UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ALABAMA
SOUTHERN DIVISION

BOBBY SINGLETON, et al., *Plaintiffs*, v. **WES ALLEN, in his official capacity as Alabama Secretary of State**, *Defendants.*	Case No.: 2:21-cv-1291-AMM **THREE JUDGE COURT**
EDWARD GALMON, SR., et al., *Plaintiffs*, v. **WES ALLEN, *in his official capacity as Alabama Secretary of State***, *Defendants.*	Case No.: 2:21-cv-01530-AMM **THREE JUDGE COURT**
MARCUS CASTER, et al., *Plaintiffs*, v. **WES ALLEN, in his official capacity as Alabama Secretary of State**, *Defendants.*	Case No.: 2:21-cv-01536-AMM

EXPERT REPORT OF SEAN P. TRENDE, Ph.D.

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1 Expert Qualifications

1.1 Career

I serve as Senior Elections Analyst for Real Clear Politics. I joined Real Clear Politics in January of 2009 and assumed a fulltime position in March of 2010. Real Clear Politics is a company of approximately 50 employees, with its main offices in Washington D.C. It produces one of the most heavily trafficked political websites in the world, which serves as a one-stop shop for political analysis from all sides of the political spectrum and is recognized as a pioneer in the field of poll aggregation. Real Clear Politics produces original content, including both data analysis and traditional reporting.

My main responsibilities with Real Clear Politics consist of tracking, analyzing, and writing about elections. I collaborate in rating the competitiveness of Presidential, Senate, House, and gubernatorial races. As a part of carrying out these responsibilities, I have studied and written extensively about demographic trends in the country, exit poll data at the state and federal level, public opinion polling, and voter turnout and voting behavior. In particular, understanding the way that districts are drawn and how geography and demographics interact is crucial to predicting United States House of Representatives races, so much of my time is dedicated to that task.

I am currently a Visiting Scholar at the American Enterprise Institute, where my publications focus on the demographic and coalitional aspects of American Politics.

I am also a Lecturer at The Ohio State University. My courseload is detailed below.

1.2 Publications and Speaking Engagements

I am the author of the 2012 book The Lost Majority: Why the Future of Government is up For Grabs and Who Will Take It. In this book, I explore realignment theory. It argues that realignments are a poor concept that should be abandoned. As part of this analysis, I conducted a thorough analysis of demographic and political trends beginning in the 1920s and continuing through modern times, noting the fluidity and fragility of the coalitions built by the major political parties and their candidates.

I also co-authored the 2014 Almanac of American Politics. The Almanac is considered the foundational text for understanding congressional districts and the representatives of those districts, as well as the dynamics in play behind the elections. My focus was researching the history of and writing descriptions for many of the 2012 districts, including tracing the history of how and why they were drawn the way that they were drawn. Because the 2014 Almanac covers the 2012 elections, analyzing how redistricting was done was crucial to my work. I have also authored a chapter in Dr. Larry Sabato's post-election compendium after every election dating back to 2012.

I have spoken on these subjects before audiences from across the political spectrum, including at the Heritage Foundation, the American Enterprise Institute, the CATO Institute, the Bipartisan Policy Center, and the Brookings Institution. In 2012, I was invited to Brussels to speak about American elections to the European External Action Service, which is the European Union's diplomatic corps. I was selected by the United States Embassy in Sweden to discuss the 2016 elections to a series of audiences there and was selected by the United States Embassy in Spain to fulfill a similar mission in 2018. I was invited to present by the United States Embassy in Italy, but was unable to do so because of my teaching schedule.

1.3 Education

I received my Ph.D. in political science at The Ohio State University in 2023. I passed comprehensive examinations in both Methodology and American Politics. The first chapter of my dissertation involves voting patterns on the Supreme Court from 1900 to 1945; the second chapter involves the application of integrated nested LaPlace approximations to enable the incorporation of spatial statistical analysis in the study of United States elections. The third chapter of the dissertation involves the use of communities of interest in redistricting simulations. In pursuit of this degree, I also earned a Master's Degree in Applied Statistics. My coursework for my Ph.D. and M.A.S. included, among other things, classes on G.I.S. systems, spatial statistics, issues in contemporary redistricting, machine learning, non-parametric hypothesis tests and probability theory. I also earned a B.A. from Yale University in history and political science in 1995, a Juris Doctor from Duke University in 2001, and a Master's Degree in political science from Duke University in 2001.

In the winter of 2018, I taught American Politics and the Mass Media at Ohio Wesleyan University. I taught Introduction to American Politics at The Ohio State University for three semesters from Fall of 2018 to Fall of 2019, and again in Fall of 2021. In the Springs of 2020, 2021, 2022 and 2023, I taught Political Participation and Voting Behavior at The Ohio State University. This course spent several weeks covering all facets of redistricting: how maps are drawn, debates over what constitutes a fair map, measures of redistricting quality, and similar topics. It also covers the Voting Rights Act and racial gerrymandering claims. I also taught survey methodology in Fall of 2022 and Spring of 2024.

1.4 Prior Engagements as an Expert

A full copy of all cases in which I have testified or been deposed is included on my C.V., attached as Exhibit 1. In 2021, I served as one of two special masters appointed by the Supreme Court of Virginia to redraw the districts that will elect the Commonwealth's representatives to the House of Delegates, state Senate, and U.S. Congress in the following decade. The Supreme Court of Virginia accepted those maps, which were praised by observers from across the political spectrum. [1]

In 2019, I was appointed as the court's expert by the Supreme Court of Belize.

[1] *See, e.g.*, *New Voting Maps, and a New Day, for Virginia*, The Washington Post (Jan. 2, 2022), available at `https://www.washingtonpost.com/opinions/2022/01/02/virginia-redistricting-voting-maps-gerrymander`; Henry Olsen, *Maryland Shows How to do Redistricting Wrong. Virginia Shows How to Do it Right*, The Washington Post (Dec. 9, 2021), available at `https://www.washingtonpost.com/opinions/2021/12/09/maryland-virginia-redistricting`; Richard Pildes, *Has VA Created a New Model for a Reasonably Non-Partisan Redistricting Process*, Election Law Blog (Dec. 9, 2021), available at `https://electionlawblog.org/?p=126216`.

In that case I was asked to identify international standards of democracy as they relate to malapportionment claims, to determine whether Belize's electoral divisions (similar to our congressional districts) conformed with those standards, and to draw alternative maps that would remedy any existing malapportionment.

I served as a Voting Rights Act expert to counsel for the Arizona Independent Redistricting Commission in 2021 and 2022.

2 Scope of Engagement

I was hired by the Attorney General of Alabama to analyze Illustrative Congressional Districts drawn by Mr. William Cooper and Dr. Moon Duchin in the above-captioned matter. I have also been asked to review two plans enacted by the Alabama legislature in 2021 and 2023 ("2021 Map" and "Enacted Map", respectively), as well as the map drawn by a Special Master and adopted by this Court ("Special Master's Map"). In particular, I was asked to compare the compactness of these districts to that of the Enacted Map. I am being compensated for my time at a rate of $450/hr. My compensation in no way depends on the conclusions that I reach. All opinions are offered with a reasonable degree of scientific certainty typical of my field.

3 Data Utilized

For this report I relied upon:

- The Expert Reports of various plaintiffs' experts offered at the Preliminary Injunction phase, as well as those recently produced. The supporting materials for those reports, including block assignment files.
- Computer code written in the widely used statistical programming language R, which was used to process the data.
- Other documents referenced in this report or the computer code.

4 Map Compendium

To assist the analysis of these districts, I have created a compendium of every Congressional map used in Alabama dating back to the Civil War. ("Alabama District Set"). The redistricting years are sourced from Kennth Martis' seminal work on United States districts. See Kenneth C. Martis, *Historical Atlas of United States Congressional Districts* 234-235 (1982). I did not include years where districts were unchanged but at-large districts were added. Nor did I include years where only at-large districts were used. These maps are printed separately in an Appendix, for easier reference. Data were downloaded from a complete repository of shapefiles for congressional districts maintained by the political science department at the University of California, Los Angeles. *See* Jeffrey B. Lewis, Brandon DeVine, Lincoln Pitcher, & Kenneth C. Martis. (2013) *Digital Boundary Definitions of United States Congressional Districts*, 1789-2012. [Data file and code book]. Retrieved from https://cdmaps.polisci.ucla.edu on January 31, 2022.

I also created a compendium of all maps utilized in the first year of redistricting dating back to 1972, as well as the immediate post-Baker maps used in 1966 (though some of these maps are coterminous with the maps used in the 1962 redistricting). ("National District Set"). These are taken from the above sources as well.

One issue that arises is that the UCLA maps do not use blocks for oceans, the Great Lakes, or the Gulf of Mexico. To understand this issue better, census blocks are typically clipped at the shorelines of rivers, oceans, and lakes. The maps then uses additional blocks to fill in these bodies of water out to the territorial boundaries of the state. Precincts will often include these blocks in their shapes. Thus, in most of the expert shapefiles, Mobile Bay, Bons Secour Bay, and the Gulf of Mexico are filled in, creating a smooth boundary for the state. The UCLA maps, however, adhere to the shoreline in this area.

To enable an apples-to-apples comparison, I've appended the UCLA districts with the relevant water blocks to the UCLA maps for the 113th, 108th, 103rd, 98th, and 93rd

Congresses. This enables us to make more direct compactness comparisons to every redistricting map since Alabama lost its 8th seat in the 1972 redistricting; This also roughly corresponds with redistricting being performed under the constraint of one-person-one-vote. While it would have been more straightforward to clip the experts' maps, and would have enabled a robust comparison to national maps, I suspect that this would have brought charges of unfairness since it would have lowered the compactness of the maps, particularly with respect to Polsby-Popper scores (it would have done this for both the UCLA maps and the expert maps). Note too that choice of shapefile, the projection used, and other issues may affect the scores modestly.

5 Overview of Compactness Metrics

5.1 District Compactness Metrics

Although the parties have briefed the various compactness metrics, a brief reminder may be in order as to what exactly these various numbers mean. To my understanding, the experts in this matter have utilized four unique compactness measures in this case: Reock, Polsby-Popper, Convex Hull and edges removed.[2] The first three are probably the most commonly used redistricting methods; the fourth is relatively new. They are but a sample of dozens of metrics that have been proposed over the years. *See* `https://alarm-redist.org/redistmetrics/articles/compactness.html`.

There is no agreed-upon "best metric," and the search for such a metric is likely fruitless. This is because compactness is a multi-faceted concept, and each of these metrics explores a different aspect of compactness. *See* Aaron Kaufman, Gary King, and Mayya Komisarchik, "How to Measure Legislative District Compactness if you Only Know it When you See it," 65 *Am. J. Poli. Sci.* 553 (2021). Which facet is most important is a normative question, to which different experts may (and have) give different answers.

[2]Dr. Duchin has explained that a fifth metric, Inverse Schwartzberg, is simply the square root of the Polsby-Popper score. I therefore do not include it, as it adds little to the discussion.

I know of no scientific survey of redistricting experts inquiring as to which compactness metric is the best. Given Reock scores' ubiquitous use in political science literature and in redistricting matters I would be surprised if "most" or "all" redistricting experts find it to be weakly justified. Of course, even if such a consensus exists, courts aren't required to bend the knee to social scientists or mathematicians, least of all on normative questions, so a court may decide that an entirely different metric is the most important for legal purposes. *See* Kaufman, King & Komisarchik (describing disconnect between academic and "real world" views of compactness).

To give a few examples of how this might be the case, the "edges removed" metric does have some nice properties. However, it is generally used as a map-wide metric, rather than a district-specific metric, which might lead a court to disfavor it in the context of a VRA matter regardless of these properties. As discussed *infra*, *Gingles* analysis typically requires a district-specific analysis, which this metric does not generally provide (to the extent it might, it would favor those districts which adhere to a state boundary, since those cut no edges. On a statewide level, this would seem to cancel out across districts). Moreover, although Dr. Duchin makes an interesting theoretical point when she criticizes Reock scores as having "a much weaker justification, since the primacy of circles is the goal rather than the consequence of the definition," Duchin First Report at 6, it is unclear why this would matter from a redistricting or legal perspective. After all, whether or not a district is distended or not is a feature of compactness that most people consider; a court may wish to acknowledge this real-world concern over theoeretical objections. Kaufman, King & Komisarchik, at 544. Additionally, dictionary definitions of compactness contemporary with the 1982 Amendments to the Voting Rights Act emphasize a district's concentration around a single point or small area. A court might consider contemporary understandings of the term to a greater degree than a mathematician might, and use a score like Reock that does help explore such facets to a greater degree than Polsby-Popper or cut edges. *E.g.*, *Webster's New Twentieth Century Dictionary, Unabridged* 368 (2d ed. 1980) (defining the adjective version of compact as "1.

Closely and firmly united, as the particles of solid bodies; solid; dense; as a compact mass of people; a compact body or substance. . . . 5. taking little space; arranged neatly in a small space. 6. Designating or of a relatively small, light, economical model of automobile. Syn. – close, condensed, hard, solid) (including also other less relevant definitions such as 2. Composed of, 3. Held together, 4. Brief, as in "compact discourse").

Instead, it I use the beginning of this report to provide some additional analysis as to what these metrics really describe, and to give some insight as to their pros and cons to assist the court in its decisions. *Cf.* Fed. R. Evid. 702 (describing the role of the expert as to "help the trier of fact to understand the evidence or to determine a fact in issue").

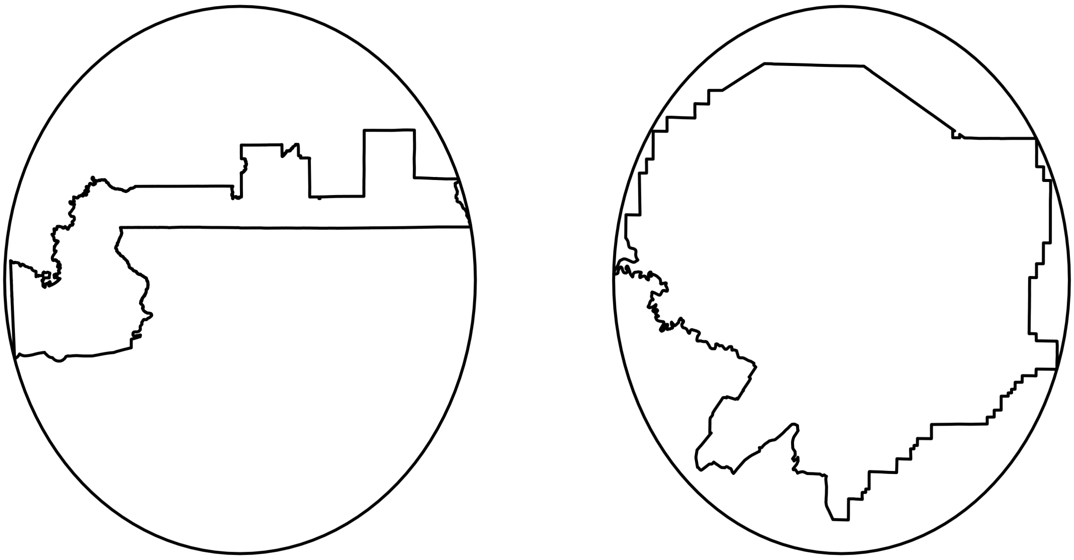
The first metric is the Reock score. It is the first metric discussed here, but it was also arguably the first numeric measure of compactness developed. It is defined as the ratio between the area of the district and the area of smallest possible circumscribing circle. *See* Ernest Reock, "A Note: Measuring Compactness as a Requirement of Legislative Apportionment," 5 *Midwest J. Poli. Sci.* 70 (1961). In lay terms, we might imagine the smallest circle that wholly encloses the district without cutting it, called the "minimum bounding circle." The Reock score is the percentage of that circle that the district would fill, expressed as a decimal. Were a district perfectly circular, it would fill 100% of that minimum bounding circle, and the Reock score would be 1. Were a district somehow a line segment or a point, it would fill 0% of that district, and the Reock score would be 0.

In practical terms, Reock scores measure how distended a district is. Elongated districts have low Reock scores, while districts with high Reock scores tend to be, for lack of a better word, "stocky." To help illustrate this, compare the *least* compact district in our dataset of post-1972 enacted Alabama plans and illustrative districts according to Reock scores – District 1 from Cooper's 5th map, with a Reock Score of 0.171[3] – with the most compact district according to Reock scores among the various demonstration

[3]To put this in perspective, the district that the Supreme Court struck down in *Miller v. Johnson*, 15 U.S. 900 (1995) and described as a "monstrosity", *id.* at 909 (quoting the Almanac of American Politics), had a Reock score of 0.157, even without adding the ocean blocks to smooth the shoreline.

and enacted plans – District 6 from Alabama's 1982 map, with a Reock Score of 0.66.[4]

Figure 1: Illustration of Reock Scores



(a) Reock=0.171 (Cooper Illus. 5, Dist. 1) (b) Reock=0.66 (AL 98th Cong.(1983), Dist. 6)

Regardless, one can readily see that the district on the right "fills" a higher percentage of its minimum bounding circle than the district on the left. This is what a Reock score measures; an opinion that relies upon a Reock score is relying upon the percentage of a particular circle that a district would fill.

Reock scores do have real limitations for redistricting purposes. One can imagine a circular district, which would have a Reock score of 1. Now imagine a map maker carves out a narrow, serpentine channel running into the center of the district. The district would still fill a large portion of the Minimum Bounding Circle, and thus would score well on the compactness score. Likewise, a district covered with small protrusions, like potato eyes, could nevertheless score well on Reock scores, even though such inlets and protrusions might signify a gerrymander or be identified by laypeople as not compact.

[4]Note that the circles appear somewhat as ovals here; this is a difficulty springing from depicting a curved Earth in two-dimensional space.

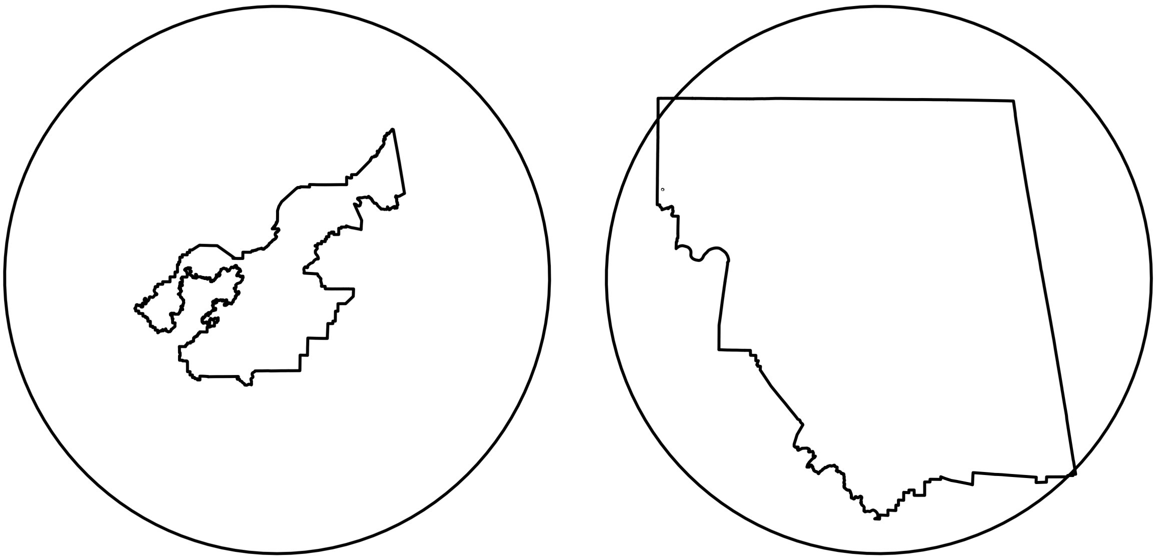
Polsby-Popper scores help to address this. Daniel D. Polsby & Robert D. Popper, "The Third Criterion: Compactness as a procedural safeguard against partisan gerrymandering." 9 *Yale L. & Pol. Rev.* 301 (1991). In lay terms, imagine taking a district and then stretching it until it is shaped into a circle. That circle would have the same perimeter as the district. The Polsby-Popper score is the percentage of such a circle (i.e. a circle with the same perimeter as the district) that such a district would fill.

Practically speaking, a "smoother" district will have a higher Polsby-Popper score, while a district with many "arms and inlets" will have lower Polsby-Popper scores. Once again, a perfectly circular district would have no arms and inlets, so its area would be the same as that of a circle with the same perimeter; it would fill 100% of the circle and would receive a Polsby-Popper score of one. As more and more "bends" are added to the district, its perimeter will increase, and it will fill less and less of the circle with the same perimeter as the district.

To help illustrate this, compare the least compact district in our dataset of enacted Alabama plans and illustrative districts according to Polsby-Popper scores – District 6 from Cooper's 6th map, with a Polsby-Popper score of 0.985[5] – with the most compact district according to Polsby-Popper scores among the various demonstration and enacted plans – this time, District 5 from Dr. Duchin's Map B, with a Polsby-Popper score of 0.531.

[5]The district in *Miller* described above had a Polsby-Popper score of 0.0985

Figure 2: Illustration of Polsby-Popper Scores



(a) P-P=0.0985 (Cooper Illus. 6, Dist. 6) (b) P-P=0.531 (Duchin Illus. B, Dist. 5)

This approach has limitations as well. Polsby-Popper scores can be sensitive to features that mapmakers are directed to follow. For example, river boundaries tend to meander, which can increase the perimeter of a district if they are followed. At the same time, mapmakers are often instructed to follow natural features, such as river boundaries. Thus, a mapmaker who forms a district boundary out of precincts drawn by straight lines and who avoids precincts that follow river boundaries would be rewarded with a higher Polsby-Popper score.

Likewise, some states have very regular edges – think Colorado – while other states have irregular coastlines – think Maine. Districts that respect those shorelines will have more "arms and inlets" and therefore higher perimeters simply by virtue of state geography, and their Polsby-Popper scores will suffer. This can be somewhat avoided by including "water blocks" (explored above), although that could equally advantage a district by giving is a smoother edge than typically found in terrestrial precincts.

Finally, we examine Convex Hull scores. To understand the motivation for this test, imagine a district that is a perfect square. That square will, by definition, fill $2/\pi$ percent of the minimum bounding circle, or approximately 63.7% of the circle.[6] Its Reock score would therefore be 0.637. That is still relatively high as far as Reock scores go, but many would consider a perfectly square district to be quite compact.

Convex Hull scores therefore seek to dispense with circles altogether, and instead look at the area of a convex polygon that would enclose a district. A more straightforward way to think of this is to imagine a rubber band snapped around a district. The Convex Hull score would ask what percentage of that rubber band the district would fill.

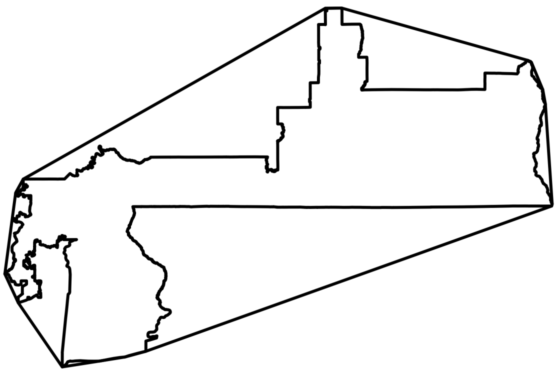
We once again illustrate this by comparing the least compact district in our dataset of enacted Alabama plans and illustrative districts according to Convex Hull scores – District 1 from Cooper's 6th map, with a score of 0.506[7] – with the most compact district according to Convex Hull scores among the various demonstration and enacted plans – also, District 5 from Dr. Duchin's Map B with a Convex Hull score of 0.932.[8]

[6] If S is the length of one of the sides of the square, the area of the square would be S^2. The radius of the minimum bounding circle would be the quantity (square root of $2S^2$) divided by 2. Since the area of the circle is πr^2, the area of the circle will be $2\pi S^2/4$. For the Reock score we take the area of the district and then divide by the area of the circle, which simplifies to $2/\pi$, or approximately 0.637.

[7] The district at issue in *Miller* described above had a Convex Hull score of 0.472.

[8] It's unsurprising that the answers from Polsby-Popper and Convex Hull scores are similar, as they are highly correlated ($\rho = 0.89$, for Alabama). This stands in contrast to Reock scores, which has weaker correlations with Polsby-Popper ($\rho = 0.363$, for Alabama) and Convex Hull ($\rho = 0.471$).

Figure 3: Illustration of Convex Hull Scores



(a) C-H=0.506 (Cooper Illus. 6, Dist. 1)

(b) C-H=0.932 (Duchin Illus. B, Dist. 5)

Once again we can see how the more compact district fills a much larger percentage of the shape "rubber-banded" around the district, when compared to the percentage of the less-compact district using Convex Hull.

As with all of these attempts to quantify the notion of "compactness," the Convex Hull score has its plusses and minuses. As a plus, it is likely impossible to ever draw a perfectly circular district (although circular cities do exist throughout the South), but square counties, townships and precincts do exist. It is therefore at least possible to draw a district with a Convex Hull score of 1 while adhering to traditional redistricting principles. At the same time, as is the case with Polsby-Popper scores, a badly distended district can score well on Convex Hull scores; imagine a largely rectangular district that spanned the entire Colorado/Wyoming border. There are no clear solutions here, only tradeoffs.

5.2 It is frequently difficult to opine with a reasonable degree of scientific certainty whether a district is "reasonably" compact or whether one map receives "unreasonably lower scores" or "unreasonable" scores.

In the interest of full disclosure, in a previous order this Court has criticized me for failing to address "what is reasonable or what is not reasonable in terms of compactness." Injunction, Opinion, and Order, Sept. 5, 2023, at 151. I have reviewed the Court's order, as well as the Court's previous Preliminary Injunction, Memorandum Opinion and Order (Jan. 24, 2022), with attention paid to pages 157-165. I have also reviewed the reports of Dr. Duchin and Mr. Cooper, and have reviewed their opinions that their plans are "reasonably compact," "within the normal range if you look at districts around the country," or "significantly" more or less compact than a set of districts.

With the above defintions in mind, it should be more straightforward to understand why I'm reluctant to offer such an opinion: It's unclear what the standard is to support that opinion. While there may be extreme cases where no reasonable expert would dispute that a district is compact (e.g. a district with a Reock score of 0.8) or that a district is substantially similar to another district (e.g., a difference in Convex Hull scores of 0.00001), there's ultimately no clear way, at least from an expert perspective, to decide what percentage of a bounding circle a district must fill before it becomes reasonably compact. *See also* Cooper Report at 4 ("To be clear, there is no bright line rule as to what constitutes a sufficiently compact redistricting plan or district. There are many factors that a map drawer must take into account, such as odd-shaped precincts and jurisdictional lines, that can impact compactness."). There isn't a clear-cut way to say that a district that fills, say, 5% less of a circle with a similar perimeter is "unreasonably" less compact. I say this as someone who has drawn both *Gingles* demonstration districts and Court-ordered plans, who uses these tools routinely in work, and as someone who has testified in redistricting cases for almost a decade.

Dr. Duchin and Mr. Cooper offer a number of ways to try to do this, but they have problems and limitations as well. For example, Mr. Cooper compares the districts in Alabama to other districts in the country. I have performed similar, if more far-ranging, comparisons in my own expert work. The problem is that it must be done carefully. The reason is two-fold. First, as all experts seem to agree, state boundaries can constrain what is possible in terms of compactness. If we look at the collection of districts in the post-Baker world, we can pull out the 25 least compact districts and immediately identify problems unique to almost all of them (note that none of these have blocks for oceans inserted).

Many of these districts are draawn under severe geographic limitations. First, Hawaii dominates this list. This is unsurprising, as it has a relatively unique "ocean problem" that demands its districts have poor Reock scores. We also note California 5's maps from the 88th (1963) and 93rd (1973) and 98th (1983) Congresses. This district was anchored in San Francisco, but includes the Farallon Islands, about 20 miles off the coast, as well as various islands in the San Francisco Bay. Florida's 1st District contains the panhandle of Florida. Florida's 22nd District from the 103rd Congress (1993) contains the Florida Keys. The other California districts on the list either include the Farallon Islands or part of the Channel Islands.

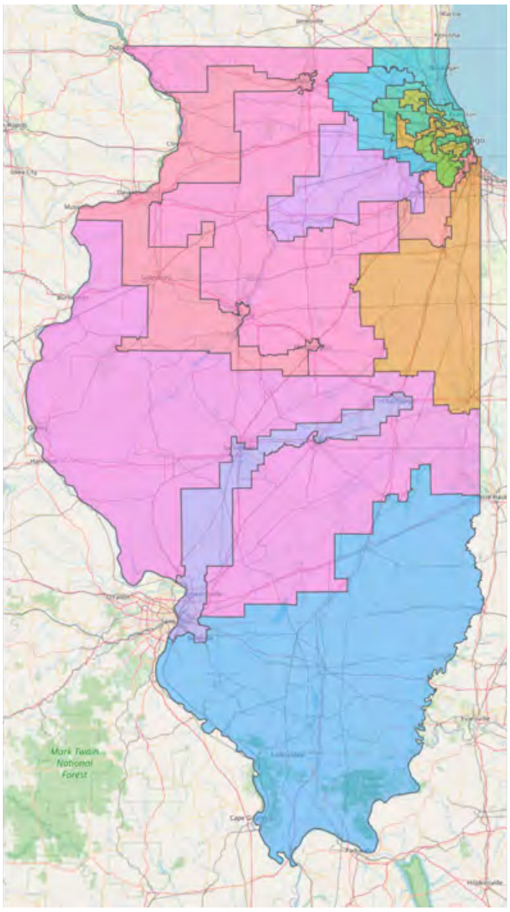
Additionally, using "all maps" passed in America as the benchmark ignores the fact that many maps that are purposely not reasonably configured, as they reflect political or racial gerrymanders, or the byproducts of such. North Carolina's 12th District from the 103rd Congress, for example, was struck down as a racial gerrymander in *Shaw v. Reno*, 509 U.S. 630 (1993). Ohio's 9th District from the 113th Congress (2013), nicknamed the "snake on the lake," was a meandering district that was struck down by a federal court as being part of a political gerrymander that packed Democratic voters and, as described by Mr. Cooper, severed communities of interest. *Ohio A. Philip Randolph Inst. v. Householder* 367 F.Supp.3d 697 (S.D. Ohio 2019).

Mr. Cooper, of course, utilizes a more limited dataset of nationwide maps for

Figure 4: 25 Least Compact Districts Using Reock, 1972-2020.

State	District	Congress	Reock
Hawaii	1	92	0.000
Hawaii	1	98	0.000
Hawaii	2	108	0.003
Hawaii	2	103	0.003
Hawaii	2	113	0.003
Hawaii	0	86	0.003
California	5	88	0.009
California	5	93	0.015
Florida	1	98	0.015
Florida	18	108	0.016
California	5	98	0.021
Florida	22	103	0.031
North Carolina	12	103	0.040
Ohio	9	113	0.042
California	23	108	0.045
Hawaii	2	98	0.048
Hawaii	2	92	0.048
California	36	103	0.050
California	35	93	0.051
California	47	113	0.055
California	12	103	0.056
California	12	108	0.060
Florida	17	98	0.061
New York	20	93	0.067
North Carolina	12	113	0.070

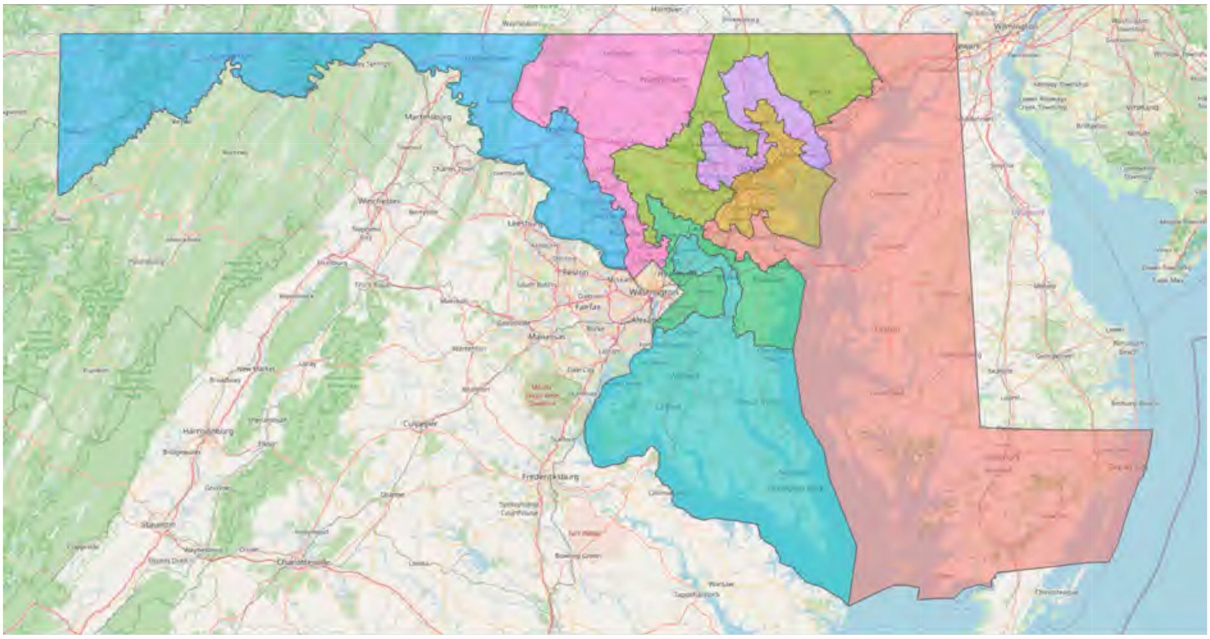
Figure 5: Illinois Congressional Districts, 2021-present



the 118th Congress (2023). This wouldn't avoid the above problems, as Hawaii is still an island. Moreover, when Mr. Cooper initially declared that his maps were within reasonable bounds for districts used in the United States, districts in places like Illinois and Maryland, which looked (and in the case of Illinois, still look) like the maps below, were used to help set the outer boundaries of reasonability.

In other words, by comparing maps to all maps enacted nationally, we inherently compare the maps drawn to maps that are either beset by geographic features not present in Alabama (New Hampshire's districts always score poorly on Reock scores, something constrained by the state's geography) or by districts that aren't reasonably configured/are gerrymanders. To be sure, if a district is more extreme than almost all of these districts, as Maryland's were in 2022 using the Polsby-Popper metric, it would likely be a useful

Figure 6: Maryland Congressional Districts, 2021-2022



insight that a court might use to inform its decision. But to prove that a map is reasonable using nationwide metrics is a fraught endeavor.

We might also compare the maps to maps passed within the state. This has always struck me as a bit odd, since these maps are often challenged as racial or political gerrymanders. Indeed, it is my understanding that the 2021 map at issue in the preliminary injunction phase of this map was challenged as a racial gerrymander. The Enacted Map here may have been drawn in part as a political effort to protect Republican officeholders in the state. Why would such a map be used to define "reasonably compact" for purposes of a federal law?

Regardless, this is a more promising approach, since it neutralizes the "geography issue." The problem is that it often gives rise to the intractable problem of distinguishing whether an Illustrative Map that is less compact than the Enacted Map is "significantly" so. This runs into the Sorites Paradox[9] argument that makes expert analysis here difficult: If a district that fills 1% less of its Minimum Bounding Circle than does the Enacted Map's version is not "significantly" less compact, then why not 2%? Or 3%? And so forth. Again, we might have cases where no reasonable person would dispute that a difference is small.

To illustrate this problem further, using Mr. Cooper's calculations, the Enacted Map has an average Polsby-Popper score of .28 and an average Reock score of .41. District 2's Polsby-Popper is 0.37 and its Reock is .61.

Mr. Cooper's Illustrative Plan 6, by contrast, has an average Polsby-Popper score of 0.16 and a Reock of 0.31, while his District 2 has a Polsby-Popper of 0.11 and a Reock of 0.29. See Cooper Report at 48.

[9]The Soirtes Paradox is an ancient philosophical problem that runs something like this: 1,000,000 grains of sand is clearly a heap of sand. Removing one grain of sand does not alter that. Therefore, 999,999 grains of sand is also clearly a heap. The paradox is that if you repeat this reasoning over and over again, you'll eventually conclude that a single grain of sand is a heap. Put differently, my hair may be thinning, but few would call me bald. Losing a single hair won't change that. Extending that logic means that I can never be bald. We might definitionally claim that a person with no hair is by definition bald, but what if they have one hair? Most would still call that person bald. We can then work the paradox out in reverse as well, such that a full head of hair is bald. E.g., J.C. Beall & Mark Colyvan, "Heaps of Gluts and Hyde-ing the Sorites," 110 Mind 401 (2001).

In other words, his districts, on average, fill up their minimum bounding circles about half as well as the Enacted Map does, and fill up circles with the same perimeters about 75% as well as the Enacted Map. His District 2 fills up its minimum bounding circle about 30% as well as Enacted District 2 and fills up its circle of the same perimeter about 47.5% as well as Enacted District 2. These strike me as obviously significant differences. But Mr. Cooper asserts that "the illustrative plans are generally in the same range of compactness" as the Enacted Map is without citation or authority. This seems absurd, and there's nothing offered to rebut here except for his *ipse dixit*. But since gerrymandering is an inherently vague concept (as shown above), and because these mathematical measures ultimately just push the problem back a step, it's difficult, to make that opinion under the strictures that Federal Courts have set up for expert testimony.

5.3 Population Compactness

Instead of focusing on the population of the district itself, we might also inquire as to the compactness of the population of the individuals in the district. Some courts have distinguished between the two for purposes of the Voting Rights Act. *E.g., Robinson v. Ardoin*, 37 F.4th 208, 218 (2022) (concluding that a district court erred – but did not commit clear error – by not focusing on district compactness, and also stating that "before explaining why, we should first relate the law governing *Gingles*'s compactness requirement. Importantly, that requirement relates to the compactness of the minority population in the proposed district, not the proposed district itself."). *But see id.* at n.4 (calling the district's compactness a "reasonable proxy" for the compactness of a minority group within the district but observing that this would be but one factor in the compactness inquiry). *Cf. Sensley v. Albritton*, 385 F.3d 591 (2004) (concluding that a district court's finding that a map joining together distinct clusters of Black voters was not compact was not clearly erroneous).

I cite these cases not to direct the Court as to how it should rule – that is for the lawyers to fight about and judges to decide – but rather to explain why I view this distinction as at least worth exploring as something that might "help the trier of fact to understand the evidence or to determine a fact in issue," depending on how it rules on the legal matter.

To understand why population compactness can be different from district compactness, imagine a courtroom. These are often rectangular, and so will perform well on Convex Hull scoring. At the same time, the distribution of people within a courtroom can vary widely. You might have everyone clustered around a central table. This population would seem to be more compact than were everyone spread evenly throughout the courtroom, or perhaps clustered around the bench, table for counsel, and the audience gallery. We could even imagine people sorted into the four corners of the courtroom. In all of these circumstances, the compactness of the courtroom would be the same, but the compactness of the populations within would change.[10]

While Reock scores were the first compactness metric seriously explored in academic literature, the second compactness metric focused on the compactness of the population. The "moment of inertia measure" or MOI was introduced by in the 1960s. *See* James B. Weaver & Sidney W. Hess, "A Procedure for Nonpartisan Districting: Development of Computer Techniques," 73 *The Yale Law Journal* 228, 297-300 (Dec. 1963) (describing the moment of inertia metric and its use in redistricting); Henry F. Kaiser, "An Objective Method for Establishing Legislative Districts," 10 *Midwest Jrnl. Pol. Sci.* 200 (1966) (providing a lengthy mathematical description of the moment of inertia as applied to redistricting); S.W. Hess, et al, "Nonpartisan Political Redistricting by Computer," 13 *Op. Rsrch.* 998, 999 (1965). It borrows from physics to define population compactness as the average squared distance of the individuals in the district from their center of mass. Put differently, if everyone is clustered around the table, everyone would

[10] In terms of spatial statistics, district compactness is an areal unit problem, while population compactness deals with a point process. *See* Noel Cressie, *Statistics for Spatial Data* 577 (1993) (describing point processes). Because people in a room are discrete, unconnected dots, they don't really have an area or perimeter. They therefore require different units of measurement. *See also* Besag et al., "Bayesian Image Restoration, with Two Applications in Spatial Statistics," 43 *Brit. J. of Pol. Sci.* 1 (1991) (developing a model specific for areal units).

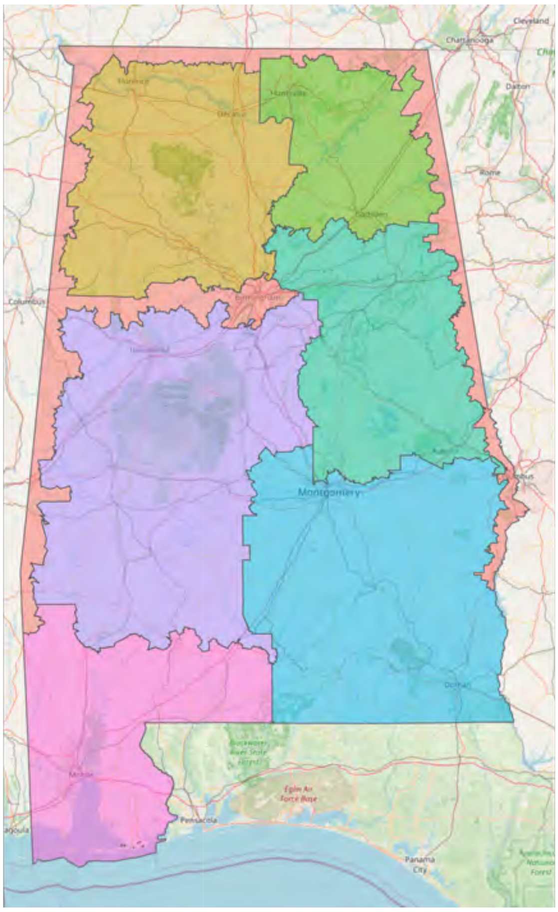
be very close to the center of the group, and the MOI score would be relatively small. On the other hand, if people all take three equal steps back in opposing directions, the center of mass would stay the same, but the individuals' distances from that center would all increase. The MOI would then increase. This is consistent with a notion that people clustered around a single point are a compact mass, but people who are more dispersed are less so.

The MOI was the more widely used technique in the early days of peer-reviewed studies of gerrymandering and redistricting but began to fall by the wayside as other district compactness metrics were proposed and as computing them became more attainable with computers.

This leaves population compactness metrics under-developed. I have used the MOI in previous litigation for a narrow purpose: To determine, within an Illustrative Plan with districts with higher BVAPs, which of the thousands of possible combinations of Black residents that might give rise to a majority Black population within the Illustrative District is the *most* compact combination. That subsection would then be analyzed, rather than the population of the district as a whole.

Here, there's little reason for such analysis, since the BVAPs in the proposed district 2s are pretty close to 50% BVAP; any such minimal grouping will traverse most of the district. The problem, though, is that there's even less way to evaluate or interpret the MOIs than for the district compactness metrics. We can't compare to Enacted Maps, because the whole point of VRA litigation is that Enacted Maps lack a sufficient number of districts with high BVAPs. Moreover, unlike district compactness, I'm unaware of any state constitution that requires population compactness as a metric. State districts might have grotesquely dispersed populations because state lawmakers aren't required to pay attention to this metric, except insofar as they are following the VRA. There is much work that has to be done in this area if courts are serious about population compactness and the VRA, but for now an eyeball test has to suffice. Fortunately, such tests are performed with a fair amount of regularity in redistricting and VRA litigation.

Figure 7: Maryland Congressional Districts, 2021-2022



5.4 The Problem with Plan-Wide Averages.

Finally, before diving deeper into the analysis, a word on plan-wide averages is in order. Both Mr. Cooper and Dr. Duchin rely on these averages. I have relied on them as well in my own analysis; they are not inherently untrustworthy. At the same time, in the context of Gingles Prong 1, there are two interrelated problems. The first is that Gingles calls for district-specific analyses rather than plan-wide analyses. Second, an average can be gamed. By this I mean that one can draw a badly non-compact district and make up for it by drawing compact districts elsewhere. Consider the following "toy" example:

Obviously, this is using an extreme example to illustrate a broader point; we will explore more concrete examples of this technique later on. But this map features a district that skirts the perimeter of the state on three sides, with an arm jutting into

Birmingham. Needless to say, it is not terribly compact, although somewhat surprisingly, it would not fall among the 25 least compact districts in recent U.S. history using Reock scores (Reock = 0.082). The rest of the districts, however, are extremely compact, leaving an average compactness for the map of 0.47. This is higher than the average compactness of any of the demonstration districts or enacted plans. The mean Polsby-Popper score of 0.198 is higher than that of Mr. Cooper's maps 1-3 and 6, and is equal to Map 5. The mean Convex Hull score of 0.715 is higher than the mean score produced by any of Mr. Cooper's maps except for map 4.

Again, the point is not to suggest that Mr. Cooper or Dr. Duchin drew districts comparable to the example here; they did not. It simply demonstrates the dangers of relying upon averages. The scores of the individual districts aren't afterthoughts, they are a key portion of the inquiry.

6 Analysis of District Compactness

6.1 Alabama's Congressional maps have never connected Mobile with Montgomery, Dothan or Phenix City.

As discussed above, the Appendix to this report contains maps of every Alabama redistricting plan dating back to the state's readmission post-Civil War. The districts have been drawn by Republicans, Democrats, and Republicans again. They've been drawn during the pre-Jim Crow years, during Jim Crow, and in post-Jim Crow years. One thing that they have not done during this time is to connect Mobile with Montgomery, Dothan or Phenix City. Indeed, the last time Montgomery and Mobile were in a district together was 1830, when the state had just three Congressional Districts. See Martis at 71-93. The same is true for Mobile and what is now Dothan.[11] The area where Phenix City now stands was not in any congressional map at that point, as this was still

[11] Dothan itself was not yet incorporated in 1830, although there was a fort with a small town nearby. https://www.dothan.org/474/About-Dothan.

considered territory held by indigenous populations. See Martis at 71.

6.2 The districts in the Illustrative Maps are less compact than those in the Enacted Map.

As a threshold matter, the Illustrative Maps are all less compact than the Enacted Map. This is true both of Dr. Duchin's maps and Mr. Cooper's maps. Since these map sets raise somewhat different issues, I will address them separately. This section will focus mostly on aggregate measures of compactness. The remaining sections will focus on individual districts.

6.2.1 Mr. Cooper's maps.

Mr. Cooper proffers, to date, eight illustrative maps that purport to demonstrate that two reasonably compact 50%+1 districts can be drawn. These districts employ a variety of configurations, particularly for District 7. But Districts 1 and 2 are all variations on a theme. District 1 is laid flat, and runs the length of the state's southern border, connecting Mobile with Dothan. District 2 is layered on top of this district, connecting Mobile with Montgomery. In some iterations (1, 2, 4 and 8), District 2 traverses the state completely, with the first two maps pulling Phenix City into the district.

Two maps in particular deserve attention. While many of the other maps do have relatively smooth boundaries, District 2 in Cooper Map 2 plainly contains "arms" and "inlets," reaching over to grab Montgomery, Dothan and Mobile. As we'll see in Part VII, these arms and inlets serve to pull in the Black populations in these dispersed cities at the expense of traditional criteria.

Likewise, Cooper Map 6 includes an ungainly tail that hooks through a string of heavily white precincts, oftentimes only a single precinct wide, before turning back and scooping up the heavily Black portion of Mobile. This "tail" is unlike anything ever included in an Alabama map before.

Figure 8: Cooper Illustrative Map 2

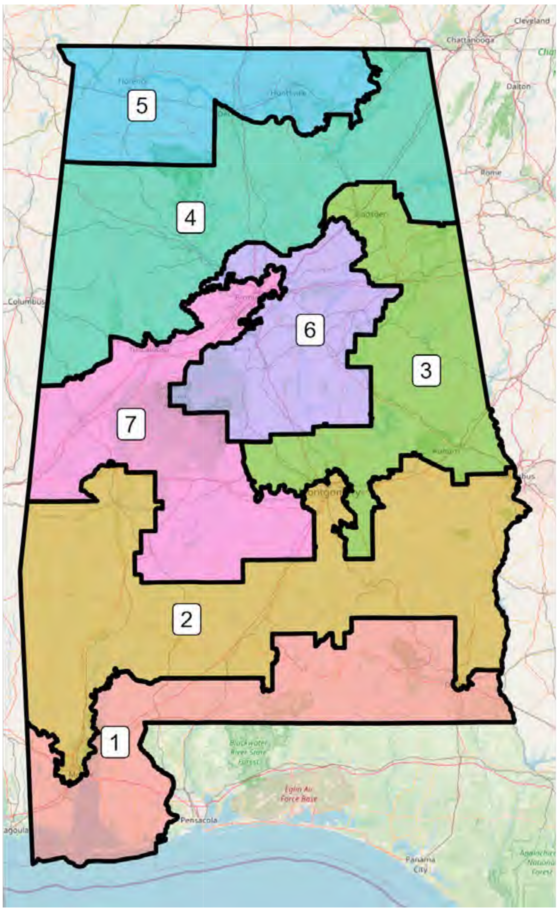


Figure 9: Cooper Illustrative Map 6

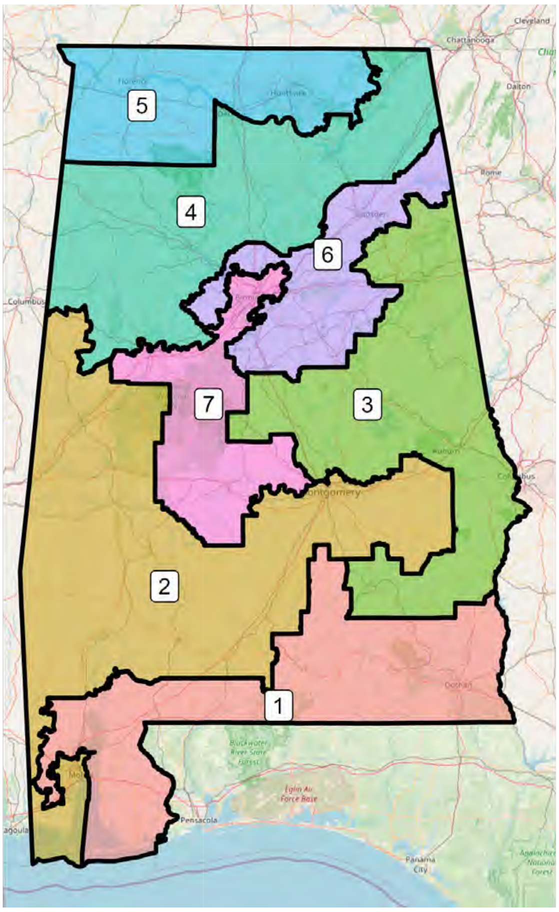


Figure 10: Average Reock Scores, Cooper Illustrative Districts and other 2020s maps

Author	Map	Reock
Alabama	2023	0.4112
Cooper	7	0.4001
Alabama	2021	0.3888
Special Master	2023	0.3468
Cooper	8	0.3334
Cooper	2	0.3274
Cooper	4	0.3246
Cooper	3	0.3236
Cooper	1	0.3204
Cooper	6	0.3061
Cooper	5	0.2826

Regardless, the following table depicts the average Reock score for the various Cooper maps, the Enacted Map, the 2021 map, and the Special Master's map.

Subject to the caveats in Part V.B., Cooper 7 has a Reock score that appears similar to that of the Enacted Map; more on that later. The remaining Cooper maps, however, fill between 18 to 30% less of their Minimum Bounding Circles, on average, than the Enacted Map. That is a substantial difference in my experience, one that the eye can readily detect comparing the Enacted Map with, say, Cooper 5, using Appendix B

Likewise, the Enacted Map is more compact than all of Mr. Cooper's proposed maps using Polsby-Popper. The differences here are more stark, with the districts in Mr. Cooper's most compact map filling, on average, 24% less of their respective circles with the same perimeters than the Enacted Map. For the least compact version of Mr. Cooper's plans, the districts fill about 44% less of the circles. Again, there are no magic cutoff points to enable someone to state that the differences are meaningful, but filling

Figure 11: Average Polsby-Popper Scores, Cooper Illustrative Districts and other 2020s maps

Author	Map	Polsby-Popper
Alabama	2023	0.2817
Special Master	2023	0.2352
Alabama	2021	0.2221
Cooper	4	0.2142
Cooper	7	0.2113
Cooper	8	0.2001
Cooper	5	0.1829
Cooper	3	0.1827
Cooper	1	0.1800
Cooper	2	0.1755
Cooper	6	0.1585

nearly twice as much of the relevant circle seems like an obviously significant difference.

.

Finally, using the Convex Hull scores, all of Mr. Cooper's maps are again less compact than the Enacted Map. Convex Hull scores are typically higher than Reock scores and much higher than Polsby-Popper scores, in part because squarish or rectangular building blocks are more common than are portions of circles. Regardless, Maps 4 and 7 seem similar on this metric, while the others fall around 10% or more behind the Enacted Map.

To provide context, the map struck down in *Miller v. Georgia* had mean Reock scores of 0.347, mean Polsby-Popper scores of 0.158, and mean Convex Hull scores of 0.689.

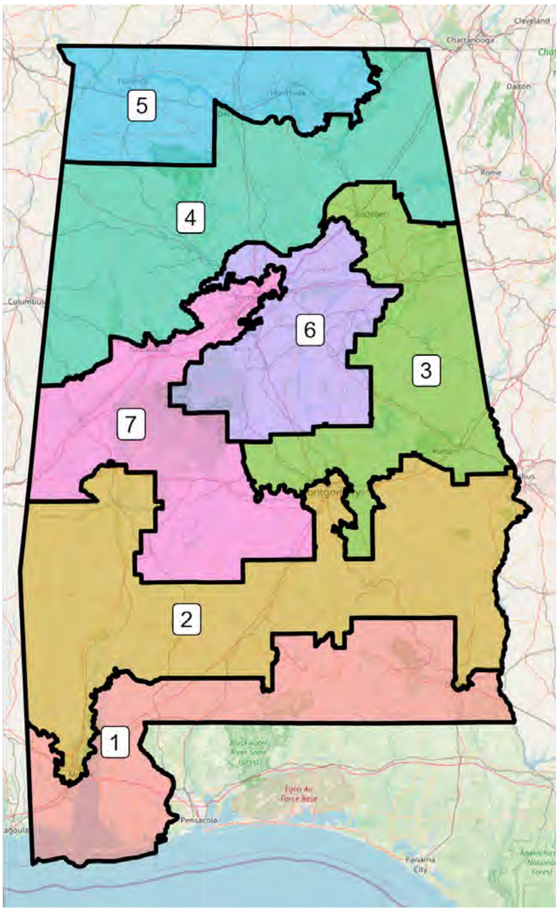
Cooper's Map 7 seems the closest to the 2023 map overall. How does it score well? It isn't by drawing more compact majority-minority districts or handing the inevitable consequences of that map particularly well. As we'll see below, Districts 1 and 2 are still low-compactness districts by Alabama standards. Instead, it achieves a relatively high

Figure 12: Average Convex Hull Scores, Cooper Illustrative Districts and other 2020s maps

Author	Map	Convex Hull
Alabama	2023	0.7514
Cooper	4	0.7240
Alabama	2021	0.7159
Cooper	7	0.7122
Special Master	2023	0.7055
Cooper	3	0.6828
Cooper	8	0.6780
Cooper	5	0.6699
Cooper	1	0.6639
Cooper	2	0.6515
Cooper	6	0.6375

level of compactness overall by drawing two box-like districts in northern Alabama, far from where any concerns about the Voting Rights Act are triggered at the Congressional level.

Figure 13: Cooper Illustrative Map 7



The following table shows the Reock, Polsby-Popper, and Convex Hull scores for Map 7.

Figure 14: Scores for Individual Districts in Cooper Map 7

District	Reock	Polsby-Popper	Convex Hull
1	0.1864	0.1329	0.5760
2	0.3746	0.1925	0.7241
3	0.3804	0.1704	0.6770
4	0.5976	0.3231	0.8175
5	0.4258	0.3864	0.8231
6	0.4762	0.1444	0.7745
7	0.3596	0.1292	0.5934

As you can see, the scores for districts 4 and 5 are consistently higher than those for districts 1 and 2. In the case of Polsby-Popper, the Polsby-Popper score for District 5 is over 3 times the score for District 1. In short, the higher overall compactness score for the map derives from clever map-drawing unrelated to the alleged VRA violation. This illustrates the issue with relying upon averages, albeit certainly to a lesser degree than the extreme example above.

As an additional note, Alabama has drawn a district along the Northern border of the state in every map since the 45th Congress (1877) and has had two districts running roughly parallel across the north in every map since the 89th Congress (1964). These roughly cover the Cumberland Plateau and Highland Rim portions of the state. In other words, Cooper's Map 7 improves its average scores by breaking up longstanding districts in the northern portion of the state, creating a districting arrangement here not seen since shortly after the Civil War.

These maps are less compact on average than the Enacted Map, in many cases substantially so, to the extent that such factors are quantifiable.

6.2.2 Dr. Duchin's Maps

Dr. Duchin's maps fare better. The following three tables present the average Reock, Polsby-Popper and Convex Hull scores for Dr. Duchin's maps.

Figure 15: Average Reock Scores, Duchin Illustrative Districts and other 2020s maps

Author	Map	Reock
Alabama	2023	0.4112
Alabama	2021	0.3888
Duchin	d	0.3841
Duchin	a	0.3629
Duchin	b	0.3581
Duchin	e	0.3476
Special Master	2023	0.3468
Duchin	c	0.3347

Figure 16: Average Polsby-Popper Scores, Duchin Illustrative Districts and other 2020s maps

Author	Map	Polsby-Popper
Duchin	b	0.2824
Alabama	2023	0.2817
Duchin	e	0.2728
Duchin	a	0.2564
Duchin	c	0.2553
Duchin	d	0.2492
Special Master	2023	0.2352
Alabama	2021	0.2221

Figure 17: Average Convex Hull Scores, Duchin Illustrative Districts and other 2020s maps

Author	Map	Convex Hull
Duchin	b	0.7563
Duchin	c	0.7524
Duchin	a	0.7515
Alabama	2023	0.7514
Duchin	d	0.7422
Alabama	2021	0.7159
Duchin	e	0.7097
Special Master	2023	0.7055

In terms of Reock scores, Dr. Duchin's maps are less compact than the Enacted Map. Using Polsby-Popper, Map B is more compact than the Enacted Map, while using Convex Hull maps A, B and C are more compact than the Enacted Map.

Once again, however, these maps achieve their relatively strong scores through careful line drawing in the northern portion of the state. Maps A, B, C and D all offset the decline in compactness created by the actual VRA line-drawing in the south by creating box-like districts in Northern Alabama. As noted above, such a configuration last occurred 150 years ago in the state. More importantly, this is utterly detached from any need to draw actual VRA-compliant districts and seem to function solely as a compactness offset. Consider Map B:

Figure 18: Duchin Map B Summary

District	Reock	Polsby-Popper	Convex Hull
1	0.1848	0.1559	0.5789
2	0.3107	0.1857	0.6662
3	0.3064	0.2271	0.6709
4	0.4513	0.3956	0.8689
5	0.4831	0.5313	0.9321
6	0.4483	0.2483	0.8039
7	0.3220	0.2326	0.7729

The Polsby-Popper score in District 5 is almost five times higher than that of District 1 – a district created as a by-product of the VRA-drawn District 2. District 5 is almost a perfect polygon, with one of the highest Convex Hull scores I believe I've seen. District 4 is not far behind. These approach being twice as high as the Convex Hull score for District 1 – and remember, Convex Hull scores skew toward the higher end of the possible distribution. The effect of this is to boost the average score of the map overall, while still drawing historically non-compact districts in the southern portion of the state.

Map E is something of a different story. It produces versions of Districts 4 and 5 that are almost identical to the versions contained within the Special Master Map and Enacted 2023 Map, and versions of District 1 and 2 that are largely the same as the Special Master Map; some minor adjustments to District 2 push it back over 50% BVAP. The largest changes come to Districts 6 and 7, which are smoothed out and made more compact. The Polsby-Popper scores in particular are improved as a result of this movement vis-a-vis the Special Master's Map.

In addition, Dr. Duchin splits almost every precinct on the boundary of Districts 6 and 7 in Jefferson County in an apparent effort to smooth out the district boundary here. The Special Master Map upon which her map is based splits two precincts here; she splits 21 (including a 3-way split of one precinct). In the following map the dotted line reflects the boundary between Districts 6 and 7 in southeastern Jefferson County (where the map splits the county). Since it is a light dotted line, when the boundary follows precinct borders it blends into those solid borders and disappears. The fact that you can trace the district boundary almost entirely across Jefferson County shows the large number of split precincts here. To put this in perspective, the Enacted Map splits 11 precincts total while the Special Master Map also splits 11. Dr. Duchin Map E exceeds this in Jefferson County alone; overall it splits 73 precincts.

6.2.3 National Comparison

Finally, I have collected the Reock, Polsby-Popper and Convex Hull scores for all current states with at least three Congressional Districts, and excluding Louisiana (which has a district that has been declared a racial gerrymander).

It does not appear that these districts are within normal ranges for this cycle, particularly not Mr. Cooper's. The 25 least compact maps by Reock, Polsby-Popper and Convex Hull are reported below

As to Reock scores, Mr. Cooper's maps are in poor company. The only map that is more extreme than his maps 1, 5 or 6 is Illinois, an obvious gerrymander. The only other map more extreme than 3 or 4 is Texas, which I maintain is a political gerrymander and Dr. Duchin maintains is a racial gerrymander. A court declared Kentucky's map to be a gerrymander before declaring the matter non-justiciable. There are also a host of maps with poor geography for Reock scores such as Maryland (panhandle), Massachusetts, and Tennessee (which is presently being challenged as a racial gerrymander). California is probably the only reasonable map less compact than Duchin E. Duchin A, B and D fare better, but they have problems described above and below.

Polsby-Popper scores produce a similar cast of characters with similar problems. The Supreme Court recently noted that South Carolina is a political gerrymander; Georgia has not yet been challenged, but most political analysts would likely argue its convoluted boundaries are not the result of detached map drawing. North Carolina is currently

Figure 19: District 6/7 Boundary in Jefferson County, Laid Over Precinct Boundaries

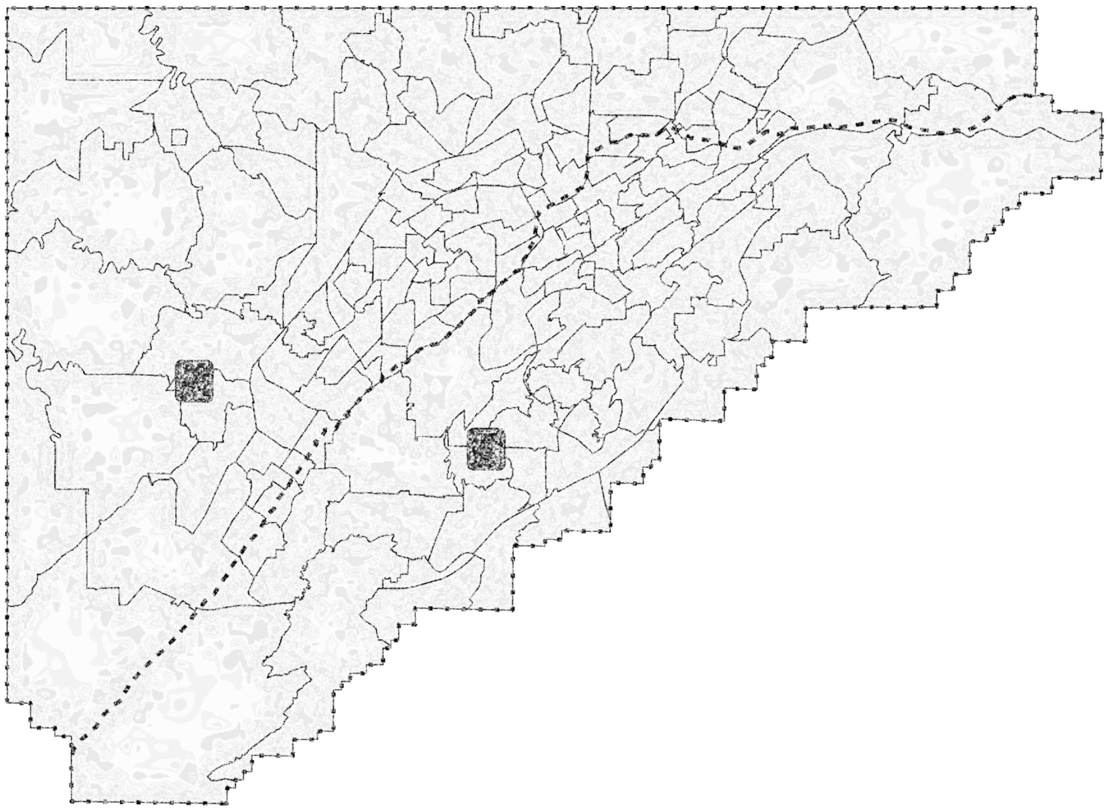


Figure 20: Reock Scores, Current National Maps and Illustrative Maps

State	Reock
IL	0.2712
Cooper-5	0.2826
Cooper-6	0.3061
Cooper-1	0.3204
TX	0.3215
Cooper-3	0.3236
Cooper-4	0.3246
MD	0.3249
Cooper-2	0.3274
Cooper-8	0.3334
Duchin-c	0.3347
KY	0.3376
MA	0.3383
TN	0.3419
CA	0.3443
Special Master-2023	0.3468
Duchin-e	0.3476
NE	0.3498
Duchin-b	0.3581
NJ	0.3584
SC	0.3614
Duchin-a	0.3629
Alabama-108	0.3660
NM	0.3683
MI	0.3758

Figure 21: Polsby-Popper Scores, Current National Maps and Illustrative Maps

State	Polsby-Popper
IL	0.1489
Cooper-6	0.1585
Cooper-2	0.1755
Alabama-108	0.1792
Cooper-1	0.1800
Cooper-3	0.1827
Cooper-5	0.1829
TX	0.1911
Alabama-113	0.1924
Alabama-103	0.1989
Cooper-8	0.2001
TN	0.2072
Cooper-7	0.2113
CA	0.2125
NJ	0.2137
Cooper-4	0.2142
SC	0.2188
MA	0.2189
Alabama-2021	0.2221
Special Master-2023	0.2352
KY	0.2436
GA	0.2445
Duchin-d	0.2492
NC	0.2505
Duchin-c	0.2553

being challenged as both a political and a racial gerrymander, and was adopted in response to a court ruling that political gerrymandering claims were non-justiciable.

Figure 22: Convex Hull Scores, Current National Maps and Illustrative Maps

State	Convex Hull
IL	0.5679
Cooper-6	0.6375
Cooper-2	0.6515
TX	0.6575
Cooper-1	0.6639
NJ	0.6654
MA	0.6692
Cooper-5	0.6699
Cooper-8	0.6780
Cooper-3	0.6828
CA	0.6909
KY	0.6938
MD	0.6965
Alabama-113	0.6998
Alabama-103	0.7052
Special Master-2023	0.7055
Duchin-e	0.7097
TN	0.7105
Cooper-7	0.7122
NC	0.7154
Alabama-2021	0.7159
Alabama-108	0.7178
Cooper-4	0.7240
NM	0.7298
CT	0.7377

Convex Hull scores are more of the same. The New Mexico map was found by a court to have been drawn with partisan intent (but not with partisan effect).

Again, I believe these types of comparisons have their limitations. But it is difficult to see how these maps could be considered within the normal range of maps in the United States. At best, they fall into the range of maps that have been found to be, or almost unanimously considered to be, political and/or racial gerrymanders.

6.3 The Illustrative Maps include districts that are among the least compact drawn in recent Alabama History.

Focusing on the individual districts further illustrates how non-compact these districts are. We can again break our analysis down between Dr. Duchin's districts and Mr. Cooper's.

6.3.1 Mr. Cooper's Districts

As discussed above, Mr. Cooper asserts that his districts are "clearly within the normal range for compactness as compared to congressional plans nationwide." This at least has some support, even if he is comparing his districts to those found in maps with radically different geometries and to those found in maps that are aggressively gerrymandered.

To account for these differences, I've narrowed the focus to districts drawn in Alabama, using the post-1972 Alabama District Set described above. We can compute Reock, Polsby-Popper and Convex Hull scores for all of these districts and see how Mr. Cooper's districts compare. Thus, all of these maps will at the very least have the same geographic hurdles to overcome and will have the same amount of coastline to contend with.

Using Reock scores, Mr. Cooper's districts do not fare well, particularly among the districts most heavily influenced by the attempt to draw two majority-minority districts. Because District 2 in all of these configurations stretches down almost to the southern boundary of the map (but not quite), it largely forces the configuration of District 1. In cases where it traverses the map entirely, it completely forces the configuration of District One.

The following table shows the 25 least-compact districts using Reock score. As you can see, these "left-over" districts comprised of the areas left over in an attempt to draw a second majority-minority district are grotesquely configured by Alabama standards. All Mr. Cooper's eight District 1's are among the least compact districts drawn recently in the state, with the Map 5 version being the least compact district drawn (using Reock to measure compactness). Only District 5 from the 113th Congress (2013), which stretched across the top of the state as it has for over a hundred years, is in competition. Only eight districts drawn by the Alabama legislature in the past 50 years make the list.

All of Cooper's versions of District 2 itself are likewise less compact than any version of District 2 (which has been the number of the Montgomery-based district since at least the Civil War) since the state went to seven districts in 1972.

Pivoting to Polsby-Popper scores, Cooper's districts continue to dominate the list of least-compact districts in the past 50 years. This includes several of his actual VRA Illustrative districts (2 and 7).

His District 2 variations are likewise the least compact Montgomery-based districts in the past 50 years. In some cases, the scores are half those of the least compact District 2 Alabama's legislature drew (in 2013) in the past 50 years.

Using Convex Hull is more of the same. Cooper Map 6, District 1 is non-compact, with Map 5, District 1 not far behind. Map 5, District 1 appears on all three lists; there is a decent argument that it is the least compact district drawn in Alabama at least since the state went to 7 districts. Only three districts drawn by the Alabama legislature in the past 50 years appear on this list.

Cooper's version of District 2 is likewise less compact using Convex Hull than any version of District 2 since the state went to seven districts in 1972. Map 3's variant is probably comparable to those drawn for 1992, 2012 and 2022, and 2002.

Figure 23: Twenty-Five Least Compact Districts in Alabama Since 1972, Reock

Author	Map	District	Reock
Cooper	5	1	0.1709
Alabama	113	5	0.1823
Cooper	3	1	0.1847
Cooper	4	1	0.1847
Cooper	7	1	0.1864
Cooper	2	1	0.1875
Cooper	1	1	0.1875
Cooper	8	1	0.1896
Special Master	2023	1	0.1915
Special Master	2023	2	0.2047
Cooper	6	1	0.2119
Alabama	103	5	0.2181
Alabama	108	5	0.2217
Cooper	5	7	0.2268
Alabama	98	5	0.2461
Alabama	93	5	0.2461
Alabama	2021	5	0.2484
Alabama	98	4	0.2705
Cooper	1	4	0.2706
Cooper	2	4	0.2706
Cooper	4	4	0.2739
Cooper	5	4	0.2744
Cooper	6	6	0.2754
Alabama	93	4	0.2780
Cooper	1	5	0.2802

Figure 24: Cooper's District 2, compared to other District 2 variants, Reock

Author	Map	District	Reock
Special Master	2023	2	0.2047
Cooper	2	2	0.2826
Cooper	6	2	0.2939
Cooper	8	2	0.3003
Cooper	1	2	0.3023
Cooper	4	2	0.3260
Cooper	5	2	0.3641
Cooper	3	2	0.3651
Cooper	7	2	0.3746
Alabama	93	2	0.4513
Alabama	98	2	0.4513
Alabama	103	2	0.4698
Alabama	113	2	0.4713
Alabama	2021	2	0.4834
Alabama	108	2	0.4873
Alabama	2023	2	0.5830

Figure 25: Twenty-Five Least Compact Districts in Alabama Since 1972, Reock

Author	Map	District	Polsby-Popper
Cooper	6	6	0.0985
Cooper	6	7	0.1052
Alabama	108	7	0.1087
Cooper	6	2	0.1101
Cooper	5	7	0.1124
Alabama	108	6	0.1132
Alabama	103	7	0.1133
Cooper	2	2	0.1151
Cooper	6	1	0.1174
Cooper	8	2	0.1237
Cooper	3	4	0.1237
Cooper	2	7	0.1263
Cooper	5	1	0.1269
Cooper	8	7	0.1270
Cooper	7	7	0.1292
Cooper	3	6	0.1299
Alabama	113	7	0.1313
Cooper	4	6	0.1315
Cooper	5	6	0.1321
Cooper	7	1	0.1329
Cooper	1	7	0.1339
Cooper	2	1	0.1359
Alabama	103	6	0.1374
Alabama	113	6	0.1376
Alabama	108	1	0.1386

Figure 26: Cooper's District 2, compared to other District 2 variants, Polsby-Popper

Author	Map	District	Polsby Popper
Cooper	6	2	0.1101
Cooper	2	2	0.1151
Cooper	8	2	0.1237
Cooper	1	2	0.1387
Special Master	2023	2	0.1411
Cooper	4	2	0.1794
Cooper	7	2	0.1925
Cooper	5	2	0.1941
Cooper	3	2	0.2167
Alabama	113	2	0.2237
Alabama	103	2	0.2309
Alabama	2021	2	0.2566
Alabama	108	2	0.2689
Alabama	2023	2	0.3682
Alabama	98	2	0.3913
Alabama	93	2	0.3913

Figure 27: Twenty-Five Least Compact Districts in Alabama Since 1972, Convex Hull

Author	Map	District	Convex Hull
Cooper	6	1	0.5061
Cooper	5	1	0.5287
Cooper	2	3	0.5567
Cooper	6	7	0.5575
Cooper	2	2	0.5629
Cooper	2	1	0.5644
Cooper	1	1	0.5645
Cooper	1	3	0.5686
Cooper	6	2	0.5745
Cooper	7	1	0.5760
Cooper	3	4	0.5793
Cooper	3	1	0.5827
Cooper	4	1	0.5827
Alabama	103	7	0.5840
Cooper	7	7	0.5934
Cooper	8	1	0.5939
Special Master	2023	1	0.5948
Cooper	8	2	0.5994
Special Master	2023	2	0.6047
Cooper	2	7	0.6055
Cooper	8	4	0.6106
Special Master	2023	4	0.6106
Alabama	2023	4	0.6106
Cooper	1	2	0.6111
Alabama	2021	4	0.6125

Figure 28: Cooper's District 2, compared to other District 2 variants, Convex Hull

Author	Map	District	Conv. Hull
Cooper	2	2	0.5629
Cooper	6	2	0.5745
Cooper	8	2	0.5994
Special Master	2023	2	0.6047
Cooper	1	2	0.6111
Cooper	5	2	0.6994
Cooper	4	2	0.7018
Cooper	7	2	0.7241
Cooper	3	2	0.7402
Alabama	103	2	0.7408
Alabama	113	2	0.7425
Alabama	2021	2	0.7580
Alabama	108	2	0.7683
Alabama	2023	2	0.8467
Alabama	98	2	0.8590
Alabama	93	2	0.8590

6.3.2 Dr. Duchin's Districts

Dr. Duchin's Districts suffer from similar problems. As with Mr. Cooper's maps, her version of District 2 are the least compact versions of that district using Reock, Polsby-Popper, or Convex Hull scoring since Alabama went to seven districts in 1972.

Using Reock scores, her versions of District 1 are among the least compact districts drawn in the state. Her versions of District 2 in maps c and e are likewise among the least compact districts drawn in the state. Only one and three districts drawn by the state are less compact; all of those are variants of the District 5 that has run across the top of the state since the 1800s.

Using Polsby-Popper scores her districts look a bit better, though they still dominate the list.

Finally, using Convex Hull scores her District 1 variants are less compact than anything drawn in Alabama in recent years. Map E District 2 is the least compact district in recent times using the Convex Hull score. Only nine districts drawn by the Alabama legislature for the seven maps it enacted during this time period appear on this list.

7 The Illustrative Districts are not compact overall.

Mr. Cooper stated that "there is no bright line rule as to what constitutes a sufficiently compact redistricting plan or district." ¶4. This is true, and it makes it difficult to give the Court the answer it wants: that the districts are or are not reasonably compact overall. The substantial wiggle room is what allows Mr. Cooper to declare a map whose average Polsby-Popper score is half that of the Enacted Map is "generally in the same range of compactness." Cooper Report ¶112.

But no matter how these maps are looked at, the districts that are drawn are not compact, at least by Alabama standards. If we use the map compactness means – which are problematic measures since they look at the maps as a whole rather than

Figure 29: Twenty-Five Least Compact Districts in Alabama Since 1972, Reock

Author	Map	District	Reock
Alabama	113	5	0.1823
Duchin	b	1	0.1848
Duchin	c	1	0.1848
Duchin	e	1	0.1885
Duchin	d	1	0.1897
Special Master	2023	1	0.1915
Duchin	a	1	0.1916
Special Master	2023	2	0.2047
Duchin	c	2	0.2128
Alabama	103	5	0.2181
Alabama	108	5	0.2217
Duchin	e	2	0.2232
Alabama	98	5	0.2461
Alabama	93	5	0.2461
Alabama	2021	5	0.2484
Alabama	98	4	0.2705
Duchin	a	6	0.2764
Alabama	93	4	0.2780
Alabama	2023	1	0.2852
Alabama	103	4	0.2898
Alabama	108	4	0.2903
Duchin	d	6	0.2962
Duchin	c	7	0.3029
Duchin	a	2	0.3039
Duchin	d	2	0.3052

Figure 30: Twenty-Five Least Compact Districts in Alabama Since 1972, Polsby-Popper

Author	Map	District	Polsby-Popper
Alabama	108	7	0.1087
Alabama	108	6	0.1132
Alabama	103	7	0.1133
Duchin	a	1	0.1289
Alabama	113	7	0.1313
Duchin	d	1	0.1316
Alabama	103	6	0.1374
Alabama	113	6	0.1376
Alabama	108	1	0.1386
Special Master	2023	2	0.1411
Duchin	c	2	0.1489
Special Master	2023	1	0.1523
Duchin	d	2	0.1524
Duchin	e	2	0.1534
Alabama	2021	6	0.1542
Duchin	b	1	0.1559
Duchin	c	1	0.1559
Duchin	e	1	0.1561
Duchin	a	2	0.1606
Alabama	113	1	0.1622
Duchin	c	6	0.1737
Alabama	108	4	0.1751
Alabama	113	4	0.1829
Duchin	c	7	0.1835
Alabama	2023	6	0.1848

Figure 31: Twenty-Five Least Compact Districts in Alabama Since 1972, Convex Hull

Author	Map	District	Convex Hull
Duchin	e	2	0.5496
Duchin	d	1	0.5667
Duchin	a	1	0.5725
Duchin	e	1	0.5779
Duchin	b	1	0.5789
Duchin	c	1	0.5789
Alabama	103	7	0.5840
Special Master	2023	1	0.5948
Special Master	2023	2	0.6047
Special Master	2023	4	0.6106
Alabama	2023	4	0.6106
Alabama	2021	4	0.6125
Alabama	113	7	0.6215
Duchin	d	2	0.6217
Alabama	113	4	0.6226
Duchin	e	4	0.6265
Alabama	93	4	0.6343
Duchin	a	2	0.6400
Alabama	108	7	0.6472
Alabama	2023	1	0.6488
Alabama	103	4	0.6591
Alabama	98	4	0.6637
Duchin	b	2	0.6662
Duchin	d	6	0.6670
Duchin	b	3	0.6709

individual districts – the maps are generally less compact than the Enacted Map, at times significantly so. Yet those times when they are more compact on average than the Enacted Map are usually due to careful line drawing in the Northern portion of the state, far from where the alleged VRA violation occurs. At times it is because of a decision to smooth out district lines by splitting VTDs at high rates (as we shall see, doing so along racial lines in the process). In other words, all of those instances come with asterisks.

More importantly, when we focus on the districts that are reconfigured to create the second majority-minority district – 1 and 2 – we consistently see districts with unusually low compactness. Using Reock scoring, the resulting District 1s are typically the least compact districts drawn in Alabama in recent years, and often ever. Polsby-Popper and Convex Hull are a bit of a mixed bag, but even then, the districts along the Alabama/Florida boundary are among the least compact in Alabama history. The actual VRA district offered – District 2 – is typically the least compact Montgomery-based district drawn in the last 50 years, often by substantial margins.

When we add in the fact that these maps utilize combinations of metropolitan areas that haven't been used in Alabama in 190 years, to the extent we can draw any conclusion about relative compactness, it would have to be that these districts are not reasonably compact.

8 The State Board of Education Districts are not to the contrary.

I have also been asked to review the history of the State Board of Education districts that Plaintiffs point to as evidence that Montgomery and Mobile can be linked in the same district. First, as noted above, this configuration does not appear to have occurred in congressional districts since the 1830s. It appears to be a one-off configuration in Alabama.

Second, this district appears to have a unique history that is not necessarily based upon any expression of a common interest between Montgomery and Mobile. Instead, its history appears to be based upon the existence and understanding of what section 5 of the VRA required pre-*Shelby County* and *Alabama Black Legislative Caucus*, and inertia. I have reviewed the pre-clearance submissions for 2000 and 2010 (obviously there is no 2020 pre-clearance submission), and relevant attachments here.

These maps grew out of the 1996 *Sahag v. Mitchell* case. *See* 2002 Preclearance Submission. The initial *Sahag* maps created two Black majority districts out of the 8 SBOE districts in effect at the time. *Id.* The boundaries were as follows (county boundaries are depicted with blue dashed lines):

In 2002, the maps were updated to slightly increase the Black population and the BVAPs. The eventual submission to DOJ expressed concerns about avoiding retrogression under section 5 of the Voting Rights Act, which applied to the state of Alabama vis-à-vis section 4 of that Act. This map did not extend into Mobile, but rather connected Montgomery with other Black Belt counties. The Fourth District's presence in Jefferson County was reduced, and the district was pushed into Bibb and Hale Counties. The Fifth was mostly otherwise unchanged, but took on a bit more of Montgomery County.

By 2011, these districts had become underpopulated once again. The population of Alabama after the 2010 census was 4,779,736. See `https://www2.census.gov/library/publications/2012/dec/cph-1-2.pdf`. The ideal district population for an eight-member delegation was therefore 597,467. The two Black majority districts – 4 and 5 – were underpopulated by around 87,000 and 82,000 individuals, respectively. At the time, Section 5's anti-retrogression provisions were still in effect. Alabama (wrongly) believed that section 5 required districts be maintained at roughly the same BVAP to avoid a retrogression claim. Alabama Black Legislative Caucus, and in any event, these districts were only marginally majority BVAP (unlike the districts at issue in Alabama Black Legislative Caucus). District 4 was 51.7% BVAP, while District 5 was 54.7% BVAP (note that the legislature was using Black Alone as their measure of BVAP).

This left the legislature with few options. As you can see from the accompanying

Figure 32: *Sahag* SBOE Map

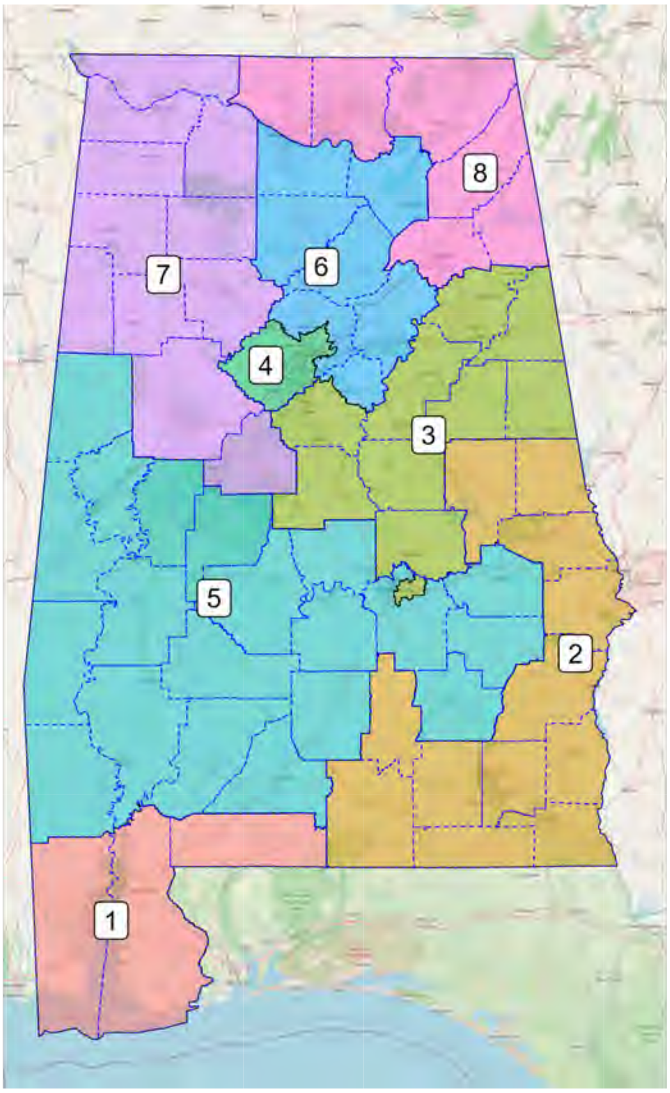


Figure 33: 2000s SBOE Map

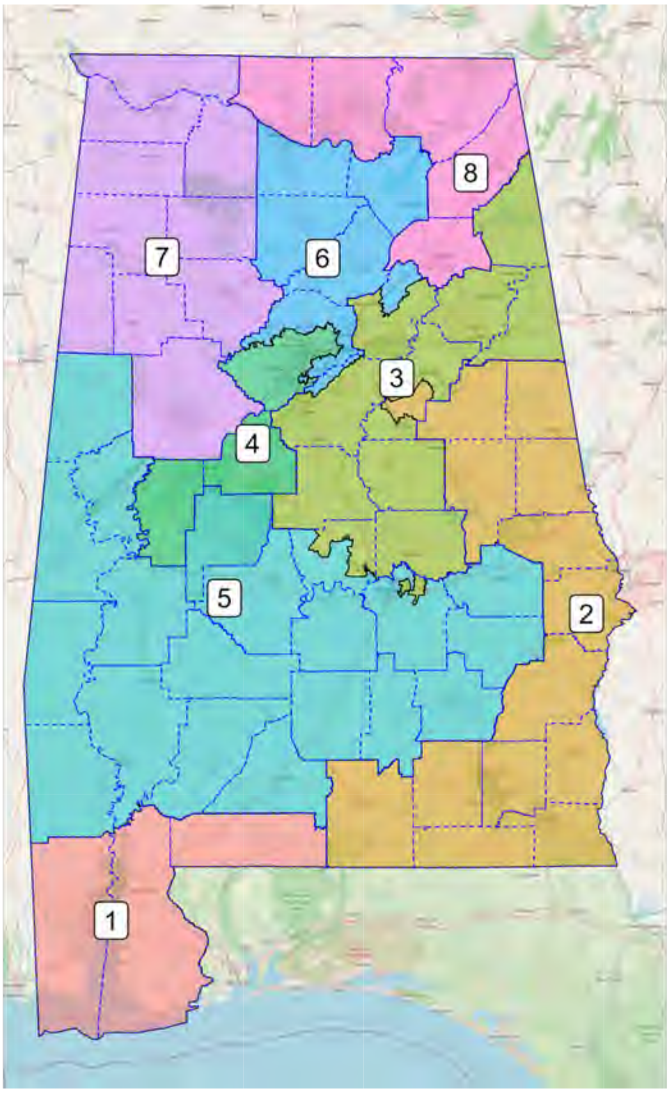
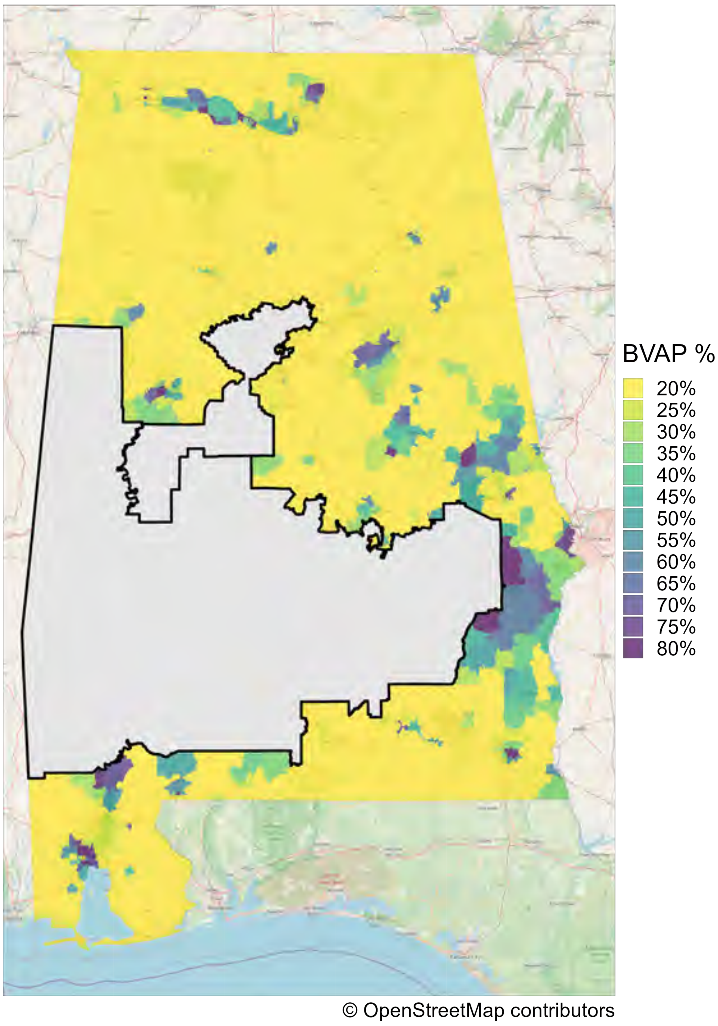


Figure 34: Precincts in AL, by 2010 BVAP, with 2000-era SBOE Districts 4 (top) and 5 (bottom) shaded out.



map, there were very few areas of Black voting strength left near District 4, which meant it would have to push further into District 5 to maintain Black voting strength. Here, SBOE Districts 4 (top) and 5 (bottom) are shaded, to illustrate what the BVAPs in neighboring areas not already included in the districts were.

This is exactly what happened. District 5 took Tuscaloosa County from District 7 and Greene County (80.5% BVAP according to the 2010 census) from District 4. It also gained Pickens County (38.4% BVAP in 2010) from District 4. These changes, along with changes in the Jefferson County area, raised the population of District 5 while keeping the BVAP above 50%, but it left District 4 even more underpopulated. Once the changes to District 4 were implemented, its population would have been reduced to 486,052. Its BVAP was fairly robust, at 54.9%, but it needed to gain 111,415 residents to achieve ideal population; it needed to gain 81,542 residents to achieve the extreme lower bound for population compliance. If these residents were pulled from heavily White areas, the BVAPs would plummet.

Here, the district was hemmed in by geographic *and* racial constraints. There were very few concentrations of Black Americans to the north. There were heavy concentrations to the East, but pushing in that direction would mean cutting District 2 in half, and there was not enough population to support two full districts in what remained. That left the legislature with one option: Pushing south. This is what the legislature did by adding the Black population in Mobile. There isn't any evidence in the submissions or contemporary news accounts that people thought this made sense; in fact, contemporary news accounts suggest that this move was controversial in Mobile. *See* 2012 Preclearance Submission, Exhibit I. It was done because the district had nowhere else to go under contemporary understandings of the VRA. The result was this:

The resulting maps carved out Black majority areas in and around District 4 and 5:

By 2020, the districts were malapportioned once again, though not to the same degree as after the 2010 census. District 8 was 6.6% over the ideal population, District 1 was 4.2% above, and Districts 2 and 3 were between 2 and 3% above. District 4 was 3% below the ideal and District 5 was 10.2% below the ideal. Ultimately, fewer than a million residents were moved around, which given the movement of whole counties, is reasonable. The lines were smoothed out a bit. The result is that Districts 1, 2, 4 and 8 retained over 90% of their previous cores, while 3 retained more than 80% of its core. The remaining districts retained over 70% of their cores. The resulting map looked like this, once again carefully carving out Black precincts in the Montgomery, Mobile and Birmingham areas:

Figure 35: 2010s SBOE Map

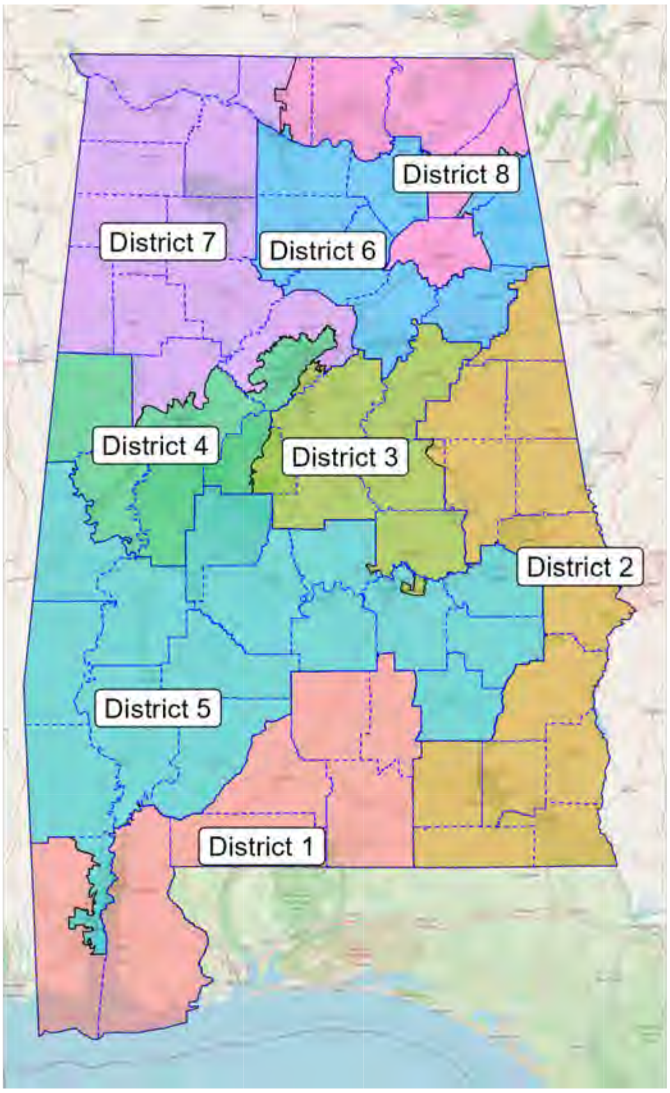


Figure 36: SBOE District 4 (Top) and 5 (Bottom), overlaid on 2010s BVAPs

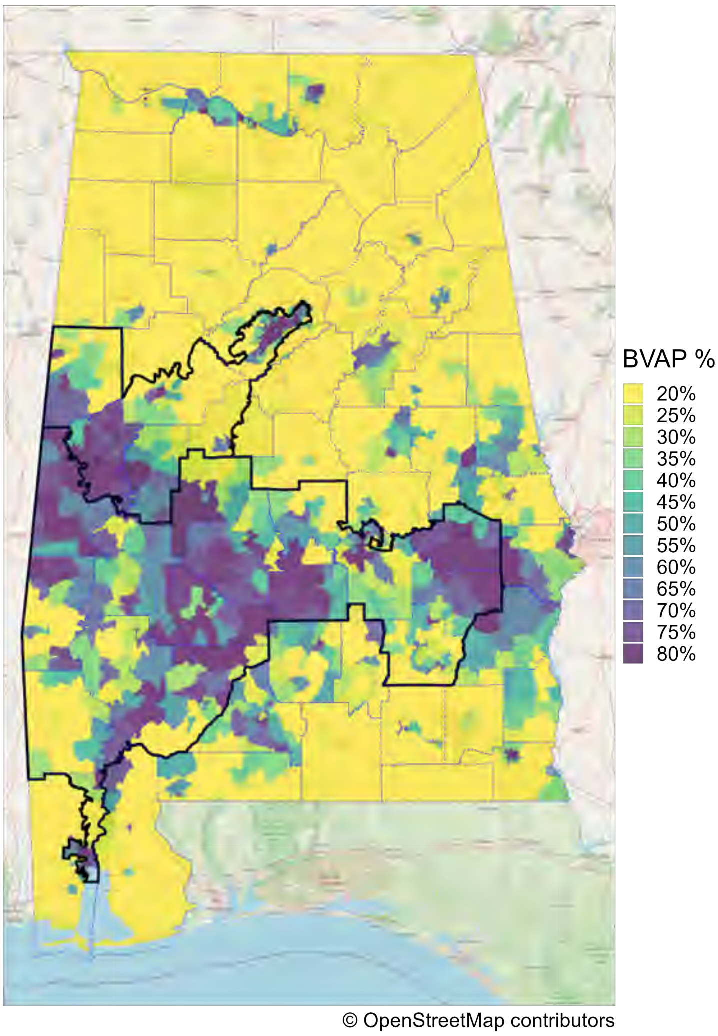
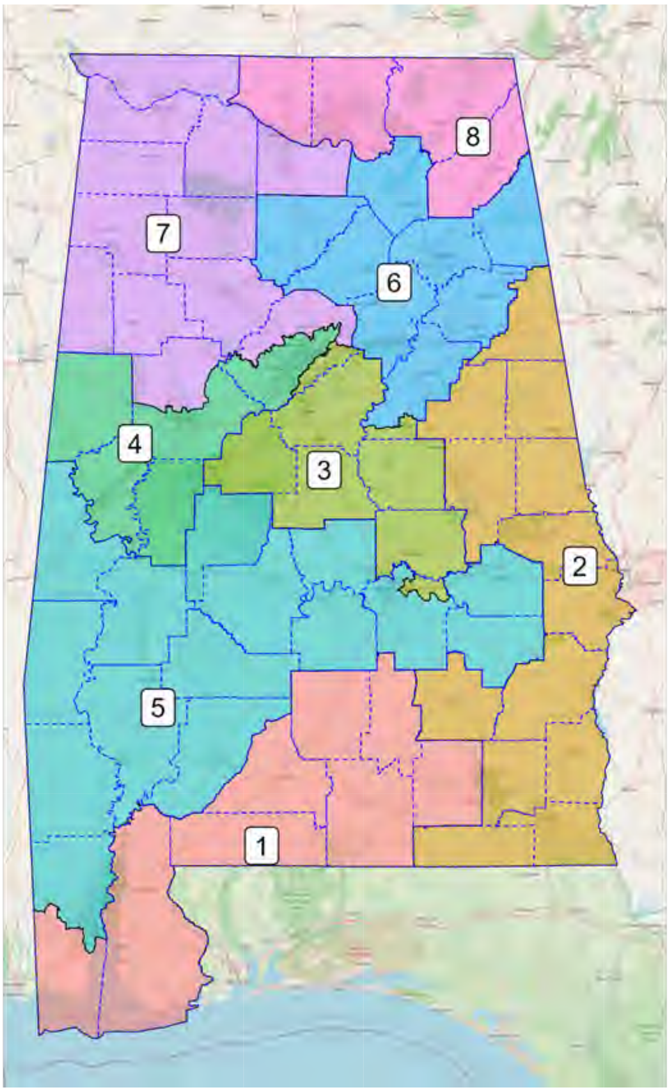


Figure 37: 2020s SBOE Map

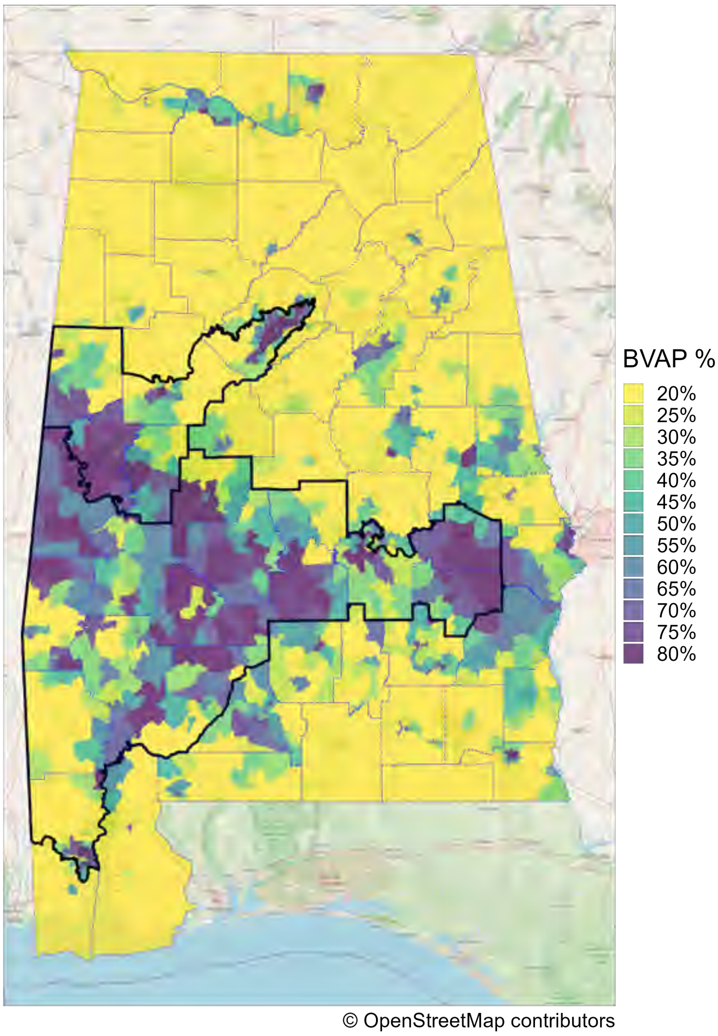


9 The Illustrative Maps carefully carve out Black populations when splitting counties.

Returning to the Illustrative Maps, when the maps *do* split counties between an Illustrative majority-minority district and a non-VRA district[12], they typically do so on racial lines. For example, consider the ways in which Mr. Cooper's maps split up Jefferson

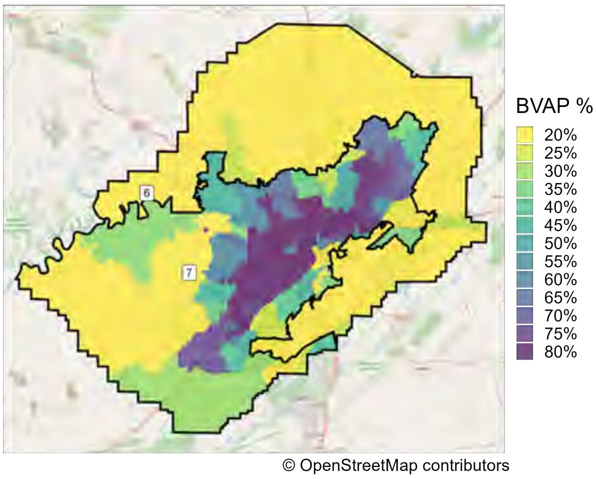
[12] as between two majority-minority districts, these splits are typically occurring in heavily Black areas

Figure 38: SBOE District 4 (Top) and 5 (Bottom), overlaid on 2020s BVAPs

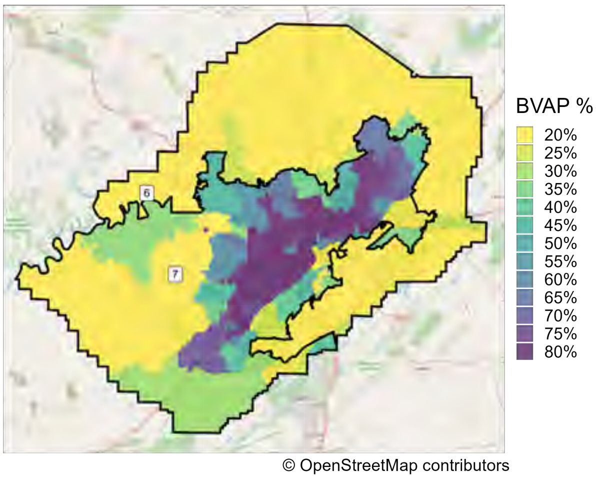


County. The following group of four maps represents Cooper Maps 1 – 4. As you can see, regardless of the district configuration, the district is carefully drawn to cut through Jefferson County and sort precincts by race. Occasionally a precinct with a BVAP in excess of 20% is allowed to slip out of District 7 and into 6, but those occasions are rare.

Figure 39: Cooper Splits of Jefferson County, AL

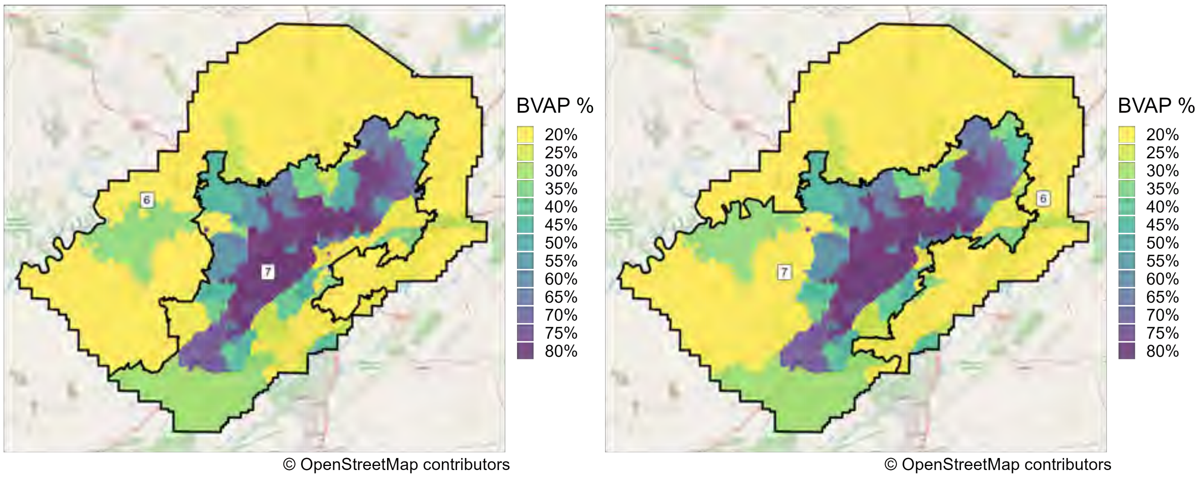


(a) Cooper Map 1, Jefferson County



(b) Cooper Map 2, Jefferson County

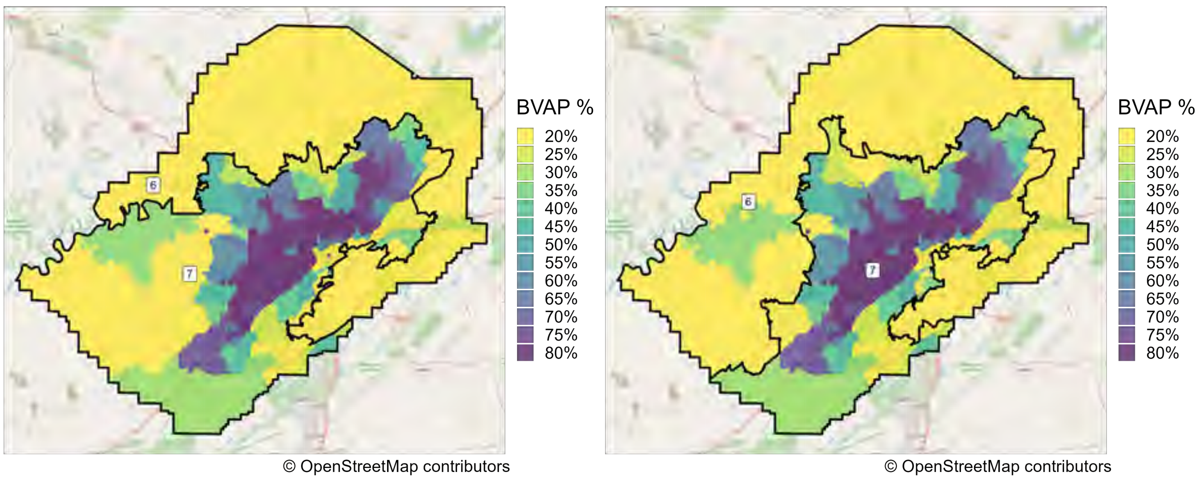
Figure 40: Cooper Splits of Jefferson County, AL



(a) Cooper Map 3, Jefferson County (b) Cooper Map 4, Jefferson County

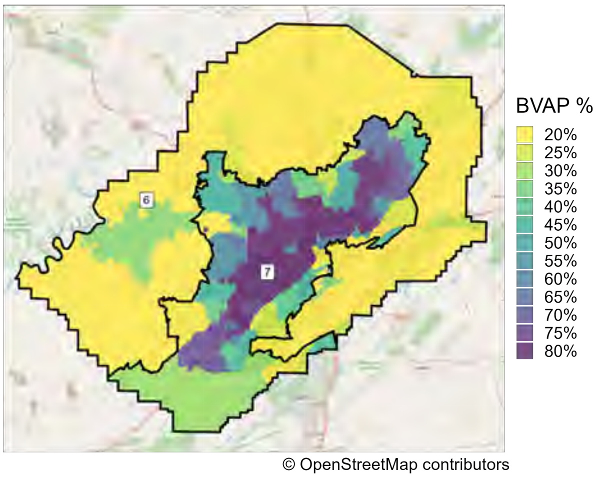
The same holds true for Maps 5 – 8.

Figure 41: Cooper Splits of Jefferson County, AL

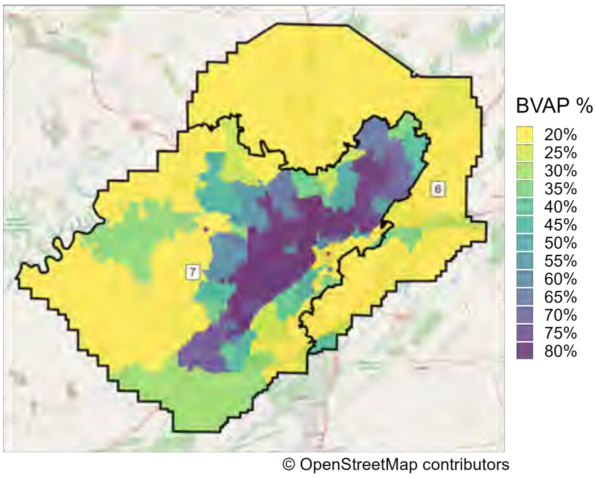


(a) Cooper Map 5, Jefferson County (b) Cooper Map 6, Jefferson County

Figure 42: Cooper Splits of Jefferson County, AL



(a) Cooper Map 7, Jefferson County

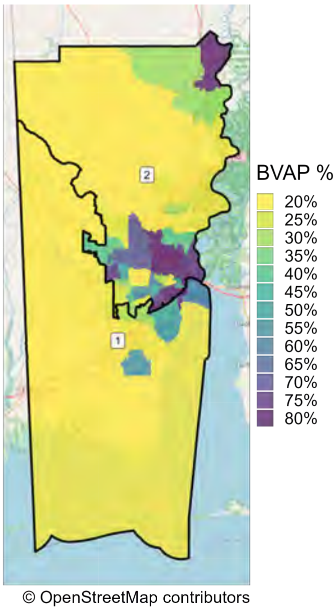


(b) Cooper Map 8, Jefferson County

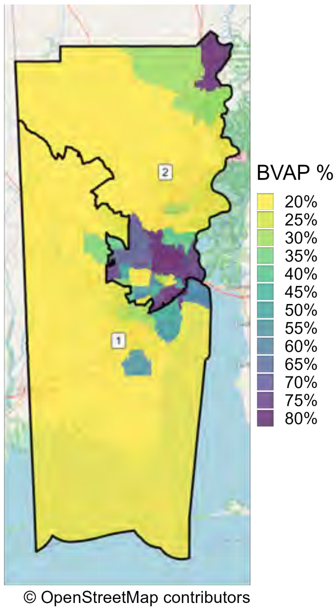
Regardless of the district configuration, the boundary between District 6 and 7 in Jefferson County hews closely to racial boundaries in Jefferson County in all of Mr. Cooper's maps.

The same is true in Mobile County for Map 1-4, which splits the county carefully along racial lines:

Figure 43: Cooper Splits of Mobile County, AL

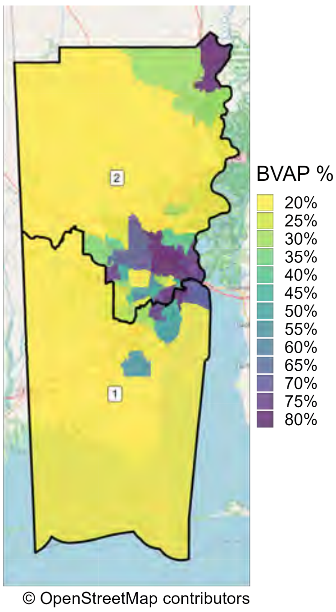


(a) Cooper Map 1, Mobile County

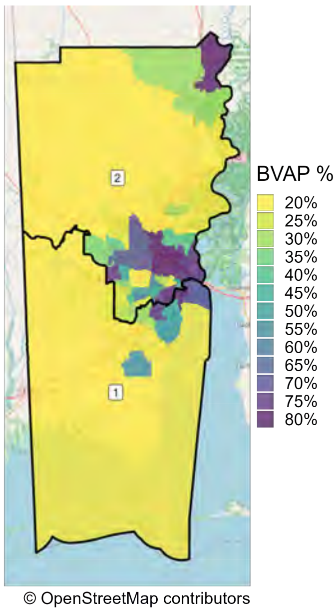


(b) Cooper Map 2, Mobile County

Figure 44: Cooper Splits of Mobile County, AL



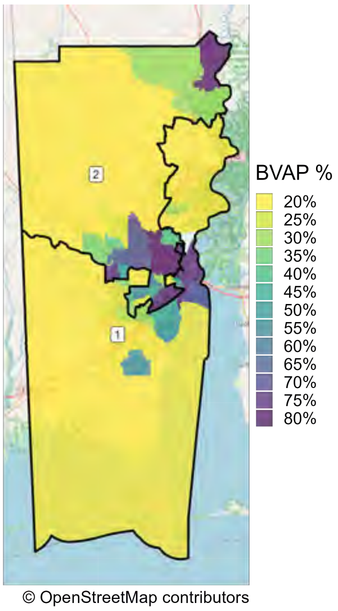
(a) Cooper Map 3, Mobile County



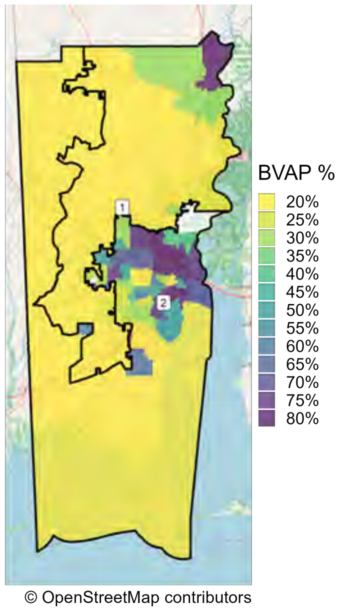
(b) Cooper Map 4, Mobile County

As is also the case for Maps 5-8. Maps 6 and 7 are particularly aggressive along these lines:

Figure 45: Cooper Splits of Mobile County, AL

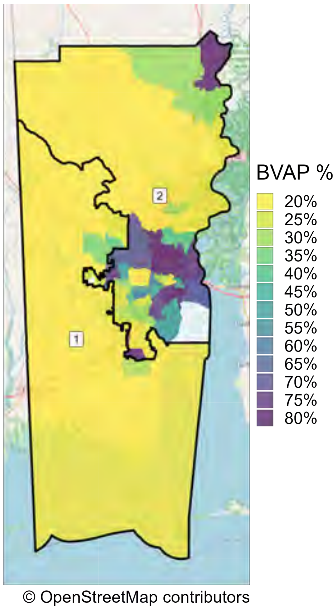


(a) Cooper Map 5, Mobile County

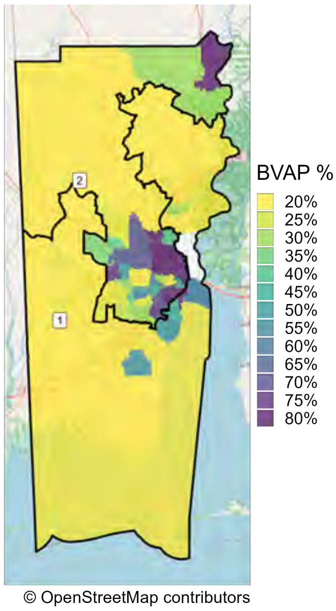


(b) Cooper Map 6, Mobile County

Figure 46: Cooper Splits of Mobile County, AL



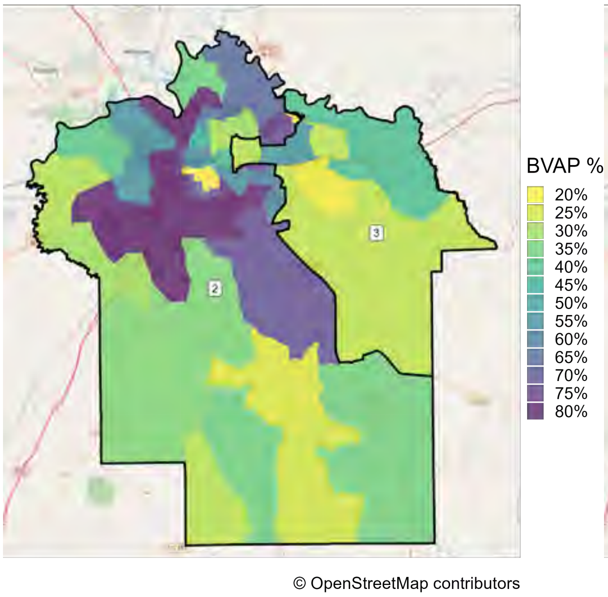
(a) Cooper Map 7, Mobile County



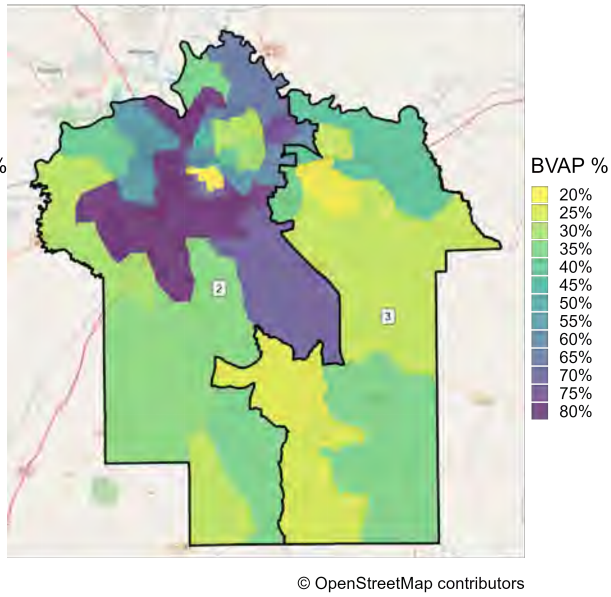
(b) Cooper Map 8, Mobile County

Finally, Cooper's maps occasionally split Montgomery County, Houston County, and Pickens County. When they do so, they do so along racial lines.

Figure 47: Cooper Splits of Montgomery County, AL

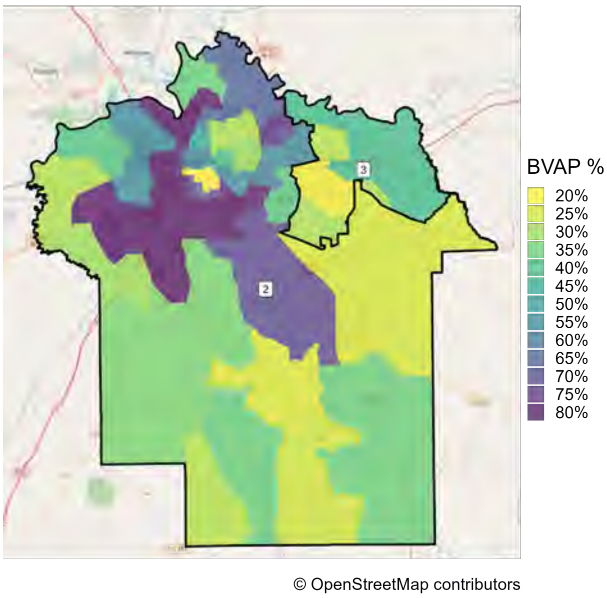


(a) Cooper Map 1, Montgomery County

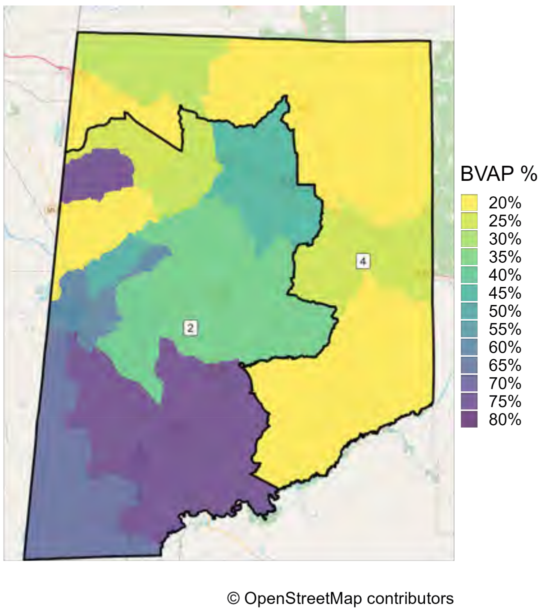


(b) Cooper Map 2, Montgomery County

Figure 48: Cooper Splits of Montgomery and Pickens counties, AL

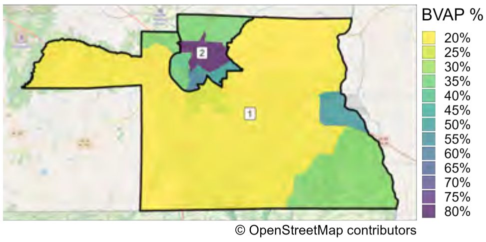


(a) Cooper Map 4, Montgomery County



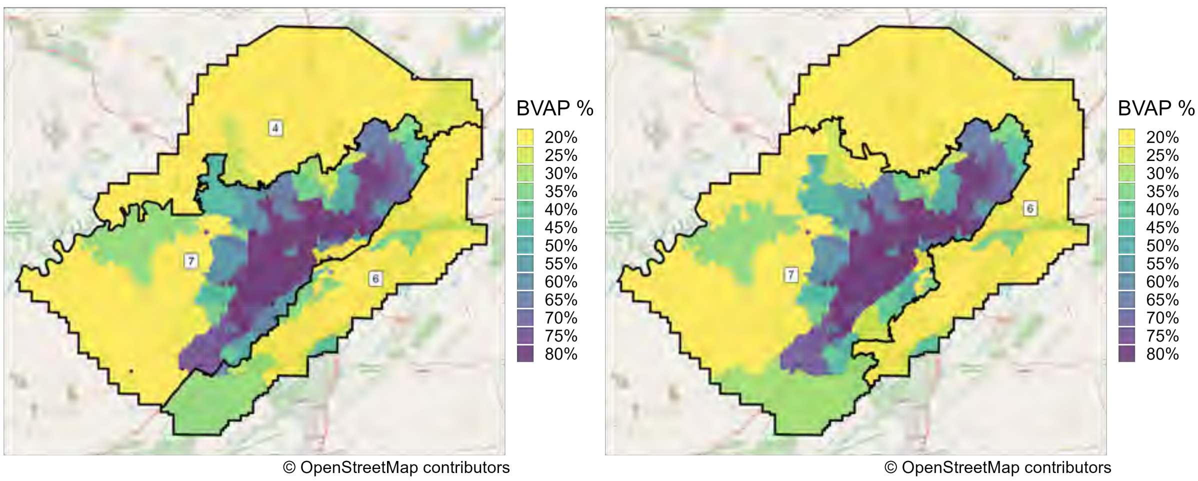
(b) Cooper Map 8, Pickens County

Figure 49: Cooper Split of Houston County, Alabama



Dr. Duchin's districts are much the same, if not more so. Here, for example, are her divisions of Jefferson County VTDs. Again, there are outlying precincts here-and-there, but overall the district boundaries do a nice job separating heavily Black precincts from heavily White precincts.

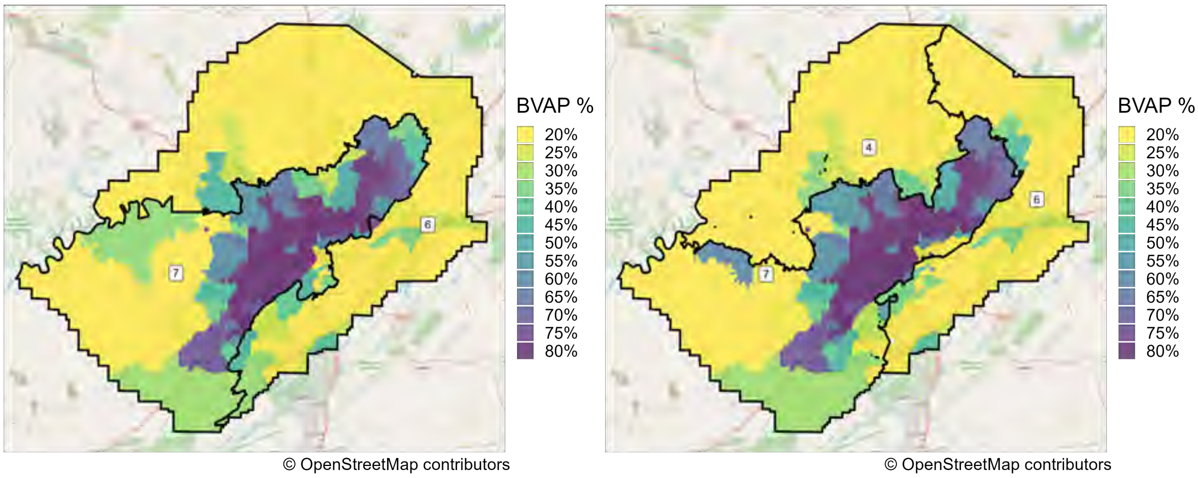
Figure 50: Duchin Splits of Jefferson County, AL



(a) Duchin Map A, Jefferson County

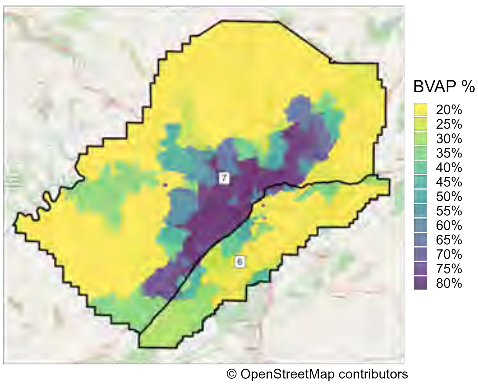
(b) Duchin Map B, Jefferson County

Figure 51: Duchin Splits of Jefferson County, AL



(a) Duchin Map C, Jefferson County (b) Duchin Map D, Jefferson County

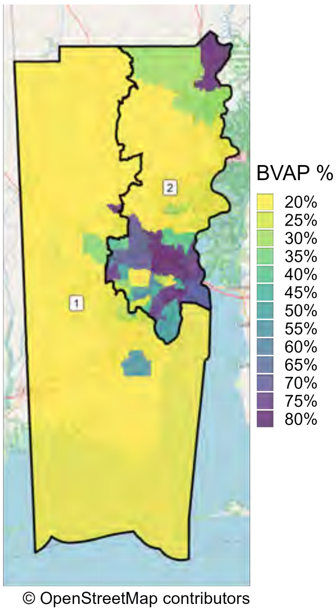
Figure 52: Duchin Map E, Jefferson County



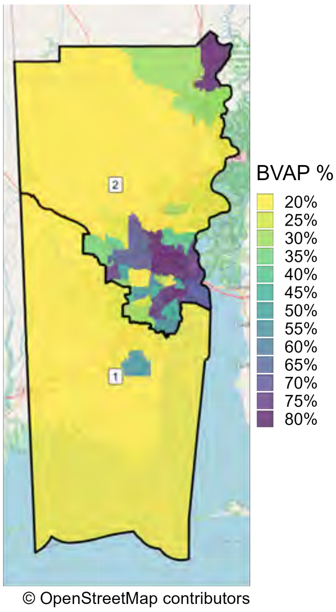
The last map, in particular, is telling. Recall that the boundary between the districts here is comprised largely of split precincts. The fact that you can still make out a racial boundary along the district lines means that she has not only divvied up the districts by BVAP, but has also split precincts by BVAP.

In Mobile County, we see much the same thing.

Figure 53: Duchin Splits of Mobile County, AL

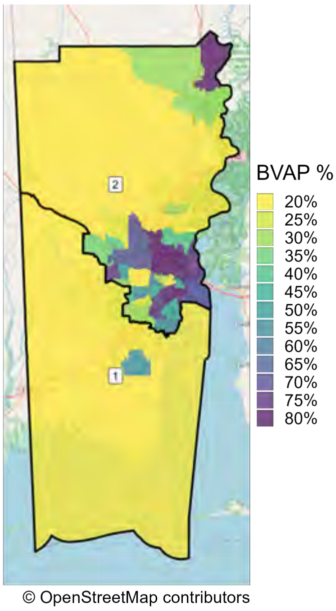


(a) Duchin Map A, Mobile County

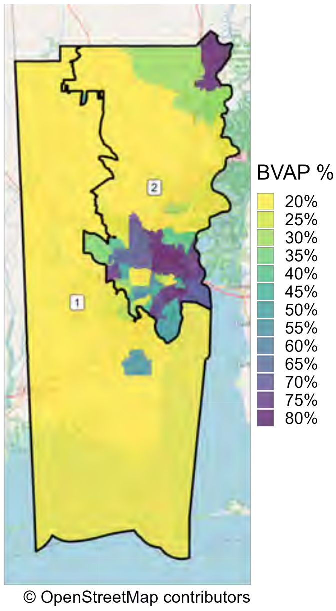


(b) Duchin Map B, Mobile County

Figure 54: Duchin Splits of Mobile County, AL



(a) Duchin Map C, Mobile County



(b) Duchin Map D, Mobile County

Figure 55: Duchin Map E, Mobile County

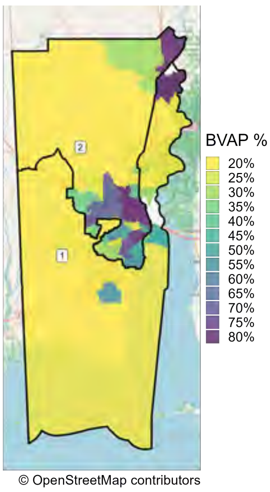
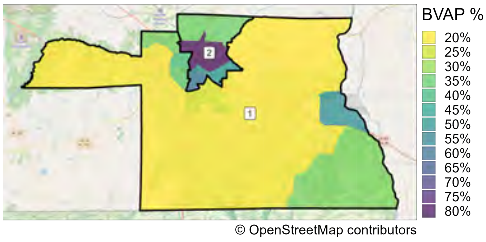


Figure 56: Duchin Map A, Mobile County



10 Analysis of Population Compactness

10.1 Examining the population dotplots reveals that the Black Population in the districts are spread across significant geographic spaces, with clusters at each end of the district.

Finally, we should re-examine the compactness of the population. In its initial Order, this Court reviewed choropleth maps, such as the ones above, of the distribution of BVAPs by precincts. In my experience, this is not the way to explore population compactness. Choropleth maps are useful for seeing when maps carve out areas of highly concentrated BVAPs at the expense of maps with lower BVAPs. But the problem with Choropleth maps is that they give us the distribution of percentages, not of the population itself. A precinct with 1 Black resident and no white residents is treated the same under a choropleth map as a precinct with 1,000 Black residents and no white residents. Obviously, these are not equivalent when talking about the distribution of the population.

To discuss the distribution of population, it is much better to utilize dot density maps. These place a single dot to reflect a person or collection of people. Here, I utilize one dot to represent every 10 Black residents of voting age in a precinct. This allows us to see what the overall population distribution is. It's important to note that just as choropleth maps don't reflect population compactness well, dot density maps don't reflect redistricting decisions well. 1,000 Black residents will show up as 100 dots in a precinct where there are no White residents, and they will show up as a 100 dots in a precinct where there are 10,000 White residents. A cluster of Black residents will appear either way, but the decision to exclude that precinct obviously has different racialized implications depending on the circumstance.

What we see is that many of the areas that show high concentrations of BVAP are, in fact, lightly populated and have no appreciable concentration of Black residents of voting age. Consider District 2 in Cooper's Map 1. It has 280,226 Black residents of voting age. Of those, 190,247, or 68%, live in either Mobile County, Russell County, or Montgomery County. In fact. 31% live in Mobile and 30% live in Montgomery. Obviously, these clusters are spread across an already-sprawling district. The remainder of the district may have areas of high BVAP, but they are lightly populated areas overall that serve to stitch together the main clusters.

Cooper Map 2 is much the same. Its District 2 has 284,132 Black residents of voting age. 199,877 of these, or 70%, are located in one of the four counties listed above. 31% of those residents reside in Montgomery County, while 28% of those residents reside in Mobile County.

Cooper Map 3's 281,155 Black residents of voting age in District 2 are similarly distributed. 36% reside in Montgomery County, while 30% reside in Mobile County.

Cooper Map 4's District 2 likewise has 281,106 Black residents of voting age. 33% live in Montgomery County and 30% live in Mobile County.

Cooper Map 5's District 2 has 280,044 Black residents of voting age. 26% live in Mobile County, while 36% live in Montgomery County.

Cooper Map 6's District 2 has 287,511 Black residents of voting age. 33% reside in Mobile County while 35% reside in Montgomery.

Figure 57: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Cooper Map 1 Overlaid

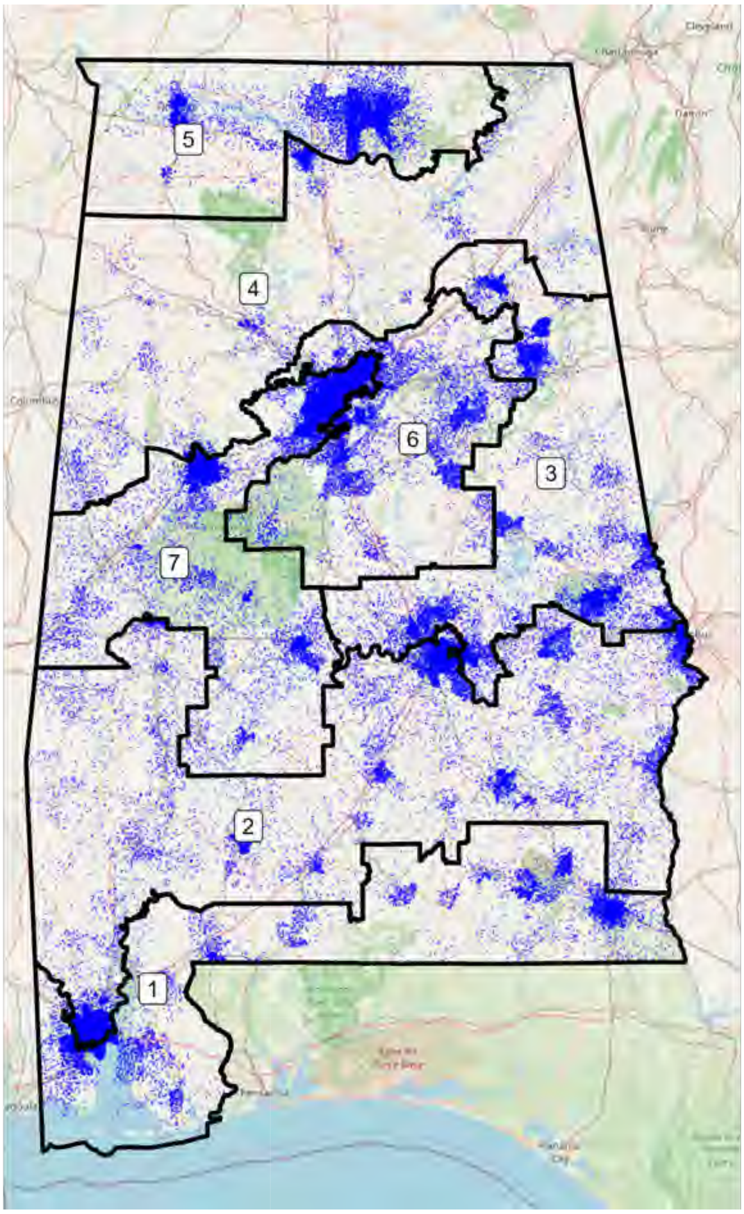


Figure 58: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Cooper Map 2 Overlaid

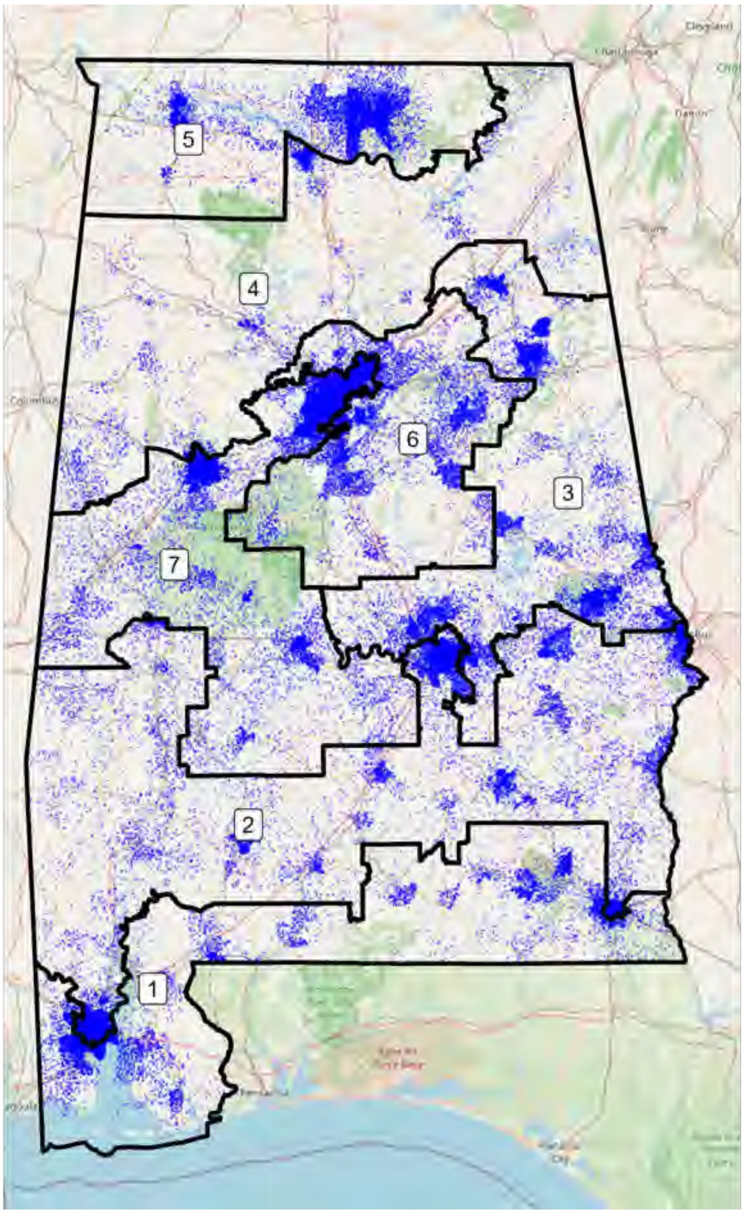


Figure 59: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Cooper Map 3 Overlaid

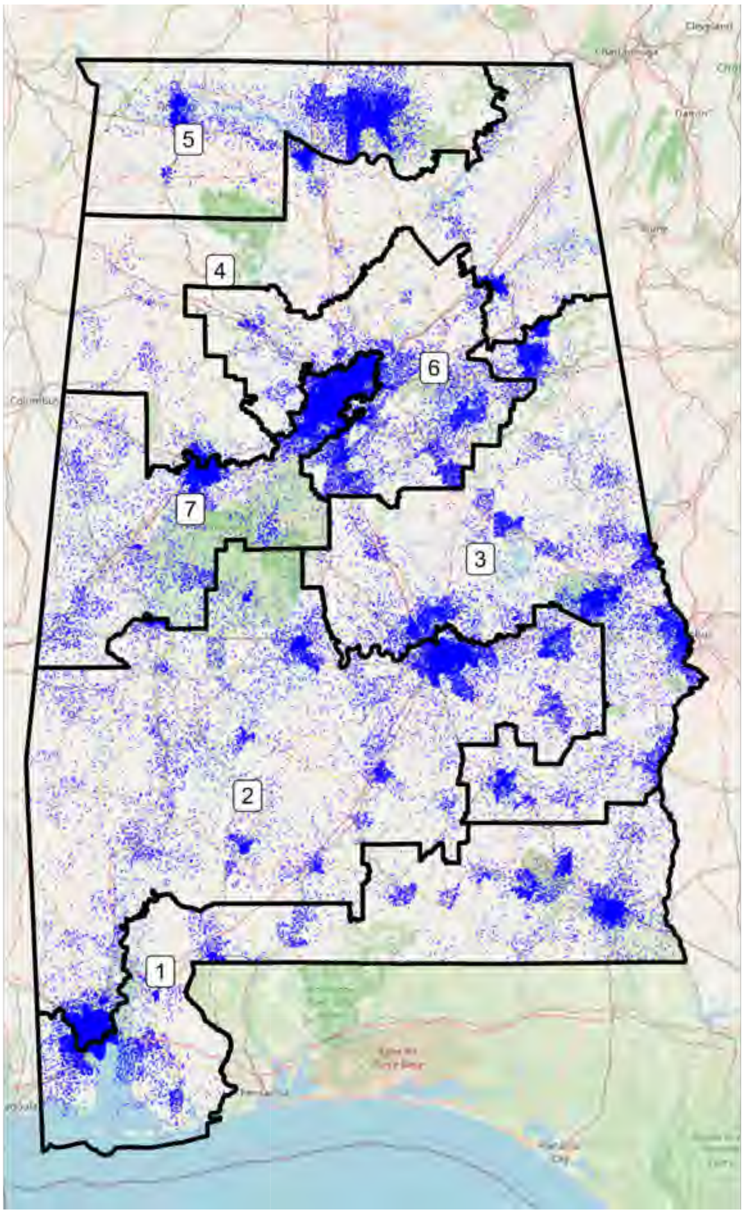


Figure 60: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Cooper Map 4 Overlaid

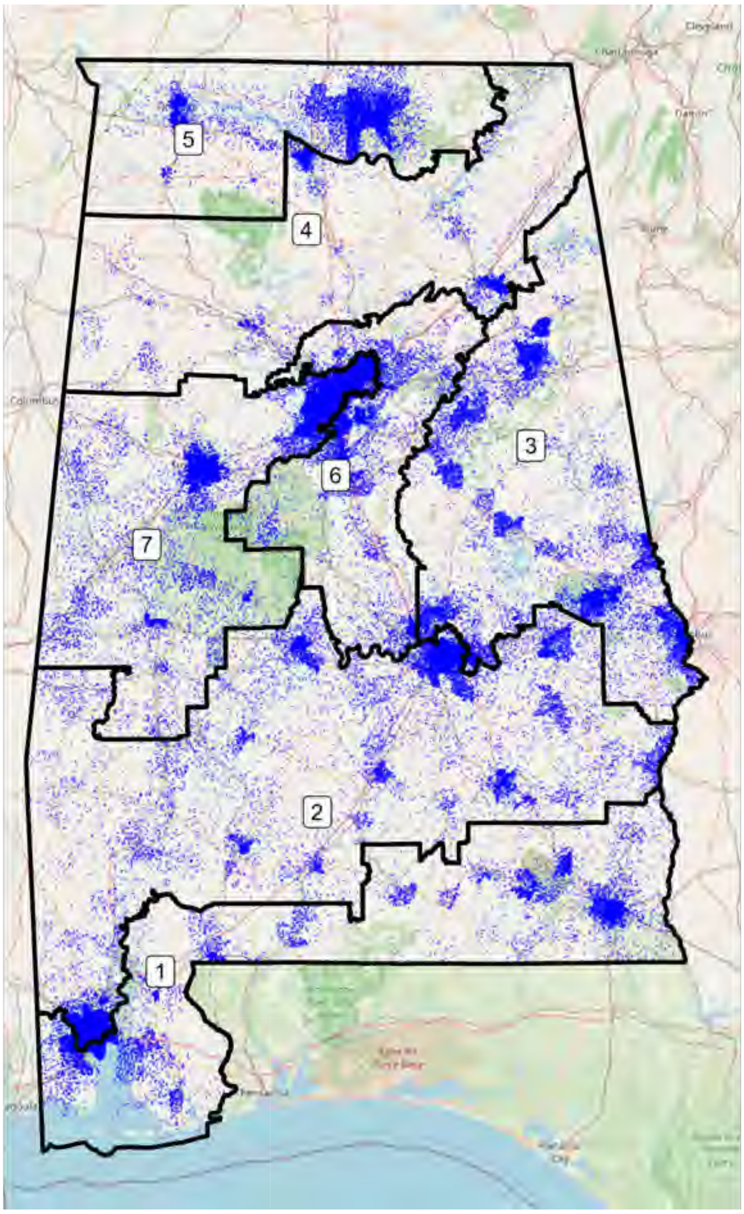


Figure 61: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Cooper Map 5 Overlaid

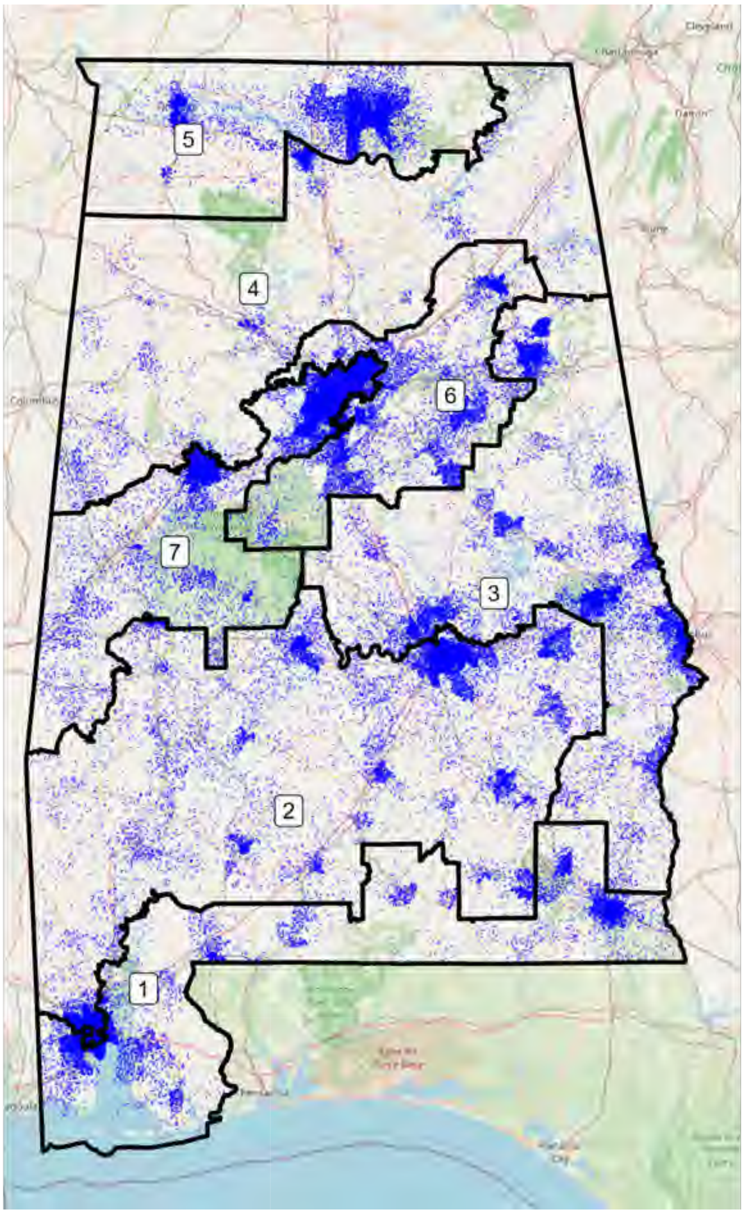
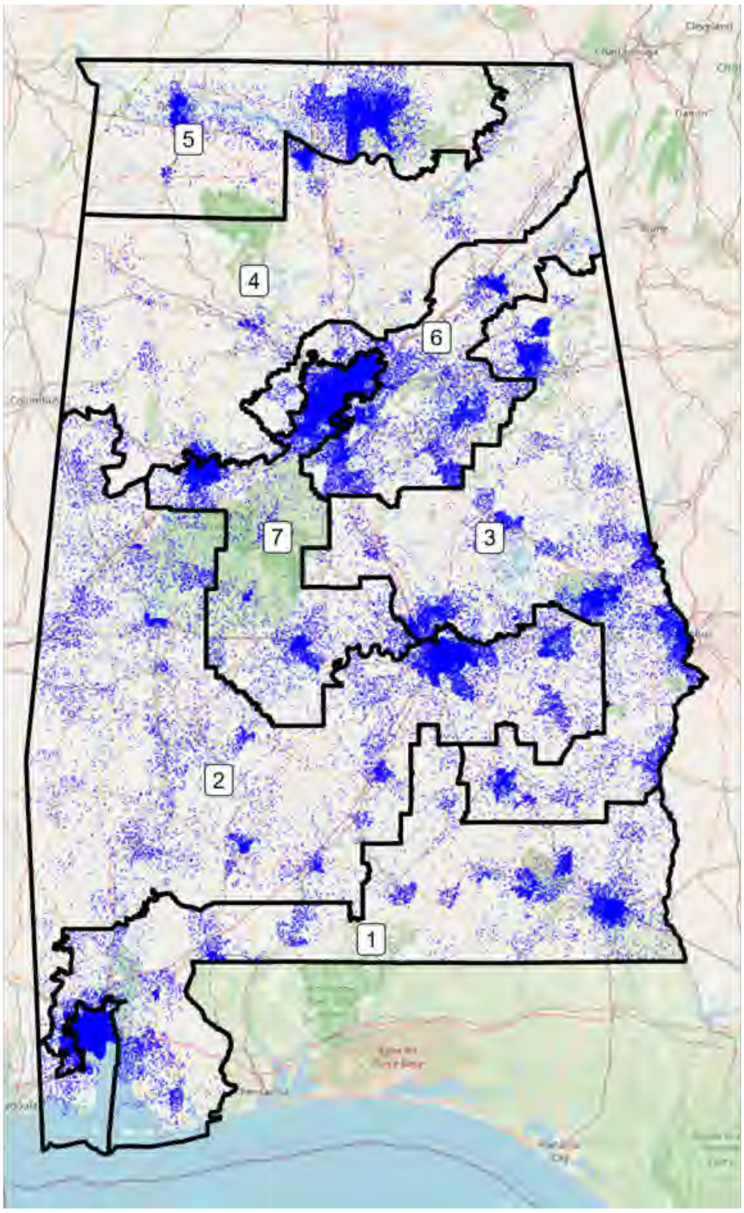


Figure 62: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Cooper Map 6 Overlaid



nter-label

Cooper Map 7's District 2 has 290,359 Black residents of voting age. 32% of these residents live in Mobile County, while 34% reside in Montgomery County.

Finally, Cooper Map 8's District 2 has 280,577 Black residents of voting age. Of these, 32.5% live in Mobile County, while 35.6% live in Montgomery County.

In short, Mr. Cooper's maps consist of districts where supermajorities of Black residents are concentrated in two geographically distant cities that have never been in a Congressional district together before in the state's history. The remainder of the Black population is scattered across multiple counties and small towns that dot the countryside.

Dr. Duchin's maps are built in the same way. District 2 in her Map A consists of 287,750 Black residents of voting age, 31% of whom reside in Mobile, 36% of whom resident in Montgomery. No other County has more than 5% of the district's Black population.

Map B is much the same. Its District 2 has 285,761 Black residents of voting age. 35% of these residents live in Montgomery County, 33% live in Mobile County, and 7% live in Dallas County. No other county has more than 5% of the district's Black population.

Map C follows suit. For District 2, 279,466 Black residents of voting age, 36% live in Montgomery County, 33% live in Mobile County, and 7% live in Russell County. None of the remaining 11 counties contains more than 5% of the district's population.

In Map D, the BVAP for District 2 is 280,534. 36% of these residents live in Montgomery County, and 32% live in Mobile County. None of the remaining 15 counties holds more than 5% of the districts BVAP.

Finally, in Map E, the District 2 BVAP is 279,053. 36% live in Montgomery County, and 33% live in Mobile County. Russell County is home to another 7%. The remaining 14% of the district's BVAP is spread across the other 12 counties, none of which is home to more than 5% of the district's Black population.

In other words, there is a large, compact Black population in Mobile, and a large, compact Black population in Montgomery. Both of these populations are roughly suffi-

Figure 63: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Cooper Map 7 Overlaid

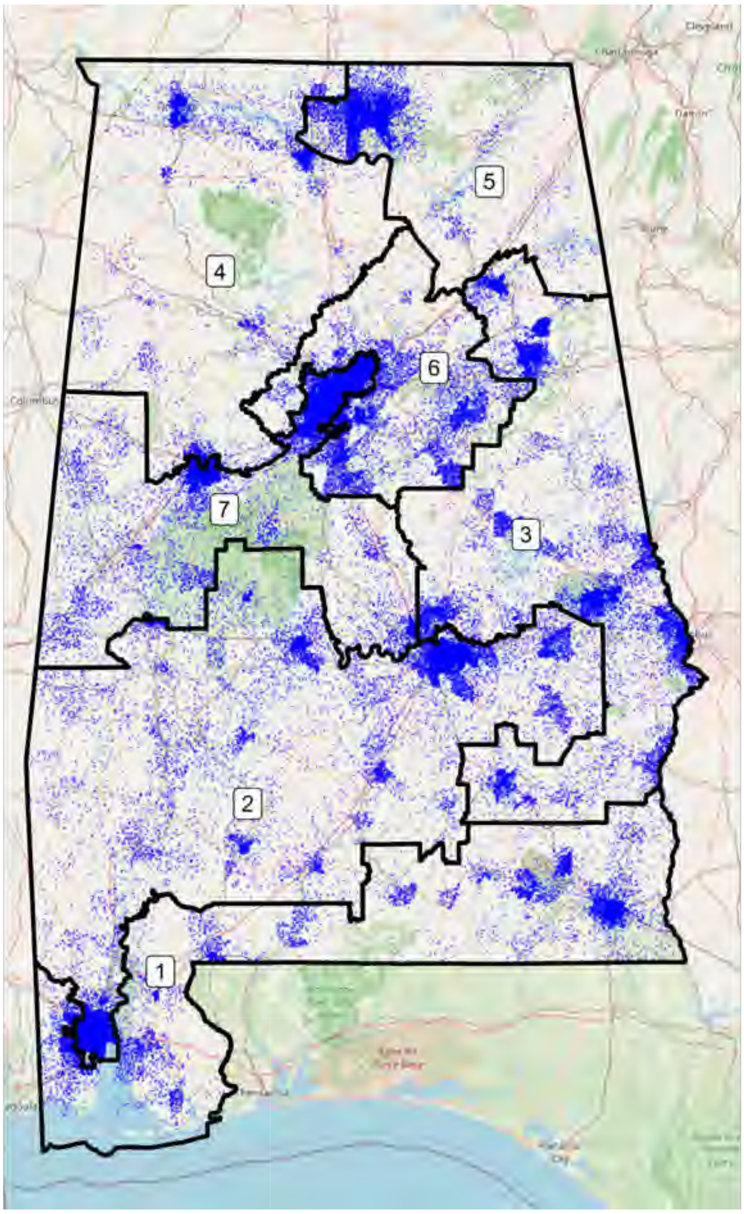


Figure 64: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Cooper Map 8 Overlaid

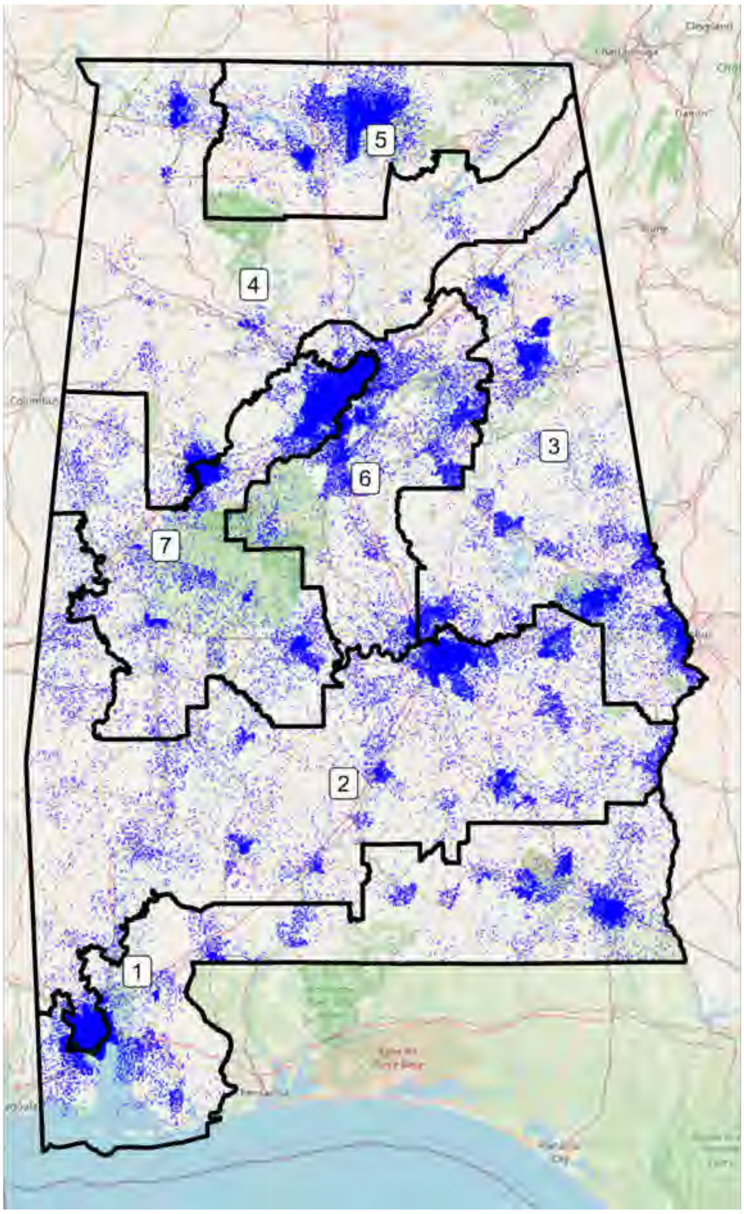


Figure 65: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Duchin Map A Overlaid

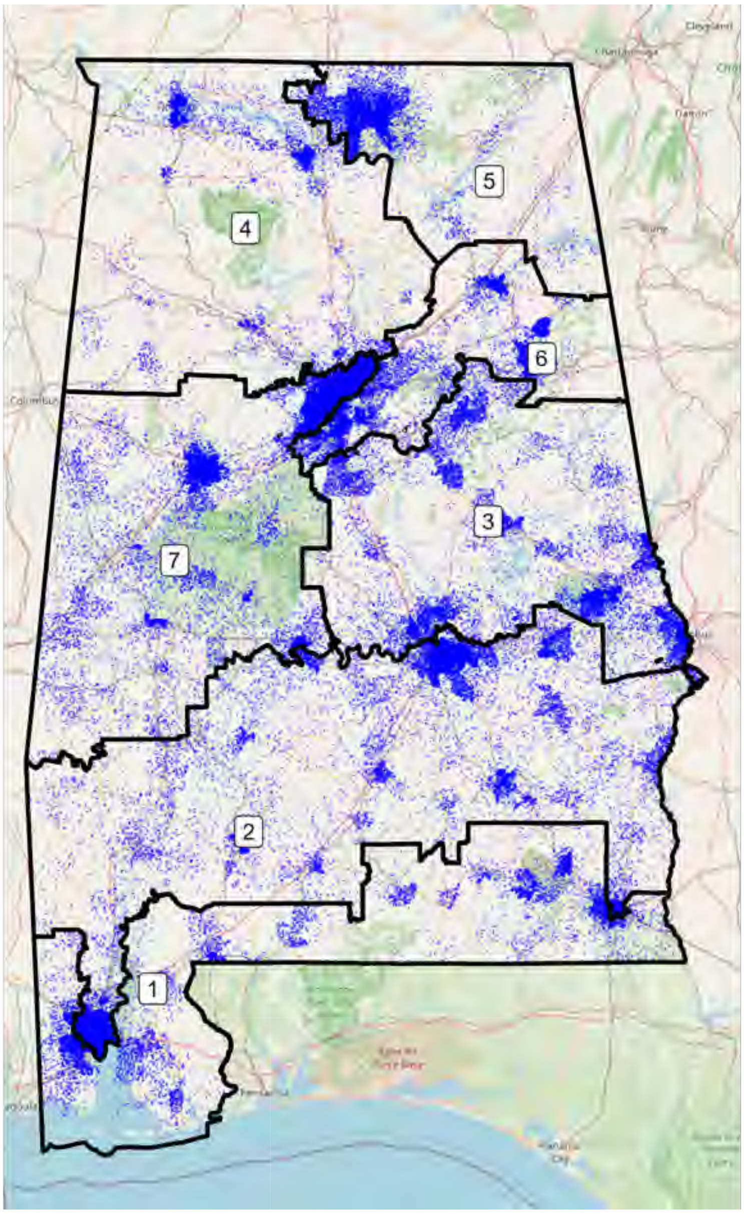


Figure 66: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Duchin Map B Overlaid

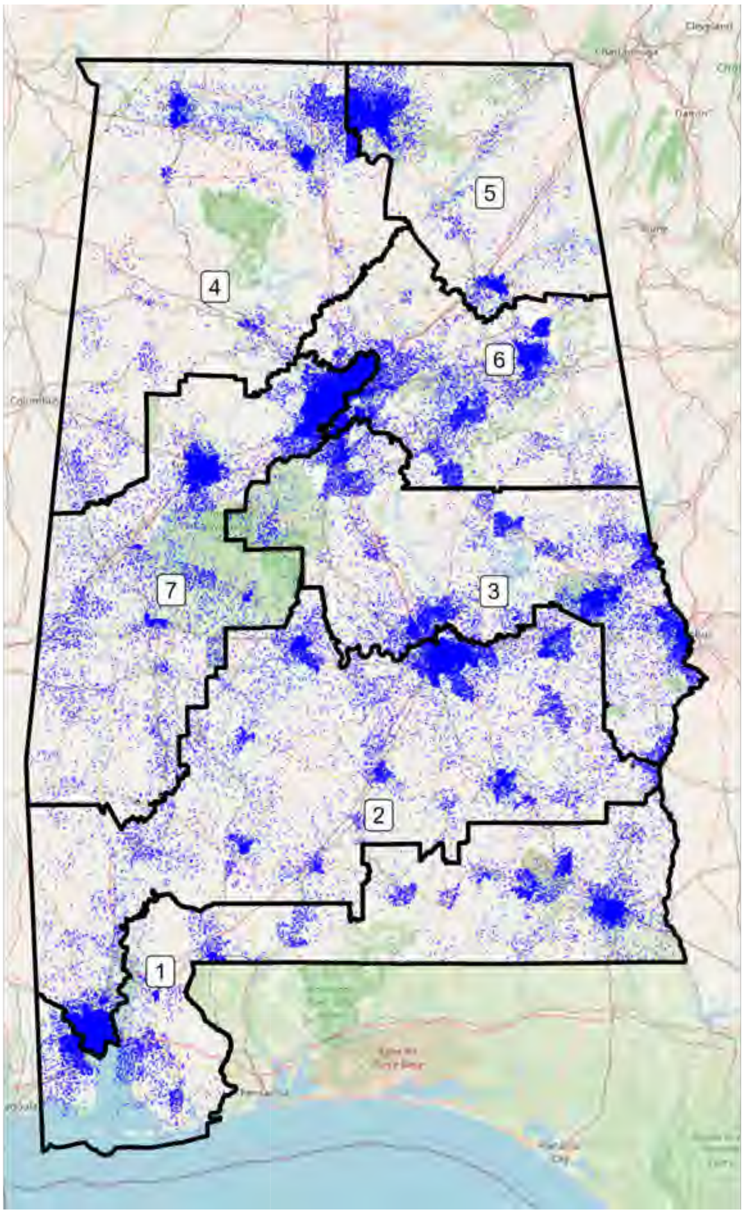


Figure 67: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Duchin Map C Overlaid

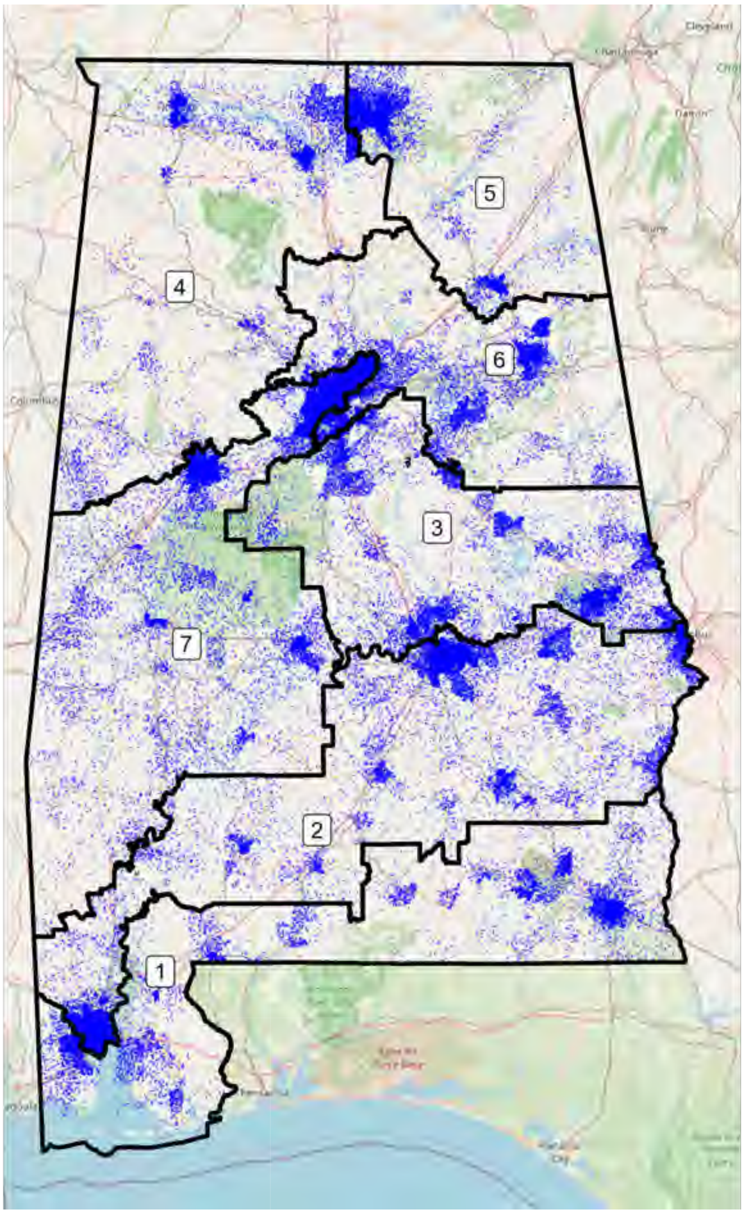


Figure 68: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Duchin Map D Overlaid

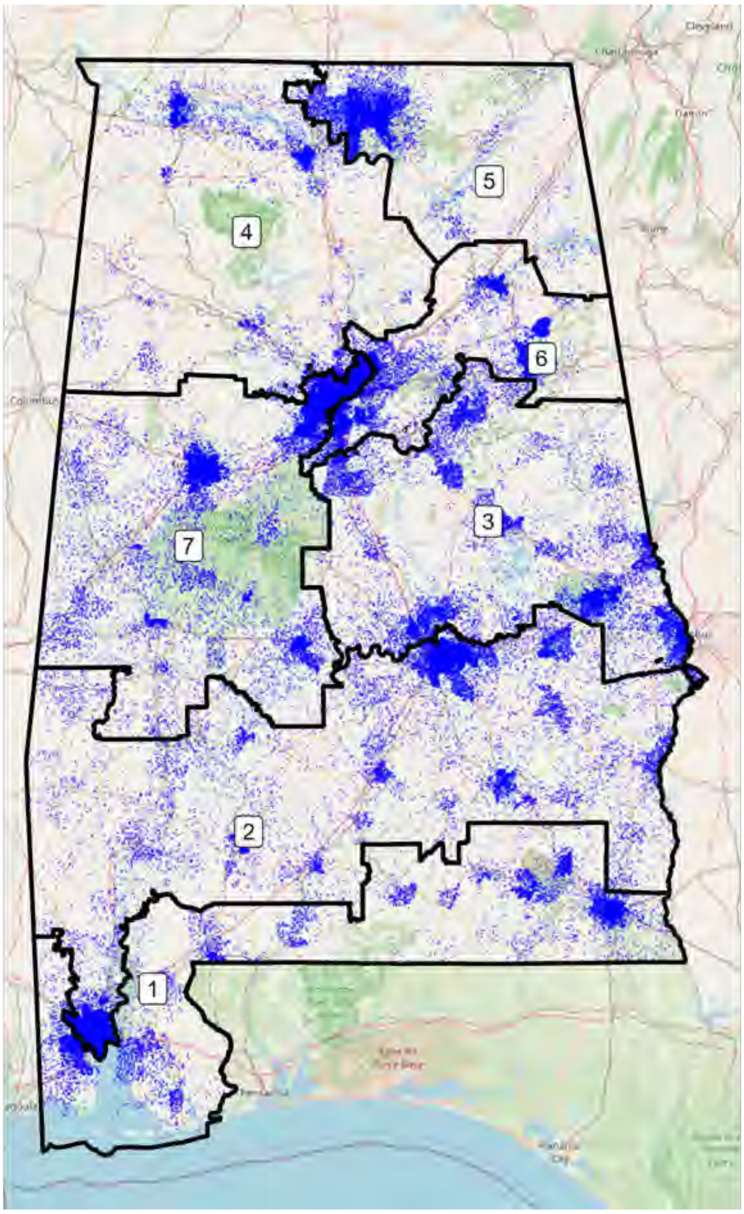
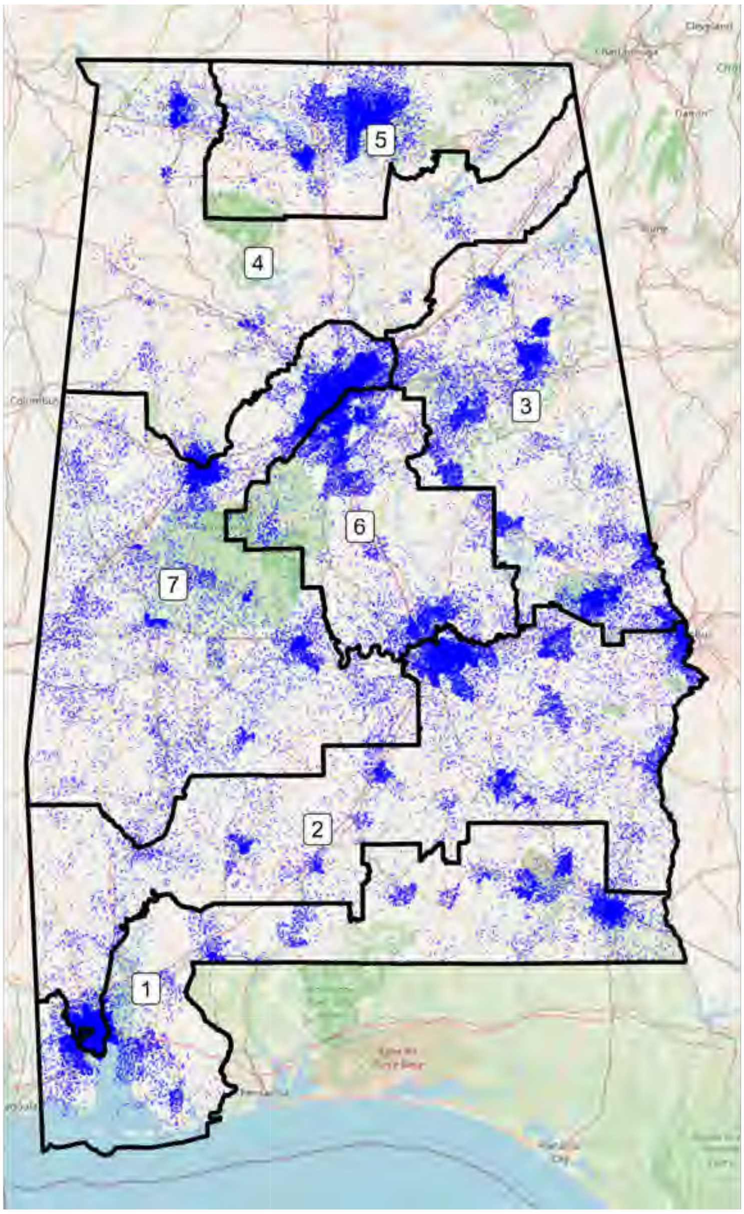


Figure 69: 1 Blue Dot = 10 Black Alabama Residents of Voting Age. Duchin Map E Overlaid



cient by themselves to supply 1/3 of the BVAP needed to satisfy Gingles I. The various maps stitch these two groups together, and then seek out the remaining 20% or so of the population from lightly populated counties in the surrounding countryside. Regardless, these maps don't contain a single compact population sufficient to constitute 50% + 1 of the population in a district.

11 Conclusion

Opining as to compactness is difficult, but by the standards of Alabama's recent history, these are some of the least compact districts drawn, that combine population centers together that have never been combined, and then altering map configurations that have stood for over 100 years to try to make up for the lack of compactness in the redrawn southern districts. The SBOE map appears to be a one-off configuration that was a result of litigation and the state's understanding of Section 5, rather than an admission that Mobile and Montgomery belong together in the same district. The illustrative districts carve up major population centers by race, and mostly function by stitching together two populations of Black residents in distinct metropolitan areas, with lightly populated, rural areas in between. All told, these districts are not reasonably configured.

I declare under penalty of perjury under the laws of the State of Ohio that the foregoing is true and correct to the best of my knowledge and belief. Executed on 28 June, 2024 in Delaware, Ohio.

Sean Trende

Sean P. Trende

12 Exhibit 1 – Sean Trende C.V.

SEAN P. TRENDE
[redacted]
Delaware, OH 43015
strende@realclearpolitics.com

EDUCATION

Ph.D., The Ohio State University, Political Science, 2023. Dissertation titled *Application of Spatial Analysis to Contemporary Problems in Political Science*, September 2023.

M.A.S. (Master of Applied Statistics), The Ohio State University, 2019.

J.D., Duke University School of Law, *cum laude*, 2001; Duke Law Journal, Research Editor.

M.A., Duke University, *cum laude*, Political Science, 2001. Thesis titled *The Making of an Ideological Court: Application of Non-parametric Scaling Techniques to Explain Supreme Court Voting Patterns from 1900-1941*, June 2001.

B.A., Yale University, with distinction, History and Political Science, 1995.

PROFESSIONAL EXPERIENCE

Law Clerk, Hon. Deanell R. Tacha, U.S. Court of Appeals for the Tenth Circuit, 2001-02.

Associate, Kirkland & Ellis, LLP, Washington, DC, 2002-05.

Associate, Hunton & Williams, LLP, Richmond, Virginia, 2005-09.

Associate, David, Kamp & Frank, P.C., Newport News, Virginia, 2009-10.

Senior Elections Analyst, RealClearPolitics, 2010-present.

Columnist, Center for Politics Crystal Ball, 2014-17.

Visiting Scholar, American Enterprise Institute, 2018-present.

BOOKS AND BOOK CHAPTERS

Larry J. Sabato, ed., *The Red Ripple*, Ch. 15 (2023).

Larry J. Sabato, ed., *A Return to Normalcy?: The 2020 Election that (Almost) Broke America* Ch. 13 (2021).

Larry J. Sabato, ed., *The Blue Wave*, Ch. 14 (2019).

Larry J. Sabato, ed., *Trumped: The 2016 Election that Broke all the Rules* (2017).

Larry J. Sabato, ed., *The Surge:2014's Big GOP Win and What It Means for the Next Presidential Election*, Ch. 12 (2015).

Larry J. Sabato, ed., *Barack Obama and the New America*, Ch. 12 (2013).

Barone, Kraushaar, McCutcheon & Trende, *The Almanac of American Politics* 2014 (2013).

The Lost Majority: Why the Future of Government is up for Grabs – And Who Will Take It (2012).

PREVIOUS EXPERT TESTIMONY AND/OR DEPOSITIONS

Dickson v. Rucho, No. 11-CVS-16896 (N.C. Super. Ct., Wake County) (racial gerrymandering).

Covington v. North Carolina, No. 1:15-CV-00399 (M.D.N.C.) (racial gerrymandering).

NAACP v. McCrory, No. 1:13CV658 (M.D.N.C.) (early voting).

NAACP v. Husted, No. 2:14-cv-404 (S.D. Ohio) (early voting).

Ohio Democratic Party v. Husted, Case 15-cv-01802 (S.D. Ohio) (early voting).

Lee v. Virginia Bd. of Elections, No. 3:15-cv-357 (E.D. Va.) (early voting).

Feldman v. Arizona, No. CV-16-1065-PHX-DLR (D. Ariz.) (absentee voting).

A. Philip Randolph Institute v. Smith, No. 1:18-cv-00357-TSB (S.D. Ohio) (political gerrymandering).

Whitford v. Nichol, No. 15-cv-421-bbc (W.D. Wisc.) (political gerrymandering).

Common Cause v. Rucho, No. 1:16-CV-1026-WO-JEP (M.D.N.C.) (political gerrymandering).

Mecinas v. Hobbs, No. CV-19-05547-PHX-DJH (D. Ariz.) (ballot order effect).

Fair Fight Action v. Raffensperger, No. 1:18-cv-05391-SCJ (N.D. Ga.) (statistical analysis).

Pascua Yaqui Tribe v. Rodriguez, No. 4:20-CV-00432-TUC-JAS (D. Ariz.) (early voting).

Ohio Organizing Collaborative, et al v. Ohio Redistricting Commission, et al, No. 2021-1210 (Ohio) (political gerrymandering).

NCLCV v. Hall, No. 21-CVS-15426 (N.C. Sup. Ct.) (political gerrymandering).

Szeliga v. Lamone, Case No. C-02-CV-21-001816 (Md. Cir. Ct.) (political gerrymandering).

Montana Democratic Party v. Jacobsen, DV-56-2021-451 (Mont. Dist. Ct.) (early voting; ballot collection).

Carter v. Chapman, No. 464 M.D. 2021 (Pa.) (map drawing; amicus).

NAACP v. McMaster, No. 3:21-cv-03302 (D.S.C.) (racial gerrymandering).

Graham v. Adams, No. 22-CI-00047 (Ky. Cir. Ct.) (political gerrymandering).

Harkenrider v. Hochul, No. E2022-0116CV (N.Y. Sup. Ct.) (political gerrymandering).

LULAC v. Abbott, Case No. 3:21-cv-00259 (W.D. Tex.) (racial/political gerrymandering/VRA).

Moore et al., v. Lee, et al., (Tenn. 20th Dist.) (state constitutional compliance).

Agee et al. v. Benson, et al., (W.D. Mich.) (racial gerrymandering/VRA).

Faatz, et al. v. Ashcroft, et al., (Cir. Ct. Mo.) (state constitutional compliance).

Coca, et al. v. City of Dodge City, et al., Case No. 6:22-cv-01274-EFM-RES (D. Kan.) (VRA).

Milligan v. Allen, Case No. 2:21-cv-01530-AMM (N.D. Ala.) (VRA).

Nairne v. Ardoin, NO. 22-178-SDD-SDJ (M.D. La.) (VRA).

Robinson v. Ardoin, NO. 22-211-SDD-SDJ (M.D. La.) (VRA).

Republican Party v. Oliver, No. D-506-CV-2022-00041 (N.M. Cir. Ct. (Lea County)) (political gerrymandering).

Palmer v. Hobbs, Case No. 3:22-CV-5035-RSL (W.D. Wash) (VRA; remedial phase only).

Clarke v. Evers, No. 2023AP001399-OA (Wisc.) (Political gerrymandering; remedial phase only).

Stone v. Allen, No. 2:21-cv-1531-AMM (N.D. Ala.) (VRA).

COURT APPOINTMENTS

Appointed as Voting Rights Act expert by Arizona Independent Redistricting Commission (2020)

Appointed Special Master by the Supreme Court of Virginia to redraw maps for the Virginia House of Delegates, the Senate of Virginia, and for Virginia's delegation to the United States Congress for the 2022 election cycle.

Appointed redistricting expert by the Supreme Court of Belize in Smith v. Perrera, No. 55 of 2019 (one-person-one-vote).

INTERNATIONAL PRESENTATIONS AND EXPERIENCE

Panel Discussion, European External Action Service, Brussels, Belgium, Likely Outcomes of 2012 American Elections.

Selected by U.S. Embassies in Sweden, Spain, and Italy to discuss 2016 and 2018 elections to think tanks and universities in area (declined Italy due to teaching responsibilities).

Selected by EEAS to discuss 2018 elections in private session with European Ambassadors.

TEACHING

American Democracy and Mass Media, Ohio Wesleyan University, Spring 2018.

Introduction to American Politics, The Ohio State University, Autumns 2018, 2019, 2020, Spring 2018.

Political Participation and Voting Behavior, Springs 2020, 2021, 2022, 2023.

Survey Methodology, Fall 2022, Spring 2024.

PUBLICATIONS

James G. Gimpel, Andrew Reeves, & Sean Trende, "Reconsidering Bellwether Locations in U.S. Presidential Elections," Pres. Stud. Q. (2022) (forthcoming, available online at http://doi.org/10.1111/psq.12793).

REAL CLEAR POLITICS COLUMNS

Full archives available at `http://www.realclearpolitics.com/authors/sean_trende/`

13 Exhibit 2 – Illustrative and Historical Maps

Figure 70: Alabama Congressional Districts for the 40th Congress (1867)

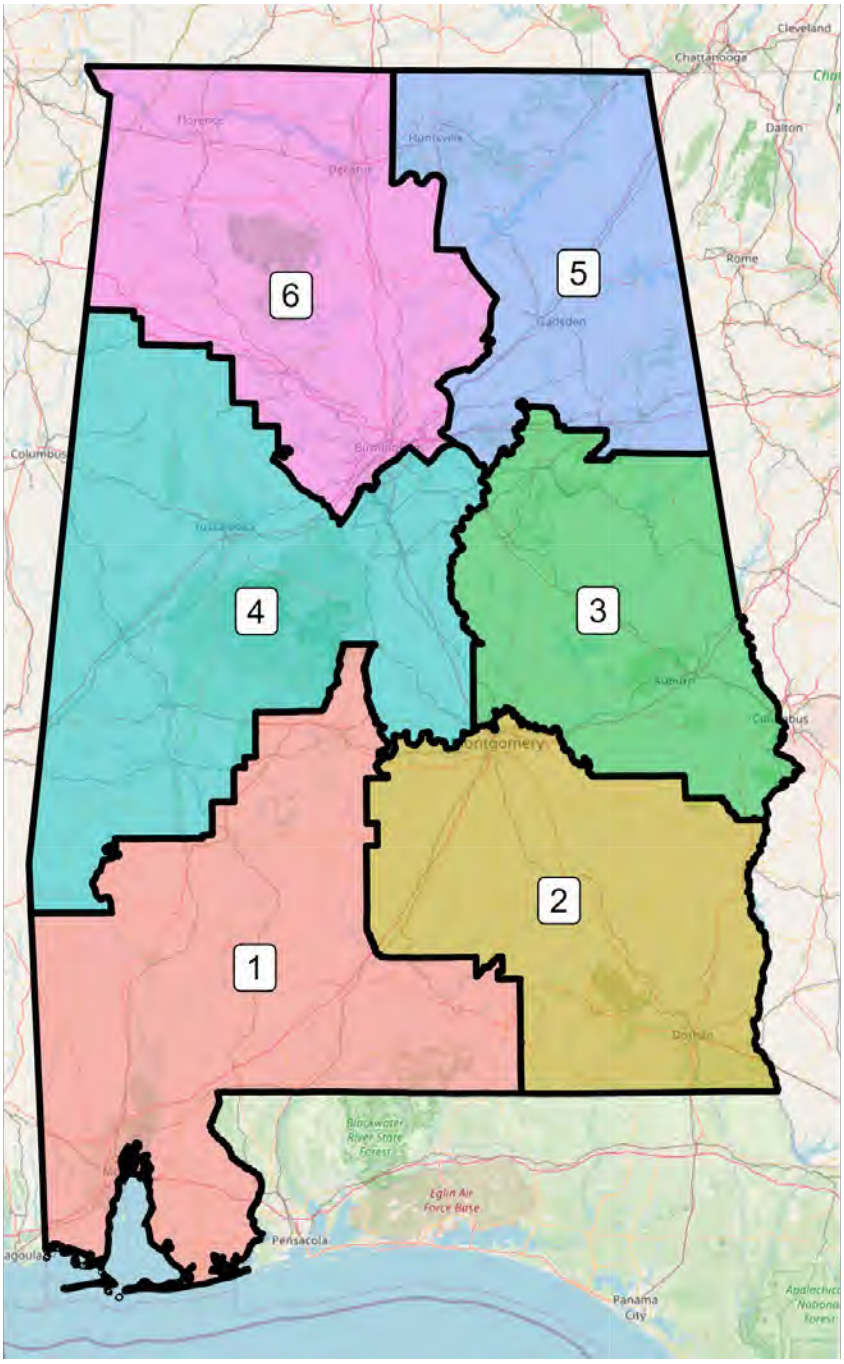


Figure 71: Alabama Congressional Districts for the 45th Congress (1875)

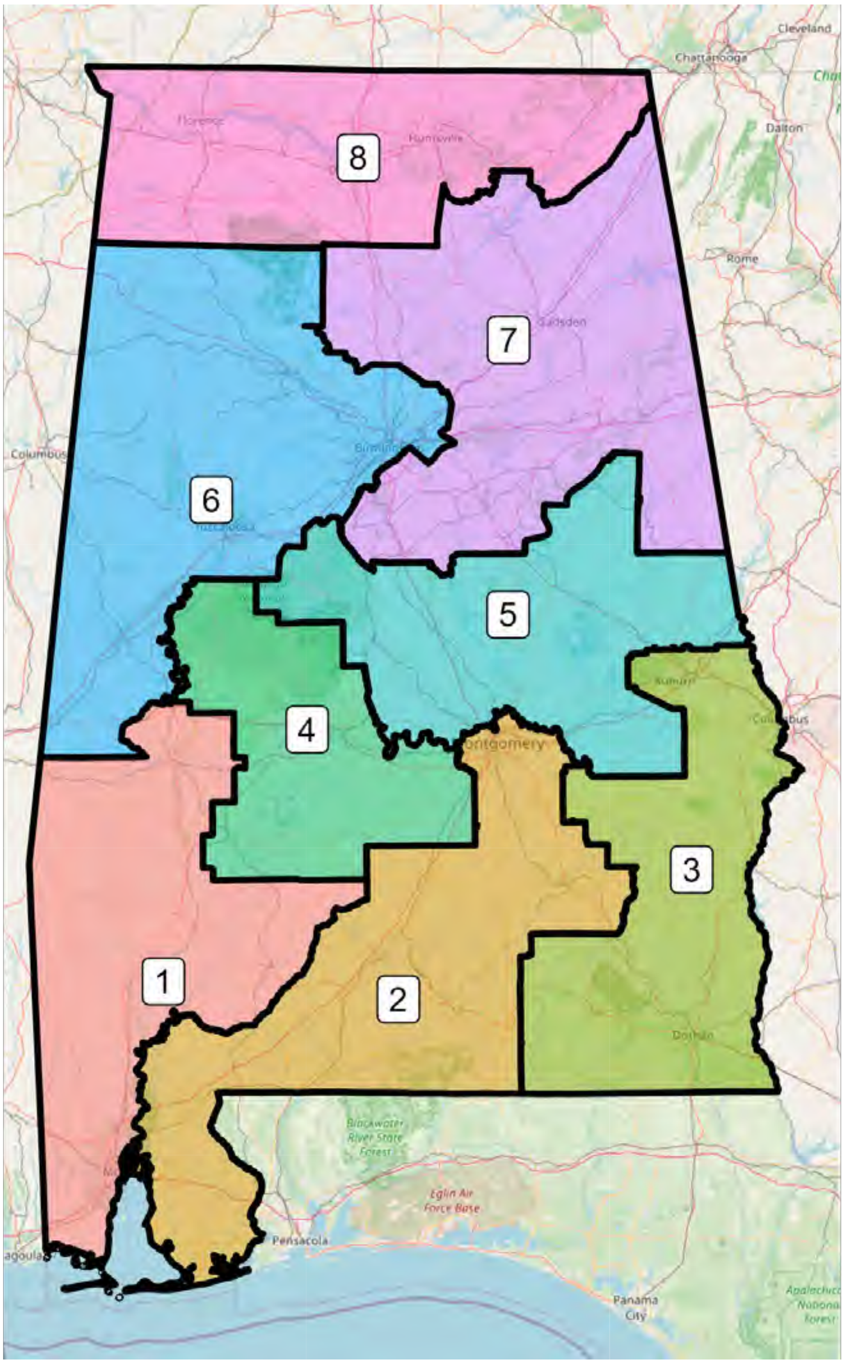


Figure 72: Alabama Congressional Districts for the 49th Congress (1885)

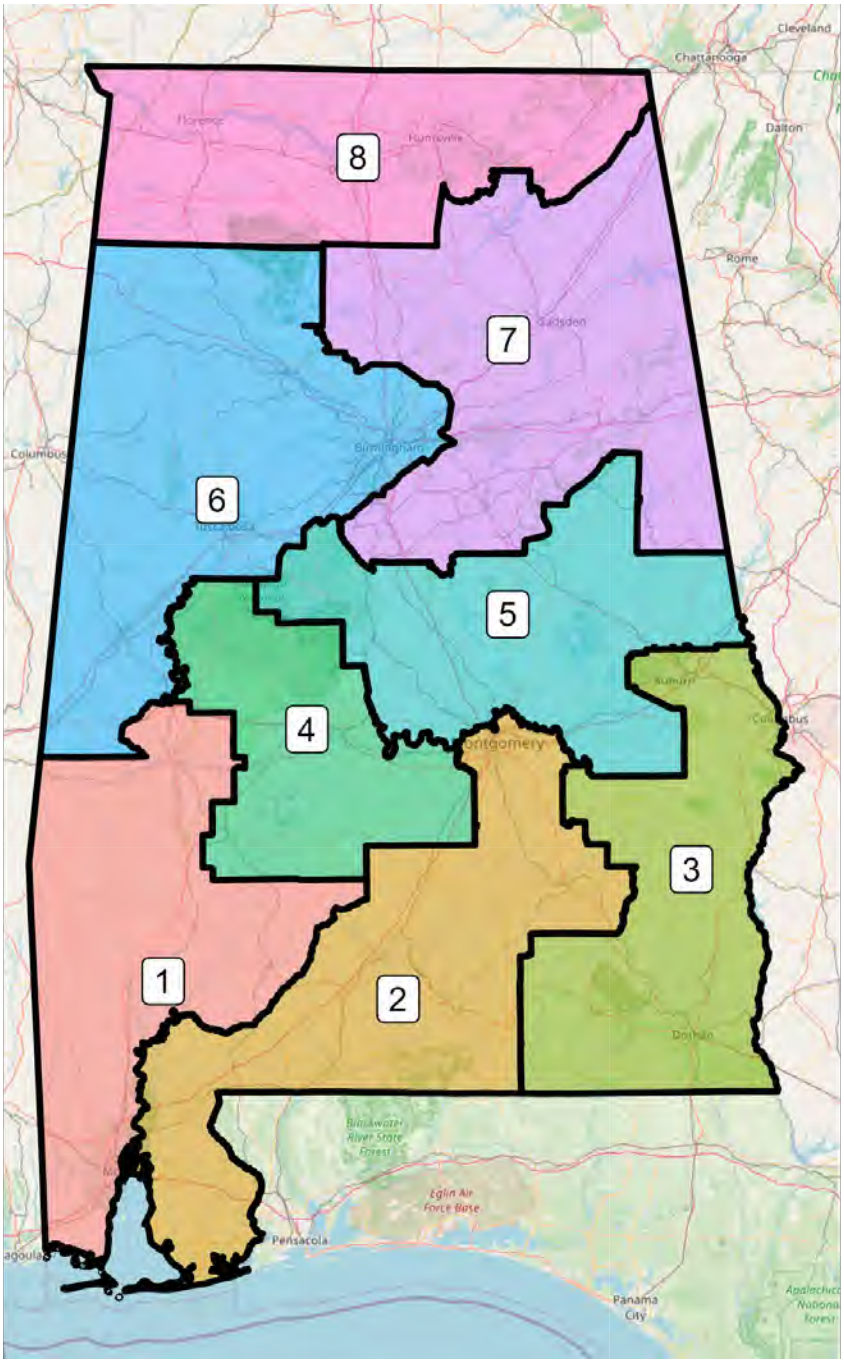


Figure 73: Alabama Congressional Districts for the 58th Congress (1903)

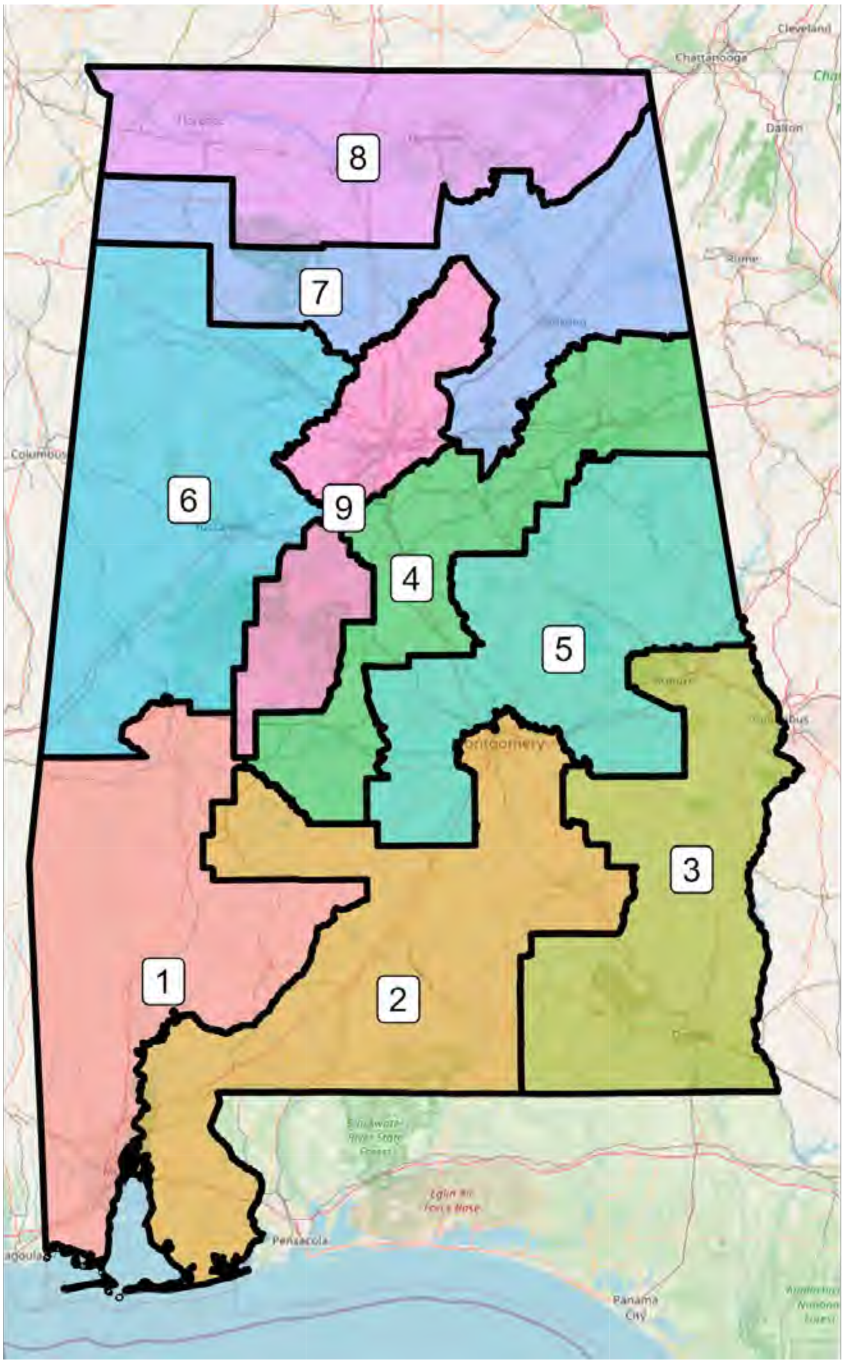


Figure 74: Alabama Congressional Districts for the 65th Congress (1917)

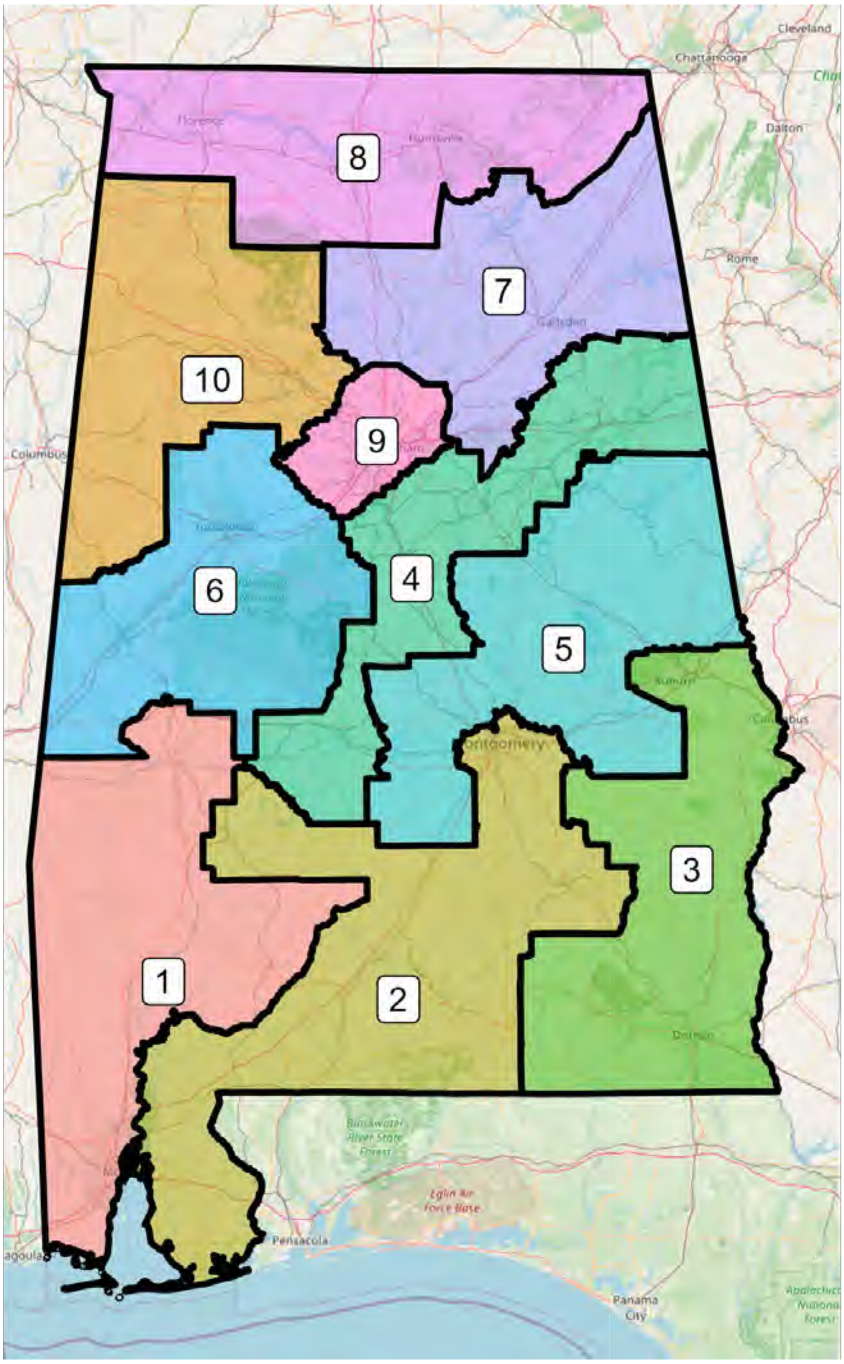


Figure 75: Alabama Congressional Districts for the 73rd Congress (1933)

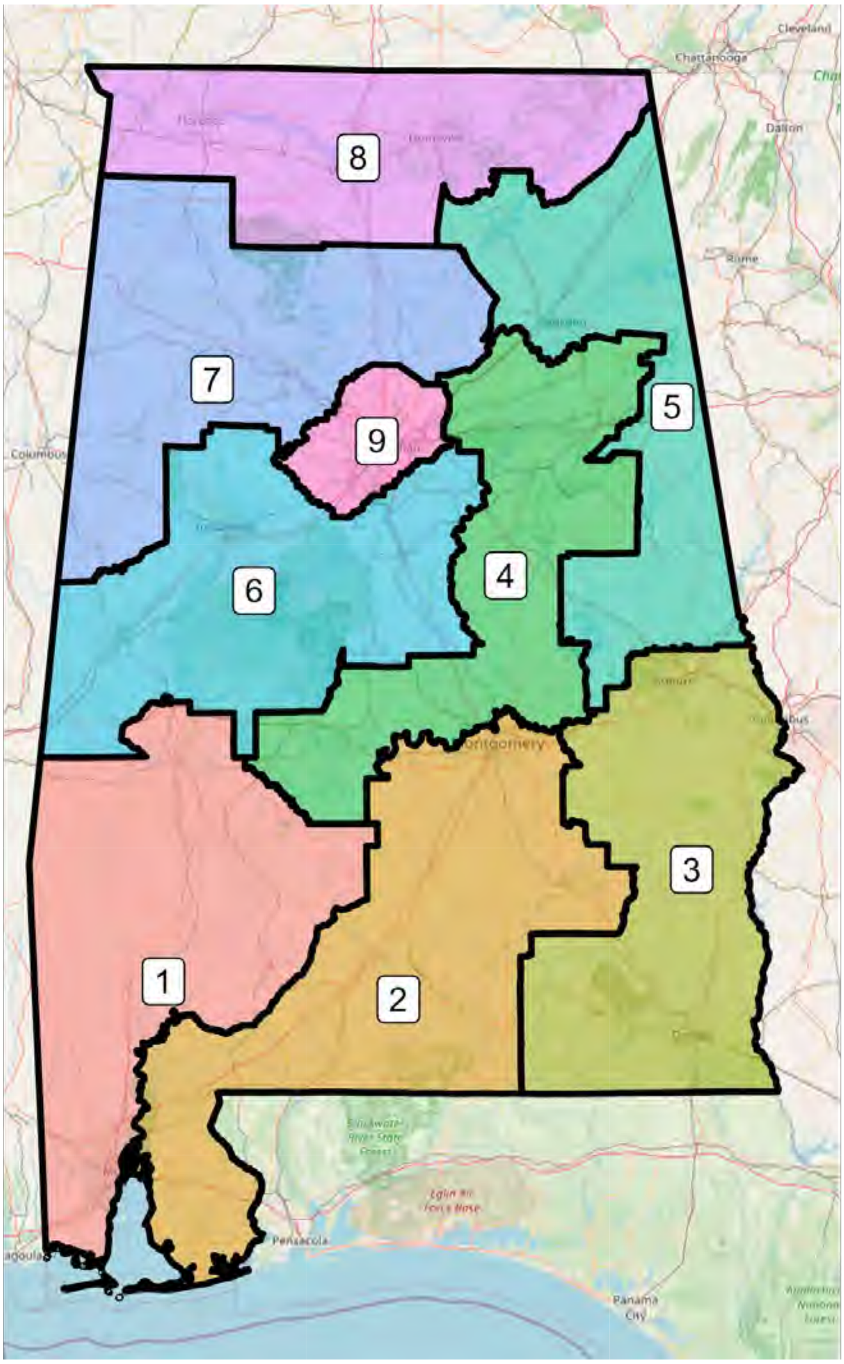


Figure 76: Alabama Congressional Districts for the 89th Congress (1965)

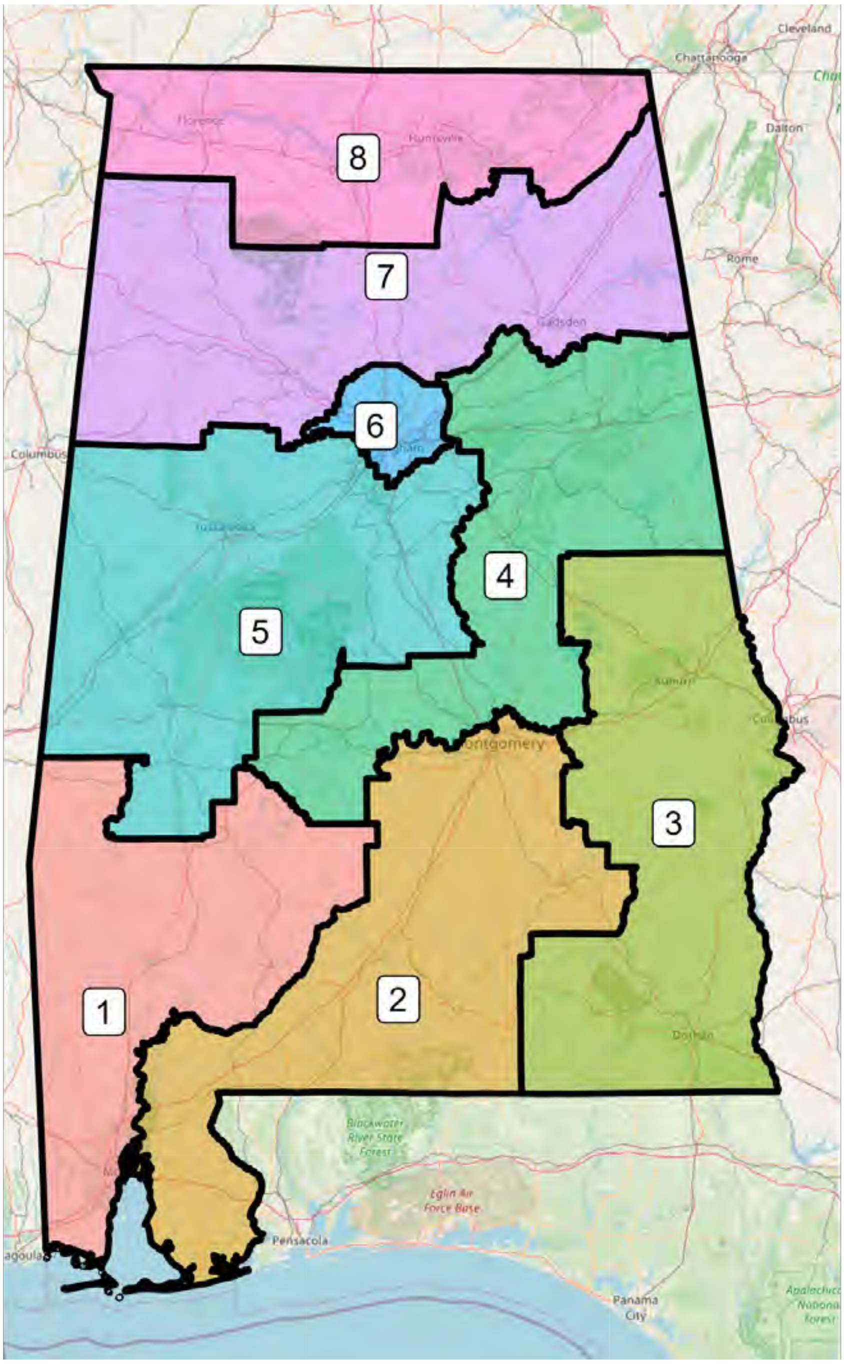


Figure 77: Alabama Congressional Districts for the 90th Congress (1967)

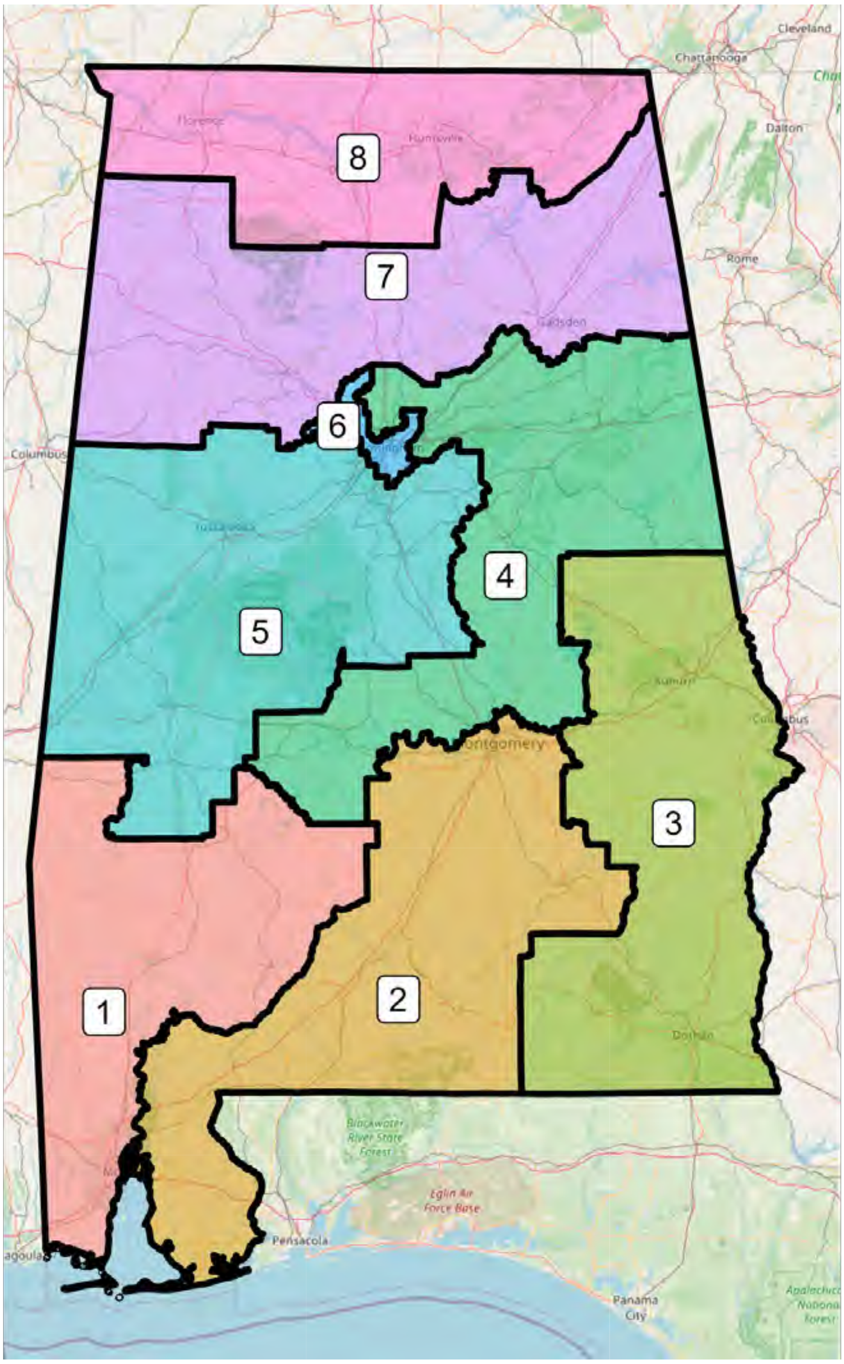


Figure 78: Alabama Congressional Districts for the 93rd Congress (1973)

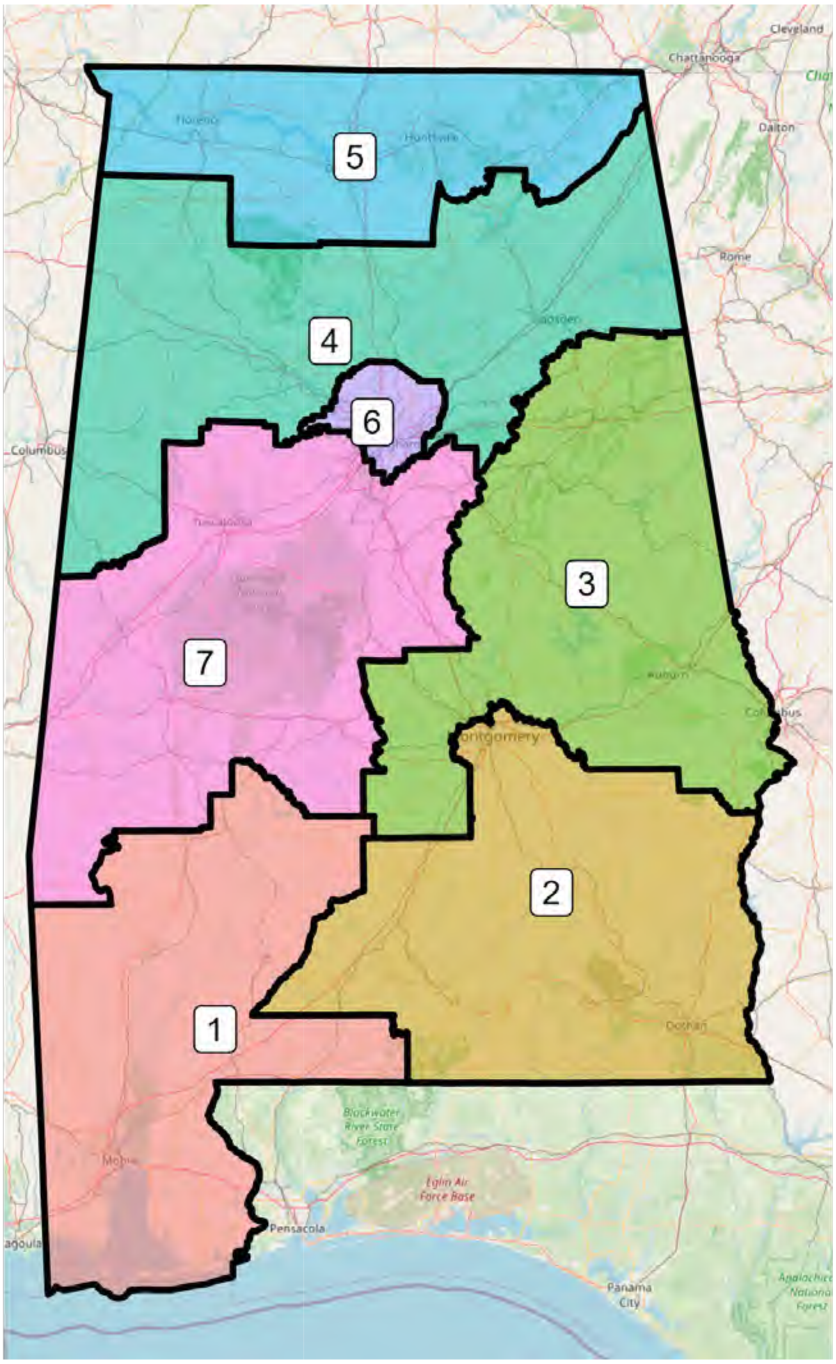


Figure 79: Alabama Congressional Districts for the 98th Congress (1983)

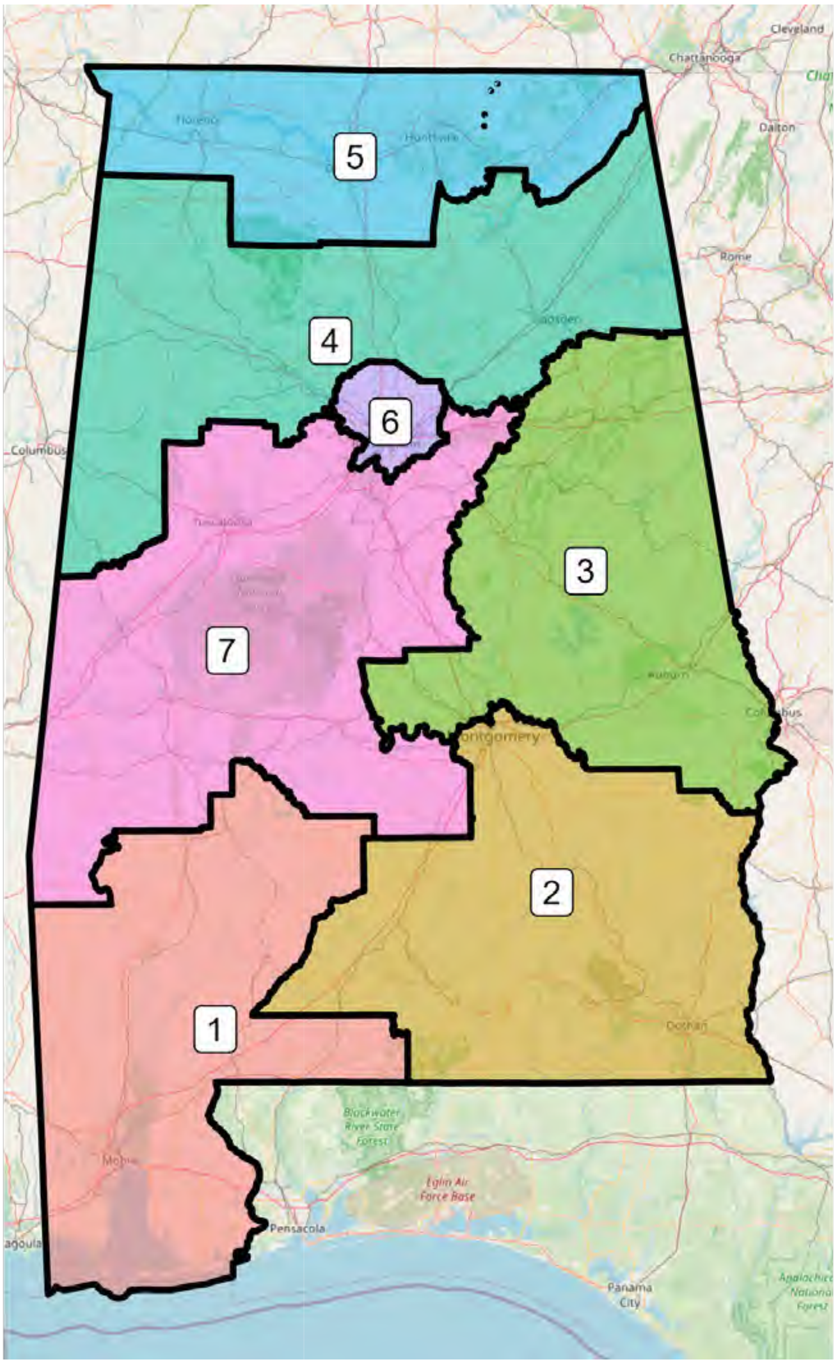


Figure 80: Alabama Congressional Districts for the 103rd Congress (1993)

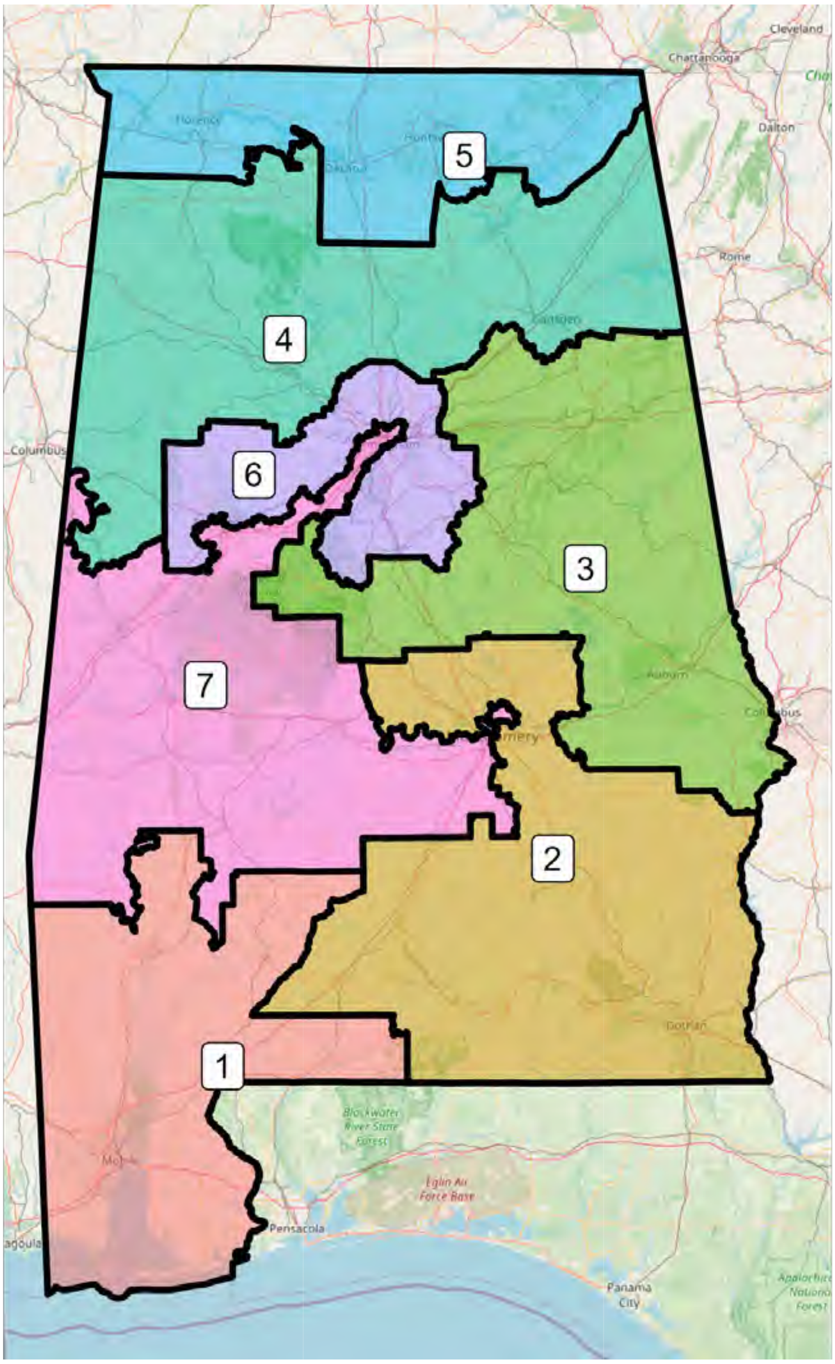


Figure 81: Alabama Congressional Districts for the 108th Congress (2003)

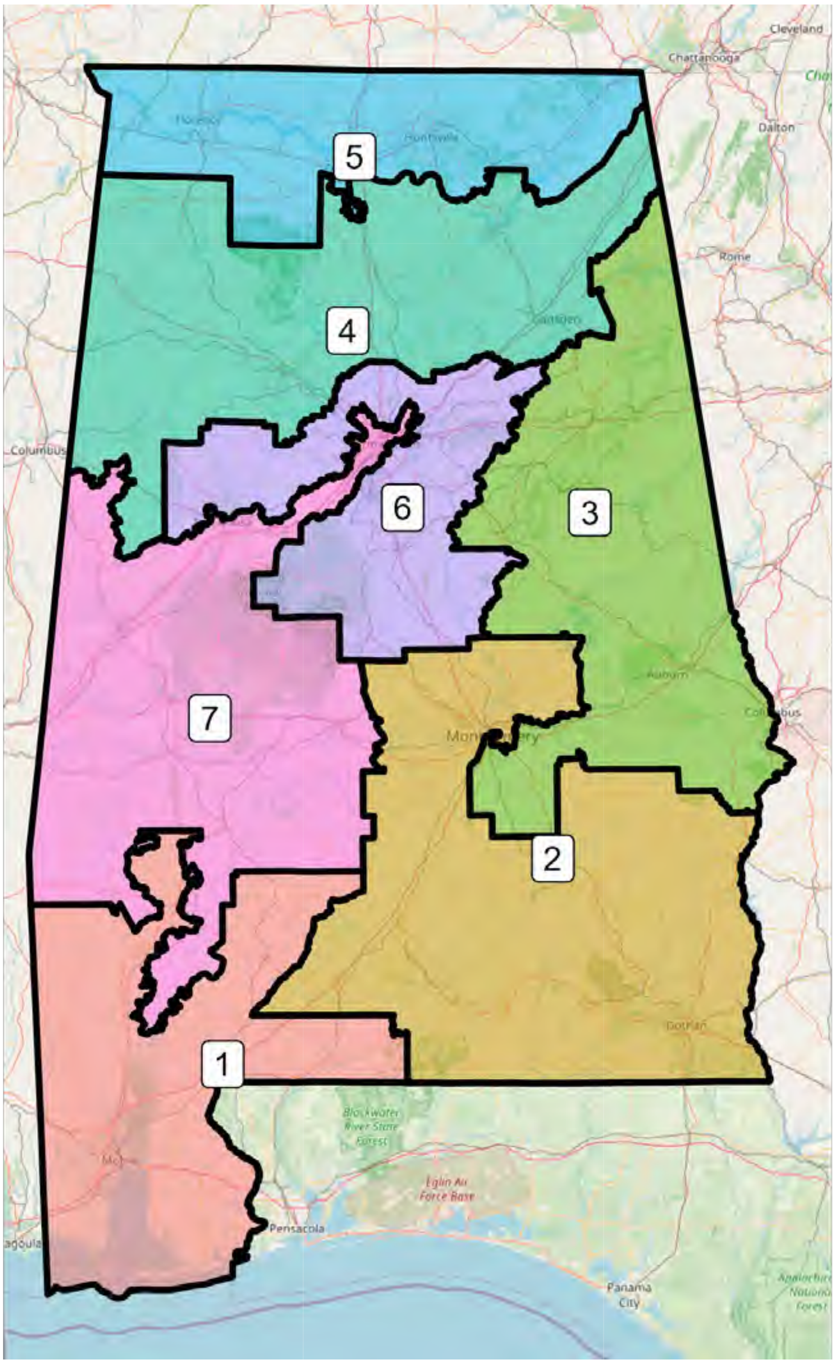


Figure 82: Alabama Congressional Districts for the 113th Congress (2013)

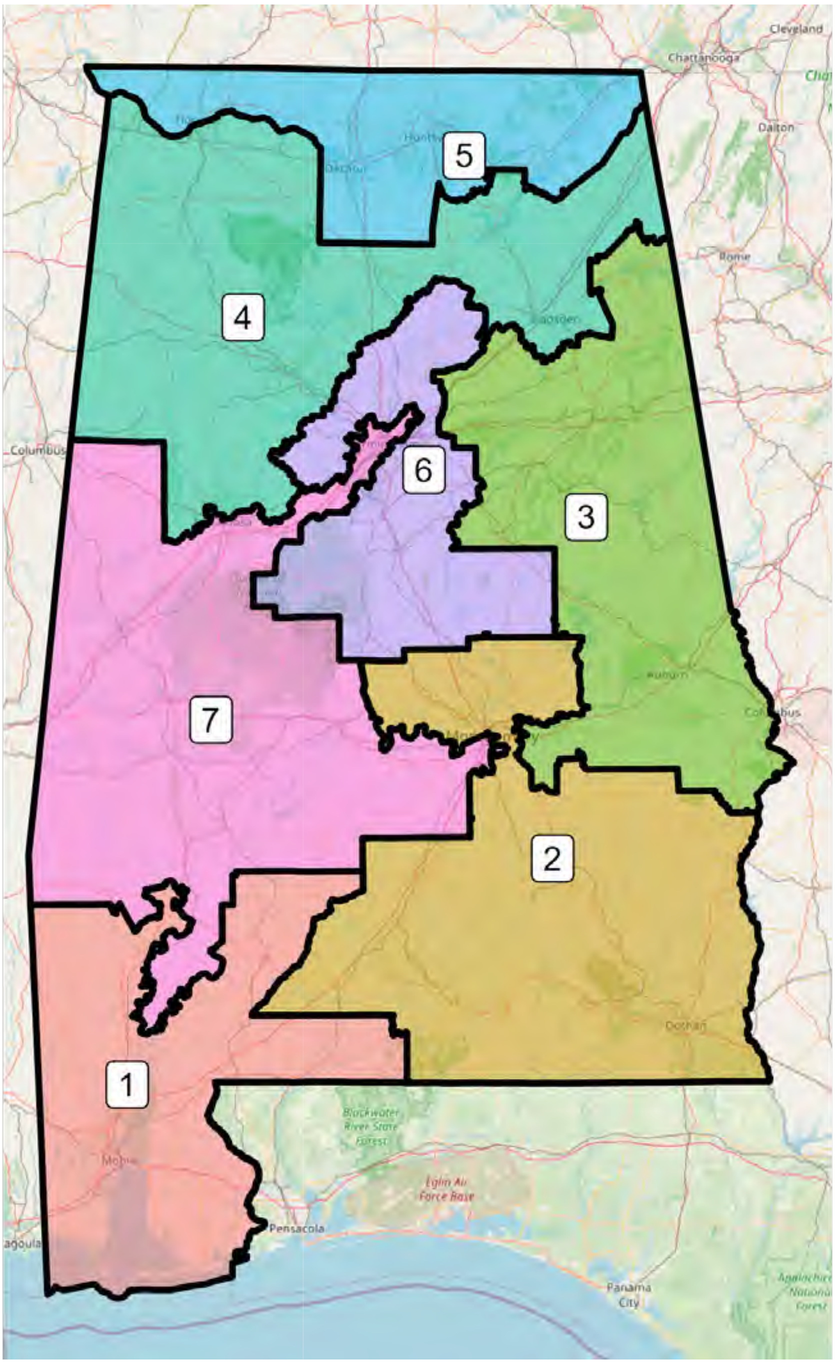


Figure 83: Alabama Congressional Districts for the 118th Congress (2023)

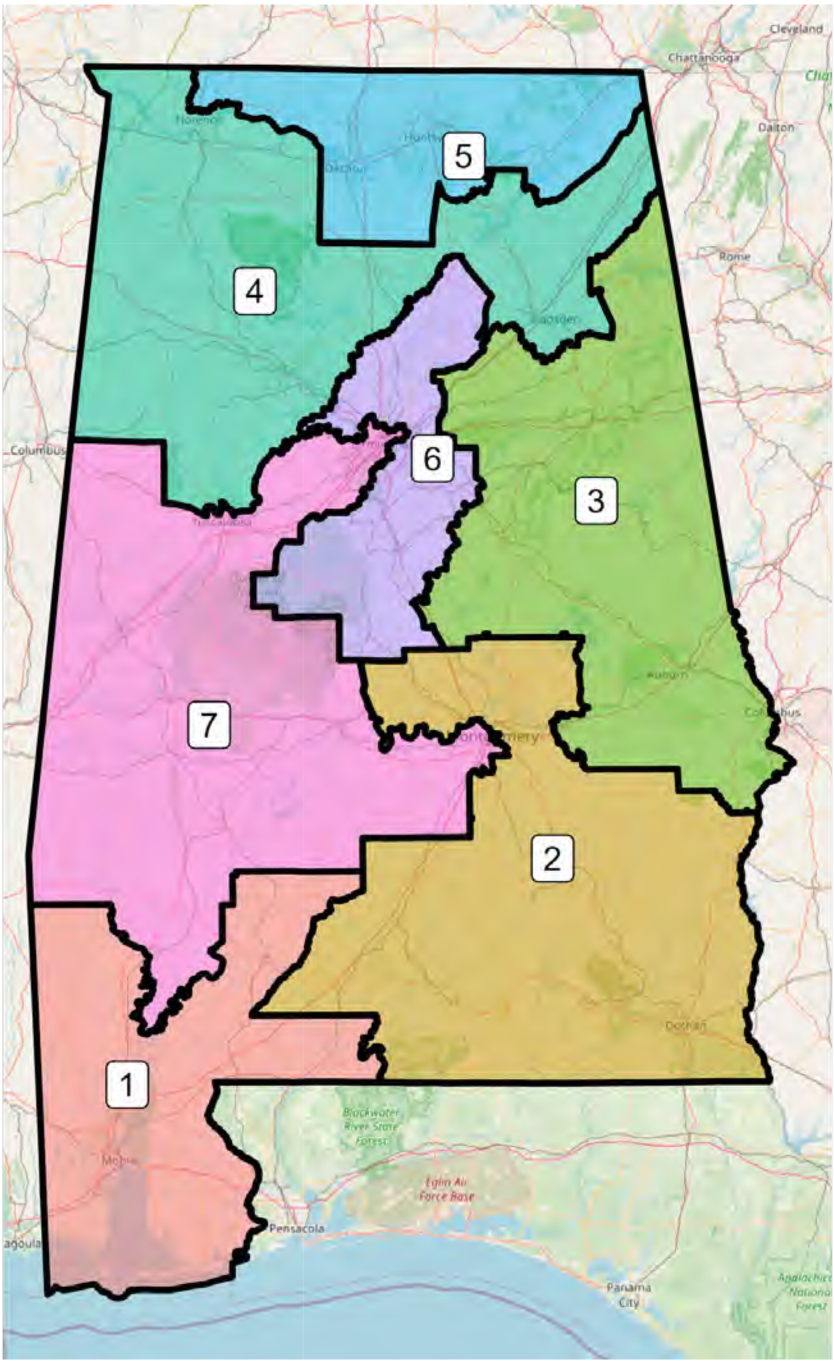


Figure 84: Alabama Enacted Map

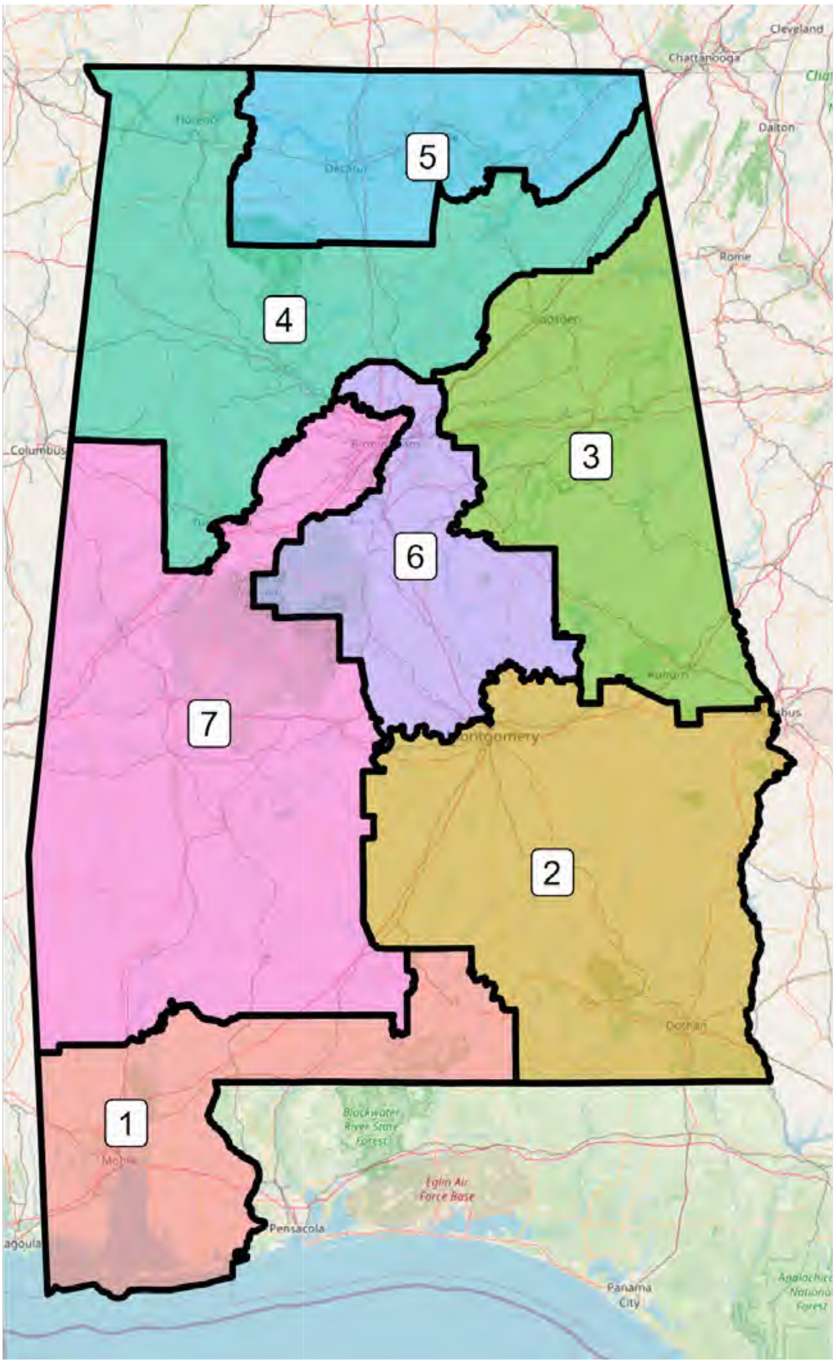


Figure 85: Alabama Special Master Map

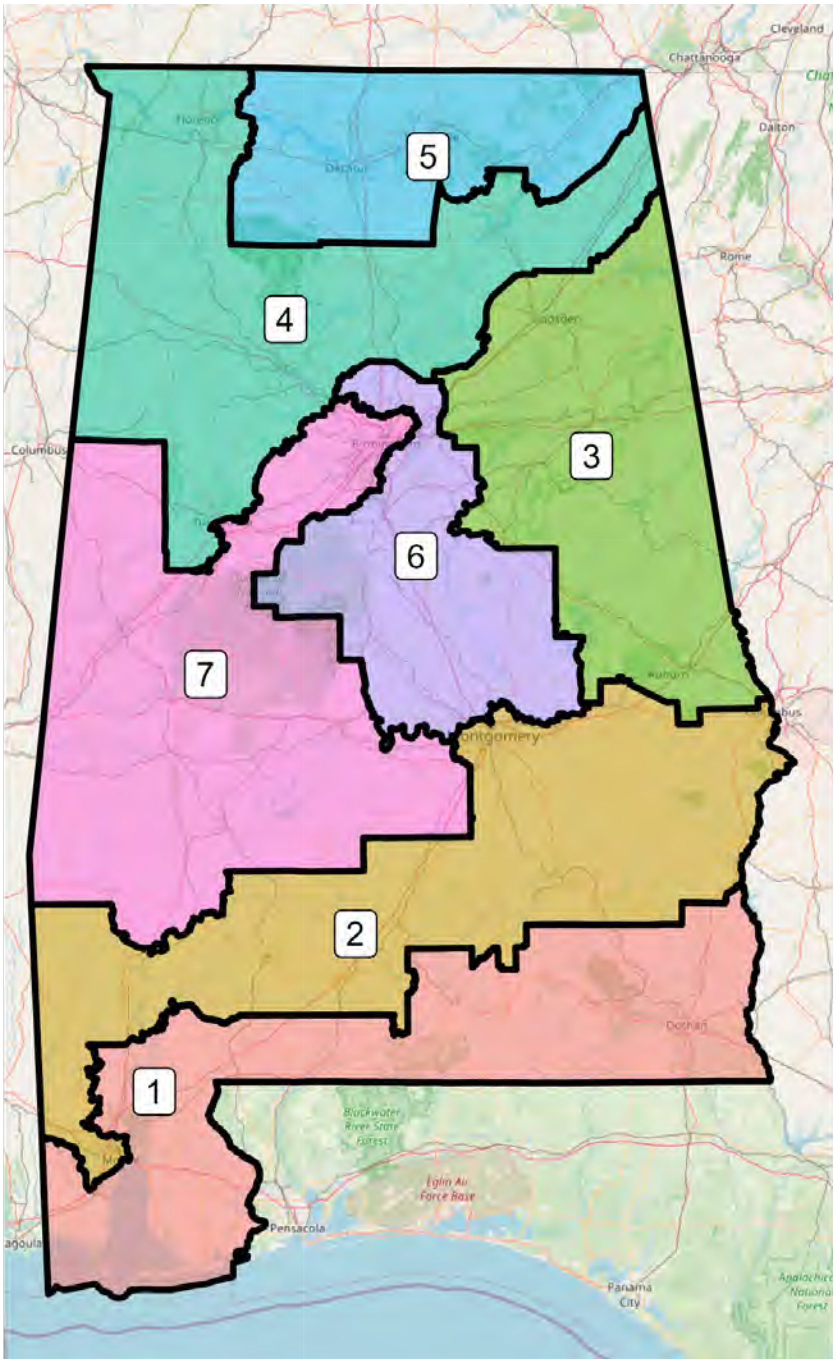


Figure 86: Cooper Illustrative Map 1

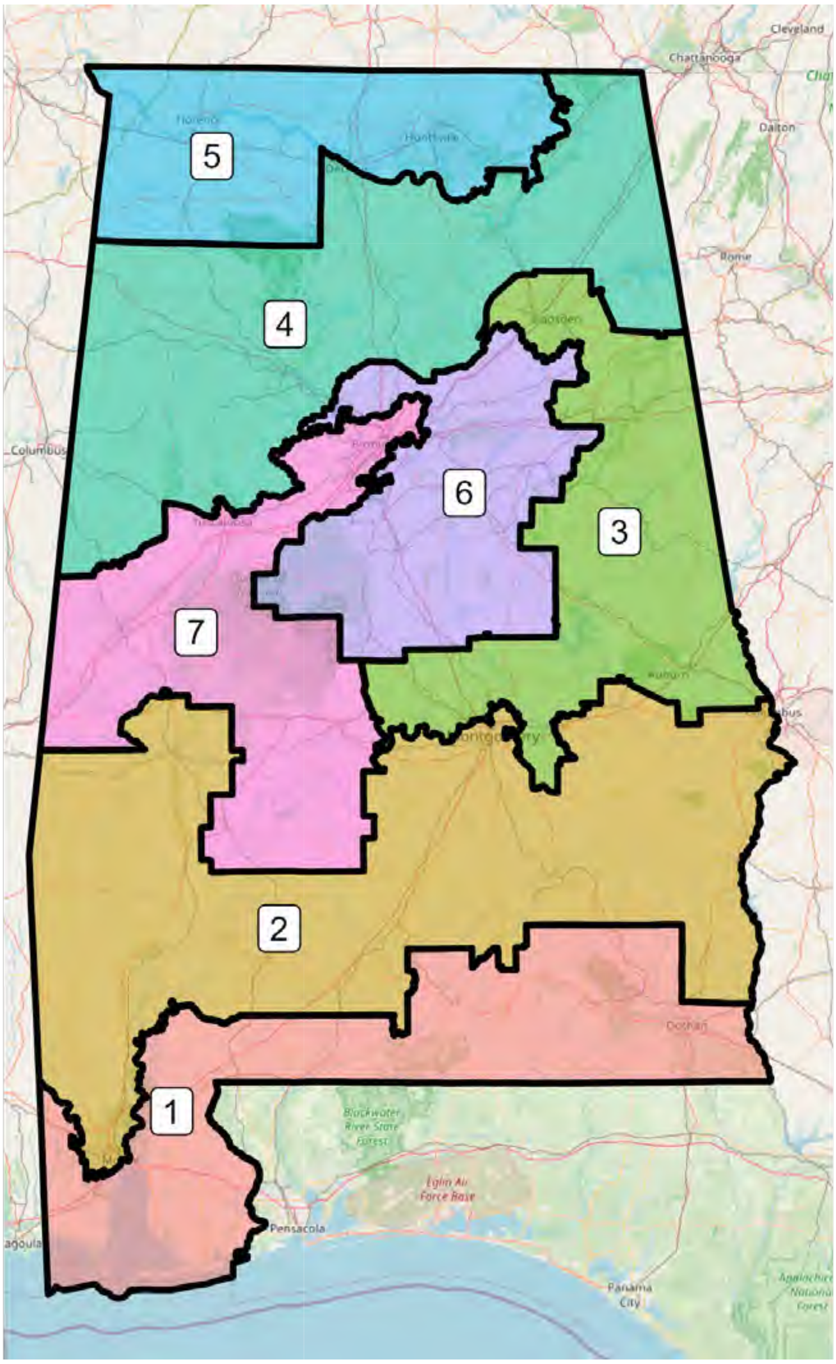


Figure 87: Cooper Illustrative Map 2

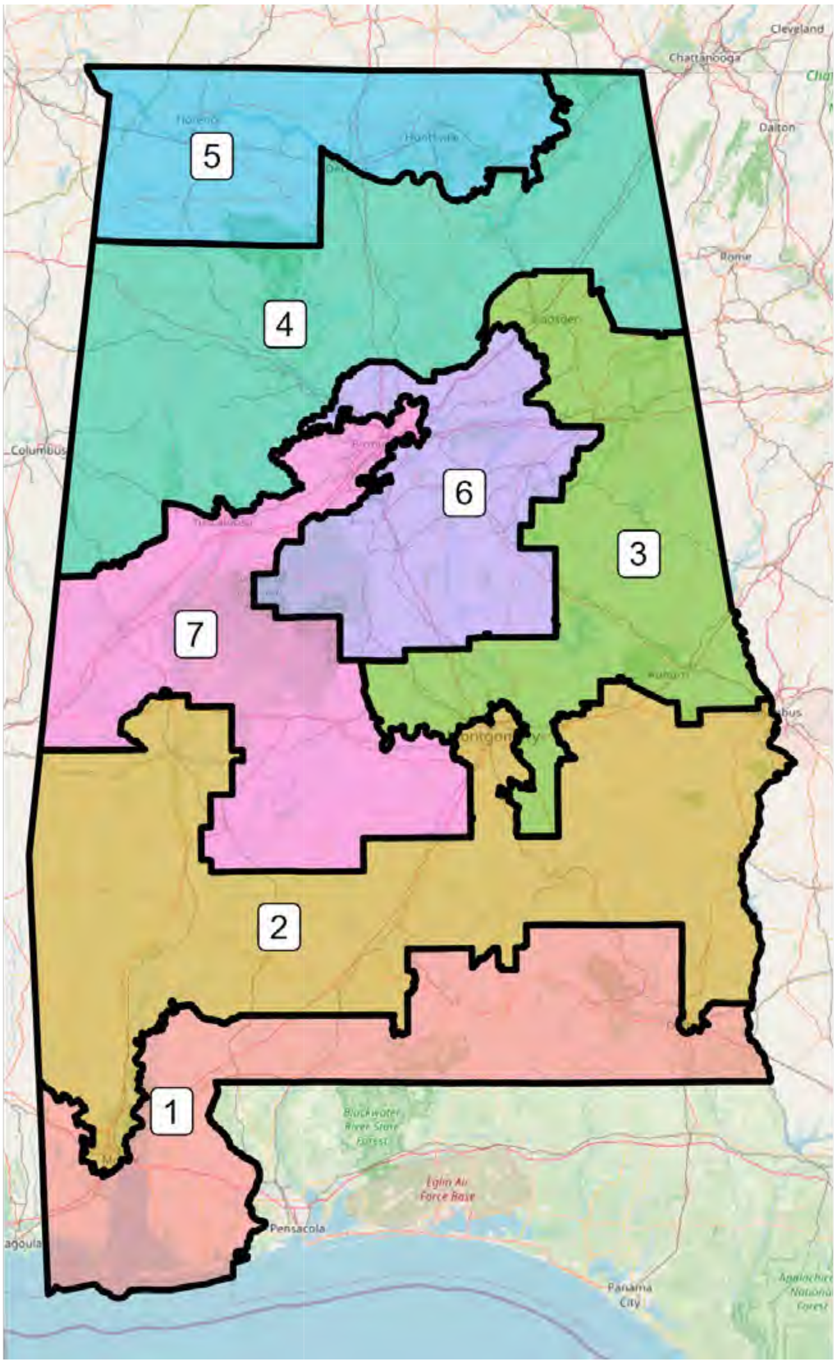


Figure 88: Cooper Illustrative Map 3

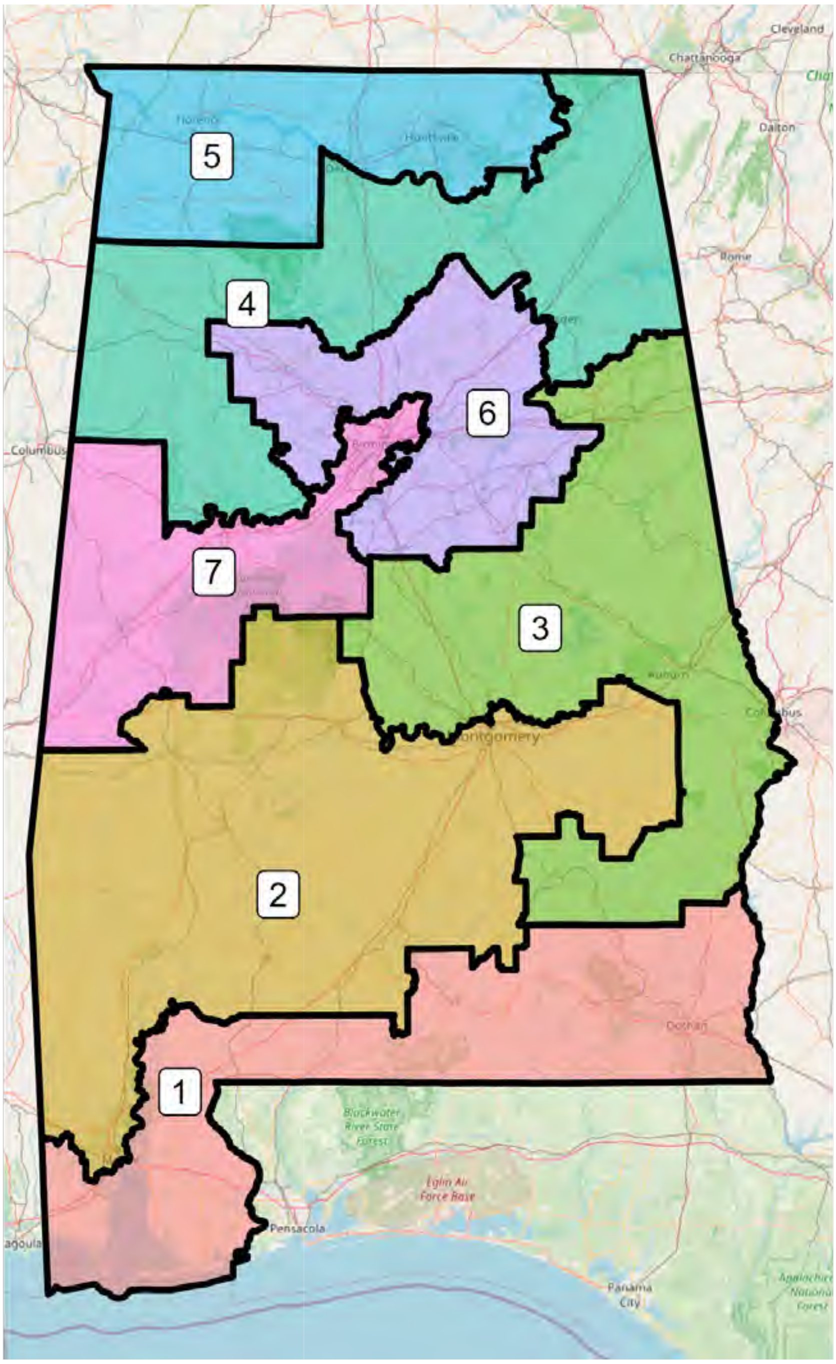


Figure 89: Cooper Illustrative Map 4

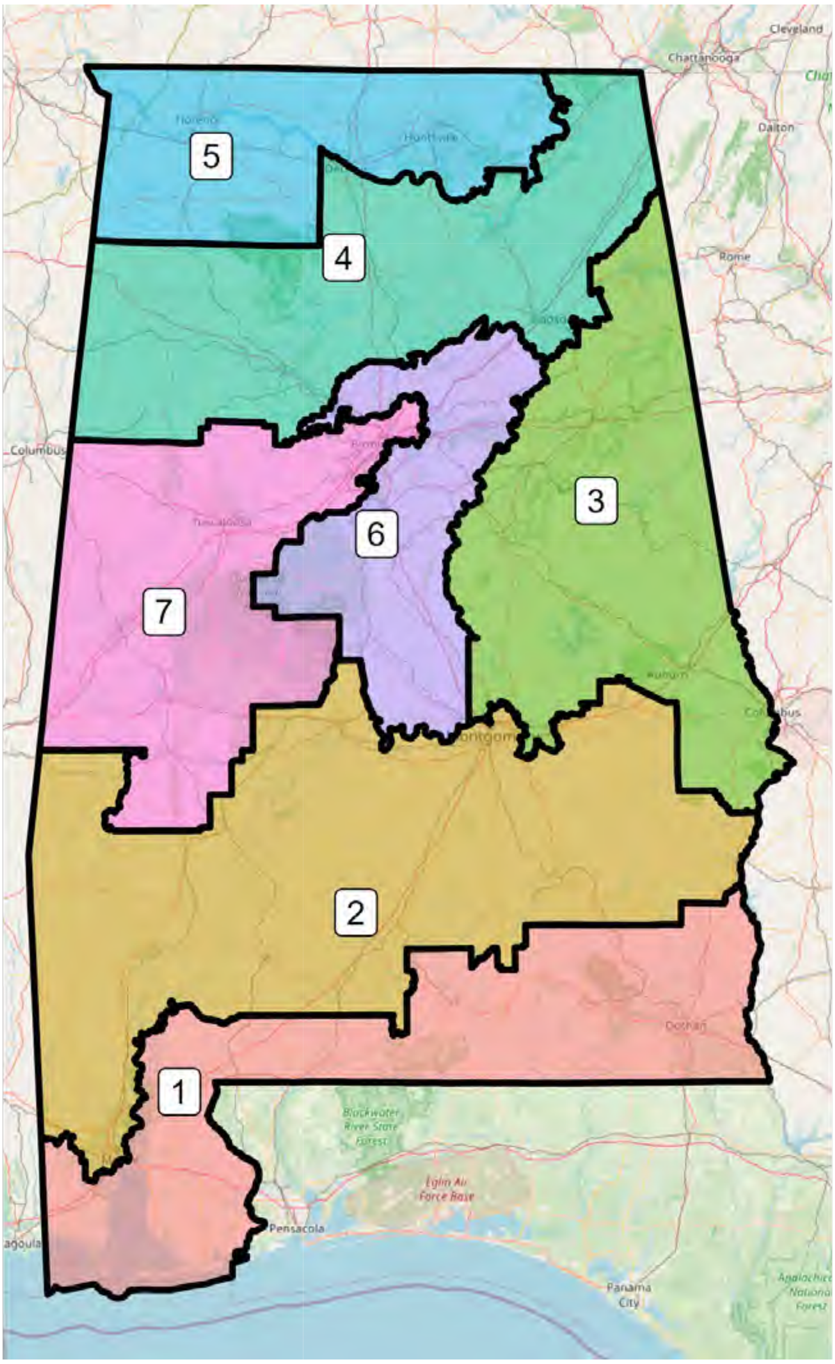


Figure 90: Cooper Illustrative Map 5

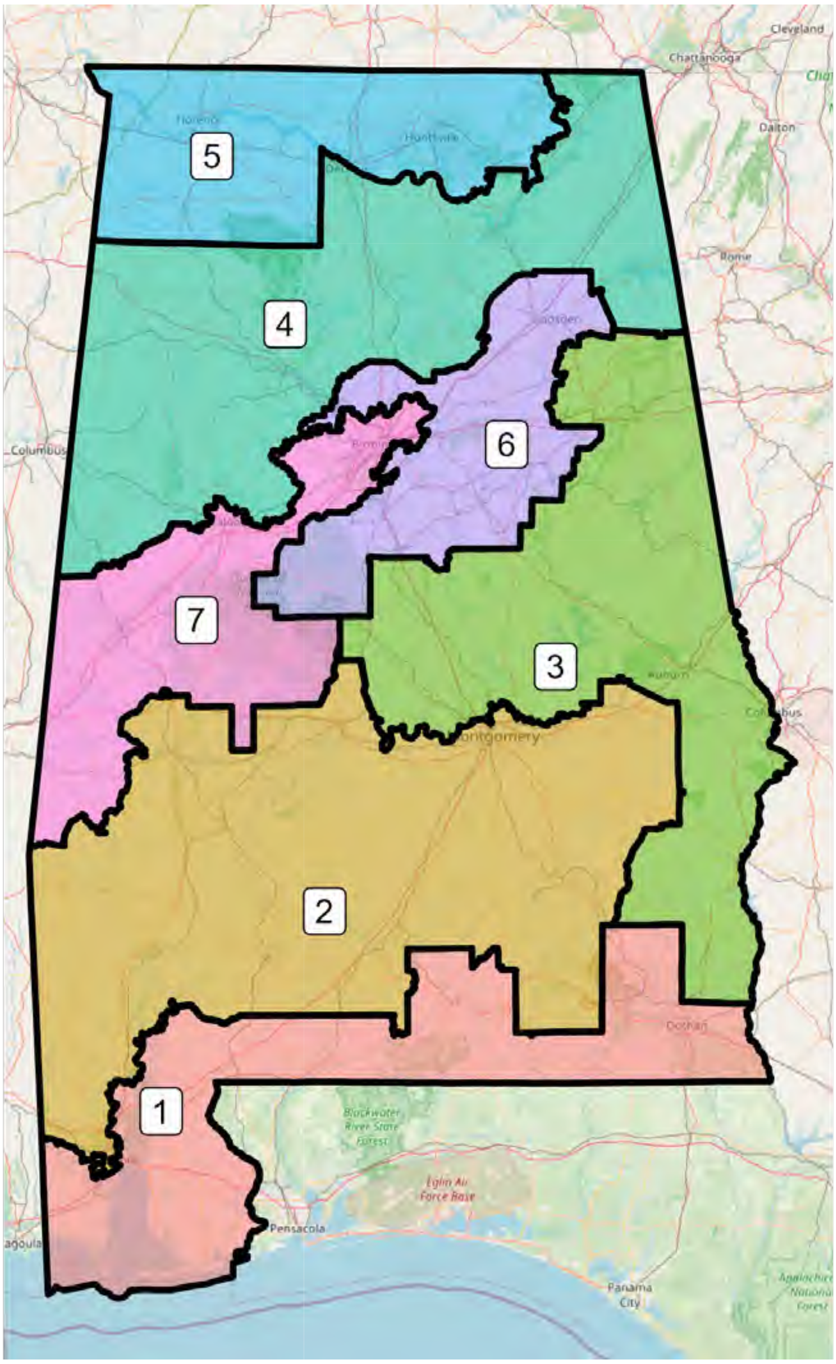


Figure 91: Cooper Illustrative Map 6

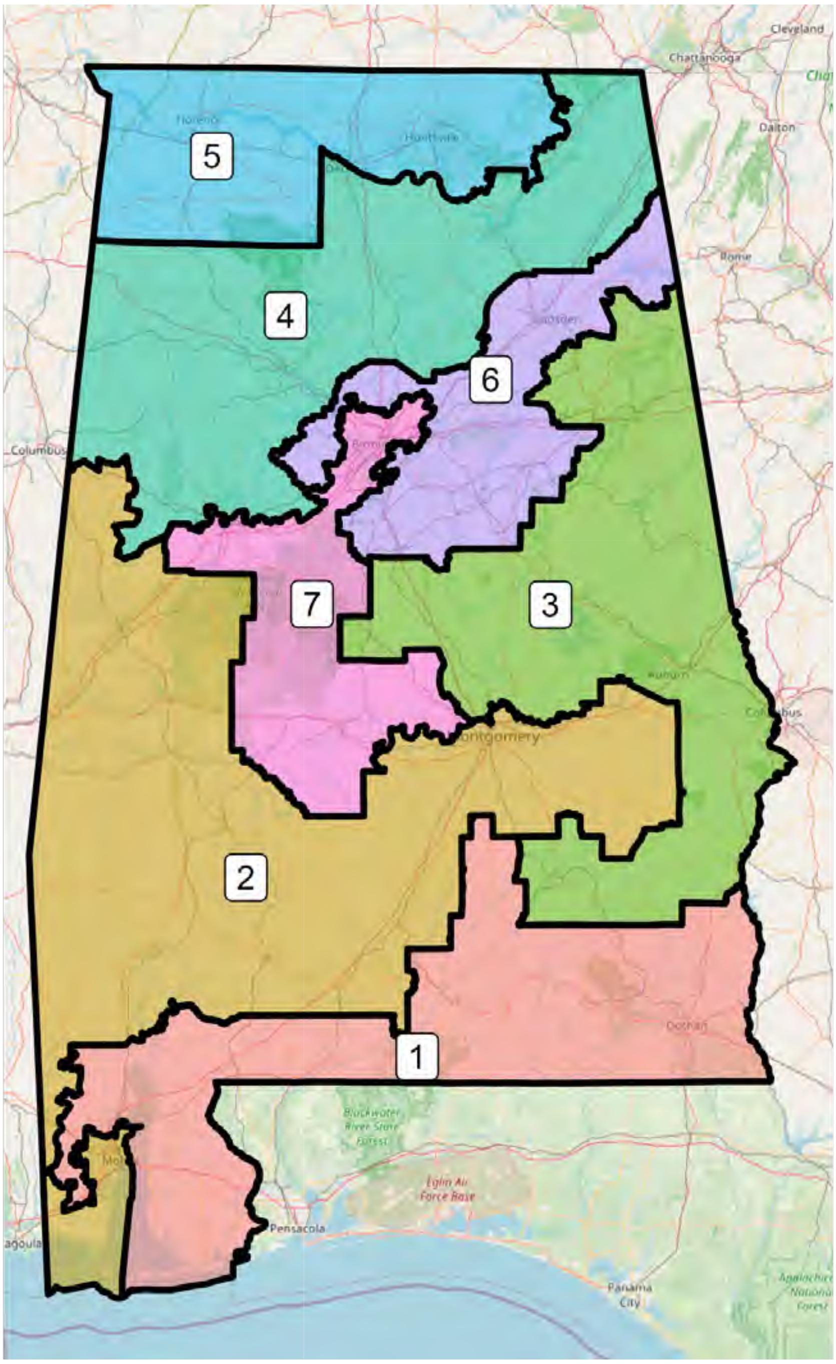


Figure 92: Cooper Illustrative Map 7

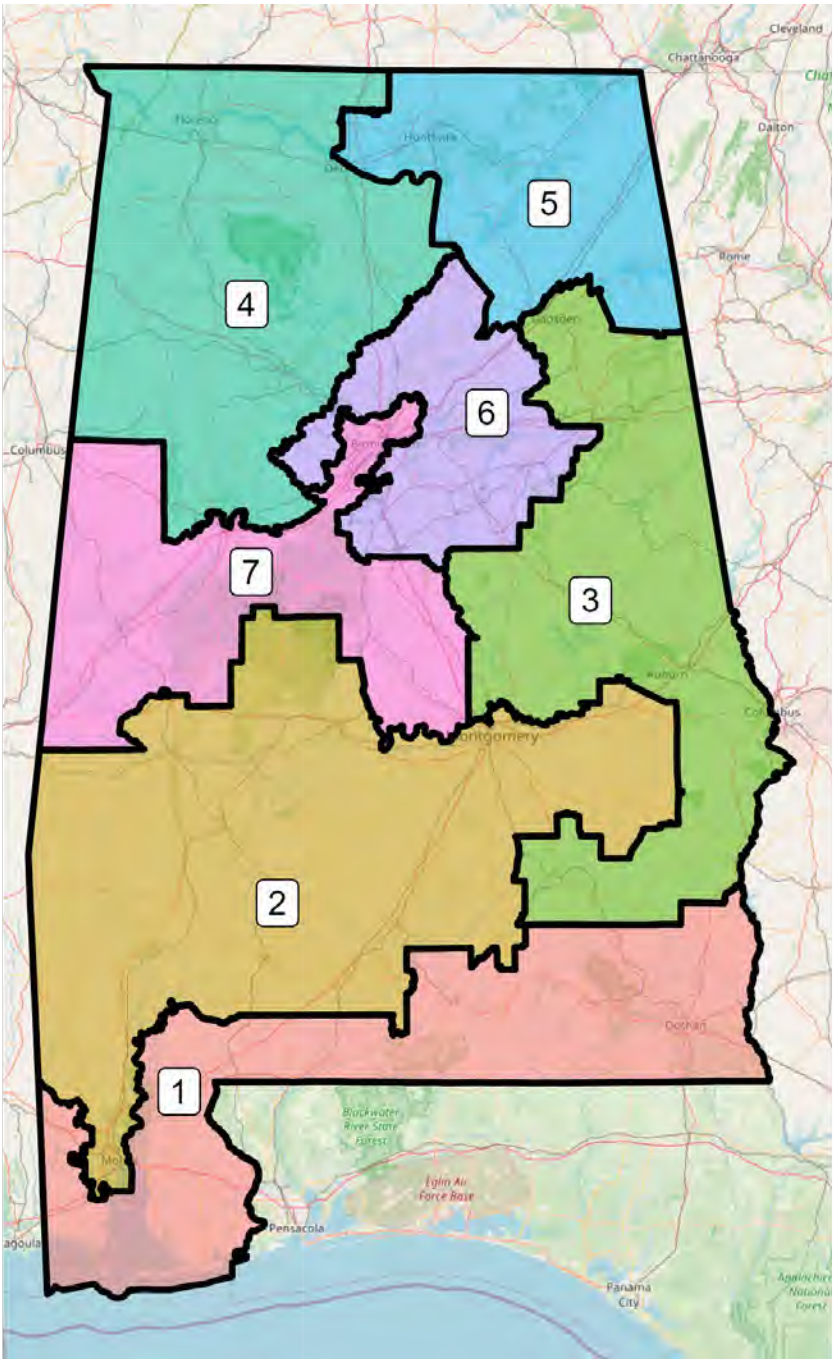


Figure 93: Cooper Illustrative Map 8

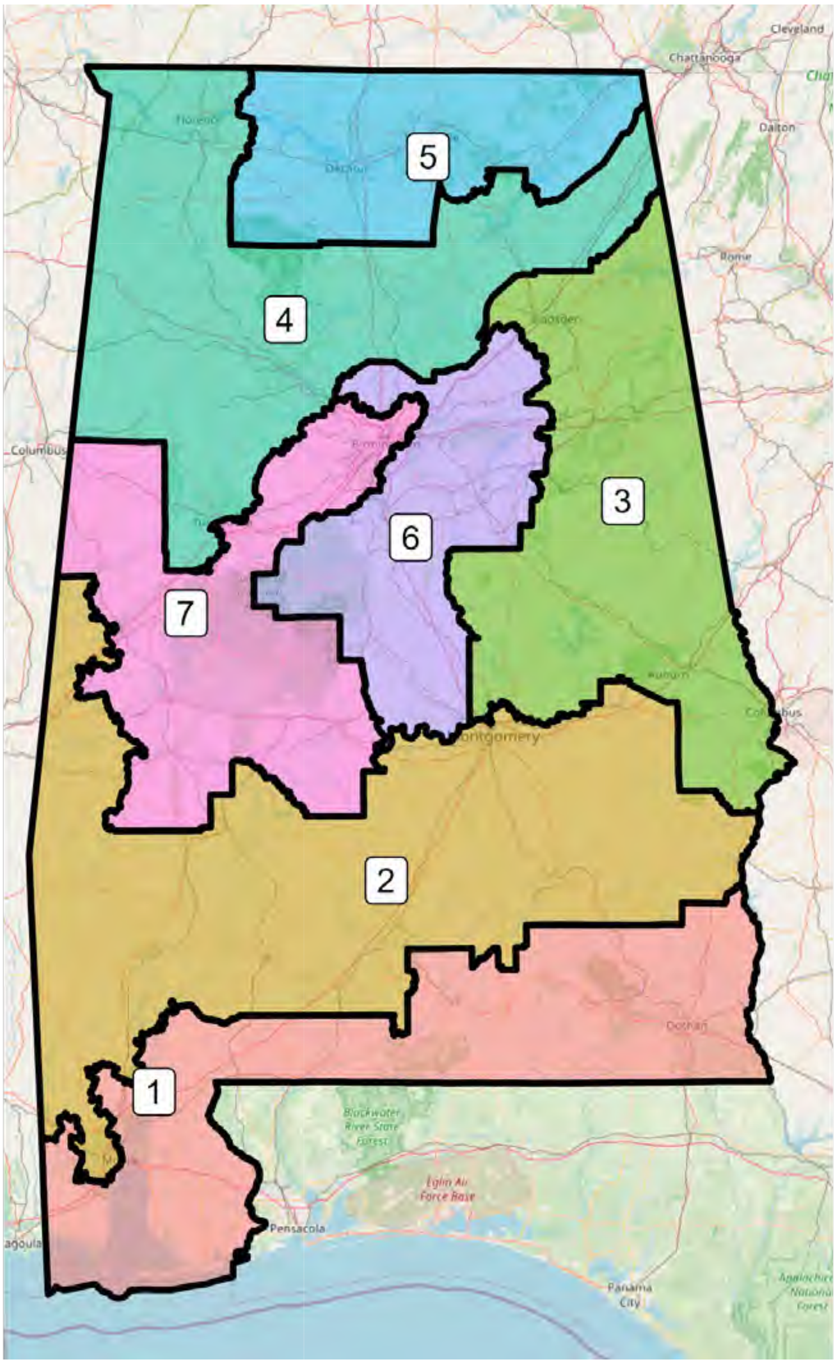


Figure 94: Duchin Illustrative Map A

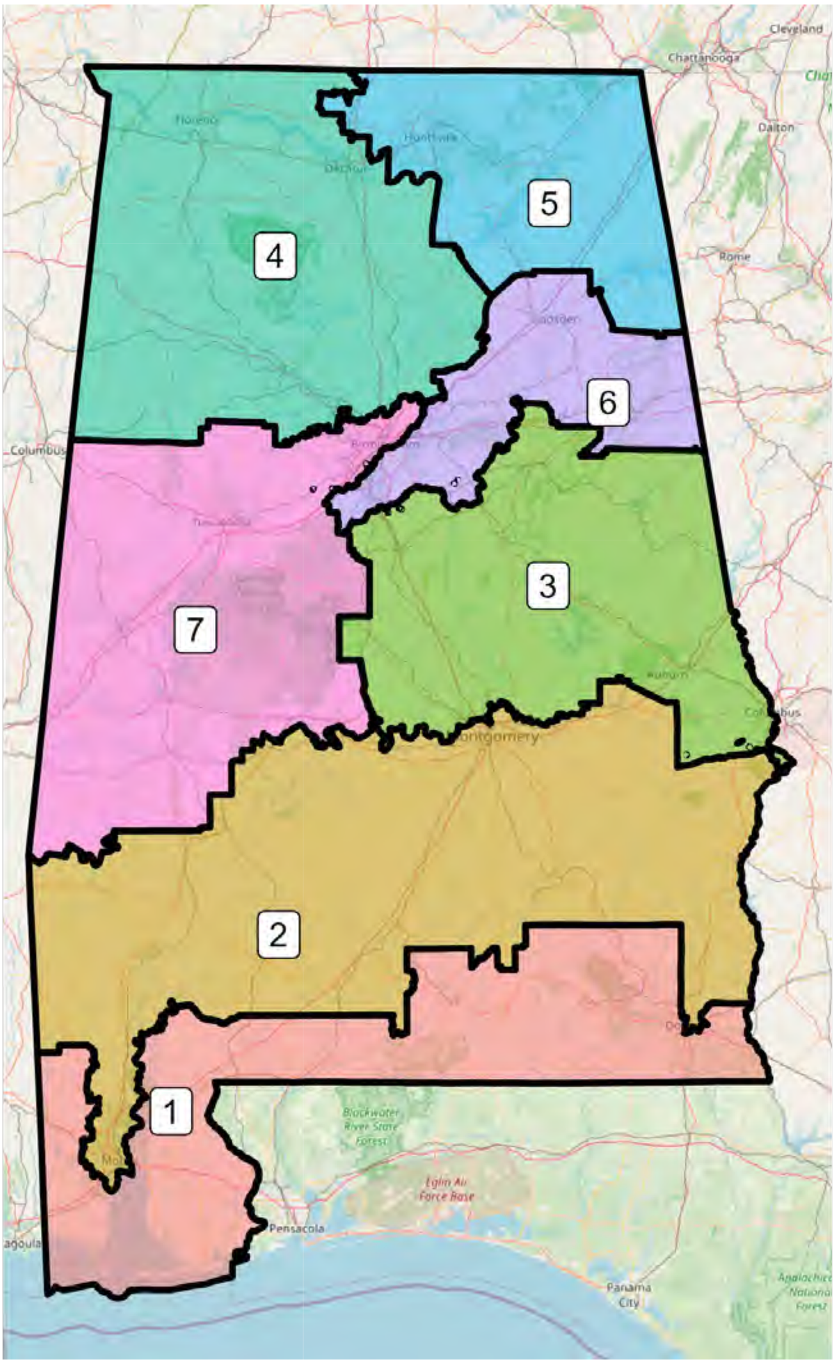


Figure 95: Duchin Illustrative Map B

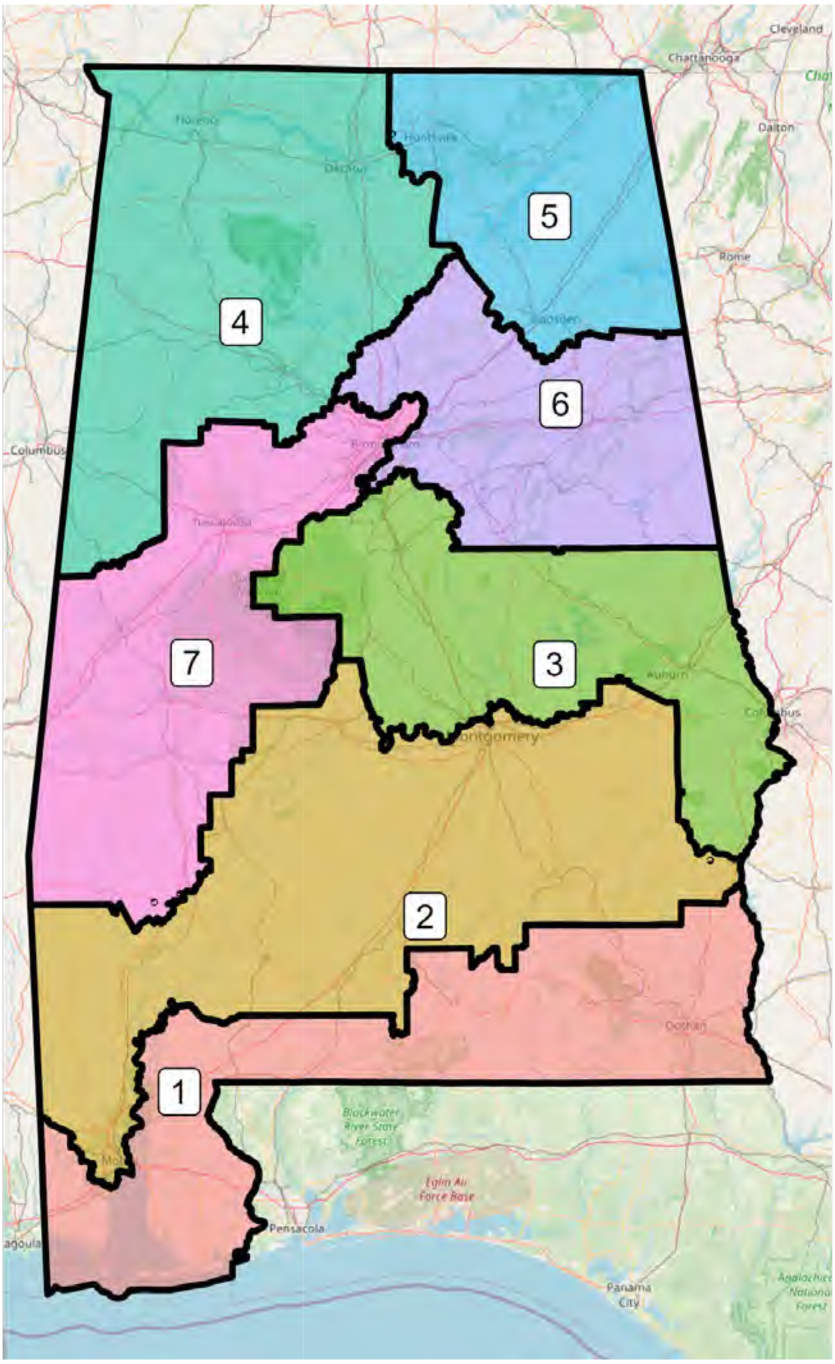


Figure 96: Duchin Illustrative Map C

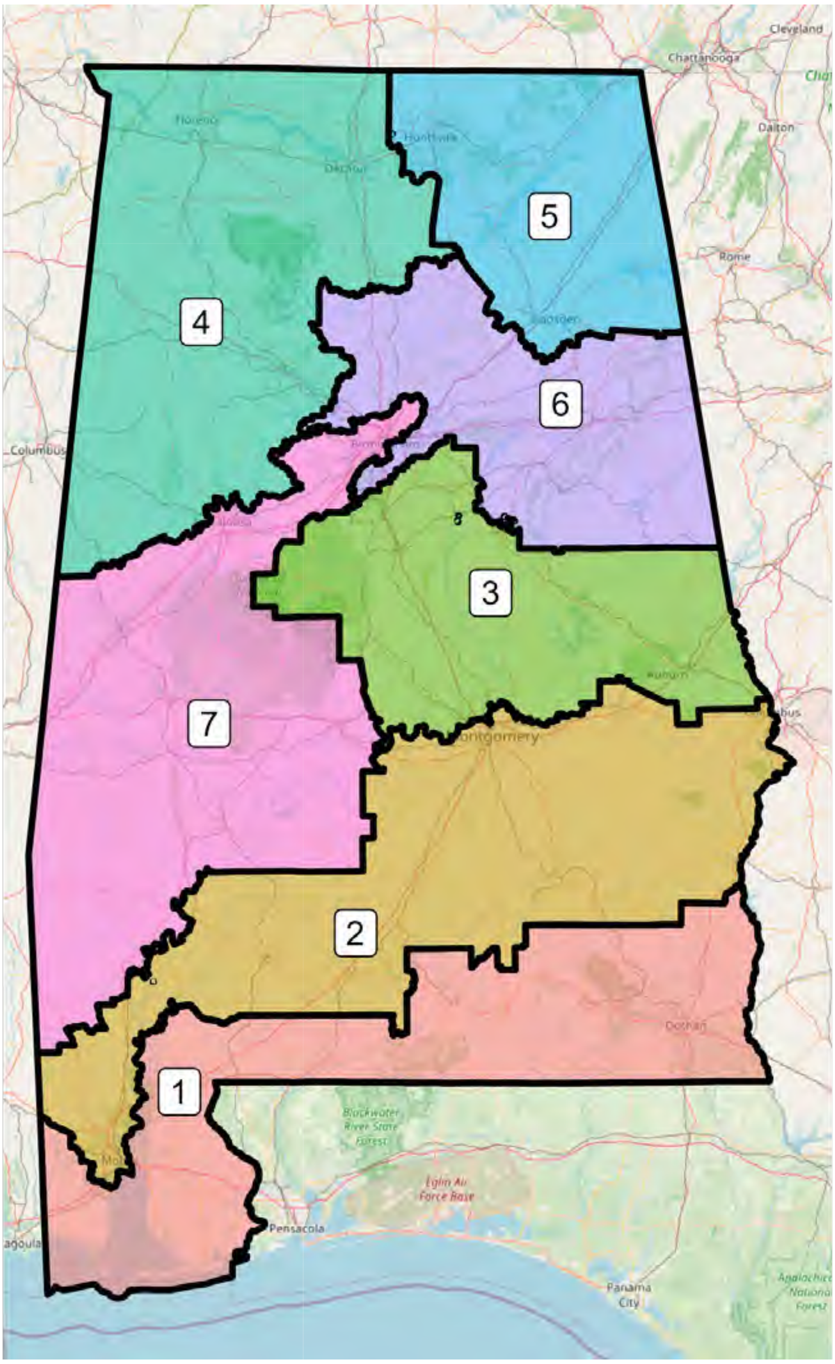


Figure 97: Duchin Illustrative Map D

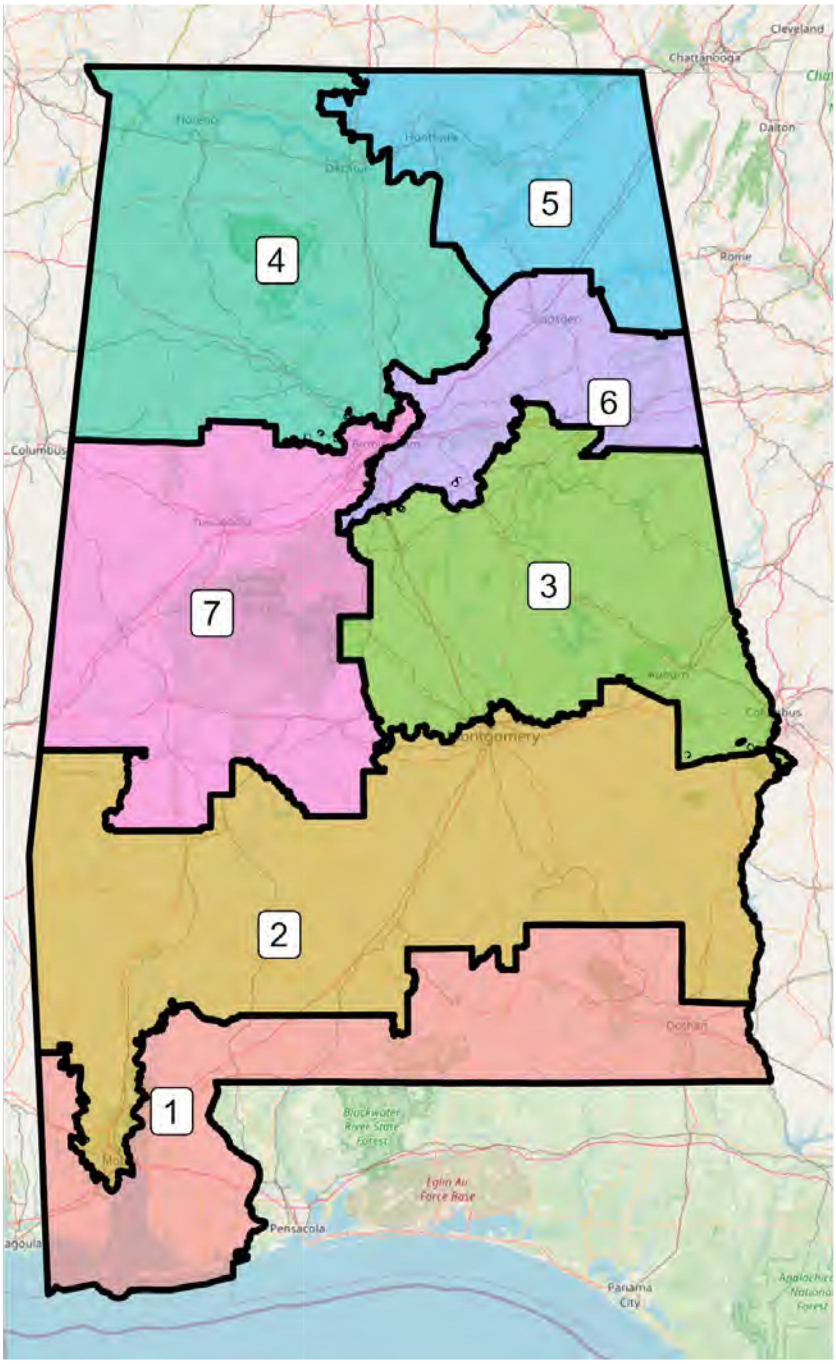


Figure 98: Duchin Illustrative Map E