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Math Models and Heuristic Methods for Constructing Fair Political Districts

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MATH MODELS AND HEURISTIC METHODS FOR CONSTRUCTING FAIR POLITICAL DISTRICTS

by

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ABSTRACT

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Political parties' attempts to manipulate district boundaries in order to gain political advantages in the election system lead to huge inefficiency and unfair election results. Previously some studies have developed methods for forming political districts considering various factors such as population equality, compactness, and contiguity; but only a few recent studies have considered political fairness as an objective for redistricting political map.

This study attempts to find a solution to draw political districts using political fairness as a factor in addition to integrity, population equality, contiguity, and compactness of the districts in order to prevent gerrymandering. In this research, we introduce two new metrics to measure political fairness that supplement efficiency gap which is the standard measure of political fairness. We then develop several mathematical models, that address various aspects of political redistricting to form state assembly, senate and congressional maps. Due to several drawbacks in these models, a heuristic methodology – in particular simulated annealing (SA) algorithm – is ultimately utilized to find a good solution for this problem. The algorithm is coded in C++ and then tested on three large scenarios. The first is a fictional rectangular state having 3000 wards. The second and third scenarios focus on combining nearly 7000 election wards to form U.S.

Congressional and state legislative districts in Wisconsin respectively. The results for the Wisconsin scenarios are displayed as maps that are created using state-of-the-art ArcGIS software. A significant data collection and cleaning effort was undertaken before the Wisconsin scenarios were considered. Experimental results demonstrate the effectiveness of the proposed heuristic method, the efficiency of political redistricting problems in general, and the inevitable trade-off that are made between competing objectives in this highly challenging real-world problem.

To

my parents,

and the best friend, toughest critic, and kindest spouse,

Shaahin

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1. Introduction

In the U.S., the act of drawing boundaries for electoral districts is called redistricting, and it happens every ten years right after the census is done. The way political districts are formed directly affects voters' influence in every election. Fair political redistricting tends to minimize total wasted votes and improves the efficiency of the democratic process, whereas unfair redistricting tends to exaggerate the power of the party that draws the maps.

Gerrymandering is defined as the act of drawing legislative district lines to increase one party's political power. It is a topic of significant importance in the current state of U.S. politics. As a practice, gerrymandering has been around almost since the U.S. Constitution was ratified in 1788 (Hunter 2011). However, the term "gerrymandering" was born in 1812 when Elbridge Gerry, the governor of Massachusetts at the time, facilitated redrawing districts in order to create new districts favoring his party, therefore gaining a political advantage over his opponents. One of the newly created districts was drawn in the shape of a salamander, which the Boston Gazette took notice of, and hence the phrase "Gerry – mandering" was coined referring to this new district (Miller 2018).

Figure 1-1: Elbridge Gerry and the district in Massachusetts which became the symbol of gerrymandering in 1812

There are three main kinds of electoral districts: (i) state assembly districts, (ii) state senate districts, and (iii) U.S. Congressional districts. All U.S. states perform redistricting for districts of type (i) and (ii). Each electoral district has a single representative. In addition, all states are subject to U.S. Congressional redistricting with the exception of Vermont, Alaska, Montana, North Dakota, South Dakota, Delaware, and Wyoming. These states have low populations and therefore the entire state has only one representative in the U.S. House of Representatives.

Within the U.S. population, 7 out of 10 people have a negative view towards gerrymandering, saying that people with political motives should not be given the ability to redraw districts (Saxe 2018).

In recent years, however, gerrymandering has become a much more prominent problem in U.S. politics. Manipulating political districts for political gain is unfortunately a common practice among both parties, and it negatively affects election fairness. A few more well-known examples of gerrymandering are described below.

North Carolina's 12th Congressional district has a reputation for being the most gerrymandered district in the United States. The district has been a constant target of redraw attempts in order to contain black voters within a single district. During the congressional elections in 2016, only 7% of the registered voters in this district actually voted, which is mostly attributed to discouragement as a result of constant attempts to deny black people their influence and voting rights (Blau 2016).

Illinois's 4th Congressional district has a distinctive shape, giving it the nickname "earmuffs." It has clearly been drawn in a way that contains two large Hispanic areas, and the two areas are connected by a very narrow line across Interstate 294 (Blake 2011). Not all agree about this case qualifying as gerrymandering, but rather many argue the district is drawn this way to avoid diluting the influence of Latino voters (Levine 2018).

In California, two well-known cases of gerrymandering exist. First, the 23rd Congressional district was redrawn in 2001 to exclude Republicans from the district. Also, the 15th State Senate district was drawn by then-governor Pete Wilson to be in favor of Republicans. These instances of gerrymandering exist despite California state law which requires that districts maintain the integrity of cities and counties (Wall Street Journal 2005).

There have been far more organized gerrymandering efforts as well. In 2010, Republicans started a project called REDMAP which stands for Redistricting Majority Project. The project, funded with $30 million, was aimed at states such as Wisconsin, Florida, North Carolina, Michigan, Pennsylvania, and Ohio. The project worked exactly as planned. For example, in the November 2012 elections in Pennsylvania, Democrats won 51 percent of all votes cast, but they grabbed only 28 percent of the seats in the state legislature. In Ohio, a swing state, Republicans won 12 out of 16 U.S. Congressional districts despite winning 50% of the statewide votes (Daley 2016).

According to the famous Republican strategist Karl Rove, "The political world is fixated on whether this year's elections will deliver an epic rebuke of President Barack Obama and his party. If that happens, it could end up costing Democrats congressional seats for a decade to come" (Rove 2010).

Gerrymandering can also have a negative impact on environmental conditions. Minorities have higher chances than whites of living near U.S. superfund sites – lands that are labeled as contaminated and hazardous to people’s health. For instance, 60% of African Americans live near a U.S. superfund site. For those living near superfund sites, gerrymandering can effectively weaken their access to fair representation in order to facilitate steps to clean up their environment (Kramar et al. 2018).

To better understand the influence of gerrymandering in today's U.S. politics, we should look back to 2008 when Republicans declared a strategy to gain control of state legislatures so that they could redraw the districts in favor of their party after the 2010 census. Political scientists now recognize this was one of the main reasons that Democrats' presence in the U.S. House of Representatives decreased to 75-year lows after the 2012, 2014, and 2016 elections. One outcome of this strategy was that in the November 2016 elections, Democratic candidates for Wisconsin State Assembly and Wisconsin State Senate clearly received the majority of all votes cast, but they won only 36 of 99 state assembly seats and 14 of 33 state senate seats. Also, although Republicans and Democrats each received roughly 50% of the statewide vote in Wisconsin's U.S. Congressional elections, Democrats won only three out of the eight U.S. Congressional seats in Wisconsin (Burden and Canon 2018).

The situation in Wisconsin and other states elsewhere in the U.S. has resulted in major lawsuits. For example, the U.S. Supreme Court started hearing arguments in Wisconsin's landmark redistricting lawsuit, Gill v. Whitford, in October 2017. In June 2018, the Supreme Court unanimously decided to send the case back to the lower court (the Wisconsin District Court) in order to have the plaintiffs gather stronger evidence about the credibility of their case (Burden and Canon 2018).

The reasoning of the court was that the plaintiffs must show evidence that they have been personally affected, also known as "injury in fact." Chief Justice John Roberts later penned that voters can create a case about the district they live in. The plaintiff in the trial, William Whitford, lives in a district that was largely unaffected by the redraw of the state district map. This caused the court to question his claim about his voting influence being affected as the result of this redraw. There were other plaintiffs that did in fact qualify as people whose votes were affected, but they did not testify, and their evidence was limited.

In May 2019, in a similar fashion, the U.S. Supreme Court blocked two rulings from lower courts that claimed voting maps drawn by Republicans were unconstitutional in Michigan and Ohio. This was somewhat expected as the court had already heard, but had not yet decided, two similar high-profile cases for Maryland and North Carolina that would essentially decide whether manipulating voting maps for political gain is deemed constitutional (Hurley and Chung 2019).

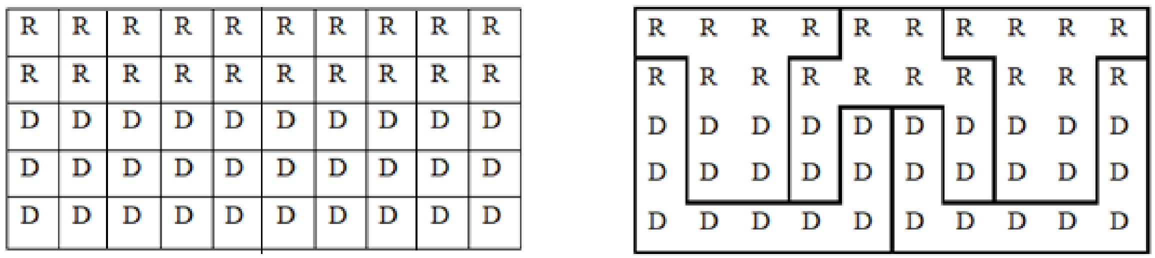
Finally, in June 2019, the Supreme Court ruled on a split 5-4 vote that gerrymandering by Democrats in Maryland and by Republicans in North Carolina is not unconstitutional (Williams 2019).

The U.S. Supreme Court has been struggling to define a set of standards for gerrymandering since 1986. In 2004, Justice Scalia declared that partisan gerrymandering cannot be identified; therefore cases appealing for such should no longer be considered. However, Justice Kennedy kept pushing for the search for standards, as he believed that as technology goes forward, it can act as a double-edged sword. His prediction has come true, as computers are now able to produce extremely gerrymandered maps that adhere to basic legal standards containing contiguity and equal population (Suri and Saxe 2019).

This dissertation explores the possibility of using mathematics and new standards of political fairness as possible remedies for the current gerrymandering crisis. In order to utilize math as a remedy in such efforts, the first step is to create a collection of new maps with no political bias, all of which follow existing redistricting rules. New proposed maps can be compared to this collection, and if they appear to be outliers, they can be discarded as biased. Mathematical approaches to redistricting are the focus of Chapters 5 - 10 of this dissertation. Another possible approach is to develop new standards for measuring political fairness. Currently the "efficiency gap" is the standard used to measure political fairness. However other measures can be used as well, and one can use a combination of measures too. Various measures of political fairness will be introduced in Chapter 4 of this dissertation.

Unfortunately, the U.S. Supreme Court, has not been exactly open to the involvement of mathematics in setting standards for gerrymandering disputes. Chief Justice John Roberts, Justice Neil Gorsuch, Justice Brett Kavanaugh, and Justice Samuel Amito have expressed their skepticism in a few instances. Despite such skepticism, a mathematical approach has proven itself worthy in a couple of legal cases, including in Pennsylvania where Governor Tom Wolf rejected the GOP's proposed congressional map after it was flagged as an extreme statistical outlier (Suri and Saxe 2019).

Figure 1-2 provides a simple example of gerrymandering in which a territory with 50 units is divided into 5 districts. Assume that each unit has the same population and the same number of votes cast. Assume that 40% of all units vote 100% Republican and the remaining 60% of the units vote 100% Democratic. So 60% of all votes cast for Democrats in territory (Figure 1-2(a)). However, due to the way the territory is divided, 3 out of 5 districts are won by Republicans. On the other hand, only 2 out of 5 districts are won by Democrats (Figure 1-2(b)). This is possible because the Republican victories are narrow, whereas the Democratic victories are overwhelming. The difference between the Republican-to-Democrat ratio for total votes (2:3) versus the same ratio for districts won (3:2) indicates that the territory may be gerrymandered. All in all, looking into alternative approaches to ensure fair and nonpartisan drawing of district lines is crucial.



(a) (b)

Figure 1-2: Dividing a territory with (a) 50 units into (b) 5 districts

Several studies in the literature have proposed methods for automatically constructing political districts considering factors such as population equality, compactness, and contiguity. However only a handful of studies have considered political fairness as an objective. This dissertation tries to include political fairness as a factor when political districts are drawn. In this work, we focus on a very difficult real cases which have not received much attention in previous studies.

As part of this effort, we introduce two new metrics to measure political fairness that supplement the standard method of measuring political fairness which is known as the “efficiency gap.” We then develop several generic mathematical models for forming state assembly, state senate and U.S. Congressional districts. These models do not work well with larger scenarios, so a heuristic method based on simulated annealing (SA) is proposed for real-life scenarios. This method is implemented in several thousand lines of C++ code. The heuristic method is then applied to a few large scenarios including the creation of U.S. Congressional and state legislative districts in Wisconsin. Overall this dissertation provides a starting point for forming state assembly and state senate districts that consider political fairness factor. It also adds to the previous results regarding the formation of U.S. Congressional districts. The resulting maps, which are created by the ArcGIS software program, demonstrate the advantages of the proposed heuristic method.

The next chapters are categorized as follows. Chapter 2 reviews the related previous studies. Chapter 3 formally introduces the political redistricting problem and shows the district maps currently being used in Wisconsin. Chapter 4 reviews the “efficiency gap” concept; introduces two new standards of political fairness; and presents related theoretical and experimental results. In Chapter 5, math models for constructing state assembly, state senate, and U.S. Congressional districts are introduced. In Chapter 6, a simulated annealing (SA) algorithm for creating political districts is described. The results of preliminary experiments on a large fictional instance are discussed in Chapter 7. Chapter 8 describes the data collection effort for the Wisconsin case studies in detail. In Chapter 9, experimental results for forming Wisconsin’s U.S. Congressional districts are presented. In Chapter 10, computational results for forming Wisconsin State Assembly and Wisconsin State Senate districts are discussed. Chapter 11 summarizes our findings and discusses the potential for future work in this area.

2. Literature review

This dissertation focusses on two aspects of political redistricting: algorithms for automatically creating political districts and alternative measures of political fairness. The first aspect mostly focuses on forming a desirable set of political districts considering different factors, and the second aspect is related to measuring the gap between political parties' electoral performance and rights. We now review the literature concerning these two aspects in detail.

2.1. Algorithms for constructing political districts

Ricca et al. (2013) have comprehensively reviewed all political districting papers in the field of operations research from classical models to recent approaches before the year 2011. Table 2-1 summarizes the criteria considered in such papers (and in more recent papers) and the kinds of algorithms proposed in these studies. The main criteria for constructing political districts are the following (Ricca et al. 2008):

- Integrity: Each territorial *unit* (e.g. census block, election ward) cannot be shared between two or more districts
- Population equality: Each district should have nearly equal population.
- Contiguity: Each district should be connected (contiguous).
- Compactness: The area within each district should be closely packed together.
- Conformity: Existing administrative boundaries (e.g. county boundaries) should be respected.

Some other criteria are used for specific situations such as:

- Respecting natural boundaries such as rivers and lakes.
- Respecting the integrity of communities and the representation of ethnic minorities as required by the Voting Rights Act.

Political fairness is formally defined in Chapter 3 of this dissertation. Below, we review some of the previous algorithms that have been developed for political redistricting. These include exact, approximation, and heuristic methods. Exact methods using integer programming models are usually solved with a standard optimization software package (Ricca et al. 2008). Contiguity has been a challenging aspect to consider for exact methods. Most of the studies presenting exact methods have not considered contiguity. Exact methods are generally unable to find good solutions for large, real-world redistricting problems within a reasonable time, so heuristic methods are the currently preferred methodology for dealing with districting problems. We categorized the studies for constructing political districts based on whether they have considered political fairness or not.

2.1.1. Studies that have not considered political fairness

Almost all redistricting algorithms presented in the literature have considered population equality and integrity, and most have considered contiguity and compactness. Less than a half of the previous studies have considered conformity and only a few recent studies have considered political fairness using historical electoral data. In this section we review all studies which have not considered political fairness. Vickrey (1961) suggested a multi-kernel growth procedure for forming districts, building them one at a time. He considered population equality, contiguity, and compactness as the main criteria for the problem. The districts are formed one by one beginning with a single unit (i.e. kernel, district center), and they grow by one unassigned unit at a time until the population equality requirement is met.

Table 2-1: Political redistricting criteria and modeling approaches considered in the academic literature

Model	Integrity	Population Equality	Compactness	Contiguity	Conformity	Political Fairness	Other	Category/ Methodology
Vickery (1961)	Yes	Yes	Yes	Yes	Yes	No	No	
Hess et al. (1965)	No	Yes	Yes	No	No	No	No	location problem/ transportation problem
Garfinkel and Nemhauser (1970)	Yes	Yes	Yes	Yes	No	No	No	exact approach
Bodin (1973)	Yes	Yes	No	Yes	No	No	No	
Bourjolly et al. (1981)	Yes	Yes	Yes	No	Yes	No	No	local search
Nygreen (1988)	Yes	Yes	Yes	Yes	Yes	No	No	exact approach
Hojati (1996)	No	Yes	Yes	No	No	No	No	transportation problem
Ricca (1996)	Yes	Yes	Yes	Yes	Yes	No	No	heuristics
George et al. (1997)	No	Yes	Yes	No	No	No	No	
Mehrotra et al. (1998)	Yes	Yes	Yes	Yes	No	No	No	column generation
Drexl and Haase (1999)	Yes	Yes	N/A	Yes	N/A	N/A	No	
Nemoto and Hotta (2003)	Yes	Yes	No	Yes	No	No	No	exact approach
Forman and Yue (2003)	No	Yes	Yes	Yes	No	No	No	genetic algorithm (GA)
Bozkaya et al. (2003)	Yes	Yes	Yes	Yes	Yes	No	Yes	Tabu, adaptive memory
Bacao et al. (2005)	Yes	Yes	Yes	No	No	No	No	genetic algorithm (GA)
Kalcsics et al. (2005)	Yes	Yes	Yes	Yes	No	No	No	binary tree search
Chou and Li (2006)	No	Yes	Yes	No	No	No	No	
Li et al. (2007)	No	Yes	Yes	No	No	No	No	exact approach
Ricca et al. (2008)	Yes	Yes	Yes	Yes	No	No	No	heuristics
Ricca and Simeone (2008)	Yes	Yes	Yes	Yes	Yes	No	No	SA, Tabu, local search
Puppe and Tasnadi (2008)	Yes	Yes	Yes	Yes	No	Yes	No	
Appolonia et al. (2009)	Yes	N/A	N/A	N/A	N/A	Yes	No	graph formulation
Salazar-Aguilar et al. (2011)	Yes	Yes	Yes	Yes	No	No	No	multi-objective approach
King et al. (2012)	Yes	Yea	No	Yes	No	No	No	graph model
Haase and Muller (2014)	Yes	N/A	No	Yes	N/A	N/A	No	heuristics
Gentry et al. (2015)	No	Yes	No	No	No	No	No	
King et al. (2015)	Yes	Yes	Yes	Yes	No	Yes	No	local search
Fifield et al. (2015)	Yes	Yes	Yes	Yes	No	Yes	No	automated redistricting simulator
Liu et al. (2016)	Yes	Yes	Yes	Yes	No	Yes	No	genetic algorithm
Swamy et al. (2019)	Yes	Yes	Yes	Yes	No	Yes	No	multilevel algorithm

A very basic political districting model was introduced by Hess et al. (1965) who formulated the problem as a district location problem that maximizes compactness given a population equality requirement. The study does not consider the contiguity of the districts. A heuristic method based on the transportation problem is proposed as an alternate solution, and allocation techniques are used to assign population to the district centers so that the distance between the population assigned to districts and the districts centers of the districts is minimized. The district centers are then updated, and the process is repeated.

Garfinkel and Nemhauser (1970) is considered a seminal work among political districting algorithms with an exact approach. They proposed two phases for a political redistricting algorithm. In phase I, they generate all possible feasible solutions with respect to population equality, contiguity, and compactness. In phase II, a model is used to select a feasible solution by minimizing the deviation of the district populations from the average district's population. Bodin (1973) introduced a contiguity graph algorithm for solving political districting problems. Population equality is the main criterion used in the objective function, and local search is applied to improve it. The algorithm works by moving a node (unit) from a district to another one or exchanging two units between two adjacent districts. Compactness is not considered in this model.

Bourjolly et al. (1981) developed an integer programming model that considers population equality, compactness, and socia-economic homogeneity as the main criteria. They used a local search method which starts from a given set of districts and tries to move units from their current districts to new ones as long as the objective function improves. Nygreen (1988) suggests a two-stage approach similar to the approach by Garfinkel and Nemhauser (1970). They started with a set of feasible districts and combine them to form a statewide district plan using a graph theoretic model. They considered population equality, contiguity, compactness, and conformity as their objectives and are able to solve a small problem (38 units and 4 districts).

Hojati (1996) proposed a procedure that includes three phases. In phase 1, he developed a mixed integer programming for political redistricting. In phase 2, he presented a solution of the model which comes from the algorithm by Hess et al. (1965). In phase 3, he suggested a heuristic method based on transportation techniques to assign population units to the centers and does not guarantee integrity of the units. This study also does not consider district contiguity. Ricca (1996) experimentally compared the performance of three local search heuristics - tabu search, simulated annealing, and descent - in redistricting problems. In this experiment, population equality, compactness, conformity, and contiguity are considered. The result of the experiment showed that tabu search performed better than the other methods.

George et al. (1997) modified the procedure by Hess et al. (1965) so that when the population of the units are assigned to the district centers, it results in alternating the centers. In their procedure, there is a risk of splitting a unit between multiple districts. To decrease the number of split units, they assign a split unit to the district that owns the highest proportion of its population. In this model, contiguity may not be satisfied. Mehrotra et al. (1998) followed the model from Garfinkel and Nemhauser (1970) with a different objective function which measures the non-compactness of each district. Contiguity is considered as a hard constraint. This method reassigns units from districts with high population to ones with low population. They started with a set of feasible districts and use a column generation methodology and branch-and-price approach to solve the model only for the small problem (51 territorial units and 6 districts).

Drexl and Haase (1999) considered a commercial districting problem motivated by challenges involving sales force deployment. In this problem small units called SCUs (sales coverage units) are assigned to larger sales territories. They used non-linear mixed integer programming and developed constraints to guarantee that all the SCUs assigned to one sales territory are connected to each other, so contiguity is satisfied. Nemoto and Hotta (2003) developed a nonlinear mixed integer math model. They used a contiguity graph in which the nodes of the graph correspond to the wards of the territory. The factors considered in the model are population equality, integrity, and contiguity, but compactness is not considered.

Forman and Yue (2003) proposed a genetic algorithm for solving political districting problems. The criteria considered in their model are contiguity, population equality, and compactness. However, contiguous districts are not guaranteed in the result. The algorithm considers units that lie on the border of territory and it randomly adds new units to districts until population balance is satisfied. Bozkaya et al. (2003) considered the criteria of population equality, compactness, socio-economic homogeneity, similarity to the existing plan, and integrity of communities. They also considered contiguity as a hard constraint based on an adjacency list. They used tabu search and an adaptive memory search algorithm to solve the problem. Their objective was to minimize the following function which is a weighted sum of the five terms that correspond to the five criteria above:

$$F(x) = \alpha_{pop}\, f_{pop}\,(x) + \alpha_{comp}\, f_{comp}(x) + \alpha_{soc}\, f_{soc}\,(x) + \alpha_{sim}\, f_{sim}\,(x) + \alpha_{int}\, f_{int}\,(x) \tag{2-1}$$

Bacao et al. (2005) proposed a genetic algorithm to improve an initial set of solutions and also checked the contiguity and population equality of all district plans in every generation, but their fitness function does not consider compactness. Contiguity, population equality, and compactness are the criteria considered by Kalcsics et al. (2005) in a territory design problem. They proposed a strategy based on binary tree search which starts from a set of units. The original problem containing *k* districts is the root of the tree and the nodes are considered as subproblems which are derived from the *k* districts. The algorithm stops when all the active nodes are solved and finished. Chou and Li (2006) proposed a quadratic mathematical model that considers population equality and compactness. To encourage contiguous districts, they used the concept of a contiguity graph, but they did not consider contiguity explicitly as a constraint. Hence, their solutions may have non-contiguous districts. They maximized the total absolute deviation of the district populations from average district's population. Li et al. (2007) proposed a quadratic model for political districting problems. In this study, population equality and compactness factors are considered. They defined the problem in graph theorical term, and then solved it using a quadratic program. Neither contiguity nor integrity are guaranteed in their model.

Ricca et al. (2008) proposed a weighted Voronoi algorithm that considers population equality and compactness in the objective function. Ricca and Simeone (2008) considered population equality, contiguity, compactness, and conformity in another political districting algorithm. They propose a new method for computing district compactness and evaluate the performance of different local search methods like tabu search and simulated annealing.

Salazar-Aguilar et al. (2011) used a multi-objective approach for a commercial territory design problem in which basic units are assigned to large connected compact groups that should have nearly equal numbers of customers and sales volumes. They proposed a new metaheuristic method, evaluated it experimentally, and compared it with a scatter tabu search procedure for optimization and a non-dominated sorting genetic algorithm. They used an improved ε-constraint method to overcome connectivity constraints. King et al. (2012) introduced a graph model to enforce contiguity and hole constraints during the local search. They also show how undesirable districts can be eliminated via a partitioning process.

In their recent work, Haase and Muller (2014) considered a sales force deployment problem to solve force sizing, sales representatives' location, sales territory alignment, and sales resource allocation subproblems in an overall effort to maximize profit. They proposed explicit contiguity constraints based on flow variables and introduced some exact approaches like branch-and-price and column generation. Gentry et al. (2015) used zero-one integer programming for a U.S. liver redistricting model without considering contiguity to assign liver donor areas to multiple sharing districts so as to minimize the imbalance of liver availability among those districts

2.1.2. Studies that have considered political fairness

We now turn over attention to the algorithms of political districting that have considered political fairness as an objective. Puppe and Tasnadi (2008) defined an unbiased district plan as one in which the number of representatives of a party is proportional to its share of votes, and they showed that creating such a district plan is a computationally NP-hard problem. They suggested that fair redistricting cannot be easily performed for a state with a large population. Also, they showed that, without geographical constraints, fair redistricting can happen with an alternating move game between two parties.

Apollonia et al. (2009) used political data and a graph-theoretic formulation to show how gerrymandering can "reverse" the result of an election. They considered a territory represented on a rectangular grid in which the vote outcome is represented by a bicoloring of the units. They maximized the gap between the number of districts won by blue and red parties, subject to constraints of integrity, contiguity and population equality. Fifield et al. (2015) formulated the redistricting problem as a graph cut problem where nodes correspond to geographical units and edges between nodes represent adjacent units. They developed an automated redistricting simulator based on Markov chain Monte Carlo (MCMC) techniques to sample redistricting plans over a set of contiguous districts that satisfy equal population constraints. King et al. (2015) maximized district competitiveness and compactness and used their previously proposed geo-graph model concept combined with local search to create contiguous districts of roughly equal population.

Liu et al. (2016) proposed a new computational approach for multi-objective political district optimization. They demonstrated the effectiveness of using computational tools such as high-performance parallel computing to enable the procedure of a parallel genetic algorithm (PGA) using super computers. They added district competitiveness to their multi-objective model which includes the traditional criteria of contiguity, compactness, and population equality. They presented a variety of experimental results for forming North Carolina's U.S. Congressional districts in which single or multiple objectives are considered. In research done by Chatterjee et al. (2018), a fast semi-randomized algorithm based on local search paradigm is suggested to increase the fairness of the 2012 congressional district maps for Wisconsin, Virginia, Texas, and Pennsylvania. Political fairness is judged by the well-known efficiency gap concept, and district populations are allowed to deviate from one another by 10%.

The recent work by Swamy et al. (2019) introduced general optimization models for political districting which considered many criteria discussed above: population equality, contiguity, and political fairness. They consider political fairness from three perspectives: the well-known efficiency gap concept, partisan symmetry, and competitiveness. They used a multilevel algorithm whose features include graph contractions for reducing the instance size, an ε-constraint for exactly solving the multi-objective problem, and a branch-and-cut method to attack the non-linearity of the partisan symmetry objective.

In this dissertation, exact methods, that do not include the contiguity constraints are proposed for small cases, and a heuristic method that considers contiguity, population equality, integrity, compactness, and political fairness – namely simulated annealing – is proposed for and tested on large, real-world cases.

2.2. Measuring political fairness

Several articles in the literature have discussed, proposed, and/or analyzed various ways to measure political fairness in the context of redistricting. The "efficiency gap" is currently the most commonly used measure of political fairness in the literature. It calculates the total wasted votes cast for each party after an election takes place.

Gelman and King (1994) used linear regression models to estimate the effects of redistricting on partisan bias. They developed statistical models that link electoral responsiveness and partisan bias to legislative data, and they concluded that redistricting reduces partisan bias as compared to an electoral system without redistricting. Jones (2013) showed how competition affects different aspects of representation and increases the accountability of representatives. This study showed that the voters in competitive states are generally more aware of what their representative has done and will respond accordingly. Chen and Rodden (2013) statistically demonstrated that Democratic voters are concentrated in specific areas in the U.S.A. – mostly in big cities – and this situation favors Republicans. They showed that even if Democrats receive a majority of votes, they should probably expect fewer seats than Republicans.

In a seminal article, McGhee (2014) introduced the concept of "relative wasted votes" which eventually become known as the "efficiency gap." The efficiency gap equals the difference between the two parties' wasted votes divided by total votes cast. According to this article, if a party loses a district, all votes cast for that party in that district are considered wasted. Also, if a party wins a district, all votes cast for that party in that district that exceed half of the total number of votes cast in that district are considered wasted. He also proved that if all districts are equal in population, "relative wasted votes" could be converted to the simpler form shown in equation (2-2).

Relative wasted votes = (Seat margin) – 2 (Vote margin) (2-2)

A party's seat margin is equal to the party's excess seat share over 0.5 and a party's vote margin is its excess vote share (statewide) over 0.5. In another seminal article Stephanopoulos and McGhee (2015) formalized the efficiency gap concept that was introduced by McGhee (2014). They computed the efficiency gap for all congressional and state house plans formed between 1972 and 2012. Also, they proposed setting a threshold for the efficiency gap for congressional and state house plans above which a plan should be deemed unlawful. Wang (2016) proposed three statistical tests to assess when the partisan distortions created by gerrymandering are statistically significant. All tests use the districts' election results. The first two tests analyze the intent to gerrymander statistically and third test computes the effect of gerrymandering using computer simulation. Nagle (2017) argued that a fair voting system is one in which the fraction of seats won by a party is proportional to the fraction of the statewide votes cast for that party. Nagle showed that the surplus votes defined as the entire vote margin and that wasted votes can be generalized as a weighted sum of lost and surplus votes. He also introduced measures for average voter effectiveness and average voter harm respectively shown in equations (2-3) and (2-4). V_A refers to the total number of votes cast for Party A and W_A refers to the number of wasted votes cast for Party A.

$$\text{Effectiveness} = \frac{V_A - W_A}{V_A} \qquad (2\text{-}3)$$

$$\text{Ineffectiveness} = \frac{W_A}{V_A} \qquad (2\text{-}4)$$

He used vote-centric measures to equalize the average effectiveness of voters. In this way, he compared parties' relative wasted vote shares rather than relative wastes votes as a proportion of total votes cast. Based on vote-centric measure, he generated a vote-seat curve which is depended on competitiveness. Cover (2018) reviewed the efficiency gap concept and examined the historical data to show the relationship between the efficiency gap, district competitiveness, seat-vote proportionality, and voter turnout. He analyzed and expanded Nagle's party-centric scale and considered it as modified efficiency gap measure which is shown by equation (2-5). V_x and V_y refer to the total number of votes cast for Party *X* and party *Y* respectively, and W_x and W_y respectively show the number of wasted votes cast for Party *X* and Party *Y*.

$$\textit{Modified efficiency gap measure} = \frac{W_y}{V_y} - \frac{W_x}{V_x} \qquad (2\text{-}5)$$

Chen (2017) used a simulation approach for legislative redistricting to show the relationship between political geography and electoral bias. He statistically analyzed the Wisconsin State Assembly districting plan based on Wisconsin's Act 43 and concluded that packing Democratic voters in certain areas leads to district plans which are remarkably in favor of Republicans. Cho (2017) examined the efficiency gap as a measure of partisan fairness for sophisticated situations and queried the application of it. Features of the efficiency gap were analyzed to see how it behaves when the type of election, election time period, and total number of seats up for election are varied. The study also investigated how the efficiency gap relates to the concepts of responsiveness and bias. Bernstein and Duchin (2017) also challenged the functionality of the efficiency gap and introduced an alternate sampling approach based on outlier analysis to identify notions of legal district plans that satisfy criteria related to population equality, compactness, contiguity, and majority-minority districts. Their approach is based on well-established random walk sampling theory which is continuously growing. Warrington (2018) compared an ensemble of North Carolina Congressional redistricting plans created by a Monte Carlo algorithm to historical voting data for the 2012 and 2016 North Carolina elections and showed that enacted district plans for the state are highly gerrymandered.

In another work, Stephanopoulos and McGhee (2018) challenged some measures of partisan gerrymandering such as mean-median difference and the difference between the parties' average margins of victory. They defined additional methods for measuring partisan gerrymandering and argued that a metric should capture efficiency and does not need to support other electoral values like competitiveness. It also should be applicable to a wide range of electoral conditions and be tested on historical election data. Krasno et al. (2018) proposed a median-mean method for measuring political fairness. They produced 10,000 neutral state assembly maps to show that the current Wisconsin State Assembly district plan is remarkably gerrymandered according to the median-mean formula but not according to the efficiency gap formula. In recent work by Tapp (2019), the mathematical aspects of different measures of political fairness – including measures of partisan symmetry, political efficiency, and political competitiveness - are formulated, analyzed and compared. They mathematically formulated and compared several measures of Political Fairness which had been developed by other researchers. He showed that the relative efficiency gap introduced by Nagle (2017) and Cover (2018), not only depends on V_m (vote margin), S_m (seat margin), but also on C (competitiveness measurement) as shown in equation (2-6). $\lambda \in \{1,2\}$ is an arbitrary positive constant. Note that, as previously mentioned, a majority party's seat margin is equal to the party's excess seat share over 0.5 and a majority party's vote margin is its excess vote share over 0.5.

$$\text{The relative efficiency gap} = \frac{S_m - (\lambda + (1-\lambda)C)\, V_m}{2(0.5+V_m)(0.5-V_m)} \quad (2\text{-}6)$$

2.3. Contribution of this research

Overall, our review of the literature has identified several dozen outstanding contributions that introduce mathematical models and/or computer algorithms for constructing political districts and that introduce ways of measuring political fairness. This dissertation contributes to the literature in three main ways. First, we consider political fairness as part of the objective when constructing state assembly districts. As discussed above, only a few recent studies have considered political fairness when constructing political districts and used historical election data in their redistricting algorithms. The majority of these studies, however, focus on constructing small problem instances and/or constructing roughly a dozen U.S. Congressional districts for states (which is easier than constructing roughly 100 state assembly districts). This dissertation therefore serves as a starting point for integrating political fairness into districting approaches for state assembly districts. Second, we present a novel algorithm for constructing state senate districts from a given set of state assembly districts. Third, in Chapter 4 we introduce two new metrics for measuring political fairness.

3. Problem description

In this research, we consider a state (or territory) consisting of M individual units which can be counties, census tracts, electoral wards, or census blocks. The location and shape of each unit is known. Supporters of two political parties – Democrats and Republicans – occupy the state. Our goal is to divide the state into D political districts that satisfy criteria related to integrity, population equality, contiguity, political fairness, and compactness.

3.1. Given information

In order to create D districts from M units in a state, some geographical, demographic, and political information about that state and the units inside it are needed. Some general notations which are used in this research are listed in Table 3-1. General information available to the decision maker includes the population P_m of unit m, number of votes cast V_m in unit m, number of votes cast for Democrats VD_m in unit m, number of votes cast for Republicans VR_m in unit m, area AR_m of unit m, perimeter PE_m of unit m, a boolean value A_{mn} which equals 1(0) if units m and n are adjacent (not adjacent), a real value L_{mn} which is the length of the border (if any) shared by unit m and n, and the Euclidean distance T_{mn} from the centroid of unit m to the centroid of the unit n. We assume that $VD_m + VR_m = V_m$. In other words, there are no third parties. We assume that the information can be obtained from recent data which is available to the decision maker.

The state population P_{state} is the sum of the population of all units; number of votes cast in the state V_{state} is the sum of the number of votes cast in all units; and number of votes cast for Democrats in the state VD_{state} is the sum of the number of votes cast for Democrats in all units. P is the average population of a district; V is the average number of votes cast per district; and VD is the average number of votes cast for Democrats per district. *NumDemWins* is the number of districts that Democrats would win if the proportion of districts they win is as close as possible to the proportion of total votes they receive statewide.

Table 3-1: General notations used in this research

Terms	Explanation
D	Number of political districts needing to be created (*integer,* ≥ 2)
M	Number of units (e.g. voting wards in a state), (*integer,* $\geq D$)
P_m	Population of unit m
V_m	Number of votes cast in unit m
VD_m	Number of votes cast for Democrats in unit m
VR_m	Number of votes cast for Republicans in unit m
AR_m	Area of unit m in square meters
PE_m	Perimeter of unit m in meters
$A_{mn}=\begin{cases}1\\0\end{cases}$	If units m and n are adjacent Otherwise (*binary*)
L_{mn}	Length of boundary shared by unit m and unit n (*real* ≥ 0)
T_{mn}	Straight-line distance from centroid of unit m to centroid of unit n
P_{state}	State population
V_{state}	Total number of votes cast in state
VD_{state}	Total number of votes cast for Democrats in state
P	Average population of a district ($P= \Sigma_{m=1}^{M} P_m \;/\; D$)
V	Average number of votes cast per district ($V= \Sigma_{m=1}^{M} V_m \;/\; D$)
VD	Average number of votes cast for Democrats per district ($VD = \Sigma_{m=1}^{M} VD_m \;/\; D$)
Pd_d	Population of district d
Vd_d	Number of votes cast in district d
VDd_d	Number of votes cast for Democrats in district d
$DWINd_d=\begin{cases}1\\0\end{cases}$	If Democrats are expected to win (i.e. receive the majority of votes cast in) district d Otherwise (*binary*)
ARd_d	Area of district d
PEd_d	Perimeter of district d
$NumDemWins$	Number of districts which Democrats would win if the proportion of districts they win is as close as possible to the proportion of total votes they receive statewide
Pen_p	Raw population penalty
Pen_{f1}	Raw political fairness penalty based on the first strategy
Pen_{f2}	Raw political fairness penalty based on the second strategy
Pen_{f3}	Raw political fairness penalty based on the third strategy
Pen_{c1}	Raw penalty for lack of compactness based on Polsby and Popper method
Pen_{c2}	Raw penalty for lack of compactness based on the maximum distance between centroids of two units inside a district
$NPen_p$	Normalized population penalty
$NPen_{f1}$	Normalized political fairness penalty based on the first strategy
$NPen_{f2}$	Normalized political fairness penalty based on the second strategy
$NPen_{f3}$	Normalized political fairness penalty based on the third strategy
$NPen_{c1}$	Normalized penalty for lack of compactness based on Polsby and Popper method
$NPen_{c2}$	Normalized penalty for lack of compactness based on the maximum distance between centroids of two units inside a district
w_p	Weight for objective function component related to population equality
w_{f1}	Weight for objective function component related to political fairness (first strategy)
w_{f2}	Weight for objective function component related to political fairness (second strategy)
w_{f3}	Weight for objective function component related to political fairness (third strategy)
w_{c1}	Weight for objective function component related to compactness (Polsby and Popper method)
w_{c2}	Weight for objective function component related to compactness (maximum distance between centroids of two units inside a district)

3.2. Decisions made

To divide the state into D districts, each of the M units must be assigned to one of the D districts. After this is done, the population Pd_d of district d is the sum of the populations of the units assigned to that district. The number of votes cast Vd_d in district d is the sum of the number of votes cast in the units assigned to that district. The number of votes cast for Democrats VDd_d in district d is the sum of the number of votes cast for Democrats in the units assigned to that district. The area ARd_d of district d is the sum of the areas of all units assigned to that district, and the perimeter PEd_d of district d is the sum of the length of shared borders between units inside district d and units outside of that district. $DWINd_d$ is a binary variable that equals 1 if Democrats are expected to win (i.e. have the majority of votes in) district d and equals 0 otherwise.

3.3. Hard constraints

Two constraints must be satisfied when we divide the state into D political districts. First, each unit is assigned to one and only one district, and no unit is shared between multiple districts (integrity). Figure 3-1 shows an example of an infeasible set of districts due to the existence of units that belong to two districts. Second, all districts must be contiguous. Contiguity is verified using the adjacency information A_{mn}. Figure 3-2 shows an example of an infeasible set of districts due to the existence of a non-contiguous district. In this set of districts, district 1 is not contiguous.

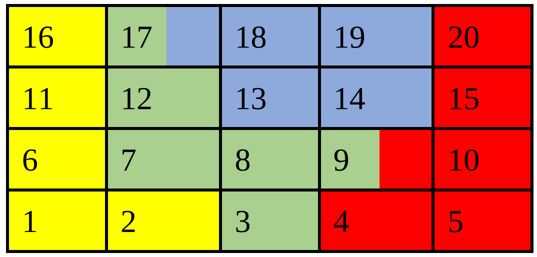


Figure 3-1: Infeasible set of districts because units 9 and 17 each belong to two districts

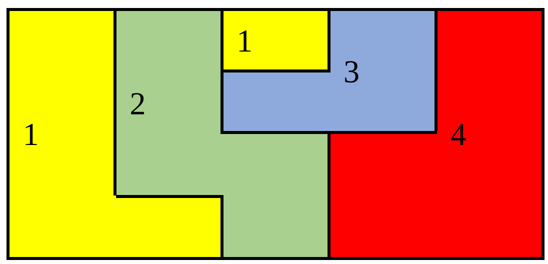


Figure 3-2: Infeasible set of districts due to non-contiguity

3.4. Objectives

Our objective is to minimize the total penalty associated with the set of *D* districts that are created. This total penalty is a weighted sum of five terms.

$$\text{Total penalty} = w_p * NPen_p + w_{f1} * NPen_{f1} + w_{f2} * NPen_{f2} + w_{f3} * NPen_{f3} + w_{c1} * NPen_{c1} + w_{c2} * NPen_{c2} \qquad (3\text{-}1)$$

The first term is a population deviation penalty (penalty type *p*); the second, third and fourth terms are political fairness penalties (penalty types *f1*, *f2* and *f3*); and the fifth and sixth terms are penalties for lack of compactness (penalty types *c1* and *c2*). All six penalty components are normalized as discussed in Section 3.5. The term w_i ($\forall\ i = p,\ f1,\ f2,\ f3,\ c1,\ c2$) is the weight of penalty type *i*. w_p is the weight for objective function component related to population deviation penalty; w_{f1} , w_{f2} and w_{f3} are the weights for the objective function components related to political fairness penalties based on the first, second, and third strategies respectively which are explained in detail in the later sections. w_{c1} and w_{c2} are the weights for the objective function components related to different types of compactness penalties which are also presented later. We now discuss each of these penalty components in detail.

3.4.1. Population equality

Almost all previous studies regarding political districting have considered this factor. Put simply, the requirement is that the population of each district should be as close as possible to the average district's population. In this research we compute a raw population penalty Pen_p which equals the deviation of each district's population from the average district's population, summed over all districts.

$$Pen_p = \sum_d |Pd_d - P| \tag{3-2}$$

The value Pen_p is then normalized and converted to $NPen_p$ using the procedure described in Section 3.5.

3.4.2. Political fairness

As mentioned above, only a few previous studies have used political data in constructing political districts to prevent gerrymandering. There are at least three strategies for applying political data in such cases. The first strategy is to minimize the difference between a party's percentage of total districts (i.e. seats) won and percentage of total votes received statewide (vote-seat proportionality). This is a commonly recommended strategy for dividing a state into fair political districts. In this case, the political fairness penalty (Pen_{f1}) equals the difference between the number of total seats won by a party in the state, and the number of total votes it receives:

$$Pen_{f1} = \left|\sum_d DWINd_d - NumDemWins\right| \tag{3-3}$$

In the second strategy, the percentage of votes cast for Democrats (Republicans) in each district is made as close as possible to the overall percentage of votes cast for Democrats (Republicans) in the state. In other words, each district should be made as politically similar to the whole state as possible. In this case, total political fairness penalty (Pen_{f2}) equals the deviation of each district's number of votes cast for Democrats (Republicans) from the number of votes cast for Democrats (Republican) in the average district, summed over all districts:

$$Pen_{f2} = \sum_d |VDd_d - VD| \tag{3-4}$$

This second strategy is likely to work better in states like Wisconsin having nearly equal numbers of votes cast for Democrats and Republicans.

The third strategy is to minimize the efficiency gap (Pen_{f3}). The smaller the value of efficiency gap, the fairer the districts are politically. The efficiency gap is formally defined in Chapter 4. The values Pen_{f1}, Pen_{f2}, and Pen_{f3} are then normalized and converted to $NPen_{f1}$, $NPen_{f2}$, and $NPen_{f3}$ using the procedure described in Section 3.5.

3.4.3. Compactness

There are many ways to measure district compactness. Young (1988) demonstrated that there is no perfect definition for compactness. After surveying eight approaches for measuring district compactness, that study gave reasons to dispute each one in some crucial respects. Among all recommended and existing approaches, we identified two preferred ways – named $c1$ and $c2$ – to compute district compactness in this dissertation.

In strategy $c1$, the compactness of district d is equal to the ratio of the area of that district to the area of a circle whose circumference is equal to the perimeter of that district. In this case the *compactness score* is equal to $4\pi * ARd_d / PEd_d^2$ (Polsby and Popper 1991). Based on this, we assume a district's lack of compactness is proportional to the inverse of its Polsby and Propper compactness score. So a district's lack of compactness is $\frac{{PEd_d}^2}{ARd_d}$. The associate penalty we use for a district plan's lack of compactness (Pen_{c1}) is therefore $\sum_d \frac{{PEd_d}^2}{ARd_d}$.

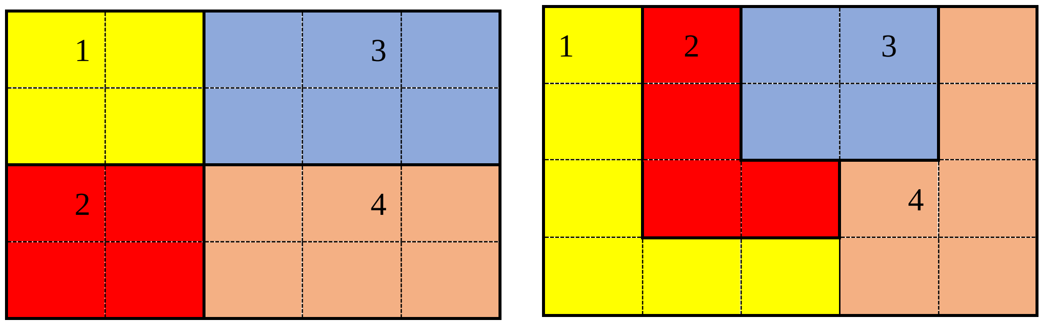
$$Pen_{c1} = \sum_d \frac{{PEd_d}^2}{ARd_d} \tag{3-5}$$

In strategy $c2$, the compactness of district d is equal to the district's area (ARd_d) divided by the maximum distance between unit centroids (T_{mn}) in that district. In this case, the total penalty for the lack of compactness of a district plan (Pen_{c2}) equals the maximum distance between unit centroids inside district d divided by area of that district, summed over all districts.

$$Pen_{c2} = \sum_d \left(\frac{max_{m,n}\{T_{mn}: both\ m\ and\ n\ are\ in\ district\ d\}}{ARd_d}\right) \tag{3-6}$$

The values of Pen_{c1} and Pen_{c2} are then normalized and converted to $NPen_{c1}$ and $NPen_{c2}$ using the procedure described in Section 3.5.

In the experiments in this dissertation, we use strategy $c1$- the Polsby and Popper method - for computing district compactness. Also, in Math Models 1 and 2 which are presented in Chapter 5, we use strategy $c2$ for measuring compactness. Figure 3-3 shows two sets of districts with different compactness for the same territory. Visually we can see that the districts in (a) are more compact than the districts in (b).



(a) **(b)**

Figure 3-3: More compact districts and less compact districts for the same territory

3.5. Normalization

Normalization is defined as adjusting values that are measured on different scales to a notionally common scale. Weighting is strengthening the effect of particular values. In this study, we normalize the value of each penalty component and then multiply it by a weight based on our priorities. Our overall goal is to find the best tradeoff point which minimizes the weighted sum of the penalty components after they have been normalized.

There exist multiple methods for normalization. The normalization method used in this research is based on computing a mean and standard deviation for each penalty component. We need to generate multiple initial solutions (G) to be able to perform this method of normalization. Let G be the number of random initial feasible solutions (district plans) that we generate. Also let Pen_{ig} be the value of penalty component i in initial solution g that is generated ($i \in p, f1, f2, f3, c1, c2; g = 1 \; to \; G$). We then calculate the mean (μ_i) and standard deviation (σ_i) of every penalty component i over all generated initial solutions as respectively shown in equations (3-7) and (3-8).

$$\mu_i = \frac{\sum_{g=1}^{G} Pen_{ig}}{G} \tag{3-7}$$

$$\sigma_i = \sqrt{\frac{\sum_{g=1}^{G}(Pen_{ig} - \mu_i)^2}{G}} \tag{3-8}$$

We next apply the obtained mean and standard deviation to the original raw value of penalty component *i* to normalize it:

$$NPen_i = (Pen_i - \mu_i)/\sigma_i \tag{3-9}$$

Normalization is a very efficient method in order to find the best tradeoff between objective function components, because all types of penalties are adjusted to the same scale and get the same chance to be minimized. In other words, normalization equalizes the contribution of all types of penalty components in constructing a set of districts.

3.6. Illustrative problem instance

We next use an illustrative instance to show how the overall quality of a district plan can be computed. Assume there exist 20 units in a small state (territory) and we are going to divide the state into 4 districts. The districts should be contiguous and respect the integrity of the units to be feasible. We assume that each unit is a square measuring 2 km on a side, and the state is a perfect rectangle measuring 8 km × 10 km (Figure 3-4).

Figure 3-4 shows the information for each unit. The unit number, population, number of votes cast, and number of votes cast for Democrats for each unit is shown in the unit's bottom-left, top-left, bottom-right, and top-right corner respectively.

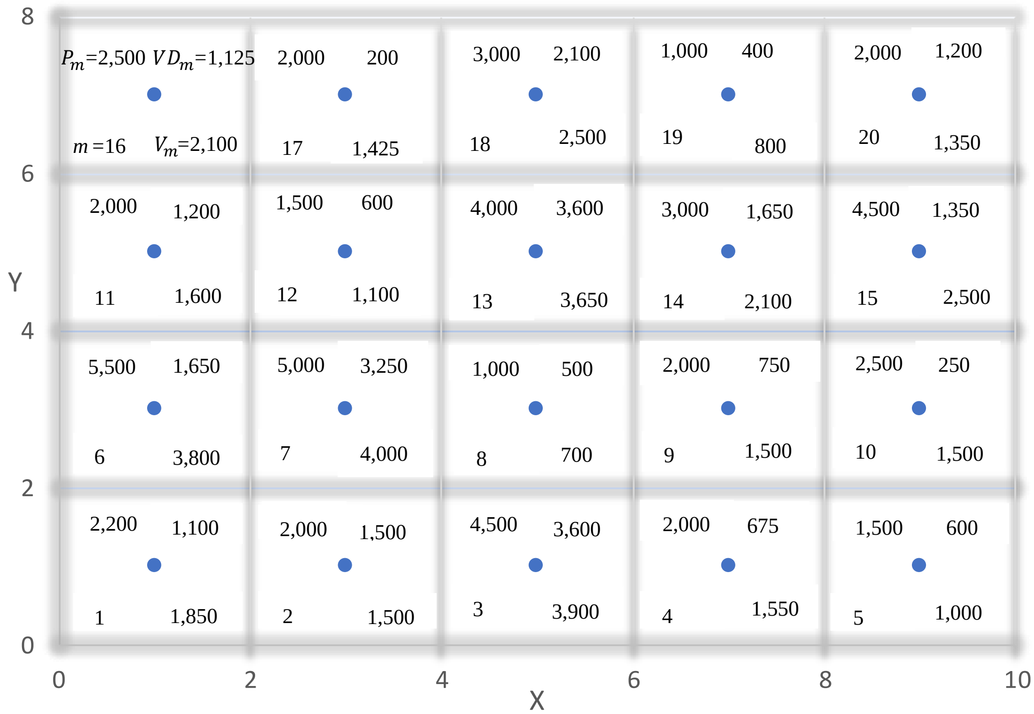


Figure 3-4: Illustrative instance

Table 3-2: Additional information regarding the illustrative instance

State population	$P_{state} = \sum_m P_m$	53,700
Average population per district	$P = \sum_m P_m \ /D$	13,425
Total number of votes cast	$V_{state} = \sum_m V_m$	40,425
Average number of votes cast per district	$V = \sum_m V_m \ /D$	10,106
Total number of votes cast for Democrats	$VD_{state} = \sum_m VD_m$	27,300
Average number of votes cast for Democrats per district	$VD = \sum_m VD_m \ /D$	6,825

Based on the given information, we calculate the state population, average population per district, total votes cast, average number of votes cast per district, total number of votes cast for Democrats, and average number of votes cast for Democrats per district. Table 3-2 shows the results for each. According to the given information we can also compute the adjacency (A_{mn}) and Euclidian distance (T_{mn}) matrices which are shown in Tables 3-3 and 3-4 respectively. Figure 3-5 shows two feasible district plans for this state. In this illustrative instance, our objective function has three components.

Total penalty = $w_p * NPen_p + w_{f2} * NPen_{f2} + w_{c1} * NPen_{c1}$

The political fairness penalty is calculated based on the second strategy and compactness is calculated based on the Polsby and Popper method. So the different types of penalties for each district are calculated as follows:

Population deviation penalty = $Pen_p = \sum_d |Pd_d - P|$

Political fairness penalty (second strategy) for each district = $Pen_{f2} = \sum_d |VDd_d - VD|$

Lack of compactness penalty for each district = $Pen_{c1} = \sum_d \frac{{PEd_d}^2}{ARd_d}$

Table 3-3: Adjacency matrix for the illustrative instance

$$A_{mn} = \begin{bmatrix}
0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0
\end{bmatrix}$$

Table 3-4: Matrix of distances between unit centroids for the illustrative instance (km)

$$T_{mn} = \begin{bmatrix}
0 & 2 & 4 & 6 & 8 & 2 & 2.83 & 4.47 & 6.32 & 8.25 & 4 & 4.47 & 5.66 & 7.21 & 8.94 & 6 & 6.32 & 7.21 & 8.49 & 10 \\
2 & 0 & 2 & 4 & 6 & 2.83 & 2 & 2.83 & 4.47 & 6.32 & 4.47 & 4 & 4.47 & 5.66 & 7.21 & 6.32 & 6 & 6.32 & 7.21 & 8.49 \\
4 & 2 & 0 & 2 & 4 & 4.47 & 2.83 & 2 & 2.83 & 4.47 & 5.66 & 4.47 & 4 & 4.47 & 5.66 & 7.21 & 6.32 & 6 & 6.32 & 7.21 \\
6 & 4 & 2 & 0 & 2 & 6.32 & 4.47 & 2.83 & 2 & 2.83 & 7.21 & 5.66 & 4.47 & 4 & 4.47 & 8.49 & 7.21 & 6.32 & 6 & 6.32 \\
8 & 6 & 4 & 2 & 0 & 8.25 & 6.32 & 4.47 & 2.83 & 2 & 8.94 & 7.21 & 5.66 & 4.47 & 4 & 10 & 8.49 & 7.21 & 6.32 & 6 \\
2 & 2.83 & 4.47 & 6.32 & 8.25 & 0 & 2 & 4 & 6 & 8 & 2 & 2.83 & 4.47 & 6.32 & 8.25 & 4 & 4.47 & 5.66 & 7.21 & 8.94 \\
2.83 & 2 & 2.83 & 4.47 & 6.32 & 2 & 0 & 2 & 4 & 6 & 2.83 & 2 & 2.83 & 4.47 & 6.32 & 4.47 & 4 & 4.47 & 5.66 & 7.21 \\
4.47 & 2.83 & 2 & 2.83 & 4.47 & 4 & 2 & 0 & 2 & 4 & 4.47 & 2.83 & 2 & 2.83 & 4.47 & 5.66 & 4.47 & 4 & 4.47 & 5.66 \\
6.32 & 4.47 & 2.83 & 2 & 2.83 & 6 & 4 & 2 & 0 & 2 & 6.32 & 4.47 & 2.83 & 2 & 2.83 & 7.21 & 5.66 & 4.47 & 4 & 4.47 \\
8.25 & 6.32 & 4.47 & 2.83 & 2 & 8 & 6 & 4 & 2 & 0 & 8.25 & 6.32 & 4.47 & 2.83 & 2 & 8.94 & 7.21 & 5.66 & 4.47 & 4 \\
4 & 4.47 & 5.66 & 7.21 & 8.94 & 2 & 2.83 & 4.47 & 6.32 & 8.25 & 0 & 2 & 4 & 6 & 8 & 2 & 2.83 & 4.47 & 6.32 & 8.25 \\
4.47 & 4 & 4.47 & 5.66 & 7.21 & 2.83 & 2 & 2.83 & 4.47 & 6.32 & 2 & 0 & 2 & 4 & 6 & 2.83 & 2 & 2.83 & 4.47 & 6.32 \\
5.66 & 4.47 & 4 & 4.47 & 5.66 & 4.47 & 2.83 & 2 & 2.83 & 4.47 & 4 & 2 & 0 & 2 & 4 & 4.47 & 2.83 & 2 & 2.83 & 4.47 \\
7.21 & 5.66 & 4.47 & 4 & 4.47 & 6.32 & 4.47 & 2.83 & 2 & 2.83 & 6 & 4 & 2 & 0 & 2 & 6.32 & 4.47 & 2.83 & 2 & 2.83 \\
8.94 & 7.21 & 5.66 & 4.47 & 4 & 8.25 & 6.32 & 4.47 & 2.83 & 2 & 8 & 6 & 4 & 2 & 0 & 8.25 & 6.32 & 4.47 & 2.83 & 2 \\
6 & 6.32 & 7.21 & 8.49 & 10 & 4 & 4.47 & 5.66 & 7.21 & 8.94 & 2 & 2.83 & 4.47 & 6.32 & 8.25 & 0 & 2 & 4 & 6 & 8 \\
6.32 & 6 & 6.32 & 7.21 & 8.49 & 4.47 & 4 & 4.47 & 5.66 & 7.21 & 2.83 & 2 & 2.83 & 4.47 & 6.32 & 2 & 0 & 2 & 4 & 6 \\
7.21 & 6.32 & 6 & 6.32 & 7.21 & 5.66 & 4.47 & 4 & 4.47 & 5.66 & 4.47 & 2.83 & 2 & 2.83 & 4.47 & 4 & 2 & 0 & 2 & 4 \\
8.49 & 7.21 & 6.32 & 6 & 6.32 & 7.21 & 5.66 & 4.47 & 4 & 4.47 & 6.32 & 4.47 & 2.83 & 2 & 2.83 & 6 & 4 & 2 & 0 & 2 \\
10 & 8.49 & 7.21 & 6.32 & 6 & 8.94 & 7.21 & 5.66 & 4.47 & 4 & 8.25 & 6.32 & 4.47 & 2.83 & 2 & 8 & 6 & 4 & 2 & 0
\end{bmatrix}$$

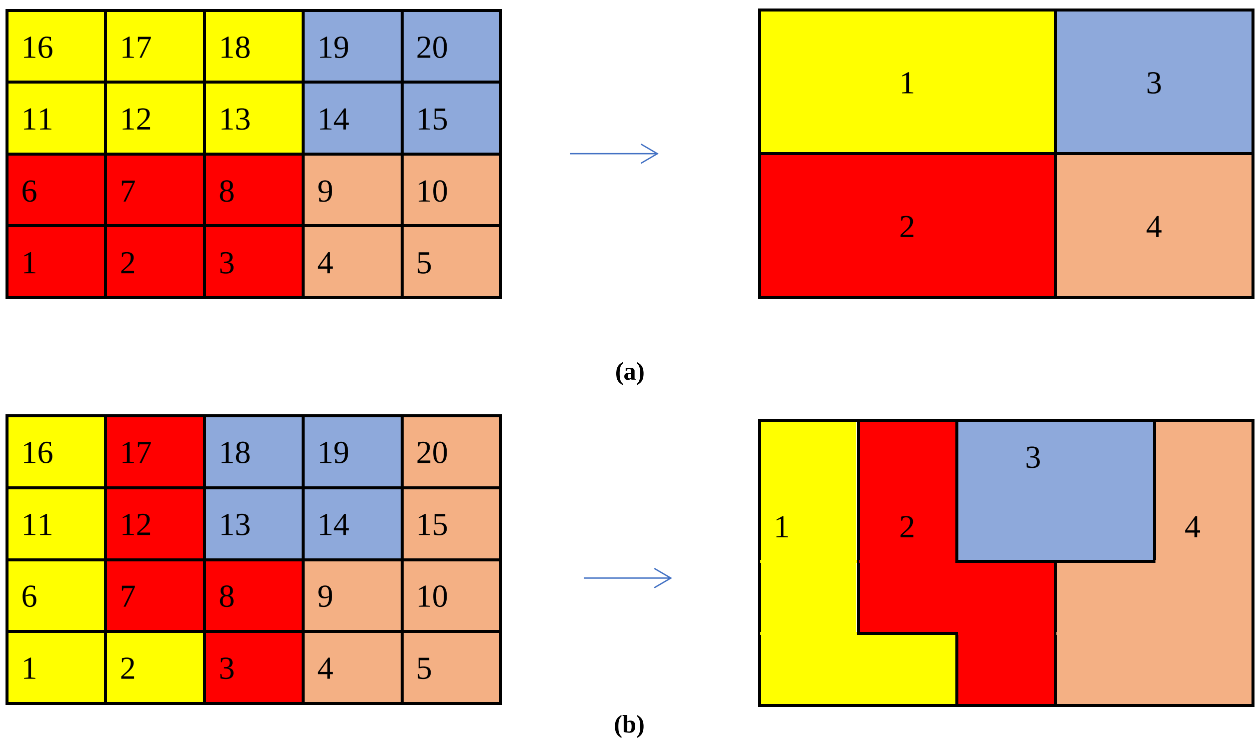


Figure 3-5: Possible district plans for the illustrative instance

Assume that all penalty weights are 1. Table 3-5 shows the penalty for each category for solutions (a) and (b). We can compare the solutions based on the penalty in each category. The population and political fairness penalty of solution (b) is less than solution (a) by 71% and 67% respectively. The lack of compactness penalty of solution (a) is less than solution (b) by 33%. Also, in Table 3-5, in addition to the lack of compactness penalty, we calculated the compactness score based on the Polsby and Popper method ($4\pi * ARd_d / PEd_d^2$).

Table 3-5: Raw penalty scores for the two district plans shown in Figure 3-5

Trial	Population deviation penalty					Political fairness penalty (strategy *f2*)					Lack of compactness penalty (PEd_d^2 / ARd_d)					Compactness score ($4\pi * ARd_d / PEd_d^2$)					Total penalty
	Dist1	Dist2	Dist3	Dist4	Total	Dist1	Dist2	Dist3	Dist4	Total	Dist1	Dist2	Dist3	Dist4	Total	Dist1	Dist2	Dist3	Dist4	Total	
(a)	1,575	6,775	2,925	5,425	16,700	2,000	4,775	2,225	4,550	13,550	16.7	16.7	16	16	65.3	0.75	0.75	0.79	0.79	3.1	30315.3
(b)	775	575	2,425	1,075	4,850	250	1,325	925	2,000	4,500	28.8	28.8	16	24	97.6	0.44	0.44	0.79	0.52	2.2	9447.6

We then normalize the penalty for each component in Table 3-5 based on the mean and standard deviation method. We calculated the mean and standard deviation of each penalty component by generating six random feasible solutions. In this randomly generated solution, the average solution's total population deviation penalty is 16,350, and the standard deviation of the solutions' total population deviation penalties is 5,200. The average solution's total political fairness penalty is 1,3262.5, and the standard deviation of the solutions' total political fairness penalties is 3,487.5. The average solution's total lack of compactness penalty is 77.48, and the standard deviation of the solutions' total lack of compactness penalties is 8.71.

Table 3-6 shows the normalized results for each category. Overall, solution (b) is judged to be superior to solution (a) because it has a lower total normalized penalty.

Table 3-6: Normalized penalty scores for the two district plans shown in Figure 3-5

Trial	Normalized population deviation penalty					Normalized political fairness penalty (strategy *f2*)					Normalized lack of compactness penalty (PEd_d^2 / ARd_d)					Total normalized penalty
	Dist1	Dist2	Dist3	Dist4	Total	Dist1	Dist2	Dist3	Dist4	Total	Dist1	Dist2	Dist3	Dist4	Total	
(a)	n/a	n/a	n/a	n/a	0.07	n/a	n/a	n/a	n/a	0.08	n/a	n/a	n/a	n/a	-1.39	-1.24
(b)	n/a	n/a	n/a	n/a	-2.21	n/a	n/a	n/a	n/a	-2.51	n/a	n/a	n/a	n/a	2.31	-2.42

3.7. Wisconsin's current political districts

We now continue the discussion of Wisconsin's current political districts that was begun in Chapter 1. Based on recent election results, it appears that the political districts in Wisconsin have been gerrymandered. As previously indicated, based on the results of the November 2016 election, Democratic candidates for Wisconsin State Assembly and Wisconsin State Senate clearly received the majority of all votes cast, but they won only 37% of state assembly seats and 42% of the state senate seats. Also, although Republican and Democratic candidates for U.S. Congress in Wisconsin each received roughly 50% of the statewide vote overall, Democrats only won three of the eight U.S. Congressional seats in Wisconsin.

Figures 3-6 and 3-7 show the current Wisconsin State Assembly districts, and Figures 3-8 and 3-9 show the current Wisconsin State Senate districts. As shown in Figures 3-7(a) and 3-9(a), the Wisconsin State Assembly and Wisconsin State Senate districts in the Madison area are severely non-contiguous which is against guidelines for forming political districts established by the U.S. Supreme Court. Some non-contiguous assembly districts can also be found in other areas like Milwaukee and La Crosse. Figure 3-10 shows the current U.S. Congressional districts in Wisconsin. It can be observed that one such district is highly non-compact.

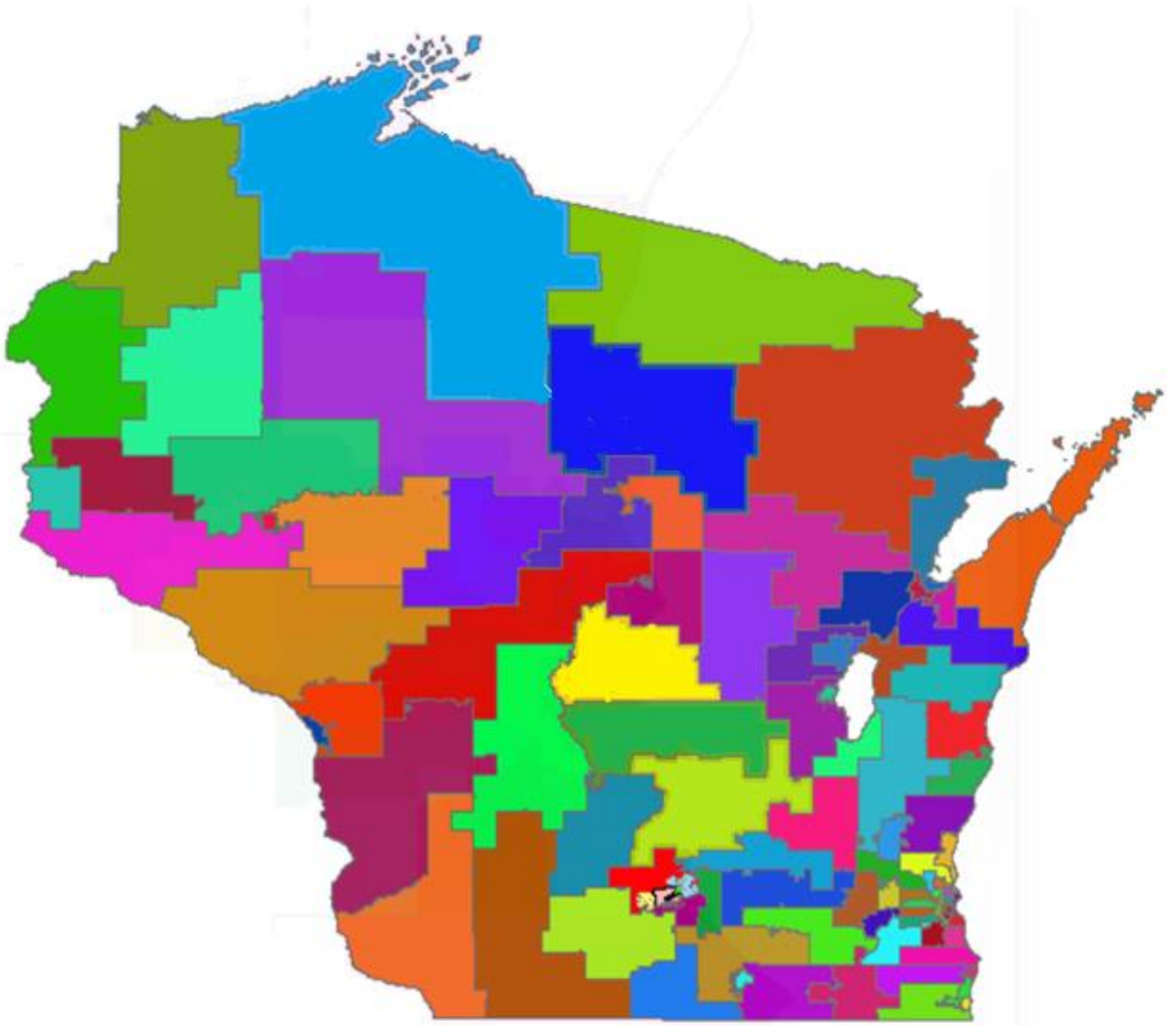
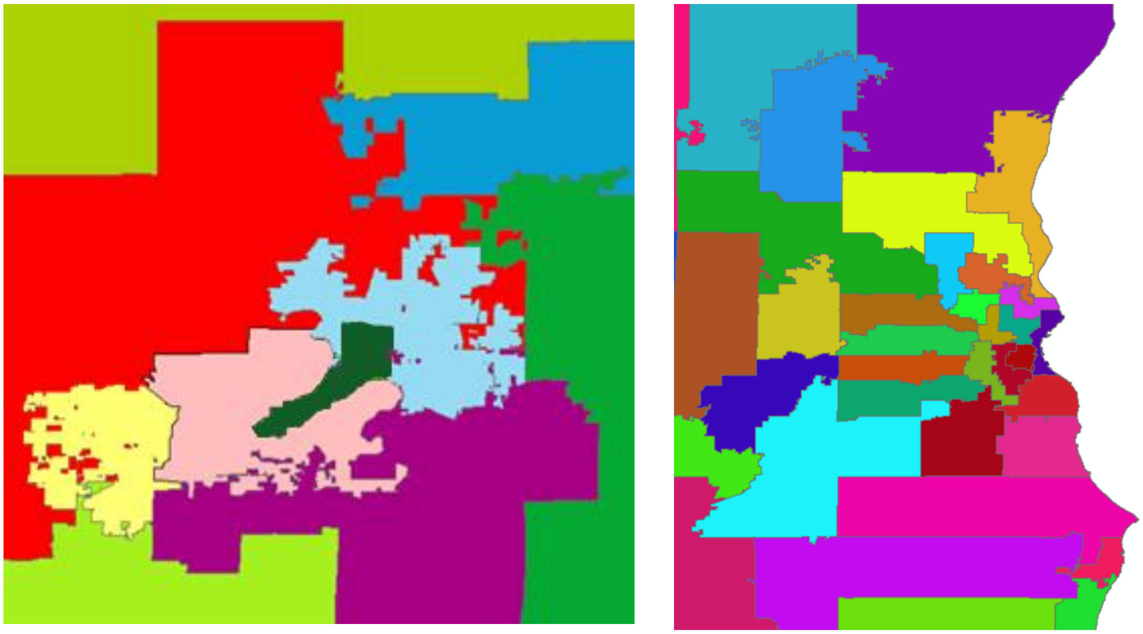


Figure 3-6: The 99 Wisconsin State Assembly districts (Wisconsin State Legislature's GIS open portal)



(a) (b)

Figure 3-7: Wisconsin State Assembly districts with (a) Madison area detail and (b) Milwaukee area detail

On the other hand, although most Wisconsin State Assembly districts are compact from a distance, if we zoom in on high-population areas like Milwaukee, Madison, and Appleton, we can see that the districts are not particularly compact.

As mentioned previously, one of the most important factors for forming political districts is political fairness. In the next chapter we review the "efficiency gap" measure of political fairness, introduce two measures of political fairness, and present theoretical and experimental results relating to these measures.

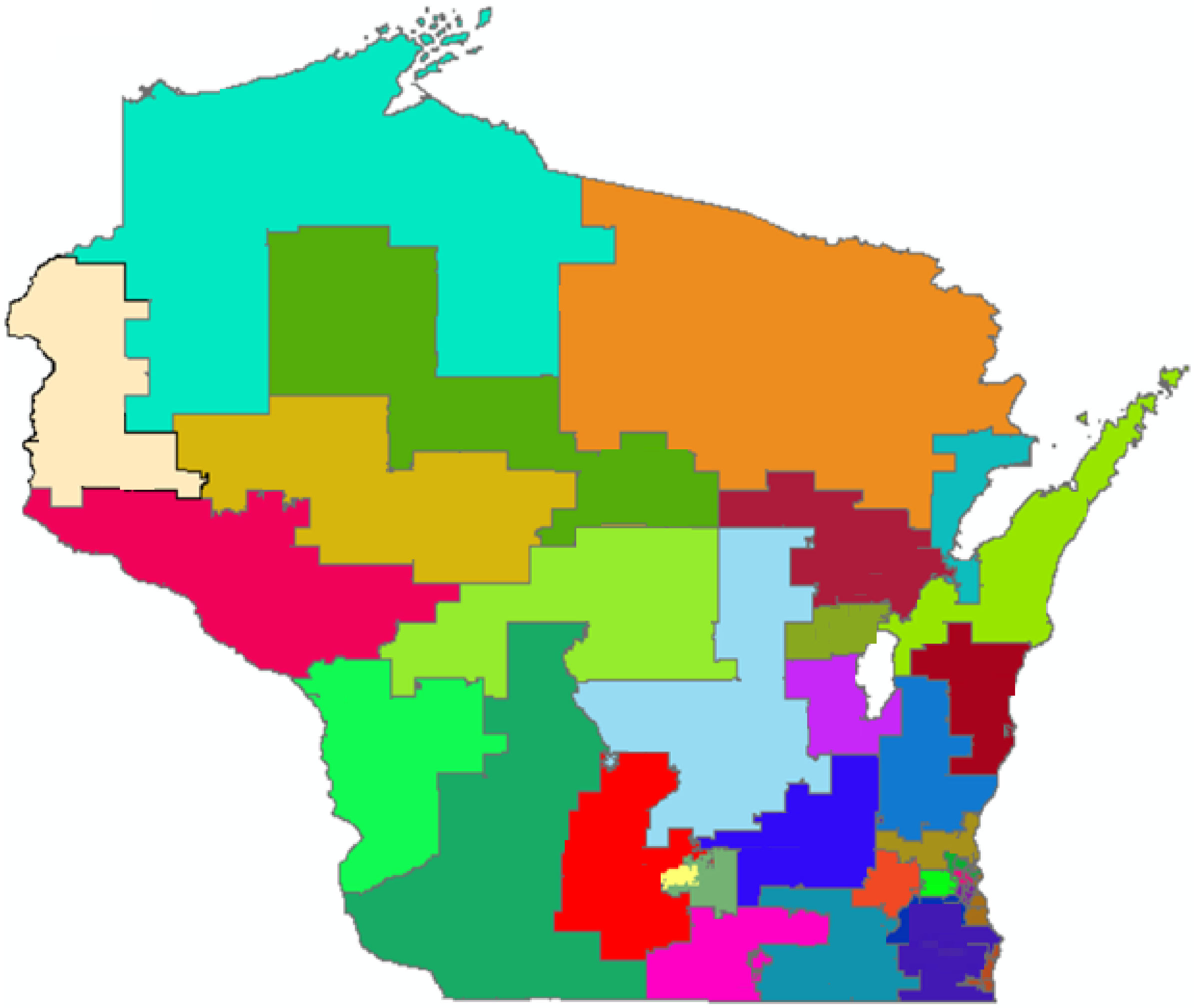
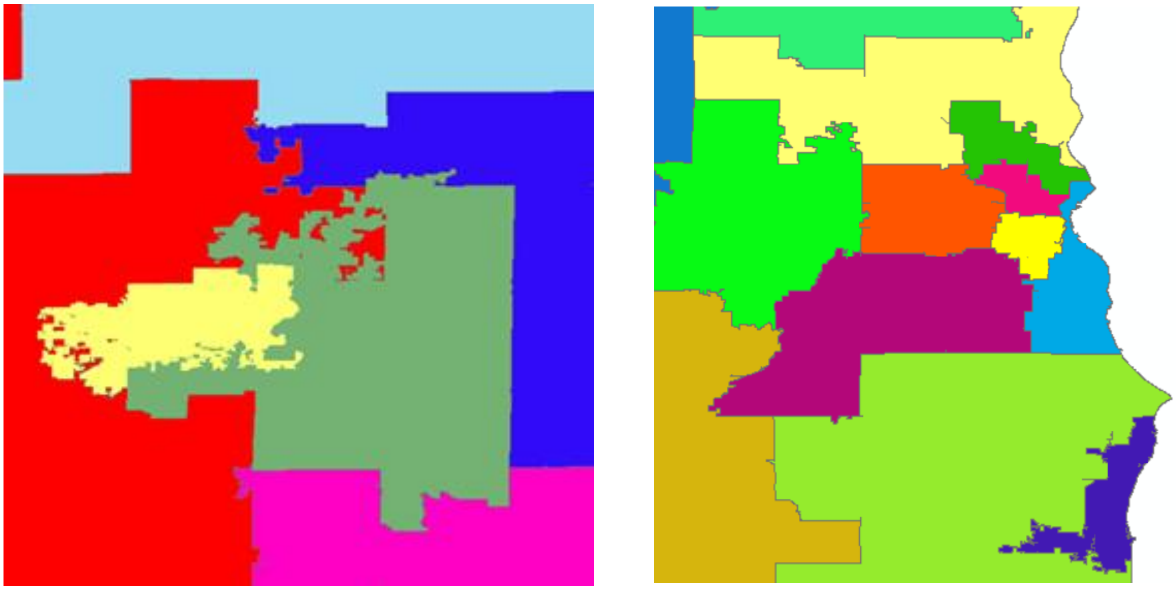


Figure 3-8: The 33 Wisconsin State Senate districts (Wisconsin State Legislature's GIS open portal)



(a) (b)

Figure 3-9: Wisconsin State Senate districts with (a) Madison area detail and (b) Milwaukee area detail

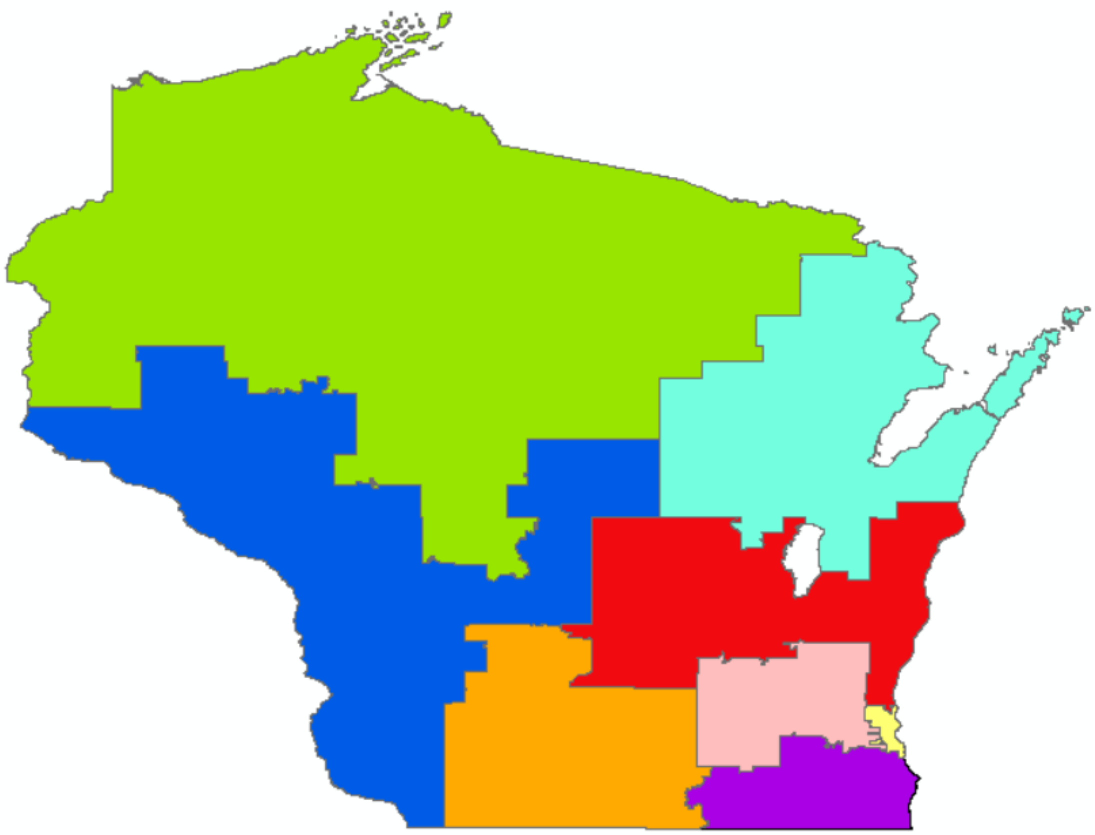


Figure 3-10: Wisconsin eight U.S. Congressional districts (Wisconsin State Legislature's GIS open portal)

4. Methods for measuring political fairness

Political parties' attempts to manipulate district boundaries in order to gain political advantages in the election system may lead to unfair election results. Having contiguous and compact districts with nearly equal population does not guarantee prevention of gerrymandering in political districts. The political parties can still use historical election data to form gerrymandered districts. In this context, it is very important to develop measures of political fairness. In this chapter, we begin by reviewing the currently used standard for measuring political fairness called the "efficiency gap." Later we challenge the application of the traditional efficiency gap and introduce two measures of political fairness which we call the *revised efficiency gap* and *fairness gap*. After presenting some theoretical results considering these new measures, we conduct numerical experiments showing that these measures might be preferable to the traditional efficiency gap.

To form politically fair districts and neutralize gerrymandering, we need to account for the number of votes cast for each political party in each unit and try to minimize some measures that compare the fraction of votes cast for each party to the fraction of districts expected to be won by each party. Table 4-1 shows the notation we use in the equations in this chapter.

Table 4-1: Notations used in Chapter 4

Notations	
D	Number of districts into which the state is divided
V_{state}	Total number of votes cast in the state
V_{avg}	Average number of votes cast per district
V_i	Number of votes cast in district *i*
V_{Ai}	Number of votes cast for *Party A* in district *i*
V_{Bi}	Number of votes cast for *Party B* in district *i*
W_{Ai}	Number of *Party A* wasted votes in district *i*
W_{Bi}	Number of *Party B* wasted votes in district *i*
S_A	Number of seats won by *Party A*
S_B	Number of seats won by *Party B*

In this chapter, we make the following assumptions:

(1) All districts are equal in number of votes cast. In other words,

$V_1=V_2=\ldots = V_D = V_{avg}$.

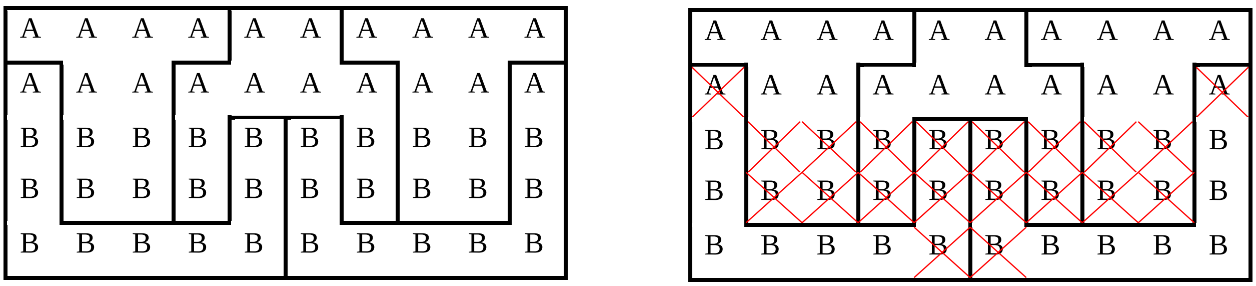
(2) There are only two parties A and B. Therefore, the following equations hold:

$$V_{state} = \sum_{i=1}^{D} V_i = \sum_{i=1}^{D} V_{Ai} + \sum_{i=1}^{D} V_{Bi} \quad (4\text{-}1)$$

$$S_A + S_B = D \quad (4\text{-}2)$$

Equation (4-1) shows that the total number of votes cast for Party A plus the total number of votes cast for Party B is equal to the total number of votes cast in the state. Equation (4-2) demonstrates that the number of seats won by Party A plus the number of seats won by Party B equals the total number of districts in the state. We also assume that Party A (winning party) is the party that wins at least half of the total seats (either over or under its vote share). That is, $S_A \geq S_B$.

Let us now reconsider the scenario from Figure 1-2 except that now we assume that each unit has only one vote cast for either Party A or Party B. This scenario is reproduced in Figure 4-1(a). In Figure 4-1(a), we assign 50 units to 5 districts. Assume that 40% of all units vote for Party A and the remaining 60% of the units vote for Party B. Due to the way the state is divided, 3 out of 5 districts are won by Party A, each by a 6-4 margin. On the other hand, only 2 out of 5 districts are won by Party B, each by a 9-1 margin. The difference between the Party A-to-Party B ratio for total votes cast (2:3) versus the same ratio for districts won (3:2) indicates that the districts may be gerrymandered.



(a) (b)

Figure 4-1: Wasted votes for the instance shown in Figure 1-2

To analyze whether the districts in a state like those shown in Figure 4-1 have been gerrymandered, we revisit the concept of *wasted votes* that was introduced by McGhee (2014). If the total votes cast for a party in a district are less than 50% of that district's total votes, all votes cast for that party in the district are wasted (lost votes that cast for the losing party). If the total votes cast for a party in a district are more than 50% of that district's total votes, the wasted votes of that party would be the party's received votes minus 50% of that district's total votes (surplus votes cast for the winning party) minus 1. Equations (4-3) and (4-4) show the calculation of wasted votes for both parties.

$$\text{Party A's wasted votes} = \sum_{i=1}^{D} W_{Ai} = \sum_{V_{Ai}<V_{Bi}} VA_i + \sum_{V_{Ai}>V_{Bi}} (V_{Ai} - \frac{V_i}{2} - 1) \quad (4\text{-}3)$$

$$\text{Party B's wasted votes} = \sum_{i=1}^{D} W_{Bi} = \sum_{V_{Bi}<V_{Ai}} V_{Bi} + \sum_{V_{Bi}>V_{Ai}} (V_{Bi} - \frac{V_i}{2} - 1) \quad (4\text{-}4)$$

Before moving on, we define two new terms: “deserved” seat share, and number of “extra seats” won. “Deserved” seat share is proportional to the fraction of votes cast for a party in an election. The number of “extra” seats is the number of seats a party wins that it would not have won under a perfectly balanced plan (fair plan). In other words, the number of “extra” seats equals the number of seats that a party wins over its “deserved” seat share in a state.

In Figure 4-1(b), we show the parties’ wasted votes in every district. Each wasted vote is indicated by an “X.” Table 4-2 shows the calculation of each district’s wasted votes based on Figure 4-1. We use parties’ wasted votes to compute political fairness. The final column in Table 4-2 shows the difference between parties’ wasted votes (18-2=16) which we use later for calculating the well-known efficiency gap.

Table 4-2: Computation of wasted votes for each party for Figure 4-1

District	**Party A votes**	**Party B votes**	**Party A wasted votes**	**Party B wasted votes**	**(Party B wasted votes - Party A wasted votes)**
1	6	4	0	4	4
2	6	4	0	4	4
3	6	4	0	4	4
4	1	9	1	3	2
5	1	9	1	3	2
Total	20	30	2	18	16

We now explain more about the traditional efficiency gap in Section 4.1.

4.1. Traditional efficiency gap

The traditional efficiency gap is one way to assess partisan gerrymandering which amounts to the difference between the parties’ total wasted votes, divided by total number of votes cast in an election. The value of efficiency gap is considered as a measurement of partisan gerrymandering.

Efficiency gap $=\left[\frac{\sum_{i=1}^{D} WB_i - \sum_{i=1}^{D} WA_i}{\sum_{i=1}^{D} V_i}\right]$

If the two parties have an equal number of wasted votes in a state, the value of the traditional efficiently gap is zero; however, it does not guarantee fairness. Later by illustrative instances, we will show the unfair plan with the value of the traditional efficiency gap of zero. Now we measure political fairness for the small example shown in Figure 4-1 based on the efficiency gap formula:

Efficiency gap = (18-2)/50 = 16 / 50 = 0.32

This value of the efficiency gap shows that Party A was better able to convert its votes into legislative seats and won 32% more seats (1.6 "extra" seats) than it would have if both parties had an equal number of wasted votes. We can see that Party A won one "undeserved" seat ("extra" seat) over what it would have won under a fair plan.

We now survey a mathematical aspect of the alternative version of the traditional efficiency gap formula that was proven by McGhee (2014). He proved that the efficiency gap, under specific circumstances, is equal to the difference between a parties' seat margin and twice the vote margin.

We provide new illustrations of the metric presented by McGhee (2014) and introduce a new metric for measuring political metric by revising equations (4-5) and (4-6). McGhee (2014) proved that equations (4-5) and (4-6) are equal under specific circumstances that we later show it considering his assumptions. Regardless of the numerical sign of the result from formulas shown in following equations for the traditional efficiency gap, the result would be in favor of Party A (winning party), if Party A wins surplus seats over its "deserved" seat share, and it would be in favor of Party B (losing party), if party A wins fewer seats than its "deserved" seat share.

$$\text{Efficiency gap} =\left[\frac{\sum_{i=1}^{D} W_{Bi} - \sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i}\right] \qquad (4\text{-}5)$$

Efficiency gap = Proportion of Party A's seats above 0.5 – (2 * Proportion of party A's votes above 0.5) (4-6)

McGhee (2014) calculated surplus votes and lost votes for each party, and he then used them for computing parties' wasted votes. Note that surplus votes for the winner party in a district is equal to half of the total votes cast in that district minus the votes cast for the loser party in that district minus one. However, McGhee assumed that the total votes in each district becomes equal to 1, and considered that the surplus votes for the winner party in a district is equal to half of the total votes cast in that district minus the votes cast for the loser party in that district. Since subtracting one vote from the surplus votes and consequently from wasted votes in each district does not make a significant difference in a result, it can be ignored. McGhee (2014) then calculated the wasted votes for each party which is the sum of the party's surplus votes and the lost votes. Based on his assumptions, we calculate surplus and lost votes for each party and then rewrite equations (4-5) and (4-6).

Surplus votes for Party A = $\sum_{V_{Ai}>V_{Bi}}(\frac{V_i}{2} - V_{Bi})$

Lost votes for Party A= $\sum_{V_{Ai}<V_{Bi}}(V_i - V_{Bi})$

Surplus votes for Party B = $\sum_{V_{Bi}>V_{Ai}}(V_{Bi} - \frac{V_i}{2})$

Lost votes for Party B = $\sum_{V_{Bi}<V_{Ai}} V_{Bi}$

As mentioned earlier, based on McGhee (2014), wasted votes for each party is equal to the party's surplus votes plus party's lost votes so we have following equations:

Party A's wasted votes = $\sum_{i=1}^{D} W_{Ai} = \sum_{V_{Ai}<V_{Bi}}(V_i - V_{Bi}) + \sum_{V_{Ai}>V_{Bi}}(\frac{V_i}{2} - V_{Bi})$

$$= \sum_{i=1}^{D} W_{Ai} = \sum_{V_{Ai}<V_{Bi}} VA_i + \sum_{V_{Ai}>V_{Bi}} (V_{Ai} - \frac{V_i}{2}) \quad (4\text{-}7)$$

$$\text{Party B' wasted votes} = \sum_{i=1}^{D} W_{Bi} = \sum_{V_{Bi}<V_{Ai}} V_{Bi} + \sum_{V_{Bi}>V_{Ai}} (V_{Bi} - \frac{V_i}{2}) \quad (4\text{-}8)$$

Considering recent assumption, if equal number of votes are cast in all districts, then half of all votes are wasted. That is the ratio of Party A's total wasted votes to total votes cast plus the ratio of Party B's total wasted votes to total votes cast is equal to 0.5 (equation 4-9). Of course, it is also true that the sum of the fraction of total votes cast for Party A and the fraction of total votes cast for Party B is equal to 1 (equation 4-10).

$$\frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + \frac{\sum_{i=1}^{D} W_{Bi}}{\sum_{i=1}^{D} V_i} = 0.5 \quad (4\text{-}9)$$

$$\frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} + \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} = 1 \quad (4\text{-}10)$$

If equation (4-5) is negative, it means that more wasted votes were cast for Party A than Party B; if it is positive, it means the opposite is true.

We use equations (4-7) and (4-8) to expand equation (4-5) as follows:

$$\text{Efficiency gap} = \left[\frac{\sum_{V_{Bi}<V_{Ai}} V_{Bi} + \sum_{V_{Bi}>V_{Ai}} (V_{Bi} - \frac{V_i}{2}) - \sum_{V_{Ai}<V_{Bi}} VA_i - \sum_{V_{Ai}>V_{Bi}} (V_{Ai} - \frac{V_i}{2})}{\sum_{i=1}^{n} V_i}\right]$$

$$\text{Efficiency gap} = \left[\frac{\sum_{i=1}^{D} V_{Bi} - \sum_{i=1}^{D} V_{Ai} - \sum_{V_{Ai}<V_{Bi}} \left(\frac{V_i}{2}\right) + \sum_{V_{Ai}>V_{Bi}} (\frac{V_i}{2})}{\sum_{i=1}^{D} V_i}\right]$$

Given the assumption that an equal number of votes are cast in each district, we have the following:

$$\text{Efficiency gap} = \left[\frac{\sum_{i=1}^{D} V_{Bi} - \sum_{i=1}^{D} V_{Ai} - \sum_{V_{Ai}<V_{Bi}} \left(\frac{V_{\text{avg}}}{2}\right) + \sum_{V_{Ai}>V_{Bi}} (\frac{V_{\text{avg}}}{2})}{\sum_{i=1}^{D} V_i}\right]$$

$$\text{Efficiency gap} = \left[\frac{\sum_{i=1}^{D} V_{Bi} - \sum_{i=1}^{D} V_{Ai} - 0.5(S_B - S_A) V_{\text{avg}}}{\sum_{i=1}^{D} V_i}\right]$$

$$\text{Efficiency gap} = \left[\frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - 0.5 * \frac{(S_B - S_A)V_{\text{avg}}}{D * V_{\text{avg}}}\right]$$

$$= \left[\frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - 0.5 * \frac{(S_B - S_A)}{D}\right]$$

Based on equation (4-2), $S_A + S_B = D$. *T*hen $S_B = D - S_A$. This gives us the following:

$$\text{Efficiency gap} = \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + \left(\frac{S_A}{D} - 0.5\right) \tag{4-11}$$

Now we expand equation (4-6):

Efficiency gap = Proportion of Party A's seats above 0.5 – (2 * Proportion of party A's votes above 0.5)

$$\text{Efficiency gap} = \left[\frac{S_A}{D} - 0.5\right] - 2\left[\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - 0.5\right]$$

$$\text{Efficiency gap} = \left[\frac{S_A}{D} - 0.5\right] - 2\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + 1$$

Based on equation (4-10), the sum of the fraction of total votes cast for each party in the state, summed over both parties is equal to 1.

$$\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} = 1$$

So

$$\text{Efficiency gap} = \left[\frac{S_A}{D} - 0.5\right] - 2\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i}$$

$$\text{Efficiency gap} = \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + \left(\frac{S_A}{D} - 0.5\right) \tag{4-12}$$

We can see that equation (4-11) is equal to equation (4-12). We have just shown that two metrics for the efficiency gap provided by McGhee (2014) – equations (4-5) and (4-6) – are equivalent under the assumption that equal number of votes are cast in all districts. Therefore, we have the following equation:

$$\frac{\sum_{i=1}^{D} WB_i - \sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} = \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + (\frac{S_A}{D} - 0.5) \tag{4-13}$$

Equation (4-13) is a novel illustration of the metric introduced by McGhee (2014) shows that the difference between the fraction of total votes cast for the two parties plus the difference between the fraction of total seats won by Party A (winning party) and 0.5. In the next section, we establish a new metric for measuring political fairness.

4.2. Revised efficiency gap

In this section, we introduce a modified version of the traditional efficiency gap and name it "revised efficiency gap." The revised efficiency gap equals the result of the traditional efficiency gap plus half of the difference between the fraction of the votes cast for two parties in the state, as shown in equation (4-14).

$$\text{Revised efficiency gap} = \left[\frac{\sum_{i=1}^{D} W_{Bi} - \sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + 0.5 * (\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i})\right] \tag{4-14}$$

We now claim that the value obtained from the revised efficiency gap in equation (4-14) under specific circumstances (the assumptions) explained earlier, is equal to the difference between the fraction of the total seats won by a party and the fraction of the total votes cast for that party. In other words, we claim the following:

$$\text{Revised efficiency gap} = \left[\frac{\sum_{i=1}^{D} W_{Bi} - \sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + 0.5 * (\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i})\right] = \frac{S_A}{D} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} \tag{4-15}$$

Now we start proving this claim.

Based on equation (4-13), we have:

$$\frac{\sum_{i=1}^{D} W_{Bi} - \sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} = \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + (\frac{S_A}{D} - 0.5)$$

Based on equation (4-10), we have:

$$\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} = 1.$$

Therefore:

$$\frac{\sum_{i=1}^{D} W_{Bi} - \sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + 0.5(\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i})$$

$$= \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + (\frac{S_A}{D} - 0.5) + 0.5(\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i})$$

$$= \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + \left(\frac{S_A}{D}\right) - 0.5(\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i}) + 0.5(\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i})$$

$$= \frac{S_A}{D} - \frac{\sum_{i=1}^{D} VA_i}{\sum_{i=1}^{D} V_i}$$

Therefore:

$$\frac{\sum_{i=1}^{D} W_{Bi} - \sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + 0.5(\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i}) = \frac{S_A}{D} - \frac{\sum_{i=1}^{D} VA_i}{\sum_{i=1}^{D} V_i}$$

Considering our assumptions, we proved that the result of the revised efficiency gap is directly proportionate to the number of "extra" seats or "undeserved" seats that one party wins over its "deserved" seat share, or the lack of "deserved" seats for the other party. In other words, the value obtained from the revised efficiency gap times the total number of districts (i.e. seats) directly shows the difference between the number of seats won by one party and the share of that party's received votes. If the result of the revised efficiency gap is positive, that means the result is in favor of Party A (winning party), and if is negative, that means the result is in favor of Party B (losing party).

We now address another aspect of the revised efficiency gap. Regardless of assuming equal votes for all districts, we claim that the value obtained from equation (4-14) is equal to the difference between the fraction of the total votes cast for Party A (winning party) and twice the percentage of Party A's wasted votes in an election. In other words, we claim the following:

$$\text{Revised efficiency gap} = \left[\frac{\sum_{i=1}^{D} W_{Bi} - \sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + 0.5 * \left(\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i}\right)\right] = \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - 2 * \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} \qquad (4\text{-}16)$$

Let us prove equation (4-16). We use equations (4-9) and (4-10) and expand above formula.

Equation (4-9): $\frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + \frac{\sum_{i=1}^{D} W_{Bi}}{\sum_{i=1}^{D} V_i} = 0.5 \Rightarrow \frac{\sum_{i=1}^{D} W_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + 2 * \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} = 0.5$

Equations (4-10): $\frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} + \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} = 1 \Rightarrow \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + 2 * \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} = 1$

$$\frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} + 2 * \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} = 2 * \left(\frac{\sum_{i=1}^{D} W_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i}\right) + 4 * \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i}$$

$$0.5 * \left(\frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i}\right) + \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} = \frac{\sum_{i=1}^{D} W_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + 2 * \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i}$$

$$\frac{\sum_{i=1}^{D} W_{Bi}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + 0.5 * \left(\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i}\right) = \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - 2 * \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i}$$

We proved that even if all districts are not equal in the number of votes cast, the value obtained from the revised efficiency gap is proportional to the difference between the percentage of votes cast for a party and twice the percentage of that party's wasted votes in an election.

In the next section of this chapter, we will provide another new metric for measuring political fairness. We name this new measure "fairness gap." It approximately gives the same result as the revised efficiency gap. We are experimentally able to show the functionality of the recommended metric.

4.3. Fairness gap

As mentioned in the literature review, Nagle (2017) measured the average ineffectiveness of voters who support a party in a district by dividing the number of their wasted votes by the total votes cast for that party in a district. He introduced a vote-centric measure to equalize the average effectiveness of voters. Also, later Cover (2018) used Nagle's vote-centric measure as a metric for measuring political fairness, which was the difference between parties' wasted vote share, as follows:

$$\text{Modified efficiency gap measure} = \frac{W_B}{V_B} - \frac{W_A}{V_A} \tag{4-17}$$

Based on that, we introduce a new metric in equation (4-16) to measure political fairness, called the "fairness gap." The value of the fairness gap is half of the value obtained from the metric introduced in equation (4-15). It is proportional to the "extra" seats that a party wins over its "deserved" seat share based on a fair plan.

$$\text{Fairness gap} = 0.5 * \left(\frac{\sum_{i=1}^{D} W_{Bi}}{\sum_{i=1}^{D} V_{Bi}} - \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_{Ai}}\right) \tag{4-18}$$

In later sections of this chapter, we experimentally show that the result for the fairness gap is nearly equal to the result of the revised efficiency gap that we introduced earlier.

Using the above metric, a positive result means that Party A (winning party) wins more seats than its "deserved" seat share, and a negative result means Party B (losing party) receives more seats than its "deserved" seat share.

Now we show an alternative illustration for the fairness gap. Based on equations (4-7) and (4-8), the wasted votes for Party A and Party B are as follows:

$$\text{Party A's wasted votes} = \sum_{i=1}^{D} W_{Ai} = \sum_{V_{Ai}<V_{Bi}} V_{Ai} + \sum_{V_{Ai}>V_{Bi}} (V_{Ai} - \frac{V_i}{2})$$

Party B' wasted votes = $\sum_{i=1}^{D} W_{Bi} = \sum_{V_{Bi}<V_{Ai}} V_{Bi} + \sum_{V_{Bi}>V_{Ai}} (V_{Bi} - \frac{V_i}{2})$

Fairness gap = $0.5 * \left[\frac{\sum_{V_{Bi}<V_{Ai}} V_{Bi} + \sum_{V_{Bi}>V_{Ai}} (V_{Bi} - \frac{V_i}{2})}{\sum_{i=1}^{D} V_{Bi}} - \frac{\sum_{V_{Ai}<V_{Bi}} VA_i + \sum_{V_{Ai}>V_{Bi}} (V_{Ai} - \frac{V_i}{2})}{\sum_{i=1}^{D} V_{Ai}}\right]$

Fairness gap = $0.5 * \left[\frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_{Bi}} - \frac{\sum_{V_{Bi}>V_{Ai}} \left(\frac{V_i}{2}\right)}{\sum_{i=1}^{D} V_{Bi}} + \frac{\sum_{V_{Bi}<V_{Ai}} \left(\frac{V_i}{2}\right)}{\sum_{i=1}^{D} V_{Ai}} - \frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_{Ai}}\right]$

Assumed $V_1 = V_2 = \ldots = V_D = V_{\text{avg}}$

Fairness gap = $0.5 * \left[\frac{\sum_{V_{Bi}<V_{Ai}} \left(\frac{V_i}{2}\right)}{\sum_{i=1}^{D} V_{Ai}} - \frac{\sum_{V_{Bi}>V_{Ai}} \left(\frac{V_i}{2}\right)}{\sum_{i=1}^{D} V_{Bi}}\right] = 0.25 * \left[\frac{S_A * V_{\text{avg}}}{\sum_{i=1}^{D} V_{Ai}} - \frac{S_B * Vavg}{\sum_{i=1}^{D} V_{Bi}}\right]$

$$\text{Fairness gap} = 0.25 * \left[\frac{S_A/D}{\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i}} - \frac{S_B/D}{\frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i}}\right] \quad (4\text{-}19)$$

Equation (4-17) shows another form of the fairness gap formula. We will do some experiments for small size and large size cases to show the efficiency of the new measures.

4.4. Experimental results

In this section, we show the behavior of three political fairness measures in different cases and then we apply the measures to some fictional cases as well as to the recent U.S. Congressional election. Our goal is to observe how these three measures perform across a variety of scenarios.

We created twelve different instances shown in Table 4-3. Each case is a fictional state. 1,000 votes are cast in the state, and each state consist of 10 districts with equal number of votes cast (100 votes cast for parties in every district) and two parties (Republican and Democratic). The distribution of votes cast for each party is different for each case. The total wasted votes for Democrats and Republicans are calculated and shown in Table 4-3. We assume that we have 10 seats (10 districts) to be taken by the parties.

Table 4-3: Twelve imaginary states, each having 10 districts with 100 votes cast per district

(1)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	80	20	30	20
2	90	10	40	10
3	100	0	50	0
4	70	30	20	30
5	80	20	30	20
6	20	80	20	30
7	90	10	40	10
8	90	10	40	10
9	90	10	40	10
10	90	10	40	10
Total	800	200	350	150

(2)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	40	60	40	10
2	40	60	40	10
3	40	60	40	10
4	90	10	40	10
5	90	10	40	10
6	100	0	50	0
7	100	0	50	0
8	100	0	50	0
9	100	0	50	0
10	100	0	50	0
Total	800	200	450	50

(3)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	80	20	30	20
2	80	20	30	20
3	80	20	30	20
4	80	20	30	20
5	80	20	30	20
6	80	20	30	20
7	80	20	30	20
8	80	20	30	20
9	80	20	30	20
10	80	20	30	20
Total	800	200	300	200

(4)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	55	45	5	45
2	55	45	5	45
3	55	45	5	45
4	55	45	5	45
5	55	45	5	45
6	55	45	5	45
7	55	45	5	45
8	55	45	5	45
9	55	45	5	45
10	55	45	5	45
Total	550	450	50	450

(5)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	55	45	5	45
2	55	45	5	45
3	55	45	5	45
4	45	55	45	5
5	45	55	45	5
6	45	55	45	5
7	60	40	10	40
8	60	40	10	40
9	60	40	10	40
10	70	30	20	30
Total	550	450	200	300

(6)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	40	60	40	10
2	40	60	40	10
3	40	60	40	10
4	40	60	40	10
5	40	60	40	10
6	40	60	40	10
7	70	30	20	30
8	70	30	20	30
9	70	30	20	30
10	100	0	50	0
Total	550	450	350	150

(7)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	10	90	10	40
2	90	10	40	10
3	100	0	50	0
4	10	90	10	40
5	80	20	30	20
6	10	90	10	40
7	80	20	30	20
8	10	90	10	40
9	80	20	30	20
10	80	20	30	20
Total	550	450	250	250

(8)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	30	70	30	20
2	90	10	40	10
3	100	0	50	0
4	30	70	30	20
5	80	20	30	20
6	20	80	20	30
7	80	20	30	20
8	10	90	10	40
9	80	20	30	20
10	80	20	30	20
Total	600	400	300	200

(9)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	60	40	10	40
2	10	90	10	40
3	0	100	0	50
4	60	40	10	40
5	10	90	10	40
6	60	40	10	40
7	10	90	10	40
8	60	40	10	40
9	10	90	10	40
10	20	80	20	30
Total	300	700	100	400

(10)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	60	40	10	40
2	30	70	30	20
3	30	70	30	20
4	30	70	30	20
5	30	70	30	20
6	20	80	20	30
7	20	80	20	30
8	20	80	20	30
9	30	70	30	20
10	30	70	30	20
Total	300	700	250	250

(11)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	51	49	1	49
2	51	49	1	49
3	0	100	0	50
4	0	100	0	50
5	0	100	0	50
6	0	100	0	50
7	0	100	0	50
8	0	100	0	50
9	0	100	0	50
10	0	100	0	50
Total	102	898	2	498

(12)

District No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes
1	55	45	5	45
2	55	45	5	45
3	55	45	5	45
4	35	65	35	15
5	0	100	0	50
6	0	100	0	50
7	0	100	0	50
8	0	100	0	50
9	0	100	0	50
10	0	100	0	50
Total	200	800	50	450

The information from those 12 cases is summarized in Table 4-4. The total votes cast for each party, the party's total wasted votes, the party's vote share in the state, each party's "deserved" seat share in the state, the number of seats won by each party, and the number of "undeserved" seats ("extra" seats) received by a party are presented in Table 4-4. We can see that the values of the revised efficiency gap and the fairness gap are relatively close. Party A is the winning party in each district that can be either Democratic or Republican. The number of "deserved" seat share for a party equals the fraction of the total votes cast for that party times the number of districts (number of total seats). The number of seats should not be fractional in practice. We can round them up or down to the nearest desired integer number if the result is fractional. To better address the efficiency of new metrics introduced in this chapter, we decide not to round the number of seats in case they are fractional.

We measure political fairness using the traditional efficiency gap (Tr. Eff. Gap), the revised efficiency gap (Rev. Eff. Gap) and the fairness gap for those twelve cases. The computational results of the three political fairness measures for the 12 imaginary states are presented in Table 4-5. We already proved that the values of the new measures of political fairness times the number of total districts (total seats) equals the number of "extra" seats. So we calculated the number of "extra" seats ("undeserved" seats) based on the traditional efficiency gap, the revised efficiency gap, and the fairness gap.

Now we address the accuracy of those measures. The number of "extra" seats shown in Table 4-4 exactly equals the number of expected "extra" seats calculated by the revised efficiency gap in Table 4-5. The calculated "extra" seats using the fairness gap is equal or—with good accuracy—close to the number of seats won by one party. The number of "extra" seats by the traditional efficiency gap is far from the actual "extra" seats in Table 4-4. It is clear that we can use both the revised efficiency gap and the fairness gap with good accuracy rather than using the traditional efficiency gap formula for computing number of "undeserved" seats. Ultimately we showed that even if the result of the traditional efficiency gap is zero (such as case 10), it only shows that the parties' wasted votes are equal statewide, and the political map of the state may still be gerrymandered.

Table 4-4: Summarized information for the 10 imaginary states shown in Table 4-3

Case No.	Rep. Votes	Dem. Votes	Rep. Wasted Votes	Dem. Wasted Votes	Rep. Vote Share	Dem. Vote Share	Rep. deserved seat share	Dem. deserved seat share	No. Rep. Seats	No. Dem. Seats	No. extra seats	Party A
1	800	200	350	150	0.8	0.2	8	2	9	1	1	Rep.
2	800	200	450	50	0.8	0.2	8	2	7	3	1	Rep.
3	800	200	300	200	0.8	0.2	8	2	10	0	2	Rep.
4	550	450	50	450	0.55	0.45	5.5	4.5	10	0	4.5	Rep.
5	550	450	200	300	0.55	0.45	5.5	4.5	7	3	1.5	Rep.
6	550	450	350	150	0.55	0.45	5.5	4.5	4	6	1.5	Dem.
7	550	450	250	250	0.55	0.45	5.5	4.5	6	4	0.5	Rep.
8	600	400	300	200	0.6	0.4	6	4	6	4	0	Rep.
9	300	700	100	400	0.3	0.7	3	7	4	6	1	Dem.
10	300	700	250	250	0.3	0.7	3	7	1	9	2	Dem.
11	102	898	2	498	0.102	0.898	1.02	8.98	2	8	0.98	Dem.
12	200	800	50	450	0.2	0.8	2	8	3	7	1	Dem.

In all cases, Party A (either Democratic or Republican party) wins the majority of the seats over its "deserved" seat share with the exception of cases 2, 9, 11, and 12 in which Party A wins the majority of the seats but under its "deserved" seat share. So regardless of the numerical sign of the results, the values of the traditional efficiency gap for cases 1, 3, 4, 5, 6, 7, 8, and 10 will be in favor of Party A (winning party), but for cases 2, 9, 11, and 12, it is in favor of Party B (losing party). For the revised efficiency gap and the fairness gap, if the result is positive, it is in favor of Party A (winning party), and if negative, it is in favor of Party B (losing party). We can see that political measures are able to track the parties that are still suffering from gerrymandering even while having the majority of the seats.

Table 4-5: Computing three political fairness measures for the twelve imaginary states

Case No.	Traditional Eff. Gap	Revised Eff. Gap	Fairness Gap	Calculated extra seats by Tr. Eff. Gap	Calculated extra seats by Rev. Eff. Gap	Calculated extra seats by Fairness Gap	In favor of.
1	-0.2	0.1	0.156	2	1	1.56	Rep.
2	-0.4	-0.1	-0.156	4	1	1.56	Dem.
3	-0.1	0.2	0.313	1	2	3.13	Rep.
4	0.4	0.45	0.455	4	4.5	4.55	Rep.
5	0.1	0.15	0.152	1	1.5	1.52	Rep.
6	0.2	0.15	0.152	2	1.5	1.52	Dem.
7	0	0.05	0.051	0	0.5	0.51	Rep.
8	-0.1	0	0.000	1	0	0.00	Rep.
9	-0.3	-0.1	-0.119	3	1	1.19	Rep.
10	0	0.2	0.238	0	2	2.38	Dem.
11	-0.496	-0.098	-0.267	4.96	0.98	2.67	Rep.
12	-0.4	-0.1	-0.156	4	1	1.56	Rep.

In addition, we calculate the political fairness with three measures for real cases. We consider the election results (Congress 2018), parties' total population, and parties' wasted votes for six states to show the efficiency of the proposed metrics in this study compared to the old one. The results of the 2018 congressional election for states of California, New Jersey, Ohio, North Carolina, Connecticut, and Louisiana are selected to be tested using three political fairness measures. Since one of the requirements of using the revised efficiency gap and the fairness gap is to consider an equal number of votes for all districts, we tried to apply the metrics to the states with a nearly equal number of votes cast for all districts.

Table 4-6 shows the results of the 2018 congressional election, including the number of votes cast for Republicans and Democrats, each party's wasted votes, each party's share of the total votes cast, the number of seats won by each party, and also the number of the "extra" seats ("undeserved" seats) won by one party over its "deserved" seat share.

Table 4-6: Summary of U.S. Congressional election results in 2018 for six states

State	Rep. votes	Dem. votes	Rep. wasted votes	Dem. wasted votes	Rep. share	Dem. share	Total seats	No. seats won by Rep.	No. seats won by Dem.	Existing extra seats
California	3,973,396	8,010,445	3,111,932	2,879,989	0.331563	0.668437	53	7	46	11
New Jersey	1,198,664	1,856,819	1,053,749	473,993	0.392299	0.607701	12	1	11	4
Ohio	2,245,403	2,019,120	588,063	1,544,199	0.526531	0.473469	16	12	4	4
North Carolina	1,846,039	1,771,055	477,958	1,330,589	0.510365	0.489635	13	10	3	3
Connecticut	512,495	808,652	512,495	148,079	0.387917	0.612083	5	0	5	2
Louisiana	835,715	553,184	236,357	458,093	0.60171	0.39829	6	5	1	2

We applied the traditional efficiency gap, the revised efficiency gap, and the fairness gap to the results of the 2018 congressional election for those six states. As stated before, the number of "deserved" seat share for a party equals the fraction of the total votes cast for that party times the number of districts (number of total seats). Table 4-7 indicates the values of the three measures and the calculated "extra" seats won by one party. The obtained values of the three metrics times the number of total seats (number of districts) provides the number of "undeserved" seats. The number of seats are rounded in this experiment.

Let us show the calculation of three political fairness measures and the corresponding "extra" seats in detail for the state of California. Party A (winning pary) is Democratic in this state.

$$\text{Traditional efficiency gap} = \left[\frac{\sum_{i=1}^{D} W_{Bi} - \sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i}\right] = \left[\frac{3{,}111{,}932 - 2{,}879{,}988.5}{(3{,}973{,}396 + 8{,}010{,}445)}\right] = 0.019355$$

Extra seats based on traditional Efficiency gap = 0.019355 * 53 = 1.025798

$$\text{Fairness gap} = 0.5 * \left(\frac{\sum_{i=1}^{D} W_{Bi}}{\sum_{i=1}^{D} V_{\boldsymbol{Bi}}} - \frac{\sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_{Ai}}\right) = \left(\frac{3{,}111{,}932}{3{,}973{,}396} - \frac{2{,}879{,}988.5}{8{,}010{,}445}\right) = 0.212$$

Extra seats based on fairness gap = 0.212 * 53 = 11

Revised efficiency gap= $\left[\frac{\sum_{i=1}^{D} W_{Bi} - \sum_{i=1}^{D} W_{Ai}}{\sum_{i=1}^{D} V_i} + 0.5 * \left(\frac{\sum_{i=1}^{D} V_{Ai}}{\sum_{i=1}^{D} V_i} - \frac{\sum_{i=1}^{D} V_{Bi}}{\sum_{i=1}^{D} V_i}\right)\right]$

= $\left[0.019355 + 0.5 * \left(\frac{8{,}010{,}445 - 3{,}973{,}396}{3{,}973{,}396 + 8{,}010{,}445}\right)\right]$ = 0.019355+ 0.168437 = 0.1878

Extra seats based on revised Efficiency gap = 0.1878 * 53 = 9.953

Similarly, we compute three political fairness measures and the number of "extra" seats for the other states. According to the calculations, the existing "extra" seats (outcomes of the congressional election) are remarkably close to the "extra" seats calculated by the fairness gap and the revised efficiency gap. The "extra" seats calculated by the traditional efficiency gap for most of the states is not close to the real number of "extra" seats; therefore, it is not a reliable metric to be used for measuring the undeserved electoral gap between the two parties.

Table 4-7: Computing three political fairness measures for the six states shown in Table 4-6

State	Traditional Eff. Gap	Revised Eff. Gap	Fairness Gap	Calculated extra seats using traditional Eff. Gap	Calculated extra seats using Rev. Eff. Gap	Calculated extra seats using Fairness Gap	Existing extra seats
California	0.019	0.188	0.212	1	10	11	11
New Jersey	0.19	0.297	0.312	3	4	4	4
Ohio	0.224	0.251	0.251	4	4	4	4
North Carolina	0.236	0.246	0.246	3	3	3	3
Connecticut	0.276	0.388	0.408	1	2	2	2
Louisiana	0.16	0.261	0.273	1	2	2	2

In this chapter, two measures of political fairness have been introduced and developed. The new metrics measure the gap between a party's "deserved" seat share and the fraction of total seats won by that party. The first metric is a revised version of the traditional efficiency gap. The result of the revised efficiency gap is proportional to the existing undeserved gap between the parties' election results. The second introduced metric, the fairness gap, experimentally shows the same results as the first metric with high accuracy. The results from the formulas in this chapter represent the number of “extra” seats won by one party. However, the current metric (traditional efficiency gap) does not provide reliable answers in this area.

All three measures are applied on 12 generated cases. Also, from the 2018 U.S. Congressional election, six gerrymandered states with nearly close votes cast in each district are considered in order to compare the capability of the current and proposed measures. The results from the suggested metrics for each state are very close to the percentage of “extra” seats won by one party. The results show the accuracy of these formulas compared to the old one and the necessity of replacing the current efficiency gap.

In the next chapter, various math models for forming political districts are presented.

5. Math models

In this chapter, two math models for political redistricting are developed. Some factors, such as political fairness, population equality, and compactness, have been considered in these models in order to create approximately fair districts. We assume there are only two political parties: Democratic or Republican. In this chapter, the math models are developed for creating *D* districts from *M* units. These two models are utilized to form congressional and assembly districts. We developed a mixed integer programming math model (Math Model 1) and used column generation methodology (Math Model 2) to form these districts. Despite contiguity being one of the main criteria to form political districts, this aspect of the problem has not been mathematically considered in the Math Models, so contiguity is not guaranteed in these models. Also we revised above math models for forming state senate districts. Since usually every two or three contiguous assembly districts are nested within a senate district, the constructed assembly districts are used as the model input.

5.1. Math Model 1 for creating D districts from M units

The first model is a mixed integer programming math model. Linear programming maximizes (or minimizes) a linear objective function subject to one or more constraints. The form of a linear programming problem is as following:

$$Max\ \ or\ Min \quad \vec{C}^T\ \vec{X}$$

$$s.t. \qquad A\overrightarrow{X}\,(\leq, =, or\ \ \geq)\ \vec{b}$$

$$with \quad \vec{X} \geq \overrightarrow{0}$$

and the expanded form of above model is as below:

Minimize or maximize $C_1\ X_1 + C_2X_2 + \cdots + C_nX_n$

subject to:

$a_{11}X_1 + a_{12}X_2 + \cdots + a_{1n}X_n\ (\leq, =, or \geq)\ b_1$

$a_{21}X_1 + a_{22}X_2 + \cdots + a_{2n}X_n\ (\leq, =, or \geq)\ b_2$

. . .

$a_{m1}X_1 + a_{m2}X_2 + \cdots + a_{mn}X_n\ (\leq, =, or \geq)\ b_m$

$X_j \geq 0 \quad \forall j = 1, \ldots, n.$

The terms $X_1, \ldots, X_n$ represent a set of decision variables, and $C_1, \ldots, C_n$ are objective coefficients that can be the costs or benefit associated with the corresponding decision variables. The values $b_1, \ldots, b_m$ are the right-hand-side values of the constraints, and usually represent amounts of resources or requirements, and a_{ij} matrix shows the amount of satisfaction or consumption of decision variable j by resource or requirement i.

A mixed integer program (MIP) is a linear program with some added restrictions of integer variables. The first step to model a mixed integer programming problem is defining a set of decision variables that represent what should be optimized in the problem. The second step is formulating the constraints in the model. The third step is related to defining the objective function.

Integer programming is a very flexible technique for solving optimization problems. The algorithms can also measure the quality of the solution. Branch-and-cut, which is a generalization of branch-and-bound with LP relaxations, is a common approach to solve MIPs so that the solution to the LP relaxation represents solutions to the MIP. It is possible to use MIP-based algorithms as a heuristic in the problems having computational complexity (Smith and Taskin 2007).

In this model, we consider the penalties for population equality, compactness, and political fairness criteria as the components of the objective function. The original form of the objective function is based on the following equation, which was explained in Chapter 3.

Total penalty = $w_p * Pen_p + w_{f1} * Pen_{f1} + w_{f2} * Pen_{f2} + w_{c1} * Pen_{c1} + w_{c2} * Pen_{c2}$

The compactness is calculated based on Polsby and Popper's method (Polsby and Popper 1991) by which the compactness penalty would be the perimeter squared of each district divided by the area of that district. Also, we minimize the maximum distance between two units in each district to avoid non-compact districts. Political fairness is obtained either based on (a) first strategy, so the total number of seats won by each party is proportional to percentage of votes cast in state that supports the party, or (b) second strategy, so that each district should be made as politically similar to the whole state as possible. Contiguity has not been considered in this math model. The indices, input parameters, and decision variables are shown in Table 5-1.

Table 5-1: Indices, input parameters, and decision variables for Math Model 1

Indices	
d	Districts (d =1…D)
m,n	Units (m,n =1…M)
Primary parameters	
D	Number of political districts needing to be created (*integer,* ≥ 1)
M	Number of units (e.g. voting wards in a state - *integer,* ≥ 1)
V_m	Expected number of votes cast in unit m
VD_m	Expected number of votes cast for Democrats in unit m
P_m	Population of unit m
AR_m	Area of unit m (km^2)
PE_m	Perimeter of unit m (km)
L_{mn}	Length of boundary shared by unit m and unit n (*real*, ≥ 0)
T_{mn}	Straight-line distance from centroid of unit m to centroid of unit n
NumDemWins	Number of districts which Democrats would win if the proportion of districts they win is as close as possible to the proportion of total votes they receive
w_i	Weight for objective function component i ($\forall\ i = p,\ f1,\ f2,\ c1,\ c2$)
Secondary parameters	
P	Average population of a district ($P = \Sigma_{m=1}^{M} P_m\ /\ D$)
V	Average number of votes cast per district ($V = \Sigma_{m=1}^{M} V_m\ /\ D$)
VD	Average number of votes cast for Democrats per district ($VD\ = \Sigma_{m=1}^{M} VD_m\ /\ D$)
Decision variables	
$X_{md} = \begin{cases}1\\0\end{cases}$	If unit m is assigned to district d Otherwise (*binary*)
$Y_{mnd} = \begin{cases}1\\0\end{cases}$	If units m and n are both in district d Otherwise (*binary*)
$I_d = \begin{cases}1\\0\end{cases}$	If Democrats are expected to win district d Otherwise (*binary*)
PD_d^+	Deviation of district d population above average district's population (*real*, ≥ 0)
PD_d^-	Deviation of district d population below average district's population (*real*, ≥ 0)
VD_d^+,	Deviation of number of votes cast for Democrats in district d above average number of votes cast for Democrats per district (*real*, ≥ 0)
VD_d^-	Deviation of number of votes cast for Democrats in district d below average number of votes cast for Democrats per district (*real*, ≥ 0)
AR_d	Area of district d
PE_d	Perimeter of district d
MD_d	Maximum distance between two units in district d

Minimize:

$$\sum_{d=1}^{D}[(w_p * (PD_d^+ + PD_d^-) + w_{f2} * (VD_d^+ + VD_d^-) + w_{c1} * \frac{(PE_d)^2}{AR_d} + w_{c2} * MD_d)]$$

$$+w_{f1} * (NumDemWins - \sum_{d=1}^{D} I_d) \quad (5\text{-}1)$$

Subject to:

$$Y_{mnd} \geq X_{md} + X_{nd} - 1 \quad \forall\, (m, n \in d{:}\, m \neq n) \quad \forall\, d = 1 \dots D \quad (5\text{-}2)$$

$$Y_{mnd} \leq X_{md} \quad \forall\, (m, n \in d{:}\, m \neq n) \quad \forall\, d = 1 \dots D \quad (5\text{-}3)$$

$$Y_{mnd} \leq X_{nd} \quad \forall\, (m, n \in d{:}\, m \neq n) \quad \forall\, d = 1 \dots D \quad (5\text{-}4)$$

$$\sum_{d=1}^{D} X_{md} = 1 \quad \forall\, m = 1 \dots M \quad (5\text{-}5)$$

$$MD_d \geq T_{mn}(Y_{mnd}) \quad \forall\, (m, n \in d{:}\, m \neq n) \quad \forall\, d = 1 \dots D \quad (5\text{-}6)$$

$$PD_d^+ - PD_d^- = P - \sum_{m=1}^{M} P_m X_{md} \quad \forall\, d = 1 \dots D \quad (5\text{-}7)$$

$$VD_d^+ - VD_d^- = VD - \sum_{m=1}^{M} VD_m X_{md} \quad \forall\, d = 1 \dots D \quad (5\text{-}8)$$

$$PE_d = \sum_{m=1}^{M} PE_m X_{md} - 2[\sum_{m=1}^{M}\sum_{n=1}^{M} L_{mn} Y_{mnd}] \quad \forall\, d = 1 \dots D \quad (5\text{-}9)$$

$$AR_d = \sum_{m=1}^{M} AR_m X_{md} \quad \forall\, d = 1 \dots D \quad (5\text{-}10)$$

$$\sum_{m=1}^{M} VD_m X_{md} - \sum_{m=1}^{M}(V_m - VD_m) X_{md} \leq \sum_{m=1}^{M} P_m I_d \quad \forall\, d = 1 \dots D \quad (5\text{-}11)$$

$$\sum_{m=1}^{M}(V_m - VD_m) X_{md} - \sum_{m=1}^{M} VD_m X_{md} \leq \sum_{m=1}^{M} P_m (1 - I_d) \quad \forall\, d = 1 \dots D \quad (5\text{-}12)$$

Constraints (5-2), (5-3), and (5-4) are the relationship between a pair of units' presences in a district together and individually. Constraint (5-5) guarantees that each unit is included in exactly one district. Maximum distance in district *d* is shown by constraint (5-6). Constraints (5-7) and (5-8) represent the deviation of each district's population from the average district's population and the deviation of each district's number of votes cast for Democrats from the number of votes cast for Democrats in the average district, respectively. Based on constraint (5-9), each district's perimeter is equal to the sum of the length of the shared borders with its neighbor districts. Constraint (5-10) shows that the area of each district is equal to the sum of the area of the units inside that district. Constrains (5-11) and (5-12) determine the districts that are expected to be won by Democrats.

As stated above, contiguity has not been considered in this model, so non-contiguous districts are not guaranteed. Although an exact model is a good starting point to gain insight into the structure of the problem and a common language to uniquely describe a problem in strict mathematical terms, using exact methods for large-size instances (real states problems) is difficult and almost not practical. Also, for real cases, we might face some challenges and limitations that are not predicted in exact math models. So because of computational complexity and lack of flexibility, we are not able to use it for large-size, real-world problems. In the next section, we develop a math model based on column generation methodology, which is an efficient way for solving MIPs. Then we code and execute the model in CPLEX for small-size problems.

5.2. Math Model 2 for creating D districts from M units

In this section, we develop a math model based on column generation methodology for forming *D* districts from *M* units. Column generation provides a decomposition of the problem into master and sub-problems to generate variables that can potentially improve the objective function. Pricing and cutting are complementary procedures for tightening an LP relaxation that focuses on column generation (Barnhart et al. 1998).

Consider the following linear program as a master problem:

$$min\ \vec{C}^T\ \vec{X}$$

$$A\vec{X} = \vec{b}$$

$$\vec{X} \geq \overrightarrow{0} \tag{5-13}$$

Where $\vec{X}$ is a set of decision variables (in our problem, $\vec{X}$ refers to the number of times that each district is used); $\vec{C}^T$ is the vector of objective coefficients representing a set of per-unit cost or profit of corresponding decision variables; A is the coefficient matrix for the variables; $\vec{b}$ is the vector of right-hand-side values of constraints related to the requirement or availability of the constraints; and $\vec{X} \geq 0$ is the set of non-negative restriction on the linear programming.

The canonical form of the problem is as follows:

$$\text{Min } Z + \left(-\overrightarrow{C_N} + \overrightarrow{C_B}B^{-1}N\right)\overrightarrow{X_N} + \vec{0}\,\overrightarrow{X_B} = \overrightarrow{C_B}B^{-1}b$$

$$B^{-1}N\overrightarrow{X_N} + \vec{I}\,\overrightarrow{X_B} = B^{-1}\vec{b}$$

$$\vec{X} \geq \overrightarrow{0} \tag{5-14}$$

Where $\overrightarrow{X_B}$ is a vector of basic variables that can take any value other than zero; $\overrightarrow{X_N}$ are known as the non-basic variables (the values of the non-basic variables is set to be zero); $\overrightarrow{C_B}$ is the cost vector for the current basic variables; B^{-1} is the inverse basic matrix; $\overrightarrow{C_B}B^{-1}$is the vector of values of the basic variables; and $\overrightarrow{C_B}B^{-1}b$ is the current optimization value (the current values of non-basic variables are zero). $-\overrightarrow{C_N} + \overrightarrow{C_B}B^{-1}N$ are the coefficients of non-basic variables that are called reduced cast. The coefficients of the basic variables in the objective function are zero.

Assume X and Y, respectively, are the primal and dual solutions to the current master problem. In column generation, we are trying to find a new column that satisfies (for a minimization problem) $C_j - \left(\overrightarrow{C_B}B^{-1}\right)A_j < 0$, where $\overrightarrow{C_B}B^{-1}$ is the dual solution of the constraint j and $C_j - \left(\overrightarrow{C_B}B^{-1}\right)A_j$ is the reduced cost. We can find dual prices for each of the constraints by solving the master problem and use them to form the objective function of the sub-problem. By solving the sub-problem, we will obtain the reduced cost. If the reduced cost is negative, we can add the new variable to the master problem and resolve it until reduced cost becomes positive, which means the master problem is optimal. The reduced cost vector is $\vec{C} - A^{-1}Y$, where Y is the dual cost vector $(\overrightarrow{C_B}B^{-1})$.

Figure 5-1 shows a simple column generation algorithm flowchart for a minimization problem.

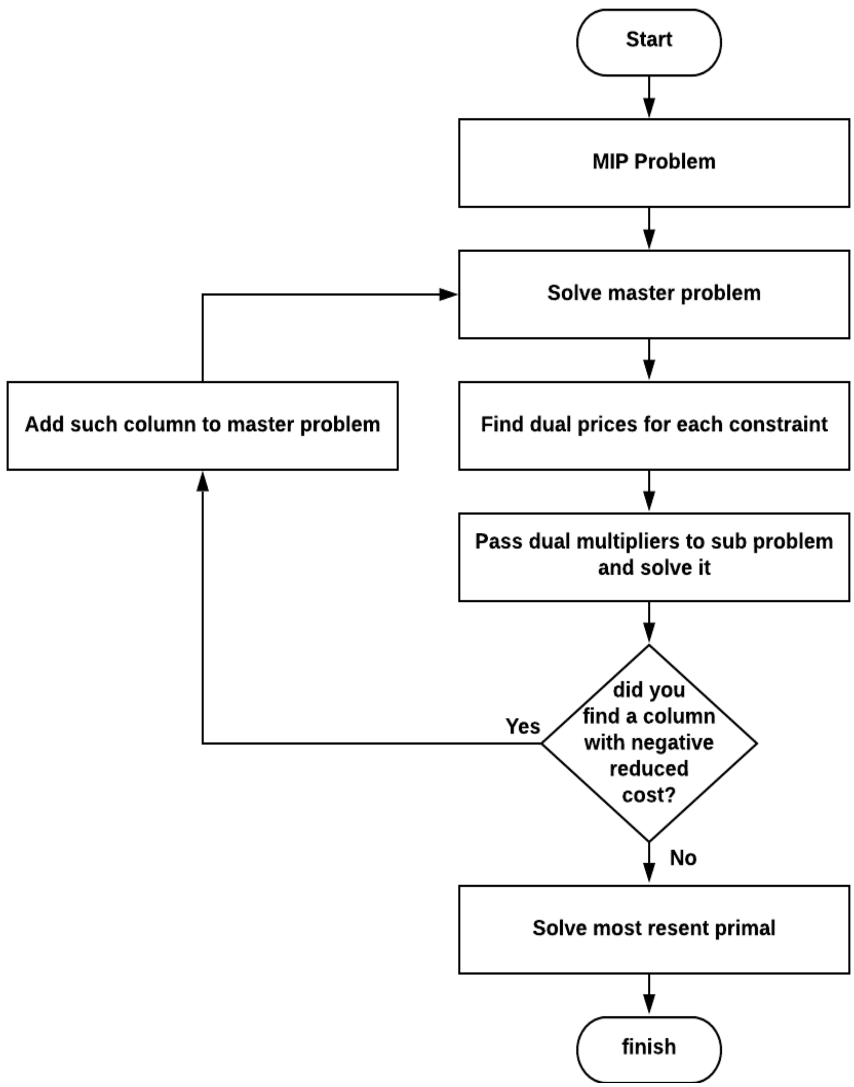


Figure 5-1: Flowchart for a column generation algorithm

In our problem, the master problem—which is feasible—minimizes the total penalty of the districts based on population equality, political fairness, and compactness, and returns the dual prices that are used in the sub-problem to find the reduced cost of adding a new potential district. It then checks if the main problem remains optimal. Districts' contiguity is not considered in Math Model 2 either. Table (5-2) shows the indices, parameters, and decision variables for the master and sub-problem.

Political fairness is calculated based on the second strategy. Compactness is just based on maximum distance inside a district. The general form of the objective function based on the given information in Chapter 3 is as follows:

Total penalty = $w_p * Pen_p + w_{f2} * Pen_{f2} + w_{c2} * Pen_{c2}$

So the penalty of each criteria considered in the objective function is calculated as follows:

1) Population deviation penalty ($PenP_p$):

$$PenP_p = |P - \Sigma_{m=1}^{M} P_m Z_{mp}|$$

2) Political fairness penalty ($PenF_p$):

$$PenF_p = |VD - \Sigma_{m=1}^{M} VD_m Z_{mp}|$$

3) Compactness penalty ($PenC_p$):

$$PenC_p = T_{mn}(Z_{mp}+Z_{np}-1)$$

Table 5-2: Indices, input parameters, and decision variables for Math Model 2

Indices	
d	Potential district (d =1…D)
m,n	Unit (m =1…M)
Primary parameters	
PD	Number of districts currently under consideration (*integer,* ≥ 1)
M	Number of units (*integer,* ≥ 1)
D	Number of districts into which the state will be divided (*integer,* ≥ 1), ($D \le PD$)
V_m	Number of votes cast in unit *m*
VD_m	Number of votes cast for Democrats in unit *m*
P_m	Population of unit *m*
AR_m	Area of unit *m* (km^2)
PE_m	Perimeter of unit *m* (*km*)
T_{mn}	Straight line distance from centroid of unit *m* to centroid of unit *n*
L_{mn}	Length of boundary shared by unit *m* and unit *n*
$Z_{mp} = \begin{cases} 1 \\ 0 \end{cases}$	If unit *m* is assigned to potential district *p* Otherwise (*binary*)
$I_p = \begin{cases} 1 \\ 0 \end{cases}$	If democrats are expected to win new potential district *p* Otherwise (*binary*)
$A_{mn} = \begin{cases} 1 \\ 0 \end{cases}$	If units *m* and *n* are adjacent Otherwise (*binary*)
$Y_{mnp} = \begin{cases} 1 \\ 0 \end{cases}$	If both units *m* and *n* are in potential district *p* Otherwise (*binary*)
NumDemWins	Number of districts which Democrats should win if the proportion of districts they win is as close as possible to the proportion of total votes they receive
w_i	Weight of objective function component *i* ($\forall\ i = p,\ f2,\ c2$)
Secondary parameters	
P	Average population of District *d* ($P = \Sigma_{m=1}^{M} P_m \ /\ D$)
V	Average number of votes cast per district ($V = \Sigma_{m=1}^{M} V_m \ /\ D$)
VD	Average number of votes cast for Democrats per district ($VD = \Sigma_{m=1}^{M} VD_m \ /\ D$)
Bp	Penalty of district *p*
$PenP_p$	Deviation of district *p*'s population from average district population
$PenF_p$	Deviation of district *p*'s votes cast for Democrats from number of votes cast for Democrats in average district
$PenC_p$	Penalty of lack of compactness
Decision variables	
Master Problem:	
X_p	Number of times potential district *p* is used (*real,* ≥ 0, ≤ 1)
Sub Problem:	
$Z_m = \begin{cases} 1 \\ 0 \end{cases}$	If unit *m* is in the new potential district that is created Otherwise (*binary*)
$Y_{mn} = \begin{cases} 1 \\ 0 \end{cases}$	If both units *m* and *n* are in the new potential district that is created Otherwise (*binary*)
Pop	Deviation of new potential district's population from average population
Fair	Deviation of new potential district' number of votes cast for Democrats from number of votes cast for Democrats in average district
Comp	Compactness penalty for new potential districts

Master Problem:

Minimize:

$$\sum_p B_p X_p \tag{5-15}$$

where:

$B_p = w_p *(PenP_p) + w_{f2}* (PenF_p) + w_{c2} * (PenC_p)$

Subject to:

$$\sum_p Z_{mp} X_p = 1 \qquad \forall m: 1\ldots \text{M} \tag{5-16}$$

$$\sum_p X_p = D \tag{5-17}$$

Constraint (5-16) ensures that each unit is included in exactly one district that is used, and the state (territory) is divided into exactly *D* districts by constraint (5-17).

Expanded math model:

Minimize:

$$B_1 X_1 + B_2 X_2 + B_3 X_3 + \ldots + B_p X_p$$

Subject to:

$$Z_{11} X_1 + Z_{12} X_2 + Z_{13} X_3 + \ldots + Z_{1p} X_p = 1$$

$$Z_{21} X_1 + Z_{22} X_2 + Z_{23} X_3 + \ldots + Z_{2p} X_p = 1$$

.

.

.

$$Z_{m1} X_1 + Z_{m2} X_2 + Z_{m3} X_3 + \ldots + Z_{mp} X_p = 1$$

$$X_1 + X_2 + X_3 + \ldots + X_p = D$$

Sub-Problem:

After solving and getting the dual values from the master problem, the sub-problem would be as follows:

Minimize:

$$w_p *(Pop) + w_{f1} * (Fair) + w_{c2} * (Comp) - (\overrightarrow{Dual})\ \vec{Z} \qquad (5\text{-}18)$$

Subject to:

$$Pop \geq \sum_{m=1}^{M} P_m\, Z_m - P \qquad (5\text{-}19)$$

$$Pop \geq P - \sum_{m=1}^{M} P_m\, Z_m \qquad (5\text{-}20)$$

$$Fair \geq VD - \sum_{m=1}^{M} VD_m\, Z_m \qquad (5\text{-}21)$$

$$Fair \geq \sum_{m=1}^{M} VD_m\, Z_m - VD \qquad (5\text{-}22)$$

$$Comp \geq T_{mn} * (Z_m + Z_n - 1) \qquad (5\text{-}23)$$

Constrains (5-19) and (5-20) demonstrate the deviation of the new potential district's population from the average population, and constraints (5-21) and (5-22) represent the deviation of the new potential district's number of votes cast for Democrats from the number of votes cast for Democrats in average district. Constraint (5-23) shows the compactness penalty for a new potential district based on the maximum distance of the centroid of the wards inside a district. The column generation model that we coded in CPLEX and executed was based on constraints (5-19) to (5-23) of the sub-problem.

As mentioned before, there exist different methods for measuring compactness. We can also consider one of the following measures for the lack of compactness penalty and rewrite constraint (5-23) based on them:

a) Compactness penalty is equal to maximum distance between units in district *d* divided by the number units assigned to district *d*.

$$PenC_p = T_{mn}(Z_{mp}+Z_{np}\text{-}1) \,/\, \sum_{m=1}^{M} Z_{mp}$$

b) Compactness penalty is equal to the perimeter of district *d* divided by the area of district *d*

$$PenC_p = \frac{(\sum_{m=1}^{M} PE_m Z_{mp} - 2[\sum_{m=1}^{M}\sum_{n=1}^{M} L_{mn} Y_{mnp}]}{\sum_{m=1}^{M} AR_m Z_{mp}}$$

c) Compactness penalty is equal to the ratio of the area of a circle whose circumference is equal to the perimeter of the district *d* to the area of the district *d*

$$PenC_p = \frac{(\sum_{m=1}^{M} PE_m Z_{mp} - 2[\sum_{m=1}^{M}\sum_{n=1}^{M} L_{mn} Y_{mnp}]\ )^2}{\sum_{m=1}^{M} AR_m Z_{mp}}$$

So constraint (5-23) could be written as one of the following equations:

$$a)\quad Comp \geq (\frac{T_{mn} * (\, Z_m + Z_n - 1)}{\sum_{m=1}^{M} Z_m})$$

$$b)\quad Comp \geq \frac{\sum_{m=1}^{M} PE_m Z_m - 2[\sum_{m=1}^{M}\sum_{n=1}^{M} B_{mn} Y_{mn}]}{\sum_{m=1}^{M} AR_m Z_m}$$

$$c)\quad Comp \geq \frac{(\sum_{m=1}^{M} PE_m Z_m - 2[\sum_{m=1}^{M}\sum_{n=1}^{M} B_{mn} Y_{mn}]\ )^2}{\sum_{m=1}^{M} AR_m Z_m} \qquad (5\text{-}24)$$

If we use constraints (5-24(a)), (5-24(b)), or (5-24(c)) instead of constraint (5-23), the model would be non-linear, and we may need to add the constraints (5-25), (5-26), and (5-27).

$$Y_{mn} \geq Z_m + Z_n - 1 \qquad \forall\ (m, n\ \epsilon\ new\ potential\ district{:}\ m \neq n\ ) \qquad (5\text{-}25)$$

$$Y_{mn} \leq Z_m \qquad \forall\ (m, n\ \epsilon\ new\ potential\ district{:}\ m \neq n\ ) \qquad (5\text{-}26)$$

$$Y_{mn} \leq Z_n \qquad \forall\ (m, n\ \epsilon\ new\ potential\ district{:}\ m \neq n\ ) \qquad (5\text{-}27)$$

The column generation algorithm for a non-linear model would be different. Constraint (5-24(a)) is the penalty for lack of compactness that is equal to the ratio of the maximum distance between units to the number of units inside the new potential district. Constraint (5-24(b)) is the penalty for lack of compactness that is equal to the perimeter (the summation of the length of the shared borders by its neighbor districts) of the new potential district divided by the area of that district. Constraint (5-24(c)) is the penalty for lack of compactness that is equal to the perimeter squared of the new potential district divided by the summation of units' area assigned to that district. Constraints (5-25), (5-26), and (5-27) are the relationship between a pair of units' presences together and individually in the new potential district.

Column generation is a potent method for solving large-scale integer programming. The advantage of keeping only a few columns at any time makes many real-world integer optimization problems easier to solve. As mentioned earlier, contiguity has not been considered in Math Model 2, so the resulting map may lead to non-contiguous districts. This model has been coded in CPLEX and was used for solving small-size problems (50 units and 5 districts). The model is computationally intractable for large-size problems. Also, it is not flexible enough for applying all real-world unexpected limitations and potential noises; therefore, developing a heuristic method for solving a large-size problem is a necessity.

We also revised and executed those models for forming state senate districts using CPLEX and were able to solve it for a maximum of 24 districts in a reasonable time. In order to increase the efficiency of computations and have a practical and fast solution, a heuristic method—Simulated Annealing (SA) —is developed and coded in C++ for large-size instances (real states problems). In the next chapter, the heuristic algorithm for solving large-size redistricting problems and the steps of our code in C++ are described.

6. Simulated annealing algorithm

In this chapter, we develop a simulated annealing (SA) heuristic method to create *D* districts from *M* units. First, the advantages of developing a heuristic algorithm over exact models in this research are addressed; and then the major stages of the algorithm are described in later sections. The SA algorithm for this research is coded in C++.

6.1. Advantages of using a heuristic algorithm

Despite contiguity being one of the main criteria for forming political districts, this aspect of the problem has not been mathematically represented in proposed math models for forming assembly and congressional districts. The results of those math models may lead to non-contiguous districts. The developed math models have been coded and executed in CPLEX for small-size problems. Using exact methods for large-size cases is difficult and almost non-practical. To avoid computational complexity for large-size problems, a heuristic method is recommended. The other caveat of exact models is lack of flexibility. If we deal with large-size, real-world problems, we might face unexpected challenges and potential restrictions that are not usually predicted and considered in exact models. Heuristic methods are flexible and do not rely on the restrictive properties of the model.

Simulated annealing is one of the effective and robust optimization algorithms. It can deal with complicated models, chaotic and noisy data, and many constraints. Its main advantages over other local search methods are its flexibility and its ability to approach global optimality. The flowchart of SA functionality in general is shown in Figure 6-1. Also the steps of an SA algorithm are shown in Table 6-1.

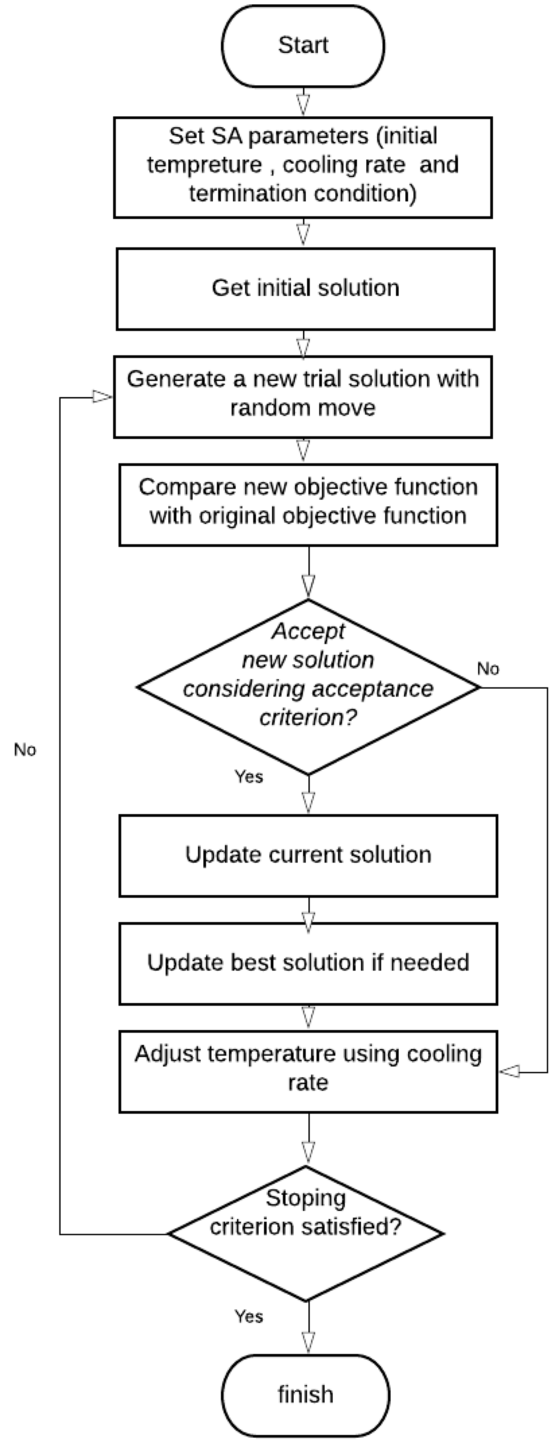


Figure 6-1: Simulated annealing algorithm procedure

Table 6-1: Simulated annealing algorithm steps

Step number	Description
1	Generate random initial feasible solution
2	Calculate the initial penalty of initial solution
3	Set the SA requirements (start temperature (*ST*), final temperature (*FT*), cooling rate (α), and iteration number (n))
4	Find the new neighbor solution
5	Normalize the penalties if needed
6	Calculate the total penalty of the new neighbor solution. If it is less than the current penalty, go to step 10; if it is higher than current penalty, go to step 7
7	Calculate the difference between current and new objective functions and find the result of the acceptance probability *(e^(-Δf / T))*
8	Generate a random number ($r \in [0,1]$)
9	If r is less than acceptance probability, then go to step 10; if not, go to step 13
10	The new solution is accepted
11	Compare the penalty of accepted neighboring solution to the best penalty. If it is less than the best penalty, go to step 12, save it as a current penalty, increase the iteration by 1, and go to step 14
12	Save it as the best solution, increase the iteration by 1, and go to step 14
13	The new solution is rejected. Go to step 4
14	If iteration is less than number of iterations (n), go to step 4; otherwise, set iteration to zero
15	Decrease the temperature by cooling rate
16	If the new temperature is higher than the final temperature, go to step 4; otherwise, the best saved solution would be the final answer

6.2. Major aspects of the algorithm for creating D districts from M units

In this section, we describe the main phases of the developed simulated annealing algorithm used in this research. Generating initial feasible solutions, normalization, forming the objective function, finding neighbor solutions, ensuring contiguity, and analyzing the results are some of the main steps of the algorithm. We define some new terms used in the proposed algorithm, using an example before going through the details of the algorithm stages. Consider an imaginary state, as shown in Figure 6-2. The state consists of 220 units that are assigned to four feasible (contiguous) districts. Each color represents a district. There are four districts: A, B, C, and D. In the full color of this document, District A is red, B is green, C is blue, and D is white. In the black-and-white version of this document, District A is dark gray, B is medium gray, C is light gray, and D is white.

1	**23**	**45**	**67**	**88**	**109**	**130**	**152**	**174**	**196**	**218**
2	**24**	**46**	**68**	**89**	**110**	**131**	**153**	**175**	**197**	
3	**25**	**47**	**69**	**90**	**111**	**132**	**154**	**176**	**198**	
4	**26**	**48**	**70**	**91**	**112**	**133**	**155**	**177**	**199**	
5	**27**	**49**	**71**	**92**	**113**	**134**	**156**	**178**	**200**	
6	**28**	**50**	**72**	**93**	**114**	**135**	**157**	**179**	**201**	
7	**29**	**51**	**73**	**71**	**115**	**136**	**158**	**180**	**202**	
8	**30**	**52**	**74**	**94**	**116**	**137**	**159**	**181**	**203**	
9	**31**	**53**	**71**	**95**	**117**	**138**	**160**	**182**	**204**	
10	**32**	**54**	**75**	**96**	**118**	**139**	**161**	**183**	**205**	
11	**33**	**55**	**76**	**97**	**119**	**140**	**162**	**184**	**206**	
12	**34**	**56**	**77**	**98**	**120**	**141**	**163**	**185**	**207**	
13	**35**	**57**	**78**	**99**	**121**	**142**	**164**	**186**	**208**	**219**
14	**36**	**58**	**79**	**100**	**122**	**143**	**165**	**187**	**209**	**220**
15	**37**	**59**	**80**	**101**	**123**	**144**	**166**	**188**	**210**	
16	**38**	**60**	**81**	**102**	**124**	**145**	**167**	**189**	**211**	
17	**39**	**61**	**82**	**103**	**125**	**146**	**168**	**190**	**212**	
18	**40**	**62**	**83**	**104**		**147**	**169**	**191**	**213**	
19	**41**	**63**	**84**	**105**	**126**	**148**	**170**	**192**	**214**	
20	**42**	**64**	**85**	**106**	**127**	**149**	**171**	**193**	**215**	
21	**43**	**65**	**86**	**107**	**128**	**150**	**172**	**194**	**216**	
22	**44**	**66**	**87**	**108**	**129**	**151**	**173**	**195**	**217**	

Figure 6-2: Imaginary state with 220 units and four districts (A = dark gray (red), B = medium gray (green), C = light gray (blue), D = white)

Some essential terms used in our algorithm are as follows:

- *Neighbor units:* If two units have a shared border with length greater than zero, they are neighbors. For example, Units 35, 56, 58, and 78 are the neighbors of Unit 57 from the imaginary state shown in Figure 6-2 because they have shared border of non-zero length with Unit 57. Although the borders of Units 36 and 57 are connected at their corner, they are not considered neighbors.
- *Edge wards:* These are units (wards) that are located on the border of a district and have a common border with at least one ward outside of that district. Edge wards of District B are Units 88, 89, 90, 91, 92, 114, 115, 116, 117, 118, 133, 155, 162, 163, 178, 179, 180, 181, 182, 183, 185, and 207.
- *Split wards:* Split units (wards) are non-contiguous units (wards). The pieces of split ward are apart from each other. Unit 71 inside the imaginary state in Figure 6-2 is a split ward.
- *Glue (connecting) wards:* The wards that connect different parts of a split ward. Each split ward might have multiple set of glue wards. Unit 71 inside the imaginary state has three separated parts. One set of glue wards for split Unit 71 are Units 72, 73, and 74. The other set of glue wards for Unit 71 are Units 72, 74, 93, and 94. We can choose the glue wards with the shortest path for connecting the pieces of the split ward.
- *Single-neighbor wards:* The ward that shares the border with only one ward (unit). Units 125 and 218 have only one neighbor and are considered single-neighbor wards.
- *Dependent (accompanying) wards:* These are the wards that need to be assigned together. For example, if we assign a split ward to a new district, we must assign a set of its glue wards to that district as well to avoid non-contiguity. Also, if one or multiple

units are located inside another unit, we need to move that unit and all units inside it to the new district in order to stop forming non-contiguous districts. Unit 125 is located inside Unit 124, as shown in Figure 6-2. We cannot assign Unit 124 from District C to District A without assigning Unit 125 to District A. So Units 124 and 125 are dependent units. Also, if we want to assign Unit 71 located in District D to District B, we must assign a set of its glue wards to District B as well. Units 71, 72, 73, and 74 are considered dependent wards.

- *Giving district:* This is an origin district that we choose to take away (a) unit/units from in every iteration.
- *Taking district:* This is a destination district that we choose to assign (a) unit/units to in every iteration.
- *Giving node/nodes:* This is one of the edge wards (and its dependent wards) of a district that is (are) taken from that district in an iteration.
- *Taking node:* This is random neighbor unit of giving node/nodes located on the edge of a taking district.

Considering the above example, assume we want to assign Unit 156 from District D to District B. So Unit 156 is the giving node, District D is the giving district, either Unit 155 or Unit 178 (neighbors of Unit 156 in District B) can be considered as the taking node, and District B is the taking district.

Let us now mention some important input data structures used in our heuristic algorithm, which are presented in Table 6-2. Some input files such as adjacency and shared border files are imported as $m \times m$ matrix. Adjacency matrix is a boolean matrix and indicates adjacent wards. Shared border file is another matrix with real values that presents the length of the shared borders between every two wards. Population, total number of votes cast in each unit (ward), number of votes cast for Democrats in each unit (ward), and perimeter and area of each unit (ward) are presented as arrays of size *m*.

Also, in real-world cases, we might need to consider split wards (if any). In that case, we import another boolean matrix named "split wards file," which indicates whether each two wards are dependent or not. In the fictional case that will be presented in Chapter 7, all input files are created based on the generated data. For our case study (State of Wisconsin), the input files are created based on collected geographical and electoral data, which will be explained in Chapter 8.

Table 6-2: Input data structures for the heuristic method

File name	Data size and type	Description
Adjacency	$m \times m$ boolean matrix	Indicates which wards are adjacent
Population	Array of size *m* (real)	Population of each ward
Total votes	Array of size *m* (real)	Number of votes cast in each ward
Democrats votes	Array of size *m* (real)	Number of votes cast for Democrats in each ward
Perimeter	Array of size *m* (real)	Perimeter of each ward
Area	Array of size *m* (real)	Area of each ward
Split wards file	$m \times m$ boolean matrix	Split wards, glue wards and single-neighbor wards
Shared border	$m \times m$ matrix of real values	The length of shared boundaries between wards

We imported some input data files as matrices (adjacency, shared border, and split wards files) but apart from that, we converted most of the arrays to create vectors. Some two-dimensional vectors that we used in the code are shown in Table 6-3. We were able to significantly speed up the code using vectors instead of arrays. In Tables 6-2 and 6-3, "*m*" stands for number of units (wards).

Table 6-3: Data structures used in the heuristic method

Name	Data type	Description	Derived from
Neighbors	Two-dimensional vector (length of *m*)	Neighbors of each wards	Adjacency file
Districts' wards	Two-dimensional vector (length of *m*)	Wards inside a district	Adjacency file
Wards' districts	Two-dimensional vector (length of *m*)	Each ward's assigned districts	Adjacency file
Edge wards	Two-dimensional vector (length of *m*)	All wards on the edge of a district	Adjacency file
Dependent wards	Two-dimensional vector (length of *m*)	All wards that need to be assigned together	Split files and perimeter

Besides, in this research, the preliminary experiments were conducted to find the appropriate range for heuristic algorithm input parameters. *ST, n, α*, respectively, represent start temperature, number of iterations, and cooling rate as the requirements of simulated annealing algorithm. Also, we should set the number of initial feasible solutions, population deviation threshold (if applicable), and code run time. Table 6-4 shows the range of input parameters used in our algorithm in different situations.

Table 6-4: The range of algorithm input parameters

Start temperature (ST)	Number of iteration (n)	Cooling rate (α)	Number of initial feasible solution (G)	Population deviation (if applicable)	Run time (Sec)
[0.01 , 1,000]	[50 , 100]	[0.9 , 0.999]	[50 , 120]	[0.5% , 5%]	3,600

We now want to explain the steps of the SA algorithm for assigning *M* wards to *D* districts, which was coded in C++. The general steps of the heuristic algorithm used in this research is shown in Figure 6-3. "HP" is the number of districts in which the difference between district's population and average district's population is higher than the defined deviation threshold. The code run time is set to 3,600 seconds. The code also can stop if the predefined condition is satisfied.

In other words, it can stop either when population equality requirements are met (also we can define other conditions such as political fairness requirements) or at the end of 3,600 seconds. Further elaboration of the above algorithm is summarized in Table 6-5.

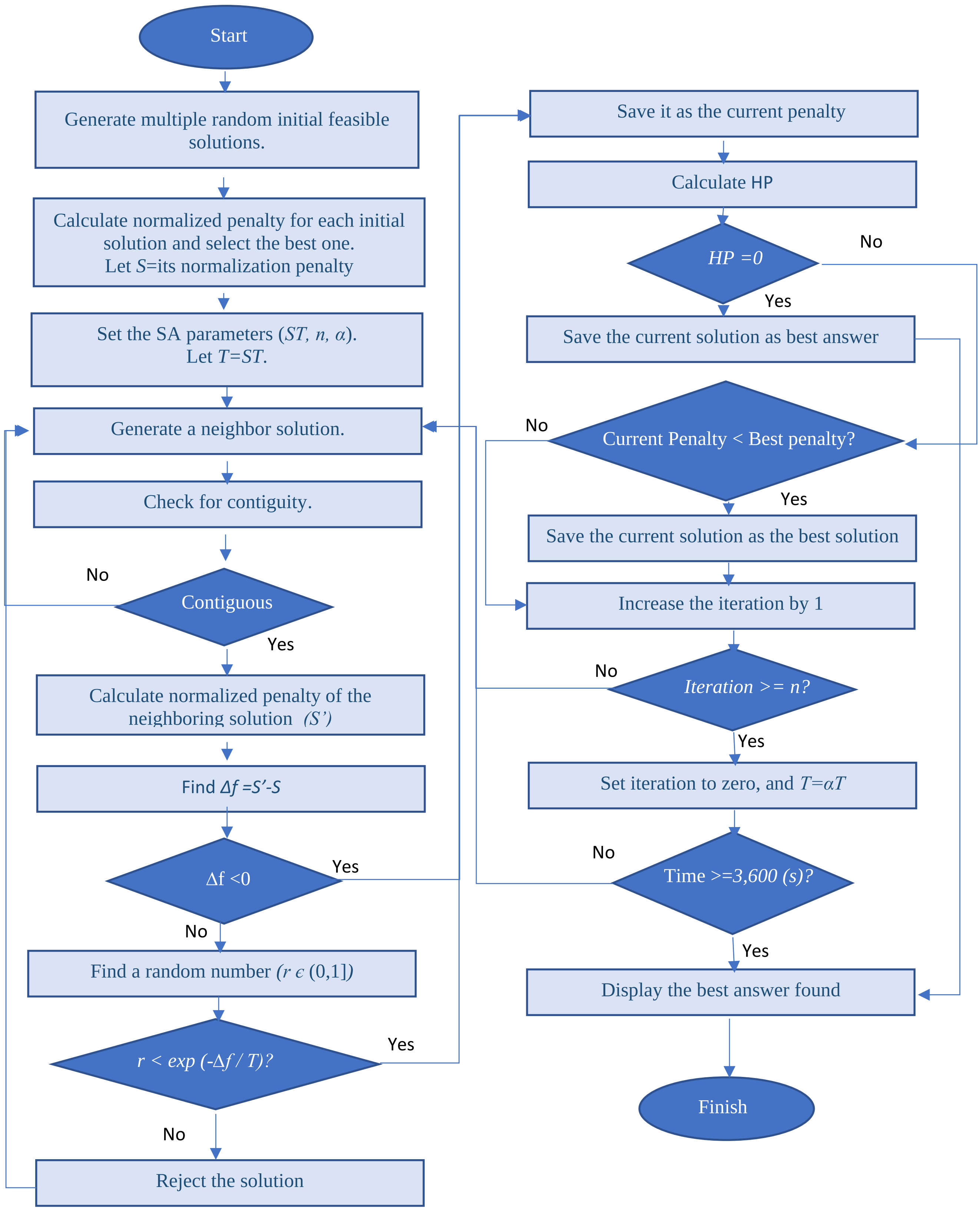


Figure 6-3: Flowchart of heuristic algorithm

Table 6-5: Steps of the heuristic algorithm for forming state assembly and US. Congressional districts

Step number	**Description**
1	Generate a bunch of random feasible (contiguous districts and not-shared units) initial solutions
2	Calculate the initial normalized penalty (for population equality, political fairness, and compactness) for each initial feasible solution and save the one with the lowest first penalty as current solution and as best solution so far
3	Set the SA requirements (start temperature (*ST*), cooling rate(α), and iterations number (n)) and set running time limit of 3,600 seconds
4	Find the new neighbor solution
5	Check for contiguity. If it is not feasible (not contiguous), go to step 4; otherwise, go to step 6
6	Calculate normalized penalty of the neighbor solution
7	If total penalty of new neighboring solution is less than current penalty, go to step 11; if it is higher than current penalty, go to step 8
8	Calculate the difference between current and new total penalty and find the result of the acceptance probability $(exp\ (-\Delta f\ /\ T))$
9	Generate a random number ($r \in [0,1]$)
10	If the random number (r) is less than acceptance probability, then go to step 11; if not, go to step 15
11	The new set of districts (new neighboring solution) are accepted; save it as current penalty and count the number of districts in which their population is out of allowable deviation from average population (HP)
12	If HP =0, save the current solution as best solution and go to step 18; otherwise, go to step 13
13	Compare total penalty of new solution to the best penalty. If it is less than the best penalty, go to step 14; otherwise, increase the iteration by 1 and go to step 16
14	Save it as the best political set of districts, increase the iteration by 1, and go to step 16
15	The new set of districts is rejected. Go to step 4
16	If iteration is less than number of iterations (n), go to step 4; otherwise, set iteration to zero and decrease the temperature by cooling rate
17	If time is greater than 3,600 seconds, go to step 18; otherwise, go to step 4
18	The best saved set of political districts would be the final answer

The details of the important parts of the code, such as generating initial feasible solutions, ensuring contiguity, and forming neighbor structure, have been elaborated on in later sections.

6.2.1. Initial feasible solution

In the beginning, we generate multiple random feasible initial solutions (they range between 50 and 120 solutions). The feasible solutions must contain contiguous districts and ensure integrated wards. Also, split wards, single-neighbor wards, and all their dependent wards are assigned to a single district to avoid non-contiguous districts in initial solutions. The steps of the code for this procedure are shown in Figure 6-4. The results of this step of the proposed algorithm are shown as a boolean matrix of D (number of districts) rows and M (number of units) columns. If an element in row d *and* column m (e_{dm}) equals 1(0), that means unit m is (not) assigned to district d.

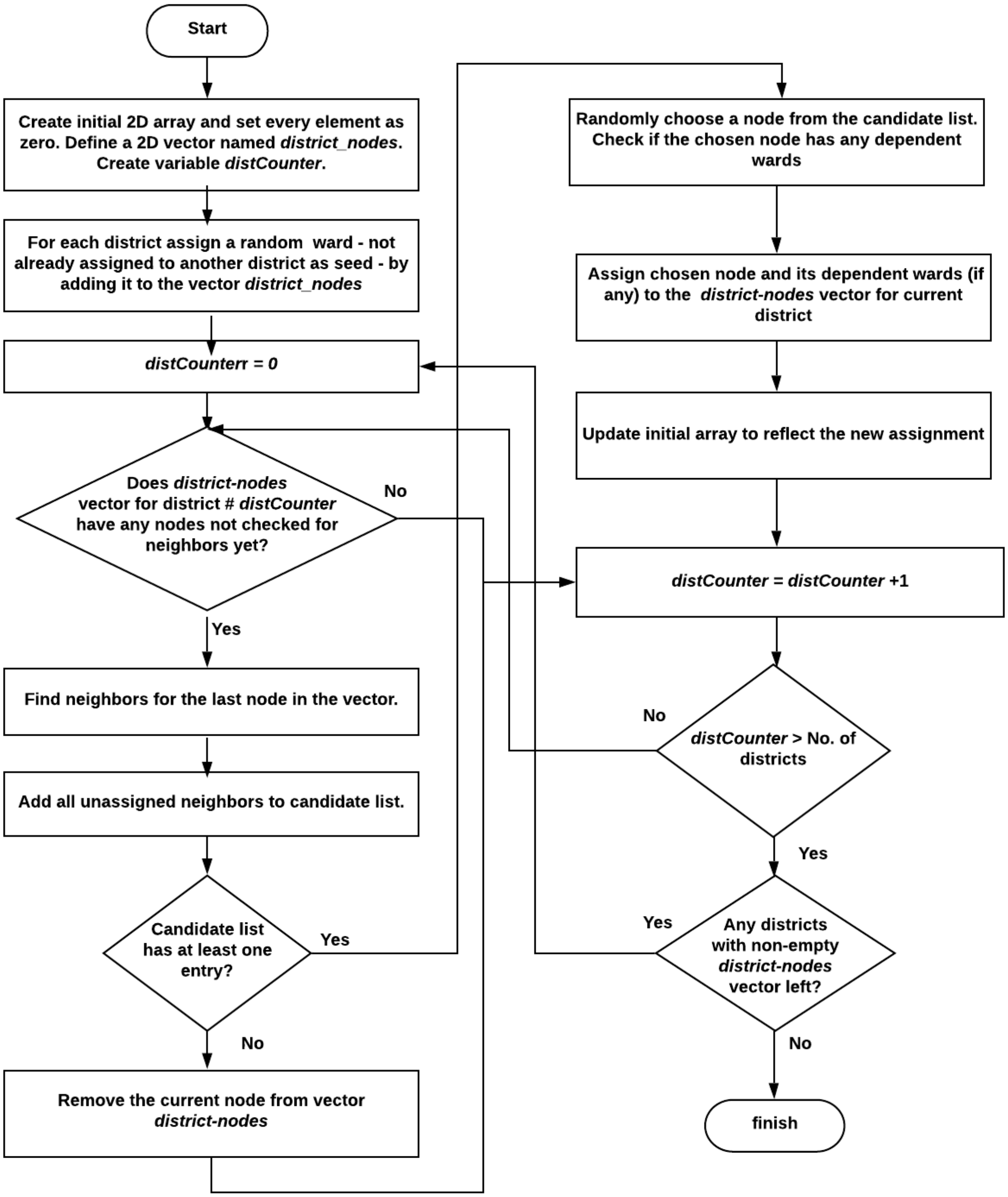


Figure 6-4: Flowchart for creating the initial solution

6.2.2. Objective function components

As discussed in detail in Chapter 3, the objective function has three main components. The first component is the penalty for district population deviation from the district's average population. Second component is the political fairness penalty, and the third one is the penalty for the lack of compactness. All types of penalties should be normalized. They can also be weighted based on their priority in order to find the best tradeoff point among objective function components.

For population penalty, we minimize the deviation of each district's population from the average districts' population for the fictional case presented. For our case study (forming Wisconsin's political districts), as the consequence of minimizing district population deviation, we most likely minimize the number of districts whose population deviation from the average district's population is higher than the defined deviation (population deviation threshold).

In terms of political fairness, based on one of the defined scenarios in Chapter 3, we use the second procedure in our large fictional example by which we minimize the difference between a district's number of votes cast for Democrats and the number of votes cast for Democrats in average district. For our case study (Wisconsin), we use the first strategy by which we minimize the difference between number of parties' "deserved" seat share based on the received votes, and the number of the seats won by them in an election. For lack of compactness, we use the Polsby and Popper method (Polsby and Popper 1991) (PEd_d^2/ ARd_d) for all large size cases.

All in all, we minimize a weighted normalized sum of different types of penalties that form our objective function in the proposed algorithm.

6.2.3. Generating neighboring solutions

After generating random initial feasible solutions between the range 50 and 120, we start with the best initial solution (a solution with minimum total penalty) and improve the result using the SA algorithm. The strategy for finding neighboring solutions is described in Table 6-6.

In this algorithm, four vectors (edge wards, neighbors, dependent wards, and ward's district) are utilized as presented in Table 6-3.

Table 6-6: Method for searching for neighboring solutions

Step number	Description
1	If it is the first iteration, go to step 2; if not, go to step 3
2	Select a random district and name it "District A". Go to step 6
3	Select a random number (r) between 0 and 1
4	If the number of the districts with population deviation over defined deviation threshold is greater than zero, go to step 5
5	If r > 0.3, select a random district among all districts having population deviation over defined deviation, otherwise go to step 2
6	Select a random ward on the edge of selected district using "edge wards" vector and name it "Node A"
8	Find a random ward among all neighbors of Node A outside "District A" using "neighbors" vector and name it "Node B"
9	Find which district "Node B" belongs to using "ward's district" vector, and name it "District B"
10	Check whether the population of "District A" is more than average population; if yes, go to step 11, otherwise, go to step 12
11	Check if "Node A" has dependent wards using "dependent wards" vector; if yes, save all its dependent wards, which should be assigned with "Node A." Assign "Node A" and its dependent nodes (if any) to "District B". Go to step 13
12	Check if "Node B" has dependent wards using "dependent wards" vector; if yes, save all its dependent wards which should be assigned with "Node B." Assign all "Node B" and its dependent nodes (if any) to "District A"
13	Finish

Based on the above 13 steps, we find a new neighboring solution. We then need to check the feasibility of the new solution. The steps for checking the contiguity of the new set of districts will be explained in the next section.

6.2.4. Ensuring contiguity

All the generated initial feasible solutions are contiguous. Also, the districts of the new solution must be contiguous to make the solution feasible. Based on the algorithm in Figure 6-3, in every iteration after reassigning (a) node/ nodes (ward/ wards) to another district, we need to check the contiguity of the giving district and the taking district to make sure that all districts in every iteration stay contiguous. To check contiguity of a district, we design a contiguity test. If the taking and giving districts of the new solution passes the contiguity test, that means the new solution is feasible and potentially can be accepted. For a contiguity test for a target district, the following steps are taken:

The process starts by a random node (ward) being chosen within the target district (taking or giving district) and added to the "nodes-to-traverse" list. All of the neighbor units of this node—that are inside the same district—are added to the list named “nodes-to-traverse,” and consequently, this node is moved from "nodes-to-traverse" and added to the list named “traversed-nodes”. Then each node inside “nodes-to-traverse" is checked one-by-one. If the node already exists in the “traversed-nodes” list, it is ignored. Otherwise, it's added to “traversed-nodes” list, and all of its neighbors inside the same districts, that are not already in "traversed-nodes" are then added to “nodes-to-traverse”. This process goes on until the “nodes-to-traverse” list is empty. At this point we compare the nodes (wards) in the “traversed-nodes” list, to the list of units within the district. If they have the exact same nodes, then the district passes the contiguity test. The contiguity test procedure is also shown in the flowchart in Figure 6-5.

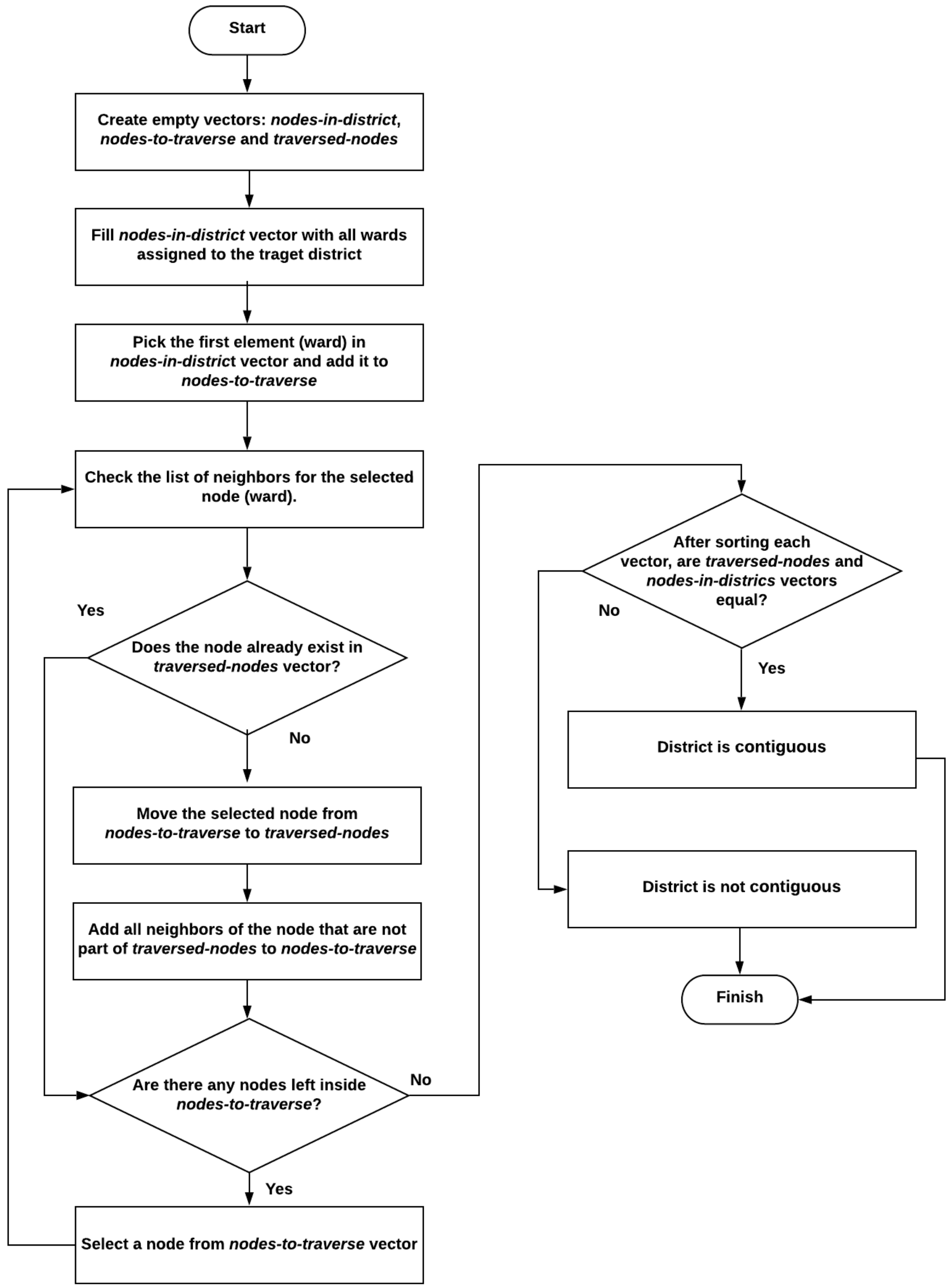


Figure 6-5: Flowchart for testing district contiguity

6.2.5. Additional explanations

Here we briefly explain all calculations related to the districts in every iteration of the algorithm. After ensuring contiguity, we need to update the total penalty based on the new solution and compare it to the current penalty. As noted earlier in Table 6-5, we may or may not accept the new solution. The penalty regarding population equality, lack of compactness, and political fairness mostly remains unaffected for the districts that did not change. So we only need to recalculate the penalty for the giving and taking districts and update the total penalty. For the lack of compactness, we need to update the area and perimeter of giving and taking districts in every iteration.

After normalizing all types of penalties (which was explained in Chapter 3), we compare the total penalty of the new solution to the current total penalty. Based on the procedure of the SA algorithm shown in Figure 6-2, the new neighboring solution can be either accepted or rejected. If the new neighboring structure is rejected and the stopping condition is not met, the algorithm starts over to find another feasible solution. If the new solution is accepted, we then compare the result to the best solution found so far. If the current best penalty has improved (the total penalty of the new solution is less than the best total penalty), we replace the current best solution with the new neighboring solution. Also, after accepting the new neighboring structure either as a best solution or not, we need to calculate the number of districts whose population deviation from an average district's population is more than the defined deviation threshold (HP).

6.3. SA algorithm for creating state senate districts from a given set of assembly districts

Senate districts for most U.S. states, including Wisconsin, are usually created from a set of assembly districts in such a way that two or three adjacent assembly districts must be nested within one senate district. In this section, an algorithm for forming state senate political districts from a given set of assembly districts is described. Based on this algorithm, every three assembly districts are assigned to a senate district. Since the formed assembly map includes districts with almost equal population, the consequently created senate districts also meet the population equality requirement. The number of Democratic and Republican districts are proportional to the fraction of votes cast for parties statewide. Contiguity is considered in this algorithm by which if the formed assembly districts are contiguous, the senate districts are also contiguous. Some important input data structures used in SA algorithm for forming senate districts are presented in Table 6-7 and "*m*" stands for number of created assembly districts. If we use non-contiguous assembly districts for forming senate districts, we must consider all split assembly districts as another input file to make sure that the created senate districts will be contiguous. Since in this research, we use contiguous assembly districts to form senate districts, we don't have any input file for non-contiguous assembly districts. Compactness is not considered in forming senate districts.

Table 6-7: Input data structure for forming state senate districts

File name	Data size and type	Description
Adjacency	$m \times m$ boolean matrix	Indicates which assembly districts are adjacent
Total votes	Array of size m (real)	Number of votes cast in each assembly district
Democrats votes	Array of size m (real)	Number of votes cast for Democrats in each assembly district

Table 6-8: Steps of thr heuristic algorithm for forming state senate districts

Step number	Description
1	Generate a random feasible (contiguous assembly districts) initial solutions
2	Calculate the initial normalized penalty (for population equality, and political fairness) for the initial feasible solution and save it as current solution and as best solution so far
3	Set the SA requirements (start temperature (*ST*), cooling rate(α), and iterations number (n)) and set running time
4	Set number of senate districts, population of average senate district, and number of senate districts in which democrats should win
5	Find the new neighbor solution
6	Check for contiguity. If it is not feasible (not contiguous), go to step 5; otherwise, go to step 7
7	Calculate normalized penalty of the neighbor solution
8	If total penalty of new neighboring solution is less than current penalty, go to step 12; if it is higher than current penalty, go to step 9
9	Calculate the difference between current and new total penalty and find the result of the acceptance probability $(exp\ (-\Delta f\ /\ T))$
10	Generate a random number ($r \in [0,1]$)
11	If the random number (r) is less than acceptance probability, then go to step 12; if not, go to step 16
12	The new set of districts (new neighboring solution) are accepted; save it as current penalty; calculate the difference between the number of formed senate districts with higher democratic votes and the number of senate districts in which democrats should win (DD), and count the number of districts in which their population is out of allowable deviation from population of average senate district (HP)
13	If DD =0 and HP=0, save the current solution as best solution and go to step 19; otherwise, go to step 14
14	Compare total penalty of new solution to the best penalty. If it is less than the best penalty, go to step 15; otherwise, increase the iteration by 1 and go to step 17
15	Save it as the best political set of districts, increase the iteration by 1, and go to step 16
16	The new set of districts is rejected. Go to step 5
17	If iteration is less than number of iterations (n), go to step 5; otherwise, set iteration to zero and decrease the temperature by cooling rate
18	If time is greater than defined runtime, go to step 19; otherwise, go to step 5
19	The best saved set of political districts would be the final answer

In the next chapter, experimentation on a state-size fictional case is represented.

7. Experimentation on a large fictional case

The proposed heuristic method has been coded in Microsoft visual C++ 2010, and is executed for a large fictional instance with 3,000 square-shaped units (wards).

We assume that each unit is a square measuring 2 km on a side, and the state (territory) is a perfect rectangle measuring 120 km × 100 km. The given units are supposed to be assigned to 100 districts. Table 7-1 shows all the input files information. Table 7-2 gives some general information about the state. For this problem, we assume that all units have equal areas, so the total number of neighbor units with shared boundaries could be considered as a ward's perimeter. To increase algorithm performance, the temperature is reheated every 250 steps and the penalties have been normalized.

Table 7-1: Input files for the large fictional case

Population of each unit (ward)	Array of 3,000 integers
Total votes cast in each unit (ward)	Array of 3,000 integers
Number of votes cast for Republicans in each unit (ward)	Array of 3,000 integers
Number of votes cast for Democrats in each unit (ward)	Array of 3,000 integers
Adjacency file	3,000 × 3,000 boolean matrix
The length of the shared boarders	3,000 × 3,000 matrix of real values
Area of each unit (ward)	Array of 3,000 integers
Perimeter of each unit (ward)	Array of 3,000 integers

Table 7-2: Geeneral information concerning the large fictional case

Total Population	6,035,234
Average population per district	60,352
Total votes cast	4,720,876
Average number of votes cast per district	47,208
Total number of votes cast for Democrats	3,040,130
Average number of votes cast for Democrats per district	30,401
Area of each ward	4 km^2
Perimeter of each ward	8 km

The population deviation penalty is the deviation of each district's population from the average district's population. The political fairness penalty is based on the second strategy by which the percentage of votes cast for Democrats (Republican) in each district could be made as close as possible to the overall percentage of votes cast for Democrats (Republican). The lack of compactness factor is based on the Polsby and Popper method (Polsby and Popper 1991) (PEd_d^2 / ARd_d). So the general form of the objective function would be as a following function, which was explained in Chapter 3.

Total penalty = $w_p * NPen_p + w_{f2} * NPen_{f2} + w_{c1} * NPen_{c1}$

The running time has been set to 3,600 seconds. The algorithm input parameters are set as shown in Table 7-3.

Table 7-3: Algorithm input parameter for lthe arge fictional case

Start temperature (ST)	Number of iteration (n)	Cooling rate (α)	Number of initial feasible solution (G)	Run time (Sec)
10	50	0.99	50	3,600

We run the algorithm three times. The first and second trials are weighted equally for all factors; in the third trial, the weight of compactness is 10 times the weight of the other factors. We start from a random feasible solution. One hundred random seeds are selected from 3,000 units in order to create contiguous districts, as explained in Chapter 6. We calculated the initial values of the objective function components and normalized them based on normalization factors (mean and standard deviation), as explained in Chapter 3. Then we minimize the weighted normalized penalties. Table 7-4 shows normalization factors as well as the first and best normalized values for each type of penalty. All normalized values are multiplied by 1,000. The normalization results in all penalty categories in the objective function contribute equally in forming the districts. Minimizing the normalized penalty decreases the original value of objective function simultaneously. Table 7-5 shows the first and best original objective values of total penalties, and the penalty for population equality, political fairness, and lack of compactness individually.

Table 7-4: Normalized factors and results of the SA algorithm on the large fictional case

Trial	Normalized objective value	Normalization factors μ_p	σ_p	μ_{f2}	σ_{f2}	μ_{c1}	σ_{c1}	Normalized population deviation penalty	Normalized political fairness penalty	Normalized lack of compactness Penalty
1	First normalized objective value	1,941,800	15,369	1,015,520	8,008.22	4,582.38	20.56	1,848.99	8,018.16	14,100.10
	Best normalized objective value							-98,474.10	-97,472.90	-99,275.30
2	First normalized objective value	1,965,440	15,473	1,028,630	8,064.63	4,573.15	20.42	27,336.40	18,989.90	498.09
	Best normalized objective value							-75,431.90	-82,378.30	-110,843.00
3	First normalized objective value	1,941,800	15,369	1,015,520	8,008.22	4,582.38	20.56	1,848.99	8,018.16	14,100.10
	Best normalized objective value							-28,582.10	-30,090.10	-108,067.00

Table 7-5: Results of the SA algorithm on the large fictional case

Trial	Objective value	Weights	Total penalty	Population deviation penalty	Political fairness penalty	Lack of compactness Penalty	Total compactness score
1	First objective value	w_p=1	3,045,822	1,970,220	1,079,730	4,872	41.2888
	Best objective value	w_{f2}=1	600,641	385,277	212,775	2,589	
	Improvement (%)	w_{c1}=1	80.34%	80.44%	80.29%	46.87%	
2	First objective value	w_p=1	3,574,773	2,388,410	1,181,780	4,583.32	43.3405
	Best objective value	w_{f2}=1	1,164,891	798,298	364,283	2,310	
	Improvement (%)	w_{c1}=1	67.41%	66.58%	69.18%	49.60%	
3	First objective value	w_p=1	3,054,822	1,970,220	1,079,730	4,872	44.9265
	Best objective value	w_{f2}=1	2,178,043	1,420,720	755,142	2,181	
	Improvement (%)	w_{c1}=10	28.70%	27.89%	30.06%	55.23%	

To visualize the results from running the program, they are mapped using R programming language based on their coordinates. The units' coordinates are grouped by the assigned districts. We visualize the initial feasible solution and best feasible solution obtained in trial 1. Figure 7-1 shows one hundred contiguous political districts that are created randomly as feasible initial districts. Each color represents a district.

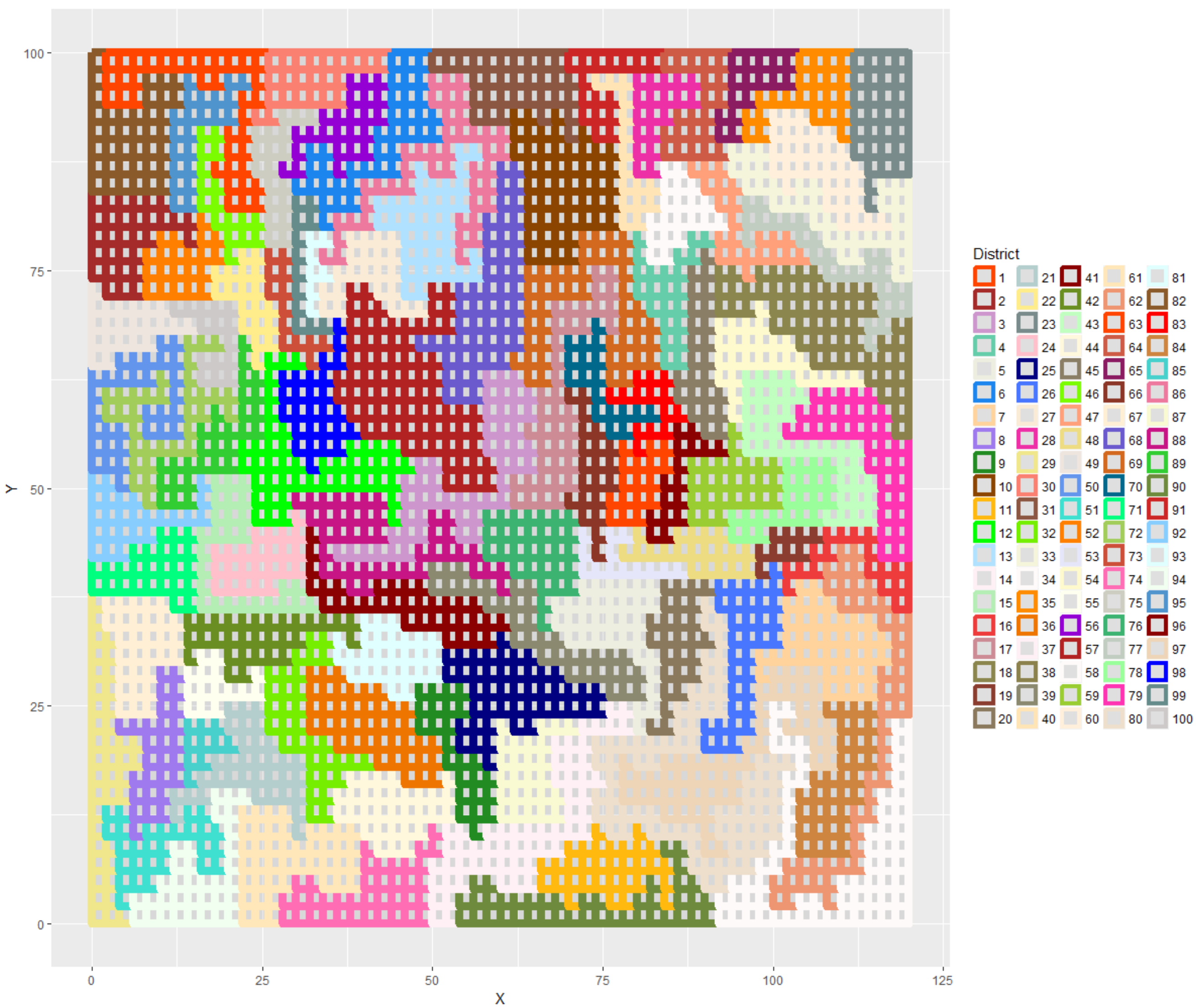


Figure 7-1: Initial feasible solution for trial 1

The results obtained in trial 1 from running the SA algorithm for an hour show a reduction in total penalty by 80%. Specifically, the penalty for population equality, political fairness, and compactness is reduced by 80%, 80%, and 46%, respectively. Also, the mapped results in Figure 7-2 show the improvement in terms of compactness. The districts are more compact compared to Figure 7-1.

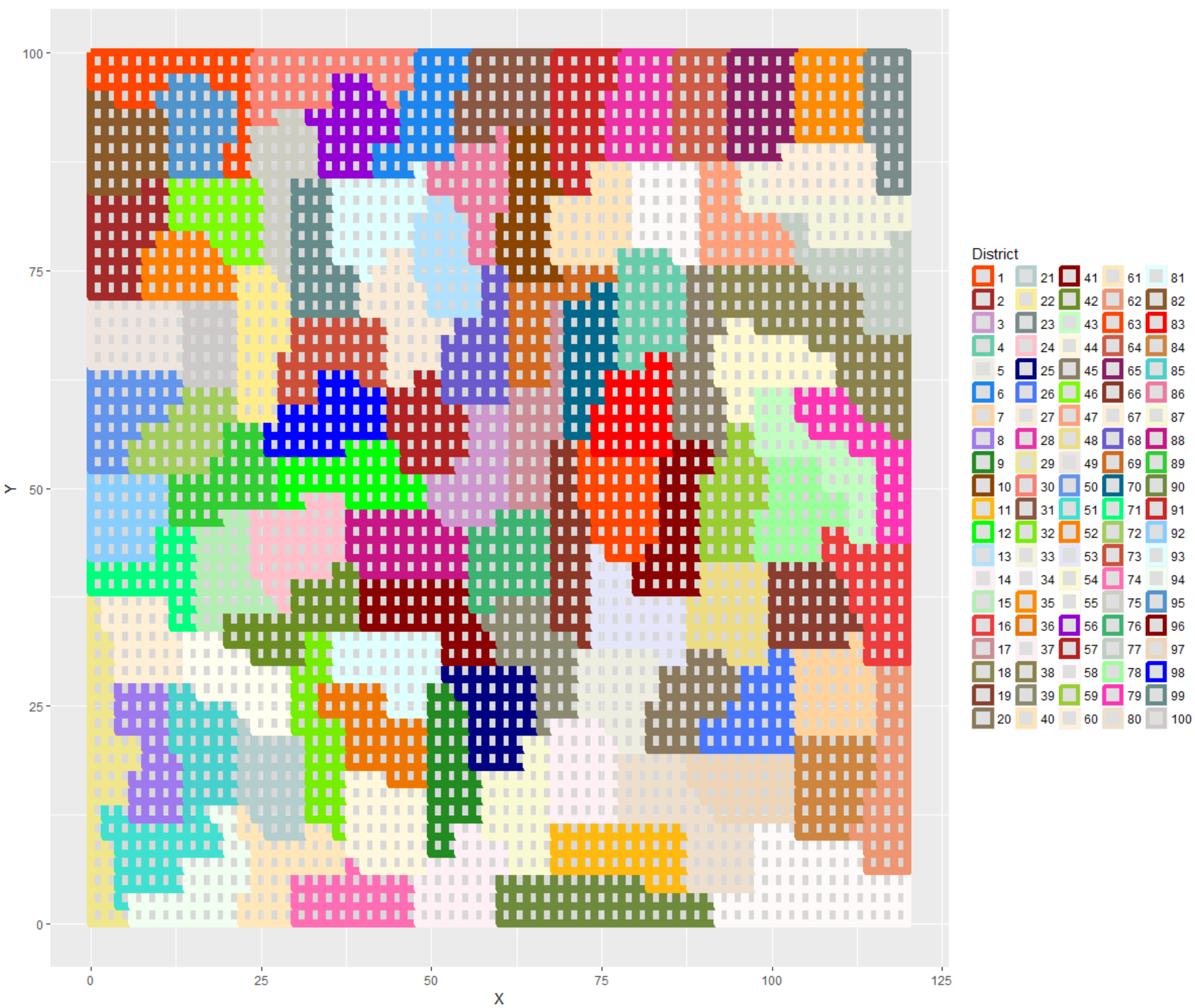


Figure 7-2: Best feasible solution obtained in trial 1

In next chapters, we review the political map of the State of Wisconsin as a case study and discuss all the challenges we faced during data collection.

8. Data collection for the Wisconsin case study

As previously discussed, Wisconsin is one of the states with an extremely gerrymandered political map, which seriously impacts the fairness as of the election result. Therefore, Wisconsin always comes to the attention of researchers who have tried to address gerrymandering. In this research, we decided to construct Wisconsin U.S. Congressional, Wisconsin State Assembly, and Wisconsin State Senate districts. To accomplish this, we collected, manipulated, and used Wisconsin geographical and historical election data as algorithm inputs to assign 6,977 wards of the state to 99 assembly, 33 senate, and eight congressional districts.

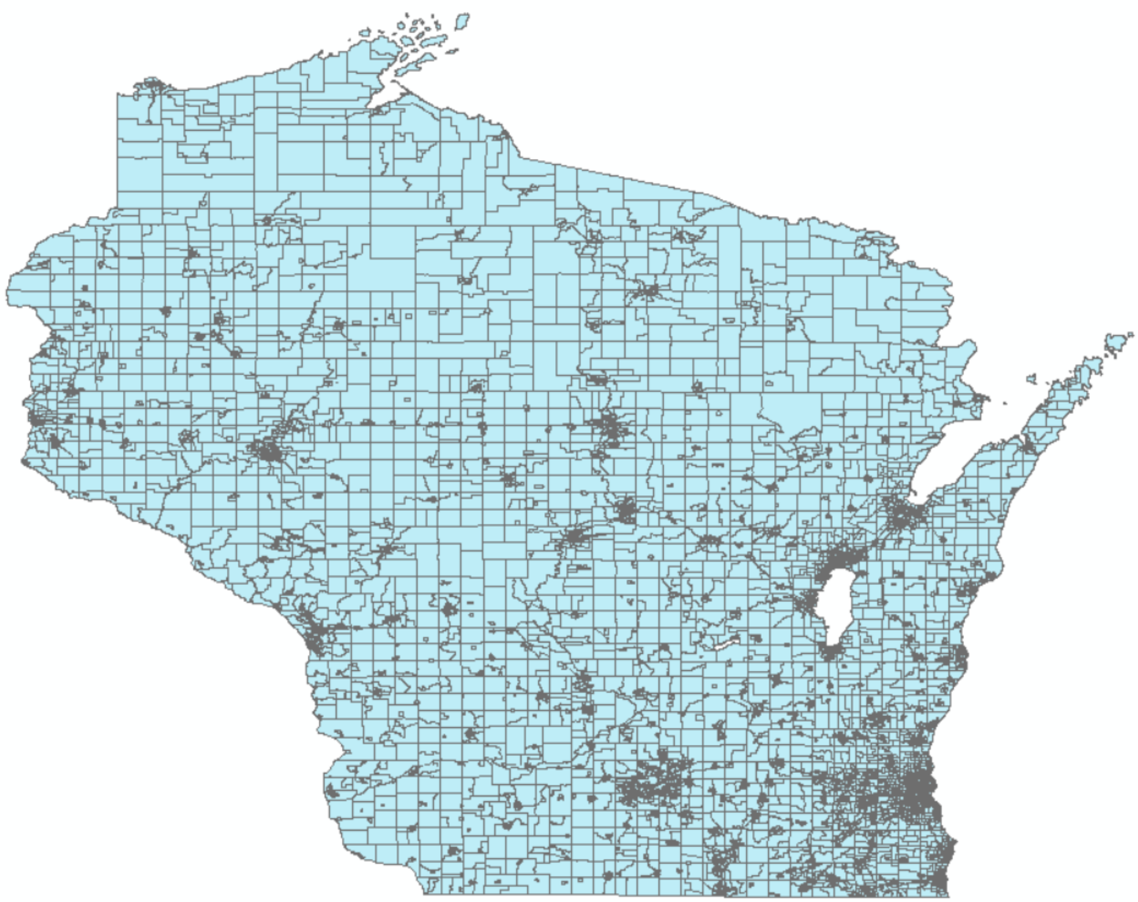


Figure 8-1: Boundaries of Wisconsin's 6977 election wards (Fall 2018)

8.1. Data sources and types

The State of Wisconsin has 6,977 wards based on the legislative map of 2018. Figure 8-1 shows Wisconsin's municipal wards. Wisconsin demographic, electoral, and geographical data has been collected using the online legislative maps of Wisconsin and ArcGIS software.

Table 8-1 shows some general data related to the State of Wisconsin. The historical election data refers to the 2016 presidential election, and the geographical data is based on map related to the 2018 Wisconsin municipal wards.

Based on the most recent census, total population of Wisconsin is 5,687,456. The total number of votes cast in the 2016 presidential election were 2,788,080, which is the sum of the number of votes cast for Democrats (1,382,640), and the number of votes cast for Republicans (1,405,440). Table 8-1 also addresses the total Hispanic and African-American populations, average ward compactness score, most populated ward, least populated ward, most compact ward, and least compact ward in the State of Wisconsin.

Table 8-1: General data related to the State of Wisconsin

Total population	5,687,456
Hispanic population	336,073
Total African - Anmerican population	380,662
Total number of votes cast	2,788,080
Total number of votes cast for Democrats	1,382,640
Total number of votes cast for Republicans	1,405,440
Average ward compactness score	0.038
Most populated ward	Milwaukee - C0032
Least populated ward	Sparta - C0020
Most compact ward	ElmGrove - V 0005
Least compact ward	Somers - T 0002

Now we explain more about the details of the political and geographical data collection process.

The process and the history of data collection for the Wisconsin case was as follows:

1. Data collection was started in November 2018.
2. Geographical data, including wards' latitude, longitude, area, perimeter, wards' neighbors, and the length of the shared boundaries between wards, were derived from the Wisconsin State Legislature website, in a file named "WI Municipal Wards (Fall 2018)." The map was opened in ArcGIS, and neighbor analysis and some other calculations were performed to create the neighbor adjacency file, including each wards' neighbors and the length of common borders. Also, the other parameters, such as area, length, longitude, and latitude, were calculated based on the wards' FIPS (Federal Information Processing Standard) geographic code.
3. Election and population data were also collected from the same website, in a file named "2012-2020 Election Data with 2017 Wards", because it was the latest version uploaded on the website at the time. The data was provided for only 6,926 wards.
4. It was decided to go with 6,977 wards based on the 2018 map; therefore, another online source (Wisconsin Election Commission 2019) was used for the remaining 51 wards, which were not provided with population and election data.
5. At the end of summer 2019, the website managers dropped the file "2012-2020 Election Data with 2017 Wards" and uploaded a file named "2012-2020 Election Data with 2018 Wards" with 6,975 wards; it did not include the wards' population. Therefore, the election data for those 6,975 wards was updated in input files. Population distribution of the State of Wisconsin is shown in Figure 8-2. Also, in Figure 8-3, the density of population based on districts' area (square mile) is illustrated.

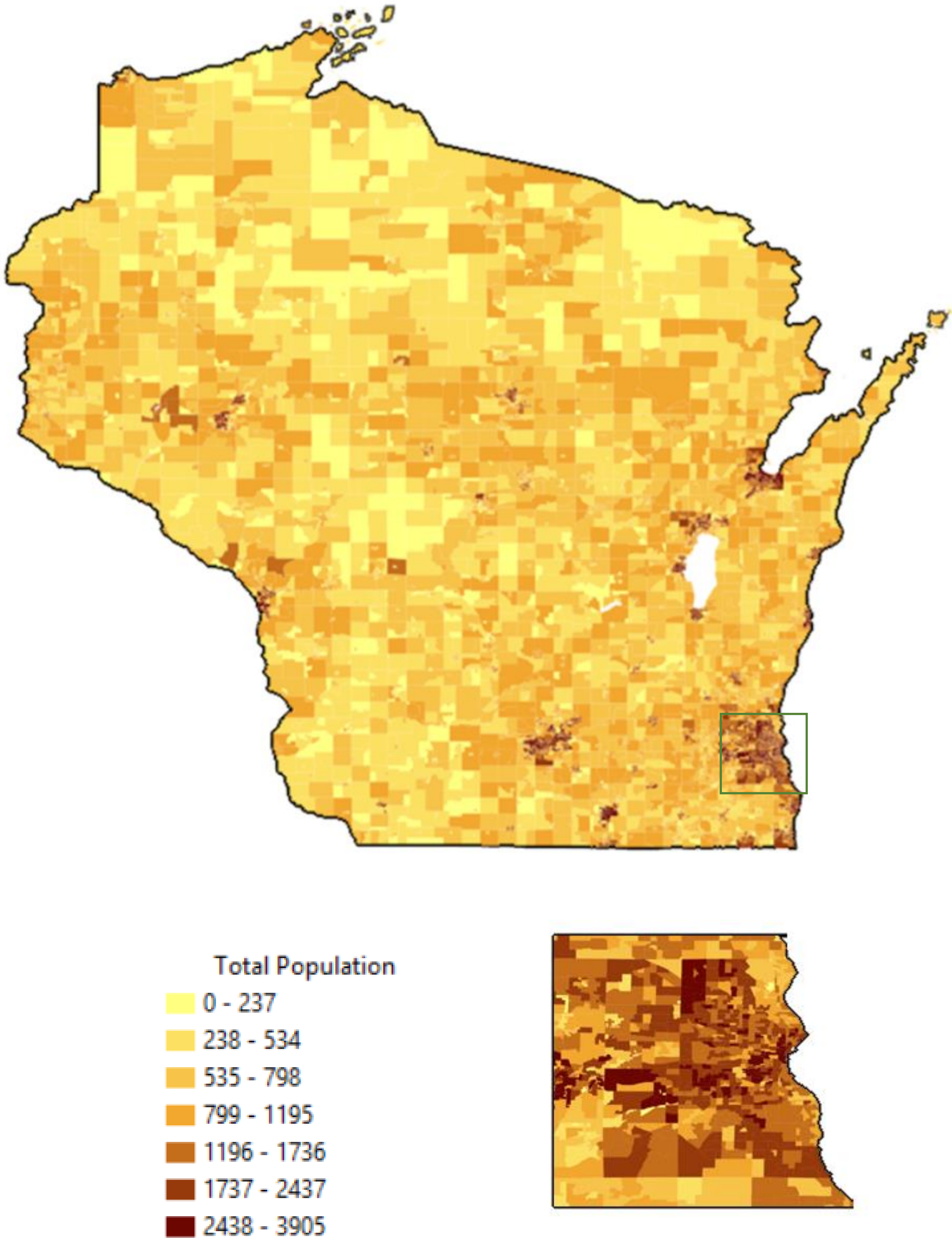


Figure 8-2: Population of Wisconsin's 6977 wards

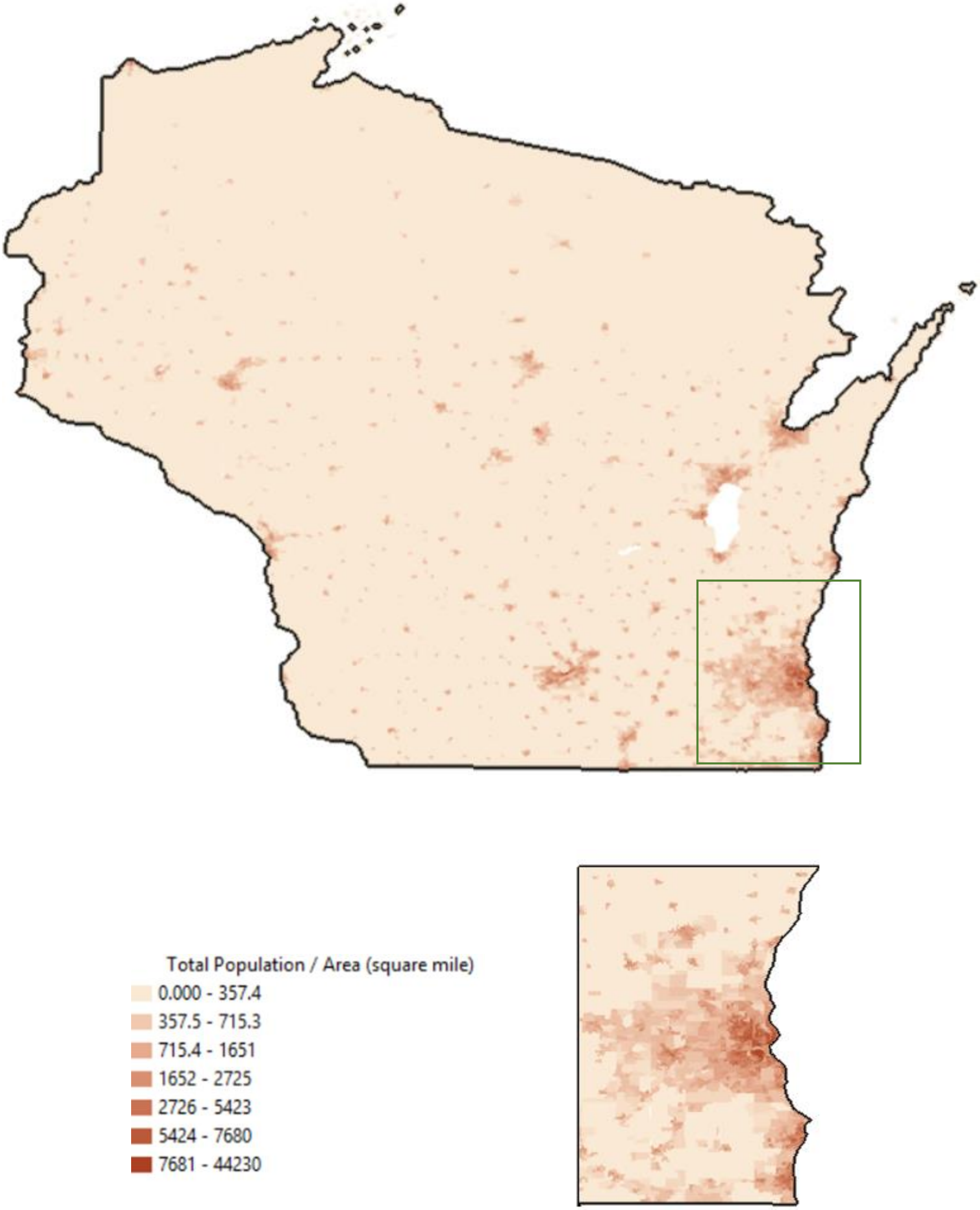


Figure 8-3: Population density within Wisconsin's 6977 wards

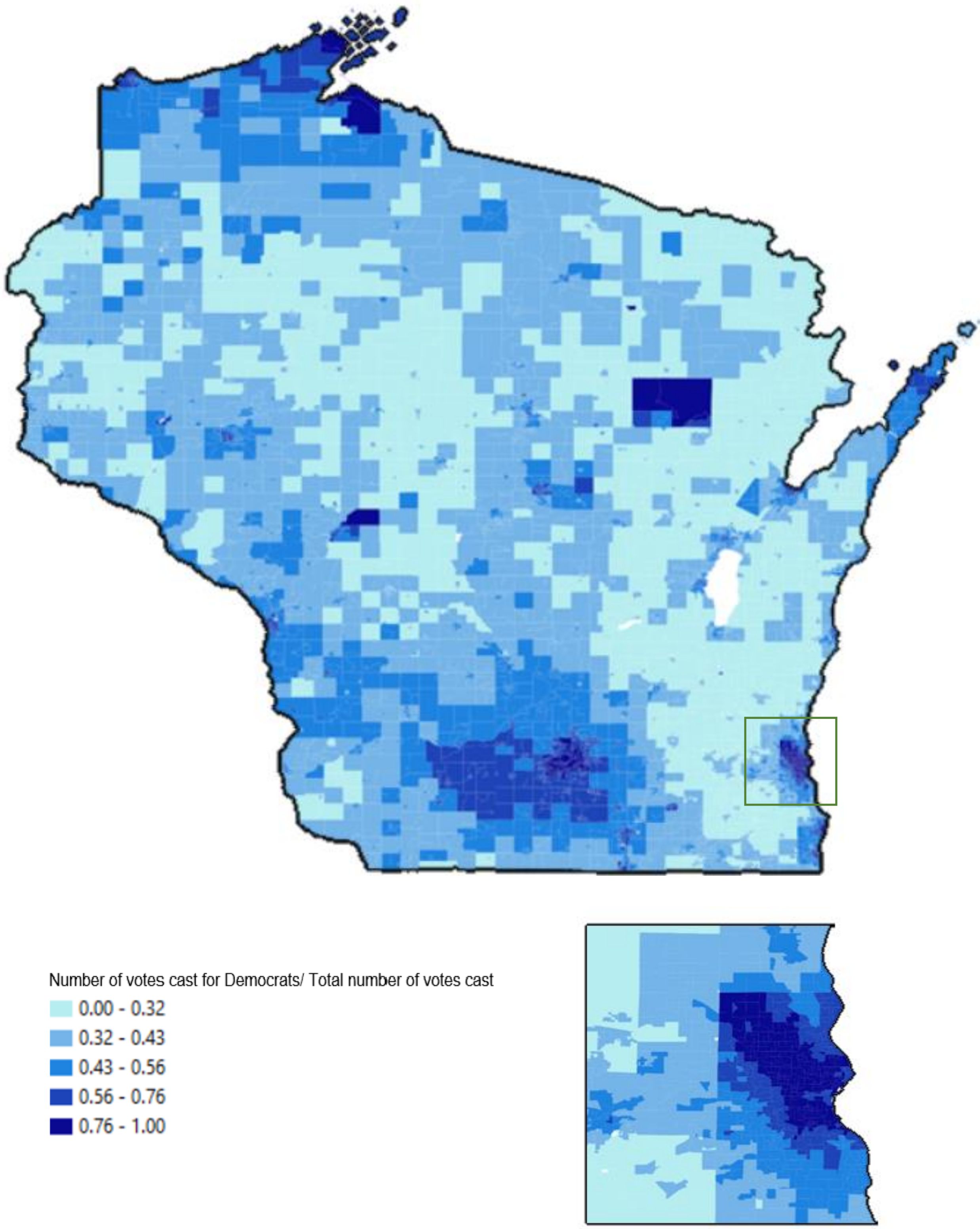


Figure 8-4: Distribution of the votes cast for Democrats in the State of Wisconsin (2016 presidential election)

6. In November 2019, the website was updated with a file named "2012-2020 Election Data with 2018 Wards," including the wards' population. So our project's input files for population and election were updated again based on this new file.
7. Among all accessible election data from the website, we chose to use the 2016 presidential election for the information regarding the number of votes cast for Democrats and Republicans. The distribution of the votes cast for Democrats in the State of Wisconsin is presented in Figure 8-4. We did not consider the other parties in this case because the votes cast for them do not affect the results of political redistricting. So in input file, the sum of the number of votes cast for Democrats and Republicans was considered as total the number of votes cast. However, for 55 wards, the reported total population was less than the reported total votes cast in the 2016 U.S. presidential election (For 44 wards, ward population was less than the number of votes cast for Democrats and Republicans in that ward.) For those 44 wards with questionable population data, three options were considered:
    - Do nothing
    - Change the population to become the total number of votes cast for Democrats and Republicans
    - Change the population to become twice the total of number of votes cast for Democrats and Republicans
8. For the population of each ward, every person who lives in that ward was counted (both over 18 and under 18 years of age). Also, African-American and Hispanic population data was collected for the final analysis regarding the concept of the Voting Rights Act.

Hispanic and African-American population density in the State of Wisconsin are shown, respectively in Figures 8-5 and 8-6.

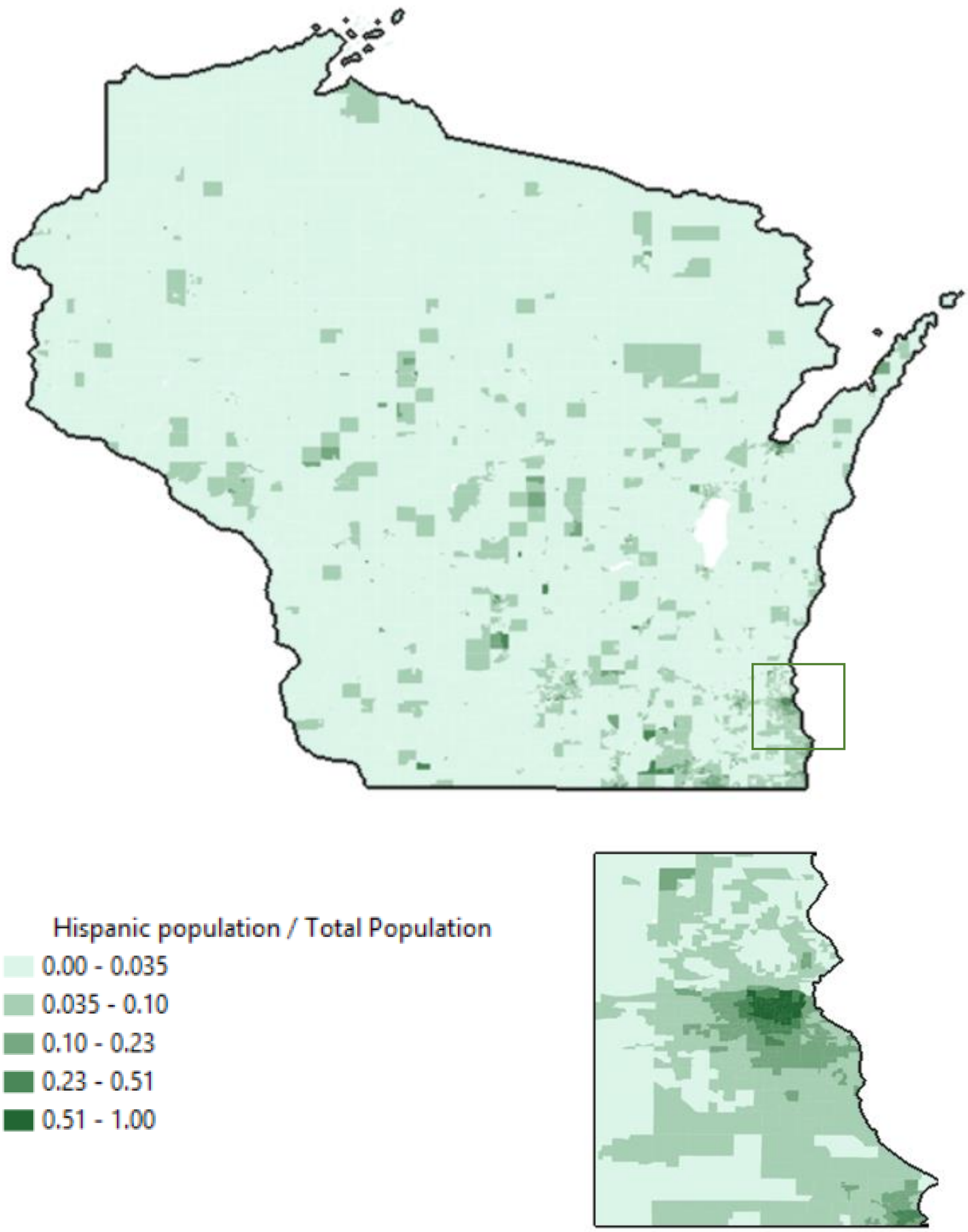


Figure 8-5: Hispanic population density in Wisconsin's 6977 wards

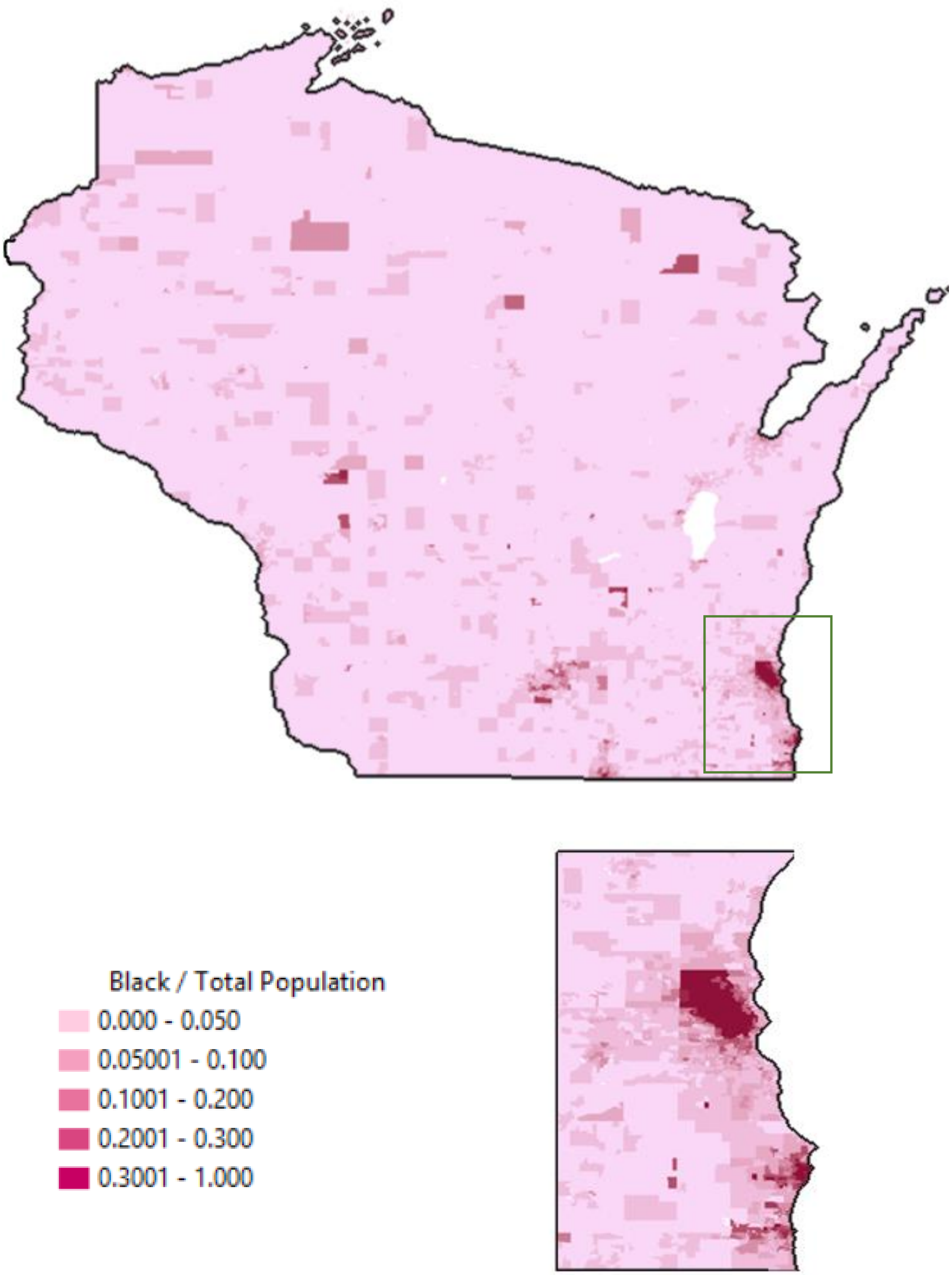


Figure 8-6: African-American population density in Wisconsin's 6977 wards

Politicians have opposing views on Voting Rights Act (VRA). Some believe that the Act, which was passed in 1965, ensures American citizens have the equal right to vote regardless of their race (Brennan Center for Justice 2013).

On the other hand, some other politicians—mostly Democrats—have the opposite point of view. They believe that the Voting Rights Act is subjective and ultimately increases partisan gerrymandering. Originally it was meant to make sure minorities' votes counted. But it was later reinterpreted by the U.S. Supreme Court to mean that minorities could get elected under the strange but unfortunately true assumption that in some places, people would only vote for people of their same race. The unfortunate effect of this decision is that it packs minorities into a few districts, and since they all tend to vote the same way (for Democrats), it essentially makes their vote useless. It disenfranchises them, which is the exact opposite of what the law was meant to do. In fact, defendants in the North Carolina partisan gerrymandering lawsuit argued that they were just trying to satisfy the Voting Rights Act, but that argument was rejected by the court. Also, the VRA was recently gutted by Republicans. The only thing they left in place was that "majority minority" districts rule, which gives them cover to do extremely partisan gerrymanders.

Because of different interpretations of the Voting Rights Act and its influence on the results of fair elections, we decided not to consider this factor in our objective function. Later, after constructing Wisconsin State Assembly districts, we will observe the number of African-American and Hispanic districts that are formed in fair assembly maps without factoring the Voting Rights Act factor into the algorithm.

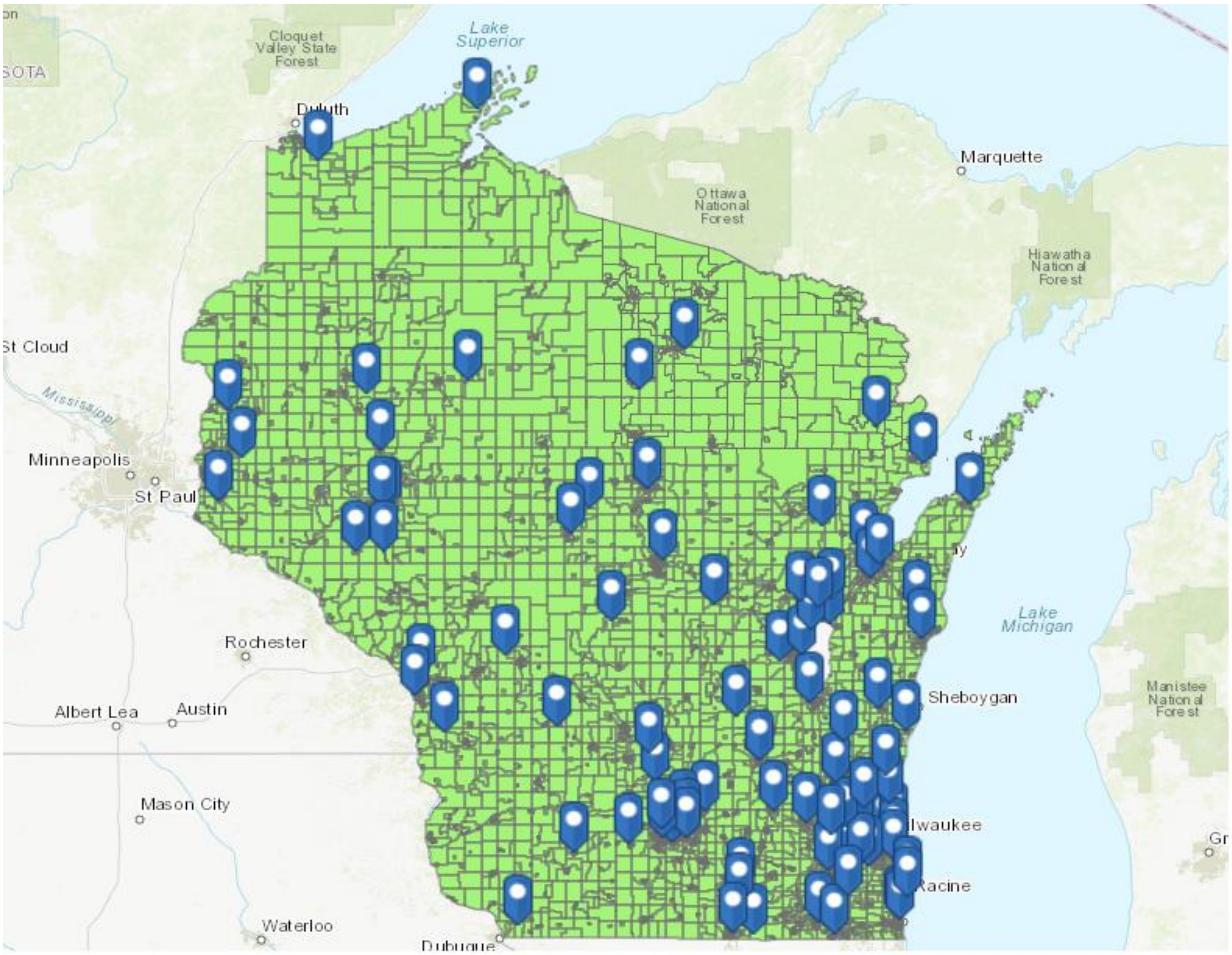


Figure 8-7: Home addresses of the 99 members of the Wisconsin State Assembly

9. Wisconsin's current Assembly Representatives' (99 members of the Wisconsin State Assembly) and Senators' (33 members of the Wisconsin State Senate) home addresses based on wards coordinates have been collected. Distribution of the home addresses of the members of Wisconsin State Assembly and Wisconsin State Senate are presented in Figures 8-7 and 8-8 respectively.

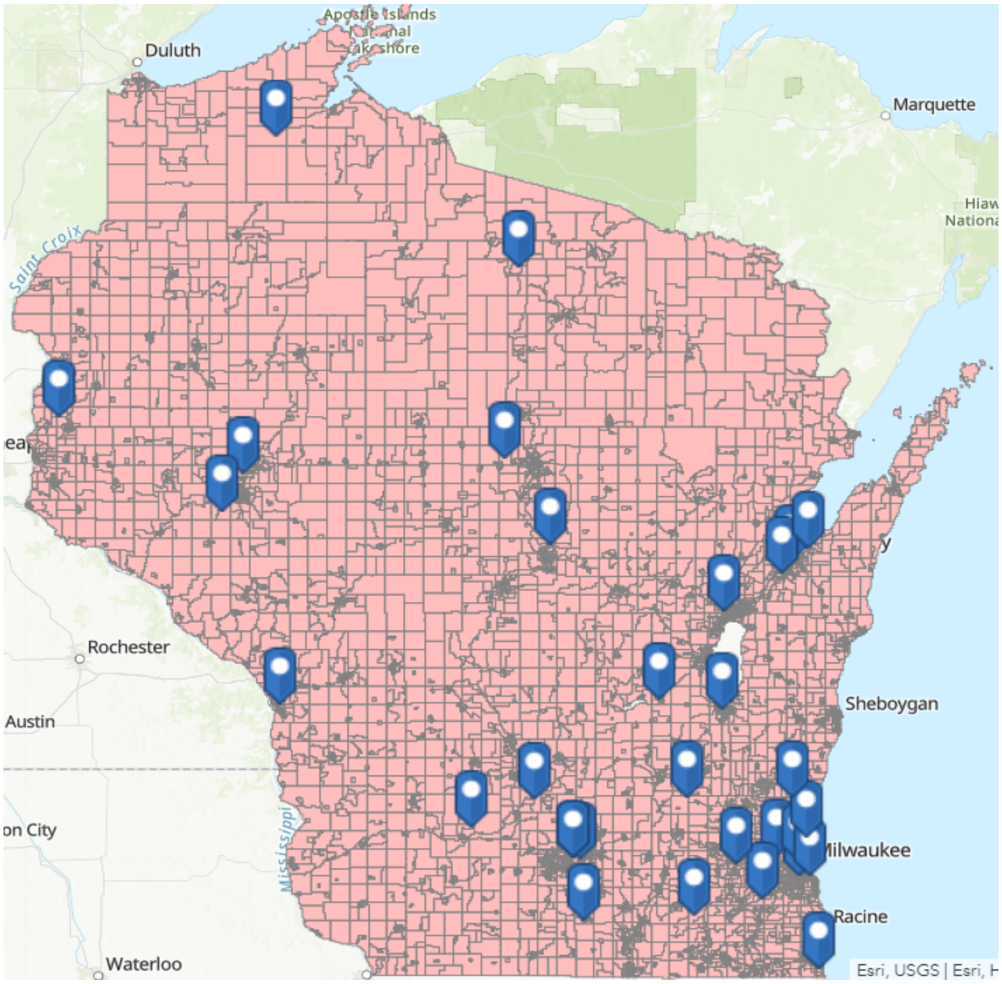


Figure 8-8: Home addresses of the 33 members of the Wisconsin State Senate

8.2. Data cleaning and final data structures

The collected data has been cleaned up using R programming in order to be compatible with C++. All input data has been converted to text files and used for running the code. The information, sizes, and types of all .txt files that are used as inputs for the code are listed in Table 8-2. During data collection process, some challenging situations came up, which are explained briefly as follows:

1. During data collection process, we noticed that there are some non-contiguous wards (more than 600 split wards) on the map, so even if we ensured district contiguity in the

algorithm, the result can still lead to non-contiguous districts. Some extra work was done to handle the issue of split wards. After exploring the map and finding split wards, the wards that connect the separate pieces of split wards were found and listed as connecting (glue) wards. Later the file, including split wards and their connecting wards (glue wards), were used in the code to take care of possible non-contiguous districts. As explained in Chapter 6, a split ward and its dependents must be assigned together.

2. We found some single-neighbor wards (wards inside another ward or located on the edge of the state and thus having only one neighbor). These wards must be assigned with their dependents when finding the neighbor structure in the SA algorithm.
3. There have been some neighbor wards with the length of shared border being zero (the wards only touch borders at one of their corners). For this issue, it was decided not to consider the neighbors with the length of zero.
4. Some wards have more than one neighbor, but in the neighbor analysis, only one neighbor showed up. This problem was solved by checking the perimeter of those wards with the shared length of that single neighbor. If they were not equal, there was a possibility that other neighbors exist. All the possibilities were checked manually and fixed.
5. Some wards had shared borders with other wards, but in the neighbor analysis, the length of the common borders was zero because of existence of a river, water canal, and even overlapping borders on the map. All the neighbors with a length of zero were checked, and in the case of having this issue, the lost length was measured and added.

Table 8-2: Files created after the Wisconsin data was collected and cleaned

Input files	Description	Data size and type
Total Population	Total population of each ward	Array of 6,977 integers
Number of African-Americans	African-American population of each ward	Array of 6,977 integers
Number of Hispanics	Hispanic population of each ward	Array of 6,977 integers
Total number of votes cast	Number of Republican and Democratic votes in each ward	Array of 6,977 integers
Number of Republican votes	Number of votes cast for Republicans in each ward	Array of 6,977 integers
Number of Democrat votes	Number of votes cast for Democrats in each ward	Array of 6,977 integers
Adjacency file	Indicates which pairs of wards are adjacent	6,977 × 6,977 boolean matrix
Shared border length	Length of border shared by each pair of wards	6,977 × 6,977 matrix of real values
Senators' home addresses	Wards in which the current Senators live	Array of 33 integers
Representatives' home addresses	Wards in which the current Representatives live	Array of 99 integers
Area	Area of each ward	Array of 6,977 integers
Perimeter	Perimeter of each ward	Array of 6,977 integers
Split wards file	Non-contiguous wards (dependent wards)	6,977 × 6,977 boolean matrix

6. For some wards, some of their neighbors did not appear after the neighbor analysis was done by ArcGIS. The map was reviewed for missing neighbors. It took us about six months to review them. After the review was completed, adjacency and length files were updated.

All these unexpected issues, followed by the serious challenges we faced in order to fix them, consumed considerable time and effort before we were able to clean the data and increase the accuracy of the political maps.

In the next chapters, forming Wisconsin's U.S. Congressional, Wisconsin State Senate, and Wisconsin State Assembly districts for the purposes of this study are discussed.

9. Wisconsin's U.S. Congressional districts: Experimental setup, results, and discussion

The first step in forming a fair political map for Wisconsin starts with its U.S. Congressional districts. Based on the 2018 political map, the State of Wisconsin has 6,977 wards, and eight seats of U.S. House of Representatives belong to this state. We are going to assign 6,977 wards of the state to eight political districts (named Experiment C). Wisconsin is one of the swing states in the United States where Democratic and Republican parties receive an approximately equal share of the votes cast. Based on the 2016 U.S. presidential election, the share of the total number of votes cast for Democrats is 49.60% and the share of the total number of votes cast for Republicans is 50.40%. Therefore, each party's "deserved" seat share should be four seats.

In our algorithm, we minimize the penalties regarding population equality, political fairness (first strategy), and lack of compactness. The general form of the objective function we use in the algorithm is as follows (which was explained in detail in Chapter 3).

Total penalty = $w_p * NPen_p + w_{f1} * NPen_{f1} + w_{c1} * NPen_{c1}$

The details of the algorithm and the related codes, and also the type of input data, have been explained in Chapters 6 and 8. As previously discussed, we have two hard constraints, which are integrity and contiguity. These two factors are never violated, so all the formed districts will be contiguous and meet the integrity requirement.

We now define multiple scenarios by establishing the conditions for other criteria in order to form congressional districts. For population equality, we consider two conditions, named strict (S) and loose (L). For strict population equality, the population deviation threshold is set to 0.5%, which means each district's population deviation from the average district's population should be less than 0.5%. For loose population equality, the population deviation threshold is set to 2%, by which each district's population deviation from the average district's population will be up to 2%. For the political fairness criterion, we consider three conditions: fair (F), Democrat favoring (D), and Republican favoring (R). Fair condition means two parties should win the number of seats that is equal to their "deserved" seat share in an election. Democrat (Republican) favoring happens when we aim to create a set of gerrymandered districts in which the Democrat party (Republican party) wins "extra" seats ("undeserved" seats) over its "deserved" seat share in the state as much as possible. For compactness, we consider improving compactness (Y) and not so (N). The combination of the above conditions forms different scenarios. An ID is assigned to each scenario. For example, "CNLF" is an ID for a scenario in which compactness is not considered, population deviation threshold is set to 2% (loose), and political fairness is based on fair condition.

It is worth mentioning that compactness is not a required criterion established by the U.S. Supreme Court for constructing fair political districts, and it does not guarantee fairness. A compact district could be gerrymandered when there is a large gap between the parties' share of votes cast in that district. On the other hand, non-compact districts with high competitiveness might be fair. Figure 9-1 shows a map of Wisconsin's U.S. Congressional districts that does not contain compact districts, and Figure 9-2 shows a map with more compact districts. The map in Figure 9-2 is absolutely gerrymandered (contains two Democratic and six Republican districts) despite looking compact, while the map in Figure 9-1 is totally fair (contains four Republican and four Democratic districts with equal population).

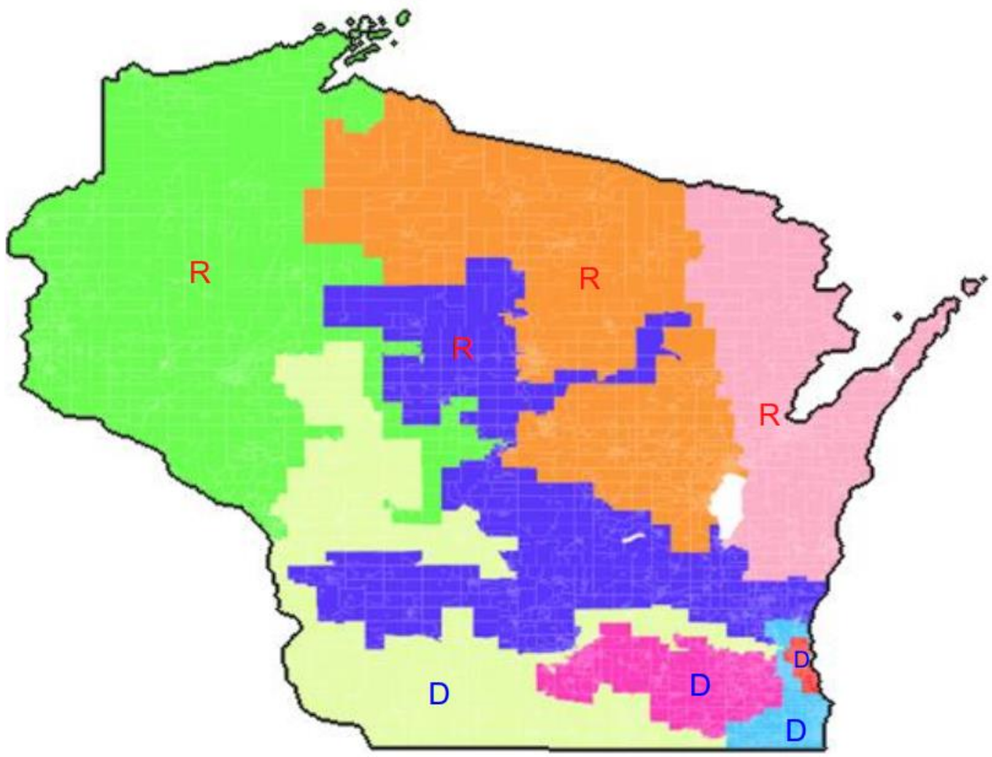


Figure 9-1: Politically fair U.S. Congressional districts with low compactness score

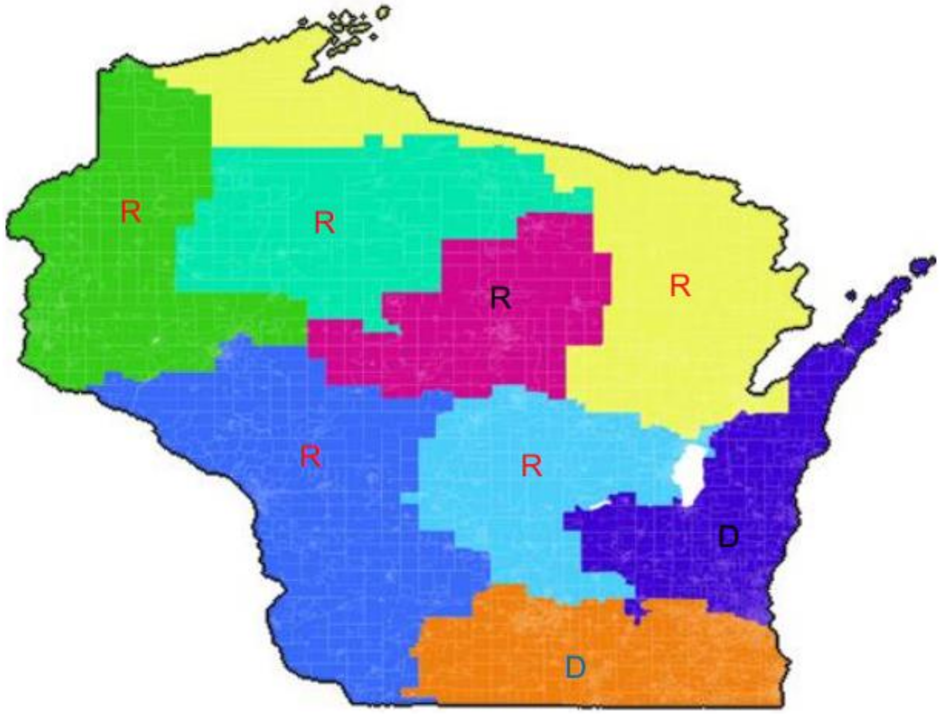


Figure 9-2: Politically unfair U.S. Congressional districts with high compactness score

The difficulty of constructing fair political districts with respect to population equality and compactness is evident especially if the number of votes cast for Republicans and Democrats is not well distributed in the state. For example, in the State of Wisconsin, the votes cast for Democrats in the 2016 presidential election are concentrated on three areas: Milwaukee, Madison, and Appleton. So this increases the difficulty of improving compactness in politically fair and equally populated districts. Despite all mentioned limitations in forming Wisconsin's U.S. Congressional districts, we aim to form four Democratic and four Republican districts with nearly equal population and also try to improve districts' compactness as much as possible.

First, we defined 17 scenarios. We ran the code for each defined scenario at least six times and named it Experiment C. Algorithm input parameters for Experiment C are set up, as shown in Table 9-1.

Table 9-1: Algorithm input parameters for Experiment C

Start temperature (ST)	Number of iteration (n)	Cooling rate (α)	Number of initial feasible solution (G)	Population deviation	Run time (Sec)
0.01	50	0.97	100	0.5% and 2%	3,600

Table 9-2 shows all the defined scenarios and one of the best answers for each. Table 9-3 shows some details of the best results from Table 9-2.

Table 9-2: Scenarios considered and summary of results for Experiment C

No.	Districts Formed	Compactness considered?	Population Deviation Requirement	Political Fairness Goal	ID	# Trials	Run Time (Sec)	Best result				
								HP	Dem Seats	Rep Seats	Total Compactness Score	Compactness Improvement
1	Congress	No	Strict (0.5%)	None	CNSN	6	3600	0	4	4	0.703	-
2	Congress	No	Strict (0.5%)	Fair	CNSF	6	3600	0	4	4	0.502	-
3	Congress	No	Strict (0.5%)	Dem Favor	CNSD	6	3600	0	6	2	0.352	-
4	Congress	No	Strict (0.5%)	Rep Favor	CNSR	6	3600	0	1	7	0.716	-
5	Congress	No	Loose (2%)	None	CNLN	6	3600	0	4	4	0.666	-
6	Congress	No	Loose (2%)	Fair	CNLF	6	3600	0	4	4	0.816	-
7	Congress	No	Loose (2%)	Dem Favor	CNLD	6	3600	0	6	2	0.842	-
8	Congress	No	Loose (2%)	Rep Favor	CNLR	6	3600	0	2	6	0.779	-
9	Congress	Yes	Strict (0.5%)	None	CYSN	6	3600	0	3	5	1.608	20%
10	Congress	Yes	Strict (0.5%)	Fair	CYSF	6	3600	0	4	4	2.763	43%
11	Congress	Yes	Strict (0.5%)	Dem Favor	CYSD	6	3600	0	4	4	1.267	12%
12	Congress	Yes	Strict (0.5%)	Rep Favor	CYSR	6	3600	0	2	6	1.321	14%
13	Congress	Yes	Loose (2%)	None	CYLN	6	3600	0	4	4	2.462	44%
14	Congress	Yes	Loose (2%)	Fair	CYLF	6	3600	0	4	4	2.273	33%
15	Congress	Yes	Loose (2%)	Dem Favor	CYLD	6	3600	2	5	3	1.805	24%
16	Congress	Yes	Loose (2%)	Rep Favor	CYLR	6	3600	0	2	6	2.185	28%
17	**Congress**	**Yes**	**None**	**None**	**CYNN**	**6**	**3600**	**3**	**3**	**5**	**5.802**	**53%**

For all the scenarios, we tried to form the districts with nearly equal population based on defined threshold. In Tables 9-2 and 9-3, “HP” means the number of districts whose population deviation from the average district’s population is more than the deviation threshold. “Dem seats” and “Rep seats,” respectively, represent the number of seats that Democrats and Republicans are expected to win based on the maps constructed using either of the scenarios in Table 9-2.

Table 9-3: Details of the best result for each scenario in Experiment C

No.	ID	w_p	w_{f1}	w_{c1}	Normalization factors μ_p	μ_{f1}	μ_{c1}	σ_p	σ_{f1}	σ_{c1}	HP	Dem Seats	Rep Seats	Best Answer Time (Sec)
1	CNSN	✓	×	×	2,323,504	1.22	621	223,021	0.50	51.99	0	4	4	145
2	CNSF	✓	✓	×	2,300,632	1.30	634	214,895	0.35	55.60	0	4	4	140
3	CNSD	✓	✓	×	2,275,184	1.16	617	216,462	0.57	52.44	0	6	2	1,186
4	CNSR	✓	✓	×	2,384,888	1.24	630	226,152	0.38	57.26	0	1	7	3,600
5	CNLN	✓	×	×	2,306,376	1.04	635	220,321	1.13	51.85	0	4	4	188
6	CNLF	✓	✓	×	2,509,528	1.36	616	253,181	0.50	53.14	0	4	4	137
7	CNLD	✓	✓	×	2,336,032	1.32	627	218,344	0.34	56.00	0	6	2	419
8	CNLR	✓	✓	×	2,438,528	1.00	627	245,428	0.50	52.58	0	2	6	146
9	CYSN	✓	×	✓	2,471,408	1.26	620	243,338	0.49	51.42	0	3	5	338
10	CYSF	✓	✓	✓	2,237,264	1.12	620	221,577	0.44	55.32	0	4	4	236
11	CYSD	✓	✓	✓	2,310,136	1.06	602	219,520	0.50	53.54	0	4	4	552
12	CYSR	✓	✓	✓	2,377,032	1.30	599	231,810	1.02	50.88	0	2	6	451
13	CYLN	✓	×	✓	2,382,512	1.18	648	235,704	0.42	56.59	0	4	4	293
14	CYLF	✓	✓	✓	2,457,192	1.44	601	230,904	0.28	52.64	0	4	4	178
15	CYLD	✓	✓	✓	2,412,744	1.16	608	231,984	0.50	52.71	2	5	3	598
16	CYLR	✓	✓	✓	2,354,904	1.28	634	216,023	0.37	53.04	0	2	6	943
17	CYNN	✓	×	✓	2,489,208	1.40	618	243,942	0.51	51.95	3	3	5	1,298

w_p, w_{f1}, and w_{c1} are, respectively, the weights for the penalties for the population equality, political fairness, and compactness criteria. The cross sign (×) for the weights means that the corresponding criterion has not been considered (w=0) in forming the political districts. The tick (✓) sign means that the criterion is weighted. The weights could have different values for different scenarios. μ_p, μ_{f1}, μ_{c1}, σ_p, σ_{f1}, and σ_{c1} are normalization factors that were explained in Chapter 3. Based on the calculated mean and standard deviation averaged over the initial feasible solutions, we normalized the original value of different types of penalties in the objective function. The goal of normalization is to adjust the value of different types of penalties to equalize their contribution in constructing a set of districts. "Best answer time" is the time at which we get the best answer during running time, and the total penalty is not improved after that.

In Scenarios 1 and 5 (CNSN and CNLN), we only consider the population equality (P) factor for each district. In Scenarios 2 and 6 (CNSF and CNLF), we consider the population equality (P) and political fairness (F) factors. In Scenarios 10 and 14 (CYSF and CYLF), we consider population equality (P), political fairness (F) and compactness (C). We aim to use Scenarios 10 and 14 to reach politically fair and equally populated congressional districts with respect to the districts' compactness. In Scenarios 9 and 13 (CYSN and CYLN), we look at population equality (P) and compactness (c). In Scenarios 4 and 8 (CNSR and CNLR), we consider population equality (P) and try to perform gerrymandering in favor of Republicans. In Scenarios 12 and 16 (CYSR and CYLR), we consider population equality (P) and compactness (C) factors and try to perform gerrymandering in favor of Republicans. In Scenarios 3, 7, 11, and 15 (CNSD, CNLD, CYSD and CYLD), we try to form gerrymandered congressional districts in favor of Democrats. In Scenarios 3 and 7, we only look at the population equality factor (P), and for Scenarios 11 and 15, we consider population equality (P) and compactness (C). Forming a gerrymandered congressional map in favor of Republicans for the State of Wisconsin is effortless because the Republican votes are well distributed all over the state compared to the Democratic votes.

In the beginning, we executed the code based on Scenario 17 concerning only the compactness criterion for an hour to form compact congressional districts. We then visualized a few of the political maps based on the results of Scenario 17 to show that compactness is significantly improved from the initial maps. Figures 9-3 and 9-4 (solution C1), respectively, show the initial and final solutions. Figure 9-5 (solution C2) shows another map with respect to only the compactness factor. Afterwards we visualized a map considering both the compactness (C) and political fairness (F) criteria, as shown in Figure 9-6 (solution C3) and also a map concerning the population equality (P) and compactness (C) factors, as shown in Figure 9-7 (solution C4 based on Scenario 13).

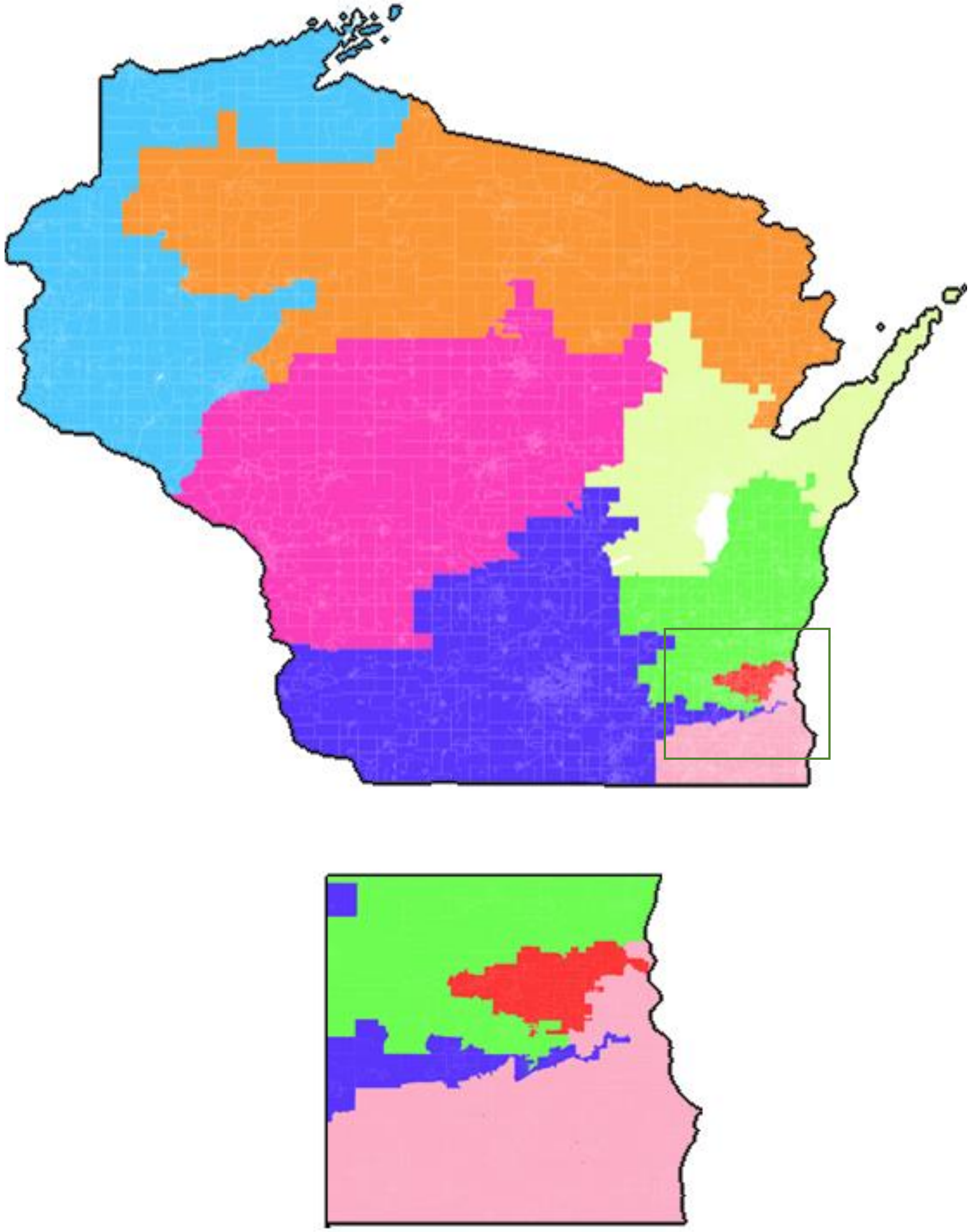


Figure 9-3: Initial solution C1

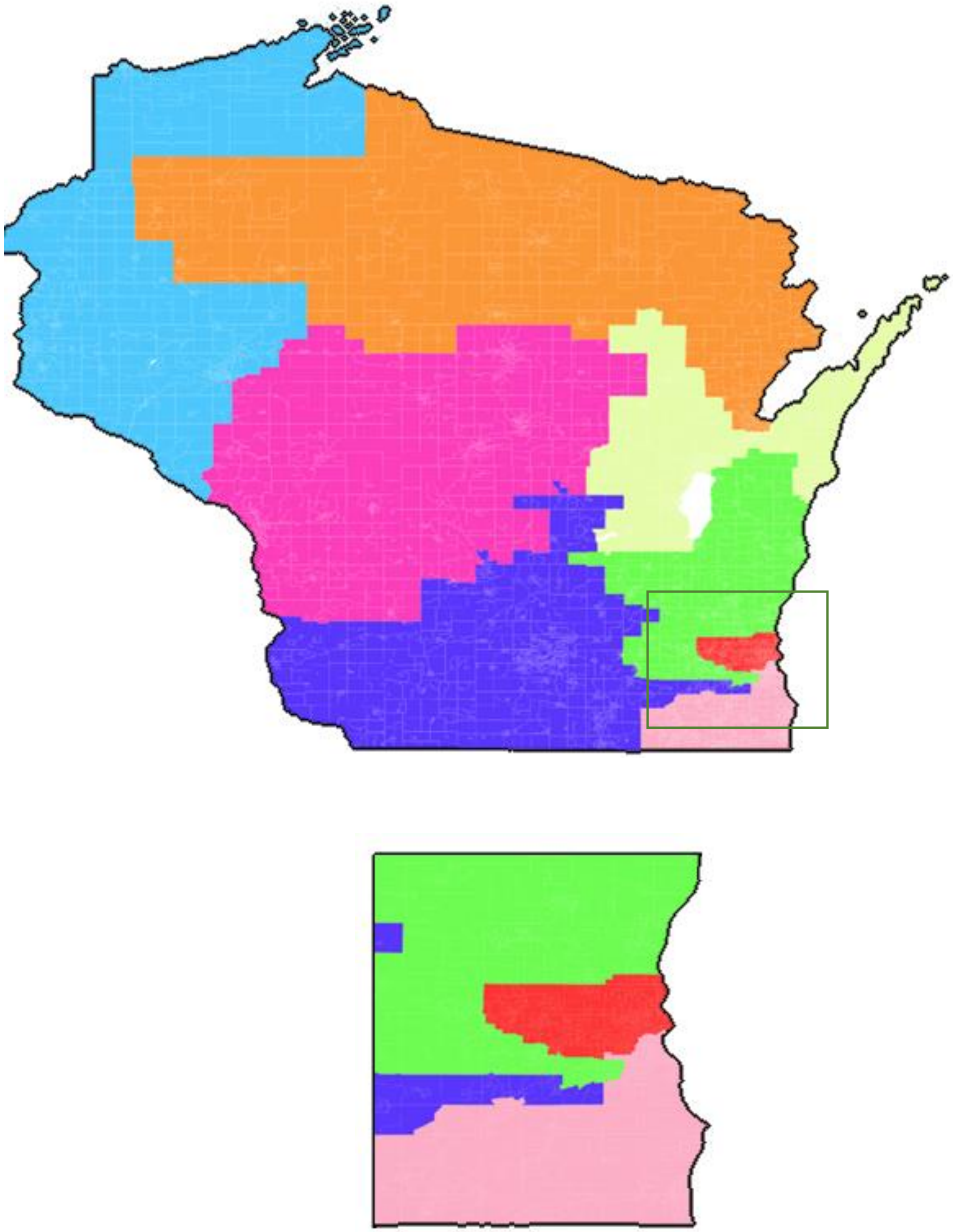
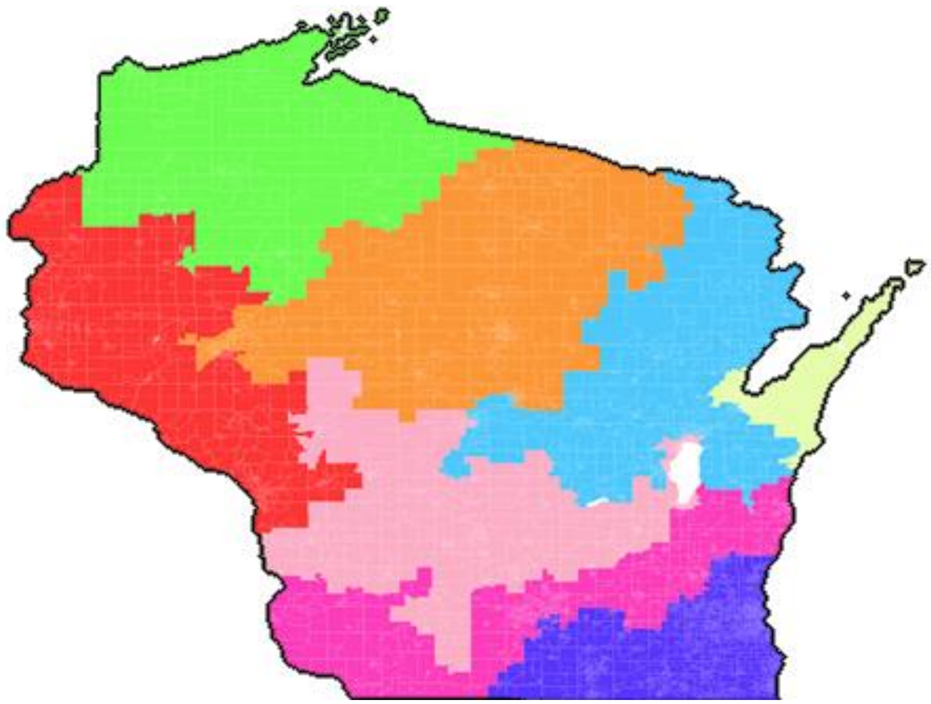
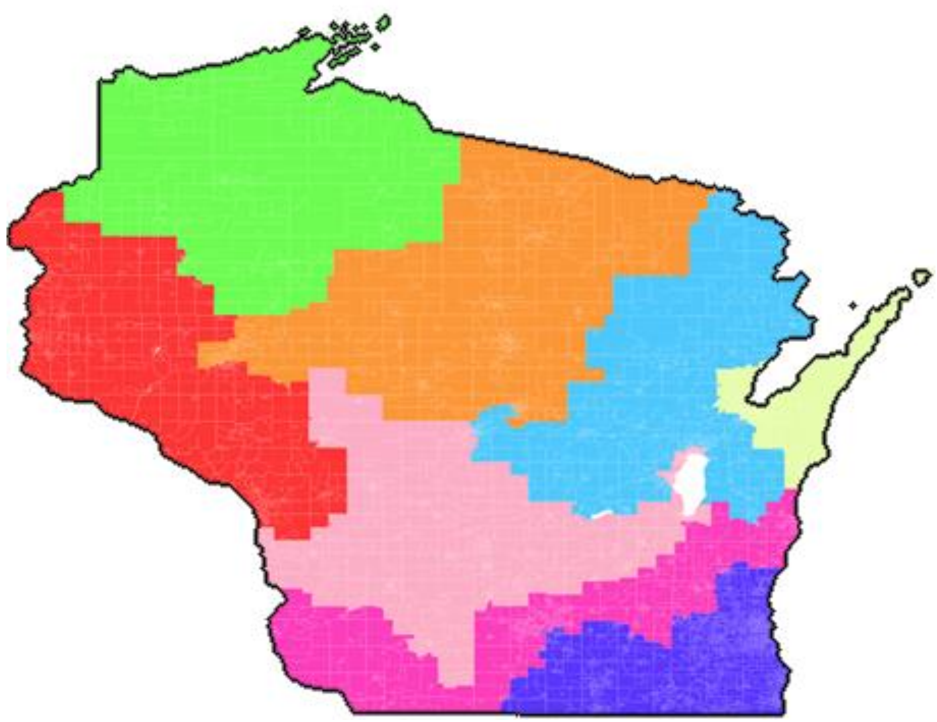


Figure 9-4: Final solution C1 considering objective C

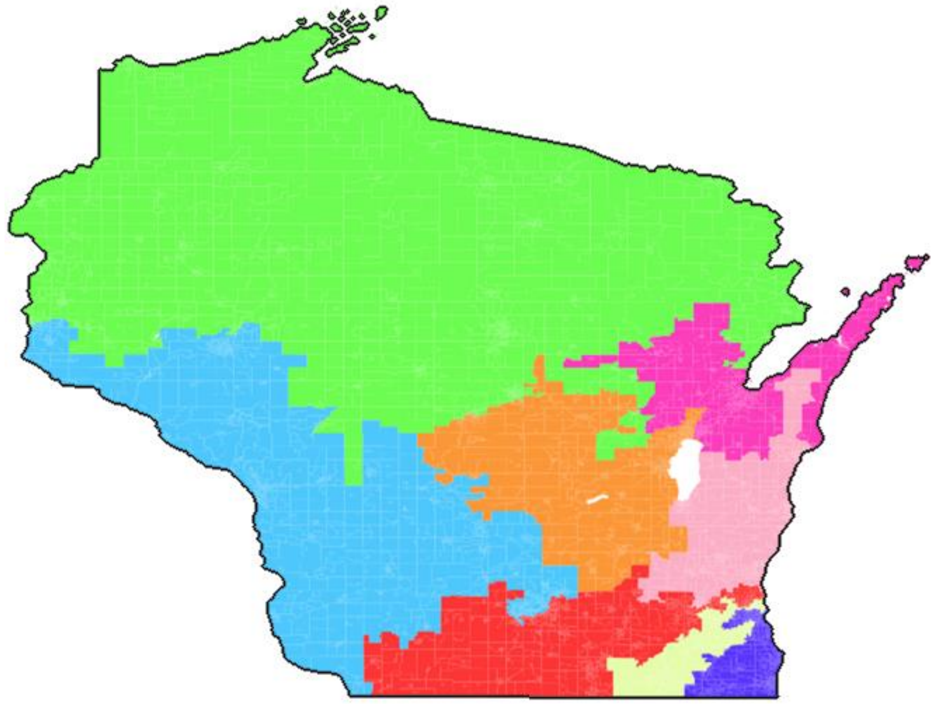


(a)

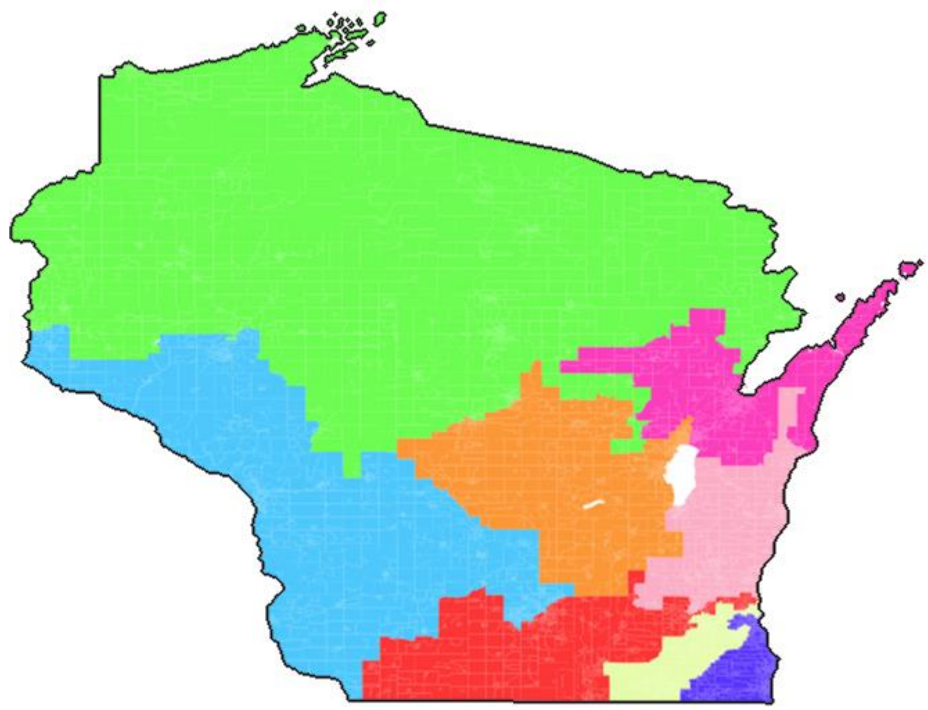


(b)

Figure 9-5: (a) Initial solution C2 and (b) final solution C2 considering objective C

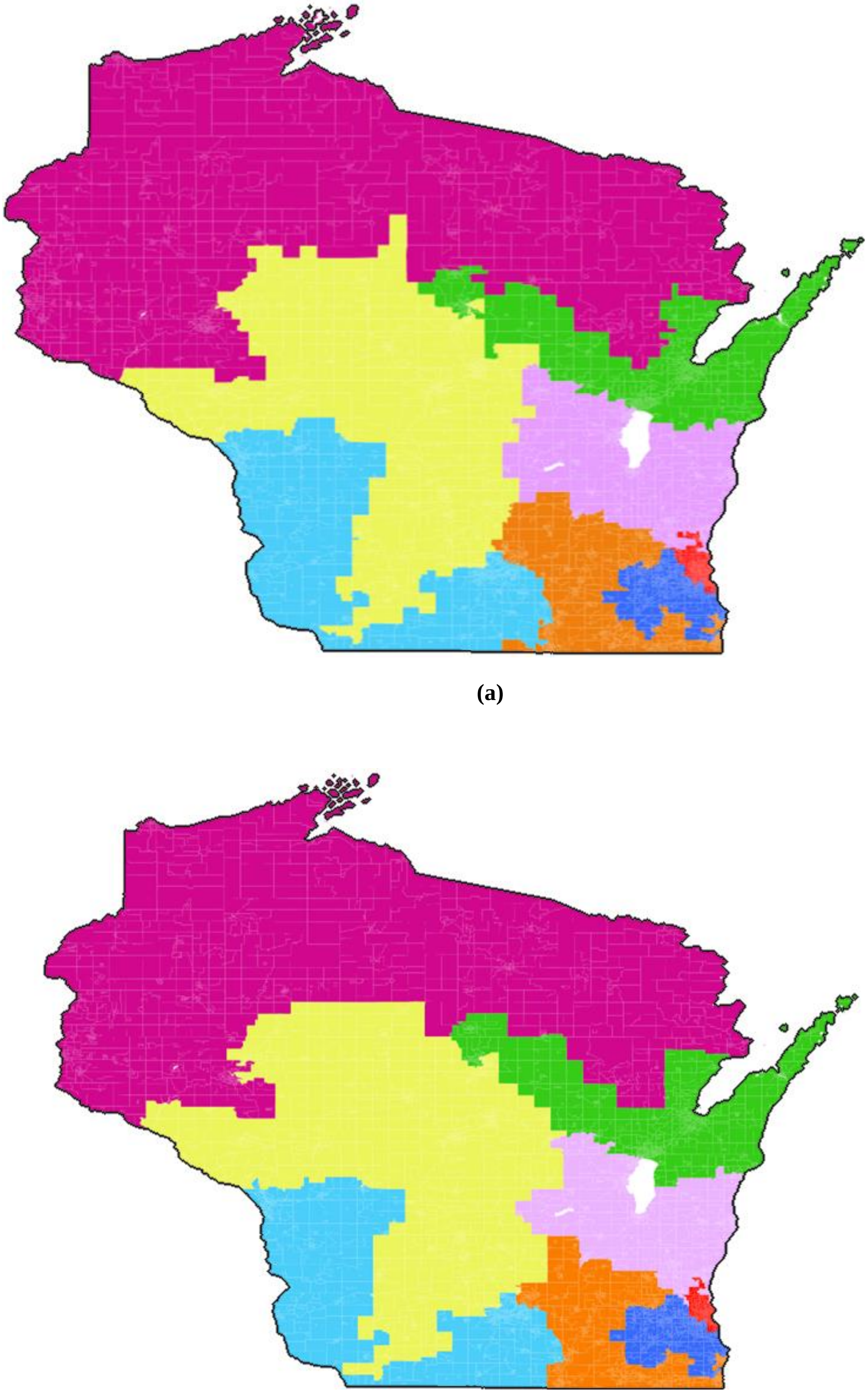


(a)



(b)

Figure 9-6: (a) Initial solution C3 and (b) final solution C3 considering objectives C and F



(a)

(b)

Figure 9-7: (a) Initial solution C4 and (b) final solution C4 considering objectives C and P

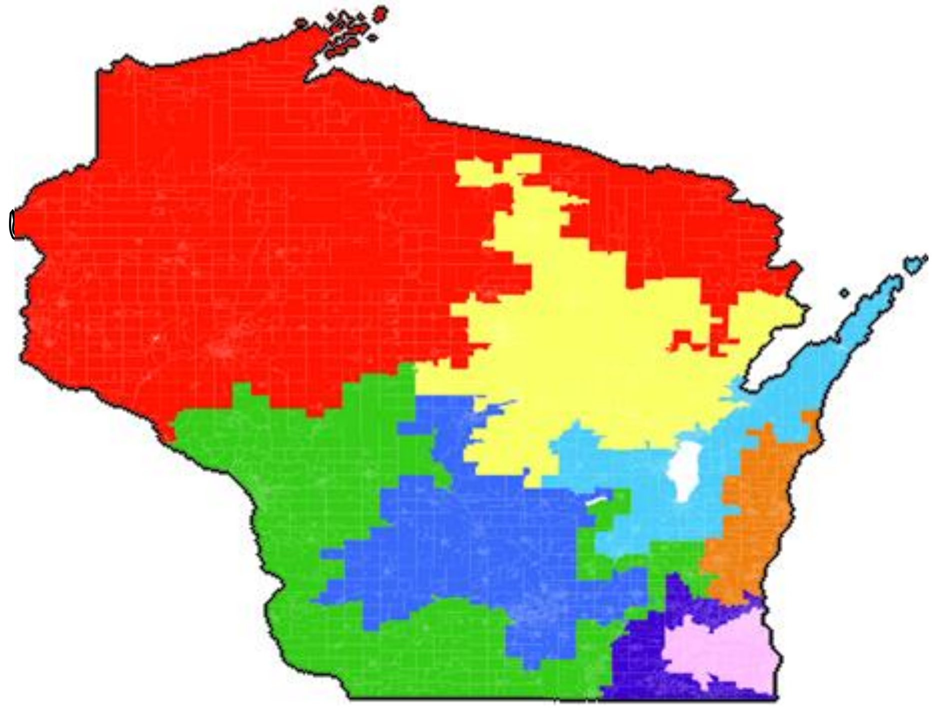
In this section, we present the results of Experiment C in detail (forming Wisconsin U.S. Congressional districts) based on Scenario 10 from Table 9-2. Table 9-4 shows the details of four sets of fair political districts.

Table 9-4: Results based on Scenario 10 (ID=CYSF) from Experiment C

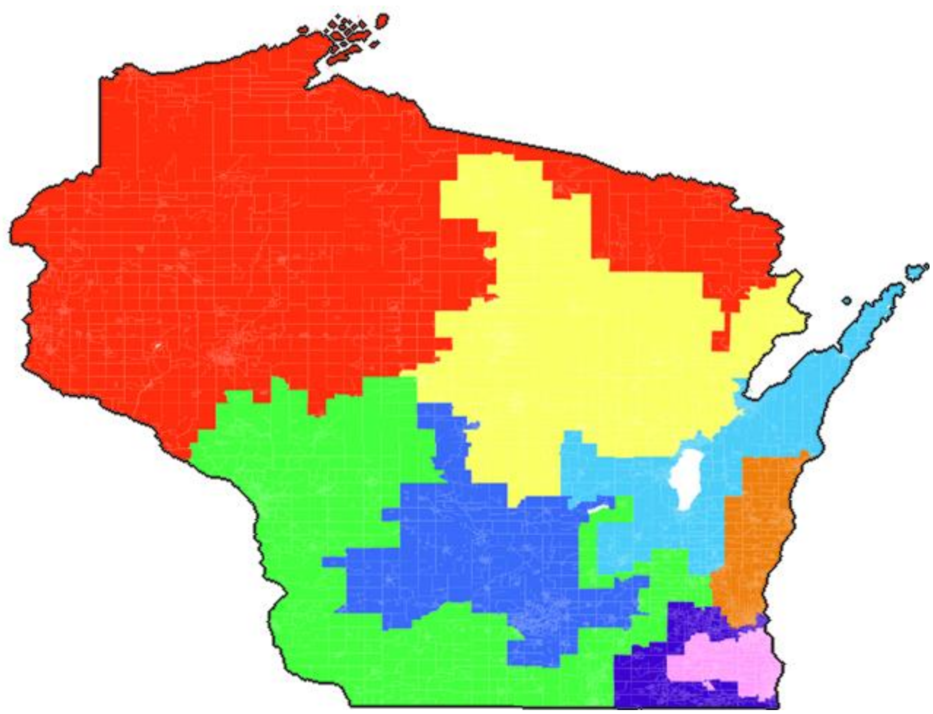
Case No.	District No.	Population	Population Deviation	Total Votes	No. Votes Cast for Republicans	No. Votes Cast for Democrats	Percentage of Votes Cast for Democrats	Compactness Score	Total Compactness Score
1	1	711,337	0.0002%	340,610	185,985	154,625	45.40%	0.2509	2.423310
	2	711,396	0.0085%	387,066	143,540	243,526	62.92%	0.1590	
	3	711,258	0.0109%	336,245	184,526	151,719	45.12%	0.1053	
	4	711,289	0.0066%	348,806	167,441	181,365	52.00%	0.1119	
	5	711,426	0.0127%	355,766	176,160	179,606	50.48%	0.2030	
	6	711,341	0.0007%	319,236	135,233	184,003	57.64%	0.7311	
	7	711,339	0.0005%	347,171	202,833	144,338	41.58%	0.4317	
	8	711,300	0.0050%	353,180	209,722	143,458	40.62%	0.4304	
2	1	711,269	0.0094%	334,195	199,544	134,651	40.29%	0.1525	2.035326
	2	711,293	0.0060%	354,079	141,500	212,579	60.04%	0.0841	
	3	711,353	0.0024%	346,062	199,316	146,746	42.40%	0.4626	
	4	711,291	0.0063%	308,469	140,341	168,128	54.50%	0.3085	
	5	711,327	0.0012%	402,880	174,379	228,501	56.72%	0.1019	
	6	711,312	0.0033%	353,484	209,005	144,479	40.87%	0.2925	
	7	711,422	0.0121%	336,507	165,083	171,424	50.94%	0.5250	
	8	711,419	0.0117%	352,404	176,272	176,132	49.98%	0.1081	
3	1	711,872	0.0754%	343,636	167,086	176,550	51.38%	0.2055	2.462435
	2	711,146	0.0267%	356,199	161,681	194,518	54.61%	0.5205	
	3	710,347	0.1390%	339,873	195,984	143,889	42.34%	0.3392	
	4	711,280	0.0078%	336,843	176,261	160,582	47.67%	0.2056	
	5	710,802	0.0750%	353,754	212,901	140,853	39.82%	0.2916	
	6	711,346	0.0014%	349,720	203,373	146,347	41.85%	0.2370	
	7	711,366	0.0043%	389,228	129,753	259,475	66.66%	0.2101	
	8	712,527	0.1675%	318,827	158,401	160,426	50.32%	0.4528	
4	1	711,643	0.0432%	383,133	155,911	227,222	0.593063	0.1255	2.768827
	2	711,441	0.0148%	333,671	187,879	145,792	43.69%	0.1457	
	3	711,387	0.0072%	354,716	204,138	150,578	42.45%	0.5496	
	4	711,493	0.0221%	341,300	153,223	188,077	55.11%	0.4749	
	5	710,656	0.0956%	328,546	110,495	218,051	66.37%	0.5621	
	6	711,565	0.0322%	349,595	209,316	140,279	40.13%	0.2327	
	7	711,203	0.0187%	339,520	163,525	175,995	51.84%	0.2910	
	8	711,298	0.0053%	357,599	220,953	136,646	38.21%	0.3873	

Each case in Table 9-4 consists of four Democratic and four Republican districts (F) that are equally populated (P). Setting the population deviation threshold to 0.5%, we reached less than 0.2% population deviation for all districts in the above four cases with slight improvement in compactness (C). Looking at the percentage of votes cast for Democrats in each district, we were able to form more competitive districts compared to the current congressional map of Wisconsin.

We selected two results from Table 9-4 and visualized them in Figures 9-8 (case 2 of Table 9-4/ solution C5) and 9-9 (case 4 of Table 9-4/ solution C6). Figures 9-10 and 9-11, respectively, show which districts from solutions C5 and C6 have potential to be Republican (red color) and which ones have Democratic tendency (blue color). In other words, Figures 9-10 and 9-11 show the final solutions, with four expected Democratic victories (blue) and four expected Republican victories (red). The color intensity displays the strength of tendency, which refers to the parties' competitiveness in each district.

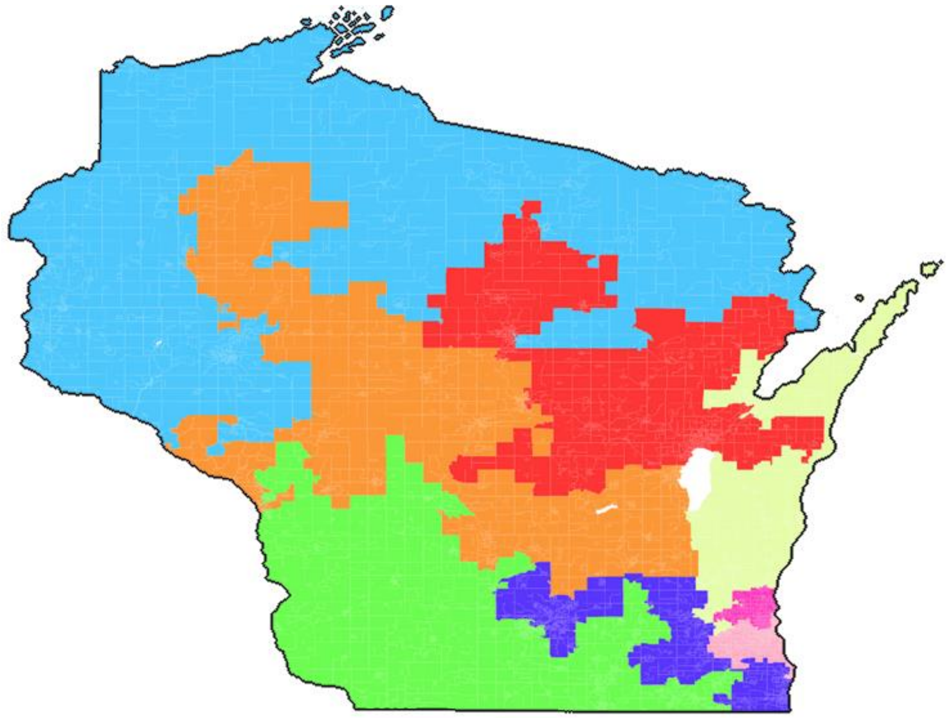


(a)

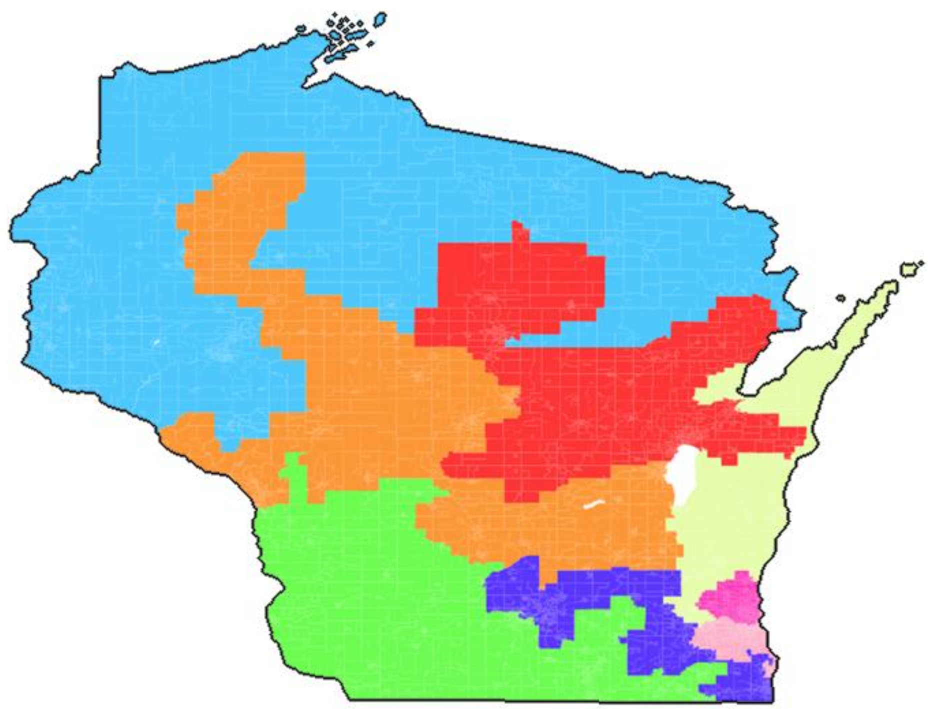


(b)

Figure 9-8: (a) Initial solution C5 and (b) final solution C5 considering objectives P, F, and C



(a)



(b)

Figure 9-9: (a) Initial solution C6 and (b) final solution C6 considering objectives P, F, and C

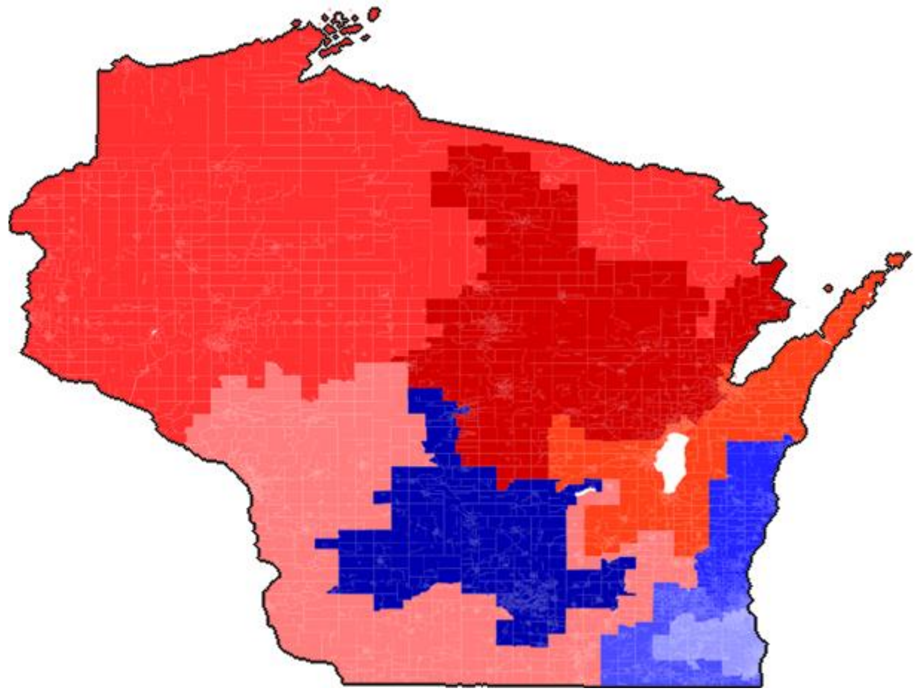


Figure 9-10: Final solution C5 with four expected Democratic victories (blue) and four expected Republican victories (red)

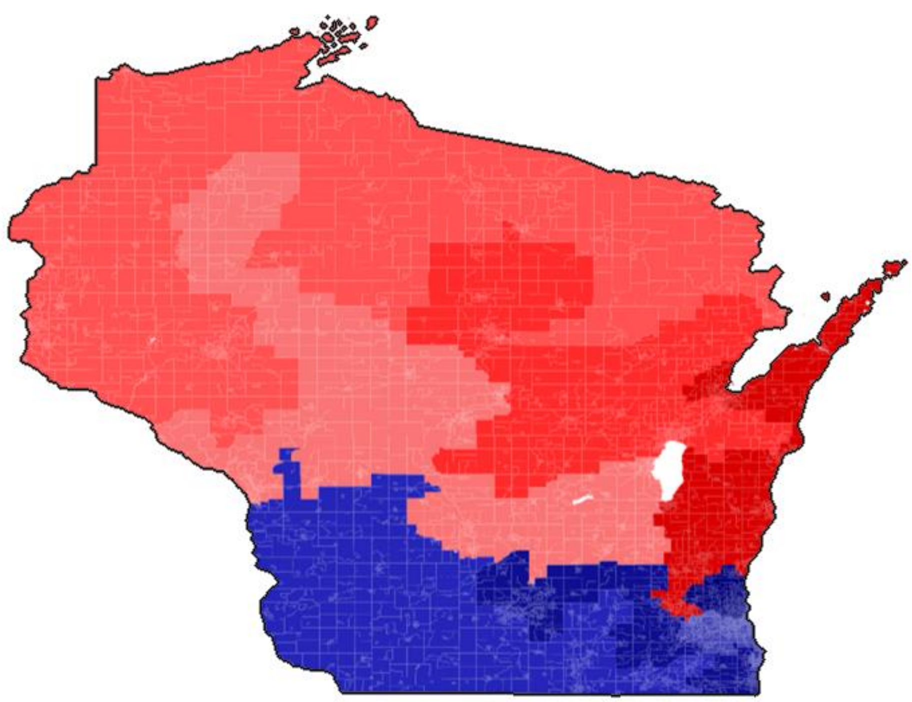


Figure 9-11: Final solution C6 with four expected Democratic victories (blue) and four expected Republican victories (red)

For one of the best results we had achieved based on Scenario 10, we show how the number of Democratic districts, the number of Republican districts, and the number of districts whose population deviation is over the defined threshold, change by running the code for an hour. Figure 9-12 shows the trend of those changes in first 400 seconds.

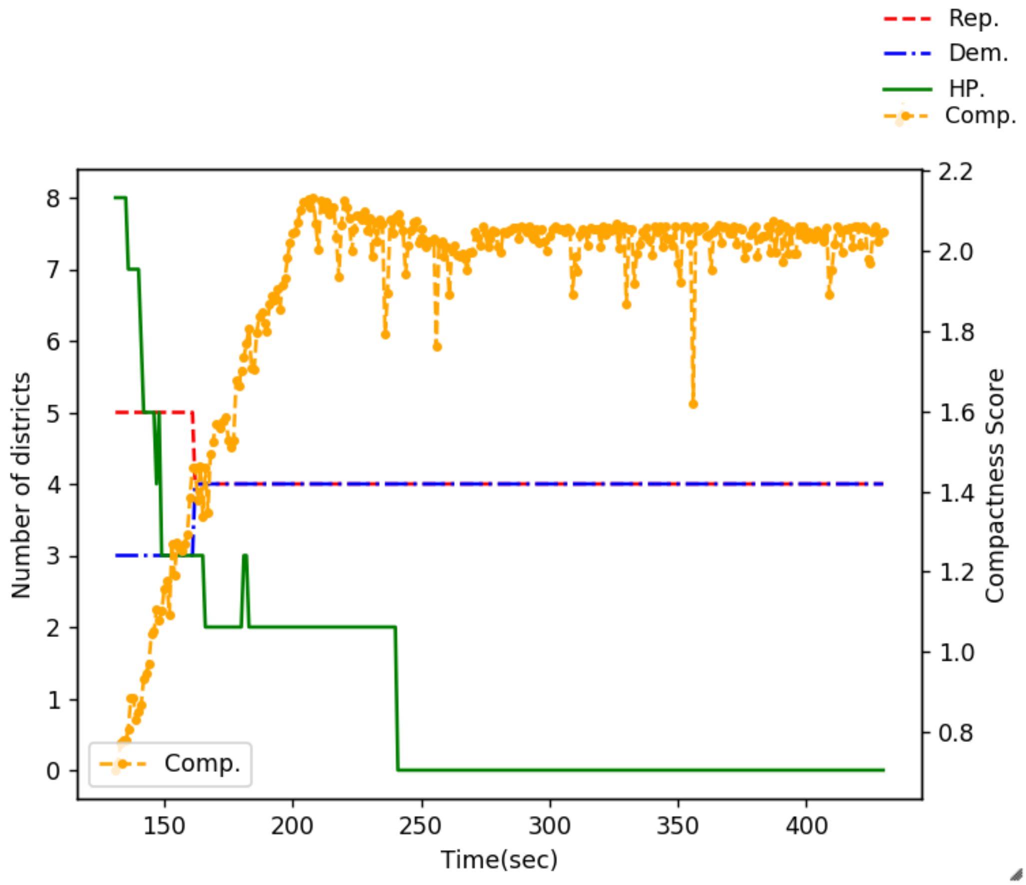


Figure 9-12: The trend of changes for the number of Democratic districts, Republican districts, the number of districts with population deviation over defined threshold, and compactness score during running the code for an hour for case 2 from Table 9-4

As shown in figure 9-12, the number of districts whose population deviation is over the defined deviation threshold (HP.) decreases to zero. The number of Democratic districts (Dem.) increases, and the number of Republican districts (Rep.) decreases to 4. Axis Y on the left side demonstrates the changes on Democratic and Republican districts, as well as changes to number of districts having out of range population. Axis Y on the right side shows the changes to compactness score. We run the code for an hour to improve compactness as much as possible. However, we can terminate the code execution when we reach our goal in population equality and political fairness.

Table 9-5 shows the summary of computational results by running the algorithm for forming politically fair Wisconsin's U.S. Congressional districts. Every time we run the code, the severe improvement in population equality and political fairness is noticeable. 30% of the results were perfect and we were able to achieve the politically and populationally fair districts, as well as having improvement in compactness score. As mentioned previously, the final answer is sensitive to both the assigned weights and the initial feasible solution, which is the best one among bunch of generated random initial solutions.

Table 9-5: Summary of computational results for forming Wisconsin's U.S. Congressional districts

Number of trials	50
Number of the perfect results (Fair plan)	15
Average number of districts in which the population deviation exceeds deviation threshold	1.1
Average number of districts in which Democrats expect to win	3.5
Average number of districts in which Republicans expect to win	4.5
Average improvement on compactness score	23%
Range of weights used for population equality	[0.1, 1]
Range of weights used for political fairness	[0.1, 1]
Range of weights used for compactness	[0.05, 0.1]

Although in this chapter we formed the congressional districts using different conditions, our main goal was creating sets of politically fair congressional districts with respect to population equality and compactness. We constructed fair U.S. Congressional maps for the State of Wisconsin containing four Democratic and four Republican districts. The population deviation of the formed districts exceeded our expectation and reached less than 0.2%. We did not intend to sacrifice political fairness in order to keep districts compact; however, in forming the U.S. Congressional districts, we achieved a reasonable level of improvement in district compactness.

The recent work by Swamy et al (2019), reviewed in Chapter 2, has been the only study that constructed Wisconsin U.S. Congressional districts focusing on political fairness. Although they have done valuable work to optimize a set of fairness metrics considering different aspects of fairness, their approach has some shortcomings. For congressional redistricting in Wisconsin, in terms of the population equality factor, they set the population deviation threshold for 4.8%. Also, they were able to reach an optimal answer with respect to only one objective at a time. In our model, we set the population deviation threshold for 0.5%, and we were able to form the districts with a population deviation less than 0.2%. Meeting population equality requirements in that level, we were also able to form politically fair districts based on seat-vote proportionality and simultaneously improve districts' compactness scores. All the mentioned achievements for forming U.S. Congressional districts unfold the advantages of the proposed algorithm.

The details of one of the results for fairly assigning the wards to eight Wisconsin U.S. Congressional districts (case 4 from Table 9-4) are illustrated in the appendix (Table A-2). In the next chapter, we present our experimental results for Wisconsin State Assembly and Wisconsin State Senate districts.

10. Wisconsin State Assembly and Wisconsin State Senate districts: Experimental setup, results, and discussion

In previous chapter, we constructed Wisconsin U.S. Congressional districts based on defined scenarios, and we were able to reach a politically fair map and equally populated districts with a slight improvement in compactness.

As stated before, based on the 2018 political map, the State of Wisconsin has 6,977 wards, 99 assembly districts and 33 senate districts. In this chapter, we assign 6,977 wards of the state to 99 political districts (Experiment A) and then, based on the established assembly districts, we form 33 senate districts (Experiment S). Each senate district contains exactly three contiguous assembly districts.

In the last chapter, we explained the difficulty in finding optimal results using all factors in parallel. The votes cast for Democrats in Wisconsin are mostly concentrated in three small areas with large populations. So creating politically fair and equally populated districts with respect to the compactness factor is a laborious process.

Despite this situation, we were able to keep the district relatively compact for U.S. Congressional districts while having perfect population distribution as well as absolute fairness politically. This was possible because the number of districts for the congressional map is small and assigning 6,977 wards to only eight districts is simpler than assigning the wards to 99 districts perfectly.

In our proposed algorithm for creating assembly districts, we minimize the penalties regarding population equality, political fairness (first strategy), and lack of compactness. The general form of the objective function would be as follows (which was explained in detail in Chapter 3).

Total penalty = $w_p * NPen_p + w_{f1} * NPen_{f1} + w_{c1} * NPen_{c1}$

We can improve population equality, political fairness, and compactness simultaneously; however, we cannot reach the optimum answer in every criterion this way. If we want to reach the goal of having politically fair assembly districts with closely equal populations, we need to sacrifice compactness. Therefore, we define eight scenarios for forming assembly districts, in which we do not consider compactness, and a single scenario, in which we only consider compactness. It should also be reiterated that all the districts are contiguous and meet the integrity requirement in both assembly and senate maps.

As with forming U.S. Congressional districts in the last chapter, for population equality, we considered two conditions, named strict (S) and loose (L). For the strict option, the population deviation threshold was set to 2%, which means the deviation of the average population for each district should be less than 2%. For the loose option, the population deviation threshold was set to 5%, by which a deviation of up to 5% from the average population was allowed for each district. In terms of the political fairness criterion, we consider three scenarios: fair, Democrat favoring, and Republican favoring. We have not considered improving compactness for most of the scenarios due to the reasons we explained earlier.

We set up and executed the code based on the defined scenarios. We ran the code for each scenario at least six times. The algorithm input parameters for Experiment A were set up as shown in Table 10-1.

Table 10-1: Algorithm input parameters for Experiment A

Start temperature (ST)	Number of iteration (n)	Cooling rate (α)	Number of initial feasible solution (G)	Population deviation	Run time (Sec)
0.01	50	0.97	100	2% and 5%	3600

Table 10-2 shows all the defined scenarios and one of the best answers for each. Table 10-3 shows some details of the best results from Table 10-2.

In Scenarios 1 and 5 (ANSN and ANLN), we only considered the population equality (P) factor for each district. In Scenarios 2 and 6 (ANSF and ANLF), we considered the population equality (P) and political fairness (F) factors. These scenarios were used in order to reach fair assembly districts.

In Scenarios 4 and 8 (ANSR and ANLR), we considered population equality (P) and tried to perform gerrymandering in favor of Republicans. As stated before, forming a gerrymandered assembly map in favor of Republicans for the State of Wisconsin is effortless; the main reason is because the Republican votes are well distributed all over the state compared to the Democratic votes. In Scenarios 3 and 7 (ANSD and ANLD), we tried to form a gerrymandered assembly map in favor of Democrats. Due to the reasons that are addressed earlier, we could not perform gerrymandering in favor of Democrats unless we sacrificed the population equality factor.

Table 10-2: Scenarios considered and summary of results for Experiment A

No.	Districts Formed	Compactness considered?	Population Deviation Requirement	Political Fairness Goal	ID	# Trials	Run Time (Sec)	Best result				
								HP	Dem Seats	Rep Seats	Total Compactness Score	Compactness Improvement
1	Assembly	No	Strict (2%)	None	ANSN	6	3600	0	38	61	13.29	-
2	Assembly	No	Strict (2%)	Fair	ANSF	30	3600	0	48	51	15.56	-
3	Assembly	No	Strict (2%)	Dem Favor	ANSD	6	3600	4	53	46	15.04	-
4	Assembly	No	Strict (2%)	Rep Favor	ANSR	6	3600	0	23	76	13.71	-
5	Assembly	No	Loose (5%)	None	ANLN	6	3600	0	37	62	16.28	-
6	Assembly	No	Loose (5%)	Fair	ANLF	30	3600	0	49	50	14.32	-
7	Assembly	No	Loose (5%)	Dem Favor	ANLD	6	3600	5	51	48	12.87	-
8	Assembly	No	Loose (5%)	Rep Favor	ANLR	6	3600	0	26	73	15.85	-
9	**Assembly**	**Yes**	**None**	**None**	**AYNN**	**6**	**3600**	**60**	**29**	**70**	**51.08**	**42%**

In Tables 10-2 and 10-3, “HP” is the number of districts whose population deviation from the average district’s population is more than the setup threshold. “Dem seats” and “Rep seats,” respectively, represent the number of seats that Democrats and Republican were expected to win based on the formed districts. w_p, w_{f1}, and w_{c1} were, respectively, the weights assigned to the penalties for population equality, political fairness, and lack of compactness. The cross sign (×) for the weights means that the corresponded criterion was not considered (w=0) in forming the political districts. The tick (✓) sign means that the criterion was weighted. The weights could have different values for different scenarios.

Table 10-3: Details of the best result for each scenario in Experiment A

No.	ID	w_p	w_{f1}	w_{c1}	Normalization factors μ_p	μ_{f1}	μ_{c1}	σ_p	σ_{f2}	σ_{c1}	HP	Dem Seats	Rep Seats	# Black Majority Districts	# Hispanic Majority Districts	Revised Eff. Gap	Fairness Gap	Best Answer Time (Sec)
1	ANSN	✓	×	×	2,835,390	20.33	6114	24,296.20	2.20	37.04	0	38	61	4	1	0.12131	0.12132	505
2	ANSF	✓	✓	×	2,867,555	20.45	6085	24,951.50	2.56	36.87	0	48	51	4	1	0.02004	0.02004	3,600
3	ANSD	✓	✓	×	2,850,062	19.60	6116	24,611.30	1.81	36.13	4	53	46	4	0	0.03195	0.03195	3,600
4	ANSR	✓	✓	×	2,869,367	19.70	6138	24,161.60	4.38	37.05	0	23	76	4	1	0.26486	0.26488	3,600
5	ANLN	✓	×	×	2,840,142	19.69	6128	24,615.60	1.93	36.66	0	37	62	4	1	0.12403	0.12404	2,041
6	ANLF	✓	✓	×	2,855,893	19.46	6092	24,419.30	3.65	36.50	0	49	50	3	1	0.01390	0.0139	2,791
7	ANLD	✓	✓	×	2,873,851	20.49	6069	24,908.80	3.05	36.67	5	51	48	4	2	0.00967	0.00967	3,600
8	ANLR	✓	✓	×	2,816,501	19.35	6066	23,763.30	3.81	35.92	0	26	73	3	1	0.23908	0.23909	3,600
9	AYNN	✓	×	✓	2,885,365	19.65	6170	24,677.60	2.88	36.91	60	29	70	1	0	0.13099	0.131	3,600

μ_p, μ_{f1}, μ_{c1}, σ_p, σ_{f1}, and σ_{c1} are normalization factors. We normalized the original value of different types of penalties in the objective function based on calculated mean and standard deviation averaged over initial feasible solutions. The columns "Black Districts" and "Hispanic Districts," respectively, show the number of districts in which the African-American and Hispanic populations were the majority of the district's population. In Chapter 8, we addressed the concept of the Voting Rights Act and some ideas around it. Because the Voting Rights Act is a controversial factor, we decided not to consider this factor in our model. However, we only observed how many African-American and Hispanic districts were formed after constructing the assembly maps. Considering the political fairness factor as a priority, surprisingly, we noticed that the number of the aforementioned districts was very close to what political experts who fight for minorities' rights claimed. In the beginning, we executed the code based on Scenario 9 for an hour to form compact assembly districts. We then visualized the corresponding maps (solution A1), as shown in Figures 10-1 (initial map) and 10-2 (final map).

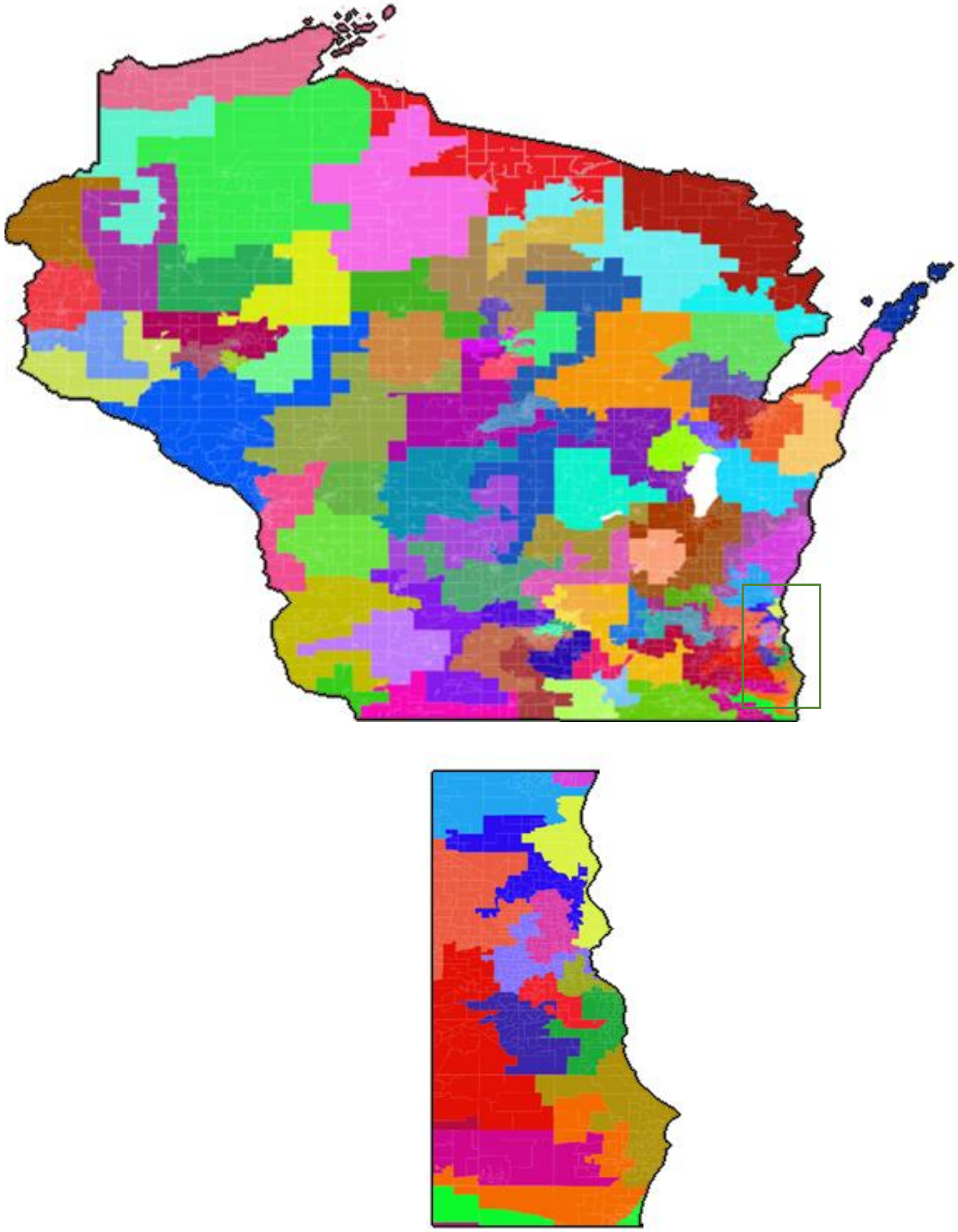


Figure 10-1: Initial solution A1 with Milwaukee and Racine detail

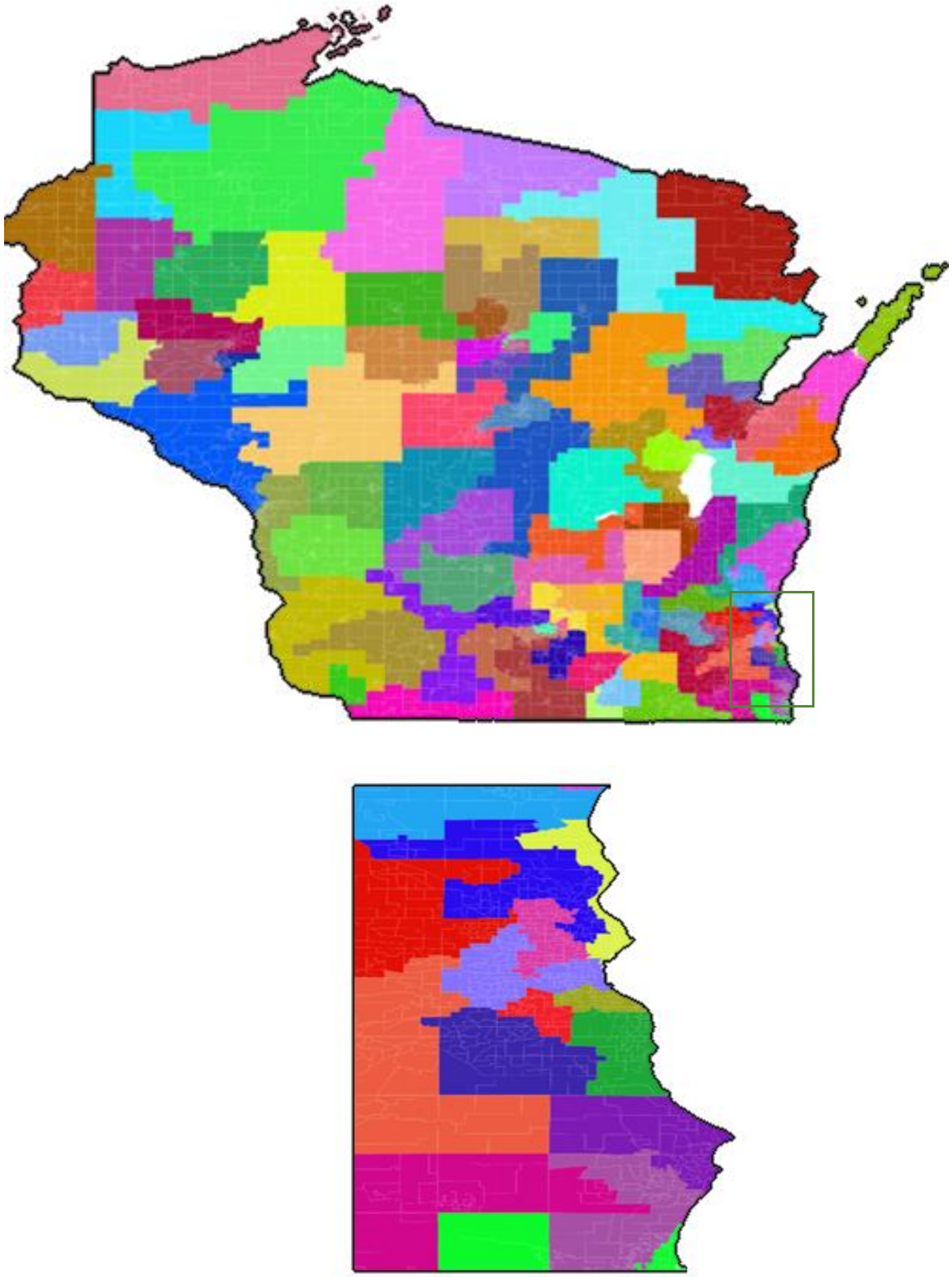


Figure 10-2: Final solution A1 considering objective C with Milwaukee and Racine detail

As stated earlier, we aimed to form politically fair and equally populated assembly districts. Only Scenarios 2 and 6 were defined based on our desired goal; however, we sacrificed improving compactness in order to get a nearly perfect answer in other criteria. In Table 10-4 we presented the details of the results for forming fair political districts (50 Republican and 49 Democratic districts) with closely equal population (less than 5% population deviation) based on Scenario 6 of Experiment A (ID=ANLF). We then visualized the corresponding assembly map shown in Figure 10-3 (solution A2).

Besides, Figure 10-4 shows which assembly districts have the potential to be Republican (red color) and which ones have a Democratic tendency (blue color) for the corresponding assembly map. Final solution A2 provides 49 expected Democratic victories (blue) and 50 expected Republican victories (red). The color intensity shows the strength of this tendency, which illustrates districts competitiveness.

Table 10-4: Best result for Scenario 6 (ID = ANLF) in Experiment A

District No.	Population	Population Deviation	No. Dem. Votes	No. Rep. Votes	Total Votes	Democrats' Percentage	Compactness Score
1	57,945	0.81%	11,972	14,369	26,341	45.5%	0.118
2	57,459	0.04%	13,749	13,703	27,452	50.1%	0.256
3	57,852	0.64%	10,973	17,871	28,844	38.0%	0.062
4	57,314	0.29%	9,025	17,071	26,096	34.6%	0.072
5	57,507	0.04%	11,451	14,494	25,945	44.1%	0.054
6	57,440	0.07%	34,274	5,715	39,989	85.7%	0.090
7	57,607	0.22%	13,316	13,088	26,404	50.4%	0.062
8	58,292	1.41%	17,820	9,905	27,725	64.3%	0.097
9	57,324	0.27%	10,417	17,248	27,665	37.7%	0.052
10	57,843	0.63%	12,352	21,231	33,583	36.8%	0.040
11	58,588	1.92%	16,598	12,572	29,170	56.9%	0.151
12	57,518	0.06%	11,156	11,153	22,309	50.0%	0.079
13	57,364	0.20%	23,111	9,491	32,602	70.9%	0.260
14	57,518	0.06%	11,044	15,704	26,748	41.3%	0.046
15	58,278	1.39%	20,044	11,722	31,766	63.1%	0.080
16	57,798	0.55%	17,839	10,666	28,505	62.6%	0.091
17	58,176	1.21%	16,325	12,562	28,887	56.5%	0.076
18	58,461	1.70%	10,787	16,896	27,683	39.0%	0.076
19	57,405	0.13%	12,257	14,600	26,857	45.6%	0.185
20	59,166	2.93%	12,179	18,996	31,175	39.1%	0.087
21	57,624	0.25%	13,955	13,911	27,866	50.1%	0.057
22	57,593	0.19%	8,929	21,338	30,267	29.5%	0.055
23	56,945	0.93%	11,532	16,393	27,925	41.3%	0.138
24	57,187	0.51%	27,054	7,820	34,874	77.6%	0.156
25	59,662	3.79%	24,015	6,330	30,345	79.1%	0.085
26	56,877	1.05%	13,560	13,490	27,050	50.1%	0.108
27	57,530	0.08%	13,450	13,387	26,837	50.1%	0.063
28	55,669	3.15%	9,874	15,758	25,632	38.5%	0.351
29	57,529	0.08%	15,253	8,525	23,778	64.1%	0.058
30	57,864	0.67%	12,375	11,105	23,480	52.7%	0.217
31	57,807	0.57%	8,645	22,237	30,882	28.0%	0.029
32	57,956	0.83%	22,358	2,606	24,964	89.6%	0.142
33	57,279	0.35%	10,120	19,648	29,768	34.0%	0.073
34	57,315	0.29%	13,622	13,566	27,188	50.1%	0.180
35	55,511	3.43%	11,924	11,891	23,815	50.1%	0.163
36	57,285	0.34%	13,699	13,494	27,193	50.4%	0.080
37	57,362	0.21%	15,397	13,947	29,344	52.5%	0.244
38	57,886	0.70%	16,756	12,285	29,041	57.7%	0.081
39	57,929	0.78%	13,598	13,547	27,145	50.1%	0.243
40	55,524	3.41%	13,020	12,855	25,875	50.3%	0.284
41	57,547	0.11%	15,757	4,270	20,027	78.7%	0.090
42	57,313	0.29%	14,660	14,507	29,167	50.3%	0.455
43	57,983	0.87%	11,762	3,162	14,924	78.8%	0.082
44	56,611	1.51%	11,436	16,672	28,108	40.7%	0.089
45	58,179	1.21%	10,282	17,593	27,875	36.9%	0.047
46	57,460	0.04%	22,497	8,505	31,002	72.6%	0.209
47	57,339	0.25%	11,981	16,226	28,207	42.5%	0.236
48	57,669	0.33%	21,303	1,939	23,242	91.7%	0.083
49	59,723	3.90%	10,198	20,545	30,743	33.2%	0.036
50	59,811	4.05%	10,861	23,369	34,230	31.7%	0.038

District No.	Population	Population Deviation	No. Dem. Votes	No. Rep. Votes	Total Votes	Democrats' Percentage	Compactness Score
51	58,456	1.70%	23,236	1,718	24,954	93.1%	0.094
52	57,609	0.22%	17,540	4,320	21,860	80.2%	0.071
53	57,796	0.55%	11,545	17,943	29,488	39.2%	0.032
54	57,679	0.34%	13,185	10,728	23,913	55.1%	0.091
55	58,099	1.07%	12,087	14,450	26,537	45.5%	0.093
56	54,657	4.91%	10,183	16,042	26,225	38.8%	0.406
57	57,254	0.40%	15,868	13,018	28,886	54.9%	0.392
58	58,432	1.65%	12,689	15,209	27,898	45.5%	0.118
59	58,478	1.73%	11,872	15,264	27,136	43.8%	0.130
60	56,266	2.11%	10,407	18,231	28,638	36.3%	0.150
61	57,974	0.86%	12,686	20,013	32,699	38.8%	0.108
62	56,054	2.48%	9,008	15,848	24,856	36.2%	0.339
63	55,222	3.93%	9,428	15,959	25,387	37.1%	0.121
64	57,382	0.17%	9,572	16,596	26,168	36.6%	0.364
65	57,158	0.56%	11,822	16,852	28,674	41.2%	0.242
66	57,574	0.16%	23,267	7,919	31,186	74.6%	0.115
67	58,862	2.40%	10,186	22,281	32,467	31.4%	0.032
68	59,159	2.92%	14,013	9,244	23,257	60.3%	0.124
69	58,827	2.34%	12,521	20,507	33,028	37.9%	0.091
70	56,866	1.07%	11,317	15,442	26,759	42.3%	0.465
71	55,367	3.68%	14,279	13,420	27,699	51.6%	0.264
72	55,286	3.82%	10,003	16,905	26,908	37.2%	0.153
73	56,922	0.97%	9,263	16,735	25,998	35.6%	0.131
74	56,963	0.90%	12,728	15,800	28,528	44.6%	0.230
75	58,110	1.09%	10,730	22,254	32,984	32.5%	0.038
76	57,414	0.12%	16,137	12,548	28,685	56.3%	0.071
77	57,690	0.36%	12,848	10,028	22,876	56.2%	0.048
78	57,385	0.17%	31,572	4,480	36,052	87.6%	0.085
79	57,504	0.04%	16,001	13,538	29,539	54.2%	0.056
80	56,948	0.93%	9,282	18,295	27,577	33.7%	0.083
81	56,945	0.93%	10,742	18,086	28,828	37.3%	0.836
82	57,677	0.34%	13,737	12,413	26,150	52.5%	0.039
83	58,501	1.77%	10,771	24,193	34,964	30.8%	0.035
84	57,360	0.21%	9,895	20,008	29,903	33.1%	0.272
85	57,509	0.05%	10,329	16,380	26,709	38.7%	0.053
86	56,329	2.01%	12,800	12,781	25,581	50.0%	0.189
87	58,361	1.53%	11,062	19,223	30,285	36.5%	0.047
88	57,867	0.67%	12,952	18,171	31,123	41.6%	0.046
89	57,472	0.02%	26,006	9,490	35,496	73.3%	0.118
90	57,872	0.68%	14,857	17,416	32,273	46.0%	0.418
91	57,499	0.03%	14,908	11,084	25,992	57.4%	0.172
92	57,653	0.30%	9,382	17,168	26,550	35.3%	0.051
93	57,675	0.34%	14,182	13,387	27,569	51.4%	0.072
94	55,779	2.96%	15,157	12,860	28,017	54.1%	0.126
95	57,514	0.06%	12,828	12,759	25,587	50.1%	0.085
96	55,329	3.74%	10,367	17,451	27,818	37.3%	0.239
97	56,054	2.48%	14,663	13,954	28,617	51.2%	0.293
98	57,377	0.18%	13,244	18,737	31,981	41.4%	0.235
99	57,696	0.37%	12,921	18,314	31,235	41.4%	0.047

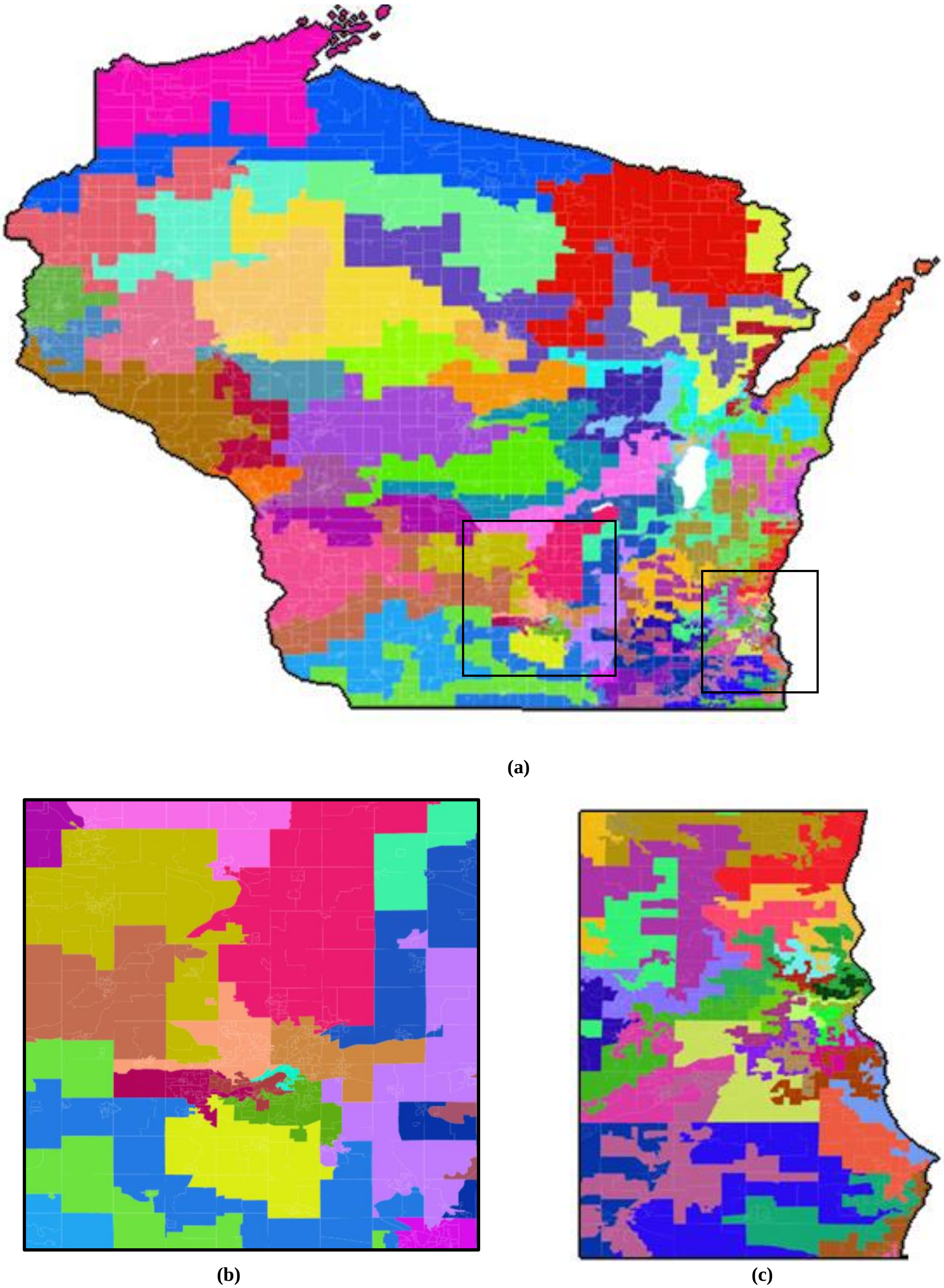


Figure 10-3: (a) Final solution A2 considering objectives P and F with (b) Madison area detail and (c) Milwaukee area detail

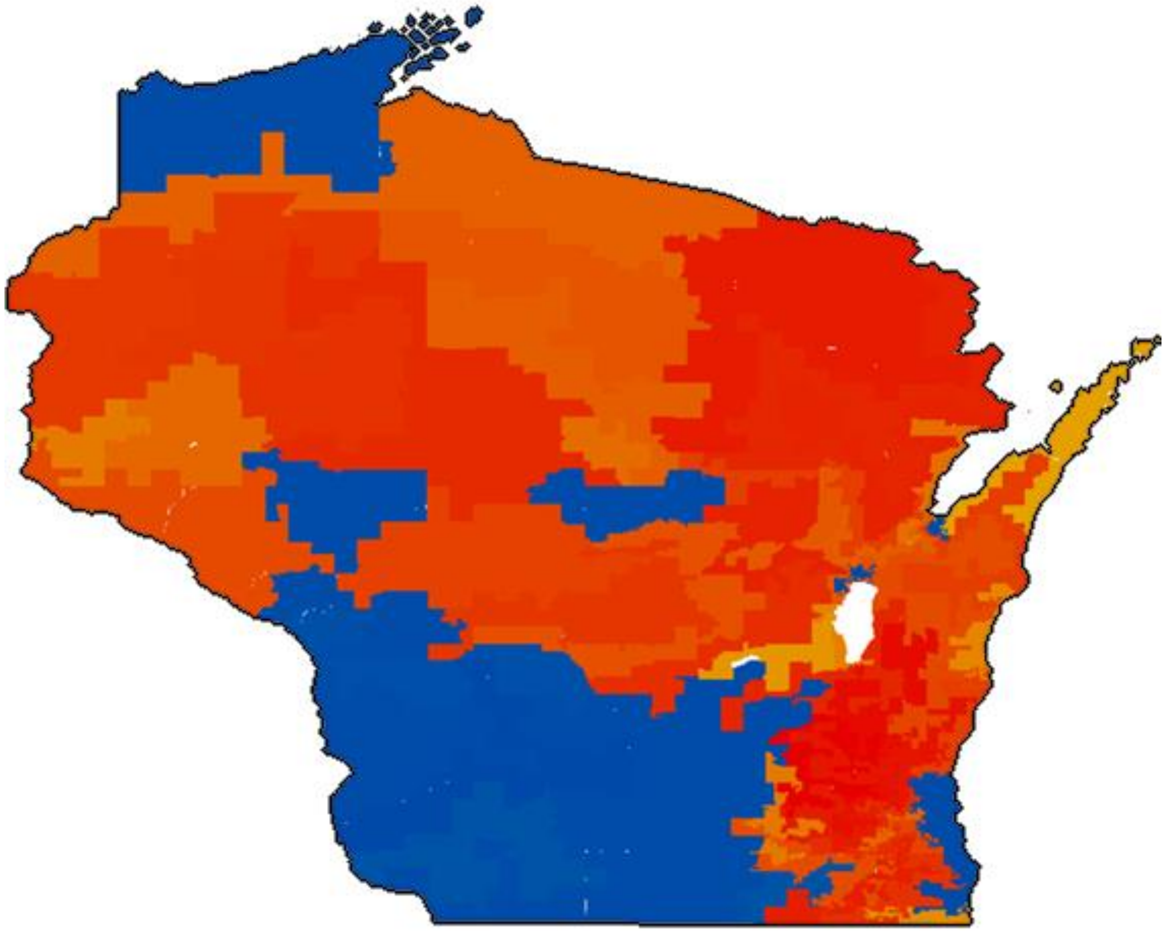


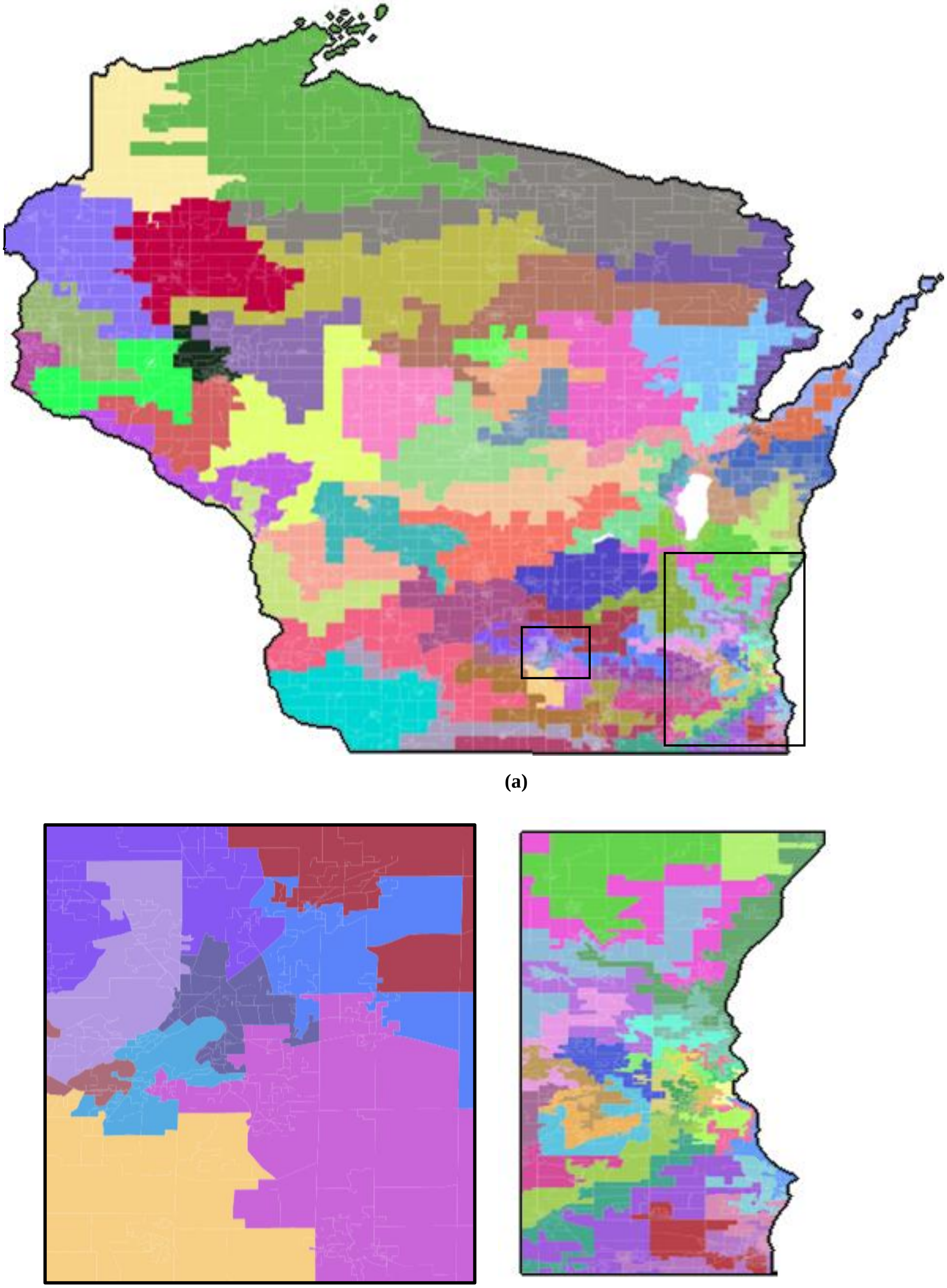
Figure 10-4: Final solution A2 with 49 expected Democratic victories (blue) and 50 expected Republican victories (red)

In Table 10-5 we also presented the details of the results for forming fair political districts (51 Republican and 48 Democratic districts) with equal population (less than 2% population deviation) based on Scenario 2 of Experiment A (ID=ANSF). We then visualized the corresponding assembly map, as shown in Figure 10-5 (solution A3).

In addition, Figure 10-6 shows which assembly districts have the potential to be Republican (red color) and which ones have a Democratic tendency (blue color) for the corresponding assembly map. Final solution A3 indicates 48 expected Democratic victories (blue) and 51 expected Republican victories (red).

Table 10-5: Best result for Scenario 2 (ID = ANSF) in Experiment A

District No.	Population	Population Deviation	No. Dem. Votes	No. Rep. Votes	Total Votes	Democrats' Percentage	Compactness Score
1	57,108	0.65%	15,177	15,145	30,322	50.1%	0.385
2	56,994	0.85%	15,235	12,252	27,487	55.4%	0.123
3	57,575	0.16%	14,524	14,242	28,766	50.5%	0.051
4	57,360	0.21%	11,756	15,830	27,586	42.6%	0.124
5	57,154	0.57%	16,897	12,770	29,667	57.0%	0.171
6	56,977	0.88%	11,719	21,445	33,164	35.3%	0.181
7	57,443	0.07%	8,902	17,099	26,001	34.2%	0.183
8	57,001	0.84%	15,043	14,130	29,173	51.6%	0.203
9	57,342	0.24%	10,032	17,984	28,016	35.8%	0.247
10	57,388	0.16%	11,768	13,769	25,537	46.1%	0.363
11	57,755	0.48%	18,162	10,713	28,875	62.9%	0.073
12	57,219	0.46%	11,748	15,324	27,072	43.4%	0.299
13	57,435	0.08%	14,107	14,014	28,121	50.2%	0.501
14	57,343	0.24%	14,997	13,416	28,413	52.8%	0.174
15	57,612	0.23%	14,417	13,042	27,459	52.5%	0.061
16	57,112	0.64%	14,713	12,698	27,411	53.7%	0.221
17	57,410	0.12%	10,391	15,991	26,382	39.4%	0.313
18	57,892	0.71%	15,364	14,707	30,071	51.1%	0.069
19	56,423	1.84%	10,761	19,178	29,939	35.9%	0.087
20	57,450	0.06%	9,074	19,697	28,771	31.5%	0.137
21	57,699	0.38%	16,004	10,686	26,690	60.0%	0.126
22	57,154	0.57%	9,463	18,306	27,769	34.1%	0.119
23	58,404	1.60%	13,223	21,330	34,553	38.3%	0.117
24	56,586	1.56%	9,272	16,201	25,473	36.4%	0.589
25	57,303	0.31%	12,290	15,227	27,517	44.7%	0.181
26	57,200	0.49%	10,397	14,089	24,486	42.5%	0.133
27	58,229	1.30%	10,965	19,082	30,047	36.5%	0.038
28	57,490	0.01%	13,558	8,631	22,189	61.1%	0.110
29	57,242	0.42%	10,851	16,713	27,564	39.4%	0.106
30	57,376	0.18%	21,509	10,173	31,682	67.9%	0.186
31	57,286	0.34%	9,764	18,305	28,069	34.8%	0.101
32	57,213	0.47%	13,710	16,727	30,437	45.0%	0.791
33	57,496	0.02%	14,691	13,177	27,868	52.7%	0.066
34	57,379	0.18%	23,357	8,209	31,566	74.0%	0.283
35	57,406	0.13%	9,196	13,834	23,030	39.9%	0.218
36	57,408	0.13%	12,449	14,697	27,146	45.9%	0.165
37	57,835	0.61%	10,367	23,311	33,678	30.8%	0.042
38	57,731	0.43%	14,226	11,390	25,616	55.5%	0.077
39	57,925	0.77%	8,647	23,633	32,280	26.8%	0.033
40	57,501	0.03%	14,624	11,220	25,844	56.6%	0.077
41	58,160	1.18%	27,357	8,240	35,597	76.9%	0.148
42	57,366	0.20%	12,755	14,727	27,482	46.4%	0.313
43	57,345	0.24%	15,487	14,844	30,331	51.1%	0.250
44	58,009	0.92%	20,592	3,040	23,632	87.1%	0.073
45	57,740	0.45%	13,871	13,120	26,991	51.4%	0.090
46	57,989	0.88%	10,527	17,710	28,237	37.3%	0.059
47	57,470	0.02%	12,775	12,761	25,536	50.0%	0.150
48	57,272	0.36%	9,952	17,984	27,936	35.6%	0.366
49	57,971	0.85%	18,001	10,126	28,127	64.0%	0.079
50	57,728	0.43%	20,298	1,325	21,623	93.9%	0.106
51	57,476	0.01%	31,350	5,699	37,049	84.6%	0.131
52	57,462	0.03%	14,779	13,679	28,458	51.9%	0.172
53	57,228	0.44%	14,795	14,355	29,150	50.8%	0.122
54	57,342	0.24%	9,642	17,857	27,499	35.1%	0.424
55	57,469	0.02%	12,649	15,843	28,492	44.4%	0.202
56	57,382	0.17%	9,601	15,138	24,739	38.8%	0.293
57	57,305	0.31%	13,881	13,189	27,070	51.3%	0.269
58	57,448	0.06%	8,376	17,207	25,583	32.7%	0.116
59	57,343	0.24%	11,414	18,702	30,116	37.9%	0.096
60	57,460	0.04%	10,961	16,194	27,155	40.4%	0.214
61	57,645	0.28%	9,586	21,323	30,909	31.0%	0.038
62	57,413	0.12%	13,723	12,254	25,977	52.8%	0.147
63	57,335	0.26%	15,182	13,769	28,951	52.4%	0.214
64	57,299	0.32%	11,107	16,518	27,625	40.2%	0.079
65	57,786	0.53%	13,855	2,467	16,322	84.9%	0.076
66	58,114	1.10%	11,648	20,862	32,510	35.8%	0.030
67	57,366	0.20%	9,752	18,206	27,958	34.9%	0.124
68	57,843	0.63%	13,964	19,253	33,217	42.0%	0.070
69	57,357	0.22%	12,468	11,674	24,142	51.6%	0.067
70	57,494	0.02%	11,836	11,766	23,602	50.1%	0.088
71	57,714	0.40%	12,870	12,436	25,306	50.9%	0.146
72	57,441	0.07%	9,869	15,870	25,739	38.3%	0.162
73	57,325	0.27%	13,900	13,809	27,709	50.2%	0.312
74	58,125	1.12%	23,537	4,714	28,251	83.3%	0.074
75	57,726	0.43%	9,968	16,959	26,927	37.0%	0.050
76	56,987	0.86%	17,821	12,060	29,881	59.6%	0.104
77	57,795	0.55%	19,317	11,414	30,731	62.9%	0.080
78	57,747	0.46%	12,419	21,672	34,091	36.4%	0.081
79	57,970	0.85%	22,150	2,327	24,477	90.5%	0.048
80	57,450	0.06%	9,988	16,148	26,136	38.2%	0.153
81	57,817	0.58%	22,037	4,371	26,408	83.4%	0.097
82	57,056	0.74%	10,743	17,410	28,153	38.2%	0.193
83	57,367	0.20%	30,658	5,505	36,163	84.8%	0.226
84	57,427	0.10%	10,386	16,891	27,277	38.1%	0.138
85	57,744	0.46%	10,812	21,430	32,242	33.5%	0.042
86	57,596	0.20%	11,155	3,885	15,040	74.2%	0.080
87	57,092	0.68%	30,098	4,851	34,949	86.1%	0.108
88	57,542	0.10%	11,629	19,036	30,665	37.9%	0.067
89	57,144	0.59%	12,256	16,517	28,773	42.6%	0.156
90	57,439	0.07%	22,471	11,487	33,958	66.2%	0.107
91	57,575	0.16%	11,110	17,360	28,470	39.0%	0.045
92	57,651	0.29%	11,925	17,922	29,847	40.0%	0.052
93	56,569	1.59%	12,365	12,337	24,702	50.1%	0.257
94	57,381	0.18%	10,399	20,081	30,480	34.1%	0.197
95	58,077	1.04%	12,766	11,855	24,621	51.9%	0.095
96	57,551	0.12%	11,561	20,048	31,609	36.6%	0.039
97	57,394	0.15%	11,951	18,059	30,010	39.8%	0.116
98	57,449	0.06%	11,840	15,081	26,921	44.0%	0.072
99	58,062	1.01%	19,105	5,686	24,791	77.1%	0.130



(a)

(b) (c)

Figure 10-5: (a) Final solution A3 considering objectives P and F with (b) Madison area detail and (c) Milwaukee area detail

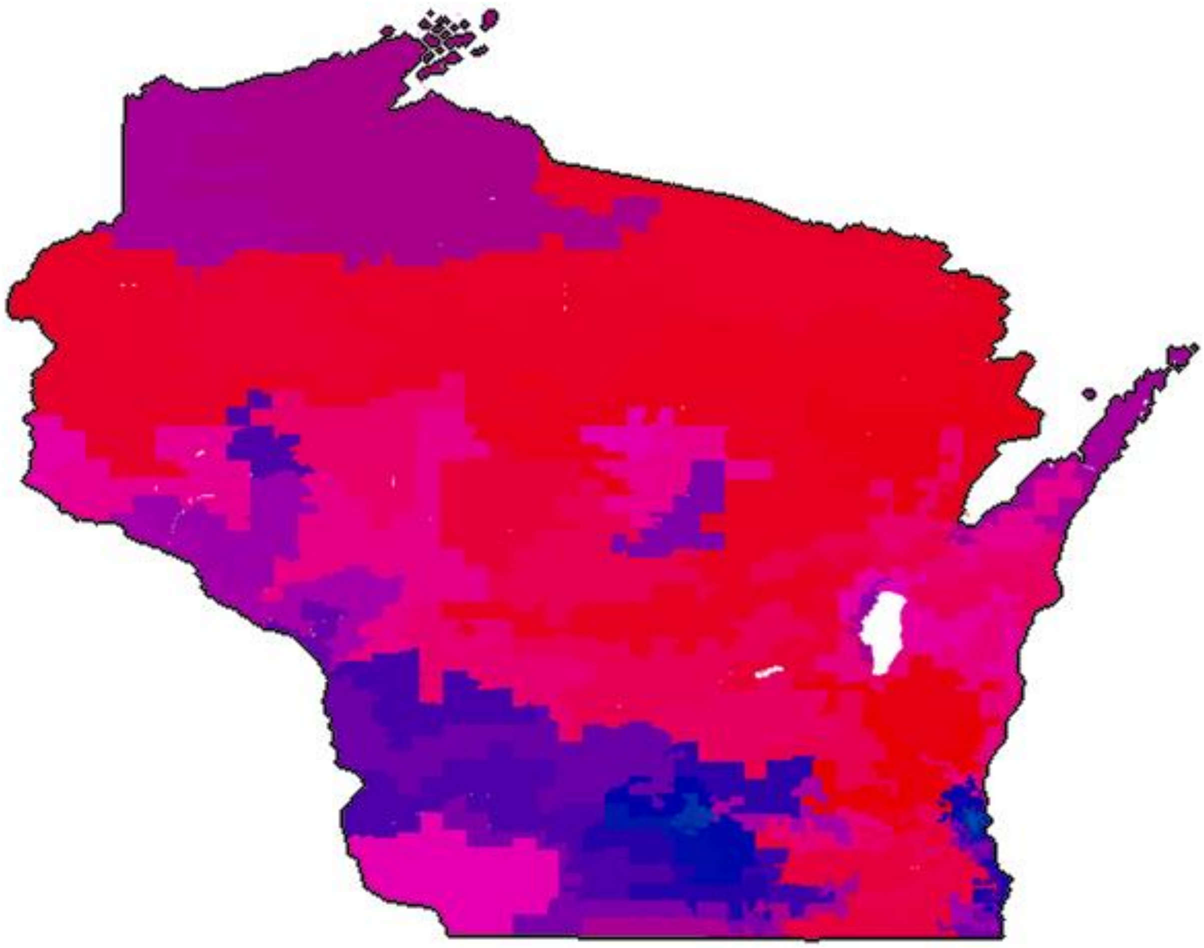


Figure 10-6: Final solution A3 with 48 expected Democratic victories (blue) and 51 expected Republican victories (red)

Senate districts for most of the states are usually created from a set of assembly districts by which every three or two adjacent assembly districts must be nested within one senate district. So after constructing politically fair and equally populated assembly districts for Wisconsin, we formed a senate map as its result. To form 33 Wisconsin State Senate districts (Experiment S), we assigned every three assembly districts to one senate district. The assembly districts assigned to each senate district must be adjacent. We used the results based on Scenarios 2 and 6 from Table 10-2 and then defined six scenarios, as shown in Table 10-6. Since the formed fair assembly map includes districts with almost equal population, consequently the senate districts meet the population equality requirement. Therefore, we did not set any threshold for population deviation for these scenarios. Compactness was not considered in forming the state senate districts either. In terms of the political fairness criterion, we considered three scenarios: fair, Democrat favoring, and Republican favoring. First three scenarios of Table 10-6 are related to Scenario 6 from Table 10-2 (forming fair assembly districts with loose population deviation), and the other three scenarios are related to Scenario 2 from Table 10-2 (the results of forming fair assembly districts with strict population deviation).

Table 10-6: Scenarios considered and summary of results for Experiment S

No.	Districts Formed	Compactness considered?	Population Deviation Requirement	Political Fairness Goal	ID	# Trials	Run Time (Sec)	Best Result				Comments
								HP	Dem Seats	Rep Seats	Best Answer Time (Sec)	
1	Senate	No	N/A	Fair	SNLF	6	3,600	0	16	17	3	Used ALFN results
2	Senate	No	N/A	Dem Favor	SNLD	6	3,600	0	17	16	1,507	Used ALFN results
3	Senate	No	N/A	Rep Favor	SNLR	6	3,600	0	7	26	2	Used ALFN results
4	Senate	No	N/A	Fair	SNSF	6	3,600	0	16	17	4	Used ASFN results
5	Senate	No	N/A	Dem Favor	SNSD	6	3,600	2	17	16	70	Used ASFN results
6	Senate	No	N/A	Rep Favor	SNSR	6	3,600	0	6	27	137	Used SLFN results

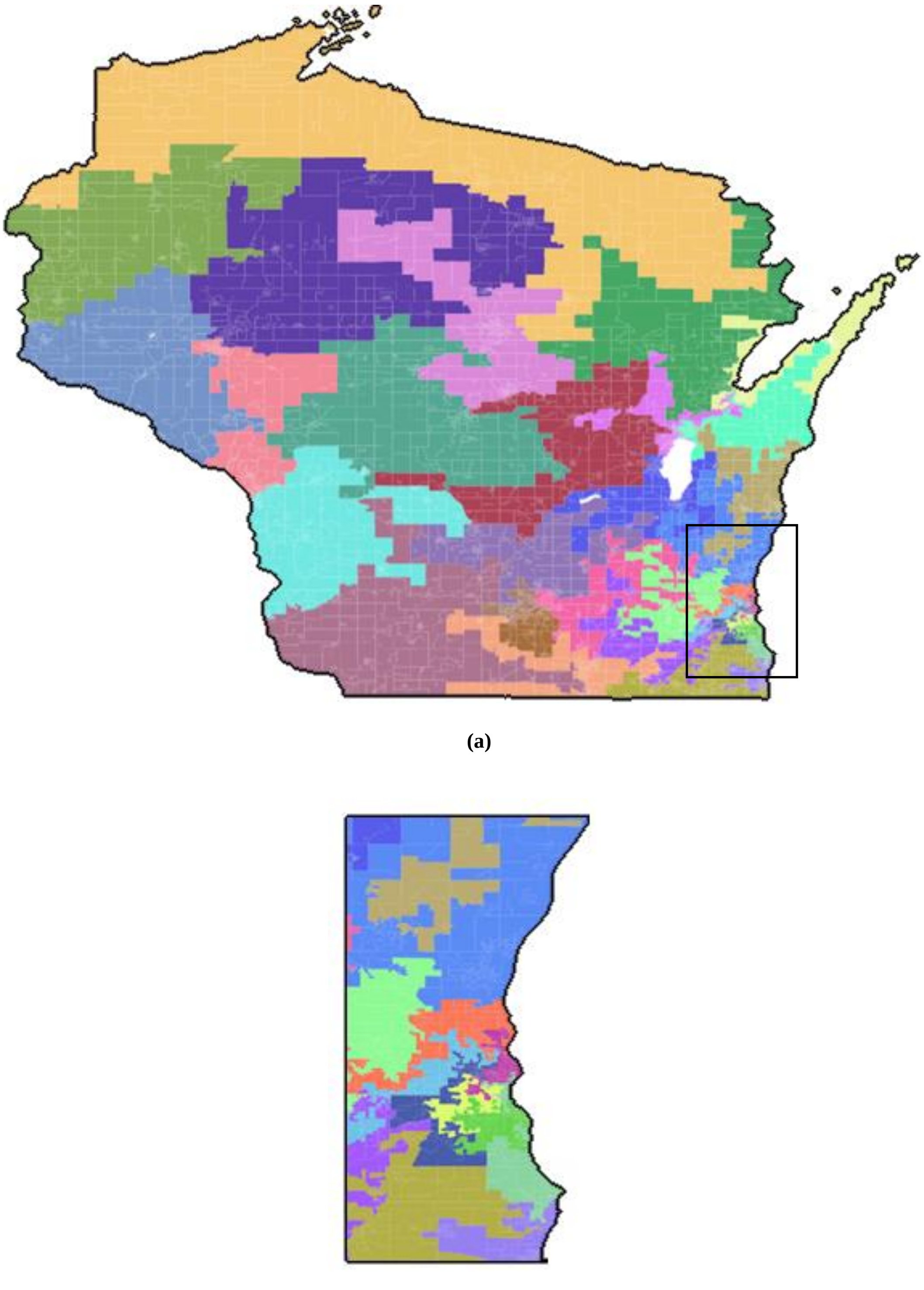
We ran the code for each scenario at least six times. Algorithm input parameters for Experiment S are set up as shown in Table 10-7.

Table 10-7: Algorithm input parameters for Experiment S

Start temperature (ST)	Number of iteration (n)	Cooling rate (α)	Number of initial feasible solution (G)	Run time (Sec)
0.01	50	0.97	100	3,600

Forming a gerrymandered senate map in favor of Republicans for the State of Wisconsin was also effortless. However, we could not succeed in forming a gerrymandered senate map in favor of Democrats due to the reasons addressed earlier in this chapter. If the value in column "HP" is equal to zero, it means each senate district contains exactly three assembly districts; therefore, it meets the population deviation requirements. Otherwise, if the column "HP" is greater than zero, it indicates that some senate districts were formed from less than or higher than three assembly districts, which is not acceptable for the State of Wisconsin. This situation happened when we tried to form a gerrymandered senate map in favor of Democrats.

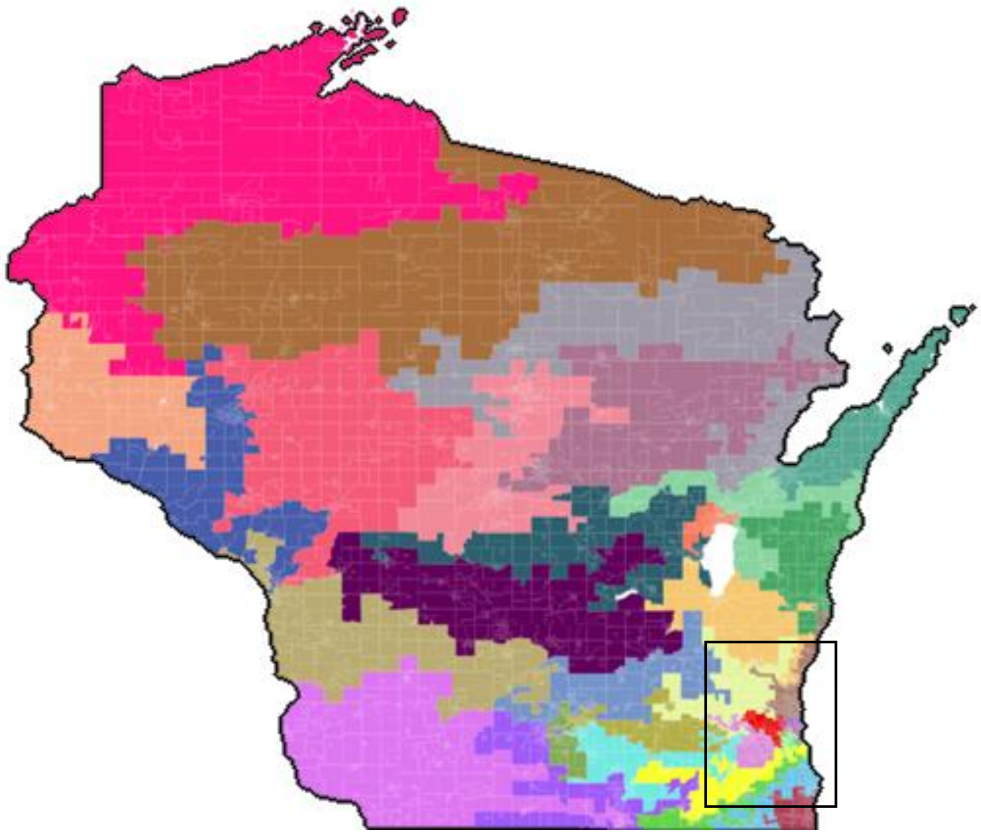
On the other hand, we successfully formed politically fair senate districts for Wisconsin and visualized corresponding fair senate maps derived from solutions A1 and A3 (fair assembly districts) in Figures 10-7 (solution S1) and 10-8 (solution S2), respectively. Every three adjacent assembly districts formed a senate district, and each set of those senate districts contained 17 Republican and 16 Democratic districts.



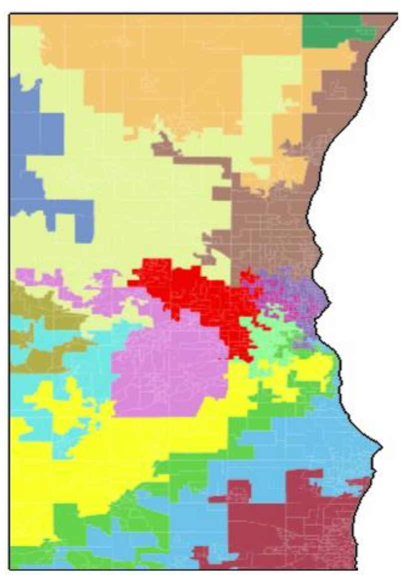
(a)

(b)

Figure 10-7: (a) Final solution S1 derived from final solution A2 considering objectives P and F with (b) Milwaukee and Racine area detail



(a)



(b)

Figure 10-8: (a) Final solution S2 derived from final solution A3 considering objectives P anf F with (b) Milwaukee and Racine area detai

Now for Scenario 6 from Table 10-2, we show how the number of Democratic districts, the number of Republican districts, and the number of districts whose population deviation exceed the deviation threshold change during an hour of running the code. Figure 10-9 shows the trend of those changes.

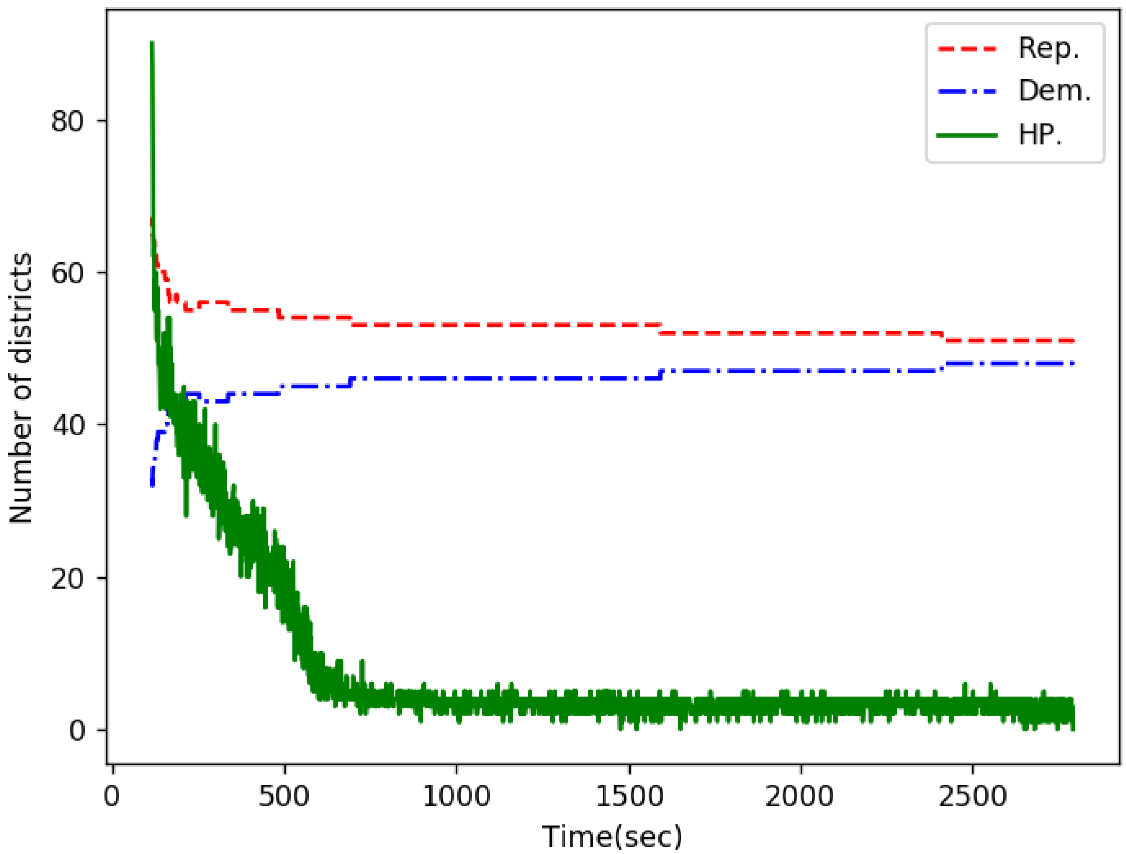


Figure 10-12: The trend of changes for the number of Democratic districts, Republican districts, and the number of districts with population deviation over defined threshold during running the code for an hour for one for Scenario 6

As shown in above figure, the number of districts whose population deviation is over the defined deviation threshold (HP.) decreases to zero. The number of Democratic districts (Dem.) increases, and the number of Republican districts (Rep.) decreases to 49 and 50 respectively. The algorithm stops when we reach to the optimum answer in these three areas.

Table 10-8 shows the summary of computational results by running the algorithm for forming politically fair Wisconsin State Assembly districts. The severe improvement in population equality and political fairness is noticeable by running the algorithm for an hour. Usually, the most significant improvement occurs during the first quarter of the running time. 24% of the result were perfect and we were able to achieve the politically and populationally fair districts. As mentioned previously, compactness is not considered in forming fair state assembly districts, and the final answer is sensitive to both the assigned weights and the initial feasible solution which is the best one among bunch of generated random initial solutions.

Table 10-8: Summary of computational results in forming Wisconsin State Assembly districts

Number of trials	55
Number of the perfect results (Fair plan)	13
Average number of districts in which the population deviation exceeds deviation threshold	1.8
Average number of districts in which Democrats expect to win	46
Average number of districts in which Republicans expect to win	53
Average improvement on compactness score	-
Range of weights used for population equality	[1, 1.05]
Range of weights used for political fairness	[0.05, 0.1]
Range of weights used for compactness	0

It should also be mentioned that 100 % of the time we were able to form Wisconsin State Senate districts from fair Assembly districts.

Serving as a starting point to focus on the political fairness criterion in computational approaches for forming state assembly and state senate districts, we constructed Wisconsin State assembly and Wisconsin State Senate maps. All formed assembly and, consequently, senate districts had nearly equal population. Also, they were politically fair based on vote-seat proportionality. We did not intend to sacrifice political fairness in order to keep districts compact, and it was nearly impossible to achieve a perfect answer for every factor simultaneously.

As previously discussed in the literature review of this dissertation, none of the previous studies worked on constructing fair state assembly and state senate districts. Krasno et al. (2018) produced a comparison set of 10,000 neutral assembly maps for Wisconsin by computer, based on a census block, which is the smallest units about which the U.S. Census reports data. They used median-mean comparison to show that the Wisconsin Assembly map is remarkably pro-Republican gerrymandered.

For only one case (ANLF), the details of the results regarding the wards' assignments to the state assembly (result of Scenario 6 from Table 10-2) and state senate (result of Scenario 1 from Table 10-6) districts are attached to the appendix (Table A-3).

11. Summary and conclusions

The results of the elections in the United States are directly impacted by political boundaries in every state. The act of redistricting political districts has always been a questionable practice for entities that are concerned with the integrity of the election, such as politicians and scientists who are trying to establish a fair political system for elections. They are also looking for methods to measure the severity of gerrymandering. So far, some methods have been developed and improved to prevent gerrymandering mathematically and computationally. This research rebuilds the redistricting process and provides an entry point to form political districts concerning political fairness for very large real-world problems.

The objectives of this research are listed as follows:

1- Find the appropriate factors for constructing fair political districts as well as considering "political fairness" factor.
2- Examine the current political fairness measures and improve them if it is possible.
3- Formalize math models and algorithms for constructing fair political districts.
4- Code the proposed political districting algorithms and evaluate the performance of them.
5- Apply new algorithms on a real case study and form the fair political maps.

We tried to look at the problem from different perspectives. First, we tracked the existing studies in this area. By reviewing the models, procedures, and the trend of improvements in political fairness in previous studies, we identified the critical factors for constructing fair political districts. The problem we aimed to solve was assigning M units to D districts considering some important criteria. The main goal was constructing contiguous politically fair and equally populated districts. Each unit must be assigned to exactly a single district, which is the concept of integrity. Also, we tried to consider compactness as long as it did not disturb our main goal. We assumed that we had only two parties: Republicans and Democrats. The crucial factor in our work for constructing fair political districts was "political fairness," which is a new concept that has been introduced in a few recent works. Political fairness was measured in three ways in our study: (a) efficiency gap, (b) the difference between a district's number of votes cast for Democrats (Republicans) from the average number of votes cast for Democrats (Republicans) per district, and (c) the difference between the number of potential seats for a party and its actual voting share (vote-seat proportionality).

As the next step, we developed several metrics for measuring political fairness. The standard metric that is widely used to track political unfairness is the traditional efficiency gap. But this method is not accurate enough to show the imbalance and disproportion between parties' won seats and "deserved" seat share. We introduced two new metrics for measuring political fairness considering the equal number of votes cast in all districts. We mathematically and experimentally showed that the new metrics revealed the gap between the parties' "deserved" seat share and portion of won seats.

In addition, we developed two math models to assign M units to D districts with both a mixed integer programing math model and column generation methodology. These two models are applicable to form U.S. Congressional and state assembly districts. Also, we used those models for forming state senate districts that is derived from assembly districts by assigning every three adjacent assembly districts to each senate district. We then coded and executed the developed math models using CPLEX for the small-size problems. Contiguity was not considered in exact math models for assembly and congressional districts; therefore, the results may lead to non-contiguous districts. However, contiguity was guaranteed in senate districts as long as the formed assembly districts were contiguous.

Due to the computational complexity of running an exact method for large-size problems and their lack of flexibility in applying unpredictable challenges and potential restrictions, we proposed a heuristic method—Simulated Annealing (SA)—to handle large-size, real-world problems. We coded the heuristic algorithm in Microsoft Visual C++ 2010. In general, we started with a best feasible solution among a group of randomly generated contiguous districts and tried to improve three components of the objective function, which are the penalties for "population equality", "political fairness", and "lack of compactness". We then normalized the aforementioned penalties and minimized them by executing the code for an hour. Also, we prioritized the objective components by assigning a weight to each. In all the iterations of the SA algorithm, the hard constraints—integrity and contiguity—must not be disturbed. The first experiment was on a large fictional case with 3,000 square-shaped units with equal areas and equal perimeters, with the goal of assigning these units to 100 districts.

In addition, we worked on reconstructing the State of Wisconsin political districts containing state assembly, state senate, and U.S. Congressional districts as a case study of our research. Wisconsin political maps are one of the most gerrymandered maps in the United States' election history. A very challenging part of our work was collecting and cleaning geographical and electoral data for the State of Wisconsin. Based on the 2018 political map, Wisconsin had 6,977 wards with different shaped, population, connectivity, and position (some wards of Wisconsin are split or inside the other wards). Based on the 2016 presidential election data, 49.6% of the total votes were cast for Democrats and 50.4% were cast for Republicans.

After cleaning up the data and taking care of all the limitations caused by split wards to avoid non-contiguous districts, we constructed Wisconsin' U.S. Congressional, Wisconsin State Assembly and Wisconsin State Senate districts considering different scenarios.

The main intention was reaching politically fair and equally populated districts. We were able to design fair Congressional, assembly, and senate maps for the State of Wisconsin with respect to population equality, political fairness, compactness, contiguity, and integrity. We created politically fair Wisconsin's U.S. Congressional districts (four Democratic and four Republican districts) with nearly equal population—less than 0.2% population deviation—as well as slight improvement in the districts' compactness.

We pioneered in creating politically fair and almost equally populated (less than 2% population deviation) Wisconsin State Assembly districts and, consequently, forming Wisconsin State Senate districts. The results of the algorithm are displayed as maps using ArcGIS software. The results achieved from this difficult real-world case demonstrate the effectiveness of the proposed heuristic algorithm. It also notable that in this study, the algorithm was applied more broadly compared to previous studies. All in all, our research main contributions are as follows:

1- Provided the bases for integrating political fairness into the algorithm to form state assembly districts.
2- Developed a novel algorithm for constructing state senate districts from a given set of state assembly districts.
3- Introduced two new metrics for measuring political fairness.
4- Developed an algorithm based on heuristic method – simulated annealing (SA) – to construct political districts for large-size real world problems.

5- Formed fair U.S Congressional districts with improved population deviation threshold as well as compactness, compared to previous researches.
6- Created an algorithm that checks whether generated districts are contiguous.

The first and foremost future work that comes to mind is to analyze and attempt to improve the political maps of other states. With the census and incoming Presidential election in April and November of 2020, updated data will be available to form states' political maps as well as Wisconsin's. If the current map's assignment information is accessible, improvement of current maps of the states, instead of generating a fair map from scratch, can be considered. We used a Simulated Annealing (SA) algorithm to form political maps. Other algorithms can be looked into to form political maps for big-size cases as well. However, if SA is the only proper algorithm, one can look into doing a sensitive analysis of the relationship between initial setting, used weights, obtained values for different factors, and the correlations among them. For the penalty of lack of compactness, we used the inverse of the Polsby and Popper (Polsby and Popper 1991) formula (PEd_d^2 / ARd_d). One minus the Polsby and Popper compactness score (1- [$4\pi * ARd_d / PEd_d^2$]) is another option for the penalty of lack of compactness.

As another future work, one can improve political fairness by maximizing competitiveness as well as minimizing the efficiency gap simultaneously. Also, one can minimize the maximum distance between the centroids of the wards in a district in addition to minimizing the ratio of the square of the district's perimeter to its area. Using units smaller than wards and with less population is another candidate for future work. It is anticipated that doing so will help form politically fair and equally populated districts with a high improvement level of districts' compactness, even for the states in which the voters supporting the parties are not well distributed. The Voting Rights Act has always been a controversial ruling, with some arguing that it negatively impacts the voting power of minorities. It is worth investigating whether the Voting Rights Act prevents gerrymandering. If so, it can be added to the objective function to form specific districts for states' minority populations. Lastly, another factor to look into is the importance of representatives' and senators' home addresses being inside the district they are running for. If it proves to be a viable factor, it can be considered as another limitation for forming districts.

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Appendix A

Three tables are presented in the appendix. Table A-1 shows the name, ID and Federal Information Processing Standard (FIPS) geographic code of Wisconsin's wards based on the 2018 political map (Wisconsin State Legislature 2020).

Table A-2 is an example of assigning the wards to Wisconsin U.S. Congressional districts for one of the best results of Scenario 10 from Table 9- 2. Table A-3 is an example of assigning the wards to Wisconsin State Assembly and Wisconsin State Senate districts for one of the best results of Scenario 6 from Table 10-2 and Scenario 1 from Table 10-6.

Table A-1: The name, ID and FIPS (Federal Information Processing Standard geographic code) of Wisconsin's 6977 election wards

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1	Adams - C 0001	55001002750001	19	LEOLA - T 0001	55001434250001	37	SPRINGVILLE - T 0001	55001763500001
2	Adams - C 0002	55001002750002	20	LINCOLN - T 0001	55001442500001	38	SPRINGVILLE - T 0002	55001763500002
3	Adams - C 0003	55001002750003	21	MONROE - T 0001	55001537250001	39	STRONGS PRAIRIE - T 0001	55001778000001
4	Adams - C 0004	55001002750004	22	NEW CHESTER - T 0001	55001565250001	40	STRONGS PRAIRIE - T 0002	55001778000002
5	ADAMS - T 0001	55001003000001	23	NEW CHESTER - T 0002	55001565250002	41	STRONGS PRAIRIE - T 0003	55001778000003
6	ADAMS - T 0002	55001003000002	24	NEW CHESTER - T 0003	55001565250003	42	Wisconsin Dells - C 0005	55001881500005
7	ADAMS - T 0003	55001003000003	25	NEW HAVEN - T 0001	55001567500001	43	Wisconsin Dells - C 0009	55001881500009
8	BIG FLATS - T 0001	55001073000001	26	PRESTON - T 0001	55001654500001	44	AGENDA - T 0001	55003005500001
9	BIG FLATS - T 0002	55001073000002	27	PRESTON - T 0002	55001654500002	45	Ashland - C 0001	55003032250001
10	COLBURN - T 0001	55001160750001	28	QUINCY - T 0001	55001658250001	46	Ashland - C 0002	55003032250002
11	DELL PRAIRIE - T 0001	55001195750001	29	QUINCY - T 0002	55001658250002	47	Ashland - C 0003	55003032250003
12	DELL PRAIRIE - T 0002	55001195750002	30	QUINCY - T 0003	55001658250003	48	Ashland - C 0004	55003032250004
13	DELL PRAIRIE - T 0003	55001195750003	31	RICHFIELD - T 0001	55001674250001	49	Ashland - C 0005	55003032250005
14	EASTON - T 0001	55001220000001	32	ROME - T 0001	55001692750001	50	Ashland - C 0006	55003032250006
15	EASTON - T 0002	55001220000002	33	ROME - T 0002	55001692750002	51	Ashland - C 0007	55003032250007
16	Friendship - V 0001	55001279500001	34	ROME - T 0003	55001692750003	52	Ashland - C 0008	55003032250008
17	JACKSON - T 0001	55001376250001	35	ROME - T 0004	55001692750004	53	Ashland - C 0009	55003032250009
18	JACKSON - T 0002	55001376250002	36	ROME - T 0005	55001692750005	54	Ashland - C 0010	55003032250010

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
55	Ashland - C 0011	55003032250011	73	SANBORN - T 0001	55003713500001	91	BEAR LAKE - T 0001	55005056500001
56	ASHLAND - T 0001	55003032500001	74	SANBORN - T 0002	55003713500002	92	Cameron - V 0001	55005122500001
57	Butternut - V 0001	55003115250001	75	SHANAGOLDEN - T 0001	55003728250001	93	Cameron - V 0002	55005122500002
58	Butternut - V 0002	55003115250002	76	WHITE RIVER - T 0001	55003868500001	94	Cameron - V 0003	55005122500003
59	CHIPPEWA - T 0001	55003145500001	77	WHITE RIVER - T 0002	55003868500002	95	CEDAR LAKE - T 0001	55005135000001
60	GINGLES - T 0001	55003292500001	78	Almena - V 0001	55005013250001	96	Chetek - C 0001	55005143250001
61	GORDON - T 0001	55003298750001	79	ALMENA - T 0001	55005013500001	97	Chetek - C 0002	55005143250002
62	GORDON - T 0002	55003298750002	80	ALMENA - T 0002	55005013500002	98	Chetek - C 0003	55005143250003
63	JACOBS - T 0001	55003377750001	81	ARLAND - T 0001	55005027750001	99	Chetek - C 0004	55005143250004
64	LA POINTE - T 0001	55003425620001	82	Barron - C 0001	55005048750001	100	CHETEK - T 0001	55005143500001
65	MARENGO - T 0001	55003492000001	83	Barron - C 0002	55005048750002	101	CHETEK - T 0002	55005143500002
66	MARENGO - T 0002	55003492000002	84	Barron - C 0003	55005048750003	102	CLINTON - T 0001	55005156000001
67	Mellen - C 0001	55003507000001	85	Barron - C 0004	55005048750004	103	CRYSTAL LAKE - T 0001	55005178750001
68	MORSE - T 0001	55003544000001	86	Barron - C 0005	55005048750005	104	Cumberland - C 0001	55005180250001
69	MORSE - T 0002	55003544000002	87	Barron - C 0006	55005048750006	105	Cumberland - C 0002	55005180250002
70	MORSE - T 0003	55003544000003	88	Barron - C 0007	55005048750007	106	Cumberland - C 0003	55005180250003
71	PEEKSVILLE - T 0001	55003616000001	89	BARRON - T 0001	55005049000001	107	Cumberland - C 0004	55005180250004
72	PEEKSVILLE - T 0002	55003616000002	90	BARRON - T 0002	55005049000002	108	CUMBERLAND - T 0001	55005180500001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
109	Dallas - V 0001	55005185750001	127	PRAIRIE LAKE - T 0001	55005652000001	145	RICE LAKE - T 0004	55005673750004
110	DALLAS - T 0001	55005186000001	128	PRAIRIE LAKE - T 0002	55005652000002	146	SIOUX CREEK - T 0001	55005741250001
111	DOVRE - T 0001	55005206500001	129	Rice Lake - C 0001	55005673500001	147	STANFOLD - T 0001	55005765500001
112	DOYLE - T 0001	55005207500001	130	Rice Lake - C 0002	55005673500002	148	STANLEY - T 0001	55005766000001
113	DOYLE - T 0002	55005207500002	131	Rice Lake - C 0003	55005673500003	149	STANLEY - T 0002	55005766000002
114	Haugen - V 0001	55005332250001	132	Rice Lake - C 0004	55005673500004	150	STANLEY - T 0003	55005766000003
115	LAKELAND - T 0001	55005416000001	133	Rice Lake - C 0005	55005673500005	151	STANLEY - T 0004	55005766000004
116	LAKELAND - T 0002	55005416000002	134	Rice Lake - C 0006	55005673500006	152	SUMNER - T 0001	55005784500001
117	MAPLE GROVE - T 0001	55005488250001	135	Rice Lake - C 0007	55005673500007	153	Turtle Lake - V 0001	55005810750001
118	MAPLE GROVE - T 0002	55005488250002	136	Rice Lake - C 0008	55005673500008	154	TURTLE LAKE - T 0001	55005811000001
119	MAPLE PLAIN - T 0001	55005489500001	137	Rice Lake - C 0009	55005673500009	155	VANCE CREEK - T 0001	55005823750001
120	New Auburn - V 0002	55005563500002	138	Rice Lake - C 0010	55005673500010	156	Ashland - C 0012	55007032250012
121	New Auburn - V 0003	55005563500003	139	Rice Lake - C 0011	55005673500011	157	BARKSDALE - T 0001	55007047250001
122	OAK GROVE - T 0001	55005589500001	140	Rice Lake - C 0012	55005673500012	158	BARNES - T 0001	55007047500001
123	OAK GROVE - T 0002	55005589500002	141	Rice Lake - C 0013	55005673500013	159	Bayfield - C 0001	55007053500001
124	Prairie Farm - V 0001	55005651500001	142	RICE LAKE - T 0001	55005673750001	160	Bayfield - C 0002	55007053500002
125	PRAIRIE FARM - T 0001	55005651750001	143	RICE LAKE - T 0002	55005673750002	161	Bayfield - C 0003	55007053500003
126	PRAIRIE FARM - T 0002	55005651750002	144	RICE LAKE - T 0003	55005673750003	162	Bayfield - C 0004	55007053500004

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
163	BAYFIELD - T 0001	55007053750001	181	NAMAKAGON - T 0001	55007553750001	199	Allouez - V 0006	55009011500006
164	BAYVIEW - T 0001	55007054750001	182	ORIENTA - T 0001	55007602750001	200	Allouez - V 0007	55009011500007
165	BELL - T 0001	55007062000001	183	OULU - T 0001	55007607750001	201	Allouez - V 0008	55009011500008
166	CABLE - T 0001	55007116750001	184	PILSEN - T 0001	55007627000001	202	Allouez - V 0009	55009011500009
167	CLOVER - T 0001	55007157500001	185	PORT WING - T 0001	55007645120001	203	Allouez - V 0010	55009011500010
168	DELTA - T 0001	55007196620001	186	RUSSELL - T 0001	55007703000001	204	Ashwaubenon - V 0001	55009034250001
169	DRUMMOND - T 0001	55007208870001	187	RUSSELL - T 0002	55007703000002	205	Ashwaubenon - V 0002	55009034250002
170	EILEEN - T 0001	55007229250001	188	TRIPP - T 0001	55007807500001	206	Ashwaubenon - V 0003	55009034250003
171	EILEEN - T 0002	55007229250002	189	Washburn - C 0001	55007835250001	207	Ashwaubenon - V 0004	55009034250004
172	GRANDVIEW - T 0001	55007301750001	190	Washburn - C 0002	55007835250002	208	Ashwaubenon - V 0005	55009034250005
173	HUGHES - T 0001	55007363000001	191	Washburn - C 0003	55007835250003	209	Ashwaubenon - V 0006	55009034250006
174	IRON RIVER - T 0001	55007372000001	192	Washburn - C 0004	55007835250004	210	Ashwaubenon - V 0007	55009034250007
175	IRON RIVER - T 0002	55007372000002	193	WASHBURN - T 0001	55007835500001	211	Ashwaubenon - V 0008	55009034250008
176	KELLY - T 0001	55007390250001	194	Allouez - V 0001	55009011500001	212	Ashwaubenon - V 0009	55009034250009
177	KEYSTONE - T 0001	55007394250001	195	Allouez - V 0002	55009011500002	213	Ashwaubenon - V 0010	55009034250010
178	LINCOLN - T 0001	55007442750001	196	Allouez - V 0003	55009011500003	214	Ashwaubenon - V 0011	55009034250011
179	Mason - V 0001	55007499000001	197	Allouez - V 0004	55009011500004	215	Ashwaubenon - V 0012	55009034250012
180	MASON - T 0001	55007499250001	198	Allouez - V 0005	55009011500005	216	Bellevue - V 0001	55009063500001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
217	Bellevue - V 0002	55009063500002	235	De Pere - C 0006	55009197750006	253	Green Bay - C 0002	55009310000002
218	Bellevue - V 0003	55009063500003	236	De Pere - C 0007	55009197750007	254	Green Bay - C 0003	55009310000003
219	Bellevue - V 0004	55009063500004	237	De Pere - C 0008	55009197750008	255	Green Bay - C 0004	55009310000004
220	Bellevue - V 0005	55009063500005	238	De Pere - C 0009	55009197750009	256	Green Bay - C 0005	55009310000005
221	Bellevue - V 0006	55009063500006	239	De Pere - C 0010	55009197750010	257	Green Bay - C 0006	55009310000006
222	Bellevue - V 0007	55009063500007	240	De Pere - C 0011	55009197750011	258	Green Bay - C 0007	55009310000007
223	Bellevue - V 0008	55009063500008	241	De Pere - C 0012	55009197750012	259	Green Bay - C 0008	55009310000008
224	Bellevue - V 0009	55009063500009	242	De Pere - C 0013	55009197750013	260	Green Bay - C 0009	55009310000009
225	Bellevue - V 0010	55009063500010	243	De Pere - C 0014	55009197750014	261	Green Bay - C 0010	55009310000010
226	Denmark - V 0001	55009197000001	244	De Pere - C 0015	55009197750015	262	Green Bay - C 0011	55009310000011
227	Denmark - V 0002	55009197000002	245	De Pere - C 0016	55009197750016	263	Green Bay - C 0012	55009310000012
228	Denmark - V 0003	55009197000003	246	De Pere - C 0017	55009197750017	264	Green Bay - C 0013	55009310000013
229	Denmark - V 0004	55009197000004	247	De Pere - C 0018	55009197750018	265	Green Bay - C 0014	55009310000014
230	De Pere - C 0001	55009197750001	248	EATON - T 0001	55009222250001	266	Green Bay - C 0015	55009310000015
231	De Pere - C 0002	55009197750002	249	EATON - T 0002	55009222250002	267	Green Bay - C 0016	55009310000016
232	De Pere - C 0003	55009197750003	250	GLENMORE - T 0001	55009295500001	268	Green Bay - C 0017	55009310000017
233	De Pere - C 0004	55009197750004	251	GLENMORE - T 0002	55009295500002	269	Green Bay - C 0018	55009310000018
234	De Pere - C 0005	55009197750005	252	Green Bay - C 0001	55009310000001	270	Green Bay - C 0019	55009310000019

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
271	Green Bay - C 0020	55009310000020	289	Green Bay - C 0038	55009310000038	307	Hobart - V 0006	55009351500006
272	Green Bay - C 0021	55009310000021	290	Green Bay - C 0039	55009310000039	308	Hobart - V 0007	55009351500007
273	Green Bay - C 0022	55009310000022	291	Green Bay - C 0040	55009310000040	309	Hobart - V 0008	55009351500008
274	Green Bay - C 0023	55009310000023	292	Green Bay - C 0041	55009310000041	310	Hobart - V 0009	55009351500009
275	Green Bay - C 0024	55009310000024	293	Green Bay - C 0042	55009310000042	311	HOLLAND - T 0001	55009353250001
276	Green Bay - C 0025	55009310000025	294	Green Bay - C 0043	55009310000043	312	HOLLAND - T 0002	55009353250002
277	Green Bay - C 0026	55009310000026	295	Green Bay - C 0044	55009310000044	313	Howard - V 0001	55009359500001
278	Green Bay - C 0027	55009310000027	296	Green Bay - C 0045	55009310000045	314	Howard - V 0002	55009359500002
279	Green Bay - C 0028	55009310000028	297	Green Bay - C 0046	55009310000046	315	Howard - V 0003	55009359500003
280	Green Bay - C 0029	55009310000029	298	Green Bay - C 0047	55009310000047	316	Howard - V 0004	55009359500004
281	Green Bay - C 0030	55009310000030	299	GREEN BAY - T 0001	55009310250001	317	Howard - V 0005	55009359500005
282	Green Bay - C 0031	55009310000031	300	GREEN BAY - T 0002	55009310250002	318	Howard - V 0006	55009359500006
283	Green Bay - C 0032	55009310000032	301	GREEN BAY - T 0003	55009310250003	319	Howard - V 0007	55009359500007
284	Green Bay - C 0033	55009310000033	302	Hobart - V 0001	55009351500001	320	Howard - V 0008	55009359500008
285	Green Bay - C 0034	55009310000034	303	Hobart - V 0002	55009351500002	321	Howard - V 0009	55009359500009
286	Green Bay - C 0035	55009310000035	304	Hobart - V 0003	55009351500003	322	Howard - V 0010	55009359500010
287	Green Bay - C 0036	55009310000036	305	Hobart - V 0004	55009351500004	323	Howard - V 0011	55009359500011
288	Green Bay - C 0037	55009310000037	306	Hobart - V 0005	55009351500005	324	Howard - V 0012	55009359500012

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
325	Howard - V 0013	55009359500013	343	LEDGEVIEW - T 0006	55009430900006	361	ROCKLAND - T 0002	55009688750002
326	Howard - V 0014	55009359500014	344	LEDGEVIEW - T 0007	55009430900007	362	ROCKLAND - T 0003	55009688750003
327	Howard - V 0015	55009359500015	345	LEDGEVIEW - T 0008	55009430900008	363	SCOTT - T 0001	55009722000001
328	Howard - V 0016	55009359500016	346	LEDGEVIEW - T 0009	55009430900009	364	SCOTT - T 0002	55009722000002
329	Howard - V 0018	55009359500018	347	LEDGEVIEW - T 0010	55009430900010	365	SCOTT - T 0003	55009722000003
330	HUMBOLDT - T 0001	55009364250001	348	MORRISON - T 0001	55009543000001	366	SCOTT - T 0004	55009722000004
331	HUMBOLDT - T 0002	55009364250002	349	MORRISON - T 0002	55009543000002	367	Suamico - V 0001	55009779750001
332	LAWRENCE - T 0001	55009429000001	350	NEW DENMARK - T 0001	55009565750001	368	Suamico - V 0002	55009779750002
333	LAWRENCE - T 0002	55009429000002	351	NEW DENMARK - T 0002	55009565750002	369	Suamico - V 0003	55009779750003
334	LAWRENCE - T 0003	55009429000003	352	NEW DENMARK - T 0003	55009565750003	370	Suamico - V 0004	55009779750004
335	LAWRENCE - T 0004	55009429000004	353	PITTSFIELD - T 0001	55009630750001	371	Suamico - V 0005	55009779750005
336	LAWRENCE - T 0005	55009429000005	354	PITTSFIELD - T 0002	55009630750002	372	Suamico - V 0006	55009779750006
337	LAWRENCE - T 0006	55009429000006	355	PITTSFIELD - T 0003	55009630750003	373	Suamico - V 0007	55009779750007
338	LEDGEVIEW - T 0001	55009430900001	356	Pulaski - V 0001	55009656750001	374	Suamico - V 0008	55009779750008
339	LEDGEVIEW - T 0002	55009430900002	357	Pulaski - V 0002	55009656750002	375	Wrightstown - V 0001	55009891500001
340	LEDGEVIEW - T 0003	55009430900003	358	Pulaski - V 0003	55009656750003	376	Wrightstown - V 0002	55009891500002
341	LEDGEVIEW - T 0004	55009430900004	359	Pulaski - V 0006	55009656750006	377	Wrightstown - V 0003	55009891500003
342	LEDGEVIEW - T 0005	55009430900005	360	ROCKLAND - T 0001	55009688750001	378	WRIGHTSTOWN - T 0001	55009891750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
379	WRIGHTSTOWN - T 0002	55009891750002	397	MILTON - T 0001	55011521750001	415	GRANTSBURG - T 0001	55013304750001
380	WRIGHTSTOWN - T 0003	55009891750003	398	MODENA - T 0001	55011534500001	416	GRANTSBURG - T 0002	55013304750002
381	Alma - C 0001	55011012250001	399	Mondovi - C 0001	55011536000001	417	GRANTSBURG - T 0003	55013304750003
382	Alma - C 0002	55011012250002	400	Mondovi - C 0002	55011536000002	418	JACKSON - T 0001	55013376500001
383	ALMA - T 0001	55011012500001	401	Mondovi - C 0003	55011536000003	419	LA FOLLETTE - T 0001	55013409750001
384	BELVIDERE - T 0001	55011066750001	402	MONDOVI - T 0001	55011536250001	420	LA FOLLETTE - T 0002	55013409750002
385	BUFFALO - T 0001	55011110250001	403	MONTANA - T 0001	55011538500001	421	LINCOLN - T 0001	55013443250001
386	Buffalo City - C 0001	55011110620001	404	NAPLES - T 0001	55011554500001	422	MEENON - T 0001	55013506500001
387	CANTON - T 0001	55011125000001	405	Nelson - V 0001	55011559500001	423	MEENON - T 0002	55013506500002
388	Cochrane - V 0001	55011160250001	406	NELSON - T 0001	55011559750001	424	MEENON - T 0003	55013506500003
389	CROSS - T 0001	55011177370001	407	WAUMANDEE - T 0001	55011843250001	425	OAKLAND - T 0001	55013590750001
390	DOVER - T 0001	55011205750001	408	ANDERSON - T 0001	55013019000001	426	OAKLAND - T 0002	55013590750002
391	Fountain City - C 0001	55011268500001	409	BLAINE - T 0001	55013080250001	427	ROOSEVELT - T 0001	55013693250001
392	Fountain City - C 0002	55011268500002	410	DANIELS - T 0001	55013187500001	428	RUSK - T 0001	55013702250001
393	GILMANTON - T 0001	55011292250001	411	DEWEY - T 0001	55013199250001	429	SAND LAKE - T 0001	55013714500001
394	GLENCOE - T 0001	55011293750001	412	Grantsburg - V 0001	55013304500001	430	SCOTT - T 0001	55013722250001
395	LINCOLN - T 0001	55011443000001	413	Grantsburg - V 0002	55013304500002	431	SCOTT - T 0002	55013722250002
396	MAXVILLE - T 0001	55011500750001	414	Grantsburg - V 0003	55013304500003	432	Siren - V 0001	55013741750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
433	Siren - V 0002	55013741750002	451	Appleton - C 0014	55015023750014	469	Chilton - C 0004	55015144750004
434	SIREN - T 0001	55013742000001	452	Appleton - C 0026	55015023750026	470	Chilton - C 0005	55015144750005
435	SIREN - T 0002	55013742000002	453	Appleton - C 0044	55015023750044	471	CHILTON - T 0001	55015145000001
436	SWISS - T 0001	55013787750001	454	Appleton - C 0045	55015023750045	472	CHILTON - T 0002	55015145000002
437	SWISS - T 0002	55013787750002	455	Appleton - C 0046	55015023750046	473	CHILTON - T 0003	55015145000003
438	TRADE LAKE - T 0001	55013803750001	456	Appleton - C 0047	55015023750047	474	Harrison - V 0003	55015327900003
439	TRADE LAKE - T 0002	55013803750002	457	Brillion - C 0001	55015097250001	475	Harrison - V 0004	55015327900004
440	UNION - T 0001	55013815000001	458	Brillion - C 0002	55015097250002	476	Harrison - V 0005	55015327900005
441	WEBB LAKE - T 0001	55013849750001	459	Brillion - C 0003	55015097250003	477	Harrison - V 0006	55015327900006
442	Webster - V 0001	55013850250001	460	Brillion - C 0004	55015097250004	478	Harrison - V 0007	55015327900007
443	Webster - V 0002	55013850250002	461	BRILLION - T 0001	55015097500001	479	Harrison - V 0008	55015327900008
444	WEST MARSHLAND - T 0001	55013858500001	462	BRILLION - T 0002	55015097500002	480	Harrison - V 0009	55015327900009
445	WEST MARSHLAND - T 0002	55013858500002	463	BROTHERTOWN - T 0001	55015103500001	481	Harrison - V 0010	55015327900010
446	WOOD RIVER - T 0001	55013889000001	464	BROTHERTOWN - T 0002	55015103500002	482	Harrison - V 0011	55015327900011
447	WOOD RIVER - T 0002	55013889000002	465	CHARLESTOWN - T 0001	55015140000001	483	Harrison - V 0012	55015327900012
448	WOOD RIVER - T 0003	55013889000003	466	Chilton - C 0001	55015144750001	484	Harrison - V 0013	55015327900013
449	Appleton - C 0012	55015023750012	467	Chilton - C 0002	55015144750002	485	Harrison - V 0014	55015327900014
450	Appleton - C 0013	55015023750013	468	Chilton - C 0003	55015144750003	486	Harrison - V 0015	55015327900015

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
487	Harrison - V 0016	55015327900016	505	New Holstein - C 0005	55015568000005	523	ANSON - T 0003	55017021750003
488	Harrison - V 0017	55015327900017	506	NEW HOLSTEIN - T 0001	55015568250001	524	ANSON - T 0004	55017021750004
489	Harrison - V 0018	55015327900018	507	NEW HOLSTEIN - T 0002	55015568250002	525	ARTHUR - T 0001	55017030750001
490	HARRISON - T 0010	55015328000010	508	NEW HOLSTEIN - T 0003	55015568250003	526	AUBURN - T 0001	55017037250001
491	Hilbert - V 0001	55015345750001	509	Potter - V 0001	55015646750001	527	BIRCH CREEK - T 0001	55017075250001
492	Hilbert - V 0002	55015345750002	510	RANTOUL - T 0001	55015662750001	528	Bloomer - C 0001	55017082250001
493	Hilbert - V 0003	55015345750003	511	Sherwood - V 0001	55015735250001	529	Bloomer - C 0002	55017082250002
494	Kaukauna - C 0011	55015388000011	512	Sherwood - V 0002	55015735250002	530	Bloomer - C 0003	55017082250003
495	Kiel - C 0007	55015395250007	513	Sherwood - V 0003	55015735250003	531	Bloomer - C 0004	55017082250004
496	Menasha - C 0016	55015508250016	514	Sherwood - V 0004	55015735250004	532	BLOOMER - T 0001	55017082500001
497	Menasha - C 0017	55015508250017	515	Sherwood - V 0005	55015735250005	533	BLOOMER - T 0002	55017082500002
498	Menasha - C 0018	55015508250018	516	Stockbridge - V 0001	55015774000001	534	Boyd - V 0001	55017090750001
499	Menasha - C 0019	55015508250019	517	STOCKBRIDGE - T 0001	55015774250001	535	Cadott - V 0001	55017117500001
500	Menasha - C 0020	55015508250020	518	STOCKBRIDGE - T 0002	55015774250002	536	Cadott - V 0002	55017117500002
501	New Holstein - C 0001	55015568000001	519	STOCKBRIDGE - T 0003	55015774250003	537	Cadott - V 0003	55017117500003
502	New Holstein - C 0002	55015568000002	520	WOODVILLE - T 0001	55015890000001	538	Chippewa Falls - C 0001	55017145750001
503	New Holstein - C 0003	55015568000003	521	ANSON - T 0001	55017021750001	539	Chippewa Falls - C 0002	55017145750002
504	New Holstein - C 0004	55015568000004	522	ANSON - T 0002	55017021750002	540	Chippewa Falls - C 0003	55017145750003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
541	Chippewa Falls - C 0004	55017145750004	559	EAGLE POINT - T 0004	55017216000004	577	LAFAYETTE - T 0006	55017409000006
542	Chippewa Falls - C 0005	55017145750005	560	EAGLE POINT - T 0005	55017216000005	578	LAFAYETTE - T 0007	55017409000007
543	Chippewa Falls - C 0006	55017145750006	561	Eau Claire - C 0016	55017223000016	579	LAFAYETTE - T 0008	55017409000008
544	Chippewa Falls - C 0007	55017145750007	562	Eau Claire - C 0040	55017223000040	580	LAFAYETTE - T 0009	55017409000009
545	Chippewa Falls - C 003a	5501714575003a	563	Eau Claire - C 0041	55017223000041	581	Lake Hallie - V 0001	55017415250001
546	Chippewa Falls - C 003b	5501714575003b	564	EDSON - T 0001	55017227500001	582	Lake Hallie - V 0002	55017415250002
547	Chippewa Falls - C 007a	5501714575007a	565	EDSON - T 0002	55017227500002	583	Lake Hallie - V 0003	55017415250003
548	CLEVELAND - T 0001	55017153500001	566	ESTELLA - T 0001	55017243750001	584	Lake Hallie - V 0004	55017415250004
549	COLBURN - T 0001	55017161250001	567	GOETZ - T 0001	55017297000001	585	Lake Hallie - V 0005	55017415250005
550	COOKS VALLEY - T 0001	55017168000001	568	GOETZ - T 0002	55017297000002	586	Lake Hallie - V 0006	55017415250006
551	Cornell - C 0001	55017171000001	569	GOETZ - T 0003	55017297000003	587	Lake Hallie - V 0007	55017415250007
552	Cornell - C 0002	55017171000002	570	HALLIE - T 0001	55017321250001	588	Lake Hallie - V 0008	55017415250008
553	Cornell - C 0003	55017171000003	571	HOWARD - T 0001	55017360000001	589	LAKE HOLCOMBE - T 0001	55017415500001
554	Cornell - C 0004	55017171000004	572	LAFAYETTE - T 0001	55017409000001	590	LAKE HOLCOMBE - T 0002	55017415500002
555	DELMAR - T 0001	55017196250001	573	LAFAYETTE - T 0002	55017409000002	591	New Auburn - V 0001	55017563500001
556	EAGLE POINT - T 0001	55017216000001	574	LAFAYETTE - T 0003	55017409000003	592	RUBY - T 0001	55017699750001
557	EAGLE POINT - T 0002	55017216000002	575	LAFAYETTE - T 0004	55017409000004	593	SAMPSON - T 0001	55017712750001
558	EAGLE POINT - T 0003	55017216000003	576	LAFAYETTE - T 0005	55017409000005	594	SIGEL - T 0001	55017738750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
595	SIGEL - T 0002	55017738750002	613	Abbotsford - C 0005	55019001000005	631	GRANT - T 0001	55019302750001
596	Stanley - C 0001	55017766250001	614	Abbotsford - C 0007	55019001000007	632	GRANT - T 0002	55019302750002
597	Stanley - C 0002	55017766250002	615	BEAVER - T 0001	55019057500001	633	Granton - V 0001	55019304250001
598	Stanley - C 0003	55017766250003	616	BUTLER - T 0001	55019114250001	634	GREEN GROVE - T 0001	55019312750001
599	Stanley - C 0004	55017766250004	617	Colby - C 0002	55019161500002	635	GREEN GROVE - T 0002	55019312750002
600	Stanley - C 0006	55017766250006	618	Colby - C 0003	55019161500003	636	Greenwood - C 0001	55019315750001
601	Stanley - C 0007	55017766250007	619	Colby - C 0004	55019161500004	637	Greenwood - C 0002	55019315750002
602	TILDEN - T 0001	55017798750001	620	COLBY - T 0001	55019161750001	638	HENDREN - T 0001	55019339000001
603	TILDEN - T 0002	55017798750002	621	COLBY - T 0002	55019161750002	639	HEWETT - T 0001	55019342000001
604	TILDEN - T 0003	55017798750003	622	COLBY - T 0003	55019161750003	640	HEWETT - T 0002	55019342000002
605	WHEATON - T 0001	55017865370001	623	Curtiss - V 0001	55019181250001	641	HIXON - T 0001	55019350500001
606	WHEATON - T 0002	55017865370002	624	DEWHURST - T 0001	55019200250001	642	HIXON - T 0002	55019350500002
607	WHEATON - T 0003	55017865370003	625	Dorchester - V 0001	55019204500001	643	HOARD - T 0001	55019351250001
608	WOODMOHR - T 0001	55017888750001	626	EATON - T 0001	55019222500001	644	HOARD - T 0002	55019351250002
609	WOODMOHR - T 0002	55017888750002	627	EATON - T 0002	55019222500002	645	LEVIS - T 0001	55019437000001
610	Abbotsford - C 0002	55019001000002	628	FOSTER - T 0001	55019267750001	646	LEVIS - T 0002	55019437000002
611	Abbotsford - C 0003	55019001000003	629	FREMONT - T 0001	55019277750001	647	LONGWOOD - T 0001	55019457000001
612	Abbotsford - C 0004	55019001000004	630	FREMONT - T 0002	55019277750002	648	LONGWOOD - T 0002	55019457000002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
649	Loyal - C 0001	55019460750001	667	PINE VALLEY - T 0001	55019630000001	685	WARNER - T 0002	55019833500002
650	Loyal - C 0002	55019460750002	668	PINE VALLEY - T 0002	55019630000002	686	WASHBURN - T 0001	55019835750001
651	LOYAL - T 0001	55019461000001	669	RESEBURG - T 0001	55019670250001	687	WESTON - T 0001	55019859250001
652	LOYAL - T 0002	55019461000002	670	RESEBURG - T 0002	55019670250002	688	WESTON - T 0002	55019859250002
653	LYNN - T 0001	55019466250001	671	SEIF - T 0001	55019724500001	689	Withee - V 0001	55019882750001
654	LYNN - T 0002	55019466250002	672	SHERMAN - T 0001	55019733500001	690	WITHEE - T 0001	55019883000001
655	MAYVILLE - T 0001	55019501750001	673	SHERMAN - T 0002	55019733500002	691	WORDEN - T 0001	55019891250001
656	MAYVILLE - T 0002	55019501750002	674	SHERWOOD - T 0001	55019735500001	692	YORK - T 0001	55019894250001
657	MEAD - T 0001	55019502750001	675	Stanley - C 0005	55019766250005	693	YORK - T 0002	55019894250002
658	MENTOR - T 0001	55019511250001	676	Stanley - C 0008	55019766250008	694	Arlington - V 0001	55021028000001
659	Neillsville - C 0001	55019558000001	677	Thorp - C 0001	55019796250001	695	ARLINGTON - T 0001	55021028250001
660	Neillsville - C 0002	55019558000002	678	Thorp - C 0002	55019796250002	696	CALEDONIA - T 0001	55021119000001
661	Neillsville - C 0003	55019558000003	679	Thorp - C 0003	55019796250003	697	CALEDONIA - T 0002	55021119000002
662	Neillsville - C 0004	55019558000004	680	Thorp - C 0004	55019796250004	698	Cambria - V 0001	55021122000001
663	Neillsville - C 0005	55019558000005	681	THORP - T 0001	55019796500001	699	Columbus - C 0001	55021164500001
664	Owen - C 0001	55019608250001	682	UNITY - T 0001	55019818250001	700	Columbus - C 0002	55021164500002
665	Owen - C 0002	55019608250002	683	Unity - V 0002	55019818500002	701	Columbus - C 0003	55021164500003
666	Owen - C 0003	55019608250003	684	WARNER - T 0001	55019833500001	702	Columbus - C 0004	55021164500004

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
703	Columbus - C 0005	55021164500005	721	LEEDS - T 0001	55021431250001	739	MARCELLON - T 0002	55021491500002
704	Columbus - C 0006	55021164500006	722	LEEDS - T 0002	55021431250002	740	NEWPORT - T 0001	55021570250001
705	Columbus - C 0007	55021164500007	723	LEWISTON - T 0001	55021437750001	741	OTSEGO - T 0001	55021606870001
706	Columbus - C 0008	55021164500008	724	LEWISTON - T 0002	55021437750002	742	PACIFIC - T 0001	55021609250001
707	Columbus - C 0010	55021164500010	725	Lodi - C 0001	55021453500001	743	PACIFIC - T 0002	55021609250002
708	COLUMBUS - T 0001	55021164750001	726	Lodi - C 0002	55021453500002	744	PACIFIC - T 0003	55021609250003
709	COURTLAND - T 0001	55021173250001	727	Lodi - C 0003	55021453500003	745	PACIFIC - T 0004	55021609250004
710	DEKORRA - T 0001	55021193750001	728	Lodi - C 0004	55021453500004	746	Pardeeville - V 0001	55021611000001
711	DEKORRA - T 0002	55021193750002	729	Lodi - C 0005	55021453500005	747	Pardeeville - V 0002	55021611000002
712	DEKORRA - T 0003	55021193750003	730	Lodi - C 0006	55021453500006	748	Pardeeville - V 0003	55021611000003
713	Doylestown - V 0001	55021207750001	731	LODI - T 0001	55021453750001	749	Portage - C 0001	55021641000001
714	Fall River - V 0001	55021251500001	732	LODI - T 0002	55021453750002	750	Portage - C 0002	55021641000002
715	Fall River - V 0002	55021251500002	733	LODI - T 0003	55021453750003	751	Portage - C 0003	55021641000003
716	FORT WINNEBAGO - T 0001	55021267250001	734	LODI - T 0004	55021453750004	752	Portage - C 0004	55021641000004
717	FOUNTAIN PRAIRIE - T 0001	55021268750001	735	LODI - T 0005	55021453750005	753	Portage - C 0005	55021641000005
718	FOUNTAIN PRAIRIE - T 0002	55021268750002	736	LOWVILLE - T 0001	55021460500001	754	Portage - C 0006	55021641000006
719	Friesland - V 0001	55021280000001	737	LOWVILLE - T 0002	55021460500002	755	Portage - C 0007	55021641000007
720	HAMPDEN - T 0001	55021323750001	738	MARCELLON - T 0001	55021491500001	756	Portage - C 0008	55021641000008

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
757	Portage - C 0009	55021641000009	775	Wisconsin Dells - C 0002	55021881500002	793	FREEMAN - T 0001	55023277000001
758	Portage - C 0010	55021641000010	776	Wisconsin Dells - C 0003	55021881500003	794	Gays Mills - V 0001	55023284500001
759	Portage - C 0011	55021641000011	777	Wisconsin Dells - C 0006	55021881500006	795	HANEY - T 0001	55023325000001
760	Poynette - V 0001	55021649000001	778	Wisconsin Dells - C 0011	55021881500011	796	Lynxville - V 0001	55023466750001
761	Poynette - V 0002	55021649000002	779	Wisconsin Dells - C 0012	55021881500012	797	MARIETTA - T 0001	55023492750001
762	Poynette - V 0003	55021649000003	780	Wyocena - V 0001	55021893000001	798	Mount Sterling - V 0001	55023549000001
763	Poynette - V 0004	55021649000004	781	WYOCENA - T 0001	55021893250001	799	Prairie Du Chien - C 0001	55023650500001
764	Randolph - V 0003	55021661500003	782	WYOCENA - T 0002	55021893250002	800	Prairie Du Chien - C 0002	55023650500002
765	RANDOLPH - T 0001	55021661750001	783	Bell Center - V 0001	55023062250001	801	Prairie Du Chien - C 0003	55023650500003
766	Rio - V 0001	55021681000001	784	BRIDGEPORT - T 0001	55023095500001	802	Prairie Du Chien - C 0004	55023650500004
767	Rio - V 0002	55021681000002	785	CLAYTON - T 0001	55023150750001	803	Prairie Du Chien - C 0005	55023650500005
768	SCOTT - T 0001	55021722500001	786	CLAYTON - T 0002	55023150750002	804	Prairie Du Chien - C 0006	55023650500006
769	SPRINGVALE - T 0001	55021762250001	787	CLAYTON - T 0003	55023150750003	805	Prairie Du Chien - C 0007	55023650500007
770	SPRINGVALE - T 0002	55021762250002	788	De Soto - V 0002	55023198500002	806	PRAIRIE DU CHIEN - T 0001	55023650750001
771	WEST POINT - T 0001	55021861000001	789	Eastman - V 0001	55023219000001	807	PRAIRIE DU CHIEN - T 0002	55023650750002
772	WEST POINT - T 0002	55021861000002	790	EASTMAN - T 0001	55023219250001	808	SCOTT - T 0001	55023722750001
773	WEST POINT - T 0003	55021861000003	791	EASTMAN - T 0002	55023219250002	809	SENECA - T 0001	55023725000001
774	Wisconsin Dells - C 0001	55021881500001	792	Ferryville - V 0001	55023257250001	810	Soldiers Grove - V 0001	55023745500001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
811	Steuben - V 0001	55023771750001	829	BLUE MOUNDS - T 0001	55025085000001	847	Cottage Grove - V 0004	55025171750004
812	UTICA - T 0001	55023821000001	830	BRISTOL - T 0001	55025097750001	848	Cottage Grove - V 0005	55025171750005
813	Wauzeka - V 0001	55023847250001	831	BRISTOL - T 0002	55025097750002	849	Cottage Grove - V 0006	55025171750006
814	WAUZEKA - T 0001	55023847500001	832	BRISTOL - T 0003	55025097750003	850	Cottage Grove - V 0007	55025171750007
815	WAUZEKA - T 0002	55023847500002	833	BRISTOL - T 0004	55025097750004	851	Cottage Grove - V 0008	55025171750008
816	ALBION - T 0001	55025008750001	834	Brooklyn - V 0001	55025100750001	852	Cottage Grove - V 0009	55025171750009
817	ALBION - T 0002	55025008750002	835	Brooklyn - V 0003	55025100750003	853	Cottage Grove - V 0010	55025171750010
818	Belleville - V 0001	55025063000001	836	BURKE - T 0001	55025111500001	854	Cottage Grove - V 0011	55025171750011
819	Belleville - V 0002	55025063000002	837	BURKE - T 0002	55025111500002	855	Cottage Grove - V 0012	55025171750012
820	BERRY - T 0001	55025070250001	838	BURKE - T 0003	55025111500003	856	COTTAGE GROVE - T 0001	55025172000001
821	BERRY - T 0002	55025070250002	839	BURKE - T 0004	55025111500004	857	COTTAGE GROVE - T 0002	55025172000002
822	Black Earth - V 0001	55025078000001	840	Cambridge - V 0002	55025122250002	858	COTTAGE GROVE - T 0003	55025172000003
823	Black Earth - V 0002	55025078000002	841	Cambridge - V 0003	55025122250003	859	COTTAGE GROVE - T 0004	55025172000004
824	BLACK EARTH - T 0001	55025078250001	842	CHRISTIANA - T 0001	55025146500001	860	COTTAGE GROVE - T 0005	55025172000005
825	BLOOMING GROVE - T 0001	55025083500001	843	CHRISTIANA - T 0002	55025146500002	861	COTTAGE GROVE - T 0006	55025172000006
826	BLOOMING GROVE - T 0002	55025083500002	844	Cottage Grove - V 0001	55025171750001	862	COTTAGE GROVE - T 0007	55025172000007
827	BLOOMING GROVE - T 0003	55025083500003	845	Cottage Grove - V 0002	55025171750002	863	Cross Plains - V 0001	55025177750001
828	Blue Mounds - V 0001	55025084750001	846	Cottage Grove - V 0003	55025171750003	864	Cross Plains - V 0002	55025177750002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
865	Cross Plains - V 0003	55025177750003	883	Deforest - V 0005	55025193500005	901	DUNKIRK - T 0002	55025211000002
866	Cross Plains - V 0004	55025177750004	884	Deforest - V 0006	55025193500006	902	DUNKIRK - T 0003	55025211000003
867	Cross Plains - V 0005	55025177750005	885	Deforest - V 0007	55025193500007	903	DUNKIRK - T 0004	55025211000004
868	Cross Plains - V 0006	55025177750006	886	Deforest - V 0008	55025193500008	904	DUNKIRK - T 0005	55025211000005
869	CROSS PLAINS - T 0001	55025178000001	887	Deforest - V 0009	55025193500009	905	DUNKIRK - T 0006	55025211000006
870	CROSS PLAINS - T 0002	55025178000002	888	Deforest - V 0010	55025193500010	906	DUNN - T 0001	55025211250001
871	CROSS PLAINS - T 0003	55025178000003	889	Deforest - V 0011	55025193500011	907	DUNN - T 0002	55025211250002
872	Dane - V 0001	55025187000001	890	Deforest - V 0012	55025193500012	908	DUNN - T 0003	55025211250003
873	DANE - T 0001	55025187250001	891	Deforest - V 0013	55025193500013	909	DUNN - T 0004	55025211250004
874	Deerfield - V 0001	55025192500001	892	Deforest - V 0014	55025193500014	910	DUNN - T 0005	55025211250005
875	Deerfield - V 0002	55025192500002	893	Deforest - V 0015	55025193500015	911	DUNN - T 0006	55025211250006
876	Deerfield - V 0003	55025192500003	894	Deforest - V 0016	55025193500016	912	DUNN - T 0007	55025211250007
877	DEERFIELD - T 0001	55025192750001	895	Deforest - V 0017	55025193500017	913	Edgerton - C 0007	55025225750007
878	DEERFIELD - T 0002	55025192750002	896	Deforest - V 0018	55025193500018	914	Fitchburg - C 0001	55025259500001
879	Deforest - V 0001	55025193500001	897	Deforest - V 0019	55025193500019	915	Fitchburg - C 0002	55025259500002
880	Deforest - V 0002	55025193500002	898	Deforest - V 0020	55025193500020	916	Fitchburg - C 0003	55025259500003
881	Deforest - V 0003	55025193500003	899	Deforest - V 0021	55025193500021	917	Fitchburg - C 0004	55025259500004
882	Deforest - V 0004	55025193500004	900	DUNKIRK - T 0001	55025211000001	918	Fitchburg - C 0005	55025259500005

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
919	Fitchburg - C 0006	55025259500006	937	Mcfarland - V 0004	55025468500004	955	Madison - C 0010	55025480000010
920	Fitchburg - C 0007	55025259500007	938	Mcfarland - V 0005	55025468500005	956	Madison - C 0011	55025480000011
921	Fitchburg - C 0008	55025259500008	939	Mcfarland - V 0006	55025468500006	957	Madison - C 0012	55025480000012
922	Fitchburg - C 0009	55025259500009	940	Mcfarland - V 0007	55025468500007	958	Madison - C 0013	55025480000013
923	Fitchburg - C 0010	55025259500010	941	Mcfarland - V 0008	55025468500008	959	Madison - C 0014	55025480000014
924	Fitchburg - C 0011	55025259500011	942	Mcfarland - V 0009	55025468500009	960	Madison - C 0015	55025480000015
925	Fitchburg - C 0012	55025259500012	943	Mcfarland - V 0010	55025468500010	961	Madison - C 0016	55025480000016
926	Fitchburg - C 0013	55025259500013	944	Mcfarland - V 0011	55025468500011	962	Madison - C 0017	55025480000017
927	Fitchburg - C 0014	55025259500014	945	Mcfarland - V 0012	55025468500012	963	Madison - C 0018	55025480000018
928	Fitchburg - C 0015	55025259500015	946	Madison - C 0001	55025480000001	964	Madison - C 0019	55025480000019
929	Fitchburg - C 0016	55025259500016	947	Madison - C 0002	55025480000002	965	Madison - C 0020	55025480000020
930	Fitchburg - C 0017	55025259500017	948	Madison - C 0003	55025480000003	966	Madison - C 0021	55025480000021
931	Fitchburg - C 0018	55025259500018	949	Madison - C 0004	55025480000004	967	Madison - C 0022	55025480000022
932	Fitchburg - C 0019	55025259500019	950	Madison - C 0005	55025480000005	968	Madison - C 0023	55025480000023
933	Fitchburg - C 0020	55025259500020	951	Madison - C 0006	55025480000006	969	Madison - C 0024	55025480000024
934	Mcfarland - V 0001	55025468500001	952	Madison - C 0007	55025480000007	970	Madison - C 0025	55025480000025
935	Mcfarland - V 0002	55025468500002	953	Madison - C 0008	55025480000008	971	Madison - C 0026	55025480000026
936	Mcfarland - V 0003	55025468500003	954	Madison - C 0009	55025480000009	972	Madison - C 0027	55025480000027

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
973	Madison - C 0028	55025480000028	991	Madison - C 0046	55025480000046	1009	Madison - C 0064	55025480000064
974	Madison - C 0029	55025480000029	992	Madison - C 0047	55025480000047	1010	Madison - C 0065	55025480000065
975	Madison - C 0030	55025480000030	993	Madison - C 0048	55025480000048	1011	Madison - C 0066	55025480000066
976	Madison - C 0031	55025480000031	994	Madison - C 0049	55025480000049	1012	Madison - C 0067	55025480000067
977	Madison - C 0032	55025480000032	995	Madison - C 0050	55025480000050	1013	Madison - C 0068	55025480000068
978	Madison - C 0033	55025480000033	996	Madison - C 0051	55025480000051	1014	Madison - C 0069	55025480000069
979	Madison - C 0034	55025480000034	997	Madison - C 0052	55025480000052	1015	Madison - C 0070	55025480000070
980	Madison - C 0035	55025480000035	998	Madison - C 0053	55025480000053	1016	Madison - C 0071	55025480000071
981	Madison - C 0036	55025480000036	999	Madison - C 0054	55025480000054	1017	Madison - C 0072	55025480000072
982	Madison - C 0037	55025480000037	1000	Madison - C 0055	55025480000055	1018	Madison - C 0073	55025480000073
983	Madison - C 0038	55025480000038	1001	Madison - C 0056	55025480000056	1019	Madison - C 0074	55025480000074
984	Madison - C 0039	55025480000039	1002	Madison - C 0057	55025480000057	1020	Madison - C 0075	55025480000075
985	Madison - C 0040	55025480000040	1003	Madison - C 0058	55025480000058	1021	Madison - C 0076	55025480000076
986	Madison - C 0041	55025480000041	1004	Madison - C 0059	55025480000059	1022	Madison - C 0077	55025480000077
987	Madison - C 0042	55025480000042	1005	Madison - C 0060	55025480000060	1023	Madison - C 0078	55025480000078
988	Madison - C 0043	55025480000043	1006	Madison - C 0061	55025480000061	1024	Madison - C 0079	55025480000079
989	Madison - C 0044	55025480000044	1007	Madison - C 0062	55025480000062	1025	Madison - C 0080	55025480000080
990	Madison - C 0045	55025480000045	1008	Madison - C 0063	55025480000063	1026	Madison - C 0081	55025480000081

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1027	Madison - C 0082	55025480000082	1045	Madison - C 0100	55025480000100	1063	Madison - C 0118	55025480000118
1028	Madison - C 0083	55025480000083	1046	Madison - C 0101	55025480000101	1064	Madison - C 0119	55025480000119
1029	Madison - C 0084	55025480000084	1047	Madison - C 0102	55025480000102	1065	Madison - C 0120	55025480000120
1030	Madison - C 0085	55025480000085	1048	Madison - C 0103	55025480000103	1066	Madison - C 0121	55025480000121
1031	Madison - C 0086	55025480000086	1049	Madison - C 0104	55025480000104	1067	Madison - C 0122	55025480000122
1032	Madison - C 0087	55025480000087	1050	Madison - C 0105	55025480000105	1068	Madison - C 0123	55025480000123
1033	Madison - C 0088	55025480000088	1051	Madison - C 0106	55025480000106	1069	Madison - C 0124	55025480000124
1034	Madison - C 0089	55025480000089	1052	Madison - C 0107	55025480000107	1070	Madison - C 0125	55025480000125
1035	Madison - C 0090	55025480000090	1053	Madison - C 0108	55025480000108	1071	Madison - C 0126	55025480000126
1036	Madison - C 0091	55025480000091	1054	Madison - C 0109	55025480000109	1072	Madison - C 0127	55025480000127
1037	Madison - C 0092	55025480000092	1055	Madison - C 0110	55025480000110	1073	Madison - C 0128	55025480000128
1038	Madison - C 0093	55025480000093	1056	Madison - C 0111	55025480000111	1074	Madison - C 0129	55025480000129
1039	Madison - C 0094	55025480000094	1057	Madison - C 0112	55025480000112	1075	Madison - C 0130	55025480000130
1040	Madison - C 0095	55025480000095	1058	Madison - C 0113	55025480000113	1076	Madison - C 0131	55025480000131
1041	Madison - C 0096	55025480000096	1059	Madison - C 0114	55025480000114	1077	Madison - C 0132	55025480000132
1042	Madison - C 0097	55025480000097	1060	Madison - C 0115	55025480000115	1078	Madison - C 0133	55025480000133
1043	Madison - C 0098	55025480000098	1061	Madison - C 0116	55025480000116	1079	Madison - C 0134	55025480000134
1044	Madison - C 0099	55025480000099	1062	Madison - C 0117	55025480000117	1080	Madison - C 0135	55025480000135

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1081	Madison - C 0136	55025480000136	1099	Maple Bluff - V 0001	55025487500001	1117	Middleton - C 0005	55025515750005
1082	Madison - C 0137	55025480000137	1100	Maple Bluff - V 0002	55025487500002	1118	Middleton - C 0006	55025515750006
1083	Madison - C 0138	55025480000138	1101	Marshall - V 0001	55025495750001	1119	Middleton - C 0007	55025515750007
1084	Madison - C 0139	55025480000139	1102	Marshall - V 0002	55025495750002	1120	Middleton - C 0008	55025515750008
1085	Madison - C 0140	55025480000140	1103	Marshall - V 0003	55025495750003	1121	Middleton - C 0009	55025515750009
1086	Madison - C 0141	55025480000141	1104	Marshall - V 0004	55025495750004	1122	Middleton - C 0010	55025515750010
1087	Madison - C 0142	55025480000142	1105	Marshall - V 0005	55025495750005	1123	Middleton - C 0011	55025515750011
1088	Madison - C 0143	55025480000143	1106	Mazomanie - V 0001	55025502250001	1124	Middleton - C 0012	55025515750012
1089	Madison - C 0144	55025480000144	1107	Mazomanie - V 0002	55025502250002	1125	Middleton - C 0013	55025515750013
1090	MADISON - T 0001	55025480250001	1108	Mazomanie - V 0003	55025502250003	1126	Middleton - C 0014	55025515750014
1091	MADISON - T 0002	55025480250002	1109	MAZOMANIE - T 0001	55025502500001	1127	Middleton - C 0015	55025515750015
1092	MADISON - T 0003	55025480250003	1110	MAZOMANIE - T 0002	55025502500002	1128	Middleton - C 0016	55025515750016
1093	MADISON - T 0004	55025480250004	1111	MEDINA - T 0001	55025504750001	1129	Middleton - C 0017	55025515750017
1094	MADISON - T 0005	55025480250005	1112	MEDINA - T 0002	55025504750002	1130	Middleton - C 0018	55025515750018
1095	MADISON - T 0006	55025480250006	1113	Middleton - C 0001	55025515750001	1131	Middleton - C 0019	55025515750019
1096	MADISON - T 0007	55025480250007	1114	Middleton - C 0002	55025515750002	1132	Middleton - C 0020	55025515750020
1097	MADISON - T 0008	55025480250008	1115	Middleton - C 0003	55025515750003	1133	MIDDLETON - T 0001	55025516000001
1098	MADISON - T 0009	55025480250009	1116	Middleton - C 0004	55025515750004	1134	MIDDLETON - T 0002	55025516000002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.
1135	MIDDLETON - T 0003	55025516000003
1136	MIDDLETON - T 0004	55025516000004
1137	MIDDLETON - T 0005	55025516000005
1138	MIDDLETON - T 0006	55025516000006
1139	MIDDLETON - T 0007	55025516000007
1140	MIDDLETON - T 0008	55025516000008
1141	Monona - C 0001	55025536750001
1142	Monona - C 0002	55025536750002
1143	Monona - C 0003	55025536750003
1144	Monona - C 0004	55025536750004
1145	Monona - C 0005	55025536750005
1146	Monona - C 0006	55025536750006
1147	Monona - C 0007	55025536750007
1148	Monona - C 0008	55025536750008
1149	Monona - C 0009	55025536750009
1150	Monona - C 0010	55025536750010
1151	MONTROSE - T 0001	55025541000001
1152	MONTROSE - T 0002	55025541000002

Ward ID.	Ward Label	WARD FIPS.
1153	Mount Horeb - V 0001	55025547250001
1154	Mount Horeb - V 0002	55025547250002
1155	Mount Horeb - V 0003	55025547250003
1156	Mount Horeb - V 0004	55025547250004
1157	Mount Horeb - V 0005	55025547250005
1158	Mount Horeb - V 0006	55025547250006
1159	Mount Horeb - V 0007	55025547250007
1160	Mount Horeb - V 0008	55025547250008
1161	Mount Horeb - V 0009	55025547250009
1162	Oregon - V 0001	55025602000001
1163	Oregon - V 0002	55025602000002
1164	Oregon - V 0003	55025602000003
1165	Oregon - V 0004	55025602000004
1166	Oregon - V 0005	55025602000005
1167	Oregon - V 0006	55025602000006
1168	Oregon - V 0007	55025602000007
1169	Oregon - V 0008	55025602000008
1170	Oregon - V 0009	55025602000009

Ward ID.	Ward Label	WARD FIPS.
1171	Oregon - V 0010	55025602000010
1172	Oregon - V 0011	55025602000011
1173	Oregon - V 0012	55025602000012
1174	Oregon - V 0013	55025602000013
1175	OREGON - T 0001	55025602250001
1176	OREGON - T 0002	55025602250002
1177	OREGON - T 0003	55025602250003
1178	OREGON - T 0004	55025602250004
1179	PERRY - T 0001	55025620500001
1180	PLEASANT SPRINGS - T 0001	55025633750001
1181	PLEASANT SPRINGS - T 0002	55025633750002
1182	PLEASANT SPRINGS - T 0003	55025633750003
1183	PLEASANT SPRINGS - T 0004	55025633750004
1184	PRIMROSE - T 0001	55025655750001
1185	Rockdale - V 0001	55025687250001
1186	ROXBURY - T 0001	55025698500001
1187	ROXBURY - T 0002	55025698500002
1188	RUTLAND - T 0001	55025704000001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1189	RUTLAND - T 0002	55025704000002	1207	Stoughton - C 0011	55025776750011	1225	Sun Prairie - C 0015	55025786000015
1190	Shorewood Hills - V 0001	55025737500001	1208	Stoughton - C 0012	55025776750012	1226	Sun Prairie - C 0016	55025786000016
1191	Shorewood Hills - V 0002	55025737500002	1209	Stoughton - C 0013	55025776750013	1227	Sun Prairie - C 0017	55025786000017
1192	SPRINGDALE - T 0001	55025758500001	1210	Stoughton - C 0014	55025776750014	1228	Sun Prairie - C 0018	55025786000018
1193	SPRINGDALE - T 0002	55025758500002	1211	Sun Prairie - C 0001	55025786000001	1229	Sun Prairie - C 0019	55025786000019
1194	SPRINGFIELD - T 0001	55025758750001	1212	Sun Prairie - C 0002	55025786000002	1230	Sun Prairie - C 0020	55025786000020
1195	SPRINGFIELD - T 0002	55025758750002	1213	Sun Prairie - C 0003	55025786000003	1231	Sun Prairie - C 0021	55025786000021
1196	SPRINGFIELD - T 0003	55025758750003	1214	Sun Prairie - C 0004	55025786000004	1232	Sun Prairie - C 0022	55025786000022
1197	Stoughton - C 0001	55025776750001	1215	Sun Prairie - C 0005	55025786000005	1233	Sun Prairie - C 0023	55025786000023
1198	Stoughton - C 0002	55025776750002	1216	Sun Prairie - C 0006	55025786000006	1234	Sun Prairie - C 0024	55025786000024
1199	Stoughton - C 0003	55025776750003	1217	Sun Prairie - C 0007	55025786000007	1235	Sun Prairie - C 0025	55025786000025
1200	Stoughton - C 0004	55025776750004	1218	Sun Prairie - C 0008	55025786000008	1236	SUN PRAIRIE - T 0001	55025786250001
1201	Stoughton - C 0005	55025776750005	1219	Sun Prairie - C 0009	55025786000009	1237	SUN PRAIRIE - T 0002	55025786250002
1202	Stoughton - C 0006	55025776750006	1220	Sun Prairie - C 0010	55025786000010	1238	SUN PRAIRIE - T 0003	55025786250003
1203	Stoughton - C 0007	55025776750007	1221	Sun Prairie - C 0011	55025786000011	1239	VERMONT - T 0001	55025825250001
1204	Stoughton - C 0008	55025776750008	1222	Sun Prairie - C 0012	55025786000012	1240	Verona - C 0001	55025826000001
1205	Stoughton - C 0009	55025776750009	1223	Sun Prairie - C 0013	55025786000013	1241	Verona - C 0002	55025826000002
1206	Stoughton - C 0010	55025776750010	1224	Sun Prairie - C 0014	55025786000014	1242	Verona - C 0003	55025826000003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1243	Verona - C 0004	55025826000004	1261	Waunakee - V 0007	55025843500007	1279	Windsor - V 0008	55025877250008
1244	Verona - C 0005	55025826000005	1262	Waunakee - V 0008	55025843500008	1280	Windsor - V 0009	55025877250009
1245	Verona - C 0006	55025826000006	1263	Waunakee - V 0009	55025843500009	1281	Windsor - V 0010	55025877250010
1246	Verona - C 0007	55025826000007	1264	Waunakee - V 0010	55025843500010	1282	YORK - T 0001	55025894500001
1247	Verona - C 0008	55025826000008	1265	Waunakee - V 0011	55025843500011	1283	ASHIPPUN - T 0001	55027032000001
1248	Verona - C 0009	55025826000009	1266	Waunakee - V 0012	55025843500012	1284	ASHIPPUN - T 0002	55027032000002
1249	VERONA - T 0001	55025826250001	1267	WESTPORT - T 0001	55025861250001	1285	ASHIPPUN - T 0003	55027032000003
1250	VERONA - T 0002	55025826250002	1268	WESTPORT - T 0002	55025861250002	1286	ASHIPPUN - T 0004	55027032000004
1251	VERONA - T 0003	55025826250003	1269	WESTPORT - T 0003	55025861250003	1287	Beaver Dam - C 0001	55027059000001
1252	VERONA - T 0004	55025826250004	1270	WESTPORT - T 0004	55025861250004	1288	Beaver Dam - C 0002	55027059000002
1253	VIENNA - T 0001	55025827500001	1271	WESTPORT - T 0005	55025861250005	1289	Beaver Dam - C 0003	55027059000003
1254	VIENNA - T 0002	55025827500002	1272	Windsor - V 0001	55025877250001	1290	Beaver Dam - C 0004	55027059000004
1255	Waunakee - V 0001	55025843500001	1273	Windsor - V 0002	55025877250002	1291	Beaver Dam - C 0005	55027059000005
1256	Waunakee - V 0002	55025843500002	1274	Windsor - V 0003	55025877250003	1292	Beaver Dam - C 0006	55027059000006
1257	Waunakee - V 0003	55025843500003	1275	Windsor - V 0004	55025877250004	1293	Beaver Dam - C 0007	55027059000007
1258	Waunakee - V 0004	55025843500004	1276	Windsor - V 0005	55025877250005	1294	Beaver Dam - C 0008	55027059000008
1259	Waunakee - V 0005	55025843500005	1277	Windsor - V 0006	55025877250006	1295	Beaver Dam - C 0009	55027059000009
1260	Waunakee - V 0006	55025843500006	1278	Windsor - V 0007	55025877250007	1296	Beaver Dam - C 0010	55027059000010

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1297	Beaver Dam - C 0011	55027059000011	1315	CALAMUS - T 0001	55027118500001	1333	Hartford - C 0019	55027330000019
1298	Beaver Dam - C 0012	55027059000012	1316	CALAMUS - T 0002	55027118500002	1334	HERMAN - T 0001	55027340000001
1299	Beaver Dam - C 0013	55027059000013	1317	CHESTER - T 0001	55027143000001	1335	HERMAN - T 0002	55027340000002
1300	Beaver Dam - C 0014	55027059000014	1318	CHESTER - T 0002	55027143000002	1336	Horicon - C 0001	55027357500001
1301	BEAVER DAM - T 0001	55027059250001	1319	Clyman - V 0001	55027159000001	1337	Horicon - C 0002	55027357500002
1302	BEAVER DAM - T 0002	55027059250002	1320	CLYMAN - T 0001	55027159250001	1338	Horicon - C 0003	55027357500003
1303	BEAVER DAM - T 0003	55027059250003	1321	Columbus - C 0009	55027164500009	1339	Horicon - C 0004	55027357500004
1304	BEAVER DAM - T 0004	55027059250004	1322	ELBA - T 0001	55027230000001	1340	Horicon - C 0005	55027357500005
1305	BEAVER DAM - T 0005	55027059250005	1323	EMMET - T 0001	55027240000001	1341	Horicon - C 0006	55027357500006
1306	BEAVER DAM - T 0006	55027059250006	1324	EMMET - T 0002	55027240000002	1342	Horicon - C 0007	55027357500007
1307	BEAVER DAM - T 0007	55027059250007	1325	Fox Lake - C 0001	55027270000001	1343	HUBBARD - T 0001	55027361000001
1308	BEAVER DAM - T 0008	55027059250008	1326	Fox Lake - C 0002	55027270000002	1344	HUBBARD - T 0002	55027361000002
1309	BEAVER DAM - T 0009	55027059250009	1327	Fox Lake - C 0003	55027270000003	1345	HUBBARD - T 0003	55027361000003
1310	BEAVER DAM - T 0010	55027059250010	1328	FOX LAKE - T 0001	55027270250001	1346	HUBBARD - T 0004	55027361000004
1311	BEAVER DAM - T 0011	55027059250011	1329	FOX LAKE - T 0002	55027270250002	1347	HUBBARD - T 0005	55027361000005
1312	Brownsville - V 0001	55027104500001	1330	FOX LAKE - T 0003	55027270250003	1348	HUBBARD - T 0006	55027361000006
1313	BURNETT - T 0001	55027112750001	1331	FOX LAKE - T 0004	55027270250004	1349	Hustisford - V 0001	55027366250001
1314	BURNETT - T 0002	55027112750002	1332	Hartford - C 0018	55027330000018	1350	Hustisford - V 0002	55027366250002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1351	HUSTISFORD - T 0001	55027366500001	1369	LOWELL - T 0001	55027459750001	1387	PORTLAND - T 0001	55027643750001
1352	HUSTISFORD - T 0002	55027366500002	1370	LOWELL - T 0002	55027459750002	1388	PORTLAND - T 0002	55027643750002
1353	Iron Ridge - V 0001	55027371500001	1371	LOWELL - T 0003	55027459750003	1389	Randolph - V 0001	55027661500001
1354	Juneau - C 0001	55027386750001	1372	LOWELL - T 0004	55027459750004	1390	Randolph - V 0002	55027661500002
1355	Juneau - C 0002	55027386750002	1373	Mayville - C 0001	55027502000001	1391	Reeseville - V 0001	55027669000001
1356	Juneau - C 0003	55027386750003	1374	Mayville - C 0002	55027502000002	1392	RUBICON - T 0001	55027699620001
1357	Kekoskee - V 0001	55027389000001	1375	Mayville - C 0003	55027502000003	1393	RUBICON - T 0002	55027699620002
1358	LEBANON - T 0001	55027430500001	1376	Mayville - C 0004	55027502000004	1394	RUBICON - T 0003	55027699620003
1359	LEBANON - T 0002	55027430500002	1377	Mayville - C 0005	55027502000005	1395	SHIELDS - T 0001	55027735750001
1360	LEROY - T 0001	55027436500001	1378	Mayville - C 0006	55027502000006	1396	Theresa - V 0001	55027793750001
1361	LEROY - T 0002	55027436500002	1379	Mayville - C 0007	55027502000007	1397	Theresa - V 0002	55027793750002
1362	Lomira - V 0001	55027454750001	1380	Mayville - C 0008	55027502000008	1398	Theresa - V 0003	55027793750003
1363	Lomira - V 0002	55027454750002	1381	Neosho - V 0001	55027560750001	1399	THERESA - T 0001	55027794250001
1364	Lomira - V 0003	55027454750003	1382	OAK GROVE - T 0001	55027590000001	1400	THERESA - T 0002	55027794250002
1365	LOMIRA - T 0001	55027455000001	1383	OAK GROVE - T 0002	55027590000002	1401	THERESA - T 0003	55027794250003
1366	LOMIRA - T 0002	55027455000002	1384	OAK GROVE - T 0003	55027590000003	1402	THERESA - T 0004	55027794250004
1367	LOMIRA - T 0003	55027455000003	1385	OAK GROVE - T 0004	55027590000004	1403	THERESA - T 0005	55027794250005
1368	Lowell - V 0001	55027459500001	1386	OAK GROVE - T 0005	55027590000005	1404	THERESA - T 0006	55027794250006

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1405	THERESA - T 0007	55027794250007	1423	Waupun - C 0013	55027844250013	1441	Forestville - V 0001	55029266250001
1406	TRENTON - T 0001	55027805250001	1424	Waupun - C 0014	55027844250014	1442	FORESTVILLE - T 0001	55029266500001
1407	TRENTON - T 0002	55027805250002	1425	WESTFORD - T 0001	55027856500001	1443	FORESTVILLE - T 0002	55029266500002
1408	Watertown - C 0001	55027839750001	1426	WESTFORD - T 0002	55027856500002	1444	GARDNER - T 0001	55029283000001
1409	Watertown - C 0002	55027839750002	1427	WESTFORD - T 0003	55027856500003	1445	GARDNER - T 0002	55029283000002
1410	Watertown - C 0003	55027839750003	1428	WILLIAMSTOWN - T 0001	55027872250001	1446	GIBRALTAR - T 0001	55029289500001
1411	Watertown - C 0004	55027839750004	1429	WILLIAMSTOWN - T 0002	55027872250002	1447	GIBRALTAR - T 0002	55029289500002
1412	Watertown - C 0005	55027839750005	1430	WILLIAMSTOWN - T 0003	55027872250003	1448	JACKSONPORT - T 0001	55029377500001
1413	Watertown - C 0006	55027839750006	1431	BAILEYS HARBOR - T 0001	55029043250001	1449	JACKSONPORT - T 0002	55029377500002
1414	Watertown - C 0007	55027839750007	1432	BAILEYS HARBOR - T 0002	55029043250002	1450	LIBERTY GROVE - T 0001	55029439250001
1415	Waupun - C 0001	55027844250001	1433	BRUSSELS - T 0001	55029107000001	1451	LIBERTY GROVE - T 0002	55029439250002
1416	Waupun - C 0002	55027844250002	1434	BRUSSELS - T 0002	55029107000002	1452	LIBERTY GROVE - T 0003	55029439250003
1417	Waupun - C 0003	55027844250003	1435	CLAY BANKS - T 0001	55029150250001	1453	NASEWAUPEE - T 0001	55029555000001
1418	Waupun - C 0004	55027844250004	1436	Egg Harbor - V 0001	55029228500001	1454	NASEWAUPEE - T 0002	55029555000002
1419	Waupun - C 0005	55027844250005	1437	EGG HARBOR - T 0001	55029228750001	1455	NASEWAUPEE - T 0003	55029555000003
1420	Waupun - C 0006	55027844250006	1438	EGG HARBOR - T 0002	55029228750002	1456	SEVASTOPOL - T 0001	55029726000001
1421	Waupun - C 0007	55027844250007	1439	EGG HARBOR - T 0003	55029228750003	1457	SEVASTOPOL - T 0002	55029726000002
1422	Waupun - C 0008	55027844250008	1440	Ephraim - V 0001	55029241500001	1458	SEVASTOPOL - T 0003	55029726000003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1459	SEVASTOPOL - T 0004	55029726000004	1477	Sturgeon Bay - C 0016	55029778750016	1495	WASHINGTON - T 0001	55029836000001
1460	SEVASTOPOL - T 0005	55029726000005	1478	Sturgeon Bay - C 0017	55029778750017	1496	AMNICON - T 0001	55031018250001
1461	Sister Bay - V 0001	55029742250001	1479	Sturgeon Bay - C 0018	55029778750018	1497	AMNICON - T 0002	55031018250002
1462	Sturgeon Bay - C 0001	55029778750001	1480	Sturgeon Bay - C 0019	55029778750019	1498	BENNETT - T 0001	55031067750001
1463	Sturgeon Bay - C 0002	55029778750002	1481	Sturgeon Bay - C 0020	55029778750020	1499	BRULE - T 0001	55031105750001
1464	Sturgeon Bay - C 0003	55029778750003	1482	Sturgeon Bay - C 0021	55029778750021	1500	BRULE - T 0002	55031105750002
1465	Sturgeon Bay - C 0004	55029778750004	1483	Sturgeon Bay - C 0022	55029778750022	1501	CLOVERLAND - T 0001	55031158250001
1466	Sturgeon Bay - C 0005	55029778750005	1484	Sturgeon Bay - C 0023	55029778750023	1502	DAIRYLAND - T 0001	55031184250001
1467	Sturgeon Bay - C 0006	55029778750006	1485	Sturgeon Bay - C 0024	55029778750024	1503	GORDON - T 0001	55031299250001
1468	Sturgeon Bay - C 0007	55029778750007	1486	Sturgeon Bay - C 0025	55029778750025	1504	HAWTHORNE - T 0001	55031333500001
1469	Sturgeon Bay - C 0008	55029778750008	1487	Sturgeon Bay - C 0026	55029778750026	1505	HAWTHORNE - T 0002	55031333500002
1470	Sturgeon Bay - C 0009	55029778750009	1488	Sturgeon Bay - C 0027	55029778750027	1506	HIGHLAND - T 0001	55031344250001
1471	Sturgeon Bay - C 0010	55029778750010	1489	Sturgeon Bay - C 0028	55029778750028	1507	Lake Nebagamon - V 0001	55031417250001
1472	Sturgeon Bay - C 0011	55029778750011	1490	Sturgeon Bay - C 0029	55029778750029	1508	Lake Nebagamon - V 0002	55031417250002
1473	Sturgeon Bay - C 0012	55029778750012	1491	Sturgeon Bay - C 0030	55029778750030	1509	LAKESIDE - T 0001	55031418000001
1474	Sturgeon Bay - C 0013	55029778750013	1492	STURGEON BAY - T 0001	55029779000001	1510	MAPLE - T 0001	55031487250001
1475	Sturgeon Bay - C 0014	55029778750014	1493	STURGEON BAY - T 0002	55029779000002	1511	OAKLAND - T 0001	55031591000001
1476	Sturgeon Bay - C 0015	55029778750015	1494	UNION - T 0001	55029815250001	1512	OAKLAND - T 0002	55031591000002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1513	Oliver - V 0001	55031598000001	1531	Superior - C 0009	55031786500009	1549	Superior - C 0027	55031786500027
1514	PARKLAND - T 0001	55031612500001	1532	Superior - C 0010	55031786500010	1550	Superior - C 0028	55031786500028
1515	PARKLAND - T 0002	55031612500002	1533	Superior - C 0011	55031786500011	1551	Superior - C 0029	55031786500029
1516	Poplar - V 0001	55031639750001	1534	Superior - C 0012	55031786500012	1552	Superior - C 0030	55031786500030
1517	Solon Springs - V 0001	55031745750001	1535	Superior - C 0013	55031786500013	1553	Superior - C 0031	55031786500031
1518	SOLON SPRINGS - T 0001	55031746000001	1536	Superior - C 0014	55031786500014	1554	Superior - C 0032	55031786500032
1519	SOLON SPRINGS - T 0002	55031746000002	1537	Superior - C 0015	55031786500015	1555	Superior - V 0001	55031786600001
1520	SOLON SPRINGS - T 0003	55031746000003	1538	Superior - C 0016	55031786500016	1556	SUPERIOR - T 0001	55031786750001
1521	SUMMIT - T 0001	55031782750001	1539	Superior - C 0017	55031786500017	1557	SUPERIOR - T 0002	55031786750002
1522	SUMMIT - T 0002	55031782750002	1540	Superior - C 0018	55031786500018	1558	WASCOTT - T 0001	55031835120001
1523	Superior - C 0001	55031786500001	1541	Superior - C 0019	55031786500019	1559	Boyceville - V 0001	55033090500001
1524	Superior - C 0002	55031786500002	1542	Superior - C 0020	55031786500020	1560	Colfax - V 0001	55033162750001
1525	Superior - C 0003	55031786500003	1543	Superior - C 0021	55031786500021	1561	Colfax - V 0002	55033162750002
1526	Superior - C 0004	55031786500004	1544	Superior - C 0022	55031786500022	1562	COLFAX - T 0001	55033163000001
1527	Superior - C 0005	55031786500005	1545	Superior - C 0023	55031786500023	1563	COLFAX - T 0002	55033163000002
1528	Superior - C 0006	55031786500006	1546	Superior - C 0024	55031786500024	1564	COLFAX - T 0003	55033163000003
1529	Superior - C 0007	55031786500007	1547	Superior - C 0025	55031786500025	1565	Downing - V 0001	55033206750001
1530	Superior - C 0008	55031786500008	1548	Superior - C 0026	55031786500026	1566	DUNN - T 0001	55033211500001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1567	DUNN - T 0002	55033211500002	1585	Menomonie - C 0007	55033510250007	1603	SHERIDAN - T 0001	55033733000001
1568	EAU GALLE - T 0001	55033223750001	1586	Menomonie - C 0008	55033510250008	1604	SHERMAN - T 0001	55033733750001
1569	Elk Mound - V 0001	55033233250001	1587	Menomonie - C 0009	55033510250009	1605	SPRING BROOK - T 0001	55033757500001
1570	ELK MOUND - T 0001	55033233500001	1588	Menomonie - C 0010	55033510250010	1606	SPRING BROOK - T 0002	55033757500002
1571	ELK MOUND - T 0002	55033233500002	1589	Menomonie - C 0011	55033510250011	1607	STANTON - T 0001	55033766500001
1572	ELK MOUND - T 0003	55033233500003	1590	Menomonie - C 0012	55033510250012	1608	TAINTER - T 0001	55033789750001
1573	GRANT - T 0001	55033303000001	1591	MENOMONIE - T 0001	55033510500001	1609	TAINTER - T 0002	55033789750002
1574	GRANT - T 0002	55033303000002	1592	MENOMONIE - T 0002	55033510500002	1610	TAINTER - T 0003	55033789750003
1575	HAY RIVER - T 0001	55033334000001	1593	MENOMONIE - T 0003	55033510500003	1611	TIFFANY - T 0001	55033797750001
1576	HAY RIVER - T 0002	55033334000002	1594	NEW HAVEN - T 0001	55033567750001	1612	TIFFANY - T 0002	55033797750002
1577	Knapp - V 0001	55033399750001	1595	OTTER CREEK - T 0001	55033607250001	1613	WESTON - T 0001	55033859750001
1578	LUCAS - T 0001	55033461750001	1596	PERU - T 0001	55033621250001	1614	WESTON - T 0002	55033859750002
1579	Menomonie - C 0001	55033510250001	1597	RED CEDAR - T 0001	55033665500001	1615	Wheeler - V 0001	55033865750001
1580	Menomonie - C 0002	55033510250002	1598	RED CEDAR - T 0002	55033665500002	1616	WILSON - T 0001	55033873750001
1581	Menomonie - C 0003	55033510250003	1599	RED CEDAR - T 0003	55033665500003	1617	Altoona - C 0001	55035015500001
1582	Menomonie - C 0004	55033510250004	1600	Ridgeland - V 0001	55033678000001	1618	Altoona - C 0002	55035015500002
1583	Menomonie - C 0005	55033510250005	1601	ROCK CREEK - T 0001	55033687000001	1619	Altoona - C 0003	55035015500003
1584	Menomonie - C 0006	55033510250006	1602	SAND CREEK - T 0001	55033714250001	1620	Altoona - C 0004	55035015500004

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1621	Altoona - C 0005	55035015500005	1639	BRUNSWICK - T 0001	55035106250001	1657	Eau Claire - C 0014	55035223000014
1622	Altoona - C 0006	55035015500006	1640	BRUNSWICK - T 0002	55035106250002	1658	Eau Claire - C 0015	55035223000015
1623	Altoona - C 0007	55035015500007	1641	CLEAR CREEK - T 0001	55035152000001	1659	Eau Claire - C 0017	55035223000017
1624	Altoona - C 0008	55035015500008	1642	CLEAR CREEK - T 0002	55035152000002	1660	Eau Claire - C 0018	55035223000018
1625	Altoona - C 0009	55035015500009	1643	DRAMMEN - T 0001	55035208000001	1661	Eau Claire - C 0019	55035223000019
1626	Altoona - C 0010	55035015500010	1644	Eau Claire - C 0001	55035223000001	1662	Eau Claire - C 0020	55035223000020
1627	Altoona - C 0011	55035015500011	1645	Eau Claire - C 0002	55035223000002	1663	Eau Claire - C 0021	55035223000021
1628	Altoona - C 0012	55035015500012	1646	Eau Claire - C 0003	55035223000003	1664	Eau Claire - C 0022	55035223000022
1629	Altoona - C 0013	55035015500013	1647	Eau Claire - C 0004	55035223000004	1665	Eau Claire - C 0023	55035223000023
1630	Altoona - C 0014	55035015500014	1648	Eau Claire - C 0005	55035223000005	1666	Eau Claire - C 0024	55035223000024
1631	Altoona - C 0015	55035015500015	1649	Eau Claire - C 0006	55035223000006	1667	Eau Claire - C 0025	55035223000025
1632	Augusta - C 0001	55035038250001	1650	Eau Claire - C 0007	55035223000007	1668	Eau Claire - C 0026	55035223000026
1633	Augusta - C 0002	55035038250002	1651	Eau Claire - C 0008	55035223000008	1669	Eau Claire - C 0027	55035223000027
1634	Augusta - C 0003	55035038250003	1652	Eau Claire - C 0009	55035223000009	1670	Eau Claire - C 0028	55035223000028
1635	Augusta - C 0004	55035038250004	1653	Eau Claire - C 0010	55035223000010	1671	Eau Claire - C 0029	55035223000029
1636	Augusta - C 0005	55035038250005	1654	Eau Claire - C 0011	55035223000011	1672	Eau Claire - C 0030	55035223000030
1637	BRIDGE CREEK - T 0001	55035095000001	1655	Eau Claire - C 0012	55035223000012	1673	Eau Claire - C 0031	55035223000031
1638	BRIDGE CREEK - T 0002	55035095000002	1656	Eau Claire - C 0013	55035223000013	1674	Eau Claire - C 0032	55035223000032

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1675	Eau Claire - C 0033	55035223000033	1693	Eau Claire - C 0053	55035223000053	1711	Eau Claire - C 0071	55035223000071
1676	Eau Claire - C 0034	55035223000034	1694	Eau Claire - C 0054	55035223000054	1712	Eau Claire - C 0072	55035223000072
1677	Eau Claire - C 0035	55035223000035	1695	Eau Claire - C 0055	55035223000055	1713	Fairchild - V 0001	55035248250001
1678	Eau Claire - C 0036	55035223000036	1696	Eau Claire - C 0056	55035223000056	1714	FAIRCHILD - T 0001	55035248500001
1679	Eau Claire - C 0037	55035223000037	1697	Eau Claire - C 0057	55035223000057	1715	Fall Creek - V 0001	55035251250001
1680	Eau Claire - C 0038	55035223000038	1698	Eau Claire - C 0058	55035223000058	1716	Fall Creek - V 0002	55035251250002
1681	Eau Claire - C 0039	55035223000039	1699	Eau Claire - C 0059	55035223000059	1717	LINCOLN - T 0001	55035443500001
1682	Eau Claire - C 0042	55035223000042	1700	Eau Claire - C 0060	55035223000060	1718	LINCOLN - T 0002	55035443500002
1683	Eau Claire - C 0043	55035223000043	1701	Eau Claire - C 0061	55035223000061	1719	LUDINGTON - T 0001	55035462750001
1684	Eau Claire - C 0044	55035223000044	1702	Eau Claire - C 0062	55035223000062	1720	OTTER CREEK - T 0001	55035607500001
1685	Eau Claire - C 0045	55035223000045	1703	Eau Claire - C 0063	55035223000063	1721	PLEASANT VALLEY - T 0001	55035634000001
1686	Eau Claire - C 0046	55035223000046	1704	Eau Claire - C 0064	55035223000064	1722	PLEASANT VALLEY - T 0002	55035634000002
1687	Eau Claire - C 0047	55035223000047	1705	Eau Claire - C 0065	55035223000065	1723	PLEASANT VALLEY - T 0003	55035634000003
1688	Eau Claire - C 0048	55035223000048	1706	Eau Claire - C 0066	55035223000066	1724	PLEASANT VALLEY - T 0004	55035634000004
1689	Eau Claire - C 0049	55035223000049	1707	Eau Claire - C 0067	55035223000067	1725	SEYMOUR - T 0001	55035726750001
1690	Eau Claire - C 0050	55035223000050	1708	Eau Claire - C 0068	55035223000068	1726	SEYMOUR - T 0002	55035726750002
1691	Eau Claire - C 0051	55035223000051	1709	Eau Claire - C 0069	55035223000069	1727	SEYMOUR - T 0003	55035726750003
1692	Eau Claire - C 0052	55035223000052	1710	Eau Claire - C 0070	55035223000070	1728	SEYMOUR - T 0004	55035726750004

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1729	SEYMOUR - T 0005	55035726750005	1747	WASHINGTON - T 0013	55035836120013	1765	LONG LAKE - T 0001	55037456250001
1730	SEYMOUR - T 0006	55035726750006	1748	WILSON - T 0001	55035874000001	1766	TIPLER - T 0001	55037799750001
1731	UNION - T 0001	55035815500001	1749	AURORA - T 0001	55037038750001	1767	ALTO - T 0001	55039015250001
1732	UNION - T 0002	55035815500002	1750	AURORA - T 0002	55037038750002	1768	ALTO - T 0002	55039015250002
1733	UNION - T 0003	55035815500003	1751	AURORA - T 0003	55037038750003	1769	ASHFORD - T 0001	55039031500001
1734	UNION - T 0004	55035815500004	1752	COMMONWEALTH - T 0001	55037165500001	1770	ASHFORD - T 0002	55039031500002
1735	WASHINGTON - T 0001	55035836120001	1753	COMMONWEALTH - T 0002	55037165500002	1771	ASHFORD - T 0003	55039031500003
1736	WASHINGTON - T 0002	55035836120002	1754	COMMONWEALTH - T 0003	55037165500003	1772	AUBURN - T 0001	55039037500001
1737	WASHINGTON - T 0003	55035836120003	1755	FENCE - T 0001	55037255750001	1773	AUBURN - T 0002	55039037500002
1738	WASHINGTON - T 0004	55035836120004	1756	FERN - T 0001	55037256750001	1774	AUBURN - T 0003	55039037500003
1739	WASHINGTON - T 0005	55035836120005	1757	FLORENCE - T 0001	55037262000001	1775	Brandon - V 0001	55039093000001
1740	WASHINGTON - T 0006	55035836120006	1758	FLORENCE - T 0002	55037262000002	1776	BYRON - T 0001	55039116000001
1741	WASHINGTON - T 0007	55035836120007	1759	FLORENCE - T 0003	55037262000003	1777	BYRON - T 0002	55039116000002
1742	WASHINGTON - T 0008	55035836120008	1760	FLORENCE - T 0004	55037262000004	1778	CALUMET - T 0001	55039120750001
1743	WASHINGTON - T 0009	55035836120009	1761	FLORENCE - T 0005	55037262000005	1779	CALUMET - T 0002	55039120750002
1744	WASHINGTON - T 0010	55035836120010	1762	FLORENCE - T 0006	55037262000006	1780	Campbellsport - V 0001	55039123250001
1745	WASHINGTON - T 0011	55035836120011	1763	FLORENCE - T 0007	55037262000007	1781	Campbellsport - V 0002	55039123250002
1746	WASHINGTON - T 0012	55035836120012	1764	HOMESTEAD - T 0001	55037356000001	1782	Campbellsport - V 0003	55039123250003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1783	Campbellsport - V 0004	55039123250004	1801	Fond Du Lac - C 0007	55039262750007	1819	Fond Du Lac - C 0025	55039262750025
1784	Eden - V 0001	55039224750001	1802	Fond Du Lac - C 0008	55039262750008	1820	Fond Du Lac - C 0026	55039262750026
1785	EDEN - T 0001	55039225000001	1803	Fond Du Lac - C 0009	55039262750009	1821	Fond Du Lac - C 0027	55039262750027
1786	EDEN - T 0002	55039225000002	1804	Fond Du Lac - C 0010	55039262750010	1822	Fond Du Lac - C 0028	55039262750028
1787	ELDORADO - T 0001	55039231500001	1805	Fond Du Lac - C 0011	55039262750011	1823	Fond Du Lac - C 0029	55039262750029
1788	ELDORADO - T 0002	55039231500002	1806	Fond Du Lac - C 0012	55039262750012	1824	Fond Du Lac - C 0030	55039262750030
1789	ELDORADO - T 0003	55039231500003	1807	Fond Du Lac - C 0013	55039262750013	1825	FOND DU LAC - T 0001	55039263000001
1790	EMPIRE - T 0001	55039240500001	1808	Fond Du Lac - C 0014	55039262750014	1826	FOND DU LAC - T 0002	55039263000002
1791	EMPIRE - T 0002	55039240500002	1809	Fond Du Lac - C 0015	55039262750015	1827	FOND DU LAC - T 0003	55039263000003
1792	EMPIRE - T 0003	55039240500003	1810	Fond Du Lac - C 0016	55039262750016	1828	FOND DU LAC - T 0004	55039263000004
1793	EMPIRE - T 0004	55039240500004	1811	Fond Du Lac - C 0017	55039262750017	1829	FOND DU LAC - T 0005	55039263000005
1794	Fairwater - V 0001	55039250750001	1812	Fond Du Lac - C 0018	55039262750018	1830	FOND DU LAC - T 0006	55039263000006
1795	Fond Du Lac - C 0001	55039262750001	1813	Fond Du Lac - C 0019	55039262750019	1831	FOND DU LAC - T 0007	55039263000007
1796	Fond Du Lac - C 0002	55039262750002	1814	Fond Du Lac - C 0020	55039262750020	1832	FOND DU LAC - T 0008	55039263000008
1797	Fond Du Lac - C 0003	55039262750003	1815	Fond Du Lac - C 0021	55039262750021	1833	FOREST - T 0001	55039264500001
1798	Fond Du Lac - C 0004	55039262750004	1816	Fond Du Lac - C 0022	55039262750022	1834	FOREST - T 0002	55039264500002
1799	Fond Du Lac - C 0005	55039262750005	1817	Fond Du Lac - C 0023	55039262750023	1835	FRIENDSHIP - T 0001	55039279750001
1800	Fond Du Lac - C 0006	55039262750006	1818	Fond Du Lac - C 0024	55039262750024	1836	FRIENDSHIP - T 0002	55039279750002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1837	FRIENDSHIP - T 0003	55039279750003	1855	OAKFIELD - T 0001	55039589250001	1873	Rosendale - V 0002	55039695250002
1838	Kewaskum - V 0006	55039393000006	1856	OAKFIELD - T 0002	55039589250002	1874	ROSENDALE - T 0001	55039695500001
1839	LAMARTINE - T 0001	55039421250001	1857	OSCEOLA - T 0001	55039604250001	1875	St. Cloud - V 0001	55039705000001
1840	LAMARTINE - T 0002	55039421250002	1858	OSCEOLA - T 0002	55039604250002	1876	SPRINGVALE - T 0001	55039762500001
1841	MARSHFIELD - T 0001	55039496500001	1859	Ripon - C 0001	55039681750001	1877	TAYCHEEDAH - T 0001	55039791250001
1842	MARSHFIELD - T 0002	55039496500002	1860	Ripon - C 0002	55039681750002	1878	TAYCHEEDAH - T 0002	55039791250002
1843	METOMEN - T 0001	55039514500001	1861	Ripon - C 0003	55039681750003	1879	TAYCHEEDAH - T 0003	55039791250003
1844	METOMEN - T 0002	55039514500002	1862	Ripon - C 0004	55039681750004	1880	TAYCHEEDAH - T 0004	55039791250004
1845	Mount Calvary - V 0001	55039546500001	1863	Ripon - C 0005	55039681750005	1881	TAYCHEEDAH - T 0005	55039791250005
1846	North Fond Du Lac - V 0001	55039580000001	1864	Ripon - C 0006	55039681750006	1882	Waupun - C 0009	55039844250009
1847	North Fond Du Lac - V 0002	55039580000002	1865	Ripon - C 0007	55039681750007	1883	Waupun - C 0010	55039844250010
1848	North Fond Du Lac - V 0003	55039580000003	1866	Ripon - C 0008	55039681750008	1884	Waupun - C 0011	55039844250011
1849	North Fond Du Lac - V 0004	55039580000004	1867	Ripon - C 0009	55039681750009	1885	Waupun - C 0012	55039844250012
1850	North Fond Du Lac - V 0005	55039580000005	1868	Ripon - C 0010	55039681750010	1886	WAUPUN - T 0001	55039844500001
1851	North Fond Du Lac - V 0006	55039580000006	1869	Ripon - C 0011	55039681750011	1887	WAUPUN - T 0002	55039844500002
1852	North Fond Du Lac - V 0007	55039580000007	1870	RIPON - T 0001	55039682000001	1888	ALVIN - T 0001	55041016250001
1853	Oakfield - V 0001	55039589000001	1871	RIPON - T 0002	55039682000002	1889	ARGONNE - T 0001	55041026250001
1854	Oakfield - V 0002	55039589000002	1872	Rosendale - V 0001	55039695250001	1890	ARGONNE - T 0002	55041026250002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1891	ARGONNE - T 0003	55041026250003	1909	LINCOLN - T 0003	55041443750003	1927	Boscobel - C 0003	55043088500003
1892	ARMSTRONG CREEK - T 0001	55041029500001	1910	NASHVILLE - T 0001	55041555750001	1928	Boscobel - C 0004	55043088500004
1893	BLACKWELL - T 0001	55041079500001	1911	NASHVILLE - T 0002	55041555750002	1929	BOSCOBEL - T 0001	55043088750001
1894	CASWELL - T 0001	55041131250001	1912	NASHVILLE - T 0003	55041555750003	1930	BOSCOBEL - T 0002	55043088750002
1895	Crandon - C 0001	55041174250001	1913	POPPLE RIVER - T 0001	55041640500001	1931	Cassville - V 0001	55043130500001
1896	Crandon - C 0002	55041174250002	1914	ROSS - T 0001	55041696250001	1932	Cassville - V 0002	55043130500002
1897	Crandon - C 0003	55041174250003	1915	WABENO - T 0001	55041830250001	1933	CASSVILLE - T 0001	55043130750001
1898	Crandon - C 0004	55041174250004	1916	WABENO - T 0002	55041830250002	1934	CASTLE ROCK - T 0001	55043131000001
1899	CRANDON - T 0001	55041174500001	1917	WABENO - T 0003	55041830250003	1935	CLIFTON - T 0001	55043155000001
1900	CRANDON - T 0002	55041174500002	1918	WABENO - T 0004	55041830250004	1936	CLIFTON - T 0002	55043155000002
1901	CRANDON - T 0003	55041174500003	1919	WABENO - T 0005	55041830250005	1937	Cuba City - C 0001	55043179500001
1902	FREEDOM - T 0001	55041276000001	1920	Bagley - V 0001	55043042500001	1938	Cuba City - C 0002	55043179500002
1903	HILES - T 0001	55041346500001	1921	BEETOWN - T 0001	55043061000001	1939	Cuba City - C 0003	55043179500003
1904	LAONA - T 0001	55041425000001	1922	Bloomington - V 0001	55043083750001	1940	Cuba City - C 0004	55043179500004
1905	LAONA - T 0002	55041425000002	1923	BLOOMINGTON - T 0001	55043084000001	1941	Dickeyville - V 0001	55043201750001
1906	LAONA - T 0003	55041425000003	1924	Blue River - V 0001	55043085250001	1942	Dickeyville - V 0002	55043201750002
1907	LINCOLN - T 0001	55041443750001	1925	Boscobel - C 0001	55043088500001	1943	ELLENBORO - T 0001	55043234000001
1908	LINCOLN - T 0002	55041443750002	1926	Boscobel - C 0002	55043088500002	1944	Fennimore - C 0001	55043256000001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1945	Fennimore - C 0002	55043256000002	1963	Lancaster - C 0004	55043422500004	1981	PARIS - T 0001	55043611500001
1946	Fennimore - C 0003	55043256000003	1964	Lancaster - C 0005	55043422500005	1982	PARIS - T 0002	55043611500002
1947	Fennimore - C 0004	55043256000004	1965	Lancaster - C 0006	55043422500006	1983	Patch Grove - V 0001	55043614250001
1948	FENNIMORE - T 0001	55043256250001	1966	LIBERTY - T 0001	55043438250001	1984	PATCH GROVE - T 0001	55043614500001
1949	FENNIMORE - T 0002	55043256250002	1967	LIMA - T 0001	55043440500001	1985	Platteville - C 0001	55043632500001
1950	GLEN HAVEN - T 0001	55043295250001	1968	LITTLE GRANT - T 0001	55043450250001	1986	Platteville - C 0002	55043632500002
1951	HARRISON - T 0001	55043328250001	1969	Livingston - V 0001	55043453250001	1987	Platteville - C 0003	55043632500003
1952	Hazel Green - V 0001	55043335000001	1970	MARION - T 0001	55043493500001	1988	Platteville - C 0004	55043632500004
1953	Hazel Green - V 0002	55043335000002	1971	MILLVILLE - T 0001	55043521500001	1989	Platteville - C 0005	55043632500005
1954	HAZEL GREEN - T 0001	55043335250001	1972	Montfort - V 0001	55043539500001	1990	Platteville - C 0006	55043632500006
1955	HAZEL GREEN - T 0002	55043335250002	1973	Mount Hope - V 0001	55043546750001	1991	Platteville - C 0007	55043632500007
1956	HICKORY GROVE - T 0001	55043343000001	1974	MOUNT HOPE - T 0001	55043547000001	1992	Platteville - C 0008	55043632500008
1957	JAMESTOWN - T 0001	55043378000001	1975	MOUNT IDA - T 0001	55043547750001	1993	PLATTEVILLE - T 0001	55043632750001
1958	JAMESTOWN - T 0002	55043378000002	1976	Muscoda - V 0001	55043552000001	1994	PLATTEVILLE - T 0002	55043632750002
1959	JAMESTOWN - T 0003	55043378000003	1977	Muscoda - V 0002	55043552000002	1995	PLATTEVILLE - T 0003	55043632750003
1960	Lancaster - C 0001	55043422500001	1978	MUSCODA - T 0001	55043552250001	1996	Potosi - V 0001	55043646250001
1961	Lancaster - C 0002	55043422500002	1979	NORTH LANCASTER - T 0001	55043581250001	1997	POTOSI - T 0001	55043646500001
1962	Lancaster - C 0003	55043422500003	1980	NORTH LANCASTER - T 0002	55043581250002	1998	SMELSER - T 0001	55043744500001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
1999	SMELSER - T 0002	55043744500002	2017	Brodhead - C 0001	55045099250001	2035	EXETER - T 0002	55045247250002
2000	SOUTH LANCASTER - T 0001	55043750750001	2018	Brodhead - C 0002	55045099250002	2036	EXETER - T 0003	55045247250003
2001	SOUTH LANCASTER - T 0002	55043750750002	2019	Brodhead - C 0003	55045099250003	2037	EXETER - T 0004	55045247250004
2002	SOUTH LANCASTER - T 0003	55043750750003	2020	Brodhead - C 0004	55045099250004	2038	JEFFERSON - T 0001	55045378750001
2003	Tennyson - V 0002	55043792500002	2021	Brodhead - C 0005	55045099250005	2039	JEFFERSON - T 0002	55045378750002
2004	WATERLOO - T 0001	55043839000001	2022	Brodhead - C 0006	55045099250006	2040	JORDAN - T 0001	55045385500001
2005	WATTERSTOWN - T 0001	55043840750001	2023	Brooklyn - V 0002	55045100750002	2041	Monroe - C 0001	55045537500001
2006	WATTERSTOWN - T 0002	55043840750002	2024	BROOKLYN - T 0001	55045101000001	2042	Monroe - C 0002	55045537500002
2007	WINGVILLE - T 0001	55043878000001	2025	BROOKLYN - T 0002	55045101000002	2043	Monroe - C 0003	55045537500003
2008	Woodman - V 0001	55043888250001	2026	BROOKLYN - T 0003	55045101000003	2044	Monroe - C 0004	55045537500004
2009	WOODMAN - T 0001	55043888500001	2027	Browntown - V 0001	55045104750001	2045	Monroe - C 0005	55045537500005
2010	WYALUSING - T 0001	55043892500001	2028	CADIZ - T 0001	55045117250001	2046	Monroe - C 0006	55045537500006
2011	ADAMS - T 0001	55045003250001	2029	CLARNO - T 0001	55045150000001	2047	Monroe - C 0007	55045537500007
2012	Albany - V 0001	55045007500001	2030	CLARNO - T 0002	55045150000002	2048	Monroe - C 0008	55045537500008
2013	Albany - V 0002	55045007500002	2031	DECATUR - T 0001	55045190750001	2049	Monroe - C 0009	55045537500009
2014	ALBANY - T 0001	55045007750001	2032	DECATUR - T 0002	55045190750002	2050	Monroe - C 0010	55045537500010
2015	ALBANY - T 0002	55045007750002	2033	DECATUR - T 0003	55045190750003	2051	MONROE - T 0001	55045537750001
2016	Belleville - V 0003	55045063000003	2034	EXETER - T 0001	55045247250001	2052	MONROE - T 0002	55045537750002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2053	Monticello - V 0001	55045540000001	2071	Berlin - C 0003	55047069250003	2089	KINGSTON - T 0001	55047397750001
2054	Monticello - V 0002	55045540000002	2072	Berlin - C 0004	55047069250004	2090	KINGSTON - T 0002	55047397750002
2055	MOUNT PLEASANT - T 0001	55045548500001	2073	Berlin - C 0005	55047069250005	2091	MACKFORD - T 0001	55047468750001
2056	MOUNT PLEASANT - T 0002	55045548500002	2074	Berlin - C 0006	55047069250006	2092	MANCHESTER - T 0001	55047484000001
2057	MOUNT PLEASANT - T 0003	55045548500003	2075	BERLIN - T 0001	55047069500001	2093	Markesan - C 0001	55047494500001
2058	New Glarus - V 0001	55045567000001	2076	BERLIN - T 0002	55047069500002	2094	Markesan - C 0002	55047494500002
2059	New Glarus - V 0002	55045567000002	2077	BERLIN - T 0003	55047069500003	2095	Markesan - C 0003	55047494500003
2060	New Glarus - V 0003	55045567000003	2078	BROOKLYN - T 0001	55047101250001	2096	Marquette - V 0001	55047495000001
2061	New Glarus - V 0004	55045567000004	2079	BROOKLYN - T 0002	55047101250002	2097	MARQUETTE - T 0001	55047495250001
2062	NEW GLARUS - T 0001	55045567250001	2080	BROOKLYN - T 0003	55047101250003	2098	Princeton - C 0001	55047656000001
2063	NEW GLARUS - T 0002	55045567250002	2081	Green Lake - C 0001	55047313000001	2099	Princeton - C 0002	55047656000002
2064	SPRING GROVE - T 0001	55045760750001	2082	Green Lake - C 0002	55047313000002	2100	Princeton - C 0003	55047656000003
2065	SYLVESTER - T 0001	55045788750001	2083	Green Lake - C 0003	55047313000003	2101	Princeton - C 0004	55047656000004
2066	SYLVESTER - T 0002	55045788750002	2084	Green Lake - C 0004	55047313000004	2102	PRINCETON - T 0001	55047656250001
2067	WASHINGTON - T 0001	55045836250001	2085	Green Lake - C 0005	55047313000005	2103	PRINCETON - T 0002	55047656250002
2068	YORK - T 0001	55045894750001	2086	GREEN LAKE - T 0001	55047313500001	2104	PRINCETON - T 0003	55047656250003
2069	Berlin - C 0001	55047069250001	2087	GREEN LAKE - T 0002	55047313500002	2105	PRINCETON - T 0004	55047656250004
2070	Berlin - C 0002	55047069250002	2088	Kingston - V 0001	55047397500001	2106	ST. MARIE - T 0001	55047709250001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2107	ST. MARIE - T 0002	55047709250002	2125	Dodgeville - C 0006	55049203500006	2143	Livingston - V 0002	55049453250002
2108	SENECA - T 0001	55047725250001	2126	Dodgeville - C 0007	55049203500007	2144	MIFFLIN - T 0001	55049517250001
2109	Arena - V 0001	55049025500001	2127	Dodgeville - C 0008	55049203500008	2145	MIFFLIN - T 0002	55049517250002
2110	ARENA - T 0001	55049025750001	2128	Dodgeville - C 0009	55049203500009	2146	Mineral Point - C 0001	55049531000001
2111	ARENA - T 0002	55049025750002	2129	Dodgeville - C 0010	55049203500010	2147	Mineral Point - C 0002	55049531000002
2112	Avoca - V 0001	55049040250001	2130	DODGEVILLE - T 0001	55049203750001	2148	Mineral Point - C 0003	55049531000003
2113	Barneveld - V 0001	55049047750001	2131	DODGEVILLE - T 0002	55049203750002	2149	Mineral Point - C 0004	55049531000004
2114	Barneveld - V 0002	55049047750002	2132	DODGEVILLE - T 0003	55049203750003	2150	Mineral Point - C 0005	55049531000005
2115	Blanchardville - V 0002	55049081250002	2133	DODGEVILLE - T 0004	55049203750004	2151	Mineral Point - C 0006	55049531000006
2116	BRIGHAM - T 0001	55049096000001	2134	EDEN - T 0001	55049225250001	2152	MINERAL POINT - T 0001	55049531250001
2117	BRIGHAM - T 0002	55049096000002	2135	Highland - V 0001	55049344500001	2153	MINERAL POINT - T 0002	55049531250002
2118	CLYDE - T 0001	55049158750001	2136	HIGHLAND - T 0001	55049344750001	2154	Montfort - V 0002	55049539500002
2119	Cobb - V 0001	55049159750001	2137	HIGHLAND - T 0002	55049344750002	2155	MOSCOW - T 0001	55049544250001
2120	Dodgeville - C 0001	55049203500001	2138	Hollandale - V 0001	55049354000001	2156	MOSCOW - T 0002	55049544250002
2121	Dodgeville - C 0002	55049203500002	2139	Linden - V 0001	55049446250001	2157	Muscoda - V 0003	55049552000003
2122	Dodgeville - C 0003	55049203500003	2140	LINDEN - T 0001	55049446500001	2158	PULASKI - T 0001	55049657000001
2123	Dodgeville - C 0004	55049203500004	2141	LINDEN - T 0002	55049446500002	2159	Rewey - V 0001	55049671000001
2124	Dodgeville - C 0005	55049203500005	2142	LINDEN - T 0003	55049446500003	2160	Ridgeway - V 0001	55049678750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2161	RIDGEWAY - T 0001	55049679000001	2179	MERCER - T 0004	55051512000004	2197	ALMA - T 0005	55053012750005
2162	RIDGEWAY - T 0002	55049679000002	2180	Montreal - C 0001	55051540750001	2198	Alma Center - V 0001	55053013000001
2163	WALDWICK - T 0001	55049831500001	2181	Montreal - C 0002	55051540750002	2199	BEAR BLUFF - T 0001	55053055500001
2164	WALDWICK - T 0002	55049831500002	2182	OMA - T 0001	55051598500001	2200	Black River Falls - C 0001	55053079000001
2165	WYOMING - T 0001	55049893500001	2183	PENCE - T 0001	55051618250001	2201	Black River Falls - C 0002	55053079000002
2166	WYOMING - T 0002	55049893500002	2184	SAXON - T 0001	55051718750001	2202	Black River Falls - C 0003	55053079000003
2167	ANDERSON - T 0001	55051019250001	2185	SHERMAN - T 0001	55051734000001	2203	Black River Falls - C 0004	55053079000004
2168	CAREY - T 0001	55051125250001	2186	ADAMS - T 0001	55053003500001	2204	BROCKWAY - T 0001	55053099000001
2169	GURNEY - T 0001	55051318750001	2187	ADAMS - T 0002	55053003500002	2205	BROCKWAY - T 0002	55053099000002
2170	Hurley - C 0001	55051365250001	2188	ADAMS - T 0003	55053003500003	2206	BROCKWAY - T 0003	55053099000003
2171	Hurley - C 0002	55051365250002	2189	ALBION - T 0001	55053009000001	2207	BROCKWAY - T 0004	55053099000004
2172	Hurley - C 0003	55051365250003	2190	ALBION - T 0002	55053009000002	2208	BROCKWAY - T 0005	55053099000005
2173	Hurley - C 0004	55051365250004	2191	ALBION - T 0003	55053009000003	2209	BROCKWAY - T 0006	55053099000006
2174	KIMBALL - T 0001	55051396250001	2192	ALBION - T 0004	55053009000004	2210	CITY POINT - T 0001	55053148000001
2175	KNIGHT - T 0001	55051400750001	2193	ALMA - T 0001	55053012750001	2211	CLEVELAND - T 0001	55053153750001
2176	MERCER - T 0001	55051512000001	2194	ALMA - T 0002	55053012750002	2212	CURRAN - T 0001	55053180750001
2177	MERCER - T 0002	55051512000002	2195	ALMA - T 0003	55053012750003	2213	FRANKLIN - T 0001	55053272250001
2178	MERCER - T 0003	55051512000003	2196	ALMA - T 0004	55053012750004	2214	GARDEN VALLEY - T 0001	55053282500001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2215	GARFIELD - T 0001	55053283250001	2233	AZTALAN - T 0001	55055041250001	2251	HEBRON - T 0001	55055337000001
2216	Hixton - V 0001	55053350750001	2234	AZTALAN - T 0002	55055041250002	2252	HEBRON - T 0002	55055337000002
2217	HIXTON - T 0001	55053351000001	2235	Cambridge - V 0001	55055122250001	2253	IXONIA - T 0001	55055376000001
2218	HIXTON - T 0002	55053351000002	2236	COLD SPRING - T 0001	55055162250001	2254	IXONIA - T 0002	55055376000002
2219	IRVING - T 0001	55053372750001	2237	CONCORD - T 0001	55055166500001	2255	IXONIA - T 0003	55055376000003
2220	IRVING - T 0002	55053372750002	2238	CONCORD - T 0002	55055166500002	2256	IXONIA - T 0004	55055376000004
2221	IRVING - T 0003	55053372750003	2239	CONCORD - T 0003	55055166500003	2257	IXONIA - T 0005	55055376000005
2222	KNAPP - T 0001	55053400000001	2240	FARMINGTON - T 0001	55055253000001	2258	IXONIA - T 0006	55055376000006
2223	KOMENSKY - T 0001	55053403250001	2241	FARMINGTON - T 0002	55055253000002	2259	Jefferson - C 0001	55055379000001
2224	MANCHESTER - T 0001	55053484250001	2242	Fort Atkinson - C 0001	55055266750001	2260	Jefferson - C 0002	55055379000002
2225	Melrose - V 0001	55053507500001	2243	Fort Atkinson - C 0002	55055266750002	2261	Jefferson - C 0003	55055379000003
2226	MELROSE - T 0001	55053507750001	2244	Fort Atkinson - C 0003	55055266750003	2262	Jefferson - C 0004	55055379000004
2227	Merrillan - V 0001	55053513000001	2245	Fort Atkinson - C 0004	55055266750004	2263	Jefferson - C 0005	55055379000005
2228	MILLSTON - T 0001	55053520500001	2246	Fort Atkinson - C 0005	55055266750005	2264	Jefferson - C 0006	55055379000006
2229	NORTH BEND - T 0001	55053577750001	2247	Fort Atkinson - C 0006	55055266750006	2265	Jefferson - C 0007	55055379000007
2230	NORTHFIELD - T 0001	55053579750001	2248	Fort Atkinson - C 0007	55055266750007	2266	Jefferson - C 0008	55055379000008
2231	SPRINGFIELD - T 0001	55053759000001	2249	Fort Atkinson - C 0008	55055266750008	2267	Jefferson - C 0009	55055379000009
2232	Taylor - V 0001	55053791500001	2250	Fort Atkinson - C 0009	55055266750009	2268	Jefferson - C 0010	55055379000010

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2269	Jefferson - C 0011	55055379000011	2287	Lake Mills - C 0005	55055416750005	2305	SULLIVAN - T 0001	55055782000001
2270	JEFFERSON - T 0001	55055379250001	2288	Lake Mills - C 0006	55055416750006	2306	SULLIVAN - T 0002	55055782000002
2271	JEFFERSON - T 0002	55055379250002	2289	Lake Mills - C 0007	55055416750007	2307	SULLIVAN - T 0003	55055782000003
2272	JEFFERSON - T 0003	55055379250003	2290	Lake Mills - C 0008	55055416750008	2308	SUMNER - T 0001	55055784750001
2273	Johnson Creek - V 0001	55055383500001	2291	LAKE MILLS - T 0001	55055417000001	2309	Waterloo - C 0001	55055839250001
2274	Johnson Creek - V 0002	55055383500002	2292	LAKE MILLS - T 0002	55055417000002	2310	Waterloo - C 0002	55055839250002
2275	Johnson Creek - V 0003	55055383500003	2293	LAKE MILLS - T 0003	55055417000003	2311	Waterloo - C 0003	55055839250003
2276	KOSHKONONG - T 0001	55055403750001	2294	MILFORD - T 0001	55055518500001	2312	Waterloo - C 0004	55055839250004
2277	KOSHKONONG - T 0002	55055403750002	2295	MILFORD - T 0002	55055518500002	2313	Waterloo - C 0005	55055839250005
2278	KOSHKONONG - T 0003	55055403750003	2296	OAKLAND - T 0001	55055591250001	2314	WATERLOO - T 0001	55055839500001
2279	KOSHKONONG - T 0004	55055403750004	2297	OAKLAND - T 0002	55055591250002	2315	Watertown - C 0008	55055839750008
2280	KOSHKONONG - T 0005	55055403750005	2298	OAKLAND - T 0003	55055591250003	2316	Watertown - C 0009	55055839750009
2281	KOSHKONONG - T 0006	55055403750006	2299	OAKLAND - T 0004	55055591250004	2317	Watertown - C 0010	55055839750010
2282	Lac La Belle - V 0002	55055407500002	2300	Palmyra - V 0001	55055610250001	2318	Watertown - C 0011	55055839750011
2283	Lake Mills - C 0001	55055416750001	2301	Palmyra - V 0002	55055610250002	2319	Watertown - C 0012	55055839750012
2284	Lake Mills - C 0002	55055416750002	2302	PALMYRA - T 0001	55055610500001	2320	Watertown - C 0013	55055839750013
2285	Lake Mills - C 0003	55055416750003	2303	PALMYRA - T 0002	55055610500002	2321	Watertown - C 0014	55055839750014
2286	Lake Mills - C 0004	55055416750004	2304	Sullivan - V 0001	55055781750001	2322	Watertown - C 0015	55055839750015

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2323	Watertown - C 0016	55055839750016	2341	Elroy - C 0005	55057238000005	2359	LISBON - T 0002	55057448250002
2324	Watertown - C 0017	55055839750017	2342	Elroy - C 0006	55057238000006	2360	LISBON - T 0003	55057448250003
2325	Watertown - C 0018	55055839750018	2343	Elroy - C 0007	55057238000007	2361	LYNDON - T 0001	55057465250001
2326	Watertown - C 0019	55055839750019	2344	FINLEY - T 0001	55057258500001	2362	LYNDON - T 0002	55057465250002
2327	WATERTOWN - T 0001	55055840000001	2345	FOUNTAIN - T 0001	55057268250001	2363	LYNDON - T 0003	55057465250003
2328	WATERTOWN - T 0002	55055840000002	2346	FOUNTAIN - T 0002	55057268250002	2364	Lyndon Station - V 0001	55057466000001
2329	Whitewater - C 0010	55055869250010	2347	GERMANTOWN - T 0001	55057288500001	2365	MARION - T 0001	55057493750001
2330	Whitewater - C 0011	55055869250011	2348	GERMANTOWN - T 0002	55057288500002	2366	Mauston - C 0001	55057500250001
2331	Whitewater - C 0012	55055869250012	2349	GERMANTOWN - T 0003	55057288500003	2367	Mauston - C 0002	55057500250002
2332	ARMENIA - T 0001	55057028500001	2350	Hustler - V 0001	55057366750001	2368	Mauston - C 0003	55057500250003
2333	Camp Douglas - V 0001	55057123500001	2351	KILDARE - T 0001	55057395750001	2369	Mauston - C 0004	55057500250004
2334	CLEARFIELD - T 0001	55057152250001	2352	KINGSTON - T 0001	55057398000001	2370	Mauston - C 0005	55057500250005
2335	CLEARFIELD - T 0002	55057152250002	2353	LEMONWEIR - T 0001	55057433000001	2371	Mauston - C 0006	55057500250006
2336	CUTLER - T 0001	55057182250001	2354	LEMONWEIR - T 0002	55057433000002	2372	Mauston - C 0007	55057500250007
2337	Elroy - C 0001	55057238000001	2355	LEMONWEIR - T 0003	55057433000003	2373	Necedah - V 0001	55057557000001
2338	Elroy - C 0002	55057238000002	2356	LEMONWEIR - T 0004	55057433000004	2374	NECEDAH - T 0001	55057557250001
2339	Elroy - C 0003	55057238000003	2357	LINDINA - T 0001	55057446750001	2375	NECEDAH - T 0002	55057557250002
2340	Elroy - C 0004	55057238000004	2358	LISBON - T 0001	55057448250001	2376	NECEDAH - T 0003	55057557250003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2377	NECEDAH - T 0004	55057557250004	2395	BRIGHTON - T 0001	55059096350001	2413	Kenosha - C 0006	55059392250006
2378	New Lisbon - C 0001	55057569000001	2396	BRIGHTON - T 0002	55059096350002	2414	Kenosha - C 0007	55059392250007
2379	New Lisbon - C 0002	55057569000002	2397	BRIGHTON - T 0003	55059096350003	2415	Kenosha - C 0008	55059392250008
2380	New Lisbon - C 0003	55057569000003	2398	BRIGHTON - T 0004	55059096350004	2416	Kenosha - C 0009	55059392250009
2381	New Lisbon - C 0004	55057569000004	2399	Bristol - V 0001	55059098000001	2417	Kenosha - C 0010	55059392250010
2382	New Lisbon - C 0005	55057569000005	2400	Bristol - V 0002	55059098000002	2418	Kenosha - C 0011	55059392250011
2383	New Lisbon - C 0006	55057569000006	2401	Bristol - V 0003	55059098000003	2419	Kenosha - C 0012	55059392250012
2384	New Lisbon - C 0007	55057569000007	2402	Bristol - V 0004	55059098000004	2420	Kenosha - C 0013	55059392250013
2385	ORANGE - T 0001	55057601500001	2403	Bristol - V 0005	55059098000005	2421	Kenosha - C 0014	55059392250014
2386	PLYMOUTH - T 0001	55057636500001	2404	Bristol - V 0006	55059098000006	2422	Kenosha - C 0015	55059392250015
2387	SEVEN MILE CREEK - T 0001	55057726250001	2405	Bristol - V 0007	55059098000007	2423	Kenosha - C 0016	55059392250016
2388	SEVEN MILE CREEK - T 0002	55057726250002	2406	Bristol - V 0008	55059098000008	2424	Kenosha - C 0017	55059392250017
2389	SUMMIT - T 0001	55057783000001	2407	Genoa City - V 0005	55059286750005	2425	Kenosha - C 0018	55059392250018
2390	Union Center - V 0001	55057817250001	2408	Kenosha - C 0001	55059392250001	2426	Kenosha - C 0019	55059392250019
2391	Wisconsin Dells - C 0007	55057881500007	2409	Kenosha - C 0002	55059392250002	2427	Kenosha - C 0020	55059392250020
2392	Wonewoc - V 0001	55057885000001	2410	Kenosha - C 0003	55059392250003	2428	Kenosha - C 0021	55059392250021
2393	WONEWOC - T 0001	55057885250001	2411	Kenosha - C 0004	55059392250004	2429	Kenosha - C 0022	55059392250022
2394	WONEWOC - T 0002	55057885250002	2412	Kenosha - C 0005	55059392250005	2430	Kenosha - C 0023	55059392250023

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2431	Kenosha - C 0024	55059392250024	2449	Kenosha - C 0042	55059392250042	2467	Kenosha - C 0060	55059392250060
2432	Kenosha - C 0025	55059392250025	2450	Kenosha - C 0043	55059392250043	2468	Kenosha - C 0061	55059392250061
2433	Kenosha - C 0026	55059392250026	2451	Kenosha - C 0044	55059392250044	2469	Kenosha - C 0062	55059392250062
2434	Kenosha - C 0027	55059392250027	2452	Kenosha - C 0045	55059392250045	2470	Kenosha - C 0063	55059392250063
2435	Kenosha - C 0028	55059392250028	2453	Kenosha - C 0046	55059392250046	2471	Kenosha - C 0064	55059392250064
2436	Kenosha - C 0029	55059392250029	2454	Kenosha - C 0047	55059392250047	2472	Kenosha - C 0065	55059392250065
2437	Kenosha - C 0030	55059392250030	2455	Kenosha - C 0048	55059392250048	2473	Kenosha - C 0066	55059392250066
2438	Kenosha - C 0031	55059392250031	2456	Kenosha - C 0049	55059392250049	2474	Kenosha - C 0067	55059392250067
2439	Kenosha - C 0032	55059392250032	2457	Kenosha - C 0050	55059392250050	2475	Kenosha - C 0068	55059392250068
2440	Kenosha - C 0033	55059392250033	2458	Kenosha - C 0051	55059392250051	2476	Kenosha - C 0069	55059392250069
2441	Kenosha - C 0034	55059392250034	2459	Kenosha - C 0052	55059392250052	2477	Kenosha - C 0070	55059392250070
2442	Kenosha - C 0035	55059392250035	2460	Kenosha - C 0053	55059392250053	2478	Kenosha - C 0071	55059392250071
2443	Kenosha - C 0036	55059392250036	2461	Kenosha - C 0054	55059392250054	2479	Kenosha - C 0072	55059392250072
2444	Kenosha - C 0037	55059392250037	2462	Kenosha - C 0055	55059392250055	2480	Kenosha - C 0073	55059392250073
2445	Kenosha - C 0038	55059392250038	2463	Kenosha - C 0056	55059392250056	2481	Kenosha - C 0074	55059392250074
2446	Kenosha - C 0039	55059392250039	2464	Kenosha - C 0057	55059392250057	2482	Kenosha - C 0075	55059392250075
2447	Kenosha - C 0040	55059392250040	2465	Kenosha - C 0058	55059392250058	2483	Kenosha - C 0076	55059392250076
2448	Kenosha - C 0041	55059392250041	2466	Kenosha - C 0059	55059392250059	2484	Kenosha - C 0077	55059392250077

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2485	Kenosha - C 0078	55059392250078	2503	Kenosha - C 0096	55059392250096	2521	Pleasant Prairie - V 0006	55059633000006
2486	Kenosha - C 0079	55059392250079	2504	Kenosha - C 0097	55059392250097	2522	Pleasant Prairie - V 0007	55059633000007
2487	Kenosha - C 0080	55059392250080	2505	Kenosha - C 0098	55059392250098	2523	Pleasant Prairie - V 0008	55059633000008
2488	Kenosha - C 0081	55059392250081	2506	Kenosha - C 0099	55059392250099	2524	Pleasant Prairie - V 0009	55059633000009
2489	Kenosha - C 0082	55059392250082	2507	Kenosha - C 0100	55059392250100	2525	Pleasant Prairie - V 0010	55059633000010
2490	Kenosha - C 0083	55059392250083	2508	Paddock Lake - V 0001	55059609750001	2526	Pleasant Prairie - V 0011	55059633000011
2491	Kenosha - C 0084	55059392250084	2509	Paddock Lake - V 0002	55059609750002	2527	Pleasant Prairie - V 0012	55059633000012
2492	Kenosha - C 0085	55059392250085	2510	Paddock Lake - V 0003	55059609750003	2528	Pleasant Prairie - V 0013	55059633000013
2493	Kenosha - C 0086	55059392250086	2511	Paddock Lake - V 0004	55059609750004	2529	Pleasant Prairie - V 0014	55059633000014
2494	Kenosha - C 0087	55059392250087	2512	Paddock Lake - V 0005	55059609750005	2530	RANDALL - T 0001	55059661250001
2495	Kenosha - C 0088	55059392250088	2513	Paddock Lake - V 0006	55059609750006	2531	RANDALL - T 0002	55059661250002
2496	Kenosha - C 0089	55059392250089	2514	PARIS - T 0001	55059611750001	2532	RANDALL - T 0003	55059661250003
2497	Kenosha - C 0090	55059392250090	2515	PARIS - T 0002	55059611750002	2533	RANDALL - T 0004	55059661250004
2498	Kenosha - C 0091	55059392250091	2516	Pleasant Prairie - V 0001	55059633000001	2534	RANDALL - T 0005	55059661250005
2499	Kenosha - C 0092	55059392250092	2517	Pleasant Prairie - V 0002	55059633000002	2535	RANDALL - T 0006	55059661250006
2500	Kenosha - C 0093	55059392250093	2518	Pleasant Prairie - V 0003	55059633000003	2536	RANDALL - T 0007	55059661250007
2501	Kenosha - C 0094	55059392250094	2519	Pleasant Prairie - V 0004	55059633000004	2537	Salem Lakes - V 0001	55059711630001
2502	Kenosha - C 0095	55059392250095	2520	Pleasant Prairie - V 0005	55059633000005	2538	Salem Lakes - V 0002	55059711630002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2539	Salem Lakes - V 0003	55059711630003	2557	Somers - V 0008	55059746250008	2575	WHEATLAND - T 0004	55059865000004
2540	Salem Lakes - V 0004	55059711630004	2558	Somers - V 0009	55059746250009	2576	WHEATLAND - T 0005	55059865000005
2541	Salem Lakes - V 0005	55059711630005	2559	Somers - V 0010	55059746250010	2577	WHEATLAND - T 0006	55059865000006
2542	Salem Lakes - V 0006	55059711630006	2560	Somers - V 0011	55059746250011	2578	AHNAPEE - T 0001	55061006000001
2543	Salem Lakes - V 0007	55059711630007	2561	Somers - V 0012	55059746250012	2579	Algoma - C 0001	55061010000001
2544	Salem Lakes - V 0008	55059711630008	2562	SOMERS - T 0001	55059746500001	2580	Algoma - C 0002	55061010000002
2545	Salem Lakes - V 0009	55059711630009	2563	SOMERS - T 0002	55059746500002	2581	Algoma - C 0003	55061010000003
2546	Salem Lakes - V 0010	55059711630010	2564	Twin Lakes - V 0001	55059812500001	2582	Algoma - C 0004	55061010000004
2547	Salem Lakes - V 0011	55059711630011	2565	Twin Lakes - V 0002	55059812500002	2583	Algoma - C 0005	55061010000005
2548	Salem Lakes - V 0012	55059711630012	2566	Twin Lakes - V 0003	55059812500003	2584	Algoma - C 0006	55061010000006
2549	Salem Lakes - V 0013	55059711630013	2567	Twin Lakes - V 0004	55059812500004	2585	CARLTON - T 0001	55061125750001
2550	Somers - V 0001	55059746250001	2568	Twin Lakes - V 0005	55059812500005	2586	CARLTON - T 0002	55061125750002
2551	Somers - V 0002	55059746250002	2569	Twin Lakes - V 0006	55059812500006	2587	Casco - V 0001	55061128500001
2552	Somers - V 0003	55059746250003	2570	Twin Lakes - V 0007	55059812500007	2588	CASCO - T 0001	55061128750001
2553	Somers - V 0004	55059746250004	2571	Twin Lakes - V 0008	55059812500008	2589	CASCO - T 0002	55061128750002
2554	Somers - V 0005	55059746250005	2572	WHEATLAND - T 0001	55059865000001	2590	CASCO - T 0003	55061128750003
2555	Somers - V 0006	55059746250006	2573	WHEATLAND - T 0002	55059865000002	2591	FRANKLIN - T 0001	55061272500001
2556	Somers - V 0007	55059746250007	2574	WHEATLAND - T 0003	55059865000003	2592	Kewaunee - C 0001	55061393500001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2593	Kewaunee - C 0002	55061393500002	2611	RED RIVER - T 0001	55061667000001	2629	FARMINGTON - T 0002	55063253250002
2594	Kewaunee - C 0003	55061393500003	2612	RED RIVER - T 0002	55061667000002	2630	GREENFIELD - T 0001	55063311500001
2595	Kewaunee - C 0004	55061393500004	2613	RED RIVER - T 0003	55061667000003	2631	GREENFIELD - T 0002	55063311500002
2596	Kewaunee - C 0005	55061393500005	2614	WEST KEWAUNEE - T 0001	55061857750001	2632	HAMILTON - T 0001	55063322750001
2597	LINCOLN - T 0001	55061444250001	2615	WEST KEWAUNEE - T 0002	55061857750002	2633	HAMILTON - T 0002	55063322750002
2598	Luxemburg - V 0001	55061464000001	2616	Bangor - V 0001	55063045500001	2634	HAMILTON - T 0003	55063322750003
2599	Luxemburg - V 0002	55061464000002	2617	Bangor - V 0002	55063045500002	2635	HAMILTON - T 0004	55063322750004
2600	Luxemburg - V 0003	55061464000003	2618	BANGOR - T 0001	55063045750001	2636	HAMILTON - T 0005	55063322750005
2601	Luxemburg - V 0004	55061464000004	2619	BARRE - T 0001	55063048250001	2637	HOLLAND - T 0001	55063353500001
2602	Luxemburg - V 0005	55061464000005	2620	BARRE - T 0002	55063048250002	2638	HOLLAND - T 0002	55063353500002
2603	LUXEMBURG - T 0001	55061464250001	2621	BURNS - T 0001	55063113000001	2639	HOLLAND - T 0003	55063353500003
2604	LUXEMBURG - T 0002	55061464250002	2622	CAMPBELL - T 0001	55063123000001	2640	HOLLAND - T 0004	55063353500004
2605	LUXEMBURG - T 0003	55061464250003	2623	CAMPBELL - T 0002	55063123000002	2641	HOLLAND - T 0005	55063353500005
2606	MONTPELIER - T 0001	55061540500001	2624	CAMPBELL - T 0003	55063123000003	2642	HOLLAND - T 0006	55063353500006
2607	MONTPELIER - T 0002	55061540500002	2625	CAMPBELL - T 0004	55063123000004	2643	Holmen - V 0001	55063354500001
2608	MONTPELIER - T 0003	55061540500003	2626	CAMPBELL - T 0005	55063123000005	2644	Holmen - V 0002	55063354500002
2609	PIERCE - T 0001	55061626250001	2627	CAMPBELL - T 0006	55063123000006	2645	Holmen - V 0003	55063354500003
2610	PIERCE - T 0002	55061626250002	2628	FARMINGTON - T 0001	55063253250001	2646	Holmen - V 0004	55063354500004

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2647	Holmen - V 0005	55063354500005	2665	La Crosse - C 0011	55063407750011	2683	La Crosse - C 0029	55063407750029
2648	Holmen - V 0006	55063354500006	2666	La Crosse - C 0012	55063407750012	2684	La Crosse - C 0030	55063407750030
2649	Holmen - V 0007	55063354500007	2667	La Crosse - C 0013	55063407750013	2685	La Crosse - C 0031	55063407750031
2650	Holmen - V 0008	55063354500008	2668	La Crosse - C 0014	55063407750014	2686	La Crosse - C 0032	55063407750032
2651	Holmen - V 0009	55063354500009	2669	La Crosse - C 0015	55063407750015	2687	La Crosse - C 0033	55063407750033
2652	Holmen - V 0010	55063354500010	2670	La Crosse - C 0016	55063407750016	2688	La Crosse - C 0034	55063407750034
2653	Holmen - V 0011	55063354500011	2671	La Crosse - C 0017	55063407750017	2689	La Crosse - C 0035	55063407750035
2654	Holmen - V 0012	55063354500012	2672	La Crosse - C 0018	55063407750018	2690	MEDARY - T 0001	55063504000001
2655	La Crosse - C 0001	55063407750001	2673	La Crosse - C 0019	55063407750019	2691	MEDARY - T 0002	55063504000002
2656	La Crosse - C 0002	55063407750002	2674	La Crosse - C 0020	55063407750020	2692	Onalaska - C 0001	55063599250001
2657	La Crosse - C 0003	55063407750003	2675	La Crosse - C 0021	55063407750021	2693	Onalaska - C 0002	55063599250002
2658	La Crosse - C 0004	55063407750004	2676	La Crosse - C 0022	55063407750022	2694	Onalaska - C 0003	55063599250003
2659	La Crosse - C 0005	55063407750005	2677	La Crosse - C 0023	55063407750023	2695	Onalaska - C 0004	55063599250004
2660	La Crosse - C 0006	55063407750006	2678	La Crosse - C 0024	55063407750024	2696	Onalaska - C 0005	55063599250005
2661	La Crosse - C 0007	55063407750007	2679	La Crosse - C 0025	55063407750025	2697	Onalaska - C 0006	55063599250006
2662	La Crosse - C 0008	55063407750008	2680	La Crosse - C 0026	55063407750026	2698	Onalaska - C 0007	55063599250007
2663	La Crosse - C 0009	55063407750009	2681	La Crosse - C 0027	55063407750027	2699	Onalaska - C 0008	55063599250008
2664	La Crosse - C 0010	55063407750010	2682	La Crosse - C 0028	55063407750028	2700	Onalaska - C 0009	55063599250009

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2701	Onalaska - C 0010	55063599250010	2719	WASHINGTON - T 0001	55063836500001	2737	BENTON - T 0002	55065068500002
2702	Onalaska - C 0011	55063599250011	2720	West Salem - V 0001	55063862750001	2738	BLANCHARD - T 0001	55065081000001
2703	Onalaska - C 0012	55063599250012	2721	West Salem - V 0002	55063862750002	2739	Blanchardville - V 0001	55065081250001
2704	ONALASKA - T 0001	55063599500001	2722	West Salem - V 0003	55063862750003	2740	Cuba City - C 0005	55065179500005
2705	ONALASKA - T 0002	55063599500002	2723	West Salem - V 0004	55063862750004	2741	Darlington - C 0001	55065188750001
2706	ONALASKA - T 0003	55063599500003	2724	West Salem - V 0005	55063862750005	2742	Darlington - C 0002	55065188750002
2707	ONALASKA - T 0004	55063599500004	2725	West Salem - V 0006	55063862750006	2743	Darlington - C 0003	55065188750003
2708	ONALASKA - T 0005	55063599500005	2726	West Salem - V 0007	55063862750007	2744	Darlington - C 0004	55065188750004
2709	ONALASKA - T 0006	55063599500006	2727	West Salem - V 0008	55063862750008	2745	Darlington - C 0005	55065188750005
2710	ONALASKA - T 0007	55063599500007	2728	Argyle - V 0001	55065026500001	2746	Darlington - C 0006	55065188750006
2711	ONALASKA - T 0008	55063599500008	2729	ARGYLE - T 0001	55065026750001	2747	DARLINGTON - T 0001	55065189000001
2712	Rockland - V 0001	55063689000001	2730	ARGYLE - T 0002	55065026750002	2748	DARLINGTON - T 0002	55065189000002
2713	SHELBY - T 0001	55063731250001	2731	ARGYLE - T 0003	55065026750003	2749	ELK GROVE - T 0001	55065232620001
2714	SHELBY - T 0002	55063731250002	2732	Belmont - V 0001	55065064250001	2750	ELK GROVE - T 0002	55065232620002
2715	SHELBY - T 0003	55063731250003	2733	BELMONT - T 0001	55065064500001	2751	FAYETTE - T 0001	55065254750001
2716	SHELBY - T 0004	55063731250004	2734	BELMONT - T 0002	55065064500002	2752	FAYETTE - T 0002	55065254750002
2717	SHELBY - T 0005	55063731250005	2735	Benton - V 0001	55065068250001	2753	Gratiot - V 0001	55065305750001
2718	SHELBY - T 0006	55063731250006	2736	BENTON - T 0001	55065068500001	2754	GRATIOT - T 0001	55065306000001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2755	Hazel Green - V 0003	55065335000003	2773	AINSWORTH - T 0001	55067006250001	2791	NORWOOD - T 0001	55067587000001
2756	KENDALL - T 0001	55065391250001	2774	Antigo - C 0001	55067022500001	2792	PARRISH - T 0001	55067613750001
2757	LAMONT - T 0001	55065421750001	2775	Antigo - C 0002	55067022500002	2793	PECK - T 0001	55067615250001
2758	LAMONT - T 0002	55065421750002	2776	Antigo - C 0003	55067022500003	2794	POLAR - T 0001	55067638250001
2759	MONTICELLO - T 0001	55065540250001	2777	Antigo - C 0004	55067022500004	2795	POLAR - T 0002	55067638250002
2760	NEW DIGGINGS - T 0001	55065566250001	2778	Antigo - C 0005	55067022500005	2796	PRICE - T 0001	55067655500001
2761	SEYMOUR - T 0001	55065727000001	2779	Antigo - C 0006	55067022500006	2797	PRICE - T 0002	55067655500002
2762	SEYMOUR - T 0002	55065727000002	2780	Antigo - C 0007	55067022500007	2798	ROLLING - T 0001	55067691750001
2763	Shullsburg - C 0001	55065738250001	2781	Antigo - C 0008	55067022500008	2799	ROLLING - T 0002	55067691750002
2764	Shullsburg - C 0002	55065738250002	2782	Antigo - C 0009	55067022500009	2800	SUMMIT - T 0001	55067783250001
2765	Shullsburg - C 0003	55065738250003	2783	ANTIGO - T 0001	55067022750001	2801	UPHAM - T 0001	55067819500001
2766	SHULLSBURG - T 0001	55065738500001	2784	ANTIGO - T 0002	55067022750002	2802	VILAS - T 0001	55067828250001
2767	South Wayne - V 0001	55065752750001	2785	ELCHO - T 0001	55067230500001	2803	White Lake - V 0001	55067867500001
2768	WAYNE - T 0001	55065848500001	2786	ELCHO - T 0002	55067230500002	2804	WOLF RIVER - T 0001	55067884500001
2769	WHITE OAK SPRINGS - T 0001	55065868000001	2787	EVERGREEN - T 0001	55067245750001	2805	WOLF RIVER - T 0002	55067884500002
2770	WILLOW SPRINGS - T 0001	55065872750001	2788	LANGLADE - T 0001	55067424250001	2806	BIRCH - T 0001	55069075000001
2771	WIOTA - T 0001	55065880500001	2789	LANGLADE - T 0002	55067424250002	2807	BRADLEY - T 0001	55069092250001
2772	ACKLEY - T 0001	55067002250001	2790	NEVA - T 0001	55067562000001	2808	BRADLEY - T 0002	55069092250002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2809	BRADLEY - T 0003	55069092250003	2827	Merrill - C 0008	55069512500008	2845	MERRILL - T 0007	55069512750007
2810	BRADLEY - T 0004	55069092250004	2828	Merrill - C 0009	55069512500009	2846	PINE RIVER - T 0001	55069629500001
2811	BRADLEY - T 0005	55069092250005	2829	Merrill - C 0010	55069512500010	2847	PINE RIVER - T 0002	55069629500002
2812	CORNING - T 0001	55069171250001	2830	Merrill - C 0011	55069512500011	2848	PINE RIVER - T 0003	55069629500003
2813	CORNING - T 0002	55069171250002	2831	Merrill - C 0012	55069512500012	2849	ROCK FALLS - T 0001	55069688250001
2814	HARDING - T 0001	55069326500001	2832	Merrill - C 0013	55069512500013	2850	ROCK FALLS - T 0002	55069688250002
2815	HARRISON - T 0001	55069328750001	2833	Merrill - C 0014	55069512500014	2851	RUSSELL - T 0001	55069703250001
2816	HARRISON - T 0002	55069328750002	2834	Merrill - C 0015	55069512500015	2852	SCHLEY - T 0001	55069721000001
2817	HARRISON - T 0003	55069328750003	2835	Merrill - C 0016	55069512500016	2853	SCHLEY - T 0002	55069721000002
2818	KING - T 0001	55069396750001	2836	Merrill - C 0017	55069512500017	2854	SCOTT - T 0001	55069723000001
2819	KING - T 0002	55069396750002	2837	Merrill - C 0018	55069512500018	2855	SCOTT - T 0002	55069723000002
2820	Merrill - C 0001	55069512500001	2838	Merrill - C 0019	55069512500019	2856	SKANAWAN - T 0001	55069742500001
2821	Merrill - C 0002	55069512500002	2839	MERRILL - T 0001	55069512750001	2857	SOMO - T 0001	55069747250001
2822	Merrill - C 0003	55069512500003	2840	MERRILL - T 0002	55069512750002	2858	Tomahawk - C 0001	55069801250001
2823	Merrill - C 0004	55069512500004	2841	MERRILL - T 0003	55069512750003	2859	Tomahawk - C 0002	55069801250002
2824	Merrill - C 0005	55069512500005	2842	MERRILL - T 0004	55069512750004	2860	Tomahawk - C 0003	55069801250003
2825	Merrill - C 0006	55069512500006	2843	MERRILL - T 0005	55069512750005	2861	Tomahawk - C 0004	55069801250004
2826	Merrill - C 0007	55069512500007	2844	MERRILL - T 0006	55069512750006	2862	Tomahawk - C 0005	55069801250005

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2863	Tomahawk - C 0006	55069801250006	2881	Kiel - C 0001	55071395250001	2899	Manitowoc - C 0006	55071485000006
2864	TOMAHAWK - T 0001	55069801500001	2882	Kiel - C 0002	55071395250002	2900	Manitowoc - C 0007	55071485000007
2865	WILSON - T 0001	55069874250001	2883	Kiel - C 0003	55071395250003	2901	Manitowoc - C 0008	55071485000008
2866	CATO - T 0001	55071132370001	2884	Kiel - C 0004	55071395250004	2902	Manitowoc - C 0009	55071485000009
2867	CATO - T 0002	55071132370002	2885	Kiel - C 0005	55071395250005	2903	Manitowoc - C 0010	55071485000010
2868	CENTERVILLE - T 0001	55071137500001	2886	Kiel - C 0006	55071395250006	2904	Manitowoc - C 0011	55071485000011
2869	Cleveland - V 0001	55071154000001	2887	Kiel - C 0008	55071395250008	2905	Manitowoc - C 0012	55071485000012
2870	Cleveland - V 0002	55071154000002	2888	Kiel - C 0009	55071395250009	2906	Manitowoc - C 0013	55071485000013
2871	COOPERSTOWN - T 0001	55071169500001	2889	KOSSUTH - T 0001	55071404250001	2907	Manitowoc - C 0014	55071485000014
2872	COOPERSTOWN - T 0002	55071169500002	2890	KOSSUTH - T 0002	55071404250002	2908	Manitowoc - C 0015	55071485000015
2873	EATON - T 0001	55071222750001	2891	KOSSUTH - T 0003	55071404250003	2909	Manitowoc - C 0016	55071485000016
2874	Francis Creek - V 0001	55071271250001	2892	LIBERTY - T 0001	55071438500001	2910	Manitowoc - C 0017	55071485000017
2875	FRANKLIN - T 0001	55071272750001	2893	LIBERTY - T 0002	55071438500002	2911	Manitowoc - C 0018	55071485000018
2876	FRANKLIN - T 0002	55071272750002	2894	Manitowoc - C 0001	55071485000001	2912	Manitowoc - C 0019	55071485000019
2877	FRANKLIN - T 0003	55071272750003	2895	Manitowoc - C 0002	55071485000002	2913	Manitowoc - C 0020	55071485000020
2878	GIBSON - T 0001	55071289750001	2896	Manitowoc - C 0003	55071485000003	2914	Manitowoc - C 0021	55071485000021
2879	GIBSON - T 0002	55071289750002	2897	Manitowoc - C 0004	55071485000004	2915	Manitowoc - C 0022	55071485000022
2880	Kellnersville - V 0001	55071390000001	2898	Manitowoc - C 0005	55071485000005	2916	Manitowoc - C 0023	55071485000023

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2917	Manitowoc - C 0024	55071485000024	2935	MEEME - T 0004	55071506250004	2953	TWO CREEKS - T 0001	55071813000001
2918	Manitowoc - C 0025	55071485000025	2936	Mishicot - V 0001	55071533250001	2954	Two Rivers - C 0001	55071813250001
2919	Manitowoc - C 0026	55071485000026	2937	Mishicot - V 0002	55071533250002	2955	Two Rivers - C 0002	55071813250002
2920	Manitowoc - C 0027	55071485000027	2938	Mishicot - V 0003	55071533250003	2956	Two Rivers - C 0003	55071813250003
2921	Manitowoc - C 0028	55071485000028	2939	Mishicot - V 0004	55071533250004	2957	Two Rivers - C 0004	55071813250004
2922	Manitowoc - C 0029	55071485000029	2940	MISHICOT - T 0001	55071533500001	2958	Two Rivers - C 0005	55071813250005
2923	MANITOWOC - T 0001	55071485250001	2941	MISHICOT - T 0002	55071533500002	2959	Two Rivers - C 0006	55071813250006
2924	MANITOWOC - T 0002	55071485250002	2942	NEWTON - T 0001	55071572000001	2960	Two Rivers - C 0007	55071813250007
2925	MANITOWOC RAPIDS - T 0001	55071485750001	2943	NEWTON - T 0002	55071572000002	2961	Two Rivers - C 0008	55071813250008
2926	MANITOWOC RAPIDS - T 0002	55071485750002	2944	NEWTON - T 0003	55071572000003	2962	TWO RIVERS - T 0001	55071813500001
2927	MANITOWOC RAPIDS - T 0003	55071485750003	2945	Reedsville - V 0001	55071668750001	2963	TWO RIVERS - T 0002	55071813500002
2928	MANITOWOC RAPIDS - T 0004	55071485750004	2946	Reedsville - V 0002	55071668750002	2964	Valders - V 0001	55071822000001
2929	MANITOWOC RAPIDS - T 0005	55071485750005	2947	Reedsville - V 0003	55071668750003	2965	Whitelaw - V 0001	55071867750001
2930	MAPLE GROVE - T 0001	55071488750001	2948	ROCKLAND - T 0001	55071689250001	2966	Abbotsford - C 0001	55073001000001
2931	Maribel - V 0001	55071492500001	2949	ROCKLAND - T 0002	55071689250002	2967	Abbotsford - C 0006	55073001000006
2932	MEEME - T 0001	55071506250001	2950	St. Nazianz - V 0001	55071710250001	2968	Athens - V 0001	55073035500001
2933	MEEME - T 0002	55071506250002	2951	SCHLESWIG - T 0001	55071720750001	2969	Athens - V 0002	55073035500002
2934	MEEME - T 0003	55071506250003	2952	SCHLESWIG - T 0002	55071720750002	2970	BERGEN - T 0001	55073068750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
2971	BERLIN - T 0001	55073069750001	2989	EAU PLEINE - T 0001	55073224250001	3007	HULL - T 0001	55073363250001
2972	BERLIN - T 0002	55073069750002	2990	Edgar - V 0001	55073225500001	3008	JOHNSON - T 0001	55073383000001
2973	BERN - T 0001	55073070000001	2991	Edgar - V 0002	55073225500002	3009	KNOWLTON - T 0001	55073401500001
2974	BEVENT - T 0001	55073071250001	2992	Elderon - V 0001	55073230750001	3010	KNOWLTON - T 0002	55073401500002
2975	BEVENT - T 0002	55073071250002	2993	ELDERON - T 0001	55073231000001	3011	KNOWLTON - T 0003	55073401500003
2976	Birnamwood - V 0002	55073076000002	2994	EMMET - T 0001	55073240250001	3012	Kronenwetter - V 0001	55073405500001
2977	BRIGHTON - T 0001	55073096500001	2995	EMMET - T 0002	55073240250002	3013	Kronenwetter - V 0002	55073405500002
2978	Brokaw - V 0001	55073099750001	2996	Fenwood - V 0001	55073256500001	3014	Kronenwetter - V 0003	55073405500003
2979	CASSEL - T 0001	55073129750001	2997	FRANKFORT - T 0001	55073271500001	3015	Kronenwetter - V 0004	55073405500004
2980	CLEVELAND - T 0001	55073154250001	2998	FRANZEN - T 0001	55073274500001	3016	Kronenwetter - V 0005	55073405500005
2981	CLEVELAND - T 0002	55073154250002	2999	GREEN VALLEY - T 0001	55073314500001	3017	Kronenwetter - V 0006	55073405500006
2982	Colby - C 0001	55073161500001	3000	GUENTHER - T 0001	55073318000001	3018	Kronenwetter - V 0007	55073405500007
2983	DAY - T 0001	55073189500001	3001	HALSEY - T 0001	55073321500001	3019	Kronenwetter - V 0008	55073405500008
2984	DAY - T 0002	55073189500002	3002	HAMBURG - T 0001	55073322000001	3020	Kronenwetter - V 0009	55073405500009
2985	Dorchester - V 0002	55073204500002	3003	HARRISON - T 0001	55073329000001	3021	Kronenwetter - V 0010	55073405500010
2986	Dorchester - V 0003	55073204500003	3004	Hatley - V 0001	55073331750001	3022	MCMILLAN - T 0001	55073469750001
2987	EASTON - T 0001	55073220250001	3005	HEWITT - T 0001	55073342250001	3023	MCMILLAN - T 0002	55073469750002
2988	EASTON - T 0002	55073220250002	3006	HOLTON - T 0001	55073355000001	3024	MCMILLAN - T 0003	55073469750003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3025	Maine - V 0001	55073482250001	3043	Mosinee - C 0005	55073545000005	3061	RIB MOUNTAIN - T 0008	55073673250008
3026	Maine - V 0002	55073482250002	3044	Mosinee - C 0006	55073545000006	3062	RIB MOUNTAIN - T 0009	55073673250009
3027	Maine - V 0003	55073482250003	3045	Mosinee - C 0007	55073545000007	3063	RIB MOUNTAIN - T 0010	55073673250010
3028	Maine - V 0004	55073482250004	3046	MOSINEE - T 0001	55073545250001	3064	RIETBROCK - T 0001	55073679500001
3029	MARATHON - T 0001	55073490750001	3047	MOSINEE - T 0002	55073545250002	3065	RINGLE - T 0001	55073680750001
3030	MARATHON - T 0002	55073490750002	3048	MOSINEE - T 0003	55073545250003	3066	RINGLE - T 0002	55073680750002
3031	Marathon City - V 0001	55073491000001	3049	NORRIE - T 0001	55073576000001	3067	Rothschild - V 0001	55073697250001
3032	Marathon City - V 0002	55073491000002	3050	PLOVER - T 0001	55073635000001	3068	Rothschild - V 0002	55073697250002
3033	Marathon City - V 0003	55073491000003	3051	REID - T 0001	55073669500001	3069	Rothschild - V 0003	55073697250003
3034	Marathon City - V 0004	55073491000004	3052	REID - T 0002	55073669500002	3070	Rothschild - V 0004	55073697250004
3035	Marshfield - C 0012	55073496750012	3053	RIB FALLS - T 0001	55073672500001	3071	Rothschild - V 0005	55073697250005
3036	Marshfield - C 0020	55073496750020	3054	RIB MOUNTAIN - T 0001	55073673250001	3072	Rothschild - V 0006	55073697250006
3037	Marshfield - C 0021	55073496750021	3055	RIB MOUNTAIN - T 0002	55073673250002	3073	Schofield - C 0001	55073721500001
3038	Marshfield - C 0024	55073496750024	3056	RIB MOUNTAIN - T 0003	55073673250003	3074	Schofield - C 0002	55073721500002
3039	Mosinee - C 0001	55073545000001	3057	RIB MOUNTAIN - T 0004	55073673250004	3075	Schofield - C 0003	55073721500003
3040	Mosinee - C 0002	55073545000002	3058	RIB MOUNTAIN - T 0005	55073673250005	3076	Schofield - C 0004	55073721500004
3041	Mosinee - C 0003	55073545000003	3059	RIB MOUNTAIN - T 0006	55073673250006	3077	Spencer - V 0001	55073754000001
3042	Mosinee - C 0004	55073545000004	3060	RIB MOUNTAIN - T 0007	55073673250007	3078	Spencer - V 0002	55073754000002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3079	Spencer - V 0003	55073754000003	3097	Wausau - C 0007	55073844750007	3115	Wausau - C 0025	55073844750025
3080	SPENCER - T 0001	55073754250001	3098	Wausau - C 0008	55073844750008	3116	Wausau - C 0026	55073844750026
3081	SPENCER - T 0002	55073754250002	3099	Wausau - C 0009	55073844750009	3117	Wausau - C 0027	55073844750027
3082	STETTIN - T 0001	55073771500001	3100	Wausau - C 0010	55073844750010	3118	Wausau - C 0028	55073844750028
3083	STETTIN - T 0002	55073771500002	3101	Wausau - C 0011	55073844750011	3119	Wausau - C 0029	55073844750029
3084	STETTIN - T 0003	55073771500003	3102	Wausau - C 0012	55073844750012	3120	Wausau - C 0030	55073844750030
3085	STETTIN - T 0004	55073771500004	3103	Wausau - C 0013	55073844750013	3121	Wausau - C 0031	55073844750031
3086	Stratford - V 0001	55073777500001	3104	Wausau - C 0014	55073844750014	3122	Wausau - C 0032	55073844750032
3087	Stratford - V 0002	55073777500002	3105	Wausau - C 0015	55073844750015	3123	Wausau - C 0033	55073844750033
3088	TEXAS - T 0001	55073793500001	3106	Wausau - C 0016	55073844750016	3124	Wausau - C 0034	55073844750034
3089	TEXAS - T 0002	55073793500002	3107	Wausau - C 0017	55073844750017	3125	Wausau - C 0035	55073844750035
3090	Unity - V 0001	55073818500001	3108	Wausau - C 0018	55073844750018	3126	Wausau - C 0036	55073844750036
3091	Wausau - C 0001	55073844750001	3109	Wausau - C 0019	55073844750019	3127	Wausau - C 0037	55073844750037
3092	Wausau - C 0002	55073844750002	3110	Wausau - C 0020	55073844750020	3128	Wausau - C 0048	55073844750048
3093	Wausau - C 0003	55073844750003	3111	Wausau - C 0021	55073844750021	3129	Wausau - C 0049	55073844750049
3094	Wausau - C 0004	55073844750004	3112	Wausau - C 0022	55073844750022	3130	WAUSAU - T 0001	55073845000001
3095	Wausau - C 0005	55073844750005	3113	Wausau - C 0023	55073844750023	3131	WAUSAU - T 0002	55073845000002
3096	Wausau - C 0006	55073844750006	3114	Wausau - C 0024	55073844750024	3132	WAUSAU - T 0003	55073845000003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3133	Weston - V 0001	55073860250001	3151	BEAVER - T 0001	55075058000001	3169	Marinette - C 0006	55075493000006
3134	Weston - V 0002	55073860250002	3152	BEAVER - T 0002	55075058000002	3170	Marinette - C 0007	55075493000007
3135	Weston - V 0003	55073860250003	3153	BEECHER - T 0001	55075060000001	3171	Marinette - C 0008	55075493000008
3136	Weston - V 0004	55073860250004	3154	Coleman - V 0001	55075162500001	3172	MIDDLE INLET - T 0001	55075515370001
3137	Weston - V 0005	55073860250005	3155	Crivitz - V 0001	55075177250001	3173	MIDDLE INLET - T 0002	55075515370002
3138	Weston - V 0006	55073860250006	3156	DUNBAR - T 0001	55075210000001	3174	Niagara - C 0001	55075573250001
3139	Weston - V 0007	55073860250007	3157	DUNBAR - T 0002	55075210000002	3175	Niagara - C 0002	55075573250002
3140	Weston - V 0008	55073860250008	3158	GOODMAN - T 0001	55075297750001	3176	Niagara - C 0003	55075573250003
3141	Weston - V 0009	55073860250009	3159	GROVER - T 0001	55075317250001	3177	NIAGARA - T 0001	55075573500001
3142	Weston - V 0010	55073860250010	3160	GROVER - T 0002	55075317250002	3178	PEMBINE - T 0001	55075617750001
3143	Weston - V 0011	55073860250011	3161	GROVER - T 0003	55075317250003	3179	PEMBINE - T 0002	55075617750002
3144	Weston - V 0012	55073860250012	3162	LAKE - T 0001	55075410750001	3180	Peshtigo - C 0001	55075621750001
3145	Weston - V 0013	55073860250013	3163	LAKE - T 0002	55075410750002	3181	Peshtigo - C 0002	55075621750002
3146	WESTON - T 0001	55073860500001	3164	Marinette - C 0001	55075493000001	3182	Peshtigo - C 0003	55075621750003
3147	WIEN - T 0001	55073870250001	3165	Marinette - C 0002	55075493000002	3183	Peshtigo - C 0004	55075621750004
3148	AMBERG - T 0001	55075016750001	3166	Marinette - C 0003	55075493000003	3184	Peshtigo - C 0005	55075621750005
3149	ATHELSTANE - T 0001	55075035250001	3167	Marinette - C 0004	55075493000004	3185	Peshtigo - C 0006	55075621750006
3150	ATHELSTANE - T 0002	55075035250002	3168	Marinette - C 0005	55075493000005	3186	Peshtigo - C 0007	55075621750007

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3187	PESHTIGO - T 0001	55075622000001	3205	STEPHENSON - T 0005	55075770000005	3223	MONTELLO - T 0003	55077539000003
3188	PESHTIGO - T 0002	55075622000002	3206	WAGNER - T 0001	55075830500001	3224	MONTELLO - T 0004	55077539000004
3189	PESHTIGO - T 0003	55075622000003	3207	Wausaukee - V 0001	55075845250001	3225	MOUNDVILLE - T 0001	55077546000001
3190	PESHTIGO - T 0004	55075622000004	3208	WAUSAUKEE - T 0001	55075845500001	3226	MOUNDVILLE - T 0002	55077546000002
3191	PESHTIGO - T 0005	55075622000005	3209	WAUSAUKEE - T 0002	55075845500002	3227	Neshkoro - V 0001	55077561250001
3192	PESHTIGO - T 0006	55075622000006	3210	BUFFALO - T 0001	55077110500001	3228	NESHKORO - T 0001	55077561500001
3193	PORTERFIELD - T 0001	55075642750001	3211	BUFFALO - T 0002	55077110500002	3229	NESHKORO - T 0002	55077561500002
3194	PORTERFIELD - T 0002	55075642750002	3212	CRYSTAL LAKE - T 0001	55077179000001	3230	NEWTON - T 0001	55077572250001
3195	PORTERFIELD - T 0003	55075642750003	3213	DOUGLAS - T 0001	55077205250001	3231	NEWTON - T 0002	55077572250002
3196	Pound - V 0001	55075647500001	3214	Endeavor - V 0001	55077240750001	3232	Oxford - V 0001	55077608750001
3197	POUND - T 0001	55075647750001	3215	HARRIS - T 0001	55077327750001	3233	OXFORD - T 0001	55077609000001
3198	POUND - T 0002	55075647750002	3216	MECAN - T 0001	55077503500001	3234	OXFORD - T 0002	55077609000002
3199	POUND - T 0003	55075647750003	3217	Montello - C 0001	55077538750001	3235	PACKWAUKEE - T 0001	55077609620001
3200	SILVER CLIFF - T 0001	55075739750001	3218	Montello - C 0002	55077538750002	3236	PACKWAUKEE - T 0002	55077609620002
3201	STEPHENSON - T 0001	55075770000001	3219	Montello - C 0003	55077538750003	3237	PACKWAUKEE - T 0003	55077609620003
3202	STEPHENSON - T 0002	55075770000002	3220	Montello - C 0004	55077538750004	3238	SHIELDS - T 0001	55077736000001
3203	STEPHENSON - T 0003	55075770000003	3221	MONTELLO - T 0001	55077539000001	3239	SPRINGFIELD - T 0001	55077759250001
3204	STEPHENSON - T 0004	55075770000004	3222	MONTELLO - T 0002	55077539000002	3240	Westfield - V 0001	55077855750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3241	Westfield - V 0002	55077855750002	3259	Brown Deer - V 0004	55079103750004	3277	Fox Point - V 0001	55079270750001
3242	WESTFIELD - T 0001	55077856000001	3260	Brown Deer - V 0005	55079103750005	3278	Fox Point - V 0002	55079270750002
3243	WESTFIELD - T 0002	55077856000002	3261	Brown Deer - V 0006	55079103750006	3279	Fox Point - V 0003	55079270750003
3244	MENOMINEE - T 0001	55078509750001	3262	Cudahy - C 0001	55079179750001	3280	Fox Point - V 0004	55079270750004
3245	MENOMINEE - T 0002	55078509750002	3263	Cudahy - C 0002	55079179750002	3281	Fox Point - V 0005	55079270750005
3246	MENOMINEE - T 0003	55078509750003	3264	Cudahy - C 0003	55079179750003	3282	Fox Point - V 0006	55079270750006
3247	MENOMINEE - T 0004	55078509750004	3265	Cudahy - C 0004	55079179750004	3283	Fox Point - V 0007	55079270750007
3248	MENOMINEE - T 0005	55078509750005	3266	Cudahy - C 0005	55079179750005	3284	Fox Point - V 0008	55079270750008
3249	Bayside - V 0001	55079054500001	3267	Cudahy - C 0006	55079179750006	3285	Fox Point - V 0009	55079270750009
3250	Bayside - V 0002	55079054500002	3268	Cudahy - C 0007	55079179750007	3286	Franklin - C 0001	55079273000001
3251	Bayside - V 0003	55079054500003	3269	Cudahy - C 0008	55079179750008	3287	Franklin - C 0002	55079273000002
3252	Bayside - V 0004	55079054500004	3270	Cudahy - C 0009	55079179750009	3288	Franklin - C 0003	55079273000003
3253	Bayside - V 0005	55079054500005	3271	Cudahy - C 0010	55079179750010	3289	Franklin - C 0004	55079273000004
3254	Bayside - V 001S	5507905450001S	3272	Cudahy - C 0011	55079179750011	3290	Franklin - C 0005	55079273000005
3255	Bayside - V 003S	5507905450003S	3273	Cudahy - C 0012	55079179750012	3291	Franklin - C 0006	55079273000006
3256	Brown Deer - V 0001	55079103750001	3274	Cudahy - C 0013	55079179750013	3292	Franklin - C 0007	55079273000007
3257	Brown Deer - V 0002	55079103750002	3275	Cudahy - C 0014	55079179750014	3293	Franklin - C 0008	55079273000008
3258	Brown Deer - V 0003	55079103750003	3276	Cudahy - C 0015	55079179750015	3294	Franklin - C 0009	55079273000009

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3295	Franklin - C 0010	55079273000010	3313	Glendale - C 0003	55079294000003	3331	Greendale - V 0007	55079311250007
3296	Franklin - C 0011	55079273000011	3314	Glendale - C 0004	55079294000004	3332	Greendale - V 0008	55079311250008
3297	Franklin - C 0012	55079273000012	3315	Glendale - C 0005	55079294000005	3333	Greendale - V 0009	55079311250009
3298	Franklin - C 0013	55079273000013	3316	Glendale - C 0006	55079294000006	3334	Greendale - V 0010	55079311250010
3299	Franklin - C 0014	55079273000014	3317	Glendale - C 0007	55079294000007	3335	Greenfield - C 0001	55079311750001
3300	Franklin - C 0016	55079273000016	3318	Glendale - C 0008	55079294000008	3336	Greenfield - C 0002	55079311750002
3301	Franklin - C 0017	55079273000017	3319	Glendale - C 0009	55079294000009	3337	Greenfield - C 0003	55079311750003
3302	Franklin - C 0018	55079273000018	3320	Glendale - C 0010	55079294000010	3338	Greenfield - C 0004	55079311750004
3303	Franklin - C 0019	55079273000019	3321	Glendale - C 0011	55079294000011	3339	Greenfield - C 0005	55079311750005
3304	Franklin - C 0020	55079273000020	3322	Glendale - C 0012	55079294000012	3340	Greenfield - C 0006	55079311750006
3305	Franklin - C 0021	55079273000021	3323	Glendale - C 008S	5507929400008S	3341	Greenfield - C 0007	55079311750007
3306	Franklin - C 0023	55079273000023	3324	Glendale - C 011S	5507929400011S	3342	Greenfield - C 0008	55079311750008
3307	Franklin - C 015A	5507927300015A	3325	Greendale - V 0001	55079311250001	3343	Greenfield - C 0009	55079311750009
3308	Franklin - C 015B	5507927300015B	3326	Greendale - V 0002	55079311250002	3344	Greenfield - C 0010	55079311750010
3309	Franklin - C 022A	5507927300022A	3327	Greendale - V 0003	55079311250003	3345	Greenfield - C 0011	55079311750011
3310	Franklin - C 022B	5507927300022B	3328	Greendale - V 0004	55079311250004	3346	Greenfield - C 0012	55079311750012
3311	Glendale - C 0001	55079294000001	3329	Greendale - V 0005	55079311250005	3347	Greenfield - C 0013	55079311750013
3312	Glendale - C 0002	55079294000002	3330	Greendale - V 0006	55079311250006	3348	Greenfield - C 0014	55079311750014

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3349	Greenfield - C 0015	55079311750015	3367	Milwaukee - C 0003	55079530000003	3385	Milwaukee - C 0021	55079530000021
3350	Greenfield - C 0016	55079311750016	3368	Milwaukee - C 0004	55079530000004	3386	Milwaukee - C 0022	55079530000022
3351	Greenfield - C 0017	55079311750017	3369	Milwaukee - C 0005	55079530000005	3387	Milwaukee - C 0023	55079530000023
3352	Greenfield - C 0018	55079311750018	3370	Milwaukee - C 0006	55079530000006	3388	Milwaukee - C 0024	55079530000024
3353	Greenfield - C 0019	55079311750019	3371	Milwaukee - C 0007	55079530000007	3389	Milwaukee - C 0025	55079530000025
3354	Greenfield - C 0020	55079311750020	3372	Milwaukee - C 0008	55079530000008	3390	Milwaukee - C 0026	55079530000026
3355	Greenfield - C 0021	55079311750021	3373	Milwaukee - C 0009	55079530000009	3391	Milwaukee - C 0027	55079530000027
3356	Hales Corners - V 0001	55079320750001	3374	Milwaukee - C 0010	55079530000010	3392	Milwaukee - C 0028	55079530000028
3357	Hales Corners - V 0002	55079320750002	3375	Milwaukee - C 0011	55079530000011	3393	Milwaukee - C 0029	55079530000029
3358	Hales Corners - V 0003	55079320750003	3376	Milwaukee - C 0012	55079530000012	3394	Milwaukee - C 0030	55079530000030
3359	Hales Corners - V 0004	55079320750004	3377	Milwaukee - C 0013	55079530000013	3395	Milwaukee - C 0031	55079530000031
3360	Hales Corners - V 0005	55079320750005	3378	Milwaukee - C 0014	55079530000014	3396	Milwaukee - C 0032	55079530000032
3361	Hales Corners - V 0006	55079320750006	3379	Milwaukee - C 0015	55079530000015	3397	Milwaukee - C 0033	55079530000033
3362	Hales Corners - V 0007	55079320750007	3380	Milwaukee - C 0016	55079530000016	3398	Milwaukee - C 0034	55079530000034
3363	Hales Corners - V 0008	55079320750008	3381	Milwaukee - C 0017	55079530000017	3399	Milwaukee - C 0035	55079530000035
3364	Hales Corners - V 0009	55079320750009	3382	Milwaukee - C 0018	55079530000018	3400	Milwaukee - C 0036	55079530000036
3365	Milwaukee - C 0001	55079530000001	3383	Milwaukee - C 0019	55079530000019	3401	Milwaukee - C 0037	55079530000037
3366	Milwaukee - C 0002	55079530000002	3384	Milwaukee - C 0020	55079530000020	3402	Milwaukee - C 0038	55079530000038

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3403	Milwaukee - C 0039	55079530000039	3421	Milwaukee - C 0057	55079530000057	3439	Milwaukee - C 0075	55079530000075
3404	Milwaukee - C 0040	55079530000040	3422	Milwaukee - C 0058	55079530000058	3440	Milwaukee - C 0076	55079530000076
3405	Milwaukee - C 0041	55079530000041	3423	Milwaukee - C 0059	55079530000059	3441	Milwaukee - C 0077	55079530000077
3406	Milwaukee - C 0042	55079530000042	3424	Milwaukee - C 0060	55079530000060	3442	Milwaukee - C 0078	55079530000078
3407	Milwaukee - C 0043	55079530000043	3425	Milwaukee - C 0061	55079530000061	3443	Milwaukee - C 0079	55079530000079
3408	Milwaukee - C 0044	55079530000044	3426	Milwaukee - C 0062	55079530000062	3444	Milwaukee - C 0080	55079530000080
3409	Milwaukee - C 0045	55079530000045	3427	Milwaukee - C 0063	55079530000063	3445	Milwaukee - C 0081	55079530000081
3410	Milwaukee - C 0046	55079530000046	3428	Milwaukee - C 0064	55079530000064	3446	Milwaukee - C 0082	55079530000082
3411	Milwaukee - C 0047	55079530000047	3429	Milwaukee - C 0065	55079530000065	3447	Milwaukee - C 0083	55079530000083
3412	Milwaukee - C 0048	55079530000048	3430	Milwaukee - C 0066	55079530000066	3448	Milwaukee - C 0084	55079530000084
3413	Milwaukee - C 0049	55079530000049	3431	Milwaukee - C 0067	55079530000067	3449	Milwaukee - C 0085	55079530000085
3414	Milwaukee - C 0050	55079530000050	3432	Milwaukee - C 0068	55079530000068	3450	Milwaukee - C 0086	55079530000086
3415	Milwaukee - C 0051	55079530000051	3433	Milwaukee - C 0069	55079530000069	3451	Milwaukee - C 0087	55079530000087
3416	Milwaukee - C 0052	55079530000052	3434	Milwaukee - C 0070	55079530000070	3452	Milwaukee - C 0088	55079530000088
3417	Milwaukee - C 0053	55079530000053	3435	Milwaukee - C 0071	55079530000071	3453	Milwaukee - C 0089	55079530000089
3418	Milwaukee - C 0054	55079530000054	3436	Milwaukee - C 0072	55079530000072	3454	Milwaukee - C 0090	55079530000090
3419	Milwaukee - C 0055	55079530000055	3437	Milwaukee - C 0073	55079530000073	3455	Milwaukee - C 0091	55079530000091
3420	Milwaukee - C 0056	55079530000056	3438	Milwaukee - C 0074	55079530000074	3456	Milwaukee - C 0092	55079530000092

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3457	Milwaukee - C 0093	55079530000093	3475	Milwaukee - C 0111	55079530000111	3493	Milwaukee - C 0129	55079530000129
3458	Milwaukee - C 0094	55079530000094	3476	Milwaukee - C 0112	55079530000112	3494	Milwaukee - C 0130	55079530000130
3459	Milwaukee - C 0095	55079530000095	3477	Milwaukee - C 0113	55079530000113	3495	Milwaukee - C 0131	55079530000131
3460	Milwaukee - C 0096	55079530000096	3478	Milwaukee - C 0114	55079530000114	3496	Milwaukee - C 0132	55079530000132
3461	Milwaukee - C 0097	55079530000097	3479	Milwaukee - C 0115	55079530000115	3497	Milwaukee - C 0133	55079530000133
3462	Milwaukee - C 0098	55079530000098	3480	Milwaukee - C 0116	55079530000116	3498	Milwaukee - C 0134	55079530000134
3463	Milwaukee - C 0099	55079530000099	3481	Milwaukee - C 0117	55079530000117	3499	Milwaukee - C 0135	55079530000135
3464	Milwaukee - C 0100	55079530000100	3482	Milwaukee - C 0118	55079530000118	3500	Milwaukee - C 0136	55079530000136
3465	Milwaukee - C 0101	55079530000101	3483	Milwaukee - C 0119	55079530000119	3501	Milwaukee - C 0137	55079530000137
3466	Milwaukee - C 0102	55079530000102	3484	Milwaukee - C 0120	55079530000120	3502	Milwaukee - C 0138	55079530000138
3467	Milwaukee - C 0103	55079530000103	3485	Milwaukee - C 0121	55079530000121	3503	Milwaukee - C 0139	55079530000139
3468	Milwaukee - C 0104	55079530000104	3486	Milwaukee - C 0122	55079530000122	3504	Milwaukee - C 0140	55079530000140
3469	Milwaukee - C 0105	55079530000105	3487	Milwaukee - C 0123	55079530000123	3505	Milwaukee - C 0141	55079530000141
3470	Milwaukee - C 0106	55079530000106	3488	Milwaukee - C 0124	55079530000124	3506	Milwaukee - C 0142	55079530000142
3471	Milwaukee - C 0107	55079530000107	3489	Milwaukee - C 0125	55079530000125	3507	Milwaukee - C 0143	55079530000143
3472	Milwaukee - C 0108	55079530000108	3490	Milwaukee - C 0126	55079530000126	3508	Milwaukee - C 0144	55079530000144
3473	Milwaukee - C 0109	55079530000109	3491	Milwaukee - C 0127	55079530000127	3509	Milwaukee - C 0145	55079530000145
3474	Milwaukee - C 0110	55079530000110	3492	Milwaukee - C 0128	55079530000128	3510	Milwaukee - C 0146	55079530000146

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3511	Milwaukee - C 0147	55079530000147	3529	Milwaukee - C 0165	55079530000165	3547	Milwaukee - C 0183	55079530000183
3512	Milwaukee - C 0148	55079530000148	3530	Milwaukee - C 0166	55079530000166	3548	Milwaukee - C 0184	55079530000184
3513	Milwaukee - C 0149	55079530000149	3531	Milwaukee - C 0167	55079530000167	3549	Milwaukee - C 0185	55079530000185
3514	Milwaukee - C 0150	55079530000150	3532	Milwaukee - C 0168	55079530000168	3550	Milwaukee - C 0186	55079530000186
3515	Milwaukee - C 0151	55079530000151	3533	Milwaukee - C 0169	55079530000169	3551	Milwaukee - C 0187	55079530000187
3516	Milwaukee - C 0152	55079530000152	3534	Milwaukee - C 0170	55079530000170	3552	Milwaukee - C 0188	55079530000188
3517	Milwaukee - C 0153	55079530000153	3535	Milwaukee - C 0171	55079530000171	3553	Milwaukee - C 0189	55079530000189
3518	Milwaukee - C 0154	55079530000154	3536	Milwaukee - C 0172	55079530000172	3554	Milwaukee - C 0190	55079530000190
3519	Milwaukee - C 0155	55079530000155	3537	Milwaukee - C 0173	55079530000173	3555	Milwaukee - C 0191	55079530000191
3520	Milwaukee - C 0156	55079530000156	3538	Milwaukee - C 0174	55079530000174	3556	Milwaukee - C 0192	55079530000192
3521	Milwaukee - C 0157	55079530000157	3539	Milwaukee - C 0175	55079530000175	3557	Milwaukee - C 0193	55079530000193
3522	Milwaukee - C 0158	55079530000158	3540	Milwaukee - C 0176	55079530000176	3558	Milwaukee - C 0194	55079530000194
3523	Milwaukee - C 0159	55079530000159	3541	Milwaukee - C 0177	55079530000177	3559	Milwaukee - C 0195	55079530000195
3524	Milwaukee - C 0160	55079530000160	3542	Milwaukee - C 0178	55079530000178	3560	Milwaukee - C 0196	55079530000196
3525	Milwaukee - C 0161	55079530000161	3543	Milwaukee - C 0179	55079530000179	3561	Milwaukee - C 0197	55079530000197
3526	Milwaukee - C 0162	55079530000162	3544	Milwaukee - C 0180	55079530000180	3562	Milwaukee - C 0198	55079530000198
3527	Milwaukee - C 0163	55079530000163	3545	Milwaukee - C 0181	55079530000181	3563	Milwaukee - C 0199	55079530000199
3528	Milwaukee - C 0164	55079530000164	3546	Milwaukee - C 0182	55079530000182	3564	Milwaukee - C 0200	55079530000200

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3565	Milwaukee - C 0201	55079530000201	3583	Milwaukee - C 0219	55079530000219	3601	Milwaukee - C 0237	55079530000237
3566	Milwaukee - C 0202	55079530000202	3584	Milwaukee - C 0220	55079530000220	3602	Milwaukee - C 0238	55079530000238
3567	Milwaukee - C 0203	55079530000203	3585	Milwaukee - C 0221	55079530000221	3603	Milwaukee - C 0239	55079530000239
3568	Milwaukee - C 0204	55079530000204	3586	Milwaukee - C 0222	55079530000222	3604	Milwaukee - C 0240	55079530000240
3569	Milwaukee - C 0205	55079530000205	3587	Milwaukee - C 0223	55079530000223	3605	Milwaukee - C 0241	55079530000241
3570	Milwaukee - C 0206	55079530000206	3588	Milwaukee - C 0224	55079530000224	3606	Milwaukee - C 0242	55079530000242
3571	Milwaukee - C 0207	55079530000207	3589	Milwaukee - C 0225	55079530000225	3607	Milwaukee - C 0243	55079530000243
3572	Milwaukee - C 0208	55079530000208	3590	Milwaukee - C 0226	55079530000226	3608	Milwaukee - C 0244	55079530000244
3573	Milwaukee - C 0209	55079530000209	3591	Milwaukee - C 0227	55079530000227	3609	Milwaukee - C 0245	55079530000245
3574	Milwaukee - C 0210	55079530000210	3592	Milwaukee - C 0228	55079530000228	3610	Milwaukee - C 0246	55079530000246
3575	Milwaukee - C 0211	55079530000211	3593	Milwaukee - C 0229	55079530000229	3611	Milwaukee - C 0247	55079530000247
3576	Milwaukee - C 0212	55079530000212	3594	Milwaukee - C 0230	55079530000230	3612	Milwaukee - C 0248	55079530000248
3577	Milwaukee - C 0213	55079530000213	3595	Milwaukee - C 0231	55079530000231	3613	Milwaukee - C 0249	55079530000249
3578	Milwaukee - C 0214	55079530000214	3596	Milwaukee - C 0232	55079530000232	3614	Milwaukee - C 0250	55079530000250
3579	Milwaukee - C 0215	55079530000215	3597	Milwaukee - C 0233	55079530000233	3615	Milwaukee - C 0251	55079530000251
3580	Milwaukee - C 0216	55079530000216	3598	Milwaukee - C 0234	55079530000234	3616	Milwaukee - C 0252	55079530000252
3581	Milwaukee - C 0217	55079530000217	3599	Milwaukee - C 0235	55079530000235	3617	Milwaukee - C 0253	55079530000253
3582	Milwaukee - C 0218	55079530000218	3600	Milwaukee - C 0236	55079530000236	3618	Milwaukee - C 0254	55079530000254

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3619	Milwaukee - C 0255	55079530000255	3637	Milwaukee - C 0273	55079530000273	3655	Milwaukee - C 0291	55079530000291
3620	Milwaukee - C 0256	55079530000256	3638	Milwaukee - C 0274	55079530000274	3656	Milwaukee - C 0292	55079530000292
3621	Milwaukee - C 0257	55079530000257	3639	Milwaukee - C 0275	55079530000275	3657	Milwaukee - C 0293	55079530000293
3622	Milwaukee - C 0258	55079530000258	3640	Milwaukee - C 0276	55079530000276	3658	Milwaukee - C 0294	55079530000294
3623	Milwaukee - C 0259	55079530000259	3641	Milwaukee - C 0277	55079530000277	3659	Milwaukee - C 0295	55079530000295
3624	Milwaukee - C 0260	55079530000260	3642	Milwaukee - C 0278	55079530000278	3660	Milwaukee - C 0296	55079530000296
3625	Milwaukee - C 0261	55079530000261	3643	Milwaukee - C 0279	55079530000279	3661	Milwaukee - C 0297	55079530000297
3626	Milwaukee - C 0262	55079530000262	3644	Milwaukee - C 0280	55079530000280	3662	Milwaukee - C 0298	55079530000298
3627	Milwaukee - C 0263	55079530000263	3645	Milwaukee - C 0281	55079530000281	3663	Milwaukee - C 0299	55079530000299
3628	Milwaukee - C 0264	55079530000264	3646	Milwaukee - C 0282	55079530000282	3664	Milwaukee - C 0300	55079530000300
3629	Milwaukee - C 0265	55079530000265	3647	Milwaukee - C 0283	55079530000283	3665	Milwaukee - C 0301	55079530000301
3630	Milwaukee - C 0266	55079530000266	3648	Milwaukee - C 0284	55079530000284	3666	Milwaukee - C 0302	55079530000302
3631	Milwaukee - C 0267	55079530000267	3649	Milwaukee - C 0285	55079530000285	3667	Milwaukee - C 0303	55079530000303
3632	Milwaukee - C 0268	55079530000268	3650	Milwaukee - C 0286	55079530000286	3668	Milwaukee - C 0304	55079530000304
3633	Milwaukee - C 0269	55079530000269	3651	Milwaukee - C 0287	55079530000287	3669	Milwaukee - C 0305	55079530000305
3634	Milwaukee - C 0270	55079530000270	3652	Milwaukee - C 0288	55079530000288	3670	Milwaukee - C 0306	55079530000306
3635	Milwaukee - C 0271	55079530000271	3653	Milwaukee - C 0289	55079530000289	3671	Milwaukee - C 0307	55079530000307
3636	Milwaukee - C 0272	55079530000272	3654	Milwaukee - C 0290	55079530000290	3672	Milwaukee - C 0308	55079530000308

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3673	Milwaukee - C 0309	55079530000309	3691	Oak Creek - C 0002	55079588000002	3709	River Hills - V 0001	55079683250001
3674	Milwaukee - C 0310	55079530000310	3692	Oak Creek - C 0003	55079588000003	3710	River Hills - V 0002	55079683250002
3675	Milwaukee - C 0311	55079530000311	3693	Oak Creek - C 0004	55079588000004	3711	River Hills - V 0003	55079683250003
3676	Milwaukee - C 0312	55079530000312	3694	Oak Creek - C 0005	55079588000005	3712	St. Francis - C 0001	55079706500001
3677	Milwaukee - C 0313	55079530000313	3695	Oak Creek - C 0006	55079588000006	3713	St. Francis - C 0002	55079706500002
3678	Milwaukee - C 0314	55079530000314	3696	Oak Creek - C 0007	55079588000007	3714	St. Francis - C 0003	55079706500003
3679	Milwaukee - C 0315	55079530000315	3697	Oak Creek - C 0008	55079588000008	3715	St. Francis - C 0004	55079706500004
3680	Milwaukee - C 0316	55079530000316	3698	Oak Creek - C 0009	55079588000009	3716	St. Francis - C 0005	55079706500005
3681	Milwaukee - C 0317	55079530000317	3699	Oak Creek - C 0010	55079588000010	3717	St. Francis - C 0006	55079706500006
3682	Milwaukee - C 0320	55079530000320	3700	Oak Creek - C 0011	55079588000011	3718	St. Francis - C 0007	55079706500007
3683	Milwaukee - C 0321	55079530000321	3701	Oak Creek - C 0012	55079588000012	3719	St. Francis - C 0008	55079706500008
3684	Milwaukee - C 0322	55079530000322	3702	Oak Creek - C 0013	55079588000013	3720	St. Francis - C 0009	55079706500009
3685	Milwaukee - C 0323	55079530000323	3703	Oak Creek - C 0014	55079588000014	3721	St. Francis - C 0010	55079706500010
3686	Milwaukee - C 0324	55079530000324	3704	Oak Creek - C 0015	55079588000015	3722	St. Francis - C 0011	55079706500011
3687	Milwaukee - C 0325	55079530000325	3705	Oak Creek - C 0016	55079588000016	3723	St. Francis - C 0012	55079706500012
3688	Milwaukee - C 0326	55079530000326	3706	Oak Creek - C 0017	55079588000017	3724	Shorewood - V 0001	55079737250001
3689	Milwaukee - C 0327	55079530000327	3707	Oak Creek - C 0018	55079588000018	3725	Shorewood - V 0002	55079737250002
3690	Oak Creek - C 0001	55079588000001	3708	Oak Creek - C 0019	55079588000019	3726	Shorewood - V 0003	55079737250003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3727	Shorewood - V 0004	55079737250004	3745	South Milwaukee - C 0010	55079751250010	3763	Wauwatosa - C 0012	55079846750012
3728	Shorewood - V 0005	55079737250005	3746	South Milwaukee - C 0011	55079751250011	3764	Wauwatosa - C 0013	55079846750013
3729	Shorewood - V 0006	55079737250006	3747	South Milwaukee - C 0012	55079751250012	3765	Wauwatosa - C 0014	55079846750014
3730	Shorewood - V 0007	55079737250007	3748	South Milwaukee - C 0013	55079751250013	3766	Wauwatosa - C 0015	55079846750015
3731	Shorewood - V 0008	55079737250008	3749	South Milwaukee - C 0014	55079751250014	3767	Wauwatosa - C 0016	55079846750016
3732	Shorewood - V 0009	55079737250009	3750	South Milwaukee - C 0015	55079751250015	3768	Wauwatosa - C 0017	55079846750017
3733	Shorewood - V 0010	55079737250010	3751	South Milwaukee - C 0016	55079751250016	3769	Wauwatosa - C 0018	55079846750018
3734	Shorewood - V 0011	55079737250011	3752	Wauwatosa - C 0001	55079846750001	3770	Wauwatosa - C 0019	55079846750019
3735	Shorewood - V 0012	55079737250012	3753	Wauwatosa - C 0002	55079846750002	3771	Wauwatosa - C 0020	55079846750020
3736	South Milwaukee - C 0001	55079751250001	3754	Wauwatosa - C 0003	55079846750003	3772	Wauwatosa - C 0021	55079846750021
3737	South Milwaukee - C 0002	55079751250002	3755	Wauwatosa - C 0004	55079846750004	3773	Wauwatosa - C 0022	55079846750022
3738	South Milwaukee - C 0003	55079751250003	3756	Wauwatosa - C 0005	55079846750005	3774	Wauwatosa - C 0023	55079846750023
3739	South Milwaukee - C 0004	55079751250004	3757	Wauwatosa - C 0006	55079846750006	3775	Wauwatosa - C 0024	55079846750024
3740	South Milwaukee - C 0005	55079751250005	3758	Wauwatosa - C 0007	55079846750007	3776	West Allis - C 0001	55079853000001
3741	South Milwaukee - C 0006	55079751250006	3759	Wauwatosa - C 0008	55079846750008	3777	West Allis - C 0002	55079853000002
3742	South Milwaukee - C 0007	55079751250007	3760	Wauwatosa - C 0009	55079846750009	3778	West Allis - C 0003	55079853000003
3743	South Milwaukee - C 0008	55079751250008	3761	Wauwatosa - C 0010	55079846750010	3779	West Allis - C 0004	55079853000004
3744	South Milwaukee - C 0009	55079751250009	3762	Wauwatosa - C 0011	55079846750011	3780	West Allis - C 0005	55079853000005

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3781	West Allis - C 0006	55079853000006	3799	West Allis - C 0024	55079853000024	3817	Whitefish Bay - V 0011	55079867000011
3782	West Allis - C 0007	55079853000007	3800	West Allis - C 0025	55079853000025	3818	Whitefish Bay - V 0012	55079867000012
3783	West Allis - C 0008	55079853000008	3801	West Milwaukee - V 0001	55079858750001	3819	ADRIAN - T 0001	55081004750001
3784	West Allis - C 0009	55079853000009	3802	West Milwaukee - V 0002	55079858750002	3820	ANGELO - T 0001	55081020250001
3785	West Allis - C 0010	55079853000010	3803	West Milwaukee - V 0003	55079858750003	3821	ANGELO - T 0002	55081020250002
3786	West Allis - C 0011	55079853000011	3804	West Milwaukee - V 0004	55079858750004	3822	ANGELO - T 0003	55081020250003
3787	West Allis - C 0012	55079853000012	3805	West Milwaukee - V 0005	55079858750005	3823	BYRON - T 0001	55081116250001
3788	West Allis - C 0013	55079853000013	3806	West Milwaukee - V 0006	55079858750006	3824	Cashton - V 0001	55081129500001
3789	West Allis - C 0014	55079853000014	3807	Whitefish Bay - V 0001	55079867000001	3825	Cashton - V 0002	55081129500002
3790	West Allis - C 0015	55079853000015	3808	Whitefish Bay - V 0002	55079867000002	3826	Cashton - V 0003	55081129500003
3791	West Allis - C 0016	55079853000016	3809	Whitefish Bay - V 0003	55079867000003	3827	CLIFTON - T 0001	55081155500001
3792	West Allis - C 0017	55079853000017	3810	Whitefish Bay - V 0004	55079867000004	3828	GLENDALE - T 0001	55081294500001
3793	West Allis - C 0018	55079853000018	3811	Whitefish Bay - V 0005	55079867000005	3829	GRANT - T 0001	55081303250001
3794	West Allis - C 0019	55079853000019	3812	Whitefish Bay - V 0006	55079867000006	3830	GREENFIELD - T 0001	55081312250001
3795	West Allis - C 0020	55079853000020	3813	Whitefish Bay - V 0007	55079867000007	3831	GREENFIELD - T 0002	55081312250002
3796	West Allis - C 0021	55079853000021	3814	Whitefish Bay - V 0008	55079867000008	3832	JEFFERSON - T 0001	55081379500001
3797	West Allis - C 0022	55079853000022	3815	Whitefish Bay - V 0009	55079867000009	3833	Kendall - V 0001	55081391500001
3798	West Allis - C 0023	55079853000023	3816	Whitefish Bay - V 0010	55079867000010	3834	LAFAYETTE - T 0001	55081409250001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3835	LAFAYETTE - T 0002	55081409250002	3853	PORTLAND - T 0001	55081644250001	3871	Sparta - C 0014	55081753250014
3836	LA GRANGE - T 001a	5508141000001a	3854	RIDGEVILLE - T 0001	55081678500001	3872	Sparta - C 0015	55081753250015
3837	LA GRANGE - T 001b	5508141000001b	3855	Rockland - V 0002	55081689000002	3873	Sparta - C 0016	55081753250016
3838	LA GRANGE - T 002a	5508141000002a	3856	SCOTT - T 0001	55081723250001	3874	Sparta - C 0017	55081753250017
3839	LA GRANGE - T 002b	5508141000002b	3857	SHELDON - T 0001	55081731500001	3875	Sparta - C 0018	55081753250018
3840	LA GRANGE - T 003a	5508141000003a	3858	Sparta - C 0001	55081753250001	3876	Sparta - C 0019	55081753250019
3841	LA GRANGE - T 003b	5508141000003b	3859	Sparta - C 0002	55081753250002	3877	Sparta - C 0020	55081753250020
3842	LEON - T 0001	55081434750001	3860	Sparta - C 0003	55081753250003	3878	Sparta - C 0021	55081753250021
3843	LEON - T 0002	55081434750002	3861	Sparta - C 0004	55081753250004	3879	SPARTA - T 0001	55081753500001
3844	LINCOLN - T 0001	55081444500001	3862	Sparta - C 0005	55081753250005	3880	SPARTA - T 0002	55081753500002
3845	LITTLE FALLS - T 0001	55081449750001	3863	Sparta - C 0006	55081753250006	3881	SPARTA - T 0003	55081753500003
3846	LITTLE FALLS - T 0002	55081449750002	3864	Sparta - C 0007	55081753250007	3882	SPARTA - T 0004	55081753500004
3847	Melvina - V 0001	55081508000001	3865	Sparta - C 0008	55081753250008	3883	SPARTA - T 0005	55081753500005
3848	NEW LYME - T 0001	55081569500001	3866	Sparta - C 0009	55081753250009	3884	SPARTA - T 0006	55081753500006
3849	Norwalk - V 0001	55081585750001	3867	Sparta - C 0010	55081753250010	3885	Tomah - C 0001	55081800750001
3850	Oakdale - V 0001	55081588500001	3868	Sparta - C 0011	55081753250011	3886	Tomah - C 0002	55081800750002
3851	OAKDALE - T 0001	55081588750001	3869	Sparta - C 0012	55081753250012	3887	Tomah - C 0003	55081800750003
3852	Ontario - V 0002	55081600750002	3870	Sparta - C 0013	55081753250013	3888	Tomah - C 0004	55081800750004

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3889	Tomah - C 0006	55081800750006	3907	Tomah - C 005a	5508180075005a	3925	BAGLEY - T 0001	55083042750001
3890	Tomah - C 0007	55081800750007	3908	Tomah - C 005b	5508180075005b	3926	BRAZEAU - T 0001	55083093750001
3891	Tomah - C 0008	55081800750008	3909	TOMAH - T 0001	55081801000001	3927	BRAZEAU - T 0002	55083093750002
3892	Tomah - C 0009	55081800750009	3910	TOMAH - T 0002	55081801000002	3928	BRAZEAU - T 0003	55083093750003
3893	Tomah - C 0010	55081800750010	3911	Warrens - V 0001	55081834500001	3929	BREED - T 0001	55083094250001
3894	Tomah - C 0011	55081800750011	3912	WELLINGTON - T 0001	55081851250001	3930	CHASE - T 0001	55083141250001
3895	Tomah - C 0012	55081800750012	3913	WELLINGTON - T 0002	55081851250002	3931	CHASE - T 0002	55083141250002
3896	Tomah - C 0013	55081800750013	3914	WELLS - T 0001	55081851500001	3932	CHASE - T 0003	55083141250003
3897	Tomah - C 0014	55081800750014	3915	Wilton - V 0001	55081875250001	3933	CHASE - T 0004	55083141250004
3898	Tomah - C 0015	55081800750015	3916	WILTON - T 0001	55081875500001	3934	CHASE - T 0005	55083141250005
3899	Tomah - C 0016	55081800750016	3917	WILTON - T 0002	55081875500002	3935	DOTY - T 0001	55083204750001
3900	Tomah - C 0017	55081800750017	3918	WILTON - T 0003	55081875500003	3936	Gillett - C 0001	55083290500001
3901	Tomah - C 0018	55081800750018	3919	WILTON - T 0004	55081875500004	3937	Gillett - C 0002	55083290500002
3902	Tomah - C 0019	55081800750019	3920	WILTON - T 0005	55081875500005	3938	Gillett - C 0003	55083290500003
3903	Tomah - C 0020	55081800750020	3921	Wyeville - V 0001	55081892750001	3939	GILLETT - T 0001	55083290750001
3904	Tomah - C 0021	55081800750021	3922	ABRAMS - T 0001	55083001750001	3940	GILLETT - T 0002	55083290750002
3905	Tomah - C 0022	55081800750022	3923	ABRAMS - T 0002	55083001750002	3941	HOW - T 0001	55083359250001
3906	Tomah - C 0023	55081800750023	3924	ABRAMS - T 0003	55083001750003	3942	HOW - T 0002	55083359250002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3943	LAKEWOOD - T 0001	55083420750001	3961	Oconto - C 0002	55083593500002	3979	PENSAUKEE - T 0002	55083619000002
3944	Lena - V 0001	55083433250001	3962	Oconto - C 0003	55083593500003	3980	Pulaski - V 0005	55083656750005
3945	LENA - T 0001	55083433500001	3963	Oconto - C 0004	55083593500004	3981	RIVERVIEW - T 0001	55083684000001
3946	LITTLE RIVER - T 0001	55083451750001	3964	Oconto - C 0005	55083593500005	3982	RIVERVIEW - T 0002	55083684000002
3947	LITTLE RIVER - T 0002	55083451750002	3965	Oconto - C 0006	55083593500006	3983	SPRUCE - T 0001	55083764500001
3948	LITTLE SUAMICO - T 0001	55083452750001	3966	Oconto - C 0007	55083593500007	3984	SPRUCE - T 0002	55083764500002
3949	LITTLE SUAMICO - T 0002	55083452750002	3967	OCONTO - T 0001	55083593750001	3985	STILES - T 0001	55083773000001
3950	LITTLE SUAMICO - T 0003	55083452750003	3968	OCONTO - T 0002	55083593750002	3986	STILES - T 0002	55083773000002
3951	LITTLE SUAMICO - T 0004	55083452750004	3969	OCONTO - T 0003	55083593750003	3987	Suring - V 0001	55083787250001
3952	LITTLE SUAMICO - T 0005	55083452750005	3970	Oconto Falls - C 0001	55083594000001	3988	TOWNSEND - T 0001	55083803250001
3953	LITTLE SUAMICO - T 0006	55083452750006	3971	Oconto Falls - C 0002	55083594000002	3989	UNDERHILL - T 0001	55083814750001
3954	LITTLE SUAMICO - T 0007	55083452750007	3972	Oconto Falls - C 0003	55083594000003	3990	CASSIAN - T 0001	55085130250001
3955	LITTLE SUAMICO - T 0008	55083452750008	3973	Oconto Falls - C 0004	55083594000004	3991	CASSIAN - T 0002	55085130250002
3956	MAPLE VALLEY - T 0001	55083490000001	3974	Oconto Falls - C 0005	55083594000005	3992	CRESCENT - T 0001	55085176250001
3957	MORGAN - T 0001	55083542000001	3975	Oconto Falls - C 0006	55083594000006	3993	CRESCENT - T 0002	55085176250002
3958	MORGAN - T 0002	55083542000002	3976	OCONTO FALLS - T 0001	55083594250001	3994	CRESCENT - T 0003	55085176250003
3959	MOUNTAIN - T 0001	55083546300001	3977	OCONTO FALLS - T 0002	55083594250002	3995	ENTERPRISE - T 0001	55085241250001
3960	Oconto - C 0001	55083593500001	3978	PENSAUKEE - T 0001	55083619000001	3996	HAZELHURST - T 0001	55085335750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
3997	HAZELHURST - T 0002	55085335750002	4015	NOKOMIS - T 0002	55085574500002	4033	Rhinelander - C 0009	55085672000009
3998	LAKE TOMAHAWK - T 0001	55085418870001	4016	PELICAN - T 0001	55085616250001	4034	Rhinelander - C 0010	55085672000010
3999	LAKE TOMAHAWK - T 0002	55085418870002	4017	PELICAN - T 0002	55085616250002	4035	Rhinelander - C 0011	55085672000011
4000	LITTLE RICE - T 0001	55085451500001	4018	PELICAN - T 0003	55085616250003	4036	Rhinelander - C 0012	55085672000012
4001	LYNNE - T 0001	55085466500001	4019	PELICAN - T 0004	55085616250004	4037	Rhinelander - C 0013	55085672000013
4002	MINOCQUA - T 0001	55085532250001	4020	PIEHL - T 0001	55085626000001	4038	Rhinelander - C 0014	55085672000014
4003	MINOCQUA - T 0002	55085532250002	4021	PINE LAKE - T 0001	55085629250001	4039	SCHOEPKE - T 0001	55085721250001
4004	MINOCQUA - T 0003	55085532250003	4022	PINE LAKE - T 0002	55085629250002	4040	STELLA - T 0001	55085769750001
4005	MINOCQUA - T 0004	55085532250004	4023	PINE LAKE - T 0003	55085629250003	4041	STELLA - T 0002	55085769750002
4006	MINOCQUA - T 0005	55085532250005	4024	PINE LAKE - T 0004	55085629250004	4042	SUGAR CAMP - T 0001	55085780750001
4007	MINOCQUA - T 0006	55085532250006	4025	Rhinelander - C 0001	55085672000001	4043	SUGAR CAMP - T 0002	55085780750002
4008	MINOCQUA - T 0007	55085532250007	4026	Rhinelander - C 0002	55085672000002	4044	THREE LAKES - T 0001	55085797000001
4009	MONICO - T 0001	55085536620001	4027	Rhinelander - C 0003	55085672000003	4045	THREE LAKES - T 0002	55085797000002
4010	NEWBOLD - T 0001	55085564250001	4028	Rhinelander - C 0004	55085672000004	4046	THREE LAKES - T 0003	55085797000003
4011	NEWBOLD - T 0002	55085564250002	4029	Rhinelander - C 0005	55085672000005	4047	THREE LAKES - T 0004	55085797000004
4012	NEWBOLD - T 0003	55085564250003	4030	Rhinelander - C 0006	55085672000006	4048	WOODBORO - T 0001	55085886250001
4013	NEWBOLD - T 0004	55085564250004	4031	Rhinelander - C 0007	55085672000007	4049	WOODRUFF - T 0001	55085889500001
4014	NOKOMIS - T 0001	55085574500001	4032	Rhinelander - C 0008	55085672000008	4050	WOODRUFF - T 0002	55085889500002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4051	WOODRUFF - T 0003	55085889500003	4069	Appleton - C 0021	55087023750021	4087	Appleton - C 0042	55087023750042
4052	Appleton - C 0001	55087023750001	4070	Appleton - C 0022	55087023750022	4088	Appleton - C 0043	55087023750043
4053	Appleton - C 0002	55087023750002	4071	Appleton - C 0023	55087023750023	4089	Appleton - C 0048	55087023750048
4054	Appleton - C 0003	55087023750003	4072	Appleton - C 0024	55087023750024	4090	Appleton - C 0049	55087023750049
4055	Appleton - C 0004	55087023750004	4073	Appleton - C 0025	55087023750025	4091	Appleton - C 0050	55087023750050
4056	Appleton - C 0005	55087023750005	4074	Appleton - C 0027	55087023750027	4092	Appleton - C 0051	55087023750051
4057	Appleton - C 0006	55087023750006	4075	Appleton - C 0028	55087023750028	4093	Appleton - C 0052	55087023750052
4058	Appleton - C 0007	55087023750007	4076	Appleton - C 0029	55087023750029	4094	Appleton - C 0053	55087023750053
4059	Appleton - C 0008	55087023750008	4077	Appleton - C 0030	55087023750030	4095	Appleton - C 0054	55087023750054
4060	Appleton - C 0009	55087023750009	4078	Appleton - C 0033	55087023750033	4096	Appleton - C 0055	55087023750055
4061	Appleton - C 0010	55087023750010	4079	Appleton - C 0034	55087023750034	4097	Appleton - C 0056	55087023750056
4062	Appleton - C 0011	55087023750011	4080	Appleton - C 0035	55087023750035	4098	Appleton - C 0057	55087023750057
4063	Appleton - C 0015	55087023750015	4081	Appleton - C 0036	55087023750036	4099	Appleton - C 0058	55087023750058
4064	Appleton - C 0016	55087023750016	4082	Appleton - C 0037	55087023750037	4100	Appleton - C 0059	55087023750059
4065	Appleton - C 0017	55087023750017	4083	Appleton - C 0038	55087023750038	4101	Bear Creek - V 0001	55087055750001
4066	Appleton - C 0018	55087023750018	4084	Appleton - C 0039	55087023750039	4102	Black Creek - V 0001	55087077250001
4067	Appleton - C 0019	55087023750019	4085	Appleton - C 0040	55087023750040	4103	Black Creek - V 0002	55087077250002
4068	Appleton - C 0020	55087023750020	4086	Appleton - C 0041	55087023750041	4104	BLACK CREEK - T 0001	55087077500001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4105	BLACK CREEK - T 0002	55087077500002	4123	CENTER - T 0006	55087136000006	4141	ELLINGTON - T 0005	55087234250005
4106	BOVINA - T 0001	55087089750001	4124	CENTER - T 0007	55087136000007	4142	FREEDOM - T 0001	55087276500001
4107	BOVINA - T 0002	55087089750002	4125	CICERO - T 0001	55087147500001	4143	FREEDOM - T 0002	55087276500002
4108	BUCHANAN - T 0001	55087107500001	4126	CICERO - T 0002	55087147500002	4144	FREEDOM - T 0003	55087276500003
4109	BUCHANAN - T 0002	55087107500002	4127	Combined Locks - V 0001	55087165000001	4145	FREEDOM - T 0004	55087276500004
4110	BUCHANAN - T 0003	55087107500003	4128	Combined Locks - V 0002	55087165000002	4146	FREEDOM - T 0005	55087276500005
4111	BUCHANAN - T 0004	55087107500004	4129	Combined Locks - V 0003	55087165000003	4147	FREEDOM - T 0006	55087276500006
4112	BUCHANAN - T 0005	55087107500005	4130	Combined Locks - V 0004	55087165000004	4148	FREEDOM - T 0007	55087276500007
4113	BUCHANAN - T 0006	55087107500006	4131	Combined Locks - V 0005	55087165000005	4149	FREEDOM - T 0008	55087276500008
4114	BUCHANAN - T 0007	55087107500007	4132	Combined Locks - V 0006	55087165000006	4150	GRAND CHUTE - T 0001	55087300750001
4115	BUCHANAN - T 0008	55087107500008	4133	DALE - T 0001	55087185250001	4151	GRAND CHUTE - T 0002	55087300750002
4116	BUCHANAN - T 0009	55087107500009	4134	DALE - T 0002	55087185250002	4152	GRAND CHUTE - T 0003	55087300750003
4117	BUCHANAN - T 0010	55087107500010	4135	DALE - T 0003	55087185250003	4153	GRAND CHUTE - T 0004	55087300750004
4118	CENTER - T 0001	55087136000001	4136	DEER CREEK - T 0001	55087192000001	4154	GRAND CHUTE - T 0005	55087300750005
4119	CENTER - T 0002	55087136000002	4137	ELLINGTON - T 0001	55087234250001	4155	GRAND CHUTE - T 0006	55087300750006
4120	CENTER - T 0003	55087136000003	4138	ELLINGTON - T 0002	55087234250002	4156	GRAND CHUTE - T 0007	55087300750007
4121	CENTER - T 0004	55087136000004	4139	ELLINGTON - T 0003	55087234250003	4157	GRAND CHUTE - T 0008	55087300750008
4122	CENTER - T 0005	55087136000005	4140	ELLINGTON - T 0004	55087234250004	4158	GRAND CHUTE - T 0009	55087300750009

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4159	GRAND CHUTE - T 0010	55087300750010	4177	Harrison - V 0001	55087327900001	4195	Kaukauna - C 0012	55087388000012
4160	GRAND CHUTE - T 0011	55087300750011	4178	Harrison - V 0002	55087327900002	4196	Kaukauna - C 0013	55087388000013
4161	GRAND CHUTE - T 0012	55087300750012	4179	HORTONIA - T 0001	55087358250001	4197	Kaukauna - C 0014	55087388000014
4162	GRAND CHUTE - T 0013	55087300750013	4180	HORTONIA - T 0002	55087358250002	4198	KAUKAUNA - T 0001	55087388250001
4163	GRAND CHUTE - T 0014	55087300750014	4181	Hortonville - V 0001	55087358500001	4199	KAUKAUNA - T 0002	55087388250002
4164	GRAND CHUTE - T 0015	55087300750015	4182	Hortonville - V 0002	55087358500002	4200	KAUKAUNA - T 0003	55087388250003
4165	GRAND CHUTE - T 0016	55087300750016	4183	Hortonville - V 0003	55087358500003	4201	Kimberly - V 0001	55087396500001
4166	GRAND CHUTE - T 0017	55087300750017	4184	Howard - V 0017	55087359500017	4202	Kimberly - V 0002	55087396500002
4167	GRAND CHUTE - T 0018	55087300750018	4185	Kaukauna - C 0001	55087388000001	4203	Kimberly - V 0003	55087396500003
4168	GREENVILLE - T 0001	55087315500001	4186	Kaukauna - C 0002	55087388000002	4204	Kimberly - V 0004	55087396500004
4169	GREENVILLE - T 0002	55087315500002	4187	Kaukauna - C 0003	55087388000003	4205	Kimberly - V 0005	55087396500005
4170	GREENVILLE - T 0003	55087315500003	4188	Kaukauna - C 0004	55087388000004	4206	Kimberly - V 0006	55087396500006
4171	GREENVILLE - T 0004	55087315500004	4189	Kaukauna - C 0005	55087388000005	4207	Kimberly - V 0007	55087396500007
4172	GREENVILLE - T 0005	55087315500005	4190	Kaukauna - C 0006	55087388000006	4208	Kimberly - V 0008	55087396500008
4173	GREENVILLE - T 0006	55087315500006	4191	Kaukauna - C 0007	55087388000007	4209	Kimberly - V 0009	55087396500009
4174	GREENVILLE - T 0007	55087315500007	4192	Kaukauna - C 0008	55087388000008	4210	LIBERTY - T 0001	55087438750001
4175	GREENVILLE - T 0008	55087315500008	4193	Kaukauna - C 0009	55087388000009	4211	Little Chute - V 0001	55087449500001
4176	GREENVILLE - T 0009	55087315500009	4194	Kaukauna - C 0010	55087388000010	4212	Little Chute - V 0002	55087449500002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4213	Little Chute - V 0003	55087449500003	4231	ONEIDA - T 0001	55087600000001	4249	VANDENBROEK - T 0002	55087824000002
4214	Little Chute - V 0004	55087449500004	4232	ONEIDA - T 0002	55087600000002	4250	VANDENBROEK - T 0003	55087824000003
4215	Little Chute - V 0005	55087449500005	4233	ONEIDA - T 0003	55087600000003	4251	Wrightstown - V 0004	55087891500004
4216	Little Chute - V 0006	55087449500006	4234	ONEIDA - T 0004	55087600000004	4252	Wrightstown - V 0005	55087891500005
4217	Little Chute - V 0007	55087449500007	4235	ONEIDA - T 0005	55087600000005	4253	Bayside - V 0006	55089054500006
4218	Little Chute - V 0008	55087449500008	4236	ONEIDA - T 0006	55087600000006	4254	Belgium - V 0001	55089061500001
4219	Little Chute - V 0009	55087449500009	4237	OSBORN - T 0001	55087604000001	4255	Belgium - V 0002	55089061500002
4220	Little Chute - V 0010	55087449500010	4238	OSBORN - T 0002	55087604000002	4256	Belgium - V 0003	55089061500003
4221	Little Chute - V 0011	55087449500011	4239	Seymour - C 0001	55087727250001	4257	BELGIUM - T 0001	55089061750001
4222	Little Chute - V 0012	55087449500012	4240	Seymour - C 0002	55087727250002	4258	BELGIUM - T 0002	55089061750002
4223	Little Chute - V 0013	55087449500013	4241	Seymour - C 0003	55087727250003	4259	BELGIUM - T 0003	55089061750003
4224	Little Chute - V 0014	55087449500014	4242	Seymour - C 0004	55087727250004	4260	Cedarburg - C 0001	55089133750001
4225	Little Chute - V 0015	55087449500015	4243	Seymour - C 0005	55087727250005	4261	Cedarburg - C 0002	55089133750002
4226	MAINE - T 0001	55087482500001	4244	Seymour - C 0006	55087727250006	4262	Cedarburg - C 0003	55089133750003
4227	MAPLE CREEK - T 0001	55087487750001	4245	SEYMOUR - T 0001	55087727500001	4263	Cedarburg - C 0004	55089133750004
4228	New London - C 0001	55087569250001	4246	SEYMOUR - T 0002	55087727500002	4264	Cedarburg - C 0005	55089133750005
4229	New London - C 0002	55087569250002	4247	Shiocton - V 0001	55087736250001	4265	Cedarburg - C 0006	55089133750006
4230	Nichols - V 0001	55087573750001	4248	VANDENBROEK - T 0001	55087824000001	4266	Cedarburg - C 0007	55089133750007

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4267	Cedarburg - C 0008	55089133750008	4285	FREDONIA - T 0004	55089275750004	4303	GRAFTON - T 0004	55089300250004
4268	Cedarburg - C 0009	55089133750009	4286	Grafton - V 0001	55089300000001	4304	GRAFTON - T 0005	55089300250005
4269	CEDARBURG - T 0001	55089134000001	4287	Grafton - V 0002	55089300000002	4305	Mequon - C 0001	55089511500001
4270	CEDARBURG - T 0002	55089134000002	4288	Grafton - V 0003	55089300000003	4306	Mequon - C 0002	55089511500002
4271	CEDARBURG - T 0003	55089134000003	4289	Grafton - V 0004	55089300000004	4307	Mequon - C 0003	55089511500003
4272	CEDARBURG - T 0004	55089134000004	4290	Grafton - V 0005	55089300000005	4308	Mequon - C 0004	55089511500004
4273	CEDARBURG - T 0005	55089134000005	4291	Grafton - V 0006	55089300000006	4309	Mequon - C 0005	55089511500005
4274	CEDARBURG - T 0006	55089134000006	4292	Grafton - V 0007	55089300000007	4310	Mequon - C 0006	55089511500006
4275	CEDARBURG - T 0007	55089134000007	4293	Grafton - V 0008	55089300000008	4311	Mequon - C 0008	55089511500008
4276	CEDARBURG - T 0008	55089134000008	4294	Grafton - V 0009	55089300000009	4312	Mequon - C 0009	55089511500009
4277	CEDARBURG - T 0009	55089134000009	4295	Grafton - V 0010	55089300000010	4313	Mequon - C 0010	55089511500010
4278	CEDARBURG - T 0010	55089134000010	4296	Grafton - V 0011	55089300000011	4314	Mequon - C 0011	55089511500011
4279	Fredonia - V 0001	55089275500001	4297	Grafton - V 0012	55089300000012	4315	Mequon - C 0012	55089511500012
4280	Fredonia - V 0002	55089275500002	4298	Grafton - V 0013	55089300000013	4316	Mequon - C 0013	55089511500013
4281	Fredonia - V 0003	55089275500003	4299	Grafton - V 0014	55089300000014	4317	Mequon - C 0014	55089511500014
4282	FREDONIA - T 0001	55089275750001	4300	GRAFTON - T 0001	55089300250001	4318	Mequon - C 0015	55089511500015
4283	FREDONIA - T 0002	55089275750002	4301	GRAFTON - T 0002	55089300250002	4319	Mequon - C 0016	55089511500016
4284	FREDONIA - T 0003	55089275750003	4302	GRAFTON - T 0003	55089300250003	4320	Mequon - C 0017	55089511500017

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4321	Mequon - C 0018	55089511500018	4339	Saukville - V 0003	55089717000003	4357	FRANKFORT - T 0001	55091271750001
4322	Mequon - C 0019	55089511500019	4340	Saukville - V 0004	55089717000004	4358	LIMA - T 0001	55091440750001
4323	Mequon - C 0020	55089511500020	4341	Saukville - V 0005	55089717000005	4359	LIMA - T 0002	55091440750002
4324	Mequon - C 0021	55089511500021	4342	Saukville - V 0006	55089717000006	4360	Pepin - V 0001	55091619250001
4325	Mequon - C 007A	5508951150007A	4343	Saukville - V 0007	55089717000007	4361	Pepin - V 0002	55091619250002
4326	Mequon - C 007B	5508951150007B	4344	SAUKVILLE - T 0001	55089717250001	4362	PEPIN - T 0001	55091619500001
4327	Newburg - V 0003	55089564500003	4345	SAUKVILLE - T 0002	55089717250002	4363	PEPIN - T 0002	55091619500002
4328	Port Washington - C 0001	55089644500001	4346	SAUKVILLE - T 0003	55089717250003	4364	Stockholm - V 0001	55091774750001
4329	Port Washington - C 0002	55089644500002	4347	Thiensville - V 0001	55089794750001	4365	STOCKHOLM - T 0001	55091775000001
4330	Port Washington - C 0003	55089644500003	4348	Thiensville - V 0002	55089794750002	4366	WATERVILLE - T 0001	55091840250001
4331	Port Washington - C 0004	55089644500004	4349	Thiensville - V 0003	55089794750003	4367	WATERVILLE - T 0002	55091840250002
4332	Port Washington - C 0005	55089644500005	4350	Thiensville - V 0004	55089794750004	4368	WAUBEEK - T 0001	55091841000001
4333	Port Washington - C 0006	55089644500006	4351	ALBANY - T 0001	55091008000001	4369	Bay City - V 0001	55093053250001
4334	Port Washington - C 0007	55089644500007	4352	Durand - C 0001	55091212250001	4370	CLIFTON - T 0001	55093155750001
4335	PORT WASHINGTON - T 0001	55089644750001	4353	Durand - C 0002	55091212250002	4371	CLIFTON - T 0002	55093155750002
4336	PORT WASHINGTON - T 0002	55089644750002	4354	Durand - C 0003	55091212250003	4372	CLIFTON - T 0003	55093155750003
4337	Saukville - V 0001	55089717000001	4355	DURAND - T 0001	55091212500001	4373	DIAMOND BLUFF - T 0001	55093201500001
4338	Saukville - V 0002	55089717000002	4356	DURAND - T 0002	55091212500002	4374	Ellsworth - V 0001	55093235250001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4375	Ellsworth - V 0002	55093235250002	4393	Prescott - C 0001	55093653750001	4411	RIVER FALLS - T 0003	55093683000003
4376	Ellsworth - V 0003	55093235250003	4394	Prescott - C 0002	55093653750002	4412	ROCK ELM - T 0001	55093687750001
4377	Ellsworth - V 0004	55093235250004	4395	Prescott - C 0003	55093653750003	4413	SALEM - T 0001	55093711500001
4378	ELLSWORTH - T 0001	55093235500001	4396	Prescott - C 0004	55093653750004	4414	SPRING LAKE - T 0001	55093761000001
4379	ELLSWORTH - T 0002	55093235500002	4397	Prescott - C 0005	55093653750005	4415	SPRING LAKE - T 0002	55093761000002
4380	Elmwood - V 0001	55093237000001	4398	Prescott - C 0006	55093653750006	4416	Spring Valley - V 0001	55093763000001
4381	EL PASO - T 0001	55093237750001	4399	River Falls - C 0005	55093682750005	4417	Spring Valley - V 0002	55093763000002
4382	GILMAN - T 0001	55093291500001	4400	River Falls - C 0006	55093682750006	4418	TRENTON - T 0001	55093805500001
4383	HARTLAND - T 0001	55093330500001	4401	River Falls - C 0007	55093682750007	4419	TRENTON - T 0002	55093805500002
4384	ISABELLE - T 0001	55093373500001	4402	River Falls - C 0008	55093682750008	4420	TRIMBELLE - T 0001	55093807000001
4385	Maiden Rock - V 0001	55093481750001	4403	River Falls - C 0009	55093682750009	4421	TRIMBELLE - T 0002	55093807000002
4386	MAIDEN ROCK - T 0001	55093482000001	4404	River Falls - C 0010	55093682750010	4422	UNION - T 0001	55093816000001
4387	MARTELL - T 0001	55093497750001	4405	River Falls - C 0011	55093682750011	4423	ALDEN - T 0001	55095009500001
4388	MARTELL - T 0002	55093497750002	4406	River Falls - C 0012	55093682750012	4424	ALDEN - T 0002	55095009500002
4389	OAK GROVE - T 0001	55093590250001	4407	River Falls - C 0013	55093682750013	4425	ALDEN - T 0003	55095009500003
4390	OAK GROVE - T 0002	55093590250002	4408	River Falls - C 0014	55093682750014	4426	ALDEN - T 0004	55095009500004
4391	OAK GROVE - T 0003	55093590250003	4409	RIVER FALLS - T 0001	55093683000001	4427	Amery - C 0001	55095017250001
4392	Plum City - V 0001	55093636000001	4410	RIVER FALLS - T 0002	55093683000002	4428	Amery - C 0002	55095017250002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4429	Amery - C 0003	55095017250003	4447	Clear Lake - V 0002	55095152500002	4465	LINCOLN - T 0003	55095444750003
4430	Amery - C 0004	55095017250004	4448	CLEAR LAKE - T 0001	55095152750001	4466	LINCOLN - T 0004	55095444750004
4431	Amery - C 0005	55095017250005	4449	Dresser - V 0001	55095208500001	4467	LORAIN - T 0001	55095457750001
4432	APPLE RIVER - T 0001	55095023500001	4450	EUREKA - T 0001	55095244500001	4468	Luck - V 0001	55095462000001
4433	APPLE RIVER - T 0002	55095023500002	4451	EUREKA - T 0002	55095244500002	4469	Luck - V 0002	55095462000002
4434	Balsam Lake - V 0001	55095044750001	4452	FARMINGTON - T 0001	55095253500001	4470	LUCK - T 0001	55095462250001
4435	Balsam Lake - V 0002	55095044750002	4453	FARMINGTON - T 0002	55095253500002	4471	LUCK - T 0002	55095462250002
4436	BALSAM LAKE - T 0001	55095045000001	4454	Frederic - V 0001	55095275000001	4472	MCKINLEY - T 0001	55095469000001
4437	BALSAM LAKE - T 0002	55095045000002	4455	Frederic - V 0002	55095275000002	4473	Milltown - V 0001	55095520750001
4438	BEAVER - T 0001	55095058250001	4456	GARFIELD - T 0001	55095283500001	4474	MILLTOWN - T 0001	55095521000001
4439	BLACK BROOK - T 0001	55095077000001	4457	GARFIELD - T 0002	55095283500002	4475	MILLTOWN - T 0002	55095521000002
4440	BLACK BROOK - T 0002	55095077000002	4458	GARFIELD - T 0003	55095283500003	4476	Osceola - V 0001	55095604500001
4441	BONE LAKE - T 0001	55095087500001	4459	GEORGETOWN - T 0001	55095287250001	4477	Osceola - V 0002	55095604500002
4442	Centuria - V 0001	55095138500001	4460	GEORGETOWN - T 0002	55095287250002	4478	Osceola - V 0003	55095604500003
4443	CLAM FALLS - T 0001	55095148370001	4461	JOHNSTOWN - T 0001	55095384000001	4479	OSCEOLA - T 0001	55095604750001
4444	Clayton - V 0001	55095151000001	4462	LAKETOWN - T 0001	55095419000001	4480	OSCEOLA - T 0002	55095604750002
4445	CLAYTON - T 0001	55095151250001	4463	LINCOLN - T 0001	55095444750001	4481	OSCEOLA - T 0003	55095604750003
4446	Clear Lake - V 0001	55095152500001	4464	LINCOLN - T 0002	55095444750002	4482	OSCEOLA - T 0004	55095604750004

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4483	OSCEOLA - T 0005	55095604750005	4501	Amherst Junction - V 0001	55097018000001	4519	HULL - T 0007	55097363500007
4484	St. Croix Falls - C 0001	55095705500001	4502	BELMONT - T 0001	55097064750001	4520	HULL - T 0008	55097363500008
4485	St. Croix Falls - C 0002	55095705500002	4503	BUENA VISTA - T 0001	55097109250001	4521	Junction City - V 0001	55097386500001
4486	St. Croix Falls - C 0003	55095705500003	4504	BUENA VISTA - T 0002	55097109250002	4522	LANARK - T 0001	55097422250001
4487	St. Croix Falls - C 0004	55095705500004	4505	CARSON - T 0001	55097127250001	4523	LANARK - T 0002	55097422250002
4488	ST. CROIX FALLS - T 0001	55095705750001	4506	CARSON - T 0002	55097127250002	4524	LINWOOD - T 0001	55097448000001
4489	ST. CROIX FALLS - T 0002	55095705750002	4507	DEWEY - T 0001	55097199750001	4525	LINWOOD - T 0002	55097448000002
4490	STERLING - T 0001	55095770500001	4508	EAU PLEINE - T 0001	55097224500001	4526	Milladore - V 0002	55097518750002
4491	Turtle Lake - V 002A	5509581075002A	4509	GRANT - T 0001	55097303500001	4527	Nelsonville - V 0001	55097560000001
4492	Turtle Lake - V 002B	5509581075002B	4510	GRANT - T 0002	55097303500002	4528	NEW HOPE - T 0001	55097568500001
4493	WEST SWEDEN - T 0001	55095863500001	4511	GRANT - T 0003	55097303500003	4529	Park Ridge - V 0001	55097613250001
4494	ALBAN - T 0001	55097007250001	4512	GRANT - T 0004	55097303500004	4530	PINE GROVE - T 0001	55097628250001
4495	Almond - V 0001	55097014000001	4513	HULL - T 0001	55097363500001	4531	PINE GROVE - T 0002	55097628250002
4496	ALMOND - T 0001	55097014250001	4514	HULL - T 0002	55097363500002	4532	Plover - V 0001	55097635250001
4497	Amherst - V 0001	55097017500001	4515	HULL - T 0003	55097363500003	4533	Plover - V 0002	55097635250002
4498	Amherst - V 0002	55097017500002	4516	HULL - T 0004	55097363500004	4534	Plover - V 0003	55097635250003
4499	AMHERST - T 0001	55097017750001	4517	HULL - T 0005	55097363500005	4535	Plover - V 0004	55097635250004
4500	AMHERST - T 0002	55097017750002	4518	HULL - T 0006	55097363500006	4536	Plover - V 0005	55097635250005

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4537	Plover - V 0006	55097635250006	4555	Stevens Point - C 0008	55097772000008	4573	Stevens Point - C 0026	55097772000026
4538	Plover - V 0007	55097635250007	4556	Stevens Point - C 0009	55097772000009	4574	Stevens Point - C 0027	55097772000027
4539	Plover - V 0008	55097635250008	4557	Stevens Point - C 0010	55097772000010	4575	Stevens Point - C 0028	55097772000028
4540	Plover - V 0009	55097635250009	4558	Stevens Point - C 0011	55097772000011	4576	Stevens Point - C 0029	55097772000029
4541	PLOVER - T 0001	55097635500001	4559	Stevens Point - C 0012	55097772000012	4577	Stevens Point - C 0030	55097772000030
4542	PLOVER - T 0002	55097635500002	4560	Stevens Point - C 0013	55097772000013	4578	Stevens Point - C 0031	55097772000031
4543	PLOVER - T 0003	55097635500003	4561	Stevens Point - C 0014	55097772000014	4579	Stevens Point - C 0032	55097772000032
4544	Rosholt - V 0001	55097695750001	4562	Stevens Point - C 0015	55097772000015	4580	Stevens Point - C 0033	55097772000033
4545	SHARON - T 0001	55097728500001	4563	Stevens Point - C 0016	55097772000016	4581	Stevens Point - C 0034	55097772000034
4546	SHARON - T 0002	55097728500002	4564	Stevens Point - C 0017	55097772000017	4582	Stevens Point - C 0035	55097772000035
4547	SHARON - T 0003	55097728500003	4565	Stevens Point - C 0018	55097772000018	4583	Stevens Point - C 0036	55097772000036
4548	Stevens Point - C 0001	55097772000001	4566	Stevens Point - C 0019	55097772000019	4584	Stevens Point - C 0037	55097772000037
4549	Stevens Point - C 0002	55097772000002	4567	Stevens Point - C 0020	55097772000020	4585	Stevens Point - C 0038	55097772000038
4550	Stevens Point - C 0003	55097772000003	4568	Stevens Point - C 0021	55097772000021	4586	Stevens Point - C 0039	55097772000039
4551	Stevens Point - C 0004	55097772000004	4569	Stevens Point - C 0022	55097772000022	4587	Stevens Point - C 0040	55097772000040
4552	Stevens Point - C 0005	55097772000005	4570	Stevens Point - C 0023	55097772000023	4588	Stevens Point - C 0041	55097772000041
4553	Stevens Point - C 0006	55097772000006	4571	Stevens Point - C 0024	55097772000024	4589	Stevens Point - C 0042	55097772000042
4554	Stevens Point - C 0007	55097772000007	4572	Stevens Point - C 0025	55097772000025	4590	Stevens Point - C 0043	55097772000043

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4591	Stevens Point - C 0044	55097772000044	4609	EMERY - T 0001	55099239750001	4627	Park Falls - C 0005	55099612000005
4592	Stevens Point - C 0045	55097772000045	4610	FIFIELD - T 0001	55099257750001	4628	Park Falls - C 0006	55099612000006
4593	Stevens Point - C 0046	55097772000046	4611	FIFIELD - T 0002	55099257750002	4629	Park Falls - C 0007	55099612000007
4594	STOCKTON - T 0001	55097775370001	4612	FLAMBEAU - T 0001	55099260500001	4630	Phillips - C 0001	55099624500001
4595	STOCKTON - T 0002	55097775370002	4613	GEORGETOWN - T 0001	55099287500001	4631	Phillips - C 0002	55099624500002
4596	STOCKTON - T 0003	55097775370003	4614	HACKETT - T 0001	55099319250001	4632	Phillips - C 0003	55099624500003
4597	STOCKTON - T 0004	55097775370004	4615	HARMONY - T 0001	55099326750001	4633	Phillips - C 0004	55099624500004
4598	STOCKTON - T 0005	55097775370005	4616	HILL - T 0001	55099347250001	4634	Prentice - V 0001	55099653250001
4599	Whiting - V 0001	55097869750001	4617	Kennan - V 0001	55099391750001	4635	PRENTICE - T 0001	55099653500001
4600	Whiting - V 0002	55097869750002	4618	KENNAN - T 0001	55099392000001	4636	SPIRIT - T 0001	55099755250001
4601	Whiting - V 0003	55097869750003	4619	KNOX - T 0001	55099401750001	4637	WORCESTER - T 0001	55099891000001
4602	Whiting - V 0004	55097869750004	4620	LAKE - T 0001	55099411500001	4638	WORCESTER - T 0002	55099891000002
4603	Catawba - V 0001	55099131750001	4621	LAKE - T 0002	55099411500002	4639	WORCESTER - T 0003	55099891000003
4604	CATAWBA - T 0001	55099132000001	4622	OGEMA - T 0001	55099595250001	4640	Burlington - C 0001	55101112000001
4605	EISENSTEIN - T 0001	55099229500001	4623	Park Falls - C 0001	55099612000001	4641	Burlington - C 0002	55101112000002
4606	EISENSTEIN - T 0002	55099229500002	4624	Park Falls - C 0002	55099612000002	4642	Burlington - C 0003	55101112000003
4607	ELK - T 0001	55099232000001	4625	Park Falls - C 0003	55099612000003	4643	Burlington - C 0004	55101112000004
4608	ELK - T 0002	55099232000002	4626	Park Falls - C 0004	55099612000004	4644	Burlington - C 0005	55101112000005

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4645	Burlington - C 0006	55101112000006	4663	Caledonia - V 0005	55101119500005	4681	DOVER - T 0002	55101206250002
4646	Burlington - C 0007	55101112000007	4664	Caledonia - V 0006	55101119500006	4682	DOVER - T 0003	55101206250003
4647	Burlington - C 0008	55101112000008	4665	Caledonia - V 0007	55101119500007	4683	DOVER - T 0004	55101206250004
4648	BURLINGTON - T 0001	55101112250001	4666	Caledonia - V 0008	55101119500008	4684	DOVER - T 0005	55101206250005
4649	BURLINGTON - T 0002	55101112250002	4667	Caledonia - V 0009	55101119500009	4685	DOVER - T 0006	55101206250006
4650	BURLINGTON - T 0003	55101112250003	4668	Caledonia - V 0010	55101119500010	4686	DOVER - T 0007	55101206250007
4651	BURLINGTON - T 0004	55101112250004	4669	Caledonia - V 0011	55101119500011	4687	DOVER - T 0008	55101206250008
4652	BURLINGTON - T 0005	55101112250005	4670	Caledonia - V 0012	55101119500012	4688	Elmwood Park - V 0001	55101237250001
4653	BURLINGTON - T 0006	55101112250006	4671	Caledonia - V 0013	55101119500013	4689	Mount Pleasant - V 0001	55101548750001
4654	BURLINGTON - T 0007	55101112250007	4672	Caledonia - V 0014	55101119500014	4690	Mount Pleasant - V 0002	55101548750002
4655	BURLINGTON - T 0008	55101112250008	4673	Caledonia - V 0015	55101119500015	4691	Mount Pleasant - V 0003	55101548750003
4656	BURLINGTON - T 0009	55101112250009	4674	Caledonia - V 0016	55101119500016	4692	Mount Pleasant - V 0004	55101548750004
4657	BURLINGTON - T 0010	55101112250010	4675	Caledonia - V 0017	55101119500017	4693	Mount Pleasant - V 0005	55101548750005
4658	BURLINGTON - T 0011	55101112250011	4676	Caledonia - V 0018	55101119500018	4694	Mount Pleasant - V 0006	55101548750006
4659	Caledonia - V 0001	55101119500001	4677	Caledonia - V 0019	55101119500019	4695	Mount Pleasant - V 0007	55101548750007
4660	Caledonia - V 0002	55101119500002	4678	Caledonia - V 0020	55101119500020	4696	Mount Pleasant - V 0008	55101548750008
4661	Caledonia - V 0003	55101119500003	4679	Caledonia - V 003B	5510111950003B	4697	Mount Pleasant - V 0009	55101548750009
4662	Caledonia - V 0004	55101119500004	4680	DOVER - T 0001	55101206250001	4698	Mount Pleasant - V 0010	55101548750010

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4699	Mount Pleasant - V 0011	55101548750011	4717	NORWAY - T 0005	55101586000005	4735	Racine - C 0012	55101660000012
4700	Mount Pleasant - V 0012	55101548750012	4718	NORWAY - T 0006	55101586000006	4736	Racine - C 0013	55101660000013
4701	Mount Pleasant - V 0013	55101548750013	4719	NORWAY - T 0007	55101586000007	4737	Racine - C 0014	55101660000014
4702	Mount Pleasant - V 0014	55101548750014	4720	NORWAY - T 0008	55101586000008	4738	Racine - C 0015	55101660000015
4703	Mount Pleasant - V 0015	55101548750015	4721	NORWAY - T 0009	55101586000009	4739	Racine - C 0016	55101660000016
4704	Mount Pleasant - V 0016	55101548750016	4722	NORWAY - T 0010	55101586000010	4740	Racine - C 0017	55101660000017
4705	Mount Pleasant - V 0017	55101548750017	4723	NORWAY - T 0011	55101586000011	4741	Racine - C 0018	55101660000018
4706	Mount Pleasant - V 0018	55101548750018	4724	Racine - C 0001	55101660000001	4742	Racine - C 0019	55101660000019
4707	Mount Pleasant - V 0019	55101548750019	4725	Racine - C 0002	55101660000002	4743	Racine - C 0020	55101660000020
4708	Mount Pleasant - V 0020	55101548750020	4726	Racine - C 0003	55101660000003	4744	Racine - C 0021	55101660000021
4709	Mount Pleasant - V 0021	55101548750021	4727	Racine - C 0004	55101660000004	4745	Racine - C 0022	55101660000022
4710	Mount Pleasant - V 0022	55101548750022	4728	Racine - C 0005	55101660000005	4746	Racine - C 0023	55101660000023
4711	Mount Pleasant - V 0023	55101548750023	4729	Racine - C 0006	55101660000006	4747	Racine - C 0024	55101660000024
4712	North Bay - V 0001	55101577000001	4730	Racine - C 0007	55101660000007	4748	Racine - C 0025	55101660000025
4713	NORWAY - T 0001	55101586000001	4731	Racine - C 0008	55101660000008	4749	Racine - C 0026	55101660000026
4714	NORWAY - T 0002	55101586000002	4732	Racine - C 0009	55101660000009	4750	Racine - C 0027	55101660000027
4715	NORWAY - T 0003	55101586000003	4733	Racine - C 0010	55101660000010	4751	Racine - C 0028	55101660000028
4716	NORWAY - T 0004	55101586000004	4734	Racine - C 0011	55101660000011	4752	Racine - C 0029	55101660000029

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4753	Racine - C 0030	55101660000030	4771	Rochester - V 0006	55101685500006	4789	Waterford - V 0003	55101838250003
4754	Racine - C 0031	55101660000031	4772	Sturtevant - V 0001	55101779250001	4790	Waterford - V 0004	55101838250004
4755	Racine - C 0032	55101660000032	4773	Sturtevant - V 0002	55101779250002	4791	Waterford - V 0005	55101838250005
4756	Racine - C 0033	55101660000033	4774	Sturtevant - V 0003	55101779250003	4792	Waterford - V 0006	55101838250006
4757	Racine - C 0034	55101660000034	4775	Sturtevant - V 0004	55101779250004	4793	Waterford - V 0007	55101838250007
4758	Racine - C 0035	55101660000035	4776	Sturtevant - V 0005	55101779250005	4794	WATERFORD - T 0001	55101838500001
4759	Racine - C 0036	55101660000036	4777	Sturtevant - V 0006	55101779250006	4795	WATERFORD - T 0002	55101838500002
4760	RAYMOND - T 0001	55101663750001	4778	Sturtevant - V 0007	55101779250007	4796	WATERFORD - T 0003	55101838500003
4761	RAYMOND - T 0002	55101663750002	4779	Sturtevant - V 0008	55101779250008	4797	WATERFORD - T 0004	55101838500004
4762	RAYMOND - T 0003	55101663750003	4780	Union Grove - V 0001	55101817750001	4798	WATERFORD - T 0005	55101838500005
4763	RAYMOND - T 0004	55101663750004	4781	Union Grove - V 0002	55101817750002	4799	WATERFORD - T 0006	55101838500006
4764	RAYMOND - T 0005	55101663750005	4782	Union Grove - V 0003	55101817750003	4800	WATERFORD - T 0007	55101838500007
4765	RAYMOND - T 0006	55101663750006	4783	Union Grove - V 0004	55101817750004	4801	WATERFORD - T 0008	55101838500008
4766	Rochester - V 0001	55101685500001	4784	Union Grove - V 0005	55101817750005	4802	WATERFORD - T 0009	55101838500009
4767	Rochester - V 0002	55101685500002	4785	Union Grove - V 0006	55101817750006	4803	WATERFORD - T 0010	55101838500010
4768	Rochester - V 0003	55101685500003	4786	Union Grove - V 0007	55101817750007	4804	Wind Point - V 0001	55101877000001
4769	Rochester - V 0004	55101685500004	4787	Waterford - V 0001	55101838250001	4805	Wind Point - V 0002	55101877000002
4770	Rochester - V 0005	55101685500005	4788	Waterford - V 0002	55101838250002	4806	Wind Point - V 0003	55101877000003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4807	YORKVILLE - T 0001	55101895750001	4825	Lone Rock - V 0001	55103455750001	4843	Richland Center - C 0011	55103676250011
4808	YORKVILLE - T 0002	55101895750002	4826	MARSHALL - T 0001	55103496000001	4844	Richland Center - C 0012	55103676250012
4809	YORKVILLE - T 0003	55101895750003	4827	MARSHALL - T 0002	55103496000002	4845	RICHWOOD - T 0001	55103677750001
4810	YORKVILLE - T 0004	55101895750004	4828	ORION - T 0001	55103603500001	4846	RICHWOOD - T 0002	55103677750002
4811	YORKVILLE - T 0005	55101895750005	4829	RICHLAND - T 0001	55103675750001	4847	ROCKBRIDGE - T 0001	55103686750001
4812	AKAN - T 0001	55103006750001	4830	RICHLAND - T 0002	55103675750002	4848	ROCKBRIDGE - T 0002	55103686750002
4813	BLOOM - T 0001	55103081750001	4831	RICHLAND - T 0003	55103675750003	4849	ROCKBRIDGE - T 0003	55103686750003
4814	Boaz - V 0001	55103086000001	4832	RICHLAND - T 0004	55103675750004	4850	SYLVAN - T 0001	55103788250001
4815	BUENA VISTA - T 0001	55103109500001	4833	Richland Center - C 0001	55103676250001	4851	SYLVAN - T 0002	55103788250002
4816	BUENA VISTA - T 0002	55103109500002	4834	Richland Center - C 0002	55103676250002	4852	Viola - V 0002	55103829000002
4817	BUENA VISTA - T 0003	55103109500003	4835	Richland Center - C 0003	55103676250003	4853	WESTFORD - T 0001	55103856750001
4818	BUENA VISTA - T 0004	55103109500004	4836	Richland Center - C 0004	55103676250004	4854	WILLOW - T 0001	55103872500001
4819	Cazenovia - V 0001	55103133000001	4837	Richland Center - C 0005	55103676250005	4855	Yuba - V 0001	55103896250001
4820	DAYTON - T 0001	55103190000001	4838	Richland Center - C 0006	55103676250006	4856	AVON - T 0001	55105041000001
4821	EAGLE - T 0001	55103214000001	4839	Richland Center - C 0007	55103676250007	4857	Beloit - C 0001	55105065000001
4822	FOREST - T 0001	55103264750001	4840	Richland Center - C 0008	55103676250008	4858	Beloit - C 0002	55105065000002
4823	HENRIETTA - T 0001	55103339250001	4841	Richland Center - C 0009	55103676250009	4859	Beloit - C 0003	55105065000003
4824	ITHACA - T 0001	55103375000001	4842	Richland Center - C 0010	55103676250010	4860	Beloit - C 0004	55105065000004

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4861	Beloit - C 0005	55105065000005	4879	Beloit - C 0023	55105065000023	4897	CENTER - T 0001	55105136250001
4862	Beloit - C 0006	55105065000006	4880	Beloit - C 0024	55105065000024	4898	CENTER - T 0002	55105136250002
4863	Beloit - C 0007	55105065000007	4881	Beloit - C 0025	55105065000025	4899	Clinton - V 0001	55105156250001
4864	Beloit - C 0008	55105065000008	4882	BELOIT - T 0001	55105065250001	4900	Clinton - V 0002	55105156250002
4865	Beloit - C 0009	55105065000009	4883	BELOIT - T 0002	55105065250002	4901	Clinton - V 0003	55105156250003
4866	Beloit - C 0010	55105065000010	4884	BELOIT - T 0003	55105065250003	4902	CLINTON - T 0001	55105156500001
4867	Beloit - C 0011	55105065000011	4885	BELOIT - T 0004	55105065250004	4903	Edgerton - C 0001	55105225750001
4868	Beloit - C 0012	55105065000012	4886	BELOIT - T 0005	55105065250005	4904	Edgerton - C 0002	55105225750002
4869	Beloit - C 0013	55105065000013	4887	BELOIT - T 0006	55105065250006	4905	Edgerton - C 0003	55105225750003
4870	Beloit - C 0014	55105065000014	4888	BELOIT - T 0007	55105065250007	4906	Edgerton - C 0004	55105225750004
4871	Beloit - C 0015	55105065000015	4889	BELOIT - T 0008	55105065250008	4907	Edgerton - C 0005	55105225750005
4872	Beloit - C 0016	55105065000016	4890	BELOIT - T 0009	55105065250009	4908	Edgerton - C 0006	55105225750006
4873	Beloit - C 0017	55105065000017	4891	BELOIT - T 0010	55105065250010	4909	Evansville - C 0001	55105245500001
4874	Beloit - C 0018	55105065000018	4892	BELOIT - T 0011	55105065250011	4910	Evansville - C 0002	55105245500002
4875	Beloit - C 0019	55105065000019	4893	BRADFORD - T 0001	55105091750001	4911	Evansville - C 0003	55105245500003
4876	Beloit - C 0020	55105065000020	4894	BRADFORD - T 0002	55105091750002	4912	Evansville - C 0004	55105245500004
4877	Beloit - C 0021	55105065000021	4895	Brodhead - C 0007	55105099250007	4913	Evansville - C 0005	55105245500005
4878	Beloit - C 0022	55105065000022	4896	Brodhead - C 0008	55105099250008	4914	Evansville - C 0006	55105245500006

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4915	Evansville - C 0007	55105245500007	4933	Janesville - C 0002	55105378250002	4951	Janesville - C 0020	55105378250020
4916	Evansville - C 0008	55105245500008	4934	Janesville - C 0003	55105378250003	4952	Janesville - C 0021	55105378250021
4917	Evansville - C 0009	55105245500009	4935	Janesville - C 0004	55105378250004	4953	Janesville - C 0022	55105378250022
4918	Evansville - C 0010	55105245500010	4936	Janesville - C 0005	55105378250005	4954	Janesville - C 0023	55105378250023
4919	Footville - V 0001	55105264000001	4937	Janesville - C 0006	55105378250006	4955	Janesville - C 0024	55105378250024
4920	FULTON - T 0001	55105280750001	4938	Janesville - C 0007	55105378250007	4956	Janesville - C 0025	55105378250025
4921	FULTON - T 0002	55105280750002	4939	Janesville - C 0008	55105378250008	4957	Janesville - C 0026	55105378250026
4922	FULTON - T 0003	55105280750003	4940	Janesville - C 0009	55105378250009	4958	Janesville - C 0027	55105378250027
4923	FULTON - T 0004	55105280750004	4941	Janesville - C 0010	55105378250010	4959	Janesville - C 0028	55105378250028
4924	FULTON - T 0005	55105280750005	4942	Janesville - C 0011	55105378250011	4960	Janesville - C 0029	55105378250029
4925	FULTON - T 0006	55105280750006	4943	Janesville - C 0012	55105378250012	4961	Janesville - C 0030	55105378250030
4926	HARMONY - T 0001	55105327000001	4944	Janesville - C 0013	55105378250013	4962	Janesville - C 0031	55105378250031
4927	HARMONY - T 0002	55105327000002	4945	Janesville - C 0014	55105378250014	4963	Janesville - C 0032	55105378250032
4928	HARMONY - T 0003	55105327000003	4946	Janesville - C 0015	55105378250015	4964	Janesville - C 0033	55105378250033
4929	HARMONY - T 0004	55105327000004	4947	Janesville - C 0016	55105378250016	4965	Janesville - C 0034	55105378250034
4930	HARMONY - T 0005	55105327000005	4948	Janesville - C 0017	55105378250017	4966	JANESVILLE - T 0001	55105378500001
4931	HARMONY - T 0006	55105327000006	4949	Janesville - C 0018	55105378250018	4967	JANESVILLE - T 0002	55105378500002
4932	Janesville - C 0001	55105378250001	4950	Janesville - C 0019	55105378250019	4968	JANESVILLE - T 0003	55105378500003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
4969	JANESVILLE - T 0004	55105378500004	4987	Milton - C 0007	55105522000007	5005	PORTER - T 0001	55105642250001
4970	JANESVILLE - T 0005	55105378500005	4988	Milton - C 0008	55105522000008	5006	ROCK - T 0001	55105686000001
4971	JANESVILLE - T 0006	55105378500006	4989	Milton - C 0009	55105522000009	5007	ROCK - T 0002	55105686000002
4972	JANESVILLE - T 0007	55105378500007	4990	Milton - C 0010	55105522000010	5008	ROCK - T 0003	55105686000003
4973	JANESVILLE - T 0008	55105378500008	4991	Milton - C 0011	55105522000011	5009	ROCK - T 0004	55105686000004
4974	JANESVILLE - T 0009	55105378500009	4992	Milton - C 0012	55105522000012	5010	ROCK - T 0005	55105686000005
4975	JOHNSTOWN - T 0001	55105384500001	4993	Milton - C 0013	55105522000013	5011	ROCK - T 0006	55105686000006
4976	LA PRAIRIE - T 0001	55105425750001	4994	MILTON - T 0001	55105522250001	5012	ROCK - T 0007	55105686000007
4977	LA PRAIRIE - T 0002	55105425750002	4995	MILTON - T 0002	55105522250002	5013	ROCK - T 0008	55105686000008
4978	LIMA - T 0001	55105441250001	4996	MILTON - T 0003	55105522250003	5014	SPRING VALLEY - T 0001	55105763250001
4979	LIMA - T 0002	55105441250002	4997	MILTON - T 0004	55105522250004	5015	TURTLE - T 0001	55105810500001
4980	MAGNOLIA - T 0001	55105481500001	4998	NEWARK - T 0001	55105563250001	5016	TURTLE - T 0002	55105810500002
4981	Milton - C 0001	55105522000001	4999	NEWARK - T 0002	55105563250002	5017	TURTLE - T 0003	55105810500003
4982	Milton - C 0002	55105522000002	5000	NEWARK - T 0003	55105563250003	5018	TURTLE - T 0004	55105810500004
4983	Milton - C 0003	55105522000003	5001	Orfordville - V 0001	55105602500001	5019	UNION - T 0001	55105816500001
4984	Milton - C 0004	55105522000004	5002	Orfordville - V 0002	55105602500002	5020	UNION - T 0002	55105816500002
4985	Milton - C 0005	55105522000005	5003	PLYMOUTH - T 0001	55105636750001	5021	UNION - T 0003	55105816500003
4986	Milton - C 0006	55105522000006	5004	PLYMOUTH - T 0002	55105636750002	5022	UNION - T 0004	55105816500004

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5023	ATLANTA - T 0001	55107036000001	5041	GROW - T 0001	55107317750001	5059	Ladysmith - C 0014	55107408500014
5024	ATLANTA - T 0002	55107036000002	5042	Hawkins - V 0001	55107332750001	5060	Ladysmith - C 0015	55107408500015
5025	BIG BEND - T 0001	55107071750001	5043	HAWKINS - T 0001	55107333000001	5061	LAWRENCE - T 0001	55107429500001
5026	BIG BEND - T 0002	55107071750002	5044	HUBBARD - T 0001	55107361250001	5062	LAWRENCE - T 0002	55107429500002
5027	BIG FALLS - T 0001	55107072250001	5045	Ingram - V 0001	55107369250001	5063	MARSHALL - T 0001	55107496250001
5028	Bruce - V 0001	55107105000001	5046	Ladysmith - C 0001	55107408500001	5064	MARSHALL - T 0002	55107496250002
5029	CEDAR RAPIDS - T 0001	55107135500001	5047	Ladysmith - C 0002	55107408500002	5065	MURRY - T 0001	55107551750001
5030	Conrath - V 0001	55107167750001	5048	Ladysmith - C 0003	55107408500003	5066	RICHLAND - T 0001	55107676000001
5031	DEWEY - T 0001	55107200000001	5049	Ladysmith - C 0004	55107408500004	5067	RICHLAND - T 0002	55107676000002
5032	FLAMBEAU - T 0001	55107261000001	5050	Ladysmith - C 0005	55107408500005	5068	RUSK - T 0001	55107702750001
5033	FLAMBEAU - T 0002	55107261000002	5051	Ladysmith - C 0006	55107408500006	5069	Sheldon - V 0001	55107731750001
5034	FLAMBEAU - T 0003	55107261000003	5052	Ladysmith - C 0007	55107408500007	5070	SOUTH FORK - T 0001	55107749750001
5035	Glen Flora - V 0001	55107294750001	5053	Ladysmith - C 0008	55107408500008	5071	STRICKLAND - T 0001	55107777750001
5036	GRANT - T 0001	55107303750001	5054	Ladysmith - C 0009	55107408500009	5072	STRICKLAND - T 0002	55107777750002
5037	GRANT - T 0002	55107303750002	5055	Ladysmith - C 0010	55107408500010	5073	STUBBS - T 0001	55107778500001
5038	GRANT - T 0003	55107303750003	5056	Ladysmith - C 0011	55107408500011	5074	STUBBS - T 0002	55107778500002
5039	GRANT - T 0004	55107303750004	5057	Ladysmith - C 0012	55107408500012	5075	THORNAPPLE - T 0001	55107795750001
5040	GRANT - T 0005	55107303750005	5058	Ladysmith - C 0013	55107408500013	5076	THORNAPPLE - T 0002	55107795750002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5077	THORNAPPLE - T 0003	55107795750003	5095	BALDWIN - T 0002	55109044250002	5113	HAMMOND - T 0003	55109323500003
5078	THORNAPPLE - T 0004	55107795750004	5096	CADY - T 0001	55109117750001	5114	Hudson - C 0001	55109362500001
5079	THORNAPPLE - T 0005	55107795750005	5097	CYLON - T 0001	55109183000001	5115	Hudson - C 0002	55109362500002
5080	Tony - V 0001	55107802250001	5098	Deer Park - V 0001	55109193250001	5116	Hudson - C 0003	55109362500003
5081	TRUE - T 0001	55107809500001	5099	EAU GALLE - T 0001	55109224000001	5117	Hudson - C 0004	55109362500004
5082	WASHINGTON - T 0001	55107836750001	5100	EAU GALLE - T 0002	55109224000002	5118	Hudson - C 0005	55109362500005
5083	Weyerhaeuser - V 0001	55107864500001	5101	EMERALD - T 0001	55109239250001	5119	Hudson - C 0006	55109362500006
5084	Weyerhaeuser - V 0002	55107864500002	5102	ERIN PRAIRIE - T 0001	55109242750001	5120	Hudson - C 0007	55109362500007
5085	WILKINSON - T 0001	55107871250001	5103	FOREST - T 0001	55109265250001	5121	Hudson - C 0008	55109362500008
5086	WILLARD - T 0001	55107871750001	5104	GLENWOOD - T 0001	55109296000001	5122	Hudson - C 0009	55109362500009
5087	WILSON - T 0001	55107874500001	5105	Glenwood City - C 0001	55109296250001	5123	Hudson - C 0010	55109362500010
5088	Baldwin - V 0001	55109044000001	5106	Glenwood City - C 0002	55109296250002	5124	Hudson - C 0011	55109362500011
5089	Baldwin - V 0002	55109044000002	5107	Hammond - V 0001	55109323250001	5125	Hudson - C 0012	55109362500012
5090	Baldwin - V 0003	55109044000003	5108	Hammond - V 0002	55109323250002	5126	HUDSON - T 0001	55109362750001
5091	Baldwin - V 0004	55109044000004	5109	Hammond - V 0003	55109323250003	5127	HUDSON - T 0002	55109362750002
5092	Baldwin - V 0005	55109044000005	5110	Hammond - V 0004	55109323250004	5128	HUDSON - T 0003	55109362750003
5093	Baldwin - V 0006	55109044000006	5111	HAMMOND - T 0001	55109323500001	5129	HUDSON - T 0004	55109362750004
5094	BALDWIN - T 0001	55109044250001	5112	HAMMOND - T 0002	55109323500002	5130	HUDSON - T 0005	55109362750005

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5131	HUDSON - T 0006	55109362750006	5149	New Richmond - C 0007	55109571000007	5167	River Falls - C 0001	55109682750001
5132	HUDSON - T 0007	55109362750007	5150	New Richmond - C 0008	55109571000008	5168	River Falls - C 0002	55109682750002
5133	HUDSON - T 0008	55109362750008	5151	New Richmond - C 0009	55109571000009	5169	River Falls - C 0003	55109682750003
5134	HUDSON - T 0009	55109362750009	5152	New Richmond - C 0010	55109571000010	5170	River Falls - C 0004	55109682750004
5135	HUDSON - T 0010	55109362750010	5153	New Richmond - C 0011	55109571000011	5171	River Falls - C 0015	55109682750015
5136	HUDSON - T 0011	55109362750011	5154	New Richmond - C 0012	55109571000012	5172	Roberts - V 0001	55109684750001
5137	HUDSON - T 0012	55109362750012	5155	North Hudson - V 0001	55109580500001	5173	Roberts - V 0002	55109684750002
5138	HUDSON - T 0013	55109362750013	5156	North Hudson - V 0002	55109580500002	5174	Roberts - V 0003	55109684750003
5139	HUDSON - T 0014	55109362750014	5157	North Hudson - V 0003	55109580500003	5175	Roberts - V 0004	55109684750004
5140	KINNICKINNIC - T 0001	55109398250001	5158	North Hudson - V 0004	55109580500004	5176	RUSH RIVER - T 0001	55109702000001
5141	KINNICKINNIC - T 0002	55109398250002	5159	North Hudson - V 0005	55109580500005	5177	ST. JOSEPH - T 0001	55109708250001
5142	KINNICKINNIC - T 0003	55109398250003	5160	North Hudson - V 0006	55109580500006	5178	ST. JOSEPH - T 0002	55109708250002
5143	New Richmond - C 0001	55109571000001	5161	PLEASANT VALLEY - T 0001	55109634250001	5179	ST. JOSEPH - T 0003	55109708250003
5144	New Richmond - C 0002	55109571000002	5162	RICHMOND - T 0001	55109676500001	5180	ST. JOSEPH - T 0004	55109708250004
5145	New Richmond - C 0003	55109571000003	5163	RICHMOND - T 0002	55109676500002	5181	ST. JOSEPH - T 0005	55109708250005
5146	New Richmond - C 0004	55109571000004	5164	RICHMOND - T 0003	55109676500003	5182	ST. JOSEPH - T 0006	55109708250006
5147	New Richmond - C 0005	55109571000005	5165	RICHMOND - T 0004	55109676500004	5183	Somerset - V 0001	55109746750001
5148	New Richmond - C 0006	55109571000006	5166	RICHMOND - T 0005	55109676500005	5184	Somerset - V 0002	55109746750002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5185	Somerset - V 0003	55109746750003	5203	TROY - T 0001	55109808000001	5221	Baraboo - C 0006	55111046250006
5186	Somerset - V 0004	55109746750004	5204	TROY - T 0002	55109808000002	5222	Baraboo - C 0007	55111046250007
5187	SOMERSET - T 0001	55109747000001	5205	TROY - T 0003	55109808000003	5223	Baraboo - C 0008	55111046250008
5188	SOMERSET - T 0002	55109747000002	5206	TROY - T 0004	55109808000004	5224	Baraboo - C 0009	55111046250009
5189	SOMERSET - T 0003	55109747000003	5207	TROY - T 0005	55109808000005	5225	Baraboo - C 0010	55111046250010
5190	SOMERSET - T 0004	55109747000004	5208	TROY - T 0006	55109808000006	5226	Baraboo - C 0011	55111046250011
5191	SOMERSET - T 0005	55109747000005	5209	TROY - T 0007	55109808000007	5227	Baraboo - C 0012	55111046250012
5192	SOMERSET - T 0006	55109747000006	5210	WARREN - T 0001	55109834000001	5228	Baraboo - C 0013	55111046250013
5193	SPRINGFIELD - T 0001	55109759500001	5211	WARREN - T 0002	55109834000002	5229	Baraboo - C 0014	55111046250014
5194	Spring Valley - V 0003	55109763000003	5212	WARREN - T 0003	55109834000003	5230	BARABOO - T 0001	55111046500001
5195	STANTON - T 0001	55109766750001	5213	Wilson - V 0001	55109874750001	5231	BARABOO - T 0002	55111046500002
5196	Star Prairie - V 0001	55109768250001	5214	Woodville - V 0001	55109890250001	5232	BARABOO - T 0003	55111046500003
5197	STAR PRAIRIE - T 0001	55109768500001	5215	Woodville - V 0002	55109890250002	5233	BARABOO - T 0004	55111046500004
5198	STAR PRAIRIE - T 0002	55109768500002	5216	Baraboo - C 0001	55111046250001	5234	BEAR CREEK - T 0001	55111056000001
5199	STAR PRAIRIE - T 0003	55109768500003	5217	Baraboo - C 0002	55111046250002	5235	Cazenovia - V 0002	55111133000002
5200	STAR PRAIRIE - T 0004	55109768500004	5218	Baraboo - C 0003	55111046250003	5236	DELLONA - T 0001	55111195500001
5201	STAR PRAIRIE - T 0005	55109768500005	5219	Baraboo - C 0004	55111046250004	5237	DELLONA - T 0002	55111195500002
5202	STAR PRAIRIE - T 0006	55109768500006	5220	Baraboo - C 0005	55111046250005	5238	DELTON - T 0001	55111196750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5239	DELTON - T 0002	55111196750002	5257	Lake Delton - V 0002	55111413000002	5275	Prairie Du Sac - V 0002	55111651000002
5240	DELTON - T 0003	55111196750003	5258	Lake Delton - V 0003	55111413000003	5276	Prairie Du Sac - V 0003	55111651000003
5241	DELTON - T 0004	55111196750004	5259	Lake Delton - V 0004	55111413000004	5277	Prairie Du Sac - V 0004	55111651000004
5242	EXCELSIOR - T 0001	55111246750001	5260	Lake Delton - V 0005	55111413000005	5278	PRAIRIE DU SAC - T 0001	55111651250001
5243	EXCELSIOR - T 0002	55111246750002	5261	Lake Delton - V 0006	55111413000006	5279	PRAIRIE DU SAC - T 0002	55111651250002
5244	EXCELSIOR - T 0003	55111246750003	5262	Lake Delton - V 0007	55111413000007	5280	Reedsburg - C 0001	55111668000001
5245	FAIRFIELD - T 0001	55111249000001	5263	Lake Delton - V 0008	55111413000008	5281	Reedsburg - C 0002	55111668000002
5246	FAIRFIELD - T 0002	55111249000002	5264	La Valle - V 0001	55111428250001	5282	Reedsburg - C 0003	55111668000003
5247	FRANKLIN - T 0001	55111273500001	5265	LA VALLE - T 0001	55111428500001	5283	Reedsburg - C 0004	55111668000004
5248	FRANKLIN - T 0002	55111273500002	5266	LA VALLE - T 0002	55111428500002	5284	Reedsburg - C 0005	55111668000005
5249	FRANKLIN - T 0003	55111273500003	5267	LA VALLE - T 0003	55111428500003	5285	Reedsburg - C 0006	55111668000006
5250	FREEDOM - T 0001	55111276750001	5268	Lime Ridge - V 0001	55111442250001	5286	Reedsburg - C 0007	55111668000007
5251	FREEDOM - T 0002	55111276750002	5269	Loganville - V 0001	55111454000001	5287	Reedsburg - C 0008	55111668000008
5252	GREENFIELD - T 0001	55111312500001	5270	Merrimac - V 0001	55111513250001	5288	Reedsburg - C 0009	55111668000009
5253	HONEY CREEK - T 0001	55111356250001	5271	MERRIMAC - T 0001	55111513500001	5289	Reedsburg - C 0010	55111668000010
5254	Ironton - V 0001	55111372250001	5272	North Freedom - V 0001	55111580250001	5290	Reedsburg - C 0011	55111668000011
5255	IRONTON - T 0001	55111372500001	5273	Plain - V 0001	55111631250001	5291	Reedsburg - C 0012	55111668000012
5256	Lake Delton - V 0001	55111413000001	5274	Prairie Du Sac - V 0001	55111651000001	5292	Reedsburg - C 0013	55111668000013

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5293	Reedsburg - C 0014	55111668000014	5311	SUMPTER - T 0003	55111785250003	5329	Couderay - V 0001	55113172250001
5294	REEDSBURG - T 0001	55111668250001	5312	TROY - T 0001	55111808250001	5330	COUDERAY - T 0001	55113172500001
5295	REEDSBURG - T 0002	55111668250002	5313	WASHINGTON - T 0001	55111837000001	5331	DRAPER - T 0001	55113208250001
5296	REEDSBURG - T 0003	55111668250003	5314	WASHINGTON - T 0002	55111837000002	5332	EDGEWATER - T 0001	55113226250001
5297	Rock Springs - V 0001	55111689750001	5315	West Baraboo - V 0001	55111853250001	5333	EDGEWATER - T 0002	55113226250002
5298	Sauk City - V 0001	55111716500001	5316	West Baraboo - V 0002	55111853250002	5334	Exeland - V 0001	55113247000001
5299	Sauk City - V 0002	55111716500002	5317	WESTFIELD - T 0001	55111856250001	5335	Hayward - C 0001	55113334500001
5300	Sauk City - V 0003	55111716500003	5318	WINFIELD - T 0001	55111877750001	5336	Hayward - C 0002	55113334500002
5301	Sauk City - V 0004	55111716500004	5319	WINFIELD - T 0002	55111877750002	5337	Hayward - C 0003	55113334500003
5302	Sauk City - V 0005	55111716500005	5320	Wisconsin Dells - C 0004	55111881500004	5338	Hayward - C 0004	55113334500004
5303	Spring Green - V 0001	55111760250001	5321	Wisconsin Dells - C 0008	55111881500008	5339	Hayward - C 0005	55113334500005
5304	Spring Green - V 0002	55111760250002	5322	Wisconsin Dells - C 0010	55111881500010	5340	Hayward - C 0006	55113334500006
5305	SPRING GREEN - T 0001	55111760500001	5323	WOODLAND - T 0001	55111887750001	5341	HAYWARD - T 0001	55113334750001
5306	SPRING GREEN - T 0002	55111760500002	5324	BASS LAKE - T 0001	55113052000001	5342	HAYWARD - T 0002	55113334750002
5307	SPRING GREEN - T 0003	55111760500003	5325	BASS LAKE - T 0002	55113052000002	5343	HAYWARD - T 0003	55113334750003
5308	SPRING GREEN - T 0004	55111760500004	5326	BASS LAKE - T 0003	55113052000003	5344	HAYWARD - T 0004	55113334750004
5309	SUMPTER - T 0001	55111785250001	5327	BASS LAKE - T 0004	55113052000004	5345	HAYWARD - T 0005	55113334750005
5310	SUMPTER - T 0002	55111785250002	5328	BASS LAKE - T 0005	55113052000005	5346	HAYWARD - T 0006	55113334750006

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5347	HAYWARD - T 0007	55113334750007	5365	WINTER - T 0001	55113880000001	5383	Eland - V 0001	55115229750001
5348	HAYWARD - T 0008	55113334750008	5366	WINTER - T 0002	55113880000002	5384	FAIRBANKS - T 0001	55115247750001
5349	HUNTER - T 0001	55113364500001	5367	ALMON - T 0001	55115013750001	5385	GERMANIA - T 0001	55115288250001
5350	LENROOT - T 0001	55113434000001	5368	ANGELICA - T 0001	55115019750001	5386	GERMANIA - T 0002	55115288250002
5351	LENROOT - T 0002	55113434000002	5369	ANGELICA - T 0002	55115019750002	5387	GRANT - T 0001	55115304000001
5352	MEADOWBROOK - T 0001	55113503000001	5370	ANGELICA - T 0003	55115019750003	5388	GRANT - T 0002	55115304000002
5353	METEOR - T 0001	55113514250001	5371	Aniwa - V 0001	55115020750001	5389	GREEN VALLEY - T 0001	55115315000001
5354	OJIBWA - T 0001	55113596000001	5372	ANIWA - T 0001	55115021000001	5390	GREEN VALLEY - T 0002	55115315000002
5355	OJIBWA - T 0002	55113596000002	5373	BARTELME - T 0001	55115050000001	5391	Gresham - V 0001	55115316750001
5356	Radisson - V 0001	55113660500001	5374	BELLE PLAINE - T 0001	55115062750001	5392	HARTLAND - T 0001	55115330750001
5357	RADISSON - T 0001	55113660750001	5375	BELLE PLAINE - T 0002	55115062750002	5393	HERMAN - T 0001	55115340250001
5358	RADISSON - T 0002	55113660750002	5376	BELLE PLAINE - T 0003	55115062750003	5394	HERMAN - T 0002	55115340250002
5359	ROUND LAKE - T 0001	55113697500001	5377	Birnamwood - V 0001	55115076000001	5395	HUTCHINS - T 0001	55115367000001
5360	ROUND LAKE - T 0002	55113697500002	5378	BIRNAMWOOD - T 0001	55115076250001	5396	LESSOR - T 0001	55115436750001
5361	SAND LAKE - T 0001	55113715000001	5379	Bonduel - V 0001	55115087250001	5397	LESSOR - T 0002	55115436750002
5362	SPIDER LAKE - T 0001	55113754500001	5380	Bonduel - V 0002	55115087250002	5398	MAPLE GROVE - T 0001	55115489000001
5363	WEIRGOR - T 0001	55113851000001	5381	Bowler - V 0001	55115090250001	5399	Marion - C 0004	55115494000004
5364	Winter - V 0001	55113879750001	5382	Cecil - V 0001	55115133250001	5400	Marion - C 0005	55115494000005

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5401	Marion - C 0006	55115494000006	5419	Shawano - C 0006	55115729250006	5437	Wittenberg - V 0002	55115883250002
5402	Mattoon - V 0001	55115500000001	5420	Shawano - C 0007	55115729250007	5438	WITTENBERG - T 0001	55115883500001
5403	MORRIS - T 0001	55115542500001	5421	Shawano - C 0008	55115729250008	5439	WITTENBERG - T 0002	55115883500002
5404	NAVARINO - T 0001	55115556750001	5422	Shawano - C 0009	55115729250009	5440	Adell - V 0001	55117004500001
5405	PELLA - T 0001	55115617000001	5423	Shawano - C 0010	55115729250010	5441	Cascade - V 0001	55117128250001
5406	Pulaski - V 0004	55115656750004	5424	Shawano - C 0011	55115729250011	5442	Cedar Grove - V 0001	55117134750001
5407	Pulaski - V 0007	55115656750007	5425	Shawano - C 0012	55115729250012	5443	Cedar Grove - V 0002	55117134750002
5408	RED SPRINGS - T 0001	55115667500001	5426	Tigerton - V 0001	55115798250001	5444	Cedar Grove - V 0003	55117134750003
5409	RED SPRINGS - T 0002	55115667500002	5427	WASHINGTON - T 0001	55115837250001	5445	Elkhart Lake - V 0001	55117232750001
5410	RICHMOND - T 0001	55115676750001	5428	WASHINGTON - T 0002	55115837250002	5446	Elkhart Lake - V 0002	55117232750002
5411	RICHMOND - T 0002	55115676750002	5429	WASHINGTON - T 0003	55115837250003	5447	Glenbeulah - V 0001	55117293500001
5412	RICHMOND - T 0003	55115676750003	5430	WAUKECHON - T 0001	55115842250001	5448	GREENBUSH - T 0001	55117311000001
5413	SENECA - T 0001	55115725500001	5431	WAUKECHON - T 0002	55115842250002	5449	GREENBUSH - T 0002	55117311000002
5414	Shawano - C 0001	55115729250001	5432	WESCOTT - T 0001	55115852750001	5450	GREENBUSH - T 0003	55117311000003
5415	Shawano - C 0002	55115729250002	5433	WESCOTT - T 0002	55115852750002	5451	HERMAN - T 0001	55117340500001
5416	Shawano - C 0003	55115729250003	5434	WESCOTT - T 0003	55115852750003	5452	HERMAN - T 0002	55117340500002
5417	Shawano - C 0004	55115729250004	5435	WESCOTT - T 0004	55115852750004	5453	HERMAN - T 0003	55117340500003
5418	Shawano - C 0005	55115729250005	5436	Wittenberg - V 0001	55115883250001	5454	HOLLAND - T 0001	55117353750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5455	HOLLAND - T 0002	55117353750002	5473	MITCHELL - T 0003	55117533750003	5491	PLYMOUTH - T 0001	55117637250001
5456	HOLLAND - T 0003	55117353750003	5474	MOSEL - T 0001	55117544750001	5492	PLYMOUTH - T 0002	55117637250002
5457	Howards Grove - V 0001	55117360250001	5475	Oostburg - V 0001	55117601000001	5493	PLYMOUTH - T 0003	55117637250003
5458	Howards Grove - V 0002	55117360250002	5476	Oostburg - V 0002	55117601000002	5494	PLYMOUTH - T 0004	55117637250004
5459	Howards Grove - V 0003	55117360250003	5477	Oostburg - V 0003	55117601000003	5495	Random Lake - V 0001	55117662000001
5460	Howards Grove - V 0004	55117360250004	5478	Oostburg - V 0004	55117601000004	5496	Random Lake - V 0002	55117662000002
5461	Kohler - V 0001	55117402750001	5479	Plymouth - C 0001	55117637000001	5497	RHINE - T 0001	55117671500001
5462	Kohler - V 0002	55117402750002	5480	Plymouth - C 0002	55117637000002	5498	RHINE - T 0002	55117671500002
5463	Kohler - V 0003	55117402750003	5481	Plymouth - C 0003	55117637000003	5499	RHINE - T 0003	55117671500003
5464	LIMA - T 0001	55117441500001	5482	Plymouth - C 0004	55117637000004	5500	RUSSELL - T 0001	55117703500001
5465	LIMA - T 0002	55117441500002	5483	Plymouth - C 0005	55117637000005	5501	SCOTT - T 0001	55117723500001
5466	LIMA - T 0003	55117441500003	5484	Plymouth - C 0006	55117637000006	5502	SCOTT - T 0002	55117723500002
5467	LIMA - T 0004	55117441500004	5485	Plymouth - C 0007	55117637000007	5503	SCOTT - T 0003	55117723500003
5468	LYNDON - T 0001	55117465750001	5486	Plymouth - C 0008	55117637000008	5504	Sheboygan - C 0001	55117729750001
5469	LYNDON - T 0002	55117465750002	5487	Plymouth - C 0009	55117637000009	5505	Sheboygan - C 0002	55117729750002
5470	LYNDON - T 0003	55117465750003	5488	Plymouth - C 0010	55117637000010	5506	Sheboygan - C 0003	55117729750003
5471	MITCHELL - T 0001	55117533750001	5489	Plymouth - C 0011	55117637000011	5507	Sheboygan - C 0004	55117729750004
5472	MITCHELL - T 0002	55117533750002	5490	Plymouth - C 0012	55117637000012	5508	Sheboygan - C 0005	55117729750005

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5509	Sheboygan - C 0006	55117729750006	5527	Sheboygan - C 0024	55117729750024	5545	Sheboygan Falls - C 0001	55117730250001
5510	Sheboygan - C 0007	55117729750007	5528	Sheboygan - C 0025	55117729750025	5546	Sheboygan Falls - C 0002	55117730250002
5511	Sheboygan - C 0008	55117729750008	5529	Sheboygan - C 0026	55117729750026	5547	Sheboygan Falls - C 0003	55117730250003
5512	Sheboygan - C 0009	55117729750009	5530	Sheboygan - C 0027	55117729750027	5548	Sheboygan Falls - C 0004	55117730250004
5513	Sheboygan - C 0010	55117729750010	5531	Sheboygan - C 0028	55117729750028	5549	Sheboygan Falls - C 0005	55117730250005
5514	Sheboygan - C 0011	55117729750011	5532	Sheboygan - C 0029	55117729750029	5550	Sheboygan Falls - C 0006	55117730250006
5515	Sheboygan - C 0012	55117729750012	5533	Sheboygan - C 0030	55117729750030	5551	Sheboygan Falls - C 0007	55117730250007
5516	Sheboygan - C 0013	55117729750013	5534	Sheboygan - C 0031	55117729750031	5552	Sheboygan Falls - C 0008	55117730250008
5517	Sheboygan - C 0014	55117729750014	5535	SHEBOYGAN - T 0001	55117730000001	5553	Sheboygan Falls - C 0009	55117730250009
5518	Sheboygan - C 0015	55117729750015	5536	SHEBOYGAN - T 0002	55117730000002	5554	SHEBOYGAN FALLS - T 0001	55117730500001
5519	Sheboygan - C 0016	55117729750016	5537	SHEBOYGAN - T 0003	55117730000003	5555	SHEBOYGAN FALLS - T 0002	55117730500002
5520	Sheboygan - C 0017	55117729750017	5538	SHEBOYGAN - T 0004	55117730000004	5556	SHEBOYGAN FALLS - T 0003	55117730500003
5521	Sheboygan - C 0018	55117729750018	5539	SHEBOYGAN - T 0005	55117730000005	5557	SHERMAN - T 0001	55117734250001
5522	Sheboygan - C 0019	55117729750019	5540	SHEBOYGAN - T 0006	55117730000006	5558	SHERMAN - T 0002	55117734250002
5523	Sheboygan - C 0020	55117729750020	5541	SHEBOYGAN - T 0007	55117730000007	5559	Waldo - V 0001	55117831000001
5524	Sheboygan - C 0021	55117729750021	5542	SHEBOYGAN - T 0008	55117730000008	5560	WILSON - T 0001	55117875000001
5525	Sheboygan - C 0022	55117729750022	5543	SHEBOYGAN - T 0009	55117730000009	5561	WILSON - T 0002	55117875000002
5526	Sheboygan - C 0023	55117729750023	5544	SHEBOYGAN - T 0010	55117730000010	5562	WILSON - T 0003	55117875000003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5563	WILSON - T 0004	55117875000004	5581	MCKINLEY - T 0001	55119469250001	5599	ROOSEVELT - T 0001	55119694000001
5564	AURORA - T 0001	55119039000001	5582	MAPLEHURST - T 0001	55119489250001	5600	Stetsonville - V 0001	55119771000001
5565	BROWNING - T 0001	55119104000001	5583	Medford - C 0001	55119504250001	5601	TAFT - T 0001	55119789500001
5566	CHELSEA - T 0001	55119142000001	5584	Medford - C 0002	55119504250002	5602	WESTBORO - T 0001	55119854500001
5567	CLEVELAND - T 0001	55119154500001	5585	Medford - C 0003	55119504250003	5603	ALBION - T 0001	55121009250001
5568	DEER CREEK - T 0001	55119192250001	5586	Medford - C 0004	55119504250004	5604	ALBION - T 0002	55121009250002
5569	FORD - T 0001	55119264250001	5587	Medford - C 0005	55119504250005	5605	Arcadia - C 0001	55121025000001
5570	Gilman - V 0001	55119291750001	5588	Medford - C 0006	55119504250006	5606	Arcadia - C 0002	55121025000002
5571	GOODRICH - T 0001	55119298370001	5589	Medford - C 0007	55119504250007	5607	Arcadia - C 0003	55121025000003
5572	GREENWOOD - T 0001	55119316000001	5590	Medford - C 0008	55119504250008	5608	ARCADIA - T 0001	55121025250001
5573	GROVER - T 0001	55119317500001	5591	MEDFORD - T 0001	55119504500001	5609	ARCADIA - T 0002	55121025250002
5574	HAMMEL - T 0001	55119323000001	5592	MEDFORD - T 0002	55119504500002	5610	ARCADIA - T 0003	55121025250003
5575	HAMMEL - T 0002	55119323000002	5593	MEDFORD - T 0003	55119504500003	5611	ARCADIA - T 0004	55121025250004
5576	HOLWAY - T 0001	55119355250001	5594	MOLITOR - T 0001	55119535500001	5612	Blair - C 0001	55121080750001
5577	JUMP RIVER - T 0001	55119386270001	5595	PERSHING - T 0001	55119621000001	5613	Blair - C 0002	55121080750002
5578	LITTLE BLACK - T 0001	55119449000001	5596	Rib Lake - V 0001	55119672750001	5614	Blair - C 0003	55121080750003
5579	LITTLE BLACK - T 0002	55119449000002	5597	RIB LAKE - T 0001	55119673000001	5615	BURNSIDE - T 0001	55121113250001
5580	Lublin - V 0001	55119461500001	5598	RIB LAKE - T 0002	55119673000002	5616	BURNSIDE - T 0002	55121113250002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5617	CALEDONIA - T 0001	55121119750001	5635	Osseo - C 0001	55121605750001	5653	Whitehall - C 0001	55121867250001
5618	CALEDONIA - T 0002	55121119750002	5636	Osseo - C 0002	55121605750002	5654	Whitehall - C 0002	55121867250002
5619	CHIMNEY ROCK - T 0001	55121145250001	5637	Osseo - C 0003	55121605750003	5655	BERGEN - T 0001	55123069000001
5620	DODGE - T 0001	55121203000001	5638	PIGEON - T 0001	55121626500001	5656	BERGEN - T 0002	55123069000002
5621	Eleva - V 0001	55121231750001	5639	PIGEON - T 0002	55121626500002	5657	BERGEN - T 0003	55123069000003
5622	Ettrick - V 0001	55121244000001	5640	Pigeon Falls - V 0001	55121626750001	5658	Chaseburg - V 0001	55123141500001
5623	ETTRICK - T 0001	55121244250001	5641	PRESTON - T 0001	55121655000001	5659	CHRISTIANA - T 0001	55123146750001
5624	ETTRICK - T 0002	55121244250002	5642	PRESTON - T 0002	55121655000002	5660	CHRISTIANA - T 0002	55123146750002
5625	GALE - T 0001	55121281500001	5643	PRESTON - T 0003	55121655000003	5661	CLINTON - T 0001	55123156750001
5626	GALE - T 0003	55121281500003	5644	Strum - V 0001	55121778250001	5662	CLINTON - T 0002	55123156750002
5627	Galesville - C 0001	55121282000001	5645	Strum - V 0002	55121778250002	5663	COON - T 0001	55123168750001
5628	Galesville - C 0002	55121282000002	5646	SUMNER - T 0001	55121785000001	5664	COON - T 0002	55123168750002
5629	Galesville - C 0003	55121282000003	5647	Trempealeau - V 0001	55121804750001	5665	Coon Valley - V 0001	55123169000001
5630	HALE - T 0001	55121320500001	5648	Trempealeau - V 0002	55121804750002	5666	De Soto - V 0001	55123198500001
5631	Independence - C 0001	55121368000001	5649	TREMPEALEAU - T 0001	55121805000001	5667	FOREST - T 0001	55123265500001
5632	Independence - C 0002	55121368000002	5650	TREMPEALEAU - T 0002	55121805000002	5668	FRANKLIN - T 0001	55123274000001
5633	Independence - C 0003	55121368000003	5651	UNITY - T 0001	55121818750001	5669	FRANKLIN - T 0002	55123274000002
5634	LINCOLN - T 0001	55121445000001	5652	UNITY - T 0002	55121818750002	5670	Genoa - V 0001	55123286250001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5671	GENOA - T 0001	55123286500001	5689	JEFFERSON - T 0004	55123379750004	5707	Viroqua - C 0005	55123829250005
5672	GENOA - T 0002	55123286500002	5690	KICKAPOO - T 0001	55123394750001	5708	Viroqua - C 0006	55123829250006
5673	GREENWOOD - T 0001	55123316250001	5691	La Farge - V 0001	55123408750001	5709	Viroqua - C 0007	55123829250007
5674	HAMBURG - T 0001	55123322250001	5692	LIBERTY - T 0001	55123439000001	5710	Viroqua - C 0008	55123829250008
5675	HAMBURG - T 0002	55123322250002	5693	Ontario - V 0001	55123600750001	5711	Viroqua - C 0009	55123829250009
5676	HARMONY - T 0001	55123327250001	5694	Readstown - V 0001	55123664500001	5712	VIROQUA - T 0001	55123829500001
5677	HARMONY - T 0002	55123327250002	5695	STARK - T 0001	55123767250001	5713	VIROQUA - T 0002	55123829500002
5678	HARMONY - T 0003	55123327250003	5696	STARK - T 0002	55123767250002	5714	VIROQUA - T 0003	55123829500003
5679	Hillsboro - C 0001	55123348250001	5697	STERLING - T 0001	55123770750001	5715	VIROQUA - T 0004	55123829500004
5680	Hillsboro - C 0002	55123348250002	5698	Stoddard - V 0001	55123775500001	5716	WEBSTER - T 0001	55123850500001
5681	Hillsboro - C 0003	55123348250003	5699	UNION - T 0001	55123816750001	5717	WEBSTER - T 0002	55123850500002
5682	Hillsboro - C 0004	55123348250004	5700	UNION - T 0002	55123816750002	5718	Westby - C 0001	55123854750001
5683	HILLSBORO - T 0001	55123348500001	5701	UNION - T 0003	55123816750003	5719	Westby - C 0002	55123854750002
5684	HILLSBORO - T 0002	55123348500002	5702	Viola - V 0001	55123829000001	5720	Westby - C 0003	55123854750003
5685	HILLSBORO - T 0003	55123348500003	5703	Viroqua - C 0001	55123829250001	5721	Westby - C 0004	55123854750004
5686	JEFFERSON - T 0001	55123379750001	5704	Viroqua - C 0002	55123829250002	5722	Westby - C 0005	55123854750005
5687	JEFFERSON - T 0002	55123379750002	5705	Viroqua - C 0003	55123829250003	5723	WHEATLAND - T 0001	55123865250001
5688	JEFFERSON - T 0003	55123379750003	5706	Viroqua - C 0004	55123829250004	5724	WHITESTOWN - T 0001	55123869000001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5725	ARBOR VITAE - T 0001	55125024500001	5743	LAC DU FLAMBEAU - T 0001	55125406870001	5761	PRESQUE ISLE - T 0001	55125654250001
5726	ARBOR VITAE - T 0002	55125024500002	5744	LAC DU FLAMBEAU - T 0002	55125406870002	5762	ST. GERMAIN - T 0001	55125707250001
5727	ARBOR VITAE - T 0003	55125024500003	5745	LAC DU FLAMBEAU - T 0003	55125406870003	5763	ST. GERMAIN - T 0002	55125707250002
5728	ARBOR VITAE - T 0004	55125024500004	5746	LAC DU FLAMBEAU - T 0004	55125406870004	5764	WASHINGTON - T 0001	55125837500001
5729	ARBOR VITAE - T 0005	55125024500005	5747	LAC DU FLAMBEAU - T 0005	55125406870005	5765	WASHINGTON - T 0002	55125837500002
5730	ARBOR VITAE - T 0006	55125024500006	5748	LAC DU FLAMBEAU - T 0006	55125406870006	5766	WASHINGTON - T 0003	55125837500003
5731	ARBOR VITAE - T 0007	55125024500007	5749	LAC DU FLAMBEAU - T 0007	55125406870007	5767	WINCHESTER - T 0001	55125876000001
5732	BOULDER JUNCTION - T 0001	55125089500001	5750	LAND O'LAKES - T 0001	55125423250001	5768	Bloomfield - V 0001	55127082650001
5733	BOULDER JUNCTION - T 0002	55125089500002	5751	LINCOLN - T 0001	55125445250001	5769	Bloomfield - V 0002	55127082650002
5734	CLOVERLAND - T 0001	55125158500001	5752	LINCOLN - T 0002	55125445250002	5770	Bloomfield - V 0003	55127082650003
5735	CLOVERLAND - T 0002	55125158500002	5753	LINCOLN - T 0003	55125445250003	5771	Bloomfield - V 0004	55127082650004
5736	CONOVER - T 0001	55125167500001	5754	LINCOLN - T 0004	55125445250004	5772	Bloomfield - V 0005	55127082650005
5737	CONOVER - T 0002	55125167500002	5755	LINCOLN - T 0005	55125445250005	5773	BLOOMFIELD - T 0001	55127082750001
5738	Eagle River - C 0001	55125216250001	5756	MANITOWISH WATERS - T 0001	55125484620001	5774	BLOOMFIELD - T 0002	55127082750002
5739	Eagle River - C 0002	55125216250002	5757	PHELPS - T 0001	55125624250001	5775	Burlington - C 0009	55127112000009
5740	Eagle River - C 0003	55125216250003	5758	PHELPS - T 0002	55125624250002	5776	Burlington - C 0010	55127112000010
5741	Eagle River - C 0004	55125216250004	5759	PLUM LAKE - T 0001	55125636250001	5777	Darien - V 0001	55127188250001
5742	Eagle River - C 0005	55125216250005	5760	PLUM LAKE - T 0002	55125636250002	5778	Darien - V 0002	55127188250002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5779	DARIEN - T 0001	55127188500001	5797	Delavan - C 0016	55127194500016	5815	EAST TROY - T 0002	55127221250002
5780	DARIEN - T 0002	55127188500002	5798	DELAVAN - T 0001	55127194750001	5816	EAST TROY - T 0003	55127221250003
5781	DARIEN - T 0003	55127188500003	5799	DELAVAN - T 0002	55127194750002	5817	EAST TROY - T 0004	55127221250004
5782	Delavan - C 0001	55127194500001	5800	DELAVAN - T 0003	55127194750003	5818	EAST TROY - T 0005	55127221250005
5783	Delavan - C 0002	55127194500002	5801	DELAVAN - T 0004	55127194750004	5819	EAST TROY - T 0006	55127221250006
5784	Delavan - C 0003	55127194500003	5802	DELAVAN - T 0005	55127194750005	5820	Elkhorn - C 0001	55127233000001
5785	Delavan - C 0004	55127194500004	5803	DELAVAN - T 0006	55127194750006	5821	Elkhorn - C 0002	55127233000002
5786	Delavan - C 0005	55127194500005	5804	DELAVAN - T 0007	55127194750007	5822	Elkhorn - C 0003	55127233000003
5787	Delavan - C 0006	55127194500006	5805	DELAVAN - T 0008	55127194750008	5823	Elkhorn - C 0004	55127233000004
5788	Delavan - C 0007	55127194500007	5806	DELAVAN - T 0009	55127194750009	5824	Elkhorn - C 0005	55127233000005
5789	Delavan - C 0008	55127194500008	5807	DELAVAN - T 0010	55127194750010	5825	Elkhorn - C 0006	55127233000006
5790	Delavan - C 0009	55127194500009	5808	DELAVAN - T 0011	55127194750011	5826	Elkhorn - C 0007	55127233000007
5791	Delavan - C 0010	55127194500010	5809	East Troy - V 0001	55127221000001	5827	Elkhorn - C 0008	55127233000008
5792	Delavan - C 0011	55127194500011	5810	East Troy - V 0002	55127221000002	5828	Fontana-On-Geneva Lake - V 0001	55127263500001
5793	Delavan - C 0012	55127194500012	5811	East Troy - V 0003	55127221000003	5829	Fontana-On-Geneva Lake - V 0002	55127263500002
5794	Delavan - C 0013	55127194500013	5812	East Troy - V 0004	55127221000004	5830	Fontana-On-Geneva Lake - V 0003	55127263500003
5795	Delavan - C 0014	55127194500014	5813	East Troy - V 0005	55127221000005	5831	GENEVA - T 0001	55127285500001
5796	Delavan - C 0015	55127194500015	5814	EAST TROY - T 0001	55127221250001	5832	GENEVA - T 0002	55127285500002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5833	GENEVA - T 0003	55127285500003	5851	Lake Geneva - C 0002	55127414500002	5869	LINN - T 0006	55127447500006
5834	GENEVA - T 0004	55127285500004	5852	Lake Geneva - C 0003	55127414500003	5870	LYONS - T 0001	55127467250001
5835	GENEVA - T 0005	55127285500005	5853	Lake Geneva - C 0004	55127414500004	5871	LYONS - T 0002	55127467250002
5836	GENEVA - T 0006	55127285500006	5854	Lake Geneva - C 0005	55127414500005	5872	LYONS - T 0003	55127467250003
5837	GENEVA - T 0007	55127285500007	5855	Lake Geneva - C 0006	55127414500006	5873	LYONS - T 0004	55127467250004
5838	GENEVA - T 0008	55127285500008	5856	Lake Geneva - C 0007	55127414500007	5874	LYONS - T 0005	55127467250005
5839	Genoa City - V 0001	55127286750001	5857	Lake Geneva - C 0008	55127414500008	5875	LYONS - T 0006	55127467250006
5840	Genoa City - V 0002	55127286750002	5858	Lake Geneva - C 0009	55127414500009	5876	LYONS - T 0007	55127467250007
5841	Genoa City - V 0003	55127286750003	5859	Lake Geneva - C 0010	55127414500010	5877	Mukwonago - V 0011	55127550500011
5842	Genoa City - V 0004	55127286750004	5860	Lake Geneva - C 0011	55127414500011	5878	RICHMOND - T 0001	55127677250001
5843	Genoa City - V GENOAV - V?	55127286759999	5861	Lake Geneva - C 0012	55127414500012	5879	RICHMOND - T 0002	55127677250002
5844	LAFAYETTE - T 0001	55127409500001	5862	Lake Geneva - C 0013	55127414500013	5880	RICHMOND - T 0003	55127677250003
5845	LAFAYETTE - T 0002	55127409500002	5863	Lake Geneva - C 0014	55127414500014	5881	Sharon - V 0001	55127728750001
5846	LAFAYETTE - T 0003	55127409500003	5864	LINN - T 0001	55127447500001	5882	Sharon - V 0002	55127728750002
5847	LA GRANGE - T 0001	55127410500001	5865	LINN - T 0002	55127447500002	5883	SHARON - T 0001	55127729000001
5848	LA GRANGE - T 0002	55127410500002	5866	LINN - T 0003	55127447500003	5884	SPRING PRAIRIE - T 0001	55127761750001
5849	LA GRANGE - T 0003	55127410500003	5867	LINN - T 0004	55127447500004	5885	SPRING PRAIRIE - T 0002	55127761750002
5850	Lake Geneva - C 0001	55127414500001	5868	LINN - T 0005	55127447500005	5886	SPRING PRAIRIE - T 0003	55127761750003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5887	SPRING PRAIRIE - T 0004	55127761750004	5905	Whitewater - C 0004	55127869250004	5923	BASS LAKE - T 0001	55129052250001
5888	SUGAR CREEK - T 0001	55127781000001	5906	Whitewater - C 0005	55127869250005	5924	BEAVER BROOK - T 0001	55129058750001
5889	SUGAR CREEK - T 0002	55127781000002	5907	Whitewater - C 0006	55127869250006	5925	BEAVER BROOK - T 0002	55129058750002
5890	SUGAR CREEK - T 0003	55127781000003	5908	Whitewater - C 0007	55127869250007	5926	BEAVER BROOK - T 0003	55129058750003
5891	SUGAR CREEK - T 0004	55127781000004	5909	Whitewater - C 0008	55127869250008	5927	Birchwood - V 0001	55129075500001
5892	SUGAR CREEK - T 0005	55127781000005	5910	Whitewater - C 0009	55127869250009	5928	BIRCHWOOD - T 0001	55129075750001
5893	TROY - T 0001	55127808750001	5911	Whitewater - C 0013	55127869250013	5929	BIRCHWOOD - T 0002	55129075750002
5894	TROY - T 0002	55127808750002	5912	WHITEWATER - T 0001	55127869500001	5930	BIRCHWOOD - T 0003	55129075750003
5895	TROY - T 0003	55127808750003	5913	WHITEWATER - T 0002	55127869500002	5931	BROOKLYN - T 0001	55129101500001
5896	Walworth - V 0001	55127832500001	5914	WHITEWATER - T 0003	55127869500003	5932	CASEY - T 0001	55129129250001
5897	Walworth - V 0002	55127832500002	5915	Williams Bay - V 0001	55127872000001	5933	CHICOG - T 0001	55129144250001
5898	Walworth - V 0003	55127832500003	5916	Williams Bay - V 0002	55127872000002	5934	CHICOG - T 0002	55129144250002
5899	WALWORTH - T 0001	55127832750001	5917	Williams Bay - V 0003	55127872000003	5935	CRYSTAL - T 0001	55129178500001
5900	WALWORTH - T 0002	55127832750002	5918	Williams Bay - V 0004	55127872000004	5936	CRYSTAL - T 0002	55129178500002
5901	WALWORTH - T 0003	55127832750003	5919	BARRONETT - T 0001	55129049500001	5937	EVERGREEN - T 0001	55129246000001
5902	Whitewater - C 0001	55127869250001	5920	BASHAW - T 0001	55129051250001	5938	EVERGREEN - T 0002	55129246000002
5903	Whitewater - C 0002	55127869250002	5921	BASHAW - T 0002	55129051250002	5939	FROG CREEK - T 0001	55129280250001
5904	Whitewater - C 0003	55127869250003	5922	BASHAW - T 0003	55129051250003	5940	GULL LAKE - T 0001	55129318250001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5941	LONG LAKE - T 0001	55129456500001	5959	SPOONER - T 0002	55129756500002	5977	ERIN - T 0002	55131242250002
5942	MADGE - T 0001	55129470250001	5960	SPOONER - T 0003	55129756500003	5978	ERIN - T 0003	55131242250003
5943	MADGE - T 0002	55129470250002	5961	SPRINGBROOK - T 0001	55129758000001	5979	ERIN - T 0004	55131242250004
5944	MADGE - T 0003	55129470250003	5962	STINNETT - T 0001	55129773500001	5980	FARMINGTON - T 0001	55131253750001
5945	Minong - V 0001	55129532500001	5963	STONE LAKE - T 0001	55129776500001	5981	FARMINGTON - T 0002	55131253750002
5946	MINONG - T 0001	55129532750001	5964	TREGO - T 0001	55129804500001	5982	FARMINGTON - T 0003	55131253750003
5947	MINONG - T 0002	55129532750002	5965	TREGO - T 0002	55129804500002	5983	FARMINGTON - T 0004	55131253750004
5948	SARONA - T 0001	55129716370001	5966	ADDISON - T 0001	55131004250001	5984	FARMINGTON - T 0005	55131253750005
5949	SARONA - T 0002	55129716370002	5967	ADDISON - T 0002	55131004250002	5985	Germantown - V 0001	55131288750001
5950	Shell Lake - C 0001	55129732000001	5968	ADDISON - T 0003	55131004250003	5986	Germantown - V 0002	55131288750002
5951	Shell Lake - C 0002	55129732000002	5969	ADDISON - T 0004	55131004250004	5987	Germantown - V 0003	55131288750003
5952	Spooner - C 0001	55129756250001	5970	ADDISON - T 0005	55131004250005	5988	Germantown - V 0004	55131288750004
5953	Spooner - C 0002	55129756250002	5971	ADDISON - T 0006	55131004250006	5989	Germantown - V 0005	55131288750005
5954	Spooner - C 0003	55129756250003	5972	BARTON - T 0001	55131050500001	5990	Germantown - V 0006	55131288750006
5955	Spooner - C 0004	55129756250004	5973	BARTON - T 0002	55131050500002	5991	Germantown - V 0007	55131288750007
5956	Spooner - C 0005	55129756250005	5974	BARTON - T 0003	55131050500003	5992	Germantown - V 0008	55131288750008
5957	Spooner - C 0006	55129756250006	5975	BARTON - T 0004	55131050500004	5993	Germantown - V 0009	55131288750009
5958	SPOONER - T 0001	55129756500001	5976	ERIN - T 0001	55131242250001	5994	Germantown - V 0010	55131288750010

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
5995	Germantown - V 0011	55131288750011	6013	Hartford - C 0011	55131330000011	6031	Hartford - C 0031	55131330000031
5996	Germantown - V 0012	55131288750012	6014	Hartford - C 0012	55131330000012	6032	Hartford - C 0032	55131330000032
5997	Germantown - V 0013	55131288750013	6015	Hartford - C 0013	55131330000013	6033	Hartford - C 0033	55131330000033
5998	Germantown - V 0014	55131288750014	6016	Hartford - C 0014	55131330000014	6034	HARTFORD - T 0001	55131330250001
5999	Germantown - V 0015	55131288750015	6017	Hartford - C 0015	55131330000015	6035	HARTFORD - T 0002	55131330250002
6000	Germantown - V 0016	55131288750016	6018	Hartford - C 0016	55131330000016	6036	HARTFORD - T 0003	55131330250003
6001	Germantown - V 0017	55131288750017	6019	Hartford - C 0017	55131330000017	6037	HARTFORD - T 0004	55131330250004
6002	GERMANTOWN - T 0001	55131289000001	6020	Hartford - C 0020	55131330000020	6038	HARTFORD - T 0005	55131330250005
6003	Hartford - C 0001	55131330000001	6021	Hartford - C 0021	55131330000021	6039	Jackson - V 0001	55131376750001
6004	Hartford - C 0002	55131330000002	6022	Hartford - C 0022	55131330000022	6040	Jackson - V 0002	55131376750002
6005	Hartford - C 0003	55131330000003	6023	Hartford - C 0023	55131330000023	6041	Jackson - V 0003	55131376750003
6006	Hartford - C 0004	55131330000004	6024	Hartford - C 0024	55131330000024	6042	Jackson - V 0004	55131376750004
6007	Hartford - C 0005	55131330000005	6025	Hartford - C 0025	55131330000025	6043	Jackson - V 0005	55131376750005
6008	Hartford - C 0006	55131330000006	6026	Hartford - C 0026	55131330000026	6044	Jackson - V 0006	55131376750006
6009	Hartford - C 0007	55131330000007	6027	Hartford - C 0027	55131330000027	6045	Jackson - V 0007	55131376750007
6010	Hartford - C 0008	55131330000008	6028	Hartford - C 0028	55131330000028	6046	Jackson - V 0008	55131376750008
6011	Hartford - C 0009	55131330000009	6029	Hartford - C 0029	55131330000029	6047	Jackson - V 0009	55131376750009
6012	Hartford - C 0010	55131330000010	6030	Hartford - C 0030	55131330000030	6048	Jackson - V 0010	55131376750010

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6049	Jackson - V 0011	55131376750011	6067	Newburg - V 0002	55131564500002	6085	Slinger - V 0003	55131744000003
6050	Jackson - V 0012	55131376750012	6068	POLK - T 0001	55131638750001	6086	Slinger - V 0004	55131744000004
6051	JACKSON - T 0001	55131377000001	6069	POLK - T 0002	55131638750002	6087	Slinger - V 0005	55131744000005
6052	JACKSON - T 0002	55131377000002	6070	POLK - T 0003	55131638750003	6088	Slinger - V 0006	55131744000006
6053	JACKSON - T 0003	55131377000003	6071	POLK - T 0004	55131638750004	6089	Slinger - V 0007	55131744000007
6054	JACKSON - T 0004	55131377000004	6072	POLK - T 0005	55131638750005	6090	Slinger - V 0008	55131744000008
6055	JACKSON - T 0005	55131377000005	6073	POLK - T 0006	55131638750006	6091	Slinger - V 0009	55131744000009
6056	JACKSON - T 0006	55131377000006	6074	Richfield - V 0001	55131674750001	6092	TRENTON - T 0001	55131805750001
6057	Kewaskum - V 0001	55131393000001	6075	Richfield - V 0002	55131674750002	6093	TRENTON - T 0002	55131805750002
6058	Kewaskum - V 0002	55131393000002	6076	Richfield - V 0003	55131674750003	6094	TRENTON - T 0003	55131805750003
6059	Kewaskum - V 0003	55131393000003	6077	Richfield - V 0004	55131674750004	6095	TRENTON - T 0004	55131805750004
6060	Kewaskum - V 0004	55131393000004	6078	Richfield - V 0005	55131674750005	6096	TRENTON - T 0005	55131805750005
6061	Kewaskum - V 0005	55131393000005	6079	Richfield - V 0006	55131674750006	6097	TRENTON - T 0006	55131805750006
6062	Kewaskum - V 0007	55131393000007	6080	Richfield - V 0007	55131674750007	6098	TRENTON - T 0007	55131805750007
6063	KEWASKUM - T 0001	55131393250001	6081	Richfield - V 0008	55131674750008	6099	TRENTON - T 0008	55131805750008
6064	KEWASKUM - T 0002	55131393250002	6082	Richfield - V 0009	55131674750009	6100	WAYNE - T 0001	55131849000001
6065	Milwaukee - C 0318	55131530000318	6083	Slinger - V 0001	55131744000001	6101	WAYNE - T 0002	55131849000002
6066	Newburg - V 0001	55131564500001	6084	Slinger - V 0002	55131744000002	6102	WAYNE - T 0003	55131849000003

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6103	West Bend - C 0001	55131853500001	6121	West Bend - C 0019	55131853500019	6139	WEST BEND - T 0004	55131853750004
6104	West Bend - C 0002	55131853500002	6122	West Bend - C 0020	55131853500020	6140	WEST BEND - T 0005	55131853750005
6105	West Bend - C 0003	55131853500003	6123	West Bend - C 0021	55131853500021	6141	WEST BEND - T 0006	55131853750006
6106	West Bend - C 0004	55131853500004	6124	West Bend - C 0022	55131853500022	6142	WEST BEND - T 0007	55131853750007
6107	West Bend - C 0005	55131853500005	6125	West Bend - C 0023	55131853500023	6143	WEST BEND - T 0008	55131853750008
6108	West Bend - C 0006	55131853500006	6126	West Bend - C 0024	55131853500024	6144	Big Bend - V 0001	55133072000001
6109	West Bend - C 0007	55131853500007	6127	West Bend - C 0025	55131853500025	6145	Big Bend - V 0002	55133072000002
6110	West Bend - C 0008	55131853500008	6128	West Bend - C 0026	55131853500026	6146	Big Bend - V 0003	55133072000003
6111	West Bend - C 0009	55131853500009	6129	West Bend - C 0027	55131853500027	6147	Big Bend - V 0004	55133072000004
6112	West Bend - C 0010	55131853500010	6130	West Bend - C 0028	55131853500028	6148	Brookfield - C 0001	55133100250001
6113	West Bend - C 0011	55131853500011	6131	West Bend - C 0029	55131853500029	6149	Brookfield - C 0002	55133100250002
6114	West Bend - C 0012	55131853500012	6132	West Bend - C 0030	55131853500030	6150	Brookfield - C 0003	55133100250003
6115	West Bend - C 0013	55131853500013	6133	West Bend - C 0031	55131853500031	6151	Brookfield - C 0004	55133100250004
6116	West Bend - C 0014	55131853500014	6134	West Bend - C 0032	55131853500032	6152	Brookfield - C 0005	55133100250005
6117	West Bend - C 0015	55131853500015	6135	West Bend - C 0033	55131853500033	6153	Brookfield - C 0006	55133100250006
6118	West Bend - C 0016	55131853500016	6136	WEST BEND - T 0001	55131853750001	6154	Brookfield - C 0007	55133100250007
6119	West Bend - C 0017	55131853500017	6137	WEST BEND - T 0002	55131853750002	6155	Brookfield - C 0008	55133100250008
6120	West Bend - C 0018	55131853500018	6138	WEST BEND - T 0003	55131853750003	6156	Brookfield - C 0009	55133100250009

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6157	Brookfield - C 0010	55133100250010	6175	BROOKFIELD - T 0003	55133100500003	6193	Delafield - C 0007	55133194000007
6158	Brookfield - C 0011	55133100250011	6176	BROOKFIELD - T 0004	55133100500004	6194	Delafield - C 0008	55133194000008
6159	Brookfield - C 0012	55133100250012	6177	BROOKFIELD - T 0005	55133100500005	6195	Delafield - C 0009	55133194000009
6160	Brookfield - C 0013	55133100250013	6178	BROOKFIELD - T 0006	55133100500006	6196	Delafield - C 0010	55133194000010
6161	Brookfield - C 0014	55133100250014	6179	BROOKFIELD - T 0007	55133100500007	6197	Delafield - C 0011	55133194000011
6162	Brookfield - C 0015	55133100250015	6180	BROOKFIELD - T 0008	55133100500008	6198	Delafield - C 0012	55133194000012
6163	Brookfield - C 0016	55133100250016	6181	BROOKFIELD - T 0009	55133100500009	6199	Delafield - C 0013	55133194000013
6164	Brookfield - C 0017	55133100250017	6182	BROOKFIELD - T 0010	55133100500010	6200	Delafield - C 0014	55133194000014
6165	Brookfield - C 0018	55133100250018	6183	Butler - V 0001	55133114750001	6201	DELAFIELD - T 0001	55133194250001
6166	Brookfield - C 0019	55133100250019	6184	Butler - V 0002	55133114750002	6202	DELAFIELD - T 0002	55133194250002
6167	Brookfield - C 0020	55133100250020	6185	Butler - V 0003	55133114750003	6203	DELAFIELD - T 0003	55133194250003
6168	Brookfield - C 0021	55133100250021	6186	Chenequa - V 0001	55133142250001	6204	DELAFIELD - T 0004	55133194250004
6169	Brookfield - C 0022	55133100250022	6187	Delafield - C 0001	55133194000001	6205	DELAFIELD - T 0005	55133194250005
6170	Brookfield - C 0023	55133100250023	6188	Delafield - C 0002	55133194000002	6206	DELAFIELD - T 0006	55133194250006
6171	Brookfield - C 0024	55133100250024	6189	Delafield - C 0003	55133194000003	6207	DELAFIELD - T 0007	55133194250007
6172	Brookfield - C 0025	55133100250025	6190	Delafield - C 0004	55133194000004	6208	DELAFIELD - T 0008	55133194250008
6173	BROOKFIELD - T 0001	55133100500001	6191	Delafield - C 0005	55133194000005	6209	DELAFIELD - T 0009	55133194250009
6174	BROOKFIELD - T 0002	55133100500002	6192	Delafield - C 0006	55133194000006	6210	DELAFIELD - T 0010	55133194250010

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6211	DELAFIELD - T 0011	55133194250011	6229	Elm Grove - V 0007	55133235750007	6247	Hartland - V 0007	55133331000007
6212	Dousman - V 0001	55133205500001	6230	Elm Grove - V 0008	55133235750008	6248	Hartland - V 0008	55133331000008
6213	Dousman - V 0002	55133205500002	6231	GENESEE - T 0001	55133284870001	6249	Hartland - V 0009	55133331000009
6214	Dousman - V 0003	55133205500003	6232	GENESEE - T 0002	55133284870002	6250	Hartland - V 0010	55133331000010
6215	Dousman - V 0004	55133205500004	6233	GENESEE - T 0003	55133284870003	6251	Hartland - V 0011	55133331000011
6216	Dousman - V 0005	55133205500005	6234	GENESEE - T 0004	55133284870004	6252	Hartland - V 0012	55133331000012
6217	Eagle - V 0001	55133214250001	6235	GENESEE - T 0005	55133284870005	6253	Hartland - V 0013	55133331000013
6218	Eagle - V 0002	55133214250002	6236	GENESEE - T 0006	55133284870006	6254	Hartland - V 0014	55133331000014
6219	EAGLE - T 0001	55133214500001	6237	GENESEE - T 0007	55133284870007	6255	Lac La Belle - V 0001	55133407500001
6220	EAGLE - T 0002	55133214500002	6238	GENESEE - T 0008	55133284870008	6256	Lannon - V 0001	55133424500001
6221	EAGLE - T 0003	55133214500003	6239	GENESEE - T 0009	55133284870009	6257	Lannon - V 0002	55133424500002
6222	EAGLE - T 0004	55133214500004	6240	GENESEE - T 0010	55133284870010	6258	LISBON - T 0001	55133448500001
6223	Elm Grove - V 0001	55133235750001	6241	Hartland - V 0001	55133331000001	6259	LISBON - T 0002	55133448500002
6224	Elm Grove - V 0002	55133235750002	6242	Hartland - V 0002	55133331000002	6260	LISBON - T 0003	55133448500003
6225	Elm Grove - V 0003	55133235750003	6243	Hartland - V 0003	55133331000003	6261	LISBON - T 0004	55133448500004
6226	Elm Grove - V 0004	55133235750004	6244	Hartland - V 0004	55133331000004	6262	LISBON - T 0005	55133448500005
6227	Elm Grove - V 0005	55133235750005	6245	Hartland - V 0005	55133331000005	6263	LISBON - T 0006	55133448500006
6228	Elm Grove - V 0006	55133235750006	6246	Hartland - V 0006	55133331000006	6264	Menomonee Falls - V 0001	55133510000001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6265	Menomonee Falls - V 0002	55133510000002	6283	Menomonee Falls - V 0020	55133510000020	6301	MERTON - T 0010	55133514000010
6266	Menomonee Falls - V 0003	55133510000003	6284	Menomonee Falls - V 0021	55133510000021	6302	MERTON - T 0011	55133514000011
6267	Menomonee Falls - V 0004	55133510000004	6285	Menomonee Falls - V 0022	55133510000022	6303	Milwaukee - C 0319	55133530000319
6268	Menomonee Falls - V 0005	55133510000005	6286	Menomonee Falls - V 0023	55133510000023	6304	Mukwonago - V 0001	55133550500001
6269	Menomonee Falls - V 0006	55133510000006	6287	Merton - V 0001	55133513750001	6305	Mukwonago - V 0002	55133550500002
6270	Menomonee Falls - V 0007	55133510000007	6288	Merton - V 0002	55133513750002	6306	Mukwonago - V 0003	55133550500003
6271	Menomonee Falls - V 0008	55133510000008	6289	Merton - V 0003	55133513750003	6307	Mukwonago - V 0004	55133550500004
6272	Menomonee Falls - V 0009	55133510000009	6290	Merton - V 0004	55133513750004	6308	Mukwonago - V 0005	55133550500005
6273	Menomonee Falls - V 0010	55133510000010	6291	Merton - V 0005	55133513750005	6309	Mukwonago - V 0006	55133550500006
6274	Menomonee Falls - V 0011	55133510000011	6292	MERTON - T 0001	55133514000001	6310	Mukwonago - V 0007	55133550500007
6275	Menomonee Falls - V 0012	55133510000012	6293	MERTON - T 0002	55133514000002	6311	Mukwonago - V 0008	55133550500008
6276	Menomonee Falls - V 0013	55133510000013	6294	MERTON - T 0003	55133514000003	6312	Mukwonago - V 0009	55133550500009
6277	Menomonee Falls - V 0014	55133510000014	6295	MERTON - T 0004	55133514000004	6313	Mukwonago - V 0010	55133550500010
6278	Menomonee Falls - V 0015	55133510000015	6296	MERTON - T 0005	55133514000005	6314	Mukwonago - V 0012	55133550500012
6279	Menomonee Falls - V 0016	55133510000016	6297	MERTON - T 0006	55133514000006	6315	MUKWONAGO - T 0001	55133550750001
6280	Menomonee Falls - V 0017	55133510000017	6298	MERTON - T 0007	55133514000007	6316	MUKWONAGO - T 0002	55133550750002
6281	Menomonee Falls - V 0018	55133510000018	6299	MERTON - T 0008	55133514000008	6317	MUKWONAGO - T 0003	55133550750003
6282	Menomonee Falls - V 0019	55133510000019	6300	MERTON - T 0009	55133514000009	6318	MUKWONAGO - T 0004	55133550750004

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6319	MUKWONAGO - T 0005	55133550750005	6337	Muskego - C 0012	55133552750012	6355	New Berlin - C 0011	55133563750011
6320	MUKWONAGO - T 0006	55133550750006	6338	Muskego - C 0013	55133552750013	6356	New Berlin - C 0012	55133563750012
6321	MUKWONAGO - T 0007	55133550750007	6339	Muskego - C 0014	55133552750014	6357	New Berlin - C 0013	55133563750013
6322	MUKWONAGO - T 0008	55133550750008	6340	Muskego - C 0015	55133552750015	6358	New Berlin - C 0014	55133563750014
6323	MUKWONAGO - T 0009	55133550750009	6341	Muskego - C 0016	55133552750016	6359	New Berlin - C 0015	55133563750015
6324	MUKWONAGO - T 0010	55133550750010	6342	Nashotah - V 0001	55133555500001	6360	New Berlin - C 0016	55133563750016
6325	MUKWONAGO - T 0011	55133550750011	6343	Nashotah - V 0002	55133555500002	6361	New Berlin - C 0017	55133563750017
6326	Muskego - C 0001	55133552750001	6344	Nashotah - V 0003	55133555500003	6362	New Berlin - C 0018	55133563750018
6327	Muskego - C 0002	55133552750002	6345	New Berlin - C 0001	55133563750001	6363	New Berlin - C 0019	55133563750019
6328	Muskego - C 0003	55133552750003	6346	New Berlin - C 0002	55133563750002	6364	New Berlin - C 0020	55133563750020
6329	Muskego - C 0004	55133552750004	6347	New Berlin - C 0003	55133563750003	6365	New Berlin - C 0021	55133563750021
6330	Muskego - C 0005	55133552750005	6348	New Berlin - C 0004	55133563750004	6366	New Berlin - C 0022	55133563750022
6331	Muskego - C 0006	55133552750006	6349	New Berlin - C 0005	55133563750005	6367	New Berlin - C 0023	55133563750023
6332	Muskego - C 0007	55133552750007	6350	New Berlin - C 0006	55133563750006	6368	New Berlin - C 0024	55133563750024
6333	Muskego - C 0008	55133552750008	6351	New Berlin - C 0007	55133563750007	6369	New Berlin - C 0025	55133563750025
6334	Muskego - C 0009	55133552750009	6352	New Berlin - C 0008	55133563750008	6370	New Berlin - C 0026	55133563750026
6335	Muskego - C 0010	55133552750010	6353	New Berlin - C 0009	55133563750009	6371	New Berlin - C 0027	55133563750027
6336	Muskego - C 0011	55133552750011	6354	New Berlin - C 0010	55133563750010	6372	North Prairie - V 0001	55133584000001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6373	North Prairie - V 0002	55133584000002	6391	OCONOMOWOC - T 0002	55133592750002	6409	Pewaukee - C 0004	55133622400004
6374	North Prairie - V 0003	55133584000003	6392	OCONOMOWOC - T 0003	55133592750003	6410	Pewaukee - C 0005	55133622400005
6375	Oconomowoc - C 0001	55133592500001	6393	OCONOMOWOC - T 0004	55133592750004	6411	Pewaukee - C 0006	55133622400006
6376	Oconomowoc - C 0002	55133592500002	6394	OCONOMOWOC - T 0005	55133592750005	6412	Pewaukee - C 0007	55133622400007
6377	Oconomowoc - C 0003	55133592500003	6395	OCONOMOWOC - T 0006	55133592750006	6413	Pewaukee - C 0008	55133622400008
6378	Oconomowoc - C 0004	55133592500004	6396	OCONOMOWOC - T 0007	55133592750007	6414	Pewaukee - C 0009	55133622400009
6379	Oconomowoc - C 0005	55133592500005	6397	OCONOMOWOC - T 0008	55133592750008	6415	Pewaukee - C 0010	55133622400010
6380	Oconomowoc - C 0006	55133592500006	6398	OCONOMOWOC - T 0009	55133592750009	6416	Pewaukee - V 0001	55133622500001
6381	Oconomowoc - C 0007	55133592500007	6399	OCONOMOWOC - T 0010	55133592750010	6417	Pewaukee - V 0002	55133622500002
6382	Oconomowoc - C 0008	55133592500008	6400	Oconomowoc Lake - V 0001	55133593000001	6418	Pewaukee - V 0003	55133622500003
6383	Oconomowoc - C 0009	55133592500009	6401	OTTAWA - T 0001	55133607000001	6419	Pewaukee - V 0004	55133622500004
6384	Oconomowoc - C 0010	55133592500010	6402	OTTAWA - T 0002	55133607000002	6420	Pewaukee - V 0005	55133622500005
6385	Oconomowoc - C 0011	55133592500011	6403	OTTAWA - T 0003	55133607000003	6421	Pewaukee - V 0006	55133622500006
6386	Oconomowoc - C 0012	55133592500012	6404	OTTAWA - T 0004	55133607000004	6422	Pewaukee - V 0007	55133622500007
6387	Oconomowoc - C 0013	55133592500013	6405	OTTAWA - T 0005	55133607000005	6423	Pewaukee - V 0008	55133622500008
6388	Oconomowoc - C 0014	55133592500014	6406	Pewaukee - C 0001	55133622400001	6424	Pewaukee - V 0009	55133622500009
6389	Oconomowoc - C 0015	55133592500015	6407	Pewaukee - C 0002	55133622400002	6425	Pewaukee - V 0010	55133622500010
6390	OCONOMOWOC - T 0001	55133592750001	6408	Pewaukee - C 0003	55133622400003	6426	Summit - V 0001	55133783750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6427	Summit - V 0002	55133783750002	6445	VERNON - T 0004	55133825750004	6463	Waukesha - C 0006	55133842500006
6428	Summit - V 0003	55133783750003	6446	VERNON - T 0005	55133825750005	6464	Waukesha - C 0007	55133842500007
6429	Summit - V 0004	55133783750004	6447	VERNON - T 0006	55133825750006	6465	Waukesha - C 0008	55133842500008
6430	Summit - V 0005	55133783750005	6448	VERNON - T 0007	55133825750007	6466	Waukesha - C 0009	55133842500009
6431	Summit - V 0006	55133783750006	6449	VERNON - T 0008	55133825750008	6467	Waukesha - C 0010	55133842500010
6432	Sussex - V 0001	55133787500001	6450	VERNON - T 0009	55133825750009	6468	Waukesha - C 0011	55133842500011
6433	Sussex - V 0002	55133787500002	6451	VERNON - T 0010	55133825750010	6469	Waukesha - C 0012	55133842500012
6434	Sussex - V 0003	55133787500003	6452	VERNON - T 0011	55133825750011	6470	Waukesha - C 0013	55133842500013
6435	Sussex - V 0004	55133787500004	6453	Wales - V 0001	55133831750001	6471	Waukesha - C 0014	55133842500014
6436	Sussex - V 0005	55133787500005	6454	Wales - V 0002	55133831750002	6472	Waukesha - C 0015	55133842500015
6437	Sussex - V 0006	55133787500006	6455	Wales - V 0003	55133831750003	6473	Waukesha - C 0016	55133842500016
6438	Sussex - V 0007	55133787500007	6456	Wales - V 0004	55133831750004	6474	Waukesha - C 0017	55133842500017
6439	Sussex - V 0008	55133787500008	6457	Wales - V 0005	55133831750005	6475	Waukesha - C 0018	55133842500018
6440	Sussex - V 0009	55133787500009	6458	Waukesha - C 0001	55133842500001	6476	Waukesha - C 0019	55133842500019
6441	Sussex - V 0010	55133787500010	6459	Waukesha - C 0002	55133842500002	6477	Waukesha - C 0020	55133842500020
6442	VERNON - T 0001	55133825750001	6460	Waukesha - C 0003	55133842500003	6478	Waukesha - C 0021	55133842500021
6443	VERNON - T 0002	55133825750002	6461	Waukesha - C 0004	55133842500004	6479	Waukesha - C 0022	55133842500022
6444	VERNON - T 0003	55133825750003	6462	Waukesha - C 0005	55133842500005	6480	Waukesha - C 0023	55133842500023

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6481	Waukesha - C 0024	55133842500024	6499	Waukesha - C 0042	55133842500042	6517	WAUKESHA - T 0011	55133842750011
6482	Waukesha - C 0025	55133842500025	6500	Waukesha - C 0043	55133842500043	6518	WAUKESHA - T 0012	55133842750012
6483	Waukesha - C 0026	55133842500026	6501	Waukesha - C 0044	55133842500044	6519	BEAR CREEK - T 0001	55135056250001
6484	Waukesha - C 0027	55133842500027	6502	Waukesha - C 0045	55133842500045	6520	Big Falls - V 0001	55135072500001
6485	Waukesha - C 0028	55133842500028	6503	Waukesha - C 0046	55133842500046	6521	CALEDONIA - T 0001	55135120000001
6486	Waukesha - C 0029	55133842500029	6504	Waukesha - C 0047	55133842500047	6522	CALEDONIA - T 0002	55135120000002
6487	Waukesha - C 0030	55133842500030	6505	Waukesha - C 0048	55133842500048	6523	Clintonville - C 0001	55135157250001
6488	Waukesha - C 0031	55133842500031	6506	Waukesha - C 0049	55133842500049	6524	Clintonville - C 0002	55135157250002
6489	Waukesha - C 0032	55133842500032	6507	WAUKESHA - T 0001	55133842750001	6525	Clintonville - C 0003	55135157250003
6490	Waukesha - C 0033	55133842500033	6508	WAUKESHA - T 0002	55133842750002	6526	Clintonville - C 0004	55135157250004
6491	Waukesha - C 0034	55133842500034	6509	WAUKESHA - T 0003	55133842750003	6527	Clintonville - C 0005	55135157250005
6492	Waukesha - C 0035	55133842500035	6510	WAUKESHA - T 0004	55133842750004	6528	Clintonville - C 0006	55135157250006
6493	Waukesha - C 0036	55133842500036	6511	WAUKESHA - T 0005	55133842750005	6529	Clintonville - C 0007	55135157250007
6494	Waukesha - C 0037	55133842500037	6512	WAUKESHA - T 0006	55133842750006	6530	Clintonville - C 0008	55135157250008
6495	Waukesha - C 0038	55133842500038	6513	WAUKESHA - T 0007	55133842750007	6531	Clintonville - C 0009	55135157250009
6496	Waukesha - C 0039	55133842500039	6514	WAUKESHA - T 0008	55133842750008	6532	Clintonville - C 0010	55135157250010
6497	Waukesha - C 0040	55133842500040	6515	WAUKESHA - T 0009	55133842750009	6533	DAYTON - T 0001	55135190250001
6498	Waukesha - C 0041	55133842500041	6516	WAUKESHA - T 0010	55133842750010	6534	DAYTON - T 0002	55135190250002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6535	DAYTON - T 0003	55135190250003	6553	Iola - V 0002	55135370250002	6571	Marion - C 0002	55135494000002
6536	DAYTON - T 0004	55135190250004	6554	IOLA - T 0001	55135370500001	6572	Marion - C 0003	55135494000003
6537	DUPONT - T 0001	55135212000001	6555	IOLA - T 0002	55135370500002	6573	MATTESON - T 0001	55135499750001
6538	DUPONT - T 0002	55135212000002	6556	LARRABEE - T 0001	55135426500001	6574	MUKWA - T 0001	55135550250001
6539	Embarrass - V 0001	55135238500001	6557	LARRABEE - T 0002	55135426500002	6575	MUKWA - T 0002	55135550250002
6540	FARMINGTON - T 0001	55135254000001	6558	LEBANON - T 0001	55135430750001	6576	MUKWA - T 0003	55135550250003
6541	FARMINGTON - T 0002	55135254000002	6559	LEBANON - T 0002	55135430750002	6577	MUKWA - T 0004	55135550250004
6542	FARMINGTON - T 0003	55135254000003	6560	LEBANON - T 0003	55135430750003	6578	MUKWA - T 0005	55135550250005
6543	FARMINGTON - T 0004	55135254000004	6561	LIND - T 0001	55135445750001	6579	New London - C 0003	55135569250003
6544	FARMINGTON - T 0005	55135254000005	6562	LIND - T 0002	55135445750002	6580	New London - C 0004	55135569250004
6545	FARMINGTON - T 0006	55135254000006	6563	LIND - T 0003	55135445750003	6581	New London - C 0006	55135569250006
6546	Fremont - V 0001	55135278000001	6564	LITTLE WOLF - T 0001	55135453000001	6582	New London - C 0007	55135569250007
6547	FREMONT - T 0001	55135278500001	6565	LITTLE WOLF - T 0002	55135453000002	6583	New London - C 0008	55135569250008
6548	FREMONT - T 0002	55135278500002	6566	LITTLE WOLF - T 0003	55135453000003	6584	New London - C 0009	55135569250009
6549	HARRISON - T 0001	55135329250001	6567	Manawa - C 0001	55135483500001	6585	New London - C 0010	55135569250010
6550	HELVETIA - T 0001	55135338500001	6568	Manawa - C 0002	55135483500002	6586	New London - C 0011	55135569250011
6551	HELVETIA - T 0002	55135338500002	6569	Manawa - C 0003	55135483500003	6587	New London - C 0012	55135569250012
6552	Iola - V 0001	55135370250001	6570	Marion - C 0001	55135494000001	6588	Ogdensburg - V 0001	55135594750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6589	ROYALTON - T 0001	55135699000001	6607	Waupaca - C 0010	55135843750010	6625	DAKOTA - T 0002	55137184750002
6590	ROYALTON - T 0002	55135699000002	6608	Waupaca - C 0011	55135843750011	6626	DEERFIELD - T 0001	55137193000001
6591	ST. LAWRENCE - T 0001	55135709000001	6609	Waupaca - C 0012	55135843750012	6627	Hancock - V 0001	55137324500001
6592	ST. LAWRENCE - T 0002	55135709000002	6610	Waupaca - C 0013	55135843750013	6628	HANCOCK - T 0001	55137324750001
6593	Scandinavia - V 0001	55135719750001	6611	WAUPACA - T 0001	55135844000001	6629	LEON - T 0001	55137435000001
6594	SCANDINAVIA - T 0001	55135720000001	6612	WAUPACA - T 0002	55135844000002	6630	LEON - T 0002	55137435000002
6595	SCANDINAVIA - T 0002	55135720000002	6613	Weyauwega - C 0001	55135864000001	6631	LEON - T 0003	55137435000003
6596	UNION - T 0001	55135817000001	6614	Weyauwega - C 0002	55135864000002	6632	Lohrville - V 0001	55137454250001
6597	UNION - T 0002	55135817000002	6615	Weyauwega - C 0003	55135864000003	6633	MARION - T 0001	55137494250001
6598	Waupaca - C 0001	55135843750001	6616	WEYAUWEGA - T 0001	55135864250001	6634	MARION - T 0002	55137494250002
6599	Waupaca - C 0002	55135843750002	6617	WYOMING - T 0001	55135893750001	6635	MARION - T 0003	55137494250003
6600	Waupaca - C 0003	55135843750003	6618	AURORA - T 0001	55137039250001	6636	MARION - T 0004	55137494250004
6601	Waupaca - C 0004	55135843750004	6619	Berlin - C 0007	55137069250007	6637	MOUNT MORRIS - T 0001	55137548250001
6602	Waupaca - C 0005	55135843750005	6620	BLOOMFIELD - T 0001	55137083000001	6638	MOUNT MORRIS - T 0002	55137548250002
6603	Waupaca - C 0006	55135843750006	6621	BLOOMFIELD - T 0002	55137083000002	6639	OASIS - T 0001	55137592250001
6604	Waupaca - C 0007	55135843750007	6622	Coloma - V 0001	55137163750001	6640	Plainfield - V 0001	55137631500001
6605	Waupaca - C 0008	55135843750008	6623	COLOMA - T 0001	55137164000001	6641	PLAINFIELD - T 0001	55137631750001
6606	Waupaca - C 0009	55135843750009	6624	DAKOTA - T 0001	55137184750001	6642	POY SIPPI - T 0001	55137649750001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6643	Redgranite - V 0001	55137666250001	6661	ALGOMA - T 0001	55139010250001	6679	CLAYTON - T 0004	55139151500004
6644	Redgranite - V 0002	55137666250002	6662	ALGOMA - T 0002	55139010250002	6680	CLAYTON - T 0005	55139151500005
6645	Redgranite - V 0003	55137666250003	6663	ALGOMA - T 0003	55139010250003	6681	CLAYTON - T 0006	55139151500006
6646	RICHFORD - T 0001	55137675500001	6664	ALGOMA - T 0004	55139010250004	6682	CLAYTON - T 0007	55139151500007
6647	RICHFORD - T 0002	55137675500002	6665	ALGOMA - T 0005	55139010250005	6683	Fox Crossing - V 0001	55139269820001
6648	ROSE - T 0001	55137694250001	6666	ALGOMA - T 0006	55139010250006	6684	Fox Crossing - V 0002	55139269820002
6649	ROSE - T 0002	55137694250002	6667	ALGOMA - T 0007	55139010250007	6685	Fox Crossing - V 0003	55139269820003
6650	SAXEVILLE - T 0001	55137718250001	6668	ALGOMA - T 0008	55139010250008	6686	Fox Crossing - V 0004	55139269820004
6651	SPRINGWATER - T 0001	55137764000001	6669	ALGOMA - T 0009	55139010250009	6687	Fox Crossing - V 0005	55139269820005
6652	SPRINGWATER - T 0002	55137764000002	6670	ALGOMA - T 0010	55139010250010	6688	Fox Crossing - V 0006	55139269820006
6653	WARREN - T 0001	55137834250001	6671	Appleton - C 0031	55139023750031	6689	Fox Crossing - V 0007	55139269820007
6654	Wautoma - C 0001	55137846250001	6672	Appleton - C 0032	55139023750032	6690	Fox Crossing - V 0008	55139269820008
6655	Wautoma - C 0002	55137846250002	6673	BLACK WOLF - T 0001	55139080000001	6691	Fox Crossing - V 0009	55139269820009
6656	Wautoma - C 0003	55137846250003	6674	BLACK WOLF - T 0002	55139080000002	6692	Fox Crossing - V 0010	55139269820010
6657	WAUTOMA - T 0001	55137846500001	6675	BLACK WOLF - T 0003	55139080000003	6693	Fox Crossing - V 0011	55139269820011
6658	WAUTOMA - T 0002	55137846500002	6676	CLAYTON - T 0001	55139151500001	6694	Fox Crossing - V 0012	55139269820012
6659	WAUTOMA - T 0003	55137846500003	6677	CLAYTON - T 0002	55139151500002	6695	Fox Crossing - V 0013	55139269820013
6660	Wild Rose - V 0001	55137870750001	6678	CLAYTON - T 0003	55139151500003	6696	Fox Crossing - V 0014	55139269820014

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6697	Menasha - C 0002	55139508250002	6715	Menasha - C 0024	55139508250024	6733	Menasha - C 0042	55139508250042
6698	Menasha - C 0003	55139508250003	6716	Menasha - C 0025	55139508250025	6734	Menasha - C 005A	5513950825005A
6699	Menasha - C 0004	55139508250004	6717	Menasha - C 0026	55139508250026	6735	Menasha - C 005B	5513950825005B
6700	Menasha - C 0006	55139508250006	6718	Menasha - C 0027	55139508250027	6736	MENASHA - T 0009	55139508500009
6701	Menasha - C 0007	55139508250007	6719	Menasha - C 0028	55139508250028	6737	Neenah - C 0001	55139557500001
6702	Menasha - C 0008	55139508250008	6720	Menasha - C 0029	55139508250029	6738	Neenah - C 0002	55139557500002
6703	Menasha - C 0009	55139508250009	6721	Menasha - C 0030	55139508250030	6739	Neenah - C 0003	55139557500003
6704	Menasha - C 0010	55139508250010	6722	Menasha - C 0031	55139508250031	6740	Neenah - C 0004	55139557500004
6705	Menasha - C 0011	55139508250011	6723	Menasha - C 0032	55139508250032	6741	Neenah - C 0005	55139557500005
6706	Menasha - C 0012	55139508250012	6724	Menasha - C 0033	55139508250033	6742	Neenah - C 0006	55139557500006
6707	Menasha - C 0013	55139508250013	6725	Menasha - C 0034	55139508250034	6743	Neenah - C 0007	55139557500007
6708	Menasha - C 0014	55139508250014	6726	Menasha - C 0035	55139508250035	6744	Neenah - C 0008	55139557500008
6709	Menasha - C 0015	55139508250015	6727	Menasha - C 0036	55139508250036	6745	Neenah - C 0009	55139557500009
6710	Menasha - C 001A	5513950825001A	6728	Menasha - C 0037	55139508250037	6746	Neenah - C 0010	55139557500010
6711	Menasha - C 001B	5513950825001B	6729	Menasha - C 0038	55139508250038	6747	Neenah - C 0011	55139557500011
6712	Menasha - C 0021	55139508250021	6730	Menasha - C 0039	55139508250039	6748	Neenah - C 0012	55139557500012
6713	Menasha - C 0022	55139508250022	6731	Menasha - C 0040	55139508250040	6749	Neenah - C 0013	55139557500013
6714	Menasha - C 0023	55139508250023	6732	Menasha - C 0041	55139508250041	6750	Neenah - C 0014	55139557500014

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6751	Neenah - C 0015	55139557500015	6769	NEPEUSKUN - T 0001	55139561000001	6787	Oshkosh - C 0007	55139605000007
6752	Neenah - C 0016	55139557500016	6770	Omro - C 0001	55139598750001	6788	Oshkosh - C 0008	55139605000008
6753	Neenah - C 0017	55139557500017	6771	Omro - C 0002	55139598750002	6789	Oshkosh - C 0009	55139605000009
6754	Neenah - C 0018	55139557500018	6772	Omro - C 0003	55139598750003	6790	Oshkosh - C 0010	55139605000010
6755	Neenah - C 0019	55139557500019	6773	Omro - C 0004	55139598750004	6791	Oshkosh - C 0011	55139605000011
6756	Neenah - C 0020	55139557500020	6774	Omro - C 0005	55139598750005	6792	Oshkosh - C 0012	55139605000012
6757	Neenah - C 0021	55139557500021	6775	Omro - C 0006	55139598750006	6793	Oshkosh - C 0013	55139605000013
6758	Neenah - C 0022	55139557500022	6776	Omro - C 0007	55139598750007	6794	Oshkosh - C 0014	55139605000014
6759	Neenah - C 0023	55139557500023	6777	Omro - C 0008	55139598750008	6795	Oshkosh - C 0015	55139605000015
6760	Neenah - C 0024	55139557500024	6778	OMRO - T 0001	55139599000001	6796	Oshkosh - C 0016	55139605000016
6761	Neenah - C 0025	55139557500025	6779	OMRO - T 0002	55139599000002	6797	Oshkosh - C 0017	55139605000017
6762	Neenah - C 0026	55139557500026	6780	OMRO - T 0003	55139599000003	6798	Oshkosh - C 0018	55139605000018
6763	NEENAH - T 0001	55139557750001	6781	Oshkosh - C 0001	55139605000001	6799	Oshkosh - C 0019	55139605000019
6764	NEENAH - T 0002	55139557750002	6782	Oshkosh - C 0002	55139605000002	6800	Oshkosh - C 0020	55139605000020
6765	NEENAH - T 0003	55139557750003	6783	Oshkosh - C 0003	55139605000003	6801	Oshkosh - C 0021	55139605000021
6766	NEENAH - T 0004	55139557750004	6784	Oshkosh - C 0004	55139605000004	6802	Oshkosh - C 0024	55139605000024
6767	NEKIMI - T 0001	55139558500001	6785	Oshkosh - C 0005	55139605000005	6803	Oshkosh - C 0026	55139605000026
6768	NEKIMI - T 0002	55139558500002	6786	Oshkosh - C 0006	55139605000006	6804	Oshkosh - C 0027	55139605000027

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6805	Oshkosh - C 0030	55139605000030	6823	Oshkosh - C 025B	5513960500025B	6841	VINLAND - T 001A	5513982875001A
6806	Oshkosh - C 0031	55139605000031	6824	Oshkosh - C 028A	5513960500028A	6842	VINLAND - T 001B	5513982875001B
6807	Oshkosh - C 0032	55139605000032	6825	Oshkosh - C 028B	5513960500028B	6843	WINCHESTER - T 0001	55139876500001
6808	Oshkosh - C 0033	55139605000033	6826	Oshkosh - C 029A	5513960500029A	6844	WINCHESTER - T 0002	55139876500002
6809	Oshkosh - C 0034	55139605000034	6827	Oshkosh - C 029B	5513960500029B	6845	Winneconne - V 0001	55139879000001
6810	Oshkosh - C 0035	55139605000035	6828	OSHKOSH - T 0002	55139605250002	6846	Winneconne - V 0002	55139879000002
6811	Oshkosh - C 0036	55139605000036	6829	OSHKOSH - T 0003	55139605250003	6847	Winneconne - V 0003	55139879000003
6812	Oshkosh - C 0037	55139605000037	6830	OSHKOSH - T 0004	55139605250004	6848	Winneconne - V 0004	55139879000004
6813	Oshkosh - C 0038	55139605000038	6831	OSHKOSH - T 0005	55139605250005	6849	WINNECONNE - T 0001	55139879250001
6814	Oshkosh - C 0039	55139605000039	6832	OSHKOSH - T 001A	5513960525001A	6850	WINNECONNE - T 0002	55139879250002
6815	Oshkosh - C 0040	55139605000040	6833	OSHKOSH - T 001B	5513960525001B	6851	WINNECONNE - T 0003	55139879250003
6816	Oshkosh - C 0041	55139605000041	6834	POYGAN - T 0001	55139648750001	6852	WINNECONNE - T 0004	55139879250004
6817	Oshkosh - C 0042	55139605000042	6835	POYGAN - T 0002	55139648750002	6853	WINNECONNE - T 0005	55139879250005
6818	Oshkosh - C 022A	5513960500022A	6836	RUSHFORD - T 0001	55139701250001	6854	WOLF RIVER - T 0001	55139884750001
6819	Oshkosh - C 022B	5513960500022B	6837	RUSHFORD - T 0002	55139701250002	6855	WOLF RIVER - T 002A	5513988475002A
6820	Oshkosh - C 023A	5513960500023A	6838	UTICA - T 0001	55139821750001	6856	WOLF RIVER - T 002B	5513988475002B
6821	Oshkosh - C 023B	5513960500023B	6839	UTICA - T 0002	55139821750002	6857	WOLF RIVER - T 002C	5513988475002C
6822	Oshkosh - C 025A	5513960500025A	6840	VINLAND - T 0002	55139828750002	6858	Arpin - V 0001	55141030250001

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6859	ARPIN - T 0001	55141030500001	6877	GRAND RAPIDS - T 0009	55141301250009	6895	Marshfield - C 0011	55141496750011
6860	ARPIN - T 0002	55141030500002	6878	GRAND RAPIDS - T 0010	55141301250010	6896	Marshfield - C 0013	55141496750013
6861	ARPIN - T 0003	55141030500003	6879	GRAND RAPIDS - T 0011	55141301250011	6897	Marshfield - C 0014	55141496750014
6862	Auburndale - V 0001	55141037750001	6880	HANSEN - T 0001	55141325750001	6898	Marshfield - C 0015	55141496750015
6863	AUBURNDALE - T 0001	55141038000001	6881	Hewitt - V 0001	55141342500001	6899	Marshfield - C 0016	55141496750016
6864	Biron - V 0001	55141076500001	6882	HILES - T 0001	55141346750001	6900	Marshfield - C 0017	55141496750017
6865	CAMERON - T 0001	55141122750001	6883	LINCOLN - T 0001	55141445500001	6901	Marshfield - C 0018	55141496750018
6866	CARY - T 0001	55141127750001	6884	LINCOLN - T 0002	55141445500002	6902	Marshfield - C 0019	55141496750019
6867	CRANMOOR - T 0001	55141175250001	6885	Marshfield - C 0001	55141496750001	6903	Marshfield - C 0022	55141496750022
6868	DEXTER - T 0001	55141200750001	6886	Marshfield - C 0002	55141496750002	6904	Marshfield - C 0023	55141496750023
6869	GRAND RAPIDS - T 0001	55141301250001	6887	Marshfield - C 0003	55141496750003	6905	Marshfield - C 0025	55141496750025
6870	GRAND RAPIDS - T 0002	55141301250002	6888	Marshfield - C 0004	55141496750004	6906	Marshfield - C 0026	55141496750026
6871	GRAND RAPIDS - T 0003	55141301250003	6889	Marshfield - C 0005	55141496750005	6907	Marshfield - C 0027	55141496750027
6872	GRAND RAPIDS - T 0004	55141301250004	6890	Marshfield - C 0006	55141496750006	6908	MARSHFIELD - T 0001	55141497000001
6873	GRAND RAPIDS - T 0005	55141301250005	6891	Marshfield - C 0007	55141496750007	6909	Milladore - V 0001	55141518750001
6874	GRAND RAPIDS - T 0006	55141301250006	6892	Marshfield - C 0008	55141496750008	6910	MILLADORE - T 0001	55141519000001
6875	GRAND RAPIDS - T 0007	55141301250007	6893	Marshfield - C 0009	55141496750009	6911	Nekoosa - C 0001	55141558750001
6876	GRAND RAPIDS - T 0008	55141301250008	6894	Marshfield - C 0010	55141496750010	6912	Nekoosa - C 0002	55141558750002

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6913	Nekoosa - C 0003	55141558750003	6931	SARATOGA - T 0001	55141716000001	6949	Wisconsin Rapids - C 0002	55141882000002
6914	Nekoosa - C 0004	55141558750004	6932	SARATOGA - T 0002	55141716000002	6950	Wisconsin Rapids - C 0003	55141882000003
6915	Pittsville - C 0001	55141631000001	6933	SARATOGA - T 0003	55141716000003	6951	Wisconsin Rapids - C 0004	55141882000004
6916	Port Edwards - V 0001	55141641750001	6934	SARATOGA - T 0004	55141716000004	6952	Wisconsin Rapids - C 0005	55141882000005
6917	Port Edwards - V 0002	55141641750002	6935	SARATOGA - T 0005	55141716000005	6953	Wisconsin Rapids - C 0006	55141882000006
6918	Port Edwards - V 0003	55141641750003	6936	SARATOGA - T 0006	55141716000006	6954	Wisconsin Rapids - C 0007	55141882000007
6919	PORT EDWARDS - T 0001	55141642000001	6937	SARATOGA - T 0007	55141716000007	6955	Wisconsin Rapids - C 0008	55141882000008
6920	PORT EDWARDS - T 0002	55141642000002	6938	SARATOGA - T 0008	55141716000008	6956	Wisconsin Rapids - C 0009	55141882000009
6921	PORT EDWARDS - T 0003	55141642000003	6939	SARATOGA - T 0009	55141716000009	6957	Wisconsin Rapids - C 0010	55141882000010
6922	PORT EDWARDS - T 0004	55141642000004	6940	SENECA - T 0001	55141725750001	6958	Wisconsin Rapids - C 0011	55141882000011
6923	REMINGTON - T 0001	55141670000001	6941	SENECA - T 0002	55141725750002	6959	Wisconsin Rapids - C 0012	55141882000012
6924	RICHFIELD - T 0001	55141675000001	6942	SENECA - T 0003	55141725750003	6960	Wisconsin Rapids - C 0013	55141882000013
6925	RICHFIELD - T 0002	55141675000002	6943	SHERRY - T 0001	55141734750001	6961	Wisconsin Rapids - C 0014	55141882000014
6926	RICHFIELD - T 0003	55141675000003	6944	SIGEL - T 0001	55141739000001	6962	Wisconsin Rapids - C 0015	55141882000015
6927	ROCK - T 0001	55141686250001	6945	SIGEL - T 0002	55141739000002	6963	Wisconsin Rapids - C 0016	55141882000016
6928	Rudolph - V 0001	55141700000001	6946	SIGEL - T 0003	55141739000003	6964	Wisconsin Rapids - C 0017	55141882000017
6929	RUDOLPH - T 0001	55141700250001	6947	Vesper - V 0001	55141826500001	6965	Wisconsin Rapids - C 0018	55141882000018
6930	RUDOLPH - T 0002	55141700250002	6948	Wisconsin Rapids - C 0001	55141882000001	6966	Wisconsin Rapids - C 0019	55141882000019

Table A-1: (Continue)

Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.	Ward ID.	Ward Label	WARD FIPS.
6967	Wisconsin Rapids - C 0020	55141882000020	6971	Wisconsin Rapids - C 0024	55141882000024	6975	Wisconsin Rapids - C 0028	55141882000028
6968	Wisconsin Rapids - C 0021	55141882000021	6972	Wisconsin Rapids - C 0025	55141882000025	6976	Wisconsin Rapids - C 0029	55141882000029
6969	Wisconsin Rapids - C 0022	55141882000022	6973	Wisconsin Rapids - C 0026	55141882000026	6977	WOOD - T 0001	55141885750001
6970	Wisconsin Rapids - C 0023	55141882000023	6974	Wisconsin Rapids - C 0027	55141882000027			

Table A-2: An example of a best result scenario for fair assignment of the wards to Wisconsin U.S. Congressional districts

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
1	2	25	2	49	3	73	3	97	2	121	2	145	2	169	3	193	3	217	8	241	6
2	2	26	6	50	3	74	3	98	2	122	2	146	3	170	3	194	8	218	8	242	6
3	2	27	6	51	3	75	3	99	2	123	3	147	3	171	3	195	8	219	8	243	6
4	2	28	2	52	3	76	3	100	2	124	3	148	3	172	3	196	8	220	8	244	6
5	2	29	2	53	3	77	3	101	2	125	3	149	2	173	3	197	8	221	8	245	6
6	2	30	2	54	3	78	3	102	3	126	3	150	3	174	3	198	8	222	8	246	6
7	2	31	6	55	3	79	3	103	3	127	3	151	2	175	3	199	8	223	8	247	6
8	6	32	2	56	3	80	3	104	3	128	3	152	2	176	3	200	8	224	8	248	8
9	6	33	2	57	3	81	3	105	3	129	3	153	3	177	3	201	8	225	8	249	8
10	6	34	2	58	3	82	3	106	3	130	3	154	3	178	3	202	8	226	6	250	6
11	2	35	2	59	3	83	3	107	3	131	3	155	3	179	3	203	8	227	6	251	6
12	2	36	2	60	3	84	3	108	3	132	3	156	3	180	3	204	6	228	6	252	8
13	2	37	2	61	3	85	3	109	3	133	3	157	3	181	3	205	6	229	6	253	8
14	2	38	2	62	3	86	3	110	3	134	3	158	3	182	3	206	6	230	8	254	8
15	2	39	6	63	3	87	3	111	2	135	3	159	3	183	3	207	6	231	6	255	8
16	2	40	6	64	3	88	3	112	2	136	3	160	3	184	3	208	6	232	8	256	8
17	2	41	2	65	3	89	3	113	2	137	3	161	3	185	3	209	6	233	8	257	8
18	2	42	2	66	3	90	3	114	3	138	3	162	3	186	3	210	6	234	6	258	8
19	6	43	2	67	3	91	3	115	3	139	2	163	3	187	3	211	6	235	8	259	8
20	2	44	3	68	3	92	3	116	3	140	2	164	3	188	3	212	6	236	8	260	8
21	6	45	3	69	3	93	3	117	3	141	3	165	3	189	3	213	6	237	6	261	8
22	2	46	3	70	3	94	3	118	3	142	3	166	3	190	3	214	6	238	6	262	8
23	2	47	3	71	3	95	2	119	3	143	2	167	3	191	3	215	6	239	6	263	8
24	2	48	3	72	3	96	2	120	2	144	2	168	3	192	3	216	8	240	6	264	6

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
265	8	289	8	313	8	337	6	361	6	385	2	409	3	433	3	457	6	481	6	505	8
266	8	290	8	314	8	338	8	362	6	386	2	410	3	434	3	458	6	482	6	506	8
267	6	291	8	315	8	339	8	363	8	387	3	411	3	435	3	459	6	483	6	507	8
268	8	292	8	316	8	340	8	364	8	388	2	412	3	436	3	460	6	484	6	508	8
269	8	293	8	317	8	341	6	365	8	389	2	413	3	437	3	461	6	485	6	509	6
270	8	294	8	318	8	342	8	366	8	390	3	414	3	438	3	462	6	486	6	510	6
271	8	295	8	319	8	343	6	367	8	391	2	415	3	439	3	463	8	487	8	511	6
272	8	296	6	320	8	344	6	368	8	392	2	416	3	440	3	464	8	488	6	512	8
273	8	297	8	321	8	345	8	369	8	393	3	417	3	441	3	465	8	489	6	513	6
274	8	298	8	322	8	346	6	370	8	394	2	418	3	442	3	466	8	490	6	514	6
275	8	299	8	323	8	347	8	371	8	395	2	419	3	443	3	467	8	491	6	515	8
276	8	300	8	324	8	348	6	372	8	396	3	420	3	444	3	468	8	492	6	516	8
277	8	301	8	325	8	349	6	373	8	397	2	421	3	445	3	469	8	493	6	517	8
278	8	302	8	326	8	350	6	374	8	398	3	422	3	446	3	470	8	494	6	518	8
279	8	303	8	327	8	351	6	375	6	399	3	423	3	447	3	471	8	495	8	519	8
280	8	304	8	328	8	352	6	376	6	400	3	424	3	448	3	472	8	496	6	520	6
281	8	305	8	329	8	353	8	377	6	401	3	425	3	449	6	473	8	497	6	521	3
282	6	306	8	330	8	354	8	378	6	402	3	426	3	450	6	474	6	498	6	522	3
283	8	307	8	331	8	355	8	379	6	403	2	427	3	451	6	475	6	499	6	523	3
284	8	308	6	332	6	356	6	380	6	404	3	428	3	452	6	476	6	500	6	524	3
285	8	309	6	333	6	357	8	381	3	405	3	429	3	453	6	477	6	501	8	525	2
286	8	310	6	334	6	358	6	382	3	406	3	430	3	454	6	478	6	502	8	526	3
287	8	311	6	335	6	359	8	383	3	407	2	431	3	455	6	479	6	503	8	527	2
288	8	312	6	336	6	360	6	384	2	408	3	432	3	456	6	480	6	504	8	528	3

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
529	3	553	2	577	3	601	2	625	2	649	2	673	2	697	2	721	2	745	2	769	2
530	3	554	2	578	3	602	3	626	2	650	2	674	2	698	2	722	2	746	2	770	2
531	3	555	2	579	3	603	3	627	2	651	2	675	2	699	1	723	2	747	2	771	1
532	3	556	3	580	3	604	3	628	2	652	2	676	2	700	1	724	2	748	2	772	1
533	3	557	3	581	3	605	3	629	2	653	2	677	2	701	1	725	1	749	2	773	1
534	2	558	3	582	3	606	3	630	2	654	2	678	2	702	1	726	1	750	2	774	2
535	2	559	3	583	3	607	3	631	2	655	2	679	2	703	1	727	1	751	2	775	2
536	2	560	3	584	3	608	3	632	2	656	2	680	2	704	1	728	1	752	2	776	2
537	2	561	3	585	3	609	3	633	2	657	2	681	2	705	1	729	1	753	2	777	2
538	3	562	3	586	3	610	2	634	2	658	2	682	2	706	1	730	1	754	2	778	2
539	3	563	3	587	3	611	2	635	2	659	2	683	2	707	1	731	1	755	2	779	2
540	3	564	2	588	3	612	2	636	2	660	2	684	2	708	1	732	1	756	2	780	2
541	3	565	2	589	2	613	2	637	2	661	2	685	2	709	2	733	1	757	2	781	2
542	3	566	2	590	2	614	2	638	2	662	2	686	2	710	1	734	1	758	2	782	2
543	3	567	2	591	3	615	2	639	2	663	2	687	2	711	1	735	1	759	2	783	4
544	3	568	2	592	2	616	2	640	2	664	2	688	2	712	1	736	2	760	1	784	4
545	3	569	2	593	2	617	2	641	2	665	2	689	2	713	2	737	2	761	1	785	4
546	3	570	3	594	2	618	2	642	2	666	2	690	2	714	2	738	2	762	1	786	4
547	3	571	3	595	2	619	2	643	2	667	2	691	2	715	2	739	2	763	1	787	4
548	2	572	3	596	2	620	2	644	2	668	2	692	2	716	2	740	2	764	2	788	4
549	2	573	3	597	2	621	2	645	2	669	2	693	2	717	2	741	2	765	2	789	4
550	3	574	3	598	2	622	2	646	2	670	2	694	1	718	2	742	2	766	2	790	4
551	2	575	3	599	2	623	2	647	2	671	2	695	1	719	2	743	2	767	2	791	4
552	2	576	3	600	2	624	2	648	2	672	2	696	2	720	1	744	2	768	2	792	4

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
793	4	817	4	841	4	865	1	889	2	913	4	937	1	961	1	985	1	1009	1	1033	4
794	4	818	4	842	4	866	1	890	1	914	4	938	1	962	1	986	1	1010	1	1034	1
795	4	819	4	843	4	867	1	891	1	915	4	939	1	963	1	987	1	1011	1	1035	4
796	4	820	1	844	1	868	1	892	1	916	4	940	1	964	1	988	1	1012	1	1036	4
797	4	821	1	845	1	869	1	893	1	917	4	941	1	965	1	989	1	1013	1	1037	4
798	4	822	4	846	1	870	4	894	1	918	4	942	1	966	1	990	1	1014	1	1038	4
799	4	823	4	847	1	871	1	895	1	919	4	943	1	967	1	991	1	1015	1	1039	4
800	4	824	4	848	1	872	1	896	1	920	4	944	1	968	1	992	1	1016	1	1040	4
801	4	825	1	849	1	873	1	897	1	921	4	945	1	969	1	993	1	1017	1	1041	4
802	4	826	1	850	1	874	4	898	2	922	4	946	1	970	1	994	1	1018	1	1042	4
803	4	827	1	851	1	875	4	899	2	923	4	947	1	971	1	995	1	1019	4	1043	4
804	4	828	4	852	1	876	4	900	1	924	4	948	1	972	1	996	1	1020	4	1044	4
805	4	829	4	853	1	877	4	901	1	925	4	949	1	973	1	997	1	1021	4	1045	4
806	4	830	1	854	1	878	4	902	1	926	4	950	1	974	1	998	1	1022	4	1046	4
807	4	831	1	855	1	879	1	903	4	927	4	951	1	975	1	999	1	1023	4	1047	4
808	4	832	1	856	1	880	2	904	1	928	1	952	1	976	1	1000	1	1024	1	1048	4
809	4	833	1	857	1	881	2	905	4	929	4	953	1	977	1	1001	1	1025	4	1049	4
810	4	834	4	858	1	882	2	906	1	930	4	954	1	978	1	1002	1	1026	1	1050	4
811	4	835	1	859	1	883	2	907	1	931	4	955	1	979	1	1003	1	1027	1	1051	4
812	4	836	1	860	1	884	1	908	1	932	4	956	1	980	1	1004	1	1028	1	1052	4
813	4	837	1	861	1	885	1	909	1	933	1	957	1	981	1	1005	1	1029	1	1053	4
814	4	838	1	862	1	886	2	910	1	934	1	958	1	982	1	1006	1	1030	1	1054	4
815	4	839	1	863	1	887	2	911	1	935	1	959	1	983	1	1007	1	1031	4	1055	4
816	4	840	4	864	1	888	2	912	1	936	1	960	1	984	1	1008	1	1032	1	1056	4

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
1057	1	1081	1	1105	1	1129	1	1153	4	1177	4	1201	1	1225	1	1249	4	1273	1	1297	2
1058	1	1082	4	1106	4	1130	1	1154	4	1178	4	1202	1	1226	1	1250	4	1274	1	1298	2
1059	4	1083	4	1107	4	1131	4	1155	4	1179	4	1203	1	1227	1	1251	4	1275	1	1299	2
1060	4	1084	1	1108	4	1132	4	1156	4	1180	1	1204	1	1228	1	1252	4	1276	1	1300	2
1061	4	1085	4	1109	4	1133	1	1157	4	1181	1	1205	1	1229	1	1253	1	1277	1	1301	2
1062	4	1086	4	1110	4	1134	1	1158	4	1182	1	1206	4	1230	1	1254	1	1278	1	1302	2
1063	1	1087	1	1111	1	1135	1	1159	4	1183	1	1207	4	1231	1	1255	1	1279	1	1303	2
1064	4	1088	4	1112	1	1136	4	1160	4	1184	4	1208	1	1232	1	1256	1	1280	1	1304	2
1065	4	1089	4	1113	4	1137	4	1161	4	1185	4	1209	4	1233	1	1257	1	1281	1	1305	2
1066	4	1090	1	1114	4	1138	4	1162	4	1186	1	1210	4	1234	1	1258	1	1282	1	1306	2
1067	4	1091	4	1115	4	1139	4	1163	4	1187	1	1211	1	1235	1	1259	1	1283	1	1307	2
1068	1	1092	4	1116	4	1140	4	1164	4	1188	1	1212	1	1236	1	1260	1	1284	1	1308	2
1069	4	1093	1	1117	4	1141	1	1165	1	1189	1	1213	1	1237	1	1261	1	1285	1	1309	2
1070	4	1094	1	1118	4	1142	1	1166	4	1190	1	1214	1	1238	1	1262	1	1286	1	1310	2
1071	1	1095	1	1119	1	1143	1	1167	4	1191	1	1215	1	1239	4	1263	1	1287	2	1311	2
1072	4	1096	1	1120	1	1144	1	1168	4	1192	4	1216	1	1240	4	1264	1	1288	2	1312	2
1073	1	1097	1	1121	1	1145	1	1169	4	1193	4	1217	1	1241	4	1265	1	1289	2	1313	2
1074	1	1098	1	1122	1	1146	1	1170	4	1194	1	1218	1	1242	4	1266	1	1290	2	1314	2
1075	1	1099	1	1123	1	1147	1	1171	4	1195	1	1219	1	1243	4	1267	1	1291	2	1315	2
1076	1	1100	1	1124	1	1148	1	1172	4	1196	1	1220	1	1244	4	1268	1	1292	2	1316	2
1077	1	1101	1	1125	1	1149	1	1173	4	1197	1	1221	1	1245	4	1269	1	1293	2	1317	2
1078	1	1102	1	1126	1	1150	1	1174	4	1198	1	1222	1	1246	4	1270	1	1294	2	1318	2
1079	1	1103	1	1127	1	1151	4	1175	4	1199	1	1223	1	1247	4	1271	1	1295	2	1319	1
1080	1	1104	1	1128	1	1152	4	1176	4	1200	1	1224	1	1248	4	1272	2	1296	2	1320	1

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
1321	1	1345	2	1369	1	1393	1	1417	2	1441	8	1465	8	1489	8	1513	3	1537	3	1561	3
1322	1	1346	2	1370	1	1394	1	1418	2	1442	8	1466	8	1490	8	1514	3	1538	3	1562	3
1323	1	1347	2	1371	1	1395	1	1419	2	1443	8	1467	8	1491	8	1515	3	1539	3	1563	3
1324	1	1348	2	1372	1	1396	2	1420	2	1444	8	1468	8	1492	8	1516	3	1540	3	1564	3
1325	2	1349	1	1373	2	1397	2	1421	2	1445	8	1469	8	1493	8	1517	3	1541	3	1565	3
1326	2	1350	1	1374	2	1398	2	1422	2	1446	8	1470	8	1494	8	1518	3	1542	3	1566	3
1327	2	1351	1	1375	2	1399	2	1423	2	1447	8	1471	8	1495	8	1519	3	1543	3	1567	3
1328	2	1352	1	1376	2	1400	2	1424	2	1448	8	1472	8	1496	3	1520	3	1544	3	1568	3
1329	2	1353	2	1377	2	1401	2	1425	2	1449	8	1473	8	1497	3	1521	3	1545	3	1569	3
1330	2	1354	2	1378	2	1402	2	1426	2	1450	8	1474	8	1498	3	1522	3	1546	3	1570	3
1331	2	1355	2	1379	2	1403	2	1427	2	1451	8	1475	8	1499	3	1523	3	1547	3	1571	3
1332	1	1356	2	1380	2	1404	2	1428	2	1452	8	1476	8	1500	3	1524	3	1548	3	1572	3
1333	1	1357	2	1381	1	1405	2	1429	2	1453	8	1477	8	1501	3	1525	3	1549	3	1573	3
1334	2	1358	1	1382	2	1406	2	1430	2	1454	8	1478	8	1502	3	1526	3	1550	3	1574	3
1335	8	1359	1	1383	2	1407	2	1431	8	1455	8	1479	8	1503	3	1527	3	1551	3	1575	3
1336	2	1360	2	1384	2	1408	1	1432	8	1456	8	1480	8	1504	3	1528	3	1552	3	1576	3
1337	2	1361	2	1385	2	1409	1	1433	8	1457	8	1481	8	1505	3	1529	3	1553	3	1577	3
1338	2	1362	8	1386	2	1410	1	1434	8	1458	8	1482	8	1506	3	1530	3	1554	3	1578	3
1339	2	1363	8	1387	1	1411	1	1435	8	1459	8	1483	8	1507	3	1531	3	1555	3	1579	3
1340	2	1364	8	1388	1	1412	1	1436	8	1460	8	1484	8	1508	3	1532	3	1556	3	1580	3
1341	2	1365	2	1389	2	1413	1	1437	8	1461	8	1485	8	1509	3	1533	3	1557	3	1581	3
1342	2	1366	8	1390	2	1414	1	1438	8	1462	8	1486	8	1510	3	1534	3	1558	3	1582	3
1343	2	1367	8	1391	1	1415	2	1439	8	1463	8	1487	8	1511	3	1535	3	1559	3	1583	3
1344	2	1368	1	1392	1	1416	2	1440	8	1464	8	1488	8	1512	3	1536	3	1560	3	1584	3

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Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
1585	3	1609	3	1633	3	1657	3	1681	3	1705	3	1729	3	1753	3	1777	8	1801	8	1825	2
1586	3	1610	3	1634	3	1658	3	1682	3	1706	3	1730	3	1754	3	1778	8	1802	8	1826	8
1587	3	1611	3	1635	3	1659	3	1683	3	1707	3	1731	3	1755	3	1779	8	1803	8	1827	2
1588	3	1612	3	1636	3	1660	3	1684	3	1708	3	1732	3	1756	3	1780	8	1804	8	1828	8
1589	3	1613	3	1637	3	1661	3	1685	3	1709	3	1733	3	1757	3	1781	8	1805	8	1829	8
1590	3	1614	3	1638	3	1662	3	1686	3	1710	3	1734	3	1758	3	1782	8	1806	8	1830	8
1591	3	1615	3	1639	3	1663	3	1687	3	1711	3	1735	3	1759	3	1783	8	1807	8	1831	8
1592	3	1616	3	1640	3	1664	3	1688	3	1712	3	1736	3	1760	3	1784	8	1808	8	1832	8
1593	3	1617	3	1641	3	1665	3	1689	3	1713	3	1737	3	1761	3	1785	8	1809	8	1833	8
1594	3	1618	3	1642	3	1666	3	1690	3	1714	3	1738	3	1762	3	1786	8	1810	8	1834	8
1595	3	1619	3	1643	3	1667	3	1691	3	1715	3	1739	3	1763	3	1787	2	1811	8	1835	2
1596	3	1620	3	1644	3	1668	3	1692	3	1716	3	1740	3	1764	3	1788	2	1812	8	1836	2
1597	3	1621	3	1645	3	1669	3	1693	3	1717	3	1741	3	1765	3	1789	2	1813	8	1837	2
1598	3	1622	3	1646	3	1670	3	1694	3	1718	3	1742	3	1766	3	1790	8	1814	8	1838	8
1599	3	1623	3	1647	3	1671	3	1695	3	1719	3	1743	3	1767	2	1791	8	1815	8	1839	2
1600	3	1624	3	1648	3	1672	3	1696	3	1720	3	1744	3	1768	2	1792	8	1816	8	1840	2
1601	3	1625	3	1649	3	1673	3	1697	3	1721	3	1745	3	1769	8	1793	8	1817	8	1841	8
1602	3	1626	3	1650	3	1674	3	1698	3	1722	3	1746	3	1770	8	1794	2	1818	8	1842	8
1603	3	1627	3	1651	3	1675	3	1699	3	1723	3	1747	3	1771	8	1795	8	1819	8	1843	2
1604	3	1628	3	1652	3	1676	3	1700	3	1724	3	1748	2	1772	8	1796	8	1820	8	1844	2
1605	3	1629	3	1653	3	1677	3	1701	3	1725	3	1749	3	1773	8	1797	8	1821	8	1845	8
1606	3	1630	3	1654	3	1678	3	1702	3	1726	3	1750	3	1774	8	1798	8	1822	2	1846	2
1607	3	1631	3	1655	3	1679	3	1703	3	1727	3	1751	3	1775	2	1799	8	1823	2	1847	2
1608	3	1632	3	1656	3	1680	3	1704	3	1728	3	1752	3	1776	8	1800	8	1824	2	1848	2

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Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
1849	2	1873	2	1897	3	1921	4	1945	4	1969	4	1993	4	2017	4	2041	4	2065	4	2089	2
1850	2	1874	2	1898	3	1922	4	1946	4	1970	4	1994	4	2018	4	2042	4	2066	4	2090	2
1851	2	1875	8	1899	3	1923	4	1947	4	1971	4	1995	4	2019	4	2043	4	2067	4	2091	2
1852	2	1876	2	1900	3	1924	4	1948	4	1972	4	1996	4	2020	4	2044	4	2068	4	2092	2
1853	2	1877	8	1901	3	1925	4	1949	4	1973	4	1997	4	2021	4	2045	4	2069	2	2093	2
1854	2	1878	8	1902	3	1926	4	1950	4	1974	4	1998	4	2022	4	2046	4	2070	2	2094	2
1855	2	1879	8	1903	3	1927	4	1951	4	1975	4	1999	4	2023	4	2047	4	2071	2	2095	2
1856	2	1880	8	1904	3	1928	4	1952	4	1976	4	2000	4	2024	4	2048	4	2072	2	2096	2
1857	8	1881	8	1905	3	1929	4	1953	4	1977	4	2001	4	2025	4	2049	4	2073	2	2097	2
1858	8	1882	2	1906	3	1930	4	1954	4	1978	4	2002	4	2026	4	2050	4	2074	2	2098	2
1859	2	1883	2	1907	3	1931	4	1955	4	1979	4	2003	4	2027	4	2051	4	2075	2	2099	2
1860	2	1884	2	1908	3	1932	4	1956	4	1980	4	2004	4	2028	4	2052	4	2076	2	2100	2
1861	2	1885	2	1909	3	1933	4	1957	4	1981	4	2005	4	2029	4	2053	4	2077	2	2101	2
1862	2	1886	2	1910	3	1934	4	1958	4	1982	4	2006	4	2030	4	2054	4	2078	2	2102	2
1863	2	1887	2	1911	3	1935	4	1959	4	1983	4	2007	4	2031	4	2055	4	2079	2	2103	2
1864	2	1888	3	1912	3	1936	4	1960	4	1984	4	2008	4	2032	4	2056	4	2080	2	2104	2
1865	2	1889	3	1913	3	1937	4	1961	4	1985	4	2009	4	2033	4	2057	4	2081	2	2105	2
1866	2	1890	3	1914	3	1938	4	1962	4	1986	4	2010	4	2034	4	2058	4	2082	2	2106	2
1867	2	1891	3	1915	3	1939	4	1963	4	1987	4	2011	4	2035	4	2059	4	2083	2	2107	2
1868	2	1892	3	1916	3	1940	4	1964	4	1988	4	2012	4	2036	4	2060	4	2084	2	2108	2
1869	2	1893	3	1917	3	1941	4	1965	4	1989	4	2013	4	2037	4	2061	4	2085	2	2109	4
1870	2	1894	3	1918	3	1942	4	1966	4	1990	4	2014	4	2038	4	2062	4	2086	2	2110	4
1871	2	1895	3	1919	3	1943	4	1967	4	1991	4	2015	4	2039	4	2063	4	2087	2	2111	4
1872	2	1896	3	1920	4	1944	4	1968	4	1992	4	2016	4	2040	4	2064	4	2088	2	2112	4

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Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
2113	4	2137	4	2161	4	2185	3	2209	2	2233	4	2257	1	2281	4	2305	1	2329	1	2353	2
2114	4	2138	4	2162	4	2186	2	2210	2	2234	4	2258	1	2282	1	2306	1	2330	1	2354	2
2115	4	2139	4	2163	4	2187	2	2211	3	2235	4	2259	4	2283	4	2307	1	2331	1	2355	2
2116	4	2140	4	2164	4	2188	2	2212	2	2236	1	2260	4	2284	4	2308	4	2332	2	2356	2
2117	4	2141	4	2165	4	2189	2	2213	2	2237	1	2261	4	2285	4	2309	1	2333	4	2357	2
2118	4	2142	4	2166	4	2190	2	2214	3	2238	1	2262	4	2286	4	2310	1	2334	4	2358	4
2119	4	2143	4	2167	3	2191	2	2215	3	2239	1	2263	4	2287	4	2311	1	2335	4	2359	4
2120	4	2144	4	2168	3	2192	2	2216	2	2240	4	2264	4	2288	4	2312	1	2336	2	2360	4
2121	4	2145	4	2169	3	2193	2	2217	2	2241	4	2265	4	2289	4	2313	1	2337	4	2361	2
2122	4	2146	4	2170	3	2194	2	2218	2	2242	4	2266	4	2290	4	2314	1	2338	4	2362	2
2123	4	2147	4	2171	3	2195	2	2219	2	2243	4	2267	4	2291	4	2315	4	2339	4	2363	2
2124	4	2148	4	2172	3	2196	2	2220	2	2244	4	2268	4	2292	4	2316	1	2340	4	2364	2
2125	4	2149	4	2173	3	2197	2	2221	2	2245	4	2269	4	2293	4	2317	1	2341	4	2365	2
2126	4	2150	4	2174	3	2198	3	2222	2	2246	4	2270	4	2294	4	2318	1	2342	4	2366	2
2127	4	2151	4	2175	3	2199	2	2223	2	2247	4	2271	4	2295	4	2319	1	2343	4	2367	2
2128	4	2152	4	2176	3	2200	2	2224	2	2248	1	2272	4	2296	4	2320	1	2344	2	2368	2
2129	4	2153	4	2177	3	2201	2	2225	4	2249	4	2273	4	2297	4	2321	1	2345	4	2369	2
2130	4	2154	4	2178	3	2202	2	2226	4	2250	1	2274	4	2298	4	2322	1	2346	4	2370	2
2131	4	2155	4	2179	3	2203	2	2227	2	2251	1	2275	4	2299	4	2323	1	2347	4	2371	2
2132	4	2156	4	2180	3	2204	2	2228	2	2252	1	2276	4	2300	1	2324	1	2348	2	2372	2
2133	4	2157	4	2181	3	2205	2	2229	2	2253	1	2277	1	2301	1	2325	1	2349	4	2373	2
2134	4	2158	4	2182	3	2206	2	2230	3	2254	1	2278	4	2302	1	2326	4	2350	4	2374	2
2135	4	2159	4	2183	3	2207	2	2231	2	2255	1	2279	4	2303	1	2327	4	2351	2	2375	2
2136	4	2160	4	2184	3	2208	2	2232	2	2256	1	2280	4	2304	1	2328	1	2352	2	2376	2

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Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
2377	2	2401	1	2425	1	2449	1	2473	1	2497	1	2521	1	2545	1	2569	4	2593	8	2617	4
2378	4	2402	1	2426	1	2450	1	2474	1	2498	1	2522	1	2546	1	2570	4	2594	8	2618	4
2379	4	2403	1	2427	1	2451	1	2475	1	2499	1	2523	1	2547	1	2571	4	2595	8	2619	2
2380	4	2404	1	2428	1	2452	1	2476	1	2500	1	2524	1	2548	1	2572	1	2596	8	2620	2
2381	4	2405	1	2429	1	2453	1	2477	1	2501	1	2525	1	2549	1	2573	1	2597	8	2621	4
2382	4	2406	1	2430	1	2454	1	2478	1	2502	1	2526	1	2550	1	2574	1	2598	8	2622	2
2383	4	2407	4	2431	1	2455	1	2479	1	2503	1	2527	1	2551	1	2575	1	2599	8	2623	2
2384	4	2408	1	2432	1	2456	1	2480	1	2504	1	2528	1	2552	1	2576	1	2600	8	2624	2
2385	4	2409	1	2433	1	2457	1	2481	1	2505	1	2529	1	2553	1	2577	4	2601	8	2625	2
2386	4	2410	1	2434	1	2458	1	2482	1	2506	1	2530	1	2554	7	2578	8	2602	8	2626	2
2387	2	2411	1	2435	1	2459	1	2483	1	2507	1	2531	4	2555	7	2579	8	2603	8	2627	2
2388	2	2412	1	2436	1	2460	1	2484	1	2508	1	2532	4	2556	1	2580	8	2604	8	2628	2
2389	2	2413	1	2437	1	2461	1	2485	1	2509	1	2533	4	2557	1	2581	8	2605	8	2629	4
2390	4	2414	1	2438	1	2462	1	2486	1	2510	1	2534	4	2558	1	2582	8	2606	8	2630	4
2391	2	2415	1	2439	1	2463	1	2487	1	2511	1	2535	1	2559	1	2583	8	2607	8	2631	4
2392	4	2416	1	2440	1	2464	1	2488	1	2512	1	2536	4	2560	1	2584	8	2608	8	2632	2
2393	4	2417	1	2441	1	2465	1	2489	1	2513	1	2537	1	2561	1	2585	8	2609	8	2633	2
2394	4	2418	1	2442	1	2466	1	2490	1	2514	1	2538	1	2562	1	2586	8	2610	8	2634	2
2395	1	2419	1	2443	1	2467	1	2491	1	2515	1	2539	1	2563	1	2587	8	2611	8	2635	2
2396	1	2420	1	2444	1	2468	1	2492	1	2516	1	2540	1	2564	4	2588	8	2612	8	2636	2
2397	1	2421	1	2445	1	2469	1	2493	1	2517	1	2541	1	2565	4	2589	8	2613	8	2637	2
2398	1	2422	1	2446	1	2470	1	2494	1	2518	1	2542	1	2566	4	2590	8	2614	8	2638	2
2399	1	2423	1	2447	1	2471	1	2495	1	2519	1	2543	1	2567	1	2591	8	2615	8	2639	2
2400	1	2424	1	2448	1	2472	1	2496	1	2520	1	2544	1	2568	1	2592	8	2616	4	2640	2

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Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
2641	2	2665	2	2689	2	2713	4	2737	4	2761	4	2785	6	2809	6	2833	6	2857	6	2881	8
2642	2	2666	2	2690	2	2714	4	2738	4	2762	4	2786	6	2810	6	2834	6	2858	6	2882	8
2643	2	2667	2	2691	2	2715	4	2739	4	2763	4	2787	3	2811	6	2835	6	2859	6	2883	8
2644	2	2668	2	2692	2	2716	2	2740	4	2764	4	2788	3	2812	6	2836	6	2860	6	2884	8
2645	2	2669	2	2693	2	2717	2	2741	4	2765	4	2789	3	2813	6	2837	6	2861	6	2885	8
2646	2	2670	2	2694	2	2718	2	2742	4	2766	4	2790	6	2814	6	2838	6	2862	6	2886	8
2647	2	2671	2	2695	2	2719	4	2743	4	2767	4	2791	6	2815	6	2839	6	2863	6	2887	8
2648	2	2672	2	2696	2	2720	2	2744	4	2768	4	2792	6	2816	6	2840	6	2864	6	2888	8
2649	2	2673	2	2697	2	2721	2	2745	4	2769	4	2793	6	2817	6	2841	6	2865	6	2889	6
2650	2	2674	2	2698	2	2722	2	2746	4	2770	4	2794	6	2818	6	2842	6	2866	8	2890	6
2651	2	2675	2	2699	2	2723	2	2747	4	2771	4	2795	6	2819	6	2843	6	2867	8	2891	6
2652	2	2676	2	2700	2	2724	2	2748	4	2772	6	2796	6	2820	6	2844	6	2868	8	2892	8
2653	2	2677	2	2701	2	2725	2	2749	4	2773	6	2797	6	2821	6	2845	6	2869	8	2893	8
2654	2	2678	2	2702	2	2726	2	2750	4	2774	6	2798	6	2822	6	2846	6	2870	8	2894	8
2655	2	2679	2	2703	2	2727	2	2751	4	2775	6	2799	6	2823	6	2847	6	2871	6	2895	8
2656	2	2680	4	2704	2	2728	4	2752	4	2776	6	2800	6	2824	6	2848	6	2872	6	2896	8
2657	2	2681	4	2705	2	2729	4	2753	4	2777	6	2801	6	2825	6	2849	6	2873	8	2897	8
2658	2	2682	4	2706	2	2730	4	2754	4	2778	6	2802	6	2826	6	2850	6	2874	6	2898	8
2659	2	2683	4	2707	2	2731	4	2755	4	2779	6	2803	3	2827	6	2851	6	2875	6	2899	8
2660	2	2684	2	2708	2	2732	4	2756	4	2780	6	2804	3	2828	6	2852	6	2876	6	2900	8
2661	2	2685	2	2709	2	2733	4	2757	4	2781	6	2805	3	2829	6	2853	6	2877	6	2901	8
2662	2	2686	2	2710	2	2734	4	2758	4	2782	6	2806	6	2830	6	2854	6	2878	6	2902	8
2663	2	2687	4	2711	2	2735	4	2759	4	2783	6	2807	6	2831	6	2855	6	2879	6	2903	8
2664	2	2688	2	2712	4	2736	4	2760	4	2784	6	2808	6	2832	6	2856	6	2880	6	2904	8

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Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
2905	8	2929	8	2953	8	2977	2	3001	6	3025	6	3049	3	3073	6	3097	6	3121	6	3145	3
2906	8	2930	6	2954	8	2978	6	3002	6	3026	6	3050	6	3074	6	3098	6	3122	6	3146	6
2907	8	2931	6	2955	8	2979	6	3003	6	3027	6	3051	6	3075	6	3099	6	3123	6	3147	6
2908	8	2932	8	2956	8	2980	2	3004	3	3028	6	3052	6	3076	6	3100	6	3124	6	3148	3
2909	8	2933	8	2957	8	2981	2	3005	6	3029	6	3053	6	3077	2	3101	6	3125	6	3149	3
2910	8	2934	8	2958	8	2982	2	3006	3	3030	6	3054	6	3078	2	3102	6	3126	6	3150	3
2911	8	2935	8	2959	8	2983	2	3007	2	3031	6	3055	6	3079	2	3103	6	3127	6	3151	6
2912	6	2936	6	2960	8	2984	2	3008	6	3032	6	3056	6	3080	2	3104	6	3128	6	3152	6
2913	6	2937	6	2961	8	2985	3	3009	6	3033	6	3057	6	3081	2	3105	6	3129	6	3153	3
2914	8	2938	6	2962	8	2986	3	3010	6	3034	6	3058	6	3082	6	3106	6	3130	6	3154	6
2915	8	2939	6	2963	8	2987	6	3011	6	3035	2	3059	6	3083	6	3107	6	3131	6	3155	3
2916	8	2940	6	2964	8	2988	6	3012	6	3036	2	3060	6	3084	6	3108	6	3132	6	3156	3
2917	8	2941	6	2965	8	2989	2	3013	6	3037	2	3061	6	3085	6	3109	6	3133	3	3157	3
2918	8	2942	8	2966	2	2990	6	3014	6	3038	2	3062	6	3086	2	3110	6	3134	3	3158	3
2919	8	2943	8	2967	2	2991	6	3015	6	3039	6	3063	6	3087	2	3111	6	3135	6	3159	6
2920	6	2944	8	2968	6	2992	6	3016	6	3040	6	3064	6	3088	6	3112	6	3136	3	3160	6
2921	8	2945	6	2969	6	2993	6	3017	6	3041	6	3065	3	3089	6	3113	6	3137	3	3161	6
2922	8	2946	8	2970	2	2994	2	3018	6	3042	6	3066	3	3090	2	3114	6	3138	3	3162	6
2923	8	2947	8	2971	6	2995	2	3019	6	3043	6	3067	6	3091	6	3115	6	3139	3	3163	3
2924	8	2948	8	2972	6	2996	6	3020	6	3044	6	3068	6	3092	6	3116	6	3140	6	3164	3
2925	8	2949	8	2973	6	2997	6	3021	6	3045	6	3069	6	3093	6	3117	6	3141	6	3165	3
2926	8	2950	8	2974	6	2998	6	3022	2	3046	6	3070	6	3094	6	3118	6	3142	3	3166	3
2927	6	2951	8	2975	6	2999	2	3023	2	3047	6	3071	6	3095	6	3119	6	3143	6	3167	3
2928	8	2952	8	2976	3	3000	6	3024	2	3048	6	3072	6	3096	6	3120	6	3144	3	3168	3

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
3169	3	3193	3	3217	2	3241	6	3265	7	3289	7	3313	5	3337	7	3361	7	3385	5	3409	5
3170	3	3194	3	3218	2	3242	6	3266	7	3290	7	3314	5	3338	7	3362	7	3386	5	3410	5
3171	3	3195	3	3219	2	3243	6	3267	7	3291	7	3315	5	3339	7	3363	7	3387	5	3411	5
3172	3	3196	6	3220	2	3244	3	3268	7	3292	7	3316	5	3340	7	3364	7	3388	5	3412	5
3173	3	3197	6	3221	2	3245	3	3269	7	3293	7	3317	5	3341	7	3365	5	3389	5	3413	5
3174	3	3198	6	3222	2	3246	6	3270	7	3294	7	3318	5	3342	7	3366	5	3390	5	3414	5
3175	3	3199	6	3223	2	3247	6	3271	7	3295	7	3319	5	3343	7	3367	5	3391	5	3415	5
3176	3	3200	3	3224	2	3248	6	3272	7	3296	7	3320	5	3344	7	3368	5	3392	5	3416	5
3177	3	3201	3	3225	2	3249	5	3273	7	3297	7	3321	5	3345	7	3369	5	3393	5	3417	5
3178	3	3202	3	3226	2	3250	5	3274	7	3298	7	3322	5	3346	7	3370	5	3394	5	3418	5
3179	3	3203	3	3227	6	3251	5	3275	7	3299	7	3323	5	3347	7	3371	5	3395	5	3419	5
3180	3	3204	3	3228	6	3252	5	3276	7	3300	7	3324	5	3348	7	3372	5	3396	5	3420	5
3181	3	3205	3	3229	2	3253	5	3277	5	3301	7	3325	7	3349	7	3373	5	3397	5	3421	5
3182	3	3206	3	3230	6	3254	5	3278	5	3302	7	3326	7	3350	7	3374	5	3398	5	3422	5
3183	3	3207	3	3231	6	3255	5	3279	5	3303	7	3327	7	3351	7	3375	5	3399	5	3423	5
3184	3	3208	3	3232	2	3256	5	3280	5	3304	7	3328	7	3352	7	3376	5	3400	5	3424	5
3185	3	3209	3	3233	2	3257	5	3281	5	3305	7	3329	7	3353	7	3377	5	3401	5	3425	5
3186	3	3210	2	3234	2	3258	5	3282	5	3306	7	3330	7	3354	7	3378	5	3402	5	3426	5
3187	3	3211	2	3235	2	3259	5	3283	5	3307	7	3331	7	3355	7	3379	5	3403	5	3427	5
3188	3	3212	6	3236	2	3260	5	3284	5	3308	7	3332	7	3356	7	3380	5	3404	5	3428	5
3189	3	3213	2	3237	2	3261	5	3285	5	3309	7	3333	7	3357	7	3381	5	3405	5	3429	5
3190	3	3214	2	3238	2	3262	7	3286	7	3310	7	3334	7	3358	7	3382	5	3406	5	3430	5
3191	3	3215	6	3239	6	3263	7	3287	7	3311	5	3335	7	3359	7	3383	5	3407	5	3431	5
3192	3	3216	2	3240	6	3264	7	3288	7	3312	5	3336	7	3360	7	3384	5	3408	5	3432	5

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
3433	5	3457	5	3481	5	3505	5	3529	5	3553	5	3577	5	3601	5	3625	7	3649	7	3673	7
3434	5	3458	5	3482	5	3506	5	3530	5	3554	5	3578	5	3602	5	3626	7	3650	7	3674	7
3435	5	3459	5	3483	5	3507	5	3531	5	3555	5	3579	5	3603	7	3627	7	3651	7	3675	7
3436	5	3460	5	3484	5	3508	5	3532	5	3556	5	3580	5	3604	7	3628	7	3652	7	3676	7
3437	5	3461	5	3485	5	3509	5	3533	5	3557	5	3581	5	3605	7	3629	7	3653	7	3677	7
3438	5	3462	5	3486	5	3510	5	3534	5	3558	5	3582	5	3606	7	3630	7	3654	7	3678	7
3439	5	3463	5	3487	5	3511	5	3535	5	3559	5	3583	5	3607	7	3631	7	3655	7	3679	7
3440	5	3464	5	3488	5	3512	5	3536	5	3560	5	3584	5	3608	7	3632	7	3656	7	3680	7
3441	5	3465	5	3489	5	3513	5	3537	5	3561	5	3585	5	3609	7	3633	7	3657	7	3681	7
3442	5	3466	5	3490	5	3514	5	3538	5	3562	5	3586	5	3610	7	3634	7	3658	7	3682	5
3443	5	3467	5	3491	7	3515	5	3539	5	3563	5	3587	5	3611	7	3635	7	3659	7	3683	5
3444	5	3468	5	3492	7	3516	5	3540	5	3564	5	3588	5	3612	7	3636	7	3660	7	3684	7
3445	5	3469	5	3493	7	3517	5	3541	5	3565	5	3589	5	3613	7	3637	7	3661	7	3685	7
3446	5	3470	5	3494	7	3518	5	3542	5	3566	5	3590	5	3614	7	3638	7	3662	7	3686	7
3447	5	3471	5	3495	7	3519	5	3543	7	3567	5	3591	5	3615	7	3639	7	3663	7	3687	7
3448	5	3472	5	3496	7	3520	5	3544	7	3568	5	3592	5	3616	7	3640	7	3664	7	3688	7
3449	5	3473	5	3497	7	3521	5	3545	7	3569	5	3593	5	3617	7	3641	7	3665	7	3689	7
3450	5	3474	5	3498	7	3522	5	3546	7	3570	5	3594	5	3618	7	3642	7	3666	7	3690	7
3451	5	3475	5	3499	7	3523	5	3547	5	3571	5	3595	5	3619	7	3643	7	3667	7	3691	7
3452	5	3476	5	3500	7	3524	5	3548	5	3572	5	3596	5	3620	7	3644	7	3668	7	3692	7
3453	5	3477	5	3501	5	3525	5	3549	5	3573	5	3597	5	3621	7	3645	7	3669	7	3693	7
3454	5	3478	5	3502	5	3526	5	3550	7	3574	5	3598	5	3622	7	3646	7	3670	7	3694	7
3455	5	3479	5	3503	5	3527	5	3551	5	3575	5	3599	7	3623	7	3647	7	3671	7	3695	7
3456	5	3480	5	3504	5	3528	5	3552	5	3576	5	3600	5	3624	7	3648	7	3672	7	3696	7

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
3697	7	3721	7	3745	7	3769	5	3793	7	3817	5	3841	2	3865	2	3889	2	3913	4	3937	6
3698	7	3722	7	3746	7	3770	5	3794	7	3818	7	3842	2	3866	2	3890	2	3914	4	3938	6
3699	7	3723	7	3747	7	3771	5	3795	7	3819	2	3843	2	3867	2	3891	2	3915	4	3939	6
3700	7	3724	7	3748	7	3772	5	3796	7	3820	2	3844	2	3868	2	3892	2	3916	4	3940	6
3701	7	3725	7	3749	7	3773	5	3797	7	3821	2	3845	2	3869	2	3893	2	3917	4	3941	6
3702	7	3726	7	3750	7	3774	5	3798	7	3822	2	3846	2	3870	2	3894	2	3918	4	3942	6
3703	7	3727	7	3751	7	3775	5	3799	7	3823	2	3847	4	3871	2	3895	2	3919	4	3943	3
3704	7	3728	7	3752	5	3776	5	3800	7	3824	4	3848	2	3872	2	3896	2	3920	4	3944	6
3705	7	3729	7	3753	5	3777	7	3801	5	3825	4	3849	4	3873	2	3897	2	3921	2	3945	6
3706	7	3730	7	3754	5	3778	7	3802	5	3826	4	3850	4	3874	2	3898	2	3922	6	3946	6
3707	7	3731	7	3755	5	3779	7	3803	5	3827	4	3851	4	3875	2	3899	2	3923	6	3947	6
3708	7	3732	7	3756	5	3780	7	3804	7	3828	4	3852	4	3876	2	3900	2	3924	6	3948	8
3709	5	3733	5	3757	5	3781	5	3805	5	3829	2	3853	4	3877	2	3901	2	3925	3	3949	8
3710	5	3734	7	3758	5	3782	7	3806	5	3830	2	3854	4	3878	2	3902	2	3926	3	3950	8
3711	5	3735	5	3759	5	3783	7	3807	5	3831	2	3855	2	3879	2	3903	2	3927	6	3951	8
3712	7	3736	7	3760	5	3784	7	3808	5	3832	4	3856	2	3880	2	3904	2	3928	6	3952	8
3713	7	3737	7	3761	5	3785	7	3809	5	3833	4	3857	4	3881	2	3905	2	3929	3	3953	8
3714	7	3738	7	3762	5	3786	5	3810	5	3834	2	3858	2	3882	2	3906	2	3930	6	3954	8
3715	7	3739	7	3763	5	3787	5	3811	5	3835	2	3859	2	3883	2	3907	2	3931	6	3955	6
3716	7	3740	7	3764	5	3788	5	3812	5	3836	2	3860	2	3884	2	3908	2	3932	8	3956	6
3717	7	3741	7	3765	5	3789	7	3813	5	3837	2	3861	2	3885	2	3909	2	3933	6	3957	6
3718	7	3742	7	3766	5	3790	7	3814	5	3838	2	3862	2	3886	2	3910	2	3934	6	3958	6
3719	7	3743	7	3767	5	3791	7	3815	5	3839	2	3863	2	3887	2	3911	2	3935	3	3959	3
3720	7	3744	7	3768	5	3792	7	3816	5	3840	2	3864	2	3888	2	3912	4	3936	6	3960	6

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
3961	6	3985	6	4009	3	4033	3	4057	6	4081	6	4105	6	4129	6	4153	6	4177	6	4201	6
3962	6	3986	6	4010	3	4034	6	4058	6	4082	6	4106	6	4130	6	4154	6	4178	6	4202	6
3963	6	3987	6	4011	3	4035	3	4059	6	4083	6	4107	6	4131	6	4155	6	4179	6	4203	6
3964	6	3988	3	4012	6	4036	3	4060	6	4084	6	4108	6	4132	6	4156	6	4180	6	4204	6
3965	6	3989	6	4013	3	4037	3	4061	6	4085	6	4109	6	4133	6	4157	6	4181	6	4205	6
3966	6	3990	3	4014	3	4038	3	4062	6	4086	6	4110	6	4134	6	4158	6	4182	6	4206	6
3967	6	3991	3	4015	3	4039	6	4063	6	4087	6	4111	6	4135	6	4159	6	4183	6	4207	6
3968	6	3992	6	4016	3	4040	3	4064	6	4088	6	4112	6	4136	6	4160	6	4184	8	4208	6
3969	6	3993	6	4017	3	4041	3	4065	6	4089	6	4113	6	4137	6	4161	6	4185	6	4209	6
3970	6	3994	6	4018	3	4042	3	4066	6	4090	6	4114	6	4138	6	4162	6	4186	6	4210	6
3971	6	3995	6	4019	3	4043	3	4067	6	4091	6	4115	6	4139	6	4163	6	4187	6	4211	6
3972	6	3996	3	4020	3	4044	3	4068	6	4092	6	4116	6	4140	6	4164	6	4188	6	4212	6
3973	6	3997	3	4021	3	4045	3	4069	6	4093	6	4117	6	4141	6	4165	6	4189	6	4213	6
3974	6	3998	3	4022	3	4046	3	4070	6	4094	6	4118	6	4142	6	4166	6	4190	6	4214	6
3975	6	3999	3	4023	3	4047	3	4071	6	4095	6	4119	6	4143	6	4167	6	4191	6	4215	6
3976	6	4000	3	4024	3	4048	3	4072	6	4096	6	4120	6	4144	6	4168	6	4192	6	4216	6
3977	6	4001	3	4025	3	4049	3	4073	6	4097	6	4121	6	4145	6	4169	6	4193	6	4217	6
3978	6	4002	3	4026	3	4050	3	4074	6	4098	6	4122	6	4146	6	4170	6	4194	6	4218	6
3979	6	4003	3	4027	3	4051	3	4075	6	4099	6	4123	6	4147	6	4171	6	4195	6	4219	6
3980	6	4004	3	4028	3	4052	6	4076	6	4100	6	4124	6	4148	6	4172	6	4196	6	4220	6
3981	3	4005	3	4029	6	4053	6	4077	6	4101	6	4125	6	4149	6	4173	6	4197	6	4221	6
3982	3	4006	3	4030	3	4054	6	4078	6	4102	6	4126	6	4150	6	4174	6	4198	6	4222	6
3983	6	4007	3	4031	3	4055	6	4079	6	4103	6	4127	6	4151	6	4175	6	4199	6	4223	6
3984	6	4008	3	4032	3	4056	6	4080	6	4104	6	4128	6	4152	6	4176	6	4200	6	4224	6

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Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
4225	6	4249	6	4273	5	4297	5	4321	5	4345	8	4369	3	4393	3	4417	3	4441	3	4465	3
4226	6	4250	6	4274	5	4298	8	4322	5	4346	8	4370	3	4394	3	4418	3	4442	3	4466	3
4227	6	4251	6	4275	5	4299	8	4323	5	4347	5	4371	3	4395	3	4419	3	4443	3	4467	3
4228	6	4252	6	4276	5	4300	8	4324	5	4348	5	4372	3	4396	3	4420	3	4444	3	4468	3
4229	6	4253	5	4277	5	4301	8	4325	5	4349	5	4373	3	4397	3	4421	3	4445	3	4469	3
4230	6	4254	8	4278	5	4302	8	4326	5	4350	5	4374	3	4398	3	4422	3	4446	3	4470	3
4231	8	4255	8	4279	8	4303	5	4327	8	4351	3	4375	3	4399	3	4423	3	4447	3	4471	3
4232	6	4256	8	4280	8	4304	8	4328	8	4352	3	4376	3	4400	3	4424	3	4448	3	4472	3
4233	6	4257	8	4281	8	4305	5	4329	8	4353	3	4377	3	4401	3	4425	3	4449	3	4473	3
4234	6	4258	8	4282	8	4306	5	4330	8	4354	3	4378	3	4402	3	4426	3	4450	3	4474	3
4235	8	4259	8	4283	8	4307	5	4331	8	4355	3	4379	3	4403	3	4427	3	4451	3	4475	3
4236	8	4260	5	4284	8	4308	5	4332	8	4356	3	4380	3	4404	3	4428	3	4452	3	4476	3
4237	6	4261	5	4285	8	4309	5	4333	8	4357	3	4381	3	4405	3	4429	3	4453	3	4477	3
4238	6	4262	5	4286	8	4310	5	4334	8	4358	3	4382	3	4406	3	4430	3	4454	3	4478	3
4239	6	4263	5	4287	5	4311	5	4335	8	4359	3	4383	3	4407	3	4431	3	4455	3	4479	3
4240	6	4264	5	4288	5	4312	5	4336	8	4360	3	4384	3	4408	3	4432	3	4456	3	4480	3
4241	8	4265	5	4289	5	4313	5	4337	8	4361	3	4385	3	4409	3	4433	3	4457	3	4481	3
4242	8	4266	5	4290	5	4314	5	4338	8	4362	3	4386	3	4410	3	4434	3	4458	3	4482	3
4243	8	4267	5	4291	5	4315	5	4339	8	4363	3	4387	3	4411	3	4435	3	4459	3	4483	3
4244	8	4268	5	4292	5	4316	5	4340	8	4364	3	4388	3	4412	3	4436	3	4460	3	4484	3
4245	8	4269	5	4293	5	4317	5	4341	8	4365	3	4389	3	4413	3	4437	3	4461	3	4485	3
4246	6	4270	5	4294	5	4318	5	4342	8	4366	3	4390	3	4414	3	4438	3	4462	3	4486	3
4247	6	4271	5	4295	5	4319	5	4343	8	4367	3	4391	3	4415	3	4439	3	4463	3	4487	3
4248	6	4272	5	4296	5	4320	5	4344	8	4368	3	4392	3	4416	3	4440	3	4464	3	4488	3

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Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
4489	3	4513	2	4537	2	4561	2	4585	2	4609	3	4633	3	4657	4	4681	4	4705	7	4729	7
4490	3	4514	2	4538	2	4562	2	4586	6	4610	3	4634	3	4658	4	4682	4	4706	7	4730	7
4491	3	4515	2	4539	2	4563	6	4587	2	4611	3	4635	3	4659	7	4683	4	4707	7	4731	7
4492	3	4516	2	4540	2	4564	6	4588	6	4612	3	4636	3	4660	1	4684	4	4708	7	4732	7
4493	3	4517	2	4541	2	4565	2	4589	2	4613	3	4637	3	4661	1	4685	1	4709	7	4733	7
4494	6	4518	2	4542	6	4566	2	4590	2	4614	3	4638	3	4662	1	4686	1	4710	7	4734	7
4495	6	4519	6	4543	2	4567	2	4591	6	4615	3	4639	3	4663	1	4687	1	4711	7	4735	7
4496	6	4520	6	4544	6	4568	2	4592	2	4616	3	4640	4	4664	7	4688	7	4712	7	4736	1
4497	6	4521	2	4545	6	4569	2	4593	2	4617	3	4641	4	4665	1	4689	1	4713	7	4737	7
4498	6	4522	6	4546	6	4570	2	4594	6	4618	3	4642	4	4666	1	4690	7	4714	7	4738	7
4499	6	4523	6	4547	6	4571	2	4595	6	4619	3	4643	4	4667	7	4691	7	4715	7	4739	7
4500	6	4524	2	4548	2	4572	2	4596	6	4620	3	4644	4	4668	7	4692	7	4716	7	4740	7
4501	6	4525	2	4549	2	4573	2	4597	6	4621	3	4645	4	4669	7	4693	1	4717	7	4741	7
4502	6	4526	2	4550	2	4574	2	4598	6	4622	3	4646	4	4670	7	4694	7	4718	7	4742	7
4503	6	4527	6	4551	2	4575	2	4599	2	4623	3	4647	4	4671	7	4695	7	4719	7	4743	7
4504	6	4528	6	4552	2	4576	2	4600	2	4624	3	4648	4	4672	7	4696	7	4720	7	4744	7
4505	2	4529	2	4553	2	4577	2	4601	2	4625	3	4649	4	4673	7	4697	7	4721	1	4745	7
4506	2	4530	6	4554	2	4578	2	4602	2	4626	3	4650	4	4674	7	4698	7	4722	7	4746	7
4507	6	4531	6	4555	2	4579	2	4603	3	4627	3	4651	4	4675	7	4699	1	4723	7	4747	7
4508	2	4532	6	4556	2	4580	2	4604	3	4628	3	4652	4	4676	7	4700	7	4724	7	4748	7
4509	2	4533	6	4557	2	4581	2	4605	3	4629	3	4653	4	4677	7	4701	1	4725	7	4749	7
4510	6	4534	6	4558	2	4582	2	4606	3	4630	3	4654	4	4678	7	4702	1	4726	7	4750	7
4511	2	4535	2	4559	2	4583	6	4607	3	4631	3	4655	4	4679	1	4703	1	4727	7	4751	7
4512	2	4536	2	4560	2	4584	6	4608	3	4632	3	4656	4	4680	4	4704	1	4728	7	4752	7

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
4753	7	4777	1	4801	1	4825	4	4849	4	4873	4	4897	4	4921	4	4945	4	4969	4	4993	4
4754	7	4778	1	4802	7	4826	4	4850	4	4874	4	4898	4	4922	4	4946	4	4970	4	4994	4
4755	7	4779	1	4803	1	4827	4	4851	4	4875	4	4899	4	4923	4	4947	4	4971	4	4995	4
4756	7	4780	1	4804	7	4828	4	4852	4	4876	4	4900	4	4924	4	4948	4	4972	4	4996	4
4757	7	4781	1	4805	7	4829	4	4853	4	4877	4	4901	4	4925	4	4949	4	4973	4	4997	4
4758	7	4782	1	4806	7	4830	4	4854	4	4878	4	4902	4	4926	4	4950	4	4974	4	4998	4
4759	7	4783	1	4807	1	4831	4	4855	4	4879	4	4903	4	4927	4	4951	4	4975	4	4999	4
4760	7	4784	1	4808	1	4832	4	4856	4	4880	4	4904	4	4928	4	4952	4	4976	4	5000	4
4761	7	4785	1	4809	1	4833	4	4857	4	4881	4	4905	4	4929	4	4953	4	4977	4	5001	4
4762	1	4786	1	4810	1	4834	4	4858	4	4882	4	4906	4	4930	4	4954	4	4978	4	5002	4
4763	7	4787	1	4811	1	4835	4	4859	4	4883	4	4907	4	4931	4	4955	4	4979	4	5003	4
4764	7	4788	1	4812	4	4836	4	4860	4	4884	4	4908	4	4932	4	4956	4	4980	4	5004	4
4765	7	4789	1	4813	4	4837	4	4861	4	4885	4	4909	4	4933	4	4957	4	4981	4	5005	4
4766	4	4790	1	4814	4	4838	4	4862	4	4886	4	4910	4	4934	4	4958	4	4982	4	5006	4
4767	4	4791	1	4815	4	4839	4	4863	4	4887	4	4911	4	4935	4	4959	4	4983	4	5007	4
4768	4	4792	1	4816	4	4840	4	4864	4	4888	4	4912	4	4936	4	4960	4	4984	4	5008	4
4769	4	4793	1	4817	4	4841	4	4865	4	4889	4	4913	4	4937	4	4961	4	4985	4	5009	4
4770	4	4794	1	4818	4	4842	4	4866	4	4890	4	4914	4	4938	4	4962	4	4986	4	5010	4
4771	4	4795	1	4819	4	4843	4	4867	4	4891	4	4915	4	4939	4	4963	4	4987	4	5011	4
4772	1	4796	1	4820	4	4844	4	4868	4	4892	4	4916	4	4940	4	4964	4	4988	4	5012	4
4773	1	4797	1	4821	4	4845	4	4869	4	4893	4	4917	4	4941	4	4965	4	4989	4	5013	4
4774	1	4798	1	4822	4	4846	4	4870	4	4894	4	4918	4	4942	4	4966	4	4990	4	5014	4
4775	1	4799	1	4823	4	4847	4	4871	4	4895	4	4919	4	4943	4	4967	4	4991	4	5015	4
4776	1	4800	1	4824	4	4848	4	4872	4	4896	4	4920	4	4944	4	4968	4	4992	4	5016	4

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
5017	4	5041	3	5065	2	5089	3	5113	3	5137	3	5161	3	5185	3	5209	3	5233	2	5257	2
5018	4	5042	3	5066	3	5090	3	5114	3	5138	3	5162	3	5186	3	5210	3	5234	4	5258	2
5019	4	5043	3	5067	3	5091	3	5115	3	5139	3	5163	3	5187	3	5211	3	5235	4	5259	2
5020	4	5044	3	5068	2	5092	3	5116	3	5140	3	5164	3	5188	3	5212	3	5236	2	5260	2
5021	4	5045	3	5069	2	5093	3	5117	3	5141	3	5165	3	5189	3	5213	3	5237	2	5261	2
5022	4	5046	3	5070	3	5094	3	5118	3	5142	3	5166	3	5190	3	5214	3	5238	2	5262	2
5023	2	5047	3	5071	2	5095	3	5119	3	5143	3	5167	3	5191	3	5215	3	5239	2	5263	2
5024	2	5048	3	5072	2	5096	3	5120	3	5144	3	5168	3	5192	3	5216	2	5240	2	5264	4
5025	2	5049	3	5073	2	5097	3	5121	3	5145	3	5169	3	5193	3	5217	2	5241	2	5265	4
5026	2	5050	3	5074	2	5098	3	5122	3	5146	3	5170	3	5194	3	5218	2	5242	2	5266	2
5027	3	5051	3	5075	3	5099	3	5123	3	5147	3	5171	3	5195	3	5219	2	5243	2	5267	4
5028	2	5052	3	5076	3	5100	3	5124	3	5148	3	5172	3	5196	3	5220	2	5244	2	5268	4
5029	3	5053	3	5077	3	5101	3	5125	3	5149	3	5173	3	5197	3	5221	2	5245	2	5269	4
5030	3	5054	3	5078	3	5102	3	5126	3	5150	3	5174	3	5198	3	5222	2	5246	2	5270	4
5031	3	5055	3	5079	3	5103	3	5127	3	5151	3	5175	3	5199	3	5223	2	5247	4	5271	4
5032	3	5056	3	5080	3	5104	3	5128	3	5152	3	5176	3	5200	3	5224	2	5248	4	5272	2
5033	3	5057	3	5081	3	5105	3	5129	3	5153	3	5177	3	5201	3	5225	2	5249	4	5273	4
5034	3	5058	3	5082	2	5106	3	5130	3	5154	3	5178	3	5202	3	5226	2	5250	4	5274	1
5035	3	5059	3	5083	2	5107	3	5131	3	5155	3	5179	3	5203	3	5227	2	5251	4	5275	4
5036	3	5060	3	5084	2	5108	3	5132	3	5156	3	5180	3	5204	3	5228	2	5252	2	5276	4
5037	3	5061	3	5085	2	5109	3	5133	3	5157	3	5181	3	5205	3	5229	2	5253	4	5277	4
5038	3	5062	3	5086	2	5110	3	5134	3	5158	3	5182	3	5206	3	5230	2	5254	4	5278	4
5039	3	5063	2	5087	2	5111	3	5135	3	5159	3	5183	3	5207	3	5231	2	5255	4	5279	4
5040	3	5064	2	5088	3	5112	3	5136	3	5160	3	5184	3	5208	3	5232	2	5256	2	5280	4

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
5281	4	5305	4	5329	2	5353	2	5377	3	5401	6	5425	6	5449	8	5473	8	5497	8	5521	8
5282	4	5306	4	5330	2	5354	2	5378	3	5402	3	5426	6	5450	8	5474	8	5498	8	5522	8
5283	2	5307	4	5331	3	5355	2	5379	6	5403	6	5427	6	5451	8	5475	8	5499	8	5523	8
5284	2	5308	4	5332	2	5356	2	5380	6	5404	6	5428	6	5452	8	5476	8	5500	8	5524	8
5285	2	5309	4	5333	2	5357	2	5381	3	5405	6	5429	6	5453	8	5477	8	5501	8	5525	8
5286	2	5310	4	5334	2	5358	2	5382	6	5406	6	5430	6	5454	8	5478	8	5502	8	5526	8
5287	2	5311	4	5335	2	5359	2	5383	3	5407	6	5431	6	5455	8	5479	8	5503	8	5527	8
5288	2	5312	4	5336	2	5360	2	5384	6	5408	3	5432	6	5456	8	5480	8	5504	8	5528	8
5289	4	5313	4	5337	2	5361	2	5385	6	5409	3	5433	6	5457	8	5481	8	5505	8	5529	8
5290	4	5314	4	5338	2	5362	2	5386	6	5410	6	5434	6	5458	8	5482	8	5506	8	5530	8
5291	4	5315	2	5339	3	5363	2	5387	6	5411	6	5435	6	5459	8	5483	8	5507	8	5531	8
5292	4	5316	2	5340	2	5364	3	5388	6	5412	6	5436	6	5460	8	5484	8	5508	8	5532	8
5293	2	5317	4	5341	3	5365	2	5389	6	5413	6	5437	6	5461	8	5485	8	5509	8	5533	8
5294	4	5318	2	5342	2	5366	3	5390	6	5414	6	5438	6	5462	8	5486	8	5510	8	5534	8
5295	4	5319	2	5343	2	5367	3	5391	6	5415	6	5439	6	5463	8	5487	8	5511	8	5535	8
5296	2	5320	2	5344	2	5368	6	5392	6	5416	6	5440	8	5464	8	5488	8	5512	8	5536	8
5297	2	5321	2	5345	2	5369	6	5393	6	5417	6	5441	8	5465	8	5489	8	5513	8	5537	8
5298	1	5322	2	5346	2	5370	6	5394	6	5418	6	5442	8	5466	8	5490	8	5514	8	5538	8
5299	1	5323	4	5347	3	5371	3	5395	3	5419	6	5443	8	5467	8	5491	8	5515	8	5539	8
5300	4	5324	2	5348	2	5372	3	5396	6	5420	6	5444	8	5468	8	5492	8	5516	8	5540	8
5301	1	5325	2	5349	2	5373	3	5397	6	5421	6	5445	8	5469	8	5493	8	5517	8	5541	8
5302	1	5326	2	5350	3	5374	6	5398	6	5422	6	5446	8	5470	8	5494	8	5518	8	5542	8
5303	4	5327	2	5351	2	5375	6	5399	6	5423	6	5447	8	5471	8	5495	8	5519	8	5543	8
5304	4	5328	2	5352	2	5376	6	5400	6	5424	6	5448	8	5472	8	5496	8	5520	8	5544	8

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Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
5545	8	5569	2	5593	3	5617	2	5641	3	5665	4	5689	4	5713	4	5737	3	5761	3	5785	4
5546	8	5570	2	5594	3	5618	2	5642	3	5666	4	5690	4	5714	4	5738	3	5762	3	5786	4
5547	8	5571	3	5595	3	5619	3	5643	3	5667	4	5691	4	5715	4	5739	3	5763	3	5787	4
5548	8	5572	3	5596	3	5620	2	5644	3	5668	4	5692	4	5716	4	5740	3	5764	3	5788	4
5549	8	5573	3	5597	3	5621	3	5645	3	5669	4	5693	4	5717	4	5741	3	5765	3	5789	4
5550	8	5574	3	5598	3	5622	2	5646	3	5670	4	5694	4	5718	4	5742	3	5766	3	5790	4
5551	8	5575	3	5599	2	5623	2	5647	2	5671	4	5695	4	5719	4	5743	3	5767	3	5791	4
5552	8	5576	2	5600	3	5624	2	5648	2	5672	4	5696	4	5720	4	5744	3	5768	4	5792	4
5553	8	5577	3	5601	2	5625	2	5649	2	5673	4	5697	4	5721	4	5745	3	5769	4	5793	4
5554	8	5578	3	5602	3	5626	2	5650	2	5674	4	5698	4	5722	4	5746	3	5770	4	5794	4
5555	8	5579	3	5603	3	5627	2	5651	3	5675	4	5699	4	5723	4	5747	3	5771	4	5795	4
5556	8	5580	2	5604	3	5628	2	5652	3	5676	4	5700	4	5724	4	5748	3	5772	4	5796	4
5557	8	5581	3	5605	3	5629	2	5653	3	5677	4	5701	4	5725	3	5749	3	5773	4	5797	4
5558	8	5582	2	5606	3	5630	3	5654	3	5678	4	5702	4	5726	3	5750	3	5774	4	5798	4
5559	8	5583	3	5607	3	5631	3	5655	4	5679	4	5703	4	5727	3	5751	3	5775	4	5799	4
5560	8	5584	3	5608	3	5632	3	5656	4	5680	4	5704	4	5728	3	5752	3	5776	4	5800	4
5561	8	5585	3	5609	2	5633	3	5657	4	5681	4	5705	4	5729	3	5753	3	5777	4	5801	4
5562	8	5586	3	5610	3	5634	3	5658	4	5682	4	5706	4	5730	3	5754	3	5778	4	5802	4
5563	8	5587	3	5611	3	5635	3	5659	4	5683	4	5707	4	5731	3	5755	3	5779	4	5803	4
5564	2	5588	3	5612	3	5636	3	5660	4	5684	4	5708	4	5732	3	5756	3	5780	4	5804	4
5565	3	5589	3	5613	3	5637	3	5661	4	5685	4	5709	4	5733	3	5757	3	5781	4	5805	4
5566	3	5590	3	5614	3	5638	3	5662	4	5686	4	5710	4	5734	3	5758	3	5782	4	5806	4
5567	3	5591	3	5615	3	5639	3	5663	4	5687	4	5711	4	5735	3	5759	3	5783	4	5807	4
5568	3	5592	3	5616	3	5640	3	5664	4	5688	4	5712	4	5736	3	5760	3	5784	4	5808	4

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Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
5809	1	5833	4	5857	4	5881	4	5905	1	5929	2	5953	3	5977	8	6001	5	6025	8	6049	8
5810	1	5834	4	5858	4	5882	4	5906	1	5930	2	5954	3	5978	8	6002	5	6026	8	6050	8
5811	1	5835	4	5859	4	5883	4	5907	1	5931	3	5955	3	5979	8	6003	8	6027	8	6051	5
5812	1	5836	4	5860	4	5884	4	5908	1	5932	3	5956	3	5980	8	6004	8	6028	8	6052	5
5813	1	5837	4	5861	4	5885	1	5909	1	5933	3	5957	3	5981	8	6005	8	6029	8	6053	8
5814	1	5838	4	5862	4	5886	4	5910	1	5934	3	5958	3	5982	8	6006	8	6030	8	6054	8
5815	1	5839	4	5863	4	5887	4	5911	1	5935	3	5959	3	5983	8	6007	8	6031	8	6055	8
5816	1	5840	4	5864	4	5888	1	5912	1	5936	3	5960	3	5984	8	6008	8	6032	8	6056	8
5817	1	5841	4	5865	4	5889	1	5913	1	5937	3	5961	3	5985	5	6009	8	6033	8	6057	8
5818	1	5842	4	5866	4	5890	1	5914	1	5938	3	5962	3	5986	5	6010	8	6034	8	6058	8
5819	1	5843	4	5867	4	5891	1	5915	4	5939	3	5963	2	5987	5	6011	8	6035	8	6059	8
5820	4	5844	1	5868	4	5892	4	5916	4	5940	3	5964	3	5988	5	6012	8	6036	8	6060	8
5821	4	5845	1	5869	4	5893	1	5917	4	5941	2	5965	3	5989	5	6013	8	6037	8	6061	8
5822	1	5846	1	5870	4	5894	1	5918	4	5942	2	5966	8	5990	5	6014	8	6038	8	6062	8
5823	1	5847	1	5871	4	5895	1	5919	3	5943	2	5967	8	5991	5	6015	8	6039	8	6063	8
5824	4	5848	1	5872	4	5896	4	5920	3	5944	2	5968	8	5992	5	6016	8	6040	8	6064	8
5825	4	5849	1	5873	4	5897	4	5921	3	5945	3	5969	8	5993	5	6017	8	6041	8	6065	5
5826	4	5850	4	5874	4	5898	4	5922	3	5946	3	5970	8	5994	5	6018	8	6042	8	6066	8
5827	1	5851	4	5875	4	5899	4	5923	3	5947	3	5971	8	5995	5	6019	8	6043	8	6067	8
5828	4	5852	4	5876	4	5900	4	5924	3	5948	3	5972	8	5996	5	6020	8	6044	8	6068	8
5829	4	5853	4	5877	1	5901	4	5925	3	5949	3	5973	8	5997	5	6021	8	6045	8	6069	8
5830	4	5854	4	5878	1	5902	1	5926	3	5950	3	5974	8	5998	5	6022	8	6046	8	6070	8
5831	4	5855	4	5879	1	5903	1	5927	2	5951	3	5975	8	5999	5	6023	8	6047	8	6071	8
5832	4	5856	4	5880	1	5904	1	5928	2	5952	3	5976	8	6000	5	6024	8	6048	8	6072	8

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
6073	8	6097	8	6121	8	6145	7	6169	7	6193	8	6217	1	6241	8	6265	5	6289	5	6313	1
6074	8	6098	8	6122	8	6146	7	6170	7	6194	8	6218	1	6242	8	6266	5	6290	5	6314	7
6075	5	6099	8	6123	8	6147	7	6171	7	6195	8	6219	1	6243	8	6267	5	6291	5	6315	1
6076	8	6100	8	6124	8	6148	5	6172	5	6196	8	6220	1	6244	8	6268	5	6292	8	6316	1
6077	8	6101	8	6125	8	6149	5	6173	7	6197	8	6221	1	6245	8	6269	5	6293	8	6317	1
6078	8	6102	8	6126	8	6150	5	6174	7	6198	8	6222	1	6246	8	6270	5	6294	8	6318	7
6079	8	6103	8	6127	8	6151	5	6175	7	6199	8	6223	7	6247	8	6271	5	6295	8	6319	7
6080	5	6104	8	6128	8	6152	5	6176	5	6200	8	6224	5	6248	8	6272	5	6296	8	6320	1
6081	5	6105	8	6129	8	6153	5	6177	7	6201	8	6225	7	6249	8	6273	5	6297	8	6321	1
6082	5	6106	8	6130	8	6154	5	6178	7	6202	8	6226	7	6250	8	6274	5	6298	8	6322	1
6083	8	6107	8	6131	8	6155	5	6179	7	6203	8	6227	5	6251	8	6275	5	6299	8	6323	1
6084	8	6108	8	6132	8	6156	5	6180	7	6204	8	6228	5	6252	8	6276	5	6300	8	6324	1
6085	8	6109	8	6133	8	6157	5	6181	5	6205	8	6229	5	6253	8	6277	5	6301	8	6325	1
6086	8	6110	8	6134	8	6158	5	6182	7	6206	8	6230	5	6254	8	6278	5	6302	8	6326	7
6087	8	6111	8	6135	8	6159	5	6183	5	6207	8	6231	1	6255	1	6279	5	6303	5	6327	7
6088	8	6112	8	6136	8	6160	7	6184	5	6208	8	6232	1	6256	5	6280	5	6304	7	6328	7
6089	8	6113	8	6137	8	6161	5	6185	5	6209	8	6233	1	6257	5	6281	5	6305	7	6329	7
6090	8	6114	8	6138	8	6162	5	6186	8	6210	8	6234	1	6258	5	6282	5	6306	7	6330	7
6091	8	6115	8	6139	8	6163	7	6187	8	6211	1	6235	1	6259	5	6283	5	6307	7	6331	7
6092	8	6116	8	6140	8	6164	7	6188	8	6212	1	6236	1	6260	5	6284	5	6308	1	6332	7
6093	8	6117	8	6141	8	6165	7	6189	8	6213	1	6237	1	6261	5	6285	5	6309	7	6333	7
6094	8	6118	8	6142	8	6166	7	6190	8	6214	1	6238	7	6262	5	6286	5	6310	1	6334	7
6095	8	6119	8	6143	8	6167	7	6191	8	6215	1	6239	1	6263	5	6287	5	6311	1	6335	7
6096	8	6120	8	6144	7	6168	7	6192	1	6216	1	6240	1	6264	5	6288	5	6312	7	6336	7

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
6337	7	6361	7	6385	1	6409	8	6433	5	6457	1	6481	7	6505	7	6529	6	6553	6	6577	6
6338	7	6362	7	6386	1	6410	8	6434	5	6458	7	6482	7	6506	7	6530	6	6554	6	6578	6
6339	7	6363	7	6387	1	6411	8	6435	5	6459	7	6483	7	6507	7	6531	6	6555	6	6579	6
6340	7	6364	7	6388	1	6412	8	6436	5	6460	8	6484	7	6508	8	6532	6	6556	6	6580	6
6341	7	6365	7	6389	1	6413	8	6437	5	6461	7	6485	7	6509	7	6533	6	6557	6	6581	6
6342	8	6366	7	6390	8	6414	8	6438	5	6462	7	6486	7	6510	7	6534	6	6558	6	6582	6
6343	8	6367	7	6391	8	6415	5	6439	5	6463	7	6487	7	6511	7	6535	6	6559	6	6583	6
6344	8	6368	7	6392	1	6416	8	6440	5	6464	7	6488	7	6512	7	6536	6	6560	6	6584	6
6345	7	6369	7	6393	8	6417	8	6441	5	6465	7	6489	7	6513	7	6537	6	6561	6	6585	6
6346	7	6370	7	6394	8	6418	8	6442	7	6466	7	6490	7	6514	7	6538	6	6562	6	6586	6
6347	7	6371	7	6395	1	6419	8	6443	7	6467	7	6491	7	6515	7	6539	6	6563	6	6587	6
6348	7	6372	1	6396	8	6420	5	6444	7	6468	7	6492	8	6516	7	6540	6	6564	6	6588	6
6349	7	6373	1	6397	8	6421	8	6445	7	6469	8	6493	8	6517	7	6541	6	6565	6	6589	6
6350	7	6374	1	6398	8	6422	8	6446	7	6470	8	6494	7	6518	7	6542	6	6566	6	6590	6
6351	7	6375	1	6399	8	6423	8	6447	7	6471	7	6495	7	6519	6	6543	6	6567	6	6591	6
6352	7	6376	1	6400	8	6424	8	6448	7	6472	7	6496	8	6520	6	6544	6	6568	6	6592	6
6353	7	6377	1	6401	1	6425	5	6449	7	6473	7	6497	7	6521	6	6545	6	6569	6	6593	6
6354	7	6378	1	6402	1	6426	1	6450	7	6474	7	6498	7	6522	6	6546	6	6570	6	6594	6
6355	7	6379	1	6403	1	6427	8	6451	7	6475	7	6499	7	6523	6	6547	6	6571	6	6595	6
6356	7	6380	1	6404	1	6428	1	6452	7	6476	7	6500	7	6524	6	6548	6	6572	6	6596	6
6357	7	6381	1	6405	1	6429	1	6453	1	6477	7	6501	7	6525	6	6549	6	6573	6	6597	6
6358	7	6382	1	6406	5	6430	1	6454	1	6478	7	6502	7	6526	6	6550	6	6574	6	6598	6
6359	7	6383	8	6407	5	6431	1	6455	1	6479	7	6503	7	6527	6	6551	6	6575	6	6599	6
6360	7	6384	1	6408	8	6432	5	6456	1	6480	7	6504	7	6528	6	6552	6	6576	6	6600	6

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
6601	6	6625	6	6649	6	6673	2	6697	6	6721	6	6745	6	6769	2	6793	2	6817	2	6841	6
6602	6	6626	6	6650	6	6674	2	6698	6	6722	6	6746	6	6770	2	6794	2	6818	2	6842	6
6603	6	6627	6	6651	6	6675	2	6699	6	6723	6	6747	6	6771	2	6795	2	6819	2	6843	6
6604	6	6628	6	6652	6	6676	6	6700	6	6724	6	6748	6	6772	2	6796	2	6820	2	6844	6
6605	6	6629	6	6653	6	6677	6	6701	6	6725	6	6749	6	6773	2	6797	2	6821	2	6845	6
6606	6	6630	6	6654	6	6678	6	6702	6	6726	6	6750	6	6774	2	6798	2	6822	2	6846	6
6607	6	6631	6	6655	6	6679	6	6703	6	6727	6	6751	6	6775	2	6799	2	6823	2	6847	6
6608	6	6632	6	6656	6	6680	6	6704	6	6728	6	6752	6	6776	2	6800	2	6824	2	6848	6
6609	6	6633	6	6657	6	6681	6	6705	6	6729	6	6753	6	6777	2	6801	2	6825	2	6849	6
6610	6	6634	6	6658	6	6682	6	6706	6	6730	6	6754	6	6778	2	6802	2	6826	2	6850	6
6611	6	6635	6	6659	6	6683	6	6707	6	6731	6	6755	6	6779	2	6803	2	6827	2	6851	6
6612	6	6636	6	6660	6	6684	6	6708	6	6732	6	6756	6	6780	2	6804	2	6828	2	6852	6
6613	6	6637	6	6661	2	6685	6	6709	6	6733	6	6757	6	6781	2	6805	2	6829	2	6853	6
6614	6	6638	6	6662	2	6686	6	6710	6	6734	6	6758	6	6782	2	6806	2	6830	2	6854	6
6615	6	6639	6	6663	2	6687	6	6711	6	6735	6	6759	6	6783	2	6807	2	6831	2	6855	6
6616	6	6640	6	6664	2	6688	6	6712	6	6736	6	6760	6	6784	2	6808	2	6832	2	6856	6
6617	6	6641	6	6665	2	6689	6	6713	6	6737	6	6761	6	6785	2	6809	2	6833	2	6857	6
6618	6	6642	6	6666	2	6690	6	6714	6	6738	6	6762	6	6786	2	6810	2	6834	6	6858	2
6619	6	6643	6	6667	2	6691	6	6715	6	6739	6	6763	6	6787	2	6811	2	6835	6	6859	2
6620	6	6644	6	6668	2	6692	6	6716	6	6740	6	6764	6	6788	2	6812	2	6836	2	6860	2
6621	6	6645	6	6669	2	6693	6	6717	6	6741	6	6765	6	6789	2	6813	2	6837	2	6861	2
6622	6	6646	6	6670	2	6694	6	6718	6	6742	6	6766	6	6790	2	6814	2	6838	2	6862	2
6623	6	6647	6	6671	6	6695	6	6719	6	6743	6	6767	2	6791	2	6815	2	6839	2	6863	2
6624	6	6648	6	6672	6	6696	6	6720	6	6744	6	6768	2	6792	2	6816	2	6840	6	6864	2

Table A-2: (Continue)

Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No	Ward ID.	Congressional District No
6865	2	6889	2	6913	2	6937	2	6961	2										
6866	2	6890	2	6914	2	6938	2	6962	2										
6867	2	6891	2	6915	2	6939	2	6963	2										
6868	2	6892	2	6916	2	6940	2	6964	2										
6869	2	6893	2	6917	2	6941	2	6965	2										
6870	2	6894	2	6918	2	6942	2	6966	2										
6871	2	6895	2	6919	2	6943	2	6967	2										
6872	2	6896	2	6920	2	6944	2	6968	2										
6873	2	6897	2	6921	2	6945	2	6969	2										
6874	2	6898	2	6922	2	6946	2	6970	2										
6875	2	6899	2	6923	2	6947	2	6971	2										
6876	2	6900	2	6924	2	6948	2	6972	2										
6877	2	6901	2	6925	2	6949	2	6973	2										
6878	2	6902	2	6926	2	6950	2	6974	2										
6879	2	6903	2	6927	2	6951	2	6975	2										
6880	2	6904	2	6928	2	6952	2	6976	2										
6881	2	6905	2	6929	2	6953	2	6977	2										
6882	2	6906	2	6930	2	6954	2												
6883	2	6907	2	6931	2	6955	2												
6884	2	6908	2	6932	2	6956	2												
6885	2	6909	2	6933	2	6957	2												
6886	2	6910	2	6934	2	6958	2												
6887	2	6911	2	6935	2	6959	2												
6888	2	6912	2	6936	2	6960	2												

Table A-3: An example of a best result scenario for fair assignment of the wards to Wisconsin State Assembly and Wisconsin State Senate districts

Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
1	63	12	24	63	12	47	98	5	70	98	5	93	72	9	116	96	9	139	72	9	162	57	5	185	57	5
2	63	12	25	60	2	48	98	5	71	98	5	94	72	9	117	70	31	140	72	9	163	57	5	186	57	5
3	63	12	26	63	12	49	98	5	72	98	5	95	72	9	118	72	9	141	72	9	164	57	5	187	57	5
4	63	12	27	63	12	50	98	5	73	98	5	96	72	9	119	96	9	142	72	9	165	57	5	188	57	5
5	63	12	28	63	12	51	98	5	74	98	5	97	72	9	120	64	15	143	72	9	166	98	5	189	57	5
6	63	12	29	44	2	52	98	5	75	98	5	98	72	9	121	64	15	144	72	9	167	57	5	190	57	5
7	63	12	30	44	2	53	98	5	76	98	5	99	72	9	122	72	9	145	72	9	168	57	5	191	57	5
8	63	12	31	63	12	54	98	5	77	98	5	100	72	9	123	72	9	146	70	31	169	57	5	192	57	5
9	63	12	32	28	12	55	98	5	78	72	9	101	72	9	124	70	31	147	72	9	170	57	5	193	57	5
10	63	12	33	28	12	56	98	5	79	72	9	102	72	9	125	70	31	148	72	9	171	57	5	194	30	21
11	60	2	34	28	12	57	98	5	80	72	9	103	96	9	126	70	31	149	72	9	172	57	5	195	30	21
12	60	2	35	28	12	58	98	5	81	72	9	104	96	9	127	72	9	150	72	9	173	57	5	196	30	21
13	44	2	36	28	12	59	65	15	82	72	9	105	96	9	128	72	9	151	72	9	174	57	5	197	30	21
14	44	2	37	44	2	60	98	5	83	72	9	106	96	9	129	72	9	152	72	9	175	57	5	198	3	8
15	44	2	38	44	2	61	98	5	84	72	9	107	96	9	130	72	9	153	72	9	176	57	5	199	30	21
16	63	12	39	63	12	62	98	5	85	72	9	108	96	9	131	72	9	154	72	9	177	57	5	200	3	8
17	44	2	40	63	12	63	98	5	86	72	9	109	70	31	132	72	9	155	72	9	178	57	5	201	30	21
18	44	2	41	63	12	64	57	5	87	72	9	110	70	31	133	72	9	156	57	5	179	57	5	202	30	21
19	63	12	42	60	2	65	57	5	88	72	9	111	64	15	134	72	9	157	57	5	180	57	5	203	3	8
20	63	12	43	60	2	66	98	5	89	72	9	112	72	9	135	72	9	158	98	5	181	57	5	204	3	8
21	63	12	44	98	5	67	98	5	90	72	9	113	72	9	136	72	9	159	57	5	182	57	5	205	99	30
22	44	2	45	98	5	68	98	5	91	72	9	114	72	9	137	72	9	160	57	5	183	57	5	206	99	30
23	44	2	46	98	5	69	98	5	92	72	9	115	96	9	138	72	9	161	57	5	184	57	5	207	99	30

Table A-3: (Continue)

Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
208	59	21	231	3	8	254	90	21	277	30	21	300	90	21	323	9	18	346	3	8	369	9	18	392	56	31
209	59	21	232	3	8	255	90	21	278	59	21	301	3	8	324	9	18	347	3	8	370	59	21	393	56	31
210	99	30	233	3	8	256	90	21	279	59	21	302	33	18	325	9	18	348	3	8	371	33	18	394	56	31
211	99	30	234	99	30	257	90	21	280	99	30	303	33	18	326	33	18	349	20	8	372	9	18	395	56	31
212	59	21	235	3	8	258	90	21	281	59	21	304	33	18	327	33	18	350	20	8	373	33	18	396	56	31
213	59	21	236	99	30	259	30	21	282	3	8	305	33	18	328	33	18	351	20	8	374	9	18	397	56	31
214	99	30	237	99	30	260	30	21	283	59	21	306	33	18	329	33	18	352	20	8	375	20	8	398	56	31
215	99	30	238	99	30	261	30	21	284	59	21	307	9	18	330	3	8	353	4	18	376	20	8	399	56	31
216	30	21	239	99	30	262	90	21	285	99	30	308	59	21	331	3	8	354	33	18	377	20	8	400	56	31
217	30	21	240	59	21	263	30	21	286	59	21	309	59	21	332	59	21	355	33	18	378	20	8	401	56	31
218	30	21	241	59	21	264	30	21	287	9	18	310	59	21	333	99	30	356	4	18	379	20	8	402	56	31
219	30	21	242	59	21	265	30	21	288	9	18	311	20	8	334	99	30	357	4	18	380	20	8	403	56	31
220	30	21	243	59	21	266	30	21	289	9	18	312	3	8	335	59	21	358	4	18	381	56	31	404	56	31
221	30	21	244	59	21	267	30	21	290	59	21	313	9	18	336	99	30	359	4	18	382	56	31	405	56	31
222	90	21	245	3	8	268	30	21	291	9	18	314	9	18	337	99	30	360	99	30	383	56	31	406	56	31
223	30	21	246	3	8	269	30	21	292	59	21	315	9	18	338	3	8	361	20	8	384	56	31	407	56	31
224	30	21	247	99	30	270	30	21	293	9	18	316	9	18	339	30	21	362	99	30	385	56	31	408	96	9
225	90	21	248	3	8	271	30	21	294	9	18	317	9	18	340	3	8	363	90	21	386	56	31	409	98	5
226	20	8	249	20	8	272	59	21	295	59	21	318	59	21	341	99	30	364	90	21	387	56	31	410	98	5
227	20	8	250	3	8	273	90	21	296	59	21	319	33	18	342	99	30	365	90	21	388	56	31	411	96	9
228	20	8	251	20	8	274	30	21	297	59	21	320	9	18	343	99	30	366	90	21	389	56	31	412	98	5
229	20	8	252	90	21	275	30	21	298	9	18	321	33	18	344	99	30	367	59	21	390	56	31	413	98	5
230	3	8	253	90	21	276	9	18	299	90	21	322	9	18	345	99	30	368	59	21	391	56	31	414	98	5

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
415	98	5	438	96	9	461	3	8	484	7	30	507	18	25	530	64	15	553	64	15	576	73	15	599	64	15
416	96	9	439	96	9	462	3	8	485	20	8	508	22	32	531	64	15	554	64	15	577	73	15	600	64	15
417	98	5	440	98	5	463	92	28	486	18	25	509	18	25	532	64	15	555	64	15	578	73	15	601	64	15
418	96	9	441	98	5	464	22	32	487	20	8	510	18	25	533	64	15	556	64	15	579	73	15	602	64	15
419	96	9	442	96	9	465	18	25	488	20	8	511	18	25	534	64	15	557	64	15	580	73	15	603	64	15
420	96	9	443	96	9	466	18	25	489	27	8	512	18	25	535	64	15	558	64	15	581	73	15	604	64	15
421	98	5	444	98	5	467	92	28	490	20	8	513	20	8	536	64	15	559	64	15	582	73	15	605	70	31
422	96	9	445	98	5	468	92	28	491	18	25	514	20	8	537	64	15	560	64	15	583	73	15	606	70	31
423	96	9	446	98	5	469	92	28	492	18	25	515	18	25	538	64	15	561	71	14	584	73	15	607	64	15
424	96	9	447	98	5	470	18	25	493	18	25	516	20	8	539	64	15	562	71	14	585	73	15	608	64	15
425	96	9	448	96	9	471	92	28	494	18	25	517	20	8	540	64	15	563	64	15	586	73	15	609	64	15
426	96	9	449	27	8	472	92	28	495	18	25	518	92	28	541	64	15	564	64	15	587	73	15	610	62	12
427	96	9	450	27	8	473	92	28	496	20	8	519	92	28	542	64	15	565	73	15	588	73	15	611	62	12
428	96	9	451	27	8	474	27	8	497	20	8	520	18	25	543	64	15	566	64	15	589	64	15	612	62	12
429	96	9	452	7	30	475	20	8	498	20	8	521	64	15	544	73	15	567	64	15	590	64	15	613	62	12
430	96	9	453	27	8	476	27	8	499	20	8	522	64	15	545	64	15	568	64	15	591	64	15	614	62	12
431	96	9	454	7	30	477	20	8	500	7	30	523	64	15	546	64	15	569	64	15	592	64	15	615	62	12
432	96	9	455	27	8	478	20	8	501	22	32	524	64	15	547	73	15	570	73	15	593	64	15	616	73	15
433	96	9	456	7	30	479	20	8	502	18	25	525	64	15	548	64	15	571	70	31	594	64	15	617	62	12
434	96	9	457	3	8	480	20	8	503	18	25	526	64	15	549	64	15	572	73	15	595	73	15	618	62	12
435	96	9	458	3	8	481	27	8	504	22	32	527	64	15	550	64	15	573	73	15	596	64	15	619	62	12
436	98	5	459	3	8	482	27	8	505	18	25	528	64	15	551	64	15	574	73	15	597	64	15	620	62	12
437	98	5	460	3	8	483	20	8	506	18	25	529	64	15	552	64	15	575	73	15	598	64	15	621	62	12

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
622	62	12	645	28	12	668	28	12	691	73	15	714	79	23	737	37	27	760	37	27	783	40	29	806	40	29
623	73	15	646	28	12	669	73	15	692	62	12	715	79	23	738	37	27	761	37	27	784	26	26	807	40	29
624	28	12	647	73	15	670	73	15	693	62	12	716	60	2	739	37	27	762	37	27	785	40	29	808	40	29
625	62	12	648	73	15	671	71	14	694	37	27	717	79	23	740	34	27	763	37	27	786	40	29	809	40	29
626	62	12	649	62	12	672	62	12	695	37	27	718	95	27	741	37	27	764	95	27	787	40	29	810	40	29
627	62	12	650	62	12	673	62	12	696	34	27	719	92	28	742	37	27	765	92	28	788	40	29	811	40	29
628	71	14	651	62	12	674	28	12	697	34	27	720	37	27	743	37	27	766	37	27	789	40	29	812	40	29
629	62	12	652	62	12	675	64	15	698	92	28	721	37	27	744	37	27	767	37	27	790	40	29	813	40	29
630	62	12	653	28	12	676	64	15	699	95	27	722	37	27	745	37	27	768	37	27	791	40	29	814	26	26
631	62	12	654	28	12	677	64	15	700	95	27	723	34	27	746	37	27	769	37	27	792	40	29	815	40	29
632	62	12	655	73	15	678	64	15	701	95	27	724	34	27	747	37	27	770	37	27	793	40	29	816	79	23
633	62	12	656	62	12	679	64	15	702	95	27	725	34	27	748	37	27	771	26	26	794	40	29	817	79	23
634	73	15	657	62	12	680	73	15	703	95	27	726	34	27	749	37	27	772	26	26	795	40	29	818	13	10
635	73	15	658	71	14	681	64	15	704	95	27	727	34	27	750	37	27	773	26	26	796	40	29	819	13	10
636	62	12	659	28	12	682	62	12	705	95	27	728	34	27	751	37	27	774	34	27	797	40	29	820	26	26
637	62	12	660	28	12	683	62	12	706	95	27	729	34	27	752	60	2	775	34	27	798	40	29	821	26	26
638	71	14	661	28	12	684	62	12	707	95	27	730	34	27	753	60	2	776	34	27	799	40	29	822	36	26
639	71	14	662	28	12	685	62	12	708	95	27	731	26	26	754	60	2	777	34	27	800	40	29	823	36	26
640	71	14	663	28	12	686	28	12	709	92	28	732	26	26	755	60	2	778	34	27	801	40	29	824	36	26
641	73	15	664	73	15	687	28	12	710	37	27	733	26	26	756	60	2	779	34	27	802	40	29	825	6	19
642	73	15	665	73	15	688	28	12	711	37	27	734	34	27	757	37	27	780	37	27	803	40	29	826	46	23
643	73	15	666	73	15	689	73	15	712	34	27	735	34	27	758	60	2	781	37	27	804	40	29	827	66	10
644	73	15	667	28	12	690	73	15	713	37	27	736	37	27	759	37	27	782	37	27	805	40	29	828	76	20

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
829	76	20	852	46	23	875	79	23	898	37	27	921	66	10	944	66	10	967	46	23	990	6	19	1013	78	10
830	37	27	853	46	23	876	79	23	899	37	27	922	66	10	945	66	10	968	46	23	991	6	19	1014	78	10
831	37	27	854	46	23	877	79	23	900	79	23	923	66	10	946	66	10	969	46	23	992	6	19	1015	78	10
832	37	27	855	79	23	878	79	23	901	13	10	924	66	10	947	66	10	970	46	23	993	6	19	1016	66	10
833	37	27	856	46	23	879	37	27	902	79	23	925	66	10	948	66	10	971	46	23	994	6	19	1017	78	10
834	13	10	857	46	23	880	37	27	903	76	20	926	66	10	949	66	10	972	46	23	995	6	19	1018	78	10
835	13	10	858	46	23	881	37	27	904	76	20	927	66	10	950	6	19	973	46	23	996	6	19	1019	66	10
836	46	23	859	46	23	882	37	27	905	76	20	928	78	10	951	66	10	974	89	19	997	6	19	1020	24	19
837	46	23	860	46	23	883	37	27	906	66	10	929	66	10	952	46	23	975	46	23	998	78	10	1021	66	10
838	46	23	861	79	23	884	37	27	907	66	10	930	13	10	953	46	23	976	89	19	999	78	10	1022	24	19
839	46	23	862	46	23	885	37	27	908	66	10	931	66	10	954	46	23	977	46	23	1000	6	19	1023	24	19
840	53	4	863	89	19	886	37	27	909	66	10	932	13	10	955	46	23	978	46	23	1001	6	19	1024	78	10
841	53	4	864	89	19	887	37	27	910	13	10	933	78	10	956	46	23	979	89	19	1002	6	19	1025	78	10
842	53	4	865	89	19	888	37	27	911	66	10	934	66	10	957	6	19	980	89	19	1003	89	19	1026	78	10
843	79	23	866	89	19	889	37	27	912	13	10	935	66	10	958	6	19	981	89	19	1004	78	10	1027	89	19
844	46	23	867	89	19	890	46	23	913	79	23	936	66	10	959	66	10	982	89	19	1005	78	10	1028	78	10
845	46	23	868	89	19	891	37	27	914	13	10	937	66	10	960	6	19	983	89	19	1006	78	10	1029	78	10
846	46	23	869	89	19	892	37	27	915	13	10	938	66	10	961	6	19	984	6	19	1007	78	10	1030	78	10
847	46	23	870	24	19	893	37	27	916	66	10	939	66	10	962	46	23	985	6	19	1008	78	10	1031	24	19
848	46	23	871	89	19	894	37	27	917	66	10	940	66	10	963	46	23	986	6	19	1009	78	10	1032	78	10
849	46	23	872	89	19	895	37	27	918	66	10	941	66	10	964	46	23	987	6	19	1010	78	10	1033	24	19
850	46	23	873	34	27	896	37	27	919	66	10	942	66	10	965	46	23	988	6	19	1011	78	10	1034	78	10
851	79	23	874	79	23	897	46	23	920	66	10	943	66	10	966	46	23	989	6	19	1012	78	10	1035	24	19

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
1036	24	19	1059	24	19	1082	24	19	1105	95	27	1128	89	19	1151	13	10	1174	13	10	1197	66	10	1220	95	27
1037	13	10	1060	24	19	1083	24	19	1106	26	26	1129	34	27	1152	13	10	1175	13	10	1198	66	10	1221	95	27
1038	13	10	1061	24	19	1084	66	10	1107	26	26	1130	89	19	1153	76	20	1176	13	10	1199	79	23	1222	46	23
1039	66	10	1062	24	19	1085	24	19	1108	26	26	1131	78	10	1154	76	20	1177	13	10	1200	79	23	1223	46	23
1040	13	10	1063	89	19	1086	24	19	1109	26	26	1132	24	19	1155	76	20	1178	13	10	1201	79	23	1224	46	23
1041	13	10	1064	24	19	1087	46	23	1110	26	26	1133	89	19	1156	76	20	1179	36	26	1202	79	23	1225	37	27
1042	13	10	1065	24	19	1088	24	19	1111	95	27	1134	34	27	1157	76	20	1180	66	10	1203	79	23	1226	46	23
1043	24	19	1066	24	19	1089	24	19	1112	46	23	1135	89	19	1158	76	20	1181	66	10	1204	66	10	1227	37	27
1044	13	10	1067	24	19	1090	6	19	1113	24	19	1136	24	19	1159	76	20	1182	79	23	1205	13	10	1228	46	23
1045	24	19	1068	66	10	1091	78	10	1114	24	19	1137	24	19	1160	76	20	1183	79	23	1206	76	20	1229	46	23
1046	13	10	1069	24	19	1092	24	19	1115	24	19	1138	24	19	1161	76	20	1184	76	20	1207	76	20	1230	46	23
1047	24	19	1070	24	19	1093	78	10	1116	24	19	1139	24	19	1162	13	10	1185	53	4	1208	79	23	1231	46	23
1048	24	19	1071	46	23	1094	78	10	1117	24	19	1140	24	19	1163	13	10	1186	26	26	1209	76	20	1232	46	23
1049	24	19	1072	24	19	1095	66	10	1118	89	19	1141	6	19	1164	13	10	1187	26	26	1210	76	20	1233	37	27
1050	24	19	1073	46	23	1096	66	10	1119	89	19	1142	66	10	1165	13	10	1188	13	10	1211	95	27	1234	46	23
1051	24	19	1074	46	23	1097	78	10	1120	89	19	1143	6	19	1166	13	10	1189	13	10	1212	95	27	1235	46	23
1052	24	19	1075	46	23	1098	78	10	1121	24	19	1144	78	10	1167	13	10	1190	89	19	1213	95	27	1236	95	27
1053	24	19	1076	46	23	1099	89	19	1122	89	19	1145	6	19	1168	13	10	1191	89	19	1214	95	27	1237	46	23
1054	24	19	1077	46	23	1100	89	19	1123	34	27	1146	6	19	1169	13	10	1192	76	20	1215	95	27	1238	46	23
1055	24	19	1078	46	23	1101	95	27	1124	89	19	1147	6	19	1170	13	10	1193	76	20	1216	95	27	1239	36	26
1056	24	19	1079	46	23	1102	95	27	1125	89	19	1148	78	10	1171	13	10	1194	89	19	1217	37	27	1240	76	20
1057	89	19	1080	89	19	1103	95	27	1126	89	19	1149	6	19	1172	13	10	1195	34	27	1218	37	27	1241	13	10
1058	78	10	1081	46	23	1104	95	27	1127	89	19	1150	6	19	1173	13	10	1196	34	27	1219	37	27	1242	13	10

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
1243	76	20	1266	89	19	1289	79	23	1312	22	32	1335	31	23	1358	50	17	1381	50	17	1404	22	32	1427	95	27
1244	76	20	1267	89	19	1290	79	23	1313	95	27	1336	50	17	1359	31	23	1382	50	17	1405	22	32	1428	31	23
1245	13	10	1268	89	19	1291	95	27	1314	31	23	1337	31	23	1360	22	32	1383	31	23	1406	95	27	1429	50	17
1246	13	10	1269	89	19	1292	95	27	1315	95	27	1338	50	17	1361	92	28	1384	50	17	1407	79	23	1430	50	17
1247	13	10	1270	89	19	1293	95	27	1316	95	27	1339	50	17	1362	92	28	1385	50	17	1408	5	4	1431	90	21
1248	13	10	1271	89	19	1294	95	27	1317	92	28	1340	50	17	1363	92	28	1386	50	17	1409	5	4	1432	90	21
1249	76	20	1272	37	27	1295	79	23	1318	95	27	1341	31	23	1364	92	28	1387	79	23	1410	5	4	1433	3	8
1250	24	19	1273	37	27	1296	95	27	1319	31	23	1342	31	23	1365	22	32	1388	79	23	1411	5	4	1434	3	8
1251	13	10	1274	37	27	1297	79	23	1320	31	23	1343	31	23	1366	92	28	1389	95	27	1412	5	4	1435	90	21
1252	76	20	1275	46	23	1298	95	27	1321	95	27	1344	50	17	1367	22	32	1390	95	27	1413	5	4	1436	90	21
1253	89	19	1276	37	27	1299	95	27	1322	79	23	1345	50	17	1368	79	23	1391	79	23	1414	5	4	1437	90	21
1254	37	27	1277	37	27	1300	95	27	1323	5	4	1346	50	17	1369	79	23	1392	50	17	1415	95	27	1438	90	21
1255	89	19	1278	37	27	1301	79	23	1324	31	23	1347	50	17	1370	31	23	1393	31	23	1416	92	28	1439	90	21
1256	89	19	1279	37	27	1302	79	23	1325	95	27	1348	50	17	1371	79	23	1394	50	17	1417	95	27	1440	90	21
1257	89	19	1280	37	27	1303	95	27	1326	95	27	1349	50	17	1372	5	4	1395	5	4	1418	95	27	1441	3	8
1258	89	19	1281	37	27	1304	31	23	1327	95	27	1350	50	17	1373	50	17	1396	22	32	1419	95	27	1442	3	8
1259	89	19	1282	95	27	1305	31	23	1328	92	28	1351	31	23	1374	50	17	1397	31	23	1420	95	27	1443	90	21
1260	89	19	1283	50	17	1306	79	23	1329	95	27	1352	50	17	1375	31	23	1398	31	23	1421	95	27	1444	90	21
1261	89	19	1284	50	17	1307	79	23	1330	95	27	1353	31	23	1376	31	23	1399	31	23	1422	95	27	1445	90	21
1262	89	19	1285	31	23	1308	79	23	1331	95	27	1354	50	17	1377	31	23	1400	22	32	1423	95	27	1446	90	21
1263	89	19	1286	31	23	1309	31	23	1332	31	23	1355	50	17	1378	50	17	1401	31	23	1424	92	28	1447	90	21
1264	89	19	1287	79	23	1310	95	27	1333	31	23	1356	31	23	1379	50	17	1402	22	32	1425	95	27	1448	90	21
1265	89	19	1288	95	27	1311	31	23	1334	31	23	1357	31	23	1380	50	17	1403	31	23	1426	95	27	1449	90	21

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
1500	57	5	1523	57	5	1546	57	5	1569	70	31	1592	70	31	1615	70	31	1638	71	14	1661	71	14	1684	94	14
1501	57	5	1524	57	5	1547	57	5	1570	70	31	1593	70	31	1616	70	31	1639	56	31	1662	94	14	1685	71	14
1502	57	5	1525	57	5	1548	57	5	1571	70	31	1594	70	31	1617	94	14	1640	56	31	1663	94	14	1686	71	14
1503	57	5	1526	57	5	1549	57	5	1572	70	31	1595	70	31	1618	94	14	1641	94	14	1664	71	14	1687	71	14
1504	57	5	1527	57	5	1550	57	5	1573	70	31	1596	70	31	1619	94	14	1642	94	14	1665	71	14	1688	94	14
1505	57	5	1528	57	5	1551	57	5	1574	70	31	1597	70	31	1620	71	14	1643	56	31	1666	94	14	1689	94	14
1506	57	5	1529	57	5	1552	57	5	1575	70	31	1598	70	31	1621	71	14	1644	94	14	1667	71	14	1690	71	14
1507	57	5	1530	57	5	1553	57	5	1576	70	31	1599	70	31	1622	71	14	1645	94	14	1668	94	14	1691	71	14
1508	57	5	1531	57	5	1554	57	5	1577	70	31	1600	70	31	1623	71	14	1646	94	14	1669	71	14	1692	71	14
1509	57	5	1532	57	5	1555	57	5	1578	70	31	1601	70	31	1624	71	14	1647	71	14	1670	94	14	1693	94	14
1510	57	5	1533	57	5	1556	57	5	1579	70	31	1602	70	31	1625	71	14	1648	94	14	1671	71	14	1694	71	14
1511	57	5	1534	57	5	1557	57	5	1580	70	31	1603	70	31	1626	71	14	1649	94	14	1672	71	14	1695	71	14
1512	57	5	1535	57	5	1558	98	5	1581	70	31	1604	70	31	1627	71	14	1650	94	14	1673	94	14	1696	94	14
1513	57	5	1536	57	5	1559	70	31	1582	70	31	1605	70	31	1628	71	14	1651	71	14	1674	71	14	1697	94	14
1514	57	5	1537	57	5	1560	70	31	1583	70	31	1606	70	31	1629	94	14	1652	94	14	1675	71	14	1698	94	14
1515	57	5	1538	57	5	1561	70	31	1584	70	31	1607	70	31	1630	94	14	1653	71	14	1676	94	14	1699	94	14
1516	57	5	1539	57	5	1562	70	31	1585	70	31	1608	70	31	1631	71	14	1654	73	15	1677	71	14	1700	71	14
1517	57	5	1540	57	5	1563	70	31	1586	70	31	1609	70	31	1632	71	14	1655	71	14	1678	71	14	1701	71	14
1518	57	5	1541	57	5	1564	70	31	1587	70	31	1610	70	31	1633	71	14	1656	71	14	1679	71	14	1702	71	14
1519	57	5	1542	57	5	1565	70	31	1588	70	31	1611	70	31	1634	71	14	1657	71	14	1680	94	14	1703	56	31
1520	57	5	1543	57	5	1566	70	31	1589	70	31	1612	70	31	1635	71	14	1658	94	14	1681	94	14	1704	94	14
1521	57	5	1544	57	5	1567	70	31	1590	70	31	1613	70	31	1636	71	14	1659	94	14	1682	71	14	1705	71	14
1522	57	5	1545	57	5	1568	56	31	1591	70	31	1614	70	31	1637	71	14	1660	94	14	1683	94	14	1706	71	14

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
1707	94	14	1730	73	15	1753	84	5	1776	22	32	1799	92	28	1822	1	28	1845	22	32	1868	19	28	1891	84	5
1708	94	14	1731	71	14	1754	84	5	1777	22	32	1800	92	28	1823	92	28	1846	1	28	1869	19	28	1892	84	5
1709	94	14	1732	71	14	1755	84	5	1778	92	28	1801	1	28	1824	1	28	1847	1	28	1870	19	28	1893	84	5
1710	94	14	1733	71	14	1756	84	5	1779	22	32	1802	92	28	1825	1	28	1848	1	28	1871	19	28	1894	84	5
1711	94	14	1734	71	14	1757	84	5	1780	22	32	1803	1	28	1826	1	28	1849	1	28	1872	19	28	1895	84	5
1712	94	14	1735	94	14	1758	84	5	1781	92	28	1804	92	28	1827	92	28	1850	1	28	1873	19	28	1896	84	5
1713	71	14	1736	56	31	1759	84	5	1782	92	28	1805	92	28	1828	92	28	1851	1	28	1874	19	28	1897	84	5
1714	71	14	1737	94	14	1760	84	5	1783	22	32	1806	92	28	1829	92	28	1852	1	28	1875	22	32	1898	84	5
1715	71	14	1738	94	14	1761	84	5	1784	22	32	1807	92	28	1830	92	28	1853	95	27	1876	92	28	1899	84	5
1716	71	14	1739	94	14	1762	84	5	1785	22	32	1808	1	28	1831	22	32	1854	95	27	1877	92	28	1900	84	5
1717	71	14	1740	71	14	1763	84	5	1786	22	32	1809	92	28	1832	92	28	1855	95	27	1878	92	28	1901	84	5
1718	71	14	1741	71	14	1764	84	5	1787	19	28	1810	92	28	1833	92	28	1856	92	28	1879	92	28	1902	84	5
1719	73	15	1742	94	14	1765	84	5	1788	19	28	1811	22	32	1834	22	32	1857	92	28	1880	1	28	1903	84	5
1720	71	14	1743	71	14	1766	84	5	1789	19	28	1812	92	28	1835	1	28	1858	92	28	1881	92	28	1904	84	5
1721	94	14	1744	71	14	1767	19	28	1790	92	28	1813	92	28	1836	1	28	1859	19	28	1882	92	28	1905	84	5
1722	56	31	1745	94	14	1768	92	28	1791	92	28	1814	92	28	1837	1	28	1860	19	28	1883	95	27	1906	84	5
1723	94	14	1746	71	14	1769	22	32	1792	22	32	1815	92	28	1838	22	32	1861	19	28	1884	95	27	1907	84	5
1724	94	14	1747	94	14	1770	92	28	1793	22	32	1816	22	32	1839	92	28	1862	19	28	1885	95	27	1908	84	5
1725	73	15	1748	73	15	1771	22	32	1794	19	28	1817	92	28	1840	19	28	1863	19	28	1886	95	27	1909	84	5
1726	71	14	1749	84	5	1772	92	28	1795	1	28	1818	92	28	1841	22	32	1864	19	28	1887	92	28	1910	4	18
1727	73	15	1750	84	5	1773	22	32	1796	1	28	1819	22	32	1842	22	32	1865	19	28	1888	84	5	1911	4	18
1728	73	15	1751	84	5	1774	22	32	1797	1	28	1820	92	28	1843	19	28	1866	19	28	1889	84	5	1912	4	18
1729	73	15	1752	84	5	1775	19	28	1798	92	28	1821	92	28	1844	19	28	1867	19	28	1890	84	5	1913	84	5

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
1914	84	5	1937	86	26	1960	86	26	1983	26	26	2006	26	26	2029	76	20	2052	36	26	2075	60	2	2098	60	2
1915	84	5	1938	86	26	1961	86	26	1984	26	26	2007	86	26	2030	76	20	2053	76	20	2076	60	2	2099	60	2
1916	84	5	1939	86	26	1962	86	26	1985	86	26	2008	26	26	2031	36	26	2054	76	20	2077	60	2	2100	60	2
1917	84	5	1940	86	26	1963	86	26	1986	86	26	2009	26	26	2032	36	26	2055	76	20	2078	19	28	2101	60	2
1918	84	5	1941	86	26	1964	86	26	1987	86	26	2010	26	26	2033	36	26	2056	36	26	2079	60	2	2102	19	28
1919	84	5	1942	86	26	1965	86	26	1988	86	26	2011	86	26	2034	13	10	2057	36	26	2080	19	28	2103	19	28
1920	26	26	1943	86	26	1966	86	26	1989	86	26	2012	36	26	2035	13	10	2058	36	26	2081	19	28	2104	60	2
1921	86	26	1944	26	26	1967	86	26	1990	86	26	2013	36	26	2036	76	20	2059	36	26	2082	19	28	2105	19	28
1922	26	26	1945	26	26	1968	26	26	1991	86	26	2014	36	26	2037	76	20	2060	36	26	2083	19	28	2106	60	2
1923	26	26	1946	26	26	1969	86	26	1992	86	26	2015	76	20	2038	76	20	2061	36	26	2084	19	28	2107	60	2
1924	26	26	1947	26	26	1970	26	26	1993	86	26	2016	13	10	2039	76	20	2062	76	20	2085	19	28	2108	44	2
1925	26	26	1948	26	26	1971	26	26	1994	86	26	2017	36	26	2040	36	26	2063	36	26	2086	37	27	2109	26	26
1926	26	26	1949	26	26	1972	86	26	1995	86	26	2018	36	26	2041	36	26	2064	76	20	2087	19	28	2110	26	26
1927	26	26	1950	86	26	1973	26	26	1996	36	26	2019	36	26	2042	36	26	2065	36	26	2088	37	27	2111	36	26
1928	26	26	1951	86	26	1974	26	26	1997	36	26	2020	36	26	2043	36	26	2066	36	26	2089	37	27	2112	86	26
1929	26	26	1952	36	26	1975	26	26	1998	86	26	2021	36	26	2044	36	26	2067	36	26	2090	37	27	2113	76	20
1930	26	26	1953	36	26	1976	26	26	1999	86	26	2022	36	26	2045	36	26	2068	36	26	2091	92	28	2114	76	20
1931	86	26	1954	36	26	1977	26	26	2000	86	26	2023	13	10	2046	36	26	2069	60	2	2092	37	27	2115	36	26
1932	86	26	1955	36	26	1978	26	26	2001	86	26	2024	13	10	2047	36	26	2070	60	2	2093	37	27	2116	36	26
1933	86	26	1956	26	26	1979	86	26	2002	86	26	2025	76	20	2048	36	26	2071	60	2	2094	37	27	2117	76	20
1934	86	26	1957	36	26	1980	86	26	2003	36	26	2026	76	20	2049	36	26	2072	60	2	2095	37	27	2118	26	26
1935	86	26	1958	36	26	1981	86	26	2004	36	26	2027	76	20	2050	36	26	2073	60	2	2096	19	28	2119	86	26
1936	86	26	1959	36	26	1982	86	26	2005	26	26	2028	76	20	2051	36	26	2074	60	2	2097	19	28	2120	86	26

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
2121	86	26	2144	36	26	2167	98	5	2190	28	12	2213	28	12	2236	53	4	2259	5	4	2282	75	17	2305	5	4
2122	86	26	2145	86	26	2168	98	5	2191	28	12	2214	71	14	2237	75	17	2260	5	4	2283	79	23	2306	75	17
2123	86	26	2146	86	26	2169	98	5	2192	28	12	2215	71	14	2238	75	17	2261	5	4	2284	79	23	2307	75	17
2124	86	26	2147	86	26	2170	98	5	2193	28	12	2216	28	12	2239	31	23	2262	5	4	2285	79	23	2308	79	23
2125	86	26	2148	86	26	2171	98	5	2194	28	12	2217	28	12	2240	75	17	2263	5	4	2286	5	4	2309	79	23
2126	86	26	2149	86	26	2172	98	5	2195	28	12	2218	28	12	2241	31	23	2264	5	4	2287	79	23	2310	79	23
2127	86	26	2150	86	26	2173	98	5	2196	28	12	2219	28	12	2242	53	4	2265	5	4	2288	79	23	2311	95	27
2128	86	26	2151	86	26	2174	98	5	2197	28	12	2220	28	12	2243	5	4	2266	5	4	2289	79	23	2312	95	27
2129	86	26	2152	86	26	2175	98	5	2198	28	12	2221	28	12	2244	5	4	2267	5	4	2290	79	23	2313	95	27
2130	86	26	2153	86	26	2176	98	5	2199	28	12	2222	28	12	2245	53	4	2268	5	4	2291	79	23	2314	79	23
2131	86	26	2154	86	26	2177	98	5	2200	28	12	2223	28	12	2246	53	4	2269	75	17	2292	79	23	2315	31	23
2132	86	26	2155	36	26	2178	98	5	2201	28	12	2224	28	12	2247	5	4	2270	5	4	2293	79	23	2316	5	4
2133	86	26	2156	36	26	2179	98	5	2202	28	12	2225	28	12	2248	53	4	2271	75	17	2294	79	23	2317	5	4
2134	86	26	2157	26	26	2180	98	5	2203	28	12	2226	28	12	2249	5	4	2272	5	4	2295	5	4	2318	31	23
2135	86	26	2158	86	26	2181	98	5	2204	28	12	2227	28	12	2250	53	4	2273	31	23	2296	53	4	2319	5	4
2136	86	26	2159	36	26	2182	98	5	2205	28	12	2228	28	12	2251	5	4	2274	75	17	2297	5	4	2320	5	4
2137	86	26	2160	86	26	2183	98	5	2206	28	12	2229	94	14	2252	75	17	2275	75	17	2298	5	4	2321	5	4
2138	36	26	2161	36	26	2184	98	5	2207	28	12	2230	94	14	2253	75	17	2276	5	4	2299	53	4	2322	31	23
2139	86	26	2162	86	26	2185	98	5	2208	28	12	2231	94	14	2254	75	17	2277	53	4	2300	87	4	2323	5	4
2140	86	26	2163	86	26	2186	28	12	2209	28	12	2232	94	14	2255	75	17	2278	5	4	2301	87	4	2324	31	23
2141	86	26	2164	86	26	2187	28	12	2210	28	12	2233	5	4	2256	31	23	2279	5	4	2302	87	4	2325	5	4
2142	36	26	2165	26	26	2188	28	12	2211	71	14	2234	75	17	2257	75	17	2280	5	4	2303	53	4	2326	31	23
2143	86	26	2166	86	26	2189	28	12	2212	94	14	2235	53	4	2258	75	17	2281	53	4	2304	75	17	2327	31	23

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
2328	31	23	2351	35	29	2374	63	12	2397	45	24	2420	68	16	2443	55	24	2466	77	16	2489	68	16	2512	55	24
2329	53	4	2352	28	12	2375	63	12	2398	45	24	2421	68	16	2444	77	16	2467	77	16	2490	77	16	2513	55	24
2330	53	4	2353	35	29	2376	63	12	2399	77	16	2422	68	16	2445	55	24	2468	77	16	2491	68	16	2514	45	24
2331	5	4	2354	35	29	2377	63	12	2400	55	24	2423	68	16	2446	77	16	2469	77	16	2492	68	16	2515	54	16
2332	28	12	2355	35	29	2378	35	29	2401	55	24	2424	77	16	2447	77	16	2470	77	16	2493	77	16	2516	55	24
2333	44	2	2356	35	29	2379	35	29	2402	55	24	2425	68	16	2448	55	24	2471	77	16	2494	77	16	2517	55	24
2334	44	2	2357	35	29	2380	35	29	2403	55	24	2426	68	16	2449	77	16	2472	55	24	2495	68	16	2518	55	24
2335	44	2	2358	35	29	2381	35	29	2404	55	24	2427	77	16	2450	55	24	2473	55	24	2496	45	24	2519	55	24
2336	63	12	2359	35	29	2382	35	29	2405	55	24	2428	68	16	2451	55	24	2474	77	16	2497	68	16	2520	55	24
2337	35	29	2360	35	29	2383	35	29	2406	55	24	2429	68	16	2452	68	16	2475	68	16	2498	45	24	2521	55	24
2338	35	29	2361	35	29	2384	35	29	2407	45	24	2430	68	16	2453	77	16	2476	68	16	2499	68	16	2522	77	16
2339	35	29	2362	35	29	2385	44	2	2408	77	16	2431	77	16	2454	68	16	2477	68	16	2500	77	16	2523	55	24
2340	35	29	2363	35	29	2386	35	29	2409	77	16	2432	77	16	2455	77	16	2478	77	16	2501	68	16	2524	55	24
2341	35	29	2364	35	29	2387	35	29	2410	68	16	2433	55	24	2456	77	16	2479	68	16	2502	68	16	2525	55	24
2342	35	29	2365	35	29	2388	35	29	2411	77	16	2434	77	16	2457	68	16	2480	77	16	2503	68	16	2526	55	24
2343	35	29	2366	35	29	2389	35	29	2412	55	24	2435	68	16	2458	68	16	2481	77	16	2504	77	16	2527	77	16
2344	28	12	2367	35	29	2390	35	29	2413	55	24	2436	77	16	2459	68	16	2482	77	16	2505	68	16	2528	55	24
2345	35	29	2368	35	29	2391	34	27	2414	77	16	2437	55	24	2460	77	16	2483	68	16	2506	68	16	2529	77	16
2346	35	29	2369	35	29	2392	35	29	2415	55	24	2438	77	16	2461	68	16	2484	68	16	2507	68	16	2530	55	24
2347	44	2	2370	35	29	2393	35	29	2416	77	16	2439	77	16	2462	77	16	2485	77	16	2508	77	16	2531	45	24
2348	44	2	2371	35	29	2394	35	29	2417	77	16	2440	77	16	2463	55	24	2486	77	16	2509	45	24	2532	55	24
2349	44	2	2372	35	29	2395	45	24	2418	55	24	2441	55	24	2464	55	24	2487	55	24	2510	45	24	2533	45	24
2350	35	29	2373	63	12	2396	45	24	2419	55	24	2442	77	16	2465	55	24	2488	77	16	2511	45	24	2534	45	24

Table A-3: (Continue)

Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
2535	55	24	2558	68	16	2581	90	21	2604	3	8	2627	42	14	2650	42	14	2673	2	29	2696	42	14	2719	35	29
2536	45	24	2559	54	16	2582	90	21	2605	20	8	2628	42	14	2651	42	14	2674	2	29	2697	42	14	2720	2	29
2537	77	16	2560	54	16	2583	90	21	2606	20	8	2629	42	14	2652	42	14	2675	35	29	2698	42	14	2721	2	29
2538	77	16	2561	68	16	2584	90	21	2607	20	8	2630	35	29	2653	42	14	2676	35	29	2699	42	14	2722	2	29
2539	55	24	2562	68	16	2585	3	8	2608	20	8	2631	35	29	2654	42	14	2677	2	29	2700	42	14	2723	2	29
2540	55	24	2563	68	16	2586	20	8	2609	90	21	2632	42	14	2655	42	14	2678	2	29	2701	42	14	2724	2	29
2541	55	24	2564	45	24	2587	90	21	2610	90	21	2633	42	14	2656	42	14	2679	2	29	2702	42	14	2725	2	29
2542	55	24	2565	55	24	2588	3	8	2611	90	21	2634	42	14	2657	42	14	2680	40	29	2703	42	14	2726	42	14
2543	55	24	2566	45	24	2589	90	21	2612	3	8	2635	2	29	2658	42	14	2681	35	29	2704	42	14	2727	2	29
2544	45	24	2567	55	24	2590	90	21	2613	3	8	2636	2	29	2659	2	29	2682	40	29	2705	42	14	2728	86	26
2545	45	24	2568	55	24	2591	20	8	2614	3	8	2637	42	14	2660	42	14	2683	40	29	2706	42	14	2729	86	26
2546	45	24	2569	45	24	2592	90	21	2615	3	8	2638	42	14	2661	35	29	2684	2	29	2707	42	14	2730	86	26
2547	45	24	2570	45	24	2593	90	21	2616	2	29	2639	42	14	2662	2	29	2685	2	29	2708	42	14	2731	86	26
2548	55	24	2571	45	24	2594	3	8	2617	2	29	2640	42	14	2663	2	29	2686	42	14	2709	42	14	2732	86	26
2549	45	24	2572	55	24	2595	3	8	2618	2	29	2641	42	14	2664	35	29	2687	35	29	2710	42	14	2733	86	26
2550	68	16	2573	45	24	2596	90	21	2619	2	29	2642	42	14	2665	2	29	2688	42	14	2711	42	14	2734	86	26
2551	68	16	2574	45	24	2597	3	8	2620	35	29	2643	42	14	2666	2	29	2689	42	14	2712	2	29	2735	86	26
2552	68	16	2575	45	24	2598	20	8	2621	2	29	2644	42	14	2667	2	29	2690	42	14	2713	35	29	2736	86	26
2553	54	16	2576	45	24	2599	20	8	2622	42	14	2645	42	14	2668	35	29	2691	2	29	2714	40	29	2737	36	26
2554	54	16	2577	55	24	2600	20	8	2623	42	14	2646	42	14	2669	35	29	2692	42	14	2715	35	29	2738	86	26
2555	68	16	2578	90	21	2601	20	8	2624	42	14	2647	42	14	2670	35	29	2693	42	14	2716	35	29	2739	36	26
2556	68	16	2579	90	21	2602	3	8	2625	42	14	2648	42	14	2671	35	29	2694	42	14	2717	35	29	2740	86	26
2557	68	16	2580	90	21	2603	3	8	2626	42	14	2649	42	14	2672	2	29	2695	42	14	2718	40	29	2741	86	26

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
2742	86	26	2765	36	26	2788	4	18	2811	65	15	2834	65	15	2857	23	7	2880	20	8	2903	3	8	2926	58	25
2743	86	26	2766	36	26	2789	4	18	2812	23	7	2835	65	15	2858	65	15	2881	22	32	2904	18	25	2927	58	25
2744	86	26	2767	76	20	2790	84	5	2813	23	7	2836	65	15	2859	65	15	2882	22	32	2905	18	25	2928	3	8
2745	86	26	2768	76	20	2791	84	5	2814	23	7	2837	65	15	2860	65	15	2883	22	32	2906	18	25	2929	18	25
2746	86	26	2769	36	26	2792	65	15	2815	65	15	2838	65	15	2861	65	15	2884	22	32	2907	18	25	2930	3	8
2747	86	26	2770	86	26	2793	84	5	2816	65	15	2839	23	7	2862	65	15	2885	22	32	2908	18	25	2931	3	8
2748	86	26	2771	36	26	2794	84	5	2817	65	15	2840	65	15	2863	65	15	2886	18	25	2909	58	25	2932	18	25
2749	86	26	2772	23	7	2795	84	5	2818	65	15	2841	65	15	2864	65	15	2887	22	32	2910	18	25	2933	58	25
2750	36	26	2773	84	5	2796	84	5	2819	65	15	2842	65	15	2865	65	15	2888	22	32	2911	18	25	2934	58	25
2751	86	26	2774	84	5	2797	84	5	2820	23	7	2843	65	15	2866	3	8	2889	3	8	2912	18	25	2935	58	25
2752	86	26	2775	84	5	2798	84	5	2821	65	15	2844	65	15	2867	18	25	2890	3	8	2913	18	25	2936	3	8
2753	36	26	2776	84	5	2799	84	5	2822	65	15	2845	65	15	2868	58	25	2891	58	25	2914	3	8	2937	3	8
2754	36	26	2777	84	5	2800	65	15	2823	65	15	2846	23	7	2869	58	25	2892	3	8	2915	58	25	2938	3	8
2755	36	26	2778	84	5	2801	84	5	2824	65	15	2847	23	7	2870	58	25	2893	18	25	2916	18	25	2939	3	8
2756	36	26	2779	84	5	2802	84	5	2825	65	15	2848	23	7	2871	20	8	2894	18	25	2917	3	8	2940	3	8
2757	86	26	2780	84	5	2803	33	18	2826	65	15	2849	65	15	2872	3	8	2895	58	25	2918	18	25	2941	20	8
2758	86	26	2781	84	5	2804	33	18	2827	65	15	2850	65	15	2873	18	25	2896	58	25	2919	18	25	2942	58	25
2759	36	26	2782	84	5	2805	4	18	2828	65	15	2851	65	15	2874	3	8	2897	18	25	2920	18	25	2943	18	25
2760	36	26	2783	84	5	2806	65	15	2829	65	15	2852	65	15	2875	3	8	2898	58	25	2921	3	8	2944	18	25
2761	36	26	2784	84	5	2807	65	15	2830	65	15	2853	23	7	2876	3	8	2899	58	25	2922	18	25	2945	3	8
2762	36	26	2785	84	5	2808	65	15	2831	65	15	2854	23	7	2877	20	8	2900	18	25	2923	58	25	2946	18	25
2763	36	26	2786	84	5	2809	65	15	2832	65	15	2855	65	15	2878	20	8	2901	18	25	2924	58	25	2947	18	25
2764	36	26	2787	4	18	2810	65	15	2833	65	15	2856	65	15	2879	20	8	2902	18	25	2925	3	8	2948	18	25

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
2949	18	25	2972	73	15	2995	62	12	3018	47	7	3041	47	7	3064	73	15	3087	62	12	3110	47	7	3133	47	7
2950	18	25	2973	73	15	2996	62	12	3019	47	7	3042	47	7	3065	84	5	3088	23	7	3111	47	7	3134	47	7
2951	22	32	2974	97	7	2997	62	12	3020	47	7	3043	47	7	3066	23	7	3089	23	7	3112	47	7	3135	23	7
2952	18	25	2975	23	7	2998	97	7	3021	47	7	3044	47	7	3067	47	7	3090	62	12	3113	47	7	3136	23	7
2953	3	8	2976	84	5	2999	97	7	3022	62	12	3045	47	7	3068	47	7	3091	47	7	3114	47	7	3137	23	7
2954	3	8	2977	62	12	3000	23	7	3023	62	12	3046	47	7	3069	47	7	3092	23	7	3115	23	7	3138	23	7
2955	3	8	2978	23	7	3001	73	15	3024	62	12	3047	47	7	3070	47	7	3093	23	7	3116	23	7	3139	23	7
2956	3	8	2979	47	7	3002	73	15	3025	23	7	3048	47	7	3071	47	7	3094	23	7	3117	23	7	3140	23	7
2957	58	25	2980	62	12	3003	23	7	3026	47	7	3049	84	5	3072	47	7	3095	23	7	3118	23	7	3141	23	7
2958	58	25	2981	62	12	3004	84	5	3027	23	7	3050	84	5	3073	23	7	3096	23	7	3119	47	7	3142	47	7
2959	3	8	2982	62	12	3005	23	7	3028	23	7	3051	23	7	3074	23	7	3097	23	7	3120	23	7	3143	47	7
2960	3	8	2983	62	12	3006	62	12	3029	47	7	3052	23	7	3075	23	7	3098	47	7	3121	23	7	3144	47	7
2961	58	25	2984	97	7	3007	62	12	3030	47	7	3053	47	7	3076	47	7	3099	23	7	3122	47	7	3145	47	7
2962	58	25	2985	62	12	3008	73	15	3031	47	7	3054	47	7	3077	62	12	3100	23	7	3123	23	7	3146	23	7
2963	3	8	2986	62	12	3009	47	7	3032	47	7	3055	47	7	3078	62	12	3101	23	7	3124	47	7	3147	62	12
2964	3	8	2987	84	5	3010	62	12	3033	47	7	3056	47	7	3079	62	12	3102	23	7	3125	23	7	3148	33	18
2965	18	25	2988	84	5	3011	62	12	3034	47	7	3057	47	7	3080	62	12	3103	23	7	3126	23	7	3149	84	5
2966	62	12	2989	62	12	3012	47	7	3035	62	12	3058	47	7	3081	62	12	3104	23	7	3127	23	7	3150	84	5
2967	62	12	2990	62	12	3013	47	7	3036	62	12	3059	47	7	3082	47	7	3105	23	7	3128	23	7	3151	4	18
2968	73	15	2991	62	12	3014	47	7	3037	62	12	3060	47	7	3083	23	7	3106	23	7	3129	23	7	3152	4	18
2969	73	15	2992	9	18	3015	47	7	3038	62	12	3061	47	7	3084	47	7	3107	47	7	3130	23	7	3153	33	18
2970	62	12	2993	9	18	3016	47	7	3039	47	7	3062	47	7	3085	23	7	3108	47	7	3131	23	7	3154	33	18
2971	23	7	2994	62	12	3017	47	7	3040	47	7	3063	47	7	3086	62	12	3109	47	7	3132	23	7	3155	84	5

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
3156	84	5	3179	33	18	3202	84	5	3225	60	2	3248	4	18	3271	21	1	3294	93	1	3317	25	13	3340	93	1
3157	84	5	3180	4	18	3203	84	5	3226	60	2	3249	25	13	3272	21	1	3295	21	1	3318	25	13	3341	93	1
3158	84	5	3181	4	18	3204	84	5	3227	63	12	3250	15	22	3273	17	33	3296	93	1	3319	15	22	3342	93	1
3159	33	18	3182	4	18	3205	84	5	3228	63	12	3251	15	22	3274	17	33	3297	21	1	3320	15	22	3343	82	11
3160	33	18	3183	4	18	3206	33	18	3229	44	2	3252	15	22	3275	17	33	3298	21	1	3321	15	22	3344	38	11
3161	4	18	3184	4	18	3207	33	18	3230	63	12	3253	15	22	3276	17	33	3299	61	6	3322	15	22	3345	82	11
3162	4	18	3185	4	18	3208	33	18	3231	63	12	3254	25	13	3277	15	22	3300	93	1	3323	25	13	3346	82	11
3163	84	5	3186	4	18	3209	33	18	3232	60	2	3255	15	22	3278	25	13	3301	21	1	3324	25	13	3347	93	1
3164	33	18	3187	4	18	3210	60	2	3233	44	2	3256	15	22	3279	15	22	3302	61	6	3325	61	6	3348	93	1
3165	33	18	3188	33	18	3211	37	27	3234	60	2	3257	11	22	3280	15	22	3303	21	1	3326	82	11	3349	29	1
3166	4	18	3189	33	18	3212	44	2	3235	60	2	3258	15	22	3281	15	22	3304	82	11	3327	93	1	3350	29	1
3167	33	18	3190	33	18	3213	60	2	3236	60	2	3259	15	22	3282	25	13	3305	61	6	3328	93	1	3351	93	1
3168	4	18	3191	4	18	3214	60	2	3237	60	2	3260	15	22	3283	25	13	3306	61	6	3329	82	11	3352	29	1
3169	4	18	3192	4	18	3215	44	2	3238	44	2	3261	15	22	3284	25	13	3307	61	6	3330	93	1	3353	29	1
3170	4	18	3193	33	18	3216	60	2	3239	63	12	3262	21	1	3285	25	13	3308	61	6	3331	93	1	3354	93	1
3171	33	18	3194	33	18	3217	60	2	3240	63	12	3263	21	1	3286	61	6	3309	61	6	3332	82	11	3355	93	1
3172	84	5	3195	4	18	3218	60	2	3241	44	2	3264	17	33	3287	21	1	3310	82	11	3333	93	1	3356	82	11
3173	84	5	3196	4	18	3219	60	2	3242	44	2	3265	17	33	3288	61	6	3311	25	13	3334	82	11	3357	61	6
3174	33	18	3197	33	18	3220	60	2	3243	44	2	3266	21	1	3289	61	6	3312	48	3	3335	93	1	3358	61	6
3175	33	18	3198	33	18	3221	60	2	3244	33	18	3267	21	1	3290	61	6	3313	25	13	3336	93	1	3359	82	11
3176	33	18	3199	33	18	3222	60	2	3245	4	18	3268	21	1	3291	61	6	3314	25	13	3337	93	1	3360	82	11
3177	33	18	3200	84	5	3223	60	2	3246	4	18	3269	17	33	3292	21	1	3315	25	13	3338	29	1	3361	61	6
3178	84	5	3201	84	5	3224	60	2	3247	4	18	3270	21	1	3293	21	1	3316	15	22	3339	93	1	3362	61	6

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
3363	61	6	3386	48	3	3409	48	3	3432	48	3	3455	51	6	3478	51	6	3501	32	13	3524	8	6	3547	41	13
3364	61	6	3387	48	3	3410	48	3	3433	51	6	3456	8	6	3479	25	13	3502	32	13	3525	51	6	3548	52	33
3365	11	22	3388	48	3	3411	48	3	3434	51	6	3457	8	6	3480	25	13	3503	25	13	3526	8	6	3549	52	33
3366	11	22	3389	16	3	3412	48	3	3435	51	6	3458	8	6	3481	25	13	3504	25	13	3527	51	6	3550	52	33
3367	11	22	3390	48	3	3413	51	6	3436	48	3	3459	51	6	3482	25	13	3505	32	13	3528	8	6	3551	43	11
3368	11	22	3391	48	3	3414	51	6	3437	48	3	3460	51	6	3483	32	13	3506	32	13	3529	8	6	3552	52	33
3369	11	22	3392	48	3	3415	48	3	3438	51	6	3461	51	6	3484	32	13	3507	32	13	3530	38	11	3553	52	33
3370	16	3	3393	48	3	3416	48	3	3439	51	6	3462	51	6	3485	25	13	3508	32	13	3531	41	13	3554	43	11
3371	16	3	3394	16	3	3417	15	22	3440	48	3	3463	51	6	3486	25	13	3509	32	13	3532	38	11	3555	43	11
3372	16	3	3395	51	6	3418	15	22	3441	51	6	3464	48	3	3487	32	13	3510	32	13	3533	41	13	3556	52	33
3373	11	22	3396	16	3	3419	48	3	3442	16	3	3465	51	6	3488	32	13	3511	32	13	3534	41	13	3557	41	13
3374	48	3	3397	11	22	3420	15	22	3443	51	6	3466	51	6	3489	32	13	3512	32	13	3535	52	33	3558	52	33
3375	11	22	3398	11	22	3421	15	22	3444	16	3	3467	51	6	3490	32	13	3513	32	13	3536	41	13	3559	52	33
3376	11	22	3399	16	3	3422	48	3	3445	8	6	3468	32	13	3491	32	13	3514	8	6	3537	32	13	3560	52	33
3377	48	3	3400	16	3	3423	51	6	3446	8	6	3469	32	13	3492	52	33	3515	32	13	3538	41	13	3561	43	11
3378	11	22	3401	51	6	3424	51	6	3447	8	6	3470	25	13	3493	25	13	3516	32	13	3539	32	13	3562	43	11
3379	15	22	3402	51	6	3425	48	3	3448	8	6	3471	51	6	3494	32	13	3517	51	6	3540	41	13	3563	52	33
3380	48	3	3403	51	6	3426	15	22	3449	16	3	3472	51	6	3495	25	13	3518	51	6	3541	32	13	3564	52	33
3381	15	22	3404	16	3	3427	48	3	3450	8	6	3473	51	6	3496	25	13	3519	8	6	3542	52	33	3565	52	33
3382	15	22	3405	16	3	3428	48	3	3451	8	6	3474	25	13	3497	25	13	3520	8	6	3543	52	33	3566	41	13
3383	25	13	3406	48	3	3429	48	3	3452	8	6	3475	32	13	3498	52	33	3521	41	13	3544	52	33	3567	38	11
3384	15	22	3407	48	3	3430	48	3	3453	8	6	3476	25	13	3499	52	33	3522	41	13	3545	52	33	3568	38	11
3385	15	22	3408	48	3	3431	51	6	3454	16	3	3477	25	13	3500	32	13	3523	8	6	3546	41	13	3569	41	13

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
3570	41	13	3593	52	33	3616	43	11	3639	82	11	3662	29	1	3685	43	11	3708	39	33	3731	25	13	3754	41	13
3571	41	13	3594	43	11	3617	43	11	3640	93	1	3663	17	33	3686	52	33	3709	25	13	3732	25	13	3755	8	6
3572	38	11	3595	43	11	3618	29	1	3641	82	11	3664	17	33	3687	17	33	3710	25	13	3733	32	13	3756	8	6
3573	38	11	3596	52	33	3619	29	1	3642	93	1	3665	29	1	3688	29	1	3711	15	22	3734	25	13	3757	38	11
3574	38	11	3597	43	11	3620	29	1	3643	93	1	3666	29	1	3689	29	1	3712	29	1	3735	25	13	3758	38	11
3575	38	11	3598	43	11	3621	29	1	3644	82	11	3667	29	1	3690	21	1	3713	29	1	3736	17	33	3759	8	6
3576	41	13	3599	52	33	3622	43	11	3645	43	11	3668	21	1	3691	17	33	3714	21	1	3737	17	33	3760	8	6
3577	41	13	3600	52	33	3623	82	11	3646	43	11	3669	29	1	3692	21	1	3715	21	1	3738	17	33	3761	38	11
3578	43	11	3601	52	33	3624	82	11	3647	43	11	3670	29	1	3693	39	33	3716	29	1	3739	17	33	3762	41	13
3579	41	13	3602	43	11	3625	93	1	3648	43	11	3671	29	1	3694	21	1	3717	21	1	3740	17	33	3763	38	11
3580	41	13	3603	52	33	3626	93	1	3649	43	11	3672	21	1	3695	39	33	3718	21	1	3741	21	1	3764	38	11
3581	82	11	3604	17	33	3627	93	1	3650	29	1	3673	21	1	3696	17	33	3719	21	1	3742	21	1	3765	38	11
3582	41	13	3605	17	33	3628	93	1	3651	29	1	3674	29	1	3697	21	1	3720	29	1	3743	17	33	3766	38	11
3583	41	13	3606	29	1	3629	82	11	3652	43	11	3675	29	1	3698	17	33	3721	17	33	3744	21	1	3767	8	6
3584	41	13	3607	17	33	3630	82	11	3653	29	1	3676	21	1	3699	21	1	3722	21	1	3745	21	1	3768	16	3
3585	41	13	3608	17	33	3631	82	11	3654	29	1	3677	29	1	3700	17	33	3723	17	33	3746	21	1	3769	16	3
3586	41	13	3609	29	1	3632	93	1	3655	43	11	3678	21	1	3701	17	33	3724	32	13	3747	21	1	3770	16	3
3587	41	13	3610	29	1	3633	82	11	3656	29	1	3679	29	1	3702	39	33	3725	32	13	3748	21	1	3771	88	3
3588	43	11	3611	17	33	3634	38	11	3657	29	1	3680	29	1	3703	39	33	3726	32	13	3749	17	33	3772	88	3
3589	43	11	3612	29	1	3635	82	11	3658	17	33	3681	21	1	3704	39	33	3727	32	13	3750	21	1	3773	16	3
3590	43	11	3613	52	33	3636	82	11	3659	17	33	3682	43	11	3705	39	33	3728	25	13	3751	17	33	3774	16	3
3591	43	11	3614	43	11	3637	93	1	3660	17	33	3683	43	11	3706	17	33	3729	25	13	3752	8	6	3775	16	3
3592	43	11	3615	43	11	3638	82	11	3661	17	33	3684	29	1	3707	39	33	3730	25	13	3753	38	11	3776	41	13

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
3777	82	11	3800	38	11	3823	63	12	3846	2	29	3869	2	29	3892	2	29	3915	35	29	3938	4	18	3961	33	18
3778	93	1	3801	82	11	3824	35	29	3847	35	29	3870	2	29	3893	2	29	3916	63	12	3939	4	18	3962	33	18
3779	93	1	3802	41	13	3825	35	29	3848	2	29	3871	2	29	3894	2	29	3917	63	12	3940	4	18	3963	33	18
3780	93	1	3803	82	11	3826	35	29	3849	63	12	3872	2	29	3895	2	29	3918	35	29	3941	4	18	3964	33	18
3781	38	11	3804	82	11	3827	35	29	3850	44	2	3873	2	29	3896	2	29	3919	35	29	3942	4	18	3965	33	18
3782	38	11	3805	82	11	3828	26	26	3851	44	2	3874	2	29	3897	2	29	3920	63	12	3943	84	5	3966	59	21
3783	82	11	3806	82	11	3829	28	12	3852	35	29	3875	2	29	3898	2	29	3921	63	12	3944	59	21	3967	33	18
3784	38	11	3807	25	13	3830	2	29	3853	35	29	3876	2	29	3899	2	29	3922	33	18	3945	59	21	3968	33	18
3785	82	11	3808	15	22	3831	63	12	3854	63	12	3877	2	29	3900	63	12	3923	4	18	3946	59	21	3969	59	21
3786	8	6	3809	15	22	3832	35	29	3855	2	29	3878	2	29	3901	2	29	3924	33	18	3947	59	21	3970	4	18
3787	8	6	3810	15	22	3833	26	26	3856	63	12	3879	2	29	3902	2	29	3925	4	18	3948	59	21	3971	33	18
3788	8	6	3811	25	13	3834	2	29	3857	35	29	3880	2	29	3903	2	29	3926	84	5	3949	59	21	3972	33	18
3789	38	11	3812	25	13	3835	2	29	3858	2	29	3881	2	29	3904	2	29	3927	4	18	3950	33	18	3973	4	18
3790	38	11	3813	25	13	3836	63	12	3859	2	29	3882	2	29	3905	2	29	3928	33	18	3951	33	18	3974	4	18
3791	8	6	3814	25	13	3837	2	29	3860	2	29	3883	2	29	3906	2	29	3929	4	18	3952	33	18	3975	4	18
3792	8	6	3815	32	13	3838	63	12	3861	2	29	3884	2	29	3907	2	29	3930	4	18	3953	33	18	3976	4	18
3793	8	6	3816	25	13	3839	2	29	3862	2	29	3885	2	29	3908	63	12	3931	4	18	3954	33	18	3977	33	18
3794	38	11	3817	25	13	3840	63	12	3863	2	29	3886	2	29	3909	2	29	3932	4	18	3955	4	18	3978	59	21
3795	82	11	3818	25	13	3841	63	12	3864	2	29	3887	2	29	3910	63	12	3933	4	18	3956	4	18	3979	59	21
3796	8	6	3819	2	29	3842	2	29	3865	2	29	3888	2	29	3911	28	12	3934	4	18	3957	4	18	3980	4	18
3797	61	6	3820	2	29	3843	2	29	3866	2	29	3889	2	29	3912	35	29	3935	4	18	3958	4	18	3981	84	5
3798	38	11	3821	2	29	3844	28	12	3867	2	29	3890	2	29	3913	26	26	3936	4	18	3959	4	18	3982	84	5
3799	38	11	3822	2	29	3845	2	29	3868	2	29	3891	2	29	3914	2	29	3937	4	18	3960	59	21	3983	33	18

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
3984	4	18	4007	98	5	4030	65	15	4053	27	8	4076	27	8	4099	20	8	4122	9	18	4145	99	30	4168	99	30
3985	33	18	4008	65	15	4031	65	15	4054	27	8	4077	14	30	4100	27	8	4123	20	8	4146	9	18	4169	80	2
3986	4	18	4009	84	5	4032	65	15	4055	27	8	4078	7	30	4101	80	2	4124	99	30	4147	9	18	4170	14	30
3987	4	18	4010	98	5	4033	65	15	4056	20	8	4079	7	30	4102	9	18	4125	9	18	4148	9	18	4171	80	2
3988	84	5	4011	65	15	4034	65	15	4057	27	8	4080	27	8	4103	9	18	4126	99	30	4149	99	30	4172	14	30
3989	33	18	4012	65	15	4035	65	15	4058	27	8	4081	99	30	4104	99	30	4127	20	8	4150	14	30	4173	60	2
3990	65	15	4013	65	15	4036	65	15	4059	7	30	4082	27	8	4105	9	18	4128	20	8	4151	99	30	4174	14	30
3991	65	15	4014	65	15	4037	65	15	4060	27	8	4083	20	8	4106	14	30	4129	20	8	4152	99	30	4175	80	2
3992	65	15	4015	65	15	4038	65	15	4061	27	8	4084	20	8	4107	99	30	4130	20	8	4153	14	30	4176	80	2
3993	65	15	4016	65	15	4039	84	5	4062	27	8	4085	20	8	4108	20	8	4131	18	25	4154	27	8	4177	20	8
3994	65	15	4017	65	15	4040	84	5	4063	99	30	4086	99	30	4109	18	25	4132	20	8	4155	14	30	4178	20	8
3995	65	15	4018	65	15	4041	84	5	4064	27	8	4087	27	8	4110	20	8	4133	80	2	4156	27	8	4179	80	2
3996	65	15	4019	65	15	4042	84	5	4065	27	8	4088	27	8	4111	27	8	4134	60	2	4157	14	30	4180	80	2
3997	65	15	4020	84	5	4043	98	5	4066	99	30	4089	14	30	4112	27	8	4135	60	2	4158	14	30	4181	80	2
3998	98	5	4021	65	15	4044	84	5	4067	99	30	4090	27	8	4113	27	8	4136	80	2	4159	80	2	4182	80	2
3999	65	15	4022	65	15	4045	84	5	4068	99	30	4091	27	8	4114	27	8	4137	14	30	4160	14	30	4183	80	2
4000	65	15	4023	65	15	4046	84	5	4069	20	8	4092	27	8	4115	27	8	4138	80	2	4161	80	2	4184	33	18
4001	23	7	4024	65	15	4047	84	5	4070	99	30	4093	27	8	4116	27	8	4139	99	30	4162	80	2	4185	99	30
4002	98	5	4025	65	15	4048	65	15	4071	9	18	4094	20	8	4117	20	8	4140	99	30	4163	80	2	4186	99	30
4003	98	5	4026	65	15	4049	98	5	4072	7	30	4095	20	8	4118	9	18	4141	14	30	4164	99	30	4187	20	8
4004	98	5	4027	65	15	4050	98	5	4073	27	8	4096	14	30	4119	9	18	4142	99	30	4165	99	30	4188	20	8
4005	98	5	4028	65	15	4051	98	5	4074	7	30	4097	7	30	4120	99	30	4143	9	18	4166	20	8	4189	18	25
4006	65	15	4029	65	15	4052	27	8	4075	7	30	4098	14	30	4121	9	18	4144	9	18	4167	14	30	4190	20	8

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
4191	20	8	4214	99	30	4237	33	18	4260	67	32	4283	67	32	4306	69	32	4329	69	32	4352	56	31	4375	74	31
4192	20	8	4215	20	8	4238	33	18	4261	69	32	4284	67	32	4307	15	22	4330	69	32	4353	56	31	4376	74	31
4193	18	25	4216	20	8	4239	33	18	4262	69	32	4285	85	25	4308	15	22	4331	69	32	4354	56	31	4377	74	31
4194	18	25	4217	20	8	4240	33	18	4263	69	32	4286	67	32	4309	15	22	4332	69	32	4355	56	31	4378	74	31
4195	20	8	4218	27	8	4241	33	18	4264	67	32	4287	67	32	4310	15	22	4333	69	32	4356	56	31	4379	74	31
4196	18	25	4219	27	8	4242	33	18	4265	67	32	4288	69	32	4311	11	22	4334	69	32	4357	56	31	4380	70	31
4197	20	8	4220	20	8	4243	33	18	4266	67	32	4289	67	32	4312	11	22	4335	69	32	4358	56	31	4381	56	31
4198	99	30	4221	27	8	4244	33	18	4267	69	32	4290	67	32	4313	11	22	4336	69	32	4359	56	31	4382	70	31
4199	20	8	4222	99	30	4245	33	18	4268	67	32	4291	69	32	4314	69	32	4337	69	32	4360	56	31	4383	56	31
4200	20	8	4223	20	8	4246	33	18	4269	67	32	4292	69	32	4315	15	22	4338	67	32	4361	56	31	4384	56	31
4201	20	8	4224	20	8	4247	14	30	4270	67	32	4293	67	32	4316	11	22	4339	69	32	4362	56	31	4385	56	31
4202	27	8	4225	20	8	4248	99	30	4271	69	32	4294	69	32	4317	15	22	4340	67	32	4363	56	31	4386	56	31
4203	27	8	4226	14	30	4249	20	8	4272	67	32	4295	69	32	4318	11	22	4341	69	32	4364	56	31	4387	74	31
4204	20	8	4227	80	2	4250	99	30	4273	67	32	4296	69	32	4319	11	22	4342	67	32	4365	56	31	4388	74	31
4205	27	8	4228	14	30	4251	20	8	4274	67	32	4297	67	32	4320	11	22	4343	69	32	4366	56	31	4389	56	31
4206	20	8	4229	80	2	4252	20	8	4275	67	32	4298	67	32	4321	15	22	4344	67	32	4367	56	31	4390	56	31
4207	27	8	4230	99	30	4253	15	22	4276	67	32	4299	69	32	4322	15	22	4345	69	32	4368	56	31	4391	56	31
4208	20	8	4231	33	18	4254	69	32	4277	69	32	4300	67	32	4323	15	22	4346	67	32	4369	56	31	4392	56	31
4209	20	8	4232	33	18	4255	69	32	4278	67	32	4301	69	32	4324	15	22	4347	69	32	4370	56	31	4393	56	31
4210	14	30	4233	9	18	4256	69	32	4279	67	32	4302	69	32	4325	15	22	4348	69	32	4371	56	31	4394	56	31
4211	20	8	4234	9	18	4257	67	32	4280	69	32	4303	69	32	4326	15	22	4349	69	32	4372	56	31	4395	56	31
4212	20	8	4235	33	18	4258	69	32	4281	69	32	4304	69	32	4327	85	25	4350	15	22	4373	56	31	4396	56	31
4213	20	8	4236	33	18	4259	69	32	4282	67	32	4305	69	32	4328	69	32	4351	56	31	4374	74	31	4397	56	31

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
4398	56	31	4421	74	31	4444	72	9	4467	96	9	4490	96	9	4513	97	7	4536	44	2	4559	97	7	4582	97	7
4399	74	31	4422	56	31	4445	72	9	4468	96	9	4491	72	9	4514	97	7	4537	44	2	4560	97	7	4583	97	7
4400	74	31	4423	81	9	4446	96	9	4469	96	9	4492	72	9	4515	97	7	4538	44	2	4561	97	7	4584	97	7
4401	74	31	4424	81	9	4447	96	9	4470	96	9	4493	96	9	4516	97	7	4539	44	2	4562	97	7	4585	97	7
4402	74	31	4425	81	9	4448	96	9	4471	96	9	4494	97	7	4517	97	7	4540	44	2	4563	44	2	4586	97	7
4403	74	31	4426	81	9	4449	81	9	4472	96	9	4495	63	12	4518	97	7	4541	44	2	4564	97	7	4587	97	7
4404	74	31	4427	96	9	4450	96	9	4473	96	9	4496	63	12	4519	97	7	4542	44	2	4565	97	7	4588	97	7
4405	74	31	4428	96	9	4451	96	9	4474	96	9	4497	44	2	4520	97	7	4543	44	2	4566	97	7	4589	97	7
4406	74	31	4429	96	9	4452	81	9	4475	96	9	4498	44	2	4521	97	7	4544	97	7	4567	97	7	4590	97	7
4407	74	31	4430	81	9	4453	81	9	4476	81	9	4499	44	2	4522	44	2	4545	97	7	4568	97	7	4591	97	7
4408	74	31	4431	96	9	4454	96	9	4477	81	9	4500	44	2	4523	44	2	4546	97	7	4569	97	7	4592	97	7
4409	74	31	4432	72	9	4455	96	9	4478	81	9	4501	44	2	4524	97	7	4547	97	7	4570	97	7	4593	97	7
4410	74	31	4433	96	9	4456	81	9	4479	81	9	4502	44	2	4525	97	7	4548	97	7	4571	97	7	4594	44	2
4411	74	31	4434	96	9	4457	81	9	4480	81	9	4503	63	12	4526	97	7	4549	97	7	4572	97	7	4595	44	2
4412	70	31	4435	96	9	4458	81	9	4481	81	9	4504	44	2	4527	97	7	4550	97	7	4573	97	7	4596	44	2
4413	56	31	4436	96	9	4459	96	9	4482	81	9	4505	97	7	4528	97	7	4551	97	7	4574	97	7	4597	97	7
4414	70	31	4437	96	9	4460	96	9	4483	81	9	4506	97	7	4529	97	7	4552	97	7	4575	97	7	4598	97	7
4415	70	31	4438	96	9	4461	96	9	4484	96	9	4507	97	7	4530	28	12	4553	97	7	4576	97	7	4599	97	7
4416	70	31	4439	81	9	4462	96	9	4485	96	9	4508	97	7	4531	63	12	4554	97	7	4577	97	7	4600	97	7
4417	70	31	4440	96	9	4463	81	9	4486	96	9	4509	63	12	4532	97	7	4555	97	7	4578	97	7	4601	97	7
4418	56	31	4441	96	9	4464	96	9	4487	96	9	4510	28	12	4533	44	2	4556	97	7	4579	97	7	4602	97	7
4419	56	31	4442	96	9	4465	96	9	4488	96	9	4511	44	2	4534	44	2	4557	97	7	4580	97	7	4603	23	7
4420	56	31	4443	96	9	4466	72	9	4489	96	9	4512	44	2	4535	44	2	4558	97	7	4581	97	7	4604	23	7

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
4605	65	15	4628	65	15	4651	45	24	4674	39	33	4697	54	16	4720	45	24	4743	39	33	4766	53	4	4789	53	4
4606	65	15	4629	65	15	4652	45	24	4675	39	33	4698	54	16	4721	49	24	4744	39	33	4767	53	4	4790	53	4
4607	23	7	4630	65	15	4653	45	24	4676	17	33	4699	54	16	4722	45	24	4745	54	16	4768	49	24	4791	53	4
4608	23	7	4631	65	15	4654	53	4	4677	39	33	4700	45	24	4723	45	24	4746	54	16	4769	49	24	4792	53	4
4609	65	15	4632	65	15	4655	53	4	4678	39	33	4701	45	24	4724	68	16	4747	54	16	4770	49	24	4793	53	4
4610	65	15	4633	65	15	4656	45	24	4679	39	33	4702	54	16	4725	68	16	4748	45	24	4771	49	24	4794	49	24
4611	65	15	4634	23	7	4657	49	24	4680	45	24	4703	45	24	4726	68	16	4749	68	16	4772	54	16	4795	53	4
4612	65	15	4635	23	7	4658	49	24	4681	45	24	4704	45	24	4727	54	16	4750	39	33	4773	45	24	4796	49	24
4613	23	7	4636	23	7	4659	39	33	4682	49	24	4705	45	24	4728	54	16	4751	39	33	4774	45	24	4797	49	24
4614	23	7	4637	65	15	4660	39	33	4683	49	24	4706	54	16	4729	54	16	4752	54	16	4775	54	16	4798	53	4
4615	23	7	4638	65	15	4661	39	33	4684	49	24	4707	54	16	4730	54	16	4753	39	33	4776	45	24	4799	53	4
4616	23	7	4639	65	15	4662	39	33	4685	54	16	4708	54	16	4731	68	16	4754	39	33	4777	45	24	4800	49	24
4617	23	7	4640	49	24	4663	45	24	4686	45	24	4709	68	16	4732	68	16	4755	54	16	4778	45	24	4801	53	4
4618	23	7	4641	49	24	4664	39	33	4687	45	24	4710	68	16	4733	68	16	4756	54	16	4779	54	16	4802	53	4
4619	23	7	4642	49	24	4665	39	33	4688	45	24	4711	68	16	4734	68	16	4757	68	16	4780	54	16	4803	49	24
4620	65	15	4643	49	24	4666	39	33	4689	54	16	4712	39	33	4735	68	16	4758	39	33	4781	54	16	4804	17	33
4621	65	15	4644	53	4	4667	17	33	4690	54	16	4713	49	24	4736	39	33	4759	39	33	4782	54	16	4805	17	33
4622	23	7	4645	53	4	4668	17	33	4691	54	16	4714	49	24	4737	54	16	4760	45	24	4783	54	16	4806	39	33
4623	65	15	4646	53	4	4669	17	33	4692	39	33	4715	45	24	4738	39	33	4761	45	24	4784	54	16	4807	49	24
4624	65	15	4647	49	24	4670	17	33	4693	39	33	4716	49	24	4739	39	33	4762	45	24	4785	54	16	4808	45	24
4625	65	15	4648	45	24	4671	17	33	4694	54	16	4717	45	24	4740	54	16	4763	45	24	4786	54	16	4809	45	24
4626	65	15	4649	45	24	4672	17	33	4695	54	16	4718	49	24	4741	54	16	4764	45	24	4787	49	24	4810	54	16
4627	65	15	4650	45	24	4673	39	33	4696	54	16	4719	45	24	4742	68	16	4765	49	24	4788	49	24	4811	54	16

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
4812	40	29	4835	40	29	4858	76	20	4881	12	20	4904	79	23	4927	79	23	4950	91	20	4973	91	20	4996	79	23
4813	40	29	4836	40	29	4859	76	20	4882	36	26	4905	79	23	4928	91	20	4951	91	20	4974	91	20	4997	79	23
4814	26	26	4837	40	29	4860	76	20	4883	76	20	4906	79	23	4929	91	20	4952	91	20	4975	12	20	4998	36	26
4815	26	26	4838	40	29	4861	12	20	4884	36	26	4907	79	23	4930	91	20	4953	91	20	4976	12	20	4999	76	20
4816	26	26	4839	40	29	4862	12	20	4885	36	26	4908	79	23	4931	91	20	4954	91	20	4977	76	20	5000	76	20
4817	26	26	4840	40	29	4863	12	20	4886	36	26	4909	13	10	4932	91	20	4955	91	20	4978	53	4	5001	36	26
4818	26	26	4841	40	29	4864	12	20	4887	36	26	4910	13	10	4933	91	20	4956	91	20	4979	5	4	5002	36	26
4819	34	27	4842	40	29	4865	12	20	4888	76	20	4911	13	10	4934	12	20	4957	91	20	4980	76	20	5003	36	26
4820	26	26	4843	40	29	4866	12	20	4889	36	26	4912	13	10	4935	91	20	4958	91	20	4981	53	4	5004	36	26
4821	26	26	4844	40	29	4867	76	20	4890	36	26	4913	13	10	4936	76	20	4959	91	20	4982	79	23	5005	76	20
4822	40	29	4845	40	29	4868	76	20	4891	76	20	4914	13	10	4937	12	20	4960	12	20	4983	53	4	5006	36	26
4823	40	29	4846	26	26	4869	76	20	4892	36	26	4915	13	10	4938	91	20	4961	76	20	4984	79	23	5007	36	26
4824	40	29	4847	40	29	4870	12	20	4893	12	20	4916	13	10	4939	91	20	4962	91	20	4985	79	23	5008	76	20
4825	26	26	4848	26	26	4871	76	20	4894	12	20	4917	13	10	4940	91	20	4963	12	20	4986	79	23	5009	76	20
4826	40	29	4849	40	29	4872	12	20	4895	36	26	4918	13	10	4941	12	20	4964	76	20	4987	79	23	5010	12	20
4827	40	29	4850	40	29	4873	12	20	4896	36	26	4919	36	26	4942	91	20	4965	79	23	4988	79	23	5011	76	20
4828	26	26	4851	40	29	4874	12	20	4897	76	20	4920	76	20	4943	91	20	4966	36	26	4989	53	4	5012	12	20
4829	40	29	4852	40	29	4875	76	20	4898	76	20	4921	79	23	4944	91	20	4967	76	20	4990	53	4	5013	76	20
4830	40	29	4853	26	26	4876	76	20	4899	49	24	4922	79	23	4945	91	20	4968	76	20	4991	53	4	5014	36	26
4831	40	29	4854	26	26	4877	12	20	4900	49	24	4923	79	23	4946	91	20	4969	91	20	4992	53	4	5015	76	20
4832	40	29	4855	40	29	4878	12	20	4901	49	24	4924	76	20	4947	91	20	4970	91	20	4993	79	23	5016	12	20
4833	40	29	4856	76	20	4879	76	20	4902	49	24	4925	76	20	4948	91	20	4971	76	20	4994	53	4	5017	12	20
4834	40	29	4857	36	26	4880	12	20	4903	79	23	4926	79	23	4949	91	20	4972	76	20	4995	79	23	5018	12	20

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
5019	13	10	5042	73	15	5065	73	15	5088	74	31	5111	74	31	5134	74	31	5157	81	9	5180	81	9	5203	74	31
5020	13	10	5043	73	15	5066	64	15	5089	74	31	5112	74	31	5135	74	31	5158	81	9	5181	81	9	5204	74	31
5021	13	10	5044	73	15	5067	64	15	5090	74	31	5113	74	31	5136	74	31	5159	81	9	5182	81	9	5205	74	31
5022	13	10	5045	64	15	5068	64	15	5091	74	31	5114	74	31	5137	74	31	5160	81	9	5183	81	9	5206	56	31
5023	73	15	5046	64	15	5069	64	15	5092	74	31	5115	74	31	5138	74	31	5161	74	31	5184	81	9	5207	74	31
5024	64	15	5047	64	15	5070	73	15	5093	74	31	5116	74	31	5139	74	31	5162	81	9	5185	81	9	5208	56	31
5025	64	15	5048	64	15	5071	72	9	5094	74	31	5117	74	31	5140	74	31	5163	81	9	5186	81	9	5209	74	31
5026	64	15	5049	64	15	5072	64	15	5095	74	31	5118	74	31	5141	74	31	5164	81	9	5187	81	9	5210	81	9
5027	64	15	5050	64	15	5073	72	9	5096	70	31	5119	74	31	5142	74	31	5165	81	9	5188	81	9	5211	81	9
5028	72	9	5051	64	15	5074	64	15	5097	81	9	5120	74	31	5143	81	9	5166	81	9	5189	81	9	5212	74	31
5029	64	15	5052	64	15	5075	64	15	5098	81	9	5121	74	31	5144	81	9	5167	74	31	5190	81	9	5213	70	31
5030	64	15	5053	64	15	5076	73	15	5099	74	31	5122	74	31	5145	81	9	5168	74	31	5191	81	9	5214	74	31
5031	64	15	5054	64	15	5077	72	9	5100	70	31	5123	74	31	5146	81	9	5169	74	31	5192	81	9	5215	74	31
5032	64	15	5055	64	15	5078	64	15	5101	74	31	5124	81	9	5147	81	9	5170	74	31	5193	74	31	5216	34	27
5033	64	15	5056	64	15	5079	64	15	5102	81	9	5125	81	9	5148	81	9	5171	74	31	5194	70	31	5217	34	27
5034	64	15	5057	64	15	5080	64	15	5103	81	9	5126	81	9	5149	81	9	5172	81	9	5195	81	9	5218	34	27
5035	64	15	5058	64	15	5081	64	15	5104	70	31	5127	81	9	5150	81	9	5173	81	9	5196	81	9	5219	34	27
5036	64	15	5059	64	15	5082	64	15	5105	70	31	5128	81	9	5151	81	9	5174	81	9	5197	81	9	5220	34	27
5037	64	15	5060	64	15	5083	72	9	5106	70	31	5129	81	9	5152	81	9	5175	81	9	5198	81	9	5221	34	27
5038	64	15	5061	64	15	5084	64	15	5107	74	31	5130	81	9	5153	81	9	5176	74	31	5199	81	9	5222	34	27
5039	64	15	5062	64	15	5085	72	9	5108	74	31	5131	81	9	5154	81	9	5177	81	9	5200	81	9	5223	34	27
5040	64	15	5063	64	15	5086	64	15	5109	74	31	5132	81	9	5155	81	9	5178	81	9	5201	81	9	5224	34	27
5041	64	15	5064	64	15	5087	72	9	5110	74	31	5133	81	9	5156	81	9	5179	81	9	5202	81	9	5225	34	27

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
5226	34	27	5249	26	26	5272	34	27	5295	34	27	5318	34	27	5341	96	9	5364	72	9	5387	80	2	5410	4	18
5227	34	27	5250	34	27	5273	26	26	5296	34	27	5319	34	27	5342	96	9	5365	72	9	5388	9	18	5411	4	18
5228	34	27	5251	34	27	5274	26	26	5297	34	27	5320	34	27	5343	96	9	5366	73	15	5389	4	18	5412	4	18
5229	34	27	5252	34	27	5275	26	26	5298	26	26	5321	34	27	5344	96	9	5367	84	5	5390	33	18	5413	4	18
5230	34	27	5253	26	26	5276	26	26	5299	26	26	5322	34	27	5345	96	9	5368	33	18	5391	4	18	5414	4	18
5231	34	27	5254	34	27	5277	26	26	5300	26	26	5323	26	26	5346	72	9	5369	33	18	5392	9	18	5415	4	18
5232	34	27	5255	34	27	5278	26	26	5301	26	26	5324	96	9	5347	96	9	5370	4	18	5393	4	18	5416	4	18
5233	34	27	5256	34	27	5279	26	26	5302	26	26	5325	96	9	5348	72	9	5371	84	5	5394	4	18	5417	4	18
5234	40	29	5257	34	27	5280	34	27	5303	26	26	5326	72	9	5349	72	9	5372	84	5	5395	4	18	5418	9	18
5235	34	27	5258	34	27	5281	34	27	5304	26	26	5327	72	9	5350	96	9	5373	4	18	5396	9	18	5419	9	18
5236	35	29	5259	34	27	5282	34	27	5305	26	26	5328	73	15	5351	98	5	5374	9	18	5397	33	18	5420	9	18
5237	35	29	5260	34	27	5283	34	27	5306	26	26	5329	73	15	5352	73	15	5375	80	2	5398	33	18	5421	14	30
5238	34	27	5261	34	27	5284	34	27	5307	26	26	5330	73	15	5353	73	15	5376	80	2	5399	80	2	5422	9	18
5239	34	27	5262	34	27	5285	34	27	5308	26	26	5331	65	15	5354	72	9	5377	84	5	5400	80	2	5423	14	30
5240	34	27	5263	34	27	5286	34	27	5309	34	27	5332	72	9	5355	72	9	5378	84	5	5401	80	2	5424	14	30
5241	34	27	5264	26	26	5287	34	27	5310	26	26	5333	72	9	5356	72	9	5379	9	18	5402	4	18	5425	14	30
5242	34	27	5265	26	26	5288	34	27	5311	34	27	5334	73	15	5357	72	9	5380	9	18	5403	4	18	5426	9	18
5243	34	27	5266	34	27	5289	34	27	5312	26	26	5335	96	9	5358	72	9	5381	84	5	5404	14	30	5427	4	18
5244	34	27	5267	26	26	5290	34	27	5313	34	27	5336	96	9	5359	72	9	5382	4	18	5405	9	18	5428	9	18
5245	34	27	5268	34	27	5291	34	27	5314	26	26	5337	96	9	5360	72	9	5383	84	5	5406	4	18	5429	33	18
5246	34	27	5269	34	27	5292	34	27	5315	34	27	5338	96	9	5361	72	9	5384	9	18	5407	4	18	5430	14	30
5247	26	26	5270	26	26	5293	34	27	5316	34	27	5339	96	9	5362	98	5	5385	9	18	5408	4	18	5431	9	18
5248	26	26	5271	26	26	5294	34	27	5317	34	27	5340	96	9	5363	73	15	5386	97	7	5409	4	18	5432	4	18

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
5433	9	18	5456	67	32	5479	85	25	5502	22	32	5525	58	25	5548	85	25	5571	73	15	5594	73	15	5617	42	14
5434	4	18	5457	58	25	5480	18	25	5503	22	32	5526	69	32	5549	85	25	5572	73	15	5595	64	15	5618	42	14
5435	4	18	5458	58	25	5481	18	25	5504	58	25	5527	58	25	5550	85	25	5573	73	15	5596	23	7	5619	56	31
5436	4	18	5459	58	25	5482	18	25	5505	58	25	5528	58	25	5551	58	25	5574	73	15	5597	23	7	5620	56	31
5437	4	18	5460	58	25	5483	85	25	5506	58	25	5529	69	32	5552	58	25	5575	73	15	5598	23	7	5621	94	14
5438	4	18	5461	85	25	5484	85	25	5507	85	25	5530	58	25	5553	85	25	5576	73	15	5599	73	15	5622	94	14
5439	9	18	5462	58	25	5485	85	25	5508	58	25	5531	58	25	5554	85	25	5577	73	15	5600	73	15	5623	94	14
5440	85	25	5463	58	25	5486	85	25	5509	85	25	5532	85	25	5555	58	25	5578	73	15	5601	64	15	5624	94	14
5441	85	25	5464	69	32	5487	85	25	5510	85	25	5533	85	25	5556	58	25	5579	73	15	5602	73	15	5625	94	14
5442	69	32	5465	69	32	5488	18	25	5511	58	25	5534	85	25	5557	85	25	5580	73	15	5603	94	14	5626	94	14
5443	69	32	5466	85	25	5489	18	25	5512	58	25	5535	58	25	5558	67	32	5581	64	15	5604	56	31	5627	94	14
5444	67	32	5467	69	32	5490	85	25	5513	85	25	5536	58	25	5559	69	32	5582	73	15	5605	56	31	5628	94	14
5445	18	25	5468	85	25	5491	18	25	5514	58	25	5537	58	25	5560	85	25	5583	73	15	5606	56	31	5629	94	14
5446	18	25	5469	69	32	5492	85	25	5515	58	25	5538	58	25	5561	69	32	5584	73	15	5607	56	31	5630	94	14
5447	18	25	5470	85	25	5493	85	25	5516	85	25	5539	58	25	5562	69	32	5585	73	15	5608	94	14	5631	56	31
5448	22	32	5471	22	32	5494	85	25	5517	85	25	5540	58	25	5563	69	32	5586	73	15	5609	56	31	5632	56	31
5449	85	25	5472	22	32	5495	67	32	5518	85	25	5541	85	25	5564	64	15	5587	73	15	5610	56	31	5633	56	31
5450	22	32	5473	92	28	5496	67	32	5519	58	25	5542	85	25	5565	73	15	5588	73	15	5611	56	31	5634	56	31
5451	58	25	5474	58	25	5497	18	25	5520	58	25	5543	58	25	5566	73	15	5589	73	15	5612	56	31	5635	71	14
5452	18	25	5475	69	32	5498	22	32	5521	85	25	5544	58	25	5567	73	15	5590	73	15	5613	56	31	5636	71	14
5453	18	25	5476	69	32	5499	18	25	5522	85	25	5545	85	25	5568	73	15	5591	73	15	5614	56	31	5637	71	14
5454	67	32	5477	67	32	5500	22	32	5523	85	25	5546	85	25	5569	73	15	5592	73	15	5615	56	31	5638	94	14
5455	69	32	5478	67	32	5501	85	25	5524	85	25	5547	85	25	5570	73	15	5593	73	15	5616	56	31	5639	94	14

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
5640	94	14	5663	40	29	5686	40	29	5709	40	29	5732	98	5	5755	98	5	5778	49	24	5801	53	4	5824	12	20
5641	56	31	5664	40	29	5687	40	29	5710	40	29	5733	98	5	5756	98	5	5779	49	24	5802	53	4	5825	12	20
5642	94	14	5665	40	29	5688	40	29	5711	40	29	5734	98	5	5757	98	5	5780	49	24	5803	12	20	5826	53	4
5643	56	31	5666	40	29	5689	40	29	5712	40	29	5735	84	5	5758	98	5	5781	49	24	5804	12	20	5827	53	4
5644	94	14	5667	35	29	5690	40	29	5713	40	29	5736	98	5	5759	98	5	5782	12	20	5805	53	4	5828	45	24
5645	94	14	5668	40	29	5691	35	29	5714	40	29	5737	98	5	5760	98	5	5783	12	20	5806	12	20	5829	45	24
5646	71	14	5669	40	29	5692	40	29	5715	40	29	5738	84	5	5761	98	5	5784	12	20	5807	53	4	5830	49	24
5647	42	14	5670	40	29	5693	35	29	5716	35	29	5739	84	5	5762	98	5	5785	12	20	5808	53	4	5831	53	4
5648	42	14	5671	40	29	5694	40	29	5717	35	29	5740	84	5	5763	98	5	5786	12	20	5809	53	4	5832	53	4
5649	94	14	5672	40	29	5695	35	29	5718	40	29	5741	98	5	5764	98	5	5787	12	20	5810	12	20	5833	53	4
5650	42	14	5673	26	26	5696	35	29	5719	40	29	5742	98	5	5765	84	5	5788	12	20	5811	53	4	5834	53	4
5651	94	14	5674	35	29	5697	40	29	5720	40	29	5743	98	5	5766	84	5	5789	12	20	5812	53	4	5835	49	24
5652	94	14	5675	40	29	5698	40	29	5721	40	29	5744	98	5	5767	98	5	5790	12	20	5813	53	4	5836	49	24
5653	56	31	5676	40	29	5699	40	29	5722	40	29	5745	98	5	5768	55	24	5791	12	20	5814	53	4	5837	53	4
5654	56	31	5677	40	29	5700	35	29	5723	40	29	5746	98	5	5769	45	24	5792	12	20	5815	53	4	5838	49	24
5655	40	29	5678	40	29	5701	35	29	5724	35	29	5747	98	5	5770	55	24	5793	12	20	5816	53	4	5839	45	24
5656	40	29	5679	26	26	5702	40	29	5725	98	5	5748	98	5	5771	55	24	5794	53	4	5817	87	4	5840	45	24
5657	40	29	5680	26	26	5703	40	29	5726	98	5	5749	98	5	5772	45	24	5795	12	20	5818	53	4	5841	45	24
5658	35	29	5681	26	26	5704	40	29	5727	98	5	5750	98	5	5773	45	24	5796	49	24	5819	53	4	5842	45	24
5659	35	29	5682	26	26	5705	40	29	5728	98	5	5751	98	5	5774	45	24	5797	12	20	5820	12	20	5843	45	24
5660	40	29	5683	26	26	5706	40	29	5729	98	5	5752	98	5	5775	53	4	5798	12	20	5821	53	4	5844	53	4
5661	35	29	5684	26	26	5707	40	29	5730	98	5	5753	84	5	5776	53	4	5799	53	4	5822	12	20	5845	53	4
5662	35	29	5685	26	26	5708	40	29	5731	98	5	5754	84	5	5777	49	24	5800	53	4	5823	12	20	5846	53	4

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
5847	53	4	5870	53	4	5893	53	4	5916	53	4	5939	96	9	5962	96	9	5985	69	32	6008	22	32	6031	31	23
5848	12	20	5871	49	24	5894	53	4	5917	53	4	5940	96	9	5963	96	9	5986	50	17	6009	22	32	6032	31	23
5849	12	20	5872	53	4	5895	12	20	5918	49	24	5941	72	9	5964	96	9	5987	50	17	6010	31	23	6033	31	23
5850	45	24	5873	49	24	5896	45	24	5919	96	9	5942	72	9	5965	96	9	5988	50	17	6011	31	23	6034	31	23
5851	49	24	5874	49	24	5897	45	24	5920	72	9	5943	72	9	5966	31	23	5989	50	17	6012	31	23	6035	50	17
5852	45	24	5875	49	24	5898	49	24	5921	72	9	5944	72	9	5967	31	23	5990	15	22	6013	50	17	6036	22	32
5853	45	24	5876	53	4	5899	49	24	5922	72	9	5945	98	5	5968	22	32	5991	15	22	6014	50	17	6037	31	23
5854	49	24	5877	53	4	5900	49	24	5923	96	9	5946	98	5	5969	22	32	5992	11	22	6015	31	23	6038	31	23
5855	49	24	5878	12	20	5901	45	24	5924	72	9	5947	98	5	5970	31	23	5993	11	22	6016	31	23	6039	67	32
5856	49	24	5879	53	4	5902	5	4	5925	72	9	5948	72	9	5971	31	23	5994	15	22	6017	31	23	6040	67	32
5857	45	24	5880	12	20	5903	5	4	5926	72	9	5949	72	9	5972	85	25	5995	11	22	6018	31	23	6041	67	32
5858	45	24	5881	49	24	5904	5	4	5927	72	9	5950	72	9	5973	85	25	5996	11	22	6019	50	17	6042	50	17
5859	49	24	5882	49	24	5905	5	4	5928	72	9	5951	72	9	5974	22	32	5997	11	22	6020	31	23	6043	67	32
5860	45	24	5883	49	24	5906	5	4	5929	72	9	5952	72	9	5975	22	32	5998	11	22	6021	50	17	6044	67	32
5861	45	24	5884	49	24	5907	5	4	5930	72	9	5953	96	9	5976	31	23	5999	50	17	6022	31	23	6045	67	32
5862	45	24	5885	53	4	5908	5	4	5931	98	5	5954	72	9	5977	50	17	6000	50	17	6023	22	32	6046	67	32
5863	45	24	5886	53	4	5909	53	4	5932	98	5	5955	72	9	5978	50	17	6001	15	22	6024	22	32	6047	67	32
5864	49	24	5887	49	24	5910	5	4	5933	98	5	5956	72	9	5979	50	17	6002	50	17	6025	31	23	6048	50	17
5865	45	24	5888	12	20	5911	53	4	5934	98	5	5957	72	9	5980	85	25	6003	31	23	6026	50	17	6049	50	17
5866	49	24	5889	12	20	5912	53	4	5935	96	9	5958	72	9	5981	85	25	6004	22	32	6027	50	17	6050	50	17
5867	45	24	5890	53	4	5913	53	4	5936	96	9	5959	72	9	5982	85	25	6005	31	23	6028	31	23	6051	67	32
5868	49	24	5891	12	20	5914	5	4	5937	96	9	5960	72	9	5983	67	32	6006	22	32	6029	50	17	6052	50	17
5869	49	24	5892	12	20	5915	53	4	5938	96	9	5961	96	9	5984	85	25	6007	31	23	6030	31	23	6053	50	17

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
6054	50	17	6077	50	17	6100	22	32	6123	67	32	6146	87	4	6169	88	3	6192	75	17	6215	83	17	6238	75	17
6055	50	17	6078	50	17	6101	22	32	6124	22	32	6147	88	3	6170	88	3	6193	75	17	6216	83	17	6239	83	17
6056	67	32	6079	83	17	6102	22	32	6125	22	32	6148	88	3	6171	88	3	6194	10	22	6217	87	4	6240	75	17
6057	22	32	6080	83	17	6103	22	32	6126	22	32	6149	16	3	6172	83	17	6195	75	17	6218	87	4	6241	10	22
6058	85	25	6081	50	17	6104	22	32	6127	85	25	6150	16	3	6173	10	22	6196	75	17	6219	75	17	6242	75	17
6059	85	25	6082	83	17	6105	22	32	6128	67	32	6151	10	22	6174	88	3	6197	10	22	6220	75	17	6243	10	22
6060	85	25	6083	67	32	6106	22	32	6129	67	32	6152	10	22	6175	10	22	6198	10	22	6221	87	4	6244	10	22
6061	22	32	6084	31	23	6107	67	32	6130	85	25	6153	10	22	6176	10	22	6199	10	22	6222	87	4	6245	10	22
6062	22	32	6085	22	32	6108	67	32	6131	85	25	6154	16	3	6177	88	3	6200	10	22	6223	88	3	6246	10	22
6063	22	32	6086	67	32	6109	67	32	6132	22	32	6155	16	3	6178	10	22	6201	10	22	6224	16	3	6247	10	22
6064	85	25	6087	31	23	6110	22	32	6133	22	32	6156	16	3	6179	88	3	6202	10	22	6225	88	3	6248	10	22
6065	11	22	6088	31	23	6111	22	32	6134	67	32	6157	10	22	6180	88	3	6203	75	17	6226	88	3	6249	10	22
6066	85	25	6089	67	32	6112	67	32	6135	22	32	6158	50	17	6181	50	17	6204	10	22	6227	88	3	6250	10	22
6067	85	25	6090	67	32	6113	67	32	6136	67	32	6159	50	17	6182	88	3	6205	75	17	6228	88	3	6251	83	17
6068	22	32	6091	31	23	6114	67	32	6137	22	32	6160	10	22	6183	11	22	6206	75	17	6229	88	3	6252	83	17
6069	67	32	6092	67	32	6115	67	32	6138	22	32	6161	10	22	6184	16	3	6207	75	17	6230	88	3	6253	83	17
6070	67	32	6093	67	32	6116	85	25	6139	22	32	6162	10	22	6185	16	3	6208	75	17	6231	75	17	6254	10	22
6071	67	32	6094	67	32	6117	67	32	6140	67	32	6163	10	22	6186	83	17	6209	83	17	6232	83	17	6255	75	17
6072	50	17	6095	85	25	6118	85	25	6141	22	32	6164	16	3	6187	83	17	6210	75	17	6233	75	17	6256	50	17
6073	83	17	6096	67	32	6119	85	25	6142	31	23	6165	88	3	6188	83	17	6211	83	17	6234	75	17	6257	50	17
6074	83	17	6097	85	25	6120	85	25	6143	22	32	6166	88	3	6189	10	22	6212	83	17	6235	83	17	6258	50	17
6075	83	17	6098	67	32	6121	85	25	6144	87	4	6167	88	3	6190	75	17	6213	83	17	6236	75	17	6259	83	17
6076	50	17	6099	85	25	6122	67	32	6145	49	24	6168	88	3	6191	75	17	6214	83	17	6237	75	17	6260	83	17

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
6261	83	17	6284	10	22	6307	87	4	6330	49	24	6353	61	6	6376	83	17	6399	83	17	6422	83	17	6445	87	4
6262	83	17	6285	50	17	6308	88	3	6331	49	24	6354	87	4	6377	75	17	6400	83	17	6423	10	22	6446	88	3
6263	83	17	6286	50	17	6309	87	4	6332	49	24	6355	61	6	6378	75	17	6401	83	17	6424	83	17	6447	88	3
6264	50	17	6287	31	23	6310	87	4	6333	49	24	6356	87	4	6379	75	17	6402	83	17	6425	10	22	6448	87	4
6265	10	22	6288	31	23	6311	87	4	6334	49	24	6357	87	4	6380	31	23	6403	83	17	6426	75	17	6449	87	4
6266	50	17	6289	31	23	6312	88	3	6335	49	24	6358	87	4	6381	83	17	6404	83	17	6427	83	17	6450	49	24
6267	50	17	6290	31	23	6313	88	3	6336	49	24	6359	87	4	6382	75	17	6405	75	17	6428	83	17	6451	87	4
6268	50	17	6291	83	17	6314	88	3	6337	87	4	6360	61	6	6383	75	17	6406	10	22	6429	75	17	6452	87	4
6269	11	22	6292	31	23	6315	75	17	6338	87	4	6361	61	6	6384	75	17	6407	83	17	6430	75	17	6453	83	17
6270	11	22	6293	83	17	6316	88	3	6339	49	24	6362	61	6	6385	75	17	6408	10	22	6431	83	17	6454	83	17
6271	11	22	6294	31	23	6317	87	4	6340	61	6	6363	87	4	6386	31	23	6409	10	22	6432	83	17	6455	83	17
6272	11	22	6295	31	23	6318	75	17	6341	61	6	6364	61	6	6387	83	17	6410	75	17	6433	50	17	6456	83	17
6273	11	22	6296	31	23	6319	88	3	6342	83	17	6365	61	6	6388	83	17	6411	10	22	6434	83	17	6457	83	17
6274	16	3	6297	83	17	6320	88	3	6343	83	17	6366	61	6	6389	83	17	6412	10	22	6435	50	17	6458	10	22
6275	16	3	6298	31	23	6321	75	17	6344	83	17	6367	38	11	6390	31	23	6413	10	22	6436	83	17	6459	88	3
6276	11	22	6299	83	17	6322	75	17	6345	61	6	6368	82	11	6391	31	23	6414	10	22	6437	83	17	6460	88	3
6277	50	17	6300	83	17	6323	75	17	6346	61	6	6369	61	6	6392	75	17	6415	50	17	6438	83	17	6461	88	3
6278	11	22	6301	31	23	6324	75	17	6347	38	11	6370	61	6	6393	31	23	6416	83	17	6439	83	17	6462	87	4
6279	10	22	6302	31	23	6325	87	4	6348	38	11	6371	61	6	6394	31	23	6417	10	22	6440	83	17	6463	88	3
6280	11	22	6303	10	22	6326	61	6	6349	61	6	6372	75	17	6395	83	17	6418	83	17	6441	83	17	6464	87	4
6281	10	22	6304	87	4	6327	61	6	6350	38	11	6373	75	17	6396	83	17	6419	83	17	6442	87	4	6465	88	3
6282	10	22	6305	88	3	6328	61	6	6351	82	11	6374	75	17	6397	31	23	6420	83	17	6443	87	4	6466	87	4
6283	10	22	6306	87	4	6329	49	24	6352	61	6	6375	83	17	6398	83	17	6421	83	17	6444	88	3	6467	87	4

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Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
6468	87	4	6491	10	22	6514	88	3	6537	80	2	6560	80	2	6583	80	2	6606	80	2	6629	44	2	6652	44	2
6469	10	22	6492	75	17	6515	87	4	6538	80	2	6561	80	2	6584	80	2	6607	14	30	6630	44	2	6653	44	2
6470	10	22	6493	10	22	6516	88	3	6539	80	2	6562	14	30	6585	14	30	6608	14	30	6631	44	2	6654	63	12
6471	87	4	6494	75	17	6517	87	4	6540	44	2	6563	80	2	6586	14	30	6609	14	30	6632	44	2	6655	63	12
6472	87	4	6495	87	4	6518	87	4	6541	44	2	6564	80	2	6587	80	2	6610	80	2	6633	44	2	6656	63	12
6473	88	3	6496	75	17	6519	80	2	6542	44	2	6565	80	2	6588	80	2	6611	80	2	6634	63	12	6657	63	12
6474	87	4	6497	75	17	6520	9	18	6543	44	2	6566	80	2	6589	14	30	6612	14	30	6635	63	12	6658	63	12
6475	88	3	6498	87	4	6521	60	2	6544	80	2	6567	80	2	6590	80	2	6613	14	30	6636	63	12	6659	44	2
6476	87	4	6499	87	4	6522	80	2	6545	80	2	6568	80	2	6591	44	2	6614	14	30	6637	44	2	6660	44	2
6477	87	4	6500	87	4	6523	80	2	6546	80	2	6569	80	2	6592	80	2	6615	14	30	6638	44	2	6661	60	2
6478	87	4	6501	88	3	6524	80	2	6547	80	2	6570	80	2	6593	44	2	6616	14	30	6639	63	12	6662	60	2
6479	87	4	6502	88	3	6525	80	2	6548	80	2	6571	80	2	6594	44	2	6617	9	18	6640	63	12	6663	60	2
6480	88	3	6503	87	4	6526	80	2	6549	97	7	6572	80	2	6595	44	2	6618	60	2	6641	63	12	6664	60	2
6481	88	3	6504	87	4	6527	80	2	6550	80	2	6573	80	2	6596	80	2	6619	60	2	6642	44	2	6665	60	2
6482	88	3	6505	87	4	6528	80	2	6551	80	2	6574	80	2	6597	80	2	6620	80	2	6643	44	2	6666	60	2
6483	87	4	6506	88	3	6529	80	2	6552	44	2	6575	14	30	6598	80	2	6621	80	2	6644	44	2	6667	60	2
6484	88	3	6507	87	4	6530	80	2	6553	44	2	6576	80	2	6599	14	30	6622	63	12	6645	44	2	6668	1	28
6485	88	3	6508	75	17	6531	80	2	6554	80	2	6577	80	2	6600	80	2	6623	63	12	6646	63	12	6669	1	28
6486	88	3	6509	75	17	6532	80	2	6555	80	2	6578	80	2	6601	80	2	6624	63	12	6647	63	12	6670	19	28
6487	88	3	6510	88	3	6533	44	2	6556	80	2	6579	80	2	6602	14	30	6625	63	12	6648	44	2	6671	27	8
6488	87	4	6511	88	3	6534	80	2	6557	80	2	6580	80	2	6603	80	2	6626	63	12	6649	63	12	6672	7	30
6489	75	17	6512	88	3	6535	80	2	6558	80	2	6581	80	2	6604	14	30	6627	63	12	6650	44	2	6673	1	28
6490	75	17	6513	88	3	6536	80	2	6559	80	2	6582	80	2	6605	80	2	6628	63	12	6651	44	2	6674	1	28

Table A-3: (Continue)

Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
6675	1	28	6698	14	30	6721	7	30	6744	14	30	6767	19	28	6790	1	28	6813	1	28	6836	60	2	6859	28	12
6676	14	30	6699	14	30	6722	7	30	6745	14	30	6768	19	28	6791	19	28	6814	1	28	6837	60	2	6860	28	12
6677	14	30	6700	7	30	6723	7	30	6746	7	30	6769	60	2	6792	1	28	6815	60	2	6838	60	2	6861	28	12
6678	14	30	6701	7	30	6724	14	30	6747	7	30	6770	60	2	6793	19	28	6816	1	28	6839	60	2	6862	97	7
6679	60	2	6702	14	30	6725	7	30	6748	14	30	6771	60	2	6794	1	28	6817	1	28	6840	14	30	6863	97	7
6680	60	2	6703	14	30	6726	7	30	6749	7	30	6772	60	2	6795	19	28	6818	1	28	6841	60	2	6864	97	7
6681	60	2	6704	7	30	6727	14	30	6750	7	30	6773	60	2	6796	19	28	6819	1	28	6842	60	2	6865	62	12
6682	60	2	6705	7	30	6728	14	30	6751	14	30	6774	60	2	6797	19	28	6820	1	28	6843	60	2	6866	28	12
6683	14	30	6706	14	30	6729	7	30	6752	14	30	6775	60	2	6798	1	28	6821	19	28	6844	60	2	6867	28	12
6684	7	30	6707	7	30	6730	14	30	6753	7	30	6776	60	2	6799	1	28	6822	19	28	6845	60	2	6868	28	12
6685	7	30	6708	7	30	6731	7	30	6754	7	30	6777	60	2	6800	1	28	6823	19	28	6846	60	2	6869	28	12
6686	14	30	6709	7	30	6732	14	30	6755	14	30	6778	60	2	6801	1	28	6824	19	28	6847	60	2	6870	63	12
6687	7	30	6710	14	30	6733	7	30	6756	7	30	6779	60	2	6802	1	28	6825	1	28	6848	60	2	6871	63	12
6688	7	30	6711	14	30	6734	7	30	6757	7	30	6780	60	2	6803	1	28	6826	19	28	6849	60	2	6872	63	12
6689	14	30	6712	14	30	6735	7	30	6758	14	30	6781	1	28	6804	19	28	6827	19	28	6850	60	2	6873	63	12
6690	7	30	6713	14	30	6736	7	30	6759	7	30	6782	19	28	6805	1	28	6828	1	28	6851	60	2	6874	63	12
6691	7	30	6714	14	30	6737	7	30	6760	14	30	6783	19	28	6806	1	28	6829	1	28	6852	60	2	6875	63	12
6692	7	30	6715	7	30	6738	14	30	6761	7	30	6784	19	28	6807	1	28	6830	1	28	6853	60	2	6876	63	12
6693	7	30	6716	14	30	6739	14	30	6762	7	30	6785	19	28	6808	19	28	6831	1	28	6854	60	2	6877	44	2
6694	7	30	6717	7	30	6740	7	30	6763	14	30	6786	19	28	6809	1	28	6832	1	28	6855	80	2	6878	44	2
6695	7	30	6718	7	30	6741	7	30	6764	14	30	6787	1	28	6810	1	28	6833	60	2	6856	80	2	6879	97	7
6696	14	30	6719	7	30	6742	7	30	6765	7	30	6788	19	28	6811	19	28	6834	60	2	6857	60	2	6880	28	12
6697	14	30	6720	7	30	6743	7	30	6766	7	30	6789	19	28	6812	1	28	6835	60	2	6858	28	12	6881	97	7

Table A-3: (Continue)

Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.	Ward ID.	Assembly District No.	Senate District No.
6882	28	12	6895	62	12	6908	97	7	6921	28	12	6931	28	12	6944	28	12	6957	63	12	6970	28	12			
6883	62	12	6896	62	12	6909	97	7	6922	28	12	6932	28	12	6945	97	7	6958	63	12	6971	44	2			
6884	62	12	6897	62	12	6910	97	7	6923	28	12	6933	28	12	6946	28	12	6959	44	2	6972	63	12			
6885	62	12	6898	62	12	6911	28	12	6924	28	12	6934	63	12	6947	28	12	6960	44	2	6973	44	2			
6886	62	12	6899	62	12	6912	28	12	6925	28	12	6935	63	12	6948	28	12	6961	63	12	6974	44	2			
6887	62	12	6900	62	12	6913	28	12	6926	28	12	6936	28	12	6949	28	12	6962	63	12	6975	44	2			
6888	62	12	6901	62	12	6914	28	12	6927	28	12	6937	28	12	6950	28	12	6963	63	12	6976	44	2			
6889	62	12	6902	62	12	6915	28	12	6921	28	12	6938	28	12	6951	28	12	6964	63	12	6977	28	12			
6890	62	12	6903	62	12	6916	63	12	6922	28	12	6939	63	12	6952	28	12	6965	63	12						
6891	62	12	6904	62	12	6917	28	12	6923	28	12	6940	28	12	6953	28	12	6966	63	12						
6892	97	7	6905	62	12	6918	28	12	6928	97	7	6941	28	12	6954	63	12	6967	63	12						
6893	62	12	6906	62	12	6919	28	12	6929	97	7	6942	28	12	6955	63	12	6968	63	12						
6894	62	12	6907	62	12	6920	28	12	6930	97	7	6943	97	7	6956	63	12	6969	63	12						

Appendix B

This appendix includes important parts of our C++ code – which is over 5000 lines of code – written and executed for the redistricting algorithms in this study. The following lines of the code were used to generate random initial feasible solutions, check districts' contiguity, and to develop SA algorithm as well as defining parts of needed variables, arrays and vectors. These three code sections are common for forming state assembly, state senate, and U.S. Congressional districts.

- Define Some of the variables, arrays, and vectors of the code


```
// type of input arrays

IloInt  i, j, k;
IloInt      noDistricts;
IloNum      Vote;
IloNum      Pbar;
IloNumArray subPop(env);
IloNumArray democrats(env);
IloNumArray2 bLength(env);
IloNumArray amount(env);
IloNumArray area(env);
IloNumArray perimeter(env);
IloNumArray voter(env);
IloNumArray republicans(env);
IloNumArray2 adjacency(env);
IloNumArray corners(env);
IloNumArray black(env);
IloNumArray hispanic(env);
IloNumArray address(env);
IloNumArray senAddress(env);
IloNumArray2 split(env);
//parameters relate to the simulated annealing procedure.
```

```
        const int NUM_ITERATIONS = 50;
        const double TEMP_FACTOR = 0.997; //0.9 //0.99 //0.999 //0.995
        const double START_TEMPERATURE = 0.01; //0.01; //1000 //400 //50 // 300 // 100 //200

    //use a simulated annealing neighborhood search procedure to improve the initial solution.
        double acceptanceProbability;
        double temperature = START_TEMPERATURE;
        double FinalTemp = 0.01; //0.1 // If needed
        long int steps = 0;
        long int iterations = 0;
        bool accept;
        bool reject;
        bool given;
        int noOfGeneration=0;
        int noOfFeasibleSolution=0;
        long int bestIteration = 0;
        long int bestStep = 0;
        double populationDeviation=0.02; //districts' population deviation
        int noInitialGeneration=100; //no. of initial maps
        long int algorithmRunTime=3600;
        int listsizeHP=0; // no. of districts whose population deviation is above defined threshold

    //some new vars (for improving the code performance)
        double firstPenalty00;
        double firstPenaltyCom00;
        int indic=0;
        int iDem;
        int iPh=100;
        double irunTime=0;

    //Vectors for calculating the penalties
        vector < double >  distPop;
        vector < double >  distPerimeter;
        vector < double >  distDem;
        vector < double >  distVote;
        vector < double >  distArea;
        vector < double >  distFPop;
        vector < double >  distFPerimeter;
        vector < double >  distFDem;
        vector < double >  distFVote;
        vector < double >  distFArea;
        vector < double > Penalty;
```

```
vector < double > PenaltyP;
vector < double > PenaltyV;
vector < double > PenaltyCom;
vector < double > PenaltyR;
vector < double > OriginalPenalty;
vector < double > OriginalPenaltyP;
vector < double > OriginalPenaltyV;
vector < double > OriginalPenaltyCom;
vector < double > OriginalPenaltyR;
vector < double > OriginalFPenalty;
vector < double > OriginalFPenaltyP;
vector < double > OriginalFPenaltyV;
vector < double > OriginalFPenaltyCom;
vector < double > OriginalFPenaltyR;

vector < double > assignedMicroadjacency;
vector < int > dependentWards; // to store all dependent wards
vector <vector <int >> accompanyingWards; // to store wards with only one neighbor
vector <vector <int >> splitWards; // to store split wards
vector <vector <int >> neighbors; // to store neighbor wards
vector < double > insideWards; // to store wards inside the other wards
vector < double > myNotContiguousWards;

int Dem; // # of dem seats
int Rep; // # of rep seats
double GapD; // Democrats gap
double GapR; // Republicans gap
double VD=0; // Total Democrats
double VR; // Total Republicans
double TVoter=0; // Total voter

double firstPenalty; // Weighted Normalized total penalty
double firstPenaltyP; // Weighted Normalized total Pop penalty
double firstPenaltyV; // Weighted Normalized total Political fairness penalty
double firstPenaltyCom; // Weighted Normalized total compactness penalty
double firstPenaltyR; // Weighted Normalized total Residential penalty

double OriginalFirstPenalty; // Unweighted Normalized total penalty
double OriginalFirstPenaltyP; //Unweighted Normalized total Pop penalty
double OriginalFirstPenaltyV; // Unweighted Normalized total Political fairness penalty
double OriginalFirstPenaltyCom; // Unweighted Normalized total compactness penalty
double OriginalFirstPenaltyR; // Unweighted Normalized total Residential penalty
```

```
	double beforeNormalFirstPenalty;//Unweighted not Normalized total penalty
	double beforeNormalFirstPop; // Unweighted not Normalized total Pop penalty
	double beforeNormalFirstVote; // Unweighted not Normalized total Political fairness penalty
	double beforeNormalFirstCom; // Unweighted not Normalized total compactness penalty
	double beforeNormalFirstRes; // Unweighted not Normalized total Residential penalty

//2 dim vectors for generating initial districts
	static vector<int> district_seeds;
	vector<vector<int>> district_nodes;

//2 dim vectors for district containts and edges
	vector<vector<int>> corners_nodes;
	vector<vector<int>> district_wards;
	vector<vector<int>> Tempdistrict_wards;
	vector<vector<int>> best_district_wards;

//2 dime vectors for storing the district of each words;
	vector<vector<int>> ward_districts;
	vector<vector<int>> Tempward_districts;

//2 dime vectors for neighbors of final best district
	vector<vector<int>> neighbor_districts;

//vectors for storing districts' population, democrats' votes, area and perimeter
	vector<double> Popvect;
	vector<double> Demvect;
	vector<double> Repvect;
	vector<double> Areavect;
	vector<double> Perivect;
	vector<double> RGapvect;
	vector<double> DGapvect;

//Temporary vectors for storing districts' population, dem votes, area and perimeter
	vector<double> TPopvect;
	vector<double> TDemvect;
	vector<double> TRepvect;
	vector<double> TAreavect;
	vector<double> TPerivect;
	vector<double> TRGapvect;
	vector<double> TDGapvect;
//>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

```
//>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

- Generate random initial solutions:

```
…

int iniGenNumber = 0; // Number of initial districts
double bestbefnormpen = 9999999999999999;
int noInitialGeneration=n; //no of initial maps

// Vectors for mean and standard deviations (population, political fairness and compactness) for 100 initials
vector<double> listOfmeanP , listOfmeanV, listOfmeanVE , listOfmeanC , listOfmeanR , listOfSdP , listOfSdV, listOfSdC,
listOfSdR ,listOfInia ,listOfInib ;

do {
       // part of code for choosing best solutions

...

       //

       iniGenNumber= iniGenNumber+1;

       // put the elements of initial matrix equal zero
       for (i=0; i < numSubs; i++)
              for(j=0; j<noDistricts; j++)
              initial[i][j]=0;

       // -- START: dynamic initialization of districts based on traversing
       district_seeds.clear();
       for (int ii = 0; ii < noDistricts; ii++) {
              //cout << "sub no " << ii;
              vector<int> tmp_vec;
              int tmp_seed;
              do {
                     tmp_seed = rand() % numSubs;
              } while (std::find(district_seeds.begin(), district_seeds.end(), tmp_seed) != district_seeds.end() ||
       splitWards[tmp_seed].size() > 0 || accompanyingWards[tmp_seed].size()>0);
```

```
		district_seeds.push_back(tmp_seed);
		initial[tmp_seed][ii] = 1;
		tmp_vec.push_back(tmp_seed); // create a single-member vector using the new seed
		district_nodes.push_back(tmp_vec); // put the temp vector in the 2D vector
		vector<int>().swap(tmp_vec); // free the temp vector to avoid memory hog
	}

		//cout << "\n\n District_seeds: ";
		for (int i = 0; i < district_nodes.size(); i++)  {
			for (int j = 0; j < district_nodes[i].size(); j++) {
				//cout << district_nodes[i][j] << ", ";
			}
		}

	bool microdists_left;
	do {
		microdists_left = false;
		for (int i = 0; i < district_nodes.size(); i++)  {
			if ( district_nodes[i].size() == 0 ) {
					//cout << "\nDist. " << i << " has run out of bLength to grow.";

				continue; // no free neighbors left to grab, go to next seed
			} else {
					microdists_left = true;
				}
		vector<int> temp_neighbor_candidate;
				for (int k = 0; k < numSubs; k++) {
				// found a neighbor sub?
					if (adjacency[district_nodes[i].back()][k] == 1) {
						//cout << "\n  Neighbor for node " << district_nodes[i].back() << ": node " << k;
				// now is it unclaimed? i is index, *i is sub number
						bool already_taken = false;
						for (int m = 0; m < noDistricts; m++) {
							if (initial[k][m] == 1) {
							// check to see if K is already taking by one of the districts
								//cout << " - already belongs to dist. " << m;
								already_taken = true;
								break;
							}
						}
					if (already_taken == true) {
```

```
                                        continue;
                              } else {
                                        // push back all neighbors of last element of the vector
                                        temp_neighbor_candidate.push_back(k);
                                   }
                         }
               }


               // check to see if the last element of vector did end up having at least one neighbor (above code)?
               if ( temp_neighbor_candidate.size() > 0 ) {
               // if yes, now pick one from the list of available neighbors
                    int chosen_node = temp_neighbor_candidate[ rand() % temp_neighbor_candidate.size() ];
                    // add the neighbor to the district
                    initial[chosen_node][i] = 1;
                    //add the neighbor to single vector that we are using for traverse
                    district_nodes[i].push_back(chosen_node);
                    // also push back any glued wards
                    if(splitWards[chosen_node].size() > 0){
                         for (int j =0; j< splitWards[chosen_node].size(); ++j) {
                              initial[splitWards[chosen_node][j]][i] = 1;
                              district_nodes[i].push_back(splitWards[chosen_node][j]);

                         }
                    }
                    // also push back any inside wards
                    if(accompanyingWards[chosen_node].size() > 0){
                         for (int j =0; j< accompanyingWards[chosen_node].size(); ++j) {
                              initial[accompanyingWards[chosen_node][j]][i] = 1;
                              district_nodes[i].push_back(accompanyingWards[chosen_node][j]);

                         }
                    }

                    //cout << "\nnode " << chosen_node << " now assigned to dist. " << i;
                    //cout << " --  initial[" << chosen_node << "][" << i << "] = 1";
                                                  }
               } else {

                    //cout << "\nnode " << district_nodes[i].back() << " is a dead end! removing from traverse list. " <<
          i;
```

```
                    // if couldn't find a neighbor for last element of vector, delete it
                           district_nodes[i].pop_back();
                    }
             }
      } while (microdists_left == true);

      // some other conditions
      ...
      //
} while (iniGenNumber < noInitialGeneration); // for generating n initials


//>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
//>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

- Check districts' contiguity:


```
…

// Define some vectors

static vector<int> traversed_nodes;
static vector<int> districts_to_check_contiguity;
static vector<int> subs_in_district;
int traverseSubs(int node, IloNumArray2 adjacency);

for (auto i = districts_to_check_contiguity.begin(); i != districts_to_check_contiguity.end(); ++i) {

       subs_in_district.clear();
       traversed_nodes.clear();

       for (auto j = Tempdistrict_wards[*i].begin(); j!= Tempdistrict_wards[*i].end(); ++j) {
                     subs_in_district.push_back(*j);

       }

// start from the first sub and keep traversing nodes recursively
       traverseSubs( subs_in_district[0], adjacency );
       std::sort(traversed_nodes.begin(), traversed_nodes.end());
```

```
        std::sort(subs_in_district.begin(), subs_in_district.end());

            /*
            cout << "traversed_nodes rearranged: ";
            for (auto ii = traversed_nodes.begin(); ii != traversed_nodes.end(); ++ii) {

                    cout << *ii << " ";
            }

            cout << "subs_district rearranged: ";
            for (auto ii = subs_in_district.begin(); ii != subs_in_district.end(); ++ii) {

                cout << *ii << " ";
            }

            */

        if (traversed_nodes == subs_in_district) {

                //cout << " ** District " << *i << " Contiguous **" << endl;
        }
        else {

                //cout << " ** District " << *i << " ** NOT Contiguous! **" << endl;
                reject = true;
                break;
        }
    }


    // Contiguity output
    int traverseSubs(int node, IloNumArray2 boundry)
    {
        if(contiguety_output==true){
            cout << "traverseSubs with node " << node << endl;
        }
        // cout << "traverseSubs with node " << node << endl;
        traversed_nodes.push_back(node);
        if(contiguety_output==true){
            cout << "Current traversed_nodes: ";
            for (auto i = traversed_nodes.begin(); i != traversed_nodes.end(); ++i)
            {
```

```
            std::cout << *i << ' ';
        }
    //  cout << endl;
    }
    for (auto i = subs_in_district.begin(); i != subs_in_district.end(); ++i) {
        // check if initial "node" and "sub i" are neighbors
        if (boundry[node][*i] == 1) {
            // check if sub i is not already traversed
            if(std::find(traversed_nodes.begin(), traversed_nodes.end(), *i) == traversed_nodes.end())
            {
                // not traversed, so add it to the list of traversed nodes and
                // call traverseSubs recursively with sub i
                traverseSubs( *i, boundry );
                if(contiguety_output==true){
                    cout << *i << " added to traversed_nodes" << endl;
                }
            }
            else
            {
                if(contiguety_output==true){
                    cout << *i << " already exists in traversed_nodes" << endl;
                }
            }
        }
    }
    return 0;
}


...

//>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

//>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

- SA algorithm:

…

```
vector<int> MyKK , MyNN, Mygt, Mygg, Mytg, Mytt; // Vectors for the neighbors of giving and taking nodes
vector<int> giving_node_split, taking_node_split; // related to the split wards

while (runTime < algorithmRunTime) // we can eliminate this loop to be solved without time limit

       while (iterations < NUM_ITERATIONS) //Add \ another loop to
       {
              do {
                     districts_to_check_contiguity.clear();
                     other_contiguity_check.clear();
                     noOfGeneration=noOfGeneration+1;
                     int q;
                     MyKK.clear();
                     MyNN.clear();
                     Mygg.clear();
                     Mygt.clear();
                     Mytg.clear();
                     Mytt.clear();
                     giving_node_split.clear();
                     taking_node_split.clear();


                     int r= rand()%10;
                     if (listsizeHP >= 80) {
                            if (r>5){
                                   giving_district = HighPopNodes[rand() % listsizeHP];
                            }
                            else{
                                   giving_district = rand() % noDistricts;
                            }
                     }
                     else {
                            giving_district = rand() % noDistricts;
                     }

                     giving_node=corners_nodes[giving_district][rand() % corners_nodes[giving_district].size()];
                     inside=-1;
```

```
			spl t=-1;

			if (Popvect[giving_district] > Pbar){
				if(accompanyingWards[giving_node].size()>0){
					giving_node_inside=accompanyingWards[giving_node][0];
					inside=1;
				}
				if(splitWards[giving_node].size()>0){
					for (auto i = splitWards[giving_node].begin(); i != splitWards[giving_node].end(); ++i) {
						giving_node_split.push_back(*i);
					}
					splt=1;
				}
			}
			if (splt==1){
				for (auto i = giving_node_split.begin(); i != giving_node_split.end(); ++i) {
					other_contiguity_check.push_back(ward_districts[*i][0]);
				//giveSpltDist.push_back(ward_districts[*i][0]);
				}
			}

			for (auto i = neighbors[giving_node].begin(); i!= neighbors[giving_node].end(); ++i) {
				if(std::find(district_wards[giving_district].begin(), district_wards[giving_district].end(), *i)
== district_wards[giving_district].end() ){

					MyKK.push_back(*i);
				}
				else{
					continue;
				}
			}
			if (splt==1){
				for (auto k = giving_node_split.begin(); k!= giving_node_split.end(); ++k)
					for (auto i = neighbors[*k].begin(); i!= neighbors[*k].end(); ++i) {
						if(std::find(district_wards[ward_districts[*k][0]].begin(),
district_wards[ward_districts[*k][0]].end(), *i) == district_wards[ward_districts[*k][0]].end() &&
ward_districts[*i][0]!=giving_district ){
						MyKK.push_back(*i);

						}
						else{
							continue;
```

```
                    }
                }

            }
        }

        std::sort(MyKK.begin(), MyKK.end());
        MyKK.erase(std::unique(MyKK.begin(), MyKK.end()), MyKK.end());

        taking_node = MyKK[rand() % (MyKK.size())];
        taking_district=ward_districts[taking_node][0];

        if (Popvect[giving_district] <= Pbar){
            if(accompanyingWards[taking_node].size()>0){
                taking_node_inside=accompanyingWards[taking_node][0];
                inside=2;
            }

                                        //*
            if(splitWards[taking_node].size()>0){
                for (auto i = splitWards[taking_node].begin(); i != splitWards[taking_node].end(); ++i) {
                    taking_node_split.push_back(*i);

                }
                splt=2;
            }
        }

        std::sort(giving_node_split.begin(), giving_node_split.end());
        giving_node_split.erase(std::unique(giving_node_split.begin(), giving_node_split.end()),
    giving_node_split.end());
        std::sort(taking_node_split.begin(), taking_node_split.end());
        taking_node_split.erase(std::unique(taking_node_split.begin(), taking_node_split.end()),
    taking_node_split.end());

        if (splt==1){
        giving_node_split.erase(std::remove(begin(giving_node_split), end(giving_node_split), taking_node),
    end(giving_node_split));
        }
        if (splt==2){
        taking_node_split.erase(std::remove(begin(taking_node_split), end(taking_node_split), giving_node),
    end(taking_node_split));
```

```
		}

		if (splt==2){
			for (auto i = taking_node_split.begin(); i != taking_node_split.end(); ++i) {
				other_contiguity_check.push_back(ward_districts[*i][0]);
				//takeSpltDist.push_back(ward_districts[*i][0]);
			}
		}
		if (splt!=-1 && other_contiguity_check.size()>0){
			for (auto i = other_contiguity_check.begin(); i!= other_contiguity_check.end(); ++i) {
				districts_to_check_contiguity.push_back(*i);
			}
		}
		districts_to_check_contiguity.push_back(taking_district);
		districts_to_check_contiguity.push_back(giving_district);
		std::sort(districts_to_check_contiguity.begin(), districts_to_check_contiguity.end());
		districts_to_check_contiguity.erase(std::unique(districts_to_check_contiguity.begin(),
	districts_to_check_contiguity.end()), districts_to_check_contiguity.end());

		if (Popvect[giving_district] > Pbar){
			given=true;
		cout << "district [" << giving_district <<"] gives node ["<<giving_node <<"] to district ["<<
	taking_district <<"]" << endl;
			// add the giving node to taking district
			Tempdistrict_wards[taking_district].push_back(giving_node);
			// remove giving node from giving district
			Tempdistrict_wards[giving_district].erase(std::remove(begin(Tempdistrict_wards[giving_district])
			, end(Tempdistrict_wards[giving_district]), giving_node),
			end(Tempdistrict_wards[giving_district]));
			if (inside==1){
				// add the giving node to taking district
				Tempdistrict_wards[taking_district].push_back(giving_node_inside);
				// remove giving node from giving district
				Tempdistrict_wards[giving_district].erase(std::remove(begin(Tempdistrict_wards[giving_dis
			trict]), end(Tempdistrict_wards[giving_district]), giving_node_inside),
			end(Tempdistrict_wards[giving_district]));
			}
			if (splt==1){
				for (auto i = giving_node_split.begin(); i != giving_node_split.end(); ++i) {
				// remove giving node from giving district
```

```
			Tempdistrict_wards[ward_districts[*i][0]].erase(std::remove(begin(Tempdistrict_wards[ward
		_districts[*i][0]]), end(Tempdistrict_wards[ward_districts[*i][0]]), *i),
		end(Tempdistrict_wards[ward_districts[*i][0]]));
		// add the giving node to taking district
			Tempdistrict_wards[taking_district].push_back(*i);
			}
		}
		// find the neighbor of the giving node and giving dist. and giving node and taking dist.
		for (auto i = district_wards[giving_district].begin(); i !=
	district_wards[giving_district].end(); ++i) {
			if ( adjacency [*i][giving_node] == 1) {
				Mygg.push_back(*i);
			}
		}
		for (auto i = district_wards[taking_district].begin(); i !=
	district_wards[taking_district].end(); ++i) {
			if (adjacency [*i][giving_node] == 1) {
				Mygt.push_back(*i);
			}
		}
		if (splt==1){
							//*
			for (auto k = giving_node_split.begin(); k!= giving_node_split.end(); ++k) {
				for (auto i = district_wards[ward_districts[*k][0]].begin(); i !=
			district_wards[ward_districts[*k][0]].end(); ++i) {
					if (adjacency [*i][*k] == 1) {
						Mygg.push_back(*i);
					}
				}
			}
			for (auto i = district_wards[taking_district].begin(); i!=
		district_wards[taking_district].end(); ++i)
				for (auto k = giving_node_split.begin(); k!= giving_node_split.end(); ++k) {
					if ( adjacency [*k][*i] == 1) {
						Mygt.push_back(*i);
				}
			}
		}
	}

	else{
		given=false;
```

```
        cout << "district ["<<taking_district<<"] gives node ["<<taking_node<<"] to district
["<<giving_district <<"]"<< endl;

        //add the taking node to the low pop district
        Tempdistrict_wards[giving_district].push_back(taking_node);
        //remove the taking node from high pop district
        Tempdistrict_wards[taking_district].erase(std::remove(begin(Tempdistrict_wards[taking_district])
, end(Tempdistrict_wards[taking_district]), taking_node), end(Tempdistrict_wards[taking_district]));

        if (inside==2){
                //add the taking node to the low pop district
                Tempdistrict_wards[giving_district].push_back(taking_node_inside);
                //remove the taking node from high pop district
                Tempdistrict_wards[taking_district].erase(std::remove(begin(Tempdistrict_wards[taking_dis
        trict]), end(Tempdistrict_wards[taking_district]), taking_node_inside),
        end(Tempdistrict_wards[taking_district]));
        }
        if (splt==2){
                for (auto i = taking_node_split.begin(); i != taking_node_split.end(); ++i) {
                        //remove the taking node from high pop district
                        Tempdistrict_wards[ward_districts[*i][0]].erase(std::remove(begin(Tempdistrict_war
                ds[ward_districts[*i][0]]), end(Tempdistrict_wards[ward_districts[*i][0]]), *i),
                end(Tempdistrict_wards[ward_districts[*i][0]]));
                        //add the taking node to the low pop district
                        Tempdistrict_wards[giving_district].push_back(*i);
                }
        }

        // find the neighbor of the taking node and giving dist. and giving node and taking dist.
        for (auto i = district_wards[giving_district].begin(); i !=
district_wards[giving_district].end(); ++i) {
                if ( adjacency [*i][taking_node] == 1) {
                        Mytg.push_back(*i);
                }
        }
        for (auto i = district_wards[taking_district].begin(); i !=
district_wards[taking_district].end(); ++i) {
                if ( adjacency [*i][taking_node] == 1) {
                        Mytt.push_back(*i);
                }
        }
        if (splt==2){
```

```
                        for (auto k = taking_node_split.begin(); k!= taking_node_split.end(); ++k) {
                            for (auto i = district_wards[ward_districts[*k][0]].begin(); i !=
                        district_wards[ward_districts[*k][0]].end(); ++i) {
                                if ( adjacency [*i][*k] == 1) {
                                    Mytt.push_back(*i);
                                }
                            }
                        }
                        for (auto i = district_wards[giving_district].begin(); i!=
                    district_wards[giving_district].end(); ++i)
                            for (auto k = taking_node_split.begin(); k!= taking_node_split.end(); ++k) {
                                if ( adjacency [*k][*i] == 1) {
                                    Mytg.push_back(*i);
                                }
                            }
                        }
                }

// Time to check contiguity


    ...

//

// Evaluating objective value for the neighboring feasible solution just created *
/////////////////////////////////////////////////////////////////////////////////////////////////////////////

// we need to update all the penalties
//this part of code is for updating the penalty of new neighbor solution



    ...


////////////////////////////////////////////////////////////////////////////////////////////////////////////

                if (objValDifference >= 0 || listsizeHP > iPh)  //we can change the condition
                    {
```

```
        acceptanceProbability = exp((-1.00*objValDifference)/temperature);
        cout << "\t" << "Candidate state's objective value is WORSE by " << objValDifference <<
endl;
        cout << "\t" << "The move to candidate state will be accepted with probability " <<
acceptanceProbability << endl;
double randNum=(static_cast<double>(rand()))/(RAND_MAX+1);
cout << "\t" << "Random number generated is " << randNum;

        if (randNum < acceptanceProbability)
                {
                        cout << "\t\t\t" << "Candidate is accepted." << endl;
                        accept = true;
                        steps++;
                }
        els{
                cout << "\t\t\t" << "Candidate is rejected." << endl;
                accept = false;
                for (auto i = districts_to_check_contiguity.begin(); i !=
        districts_to_check_contiguity.end(); ++i) {

                                        TDemvect[*i]= Demvect[*i];
                                        TRepvect[*i]= Repvect[*i];
                                        TPopvect[*i]= Popvect[*i];
                                        TAreavect[*i] = Areavect[*i];
                                        TPerivect[*i] = Perivect[*i];
                                        Tempdistrict_wards[*i]=district_wards[*i];
                        }

                }
        }
        else{
                cout << "\t" << "Candidate's objective value is BETTER by " << (-
        1.00)*(objValDifference) << ", so candidate is automatically accepted." << endl;
                }
                accept = true;
                steps++;

                if (accept == true)
                {

                        firstPenalty = nextDistPenalty;
                        firstPenaltyP = nextDistPenaltyP;
```

```
        firstPenaltyV = nextDistPenaltyV;
        firstPenaltyCom = nextDistPenaltyCom;
        firstPenaltyR = nextDistPenaltyR;

        OriginalFirstPenalty = OriginalNextDistPenalty ;
        OriginalFirstPenaltyP = OriginalNextDistPenaltyP ;
        OriginalFirstPenaltyV = OriginalNextDistPenaltyV;
        OriginalFirstPenaltyCom = OriginalNextDistPenaltyCom;
        OriginalFirstPenaltyR = OriginalNextDistPenaltyR;

        beforeNormalFirstPop=beforeNormalPop ;
        beforeNormalFirstVote=beforeNormalVote;
        beforeNormalFirstCom=beforeNormalCom;
        beforeNormalFirstRes= beforeNormalRes;


        for (auto i = districts_to_check_contiguity.begin(); i !=
districts_to_check_contiguity.end(); ++i) {
                Demvect[*i]= TDemvect[*i];

                Repvect[*i]= TRepvect[*i];

                Popvect[*i]= TPopvect[*i];

                Areavect[*i] = TAreavect[*i];

                Perivect[*i] = TPerivect[*i];

                // Update the contained wards inside the giving and taking districts

                district_wards[*i]=Tempdistrict_wards[*i];
        }

        for (auto i = districts_to_check_contiguity.begin(); i !=
districts_to_check_contiguity.end(); ++i) {
                distFPop[*i] = distPop[*i];
                distFDem[*i] = distDem[*i];
                distFPerimeter[*i]=distPerimeter[*i];
                distFArea[*i]= distArea[*i];
                OriginalFPenaltyP[*i]= OriginalPenaltyP[*i];
                OriginalFPenaltyV[*i]=OriginalPenaltyV[*i];
                OriginalFPenaltyCom[*i]=OriginalPenaltyCom[*i];
```

```
        OriginalFPenaltyR[*i]=OriginalPenaltyR[*i];
}


vector < double >  myTempCorner;
//update the edges of district
//*
if (given==true) {
//add the neighbors of the giving node to the edge of the giving district if they aren't already on the edges
        for (auto i=district_wards[giving_district].begin() ; i !=
district_wards[giving_district].end() ; i++) {
                if (adjacency [*i][giving_node]==1) {
                        if(std::find(corners_nodes[giving_district].begin(),
                corners_nodes[giving_district].end(), *i) ==
                corners_nodes[giving_district].end()){
                                corners_nodes[giving_district].push_back(*i);
                        }
                }
        }

        if (splt==1){
                for (auto k = giving_node_split.begin(); k!=
        giving_node_split.end(); ++k) {
                        for (auto i = neighbors[*k].begin(); i!=
                neighbors[*k].end(); ++i) {
                                if(std::find(giving_node_split.begin(),
                        giving_node_split.end(), *i) ==
                        giving_node_split.end()){
                                        if
                                (ward_districts[*k][0]==ward_districts[*i][0] &&
                                ward_districts[*k][0]!=taking_district
                                                if(std::find(corners_nodes[ward_di
                                        stricts[*k][0]].begin(),
                                        corners_nodes[ward_districts[*k][0]].end(
                                        ), *i) ==
                                        corners_nodes[ward_districts[*k][0]].end(
                                        )){
                                                corners_nodes[ward_districts[*k][0
                                        ]].push_back(*i);
                                                }
                                        }
                                }
```

```
                        }
                }
        }

//erase giving node from giving district edge

        corners_nodes[giving_district].erase(std::remove(begin(corners_nodes
[giving_district]), end(corners_nodes[giving_district]), giving_node),
end(corners_nodes[giving_district]));
                if (splt==1){
                        for (auto k = giving_node_split.begin(); k!=
                giving_node_split.end(); ++k) {
                                if(ward_districts[*k][0]!=taking_district){
                                        corners_nodes[ward_districts[*k][0]].eras
                                e(std::remove(begin(corners_nodes[
                                ward_districts[*k][0]]), end(corners_nodes[
                                ward_districts[*k][0]]), *k), end(corners_nodes[
                                ward_districts[*k][0]]));
                        }
                }
        }

//update the assigned district to each ward

        ward_districts[giving_node][0]=taking_district;
        if(inside==1){
                ward_districts[giving_node_inside][0]=taking_district;
        }

        if (splt==1){
                for (auto k = giving_node_split.begin(); k!=
        giving_node_split.end(); ++k) {
                         ward_districts[*k][0]=taking_district;
                }
        }


//add giving node to taking district's edge

        corners_nodes[taking_district].push_back(giving_node);
        if (splt==1){
                for (auto k = giving_node_split.begin(); k!=
        giving_node_split.end(); ++k) {
                        if(ward_districts[*k][0]!=taking_district){
```

```
                        corners_nodes[taking_district].push_back(*k);
                    }
                }
            }

//update the edges of taking district
            myTempCorner.clear();
            for (auto i=corners_nodes[taking_district].begin() ; i !=
corners_nodes[taking_district].end() ; i++) {
                if (adjacency [*i][giving_node]==1) {
                    myTempCorner.push_back(*i);
                }

                if (splt==1){
                    for (auto k = giving_node_split.begin(); k!=
                    giving_node_split.end(); ++k) {
                        if (adjacency [*i][*k]==1) {
                            myTempCorner.push_back(*i);
                        }

                    }
                }
            }
            sort(myTempCorner.begin(), myTempCorner.end());
            myTempCorner.erase(std::unique(myTempCorner.begin(),
myTempCorner.end()),myTempCorner.end());

            int u;
            for (auto j=myTempCorner.begin(); j!=myTempCorner.end(); j++ ){
                u=-1;
                for (int i=0 ; i < corners_nodes.size() ; i++) {
                    for (int k=0 ; k < corners_nodes[i].size() ; k++) {
                        if(i!= taking_district ){
                            if (adjacency
                        [*j][corners_nodes[i][k]]==1){
                                u=0;
                                break
                            }

                        }
                        else{
```

```
                                                                break;
                                                        }
                                                }
                                                if (u==0) {
                                                        break;
                                                }
                                        }
                                        if (u==-1) {
                                                corners_nodes[taking_district].erase(std::remove(begin(
                                        corners_nodes[taking_district]),
                                        end(corners_nodes[taking_district]), *j),
                                        end(corners_nodes[taking_district]));
                                        }
                                }

                        }
                        else {

//add the neighbors of the taking node to the edge of taking district
                                for (auto i=district_wards[taking_district].begin() ; i !=
                        district_wards[taking_district].end() ; i++) {
                                        if (adjacency [*i][taking_node]==1){
                                                if (std::find(corners_nodes[taking_district].begin(),
                                        corners_nodes[taking_district].end(), *i) ==
                                        corners_nodes[taking_district].end()) {
                                                        corners_nodes[taking_district].push_back(*i);
                                                }
                                        }
                                }

                                        if (splt==2){
                                                for (auto k = taking_node_split.begin(); k!=
                                        taking_node_split.end(); ++k) {
                                                for (auto i = neighbors[*k].begin(); i!=
                                        neighbors[*k].end(); ++i) {
                                                        if(std::find(taking_node_split.begin(),
                                                taking_node_split.end(), *i) ==
                                                taking_node_split.end()){
                                                        if (ward_districts[*k][0]==ward_districts[*i][0]
                                                && ward_districts[*k][0]!=giving_district){
                                                                if(std::find(corners_nodes[ward_districts
                                                        [*k][0]].begin(),
```

```
                        corners_nodes[ward_districts[*k][0]].end(), *i)
                        == corners_nodes[ward_districts[*k][0]].end()){
                                corners_nodes[ward_districts[*k][0
                        ]].push_back(*i);

                                }
                        }
                    }
                }
            }
        }

//erase taking node from taking district

        corners_nodes[taking_district].erase(std::remove(begin(corners
_nodes[taking_district]), end(corners_nodes[taking_district]),
taking_node), end(corners_nodes[taking_district]));

        if (splt==2){
                for (auto k = taking_node_split.begin(); k!=
        taking_node_split.end(); ++k) {
                        if(ward_districts[*k][0]!=giving_district){
                                corners_nodes[
                        ward_districts[*k][0]].erase(std::remove(begin(c
                        orners_nodes[ ward_districts[*k][0]]),
                        end(corners_nodes[ ward_districts[*k][0]]), *k),
                        end(corners_nodes[ ward_districts[*k][0]]));
                }
        }
}

// first update the assigned district to each ward

ward_districts[taking_node][0]=giving_district;
        if(inside==2){
                ward_districts[taking_node_inside][0]=giving_district;
        }
        if (splt==2){
        for (auto k = taking_node_split.begin(); k!=
taking_node_split.end(); ++k) {
                 ward_districts[*k][0]=giving_district;
        }
}

//add taking node to giving district' edge
```

```
		corners_nodes[giving_district].push_back(taking_node);
		if (splt==2){
			for (auto k = taking_node_split.begin(); k!=
		taking_node_split.end(); ++k) {
				if(ward_districts[*k][0]!=giving_district){
					corners_nodes[giving_district].push_back(*k);
				}
			}
		}


	//update the edges of giving district
		myTempCorner.clear();
		for (auto i=corners_nodes[giving_district].begin() ; i !=
	corners_nodes[giving_district].end() ; i++) {
			if ( adjacency [*i][taking_node]==1 ) {
				myTempCorner.push_back(*i);
			}

			if (splt==2){
				for (auto k = taking_node_split.begin(); k!=
			taking_node_split.end(); ++k) {
					if (adjacency [*i][*k]==1) {
						myTempCorner.push_back(*i);
					}

				}
			}
		}
		sort( myTempCorner.begin(), myTempCorner.end());
		myTempCorner.erase(std::unique(myTempCorner.begin(),
	myTempCorner.end()),myTempCorner.end());
		int u;
		for (auto j=myTempCorner.begin(); j!=myTempCorner.end(); j++ ){
			u=-1;
			for (int i=0 ; i < corners_nodes.size() ; i++) {
				for (int k=0 ; k < corners_nodes[i].size() ; k++) {
					if(i!= giving_district ){
						if (adjacency
					[*j][corners_nodes[i][k]]==1){
							u=0;
							break;
```

```
                                                                        }
                                                                }
                                                                else{
                                                                        break;
                                                                }
                                                        }
                                                        if (u==0) {
                                                                break;
                                                        }
                                                }
                                                if (u==-1) {
                                                        corners_nodes[giving_district].erase(std::remove(begin(
                                                corners_nodes[giving_district]),
                                                end(corners_nodes[giving_district]), *j),
                                                end(corners_nodes[giving_district]));
                                                }
                                        }
                                }
// Recalculate the number of the districts whose population deviation is over the defined threshold
                HighPopNodes.clear();
                HighPop.clear();
                LowPopNodes.clear();

                for (int i = 0; i <noDistricts ; i++){
                        if (abs(Popvect[i]-Pbar)/Pbar >= populationDeviation){
                                HighPopNodes.push_back(i);
                                HighPop.push_back(abs(Popvect[i]-Pbar)/Pbar);
                        }
                }

                listsizeHP = HighPopNodes.size();

        }
        iterations++;
                //Compare the current set of districts (after "iterations" and "steps" are taking) to the best set.  If
        current districts better, set best district = current districts.
                // based on the situation we can change the conditions
                //if (firstPenalty < bestDistPenalty)
                //if (firstPenaltyV < bestDistPenaltyV)
                //if ((listsizeHP==0) || (listsizeHP!=0 && firstPenalty < bestDistPenalty ))
                //if ((listsizeHP==0 ) || (listsizeHP!=0 && listsizeHP < iPh ))
```

```
		if ((listsizeHP < iPh) || (listsizeHP==0 && Dem >= iDem ) ||(listsizeHP==0 && firstPenalty < bestDistPenalty
		)){
			bestIteration = iterations;
			bestStep = steps;
			iDem=Dem;
			iPh=listsizeHP;
			best_district_wards.clear();
			best_district_wards.resize(noDistricts);
			for (int i=0 ; i < district_wards.size(); i++){
				for (int j=0 ; j < district_wards[i].size(); j++){
						best_district_wards[i].push_back(district_wards[i][j]);
				}
			}

			bestDistPenalty = firstPenalty;
			bestDistPenaltyP = firstPenaltyP;
			bestDistPenaltyV = firstPenaltyV;
			bestDistPenaltyCom = firstPenaltyCom;
			bestDistPenaltyR = firstPenaltyR;

			OriginalBestDistPenalty = OriginalFirstPenalty;
			OriginalBestDistPenaltyP = OriginalFirstPenaltyP;
			OriginalBestDistPenaltyV = OriginalFirstPenaltyV;
			OriginalBestDistPenaltyCom = OriginalFirstPenaltyCom;
			OriginalBestDistPenaltyR = OriginalFirstPenaltyR;
			bestBeforeNormalPenalty = beforeNormalFirstPop + beforeNormalFirstVote+
		beforeNormalFirstCom+beforeNormalFirstRes;
			bestBeforeNormalP = beforeNormalFirstPop;
			bestBeforeNormalV = beforeNormalFirstVote;
			bestBeforeNormalCom = beforeNormalFirstCom;
			bestBeforeNormalR = beforeNormalFirstRes;
			bestTime = time(NULL) - startTime;
		}

		if (Dem ==d && Rep==r && listsizeHP==0){
		//if (accept==true && listsizeHP==0){
			break;
		}
	} //while (iterations < NUM_ITERATIONS)

	iterations=0;
	temperature*=TEMP_FACTOR;
```

```
        //if (accept == true&& listsizeHP==0){
        if (Dem ==49 && Rep==50 && listsizeHP==0){
                break;
        }
    }//while (runTime <  .... )



        ...
```

Curriculum Vitae

Roya Ghorashi University of Wisconsin-Milwaukee, Milwaukee, WI 53211

EDUCATION

- **Doctor of Philosophy in Industrial and Manufacturing Engineering**
  University of Wisconsin- Milwaukee | Milwaukee, WI (GPA: 3.91); Sep 2014 - Dec 2020
- **Master of Science in Industrial Engineering**
  Payam Nour University of Tehran (PNU) | Tehran, Iran; Sep 2007 - Feb 2011
- **Bachelor of Science in Industrial Engineering**
  Iran University of Science and Technology | Tehran, Iran; Sep 2001 - Dec 2005

PUBLICATIONS

Journal publications

- Journal of Multidisciplinary Engineering Science and Technology- March 2016, USA; "Manufacturing Site Selection in a Global Environment: A New Approach Based on Cluster Analysis" R. Ghorashi M. Mardikoraeim, H.K. Seifoddini.
- "Practical and Efficient Efficiency Gap" R. Ghorashi, H. K. Seifoddini, and W. Otieno. (Manuscript under preparation)
- "Math Models and Heuristic Methods for Constructing Fair Political Districts; Case study: State of Wisconsin " R. Ghorashi H. K. Seifoddini, and W. Otieno. (Manuscript under preparation)

Conference publications

- Informs Annual Meeting -Nov 2018, Phoenix, AZ, USA; "Math Models and Heuristic Methods for Constructing Fair Political Districts"
- Informs Annual Meeting -Oct 2017, Houston, TX, USA; "Storage location assignment for rectangular items beneath a gantry crane"
- International Conference on Green Manufacturing Engineering - Apr 2015-Boston, USA; "Manufacturing Facility Location Selection: A Numerical Taxonomy Approach"
- 2nd International Conference on Disaster Management and Human Health: Reducing Risk, Improving Outcomes-May.2011-Orlando- USA; "Application of a Fuzzy Inventory Control Method in the case of Natural Disasters"
- 7th International Industrial Engineering Conference IUT- Oct 2010- Isfahan- Iran; "Submission of a Fuzzy Inventory Control Method in Natural Disasters"

RESEARCH ACTIVITIES

- Designed MIP model and applied Genetic algorithm (GA) to assign optimal locations for rectangular items in warehouses using C++ and CPLEX in cooperation with my advisor
- Collected, cleaned up and manipulated political and geographical data of the State of Wisconsin using QGIS, ArcGIS, R programming and Python
- Wrote Math Models and developed Simulated Annealing algorithm (SA) for constructing fair political districts
- Coded and executed proposed redistricting algorithm using C++ and CPLEX
- Constructed Wisconsin's fair U.S. Congressional, State Assembly and State Senate districts
- Employed cluster analysis to classify countries according to attributes impacting the suitability of a location for manufacturing operations and presented a new approach to manufacturing site selection in a global context
- Implemented machine learning techniques such as XGBoost, LightGBM, Logistic Regression, and Random Forest using both R programming and Python on Porto Seguro's Safe Driver Prediction project in a collaborative effort during Kaggle competition
- Implemented machine learning techniques such as Gradient Boosting and Random Forest in Python on "Home Price Prediction" using data from Kaggle

TEACHING EXPERIENCE

- Instructor (Lean Manufacturing Systems), Spring 2016; University of Wisconsin-Milwaukee, Milwaukee, WI
- Graduate Teaching Assistant (Statistics using Minitab and Microsoft Excel, Engineering Economic Analysis and Introduction to Engineering), Sep 2014 - Dec 2019; University of Wisconsin-Milwaukee, Milwaukee, WI
- Adjunct Professor (Value Engineering and Application of some software in Industrial Engineering) Sep 2012 - Aug 2014; Payame Noor University of Tehran,Tehran, Iran
- Teacher (Mathematics and Statistics) | Sep 2006 - Sep 2007; Azad University-Sama Institute, Guilan, Iran

INDUSTRY WORK EXPERIENCE

- **Data Scientist Intern | Komatsu Mining Corp.** | Milwaukee, WI | Jun 2019 - Dec 2019
- **Enterprise Performance Assessment Intern | Elutions Inc.** | Delafield, WI | May 2017- Aug 2017
- **System Support Expert and Data Analyst | National Iranian Gas Company (NIGC)** | Tehran, Iran | May 2008 - Aug 2014