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6. INTRODUCTION

This chapter details the existing and proposed utility infrastructure that will service the Project. In addition to presenting the existing infrastructure and outlining early discussions with the City of Cambridge, the anticipated utility demands and impact on the local infrastructure is discussed. Early phases of the Concept Plan include investments by the City in the local infrastructure to improve utility capacity for development. The Applicant will implement measures to reduce impacts of the proposed infill development on the existing utility systems. These include employing a district-wide stormwater management approach to reduce the stormwater effluent off-site, mitigating Infiltration and Inflow (I/I) in the sewer system to increase available capacity for new wastewater flows, and applying water conservation measures to reduce demands on the potable water system.

CHAPTER UPDATES

The following section summarizes minor refinements to this Chapter since the Approved Concept Plan.

- **Stormwater:** The existing and proposed stormwater calculations have been updated to reflect as-built conditions associated with Commercial Building A at 145 Broadway, and the proposed conditions associated with Commercial Building B at 325 Main Street. In addition, the proposed district stormwater management approach has been updated to eliminate permeable pavers, but will continue to explore the use of green roofs, landscaped areas, and subsurface infiltration to manage stormwater as detailed in the Figures herein.
- **Sanitary Sewer/Domestic Water:** The existing and proposed sanitary sewer and domestic water calculations have been updated to reflect the as-built conditions associated with Commercial Building A at 145 Broadway, and the proposed conditions associated with Commercial Building B at 325 Main Street.
- **Vulnerability Assessment:** The vulnerability assessment has been expanded to include projected flood elevations for Commercial Building B located at 325 Main Street.

6.1 EXISTING INFRASTRUCTURE

6.1.1 STORMWATER

The existing MXD District is a densely developed, predominantly impervious urban area. The majority of the roadways in the area have separated storm drainage utilities for private and public stormwater runoff conveyance. The Cambridge Department of Public Works (CDPW) owns and maintains the extensive system of catch basins, manholes, and drain pipes. The District's catchment area drains to the Lower Charles River Basin via a 54-inch drain outfall at Broad Canal Way.

The following is a list of existing storm drain services that are located adjacent to each project Component, which are also shown in Table 6-1.

Commercial Building A (145 Broadway):

- A 54-inch main in Broadway
- A 30-inch main in Galileo Galilei Way

Commercial Building B (325 Main Street):

- A 21-inch main in Main Street
- An 18-inch main in Main Street

Residential Building South (Blue Garage):

- 54-inch main in Broadway

Residential Building North (Blue Garage):

- A 24-inch main in Binney Street

The Project will be required to meet the stormwater management standards of both the CDPW and the Massachusetts Department of Environmental Protection (DEP). To evaluate the proposed hydrologic conditions, an existing condition model was created in Hydro CAD as a baseline for evaluation. Table 6-1 shows the impervious and pervious land covers in the existing condition, as well as the resulting runoff rate and volume for the 2-year design storm.

Project Component	Existing Site Impervious Area (SF)	Existing Site Pervious Area (SF)	Existing Site Runoff Rate 2-year, 24-hour Design Storm (CFS)	Existing Site Runoff Volume 2-year, 24-hour Design Storm (AF)
Phase 1A – COMMERCIAL Building A	27,707	10,155	2.09	0.164
Phase 2 – COMMERCIAL Building B	28,823	0	2.03	0.150
Phase 2 – Residential Building South	38,630	5,974	2.68	0.217
Phase 3 – Residential Building North	37,406	9,840	2.69	0.213
TOTAL	132,566	25,969	9.49	0.744

TABLE 6-1- EXISTING SITE HYDROLOGY

6.1.2 SANITARY SEWER

The District is serviced by several separated sewer systems, as well as a large combined sewer main, as shown in Figure 6.1. The CDPW owns and maintains the local sanitary sewer system, which discharge to the Massachusetts Water Resources Authority (MWRA) conveyance system to the Deer Island Wastewater Treatment Plant. Wastewater flows from the Project will travel northeasterly by CDPW gravity flow sanitary sewer mains to the MWRA's system located in Cardinal Medeiros Avenue. During dry-weather conditions, the gravity mains in the area have sufficient capacity to support the Project. During wet weather conditions, some capacity issues arise as I/I takes capacity in the system from the wastewater. This will be mitigated through a program to remove I/I relative to the estimated wastewater generation of the Project.

The following is a list of the existing sanitary sewer mains adjacent to each Project Component:

Commercial Building A (145 Broadway):

- A 21-inch main in Broadway
- A 24-inch main in Galileo Galilei Way

Commercial Building B (325 Main Street):

- A 10-inch main in Main Street
- An 18-inch main in Main Street

Residential Building South (Blue Garage):

- A 21-inch main in Broadway

Residential Building North (Blue Garage):

- A 30-inch main in Binney Street
- A 98-inch combined sewer main in Binney Street
- A 21-inch main in Broadway

6.1.3 DOMESTIC WATER

Domestic water and fire protection services in the District provided by infrastructure owned and maintained by the Cambridge Water Department (CWD) are shown in Figure 6.2. There are several transmission and local supply lines throughout the neighborhood to service the various Project components. The local supply system generally has high flow rates, but has water pressure that is typically lower than that required for tall developments. Booster pumps may be required to achieve nominal pressure in the domestic water and fire protection services for each Project component

The following is a list of the existing water mains adjacent to each Project Component:

Commercial Building A (145 Broadway):

- A 16-inch main in Broadway
- A 30-inch main in Broadway
- A 16-inch main in Galileo Galilei Way

Commercial Building B (325 Main Street):

- A 12-inch main in Main Street
- A 12-inch main in Main Street

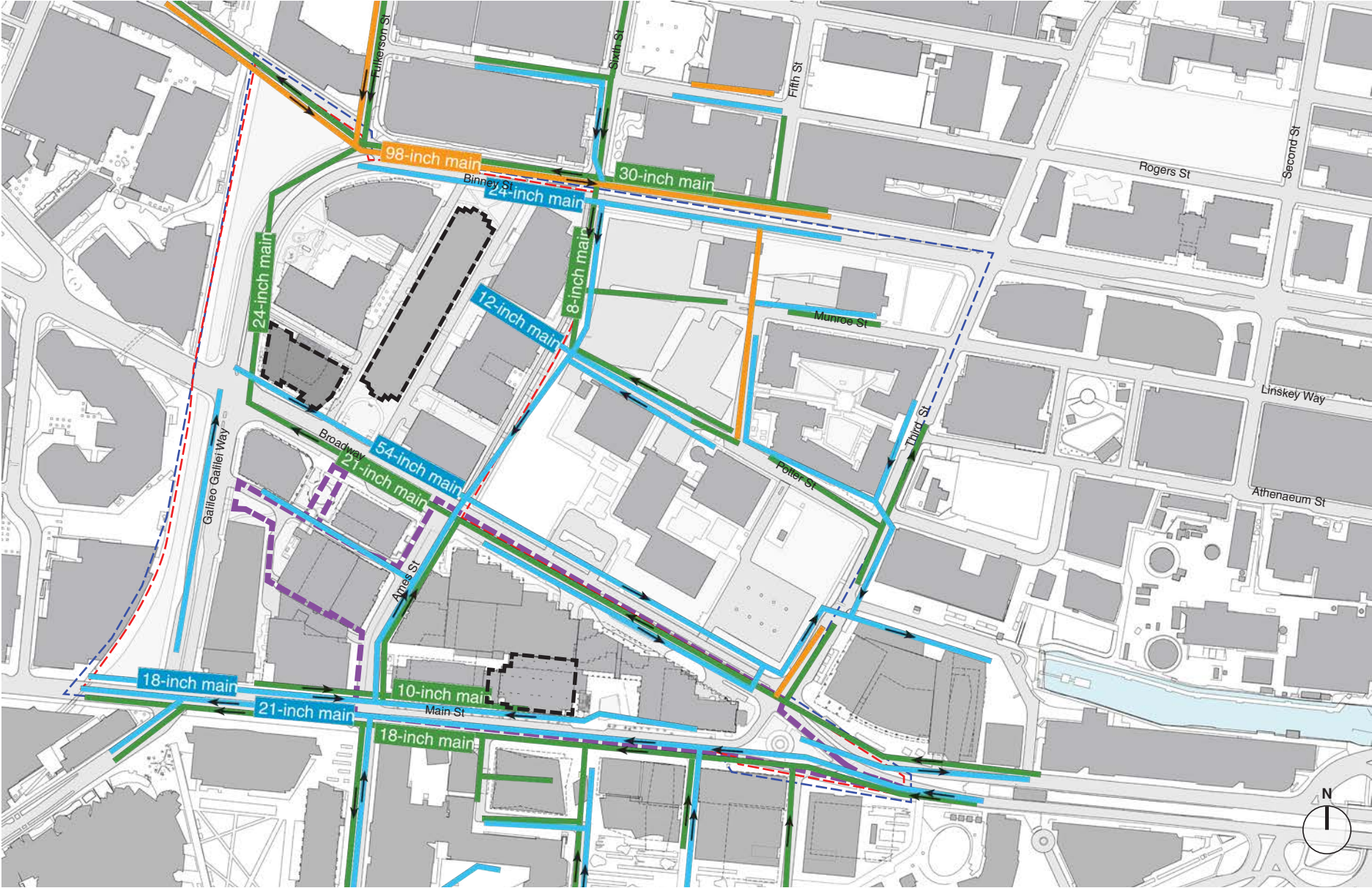
Residential Building South (Blue Garage):

- A 16-inch main in Broadway
- A 30-inch main in Broadway

Residential Building North (Blue Garage):

- A 16-inch main in Binney Street
- A 12-inch main in Binney Street

In addition, there are several water and fire protection services, which serve the existing buildings in the District. Services that are intended to remain active will be protected during the construction phase of this Project. There is also an existing private hydrant that is serviced by a water line running under the Blue Garage. This line will be maintained as part of this Project, and the CDW will be allowed unrestricted access to the line and hydrant at all times.



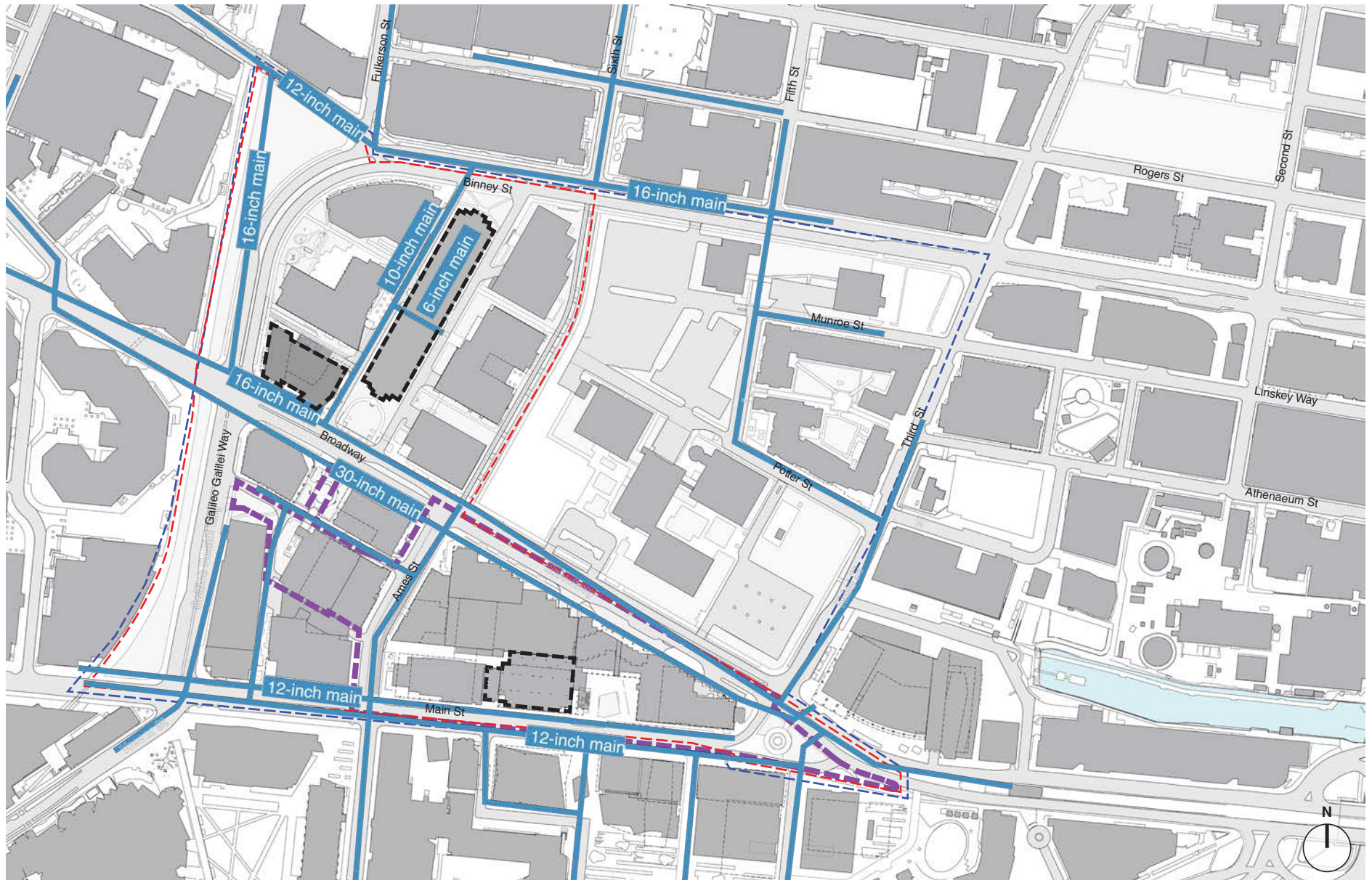
- Existing Sanitary Sewer System

Existing Storm Drain

Existing Combined Sewer
- Project Sites
- MXD Boundary

KSURP Boundary

Ames Street District ASD



- MXD Boundary
- KSURP Boundary
- Ames Street District ASD

6.2 PROPOSED INFRASTRUCTURE IMPROVEMENTS

6.2.1 STORMWATER IMPROVEMENTS

In addition to reviewing and approving any new private connections to existing infrastructure, the CDPW reviews and approves the stormwater management strategies of larger developments in the City. CDPW requires that new projects mitigate stormwater such that the peak rate and volume of stormwater runoff in the post-development condition during a 25-year design storm are equal to or lower than that of the pre-development condition for the 2-year design storm. In the existing condition, there are no stormwater management systems implemented throughout the Project Site that reduce the peak rate or total volume of runoff. Therefore, the Project will greatly improve stormwater contributions to the CDPW stormwater infrastructure by meeting the required mitigation thresholds.

To improve the quality, rate, and volume of runoff from the Project, the Applicant has designed preliminary stormwater management systems, which meet the City's requirements. As an infill project, there is limited opportunity to expand ground level landscaping to improve the hydrologic condition.

Therefore, the Applicant is exploring the use of green roofs to reduce the percentage of impervious cover for the Project. In addition, the Applicant is proposing an integrated stormwater management system for the Project that includes subsurface infiltration systems. The site at Commercial Building B introduces many challenges to infiltrate, including limited site area and the location adjacent to the MBTA red line tunnel and the City's right-of-way. Infiltration will be designed to the extent feasible at this location and will be supplemented by internal stormwater holding tanks. By applying this approach, the Applicant will meet or exceed the required stormwater mitigation standards set forth by the City of Cambridge and DEP. Table 6-2 provides the conceptual stormwater management system proposed for each Project Component. Figure 6.3A and Figure 6.3B provide a graphic display of the integrated stormwater management approach from this Project.

PROJECT COMPONENT	PROPOSED SITE IMPERVIOUS AREA (SF)	PROPOSED SITE PERVIOUS AREA (SF) ¹	INFILTRATION SYSTEM CAPACITY (CF) ²	PROPOSED SITE RUNOFF RATE 25-YEAR, 24-HOUR DESIGN STORM (CFS)	PROPOSED SITE RUNOFF VOLUME 25-YEAR, 24-HOUR DESIGN STORM (AF)
Phase 1A – Commercial Building A	27,707	10,155	2,106	2.00	0.164
Phase 2 – Residential Building South	15,009	29,595	8,119	2.64	0.168
Phase 2 – Commercial Building B	28,823	0	6,534	2.03	0.147
Phase 3 – Residential Building North	19,165	28,081	7,746	2.68	0.213
TOTAL	90,704	67,831	24,505	9.35	0.692

1. Green roofs included in proposed site pervious area

TABLE 6-2 PROPOSED SITE HYDROLOGY

In addition to mitigating runoff flow rates and volumes, the Applicant is responsible for reducing the Phosphorus loads from the Project Site to the CDPW stormwater infrastructure to comply with the Lower Charles River Total Phosphorus Total Maximum Daily Load (TMDL) that requires the removal of 80 percent of Total Phosphorus. Applicant has developed several methods for reducing the Total Phosphorus. These include non-structural methods, increased landscape coverage and green roof installation, enhanced street sweeping program, on-site catch basin cleaning program, and an enhanced organic waste and leaf litter collection program for fall months. These methods can reduce Phosphorus export rates by up to 17 percent according to Attachment 2 of Appendix F of the Massachusetts Small MS4 General Permit (MS4). These nonstructural, Phosphorus pretreatment strategies will supplement the infiltration based, filter cartridge, or tank based structural treatment systems. Subsurface infiltration structures are the most effective means for removing Phosphorus from the Project Site, as well as reducing peak rate and total discharge of runoff off-Site.

Site and building roof runoff will be directed to the subsurface infiltration systems. In order to meet the stormwater peak rate requirements set by the CDPW, these structures are designed to hold and infiltrate over 1-inch of runoff from the contributing area. A 1-inch treatment capacity will reduce phosphorus loads by 92 percent from the impervious contributing area. The entire Project Site area will drain to a structural Phosphorus mitigation measure sized to remove at least 80 percent of Total Phosphorus and therefore it is expected that the Project will meet the required DEP reduction targets.

6.2.2 SANITARY SEWER

Table 6-3 details the current wastewater generation estimate based on the DEP Sewer Connection and Extension Regulations, 310 CMR 15.203.f by building use with the latest KSURP building program. The Project is estimated to generate 151,332 of net new wastewater relative to the existing condition. As required by the CDPW, each Project component will have a sanitary holding tank capable of retaining the 8-hour peak sanitary flow from the building. The volume of each sanitary holding tank will be coordinated with the CDPW. In addition, all drainage from enclosed vehicular parking and loading will be treated with an MWRA approved gas/oil separator. If a portion of Project's program includes restaurant use, then a grease trap will be installed to pretreat kitchen wastewater effluent, thereby minimizing the potential impact to the CDPW sanitary sewer system.

The City of Cambridge is required to remove I/I from its sanitary sewer system by the MADEP in an effort to reduce and eliminate the potential for Combined Sewer Overflows (CSOs) to Massachusetts waterways. The CDPW is responsible for coordinating I/I removal for developments in Cambridge that generate greater than 15,000 GPD of wastewater, at a ratio of 4 gallons of I/I per GPD of wastewater. As such, the Applicant will coordinate an I/I removal plan with the CDPW before the individual buildings are occupied. Table 6-4 shows the estimated I/I removal for each project Component based on the estimated wastewater generation, which totals 605,328 gallons. The final I/I removal volumes will be determined at the Design Review stage for each building and in consultation with CDPW.



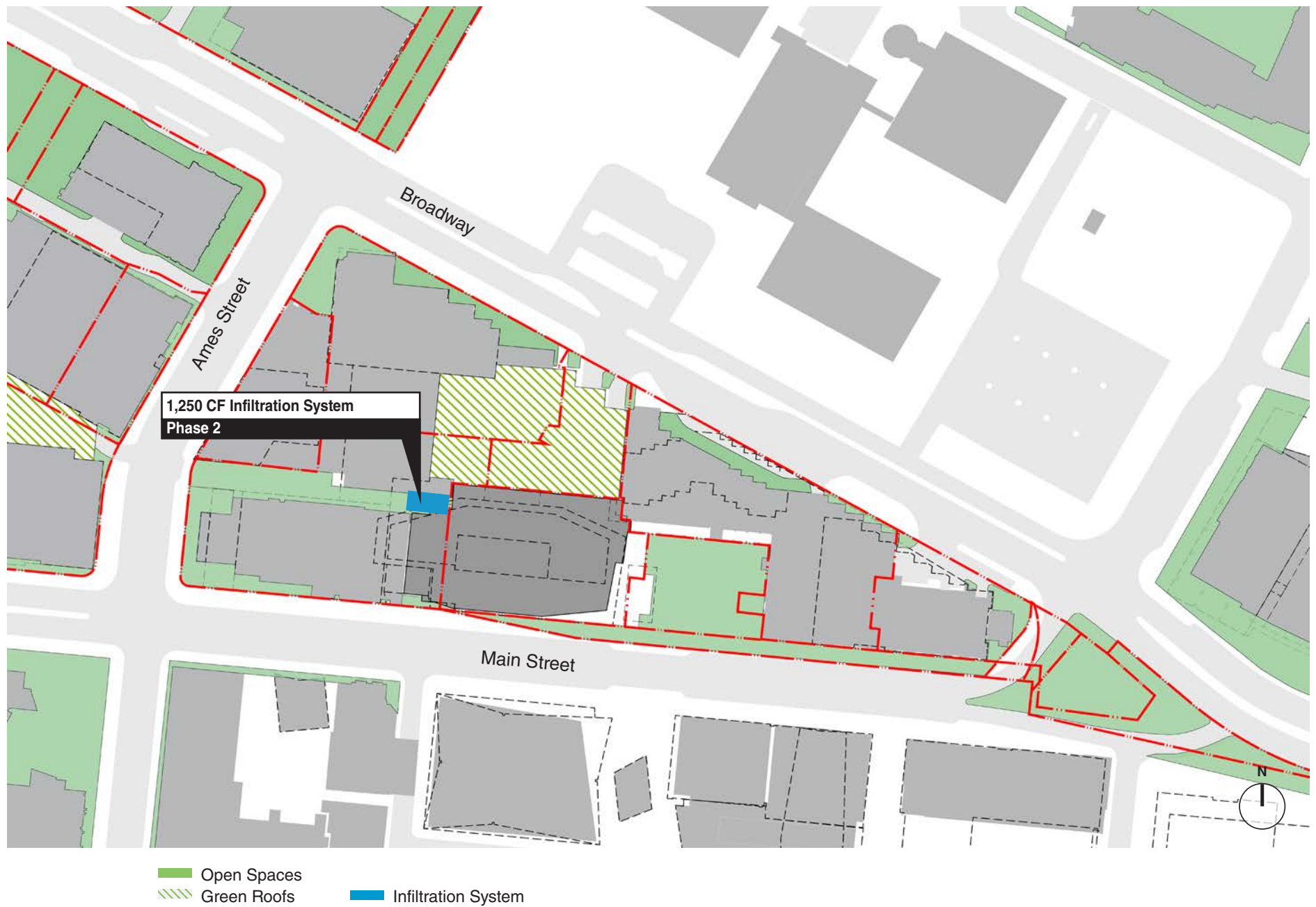


TABLE 6-3 ESTIMATED WASTEWATER GENERATION FOR THE CURRENT PROJECT

Component ¹	Use	Quantity	Flow Rate (gpd)	Sewage Generation (gpd)
New Project-Related Sewage Generation				
Phase 1A – Commercial Building A	Office	402,523	75/1,000 sf	30,189
	Restaurant	350*	35/seat	12,250
<i>Comm. Building A Total</i>				42,439
Phase 2 – Commercial Building B	Office	343,123	75/1,000 sf	25,734
	Retail	21,150	50/1,000 sf	1,058
	Restaurant	846*	35/seat	29,610
<i>Comm. Building B Total</i>				56,402
Phase 2 – Residential Building South	Residential	533**	110/bdrm	58,630
<i>Residential South Total</i>				58,630
Phase 3 – Residential Building North	Residential	105**	110/bdrm	11,550
	Retail	1,300	50/1,000 sf	65
<i>Residential North Total</i>				11,615
Broad Institute Office Conversion	Office	14,000	75/1,000 sf	1,050
<i>Broad Institute Total</i>				1,050
Total New Project-Related Sewage Generation				170,136
Existing Sewage Generation to be Removed				
325 Main Street	Commercial	74,901	(75/1,000 sf)	(5,618)
	Retail	30,956	(50/1,000 sf)	(1,548)
	Restaurant	164	(35/seat)	(5,740)
145 Broadway	Commercial	78,636	(75/1,000 sf)	(5,898)
Total Existing to be Removed				(18,804)
Net New Wastewater Generation				151,332

TABLE 6-4 CURRENT PROJECT I/I REMOVAL BY PROJECT COMPONENT

Project Component ¹	Net New Wastewater Generation (gpd)	I/I Removal Requirements (gallons)
Phase 1A – Commercial Building A Net New	36,541	146,164
Phase 2 – Commercial Building B Net New	43,496	173,984
Phase 2 – Residential Bldg. South Total	58,630	234,520
Broad Institute Office Conversion	1,050	4,200
Phase 3 – Residential Bldg. North Total	11,615	46,460
Total	151,332	605,328

- I/I removal is not required for the Innovation Space Conversion because it will generate the same amount of wastewater as the existing office space.

gpd = gallons per day

bdrm = bedroom

* assumes 25 sf per seat

**assumes 1.5 bedrooms per unit

- The Innovation Space Conversion component is not included because it will generate the same amount of wastewater as the existing office space.

6.2.3 DOMESTIC WATER

During the MEPA review process, the CWD provided initial confirmation that the local water infrastructure should have sufficient capacity to serve the Project. The water demand for each Project component is initially estimated by applying a 10% consumption factor to the wastewater generation estimate. Therefore, the estimated Project water demand over the existing condition is equal to 166,466 GPD. The estimate for each Project Component is shown in Table 6-5. As discussed in Section 8, Sustainability, to meet the Project's sustainability goals, water conservation measures will be implemented for each Project Component to greatly reduce the water demand. Preliminary discussions with the CWD during the MEPA review process did not elucidate any capacity issues in the District to serve the Project for both domestic water and fire protection services. The Applicant will evaluate the need for domestic and fire protection booster pumps to compensate for any deficiencies in the water pressure in the water mains adjacent to each Project component. Hydrant flow tests conducted in the field will be used to make this evaluation. Where possible, redundant domestic water and fire protection services will be connected to a separate supply main, otherwise isolation valves will be installed to ensure that domestic water and fire protection services are not interrupted by isolated service issues. All existing domestic water and fire protection service lines that require removal will be cut and capped at the main, as required by the CWD.

TABLE 6-5 ESTIMATED WATER DEMAND BY PROJECT COMPONENT

Project Component ¹	Water Demand (GPD)
Phase 1 - Commercial Building A Net New	40,195
Phase 2 – Commercial Building B Net New	47,846
Phase 2 – Residential Bldg. South Total	64,493
Broad Institute Office Conversion	1,155
Phase 3 - Residential North Total	12,777
Total Water Demand	166,466

1. The Innovation Space Conversion component is not included because it will have the same potable water demand as the existing office space

6.3 VULNERABILITY ASSESSMENT

The Applicant has coordinated with the City of Cambridge to identify the capacity issues in the stormwater infrastructure serving the District. Applicant is particularly concerned with the potential for inland flooding due to stormwater system surcharges, especially in context with the expected changes in precipitation patterns and sea level rise and storm surge. The Applicant has coordinated with the City to determine the appropriate building finish floor elevations in the District to reduce the risk of the Project being impacted by flooding. For Commercial Building A and Residential Building South, the 100-year flooding event projected for the year 2070 is El. 20.10 Cambridge City Base (CCB). For the Residential Building North, the 2070 100-year flood event projection is El. 20.93 CCB and for Commercial Building B, the 2070 100-year flood event projection is El. 20.30 CCB. There are no current 2070 10-year flood event projection elevations for the Project.

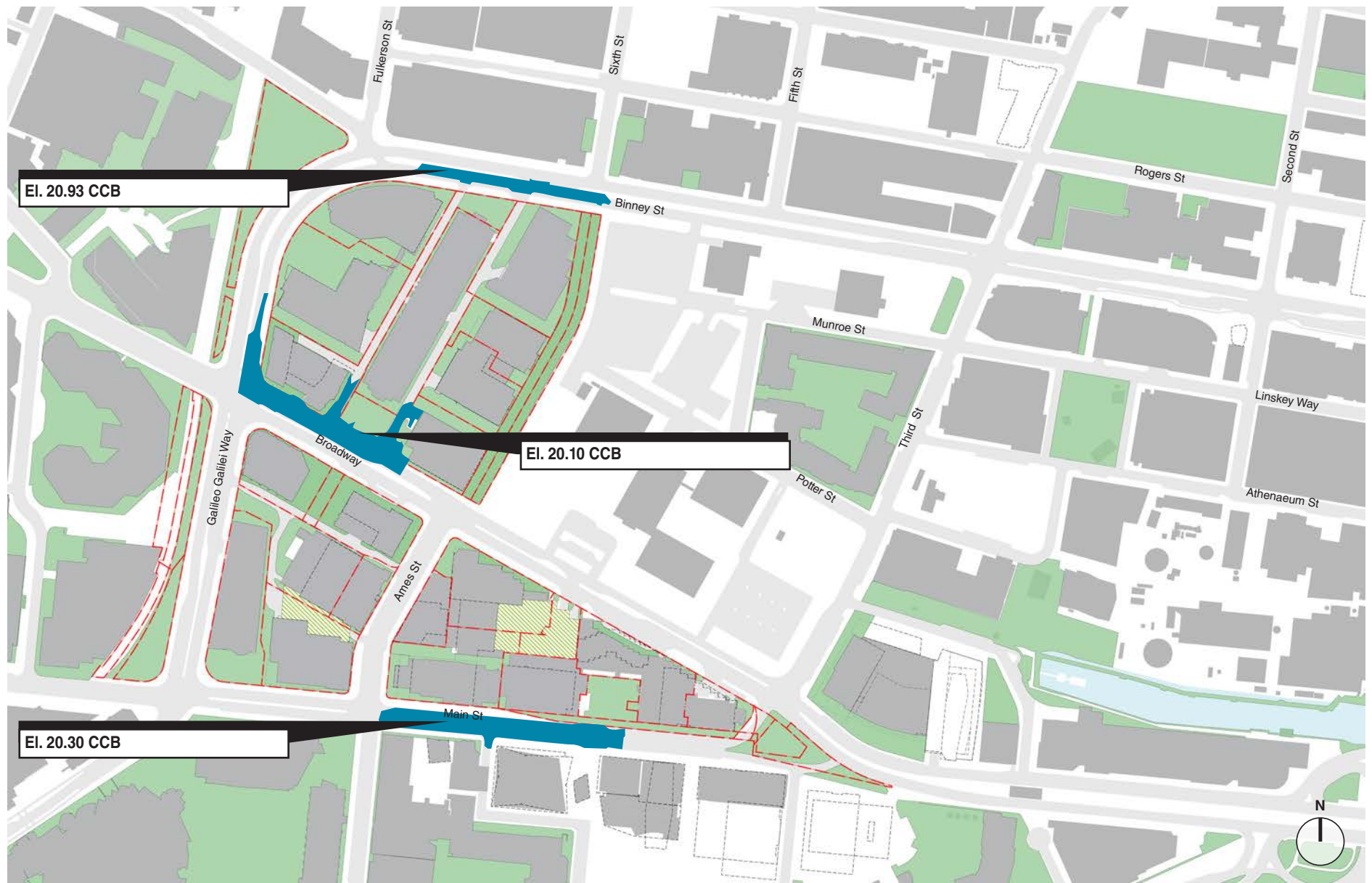
The CDPW recommends that building finish floor elevations be designed to the 2070 10-year flooding event projections, while being designed to recover from the 2070 100-year flooding elevations. The ability to recover was defined as locating critical infrastructure susceptible to flood damage above the 2070 elevation. These elevations do not take into consideration a precipitation event occurring concurrently with a storm surge event. For the 10-year storm with the impacts of climate change in 2070, minor flooding is expected in Broadway at Galileo Galilei Way, and along Main Street, and stormwater infrastructure will have limited capacity for increased flows. The flooding will be greatly exacerbated during a concurrent storm surge event propagating through the stormwater system. At the time of this filing, the City has not finished evaluating the concurrent flooding and storm surge event.

The Applicant intends to design all Project components to meet or exceed the recommended planning flood elevations. Figure 6.4 shows the recommended design flood elevations for the 2070 design events as they relate to the existing topography. To account for the probability of a concurrent precipitation event with storm surge propagation in stormwater infrastructure, the Applicant will study additional resiliency measures. These measures may include oversized stormwater conveyance infrastructure, backflow preventers on effluent stormwater pipes, watertight internal gravity piping to the second floor, and the district wide stormwater management strategies, which greatly reduce the rate and volume of site stormwater effluent providing capacity for runoff from the remaining catchment area.

As flooding is expected to worsen over time, the Applicant will continuously review the latest design recommendations and literature to determine if/when portable flood protection systems, such as Portadam or the Aquafence Flood Barrier System, should be implemented on-site to increase the Project's resiliency. Similarly, the sanitary sewer system is expected to experience greater capacity issues from I/I with changes in precipitation patterns. To mitigate risk from sanitary sewer surcharge, backflow preventers will be installed on building sewer laterals, internal gravity piping will be watertight to the second floor, offline sanitary holding tanks will hold building wastewater during surcharge conditions, and the Project will address I/I as outlined in Section 6.2.2.

FIGURE 6.4

FLOODING FROM 100-YEAR STORM SURGE EVENT PROPAGATION THROUGH DRAINAGE SYSTEM



■ 2070 area of potential flooding

An aerial photograph of a city grid, likely New York City, viewed from above. The image is heavily stylized with a semi-transparent pink overlay that covers the entire scene. The grid pattern of the streets and the shapes of the buildings are visible through the pink tint. The text '7. ENVIRONMENTAL IMPACTS' is centered on the right side of the image in a bold, white, sans-serif font.

7. ENVIRONMENTAL IMPACTS

7.0 INTRODUCTION

This section presents an updated summary of the existing environmental conditions in the vicinity of the Project site and the potential changes that may occur as a result of the Project Change. The goal of the Project continues to be to better utilize the Project Site and complement adjacent uses while minimizing potential adverse environmental impacts to the greatest extent feasible.

As discussed in more detail below, the Project-related impacts, which are to be expected in urban development of this scale, are counterbalanced by the significant public benefits for the adjacent neighborhoods and the City. The following sections identify Project impacts and discuss steps that have been or will be taken through design and management to avoid, minimize and/or mitigate adverse effects.

Where the current state of the design allows, this Concept Plan Amendment provides an updated assessment of the following Project impacts:

- Pedestrian Wind
- Shadow
- Noise
- Exhaust Re-Entrainment Review

CHAPTER UPDATES

The following section summarizes minor refinements to this Chapter since the Approved Concept Plan.

- **Pedestrian Wind:** The Master Plan wind tunnel study should be considered a baseline with the understanding that each individual building's design review submission will include an update to the baseline for comparative purposes. Accordingly, any undesirable wind conditions that are presented here are not proposed as final but are shown as a starting point with which to better inform the designs of each building and their associated public realm improvements. Further, in the case of the North parcel, the streetscape plantings were not included in the baseline study as the City CRA ALTA cycle Track plans had not been finalized. It is expected that the inclusion of the associated landscape featured in the ALTA plans will have a material beneficial impact on winter wind mitigation. Future design review packages for 135 Broadway will have the benefit of this design information.
- **Shadow:** The shadow analyses have been updated to reflect the shift of approved office GFA associated with Commercial Building B from 250 Binney Street to 325 Main Street. Additionally, considering the relocation of Commercial Building B, the previously approved MIT North of Main (NOMA) and South of Main (SOMA) buildings are now included as background.
- **Noise:** Considering the relocation of Commercial Building B, additional noise monitoring was conducted along Main Street to capture ambient sound levels associated with the existing daytime and nighttime activities and mechanical equipment. The analysis demonstrates that the Project will continue to comply with City of Cambridge's noise control ordinance (Municipal Code, Chapter 8.16).
- **Exhaust Re-Entrainment Review:** The exhaust re-entrainment review has been updated to reflect the proposed conditions associated with Commercial Building B at 325 Main Street.

7.1 WIND

7.1.1 INTRODUCTION

Since the Original Concept Plan was approved in 2017, Rowan Williams Davies & Irwin Inc. (RWDI) was retained by the Applicant to complete a quantitative pedestrian level wind assessment for the proposed Project. The objective of this assessment is to assess the potential effect of the Project on pedestrian-level wind conditions around the Project Site, and to provide recommendations for minimizing any potential adverse effects if necessary.

RWDI #1603158
August 7, 2018

7.1.2 SITE AND BUILDING INFORMATION

The pedestrian level wind assessment has been updated to reflect the shift of approved office GFA associated with Commercial Building B from 250 Binney Street to 325 Main Street. Since the Original Concept Plan was approved in 2017, the Applicant broke ground on construction of the commercial space and ground floor retail associated with the Commercial Building A (Phase I) at 145 Broadway. For the purposes of this analysis, Commercial Building A is included in the existing configuration. Additionally, considering the relocation of Commercial Building B, the previously approved MIT North of Main (NOMA) and South of Main (SOMA) buildings are now included as background. As a result of this shift, and due to the limitations of the wind tunnel model, to ensure the accuracy of the analysis the quantitative pedestrian level wind assessment was conducted in two separate segments.

- North Parcel: Consists of the construction of Commercial Building A (250 feet tall) at 145 Broadway Street, and two residential towers, the Residential North building (350 feet) and the Residential South building (170 feet) on the existing Blue Garage at 135 Broadway Street; and
- East Parcel: Consists of the construction of Commercial Building B (250 feet) at 325 Main Street.

For each parcel, the following conditions were simulated:

- Existing Configuration: includes all existing buildings, (including Commercial Building A and 88 Ames Street Residential Building) and approved buildings within the immediate Project area; and
- Future Configuration: includes the proposed Project components, and all existing and approved buildings within the immediate Project area.

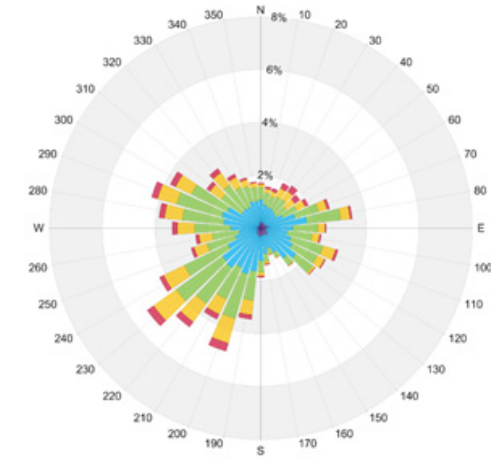
7.1.3 METEOROLOGICAL DATA

The analysis was completed for two main periods of the year, namely the summer months (May to October) and winter months (November to April). Meteorological data from Boston Logan International Airport for the period from 1988 to 2018 were used as reference for wind conditions in the region.

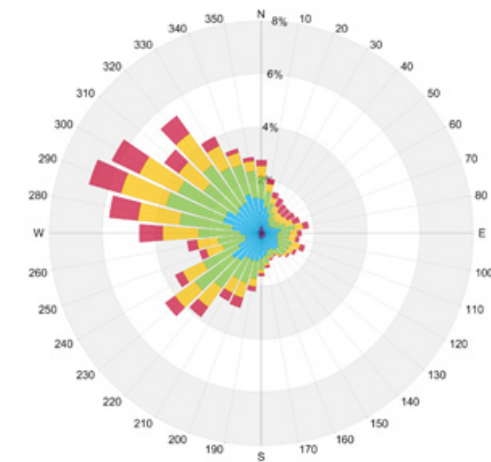
The distributions of wind frequency and directionality for summer and winter seasons are shown in the wind roses in Figure 7.1. In general, winds from the southwest and west-northwest directions are predominant in the summer. In the winter, the predominant of winds are generally from the west through the northwest.

Strong winds of a mean speed greater than 20 mph measured at the airport (red bands) occur more often in the winter than the summer and are predominantly from the southwest, northwest and northeast quadrants.

	Wind Speed (mph)	Probability (%)	
		Summer	Winter
	Calm	2.5	2.2
	1-5	7.7	5.8
	6-10	35.6	27.1
	11-15	34.5	31.6
	16-20	14.9	20.8
	>20	4.8	12.6



Summer (May – October)



Winter (November – April)

FIGURE 7.1 DIRECTIONAL DISTRIBUTION OF WINDS APPROACHING BOSTON LOGAN INTERNATIONAL AIRPORT FROM 1988 TO 2018

7.1.4 PEDESTRIAN WIND CRITERIA

The RWDI wind comfort criteria deal with both pedestrian safety and comfort, as they relate to the force of the wind. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities as well as by the building design and city planning community.

Safety: Pedestrian safety is linked to excessive gust wind speeds that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance occur more than 0.1 percent of the time or 9 hours per year, the wind conditions are considered severe.

Comfort: Wind conditions are considered suitable for sitting, standing, strolling or walking if the wind speeds corresponding to the respective categories are expected for at least four out of five days (80% of the time).

- **Sitting:** Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.
- **Standing:** Gentle breezes suitable for main building entrances and bus stops.
- **Strolling:** Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.
- **Walking:** Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.
- **Uncomfortable:** None of the above comfort categories are satisfied.

Wind control measures are typically required at locations where winds are either rated as uncomfortable or exceed the wind safety criterion.

These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

Pedestrians on walkways and parking lots will be active and wind speeds comfortable for walking or strolling are appropriate during the summer and winter. Lower wind speeds comfortable for standing are desired at building entrances where people are apt to linger. On playgrounds, sitting areas and other amenity spaces, low wind speeds comfortable for sitting or standing are desired during the summer. In the winter, wind conditions in these areas may not be of a serious concern due to limited usage and therefore higher wind activity may be acceptable.

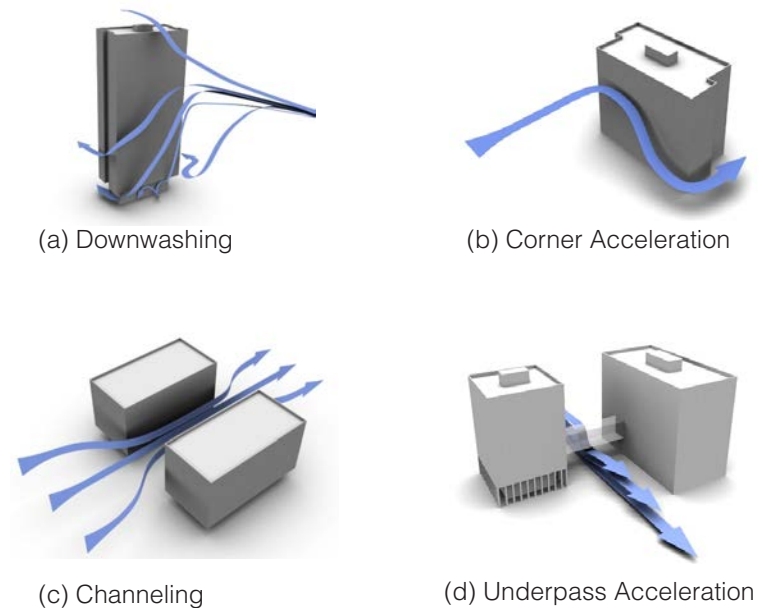


FIGURE 7.2 - GENERIC WIND FLOW PATTERNS

7.1.5 PEDESTRIAN WIND CONDITIONS

Figures 7.3-7.11 graphically depict the predicted mean speed and estimated wind comfort conditions at each wind measurement location based on the modeled annual winds for the Existing and Future Configurations. Typically, summer and fall winds tend to be somewhat more comfortable than annual winds while winter and spring winds are somewhat less comfortable than annual winds. The following summary of pedestrian wind comfort is based on annual winds for each simulated condition.

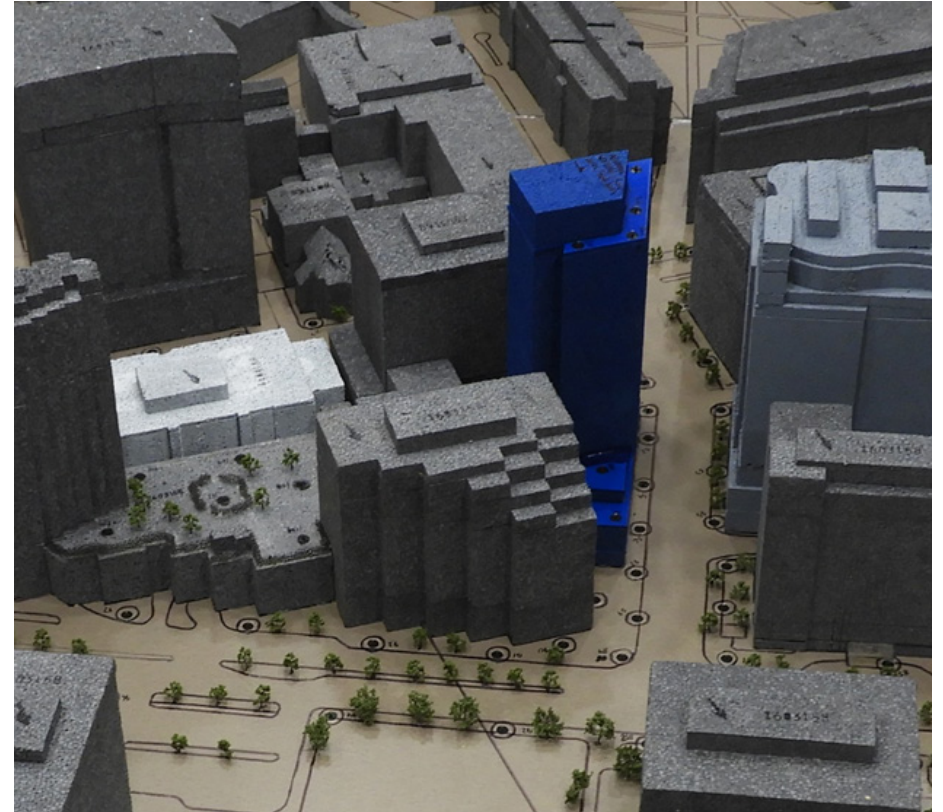
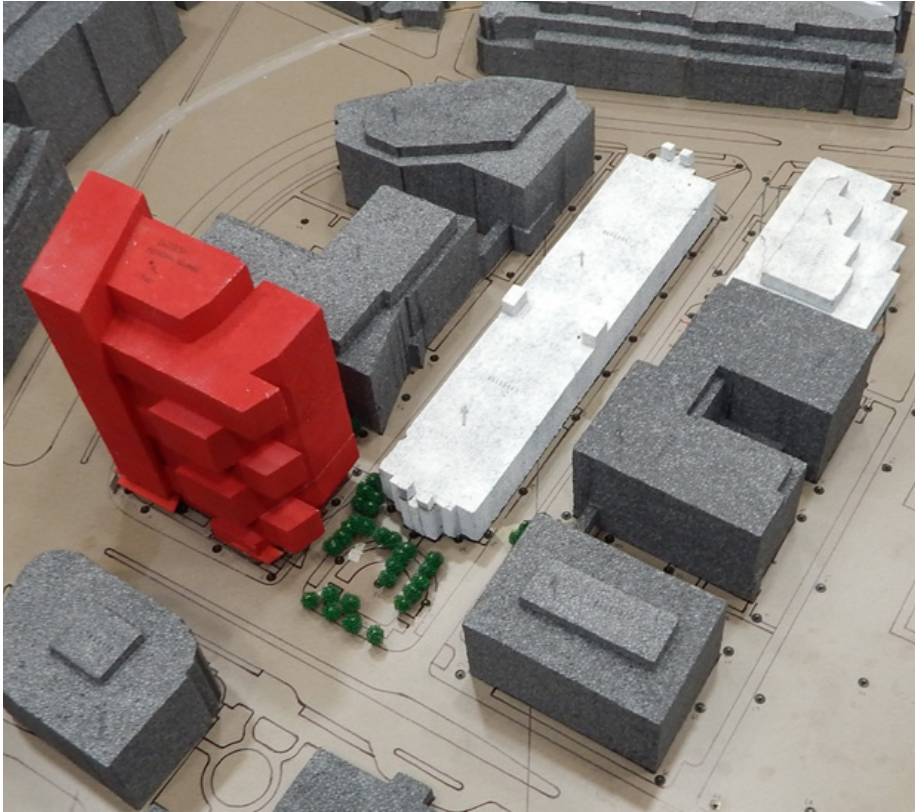


FIGURE 7.3A WIND TUNNEL STUDY MODEL - EXISTING CONFIGURATION

*No ALTA Improvements or street trees shown on broadway or Galileo Galilei Way

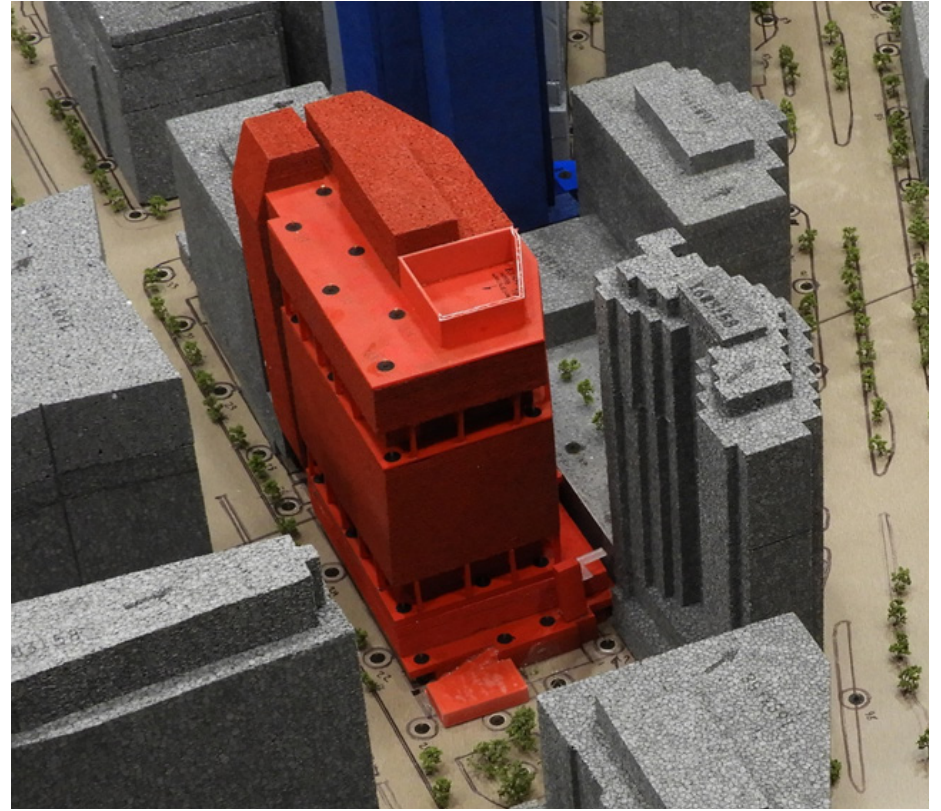


FIGURE 7.3B WIND TUNNEL STUDY MODEL - PROPOSED CONFIGURATION

*Based on approved massing for Commercial Building A, and a conceptual massing for Residential Building South, which is subject to design review.

EXISTING CONFIGURATION

SUMMER

NORTH PARCEL

Under the Existing Configuration, mean wind speeds at most of the on-site locations in the summer are generally comfortable for their intended use, including strolling or better. At off-site locations surrounding the Project components, mean wind speeds in the summer are generally comfortable for their intended use, which includes standing or better. There are no uncomfortable conditions, or conditions that exceed the effective gust speed safety criterion predicted either on-site or off-site during the summer and under the Existing Configuration. Refer to Figure 7.4.

EAST PARCEL

Under the Existing Configuration, mean wind speeds at most of the on-site locations in the summer are generally comfortable for their intended use, which includes standing or better. In the summer, mean wind speeds at the Kendall Square Rooftop Garden, Kendall Plaza, and at other off-site locations surrounding the Project components are generally comfortable for their intended use, which includes standing or better. There are no uncomfortable conditions, or conditions that exceed the effective gust speed safety criterion predicted either on-site or off-site during the summer under the Existing Configuration. Refer to Figure 7.5.

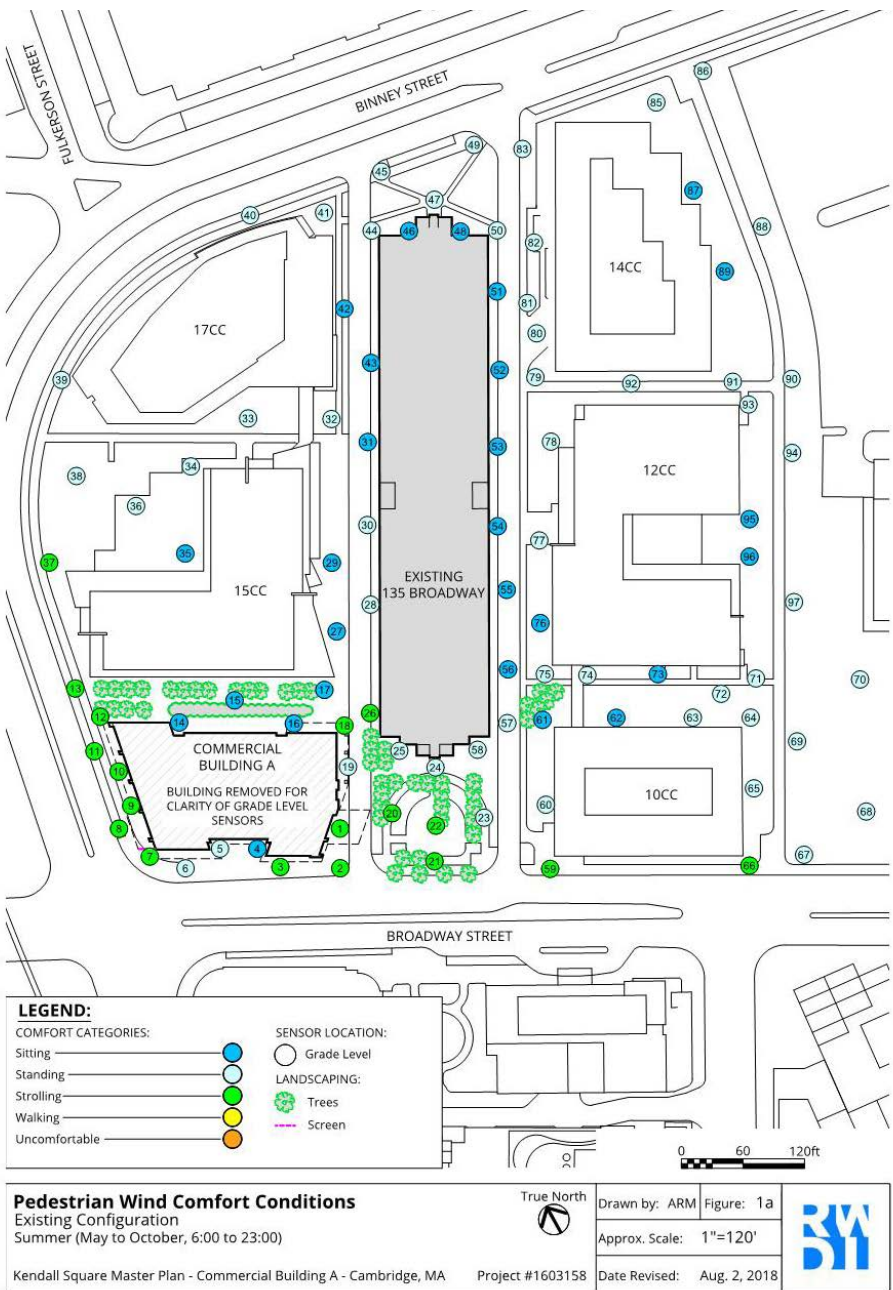


FIGURE 7.4 – PEDESTRIAN WIND COMFORT CONDITIONS
(NORTH PARCEL, EXISTING/SUMMER)

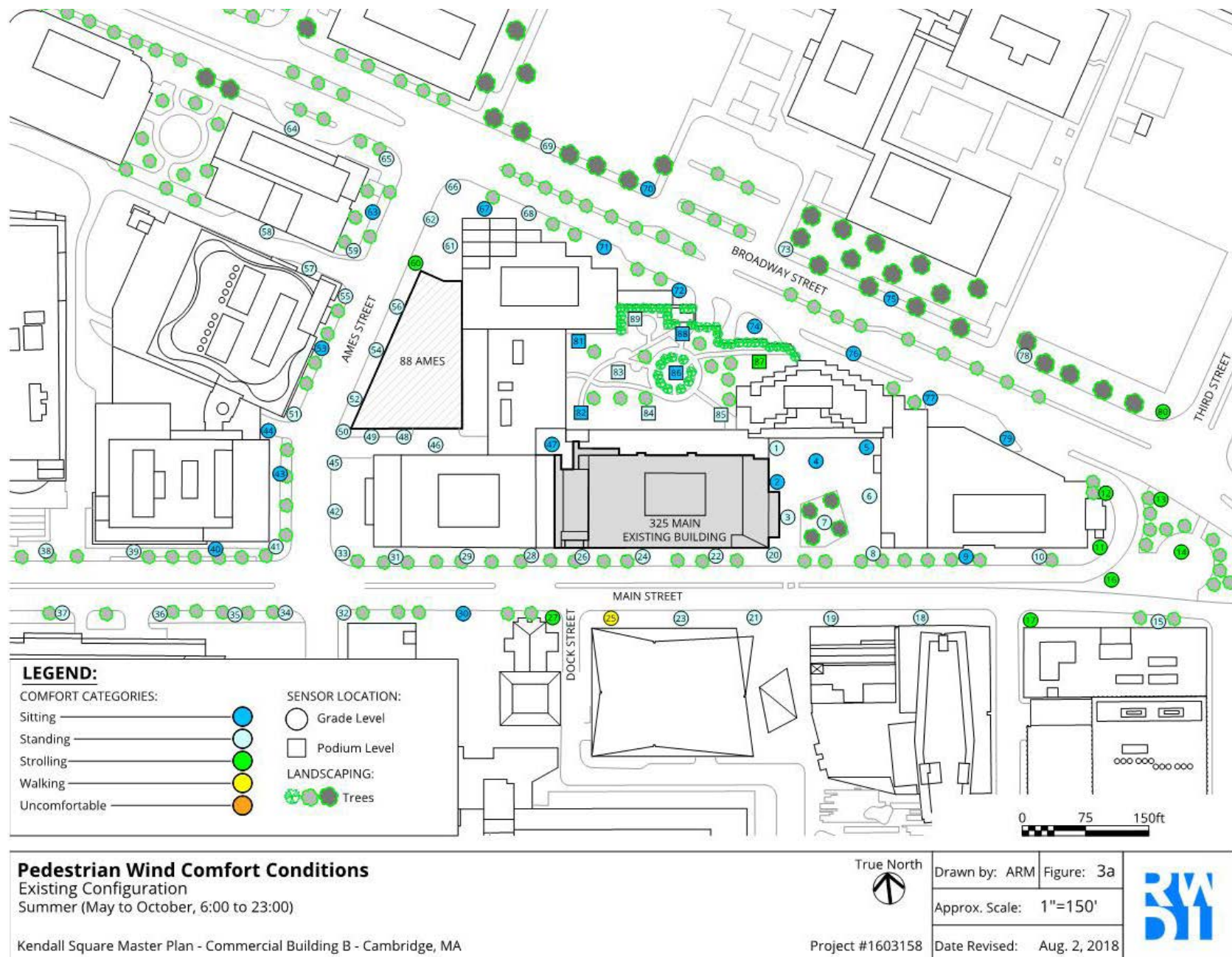


FIGURE 7.5 – PEDESTRIAN WIND COMFORT CONDITIONS (EAST PARCEL, EXISTING/SUMMER)

FIGURE 7.5 – PEDESTRIAN WIND COMFORT CONDITIONS (EAST PARCEL, EXISTING/SUMMER)

PROPOSED CONFIGURATION

SUMMER

NORTH PARCEL

Under the Proposed Configuration, mean wind speeds at most of the on-site locations in the summer are expected to be generally comfortable for their intended use, which includes strolling or better. Wind conditions generally comfortable for strolling or standing are predicted at the Commercial Building A entrances, at entrances to the Residential South Building entrance, and at Broadway Park. Wind conditions generally comfortable for standing or sitting are predicted at entrances to the Residential North building, and in Binney Park. At off-site locations surrounding the Project components, mean wind speeds in the summer are generally comfortable for their intended use, which includes standing or better. There are no uncomfortable conditions, or conditions that exceed the effective gust speed safety criterion predicted either on-site or off-site during the summer under the Proposed Configuration. Refer to Figure 7.6.

EAST PARCEL

Under the Proposed Configuration, mean wind speeds at most of the on-site locations in the summer are expected to be generally comfortable for their intended use, which includes standing or better. The Project will improve pedestrian wind comfort conditions at four (4) on-site locations in the summer, including the pedestrian realm along Main Street, and Commercial Building B entrances on Main Street, and the east edge of the building (Locations 1 - 3, and 26). At off-site locations surrounding the Project components, mean wind speeds in the summer are generally comfortable for their intended use, which includes strolling or better. Pedestrian wind comfort conditions at the Kendall Square Rooftop Garden will remain comfortable for sitting or standing, and one location is improved from strolling to standing (Location 86). The Project will also improve pedestrian wind comfort conditions at two additional off-site locations including the pedestrian realm along Main Street, and the Kendall Plaza (Locations 7 and 28). There are no uncomfortable conditions, or conditions that exceed the effective gust speed safety criterion predicted either on-site or off-site during the summer under the Proposed Configuration. Refer to Figure 7.7.

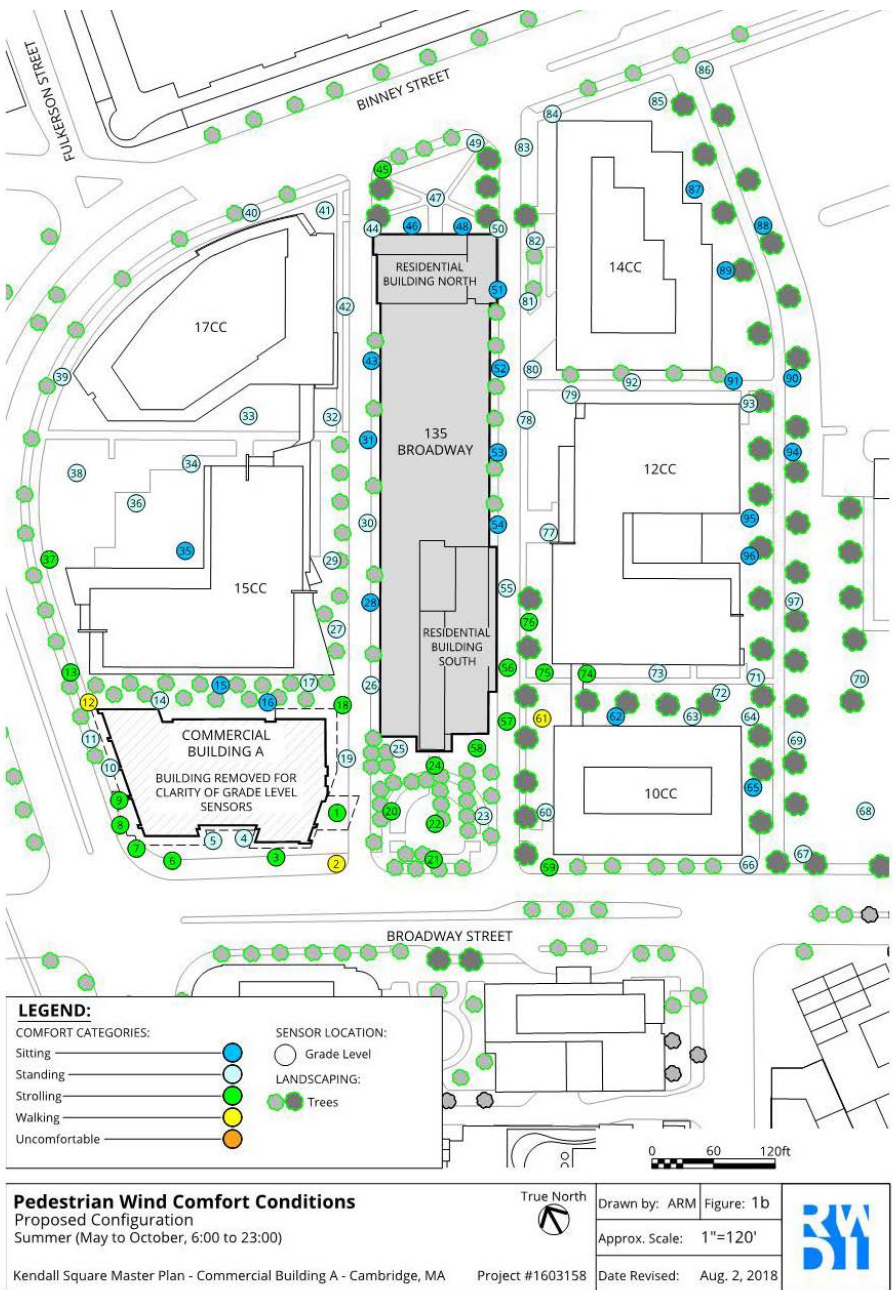


FIGURE 7.6 – PEDESTRIAN WIND COMFORT CONDITIONS (NORTH PARCEL, FUTURE/SUMMER)

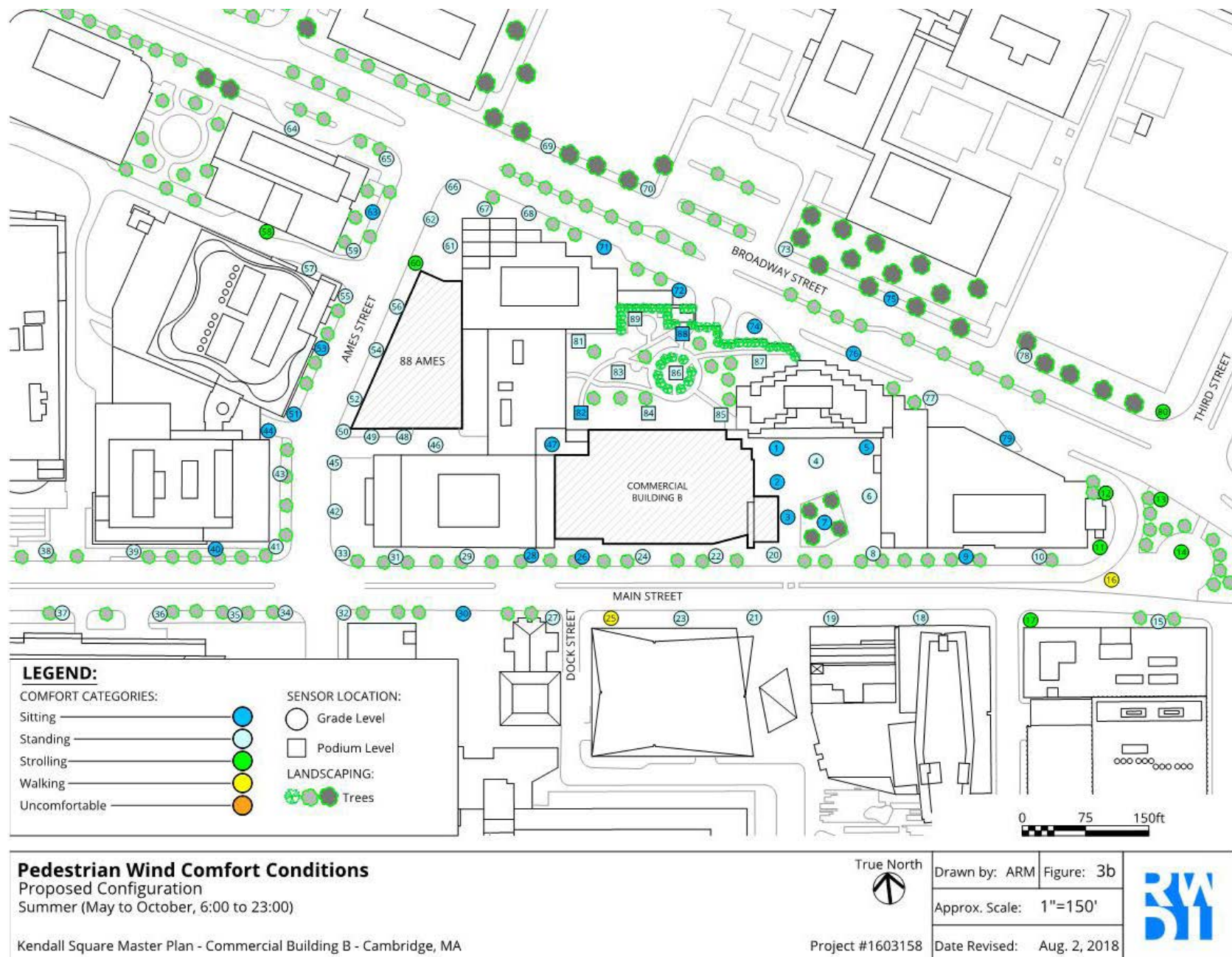


FIGURE 7.7 – PEDESTRIAN WIND COMFORT CONDITIONS
(EAST PARCEL, FUTURE/SUMMER)

EXISTING CONFIGURATION

WINTER

NORTH PARCEL

Under the Existing Configuration, mean wind speeds at most of the on-site locations in the winter are generally comfortable for their intended use, including walking or better. At off-site locations surrounding the Project components, mean wind speeds in the winter are generally comfortable for their intended use, including walking, strolling or better. There are no locations that exceed the effective gust speed safety criterion predicted either on-site or off-site during the winter under the Existing Configuration. Refer to Figure 7.8.

EAST PARCEL

Under the Existing Configuration, mean wind speeds at most of the on-site locations in the winter are generally comfortable for their intended use, which includes strolling or better. At off-site locations surrounding the Project components, including the Kendall Square Rooftop Garden and Kendall Plaza, mean wind speeds in the winter are generally comfortable for their intended use, including walking, strolling or better, with the exception of one existing uncomfortable location to the south of the Project Site along Main Street (Location 25). There are no conditions that exceed the effective gust speed safety criterion predicted either on-site or off-site during the winter under the Existing Configuration. Refer to Figure 7.9.

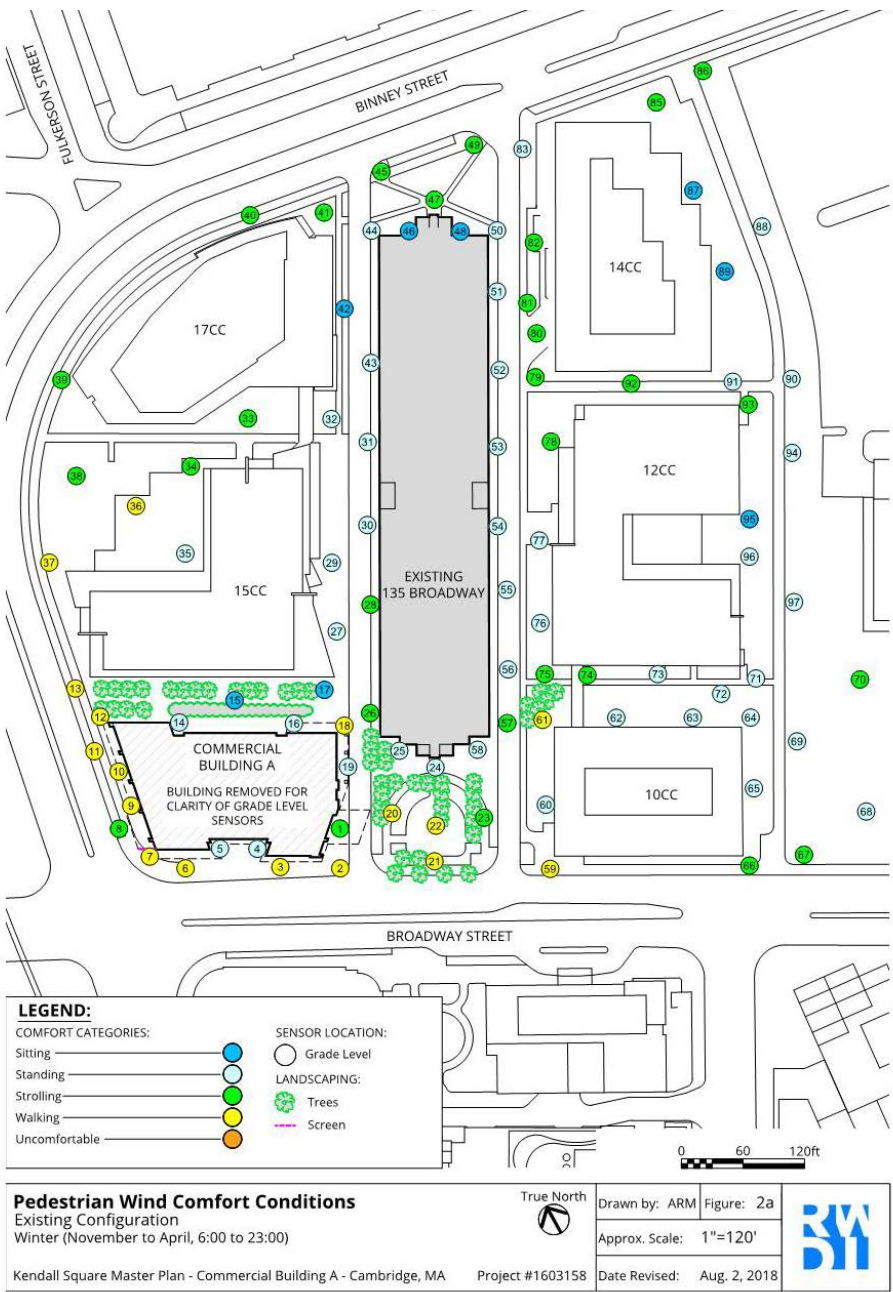


FIGURE 7.8 – PEDESTRIAN WIND COMFORT CONDITIONS (NORTH PARCEL, EXISTING/WINTER)

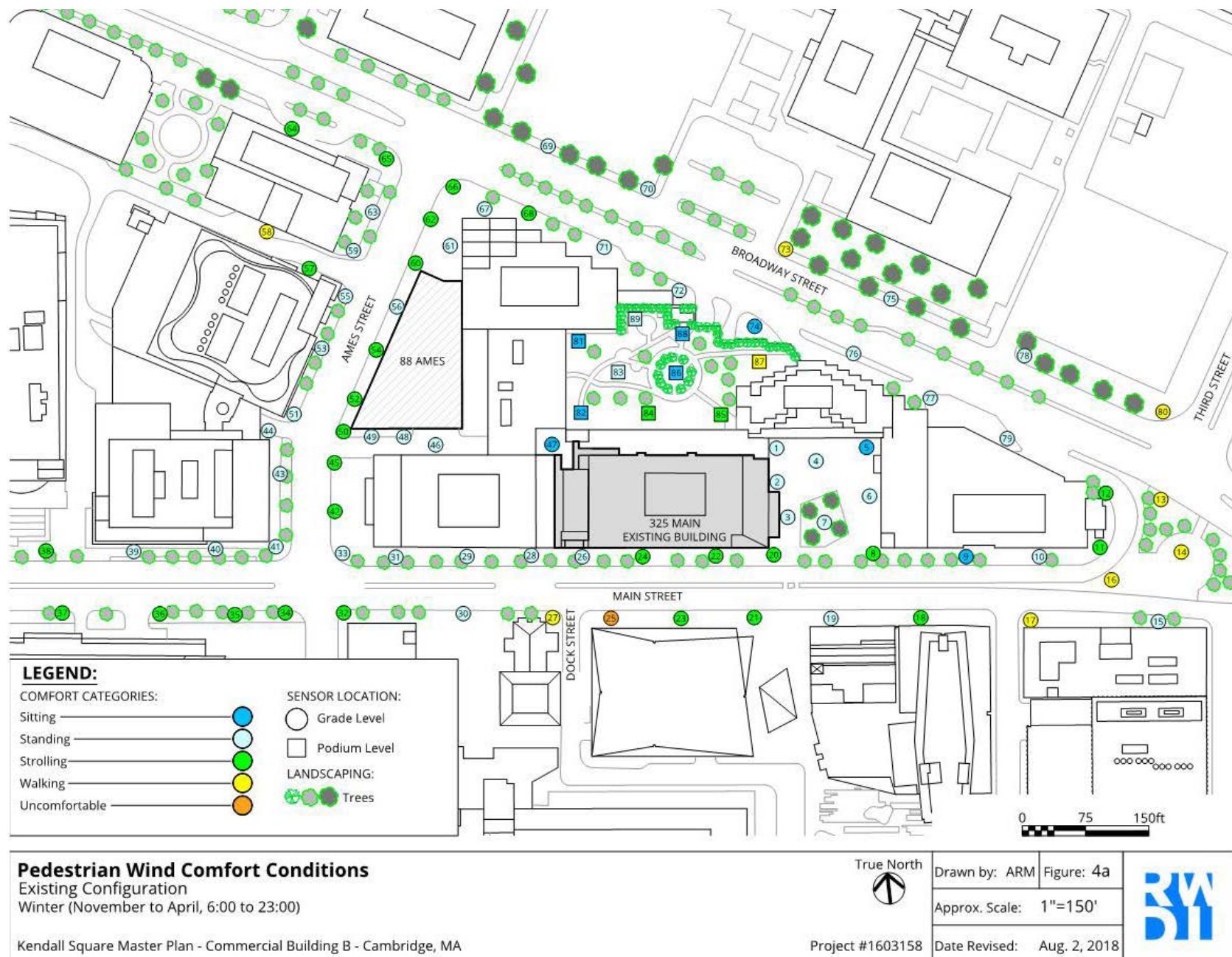


FIGURE 7.9 – PEDESTRIAN WIND COMFORT CONDITIONS
(EAST PARCEL, EXISTING/WINTER)

PROPOSED CONFIGURATION

WINTER

NORTH PARCEL

Under the Proposed Configuration, mean wind speeds at most of the on-site locations in the winter are expected to be generally comfortable for their intended use, which includes strolling or better, with the exception of two locations where uncomfortable conditions are predicted at the corner of Broadway and West Service Drive (Location 2), and at the northwest corner of the building along Galileo Galilei Way (Location 12). Wind conditions generally comfortable for walking or better are predicted at the Commercial Building A entrances, at entrances to the Residential South Building, and Broadway Park. Wind conditions generally comfortable for strolling or better are predicted at the entrances to the Residential North building and in Binney Park. At off-site locations surrounding the Project components, mean wind speeds in the winter are generally comfortable for their intended use, including walking or better, with the exception of three (3) uncomfortable conditions which are predicted along the West Service Drive (Locations 59 and 61) and along Galileo Galilei Way (Location 37). There are no conditions that exceed the effective gust speed safety criterion predicted either on-site or off-site during the winter under the Proposed Configuration.

The following conditions are a baseline that will inform the designs of the Residential Building South and Broadway Park and will mitigate “Uncomfortable” sensor points. The information shown in this Concept Plan Amendment is not proposed as a permanent condition. Changes in mass and ground plane from future Design Review will change the wind sensor outcomes. Refer to Figure 7.10. *

EAST PARCEL

Under the Proposed Configuration, mean wind speeds at most of the on-site locations in the winter are expected to be generally comfortable for their intended use, which includes strolling or better. The Project will improve pedestrian wind comfort conditions at six (6) on-site locations in the winter, including Commercial Building B entrances on Main Street, and the east edge of the building (Locations 1-3, 22, 24 and, 26). At off-site locations surrounding Commercial Building B, mean wind speeds in the winter are generally comfortable for their intended use, including strolling or better, with the exception of one existing location along Main Street that remains uncomfortable in the Proposed Configuration (Location 25). Pedestrian wind comfort conditions at the Kendall Square Rooftop Garden will remain comfortable for strolling or better, including one location that is improved from strolling to standing (Location 85), and one location that is improved from walking to strolling (Location 87). There are no conditions that exceed the effective gust speed safety criterion predicted either on-site or off-site during the winter under the Proposed Configuration. Refer to Figure 7.11.

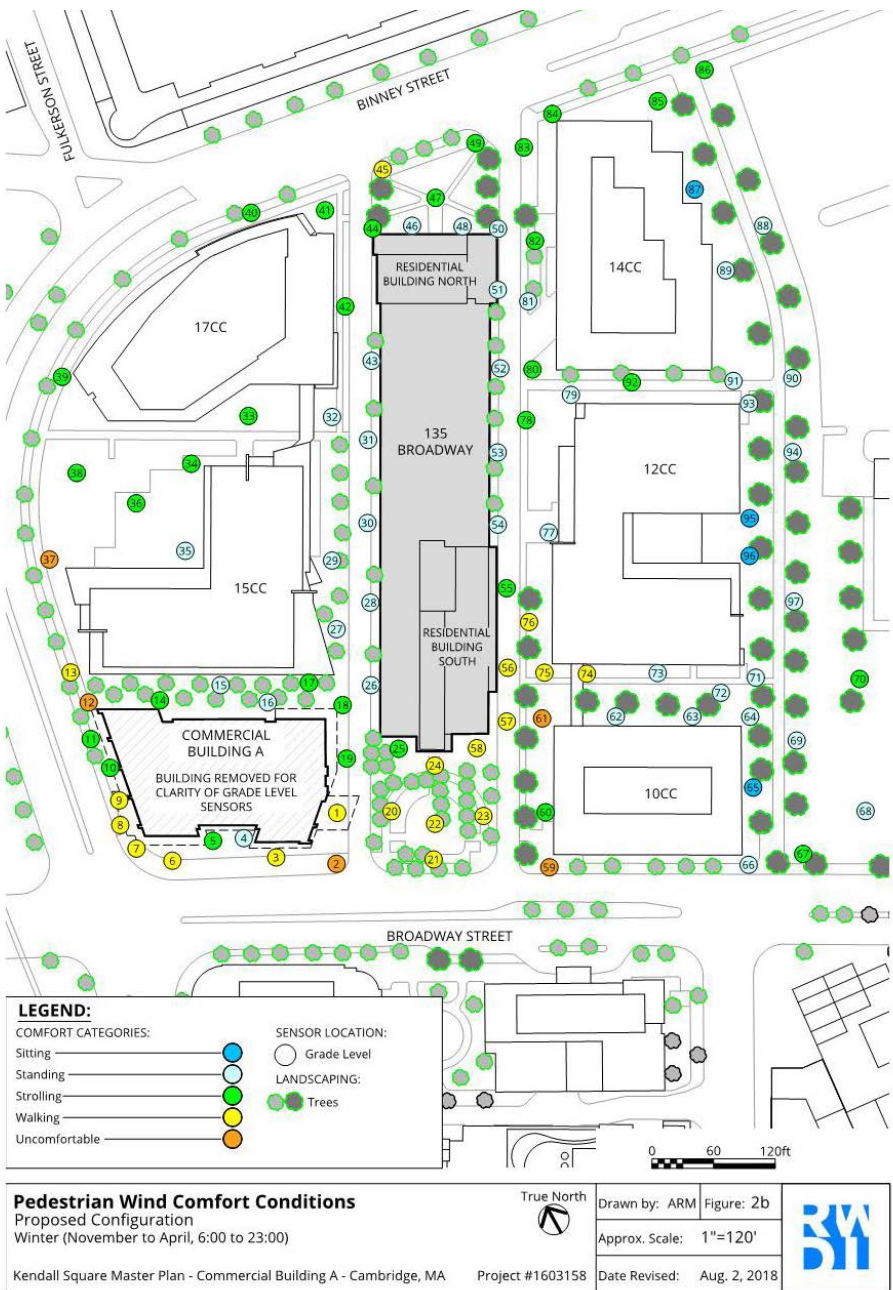


FIGURE 7.10 – PEDESTRIAN WIND COMFORT CONDITIONS (EAST PARCEL, FUTURE/WINTER)

* For more information on Pedestrian Winds Comfort Strategies, refer to Appendix C Environmental Studies / Pedestrian Wind Assessment Supplemental Memo.

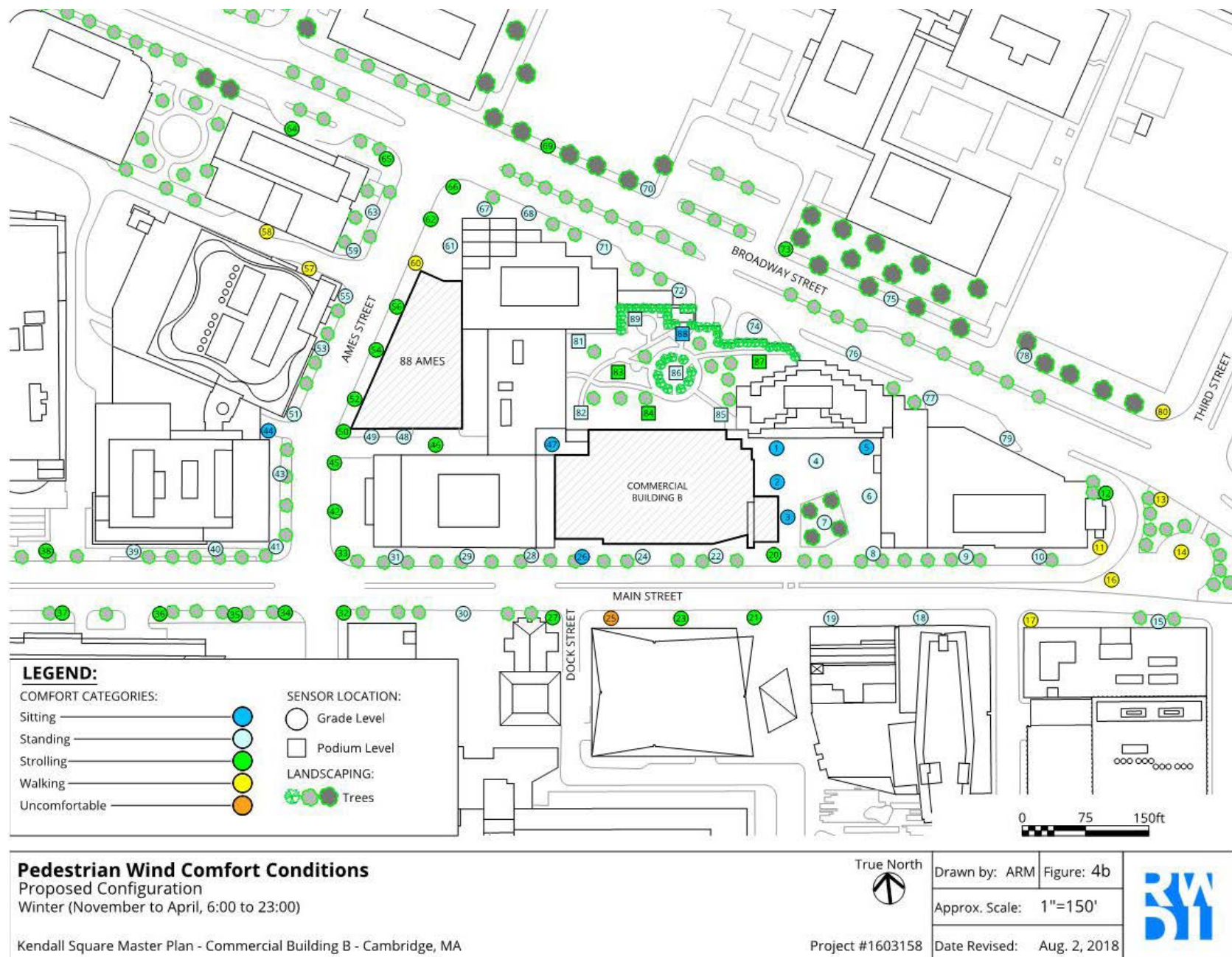


FIGURE 7.11 – PEDESTRIAN WIND COMFORT CONDITIONS
(NORTH PARCEL, FUTURE/WINTER)

7.2 SHADOW STUDIES

The illustrations in the following section have been updated to present the estimated net new shadow (shown in orange) as a result of the Project, including the Project Change for the times of 9:00 AM, 12:00 PM, and 3:00 PM during the Summer and Winter Solstices, and Spring/Fall Equinox. The net new shadow depicted falls both on the ground plane and on rooftops. Based on the shadow studies, the Project creates a modest amount of net new shadow commensurate with urban development of this scale.

Shadow Analysis Methodology

The shadow analyses have been updated to reflect the shift of approved office GFA associated with Commercial Building B from 250 Binney Street to 325 Main Street. Since the Original Concept Plan was approved in 2017, the Applicant broke ground on construction of the commercial space and ground floor retail associated with the Commercial Building A (Phase I) at 145 Broadway. For the purposes of this analysis, in order to isolate shadow related to the three as of yet unconstructed Project components, the shadow impacts associated with Commercial Building A are now shown as “existing shadow” and are not included in the description of net new shadow associated with the three remaining Project components. Additionally, considering the relocation of Commercial Building B, the previously approved MIT North of Main (NOMA) and South of Main (SOMA) buildings are now included as background.

Figures 7.12A-C summarize the methodology used to capture the resultant new shadow cast by the Project Components. For this purpose, March 21st at 9:00 AM is used as an example of the studies to follow. The estimated “net new shadow” is created by capturing the “difference” between the existing shadow (Figure 7.12A) and the proposed shadow (Figure 7.12B). The difference, or the net new shadow (Figure 7.12C), is shown in orange in the subsequent composite studies.



FIGURE 7.12A - MARCH 21, 9:00 AM (EXISTING CONDITION)



FIGURE 7.12B - MARCH 21, 9:00 AM (PROPOSED CONDITION)

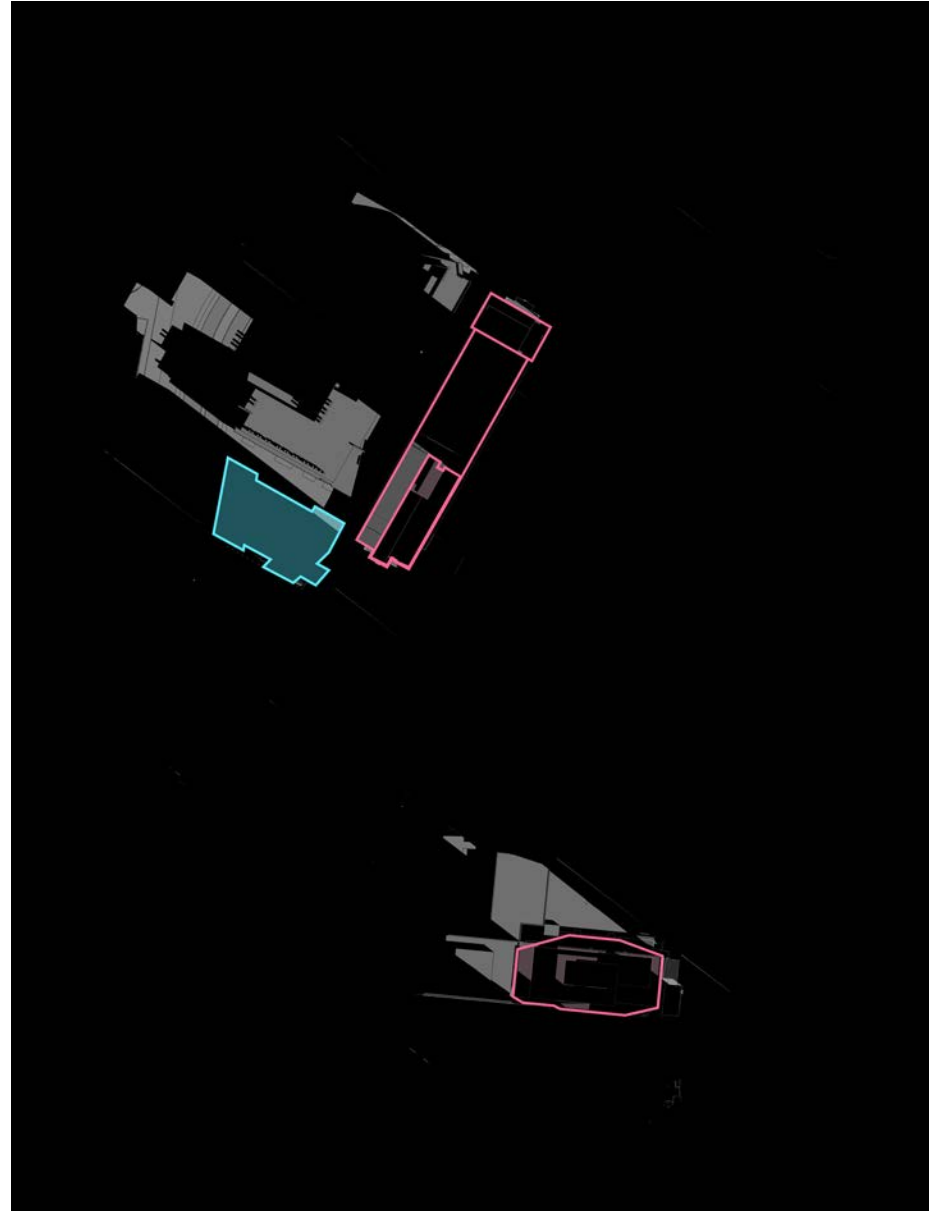


FIGURE 7.12C - MARCH 21, 9:00 AM (THE DIFFERENCE IN SHADOW)

EQUINOX

Equinox (March 21 & September 21)

March 21 and September 21 are the Spring and Fall Equinoxes, respectively, when the length of daytime and nighttime are equal. The net new shadow for these conditions are depicted at the right. At 9:00 AM, the Residential South and North Buildings will cast net new shadow towards the west-northwest that will fall along a limited portion of Binney Street Park, across Binney Street, and on an incremental portion of Binney Park. At 9:00 AM, Commercial Building B will cast some incremental net new shadow on a limited portion of the southwest corner of the Kendall Square Rooftop Garden. At 12:00 PM, the sun is in the south-southeasterly sky and shadows are cast towards the north-northeast. The majority of new shadow from the Residential South and North Buildings falls within the Project Site, with some new shadow cast on Binney Park, and across Binney Street. At noon, net new shadows from Commercial Building B will cover the Kendall Square Rooftop Garden and an incremental portion of the southern sidewalk along Broadway. At 3:00 PM, the sun is in the southwestern sky and shadows are cast to the northeast. The Residential South and North Buildings are expected to cast some net new shadow across Binney Street, along the northern end of the 6th Street Connector, and onto the adjacent Volpe parcel. At 3:00 PM, Commercial Building B is expected to cast incremental net new shadows on the eastern end of the Kendall Square Rooftop Garden, a small portion of the northern edge of Kendall Plaza and onto a portion of the northern sidewalk of Broadway, adjacent to the Volpe parcel.



FIGURE 7.13A - MARCH 21, 9:00 AM

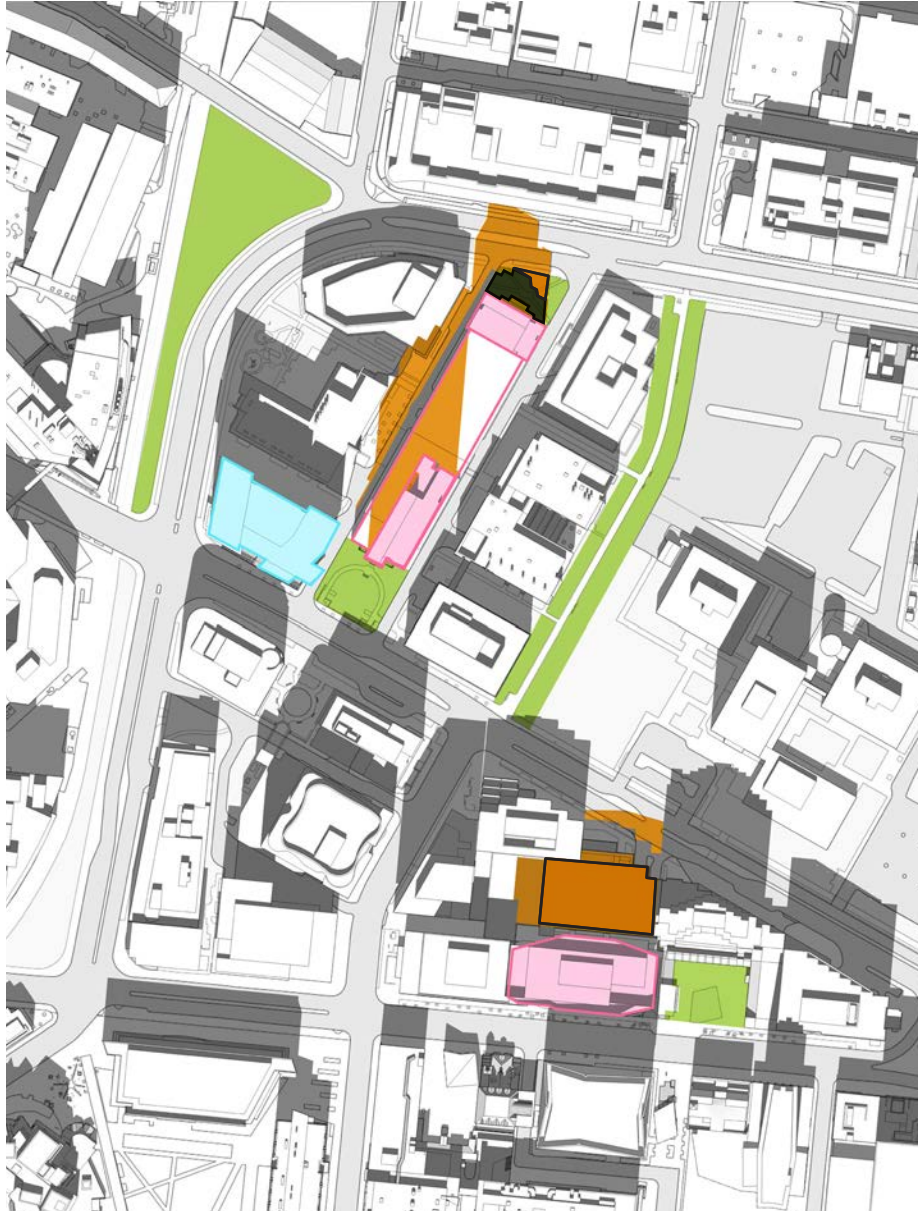


FIGURE 7.13B - MARCH 21, 12:00 PM

- New Shadow
- Existing Shadow
- New Shadow over open space
- Existing Shadow over open space

MXD INFILL DEVELOPMENT CONCEPT PLAN



FIGURE 7.1C - MARCH 21, 3:00 PM

- Buildings (Under Construction)
- Proposed Buildings

SUMMER SOLSTICE

Summer Solstice (June 21)

June 21 is the summer solstice and the longest day of the year where the sun is highest in the sky. On this day, the Project casts the least amount of net new shadow, the majority of which is cast within the Project Site. At 9:00AM, net new shadows associated with the Residential South and North Buildings are cast to the west-northwest, and largely fall within the Project Site. Commercial Building B is expected to cast incremental net new shadow onto a small sliver along the southwestern edge of the Kendall Square Rooftop Garden. At 12:00 PM, the sun is high in the southern sky and casts the shortest shadows of the day towards the north. The majority of new shadow from the Residential South and North Buildings falls within the Project Site, with some incremental net new shadow cast on Binney Park. At noon, Commercial Building B will cast some incremental net new shadow on the southern end of the Kendall Square Rooftop Garden. At 3:00 PM, the sun is in the western sky and shadows are cast towards the east-northeast. The Residential South Building is expected to cast incremental net new shadow onto the 6th Street Connector, and Commercial Building B is expected to cast net new shadow onto the southeastern corner of the Kendall Square Rooftop Garden and the northern side of the adjacent Kendall Plaza.



FIGURE 7.14A - JUNE 21, 9:00 AM



FIGURE 7.14B - JUNE 21, 12:00 PM

- New Shadow
- Existing Shadow
- New Shadow over open space
- Existing Shadow over open space



FIGURE 7.14C - JUNE 21, 3:00 PM

- Buildings (Under Construction)
- Proposed Buildings

FALL

October 21

At 9:00 AM, the sun is low in the southeast sky resulting in long shadows to the northwest. The Residential South and North Buildings will net new cast shadows to the west-northwest on to Binney Street Park and across Binney Street. Commercial Building B will cast some incremental net new shadow onto the westernmost portion of the Kendall Square Rooftop Garden. At 12:00 PM, the sun is in the southern sky and shadows will be cast nearly due north. The Residential North and South Buildings will cast incremental net new shadow onto a sliver of Binney Park, and across Binney Street. At noon, Commercial Building B will cast incremental net new shadow onto a limited portion of the Kendall Square Rooftop Garden, and onto a portion of the northern sidewalk of Broadway, adjacent to the Volpe parcel. At 3:00 PM, shadows cast from the Project are long, and extend in the northeast direction. Net new shadows from the Residential North and South Buildings fall onto existing rooftops, and onto a portion of the northern and southern sidewalk of Broadway, adjacent the Volpe Parcel. Commercial Building B is expected to cast net new shadow onto the southeastern corner of the Kendall Square Rooftop Garden, and onto a sliver of the northern edge of the adjacent Kendall Plaza.



FIGURE 7.15A – OCT 21, 9:00 AM



FIGURE 7.15B - OCT 21, 12:00 PM

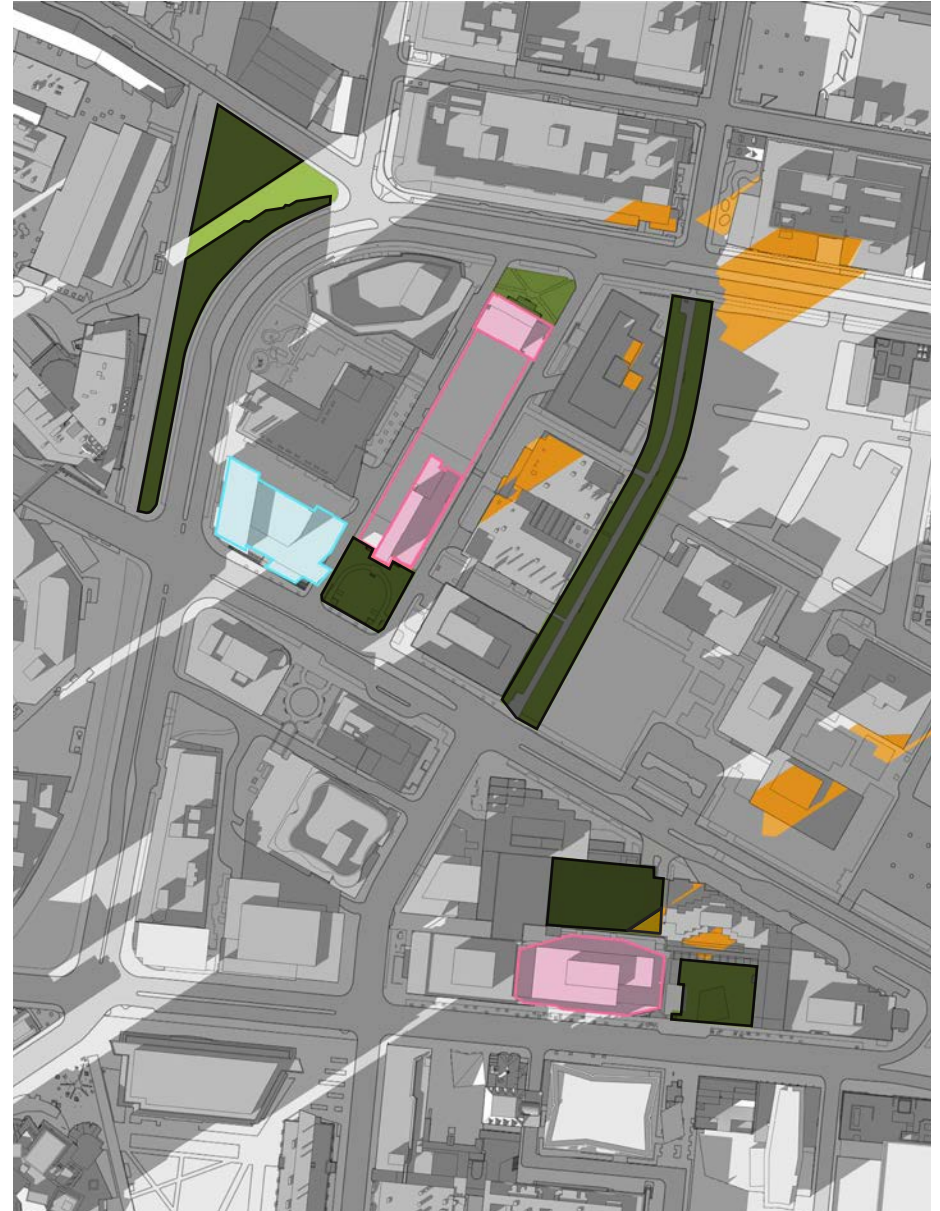


FIGURE 7.15C - OCT21, 3:00 PM

- | | | |
|---|---|--|
| ■ New Shadow | ■ New Shadow over Open space | ■ Buildings (Under Construction) |
| ■ Existing Shadow | ■ Existing Shadow over Open space | ■ Proposed Buildings |
| | ■ Open space related to project study | |

WINTER SOLSTICE

Winter Solstice (December 21)

December 21 is the winter solstice and the shortest day of the year, where the sun is low in the sky. Therefore, Cambridge experiences the longest shadows of the year on this day, and many of the adjacent sidewalks and public spaces are already subsumed in existing shadow. At 9:00 AM, the sun is low in the southeast sky resulting in long shadows to the northwest. Net new shadows cast by the Project fall primarily over surrounding building rooftops. At 12:00 PM, the Project will create new shadow primarily over building rooftops to the North, however the Residential North Building does cast incremental net new shadow onto a sliver of Binney Park. At noon, Commercial Building B casts a small amount of incremental net new shadow onto the westernmost portion of the Kendall Square Rooftop Garden. At 3:00 PM, the sun is low in the southwest sky and new shadow from the Residential South and North Buildings falls over building rooftops to the northeast. Commercial Building B casts incremental net new shadow onto the northeastern portion of the Kendall Square Rooftop Garden, and across Broadway onto existing building rooftops.

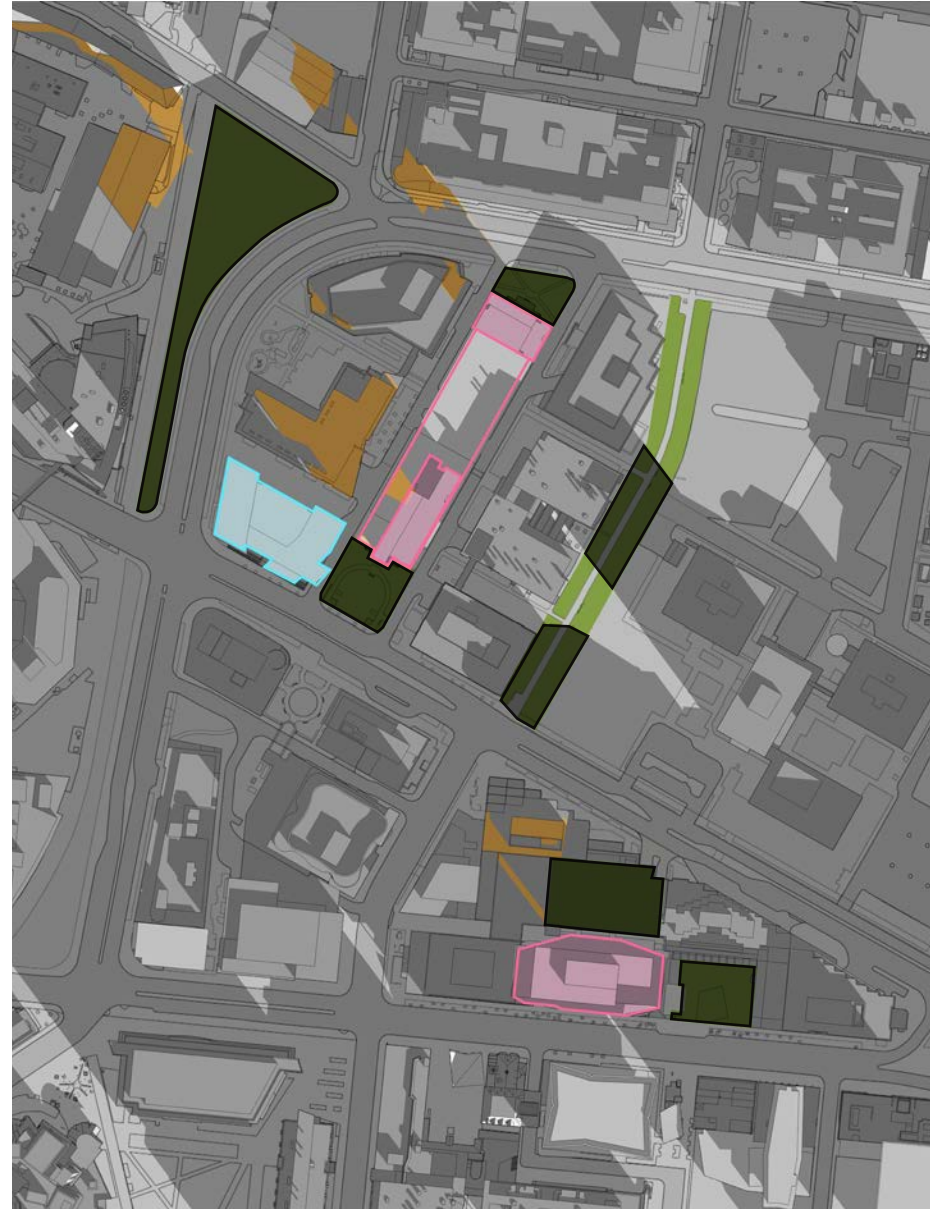


FIGURE 7.15A - DECEMBER 21, 9:00 AM



FIGURE 7.15B - DECEMBER 21, 12:00 PM

- New Shadow
- Existing Shadow
- New Shadow over open space
- Existing Shadow over open space



FIGURE 7.15C - DECEMBER 21, 3:00 PM

- Buildings (Under Construction)
- Proposed Buildings

7.3 NOISE

The noise impact assessment evaluated the potential noise impacts associated with the Project's activities, including mechanical equipment and loading activities. This section discusses the fundamentals of noise, noise impact criteria, noise analysis methodology, and potential noise impacts. Noise monitoring was conducted to determine existing ambient sound levels.

Considering the relocation of Commercial Building B, additional noise monitoring was conducted along Main Street to capture ambient sound levels associated with the existing daytime and nighttime activities and mechanical equipment. The analysis demonstrates that the Project will continue to comply with City of Cambridge's noise control ordinance (Municipal Code, Chapter 8.16).

7.3.1 FUNDAMENTALS OF NOISE

Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities such as sleep, communication, work, or recreation. How people perceive sound depends on several measurable physical characteristics, which include the following:

- **Intensity** - Sound intensity is often equated to loudness.
- **Frequency** - Sounds are comprised of acoustic energy distributed over a variety of frequencies. Acoustic frequencies, commonly referred to as tone or pitch, are typically measured in Hertz. Pure tones have all their energy concentrated in a narrow frequency range.

Sound levels are most often measured on a logarithmic scale of decibels (dB). The decibel scale compresses the audible acoustic pressure levels which can vary from the threshold of hearing (zero dB) to the threshold of pain (120 dB). Because sound levels are measured in dB, the addition of two sound levels is not linear. Adding two equal sound levels creates a 3 dB increase in the overall level. Research indicates the following general relationships between sound level and human perception:

- A 3 dB increase is a doubling of acoustic energy and is the threshold of perceptibility to the average person.
- A 10 dB increase is a tenfold increase in acoustic energy but is perceived as a doubling in loudness to the average person.

The human ear does not perceive sound levels from each frequency as equally loud. To compensate for this phenomenon in perception, a frequency filter known as A weighted [dB(A)] is used to evaluate environ-

mental noise levels. Table 7-1 presents a list of common outdoor and indoor sound levels.

A variety of sound level indicators can be used for environmental noise analysis. These indicators describe the variations in intensity and temporal pattern of the sound levels. The following is a list of common sound level descriptors used for environmental noise analyses:

- L90 is the sound level which is exceeded for 90 percent of the time during the time period. The L90 is generally considered to be the ambient or background sound level.

	Sound Pressure (μ Pa)*	Sound Level dB(A)**	
Outdoor Sound Levels			Indoor Sound Levels
	6,324,555	- 110	Rock Band at 5 m
Jet Over Flight at 300 m		- 105	
	2,000,000	- 100	Inside New York Subway Train
Gas Lawn Mower at 1 m		- 95	
	632,456	- 90	Food Blender at 1 m
Diesel Truck at 15 m		- 85	
Noisy Urban Area—Daytime	200,000	- 80	Garbage Disposal at 1 m
		- 75	Shouting at 1 m
Gas Lawn Mower at 30 m	63,246	- 70	Vacuum Cleaner at 3 m
Suburban Commercial Area		- 65	Normal Speech at 1 m
	20,000	- 60	
Quiet Urban Area—Daytime		- 55	Quiet Conversation at 1 m
	6,325	- 50	Dishwasher Next Room
Quiet Urban Area—Nighttime		- 45	
	2,000	- 40	Empty Theater or Library
Quiet Suburb—Nighttime		- 35	
	632	- 30	Quiet Bedroom at Night
Quiet Rural Area—Nighttime		- 25	Empty Concert Hall
Rustling Leaves	200	- 20	
		- 15	Broadcast and Recording Studios
	63	- 10	
		- 5	
Reference Pressure Level	20	- 0	Threshold of Hearing

TABLE 7-1 COMMON OUTDOOR AND INDOOR SOUND LEVELS

7.3.2 METHODOLOGY

The noise analysis evaluated the potential noise impacts associated with the Project's mechanical equipment and loading/service activities. The noise analysis included measurements of existing ambient background sound levels and a qualitative evaluation of potential noise impacts associated with the proposed mechanical equipment (e.g., energy recovery units, cooling towers, etc.) and loading activities. The study area was evaluated and sensitive receptor locations in the vicinity of the Project were identified and examined. The site layout and building design, as it relates to the loading area and management of deliveries at the Project site were also considered. The analysis considered sound level reductions due to distance, proposed building design, and obstructions from surrounding structures.

Receptor Locations

The noise analysis included an evaluation of the study area to identify nearby sensitive receptor locations, which typically include areas of sleep and areas of outdoor activities that may be sensitive to noise. The noise analysis identified eight nearby sensitive receptor locations in the vicinity of the Project. As shown on Figure 7.16, the receptor locations include the following:

- R1 – Residence Inn Hotel;
- R2 – Marriott Hotel;
- R3 – Eastgate Apartments;
- R4 – Lofts at Kendall Square Apartments;
- R5 – Pedestrian Walkway (connecting Broadway and Binney St); and
- R6 – Public greenspace south of Cambridge Center garage.
- R7 – The Kendall Hotel
- R8 – SOMA Residential Building (Building #4)

These receptor locations, selected based on land use considerations, represent the most sensitive locations in the vicinity of the Project Site.

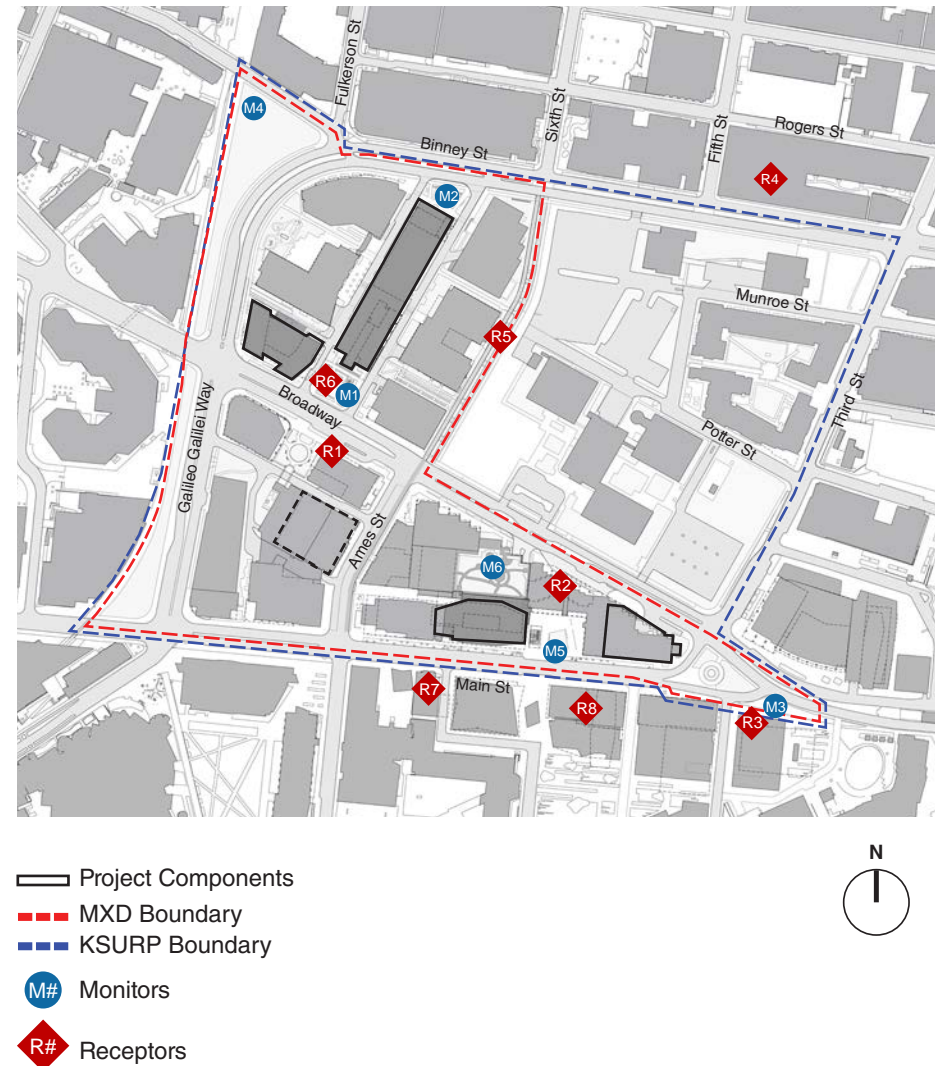


FIGURE 7.16 - RECEPTOR LOCATIONS

7.3.3 CITY OF CAMBRIDGE NOISE IMPACT STANDARDS

The City has developed noise standards that establish noise thresholds deemed to result in adverse impacts. The noise analysis for the Project used these standards to evaluate whether the proposed development will generate sound levels that result in potential adverse impacts.

The noise standards are provided under Chapter 8.16 of the City of Cambridge Municipal Code (Noise Ordinance). These standards establish maximum allowable sound levels based upon the land use affected by the proposed development. Table 7.2 summarizes the maximum allowable sound levels that should not be exceeded. For a residential zoning district, the maximum noise level affecting residential uses shall not exceed the Residential Noise

Standard. The single number equivalent noise standard for a residential use is 60 dB(A) for daytime periods (7:00 AM to 6:00 PM) and 50 dB(A) during other times of the day.

The City of Cambridge noise control regulation considers construction sound levels to be an impact to residential land uses if the L10 sound level is in excess of 75 dB(A) or the Lmax sound level is in excess of 86 dB(A) measured at the lot of the affected property.

Octave Band Center Frequency (Hz)	Residential Area		Residential in Industrial		Commercial Area	Industry Area
	Daytime	Other Times	Daytime	Other Times	Anytime	Anytime
31.5	76	68	79	72	79	83
63	75	67	78	71	78	82
125	69	69	69	69	69	69
250	62	52	68	57	68	73
500	56	46	62	51	62	67
1,000	50	40	56	45	56	61
2,000	45	33	51	39	51	57
4,000	40	28	47	34	47	53
8,000	38	26	44	32	44	50
Single Number Equivalent, dB(A)	60	50	65	55	65	70

Source: City of Cambridge Municipal Code, Chapter 8.16, Table 8.16.060E.

TABLE 7.17 CITY OF CAMBRIDGE NOISE STANDARDS BY ZONING DISTRICT

7.3.4 EXISTING NOISE CONDITIONS

Existing sound level measurements were conducted using Type 1 sound analyzers (Larson Davis 831 and SoundExpert LxT) to establish existing ambient conditions. Measurements were conducted during the weekday daytime period (approximately 9:00 AM to 11:00 AM) and late-night period (1:00 AM to 3:00 AM) in the vicinity of the Project Site on July 21, 2016. Supplemental measurements were conducted during the daytime (1:00 PM to 3:00 PM) on April 9th, 2018 and during the late-night period (1:00 AM to 3:00 AM) on April 10th, 2018. The monitoring program consists of five short-term monitoring locations, as shown in Figure 7.3. In addition, a 24-hr measurement was conducted in an open lot located at the corner of Binney Street and Fulkerson Street (M4). During the daytime period, the measured sound levels data under existing conditions were composed of noise from construction activities and vehicles

on local roadways, such as Binney Street, Broadway, and Main Street. The nighttime period sound levels were generally associated with mechanical equipment from nearby buildings. The existing measured sound level data are presented in Table 7.3.

The measured L90 sound levels range from approximately 56 dB(A) to 64 dB(A) during the daytime period and from 53 dB(A) to 59 dB(A) during the nighttime period. The result of the noise monitoring program indicates that the daytime sound levels within the study area are currently exceeding the City of Cambridge's daytime standard of 60 dB(A) along Broadway and Main Street. The existing sound levels during the nighttime period exceed the City's nighttime standard of 50 dB(A) for residential use at all evaluated locations.

Monitoring Location	City of Cambridge Residential District Noise Standard*		Measured L90 Sound Levels	
	Daytime	Nighttime	Daytime	Nighttime
M1 – Broadway	60	50	62	59
M2 – Binney Street	60	50	60	59
M3 – Broadway/Main Street	60	50	58	55
M4 – Lot at Binney St/Fulkerson St	60	50	60	58
M5 – Main Street	60	50	64	53
M6 – Green Garage	60	50	56	53

TABLE 7.18 EXISTING AMBIENT SOUND LEVELS, DB(A)

7.3.5 FUTURE NOISE CONDITIONS

The noise analysis evaluated the potential noise impacts associated with the Project's proposed mechanical equipment and loading activities. The analysis determined the potential sound level impacts at the nearby sensitive receptor locations.

MECHANICAL EQUIPMENT

Since the Project is in the early stages of the design process, the specific details related to the final selection of mechanical equipment are unknown at the time of this noise assessment. Based on preliminary design plans, the anticipated mechanical equipment associated with the Project are expected to include the following:

- Energy recovery units
- Cooling towers
- Emergency generators
- Co-generation units

The mechanical equipment will be located within screening walls on the rooftop or in mechanical rooms of the proposed buildings. During the design and selection process, the appropriate low-noise mechanical equipment will be selected, including potential noise mitigation measures, such as acoustical enclosures and/or acoustical silencers. The Project will incorporate noise attenuation measures necessary to comply with City of Cambridge's noise criteria at the sensitive receptor locations.

In addition to being located within acoustical screening walls or within a penthouse, the mechanical systems would be strategically located on the rooftop, utilizing the height of the proposed buildings in providing noise attenuation. Noise attenuation could be achieved by the Project's building design as the heights of the Project's buildings are similar or greater than the height of nearby sensitive receptors. The rooftops of the Project's buildings will serve as a barrier and break the direct line of exposure between the noise sources and receptors. With the proposed mechanical equipment located on the rooftop or within a penthouse, the sound levels associated with the Project's mechanical equipment are expected to be negligible at the surrounding sensitive receptor locations. With greater distances and impeding building structures, receptors located further away from the Project are expected to experience lower sound levels associated with the Project's noise sources.

The Project may require an emergency generator for life safety purposes such as emergency exit lighting. The determination of specific generator parameters, such as the sizes and locations will be made during the building design process. The Project will be required to adhere to Massachusetts Department of Environmental Protection's (MassDEP's) regulations that require such equipment to be certified and registered. As part of the air permitting/certification process, the Project will be required to meet additional noise requirements described in MassDEP regulations under the Codes of Massachusetts Regulations (310 CMR 7.00). When the details of the emergency generator are developed, the Applicant will submit the appropriate permit/certification application to MassDEP, which would include noise mitigation measures (such as acoustic enclosures and exhaust silencers) that are necessary to meet MassDEP's noise criteria.

Service and Loading Activities

Off-street designated loading areas will be provided for loading and service activities associated with the Project. The loading areas will be located within the ground level of the proposed buildings, with the exception of Commercial Building B, which is serviced from a below-grade loading dock, accessed from Broadway. The loading dock activities will be managed so that service and loading operations do not impact traffic circulation on the adjacent local roadways. Since loading and service activities will be enclosed within the proposed buildings and operations will be managed, noise impacts to nearby sensitive receptor locations are expected to be negligible.

Impact on Proposed Residential Use

The results of the noise monitoring program indicate existing exterior sound levels exceed the City's noise standards. Noise attenuation measures are limited since the Project consists of multi-level residential buildings and noise walls are not a feasible measure for receptors at high heights. The Project will consider measures to minimize the impacts to interior sound levels even though the City's noise ordinance does not provide interior noise standards.

The proposed buildings will be designed to incorporate building materials with the appropriate sound transmission class to minimize the impacts to the interior sound levels of the proposed residential units. Substantial sound level reductions are considered achievable since general construction material typically provides 20 decibels of attenuation. The building design would consider restricting exposure to exterior noise environment, such as limiting operable windows or balconies and providing central climate control systems.

Construction Activity

The construction activity associated with the Project may temporarily increase nearby sound levels due to the use of heavy machinery. Heavy machinery is expected to be used intermittently throughout the Project's construction phases, typically during daytime periods. The construction activities that will generate the highest sound levels may include demolition, site excavation and grading, and construction of the foundation for the proposed buildings. A construction management program will be developed with the City for each phase of the Project to ensure that the applicable noise regulation is met.

The Project will implement mitigation measures to reduce or minimize noise from construction activities. Construction vehicles and equipment would be required to maintain their original engine noise control equipment. Specific mitigation measures may include the following:

- Construction equipment would be required to have installed and properly operating appropriate noise muffler systems.
- Appropriate traffic management techniques would be implemented during the construction period would mitigate roadway traffic noise impact.
- Proper operation and maintenance, and prohibition of excessive idling of construction equipment engines, would be required.

Therefore, construction noise levels are proposed to be mitigated to the greatest extent possible.

Conclusion of Noise Impact Assessment

The noise analysis evaluated the sound levels associated with the Project. This analysis determined that the sensitive receptor locations in the vicinity of the Project Site currently experience sound levels exceeding the City's daytime and nighttime noise standards. Due to the anticipated location of the proposed equipment within screening walls on the rooftop, the sound levels associated with the Project's mechanical equipment are expected to have no adverse noise impacts at nearby sensitive receptor locations. While impacts of emergency generators are also expected to be negligible, a separate MassDEP permitting process will allow for further review of this equipment at a later date. The Project is designed such that the loading areas will be enclosed, which will attenuate sound levels associated with the loading activities. As a result of the preliminary design, the Project's operations will have no adverse noise impacts at nearby sensitive receptor locations.

The noise evaluation demonstrates that the existing ambient sound levels exceed the City's noise standards. As a result, the design of the residential buildings will incorporate sufficient acoustical material with the appropriate sound transmission class rating to minimize impacts to interior sound levels.

7.4 EXHAUST RE-ENTRAINTMENT REVIEW

Because three of the proposed buildings are adjacent to several existing laboratory buildings with exhaust stacks, the Applicant has engaged RWDI to re-evaluate the potential air quality impacts that these neighboring buildings might have on the Project Change (refer Appendix C).

The results of the modeling, presented more fully in Appendix C, predict minimum dilution levels, or unacceptable impact at all buildings facing the exhaust stacks. Boiler stacks on any of the new roofs are not expected to be a significant concern. To mitigate predicted air impacts on the proposed buildings from existing exhaust stacks, air intakes for Commercial Building A, and Residential Buildings North and South will be limited to the locations shown in Figure 4 of Appendix C. These areas are protected from the surrounding sources by the building forms. Air intakes for Commercial Building B will likely face the Kendall Square Rooftop Garden, on the north side of the Building.

A representative kitchen exhaust was modeled on the roof of Commercial Building A to determine its impact on Residential Building South. The results found predicted emissions to be well below the dilution required to eliminate odor impacts. Regardless, kitchen exhausts of Commercial Building A will be equipped with odor reduction equipment.

