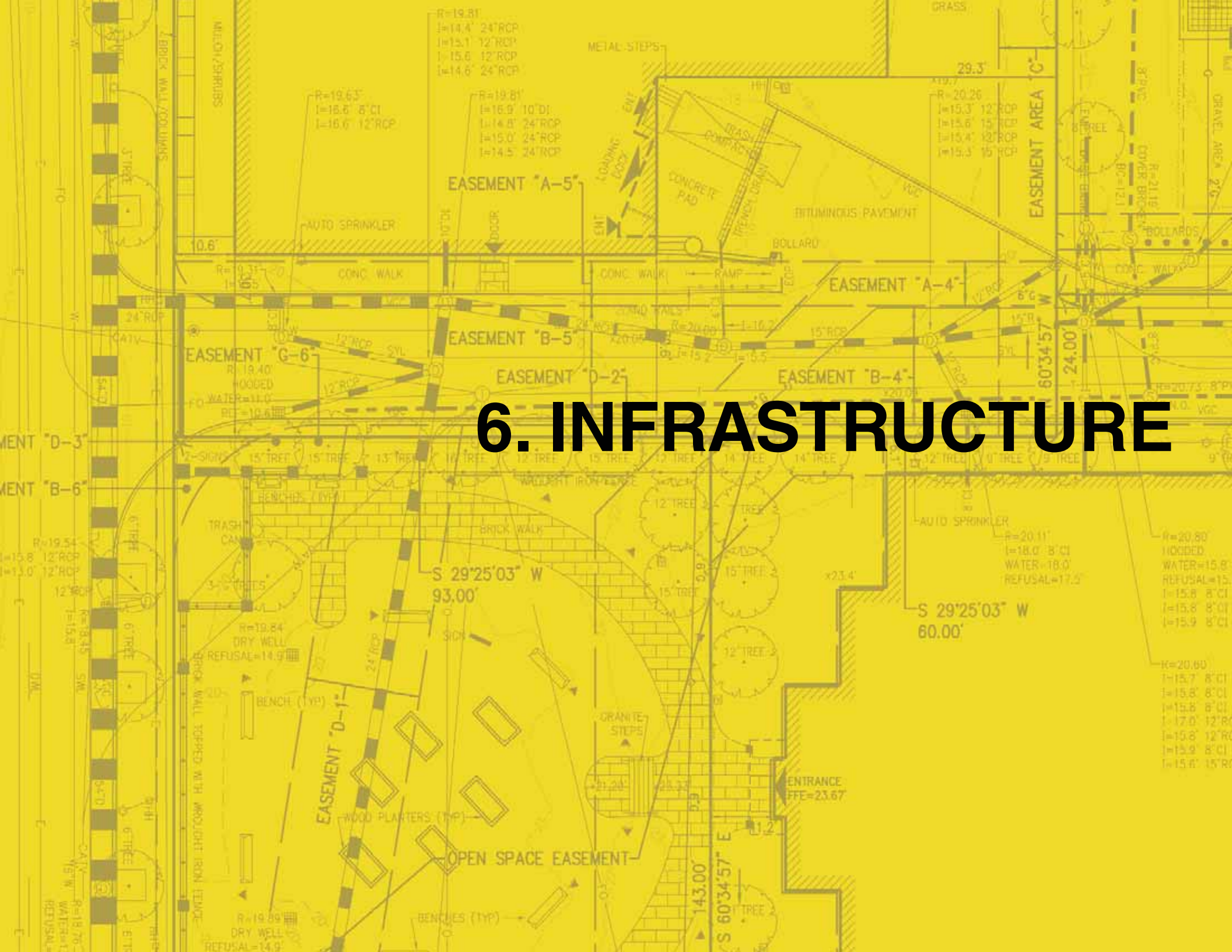


6. INFRASTRUCTURE

6.0 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 Section since the Concept Plan Amendment #1.

- **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 under construction conditions at Commercial Building B at 325 Main Street, and the proposed conditions associated with Residential Building South at 135 Broadway, Commercial Building C at 290 Binney Street, and Commercial Building D at 250 Binney Street.
- **Vulnerability Assessment:** The vulnerability assessment has been expanded to include projected flood elevations along Binney Street, Broadway Street and Main Street. While not a component of the Project, the relocation of the Eversource electrical substation will serve the Cambridge community and improve the resilience of the area electrical grid for decades to come.

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 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.

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):

- 54-inch main in Broadway (Construction is underway to replace 54-inch main with a 4.5' x 6.5' culvert)
- 30-inch main in Galileo Galilei Way

Commercial Building B (325 Main Street):

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

Residential Building South (Blue Garage):

- 54-inch main in Broadway (Construction is underway to replace 54-inch main with a 4.5' x 6.5' culvert)
- 18-inch service in East Service Drive
- 24-inch service in West Service Drive

Commercial Building C (290 Binney Street):

- 24-inch main in Binney Street
- 18-inch service in East Service Drive
- 12-inch service in West Service Drive

Commercial Building D (250 Binney Street):

- 24-inch main in Binney Street
- 18-inch service in East Service Drive
- 24-inch main in Pedestrian Way

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 1 Commercial Building A	27,707	10,155	2.09	0.164
Phase 2 Commercial Building B	28,823	0	2.03	0.150
Phase 3 Residential Building South	6,398	10,273	1.04	0.061
Phase 3 Commercial Building C	23,350	9,293	2.40	0.147
Phase 4 Commercial Building D	45,947	8,883	4.24	0.267
TOTAL	**132,225**	**38,604**	**11.80**	**0.789**

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):

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

Commercial Building B (325 Main Street):

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

Residential Building South (Blue Garage):

- 21-inch main in Broadway

Commercial Building C North (290 Binney Street):

- 30-inch main in Binney Street
- 98-inch combined sewer main in Binney Street

Commercial Building D North (250 Binney Street):

- 30-inch main in Binney Street
- 98-inch combined sewer main in Binney Street

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):

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

Commercial Building B (325 Main Street):

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

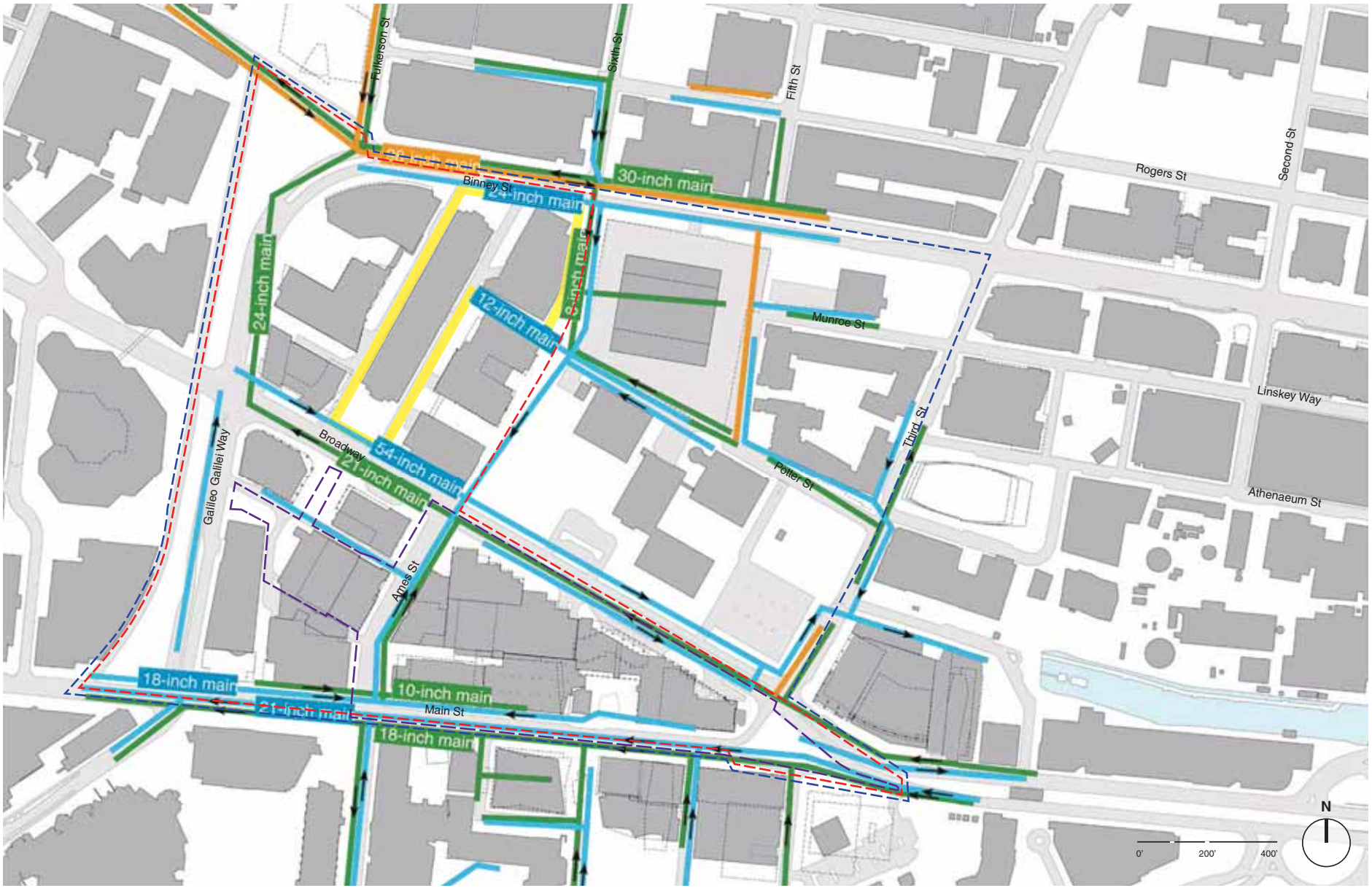
Residential Building South (Blue Garage):

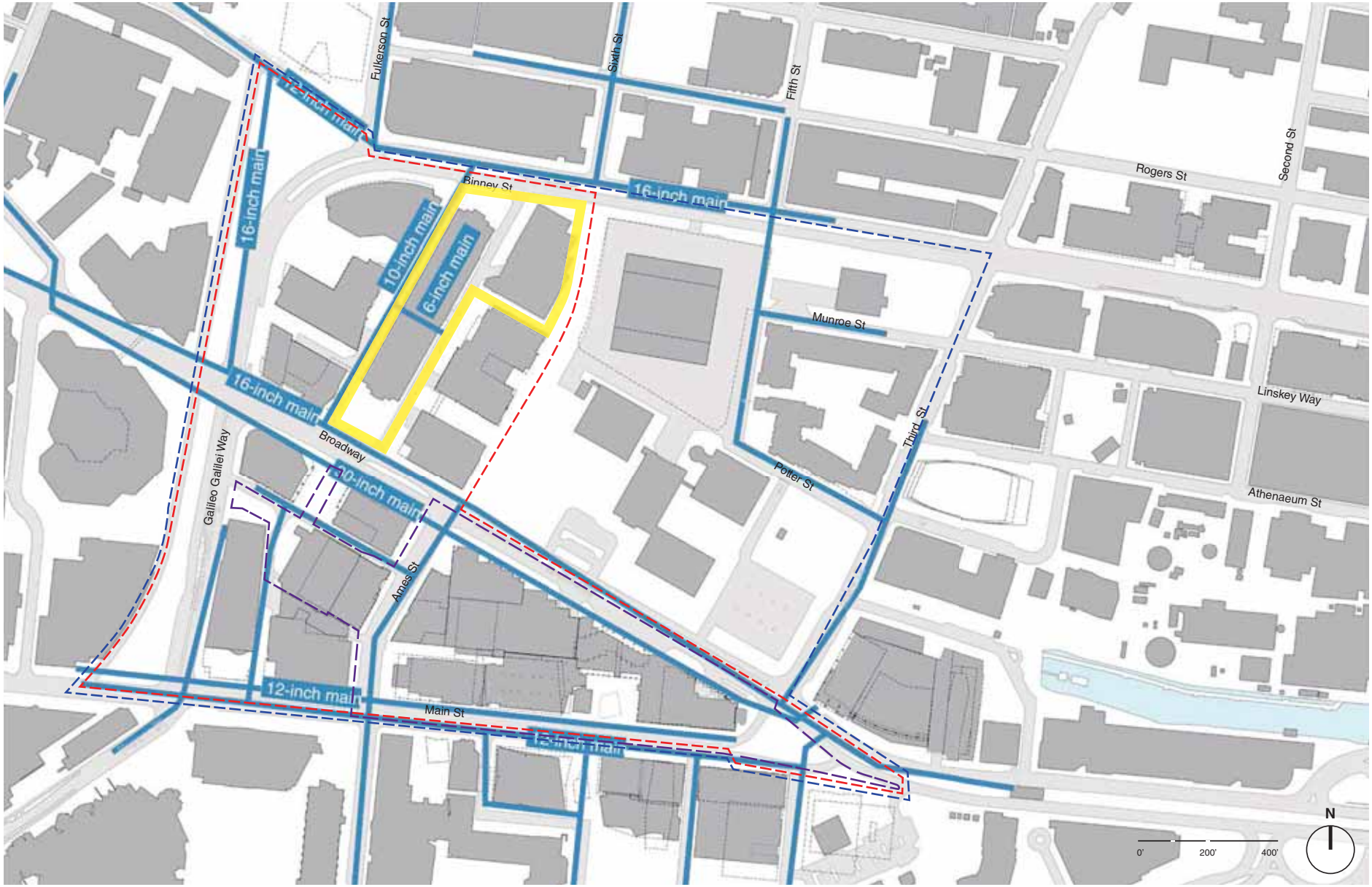
- 16-inch main in Broadway
- 30-inch main in Broadway

Residential Building North (Blue Garage):

- 16-inch main in Binney Street
- 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.


Fulkerson St
Sixth St
Fifth St
Second St
Rogers St
Binney St
30-inch main
24-inch main
24-inch main
6-inch main
12-inch main
Munroe St
Linskey Way
Third St
Broadway
54-inch main
21-inch main
Potter St
Athenaeum St
Galileo Galilei Way
Ames St
18-inch main
10-inch main
Main St
21-inch main
18-inch main
N
0'
200'
400'
Existing Sanitary Sewer System
Existing Storm Drain
Existing Combined Sewer
Project Boundary
MXD Boundary
KSURP Boundary
Ames Street District ASD


Fulkerson St
Sixth St
Fifth St
Second St
Rogers St
Binney St
16-inch main
16-inch main
10-inch main
6-inch main
Munroe St
16-inch main
Broadway
Linskey Way
Third St
Potter St
Athenaeum St
Galileo Galilei Way
10-inch main
Ames St
12-inch main
Main St
12-inch main
N
0'
200'
400'
Existing Water System
Project Boundary
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 1 Commercial Building A	27,707	10,155	2,106	2.00	0.164
Phase 2 Commercial Building B	28,823	0	5,926	2.15	0.227
Phase 3 Residential Building South	12,459	4,212	1,600	0.82	0.168
Phase 3 Commercial Building C	32,643	0	2,800	2.24	0.366
Phase 4 Commercial Building D	54,830	0	4,750	4.12	0.615
TOTAL	**156,462**	**14,367**	**17,218**	**11.33**	**1.540**

1. Green roofs included in proposed site pervious area

TABLE 6-2 PROPOSED SITE HYDROLOGY

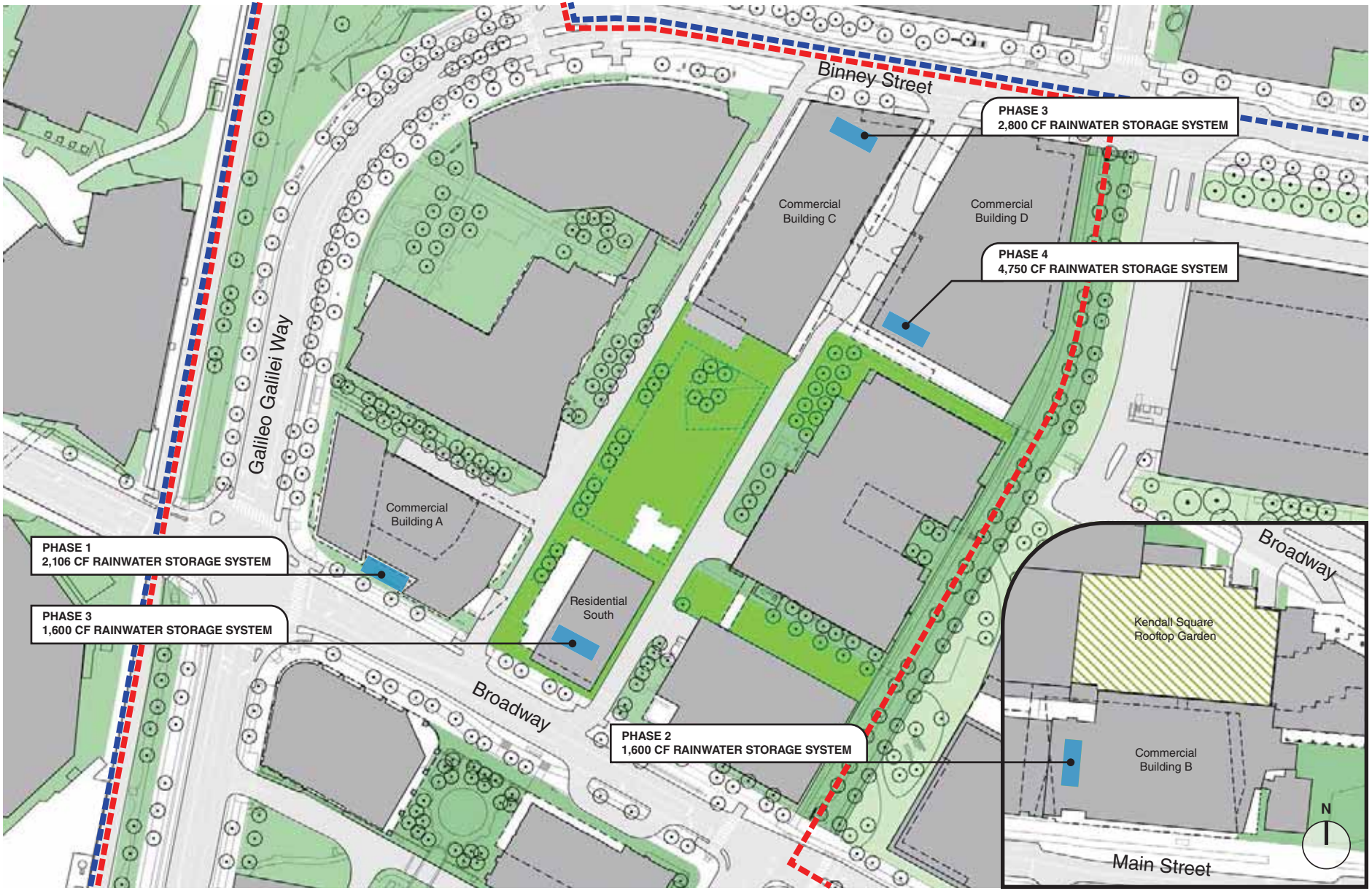
In addition to mitigating runoff flow rates and volumes, the Applicant is responsible for reducing the Phosphorus loads from the Project Site to the CDPW stormwater infrastructure to comply with the Lower Charles River Total Phosphorus Total Maximum Daily Load (TMDL) that requires the removal of 80 percent 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 or rainwater detention/reuse tanks. In order to meet the stormwater peak rate requirements, set by the CDPW, the infiltration systems 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 196,152 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 784,608 gallons. The Applicant has previously completed an I/I removal project for the CDPW in 2019 titled "East Cambridge Sewer Separation". The completed work removed 269,969 GPD of I/I mitigation. The Applicant is currently constructing a culvert in Broadway for future I/I mitigation titled "Kendall Culvert". The final I/I removal volumes will be determined at the Design Review stage for each building and in consultation with CDPW.



Open Spaces
Green Roofs
Infiltration System

PARCEL 4 - 325 MAIN ST- STORMWATER MANAGEMENT

Locations of rainwater storage systems are subject to change depending on site logistics

TABLE 6-3 ESTIMATED WASTEWATER GENERATION FOR THE PROJECT

COMPONENT[1]	USE	QUANTITY	FLOW RATE (GPD)	SEWAGE GENERATION (GPD)
New Project-Related Sewage Generation				
Phase 1 Commercial Building A	Office	432,914	75/1,000 sf	32,469
	Retail	2,872	50/1,000 sf	144
	Restaurant	207	35/seat	7,245
Commercial Building A Total				*39,858*
Phase 2 Commercial Building B	Office	345,423	75/1,000 sf	25,906
	Retail	20,000	50/1,000 sf	1,000
	Restaurant	500	35/seat	17,500
Commercial Building B Total				*44,406*
Phase 3 Residential Building South	Residential	635	110/bdrm	69,850
Residential South Total				*69,850*
Phase 3 Commercial Building C	Office	409,500	75/1,000 sf	30,712
	Retail	2,500	50/1,000 sf	125
Commercial Building C Total				*30,837*
Phase 4 Commercial Building D	Office	444,776	75/1,000 sf	33,358
	Retail	5,800	50/1,000 sf	*290*
Commercial Building D Total				*33,648*
Broad Institute Office Conversion	Office	14,000	75/1,000 sf	1,050
Broad Institute Total				1,050
Total New Project-Related Sewage Generation				**219,649**
Existing Sewage Generation to be Removed				
145 Broadway	Commercial	(78,636)	(75/1,000 sf)	(5,898)
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)
250 Binney Street	Commercial	(62,576)	(75/1,000 sf)	(4,693)
Total New Project-Related Sewage Generation				**219,649**
Net New Wastewater Generation				**196,152**

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 1 Commercial Building A Net New	33,960	135,840
Phase 2 Commercial Building B Net New	31,500	126,000
Phase 3 Residential Bldg. South Total	69,850	279,400
Phase 3 Commercial Building C	30,837	123,348
Phase 4 Commercial Building D	28,955	115,820
Broad Institute Office Conversion	1,050	4,200
Total	**151,332**	**605,328**

1. 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

1. 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 215,767 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	37,356
Phase 2 Commercial Building B Net New	34,650
Phase 3 Residential Bldg. South Total	76,835
Phase 3 Commercial Building C Net New	33,921
Phase 4 Commercial Building D Net New	31,850
Broad Institute Office Conversion	1,155
Total Water Demand	**215,767**

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. The 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. Using the City's latest flood modeling projections, the Applicant has identified the target finished floor elevations (FFEs) that would reduce the risk of the Project being impacted by sea level rise/storm surge flooding, and precipitation based from the 2070 100-year storm event. For Commercial Building A, Commercial Building C and Residential Building South, the 100-year flooding event projected for the year 2070 is approximately El. 20.20 Cambridge City Base (CCB). For Commercial Building B, the 2070 100-year flood event projection is approximately El. 20.30 CCB. According to the City's flood projections, Commercial Building D is not vulnerable to sea level rise/storm surge or precipitation based flooding from the 2070 100-year storm event.

The DPW 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. The Applicant will work with the City to review and confirm the appropriate FFE prior to design review for each Project component.

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 100-year 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.

Minor flooding is expected along Main Street, but is not anticipated to impact the Kendall Plaza or the MBTA Redline Outbound Headhouse. The Applicant is committed to working with the MBTA to explore and improve the resiliency of the MBTA Redline Outbound Headhouse to flooding. The Applicant will explore potential measures to assist the MBTA with making its transit facilities in the KSURP area more resilient to inland flooding due to extreme precipitation. Conceptual, potential measures aimed at making the Kendall Square station more resilient to flooding could include trench drains with greater capacity than the existing systems, which could be installed at all entrances to the station to redirect more runoff from the area away from staircases to the station platforms. A more intensive, but effective means of flood protection would be mobile flood barriers. These walls can be stored by the MBTA on-site for use when flooding from extreme storm events are predicted. The flood barriers could be installed at station entrances around ground level utility vaults and adjacent to air intake/exhaust to greatly minimize the potential for flooding to effect operations of the station.

At the request of the City of Cambridge, and in response to growing demand for electricity in Cambridge the Project accommodates the relocation of an electrical an Eversource electrical substation. Re-siting this electrical substation is required to accommodate growth in Kendall Square, but will serve the Cambridge community and improve the resilience of the area electrical grid for decades to come.

Source: City of Cambridge GIS, Harvard University, City of Boston, City of Cambridge, MassGIS, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, EPA https://www.arcgis.com/apps/webappviewer/index.html?id=1d30c73456d246f48daf8489405c6629

2070 - 100 Year - SLR/SS Flooding Extent

2070 - 100 Year - Extent of Flooding

MXD Boundary

KSURP Boundary

Ames Street District ASD

(Intentionally Blank)

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. 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 #2 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 Concept Plan Amendment #1.

- **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 deigns 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. It is expected that the inclusion of the associated landscape featured will have a material beneficial impact on winter wind mitigation. Future design review packages for Residential Building South, Commercial Building C and Commercial Building D will have the benefit of landscape design information.
- **Shadow:** The shadow analyses have been updated to reflect the Project, which includes construction of the consolidated 38-story Residential Building South at 135 Binney Street, the 17-story Commercial Building C at 290 Binney Street, and the 17-story Commercial Building D at 290 Binney Street. Additionally, considering the construction of Commercial Buildings C and D, the MIT Volpe Center Redevelopment buildings are now included as background. Commercial Building A at 145 Broadway (construction complete) is shown as "existing shadow" and is not included in the description of net new shadow associated with the three remaining Project components. Since this Concept Plan Amendment #2 proposes modifications only to the development program on the North Parcel, this section does not include an updated shadow study for Commercial Building B, which was studied extensively during Concept Plan Amendment #1.
- **Noise:** The construction of the Residential Building South at 135 Broadway, the Commercial Building C at 290 Binney Street, and the Commercial Building D at 250 Binney Street on the North Parcel is consistent with the previously contemplated noise monitoring that analyzed existing ambient sound levels associated with the existing daytime and nighttime activities and mechanical equipment along the south and north side of the existing Blue Garage. Section 7.3 demonstrates that the Project will continue to comply with the City of Cambridge's noise control ordinance (Municipal Code, Chapter 8.16).
- **Exhaust Re-Entrainment Review:** The Project, and more specifically the construction of the consolidated Residential Building South at 135 Broadway is consistent with the exhaust re-entrainment review that was documented in the Concept Plan Amendment #1. Recommendations to mitigate predicted air impacts specific to Residential Building South from existing exhaust stacks will be considered as this Project Component advances through design review.

7.1 WIND

7.1.1 INTRODUCTION

Since the Concept Plan Amendment #1 was approved in 2018, Rowan Williams Davies & Irwin Inc. (RWDI) was retained by the Applicant to complete a quantitative pedestrian level wind assessment for the Project Change. 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.

The Master Plan wind tunnel study presented herein 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, undesirable wind conditions that are presented in the Concept Plan Amendment #2 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. It is expected that the inclusion of the associated landscape features will have a material impact on winter wind mitigation. Future Design Review packages will have the benefit of landscape design information.

RWDI #2101718 April 13, 2021

7.1.2 SITE AND BUILDING INFORMATION

Since issuing the pedestrian wind results documented in the Concept Plan Amendment #1, the Project has been modified to include the 38-story Residential Building South at 135 Binney Street, the 17-story Commercial Building C at 290 Binney Street, and the 17-story Commercial Building D at 290 Binney Street. Since the Concept Plan Amendment #1 was approved the Applicant has also completed construction of the commercial space and ground floor retail associated with the Commercial Building A (Phase I) at 135 Broadway. For the purposes of this analysis, Commercial Building A is included in the existing configuration. Because no changes are proposed to Commercial Building B at 325 Main Street (the East Parcel), the updated pedestrian wind comfort assessment focuses entirely on the North Parcel as defined below.

- North Parcel: Consists of the completed Commercial Building A at 145 Broadway, and the construction of the Residential Building South (400 feet) at 135 Broadway, the Commercial Building C at 290 Binney Street (250 feet), and the Commercial Building D at 250 Binney Street (250 feet).

The following conditions were simulated for the North Parcel:

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

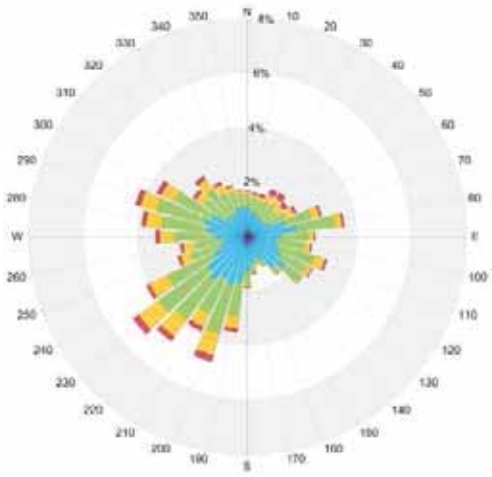
7.1.3 METEOROLOGICAL DATA

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 1990 to 2019 were used as reference for wind conditions in the region.

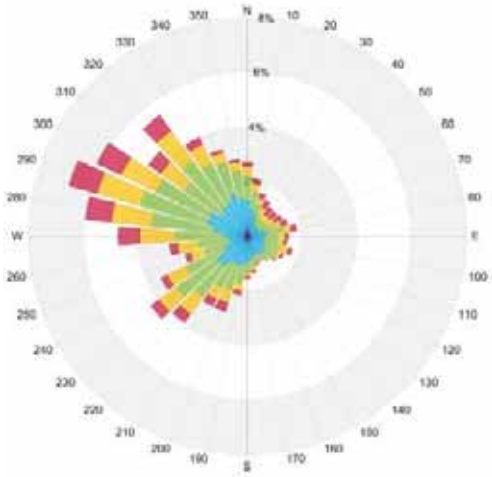
The distributions of wind frequency and directionality for summer and winter seasons are shown in the wind roses in Figure 7.1. In general, winds from the southwest and west-northwest directions are predominant in the summer. In the winter, the predominant of winds are generally from the west through 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	2.7	2.3
1-5	8.3	6.1
6-10	36.1	27.7
11-15	36.2	34.2
16-20	12.8	18.7
>20	3.9	11.0



Summer (May – October)



Winter (November – April)

FIGURE 7.1 DIRECTIONAL DISTRIBUTION OF WINDS APPROACHING BOSTON LOGAN INTERNATIONAL AIRPORT BETWEEN 1990 AND 2019

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.

7.1.5 PEDESTRIAN WIND CONDITIONS

Figures 7.4-7.9 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 7.2 - GENERIC WIND FLOW PATTERNS

(a) Downwashing

(b) Corner Acceleration

(c) Channeling

(d) Underpass Acceleration

EXISTING CONFIGURATION

FIGURE 7.3A WIND TUNNEL STUDY MODEL - EXISTING CONFIGURATION

PROPOSED CONFIGURATION

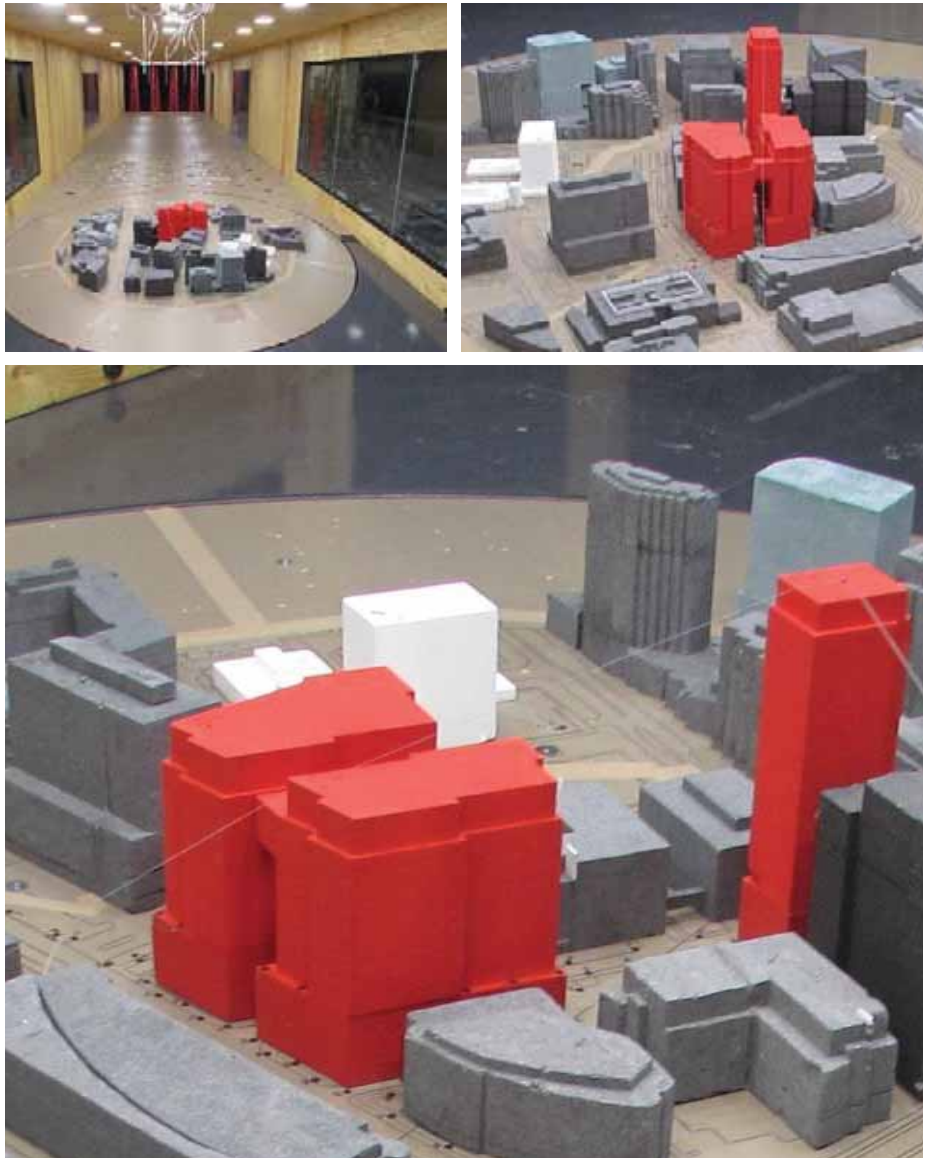


FIGURE 7.3B WIND TUNNEL STUDY MODEL - PROPOSED CONFIGURATION WITH GSA MASSING

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

FIGURE 7.3C WIND TUNNEL STUDY MODEL - PROPOSED CONFIGURATION WITH VOLPE DEVELOPMENT

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

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 Site, 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

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 sitting or standing are predicted at the Commercial Building A entrances, at the entrances to the Residential Building South, at the entrances to Commercial Buildings C and D, and at Center Plaza. 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.

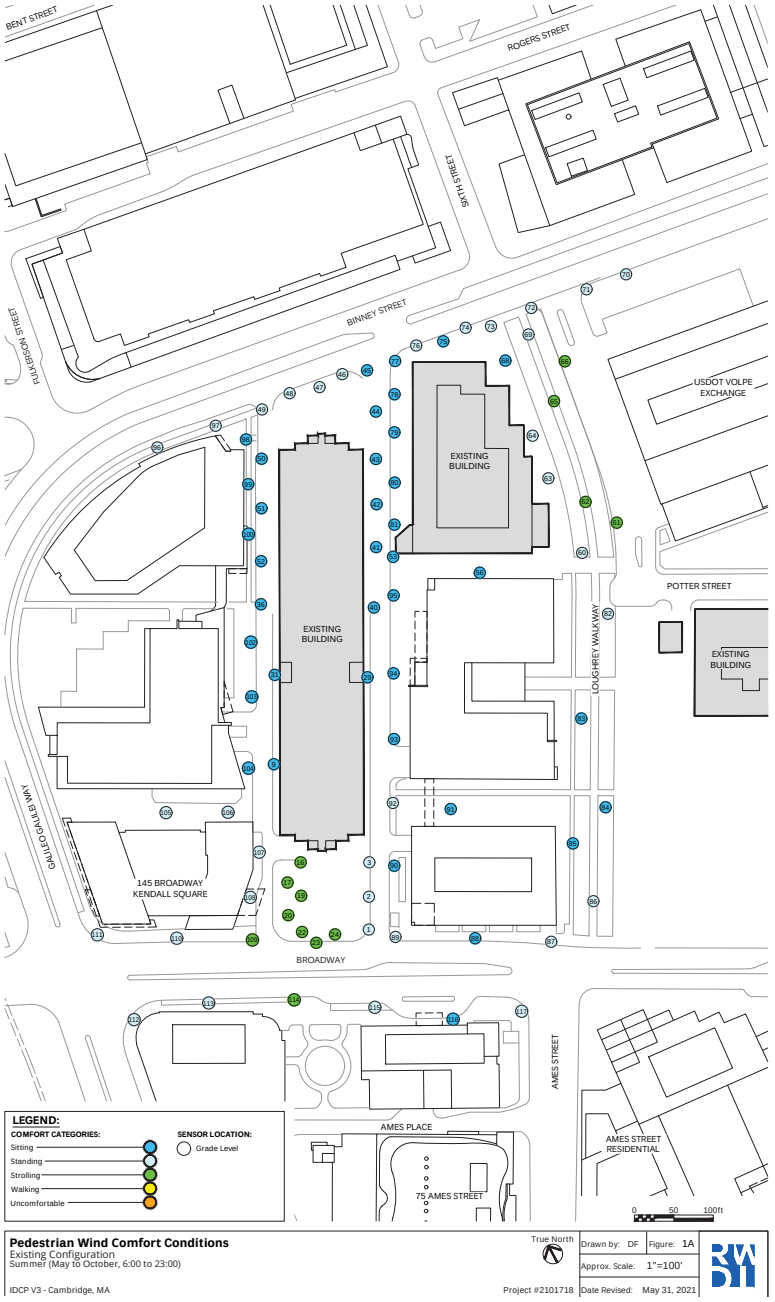


FIGURE 7.4 – PEDESTRIAN WIND COMFORT CONDITIONS (NORTH PARCEL, EXISTING/SUMMER)

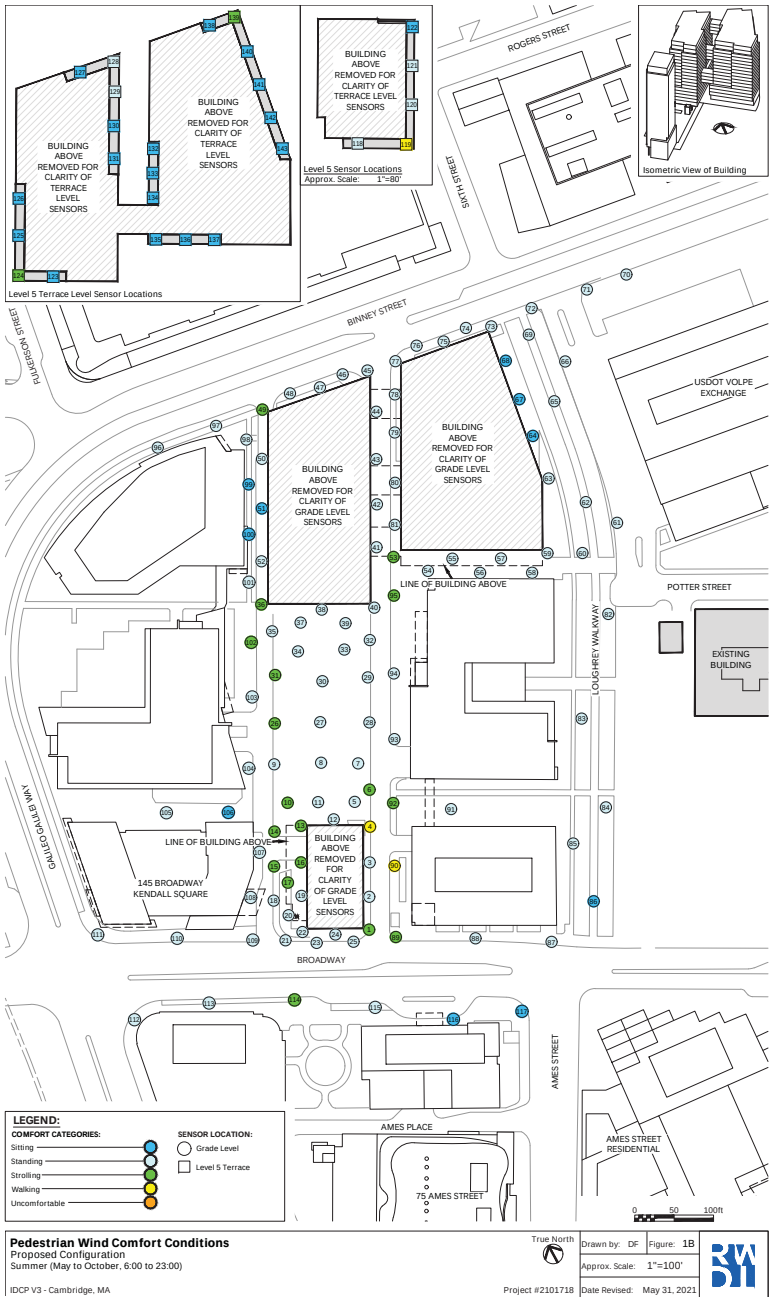


FIGURE 7.5 – PEDESTRIAN WIND COMFORT CONDITIONS
(NORTH PARCEL, PROPOSED/SUMMER)
(WITH GSA BUILDING)

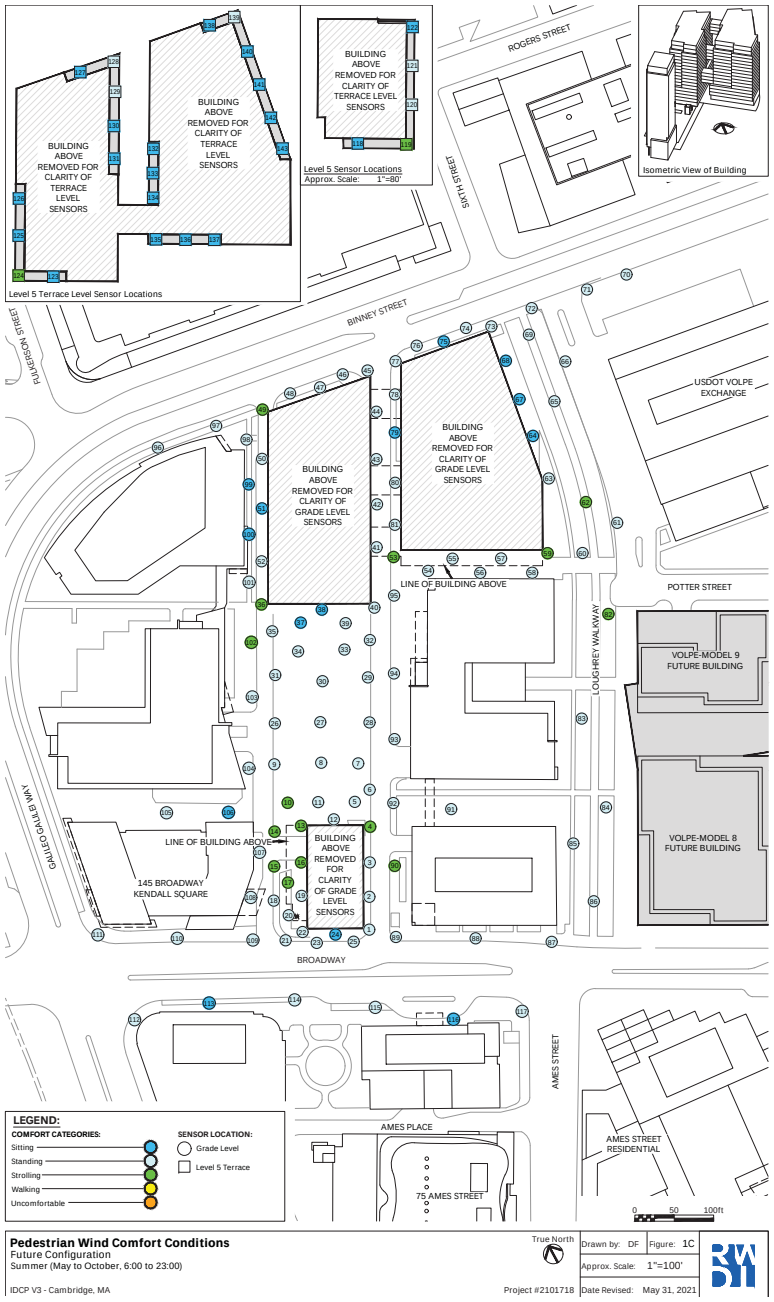


FIGURE 7.6 – PEDESTRIAN WIND COMFORT CONDITIONS
(NORTH PARCEL, PROPOSED/SUMMER)
(WITH PROPOSED VOLPE DEVELOPMENT)

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 7.7

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 (2) locations where uncomfortable conditions are predicted at the corner of Binney Street and West Service Drive (Location 49), and at the southwest corner of Commercial Building D along the East Service Drive (Location 53). Wind conditions generally comfortable for standing or better are predicted at the entrance to Commercial Building A, at the entrance to the Residential Building South, at entrances to Commercial Buildings C and Commercial Building D, and Center Plaza. 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 two (2) uncomfortable condition which are predicted along the West Service Drive (Location 90) and along the East Service Drive (Location 102). 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, Commercial Building C, Commercial Building D and Center Plaza, and will mitigate “Uncomfortable” sensor points. The information shown in this Concept Plan Amendment #2 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 7.9

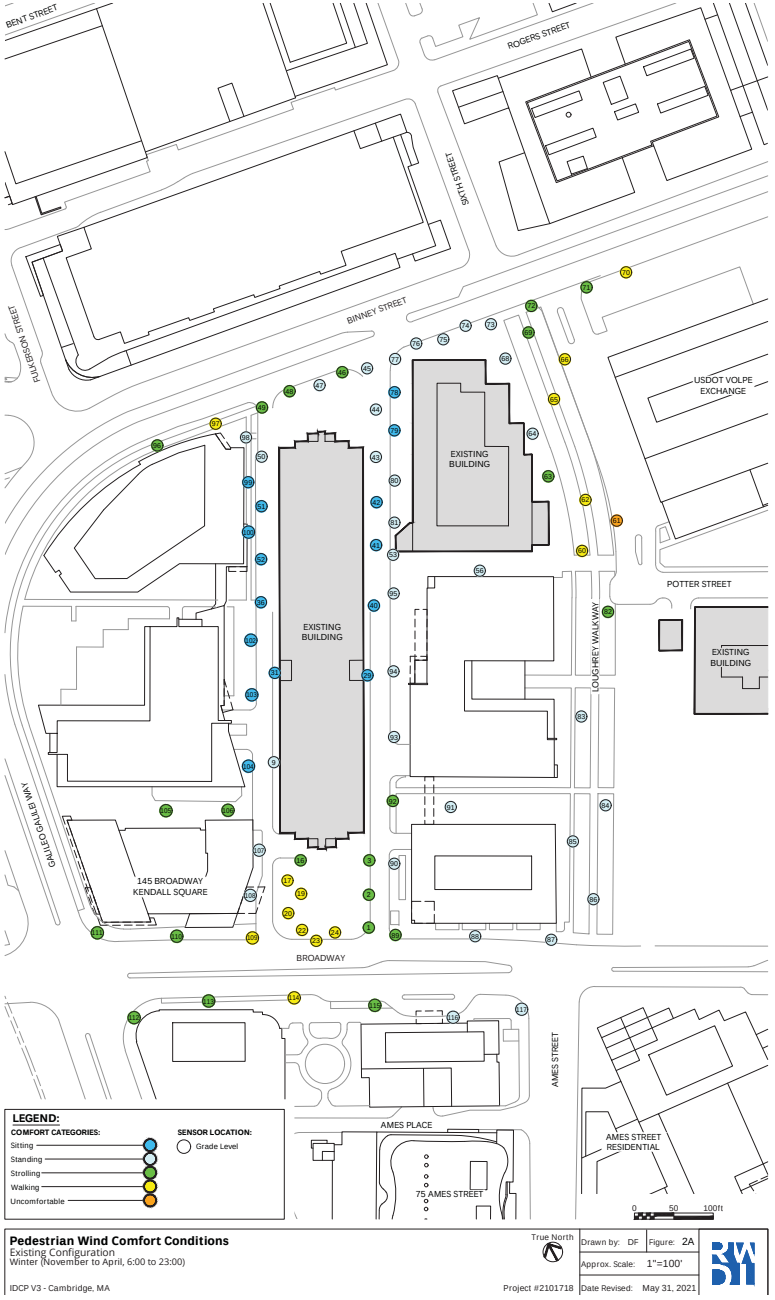


FIGURE 7.7 – PEDESTRIAN WIND COMFORT CONDITIONS (NORTH PARCEL, EXISTING/WINTER)

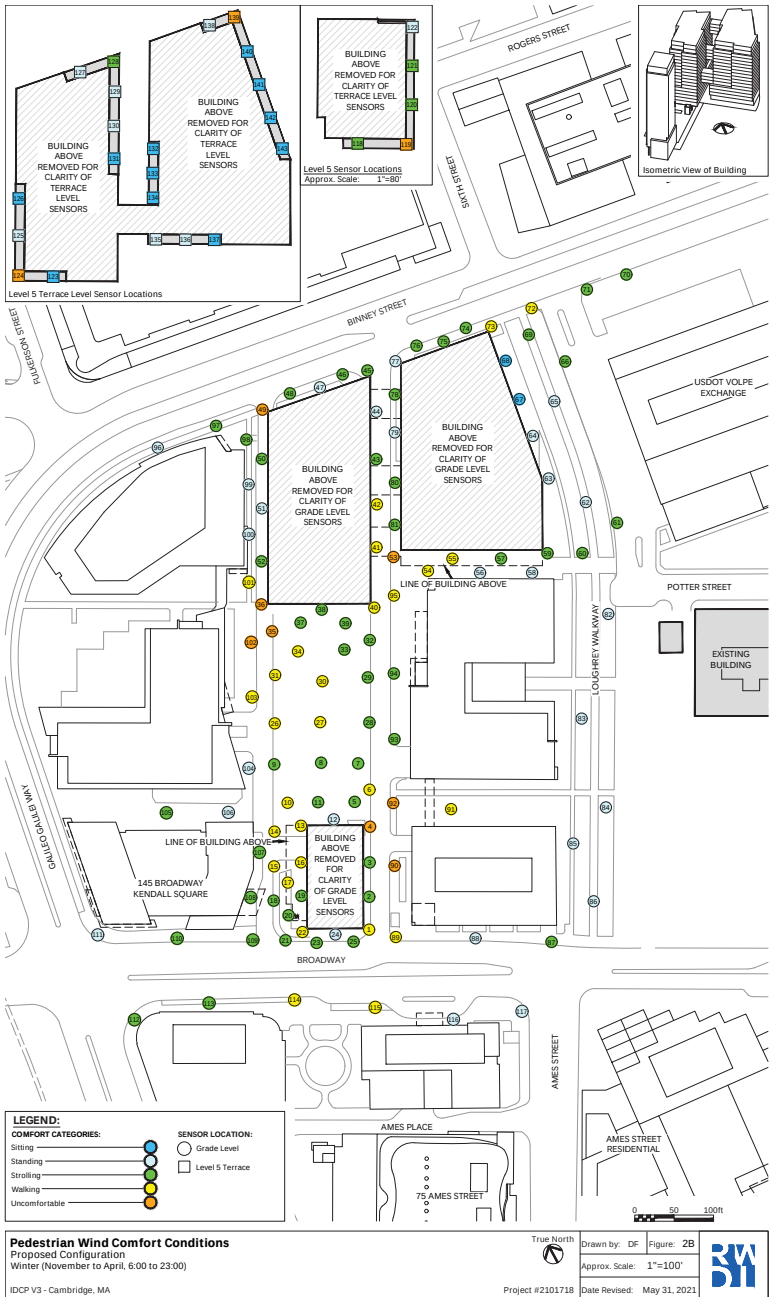


FIGURE 7.8 – PEDESTRIAN WIND COMFORT CONDITIONS
(NORTH PARCEL, PROPOSED/WINTER)
(WITH GSA BUILDING)

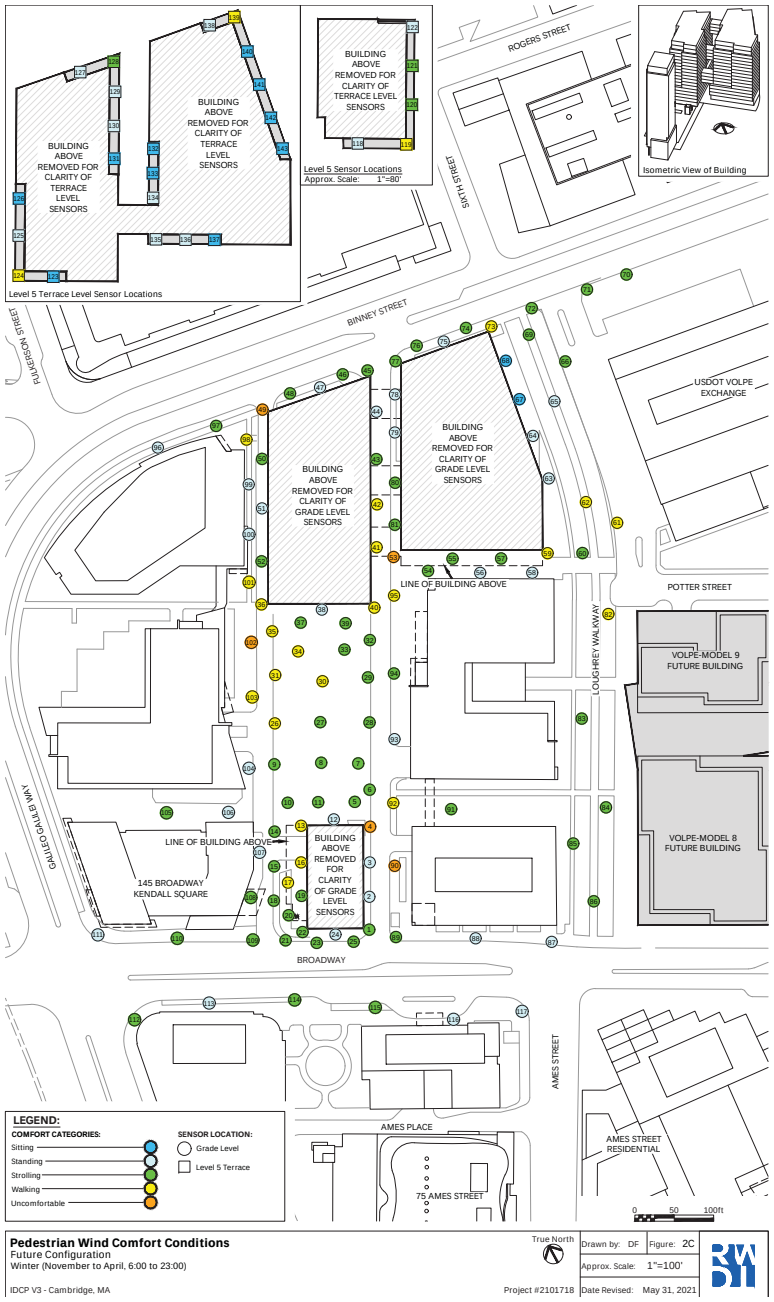


FIGURE 7.9 – PEDESTRIAN WIND COMFORT CONDITIONS
(NORTH PARCEL, PROPOSED/WINTER)
(WITH PROPOSED VOLPE DEVELOPMENT)

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 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 Project Change, which includes the consolidated 38-story Residential Building South at 135 Binney Street, and the construction the 17-story Commercial Building C at 290 Binney Street, and the 17-story Commercial Building D at 290 Binney Street. Since the Concept Plan Amendment #1 was approved in 2018, the Applicant completed construction of the commercial space and ground floor retail associated with the Commercial Building A (Phase 1) at 145 Broadway, and has commenced construction of the commercial space and retail uses associated with the Commercial Building B (Phase 2). 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 and Commercial Building B 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 construction of Commercial Buildings C and D, the MIT Volpe Center Redevelopment buildings are now included as background.

Figures 7.10A-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 7.10A) and the proposed shadow (Figure 7.10B). The difference, or the net new shadow (Figure 7.10C), is shown in orange in the subsequent composite studies.

FIGURE 7.10A - MARCH 21, 9:00 AM (EXISTING CONDITION)

RS Residential South
CC Commercial Building C
CD Commercial Building D

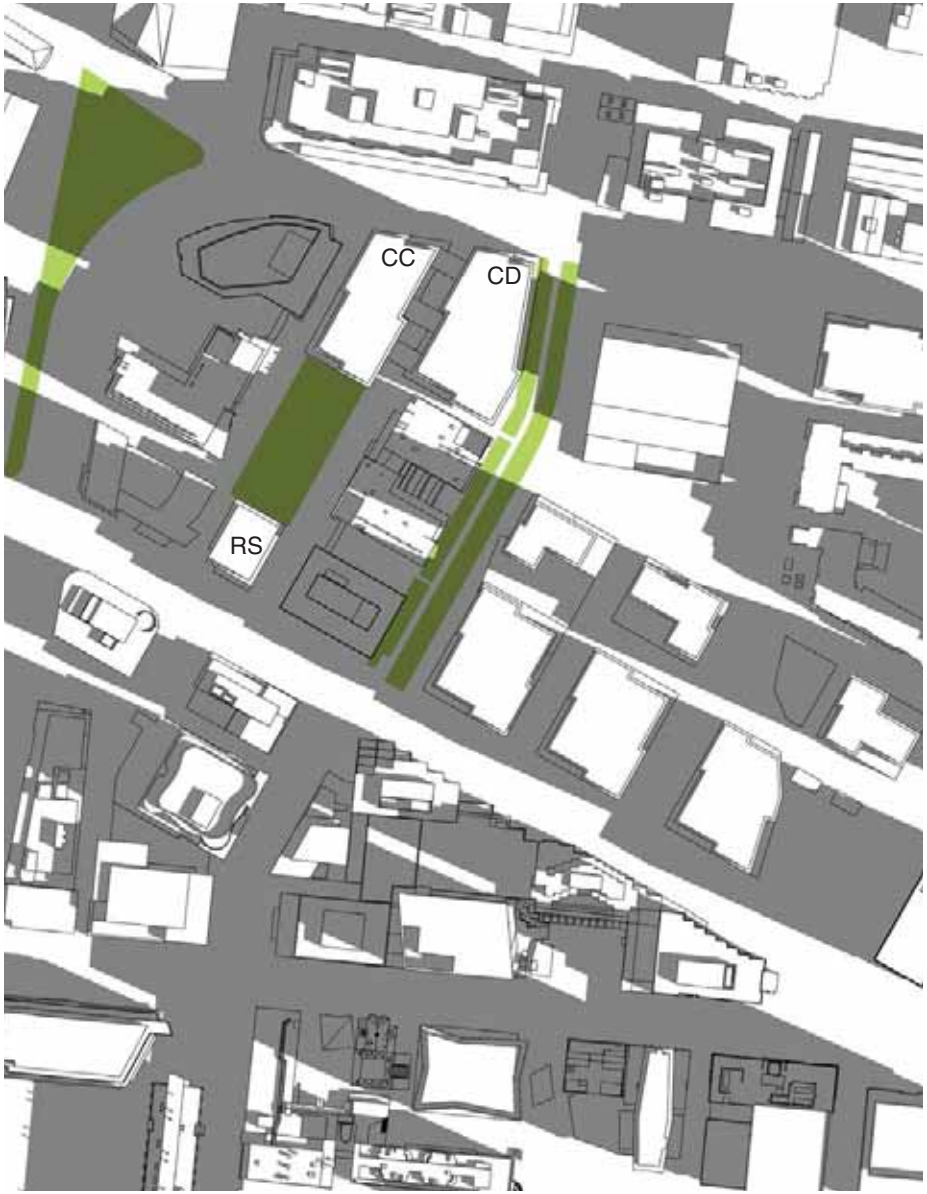


FIGURE 7.10B - MARCH 21, 9:00 AM (PROPOSED CONDITION)

FIGURE 7.10C - MARCH 21, 9:00 AM (THE DIFFERENCE IN SHADOW)

EQUINOX

Equinox (March 21 & September 21 EST)

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 Building South will cast net new shadow towards the west-northwest that will fall on the rooftop of Commercial Building A. Commercial Buildings C and D will cast net new shadow to the west-northwest that will fall across Binney Street. At 12:00 PM, the sun is in the south-southeasterly sky and shadows are cast towards the north-northwest. The majority of new shadow from the Residential Building South fall within the Project Site, with some new shadow cast onto the West Service Drive. At noon, net new shadows from Commercial Buildings C and D fall onto the East and West Service Drives, and onto Binney Street. At 3:00 PM, the sun is in the southwestern sky and shadows are cast to the northeast. The Residential Building South is expected to cast some net new shadow within the Project Site, with some new shadow cast on the East Service Drive. Commercial Buildings C and D will cast net new shadow to the north-northeast across Binney Street, along the northern end of the 6th Street Connector, and onto the adjacent Volpe parcel.

FIGURE 7.11A - MARCH 21, 9:00 AM

N

RS Residential South
CC Commercial Building C
CD Commercial Building D

EQUINOX MARCH 21 & SEPTEMBER 21 (EST)

FIGURE 7.11B - MARCH 21, 12:00 PM

FIGURE 7.11C - MARCH 21, 3:00 PM

New Shadow
Existing Shadow
New Shadow over open space
Existing Shadow over open space
Commercial Building A
Commercial Building B
Volpe Shadows
Proposed Buildings
Open space
(related to project study)

SUMMER SOLSTICE

Summer Solstice (June 21 EST)

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 Building are cast to the west, and largely fall within the Project Site. Commercial Building C casts net new shadow within the Project Site, and onto the east Service Drive. Commercial Building D casts net new shadow to the west onto the rooftops of existing buildings, and onto an incremental portion of Galileo Galilei Way. At 12:00 PM, the sun is high in the southern sky and casts the shortest shadows of the day towards the north-northeast. The majority of new shadow from the Residential South Building falls within the Project Site on the East Service Drive and the rooftop of existing buildings. At noon, Commercial Buildings C and D will cast some net new shadow on to the East Service Drive and onto Binney Street. At 3:00 PM, the sun is in the western sky and shadows are cast towards the east-northeast. The majority of new shadow from the Residential Building South falls within the Project Site onto the East Service Drive and the rooftop of existing buildings. Commercial Buildings C and D will cast some net new shadow on to the East Service Drive, Binney Street, the Sixth Street Connector, and the adjacent Volpe Parcel.

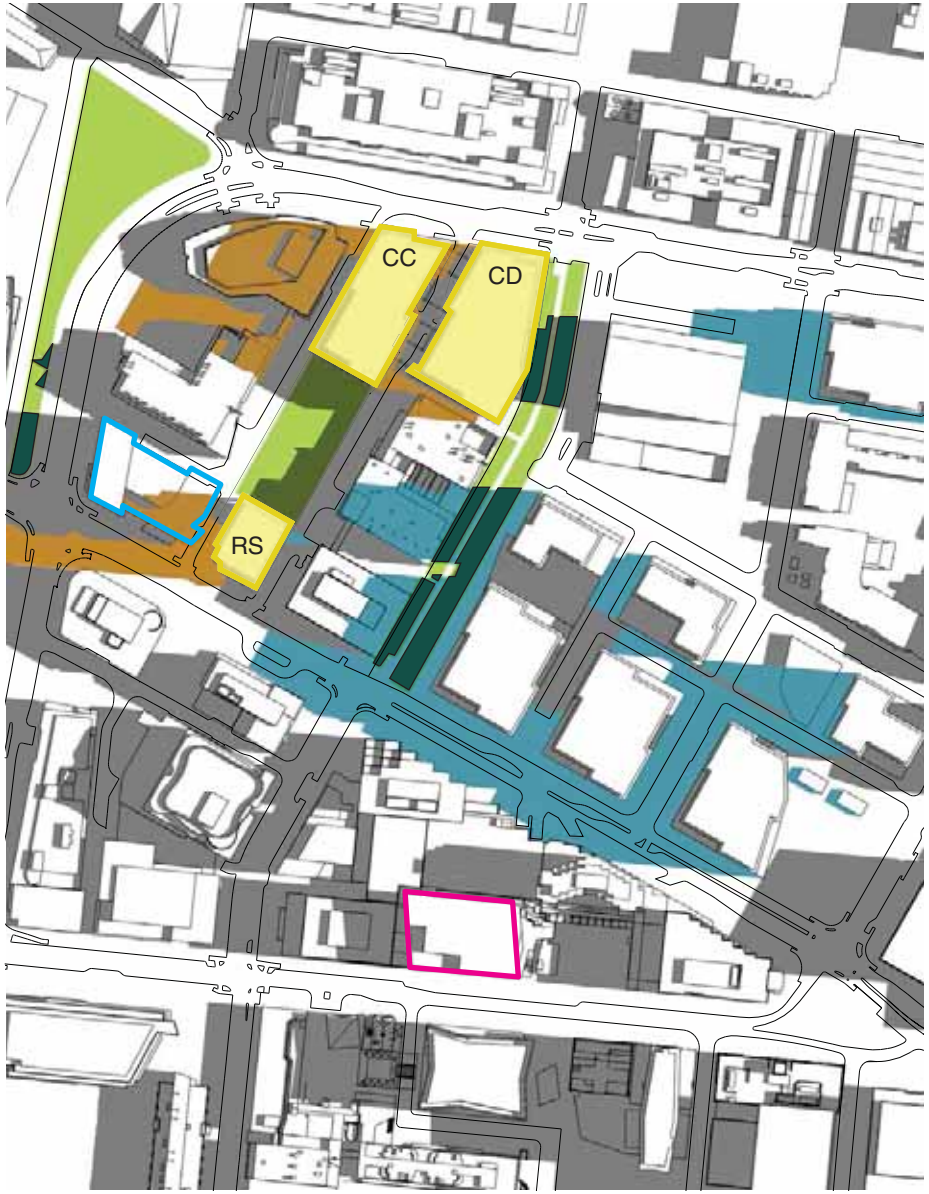


FIGURE 7.12A - JUNE 21, 9:00 AM

N

RS Residential South
CC Commercial Building C
CD Commercial Building D

SUMMER SOLSTICE JUNE 21 (EST)

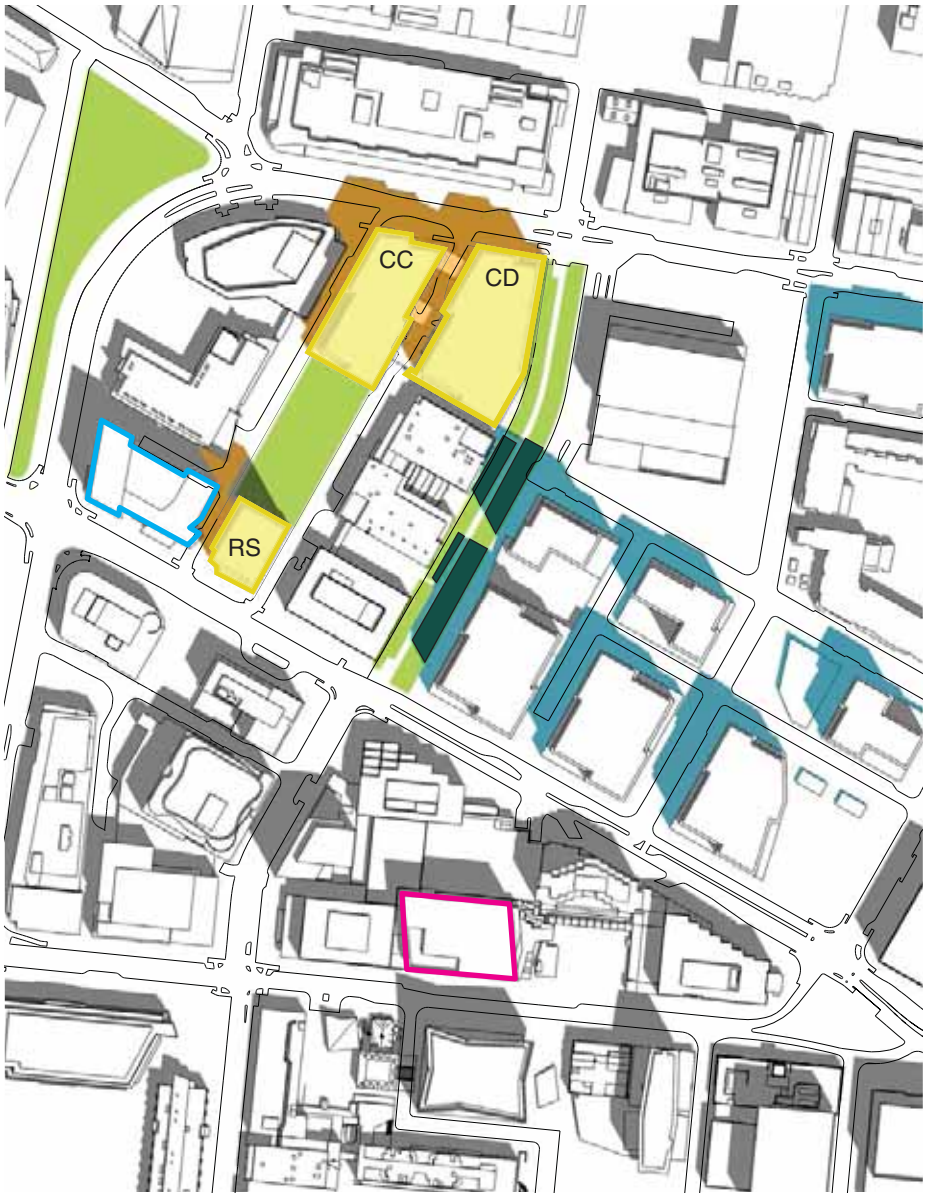


FIGURE 7.12B - JUNE 21, 12:00 PM

FIGURE 7.12C - JUNE 21, 3:00 PM

New Shadow
Existing Shadow
New Shadow over open space
Existing Shadow over open space
Commercial Building A
Commercial Building B
Volpe Shadows
Proposed Buildings
Open space
(related to project study)

FALL

October 21 EST

At 9:00 AM, the sun is low in the southeast sky resulting in long shadows to the northwest. The Residential Building South will net new cast shadows to the west-northwest onto an incremental portion of the West Service Drive, and onto the rooftop of Commercial Building A. Commercial Buildings C and D will cast limited net new shadow onto Binney Street and Galileo Galilei Way. At 12:00 PM, the sun is in the southern sky and shadows will be cast nearly due north. The Residential Building South will cast incremental net new shadow onto the East Service Drive, and onto a sliver of Galileo Galilei Way. At noon, the Commercial Buildings C and D will cast net new shadows onto the West and East Service Drives, onto Binney Street, and onto the existing buildings across Binney Street. At 3:00 PM, shadows cast from the Project are long, and extend in the northeast direction. Net new shadows from the Residential Building South fall onto the East Service Drive. Commercial Buildings C and D are expected to cast net new shadow onto the West and East Service Drives, onto Binney Street, onto the existing buildings across Binney Street and onto the northern corner of the adjacent Volpe Parcel.

FIGURE 7.13A – OCT 21, 9:00 AM

N

RS Residential South
CC Commercial Building C
CD Commercial Building D

FALL OCT 21 (EST)

FIGURE 7.13B - OCT 21, 12:00 PM

FIGURE 7.13C - OCT21, 3:00 PM

New Shadow
Existing Shadow
New Shadow over open space
Existing Shadow over open space
Commercial Building A
Commercial Building B
Volpe Shadows
Proposed Buildings
Open space
(related to project study)

WINTER SOLSTICE

Winter Solstice (December 21 EST)

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. At this time net new shadows cast by the Project are largely covered by existing shadows. At 12:00 PM, the Project will create new shadow primarily over building rooftops to the north, however Commercial Buildings C and D will cast limited net new shadow onto Binney Street. At 3:00 PM, the sun is low in the southwest sky and the existing landscape is heavily covered in existing shadow. At this time net new shadows cast by the Project are largely covered by existing shadows.

FIGURE 7.14A - DECEMBER 21, 9:00 AM

N

RS	Residential South
CC	Commercial Building C
CD	Commercial Building D

WINTER SOLSTICE DECEMBER 21 (EST)

FIGURE 7.14B - DECEMBER 21, 12:00 PM

FIGURE 7.14C - DECEMBER 21, 3:00 PM

New Shadow
Existing Shadow
New Shadow over open space
Existing Shadow over open space
Commercial Building A
Commercial Building B
Volpe Shadows
Proposed Buildings
Open space
(related to project study)

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 previously conducted to determine existing ambient sound levels.

The Project includes the construction of the Residential Building South at 135 Broadway, Commercial Building C at 290 Binney Street (250 feet), and Commercial Building D at 250 Binney Street, all of which are located on the North Parcel. The locations of the proposed Project components are consistent with the previously contemplated noise assessment that analyzed existing ambient sound levels associated with the existing daytime and nighttime activities and mechanical equipment along the south and north side of the existing Blue Garage (refer to Figure 7.16 – Receptor Locations). This section 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 environmental 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.

Outdoor Sound Levels	Sound Pressure (μPa)*		Sound Level dB(A)**	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 7.15, 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 green space 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.

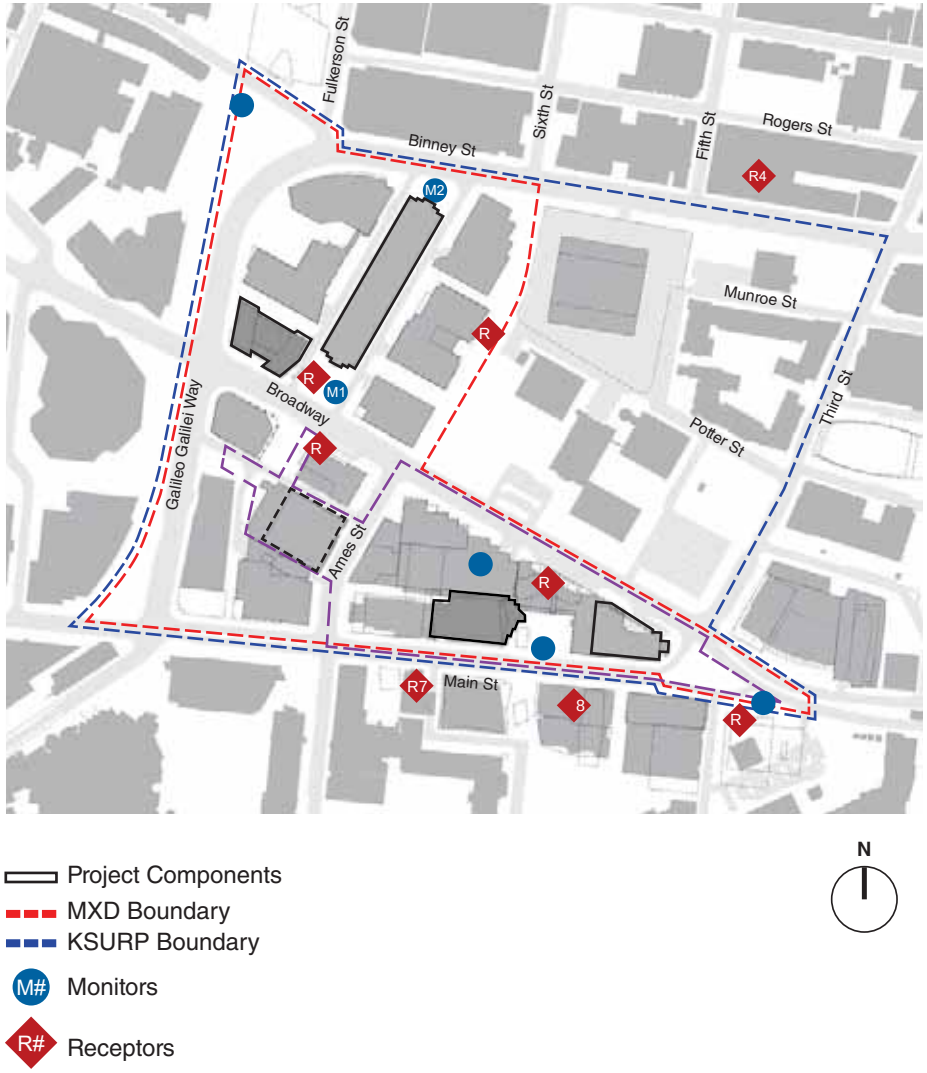


FIGURE 7.15 - RECEPTOR LOCATIONS

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.

	Residential Area		Residential in Industrial		Commercial Area	Industry Area
Octave Band Center Frequency (Hz)	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 7-2 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 7.15. 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.

	City of Cambridge Residential District Noise Standard*		Measured L90 Sound Levels	
Monitoring Location	**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 7-3 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:

- Emergency generators
- Air handling units
- Exhaust fans;
- Chillers; and
- CEnergy recovery 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 nearby sensitive 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 components 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 one multi-level residential building, 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 Building South will incorporate sufficient acoustical material with the appropriate sound transmission class rating to minimize impacts to interior sound levels within the residential units.

7.4 EXHAUST RE-ENTRAINTMENT REVIEW

The Project Change proposes to consolidate the approved residential GFA formerly located at 135 Broadway (Residential Building South) and 290 Binney Street (Residential Building North) into one residential building located at 135 Broadway. The total residential GFA located in the Residential Building South will be consistent with Concept Plan Amendment #1, however the building will be up to 38 floors, which is an increase in four floors compared to the massing analyzed in the Concept Plan Amendment #1.

The location of the current Residential Building South is consistent with the location analyzed in the Concept Plan Amendment #1, which is nearby existing and proposed laboratory buildings. Previously, the Applicant had engaged RWDI to evaluate the potential air quality impacts that neighboring laboratory buildings might have on the Residential Building South among other Project components. To mitigate predicted air impacts on the Residential Building South from existing exhaust stacks the analysis recommended locating the air intakes at the roof level along the southern, Broadway facing building facade. The additional building height proposed should result in a positive impact on minimum dilution levels. If operable windows are used, the analysis also recommended that the building mechanical systems should be capable of maintaining a slight positive pressure to avoid drawing in air from the stacks. The Residential Building South Massing depicted in this Concept Plan Amendment #2 is conceptual, however as the Project component advances through design review these recommendation will be considered.

(Intentionally Blank)

8. SUSTAINABILITY PLAN

8.0 INTRODUCTION

This section presents the Project's overall approach to sustainability and addresses the specific areas of the topic, per Article 14.74.

CHAPTER UPDATES

The following section summarizes minor refinements to this Chapter since the Concept Plan Amendment #1. There have been no significant changes to the Project's sustainability approach since the Concept Plan Amendment #1.

- Commercial Building A: Since the Concept Plan Amendment #1 was approved Commercial Building A was certified as New England's first LEED v4 Platinum building.
- **LEED V4 Gold**: In accordance with Article 22.20, all the remaining Project Components (Commercial Building B, Residential Building South, Commercial Building C and Commercial Building D), are being designed to achieve a Version 4 Leadership in Energy and Environmental Design (LEED®) Gold level or better.
- **Preliminary Energy and Greenhouse Gas Study**: The preliminary energy analysis and GHG study 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. Additionally, the results have been updated to reflect the most recent energy analysis for the proposed Residential Building South at 135 Broadway, Commercial Building C at 290 Binney Street, and Commercial Building D at 250 Binney Street.

8.1 APPROACH TO SUSTAINABILITY

Sustainable principles are integral to the Project's design. Viewed through a land use planning lens, the sustainability approach includes repurposing previously developed land rather than building on untouched land, as well as locating new development within a high-density urban area with excellent access to public transportation, pedestrian circulation systems and a robust bicycle network. New commercial and residential space will be located on previously developed sites which will allow the Project to achieve energy savings associated with lower embodied energy and reduced Greenhouse Gas (GHG) emissions through the construction process.

A key component of the Project Change includes the demolition of the existing Blue Garage to accommodate the relocation and construction of a below-grade Eversource electrical substation that will serve the Cambridge community and improve the resilience of the area electrical grid for decades to come. The demolition of the Blue Garage will also enable the opportunity to construct the approximately 56,000 square foot Center Plaza at the heart of the North Parcel, resulting in an increase of more than 30,000 square feet of open space compared to the Concept Plan Amendment #1.

As a Transit Oriented Development (TOD), the Project will integrate into the existing public transportation and mode share infrastructure to further reduce traffic and indirect air emissions, including mobile source GHG emissions. TOD is environmentally, economically, and socially sustainable; it promotes greater accessibility, walking and biking, healthy lifestyles; and increased value for property owners, businesses, local governments, transit authorities and residents.

The Project will promote the design and construction of high-performance, green buildings through an integrated design approach where all project disciplines are engaged early and throughout the design process to meet sustainability goals. The Project's design will prioritize sustainability as a core strategic imperative and will implement state-of-the-art high performance green building technologies, construction, and operating procedures. Sustainability planning with an integrated design team during conceptual design will establish a pathway to Gold-level certification under the LEED v4 rating system. The project design teams will use iterative energy modeling and life cycle analysis to consider the long-term value of sustainable property investment decisions.

The integrated design approach will address best practices in energy and emissions, water management, reduced urban heat island effect (cool roofs), energy use monitoring and rooftop mechanical equipment noise mitigation, as set forth in Article 14.74. The Applicant is looking beyond these zoning requirements by addressing climate change preparedness, implementing sustainable tenant guidelines, and considering the health and wellness of its future occupants and users through the potential use of the WELL Building Standard® (WELL) design and operation principles.

Furthermore, the Applicant will work with its design teams to evaluate and incorporate, where feasible and reasonable, strategies that support the Cambridge Net Zero Action Plan. Refer to Appendix B for Net Zero Narratives for Residential Building South at 135 Broadway, Commercial Building C at 290 Binney Street, and Commercial Building D at 250 Binney Street.

8.2 ENERGY CONSERVATION APPROACH

Buildings are significant consumers of energy and building mechanical and electrical systems are the chief consumers within any building. The Project Components will be designed to be energy-efficient, green buildings, and renewable energy strategies will continue to be evaluated as the design evolves and will be included in each Project Component's design review submission. The Applicant proposes that for each square foot of solar-ready rooftop provided, a square foot of occupiable green roof be permitted as exempt GFA (a 1:1 ratio). Renewable energy credits can also be purchased on a building-by-building basis to support off-site renewable energy production and offset non-renewable electricity use on site.

8.2.1 REGULATORY CONTEXT

Commercial Building A and Commercial Building B were permitted under and exceeded the previous Massachusetts Stretch Energy Code requirement to show at least 10 percent overall reduction in energy used as compared to the ASHRAE 90.1-2013 Appendix G code compliant baseline model with the inclusion of two additional efficiency measures per IECC 2015 section C406.1. Commercial Building C, Commercial Building D, and Residential (South) will be permitted under the new Massachusetts Stretch Energy Code requirement to show at least a 10% EUI reduction, either in site or source energy, compared to the baseline building as per ASHRAE 90.1-2013 Appendix G with the inclusion of at least three additional efficiency measures per IECC 2018 section C406.1 in both the baseline and proposed cases.

In accordance with Article 22.20, all new project buildings will also meet the LEEDv4 minimum building performance requirement of a two percent improvement in energy cost for core and shell projects and a five percent improvement in energy cost for residential new construction projects when compared to a baseline building performance as calculated using the rating method in Appendix G of ANSI/ASHREA/IESNA Standard 90.1-2010 improvement in energy cost for core and shell projects and a five percent improvement in energy cost for residential new construction projects when compared to a baseline building performance as calculated using the rating method in Appendix G of ANSI/ASHREA/IESNA Standard 90.1-2010

8.2.2 DESIGN STAGE - REDUCE ENERGY DEMAND

Success in reducing energy demand from these systems follows a four-step approach. This basic approach will be followed for each Project Component.

- Step 1 - Reduce Demand: Challenge assumptions to right size equipment, reduce plug and lighting loads, and improve the building shell.
- Step 2 - Harvest Site Energy: Orient the building to maximize passive solar and daylighting opportunities. Harvest waste energy on site through heat recovery and other means.
- Step 3 - Maximize Efficiency: Beyond simply reducing loads, use efficient equipment to maximize benefit.
- Step 4 - Efficient Operations and Maintenance: Building commissioning, training of staff, and ongoing preventative maintenance, combined with monitoring of on-going performance will be implemented to ensure energy efficiency gains are realized.

8.2.3 DESIGN STAGE – SET ENERGY TARGETS AND MODEL

These energy conservation targets are met by the selection of efficient building systems, equipment, and a lighting power density that is below code. Additionally, an improved building envelope design is required. The design teams will develop whole building energy models to demonstrate the expected energy performance of each designed building.

A variety of Energy Conservation Measures (ECM) will continue to be evaluated as design progresses. ECM's to be considered include, but are not limited to, the following:

- High-performance mechanical systems, including chilled beams in office and laboratory spaces.
- High-performance building envelope
- Reduced window-to-wall ratio
- Reduced lighting power density
- Building orientation and window locations shall be suited for improved energy efficiency
- Cogeneration
- Rooftop Solar PV
- Energy Star appliances and equipment
- Occupancy and daylight sensors and controls
- Demand Response / Peak Load Reduction / Smart Grid Compatibility

A preliminary energy analysis and GHG study was completed for each Project Component. The summary of findings is represented in the Preliminary Energy Analysis and Greenhouse Gas Study shown on the opposite page.

COMMERCIAL BUILDING A - 145 BROADWAY

Based on as-built design strategies, the estimated energy use reduction for the commercial building is approximately 12.1 percent, which equates to a 11.6 percent reduction (177 metric tons per year) in stationary source CO2 emissions when compared to the Base Case. Key energy savings features include improved glazing properties, improved roof and wall insulation, improved lighting power densities, variable volume condensing water pump, a high efficiency domestic water heater, and a high efficiency gas boiler, chiller beam system. Commercial Building A was New England's first LEED V4 Platinum Certified building.

COMMERCIAL BUILDING B - 325 MAIN STREET

Based on building currently under construction, the estimated energy use reduction for the new commercial building is approximately 15.40 percent, which equates to a 13.1 percent (245 metric tons per year) reduction in stationary source CO2 emissions when compared to the Base Case. Key energy savings features include improved glazing properties, interior lighting power density reduction, high-efficiency active chilled beam system, high-efficiency gas-fired condensing boilers, variable volume hot water and chilled water pumping systems, and high-efficiency centrifugal chillers.

RESIDENTIAL BUILDINGS SOUTH – 135 BROADWAY

Based on preliminary design strategies being considered, the estimated energy use reduction for residential building is 21.4 percent, which equates to a 17.2 percent reduction (193 metric tons per year) in stationary source CO2 emissions when compared to the Base Case. Key energy savings features include improved glazing properties, improved roof and wall insulation, improved lighting power densities, high efficiency heat pumps, high efficiency ventilation systems, and a high efficiency gas boiler.

COMMERCIAL BUILDING C (290 BINNEY)

Based on preliminary design strategies being considered, the estimated energy use reduction for the new commercial building is 43.2 percent, which equates to a 35.8 percent reduction (3,499 metric tons per year) in stationary source CO2 emissions when compared to the Base Case. Key energy savings features include improved glazing properties, improved roof and wall insulation, improved lighting power densities, variable speed hot water and chilled water pumping systems, high-efficiency centrifugal chillers, energy recovery for ventilation systems, and high-efficiency gas-fired condensing boilers.

COMMERCIAL BUILDING C (290 BINNEY)

Based on preliminary design strategies being considered, the estimated energy use reduction for the new commercial building is 43.2 percent, which equates to a 35.8 percent reduction (3,499 metric tons per year) in stationary source CO2 emissions when compared to the Base Case. Key energy savings features include improved glazing properties, improved roof and wall insulation, improved lighting power densities, variable speed hot water and chilled water pumping systems, high-efficiency centrifugal chillers, energy recovery for ventilation systems, and high-efficiency gas-fired condensing boilers.

8.2.4 OPERATIONS STAGE BUILDING COMMISSIONING

In addition, building commissioning will be conducted prior to and during occupancy to ensure the building systems are operating efficiently and as designed. Tenant green building guidelines will engage and educate building users and influence occupant behavior toward more energy (water and material) efficient practices.

8.2.5 OPERATIONS STAGE ENERGY TRACKING AND MONITORING

The Applicant has a robust internal program for tracking building energy use over time, using Energy Star Portfolio Manager and other tools. In addition, the Applicant has committed to reducing average building EUI by 15 percent, and is currently a strong supporter of the City's Building Energy Use Disclosure Ordinance.

The Applicant will implement a Measurement and Verification (M&V) plan that will utilize the base building energy management system to monitor operation of equipment or systems that are not already directly metered for electric or gas use. Core and shell projects will include a centrally monitored electronic metering network in the base building design that is capable of being expanded to accommodate and document the future tenant sub-metering.

In compliance with the Cambridge Building Energy Use Disclosure Ordinance, Chapter 8.67 of the Municipal Code, the Applicant will report energy use.

8.2.6 ON-SITE CLEAN/RENEWABLE ENERGY GENERATION

Commercial Building A includes a roof-mounted solar array that is anticipated to be capable of producing enough energy to equal at least one percent of the building's annual energy consumption. Commercial Building B is currently planning to install a roof-mounted solar array.

The remaining Project Components will be constructed to be solar-ready, including designing the roof structure to support the weight and wind loads associated with solar energy collectors as well as providing space to accommodate associated infrastructure, including conduit to the roof and space in the electrical room for an inverter. Each building will be individually analyzed for solar opportunities as the design develops. In addition, innovative strategies such as solar roadways will be considered. A solar-ready roof assessment has been provided as part of the Net Zero Narratives in Appendix B for Residential Building South at 135 Broadway, Commercial Building C at 290 Binney Street, and Commercial Building D at 250 Binney Street.

TABLE 8-1 PRELIMINARY ENERGY ANALYSIS AND GREENHOUSE GAS STUDY

	ENERGY CONSUMPTION (MMBTU/YR)			CO_2 EMISSIONS (TONS/YR)		
PROJECT COMPONENT	**BASE CASE**	**DESIGN CASE**	**PERCENT SAVINGS**	**BASE CASE**	**DESIGN CASE**	**PERCENT REDUCTION**
Commercial Building A – 145 Broadway	23,067[1]	20,281	12.1%	1,533	1,356	11.6%
Commercial Building B – 325 Main Street	21,5011[1]	18,196	15.4%	1,864	1,619	13.1%
Residential Building (South) – 135 Broadway	18,444[2]	14,506	21.4%	1,122	929	17.2%
Commercial Building C – 290 Binney Street	134,660[2]	76,504	43.2%	9,762	6,263	35.8%
Commercial Building D – 250 Binney Street	176,671[2]	104,930	40.6%	12,869	8,641	32.9%

Tons/yr = tons per year

1. Commercial Building A and Commercial Building B reflect the final energy code energy model results that were approved during the building permit application for each building. Both Commercial Building A and Commercial Building B were permitted under the previous iteration of the Massachusetts energy code.
2. The base case has also been updated to reflect the most recent building code to ASHRAE 90.1 2013 with Massachusetts amendments.

8.3 WATER CONSERVATION

The Project will reduce overall potable water use and reduce wastewater generation compared to a conventional development through installation of low-flow plumbing fixtures and high-efficiency irrigation systems. All Project Components are currently targeting a minimum 30% water use reduction compared to conventional plumbing fixtures (per Energy Policy Act of 1992 fixture performance requirements).

The landscape design will incorporate native and adaptive vegetation and the design of the irrigation system will target, at minimum, a 50% reduction in potable water use when compared to a mid-summer baseline through the use of high-efficiency irrigation systems with controllers and moisture sensors. Non-potable water use strategies, such as rainwater reuse will be considered for irrigation. In addition, the landscape design will consist mostly of local, drought resistant species to minimize or eliminate the need for irrigation over the lifetime of the Project. Landscape areas will be designed to hold as much rainwater as practicable. The Applicant is also considering the use of rainwater capture for irrigation and the incorporation of green roofs and rainwater harvesting tanks for each individual building design.

Each Project Component will largely maintain the existing site drainage, replacing existing impervious rooftop and hardscape in kind on-site. The Project will be required to mitigate stormwater runoff to comply with City and MassDEP standards. Stormwater infrastructure will be designed and installed for each Project Component to reduce the runoff discharge rate and improve the quality of the runoff to the City's stormwater system and the Charles River basin.

8.4 RECYCLING AND SOLID WASTE MANAGEMENT

Recycling and reuse programs will be developed and implemented by all construction contractors to reduce the amount of waste that is sent to landfill throughout construction. Prior to the start of construction, the construction management team will prepare and submit a Construction Waste Management plan which will be implemented on site. A minimum of 75% of C&D waste will be diverted, as required by Massachusetts' law.

Storage of collected recyclables will be accommodated on the ground floor of the new buildings in a designated recycling area. A contracted waste management company will collect the recyclables on a regular basis. It is anticipated that approximately 100% of paper, corrugated cardboard, glass, plastic and metal would be recycled during operations. The Tenant Design and Construction Guidelines (discussed further below in Section 8.8) will include strategies to reduce waste through recycling and reuse programs.

In partnership with our vendors and tenants, BXP has implemented best practices for waste management, including single-stream recycling, composting, and e-waste programs for tenant solid waste in all of our regions. As a result, 54.9% of office waste by weight is recycled or composted across our portfolio, which is a 53% increase since 2008.

The Applicant will work closely with future tenants to promote responsible waste management practices, including haul trip optimization and composting at cafés and restaurants. Additionally, the Applicant will work with future tenants to ensure that they have signage and receptacles, and the building has designated central compost bins with frequently scheduled pickup.

8.5 REDUCE HEAT ISLAND EFFECT

Over the design life of the Project, climate change is expected to significantly increase the duration and frequency of heat waves. The anticipated change in average temperatures is exacerbated by the development density of Cambridge, which results in urban heat island effect. In an effort to mitigate urban heat island effect, the Applicant is considering a number of site and building design strategies, including light colored roof materials, light colored hardscape materials, landscaped areas, and green roofs.

8.5.1 SITE DESIGN

Site landscaping will be designed with tree canopy cover, low-level plantings, discontinuous impervious covers, reflective materials and permeable pavements in an effort to reduce the capture of energy from sunlight while promoting evaporation and plant transpiration. The construction of the new Central Plaza will also result in an increase in vegetated area that will not only reduce the increased heat associated with heat island effect, but will provide for a more comfortable pedestrian environment.

8.5.2 BUILDING DESIGN

To further reduce the heat island effect and mitigate storm water runoff, the Applicant is exploring the use of green roof cover, where feasible. Vegetation and shading structures will also be employed to shade buildings and outdoor spaces, where possible. The roof membrane on all Project Components will be a high albedo roof product, excluding any green roof areas. All vehicle parking supporting the Project will be below-grade, greatly reducing the uncovered and impervious surface area needed for the Project's required parking.

The Applicant understands the City Council approved a zoning petition on May 3, 2021 that would require installation of green roofs, or BioSolar roofs on future construction and significant rehab of buildings that are 20,000 square feet and larger. The Proponent will take this requirement into account as the design advances for the remaining phases of the Project.

8.6 RESILIENCY IN BUILDING DESIGN

The Applicant has studied the vulnerability of the infill development sites for the potential of precipitation-based inland flooding events. Potential building design resiliency measures being considered include limiting basement areas, and other improvements that may mitigate potential flooding. Additionally, ground floor finish elevations for all Project Components will be raised to the greatest extent possible to reduce the risk of internal flooding. Flood-resilient materials will be specified for first floor uses, where practicable.

Flood prevention techniques could include: sealed wall penetrations for cable and electrical lines; watertight door barriers; septic line backflow prevention valves, sump pumps, and discharge pumps—all of which could be connected to auxiliary external generator connections or resilient backup power. In addition, the Project is anticipated to include green roofs/roof gardens and roofing membranes with high SRI to reduce the volume of storm water runoff and reduce solar heat gain/minimize air conditioning loads, respectively. Additionally, high-performance curtain wall is being considered to maximize views and daylighting of interior spaces, thus reducing overall lighting loads and associated internal heat gains, which has a direct impact on the space cooling load. As the climate change analysis shows, the rising temperature increases the space cooling demand in the Cambridge climate; therefore, any strategy that can reduce the space cooling demand is considered an adaptive strategy for climate change.

The Project's climate change mitigation includes the incorporation of several ECMs to reduce GHG emissions associated with energy use beyond what is required by Code. (Refer to Appendix B for further details on such measures.) Some of these measures can also be considered adaptive design approaches to mitigate the potential impacts of climate change on the Project. These GHG emissions mitigation and climate change adaptation measures are considered mutually re-enforcing and, therefore, cannot be considered in isolation. As an example, the window area in the Residential Building South will be designed at an appropriate ratio to reduce energy use while still providing enough daylight and opening area for natural ventilation. This is an adaptive strategy in response to potential future increases in mean temperature. Other climate change adaptive strategies considered will include improved envelope insulation and high-performance glazing in response to increasing temperatures. The design team will continue to investigate the feasibility of renewable energy sources and highly energy-efficient technologies, such as solar PV, air-source heat pumps and water-source heat pumps. As climate change is not limited only to temperature increase, but may also include flooding, intensified downpours, and/or hail events, the design team will continue to consider ways in which the architectural elements selected for the Project can reduce the vulnerability to these extreme events.

While the Applicant is not responsible for the execution of the electrical substation, resiliency to future climate change will be an important focus of the design and the review and approval by the Massachusetts Energy Facilities Siting Board.

OTHER POTENTIAL RESILIENCY MEASURES

On-site renewable energy, and a district energy network also provide opportunities for added resiliency during periods of power loss during storms. While the KSURP area is served by underground utility power lines and gas mains, and as such, is not normally effected by storms that disrupt power or gas transmissions, according to Massachusetts Department of Energy Resources (DOER), the Kendall Square Cogeneration Station (the "Cogeneration Station)") has been registered by the ISO-NE as a black start generation asset that can operate in island mode to provide both electricity to the Cambridge grid and thermal energy to the KSURP area in the event of a grid outage.

On-site combined heat and power (CHP), or solar PV, generally will operate in phase with the incoming utility power, and needs incoming power to synchronize phase delivery. In "island mode", generators and CHP systems can be made to operate independently of the grid and self-synchronize power phasing with on-site solar. However, this approach is normally used in large-scale shelter locations only, when long-term operation may be needed to protect a group of people.

In most cases, the proposed commercial buildings will shut down and send occupants home in storm-related power failure scenarios. Any generators provided will most likely be optional standby generators that are sized to maintain server room or process operations only. In the case of the residential components, the generators provided will be for life-safety uses only (stairway pressurization, egress elevators, fire pump, etc.) and cannot by Code be used for ordinary ongoing operations in a building. The capacity provided by solar PV, even if the available space is maximized, will not be more than 10 percent of the power needed by the building, and cannot provide all power needed for normal operations. A CHP system could be used to provide limited ongoing operation, but the economics of such a system when compared to the likelihood of repeated power outages in the Kendall Square area would not be favorable. Storm response actions and resiliency measures will be incorporated into leasing agreements or tenant guidelines, including guidance related to tenant fit-out of commercial space, particularly those located on the lower floors.

8.7 HEALTH AND WELLNESS

Human health and wellness are addressed in the Project through design, operations, and occupant behavior. Within each Project Component, special attention will be given to address human health and comfort during construction and once the building is occupied. This will be accomplished by implementing pollutant reduction strategies, using non-toxic materials, providing fresh air to occupants, installing individual lighting and heating controls, and by providing natural daylight and views to outdoor green spaces. Tenant Design and Construction Guidelines will include comfort related requirements such as installing CO2 sensors in all regularly occupied spaces.

The Applicant is also exploring the use of principles of the WELL Building Standard, which place human health and wellness at the center of design and can encourage and educate future tenants on healthy living practices. Active design principles, encouraging physical and social activity, will be employed where possible. The Project Site will include vibrant spaces where people can safely walk, bike, use transit, and access open spaces. Individual buildings will be designed wherever possible to include visible, attractive and well-lit stairs, communal services such as break areas and copy services, and a variety of public gathering spaces and individual relaxation spaces. Ground level outdoor spaces will be easily accessible to both building occupants and visitors alike.

8.8 SUSTAINABLE TENANT GUIDELINES

Tenant Design and Construction Guidelines will be provided to office and retail tenants as a guide to use when fitting out their spaces. The intent of these guidelines is to educate tenants about implementing sustainable design and construction features in their tenant improvement build-out as well as adopting green building practices that support the overall sustainability goals of the Project. The guidelines will also communicate the sustainable and resource-efficient features incorporated into the base building(s) and provide specific suggested sustainable strategies enabling tenants to coordinate their leased space design and construction with the rest of the building systems.

In summary, the guidelines may include the following information:

- Descriptions of sustainable design, construction and operations features of the proposed building(s), including resource conservation goals and features for tenant fit-out spaces (e.g., low-flow plumbing fixtures, sub-metered systems, lighting controls) as well as building certifications (i.e., LEED certification).
- Encourage tenant commitments for meeting various energy and water conservation goals.
- Descriptions of current regulatory requirements that pertain to leasable spaces.
- Strategies for energy efficiency, such as those for HVAC equipment recommendations, lighting and lighting controls, and low-flow, high-efficiency plumbing fixture recommendations.
- Information on the various high-performance building rating systems, such as EPA's ENERGY STAR and LEED for Commercial Interiors (CI) as well as information on how the design of the base building(s) can contribute towards these certifications.
- Waste reduction goals and recycling facilities/programs.
- Information on green cleaning guidelines and policies.
- Information regarding project-wide features that aim to encourage alternative transportation and TDM measures.
- Information on how to train and inform maintenance staff and employees on operations related to sustainable design features and systems.

8.9 LEED CREDIT NARRATIVE

Refer to the Sustainability Supporting Documentation in Appendix B for individual Project component reports.

(Intentionally Blank)

9. PHASING PLAN

9.0 INTRODUCTION

CHAPTER UPDATES

The following section summarizes minor refinements to this Chapter since the Concept Plan Amendment #1.

- **Phase 1:** Since the Concept Plan Amendment #1 was approved in 2019, the Applicant has completed construction of the commercial space and ground floor retail associated with the Commercial Building A (Phase 1) located at 145 Broadway.
- **Phase 2:** Commercial Building B (Phase 2), also known as 325 Main Street, is currently under construction and anticipated to be completed in Q2 of 2022.
- **Phase 3:** This chapter has been updated to reflect the construction of the consolidated Residential Building South at 135 Broadway, an electrical substation vault, and the new Commercial Building C at 290 Binney Street.
- **Phase 4:** This chapter has been updated to reflect the proposed construction of the new Commercial Building D at 250 Binney Street, build-out of the electrical substation, completion of the Center Plaza open space and conversion of the existing service drives to east and west “Plaza Drives”.

9.1 PHASING PLAN

The evolution of the Project is expected to occur over four major phases consisting of the following generally described components:

- **Phase 1 (Commercial Building A)** The commercial space and associated ground floor retail or active use at 145 Broadway;
- **Phase 2 (Commercial Building B)** The commercial space and associated ground floor retail or active use at 325 Main Street;
- **Phase 3 (Residential Building South)** The residential space on the south side of the existing Blue Garage consisting of rental apartments;
- **Phase 3 (Commercial Building C)** The commercial space and associated ground floor retail or active use at 290 Binney Street;
- **Phase 3 (Substation Vault)** The construction of an electrical substation vault under what will become the Center Plaza;
- **Phase 4 (Commercial Building D)** The commercial space and associated ground floor retail or active use at 250 Binney Street;
- **Phase 4 (Electrical Substation)** Build-out of the electrical substation; and
- **Phase 4 (Center Plaza)** Completion of the Center Plaza open space after completion of the electrical substation and opening to public use.

The specific timing of each of the phases depends upon the duration required for permitting, the leasing conditions within the Cambridge sub-market and the construction logistics associated with staging and the demolition of portions of the Blue Garage.

Since the Concept Plan Amendment #1 was approved in 2019, the Applicant has completed construction of the commercial space and ground floor retail associated with the Commercial Building A (Phase 1) located at 145 Broadway. Commercial Building B (Phase II), also known as 325 Main Street, is currently under construction and anticipated to be completed in Q2 of 2022. As part of delivery of the Phase 2 building—which will serve as Google's local headquarters—the Applicant is constructing approximately 40,000 square feet of retail uses, enhancing the Kendall Roof Garden, creating a new public lobby in the ground floor of 325 Main Street, and working closely with MBTA to renovate the existing Kendall Northbound Headhouse. Delivery of the MBTA Kendall Northbound Headhouse is subject to third party approvals of schedule and construction timeline.

The Applicant remains committed to complying with the requirements of the MXD Zoning and KSURP Amendment 11 that requires the commencement of construction of at least 400,000 square feet of residential GFA to precede or be constructed concurrent with the construction of either Commercial Building C or Commercial Building D, whichever starts first.

Table 9-1 summarizes the approximate GFA and program by phase along with the public benefits associated with each phase of development.

The combination of new active ground floor uses, the redesign of key existing public spaces along with adjustments and refinements to other parts of the public realm will significantly improve the connectivity, as well as the experience of the public realm between Broadway and Binney Street and along Main Street in proximity to Kendall Plaza in the MXD.

TABLE 9-1 GROSS FLOOR AREA

ANTICIPATED PHASING PLAN WITH PUBLIC BENEFITS					
	PHASE 1	**PHASE 2**	**PHASE 3**		**PHASE 4**
	COMMERCIAL BLDG. A (145 BROADWAY)	COMMERCIAL BLDG. B (325 MAIN STREET)	RESIDENTIAL SOUTH BLDG. (135 BROADWAY)	COMMERCIAL BLDG. C (290 BINNEY STREET)	COMMERCIAL BLDG. D (250 BINNEY STREET)
COMMERCIAL GFA	441,614	385,423	0	409,500	444,776
RESIDENTIAL GFA	0	0	420,000	0	0
ACTIVE USE/RETAIL GFA	8,700	0	700	2,500	5,800
EXISTING GFA	(78,636)	(117,201)	0	0	(62,576)
NET NEW GFA	**362,978**	**268,222**	**420,700**	**412,000**	**450,576**
(OS) OPEN SPACE IMPROVEMENTS	**6TH STREET CONNECTOR E/W CONNECTOR (W)**	**KENDALL PLAZA / KENDALL ROOF GARDEN AND PUBLIC TERRACE CONNECTOR**	**EVERSOURCE VAULT BUILD OUT**	**CENTER PLAZA & SOUTHERN E/W CONNECTOR**	**CENTER PLAZA / NORTHERN AND SOUTHERN E/W CONNECTORS / PLAZA DRIVES / VAULT EQUIPMENT BUILD-OUT**
INNOVATION SPACE AT 255 MAIN	60,496	44,704	0	0	0
VEHICLE PARKING	457	0	0[1]	1,584[1]	
LONG-TERM BIKE PARKING	134[2]	108[2]	20[3]	400-610[2]	
SHORT-TERM BIKE PARKING	34[2]	47[2]	12[3]	12[3]	12[3]
MARKET RATE HOUSING	0	0	316,000 GFA	0	0
AFFORDABLE HOUSING	0	0	84,000 GFA	0	0
MIDDLE INCOME HOUSING	0	0	21,000 GFA	0	0
STATUS	COMPLETED	UNDER CONST.	PLANNED	PLANNED	PLANNED

1. The Project Change proposes to relocate the approximately 1,170 existing above-grade parking spaces associated with the Blue Garage below-grade into in two, connected parking garages situated beneath Commercial Building C and Commercial Building D. The Project Change also proposes an additional 413 net new vehicle parking spaces to be accommodated within the new below-grade garage for a total of 1,558 vehicle spaces that will service Commercial Buildings C and D, and Residential Building South. Two existing above-grade parking garages shall be retained, with modifications as to provide more efficient self-parking striping and the provision of managed/valet spaces as approved by Concept Plan Amendment #1.
2. Reflects as-built bicycle parking for Commercial Building A, and approved bicycle parking for Commercial Building B, which is currently under construction.
3. The Applicant intends to satisfy bicycle parking demand from the Residential Building South, Commercial Building C and Commercial Building D via a commercial bicycle valet. In accordance with Article 6.108.1 the Applicant therefore intends to seek a modification of bicycle parking requirements via special permit. To complement the services of the envisioned bicycle valet, the Applicant also seeks to deliver approximately 20 traditional long-term bicycle parking spaces within the Residential Building South and 12 short-term bicycle parking spaces for Residential Building South, Commercial Building C, and Commercial Building D. The range of valet spaces illustrated (400-600) conveys the changing maximum capacities of the valet from its temporary premises within Commercial Building C to its permanent location within Commercial Building D. The Applicant also anticipates that the proposed bicycle valet will be able to offer short-term bicycle parking, subject to capacity utilization trends. The implications of applying the minimum bicycle parking requirements established by the City of Cambridge Bicycle Parking Guide to the Project are shown in Table 10 of the TIS Update Memo #2, Appendix B."

PHASE 1

FIGURE 9.2

PROJECT PHASING FORECAST																
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
PHASE 1	Commercial Building A															
PHASE 2																
PHASE 3									Residential Building South							
									Commercial Building C							
PHASE 4															P2 Open Space	
											Sub Station Fit Out					

Since the Concept Plan Amendment #1 was approved in 2018, the Applicant has completed construction of the commercial space and ground floor retail associated with the Commercial Building A (Phase I) at 145 Broadway. Commercial Building has become Akamai's new global headquarters, and provides 8,700 GFA of ground floor retail space. In conjunction with Commercial Building A, the Applicant delivered enhancements to the 6th Street Connector, enhancements to the East/ West connector connecting Galileo Galilei Way to the West Service Drive, and the creation of 60,496 GFA of Innovation Space located at 255 Main Street.

1. Timelines are estimates and subject to change in duration due to complex nature of multiple overlapping projects

PHASE 2

FIGURE 9.3

PROJECT PHASING FORECAST																
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
PHASE 1	Commercial Building A															
PHASE 2				Commercial Building B												
PHASE 3									Residential Building South							
									Commercial Building C							
PHASE 4															P2 Open Space	
											Sub Station Fit Out					

Since the Concept Plan Amendment #1 was approved in 2018, the Applicant has commenced construction of the commercial space and ground floor retail associated with Commercial Building B, with an estimated completion and Certificate of Occupancy in Q2 2022. The office space will operate as Google's local headquarters on completion, and will be accompanied by approximately 40,000 GFA of reconstructed retail delivered in the basement, ground floor, and second floor. The 325 Main Street site is bordered by Main Street to the south, 355 Main Street to the west, the Green Garage to the north, and the Kendall Plaza to the east. As part of delivery of the Phase 2 building—the Applicant is enhancing the Kendall Roof Garden and working closely with the Massachusetts Bay Transportation Authority (MBTA) to renovate the existing Kendall Northbound Headhouse. The remaining 44,704 GFA of Innovation Space will be provided in conjunction with the completion of Commercial Building B.

1. Timelines are estimates and subject to change in duration due to complex nature of multiple overlapping projects

PHASE 3

FIGURE 9.4

PROJECT PHASING FORECAST																
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
PHASE 1	Commercial Building A															
PHASE 2				Commercial Building B												
PHASE 3									Residential Building South							
									Commercial Building C							
PHASE 4															P2 Open Space	
											Sub Station Fit Out					

Will consist of both Commercial Building C and Residential Building South. The construction of these two components will require demolition of the existing above-grade Blue Garage to accommodate the relocation of the Eversource electrical substation. It is anticipated that construction of these two project components will start at different times due to on site logistics, relative complexity of each building, and market conditions, however the construction of the Residential South Building will precede or be concurrent with the construction of Commercial Building C.

Phase 3 will also include the construction of a vault beneath the Center Plaza that will be used to house the electrical substation that will be completed as part of the subsequent Phase 4. While proposed project scheduling and sequencing is complex and remains subject to change, it is estimated that this phase carries an approximate duration of 4.5 years.

1. Timelines are estimates and subject to change in duration due to complex nature of multiple overlapping projects

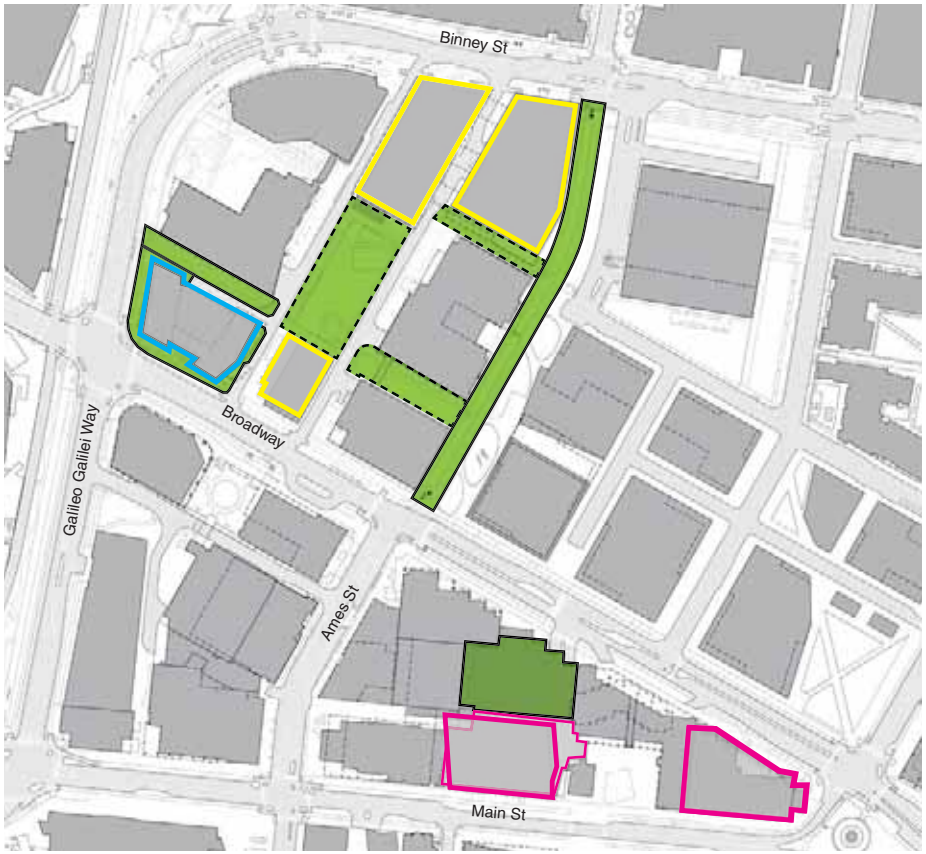
PHASE 4

FIGURE 9.5

PROJECT PHASING FORECAST																
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
PHASE 1	Commercial Building A															
PHASE 2				Commercial Building B												
PHASE 3									Residential Building South							
									Commercial Building C							
PHASE 4									Commercial Building D						P2 Open Space	
											Sub Station Fit Out					

Will consist of the demolition of the existing building at 250 Binney Street and the construction of Commercial Building D. Phase 4 will also include the build-out of the electrical substation, completion of the Center Plaza, and the planned enhancement of the northern and southern East/West Pedestrian Connectors connecting the East Service Drive to the 6th Street Connector. Lastly, Phase 4 will include the conversion of the existing service drives to east and west “plaza drives”. While proposed project scheduling and sequencing is complex and remains subject to change, it is estimated that this phase carries an approximate duration of 6 years from completion of Phase 3.

1. Timelines are estimates and subject to change in duration due to complex nature of multiple overlapping projects



(Intentionally Blank)

10. DESIGN GUIDELINES

10.0 INTRODUCTION

1. Residential Building South (135 Broadway)
2. Commercial Building C (290 Binney)
3. Commercial Building D (250 Binney)

The following design guidelines are presented in a “ground up manner” that first considers the broader goals of the overall Project and then articulates specific guidelines for streets and public pathways, landscape materials, building form and massing, building materials and guidelines for each of the proposed commercial and residential projects. The Guidelines are divided into the following sections:

I. Key Goals and Objectives

II. Character of Streets and Pathways

III. Landscape Material

IV. Built Form and Massing

V. Building Material and Facade Guidelines

A variety of design guidelines and priorities have come to act on the Infill Development Concept Plan over its history, including the original KSURP Design Guidelines, K2/C2, and others as incorporated into Amendment #1 of the Infill Development Concept Plan. These guidelines have collectively shaped previous iterations of the Concept Plan by establishing high-level goals for proposed development and then mediating execution of key facets of design in turn. These include the nature of streets and pedestrian pathways, materials to be utilized in landscaping, the character of building form and massing schemes, as well as orienting selection of building materials and façade design direction. Rather than minutely prescribing development, these guidelines have generally been intended to consistently inform project design so as to promote a more cohesive and thoughtful whole.

Consistent with representations made during the re-zoning petition that is enabling this proposed Concept Plan Amendment #2, the Applicant in this instance intends to adopt the design guidelines applied to the adjacent Volpe development project while respecting the aspirations and objectives of the guidelines that acted on Amendment #1 to the Infill Development Concept Plan. This evolution in design direction will ensure that the proposed amendment is responsive to the interrelationship between the Applicant’s proposed Concept Plan Amendment #2 and the adjacent Volpe development being elaborated by MIT. As such, the design guidelines for this proposed amendment shall serve the purpose intended in prior iterations of the Infill Development Concept Plan—to promote cohesive design via harmonization of goals, objectives and guidelines within the MXD.

I. KEY DESIGN GOALS AND OBJECTIVES

The following goals and objectives are intended to guide and support the successful execution of the MXD Infill Development Concept Plan as a whole. Overall, the Original Concept Plan is an infill development proposal that is bounded by the realities of existing development and infrastructure while seeking to contribute to the evolution of Kendall Square as a neighborhood with varied and complimentary uses. A set of design objectives are primarily provided for the MXD District in sections 501 and 702 of the KSURP. However, with the approval of the IDCP, the following goals shall also apply broadly to the district as a whole:

1. Create a complementary mix of uses that contribute to Kendall Square's evolution as a 24/7 Live Work and Play neighborhood.
2. Create permeability with pedestrian and bicycle connections through the site blocks within the district especially those routes that strengthen ground floor active use and retail.
3. Provide access to outdoor and indoor public spaces that allow people to enjoy them throughout day and evening.
4. Enhance connections between existing open spaces and public and private pedestrian and bicycle infrastructure.
5. Make housing available across multiple income spectrums as further defined in the Zoning Ordinance.
6. Design and build in a sustainable and resilient fashion.
7. Create buildings of appropriate scale, mass, height, form and texture for their site context on its parcel, the block, and in relation to the width of the street or adjacent open space, with the goal of optimizing light, air and views for all both inside and outside the buildings.
8. Building and open space design enhances and embraces that life in a dense urban setting happens vertically by including public and private open spaces such as balconies, terraces and rooftop decks.

II. CHARACTER OF STREETSCAPE AND PATHWAYS

The following section describes the guidelines for the streetscape and publicly available pathways. This section presents general guidelines that apply to Broadway, Galileo Galilei, Binney Street, Main Street the 6th Street connector and Pioneer Way. In addition to these general guidelines, City Street standards shall apply as well as the joint CRA's May 2017 City ALTA cycle track design that will impact portions of Broadway, Galileo Galilei Way, Binney Street and Main Street. At the time of this submission the ALTA CRA's May 2017 cycle track has been advanced to a Schematic Design level of detail.

For specific information on the vision for associated open spaces and parks in the Concept Plan Amendment, please refer to Chapter 3, Open Space. Note that all public space proposals will evolve with the design of each applicable building or project as more thoroughly described in Chapter 9, Phasing, and will be submitted concurrently with design review for each building. The following guidelines shall apply to all streetscapes and pathways subject to modification in the design review process:

1. Streets shall be designed to improve pedestrian and bicycle access, circulation, and safety.
2. Streets shall be designed to allow for separated circulation paths for pedestrian bicycles and automobiles to minimize conflict and ensure safety.
3. Intersections between private access roads and streets shall be carefully designed to compromise between the variable needs of pedestrians, bicycles, automobile traffic, bus traffic, delivery trucks and emergency service vehicles.
4. Where possible, lay by areas shall be planned to allow for safe access to ride sharing vehicles.
5. Bike racks shall be included in a manner consistent with zoning for short or long term bike uses, and dedicated space provided for municipal bike share systems as required by PTDM or Zoning.
6. Lighting shall be provided consistent with city standards that balances concerns between light pollution, safety, and the creation of a compelling evening streetscape, outdoor patio, retail, and open space environment.
7. Where possible, planted areas and permeable hardscape shall be included to allow for water infiltration.
8. Street furnishing shall be included consistent with City Standards to allow for points of gathering, rest, and for public transit uses.

III. LANDSCAPE MATERIALS DESIGN GUIDELINES

The following section sets forth the design goals and objectives for the landscape materials that will be used throughout the broader MXD Infill Development Concept Plan, and within the individual building sites. Specific manufacturer reference should be considered solely as precedent examples to help illustrate a guideline. The following material guidelines apply to open spaces and parks that are part of the MXD Infill Development Concept Plan, and are included as part of Chapter 3 of this submission. The following guidelines shall apply to all landscaping materials subject to modification in the design review process:

PAVING

1. All paving materials should be able to withstand high volumes of pedestrian movement and harsh weather conditions. Paving should be able to accommodate garage entrances, retail loading areas, vehicular crossings, and de-icing treatments.
2. In the event of damage, repair or utility work, hardscapes should be easily repairable with matching materials. Pavements must be slip resistant and safe for pedestrian traffic. Paving that utilizes lighter coloring can help reduce heat island effect and can count towards LEED credits. The following are pavement recommendations:
3. Paving should be predominantly used to minimize tripping hazards along the pedestrian clearway zone.
4. Specialty paving should be used to highlight entries to buildings or parks, mid-block crossings or public art. Paving over tree spaces should be porous, either by utilizing porous pavers, setting unit pavers on a pervious setting bed or using tree grates.
5. Within the district, concrete pavers may be used to signify primary building entries and stairs, Plaza Drives and within the Center Plaza. Sidewalks along Broadway, and Galileo Galilei Way will typically be cast in place concrete with saw cut joints, scoring patterns, and/or texture. Compacted almost-flush decomposed granite and or a Flexi-pave surface material could be considered an option for surfacing when permeability is necessary.

CONCRETE UNIT PAVER

CAST-IN-PLACE CONCRETE

III. LANDSCAPE MATERIALS DESIGN GUIDELINES

FURNISHINGS

1. Benches, tables and other types of seating should be located in a variety of settings to allow a choice of scenery and social settings. Within the district, a mix of fixed and movable chairs, as well as tables will be provided to allow for informal gatherings, outdoor eating, studying and socializing.
2. If located in sunny areas, umbrellas or shading devices will be considered.
3. Playful, relaxed types and shapes of furniture should be considered, including Adirondack Chairs, lounges, swings and similar.
4. In addition to movable tables and chairs, fixed benches may be used along the East West Connector, or potentially near building entrances, including vestibules, and other covered spaces.
5. Within the district core, seat walls or colored concrete benches (preferably with wooden seats) will be used to provide seating in or around the edges of these spaces. Walls shall be concrete with optional metal and wood components and be compatible in material, pattern and color with immediately adjacent buildings. Capstones will be granite or precast concrete. Seat walls should be set level.
6. The litter receptacle that should be used throughout the district is the 'collect' as supplied by "landscapeforms," or "Big Belly," with top or side opening, or similar. Finish shall be polyester powder coat in color 'silver,' 'titanium,' or 'black,' matching the color chosen for the benches.

LITTER RECEPTACLES

BigBelly Smart Waste Management System

Apex - Forms and Surfaces

Radium - Mmcite

BENCHES AND CHAIRS

Parc Center Chair - Landscapeforms

Custom Bench

BIKE RACKS

1. In all district areas, the 'Bola Rack', or similar, shall be used. Racks should be anchored to a concrete base, and shall preferably be stainless steel, receive a hot dipped galvanized finish, or a powder coat finish in black. Spacing of the racks shall conform to Bicycle Rack Cambridge Standards.

BIKE RACKS

Bola - Landscapeforms

Bikepark - Mmcite

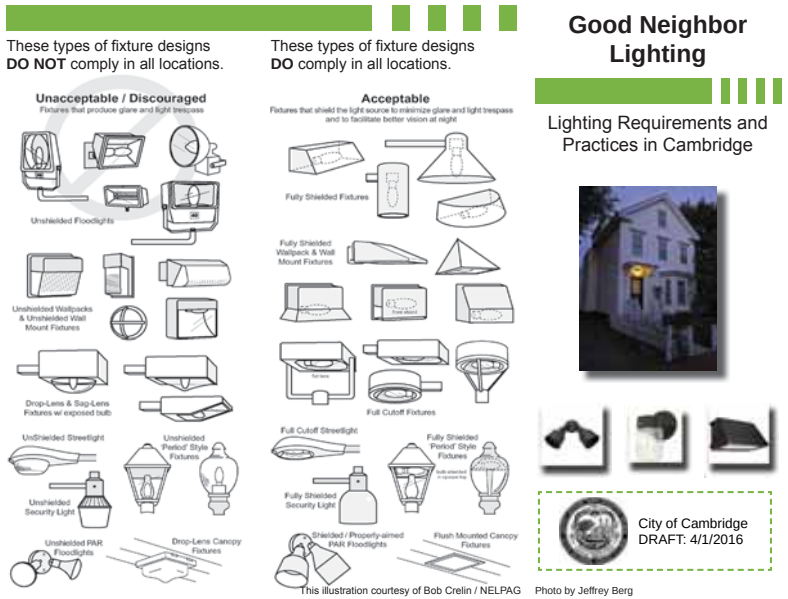
LIGHTING

The primary function of exterior lighting is the safety of drivers, cyclists and pedestrians at night, but it plays an equally important role in complementing architecture and urban form to provide a sense of place before and after sunset. Exterior lighting sources shall be light emitting diode (LED), unless approved by city staff.

Developments in the MXD District shall observe the following guidelines with respect to exterior lighting:

1. The primary function of exterior lighting is the safety of drivers, cyclists and pedestrians at night, but it plays an equally important role in complementing architecture and urban form to provide a sense of place before and after sunset. Exterior lighting sources shall be light emitting diode (LED), unless approved by city staff. Developments in the district shall observe the following guidelines with respect to exterior lighting:
2. Exterior walls of buildings may be illuminated at a regular intervals by wall-bracketed or accent up/down lighting, and such lighting should enhance the building's architectural expression. Where a feature such as a soffit or arcade is employed in the architectural design of a building, lighting should be recessed into that feature.
3. Pedestrian light fixtures should be no more than 14 feet (14') tall, and be anchored by a pedestal base that is of proportion to the height and circumference of the pole of a complementary material.
4. Lighting maybe incorporated within the paving design of the center plaza to celebrate the idea of the plaza's direct correlation with the substation.

GOOD NEIGHBOR LIGHTING



This illustration courtesy of Bob Crelin / NELPAG

Photo by Jeffrey Berg

LIGHTING

Amenity lighting (led)

Cree - Edge Series

1. See "Good Neighbor Lighting" PDF https://www.cambridgema.gov/-/media/Files/CDD/EconDev/lightingtaskforce/2016/goodneighborbrochure_180117.pdf
2. The full Outdoor Lighting Ordinance is located Chapter 15.22 Outdoor Lighting Section 15.22.050 1. Prescriptive Standard

III. LANDSCAPE MATERIALS DESIGN GUIDELINES

WATER FEATURES

Water features of the proposed public realm can play a vital role in providing places to create visual interest and serve as a landmarks or focal points. The design will integrate water features in the urban landscape as stormwater collection, storage and or circulation. Water features can be designed to incorporate children's play. Guiding principles for introducing water features into the pedestrian realm are as follows:

1. Use of high-quality stone products and applications that complement adjacent architecture.
2. Locate water features with the landscape zone, building zone, or open space locations. Water features should be kept out of the sidewalk zone of the streetscape, in order not to impede pedestrian movement.
3. Design considerations should take into account the appearance during winter months or other periods when the water feature is turned off.

CHILDREN'S PLAY WATERFEATURE

WATER FEATURE / RUNNEL

RUNNEL SIGNAGE

DECOMPOSED GRANITE

WATER SPOUTS

EXISTING / ADAPTED GARAGE STRUCTURES

Within the MXD district, recent developments have proposed to mask existing garage structures with new building proposals. For exposed parking garage surfaces, murals and screening devices or the continuation of building facade fenestration can be introduced when appropriate to mask or enliven these existing structures without impacting necessary open area for ventilation of the garage functions.

Within existing parking structures opportunities for enhanced wayfinding graphics can be applied to surfaces for greater pedestrian safety and information

PAINTED MURALS

GREEN WALLS

COLORFUL WAYFINDING AND GRAPHICS

SCREENING MATERIALS BREAK DOWN SCALE

FACADE PANEL GRAPHICS

IV. BUILT FORM AND MASSING

The following section sets forth the design goals and objectives for massing and built form of the proposed commercial and residential buildings that form the MXD Concept plan. In addition, a building specific component is included in these guidelines to help address guidelines in a site specific context including relationships to public spaces and streetscapes. The built form and massing guidelines attempt to strike balance between multiple important considerations including visual interest, interior functionality, market demand, environmental impacts, sustainability and programmatic flexibility among others. Note that all proposed massings in the MXD Concept plan will evolve with the design of each applicable building or project and through the design review process for each building. The following guidelines shall apply broadly to all proposed massings and built forms and specifically to each building and subject to modification in the design review process:

1. Create dynamic varied street walls to help frame sidewalks, plazas, and other public spaces while allowing for breaks in street wall to define entries to buildings. Varying materials and massing forms may be employed to prevent monolithic or flat street wall.
2. Use building mass to establish street corners, urban thresholds or create landmarks.
3. Create a variety of forms and rhythm, appropriate to urban context and street width.
4. Introduce vertical breaks in facades where appropriate to define entries or other programmatic changes.
5. Create interesting and varied rooflines identifiable from the ground and at a distance.
6. Create or support appropriate contextual datum lines to limit sense of height at street level.
7. Provide transition to adjacent context (parks, buildings).
8. Visually connect outdoor public realm with indoor public spaces.
9. Use recessed or projected entryways, canopies, awnings, etc., to enhance pedestrian experience, and provide weather protection to the sidewalk.
10. Architectural contrast is encouraged, while being deferential to the existing signature architectural elements of any existing buildings and/or blocks.
11. Use massing to mitigate potential wind impacts as described in wind studies provided as part of each building's Design Review submission.

BUILDING FORM

A primary planning goal of the Project is to create new human-scaled streets and open spaces and a district where the built form contributes to an overall sense of place by employing simple, shared urban design principles. The massing envelopes of each of the eight high-rise buildings proposed are conceived with four horizontal zones: pedestrian frontage, streetwall, tower, and building top.[1]

Pedestrian frontage: This street level zone will maximize transparency, revealing lobby, retail, dining and recreation uses and fostering a sense of security along the streetscape.

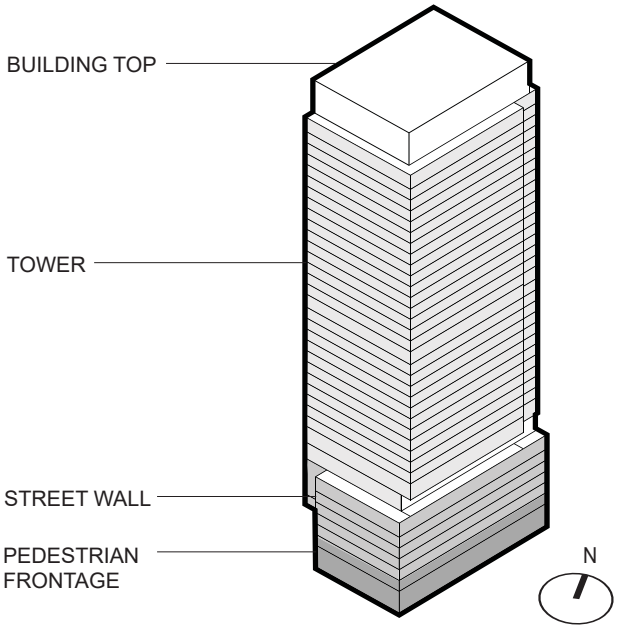
Streetwall: Floors within this zone may utilize less overall transparency than the pedestrian frontage zone, as they reflect the specific functional use of the overall building and define the urban scale of streets and open spaces.

Tower: Defining the majority of the building's presence above the streetwall zone, the building tower participates at the scale of the district. Fenestration patterns in this zone will relate to the primary function of the building, and it is in the tower massing where the most opportunity exists to manipulate bulk and proportion.

Building top: The building top operates on the scale of the city and lends identity to the building and compositional character to the profile of the city skyline.

1. Criteria Adopted from the Volpe Development Project Design Guidelines

RESIDENTIAL BUILDING



MASSING SOUTH EAST AXON

Common Features:

- Simple definition of pedestrian frontage, tower and top
- Strong expression of frame and legibility of scale
- Architectural language of residential

IV. BUILT FORM AND MASSING

BUILDING USE TYPOLOGIES

All buildings will have active, highly transparent street levels, with particular emphasis on frontages that face major streets and open spaces. The individual building architecture will reflect specific uses in building metrics like floor-to-floor height, structural bay spacing, and in fenestration patterns and material selection.[1]

Residential Buildings: Residential building architecture will reflect the private nature of individual homes and residential spaces, emphasizing a lower window-to-wall ratio and a diversity of fenestration patterns, responding to unit organization and solar orientation. Residential floor plates are inherently thinner than commercial floor plates, and accentuating the slender proportions of the residential plates is encouraged. Balconies, whether projecting from the typical plane of the exterior facade or recessed into it, will be utilized to lend scale and variety to the massing and contribute to the language of residential typology.

Commercial Buildings: The proposed commercial buildings will differ from residential buildings by virtue of their larger floor plates, greater floor-to-floor heights, rigorous structural bay spacing, and more uniform pattern of fenestration. Building massing and envelope details will respond to distinctions between primary front facades and secondary facades and to differences in solar orientation. Careful articulation of large commercial buildings is critical to enable the buildings to relate to the scales of the city, the neighborhood, and the pedestrian.

CONTEXT

Building design will consider the existing architecture of Kendall Square and East Cambridge as presenting a vocabulary of contextual precedent which is background for the integration of the Project's new buildings into the existing city fabric. That fabric is by no means uniform – multiple materials, colors, and proportions of massing elements and fenestration exist nearby and may be precedent in developing compositional strategies for new buildings. While imitation is highly discouraged, a strategy of reference and interpretation is encouraged, with individual design teams encouraged to study elements of the Cambridge vocabulary for inspiration. A city consists of both background buildings and foreground buildings. As an ensemble, the Project build-out will be comprised of foreground buildings set in the context of important background buildings.[1]

CHARACTER AND COMPOSITION

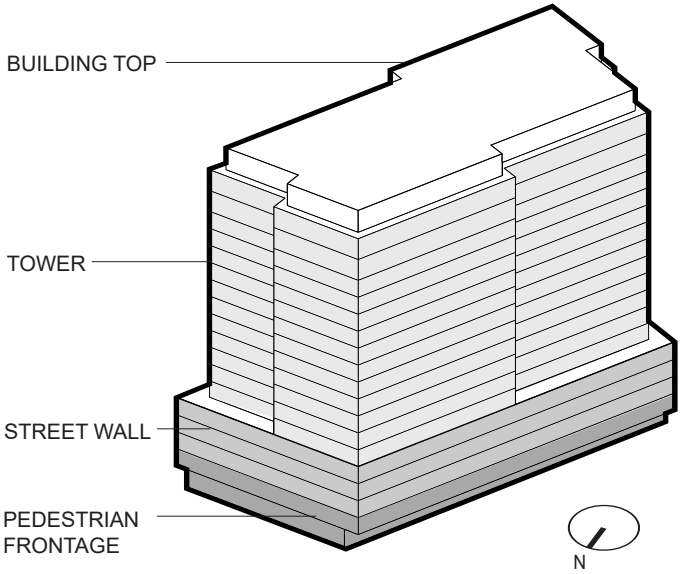
Architectural character and composition will emphasize a distinct identity for each building while also expressing a consistent level of quality, proportional elegance and detail throughout the Project. These buildings will relate to human scale by means of material selection, transparency and public accessibility at lower levels, fenestration patterns, and exterior details and articulation. They will be specific to context, climate, and to the urban and solar orientations of their specific sites. Architectural character will weave into the history and tradition, material and color palette, and compositional organization evident in Kendall Square and East Cambridge. Attributes that will create distinct architectural composition include the proportions of major massing elements, cohesive or contrasting use of materials and color. Individual building identity and character will be legible from adjacent streets and critical view corridors, while the collective Project's skyline will be recognizable when seen from a distance. [1]

The architectural character will support these objectives by:

- Providing diversity and variety within a community of buildings.
- Contributing to the definition and beauty of the public realm.
- Relating to human scale and address urban scale at the pedestrian, building, and district levels.
- Responding to the surrounding context of Kendall Square and East Cambridge.

1. Criteria Adopted from the Volpe Development Project Design Guidelines

COMMERCIAL BUILDING



MASSING NORTH WEST AXON

Common Features:

- Simple definition of pedestrian frontage, tower and top
- Strong expression of frame and legibility of scale
- Confident use of color
- Legibility of Commercial use, universal and flexible space

IV. BUILT FORM AND MASSING

RESIDENTIAL BUILDING SOUTH

Residential Tower
Approximate GFA: 420,000 SF
Maximum Height: 400 FT
Use: Residential and Retail

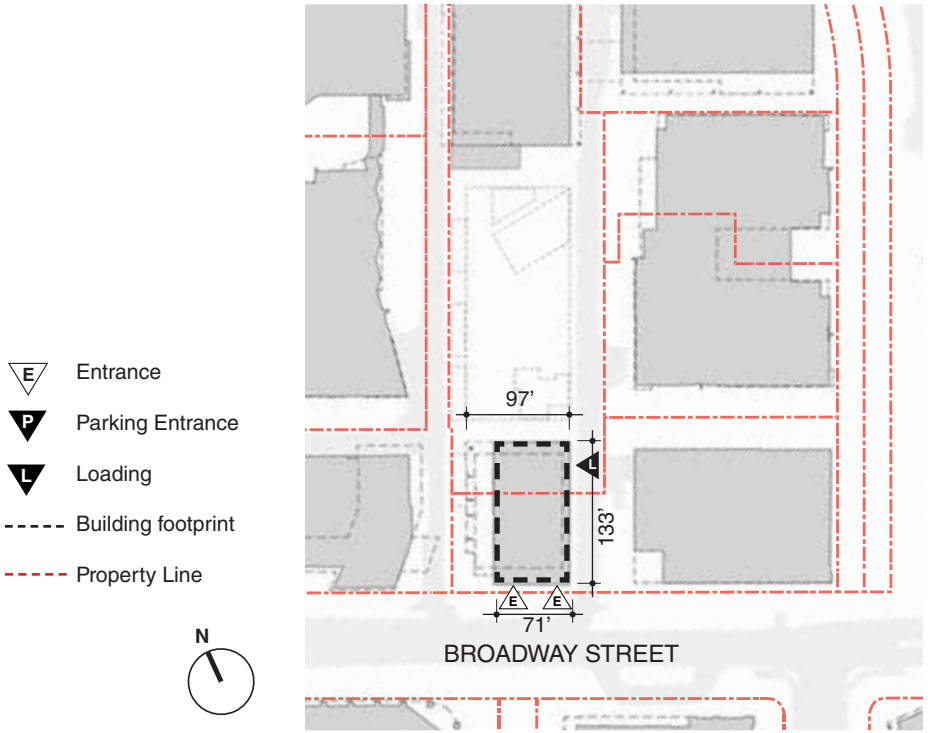
Located in the center of Parcel 2, the residential building is bounded by Broadway to the south, East Service Drive to the East, West Service drive to the West, and the Center Plaza to the North. The proposed Residential Building South contributes to the housing needs of the City of Cambridge including affordable, middle income, and market rate rental housing units. The new construction will function as a gateway to the redeveloped Blue Garage parcel, as well as activation catalyst of the Broadway street and the proposed "Center Plaza" public open space. The following are the design guidelines for Residential Building South:

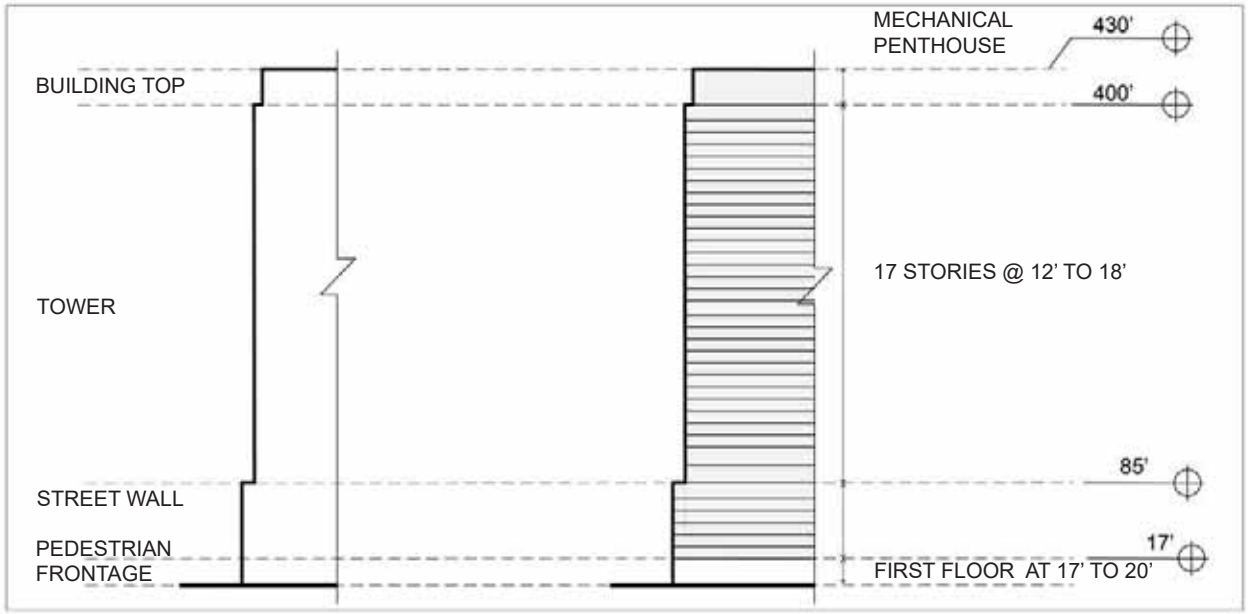
- The massing is broken into 3 primary components beginning with a podium fronting Broadway and creating continuity along the street edge. The plane of the tower is set back from the podium creating an opportunity for outdoor amenity space at the roof overlooking Broadway. The tower continues up to its allowable height where it then culminates with the expression of the mechanical penthouse. Standing at 400 feet, the tower provides an opportunity for a landmark building and can be seen from afar. Massing of the building emphasizes slender, vertically-oriented proportion and vertical breaks as necessary to minimize monolithic form. Balconies humanize the building adding horizontal, and provide outdoor space - social space and roof deck.

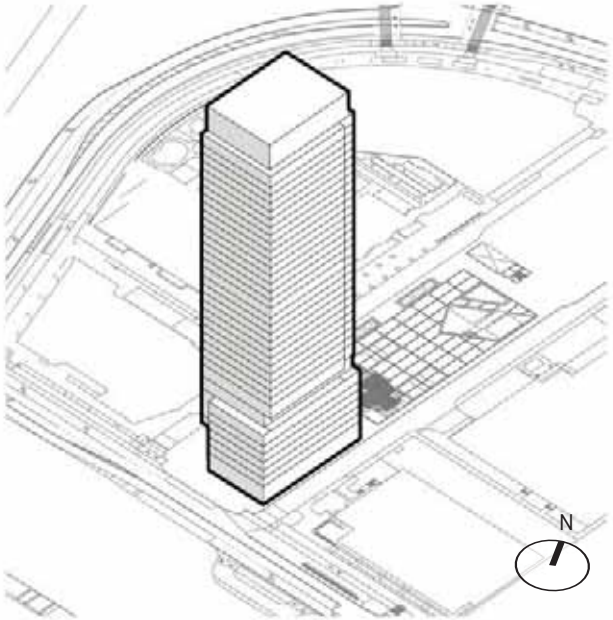
- The relationship between the residential parcel and adjacent 145 Broadway (Akamai) will be carefully studied to accommodate sufficient light and views given the current projecting bays that overhang West Service Drive. The baseline massing podium is pulled back from 145, creating a colonnade space that will allow for a stronger pedestrian connection from Center Plaza to Broadway and ultimately to Daniel Lewin Park. There will be a dedicated loading off East Service Road, so as to further pedestrian focus for the West Service Road.

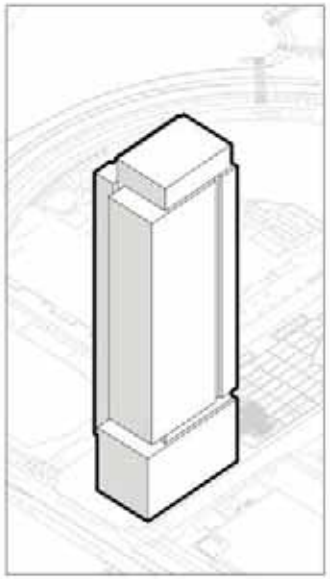
- The ground floor along Broadway will be lined with residential entry, amenities, and retail to activate the frontage. The active use spaces will return back into the colonnade passage to activate the space between the residential parcel and 145 Broadway retail that is located on West Service Drive.

- The Northern edge of the podium is pulled back along Center Plaza to create a clear connection along the East-West Connector. The current pedestrian walkway between 10 CC and Biogen Building 6 can continue uninterrupted between the 135 Broadway podium and Center Plaza. The outdoor amenity space will overlook the open space.

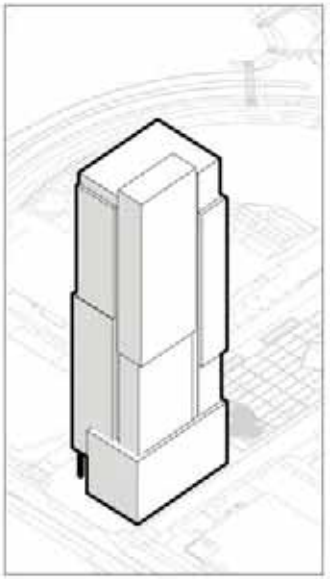




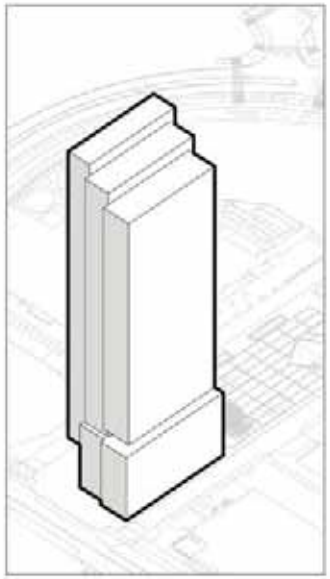




Variation 1



Variation 2

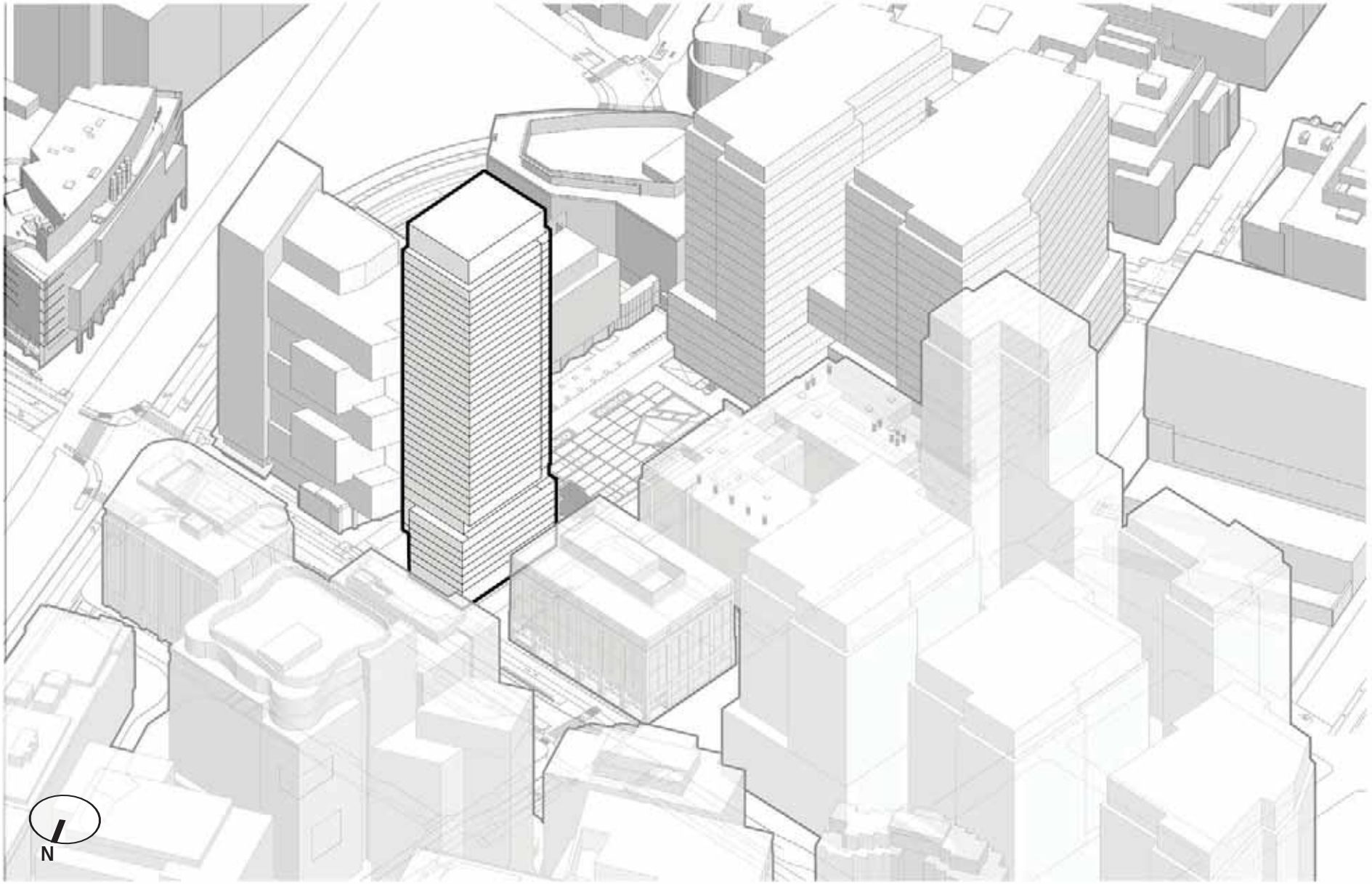


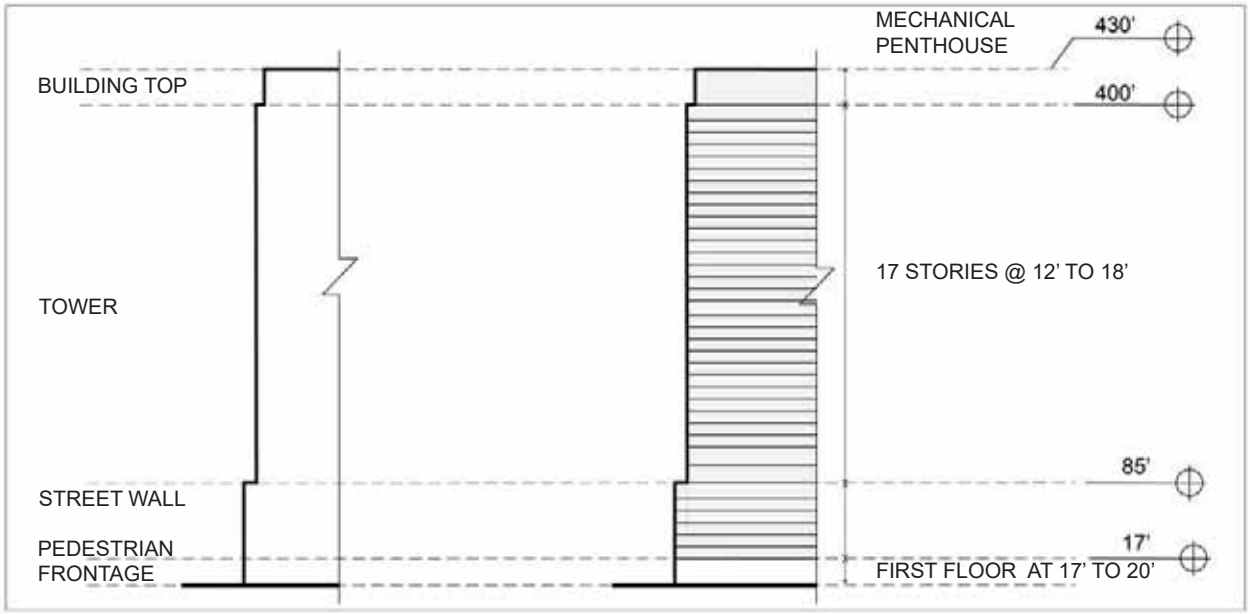
Variation 3

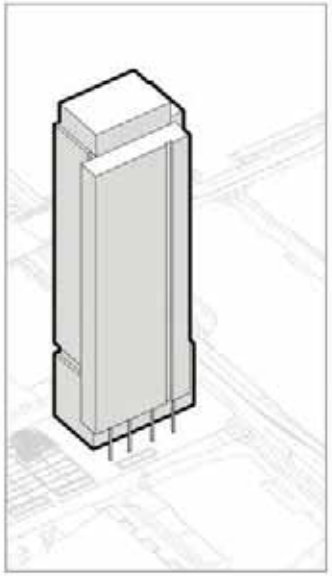
SOUTH EAST AXON

IV. BUILT FORM AND MASSING

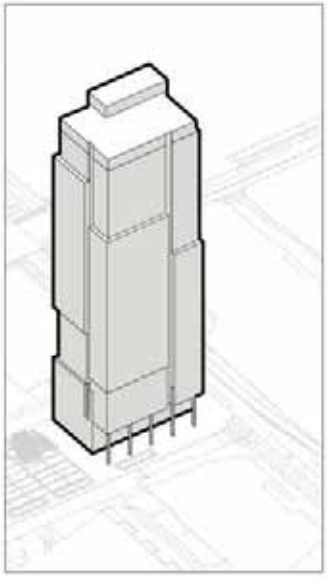
RESIDENTIAL BUILDING SOUTH



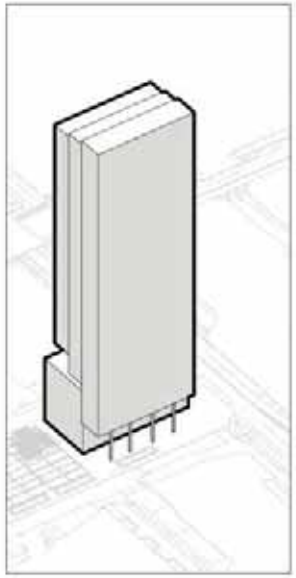




Variation 1



Variation 2



Variation 3

NORTH WEST AXON

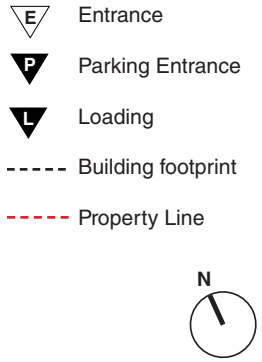
IV. BUILT FORM AND MASSING

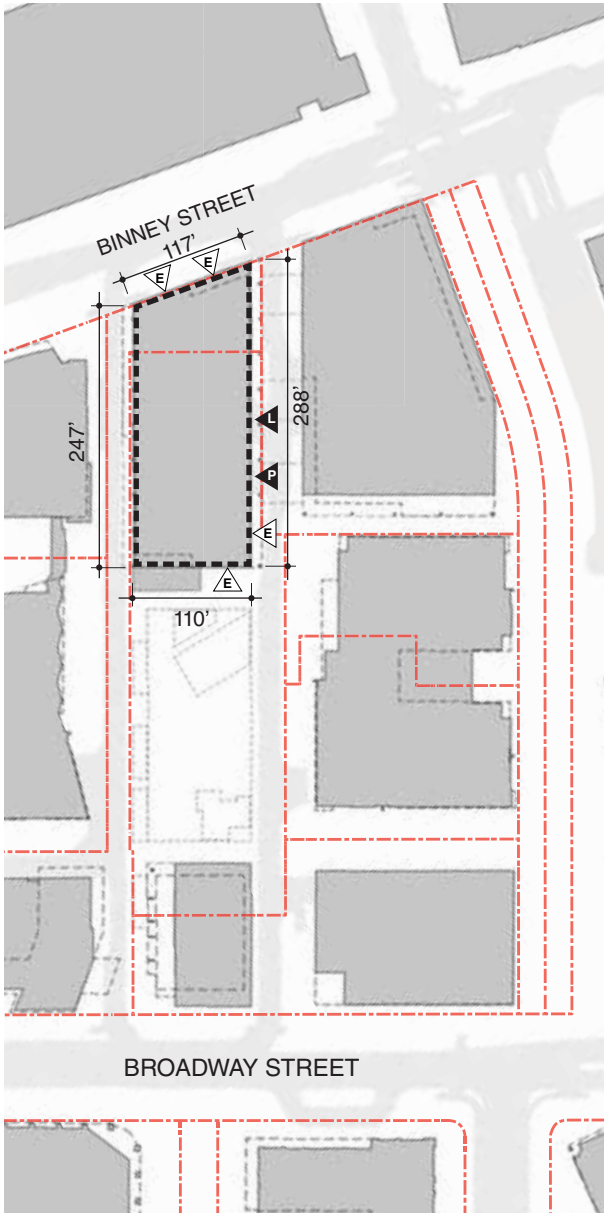
COMMERCIAL BUILDING C

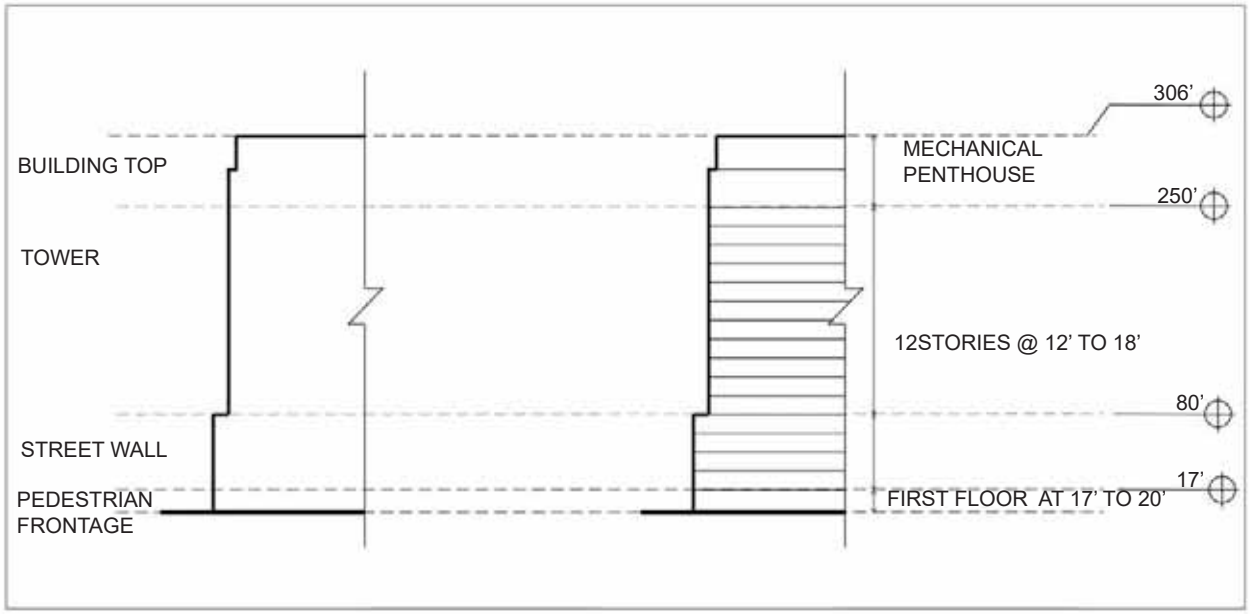
Commercial Building C
Approximate GFA: 412,000 SF
Maximum Height: 250 FT
Use: Commercial Lab/Office

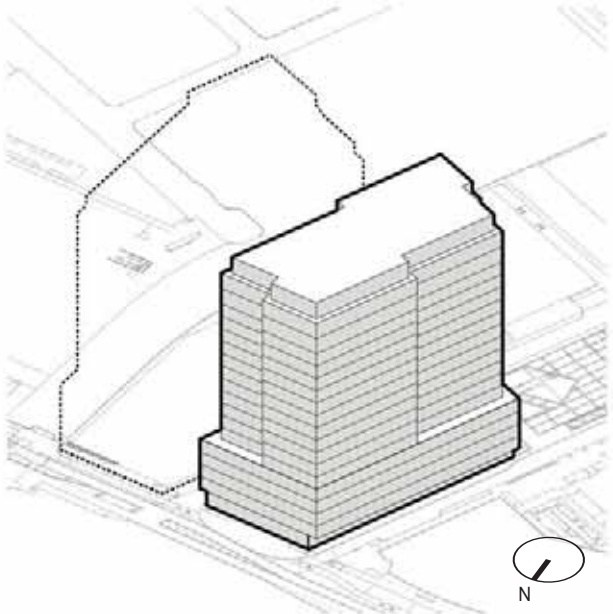
Commercial Building C is situated at the north end of the Blue Garage Parcel, located between the East and West Service Drives, Binney Street, and the new Center Plaza public open space.

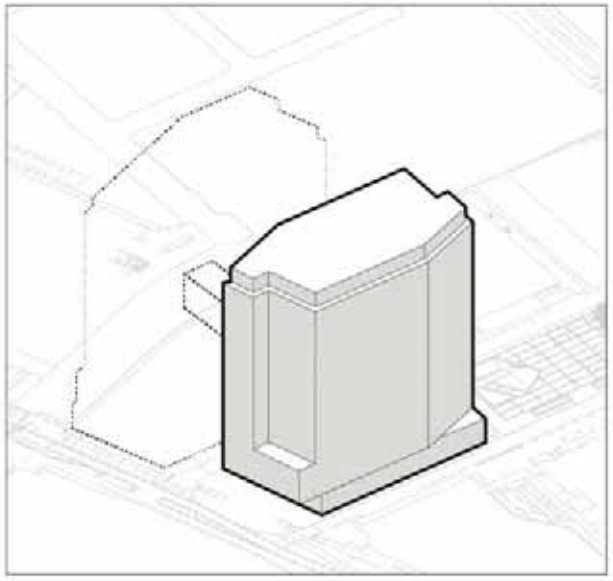
- The Commercial Building C has developed a shared service zone with Commercial Building D in the East Service Drive. The collection of these services along the same portion of the site is meant to open opportunities for other site connectivity and reduce non-active zones on the facades of both buildings along public corridors.
- The West Service Drive will serve as the primary public connection from the Central Plaza open space to Binney Street. The massing has been undercut at the podium along the service drive to increase pedestrian connectivity through the site.
- The building entrance and landscape design along Binney Street will be important elements that activate the ground plane to create a sense of place. These elements will contribute to the character of the street and along with Commercial Building D, will redefine the pedestrian experience of Binney Street.
- The ground floor program along the Central Plaza open space will contribute to the new pedestrian experience and anchor the north end of the open space.
- The massing and articulation of the north and south facades have the important role of defining the character of Binney Street and the Central Plaza open space.



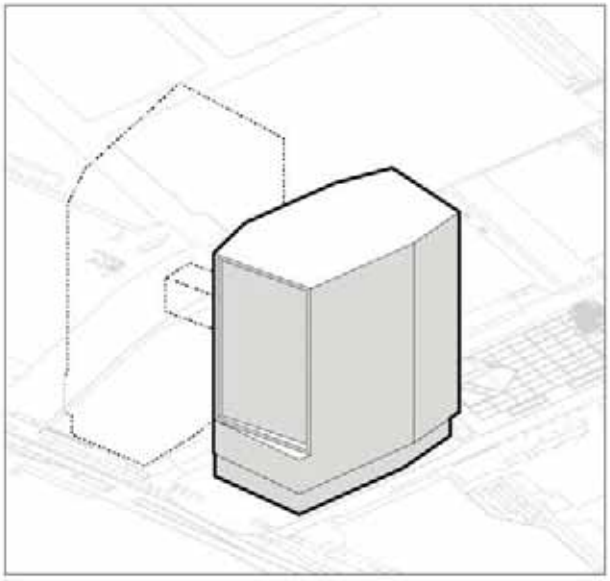




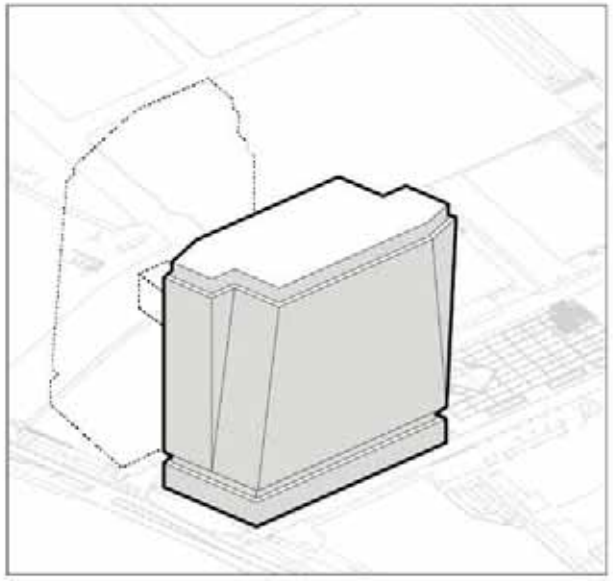




Variation 1



Variation 2

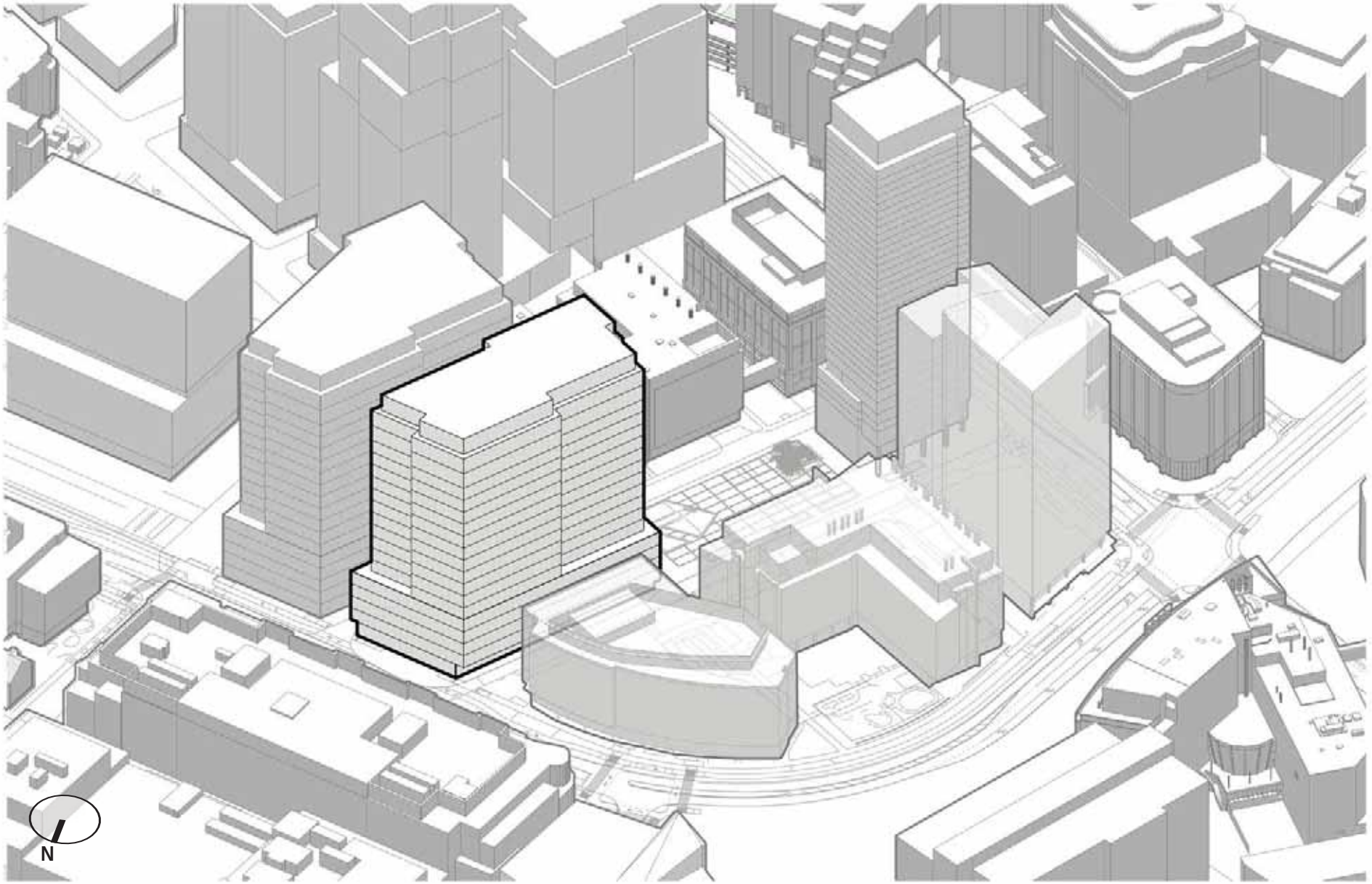


Variation 3

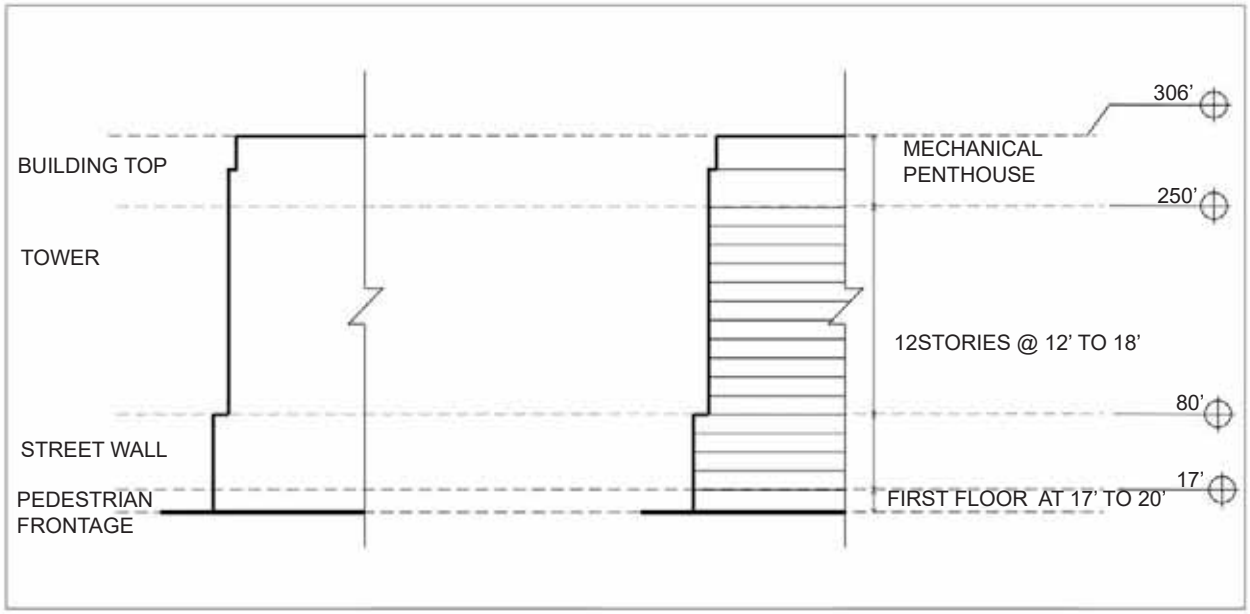
NORTH WEST AXON

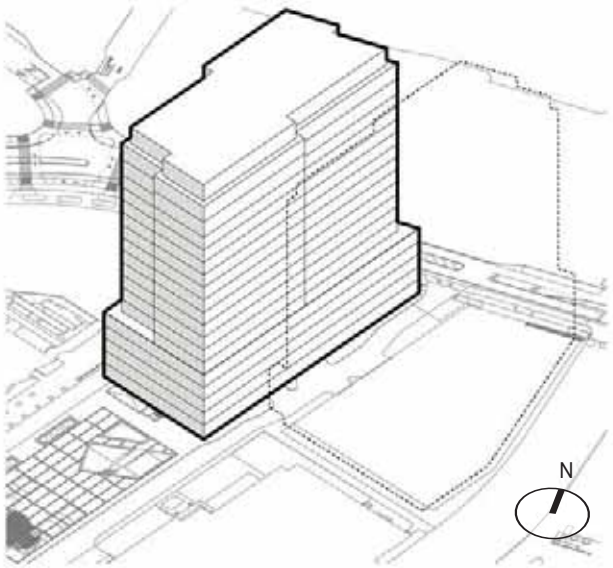
IV. BUILT FORM AND MASSING

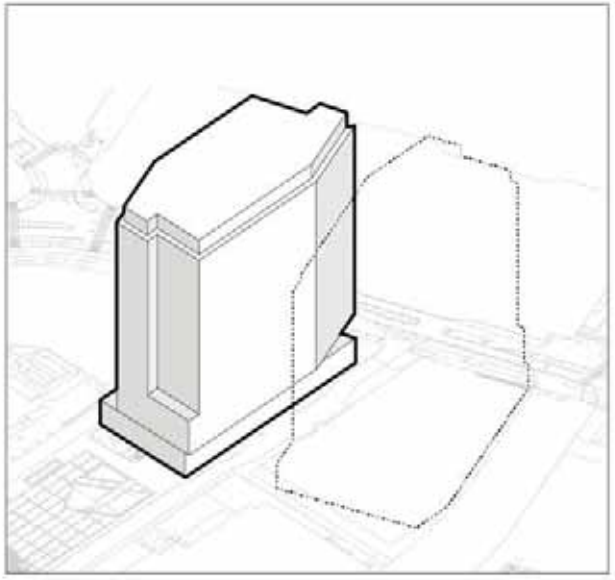
COMMERCIAL BUILDING C



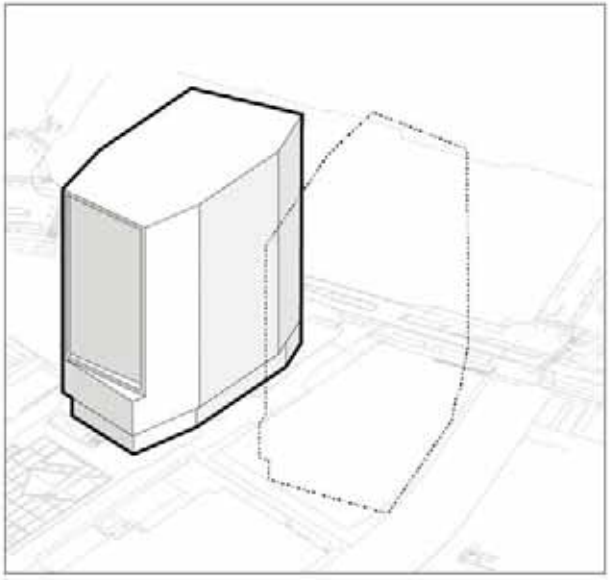
NORTH WEST AXON



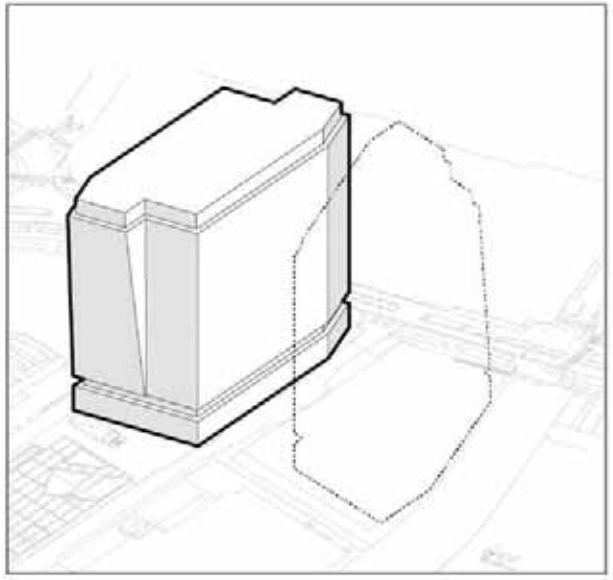




Variation 1



Variation 2



Variation 3

SOUTH EAST AXON

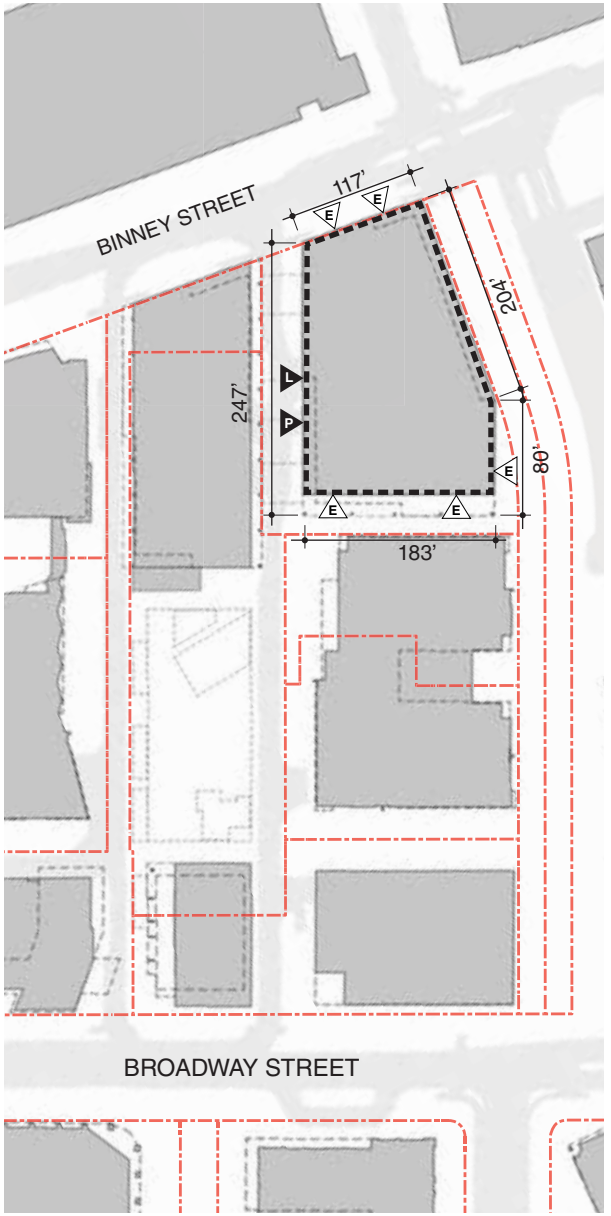
IV. BUILT FORM AND MASSING

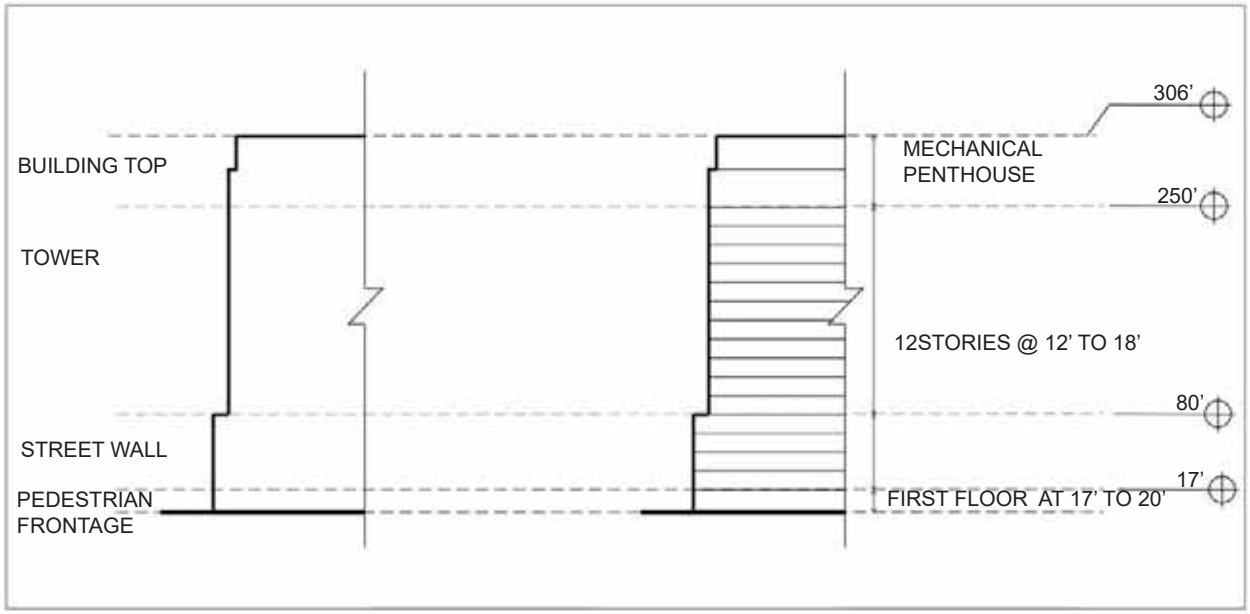
COMMERCIAL BUILDING D

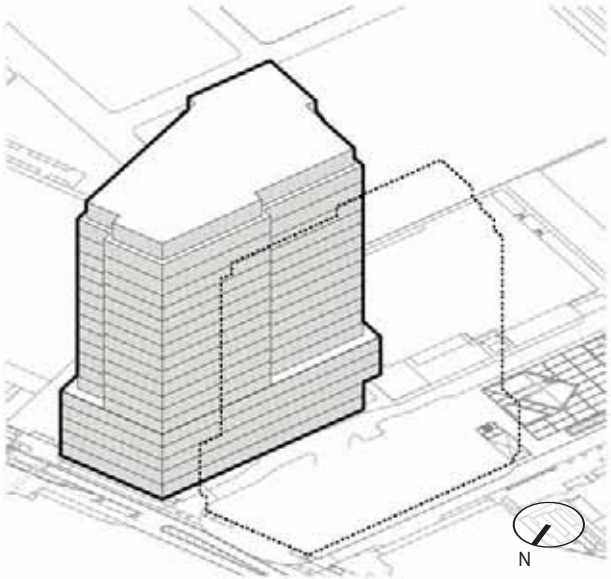
Commercial Building D
Approximate GFA: 450,000 SF
Maximum Height: 250 FT
Use: Commercial Lab/Office

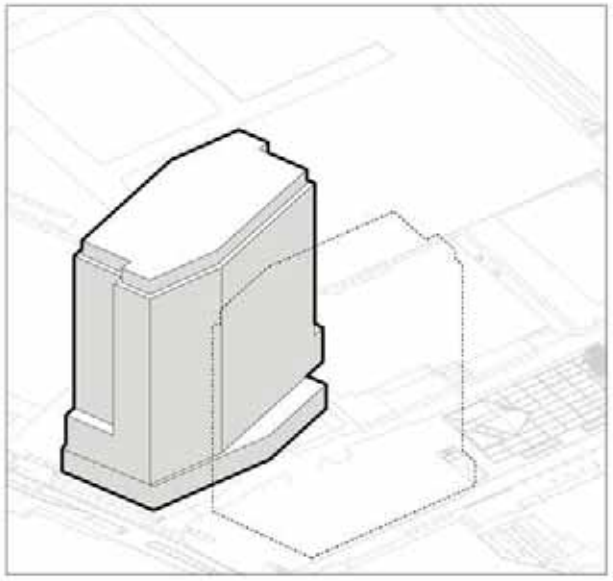
Commercial Building D is situated at the north end of the Blue Garage Parcel, located between the East service Drive, the 6th Street Connector (Loughrey Way), 12 Cambridge Center, and Binney Street.

- The Commercial Building D has developed a shared service zone with Commercial Building C in the East Service Drive. The collection of these services along the same portion of the site is meant to open opportunities for other site connectivity and reduce non-active zones on the facades of both buildings along public corridors.
- The building will have an important relationship with the 6th Street Connector and should contribute to the rejuvenated life of the connector.
- The southern portion of the massing has been undercut at the podium to increase the site connectivity between the new Central Plaza open space, the 6th Street Connector, and Volpe beyond. The ground floor program along this connection will aid in the activation of the space.
- The building entrance and landscape design along Binney Street will be important elements that activate the ground plane to create a sense of place. These elements will contribute to the character of the street and along with Commercial Building C, will redefine the pedestrian experience of Binney Street.
- The massing and articulation of the north and south facades have the important role of defining the character of Binney Street and the access route between the 6th street connector and Central Plaza public open space.

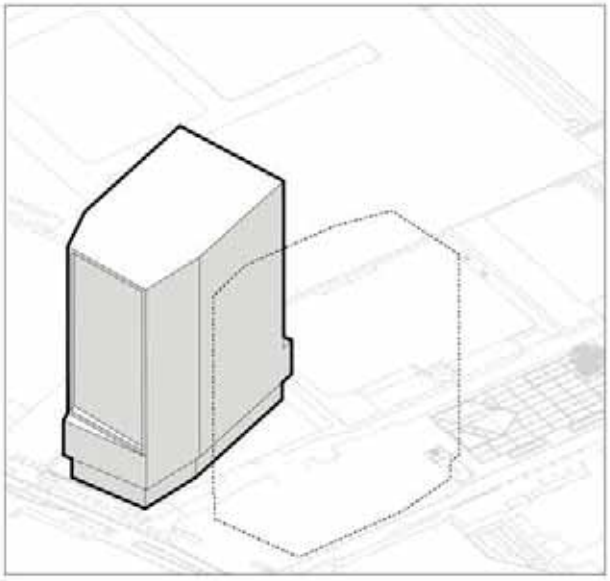




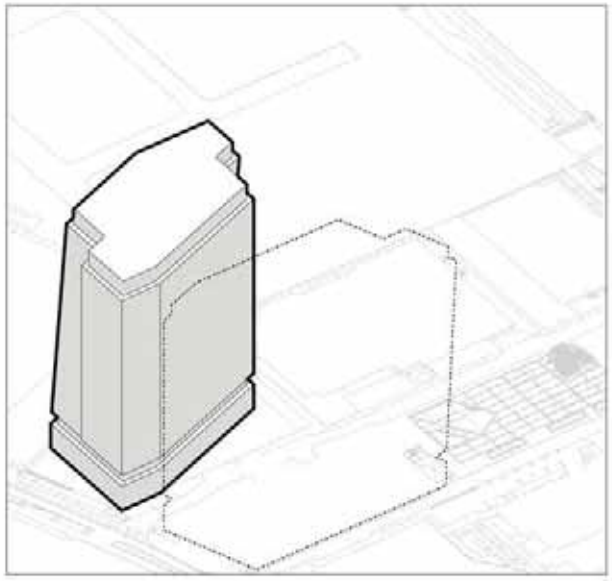




Variation 1



Variation 2

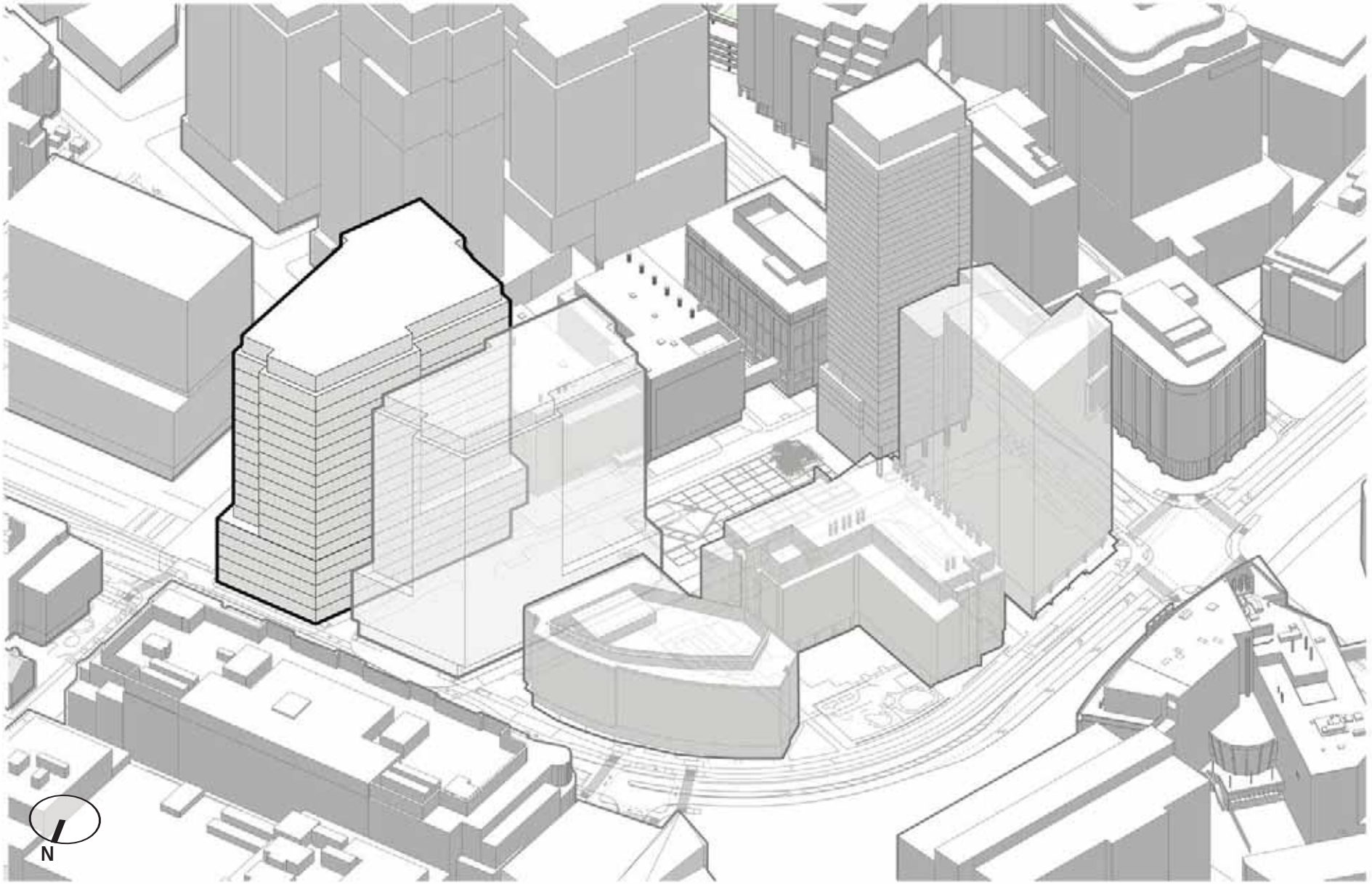


Variation 3

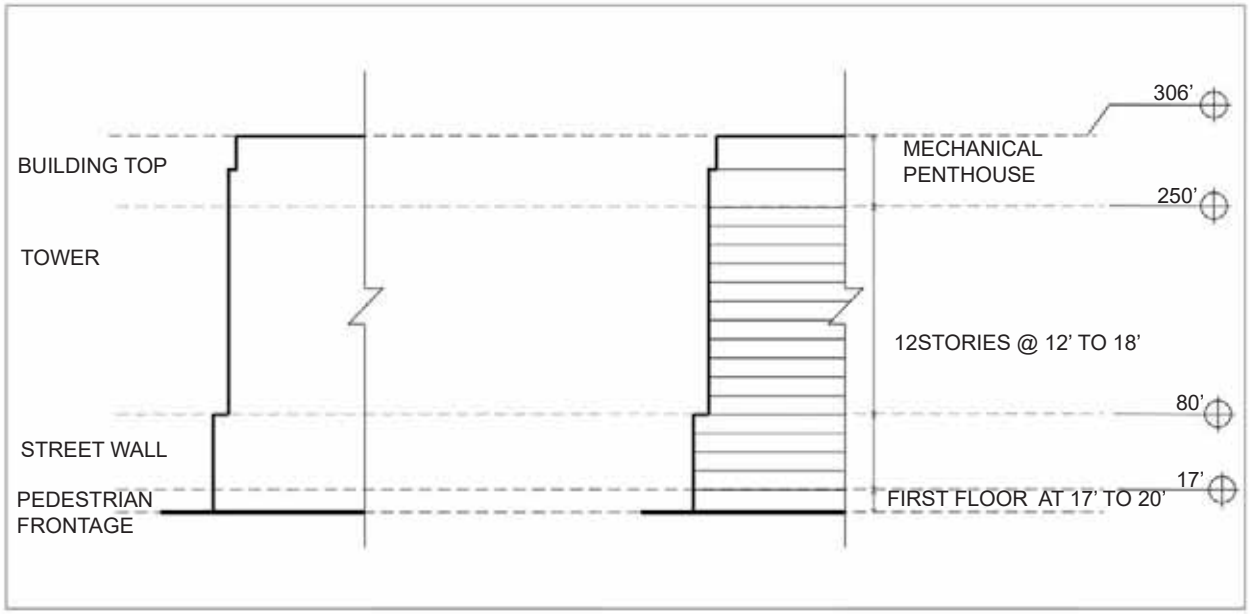
NORTH WEST AXON

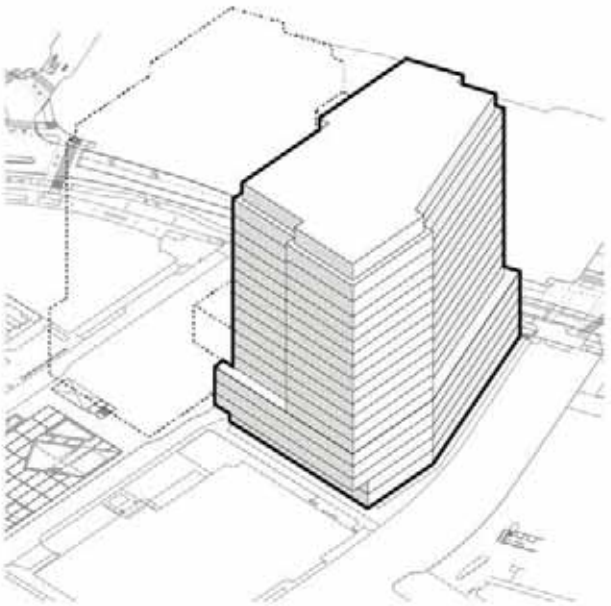
IV. BUILT FORM AND MASSING

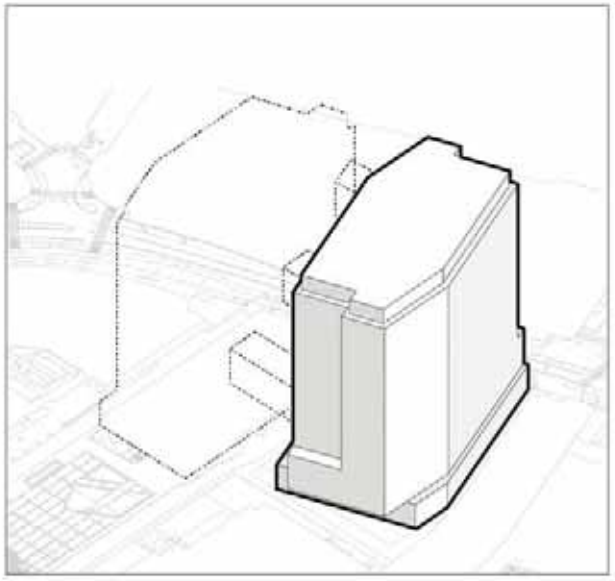
COMMERCIAL BUILDING D



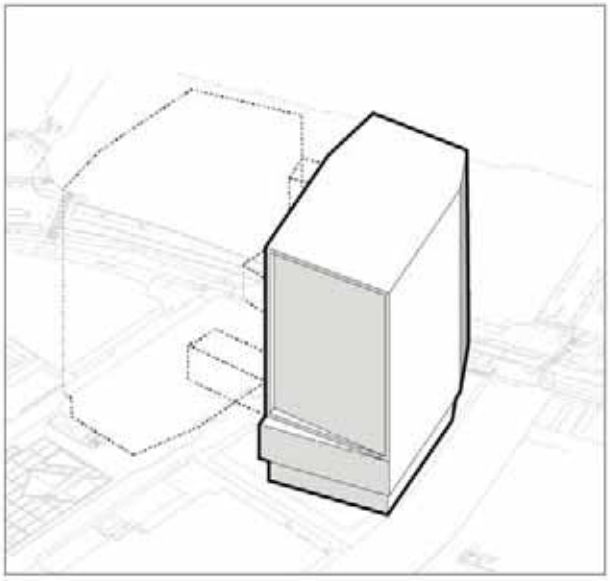
NORTH WEST AXON



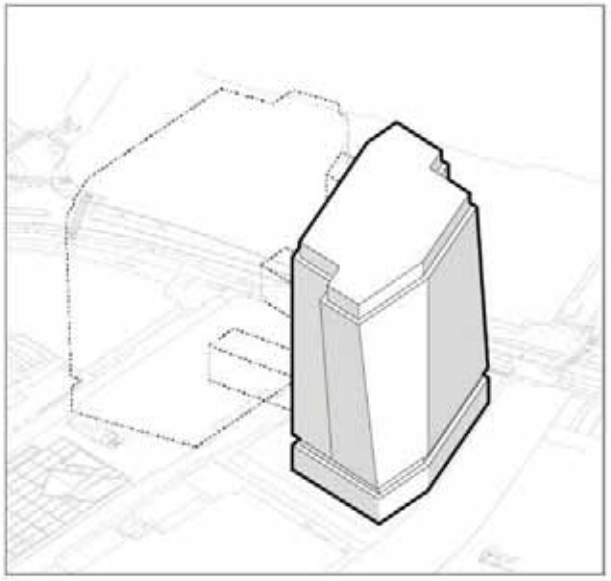




Variation 1



Variation 2



Variation 3

SOUTH EAST AXON

V. BUILDING MATERIAL AND FACADE GUIDELINES

The following section sets forth the design goals and objectives for the building and facade materials that will be used throughout the broader MXD and within the individual building sites. Specific manufacturer reference should be considered solely as precedent examples to help illustrate a guideline. The following material guidelines apply open spaces and parks that are part of the MXD concept plan is included as part of Chapter 3 of this submission. The following guidelines shall apply broadly to all commercial and residential facades as specified and subject to modification in the design review process:

COMMERCIAL BUILDING MATERIALS AND FACADE

1. Provide high transparency at the ground floor level to emphasize the activity within the building, extending the public realm and enlivening the streetscape.
2. Provide openness and permeability at the ground level and other retail/ active use levels (if applicable) by providing sliding walls and raising doors at all possible locations.
3. Maximize transparency of glass at upper levels while considering solar heat gain, energy performance, and interior daylighting.
4. Use variation in glazing types, frame depths and scale of horizontal and vertical expressions to heighten visual interest.
5. Consider using reveals, recesses, and cantilevers to break down the proportions of large facades.
6. Introduce solid wall cladding, where appropriate, to embed the scale of occupants and interior spaces on the elevations in addition to allowing for complementary materials to the urban context.
7. Solid wall cladding should incorporate a mix of color and texture, depth, create shadows and incorporate middle scaling elements.

STREET LEVEL CONDITIONS

Curtain Wall Panels - Variation in glazing types, frame depths and scales of horizontal and vertical expressions heightens visual interest.

Glazed Volumes - Reveals and recesses in the facade breakdown the proportions of large facades. Plane changes on the facade allow opportunities for exterior spaces and introduce a smaller scale of inhabitation on the facade

Opaque Wall Areas

V. BUILDING MATERIAL AND FACADE GUIDELINES

RESIDENTIAL BUILDING MATERIALS AND FACADE

1. Provide highly transparency glass at the ground floor to highlight the residential lobby and animate the streetscape.
2. Design well-lit and welcoming lobbies at the ground floor designed to be the entrance to someone's new home but also enliven the streetscape.
3. Employ material changes and various breaks in the building to reduce the scale of the building form the street.
4. Employ balconies to create outdoor space for urban living, to humanize the building architecturally, and to add visual interest and relief in large facades.
5. Employ punched window openings in the facade as a sustainable design approach that seeks to increase energy efficiency to meet the energy code and LEED requirements while using a combination of window glass and opaque materials to create interesting visual patterns.
6. Horizontal spandrels and other pattern facades can be used to accentuate thinner proportions within the building. These strategies work in combination to break down the scale of the mass.

(Intentionally Blank)

SASAKI