



# DOWNTOWN CONCORD PARKING SYSTEM STRATEGIC PLANNING FINAL REPORT

FINAL • January 2016





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## EXECUTIVE SUMMARY

The Downtown Concord Parking System Strategic Planning study was initiated to identify and quantify critical parking conditions in the City of Concord’s historic downtown. As with most successful downtowns, the complaints about parking in Concord are chronic. What is often missing in attempts to move from complaints to action is a serious assessment of whether complaints are being generated by an actual supply shortage, or just a perception of such due to a heavy concentration of demand that results in space shortage on key downtown blocks and half-full parking lots nearby. This assessment is particularly important if one of the actions being considered is building another lot or garage that will not operate significantly dissimilar from existing half-full parking lots waiting to be better used. The Parking Study was therefore designed to fully explore how drivers are utilizing all existing parking resources during periods of peak demand as a first step in evaluating future options for improving downtown Concord parking conditions.

As it turns out, during peak-demand periods, there is actually plenty of unused capacity within the current downtown parking inventory. Unlike in many downtowns where local stakeholders are convinced that more parking is needed, current utilization patterns in downtown Concord largely confirm that all available resources are actually not well utilized, adding credence to arguments that parking supply problems are more perceptual.

Several factors unique to downtown must be considered before supply-development options can be effectively and responsibly explored:

- Downtown will nearly always be the most expensive and most disruptive place in Concord to add new parking. Land costs more in areas of high demand, such as along Main Street.
- The proximity of downtown uses allows for an optimal “park-once” environment, suggesting that options for expanding supply can include incentives for sharing or leasing existing private spaces at significantly less expense and impact than building new supply.
- Downtowns like Concord’s invariably contain parking options that will fill up much faster and much more often than others if there is not effective management, and these options will continue to generate perceptions of a parking shortage, regardless of how much new supply is built.

## KEY FINDINGS

An assessment of these factors revealed several important findings:

- The City’s public parking system is a large enterprise featuring 12 facilities, almost 4,000 spaces, and assets in excess of \$22 million. Plus, there are over 5,000 private parking spaces within downtown Concord that have restricted access. To date, the City of Concord has managed parking demand with traditional methods, including reserved parking leases, paid short-term parking, time-limits, and overtime enforcement.

- Downtown Concord is no exception in terms of perceived parking supply challenges, although the actual utilization data indicates a large amount of parking supply is underutilized – even during the peak hours of the day. There is a clear, high-demand core on and along Main Street, while with the rest of downtown is only half full during peaks.
- Time-limits are having no effect at distributing demand to areas with more availability – rather they are arbitrarily limiting the time that customers can engage downtown establishments. The current meter rates also are ineffective at moving parkers away from high-demand areas. Meanwhile, when time-limits end and the price becomes zero, high-demand areas like Main Street get flooded by restaurant employees, right before the dinner-hour peak begins. Ongoing perceptions of parking shortage are typically rooted in these customer-unfriendly experiences that plague downtown Concord.
- Employees and customers are competing for the same pool of convenient parking spaces around downtown. The existing garage leasing program is valuable to only a few businesses and not flexible enough to attract the majority of employees, who instead compete with visitors for the few remaining transient spaces – even though nearly half of all reserved spaces go empty every day. This had led to a severe financial challenge for the City as it tries to sustain its garages and their heavy maintenance and debt burden. Meanwhile, payment technologies are not user-friendly, and past attempts to upgrade to efficient gate-operated systems were poorly implemented, leading to steep opposition to further changes.
- Availability of parking information is lacking yet critical to help improve the current parking system in downtown Concord. Web-based information and clear wayfinding and directional signage is needed throughout downtown to help people navigate the system and find appropriate parking facilities and destinations.
- Parking user surveys show that downtown Concord has the potential to become a successful park-once district, in which most drivers only use one parking space per visit, regardless of how many destinations they may patron. A park-once district also bodes well for expanding shared-parking strategies to increase access to existing private lots when extra capacity is needed.

Based upon this overview of conditions, issues, and opportunities, the Parking Study concludes with a series of recommendations focused on better managing the existing resources and opportunities. These recommendations are summarized below. Supporting analysis can be found in more detail within this report.

## **RECOMMENDATIONS**

The study concluded with a series of recommendations focused on maximizing the potential benefits of existing parking resources through better management.

### **Catalytic Strategies:**

- **Eliminating Time Limits** for all metered parking within the downtown area. Except where metering should be expanded, existing free time-limited zones should remain free.
- **Demand-Based Pricing**, which creates pricing tiers that are responsive to areas of demand, should be implemented in downtown, along with appropriate changes to hours of operations.

- **Formalizing the Off-Street Permit Program** for all public garages to provide more customer-friendly options and prices that will drive better garage utilization.
- **Garage Regulatory Reconfigurations** to encourage more customer-friendly circulation inside the public garages, while clearly setting aside a larger pool for downtown employees.

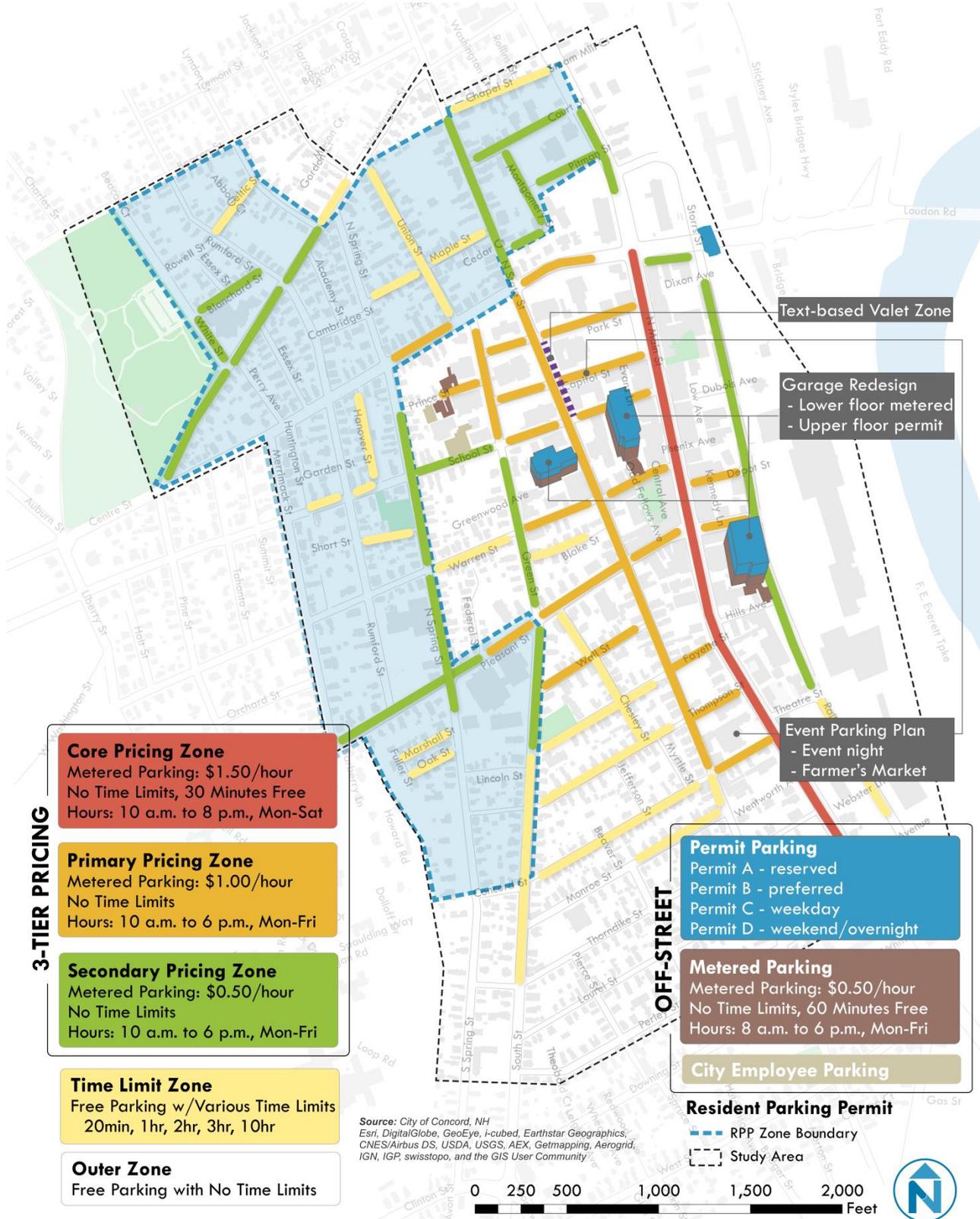
**Secondary Strategies:**

- **Resident Parking Permit** program expansion, to protect resident parking in additional areas experiencing employee parking spillover.
- **Event/Valet Parking** system to accommodate additional parking demand during special events and busy legislative sessions.
- **Signage and Information**, which includes what drivers read and hear before they arrive in downtown, what they see when they arrive, and what guides them around downtown to appropriate facilities – including necessary pedestrian way-finding between parking and downtown destinations.
- **Technology Improvements**, including new, user-friendly parking technology in existing and new locations for on- and off-street spaces, including new mobile phone and web-based solutions.

**Supportive Strategies:**

- **Shared Parking Program**, where the City brokers shared parking agreements with or between private parties.
- **Friendlier Enforcement**, with adoption of an upgraded “parking ambassador” program that serves to improve the parking experience for regulars and new visitors.
- **Governance/Administration Changes** to better coordinate the City’s disparate parking operations and management functions.

**Recommendations Overview**



**3-TIER PRICING**

- Core Pricing Zone**  
Metered Parking: \$1.50/hour  
No Time Limits, 30 Minutes Free  
Hours: 10 a.m. to 8 p.m., Mon-Sat
- Primary Pricing Zone**  
Metered Parking: \$1.00/hour  
No Time Limits  
Hours: 10 a.m. to 6 p.m., Mon-Fri
- Secondary Pricing Zone**  
Metered Parking: \$0.50/hour  
No Time Limits  
Hours: 10 a.m. to 6 p.m., Mon-Fri
- Time Limit Zone**  
Free Parking w/Variou Time Limits  
20min, 1hr, 2hr, 3hr, 10hr
- Outer Zone**  
Free Parking with No Time Limits

- OFF-STREET**
- Permit Parking**  
Permit A - reserved  
Permit B - preferred  
Permit C - weekday  
Permit D - weekend/overnight
  - Metered Parking**  
Metered Parking: \$0.50/hour  
No Time Limits, 60 Minutes Free  
Hours: 8 a.m. to 6 p.m., Mon-Fri
  - City Employee Parking**

- Resident Parking Permit**
- — — RPP Zone Boundary
  - Study Area

Source: City of Concord, NH  
Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics,  
CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid,  
IGN, IGP, swisstopo, and the GIS User Community



# 1 INTRODUCTION

The City of Concord understands that a smart, integrated parking management system could minimize the financial cost for a municipality, create an all-user friendly transportation environment, encourage downtown economic development, and help a community to become more environmentally sustainable. For years, Concord has managed parking demand with traditional methods, including parking meters, time limits, and overtime enforcement.

In the summer of 2014, the City of Concord retained Nelson\Nygaard to conduct a downtown parking strategic plan. The purpose of this study is to analyze existing parking supply and demand within downtown Concord, determine future parking needs, and recommend economically feasible alternatives to meeting future parking requirements and support economic development. The work was conducted from July 2014 to February 2015 and has captured the parking utilization patterns of various groups throughout downtown Concord. Working closely with the City of Concord, the Parking Committee, and several groups of key stakeholders, the Parking Study team documented and evaluated the parking environment in downtown Concord.

The Parking Study is a continuation of the work that Concord has completed to date in evaluating its parking supply. In 1993, the City conducted a Downtown Parking Study to assess existing conditions and project future parking requirements within a study area bounded on the north by Washington Street, on the south by Concord Street, on the east by I-93, and on the west by Merrimack Street. The report concluded that on-street directional signage was generally missing, time limits should be extended, a centralized Parking Authority should be established to better manage parking, and a 450-space parking garage was recommended to be constructed on Green Street. The City then took several measures to implement some of the recommended actions from the 1993 Parking Study, such as extending time limits from one hour to two hours on side streets along Main Street, as well as building the Capital Commons Garage on Storrs Street. Ten years later, in 2004, the City released another Downtown Parking Study of the same study area done by the same consultant team with the 1993 study. In the 2004 report, it is recommended that a uniform on-street signing plan should be implemented, more meters be installed, and the time limits of more parking meters be extended from one-hour to two-hour, as well as all of the parking-associated responsibilities be consolidated within a single department.

The City has implemented many of the recommended measures including building a new garage on Storrs Street to accommodate downtown development. But for the past two decades, downtown Concord has been experiencing tremendous changes and now is the “20-year opportunity” to revisit the downtown parking policies and management to meet the current and future needs and to include a larger study area of downtown Concord. The following report is an independent review of the City’s existing and projected parking supply and demand, and where further actions should be taken to improve the downtown parking management.

Working with The City Parking Committee, the business community, residents, City staff, and other key stakeholders, the recommendations for the Parking System Strategic Planning Study were developed with the following goals and expectations in mind:

- Ensure the parking fund remains self-sufficient
- Ensure an adequate supply of available parking to support economic development
- Encourage turnover of on-street parking to improve access to merchants

- Improved way-finding and directional signage to improve customer convenience
- Invest in technology and improve enforcement efficiency
- Review and implement changes to the rate structure
- Improve City's parking management structure

**Figure 1 Downtown Concord**



Photo credit: <http://www.tocci.com/>

## 2 APPROACH

The Parking Study's approach focuses on collecting as much existing use information as possible to come up with a profile of parking activity in downtown Concord. Key questions the data was intended to answer include:

- How much parking is available for different user groups, including residents, employees, commuters, visitors and shoppers?
- How is existing parking being utilized in the downtown?
- How are motorists directed to parking?
- What are the tensions among users' various goals and how is users' experience with the overall parking system?
- How is municipal parking assets managed and financed?
- How is current and future land use affect the parking demand in downtown?
- How is the unique parking demand during events, weekends, and during Legislature session managed?

To answer these questions, the team collected and reviewed all existing studies related to parking as well as parking regulatory language influencing the operation and provision of parking in the downtown. Several data collection tasks were conducted, including:

- **Parking Inventory.** Built on the City's existing geo-coded parking database, in August and September, 2014, the Parking Study team conducted a field check and additional inventory of all public and private spaces within the downtown. A detailed map and database is created of all regulations, time-limits, hours of operation, ownership, etc. (Section 3)
- **Parking Utilization.** During the months of June, July, and September, 2014, as well as January, 2015 when the legislature is in session, the team conducted field surveys of all spaces in the inventory to document their utilization throughout the day. Observations were conducted every two hours for 12-hour period on an average weekday and Saturday. (Section 3)
- **Land Use & Shared Parking Analysis.** Utilizing the City's Assessing Department database to develop a shared parking model that demonstrates the relationship between land uses and parking supply/demand in the overall study area and a focus area around the core. (Section 3)
- **Parking Management/Administration Analysis.** An overview of the management and administration of the current downtown parking system, including the governance and organizational structure and responsibilities, as well as the parking system's revenue and expenses. (Section 3)
- **Facility Needs Assessment.** A comprehensive evaluation of existing municipal parking assets and its various subsystems, such as drainage, plumbing, electrical, lighting, etc, identifying those elements which will require address in the next 20 years to main the service life of the facility. (Section 3, Appendix B)

- **Public Meetings.** In October, 2014 and January, 2015, the Parking Study team facilitated two community public meetings to record inputs on problems in the downtown parking system, as well as recommended changes. About fifty concerned citizens attended the first Open House to record their concerns through a voting exercise, on notecards, and directly on maps of the study area. A second Public Meeting in January was held to discuss and revise the preliminary recommendations of the parking study. (Section 4)
- **Parking User Surveys.** The team prepared an on-line survey that sought basic parking preference information from respondents. It was distributed and advertised among downtown stakeholders by City Staff. Over 580 responses were recorded. (Section 4)
- **Stakeholder Meetings.** To supplement the feedback from the public outreach process and surveys, a series of key community stakeholder meetings were held with downtown merchants, business owners, developers, key institutions, city administration staff and policy makers. Additional meetings with current garage lease holders were conducted later in the process to get feedback on possible changes to the public garage use. (Section 4)
- **Parking Rate Peer Review.** This review compared on-street and off-street rates, permit fees, lease fees, time spans, etc. in Concord to similar sized communities in the New England region, in order to provide guidance to the City of Concord on the aspects of parking rates. (Section 5)

Working in close coordination with the City, the Parking Study summarized key findings and developed the recommended parking program (Section 6) that is detailed below.

## 3 EXISTING CONDITIONS

The existing conditions section establishes a broad, yet detailed, benchmark of current parking supply, regulations, and land uses in the downtown Concord study area. Through close correspondence with the City, the team defined a study area to include all critical parking assets and encompass any perceived parking issues. This documentation of existing conditions will inform the team's recommendations and provided a benchmark for community discussion and policy decisions on parking, the transportation system, and land use.

The existing conditions data summarized in this chapter were collected primarily during the month of September in 2014 by Nelson\Nygaard. To assure validity and account for seasonal variance, the Parking Study team also conducted additional utilization counts by DESMAN in August 2014 and January 2015 to capture utilization rates and patterns on South Main Street before the construction of Main Street Project and around State House when the Legislature is in session. The data includes an inventory of the current supply and utilization for all identified publicly and privately owned parking lots, garages and all on-street parking within the study area.

This chapter includes maps, tables, and summaries of the existing conditions pertinent to the team's key findings, organized under the following headings:

- **Study Area** – A definition of the study area boundary in downtown Concord.
- **Parking Inventory** – A review of all parking spaces by location and regulation
- **Parking Utilization** – Observed use of existing parking through the course of a typical weekday and weekend. Includes utilization profiles of "core" areas, metered and reserved parking facilities.
- **Land Use & Shared Parking** –A shared parking model that demonstrates the relationship between land uses and parking supply/demand.
- **Parking Management/Administration** – A review of how the City administers and manages the parking system today.
- **Public Garages Condition Survey** – A comprehensive evaluation of existing municipal parking assets.

### 3.1 STUDY AREA

The downtown Concord study area covers a majority of parking spaces within about 434.5 acres. The study area is generally bounded by (Figure 2):

- Beacon Street to the north
- Perley Street to the south
- Merrimack Street to the west
- I93 to the east

The study area has significant on and off-street parking assets, with three public garages, five City-owned parking lots, and many privately-owned and restricted-use lots for customers of local businesses, visitors, employees, and specific user groups. On-street parking is available throughout the study area, with mostly metered, two-hour restricted parking in the core along Main Street corridor.

**Figure 2 Downtown Concord Parking Study Area**



## 3.2 PARKING INVENTORY

A complete understanding of parking supply and regulation is the base component to understanding parking patterns and behaviors. The City of Concord documented a majority of public and private parking facilities both on- and off-street in downtown study area. The Parking Study team field-checked this inventory and supplemented it by identifying additional public assets, plus privately owned parking lots and structures. This includes all parking within the defined study area, with the exception of small residential driveways that are under 5 spaces. The inventory was compiled and used to create a complete parking database of all parking facilities in downtown Concord. The database was then geo-coded to spatially display the existing parking areas on maps. This initial work created the base information used throughout the entire project.

### PARKING INVENTORY: KEY FINDINGS

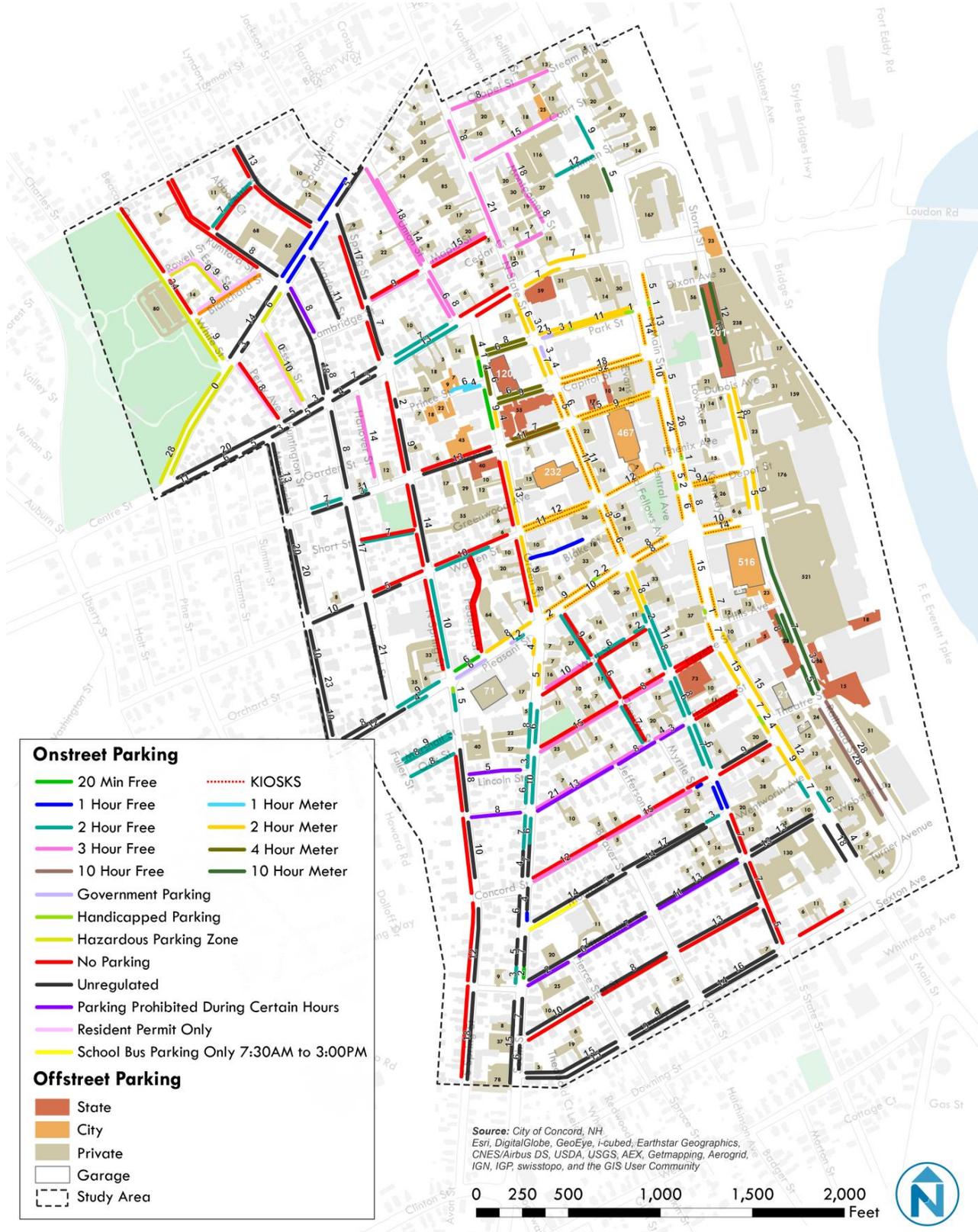
- There are approximately 9,917 total parking spaces in downtown Concord including all public and private spaces, and unregulated on-street spaces;
- Of all 3,781 public parking supply (both on-street and off-street),
  - 33% (1,248 spaces) are metered parking, costing \$0.75 per hour on-street and \$0.50 per hour off-street;
  - 20% (745 spaces) are leased parking reserved for multiple permit holders;
  - the rest are free or with certain restrictions.
- 55% of all parking is privately-owned;
- With the exception of loading zones and government parking, almost all marked on-street parking spaces are available for general use, meaning that anyone can park on-street, regardless of trip purpose, except the resident permit parking zone around University of New Hampshire School of Law.
- There are three municipal public garage across downtown Concord with a total parking supply of 1,217 spaces, including 431 general-access metered spaces, 41 reserved spaces for city employees, and 745 leased spaces for downtown employees.

Figure 3 is a summary of parking spaces and regulations in the study area. The study team catalogued the ownership, use category, and regulation for all spaces within the study area. A full parking inventory is depicted in the parking regulatory map on the following page in Figure 4.

**Figure 3 Parking Inventory Overview**

Parking Location	Number of Spaces	Percentage	% Available for General Use	% Restricted Use
On-Street	2,410	24%	98%	2%
Off-Street	7,507	76%	7%	93%
<b>Total</b>	<b>9,917</b>	<b>100%</b>		

**Figure 4 Parking Supply and Regulations: Downtown Concord**



## ON-STREET PARKING

Almost 60% of on-street parking in the study area is regulated with a time limit, meaning that anyone can park on-street, for a certain amount of time, regardless of trip purpose. This includes many residential streets that have parking allowed on one or both sides of the street. Streets marked as no-parking zone are not allowed for on-street parking.

Most of the on-street parking spaces in downtown Concord are regulated by time restrictions. There are six types: 20 minute, 1 hour, 2 hour, 3 hour, 4 hour and 10 hour spaces. These spaces are time-regulated to encourage turnover, preserving them for patrons of the shops and restaurants in downtown Concord. Time-limited spaces, particularly the 2 hour spaces, are located in the heart of the central business corridor along the Main Street. Spaces with shorter time limits are primarily located for drop-offs and quick trips at specific adjacent land uses, such as the City Hall.

**Figure 5 On-street Parking Inventory by Regulations: Downtown Concord**

Regulation	# of Spaces	Percent of Total
20 Min Free	21	1%
1 Hour Free	49	2%
1 Hour Meter	10	0%
2 Hour Free	271	11%
2 Hour Meter	616	26%
3 Hour Free	260	11%
4 Hour Meter	57	2%
10 Hour Free	56	2%
10 Hour Meter	83	3%
Government Parking	13	1%
Handicapped Parking	13	1%
Hazardous Parking Zone	77	3%
Parking Prohibited During Certain Hours	73	3%
Resident Permit Only	33	1%
School Bus Parking Only 7:30AM to 3:00PM	0	0%
Unregulated	778	32%
<b>TOTAL</b>	<b>2,410</b>	

Most of the metered on-street spaces reside in close proximity to downtown’s shops and restaurants, located along Main Street, North State Street, Storrs Street and several side streets. 32% of all on-street parking is metered and consist of both short and long term meters, ranging from 1-hour to 10-hour meters. Meters are enforced from 8:00 a.m. to 5:00 p.m., Monday to Friday, and cost \$0.75/hour. Currently City adopted 84 kiosk pay stations and the rest using traditional mechanical meters.

## OFF-STREET PARKING

Most off-street parking (93%) in downtown is restricted-access parking that is dedicated to a specific population, including reserved parking in public garages that may require a purchased parking permit and private parking facilities that are restricted to particular customers, tenants, or employees of the (typically adjacent) use.

A portion of the City-owned parking facilities in downtown is metered public parking. Metered parking in public garages has no time limits, spanning from 8:00 a.m. to 5:00 p.m. Monday to Friday and at a cost of \$0.50/hour. Kiosk pay stations are located at entrances and exits of each garage and are working on a pay-by-space basis.

The City currently has 735 leased spaces in the three public garages (Figure 6), with 284 at market rate and the rest subject to long-term discounted lease agreements. City permits are issued on an annual basis, with uncovered space at the annual cost of \$1,044/space and covered space at \$1,344/space. Other long-term leases are negotiated at various special rates on a case-by-case basis. All leased parking spaces are open to public for free after 5 p.m. and on weekends and holidays.

City General Fund employees currently get free parking at various lots, as well as in the Fire House Block garage at no cost.

**Figure 6 Garage Parking Inventory: Downtown Concord**

	Firehouse Block Garage	Durgin Garage	Capital Commons Garage	Private Garages	State Garages
Leased	75	279	391		
Metered \$0.5/hr	116	188	125		
City Employees	41				
Handicapped	2				
<b>Total</b>	<b>234</b>	<b>467</b>	<b>516</b>	<b>102</b>	<b>321</b>

## ENFORCEMENT

Parking in Concord is regulated by the Code of Ordinances. The Parking Division of the City currently is staffed with 3.6 enforcement officers who enforce the City's Parking Ordinances and issue tickets per Article 18.

According to the City's Parking Ordinances,

*“When signs are erected giving notice thereof, no person shall park a vehicle for longer than the time stated on such signs at any time between the hours of 7:00 a.m. and 6:00 p.m. on weekdays, legal holidays excluded, in any unmetered municipal parking lot or upon any of the streets described in Schedule III, attached to and made part of these regulations.*

*The application of time restrictions as described in these regulations shall mean that no driver of a vehicle shall be permitted in any one block on any one of these streets described in Schedule III for more than the time allowed in that block on that street, in any one day, whether such time is used in a single period of parking or accumulated in two (2) or more periods.”*

Thus, it is not legal to park over the time limits on the same block of the regulated streets, whether it is a one-time stop or multiple stops during the day. For instance, on the 2-hour limited block of Main Street, one parks for 30 minutes in the morning to get a coffee and breakfast, and come back for lunch on the same block. But this time, he/she can only park one and half hour given he/she has already used 30 minutes of the time limit. This regulation is very difficult to enforce using the current enforcement technology in Concord and also discourages patrons and customers to come back and stay in downtown, which will greatly harm the local business. However, according to the Code, one can potentially move his/her car one block away on the same street and get another two hour, or however long the time limit is. This will then cause more people shuffling around the downtown center and doing no good to the total parking availability on-street.

Also noted that all parking meters in the City are actually enforced from 8:00 a.m. to 5:00 p.m., although the parking ordinance and most signs in downtown indicate the regulation starts from 7:00 a.m. to 6:00 p.m. The inconsistency between the code and field enforcement may cause confusions among downtown patrons. But in general, this difference also allows a certain degree of flexibility in terms of implementing enforcement changes.

Enforcement includes monitoring all curbs, as well as proper use of handicapped spots and improperly parked cars. To monitor parking activity, the division is using the T2 Casio handheld technology devices to write tickets. Parking tickets can be paid at the Police Department or mailed using the envelope included in the ticket mail. Citation will incur late fees on the 10<sup>th</sup> and 20<sup>th</sup> day following insurance. Example of a \$10 fine, after 10 days it will be \$20 and after 20 days it will be \$40. If five outstanding citations or an amount over one hundred dollars accumulated, the ticketed vehicle is subject to impoundment. Figure 7 provides a breakdown of parking violations and fines adopted in the City of Concord.

**Figure 7 City of Concord Parking Fine Schedule**

Description	Fine	After 10 days	After 20 days
Against Traffic	\$20	\$40	\$80
Parking Ban	\$100	\$200	\$400
Blocking Driveway	\$25	\$50	\$100
No Parking Bus Zone	\$20	\$40	\$80
Too Far from Curb	\$25	\$50	\$100
Double Parking	\$25	\$50	\$100
Encumbered Meter	\$10	\$20	\$40
Expired Meter	\$10	\$20	\$40
Emergency No Parking	\$25	\$50	\$100
Fire Hydrant	\$50	\$100	\$200
Fire Lane	\$50	\$100	\$200
Disabled Access Area	\$100	\$200	\$200
Handicapped Parking	\$250	\$250	\$250
Hazardous District	\$20	\$40	\$80
Head In Only	\$10	\$20	\$40
Hazardous Zone	\$20	\$40	\$80
Meter Feeding - 1st offense	\$20	\$40	\$80
Meter Feeding 2nd offense	\$50	\$100	\$200
Within 20 ft of Intersection	\$25	\$50	\$100
No Parking Zone	\$15	\$30	\$60
Parked on Crosswalk	\$25	\$50	\$100
On-Street 48 consecutive hrs	\$25	\$50	\$100
Resident Permit	\$10	\$20	\$40
Reserved Space	\$20	\$40	\$80
Parked on Sidewalk	\$25	\$50	\$100
Too Close to Intersection	\$25	\$50	\$100
Within Intersection	\$25	\$50	\$100
Not Within Lines	\$5	\$10	\$20
Overtime 20 Min Zone	\$15	\$30	\$60
Overtime 1 Hr Zone	\$15	\$30	\$60
Overtime 2 Hr Zone	\$15	\$30	\$60
Overtime 3 Hr Zone	\$15	\$30	\$60
Overtime 30 Min Zone	\$15	\$30	\$60

### 3.3 PARKING UTILIZATION

Parking utilization counts provide a time series of typical parking use for a typical day in an area. To gather this data, the team counted parked cars in each on-street segment or off-street facility at pre-determined time intervals. Land usage, regulation, price, and signage can drastically impact how even adjoining parking assets are utilized. By compiling parking utilization spatially, one can begin to clearly identify patterns of high or low usage, the impact of regulations, and assess how much of the parking supply is actually utilized throughout a typical day.

The City staff and the Parking Study team conducted public parking utilization counts on a typical weekday and a weekend day in September 2014. Data collectors captured weekday parking demand for 12 hours, beginning at 8:00 a.m. and ending at 8:00 p.m., with counts every two hours in the core area and every four hours in the residential neighborhoods. Weekend parking utilization was counted from 10:00 a.m. to 8 p.m. Data collection began in the early morning to identify if/when employee parking would fill to capacity. Extended counts were also conducted along Main Street corridor after 8:00 p.m. to capture late night activities. It is also important to note here that data counts in public garages have distinguished between the utilization of leased parking and public metered parking, in order to understand the actual demand of different user groups.

Additional data collection efforts were conducted both in June and July, 2014 along South Main Street before the construction of Main Street project and in January, 2015 around the State House when the Legislature is in session. The former summer count was intended to rule out the possible impacts of the Main Street construction on the South Main Street parking utilization; and the latter January count's purpose was to understand the severe parking demand change during the legislature session in order to make recommendations accordingly for this seasonal annual event. As the Main Street construction did not happen when the September downtown-wide data collection was conducted, and the Legislator parking utilization data only serves for one piece of the overall recommendations, both these two data collection efforts' results were not included in the main body of this report, but will be detailed in the Appendix A.

### METHODOLOGY

It is important to note that the individuals collecting data collected each on-street segment and off-street lot at regular intervals. For example, if the Durgin Garage was counted at 8:05 a.m. in the first loop, then it was counted at 10:05 a.m. in the second loop, etc. This consistency ensured data accuracy to help draw conclusions about trends within two-hour windows. The team coordinated in advance with the city staff to ensure that there were no special events or construction that may influence parking utilization.

The series of charts on the following pages show the public parking utilization profiles throughout the collection days in downtown Concord. They are displayed in a variety of sub-sets: the entire study area, focus area, metered and leased parking spaces. The red lines indicate “functional capacity” of parking<sup>1</sup>, i.e. a vacancy of 15-percent on-street, or about 1 out of 8 on-street spaces is available and ninety-percent for off-street lots, a recognized national standard of when a parking area is effectively full.

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<sup>1</sup> Best national parking management practice suggests that parking is functionally full at 85% on-street (about one of every seven spaces is available) and 90% off-street.

## SPATIAL PATTERNS

Understanding how downtown parking is used requires being able to describe how parking facilities and on-street parking interact with each other throughout the course of a day. A chart of hourly utilization rates for one specific location is valuable, but seeing how that location behaves among others located nearby can reveal patterns and trends not evident in numbers alone. The lot which is completely full may be right around the corner from another lot that has plenty of availability at the same time.

Using the utilization data, the Parking Study team developed a series of maps based on the parking inventory map. Color represent the percentage of spaces utilized at each location based on notable breaks used to evaluate the adequacy of a parking facility:

- **“Cool” light blue/blue** refers to 0-80% utilization, a point at which on-street blocks and off-street facilities are viewed as underutilized. Any resource that consistently performs at this level, especially during peak-demand periods should be viewed as excess capacity.
- **“Ideal” green** refers to blocks and facilities with 81% to 90% utilization, and represent actively used resources. Particularly for off-street facilities, the nearer utilization levels approach the high end of this range, the more efficiently they are being utilized.
- **“Warning” pink** refers to utilization about 91% and is considered at capacity. While maximizing efficiency, these blocks often look or “feel” full to drivers, and can consequently give the impression of lack of parking.
- **“Critical” red** denotes parking beyond the marked capacity. Resources that consistently perform at this level will generate common perceptions of lack of parking options.

## DOWNTOWN PARKING UTILIZATION

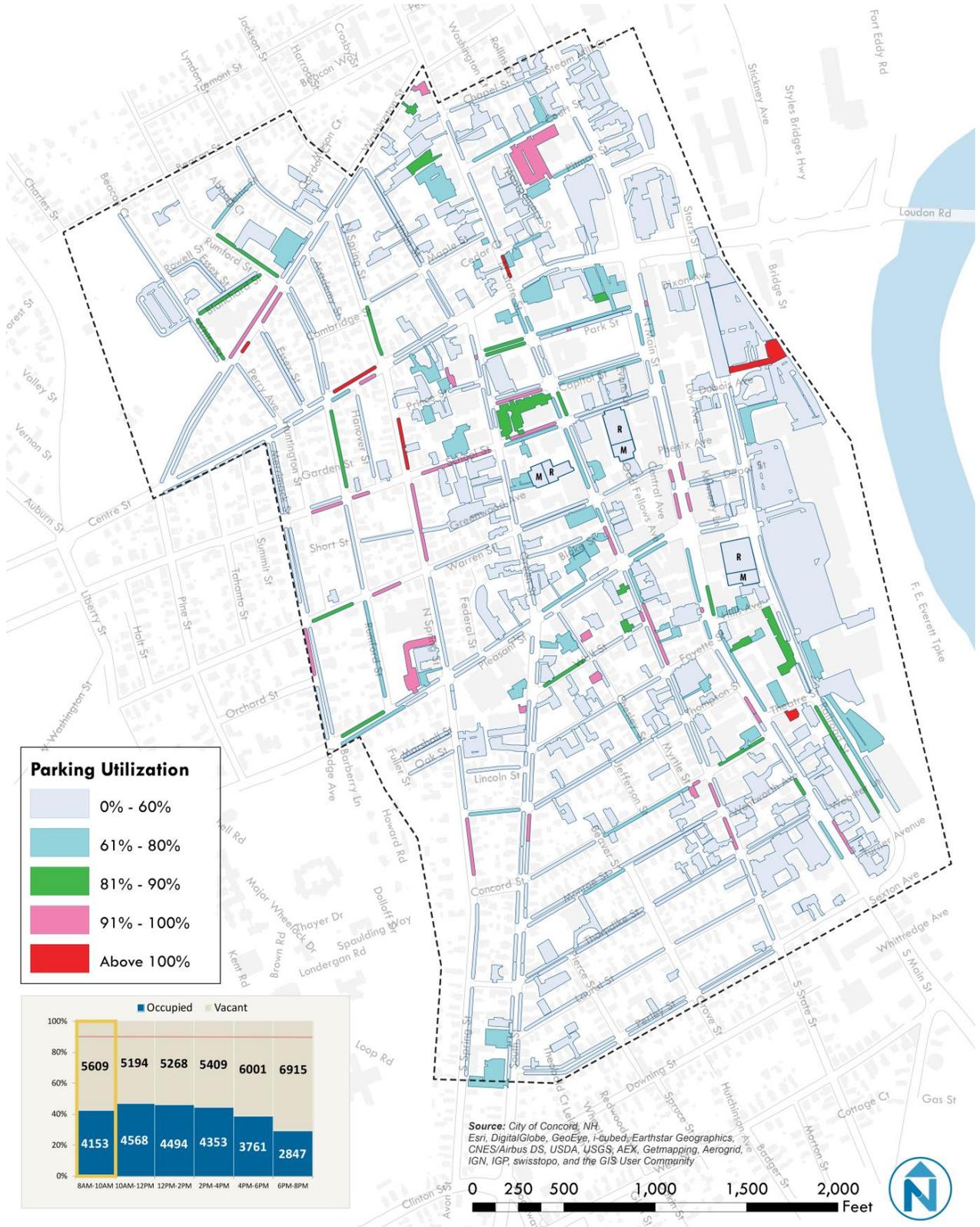
### PARKING UTILIZATION: KEY FINDINGS

- Less than 60% of all parking is utilized at peak on weekdays;
- Less than 30% of all parking is utilized at peak on weekends;
- Overall peak utilization consistently occurs mid-day around the lunch hour from 10:00 a.m. to 12:00 p.m., but on-street peak utilization along Main Street occurs at dinner time from 6:00 p.m. to 8:00 p.m.;
- North and South Main Street is amongst the most utilized of all downtown Concord;
- Three public garages are all underutilized, no matter reserved or metered parking.

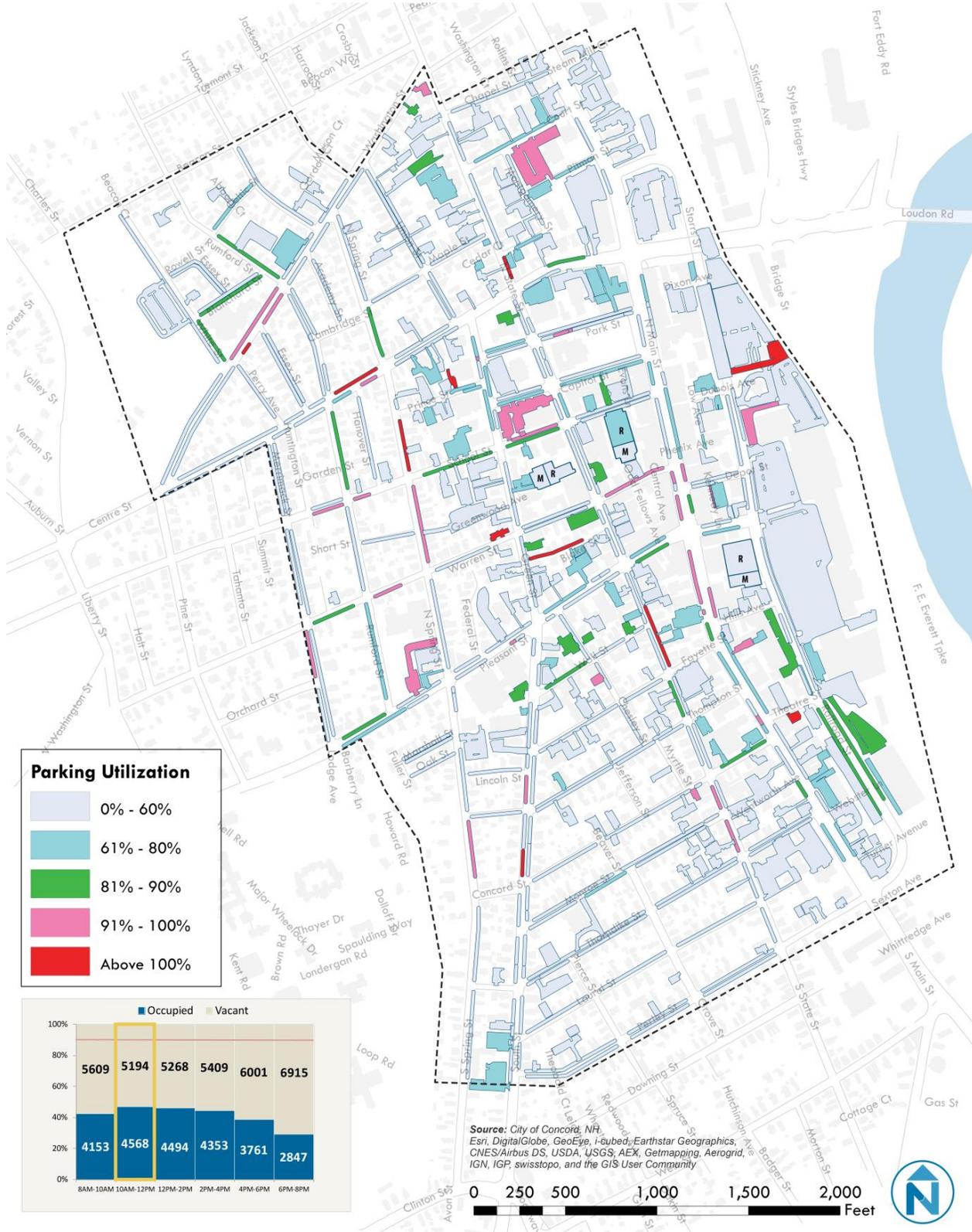
### Parking Utilization – Weekday

Figure 8 to Figure 13 show time series utilization in two-hour increments, from 8:00 a.m. - 10:00 a.m. to 6:00 p.m. - 8:00 p.m. Note that the mapping has distinguished between the utilization of leased parking (**R**) and public parking (**M**) in the municipal public garages, in order to have a better understanding of how parking is utilized by different user groups.

**Figure 8 Downtown Concord Parking Utilization: Thursday 8:00 a.m. – 10:00 a.m.**

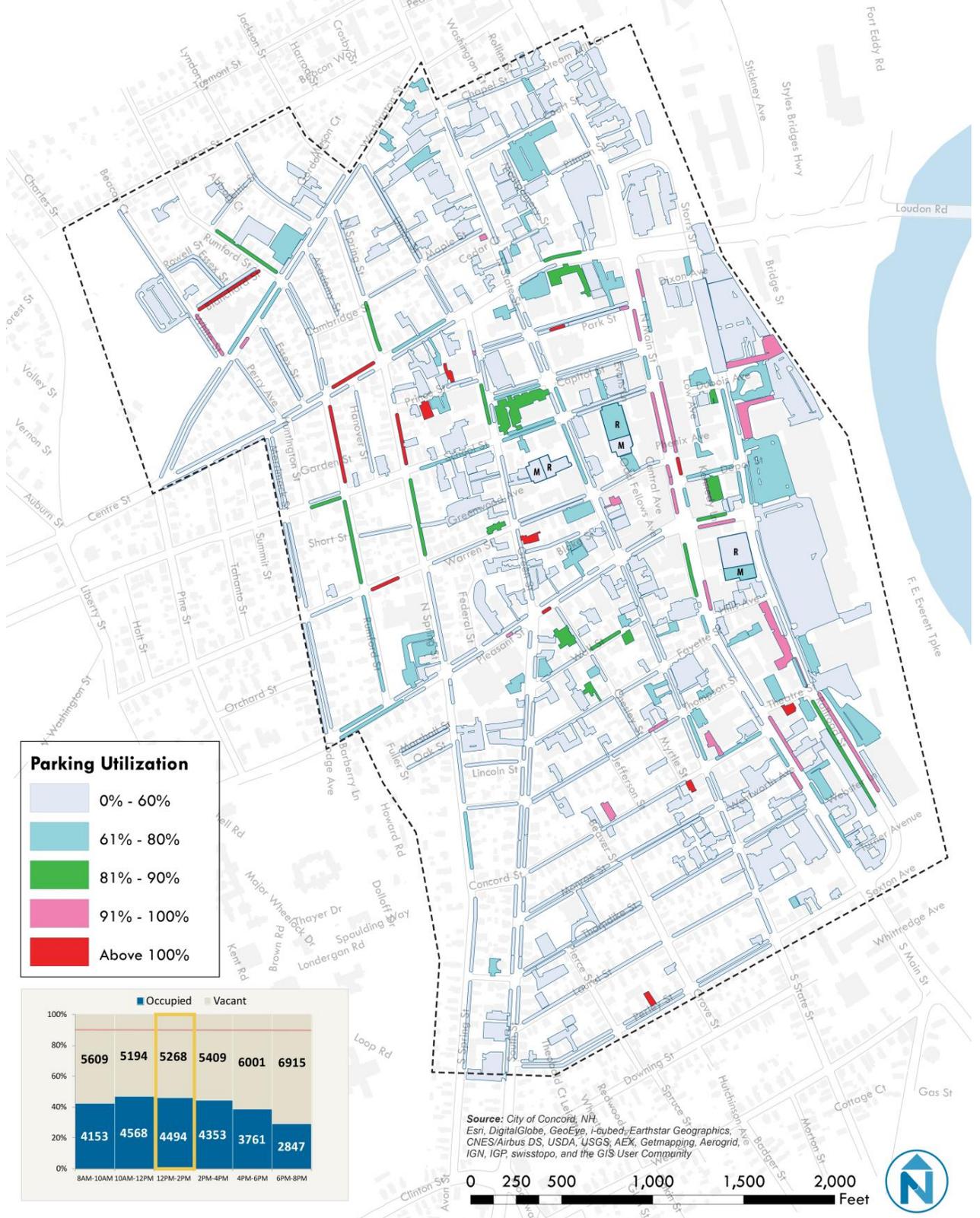


**Figure 9 Downtown Concord Parking Utilization: Thursday 10:00 a.m. – 12:00 p.m.**

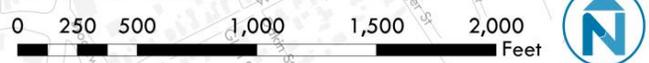


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 City of Concord, NH

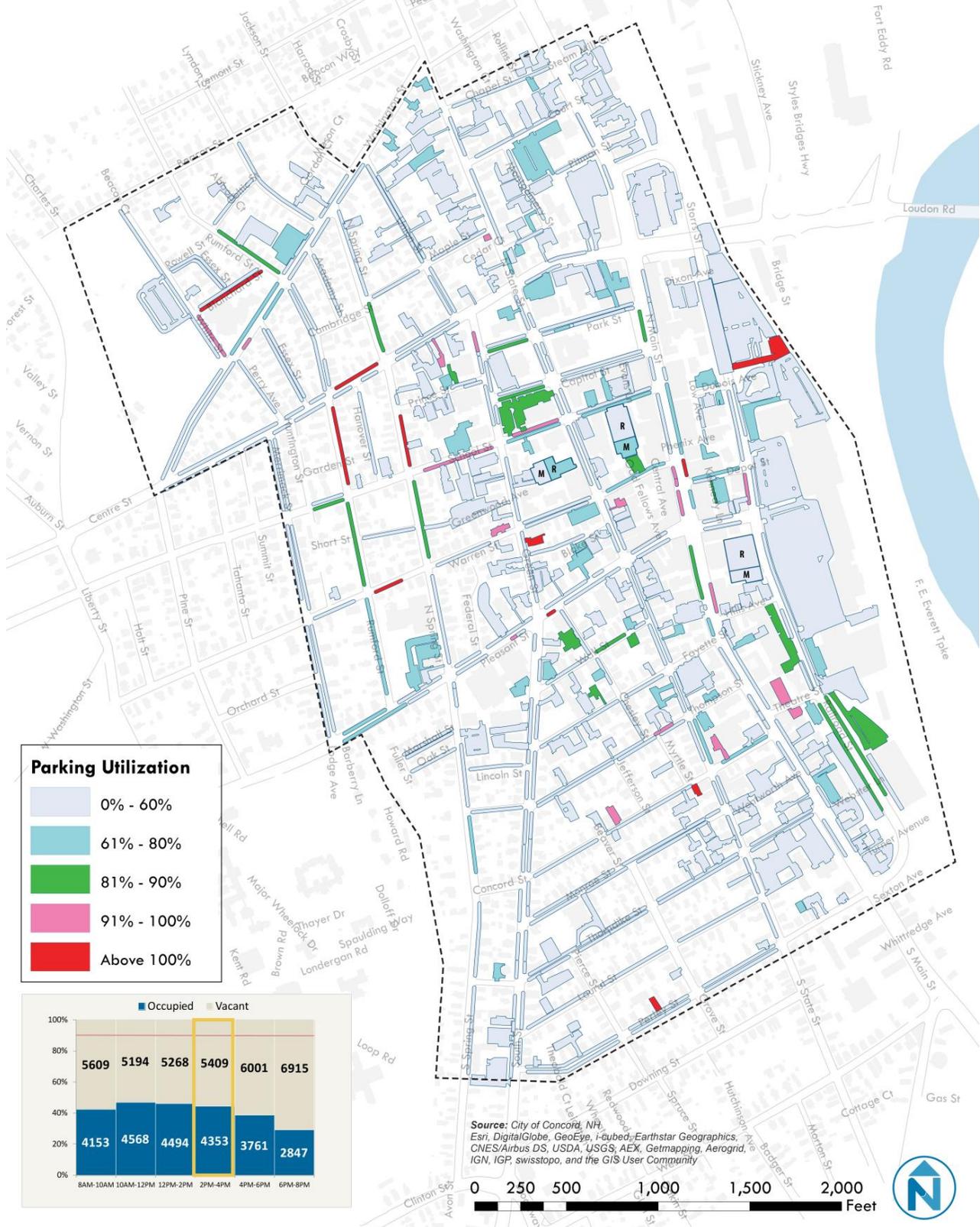
**Figure 10 Downtown Concord Parking Utilization: Thursday 12:00 p.m. – 2:00 p.m.**



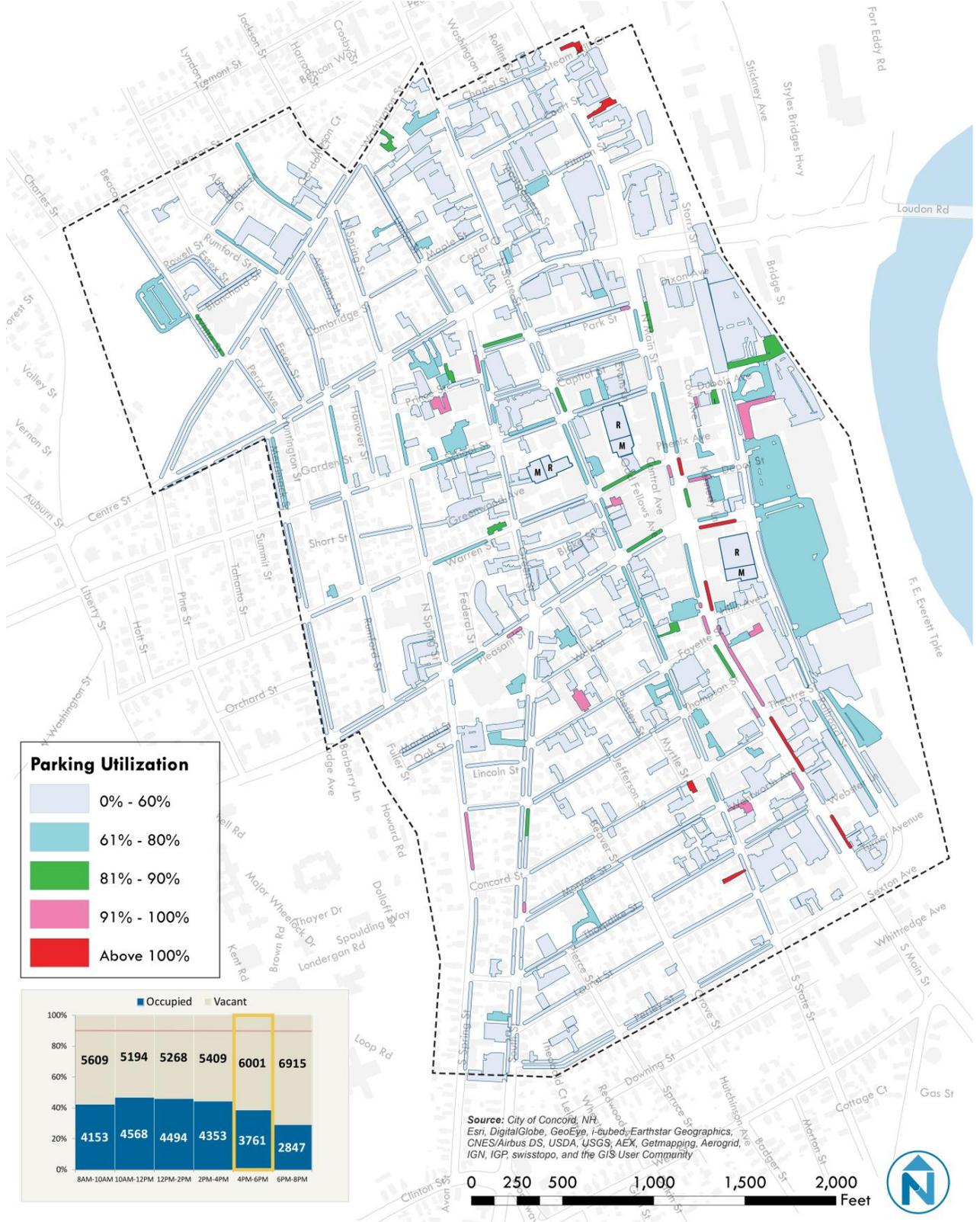
Source: City of Concord, NH, Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



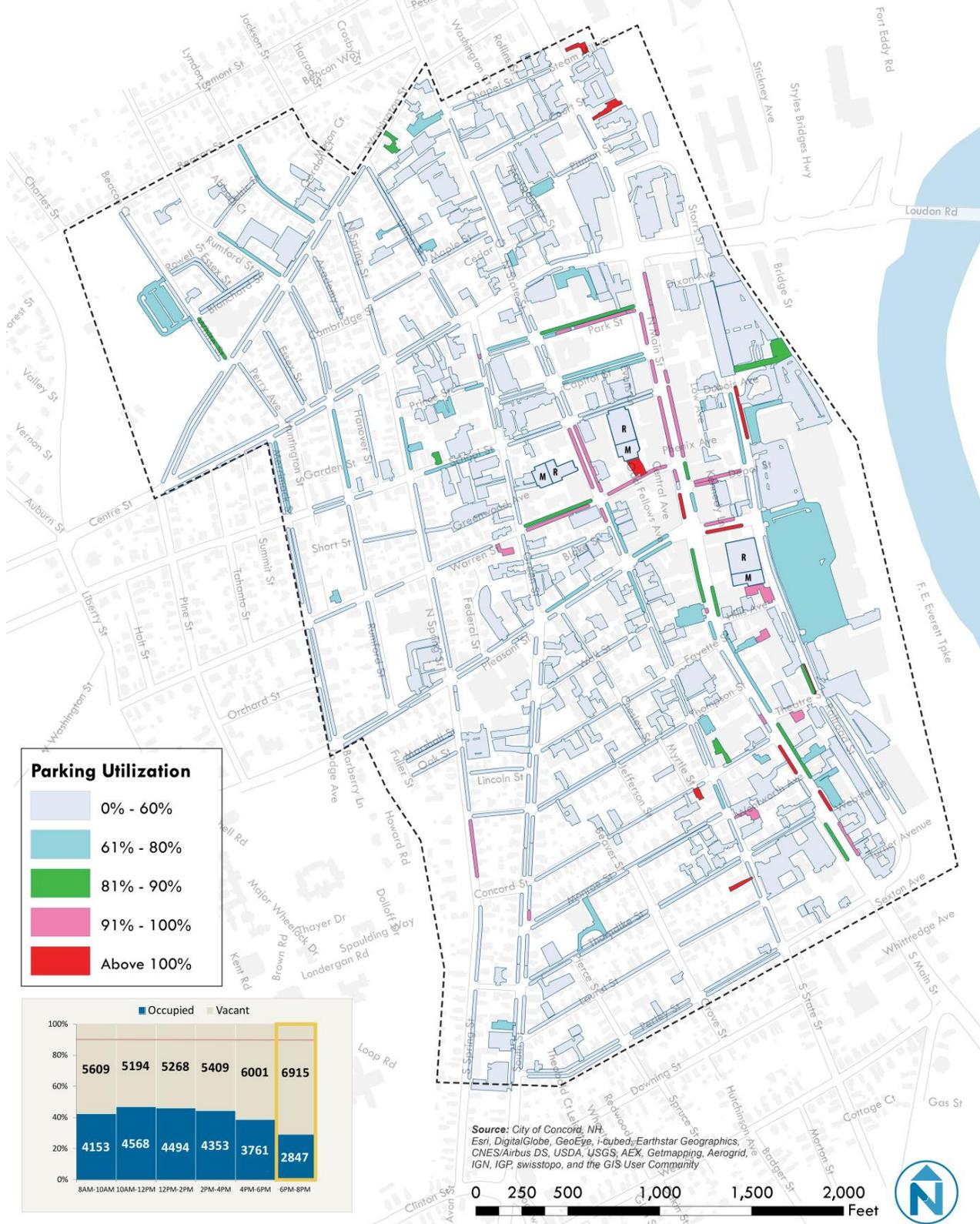
**Figure 11 Downtown Concord Parking Utilization: Thursday 2:00 p.m. – 4:00 p.m.**



**Figure 12 Downtown Concord Parking Utilization: Thursday 4:00 p.m. – 6:00 p.m.**



**Figure 13 Downtown Concord Parking Utilization: Thursday 6:00 p.m. – 8:00 p.m.**



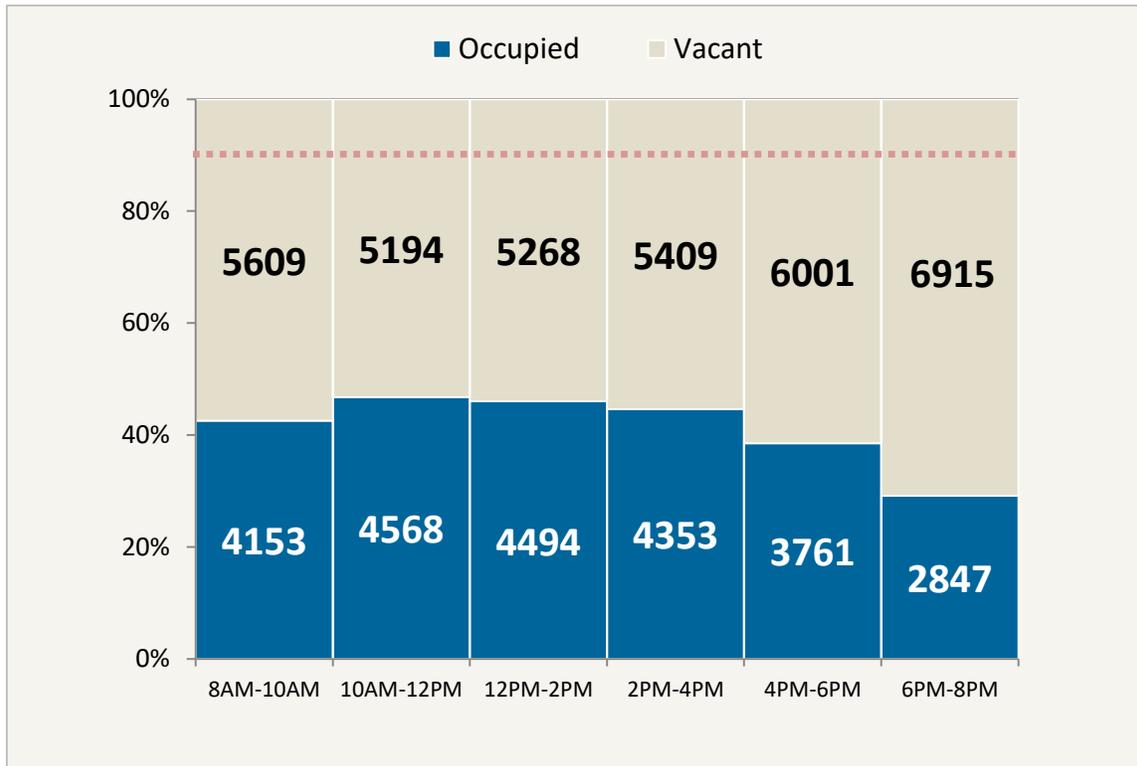
**WEEKDAY PARKING UTILIZATION: KEY FINDINGS**

- **Morning:** There is little morning activity during the early morning hours except employee parking around City Hall and free parking on south Storrs Street.
- **Noon:** Parking started to fill up and reached peak both on-street and off-street. Durgin Garage is over 60% utilized in the afternoon.
- **Evening:** Off-street demand is at one of the lowest demand periods with most activity along Main Street and portions of State and Storrs Street.

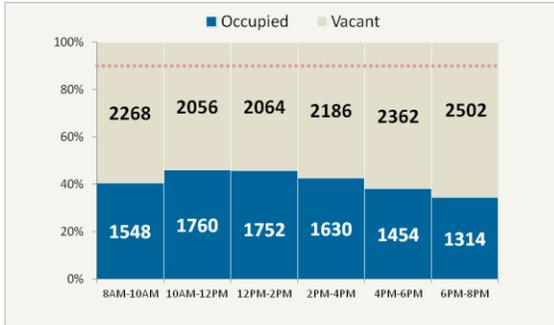
**All Parking Spaces – Weekday**

As shown in Figure 14, of the 9,762 spaces counted within the downtown Concord study area, the maximum overall utilization observed was 46.8% (4,568 spaces), occurred around lunch time, between 10:00 a.m. and 12:00 p.m.. This count included most inventoried spaces except some private parking that has restricted access. Compared to the 90-percent optimal occupancy (shown by the red dotted line), these results indicate that the study area as a whole has more than adequate parking supply to satisfy its demand – in fact, for all other intervals, the majority of the parking supply was empty. Public and private spaces both are showing similar utilization patterns with a peak utilization of fewer than 50% and an average utilization of 41%.

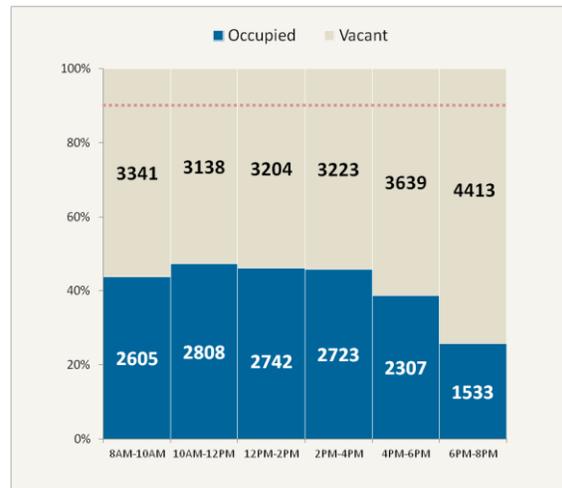
Figure 14 Study Area Overall Parking Utilization Chart: Thursday



**Figure 15 Study Area Public Parking Utilization**  
Chart: Thursday



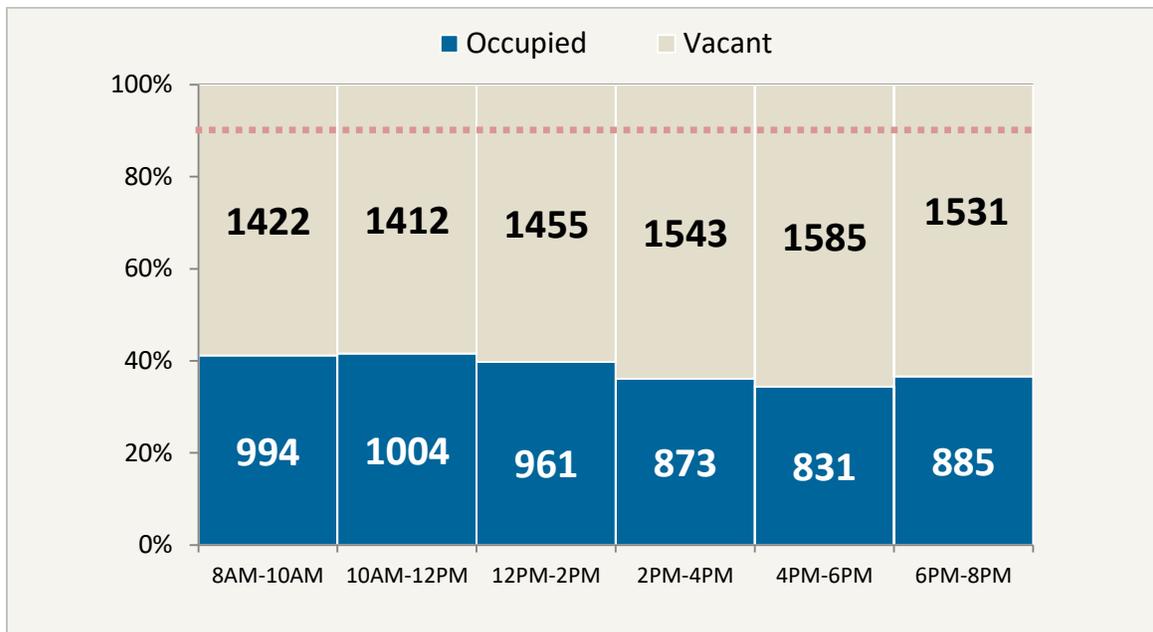
**Figure 16 Study Area Private Parking Utilization**  
Chart: Thursday



### On-Street Parking Spaces – Weekday

As shown in Figure 17, peak on-street utilization was 41.6% (1,004 occupied out of 2,416 total on-street spaces) and occurred in the interval between 10: 00 a.m. and 12:00 p.m. This left 1,412 vacant on-street spaces in the study area.

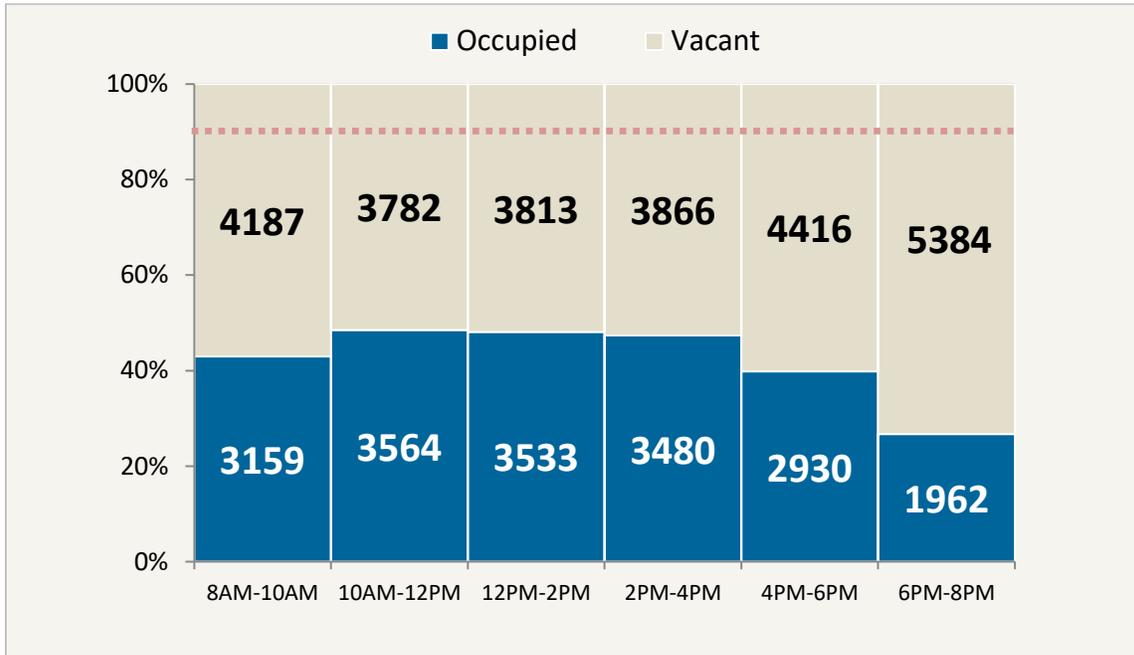
**Figure 17 Study Area On-Street Parking Utilization Chart: Thursday**



### Off-Street Parking Spaces – Weekday

Figure 18 shows that the peak off-street utilization of 48.5% (3,564 occupied out of 7,346 total off-street spaces) occurred between 10: 00 a.m. and 12:00 p.m., leaving over 3,780 vacant off-street spaces in the study area throughout the day.

Figure 18 Study Area Off-Street Parking Utilization Chart: Thursday



### Focus Area Parking Spaces – Weekday

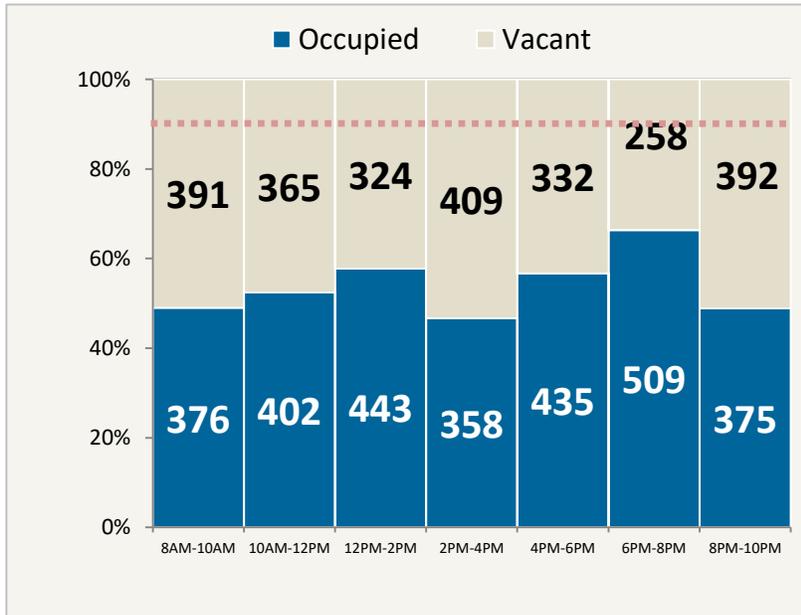
As the previous charts begin to show, the overall utilization of the entire study area may hover under 50% at peak, but parking demand is not uniform throughout the study area. There are pocket of high demand within downtown Concord where parking utilization is substantially higher than 60% (and correspondingly, areas where parking demand is very low). The series of charts on the following pages show parking utilization profiles throughout Thursday in downtown Concord.

### WEEKDAY FOCUS AREAS - KEY FINDINGS

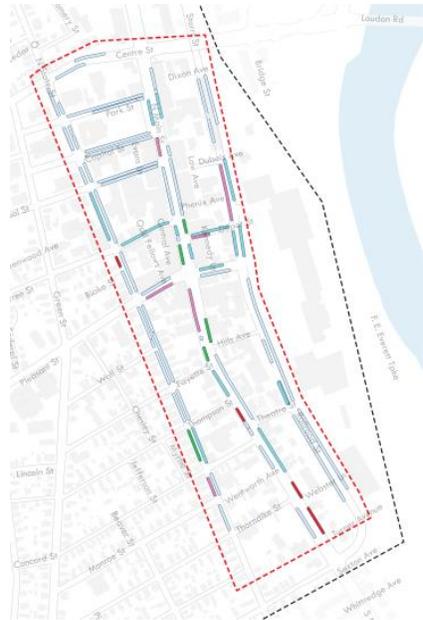
- Utilization in the core area along State, Main, and Storrs Street is high, but still shows a certain amount of availability (Figure 19);
- There are two obvious peak period in the core area with one at lunch time from 12:00 p.m. to 2:00 p.m. and the other at dinner time from 6:00 p.m. to 8:00 p.m. (Figure 19);
- Average on-street metered parking within study area is utilized at 52% full, with significant capacity and availability during the weekdays.
- On-street parking on North and South Main Street is consistently utilized throughout the day (average 70% full), with a peak of 87% between 6:00 p.m. and 8:00 p.m.(Figure 23);
- There is a clear contrast between metered and free parking on Storrs Street, where free parking gets filled up in the early morning and remains full throughout the day until 5:00 p.m.; while metered parking has adequate availability until free after 5:00 p.m. (Figure 25, Figure 26);

**FOCUS AREA: CORE ON-STREET PARKING**

**Figure 19 Core Area On-Street Parking Utilization Chart: Thursday**

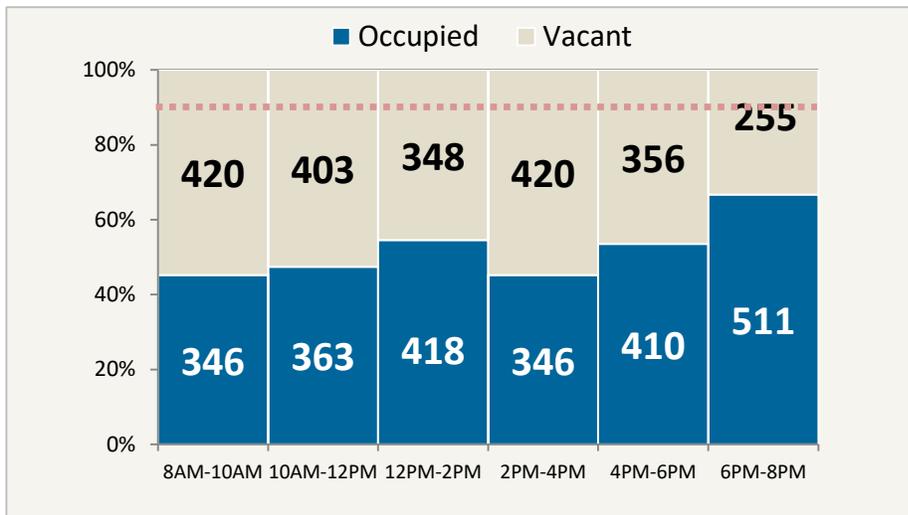


**Figure 20 Core Area On-Street Parking**



**FOCUS AREA: DOWNTOWN ON-STREET METERED PARKING**

**Figure 21 Downtown On-Street Metered Parking Utilization Chart: Thursday**

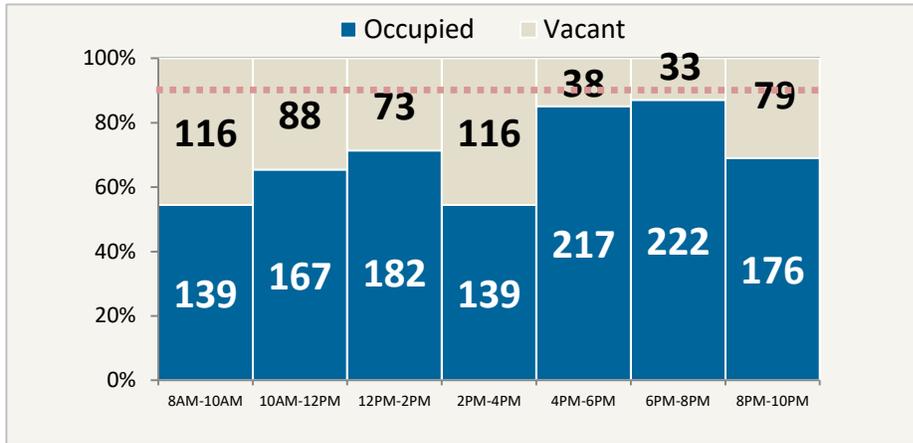


**Figure 22 On-Street Metered Parking**



**FOCUS AREA: NORTH & SOUTH MAIN STREET ON-STREET PARKING**

**Figure 23 North & South Main Street Parking Utilization Chart: Thursday**

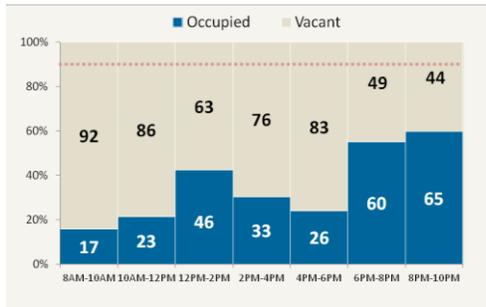


**Figure 24 N& S Main Street**

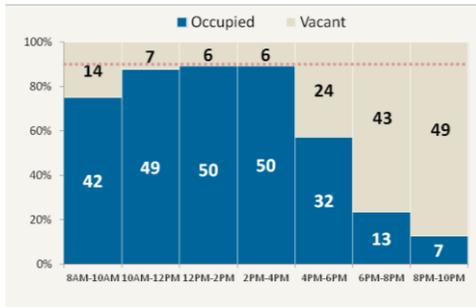


**FOCUS AREA: STORRS STREET METERED VS. FREE PARKING**

**Figure 25 Storrs Street Metered Parking Utilization Chart: Thursday**



**Figure 26 Storrs Street Free Parking Utilization Chart: Thursday**



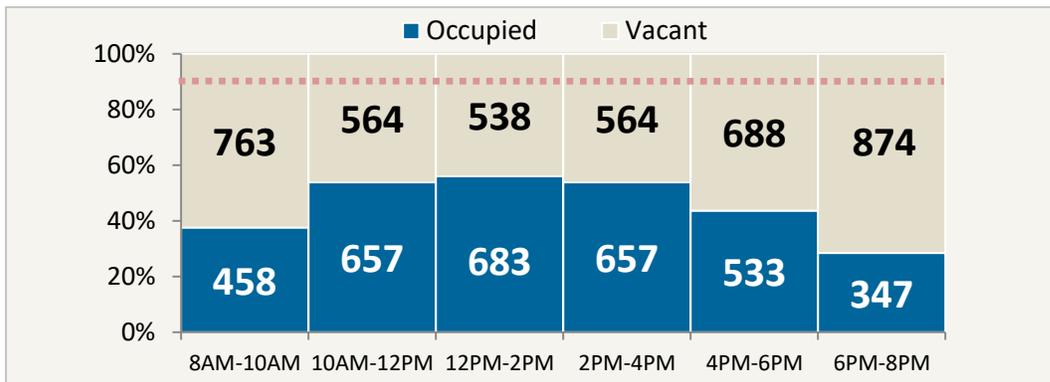
**Figure 27 Storrs Street**



**Garage Parking Spaces – Weekday**

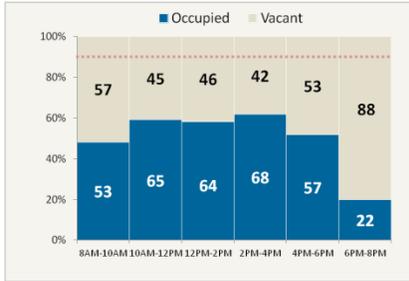
Figure 28 shows that public garage parking reached 56% utilization from 12:00 p.m. to 2:00 p.m., leaving almost half of garage supply empty. In general, public garage assets are underutilized, showing significant capacity and availability during the weekdays. Given their proximity to downtown business, all three garages could be better utilized in the future.

**Figure 28 Three Public Garages Parking Utilization Chart: Thursday**

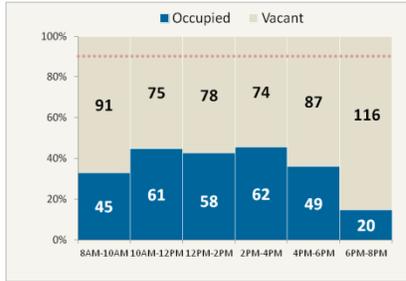


**FIREHOUSE BLOCK GARAGE – RESERVED VS. METERED PARKING**

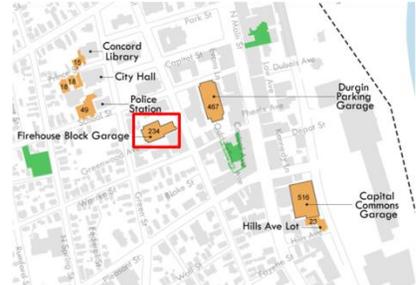
**Figure 29 Firehouse Block Garage Reserved Parking Utilization Chart: Thursday**



**Figure 30 Firehouse Block Garage Metered Parking Utilization Chart: Thursday**



**Figure 31 Firehouse Block Garage**

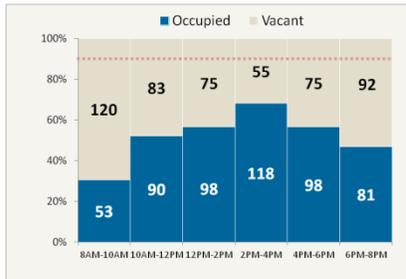


**DURGIN GARAGE – RESERVED VS. METERED PARKING**

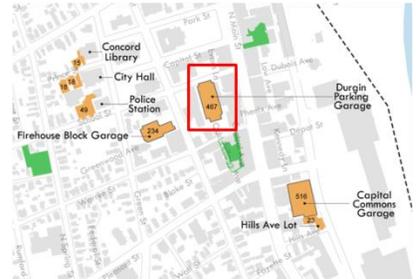
**Figure 32 Durgin Garage Reserved Parking Utilization Chart: Thursday**



**Figure 33 Durgin Garage Metered Parking Utilization Chart: Thursday**

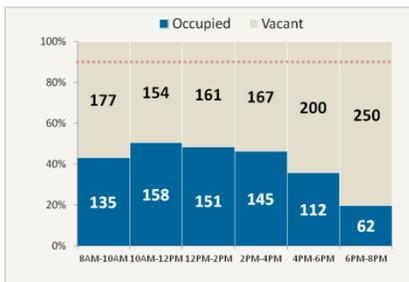


**Figure 34 Durgin Garage**

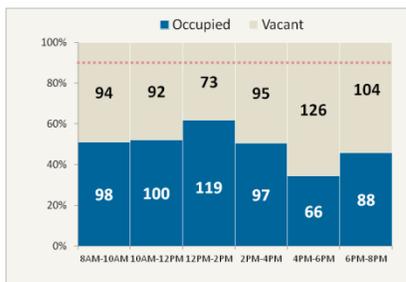


**CAPITAL COMMONS GARAGE – RESERVED VS. METERED PARKING**

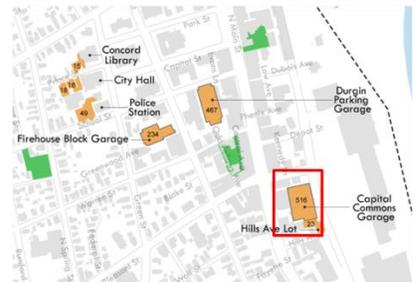
**Figure 35 Capital Commons Garage Reserved Parking Utilization Chart: Thursday**



**Figure 36 Capital Commons Garage Metered Parking Utilization Chart: Thursday**



**Figure 37 Capital Commons Garage**



## Parking Utilization – Weekend

### WEEKEND PARKING UTILIZATION: KEY FINDINGS

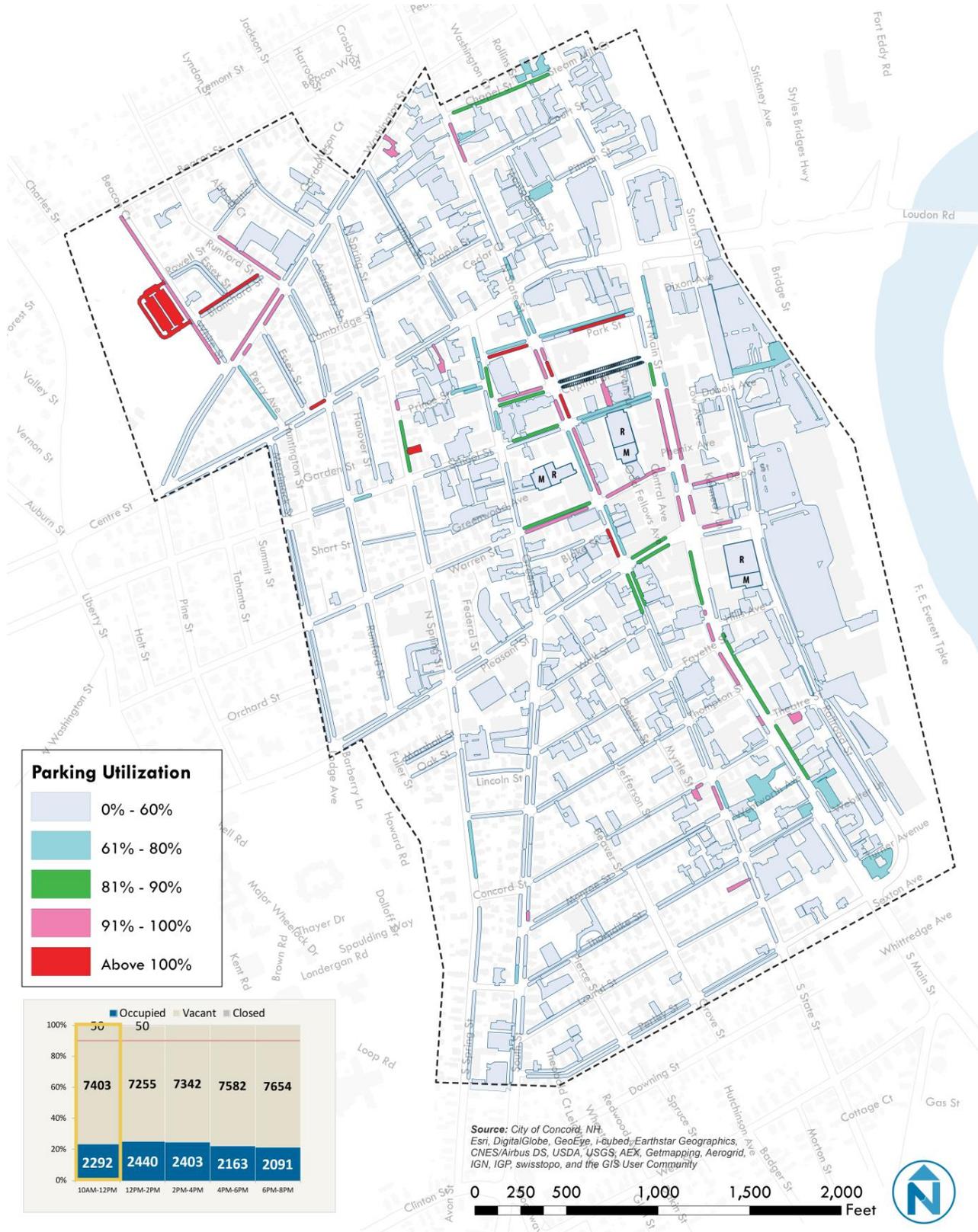
- Weekend demand was generally much lower than weekday demand with a peak utilization of 25% (2,440 out of 9,745 spaces counted) between 12:00 p.m. and 2:00 p.m.;
- Parking utilization data for Saturday shows a pattern of relatively low daytime use of the downtown parking spaces, especially for off-street assets;
- Areas of heavy utilization are similar for Saturday afternoon as for Thursday evening, indicating land uses such as dining and retail that remain active even after working hours;
- On-street parking along State and Main Street north of Pleasant Street is well utilized on Saturday morning, due to the Farmers' Market event and church activities.
- Public garages are much less utilized during weekends than weekdays, indicating that garages are more likely used by employees and commuters.

Figure 39 to Figure 43 show time series utilization in two-hour increments, from 10:00 a.m. - 12:00 p.m. to 6:00 p.m. - 8:00 p.m. Note that the mapping has distinguished between the utilization of leased parking (**R**) and public parking (**M**) in the municipal public garages, in order to have a better understanding of how parking is utilized by different user groups.

Figure 38 Farmers' Market Closed Capitol Street on Saturday



**Figure 39 Downtown Concord Parking Utilization: Saturday 10:00 a.m. – 12:00 p.m.**



**Parking Utilization**

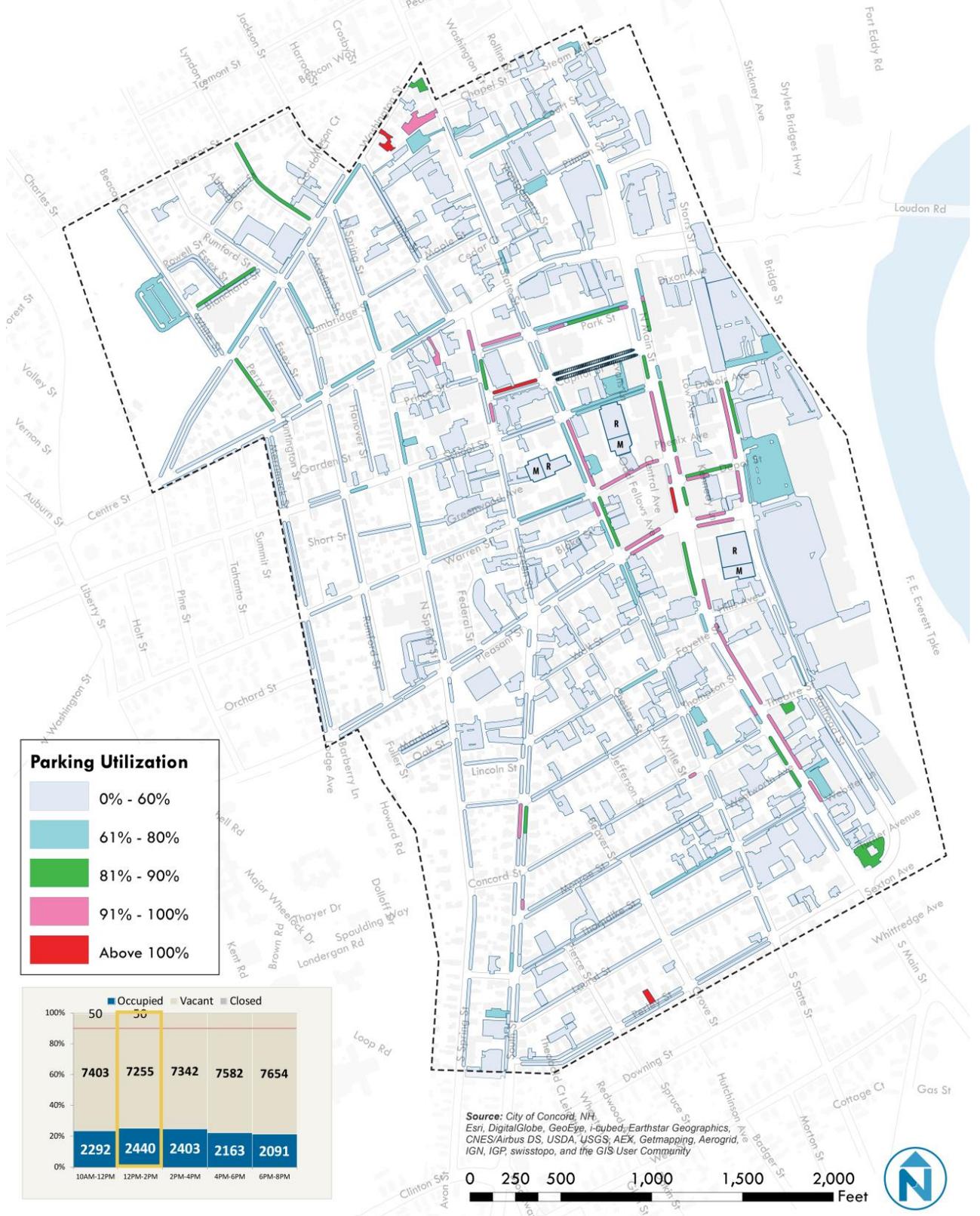
<span style="display:inline-block; width:15px; height:15px; background-color:lightblue;"></span>	0% - 60%
<span style="display:inline-block; width:15px; height:15px; background-color:mediumslateblue;"></span>	61% - 80%
<span style="display:inline-block; width:15px; height:15px; background-color:green;"></span>	81% - 90%
<span style="display:inline-block; width:15px; height:15px; background-color:pink;"></span>	91% - 100%
<span style="display:inline-block; width:15px; height:15px; background-color:red;"></span>	Above 100%

Time Period	Occupied	Vacant	Closed
10AM-12PM	2292	7403	50
12PM-2PM	2440	7255	50
2PM-4PM	2403	7342	
4PM-6PM	2163	7582	
6PM-8PM	2091	7654	

*Source: City of Concord, NH, Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aergrid, IGN, IGP, swisstopo, and the GIS User Community*

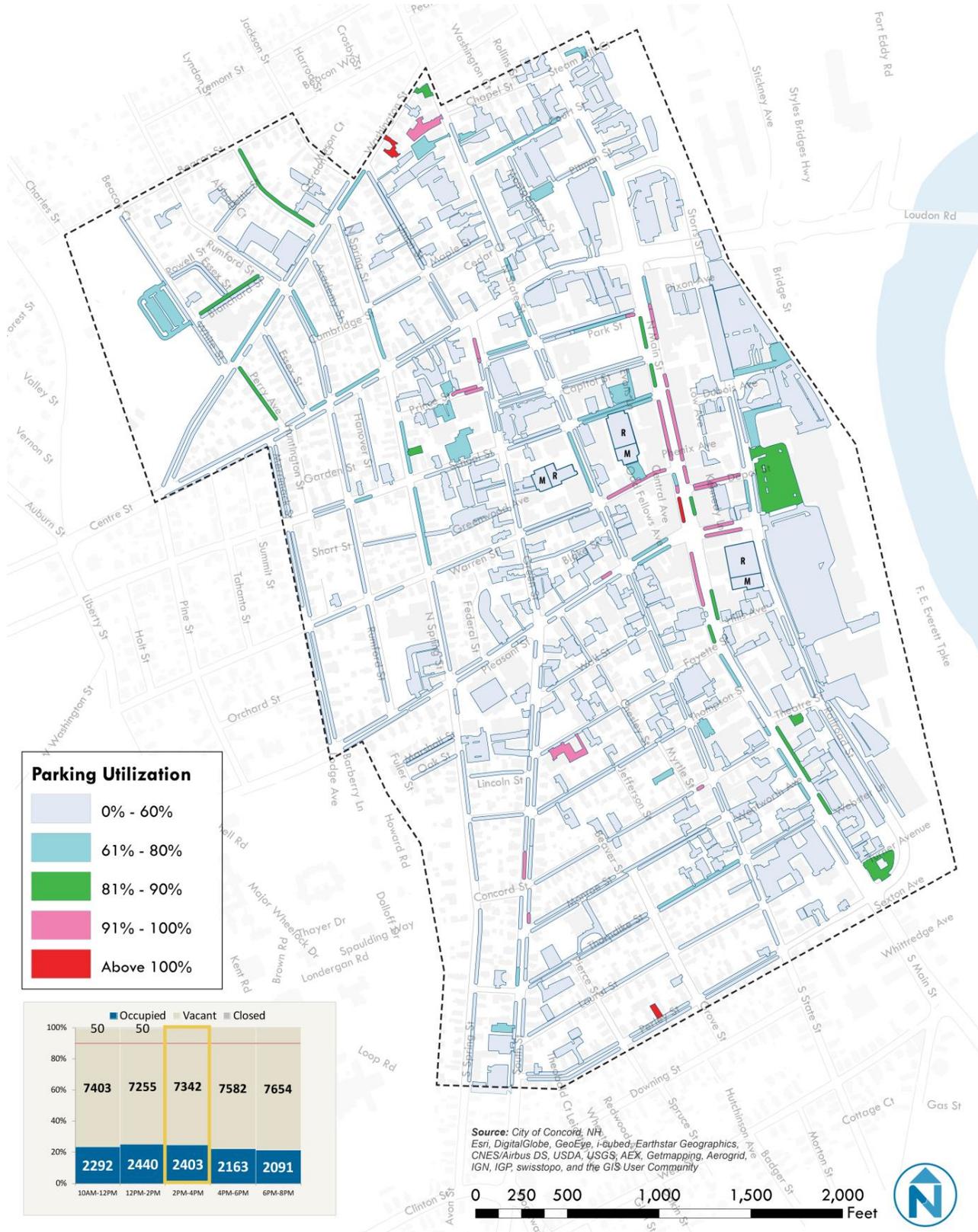


**Figure 40 Downtown Concord Parking Utilization: Saturday 12:00 p.m. – 2:00 p.m.**



**DOWNTOWN CONCORD PARKING SYSTEM STRATEGIC PLANNING | FINAL REPORT**  
City of Concord, NH

**Figure 41 Downtown Concord Parking Utilization: Saturday 2:00 p.m. – 4:00 p.m.**



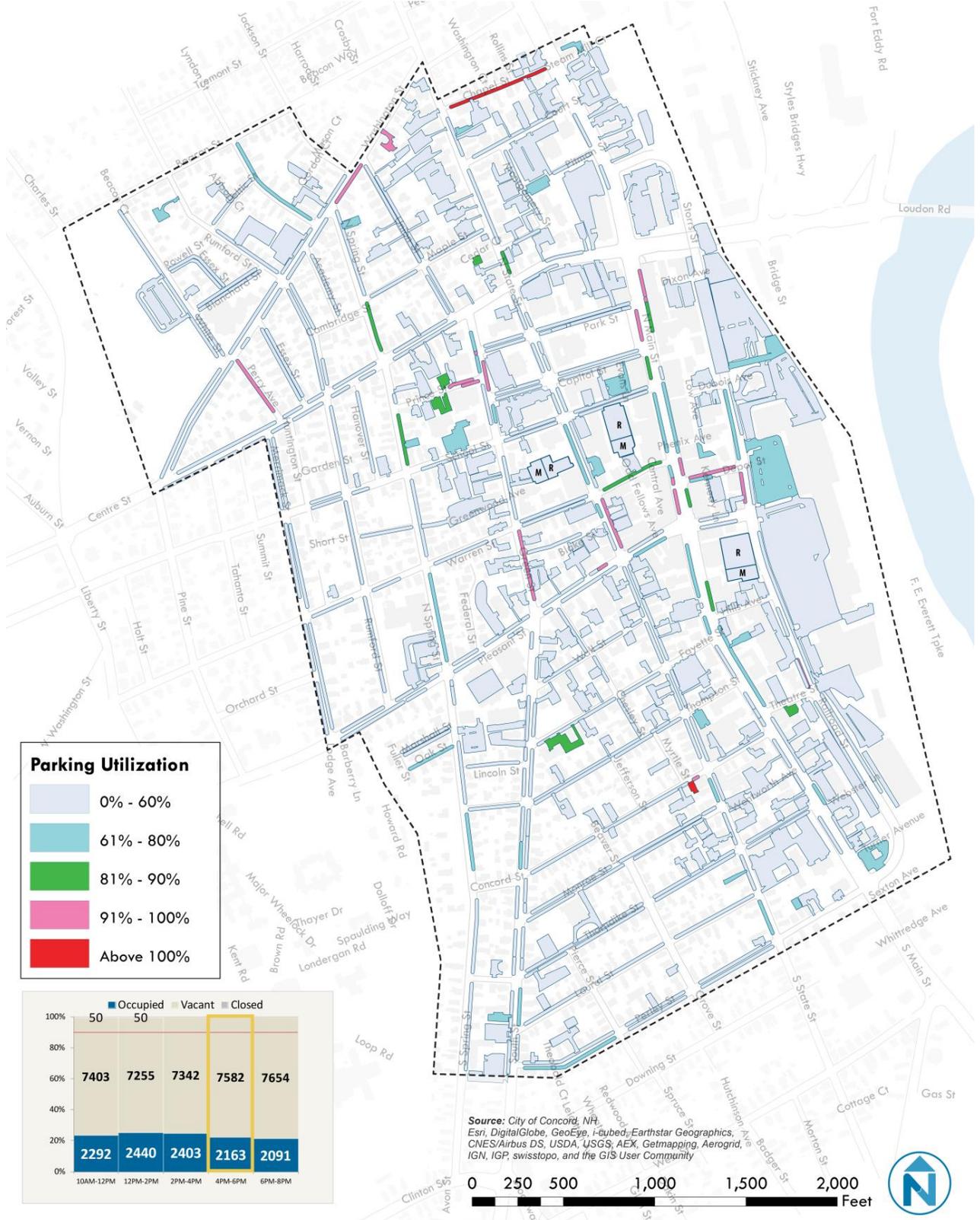
**Parking Utilization**

- 0% - 60%
- 61% - 80%
- 81% - 90%
- 91% - 100%
- Above 100%

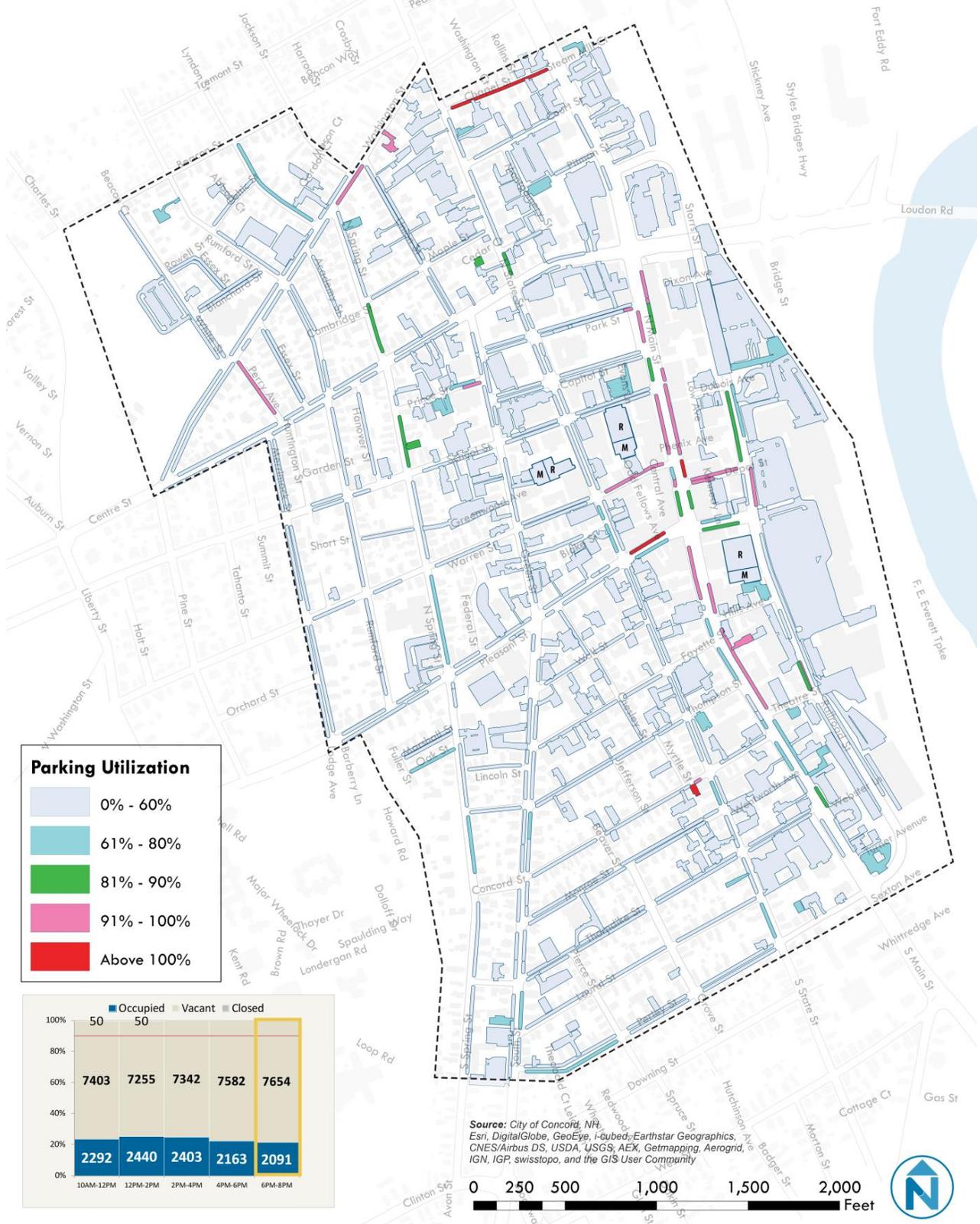
Time Period	Occupied	Vacant	Closed
10AM-12PM	2292	7403	50
12PM-2PM	2440	7255	50
2PM-4PM	2403	7342	50
4PM-6PM	2163	7582	50
6PM-8PM	2091	7654	50

*Source: City of Concord, NH; Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community*

**Figure 42 Downtown Concord Parking Utilization: Saturday 4:00 p.m. – 6:00 p.m.**



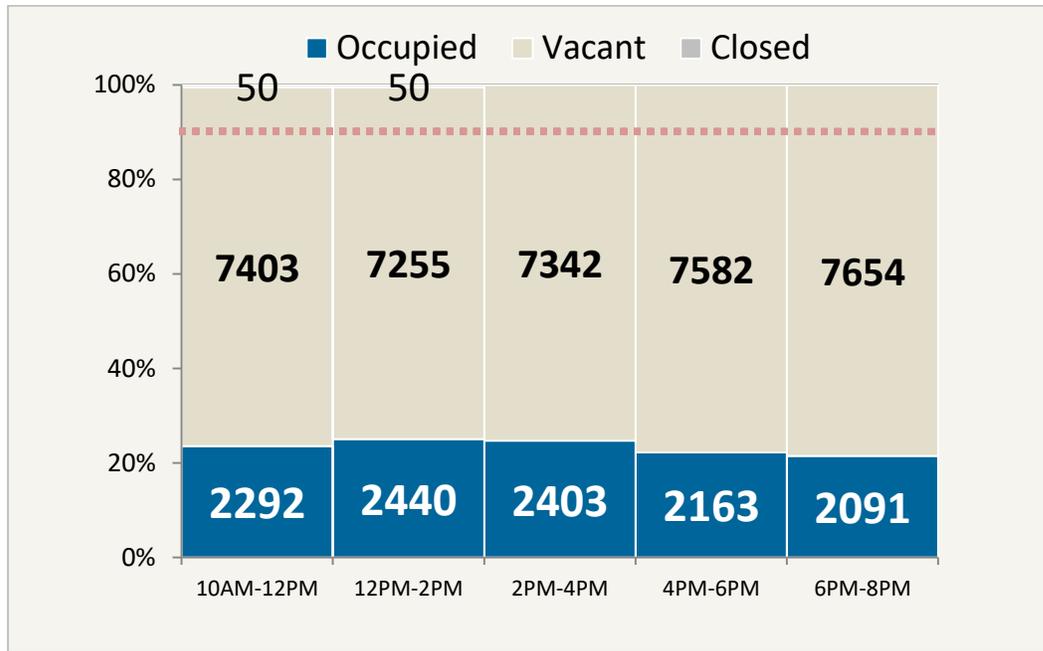
**Figure 43 Downtown Concord Parking Utilization: Saturday 6:00 p.m. – 8:00 p.m.**



### All Parking Spaces – Weekend

As shown in Figure 44, of all 9,745 spaces counted in the downtown Concord study area, the maximum utilization was 25% (2,440 spaces), which occurred between 12:00 p.m. and 2:00 p.m., indicating that the study area has more than sufficient parking supply to satisfy its demand on weekend. Note that the closed 50 spaces on Capitol Street between 10:00 a.m. and 2:00 p.m. shown in the chart below indicate the peak utilization is actually slightly higher (25.2%).

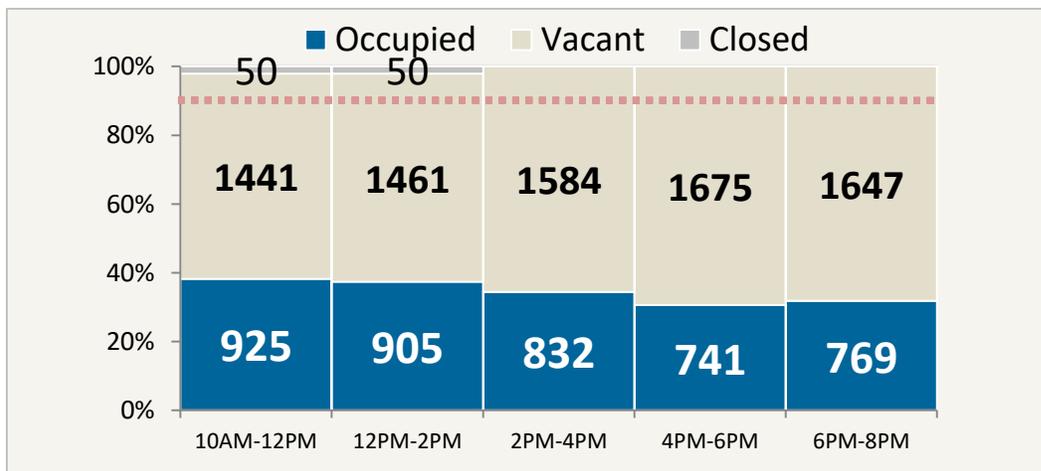
**Figure 44 Study Area Overall Parking Utilization Chart: Saturday**



### On-Street Parking Spaces – Weekend

As shown in Figure 45, peak on-street utilization was 39% (925 occupied out of 2,416 total on-street spaces minus the 50 spaces closed) and occurred in the interval between 10:00 a.m. and 12:00 p.m. This left 1,441 vacant on-street spaces in the study area.

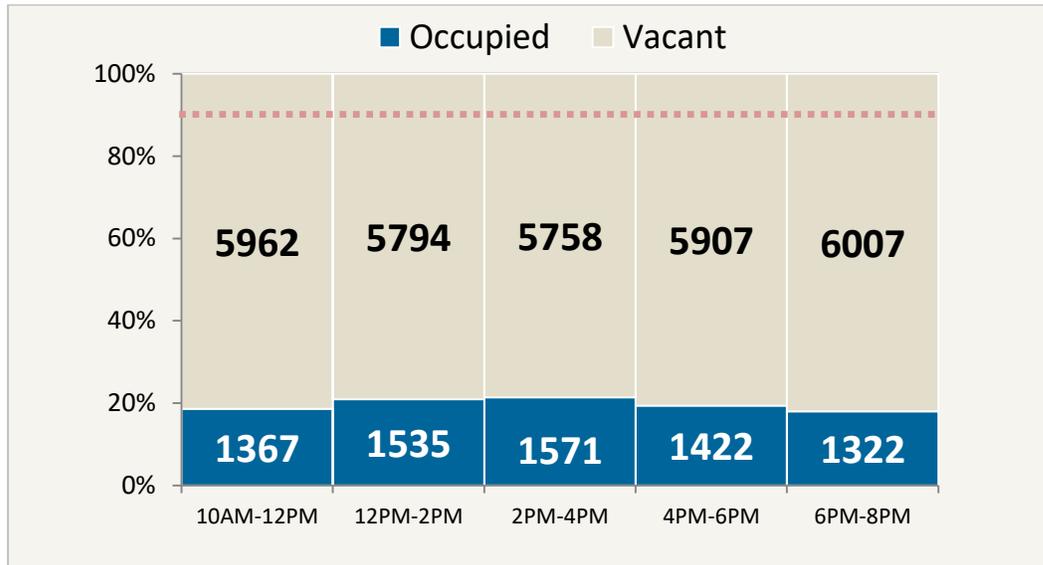
**Figure 45 Study Area On-Street Parking Utilization Chart: Saturday**



### Off-Street Parking Spaces – Weekend

In Figure 46, the peak off-street utilization of 21.4% (1,571 spaces occupied out of 7,329 off-street spaces counted) occurred between 2:00 p.m. and 4:00 p.m., leaving at least 5,758 vacant off-street spaces in the study area throughout the day.

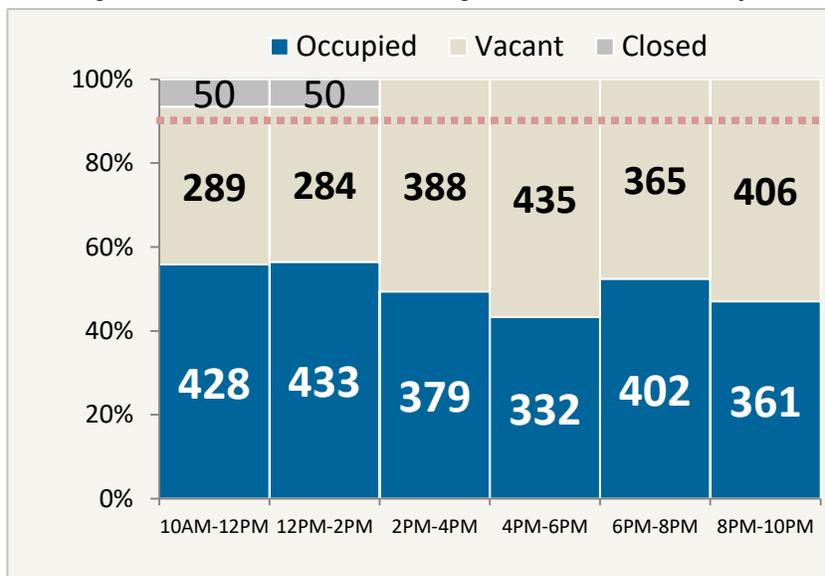
**Figure 46 Study Area Off-Street Parking Utilization Chart: Saturday**



### Focus Area Parking Spaces – Weekend

**FOCUS AREA: CORE ON-STREET PARKING**

**Figure 47 Core Area On-Street Parking Utilization Chart: Saturday**

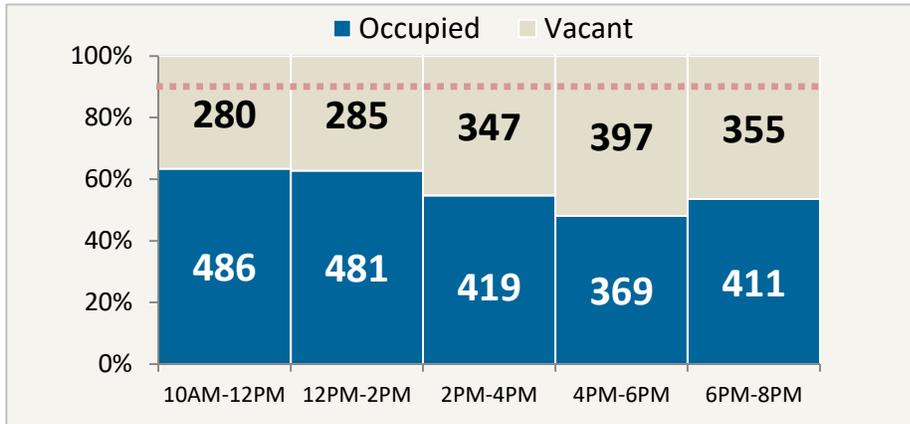


**Figure 48 Core Area On-Street Parking**



**FOCUS AREA: DOWNTOWN ON-STREET METERED PARKING**

**Figure 49 Downtown On-Street Metered Parking Utilization Chart: Saturday**

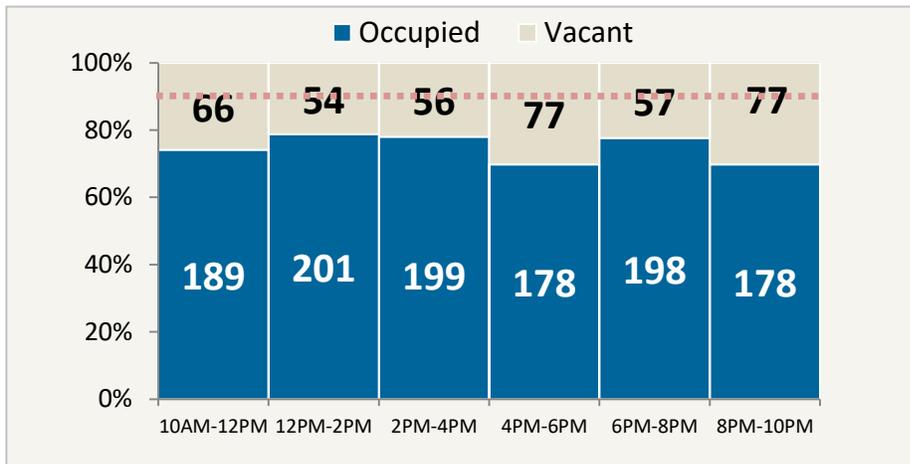


**Figure 50 On-Street Metered Parking**



**FOCUS AREA: NORTH & SOUTH MAIN STREET ON-STREET PARKING**

**Figure 51 North & South Main Street Parking Utilization Chart: Saturday**

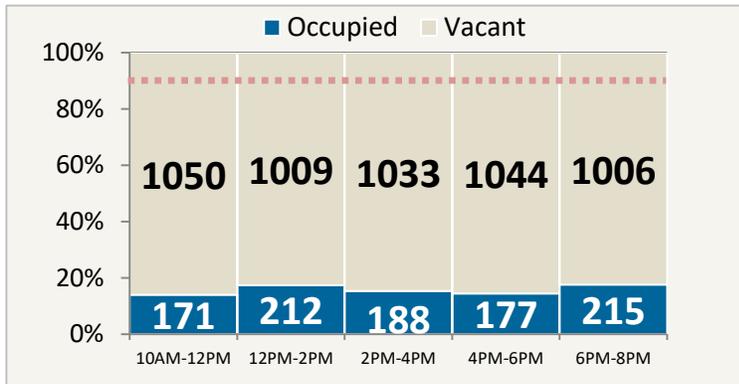


**Figure 52 N & S Main Street**

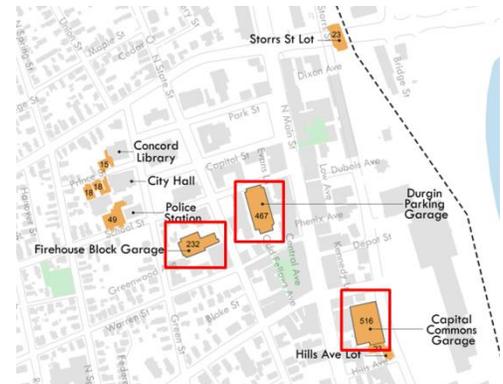


**FOCUS AREA: THREE PUBLIC GARAGES PARKING**

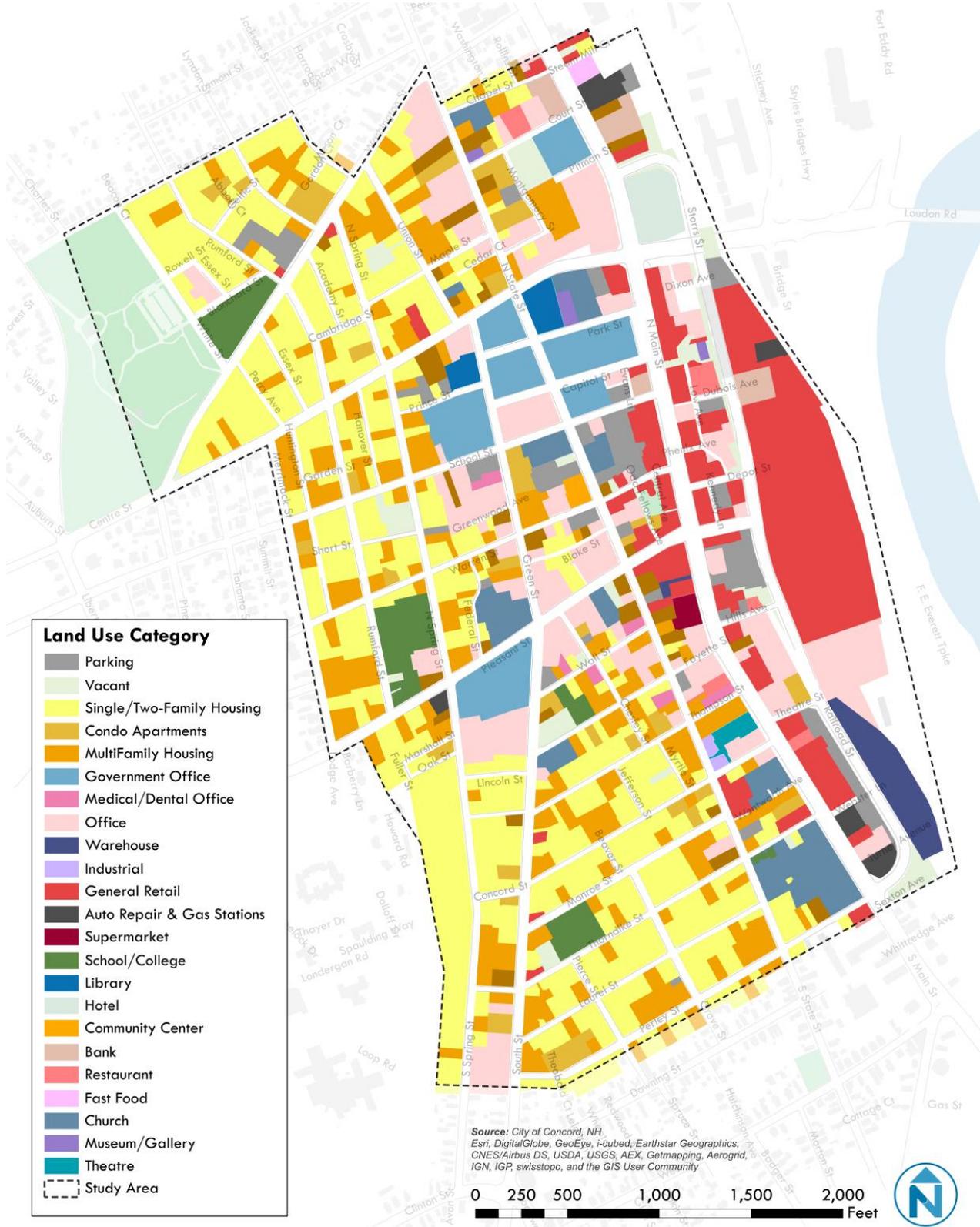
**Figure 53 Public Garages Parking Utilization Chart: Saturday**



**Figure 54 Three Public Garages**



**Figure 55 Existing Land Use: Downtown Concord Study Area**



## 3.4 LAND USE & SHARED PARKING

Parking does not exist independently, but it is intricately intertwined with the overall mix of land uses and activities it serves. As downtown Concord evolves and attracts a variety of land uses, this relationship is critical. This section explores the current relationship between existing land use and parking, and models the expected land use and parking given known and potential development.

Downtown Concord does not represent typical suburban development. The historic downtown, mix and proximity of land uses, walkable environment, active small-scale retail, and growing local dining scene helps enhance its local feel. When land is at a premium in this center of activity, careful consideration of what the land is dedicated to (built environment, roadways, open space, parking) has a significant impact on the vitality of downtown.

This section uses a model to understand the ratio of land use and parking supply and demand in the entire boundary as well as a focus area of activity in downtown. The model determines how much parking would be needed assuming that parking is shared between land uses and people (customers, employees, visitors) visiting multiple destinations. The combined results of these analyses are then compared to the actual observed parking demand. The assumptions used in the existing land use analysis will also be applied to project future land use development and shared parking demand.

### About Land Use and Parking Ratios

The Institute of Transportation Engineers (ITE) produces a periodic report titled *Parking Generation*, which is the prevailing national standard in determining parking demand for a development. ITE standards are based on parking demand studies submitted to ITE by a variety of parties, including public agencies, developers and consulting firms. The most recent parking generation manual available is the 4th edition (2010) and is a comparative starting point to determine baseline assumptions. This study includes ITE peak period parking demand rates as guidelines to benchmark how the existing parking supply in Concord compares to its land uses.

Expected parking demand is a way to examine the amount of parking that would be needed to support the level of development and activity present within the study area. In this case, the analysis is completed using industry standard methodology to equate land use with expected parking demand. ITE parking standards are often based on peak hour demands of suburban sites with isolated, single land uses which have free parking (Institute of Transportation Engineers, *Parking Generation* 4th Edition, 2010, page 2). Nelson\Nygaard's experience indicates that projections using standard ITE parking rates tend to overestimate demand for downtown areas like Concord. Mixed-use areas offer the opportunity to share parking supply between various uses. This reduces the total number of spaces which would be required by the same land-uses in stand-alone developments.

To model a park-once environment, Nelson\Nygaard used an adapted shared parking model using inputs from the Urban Land Institute's (ULI) *Shared Parking Manual* (2nd Edition, 2005) and ITE's *Parking Generation* (4th Edition, 2010). Besides demand by time of day, we tailored the shared parking model for downtown Concord to include a parking demand reduction for internal capture. Mixed-use downtowns allow for parking efficiencies through "internal capture" or "captive market" trips. Such trips are made by patrons who, having already parked, travel between uses without accessing their vehicle. Restaurants and retail services are common

generators of internal capture trips in mixed-use developments, as they serve both employees and residents within the same area. The shared parking model includes a conservative percent reduction to account for the mix of Concord development patterns.

## Study Area Existing Land Use

Overall, the entire study area covers about 272 acres. The shared parking analysis excludes single-family homes. Land uses are grouped as accurately as possible into categories created by the *Institute of Transportation Engineers Parking Generation 4th Edition (2010)*. Figure 56 shows the breakdown of land use by category in the study area; the square feet and unit numbers are adjusted for existing vacancies.

**Figure 56 Existing Land Use in the Study Area**

Land Use	Square Feet/Units	
Industrial	8,208	square feet
General Retail	379,518	square feet
Auto Repair & Gas Stations	13,478	square feet
Supermarket	18,006	square feet
School	3,321	students
Library	72,983	square feet
Hotel/Inn	122	rooms
Community Center	118,562	square feet
Drive-In Bank	62,387	square feet
Restaurant	47,313	square feet
Fast Food	2,160	square feet
Church	180,630	square feet
Museum/Gallery	60,141	square feet
Movie Theater	1,304	Seats
Warehouse	47,455	square feet
College/University	556	Campus Population
Office	998,010	square feet
Medical/Dental Office	38,290	square feet
Government Office	351,809	square feet
Apartment	1,304	units

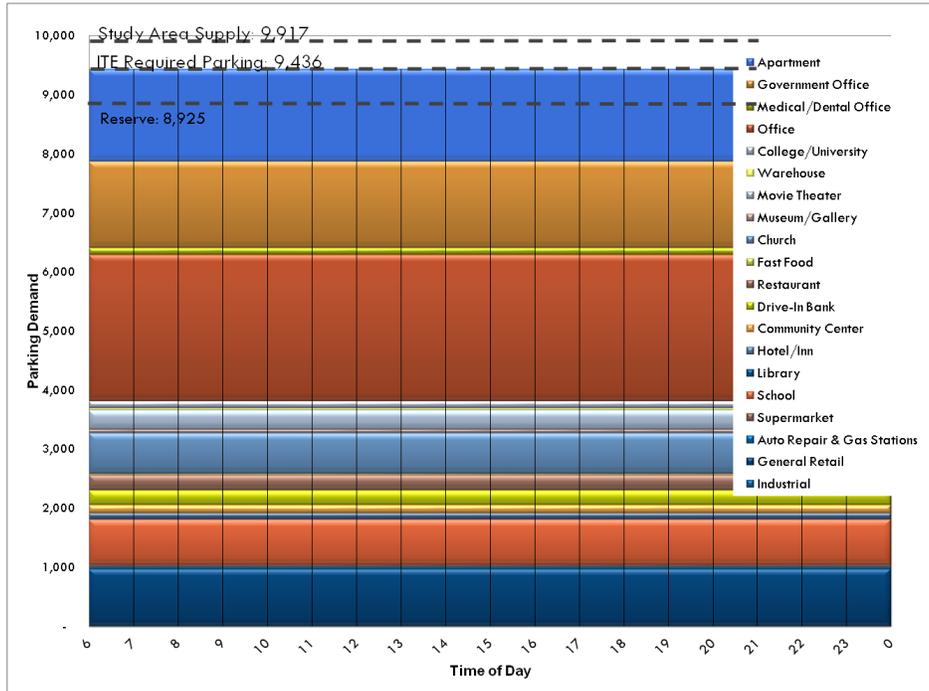
## Study Area Existing Shared Parking Analysis

According to national parking standard calculations from ITE, the needed number of parking spaces for entire study area is 9,436 spaces (Figure 57). The study area has a total of 9,917 spaces. This confirms that Concord has built a comparable parking supply to national standards for single-use suburban development, within about 500 spaces.

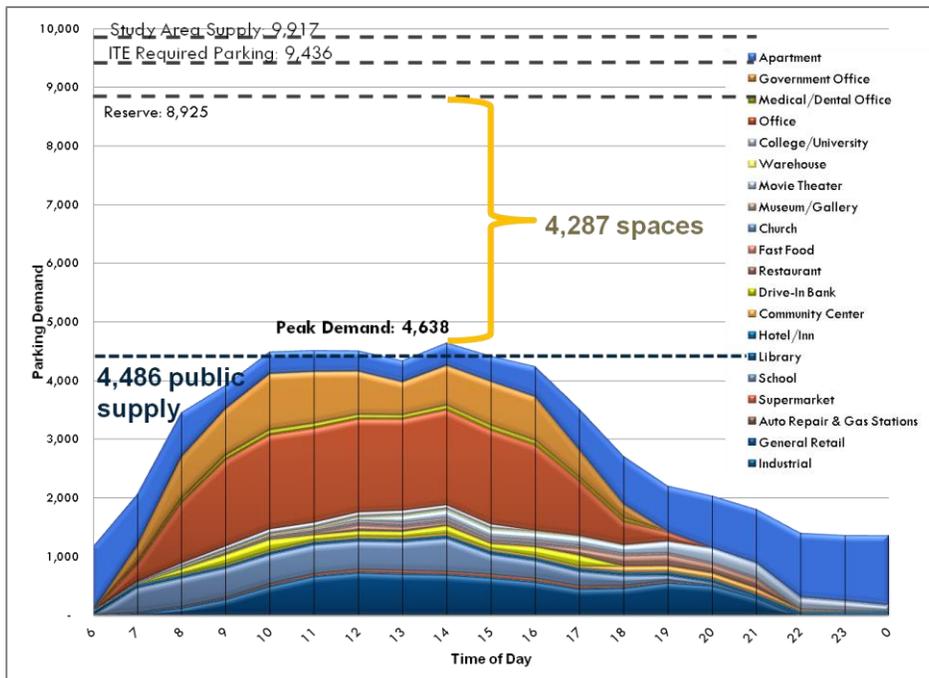
The shared parking model shows the number of parking spaces needed after factoring in time of day demands by land use and downtown Concord's mixed-use environment. The estimates show

that the peak demand is at 2:00 p.m. with 4,638 spaces. Using the same parking utilization counts shown in Figure 14, when overlaid on the expected parking demand based on land use, the patterns are quite similar. Thus there is adequate supply to meet demand, both estimating by land use and when counting today's parking demand.

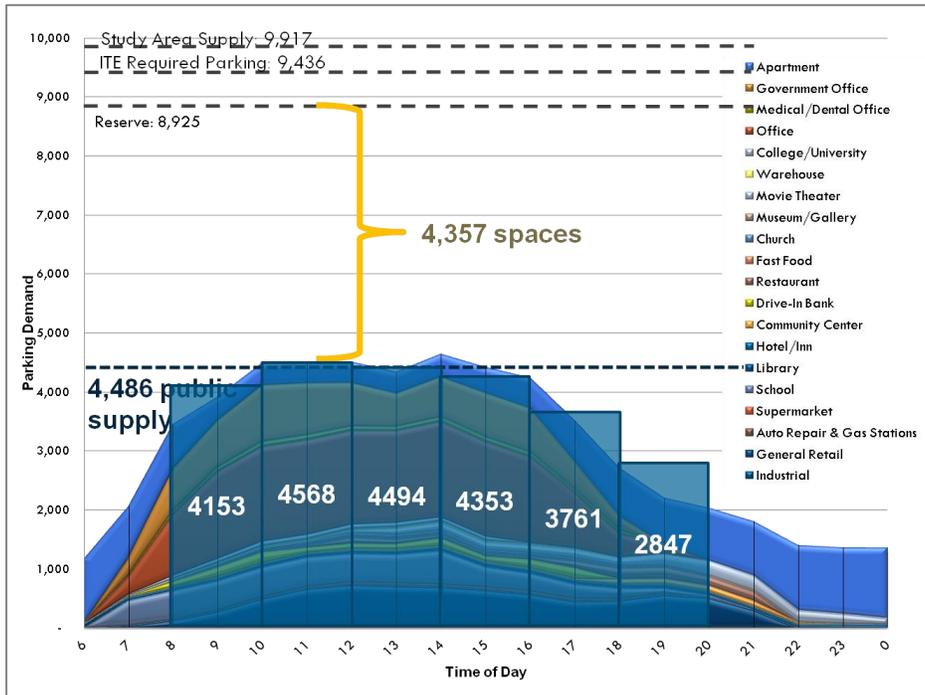
**Figure 57 Existing Demand if Unshared – Study Area**



**Figure 58 Expected Shared Demand – Study Area**



**Figure 59 Expected Shared Demand with Observed Weekday Utilization – Study Area**



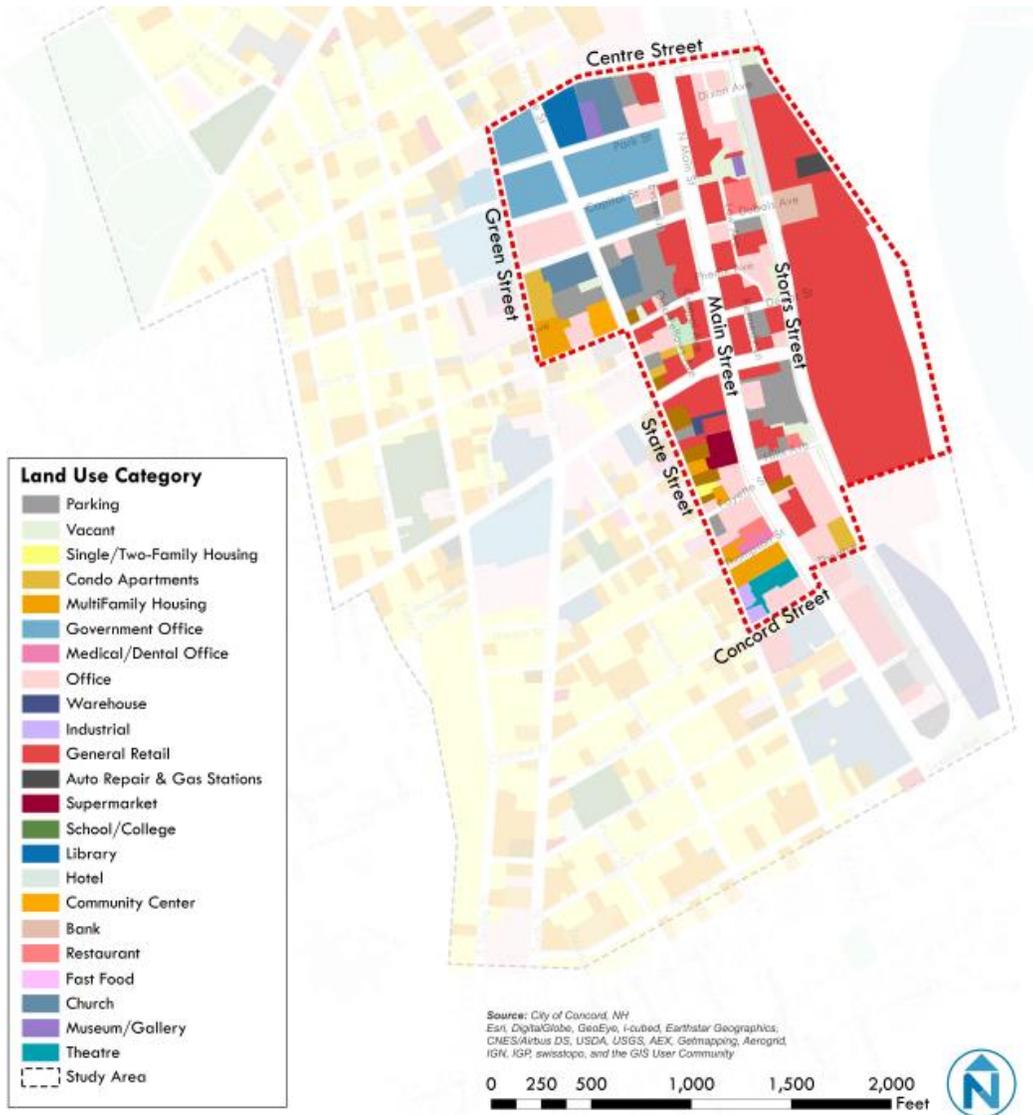
## Focus Area Existing Land Use

Working with the City, the Parking Study team has also chosen a focus area around the central business corridor for shared parking analysis, as this area is mostly concentrated with mixed land uses and will be most appropriate for piloting a shared parking program. Figure 60 shows the breakdown of land use by category in the focus area with vacancy adjustment.

**Figure 60 Existing Land Use in the Focus Area**

Land Use	Square Feet/Units	
Industrial	8,208	square feet
General Retail	324,346	square feet
Auto Repair & Gas Stations	3,530	square feet
Supermarket	18,006	square feet
Library	38,233	square feet
Community Center	118,562	square feet
Drive-In Bank	41,284	square feet
Restaurant	35,921	square feet
Church	69,614	square feet
Museum/Gallery	53,880	square feet
Warehouse	24,294	square feet
Office	762,006	square feet
Medical/Dental Office	7,844	square feet
Government Office	228,542	square feet
Apartment	385	units

Figure 61 Existing Land Use: Focus Area

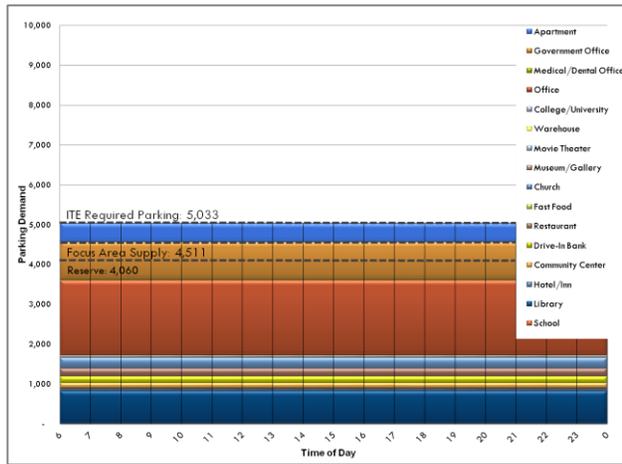


## Focus Area Existing Shared Parking Analysis

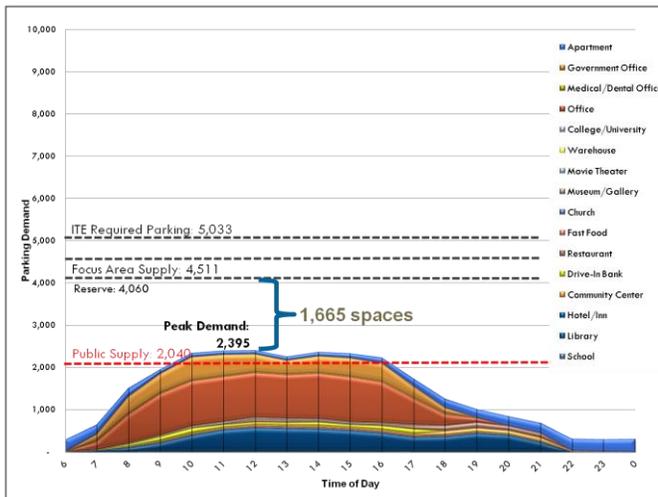
The Focus Area is bounded by Centre Street to the north, Concord Street to the south, I-93 to the east, and part of Green and State Street to the west. According to national parking standard calculations from ITE, the needed number of parking spaces for the focus area is 5,033 spaces (Figure 62). The focus area has a total of 4,511 spaces, slightly lower than the results from ITE required parking standard.

Figure 64 shows the results from the shared parking model where the shared peak parking demand is at 12:00 p.m. with a total of 2,395 spaces. Parking utilization counts within the focus area are shown in Figure 63, when overlaid on the expected parking demand based on land use, the patterns are still very similar. Thus there is adequate supply to meet demand, both estimating by land use and when counting today's parking demand.

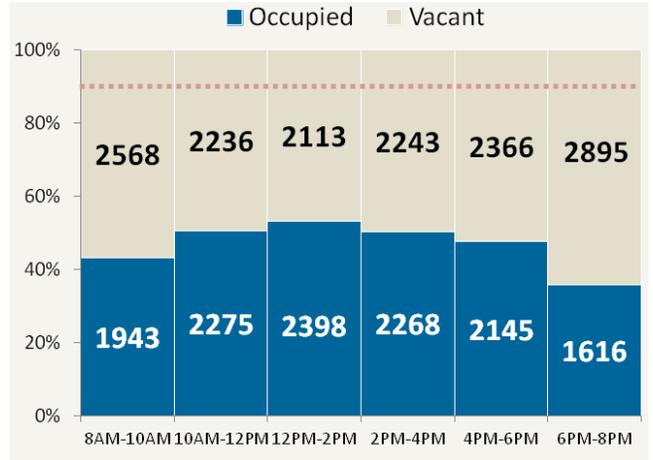
**Figure 62 Existing Demand if Unshared – Focus Area**



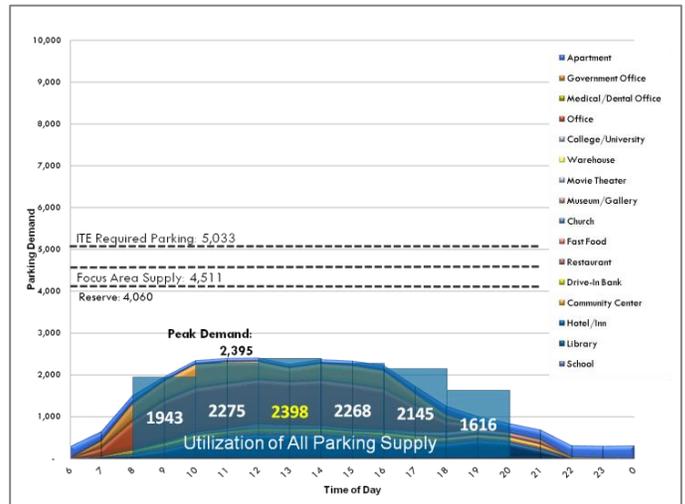
**Figure 64 Expected Shared Demand – Focus Area**



**Figure 63 Average Weekday Parking Utilization – Focus Area**



**Figure 65 Expected Shared Demand with Observed Weekday Utilization – Focus Area**

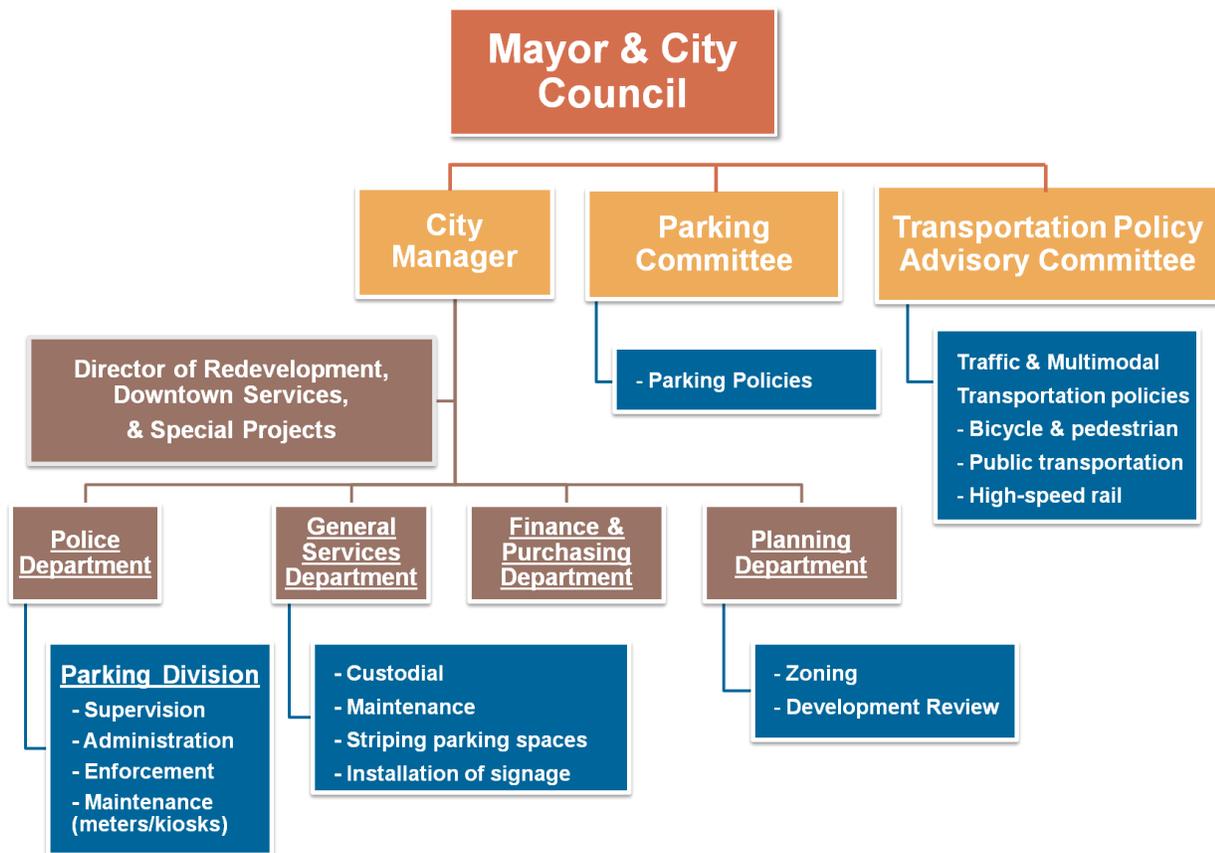


## 3.5 PARKING MANAGEMENT/ ADMINISTRATION

### PARKING GOVERNANCE

Today, parking is managed and governed among various departments and decision-making entities within the City of Concord. Decisions regarding parking policy, budget, regulation, enforcement, ticket processing, collections, maintenance, repair, etc. are decentralized, with differing priority assigned to essential functions, depending on the particular entity’s budget, available resources, and other responsibilities. As shown in Figure 66 below, there are a number of responsibilities that fall under different divisions of City management that often overlap. This lack of a centralized management body makes the parking management system operate inefficiently, adding delay and cost while creating a confusing interface for the public who can contact various entities to address their needs with varying results.

Figure 66 Existing Parking Governance Structure



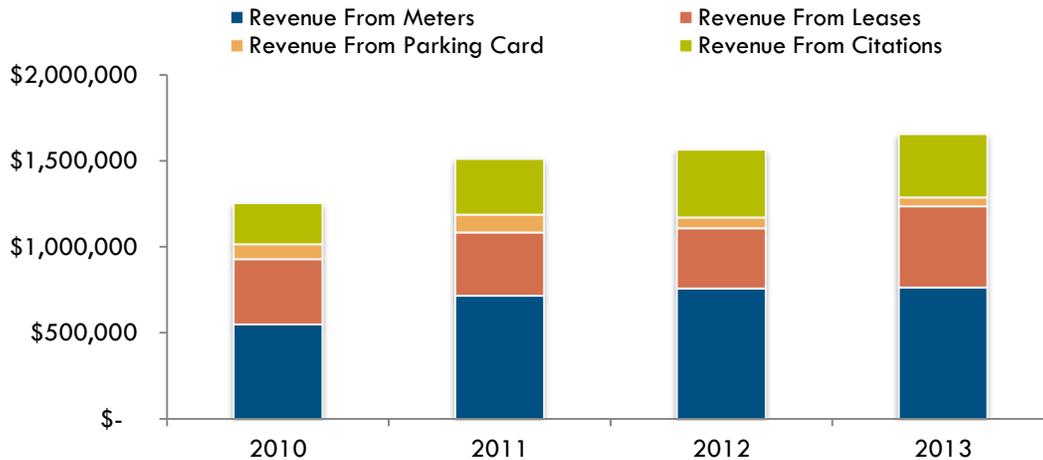
### PARKING REVENUE & EXPENSE

Parking revenue for the City of Concord is generated mostly through on- and off-street meters, garage leases, and citation fees. Since 2011, the City has generated more than \$1.2 million in parking revenues per year, and in 2013, this amount increased to well over \$1.6 million (Figure 67, Figure 68).

**Figure 67 Major Parking Revenue 2010-2013**

Year	Revenue From Meters	Revenue From Leases	Revenue From Parking Card	Revenue From Citations	Total
2010	\$ 548,179	\$ 380,455	\$ 86,445	\$ 239,616	\$ 1,254,695
2011	\$ 715,041	\$ 368,048	\$ 104,148	\$ 324,471	\$ 1,511,708
2012	\$ 758,926	\$ 348,270	\$ 63,804	\$ 394,736	\$ 1,565,735
2013	\$ 763,841	\$ 472,205	\$ 51,526	\$ 368,771	\$ 1,656,343

**Figure 68 City of Concord Parking Revenue 2010-2013**

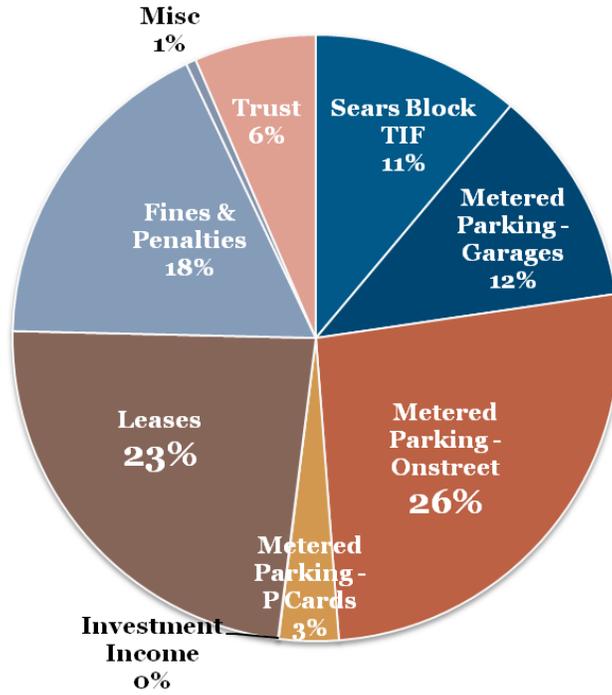


The City is not heavily-reliant on parking violations for its revenues, with user fees (meters and leases) representing more than  $\frac{3}{4}$  of revenues. While this is a healthy ratio of citation to fee revenue compared to regional peers (including Providence, Hartford, and Albany, which rely on citation revenue making up about half of total revenues), Concord’s total revenues fall about 50-percent short of what might be expected for a system of this size, relative to regional peers.

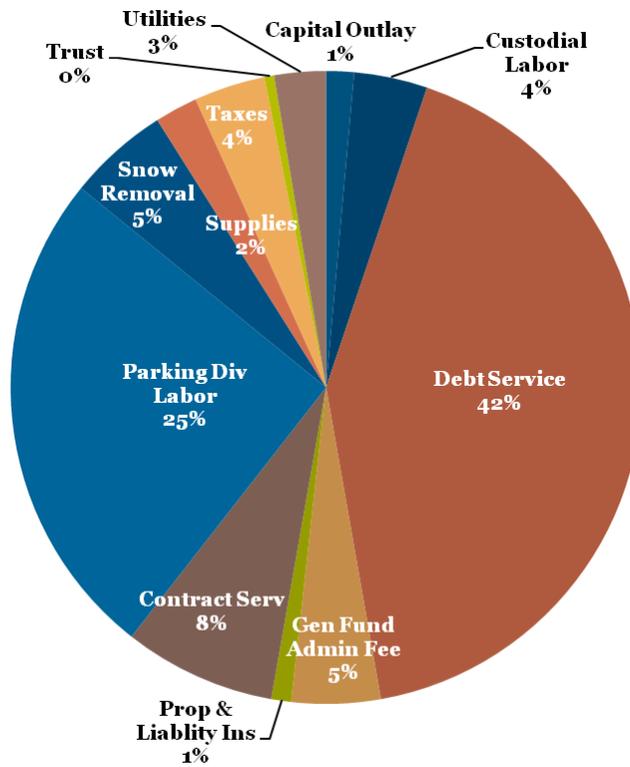
The following charts show the projected composition of the City’s Parking Fund for FY 2014. As shown in Figure 69, 41% of the projected revenue is from parking meters; 23% from garage leases; and 18% from parking fines and penalties.

As Figure 70 shows, debt service for Concord’s garages and some equipment is consuming the largest percentage of all expenses at over 40-percent. This is an inordinately large burden for any parking entity. It is mostly driven by the cost of financing the Capital Commons garage, followed by the cost of paying for deferred maintenance in the Firehouse and Durgin garages (see next section for maintenance details). Without this debt burden, Concord would be able to maintain its facilities well and produce surplus revenues for other City needs, as is typical of similarly-sized downtowns throughout America.

**Figure 69 FY2014 Parking Fund Revenue by Category**



**Figure 70 FY2014 Parking Fund Expense by Category**



## 3.6 PUBLIC GARAGES CONDITION SURVEY

The Parking Study team has executed a comprehensive evaluation of the City's three parking garages and each facility's various subsystems, such as drainage, plumbing, electrical, lighting, signage, etc. This will help the City to identify those elements that will require address in the next 20 years to maintain the service life of the facility and prepare an order-of-magnitude cost estimate associated with each action.

Site inspections of the three parking garages were conducted multiple times throughout the study. Detailed condition survey reports of the three public garages are attached in the Appendix B. For each facility evaluated, the Parking Study team has also prepared a 20-year schedule of recommended repairs and replacement, with an associated cost for each repair and replacement. This section only documented a summary of the garages' existing conditions facility-by-facility.

### GARAGE FACILITY NEEDS ASSESSMENT: KEY FINDINGS

- The Firehouse Block Garage is 36 years old and now requires maintenance to address the current structural and waterproofing deterioration, rusted sanitary piping and some relatively minor electrical issues;
- The Durgin Garage is 32 years old and is currently scheduled to undergo a significant repair and rehabilitation project that will address the existing structural and waterproofing deterioration, poor elevator conditions, leaking issues, and severely rusted stair towers.
- The Capital Commons Garage is only 8 years old and relatively in good condition, but to maintain the parking garage at the best possible condition, the deteriorated concrete and some external corrosion to sanitary piping, rust to the fire hydrant and unreliable elevator conditions in cold weather may need to be repaired or replaced;
- None of the garages have water but all need it for basic maintenance;
- Few issues in general were noted with the mechanical/heating/ventilation equipment, and all three garages have adequate lighting with minimal missing lamps;
- The garages are equipped with pay station kiosks near elevators or stair towers, all of which appeared to be in good working order.

### FIREHOUSE BLOCK GARAGE

The Firehouse Block parking garage is located on North State Street between School and Warren Streets in Concord, New Hampshire. The parking structure is free standing, with two and a half supported levels of parking, and a slab-on-grade. It is 36 years old, and has a total capacity of approximately 232 spaces, and serves leased and short term parking for downtown Concord.

The Firehouse Block Parking Garage is in fair overall condition at this time. It is the only one of the three garages without an elevator. The structural and waterproofing elements of the garage are suffering from various degrees of deterioration caused by the infiltration of water and corrosion causing elements. The parking structure requires the implementation of an effective restorative, protective and preventive maintenance program in order to address the current problems and ensure the continued long term durability of the structure.

The primary deterioration conditions observed in the parking garage are the corrosion related deterioration and cracking of the cast-in-place, supported pan/joist slabs. Water and corrosion

causing elements are leaking through cracks in the supported slabs and creating delaminations and spalling at the cast-in-place concrete frame of the structure.

Deterioration of waterproofing elements is also an issue, including failures of expansion joints and sealants. The waterproofing membrane is showing signs of wear, and also de-bonding in areas. Many of the floor drains as well as some sections of piping in the garage were observed to be deteriorated.

In order to return the parking garage at the best possible condition and to ensure the long term durability of the structure, the deteriorated concrete must be repaired and conditions that allow for water and corrosion causing contaminants to penetrate the slab must be addressed.

Structural repairs include full and partial depth concrete repairs at the pan/joist slab. Other structural repairs include overhead concrete repairs at the joists and beams, slab-on-grade concrete floor repairs, as well as concrete column, wall, curb repairs and overhead concrete repairs at the stair runs and landings.

Waterproofing repairs include sealing of cracks, replacing construction and cove joint sealants, failed crack repairs, as well as replacing deteriorated expansion joint seals. The existing traffic bearing waterproofing membrane requires maintenance, specifically removal and replacement of failed areas and re-coating of worn-out areas. The concrete floor slab repairs within these areas will also need to be recoated.

**Figure 71 Firehouse Block Garage: 6”  
Sanitary Line Leaking at  
Connection at Upper Tee.**



**Figure 72 Durgin Garage: Rust and Decay in Metal Posts on Northeast  
Stair Tower**



## **DURGIN GARAGE**

The Durgin parking garage is located just off of North Main Street, behind Capital Plaza, between School and Warren Streets in Concord, New Hampshire. It is a free standing garage with a slab on grade and three and one half supported levels of parking. The parking structure has a capacity of approximately 467 vehicles and serves leased and short term parking for downtown Concord.

The Durgin Parking Garage is scheduled to undergo a significant repair and rehabilitation project. It is our understanding that this project will address current structural and waterproofing deterioration in the garage.

Several Mechanical, Electrical and Plumbing system repair items have been noted. These items are more thoroughly discussed in Appendix A of this report and include some of the following.

- Replacement of deteriorated electrical components
- Replacement of deteriorated drains and associated piping
- Standpipe repairs
- Lighting upgrades
- Elevator modernization
- New surveillance system

**Figure 73 Durgin Garage: Negative Pitch and Corrosion of 6" Sanitary Riser at Column Line F4 Level 4**



## **CAPITAL COMMONS GARAGE**

The Capital Commons Parking Garage is located adjacent to the Capital Commons Building in Concord, New Hampshire. The structure consists of four supported levels and a slab on grade. The garage was constructed in 2007. The north facade is adjacent to an alley way, retail and the Endicott Hotel building, the south façade is adjacent to retail and a surface parking lot, the east façade is

adjacent to Storrs Street, while the west façade is adjacent to the Capital Commons building. The parking garage has a capacity of approximately 516 vehicles.

The Capital Commons Parking Garage is in fair to good condition at this time. The structural and waterproofing elements at the precast, pretopped, concrete double tees are suffering from various degrees of deterioration caused by the infiltration of water and corrosion causing elements. The parking structure requires the implementation of an effective restorative, protective and preventive maintenance program in order to address the current problems and ensure the continued long term durability of the structure.

The primary deterioration conditions observed at the supported decks are the failure of all the precast joint sealants, as well as minor delamination of the concrete at the cast-in-place pour strips and concrete structural elements, and floor cracks at the surface of the tees and pour strips. The elevator in Capital Commons is unreliable during cold weather due to lack of heat in elevator tower.

In order to maintain the parking garage at the best possible condition and to ensure the long term durability of the structure, the deteriorated concrete must be repaired and conditions that allow for water and corrosion causing contaminants to penetrate the slab must be addressed. Structural repairs include concrete pour strip repairs, overhead tee stem repairs, as well as concrete column and wall repairs. Other repairs include re-paving the deteriorated sections of asphalt at the slab-on-grade. Waterproofing measures are also imperative to protect the structural repairs and help slow future deterioration.

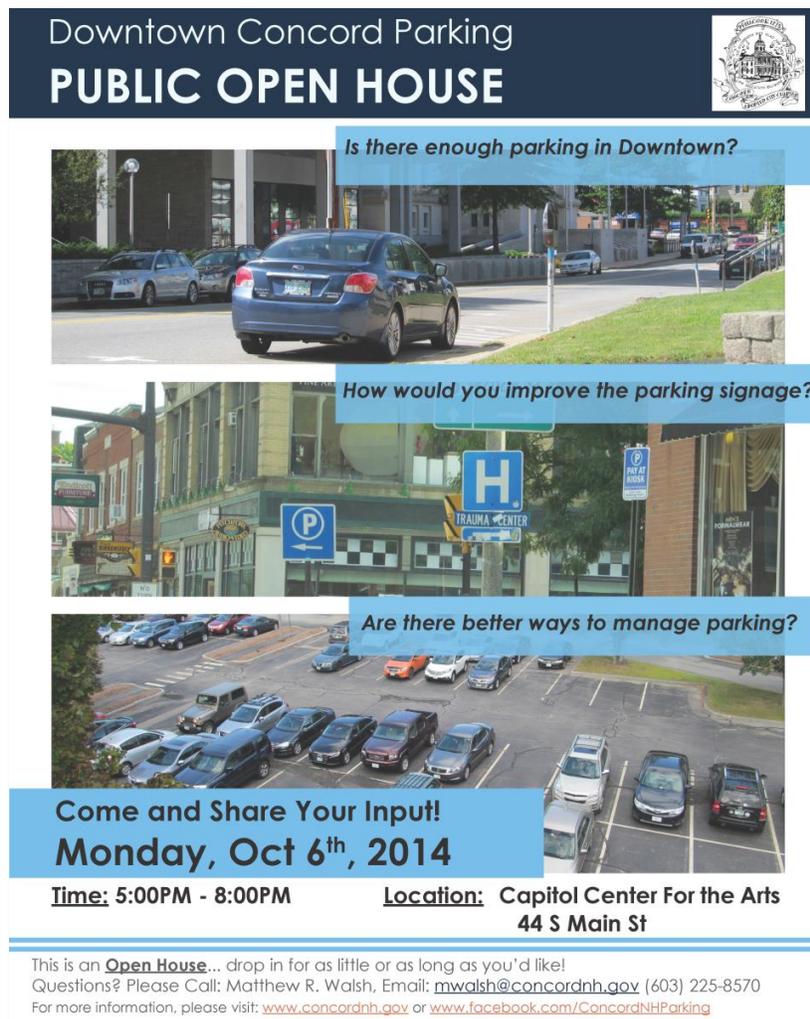
**Figure 74 Capital commons Garage: Roof Leak Southwest Area**



## 4 PUBLIC OUTREACH PROCESS

The Parking Study team undertook a multi-step public outreach process throughout this study to understand more about the preferences and behaviors of those who park in downtown Concord, as well as the different needs among different user groups. The public participation process is also intended to help parking analysis “pull back” from subjective and anecdotal descriptions of parking issues. These efforts included interviews with key stakeholder groups such as local employers, business owners, institutional employees, etc; a widely circulated online preference survey that attracted over 580 responses; specific comments emailed to City staff; and two public forums, the first open house held in October 2014 (Figure 75), the second held in January 2015. The public outreach process was an integral piece of the parking analysis. Understanding the issues by talking with community members provided valuable insights not only on what isn’t working today, but also opportunities for improvement. These insights into the community’s mobility needs, coupled with quantitative data parking analysis (previous chapter), will help steer the study in a direction that truly addresses parking challenges unique to downtown Concord.

Figure 75 October Public Open House Flyer



The flyer features a dark blue header with the title "Downtown Concord Parking PUBLIC OPEN HOUSE" and the City of Concord seal. Below the header are three images with associated questions: a street scene with cars, a street corner with parking signs, and an aerial view of a parking lot. The bottom section contains event details: "Come and Share Your Input! Monday, Oct 6<sup>th</sup>, 2014", "Time: 5:00PM - 8:00PM", and "Location: Capitol Center For the Arts 44 S Main St". A footer provides contact information for Matthew R. Walsh and links to the city website and Facebook page.

**Downtown Concord Parking**  
**PUBLIC OPEN HOUSE**

*Is there enough parking in Downtown?*

*How would you improve the parking signage?*

*Are there better ways to manage parking?*

**Come and Share Your Input!**  
**Monday, Oct 6<sup>th</sup>, 2014**

**Time:** 5:00PM - 8:00PM      **Location:** Capitol Center For the Arts  
44 S Main St

This is an **Open House**... drop in for as little or as long as you'd like!  
Questions? Please Call: Matthew R. Walsh, Email: [mwalsh@concordnh.gov](mailto:mwalsh@concordnh.gov) (603) 225-8570  
For more information, please visit: [www.concordnh.gov](http://www.concordnh.gov) or [www.facebook.com/ConcordNHParking](https://www.facebook.com/ConcordNHParking)

This chapter summarized the findings of these outreach efforts. General community concerns include:

- Like to park once and walk between establishments
- Time limit is a bigger deterrent than pricing
- Perception of low parking availability and high pricing
- No clear information and signing
- Willing to pay to get guaranteed space
- Improve the payment structure and technology
- Underutilized private spaces

## 4.1 ONLINE SURVEY

This section summarized the online survey input from parkers in downtown Concord regarding their parking activities, experiences, perceptions, and preferences. Respondents were asked to report about their most recent day in downtown Concord plus their general perceptions. The survey effort elicited over 580 responses. Charts below summarize the responses and trends in the survey data.

### Respondents by User Group

As shown in Figure 76, over half of survey respondents are downtown customers (52%), those that come downtown for social activities and appointments, such as shopping and dining.

### Parking Priorities

The survey asked respondents to rank their priorities when finding a place to park. Figure 77 shows the results of this question. In general, “not having to move my car until I leave the area” was most important to most respondents, followed by “location/convenient to destination”. “Ease of finding a space” and “security/safety” were both ranked more than “somewhat important”, while “cost/price”, “type of parking”, and “weather” was not as important to respondents. This means that respondents concern most about time limits, parking locations and availability.

Figure 76 Respondents by User Group

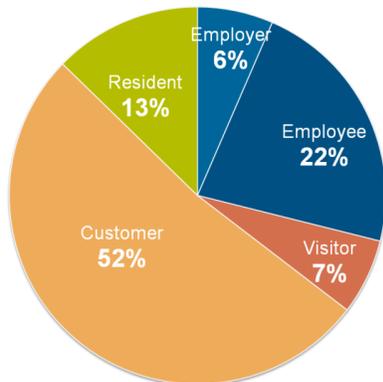
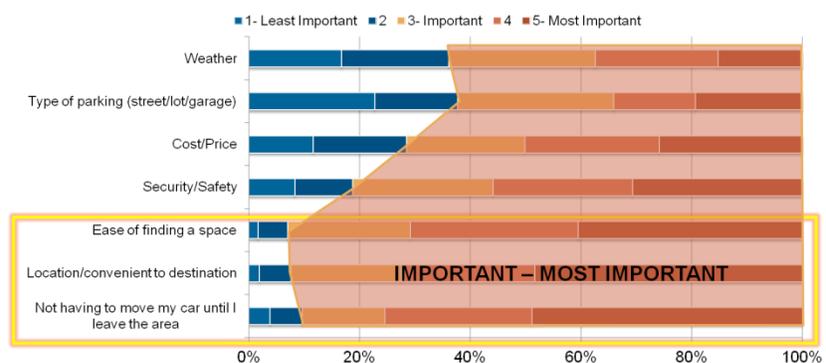


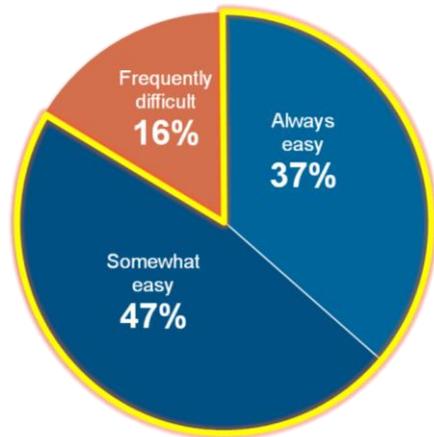
Figure 77 When choosing where to park in the downtown area, please rate the following considerations from 1 (least important) to 5 (most important).



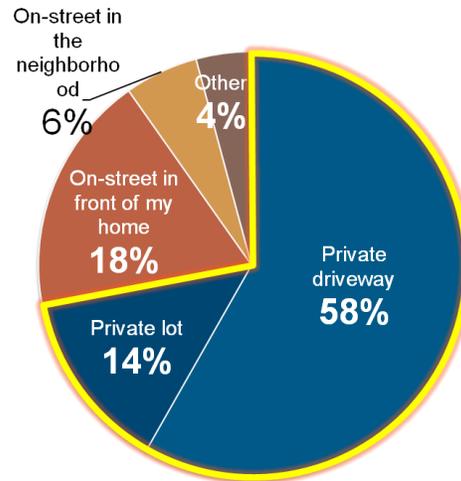
### Residents Don't Have Much Difficulty Finding Parking

In general, residential participation in the survey was low as compared to other groups, with only 13% of total respondents (Figure 76). However, some general trends emerged from the survey. Results indicate that residents don't have much difficulty finding parking in their neighborhood (Figure 78). 72% of the resident respondents park in a private lot or their own driveway when park at home, while 24% park on-street either in front of their home or in the nearby neighborhood (Figure 79).

**Figure 78 How easy is it to find on-street parking in your neighborhood?**



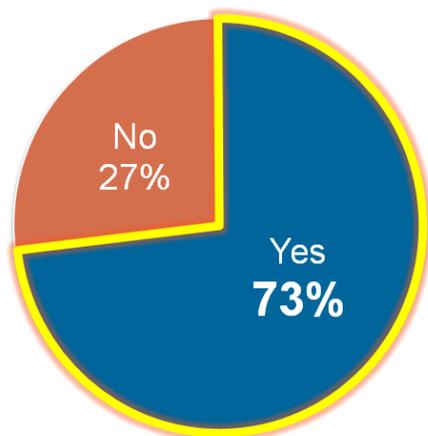
**Figure 79 Where do you normally park at home?**



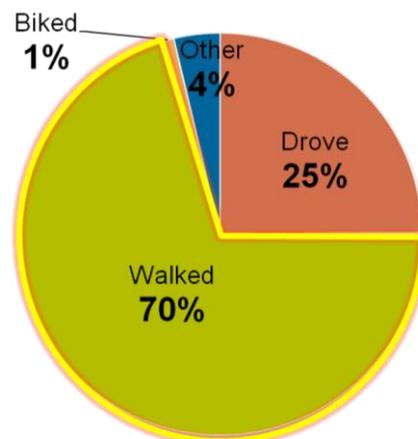
### Customers/Visitors Travel to >1 Establishments And Walk Between

Downtown customers are those running errands, going to appointments, shopping and/or dining. As Figure 80 shows, about 73% of the customer/visitor respondents travel to more than one establishment during their visits to downtown. And they usually walk between different destinations, indicating there are opportunities to establish park-once district and improve downtown walking environments (Figure 81).

**Figure 80 Did you travel to more than one establishment during your last visit to downtown?**



**Figure 81 How did you travel between establishments?**

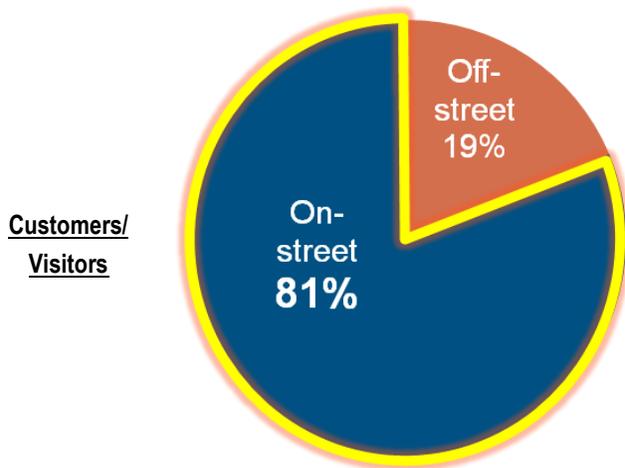


**Conflicts between Employee and Customer Parking**

People park relatively close to their destinations. Figure 83 shows that almost three-quarters of both customers and employees park within one block of their destinations. This means that although there is a perception that parking in downtown Concord is difficult, in reality, most parks very close to their destination.

However, employees are competing with customers for the on-street spaces. Figure 82 shows that 81% of customers and visitors park on-street, while 52% of employees also are searching for on-street parking, indicating a potential conflict between employee and customer parking.

**Figure 82 During your last visit, where did you park?**



**Figure 83 Approximately how far away from your destination did you park?**

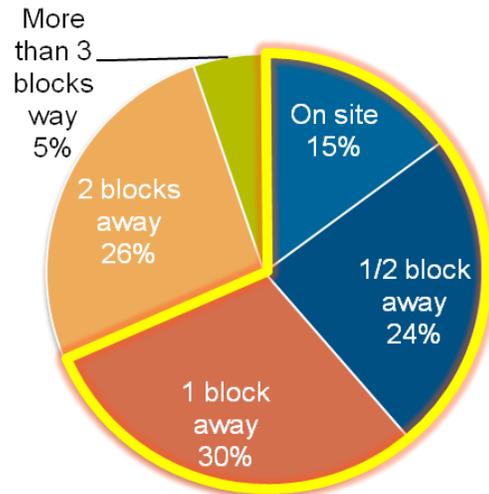
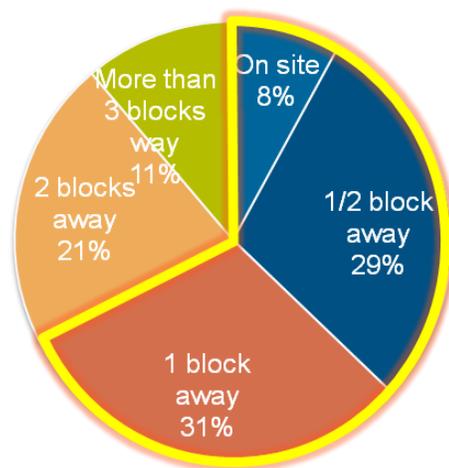
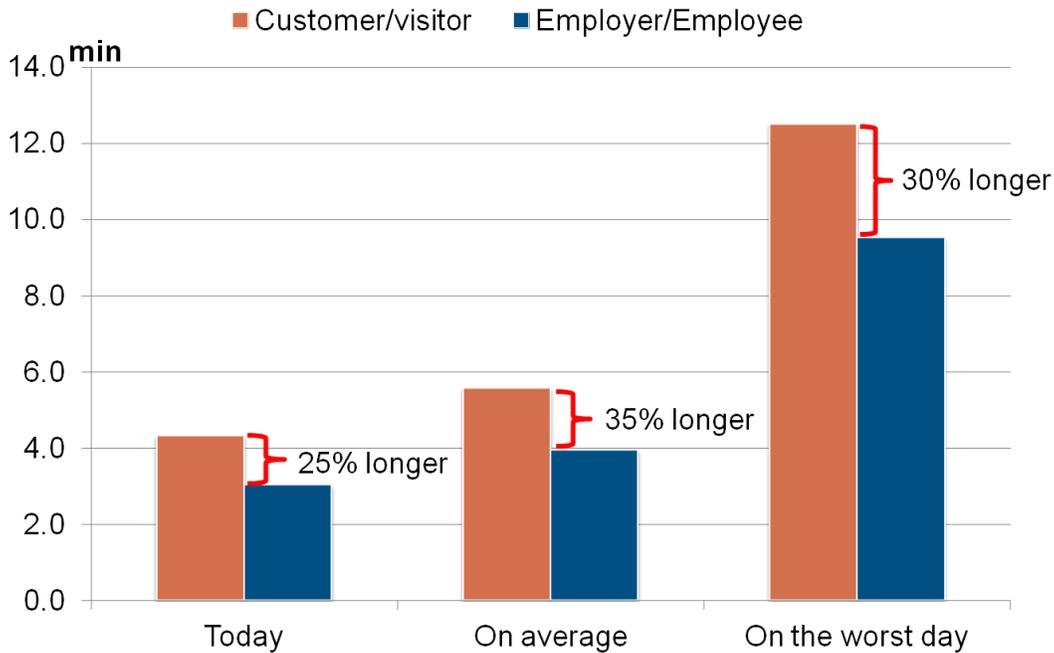


Figure 84 paints a similar picture that on average customers normally spend longer time finding parking than employees. On an average day, it takes customers and visitors 5-6 minutes to find a place to park, while employees take less than 4 minutes. The left two bars shows respondents' estimates of their "worst day" searching for parking, and are almost opposite of their actual reported parking experience. Thus, just a few bad experiences searching for parking can have a drastic impact on how users perceive parking availability.

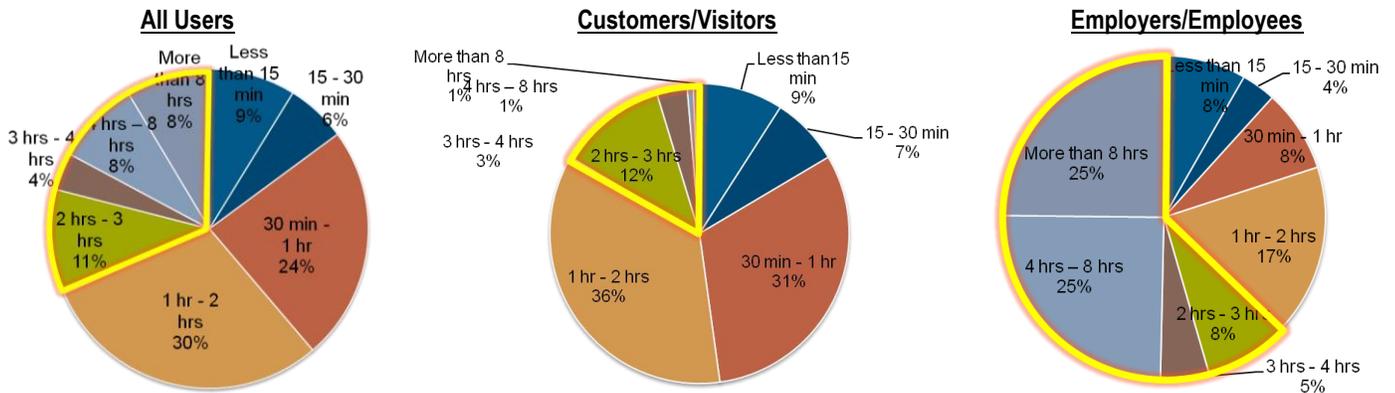
**Figure 84 How long did/ does it take you to find a spot... (in minutes)**



**Time Limits Are a Bigger Deterrent Than Pricing**

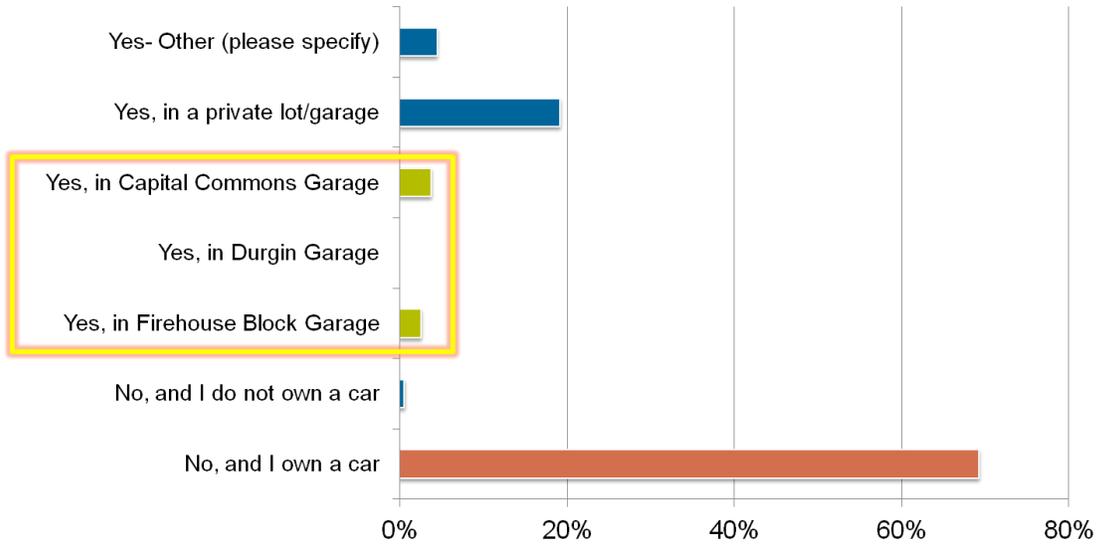
More than 30% of all respondents report that they stay in downtown longer than 2 hours, which is the predominant time limit in downtown. Figure 85 shows that only 36% of customers park in downtown for one to two hours, indicating a potential change to the time limit enforcement to better accommodate customer’s needs.

**Figure 85 How long do you typically park in Downtown Concord?**



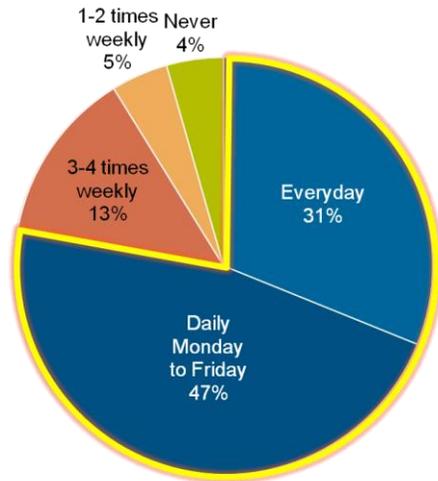
Survey also shows that more than 60% of employees are hunting for longer-term (over 2 hours) parking in downtown, but only 6% of employees have reserved parking in public garages, almost 70% don’t have a reserved space in any of the off-street facilities throughout downtown (Figure 86). Thus, there is a potential to incentivize employees to park in off-street facilities for longer term, leaving on-street short-term parking to downtown customers and visitors.

**Figure 86 Do you have a reserved parking space in a surface lot or a garage in Downtown Concord?**

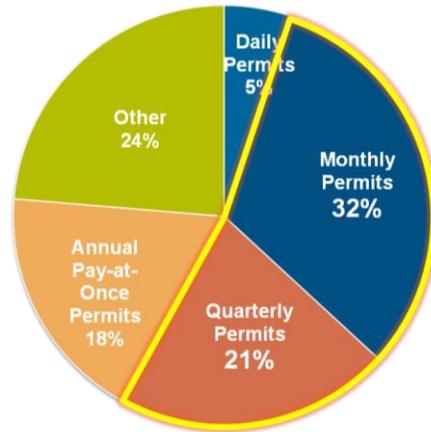


Of the 6% of employees who have reserved parking in public garages, more than three quarters park in their reserved spaces daily on weekdays (Figure 87). Compared to annual pay-at-once permits, these lease holders are more likely to use monthly and quarterly permits (Figure 88).

**Figure 87 How often do you park in your reserved space?**



**Figure 88 Which lease/permit option would you prefer?**



Compared to time limits, pricing is less than a problem. More than 40% of all respondents are willing to pay more than \$1.00/hour to ensure a convenient parking spot in downtown (Figure 89). And most of survey respondents would prefer smart meters compared to kiosks and pay-by-cell (Figure 90), indicating a desire to improve the payment technology.

Figure 89 How much would you be willing to pay to ensure a convenient on/off-street spot in Downtown Concord?

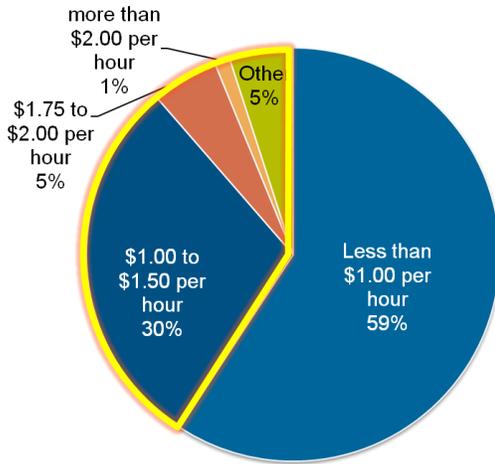
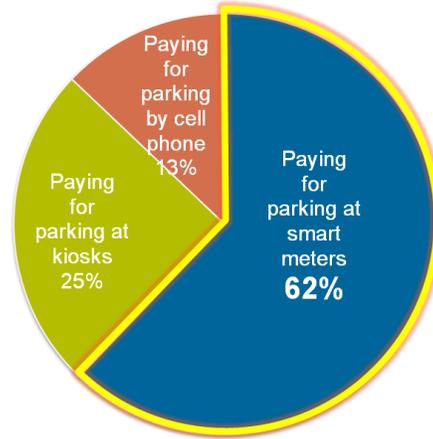


Figure 90 Which do you prefer along commercial streets such as Main Street?



## 4.2 STAKEHOLDER MEETINGS

The review of background information, online survey, and meetings were complemented by a series of key community stakeholder meetings to gather input on conditions from those most familiar with parking in downtown Concord. Focus groups were identified by the City. Stakeholders included downtown merchants, business owners, developers, key institutions, city administration staff and policy makers.

The Parking Study team presented preliminary findings of downtown parking existing conditions as the basis of the group interviews, but the primary goal was a free flowing exchange about parking and an understanding of specific experiences and perspectives in downtown Concord. Several common themes emerged, which are summarized below into key findings.

### STAKEHOLDER MEETINGS: KEY FINDINGS

Stakeholders cited a wide range of issues and opportunities related to parking in downtown Concord. A summary of those issues is below, followed by more detailed descriptions of the topics discussed.

- Perception of low parking availability and high pricing
- Unfriendly time-limits
- Conflicts: employee vs. customer parking.
- No clear information and signing
- Need user-friendly payment structure and technology
- Inefficient & unfriendly parking enforcement
- Need event parking / management
- Private spaces are currently underutilized

- Need better walking and biking environment
- Legislature takes up valuable downtown parking

## **Detailed Summaries**

Below are more detailed summaries of key conversation topics from these stakeholder discussions.

### **Conflicts between long-term employee parking and short-term customer parking**

Stakeholders report that many employees of downtown offices, restaurants, and other establishments do not have a designated place to park. Some employees shuffle around and take up valuable on-street customer spaces. Customers are having a perception of lack of parking on Main Street. Business owners want to have on-street spaces reserved for patron parking and move permit parking to locations further away, as they are concerned that a shortage of convenient on-street parking would harm their businesses.

### **The perception of parking availability and pricing**

Stakeholders report that it is sometimes very difficult to find on-street parking spaces close by for their customers. Business owners express a desire to have more convenient parking in front of their store. Patrons think parking should be free and they are not used to park one or two blocks away. Residents complain a lack of residential parking in downtown. Handicapped parking also seems to have availability issue, given the aging population in downtown Concord.

### **Lack of clear information and signage related to parking in general**

Wayfinding signage is difficult to see and makes it confusing for parkers to navigate around downtown Concord, especially for visitors and tourists coming from outside of the City. Many stakeholders don't even know the price and availability of the public garages. Better signage is needed to direct people to the garages. Patrons also sometimes find kiosk pay station taking money when it should not and difficult to use as the instruction of enforcement span and price is not legible enough. Some suggest having signage during events near the Capitol Center for the Arts, directing visitors to off-street parking.

### **Payment structure and technology need to be improved**

Stakeholders report that many don't mind paying for parking, but "pay-and-display" kiosk pay stations are not user friendly, especially for elderly, or on snow days, or travel with kids. Using meter technology that allows for debit and credit cards, or maybe pay-by-cell and in-car meters are needed. Enforcement technology should also be improved to more efficiently enforce the meter payment and illegal parking. Some suggest that adopting 15 or 30 minutes free on-street and one-hour free in garage will help business and customers. Garage leases can also be improved by adopting monthly leases rather than annual payment.

### **Time limits are not user friendly**

Many stakeholders agree on that 2 hour time limit are unfriendly and inconvenient to customer use. If a customer comes to Downtown Concord for a meal and to run some errands, two hours is often not enough, and customers shuffle their cars around. For residential neighborhoods, resident representatives report that time limits are needed to avoid employee parking on-street.

### **Parking enforcement inefficient and not friendly**

Stakeholder reports \$10 ticket is not high enough to regulate high-income employee parking, such as lawyers. Many suggest downtown need an ambassador rather than enforcement officer. Also, Saturday utilization on Main Street appears high, thus stakeholders suggest downtown conduct enforcement on Saturdays to help raise additional revenues. Security problem with homeless on street and in garage appears to be a general concern as well.

### **Need for event parking and management**

Event parking around Capitol Center for the Arts is having an availability issue, according to many stakeholders. Farmers Market on Saturday morning would close the Capital Street nearby, while the Durgin Garage nearby has adequate supply and needs signage to direct visitors parking off-street. Seasonal legislative activities can also be considered for event parking planning, which currently have taken up downtown premium parking. Some suggest to valet the legislators in order to spare on-street parking to downtown customers.

### **Shared parking opportunities**

Some describe particular off-street facilities that are underutilized or empty during different periods of the day or week, such as the leased spaces in public garages, parking lot on Storrs Street, some private lots close to Main Street and Legislator garage when not in session. Stakeholders suggest sharing parking spaces in adjacent private lots when they have complementary schedules.

### **Walking and biking in downtown Concord**

The City has already invested in place-making efforts making the downtown more walkable and attractive. The Complete Street Project for Main Street will greatly improve the walking and biking environment in downtown. Better lighting is needed on the side streets and alleyways, as well as in the public garages to ensure safety and security. Other than walking and biking, stakeholders also suggest that other alternative travel options be considered and promoted, such as bus, shuttle and remote parking, commuters' park-and-ride.

### **Unclear administration responsibility**

Some stakeholders express their concerns on the parking management and financial sustainability. It is important to understand the financial relationship between Parking Fund and General Fund. Responsibilities between different department and entities need to be clarified, for example, there has been some overlap of responsibilities for the signage installation and maintenance work.

### **Marketing and education to the public needed**

Stakeholders suggest that public parking information on website and brochures be available for business owners to direct their customers to nearby parking facilities. Education and marketing to the public may also be needed on parking regulation and price, in order to help change drivers' behavior to encourage them park once and walk.

## Parking space reconfiguration

Many stakeholders report that downtown patrons prefer to park on the lower floors for convenience, leaving the upper floors reserved for employees. The current configuration has caused inconvenience for garage parkers.

## Interviewed Focus Groups

- *Downtown Merchant / Community Organizations*
- *Policy Makers*
- *City Parking Division*
- *Key Institutions (State of NH, NH Legislature, US Federal District Court, UNH School of Law, Capitol Center for the Arts, Red River Theatres, Concord Music School, etc.)*
- *General Services Department*
- *Landlords & Developers*
- *Business Owners*
- *Residents*
- *Downtown Employees*
- *City Administration*
- *Current garage lease holders*

## 4.3 PUBLIC MEETINGS

In addition to the survey and stakeholder meetings, the project team also held two public forums. The meetings had interactive exercises, discussions, and presentations all designed to solicit public inputs on parking and parking-related issues in downtown Concord.

### Open House Meeting

On October 6, 2014, local residents, business owners, employees, and others were invited to the Capitol Center for the Arts to participate in a hands-on “Parking Open House” designated to gather as much qualitative input as possible in downtown Concord. About 50 members of the public participated.

The purpose of the Open House was to present some preliminary data to the public about the City’s parking system and invite participants to share their concerns, needs, and issues with visiting and parking in downtown Concord. The team reviewed general study area boundaries for downtown Concord and discussed the study efforts to date, which included an initial parking inventory and public parking utilization counts.

A majority of the meeting time was used to gather feedback from the public, including identification of issues, opportunities, and concerns. The Open House included several interactive exercises: quick garage quiz, parking priority voting exercise, parking need mapping exercise, and a “sticky wall” where participants can feel free to write down their general opinion of parking in downtown.

### Quick Garage Quiz

Participants were invited to do a quick quiz at the entrance of the Open House, to evaluate how well they know about their city public garages. 20 participants responded to the garage quiz and were asked to identify the name and hourly price of each garage marked on the downtown map. Results are shown in Figure 91. Only 20% got all answers right, indicating that downtown

Concord parkers have little or no knowledge of the public garage price and regulation even though they've parked there before.

Figure 91 Open House Garage Quiz Results

## Garage Quiz

**20%** got all answers right

### ■ How well you know about your City Garages?

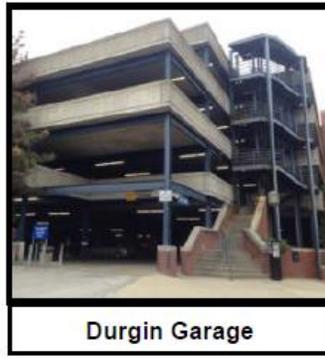
**20**  
responses

1. Do you know the name of these 3 garages?
2. Have you ever parked in these?
3. How much do you think it costs to park in these garage?



Firehouse Block Garage

**40%** got the name right  
**45%** got the price right  
**70%** parked there



Durgin Garage

**35%** got the name right  
**45%** got the price right  
**80%** parked there



Capital Commons Garage

**55%** got the name right  
**60%** got the price right  
**100%** parked there

### Parking Priorities Voting Exercise

Open House participants were invited to "vote" for the parking-related priorities that were of greatest concern to them. Faced with eight typical parking issues, participants were allotted six "votes" that could be used to prioritize one or more issues. Figure 92 shows the results of the voting exercise.

The exercise revealed a local desire to have a walkable downtown with a variety of activities and transportation options in a "park-once" zone. The second-most votes were received for a statement that people wouldn't "mind parking a little further away" if parking is free and guaranteed. Along the same lines, several respondents (17%) indicated that they find city garages easy and convenient.

Figure 92 Open House Voting Exercise Results

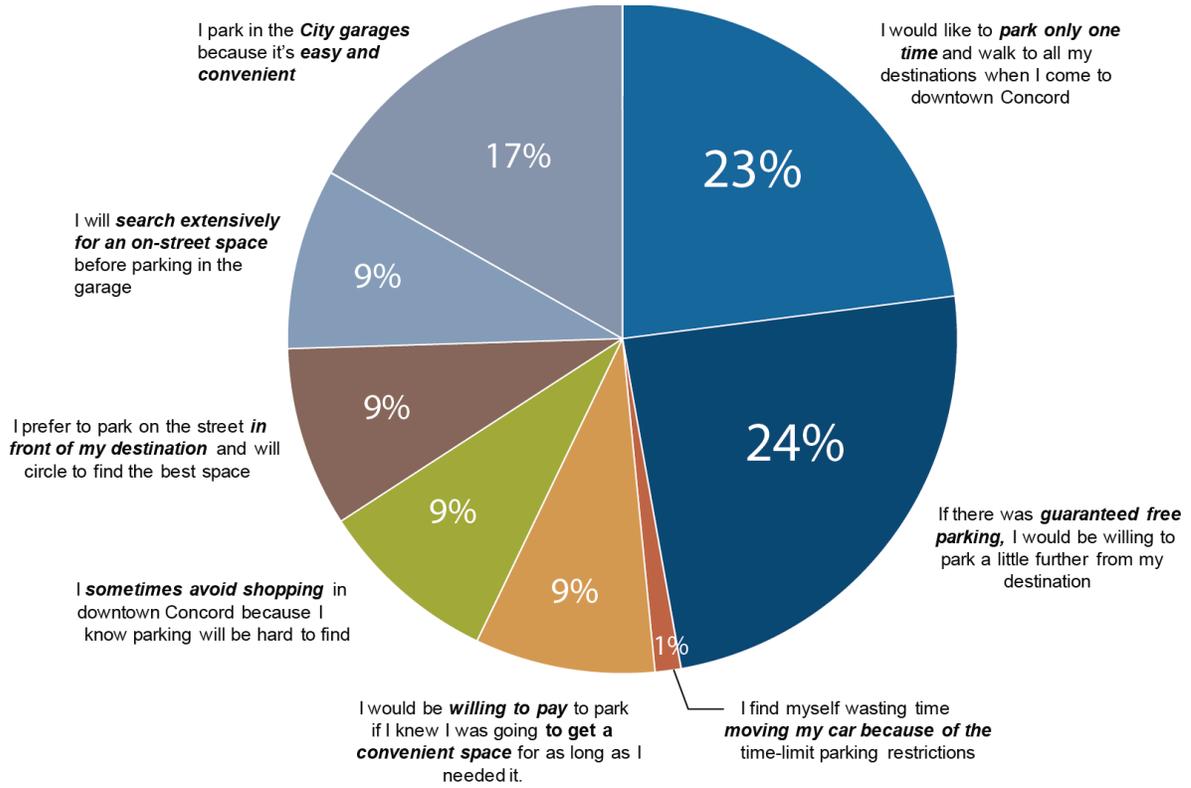


Figure 93 Open House Voting Exercise



Figure 94 Open House Mapping Exercise



### Parking Needs and Opportunities Map

During the Open House, participants were offered large printed maps of the downtown Concord study area to draw on and note areas that need attention or have opportunities for improvement (Figure 94).

Figure 95 consolidates the comments from the parking needs and opportunities maps, categorized by issues and opportunities summarized below:

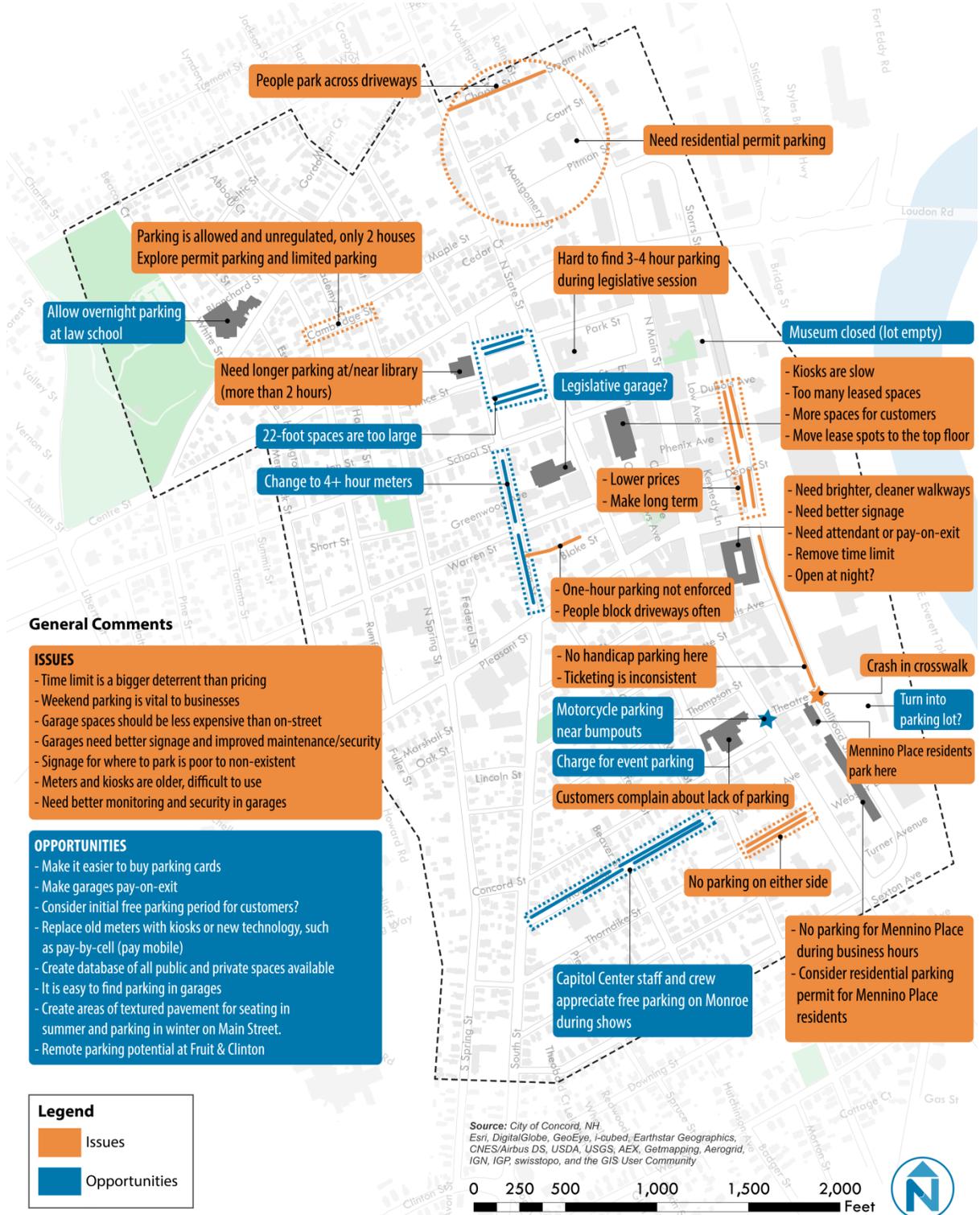
**Issues identified by public:**

- Time limit is a bigger deterrent than pricing
- Weekend parking is vital to businesses
- Garage spaces should be less expensive than on-street
- Garages need better signage and improved maintenance/security
- Signage for where to park is poor to non-existent
- Meters and kiosks are older, difficult to use
- Need better monitoring and security in garages

**Opportunities identified by public:**

- Make it easier to buy parking cards
- Make garages pay-on-exit
- Consider initial free parking period for customers
- Replace old meters with kiosks or new technology, such as pay-by-cell (pay mobile)
- Create database of all public and private spaces available
- It is easy to find parking in garages
- Create areas of textured pavement for seating in summer and parking in winter on Main St.
- Remote parking potential at Fruit & Clinton

Figure 95 Open House Public Markup Comments



## Public Forum #2

The second forum was held at the end of January, 2015 where the Parking Study team presented initial strategies to about 30 members of the public. Feedback from the public was integrated into the initial strategies and used to create more refined details of study recommendations. Generally comments were in tandem with many of the team's recommendations ranging from:

- Neighborhood parking needs to be regulated through a broader **Resident Parking Permit** program to protect resident parking on the streets in the neighborhood, especially around UNH Law School, State Court, Federal Court, and City Hall area.
- **Pricing** should be **demand-based**, and people are willing to pay more to get convenient and guaranteed spaces, both on- and off-street.
- **Education to public** is needed, to explain that availability of parking is the key for downtown economic vitality.
- Opportunities to enhance the customer and user experience in downtown Concord include more enhanced parking **payment technology**, and **wayfinding and signage**.
- **Changes to garage configuration** and a more comprehensive and flexible **permit system** should be implemented soon to accommodate the upcoming Main Street construction and potential residential development.
- Underutilized private parking spaces should be **shared** and special agreement can be coordinated by the City. The City should work with private land owners to open up private parking supply for general public access and use.

Figure 96 Consult Team Presenting Key Findings and Initial Recommendations at the 2<sup>nd</sup> Public Meeting



## 5 PEER REVIEW OF PARKING RATE STRUCTURE

To better frame the parking rate recommendation for downtown Concord, the Parking Study team has also developed a matrix comparing on-street and off-street rates, permit fees, lease fees, time spans, etc. in Concord to communities including Manchester, NH; Nashua, NH; Portsmouth, NH; Hanover, NH; Portland, ME; Salem, MA; Haverhill, MA; Lowell, MA; Burlington, VT; and Albany NY (Figure 97). The aim of this exercise is to provide guidance to the City of Concord and the Parking Study team on the aspects of parking rates in the New England Region.

The selection of peer cities was based on similarities of municipal and downtown area size, population, economic activities and political structure. A detailed comparison is documented in Figure 98. Overall, on-street parking price in Concord is relatively low to medium compared to other cities. Most cities in the region also conduct enforcement on Saturdays.

Figure 97 Selected Peer Cities to Compare Parking Rate Structure



**Figure 98 Parking Rate Structure Peer Review**

<b>City</b>	<b>On-Street Price</b>	<b>Surface Lot Price</b>	<b>Garage Price</b>	<b>Time Limit</b>	<b>Permit Price</b>	<b>Time Span (Meter Enforcement and/or Facility Hours)</b>
<b>Concord, NH</b>	\$0.75/hour	\$0.50/hour	\$0.50/hour	2 - 10 hours (Mon-Fri)	\$87 - \$112/month	8 a.m. - 5 p.m. (Mon-Fri)
<b>Manchester, NH</b>	\$0.75/hour	\$5.00/day	\$5.00 - \$6.00/day	2 - 10 hours (Mon-Sat) None (Sun)	\$55 - \$85 / month	8 a.m. - 8 p.m. (Mon-Sat)
<b>Nashua, NH</b>	\$0.50/hour	\$0.50/hour	\$0.50/hour	None	\$30 - \$50 / month	8 a.m. - 6 p.m. (Mon-Fri)
	\$0.75/hour	\$0.75/hour	\$0.75/hour	2 hours (Mon-Sat) None (Sun)		8 a.m. - 7 p.m. (Mon-Fri)
	\$1.00/hour	\$1.00/hour	\$1.00/hour	90 minutes (Mon-Sat) None (Sun)		8 a.m. - 7 p.m. (Mon-Sat)
<b>Portsmouth, NH</b>	\$1.00 - \$1.50/hour	\$1.00/hour	\$0.75 - \$1.00 /hour	3 - 4 hours	\$65 - \$135 / month	9 a.m. - 7 p.m. (Mon-Sat) 12 p.m. - 7 p.m. (Sun)
	--	Free	--	72 hours	--	24/7
<b>Hanover, NH</b>	\$0.50 - \$1.00/hour	\$1.00/hour	--	2 - 3 hours (Mon-Sat) None (Sun)	--	9 a.m. - 5 p.m. (Mon-Sat)
	\$0.35/hour	--	--	10 hours (Mon-Sat) None (Sun)	--	9 a.m. - 5 p.m. (Mon-Sat)
	--	--	\$0.50/hour \$15.00/day	None	\$110 - \$154 / month	24/7
<b>Portland, ME</b>	--	--	\$1.75/hour \$21.00/day	None	--	6 a.m. - 12 a.m. (Mon-Fri) 8 a.m. - 12 a.m. (Sat)
	\$1.00/hour	--	--	2 hours (Mon-Sat) None (Sun)	--	9 a.m. to 6 p.m. (Mon-Sat)
<b>Lowell, MA</b>	--	--	\$2.00/hour \$8.00/day	None	--	7 a.m. - 6 p.m. (Mon-Fri)
	\$1.00/hour	--	--	2 hours (Mon-Sat) None (Sun)	--	8 a.m. - 6 p.m. (Mon-Sat)
<b>Haverhill, MA</b>	\$0.50/hour	\$0.50/hour \$1.00/day	\$1.00/hour \$8.00/day	2 hours (Weekdays) None (Weekends)	\$47.50 / quarter - \$160 / year	3 p.m. - 8 p.m. (Weekdays)
<b>Salem, MA</b>	\$0.50 - \$1.50/hour	\$0.50 - \$1.00/hour \$4.00/day	\$0.25 - \$0.75 / hour	4 hours (Mon-Sat) None (Sun)	\$65 / month - \$702 / year	8 a.m. - 8 p.m. (Mon-Sat)
<b>Burlington, VT</b>	\$1.50/hour \$15.00/day	--	Free (First 2 hours) \$2.00/hour after	3 - 10 hours (Mon-Sat) None (Sun)	\$55 - \$96/month	8 a.m. - 10 p.m. (Mon-Sat)
	\$1.50/hour	--	--	15 - 30 minutes (Mon-Sat) None (Sun)	--	8 a.m. - 10 p.m. (Mon-Sat)
<b>Albany, NY</b>	\$1.25/hour	--	--	2 hours (Weekdays) None (Weekends)	--	8 a.m. - 6 p.m. (Weekdays)
	\$1.00/hour	--	--	10 hours (Weekdays) None (Weekends)	--	8 a.m. - 6 p.m. (Weekdays)
	--	\$0.50 - 1.00/hour \$4.00 - \$12.00/day	--	2 hours - 10 Hours (Mon-Sat) None (Sun)	--	All Day (Mon-Sat)
	--	--	\$2.00 - \$3.00/hour \$11.00 - \$13.00/day	Various	--	Various

## 6 RECOMMENDATIONS

The City of Concord is at a key moment to fix its parking system problems and the deteriorating financial condition of the Parking Fund. Through the course of the Parking Study, the City, the Parking Committee, and the community at large have continually expressed the need to develop a comprehensive understanding of parking to inform and support the changing needs of downtown. The currently outdated system of parking management, provision, enforcement, and policy must be altered to support broader goals and to allow management of this valuable resource as effectively as possible.

The study process developed the goals as described in Chapter 1. These goals attempt to look beyond merely parking cars to also understand the purpose and impact of any parking changes and how parking can support a lively and vibrant downtown. The study goals are listed below:

- Ensure the parking fund remains self-sufficient
- Ensure an adequate supply of available parking to support economic development
- Encourage turnover of on-street parking to improve access to merchants
- Improved way-finding and directional signage to improve customer convenience
- Invest in technology and improve enforcement efficiency
- Review and implement changes to the rate structure
- Improve City's parking management structure

The recommendations herein are intended to guide the City's parking management system and resolve the current challenges. The specific recommendations drawn from this study rely on the goals and expectations developed through this extensive planning and outreach effort. All issues, challenges, opportunities, and solutions were compiled not only by the Parking Study team but emerged from Parking Committee discussions, stakeholder interviews, and public participants during various public meeting sessions. The proposed recommendations here are aiming to address these challenges in downtown Concord:

- Overall, supply is not the problem, poor availability in prime locations drives poor perceptions of the system
- Time-limited payment and overtime threat discourages customers
- Leased parking is taking up the most premium and convenient spaces in the garages
- Limited signing, wayfinding, and other information contributes to poor perceptions
- User-friendly payment structures and technologies are needed

- Inefficient and unfriendly parking enforcement perceptions hurt overall parking perceptions
- Excessive debt service is driving the financial deterioration of the City's Parking Fund
- Parking shortages and challenges during periodic events and legislative sessions are isolated yet perceived to be a larger problem than they are
- Private parking resources are currently underutilized and restricted from public access

A comprehensive parking strategic plan should include a series of interrelated strategies that work together to resolve these challenges. The recommendations cover all aspects of parking supply, management, and administration. All measures should be considered as a holistic parking plan and be implemented and adjusted in phases with periodical monitoring and evaluation. To recognize the priority for the City to implement these measures, recommendations have been categorized into following general categories:

- 1) Catalytic strategies
- 2) Secondary strategies
- 3) Supportive strategies

## 6.1 CATALYTIC STRATEGIES

In downtown Concord, parking should be managed in a manner that ensures there is both perceived and actual parking availability. The downtown's highest parking demand is primarily concentrated during the lunchtime and dinnertime peak hours along North and South Main Street. At this time, finding a parking space on or close to Main Street appears to be difficult, and finding available parking in nearby public lots or garages is not incentivized and just as hard with little wayfinding information. As most of the downtown business district has time-limits for on-street parking, visitors and employees have difficulty finding long term parking nearby. Furthermore, current garage payment technology requires users to guess how long they will stay, compromising longer-term flexibility.

The inability to find parking along Main Street corridor is not only due to a surge of lunchgoers, but because everyone is fighting for the same most convenient spaces - customers, visitors and employees all want to find parking spaces close to their destinations. With current flat pricing throughout downtown and short on-street time limits in most locations, there is little incentive to look for a space anywhere else but on Main Street. During this lunchtime peak, core spaces are nearly full, yet there is still an ample, available parking supply within one or two blocks. However, a majority of these available spaces are located off-street with access restrictions – either private unshared spaces or public spaces reserved by a small pool of downtown employees. Visitors and customers are having a hard time finding parking spaces for more than two hours.

The following management strategies are recommended in the catalytic phase to create parking availability:

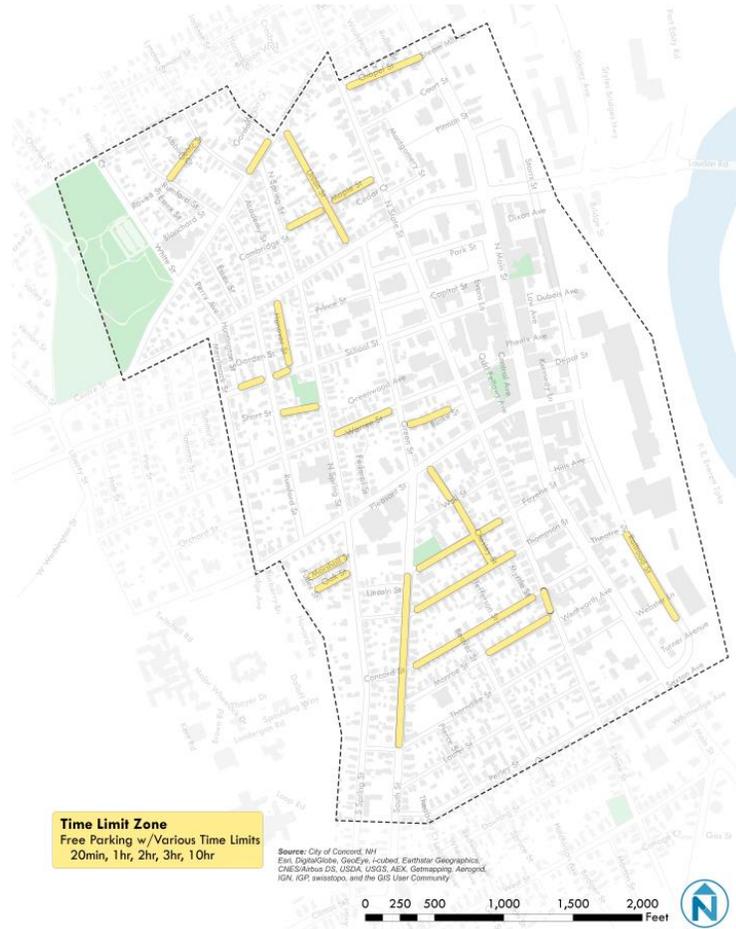
- **Eliminating Time Limits** for all metered parking within the downtown area. Except where metering should be expanded, existing free time-limited zones should remain free.
- **Demand-Based Pricing**, which creates pricing tiers that are responsive to areas of demand, should be implemented in downtown, along with appropriate changes to hours of operations.

- **Formalizing the Off-Street Permit Program** for all public garages to provide more customer-friendly options and prices that will drive better garage utilization.
- **Garage Regulatory Reconfigurations** to encourage more customer-friendly circulation inside the public garages, while clearly setting aside a larger pool for permit holders.

## ELIMINATING TIME LIMITS

Most of downtown’s on-street parking is managed by a time-limit, which limits the length of customer and visitor stays. With the completion of the Complete Street Project for Main Street streetscape project in 2015/2016, new outdoor gathering space, a more attractive retail setting, and increasing tourist activity will increase parking demand and the length of visitor stays. Good economic development policy suggests that inviting patrons to stay for a longer time period will have a positive impact on the local economy. Eliminating time-limits gives visitors and customers parking options to stay as long as they want, while managing demand through pricing can ensure just the right amount of parking availability. All time-limits of metered on-street spaces throughout downtown should be removed and regulated only as metered parking, while the adjacent streets in an “outer area” will be free but keep their time-limits to protect resident parking (Figure 99).

Figure 99 Proposed Time Limit Zone



## DEMAND-BASED PRICING

### Availability Goals

Introducing demand-based pricing is a critical opportunity for Concord to better utilize its existing parking resources. The industry standards for “optimal” availability levels are 15% for on-street spaces and about 10% for off-street. At these targets, parking is well used, but availability (and the perception of it) remains, so that customers can find parking in the most convenient and desirable areas. The City should adopt both of these measures as official parking-management targets. This means that City staff would have the authority to periodically monitor and adjust parking rates and regulations to meet the availability goals.

### Three-Tiered On-Street Pricing

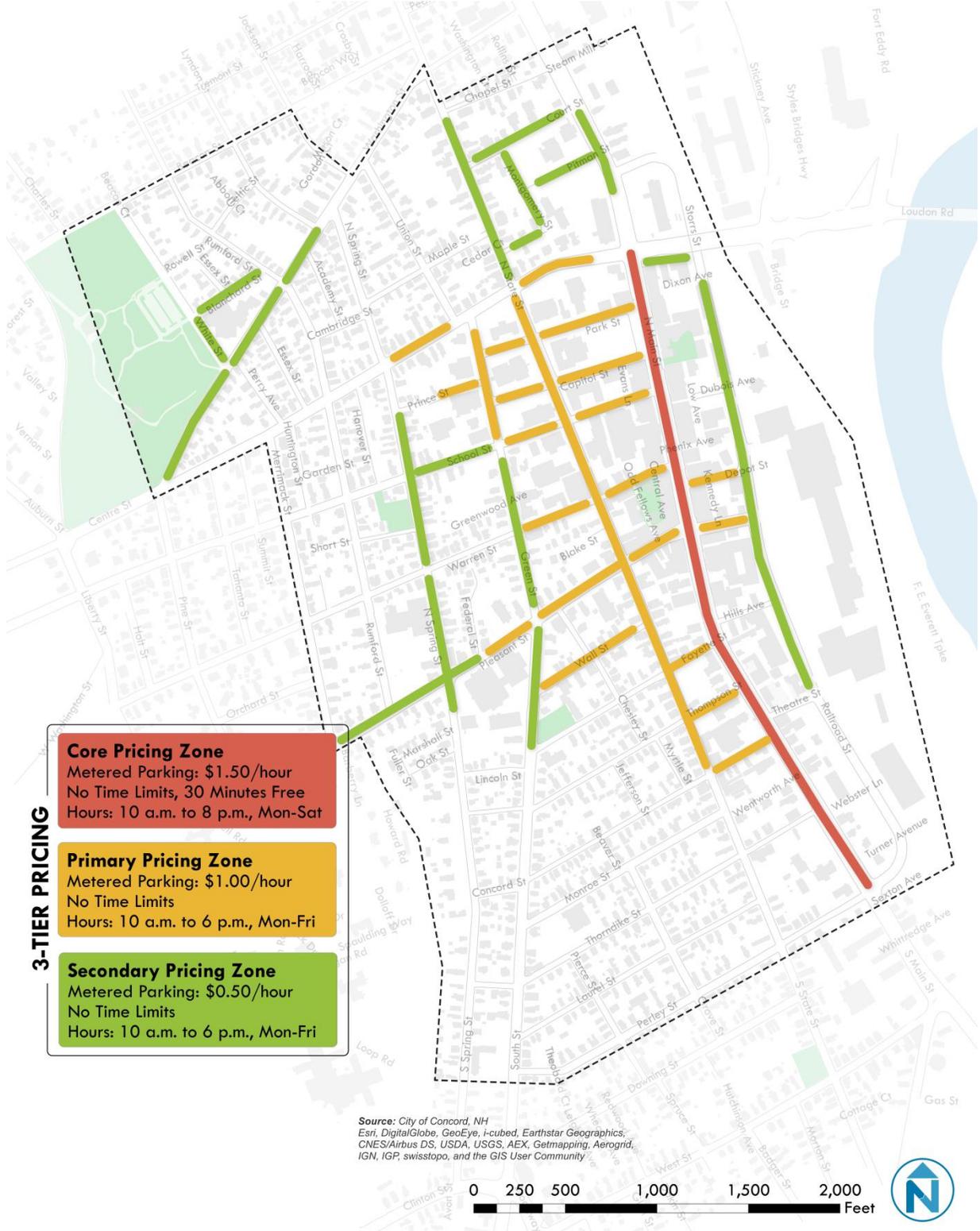
Existing parking utilization patterns indicate clear boundaries of high and low demand for on-street spaces in downtown Concord. Parking along Main Street, from Centre Street to Perley Street, is over 80% full at the peak and over 50% utilized throughout the day; while the metered parking along Storrs Street, for instance, is less than 40% utilization during the enforcement period from 8:00 a.m. to 5:00 p.m. The regulations and pricing should be changed to be reflective of the demand of these areas, driving utilization up on Storrs with a lower price while creating availability on Main with a higher price.

On-street parking everywhere in downtown should be managed using tiered pricing: the highest priced parking should be on the blocks with the greatest demand, lower pricing on blocks with modest demand, and free in the areas of little to no demand to incentivize the most efficient utilization of the existing parking resources. This helps to achieve parking availability goals in the most convenient “front door” curb parking spaces. The Parking Strategic Plan recommends that on-street demand-based pricing should be initially implemented using the following characteristics in Figure 100.

**Figure 100 On-Street Parking Management Summary**

Location	Price	Time Limit	Days of Week	Span per Day
<b>Today</b>				
Core area along Main Street corridor in downtown, from Centre to Pleasant, and from Green to Storrs Street	\$0.75/hr	1 hour, 2 hour, 4 hour, 10 hour	Mon-Fri	8am-5pm
Outer area	Free	20 min, 1 hour, 2 hour, 3 hour, 10 hour	Mon-Fri	8am-5pm
<b>Proposed</b>				
Core Zone: N & S Main Street, from Centre to Perley Street	\$1.50/hr	Unlimited	Mon-Sat	10am-8pm
Primary Zone: existing metered spaces off Main & Storrs Street	\$1.00/hr	Unlimited	Mon-Fri	10am-6pm
Secondary Zone: Storrs Street	\$0.50/hr	Unlimited	Mon-Fri	10am-6pm
Outer area	Free	20 min, 1 hour, 2 hour, 3 hour, 10 hour	Mon-Fri	10am-6pm

**Figure 101 Proposed On-Street Metered Zones (Three-Tier Pricing)**



This table presents the initial on-street management program; this program will need to be evaluated, monitored, and refined over time. See the Ongoing Management section for more detail.

Downtown Concord can be divided into three zones (Figure 101): the “core”, which focuses around the heart of downtown near the shops and destinations along North and South Main Street, from Centre Street to Perley Street; the “primary” zone, which includes the existing metered spaces off Main and Storrs Street; and the “secondary” zone, including Storrs Street, Green Street and part of School Street and North Spring Street. The rest of the study area are outer areas, which are additional side streets in the residential neighborhood one or two blocks away from the priced streets and have less demand. Pricing zones can and should be refined through monitoring and observations, including reducing or extending the boundaries of the higher priced core, combining zones into a single zone, increasing or lowering prices, etc. ***in order to reach the 15% availability goal.***

The parking system in downtown Concord should evolve using pricing as the best and primary tool to engender the driver behavior it seeks, while re-enforcing overall economic development and livability goals. Pricing parking helps to put customers first in the “public parking” area by creating vacancies and turnover of the most convenient “front door” curb parking spaces to ensure availability for customers and visitors. Paid parking ensures that residents, employees, shoppers, and visitors can find a parking space near their destination at all times of day and night, provided they are willing to pay for it. Therefore, meters support personal convenience and reduce traffic congestion. In addition, as opposed to time limits, pricing engenders a larger behavioral effect on motorists seeking short- and long-term parking.

Initial recommendations, based on parking utilization and reports from users of the system, indicate that parking should cost \$1.50 per hour in the core, \$1.00 per hour in the primary zone, \$0.50 per hour in the secondary zone, and free with existing time-limits in the outer areas. Paid parking on Main Street should begin as Monday through Saturday, keeping Sunday free, while the rest of the metered parking zones are regulated from Monday to Friday.

### **Off-Street Pricing**

Again, the existing time-limits throughout the downtown create mostly two-hour restrictions for all user groups. Although these time limits were imposed to increase turn over for merchants, they have consequently limited both customer’s and visitor’s ability for an extended period of time. If a customer would like to stay and enjoy what downtown Concord has to offer, they should be encouraged to stay. Long-term parking patrons and employees should be incentivized and encouraged to park off-street or further away, which could help relieve on-street parking in the areas of highest demand. Higher prices on-street, should be coupled with lower prices off-street. Therefore, this study suggests the off-street parking remains \$0.50 per hour and the City actively advertises the low price to attract longer-term parkers.

## **FORMALIZING THE OFF-STREET PERMIT PROGRAM**

Today’s management of public off-street assets does not reward parkers for parking further from their destination in off-street locations. Rather, they continue to seek the front door spaces closest to their destination, even though off-street parking is actually cheaper than on-street spaces. In part, this occurs because there are limited options in the public garages for downtown employees and residents. While the City does sell individual permits for its garages, they are annual permits and are therefore cost-prohibitive for most employees who instead chose to pay daily rates. Only a few downtown employers have negotiated an annual lease agreement with the City.

Off-street management practices should work in tandem and complement the proposed on-street pricing and management recommendations in order to ensure and enhance the availability of the most desirable spaces for those who are willing to pay, while providing options and alternatives for those who are more price-sensitive. The existing leased parking program contains two-tiers of pricing, differentiating covered and uncovered spaces in the garages at an annual price of \$1,344 or \$1,044. There are no more flexible monthly or quarterly options. In addition, a majority of the leased spaces in the garages are under long-term agreements between the City and multiple institutions at various discounted rates that are often far below the above rates, which has led to the great gap in revenues and debt service discussed earlier. This is exacerbated by reserving all leased spaces as numbered spaces for assigned parkers, even when they are not in town. Leased spaces are up to 40-percent vacant at peak.

With the growing constraints of today’s off-street public supply, a revised and comprehensive permit parking program should be instituted to address the needs of various user groups in the downtown area. There will also be a need to accommodate parkers shifting to off-street areas due to on-street parking pricing changes. Recommendations for off-street parking are as follows:

**Figure 102 Off-Street Parking Management Summary**

Location	Price	Days of Week	Span per Day
<b>Today</b>			
Surface Lot Metered Spaces	\$0.50/hr	Mon-Fri	8am-5pm
Garage Metered Spaces	\$0.50/hr	Mon-Fri	8am-5pm
Garage Covered Leased Spaces	\$1,344/yr	Mon-Fri	8am-5pm
Garage Uncovered Leased Spaces	\$1,044/yr	Mon-Fri	8am-5pm
Garage Discounted Leased Spaces	\$200~\$1008/yr	Mon-Fri	8am-5pm
<b>Proposed</b>			
Surface Lot Metered Spaces	\$0.50/hr	Mon-Fri	<b>10am-6pm</b>
Garage Metered Spaces	\$0.50/hr	Mon-Fri	<b>10am-6pm</b>
Garage <b>Permit A</b> - Reserved Space (numbered)	<b>\$120/month</b>	<b>Mon-Sun</b>	<b>24hours</b>
Garage <b>Permit B</b> - Preferred Space (pooled)	<b>\$75/month</b>	<b>Mon-Sun</b>	<b>24hours</b>
Garage <b>Permit C</b> - Weekday Space (pooled)	<b>\$50/month</b>	Mon-Fri	<b>10m-6pm</b>
Garage <b>Permit D</b> - Weekend/Overnight (pooled)	<b>\$25/month</b>	<b>Mon-Sun</b>	<b>6pm-10am (M-F) 24hours (S-S)</b>

This table presents the initial off-street management program; this program will need to be evaluated, monitored, and refined over time. See the Ongoing Management section for more detail.

The recommendation is to restructure the permit system to allow for permit holders the option of purchasing monthly permits rather than an annual permit. This is in response to the online survey results and allows for greater flexibility, especially for part-time or seasonal workers, plus to accommodate downtown residential tenants. Under this new off-street parking management structure, employees and residents can choose to park in the place that best fits their needs.

## GARAGE REGULATORY RECONFIGURATIONS

The existing configuration in the public garages is not intuitive and not user-friendly to downtown parkers. For example, the Firehouse Block Garage and Capital Commons Garage have both reserved and public metered spaces mixed on the same floor, causing inconvenience and confusion for parkers who are not daily or frequent parkers in the garages; while the Durgin Garage is also not well laid-out with the most premium spaces on the ground floor reserved only for lease holders, driving transients to cruise around upper floors trying to find a metered space, only to encounter more reserved spaces above a certain point with no knowledge of what is beyond them. The proposed garage configuration redesign is aimed to rearrange the permit and metered parking spaces in the garages, in order to prioritize the convenience of downtown parkers.

### Short-Term Redesign

In the short term, the reserved and public metered parking spaces in the garages should be strategically rearranged, to have the most convenient lower floors available for public metered parking and upper floors reserved for permit holders. In this way, daily commuters can go straight up to the "Permit Zone" to find their reserved spaces, leaving ground floors open for the public. There should also be a sign with "Permit Parking Beyond This Point" at the middle point, indicating the boundary, which is subject to periodic review and rearrangement based on actual utilization of metered and permit parking.

Figure 103 Existing Configuration of Capital Commons Garage

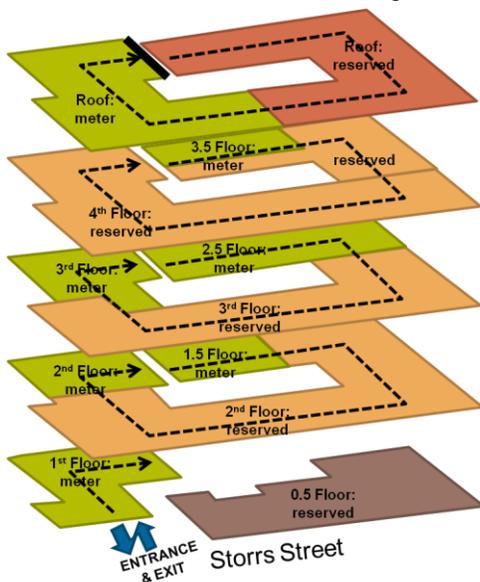
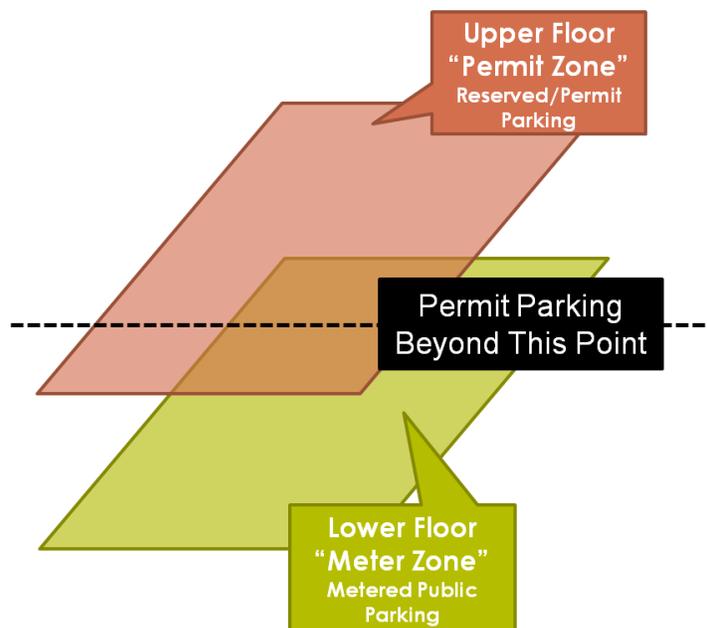


Figure 104 Proposed Configuration of Municipal Garages



Within the "Permit Zone," premium locations should be designated to "Permit A" (Figure 102) holders, who have their exclusive numbered spaces all the time, typically closest to building entry points. All other non-numbered spaces in the permit-only pool are reserved for Permit B, C, and D holders. Preferred "Permit B" holders can park anywhere within the pool, anytime any day during the week. Based on the current average utilization of the reserved spaces in the public

garages (under 50% full), the City should consider overleasing the Permit B spaces in order to better utilize the garage spaces and generate additional revenue. The overleasing rate is subject to periodic change according to utilization monitoring. “Permit C” is designed for downtown employees who can access this same pool of permit-only spaces only between the hours of 7 a.m. and 6 p.m. Monday to Friday; while Permit D is for residents who would like to have a garage space overnight and on weekends. Permit B, C, and D spaces are operated on a first-come, first-served basis. All are recommended to be overleased to the point where peak observed parking availability drops to 10-percent. The offsetting day/night demand of Permit C and Permit D holders allows the City to oversell hundreds of Permit D permits to accommodate current and future downtown residential demand.

Through the redesign of the garages’ regulatory configurations, underutilized parking spaces in each municipal garage can be used more efficiently and effectively. Additional revenue generated can be used for permit enforcement, garage repair, and daily maintenance.

### **Long-Term Payment Technology**

The most ideal scenario for garage parking in downtown Concord is to adopt a “pay-on-foot” technology using an integrated gate control system. Gated access involves the use of parking arms or other barriers that must be broached by taking a parking ticket or swiping an access transponder (a “key fob”). Gated access also can be used in conjunction with electronic debit cards, monthly pass cards (or other time-periods), ticket-pull machines, pay-on-foot machines, manned parking attendant booths, or combinations of the above.

At the early stage of the implementation, the first pay-on-foot technology may require a garage attendant present. Once users get used to it, the facility can be managed entirely automatically. The pay-on-foot system can accommodate both metered parkers and permit holders. Permit holders may use their garage fobs to come in and out, while metered parkers may get a garage ticket at the entrance and pay at the kiosk pay station when they are leaving the garages to get an exit pass. Properly implemented gate control is easier and more efficient than the current and previous garage system. The City should work with potential vendors to further evaluate the cost and benefit of pay-of-foot technology.

The advantages of the pay-on-foot system are:

- Self-monitoring;
- Limits the human resources necessary to effectively enforce payment in a parking garage;
- Technology can be employed to charge for parking on an hourly, daily, or monthly basis;
- Allows flexibility for daily parkers, visitors, or other non-regular parkers who no longer need to guess how long to stay and be worried about the time left for their metered space;
- Allows easier monitoring of traffic volumes, in-and-out activity, and parking occupancy levels. This data is useful to periodically change the proportion of permit spaces;
- If an access card is lost it can be de-activated so another person cannot use it;
- Debit or monthly access cards can be integrated with automatic payment technology to limit the staff needed to issue access cards;
- Works best when multiple tenants or employees/visitors of different firms share the same parking facility;

- Makes more efficient use of the parking supply;
- Much less opportunity for abuse of parking rules and regulations than with manually monitored systems;
- Many people do not like to put parking decals on their cars;
- Simple for employers to manage and pay the cost of parking for their employees, as the monthly permit fob can be activated or deactivated very easily.

## 6.2 SECONDARY STRATEGIES

Downtown Concord is attractive because it has the community, business and merchant activities that many New England communities strive to attract and promote. Social centers, festival events, thriving retail, quality restaurants, and juridical activities have helped to shape downtown Concord's identity as both a regional capital and local attraction. Business owners, residents, employees, out-of-town visitors and others continue to visit and invest in the downtown because they are devoted in making this community asset thrive.

The City recognizes that in order to maintain an attractive and vibrant downtown, parking policies and practices must be coordinated with broader goals for the community and address the day-to-day needs of locals and visitors. Residential neighborhoods should be protected to attract more people living in the area; judicial activities need to be managed to balance temporary versus day-to-day parking needs; travel and parking information should be available to customers and visitors to help them navigate around downtown.

The City should consider:

- **Resident Parking Permit** program expansion, to protect resident parking in additional areas experiencing employee parking spillover.
- **Event/Valet Parking** system to accommodate additional parking demand during special events and busy legislative sessions.
- **Signage and Information**, which includes what drivers read and hear before they arrive in downtown, what they see when they arrive, and what guides them around downtown to appropriate facilities – including necessary pedestrian way-finding between parking and downtown destinations.
- **Technology Improvements**, including new, user-friendly parking technology in existing and new locations for on- and off-street spaces, including new mobile phone and web-based solutions.

## RESIDENT PARKING PERMIT

Modern residential permit programs (RPP) operate by exempting permitted resident vehicles from the parking restrictions and time limits for non-metered, on-street parking spaces within a geographic area, as opposed to the blanket exclusion of all but permitted vehicles that is currently in place near the New Hampshire Law School. Many of the current free and time-limited on-street spaces are located within other residential neighborhoods, limiting options for many existing residents. With the proposed revision to Concord's RPP program, permit holders would be exempted from the time-limit regulations and be able to essentially store their vehicles on-street, up to a maximum span set by the City for street cleaning – subject to the snow clearance

ordinance. Ownership of a permit, however, does not guarantee the availability of a parking space and for this reason, it is important not to sell too many permits in excess of available curb space.

The primary goal of this RPP program is to manage parking “spillover” into residential neighborhoods. RPPs work best in neighborhoods that are impacted by high parking demand from other uses. By managing parking spillover, RPPs can ensure that residential neighborhoods are not overwhelmed by commuters, employees, or visitors, thereby enabling local residents to park their vehicles on-street more easily and conveniently.

All of these conditions apply on the edges of the downtown study area. Employment clusters near the City Hall/State House, District Court, and Federal Court cause non-resident spillover parking into adjacent residential districts. Many homes in these same areas have limited off-street parking. An RPP is a necessary parking management strategy that will significantly improve parking conditions in such residential neighborhoods, and raise additional revenue that can be used for parking signage, enforcement staffing, and curbside maintenance etc.

Figure 106 shows the proposed boundary of the revised RPP program in downtown Concord. The City is recommended to charge each permit \$25 per year per vehicle and have a maximum of two parking permits per household to better manage the limited curbside resource. All RPP holders are exempt from meters and time-limits within the RPP zone. The resident permit is renewed on an annual basis. It is recommended that renewal notices be automatically sent about 4-6 weeks prior to expiration of the permit. Pending development of an online distribution and payment system, renewal of a permit would take place online.

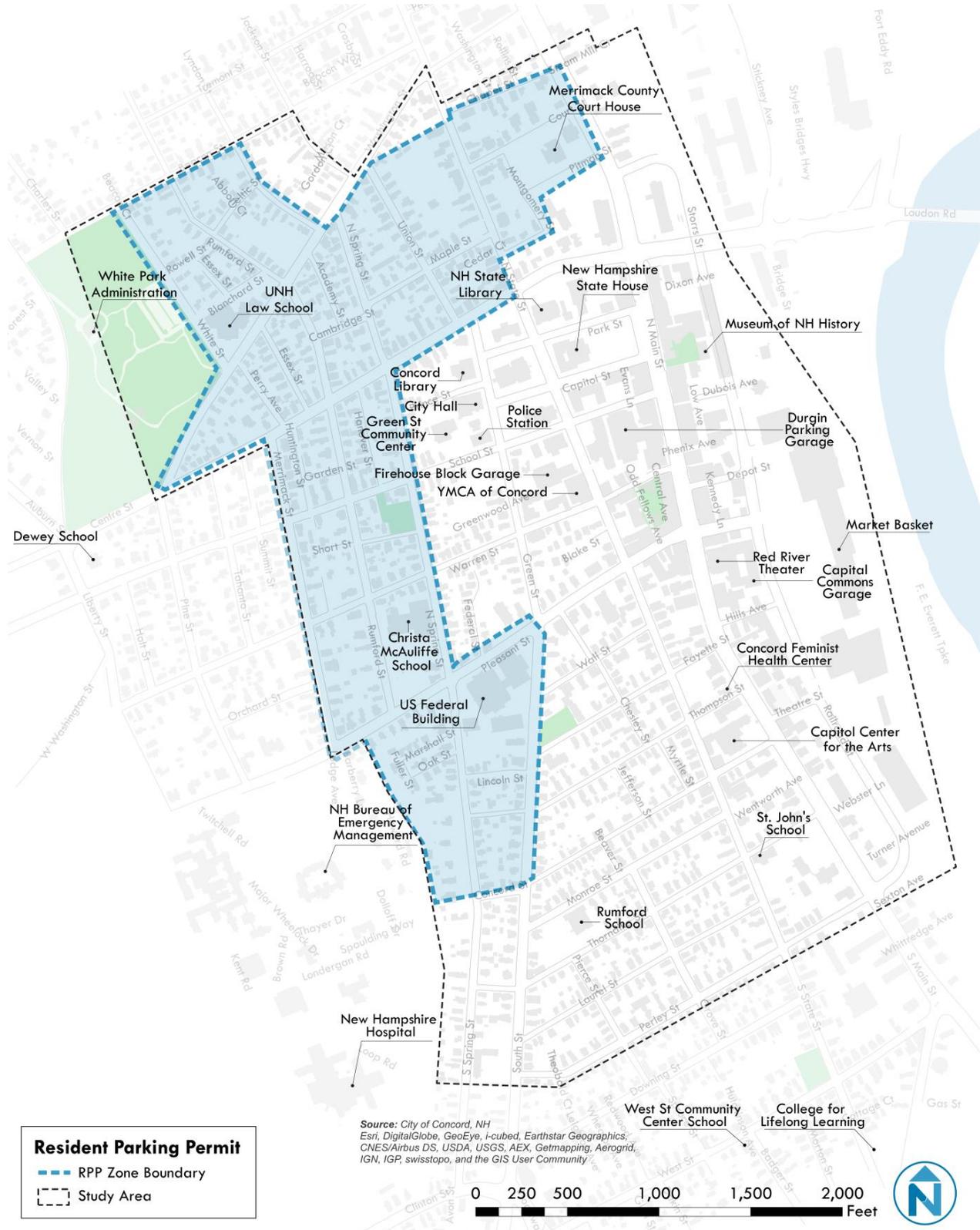
The RPP signage should be simple and streamlined and consistent with best practice from other communities. The signage should also be simple to understand so it is easy for all motorists to follow the rules with no questions about the legitimacy of citations or other enforcement actions in RPP zones (Example: Figure 105).

**Figure 105 RPP Signage in Mill Valley CA (left) and Washington DC (right)**



Source: Nelson\Nygaard (left) and Ramon Estrada (right, <http://ramonstradaanc2b09.blogspot.com>)

**Figure 106 Proposed Resident Parking Permit (RPP) Zone**



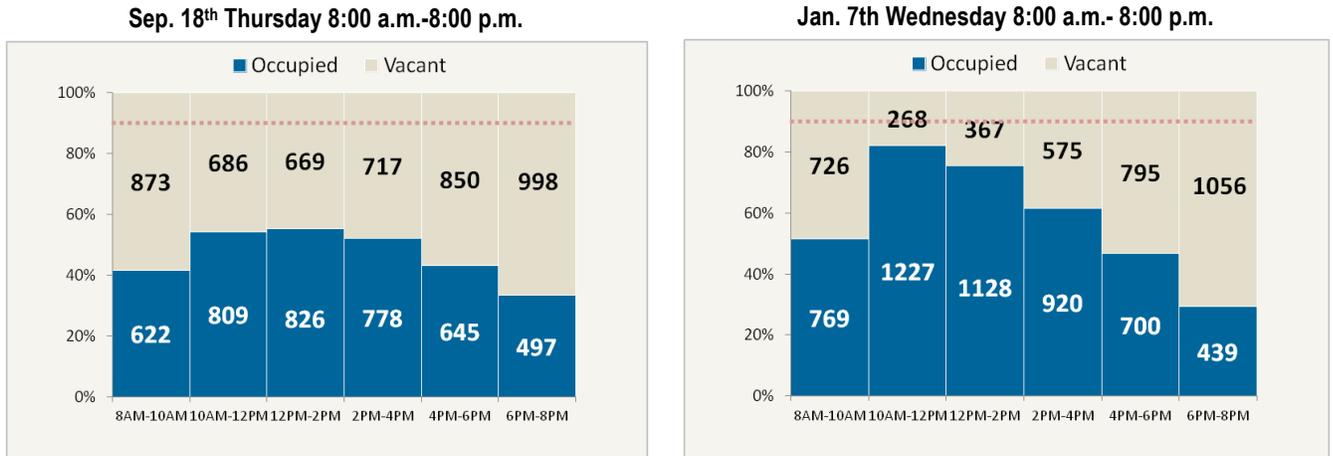
## EVENT/VALET PARKING

Activity in downtown Concord may peak at different time of the day, or the week, or even the year. But it doesn't make sense to build additional parking supply for the temporary or occasional events. For example, on an event night at Capitol Center for the Arts, parking is difficult to find nearby. When the Legislature is in session, at least four hundred more cars come in downtown and park around the State House (Figure 107).

To capture the additional parking demand during the legislation session, the Parking Study team went back to downtown Concord and collected the utilization data at some selected major on- and off-street parking facilities around the State House area. The data collection area is bounded from Centre to the North, Warren to the South, Main to the East, and North Spring Street to the West, as well as the State parking garage on Storrs Street and the remote parking lot at Stickney Avenue, from where a shuttle runs to the State House everyday during the legislature period. According to the historical records of State House shuttle ridership, the opening day of the legislature session turned to have the peak parking demand. Therefore, working with the City, the Parking Study team picked the Legislation Opening Day, January 7<sup>th</sup> for the additional data collection efforts.

A comparison of the parking utilization rate between September and January data collection efforts is shown in Figure 107. Note that the remote parking lot at Stickney Avenue was not included in the September data collection efforts as it is outside of this study area boundary. As it is shown in Figure 107, the peak utilization has increased by 28% during the legislation session compared to the September count, adding more than four hundred cars in the downtown core area in the morning from 10:00 a.m. to 12:00 p.m. The most heavily utilized parking spaces are along School Street, State Street, and in the two state garages. The remote parking lot at Stickney Avenue was also reaching its capacity in the afternoon from 12:00 p.m. to 4:00 p.m.

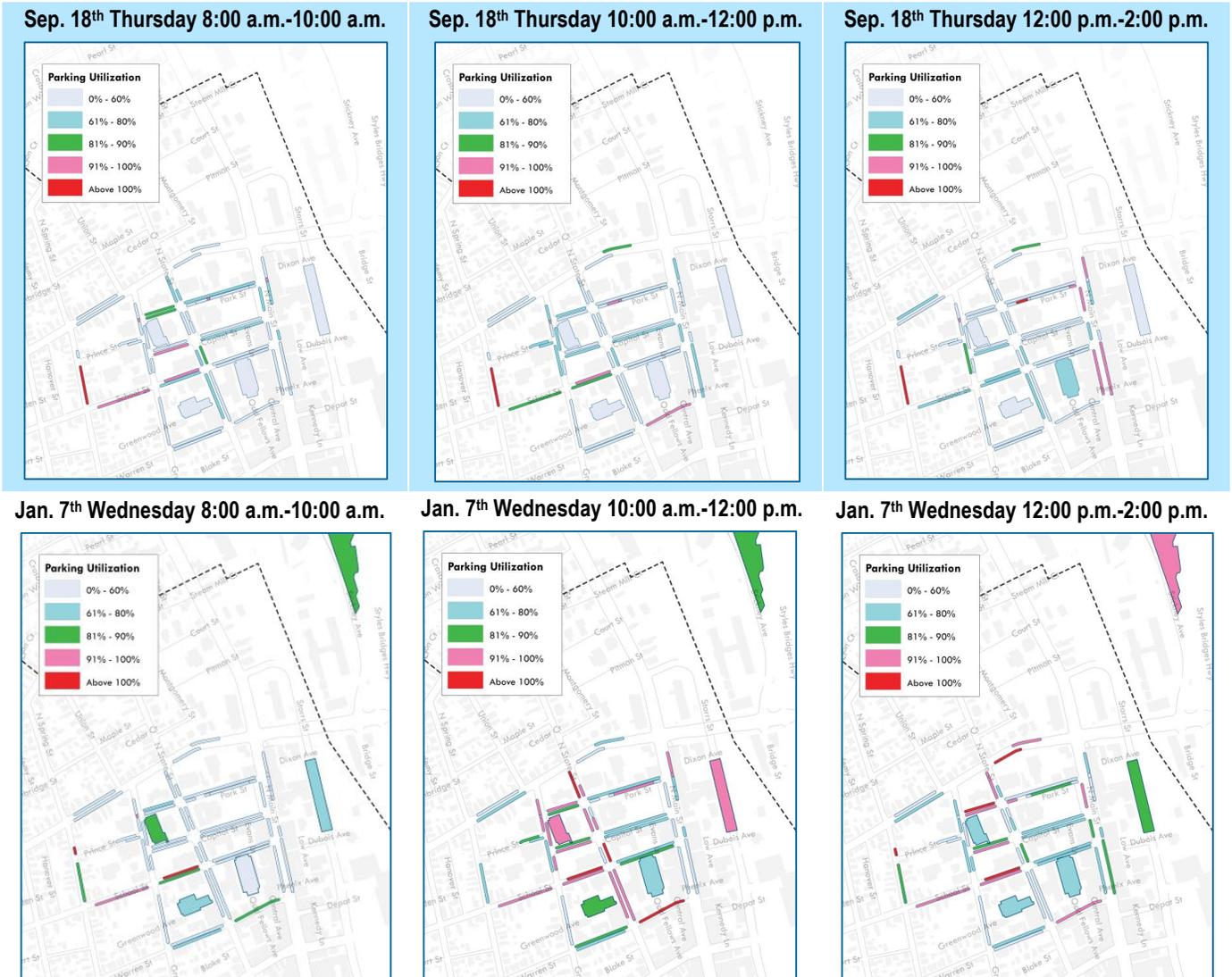
**Figure 107 Parking Utilization Comparison in September and January: 8:00 a.m. – 6:00 p.m.**



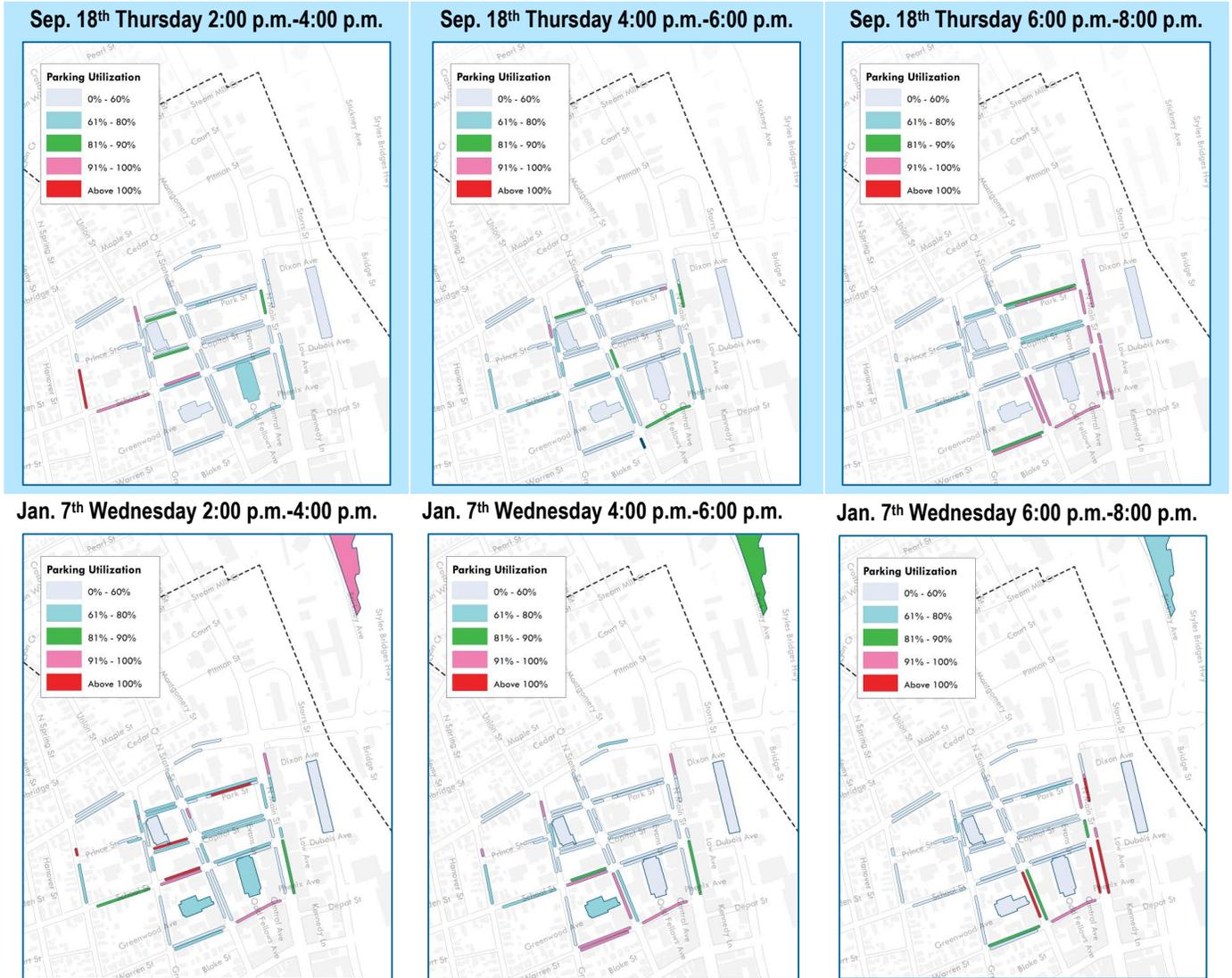
Note: for comparison purpose, the utilization chart does not include Stickney Avenue parking lot outside the study area as it was not included in September data collection.

**DOWNTOWN CONCORD PARKING SYSTEM STRATEGIC PLANNING | FINAL REPORT**  
City of Concord, NH

**Figure 108 Legislative Parking Utilization in September and January: 8:00 a.m. – 6:00 p.m.**



**DOWNTOWN CONCORD PARKING SYSTEM STRATEGIC PLANNING | FINAL REPORT**  
City of Concord, NH



An event parking management plan would plan for and utilize nearby under-utilized parking facilities during such times of peak demand. Information and signage should clearly designate parking facilities for event times. In addition, the plan should include:

- Parking location assignment
  - Avoid forcing traffic flow onto a single road
  - Access for disabled/special permit parking
- Provide Information
  - Distribute parking maps
  - Communicate information during event, such as when lots are full
- Consider valet parking for the legislators
  - Create and advertise pick-up/drop-off area

- Incorporate a place for cars to wait
- Adopt recent technology on text/phone-based valet system
- Advance sales of parking permits

The city should evaluate the event parking need based on the utilization data collected through this study. For example, during event nights at the Capitol Center for the Arts, it's not easy to find parking on South Main Street, but there are plenty of empty parking spaces one or two blocks away along Storrs Street and South State Street, as well as in the Capital Commons Garage. Information about parking should be available and advertised at the entrance of the theatre (Figure 109).

**Figure 109 Example of Parking Information Display at the Entrance of the Capitol Center for the Arts**



Another example would be an event parking plan for the Farmer's Market on Saturdays. As Figure 39 shows, parking is not allowed on Capital Street between State and Main Street, causing an over-capacity spillover onto the adjacent streets such as the North State Street, Park Street, School Street and North Main Street. However, the Durgin Garage and Firehouse Block Garage are much underutilized. Having information and signage directing people to the underutilized facilities during such events will be critical for better parking management.

As shown above, peak park demand around the State House area during the legislature session goes up by almost 30%. Legislative activities last 6 months per year from January through June. So the City should consider this as a special event in downtown Concord and work with the State to establish a temporary parking plan for legislator parking. The study would recommend a text-based valet parking program and close the section on North State Street between Park and School Street for valet parking only, where legislators can drop their cars and go, and request to pick up the cars by sending a text to the valet system. The valet vendor can work with the City and the State to find a remote underutilized parking facility to better manage the parking resources in downtown.

## **SIGNAGE AND INFORMATION**

The City has identified the lack of informational parking and wayfinding signage across downtown Concord and is currently working with a signage and wayfinding consultant team to plan and design a new signage system for downtown Concord. Easy to read and understand parking and wayfinding signage is a critical component of deciphering a parking system. Signage

that guides motorists to on and off-street parking deters drivers from excessive cruising and frustration. A wayfinding program should encourage a “park once” or “park and walk” environment, focusing not just on getting cars into the parking facilities, but getting people to visit multiple destinations on foot without moving their cars. In addition to parking facilities, signage should identify key sites of interest, area businesses, social activity centers, municipal buildings, and other points of interest, plus direct patrons to pedestrian pathways around downtown. Three components of signage and information in downtown Concord are:

1. **Before You Arrive:** Making parking information available for visitors and customers before arriving to downtown Concord will allow parkers to plan their trips ahead of time and find parking with ease. Having a single, simple map posted on the City’s website, Concord Parking Facebook page, downtown restaurants and shops’ web pages, and posted at other activity centers, will provide a consistent informational map for Concord. Off-street parking lots and garages should have consistent branding on the website as well as on site, so drivers can easily recognize the facilities based on location.



2. **At Your Arrival:** Today, when you arrive in downtown, there are a few parking signs posted, but they are small, inconsistent, and often placed in obscure locations which make it difficult to navigate to parking. Signage should be clearly visible, designed consistently, placed in strategic locations, and should provide clear guidance to and from parking locations.



3. **During Your Stay:** Pedestrian-oriented signage that includes information about parking locations and other attractions helps orient and enhance the downtown experience for all users. Providing clear pedestrian signage helps to create and promote a "park once" district, allowing customers to park once and walk to multiple locations on foot. To do so, creating clear and visible pedestrian signage to both local destinations and to and from parking locations is critical. The municipal public garages should have easy-to-read entrance signs and exit signs.

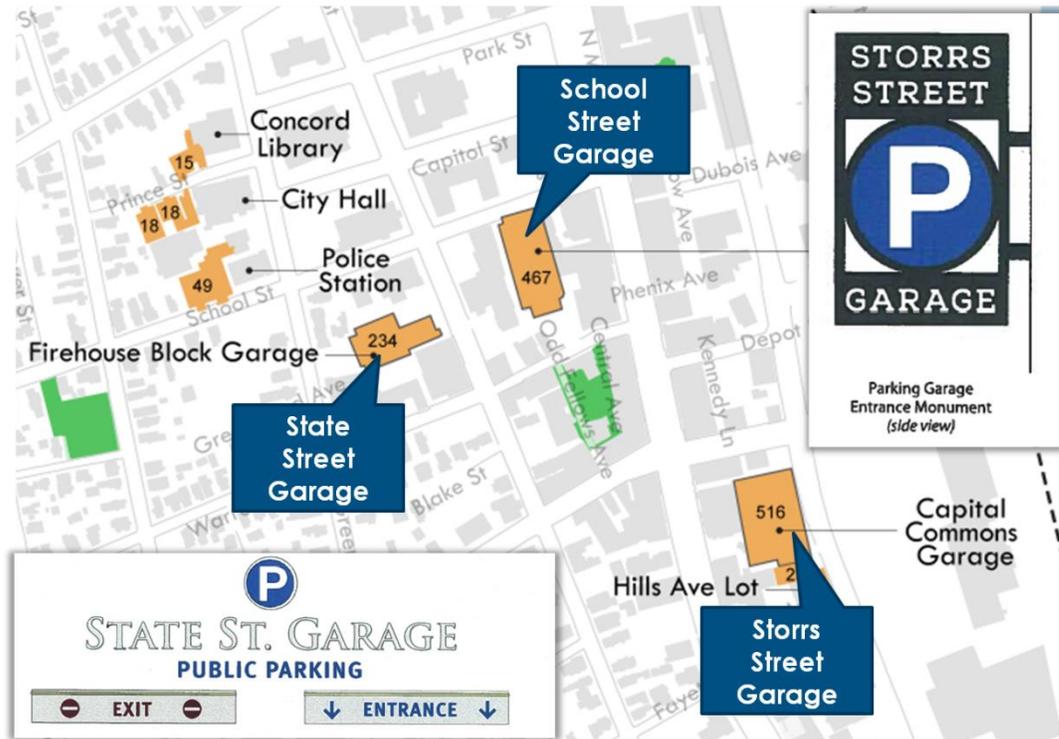


Working with the ongoing Signage project, the City should take the following elements into consideration:

- Define unified and clear design rules for all parking and wayfinding signage in downtown;
- Renaming and branding the municipal public garages based on their locations (Figure 110)
- Identify free and long-term parking locations;

- Identify major points of interests (such as the State House, City Hall, Capitol Center for the Arts, etc);
- Guide pedestrians back to their car in the easiest and shortest way.

Figure 110 Suggested Garage Branding



## TECHNOLOGY

Parking management technology has come a long way since standard meters were introduced nearly a century ago. Many meter innovations dramatically changed the operations and management of parking, both for the user and the operator. Upgrades in technology have increasingly enhanced the customer and visitor parking experiences, made more efficient use of enforcement personnel, and simplified the evaluation and monitoring of parking utilization.

Where implemented, parkers are able to utilize a number of mobile and web-based applications to plan their trips ahead of time and find parking with ease. Similarly, drivers no longer need to wonder if or where parking is available; new signing systems are able to provide dynamic and live information on parking availability.

In the past, Concord's downtown parking system was managed by traditional coin-operated meters. Six years ago, the City installed 76 Cale kiosk pay stations to replace a majority of the old meters, and adopted a pay-and-display method for on-street parking. However, this type of kiosk technology does not provide the most convenient or customer-friendly approach to parking downtown. Having to display the payment receipts at their car window shield, people found this payment technology not user friendly during snow storms, or for elderly patrons, or patrons with children. And with those old meters that haven't been replaced, customers, employees and even businesses may be frustrated by the search for change just to pay the meters, detracting from the

downtown experience. Input from the public meetings and the online survey reveal that new parking payment technology is preferable choice.

The City of Concord should consider adopting new payment technology, such as:

- **Smart meters** on-street that accept debit/credit cards and could fit into existing meter poles.
- **Pay by phone**, where a parker can pay to park (or add time) via a cellphone. This strategy eliminates the need for coins, allows people to receive text messages notifying them that their time is about to expire as well as extend legal parking time by paying remotely. Additionally, upon returning to their vehicle, a person may terminate the parking session and avoid paying for time that will not be used.
- **In-car Meters**, are small devices which are loaded with pre-paid parking time. The user displays the meter in their car, often on the dashboard or hanging from the rearview mirror, and activates the device when parked at a metered space. The digital display counts down the amount of paid parking time remaining, allowing a parking enforcement officer to see through the window that the car is legally paying for the parking time. This strategy is popular with frequent users of metered parking areas, especially those who are constantly “in and out”.
- **Pay by license plate** kiosks, which uses one kiosk for multiple parking spaces, where the user can pay with coin or credit, and the payment is linked to their license plate. Pay by plate technology can also replace the permit program hangtag system, where users would not need to display a hangtag, but instead their license plate would be linked with their purchase of a monthly permit. Currently due to State law, the City of Concord is legally prohibited from using any payment systems that would force the public to rely upon such systems exclusively without any other “non-license plate” based option for enforcement. However, technologies could be made available to the public which rely upon license plate information provided the public uses those on a voluntary basis.
- In the long term, **real-time availability information** could be available to help drivers navigate in downtown, especially during the peak hours showing which facility is full and which still has spaces.

## 6.3 SUPPORTIVE STRATEGIES

The City has a varied and wide range of responsibilities with respect to managing the parking supply. These responsibilities go above and beyond pricing and technology - this should also include parking enforcement, pedestrian access improvement, transportation demand management programs, mobilizing underutilized private facilities, and more. Although many of these functions - and the others that exist - lay within various departments within the City government, they all must be coordinated and consistent. Under a holistic administration structure, the following management strategies are recommended to improve administration of the parking system:

- **Shared Parking Program**, where the City brokers shared parking agreements with or between private parties.
- **Friendlier Enforcement**, with adoption of upgraded parking ambassador program to support the overall system.

- **Governance/Administration**, to better coordinate City's parking operations and management.

## SHARED PARKING PROGRAM

Mixed-use downtowns offer the opportunity to share parking spaces between various uses, thereby reducing the total number of spaces required compared to the same uses in stand-alone developments. This is a primary benefit in mixed-use centers where visitors are able to park once and walk to multiple shops throughout their visit. Shared facilities utilize parking spaces more efficiently, reduce the amount of land dedicated to parking, and reduce traffic congestion, as one parking space can be used for multiple uses.

Downtown Concord's parking utilization analysis revealed that throughout the course of a weekday, there is a significant available supply of parking in privately-owned and restricted lots. This suggests that to utilize parking resources most efficiently, the public and private sectors should collaborate to better utilize the under-utilized parking spaces, either for public use or for employee permits.

The City should encourage and incentivize shared parking among private landowners to maximize the efficiency of parking (and land) in the downtown. Multiple means can be considered:

- Parking minimums can be reduced in mixed-use developments with complementary uses;
- The zoning code should allow for off-site parking to satisfy requirements based on justifiable parking analysis;
- The zoning code should encourage and incentivize shared parking or shared parking access between adjacent complementary uses;
- The City could provide educational support and facilitate negotiation between potential sharing partners, on topics such as liability leasehold structure, preservation of development rights, maintenance improvements, safety and lighting improvements, appropriate signing and markings, etc.
- In the near future with additional parking revenues in place, the City can afford to monetize underutilized private parking by offering lease payments to private owners, increasing public parking supply through simple adjacent lot consolidations, and then sub-leasing or selling permits on the combined facility.
- Ultimately, the City can form a Municipal Parking District that offers attractive benefits to private landowners to participate and share their facility as part of the entire downtown pool of short- and long-term spaces.

## FRIENDLIER ENFORCEMENT

Like most communities, downtown Concord's existing parking management system relies heavily on enforcement to ensure desired compliance of regulations. However, enforcement is time-consuming and labor intensive. Because every regulation and parking strategy can be undercut by those who attempt to "game the system", this reduces the efficiency and effectiveness of existing enforcement policies. Moreover, enforcing time limited parking is even more cumbersome and labor-intensive than enforcing pricing.

Instead of relying heavily on citation enforcement, downtown Concord should first amend its parking regulations to rely less on time limits to manage behavior and more on pricing, as described in the Demand-Based Pricing section. To complement the customer-first approach, enforcement staff should be used not just to ticket cars but also as downtown ambassadors for the City. Parking fines and penalties should be increased from \$10 minimum to \$20 minimum, and the “progressive” penalty schedule should continue to be enforced with a steeper escalation, for example for a \$20 ticket, the fine will become \$40 after 10 days, and \$80 after 20 days.

Improved enforcement can be very helpful in reaching the parking goals set by the regulatory framework. Parking enforcement operations, while always necessary, should be designed to work in tandem with the larger goals and pieces of the parking management plan. Enforcement should help to ensure and enforce parking availability goals and broader parking management goals, and not be punitive and deter customers and visitors away from downtown. Ticketed customers complain to businesses or worse – never come back.

Enforcement is part of an integrated parking system. Concord should utilize its Parking Enforcement Officers (PEOs) as downtown Ambassadors for visitors in downtown Concord, focused more on encouraging appropriate parking behavior through friendly assistance and providing directions, as opposed to diligent ticket writing. Enforcement should focus on ensuring availability for customers. The PEOs may also adapt its current parking violation tickets to provide more information, such as tips on how to use the technology, what the rules and regulations are, and where to find free parking. Similarly, coordination is essential between the PEOs and parking management. PEOs should participate in regular meetings with the City to serve as a feedback loop for better management of parking resources. This would include things like identifying areas of confusion to customers, locations where availability is poor, areas where regulations should change, etc.

Recommendations for improving enforcement operations include:

- PEOs should be downtown Ambassadors, representing the City and Parking Committee. PEOs should be trained and equipped with downtown destination information, including social activity centers, theaters, local restaurants and shops, and other information.
- PEOs should be trained and equipped with parking information, including maps, to be able to direct price-sensitive customers to free, long-term parking areas, and others to appropriate parking areas, including remote parking when necessary.
- PEOs should ensure enforcement throughout all regulated hours of the day and week so regular downtown visitors and employees know when to expect enforcement.
- The City should provide information to violators on printed parking citations, e.g. unregulated, free parking opportunity locations.
- PEOs should work with the Parking Committee, City staff, and downtown businesses to ensure adherence to and satisfaction with regulations, and make recommendations for modifications to the management program.
- As technology upgrades are installed, such as pay-by-plate or pay-by-cell, integrate enforcement & ticketing with upgraded technology to maximize efficiency.

## GOVERNANCE/ADMINISTRATION

Parking management and governance in any downtown is often complicated because it involves interdepartmental coordination to manage everything from snow removal to zoning to signage. Today, parking is managed and governed by various departments and decision making bodies within the City making it difficult to coordinate amongst various groups (Figure 66). There is no central body or department that spearheads or oversees all parking management activities.

As a recommendation, all responsibilities that are involved in managing parking in downtown Concord should regularly coordinate via a single “Parking Division”. The Division is the “go-to” for all parking issues and can delegate when needed, and should vet recommendations, regularly monitor and evaluate parking utilization, and assist with implementation. The Parking Division is supported by a Parking and Transportation Advisory Committee, which should be responsible as a sounding board for parking, and other multimodal transportation issues, as parking is also closely linked to pedestrian access and accommodating all modes of transport. This Committee should be comprised completely of City Councilors who have a better understanding of overall downtown development.

In the long-term, it is recommended that the City consider creating a new department titled “Downtown Services”, which would include the Parking Division, as well as a new “Maintenance Division”. Supplemented with outside vendors and contractors, the Maintenance Division would be responsible for maintaining City’s parking facilities, improvements associated with the “Complete Streets Project”, as well as urban squares and parks. In this way, all parking management and maintenance responsibilities are managed via a single department with more efficient coordination.

Currently, the Parking Fund provides a direct cash support, as well as free-in kind support, to the General Fund totaling at about \$427,860 +/- annually, including the City’s share of property taxes paid on leased spaces. It is recommended that the City should evaluate the inter-relationship between the Parking Fund and the General Fund and make adjustments where appropriate. For example, the 108 reserved City General Fund employee spaces in the Firehouse Block Garage are provided free but are consuming the maintenance costs from the Parking Fund. The City should consider restoring these spaces into the proposed parking permit program. In addition, all parking related revenue should go to the Parking Fund, such as the Handicap tickets, parking violation tickets from crosswalk parking, time limits, illegal parking, and the Resident Parking Permit program. With the establishment of the Downtown Services Department, and the Maintenance Division, additional revenue support from the General Fund should be reallocated to the Parking Fund to cover all the maintenance expenses.

# **Appendix A Additional Parking Utilization Data Collection**

This Appendix documented the additional data collection efforts that were conducted both in June and July, 2014 along South Main Street before the construction of Main Street project and in January, 2015 around the State House when the Legislature is in session. The former summer count was intended to rule out the possible impacts of the Main Street construction on the South Main Street parking utilization; and the latter January count’s purpose was to understand the severe parking demand change during the legislature session in order to make recommendations accordingly for this seasonal annual event. As the Main Street construction did not happen when the September downtown-wide data collection was conducted, and the Legislator parking utilization data only serves for one piece of the overall recommendations, both these two data collection efforts’ results were not included in the main body of this report, but will be detailed in the following section.

## #1 PARKING UTILIZATION COUNTS – JUNE, JULY, 2014

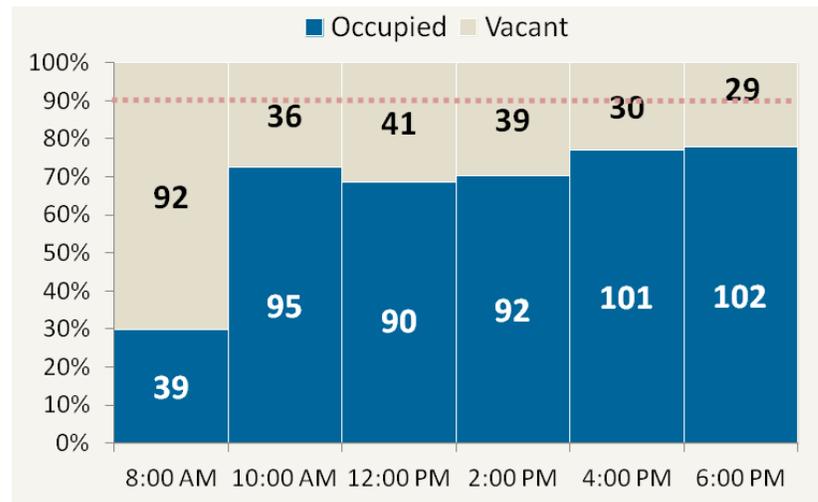
The City of Concord is currently working on its Complete Streets Improvement Project to create a “new” Main Street to support the growing mixed-use development, an enhanced sense of place, and an expanded pedestrian environment, while preserving and enhancing the authentic historic character of the downtown. The Project was intended to improve the streetscape of the whole North and South Main Street from Pitman Street to Perley Street. The construction of the South Main Street section was originally schedule before the Downtown Parking Study’s kick-off. Therefore, to rule out the potential impacts on Main Street parking activities, working with the City staff, the Parking Study team decided to conduct the South Main Street data collection efforts ahead of the construction. DESMAN Associates did the field counts of parking occupancy along South Main Street section from Pleasant Street to Perley Street on June 24, and July 1, 2014, as an average weekday (Tuesday).

Data collectors captured weekday parking demand for 12 hours, beginning at 8:00 a.m. and ending at 8:00 p.m., with counts every two hours. Data collection began in the early morning to identify if/when employee parking would fill to capacity and ended late to capture the dinner time activities along South Main Street.

**Appendix-A Figure 1 South Main Street Data Collection Boundary**



**Appendix-A Figure 2 South Main Street Parking Utilization Chart: Tuesday**



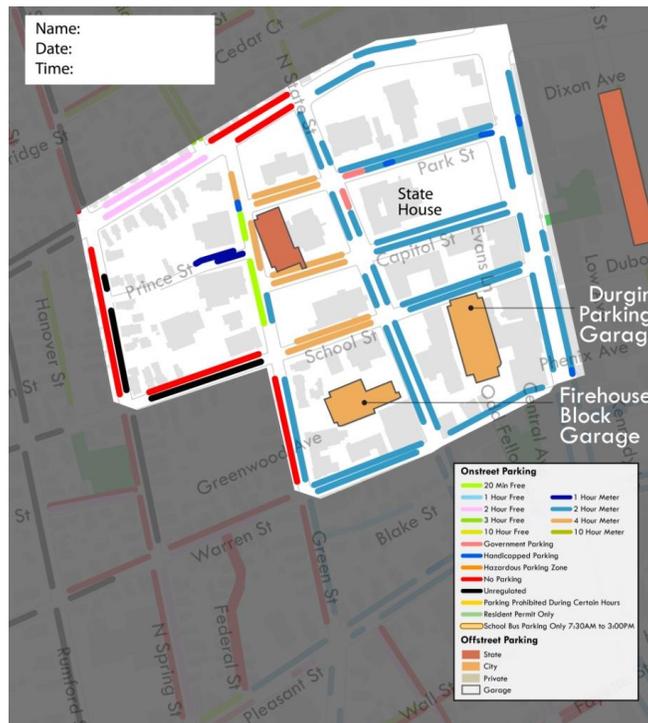
As shown in Appendix-A Figure 2, there are a total of 131 spaces on both sides of South Main Street section, and the maximum overall utilization observed was 78% (102 spaces), occurred around dinner time, between 6:00 p.m. and 8:00 p.m.. It also indicates that South Main Street parking is relatively well utilized (over 70% full after 10:00 a.m.) throughout the day, compared to the rest of the study area. This may occur due to the concentration of business, restaurants, shops, and theatres along South Main Street. The results are also consistent with the downtown-wide data collection later in the September.

## #2 PARKING UTILIZATION COUNTS – JANUARY, 2015

During the public engagement process throughout the study, many stakeholders expressed their concerns with the severe parking demand growth when the Legislature is in session. In general, parking around the State House area is harder to find compared to other time of the year. The State currently has two structural garages in downtown, one beneath the Legislative Office Building with a total of 120 spaces, and another on the two-level deck over Storrs Street with 201 spaces. To relieve the parking pressure to downtown streets and public facilities, the State is also running a shuttle service to a remote parking lot at Stickney Avenue. Stakeholders and the City are open to other possible solutions to help alleviate the parking pressure on the streets.

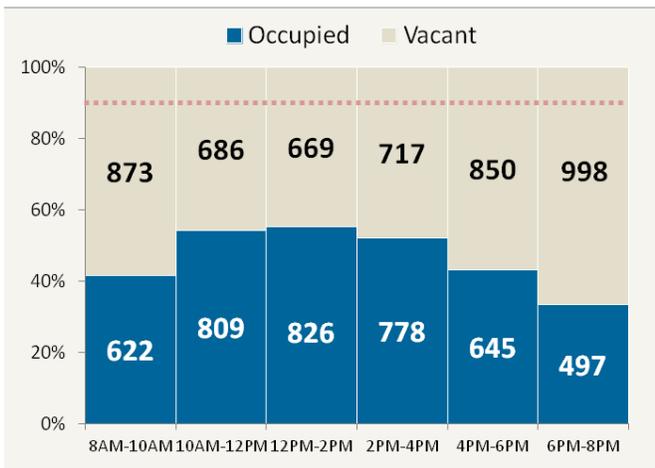
The City and the community understand that legislature activities are crucial to downtown businesses. To understand the utilization pattern during this special seasonal annual event, the Parking Study team conducted an additional utilization count on the opening day of the Legislature Session on January 7 (Wednesday), 2015, which was assumed to have the peak demand based upon the historical ridership data of the State remote parking shuttle services. DESMAN Associates data collector captured the weekday parking demand for 12 hours, beginning at 8:00 a.m. and ending at 8:00 p.m., with counts every two hours.

**Appendix-A Figure 3 January Legislature Parking Data Collection Boundary**

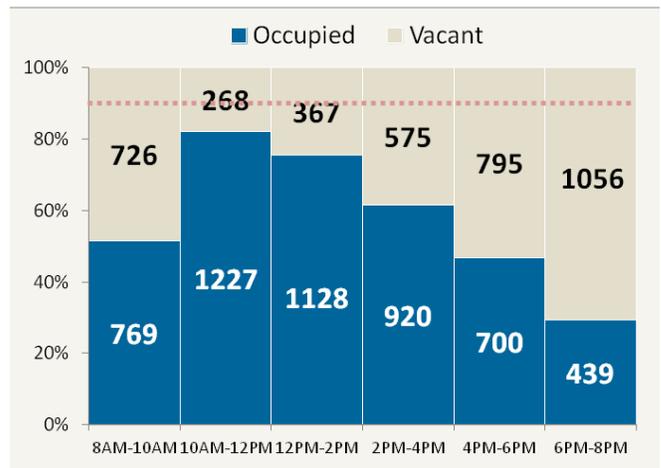


To fully capture the legislative parking activities, a broader data collection area around the State House is selected, as shown in Appendix-A Figure 3, bounded by Centre Street to the North, Warren Street to the South, part of North Spring and Green Street to the West, and North Main Street to the East, as well as the State garage deck on Storrs Street and the remote lot at Stickney Avenue<sup>2</sup> from where a shuttle runs to the State House everyday during the legislature period. There are 1,883 parking spaces in the overall data collection area, with 456 on-street and 1,427 off-street spaces. A comparison of the parking utilization rate between September and January data collection efforts is shown in Appendix-A Figure 4 and Appendix-A Figure 5, which indicates that at least four hundred more cars come in downtown and park around the State House, with a peak utilization of 84% in the morning between 10:00 a.m. and 12:00 p.m. Both on- and off-street parking facilities are over 75% full at peak (Appendix-A Figure 6, 7, & 8)

**Appendix-A Figure 4 Legislature Parking Utilization Chart:  
September 18, 2014, Thursday**

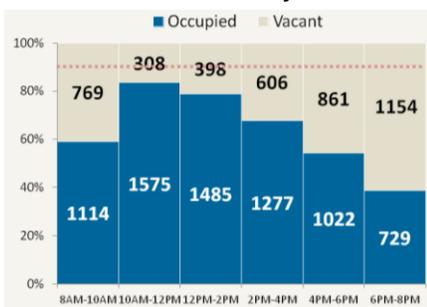


**Appendix-A Figure 5 Legislature Parking Utilization Chart:  
January 7, 2015, Wednesday**

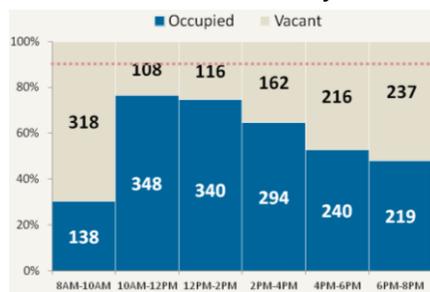


Note: for comparison purpose, the utilization chart does not include Stickney Avenue parking lot outside the study area as it was not included in September data collection.

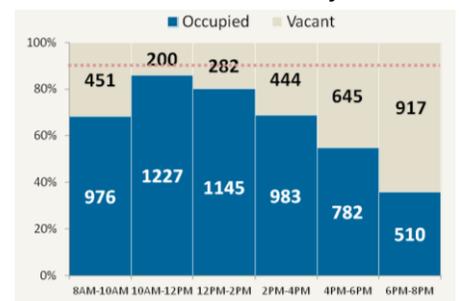
**Appendix-A Figure 6 Legislature Parking Overall Utilization Chart:  
January 7, 2015**



**Appendix-A Figure 7 Legislature Parking On-street Utilization Chart:  
January 7, 2015**



**Appendix-A Figure 8 Legislature Parking Off-street Utilization Chart:  
January 7, 2015**



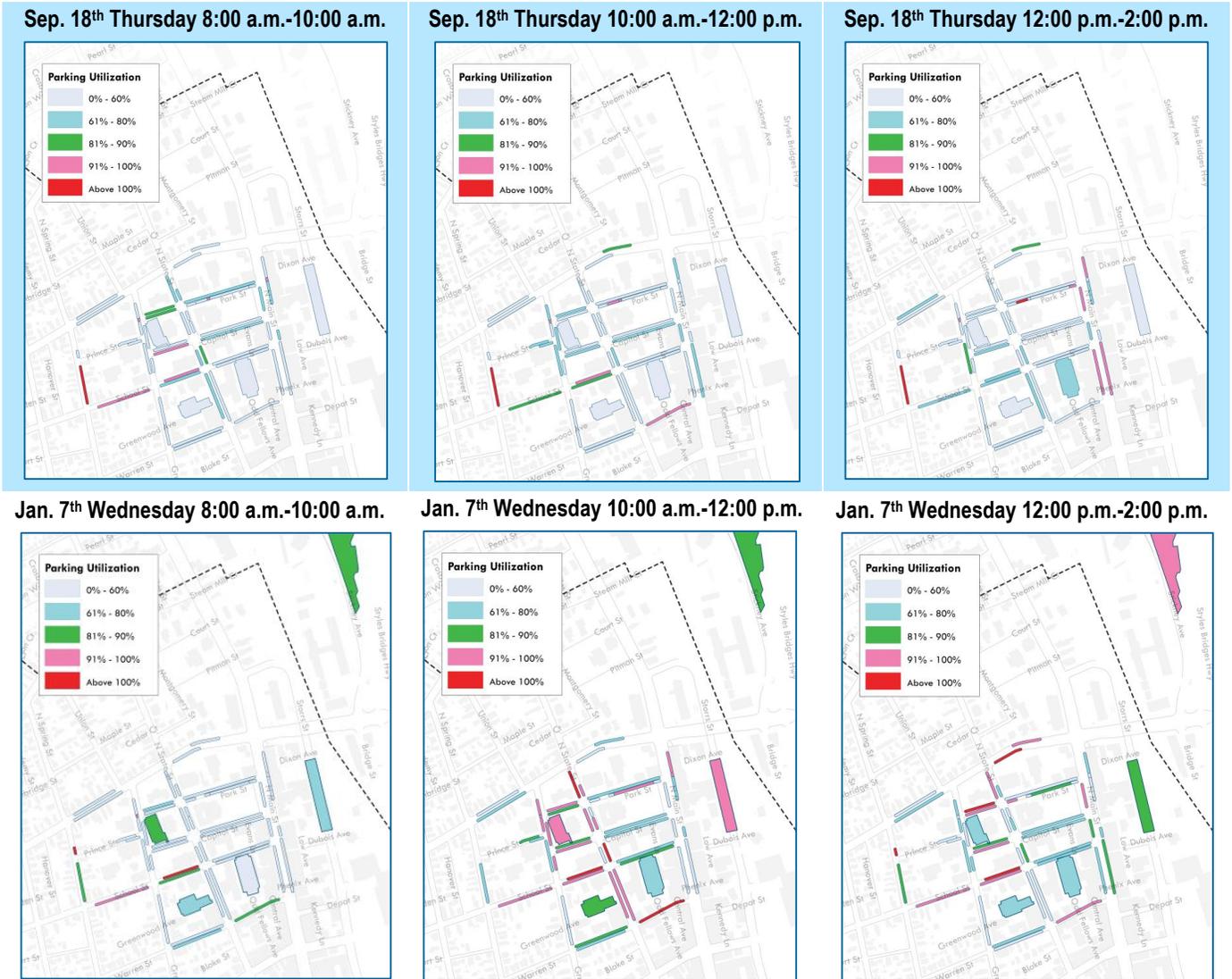
Note: the utilization charts above include Stickney Avenue parking lot.

<sup>2</sup> Note that the remote parking lot on Stickney Avenue is out of the Downtown Parking study area, thus are not included in the Appendix-A Figure 3.

**DOWNTOWN CONCORD PARKING SYSTEM STRATEGIC PLANNING | APPENDICES**  
City of Concord, NH

Appendix-A Figure 9 shows maps of time series utilization in two-hour increments, from 8:00 a.m.-10:00 a.m. to 6:00 p.m. to 8:00 p.m. with a comparison to the September data collection results. It is obvious that overall the parking demand in the district has increased. The most heavily utilized parking spaces are along School Street, State Street, and in the two state garages. The remote parking lot at Stickney Avenue was also reaching its capacity in the afternoon from 12:00 p.m. to 4:00 p.m.

**Appendix-A Figure 9 Legislative Parking Utilization in September and January: 8:00 a.m. – 6:00 p.m.**



**DOWNTOWN CONCORD PARKING SYSTEM STRATEGIC PLANNING | APPENDICES**  
City of Concord, NH

**Sep. 18<sup>th</sup> Thursday 2:00 p.m.-4:00 p.m.**



**Sep. 18<sup>th</sup> Thursday 4:00 p.m.-6:00 p.m.**



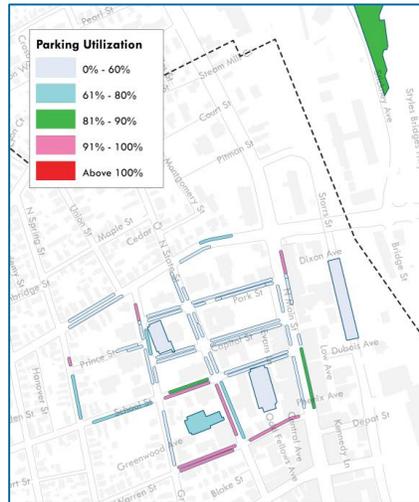
**Sep. 18<sup>th</sup> Thursday 6:00 p.m.-8:00 p.m.**



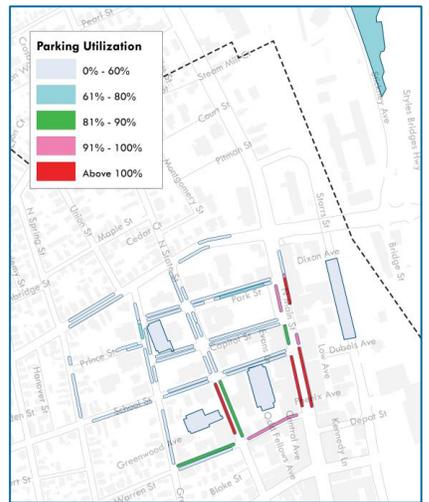
**Jan. 7<sup>th</sup> Wednesday 2:00 p.m.-4:00 p.m.**



**Jan. 7<sup>th</sup> Wednesday 4:00 p.m.-6:00 p.m.**



**Jan. 7<sup>th</sup> Wednesday 6:00 p.m.-8:00 p.m.**



# **Appendix B Municipal Garages' Condition Survey Reports**

**CONDITION SURVEY REPORT**

*of the*

**CAPITAL COMMONS PARKING GARAGE**

Concord, New Hampshire

*Prepared for*

Mr. Matthew R. Walsh  
Director of Redevelopment  
**City of Concord NH**  
41 Green Street  
Concord, NH 03301

*Submitted by*

**DESMAN ASSOCIATES**  
18 Tremont Street, Suite 300  
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***January 9, 2015***



**CONDITION SURVEY REPORT**  
of the  
**CAPITAL COMMONS PARKING GARAGE**  
Concord, New Hampshire

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<b>Concord Parking Garages MEP Inspection and Condition Assessment</b>	
<b>Prepared by CHA</b>	
<b>Dated January 2015</b>	

## 1. EXECUTIVE SUMMARY

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The Capital Commons Parking Garage is in fair to good condition at this time. The structural and waterproofing elements at the precast, pre-topped, concrete double tees are suffering from various degrees of deterioration caused by the infiltration of water and corrosion causing elements. The parking structure requires the implementation of an effective restorative, protective and preventive maintenance program in order to address the current problems and ensure the continued long term durability of the structure.

The primary deterioration conditions observed at the supported decks are the failure of all the precast joint sealants, as well as minor delamination of the concrete at the cast-in-place pour strips and concrete structural elements, and floor cracks at the surface of the tees and pour strips.

In order to maintain the parking garage at the best possible condition and to ensure the long term durability of the structure, the deteriorated concrete must be repaired and conditions that allow for water and corrosion causing contaminants to penetrate the slab must be addressed. Structural repairs include concrete pour strip repairs, overhead tee stem repairs, as well as concrete column and wall repairs. Other repairs include re-paving the deteriorated sections of asphalt at the slab-on-grade.

Waterproofing measures are imperative to protect the structural repairs and help slow future deterioration. We recommend replacing all of the existing sealants between precast floor joints in the parking garage. After the replacement of these existing sealants, it is also recommended that the areas of waterproofing membrane that are wearing thin at the second floor pour strips be re-coated.

**Corrosion:** The oxidation, or rusting, of iron in embedded reinforcing steel, which causes the steel to expand.

**Delamination:** A horizontal, sub-surface, crack at the level of the reinforcing steel caused by the corrosion of the reinforcement.

**Spall:** As corrosion continues, the delaminated concrete will eventually break away, leaving a hole and exposed reinforcing.

Other waterproofing repairs include routing and sealing floor cracks at the precast, pre-topped tees and at the cast-in-place pour strips.

In order to alleviate the ponding water on the roof deck we recommend that a new supplemental floor drain and piping be placed in the existing slab at the low area in this location, and connected to the existing drain stack in the garage. All the existing drains should also be cleaned out in order to allow proper drainage.

The spalled concrete stair tread at the second level of the main elevator/stair tower should be repaired. Additionally, the failed vertical joint sealant within the stair towers should be cut out and replaced. It is also recommended that areas of failed mortar between the brick masonry and concrete lintels and at the north and south façades of the garage, and at the masonry and concrete elements at the exterior of the stair tower head houses be replaced.

Miscellaneous repairs include re-stripping the garage and other miscellaneous work.

Other repairs include upgrades in the mechanical, electrical, lighting, fire protection, elevators and security systems, as well as improved interior and exterior signage and landscaping.

We recommend performing all of the repairs at one time and under a single contract. This will reduce the future repair costs to the greatest extent possible. The estimated costs for projected repairs over the next 20 years of the life of the garage are detailed in Section 5 of this report.

***Pour Strip:*** Cast-in-place concrete infill between precast tees and structural frame.

***Traffic Bearing Waterproofing Membrane:*** This type of system is made up of layers of polyurethane and includes sand in the top layer to protect the membrane and provide a non-slip driving surface.

## 2. INTRODUCTION

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### A. Authorization

Desman Associates was retained by the City of Concord to provide consulting engineering services in order to perform a condition survey of the Capital Commons Parking Garage in Concord, New Hampshire. The survey was performed on October 3, 2014 in accordance with our proposal dated April 25, 2014.

### B. Scope of Services

The scope of services is outlined in detail in Desman's proposal. In summary, the services primarily consist of the following:

- Document review.
- Visual survey of the precast tee surfaces and soffits, cast-in-place concrete pour strips, asphalt slab-on-grade, columns, beams, walls, tee joints, drainage, stairs, façade, etc.
- Visual inspection of exterior and interior signage, surveillance system, elevators, lighting and landscaping.
- Preparation of a report summarizing the findings, recommendations and an expected cost estimate for existing repairs, as well as a 20 year repair schedule.

### C. Objective

It is the intent of this condition survey and assessment to: (1) document the current condition and estimate the influence of deterioration on safety; (2) determine the causes and extent of the deterioration, to the extent possible using the proposed testing techniques and visual observations; (3) develop recommended programs of repair, and (4) estimate the probable construction costs of the repair programs. The field visual inspection and review of existing documents are used to gain as much information about the structure as possible. Normally, an assumption during the evaluation of the condition is that the structure was designed and constructed adequately. Due to budget constraints and the on-going operations of the building, extensive destructive and non-destructive testing is beyond the scope of this investigation. Therefore, in the development of repair programs within this report, contingency funds must be anticipated and included in any budget for repairs to account for concealed, unknown, or unanticipated conditions which may be encountered.

#### **D. Parking Garage Repair and Restoration – An Overview**

As stated by the American Concrete Institute (ACI) Committee 362 in their report titled Guide for the Design of Durable Parking Structures, issued in 1994, *“The durability of parking structures is related to many factors, including weather, the use of deicer salts, concrete materials, concrete cover over reinforcement, drainage, design and construction practices, and the response of the structural system to loads and volume change. The most common types of deterioration and undesirable performance of parking structures are due to corrosion of reinforcement, freezing and thawing, cracking, ponding of water and water penetration. Even walls and columns suffer distress from leakage, splash and spray of salt-contaminated water.”*

Concrete is a stone-like material obtained by permitting carefully proportioned mixture of cement, sand and stone or other aggregate and water to harden in forms of the shape and dimensions of the desired structure. The advantages of this building material include its high fire and weather resistance, local availability at low cost and high compressive strength. On the other hand, it is a relatively brittle material whose tensile strength is low compared to its compressive strength. This limitation is overcome by using reinforcing steel in combination with concrete to reinforce it where its low tensile strength would normally limit the carrying capacity of the member.

With the widespread use of salt deicing programs for our nation's highways and roadways, the condition of our bridge decks, parking garages and other reinforced concrete structures directly exposed to these conditions began to change. The relationship between the deterioration and use of deicing salts was most evident by the extent of deterioration found in the "snow belt" states. With the development of this deterioration, programs were initiated to study the cause and effect of the problem in order that repair procedures and preventive maintenance could be instituted.

Research during this period confirmed that corrosion of the embedded reinforcing steel was the primary cause of the structural deterioration. It was further determined that the presence of chloride in the concrete (from both external and internal sources) greatly accelerated the development of the corrosion process. External sources of chlorides mainly occur from deicing salt applications. Internal sources consisted of calcium chloride admixtures to the concrete used in winter months to speed up the temperature sensitive curing of the concrete mix. Repair programs began to consider that the only method to stop all subsequent corrosion deterioration

recurrence was one where all concrete containing threshold values of the chlorides to cause corrosion was removed and chlorides were further prevented from entering the new concrete. However, removal of all concrete containing significant chlorides is seldom a practical solution.

The service environment of parking structures is more severe than most other buildings and is more nearly like that of highway bridges. In many cases, these structures are exposed to seasonal and daily ambient temperature variations. Deicing salts may be spread directly on the slab floors or may be deposited from wheel wells of vehicles. Extreme temperature and volume changes can cause cracking of the floors, beams, columns, and walls which can lead to the ingress of water and chlorides leading eventually to deterioration.

To the greatest extent possible, a field visual inspection, field testing, laboratory tests and office studies are used to gain as much information about the structure as possible. As stated by the ACI Committee 362 in an earlier report titled State of the Art Report on Parking Structures, issued in 1985, *"Repairing an existing deteriorated structure involves many unknowns, uncertainties and risks. Especially with regard to repair of deicer caused corrosion damage, the process is considered an extension of the useful life of the deteriorated structure. It is not equivalent to building a new structure with current technology."* Therefore, in the development of repair programs within this report, contingency funds must be anticipated and included in any budget for repairs to account for concealed, unknown, or unanticipated conditions which may be encountered.

### **3. DESCRIPTION of FACILITY**

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The Capital Commons Parking Garage is located adjacent to the Capital Commons Building in Concord, New Hampshire. The structure consists of four supported levels and a slab on grade. The garage was constructed in 2007. The north facade is adjacent to an alley way, retail and the Endicott Hotel building, the south facade is adjacent to retail and a surface parking lot, the east facade is adjacent to Storrs Street, while the west facade is adjacent to the Capital Commons building. The parking garage has a capacity of approximately 516 vehicles.

The garage is rectangular in shape and measures approximately 255' x 167'. There is an entrance/exit to the garage at the southeastern corner of the grade level. This consists of a single entrance, a single exit and a reversible lane divided by a series of plastic bollards. An access way at the southwestern corner of the garage, leads to an overhead door at an adjacent retail building.

There is a rectangular light well bounded by 'gridlines 2 and 4' and 'gridlines CC and GG' at the center of the garage. The two bays at the north and south of the light well are flat, while the two bays at the east and west of the light well are ramped, and provide two-way traffic up and down through the garage. All traffic in the garage is two-way and the parking stalls are painted at 90°.

The structural system of the parking garage consists of precast, pre-topped, concrete double tees spanning the two exterior 60' parking bays. The interior double tees (at the north and south ends of the light well) are 55' long. The tees are supported by precast walls and spandrels at the outside of the garage, precast spandrels at the perimeter of the light well, and inverted tee beams at the interior of the garage. Subsequently, the spandrels, walls and inverted tee beams are supported by a frame of precast concrete columns. There are a series of cast-in-place concrete pour strips located adjacent to the exterior perimeter walls and around the light well of the garage, as well as at the crossover between the bays, running from north to south.

There is a main elevator/stair tower at the west end of the garage and two additional stair towers at the northwest and southeast corners of the garage. Lighting is provided by pendent mounted metal halide light fixtures inside the garage, and pole mounted fixtures at the roof level.



The exterior façade of the parking structure primarily consists of concrete spandrels that are inset with brick masonry. The exposed portions of the exterior columns are also clad in brick masonry. Many of the spandrel and wall openings at the exterior façade are covered with an architectural metal screen. Other sections of the exterior façade consist of aluminum and glass curtain walls at the stair/elevator towers. The interior façade at the light well consists of precast concrete columns and spandrels.

## 4. VISUAL OBSERVATIONS and FINDINGS

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### A. Visual Observations

A detailed visual observation was made of the concrete double tees, framing, pour strips, asphalt slab-on-grade, precast joints, stairs, façade, and drainage system of the parking garage. The observations were documented on floor and ceiling plans. Photographs were also used to document the various conditions and distressed areas in the garage.

A summary of visual observations is as follows:

- The precast, pre-topped concrete decks of the garage were typically observed to be in a 'like new' condition. Concrete floor deterioration was only observed at a few sections of the pour strips.



- While the tee flanges were also observed to be in 'like new' condition, a few areas of chipped concrete were observed at the underside of some of the tee stems.



- Vertical and overhead spalling at the precast concrete columns and walls were observed in a few locations in the garage.



- A few areas of deteriorated asphalt were also observed at the slab-on-grade.



- Cracks in the precast, pre-topped tees and at the cast-in-place pour strips were observed on all supported levels of the parking garage.



- The sealants between the precast concrete elements making up the supported floor slabs of the garage, appear to typically have either failed or are reaching the end of their useful service life. Failed precast sealants were observed throughout the parking garage.



- The cast-in-place concrete pour strips at the crossover bays are protected with a traffic bearing waterproofing membrane. This membrane was observed to be wearing thin in some locations on the second floor of the garage.



- An area of ponding water was observed at the northern end of the roof level deck.



- While all of the stair towers appear to be in good condition, some of the sealant at the vertical joints within the stair towers was observed to be failed. Additionally, some spalling was observed at one of the stair treads at the second level of the main elevator/stair tower.



- Some of the mortar between the brick masonry and concrete lintels and at the north and south façades of the garage was observed to be failed and is washing out. The mortar between some of the masonry and concrete elements at the exterior of the stair tower head houses at the roof level exhibited similar failure.



## **B. Findings**

The following is a summary of the deterioration conditions that were noted at the various structural and architectural components of the parking garage.

### **1. Supported Slabs**

The supported, pre-topped concrete double tees in the parking garage are in good overall condition. A few areas of concrete deterioration were observed along the cast-in-place concrete pour strips on all levels of the garage. The overhead tee flanges and stems were observed to be in good condition, with only a handful of areas of tee stem spalling.

### **2. Structural Frame**

The frame of the parking garage consists of precast concrete elements. A series of inverted tee beams, columns, spandrels and walls support the double tees. Overall, the precast frame elements were observed to be in good condition, with only a few areas of spalling at some of the walls and columns.

### **3. Waterproofing**

The cast-in-place concrete pour strips at the crossover between the bays, running from north to south, are protected by a traffic bearing waterproofing membrane. This membrane was observed to be in good condition on all levels of the garage except at the pour strips on the lower portion of the second floor, where it was observed to be wearing out. It is important to note that traffic bearing waterproofing membrane will generally begin failing 8 to 10 years after its application. Thus in addition to sections of this membrane wearing thin due to vehicular traffic, all of the original membrane will eventually fail and need to be replaced.

The sealant at the tee joints is typically failed or approaching the end of its useful life. This sealant, which is intended to prevent water from leaking through the floors, was observed to have failed throughout the garage, and in many areas it was observed to be cracking. Evidence of water leaking through the joints was also observed in a few locations. It is our experience that precast sealants will begin to fail within 7 to 10 years after application. The sealants at the Capital Commons Garage have entered this window.

Cracks in the precast, pre-topped tees and at the cast-in-place pour strips were observed on all levels of the parking garage. These cracks have not been sealed and are allowing water to travel through the slabs.

4. Deck Drainage

Overall the deck drainage is in good condition. Though a few of the floor drains in the parking garage were observed to be clogged with dirt and debris, they were not observed to be deteriorated.

A medium sized ponding area was observed at the northern end of the roof level deck.

5. Stairs

Overall the stairs are in good condition. An area of spalling concrete was observed at one of the stair treads at the second level of the main elevator/stair tower. Additionally, some of the sealant at the vertical joints within the stair towers was observed to be failed.

6. Building Façade

The façade appears to be in good condition. Some of the mortar between the brick masonry and concrete lintels at the north and south façades of the garage were observed to be failed and are washing out. Other observations at the façade included similar failure at some of the mortar joints between the masonry and concrete elements at the exterior of the stair tower head houses, at the roof level.

**C. Observations of Other Systems and Components**

Mechanical, Electrical, Plumbing, Fire Protection, Exterior and Interior Signage, Security System, Elevators, Lighting and Landscaping

See Appendix A for CHA's report outlining the garage mechanical, electrical, plumbing, fire protection, and security system recommendations.

Desman's cost recommendations for exterior and interior signage, as well as landscaping, are representative of similar projects.

## 5. RECOMMENDED REPAIRS and COST ESTIMATE

---

The repair scheme presented here is a comprehensive repair program that addresses the issues at the Capital Commons Parking Garage. The work items described in this report will ensure that the garage remains in an acceptable service condition and extend the useful service life of the structure.

Table 5.1 prioritizes the current repairs and projects the repairs over the next 20 years of the life of the garage. It is based on costs obtained for work in the local region for similar types of repair and preventive maintenance work, and previous experience with rehabilitation projects.

The primary deterioration conditions observed at the supported decks are the failure of the precast joint sealants, as well as minor delamination of the concrete at the cast-in-place pour strips and concrete structural elements, and cracking at the surface of the tees and pour strips. In order to maintain the parking garage at the best possible condition and to ensure the long term durability of the structure, the deteriorated concrete must be repaired and conditions that allow for water and corrosion causing contaminants to penetrate the slab must be addressed. Structural repairs include concrete pour strip repairs, overhead tee stem repairs, as well as concrete column and wall repairs.

Waterproofing measures are imperative to protect the structural repairs and help slow future deterioration. We recommend replacing all of the existing sealants between precast floor joints in the parking garage. After the replacement of these existing sealants, it is also recommended that the areas of waterproofing membrane that are wearing thin at the second floor pour strips be re-coated.

Other waterproofing repairs include routing and sealing floor cracks at the precast, pre-topped tees and at the cast-in-place pour strips.

In order to alleviate the ponding water on the roof deck we recommend that a new supplemental floor drain and piping be placed in the existing slab at the low area in this location, and connected to the existing drain stack in the garage. All the existing drains should also be cleaned out in order to allow proper drainage.

The spalled concrete stair tread at the second level of the main elevator/stair tower should be repaired. Additionally, the failed vertical joint sealant within the stair towers should be cut out and replaced. It is

also recommended that areas of failed mortar between the brick masonry and concrete lintels and at the north and south façades of the garage, and at the masonry and concrete elements at the exterior of the stair tower head houses be replaced.

Miscellaneous repairs include re-stripping the garage and other miscellaneous work.

We recommend performing all of the repairs at one time and under a single contract. This will reduce the future repair costs to the greatest extent possible. If budget constraints do not allow the implementation of a comprehensive repair program, the recommended repairs can be prioritized over a number of years.

Regardless of the repair program that is eventually chosen, there will be maintenance costs for the annual upkeep of the parking garage. A comprehensive repair program will reduce the future maintenance, while a phased program will result in higher repair and maintenance costs due to the continued deterioration of the decks.

Desman's recommendations for upgrades to the interior and exterior signage at the garage, as well as landscaping, are representative of similar projects. Additional recommendations in the MEP report include upgrades to the mechanical, electrical, plumbing, fire protection, elevators and lighting systems in the garage.



## 6. DETERIORATION MECHANISMS

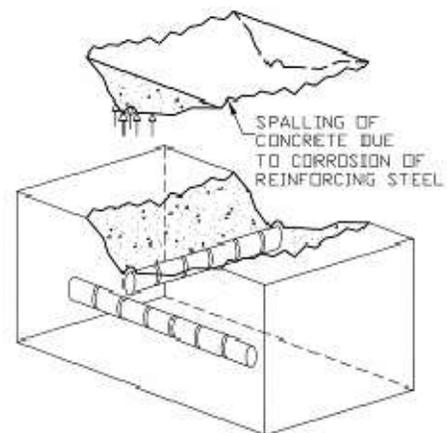
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Reinforced concrete deterioration is typically caused by one or more factors of deterioration mechanisms, including corrosion of reinforcement, water penetration, freeze-thaw cycling, volume change, or chemical attack. Any one, or combination, of these deterioration mechanisms can adversely impact the behavior/performance of a reinforced concrete structure. These adverse impacts include corrosion-induced distress, loss of reinforcing cross section, scaling, leaking, cracking, and delamination of the concrete. The following is a brief discussion of each of the mechanisms noted above, and their effect on reinforced concrete structures.

### A. Water Penetration

The primary cause of the majority of reinforced concrete deterioration within parking structures is directly related to the penetration of water into the concrete. The corrosion of embedded reinforcing steel, scaling, leaking, leaching, and delaminated concrete are all partially caused by water penetration.

Concrete is a porous material, which is susceptible to water penetration and the resultant deterioration. The corrosion of embedded reinforcing steel is an electrochemical process supported by the presence of water acting as an electrolyte. In addition, water penetrating into concrete can carry water-soluble chlorides, from de-icing salts, to the reinforcing. The combination of chlorides and water accelerates the corrosion process (reference Figure 7.1).



*Figure 7.1*

Scaling is also directly related to water penetration into concrete. Scaling is a surface deterioration resulting from pressures developed by the freeze-thaw cycling of saturated concrete. These pressures within the pore structure cause progressive failure of the cement/sand paste. This progressive failure begins with degradation of the exposed surface, advances to the exposure of coarse aggregate and in severe cases, causes paste failure surrounding the coarse aggregate. This will destroy the paste/aggregate bond.

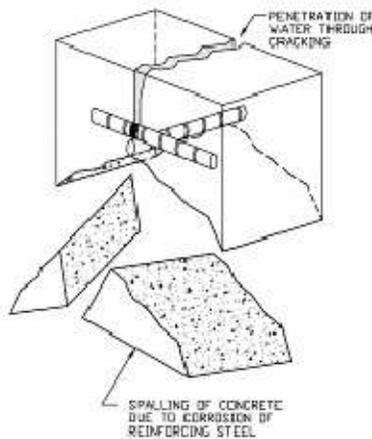
Leaking water exposes underlying members, such as reinforcing steel, to water and potentially chlorides, resulting in deterioration of these members. Water penetration through a concrete section, cracked or uncracked, can cause leaching of minerals from within the concrete matrix. Leaching is the result of frequent water penetration carrying water-soluble products within the concrete to the surface below. Continued leaching will adversely affect the concrete over time.

Water penetration can also cause delamination of concrete along subsurface fractures through pressures generated during freeze-thaw cycling.

**B. Corrosion of Embedded Reinforcement**

Corrosion of reinforcing steel, or other embedded ferrous items such as electrical conduit, is the second major factor contributing to deterioration of reinforced concrete (reference Figure 7.2).

This corrosion process produces by-products or rust. These by-products occupy a minimum of 250% of the volume of the parent metal. This increase in volume produces tensile stresses within the surrounding concrete. As concrete has poor tensile strength properties, cracking will occur, allowing additional moisture and chlorides to reach the reinforcing steel, thereby accelerating the corrosion process. The deterioration caused by this corrosion includes the reduction of the cross sectional area of the reinforcing and the delamination of the surrounding concrete.



*Figure 7.2*

**C. Freeze – Thaw Damage**

Concrete deterioration caused by freeze-thaw cycles is the third major deterioration mechanism. The mechanism occurs within saturated concrete subjected to freezing and thawing and is due to the pressures generated within the pores of the concrete paste resulting from the volume changes of water during the freeze/thawing process. These pressures are even greater in the presence of de-icing chemicals/chlorides as these chemicals reduce the freezing point and indirectly increase the pore pressures.

As previously mentioned, these pressures can cause progressive failure of the cement paste and result in scaling of the concrete and delamination of concrete along subsurface fracture planes (reference Figure 7.3).

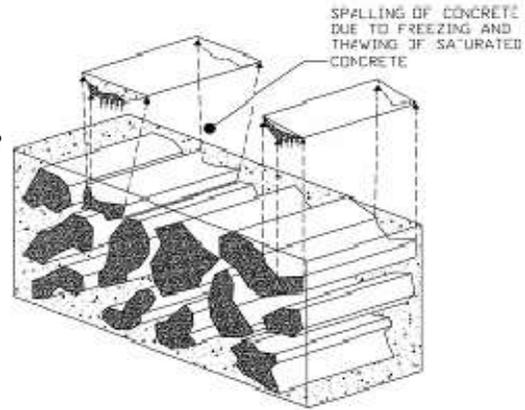


Figure 7.3

**D. Volume Changes**

Volume changes are the fourth major contributing factor of deterioration of reinforced concrete structures. Volume changes occur in both plastic and cured concrete. The volume changes can cause various types of cracking within the concrete member. Cracks allow access for water and contaminants to the concrete and reinforcing, resulting in accelerated deterioration. The cracking most often associated with plastic concrete is shrinkage cracking produced by the reduction in volume of the concrete during curing. Improper detailing, proportioning, placement or curing of the concrete can affect the extent of this cracking but the primary cause is the volume change that occurs during curing.

Volume changes due to thermal movement, shrinkage, creep, and loading can also contribute to the deterioration of reinforced concrete. These volume changes will produce stress in restrained members, which often results in cracking of the member (reference Figure 7.4).

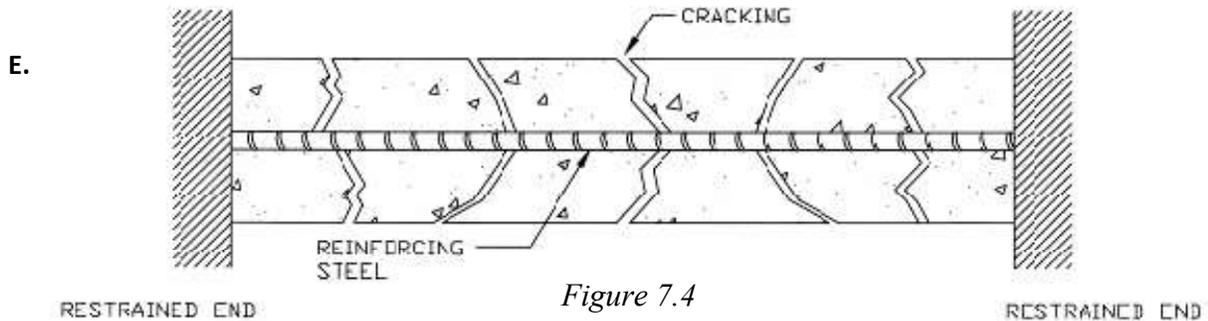


Figure 7.4

### **Chemical Attack**

Chemical attack is the roof major deterioration mechanism affecting the performance of reinforced concrete. The effect of de-icing chemical/chlorides upon reinforcing steel and scaling is one example of chemically influenced deterioration. In addition to this type of chemical attack, severe exposure to other chemicals, notably sulfates and acids, can cause deterioration of cement paste, cement paste/aggregate bond, and reinforcing steel.

In addition to these types of attack, chemical properties occurring within certain types of aggregates can cause an adverse reaction with the cement paste. The resulting volume changes can cause cracking of the concrete.

**CONDITION SURVEY REPORT**

*of the*

**DURGIN BLOCK PARKING GARAGE**

Concord, New Hampshire

*Prepared for*

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Director of Redevelopment  
**City of Concord NH**  
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***January 9, 2015***



**CONDITION SURVEY REPORT**  
of the  
**DURGIN BLOCK PARKING GARAGE**  
Concord, New Hampshire

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<b>Concord Parking Garages MEP Inspection and Condition Assessment</b>	
<b>Prepared by CHA</b>	
<b>Dated January 2015</b>	

## 1. EXECUTIVE SUMMARY

---

The Durgin Block Parking Garage is scheduled to undergo a significant repair and rehabilitation project. It is our understanding that this project will address current structural and waterproofing deterioration in the garage.

Several Mechanical, Electrical and Plumbing system repair items have been noted. These items are more thoroughly discussed in Appendix A of this report and include some of the following.

- Replacement of deteriorated electrical components
- Replacement of deteriorated drains and associated piping
- Standpipe repairs
- Lighting upgrades
- Elevator modernization
- New surveillance system

A comprehensive cost estimate for current repairs and a 20 year life cycle repair is included in Section 5 of this report. The 20 year cost estimate is based on the garage undergoing the planned repair effort.

## 2. INTRODUCTION

---

### A. Authorization

Desman Associates was retained by the City of Concord to provide consulting engineering services in order to perform a condition survey of the Durgin Block Parking Garage in Concord, New Hampshire. The survey was performed on September 26, 2014 in accordance with our proposal dated April 25, 2014.

### B. Scope of Services

The scope of services is outlined in detail in Desman's proposal. In summary, the services primarily consist of the following:

- Document review.
- Visual survey of the supported slab surfaces, pan/joist slab soffits, concrete slab-on-grade, cast-in-place columns, beams, walls, curbs, expansion joints, construction joints, waterproofing membrane, drainage, stairs, façade, etc.
- Visual inspection of exterior and interior signage, garage lighting, surveillance system, elevators, lighting and landscaping.
- Visual inspection of potential capacity for on-site storage and water service.
- Preparation of a report summarizing the findings, recommendations and an expected cost estimate for existing repairs, as well as a 20 year repair schedule.

### C. Objective

It is the intent of this condition survey and assessment to: (1) document the current condition and estimate the influence of deterioration on safety; (2) determine the causes and extent of the deterioration, to the extent possible using the proposed testing techniques and visual observations; (3) develop recommended programs of repair, and (4) estimate the probable construction costs of the repair programs. The field visual inspection and review of existing documents are used to gain as much information about the structure as possible. Normally, an assumption during the evaluation of the condition is that the structure was designed and constructed adequately. Due to budget constraints and the on-going operations of the building, extensive destructive and non-destructive testing is beyond the scope of this investigation. Therefore, in the development of repair programs within this report, contingency funds must be

anticipated and included in any budget for repairs to account for concealed, unknown, or unanticipated conditions which may be encountered.

#### **D. Parking Garage Repair and Restoration – An Overview**

As stated by the American Concrete Institute (ACI) Committee 362 in their report titled Guide for the Design of Durable Parking Structures, issued in 1994, *“The durability of parking structures is related to many factors, including weather, the use of deicer salts, concrete materials, concrete cover over reinforcement, drainage, design and construction practices, and the response of the structural system to loads and volume change. The most common types of deterioration and undesirable performance of parking structures are due to corrosion of reinforcement, freezing and thawing, cracking, ponding of water and water penetration. Even walls and columns suffer distress from leakage, splash and spray of salt-contaminated water.”*

Concrete is a stone-like material obtained by permitting carefully proportioned mixture of cement, sand and stone or other aggregate and water to harden in forms of the shape and dimensions of the desired structure. The advantages of this building material include its high fire and weather resistance, local availability at low cost and high compressive strength. On the other hand, it is a relatively brittle material whose tensile strength is low compared to its compressive strength. This limitation is overcome by using reinforcing steel in combination with concrete to reinforce it where its low tensile strength would normally limit the carrying capacity of the member.

With the widespread use of salt deicing programs for our nation's highways and roadways, the condition of our bridge decks, parking garages and other reinforced concrete structures directly exposed to these conditions began to change. The relationship between the deterioration and use of deicing salts was most evident by the extent of deterioration found in the "snow belt" states. With the development of this deterioration, programs were initiated to study the cause and effect of the problem in order that repair procedures and preventive maintenance could be instituted.

Research during this period confirmed that corrosion of the embedded reinforcing steel was the primary cause of the structural deterioration. It was further determined that the presence of chloride in the concrete (from both external and internal sources) greatly accelerated the development of the corrosion process. External sources of chlorides mainly occur from deicing salt applications. Internal sources consisted of calcium chloride admixtures to the concrete used

in winter months to speed up the temperature sensitive curing of the concrete mix. Repair programs began to consider that the only method to stop all subsequent corrosion deterioration recurrence was one where all concrete containing threshold values of the chlorides to cause corrosion was removed and chlorides were further prevented from entering the new concrete. However, removal of all concrete containing significant chlorides is seldom a practical solution.

The service environment of parking structures is more severe than most other buildings and is more nearly like that of highway bridges. In many cases, these structures are exposed to seasonal and daily ambient temperature variations. Deicing salts may be spread directly on the slab floors or may be deposited from wheel wells of vehicles. Extreme temperature and volume changes can cause cracking of the floors, beams, columns, and walls which can lead to the ingress of water and chlorides leading eventually to deterioration.

To the greatest extent possible, a field visual inspection, field testing, laboratory tests and office studies are used to gain as much information about the structure as possible. As stated by the ACI Committee 362 in an earlier report titled State of the Art Report on Parking Structures, issued in 1985, *"Repairing an existing deteriorated structure involves many unknowns, uncertainties and risks. Especially with regard to repair of deicer caused corrosion damage, the process is considered an extension of the useful life of the deteriorated structure. It is not equivalent to building a new structure with current technology."* Therefore, in the development of repair programs within this report, contingency funds must be anticipated and included in any budget for repairs to account for concealed, unknown, or unanticipated conditions which may be encountered.

### 3. DESCRIPTION of FACILITY

---

The Durgin Block parking garage is located just off of North Main Street, behind Capital Plaza, between School and Warren Streets in Concord, New Hampshire. It is a free standing garage with a slab on grade and three and one half supported levels of parking. The parking structure has a capacity of approximately 450 vehicles and serves monthly and short term parking for downtown Concord.

The parking garage is rectangular in shape with overall outside dimensions of approximately 284' x 122'. There is an entrance/exit to the garage from both School and Warren Streets. The garage is a two bay single threaded helix. The east bay is flat and the west bay is sloped to provide travel between the parking levels. All traffic in the garage is two-way and the parking stalls are painted at 90°.

The structural system of the parking garage consists of one-way, post-tensioned, cast-in-place concrete slabs. The supported slabs are 7 ½" thick. The slabs span between steel beams, which have a typical spacing of 27'. The beams frame into steel columns.

There is an expansion joint in the garage, which allows for movement due to temperature change, shrinkage, creep, etc. A traffic bearing waterproofing membrane covers all of the supported levels of the garage.

Post – tensioning is a method of reinforcing concrete slabs that uses steel cables to induce forces into the slab that work opposite to the forces placed on the slab from vehicles, etc. Current building codes provide for the use of additional mild steel reinforcing bars to help control cracking. The steel p/t cables are typically ½" thick and are made of 7 individual steel wires. The cables are greased and a plastic sheathing is placed on the cables to provide protection against corrosion causing elements.

During construction the cables are draped within the form work. They are set near the top of the slab at the column lines and near the bottom at the mid-point between columns. Once the slabs are placed and cured, the cables are stressed to provide a force in the opposite direction to the loads (vehicles, self-weight, etc.) placed on the deck. Diagram 3.1 depicts the layout and forces of the slab tendons and how these forces resist the deflection of the slab under loading.

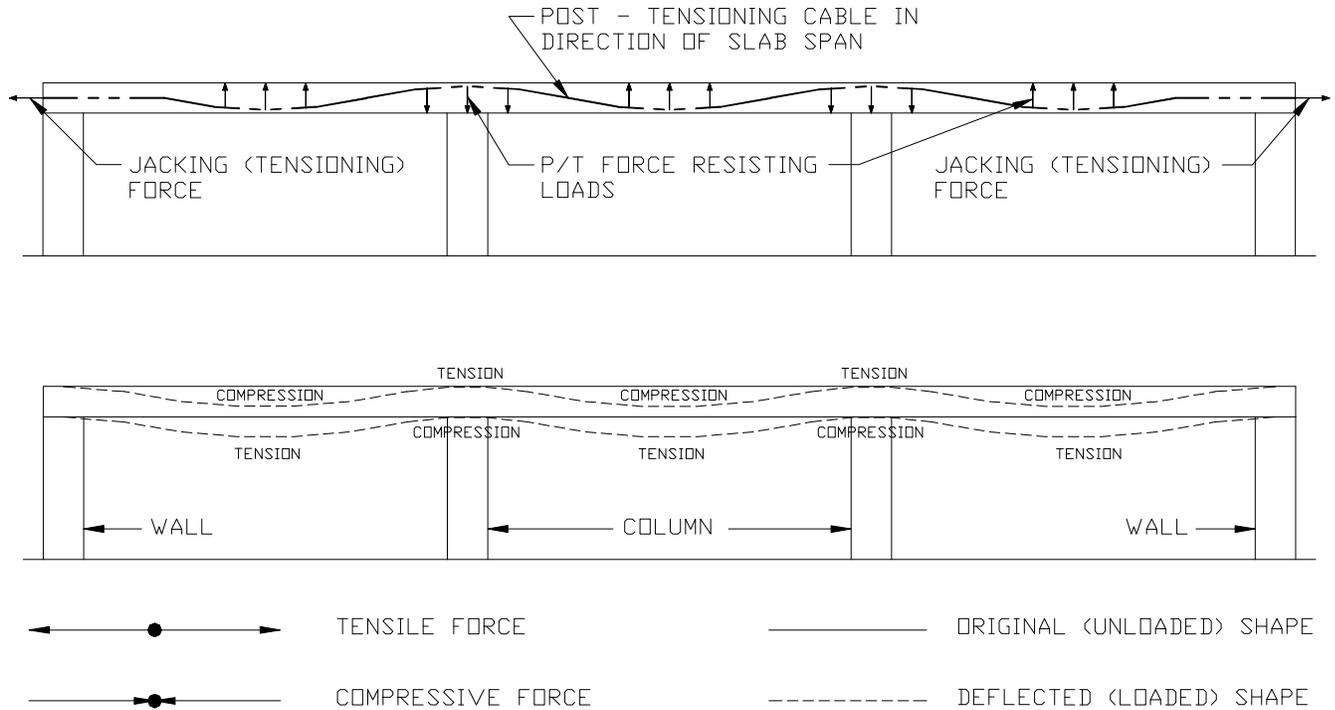


Diagram 3.1

The diagram above indicates that tensioning is performed at the edge of the slabs, which is typical in this type of construction. The tendons are also anchored at the expansion joint and there are intermediate anchors at the construction joints, where one concrete placement abuts a subsequent placement.

The façade of the garage typically consists of concrete parapet walls, which are also the vehicle barrier system. The east façade, which faces Capitol Plaza has received an inlay of brick masonry to match the plaza area.

There are two steel stair towers in the parking garage and an elevator. The stair towers are in the northeast and southeast corners of the garage. The elevator is located at the midpoint of the east bay, along the outside wall of the garage. Lighting in the garage is provided by ceiling mounted florescent fixtures.

## **4. VISUAL OBSERVATIONS and FINDINGS**

---

### **A. Visual Observations**

It is our understanding that a comprehensive structural and waterproofing repair project is scheduled for the Durgin Block parking garage. For the purposes of this report, the visual findings and observations addressed only items that are not believed to be scheduled for repairs.

A list of observations and findings for several garage components is included in Appendix A of this report.

## **5. RECOMMENDED REPAIRS and COST ESTIMATE**

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The recommended repairs and cost estimates presented in this section are based on the garage undergoing a comprehensive structural and waterproofing repair project. It is our understanding that this project will take place over the next year or two.

Current recommendations for repair generally fall under Mechanical, Electrical or Plumbing trades and are detailed further in Appendix A of this report. Additional upgrades, such as signage, elevator and security systems, have been requested by the City and are included in the cost estimates.

A comprehensive cost estimate for current repairs and a 20 year life cycle repair is included in this section. The 20 year cost estimate is based on the garage undergoing the planned repair effort.



## 6. DETERIORATION MECHANISMS

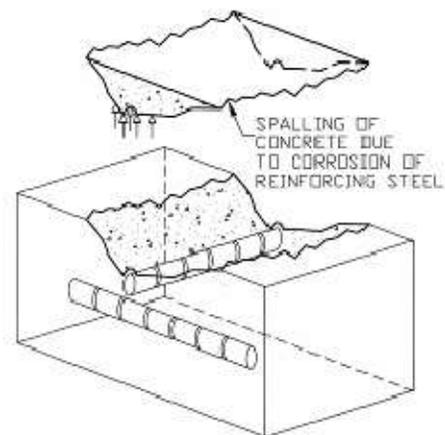
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Reinforced concrete deterioration is typically caused by one or more factors of deterioration mechanisms, including corrosion of reinforcement, water penetration, freeze-thaw cycling, volume change, or chemical attack. Any one, or combination, of these deterioration mechanisms can adversely impact the behavior/performance of a reinforced concrete structure. These adverse impacts include corrosion-induced distress, loss of reinforcing cross section, scaling, leaking, cracking, and delamination of the concrete. The following is a brief discussion of each of the mechanisms noted above, and their effect on reinforced concrete structures.

### A. Water Penetration

The primary cause of the majority of reinforced concrete deterioration within parking structures is directly related to the penetration of water into the concrete. The corrosion of embedded reinforcing steel, scaling, leaking, leaching, and delaminated concrete are all partially caused by water penetration.

Concrete is a porous material, which is susceptible to water penetration and the resultant deterioration. The corrosion of embedded reinforcing steel is an electrochemical process supported by the presence of water acting as an electrolyte. In addition, water penetrating into concrete can carry water-soluble chlorides, from de-icing salts, to the reinforcing. The combination of chlorides and water accelerates the corrosion process (reference Figure 7.1).



*Figure 7.1*

Scaling is also directly related to water penetration into concrete. Scaling is a surface deterioration resulting from pressures developed by the freeze-thaw cycling of saturated concrete. These pressures within the pore structure cause progressive failure of the cement/sand paste. This progressive failure begins with degradation of the exposed surface, advances to the exposure of coarse aggregate and in severe cases, causes

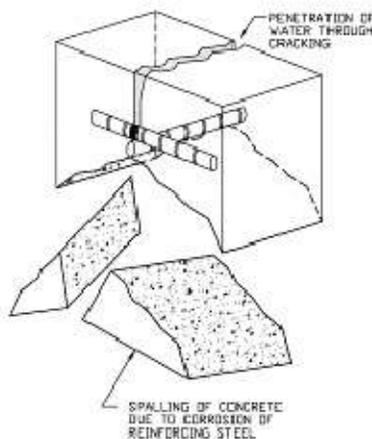
paste failure surrounding the coarse aggregate. This will destroy the paste/aggregate bond. Leaking water exposes underlying members, such as reinforcing steel, to water and potentially chlorides, resulting in deterioration of these members. Water penetration through a concrete section, cracked or uncracked, can cause leaching of minerals from within the concrete matrix. Leaching is the result of frequent water penetration carrying water-soluble products within the concrete to the surface below. Continued leaching will adversely affect the concrete over time.

Water penetration can also cause delamination of concrete along subsurface fractures through pressures generated during freeze-thaw cycling.

#### **B. Corrosion of Embedded Reinforcement**

Corrosion of reinforcing steel, or other embedded ferrous items such as electrical conduit, is the second major factor contributing to deterioration of reinforced concrete (reference Figure 7.2).

This corrosion process produces by-products or rust. These by-products occupy a minimum of 250% of the volume of the parent metal. This increase in volume produces tensile stresses within the surrounding concrete. As concrete has poor tensile strength properties, cracking will occur, allowing additional moisture and chlorides to reach the reinforcing steel, thereby accelerating the corrosion process. The deterioration caused by this corrosion includes the reduction of the cross sectional area of the reinforcing and the delamination of the surrounding concrete.



*Figure 7.2*

#### **C. Freeze – Thaw Damage**

Concrete deterioration caused by freeze-thaw cycles is the third major deterioration mechanism. The mechanism occurs within saturated concrete subjected to freezing and thawing and is due to the pressures generated within the pores of the concrete paste resulting from the volume changes of water during the freeze/thawing process. These pressures are even greater in the presence of de-icing chemicals/chlorides as these chemicals reduce the freezing point and indirectly increase the pore pressures.

As previously mentioned, these pressures can cause progressive failure of the cement paste and result in scaling of the concrete and delamination of concrete along subsurface fracture planes (reference Figure 7.3).

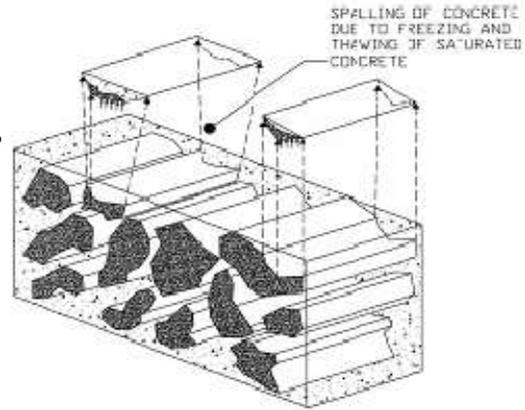


Figure 7.3

**D. Volume Changes**

Volume changes are the fourth major contributing factor of deterioration of reinforced concrete structures. Volume changes occur in both plastic and cured concrete. The volume changes can cause various types of cracking within the concrete member. Cracks allow access for water and contaminants to the concrete and reinforcing, resulting in accelerated deterioration. The cracking most often associated with plastic concrete is shrinkage cracking produced by the reduction in volume of the concrete during curing. Improper detailing, proportioning, placement or curing of the concrete can affect the extent of this cracking but the primary cause is the volume change that occurs during curing.

Volume changes due to thermal movement, shrinkage, creep, and loading can also contribute to the deterioration of reinforced concrete. These volume changes will produce stress in restrained members, which often results in cracking of the member (reference Figure 7.4).

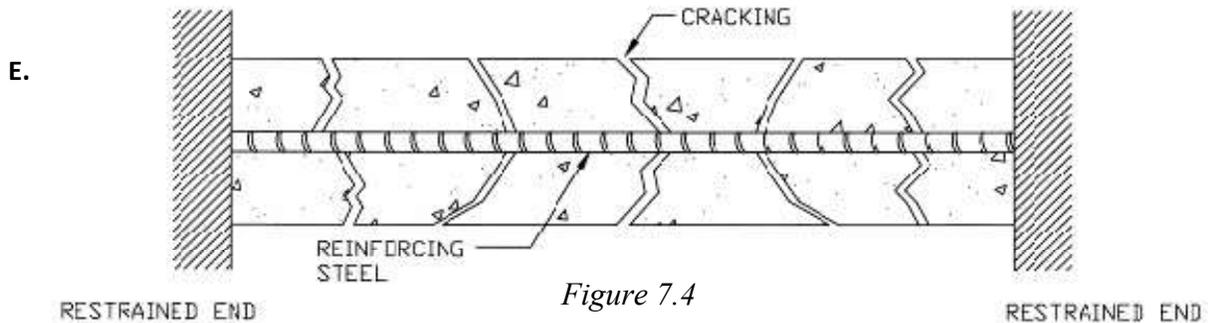


Figure 7.4

### **Chemical Attack**

Chemical attack is the roof major deterioration mechanism affecting the performance of reinforced concrete. The effect of de-icing chemical/chlorides upon reinforcing steel and scaling is one example of chemically influenced deterioration. In addition to this type of chemical attack, severe exposure to other chemicals, notably sulfates and acids, can cause deterioration of cement paste, cement paste/aggregate bond, and reinforcing steel.

In addition to these types of attack, chemical properties occurring within certain types of aggregates can cause an adverse reaction with the cement paste. The resulting volume changes can cause cracking of the concrete.

**CONDITION SURVEY REPORT**

*of the*

**FIREHOUSE BLOCK PARKING GARAGE**

Concord, New Hampshire

*Prepared for*

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***January 9, 2015***



**CONDITION SURVEY REPORT**  
of the  
**FIREHOUSE BLOCK PARKING GARAGE**  
Concord, New Hampshire

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**Appendix A    Concord Parking Garages MEP Inspection and Condition Assessment**  
**Prepared by CHA**  
**Dated January 2015**

## 1. EXECUTIVE SUMMARY

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The Firehouse Block Parking Garage is in fair overall condition at this time. The structural and waterproofing elements of the garage are suffering from various degrees of deterioration caused by the infiltration of water and corrosion causing elements. The parking structure requires the implementation of an effective restorative, protective and preventive maintenance program in order to address the current problems and ensure the continued long term durability of the structure.

The primary deterioration conditions observed in the parking garage are the corrosion related deterioration and cracking of the cast-in-place, supported pan/joist slabs. Water and corrosion causing elements are leaking through cracks in the supported slabs and creating delaminations and spalling at the cast-in-place concrete frame of the structure.

Deterioration of waterproofing elements is also an issue, including failures of expansion joints and sealants. The waterproofing membrane is showing signs of wear, and also de-bonding in areas. Many of the floor drains as well as some sections of piping in the garage were observed to be deteriorated.

In order to return the parking garage at the best possible condition and to ensure the long term durability of the structure, the deteriorated concrete must be repaired and conditions that allow for water and corrosion causing contaminants to penetrate the slab must be addressed.

Structural repairs include full and partial depth concrete repairs at the pan/joist slab. Other structural repairs include overhead concrete repairs at the joists and beams, slab-on-grade concrete floor repairs, as well as concrete column, wall, curb repairs and overhead concrete repairs at the stair runs and landings.

**Corrosion:** The oxidation, or rusting, of iron in embedded reinforcing steel, which causes the steel to expand.

**Delamination:** A horizontal, sub-surface, crack at the level of the reinforcing steel caused by the corrosion of the reinforcement.

**Spall:** As corrosion continues, the delaminated concrete will eventually break away, leaving a hole and exposed reinforcing.

**Pans and Joists:** Structural elements of the supported slabs at the Firehouse garage. See Section 3 for a full description.

Waterproofing repairs include sealing of cracks, replacing construction and cove joint sealants, failed crack repairs, as well as replacing deteriorated expansion joint seals. The existing traffic bearing waterproofing membrane requires maintenance, specifically removal and replacement of failed areas and re-coating of worn-out areas. The concrete floor slab repairs within these areas will also need to be re-coated. We also recommend that a concrete sealer be installed at the slab-on-grade.

In order to alleviate the water that is ponding on the deck we recommend the replacement of the existing damaged floor drains and damaged sections of piping in the garage.

Miscellaneous repairs include new traffic striping, removing all of the wheel stops in the garage, cleaning the existing drainage system and other miscellaneous repairs.

We recommend performing all of the repairs at one time and under a single contract. This will reduce the future repair costs to the greatest extent possible. The estimated costs for repairs are detailed in Section 6 of this report.

**Construction Joint:** The interface between a section of cured concrete slab and a subsequent placement of concrete slab.

**Cove Joint:** A concave joint between a horizontal and a vertical surface.

**Expansion Joint:** A physical division between two portions of a structure, which allows for movement due to changes in temperature, creep, shrinkage, etc. The joint is sealed with a gland to prevent leaking.

**Traffic Bearing Waterproofing Membrane:** This type of system is made up of layers of polyurethane and includes sand in the top layer to protect the membrane and provide a non-slip driving surface.

## 2. INTRODUCTION

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### A. Authorization

Desman Associates was retained by the City of Concord to provide consulting engineering services in order to perform a condition survey of the Firehouse Block Parking Garage in Concord, New Hampshire. The survey was performed on September 26, 2014 in accordance with our proposal dated April 25, 2014.

### B. Scope of Services

The scope of services is outlined in detail in Desman's proposal. In summary, the services primarily consist of the following:

- Document review.
- Visual survey of the supported slab surfaces, pan/joist slab soffits, concrete slab-on-grade, cast-in-place columns, beams, walls, curbs, expansion joints, construction joints, waterproofing membrane, drainage, stairs, façade, etc.
- Visual inspection of exterior and interior signage, garage lighting, surveillance system, elevators, lighting and landscaping.
- Visual inspection of potential capacity for on-site storage and water service.
- Preparation of a report summarizing the findings, recommendations and an expected cost estimate for existing repairs, as well as a 20 year repair schedule.

### C. Objective

It is the intent of this condition survey and assessment to: (1) document the current condition and estimate the influence of deterioration on safety; (2) determine the causes and extent of the deterioration, to the extent possible using the proposed testing techniques and visual observations; (3) develop recommended programs of repair, and (4) estimate the probable construction costs of the repair programs. The field visual inspection and review of existing documents are used to gain as much information about the structure as possible. Normally, an assumption during the evaluation of the condition is that the structure was designed and constructed adequately. Due to budget constraints and the on-going operations of the building, extensive destructive and non-destructive testing is beyond the scope of this investigation. Therefore, in the development of repair programs within this report, contingency funds must be

anticipated and included in any budget for repairs to account for concealed, unknown, or unanticipated conditions which may be encountered.

**D. Parking Garage Repair and Restoration – An Overview**

As stated by the American Concrete Institute (ACI) Committee 362 in their report titled Guide for the Design of Durable Parking Structures, issued in 1994, *“The durability of parking structures is related to many factors, including weather, the use of deicer salts, concrete materials, concrete cover over reinforcement, drainage, design and construction practices, and the response of the structural system to loads and volume change. The most common types of deterioration and undesirable performance of parking structures are due to corrosion of reinforcement, freezing and thawing, cracking, ponding of water and water penetration. Even walls and columns suffer distress from leakage, splash and spray of salt-contaminated water.”*

Concrete is a stone-like material obtained by permitting carefully proportioned mixture of cement, sand and stone or other aggregate and water to harden in forms of the shape and dimensions of the desired structure. The advantages of this building material include its high fire and weather resistance, local availability at low cost and high compressive strength. On the other hand, it is a relatively brittle material whose tensile strength is low compared to its compressive strength. This limitation is overcome by using reinforcing steel in combination with concrete to reinforce it where its low tensile strength would normally limit the carrying capacity of the member.

With the widespread use of salt deicing programs for our nation's highways and roadways, the condition of our bridge decks, parking garages and other reinforced concrete structures directly exposed to these conditions began to change. The relationship between the deterioration and use of deicing salts was most evident by the extent of deterioration found in the "snow belt" states. With the development of this deterioration, programs were initiated to study the cause and effect of the problem in order that repair procedures and preventive maintenance could be instituted.

Research during this period confirmed that corrosion of the embedded reinforcing steel was the primary cause of the structural deterioration. It was further determined that the presence of chloride in the concrete (from both external and internal sources) greatly accelerated the development of the corrosion process. External sources of chlorides mainly occur from deicing salt applications. Internal sources consisted of calcium chloride admixtures to the concrete used

in winter months to speed up the temperature sensitive curing of the concrete mix. Repair programs began to consider that the only method to stop all subsequent corrosion deterioration recurrence was one where all concrete containing threshold values of the chlorides to cause corrosion was removed and chlorides were further prevented from entering the new concrete. However, removal of all concrete containing significant chlorides is seldom a practical solution.

The service environment of parking structures is more severe than most other buildings and is more nearly like that of highway bridges. In many cases, these structures are exposed to seasonal and daily ambient temperature variations. Deicing salts may be spread directly on the slab floors or may be deposited from wheel wells of vehicles. Extreme temperature and volume changes can cause cracking of the floors, beams, columns, and walls which can lead to the ingress of water and chlorides leading eventually to deterioration.

To the greatest extent possible, a field visual inspection, field testing, laboratory tests and office studies are used to gain as much information about the structure as possible. As stated by the ACI Committee 362 in an earlier report titled State of the Art Report on Parking Structures, issued in 1985, *"Repairing an existing deteriorated structure involves many unknowns, uncertainties and risks. Especially with regard to repair of deicer caused corrosion damage, the process is considered an extension of the useful life of the deteriorated structure. It is not equivalent to building a new structure with current technology."* Therefore, in the development of repair programs within this report, contingency funds must be anticipated and included in any budget for repairs to account for concealed, unknown, or unanticipated conditions which may be encountered.

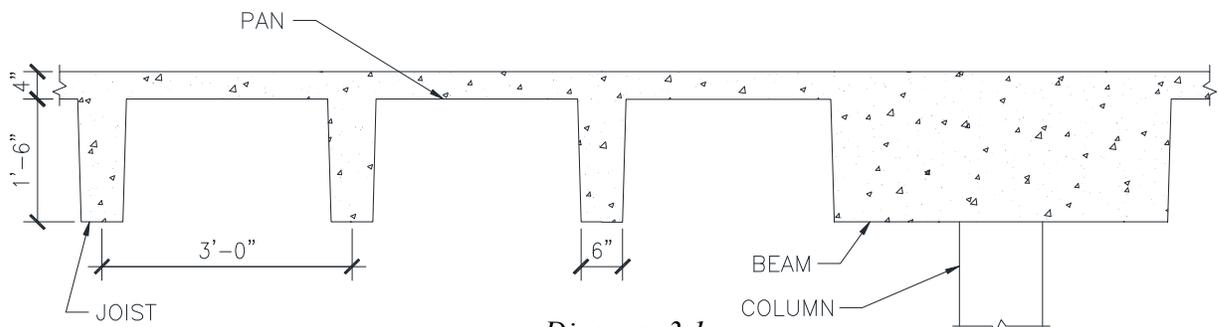
### 3. DESCRIPTION of FACILITY

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The Firehouse Block parking garage is located on North State Street between School and Warren Streets in Concord, New Hampshire. The parking structure is free standing, with two and a half supported levels of parking, and a slab-on-grade. It has a capacity of approximately 250 vehicles and serves as short term parking for downtown Concord.

The parking garage is irregular in shape. The west end of the garage is roughly square with overall outside dimensions of approximately 137' x 123'. The east end of the garage is a rectangle, measuring approximately 90' x 58'. There is an entrance/exit to the garage from both North State and Green Streets, which lead to the first supported level. There is a basement level of parking below the entrance level of the garage. The west end of the garage is a two bay single threaded helix. The south bay is flat, while the north bay is sloped and provides travel between the parking levels. The east end of the garage is flat and is a dead end, and is accessed from the west end of the garage. All traffic in the garage is two-way and the parking stalls are painted at 90°.

The structural system of the parking garage consists of one-way, cast-in-place concrete pan and joist slabs. The joists are spaced at 36" on center, are 18" deep and support a 4" thick pan. The slabs span between beams, which are the same depth as the joists. Typical column spacing is 27' x 33'. There is an expansion joint in the garage running from north to south at gridline 'G', which allows for movement due to temperature change, shrinkage, creep, etc. A traffic bearing waterproofing membrane covers all of the supported levels of the garage. Diagram 3.1 depicts a typical section through the supported slabs at the Firehouse Block parking garage.



The façade of the garage consists of cast-in-place concrete parapet walls, which also act as the vehicle barrier system. There are two stair towers in the parking garage, located at the southeast and southwest corners of the garage. Lighting is provided by ceiling mounted florescent light fixtures inside the garage, and pole mounted fixtures at the roof level.

## 4. VISUAL OBSERVATIONS and FINDINGS

---

### A. Visual Observations

- A detailed visual observation was made of the supported slab surfaces, pan/joist slab soffits, concrete slab-on-grade, cast-in-place columns, beams, walls, curbs, expansion joints, construction joints, waterproofing membrane, drainage, stairs, and façade of the parking garage. The observations were documented on floor and ceiling plans. Photographs were also used to document the various conditions and distressed areas in the garage.

A summary of visual observations is as follows:

- Deterioration at the cast-in-place concrete slab was observed at all the supported levels of the parking garage. This was typically worse at the lower supported levels of the parking garage.



- A few areas of spalling were also observed at the slab-on-grade.



- Several areas of spalling and cracking were observed at the underside of the concrete pans. Some spalls were also apparent at the underside of the concrete joists.



- Cracks and sections of spalled concrete were observed on some of the beams adjacent to the pan/joist sections of the slab.



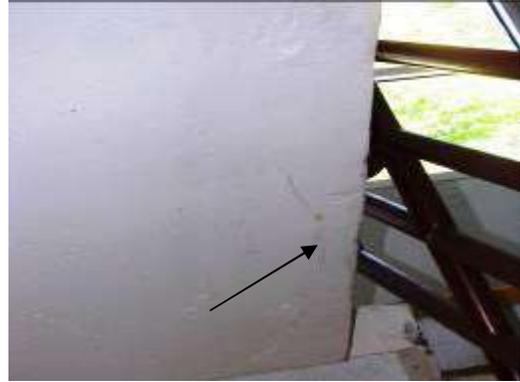
- Some of the cast-in-place concrete columns and walls in the garage were also observed to be suffering from corrosion related deterioration.



- Corrosion related deterioration and spalling was observed at some of the concrete curbs on all levels of the parking garage.



- Both stairwells exhibited some concrete deterioration at the underside of the stair runs and landings.



- Cracks at the cast-in-place concrete slab were observed on all levels of the parking garage. In addition, the sealant at previous crack repairs is failed in some areas throughout the garage, and as a result water is leaking through them.



- All of the sealant at the supported level construction joints was observed to be failed.



- The cove joints at the perimeter of each parking level, as well as between the curbs and floors, curbs and walls, floors and columns, are typically failed.



- A waterproofing membrane covers all of the supported levels of the garage. Worn out, as well as deteriorated areas of membrane exist at all supported levels.



- The expansion joints on the entry and roof levels are failing and are allowing water to travel between levels. In addition there is typically a strip of deteriorated concrete on either side of these joints.



- Some of the floor drains on all levels of the parking garage were observed to be deteriorated. A few of these drains are located within deteriorated areas of the concrete slab. Some sections of drain pipe were also observed to be suffering from corrosion related deterioration.



- Most of the wheel stops in the parking garage are severely deteriorated and create a potential trip hazard.



## **B. Findings**

The following is a summary of the deterioration conditions that were noted at the various structural and architectural components of the parking garage.

### **1. Supported Floor Slabs**

The cast-in-place concrete pan/joist slabs are typically in fair overall condition and are experiencing corrosion related deterioration in several areas throughout the parking garage. The failed expansion, construction and cove joints as well as the deteriorated membrane, are allowing water to flow into the concrete slabs and contributing to the observed concrete deterioration.

Water is leaking through the cracks and spalls in the slabs as well as at the damaged drain bodies and is causing the corrosion of the embedded reinforcing steel. The reinforcing steel in some of the underside concrete pans was also observed to be very close to the outer surface of the concrete, which is contributing to the deterioration. Since the cast-in-place concrete slabs over the pans are only 4" deep, any top side slab or underside pan deterioration would require a full depth repair.

Corrosion related deterioration and spalling was evident at some of the overhead joists, concrete curbs, and a few areas slab-on-grade deterioration were observed at the grade level of the garage. Additionally, most of the wheel stops in the parking garage are severely deteriorated and create a potential trip hazard.

### **2. Structural Frame**

The structural frame of the parking garage consists of a series of cast-in-place columns that support the cast-in-place pans/joist slabs. Overall, the frame elements of the parking garage were observed to be in fair condition, with some areas of spalling at the walls and columns, and at some of the beams.

Water flowing through the damaged expansion and construction joints, deteriorated drains and piping, and the deteriorated areas of the pan/joist slabs, is creating some cracks and spalls at the beams and columns.

Some spalling of the interior and perimeter concrete walls was also observed at a few areas in the garage.

3. Waterproofing

All of the supported levels are coated with a traffic bearing waterproofing membrane, which typically is in poor condition. This membrane is deteriorated in several areas where the concrete slabs have spalled as well as in areas around the damaged floor drains, and in areas around the turning radii. Sections of this membrane have also been torn away by regular traffic and weathering cycles. As a result several cracks have increased in width due to the freeze/ thaw cycle. This is allowing water to leak through the decks.

Other waterproofing elements in the garage were typically observed to be in a state of failure. Floor cracks have developed at the cast-in-place concrete slab on all levels of the garage and are allowing water to travel through the slabs. Additionally, the sealant at previous crack repairs is failed in some areas and as a result water is leaking through them. All of the sealant at construction joints within the garage was observed to have failed or is approaching the end of the useful life of the material.

The sealant at the cove joints, which is present at the joint between the horizontal surface of the deck and vertical surface of the columns, walls and curbs, was also observed to be typically failed on all levels.

4. Expansion Joints

There is an expansion joint in the parking garage, running from north to south at column line 'G'. The expansion joints allow the structure to move due to changes in temperature, concrete shrinkage, concrete creep, etc.

The expansion joints on the entry and roof levels are failing and are allowing water to travel between levels. In addition there is a lot of cracking and spalling of the concrete surrounding the expansion joints. Overall these expansion joints are in poor condition appear to have reached the end of their useful life.

5. Deck Drainage

Approximately a third of the drainage fixtures in the garage were suffering from some degree of deterioration. Some of the floor drains at all levels of the garage are damaged and are not allowing water to drain properly. A few of them are located within the deteriorated concrete slabs and as a result there are cracks and spalls in the concrete around them.

A few of the drainage pipe sections were observed to be corroding or broken. Overall the deck drainage is in fair to poor condition.

6. Stairs

The stairs in the facility consist of cast-in-place concrete steps and landings with metal handrails. Overall the stairs are in good condition. Both of the stairwells exhibited some overhead concrete deterioration at the underside of the stair runs and landings.

7. Building Façade

The façade of the parking garage primarily consists of cast-in-place concrete columns and walls. Overall the façade is in good condition and we did not observe any concrete deterioration.

**C. Previous Repairs**

There have been some previous repairs made to the structural and waterproofing elements of the parking garage, which have been an attempt to stabilize the deterioration. Around 2006, a repair program including full/partial depth concrete slab repairs, overhead concrete joist/beam repairs, routing and sealing cracks/construction joints, expansion joint repairs and replacing deteriorated drains and piping, was performed at Firehouse Block parking garage. The supported levels were also coated with a waterproofing membrane and the slab-on-grade was coated with a concrete surface sealer.

**D. Observations of Other Systems and Components**

Mechanical, Electrical, Plumbing, Fire Protection, Exterior and Interior Signage, Security System, Elevators, Lighting and Landscaping

See Appendix A for CHA's report outlining the garage mechanical, electrical, plumbing, fire



protection, and security system recommendations.

Desman's cost recommendations for exterior and interior signage, as well as landscaping, are representative of similar projects.

## 5. FIELD TESTING

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Sounding of the supported floor slabs revealed that cast-in-place concrete pan/joist slabs are delaminating in many areas, on all supported levels of the parking garage. The delaminations are due to the corrosion of the embedded reinforcing steel and have been caused by the presence of moisture and oxygen.

When salt laden moisture seeping through a concrete floor slab comes in contact with reinforcing steel it produces corrosion of the steel bars. The volume of rust is greater than the volume of the original steel. This greater volume exerts pressure on the surrounding concrete. Over time, this process continues until enough volume of rust builds up so that the pressure exerted by the rust results in the formation of a sub-surface horizontal crack in the floor slab. This horizontal cracking is known as a delamination and is not visible from the surface of the slab. Eventually the delamination results in a floor spall due to continued corrosion of the embedded steel and the forces of the freeze-thaw cycle.

A chain-drag sounding technique was performed at the supported decks to locate the delaminated areas of the slab, which are not visible to the naked eye. A chain dragged over the surface of a supported slab will produce a distinct hollow sound when it passes over a delaminated area. The chain-drag survey revealed that approximately 10% of concrete supported slabs in the parking garage are suffering from corrosion related deterioration.

## 6. RECOMMENDED REPAIRS and COST ESTIMATE

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The repair scheme presented here is a comprehensive repair program that addresses the issues at the Firehouse Block Parking Garage. The work items described in this report will ensure that the garage remains in an acceptable service condition and extend the useful service life of the structure.

Table 6.1 prioritizes the current repairs and projects the repairs over the next 20 years of the life of the garage. It is based on costs obtained for work in the local region for similar types of repair and preventive maintenance work, and previous experience with rehabilitation projects.

The primary deterioration conditions observed in the parking garage are the corrosion related deterioration, debonding and cracking of the supported cast-in-place pan/joist slabs. Water and corrosion causing elements are leaking through cracks in the slabs and creating delaminations and spalling at the surface of the concrete slabs, joists, beams, walls and columns.

In order to return the parking garage at the best possible condition and to ensure the long term durability of the structure, the deteriorated concrete must be repaired and conditions that allow for water and corrosion causing contaminants to penetrate the slab must be addressed. Structural repairs include partial depth and full depth concrete repairs at the pan/joist slabs, overhead concrete repairs at the joists, beams, stair runs and landings, as well as concrete column, wall and curb repairs. We also recommend repairing the deteriorated concrete at the slab-on-grade floor.

Waterproofing measures are imperative to protecting the structural repairs and help slow future deterioration. Waterproofing repairs include routing and sealing the floor cracks and removing and replacing failed sealants at previously repaired cracks. Also included are removing and replacing the failed sealant at the construction and cove joints, and replacing the deteriorated expansion joint seals at the entry and roof levels of the parking garage.

Other recommended waterproofing repairs include removing and replacing all the existing debonded and damaged membrane at the supported levels of the garage. A new traffic bearing waterproofing membrane should also be installed over areas of full and partial depth concrete slab repair. The balance of the supported levels should be re-coated with a new traffic bearing membrane. We also recommend

the application of a corrosion inhibiting sealer at the slab-on-grade.

We recommend the replacement of all of the existing damaged floor drains and damaged sections of piping in the garage. Other drainage repairs include cleaning out the existing drainage system.

Miscellaneous repairs include new traffic striping, removing all of the concrete wheel stops, and other miscellaneous repairs.

We recommend performing all of the repairs at one time and under a single contract. This will reduce the future repair costs to the greatest extent possible. If budget constraints do not allow the implementation of a comprehensive repair program, the recommended repairs can be prioritized over a number of years.

Regardless of the repair program that is eventually chosen, there will be maintenance costs for the annual upkeep of the parking garage. A comprehensive repair program will reduce the future maintenance, while a phased program will result in higher repair and maintenance costs due to the continued deterioration of the decks.

Desman's recommendations for upgrades to the interior and exterior signage at the garage, as well as landscaping, are representative of similar projects. Additional recommendations in the MEP report include upgrades to the mechanical, electrical, plumbing, fire protection, elevators and lighting systems in the garage.



## 7. DETERIORATION MECHANISMS

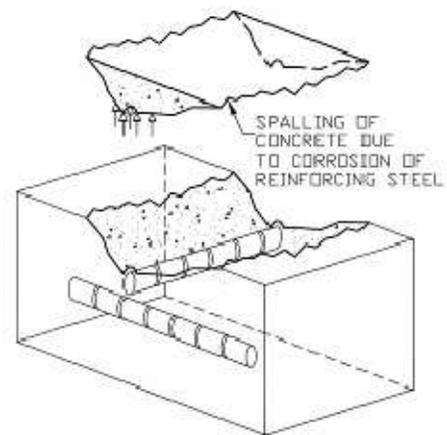
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Reinforced concrete deterioration is typically caused by one or more factors of deterioration mechanisms, including corrosion of reinforcement, water penetration, freeze-thaw cycling, volume change, or chemical attack. Any one, or combination, of these deterioration mechanisms can adversely impact the behavior/performance of a reinforced concrete structure. These adverse impacts include corrosion-induced distress, loss of reinforcing cross section, scaling, leaking, cracking, and delamination of the concrete. The following is a brief discussion of each of the mechanisms noted above, and their effect on reinforced concrete structures.

### A. Water Penetration

The primary cause of the majority of reinforced concrete deterioration within parking structures is directly related to the penetration of water into the concrete. The corrosion of embedded reinforcing steel, scaling, leaking, leaching, and delaminated concrete are all partially caused by water penetration.

Concrete is a porous material, which is susceptible to water penetration and the resultant deterioration. The corrosion of embedded reinforcing steel is an electrochemical process supported by the presence of water acting as an electrolyte. In addition, water penetrating into concrete can carry water-soluble chlorides, from de-icing salts, to the reinforcing. The combination of chlorides and water accelerates the corrosion process (reference Figure 7.1).



*Figure 7.1*

Scaling is also directly related to water penetration into concrete. Scaling is a surface deterioration resulting from pressures developed by the freeze-thaw cycling of saturated concrete. These pressures within the pore structure cause progressive failure of the cement/sand paste. This progressive failure begins with degradation of the exposed surface, advances to the exposure of coarse aggregate and in severe cases, causes paste failure surrounding the coarse aggregate. This will destroy the paste/aggregate bond.

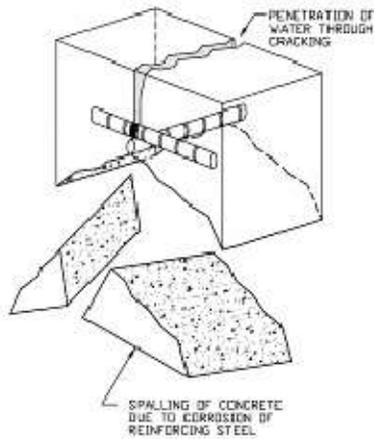
Leaking water exposes underlying members, such as reinforcing steel, to water and potentially chlorides, resulting in deterioration of these members. Water penetration through a concrete section, cracked or uncracked, can cause leaching of minerals from within the concrete matrix. Leaching is the result of frequent water penetration carrying water-soluble products within the concrete to the surface below. Continued leaching will adversely affect the concrete over time.

Water penetration can also cause delamination of concrete along subsurface fractures through pressures generated during freeze-thaw cycling.

**B. Corrosion of Embedded Reinforcement**

Corrosion of reinforcing steel, or other embedded ferrous items such as electrical conduit, is the second major factor contributing to deterioration of reinforced concrete (reference Figure 7.2).

This corrosion process produces by-products or rust. These by-products occupy a minimum of 250% of the volume of the parent metal. This increase in volume produces tensile stresses within the surrounding concrete. As concrete has poor tensile strength properties, cracking will occur, allowing additional moisture and chlorides to reach the reinforcing steel, thereby accelerating the corrosion process. The deterioration caused by this corrosion includes the reduction of the cross sectional area of the reinforcing and the delamination of the surrounding concrete.



*Figure 7.2*

**C. Freeze – Thaw Damage**

Concrete deterioration caused by freeze-thaw cycles is the third major deterioration mechanism. The mechanism occurs within saturated concrete subjected to freezing and thawing and is due to the pressures generated within the pores of the concrete paste resulting from the volume changes of water during the freeze/thawing process. These pressures are even greater in the presence of de-icing chemicals/chlorides as these chemicals reduce the freezing point and indirectly increase the pore pressures.

As previously mentioned, these pressures can cause progressive failure of the cement paste and result in scaling of the concrete and delamination of concrete along subsurface fracture planes (reference Figure 7.3).

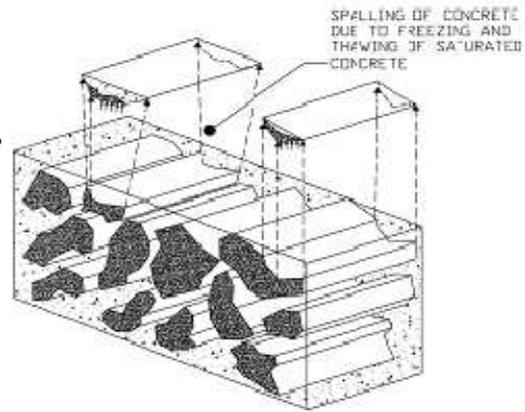


Figure 7.3

**D. Volume Changes**

Volume changes are the fourth major contributing factor of deterioration of reinforced concrete structures. Volume changes occur in both plastic and cured concrete. The volume changes can cause various types of cracking within the concrete member. Cracks allow access for water and contaminants to the concrete and reinforcing, resulting in accelerated deterioration. The cracking most often associated with plastic concrete is shrinkage cracking produced by the reduction in volume of the concrete during curing. Improper detailing, proportioning, placement or curing of the concrete can affect the extent of this cracking but the primary cause is the volume change that occurs during curing.

Volume changes due to thermal movement, shrinkage, creep, and loading can also contribute to the deterioration of reinforced concrete. These volume changes will produce stress in restrained members, which often results in cracking of the member (reference Figure 7.4).

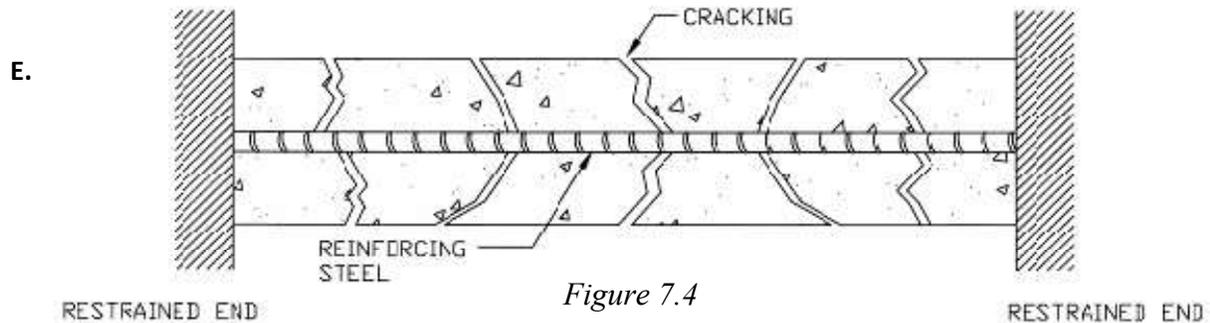


Figure 7.4

### **Chemical Attack**

Chemical attack is the roof major deterioration mechanism affecting the performance of reinforced concrete. The effect of de-icing chemical/chlorides upon reinforcing steel and scaling is one example of chemically influenced deterioration. In addition to this type of chemical attack, severe exposure to other chemicals, notably sulfates and acids, can cause deterioration of cement paste, cement paste/aggregate bond, and reinforcing steel.

In addition to these types of attack, chemical properties occurring within certain types of aggregates can cause an adverse reaction with the cement paste. The resulting volume changes can cause cracking of the concrete.

# Capital Commons Garage Quantities (with 20 year estimate) 10-29-15

Item Description	Corrective Action Required	Repair Frequency	Annualized Repair Costs	Compounded Annualized Repair Costs	Annualized Repair Costs (Per % of Supported Capacity)	Fiscal Year																						
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
<b>1. Concrete Repair &amp; Maintenance:</b>																												
a. Concrete floor surface repair	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Repaired concrete surface	15 Years	20	\$20,000	\$20,000	100%	\$20,000																						
<b>2. Waterproofing Repair &amp; Maintenance:</b>																												
a. Basement floor waterproofing	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Foundation wall waterproofing	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
c. Floor waterproofing	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
d. Foundation wall waterproofing	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
e. Foundation wall waterproofing	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>3. Mechanical Systems:</b>																												
a. Heating & Cooling	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Electrical	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
c. Plumbing	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>4. Electrical Systems:</b>																												
a. Electrical	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Electrical	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
c. Electrical	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>5. Plumbing Repair &amp; Maintenance:</b>																												
a. Plumbing	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Plumbing	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
c. Plumbing	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>6. Fire Protection:</b>																												
a. Fire Protection	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Fire Protection	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>7. Lighting:</b>																												
a. Lighting	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Lighting	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>8. Elevator &amp; Escalator:</b>																												
a. Elevator	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Escalator	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>9. Vertical Transportation:</b>																												
a. Vertical Transportation	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Vertical Transportation	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>10. Security Systems:</b>																												
a. Security Systems	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Security Systems	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>11. Sprinkler &amp; Gas Detection:</b>																												
a. Sprinkler	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Gas Detection	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>12. Miscellaneous:</b>																												
a. Miscellaneous	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
b. Miscellaneous	15 Years	20	\$10,000	\$10,000	100%	\$10,000																						
<b>Total Repair &amp; Maintenance Costs (Per Year Budget)</b>																												
			\$10,000	\$10,000	100%	\$10,000																						

**NOTE:** These repair and maintenance costs have been identified as being required for the parking facility to be properly repaired and maintained in accordance with parking industry standards.

\* Cost of LED lighting upgrade over next 10-15 years. New technology based on current market.

**NOTE:** These Repair & Maintenance Costs include the installation of new LED lighting fixtures, but do not include the cost of removing existing fluorescent fixtures.

\*\* Example of the time spent for this work. Estimated costs included at 7% of estimated value.

\*\*\* If another project is authorized by the Board, costs reflect 2014 budget year.





