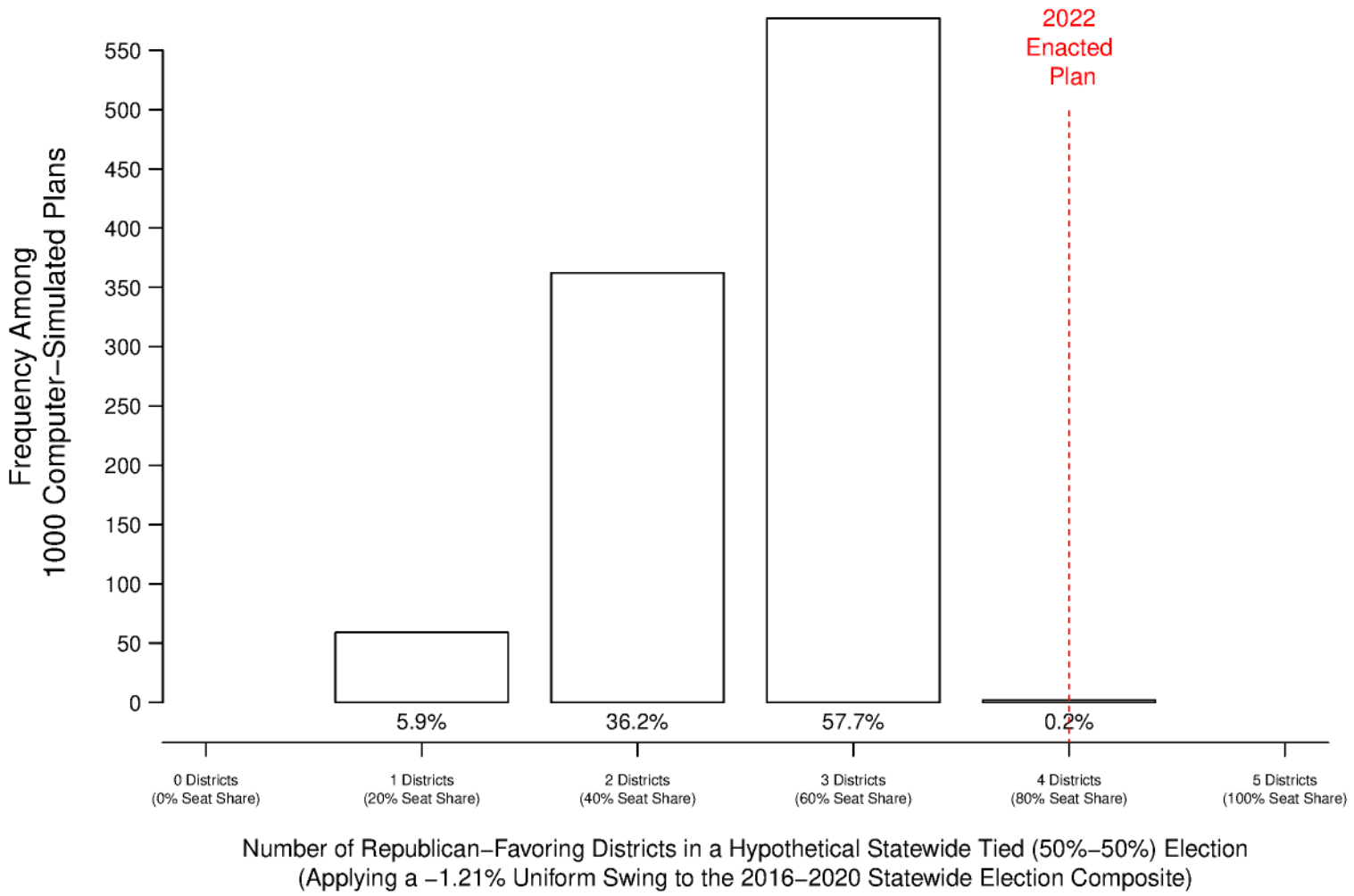
Symmetry Based on Uniform Swing" measure for the Enacted Plan. Figure E-7 also reports the calculations for all 1,000 simulated plans using this identical method.

126. Figure E-7 reveals 99.8% of the 1,000 simulated plans have a "Partisan Symmetry Based on Uniform Swing" measure that is closer to 50% than the Enacted Plan's measure. In fact, 93.9% of the simulated plans have a measure that is as close to 50% as possible, given that the Executive Council Plan contains an odd number of districts. In other words, 93.9% of the simulated plans have a "Partisan Symmetry Based on Uniform Swing" measure that is either 40% (2 out of 5 districts) or 60% (3 out of 5 districts).

127. By contrast, the Enacted Plan's measure of 80% in Figure E-7 is a statistical outlier and is more favorable to Republicans than 99.8% of the simulated plans. Substantively, this 80% measure reflects the Enacted Plan's creation of a durable Republican majority for New Hampshire's Executive Council, such that even when Democrats win 50% of the statewide vote, Republicans will still be favored in 4 out of 5 (80%) of the Executive Council districts, and Democrats will only be favored in 1 out of the 5 (20%) districts.

128. In other words, if Democrats and Republican each won 50% of the statewide vote, 93.9% of the simulated maps would result in Republicans winning two or three seats. Instead, under the Enacted Plan, Republicans will be favored to win four districts.

Figure E7:
Comparison of 2022 Enacted Executive Council Plan to 1,000 Computer−Simulated Plans On Partisan Symmetry Based on Uniform Swing



V. Conclusions Regarding Partisanship and Traditional Districting Criteria

129. The analyses described thus far in this report lead me to two main findings: first, the 2022 Enacted Plan clearly subordinated the traditional districting criteria of geographic compactness. The Legislature's plan is significantly less geographically compact than is reasonably possible under a districting process following traditional districting criteria.

130. Second, the 2022 Enacted Plan is an extreme partisan outlier when compared to computer-simulated plans produced by a process following traditional districting criteria. The Enacted Plan contains individual districts that are partisan outliers when compared to the simulated plans' individual districts, and, at a statewide level, the Enacted Plan creates a level of pro-Republican bias more extreme than 100% of the computer-simulated plans.

131. Based on these two main findings, I conclude that partisanship predominated in the drawing of the 2022 Enacted Plan, and partisanship subordinated the traditional districting principle of geographic compactness. Because the Enacted Plan fails to follow traditional districting principles and simultaneously creates an extreme level of partisan bias, I therefore conclude that the partisan bias of the Enacted Plan did not naturally arise by chance from a districting process adhering to traditional districting principles. Instead, I conclude that partisan goals predominated in the drawing of the Enacted Plan. By subordinating traditional districting principles, the Legislature's Enacted Plan was able to achieve an extreme partisan outcome that would not have normally occurred under a partisan-neutral districting process following traditional districting principles.

VI. New Hampshire's Political Geography Did Not Cause the Enacted Plan's Extreme Partisan Bias

132. How does New Hampshire's political geography affect the partisan characteristics of the 2022 Enacted Plan? Democratic voters tend to be geographically concentrated in cities such as Manchester, Nashua, and Concord. As I have explained in my prior academic research,[16] these large urban clusters of Democratic voters, combined with the traditional districting principle of drawing geographically compact districts, can sometimes result in urban districts that "naturally" pack together Democratic voters, thus boosting the Republican vote share of other surrounding suburban and rural districts.

133. More importantly, my prior academic research explained how I can estimate the precise level of electoral bias in districting caused by a state's unique political geography: I programmed a computer algorithm that draws districting plans using New Hampshire's unique political geography, including the state's census population data and political subdivision boundaries. I have also programmed the algorithm to follow traditional districting criteria. All 1,000 of these computer-simulated maps avoid splitting any of New Hampshire's cities, towns, townships, gores, and grants. The simulated maps therefore match the 2022 Enacted Plan in terms of preserving municipalities. All 1,000 simulated maps are also significantly more geographically compact, as measured by their Polsby-Popper and Reock scores, than the 2022 Enacted Plan.

134. I then analyzed the partisan characteristics of the simulated districting plans using New Hampshire's precinct-level voting data from past elections. Hence, the entire premise of

[16] Jowei Chen and Jonathan Rodden, 2013. "Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures" Quarterly Journal of Political Science, 8(3): 239-269; Jowei Chen and David Cottrell, 2016. "Evaluating Partisan Gains from Congressional Gerrymandering: Using Computer Simulations to Estimate the Effect of Gerrymandering in the U.S. House." Electoral Studies, Vol. 44, No. 4: 329-430.

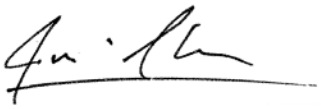
conducting districting simulations is to fully account for New Hampshire's unique political geography and its political subdivision boundaries and to analyze how the state's political geography affects electoral bias in Executive Council districting.

135. This districting simulation analysis allowed me to identify the degree to which the electoral bias in New Hampshire's 2022 Enacted Executive Council Plan is caused by New Hampshire's political geography and how much is caused by the map-drawer's intentional efforts to favor one political party over the other. New Hampshire's natural political geography, combined with the application of traditional districting principles, almost never resulted in a simulated Executive Council plan containing four relatively safe Republican-favoring districts and one relatively safe Democratic-favoring district.

136. The 2022 Enacted Plan's creation of four relatively safe Republican-favoring districts clearly goes beyond any "natural" level of electoral bias caused by New Hampshire's political geography or the political composition of the state's voters. The Enacted Plan is a statistical outlier in terms of its partisan characteristics when compared to the 1,000 computer-simulated plans. The Enacted Plan creates more safely Republican-favoring districts--districts with more than 52.5% Republican vote share--than 100% of the simulated plans. This partisan bias was not caused by New Hampshire's political geography. Instead, the extreme partisan bias in the 2022 Enacted Plan can be directly attributed to the map-drawer's clear efforts to favor the Republican Party.

137. I declare under penalty of perjury that the foregoing is true and correct to the best of myknowledge.

This 9th day of May, 2022.



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Research Grants:

"How Citizenship-Based Redistricting Systemically Disadvantages Voters of Color". 2020 ($18,225). Combating and Confronting Racism Grant. University of Michigan Center for Social Solutions and Poverty Solutions.

Principal Investigator. National Science Foundation Grant SES-1459459, September 2015 – August 2018 ($165,008). "The Political Control of U.S. Federal Agencies and Bureaucratic Political Behavior."

"Economic Disparity and Federal Investments in Detroit," (with Brian Min) 2011. Graham Institute, University of Michigan ($30,000).

"The Partisan Effect of OSHA Enforcement on Workplace Injuries," (with Connor Raso) 2009. John M. Olin Law and Economics Research Grant ($4,410).

Invited Talks:

September, 2011. University of Virginia, American Politics Workshop.
October 2011. Massachusetts Institute of Technology, American Politics Conference.
January 2012. University of Chicago, Political Economy/American Politics Seminar.
February 2012. Harvard University, Positive Political Economy Seminar.
September 2012. Emory University, Political Institutions and Methodology Colloquium.
November 2012. University of Wisconsin, Madison, American Politics Workshop.
September 2013. Stanford University, Graduate School of Business, Political Economy Workshop.
February 2014. Princeton University, Center for the Study of Democratic Politics Workshop.
November 2014. Yale University, American Politics and Public Policy Workshop.
December 2014. American Constitution Society for Law & Policy Conference: Building the Evidence to Win Voting Rights Cases.
February 2015. University of Rochester, American Politics Working Group.
March 2015. Harvard University, Voting Rights Act Workshop.
May 2015. Harvard University, Conference on Political Geography.
Octoer 2015. George Washington University School of Law, Conference on Redistricting Reform.
September 2016. Harvard University Center for Governmental and International Studies, Voting Rights Institute Conference.
March 2017. Duke University, Sanford School of Public Policy, Redistricting Reform Conference.
October 2017. Willamette University, Center for Governance and Public Policy Research
October 2017, University of Wisconsin, Madison. Geometry of Redistricting Conference.
February 2018: University of Georgia Law School
September 2018. Willamette University.
November 2018. Yale University, Redistricting Workshop.

November 2018. University of Washington, Severyns Ravenholt Seminar in Comparative Politics.
January 2019. Duke University, Reason, Reform & Redistricting Conference.
February 2019. Ohio State University, Department of Political Science. Departmental speaker series.
March 2019. Wayne State University Law School, Gerrymandering Symposium.
November 2019. Big Data Ignite Conference.
November 2019. Calvin College, Department of Mathematics and Statistics.
September 2020 (Virtual). Yale University, Yale Law Journal Scholarship Workshop

Conference Service:

Section Chair, 2017 APSA (San Francisco, CA), Political Methodology Section
Discussant, 2014 Political Methodology Conference (University of Georgia)
Section Chair, 2012 MPSA (Chicago, IL), Political Geography Section.
Discussant, 2011 MPSA (Chicago, IL) "Presidential-Congressional Interaction."
Discussant, 2008 APSA (Boston, MA) "Congressional Appropriations."
Chair and Discussant, 2008 MPSA (Chicago, IL) "Distributive Politics: Parties and Pork."

Conference Presentations and Working Papers:

"Ideological Representation of Geographic Constituencies in the U.S. Bureaucracy," (with Tim Johnson). 2017 APSA.

"Incentives for Political versus Technical Expertise in the Public Bureaucracy," (with Tim Johnson). 2016 APSA.

"Black Electoral Geography and Congressional Districting: The Effect of Racial Redistricting on Partisan Gerrymandering". 2016 Annual Meeting of the Society for Political Methodology (Rice University)

"Racial Gerrymandering and Electoral Geography." Working Paper, 2016.

"Does Deserved Spending Win More Votes? Evidence from Individual-Level Disaster Assistance," (with Andrew Healy). 2014 APSA.

"The Geographic Link Between Votes and Seats: How the Geographic Distribution of Partisans Determines the Electoral Responsiveness and Bias of Legislative Elections," (with David Cottrell). 2014 APSA.

"Gerrymandering for Money: Drawing districts with respect to donors rather than voters." 2014 MPSA.

"Constituent Age and Legislator Responsiveness: The Effect of Constituent Opinion on the Vote for Federal Health Reform." (with Katharine Bradley) 2012 MPSA.

"Voter Partisanship and the Mobilizing Effect of Presidential Advertising." (with Kyle Dropp) 2012 MPSA.

"Recency Bias in Retrospective Voting: The Effect of Distributive Benefits on Voting Behavior." (with Andrew Feher) 2012 MPSA.

"Estimating the Political Ideologies of Appointed Public Bureaucrats," (with Adam Bonica and Tim Johnson) 2012 Annual Meeting of the Society for Political Methodology (University of North Carolina)

"Tobler's Law, Urbanization, and Electoral Bias in Florida." (with Jonathan Rodden) 2010 Annual Meeting of the Society for Political Methodology (University of Iowa)

"Unionization and Presidential Control of the Bureaucracy" (with Tim Johnson) 2011 MPSA.

"Estimating Bureaucratic Ideal Points with Federal Campaign Contributions" 2010 APSA. (Washington, DC).

"The Effect of Electoral Geography on Pork Spending in Bicameral Legislatures," Vanderbilt University Conference on Bicameralism, 2009.

"When Do Government Benefits Influence Voters' Behavior? The Effect of FEMA Disaster Awards on US Presidential Votes," 2009 APSA (Toronto, Canada).

"Are Poor Voters Easier to Buy Off?" 2009 APSA (Toronto, Canada).

"Credit Sharing Among Legislators: Electoral Geography's Effect on Pork Barreling in Legislatures," 2008 APSA (Boston, MA).

"Buying Votes with Public Funds in the US Presidential Election," Poster Presentation at the 2008 Annual Meeting of the Society for Political Methodology (University of Michigan).

"The Effect of Electoral Geography on Pork Spending in Bicameral Legislatures," 2008 MPSA.

"Legislative Free-Riding and Spending on Pure Public Goods," 2007 MPSA (Chicago, IL).

"Free Riding in Multi-Member Legislatures," (with Neil Malhotra) 2007 MPSA (Chicago, IL).

"The Effect of Legislature Size, Bicameralism, and Geography on Government Spending: Evidence from the American States," (with Neil Malhotra) 2006 APSA (Philadelphia, PA).

Figure A1: Comparison of Enacted SB 240 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 Governor Election Results

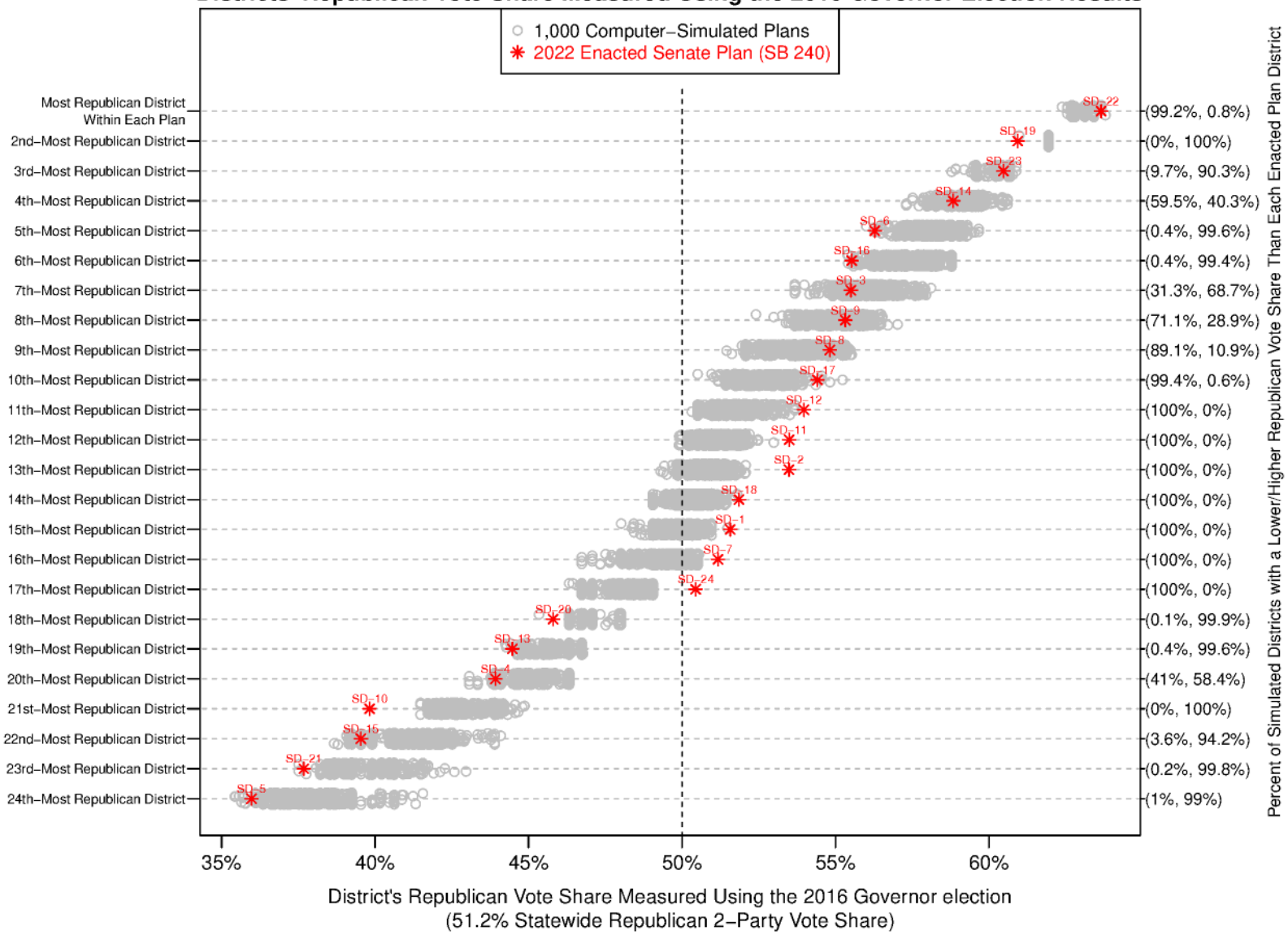


Figure A2: Comparison of Enacted SB 240 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 US President Election Results

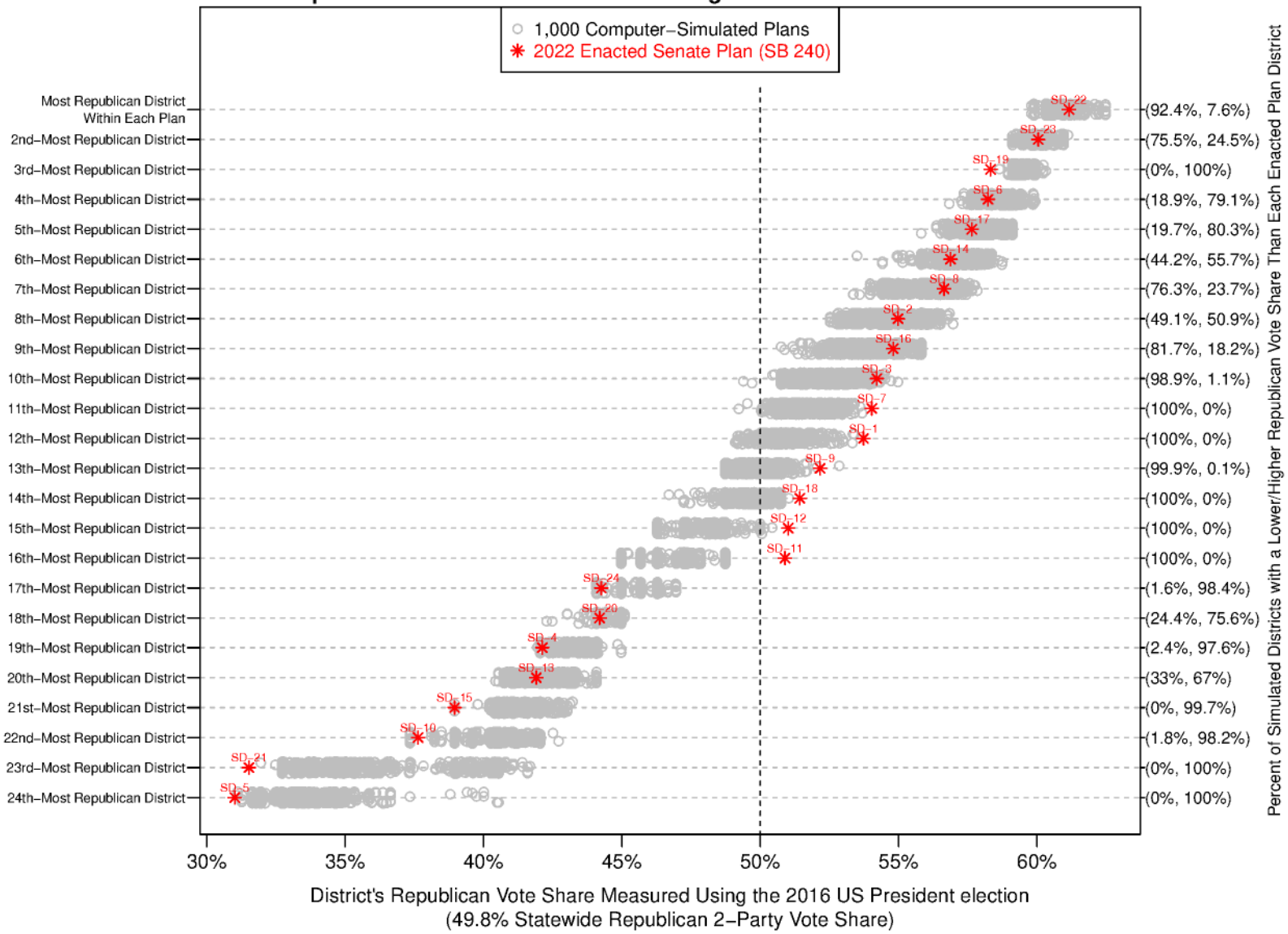


Figure A3: Comparison of Enacted SB 240 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 US Senator Election Results

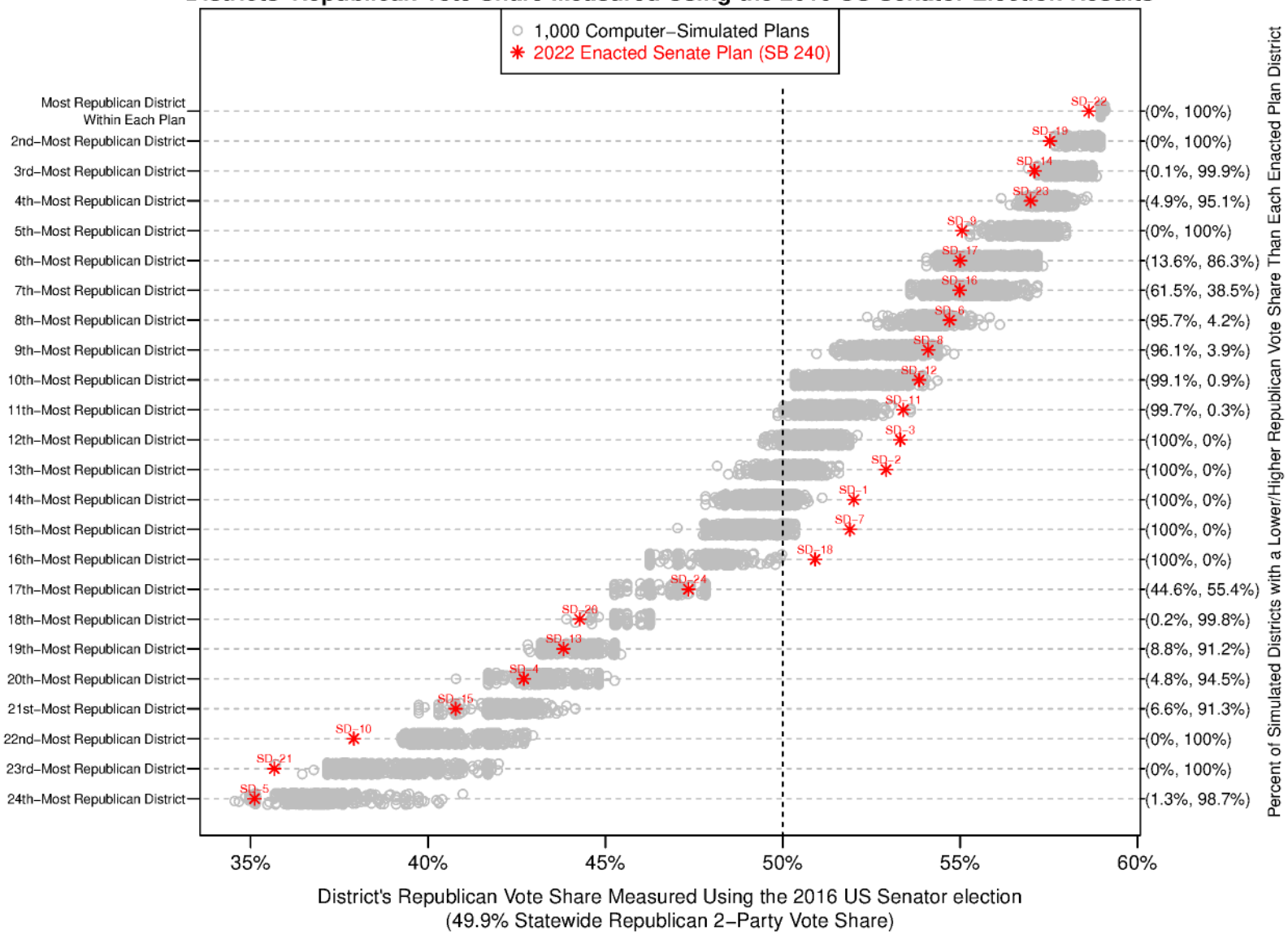


Figure A4: Comparison of Enacted SB 240 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2018 Governor Election Results

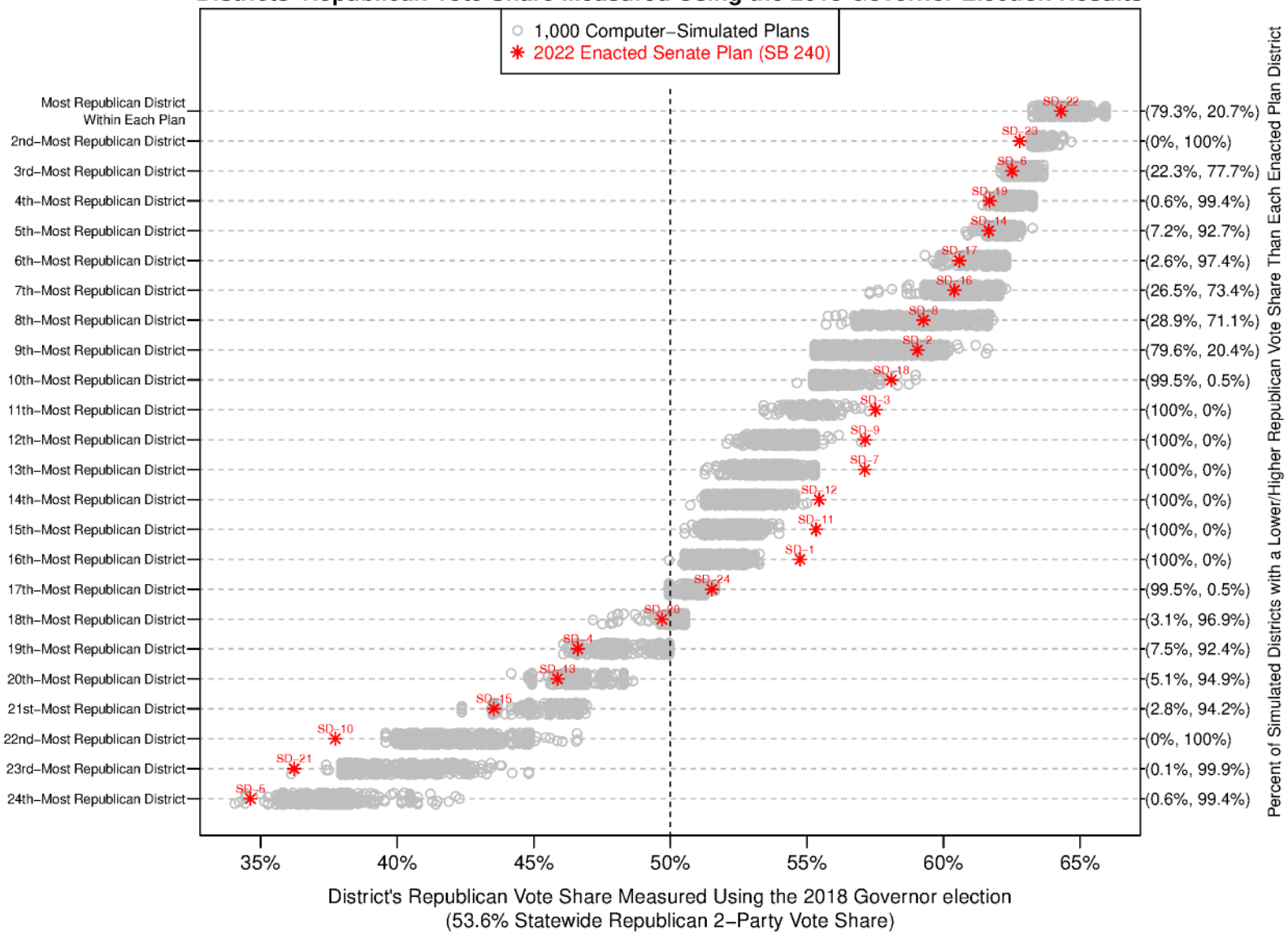


Figure A5: Comparison of Enacted SB 240 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 Governor Election Results

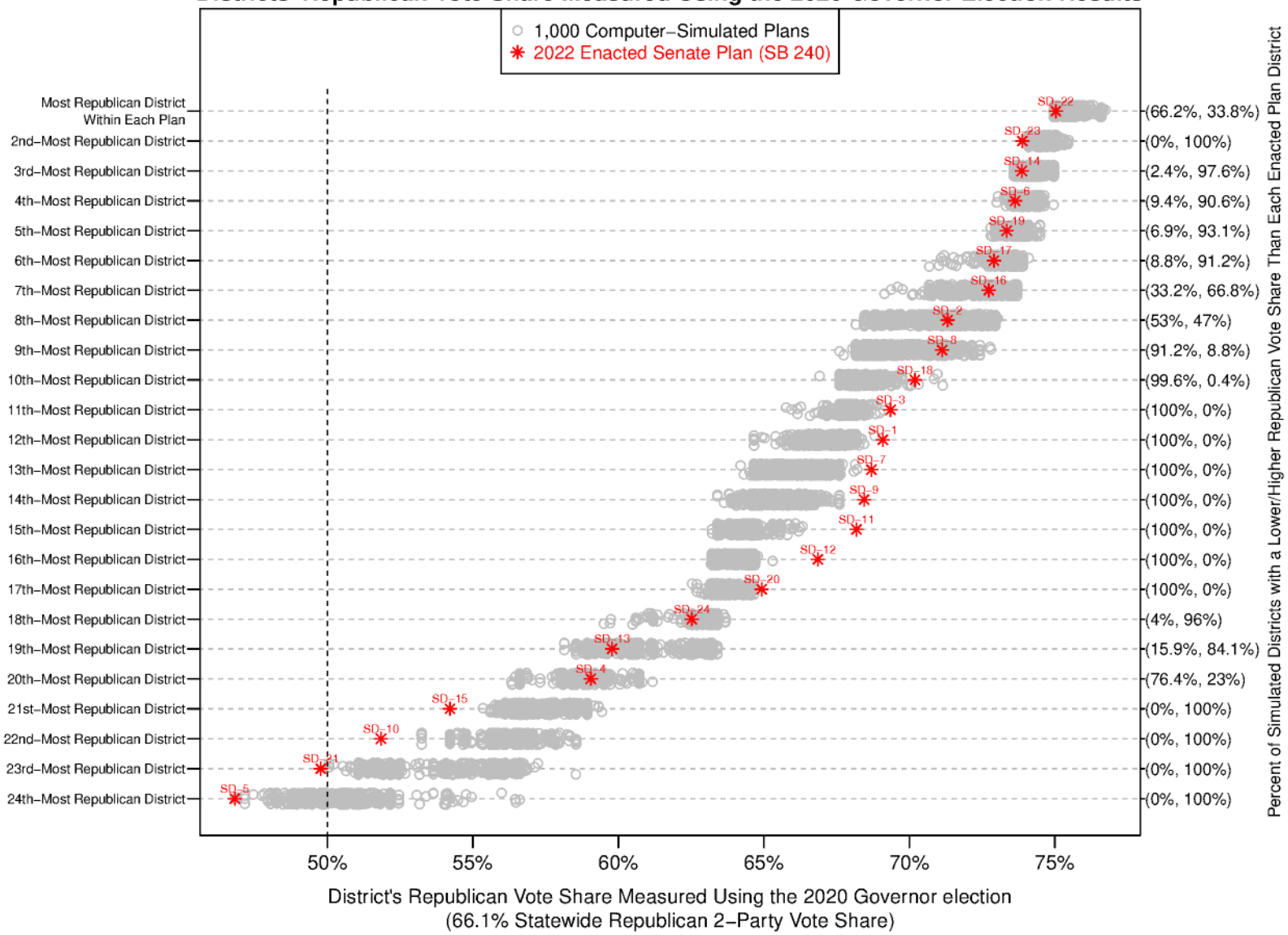


Figure A6: Comparison of Enacted SB 240 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 US President Election Results

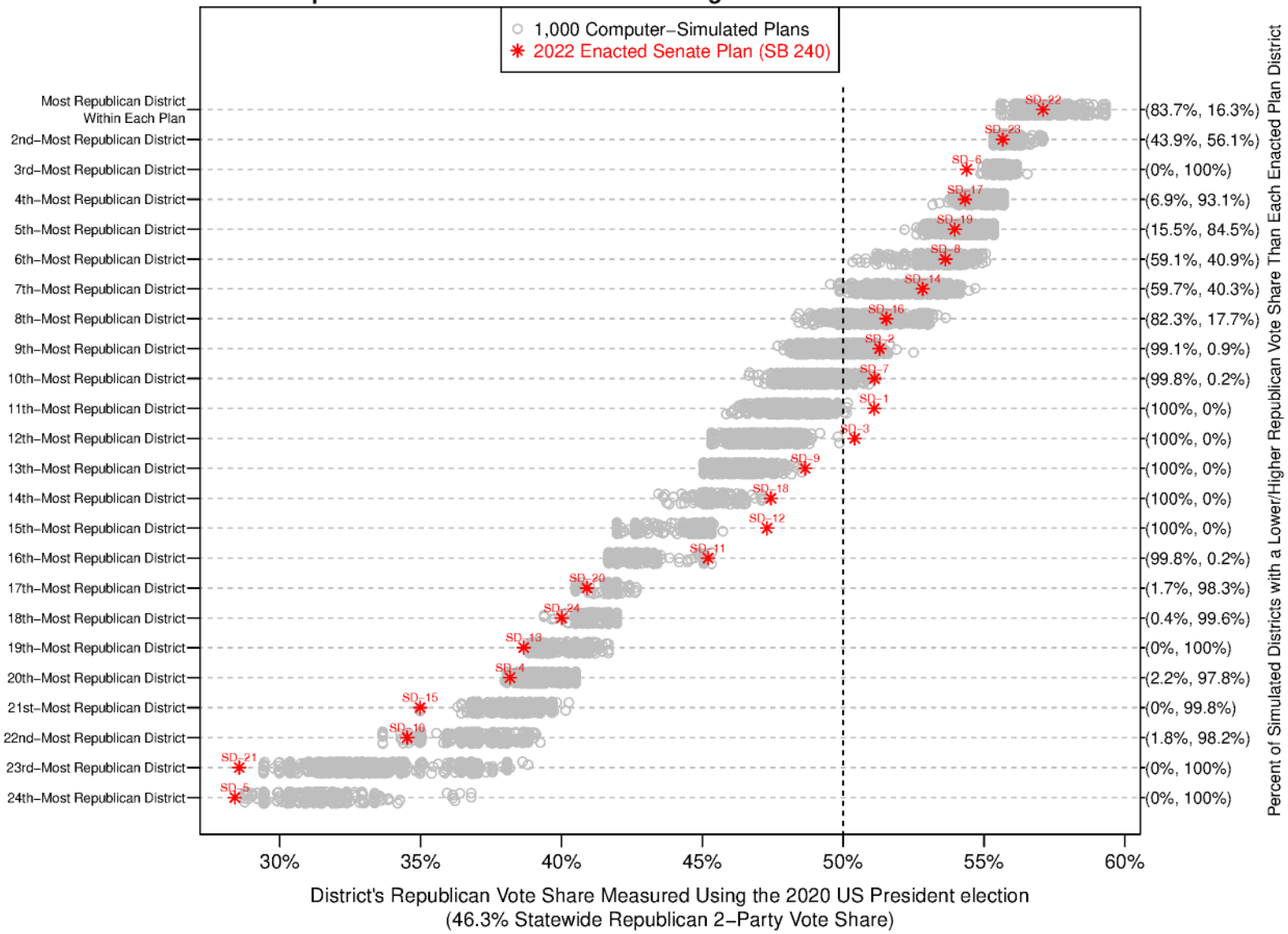
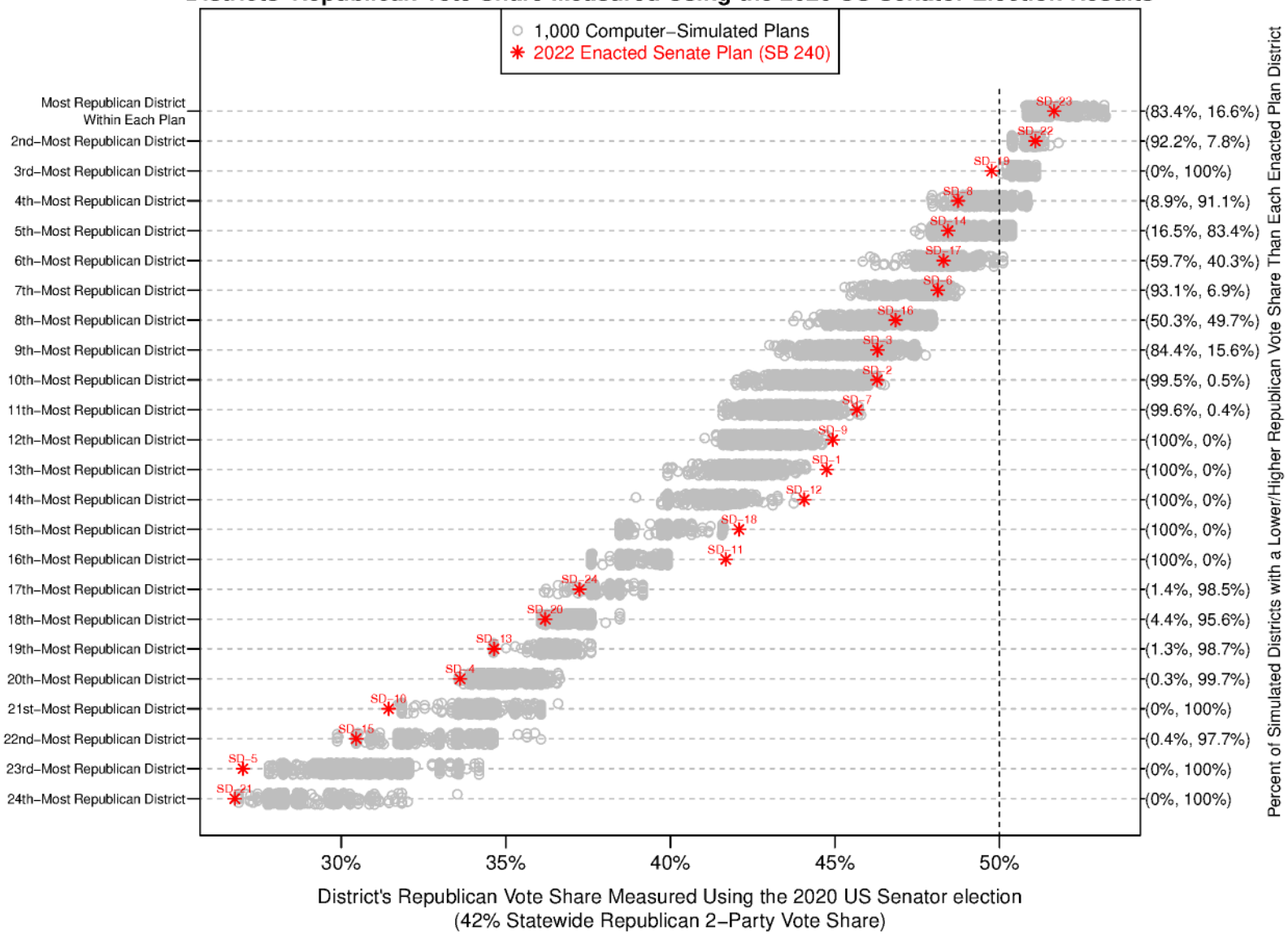


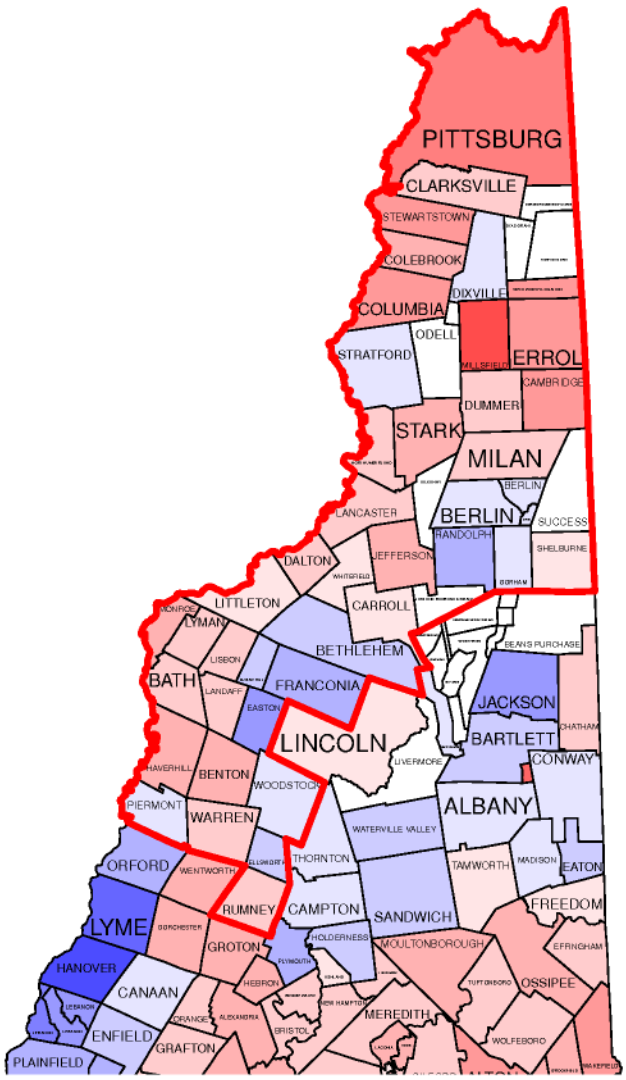
Figure A7: Comparison of Enacted SB 240 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 US Senator Election Results



Appendix B: 2022 SB 240 Enacted Senate Plan, District 1

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

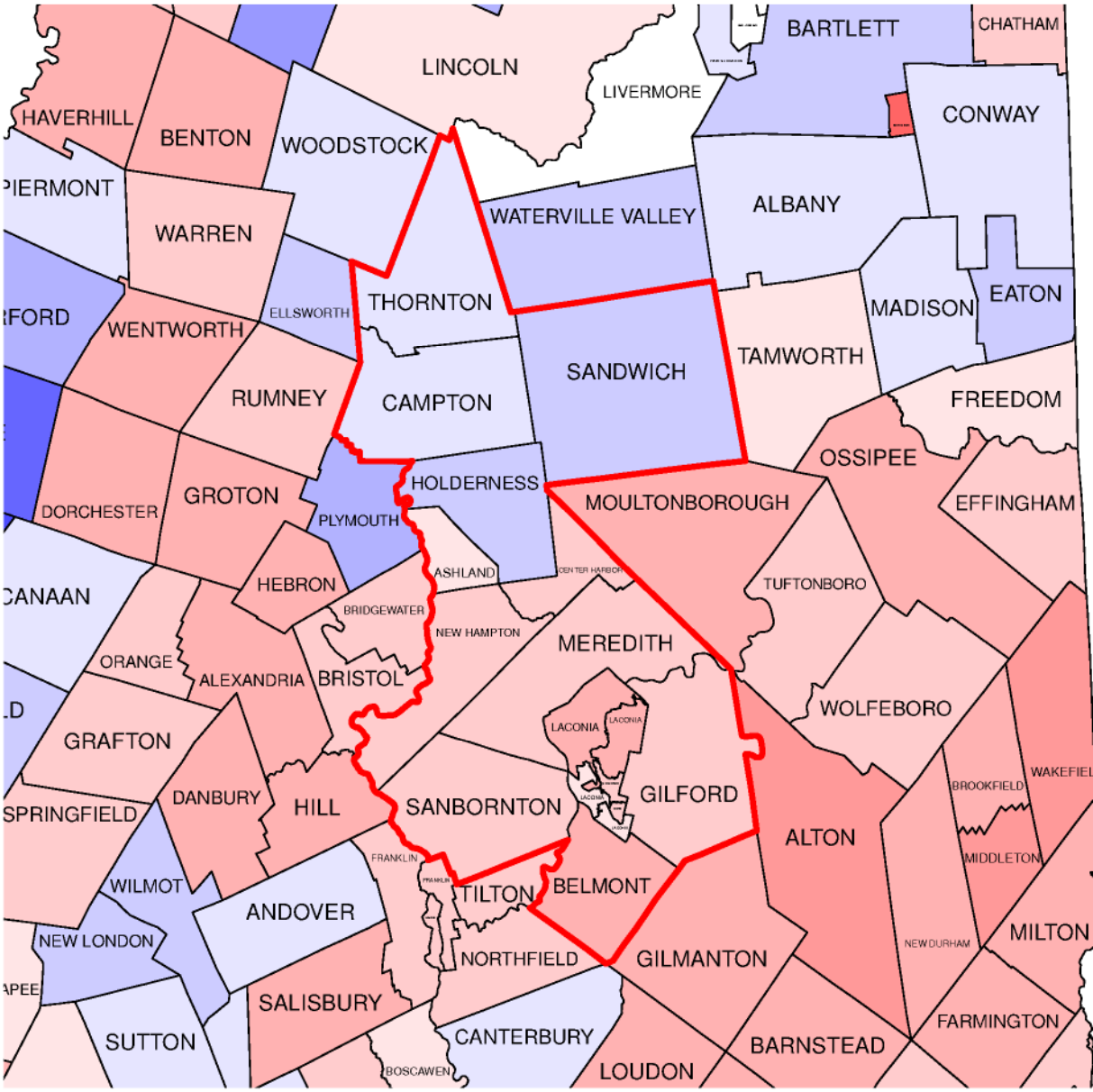
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 2

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

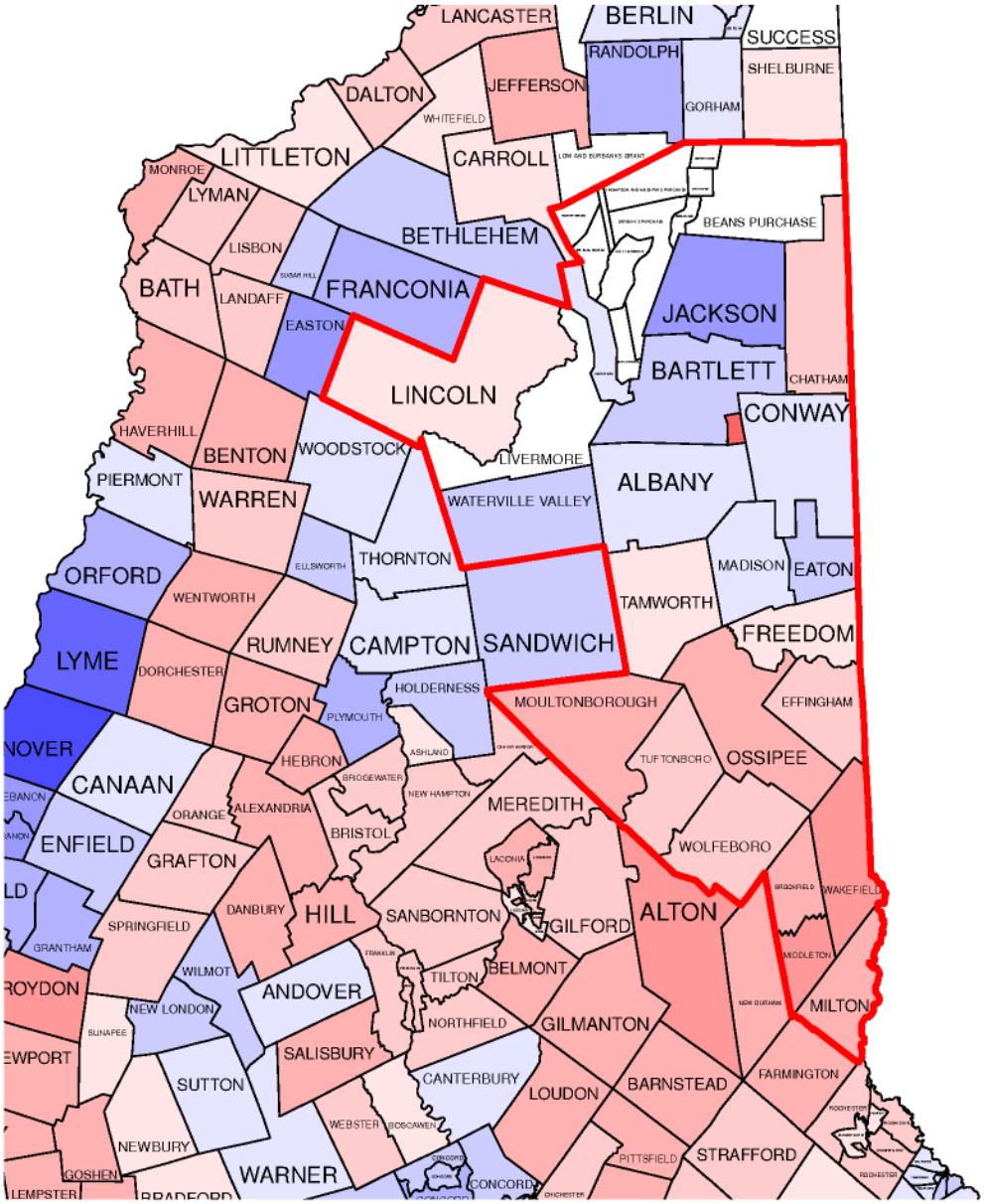
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 3

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

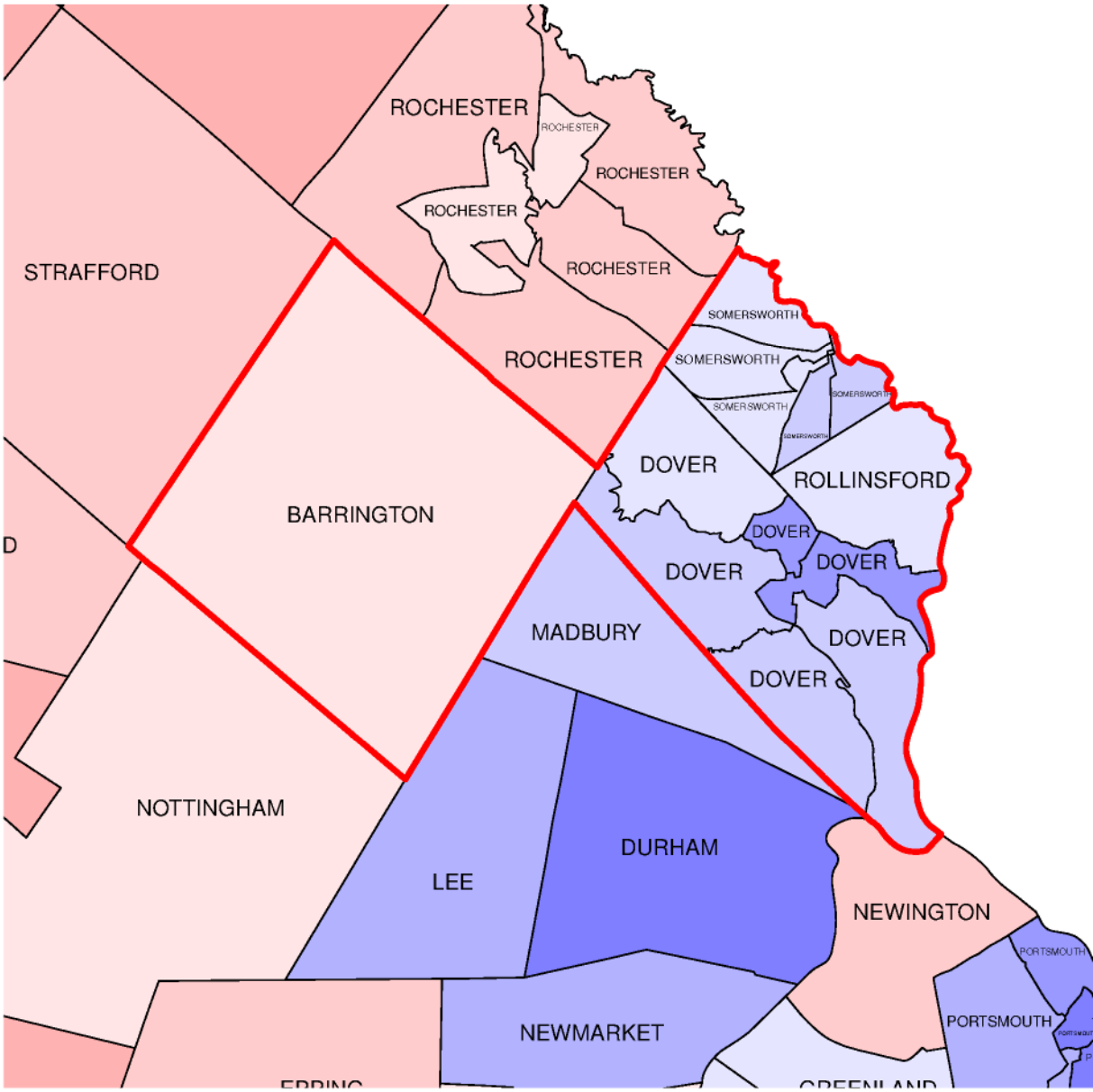
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 4

VTD-Level Republican Vote Share (2016-2020 Statewide Election Composite):

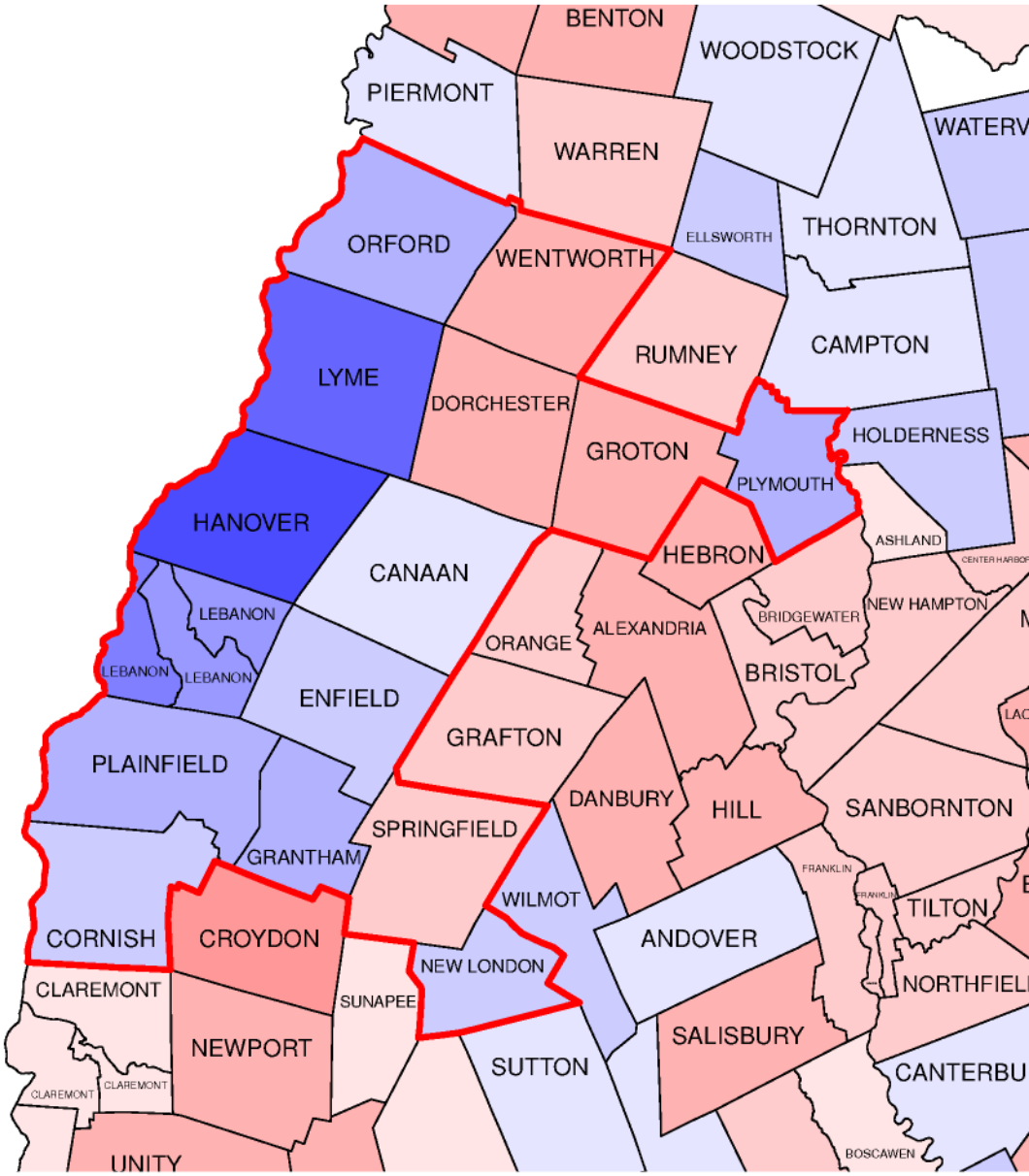
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 5

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

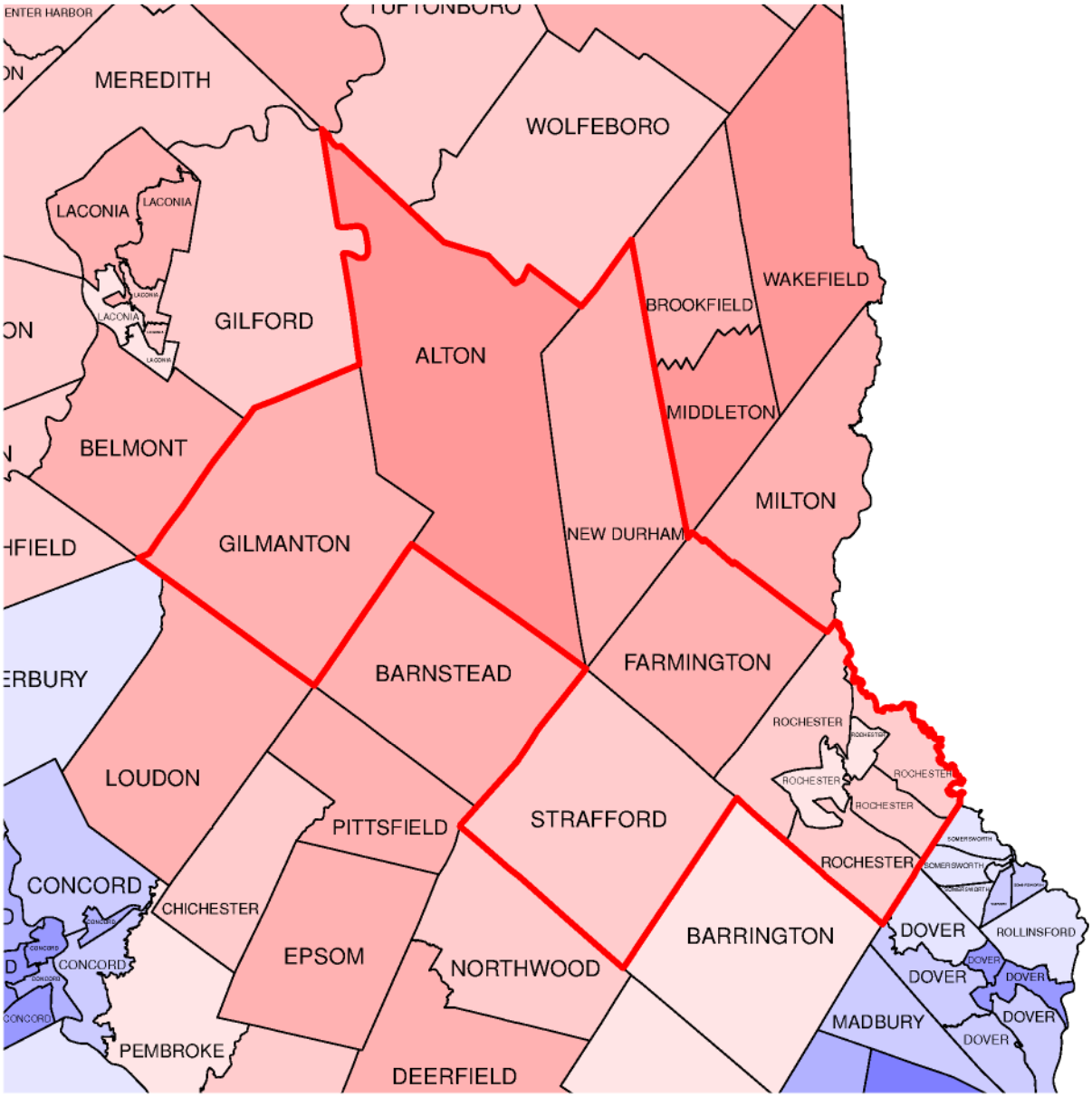
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 6

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

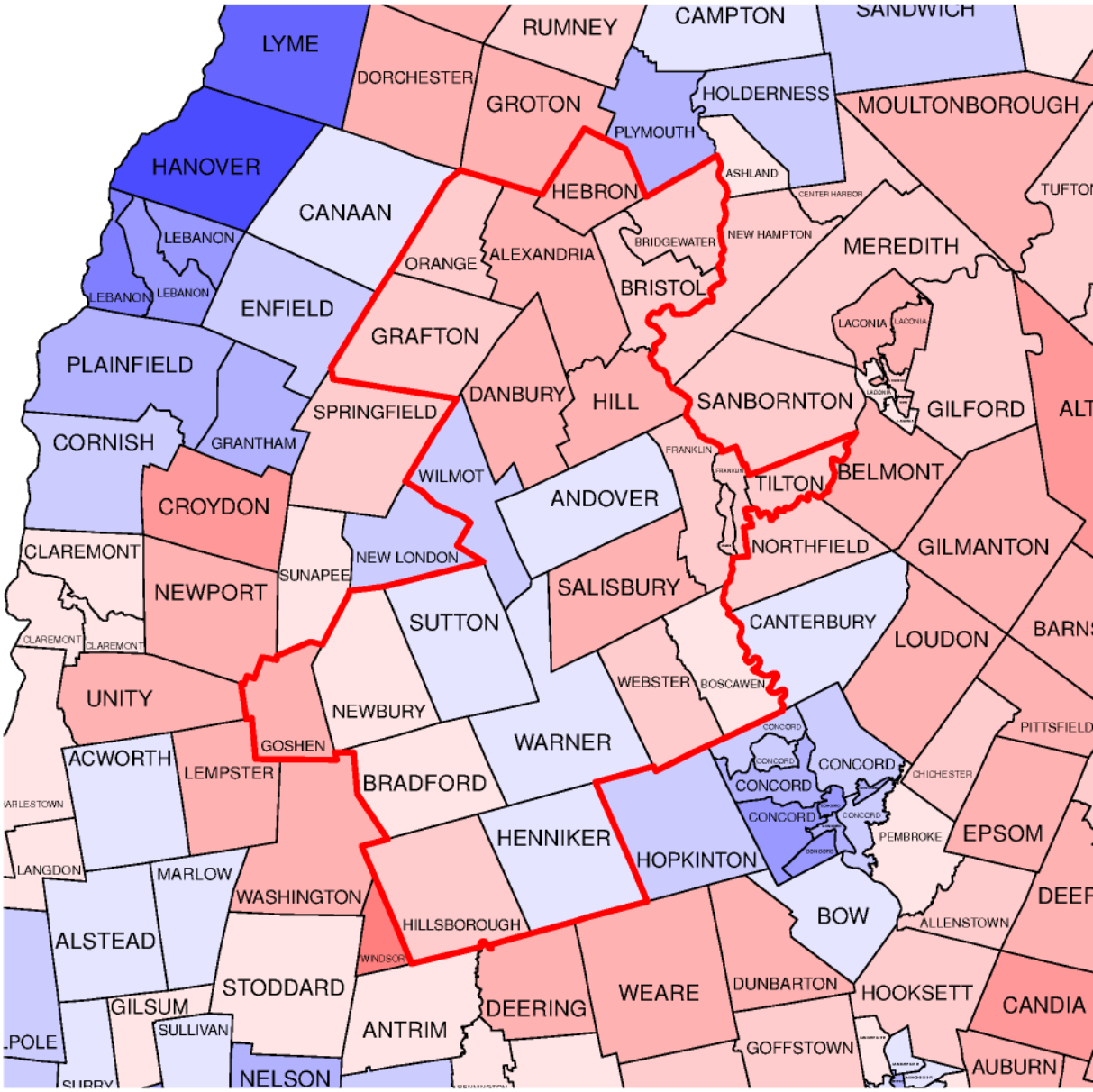
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 7

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

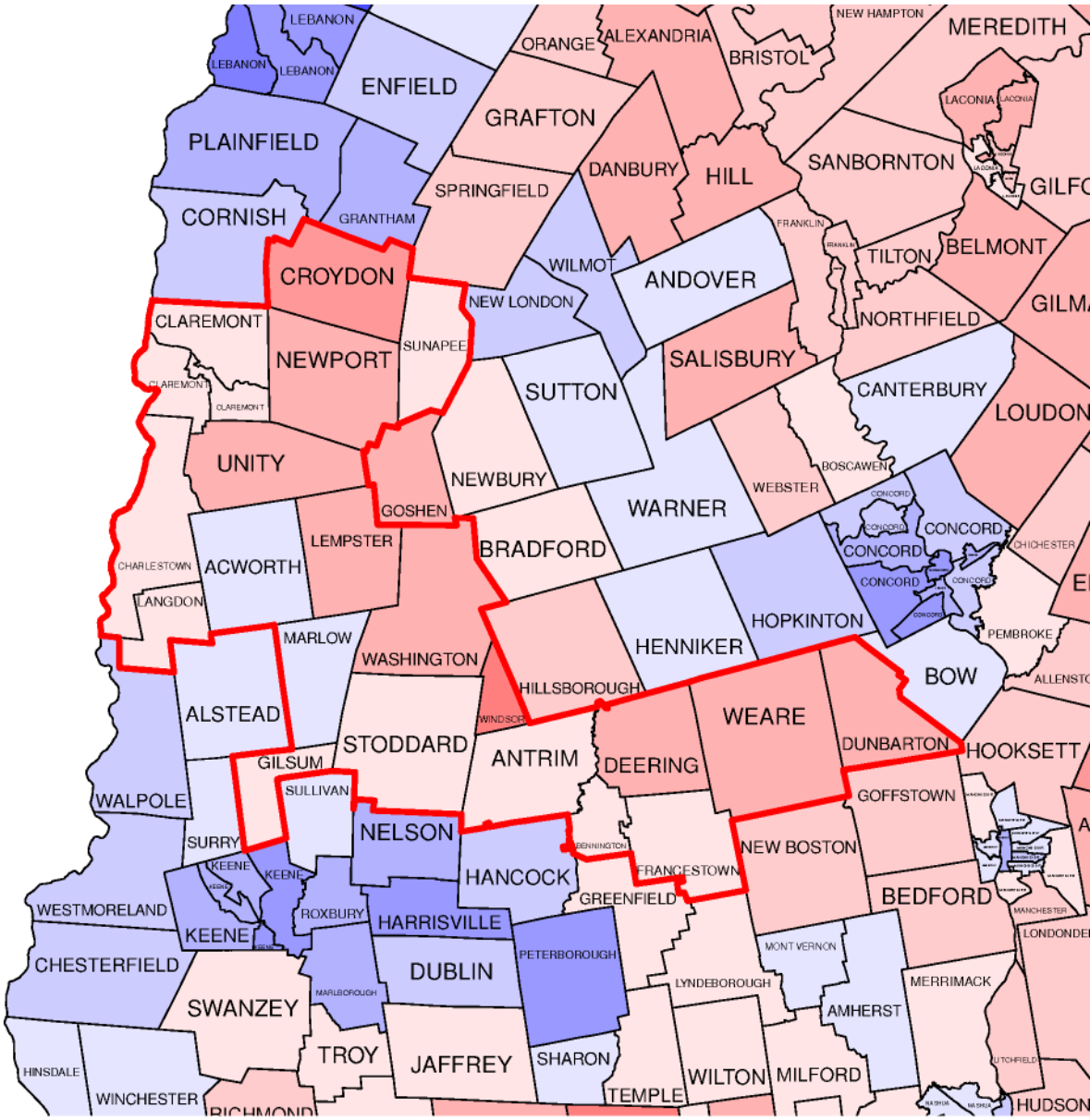
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 8

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

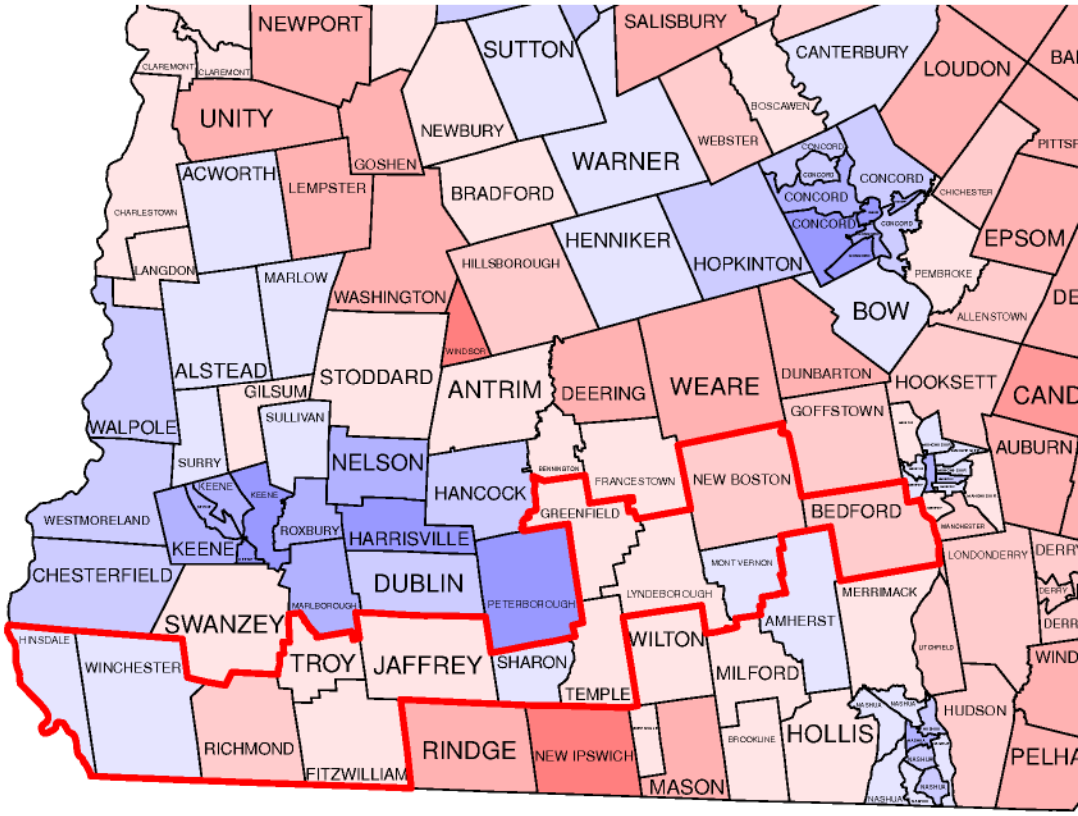
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 9

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 10

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
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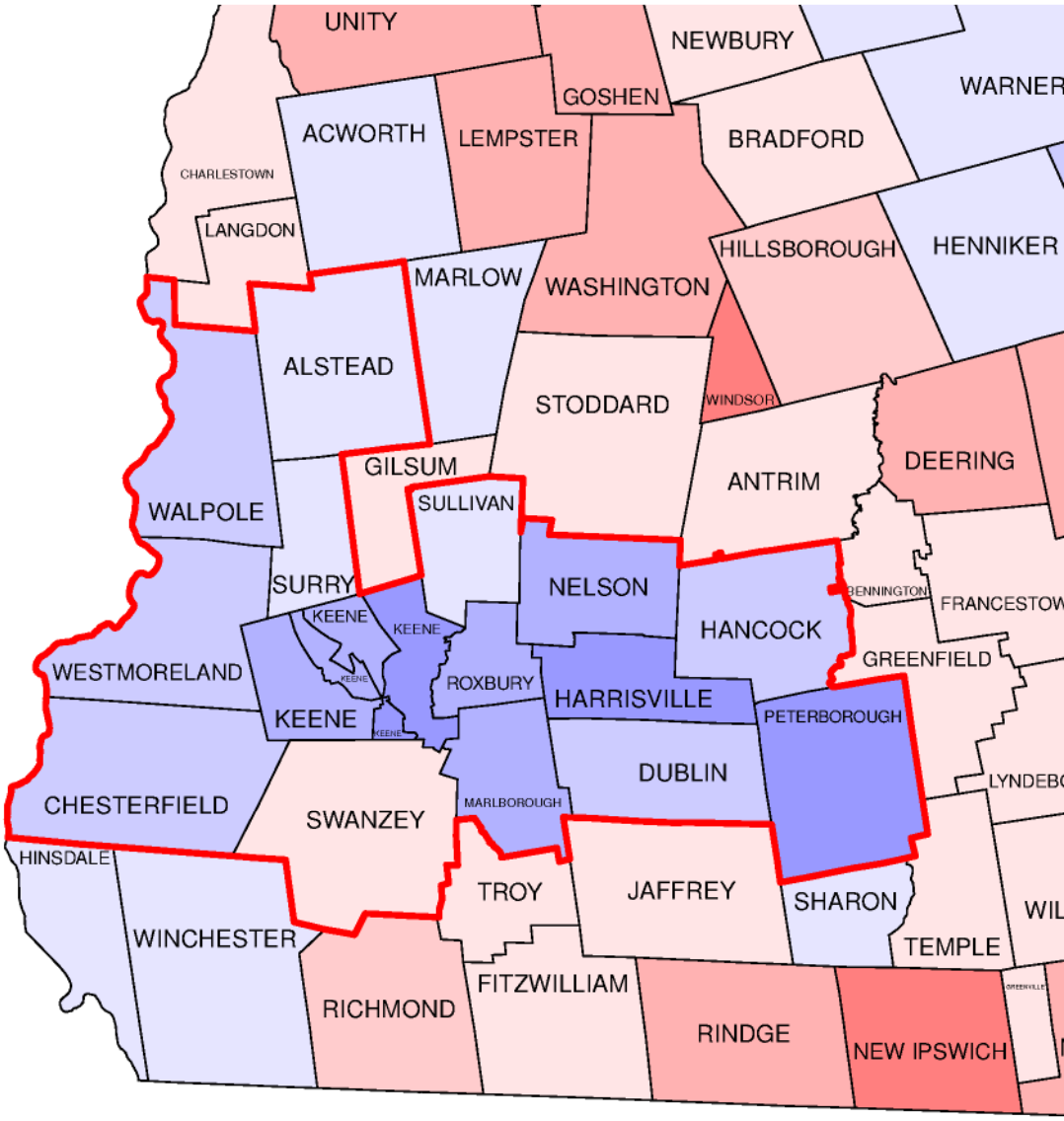
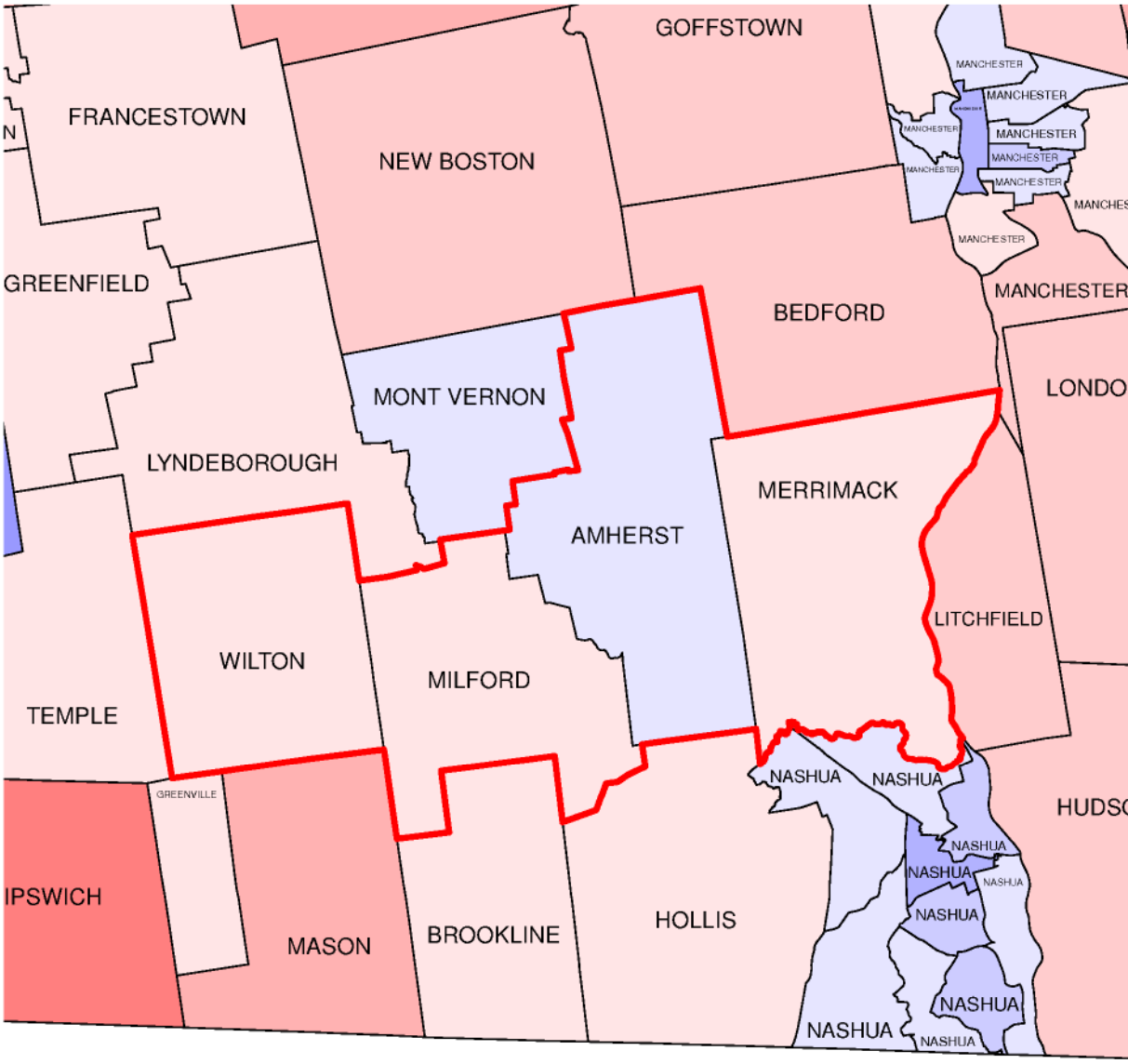
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 11

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 12

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
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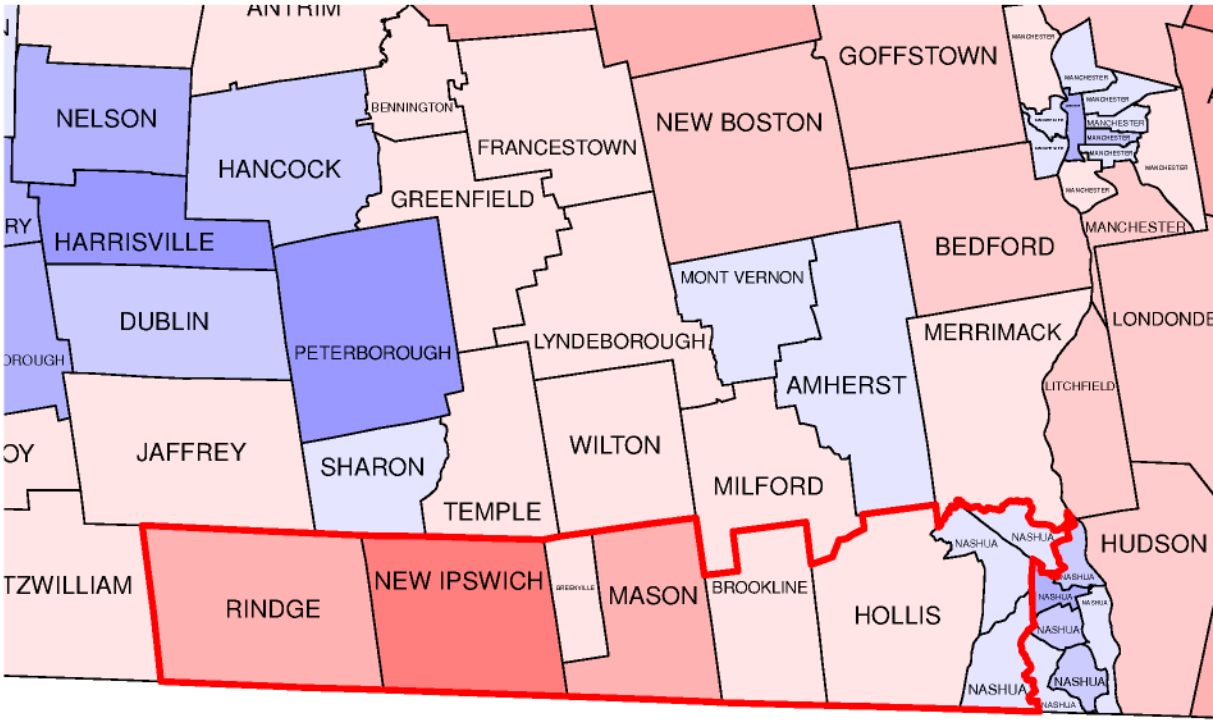
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 13

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
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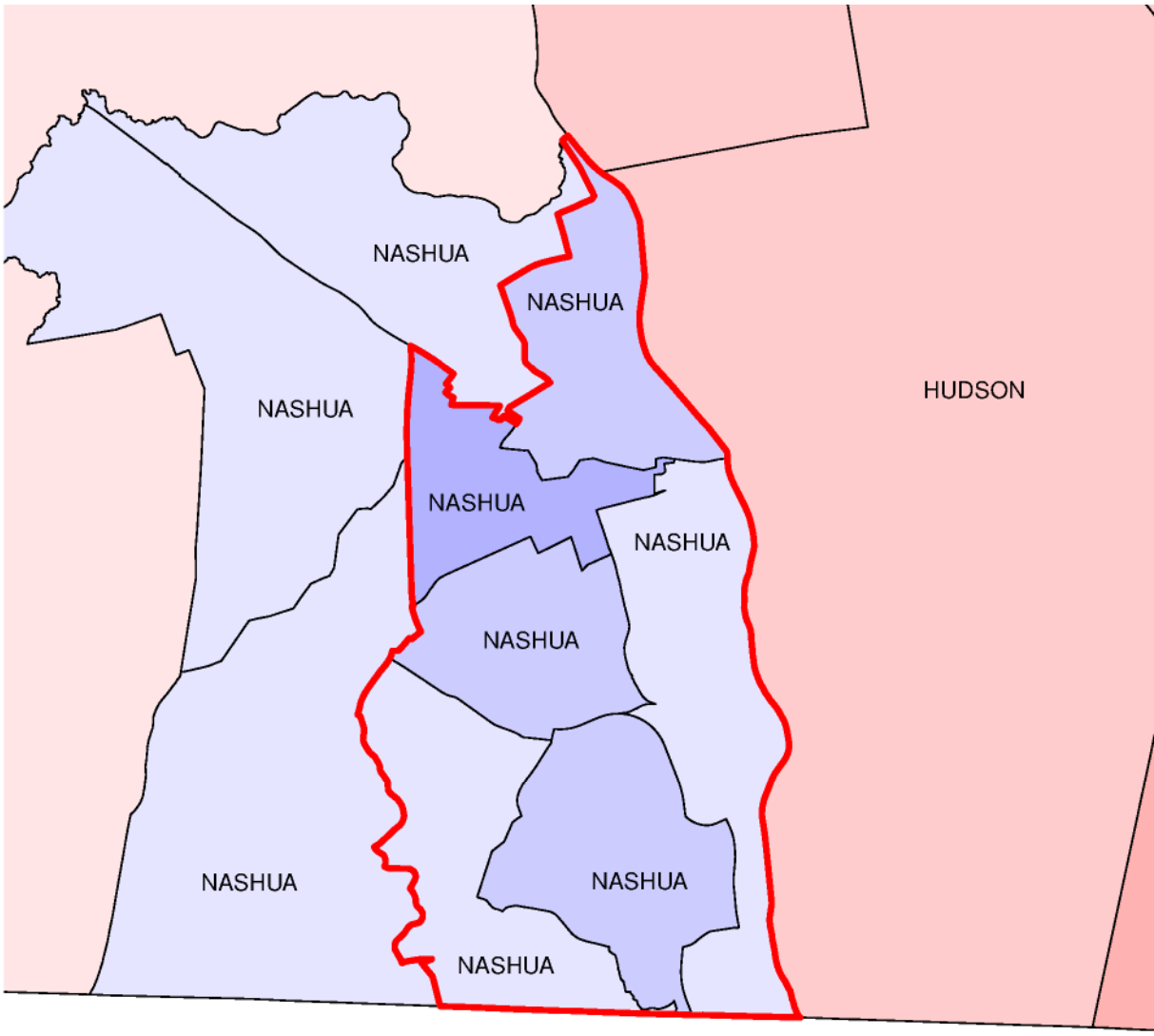
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 14

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
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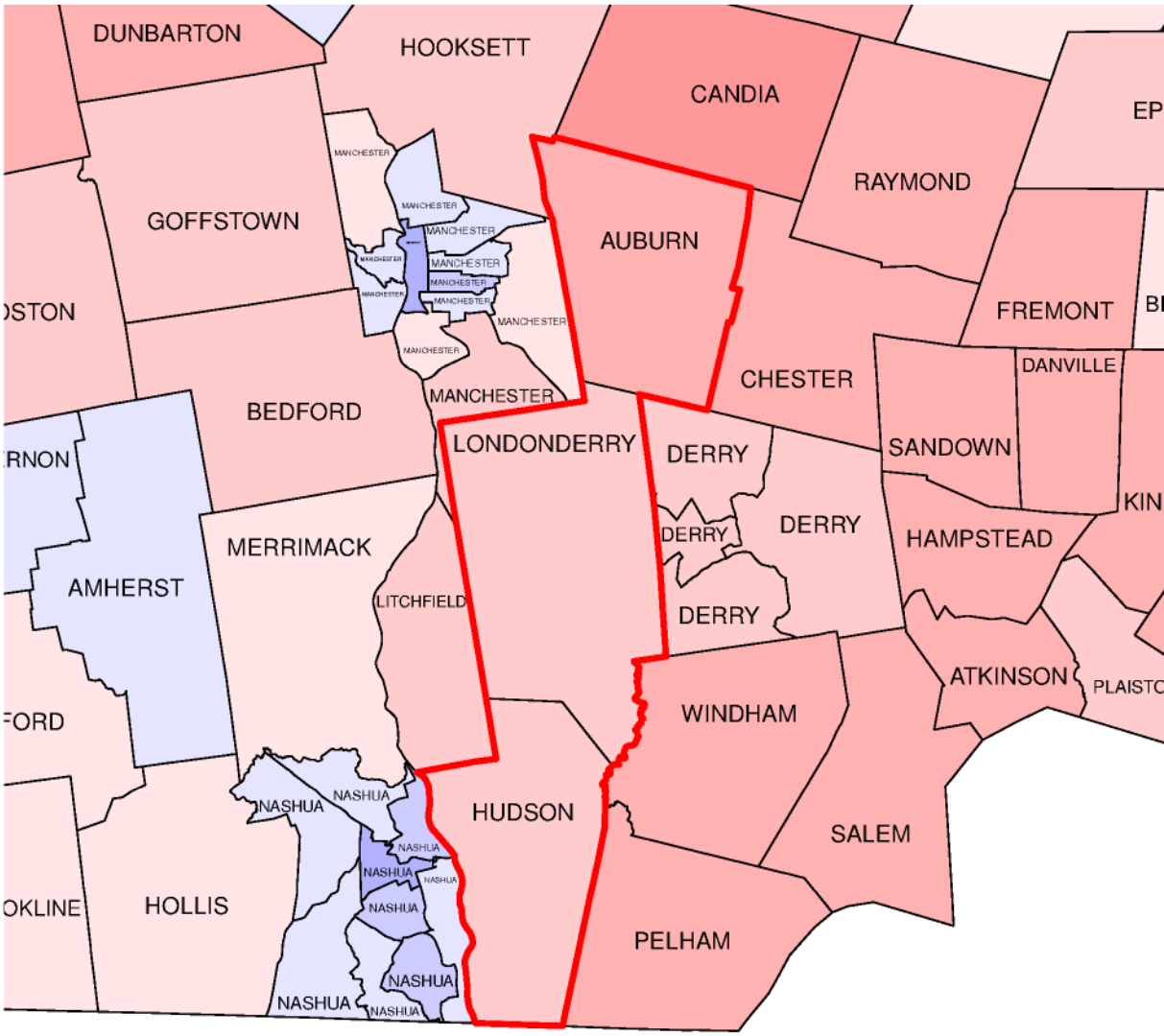
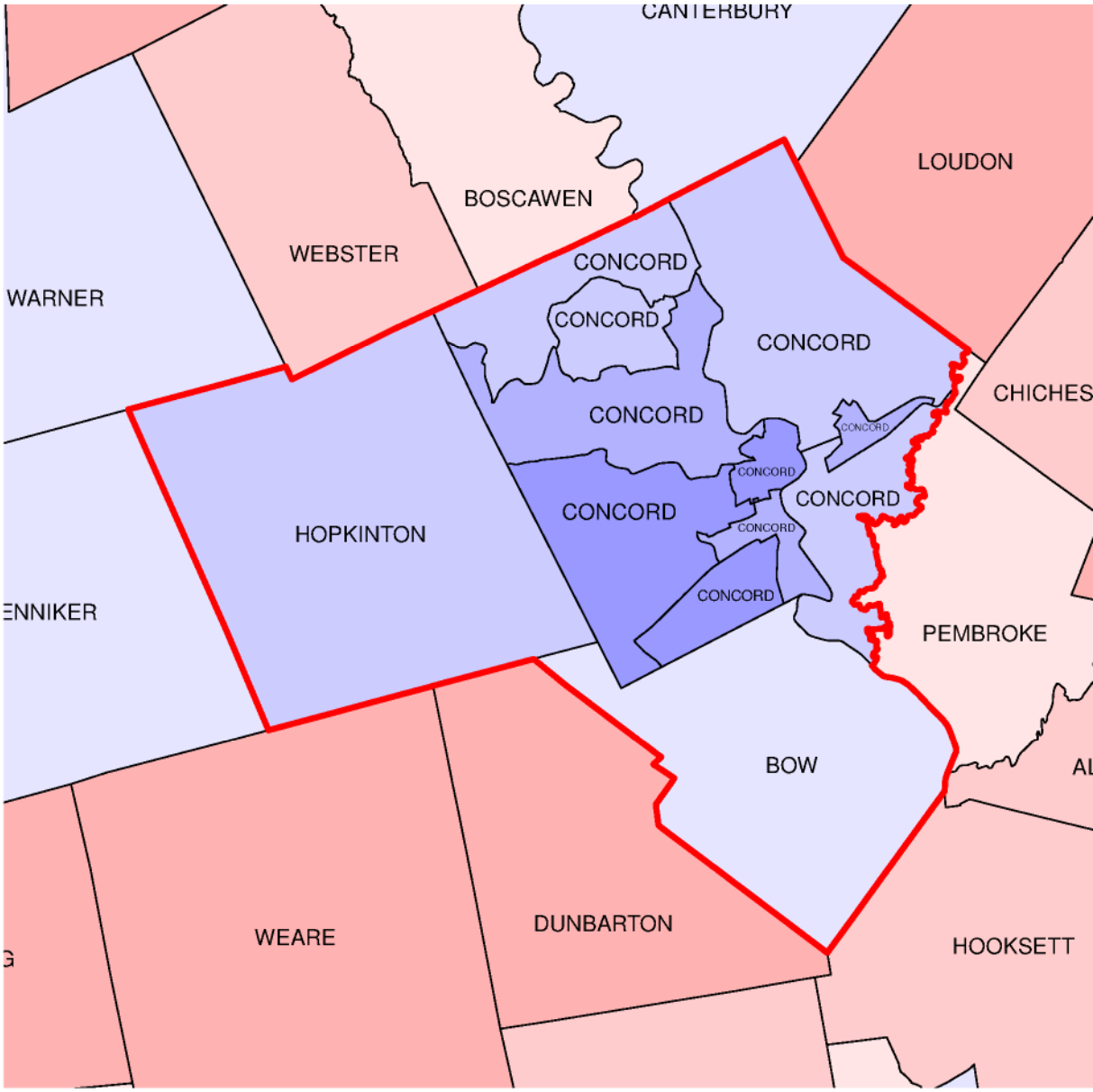
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 15

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

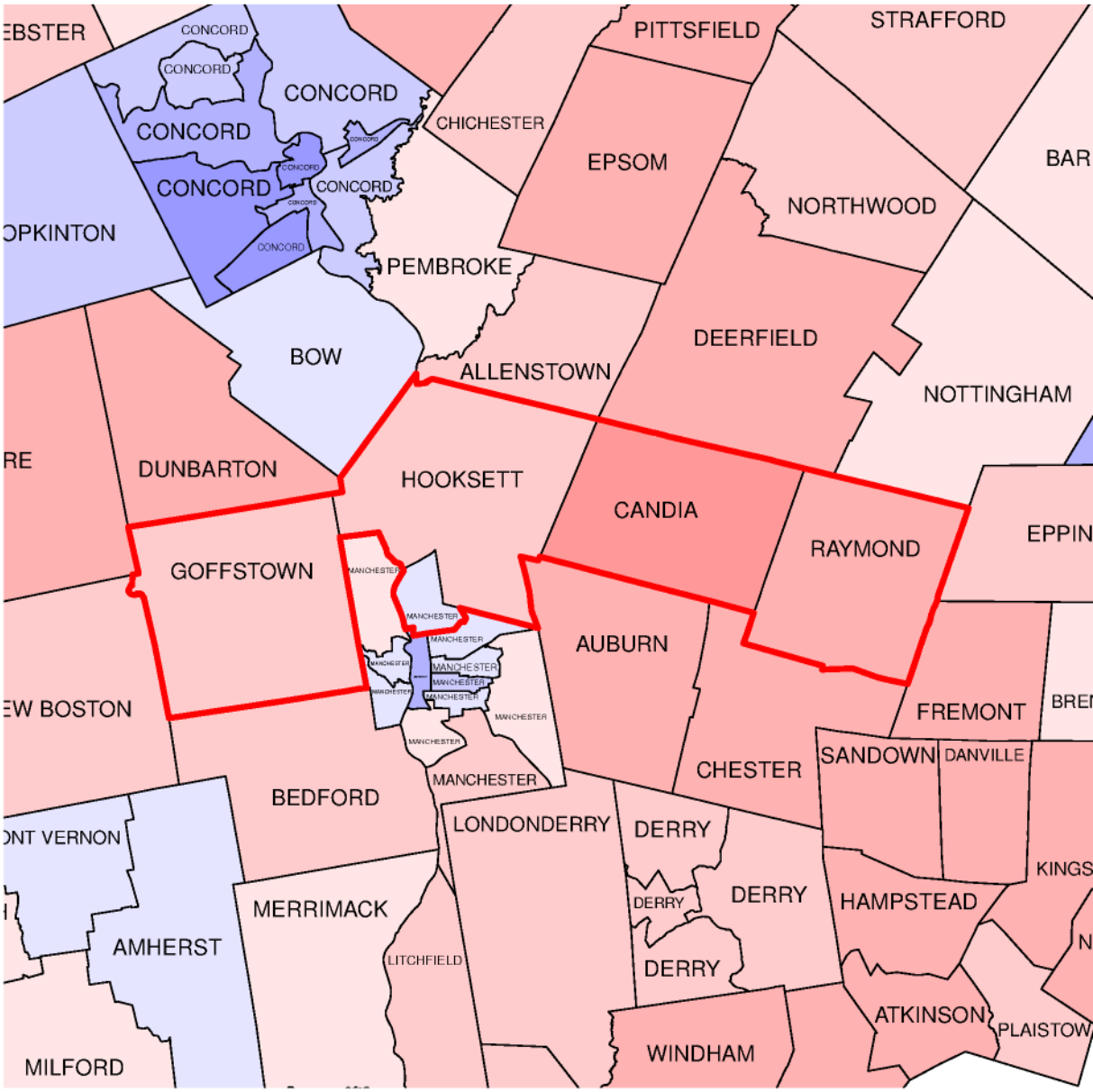
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 16

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 17

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
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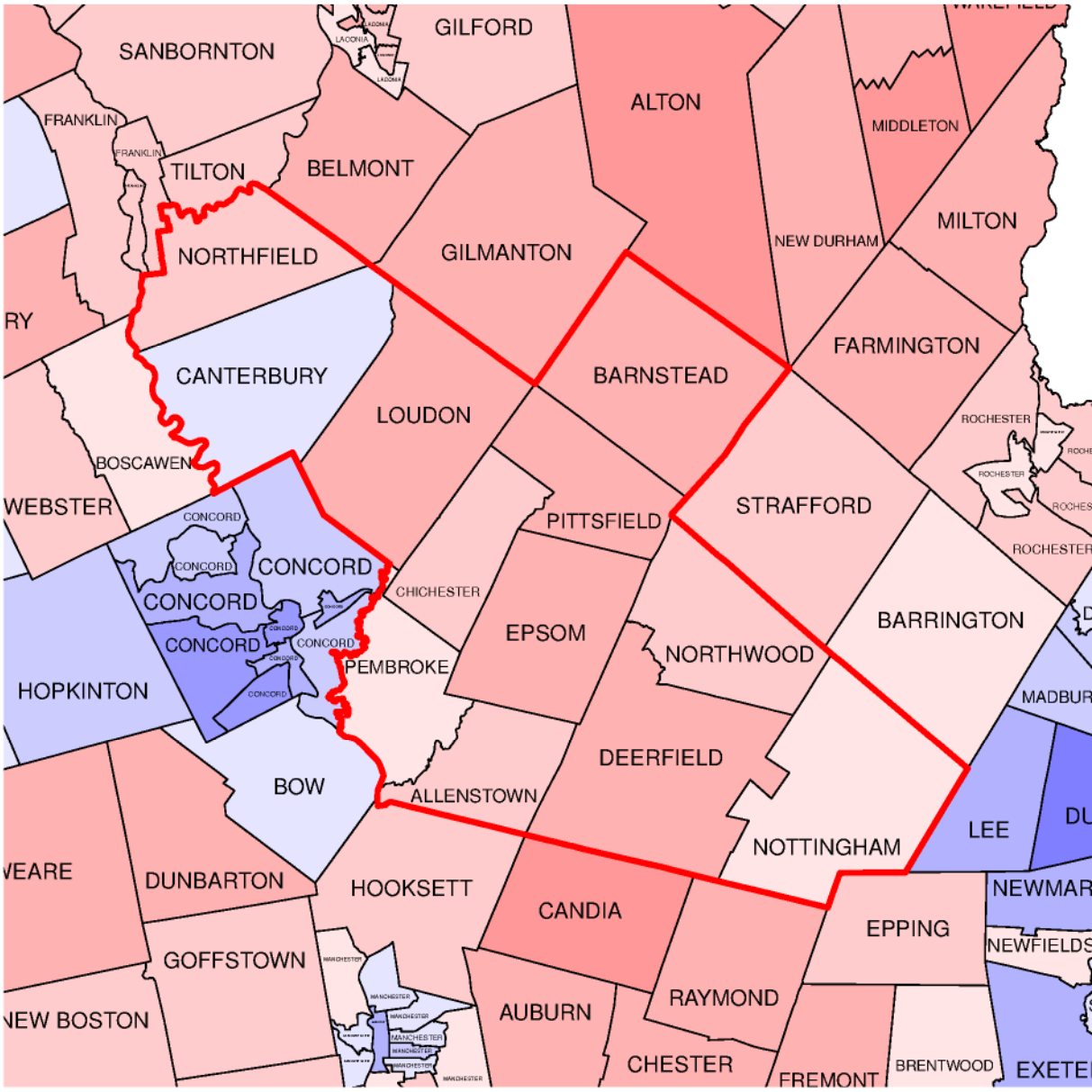
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 18

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
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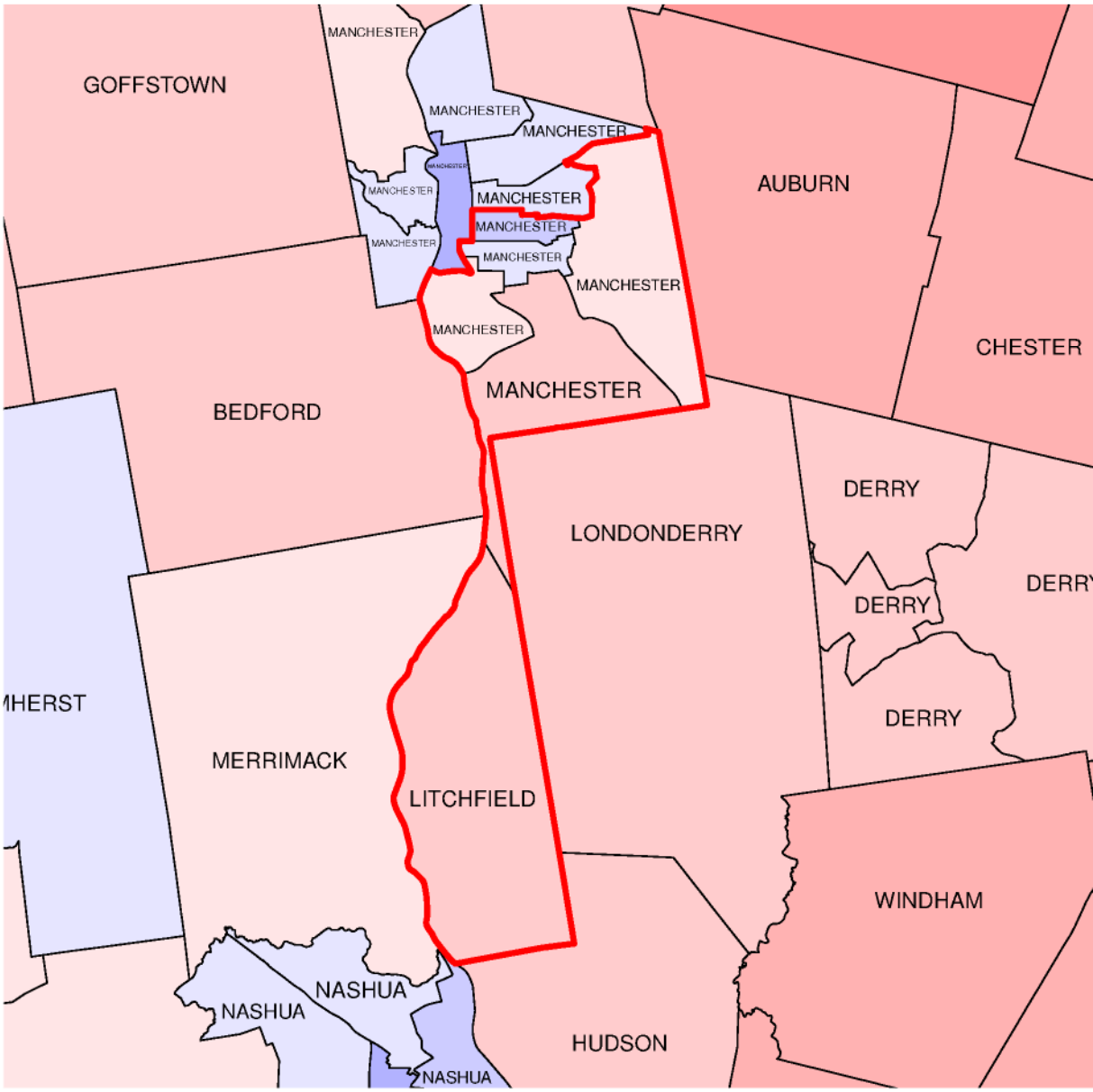
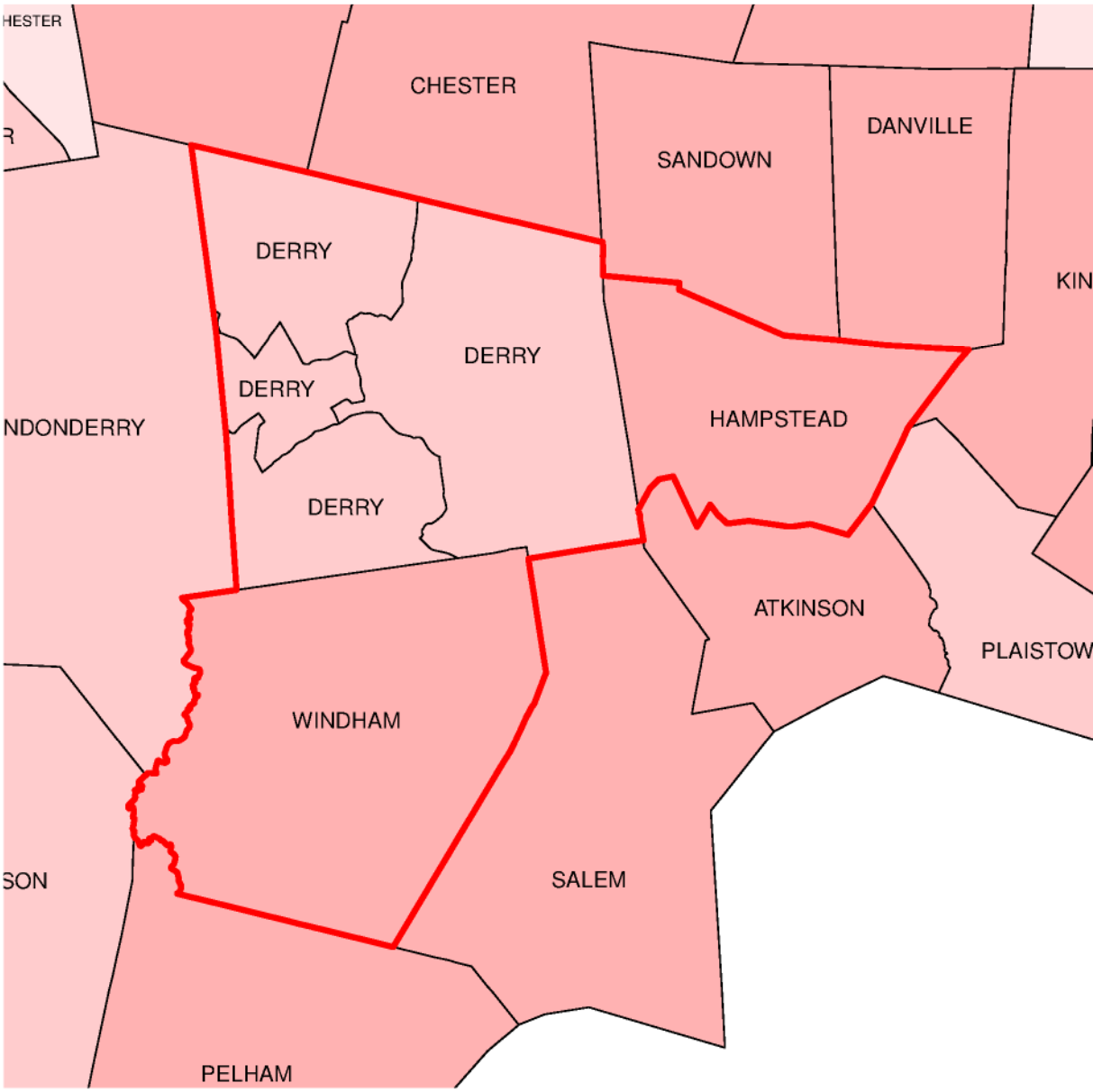
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 19

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

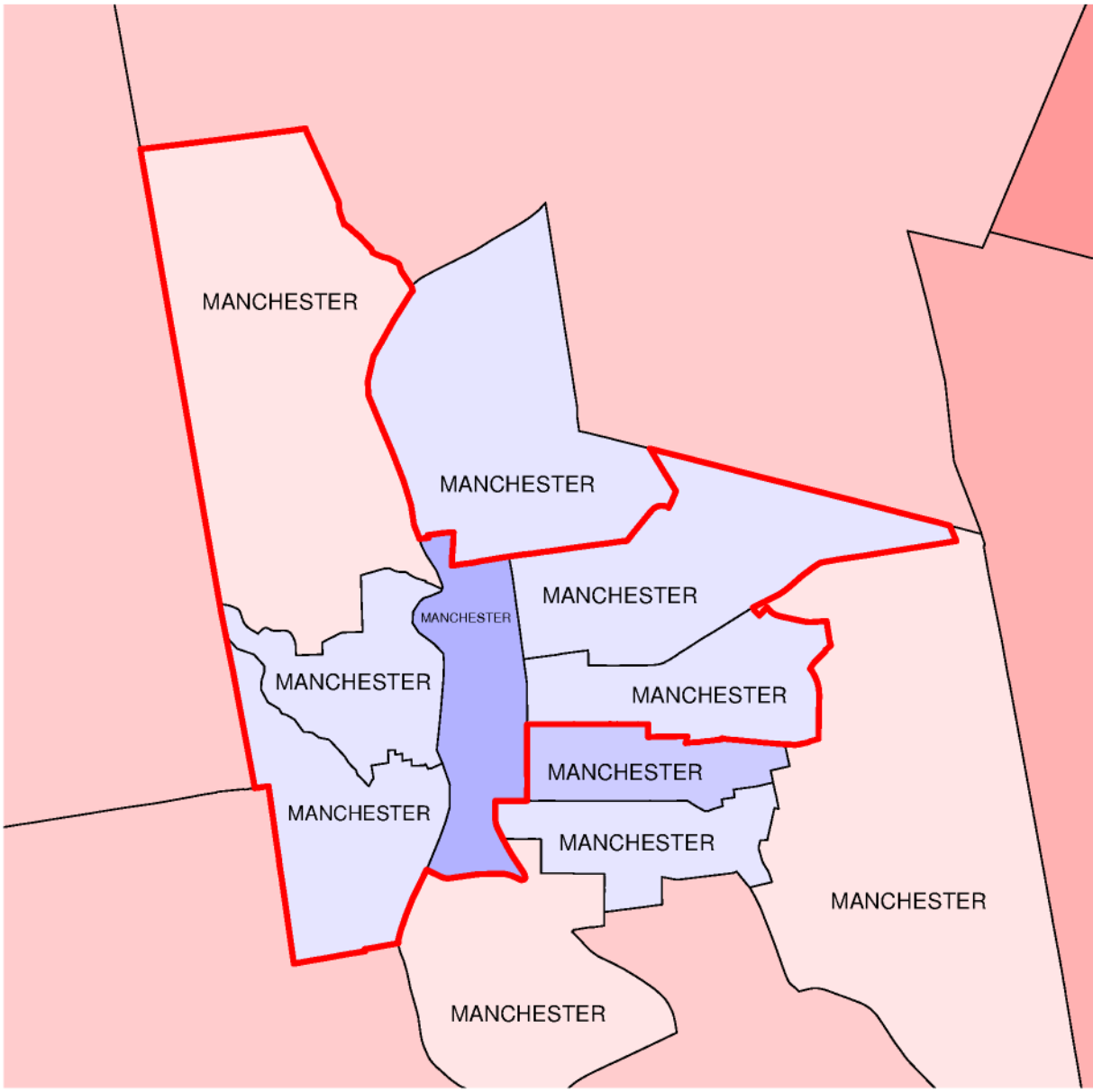
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 20

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

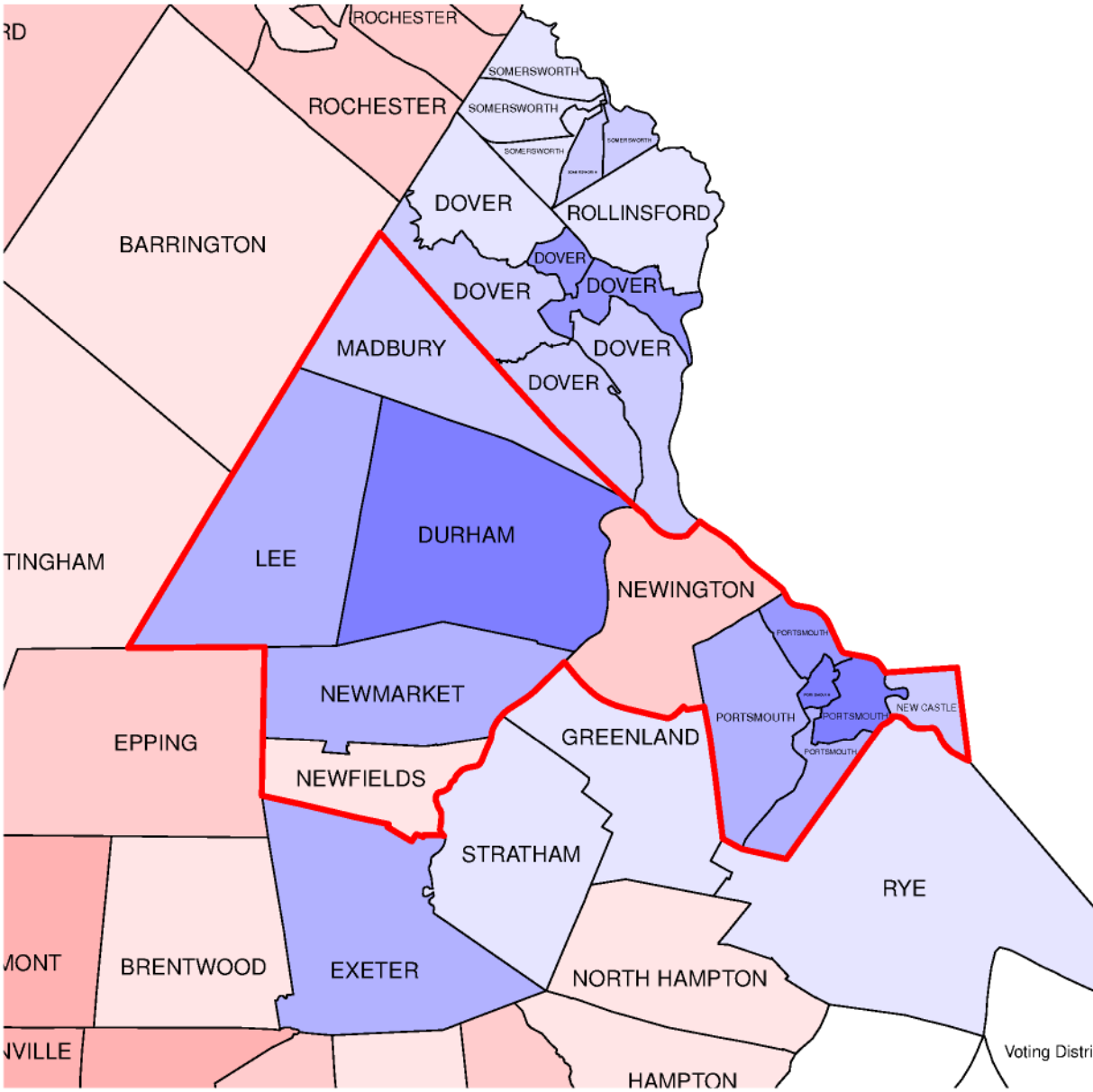
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 21

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

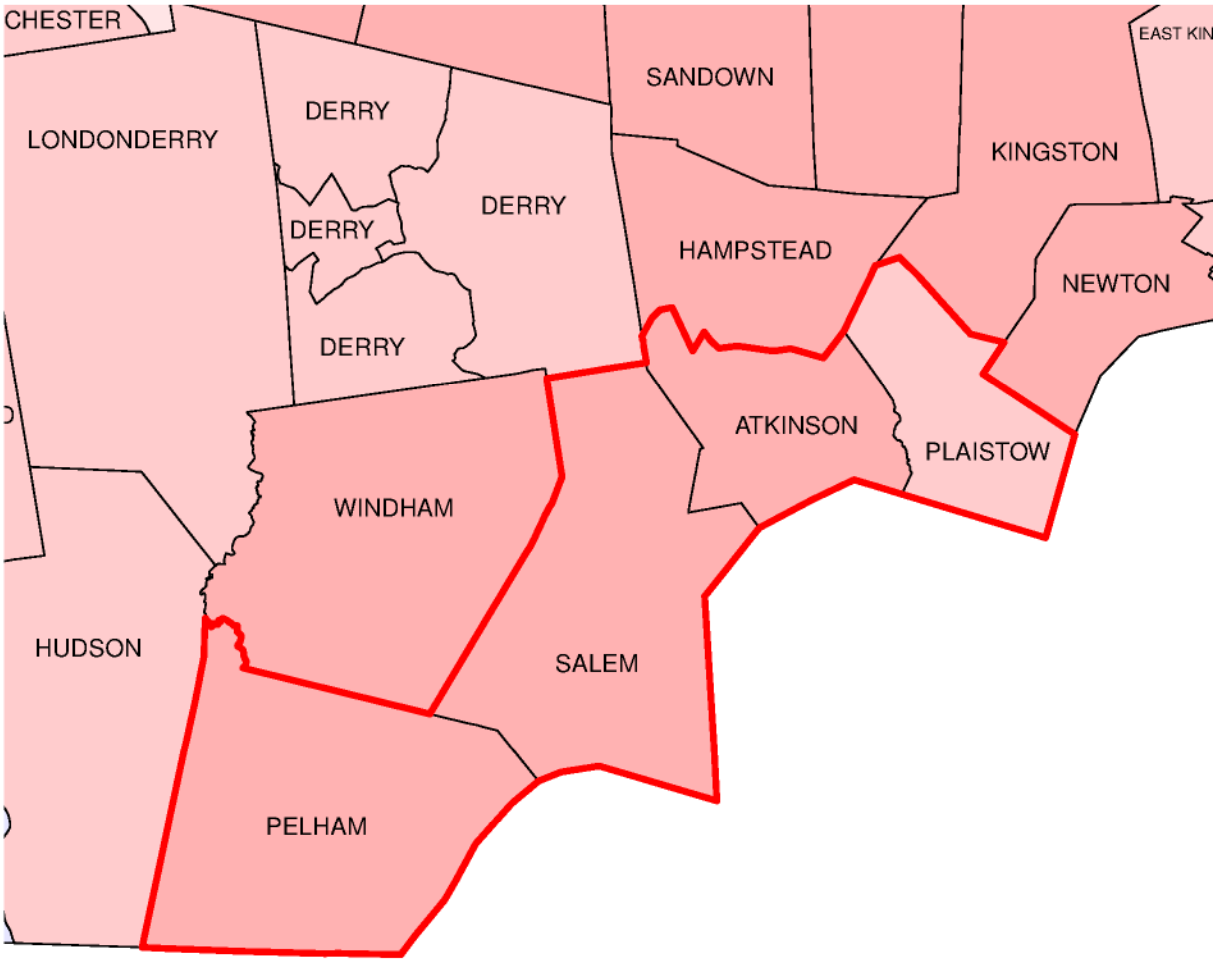
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 22

VTD-Level Republican Vote Share (2016-2020 Statewide Election Composite):

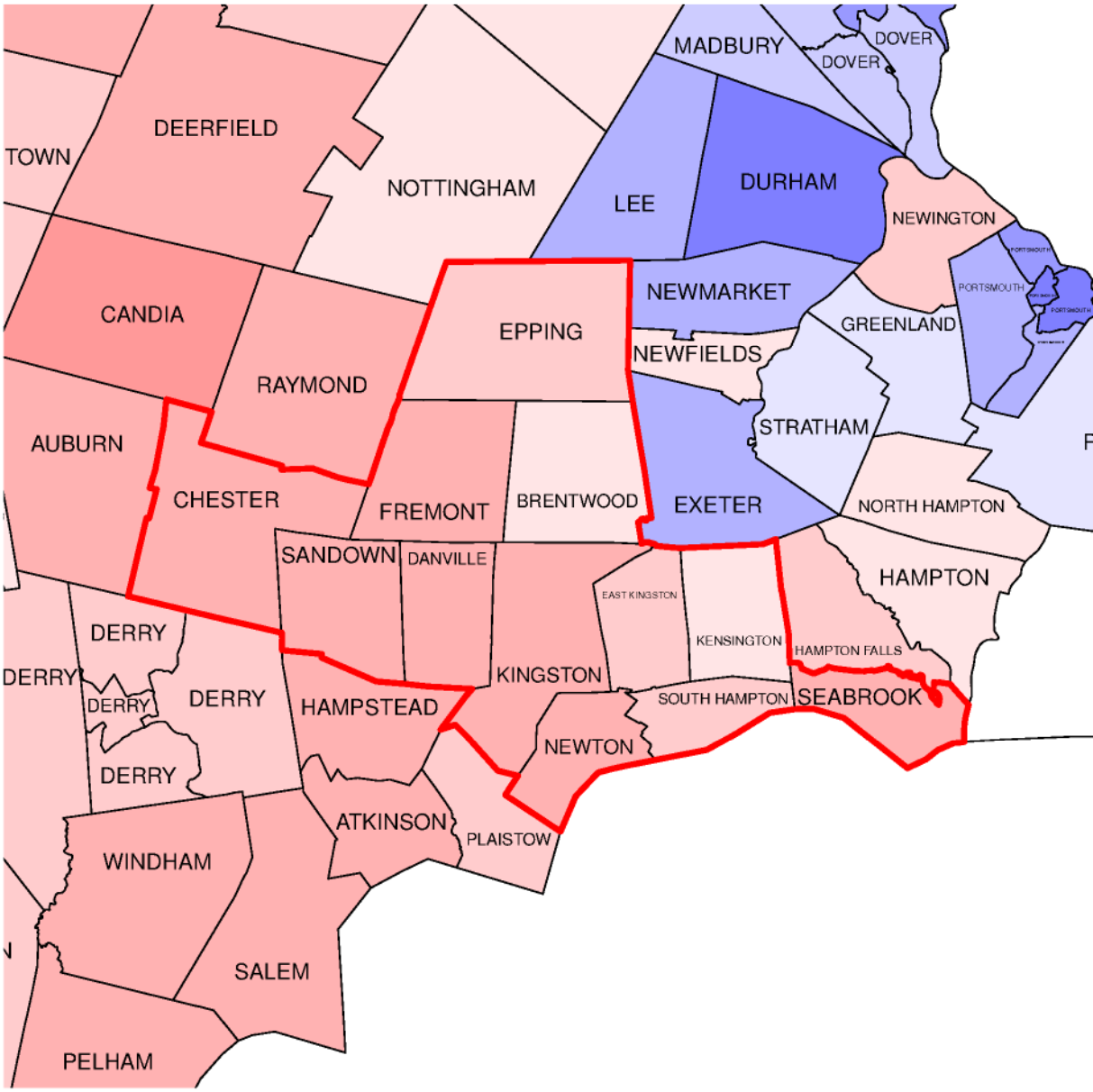
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 23

VTD-Level Republican Vote Share (2016-2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix B: 2022 SB 240 Enacted Senate Plan, District 24

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%

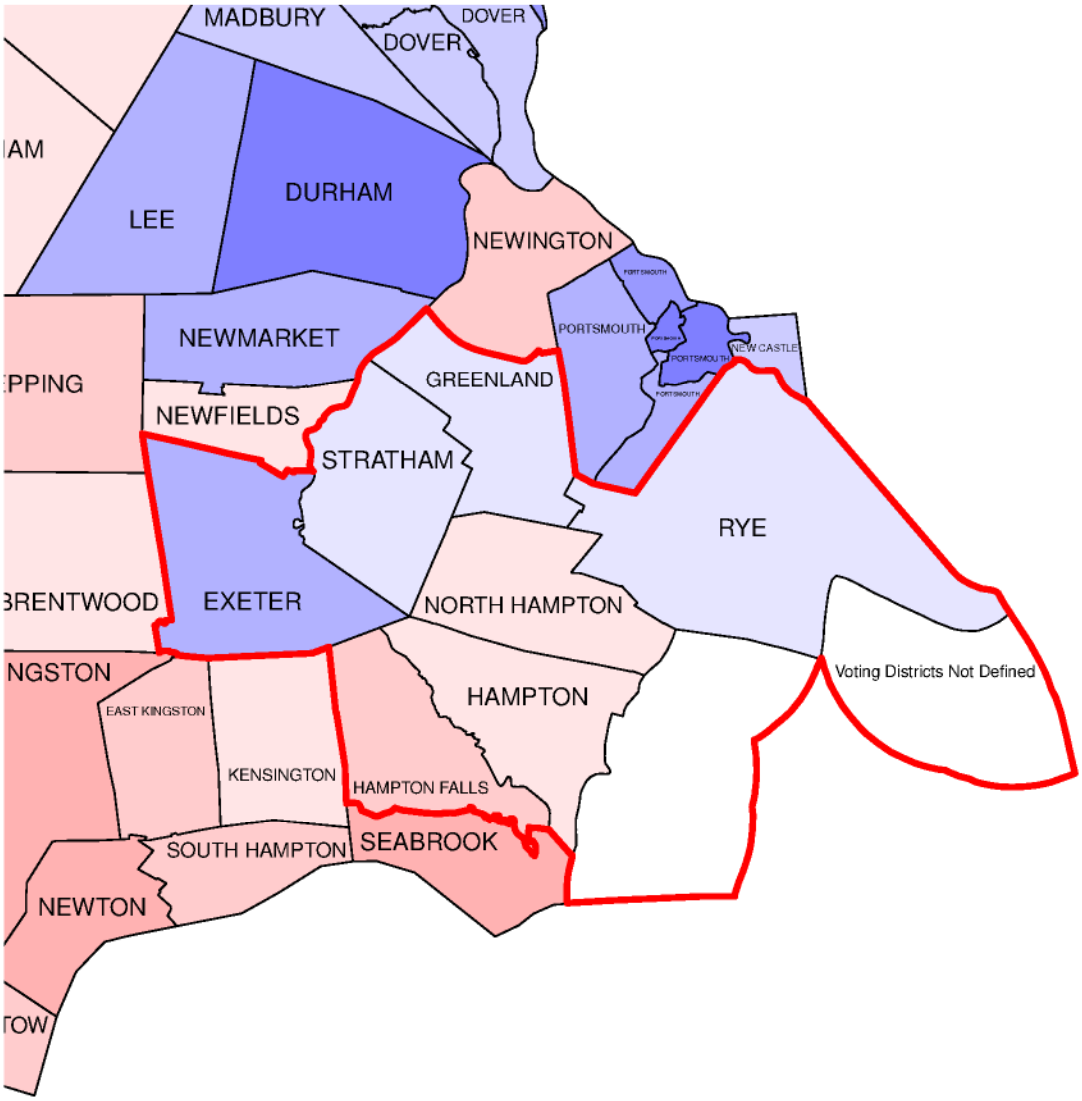


Figure C1: Comparison of Enacted SB 241 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 Governor Election Results

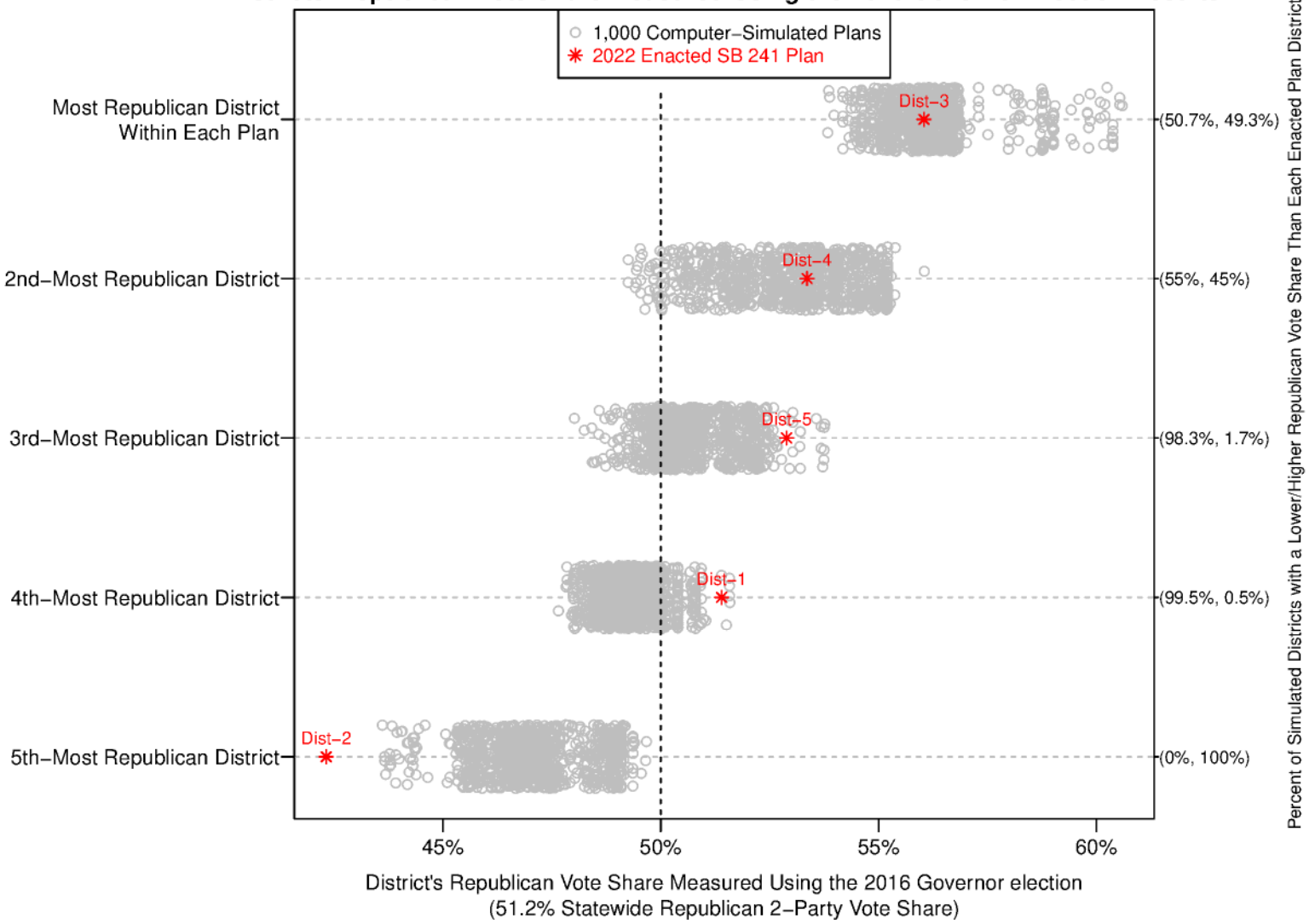


Figure C2: Comparison of Enacted SB 241 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 US President Election Results

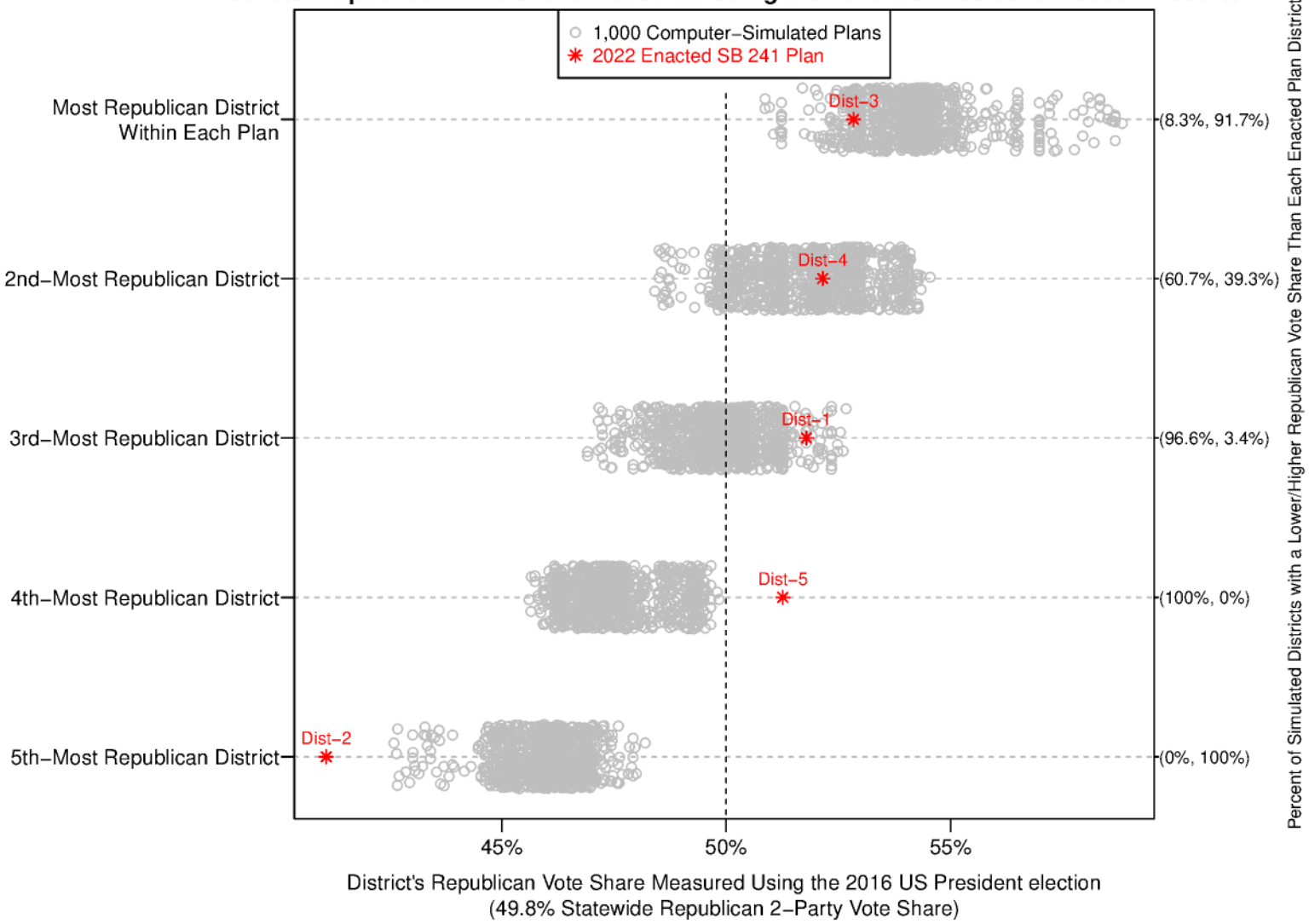


Figure C3: Comparison of Enacted SB 241 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 US Senator Election Results

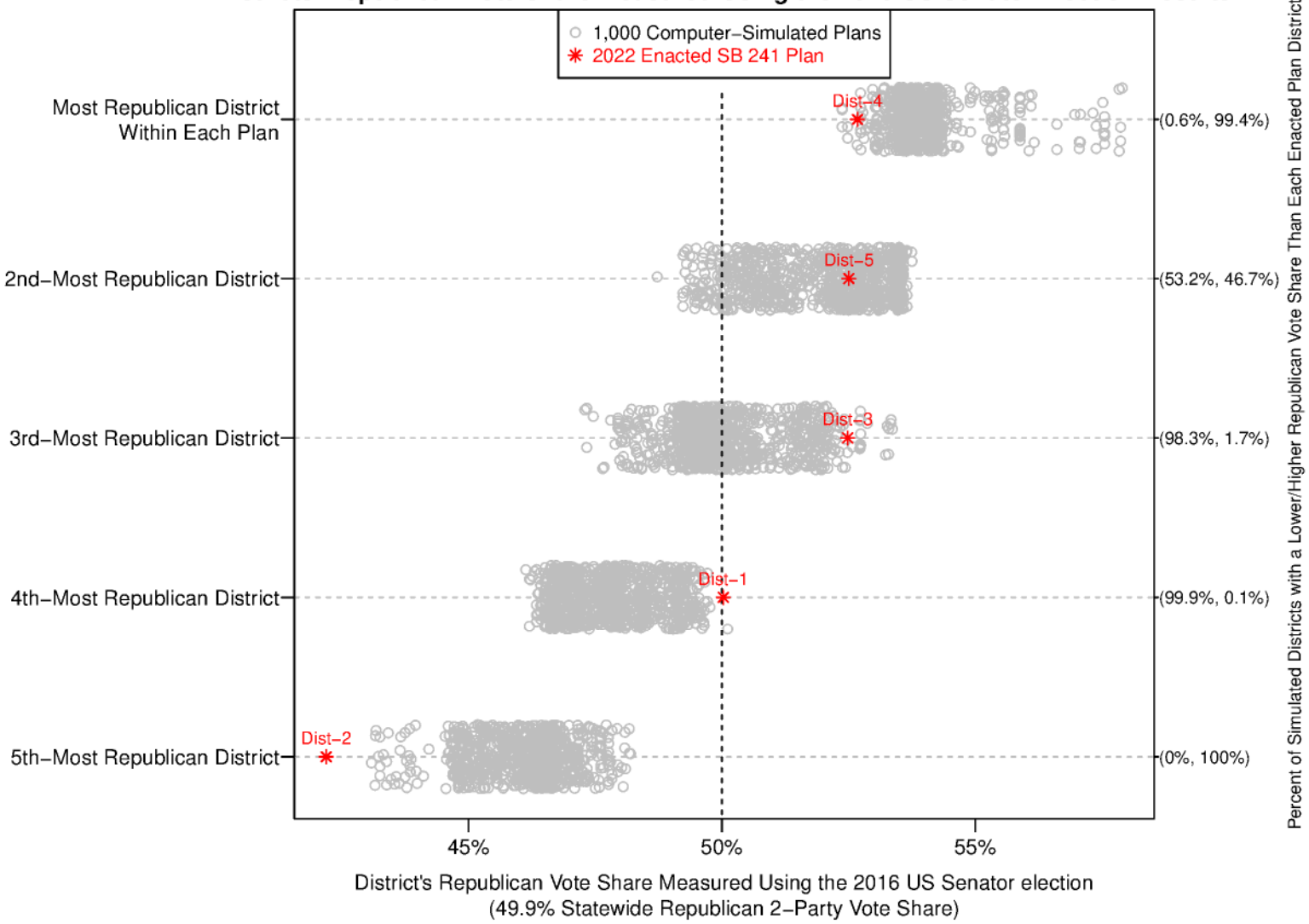


Figure C4: Comparison of Enacted SB 241 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2018 Governor Election Results

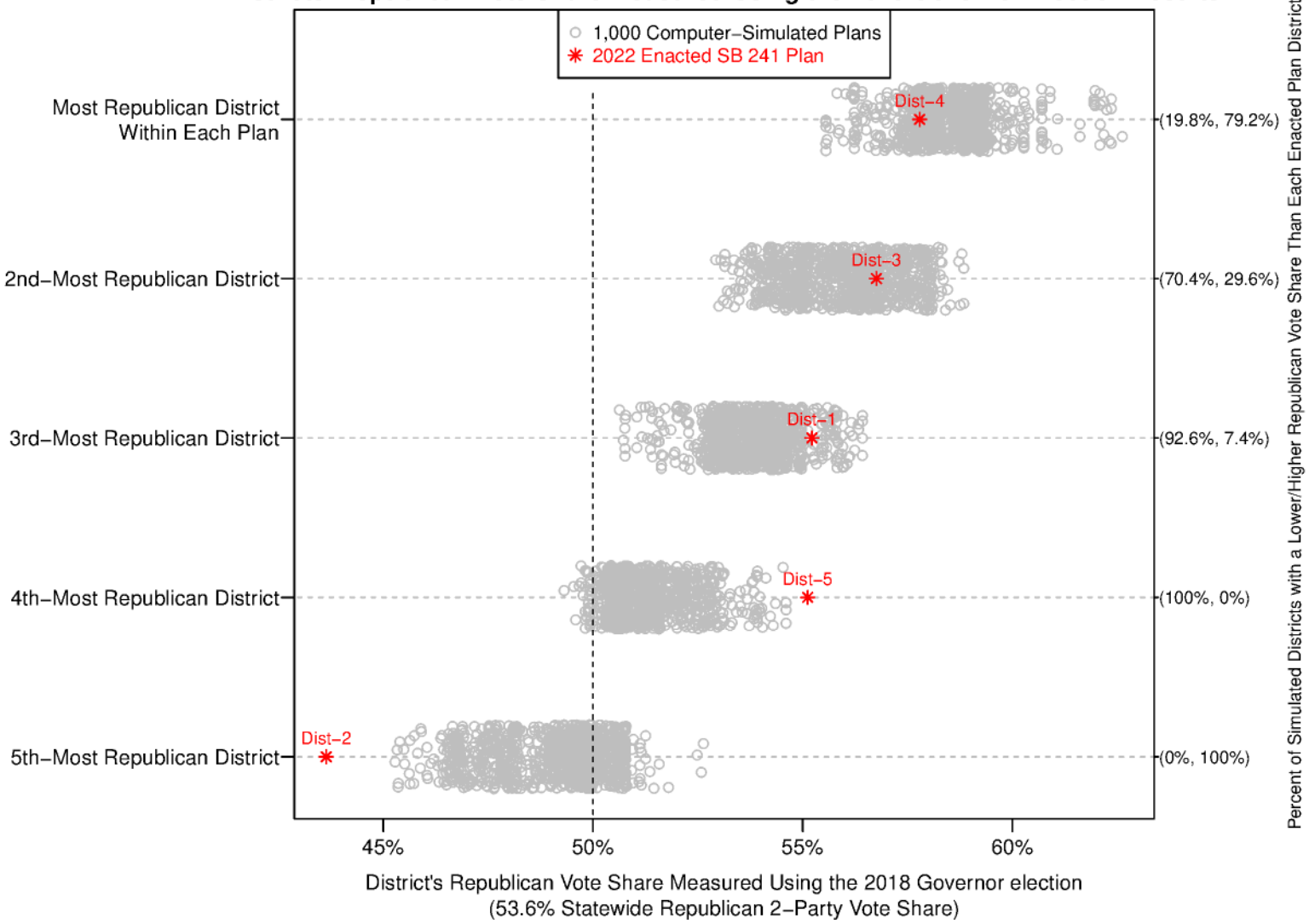


Figure C5: Comparison of Enacted SB 241 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 Governor Election Results

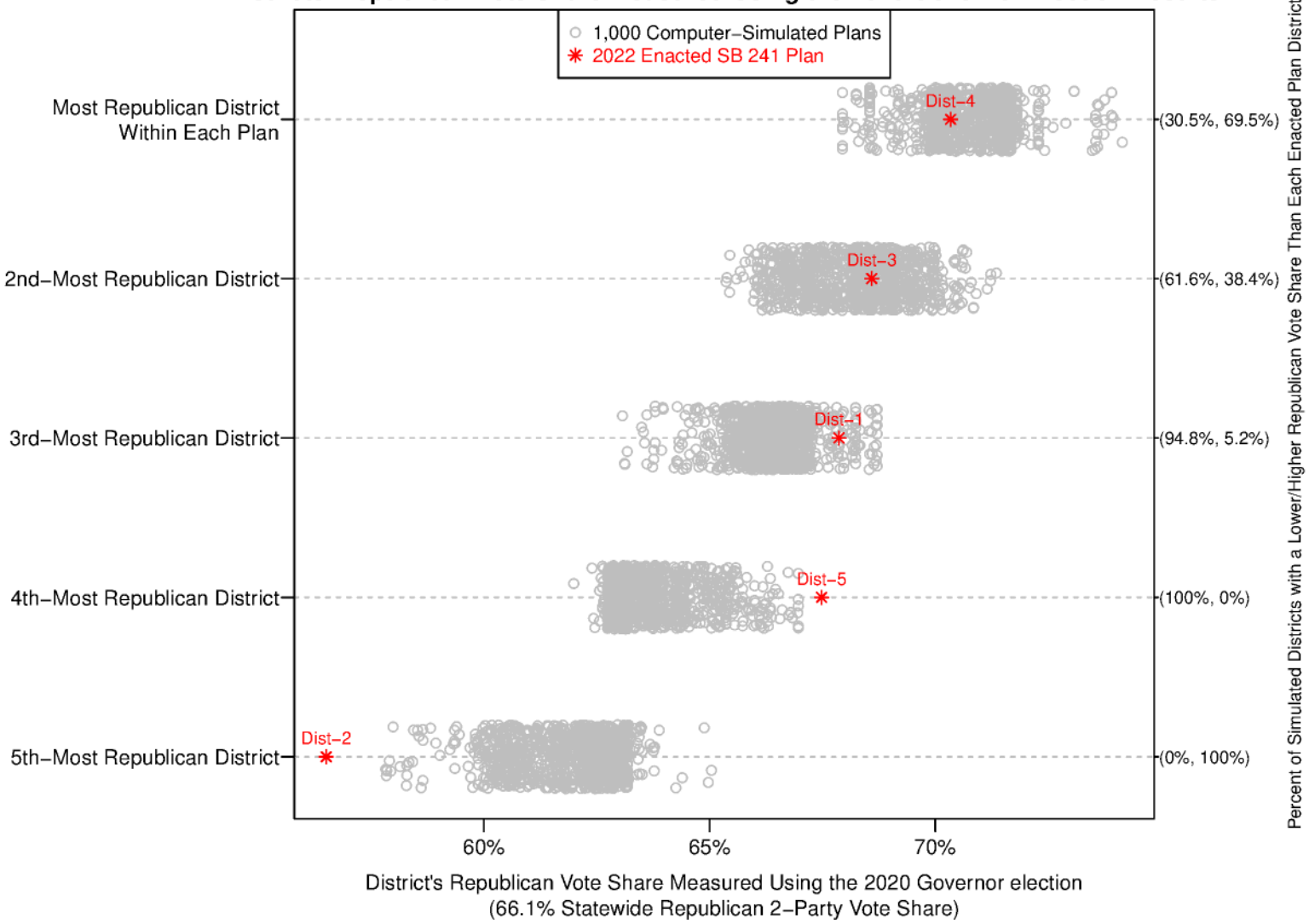


Figure C6: Comparison of Enacted SB 241 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 US President Election Results

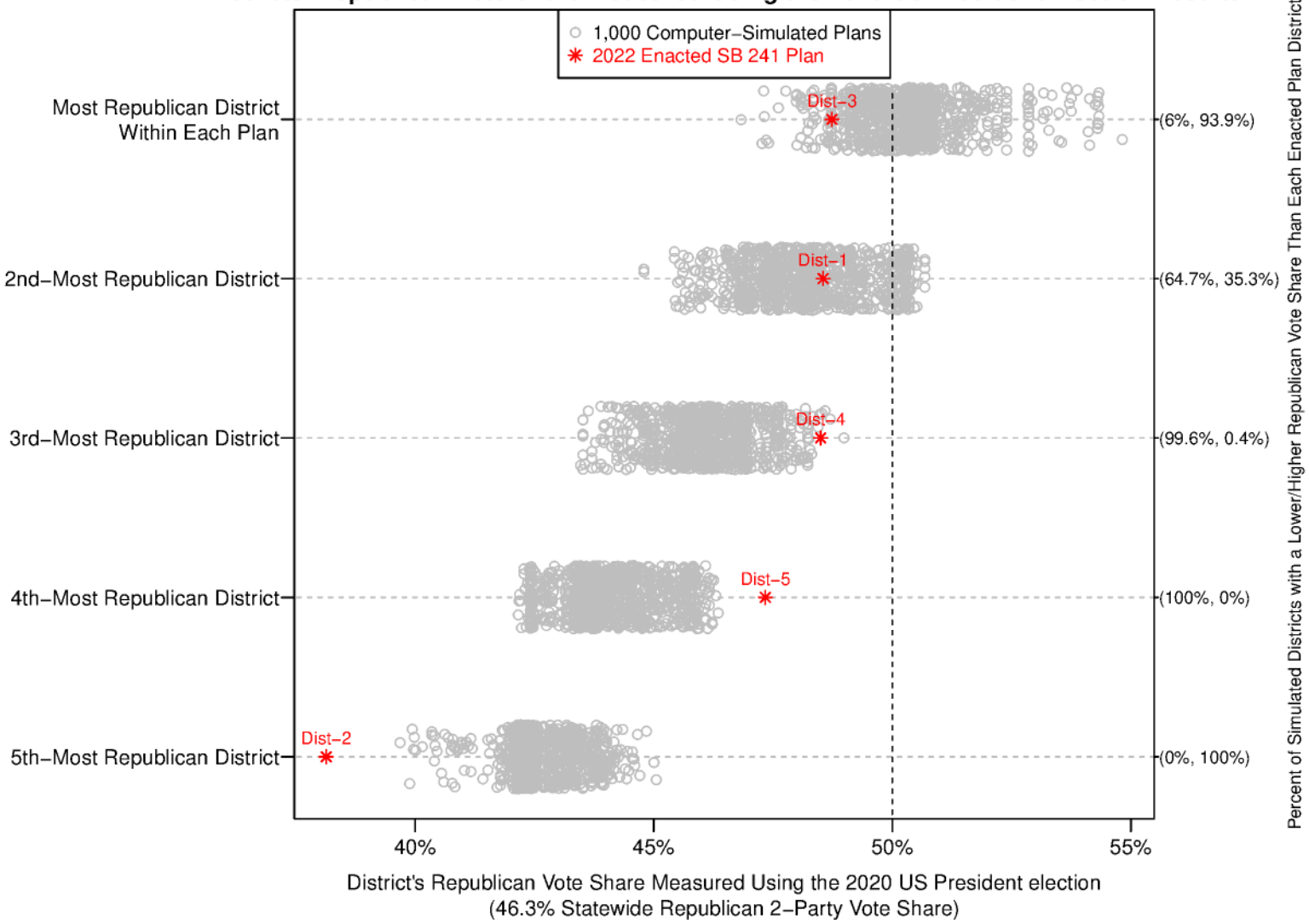
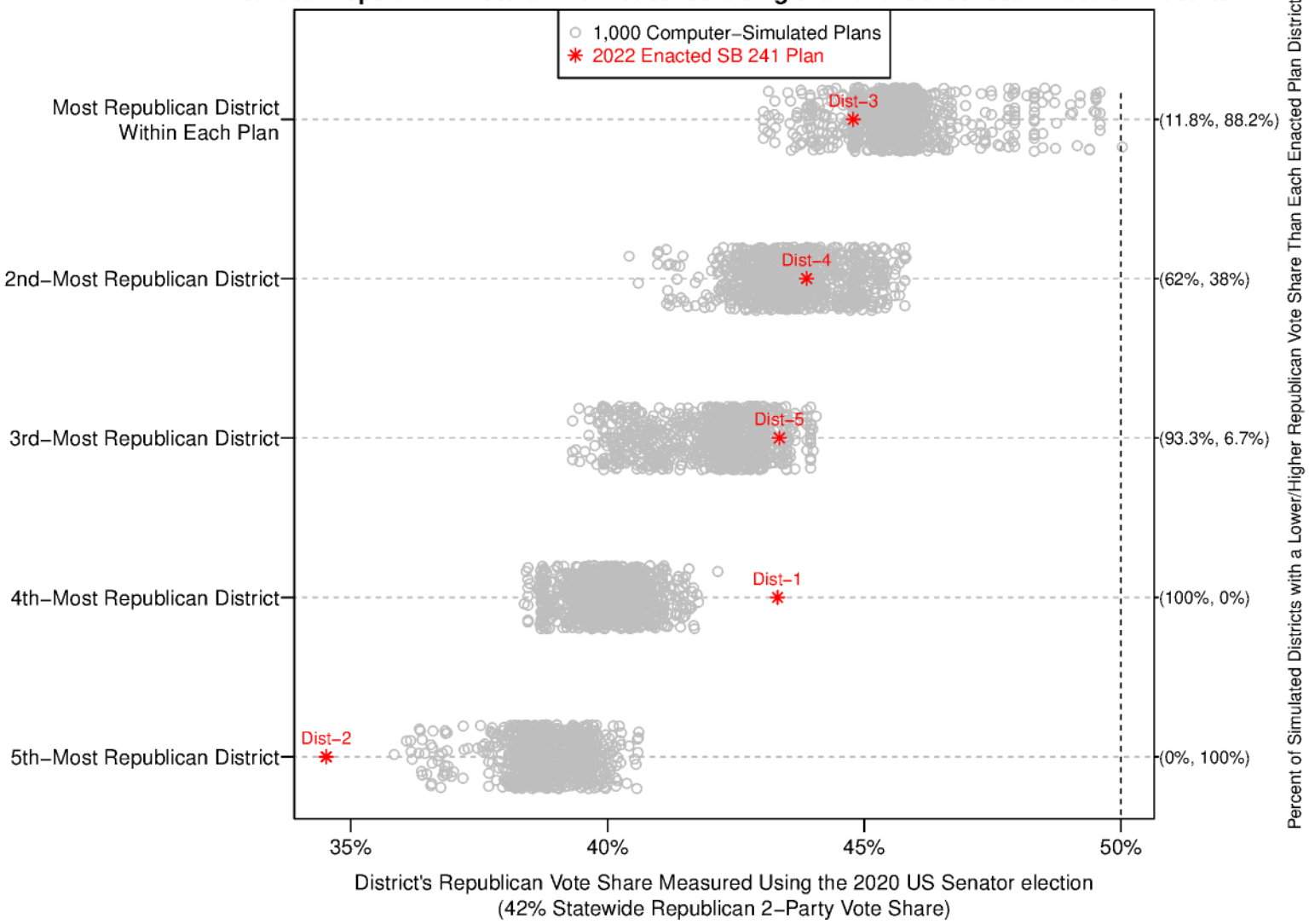


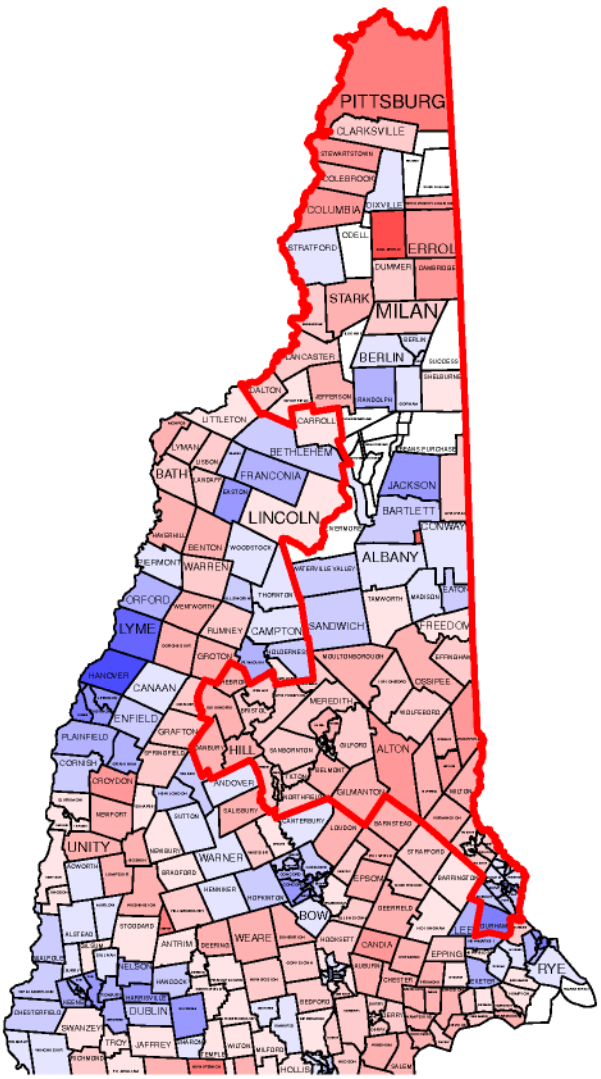
Figure C7: Comparison of Enacted SB 241 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 US Senator Election Results



Appendix D: 2022 SB 241 Enacted Executive Council Plan, District 1

VTD-Level
Republican Vote Share
(2016-2020
Statewide Election Composite):

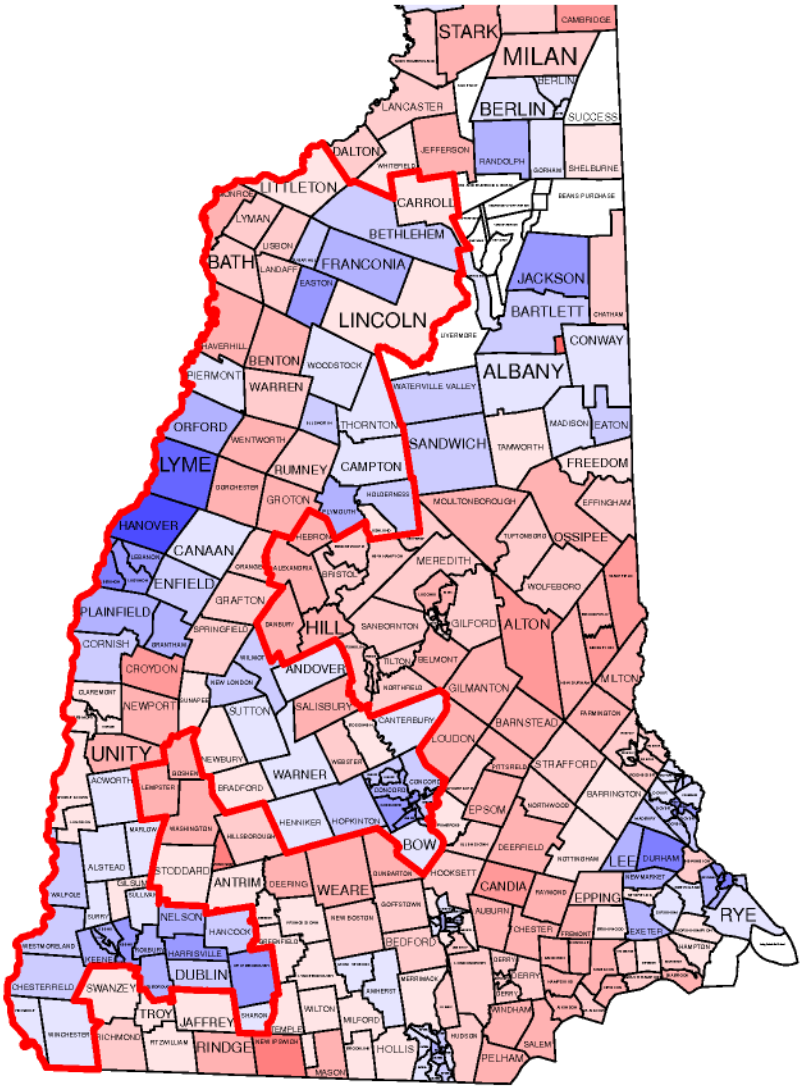
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix D: 2022 SB 241 Enacted Executive Council Plan, District 2

VTD-Level Republican Vote Share (2016-2020 Statewide Election Composite):

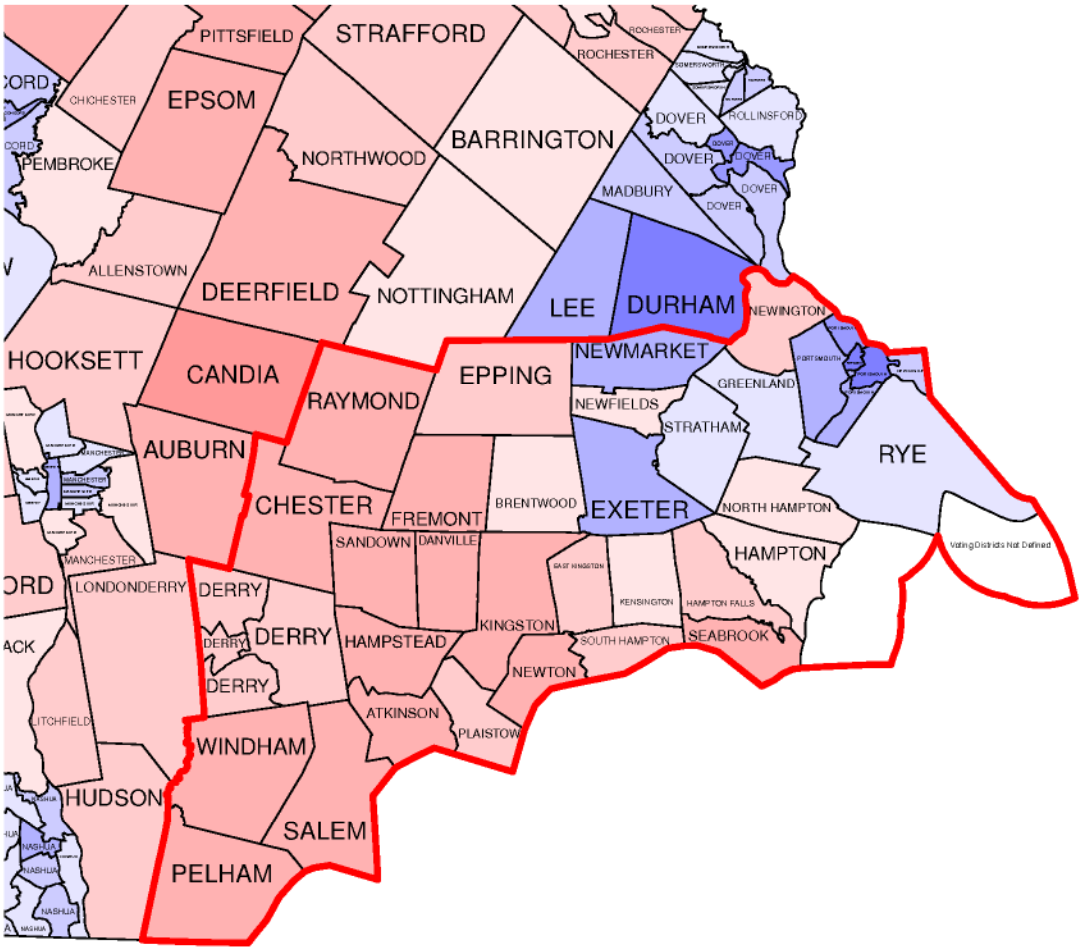
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix D: 2022 SB 241 Enacted Executive Council Plan, District 3

VTD-Level Republican Vote Share (2016-2020 Statewide Election Composite):

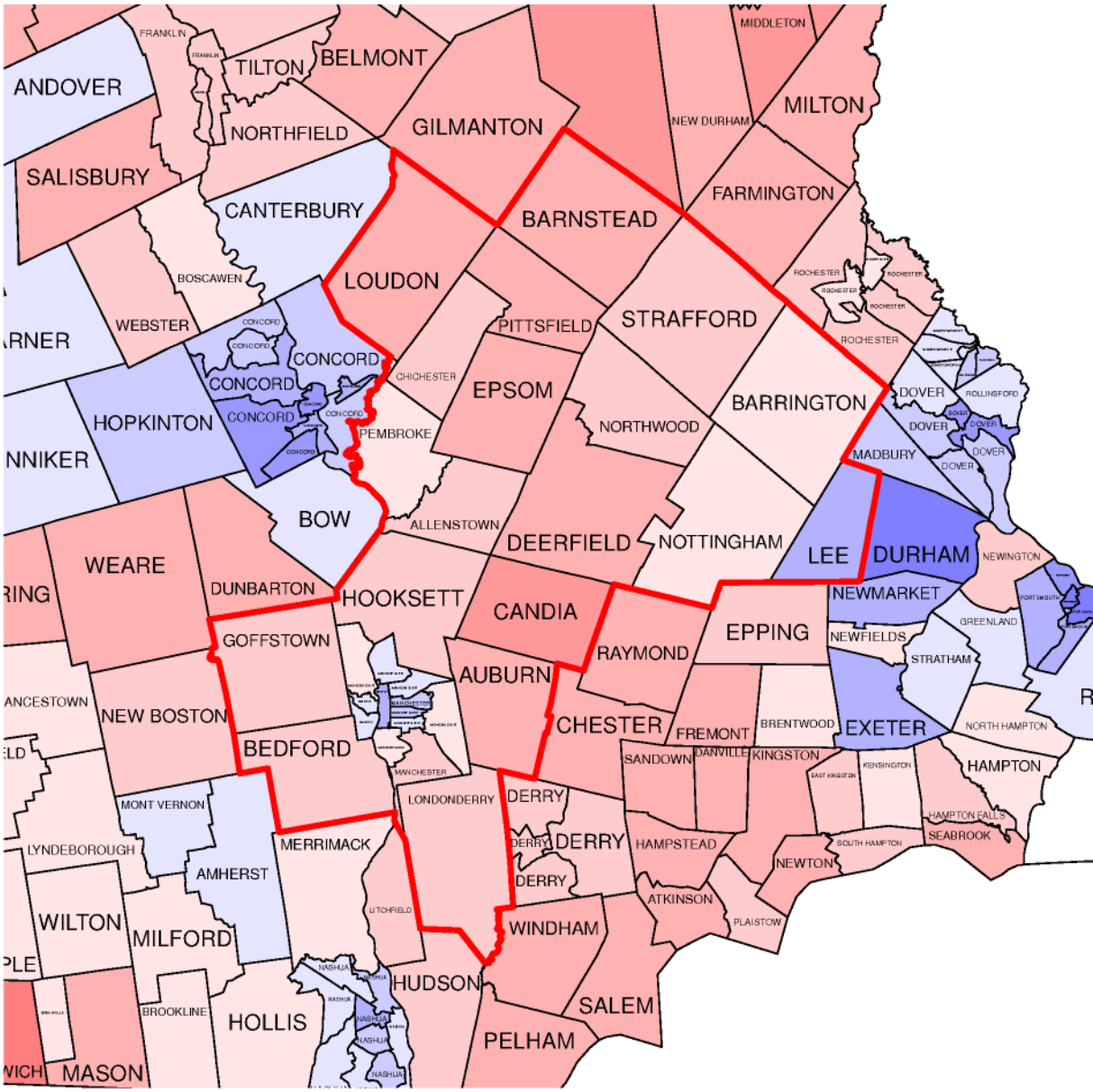
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix D: 2022 SB 241 Enacted Executive Council Plan, District 4

VTD–Level Republican Vote Share (2016–2020 Statewide Election Composite):

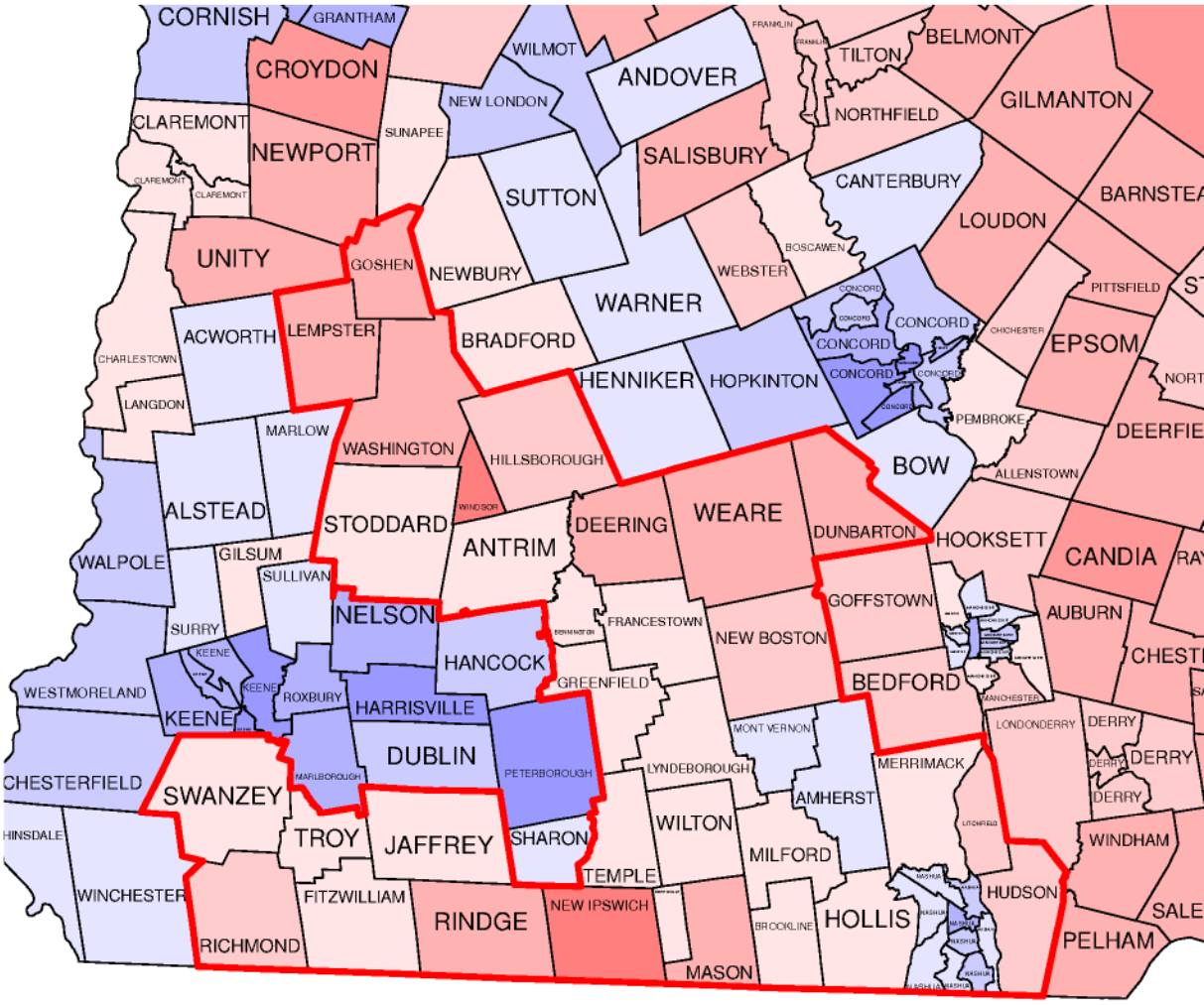
- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Appendix D: 2022 SB 241 Enacted Executive Council Plan, District 5

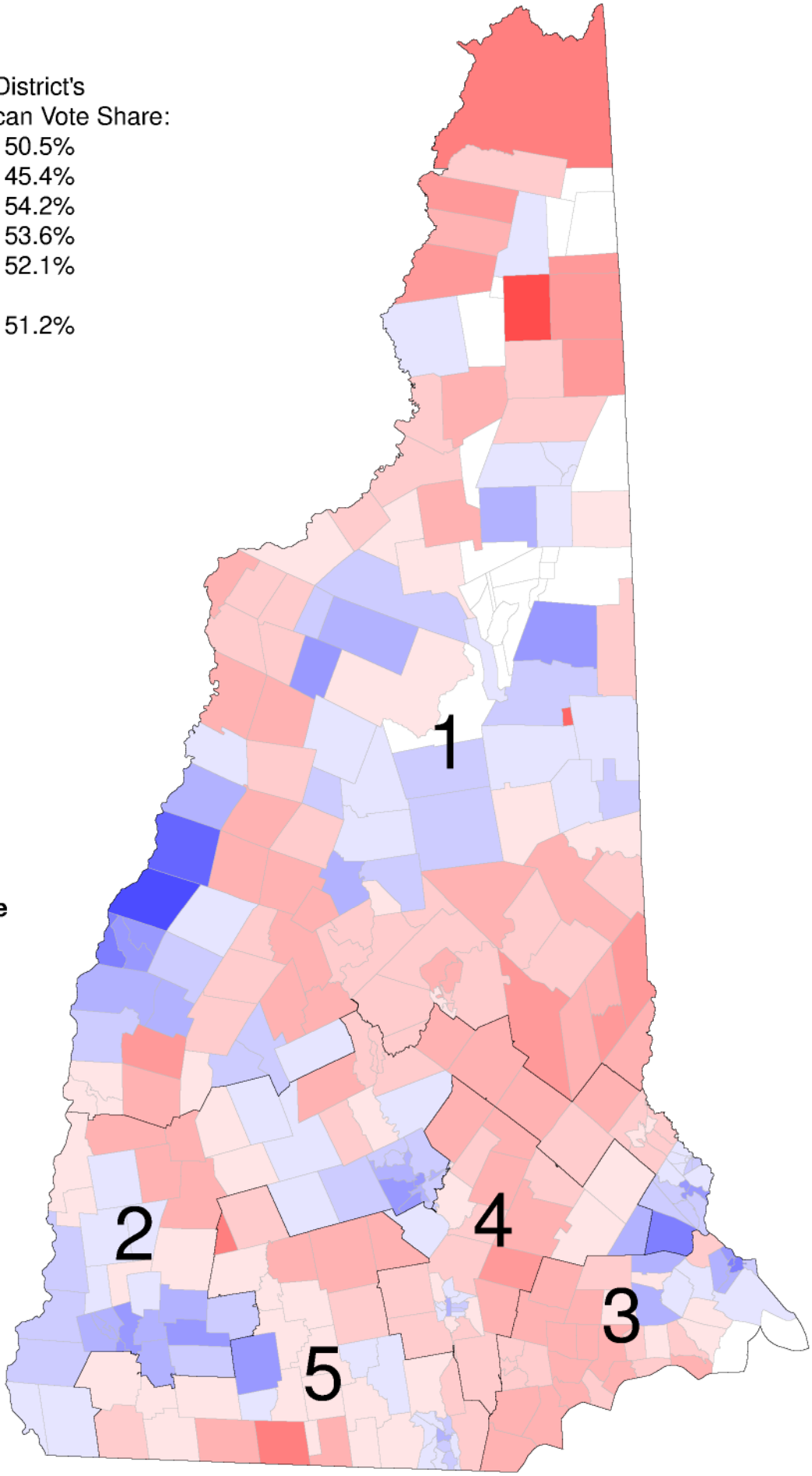
VTD-Level Republican Vote Share (2016-2020 Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%



Map E4: 2012 Enacted Executive Council Plan

District Number:	District Population:	District's Republican Vote Share:
1	271,606	50.5%
2	276,715	45.4%
3	277,893	54.2%
4	274,047	53.6%
5	277,268	52.1%
Plan Average:	275,505.8	51.2%



VTD–Level Republican Vote Share (Statewide Election Composite):

- 0–5%
- 5–10%
- 10–15%
- 15–20%
- 20–25%
- 25–30%
- 30–35%
- 35–40%
- 40–45%
- 45–50%
- 50–55%
- 55–60%
- 60–65%
- 65–70%
- 70–75%
- 75–80%
- 80–85%
- 85–90%
- 90–95%
- 95–100%