Retail Location Analysis:
A Case Study of Burger King & McDonald's in Portage & Summit Counties, Ohio

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Chapter 1

Introduction

There has been a growing interest among the academia and the private sector for the use of GIS techniques in the analysis and planning of retail store network. Almost without exceptions, various retail organizations need to plan for complex consumer markets and keep up with competitions. Over the past few decades the methodologies used for research of sighting of retail outlets have become more sophisticated as a result of applicable modeling procedures being developed with GIS. This study conducts a retail location analysis of the relationship between the fast-food store performance of McDonald's and Burger King and the various spatial and socio-economic factors of their respective catchment areas.

Analytical procedures in GIS and statistical techniques have been applied to carry out the analysis in this study. In particular, study areas have been partitioned into a set of Thiessen polygons and into various spatial configurations using variable buffer polygons to emulate various spatial configurations of catchment areas (i.e., trade areas) associated with each fast food store. The socio-economic profiles in the partitioned polygons have been analyzed with a series of regression models. The result of the study brought out a better understanding of how location factors influence the performance of the stores as well as how the socio-economic attributes of the catchment areas affect the store revenues.

1.1 Research Objectives:

The main objective of this retail location analysis is to develop and apply methodology for analyzing the relationship between fast food store performance and the various socio-economic and demographic factors with various spatial configurations of their catchment areas in Portage and Summit Counties.

The traditional role of GIS in retail demand-and-supply analysis has been to analyze market characteristics such as consumer demand, geodemographics, traffic flow, competitor locations, *etc.* and to search for an optimal location for a new retail outlet or to close retail outlets in over crowded markets. Knowing the geographical distributions of retail demand and supply is important in conducting marketing analysis using GIS analytical tools. GIS can overlay different data sets onto one another in an integrated environment. GIS analytical tools have been widely applied for exploring the relationships between demand and supply in many types of business practices, including operations of fast food restaurants.

However, perhaps due to relatively low real estate costs and flexible rentals or perhaps due to the all too often time lag in adopting newly emerging technology, many retailers do not make use of sophisticated location analysis methods that are now available. Many a times, retailers follow the location decisions previously made by anchor retailers. The choice of a store location has a profound effect on the entire business of a retail operation. For picking an optimal store-site, it is necessary to utilize data of the demographics of that area (income, family size, age, ethnic composition, etc of the population), traffic patterns, and similar kind of retail outlets or competition in the area. These factors are basic to all retail location analysis. GIS tools can help to find the right site along with market penetration, market share and trade areas by combining aerial photos/maps, competitors' locations, geodemographic factors, customer surveys and census data.

GIS market analysis tools can also help to determine whether the products match the lifestyle and buying patterns of the customers. In this study- *Retail Location Analysis*: *A Case Study of Burger King & McDonald's in Portage & Summit Counties, Ohio*, an analysis of catchment areas of the analyzed restaurants has been done using a series of regression models to analyze socio-economic and demographic factors in various spatial configurations of the study area. The study area has been partitioned to a set of Thiessen Polygons and also to sets of spatial configurations by using different buffering zones surrounding the retail outlets to create different proximity polygons for further analysis.

Thiessen polygons define individual areas of influence around each service center, or in this case each fast food restaurant, in a set of points/locations of fast food outlets geocoded in such a way that any locations within a Thiessen polygon are closer to the polygon's centroid (the retail outlet used to make up the polygon) than to any other retail outlet. Buffer polygons have been constructed around the fast food locations based on various assumptions of how far the distances consumers may be willing to travel to receive fast food services.

With the various spatial configurations of Thiessen polygons and buffer polygons as defined by the locations of retail outlets, regression models have been constructed to examine the importance of a set of selected socio-economic and geodemographic factors. The different regression models that use different independent variables as structured by both the Thiessen polygons and Buffer polygons have been done to see how well or poorly either of the two approaches capture the variations in the sales volumes of fast food stores.

In today's world of highly competitive market environment, it has become imperative that retailers must make use of spatial analytical technology to acquire new clientele, retain the existing/current customers, to enable market expansion, and to stay abreast with changing consumer tastes and requirements. Advances in GIS technology reiterates the fact that the future success of retail, real estate and restaurants will be determined to get a great extend by using this smart technology.

1.2 Summary:

Many successful businesses in the United States make use of GIS software to integrate, view and analyze data using geography. Use of GIS techniques enables retailers to understand and visualize spatial relationships and improves productivity and effectiveness of the business processes. The use of multiple regressions modeling in this study has been done to identify how the ethnic composition of population and median household income in the service areas of Burger King and McDonald’s restaurants interact with one another to produce a specific sales outcome.

Chapter 2

Problem Statements

Retail location analysis is an important part in site selection of a retail store. "A trade area of a retail store is the geographical area from which it draws most of its customers and within which its market penetration is the highest"(Ghosh and McLafferty, 1987). Retail location analysis also helps to determine the focus areas for marketing promotional activities, highlights geographic weaknesses in the customer base and projecting future growth and expansion of the retail services (Berman and Evans, 2001).

2.1 Size and Shape of the Retail Trade Area:

The size of the retail trade area often depends on the nature of goods and services rendered at the retail outlets, along with the geographical distribution of other competing retail outlets. For instance, fast food restaurants like Burger King and McDonald's sell goods and services that are popular, easily substituted and affordable by the majority of consumers create a smaller retail trade zone as compared to a specialty restaurant.

Usually, retail trade zones are not geometrically regular, i.e., a circle, a square or a polygon. Rather, the shape of the trade zone is based on road networks, geology and topography of the area, land use of the neighboring areas, etc.

When examining the way customers travel to make retail purchases, it is always necessary to take into consideration the distance that a customer has to travel. The distances that customers may be willing to travel are different, depending upon the type of object to be purchased. The number of trips undertaken by consumers and the travel time will be different based on specialty or commodity product (Salvaneschi, 1996). For purchasing a specialty product, which is generally expensive, unique or long lasting, the consumer is willing to travel over a longer distance. This tends to expand the trading area of that good or service. On the other hand, to purchase everyday supplies or common items consumers often prefer convenience, as the trips for such goods are frequent, distances are short and travel time is brief. For instance, people typically will not drive to another town for fast food, unless they are on way to or back from other destinations.

According to consumer behavior studies the time availability of consumers is an important variable in the convenience and fast food market. Therefore, it should be an important part of market strategy (Darian and Cohen, 1995). In this thesis research, the study area is partitioned into polygons representing trade areas for further analysis. Several different approaches to creating trade areas are used. These include trade areas defined as buffer polygons surrounding fast food restaurants with widths of 1, 2 and 5 miles. In addition, partitioning the study area into a set of collectively inclusive but mutually exclusive Thiessen polygons with the restaurants as polygon centroid also generates trade areas.

Generating buffers around features is a commonly used analytical procedure in GIS. Most buffering methods create simple-distance bound geometric buffers around the features. Buffers surrounding retail outlets(or other service-rendering establishments) are also known as service areas, hinterlands or market areas and have useful in many geographical applications (Shaw, 1991; Sierra et al., 1999; Van Wee et al., 2001). A buffer delineates the area within a specified distance of a feature. It can be created from points, lines or polygons. The output buffers may be lines or polygons depending upon the features and their distance are specified in map units (Price, 2004).

Concentric buffers represent the delineation of multiple levels of proximity. For example, different distances of 1 mile, 2 miles and 5 miles from the store can be used to generate buffer polygons around retail outlets. This type of concentric buffers may reveal patterns of market penetration in which the inner buffers often account for the largest proportion of customers while the density of customers decreases as one moves away from the outlet to the subsequent buffers. This distance-decay effect reflects the impact of geographic accessibility on store patronage. The actual size of the trade area for each store varies, depending on the location of the store. The sharper the distance-decay effect, the smaller would be the trade area for each of the fast food store.

For this study a regression models are applied that relates sales outcomes (dependent variable) to many factors such as ethnic composition and median household income (independent variable) of population in the retail trade zones of the Burger King and McDonald’s in Portage and Summit Counties. These regression models show that Burger King’s annual sales are better explained by the included independent variables for buffers with widths of 1 and 2 miles than those of McDonald’s sales by the same set of variables. For a 5-mile buffer and Thiessen polygons, sales are better explained for

McDonald's. Ethnic population and median household income for buffer polygons of 1 and 2 miles around the restaurants better explain annual sales for Burger King and polygons of 5-miles for McDonald's.

2.2 Summary:

Retail location analysis helps in site selection for a business outlet and in determining the performance of retail outlets in the trade area of the store. The trade area of the store reflects the socio-demographic characteristics of the clientele and is thus useful in determining the marketing strategies. The size and the shape of a retail trade area are determined by the nature of goods and services offered.

Since fast food restaurants sell goods that can be easily substituted, majority of consumers form a small retail trade area. Ethnic composition of population and the median household income within the buffer polygons constructed around the fast food restaurants indicate how much time and distance consumers drive or travel to patronize these restaurants.

Chapter 3

Literature Review

During the past three decades, several important advancements have taken place in spatial-data analysis, data storage, retrieval and mapping. Geographic Information Systems have been very useful in tackling spatial analytic approaches and in forming an interface with the field of location science (Church, 2002). Several studies give an overview of the major impacts of GIS on works done in the field of location science in terms of model application, development and various methods that can be used for land-use suitability modeling (Malczewski, 2004). For example: GIS is now the most widely used software for analyzing, visualizing and mapping spatial data such as retail location analysis, transport networks, land-use patterns and census track data.

Since GIS can be used to assemble large volumes of data from various sources with different map scales and in different coordinate systems, it is considered an important tool in location analysis. GIS can combine and simultaneously use several databases by transforming them into a common set of database (Pettit and Pullar, 1999). However, the use of GIS in location analysis involves the aspect of accuracy of representing real world situations in a GIS database. The notion of accuracy is the representation of geographical objects and representing socio-economic, cultural and political elements of the environment within which location analysis is done (Church, 2002). Not only is GIS used as the source of input data for a location model, it has also been used as a means to present model results (Malczewski, 2004).

3.1 GIS for Business and Service Sector Planning:

The growing consumer orientation in business and service planning along with advances in GIS and spatial analysis techniques, have led to the promotion of the use of GIS in the area of business and service planning (Longley and Clark, 1995). Several books and articles assess the use of GIS for supporting business and service planning at the level of tactical and strategic decision-making (for example: Davies and Clarke, 1994; Benoit and Clarke, 1997; Clarke, 1998; Birkin, et al., 2002). These studies aim to further explore and promote the use of GIS in the area of business and service planning by demonstrating the benefits of both methodological advances and evidence of benefits in GIS applications and spatial models in GIS. Business planning requires a critical review of geodemographic features and paying attention to requirements posed by end-users (Longley and Clark, 1995).

By linking GIS and spatial analysis software, proprietary GIS can be applied to solving problems in several applications like retail location analysis, localized marketing, etc. This involves the integration of spatial models and GIS customized to the specific information needs of retail organizations for specific localities. Thus spatial modeling is used in the explanation and prediction of interaction between demand and supply for retail facilities and the search for suitable locations for retail outlets in an area. The major theme of these studies is the evolution of GIS towards a more flexible and powerful spatial decision support system (DSS) or intelligent GIS (IGIS), applied in several service sectors, including retailing, financial services and health care. Marketing information systems (MKIS) are decision support systems targeted at marketing-specific decisions (Birkin, Clark and Clark, 1996). There is a realizable benefit in integrating GIS with MKIS because of its ability to provide map-based data presentation considered most effective for decision-makers (Ronald and Lawrence, 2004).

3.2 GIS as a tool for Retail Location Decision:

A dynamic and uncertain environment characterizes retailing and retail organizations as needing to plan for the complex consumer markets, while anticipating and reacting to competitions. This competitive nature of retail environment and the large number of techniques made use of by the retailers in locational planning, has led GIS to be used as an aid in strategic retail decision making and applications (Davies and Clark, 1994). GIS is used not just for location and catchments analysis but also for other retail sector issues such as category management, merchandising, marketing communications and relationship marketing (O'Malley, Patterson and Evans, 1997).

Existing literature contains a practical framework and other important issues involved in retail network planning. GIS has contributed immensely in improving the efficiency and precision of retail planning and marketing. Since the 1960s methodologies used for retail outlet location research have become more sophisticated as a result of modeling procedures brought about by GIS (Birkin, Clark and Clark, 2002).

The US experience shows that the effective utilization of geospatial databases, and the development of decision support systems (DSS), is becoming a significant source of competitive advantage for retailers over those without. Some retailers further explore information opportunities afforded by GIS technology for their business practices. Rather than relying on customer information alone, they are now combining data from several sources simultaneously in a bid to better support their process of decision-making (Birkin, Clark and Clark, 2002).

3.3 GIS Methodologies for Retail Location Studies:

For analyzing the spatial structure of retail activities with location data at micro scale, a number of technologies are now widely available and utilized. These include application of methods such as Probability Density Function (PDF), Decision Support Systems (DSS), Spatial Interaction Models, Network Huff Model, Analysis of Variance (ANOVA) (Byrom, 2005), MATISSE ("Matching Algorithm, A Technique for Industrial Site Selection and Evaluation"), and RASTT (Retail Aggregate Space Time Trip Model) (Baker, 2003), and others.

The Probability Density Function (PDF) of the retail stores is a function of how densities of the subject matters vary over specified dimension. If the specified dimension is time, the probability density function describes how such matter changes their frequencies and distribution over time. Alternatively, if the specified dimension is locations (or space), the probability density function then describes how such matters vary in their spatial patterns. The PDF has been used to analyze the spatial structure of retailing (Sadahiro, 2001). Sadahiro tested the validity of this method by applying this method to the locational data of retail stores in Yokohama. This approach helps to measure the degree of agglomeration, spatial patterns, the relationship between the size and function of retail agglomerations and analyzes the spatial structure of retail agglomeration.

Retailers for sales promotion activities and long-term strategic decision-making are increasingly developing GIS as DSS. GIS merges endogenous database by retailers and the exogenous databases sources to introduce retail decision- making and systems implementation (Nasirin and Birks, 2003). As an example, the examination of the experiences of some of the UK based retailers reflecting GIS implementation in retail location analysis shows a highly organized series of process management that has resulted as a result of this application.

The Network Huff Model is formulated on a network with the shortest-path distance as an extension of the ordinary Huff (based on Euclidean distance) (Okabe and Okunuki, 2001). This computational method can be used for estimating the demand of retail stores on a street network in a GIS environment. Extending from the gravity model, the original and network Huff models use distances (Euclidean or shortest distance over a network) between retail outlets as inverse weights to estimate divisions of the entire market area into individual trade areas of the retail outlets. The benefits of these models are the ability to meaningfully divide the studied space into a set of trade areas to support retail business operations.

MATISSE is a knowledge-based decision support system (KBDSS) based on decision tables that can be used by industrial decision-makers and planners to assess the suitability of potential sites (Witlox, 2003). Witlox explains how a relational approach to the modeling of the site suitability concept can be implemented and tried to find all possible locations that meet the spatial production requirements based on the organizational characteristics of the firm. The growing interest of urban geographers and economic geographers in applying KBS, DSS and integrated system has been largely attributed to the development of computer systems. Computers are able to store, organize and process enormous amount of data as well as make possible the availability and accessibility of the domain-specific knowledge underlying the spatial problem.

Witlox has identified three major categories of location factors at the highest level of decision-making. These three conditions are site conditions, investment and operating considerations and make up MATISSE'S head decision table. He points out that the experience with the construction of the system indicates that the developed procedure of knowledge in acquisition worked quite well, however, there are some problems with capturing of compensatory decision-making in terms of the decision table formalism. Nevertheless, the system is at a stage where it can be used in a straightforward manner. Locational requirements can be activated and even changed during consultation sessions and the system can identify and satisfy these requirements.

As another effective means of partitioning space into meaningful sections based on a set of focal points, Thiessen trade area models have been used to generate theoretical trade areas based upon stored characteristics and consumer behavior assumptions. Thiessen diagram models are used for delimiting trade areas for a set of similar and competing facilities in an area (Jones and Simmons, 1993). This method is also useful in those studies where detailed consumer patronage data is unavailable or difficult to acquire. Thiessen polygons can be used to identify the impact and changes of the existing set of facilities, as well as identify potential sites for new facilities (Ghosh and McLafferty, 1987). Thiessen models do not require complex statistical calculations and provide a quick and inexpensive appropriation of real trade areas (Jones and Simmons, 1993).

Two kinds of Thiessen diagrams can be used to model retail trade areas (Boots and South, 1997). The ordinary Thiessen or Voronoi diagrams (OVD), takes into consideration the location of the stores and assumes that the consumers patronize the nearest store (Ghosh and McLafferty, 1987). The second method is the multiplicatively weighted Thiessen.

The multiplicatively weighted Voronoi diagram (MWVD) takes into consideration both the locational as well as non-locational factors. According to this approach, the consumers select stores on the basis of distance (time) and attractions of stores (Boots, 1980). Boots and South used this approach to delineate the trade areas and project sales estimates of supermarkets owned by the Zehrs chain in the twin cities of Kitchener-Waterloo in Ontario, Canada. Thiessen polygons are contiguous but mutually exclusive. They cover all of the available area and are collectively exhaustive. They have been used to estimate individual breeding densities for great tits in Wytham Woods, United Kingdom (Wilkin, et al, 2006). The concept of Voronoi diagram has been in use since antiquity. Voronoi-like diagrams were used to show cosmic fragmentation and disposition of matter in the solar system and its environs in the works of Descartes in 1664 (Mahoney, 1979).

A more comprehensive use of Voronoi diagrams appeared in the works of Peter Dirichlet (1805-1859) and Georgy Voronoy (1868-1908) (Dirichlet, 1850). In their context, sets of points was considered to be regularly placed in the space generated by linear combinations of linearly independent vectors with integer coefficients. This contains many points and the Voronoi diagram generated by these points partitions the space into congruent polyhedra (Delone, 1961). Since the initial concept of Voronoi diagram involved sets of regularly placed points in space, it was first applied in crystallography (Nowacki, 1933, 1976). At this time Voronoi diagram was also applied to areas involving spatial interpolation. Thiessen used Voronoi regions to compute estimates of regional rainfall averages (Thiessen, 1911). Horton also developed the procedure in the same context (Horton, 1917).

In 1912, Whitney referred to the procedure as ‘Thiessen’s method’ and since then this application has been widely used in geography, meteorology and other social science disciplines (Whitney, 1912). By 1960s, the knowledge of Voronoi diagram was being applied in various studies of natural and social sciences. Somehow, the empirical application of the concept was limited as it lacked a simple and efficient means of construction. The researcher had to rely on methods that involved tools such as the compass and the ruler (Kopec, 1963). Gradually with the developments in the field of computer sciences, algorithms were developed to help in constructing Voronoi diagram in two and three dimensions (Shamos and Hoey, 1975).

Thiessen polygons have been extensively used in a wide variety of studies. For example, Thiessen polygons have been applied to calculate mean areal precipitation computation (Dartiguenave and Maidment, 1996), derivation of Road centerlines (Ladak and Martinez, 1996), distribution of health services (Taylor and Carmichael, 1980; Brabyn and Skelly, 2002) and watershed delineation (http://www.barrodale.com/watershed/tour.htm), climate change on forestry (http://www.pfc.forestry.ca/climate/change/spatial_e.html), snow investigations (http://www.ph.ucla.edu/epi/snow/mapmyth/mapmyth2_a.html), hydrodynamics (Hargrove, Winterfield and Levine, 1995).

Voronoi diagrams are useful for spatial analysis and also for spatial optimization (Okabe, et al., 2000). They are used to discuss the locational optimization of points in a plane or space where points represent certain facilities or services. These points are located in a continuous plane where demand arises at any point in a plane and the feasible locations of these facilities are these points in the place. Computational methods have been developed to solve locational optimization problems of a large number of points in a continuous plane or space with the help of Voronoi diagram Okabe and Suzuki, 1997). Voronoi diagram have also been used to minimize the total travel time and average travel cost to the nearest point facilities and locational optimization of lines.

3.4 Analysis of Trade Areas:

According to the available literature, some other methods have also been used for delineating retail areas. These methods have been classified into the following categories:

1. Simple or Basic methods for trade area analysis
2. Gravitational methods for trade analysis

3.4.1 Simple or Basic Methods of Trade Area Analysis:

William Applebaum pioneered the analog method in 1932, for developing systematic retail forecasting model based on empirical data. This method is commonly used by retail and consulting firms to quantify the performance characteristics of existing stores in order to forecast sales at new sites (Rogers and Green, 1979). The analog method is non-geographic and is often implemented by regression analysis (Wang, 2006).

Proximal Area Method is a geographic approach for delineating trade areas. This method assumes that consumers choose the nearest store to visit among the similar kind of outlets (Ghosh and McLafferty, 1987). This method also assumes that customers also consider travel distance and time while choosing a store. Once the trade area is defined, the store sales can be projected by analyzing demographic variables and spending habits of the perspective customers (Wang, 2006). By using GIS techniques, proximal area method can be studied by two approaches. The first approach is the consumer based and the second is store based (Wang, 2006).

3.4.2 Gravitational Methods for Trade Analysis:

The consumer based approach looks for the nearest store location in relation to the consumers. The store based approach constructs Thiessen polygons around each store in order to define the proximal area. The Thiessen polygon layer can be overlaid by demographic variables in order to obtain consumer information. This method takes into consideration distance and time traveled to delineate trade areas. Other sales-forecast methodologies have been developed and applied that consider distances (or time) and attraction of stores (Reilly, 1931 and Converse, 1949). One of these techniques that have been used for many years to delineate retail-trading areas is based on the law of retail gravitation. This law establishes the relationship between two cities on the basis of their relative populations and distances between them (Reilly, 1929). The statistical formula applied for establishing this relationship as given by Converse (1943):

$$\textit{The Dist. from B to the breaking point of the retail trade area between two cities}$$

$$= \frac{\textit{Dist. from A to B}}{1+\sqrt{\textit{Population of A}/\textit{Population of B}}}$$

Where:

A = first city

B = second city

The law of retail gravitation has been used for marking off the areas/ zones from which a retail outlet gets its patronage.

D. Huff, T.R. Lakshmanan and W.G. Hansen later improved a more general gravity based model in a probabilistic framework to define trade areas of multiple stores. This model is based on the assumption that the probability of a customer offered a set of alternatives, selecting a particular item/service is directly proportional to the perceived utility of each alternative. This model can be used for predicting consumer spatial behavior, delineating trade areas, locating retail and service facilities, analyzing market performance and forecasting sales, etc.

3.5 Forecasting the Fast Food Restaurant Sales:

Retailers always seek growth and expansion of their revenues and profits. In order to achieve this, they adopt various strategies like opening up new outlets, diversification of goods and products, increasing marketing efforts, etc. The scope for increasing the revenues of existing outlets also depends upon the size and economic potential of the geographic area served by the outlets. An essential feature of retail outlets is the spatial orientation of their markets (Ghosh and McLafferty, 1987). Each store may have a geographic area from where most of its customers originate. Market potential of any store is determined by the expenditure pattern of residents in the trade area. The market potentials are however, not static and may change over time due to changes in economic trends, population size, age and ethnic composition and other socio-economic indicators (Ghosh and McLafferty, 1987). Therefore, an understanding of the orientation of customers is the basis on which the retail outlets should make their target market decisions.

The population size, its demographic composition, expenditure potential and customer orientation has to be related to the competitive environment of a retail chain. The level and quality of direct competition is an important assessment that has to be considered in any store location strategy (Mercurio, 1984). Retailers measure competition levels by including stores per capita, square footage per capita as well as the degree of market share concentration, etc.

A retail chain develops its store location strategy keeping in view the future retail setting of the market. The population numbers, demographic set-up and the expenditure potential of the catchment area are important factors of the competitive environment (Davies and Rogers, 1984). Knowledge of the regional shopping area and consumer orientation provide a general orientation to the retail environment.

Sales forecasts/ projections can be made for future store locations. A gravity model uses three key factors such as: size of the store, distance traveled to get to the store and the retail image of the store based on its products, easy accessibility, visibility, parking, etc. (Mercurio, 1984). One of the prominent features of retail revolution over the past few decades has been the transformation from independent, family-run firms to large-scale, professionally managed multiple retail organizations (Dawson, 1991). In most developed countries large multiples (i.e. with ten or more retail outlets) account for a major part of the total retail sales (Burt and Dawson, 1990).

The extent of chain store dominance may vary from sector to sector, but the food retailing exhibits the greatest degree of concentration. The retail trade market is characterized by a small number of extremely large retail organizations and a large number of small-scale outlets (Brown, 1992). Therefore, it becomes imperative for the fast-food retail outlets to not ignore their competitors when taking locational decisions. Micro-scale retail location cannot be studied in complete isolation. Hence, the broader locational literatures like Central Place theory, Spatial Interaction theory, bid-rent theory, etc. that has been applied at the macro level can be adapted to the micro-scale retail location settings. Similarly, cognitive mapping and methodologies exercises conducted at micro-scale can be employed in wider macro-scale context (Brown, 1992).

Retail site selection is the most important aspect of any business. An accurate projection of sales often helps to determine the right amount to invest in order to get maximum returns. For opening retail business hard costs, such as real estate, construction, equipment, interior decoration and furniture and soft costs such as zoning, professional fees, training and personnel relocation are taken into consideration (Salvaneschi, 1996). Many a times for estimating the sales projection figures of a future store, similar kinds of stores or outlets offering similar kind of goods and services are evaluated- also called analogues.

Statistical or mathematical models of analysis have also been used to forecast a store's future sales. Regional and trade related data can be used as inputs for these models for sales forecasting. Three major statistical methods used are:

1. The Regression Model
2. The Gravity Model
3. Reilly's Law

Many real estate consultants prefer regression model. Volume Shoe Corporation uses four types of multiple regression models to predict new stores based on quantitative information derived from existing stores. These models contain demographic data from new store location: population density, median household income, percentage of low-middle income households, age data, percentage of non-white population, occupation, etc. (Wood, 1986).

A regression model can be applied in retail location decisions, that relates sales output (dependent variables) to one or more factors (independent variables) positively or negatively related to sales. The results can be compared to existing similar stores for future development of the retail business (Thompson, 1982; Green, 1986).

Regression models have also been used to identify location variables related to store sales performance. For state-owned liquor stores in Charlotte, North Carolina, the regression model related annual sales volume for each existing store (dependent variable) and population within 1.5 miles of the store site, mean household income, distance from subject store to next nearest liquor store, daily traffic volume, employment within 1.5 miles of the store, etc. (independent variables) (Lord and Lynds, 1981).

Regression analysis can be used to determine the factors that influence the performance of retail outlets at a particular site. The performance of an individual store may depend upon a number of factors and regression analysis can help to identify the factor that has the greatest impact for a particular retail outlet. The development of regression model is based on two assumptions:

1. Performance of a store affected by its location characteristics, socio-economic composition of the trade area, level of competition and store characteristics
2. These factors can be isolated by systematic analysis (Ghosh and McLafferty, 1987).

There are many empirical studies done that have used regression models on retail performance of a variety of outlets. Some of these studies include convenience stores (Hise et al., 1983; Jones and Mock, 1984), hospitals and health services (Erickson and Finkler, 1985), grocery stores (Cottrell, 1973), banks and financial institutions (Martin, 1967; Clawson, 1974; Olsen and Lord, 1979; Lynge and Shin, 1981), etc. Most of these studies infer that the population numbers and demographic composition of an outlet's trade area affect performance to a great extent. Composition has a complex influence on store performance but merchandizing, promotion, customer services and sales also have a positive relationship.

The regression model can be explained as:

$$Y = b0 + b1x1 + b2x2 + ... + bnxn$$

Where:

Y = Dependent variable: measure of performance of a store (store sales revenue/ profitability)

x = Independent variables: that may influence store performance

Parameters $b0$ = intercept term

$b1, b2, ..., bn$ = Regression coefficients corresponding to independent variables (measure the relative impact of each variable on performance).

3.6 Identifying the Trading Area of the Fast Food Restaurants:

Every retailer seeks growth and expansion of the business. This growth can be accomplished by either increasing sales/revenues from existing stores/establishments and expansion by adding more establishments. For physical expansion into new or existing markets, an analysis and selection of the broad geographical region should be done. This process of site selection for a new retail outlet follows a hierarchy from a macro-analysis at the regional and market levels, to trade area analysis and finally down to a micro-analysis of a particular site (Anderson, 1993).

A region consists of several geographic markets, which in turn consist of several trading areas encompassing metropolitan regions, cities and towns. Within each trade area there might be a number of potential sites for establishing retail outlets. According to the United States Census Bureau, there are nine census regions in the country, which were established in 1910 for the presentation of census data. These regions are: New England, Mid-Atlantic, South Atlantic, East North Central, East South Central, West North Central, West South Central, Mountain and Pacific (US Census Bureau, 2002). This Census Bureau classification has been used by a number of data sources for reporting statistics on retailing, manufacturing and other economic analysis. Many large chains like JC Penny, have divided the United States into regions based on their operations (JC Penny, 1987). These nine regions of the United States can also be conceptualized as the nine nations within North American. Each of these divisions depicts a distinct cultural and anthropological entity rather than mere political divisions (Garreau, 1981). Each regional market may exhibit varying retailing opportunities. Large retailing chains adapt their marketing strategies to fit the requirements of the individual regional market based on its physical, geographical, consumer, economic and competitive characteristics (Anderson, 1993). A regional market further consists of diverse geographic markets like a metropolitan region, city or town. Retailers have to be constantly aware of the changing boundaries of market area and conduct market analysis as an ongoing process. The changes in the boundary of the market areas may be brought about by customer locations and characteristics, modifications in major traffic arteries and entry of a new competition in the market, etc. (Huff and Rust, 1984).

Market areas are further subdivided into trade areas that contain target market populations from which a particular retail outlet draws its customers. The point, at which the competition edge of a particular retail establishment is lost in favor of an alternative establishment, determines the trade area boundaries of a retail outlet or service (Anderson, 1993). While carrying out this trade area analysis, customer movement based on points of origin (residential or employment areas), preferred retail destinations and nature of outlets bypassed on their way to the destination store, must be evaluated. The trade area analysis is carried out on the basis of geography, demographics, economic, administrative and competitive characteristics prevailing in the trade area.

Although there have been different interpretations for the concept of a retail trading area, generally it refers to a geographical area from where retail patronage or clientele is derived. But the question arises as to how much clientele contribute from an area should be included within a retail trade zone of a retail outlet. Theoretically it has been accepted that if there are any customers of a retail outlet living in the study area, then it should be included as a part of the retail trade zone (Fine, 1954).

A retail trade area surrounds the retail outlets and within which 75 to 80% of customers more from one point to another (Salvaneschi, 1996). The retail trade area is formed by people who live, work and move there and also a percentage of customers who come from outside. According Salvaneschi, a retail-trading zone has three main sections of customers. The core area that accounts for about 50% of customers, the secondary area that accounts for up to 25% of customers and the tertiary area that accounts for 10-15% of customers (including those from beyond 4-5 miles). The customers who come from beyond the tertiary area are sometimes referred to as the off-map customers. These customers vary in frequency and numbers according to the type of goods or services offered, the type of road and the topography of the area.

A retail outlet's retail trade zone can fall into one or a combination of areas such as: downtown, urban, rural or suburban. Each of these categories can reflect different types of land uses such as residential, industrial, commercial, professional or recreational. The profile of the customers will differ according to the zone in which they are located.

3.7 Retail Marketing Strategies:

The retail marketing strategy is greatly dependent upon the firm's value platform. The value platform deals with the manner in which a firm distinguished itself from its competitors (Ghosh and McLafferty, 1987). Therefore, in order that consumers patronize a particular fast-food outlet, a value platform has to be established by the outlets. Creating and maintaining this value platform will allow the store to achieve a differential advantage over its competitors.

The other functional strategies followed by the store such as merchandizing, advertising, store atmosphere, customer service, easy accessibility, visibility, parking, etc. have to be kept consistent with the value platform (Ghosh and McLafferty, 1987; Mercurio, 1984). The store management has to understand the customer needs and wants and also be aware of competitions faced by the outlet. Customers may have varying needs and wants and how they perceive the value of eating at a fast-food joint.

These differences may create the potential for segmenting the trade area based on different customer expectations.

The fast food stores can select the segment of consumers it can serve best and orient its services to meet the needs of that group. In delimiting its trade market, the store must also take into consideration the strengths and weaknesses of the potential competitors as well as its own resource base (Ghosh and McLafferty, 1987). In any market area, there may be a variety of stores offering similar products and services. Under such circumstances, the value platform of each store will determine where it stands in the extent of competition. And if the value platform of two competing stores is more or less similar, then an overlap in their target markets is greater.

According to Ghosh and McLafferty, retail stores can be grouped into competitive clusters based on how similar their value platforms are. Firms belonging to each of these groups follow similar marketing strategies, target the same segment of consumers and compete directly with each other. The competitive edge of the store can thus be maintained by price of goods and services as well as the outlet location. Therefore, if a consumer has to choose among similar retail alternatives, he or she is likely to choose the store that is more conveniently located. Price of products and services and store location are the most important factors at this stage of competition within strategic groups, when consumers have to make a choice (Ghosh and McLafferty, 1987).

3.8 Eating Facilities At Fast Food Restaurants:

Fast food restaurants like Burger King and McDonald's generally have three types of eating facilities like: Dine-in, Carryout and Drive-thru. The types of customers for each of these facilities are different and therefore, their expectations are also based accordingly. In today's fast-paced life, where customers are looking for convenience, the Drive-thru concept has become very popular. Customers on the move generally prefer the Drive-in facility for pure convenience.

A substantial part of any quick service restaurant's (QSR) revenue comes from the Drive-thru. According to an article in QSR magazine, "Technology as a whole, now plays an indispensable role in quick-serve. From consumer applications that enhance the diner experience to operational applications that improve the restaurants' day to day functioning, experts say quick-serves that do not embrace technology are missing both revenue-boosting and cost cutting opportunities that could put them at a competitive advantage". (QSR Magazine, 2002).

Drive-thru facilities have existed since the late 1920s and until 1970s most QSR customer orders were taken inside the restaurants. Over the last twenty-five years there has been a spurt in drive-thru sales. Some newer QSR chains have reported a 50-75% share of their revenues from the drive-thru restaurant facilities (USA Today, 2002). In 1975, McDonald's opened its first drive-thru window in Sierra Vista, Arizona. This service gave the fast food consumers a convenient way to get a quick meal. The company's goal was to provide service in 50 seconds or less. Drive-thru sales eventually accounted for about half of all McDonald's restaurant sales in the United

States (www.mcdonalds.ca and www.fundinguniverse.com). Even though the drive-thru concept originated in the QSR history, today we can find drive-thru video-stores, banks, photo-processing shops, coffee outlets and grocery stores, etc.

3.9 Pricing Strategies:

Although both McDonald's and Burger King were established in the same year (1954) and by the 21st century, McDonald's has been considered as the undisputed hamburger king especially in terms of sheer size. By 2000, more than 43 million people visited one of McDonald's 26,000 restaurants in 120 countries every single day. Which is about more than 15 billion customers a year with system-wide sales of over $40 billion. Burger King, by comparison, served nearly 15 million customers daily. Burger King Corporation and its franchisees operated over 11,000 restaurants in the U.S. and 57 countries and international territories around the world, producing 2000 system wide sales of about $11 billion.

While both companies sold burgers and fries, their nearly 50-year battle had been waged around two competing concepts. McDonald's aimed to be the world's best 'quick service restaurant experience'. Being the best meant providing outstanding quality, service, cleanliness and value. Burger King based its strategy around customer satisfaction through flexibility. Since the company's founding in Miami, the Burger King brand had become recognized for its flame-broiled taste and 'Have it Your Way Food Customization' (Johnson & Pyke, 2004).

Most fast food restaurants offer discounted prices on their products in order to attract more customers. McDonald’s has a $1 Billion marketing budget, almost twice that of Burger King Corp. But in order to compete on the basis of price discounts, McDonald’s is forced to sell Quarter Pounder at 99 cents (Regular price $1.90) (Bremner and DeGeorge, 1989). Even though McDonald’s is continuously fighting for market share, it is also worried about the negative effect of price slashing of its products in the eyes of consumers.

McDonald’s have been introducing new products on its menu (pizzas, low-fat milkshakes) and also opening up outlets in diverse markets like hospitals, airports and museums. McDonald’s have also extended their menu choices by including healthier platter like salads, soups and yogurts. But they still maintain discounted burgers on their menu in order retain their clientele and win new customers (Gibson, 1990).

3.10 Summary:

Much technological advancement has taken place in the field of GIS over the past few years and it is widely used software for spatial data analysis. The review of available literature related to the study topic in this chapter provides the necessary background understanding for the interplays between retail outlets and various location and socio-economic factors. This literature review has helped to identify a set of useful articles and books by accredited scholars and researchers, which have applied GIS principles of analysis to retail location studies.

GIS has been helpful in accurately representing real world situations and has therefore been used for business and service planning. GIS offers a large number of techniques that have been successfully made use of by the retail businesses in location planning and strategic retail decision-making and applications. Over the past few decades, the methodologies used for retail outlet location research have become more sophisticated as a result of modeling procedures brought about by GIS.

Retailers are always trying to grow and expand their business. This is done by increasing sales revenues of the existing stores and by adding more establishments. Looking into the size and economic potential of the trade area often does this. The market potential of a store is determined by the ethnic composition and the expenditure pattern of residents in the trade area. Selecting site for a new retail outlet requires an accurate projection of sales in order to determine the right amount of investments for maximum returns.

A good marketing strategy has to be integrated into the organization's marketing policies and goals. Retail marketing strategies can allow the businesses to concentrate their resources on the greatest opportunities to increase sales and at the same time achieve a competitive advantage.

Chapter 4

Data and Research Methodology

The concept of Trade Area analysis has always been quite appealing and popular with retailers because it helps them to gain much needed understanding of the business potential and the competition with other retailers. In its simplest form, a circle of certain radius around a retail outlet can function as the outlet's trade area. In the circle around a retail outlet, it is possible to analyze certain geodemographic factors and other variables related to that particular business.

GIS can easily calculate the size and the potential of the market based on the socio-economic profile of the area in the identified trade area, for example, the circle around a store. However, Trade Area analysis in the past was limited to rough estimates and mental arithmetic because of the time consuming manual calculations involved. With laborious manual calculation required, analysts often assumed that people travel in straight lines, instead of using actual distance or traveling time. They also had to work with the notion that those residing within the radius of the circle are the customers and nobody outside the circle shops at that store, ignoring traffic patterns and the additional attracting factors by any nearby attractions. Moreover, they often assumed away competition because of the extensive time and labor involved in including all these in their calculation and analysis. With GIS, however, it is now possible to handle larger volumes of data, with higher levels of precision/details, and shorter turn around time (speed).

Competitive Location Evaluation and Optimization (CLEO) (http://dgrc.ca/services/retail/index.html) is a suite of retail location models that push the frontiers of location science to identify the very best sites in a multi-store market. It is retail location software developed by a GIS consulting firm Digital Geographic Research Corporation (DGRC) (http://dgrc.ca/index.html). Some of the recent retail location analyses have tried to improve upon the aforementioned limitations by considering non-circular trade areas; by detailing trade areas into primary or secondary trade areas and even by constructing Thiessen polygons to partition the space with a given pattern of retailers. In today's consumer society, shopping behavior and store choices depend upon many factors such as advertisement, complementary shopping opportunities and proximity to one's place of residence or work (CLEO) and others.

4.1 Data Preparation:

In this study, GIS and statistical analysis techniques have been applied as an applicable tool for retail business. This study examines the spatial patterns, and the dynamics of the fast food restaurant chains of Burger King and McDonald's in Portage and Summit Counties in Northeastern Ohio.

The data used in this study include data layers of Block Groups 2000 – TIGER/Line® Shapefiles for Portage and Summit Counties provided by U.S. Census Bureau. The data layers were in Geographic Coordinates NAD83 and re-projected to

Geographic Coordinate System GCS_Clarke_1866. Geodemographic data for ethnic composition of population and median household income has been taken from Census 2000 Summary Files (SF 3) and joined with the Block group layer. The annual sales data for midyear 2004, for Burger King and McDonald's QSR (Quick Service Restaurants) in Portage and Summit Counties of Ohio, has been obtained from Restaurant Trends^{TM}, a research company in the United States that tracks the performance of the chain restaurant industry.

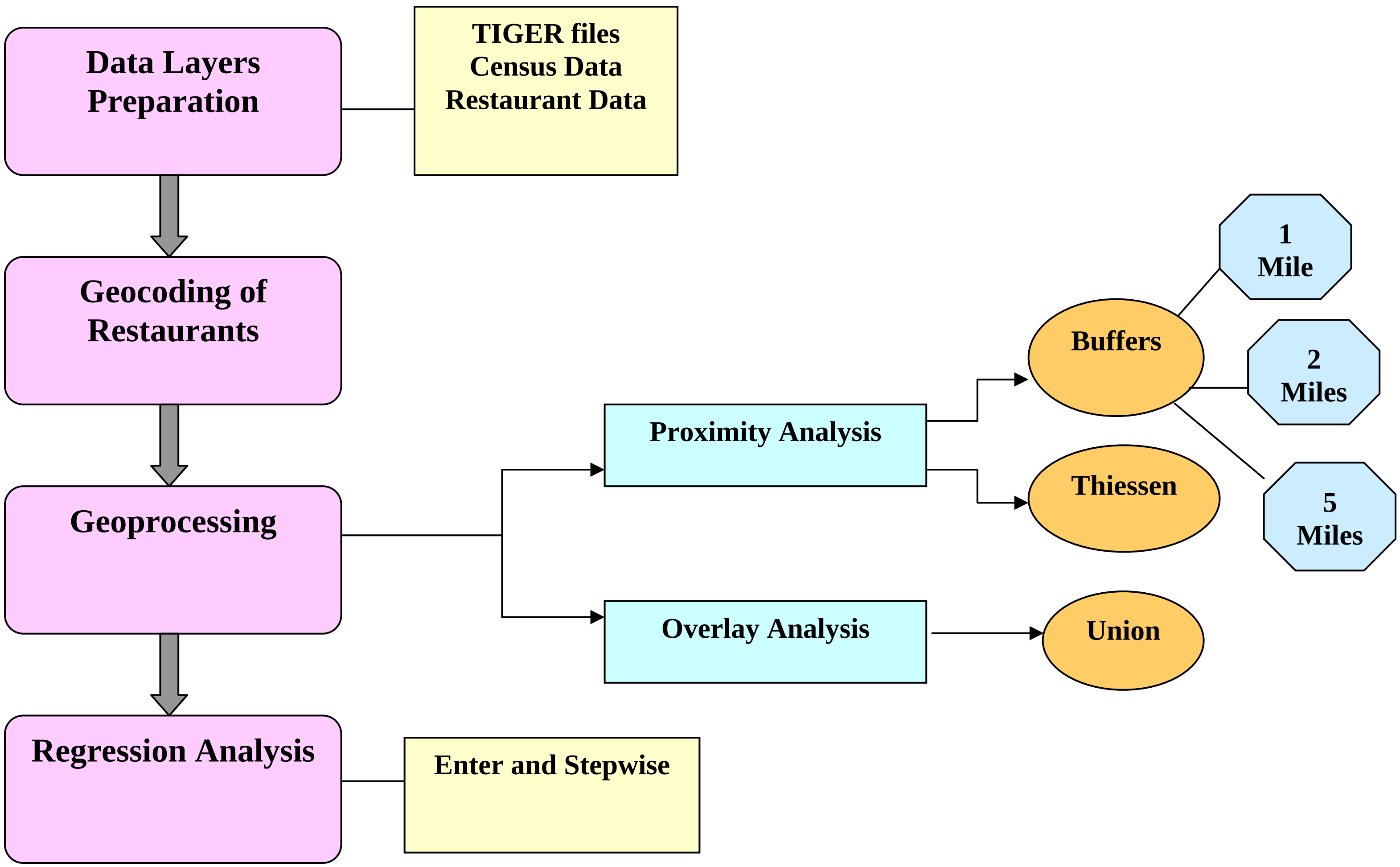

Chart 4.1: Research Methodology

4.2 Research Methodology:

Research methodology includes the following GIS techniques and statistical analysis. The analytical procedures are outlined in Chart 4.1 as well as in the discussion below.

4.2.1 Geocoding:

This is the method that converts addresses to specific point locations on the street network based on locations of the addresses as defined in a reference data layer of street information. Taking into consideration the various types of address parameters one can do Geocoding by matching the house number and street number against those in the referenced street database. In this study the fast food stores have been geocoded using their street address.

Geocoding combines map information with street address so that a point can be located uniquely on a base map for each corresponding address. The process of address matching, or Geocoding, required a database of properly formed addresses of the studied restaurants, a reference database of streets for Portage and Summit Counties and a Geocoding service for matching them.

In *ArcCatalog*, a new Address Locator was created by choosing the style of the Geocoding service as US Streets. The US Streets address locator style helps to create address locators for common addresses. Another advantage of using this style is that it provides a range of house or property number values for both sides of a street segment. This style also provides a location along the street and the side of the road segment where the address is located (Crosier, 2004). The US Census Bureau maintains a database of streets with address ranges that have been enhanced in the various commercial Geocoding products/ software. This database, referred to as the TIGER/Line files, can be easily downloaded from the Bureau of the Census website (http://www.census.gov). Moreover, private data vendors also make this database available for downloads. For example, ERSI's website has the TIGER/Line files formatted to shapefiles so that their software can work with them directly. TIGER/Line files in shapefile format can be downloaded from http://www.esri.com/data.

Since each of the Burger King and McDonald's restaurants in Portage and Summit Counties has a properly formed address, ArcGIS estimated the position of each address as a point location and stored them in a point data layer that has the same geographic projection as that of the street reference data layer. This estimation is done with the linear interpolation between the two endpoints of the street segment that contains the house number of the matched address. Figure 1, Figure 2 and Figure 3 show the spatial distribution of the fast food restaurants included in the study.

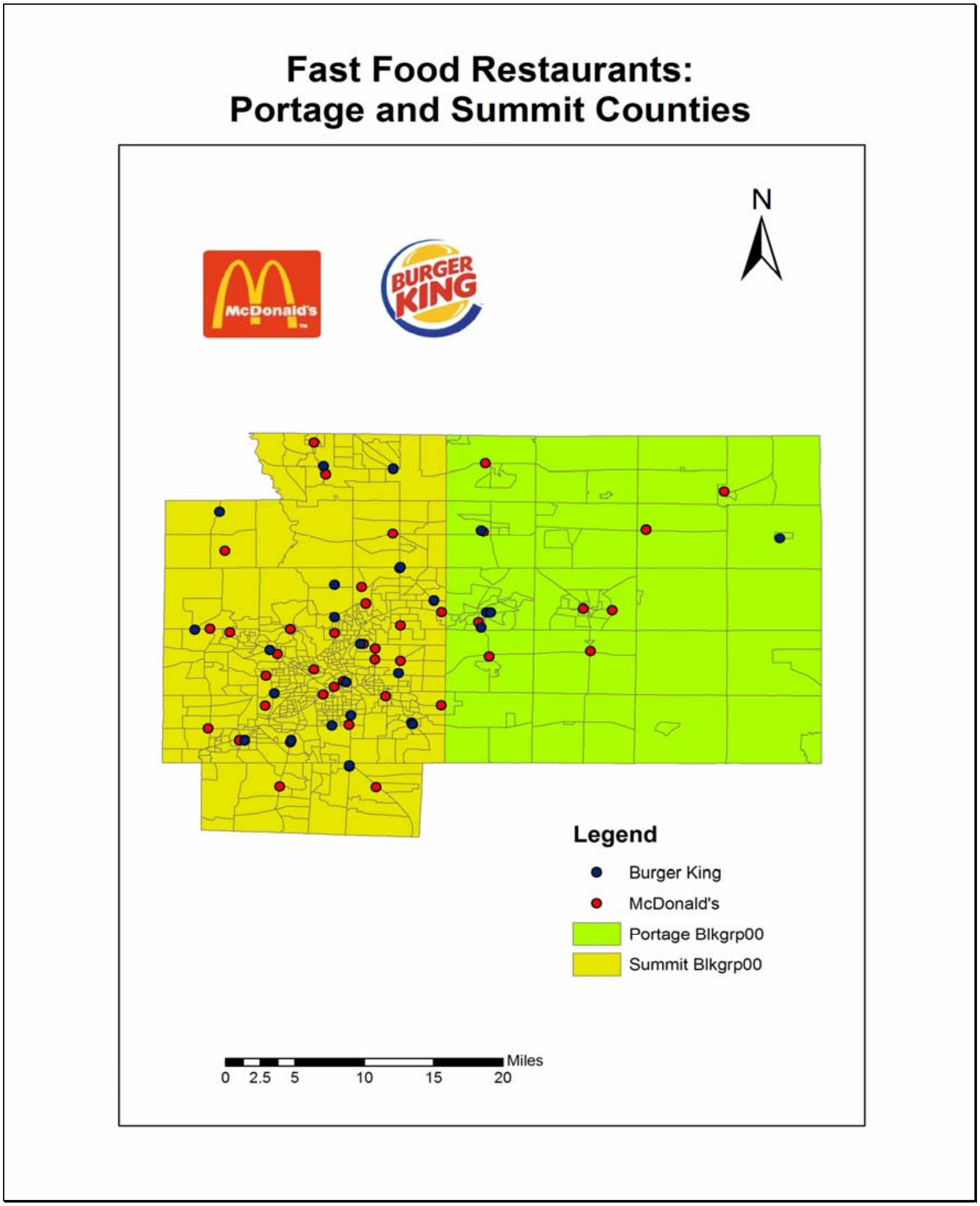

Fig: 1 Burger Kings and McDonalds' QSR: Portage and Summit Counties

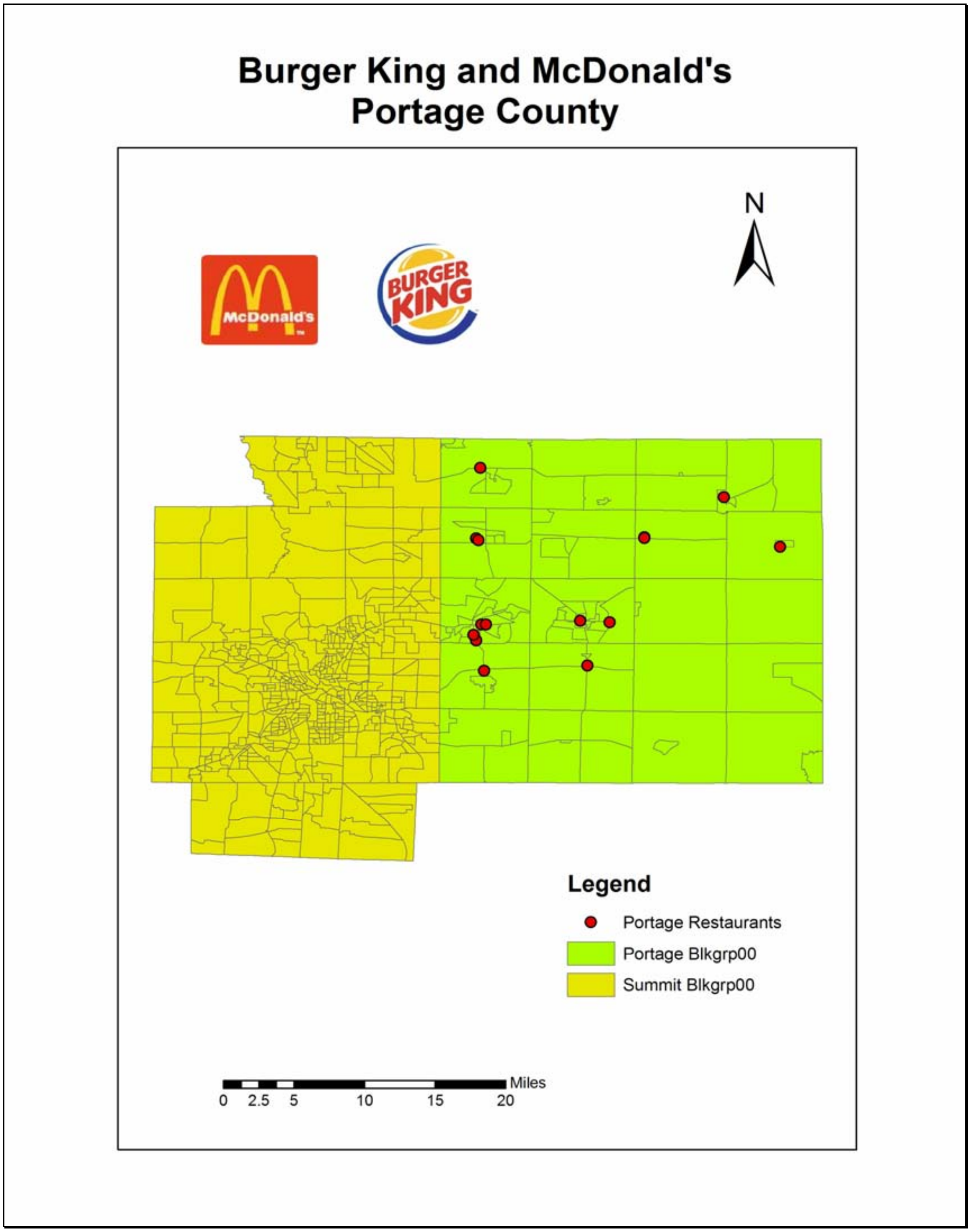

Fig 2: Burger Kings and McDonalds'- Portage County

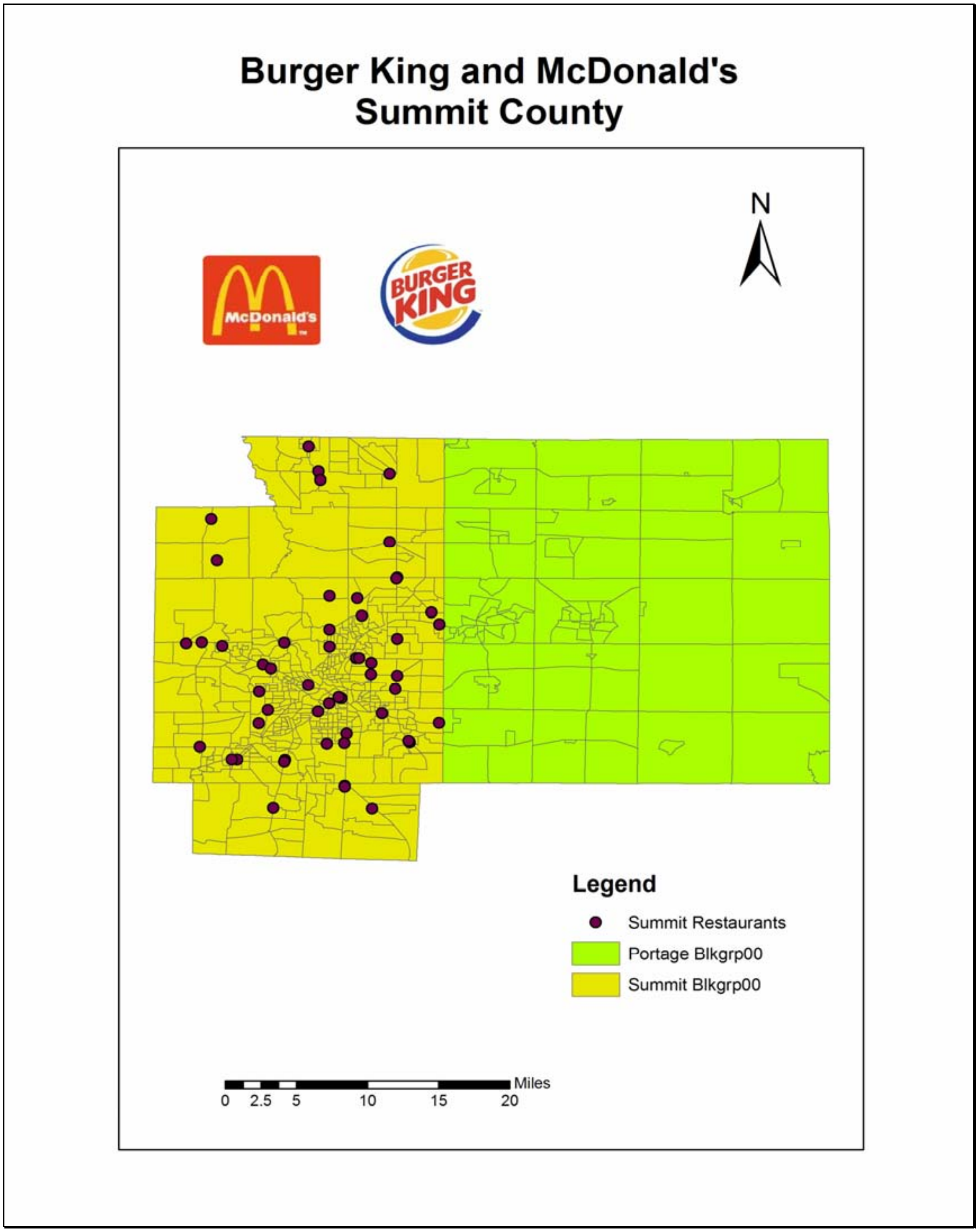

Fig 3: Burger King and McDonald's- Summit County

Sixty-five of the studied restaurants fall under the Urbanized areas of Cleveland (66.98 square miles), Akron (273.43 square miles), Windham (1.69 square miles) and Youngstown (0.12 square mile). The other four restaurants that are situated outside of these urbanized areas are in Garrettsville (McDonald's in Portage County), Mantua (McDonald's in Portage County) and Richfield (Burger King and McDonald's in Summit County).

Figure 4 shows the distance of the studied restaurants from four types of roads as classified by the US Census Bureau has been taken into consideration. According to the Census Feature Class Codes (CFCC) these roads are A1- Interstate Highways and Toll Highways, A2- nationally & regionally important highways, A3- State Highways and A4- Local Roads.

Table 1: Distance of Burger King & McDonald's QSR from Major Roads

Number of Burger King QSR		
Road Type	**1 Mile**	**2 Miles**
A1	12	16
A2	3	3
A3	23	24
Number of McDonald's QSR		
Road Type	**1 Mile**	**2 Miles**
A1	24	33
A2	2	4
A3	41	44

Above table shows that about 36 restaurants are situated within one mile of the interstate highways and toll highways. Out of these 12 are the Burger King restaurants and 24 are the McDonald's restaurants. About 49 of the restaurants are situated within two miles of the interstate highways. Out of these, 16 are the Burger King and 33 are McDonald's restaurants.

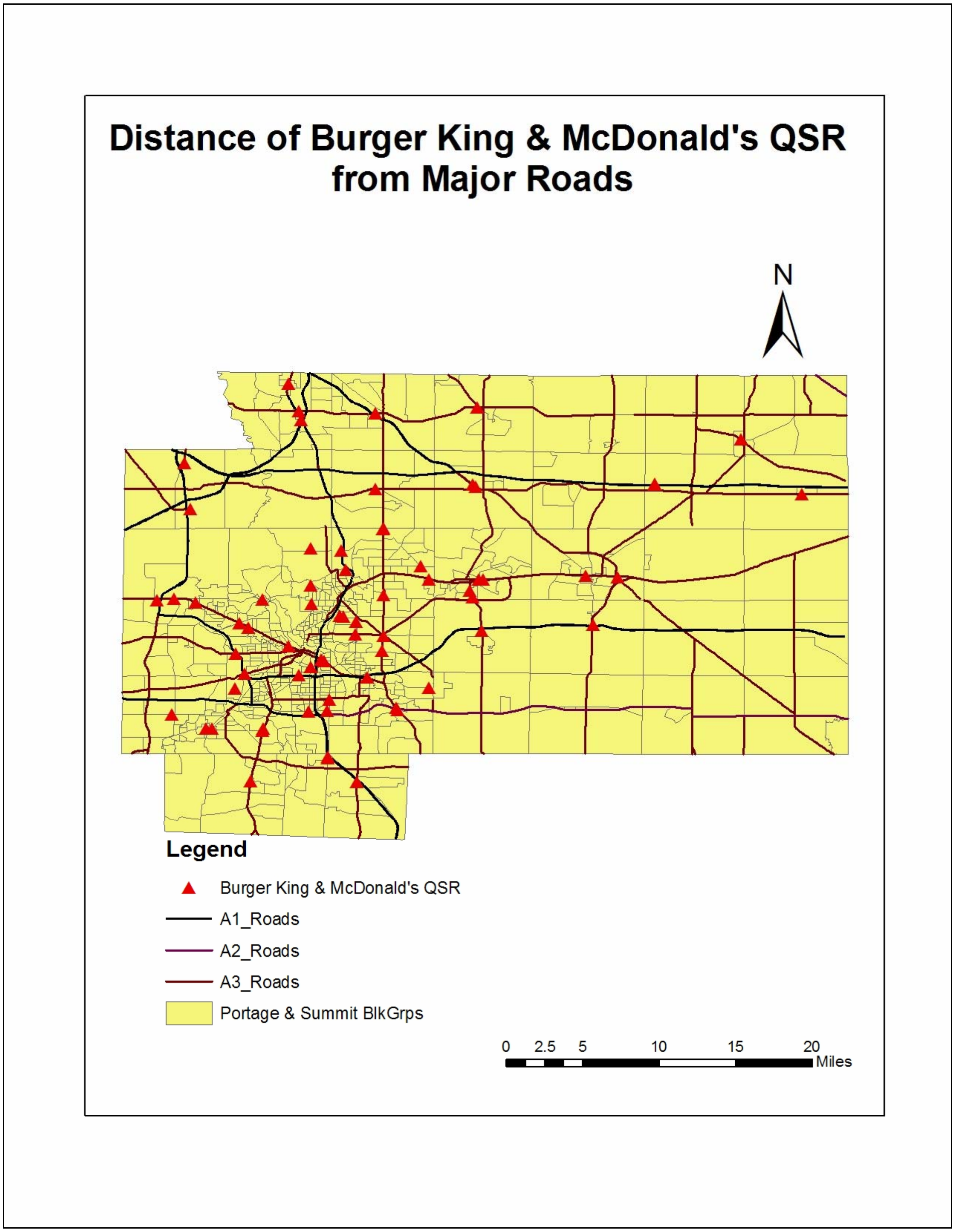

Fig 4: Distance of Burger King & McDonald's Restaurants from Major Roads

Five fast food restaurants are situated within a mile of the A2 roads. Three of these are Burger King and 2 are McDonald's QSR. And within 2 miles of the A2 roads, seven fast food restaurants are situated. Three are the Burger King and four are the McDonald's restaurants.

About 64 of the 69 studied restaurants are situated within a mile of A3 roads. Burger King makes up about 23 and McDonald's 41 of these QSR. Sixty-eight restaurants are situated within 2 miles of the state highways (Burger Kings 24 and McDonalds' 44 restaurants).

All the sixty-nine studied restaurants are accessible by local (A4) roads.

4.2.2 Catchment area analysis: has been done by using:

(a.) Thiessen Polygon

Thiessen polygons, also known as Voronoi polygons, represent areas of influence around a set of focal points (or retail outlets as in this study). They can be generated based on a set of points as centroid for the polygons. Thiessen polygons have been so constructed that each polygon contains exactly one of the outlets and that any location with a Thiessen polygon is closer to that point outlet (centroid) than to any other point outlets. This polygon structure is constructed by using the perpendicular bisectors between neighboring points (in this case, retail outlets) as the boundaries of the resulting Thiessen polygons.

In this study, GIS techniques have been used to predict the catchment boundary along a direct transact between each pair of neighboring fast food outlet in the sample set based on customer choice patterns. Once the location of a catchment area boundary has been established along a given transact, this has been compared to that predicted by the theoretical polygon boundary. This process helps to assess the validity of the Thiessen boundary, and if its position is found to be inappropriate, the position of a more realistic boundary can be identified (Gething et. al, 2004). Many commercially available GIS software packages now offer such functions at only a few keystrokes to produce Thiessen polygons for a given set of points.

The Thiessen tool in ArcGIS can proportionally divide and distribute point coverage into Thiessen or Voronoi polygons (ArcGIS Desktop Help 9.2).

The Thiessen polygons are constructed as follows:

a.) All geocoded restaurants are triangulated into a triangulated irregular network (TIN).

b.) The perpendicular bisectors of each triangle edge are generated that form the edges of the Thiessen polygons. The locations at which the bisectors intersect determine the locations of the Thiessen polygons vertices.

c.) The Thiessen polygons generate polygon topology.

Each Thiessen polygon contains only one input point (geocoded restaurant) and any location within the polygon is closer to its point than to the point of any other polygon. Thiessen polygons have been generated for Burger King and McDonald's Restaurants in Portage and Summit Counties, Burger King and McDonald's in Portage

County, Burger King and McDonald’s in Summit County, Burger King in Portage County, Burger King in Summit County, Burger King in Portage and Summit Counties, McDonald’s in Portage County, McDonald’s in Summit County and McDonald’s in Portage and Summit Counties. Figure 5 to Figure 13 show the spatial structures of the Thiessen polygons calculated using different subsets of the fast food restaurants included in this study. Figure 5, shows the Thiessen polygons around the geocoded Burger King and McDonald’s restaurants in Portage and Summit Counties. (Please refer to Figure 6 to Figure 13 in the Appendix).

Using Thiessen polygons as trade areas of a set of retail outlets, analysts can evaluate the retail outlets in terms of socio-economic and/or demographic attributes of each outlet’s trade area. For example, census data can be summarized by Thiessen polygons to provide hints to business planners the size of the market, the potential customer base, the demographic composition of the population in a particular trade area, or the estimated purchasing power or consumption patterns of the population in the trade area.

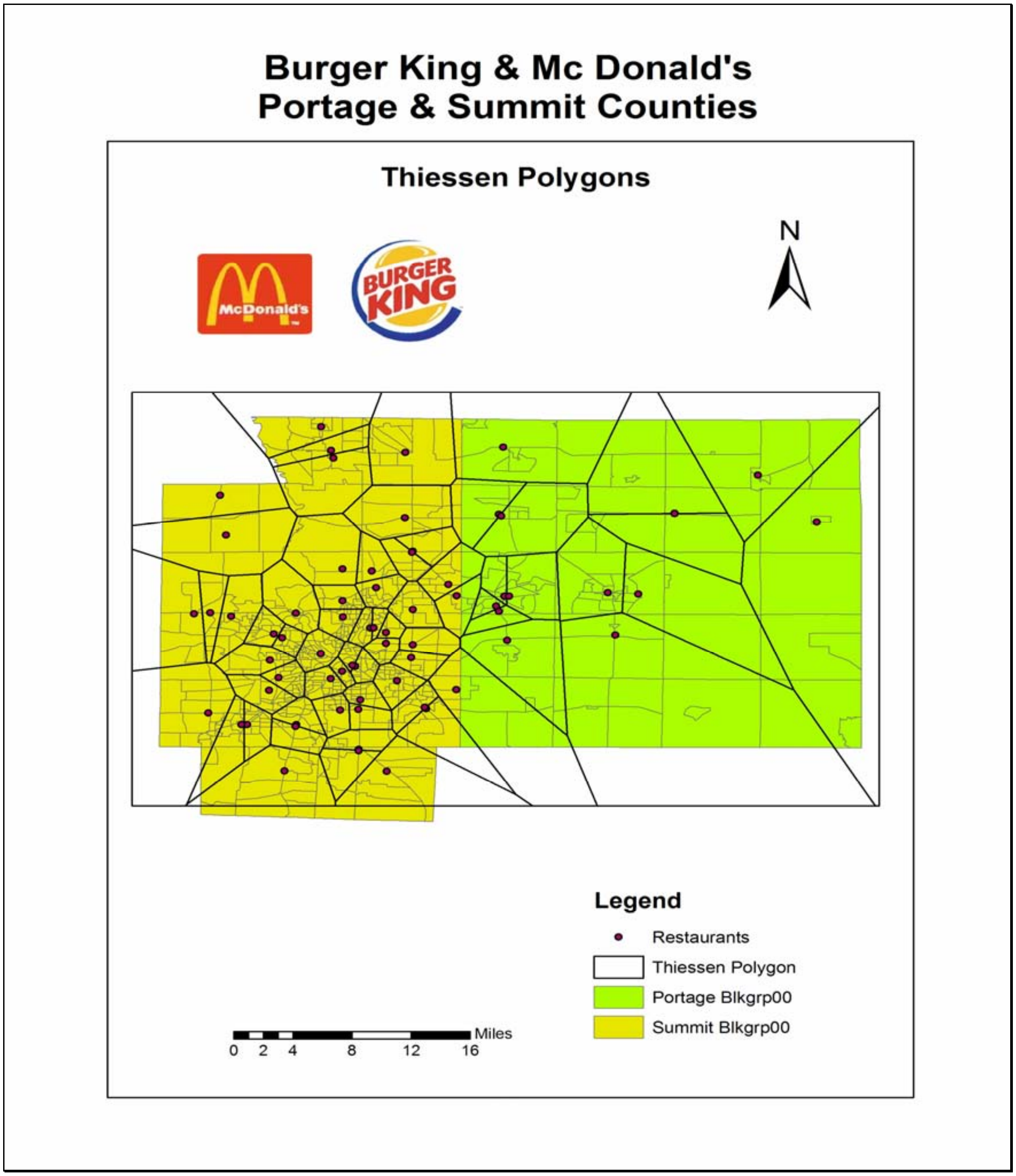

Fig: 5 Burger King and McDonald's-Portage and Summit Counties

(Thiessen Polygons)

(b.) Buffer Polygons

Rather than simply being interested in the locations of a retail store, an analyst may be interested in the locations within a pre-defined distance from a store. For instance, wanting to know about geodemographics of all areas within or outside of 1 mile from a particular fast-food store, or within 5 miles of a highway exit or within 2 miles of an urban area. Where information of this type is required, a buffering technique is made use of. Buffers may be generated around a point, a line segment, or a polygon, with a specified width. Following the establishment of buffer polygons, analytic steps similar to those used in analyzing Thiessen polygons have been taken to examine how buffer polygons behave similarly or differently from those of Thiessen polygons in this study.

Geoprocessing is the process of applying geographic analysis and modeling to data to produce new information. The *ArcINFO* Geoprocessing environment has many tools for processing all types of data. Some of these tools that have been used for this study are: *Overlay analysis* (Union tool) and *Proximity analysis* (Buffer tool).

Buffer analysis tool creates a new feature class of buffer polygons around the geocoded fast food restaurants. Buffers work in Euclidean space and use a two-dimensional algorithm (ArcGIS 9.2 Desktop Help).

The width of the buffer can be specified by two methods:

a.) Fixed distance - when a constant distance is specified and applied to the Input Features.

b.) From Field- when the name of a numeric distance is chosen from the specified feature class and each feature is buffered according to the chosen value.

These buffer polygons allow us to see how they are related to the performance of the fast food restaurants. The buffering function generates polygons by encircling a point with a specified distance, or the buffer width. Geometric buffers (sometimes also referred to as geometric outlines, geodesic offsets, or geodesic parallel) are applied for various spatial analyses in GIS (Gombosi and Zalik, 2005). Theoretically, geometric buffer is defined as a *Minkowski* sum by:

$$\mathrm{A} + \mathrm{B} = \{x + y / x \in A, y \in B\}$$

Where: - A represents a disk, and B a polyline (Gombosi and Zalik, 2005).

In order to calculate store revenue and optimum locations of retail outlets, GIS literature often suggest the techniques of buffer and overlay analysis (Beaumont, 1991; Elliot, 1991; Howe, 1991; Reid, 1993; and others). These studies first estimate how far customers are willing to travel to a store and the result will be either a travel time or distance. The next stage delimits an area around the store with the help of a buffer to mark the limit of that time or distance from the store. The revenue generated from that store can be estimated by overlaying the consumer spending power that resides within that buffer (Benoit and Clarke, 1997).

Three buffer zones generated around each fast food restaurant with the widths of 1-mile, 2-mile and 5-mile, are chosen to emulate consumers' willingness to walk over to a fast-food restaurant for a quick lunch in a congested area (1-mile), in a less congested area (2-mile), or with a car they can drive to the restaurant (5-Mile). Demographic data and median household income data of each polygon serves as the independent variable for regression analysis and store sales volume as the dependent variable.

However, when the buffers around the fast-food outlets overlap one another, it may become difficult to distribute the attributes of the population between different buffers. This problem would be more apparent when there are two or more stores located closer together and have very similar catchment areas. When it becomes difficult to estimate how much revenue exists for each store in such a situation, the fair-share method can be employed (Beaumont, 1991). According to this method the number of stores in the buffer divides the total amount of revenue generated within the buffer.

In this study, fixed distance method of Buffering has been applied to generate buffers of 1 mile, 2 miles and 5 miles around each of the Burger King and McDonald's fast food restaurants in Portage & Summit Counties. Figure 14 to Figure 40 provide the layout of the buffer polygons with various subsets of the fast food restaurants included in this study. Among these maps, I wish to point out that Figure 14, Figure 15 and Figure 16 show the Buffers with radii of 1mile, 2 miles and 5 miles around the geocoded Burger

King and McDonald's restaurants in Portage and Summit Counties (Please refer to Figure 17 to Figure 40 in the Appendix).

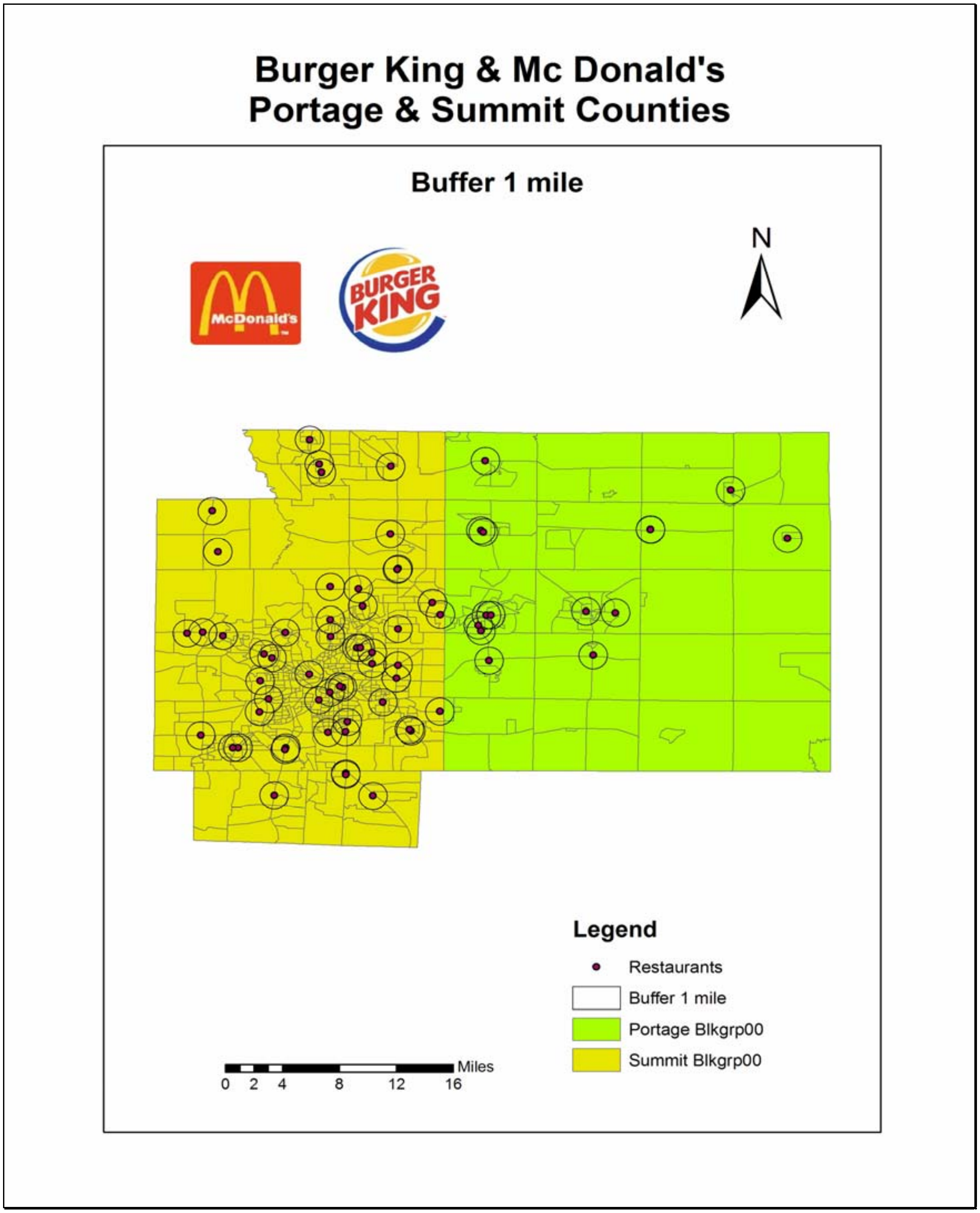

Fig 14: Burger King & McDonald's-Portage & Summit Counties (Buffer 1-mile)

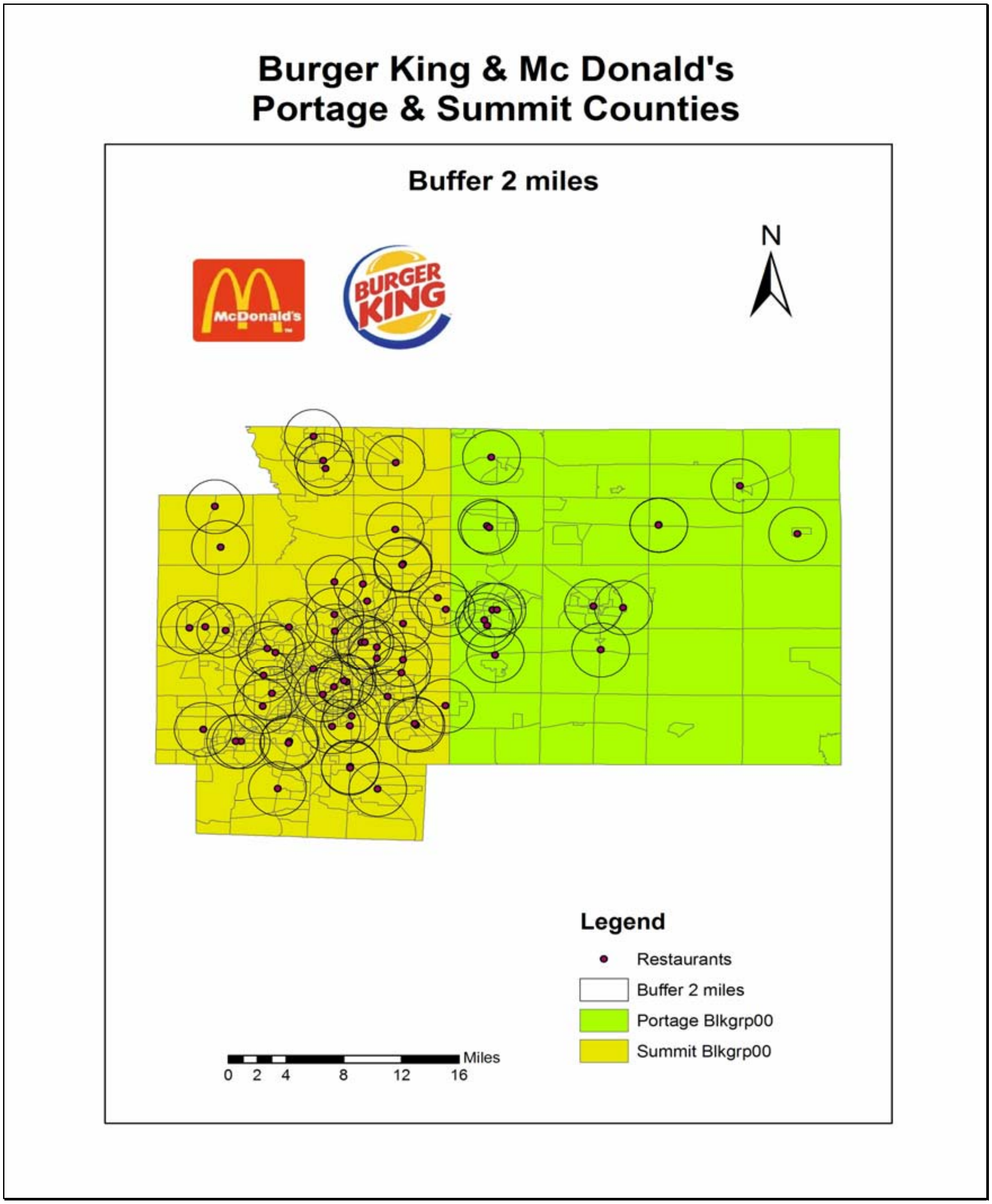

Fig 15: Burger King & McDonald's Portage & Summit Counties (Buffer 2 miles)

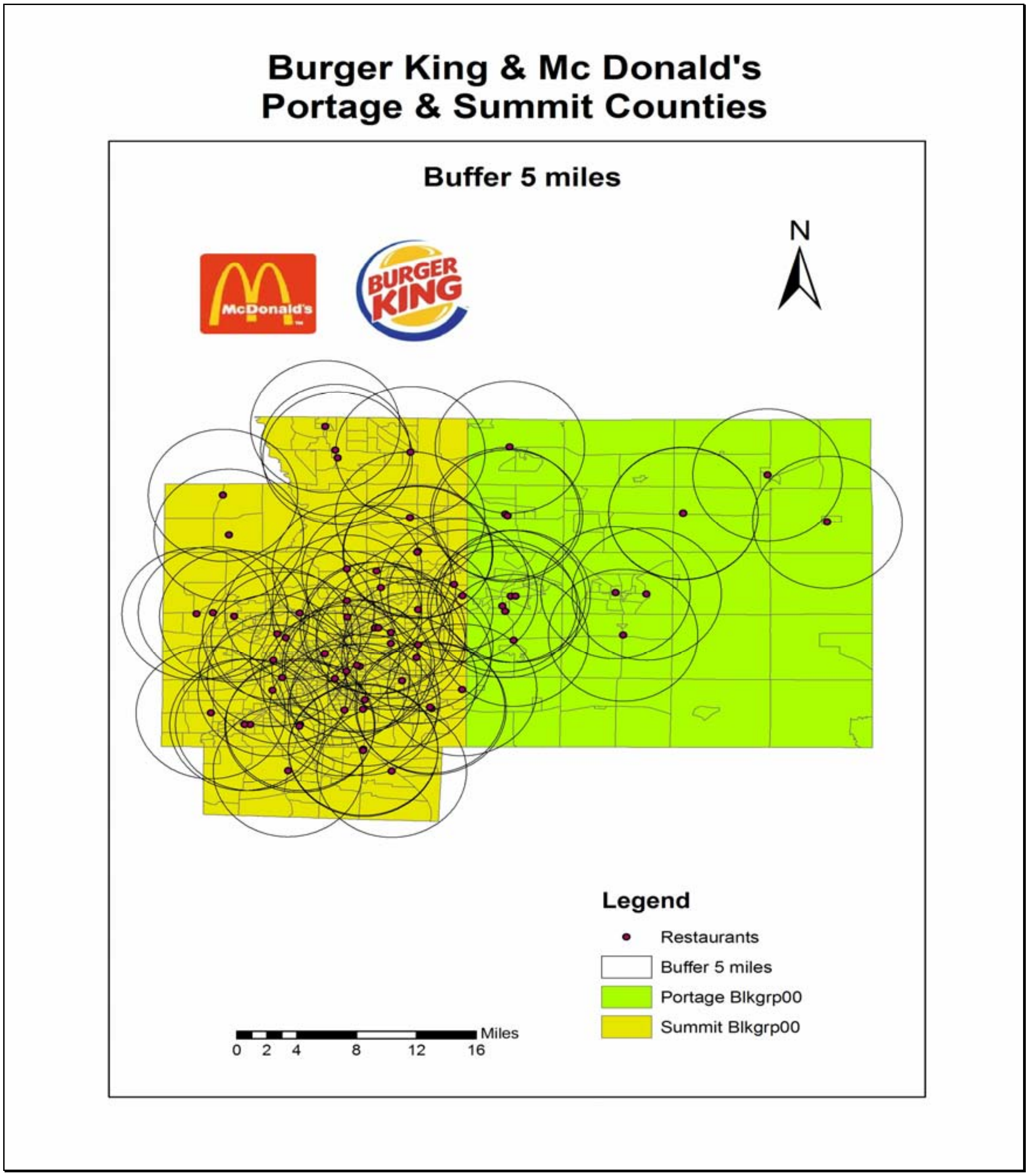

Fig 16: Burger King & McDonald’s Portage & Summit Counties (Buffer 5 miles)

(c.) Overlay Analysis:

Map overlay is one of the fundamental operations of GIS (Sadahiro, 2004). Overlay Analysis tools allow the user to apply weights to several inputs and combine them into a single output. In other words, it applies a common scale of values to diverse and dissimilar input to create an integrated analysis (ArcGIS Desktop Help 9.2). Overlay operation not only merges all line work, but also the attributes of the features taking part in the overlay are carried through to create a new polygon.

Thiessen polygon and Buffer polygons (1, 2 and 5 miles) layers are overlaid on the data layer of Census Block groups. The Block group level data layer is associated with information of percentage of Whites, Blacks, Native Americans, Asians, Pacific Islanders, Other Races, Two Plus Races and Average Median Household Income. The Union tool has been used to carry out an overlay of generated Thiessen polygons and buffer polygons over the Census block group map (reporting demographic and household income data).

Union calculates the geometric intersection of any number of feature class and layers. For doing a union analysis, all inputs must be of a common geometry type and the output will be of that same geometry type. The output features have the attributes of all the input features that are '*unioned*' together (ArcGIS Desktop Help 9.2).

Union tool in ArcGIS does the following:

(i.) It determines the spatial reference of the output. All the input feature classes and layers are projected into this spatial reference.

(ii.) Union cracks and clusters the features. The cracking process inserts vertices at the intersection of feature edges and clustering snaps together vertices that are within the XY tolerance.

(iii.) A geometric relationship is formed between features of the various feature classes and layers that are overlaid.

4.2.3 **Regression Analysis**:

Assuming that Thiessen polygons or Buffer polygons are a reasonable representation of trade areas, it is then possible to summarize the socio-economic and other demographic attributes for the fast-food restaurants available in the study over Thiessen polygons and Buffer polygons.

Regression is a statistical technique that has been used to quantify the level of change in the outcome of dependent variable that would be expected based upon a given level of change in one or more independent variables (Skrepnek, 2005). Linear regression describes the trend of changes in values of a dependent variable as a straight-line function with respect to one or more independent variables. Simple linear regression refers to a case where in a linear relationship is analyzed between one dependent variable and one independent variable, whereas multiple regressions involve more than one explanatory (independent) variable.

Multi-variate Regression models the degree to which the variation within values of a dependent variable measured at ratio scale (for example, Annual Sales of Burger King and McDonald's Restaurants in Portage and Summit Counties) as explained by predictors such as the percentage to total population of Whites, Blacks, Native Americans, Asians, Pacific Islanders, Others, Two Plus races and median household income. The multivariate linear regression model assumes that there is a direct linear relationship between the dependent variable and each predictor. This relationship is described as:

$$Y = b_0 + b_1 x_1 + b_2 x_2 + \ldots + b_p x_p + e$$

Where: -

Y = the value of the i^th case of the dependent scale variable

p = no. of predictors

b_i = the i^th regression coefficient, i = 0,…,p

x_i = the i^th predictor

e = error term

This regression model is referred to as linear because increasing the value of the i^th predictor by one unit increases the value of the dependent by b_i units. The intercept, b_0, is the value of dependent variable when all predictors are set to 0.

The validity of a regression model is often evaluated by the value of the coefficient of determination, or know otherwise as R^2. It gives the degree to which variation among values in the dependent variable explained by the combined variation of the predictor variables (independent variables). For example, if $R^2 = 0.53$, the regression model is said to have 53% of the variability in the dependent variable being explained by the variation among the independent variables.

In terms of statistical testing, regression models are often tested with a hypothesis of no statistical significance. This is often translated to

$$H_o : R^2 = 0$$

Which means that the variation among values of the dependent variable does not have a statistically significant relationship with the variation among values in the predictor variables.

Beyond testing the statistical significance of R^2, it is possible to test the significance of the model parameters. These would include the regression coefficients and the error term. The concepts of this statistical testing would also follow the same general format as that of the hypothesis for testing R^2.

For the purpose of testing hypotheses about the values of model parameters, the linear regression model assumes the following:

a.) The error term has a normal distribution with a mean of zero.

b.) The variance of the error term is constant across cases and independent of the variables in the model

c.) The value of the error term for a given case is independent of the values of the variables in the model and of the values of the error term for other cases.

In addition to examining the relationship between dependent and independent variables by regression models, it should be noted that regression models could take one of many forms. For this study, both Enter and stepwise regression models are used. The stepwise regression model is used here for two reasons:

a.) That no pre-conceptualized relative importance of each independent variable will be assumed or used. This is to avoid any bias that may be introduced by the analyst.

b.) That the stepwise regression model reveals the importance of each individual independent variable one at a time. This will allow analysis be carried out to compare how each individual independent variable perform in different regression models run for this study.

The statistical analysis in this thesis research uses the SPSS (Statistical Package for Social Science) of SPSS Inc. (233 S. Wacher Dr, Chicago, IL 60606). SPSS is widely used among academic and professional analysts for its robustness and accuracy of statistical calculations. Furthermore, Kent State University holds a site license of SPSS that enables faculty and students to access the package for academic studies. The paragraphs below discuss the output from multivariate regression analysis by SPSS. For the purpose of illustration, a sample output is included here to facilitate the discussion.

The following tables of the statistical output from SPSS are considered for this study:

Model Summary Table:

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.341(a)	.117	.014	523.998

b Dependent Variable: ANN_SALE
a Predictors: (Constant), Ave_MEDHHI, PerASIAN, PerPACIF, PerNATIVE, PerBLACK, PerOTHRS, PerTWOPL

In the model summary R gives the strength of correlation among included variables. As mentioned earlier, R-squared, or R^2 is R that has been squared. It represents the total amount of variance in the dependent variable accounted for by the independent variables. The value of R^2 can be interpreted as the proportion of variance explained by moving the decimal point two places to the right and expressing this value as a percentage. The coefficient of determination is R-squared. R^2 gives an indication of how good a choice the independent variables are in predicting the dependent variable. The larger the value the better the regression line describes the data. Adjusted R square is computed using the formula:

$$1-\frac{(1-R^2)(N-1)}{N-K-1}$$

When the number of observations is small and the number of predictors (k) is large, there will be a much greater difference between R Square and Adjusted R Square (because the ratio of (N-1)/ (N-k-1) and will be much less than 1). By contrast, when the number of observations is very large as compared to the number of predictors, the value of R square and adjusted R square will be much closer as the ratio of (N-1)/ (N-k-1) will approach 1.

Analysis of Variance (ANOVA) Table:

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2174266.862	7	310609.552	1.131	.356(a)
	Residual	16474463.770	60	274574.396		
	Total	18648730.632	67			

a Predictors: (Constant), Ave_MEDHHI, PerASIAN, PerPACIF, PerNATIVE, PerBLACK, PerOTHRS, PerTWOPL
b Dependent Variable: ANN_SALE

ANOVA is a multivariate regression output that examines the variability, which can be applied to look at the total amount of variance in the variance among the dependent variables. It also gives clues to how much of that variance is accounted for by the independent variables. The significance of the value F (called Sig. In the table) is the probability associated with R^2. This probability can be regarded of as a significance value for the whole model or a significant value of R^2 (Miles and Shevlin, 2001).

Coefficient Table (Parameter Estimates):

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1276.802	582.794		2.191	.032
	PerBLACK	.630	6.909	.015	.091	.928
	PerNATIVE	-714.970	583.791	-.175	-1.225	.225
	PerASIAN	-42.460	104.981	-.075	-.404	.687
	PerPACIF	2122.583	1549.094	.195	1.370	.176
	PerOTHRS	-435.873	402.795	-.181	-1.082	.284
	PerTWOPL	160.076	162.492	.234	.985	.329
	Ave_MEDHHI	.003	.009	.077	.332	.741

a. Dependent Variable: ANN_SALE

In the Coefficient Tables the following parameters have been used for the study:

***t* and Sig.:**

These columns provide the *t*-value and 2-tailed *p*-value used in testing the null hypothesis that the coefficient/ parameter is 0. The *p*-value is the calculated probability level of the tested parameter. If using a 2-tailed test, each *p*-value is compared to the pre-selected value of α – a pre-defined level of statistical significance. Coefficients having *p*-values less than the pre-defined α are statistically significant. Following a conventional level of statistical significance, this study also uses $\alpha = 0.05$. Therefore, regression coefficients having a *p*-value of 0.05 or less are said to be statistically significantly different from 0 (*i.e.*, the null hypothesis can be rejected and it can be said that the coefficient is statistically significantly different from 0).

A comparative analysis of the R^2 of the Thiessen polygons and Buffer polygons with three different buffering limits has been done to see how well or poorly either of the two approaches captures the variations in the sales volumes of fast food stores in the study area.

In addition a comparative analysis of the R2 of three buffer limits has also been performed to determine a near ideal buffering limit for each of the fast food retail stores

4.3 Study Area

A total of 65 fast-food restaurants in Summit County and Portage County of Ohio are included in this study. These 65 restaurants are all the McDonalds and the Burger King restaurants in these two counties. These two brands are chosen because they are the top two leaders in fast food industry in the region and the food items they serve are similar and, to a great extent, substituted easily. There have been various reasons why this particular set of counties has been chosen to apply the retail location analysis model. A variety of socio-economic and demographic attributes are found to be consistent with those of the state as well as those of the national averages. These counties also represent a good mix of urban, rural as well as suburban lifestyles (Joseph, 2005). Hence, a retail location analysis done for these counties can also be applied to several other retail markets across the country.

The use of McDonalds and Burger Kings as study subjects is based on the assumption that quality of food at both the chains is expected to be standard at each of their stores (McDonalds' Burger will be the same quality at all McDonalds outlets and similarly for

Burger King as well). With the quality of products controlled, the comparative studies of how socio-economic and demographic factors have led us to understand how markets with different location factors perform. These results can be applied to other types of businesses as well, if product quality control can be achieved.

4.4 Summary

Trade area analysis has been an important and popular concept with retail businesses. GIS tools and statistical analysis can be used to calculate the size and potential of the market based on the geodemographic profile of the trade area. This study aims at developing a methodology for analyzing the relationship between fast food store performance and the demographic and socio-economic variables in the outlets' catchment areas in Portage and Summit Counties, Ohio. These counties represent a good mix of urban, rural as well as suburban lifestyles and therefore, the location analysis can be applied to several other retail markets across the United States.

The locations of Burger King and McDonald's QSR have been geocoded and a catchment area analysis has been done for these restaurants by constructing Thiessen and buffer polygons around the locations. Geoprocessing environment including overlay and proximity analysis has been made use of to see how the ethnic composition of population and the median household income in trade areas are related to the performance of the QSR. The statistical technique of regression analysis has been used to quantify the level of change in the outcome of Annual Sales of the restaurants that would be based upon a given level of change in percentage of ethnic populations and the median household income of the trade areas. In the end, a comparative analysis of the coefficient of determination (R^2) of Thiessen and buffer polygons of different buffering units show how well or poorly either of these two catchment analysis approaches capture variations in sales volumes of the QSR. This comparative analysis also helps to determine an ideal buffering limit for each of the fast food restaurants.

Chapter 5

Analysis and Discussions

The Coefficient of Determination, or R^2 is the percent of the Total Sum of Squares that is explained: regression Sum of Squares divided by Total Sum of Squares. The denominator is fixed and the numerator can only increase. Each additional variable used in the equation, increases the numerator at least slightly, resulting in a higher R^2 even when the new variable causes the equation to become less efficient.

The adjusted R^2 represents the result of adjusting both the numerator and denominator by their respective degrees of freedom. Adjusted R^2 can decline in value if the contribution to the explained deviation by the additional variable is less than the impact on the degrees of freedom. The adjusted R^2 will react to alternative equations for the same dependent variable in a manner similar to the Standard Error of the estimate, i.e. the equation with the smallest Standard Error of the Estimate will most likely also have the highest adjusted R^2. Unlike R^2 , adjusted R^2 is referred to as an index value and not a percept (Jensen, 2006). The statistical models have been tabulated based on spatial configuration of Buffers 1, 2, 5 miles and Thiessen, Restaurants within each County, Restaurant-wise and County-wise (Tables2-5).

Table 2: Spatial Configuration (Regression Analysis: Enter Method: S-Summit, P-Portage, M-McDonald's, B-Burger King)

(. – Excluded Variables)

Model	Buffer	N	R2	Adj_R2	F	Prob(F)	Constant	%White	%Black	%Native	%Asian	%Pacific	%Others	%Twopl	Avg_MedInc
Buffer 1 mile															
BP	1-mile	5	1.00	.	.	.	785.85	.	-9.81	.	.	.	564.77	-149.34	0.01
BS	***1-mile***	***19***	***0.75***	***0.59***	***4.70***	***0.01***	***1020.52***	.	***2.90***	***412.86***	***58.52***	***1196.38***	***75.21***	***72.13***	***0.00***
BPS	***1-mile***	***24***	***0.58***	***0.39***	***3.10***	***0.03***	***583.42***	.	***6.22***	***131.59***	***-49.98***	***1285.68***	***271.74***	***105.85***	***0.01***
BMP	1-mile	14	0.67	0.29	1.76	0.25	12.69	.	-43.62	-690.53	172.77	5406.49	-1142.84	645.68	0.02
MP	1-mile	9	0.89	0.08	1.10	1.10	1003.46	.	-171.09	1793.71	-37.19	5446.70	910.34	434.63	0.01
MPS	1-mile	41	0.11	-0.08	0.56	0.78	1498.37	.	3.34	-309.47	-106.25	134.18	166.64	23.17	0.01
BMPS	1-mile	64	0.15	0.04	1.38	0.23	1059.84	.	1.39	-105.10	-119.13	1064.29	9.52	135.64	0.01
BMS	1-mile	51	0.05	-0.10	0.36	0.92	1307.01	.	4.20	-41.33	-54.41	1452.19	6.62	47.71	0.00
MS	1-mile	32	0.10	-0.16	0.37	0.91	1840.61	.	5.97	-270.08	-35.69	265.56	-1.82	-79.29	0.00
Buffer 2 miles															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**Avg_MedInc**
BP	2-mile	5	1.00	.	.	.	-340.33	.	-5.28	790.08	.	.	465.54		0.02
BS	***2-mile***	***19***	***0.78***	***0.64***	***5.55***	***0.01***	***1805.82***	***-5.18***	.	***352.26***	***77.62***	***1041.00***	***-427.44***	***105.27***	***-0.01***
BPS	***2-mile***	***24***	***0.65***	***0.50***	***4.34***	***0.01***	***1390.14***	***-6.01***	.	***-469.05***	***-4.70***	***1852.82***	***-301.94***	***207.40***	***0.00***
MP	2-mile	9	0.93	0.46	1.99	0.50	1902.26	.	-227.38	3460.77	-856.14	-20051.19	4209.38	80.15	0.00
MPS	2-mile	41	0.12	-0.06	0.67	0.70	1907.97	-4.99	.	-285.72	-155.52	-145.62	275.00	-5.90	0.01
BMP	2-mile	14	0.73	0.41	2.31	0.16	-1172.98	.	5.97	-1293.89	-284.92	14240.75	237.58	877.64	0.04
BMS	2-mile	51	0.07	-0.08	0.46	0.86	2487.62	-8.32		-203.00	-50.69	-184.05	-399.43	-32.10	0.00
BMPS	2-mile	64	0.17	0.07	1.68	0.13	1586.19	-6.33		-182.40	-176.96	1553.99	-399.05	161.59	0.01
MS	2-mile	32	0.14	-0.11	0.57	0.78	1819.46		7.46	-420.01	-76.28	209.04	27.71	-111.01	0.00
Buffer 5 miles															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**Avg_MedInc**
BP	5-mile	5	1.00	.	.	.	33.19	.	.	-816.71	.	.	-1251.61	1077.02	0.00
MP	5-mile	9	0.99	0.95	25.17	0.15	10683.60	.	-2130.85	20024.62	2905.38	-116642.80	-3407.87	-3040.52	-0.08
MPS	5-mile	41	0.18	0.01	1.03	0.43	-27.03	.	-5.13	1266.09	-202.24	1309.98	-702.16	485.61	0.03
BPS	5-mile	24	0.43	0.18	1.73	0.17	416.40	.	-5.25	178.55	116.92	933.62	107.62	278.30	0.00
BS	5-mile	19	0.42	0.05	1.12	0.41	400.44	.	-5.43	9.22	158.08	470.97	904.65	145.20	0.00
MS	5-mile	32	0.25	0.03	1.15	0.36	842.03	.	5.13	1494.91	13.74	1701.17	-2476.06	503.33	0.01
BMPS	5-mile	64	0.10	-0.01	0.91	0.51	2524.21	.	3.05	-566.60	173.71	38.91	-1393.99	27.93	-0.02
BMS	5-mile	51	0.11	-0.04	0.76	0.63	2287.86	.	4.54	-242.55	225.52	1036.14	-1799.99	115.35	-0.01
BMP	5-mile	14	0.48	-0.13	0.79	0.62	-866.07	.	374.09	-3673.27	-666.50	69201.60	-2242.17	456.17	0.04
Thiessen															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**Avg_MedInc**
BP	Theissen	5	1.00	.	.	.	559.51	.	.	.	.	-8595.10	-157.85	55.24	0.01
MP	Theissen	9	0.95	0.60	2.72	0.44	2065.87	.	-716.37	-1316.26	1327.26	-51145.21	1789.96	1387.65	-0.01
MPS	Theissen	41	0.16	-0.02	0.86	0.55	2232.98	.	5.93	-622.88	19.19	727.01	-436.58	-126.28	-0.01
BS	***Theissen***	***19***	***0.72***	***0.54***	***4.02***	***0.02***	***842.65***	.	***8.87***	***482.39***	***1.08***	***1251.79***	***-305.08***	***81.89***	***0.00***
BPS	***Theissen***	***24***	***0.66***	***0.52***	***4.50***	***0.01***	***750.27***	.	***10.94***	***295.41***	***-20.82***	***1517.22***	***-192.28***	***71.05***	***0.00***
BMP	Theissen	14	0.76	0.47	2.65	0.13	3752.01	.	-36.51	-3067.44	175.59	-36458.61	-1082.73	-270.41	-0.02
BMPS	Theissen	64	0.17	0.06	1.59	0.16	1503.71	.	5.63	-579.09	-99.25	1037.93	-191.28	51.56	0.00
BMS	Theissen	51	0.10	-0.05	0.69	0.68	1417.84	.	7.42	-414.44	-85.96	832.62	-124.20	39.75	0.00
MS	Theissen	32	0.19	-0.05	0.78	0.61	1918.09	.	6.55	-634.38	-77.36	759.64	-222.54	-62.37	0.00

Table 3: Restaurant wise (Regression Analysis: Enter Method: S-Summit, P-Portage, M-McDonald's, B-Burger King)

Burger King & McDonald's															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
BMP	1-mile	14	0.67	0.29	1.76	0.25	12.69	.	-43.62	-690.53	172.77	5406.49	-1142.84	645.68	0.02
BMP	2-mile	14	0.73	0.41	2.31	0.16	-1172.98	.	5.97	-1293.89	-284.92	14240.75	237.58	877.64	0.04
BMP	5-mile	14	0.48	-0.13	0.79	0.62	-866.07	.	374.09	-3673.27	-666.50	69201.60	-2242.17	456.17	0.04
BMP	Theissen	14	0.76	0.47	2.65	0.13	3752.01	.	-36.51	-3067.44	175.59	-36458.61	-1082.73	-270.41	-0.02
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
BMPS	1-mile	64	0.15	0.04	1.38	0.23	1059.84	.	1.39	-105.10	-119.13	1064.29	9.52	135.64	0.01
BMPS	2-mile	64	0.17	0.07	1.68	0.13	1586.19	-6.33		-182.40	-176.96	1553.99	-399.05	161.59	0.01
BMPS	5-mile	64	0.10	-0.01	0.91	0.51	2524.21	.	3.05	-566.60	173.71	38.91	-1393.99	27.93	-0.02
BMPS	Theissen	64	0.17	0.06	1.59	0.16	1503.71	.	5.63	-579.09	-99.25	1037.93	-191.28	51.56	0.00
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
BMS	1-mile	51	0.05	-0.10	0.36	0.92	1307.01	.	4.20	-41.33	-54.41	1452.19	6.62	47.71	0.00
BMS	2-mile	51	0.07	-0.08	0.46	0.86	2487.62	-8.32		-203.00	-50.69	-184.05	-399.43	-32.10	0.00
BMS	5-mile	51	0.11	-0.04	0.76	0.63	2287.86	.	4.54	-242.55	225.52	1036.14	-1799.99	115.35	-0.01
BMS	Theissen	51	0.10	-0.05	0.69	0.68	1417.84	.	7.42	-414.44	-85.96	832.62	-124.20	39.75	0.00
Burger King															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
BP	1-mile	5	1.00	.	.	.	785.85	.	-9.81	.	.	.	564.77	-149.34	0.01
BP	2-mile	5	1.00	.	.	.	-340.33	.	-5.28	790.08	.	.	465.54		0.02
BP	5-mile	5	1.00	.	.	.	33.19	.	.	-816.71	.	.	-1251.61	1077.02	0.00
BP	Theissen	5	1.00	.	.	.	559.51	.	.	.	.	-8595.10	-157.85	55.24	0.01
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
BPS	***1-mile***	***24***	***0.58***	***0.39***	***3.10***	***0.03***	***583.42***	.	***6.22***	***131.59***	***-49.98***	***1285.68***	***271.74***	***105.85***	***0.01***
BPS	***2-mile***	***24***	***0.65***	***0.50***	***4.34***	***0.01***	***1390.14***	***-6.01***	.	***-469.05***	***-4.70***	***1852.82***	***-301.94***	***207.40***	***0.00***
BPS	5-mile	24	0.43	0.18	1.73	0.17	416.40	.	-5.25	178.55	116.92	933.62	107.62	278.30	0.00
BPS	***Theissen***	***24***	***0.66***	***0.52***	***4.50***	***0.01***	***750.27***	.	***10.94***	***295.41***	***-20.82***	***1517.22***	***-192.28***	***71.05***	***0.00***
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
BS	***1-mile***	***19***	***0.75***	***0.59***	***4.70***	***0.01***	***1020.52***	.	***2.90***	***412.86***	***58.52***	***1196.38***	***75.21***	***72.13***	***0.00***
BS	***2-mile***	***19***	***0.78***	***0.64***	***5.55***	***0.01***	***1805.82***	***-5.18***	.	***352.26***	***77.62***	***1041.00***	***-427.44***	***105.27***	***-0.01***
BS	5-mile	19	0.42	0.05	1.12	0.41	400.44	.	-5.43	9.22	158.08	470.97	904.65	145.20	0.00
BS	***Theissen***	***19***	***0.72***	***0.54***	***4.02***	***0.02***	***842.65***	.	***8.87***	***482.39***	***1.08***	***1251.79***	***-305.08***	***81.89***	***0.00***
McDonald's															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
MP	1-mile	9	0.89	0.08	1.10	1.10	1003.46	.	-171.09	1793.71	-37.19	5446.70	910.34	434.63	0.01
MP	2-mile	9	0.93	0.46	1.99	0.50	1902.26	.	-227.38	3460.77	-856.14	-20051.19	4209.38	80.15	0.00
MP	5-mile	9	0.99	0.95	25.17	0.15	10683.60	.	-2130.85	20024.62	2905.38	-116642.80	-3407.87	-3040.52	-0.08
MP	Theissen	9	0.95	0.60	2.72	0.44	2065.87	.	-716.37	-1316.26	1327.26	-51145.21	1789.96	1387.65	-0.01
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
MPS	1-mile	41	0.11	-0.08	0.56	0.78	1498.37	.	3.34	-309.47	-106.25	134.18	166.64	23.17	0.01
MPS	2-mile	41	0.12	-0.06	0.67	0.70	1907.97	-4.99	.	-285.72	-155.52	-145.62	275.00	-5.90	0.01
MPS	5-mile	41	0.18	0.01	1.03	0.43	-27.03	.	-5.13	1266.09	-202.24	1309.98	-702.16	485.61	0.03
MPS	Theissen	41	0.16	-0.02	0.86	0.55	2232.98	.	5.93	-622.88	19.19	727.01	-436.58	-126.28	-0.01
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
MS	1-mile	32	0.10	-0.16	0.37	0.91	1840.61	.	5.97	-270.08	-35.69	265.56	-1.82	-79.29	0.00
MS	2-mile	32	0.14	-0.11	0.57	0.78	1819.46		7.46	-420.01	-76.28	209.04	27.71	-111.01	0.00
MS	5-mile	32	0.25	0.03	1.15	0.36	842.03	.	5.13	1494.91	13.74	1701.17	-2476.06	503.33	0.01
MS	Theissen	32	0.19	-0.05	0.78	0.61	1918.09	.	6.55	-634.38	-77.36	759.64	-222.54	-62.37	0.00

Table 4: County wise (Regression Analysis: Enter Method: S-Summit, P-Portage, M-McDonald’s, B-Burger King)

Model	Buffer	N	R2	Adj_R2	F	Prob(F)	Constant	%White	%Black	%Native	%Asian	%Pacific	%Others	%Twopl	g_MedInc
Portage County															
BMP	1-mile	14	0.67	0.29	1.76	0.25	12.69	.	-43.62	-690.53	172.77	5406.49	-1142.84	645.68	0.02
BMP	2-mile	14	0.73	0.41	2.31	0.16	-1172.98	.	5.97	-1293.89	-284.92	14240.75	237.58	877.64	0.04
BMP	5-mile	14	0.48	-0.13	0.79	0.62	-866.07	.	374.09	-3673.27	-666.50	69201.60	-2242.17	456.17	0.04
BMP	Theissen	14	0.76	0.47	2.65	0.13	3752.01	.	-36.51	-3067.44	175.59	-36458.61	-1082.73	-270.41	-0.02
BP	1-mile	5	1.00	.	.	.	785.85	.	-9.81	.	.	.	564.77	-149.34	0.01
BP	2-mile	5	1.00	.	.	.	-340.33	.	-5.28	790.08	.	.	465.54		0.02
BP	5-mile	5	1.00	.	.	.	33.19	.	.	-816.71	.	.	-1251.61	1077.02	0.00
BP	Theissen	5	1.00	.	.	.	559.51	.	.	.	.	-8595.10	-157.85	55.24	0.01
MP	1-mile	9	0.89	0.08	1.10	1.10	1003.46	.	-171.09	1793.71	-37.19	5446.70	910.34	434.63	0.01
MP	2-mile	9	0.93	0.46	1.99	0.50	1902.26	.	-227.38	3460.77	-856.14	-20051.19	4209.38	80.15	0.00
MP	5-mile	9	0.99	0.95	25.17	0.15	10683.60	.	-2130.85	20024.62	2905.38	-116642.80	-3407.87	-3040.52	-0.08
MP	Theissen	9	0.95	0.60	2.72	0.44	2065.87	.	-716.37	-1316.26	1327.26	-51145.21	1789.96	1387.65	-0.01
Summit County															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
BMS	1-mile	51	0.05	-0.10	0.36	0.92	1307.01	.	4.20	-41.33	-54.41	1452.19	6.62	47.71	0.00
BMS	2-mile	51	0.07	-0.08	0.46	0.86	2487.62	-8.32		-203.00	-50.69	-184.05	-399.43	-32.10	0.00
BMS	5-mile	51	0.11	-0.04	0.76	0.63	2287.86	.	4.54	-242.55	225.52	1036.14	-1799.99	115.35	-0.01
BMS	Theissen	51	0.10	-0.05	0.69	0.68	1417.84	.	7.42	-414.44	-85.96	832.62	-124.20	39.75	0.00
BS	***1-mile***	***19***	***0.75***	***0.59***	***4.70***	***0.01***	***1020.52***	.	***2.90***	***412.86***	***58.52***	***1196.38***	***75.21***	***72.13***	***0.00***
BS	***2-mile***	***19***	***0.78***	***0.64***	***5.55***	***0.01***	***1805.82***	***-5.18***	.	***352.26***	***77.62***	***1041.00***	***-427.44***	***105.27***	***-0.01***
BS	5-mile	19	0.42	0.05	1.12	0.41	400.44	.	-5.43	9.22	158.08	470.97	904.65	145.20	0.00
BS	***Theissen***	***19***	***0.72***	***0.54***	***4.02***	***0.02***	***842.65***	.	***8.87***	***482.39***	***1.08***	***1251.79***	***-305.08***	***81.89***	***0.00***
MS	1-mile	32	0.10	-0.16	0.37	0.91	1840.61	.	5.97	-270.08	-35.69	265.56	-1.82	-79.29	0.00
MS	2-mile	32	0.14	-0.11	0.57	0.78	1819.46		7.46	-420.01	-76.28	209.04	27.71	-111.01	0.00
MS	5-mile	32	0.25	0.03	1.15	0.36	842.03	.	5.13	1494.91	13.74	1701.17	-2476.06	503.33	0.01
MS	Theissen	32	0.19	-0.05	0.78	0.61	1918.09	.	6.55	-634.38	-77.36	759.64	-222.54	-62.37	0.00
Portage & Summit Counties															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**%White**	**%Black**	**%Native**	**%Asian**	**%Pacific**	**%Others**	**%Twopl**	**g_MedInc**
BMPS	1-mile	64	0.15	0.04	1.38	0.23	1059.84	.	1.39	-105.10	-119.13	1064.29	9.52	135.64	0.01
BMPS	2-mile	64	0.17	0.07	1.68	0.13	1586.19	-6.33		-182.40	-176.96	1553.99	-399.05	161.59	0.01
BMPS	5-mile	64	0.10	-0.01	0.91	0.51	2524.21	.	3.05	-566.60	173.71	38.91	-1393.99	27.93	-0.02
BMPS	Theissen	64	0.17	0.06	1.59	0.16	1503.71	.	5.63	-579.09	-99.25	1037.93	-191.28	51.56	0.00
BPS	***1-mile***	***24***	***0.58***	***0.39***	***3.10***	***0.03***	***583.42***	.	***6.22***	***131.59***	***-49.98***	***1285.68***	***271.74***	***105.85***	***0.01***
BPS	***2-mile***	***24***	***0.65***	***0.50***	***4.34***	***0.01***	***1390.14***	***-6.01***	.	***-469.05***	***-4.70***	***1852.82***	***-301.94***	***207.40***	***0.00***
BPS	5-mile	24	0.43	0.18	1.73	0.17	416.40	.	-5.25	178.55	116.92	933.62	107.62	278.30	0.00
BPS	***Theissen***	***24***	***0.66***	***0.52***	***4.50***	***0.01***	***750.27***	.	***10.94***	***295.41***	***-20.82***	***1517.22***	***-192.28***	***71.05***	***0.00***
MPS	1-mile	41	0.11	-0.08	0.56	0.78	1498.37	.	3.34	-309.47	-106.25	134.18	166.64	23.17	0.01
MPS	2-mile	41	0.12	-0.06	0.67	0.70	1907.97	-4.99	.	-285.72	-155.52	-145.62	275.00	-5.90	0.01
MPS	5-mile	41	0.18	0.01	1.03	0.43	-27.03	.	-5.13	1266.09	-202.24	1309.98	-702.16	485.61	0.03
MPS	Theissen	41	0.16	-0.02	0.86	0.55	2232.98	.	5.93	-622.88	19.19	727.01	-436.58	-126.28	-0.01

Table 5: Restaurant wise and County wise (Regression Analysis: Enter Method: S-Summit, P-Portage, M-McDonald's, B-Burger King)

Portage County															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**% White**	**% Black**	**% Native**	**% Asian**	**% Pacific**	**% Others**	**% Twopl**	**Avg_MedInc**
BMP	1-mile	14	0.67	0.29	1.76	0.25	12.69	.	-43.62	-690.53	172.77	5406.49	-1142.84	645.68	0.02
BMP	2-mile	14	0.73	0.41	2.31	0.16	-1172.98	.	5.97	-1293.89	-284.92	14240.75	237.58	877.64	0.04
BMP	5-mile	14	0.48	-0.13	0.79	0.62	-866.07	.	374.09	-3673.27	-666.50	69201.60	-2242.17	456.17	0.04
BMP	Theissen	14	0.76	0.47	2.65	0.13	3752.01	.	-36.51	-3067.44	175.59	-36458.61	-1082.73	-270.41	-0.02
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**% White**	**% Black**	**% Native**	**% Asian**	**% Pacific**	**% Others**	**% Twopl**	**Avg_MedInc**
BP	1-mile	5	1.00	.	.	.	785.85	.	-9.81	.	.	.	564.77	-149.34	0.01
BP	2-mile	5	1.00	.	.	.	-340.33	.	-5.28	790.08	.	.	465.54		0.02
BP	5-mile	5	1.00	.	.	.	33.19	.	.	-816.71	.	.	-1251.61	1077.02	0.00
BP	Theissen	5	1.00	.	.	.	559.51	.	.	.	.	-8595.10	-157.85	55.24	0.01
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**% White**	**% Black**	**% Native**	**% Asian**	**% Pacific**	**% Others**	**% Twopl**	**Avg_MedInc**
MP	1-mile	9	0.89	0.08	1.10	1.10	1003.46	.	-171.09	1793.71	-37.19	5446.70	910.34	434.63	0.01
MP	2-mile	9	0.93	0.46	1.99	0.50	1902.26	.	-227.38	3460.77	-856.14	-20051.19	4209.38	80.15	0.00
MP	5-mile	9	0.99	0.95	25.17	0.15	10683.60	.	-2130.85	20024.62	2905.38	-116642.80	-3407.87	-3040.52	-0.08
MP	Theissen	9	0.95	0.60	2.72	0.44	2065.87	.	-716.37	-1316.26	1327.26	-51145.21	1789.96	1387.65	-0.01
Summit County															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**% White**	**% Black**	**% Native**	**% Asian**	**% Pacific**	**% Others**	**% Twopl**	**Avg_MedInc**
BMS	1-mile	51	0.05	-0.10	0.36	0.92	1307.01	.	4.20	-41.33	-54.41	1452.19	6.62	47.71	0.00
BMS	2-mile	51	0.07	-0.08	0.46	0.86	2487.62	-8.32		-203.00	-50.69	-184.05	-399.43	-32.10	0.00
BMS	5-mile	51	0.11	-0.04	0.76	0.63	2287.86	.	4.54	-242.55	225.52	1036.14	-1799.99	115.35	-0.01
BMS	Theissen	51	0.10	-0.05	0.69	0.68	1417.84	.	7.42	-414.44	-85.96	832.62	-124.20	39.75	0.00
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**% White**	**% Black**	**% Native**	**% Asian**	**% Pacific**	**% Others**	**% Twopl**	**Avg_MedInc**
BS	***1-mile***	***19***	***0.75***	***0.59***	***4.70***	***0.01***	***1020.52***	.	***2.90***	***412.86***	***58.52***	***1196.38***	***75.21***	***72.13***	***0.00***
BS	***2-mile***	***19***	***0.78***	***0.64***	***5.55***	***0.01***	***1805.82***	***-5.18***	.	***352.26***	***77.62***	***1041.00***	***-427.44***	***105.27***	***-0.01***
BS	5-mile	19	0.42	0.05	1.12	0.41	400.44	.	-5.43	9.22	158.08	470.97	904.65	145.20	0.00
BS	***Theissen***	***19***	***0.72***	***0.54***	***4.02***	***0.02***	***842.65***	.	***8.87***	***482.39***	***1.08***	***1251.79***	***-305.08***	***81.89***	***0.00***
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**% White**	**% Black**	**% Native**	**% Asian**	**% Pacific**	**% Others**	**% Twopl**	**Avg_MedInc**
MS	1-mile	32	0.10	-0.16	0.37	0.91	1840.61	.	5.97	-270.08	-35.69	265.56	-1.82	-79.29	0.00
MS	2-mile	32	0.14	-0.11	0.57	0.78	1819.46		7.46	-420.01	-76.28	209.04	27.71	-111.01	0.00
MS	5-mile	32	0.25	0.03	1.15	0.36	842.03	.	5.13	1494.91	13.74	1701.17	-2476.06	503.33	0.01
MS	Theissen	32	0.19	-0.05	0.78	0.61	1918.09	.	6.55	-634.38	-77.36	759.64	-222.54	-62.37	0.00
Portage & Summit Counties															
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**% White**	**% Black**	**% Native**	**% Asian**	**% Pacific**	**% Others**	**% Twopl**	**Avg_MedInc**
BMPS	1-mile	64	0.15	0.04	1.38	0.23	1059.84	.	1.39	-105.10	-119.13	1064.29	9.52	135.64	0.01
BMPS	2-mile	64	0.17	0.07	1.68	0.13	1586.19	-6.33		-182.40	-176.96	1553.99	-399.05	161.59	0.01
BMPS	5-mile	64	0.10	-0.01	0.91	0.51	2524.21	.	3.05	-566.60	173.71	38.91	-1393.99	27.93	-0.02
BMPS	Theissen	64	0.17	0.06	1.59	0.16	1503.71	.	5.63	-579.09	-99.25	1037.93	-191.28	51.56	0.00
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**% White**	**% Black**	**% Native**	**% Asian**	**% Pacific**	**% Others**	**% Twopl**	**Avg_MedInc**
BPS	***1-mile***	***24***	***0.58***	***0.39***	***3.10***	***0.03***	***583.42***	.	***6.22***	***131.59***	***-49.98***	***1285.68***	***271.74***	***105.85***	***0.01***
BPS	***2-mile***	***24***	***0.65***	***0.50***	***4.34***	***0.01***	***1390.14***	***-6.01***	.	***-469.05***	***-4.70***	***1852.82***	***-301.94***	***207.40***	***0.00***
BPS	5-mile	24	0.43	0.18	1.73	0.17	416.40	.	-5.25	178.55	116.92	933.62	107.62	278.30	0.00
BPS	***Theissen***	***24***	***0.66***	***0.52***	***4.50***	***0.01***	***750.27***	.	***10.94***	***295.41***	***-20.82***	***1517.22***	***-192.28***	***71.05***	***0.00***
Model	**Buffer**	**N**	**R2**	**Adj_R2**	**F**	**Prob(F)**	**Constant**	**% White**	**% Black**	**% Native**	**% Asian**	**% Pacific**	**% Others**	**% Twopl**	**Avg_MedInc**
MPS	1-mile	41	0.11	-0.08	0.56	0.78	1498.37	.	3.34	-309.47	-106.25	134.18	166.64	23.17	0.01
MPS	2-mile	41	0.12	-0.06	0.67	0.70	1907.97	-4.99	.	-285.72	-155.52	-145.62	275.00	-5.90	0.01
MPS	5-mile	41	0.18	0.01	1.03	0.43	-27.03	.	-5.13	1266.09	-202.24	1309.98	-702.16	485.61	0.03
MPS	Theissen	41	0.16	-0.02	0.86	0.55	2232.98	.	5.93	-622.88	19.19	727.01	-436.58	-126.28	-0.01

Examining the adjusted R^2 of the models (Tables 2-5) show that Burger King's annual sales revenues are better explained by the included independent variables than those of McDonald's sales by the same set of variables. This is apparent by looking at the adjusted R^2 of the models for Buffer-1 mile for Burger King in Summit County and Burger King in Portage and Summit Counties, Buffer-2 miles for Burger King in Summit County and Burger King restaurants in Portage and Summit Counties.

However, this trend is not apparent for the Buffer-5 mile around Burger King restaurants but sales are better explained by the variables for McDonald's restaurants in Portage and McDonald's in Portage and Summit Counties. For the Thiessen buffers, annual sales figures for McDonald's in Portage and McDonald's taken together for both counties are better explained by the independent variables than those for Burger King. The models for Burger King in Portage County have a very small sample size; hence their statistical analysis is unable to project any relevant results.

Looking at the ethnic percentage of population in the buffers, it is seen that in most of the cases, for every unit decrease in the percentage of Black population, there has been a relative increase in Annual Sales of the fast food restaurants. This trend is more pronounced in Portage County as compared to Summit County. Summit County has a higher mean of average median household income ($ 47,176) than Portage County ($ 46,138) (US Census Bureau, 2001). One can infer that the black population is not necessarily the largest clientele for these fast food restaurants. This could also point towards the economic status of the black population as well as their eating preferences.

Taking a look at both Burger King and McDonald's together, a decrease in the percentage of black population and an increase in the sales revenues of these restaurants are recorded for Portage County Buffer-1 mile and Thiessen. For the Native American population a decrease in their numbers reflect an increase in the sales revenues of the restaurants. However, looking at the percentage of their population to the total population of both the counties shows that they are less than 1% in numbers for each buffer around the restaurants.

A decrease in the percentage of Asian population and an increase in sales revenues of the restaurants are recorded for both Burger King and McDonald's in Portage and Summit Counties within Buffers-1, 2, 5 miles and Thiessen. The percentage of Asian population in these counties varies from less than 1% to 3% for the different blocks. An increase in sales revenues as a result of decrease in Asian population reflects that either their numbers are very small to reflect any significant impact over the sales revenues or the other possible reason could be that the Asian population prefers to eat out at other types of restaurants/ ethnic specialty restaurants or cook at home.

With a decrease in the population of all other races (including Hispanics), there is an increase in sales revenues for both Burger King and McDonald's in Buffer-1, 2, 5 miles and Thiessen. But for Burger King and McDonald's (Portage and Summit Counties) Buffer-1 mile, Burger King and McDonald's (Summit County alone) Buffer-1 mile show an increase in sales revenues along with an increase in the percentage of population of all other races (including Hispanics). The percentage of all the other races (including Hispanics) varies from less than 1% to 1.12%.

5.1 Regression Analysis: Enter Method:

Figures for Burger King Restaurants in Portage County with Buffer-1, 2 and 5 miles and Burger King in Portage and Summit County Buffer-5 miles show that a decrease in percentage of Black population reflects an increase in sales revenue. Since the number of Burger King stores in Portage County is only five, it does not give a very clear picture of the actual trend prevailing in the region. However, an increase in sales revenues for Burger King in both Portage as well as Summit County could possibly mean that these restaurants draw clientele from mainly 1 to 2 miles around the restaurants. Customers either walk to the restaurants or drive for a distance of 1~2 miles.

Burger King in Summit County and Burger King and McDonald’s for Portage and Summit County for Buffer-2 miles show an increase in sales revenues with a decrease in percentage of white population. These buffers also show a decrease in percentage of Native Americans, Asians and all other races (including Hispanics). Such a trend suggests that most of these stores are probably located away from the residential areas, in commercial establishments, near office areas or along the highway exits.

McDonald’s restaurants show a rather clear-cut trend in terms of an increase in Annual Sales as a result of a decrease in percentage of black population in Portage County for Buffer-1, 2, 5 miles and Thiessen. For McDonald’s in Summit County a decrease in Asians, Native Americans and all other races, an increase in annual sales is observed.

From the above observations one can infer that:

- Ethnic population and median household income for Buffers-1 and 2 miles around the restaurants better explain Annual Sales for Burger King.
- Ethnic population and median income for Buffer-5 miles better explain Annual Sales for McDonald's. This could mean that either these restaurants are located at highway exits or are more accessible to commuters on their way to or from work or even that the consumers are more willing to travel a longer distance to eat at a McDonald's restaurant as compared to a Burger King restaurant.
- White population is the largest clientele for Burger King and McDonald's restaurants in Portage and Summit County.
- The other minority races (besides the Black population) in these predominantly white counties are too less in numbers to reflect any significant effect on the sales revenues of the fast food restaurants.
- The ethnic minorities have other food preferences and prefer to eat out at other specialty restaurants or even cook at home.
- The ethnic minorities are either economically weaker or more health conscious and prefer to not eat at the fast food restaurants very often.

Analyzing the Probability (F) values for these models show that the coefficients for Burger King (Summit County) Buffer-1 and -2 miles and Thiessen, Burger King (Portage and Summit Counties) Buffer-1 and -2 miles and Thiessen, are statistically significant using alpha value of 0.05 as their p-values are less than 0.05. The statistically significant models are highlighted by gray in the Table no. 2, 3, 4 & 5.

5.2 Regression Analysis: Stepwise Method

Stepwise is one of the most frequently used regression analysis methods. It includes regression models in which the choice of predictive variables is carried out by how much variable contributes to increasing the explained variation in the dependent variable. The statistical software without manual intervention normally does this automatically. The statistical software program determines which variables among the specified set of independent variables will actually be used for the regression, and in which order they will be introduced, beginning with the forced variables and continuing with the other variables, one by one.

After each step the algorithm selects from the remaining predictor variables the variable, which yields the largest reduction in the residual (unexplained) variance of the dependent variable, unless its contribution to the total F-ratio for the regression remains below a specified threshold. Similarly, the program evaluates after each step whether the contribution of any variable already included falls below a specified threshold, in which case it is dropped from the regression.

Stepwise regression was also run for each of these models. However, results were obtained for only few of them. Statistical results were not yielded for McDonald's restaurants unless there were taken with Burger King. These tables show that a decrease in which ethnic population group has yielded the largest reduction in annual sales of fast food restaurant.

Table 6: Spatial Configuration (Stepwise Regression)
(S-Summit, P-Portage, M-McDonald's, B-Burger King)

Buffer 1 mile						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	1 mile	14	PerBlack	0.273	..	..
BS	1 mile	19	PerWhite	0.476	..	..
BPS	1 mile	24	PerBlack	0.428	..	..
Buffer 2 miles						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BS	2 miles	19	PerTwoPl	0.474	PerPacific	0.565
BPS	2 miles	24	PerWhite	0.368	PerPacific	0.487
Buffer 5 miles						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	5 miles	14	PerNative	0.238	..	..
BP	5 miles	5	AvMedHH	0.799	..	..
BS	5 miles	19	PerOthers	0.246	..	..
BPS	5 miles	24	PerTwoPl	0.271	..	..
Thiessen						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	Thiessen	14	PerNative	0.468	PerPacific	0.634
BS	Thiessen	19	PerWhite	0.528	..	..
BPS	Thiessen	24	PerBlack	0.521	PerPacific	0.595
BMPS	Thiessen	64	PerAsian	0.066	..	..

According to the data summarized in Table 6, the percentage of Pacific Islanders yielded the largest effect on sales revenues of Burger King Restaurants within Buffer-2 miles and Thiessen. Black population shows the largest effect on annual sales of Burger King restaurants within Buffer-1 mile. Percentage of Whites shows the largest effect on sales revenues of Burger King Restaurants in Summit County for Buffer-1, 2 miles and Thiessen. This could be due to that most of these stores are situated away from the residential areas and are near office areas, commercial establishments or along highways. Native Americans reflect the largest effect on sales revenues in Portage County for both chains in Buffer 5 miles and Thiessen.

Table 7: Restaurant wise (Stepwise Regression)
(S-Summit, P-Portage, M-McDonald's, B-Burger King)

Burger King						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BPS	1 mile	24	PerBlack	0.428		
BS	1 mile	19	PerWhite	0.476		
BPS	2 miles	24	PerWhite	0.368	PerPacific	0.487
BS	2 miles	19	PerTwoPl	0.474	PerPacific	0.565
BP	5 miles	5	AvMedHH	0.799		
BPS	5 miles	24	PerTwoPl	0.271		
BS	5 miles	19	PerOthers	0.246		
BPS	Thiessen	24	PerBlack	0.521	PerPacific	0.595
BS	Thiessen	19	PerWhite	0.528		
Burger King and McDonald's						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	1 mile	14	PerBlack	0.273		
BMP	5 miles	14	PerNative	0.238		
BMP	Thiessen	14	PerNative	0.468	PerPacific	0.634
BMPS	Thiessen	64	PerAsian	0.066		

Table 7 shows that, Pacific Islanders is the most common ethnic minority group that has shown the largest effect on sales revenues of Burger King due to a decrease in their numbers. The White populations and the Blacks follow them. For both Burger Kings and McDonalds' in Portage County, a decrease in Native American population reflects the largest effect of increase in sales revenues.

Table 8: County wise (Stepwise Regression)
(S-Summit, P-Portage, M-McDonald's, B-Burger King)

County wise						
Portage County						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	1 mile	14	PerBlack	0.273	..	..
BMP	5 miles	14	PerNative	0.238	..	..
BMP	Thiessen	14	PerNative	0.468	PerPacific	0.634
BP	5 miles	5	AvMedHH	0.799	..	..
Summit County						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BS	1 mile	19	PerWhite	0.476	..	..
BS	2 miles	19	PerTwoPl	0.474	PerPacific	0.565
BS	5 miles	19	PerOthers	0.246	..	..
BS	Thiessen	19	PerWhite	0.528	..	..
Portage and Summit County						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BPS	1 mile	24	PerBlack	0.428	..	..
BPS	2 miles	24	PerWhite	0.368	PerPacific	0.487
BPS	5 miles	24	PerTwoPl	0.271	..	..
BPS	Thiessen	24	PerBlack	0.521	PerPacific	0.595
BMPS	Thiessen	64	PerAsian	0.066	..	..

It is apparent from the data in Table 8 that, a decrease in percentage of Native American population in Portage County yields the largest effect on sales revenues of Burger King and McDonald's. For Summit County a decrease in percentage of White population has yielded the largest effect on sales revenues of Burger King and McDonald's. For both Portage and Summit Counties, a decrease in percentage of Pacific Islanders and Blacks reflects an increase in annual sales of Burger King Restaurants.

Table 9: Restaurant wise and County wise (Stepwise Regression)
(S-Summit, P-Portage, M-McDonald's, B-Burger King)

Restaurant wise and County wise						
Burger King						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BP	5 miles	5	AvMedHH	0.799	..	..
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BPS	1 mile	24	PerBlack	0.428	..	..
BPS	2 miles	24	PerWhite	0.368	PerPacific	0.487
BPS	5 miles	24	PerTwoPl	0.271	..	..
BPS	Thiessen	24	PerBlack	0.521	PerPacific	0.595
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BS	1 mile	19	PerWhite	0.476	..	..
BS	2 miles	19	PerTwoPl	0.474	PerPacific	0.565
BS	5 miles	19	PerOthers	0.246	..	..
BS	Thiessen	19	PerWhite	0.528	..	..
Burger King and McDonald's						
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	1 mile	14	PerBlack	0.273	..	..
BMP	5 miles	14	PerNative	0.238	..	..
BMP	Thiessen	14	PerNative	0.468	PerPacific	0.634
Model	**Buffer**	**N**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMPS	Thiessen	64	PerAsian	0.066	..	..

Data tabulated in Table 9 shows that, Burger Kings in Summit County shows an increase in sales as a result of decrease in percentage of White population. Burger Kings in Portage and Summit County experience an increase in annual sales as a result of decrease in percentage of Pacific Islanders and Blacks. Native Americans yield the largest effect on sales for Burger Kings and McDonalds' in Portage, and Asian population shows an increase in sales revenues of both Burger Kings and McDonalds' for Portage and Summit Counties for Thiessen buffers.

Another set of Stepwise Regression analysis is run for the models. This regression is run excluding the percentage of Pacific Islanders. The other ethnic groups show the same pattern of exerting effect on sales revenues of restaurants when the regression analysis was run including the percentage of Pacific Islanders.

Table 10: Spatial Configuration (Stepwise Regression)
(S-Summit, P-Portage, M-McDonald's, B-Burger King)

Stepwise Regression (minus % of Pacific Population)						
Buffer 1 mile						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	14	1 mile	PerBlack	0.273	..	..
BS	19	1 mile	PerWhite	0.476	..	..
BPS	24	1 mile	PerBlack	0.428	..	..
Buffer 2 miles						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BS	19	2 miles	PerTwoPl	0.474	..	..
BPS	24	2 miles	PerWhite	0.368	..	..
Buffer 5 miles						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	14	5 miles	PerNative	0.238	..	..
BP	5	5 miles	AvMedHHI	0.799	..	..
BS	19	5 miles	PerOthers	0.246	..	..
BPS	24	5 miles	PerTwoPl	0.271	..	..
Thiessen						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	14	Thiessen	PerNative	0.468	..	..
BS	19	Thiessen	PerWhite	0.528	..	..
BPS	24	Thiessen	PerBlack	0.521	..	..

Table 10 shows that a variation in Black population yields the largest changes in sales revenues of Burger Kings and McDonalds' in Portage County and Burger Kings in Portage and Summit County for Buffer-1 mile. For Buffer-5 miles and Thiessen, no single ethnic group shows a consistency in terms of yielding changes in sales in sales revenues of the Burger Kings Restaurants. The White population exerts changes in sales revenues for Burger Kings Restaurants in Summit County.

Table 11: Restaurant wise (Stepwise Regression)
(S-Summit, P-Portage, M-McDonald's, B-Burger King)

Stepwise Regression (minus % of Pacific Population)						
Burger King						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BS	19	1 mile	PerWhite	0.476	..	..
BPS	24	1 mile	PerBlack	0.428	..	..
BS	19	2 miles	PerTwoPl	0.474	..	..
BPS	24	2 miles	PerWhite	0.368	..	..
BP	5	5 miles	AvMedHHI	0.799	..	..
BS	19	5 miles	PerOthers	0.246	..	..
BPS	24	5 miles	PerTwoPl	0.271	..	..
BS	19	Thiessen	PerWhite	0.528	..	..
BPS	24	Thiessen	PerBlack	0.521	..	..
Burger King and McDonald's						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	14	1 mile	PerBlack	0.273	..	..
BMP	14	5 miles	PerNative	0.238	..	..
BMP	14	Thiessen	PerNative	0.468	..	..

Data in Table 11 shows that sales revenues of Burger King Restaurants in Summit County are affected by the changes in percentage of White population in the Buffer zones. Burger King Restaurants combined for Portage and Summit Counties experience effects in their annual sales with a change in Black population.

Table 12: County wise (Stepwise Regression)
(S-Summit, P-Portage, M-McDonald's, B-Burger King)

Stepwise Regression (minus % of Pacific Population)						
Portage County						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	14	1 mile	PerBlack	0.273	..	..
BMP	14	5 miles	PerNative	0.238	..	..
BP	5	5 miles	AvMedHHI	0.799	..	..
BMP	14	Thiessen	PerNative	0.468	..	..
Summit County						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BS	19	1 mile	PerWhite	0.476	..	..
BS	19	2 miles	PerTwoPl	0.474	..	..
BS	19	5 miles	PerOthers	0.246	..	..
BS	19	Thiessen	PerWhite	0.528	..	..
Portage County and Summit County						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BPS	24	1 mile	PerBlack	0.428	..	..
BPS	24	2 miles	PerWhite	0.368	..	..
BPS	24	5 miles	PerTwoPl	0.271	..	..
BPS	24	Thiessen	PerBlack	0.521	..	..

In Portage County, a change in percentage of Native Americans exerts effects on sales revenues of Burger King and McDonald's Restaurants for Buffer-5 miles and Thiessen. A decrease in Black population shows an increase in annual sales for within 1-mile buffer of the restaurants in table 12.

In Summit County, it's the changes in percentage of white population that shows effects on sales revenues of Burger King restaurants.

For Portage and Summit Counties together, it is the percentage of Black population that causes an increase in sales revenues of Burger King within 1-mile from the restaurants and White population within 2-miles. For a much larger service area of 5-

miles, it's the percentage of population comprised of two or more races that have an effect on sales revenues of Burger King restaurants.

Table 13: Restaurant wise and County wise (Stepwise Regression)
(S-Summit, P-Portage, M-McDonald's, B-Burger King)

Stepwise Regression (minus % of Pacific Population)						
Burger King						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BP	5	5 miles	AvMedHHI	0.799	..	..
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BS	19	1 mile	PerWhite	0.476	..	..
BS	19	2 miles	PerTwoPl	0.474	..	..
BS	19	5 miles	PerOthers	0.246	..	..
BS	19	Thiessen	PerWhite	0.528	..	..
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BPS	24	1 mile	PerBlack	0.428	..	..
BPS	24	2 miles	PerWhite	0.368	..	..
BPS	24	5 miles	PerTwoPl	0.271	..	..
BPS	24	Thiessen	PerBlack	0.521	..	..
Burger King and McDonald's						
Model	**N**	**Buffer**	**Var(1)**	**Adj R2(1)**	**Var(2)**	**Adj R2(2)**
BMP	14	Thiessen	PerNative	0.468	..	..
BMP	14	1 mile	PerBlack	0.273	..	..
BMP	14	5 miles	PerNative	0.238	..	..

Burger King restaurants in Summit County mainly experience an increase in their sales as a result of change in percentage of White population, followed by Two Plus Races and Other Races (including Hispanics). Burger King restaurants in both Portage and Summit Counties considered together (Table 13), show a variation in sales revenues as a result of change in percentage of mainly Black population, followed by the Whites.

Sales revenues for both Burger King and McDonald's in Portage and Summit Counties are affected by decrease in population of Native Americans, followed by the Blacks.

5.3 Summary:

Regression analysis is a statistical tool that is used to investigate relationship between variables. In this study, the fast-food annual sales revenue has been taken as the dependent variable and the demographic data and median household income as the independent variables. The result of a regression analysis includes the coefficient of multiple determinations, R^2, and considers whether the overall regression equation was statistically significant via a F statistic. The R^2 indicates the extent to which the variations as shown by values in the dependent variable being explained by the variations among the values of the independent variables.

There are two methods for entering variables into the regression equation that are used in this study. First the Enter method is used, which is the option of using forced entry of the independent variables into the model. The SPSS software enters at one time all specified variables regardless of significance levels. The second method is the stepwise method that enters or removes one variable at a time based on a preset significance value. The process comes to an end when there are no additional variables for addition or removal. In this method the variance explained by certain variables will change when new variables enter the equation.

The analysis models show that the White population is the largest clientele for the QS Restaurants in Portage and Summit Counties. The other ethnic minorities seem to have other food preferences rather than eating at the fast food restaurants. These restaurants show an increase in Annual Sales figures as a result of decrease in percentage of Black population in Portage County for Thiessen and buffer polygons of varying distance around the restaurants. This also indicates an economically weaker condition of the Black population, which makes them eat out less and a preference to cook at home. Ethnic population and median household income better explain annual sales variations for Burger King within buffers of 1 and 2 miles around the restaurants.

For McDonald’s, ethnic population and median household income for 5-mile buffers better explain the annual sales variations. This suggests that the consumers are more willing to travel a longer distance to eat at McDonald’s as compared to Burger King. McDonald’s Restaurants are more in number and are located at highway exits and accessible routes. A comparative analysis of both types of proximity analysis methods show that the buffer polygons of 1, 2 and 5 miles are able to better explain the variations in annual revenues of QSR as a result of changes in ethnic population and median household income as compared to the Thiessen polygons.

Chapter 6

Conclusion

Geographic Information System is rapidly becoming a popular tool in retail industry for the site location analysis. The main advantage of using GIS in solving location problem is that the spatial as well as attribute data can be integrated and applied to a variety of fields. There are many companies in the United States that have invested in GIS for site location analysis and achieved considerable retail benefits and cost savings. For the retailers that make use of retail location methods, the most frequently applied techniques are analog methods, statistical modeling and gravity/spatial interaction models.

Retail location analysis has also been used in determining the size and shape of the retail trade area. The trade area of a retail store is the geographical area from which it draws most of its clientele and has the highest market penetration. GIS helps in not only processing the data and retail information, but also provides the presentation of processed data. A retail location analysis of relationship between the annual sales performance of McDonald's and Burger King QRS and various spatial and socio-economic factors of their trade areas has been done. The results of this study show how location factors influence the performance of the stores as well as how the socio-economic attributes of the trade areas affect the annual sales revenues. This retail location analysis has been done by partitioning the study area into a set of Thiessen polygons and buffers of different spatial configurations surrounding the QSR outlets.

The distance customers are willing to travel to make retail purchases depends upon the type of goods or services to be purchased. The type of fast food offered by Burger King and McDonald’s are inexpensive and easily substituted, hence creating a smaller retail trade zones as compared to other specialty restaurants. Concentric buffers of varying distances generated around these restaurants show distinct market penetration patterns. The innermost buffer of 1-mile width accounts for the largest proportion of customers who can walk or drive to the restaurants. Ethnic composition of the population and the median household income within these buffer polygons also give an idea regarding how much time and distance consumers are willing to travel to patronize these restaurants.

Retail businesses are constantly working towards growing and expanding their sales revenues and market shares. Market potential of the retail stores is often determined by the expenditure pattern of the population in the respective trade zones. The market potential is however not static. It may change due to variations in demographics, ethnic composition and socio-economic indicators over time. A retail chain’s store location strategy can be developed not only by keeping in view the future retail setting of the market, but also getting fully acquainted with the regional shopping areas and consumer orientation.

A small number of very large retail organizations and a large number of small-scale outlets characterize the retail market. This retail environment makes it necessary that the QRS outlets do not ignore their competitors when selecting sites for the store outlets. Their retail marketing strategy should be greatly dependent upon the store’s value platform in order to distinguish itself from its competitors. In addition to establishing a value platform, QRS retailers also follow functional strategies like customer service, merchandising, advertising, store accessibility and parking, etc. The retailers can select the segment of its consumers and can orient its services to meet the requirements of that group. The competitive edge of the fast-food restaurants can be maintained by prices of goods offered and the location of the outlet. Consumers are likely to patronize a conveniently located store when choosing between similar retail alternatives.

Besides using GIS tools for retail location analysis, statistical and mathematical models of analysis have also been used widely by researchers to forecast a retail store's future sales and site selection. GIS tools can help in calculating the size and potential of the market based on the socio-economic profile of the trade area. With GIS software, it is possible to handle large volumes of data and generate results with higher levels of precision and details in a short time. In this study, GIS and statistical analysis techniques have been applied to examine the spatial patterns and dynamics of the QSR chains of Burger King and McDonald's in Portage and Summit Counties in Northeastern Ohio.

The research methodology includes the GIS techniques and statistical analysis of Geocoding, geoprocessing and regression analysis. Each of the studied Burger King and McDonald's restaurants has been converted to specific point location on the street network using the technique of Geocoding. A catchment area analysis has been done for these restaurants by using Thiessen polygons, buffer polygons and overlay analysis. Thiessen polygons have been constructed around the geocoded restaurants to represent areas of influence. Thiessen polygons have been used to evaluate the restaurants in terms of socio-economic and demographic attributes of each outlet's trade area.

Geoprocessing has been made use of in this study to apply geographic analysis and modeling to data to generate new information. Geoprocessing tools of Proximity analysis (Buffer tool) and Overlay analysis (Union tool) have been used for this study. Buffer analysis tool has been used to create a new feature class of buffer polygons of varying widths around the geocoded QSR. These polygons allow us to analyse how they are related to the performance of the fast food restaurants. The Buffer polygons of width 1-mile, 2-miles and 5-miles help to estimate customer willingness to travel to a store.

Overlay analysis tool has been used to apply weights to several inputs and combining them into a single output in order to create an integrated analysis. Thiessen polygons and Buffer polygons of varying widths have been overlaid on the data layer of Census Block groups associated with ethnic information and median household income. It has been assumed that both Thiessen polygons and Buffer polygons reasonably represent trade areas in this study.

Statistical techniques of Regression analysis has been used to quantify the level of change in the outcome of dependent variable based upon given level of change in one or more independent variables. Multi-variate Regression analysis regression analysis models the degree to which the variation within values of the dependent variable (Annual Sales of studied QSR) as explained by predictors/independent variables (percentage of ethnic populations and median household incomes). The regression analysis gives the degree to which variation among values in the dependent variable is explained by the combined variation of the predictor variables. Regression models are tested with a hypothesis of no statistical significance, which means that the variation among the values of the dependent variables do not have a statistically significant relationship with the variation among values in the predictor variables. There are two methods of entering variables into Regression analysis used in this study. The Enter method is the forced entry option and the Stepwise method enters or removes one variable at a time based on a preset significance value.

A comparative analysis of the coefficient of determination (R^2) of the Thiessen polygons and Buffer polygons with varying buffering limits of a total of 68 fast food restaurants show how well or poorly either of these two approaches capture the variations in the annual sales figures. A comparative analysis of R^2 of three Buffer limits around these restaurants determine a near ideal buffering limit for each of the fast food retail stores.

The analysis of regression models show that Burger King's annual sales revenues are better explained by the ethnic population and median house-hold incomes for 1-mile & 2-miles buffers than those of McDonald's by the same set of variables. Annual sales are better explained by the variables for McDonald's for a 5-miles buffer in Portage and Summit Counties. This suggests that consumers are more willing to travel a longer distance to eat at/from McDonald's as compared to Burger King. The ethnic population and median household income better explain annual sales figures for McDonald's than those for Burger King, within the Thiessen polygons generated around each restaurant. Further analysis of ethnic data suggests that white population is the largest clientele for both Burger King & McDonald's and other minorities (except the Black population) are too few in numbers to reflect any significant effect on annual sales figures. This could also suggest that the ethnic minorities have other preferences and eat at other specialty restaurants or maybe even cook more at home.

McDonald's and Burger King are generally assumed to be maintaining a consistency in the quality of their food served at other outlets nation-wide. The socio-economic and demographic attributes found in the study area are consistent with those of Ohio state as well as national averages. The study area also represents a good mix of urban, rural and suburban lifestyles. A comparative analysis of socio-economic and demographic factors can help us to understand the performance of markets with different location factors. The results from this study can be applied to other fast-food chains as well as other types of businesses.

This study can be further developed to improve upon site selection location research tools for successful site selection of retail outlets. In order to make informed site location and retail location decisions, a more efficient approach of on-site assessment and evaluation of customers and markets can be undertaken. This would help in a more accurate analysis of the market, sites and trade areas and also help in uncovering potential, in-fill opportunities and eliminating overlaps in existing markets. A more detailed business data, market surveys, demographic data, and household consumer data can be used to uncover new marketing opportunities and identify profitable consumers. By analyzing and combining the data layers formed in this study and benchmarking the current sales performance of the stores, we can also find an optimal store location and manage the retail network more efficiently

Appendix

(Maps and Figures)

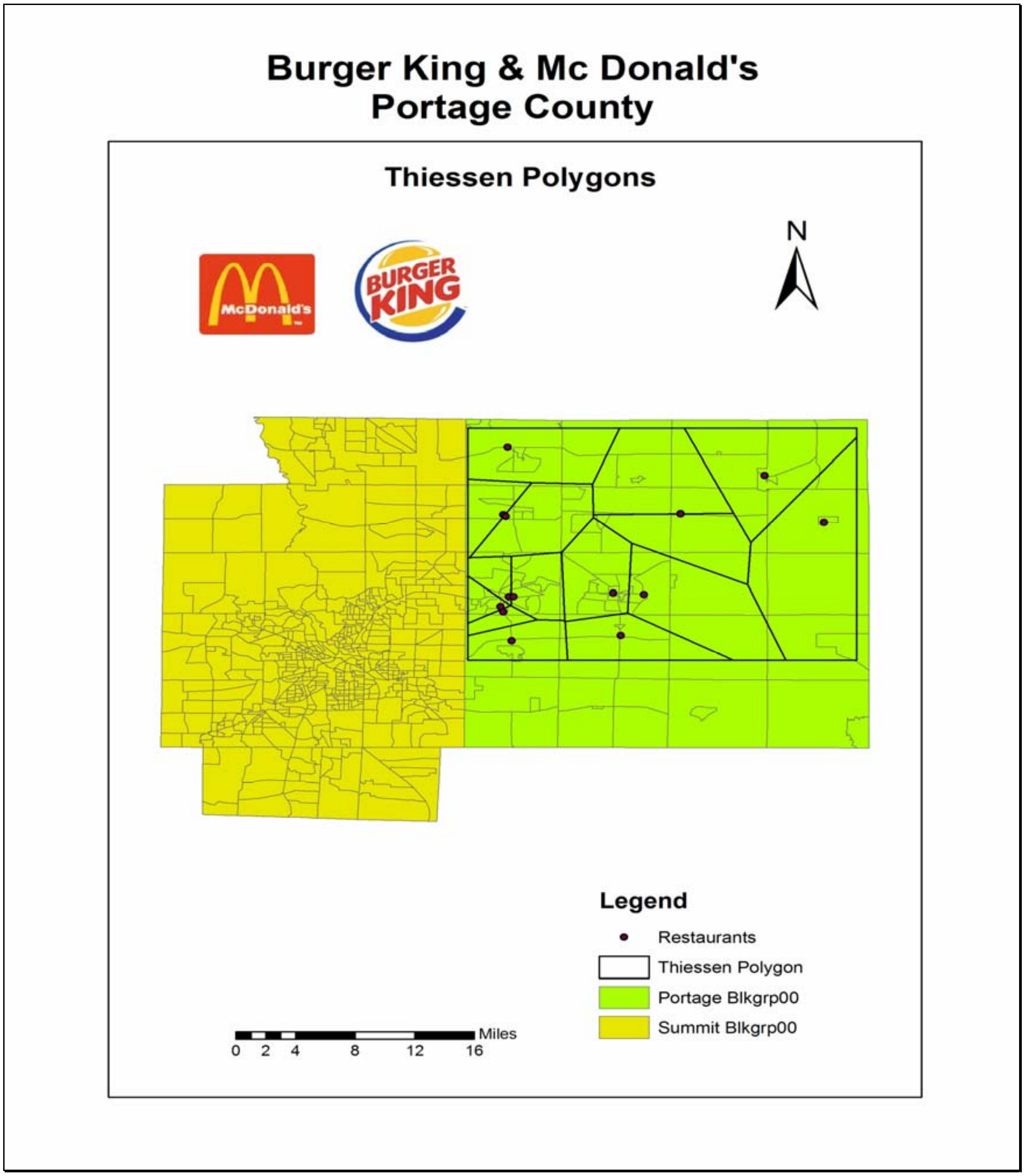

Fig: 6 Burger King and McDonald's in Portage County (Thiessen Polygons)

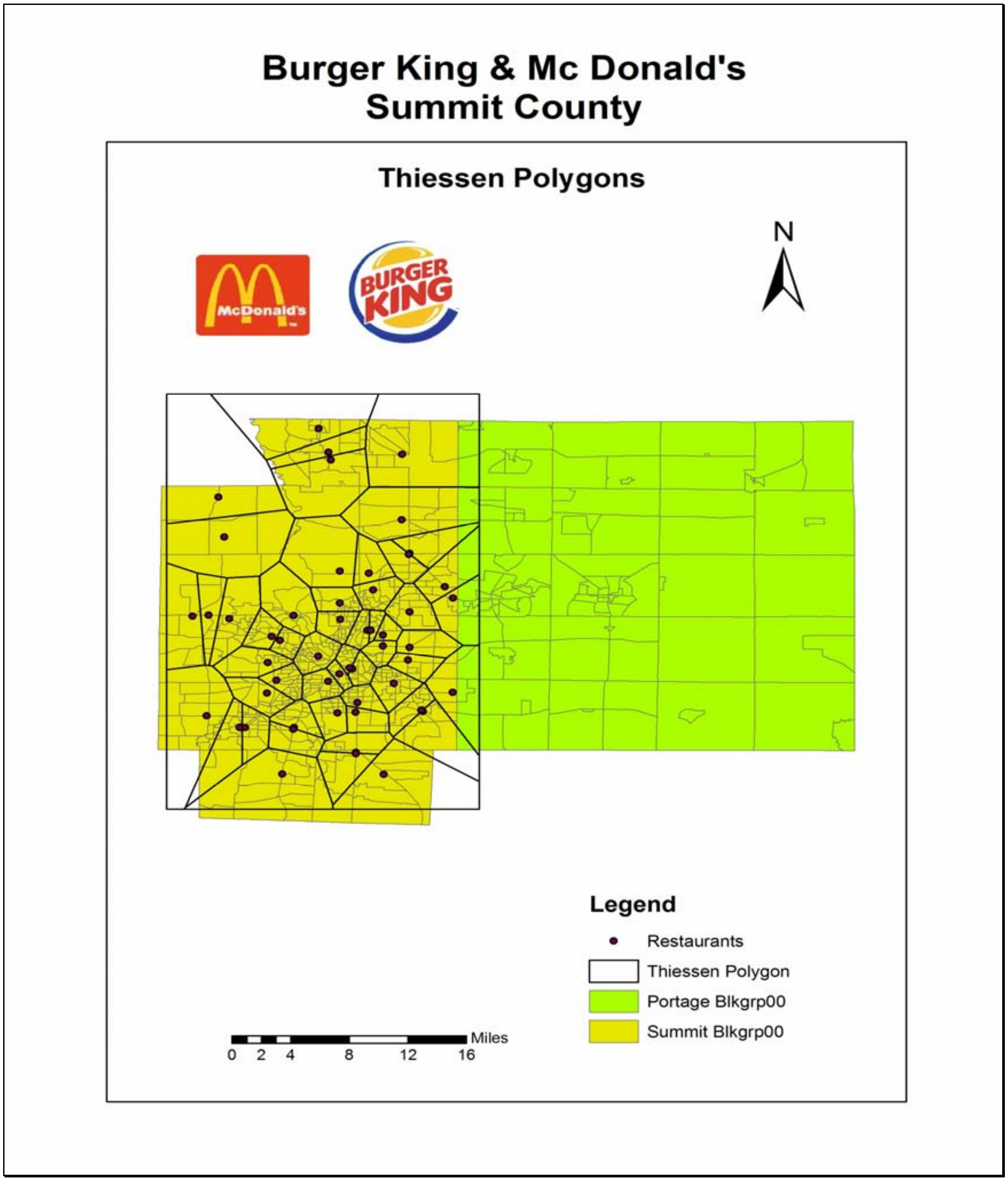

Fig: 7 Burger King and McDonald's in Summit County (Thiessen Polygon)

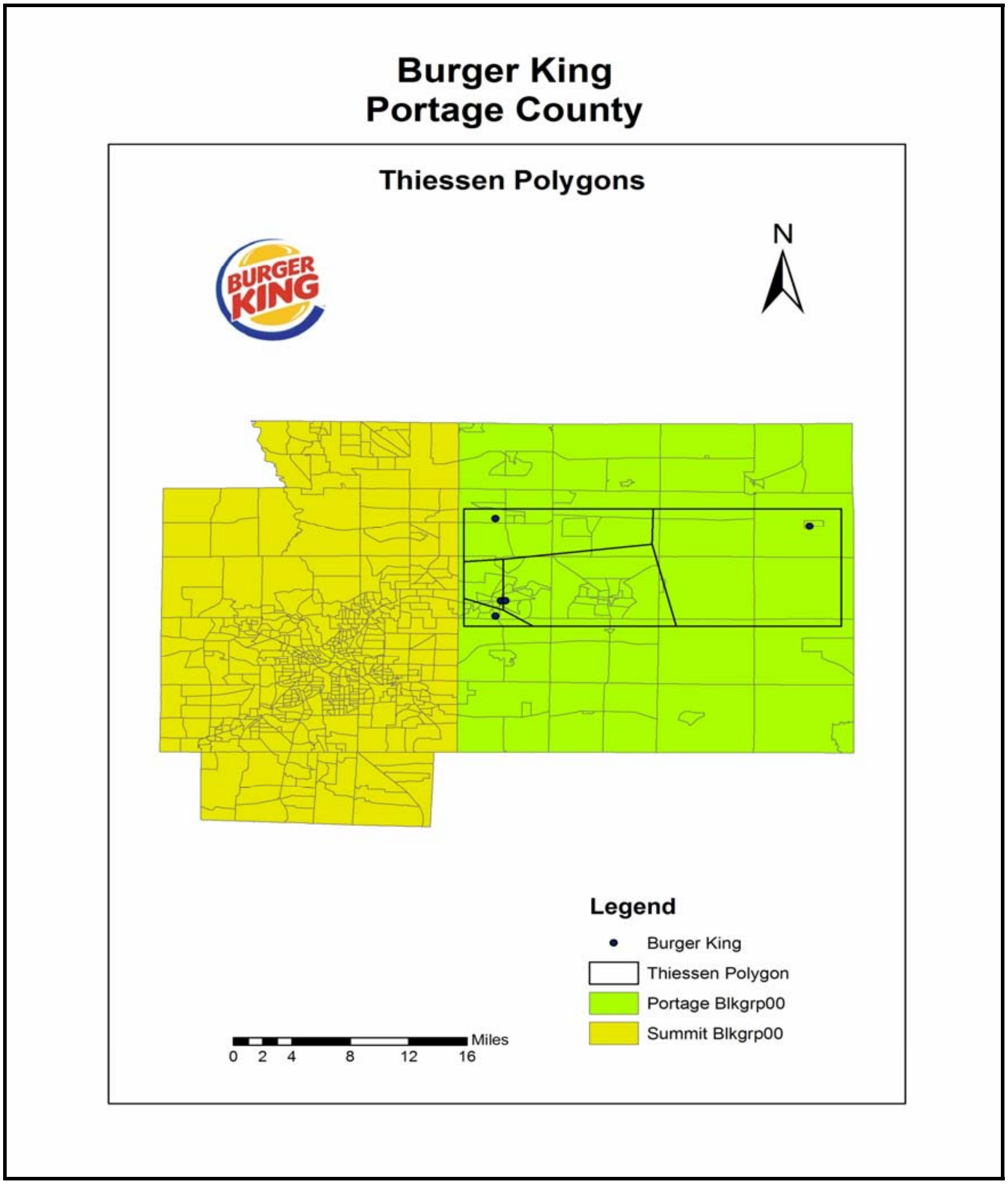

Fig: 8 Burger Kings in Portage County (Thiessen Polygons)

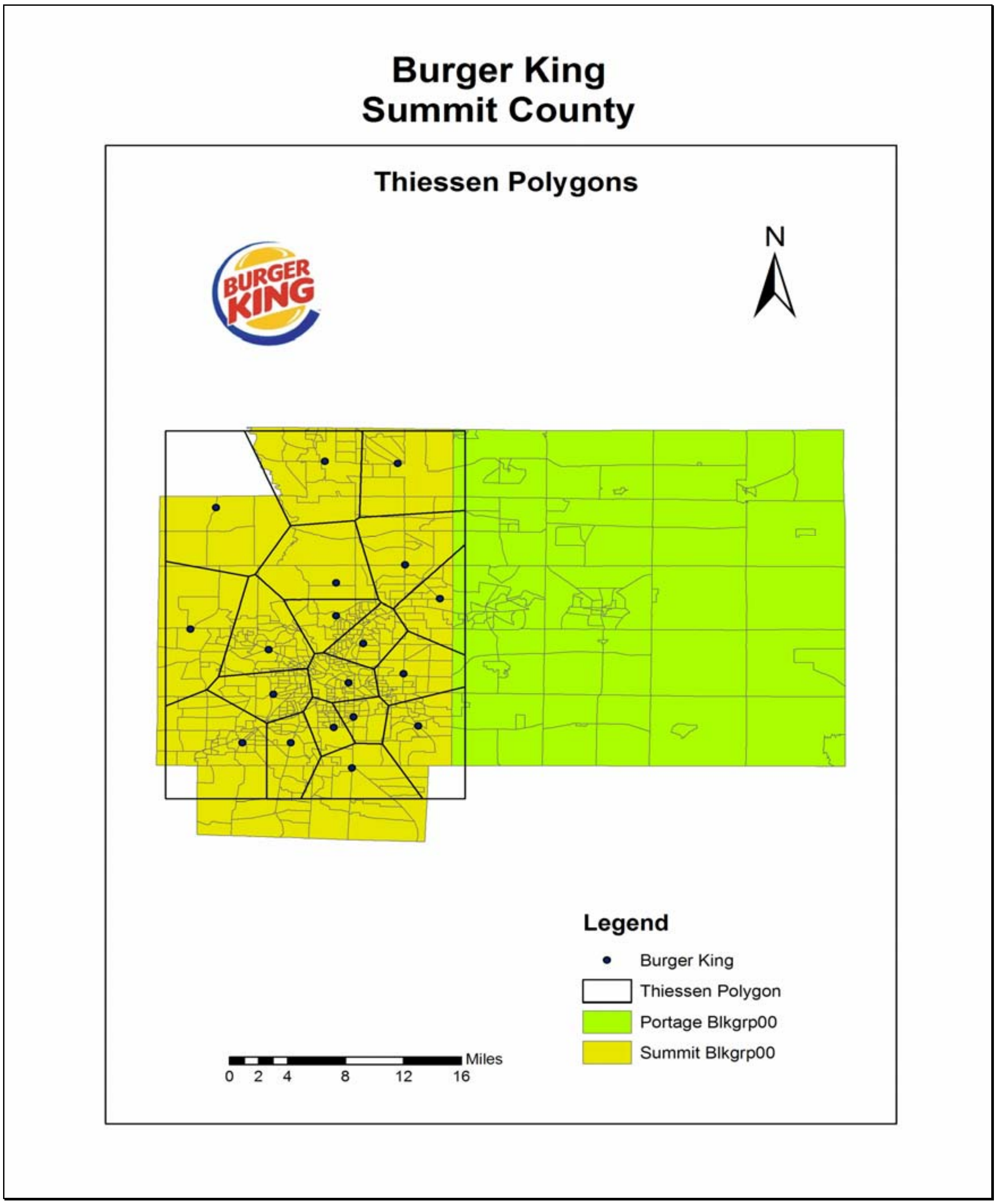

Fig: 9 Burger Kings in Summit County (Thiessen Polygons)

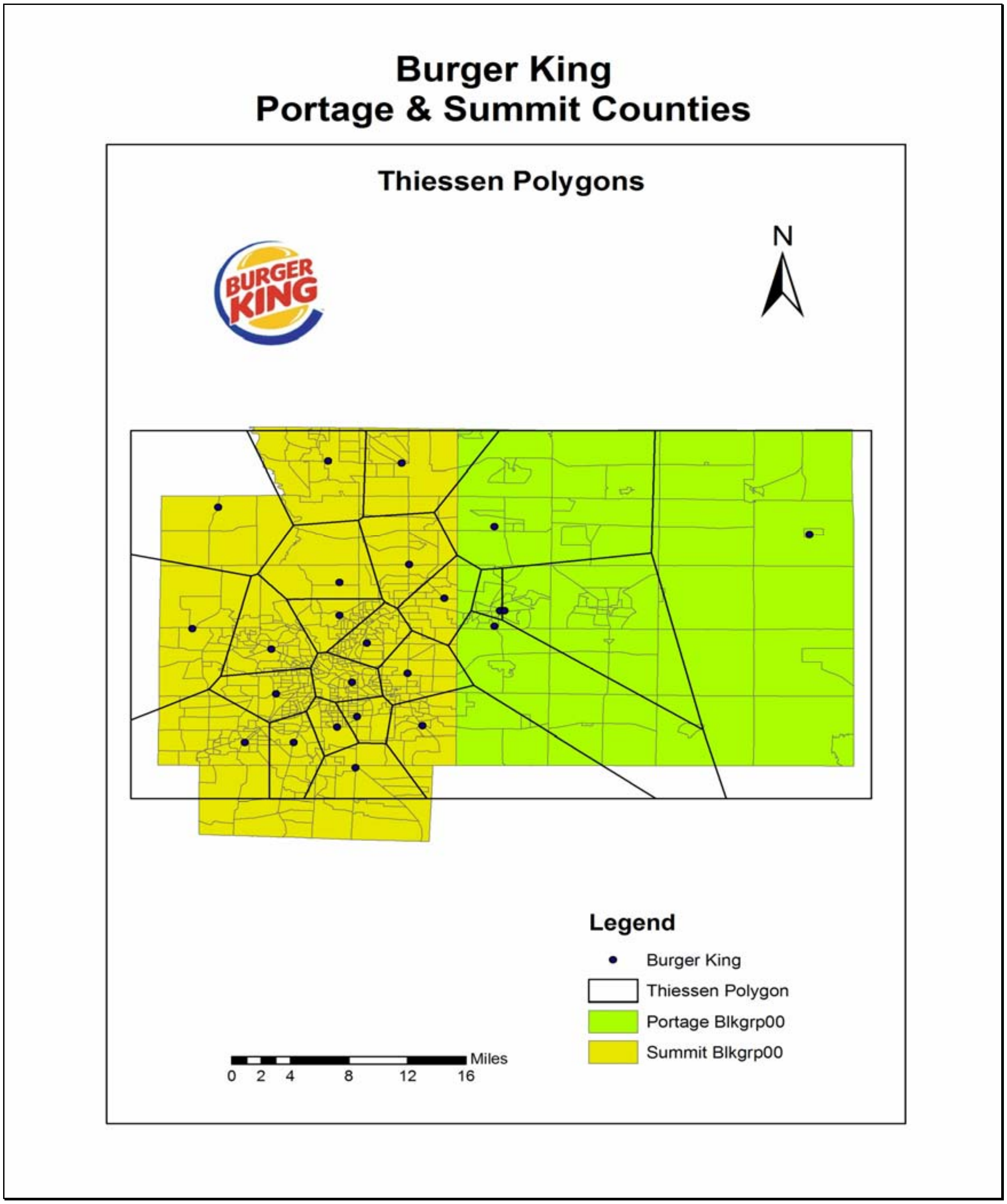

Fig: 10 Burger King in Portage and Summit Counties (Thiessen Polygons)

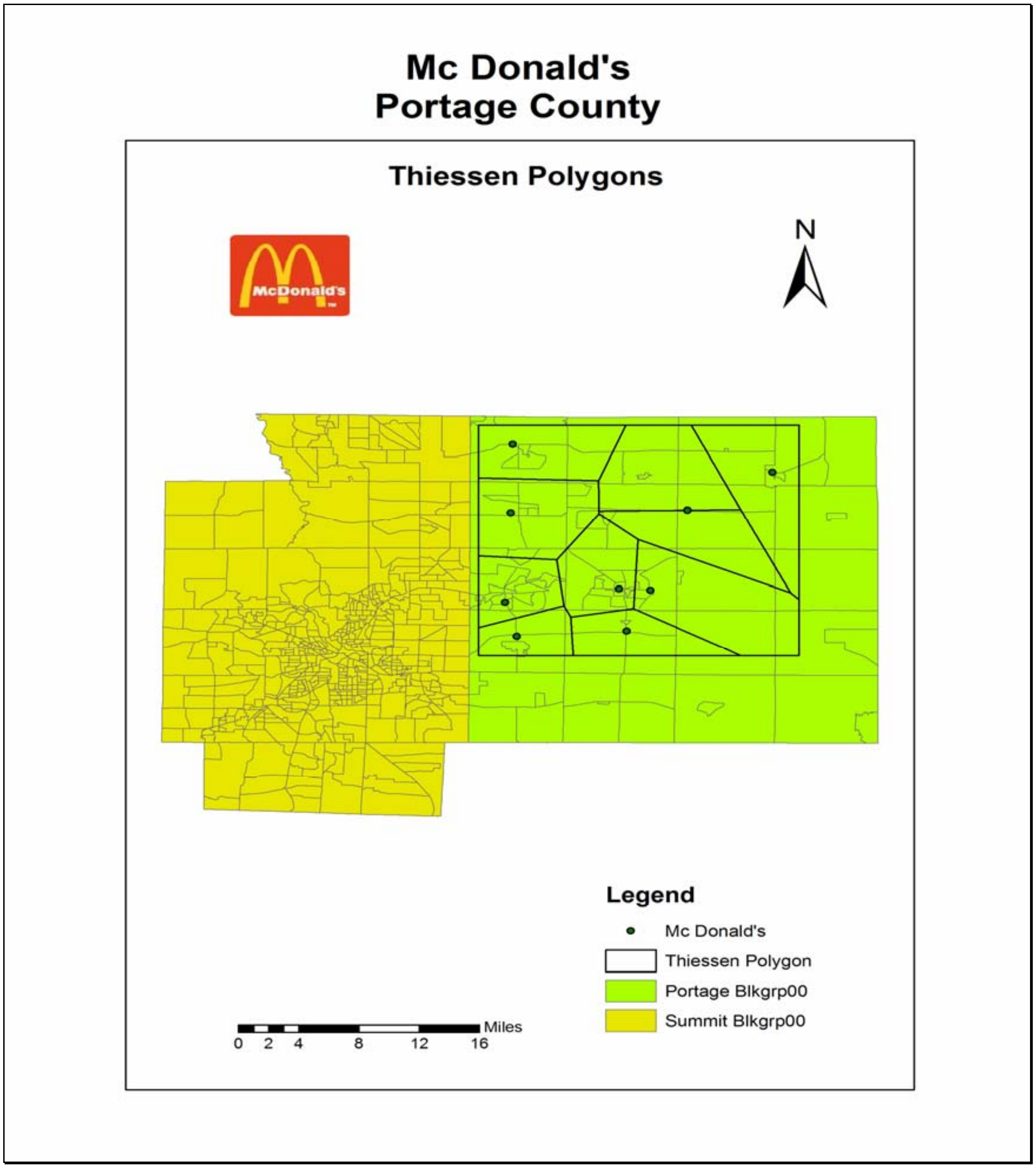

Fig 11: McDonald’s in Portage County (Thiessen Polygons)

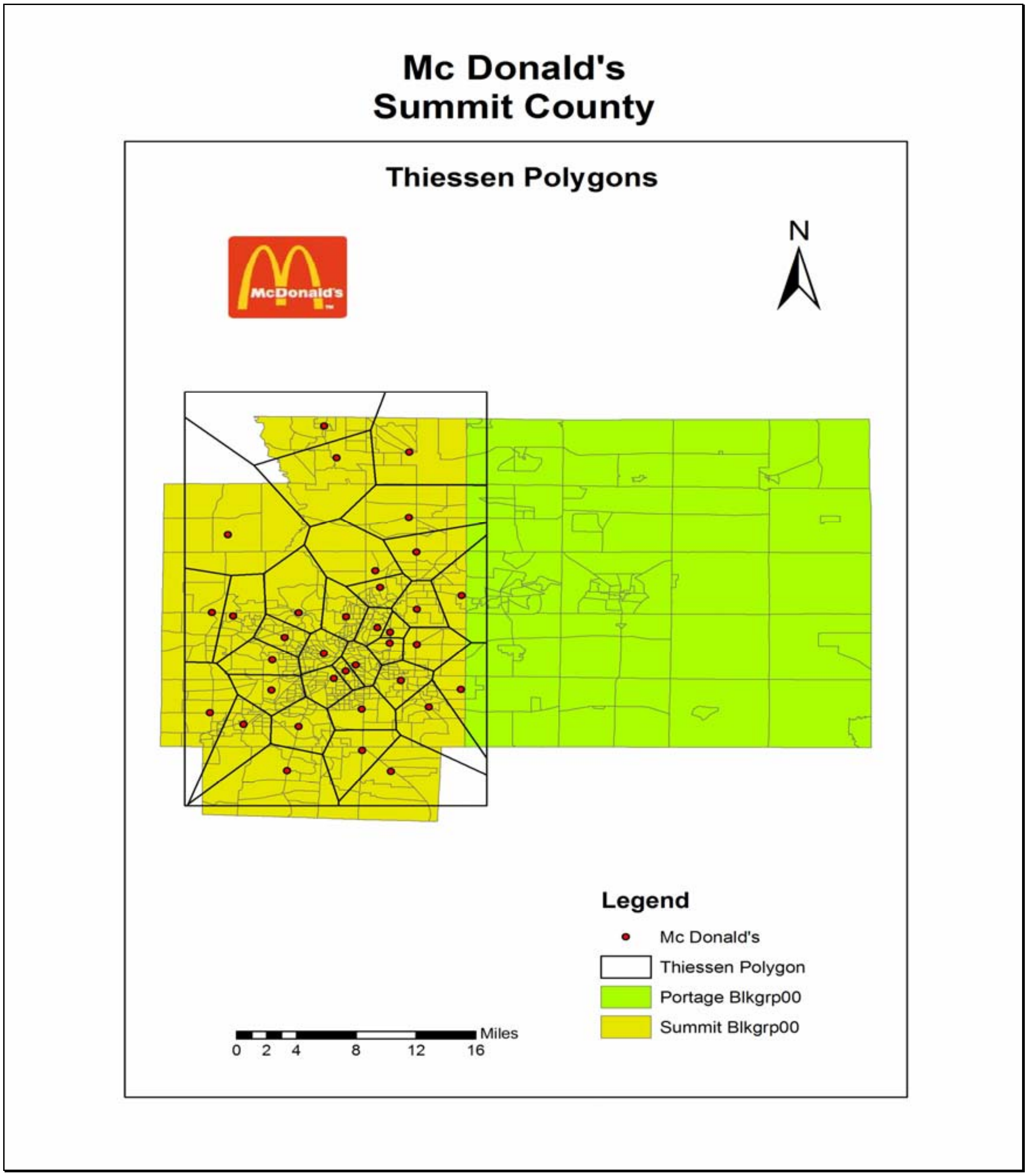

Fig 12: McDonald's in Summit County (Thiessen Polygons)

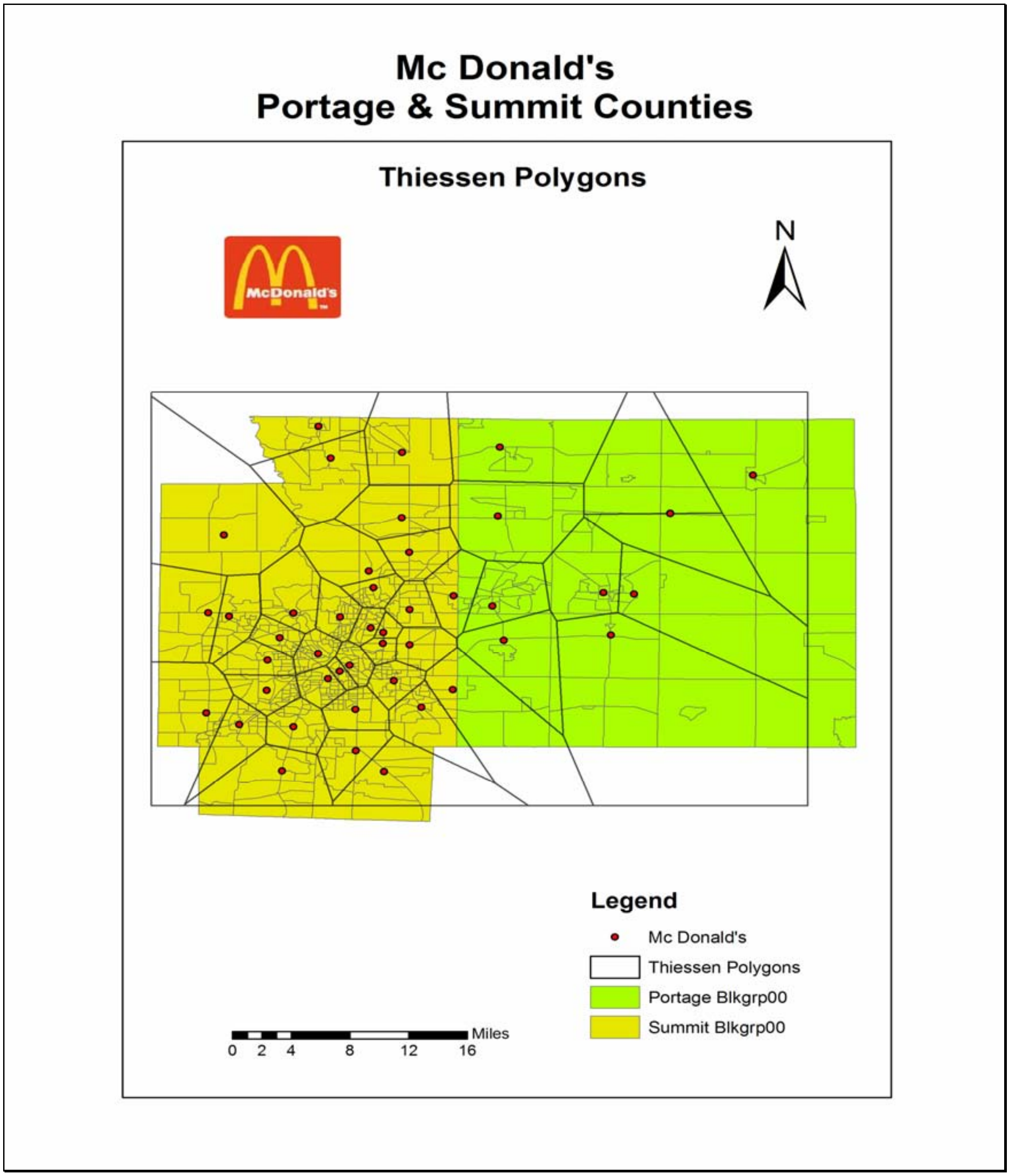

Fig 13: McDonald’s in Portage and Summit Counties (Thiessen Polygons)

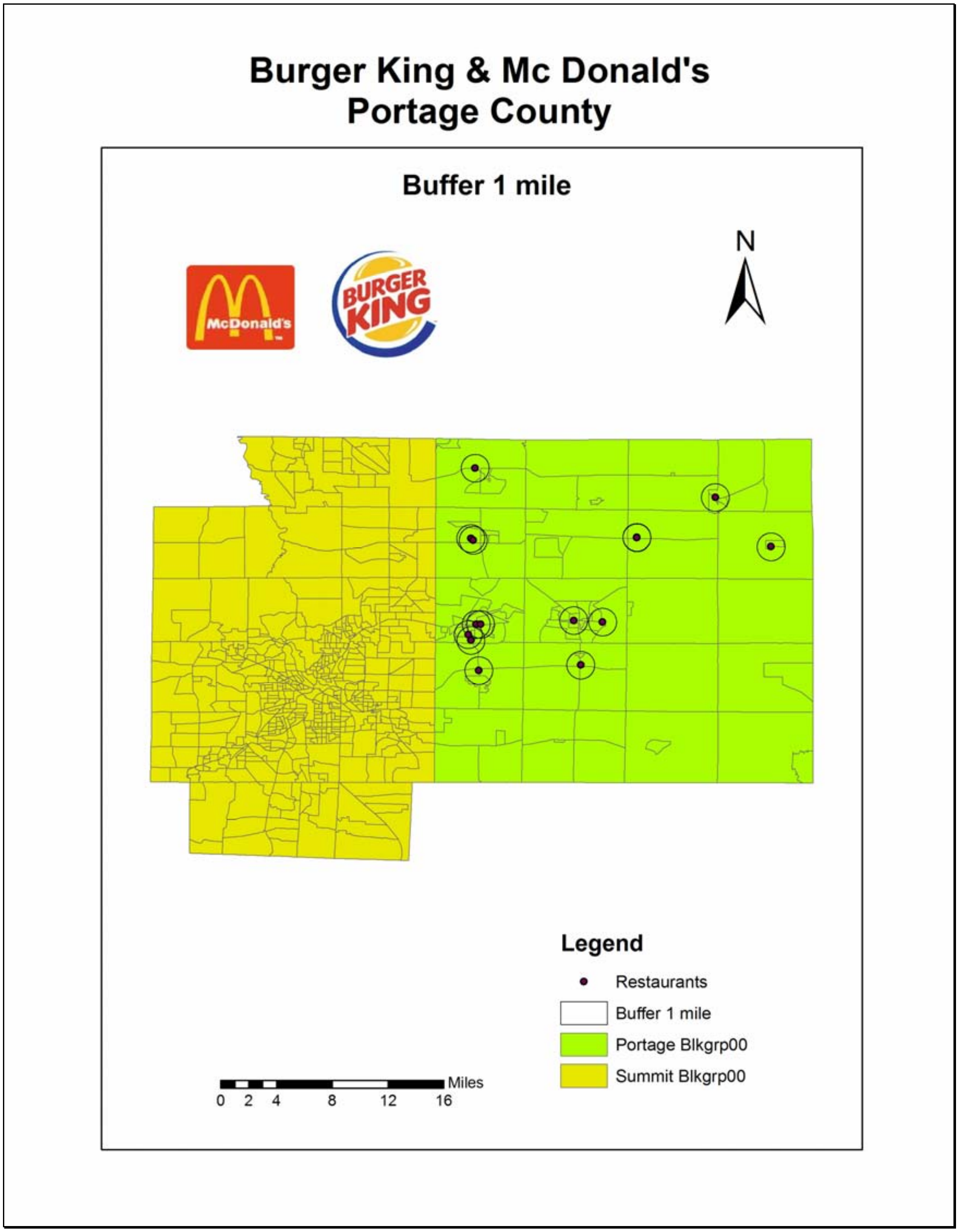

Fig 17: Burger King & McDonald's in Portage County (Buffer 1 mile)

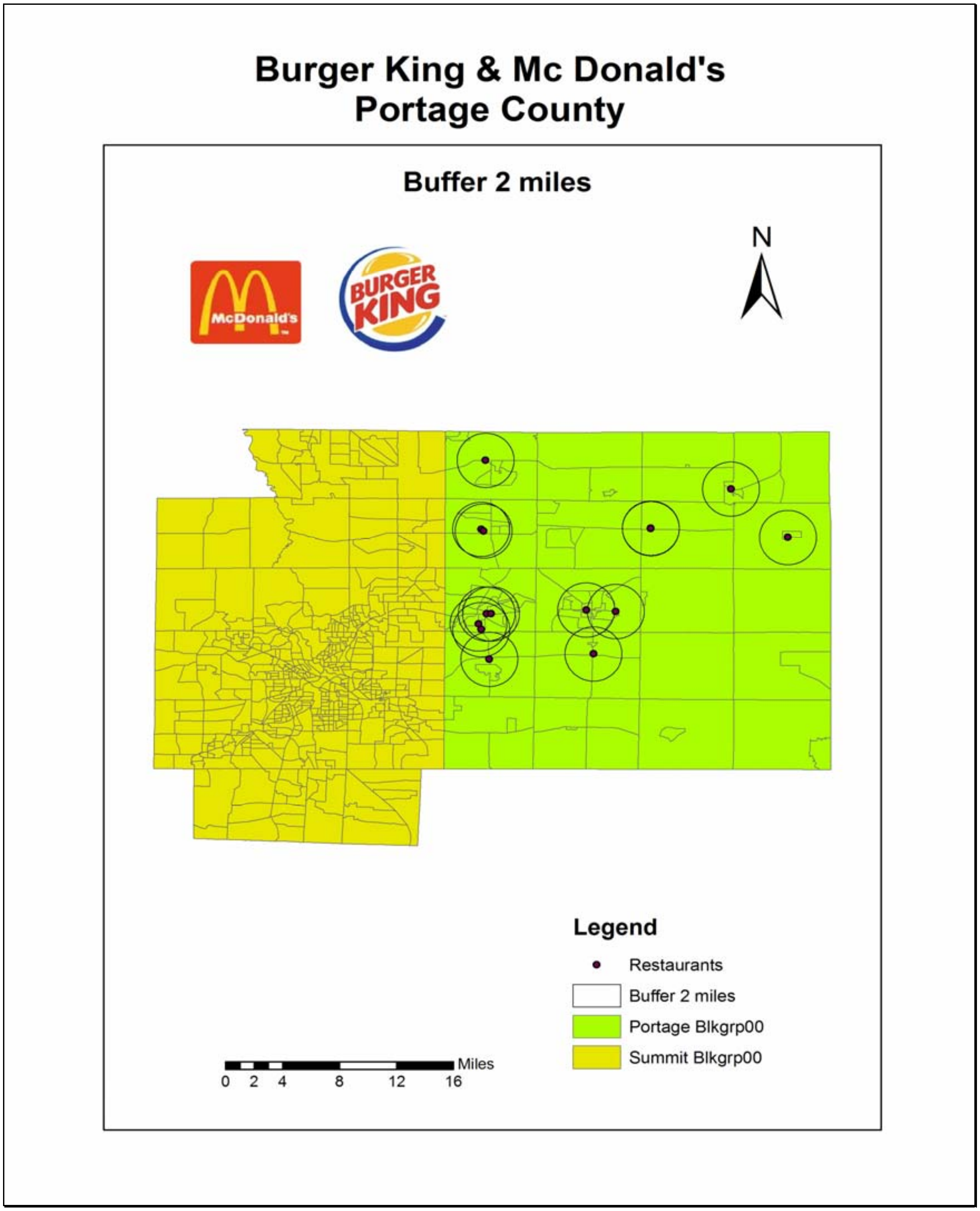

Fig 18: Burger King & McDonald's in Portage County (Buffer 2 miles)

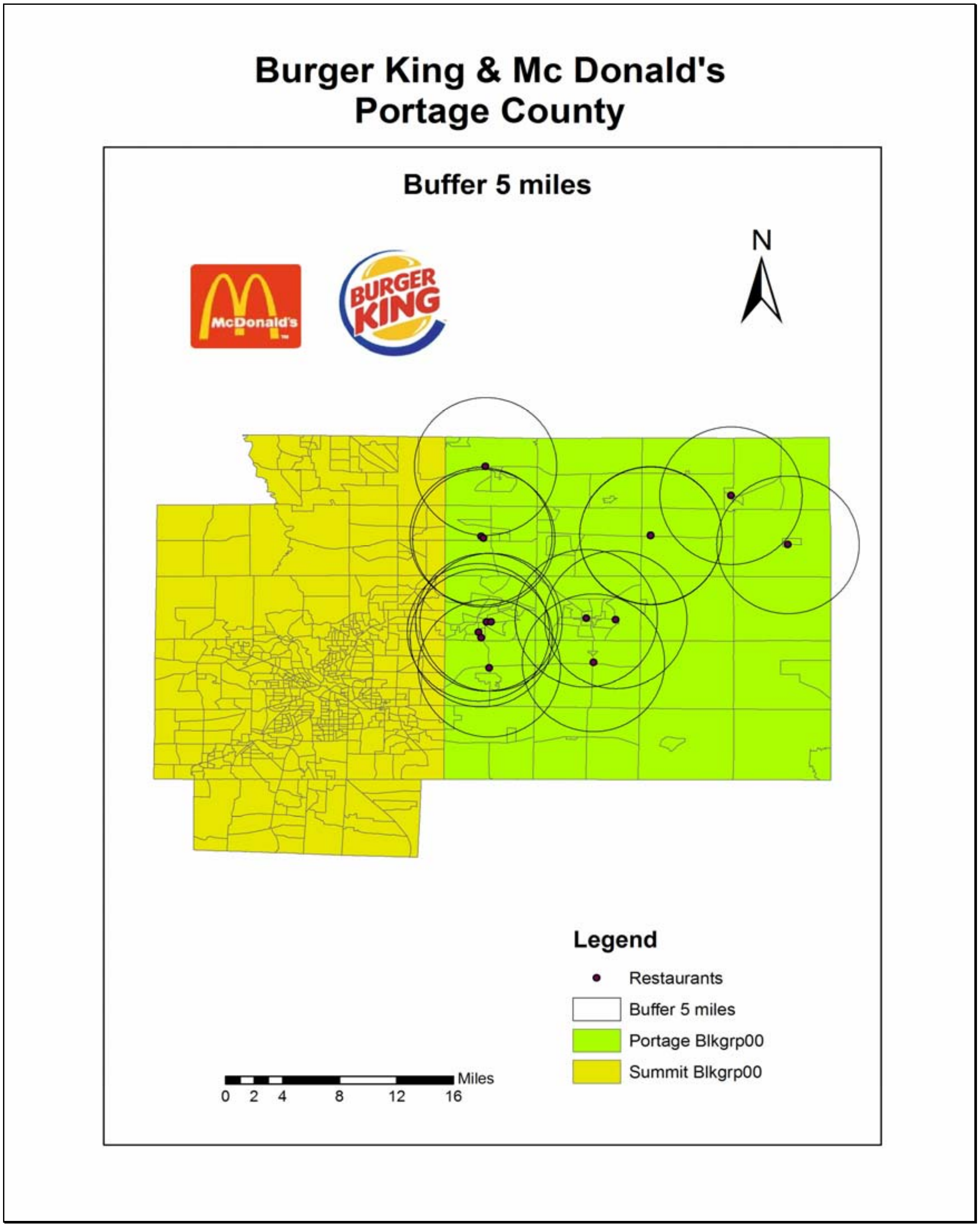

Fig 19: Burger King & McDonald’s in Portage County (Buffer 5 miles)

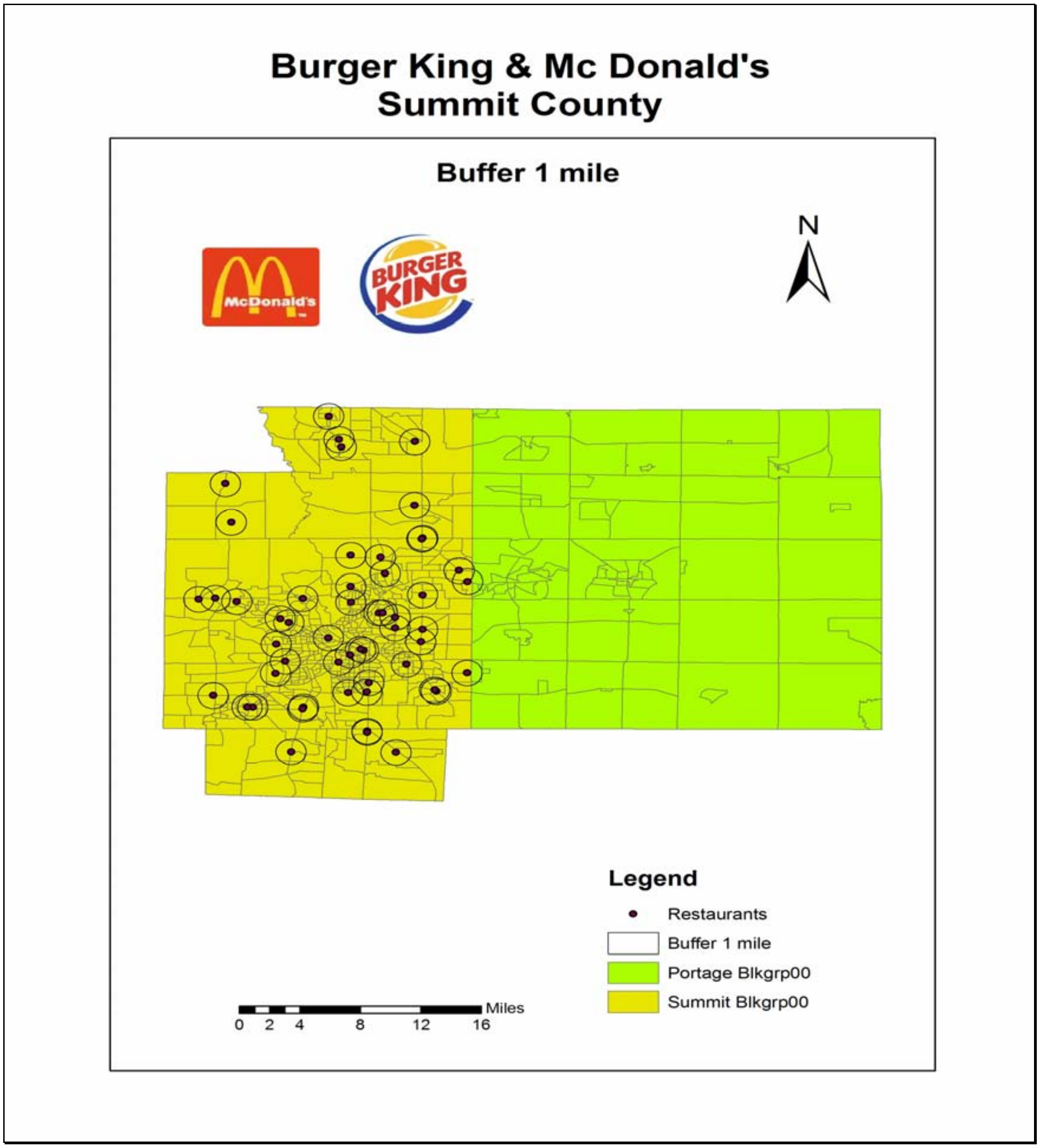

Fig 20: Burger King & McDonald's in Summit County (Buffer 1 mile)

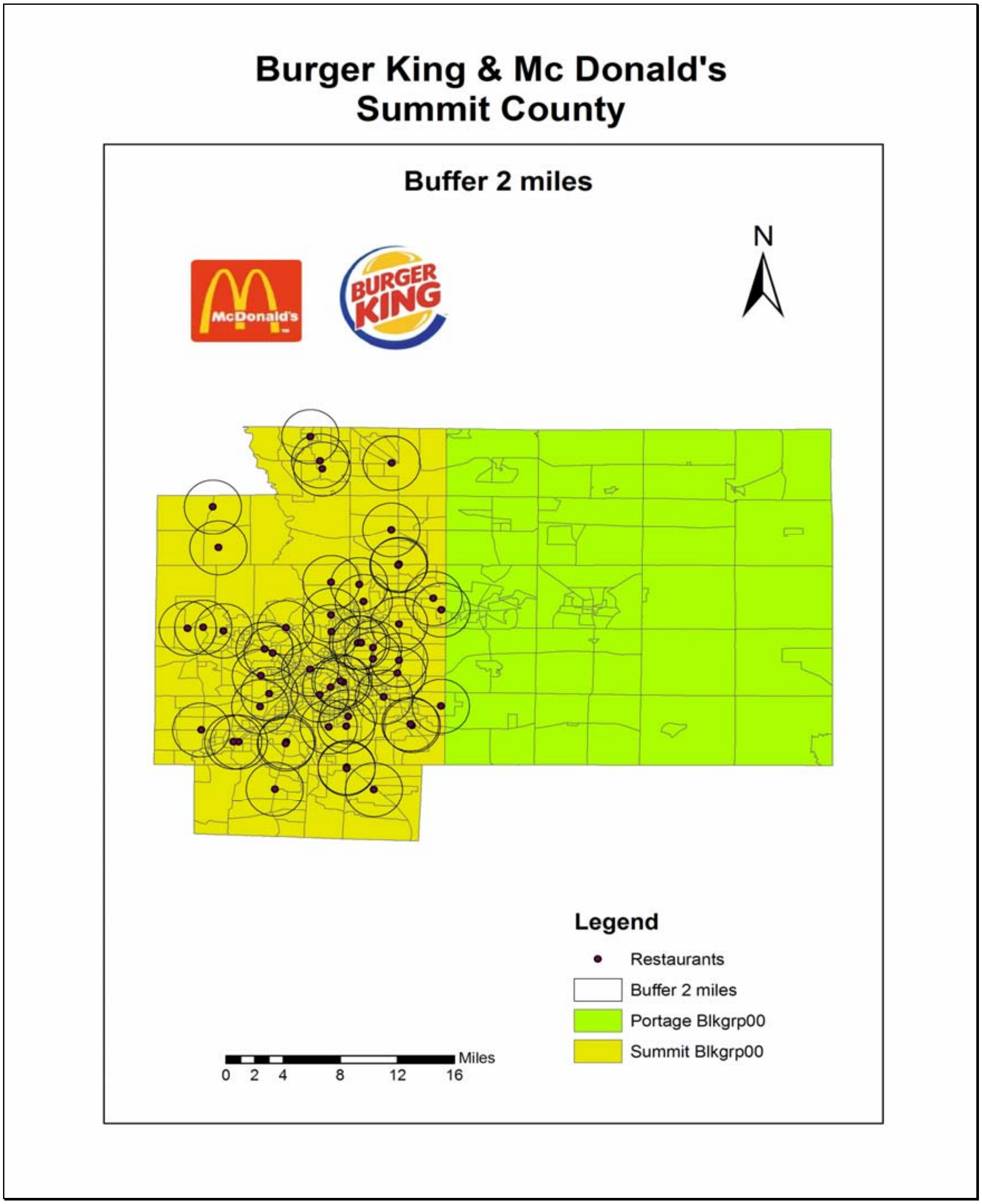

Fig 21: Burger King & McDonald's in Summit County (Buffer 2 miles)

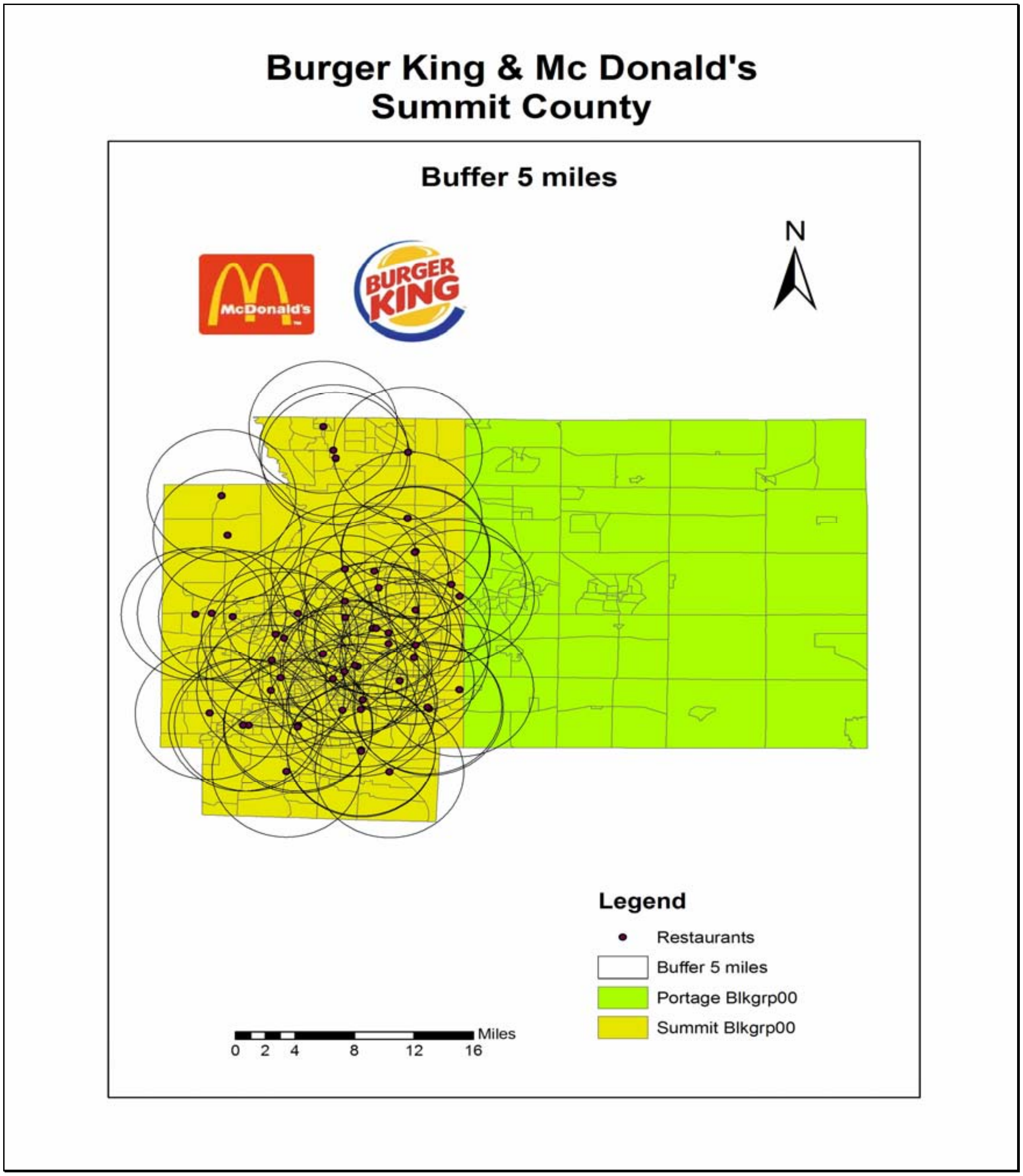

Fig 22: Burger King & McDonald's in Summit County (Buffer 5 miles)

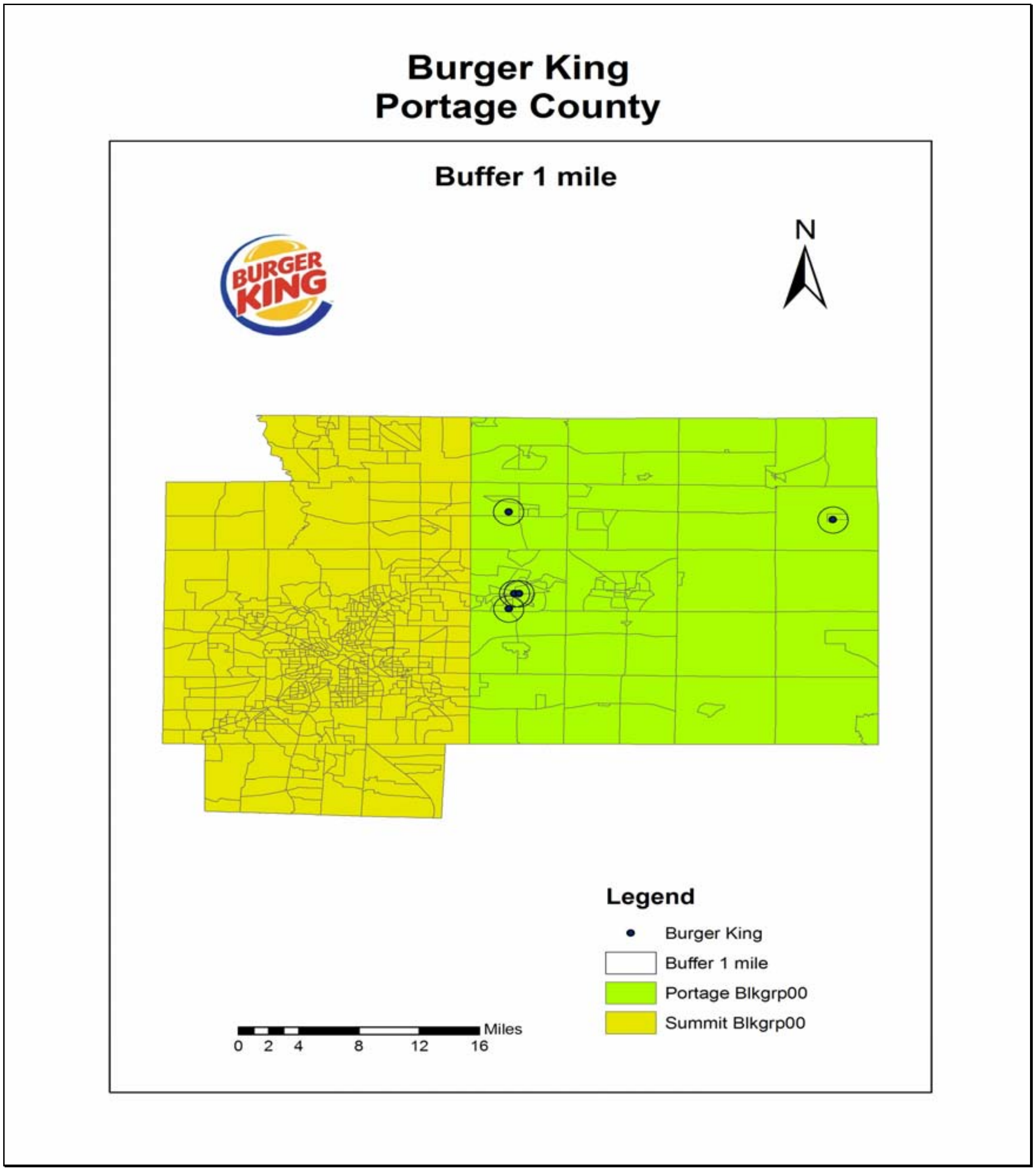

Fig 23: Burger King in Portage County (Buffer 1 mile)

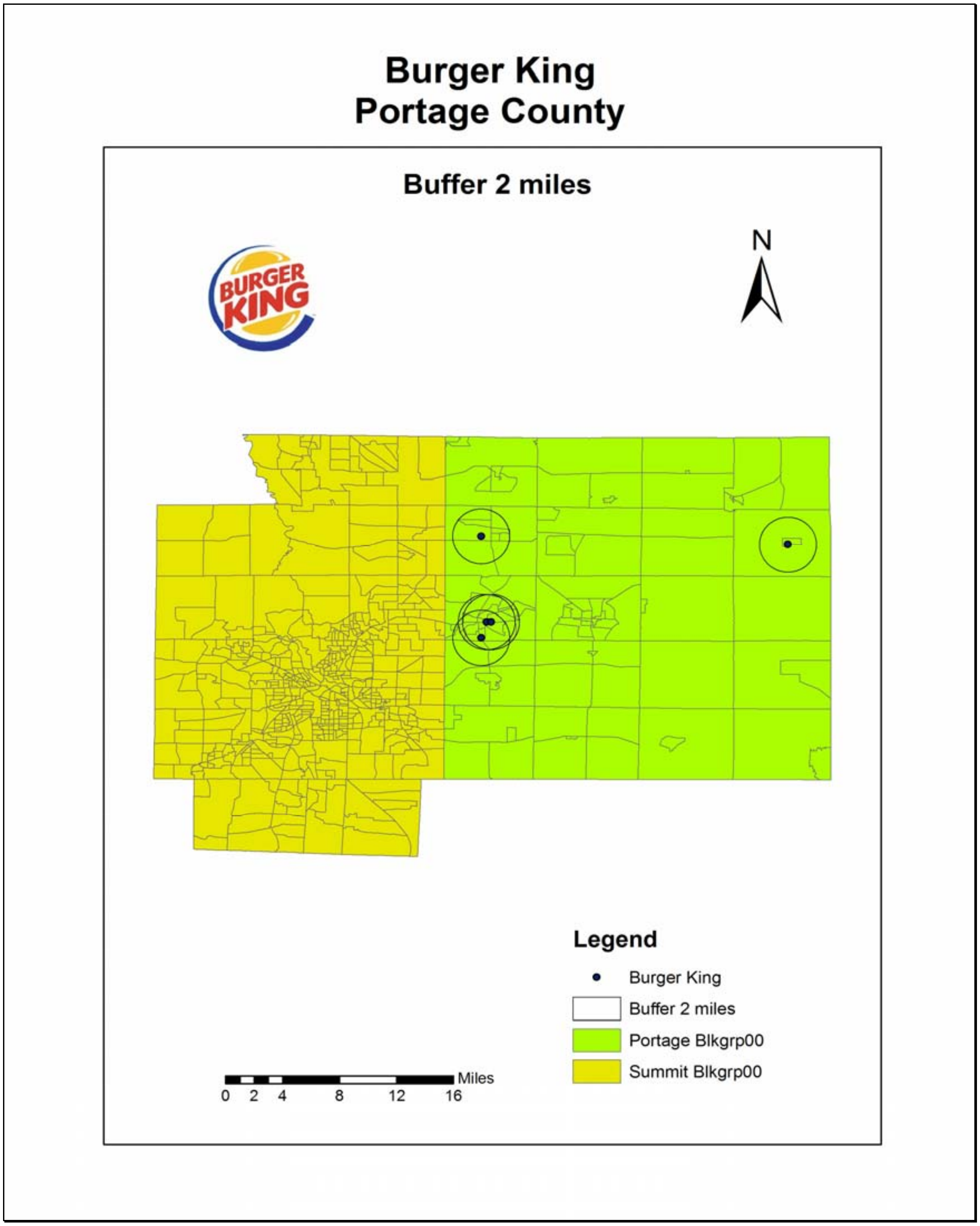

Fig 24: Burger Kings in Portage County (Buffer 2 miles)

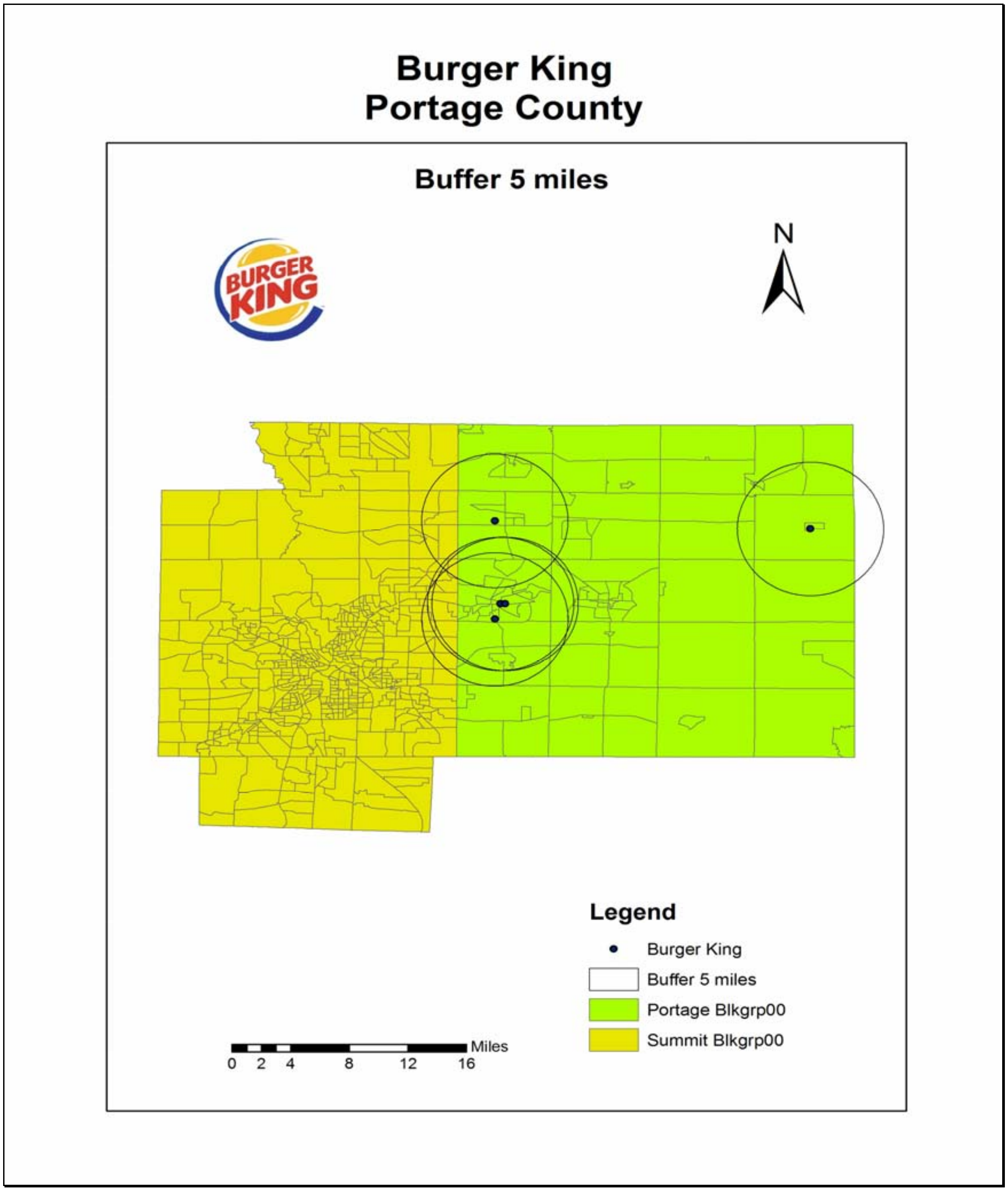

Fig 25: Burger Kings in Portage County (Buffer 5 miles)

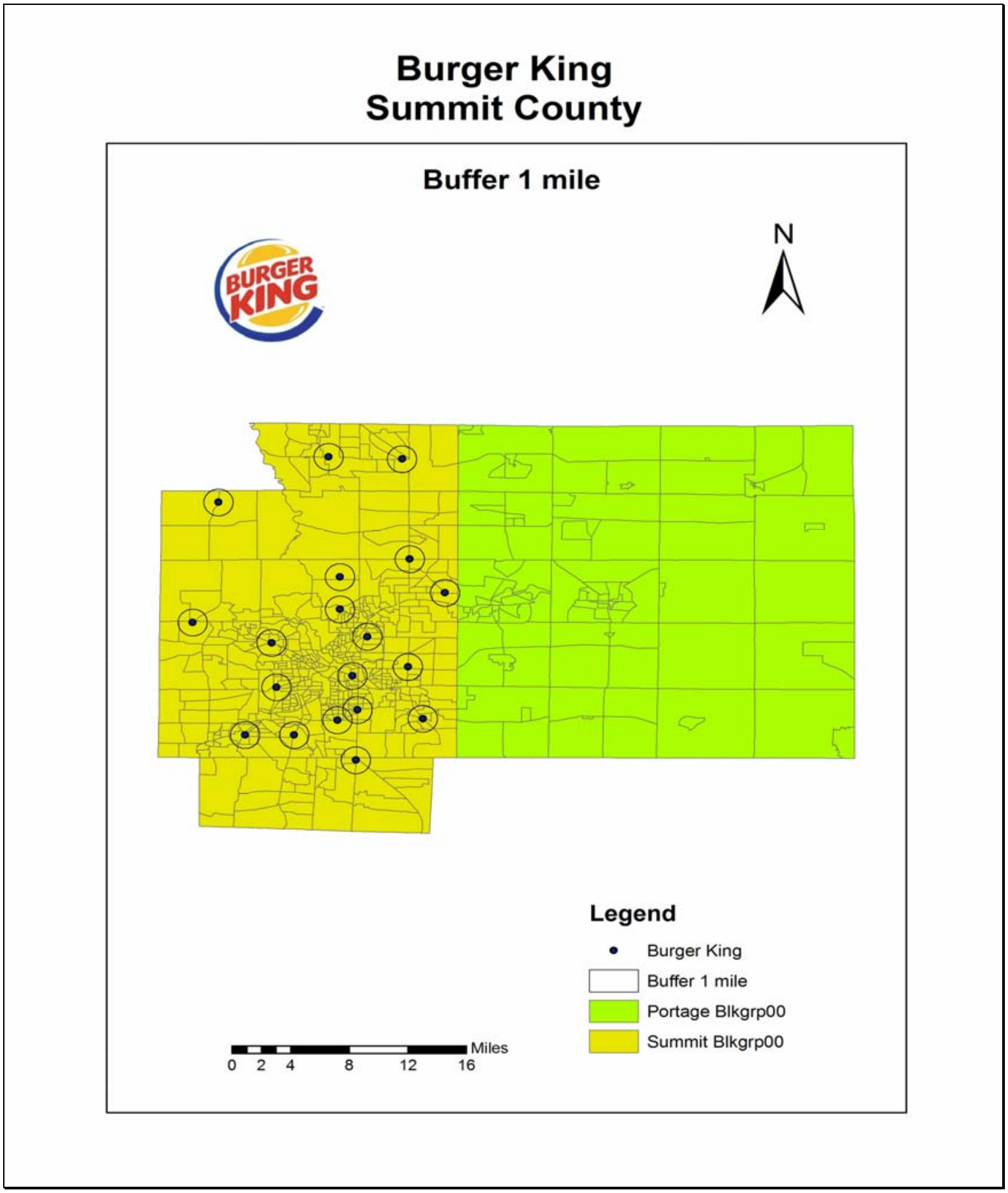

Fig 26: Burger Kings in Summit County (Buffer 1 mile)

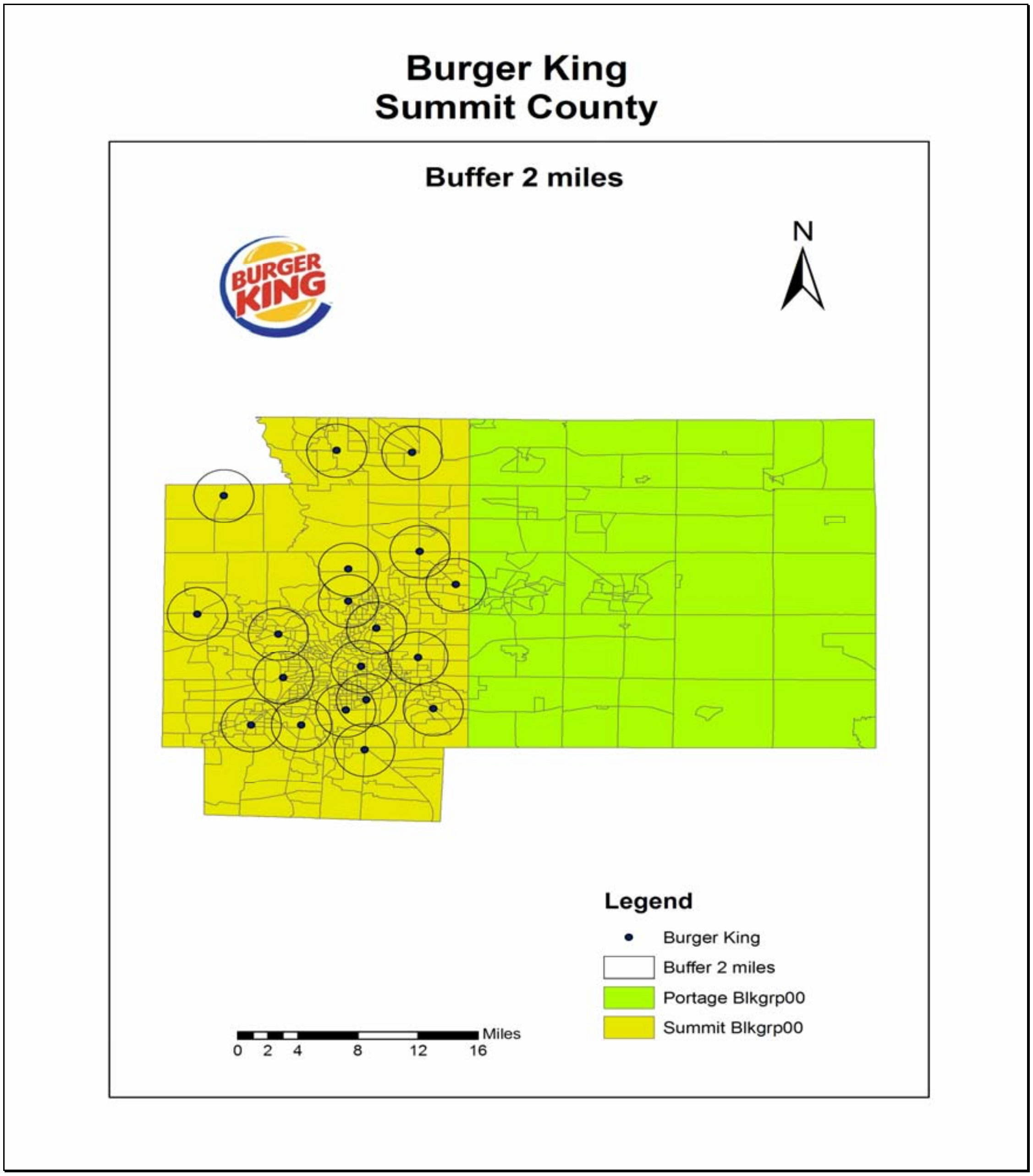

Fig 27: Burger Kings in Summit County (Buffer 2 miles)

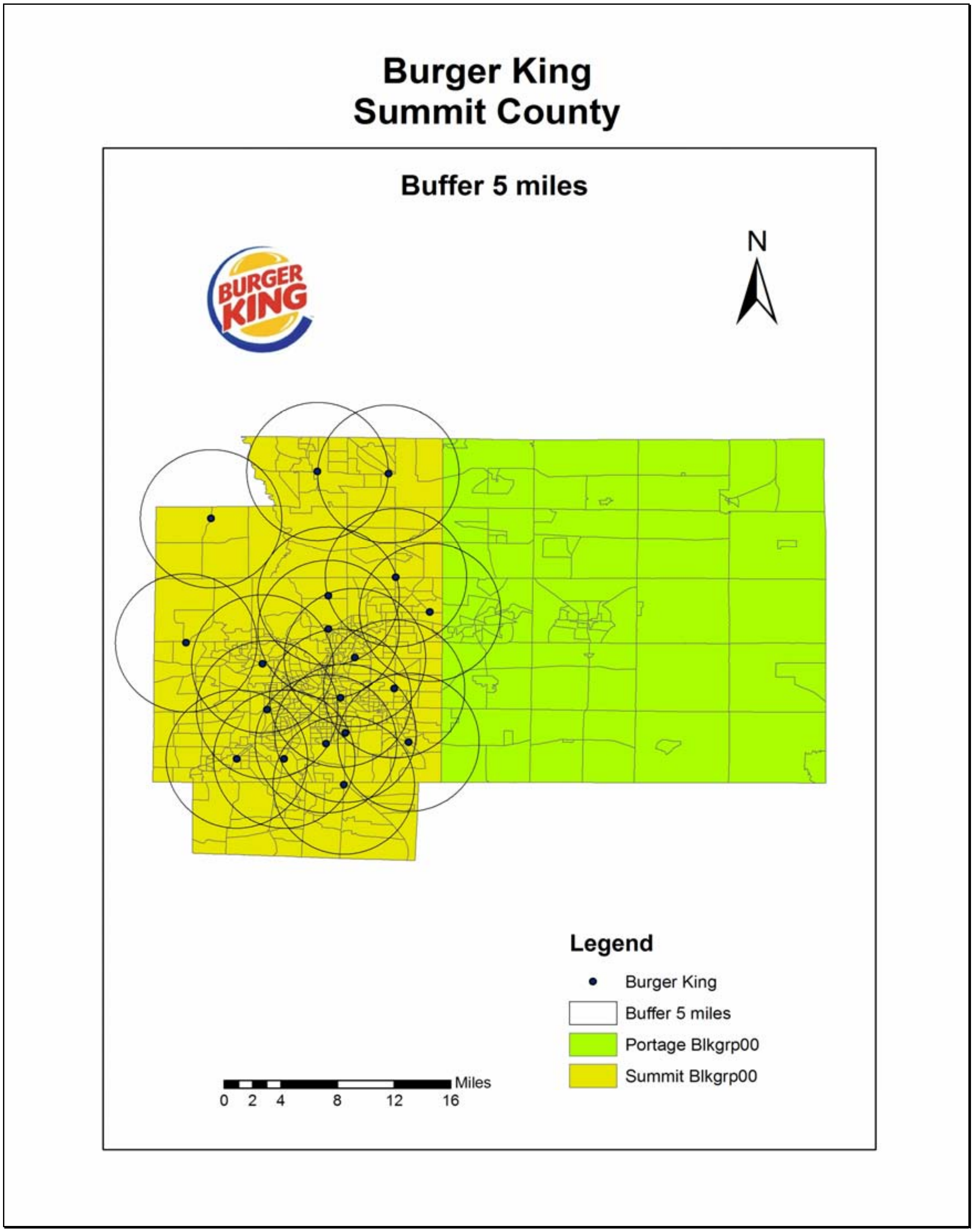

Fig 28: Burger Kings in Summit County (Buffer 5 miles)

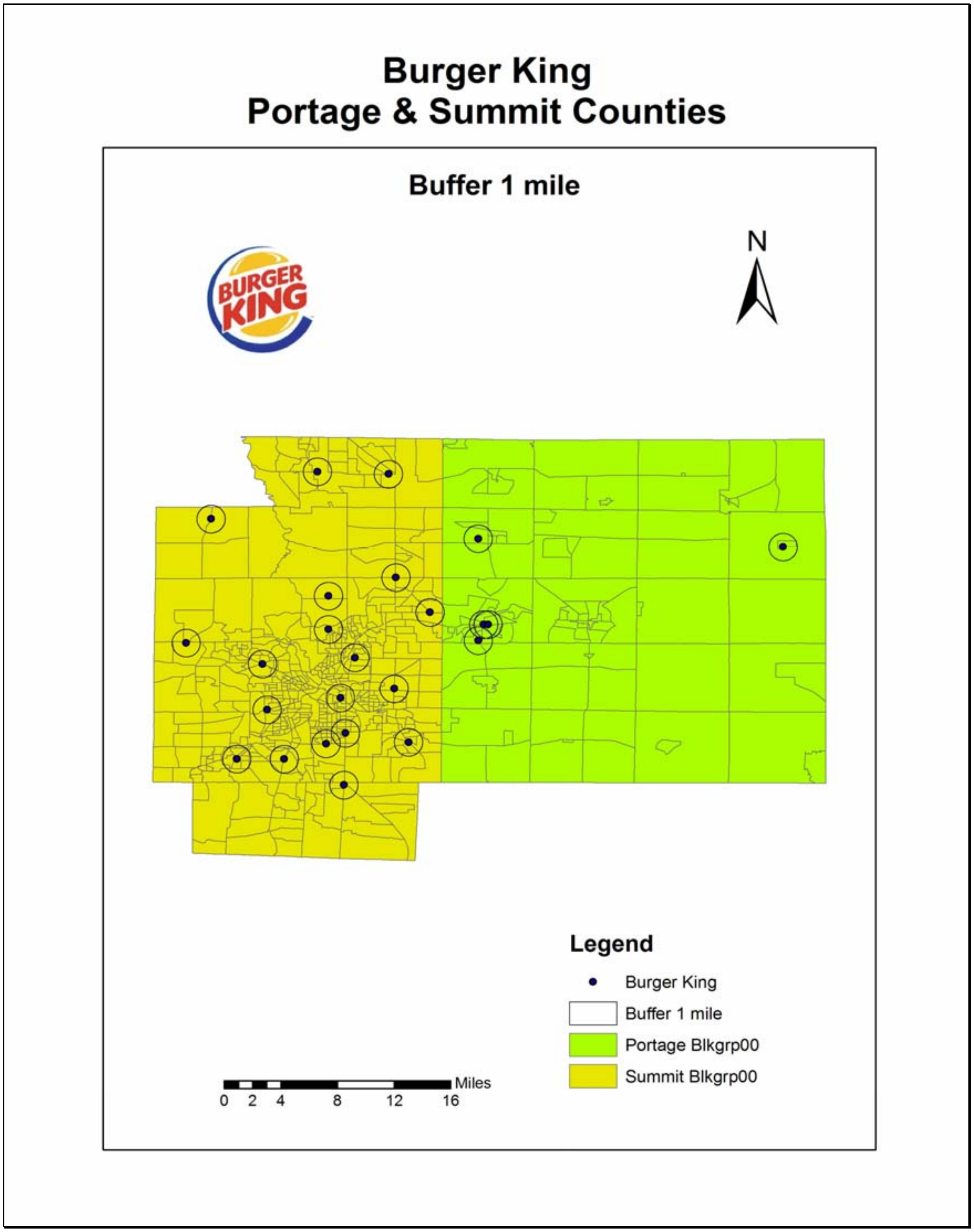

Fig 29: Burger Kings in Portage & Summit Counties (Buffer 1 mile)

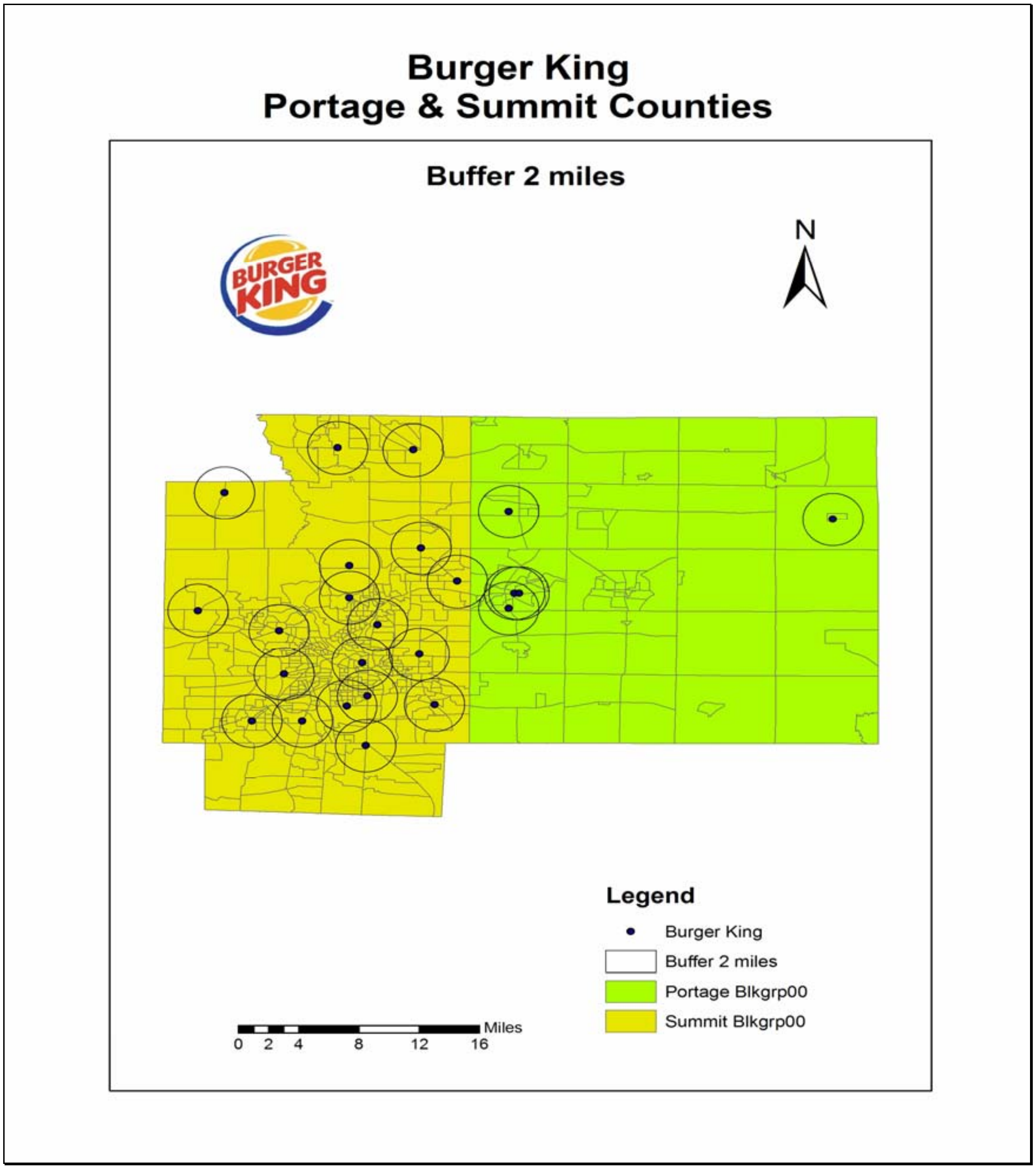

Fig 30: Burger Kings in Portage & Summit Counties (Buffer 2 miles)

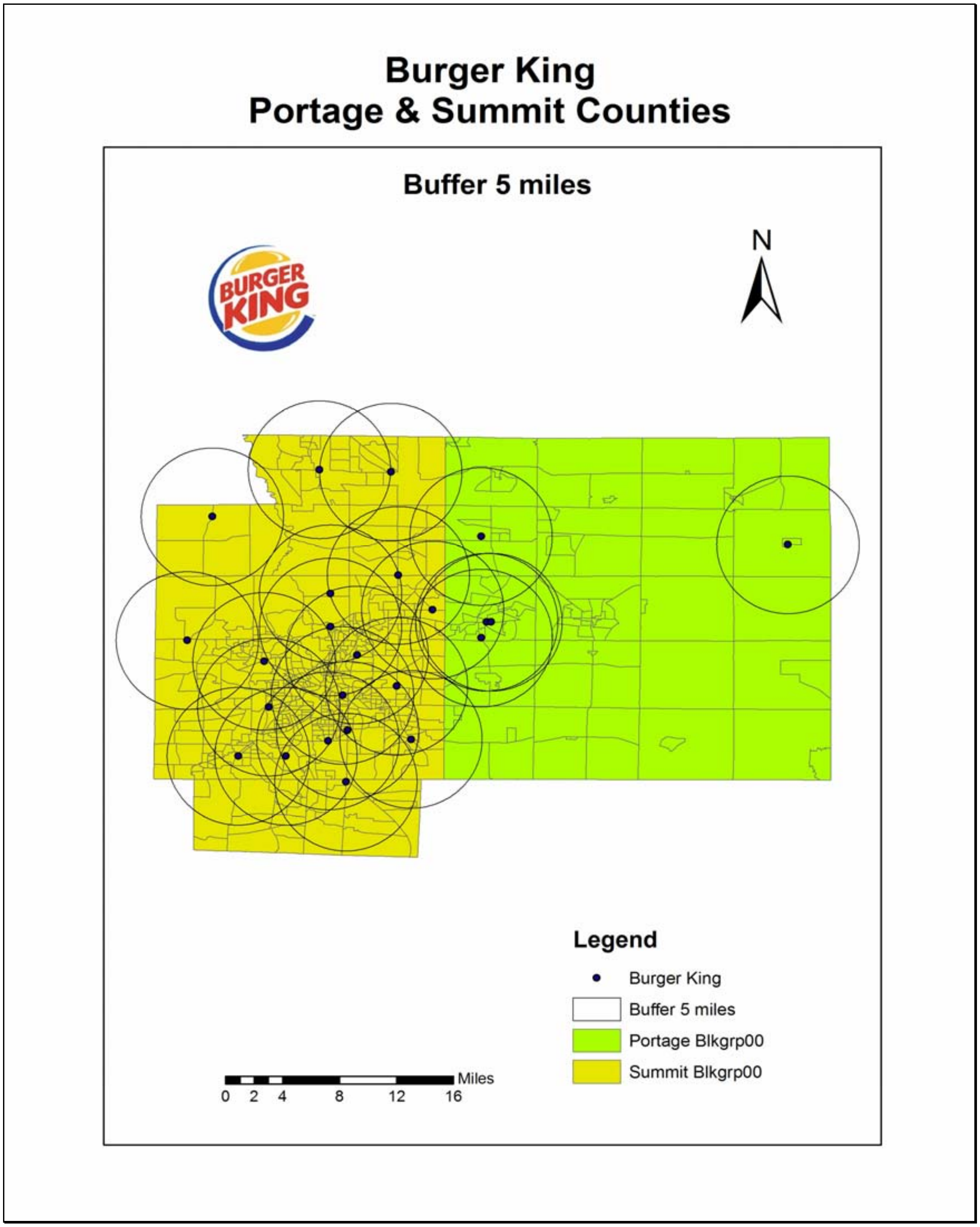

Fig 31: Burger Kings in Portage & Summit Counties (Buffer 5 miles)

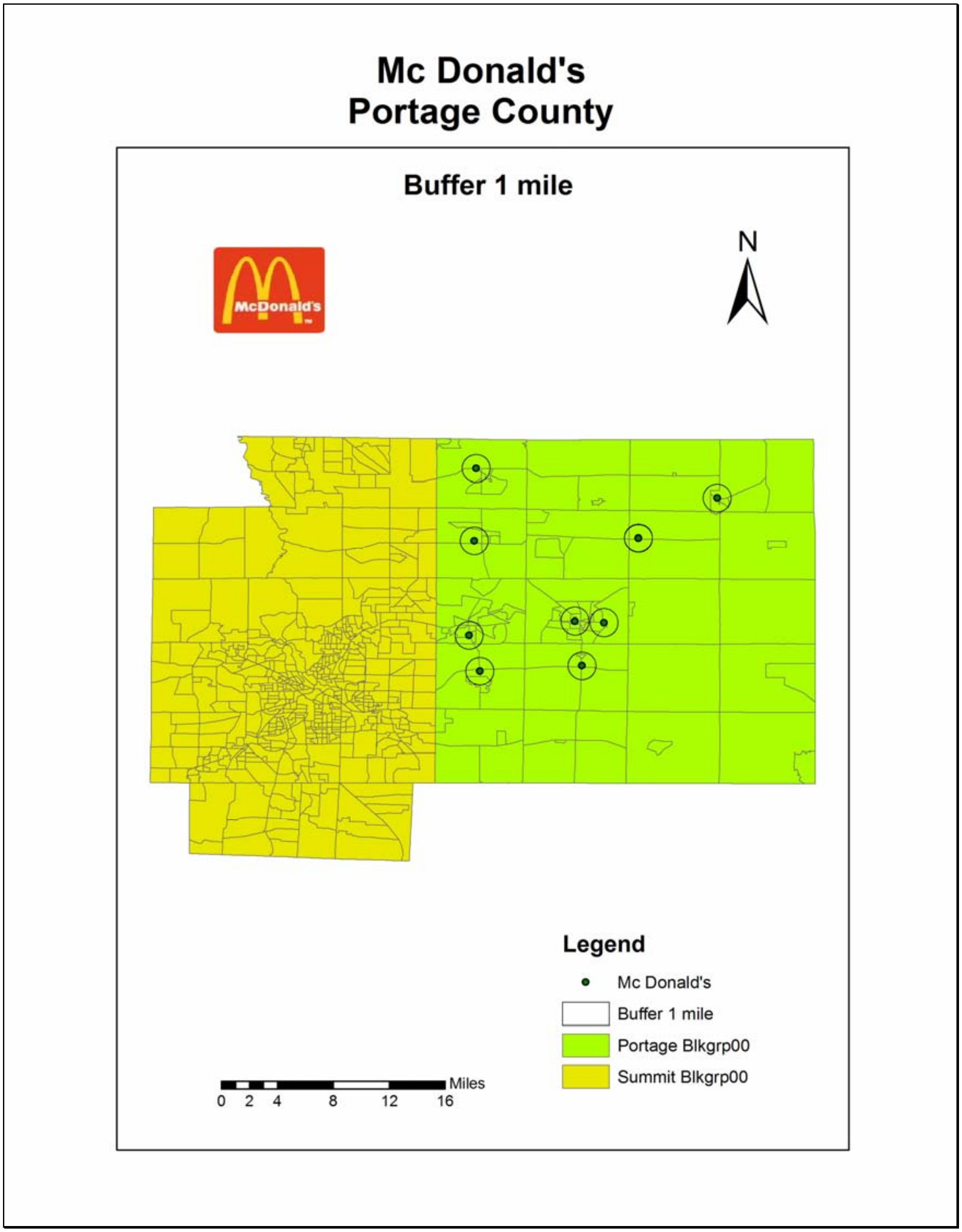

Fig 32: McDonalds' in Portage County (Buffer 1 mile)

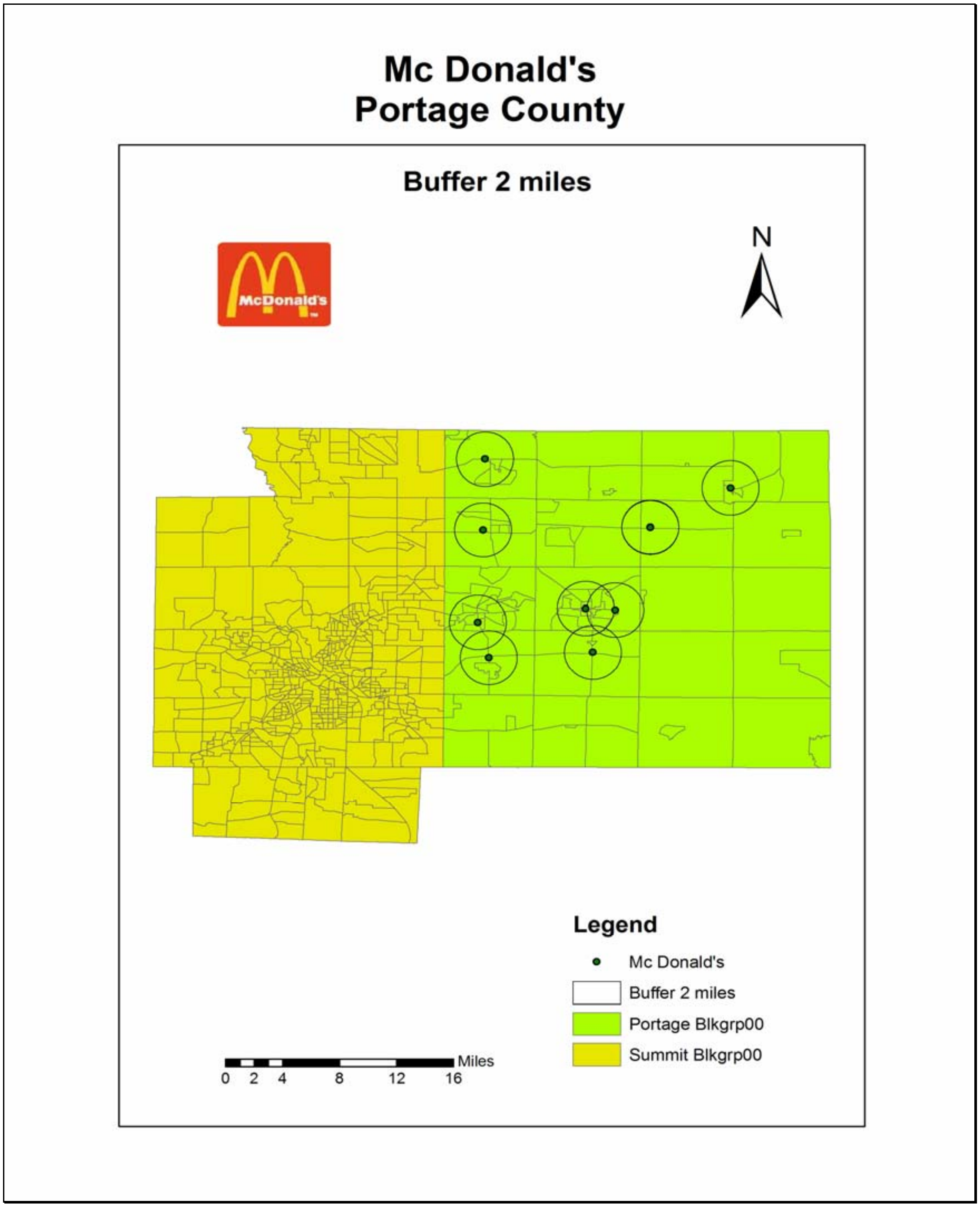

Fig 33: McDonalds' in Portage County (Buffer 2 miles)

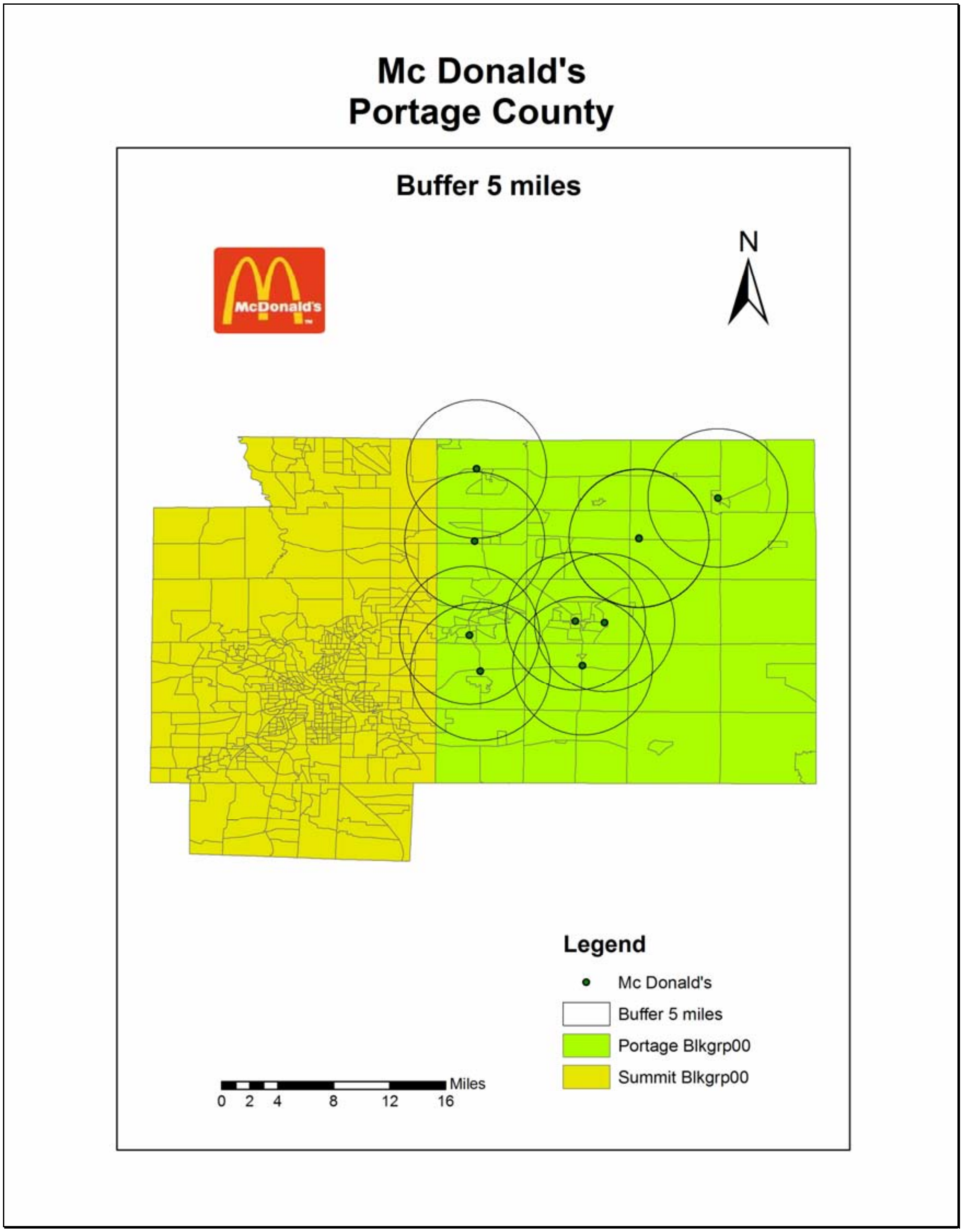

Fig 34: McDonalds' in Portage County (Buffer 5 miles)

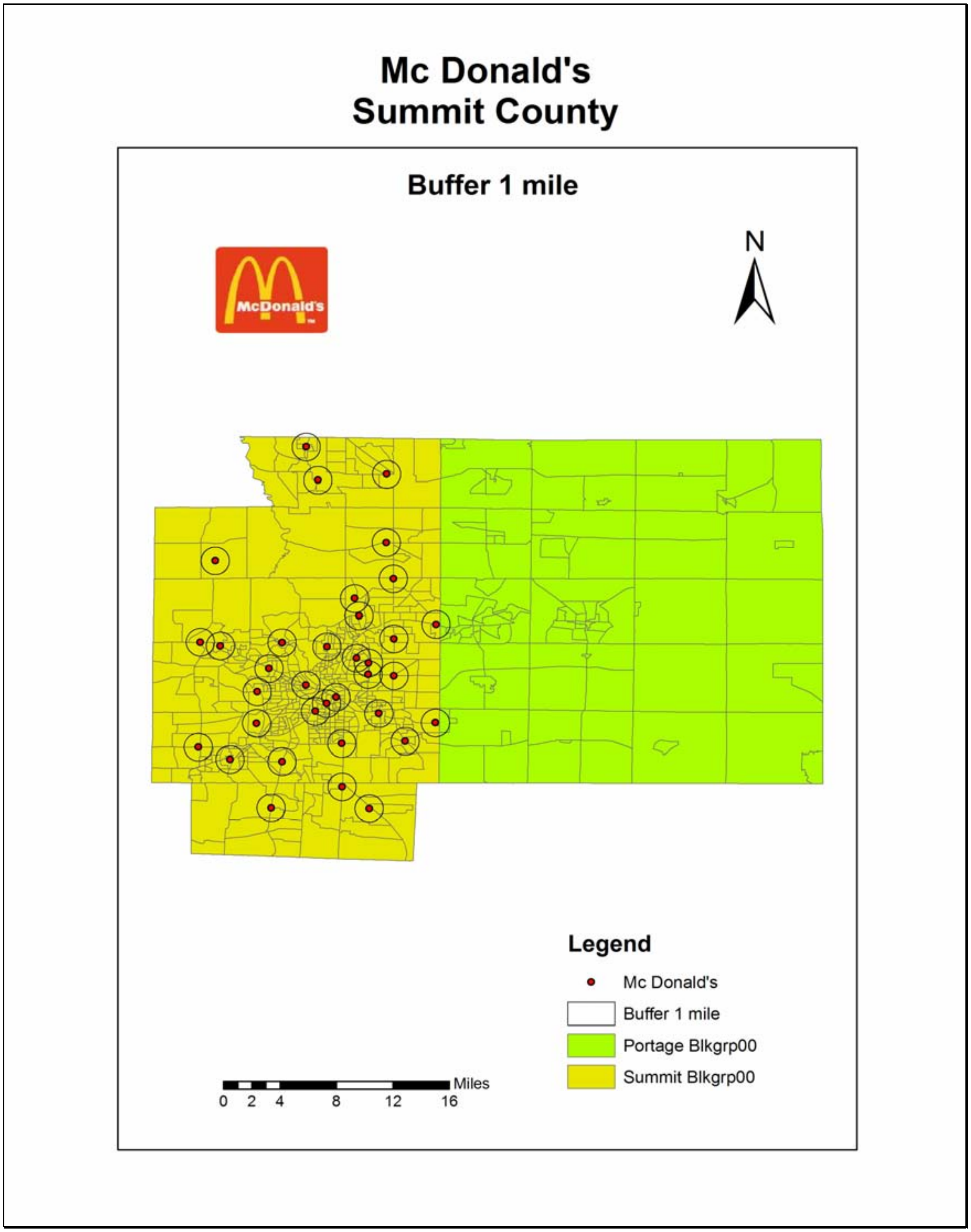

Fig 35: McDonalds' in Summit County (Buffer 1 mile)

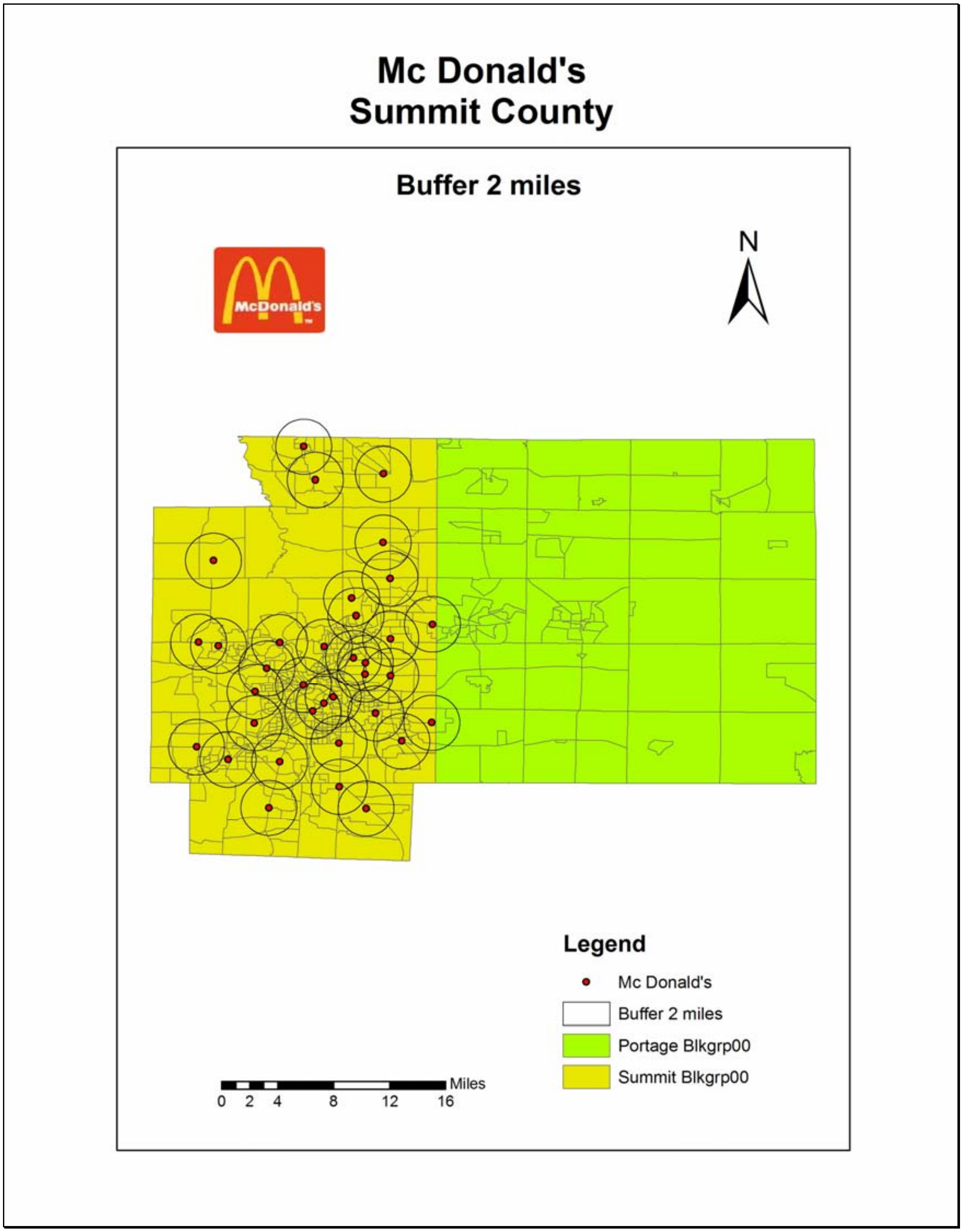

Fig 36: McDonalds' in Summit County (Buffer 2 miles)

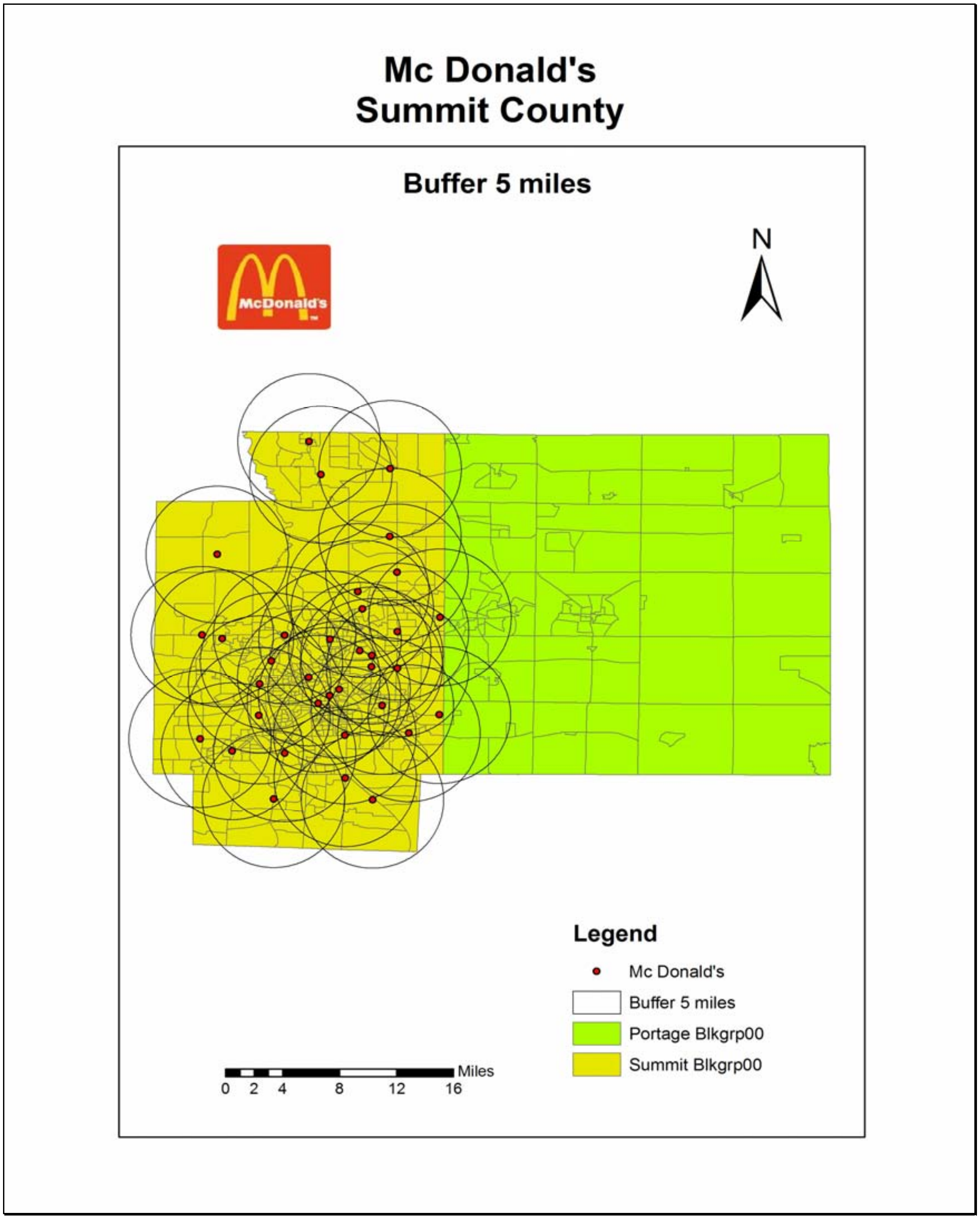

Fig 37: McDonalds' in Summit County (Buffer 5 miles)

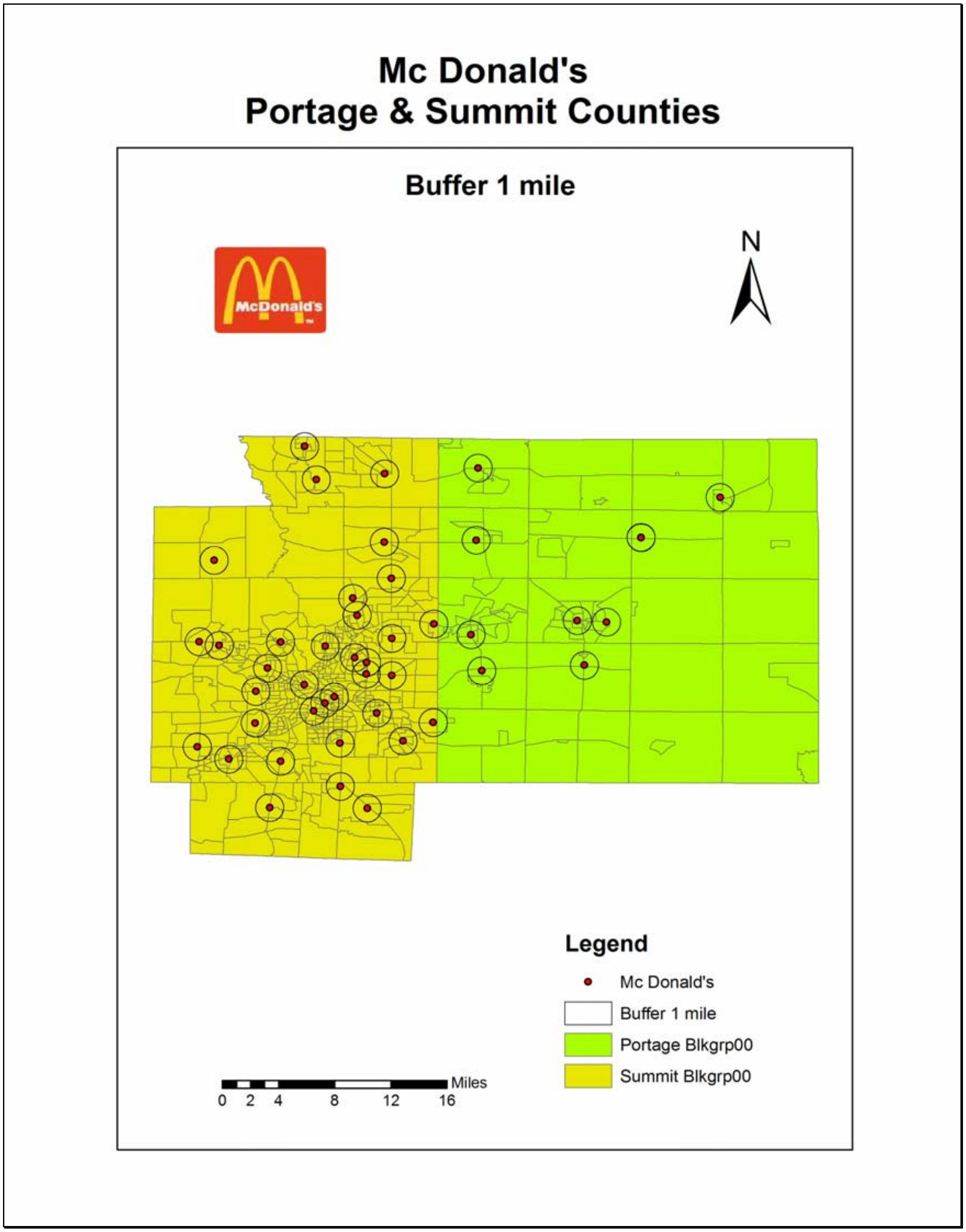

Fig 38: McDonalds' in Portage & Summit Counties (Buffer 1 mile)

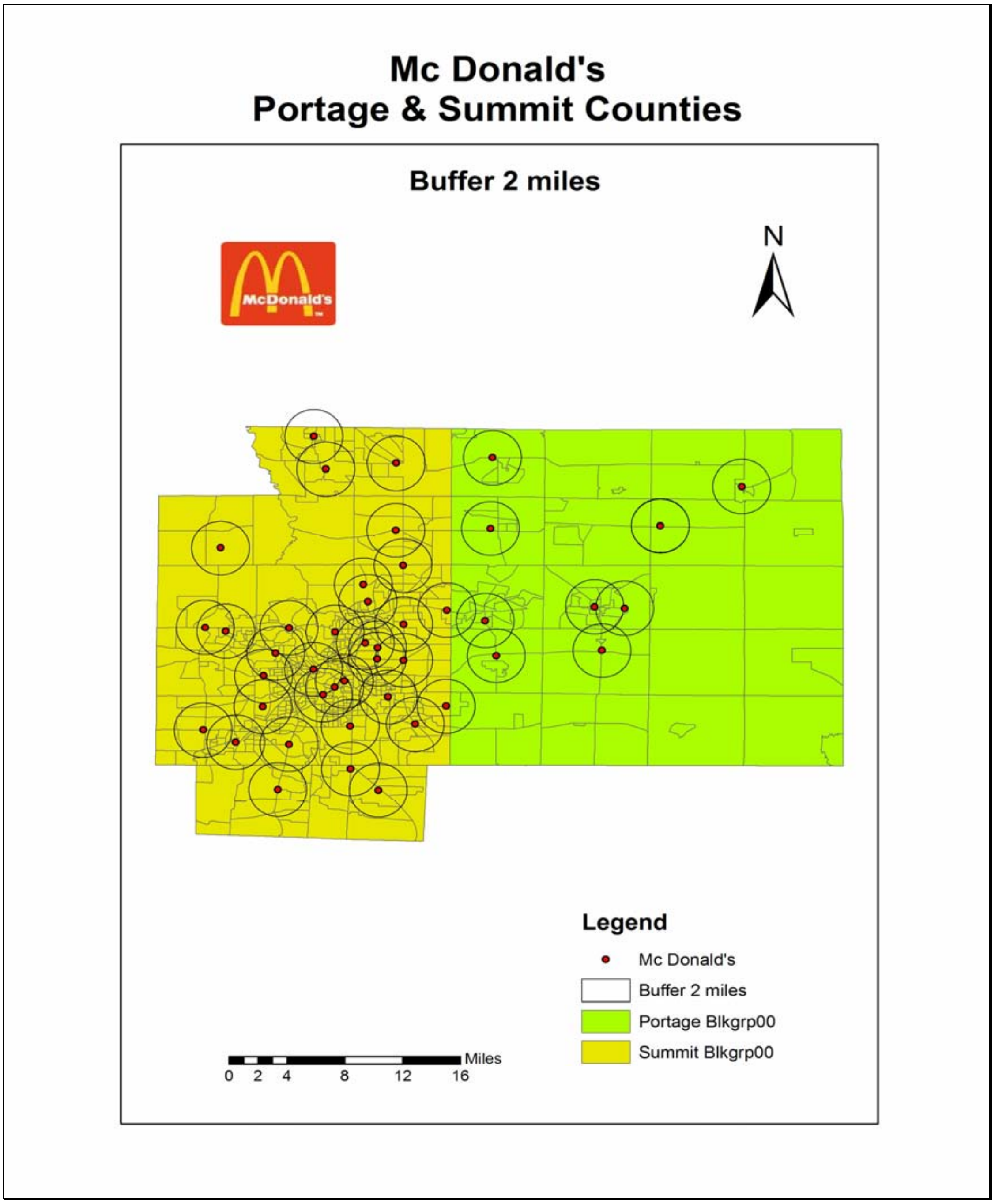

Fig 39: McDonalds' in Portage & Summit Counties (Buffer 2 miles)

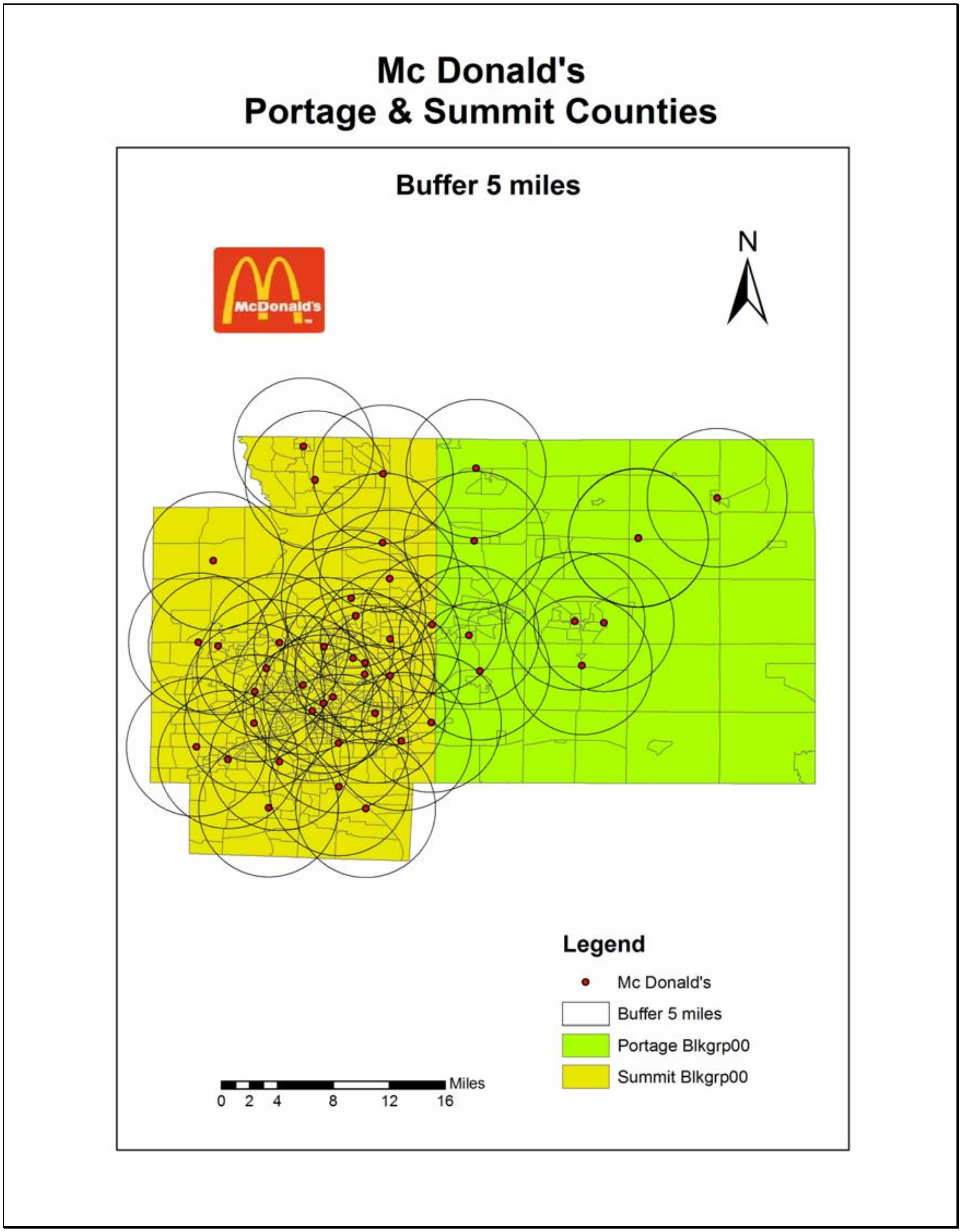

Fig 40: McDonalds' in Portage & Summit Counties (Buffer 5 miles)

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