

# **City of Bismarck**

## **On-Street Parking Inventory & Occupancy Survey**

**AUGUST 2018**

---

City of Bismarck

Community Development Department –  
Planning Division

# CONTENTS

Introduction.....	2
Key Findings.....	3
Parking Inventory Methods.....	4
Defining the Study Area.....	4
Establishing Parking Types.....	5
Determining the Number of Parallel Parking Spaces.....	6
Mapping the Inventory.....	7
Parking Inventory Analysis.....	8
Parking Availability by Type .....	8
Handicap and Loading Zones .....	9
Space Efficiency and Pavement Marking .....	10
Space Efficiency and Parking Orientation.....	10
Parking Occupancy Survey Methods.....	12
Using the Aerial as a Survey .....	12
Scheduling Field Surveys .....	12
Routing Field Surveys .....	12
Collecting Data During Field Surveys .....	13
Future Enhancements.....	14
Parking Occupancy Survey Analysis.....	16
Regular Variations in Occupancy .....	17
Occupancy by Restriction Type.....	17
Historic Trends.....	18

## **Introduction**

On-street parking is an important City-owned public resource for downtown Bismarck and its surrounding areas. Serving as the primary type of parking for the neighborhood, on-street parking is a shared asset that serves many businesses and activities. This 2018 On-Street Parking Inventory & Occupancy Survey measures the availability and type of on-street parking in and around downtown Bismarck, as well as parking occupancy rates throughout the area at different times of the day.

## Key Findings

- There are 2,961 on-street parking spaces in the study area and 598 on-street parking spaces in the core study area.
- Approximately 33% of all on-street spaces were occupied, and 51% of spaces within the core area were occupied, on average for all four surveys.
- Over half (53%) of all street frontage in the study area is completely restricted for on-street parking or loading.
- Parking occupancy is consistent throughout the day but varies considerably in the evening. Occupancy rates throughout the study area are higher in the daytime (37%) than evening (20%), but in the core area evening occupancy (42%) approaches daytime occupancy (54%).
- Parking areas with the highest utilization are generally within a short walking distance of an area with available parking spaces. No places within the study area have a significant loss of level of service due to insufficient parking.
- Unmarked parallel parking spaces are currently being used relatively efficiently and striping those spaces is unlikely to yield greater parking capacity.
- One out of every 423 spaces in the study area is designated as handicap.
- Angled parking requires less space than parallel parking. A typical north-south block in the study area could gain seven additional parking spaces if one side is reconfigured from parallel to angled parking.
- There has been a decrease of nearly 385 on-street parking spaces between 1978 and 2018 in the area included in respective studies.
- On-street parking occupancy rates have decreased since previous studies. In 1978, 71% of all spaces were occupied. For the same area in 2018, 47% of the spaces are occupied.

# Parking Inventory Methods

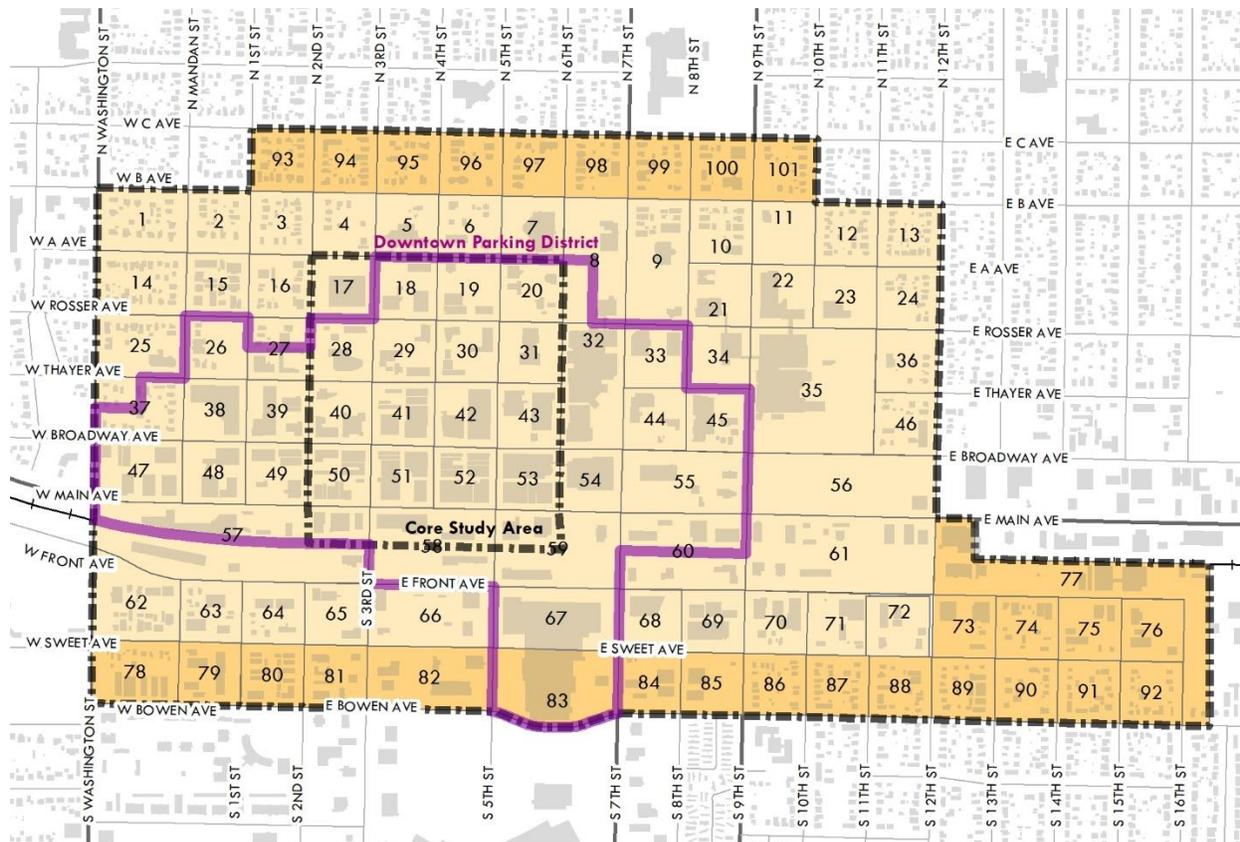
This study created an inventory of all on-street parking resources within a defined study area, a total of 1,873 separate street frontage segments. This section describes the methods of creating this inventory.

## Defining the Study Area

While on-street parking is available throughout the city, the study area was chosen based on the location where high levels of usage and potential parking constraints are observed. The 2008 Bismarck Parking Study defined the study area as the area bounded by Washington Street, Avenue B, 12<sup>th</sup> Street, and Sweet Avenue. A smaller core area centered around Chancellor Square was also identified.

This study expands the boundaries from the 2008 study to account for areas surrounding the downtown that are experiencing redevelopment or existing parking constraints, such as the area between the CHI Saint Alexius Hospital and Bismarck High School, as well as additional areas south of Main Avenue that are experiencing redevelopment. Although redevelopment is currently limited, a baseline parking count can establish existing conditions from which future changes to parking demand can be measured.

The study area also includes the entirety of the Downtown Parking District, where the provision to provide off-street parking with new development or redevelopment is not required by ordinance.



On-Street Parking Study Area

## Establishing Parking Types

Both frontages of each street in the study area are assigned one of the following on-street parking types, based on legal and physical constraints:

<i>Parking Type</i>	<i>Definition</i>
<i>Restricted</i>	No parking allowed any time
<i>Public</i>	Parking allowed (time limits may apply)
<i>Handicap</i>	Parking allowed only with a disability parking permit
<i>Loading</i>	Parking and standing only allowed in short-term for purposes of loading and unloading
<i>Daytime Restricted</i>	No parking allowed from Monday to Friday, 8:00am to 5:00 pm

Parking areas were identified primarily through existing signs in the public right-of-way. Where parking restrictions are not indicated by sign, Title 12 of the City Code of Ordinances was used to determine any additional legal restrictions. Parking is prohibited in the following areas within the paved street, according to section 12-13-02 of the City Code of Ordinances:

- In front of a public or private driveway
- Within fifteen feet of an intersection
- Within ten feet of a fire hydrant
- Within ten feet of a crosswalk at an intersection
- Within fifteen feet of the nearest rail of a railroad crossing
- Upon any bridge or other elevated structure upon a highway or within a highway tunnel

Once public parking segments were identified, these segments were further differentiated by time limits. Parking time limitations in the study area range from 10 minutes to 2 hours.

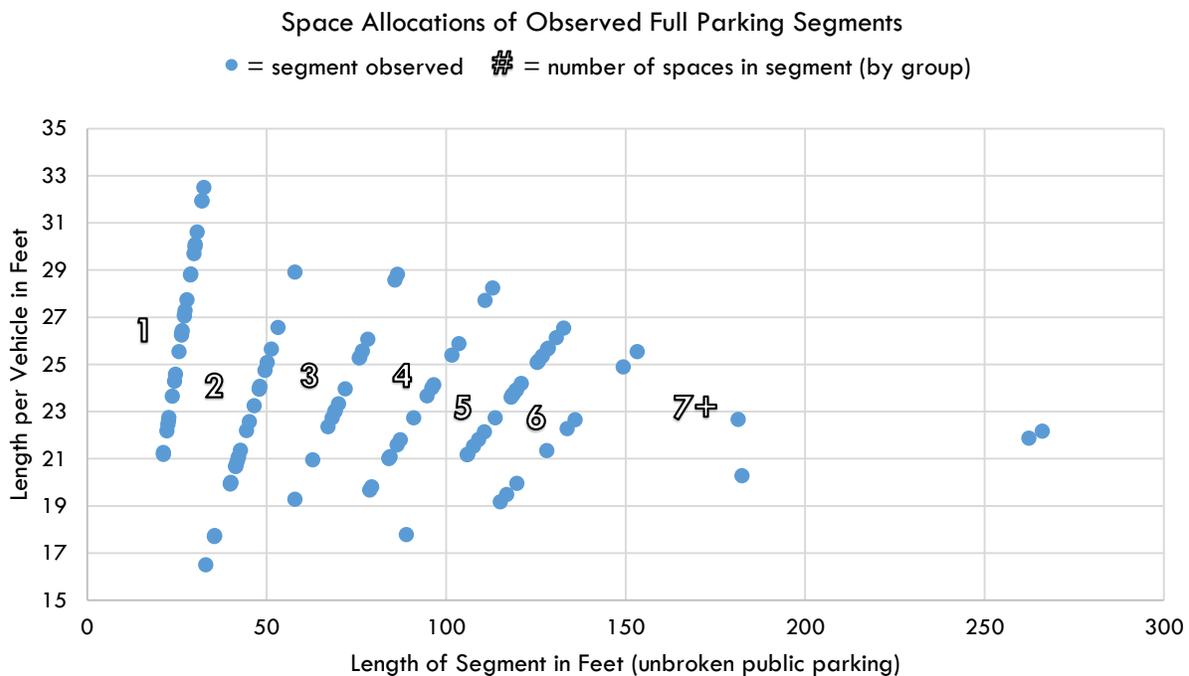
There are additional restrictions that were not considered in the study, such as nighttime parking restricted areas, street cleaning restrictions during certain times, and restrictions on re-parking on a block after the time limit has lapsed. Parking is also restricted during snow emergencies along Main Avenue, 7th Street, 9th Street, portions of Rosser and 6th Street around Sanford Hospital.

The Engineering Department maintains GIS points for each street sign and hydrant. This data along with a 2016 aerial was used to identify each segment. The inventory was verified and small revisions were made to the segments based on the occupancy field surveys.

## Determining the Number of Parallel Parking Spaces

On-street parallel parking spaces are not marked in the City of Bismarck. In order to count the availability of on-street parking, estimates for the amount of street space necessary to fit a vehicle into a parallel spot were generated. There is variability in the amount of space needed due to differences in vehicle lengths, differences in the lengths of public parking segments, and behavior of parkers (e.g. some parkers leave more space between vehicles than others). The intent of this study is to determine a space allocation that is derived from observed behavior in the study area.

A sample of 110 parallel public parking segments, not including special designations such as handicap and loading zones, were determined to be “full” at a particular point in time in 2016 – meaning that a driver of any vehicle passing this segment would not be able to adequately fit within it. The amount of vehicles in the full segments, and the amount of space per parked vehicle were determined.



The amount of space utilized per parking space varies significantly within the sample from 16 feet to 33 feet per space. The most important factor is segment size. Because the segments are not all evenly divisible by the typical car length, there is often a remainder that cannot be utilized for parking.

On average, the typical amount of space used per vehicle is 23.2 feet. The exception to this is single-space segments. Single and double space segments may be shorter than multi-space segments, because there is no need for extra area to maneuver into the parking space. This study assumes that 16 feet is sufficient to comfortably fit an average sedan into a single space. On the other hand, drivers appear to treat any space of up to approximately 32 feet as a single space and park in the middle of it, which renders these spaces uniquely inefficient on the higher end of the spectrum. Spaces smaller than 16 feet may be utilized by compact vehicles and motorcycles. However, this report does not detail any evaluation of motorcycles and compact cars utilizing smaller spaces.

Based on the results of these observations, the following allocation rule is applied to all segments in the study area:

<i>Segment Length</i>	<i>Number of Spaces Allocated</i>
<i>Segments &lt; 16'</i>	0 Spaces (treated as restricted)
<i>Segments between 16' and 32'</i>	1 Space
<i>Segments between 32' and 58'</i>	2 Spaces
<i>Segments &gt; 58'</i>	[Spaces] = [Length of Segment]/23.2 feet, rounded to nearest integer

### Mapping the Inventory

A map of all segments in the study area was created in the City's GIS. The following table is a key to all of the data available in this feature class (see the following section for more information on observation data collection):

<i>GIS Field</i>	<i>Definition</i>
<b>PARKING_TYPE</b>	Availability or restrictions of parking along street segment
<b>CONFIGURATION</b>	Orientation of parking: parallel, angled, or right angled
<b>SPACES</b>	Number of available spaces in segment
<b>TIME LIMIT</b>	Limit on allowable parking time in minutes
<b>STUDY_2008</b>	Whether the segment was included in 2008 study
<b>OBS#_TIME</b>	Exact time and date of that observation (e.g. OBS1_TIME)
<b>OBS#_COUNT</b>	Number of vehicles occupying spaces in segment during that observation
<b>OBS#_PERCENT</b>	Percentage of available spaces in segment that are occupied during that observation
<b>Shape.STLength()</b>	Length of segment in feet

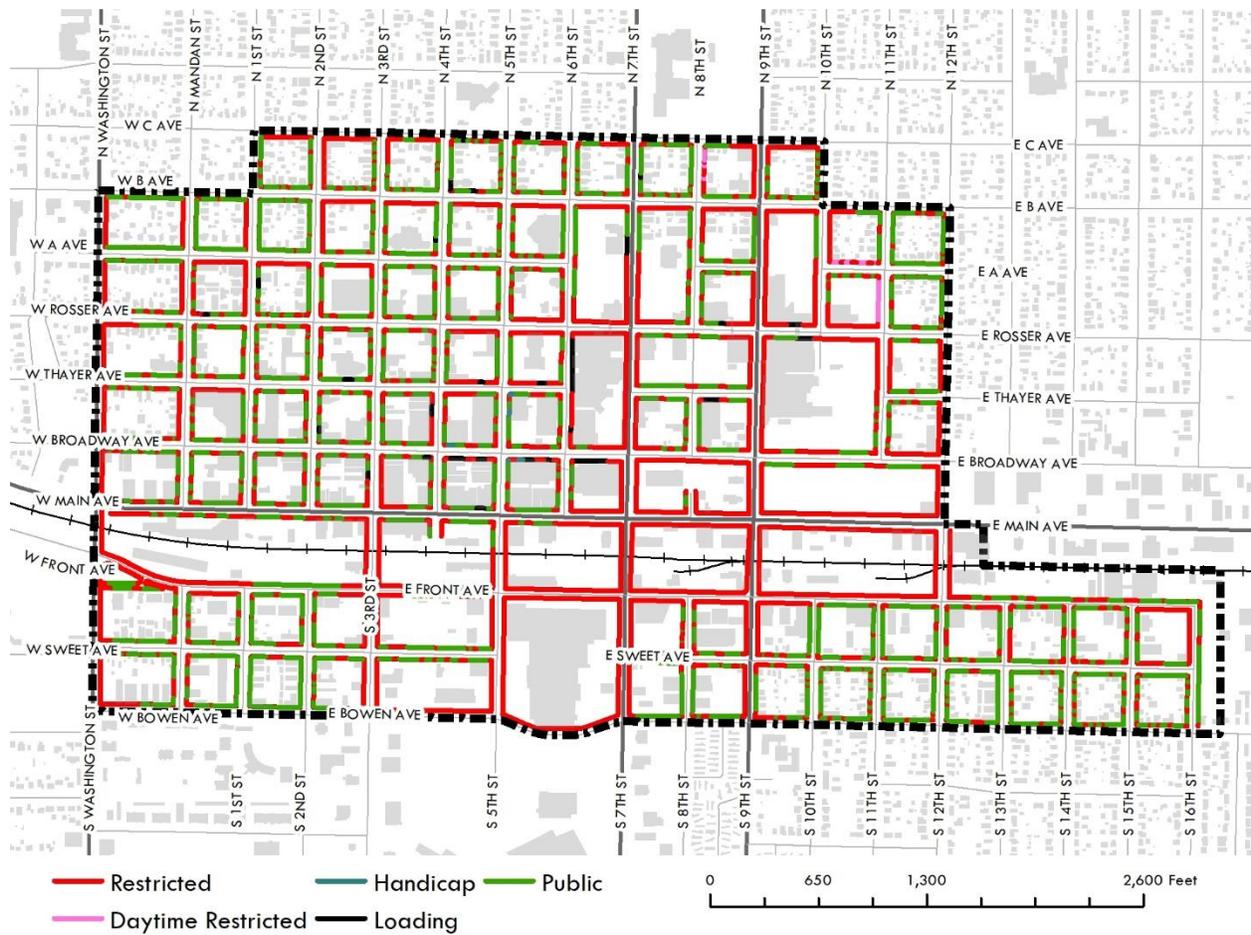
# Parking Inventory Analysis

The complete final results of the analysis are available online to the public through the City's GIS. This section provides some preliminary analysis of the data.

## Parking Availability by Type

There are a total of 2,961 on-street parking spaces in the study area, and 598 within the core study area. Although this study did not count off-street parking, the total number of spaces within public surface lots and structures operated by the Bismarck Parking Authority is an additional 1,786.

Over half (53%) of all street frontage in the study area is completely unavailable to on-street parking or loading. The most common reason for restrictions is the presence of additional drive lanes on arterial roads, turning lanes, streets considered to be insufficiently wide, driveways or curb cuts, proximity to intersections, and hydrants.



**On-Street Parking by Restriction Type**

Time limits of some form are applied to 58% of all parking spaces in the study area. The time limits range from 10 minutes to 2 hours. The strictest time limits are typically applied to small areas in front of specific uses that generate rapid turn-over. Otherwise, typically parking in the core area is limited to 90 minutes, with 2-hour parking on the fringes. Time limits of 30 and 60 minutes are uncommon.



**On-Street Parking by Time Limit**

**Handicap and Loading Zones**

There are seven handicap on-street parking spaces currently within the study area, mostly concentrated around Chancellor Square. One out of every 423 spaces in the study area is designated as handicap.

There are 81 loading zone spaces, although larger trucks may occupy multiple spaces while loading. The most extensive loading zones are on the south side of Broadway Avenue in Chancellor Square, near the Sanford Emergency Room entrance, outside of the Radisson hotel, and in front of certain multifamily buildings and churches.

## Space Efficiency and Pavement Marking

Some cities use pavement markings of parallel on-street spaces as a tool to increase compliance and improve the efficiency of parking. Using the observed spatial allocations of on-street parking in Bismarck, it is possible to estimate whether, or to what degree, applying pavement markings would result in additional available parking spaces in the downtown.

If markings are used, The Manual of Uniform Traffic Control Devices (MUTCD) recommends marking 20 feet for end spaces and between 22 feet and 26 feet for middle spaces of a parking segment. Traditionally, a parallel space was considered to be 20' in length, but the standards have been increased in recent years due to increasing lengths of vehicles.

The observed space allocation for unmarked segments generated above can be compared to the number of spaces that would be marked within the study area following the MUTCD guidelines.

<i>Type of Pavement Marking</i>	<i>Estimated Total Parallel Spaces in Study Area</i>	<i>Estimated Total Parallel Spaces in Core Area</i>
<i>Allocated Unmarked</i>	2,828	501
<i>Low-End MUTCD (22 feet per mid space)</i>	2,943	523
<i>High-End MUTCD (26 feet per mid space)</i>	2,656	476

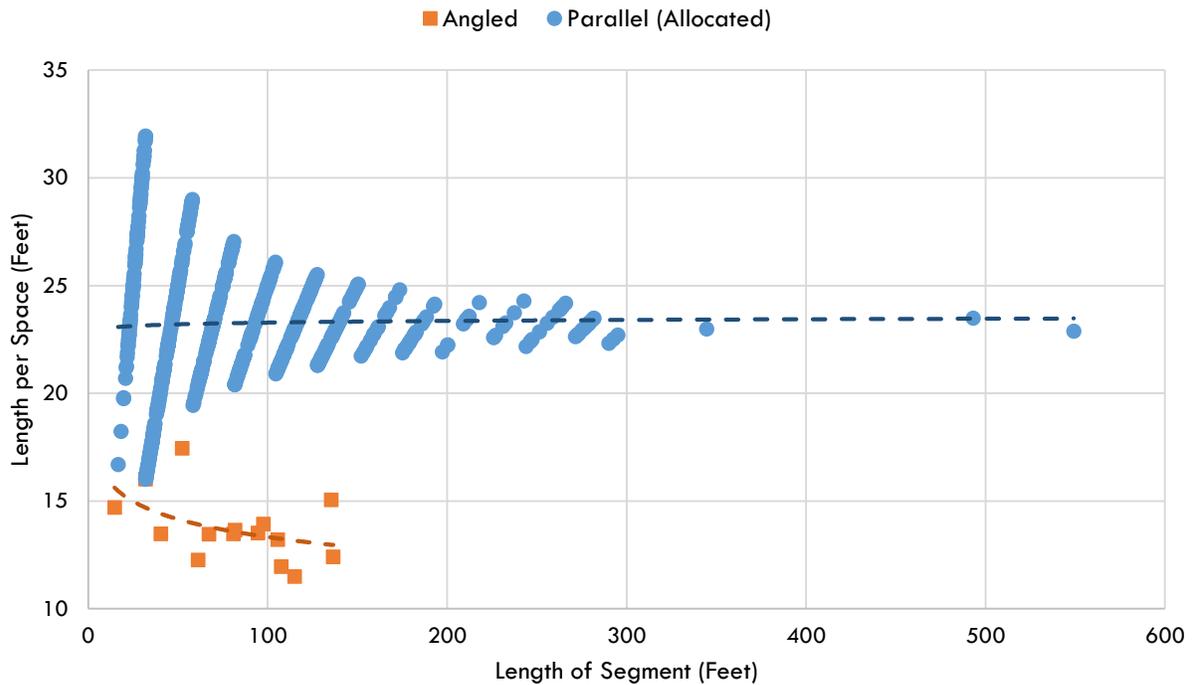
Using pavement marking in the study area may yield modest improvements in efficiency of parking (approximately 4%), but only if the low-end MUTCD recommendation for space size is applied. Using the more generous MUTCD parking space recommendations would result in a reduction of parking spaces in the study area. However, using the lower-end recommendation in Bismarck may result in significant inconvenience and possible conflicts for larger vehicles. The cost of applying and maintaining markings is also a factor. Thus, pavement marking of on-street parallel parking spaces in Bismarck would likely achieve no to minimal efficiency gains, while incurring costs in terms of convenience and public finances.

## Space Efficiency and Parking Orientation

The majority of all on-street parking in the study area is oriented as parallel parking. However, there are 108 spaces (4% of total) that are currently marked as angled spaces. Most of these are in Chancellor Square, although there are a few segments in the southeast portion of the study area. There are also 25 right-angle spaces in the southeast portion of the study area, although some of these appear to straddle the boundary between private property and public right-of-way.

The angled parking spaces generally use 10 feet of street frontage length per interior space, and 18.5 feet for end spaces (to account for the remaining wedge from the angle). There is currently a small amount of lost space for angled parking in Chancellor Square because the orientations are not aligned with the curbs due to a change in street direction in 2016. The average angled parking space in the study area uses approximately 13 feet of street frontage, compared to 23 feet for parallel spaces.

### Space Efficiency of On-Street Parking by Orientation



This efficiency difference suggests that additional parking may be provided if parallel spaces were converted to angled spaces, especially along segments that have fewer interruptions from driveways, hydrants, and other restrictions. A typical north-south street segment with a mid-block alley could increase the number of parking spaces by 35% (from 20 spaces to 27 spaces) if one side is converted to angled parking.

Angled parking can only be used if sufficient street width is available, typically at least 48 feet of width from curb to curb for a single side of angled parking with parallel parking on the opposite side. There are a number of streets in the study area that could potentially support additional angled parking, although additional investigation of traffic conflicts and engineering feasibility are necessary to justify any changes.

## Parking Occupancy Survey Methods

Parking occupancy for each segment was measured through point-in-time manual counts of vehicles occupying each segment in the on-street parking inventory. This section details the methods used to collect this data to improve survey efficiency and ensure comparability between present and future surveys.

The following surveys were taken:

<i>Survey</i>	<i>Data Field</i>	<i>Method</i>	<i>Time/Date</i>
<b>2016 Mid-Day</b>	Obs_1	Aerial	Monday, 3/28/2016 at 11:35 am
<b>2018 Morning</b>	Obs_2	Field Count	Weekdays, 7/25 – 8/3/18, 9 – 11 am
<b>2018 Evening Weekend</b>	Obs_3	Field Count	Friday, 8/10/18, 6 – 7:30pm
<b>2018 Afternoon</b>	Obs_4	Field Count	Weekdays, 7/26 – 8/15/18, 1 – 4 pm

### Using the Aerial as a Survey

Aerial imagery from 2016 was utilized as a survey. The high-resolution imagery was obtained from the Bismarck-Mandan MPO. This survey method is only possible with high enough resolution to discern individual vehicles obtained during times of the year without leaves on trees. The data could be entered from a desk in approximately two hours. The aerial survey has the advantage of being collected at a single point in time, although that point could not be pre-selected as it was predetermined by the time of flight.

### Scheduling Field Surveys

The surveys were scheduled for dates and times that could be considered representative of that time slot in a summer month. Known events, such as the Urban Harvest festival, and inclement weather were avoided. However, construction projects could not be entirely be avoided. In some cases, temporary on-street parking restrictions were in effect due to construction projects within the street. These areas were not included in the survey (coded “NULL” rather than 0).

### Routing Field Surveys

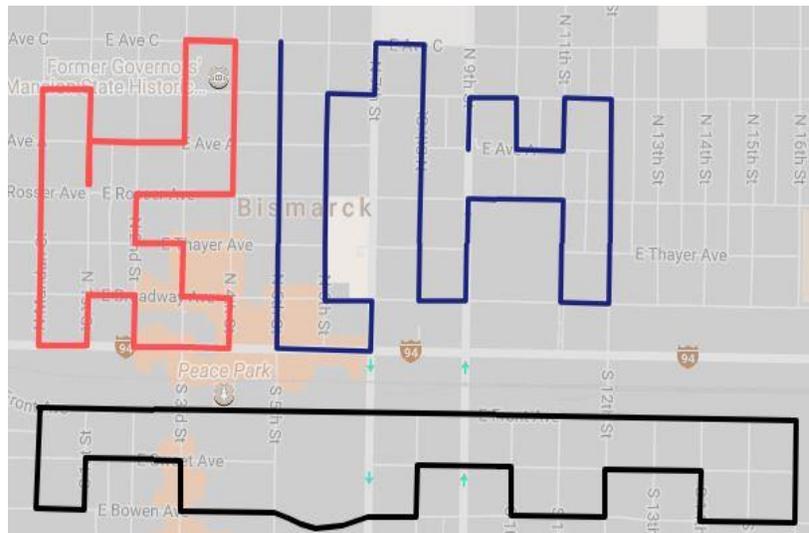
Routing for in-person counts was created in advance to minimize the amount of time necessary in the field. A map of the routes was printed and distributed to each surveyor. The routes were designed to be walked, but surveyors used bicycles and vehicles as well – although without any noticeable gains in speed.

Weekday counts between 8:00 AM and 5:00 PM were performed twice, once in the morning and once in the afternoon. They were designed to originate and return at or as close to the City/County Office Building as possible while efficiently reaching the entire study area. Seven routes were created to break the survey into manageable 45-minute periods. The routes provide visibility for all segments in the inventory.



**Seven Route Layout**

An evening count was performed on Friday, August 10, 2018 at approximately 7:00 PM to collect information on how on-street parking is utilized during typical non-working hours. Longer routes were designed to allow three surveyors to simultaneously collect data over a condensed period of time. The evening survey is faster because of a reduced amount of vehicles parked in many parts of the study area. Each route took approximately one hour to complete.



**Three Route Layout**

### Collecting Data During Field Surveys

The surveyors used the ArcGIS Collector application on a smartphone to collect data. The inventory map of parking segments was preloaded and colored to reflect whether data on that particular survey had been entered into the segment yet or not. The color scheme provided real-time feedback on progress, which assisted with memory and allowed coordination between multiple surveyors in the field. However, surveyors did encounter difficulties with differentiating between adjacent segments of different types. In the future, the map should be colored by type and time limit to avoid this problem.

The map centers around the GPS reading on the phone, which allows the surveyor to identify segments in the vicinity. The phone also automatically time stamps each count. As a shortcut, if there were multiple segments on a block with no vehicles, all but one segments was left blank and entered later from a desktop, copying the time stamp from a nearby segment.

In some case, errors in the inventory were noticed and corrections were made based on occupancy survey field work.

The following rules were used to determine which vehicles were counted:

- Vehicles parked in a clearly illegal location were not counted. However, vehicles that extend beyond a parking zone were included if a majority of the vehicle was within the legal zone.
- Trailers, construction containers, or other non-vehicles occupying parking spaces were not counted.
- Motorcycles or mopeds parked legally were counted. However, there was one moped that was parked legally in a segment too small to register as a valid parking segment. This was not counted.
- In residential areas, some properties have curb cuts allowing cars to parking perpendicularly in wide boulevards in the right-of-way. Although on public property, these may be perceived as private. They were not included in the inventory or count.
- During the surveys, Avenue A and Avenue B were closed to through-traffic, but still allowed local traffic. This was still counted, because parking seemed to be almost at capacity.
- Streets closed for special events were noted and counted on days without any event closures.



Screenshot from ArcGIS Collector

### Future Enhancements

The intent is to perform similar surveys on a regular basis, likely semi-annually, in order to grow the size of the dataset and observe changes over time and to measure impacts on parking utilization during different weather conditions. Changes in the inventory, such as new or altered restrictions to on street-parking, should be incorporated in the dataset. The Planning Division of the Community Development Department will work with the Engineering Department to keep the data up to date.

The scope of this survey is limited in the interest of time and a desire to maximize the accuracy of the data. Additional information would also create a more complete understanding of parking in the study area:

1. *Off-Street Parking Inventory.* Public parking spaces operated by the Parking Authority are known, but private off-street parking lots in the study area have not been counted since 2008.

2. *Off-Street Parking Occupancy.* Off-street parking occupancy rates, either collected through a parking management system for metered lots or counted manually, are not available at this time.
3. *Duration Surveys.* This study does not measure the length of time vehicles occupy a space. Duration surveys are typically conducted by tracking license plates on an hourly basis for a sample of street segments. However, achieving adequate sample sizes can be labor-intensive. Duration could also be examined with use of a camera that is reviewed at high speed.
4. *Parking Violations.* This study intentionally ignored parking violations to avoid representing these spaces as available. However, data on violations obtained from the City's Parking Enforcement Division could provide insight into behavior and possible supply constraints.

## Parking Occupancy Survey Analysis

This on-street parking analysis provides information on the availability and use patterns of on-street parking in the study area. All of the data collected is available in both segments and blocks on the City's GIS.

<i>Survey</i>	<i>Study Area Total Count</i>	<i>Study Area Percent</i>	<i>Core Area Total Count</i>	<i>Core Area Percent</i>
<b>2016 Mid-Day</b>	1,100	37%	329	55%
<b>2018 Morning</b>	1,070	36%	324	54%
<b>2018 Afternoon</b>	1,100	37%	319	53%
<b>2018 Evening Weekend</b>	581	20%	250	42%

Optimal on-street parking occupancy is generally considered to be 85% for a block, which indicates that the parking resources are being utilized efficiently with still enough available capacity for anyone to find a space within a block. Blocks that exceed 85% are considered overcapacity, which may lead to cruising / block re-circling for parking and a reduction in level of service for customers, employees, and visitors. Blocks with occupancies that are significantly less than 85% are considered underutilized. Setting policies or pricing, where available, to achieve between occupancies approaching 85% is considered best practice in the on-street parking management field<sup>1</sup>.

Within the core area, parking spot utilization is optimal on a few blocks but on average still somewhat underutilized. The utilization is more consistent throughout the day, reflecting the types of parking spaces and land use in the core being a combination of workplaces, businesses and restaurants.

Outside of the core area, the areas of higher utilization are the parking segments with no time limits in the northern portion of the study area near medical centers and the blocks around Broadway Centre in the western portion of downtown. On-street parking in the south side of the study area is generally underutilized. These areas were added in the 2018 study to collect baseline information, in anticipation of growing interest in infill and redevelopment.

Surrounding the DC – Downtown Core and in the HM – Health Medical zoning districts are time-restricted spaces and arterial roads that prohibit parking. The land use patterns shift from mixed uses to office and retail uses that often provide their own parking lots. The on-street parking utilization is lower in this area. On the fringes of downtown and reaching slightly into residential areas there are areas with no parking limits that have higher daytime utilization. It is presumed that employees of the HM – Health Medical Zoning District and offices on the edges of downtown are parking on these streets and walking to their buildings. This was identified in the 2008 study and 1978 study and remains consistent today.

<sup>1</sup> Shoup et al, "Parking and the City" (2018)

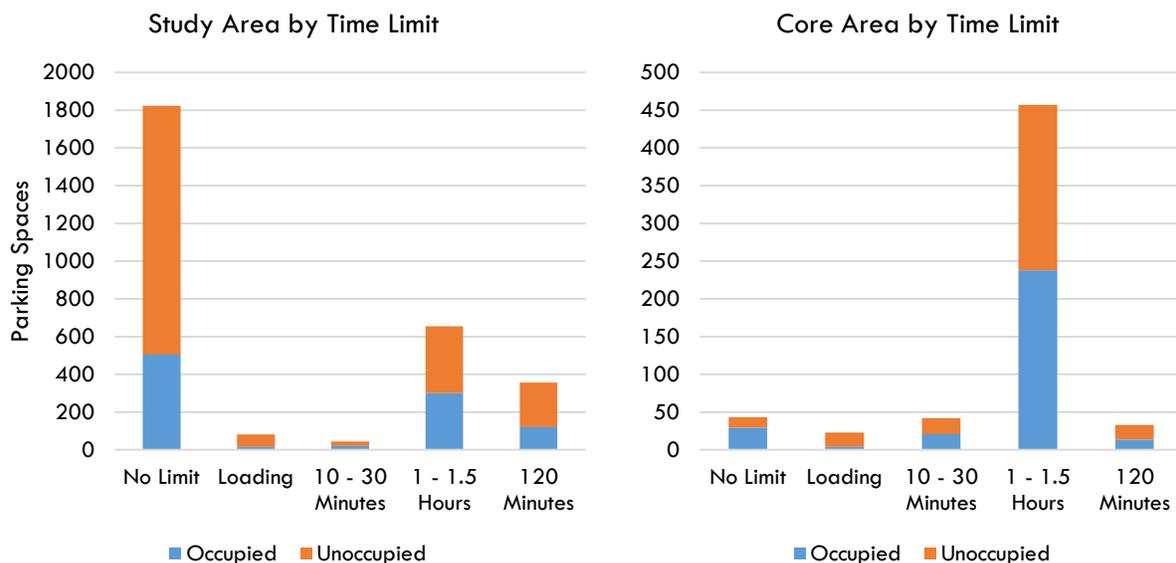
## Regular Variations in Occupancy

No significant variation in on-street parking utilization between morning, mid-day, and afternoon counts was observed. However, significant variation between daytime and evening was observed, as the area transitions from being an employment center to an entertainment and shopping district (however, it should be noted that only one evening data point is currently available). Only 20% of spaces were occupied in the evening throughout the study area, with the exception of the very core of downtown from Main Avenue through Chancellor Square. In the core study area, 42% of all spaces were occupied in the evening.

There is currently insufficient data to determine seasonal variation. There is no significant difference between the March survey in 2016 and the August daytime surveys of 2018. However, additional data from winter is necessary to present an accurate assessment.

## Occupancy by Restriction Type

Occupancy of on-street parking spaces varies by time limit throughout the study area and in the core area. The following charts show average occupancy from all four counts by time limit. While the no-limit spaces generally have lower occupancy through the study area, the few no-limit spaces in core area are the most heavily utilized.

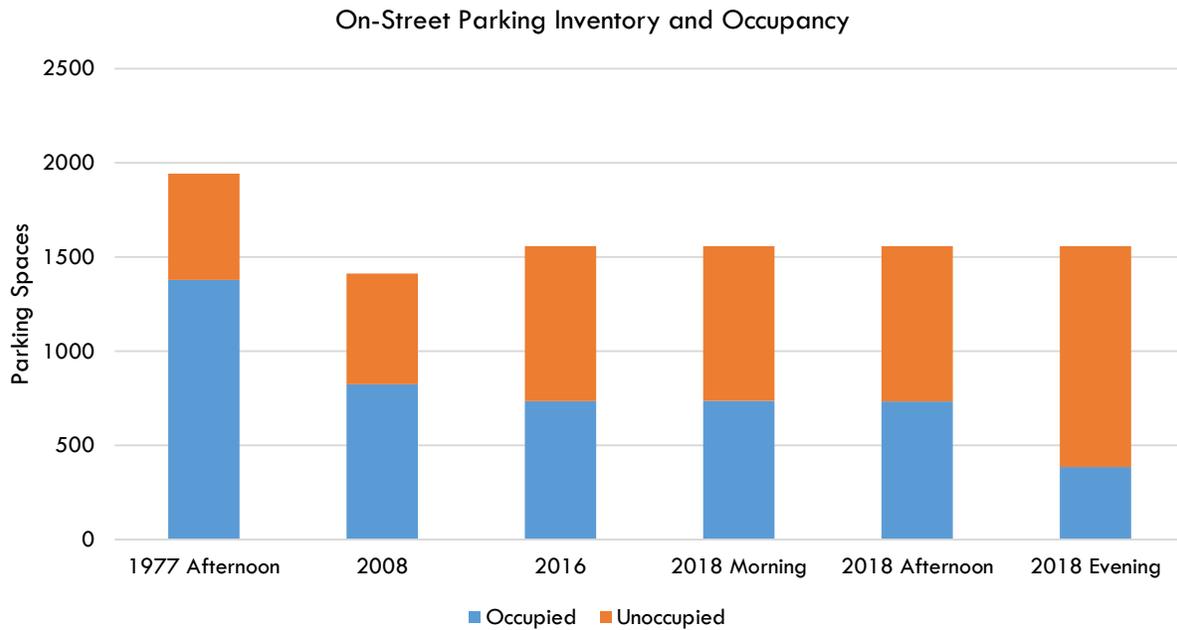


Loading zones had the lowest occupancy of all time-limited areas, with 19% of loading zone spaces being utilized at the times of the counts. Occupancy rates for handicap spaces were comparable to non-handicap spaces. Of the 27 spaces restricted to any parking between 8am and 5pm, only three vehicles were observed in any of the surveys. All were illegally parked during the daytime.

## Historic Trends

The results of this study have been compared to previous surveys: the 2008 Downtown Parking Study and the 1978 Downtown Parking Plan (surveyed in 1977). An earlier parking survey from 1956 counted 1,420 on-street parking spaces, but the boundaries of the study area were not recorded.

The earlier studies were tallied with a coarser level of detail, so the results from this study were aggregated to the block level to allow comparison. The study areas vary, so the results are shown only for blocks that are included in all of the study areas.



The 1977 survey inventoried 25% more parking spaces than exist today. The occupancy rates observed were also significantly higher in 1978. This may be explained by the fact that fewer off-street spaces in structures were available at this time. The 2008 count is more comparable. The deviation in parking spaces may be attributed to different inventory methods.

Several earlier inventories were conducted without any occupancy counts, from 1957, 1962, and 1974. The 1962 inventory counted 852 on-street spaces within the study area, which was bounded by Rosser Avenue, 7<sup>th</sup> Street, Main Avenue, and 2<sup>nd</sup> Street (include both sides of these streets). The 2018 inventory counted 556 spaces in these segments, representing a 35% drop in inventory from 1962.

There are a few possible explanations for the loss of parking since 1962 and 1978. There have been several street vacations in the HM – Health and Medical zoning district that removed on-street parking, and there are additional parking restrictions, especially along major roadways, that were not in effect at that time. Also increased vehicle lengths and standards of space expected by parkers may have resulted in fewer available spaces.

1978 Afternoon Occupancy



2008 Afternoon Occupancy



2016 Afternoon Occupancy



2018 Afternoon Occupancy

