CAMBRIDGESIDE

AUGUST 2020

CambridgeSide 2.0 Special Permit Application

Volume II: Appendices

Submitted to:
City of Cambridge

Submitted by:
NEW ENGLAND DEVELOPMENT

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ELKUS | MANFREDI ARCHITECTS

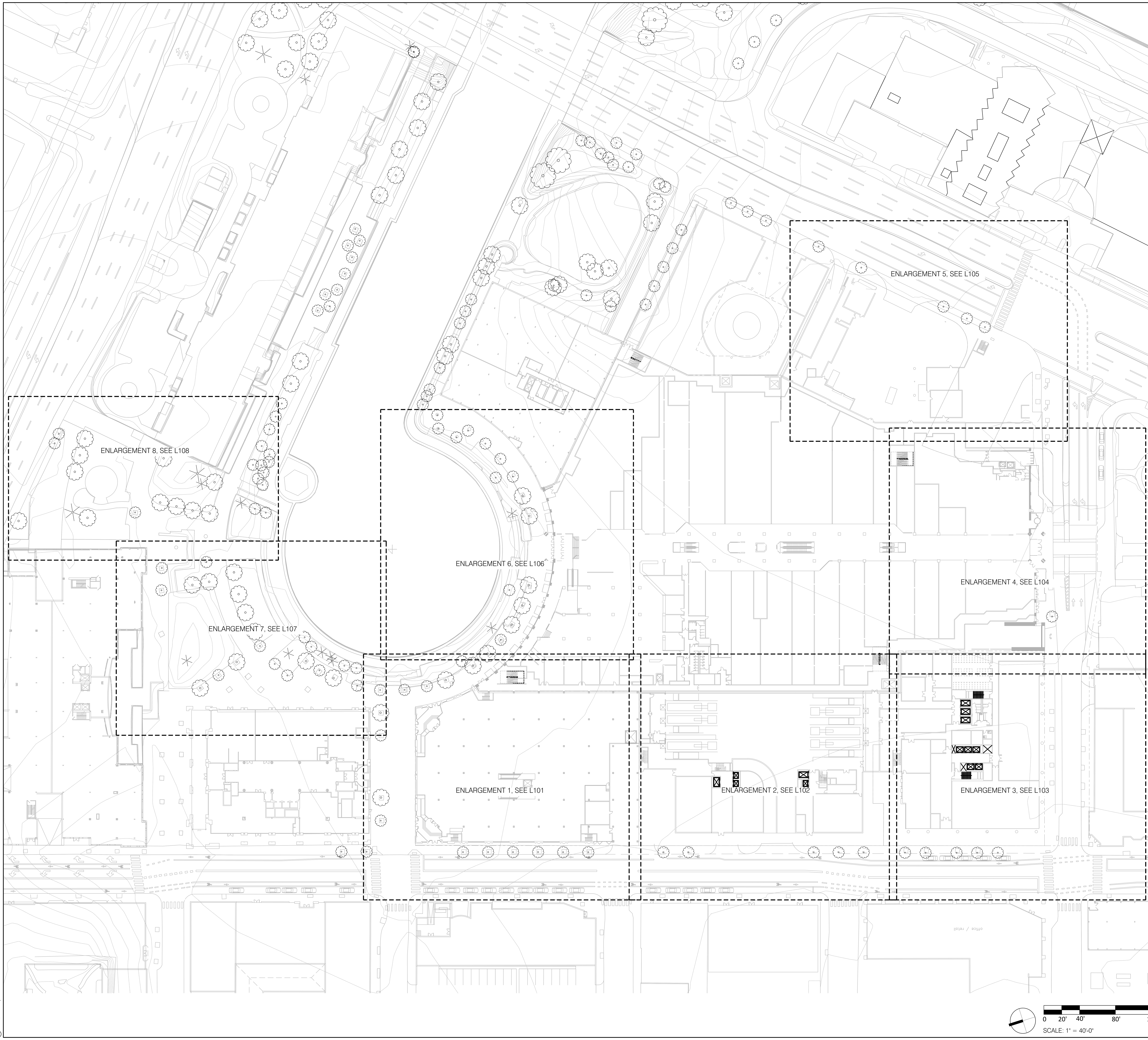
Volume II: Appendices
Table of Contents

List of Appendices

Appendix A

Tree Study

UNIT CALCULATIONS	
EXISTING TREES	
Total DBH Diameter of On-Site Trees Removed	0
Total DBH Diameter of Significant Trees Removed (Includes Trees > 8" Dia.)	0



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PROJECT NUMBER: 18037

DATE: 2020-03-26

REVISIONS:

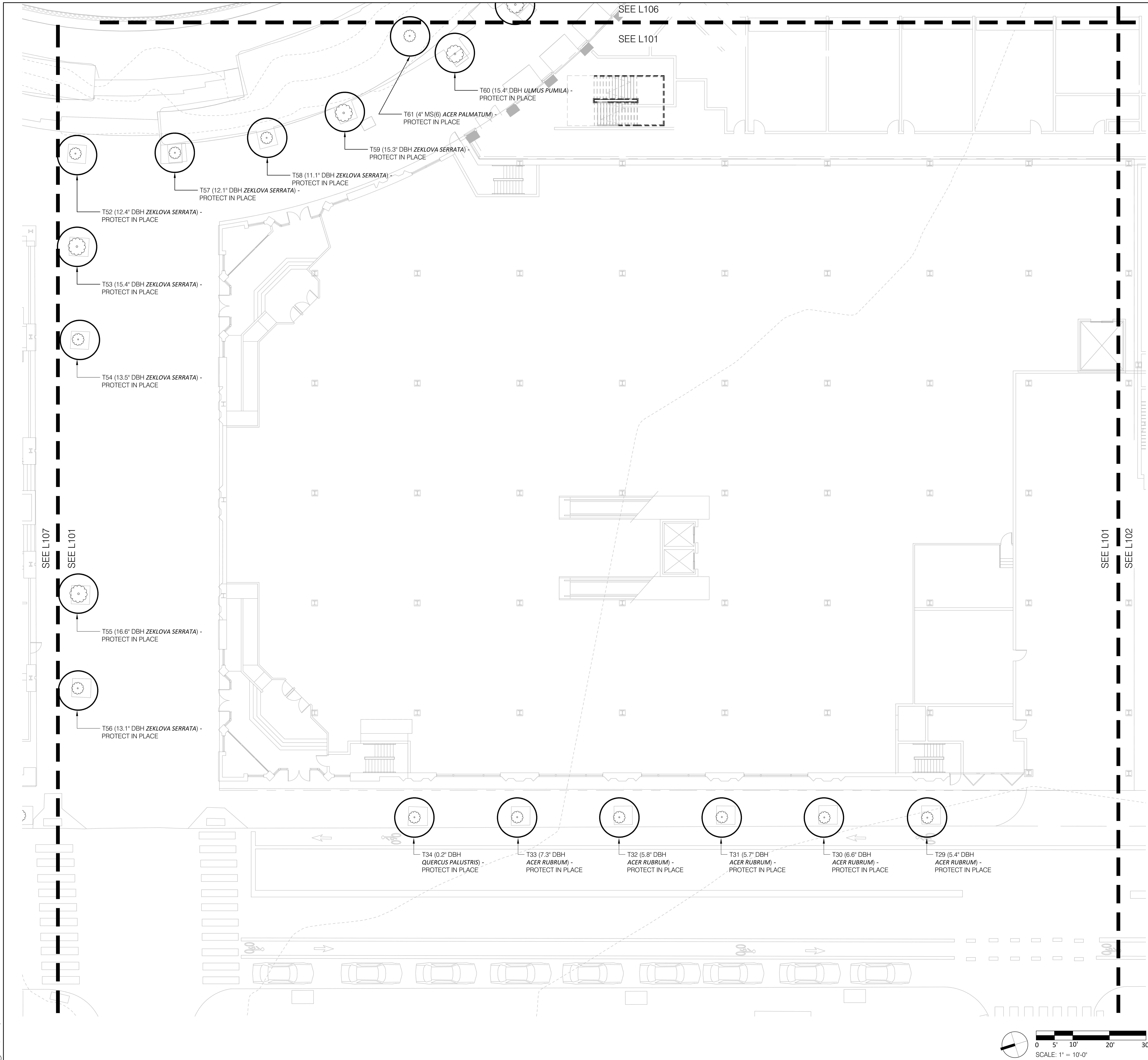
SCALE:

DRAWING NAME:

TREE PROTECTION & REMOVAL ENLARGEMENT KEY PLAN

DRAWING NUMBER:

L100



UNIT CALCULATIONS

EXISTING TREES

ID	SPECIES	CONDITION	DBH DIAMETER
T29	Acer rubrum	Good	5.4"
T30	Acer rubrum	Fair	6.6"
T31	Acer rubrum	Fair	5.7"
T32	Acer rubrum	Fair	5.8"
T33	Acer rubrum	Fair	7.3"
T34	Quercus palustris	Good	0.2"
T52	Zelkova serrata	Poor	*12.4"
T53	Zeklova serrata	Fair	*15.4"
T54	Zeklova serrata	Fair	*13.5"
T55	Zeklova serrata	Poor	*16.6"
T56	Zeklova serrata	Poor	*13.1"
T57	Zelkova serrata	Fair	*12.1"
T58	Zelkova serrata	Fair	*11.1"
T59	Zelkova serrata	Fair	*15.3"
T60	Ulmus pumila	Fair	*15.4"
T61	Acer palmatum	Good	4" (6)

* Significant Tree per City of Cambridge Section 8.66.030

Total DBH Diameter of On-Site Trees Removed	0
Total DBH Diameter of Significant Trees Removed (Includes Trees > 8" Dia.)	0

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PROJECT NUMBER: 18037

DATE: 2020-03-26

REVISIONS:

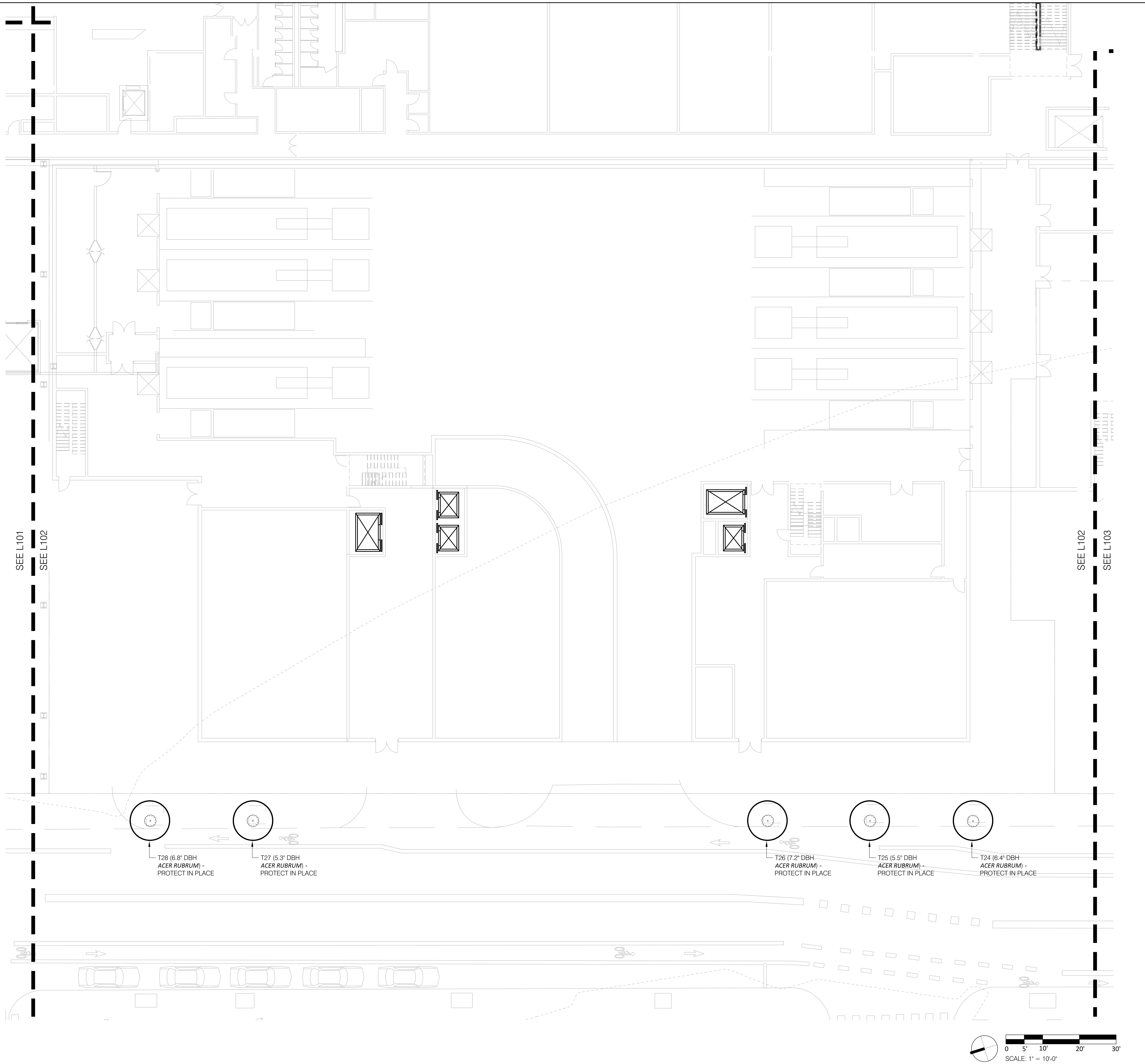
SCALE:

DRAWING NAME:

TREE PROTECTION & REMOVAL PLAN

DRAWING NUMBER:

L101



UNIT CALCULATIONS

EXISTING TREES

ID	SPECIES	CONDITION	DBH DIAMETER
T24	Acer rubrum	Fair	6.4"
T25	Acer rubrum	Fair	5.5"
T26	Acer rubrum	Good	7.2"
T27	Acer rubrum	Fair	5.3"
T28	Acer rubrum	Fair	6.8"
* Significant Tree per City of Cambridge Section 8.66.030			
Total DBH Diameter of On-Site Trees Removed			0
Total DBH Diameter of Significant Trees Removed (Includes Trees > 8" Dia.)			0

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DATE: 2020-03-26

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SCALE:

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TREE PROTECTION & REMOVAL PLAN

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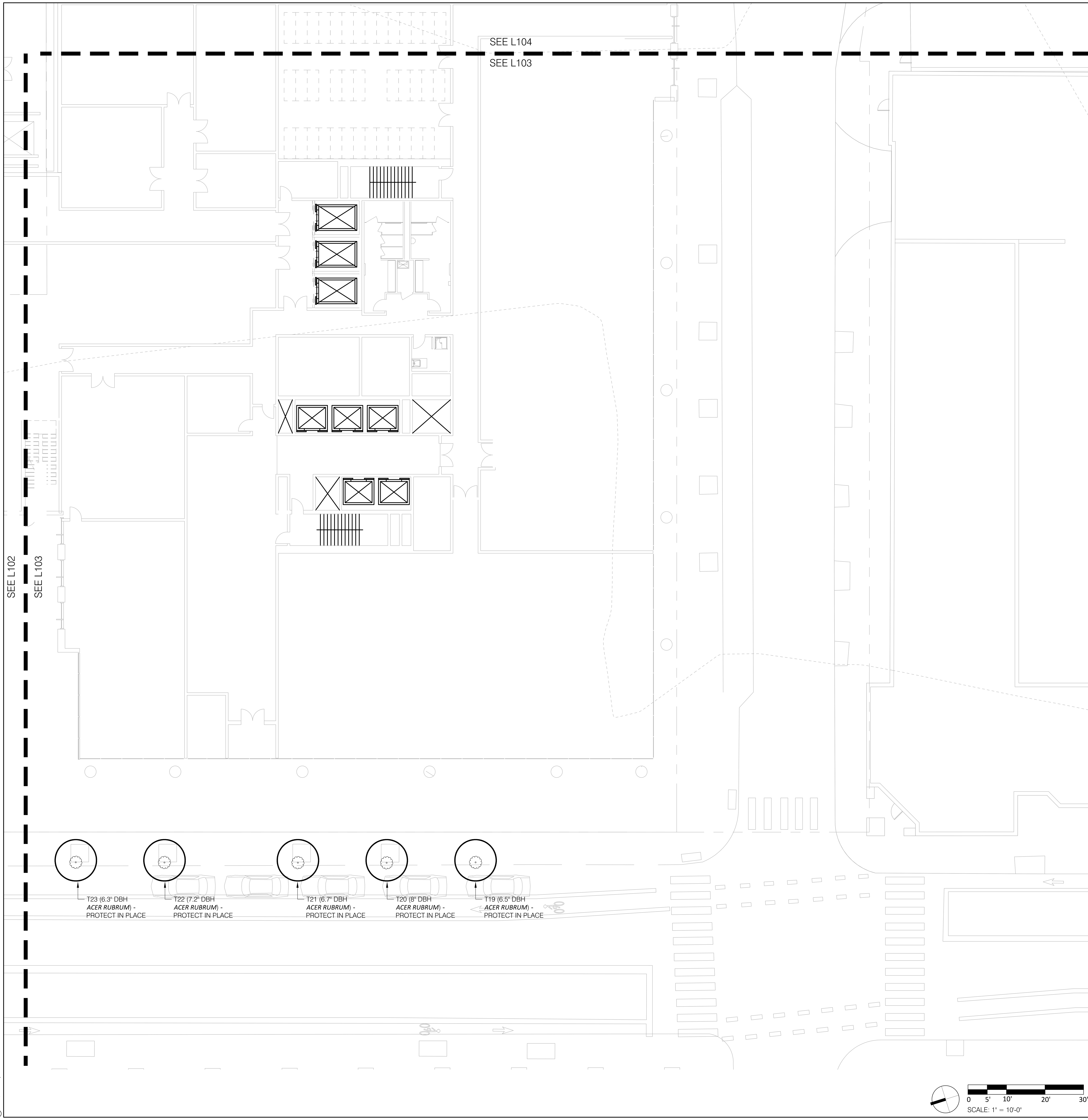
L102



UNIT CALCULATIONS

EXISTING TREES

ID	SPECIES	CONDITION	DBH DIAMETER
T19	Acer rubrum	Fair	6.5"
T20	Acer rubrum	Fair	*8"
T21	Acer rubrum	Fair	6.7"
T22	Acer rubrum	Fair	7.2"
T23	Acer rubrum	Fair	6.3"
* Significant Tree per City of Cambridge Section 8.66.030			
Total DBH Diameter of On-Site Trees Removed			0
Total DBH Diameter of Significant Trees Removed (Includes Trees > 8" Dia.)			0

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PROJECT NUMBER: 18037

DATE: 2020-03-26

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SCALE:

DRAWING NAME:

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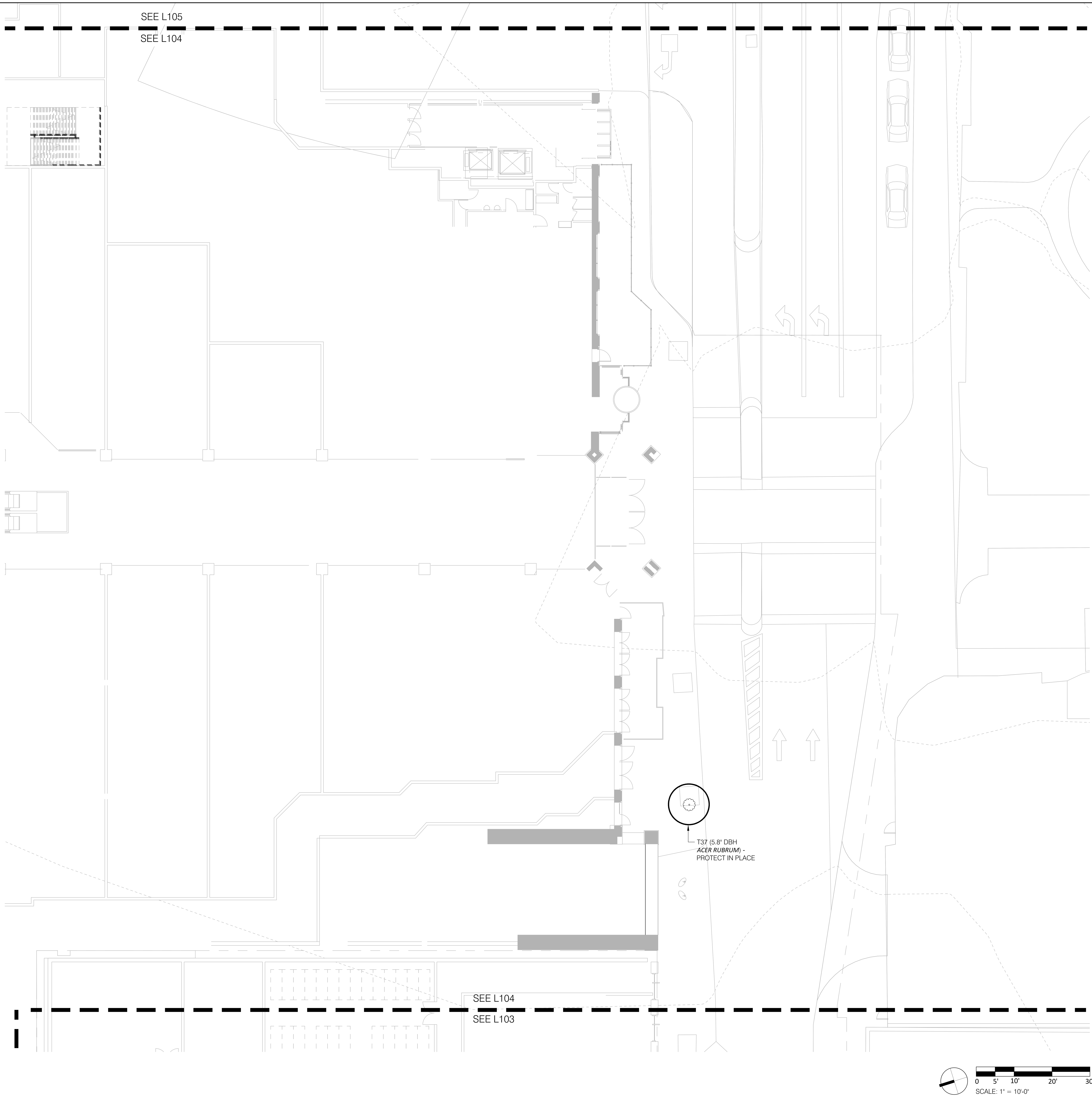
DRAWING NUMBER:

L103



UNIT CALCULATIONS

EXISTING TREES

ID	SPECIES	CONDITION	DBH DIAMETER
T37	Acer rubrum	Fair	5.8"
* Significant Tree per City of Cambridge Section 8.66.030			
Total DBH Diameter of On-Site Trees Removed			0
Total DBH Diameter of Significant Trees Removed (Includes Trees > 8" Dia.)			0

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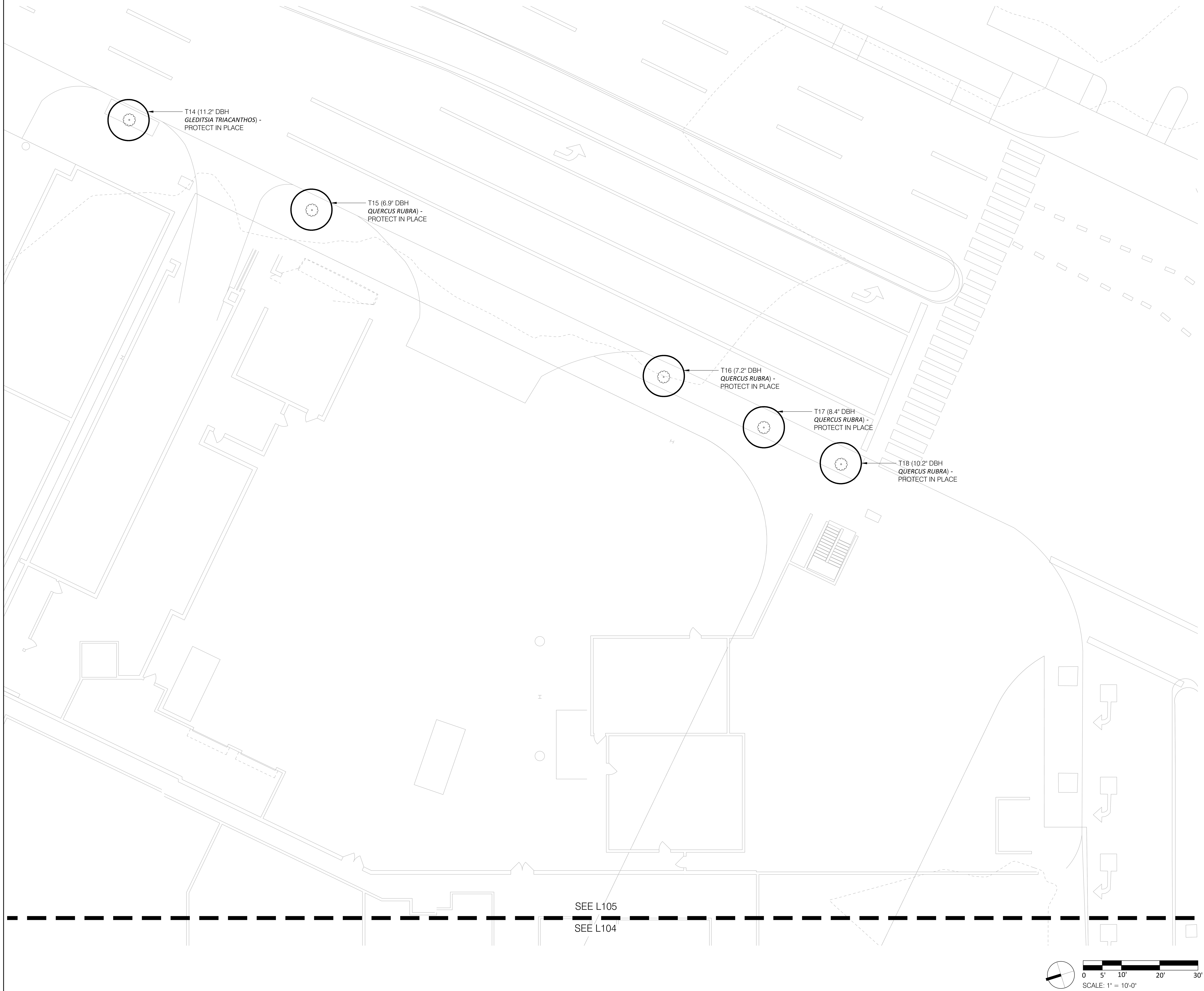
L104



UNIT CALCULATIONS

EXISTING TREES

ID	SPECIES	CONDITION	DBH DIAMETER
T14	Gleditsia triacanthos	Fair	*11.2"
T15	Quercus rubra	Poor	6.9"
T16	Quercus rubra	Fair	7.2"
T17	Quercus rubra	Poor	*8.4"
T18	Quercus rubra	Fair	*10.2"

* Significant Tree per City of Cambridge Section 8.66.030

Total DBH Diameter of On-Site Trees Removed	0
Total DBH Diameter of Significant Trees Removed (Includes Trees > 8" Dia.)	0

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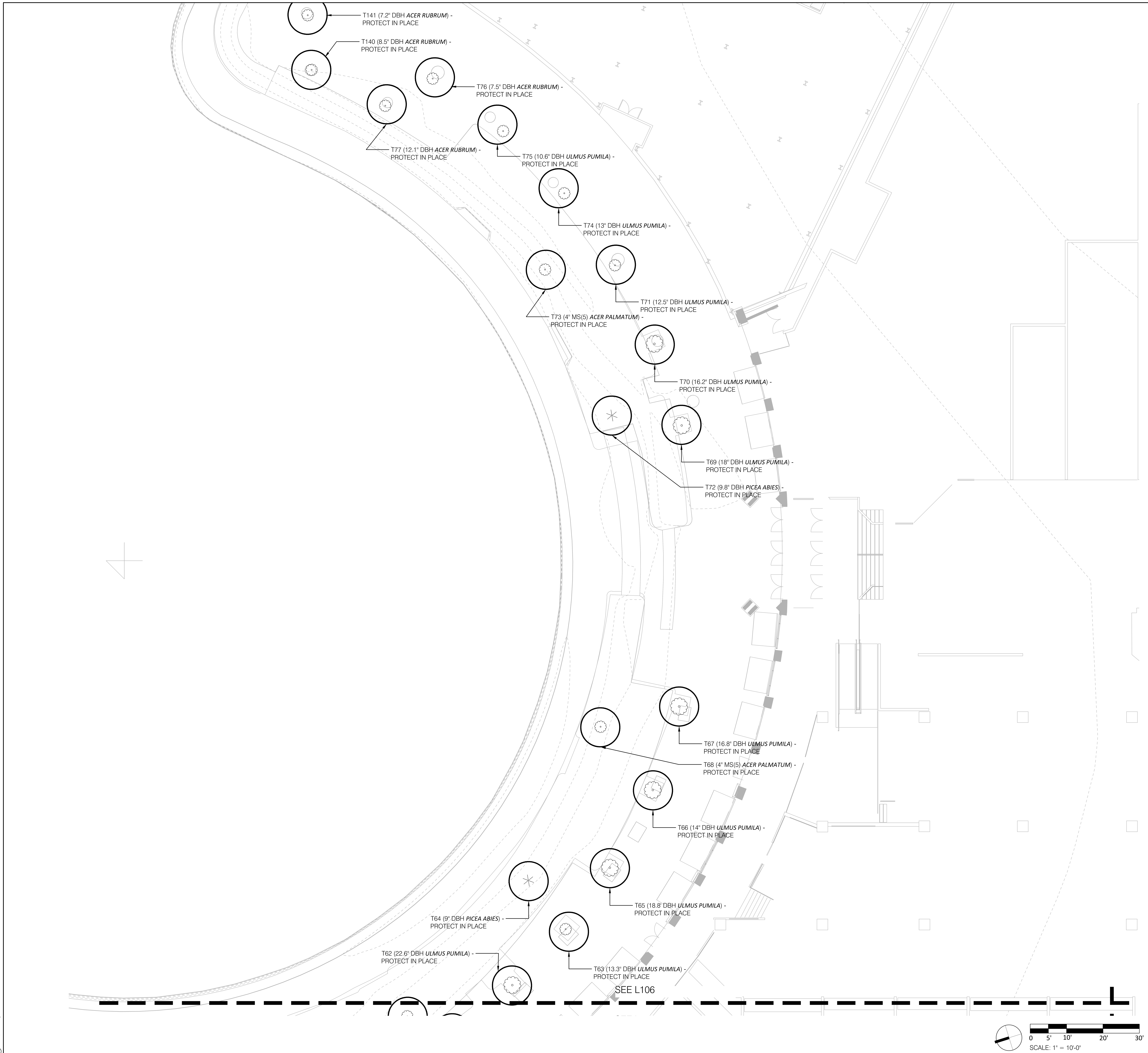
L105



UNIT CALCULATIONS

EXISTING TREES

ID	SPECIES	CONDITION	DBH DIAMETER
T62	Ulmus pumila	Fair	*22.6"
T63	Ulmus pumila	Fair	*13.3"
T64	Picea abies	Fair	*9"
T65	Ulmus pumila	Fair	*18.8"
T66	Ulmus pumila	Fair	*14"
T67	Ulmus pumila	Fair	*16.8"
T68	Acer palmatum	Fair	4" (5)
T69	Ulmus pumila	Good	*18"
T70	Ulmus pumila	Fair	*16.2"
T71	Ulmus pumila	Fair	*12.5"
T72	Picea abies	Poor	*9.8"
T73	Acer palmatum	Good	4" (5)
T74	Ulmus pumila	Fair	*13"
T75	Ulmus pumila	Poor	*10.6"
T76	Acer rubrum	Fair	7.5"
T77	Acer rubrum	Good	*12.1"
T140	Acer rubrum	Good	*8.5"
T141	Acer rubrum	Poor	7.2"

* Significant Tree per City of Cambridge Section 8.66.030

Total DBH Diameter of On-Site Trees Removed	0
Total DBH Diameter of Significant Trees Removed (Includes Trees > 8" Dia.)	0

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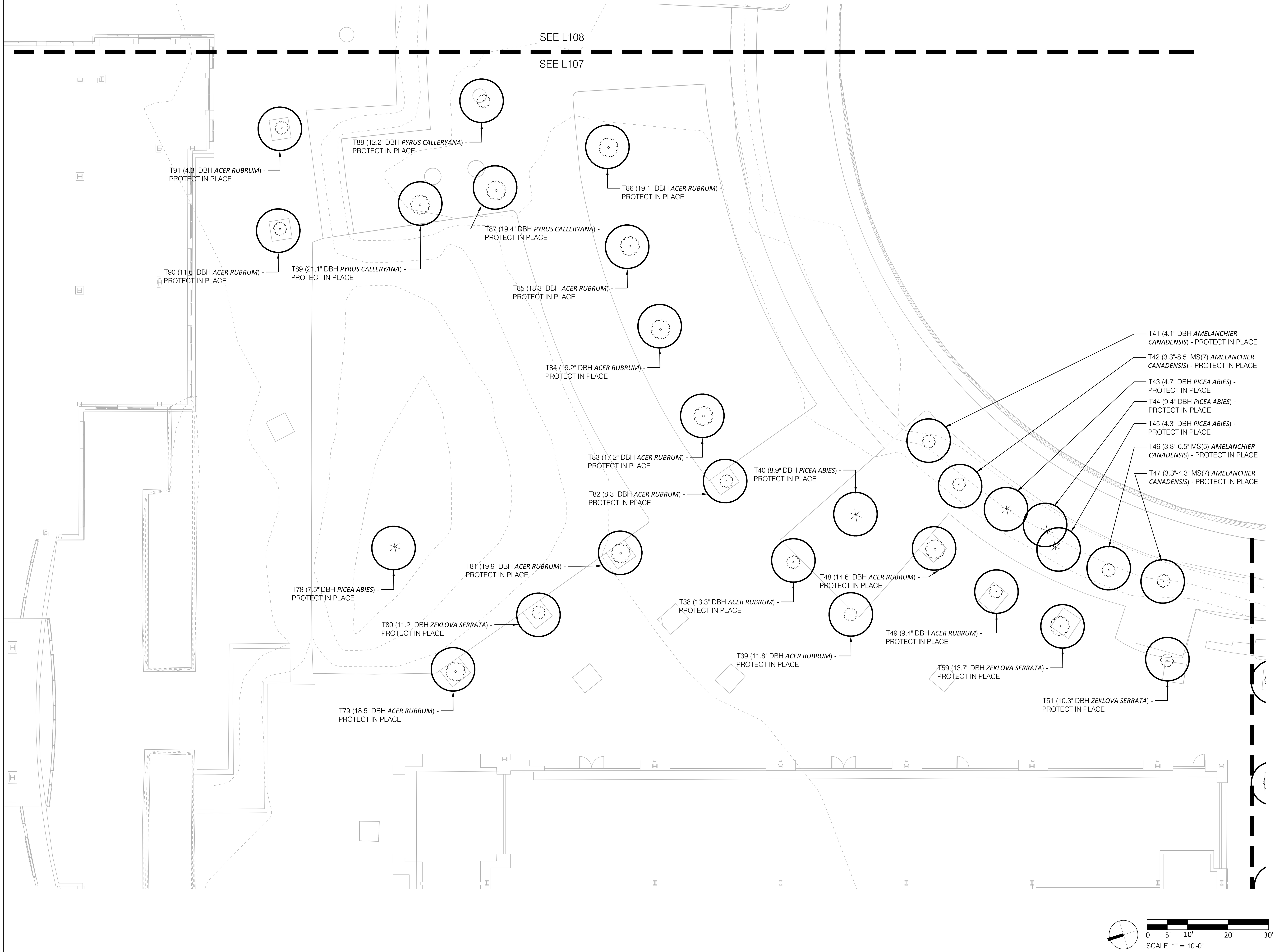
L106



UNIT CALCULATIONS

EXISTING TREES

ID	SPECIES	CONDITION	DBH DIAMETER
T38	Acer rubrum	Poor	*13.3"
T39	Acer rubrum	Fair	*11.8"
T40	Picea abies	Fair	*8.9"
T41	Amelanchier canadensis	Fair	4.1"
T42	Amelanchier canadensis	Good	3.3"-8.5" (7)
T43	Picea abies	Fair	4.7"
T44	Picea abies	Fair	*9.4"
T45	Picea abies	Fair	4.3"
T46	Amelanchier canadensis	Good	3.8"-6.5" (5)
T47	Amelanchier canadensis	Fair	3.3"-4.3" (7)
T48	Acer rubrum	Good	*14.6"
T49	Acer rubrum	Fair	*9.4"
T50	Zelkova serrata	Fair	*13.7"
T51	Zelkova serrata	Fair	*10.3"
T78	Picea abies	Fair	7.5"
T79	Acer rubrum	Fair	*18.5"
T80	Acer rubrum	Poor	*11.2"
T81	Acer rubrum	Poor	*19.9"
T82	Acer rubrum	Poor	*8.3"
T83	Acer rubrum	Fair	*17.2"
T84	Acer rubrum	Good	*19.2"
T85	Acer rubrum	Good	*18.3"
T86	Acer rubrum	Good	*19.1"
T87	Pyrus calleryana	Fair	*19.4"
T88	Pyrus calleryana	Fair	*12.2"
T89	Pyrus calleryana	Poor	*21.1"
T90	Acer rubrum	Fair	*11.6"
T91	Acer rubrum	Poor	4.3"

* Significant Tree per City of Cambridge Section 8.66.030

Total DBH Diameter of On-Site Trees Removed	0
Total DBH Diameter of Significant Trees Removed (Includes Trees > 8" Dia.)	0

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DATE: 2020-03-26

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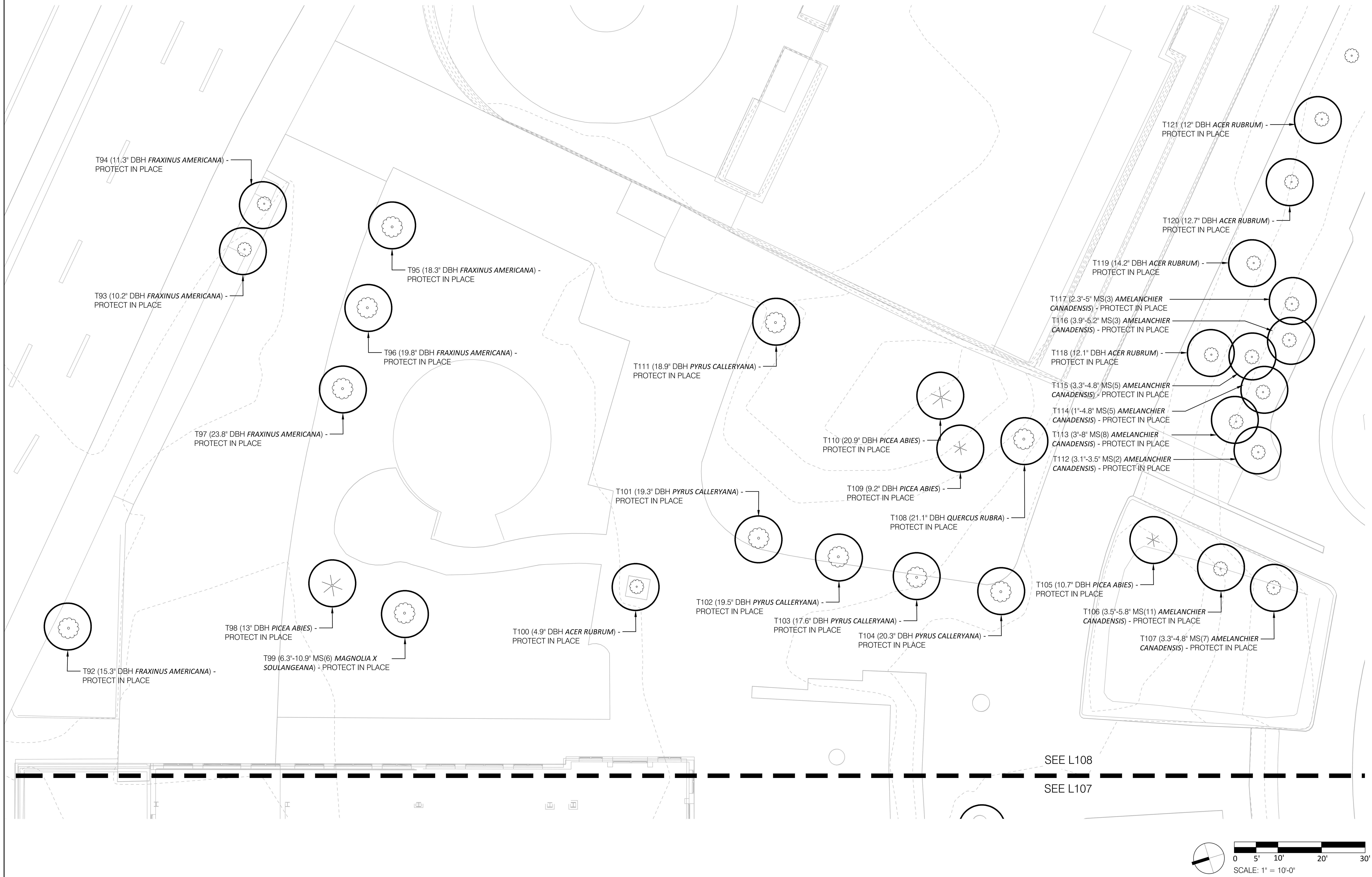
L107



UNIT CALCULATIONS

EXISTING TREES

ID	SPECIES	CONDITION	DBH DIAMETER
T92	Fraxinus americana	Fair	*15.3"
T93	Fraxinus americana	Fair	*10.2"
T94	Fraxinus americana	Fair	*11.3"
T95	Fraxinus americana	Good	*18.3"
T96	Fraxinus americana	Good	*19.8"
T97	Fraxinus americana	Fair	*23.8"
T98	Picea abies	Good	*13"
T99	Magnolia x soulangeana	Good	6.3"-10.9" (6)
T100	Acer rubrum	Poor	4.9"
T101	Pyrus calleryana	Fair	*19.3"
T102	Pyrus calleryana	Fair	*19.5"
T103	Pyrus calleryana	Fair	*17.6"
T104	Pyrus calleryana	Fair	*20.3"
T105	Picea abies	Fair	*10.7"
T106	Amelanchier canadensis	Fair	3.5"-5.8" (11)
T107	Amelanchier canadensis	Fair	3.2"-4.8" (7)
T108	Quercus rubra	Good	*21.1"
T109	Picea abies	Fair	*9.2"
T110	Picea abies	Good	*20.9"
T111	Pyrus calleryana	Fair	*18.9"
T112	Amelanchier canadensis	Fair	3.1"-3.5" (2)
T113	Amelanchier canadensis	Fair	3"-8" (8)
T114	Amelanchier canadensis	Poor	1"-4.8" (5)
T115	Amelanchier canadensis	Fair	3.3"-4.8" (5)
T116	Amelanchier canadensis	Fair	3.9"-5.2" (3)
T117	Amelanchier canadensis	Fair	2.3"-5" (3)
T118	Acer rubrum	Fair	*12.1"
T119	Acer rubrum	Fair	*14.2"
T120	Acer rubrum	Fair	*12.7"
T121	Acer rubrum	Fair	*12"
* Significant Tree per City of Cambridge Section 8.66.030			
Total DBH Diameter of On-Site Trees Removed			0
Total DBH Diameter of Significant Trees Removed (Includes Trees > 8" Dia.)			0

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SCALE:

DRAWING NAME:

TREE PROTECTION AND REMOVAL PLAN

DRAWING NUMBER:

L108

Appendix B

Article 22 Green Building Report

REVISED Cambridge Article 22: Green Building Package

Project: CambridgeSide 2.0

Issued: July 14, 2020

Enclosed please find updated documentation for the CambridgeSide 2.0 project.

We have enclosed the following Sections:

Section A (page 2):	A point-by-point response matrix to all comments within the City's The "Cambridgeside Green Building SP Submission_Comments_07-02-2020" document.
Section B (page 4):	A completed Cambridge *Green Building Project Checklist*
Section C (page 8):	An executed Cambridge *Green Building Professional Affidavit*
Section D (page 10):	An updated Article 22 Green Building Report that includes LEED-NC & CS v4 Rating System checklists and a combined compliance approach narrative
Section E (page 30):	An updated Net Zero narrative
Section F (page 44):	An updated Solar Photovoltaic Feasibility Assessment

Summary of CDD Comments/Responses for Preliminary Green Building Requirements for Special Permit
Project: CambridgeSide 2.0

Date: July 14, 2020

The following is a point-by-point response matrix to comments addressed from within the City's "Cambridgeside Green Building SP Submission_Comments_07-02-2020" document. The City's comments are provided verbatim below, including any bolding or formatting.

#		Response Section	Summary of Response
	SUSTAINABILITY AND RESILIENCY PLAN		
107	Clarify intent to pursue vegetated/green roofs. The GHG analysis states the proponent does not consider green roofs to be financially feasible, but, the ENF suggests considering green roof is still an option.	Pg. 9 of A22 report (SSc5).	The roofs will be PV/Solar ready and the team is continuing to evaluate economics for solar/PV. At a minimum the roof will be a cool roof with a white roof, but green roofs are not planned at this time.
108	Identify locations and layouts of solar-ready roof space for PV system. Clarify intent and commitment to provide the PV space.	Layouts: Section F Solar Photovoltaic Feasibility Study Figure 1 Commitment: Pg. 12 of A22 Report (EAc5)	Section F Solar Photovoltaic Feasibility Study Figure 1 identifies the roof space locations (highlighted in yellow) that have been identified as having potential for solar PV arrays based on available roof area and a shading analysis to confirm solar access.
109	Will electricity provided to residential units be from non-fossil fuel sources?	Pg 18 of A22 Report.	The electricity to be provided to the future residential units will be by Eversource, and will be generated by whatever their mix of fossil-fuel and renewable energy sources are at the time, several years from now, after this building is constructed and operating.
110	How can the project do more to reduce the urban heat island effect?	Pg 9 + 10 of A22 Report (SSc5)	The improvements to Charles and Canal park will also contribute to a reduction in the urban heat island effect by replacing existing hardscape with more vegetation and/or light-colored paving. The increased setback on 1st Street will allow for optimized street tree layout compared to the existing plantings. The core mall and atrium will be open to the public and have extended hours with air conditioning to help mitigate the effects of increased temperatures of the surrounding urban environment. The residential project is open to the idea of Passive House which creates an extremely stable indoor thermal environment for residents. This would allow for residents to "shelter in place" comfortably during extreme heat waves.
111	Identify potential areas of roof space that would accommodate a modular or propriety vegetated type green roof i.e., extensive/intensive modular green roof. Vegetated roofs offer urban heat island reduction and energy efficiency benefits as a green infrastructure strategy, and also as an amenity of building tenants.	Pg 9 of A22 Report (SSc5)	See response to comment 107
112	What is the rationale for using LEED 4.1 Beta for some credits and not others?	Pg 18 of A22 Report.	The USGBC released the beta version of the LEEDv4.1 rating system which is intended to serve as an update to (and improvement upon) LEEDv4. Recent guidance issued by the USGBC allows LEEDv4 projects to substitute any prerequisite or targeted credit for the LEEDv4.1 equivalent. LEEDv4.1 versus LEEDv4 compliance approach will be evaluated on a credit-by-credit basis. The team will use the requirements that are most suitable for the project.\
113	We encourage you to focus on social equity in pursuit of Innovation credits.	Pg 15 of A22 Report (INc4)	The team will prioritize evaluation of the following social equity-related Innovation credits and determine if they will be a good fit for the project: Social Equity within the Supply Chain, Social Equity within the Community, and Social Equity within the Project Team. Also note Mitigation Matrix: Minority & Women-Owned Business, support, Subsidy for Innovation/Start-up or Non-Profit Space, Local Retail Subsidy, Affordable Childcare, East End House contributions, existing open space improvements, Community Space".
114	We encourage you to provide guidance to speculative lab tenants to use the principals of WELL certification criteria to complement LEED CI (Commercial Interiors).	Pg 10 of A22 Report (SSc7)	The team will encourage tenants to pursue LEED and/or WELL certification as part of their build out.
115	It would be helpful to get more clarity in the next stages of design to give direction pursuing green roofs where possible.	Pg 9 of A22 Report (SSc5)	See response to comment 107
116	There are best practices for water use reduction in labs from the International Institute for Sustainable laboratories (formally Lab21) and others that the design team may want to consider using. For example, one best practice is a closed loop system that circulates water for equipment that requires cooling. The closed loop system would eliminate the practice of using water only once for cooling the equipment and gets wasted and never gets reused again. I am not sure if the design team has explored that but would be helpful to learn from their perspective on this.	Pg 11 of A22 Report (WEc3)	Cooling towers are in the base-building design for both 60 1st Street & 20 CambridgeSide. In addition to meeting the requirements of the WEc3 Cooling Tower Water Use credit, these projects prioritize implementing as many best practices as possible for water use reduction in labs as per the International Institute for Sustainable Laboratories
117	More of the LEED credit points should come from the EA category. Only 2 points were added to this category for Office/Lab use and none were added for Residential use. This is not enough, especially for the lab building.	Pg 12 of A22 Report (EAc2)	The team recognizes the importance of energy efficiency and will continue to evaluate opportunities reduce energy use and increase points within the Energy & Atmosphere category, specifically within the Optimize Energy Performance credit.

118	We encourage you to use Envelope Commissioning.	Pg 12 of A22 Report (EAc1)	Building envelope commissioning will not be pursued. As mentioned above, each new CambridgeSide building project will be performing LEED EAp1 Fundamental Commissioning and Verification and EAc1 Enhanced Systems Commissioning. These activities will support the owner's project requirements for energy performance. The building project will not utilize envelope commissioning because it has inherent redundancies and areas of conflict with the roles and scope of members of the project's design team – waterproofing and glazing consultants. These consultants provide design guidance, set performance standards, write specifications, review submittals, and help to maintain quality control. Using an envelope commissioning agent would overlap and duplicate much of this scope, confuse the roles, and confuse the inherent liabilities of each of the consultants. The project will be getting energy-performance benefits of envelope commissioning albeit through the design process and the expertise of the design-team.
	NET ZERO PLAN		
119	This must be provided as a section of the PUD Development Proposal describing how the proposal addresses the requirements in Section 13.102.3, paragraph (j). The Green Building submission discusses these items under "Section V: Additional Requests by City" which is not the correct way to categorize them.	Pg 16 of A22 Report (Section IV)	Section IV has been renamed to "Additional Strategies & Considerations Not Covered in LEED Narrative".
120	The Net Zero Plan should address the Article 22 "Net Zero Narrative" requirements at a master plan level, but individual submissions will be required for each building. Use the City's Net Zero Narrative Template to confirm that you have included all the required information.	-	Noted. The team will provide updated NZE reports for individual buildings as part of their individual submissioned.
121	Confirm whether there is an error on the chart shown on "Page 4 of 14" – it seems to indicate that the 60 First Street building can achieve net zero with PV.	Pg 4 of Pathwat to Net Zero Report	This was an error, which has been corrected
122	Many items noted in this section have been indicated as being considered as part of design development. If it cannot be confirmed by final application stage, staff may recommend that these items be studied as part of continuing design review for each building.	-	Noted
	DESIGN REVIEW APPLICATION - MACY'S		
152	Provide more information on the roof plans: penthouses and screened mechanical areas, potential areas of green roofs, potential PV, spot grades, notes, dimensions, etc.	Green Roof: Pg 9 of A22 Report (SSc5) PV: Pg 12 of A22 Report (EAc5)	See response to comment 107
153	What is the potential of the core building for green roof or PV?	Pg 12 of A22 Report (EAc5)	The roof for 20 CambridgeSide is solar-ready and the team is continuing to evaluate economics for PV installations
	GREEN BUILDING SUBMISSION (for individual buildings)		
173	Separate Green Building reports (forms, LEED checklist, LEED narrative, & Net Zero narrative) must be submitted for each building during design review.	-	Noted
174	Use attached LEED Checklist template for separate building design review submissions.	-	Noted. CDD confirmed that alternative formats were acceptable as long as required contents were included, which is the case.
175	Use the attached City's Net Zero Narrative Template for separate building design review submissions.	-	Noted. CDD confirmed that alternative formats were acceptable as long as required contents were included, which is the case.
177	EA-1 Credit: Provide explanation on why envelope commissioning is not being pursued.	Pg 12 of A22 Report (EAc1)	See response to comment 118
178	EA-2 Credit: Confirm that the energy performance for each building will be established during the schematic design phase as required.	Pg 11 of A22 Report (EAp2)	Confirmed. Energy performance goals have been/will be established during SD for each separate project phase
179	IN-3 Credit: Exemplary performance for Heat Island is an Exemplary Performance credit and not an Innovation credit.	Pg 15 of A22 Report (INc3)	No change will be made for Master Plan submission. Exemplary Performance in an existing credit is an approved path for achievement of an Innovation credit using Option 3 Additional Strategies.
180	IN-4 Credit: This credit has to be identified as Innovation credit, Pilot credit, or Exemplary Performance credit by final application stage.	Pg 15 of A22 Report (INc4)	No change will be made for Master Plan submission. Specific Innovation Credit paths pursued will be listed in each separate project phase's Green Building Report

Section B

Green Building Project Checklist

Green Building
Project Location: CambridgeSide 2.0

Applicant

Name: Christopher Schaffner

Address: 23 Bradford St., 1st Floor, Concord, MA 01742

Contact Information

Email Address: chris@greenengineer.com

Telephone #: 978-369-8978

Project Information (select all that apply):

- [x] New Construction – GFA: 575,000 SF of Net New GFA
- [ ] Addition – GFA of Addition: ______
- [ ] Rehabilitation of Existing Building – GFA of Rehabilitated Area: ______
  - [ ] Existing Use(s) of Rehabilitated Area: ______
  - [ ] Proposed Use(s) of Rehabilitated Area: ______
- [x] Requires Planning Board Special Permit approval
- [ ] Subject to Section 19.50 Building and Site Plan Requirements
- [ ] Site was previously subject to Green Building Requirements

Green Building Rating Program/System:

- [x] Leadership in Energy and Environmental Design (LEED) – Version: 4
  - [x] Building Design + Construction (BD+C) – Subcategory: New Construction, Core & Shell
  - [ ] Residential BD+C – Subcategory: ______
  - [ ] Interior Design + Construction (ID+C) – Subcategory: ______
  - [ ] Other: ______
- [ ] Passive House – Version: ______
  - [ ] PHIUS+
  - [ ] Passivhaus Institut (PHI)
  - [ ] Other: ______
- [ ] Enterprise Green Communities – Version: ______

Project Phase

☒ **SPECIAL PERMIT**

Before applying for a building permit, submit this documentation to CDD for review and approval.

Required Submissions

All rating programs:

- ☒ Rating system checklist
- ☒ Rating system narrative
- ☒ Net zero narrative (see example template for guidance)
- ☒ Affidavit signed by Green Building Professional with attached credentials – use City form provided (Special Permit)

Project Phase

☐ **BUILDING PERMIT**

Before applying for a building permit, submit this documentation to CDD for review and approval.

Required Submissions

All rating programs:

- ☐ Rating system checklist – updated from any prior version
- ☐ Rating system narrative – updated from any prior version with additional supporting information from construction documents
- ☐ Net zero narrative – updated from any prior version (see example template for guidance)
- ☐ Energy Simulation Tool results demonstrating compliance with selected rating system. *[Note: For Passive House rating program, must use WUFI Passive, Passive House Planning Package (PHPP), or comparable software tool authorized by Passive House.]*
- ☐ Credentials of Green Commissioning Authority (or copy of contract between developer and Commissioning Authority if an independent consultant or subcontractor), including documentation of Green Commissioning process experience on at least two building projects with a scope of work similar to the proposed project extending from early design phase through at least ten (10) months of occupancy
- ☐ Affidavit signed by Green Building Professional with attached credentials – use City form provided (Building Permit)

Passive House rating program only:

- ☐ Letter of intent from Passive House rater/verifier hired for on-site verification, with credentials of rater/verifier
- ☐ Credentials of Certified Passive House Consultant who has provided design, planning, or consulting services (if different from the Green Building Professional for the project)
- ☐ Construction drawings and specifications

Project Phase

☐ **CERTIFICATE OF OCCUPANCY**

Before applying for a certificate of occupancy, submit this documentation to CDD for review and approval.

Required Submissions

All rating programs:

- ☐ Rating system checklist – updated from any prior version
- ☐ Rating system narrative – updated from any prior version with additional supporting information from as-built conditions
- ☐ Net zero narrative – updated from any prior version (see example template for guidance)
- ☐ Energy Simulation Tool results demonstrating compliance with selected rating system, updated to as-built conditions. *[Note: For Passive House rating program, must use WUFI Passive, Passive House Planning Package (PHPP), or comparable software tool authorized by Passive House.]*
- ☐ Affidavit with schedule of commissioning requirements signed by Green Commissioning Authority, with attached credentials – use City form provided (Certificate of Occupancy)
- ☐ Affidavit signed by Green Building Professional with attached credentials – use City form provided (Certificate of Occupancy)

Passive House rating program only:

- ☐ Pressure Test Verification
- ☐ Ventilation Commissioning
- ☐ Quality Assurance Workbook
- ☐ Final testing and verification report from rater/verifier

Section C

Affidavit Form for Green Building Professional Special Permit

Green Building Project Location: CambridgeSide 2.0

Green Building Professional

Name: Christopher Schaffner

☐ Architect

☒ Engineer

Mass. License Number: Massachusetts PE Registration #37211

Company: The Green Engineer Inc.

Address: 23 Bradford St., 1st Floor, Concord, MA 01742

Contact Information

Email Address: chris@greenengineer.com

Telephone Number: 978-369-8978

I, Christopher Schaffner, as the Green Building Professional for this Green Building Project, have reviewed all relevant documents for this project and confirm to the best of my knowledge that those documents indicate that the project is being designed to achieve the requirements of Section 22.24 under Article 22.20 of the Cambridge Zoning Ordinance.

(Signature) 6/2/20 (Date)

Attach either:

☒ Credential from the applicable Green Building Rating Program indicating advanced knowledge and experience in environmentally sustainable development in general as well as the applicable Green Building Rating System for this Green Building Project.

☐ If the Green Building Rating Program does not offer such a credential, evidence of experience as a project architect or engineer, or as a consultant providing third-party review, on at least three (3) projects that have been certified using the applicable Green Building Rating Program.

LEED
AP
BD+C

10580514-AP-BD+C

CREDENTIAL ID

10 OCT 2009

ISSUED

07 OCT 2021

VALID THROUGH

GREEN BUSINESS CERTIFICATION INC. CERTIFIES THAT

Christopher Schaffner

HAS ATTAINED THE DESIGNATION OF

LEED AP® Building Design + Construction

by demonstrating the knowledge and understanding of green building practices and principles needed to support the use of the LEED® green building program.

Mahesh Ramanujam

The Green Engineer
Sustainable Design Consulting

www.greenengineer.com

REVISED* Cambridge Article 22: Green Building Report

Issued: July 14, 2020

Project: CambridgeSide 2.0

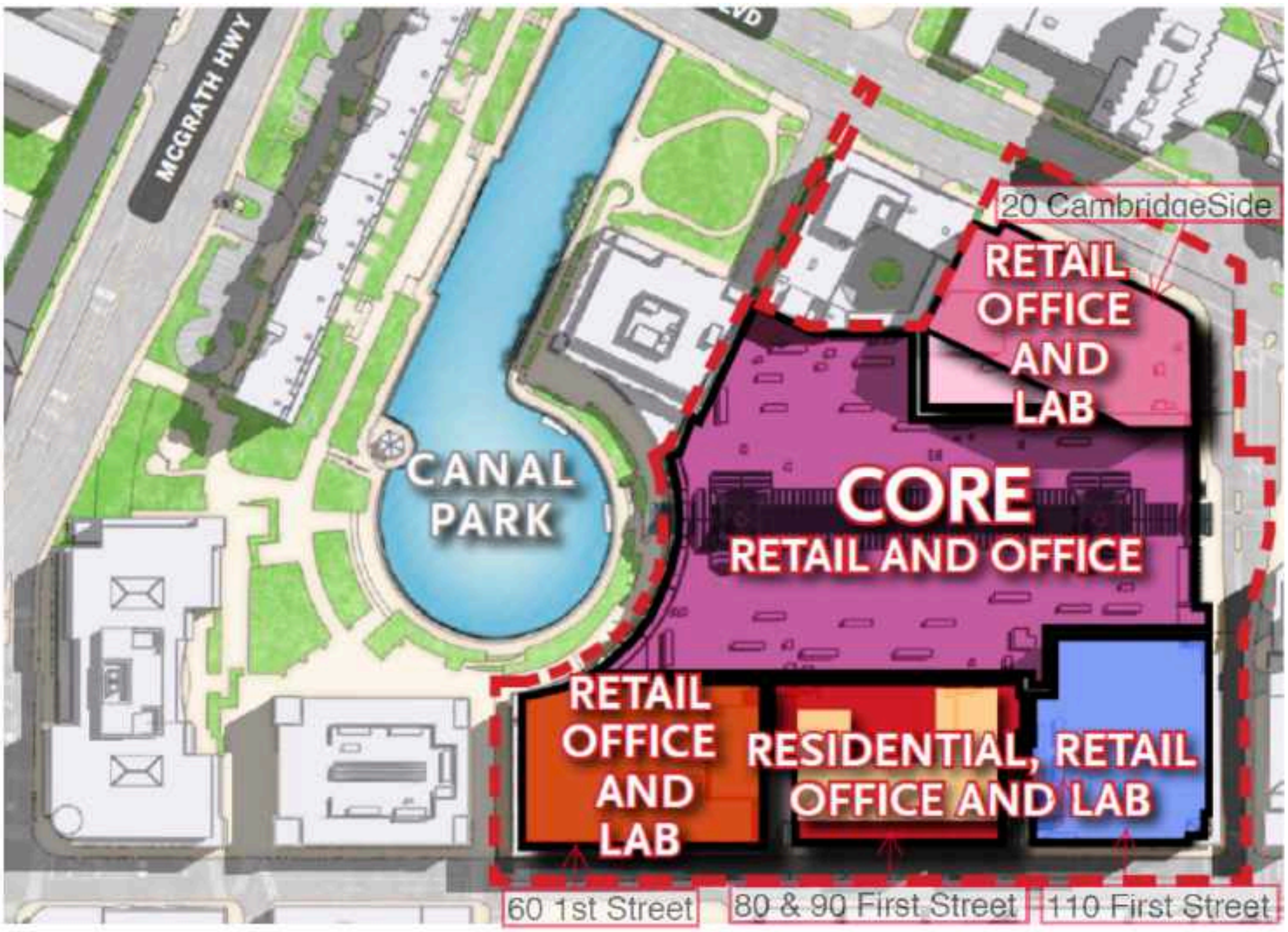


Image courtesy of Elkus Manfredi Architects

*Revised in response to the City's "*Cambridgeside Green Building SP Submission_Comments_07-02-2020*" document

Table of Contents

Section I. PROJECT DESCRIPTION

In December of 2019, following a significant public process over the last two years, the City of Cambridge City Council, consistent with a positive recommendation from the City of Cambridge Planning Board, voted to approve a rezoning of the project site into a new Planned Unit Development 8 (PUD-8) District. The new PUD-8 District allows retail, office, laboratory and restaurant uses and requires a minimum of 30% of the Net New GFA (as defined in Section 13.104.1 of the City of Cambridge Zoning Ordinance) to be constructed as residential uses. Pursuant to the PUD-8 zoning, the Applicant proposes to convert the existing retail center into a dynamic mixed-use center, responding to current market demands and providing an attractive place where people can shop, work and live. The project will:

(i) maintain the active retail and office uses within the core mall, as well as the sky-lit atrium open space that is the heart of CambridgeSide;
(ii) renovate the former Sears building to provide for a mix of retail and office/laboratory uses;
(iii) replace the Upper Garage, Macy's and Best Buy buildings to provide for a mix of retail, office/laboratory and residential uses; and
(iv) transform First Street into an active streetscape and animate Canal Park through the provision of open space improvements.

The project will include conversion of the existing anchor stores and Upper Garage, as well as an addition of approximately 575,000 square feet of Net New GFA, expanding the existing approximately 1.090 million square foot retail shopping destination to an approximately 1.665 million square foot mixed-use development (the "Project"). Approximately 175,000 square feet of that total Net New GFA will be devoted to residential uses, while approximately 400,000 square feet of Net New GFA will be devoted to commercial uses, currently anticipated to include a combination of office, laboratory, restaurant and retail uses.

The Applicant currently anticipates developing the Project in phases over a multi-year period, commencing with the 20 CambridgeSide and 60 First Street buildings and associated landscape and streetscape improvements, as well as improvements to Thorndike Way and Canal Park, beginning once all required permits and approvals are obtained in late 2020.

The 80 & 90 First Street and 110 First Street buildings will be constructed, along with associated landscape and streetscape improvements, following completion of the first two buildings.

The scope of work of each phase determines what LEED Rating System will be used to demonstrate Article 22 compliance. Commercial core and shell development phases will use the LEED for Core and Shell (LEED-CS) v4 rating system while the residential-dominated development will use the LEED for New Construction (LEED-NC) v4 rating. The following table outlines the specific phases listing anticipated scope, program and associated LEED Rating System. Since there will be significant overlap in the compliance approaches for the different phases we have presented one combined narrative. We have noted when there is a potential difference in approach between the phases using the LEED-CS or LEED-NC Rating System.

Existing Bldg Name	Address	Project Phase Name	Anticipated Scope & Program	LEED Rating System
Sears	60 First Street	60 First Street	Core & Shell Speculative Lab Ground Floor Retail	LEED-CS v4
Upper Garage	80-90 1 First Street	80 & 90 First Street	Full build out Resi/ Ground Floor retail	LEED-NC v4
Best Buy	110 First Street	110 First Street	Core & Shell 1/3rd Office 2/3rd Spec Lab floors Ground Floor retail	LEED-CS v4
Macy's	20 Cambridgeside Place	20 CambridgeSide	Core & Shell Speculative Lab Ground Floor Retail	LEED-CS v4

Section II. AFFIDAVIT

I, Christopher Schaffner, do hereby affirm that I have thoroughly reviewed the supporting documents for the LEEDv4 Core and Shell and New Construction rating systems and confirm that the CambridgeSide 2.0 commerical Core and Shell phases are targeted to meet the requirement for Gold with **65** points and **18** possible (‘maybe’) points and the Residential phase is on target to meet the requirement for Gold with **60** points and **20** possible (‘maybe’) points. The CambridgeSide 2.0 project, located in Cambridge, MA will be designed to meet the green building requirement under Article 22.20 of the Cambridge Zoning Ordinance.

Chris Schaffner, PE, LEED Fellow is Founder and President of The Green Engineer, Inc. Chris has over 30 years of experience in the design of building systems with a focus on energy efficiency and sustainability.

A long time promoter of sustainable design, Chris has been a member of the US Green Building Council’s (USGBC) LEED Faculty since 2001, training more than 9,600 building industry professionals in the use of the LEED Rating System. He is currently an elected member of the USGBC Advisory Council, as well as a volunteer with the LEED Advisory Committee. He previously served on the USGBC Board of Directors, as Chair of the Energy and Atmosphere Technical Advisory Group (TAG) and as a member of the Indoor Environmental Quality TAG, among other volunteer roles with the USGBC.

To date, Chris and The Green Engineer has managed or been involved in over 200 LEED certified projects.

An executed Cambridge Affidavit has been provided.

Christopher Schaffner, PE, LEED Fellow
Massachusetts PE Registration #37211
The Green Engineer, Inc.
LEED Administrator and Sustainability Consultant


LEED AP BD+C

10580514-AP-BD+C

10 OCT 2009

07 OCT 2021

GREEN BUSINESS CERTIFICATION INC. CERTIFIES THAT

Christopher Schaffner

HAS ATTAINED THE DESIGNATION OF

LEED AP® Building Design + Construction

by demonstrating the knowledge and understanding of green building practices and principles needed to support the use of the LEED® green building program.

MAHESH RAMANUJAM
PRESIDENT & CEO, U.S. GREEN BUILDING COUNCIL
PRESIDENT & CEO, GREEN BUSINESS CERTIFICATION INC.

Section III. LEEDv4 SCORECARD SUMMARY

- Please refer to the LEED credit summary below and the attached LEEDv4 Core and Shell (CS) and LEEDv4 New Construction (NC) Project Scorecards.
- The Core and Shell phases, as listed in the Section I. table, anticipate attaining the Gold Certification threshold of 60 credit points by attempting **65** credit points. Additionally, the projects have earmarked an additional **18 possible** 'maybe' credit points that require further research; these credits will remain under consideration as the design continues to evolve.
- The Residential phase, as listed in the Section I. table, anticipates attaining the Gold Certification threshold of 60 credit points by attempting **60** credit points. Additionally, the project has earmarked an additional **20 possible** 'maybe' credit points that require further research; these credits will remain under consideration as the design continues to evolve.
- The team will continue to evaluate design options against LEED requirements with the goal to design and construct buildings which minimize their impact on the environment, create an engaging and healthy space for occupants and reduce operating costs. Several credits remain designated as 'Maybe' due to the uncertainty of future design decisions, which is common at this phase of the Project. The team will continue to evaluate LEED credits to pursue to ensure enough of a "point cushion" to ensure the LEED Gold requirement is met for each project.
- The USGBC recently released the beta version of the LEEDv4.1 rating system which is intended to serve as an update to (and improvement upon) LEEDv4. Recent guidance issued by the USGBC allows LEEDv4 projects to substitute any prerequisite or targeted credit for the LEEDv4.1 equivalent. Credits these projects intend to pursue using the LEED v4.1 criteria have been denoted with LEEDv4.1 adjacent to the credit name in the ensuing credit narrative below.
- LEED Point Summary by Category:

CORE AND SHELL PHASES – LEED-CSv4

LEED CREDIT SUMMARY	**Yes**	***Maybe***
Integrative Process	1 point	*0 possible points*
Location and Transportation	19 points	*1 possible point*
Sustainable Sites (SS)	6 points	*3 possible points*
Water Efficiency (WE)	5 points	*2 possible points*
Energy & Atmosphere (EA)	14 points	*7 possible points*
Materials & Resources (MR)	5 points	*3 possible points*
Indoor Environmental Quality (EQ)	6 points	*1 possible point*
Innovation in Design (ID)	6 points	*0 possible points*
Regional Priority (RP)	3 points	*1 possible point*
Total Points	**65 points**	***18 possible points***

RESIDENTIAL PHASE – LEED-NCv4

LEED CREDIT SUMMARY	**Yes**	***Maybe***
Integrative Process	1 point	*0 possible points*
Location and Transportation	15 points	*1 possible point*
Sustainable Sites (SS)	5 points	*3 possible points*
Water Efficiency (WE)	5 points	*2 possible points*
Energy & Atmosphere (EA)	13 points	*6 possible points*
Materials & Resources (MR)	5 points	*3 possible points*
Indoor Environmental Quality (EQ)	8 points	*3 possible points*
Innovation in Design (ID)	6 points	*0 possible points*
Regional Priority (RP)	2 points	*2 possible points*
Total Points	**60 points**	***20 possible points***

Section IV. LEED Credit Narrative

As detailed below, the Project meets the LEEDv4 Core and Shell and LEEDv4 New Construction Minimum Program Requirements and each of the required Prerequisites. Additionally, the following credits are being targeted.

A. Integrative Process (IP)

IP Credit 1 Integrative Process — CS & NC 1 credit point

All phases of the Project will meet the intent of this credit through the identification of cross discipline opportunities to design a sustainable building project. Sustainable design focused meetings were held early and will be ongoing throughout the design process to assist the team in establishing shared sustainable design and energy efficiency goals for the Projects. Early design phase energy modeling will be conducted to review systems synergies and assess areas where energy loads may be significantly reduced. A water use analysis will be conducted to aid in establishing water use reduction targets.

The overall development team has conducted numerous interdisciplinary early meetings focusing on sustainability. These meetings have included the ownership groups, architects, MEP engineers, civil engineers, landscape architects, energy analysts, utility representatives, and sustainability experts. An initial charrette was conducted in January 2020 focusing on the overall Project. Phase-specific follow up charrettes have subsequently been conducted for those phases in design. Early energy modeling is occurring and providing real feedback on decision-making; and the projects are already linked into the MassSave energy-efficiency incentive program. The workshops and early energy analyses are being used to inform the Basis of Design documents. This early work has pushed the design to increase the performance of the envelope and HVAC systems and explore additional opportunities for decreasing water use on campus.

A commissioning agent will be engaged as each of the building projects enter their design development phase.

B. Location and Transportation (LT)

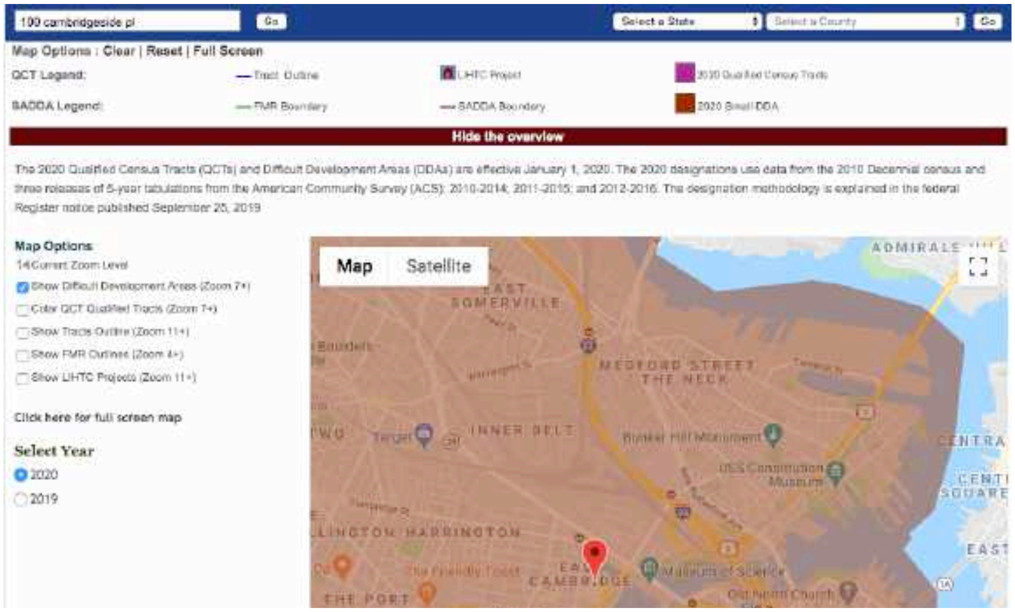
LT Credit 2 Sensitive Land Protection — CS 2 credit points
NC 1 credit point

All phases of the Project will meet the credit requirements by being located on land that has been previously developed.

LT Credit 3 High Priority Site — CS 2 credit points, *1 maybe point*
NC 1 credit point, *1 maybe point*

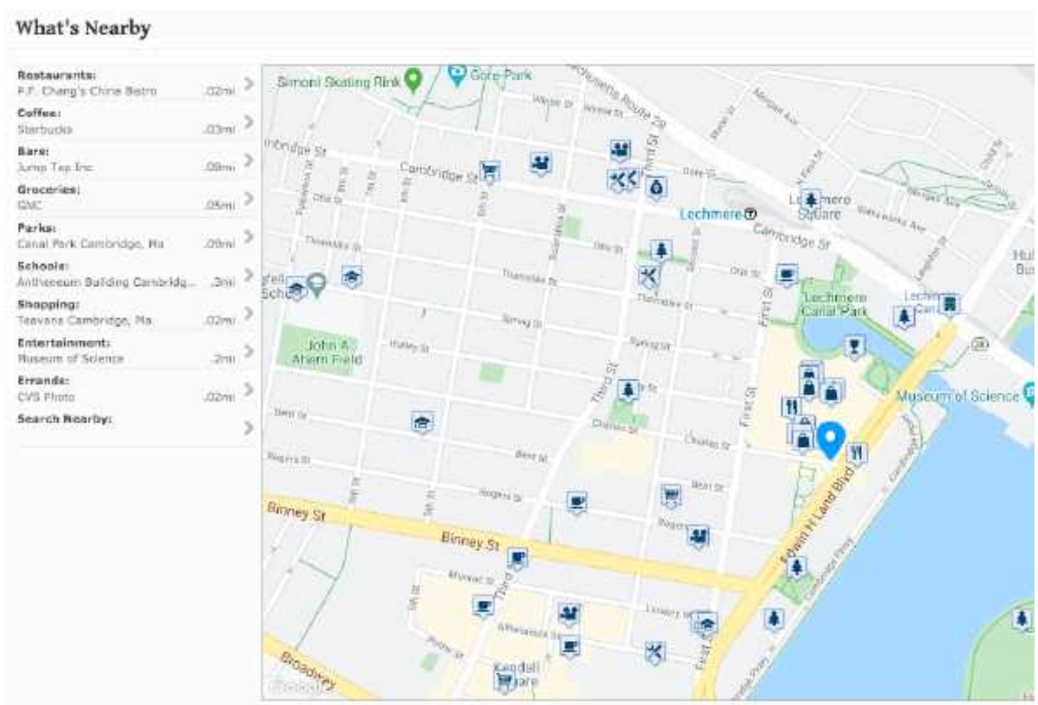
All phases of the Project will meet the credit requirements by being located on a site in a U.S. Department of Housing and Urban Development's Difficult Development Area as shown in the map below.

One point remains as 'Maybe' pending the discovery of soil or groundwater contamination that requires remediation.



<u>LT Credit 4 Surrounding Density and Diverse Uses</u> CS 6 credit points
NC 5 credit points

All phases of the Project will meet Option 1 for Surrounding Density by being located in an area with an average density greater than 35,000 sf/acre. Additionally, all phases of the Project will meet Option 2 for Diverse Uses by being located within ½ mile walking distance of at least 9 publicly available diverse uses in at least three separate use categories.



All phases of the Project are located within ½ mile of the following 9 diverse uses:

Use Label on Map	Name of Use	Use Category	Use Type [1]	Walking Distance (mi)	
1	Shabu & Mein	Services	Restuarant, cafe, diner	0.1	+ -
2	Catalyst Cafe	Services	Restuarant, cafe, diner	0.3	+ -
3	Lechmere Canal Park	Civic and community facilities	Public park	0.01	+ -
4	Museum of Science	Civic and community facilities	Cultural arts facility	0.4	+ -
5	Middlesex Probate and Fa	Civic and community facilities	Government office that serves public on-site	0.3	+ -
6	River Court Condos	Community anchor uses	Housing (100 or more dwelling units)	0.1	+ -
7	Thomas Graves Landing C	Community anchor uses	Housing (100 or more dwelling units)	0.2	+ -
8	Boston Convenience	Community-serving retail	Convenience store	0.3	+ -
9	The Brother's Market	Food retail	Supermarket	0.5	+ -
Number of uses within 1/2-mi walking distance [2]				9	
Number of use categories within 1/2-mi walking distance [2]				5	

LT Credit 5 Access to Quality Transit — CS 6 credit points
NC 5 credit points

LEEDv4.1: All phases of the Project are located within ½ mile walking distance of the Lechmere T station. This transit station provides occupants with access to 424 weekday rides and 264 weekend rides via the MBTA Green B, C, D, and E lines, and MBTA bus lines 69, 80, 87, and 88 which is greater than the 360 weekday and 216 weekend trips required.

Route Name	Transit Type	Walking Distance to Closest Stop [1] (mi)	Daily Weekday Trips [2]	Average Daily Weekend Trips [2, 3]	
Green Line E Train	Light rail	0.2	154	109	+ -
69	Bus	0.2	56	45	+ -
80	Bus	0.2	35	26	+ -
87	Bus	0.2	52	41	+ -
88	Bus	0.2	55	43	+ -
EZ Ride	Bus	0.01	72	0	+ -
Total weekday trips				424	
Total weekend trips				264	

LT Credit 6 Bicycle Facilities — CS & NC 1 credit point

Exterior short-term and covered long-term bicycle storage is planned for visitors and regular occupants of all phases of the Project. The immediate neighborhood provides a direct connection to a local bicycle network that links to a variety of services with pedestrian and cyclist access. All phases of the Project will meet City of Cambridge requirements for bike storage, which are more stringent than the LEEDv4 LTc6 Bicycle Facilities requirements.

LT Credit 7 Reduced Parking Footprint — CS & NC 1 credit point

LEEDv4.1: No new parking will be constructed as a part of the Project.

LT Credit 8 Green Vehicles — CS & NC 1 credit point

LEEDv4.1: The Applicants commit to provide EV charging stations to satisfy the LEED credit by providing EV charging stations for 2% of the total parking capacity. There are 1,695 existing parking spaces below the existing mall building. Of those spaces ultimately allocated to each of the four new building projects and their respective tenants, 2% of these will be outfitted as electric vehicle charging stations, which will require a total of 34 EV charging station. The required new EV Stations will be provided in the below-grade garage proximate to the buildings they serve.

C. Sustainable Sites (SS)

SS Prerequisite 1: Construction Activity Pollution Prevention Required
The construction manager will be required to submit and implement an appropriate SWPPP/Erosion and Sedimentation Control (ESC) Plan for construction activities related to the construction of all phases of the Project. The ESC Plan will conform to the erosion and sedimentation requirements of the applicable NPDES regulations and specific municipal requirements for the City of Cambridge. Additionally, the ESC Plan will address management and containment of dust and particulate matter generated by on site demolition and construction activities. Civil design drawings will include measures for the implementation of the ESC plan.

SS Credit 1: Site Assessment CS & NC 1 credit point
A comprehensive site assessment will be completed as part of all phases of the Project. The site assessment will include topography, hydrology, climate, vegetation, soils, human use, and human health effects and was used to inform the design.

SS Credit 2: Site Development- Protect and Restore CS & NC 1 credit point
LEEDv4.1: The Applicant will provide financial support equivalent to $0.20 per square foot for the total site area to a nationally or locally recognized land trust or conservation organization following the LEED v4.1 updated requirement which revised the contribution amount from $0.40/sf to $0.20/sf.

SS Credit 4: Rainwater Management CS & NC *3 maybe points*
LEEDv4.1: The Applicant is exploring the options to manage the rainwater runoff from the developed site for the 80th percentile (1pt), 85th percentile (2pts), or the 90th percentile (3 pts) of regional or local rainfall events using LID & GI strategies that best mimic natural site hydrology. It is understood that at a minimum the all phases of the Project will meet the Cambridge DPW water management standards. The Project will incorporate Low Impact Development (LID) techniques and green infrastructure such as permeable pavers and tree box filters where feasible. The landscape design will utilize permeable pavers where feasible and strive to reduce impervious surfaces where possible, especially around the canal.

SS Credit 5 Heat Island Reduction CS & NC 2 credit points
The roof and non-roof hardscape materials of all phases of the Project will include light-colored surfaces to reduce the overall heat island effect impact on the Project site. The roof membranes will be high albedo roof products with an initial SRI value of 82 minimum. . All parking associated with the Project will be located undercover, qualifying all phases of the Project for an exemplary performance point.

The existing roof of the existing Core building has a white membrane. The existing rooftops of Upper Garage and Lechmere are currently somewhat reflective, light grey colored concrete parking decks – which will be replaced with white membranes when these new buildings are built. As mentioned above, all buildings will have “cool roofs” with white membranes, but green roofs are not planned at this time.

The improvements to Charles and Canal park will also contribute to a reduction in the urban heat island effect by replacing existing hardscape with more vegetation and/or light-colored paving. The increased setback on 1st Street will allow for optimized street tree layout compared to the existing plantings. The core mall and atrium will be open to the public and have extended hours with air conditioning to help mitigate the effects of increased temperatures of the surrounding urban environment. The residential project is open to the idea of Passive House which creates an extremely stable indoor thermal environment for residents. This would allow for residents to “shelter in place” comfortably during extreme heat waves.

SS Credit 6 Light Pollution Reduction — CS & NC 1 credit point
All phases of the Project will meet uplight and light trespass requirements by complying with the LEED v4 BUG Rating method. To meet credit requirements, the site lighting will not exceed the LEEDv4 allowable luminaire backlight, uplight and glare ratings for the lighting zone.

SS Credit 7 Tenant Design and Construction Guidelines — CS 1 credit point
Tenant Design and Construction Guidelines will be developed outlining the sustainable design and energy efficiency measures in the core and shell phases and providing detailed guidance for the office/lab tenants to design and build in alignment with the project sustainability goals. Information will also be included to assist tenants in pursuing LEED certification for their spaces. The team will encourage tenants to pursue LEED and/or WELL certification as part of their build out.

D. Water Efficiency (WE)

WE Prerequisite 1 Outdoor Water Use Reduction, 30% — Required
Through the use of native/adaptive plant species selection and optimized irrigation system efficiency, all phases of the Project landscape water requirement (as calculated by the EPA WaterSense Water Budget Tool) will be reduced by at least 30% from the calculated baseline for the site’s peak watering month. The landscape design will include softscape areas which will be planted with a diverse palette of materials which are native, adaptive, low-maintenance, low or no irrigation requirements beyond establishment and have year round aesthetic appeal. At a minimum the Project will meet the Cambridge DPW water management standards. At a minimum all phases of the Project will meet the Cambridge DPW water management standards.

WE Prerequisite 2 Indoor Water Use Reduction, 20% Reduction — Required
Through the specification of low flush and flow and high efficiency plumbing fixtures, all phases of the Project will reduce potable water consumption by at least 20% over the baseline calculated for the building (not including irrigation) after meeting Energy Policy Act of 1992 fixture performance requirements. Preliminary water use calculations are provided below.

WE Prerequisite 3 Building Level Water Metering — Required
All phases of the Project will meet the requirements of this prerequisite by installing permanent water meters that measure the total potable water use for each building and associated grounds. In addition to installing the meters, all phases of the Project will commit to sharing water usage data with the USGBC for a five-year period beginning on the date each phase accepts LEED certification or typical occupancy, whichever comes first. It is understood that the buildings will be subject to the Building Energy Use Disclosure Ordinance and will annually report and disclose energy performance in terms of energy usage.

WE Credit 2 Indoor Water Use Reduction — CS & NC 2 credit points, *2 maybe points*
Through the specification of low flow and high efficiency plumbing fixtures, all phases of the Project will implement water use reduction strategies that at a minimum result in a 30% reduction in potable water use annually when compared to EPA baseline fixtures for the

building (not including irrigation) after meeting Energy Policy Act of 1992 fixture performance requirements.

WE Credit 3 Cooling Tower Water Use — CS & NC 2 credit points

All phases of the Project will conduct a one-time potable water analysis for the cooling tower water and calculate the cycles of concentration. Through increasing the level of treatment in the make-up and/or condenser water, all phases will achieve the calculated maximum number of cycles before any of the parameters analyzed exceed their maximum allowable levels of concentration. The control parameters that are required to be assessed are: Ca, total alkalinity, SiO_2, Ci, and conductivity.

Cooling towers are in the base-building design for both 60 1st Street & 20 CambridgeSide. In addition to meeting the requirements of the WEc3 Cooling Tower Water Use credit, these projects prioritize implementing as many best practices as possible for water use reduction in labs as per the International Institute for Sustainable Laboratories.

WE Credit 4 Water Metering — CS & NC 1 credit point

To support water management and identify opportunities for additional water savings, all phases of the Project will include permanent water meters for two of the following: irrigation, indoor plumbing fixtures and fittings, domestic hot water, boiler, reclaimed water, and/or other process water.

E. Energy and Atmosphere (EA)

EA Prerequisite 1 Fundamental Commissioning and Verification — Required

A Commissioning agent will be engaged for all phases of the Project by the Building Owner(s) for purposes of providing fundamental commissioning services for the building energy related systems including HVAC, lighting, domestic hot water systems and building envelope before the end of DD. The CxA will be required to perform the scope of work required to comply with the prerequisite in accordance with ASHRAE Guideline 0-2005 and ASHRAE Guideline 1.1-2007 for HVAC & R systems. Owner's Project Requirements (OPR) and Basis of Design (BOD) documents will be developed.

EA Prerequisite 2 Minimum Energy Performance — Required

To meet the prerequisite, All phases of the Project's building performance will demonstrate a minimum of 2% improvement in energy use by cost when compared to a baseline building performance as calculated using the rating method in Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2010. All phases are also required to meet the MA Energy Code and MA Stretch Energy Code requirements.

Comprehensive, iterative energy modeling will be used to explore design options to meet all Code requirements and to provide substantiation for the LEED applications. Energy performance goals have been/will be established during SD for each separate project phase.

EA Prerequisite 3 Building Level Energy Metering — Required

To meet the requirements of this prerequisite, all phases of the Project will install whole building energy meters for gas and electricity used by the phase. In addition to installing the meters, all phases of the Project will commit to sharing energy usage data with the USGBC for a five-year period beginning on the date each accepts LEED certification or typical occupancy, whichever comes first. It is understood that at a minimum the all phases of the Project will be subject to the Building Energy Use Disclosure Ordinance and will annually report and disclose energy performance in terms of energy usage.

EA Prerequisite 4 Fundamental Refrigerant Management — Required

CFC based refrigerants will not be used in any phase of the Project HVAC & R systems. Additionally, depending on use of leasable space in the Core and Shell buildings, equipment such as walk in freezers and coolers installed by future tenants will be required to meet credit requirements.

EA Credit 1 Enhanced Commissioning — CS & NC 3 credit points

In addition to EApr1 Fundamental Commissioning and Verification requirements, Option 1 Path 1 Enhanced Commissioning will be pursued by all phases of the Project. The building owner(s) will engage a Commissioning Agent during the design phase to review the proposed design and verify the building systems meet the owner's expectations and requirements.

Enhanced commissioning scope will include reviewing the owner's project requirements, and the basis of design, creating, distributing and implementing a commissioning plan, performing a design review of the project documents, witnessing on-site installations and testing and performing commissioning of installed HVAC, lighting, lighting controls and domestic hot water systems.

Building envelope commissioning will not be pursued. As mentioned above, each new CambridgeSide building project will be performing LEED EAp1 Fundamental Commissioning and Verification and EAc1 Enhanced Systems Commissioning. These activities will support the owner's project requirements for energy performance. The building project will not utilize envelope commissioning because it has inherent redundancies and areas of conflict with the roles and scope of members of the project's design team – waterproofing and glazing consultants. These consultants provide design guidance, set performance standards, write specifications, review submittals, and help to maintain quality control.

Using an envelope commissioning agent would overlap and duplicate much of this scope, confuse the roles, and confuse the inherent liabilities of each of the consultants.
The project will be getting energy-performance benefits of envelope commissioning albeit through the design process and the expertise of the design-team.

EA Credit 2 Optimize Energy Performance — CS 10 credit points, *4 maybe points*
NC 8 credit points, *5 maybe points*

For this submission the Project phases are carrying an estimate that the projects will perform 20% (NC) and 17% (CS) better than the baseline (ASHRAE 90.1-2013). We anticipate these percentages to increase as a result of the team's commitment to energy efficiency to meet the MA State Stretch Energy Code. Please see the Pathway to Net Zero Ready and report for more.

The team recognizes the importance of energy efficiency and will continue to evaluate opportunities reduce energy use and increase points within the Energy & Atmosphere category, specifically within the Optimize Energy Performance credit.

EA Credit 5 Renewable Energy Production — CS & NC *1 maybe point*

The roof for 20 CambridgeSide is solar-ready and the team is continuing to evaluate economics for PV installations.. See the separate preliminary Solar Feasibility assessment for more.

EA Credit 6 Enhanced Refrigerant Management — CS 1 credit point

The HVAC equipment installed in the base building of the Core and Shell phases will use refrigerants that have low global warming and ozone depletion potential.

EA Credit 7 Green Power and Carbon Offsets — *CS 2 maybe points*
NC 2 credit points

The Applicant intends to purchase Green Power and Carbon Offsets through a 5-year contract to offset a minimum of 100% of the buildings' energy use with renewable sources for the 80 & 90 First Street residential phase. The team is exploring the options to do the same for the core and shell phases identified in the Section I table above.

F. Materials and Resources (MR)

MR Prerequisite 1 Storage and Collection of Recyclables Required
Storage of collected recyclables will be accommodated in a designated recycling area within the development. Recyclable materials collected will include mixed paper, corrugated cardboard, glass, plastics, and metals, and the disposal of batteries and electronic waste. Tenants will bring their recyclables to the central storage room. A contracted waste management company will collect the recyclables on a regular basis.

MR Prerequisite 2 Construction and Demolition Waste Management Planning Required
All phases of the Project will meet the requirements of this prerequisite by including a Construction Waste Management section in Division 1 of the project manual. The specification will include direction for the construction manager to submit and implement a compliant waste management plan for the duration of construction. Waste diversion goals for the project will include at least five materials targeted for diversion.

MR Credit 1 Building Life-Cycle Impact Reduction CS & NC 2 credit points, *1 maybe point*
LEEDv4.1: The Applicant is planning to conduct a whole-building life-cycle assessment for all phases of the Project that demonstrates that each phases' structure and enclosure achieves at least a 5% reduction in a minimum of three of the six impact categories when compared to a baseline building. One of the impact categories must be global warming potential. The remaining impact categories that will be assessed are: depletion of the stratospheric ozone layer, acidification, eutrophication, formation of tropospheric ozone and depletion of nonrenewable energy resources.

MR Credit 2 Building Product Disclosure & Optimization (BPDO): EPDs CS & NC 1 credit point
LEEDv4.1: All phases of the Project will attempt this credit via Option 1. The technical specifications will include direction for the construction manager and their sub-contractors to provide and submit materials and products Environmental Product Declarations that conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope. The team will work to provide documentation for 10 different permanently installed products sourced from at least 3 different manufacturers (CS) and 20 different permanently installed products sourced from at least 5 different manufacturers (NC).

MR Credit 3 BPDO: Sourcing of Raw Materials CS & NC *1 maybe point*
LEEDv4.1: All phases of the Project will attempt this credit via Option 2. The technical specification will include information for applicable products and materials to meet one of the following extraction criteria (as applicable): Extended producer responsibility, Bio-Based materials, FSC wood, Materials reuse, Recycled Content, and/or regionally extracted and manufactured (within 100 miles of the project site). (Credit achievement cannot be determined until construction phase.)

MR Credit 4 BPDO: Material Ingredients CS & NC 1 credit point
LEEDv4.1: All phases of the Project will attempt this credit via Option 1. The project manual will include the information and direction for the construction manager and their sub-contractors to provide and submit materials and products documentation identifying the chemical make-up. The documentation may be Health Product Declarations, Cradle-to-Cradle or Declare certification. The team will work to provide documentation for 10 different

permanently installed products sourced from at least 3 different manufacturers (CS) and 20 different permanently installed products sourced from at least 5 different manufacturers (NC).

MR Credit 5 Construction & Demolition Waste Management CS & NC 1 credit point, *1 maybe point*
All phases of the Project will meet the requirements of this credit by including a Construction Waste Management section in Division 1 of the project manuals. The specification will include direction for the construction manager to attempt to divert a minimum of 75% of the demolition and construction waste generated on site from area landfills. The construction waste management plan will include tracking 5 waste streams. Diverted material reported will include at least four different material streams. Demolition waste will be separated on site as part of the strategy to meet this credit.

G. Indoor Environmental Quality (IEQ)

IEQ Prerequisite 1 Minimum IAQ Performance Required
All phases of the Project's mechanical systems will be designed to meet or exceed the requirements of ASHRAE Standard 62.1-2010 sections 4 through 7 and/or applicable building codes. The mechanical engineer will complete a ventilation rate procedure (VRP) calculator to verify compliance for each project. Outdoor airflow monitors will be included in the projects.

IEQ Prerequisite 2 Environmental Tobacco Smoke Control Required
LEEDv4.1: Smoking will be prohibited in All phases of the Project and within 25' of the buildings. Signage will be posted within 10' of all building entrances to indicate the interior and exterior no-smoking policy.

IEQ Credit 1 Enhanced Indoor Air Quality Strategies CS & NC 2 credit points
All phases of the Project are being designed to incorporate permanent entryway systems, properly enclosed and ventilated chemical use/storage areas and compliant filtration media. Additionally, C02 monitoring will be performed by tenants in all densely occupied spaces. Credit compliance for the Core and Shell projects is dependent on tenants agreeing to meet credit requirement as part of the fit-out scope of work. This requirement will be outlined in a binding Tenant Sales and Lease Agreement.

IEQ Credit 2 Low Emitting Materials CS & NC 2 credit points, *1 maybe point*
LEEDv4.1: All phases of the Project will attempt this credit through meeting the compliance criteria for the following compliant categories: interior paints and coatings, adhesives and sealants, flooring, ceilings, and composite wood. Intending to achieve 3 categories for 2 points.

IEQ Credit 3 Construction Indoor Air Quality Management Plan CS & NC 1 credit point
The project manuals for all phases of the Project will include direction for the construction manager to develop and implement an Indoor Air Quality Management plan in compliance with applicable control measures as stated in the SMACNA IAQ Guidelines for Occupied Buildings under construction 2nd Edition, 2007 ANSI/SMACNA 008-2008 Chapter 3. Additional measures will be implemented to ensure absorptive materials will be protected from moisture damage.

IEQ Credit 5 Thermal Comfort NC 1 credit point
The 80 & 90 First Street Residential phase will comply with AHSRAE 55-2010. Additionally, thermal controls will be provided in 100% of multi-occupant and 50% of individual occupant spaces.

IEQ Credit 6 Interior Lighting NC 1 credit point

The 80 & 90 First Street Residential phase will provide lighting controls with three levels of lighting (on, off, mid-level) in 100% of multi-occupant and 50% of individual occupant spaces.

IEQ Credit 8 Quality Views CS & NC 1 credit point
A direct line of sight to the outdoors will be provided for 75% of the regularly occupied floor area of all phases of the Project. 75% of the regularly occupied floor area will also have quality views to the outdoors which may include multiple lines of sight; unobstructed views; views to landscaped areas, sky, pedestrian walkways, and streetscapes. The Core and Shell buildings will use a test fit tenant layout plan to demonstrate compliance.

H. Innovation (IN)

INc1 Innovation: Operations and Maintenance (O+M) Starter Kit CS & NC 1 credit point
The Applicant will develop and implement a green cleaning plan that focuses on the use of green cleaning products and equipment in the common areas of all phases of the project.

The Applicant will develop and implement an indoor integrated pest management (IPM) program. The plan will require routine inspection and monitoring, along with the incorporation of integrated methods, specification of emergency application measures for pesticides, and communication strategies to building occupants. All cleaning products included in the IPM plan will adhere to the requirements listed in the Green Cleaning plan for all phases of the project.

INc2 Innovation: Purchasing - Lamps CS & NC 1 credit point
All phases of the Project will achieve one innovation point by complying with LEED Innovation Credit: Purchasing – Lamps, which requires that the calculated average mercury content for each phases be below 35 picograms of Hg per lumen hour.

INc3 Exemplary Performance: SSc5 Heat Island Reduction CS & NC 1 credit point
All phases of the Project will achieve Exemplary Performance for Heat Island Reduction by meeting both Option 1: Roof and Nonroof and Option 2: Parking Under Cover.

INc4 Innovation, Pilot Credit, Exemplary Performance: To be Determined CS & NC 1 credit point
The Applicant is exploring options to achieve this Innovation credit and is confident that a path will be found to earn all innovation credits. Options include, but are not limited to, exemplary performance in an existing credit, Green Building Education, Occupant Comfort Survey, Social Equity within the Project team, or Beauty and Design WELL feature compliance.

The team will prioritize evaluation of the following social equity-related Innovation credits and determine if they will be a good fit for the project: Social Equity within the Supply Chain, Social Equity within the Community, and Social Equity within the Project Team. Also note Mitigation Matrix: Minority & Women-Owned Business, support, Subsidy for Innovation/Start-up or Non-Profit Space, Local Retail Subsidy, Affordable Childcare, East End House contributions, existing open space improvements, Community Space".

INc5 Pilot: Integrative Analysis of Building Materials CS & NC 1 credit point
All phases of the Project will specify, purchase and install three different permanently installed products that have a documented qualitative analysis of potential health, safety, and environmental impacts of the product over its life cycle.

INc6 LEED Accredited Professional CS & NC 1 credit point
Many members of the team are LEED Accredited Professionals (APs).

I. Regional Priority (RP)

Regional Priority Credits (RPCs) are established by the USGBC to have priority for a particular area of the country. When a project team achieves one of the designated RPCs, an additional credit is awarded to the project. LEEDv4 RPCs applicable to the Cambridge area include: LTc3 High Priority Site (2 points), SSc4 Rainwater Management (2 points), WEc2 Indoor Water Use Reduction (4 points), EAc2 Optimize Energy Performance (17%/8 points), EAc5 Renewable Energy Production (3%/2 points), and MRc1 Building Life-Cycle Impact Reduction (2 points).

Project phases are currently tracking the following RPCs:

RPc1 EAc2 Optimize Energy Performance (17%/8 points)	CS & NC 1 credit point
RPc2 MRc1 Building Life-Cycle Impact Reduction (2 points)	CS & NC 1 credit point
RPc3 LTc3 High Priority Site (2 points)	CS 1 credit point, *NC 1 maybe point*
RPc4 Indoor Water Use Reduction (4 points)	*NC 1 maybe point*

Section IV. Additional Strategies & Considerations Not Covered in LEED Narrative

The following section has been added to address those comments from the City within the "*Cambridgeside Green Building SP Submission_Comments_07-02-2020" PDF* & "*Cambridge Green Building SP Submission-Comments_04-16-2020*" documents provided by the Cambridge Community Development Department to the Applicant that have not been addressed elsewhere. We have provided the City comment (including any bolding/formatting) and the team response below.

- City Comment: Description of ways in which building energy performance has been integrated into aspects of the Green Building Project's planning, design, and engineering, including building use(s), orientation, massing, envelope systems, building mechanical systems, on-site and off-site renewable energy systems, and district-wide enerfy systems [This narrative should discuss if the use of the district steam system was evaluated and what difference it would make for energy and emissions performance. There should be a steam line on at least the Land Blvd side.]
    - Team Response: Each phase is utilizing an integrative design methodology, and is incorporating early energy modeling for whole building analysis at multiple stages of design to advise the appropriate thermal properties of specific building envelope assemblies, and to further explore opportunities for energy reduction, energy efficiency, and greenhouse gas reduction. The team will continue to evaluate the feasibility of district steam as the design progresses. Energy and emissions impacts are difficult to quantify because steam production data is unavailable at the current time. Additionally, steam is produced via a non-renewable source fuel, which will not assist with City NZE goals.

- City Comment: Sustainability Criteria in PUD Zoning - Healthy Living and Working. All new buildings in the PUD-8 District shall provide people with access to daylight and enhance the visual and thermal comfort of people living within the PUD-8 District. [This information should be added.]
    - Team Response: Providing a healthy living and work environment is a defining factor of the Project. Each of the phases will incorporate an envelope design that maximizes access to daylight and views while providing insulated facades that manage the occupant's thermal comfort. Views out through the glazing provides visual connection to the adjacent streetscapes, open spaces, canal and river, and skyline views beyond. Outside, there are ample opportunities to directly connect with the water's edge, with open spaces and green parks, and with the local bicycle network. Inside, in addition to the neighborhood's retail and community activities, the Core mall maintains programmed activities and classes.

The four buildings that compose the project share the same site-related attributes of adjacencies to outdoor spaces, parks, and activities; and direct connections to bicycle and pedestrian networks. See the related evidence in the MPSP volume II "Development Proposal".

The project's design team recognizes the components that help guide the design of a healthy interior environment, (based upon "The Nine Foundations of a Healthy Building", Harvard School of Public Health, 2016) which includes ventilation, air quality, thermal health, moisture, dust and pests, safety and security, water quality, noise, lighting and views.

All four buildings will have a high level of thermal comfort, due in part to the code-required, high-performing building envelope and the relatively low window-to-wall ratio. They also all share in having long and direct views to outdoor spaces. Only two of the four buildings, 60 1st Street and 20 Cambridgeside Place, are in development beyond the master-plan, conceptual level and are "core and shell" projects, inherently providing less opportunity to implement actions related to healthy interiors than during the fit-out of the tenant space. Suggestion will be made to future tenants to utilize healthy guiding principles or certification programs such as Fitwel and WELL.

Nevertheless, the common spaces of the "core and shell" buildings will have good ventilation, air-quality, and dust-control due to following the LEED credits for Indoor Air Quality Performance and Enhanced Indoor Air Quality Strategies; and will have access to good views due to following the LEED Views credit. There will be enhanced HVAC filtration and limited VOC's in indoor materials. Drinking water will be easily accessible on each occupiable floor. Each toilet room at 20 Cambridgeside Place will be a gender-neutral, single-use room with its own lavatory. There will be a wide, visible, inviting stairway at the ground level entry communicating people to the second floor -- promoting passive exercise.

- City Comment: Sustainability Criteria in PUD Zoning - Transportation. Final Development Plans within the PUD-8 District shall encourage multimodal transportation, provide facilities for cyclists and provide an infrastructure to support alternative energy vehicles. [OK if this is covered in the Transportation section of the Development Proposal]
  - Team Response: As provided in the TIS submitted in connection with the Project, the Applicant is committed to comprehensive transportation mitigation and TDM measures that will encourage multimodal transportation. The Project will also support the use of alternative energy vehicles, including through the provision of 34 EV charging stations. Additionally, the Project includes wider sidewalks, improved pedestrian and cyclist amenities and dramatically increased bicycle parking to support these alternative modes of transportation.

- City Comment: Requirements for Net Zero Plan in PUD Zoning - Opportunities for ground source and air source heat pumps [Mentioned in Net Zero Narrative but could include more detail of what opportunities were studied]
  - Team Response: The Project will explore future electrification and an air-source heat pump system that could provide chilled and hot water as needed. We contend that it would be cost prohibitive to add GSHP to the Project given site constraints and the existing nature of the building.

- City Comment: Requirements for Net Zero Plan in PUD Zoning - Solar hot water [Not covered in report]
  - Team Response: The Applicant believes technology is not practical for commercial buildings because demand for hot water is low. The team will evaluate this system on the future residential building when the project moves forward, if rooftop space is available.

- City Comment: Requirements for Net Zero Plan in PUD Zoning - Bio-fuel emergency power fuel [Not covered in report]

  - Team Response: The use of bio-fuels will be evaluated on a phase-by-phase basis as design progresses.

- City Comment: Requirements for Net Zero Plan in PUD Zoning - Battery storage [Not covered in report]
  - Team Response: The feasibility of installing battery storage for peak shaving will be evaluated as design of buildings progresses.

- City Comment: Requirements for Net Zero Plan in PUD Zoning - Relevant energy initiatives implemented through the City of Cambridge [Not covered in report]
  - Team Response: The team will meet all required City energy initiatives and is open to evaluating opportunities to participate in City programs.

- City Comment: Requirements for Net Zero Plan in PUD Zoning - Participation, if available, in any program sponsored by the City of Cambridge for community renewable energy purchase [Not covered in report]
  - Team Response: The team is open to evaluating opportunities to participate in City programs.

- City Comment: Has Passive House been considered as an alternative to LEED, particularly for the residential building? Passive House-based design may provide additional thermal resilience benefits as well as better energy performance.
  - Team Response: When the residential phase approaches, the Project will aim to incorporate appropriate Passive House methodologies.

- City Comment: Regarding the solar energy study, it seems that there are a range of financial options that should make solar PV installation viable. Generally, projects in Cambridge that have been designed to be "solar ready" have not led to actual installation of PV systems. Consider working with a third party installer through a PPA if not interested in owning.
  - Team Response: The Applicant will consider a PPA. This discussion will happen as each phase progresses through design to accurately assess feability based on available roof area and current market and incentive conditions.

- City Comment: Regarding the EA-Greenpower credit, staff feels that investing in onsite solar or a new offsite project would be more valuable than buying RECs or carbon credits that are as old as 2005.
  - Team Response: Noted. The Applicant will continue to consider PV on-site including through a PPA.

- City Comment: Will electricity provided to residential units be from non-fossil fuel sources?
  - Team Response: The electricity to be provided to the future residential units will be by Eversource, and will be generated by whatever their mix of fossil-fuel and renewable energy sources are at the time, several years from now, after this building is constructed and operating.

- City Comment: What is the rationale for using LEED 4.1 Beta for some credits and not others?
  - Team Response: The USGBC released the beta version of the LEEDv4.1 rating system which is intended to serve as an update to (and improvement upon) LEEDv4. Recent guidance issued by the USGBC allows LEEDv4 projects to substitute any prerequisite or targeted credit for the LEEDv4.1 equivalent. LEEDv4.1 versus LEEDv4 compliance approach will be evaluated on a credit-by-credit basis. The team will use the requirements that are most suitable for the project.

Section VI. LEED SCORECARDS

LEEDv4 Core & Shell Office/Lab Project Scorecard (target)

LEED v4 for BD+C: Core and Shell
Project Checklist

Project Name: **CambridgeSide Office/Lab**
Date: **5.26.2020**

Project Total

Y	M	N
65	18	27

Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80+ points

Y	M	N			
1	0	0		**Integrative Process**	1
1			Credit	Integrative Process	1
19	1	0		**Location and Transportation**	20
		x	Credit	LEED for Neighborhood Development Location	16
2			Credit	Sensitive Land Protection	2
2	1		Credit	High Priority Site (RP@2)	3
6			Credit	Surrounding Density and Diverse Uses	6
6			Credit	Access to Quality Transit	6
1			Credit	Bicycle Facilities	1
1			Credit	Reduced Parking Footprint	1
1			Credit	Green Vehicles	1
6	3	2		**Sustainable Sites**	11
Y			Prereq	Construction Activity Pollution Prevention	Required
1			Credit	Site Assessment	1
1		1	Credit	Site Development - Protect or Restore Habitat	2
		1	Credit	Open Space	1
	3		Credit	Rainwater Management (RP@2)	3
2			Credit	Heat Island Reduction	2
1			Credit	Light Pollution Reduction	1
1			Credit	Tenant Design and Construction Guidelines	1
5	2	4		**Water Efficiency**	11
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
		2	Credit	Outdoor Water Use Reduction	2
2	2	2	Credit	Indoor Water Use Reduction (RP@4)	6
2			Credit	Cooling Tower Water Use	2
1			Credit	Water Metering	1
14	7	12		**Energy and Atmosphere**	33
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
3		3	Credit	Enhanced Commissioning	6
10	4	4	Credit	Optimize Energy Performance (RP@8)	18
		1	Credit	Advanced Energy Metering	1
		2	Credit	Demand Response	2
	1	2	Credit	Renewable Energy Production (RP@2)	3
1			Credit	Enhanced Refrigerant Management	1
	2		Credit	Green Power and Carbon Offsets	2

Y	M	N			
5	3	6		**Materials and Resources**	14
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
2	1	3	Credit	Building Life-Cycle Impact Reduction (RP@2)	6
1		1	Credit	Building Product Disclosure & Optimization Environmental Product Declarations	2
	1	1	Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1		1	Credit	Building Product Disclosure and Optimization - Material Ingredients	2
1	1		Credit	Construction and Demolition Waste Management	2
6	1	3		**Indoor Environmental Quality**	10
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
2			Credit	Enhanced Indoor Air Quality Strategies	2
2	1		Credit	Low-Emitting Materials	3
1			Credit	Construction IAQ Management Plan	1
		3	Credit	Daylight	3
1			Credit	Quality Views	1
6	0	0		**Innovation**	6
1			Credit	Innovation: Exemplary Performance Heat Island	1
1			Credit	Innovation: Sustainable Purchasing - Lamps	1
1			Credit	Innovation: Pilot - Integrative Analysis of Building Materials	1
1			Credit	Innovation: TBD	1
1			Credit	Innovation: TBD	1
1			Credit	LEED Accredited Professional	1
3	1	0		**Regional Priority (max of 4 points)**	4
1			Credit	High Priority Site (RP@2)	
	X		Credit	Rainwater Management (RP@2)	
	1		Credit	Indoor Water Use Reduction (RP@4)	
1			Credit	Optimize Energy Performance (RP@8)	
	X		Credit	Renewable Energy Production (RP@2)	
1			Credit	Building Life-Cycle Impact Reduction (RP@2)	
65	18	27		**TOTALS**	110

Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80+ points

The Green Engineer
Sustainable Design Consulting

LEED v4 New Construction Residential Project Scorecard (target)

LEED v4 for BD+C: New Construction & Major Renovation
Project Checklist

Project Name: CambridgeSide Residential
Date: 5.26.2020

Project Total

Y	M	N	
60	20	30	Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80+ points

Y	M	N	Type	Category / Credit	Points
1	0	0		**Integrative Process**	1
1			Credit	Integrative Process	1
15	1	0		**Location and Transportation**	16
		x	Credit	LEED for Neighborhood Development Location	15
1			Credit	Sensitive Land Protection	1
1	1		Credit	High Priority Site (RP@2)	2
5			Credit	Surrounding Density and Diverse Uses	5
5			Credit	Access to Quality Transit	5
1			Credit	Bicycle Facilities	1
1			Credit	Reduced Parking Footprint	1
1			Credit	Green Vehicles	1
5	3	2		**Sustainable Sites**	10
Y			Prereq	Construction Activity Pollution Prevention	Required
1			Credit	Site Assessment	1
1		1	Credit	Site Development - Protect or Restore Habitat	2
		1	Credit	Open Space	1
	3		Credit	Rainwater Management (RP@2)	3
2			Credit	Heat Island Reduction	2
1			Credit	Light Pollution Reduction	1
5	2	4		**Water Efficiency**	11
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
		2	Credit	Outdoor Water Use Reduction	2
2	2	2	Credit	Indoor Water Use Reduction (RP@4)	6
2			Credit	Cooling Tower Water Use	2
1			Credit	Water Metering	1
13	6	14		**Energy and Atmosphere**	33
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
3		3	Credit	Enhanced Commissioning	6
8	5	5	Credit	Optimize Energy Performance (RP@8)	18
		1	Credit	Advanced Energy Metering	1
		2	Credit	Demand Response	2
	1	2	Credit	Renewable Energy Production (RP@2)	3
		1	Credit	Enhanced Refrigerant Management	1
2			Credit	Green Power and Carbon Offsets	2
5	3	5		**Materials and Resources**	13
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
2	1	2	Credit	Building Life-Cycle Impact Reduction (RP@2)	5
1		1	Credit	Building Product Disclosure & Optimization Environmental Product Declarations	2
	1	1	Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1		1	Credit	Building Product Disclosure and Optimization - Material Ingredients	2
1	1		Credit	Construction and Demolition Waste Management	2
8	3	5		**Indoor Environmental Quality**	16
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
2			Credit	Enhanced Indoor Air Quality Strategies	2
2	1		Credit	Low-Emitting Materials	3
1			Credit	Construction IAQ Management Plan	1
	2		Credit	Indoor Air Quality Assessment	2
1			Credit	Thermal Comfort	1
1		1	Credit	Interior Lighting	2
		3	Credit	Daylight	3
1			Credit	Quality Views	1
		1	Credit	Acoustic Performance	1
6	0	0		**Innovation**	6
1			Credit	Innovation: Exemplary Performance Heat Island	1
1			Credit	Innovation: Sustainable Purchasing - Lamps	1
1			Credit	Innovation: Pilot - Integrative Analysis of Building Materials	1
1			Credit	Innovation: TBD	1
1			Credit	Innovation: TBD	1
1			Credit	LEED Accredited Professional	1
2	2	0		**Regional Priority (max of 4 points)**	4
	1		Credit	High Priority Site (RP@2)	
	X		Credit	Rainwater Management (RP@2)	
	1		Credit	Indoor Water Use Reduction (RP@4)	
1			Credit	Optimize Energy Performance (RP@8)	
	X		Credit	Renewable Energy Production (RP@2)	
1			Credit	Building Life-Cycle Impact Reduction (RP@2)	
60	20	30		**TOTALS**	110

Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80+ points

The Green Engineer
Sustainable Design Consulting

The Green Engineer
Sustainable Design Consulting

www.greenengineer.com

Memo

Project: CambridgeSide 2.0
Re: PATHWAY TO NET ZERO READY
Date Issued: July 14, 2020

Executive Summary

The purpose of this study is to outline a potential pathway to “net zero emissions” for the proposed redevelopment of CambridgeSide mall into a mixed-use development including retail, office, laboratory, restaurant and residential uses (the "Project"), as described further. “Net zero emissions ready” is understood to be a building that has a low site energy consumption and uses no fossil fuels. The current design for the proposed building typologies in the Project creates low site energy buildings but relies on natural gas for building heating or service water heating. Future advances in lighting and control technology, and the use of air source heat pumps, could allow the buildings to be converted to all electric in the future. In addition, there may be opportunity for onsite solar to be incorporated, but not enough to bring the buildings to net zero onsite. Additional off-site renewable energy will be required to bring the buildings to net zero.

The Project will provide approximately 875,000 sf of commercial space (retail, office, laboratories), and approximately 175,000 sf of residential space (with 200 dwelling units). These spaces would be designed in place of the existing anchor retail stores - Sears, Macy’s, and Best Buy, as well as the Upper Garage. Each proposed building is utilizing an integrative design methodology, and is incorporating early energy modeling for whole building analysis at multiple stages of design to advise the appropriate thermal properties of specific building envelope assemblies, and to further explore opportunities for energy reduction on mechanical systems, improve energy efficiency, and reduce greenhouse gas emissions. The following energy conservation measures (ECMs), customized for each building will be evaluated during design. Please refer to Appendix A of this report for details of each ECM.

1. Better performing building envelope.
2. Installing cool roofs covered with high albedo material.
3. Air Source Heat Pumps with VRF in the residential building.
4. High efficiency (better than Code requirement) equipment for space heating and cooling.
5. Energy Recovery Ventilation (ERV) systems in all buildings.
6. High efficiency service hot water systems and low flow plumbing fixtures.
7. Reduced lighting power density.
8. Using Energy STAR rated appliances in residential units.
9. Providing solar-ready roof space on some of the new roofs for a possible PV system.

Table 1: Project Energy Use Intesity (EUI) Summary

Buildings	Basecase EUI (kBTU/SF)	Design Case EUI (kBTU/SF)	Net Zero Option EUI (kBTU/SF)
80 & 90 First Street (Residential and Office)	52.5	32.1	23.1
60 First Street (Laboratory)	193.6	120.4	78.9
110 First Street (Office and Laboratory)	159.7	101.1	67.3
20 CambridgeSide (Laboratory)	230.0	136.8	80.5

Table 2: Project Greenhouse Gas (GHG) Emissions Summary

Buildings	Basecase GHG (MTCO2e)	Design Case GHG (MTCO2e)	Net Zero Option GHG (MTCO2e)
80 & 90 First Street (Residential and Office)	955	660	474
60 First Street (Laboratory)	2511	1728	1202
110 First Street (Office and Laboratory)	3048	2130	1509
20 CambridgeSide (Laboratory)	5480	3532	2327

Summary of Current Model Results

Early energy studies were used to estimate site Energy Use Intensities (EUI) and greenhouse gas (GHG) emissions for the four buildings in the development. The energy modeling details have been updated and results refined in response to comments received from the Community Development Department (CDD) during the pre-filing review and to reflect the ongoing development of the design. The current set of results are based on building typology specific modeling and incorporate detailed inputs as it pertains to thermal envelope, internal loads, and HVAC system selections. Three alternatives per building were evaluated: Baseline MA energy code, Proposed per design and Net Zero Energy option.

Two of the four buildings, 60 First Street and 20 CambridgeSide, are in Schematic Design phase and are Core and Shell speculative laboratory building typology (60/40 laboratory/office space split) with ground floor retail. For these buildings, project specific energy analysis was performed to identify ECMs and estimate building site EUI and GHG emissions.

For the other two buildings which the Applicant does not anticipate constructing until after 60 First Street and 20 CambridgeSide are completed, 80 & 90 First Street and 110 First Street, detailed prototypical models were used. The 80 & 90 First Street building is a residential typology and assumes 200 residential units, with a ground floor retail, office floors, and other amenity spaces like gymnasium, office, etc. Energy use of a residential building is dependent on number of bedrooms per unit and may change as design progresses.110 First Street building is assumed to be a Core and Shell with office tenant floors and laboratory (60/40 laboratory/office space split) tenant floors. It also includes ground floor retail. Details of inputs for each building typology can be found in the appendix A of this report.

As the individual buildings design progresses, integrative analysis will remain part of the design strategy to implement effective and feasible mitigation measures to optimize Project's energy performance and reduce GHG emissions.

Tables 3, 4, 5 and 6 provide details of energy use by fuel type, site EUI and GHG emissions for the Project.

Table 3: Site Summary - 80 & 90 First Street (Residential and Office)				
Energy Source	Unit	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option with PV
Natural Gas	Therm	57,817	-	-
Electricity	kWh	2,540,782	2,589,530	1,859,662
Total Building Site EUI (kBtu/SF-yr)		52.5	32.1	23.1
% Site Energy Savings Over Code Baseline			38.9%	56.1%
Total Building GHG emissions (MTCo2e)		954.7	660.0	474.0
% GHG Savings Over Code Baseline			30.9%	50.4%

Table 4: Site Summary - 60 First Street (Laboratory)				
Energy Source	Unit	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option w/PV
Natural Gas	Therm	210,237	53,605	-
Electricity	kWh	5,470,324	5,662,026	4,717,520
Total Building Site EUI (kBtu/SF-yr)		193.6	120.4	78.5
% Site Energy Savings Over Code Baseline			37.8%	59.4%
Total Building GHG emissions (MTCo2e)		2510.8	1727.8	1202.4
% GHG Savings Over Code Baseline			31.2%	52.1%

Table 5: Site Summary - 110 First Street (Office and Laboratory)				
Energy Source	Unit	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option w/PV
Natural Gas	Therm	246,131	62,757	-
Electricity	kWh	6,828,124	7,049,578	5,918,913
Total Building Site EUI (kBtu/SF-yr)		159.7	101.1	67.3
% Site Energy Savings Over Code Baseline			36.7%	57.8%
Total Building GHG emissions (MTCo2e)		3047.5	2130.1	1508.6
% GHG Savings Over Code Baseline			30.1%	50.5%

Table 6: Site Summary - 20 CambridgeSide (Laboratory)				
Energy Source	Unit	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option w/ PV
Natural Gas	Therm	541,298	196,066	-
Electricity	kWh	10,220,941	9,773,038	9,130,597
Total Building Site EUI (kBtu/SF-yr)		230.0	136.8	80.5
% Site Energy Savings Over Code Baseline			40.5%	65.0%
Total Building GHG emissions (MTCo2e)		5479.9	3532.2	2327.2
% GHG Savings Over Code Baseline			35.5%	57.5%

Getting to Net Zero Energy Use in the future

Five opportunities for future improvement of the Project have been identified that are included in the Net Zero Option energy results provided in tables 3 to 6.

1) In a Core and Shell project, space lighting design is driven by the tenant design. Although beyond the Applicant's scope of work, it is assumed that the tenants will design their spaces to be at least 20% below new code allowable lighting power density (LPD) for the core and shell buildings. It is important to acknowledge that the new Massachusetts Building Energy code has stringent LPD thresholds and the Applicant will be engaging in dialogue with the tenants to go beyond the code thresholds. This LPD reduction in tenant spaces may be required through tenant lease and sale agreements on individual buildings.

2) Lighting technology continues to improve, as LED technology and automatic lighting controls become commonplace. We anticipate that over time, future lighting improvements will reduce both interior lighting and exterior lighting by about 50%. This would also have the effect of reducing cooling loads while increasing heating loads.

3) Receptacle loads represent the significant energy end use in the proposed buildings, due to the high numbers of lab equipment, computers, monitors, printers, etc. expected in the building. Currently plug loads are growing and continue to grow, as phones, tablets, etc. proliferate, along with the phantom loads their chargers create. We anticipate that this trend will reverse with improvement in equipment technology over time and estimate a future plug load savings at 25%. This would also have the effect of reducing cooling loads while increasing heating loads.

4) While not currently economically feasible, the commercial projects that are proposed to use natural gas heating could eventually be converted to all electric service. We would expect this to occur at the end of life of the original HVAC systems. There are a few options potentially available. The actual methodology will depend on innovations in technology over the next several decades.

Our analysis assumes that some sort of air source heat pump technology would be used. In this option the boilers and chillers would be replaced with modular air-cooled heat pumps that could provide chilled and hot water as needed. These are split units - the indoor portion would replace the existing chillers and boilers, while the outdoor portion would be located on the roof, potentially augmenting, or replacing the cooling towers.

Potential difficulties include the hot water temperatures the heat pumps can generate. Current technology struggles to heat beyond 130 deg F. It is possible that future heat pump technology can generate higher temperatures, but it should also be noted that the proposed HVAC systems will use lower temperatures to maximize boiler efficiency.

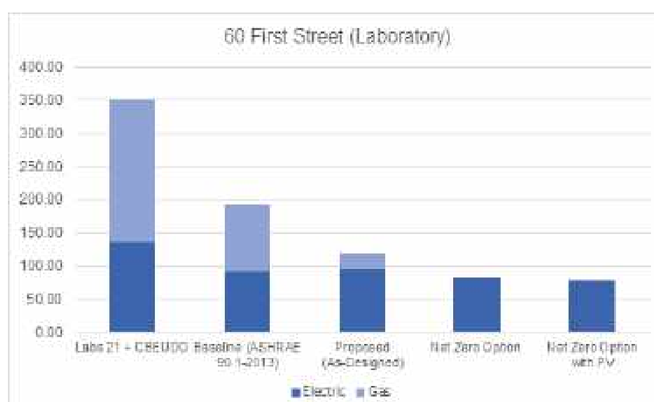
The modular nature of the future systems would allow relatively easy installation - equipment could be brought in through service elevators. Another alternative would be to use electric boilers, or a hybrid heat pump with electric boiler back-up/booster.

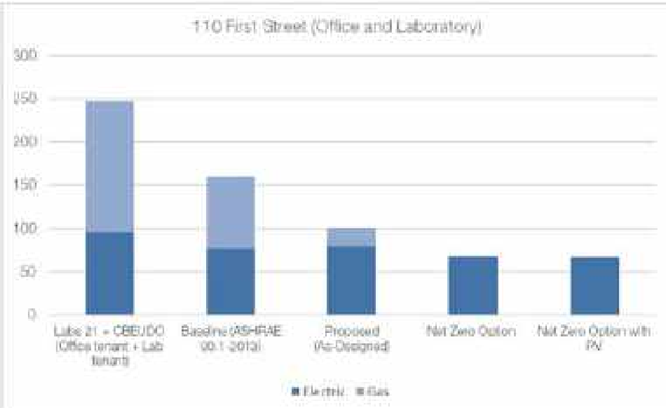
5) The residential typology currently proposes Air Source Heat Pump (ASHP) for building heating and service water heating. To lower the energy use in the future, at the end of life of the original equipment it is possible to convert to a higher efficiency heat pump systems of the future, along with further reductions in installed lighting, in-unit appliances, and plug loads.

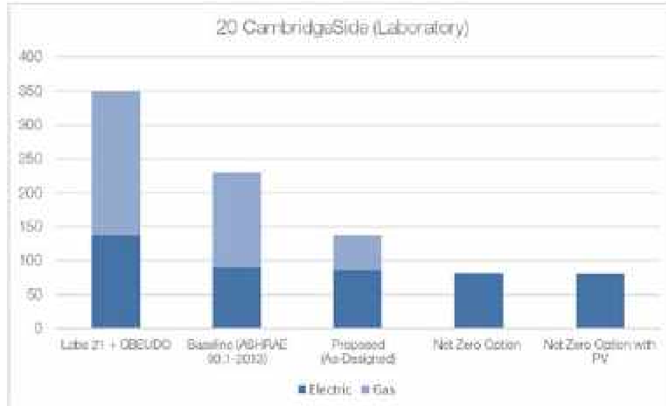
In addition, there may be opportunity for some onsite solar PV based on the preliminary feasibility study (refer to the PV analysis report for details). The study indicates that about 485 kW capacity may be available for all the top tier roofs combined. This estimate is dependent on the final layout of the rooftop penthouses and equipment and the actual numbers will change as individual buildings progress. For the Project, there is considerable area that needs to be dedicated to primary HVAC equipment and mechanical penthouses. That area has not been included in the PV feasibility study report. Of the remaining roof area with good solar access only 85% could be available for PV arrays and be deemed solar ready. This area is being referred to as “Net Available Roof Area” in the PV analysis report. The 15% area deduction accounts for setbacks from equipment, space for various vent pipes, shafts, fire access, etc.

Any further carbon emission reductions would have to come through greening of grid electricity, offsite renewables, and/or carbon offsets.

In context we find that the current proposed design for the residential building typology is low energy, compared to a residential building with an Energy Star score of 75. Similarly, we also find that the current proposed design for the commercial building typologies is low energy, compared to an average performing building in the Labs21 dataset and Cambridge Building Energy Use Disclosure Ordinance dataset.







Conclusions

The current design of the Project results in low energy buildings, as seen through the early energy analysis summarized above. We anticipate that advances in technology will further reduce consumption. The future conversion to heat pump technology would allow the buildings to be “net zero energy ready”. While there are some opportunities for onsite renewables, it is not expected to be sufficient to meet all the Project's future energy needs. Based on the analysis performed for the net zero energy option with potential PV on site for each of the buildings, there is need to offset remainder of the on-site energy use. To achieve net carbon neutrality, the greening of grid electricity, offsite renewables and/or the purchase of carbon offsets would have to occur for the Project.

See Appendix A on the following pages for further energy analysis details.

Appendix A:

Detailed Results and Summary of Inputs

Below are detailed modeling results per end-use for each building based on preliminary energy assessments.

80 & 90 First Street -Residential & Office			
	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option with PV
Natural Gas	Therm	Therm	Therm
Interior Lighting	-	-	-
Task Lights	-	-	-
Process Energy	-	-	-
Space Heating	41,818	-	-
Space Cooling	-	-	-
Heat Rejection	-	-	-
Pumps	-	-	-
Fans	-	-	-
Refrigeration	-	-	-
Heat Pump Auxilliary	-	-	-
DHW	15,999	-	-
Exterior Lighting	-	-	-
		-	-
Sub-Total	57,817	-	-

Electricity	kWh	kWh	kWh
Interior Lighting	376,395	311,249	233,437
Task Lights	-	-	-
Process Energy	794,836	771,724	578,832
Space Heating	-	184,639	156,943
Space Cooling	372,151	196,078	166,666
Heat Rejection	-	-	-
Pumps	11,498	-	-
Fans	974,324	930,932	769,061
Refrigeration	-	-	-
Heat Pump Auxilliary	-	41,368	37,231
DHW	-	143,214	71,754
Garage Lighting	11,579	10,327	3,431
On-Site PV potential		-	(157,693)
Sub-Total	2,540,782	2,589,530	1,859,662

Table 3: Site Summary - 80 & 90 First Street (Residential and Office)				
Energy Source	Unit	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option with PV
Natural Gas	Therm	57,817	-	-
Electricity	kWh	2,540,782	2,589,530	1,859,662
Total Building Site EUI (kBtu/SF-yr)		52.5	32.1	23.1
% Site Energy Savings Over Code Baseline			38.9%	56.1%
Total Building GHG emissions (MTCo2e)		954.7	660.0	474.0
% GHG Savings Over Code Baseline			30.9%	50.4%

60 First Street - Core and Shell (Laboratory)			
	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option w/PV
Natural Gas	Therm	Therm	Therm
Interior Lighting	-	-	-
Task Lights	-	-	-
Process Energy	-	-	-
Space Heating	210,237	53,605	-
Space Cooling	-	-	-
Heat Rejection	-	-	-
Pumps	-	-	-
Fans	-	-	-
Refrigeration	-	-	-
Heat Pump Auxilliary	-	-	-
DHW		-	-
Exterior Lighting	-	-	-
		-	-
Sub-Total	210,237	53,605	-

Electricity	kWh	kWh	kWh
Interior Lighting	582,556	582,858	218,572
Task Lights	-	-	-
Process Energy	2,131,308	2,131,308	1,598,481
Space Heating	-	6,297	493,330
Space Cooling	432,434	369,842	295,874
Heat Rejection	46,927	40,421	32,337
Pumps	296,757	228,688	217,254
Fans	1,882,313	2,234,434	2,010,991
Refrigeration	-	-	-
Heat Pump Auxilliary	-	-	5,629
DHW	73,360	43,509	21,809
Elevator	24,669	24,669	6,862
On-Site PV potential		-	(183,617)
Sub-Total	5,470,324	5,662,026	4,717,520

Table 4: Site Summary - 60 First Street (Laboratory)				
Energy Source	Unit	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option w/PV
Natural Gas	Therm	210,237	53,605	-
Electricity	kWh	5,470,324	5,662,026	4,717,520
Total Building Site EUI (kBtu/SF-yr)		193.6	120.4	78.5
% Site Energy Savings Over Code Baseline			37.8%	59.4%
Total Building GHG emissions (MTCo2e)		2510.8	1727.8	1202.4
% GHG Savings Over Code Baseline			31.2%	52.1%

110 First Street - Core and Shell (Office and Laboratory)			
	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option w/PV
Natural Gas	Therm	Therm	Therm
Interior Lighting	-	-	-
Task Lights	-	-	-
Process Energy	-	-	-
Space Heating	246,131	62,757	-
Space Cooling	-	-	-
Heat Rejection	-	-	-
Pumps	-	-	-
Fans	-	-	-
Refrigeration	-	-	-
Heat Pump Auxilliary	-	-	-
DHW		-	-
Exterior Lighting	-	-	-
		-	-
Sub-Total	246,131	62,757	-

Electricity	kWh	kWh	kWh
Interior Lighting	767,269	767,667	287,875
Task Lights	-	-	-
Process Energy	2,807,089	2,807,089	2,105,316
Space Heating	-	9,215	579,400
Space Cooling	506,264	432,986	346,389
Heat Rejection	54,939	47,322	37,858
Pumps	390,851	301,199	286,139
Fans	2,203,684	2,615,923	2,354,330
Refrigeration	-	-	-
Heat Pump Auxilliary	-	-	5,629
DHW	73,360	43,509	21,809
Elevator	24,669	24,669	24,669
On-Site PV potential		-	(130,501)
Sub-Total	6,828,124	7,049,578	5,918,913

Table 5: Site Summary - 110 First Street (Office and Laboratory)				
Energy Source	Unit	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option w/PV
Natural Gas	Therm	246,131	62,757	-
Electricity	kWh	6,828,124	7,049,578	5,918,913
Total Building Site EUI (kBtu/SF-yr)		159.7	101.1	67.3
% Site Energy Savings Over Code Baseline			36.7%	57.8%
Total Building GHG emissions (MTCo2e)		3047.5	2130.1	1508.6
% GHG Savings Over Code Baseline			30.1%	50.5%

20 CambridgeSide - Core and Shell (Laboratory)			
	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option w/ PV
Natural Gas	Therm	Therm	Therm
Interior Lighting	-	-	-
Task Lights	-	-	-
Process Energy	-	-	-
Space Heating	541,298	196,066	-
Space Cooling	-	-	-
Heat Rejection	-	-	-
Pumps	-	-	-
Fans	-	-	-
Refrigeration	-	-	-
Exterior Lighting	-	-	-
DHW		-	-
Exterior Lighting	-	-	-
		-	-
Sub-Total	541,298	196,066	-

Electricity	kWh	kWh	kWh
Interior Lighting	1,537,844	1,522,905	571,089
Task Lights	-	-	-
Process Energy	2,974,053	2,974,053	2,230,540
Space Heating	-	11,449	1,792,822
Space Cooling	1,152,701	543,698	434,958
Heat Rejection	13,300	11,949	9,559
Pumps	823,457	424,396	403,176
Fans	3,386,121	3,991,180	3,592,062
Refrigeration	-	-	-
Exterior Lighting	31,892	31,892	15,946
DHW	116,245	76,188	38,189
Elevator	185,328	185,328	185,328
On-Site PV potential		-	(143,074)
Sub-Total	10,220,941	9,773,038	9,130,597

Table 6: Site Summary - 20 CambridgeSide (Laboratory)				
Energy Source	Unit	Baseline (ASHRAE 90.1-2013)	Proposed (As-Designed)	Net Zero Option w/ PV
Natural Gas	Therm	541,298	196,066	-
Electricity	kWh	10,220,941	9,773,038	9,130,597
Total Building Site EUI (kBtu/SF-yr)		230.0	136.8	80.5
% Site Energy Savings Over Code Baseline			40.5%	65.0%
Total Building GHG emissions (MTCo2e)		5479.9	3532.2	2327.2
% GHG Savings Over Code Baseline			35.5%	57.5%

Input Summary: Residential Building Typology 80 & 90 First Street		
Energy Conservation Measure Summary		
1. Improved opaque envelope 2. Improved fenestration with WWR - 24% per MA amendments 3. Low flow plumbing fixtures 4. DOAS + Energy Recovery 5. High Efficiency HVAC systems 6. Energy Star Rated appliances		
Building Component	Baseline (ASHRAE 90.1-2013)	Proposed (As-Design)
Building Type	Residential	
Utility Rates	EIA State Average 2019 Electricity $0.16/kWh Gas $1.1/therm	
Roof Assembly	Per Table 5.5-5, ASHRAE 90.1-2013 R-30 continuous insulation U-0.032	Proposed design R-40 c.i. (U-Value - 0.025)
Wall Assembly	Per Table 5.5-5, ASHRAE 90.1-2013 R13 + R10 c.i. on steel frame assembly U-0.055	Per proposed design 4" of ci Assembly U-Value : 0.054
Windows & Glazing	Per Table 5.5-5, ASHRAE 90.1-2013 Dwelling Units - Operable Metal Frame U - 0.50 SHGC - 0.40 VT - 0.44	Operable Metal Frame Glazing Assembly values U-Value - 0.28 SHGC - 0.37 VT- 0.49
Window to Wall Ratio *Per MA C401.2.4 of new code*	24%	24%
Infiltration	0.4 cfm/sf	0.4 cfm/sf
HVAC System	Per Table G3.1.1-3, ASHRAE 90.1-2013 Heat Recovery per code in Baseline Dwelling Unit: PTAC with DX cooling and hot water heating packaged DOAS+Energy Recovery for ventilation Common Areas: PTAC with DX cooling and hot water heating	Per proposed design: Dwelling Unit: ASHP - VRF packaged DOAS+Energy Recovery for ventilation Common Areas: Same as Dwelling Unit
Cooling Efficiency	Dwelling Unit: 9.5 EER - PTAC units per ASHRAE - 90.1-2013 Common Areas: 9.5 EER - PTAC units per ASHRAE - 90.1-2013	ASHP for Cooling EER of 14.5 Packadged DX cooling for DOAS system EER of 14
Heating Efficiency	80% Efficient Conventional Boiler, Per ASHRAE - 90.1-2013	ASHP for Heating DOAS (all electric)
Supply Air (CFM) (Estimated)	Auto-sized	auto-sized
Ventilation Air (CFM) (Estimated)	As per ASHRAE 62.1 minimum ventilation requirements	As per ASHRAE 62.1 minimum ventilation requirements
Fan Power Per ASHRAE 90.1-2013	Dwelling Unit: In-Unit PTAC fan power 0.3 w/cfm DOAS fan power unit for code C406 options, 1.5 w/cfm (DOAS ventilation only) Common Areas: 0.3 w/cfm	Dwelling Unit: 1.5 w/cfm (DOAS ventilation only) In-Unit Heat Pump Fan Power - 0.2 W/CFM Common Areas: Same as Dwelling Unit

Ventilation Energy Recovery Per IECC C403.7.4(2.1)	DOAS will have energy recovery, required by code, 50% total effectiveness	Total Enthalpy 70% effectiveness
Demand Control Ventilation Per IECC C403.7.1	Not required	N/A
Lighting LPD *Per MA Amendment for section C405.3.2(2) & C406.3*	Space by space type: MA amendment LPD (ASHRAE 90.1-2013 allowance) Amenity : 0.9 W/SF Elevator Lobby: 0.51 W/SF (0.64 W/SF) Entry Lobby: 0.84 W/SF (0.90 W/SF) Corridor: 0.41 W/SF (0.66 W/SF) Office: 0.61 W/SF (0.98 W/SF) Retail: 1.05 W/SF (1.44 W/SF) Dwelling Units: 1.07 W/SF as per energy star multifamily Amenities: 0.66 W/SF (0.73 W/SF) Laundry: 0.53 W/SF (0.60 W/SF) Stairwell: 0.49 W/SF (0.69) Elect/Mech: 0.43 W/SF (0.42 W/sF) Parking Garage: 0.15 w/sf (0.19 W/SF)- C406.4 controls dont apply **Code Baseline model run includes 10% reduction on the LPD reduction, 5% reduction for controls*	Space by space type: as per design targets Amenity : 0.9 W/SF Elevator Lobby: 0.45 W/SF Entry Lobby: 0.75 W/SF Corridor: 0.30 W/SF Office: 0.50 W/SF Retail: 1.05 W/SF Dwelling Units: 0.8 W/SF design target for hardwired areas Amenities: 0.55 W/SF Laundry: 0.45 W/SF Stairwell: 0.35 W/SF Elect/Mech: 0.35 W/SF Parking Garage: 0.10 W/SF - C406.4 controls dont apply **model run includes 5% reduction on the MA Amendment allowance.*
Lighting Controls Per MA C406.4	Not required in dwelling unit	Parking garage zone control with occupancy sensors - imbedded in fixtures.
Service Hot Water & Fixtures Per MA C406.7.1	Electric Resistance DHW storage heater Plumbing flow fixtures (as per LEED Baseline) Showerhead - 2.5 gpm Lav Faucet - 2.2 gpm Kitchen Faucet - 2.2 gpm	In-Unit ASHP , COP of 2.1 30% hot water fixture reduction (as per LEED requirements) Showerhead - 1.75 gpm Lav Faucet - 1.0 gpm Kitchen Faucet - 1.75 gpm
Process Loads (Unregulated)	Dwelling Unit: 1.75 w/sf (intensity is high due to more studio units) Common Areas: 0.25 w/sf	Energy star rated appliances Fridge, washer/dryer, dishwasher Model to take credit for energy star rated appliances Dwelling Unit: 1.64 w/sf (intensity is high due to more studio units)
Stretch Code requirements per MA Amendments *Comply with C406.1 Options* *(3 of 10)* Project selections are high-lighted in red and required to be identical in the baseline and proposed case models per the new MA energy code amendments.	1. More efficient HVAC performance in accordance with section C406.2. 2. Reduced lighting power density system in accordance with section C406.3. 3. Enhanced lighting controls in accordance with section C406.4. (assumed applicable to non-resi spaces ONLY) 4. On-site supply of renewable energy in accordance with section C406.5. 5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with section C406.6. 6. High-efficiency service water heating in accordance with section C406.7. 7. Enhanced envelope performance in accordance with Section C406.8. 8. Reduced air-infiltration in accordance with Section 406.9. 9. Renewable space heating in accordance with Section 406.10. 10. Type IV Heavy timber construction in accordance with Section 406.11.	Options same as Baseline

Input Summary : Commercial Building Typology 60 First Street, 110 First Street, and 20 CambridgeSide		
Energy Conservation Measures		
1. Improved Fenestration 2. Reduced LPD and lightign controlrs 3. Effiicient HVAC system 4. Energy Recovery on air-handling units 5. Office spaces - DOAS +FCU 6. Flow flow plumbing fixtures		
Model Input Parameter	Baseline (ASHRAE 90.1-2013)	Proposed (as-designed)
Building Envelope (Construction Assemblies)		
Roof	As per ASHRAE 90.1-2013 code Insulation entirely above deck R-value: 30 c.i. Roof U-Value (assembly): 0.032	Insulation above deck - Roof Assembly R-value: 30 c.i. Roof U-Value (assembly): 0.032
Walls - Above Grade	Exterior wall : Steel Framed Walls Insulation as per Appendix G, ASHRAE 90.1-2013 - R-13 + R-10 c.i. Wall U-Value (assembly): 0.055	Metal Panel Wall: 4" mineral wool insulation - R-17.2 Masonry Wall: 4" mineral wool insulation - R- 18.4 CMU Wall: R-17.2 Average Wall: U-VAlue (assembly): 0.057
Exposed Floor	R-30	R-30
Building Infiltration	0.4 cfm/sf	0.4 cfm/sf
Window Wall Ratio	40% as per Appendix G, Table G3.1.5c, ASHRAE 90.1-2013	60 First Street - 30% 20 CambridgeSide - 45% 110 First Street - 45%
Vertical Glazing Description	As per ASHRAE 90.1-2013	Basis of Design: Storefront and Curtainwall Double Glazed assemblies (10mm/12mmargon/6mm)
Glazing Properties: U-Factor	Assembly U-Value - 0.42	Storefront : U-0.34 (Assembly Values) Curtainwall: U-0.29 (Assembly Values)
Glazing Properties: SHGC	SHGC - 0.40	Storefront : SHGC 0.63 (Assembly Values) Curtainwall: SHGC 0.25 (Assembly Values)
Glazing Properties: VLT	VLT - 44%	Storefront: VLT 83% Curtainwall : VLT 55%
Lighting and Equipment		
Receptacle equipment	Office - 1.0 W/SF Conference - 0.7 W/SF Lab - 6 W/SF IDF/Telecom rooms - 2.0 W/SF restrooms - 0.1 W/SF	Office - 1.0 W/SF Conference - 0.7 W/SF Lab - 6 W/SF IDF/Telecom rooms - 2.0 W/SF restrooms - 0.1 W/SF
Interior Lighting Power Calc Method	Space by Space Method	Space by Space Method
Interior Lighting Power Density (Space by Space)	Code model has MA amendments and C406.1 reductions for base building spaces ONLY	Basis of Design LPD as per C406.1 reductions Basis of Desing LDP Corridor - 0.41 W/SF Retail - 0.82 W/SF Restrooms - 0.63 W/SF Storage - 0.51 W/SF Mech - 0.43 W/SF Office - 0.61 W/SF Conferene - 0.97 W/SF Labs - 1.33 W/SF
Primary HVAC Type	Systems based on ASHRAE 90.1-2013, Appendix G table Laboratory and offices: System Tpe #7: Variable air volume (VAV) w/ reheat. Heat Recovery as per code Retail Spaces: System Type #3: Packadged DX unit with Furnace. Heat recovery as per code	Systems based on SD Pricing Package Laboratory and offices: 100% OA Variable air volume (VAV) w/ reheat. Konvekta Heat Recovery Fan Coil units serving high load base building areas like IT rooms, Mech rooms, etc. FCUs in office spaces served by DOAS for ventilation Retail Spaces: System Type #3: Packadged DX unit with Furnace. Heat recovery as per code
Other HVAC Type	Cabinet Unit Heaters serving storage, vestibules, etc.	Cabinet Unit Heaters serving storage, vestibules, etc.

Minimum Outdoor Air Criteria	Office and Conference space modeled as per ASHRAE 62.1 Lab sapces modeled with 1.75 CFM/SF - 8 ACH (blg avg)	Office and Conference space modeled as per ASHRAE 62.1and to meet load Lab sapces modeled with 1.75 CFM/SF - 8 ACH
Unitary Cooling Capacity/Efficiency	Retail Spaces Modeled Identically in BC and PC System#3: PSZ system - DX cooling ; 9.8 EER/11.4 IEER	Retail Spaces Modeled Identically in BC and PC System#3: PSZ system - DX cooling ; 9.8 EER/11.4 IEER
Unitary Heating Capacity	Retail Spaces Modeled Identically in BC and PC System#3: PSZ system - Furnace Heating; Furnace Efficiency - 80%	Retail Spaces Modeled Identically in BC and PC System#3: PSZ system - Furnace Heating; Furnace Efficiency - 80%
Fan System Capacity and Operation	Per ASHRAE 90.1-2013, Section G3.1.2.4- For Office Spaces : Supply and return fans operate continuously whenever spaces are occupied and cycled to meet heating and cooling loads during unoccupied hours. For Lab Spaces: Fan operate continuously to maintain 8 ACH during occupied hours and 4 ACH during unoccupied hours'	As per Design For Office Spaces : AHU Supply and return fans operate continuously VAV boxes in offices spaces are open whenever spaces are occupied to meet heating and cooling loads and close fully during unoccupied hours. For Lab Spaces: Fan operate continuously to maintain 8 ACH during occupied hours and 4 ACH during unoccupied hours'
HVAC Air-side Economizer Cycle	Outdoor air economizers included on VAV systems with Economizer High-Limit Shutoff of 70 deg F.	NA
Design Airflow Rates	Office Spaces: System design supply air flow rates based on a supply-air-to-room-air temperature difference of 20 degF (Supply Air Temp 55 degF; Room Air Temperature 75 degF). Office VAV Terminals - 30% Turndown Ratio Lab Spaces: AHU sized to maitain 8 ACH or satisfy loads, whichever is higher. Lab VAV terminals turn down to maintain 4 ACH during unoccupied hours	AS per Design Office Spaces: Auto-sized for this early analysis ~1.00 CFM/SF Lab Spaces: AHU sized to maitain 8 ACH or satisfy loads , whichever is higher. Lab VAV terminals turn down to maintain 4 ACH during unoccupied hours
Fan Power	As per ASHRAE 90.1-2013, office and Lab spaces are modeled with separate AHUs Office AHU VAV- 0.00133 kW/cfm Lab AHU VAV – 0.001702 kW/cfm System #9: Cabinet Unit Heaters: 0.0003 kW/CFM	As per Design. Fan Power for the RTUs and DOAS is significantly higher than the ASHRAE allowed for the supply CFM. *Fan power numbers are estimated at this early stage, the design fans are modeled with a total fan power penalty and with a total fan power of 0.0022 kW/CFM based on other similar projects . The fan power will have an impact on the results*
Exhaust Air Energy Recovery	50% effectiveness for ONLY the office system required by ASHRAE 90.1 2013 Table 6.5.6.1 Lab AHUs in the baseline are modeled with ACH turndown and are NOT modeled with energy recovery	Konvekta energy recovery on the AHUs Lab Modeled with energy recovery effectiveness of 60% and ACH turndown
Supply Air Temperature Reset Parameters	Air tempertature for cooling reset higher by 5F under minimum cooling load	Air tempertature for cooling reset higher by 5F under minimum cooling load, reduces reheat
Chiller Efficiency[2]	As per ASHRAE 90.1 2013 minimum requirements Full Loaf 0.56 kW/Ton; COP of 5.76	Assumed efficiency better than code Full Load 0.52 kW/ton ; VSD on the chiller
CHW Loop Parameters	CHWS - 44F ; dT 12 F	CHWS - 42F ; dT 18 F
CHW Loop Configuration[3]	Primary-Secondary	Variable primary
Number of Cooling Towers / Fluid Coolers	2 towers	2 towers
Cooling Tower Fan Power	38.2 gpm/HP ; two speed fans	38.2 gpm/HP; variable speed fans
CW Pump Speed Control	one speed	variable speed
Boiler Efficiency	80% Et	94% Et
HW Loop Parameters	HWS - 180F ; dT 50F	HWS - 160F ; dT 30F
HHW Loop Configuration and Pumps	Primary variable ; 19W/gpm; flow auto-size	Primary Variable; 19W/gpm; flow auto-size; will be updated at design
Primary HHW Pump Speed Control	VFD	VFD
SHW DHW Flow	Electric Water Heater point of use	Electric Water Heater point of use

Stretch Code requirements per MA Amendments *Comply with C406.1 Options* *(3 of 10 options)* Project selections are high-lighted in red and at least three options are required to be identical in the baseline and proposed case models per the new MA energy code amendments. The three commercial buildings will have different options.	1. More efficient HVAC performance in accordance with section C406.2. 2. Reduced lighting power density system in accordance with section C406.3. 3. Enhanced lighting controls in accordance with section C406.4. (assumed applicable to non-resi spaces ONLY) 4. On-site supply of renewable energy in accordance with section C406.5. 5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with section C406.6. 6. High-efficiency service water heating in accordance with section C406.7. 7. Enhanced envelope performance in accordance with Section C406.8. 8. Reduced air-infiltration in accordance with Section 406.9. 9. Renewable space heating in accordance with Section 406.10. 10. Type IV Heavy timber construction in accordance with Section 406.11.	Options same as Baseline

END OF MEMO

The Green Engineer
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Solar Photovoltaics Feasibility

Project: CambridgeSide 2.0

Date Issued: July 14, 2020

The CambridgeSide 2.0 project is examining rooftop photovoltaic (PV) arrays. A quick shading analysis was performed on the proposed massing to estimate available roof area with solar access. Figure 1 shows roof area that may have a potential for solar PV arrays.

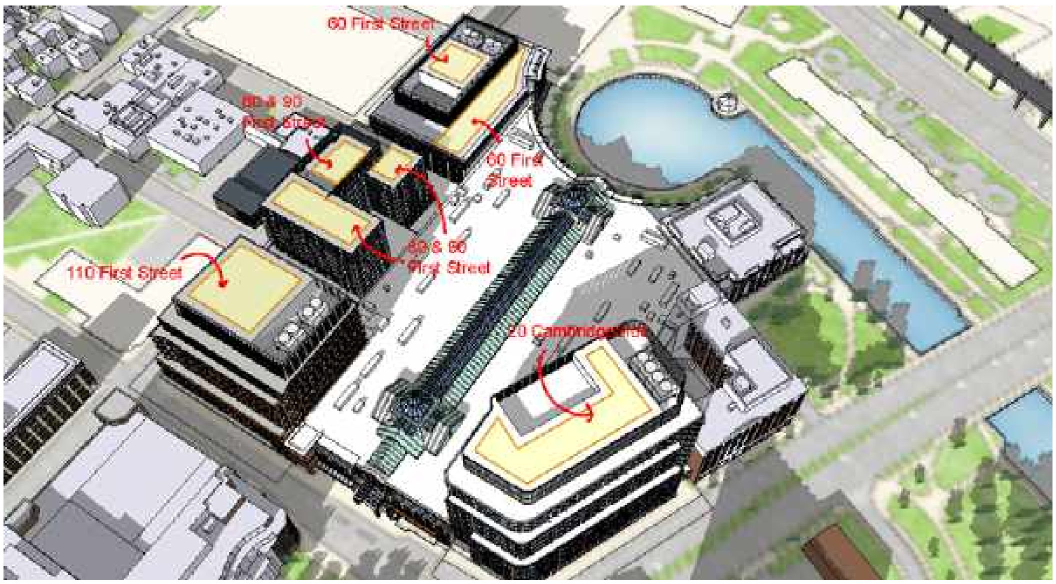

Figure 1: Overall project roof area with solar access excluding a 6' minimum offset from roof edge and shaded areas.

For the proposed development, estimated gross roof area is ~ 59,000 SF. Excluding areas with big mechanical equipment, shaded area, and 15% additional deductions for setbacks, fire code, spaces for vent-pipes, shafts, etc, it is estimated that ~ 39,000 SF of roof area with solar access will be available for PV arrays and be deemed solar ready. Refer to Figure 1 for potential solar ready area. This area is being referred as "Net Available Roof Area" in the analysis. This equals to a PV panel surface area of 31,545 SF to optimize production and avoid self-shading between the panels at about 20-deg tilt.

Table 2 provides a summary of the finding from this analysis for the proposed development.

Table 2: Rooftop PV Output for All Roof Options Combined

Buildings	Net Available Roof Area	PV Panel Surface Area	Array Size	Annual Production	Annual Value	Installed Cost	Simple Payback w/o Incentives
	SF	SF	kW	kWh/yr	($)	($)	(Years)
The Project Total	38,945	31,545	485.3	614,885	$ 98,382	$ 1,455,925	15

1. Analysis Methodology and Outputs: Individual Roofs Calculations

Assumed PV performance - 15.4 watts (peak)/sf (65 SF/kW)[1]
Estimated installation cost: $3/Watt (Peak)[2]
Estimated utility rate - $0.16/ kWh (2019 EIA Average)
Estimated Net Roof Area for PV (excl. setbacks, fire access, space for roof-top equipment, etc.) – 39,000 SF
Snow Coverage Losses[3]: 20-degree tilt: 4%

PV panels mounted at 20-degrees to the horizontal with an azimuth of 180 degrees i.e. facing south have been analyzed. This maximizes installed PV capacity and optimizes production for a given area. This configuration also requires reduced distance between the panel rows (compared to a 42-degrees tilt) and assumes a 15-18” clearance between the rows to allow access to the panels and minimize shading.

The PV potential was calculated using the PV Watts program. Detailed outputs of the analysis are provided in the following Table-3.

Table 3: CambridgeSide 2.0 PV Feasibility Analysis

Buildings	Net Available Roof Area	PV Panel Surface Area*	PV Array Size	Annual Production	Annual Value	Installed Cost	Simple Payback w/o Incentives
	SF	SF	kW	kWh/yr	($)	($)	(Years)
20 CambridgeSide	9,060	7,340	112.9	143,074	$ 22,892	$ 338,770	15
110 First Street	8,265	6,695	103.0	130,501	$ 20,880	$ 309,000	15
80 & 90 First Street (roof lvl 1)	5,600	4,535	69.8	88,398	$ 14,144	$ 209,310	15
80 & 90 First Street (roof lvl 2)	2,935	2,375	36.5	46,294	$ 7,407	$ 109,615	15
80 & 90 First Street (roof lvl 3)	1,455	1,180	18.2	23,001	$ 3,680	$ 54,460	15
60 First Street (roof lvl 1)	3,745	3,035	46.7	59,159	$ 9,465	$ 140,075	15
60 First Street (roof lvl 2)	7,885	6,385	98.2	124,458	$ 19,913	$ 294,690	15
The Project Total	38,945	31,545	485.3	614,885	$ 98,382	$ 1,455,925	15

*Actual surface area of the panel

It is important to note that the building footprints and layouts are not yet defined as they remain subject to approval by the City of Cambridge Planning Board through the special permit process. Accordingly, it is not feasible to provide building footprints and system selections at this pre-conceptual stage. The potential for PV is calculated based on preliminary estimates for available roof areas with a certain percentage of roof area set aside for mechanical equipment, vent-pipes, fire access, minimum setback requirements, etc. As the design progresses details such as areas required for set-backs and fire access[4], shafts and vents, other small roof mounted HVAC equipment, etc. will be refined. The net available capacity may change as the design progresses.

1Reference: ASHRAE Journal, Feasibility of ZNE by Building Type and Climate
http://www.eley.com/sites/default/files/pdfs/ASHRAE_Journal_July_2017_[36-37].pdf

2 Reference: NREL U.S. Solar Benchmark Q1 2017
https://www.nrel.gov/docs/fy17osti/68925.pdf

3 Reference: NREL Technical Report (NREL/TP-6A20-68705) Integration, Validation, and Application of a PV Snow Coverage Model in SAM, dated Aug 2017: for eastern Massachusetts, PV system designs that follow tilt-equals-20deg convention the loss in solar generation due to snow coverage is estimated at 2-4%.
https://www.nrel.gov/docs/fy17osti/68705.pdf

4 Set-back requirements for roof mounted PV arrays, based on 2015 International Solar Energy Provision

Appendix C

Wind Comfort Study

FINAL REPORT

CAMBRIDGESIDE 2.0

CAMBRIDGE, MA

PEDESTRIAN WIND STUDY
RWDI # 1900133
March 24, 2020

SUBMITTED TO

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EXECUTIVE SUMMARY

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a pedestrian wind assessment for the proposed CambridgeSide 2.0 in Cambridge, MA (Image 1). The potential wind conditions have been assessed based on wind tunnel testing of the project under the No Build, Build and Full Build configurations (Images 2A through 2C), and the local wind records (Image 3) and compared to the Mean Speed and Effective Gust pedestrian wind criteria. The results of the assessment are shown on site plans in Figures 1A through 2C, and the associated wind speeds are listed in Table 1. The key findings are summarized as follows:

Effective Gust

- For all tested configurations, wind speeds at all locations on an annual basis are predicted to meet the effective gust criterion used to evaluate pedestrian wind safety.
- Seasonally, wind speeds at one location along Edwin H Land Blvd during the winter is predicted to exceed the effective gust criterion for the Build and Full Build configurations.

Mean Speed

- No dangerous mean wind speeds are predicted for the three configurations assessed.
- Relatively low mean speeds around the existing site are observed on an annual basis, with slightly higher wind activity to the south of the project site.
- With the addition of the proposed developments, mean wind speeds on an annual basis along the streets bounding the project site are predicted to remain relatively similar to the No Build configuration. Exceptions include elevated mean speeds along Charles St and Edwin H Land Blvd.
- With the anticipated future surrounding buildings included, comparable mean speeds to the Build configuration are anticipated.
- Conceptual wind control measures have been presented for select entrances where mean wind speeds are higher than desired.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a pedestrian wind assessment for the proposed CambridgeSide 2.0 in Cambridge, MA. This report presents the project objectives, background and approach, discusses the results from RWDI's assessment and provides conceptual wind control measures, where necessary.

1.1 Project Description

The project (site shown in Image 1) is located on the north side of Charles St between First St and Edwin H Land Blvd. It is currently an existing retail shopping complex with a central mall, three retail anchor tenants, and an above-grade parking garage. It is proposed to replace these four existing structures with four new buildings.

1.2 Objectives

The objective of the study was to assess the effect of the proposed development on local conditions in pedestrian areas on and around the study site and provide recommendations for minimizing adverse effects, if needed. This quantitative assessment was based on wind speed measurements on a scale model of the project and its surroundings in one of RWDI's boundary-layer wind tunnels. These measurements were combined with the local wind records and compared to appropriate criteria for gauging wind comfort and safety in pedestrian areas. The assessment focused on critical pedestrian areas, including the main entrances and public sidewalks.

Image 1: Aerial View of Site and Surroundings (Photo Courtesy of Google™ Earth)

2 BACKGROUND AND APPROACH

2.1 Wind Tunnel Study Model

To assess the wind environment around the proposed project, a 1:400 scale model of the project site and surroundings was constructed for the wind tunnel tests of the following configurations:

A – No Build:	Existing site with existing surroundings (Image 2A),
B – Build:	Proposed project with existing surroundings (Image 2B), and,
C – Full Build:	Proposed project with existing and future surroundings (Image 2C).

The wind tunnel model included all relevant surrounding buildings and topography within an approximately 1600 ft radius of the study site. The wind and turbulence profiles in the atmospheric boundary layer beyond the modelled area were also simulated in RWDI's wind tunnel. The wind tunnel model was instrumented with 119 specially designed wind speed sensors to measure mean and gust speeds at a full-scale height of approximately 5 ft above local grade in pedestrian areas throughout the study site. Wind speeds were measured for 36 directions in a 10-degree increment. The measurements at each sensor location were recorded in the form of ratios of local mean and gust speeds to the mean wind speed at a reference height above the model. The placement of wind measurement locations was based on our experience and understanding of the pedestrian usage for this site and was reviewed by the design team.

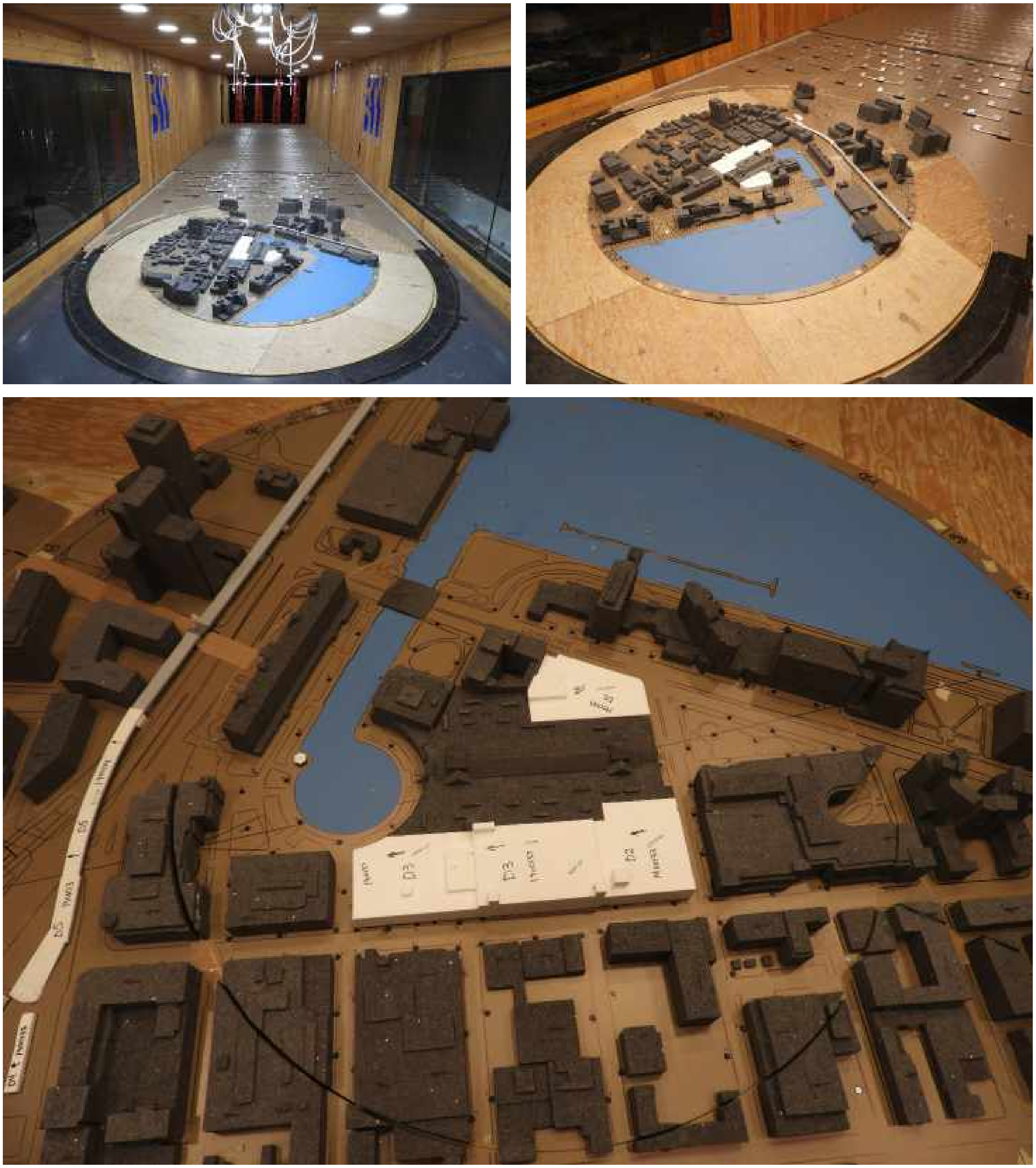


Image 2A: Wind Tunnel Study Model – No Build Configuration

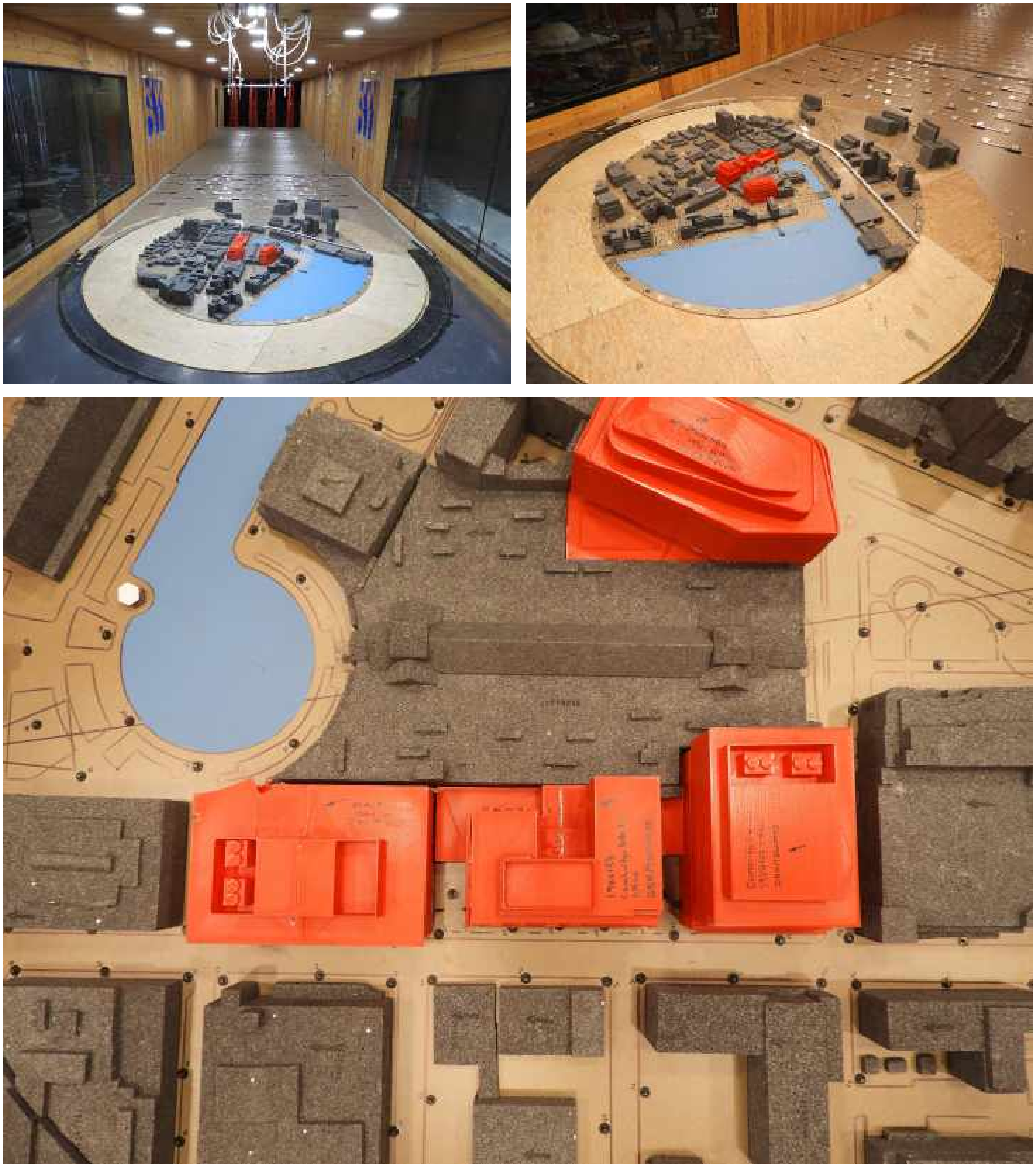


Image 2B: Wind Tunnel Study Model – Build Configuration

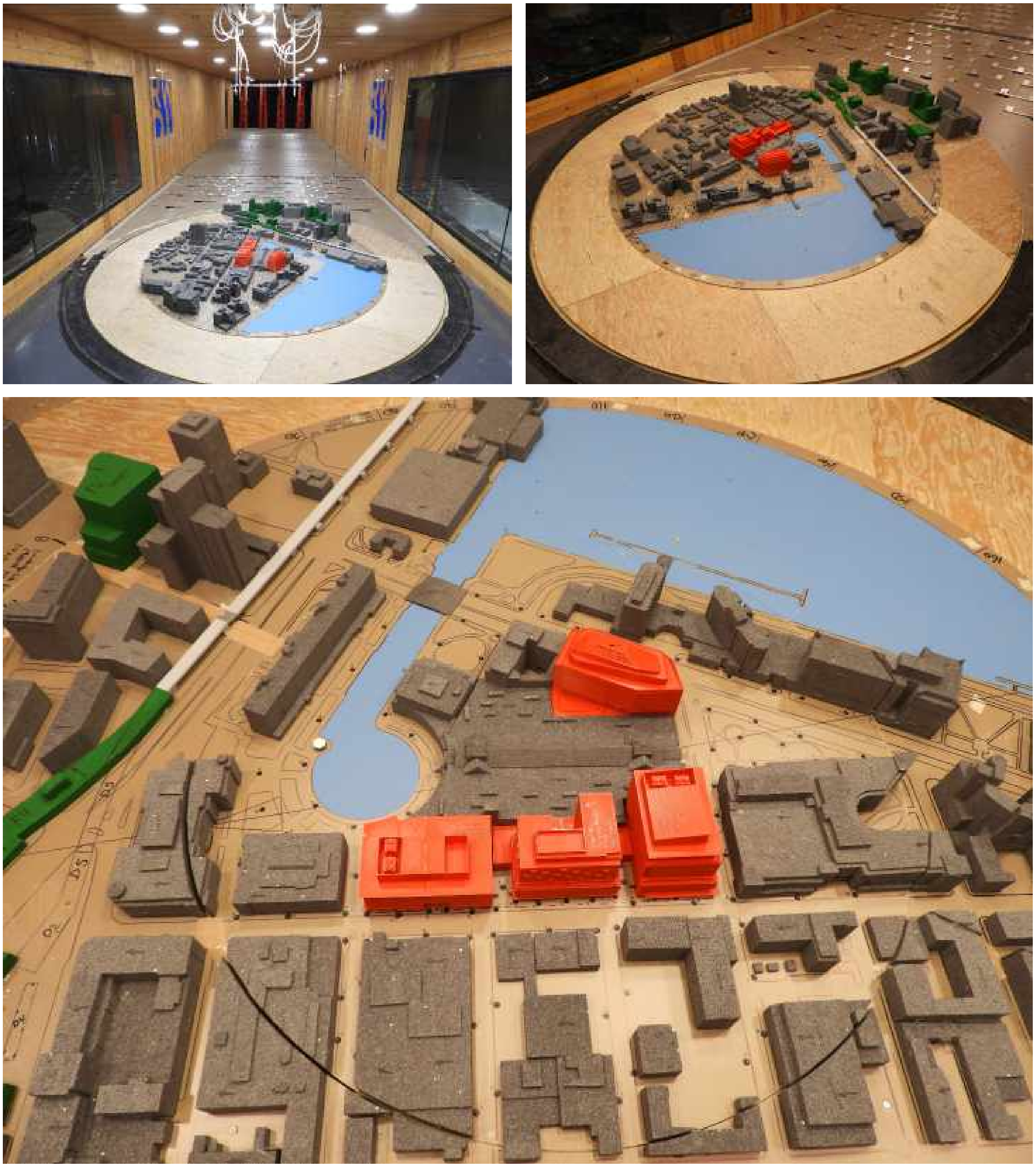
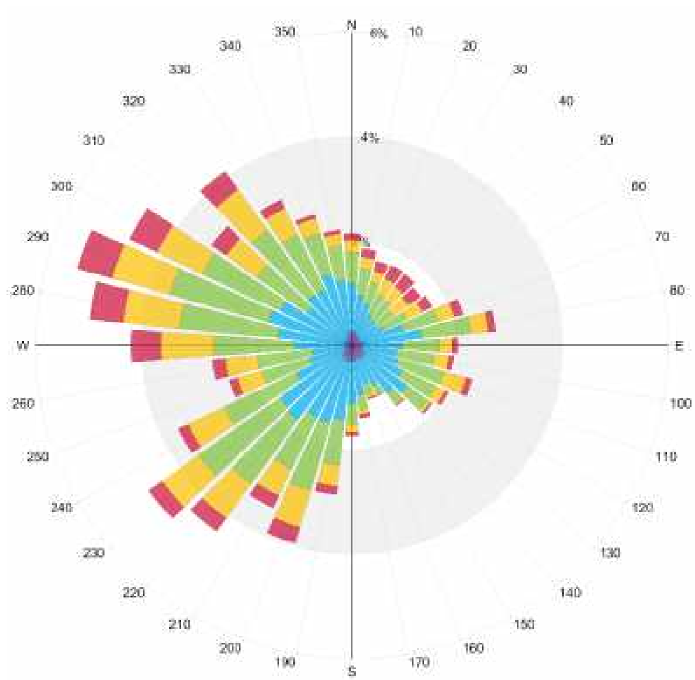


Image 2C: Wind Tunnel Study Model – Full Build Configuration

2.2 Meteorological Data

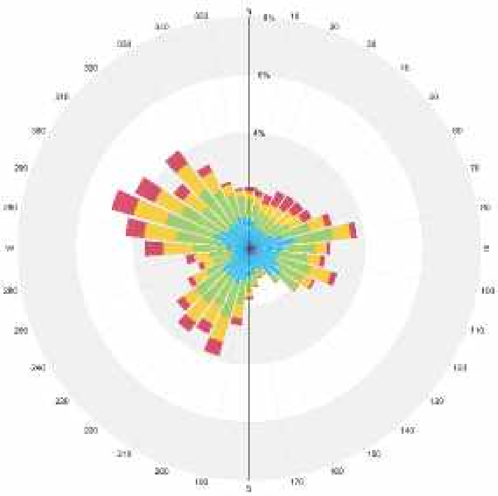
The data from the wind tunnel test were combined with long-term meteorological data, recorded during the years 1995 through 2018 at Boston Logan International Airport to predict full scale wind conditions. The analysis was performed separately for the entire year and for each of the four seasons. Images 3 and 4 present "wind roses", summarizing the annual and seasonal wind climates in the Boston area, respectively.

For example, the wind rose in Image 3, summarizes the annual wind data which in general, indicates the most common wind directions are those between north-northwest and south-southwest. Winds from the east-northeast to the east-southeast are also relatively common. In the case of strong winds, northeast, northwest, west and southwest are the dominant wind directions.

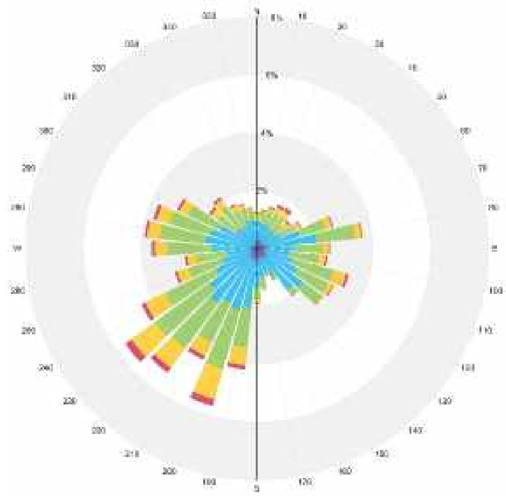


Wind Speed (mph)	Annual Probability (%)
Calm	3.0
1-5	7.9
6-10	32.5
11-15	32.4
16-20	16.3
>20	7.9

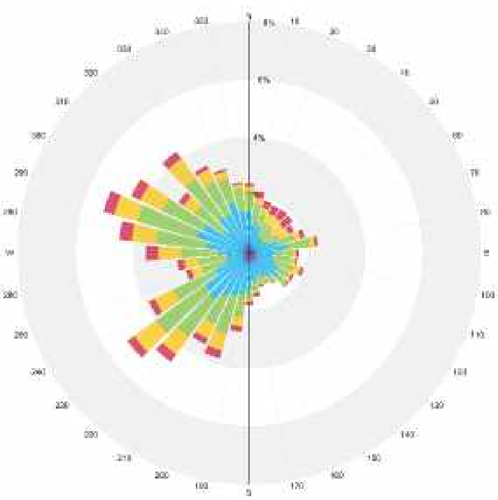
Image 3: Annual Directional Distribution of Winds Approaching Boston Logan International Airport from 1995 to 2018



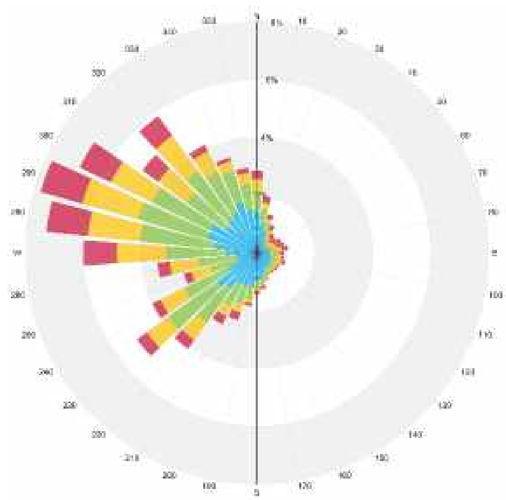
Spring (March – May)



Summer (June – August)



Fall (September – November)



Winter (December – February)

Wind Speed (mph)	Seasonal Probability (%) Spring	Summer	Fall	Winter
Calm	2.8	3.0	3.4	2.6
1-5	6.8	9.4	8.7	6.5
6-10	28.9	38.8	34.6	27.9
11-15	32.3	34.4	32.0	30.9
16-20	19.2	11.8	14.5	19.7
>20	10.1	2.6	6.8	12.4

Image 4: Seasonal Directional Distribution of Winds Approaching Boston Logan International Airport from 1995 to 2018

2.3 Pedestrian Wind Criteria

The pedestrian wind criteria implemented for the current study uses two standards for assessing the relative wind comfort of pedestrians. First, the wind design guidance criterion states that an effective gust velocity (hourly mean wind speed +1.5 times the root-mean-square wind speed) of 31 mph should not be exceeded more than one percent of the time.

Wind Acceptability	Effective Gust Speed (mph)
Acceptable	≤ 31
Unacceptable	> 31
1% exceedance or 99 percentile wind speeds	

The second set of criteria used to determine the acceptability of specific locations is based on the work of Melbourne. This set of criteria is used to determine the relative level of pedestrian wind comfort for activities such as sitting, standing, or walking. The criteria are expressed in terms of benchmarks for the 1-hour mean wind speed exceeded 1% of the time.

Comfort Category	Mean Wind Speed (mph)
Dangerous	> 27
Uncomfortable for Walking	> 19 and ≤ 27
Comfortable for Walking	> 15 and ≤ 19
Comfortable for Standing	> 12 and ≤ 15
Comfortable for Sitting	< 12
1% exceedance or 99 percentile wind speeds	

The consideration of wind in planning outdoor activity areas is important since high winds in an area tend to deter pedestrian use. For example, winds should be light or relatively light in areas where people would be sitting, such as outdoor cafes or playgrounds. For bus stops and other locations where people would be standing, somewhat higher winds can be tolerated. For frequently used sidewalks, where people are primarily walking, stronger winds are acceptable. For infrequently used areas, the wind comfort criteria can be relaxed even further. The actual effects of wind can range from pedestrian inconvenience, due to the blowing of dust and other loose material in a moderate breeze, to severe difficulty with walking due to the wind forces on the pedestrian.

The wind climate found in Cambridge is generally comfortable for the pedestrian use of sidewalks and thoroughfares and meets the effective gust velocity criterion of 31 mph. However, without any mitigation measures, this wind climate is likely to be frequently uncomfortable for more passive activities such as sitting.

This study involved state-of-the-art measurement and analysis techniques to predict wind conditions. Nevertheless, some uncertainty remains in predicting wind comfort, and this must be kept in mind. For example, the sensation of comfort among individuals can be quite variable. Variations in age, individual health, clothing, and other human factors can change a particular response of an individual. The comfort limits used in this report represent an average for the total population. Also, unforeseen changes in the project area, such as the construction or removal of buildings, can affect the conditions experienced at the site. Finally, the prediction of wind speeds is necessarily a statistical procedure. The wind speeds reported are for the frequency of occurrence stated (1% of the time). Higher wind speeds will occur but on a less frequent basis.

3 RESULTS AND DISCUSSION

The predicted wind conditions in terms of mean and effective gust speeds pertaining to the tested configurations are graphically depicted on site plans in Figures 1A through 2C located in the "Figures" section of this report. These conditions and the associated wind speeds are presented in Tables 1 and 2, located in the "Tables" section of this report. The following summary of pedestrian wind comfort is based on the annual winds for each configuration tested. Typically, the summer and fall winds tend to be more comfortable than the annual winds while the winter and spring winds are less comfortable than the annual winds.

Wind conditions comfortable for walking are appropriate for sidewalks and walkways as pedestrians will be active and less likely to remain in one area for prolonged periods of time. Lower wind speeds conducive to standing are preferred at main entrances where pedestrians are apt to linger. Wind speeds comfortable for sitting are ideal during the summer for areas intended for passive activities, such as plaza spaces or outdoor dining areas.

3.1 No Build Configuration

In general, the mean wind speeds on an annual basis for the existing site are comfortable for sitting or standing, with a few locations categorized for walking to the south of the proposed developments along Edwin H Land Blvd (Figure 1A). Wind speeds at no areas around the site are dangerous on an annual or seasonal basis for the existing site.

The effective gust criterion used to evaluate pedestrian wind safety is met at all sensor locations around the existing site (Figure 2A).

3.2 Build Configuration

In general, with the addition of the proposed developments, low to moderate mean wind speeds on an annual and seasonal basis are expected. The following is a detailed discussion of the suitability of the predicted wind conditions for the anticipated pedestrian use of each area of interest.

3.2.1 Main Entrances

Main entrances to the proposed developments are located near Locations 21, 22, 98, 101, 105, 109 and 110 in Figure 1B. Predicted mean speeds at the majority of these entrances are predicted to be appropriate for the intended use (sitting or standing) on an annual basis. Exceptions are near Locations 22 and 105 where higher than desired wind speeds categorized as uncomfortable and walking are predicted (Figure 1B).

Both entrances near Locations 22 and 105 are recessed into the building façades which is a positive design strategy in reducing door operability issues. However, wind speeds directly in front of the entrances are higher than desired for pedestrians to linger. For Location 22 specifically, these elevated wind speeds are a result of easterly and westerly winds accelerating around the corner of Charles St and Edwin H Land Blvd. Reduced wind speeds at this location may be achieved by implementing localized hard and/or soft vertical features (i.e. wind screens and dense shrubs or trees) near both sides of the entrance. Additionally, consideration should be given to extending the overhead canopy to provide more overhead protection. For Location 105, slightly elevated mean speeds are a result of exposure to westerly winds and winds downwashing off the proposed building façade. To reduce wind speeds near this location, it is recommended that features be placed on the west side of the entrance along First St.

For wind screens to be effective, they should be a minimum of 6.5 ft tall and approximately 80% solid and for landscaping being considered, the species should be marcescent or evergreen which are able to retain their foliage year-round and provide protection during the winter when the strongest prevailing winds occur. Examples of wind screens and landscaping features near entrances are provided in Image 5.

Image 5: Examples of Windscreens (Top) and Landscaping (Bottom) Near Entrances

3.2.2 Sidewalks and Walkways

With the addition of the proposed developments, mean wind speeds on an annual basis along the streets bounding the project site are predicted to remain relatively similar to the No Build configuration with the majority of locations suitable for standing or more passive use (Figure 1B). Exceptions include uncomfortable wind speeds on annual basis along Charles St (Locations 22 and 95 in Figure 1B) and east of Charles Park along Edwin H Land Blvd (Locations 14 and 19 in Figure 1B). If improved conditions are desired for these areas by the design team, wind control measures can be developed with RWDI's team. Mean wind speeds along the Lechmere Canal are predicted to be similar to those observed in the No Build configuration and no dangerous wind conditions are expected in the Build configuration on an annual or seasonal basis (Figure 1B).

On an annual basis, the effective gust criterion is anticipated to still be met at all sensor locations with the proposed developments in place (Figure 2B). Seasonally, the effective gust criterion is predicted to be exceeded at one location along Edwin H Land Blvd during the winter, defined from December to February (Location 19 in Table 2).

3.3 Full Build Configuration

With the anticipated future surrounding buildings included (shown in green in Image 2C), comparable mean speeds to the Build configuration are anticipated and similarly, no dangerous mean wind speeds are expected on an annual or seasonal basis (Figure 1C).

On an annual basis, the effective gust criterion is anticipated to be met at all sensor locations with the future developments in place (Figure 2C). Seasonally, the effective gust criterion is predicted to be exceeded at one location along Edwin H Land Blvd during the winter (Location 19 in Table 2).

4 APPLICABILITY OF RESULTS

The wind conditions presented in this report pertain to the model of the CambridgeSide 2.0 constructed using the drawings and information listed below. Should there be any design changes that deviate from this list of drawings, the wind condition predictions presented may change. Therefore, if changes in the design are made, it is recommended that RWDI be contacted and requested to review their potential effects on wind conditions.

File Name	File Type	Date Received (dd/mm/yyyy)
19_1218_CambridgeSide	SketchUp (.skp)	15/01/2020

FIGURES

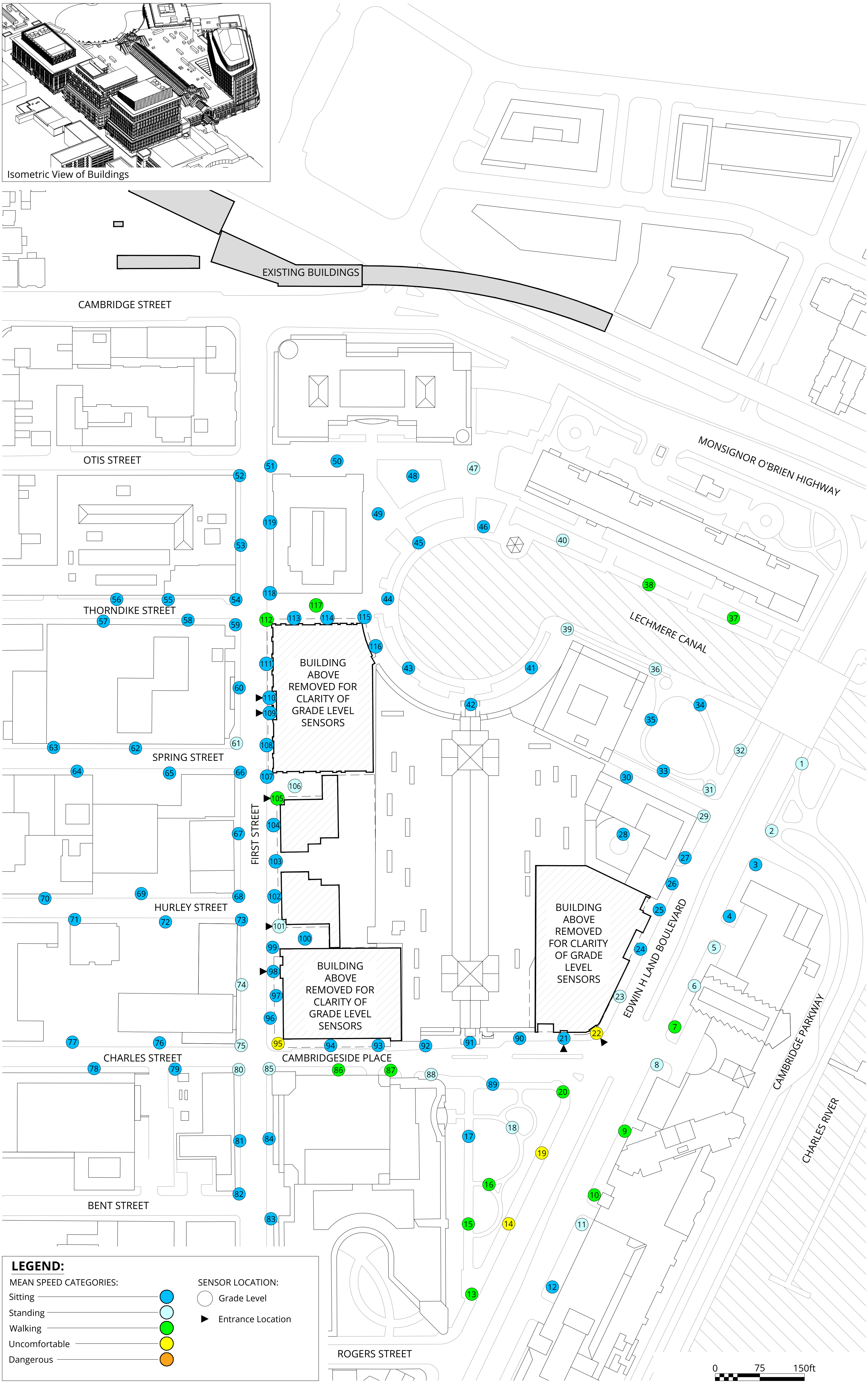
Pedestrian Wind Conditions - Mean Speed
No Build
Annual

CambridgeSide 2.0 - Cambridge, MA

True North

Project #1900133

Drawn by: GRE	Figure: 1A
Approx. Scale:	1"=150'
Date Revised:	Mar. 20, 2020



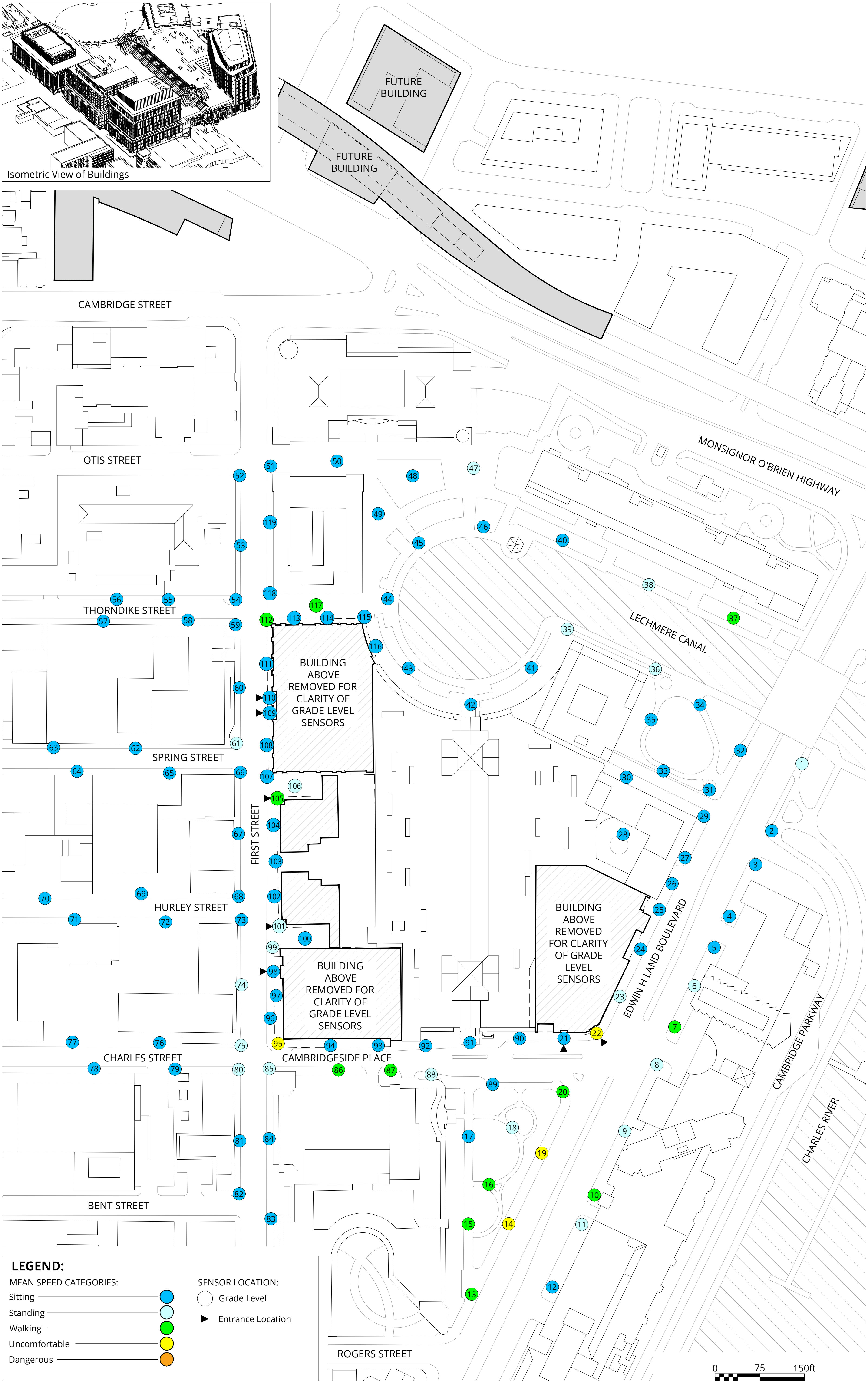
Pedestrian Wind Conditions - Mean Speed
Build
Annual

CambridgeSide 2.0 - Cambridge, MA

True North

Project #1900133

Drawn by: GRE | Figure: 1B
Approx. Scale: 1"=150'
Date Revised: Mar. 20, 2020



Pedestrian Wind Conditions - Mean Speed
Full Build
Annual

CambridgeSide 2.0 - Cambridge, MA

Project #1900133

Drawn by: GRE	Figure: 1C
Approx. Scale: 1"=150'	
Date Revised: Mar. 20, 2020	

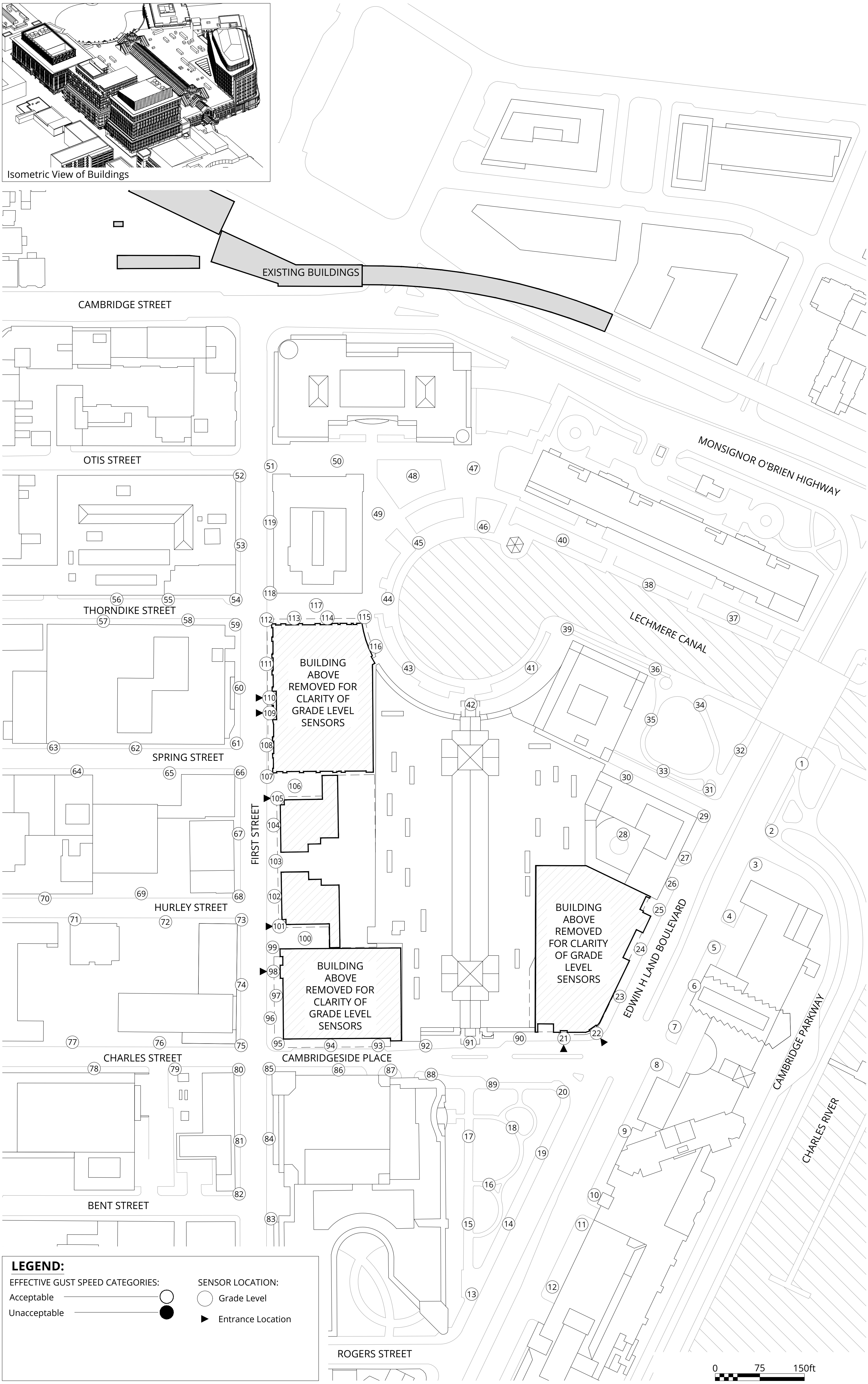
Pedestrian Wind Conditions - Effective Gust Speed
No Build
Annual

CambridgeSide 2.0 - Cambridge, MA

True North

Project #1900133

Drawn by: GRE	Figure: 2A
Approx. Scale: 1"=150'	
Date Revised: Mar. 20, 2020	



LEGEND:

EFFECTIVE GUST SPEED CATEGORIES:
Acceptable
Unacceptable

SENSOR LOCATION:
Grade Level
Entrance Location

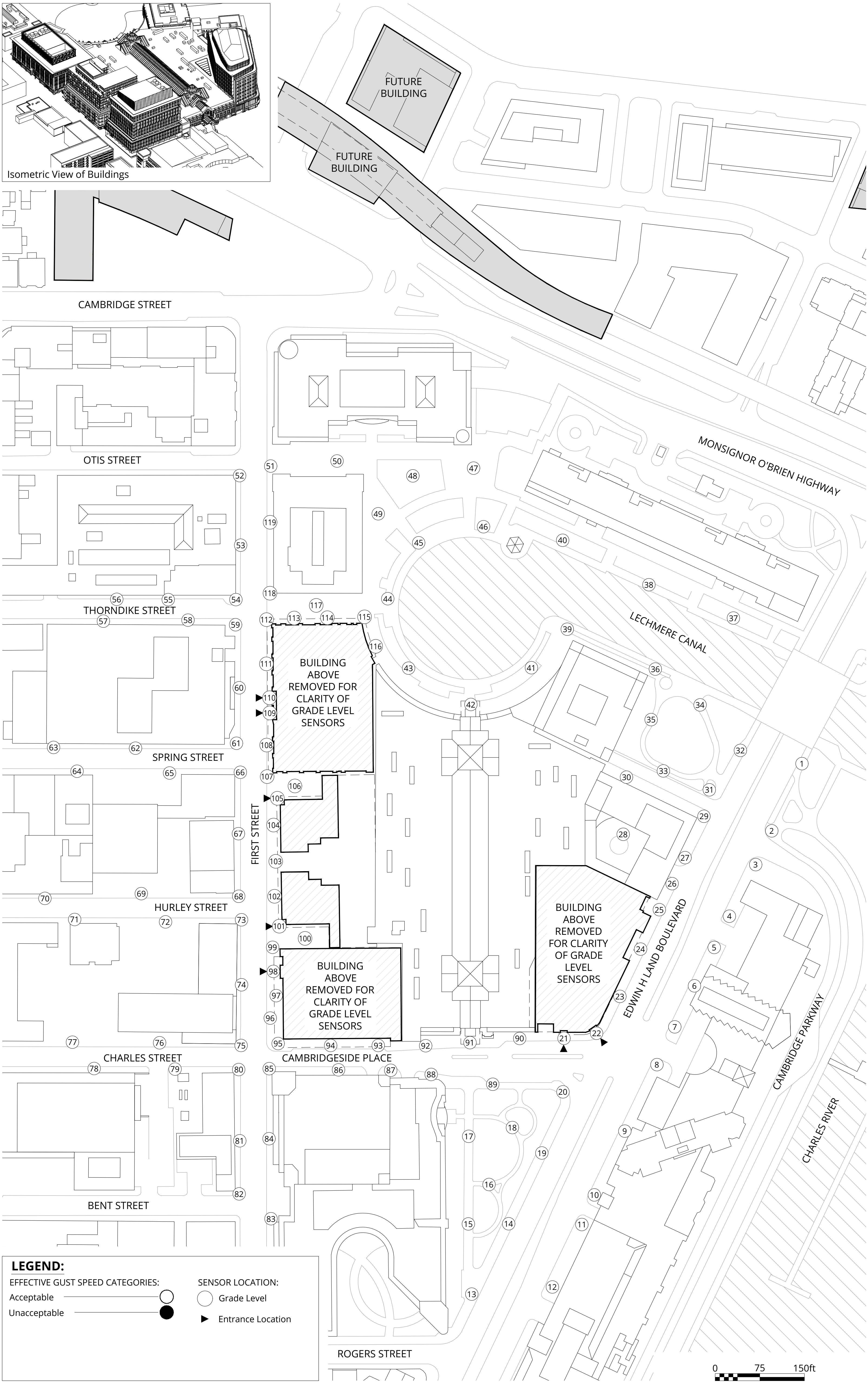
Pedestrian Wind Conditions - Effective Gust Speed
Build
Annual

CambridgeSide 2.0 - Cambridge, MA

True North

Project #1900133

Drawn by: GRE	Figure: 2B
Approx. Scale: 1"=150'	
Date Revised: Mar. 20, 2020	



Pedestrian Wind Conditions - Effective Gust Speed

Full Build

Annual

CambridgeSide 2.0 - Cambridge, MA

Project #1900133

Drawn by: GRE | Figure: 2C

Approx. Scale: 1"=150'

Date Revised: Mar. 20, 2020

TABLES

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
1	No Build	Annual	14		Standing	20		Acceptable
	Build	Annual	14		Standing	20		Acceptable
	Full Build	Annual	14		Standing	20		Acceptable
2	No Build	Annual	13		Standing	20		Acceptable
	Build	Annual	13		Standing	20		Acceptable
	Full Build	Annual	12		Sitting	19		Acceptable
3	No Build	Annual	12		Sitting	19		Acceptable
	Build	Annual	11		Sitting	18		Acceptable
	Full Build	Annual	11		Sitting	17	-11%	Acceptable
4	No Build	Annual	12		Sitting	18		Acceptable
	Build	Annual	11		Sitting	17		Acceptable
	Full Build	Annual	11		Sitting	17		Acceptable
5	No Build	Annual	14		Standing	21		Acceptable
	Build	Annual	13		Standing	19		Acceptable
	Full Build	Annual	12	-14%	Sitting	18	-14%	Acceptable
6	No Build	Annual	13		Standing	20		Acceptable
	Build	Annual	15	15%	Standing	21		Acceptable
	Full Build	Annual	14		Standing	20		Acceptable
7	No Build	Annual	14		Standing	21		Acceptable
	Build	Annual	17	21%	Walking	24	14%	Acceptable
	Full Build	Annual	16	14%	Walking	23		Acceptable
8	No Build	Annual	13		Standing	20		Acceptable
	Build	Annual	14		Standing	21		Acceptable
	Full Build	Annual	14		Standing	20		Acceptable
9	No Build	Annual	14		Standing	23		Acceptable
	Build	Annual	16	14%	Walking	25		Acceptable
	Full Build	Annual	15		Standing	23		Acceptable
10	No Build	Annual	17		Walking	26		Acceptable
	Build	Annual	18		Walking	27		Acceptable
	Full Build	Annual	16		Walking	25		Acceptable
11	No Build	Annual	12		Sitting	20		Acceptable
	Build	Annual	14	17%	Standing	22		Acceptable
	Full Build	Annual	13		Standing	21		Acceptable
12	No Build	Annual	9		Sitting	15		Acceptable
	Build	Annual	8	-11%	Sitting	14		Acceptable
	Full Build	Annual	8	-11%	Sitting	14		Acceptable
13	No Build	Annual	17		Walking	24		Acceptable
	Build	Annual	17		Walking	25		Acceptable
	Full Build	Annual	16		Walking	23		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
14	No Build	Annual	18		Walking	27		Acceptable
	Build	Annual	20	11%	Uncomfortable	28		Acceptable
	Full Build	Annual	20	11%	Uncomfortable	28		Acceptable
15	No Build	Annual	15		Standing	22		Acceptable
	Build	Annual	17	13%	Walking	23		Acceptable
	Full Build	Annual	16		Walking	22		Acceptable
16	No Build	Annual	17		Walking	25		Acceptable
	Build	Annual	19	12%	Walking	27		Acceptable
	Full Build	Annual	17		Walking	25		Acceptable
17	No Build	Annual	10		Sitting	16		Acceptable
	Build	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	10		Sitting	15		Acceptable
18	No Build	Annual	13		Standing	21		Acceptable
	Build	Annual	15	15%	Standing	24	14%	Acceptable
	Full Build	Annual	14		Standing	22		Acceptable
19	No Build	Annual	17		Walking	26		Acceptable
	Build	Annual	20	18%	Uncomfortable	29	12%	Acceptable
	Full Build	Annual	20	18%	Uncomfortable	29	12%	Acceptable
20	No Build	Annual	14		Standing	22		Acceptable
	Build	Annual	16	14%	Walking	25	14%	Acceptable
	Full Build	Annual	16	14%	Walking	24		Acceptable
21	No Build	Annual	8		Sitting	14		Acceptable
	Build	Annual	11	38%	Sitting	17	21%	Acceptable
	Full Build	Annual	11	38%	Sitting	17	21%	Acceptable
22	No Build	Annual	13		Standing	20		Acceptable
	Build	Annual	20	54%	Uncomfortable	27	35%	Acceptable
	Full Build	Annual	20	54%	Uncomfortable	27	35%	Acceptable
23	No Build	Annual	13		Standing	19		Acceptable
	Build	Annual	13		Standing	19		Acceptable
	Full Build	Annual	13		Standing	19		Acceptable
24	No Build	Annual	13		Standing	18		Acceptable
	Build	Annual	12		Sitting	17		Acceptable
	Full Build	Annual	11	-15%	Sitting	17		Acceptable
25	No Build	Annual	12		Sitting	18		Acceptable
	Build	Annual	10	-17%	Sitting	15	-17%	Acceptable
	Full Build	Annual	9	-25%	Sitting	14	-22%	Acceptable
26	No Build	Annual	8		Sitting	13		Acceptable
	Build	Annual	7	-12%	Sitting	12		Acceptable
	Full Build	Annual	7	-12%	Sitting	12		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
27	No Build	Annual	8		Sitting	13		Acceptable
	Build	Annual	8		Sitting	13		Acceptable
	Full Build	Annual	7	-12%	Sitting	12		Acceptable
28	No Build	Annual	9		Sitting	13		Acceptable
	Build	Annual	8	-11%	Sitting	12		Acceptable
	Full Build	Annual	8	-11%	Sitting	12		Acceptable
29	No Build	Annual	12		Sitting	20		Acceptable
	Build	Annual	13		Standing	21		Acceptable
	Full Build	Annual	11		Sitting	18		Acceptable
30	No Build	Annual	7		Sitting	12		Acceptable
	Build	Annual	7		Sitting	12		Acceptable
	Full Build	Annual	7		Sitting	12		Acceptable
31	No Build	Annual	12		Sitting	19		Acceptable
	Build	Annual	13		Standing	20		Acceptable
	Full Build	Annual	12		Sitting	18		Acceptable
32	No Build	Annual	12		Sitting	18		Acceptable
	Build	Annual	13		Standing	19		Acceptable
	Full Build	Annual	12		Sitting	19		Acceptable
33	No Build	Annual	11		Sitting	18		Acceptable
	Build	Annual	11		Sitting	18		Acceptable
	Full Build	Annual	10		Sitting	16	-11%	Acceptable
34	No Build	Annual	11		Sitting	18		Acceptable
	Build	Annual	11		Sitting	18		Acceptable
	Full Build	Annual	11		Sitting	18		Acceptable
35	No Build	Annual	10		Sitting	16		Acceptable
	Build	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	8	-20%	Sitting	14	-12%	Acceptable
36	No Build	Annual	15		Standing	21		Acceptable
	Build	Annual	15		Standing	21		Acceptable
	Full Build	Annual	15		Standing	21		Acceptable
37	No Build	Annual	15		Standing	21		Acceptable
	Build	Annual	16		Walking	22		Acceptable
	Full Build	Annual	16		Walking	22		Acceptable
38	No Build	Annual	15		Standing	22		Acceptable
	Build	Annual	16		Walking	22		Acceptable
	Full Build	Annual	15		Standing	22		Acceptable
39	No Build	Annual	15		Standing	23		Acceptable
	Build	Annual	15		Standing	22		Acceptable
	Full Build	Annual	14		Standing	22		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
40	No Build	Annual	13		Standing	19		Acceptable
	Build	Annual	13		Standing	19		Acceptable
	Full Build	Annual	12		Sitting	18		Acceptable
41	No Build	Annual	9		Sitting	15		Acceptable
	Build	Annual	9		Sitting	16		Acceptable
	Full Build	Annual	9		Sitting	16		Acceptable
42	No Build	Annual	9		Sitting	15		Acceptable
	Build	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	15		Acceptable
43	No Build	Annual	8		Sitting	13		Acceptable
	Build	Annual	8		Sitting	14		Acceptable
	Full Build	Annual	8		Sitting	13		Acceptable
44	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	11	22%	Sitting	18	29%	Acceptable
	Full Build	Annual	12	33%	Sitting	18	29%	Acceptable
45	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	15		Acceptable
46	No Build	Annual	12		Sitting	19		Acceptable
	Build	Annual	11		Sitting	18		Acceptable
	Full Build	Annual	10	-17%	Sitting	16	-16%	Acceptable
47	No Build	Annual	14		Standing	21		Acceptable
	Build	Annual	14		Standing	21		Acceptable
	Full Build	Annual	13		Standing	19		Acceptable
48	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	15		Acceptable
49	No Build	Annual	10		Sitting	15		Acceptable
	Build	Annual	10		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	14		Acceptable
50	No Build	Annual	11		Sitting	16		Acceptable
	Build	Annual	11		Sitting	16		Acceptable
	Full Build	Annual	10		Sitting	16		Acceptable
51	No Build	Annual	8		Sitting	14		Acceptable
	Build	Annual	9	12%	Sitting	15		Acceptable
	Full Build	Annual	10	25%	Sitting	16	14%	Acceptable
52	No Build	Annual	11		Sitting	15		Acceptable
	Build	Annual	10		Sitting	15		Acceptable
	Full Build	Annual	11		Sitting	15		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed: Speed (mph)	Mean Wind Speed: % Change	Mean Wind Speed: Rating	Effective Gust Wind Speed: Speed (mph)	Effective Gust Wind Speed: % Change	Effective Gust Wind Speed: Rating
53	No Build	Annual	8		Sitting	13		Acceptable
	Build	Annual	9	12%	Sitting	14		Acceptable
	Full Build	Annual	10	25%	Sitting	14		Acceptable
54	No Build	Annual	7		Sitting	12		Acceptable
	Build	Annual	10	43%	Sitting	15	25%	Acceptable
	Full Build	Annual	10	43%	Sitting	15	25%	Acceptable
55	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	8	-11%	Sitting	14		Acceptable
	Full Build	Annual	9		Sitting	15		Acceptable
56	No Build	Annual	7		Sitting	12		Acceptable
	Build	Annual	7		Sitting	11		Acceptable
	Full Build	Annual	6	-14%	Sitting	11		Acceptable
57	No Build	Annual	10		Sitting	14		Acceptable
	Build	Annual	9		Sitting	13		Acceptable
	Full Build	Annual	9		Sitting	13		Acceptable
58	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	9		Sitting	14		Acceptable
	Full Build	Annual	9		Sitting	14		Acceptable
59	No Build	Annual	12		Sitting	17		Acceptable
	Build	Annual	10	-17%	Sitting	17		Acceptable
	Full Build	Annual	11		Sitting	18		Acceptable
60	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	10	11%	Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	14		Acceptable
61	No Build	Annual	13		Standing	18		Acceptable
	Build	Annual	13		Standing	19		Acceptable
	Full Build	Annual	13		Standing	19		Acceptable
62	No Build	Annual	8		Sitting	13		Acceptable
	Build	Annual	8		Sitting	13		Acceptable
	Full Build	Annual	8		Sitting	13		Acceptable
63	No Build	Annual	9		Sitting	15		Acceptable
	Build	Annual	9		Sitting	14		Acceptable
	Full Build	Annual	9		Sitting	15		Acceptable
64	No Build	Annual	12		Sitting	18		Acceptable
	Build	Annual	11		Sitting	17		Acceptable
	Full Build	Annual	12		Sitting	19		Acceptable
65	No Build	Annual	11		Sitting	18		Acceptable
	Build	Annual	12		Sitting	18		Acceptable
	Full Build	Annual	12		Sitting	18		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
66	No Build	Annual	11		Sitting	16		Acceptable
	Build	Annual	10		Sitting	17		Acceptable
	Full Build	Annual	10		Sitting	17		Acceptable
67	No Build	Annual	7		Sitting	12		Acceptable
	Build	Annual	9	29%	Sitting	15	25%	Acceptable
	Full Build	Annual	9	29%	Sitting	14	17%	Acceptable
68	No Build	Annual	8		Sitting	14		Acceptable
	Build	Annual	12	50%	Sitting	18	29%	Acceptable
	Full Build	Annual	12	50%	Sitting	18	29%	Acceptable
69	No Build	Annual	8		Sitting	13		Acceptable
	Build	Annual	8		Sitting	13		Acceptable
	Full Build	Annual	8		Sitting	13		Acceptable
70	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	8	-11%	Sitting	13		Acceptable
	Full Build	Annual	8	-11%	Sitting	13		Acceptable
71	No Build	Annual	10		Sitting	16		Acceptable
	Build	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	14	-12%	Acceptable
72	No Build	Annual	9		Sitting	15		Acceptable
	Build	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	15		Acceptable
73	No Build	Annual	11		Sitting	16		Acceptable
	Build	Annual	12		Sitting	19	19%	Acceptable
	Full Build	Annual	11		Sitting	18	12%	Acceptable
74	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	14	56%	Standing	20	43%	Acceptable
	Full Build	Annual	13	44%	Standing	20	43%	Acceptable
75	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	15	67%	Standing	22	57%	Acceptable
	Full Build	Annual	14	56%	Standing	22	57%	Acceptable
76	No Build	Annual	8		Sitting	14		Acceptable
	Build	Annual	8		Sitting	14		Acceptable
	Full Build	Annual	8		Sitting	13		Acceptable
77	No Build	Annual	9		Sitting	16		Acceptable
	Build	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	15		Acceptable
78	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	9		Sitting	14		Acceptable
	Full Build	Annual	8	-11%	Sitting	14		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
79	No Build	Annual	10		Sitting	16		Acceptable
	Build	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	9		Sitting	15		Acceptable
80	No Build	Annual	9		Sitting	15		Acceptable
	Build	Annual	14	56%	Standing	19	27%	Acceptable
	Full Build	Annual	13	44%	Standing	19	27%	Acceptable
81	No Build	Annual	8		Sitting	13		Acceptable
	Build	Annual	8		Sitting	13		Acceptable
	Full Build	Annual	8		Sitting	14		Acceptable
82	No Build	Annual	10		Sitting	16		Acceptable
	Build	Annual	8	-20%	Sitting	13	-19%	Acceptable
	Full Build	Annual	8	-20%	Sitting	13	-19%	Acceptable
83	No Build	Annual	10		Sitting	16		Acceptable
	Build	Annual	8	-20%	Sitting	14	-12%	Acceptable
	Full Build	Annual	8	-20%	Sitting	13	-19%	Acceptable
84	No Build	Annual	7		Sitting	11		Acceptable
	Build	Annual	8	14%	Sitting	13	18%	Acceptable
	Full Build	Annual	8	14%	Sitting	13	18%	Acceptable
85	No Build	Annual	11		Sitting	15		Acceptable
	Build	Annual	14	27%	Standing	20	33%	Acceptable
	Full Build	Annual	14	27%	Standing	20	33%	Acceptable
86	No Build	Annual	9		Sitting	13		Acceptable
	Build	Annual	18	100%	Walking	25	92%	Acceptable
	Full Build	Annual	17	89%	Walking	25	92%	Acceptable
87	No Build	Annual	12		Sitting	16		Acceptable
	Build	Annual	16	33%	Walking	22	38%	Acceptable
	Full Build	Annual	16	33%	Walking	23	44%	Acceptable
88	No Build	Annual	12		Sitting	17		Acceptable
	Build	Annual	13		Standing	19	12%	Acceptable
	Full Build	Annual	14	17%	Standing	20	18%	Acceptable
89	No Build	Annual	10		Sitting	15		Acceptable
	Build	Annual	11		Sitting	17	13%	Acceptable
	Full Build	Annual	11		Sitting	18	20%	Acceptable
90	No Build	Annual	7		Sitting	11		Acceptable
	Build	Annual	9	29%	Sitting	13	18%	Acceptable
	Full Build	Annual	9	29%	Sitting	14	27%	Acceptable
91	No Build	Annual	7		Sitting	12		Acceptable
	Build	Annual	10	43%	Sitting	16	33%	Acceptable
	Full Build	Annual	10	43%	Sitting	17	42%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
92	No Build	Annual	10		Sitting	15		Acceptable
	Build	Annual	11		Sitting	16		Acceptable
	Full Build	Annual	11		Sitting	16		Acceptable
93	No Build	Annual	8		Sitting	12		Acceptable
	Build	Annual	9	12%	Sitting	14	17%	Acceptable
	Full Build	Annual	9	12%	Sitting	14	17%	Acceptable
94	No Build	Annual	8		Sitting	12		Acceptable
	Build	Annual	9	12%	Sitting	14	17%	Acceptable
	Full Build	Annual	9	12%	Sitting	15	25%	Acceptable
95	-	-	-		-	-		-
	Build	Annual	21		Uncomfortable	28		Acceptable
	Full Build	Annual	21		Uncomfortable	27		Acceptable
96	No Build	Annual	10		Sitting	17		Acceptable
	Build	Annual	11		Sitting	17		Acceptable
	Full Build	Annual	11		Sitting	18		Acceptable
97	-	-	-		-	-		-
	Build	Annual	11		Sitting	16		Acceptable
	Full Build	Annual	11		Sitting	16		Acceptable
98	-	-	-		-	-		-
	Build	Annual	11		Sitting	18		Acceptable
	Full Build	Annual	11		Sitting	18		Acceptable
99	No Build	Annual	12		Sitting	19		Acceptable
	Build	Annual	12		Sitting	19		Acceptable
	Full Build	Annual	13		Standing	19		Acceptable
100	-	-	-		-	-		-
	Build	Annual	12		Sitting	19		Acceptable
	Full Build	Annual	12		Sitting	19		Acceptable
101	-	-	-		-	-		-
	Build	Annual	14		Standing	21		Acceptable
	Full Build	Annual	14		Standing	21		Acceptable
102	-	-	-		-	-		-
	Build	Annual	10		Sitting	17		Acceptable
	Full Build	Annual	11		Sitting	17		Acceptable
103	-	-	-		-	-		-
	Build	Annual	8		Sitting	13		Acceptable
	Full Build	Annual	8		Sitting	13		Acceptable
104	-	-	-		-	-		-
	Build	Annual	10		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	15		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
105	-	-	-		-	-		-
	Build	Annual	18		Walking	25		Acceptable
	Full Build	Annual	18		Walking	25		Acceptable
106	-	-	-		-	-		-
	Build	Annual	15		Standing	22		Acceptable
	Full Build	Annual	15		Standing	22		Acceptable
107	No Build	Annual	9		Sitting	15		Acceptable
	Build	Annual	12	33%	Sitting	20	33%	Acceptable
	Full Build	Annual	12	33%	Sitting	20	33%	Acceptable
108	No Build	Annual	11		Sitting	17		Acceptable
	Build	Annual	8	-27%	Sitting	14	-18%	Acceptable
	Full Build	Annual	9	-18%	Sitting	14	-18%	Acceptable
109	No Build	Annual	7		Sitting	11		Acceptable
	Build	Annual	8	14%	Sitting	13	18%	Acceptable
	Full Build	Annual	8	14%	Sitting	13	18%	Acceptable
110	No Build	Annual	9		Sitting	14		Acceptable
	Build	Annual	8	-11%	Sitting	13		Acceptable
	Full Build	Annual	8	-11%	Sitting	13		Acceptable
111	No Build	Annual	11		Sitting	16		Acceptable
	Build	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	10		Sitting	16		Acceptable
112	No Build	Annual	11		Sitting	17		Acceptable
	Build	Annual	17	55%	Walking	24	41%	Acceptable
	Full Build	Annual	18	64%	Walking	24	41%	Acceptable
113	No Build	Annual	10		Sitting	15		Acceptable
	Build	Annual	11		Sitting	17	13%	Acceptable
	Full Build	Annual	11		Sitting	16		Acceptable
114	No Build	Annual	10		Sitting	15		Acceptable
	Build	Annual	11		Sitting	17	13%	Acceptable
	Full Build	Annual	11		Sitting	16		Acceptable
115	No Build	Annual	10		Sitting	16		Acceptable
	Build	Annual	12	20%	Sitting	20	25%	Acceptable
	Full Build	Annual	12	20%	Sitting	19	19%	Acceptable
116	No Build	Annual	7		Sitting	12		Acceptable
	Build	Annual	8	14%	Sitting	13		Acceptable
	Full Build	Annual	8	14%	Sitting	13		Acceptable
117	No Build	Annual	11		Sitting	16		Acceptable
	Build	Annual	16	45%	Walking	22	38%	Acceptable
	Full Build	Annual	16	45%	Walking	22	38%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
118	No Build	Annual	11		Sitting	15		Acceptable
	Build	Annual	12		Sitting	17	13%	Acceptable
	Full Build	Annual	12		Sitting	18	20%	Acceptable
119	No Build	Annual	11		Sitting	17		Acceptable
	Build	Annual	11		Sitting	17		Acceptable
	Full Build	Annual	10		Sitting	17		Acceptable

Configurations	Mean Wind Criteria Speed (mph)		Effective Gust Criteria (mph)	
No Build	≤ 12	Comfortable for Sitting	≤ 31	Acceptable
Existing site and surroundings	13 - 15	Comfortable for Standing	> 31	Unacceptable
Build	16 - 19	Comfortable for Walking		
Proposed development and existing surroundings	20 - 27	Uncomfortable for Walking		
Full Build	> 27	Dangerous Conditions		
Build including future developments				

Notes

1) Wind Speeds are for a 1% probability of exceedance

2) % Change is based on comparison with the No Build configuration

3) % changes less than 10% are excluded

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
1	No Build	14	11	13	15	20	15	19	22
	Build	15	11	14	16	21	16	20	22
	Full Build	15	11	14	16	21	16	19	22
2	No Build	13	10	12	14	21	15	19	21
	Build	14	10	12	14	21	15	19	21
	Full Build	13	10	12	13	20	15	18	21
3	No Build	12	9	11	13	20	15	18	20
	Build	12	9	11	12	19	15	18	19
	Full Build	11	9	10	11	18	14	17	18
4	No Build	12	9	11	13	19	15	18	20
	Build	12	10	11	12	18	14	17	18
	Full Build	11	9	10	11	18	14	16	18
5	No Build	14	12	13	15	22	17	20	23
	Build	14	12	13	14	20	16	19	21
	Full Build	13	11	12	13	19	16	18	19
6	No Build	14	11	13	14	21	15	19	21
	Build	15	11	14	16	22	16	21	23
	Full Build	15	11	14	15	22	16	20	21
7	No Build	15	13	14	15	22	17	20	22
	Build	18	14	16	18	25	19	23	26
	Full Build	17	14	16	17	24	19	22	24
8	No Build	13	10	12	14	20	15	19	22
	Build	15	11	14	15	22	16	20	23
	Full Build	14	12	13	15	21	16	20	22
9	No Build	14	11	13	16	23	17	21	26
	Build	17	13	15	18	25	19	24	28
	Full Build	16	12	14	17	23	18	22	26
10	No Build	17	12	16	19	27	19	24	29
	Build	18	13	16	20	28	20	25	31
	Full Build	17	12	15	18	26	19	23	28
11	No Build	12	9	11	13	20	15	19	22
	Build	14	11	13	15	22	16	20	25
	Full Build	14	11	12	15	21	16	19	23
12	No Build	9	7	8	9	15	12	14	16
	Build	8	6	8	9	15	11	13	16
	Full Build	8	6	8	9	14	11	13	15
13	No Build	17	13	16	18	25	19	23	27
	Build	18	13	16	19	26	19	23	27
	Full Build	17	13	15	18	24	19	22	26

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
14	No Build	18	13	17	20	27	19	25	30
	Build	20	14	18	22	28	21	26	31
	Full Build	18	13	16	20	26	19	24	28
15	No Build	16	12	14	17	23	17	21	24
	Build	17	13	15	18	24	18	22	26
	Full Build	16	12	15	17	22	17	20	24
16	No Build	17	13	16	19	26	19	24	28
	Build	19	14	17	21	27	20	25	30
	Full Build	17	13	16	19	25	18	23	28
17	No Build	11	10	10	11	17	14	15	17
	Build	11	9	10	11	16	13	15	17
	Full Build	11	10	10	11	16	13	15	16
18	No Build	13	10	12	14	21	16	20	23
	Build	16	12	15	17	24	18	23	26
	Full Build	15	12	14	16	22	17	21	24
19	No Build	17	13	16	19	27	19	24	30
	Build	20	15	18	22	29	21	27	32
	Full Build	18	15	17	22	26	20	24	32
20	No Build	14	11	13	15	22	17	21	24
	Build	17	14	16	18	26	20	24	27
	Full Build	17	14	15	17	24	19	23	26
21	No Build	9	7	8	9	15	13	14	15
	Build	11	9	10	11	17	14	17	18
	Full Build	11	9	10	11	17	14	16	18
22	No Build	13	11	12	14	20	17	19	21
	Build	21	17	19	21	28	23	26	29
	Full Build	21	18	19	21	29	24	26	29
23	No Build	14	11	12	14	20	16	18	20
	Build	14	11	13	14	20	16	19	21
	Full Build	14	11	12	14	20	16	18	20
24	No Build	13	11	12	14	19	15	18	20
	Build	12	10	12	12	18	15	17	19
	Full Build	12	10	11	12	18	14	17	18
25	No Build	13	10	12	14	18	14	17	19
	Build	10	8	10	11	16	12	15	17
	Full Build	10	8	9	10	15	12	14	15
26	No Build	8	6	8	9	13	10	12	14
	Build	7	6	7	8	13	10	12	13
	Full Build	7	6	7	7	12	10	12	13

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
27	No Build	8	6	7	8	13	10	12	14
	Build	8	6	8	8	14	10	13	14
	Full Build	7	6	7	7	12	10	12	13
28	No Build	9	6	8	10	13	10	12	14
	Build	8	6	7	8	12	9	11	13
	Full Build	8	6	7	9	12	9	11	13
29	No Build	13	9	12	13	21	15	19	21
	Build	14	10	13	14	23	16	21	23
	Full Build	12	9	11	12	20	15	18	20
30	No Build	8	7	7	8	13	10	12	13
	Build	7	6	7	8	12	9	11	13
	Full Build	7	6	7	8	13	9	12	13
31	No Build	13	9	12	13	20	14	19	21
	Build	14	10	13	14	21	15	20	21
	Full Build	12	9	11	13	19	15	18	20
32	No Build	12	9	11	13	18	14	18	19
	Build	13	10	12	13	19	15	18	20
	Full Build	13	10	12	13	19	15	18	20
33	No Build	12	8	11	12	19	14	18	20
	Build	12	8	11	12	20	13	18	19
	Full Build	10	8	9	10	17	12	16	17
34	No Build	12	9	11	12	18	14	17	19
	Build	12	9	11	12	18	14	17	19
	Full Build	12	9	11	12	18	14	17	19
35	No Build	10	7	10	11	17	11	16	17
	Build	10	7	10	10	17	12	16	17
	Full Build	9	6	8	9	15	10	14	15
36	No Build	16	14	15	16	22	18	21	23
	Build	16	13	15	16	23	19	21	23
	Full Build	16	13	14	16	22	18	20	23
37	No Build	15	12	14	17	21	16	20	23
	Build	16	12	15	17	22	17	21	24
	Full Build	16	12	15	17	22	17	21	24
38	No Build	16	12	15	17	22	18	22	24
	Build	16	12	15	17	22	17	22	24
	Full Build	16	12	15	17	22	17	21	24
39	No Build	16	12	14	17	24	18	21	25
	Build	15	11	14	16	23	17	21	23
	Full Build	15	11	14	16	23	17	20	23

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
40	No Build	13	11	13	13	20	17	19	20
	Build	13	11	13	13	19	16	19	20
	Full Build	13	10	12	13	19	15	18	19
41	No Build	9	7	9	10	16	12	15	17
	Build	9	7	9	10	16	12	15	17
	Full Build	9	7	8	10	16	12	15	17
42	No Build	9	7	9	9	16	12	14	16
	Build	10	7	9	10	17	12	15	16
	Full Build	9	7	8	10	16	12	14	16
43	No Build	9	7	8	8	14	11	13	14
	Build	9	7	8	9	15	11	13	15
	Full Build	9	6	8	8	14	11	13	14
44	No Build	9	7	9	10	15	11	14	15
	Build	12	9	11	13	18	14	17	19
	Full Build	12	9	11	13	18	14	17	19
45	No Build	9	7	9	10	15	11	14	16
	Build	10	7	9	10	16	12	15	16
	Full Build	9	7	9	10	15	12	14	16
46	No Build	13	9	12	13	20	15	19	20
	Build	12	9	12	12	19	15	18	19
	Full Build	10	8	9	10	17	13	16	17
47	No Build	16	11	15	14	23	17	22	22
	Build	15	11	14	14	23	16	21	21
	Full Build	14	10	13	12	21	16	20	20
48	No Build	9	7	9	9	15	12	14	15
	Build	10	8	9	10	16	13	15	16
	Full Build	10	8	9	10	16	13	15	16
49	No Build	11	9	9	10	16	13	14	16
	Build	11	9	10	11	16	13	15	16
	Full Build	10	8	9	10	15	13	14	15
50	No Build	11	8	11	11	17	13	16	17
	Build	11	8	10	11	17	13	16	17
	Full Build	10	8	10	11	16	13	15	17
51	No Build	8	6	8	9	14	11	13	15
	Build	9	7	9	10	15	12	14	16
	Full Build	10	8	10	11	17	13	16	18
52	No Build	12	9	11	12	16	12	14	16
	Build	11	8	10	11	16	12	14	16
	Full Build	11	8	10	12	16	12	14	16

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
53	No Build	9	7	8	9	14	11	13	14
	Build	10	8	9	10	15	12	14	15
	Full Build	10	9	9	10	15	12	14	15
54	No Build	8	6	7	8	12	9	12	13
	Build	10	7	9	10	16	11	14	16
	Full Build	10	8	9	11	16	12	14	16
55	No Build	9	8	9	9	15	13	14	15
	Build	9	7	8	9	15	12	14	15
	Full Build	9	8	8	9	15	13	14	16
56	No Build	7	6	7	8	12	9	11	13
	Build	7	5	7	7	12	9	11	12
	Full Build	7	5	6	7	11	9	11	12
57	No Build	10	8	9	11	14	11	13	15
	Build	10	7	9	10	14	10	13	14
	Full Build	10	7	9	10	14	11	13	14
58	No Build	10	7	9	10	15	11	14	16
	Build	9	7	8	9	14	11	13	15
	Full Build	9	7	8	9	14	11	13	15
59	No Build	12	9	11	12	17	14	16	18
	Build	11	8	10	11	17	14	17	18
	Full Build	11	9	10	12	18	15	17	19
60	No Build	10	8	9	10	14	12	13	15
	Build	10	8	10	10	16	12	15	15
	Full Build	10	8	9	9	15	12	14	15
61	No Build	14	12	13	14	19	16	18	19
	Build	14	11	13	14	20	17	18	20
	Full Build	14	12	13	14	20	17	19	21
62	No Build	8	7	8	9	13	11	13	14
	Build	9	7	8	9	13	10	13	14
	Full Build	8	6	8	9	13	11	13	14
63	No Build	9	8	9	10	15	12	15	16
	Build	9	7	9	10	15	12	14	16
	Full Build	9	8	9	10	15	13	15	16
64	No Build	12	10	11	12	18	16	17	19
	Build	11	10	10	11	18	16	17	18
	Full Build	13	11	12	13	20	18	19	20
65	No Build	12	10	12	12	19	15	17	18
	Build	12	10	12	12	19	16	18	19
	Full Build	12	11	11	12	19	17	18	19

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
66	No Build	12	8	11	11	18	13	17	17
	Build	10	8	10	11	17	13	16	18
	Full Build	10	8	9	11	17	13	16	18
67	No Build	8	6	7	8	13	10	12	13
	Build	9	7	9	10	15	12	14	16
	Full Build	9	7	8	10	14	11	13	15
68	No Build	9	7	8	9	15	11	14	16
	Build	12	9	11	13	19	14	17	20
	Full Build	12	9	11	13	19	14	17	20
69	No Build	8	6	8	9	14	11	13	14
	Build	8	7	8	9	14	11	13	14
	Full Build	8	7	8	8	14	11	13	14
70	No Build	9	7	9	9	15	11	14	15
	Build	9	7	8	8	14	11	13	14
	Full Build	8	7	8	8	14	11	13	14
71	No Build	11	8	10	10	17	12	16	16
	Build	10	7	9	10	16	12	15	16
	Full Build	10	7	9	9	16	11	14	15
72	No Build	10	7	9	10	16	12	15	16
	Build	10	7	9	10	16	12	15	16
	Full Build	9	7	9	9	15	12	14	16
73	No Build	11	8	10	12	17	13	16	18
	Build	12	9	12	13	19	15	18	20
	Full Build	12	9	11	13	19	14	17	19
74	No Build	10	7	9	11	15	11	13	16
	Build	15	10	14	14	22	16	21	21
	Full Build	14	10	13	14	22	15	20	21
75	No Build	9	7	8	9	14	12	13	15
	Build	15	11	14	16	22	16	21	25
	Full Build	14	11	13	16	22	16	20	24
76	No Build	9	7	8	9	14	11	13	15
	Build	9	7	8	9	14	11	13	15
	Full Build	8	7	8	8	14	11	13	14
77	No Build	10	8	9	10	17	14	15	16
	Build	10	8	9	9	16	14	15	16
	Full Build	10	9	9	9	16	14	15	15
78	No Build	9	7	9	10	15	12	14	15
	Build	9	7	8	9	15	12	14	15
	Full Build	9	7	8	9	15	12	13	15

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
79	No Build	10	8	9	10	16	13	15	17
	Build	10	8	9	11	16	13	16	17
	Full Build	10	8	9	10	16	14	15	17
80	No Build	10	8	9	10	15	12	14	16
	Build	14	10	13	15	19	14	18	21
	Full Build	14	10	13	15	19	15	18	21
81	No Build	8	7	8	9	14	11	13	15
	Build	8	6	7	9	14	11	12	15
	Full Build	9	7	8	9	14	11	13	15
82	No Build	10	8	9	11	16	13	15	17
	Build	8	7	8	8	14	11	13	14
	Full Build	8	7	7	8	14	11	13	14
83	No Build	10	8	10	11	17	13	16	18
	Build	9	7	8	9	15	11	13	16
	Full Build	8	6	8	9	14	11	13	14
84	No Build	8	6	7	8	12	10	11	12
	Build	8	6	8	9	13	10	12	14
	Full Build	8	6	8	9	14	10	13	14
85	No Build	11	8	10	12	15	12	14	16
	Build	14	10	13	16	21	16	19	23
	Full Build	14	11	13	15	21	16	19	22
86	No Build	9	8	8	9	13	11	12	14
	Build	18	13	16	19	25	19	23	27
	Full Build	18	13	16	19	25	19	23	27
87	No Build	13	11	11	12	18	15	16	17
	Build	16	13	15	18	23	19	21	24
	Full Build	17	14	15	18	23	19	22	25
88	No Build	13	11	11	13	19	15	16	18
	Build	14	12	13	14	20	17	18	20
	Full Build	15	13	13	15	21	18	19	21
89	No Build	10	8	9	11	16	12	15	17
	Build	11	10	11	12	18	15	17	19
	Full Build	12	10	11	12	18	16	17	19
90	No Build	7	6	7	7	11	9	11	12
	Build	9	7	8	9	14	11	13	15
	Full Build	9	7	8	9	14	11	13	15
91	No Build	8	6	7	8	12	10	11	13
	Build	10	9	10	10	16	15	16	16
	Full Build	11	10	10	10	18	16	16	17

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
92	No Build	11	9	10	11	16	12	15	16
	Build	11	9	11	12	17	14	16	17
	Full Build	11	9	11	12	17	14	16	17
93	No Build	8	7	7	8	12	10	11	13
	Build	9	8	9	10	14	11	13	15
	Full Build	9	8	9	10	14	12	13	15
94	No Build	8	7	7	8	12	10	11	13
	Build	9	7	9	10	15	11	14	15
	Full Build	9	8	9	10	15	12	14	16
95	No Build	-	-	-	-	-	-	-	-
	Build	22	16	20	24	28	21	26	31
	Full Build	21	15	19	23	28	21	26	30
96	No Build	11	8	10	12	18	13	16	19
	Build	12	9	11	12	18	14	17	19
	Full Build	11	9	11	12	18	14	17	19
97	No Build	-	-	-	-	-	-	-	-
	Build	11	8	10	12	16	13	15	18
	Full Build	11	8	10	12	16	12	15	18
98	No Build	-	-	-	-	-	-	-	-
	Build	11	9	10	12	18	14	17	19
	Full Build	11	9	10	12	18	14	17	19
99	No Build	12	9	11	13	19	14	18	21
	Build	13	10	12	14	20	15	18	21
	Full Build	13	10	12	14	20	15	18	21
100	No Build	-	-	-	-	-	-	-	-
	Build	13	10	12	14	19	15	18	21
	Full Build	13	10	12	14	19	15	18	21
101	No Build	-	-	-	-	-	-	-	-
	Build	14	10	13	16	21	16	20	23
	Full Build	14	11	13	16	22	16	20	24
102	No Build	-	-	-	-	-	-	-	-
	Build	11	8	10	11	17	13	16	18
	Full Build	11	8	10	12	17	13	16	18
103	No Build	-	-	-	-	-	-	-	-
	Build	8	7	8	8	13	11	13	14
	Full Build	9	7	8	9	14	11	13	14
104	No Build	-	-	-	-	-	-	-	-
	Build	10	8	9	10	16	13	15	16
	Full Build	10	8	9	10	16	13	15	16

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
105	No Build	-	-	-	-	-	-	-	-
	Build	18	14	17	20	25	19	24	28
	Full Build	18	14	16	19	25	19	24	28
106	No Build	-	-	-	-	-	-	-	-
	Build	15	13	14	16	22	19	21	24
	Full Build	15	13	14	16	22	19	21	23
107	No Build	9	7	9	10	16	13	15	17
	Build	13	10	12	14	20	16	19	22
	Full Build	12	10	12	14	20	16	19	22
108	No Build	11	9	11	12	17	14	16	18
	Build	9	8	8	9	14	12	13	15
	Full Build	9	8	8	9	15	12	14	15
109	No Build	7	6	7	8	12	10	11	12
	Build	8	7	8	8	13	11	12	14
	Full Build	8	7	8	8	13	11	12	14
110	No Build	9	7	8	9	14	11	13	15
	Build	8	7	8	9	13	11	12	14
	Full Build	8	7	8	9	13	11	12	14
111	No Build	11	9	10	11	17	14	16	17
	Build	11	9	10	11	16	14	15	17
	Full Build	11	9	10	11	16	14	15	17
112	No Build	11	9	11	12	17	13	16	18
	Build	18	14	17	19	24	18	23	26
	Full Build	18	14	17	19	24	19	23	26
113	No Build	11	8	10	11	16	12	14	16
	Build	12	9	11	12	18	13	16	18
	Full Build	11	9	10	12	17	13	15	17
114	No Build	10	8	9	10	16	13	15	16
	Build	12	9	11	12	17	13	16	18
	Full Build	12	9	11	12	17	13	16	17
115	No Build	10	8	9	10	18	13	16	17
	Build	14	11	12	13	22	17	19	21
	Full Build	13	10	11	12	21	16	18	20
116	No Build	7	5	7	7	13	9	12	13
	Build	8	6	8	8	14	10	13	14
	Full Build	8	6	7	8	13	10	12	13
117	No Build	11	9	10	12	17	13	16	18
	Build	16	12	15	17	22	17	21	24
	Full Build	16	13	15	17	22	18	21	24

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
118	No Build	11	9	10	12	16	12	15	17
	Build	12	9	11	13	18	14	17	19
	Full Build	12	9	11	13	19	14	17	19
119	No Build	11	8	10	11	18	13	16	18
	Build	11	9	10	11	18	14	16	18
	Full Build	11	9	10	11	18	14	17	19

Seasons	Months	Mean Wind Criteria Speed (mph)		Effective Gust Criteria (mph)	
Spring	March - May	≤ 12	Comfortable for Sitting	≤ 31	Acceptable
Summer	June - August	13 - 15	Comfortable for Standing	> 31	Unacceptable
Fall	September - November	16 - 19	Comfortable for Walking		
Winter	December - February	20 - 27	Uncomfortable for Walking		
Annual	January - December	> 27	Dangerous Conditions		

Configurations	
No Build	Existing site and surroundings
Build	Proposed development and existing surroundings
Full Build	Build including future developments

Appendix D

Acoustic Report

ACOUSTIC STUDY FOR CAMBRIDGESIDE

CAMBRIDGE, MASSACHUSETTS

July 2020

TECH environmental

FOCUSED KNOWLEDGE. REAL SOLUTIONS.

ACOUSTIC STUDY FOR CAMBRIDGESIDE

CAMBRIDGE, MASSACHUSETTS

Prepared for:

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July 28, 2020

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

List of Tables

List of Figures

1.0 EXECUTIVE SUMMARY

The Project is a reconstruction of the existing retail mall to provide: reconstruction of the existing retail mall to provide: (1) 875,000 GSF of new commercial space (split 1/4 office and 3/4 laboratory); and (2) approximately 175,000 GSF of residential space (200 dwelling units). Most of the new commercial space will be built in three reconfigured and expanded buildings at the site of the existing Sears (60 First Street), Macy's (10 CambridgeSide), and Best Buy (110 First Street) stores. A fourth building will replace the existing upper garage (80/90 First Street), and will contain approximately 100,000 SF of the commercial space and all of the new residential space.

As required under Section 13.107.2 of the Zoning Petition approved by the Cambridge City Council, an acoustic modeling analysis of the rooftop mechanical equipment was performed to demonstrate that sound emanating from the rooftop equipment will not be normally perceptible without instruments at a distance of 100 feet from the source lot line. And to demonstrate compliance with the City of Cambridge Noise Ordinance for Commercial Areas.

The following steps were completed for the acoustic modeling analyses:

1. Perform an acoustic modeling analysis to assess the potential noise impacts from the exterior mechanical equipment for the Project. The purpose of the modeling analysis was to demonstrate that the projected noise levels from the buildings' exterior rooftop mechanical equipment will not exceed the City of Cambridge Noise Ordinance at the nearest noise sensitive commercial and residential receivers, and will not perceptible at 100 feet from the source lot line. An ambient sound level was assumed that is applicable for the area as part of the demonstration of not being perceptible at 100 feet from the lot line.

2. Acoustic modeling was performed using the Cadna-A computer model, in accordance with International Standard ISO 9613.2 "Acoustics - Attenuation of Sound During Propagation Outdoors". Cadna-A is a sophisticated 3-dimensional model that accounts for sound attenuation due to building structures, atmospheric absorption and ground effects. Cadna-A simulates all relevant acoustic effects involving sound propagation, reflection and attenuation.

3. The predicted sound level impacts were compared to City of Cambridge Noise Ordinance broadband and octave band sound limits for commercial and residential areas, and incremental change in sound over the assumed ambient level. The acoustic modeling was based on Best Available Noise Control Technology (BANCT) requirements specified in Section 13.107.2(b) of the Zoning Petition for those buildings with laboratory space. BANCT noise mitigation strategies were modeled through additional acoustic model runs. The results of the acoustic modeling analyses demonstrate compliance with City of Cambridge Municipal and Zoning Noise Ordinances.

As discussed in Section 5.0, the acoustic modeling analysis included evaluating the sizing and selection of equipment, its placement on the roof, and the use of effective sound attenuation design elements, and the following sound mitigation measures for those buildings (60 First Street, 110 First Street and 20 Cambridge Side) with laboratory space:

1. Fans with variable speed drives, cooling towers that include large diameter slow speed fans;
2. Silencers on air handling units and specialty tenant laboratory exhaust fans;
3. Air handling units are located within an enclosed mechanical penthouse with acoustic louvers;
4. Cooling towers are located within a screening wall and with sound absorbent wall panels on a portion of the screen walls, and
5. Emergency generators will be enclosed in acoustic-treated housing with critical grade exhaust silencers.

Appendix A shows the locations of the proposed sound absorbent wall panels and acoustic louvers. The sound transmission losses (sound attenuation) for acoustic louvers, used in the acoustic model, were based on IAC Acoustics, Noishield ™, Model SL6 or equal. Appendix B presents the acoustic louver manufacturer specification sheet for the Noishield ™ louvers.

The results of the acoustic modeling analysis of the rooftop mechanical equipment demonstrated that sound emanating from the rooftop equipment will comply with the City of Cambridge Noise Ordinance for Commercial and Residential Areas. The modeling results also demonstrate compliance Zoning Code requirement that sound levels will not be normally perceptible without instruments at a distance of 100 feet from the source lot line.

The results of the acoustic modeling analysis are presented in Appendix C.

2.0 COMMON MEASURES OF COMMUNITY NOISE

Audible sound is reported as a sound pressure level[1] in decibels (dB). The decibel scale is logarithmic to accommodate the wide range of sound intensities to which the human ear is subjected. A property of the decibel scale is that the sound pressure levels of two separate sounds are not directly additive. For example, if a sound of 70 dB is added to another sound of 70 dB, the total is only a 3-decibel increase (or 73 dB), not a doubling to 140 dB. Thus, every 3-dB increase represents a doubling of sound energy. For broadband sounds, a 3-dB change is the minimum change perceptible to the human ear. Table 1 below gives the perceived change in loudness of different changes in sound pressure levels.[2]

TABLE 1

SUBJECTIVE EFFECT OF CHANGES IN SOUND PRESSURE LEVELS

CHANGE IN SOUND LEVEL	APPARENT CHANGE IN LOUDNESS
3 dB	Just perceptible
5 dB	Noticeable
10 dB	Twice (or half) as loud

The acoustic energy level of a source is known as its sound power level (L_w), which is also measured on a decibel scale. The sound power level of a source is the same at any distance; therefore, L_w values do not have reference distances. In contrast, sound pressure levels vary with distance from the source. Sound power levels are typically greater than 100 dBA; these large L_w numbers should not be confused with the sound pressure levels we hear.

Non-steady noise exposure in a community is commonly expressed in terms of the A-weighted sound level (dBA); A-weighting approximates the frequency response of the human ear. Levels of many sounds change from moment to moment. Some are sharp impulses lasting 1 second or less, while

[1] The sound pressure level is defined as 20*log10 (P/Po) where P is the sound pressure and Po is the reference pressure of 20 micro-Pascals (20 μPa), which by definition corresponds to 0 dB.

[2] American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 1989 ASHRAE Handbook--Fundamentals (I-P) Edition, Atlanta, GA, 1989.

others rise and fall over much longer periods of time. There are various measures of sound pressure designed for different purposes. To establish the background sound level in an area, the **L_{90}** metric, which is the sound level exceeded 90 percent of the time, is typically used. The **L_{90}** can also be thought of as the level representing the quietest 10 percent of any time period. This is a broadband sound pressure measure, i.e., it includes sounds at all frequencies. The **L_{eq}**, or equivalent sound level, is the steady-state sound level over a period of time that has the same acoustic energy as the fluctuating sounds that actually occurred during that same period. It is commonly referred to as the average sound level. The **L_{max}**, or maximum sound level, represents the one second peak level experienced during a given time period.

Sound level measurements typically include an analysis of the sound spectrum into its various frequency components to determine tonal characteristics. The unit of frequency is Hertz (Hz), measuring the cycles per second of the sound pressure waves, and typically the frequency analysis examines eleven octave bands from 16 to 16,000 Hz.

The acoustic environment in an urban area such as Cambridge results from numerous sources and the major source is motor vehicle traffic on surrounding arterial and local roads. Typical sound levels associated with various activities and environments are presented in Table 2.

TABLE 2

COMMON SOUND LEVELS

Sound Level (dBA)	Common Indoor Sounds	Common Outdoor Sounds
110	Rock Band	Jet Takeoff at 1000’
100	Inside NYC Subway Train	Chain Saw at 3’
90	Food Blender at 3’	Impact Hammer (Hoe Ram) at 50’
80	Garbage Disposal at 3’	Diesel Truck at 100’
70	Vacuum Cleaner at 10’	Lawn Mower at 100’
60	Normal Speech at 3’	Auto (40 mph) at 100’
50	Dishwasher in Next Room	Busy Suburban Area at night
40	Empty Conference Room	Quiet Suburban Area at night
25	Empty Concert Hall	Rural Area at night

3.0 CITY OF CAMBRDIGE NOISE ORDINANCES

The City of Cambridge regulates noise in both their municipal and zoning codes. The applicable noise regulations for the Project are summarized below.

3.1 Municipal Code

The City of Cambridge regulates noise through Chapter 8.16 – Noise Control of the Municipal Code. Section 8.16.060E of the Code provides noise limits for each zoning district for daytime and other times. Daytime is defined as occurring between the hours of 7:00 a.m. and 6:00 p.m. daily, except Sunday and holidays. Table 3 lists the maximum allowable octave band and broadband sound pressure levels for each zoning district. CambridgeSide is located in a business-zoned district. The abutting properties are zoned as either office or business districts. Within these zoned areas, there are a mix of uses that include multifamily residences and hotels. For the purposes of this sound study, the more restrictive Residential limits are applied to residential uses located in Commercial/Business zoning districts. This is a conservative approach because compliance with the Residential limits infers compliance with the higher Commercial limits.

TABLE 3

CITY OF CAMBRIDGE MUNICPAL CODE
MAXIMUM ALLOWABLE SOUND PRESSURE LEVELS (dB)

Octave Band (Hz)	Zoning District					
	Residential (Daytime)	Residential (Other Times)	Residential in Industrial (Daytime)	Residential in Industrial (Other Times)	Commercial (anytime)	Industrial (anytime)
31.5 Hz	76	68	79	72	79	83
63 Hz	75	67	78	71	78	82
125 Hz	69	61	73	65	73	77
250 Hz	62	52	68	57	68	73
500 Hz	56	46	62	51	62	67
1000 Hz	50	40	56	45	56	61
2000 Hz	45	33	51	39	51	57
4000 Hz	40	28	47	34	47	53
8000 Hz	38	26	44	32	44	50
Broadband (dBA)	**60**	**50**	**65**	**55**	**65**	**70**

3.2 Zoning Code

Under Article 13.000 of the City of Cambridge Zoning Code, the City has established Planned Unit Development (PUD Districts. The Project is located in the PUD-4, PUD-4A, PUD-4B and PUD-4C Districts. Section 13.59.1 requires that "*At a minimum, any noise or vibration shall not be normally perceptible at ground level without instruments at a distance of one hundred (100) feet from the source lot line and buildings shall comply with the City of Cambridge Noise Ordinance.*" For the purposes of this sound study, normally perceptible is defined as 3 dBA or less increase in sound above ambient.

CambridgeSide is located in a business-zoned district. The abutting properties are zoned as either office or business districts. The primary sources of sound are from traffic on First Street and surrounding local roads, aircraft and mechanical equipment from other abutting commercial properties. Ambient daytime and nighttime sound levels are estimated to be relatively the same. Typical, background L_{90} sound levels range from 52 to 58 dBA for urban residential areas.[3] These sound levels are very similar to those measured in similar area of Cambridge.[4] Under these extraordinary times with COVID19 pandemic, ambient sound levels are lower than the sound levels described above due to significantly less local and highway traffic and local commercial area operations. Sound measurements will be taken around the Project site to establish ambient conditions once traffic and local commercial businesses are back to a more normal level as part of the sound compliance monitoring requirement prior to obtaining a certificate of occupancy for each building.

For this sound study, these ambient sound levels were used to demonstrate compliance with the Zoning Code. Therefore, predicted sound levels at ground level at a distance of 100 feet from the CambridgeSide property line are limited to 58 dBA during the daytime and 52 dBA during the nighttime. When added to the ambient levels, the future sound levels are limited to a 3 dBA increase or 61 dBA during the daytime and 55 dBA during the nighttime.

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[3] U.S. Environmental Protection Agency, Legal Compilations Statutes and Legislative History Executive Orders Regulations Guidelines and Reports, p. 2-15 – 2-16, January 1973.

[4] Acentech, Article 19 Noise Mitigation Narrative MIT Investment Management Company/MIT SoMa and NoMa Site Environmental Noise Evaluation and Compliance Cambridge, MA,Acentech Project No. 626051, July 13, 2015.

4.0 FUTURE SOUND SOURCES

The Project is a reconstruction of the existing retail mall to provide: reconstruction of the existing retail mall to provide: (1) 875,000 GSF of new commercial space (split 1/4 office and 3/4 laboratory); and (2) approximately 175,000 GSF of residential space (200 dwelling units). Most of the new commercial space will be built in three reconfigured and expanded buildings at the site of the existing Sears (60 First Street), Macy's (20 CambridgeSide), and Best Buy (110 First Street) stores. A fourth building will replace the existing upper garage (80/90 First Street), and that building will contain approximately 100,000 SF of the commercial space and all of the new residential space.

The potential sound sources expected for each of the buildings that will include laboratory space (60 First Street, 20 CambridgeSide and 110 First Street) are:

- Exhaust Fans (EF)
- Cooling Towers (CT)
- Cooling Water Pumps (CWP)
- Chilled Water Pumps (CHWP)
- Hot Water Pumps (HWP)
- Water Cooled Chillers (Chiller)
- Air Handling Units (AHU)
- Exhaust Air Handling Units (EAHU) and EAHU Exhausts Fans (EF)
- Emergency generators (EG)
- Specialty Tenant Laboratory Exhaust Fans (SEF)
- Boilers

The potential sound sources expected for the residential building (80/90 First Street) are:

- Energy Recovery Units (ERU)
- Emergency generators (EG)
- Air Handling Units (AHU)

Many of these sound sources will be enclosed in a fully or partially enclosed mechanical penthouse or behind screening walls. Sound data for each sound source were either provided from manufacturer's specification and literature research. The potential sources of sound for each of the buildings are presented in Table 4. All sound sources were assumed to be operating simultaneously at their maximum loads and maximum sound levels. Emergency generators are assumed to be tested only during daytime hours. This is a worst-case assumption given that mechanical equipment operations are dependent upon on the occupancy of each building.

TABLE 4

PROPOSED MECHANIAL EQUIPMENT AND SOUND POWER LEVELS (dBA)

Building Address	Building Name	Equipment Type	Quantity	Sound Power Level
20 CambridgeSide	Macy	Water Cooled Chillers	3	97
		Cooling Water Pumps (CWP)	7	102
		Hot Water Pumps (HWP)	4	102
		Boilers	6	92
		Air Handling Units (AHU)	6	79
		1500 KW Emergency Generator (EG)	1	113
		500 KW Future Tenant (EG)	1	100
		EAHU Exhaust Fans (EF)	6	78
		Cooling Towers (CT)	4	89
		Specialty Tenant Lab Exhaust Fans (SEF)	14	89
110 First Street	Best Buy	Water Cooled Chillers	3	97
		Chilled Water Pumps (CHWP)	8	99
		Cooling Water Pumps (CWP)	8	102
		Hot Water Pumps (HWP)	6	102
		Boilers	6	92
		Air Handling Units (AHU)	6	79
		Exhaust Air Handling Units (EAHU)	6	79
		Cooling Towers (CT)	4	89
		Exhaust Fans (EF)	6	78
80/90 First Street	Upper Garage	Energy Recovery Unit (ERU-1)	1	96
		Energy Recovery Unit (ERU-2)	1	91
		Air Handling Units (AHU)	75	73
		800 KW Emergency Generator (EG)	1	107
		500 KW Future Tenant (EG)	1	100
60 First Street	Sears	Exhaust Fans (EF)	2	103
		EAHU Exhaust Fans (EF)	4	85
		Specialty Tenant Exhaust Fans (SEF)	8	89
		800 KW Emergency Generator (EG)	1	107
		500 KW Future Tenant (EG)	1	100
		Cooling Towers (CT)	3	87
		Hot Water Pumps (HWP)	3	99
		Boiler	3	92
		Chilled Water Pumps (CHWP)	3	99
		Chillers	2	97
		Cooling Water Pumps (CWP)	3	102
		Air Handling Units (AHU)	4	79

5.0 CALCULATED FUTURE SOUND LEVELS

This section describes the acoustic modeling approach, Best Available Noise Control Technology (BANCT) for those buildings with laboratory space and acoustic modeling results for all buildings.

5.1 Acoustic Modeling Approach

Predicted future sound levels at the upper story windows of the nearest residences were calculated with the Cadna-A acoustic model, assuming simultaneous operation of all equipment at their maximum loads. Cadna-A is a sophisticated 3-D model for sound propagation and attenuation based on International Standard ISO 9613[5]. Atmospheric absorption is the process by which sound energy is absorbed by the air and was calculated using ANSI S1.26-1995.[6] Absorption of sound assumed standard day conditions and is significant at large distances and at high frequencies. ISO 9613 was used to calculate propagation and attenuation of sound energy by hemispherical divergence with distance, surface reflection, ground, and shielding effects by barriers, buildings, and ground topography. Offsite topography was determined using official USGS digital elevation data for the study area.

Predicted future sound levels were calculated at the upper story windows of the nearest 19 noise-sensitive commercial and residential areas. Figure 1 shows the project location and acoustic modeling receivers. The acoustic model also included an additional 22 modeling receptors at height of five feet above ground to represent the 100-foot distance from the Project property line.

5.2 Best Available Noise Control Technology (BANCT) for Laboratory Use

This section describes the Best Available Noise Control Technology (BANCT) for Laboratory Use required under the Zoning Petition and the recommended BANCT for the Project.

---

[5] International Standard, ISO 9613-2, Acoustics – Attenuation of Sound During Propagation Outdoors, -- Part 2 General Method of Calculation.

[6] American National Standards Institute, ANSI S1.26-1995, American National Standard Method for the Calculation of the Absorption of Sound by the Atmosphere, 1995.

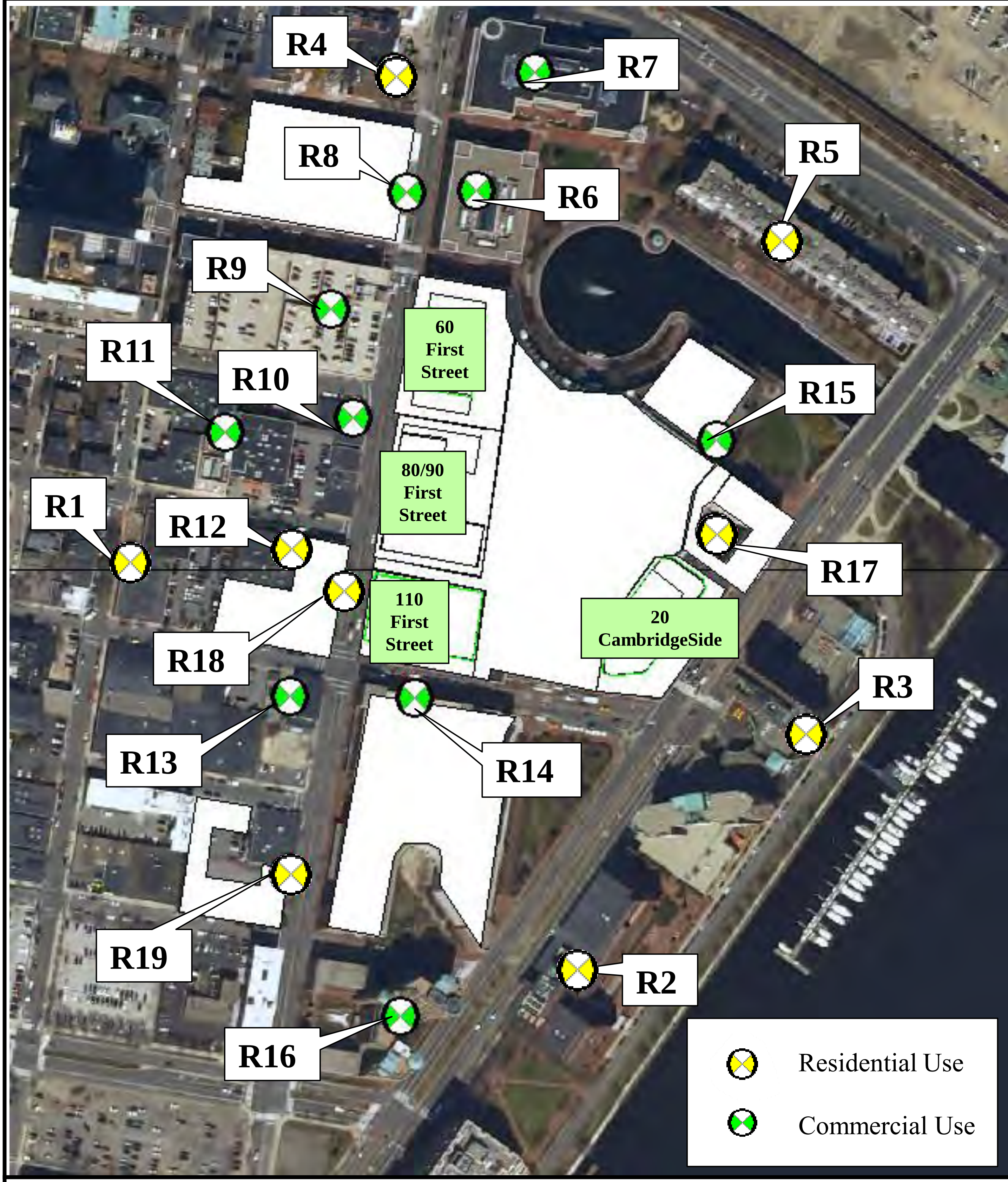

FIGURE 1.
Project Location and Acoustic Modeling Receivers
Cambridge, MA

5.2.1 Zoning Petition Requirements

As required under Section 13.107.2 of the Zoning Petition[7] approved by the Cambridge City Council, Sound emanating from rooftop mechanical equipment on all new or substantially altered structures in an approved Final Development Plan shall be minimized by the adoption of best available and feasible practices regarding the location and sizing of equipment, the selection of equipment and sound attenuation measures. As described in Section 3.0, at a minimum, any noise or vibration emanating from new commercial or substantially altered commercial buildings shall not be normally perceptible without instruments at a distance of one hundred (100) feet from the source lot line and shall comply with the provisions of the City of Cambridge Noise Ordinance applicable to Commercial Areas.

Furthermore, the Zoning Petition requires any new commercial or substantially altered commercial building that will contain laboratory use, the heating, ventilation and air conditioning (HVAC) design shall adopt Best Available Noise Control Technology (BANCT) in the sizing and selection of equipment, its placement on the roof, and the use of effective sound attenuation design elements, including through the following measures:

1. Fans shall be provided with variable speed drives to conserve energy when airflow is not needed to condition the space, and sound attenuators will be installed in the ductwork;
2. Cooling towers shall be provided with large diameter, slow speed whisper quiet fans and variable speed drives for capacity control and energy conservation, and such towers will be located within a sound absorbent screen wall;
3. Air cooled chillers shall use variable-speed compressors, variable-speed fans and integrated compressor mufflers;
4. Air handling units shall be in a sound-insulated penthouse that is ventilated through acoustical louvers, and
5. Additionally, appropriate screening for any rooftop mechanical equipment shall be provided to the fullest extent permitted by law.

[7] Cambridge City Council, Cambridge Side Galeria LLC Zoning Petition, December 16, 2019.

5.2.2 Recommended BANCT

The proposed Project design includes the following BANCT for the laboratory space on the three buildings: 60 First Street, 110 First Street and 20 CambridgeSide:

1. Fans with variable speed drives, cooling towers that include large diameter slow speed fans;
2. Silencers on air handling units and specialty tenant laboratory exhaust fans;
3. Air handling units are located within an enclosed mechanical penthouse with acoustic louvers;
4. Cooling towers are located within a screening wall and with sound absorbent wall panels on a portion of the screen walls, and
5. Emergency generators will be enclosed in acoustic-treated housing with critical grade exhaust silencers.

Appendix A shows the locations of the proposed sound absorbent wall panels and acoustic louvers. The sound transmission losses (sound attenuation) for acoustic louvers, used in the acoustic model, were based on IAC Acoustics, Noishield ™, Model SL6 or equal. Appendix B presents the acoustic louver manufacturer specification sheet for the Noishield ™ louvers.

5.3 Acoustic Modeling Results

This section describes the acoustic modeling results and comparison to the Cambridge municipal and zoning noise codes. Table 5 presents the modeling results and its comparison with the Cambridge commercial noise code sound limit. Table 5 shows that the Project will comply with the both the octave band and A-weighted 65-dBA sound limits at the nine commercial receivers. Table 6A and 6B present the modeling results and their comparison with the Cambridge daytime and nighttime residential noise code sound limits. Table 6A shows that the Project will comply with the both the octave band and A-weighted 60-dBA daytime sound limits at the 10 residential receivers. Table 6B shows that the Project will comply with the both the octave band and A-weighted 60-dBA nighttime sound limits at the 10 residential receivers.

Figure 2 shows color-coded decibel contours at the upper stories of the buildings (average height of 82 feet above ground level) for the operation of the Project. These contours display the predicted continuous daytime sound levels for Project. Similarly, Figure 3 shows color-coded decibel contours at the upper stories of the buildings. These contours display the predicted continuous nighttime sound levels for Project. Both figures shows that there are no broadband sound levels above 65 dBA for the abutting commercial receptors at anytime and no broadband sound levels above 60 dBA (daytime) and 50 dBA (nighttime) for nearby residential receptors, respectively.

The predicted continuous sound levels for the Project at the 100-foot distance from the Project property line at ground level range from 37 to 48 dBA during the daytime and 32 to 46 dBA during the nighttime. These sound levels are below the daytime and nighttime 58-dBA and 52-dBA limits, respectively. Therefore, the Project complies with Zoning Code requirement that sound levels will not be normally perceptible without instruments at a distance of 100 feet from the source lot line.

A summary of the acoustic modeling results are presented in Appendix C.

TABLE 5

COMPARISON OF PREDICTED ANYTME OPERATIONAL SOUND LEVELS WITH CAMBRIDGE MUNICIPAL CODE COMMERCIAL SOUND LIMITS

Receptor #	Commercial Zoning District	31.5	63	125	250	500	1000	2000	4000	8000	A-Wtd	Octave Bands Comply?	A-wtd Comply?
	Anytime Limit	**79**	**78**	**73**	**68**	**62**	**56**	**51**	**47**	**44**	**65**		
	Receptor Address	**32**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**A-Wtd**		
R6	2-12 CANAL PARK	20	31	40	41	42	41	39	36	25	48	**YES**	**YES**
R7	ONE CANAL PARK	19	30	40	39	39	39	36	30	11	46	**YES**	**YES**
R8	21 THORNDIKE ST	21	31	40	43	44	42	40	38	26	49	**YES**	**YES**
R9	51-69 FIRST ST	21	32	39	44	45	43	40	39	28	50	**YES**	**YES**
R10	75 FIRST ST	19	28	35	39	39	38	38	36	24	45	**YES**	**YES**
R13	113-115 FIRST ST	22	29	34	35	35	34	32	26	7	42	**YES**	**YES**
R11	14-24 SPRING ST	19	28	35	39	40	38	35	32	16	45	**YES**	**YES**
R14	150 FIRST ST	23	30	36	36	38	37	35	31	15	44	**YES**	**YES**
R15	10 CANAL PARK	25	35	44	46	48	48	47	44	27	54	**YES**	**YES**

TABLE 6A

COMPARISON OF PREDICTED DAYTME OPERATIONAL SOUND LEVELS WITH CAMBRIDGE MUNICIPAL CODE RESIDENTIAL SOUND LIMITS

Receptor #	Residential Zoning District	31.5	63	125	250	500	1000	2000	4000	8000	A-Wtd	Octave Bands Comply?	A-wtd Comply?
	Daytime Limit	**77**	**75**	**69**	**62**	**56**	**50**	**45**	**40**	**38**	**60**		
	Receptor Address	**32**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**A-Wtd**		
R1	106-108 SECOND ST	18	26	36	37	39	38	36	30	7	45	**YES**	**YES**
R2	43-57 CAMBRIDGE PKWY	19	29	37	36	36	37	35	26	3	43	**YES**	**YES**
R3	23 CAMBRIDGE PKWY	22	32	40	37	37	36	36	34	21	45	**YES**	**YES**
R4	17 OTIS ST #D403	18	29	39	39	40	40	39	31	7	46	**YES**	**YES**
R5	4 CANAL PK #606	19	30	40	42	44	44	44	39	14	50	**YES**	**YES**
R12	18 HURLEY ST	22	29	34	35	35	34	32	26	7	42	**YES**	**YES**
R16	10 ROGERS ST	17	24	30	34	35	34	33	29	13	50	**YES**	**YES**
R17	25 EDWIN H LAND BLVD	23	32	39	36	37	40	42	39	28	47	**YES**	**YES**
R18	107 FIRST ST	23	29	34	38	39	38	36	33	19	45	**YES**	**YES**
R19	159 FIRST ST	20	27	34	35	36	34	30	24	0	41	**YES**	**YES**

TABLE 6B

COMPARISON OF PREDICTED NIGHTIME OPERATIONAL SOUND LEVELS WITH CAMBRIDGE MUNICIPAL CODE RESIDENTIAL SOUND LIMITS

Receptor #	Residential Zoning District	31.5	63	125	250	500	1000	2000	4000	8000	A-Wtd	Octave Bands Comply?	A-wtd Comply?
	Other TImes Limit	**68**	**67**	**61**	**52**	**46**	**40**	**33**	**28**	**26**	**50**		
	Receptor Address	**32**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**A-Wtd**		
R1	106-108 SECOND ST	18	25	29	35	37	35	29	23	0	41	**YES**	**YES**
R2	43-57 CAMBRIDGE PKWY	18	25	29	33	33	31	25	16	0	38	**YES**	**YES**
R3	23 CAMBRIDGE PKWY	18	26	29	32	33	29	23	17	0	38	**YES**	**YES**
R4	17 OTIS ST #D403	15	24	31	36	37	34	27	20	0	41	**YES**	**YES**
R5	4 CANAL PK #606	16	26	33	40	42	39	33	25	2	46	**YES**	**YES**
R12	18 HURLEY ST	21	27	28	33	34	31	25	18	3	39	**YES**	**YES**
R16	10 ROGERS ST	17	23	27	34	34	31	26	23	8	40	**YES**	**YES**
R17	25 EDWIN H LAND BLVD	17	24	26	30	32	30	26	20	6	37	**YES**	**YES**
R18	107 FIRST ST	22	28	30	37	38	36	31	28	16	43	**YES**	**YES**
R19	159 FIRST ST	18	25	28	33	35	32	26	21	0	39	**YES**	**YES**

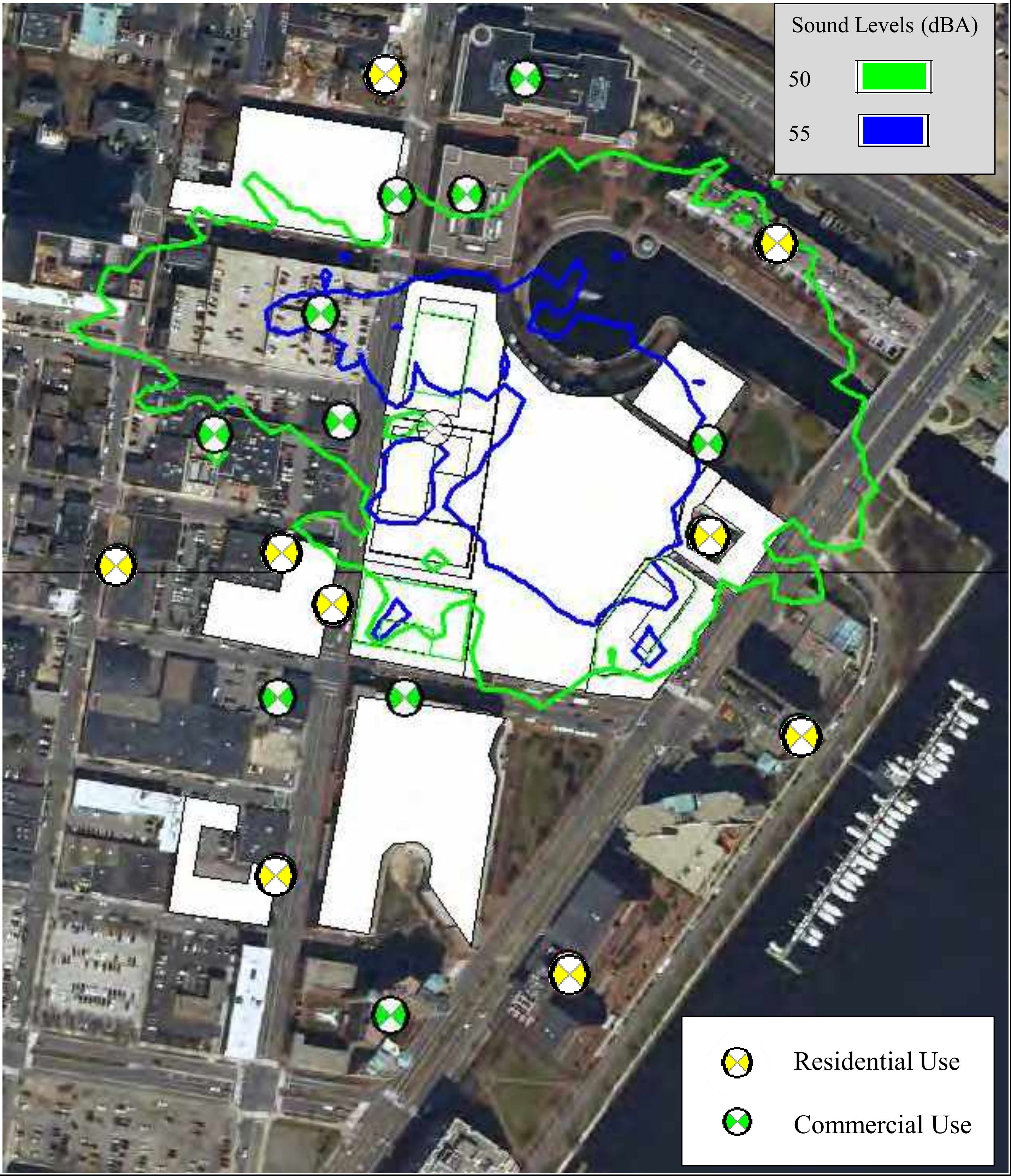

FIGURE 2.
Predicted Daytime Operational Sound Levels at Upper Stories
Cambridge, MA

TECH environmental

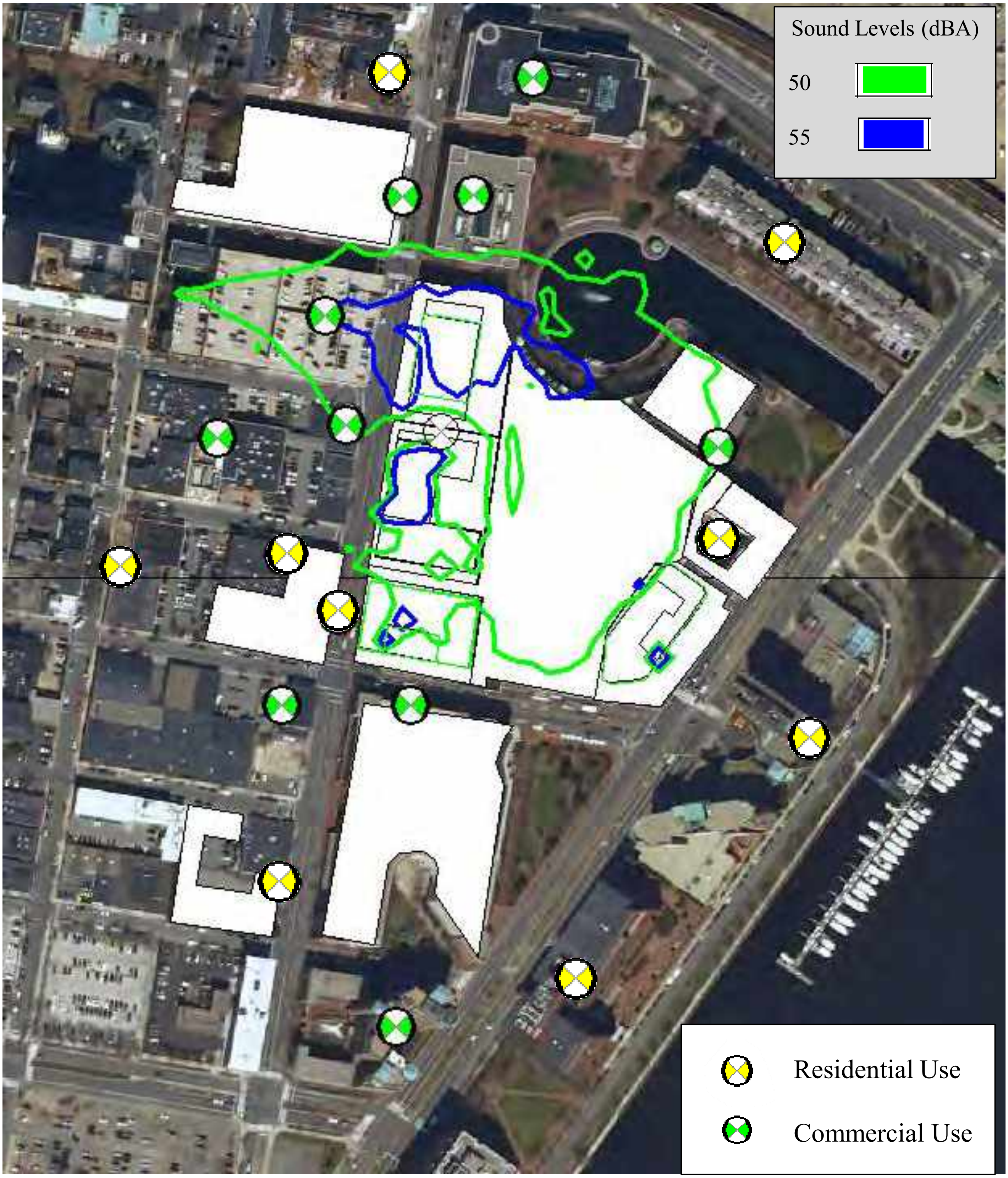

FIGURE 3.
Predicted Nighttime Operational Sound Levels at Upper Stories
Cambridge, MA

TECH environmental

6.0 CONCLUSIONS

The results of the acoustic modeling analysis of the rooftop mechanical equipment demonstrated that sound emanating from the rooftop equipment will comply with the City of Cambridge Noise Ordinance for commercial and residential areas. The modeling results also demonstrate compliance Zoning Code requirement that sound levels will not be normally perceptible without instruments at a distance of 100 feet from the source lot line.

In order to ensure that sound levels from the Project comply with the City of Cambridge municipal and zoning code sound limits, the following sound mitigation elements are included in the Project design for laboratory use:

1. Fans with variable speed drives, cooling towers that include large diameter slow speed fans;
2. Silencers on air handling units and specialty tenant laboratory exhaust fans;
3. Air handling units are located within an enclosed mechanical penthouse with acoustic louvers;
4. Cooling towers are located within a screening wall and with sound absorbent wall panels on a portion of the screen walls, and
5. Emergency generators will be enclosed in acoustic-treated housing with critical grade exhaust silencers.

APPENDIX A

ACOUSTIC TREATMENT LOCATIONS

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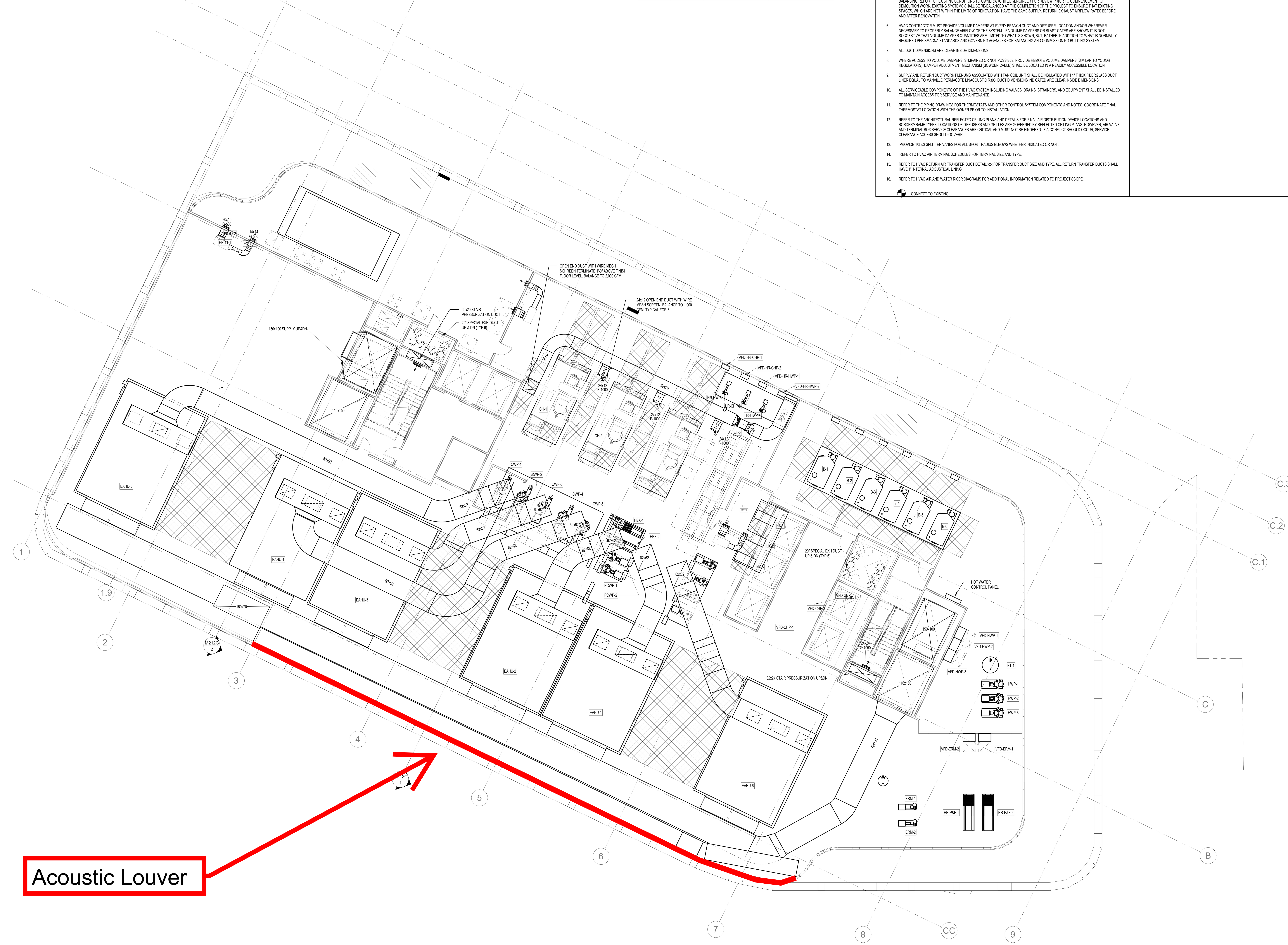
LEVEL 11 WATER SOURCE HEAT PUMPS					
BR+A HVAC Tag	BOXTYPE &SIZE	MAX CFM	MIN CFM	PCW GPM	Stand-By-Power
HP-11-2	WSHP-24	750	600	5.6	YES
HP-11-1	WSHP-24	750	600	5.6	YES
HP-11-3	WSHP-24	750	600	5.6	YES

GENERAL NOTES:

1. DEMOLITION, RELOCATION, AND NEW WORK SHALL BE PHASED TO MINIMIZE DISRUPTION OF FACILITY OPERATION. PROVIDE TEMPORARY CAPPING AND CONNECTIONS AS REQUIRED TO MAINTAIN EXISTING SYSTEMS DURING CONSTRUCTION. COORDINATE ALL SHUT-DOWNS OF EXISTING SYSTEMS WITH BUILDING AND CONSTRUCTION MANAGER.
2. INFORMATION ON EXISTING SYSTEMS HAS BEEN OBTAINED FROM ORIGINAL DESIGN DRAWINGS, SUBSEQUENT RENOVATION DRAWINGS, AND FIELD SURVEYS. THE HVAC CONTRACTOR SHALL FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO DEMOLITION OR DEACTIVATION.
3. THE HVAC CONTRACTOR SHALL PERFORM A SITE VISIT IN ORDER TO EVALUATE EXISTING CONDITIONS PRIOR TO SUBMITTING A BID.
4. THE TERM "CAP" AND ITS INDICATION ON THESE PLANS IS FOR THE CONVENIENCE OF THE CONTRACTOR, REGARDLESS OF WHETHER OR NOT INDICATED, ALL DUCTS AND PIPES SHALL BE CAPPED AIR/WATER TIGHT. PROVIDE ISOLATION VALVES AT PIPING TO BE CAPPED, REFER TO SPECIFICATION FOR VALVE TYPE. THIS SHALL INCLUDE TEMPORARY CAPS PENDING NEW CONNECTION, AND PERMANENT CAPPING INCLUDING INSULATION.
5. EXISTING AIRFLOW QUANTITIES NOTED ON THE DRAWINGS ARE FOR REFERENCE ONLY. THE HVAC CONTRACTOR SHALL MEASURE ACTUAL EXISTING AIRFLOW RATES WHEN THE FANS ARE AT THE PEAK DESIGN FLOW. HVAC CONTRACTOR SHALL SUBMIT AIR FLOW BALANCING REPORT OF EXISTING CONDITIONS TO OWNER/ARCHITECT/ENGINEER FOR REVIEW PRIOR TO COMMENCEMENT OF DEMOLITION WORK. EXISTING SYSTEMS SHALL BE RE-BALANCED AT THE COMPLETION OF THE PROJECT TO ENSURE THAT EXISTING SPACES, WHICH ARE NOT WITHIN THE LIMITS OF RENOVATION, HAVE THE SAME SUPPLY, RETURN, EXHAUST AIRFLOW RATES BEFORE AND AFTER RENOVATION.
6. HVAC CONTRACTOR MUST PROVIDE VOLUME DAMPERS AT EVERY BRANCH DUCT AND DIFFUSER LOCATION AND/OR WHEREVER NECESSARY TO PROPERLY BALANCE AIRFLOW OF THE SYSTEM. IF VOLUME DAMPERS OR BLAST GATES ARE SHOWN IT IS NOT SUGGESTIVE THAT VOLUME DAMPER QUANTITIES ARE LIMITED TO WHAT IS SHOWN, BUT, RATHER IN ADDITION TO WHAT IS NORMALLY REQUIRED PER SMACNA STANDARDS AND GOVERNING AGENCIES FOR BALANCING AND COMMISSIONING BUILDING SYSTEM.
7. ALL DUCT DIMENSIONS ARE CLEAR INSIDE DIMENSIONS.
8. WHERE ACCESS TO VOLUME DAMPERS IS IMPAIRED OR NOT POSSIBLE, PROVIDE REMOTE VOLUME DAMPERS (SIMILAR TO YOUNG REGULATORS). DAMPER ADJUSTMENT MECHANISM (BOWDEN CABLE) SHALL BE LOCATED IN A READILY ACCESSIBLE LOCATION.
9. SUPPLY AND RETURN DUCTWORK PLENUMS ASSOCIATED WITH FAN COIL UNIT SHALL BE INSULATED WITH 1" THICK FIBERGLASS DUCT LINER EQUAL TO MANVILLE PERMACOTE LINACOUSTIC R300. DUCT DIMENSIONS INDICATED ARE CLEAR INSIDE DIMENSIONS.
10. ALL SERVICEABLE COMPONENTS OF THE HVAC SYSTEM INCLUDING VALVES, DRAINS, STRAINERS, AND EQUIPMENT SHALL BE INSTALLED TO MAINTAIN ACCESS FOR SERVICE AND MAINTENANCE.
11. REFER TO THE PIPING DRAWINGS FOR THERMOSTATS AND OTHER CONTROL SYSTEM COMPONENTS AND NOTES. COORDINATE FINAL THERMOSTAT LOCATION WITH THE OWNER PRIOR TO INSTALLATION.
12. REFER TO THE ARCHITECTURAL REFLECTED CEILING PLANS AND DETAILS FOR FINAL AIR DISTRIBUTION DEVICE LOCATIONS AND BORDER/FRAME TYPES. LOCATIONS OF DIFFUSERS AND GRILLES ARE GOVERNED BY REFLECTED CEILING PLANS. HOWEVER, AIR VALVE AND TERMINAL BOX SERVICE CLEARANCES ARE CRITICAL AND MUST NOT BE HINDERED. IF A CONFLICT SHOULD OCCUR, SERVICE CLEARANCE ACCESS SHOULD GOVERN.
13. PROVIDE 1/3 2/3 SPLITTER VANES FOR ALL SHORT RADIUS ELBOWS WHETHER INDICATED OR NOT.
14. REFER TO HVAC AIR TERMINAL SCHEDULES FOR TERMINAL SIZE AND TYPE.
15. REFER TO HVAC RETURN AIR TRANSFER DUCT DETAIL xxx FOR TRANSFER DUCT SIZE AND TYPE. ALL RETURN TRANSFER DUCTS SHALL HAVE 1" INTERNAL ACOUSTICAL LINING.
16. REFER TO HVAC AIR AND WATER RISER DIAGRAMS FOR ADDITIONAL INFORMATION RELATED TO PROJECT SCOPE.

CONNECT TO EXISTING

KEY NOTES:



1 MECHANICAL LEVEL 1 - NEW DUCTWORK PLAN
1/8" = 1'-0"

20 CambridgeSide Lower Mechanical Penthouse

ELKUS | MANFREDI ARCHITECTS

[address] 25 DRYDOCK AVENUE
BOSTON MASSACHUSETTS 02210
[tel] 617.426.1300

20 CambridgeSide

20 Cambridgeside Place
Cambridge, MA, 02141

Client
NEW ENGLAND DEVELOPMENT
75 Park Plaza
Boston, Massachusetts, 02116
617.965.8700

Geotechnical Engineer

Civil Engineer
Tetra Tech
100 Nickerson Road
Marlborough, Massachusetts, 01752
508.786.2200

Structural Engineer
Mcnamara/Salvia Inc.
101 Federal Street, 11th Floor
Boston, Massachusetts, 02110
617.737.0040

MEP Engineer
BR+A Consulting Engineers
10 Guest St. 4th Floor
Boston, Massachusetts, 02135
617.254.0016

Landscape Architect
IBI Placemaking
21 Custom House St., 3rd Floor
Boston, Massachusetts, 02110
617.896.2500

Code Consultant
Jensen Hughes
1661Worcester Road, Suite 501
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508.624.7766

Elevator Consultant
VDA
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Boston, Massachusetts, 02110
716.769.3747

Lighting Consultant
HLB
233 Lewis Warf
Boston, Massachusetts, 02110
617.229.5190

Acoustic Consultant
ACENTECH
33 Mouton Street
Cambridge, Massachusetts, 02138
617.499.8000

Ref. North

07/02/2020

DESIGN DEVELOPMENT SET
ISSUE FOR BUDGET PRICING
AND FACADE BIDDING

PROJECT NUMBER: 20027

DATE: 07/02/2020

REVISIONS:

SEE PREVIOUS ISSUES FOR REVISIONS NOT LISTED HERE

SCALE: As indicated

DRAWING NAME:
HVAC PENTHOUSE LEVEL 1 DUCTWORK PLAN

DRAWING NUMBER:
M211

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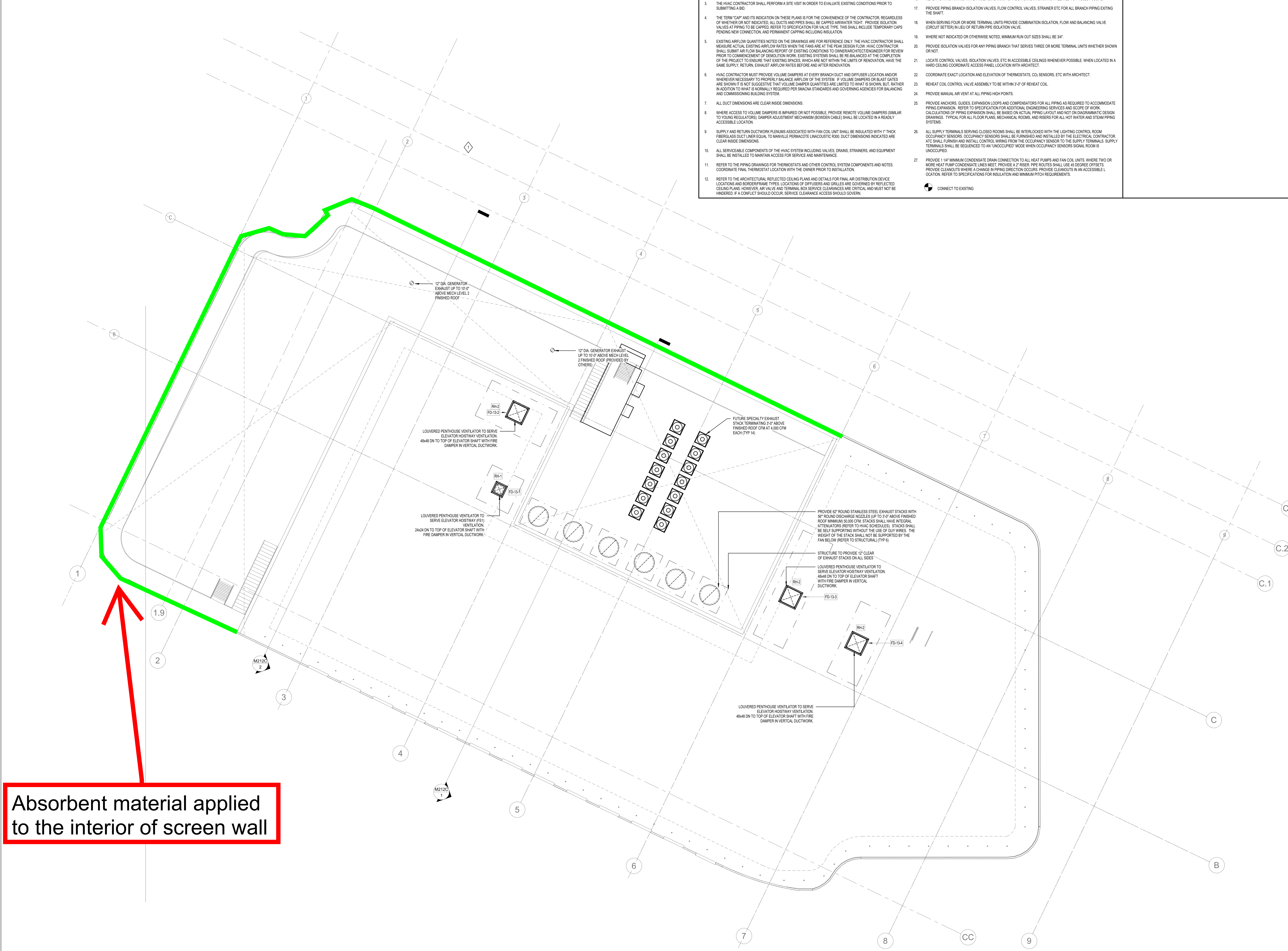

1 ROOF - NEW DUCTWORK PLAN
1/8" = 1'-0"

20 CambridgeSide Penthouse Roof

NEW WORK GENERAL NOTES:

1. DEMOLITION, RELOCATION, AND NEW WORK SHALL BE PHASED TO MINIMIZE DISRUPTION OF FACILITY OPERATION. PROVIDE TEMPORARY CAPPING AND CONNECTIONS AS REQUIRED TO MAINTAIN EXISTING SYSTEMS DURING CONSTRUCTION. COORDINATE ALL SHUT-DOWNS OF EXISTING SYSTEMS WITH BUILDING AND CONSTRUCTION MANAGER.
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14. REFER TO HVAC AIR TERMINAL SCHEDULES FOR TERMINAL SIZE AND TYPE.
15. REFER TO HVAC RETURN AIR TRANSFER DUCT DETAIL xxx FOR TRANSFER DUCT SIZE AND TYPE. ALL RETURN TRANSFER DUCTS SHALL HAVE 1" INTERNAL ACOUSTICAL LINING.
16. REFER TO HVAC AIR AND WATER RISER DIAGRAMS FOR ADDITIONAL INFORMATION RELATED TO PROJECT SCOPE.
17. PROVIDE PIPING BRANCH ISOLATION VALVES, FLOW CONTROL VALVES, STRAINER ETC FOR ALL BRANCH PIPING EXITING THE SHAFT.
18. WHEN SERVING FOUR OR MORE TERMINAL UNITS PROVIDE COMBINATION ISOLATION, FLOW AND BALANCING VALVE (CIRCUIT SETTER) IN LIEU OF RETURN PIPE ISOLATION VALVE.
19. WHERE NOT INDICATED OR OTHERWISE NOTED, MINIMUM RUN OUT SIZES SHALL BE 3/4".
20. PROVIDE ISOLATION VALVES FOR ANY PIPING BRANCH THAT SERVES THREE OR MORE TERMINAL UNITS WHETHER SHOWN OR NOT.
21. LOCATE CONTROL VALVES, ISOLATION VALVES, ETC IN ACCESSIBLE CEILINGS WHENEVER POSSIBLE. WHEN LOCATED IN A HARD CEILING COORDINATE ACCESS PANEL LOCATION WITH ARCHITECT.
22. COORDINATE EXACT LOCATION AND ELEVATION OF THERMOSTATS, CO_2 SENSORS, ETC WITH ARCHITECT.
23. REHEAT COIL CONTROL VALVE ASSEMBLY TO BE WITHIN 3'-0" OF REHEAT COIL.
24. PROVIDE MANUAL AIR VENT AT ALL PIPING HIGH POINTS.
25. PROVIDE ANCHORS, GUIDES, EXPANSION LOOPS AND COMPENSATORS FOR ALL PIPING AS REQUIRED TO ACCOMMODATE PIPING EXPANSION. REFER TO SPECIFICATION FOR ADDITIONAL ENGINEERING SERVICES AND SCOPE OF WORK. CALCULATIONS OF PIPING EXPANSION SHALL BE BASED ON ACTUAL PIPING LAYOUT AND NOT ON DIAGRAMMATIC DESIGN DRAWINGS. TYPICAL FOR ALL FLOOR PLANS, MECHANICAL ROOMS, AND RISERS FOR ALL HOT WATER AND STEAM PIPING SYSTEMS.
26. ALL SUPPLY TERMINALS SERVING CLOSED ROOMS SHALL BE INTERLOCKED WITH THE LIGHTING CONTROL ROOM OCCUPANCY SENSORS. OCCUPANCY SENSORS SHALL BE FURNISHED AND INSTALLED BY THE ELECTRICAL CONTRACTOR. ATC SHALL FURNISH AND INSTALL CONTROL WIRING FROM THE OCCUPANCY SENSOR TO THE SUPPLY TERMINALS. SUPPLY TERMINALS SHALL BE SEQUENCED TO AN “UNOCCUPIED” MODE WHEN OCCUPANCY SENSORS SIGNAL ROOM IS UNOCCUPIED.
27. PROVIDE 1 1/4" MINIMUM CONDENSATE DRAIN CONNECTION TO ALL HEAT PUMPS AND FAN COIL UNITS. WHERE TWO OR MORE HEAT PUMP CONDENSATE LINES MEET, PROVIDE A 2" RISER. PIPE ROUTES SHALL USE 45 DEGREE OFFSETS. PROVIDE CLEANOUTS WHERE A CHANGE IN PIPING DIRECTION OCCURS. PROVIDE CLEANOUTS IN AN ACCESSIBLE L OCATION. REFER TO SPECIFICATIONS FOR INSULATION AND MINIMUM PITCH REQUIREMENTS.

CONNECT TO EXISTING

KEYNOTES:

ELKUS | MANFREDI ARCHITECTS
(address) 25 DRYDOCK AVENUE
BOSTON MASSACHUSETTS 02210
(tel) 617.426.1300

20 CambridgeSide
20 Cambridgeside Place
Cambridge, MA, 02141

Client
NEW ENGLAND DEVELOPMENT
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Boston, Massachusetts, 02116
617.965.8700

Geotechnical Engineer

Civil Engineer
Tetra Tech
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Marlborough, Massachusetts, 01752
508.786.2200

Structural Engineer
Mcnamara/Salvia Inc.
101 Federal Street, 11th Floor
Boston, Massachusetts, 02110
617.737.0040

MEP Engineer
BR+A Consulting Engineers
10 Guest St. 4th Floor
Boston, Massachusetts, 02135
617.254.0016

Landscape Architect
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617.896.2500

Code Consultant
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Framingham, Massachusetts, 01701
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Boston, Massachusetts, 02110
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HLB
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Boston, Massachusetts, 02110
617.229.5190

Acoustic Consultant
ACENTECH
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Cambridge, Massachusetts, 02138
617.499.8000

Ref. North

07/02/2020

DESIGN DEVELOPMENT SET
ISSUE FOR BUDGET PRICING
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PROJECT NUMBER: 20027

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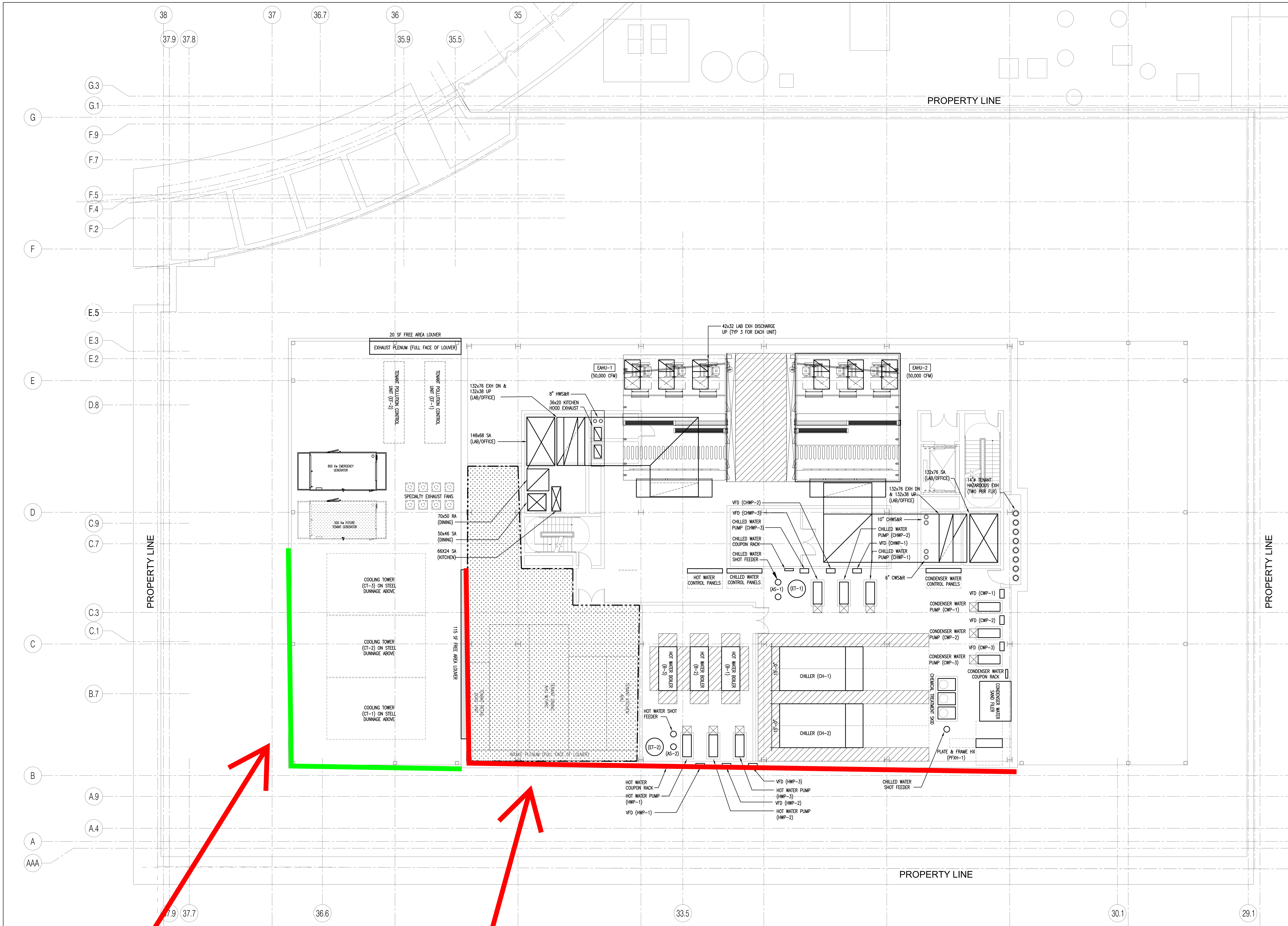
REVISIONS:

SEE PREVIOUS ISSUES FOR REVISIONS NOT LISTED HERE

SCALE: As indicated

DRAWING NAME:
HVAC ROOF DUCTWORK PLAN

DRAWING NUMBER:
M213



Absorbent material applied to the interior of screen wall

Acoustic Louver

60 First Street Lower Mechanical Penthouse

ELKUS | MANFREDI ARCHITECTS

25 DRYDOCK AVENUE
BOSTON MASSACHUSETTS 02210
617.426.1300

60 FIRST STREET
OFFICE/LAB BUILDING
CORE + SHELL

Anchor Line Partners
Owner
One Post Office Square, Suite 4100
Boston, MA, 02109
617-451-0500

Northwood Investors LLC
Owner
575 Fifth Avenue, 23rd Floor
New York, NY, 10017
000-000-0000

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BR+A
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Boston, MA, 02135
617-254-0016

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Landscape Architect
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Boston, MA, 02110
617-896-2500

Nitsch Engineering
Civil Engineer
2 Central Plaza, Suite 430
Boston, MA, 02108-1928
617-338-0063

SCHEMATIC DESIGN

PROJECT NUMBER: 18037

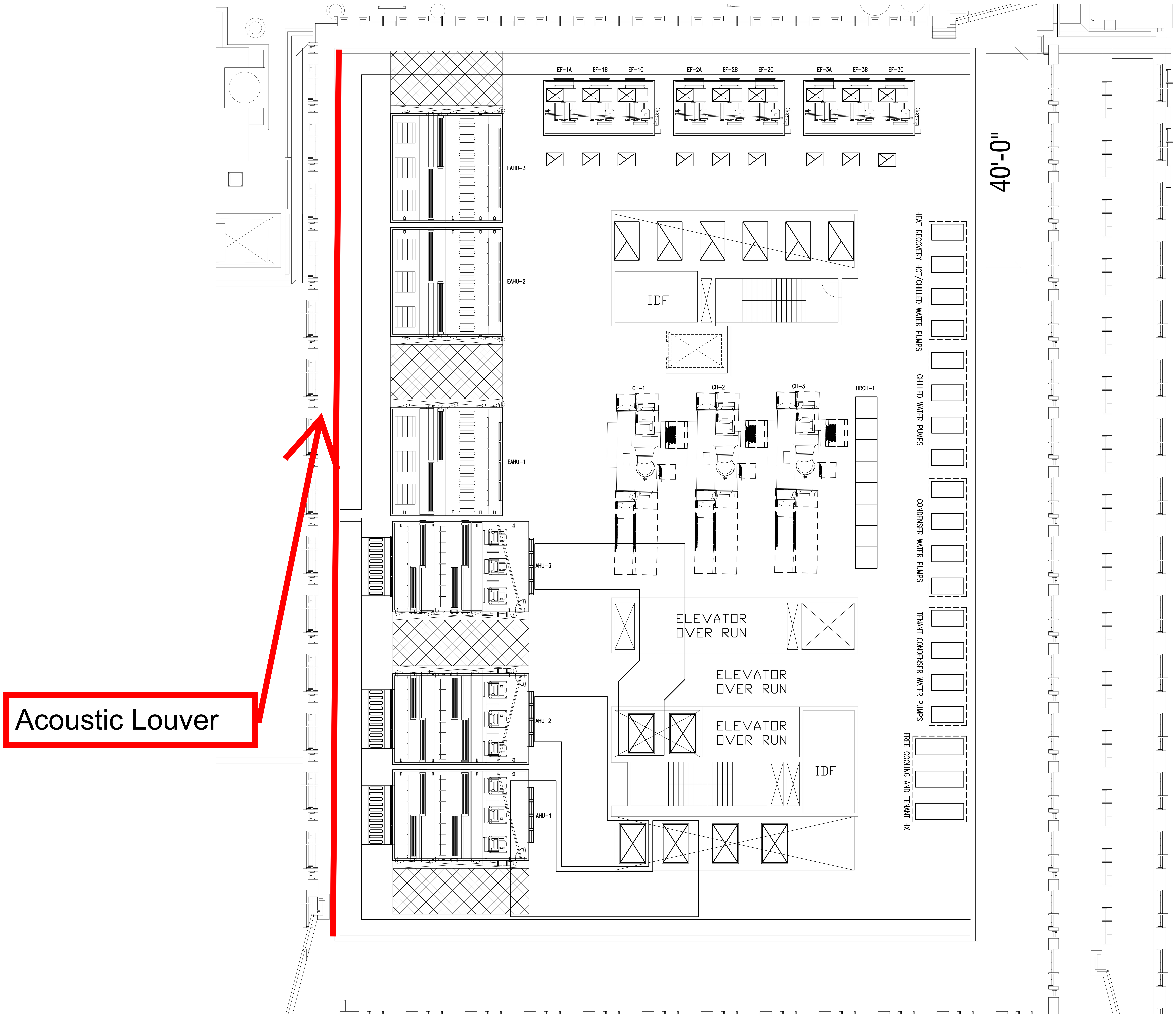
DATE: 4/27/20

REVISIONS:

SCALE: 1/8"=1'-0"

DRAWING NAME:
HVAC LOWER LEVEL PENTHOUSE DUCTWORK PLAN

DRAWING NUMBER:
H106



110 First Street Lower Mechanical Penthouse

APPENDIX B

ACOUSTIC LOUVER SPECIFICATION

Acoustic Louvers

A Complete Range of Certified, High-Performance Acoustic Louvers to Solve Diverse Environmental Noise Pollution Problems

- Certified performance data per ASTM E90
- Easy to install and engineered for high performance
- Rugged galvanized construction (other materials available)
- Standard and specialty shaped louvers available
- Louver barriers/walls
- Airfoil and straight splitter blades available
- Variety of durable attractive finishes
- Over 60 years experience

iac acoustics

IAC Acoustics
Making the World a Quieter Place

Founded on an unrivalled history of engineering with some of the most pioneering discoveries in the industry, the IAC Acoustics brand is synonymous with technological innovation.

From controlling noise at a power station to tuning the sound in a TV or radio studio, IAC Acoustics has had a positive impact on society and helped to shape what can be achieved to make speech more intelligible, make music more enjoyable, reduce the impact of industrial noise and protect people's sense of hearing.

The continual success of our products and services over the decades has brought the brand a reputation for quality and reliability among customers, whether they are multinational corporations or independent family businesses. This is supported by the expertise and passion of our workforce, the people behind the products, including designers, engineers and industry experts.

To face the ever increasing noise reduction demands of the future, we will strive to further enhance our ability to reduce excessive noise. We aim to focus on developing tomorrow's solution today, innovating faster and delivering solutions that meet the requirements of the next generation. In doing so, we will stay true to our key values and founding philosophy to make the world a quieter place.

Table of Contents

Page

Acoustic Louvers Overview

IAC Acoustics is a leading global manufacturer of rugged, high performance acoustic louvers and has completed thousands of installations worldwide. Applications include:

Air Conditioning Systems & Equipment

- Return air and supply systems
- Cross-talk silencers
- Recording and broadcasting studios
- Air conditioning and refrigeration equipment
- Ventilation openings
- Cooling towers
- Data centers
- Fans
- Hospitals
- Hotels and motels
- Boiler rooms
- Conference rooms

Industrial, Transportation & Construction Equipment

- Diesel generator sets
- Marine or propulsion fans
- Machinery enclosures
- Gas turbines
- Oil coolers
- Electric motors
- Trucks and buses
- Locomotives
- Transformer barriers
- Tractors
- Pumps
- Bulldozers
- Air compressors
- Diesel powered vehicles and equipment
- Industrial cooling towers
- Noise barriers
- Air coolers

IAC Acoustics can provide louver solutions to combat environmental noise problems in mixed commercial / residential areas, carrying out all relevant noise surveys and acoustical analysis.

Form & Function Together

IAC Acoustics Noishield™ (curved) or Slimshield™ (linear) blade louver styles can be used to match the overall scale and aesthetics of a new or existing building.

Our acoustic louvered screens result in a high performance solution to unwanted levels of noise without the need for additional architectural cladding.

Acoustic Louvers Range

Noishield™ – Airfoil Blade

- Model R & Model LP: 12" (305mm) deep
- Model 2R & Model 2LP: 24" (610mm) deep
- LF2-24: 24" (610mm) deep

Slimshield™ – Linear Blade

- SL-4: 4" (101mm deep)
- SL-6: 6" (152mm) deep
- SL-12: 12" (305mm deep)
- SL-24 (double banked): 24" (610mm deep)

Noishield™ Louvers – Sound Transmission Loss (dB)

Model	Louver Depth	Octave Band Center Frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
		Sound Transmission Loss, dB							
Model R	12"	5	7	11	12	13	14	12	9
Model 2R	24"	6	12	15	21	24	27	25	20
Model LP	12"	4	5	8	9	12	9	7	6
Model 2LP	24"	5	8	12	16	22	18	15	14
Model LF2-24	24"	6	11	19	24	28	23	17	17

Slimshield™ Louvers – Sound Transmission Loss (dB)

Model	Louver Depth	Octave Band Center Frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
		Sound Transmission Loss, dB							
SL-4	4"	5	4	5	6	9	13	14	13
SL-6	6"	6	6	8	10	14	18	16	15
SL-12	12"	6	7	10	12	18	18	14	13
SL-24	24"	7	9	12	24	31	33	29	30

IAC Acoustics' acoustical louvers adhere to and are applicable to ASTM Standard E90.

Integrated or Standalone

Our acoustic louvers can be used as standalone screens around mechanical plants, or be integrated into walls and building façades.

APPENDIX C

ACOUSTIC MODELING RESULTS

Cadna Results

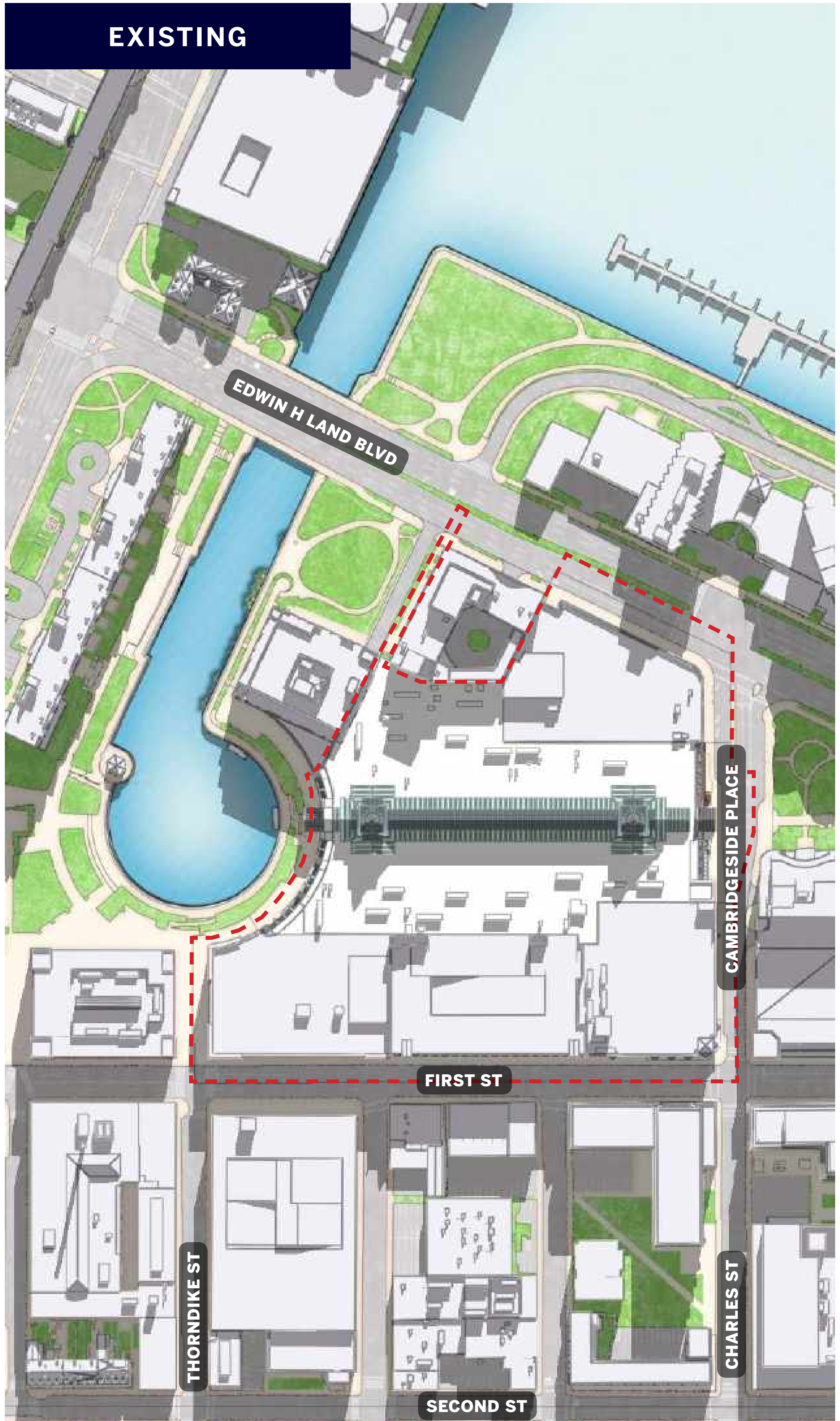
Name	M.	ID	Level Lr		Limit. Value		Octave Band Day									Land Use			Height		Coordinates		
			Day	Night	Day	Night	31	63	125	250	500	1000	2000	4000	8000	Type	Auto	Noise Type			X	Y	Z
			(dBA)	(dBA)	(dBA)	(dBA)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)				(m)		(m)	(m)	(m)
106-108 SECOND ST		R1	44.6	41.1	60	50	18	26.3	36	37.2	38.5	38.4	36.2	30.1	7.4				12.19	r	234665.5	902005	15.07
43-57 CAMBRIDGE PKWY		R2	43.2	37.9	60	50	19.3	28.5	36.7	35.9	35.8	36.7	34.6	26.2	3				30	r	234915.7	901779.1	33.05
23 CAMBRIDGE PKWY		R3	45.2	37.6	60	50	22.3	32	40.3	37.3	36.8	36.3	36.4	33.5	20.5				30.48	r	235043.8	901910.7	33.27
17 OTIS ST #D403		R4	46.3	41.3	60	50	18.1	28.9	38.9	38.6	39.7	39.8	38.5	30.5	6.6				21.34	r	234813.2	902274.9	24.12
4 CANAL PK #606		R5	50.4	45.7	60	50	19.2	30.4	39.8	41.9	43.6	44.3	44	38.7	13.6				21.34	r	235030	902182.1	24.54
2-12 CANAL PARK		R6	47.9	44.6	65	65	20.4	31	40	40.6	41.6	40.6	39.2	36.4	24.6				15.24	r	234859.8	902209.5	17.43
ONE CANAL PARK		R7	46	41.9	65	65	19.1	29.8	39.6	39.1	39.3	38.7	36.4	29.7	10.8				15.24	r	234891.8	902274.7	14.68
21 THORNDIKE ST		R8	49.3	47.2	65	65	20.9	31.4	39.7	42.7	43.7	42	40.1	37.7	25.5				15.24	r	234820.8	902208.9	16.84
51-69 FIRST ST		R9	50.4	49.1	65	65	20.8	31.5	39.4	44	45.2	43.4	40.4	38.8	28.4				15.24	r	234778.4	902143.9	18.46
75 FIRST ST		R10	45.4	42.8	65	65	19.4	27.9	34.8	38.9	38.9	37.8	37.5	35.6	23.7				1.52	r	234790.1	902083.8	4.67
14-24 SPRING ST		R11	45.1	43.9	65	65	18.8	27.8	35.2	38.6	39.9	38.3	34.9	31.5	15.7				1.52	r	234719	902076.6	4.36
18 HURLEY ST		R12	41	38.9	60	50	17.4	24.4	30.3	34.4	34.9	33.9	33.1	29.4	13.4				7.62	a	234755.5	902012	7.62
113-115 FIRST ST		R13	41.6	38.5	65	65	21.7	28.6	34.2	34.7	35.3	34.2	32.3	26.4	6.6				15.24	r	234754.9	901930.4	18.29
150 FIRST ST		R14	43.8	41.4	65	65	22.9	30	35.9	35.6	37.9	36.6	34.6	31.3	14.8				15.24	r	234824.8	901929.7	18.29
10 CANAL PARK		R15	54.4	50	65	65	25	35.1	44.1	46.2	48	47.9	47.4	43.8	27.3				25.6	r	234993.3	902071.7	29.3
10 ROGERS ST		R16	49.6	40.1	60	50	19.2	29.4	39.1	38.1	39.6	44.1	45.3	38	8.5				67	a	234817.2	901753.8	67
25 EDWIN H LAND BLVD		R17	47.1	36.8	60	50	22.5	31.6	39.2	35.7	36.8	39.7	41.7	39.3	28.3				1.52	r	234992.3	902021.3	4.78
107 FIRST ST		R18	44.6	42.8	60	50	22.6	29.1	34.2	37.5	38.9	37.6	36.3	32.9	18.6				15	a	234785	901979.6	15
159 FIRST ST		R19	41.3	39.2	60	50	19.5	27.4	34.2	34.5	35.6	34.1	30	23.9	-1.5				21	a	234754.2	901832.7	21
PL1		1	48.3	45.9	58	52	18.7	28.8	36.6	40.6	42.8	41.5	40.4	38.3	27.5				1.52	r	234824.2	902192.7	2.98
PL2		2	46.7	44.1	58	52	19.1	28.5	36	40	40.5	39.3	38.8	36.6	25.1				1.52	r	234807.7	902175	3.57
PL3		3	45.5	43.2	58	52	19.4	28.4	35	39.4	39.1	37.8	37.4	35.2	23.1				1.52	r	234795.3	902103.7	4.38
PL4		4	46.3	44.3	58	52	20.6	28.5	35.6	39.7	40.1	39	38.2	36	23.7				1.52	r	234781.4	902025.2	4.61
PL5		5	37.4	33	58	52	18.7	23.1	26.9	27.8	30.1	31.2	31.4	26.5	7.1				1.52	r	234767.4	901950.7	4.56
PL6		6	39.7	37	58	52	21	26.8	30.8	31.4	33.5	32.8	31.6	26.5	6.5				1.52	r	234779.9	901930.5	4.59
PL7		7	43.6	41.2	58	52	18.3	25.8	32	34.9	37.7	37.2	36.5	33.6	18.4				1.52	r	234875.2	901900.6	4.61
PL8		8	42.1	39.7	58	52	20.5	27.4	33	33.1	36	35.5	34.2	31.4	15.4				1.52	r	234894.9	901885.3	4.4
PL9		9	40.6	37.9	58	52	20.9	27.5	32.1	32.3	34.1	33.4	32.4	29.3	13.5				1.52	r	234917.5	901888.1	4.65
PL10		10	41.5	36.6	58	52	21.1	28.6	34	32	33.5	33.8	35	31.5	16.5				1.52	r	234939.6	901894.9	4.84
PL11		11	40.4	35.8	58	52	20.8	28.1	33.2	31.3	32.7	32.8	33.1	29.9	15.8				1.52	r	234968.5	901890.5	4.71
PL12		12	41.6	34.6	58	52	21	28.9	35.4	31.6	32.1	33.6	34.8	31.7	18.1				1.52	r	234987.2	901898.2	4.6
PL13		13	41.4	32.5	58	52	21	29.3	35.8	30.6	31.1	33.2	34.8	31.9	19.3				1.52	r	235000.2	901916.5	4.61
PL14		14	42.4	32.4	58	52	22.2	30.8	36.8	31.2	31.4	34.1	35.7	32.9	21.1				1.52	r	235036.8	901967.5	4.53
PL15		15	43.8	32.9	58	52	21.7	30.9	38.3	33.4	32.8	35.5	37.3	34.5	22.2				1.52	r	235058.4	901999.3	4.92
PL16		16	43	33.9	58	52	20.8	30.2	37.7	33.4	33.1	34.5	36	32.8	19.1				1.52	r	235072.4	902018.5	5.68
PL17		17	42.6	35.8	58	52	19.8	29.3	37.3	34.5	33.8	33.8	34.6	31	15.9				1.52	r	235085.9	902036.3	5.53
PL18		18	40.3	34.6	58	52	18.9	27.1	34.6	32.6	32.1	31.8	32.1	28.1	12.6				1.52	r	235067.6	902051.7	6.37
PL19		19	40.9	33.2	58	52	18.6	26.9	34.6	32.4	32.4	33.3	33.7	29.6	14.1				1.52	r	235040.6	902070	5.31
PL20		20	41.3	33.9	58	52	18.8	28	35	32	32.4	33.5	34.5	30.8	15.4				1.52	r	235014.2	902086.3	4.24
PL21		21	45.8	43.5	58	52	16.9	26.4	35.9	39.4	39.9	38.2	37.4	33.9	17.7				1.52	r	234961.8	902123.3	3.95
PL22		22	47.5	43.5	58	52	20	30.8	39	39.1	40.9	40.3	39.8	37.7	27				1.52	r	234889.6	902180.1	3.92

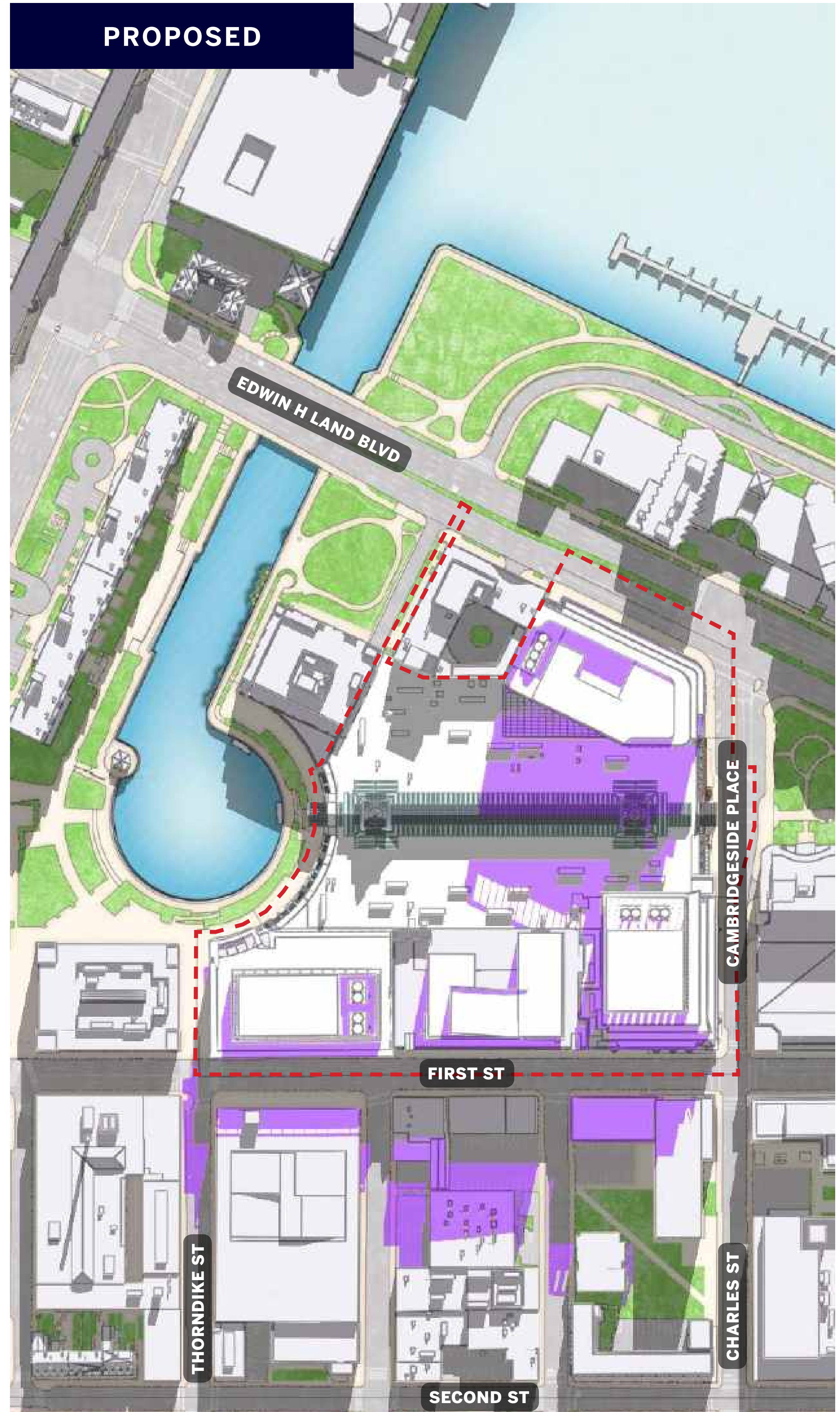
Sound Sources

Name	ID	Type	Oktave Spectrum (dB)												Source
			Weight.	31.5	63	125	250	500	1000	2000	4000	8000	A	lin	
Cook EF1	CookEF1	Lw		101	101	104	106	103	97	89	82	75	103.4	110.6	02.14.2020 - 10 CS.pdf
GreenheckSpecialtyExhuastFans	GreenheckSpecialtyExhuastFans	Lw		95	95	92	89	88	82	77	74	68	88.6	99.8	Cambdigeside 60 first street submittal.pdf
ERU1	ERU1	Lw		90	90	90	94	93	92	85	81	76	95.5	99.8	02.14.2020 - 80 CS.pdf
ERU2	ERU2	Lw		89	89	90	92	88	87	82	77	73	91.3	97.4	02.14.2020 - 80 CS.pdf
Daikin	Daikin	Lw (c)		75	75	76	72	71	66	66	60	55	73	81.5	02.14.2020 - 80 CS.pdf
Generator - CAT C15, 500 ekW, Sound Attenuated	Generator500ekW	Lw		101.3	105.1	107.1	100.7	97.9	93.4	90	84.8	78.4	99.9	110.7	J4213 CAT LEHE0465-02, Spectrum Estimated
Generator 750 ekW	Generator750ekW	Lw (c)		112.5	112.5	127.5	123.5	115.5	114.5	115.5	115.5	113.5	123	129.9	Gen Set Package Performance Data [DM8260]
Generator1500kw	Generator1500kw	Lw (c)		129.9	129.9	139.9	132.9	123.9	120.9	121.9	120.9	119.9	130.7	141.6	1500 Gen.xlsx
York YZ Chiller	YorkYZChiller	Lw		88.6	88.6	87.6	85.6	85.6	87.6	91.6	90.6	86.6	96.6	98	02.14.2020 - 10 CS.pdf & Est Chiller.xls
Boiler	Boiler	Lw		102	101	82	89	88	86	84	84	84	92.3	104.9	CFLC BB 2018.pdf & Est Boiler.xls
CWP	CWP	Lw (c)		94	94	97	99	99	97	94	94	86	102.2	105.6	80 HP Pumps Table 12 US Army Noise Control pdf.
HWP	HWP	Lw (c)		94	94	97	99	99	97	94	94	86	102.2	105.6	60 HP Pumps Table 12 US Army Noise Control pdf.
CHWP	CHWP	Lw (c)		91	91	94	96	96	94	91	88	83	98.8	102.4	40 HP Pumps Table 12 US Army Noise Control pdf.
HWPSears	HWPSears	Lw (c)		91	91	94	96	96	94	91	88	83	98.8	102.4	30 HP Pumps Table 12 US Army Noise Control pdf.
CWPSears	CWPSears	Lw (c)		94	94	97	99	99	97	94	94	86	102.2	105.6	50 HP Pumps Table 12 US Army Noise Control pdf.
NC8409PCN3MarleyCoolingTower	NC8409PCN3MarleyCoolingTower	Lw		98	98	90	85	83	82	80	76	71	87.2	101.6	07-01-2020 Marley Selection.pdf
NC8409RCN4MarleyCoolingTower	NC8409RCN4MarleyCoolingTower	Lw		96	96	91	88	85	85	81	76	72	89.2	100.3	Sound_06-03-2020.pdf
EFHaakonIndustries	EFHaakonIndustries	Lw		90	90	94	90	82	81	78	74	70	87.2	97.7	Fan Data - 4-23-2020 - 10 Cambridgeside .PDF
EFHaakonIndustriesN1	EFHaakonIndustriesN1	Lw		95	95	100	99	89	88	85	80	74	94.7	104.2	Fan Data - 4-23-2020 - 10 Cambridgeside .PDF
AHUSFHaakonIndustries	AHU	Lw		83	83	83	98	93	82	79	76	72	93.3	99.6	Fan Data - 4-23-2020 - 10 Cambridgeside .PDF
MacysLowerMechanicalPenthouseWall	MacysLowerMechanicalPenthouseWall	Li (c)		87.7	85.5	81.9	83.1	84.5	82.9	79.2	80.9	77.6	88.3	93.1	Estimated
BestBuyLowerMechanicalPenthouseWall	BestBuyLowerMechanicalPenthouseWall	Li (c)		81.1	79.8	81.5	82.7	84.2	82.4	78.7	79.8	76.4	87.7	90.8	Estimated
BestBuyUpperMechanicalPenthouseWall	BestBuyUpperMechanicalPenthouseWall	Li (c)		88.8	86.9	78.6	80.5	82.1	80.4	76.4	77.9	75	85.6	92.7	Estimated
BestBuyLowerMechanicalPenthouseWall	BestBuyLowerMechanicalPenthouseWall	Li (c)		86.7	84.5	76.3	78	79.4	77.6	73.5	75.5	73.5	83	90.3	Estimated
SearsLowerMechanicalPenthouseWall	SearsLowerMechanicalPenthouseWall	Li (c)		86.3	84.3	80.9	82	83.6	82	78.3	79.1	76.6	87.2	91.9	Estimated

Appendix E

Shadow Study





Mar / Sep 21
9:00 am

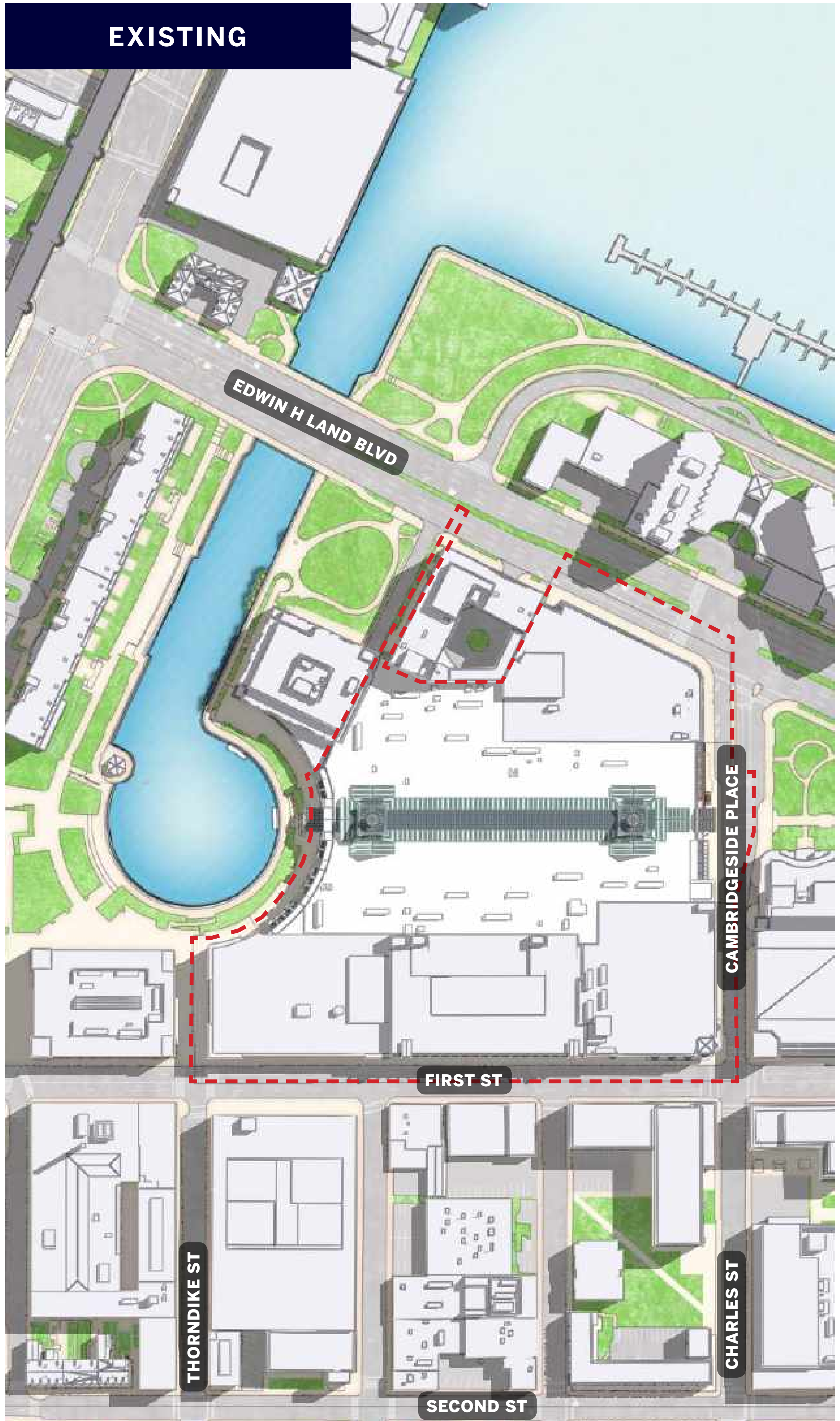
PUD-8 Special Permit
CambridgeSide
Cambridge, MA

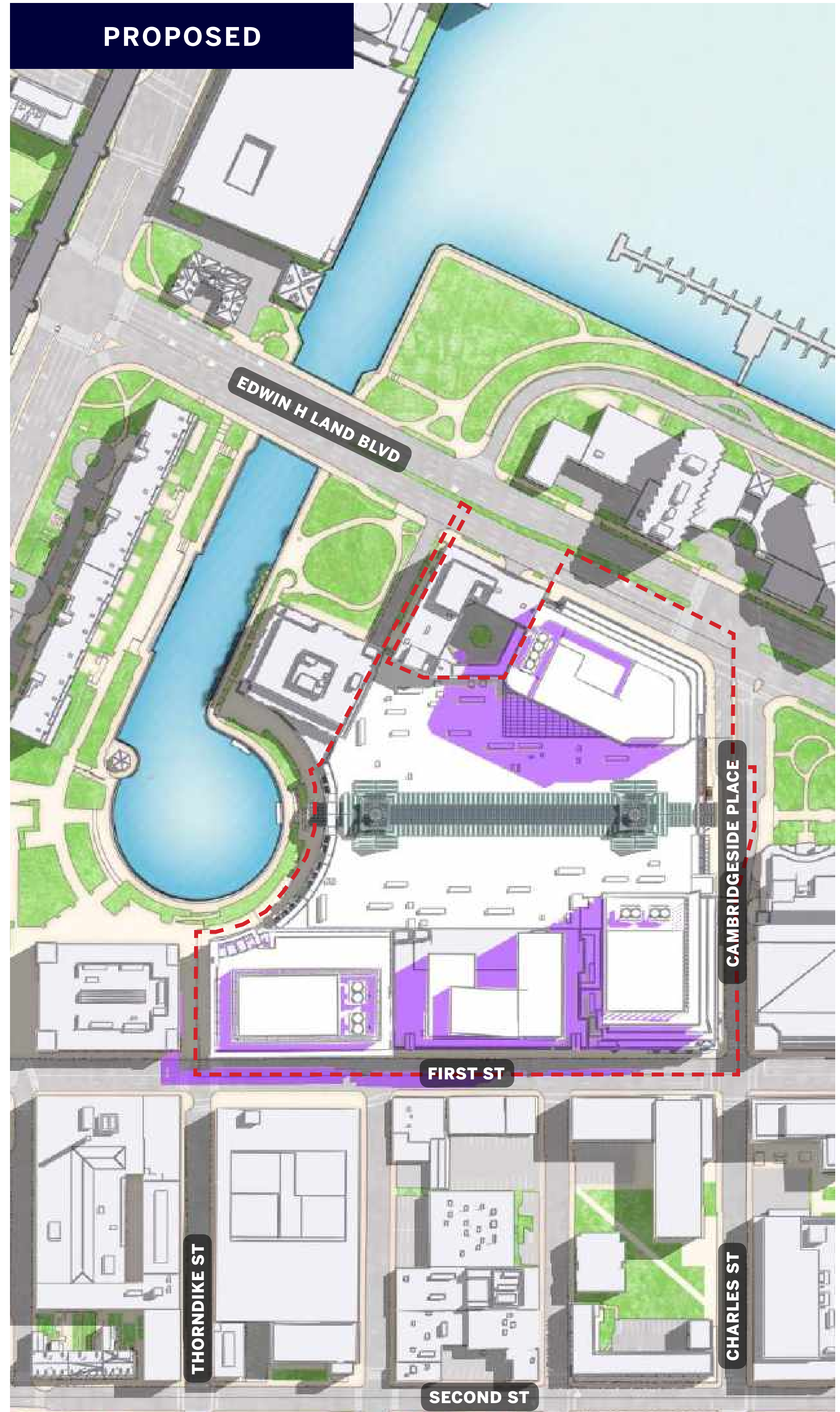
N 0 100 200 400

Legend

PUD BOUNDARY
GREEN SPACE
EXISTING SHADOW
PROPOSED BUILDING SHADOW

NEW ENGLAND DEVELOPMENT
ELKUS | MANFREDI ARCHITECTS





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12:00 pm

PUD-8 Special Permit
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Cambridge, MA

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Legend

- PUD BOUNDARY
- GREEN SPACE
- EXISTING SHADOW
- NET NEW SHADOW

NEW ENGLAND DEVELOPMENT

ELKUS | MANFREDI ARCHITECTS

Mar / Sep 21
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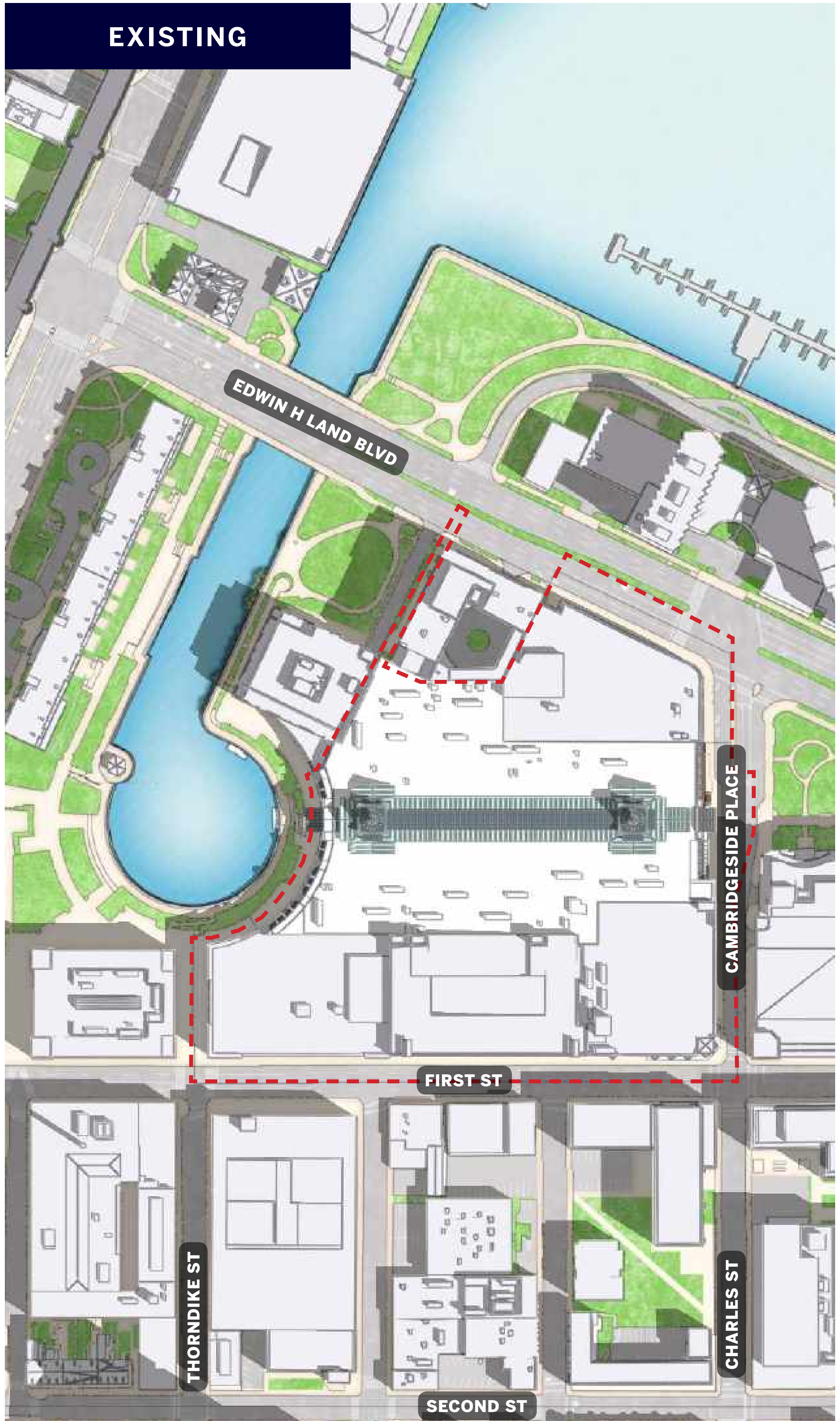
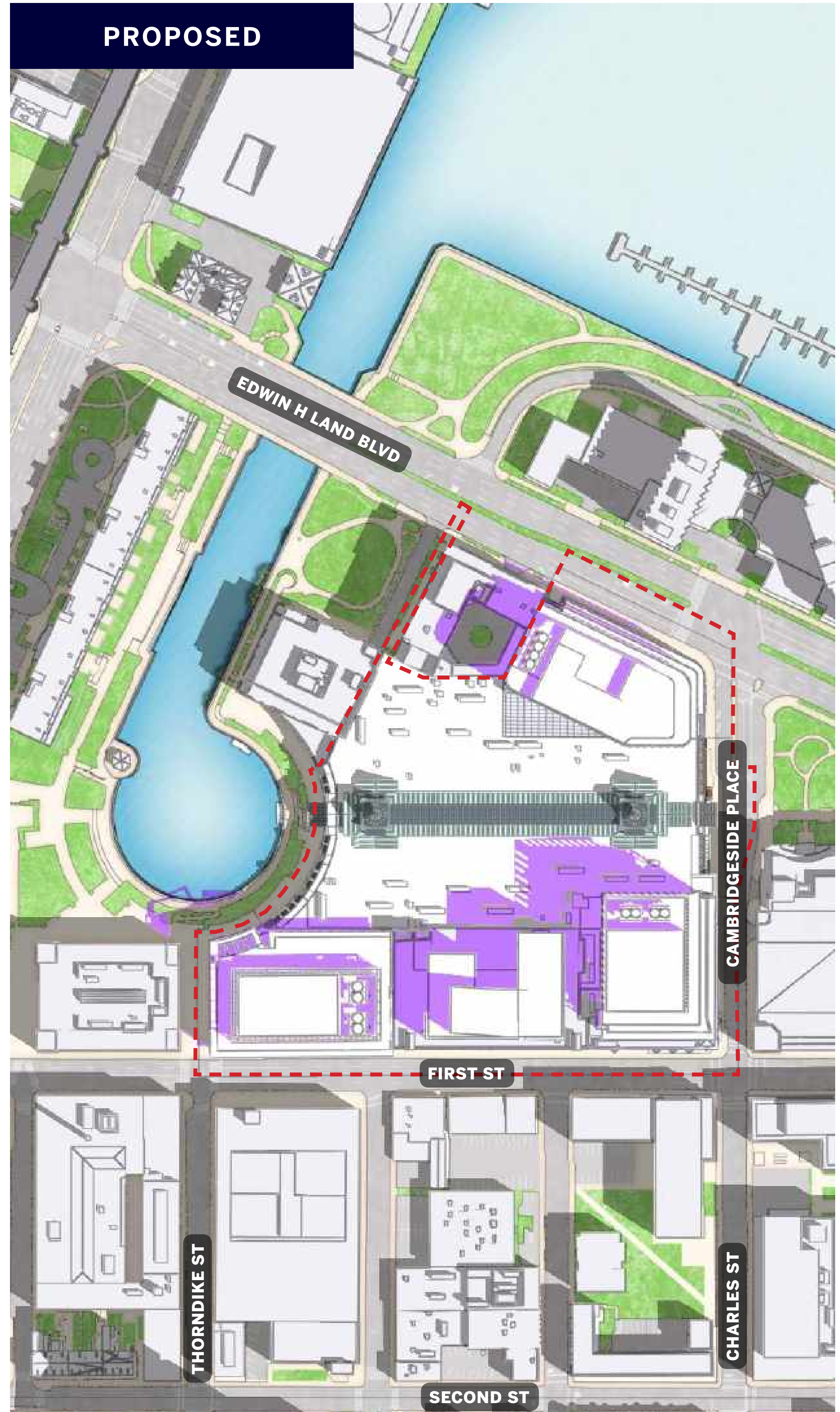
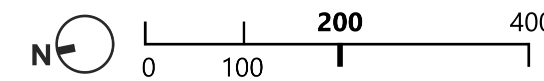
PUD-8 Special Permit
CambridgeSide
Cambridge, MA







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- GREEN SPACE
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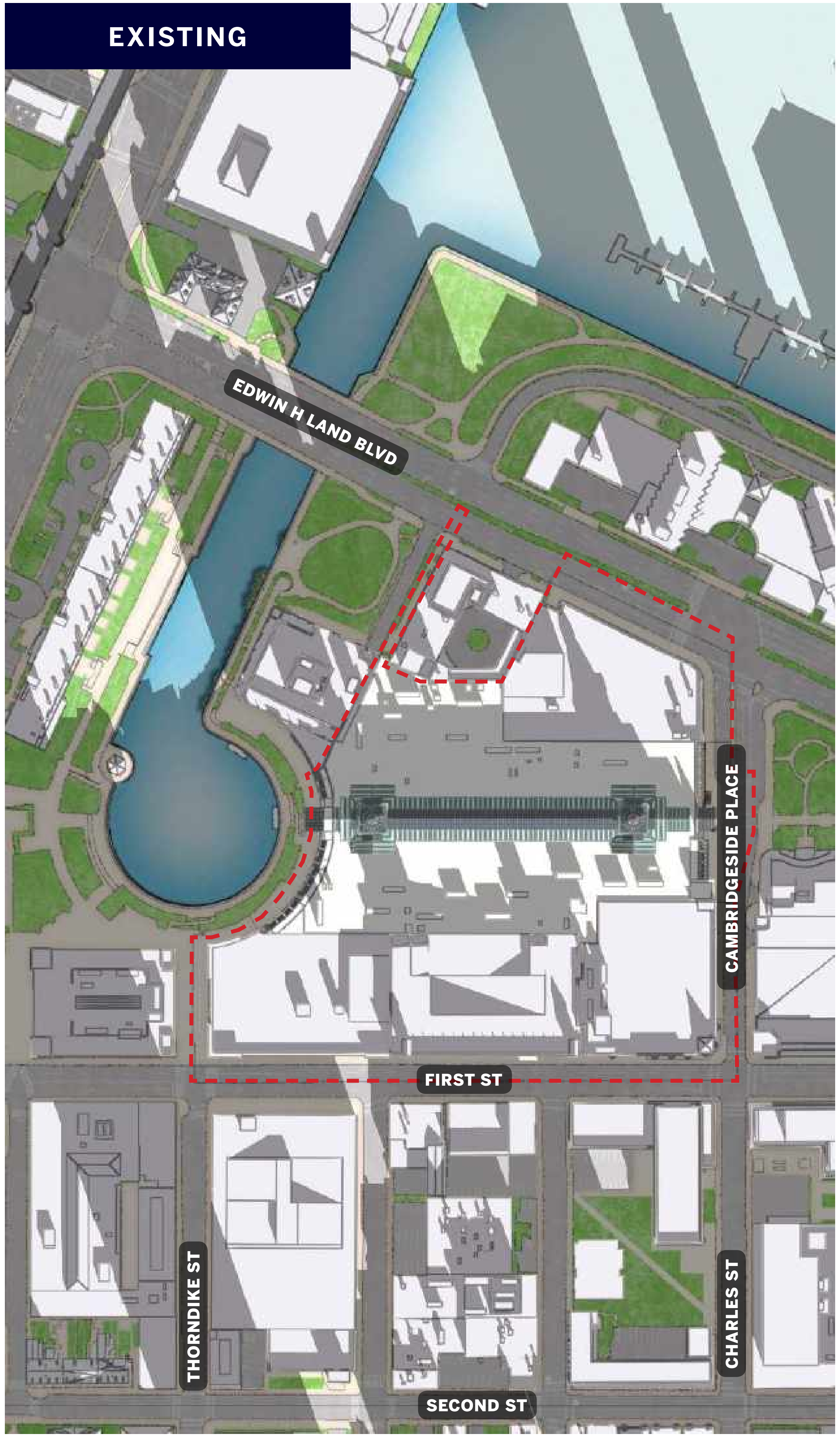
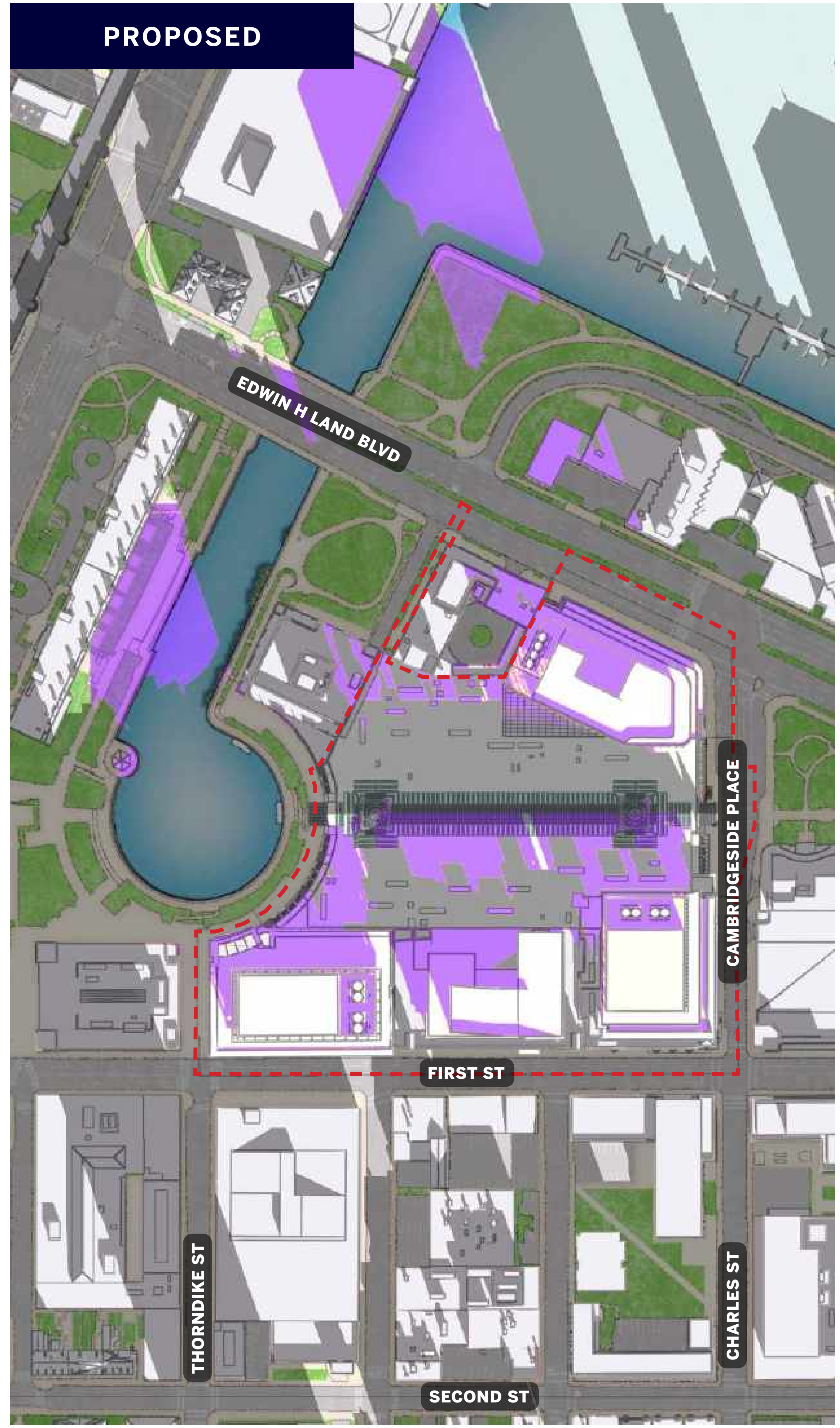
NEW ENGLAND DEVELOPMENT

ELKUS | MANFREDI ARCHITECTS





Mar / Sep 21

6:00 pm

PUD-8 Special Permit
CambridgeSide
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NEW ENGLAND DEVELOPMENT

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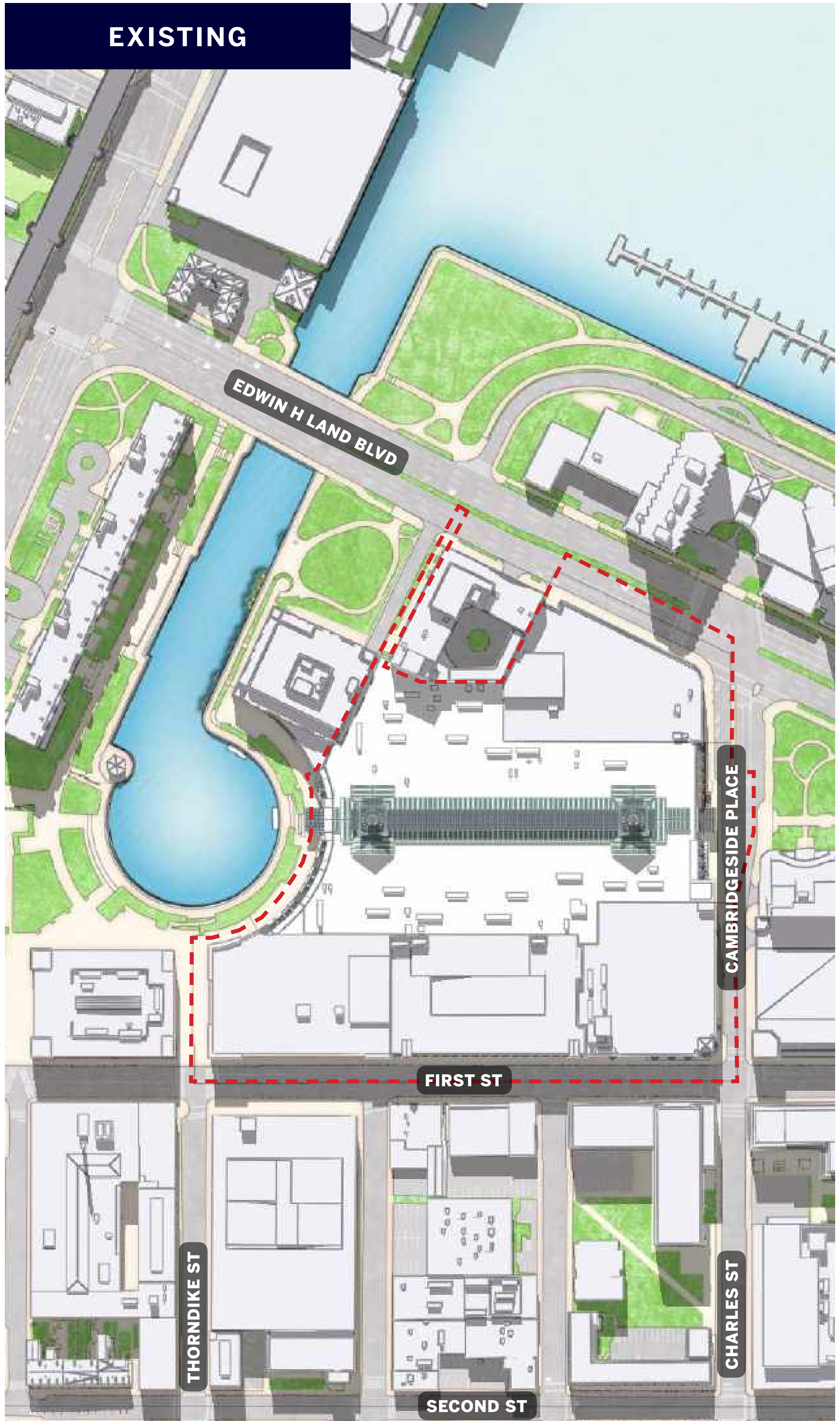

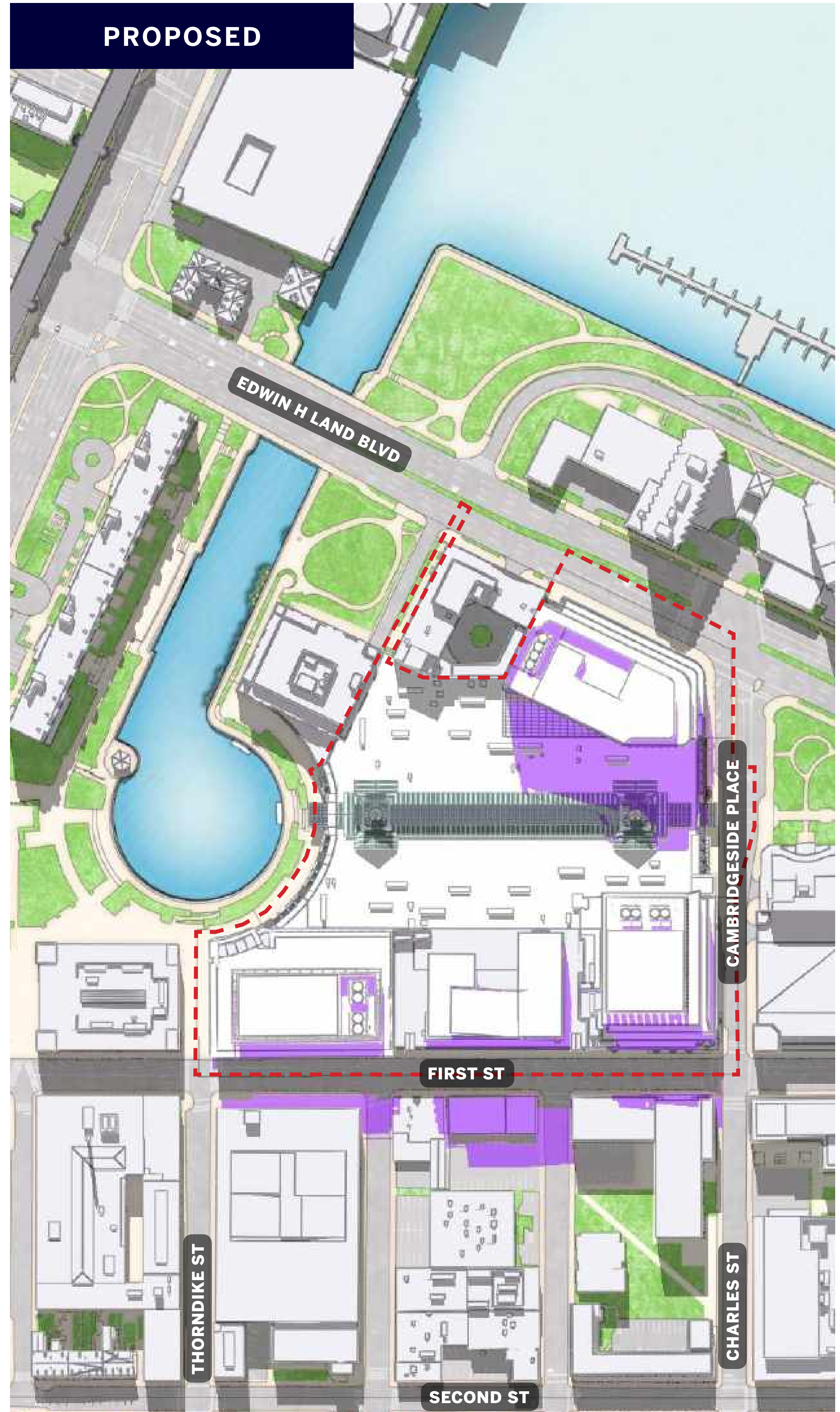

Jun 21
9:00 am

PUD-8 Special Permit
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NEW ENGLAND DEVELOPMENT

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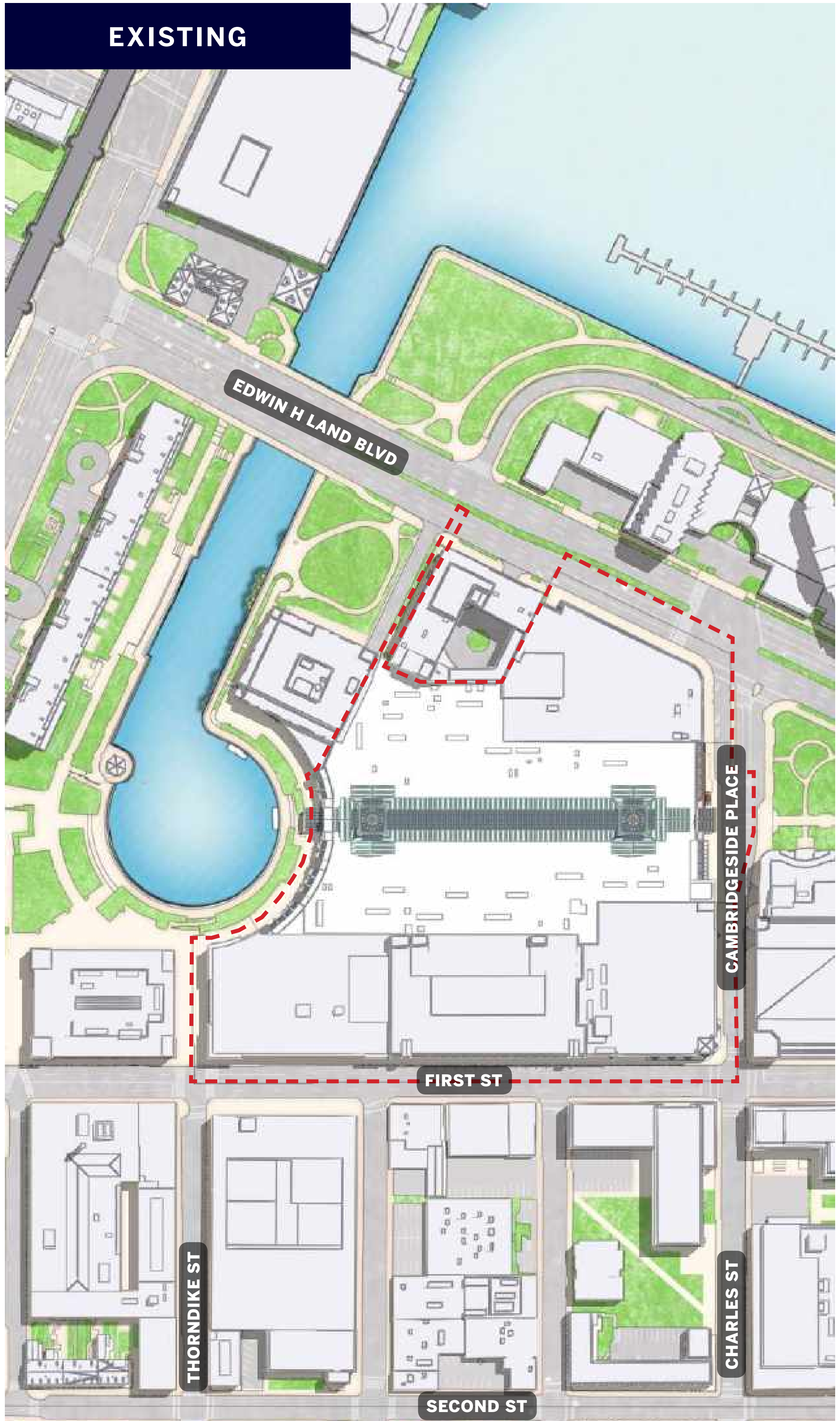

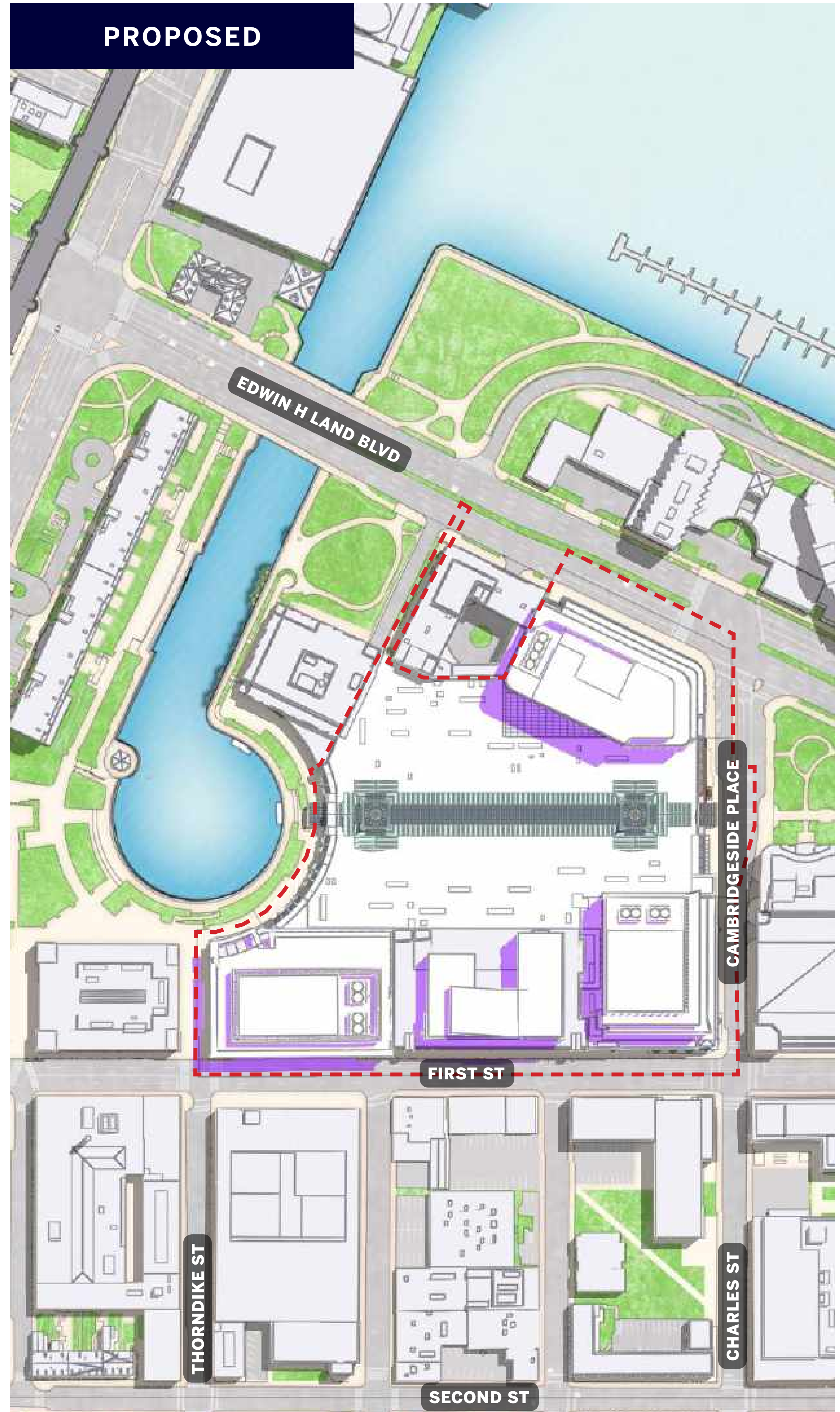

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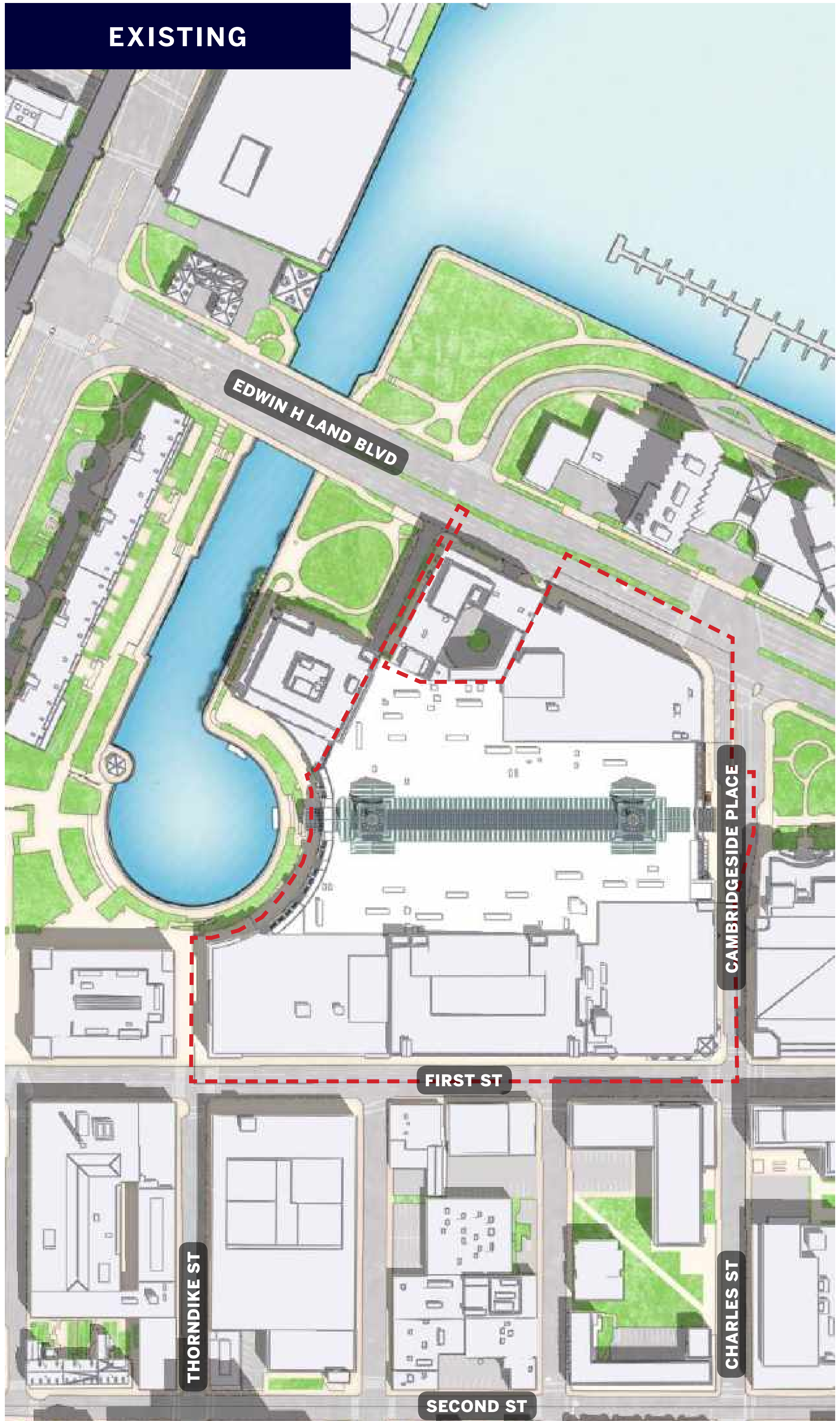

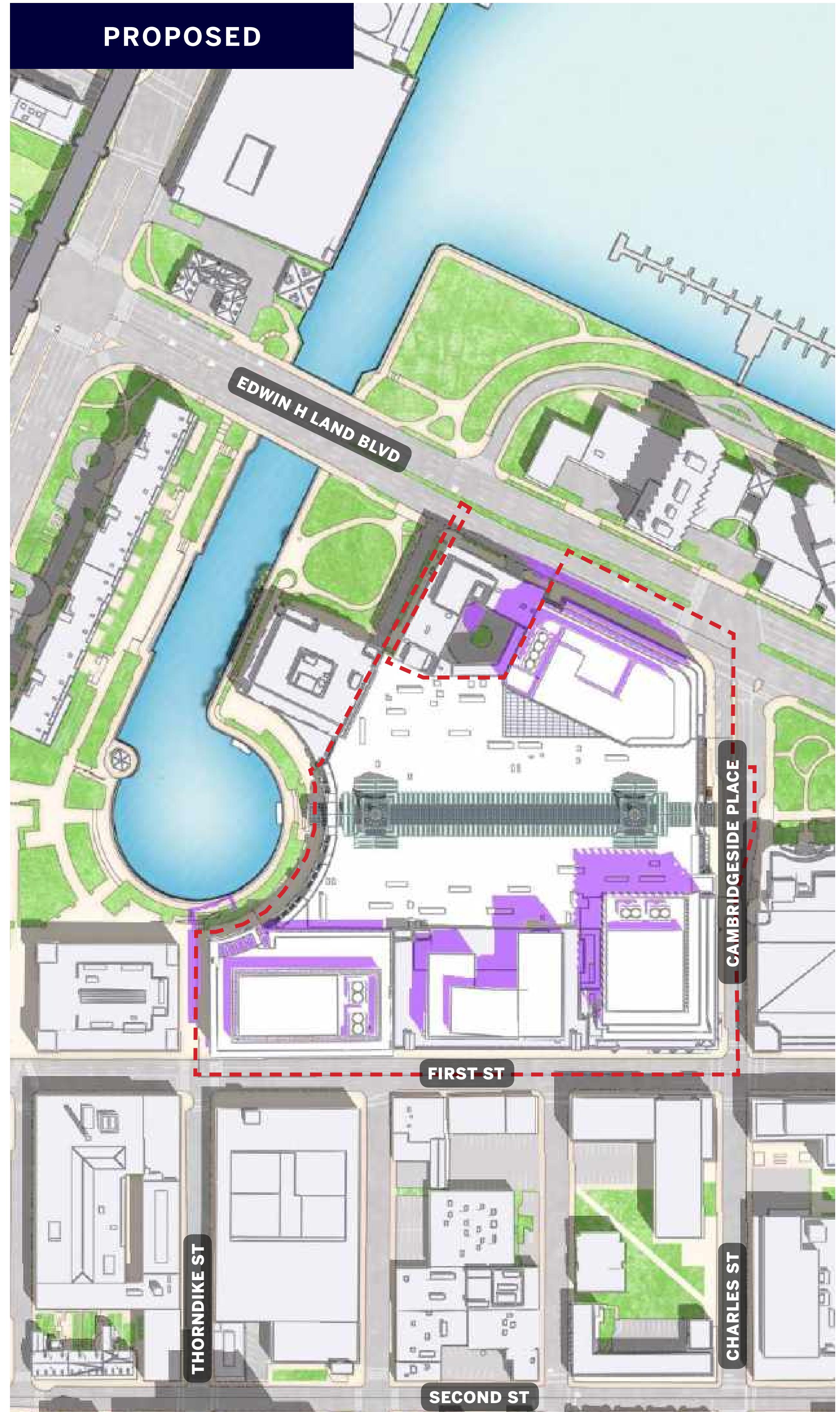

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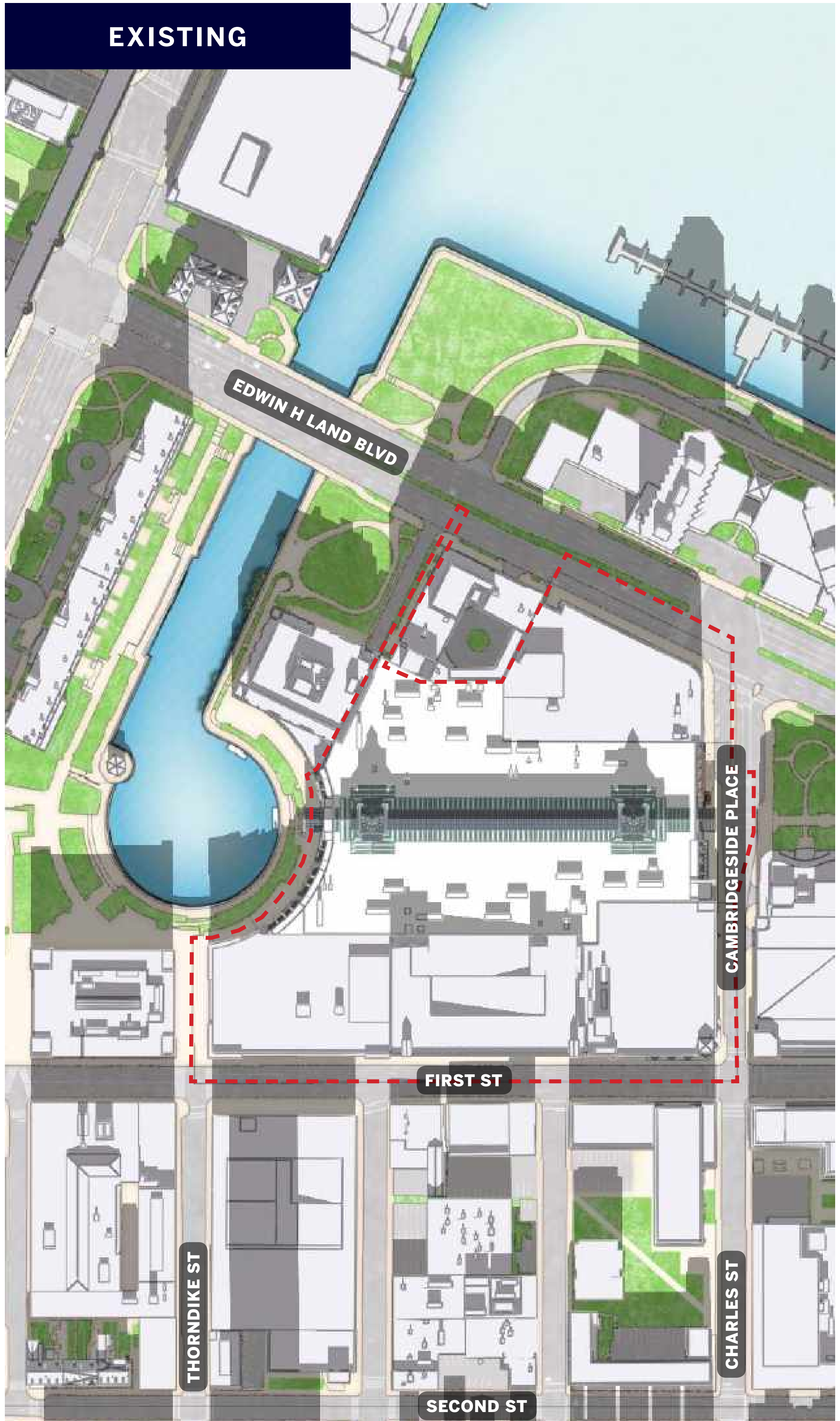
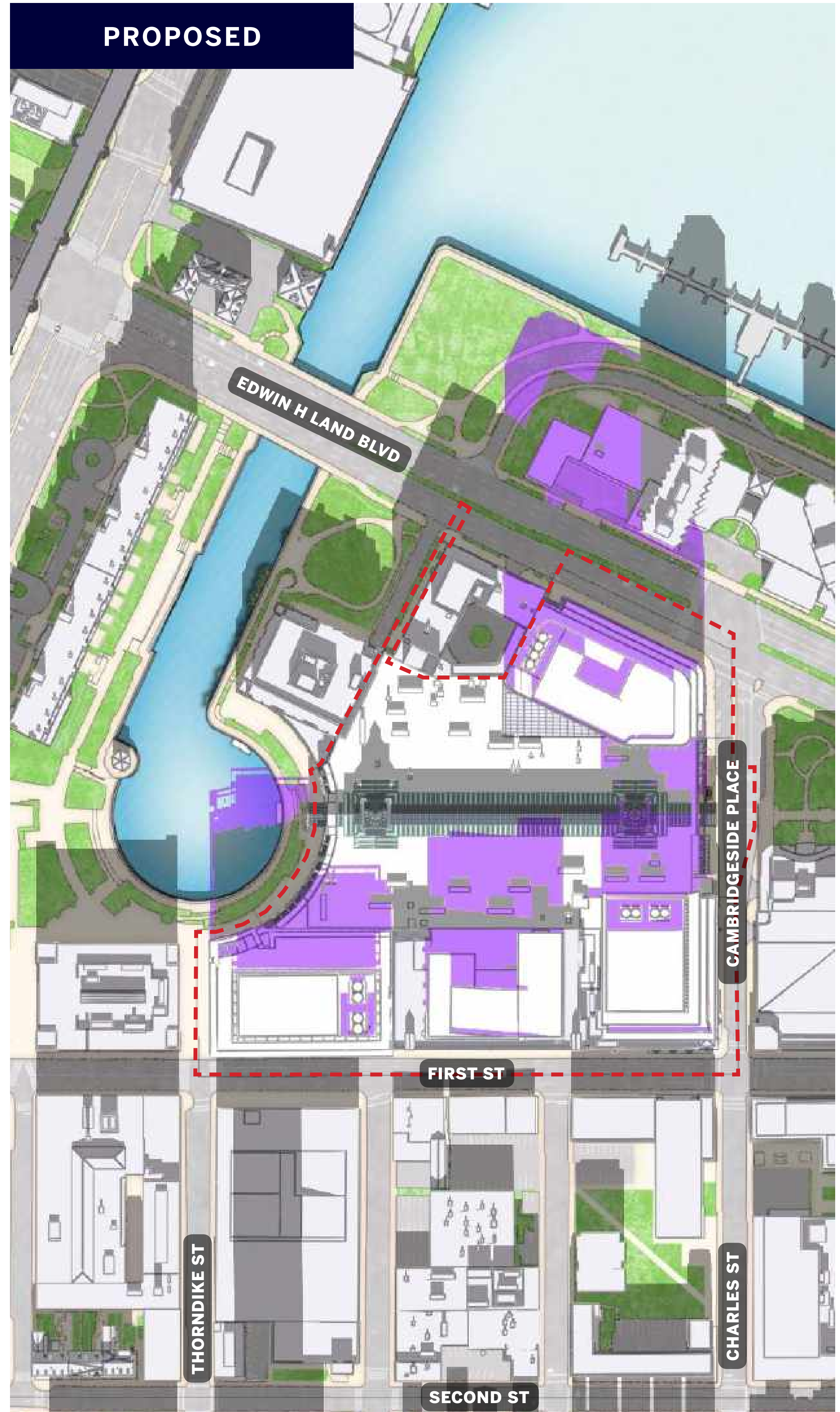
NEW ENGLAND DEVELOPMENT

ELKUS | MANFREDI ARCHITECTS





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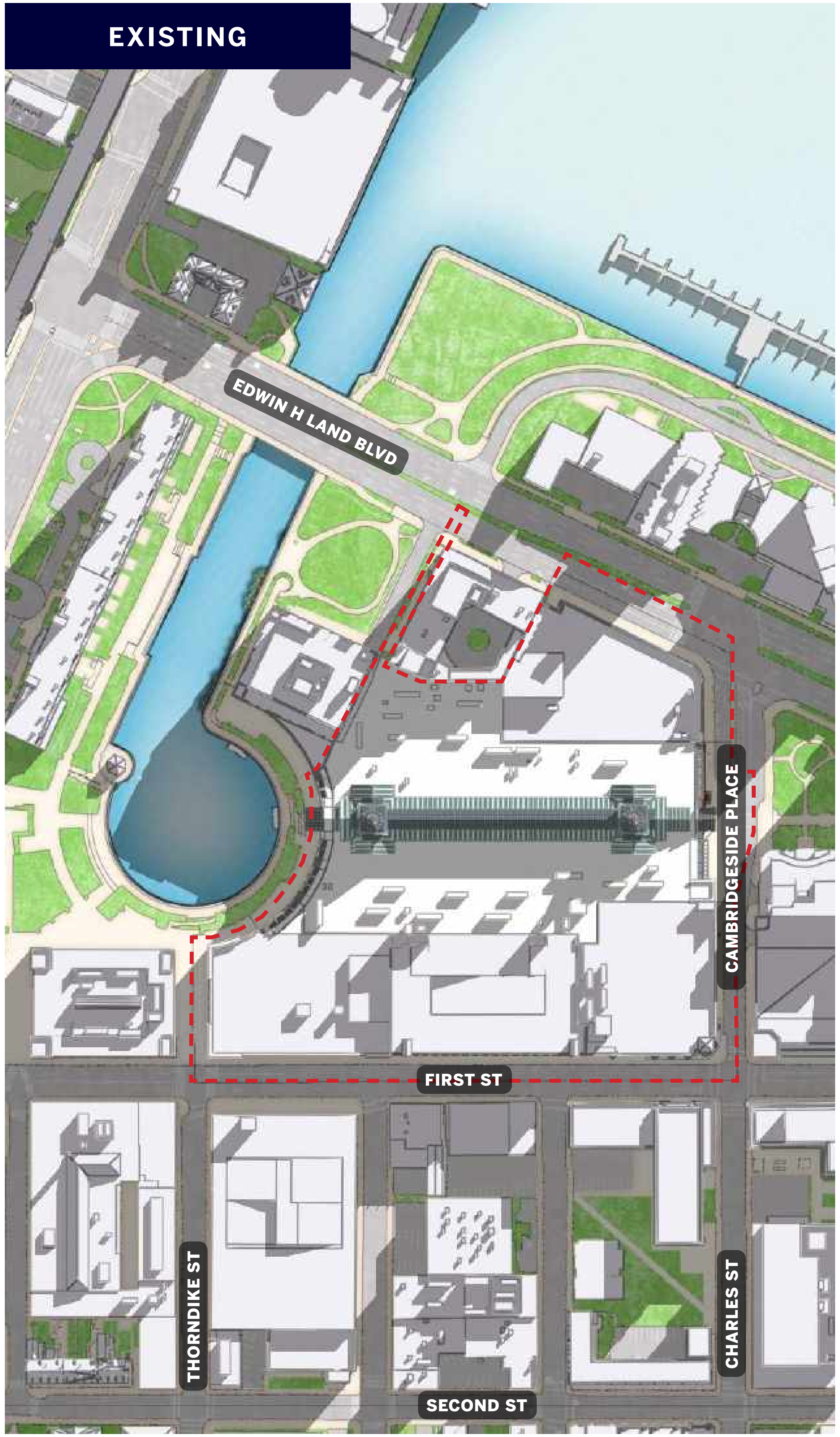
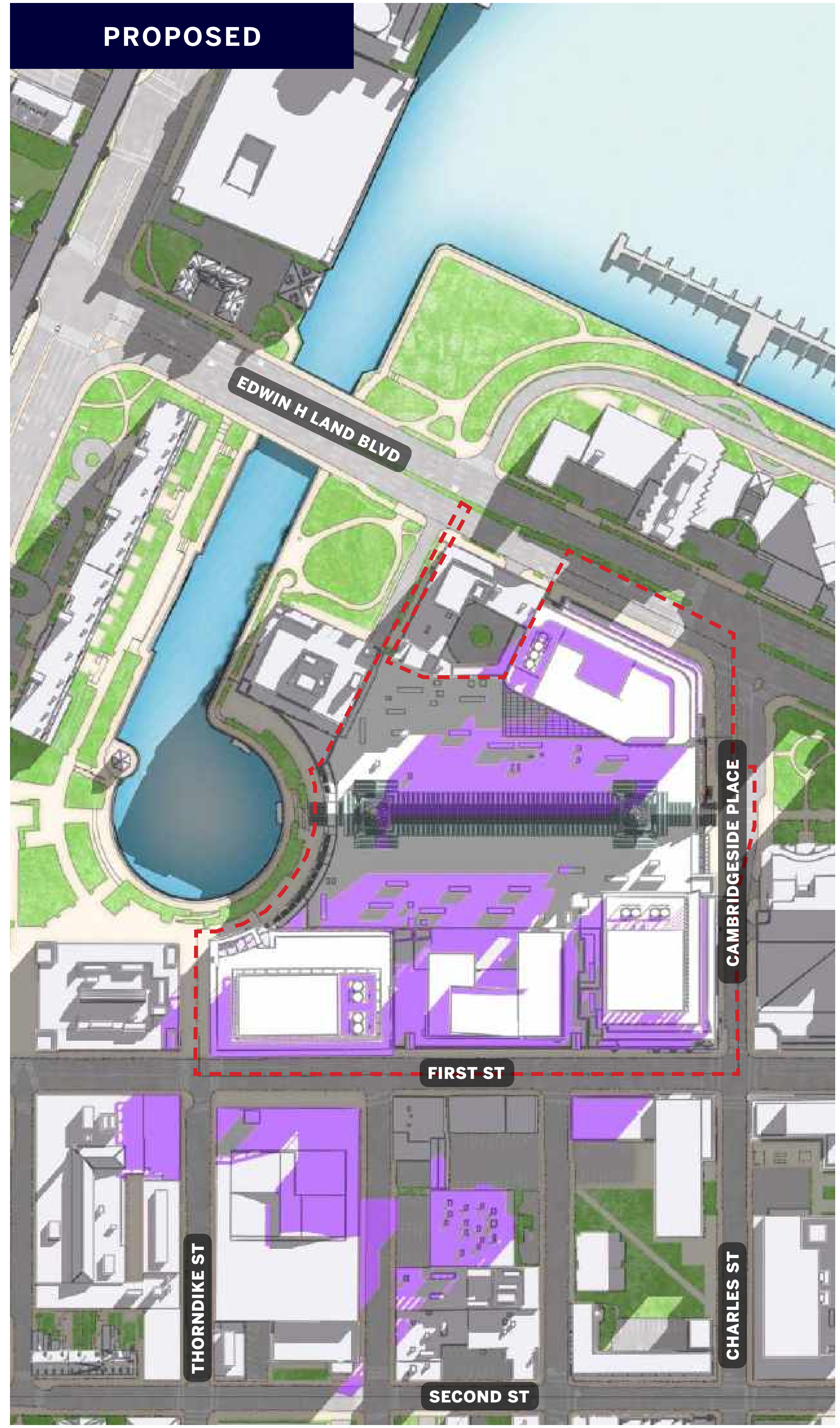
NEW ENGLAND DEVELOPMENT

ELKUS | MANFREDI ARCHITECTS





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PUD-8 Special Permit
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Cambridge, MA

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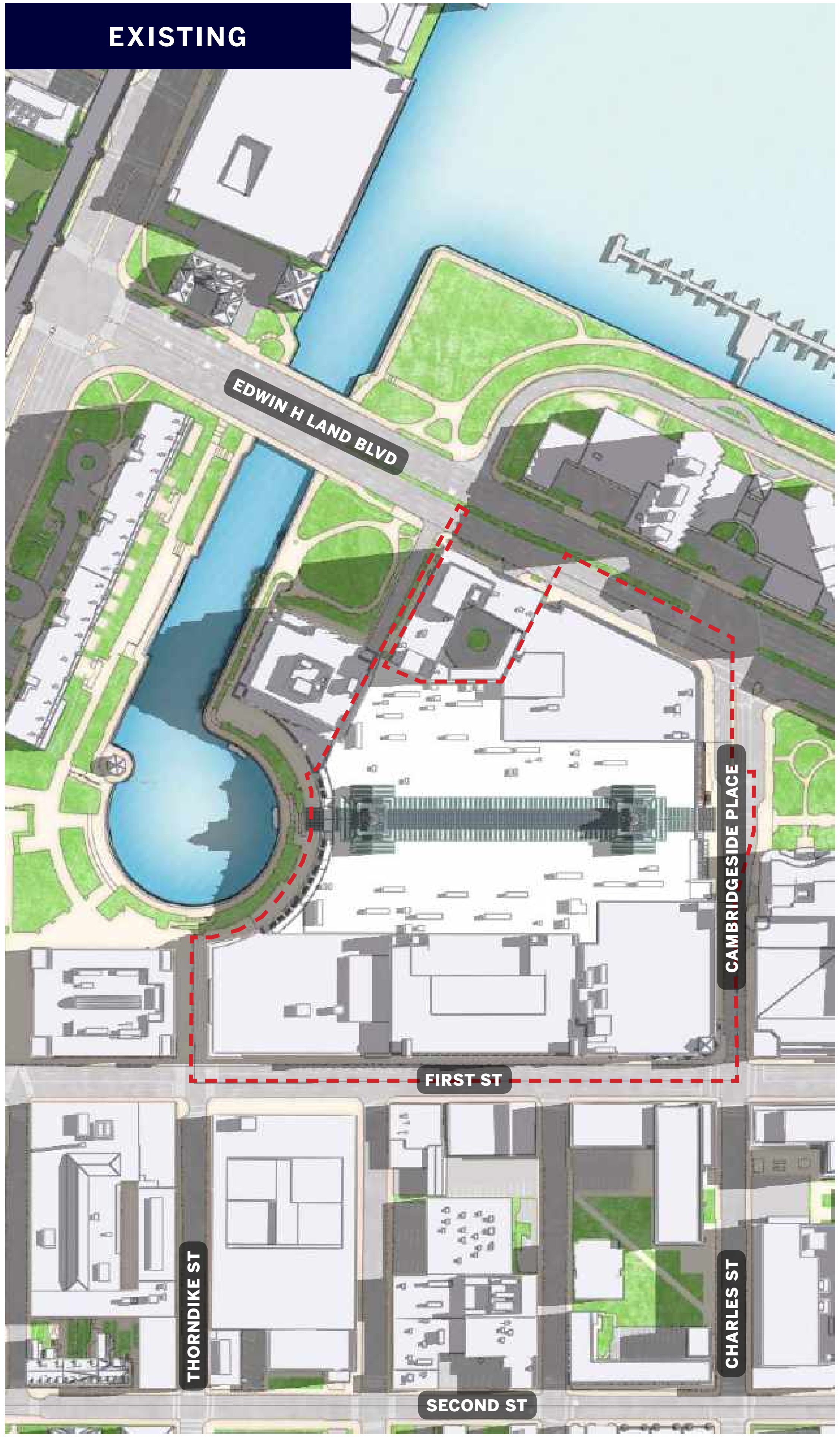
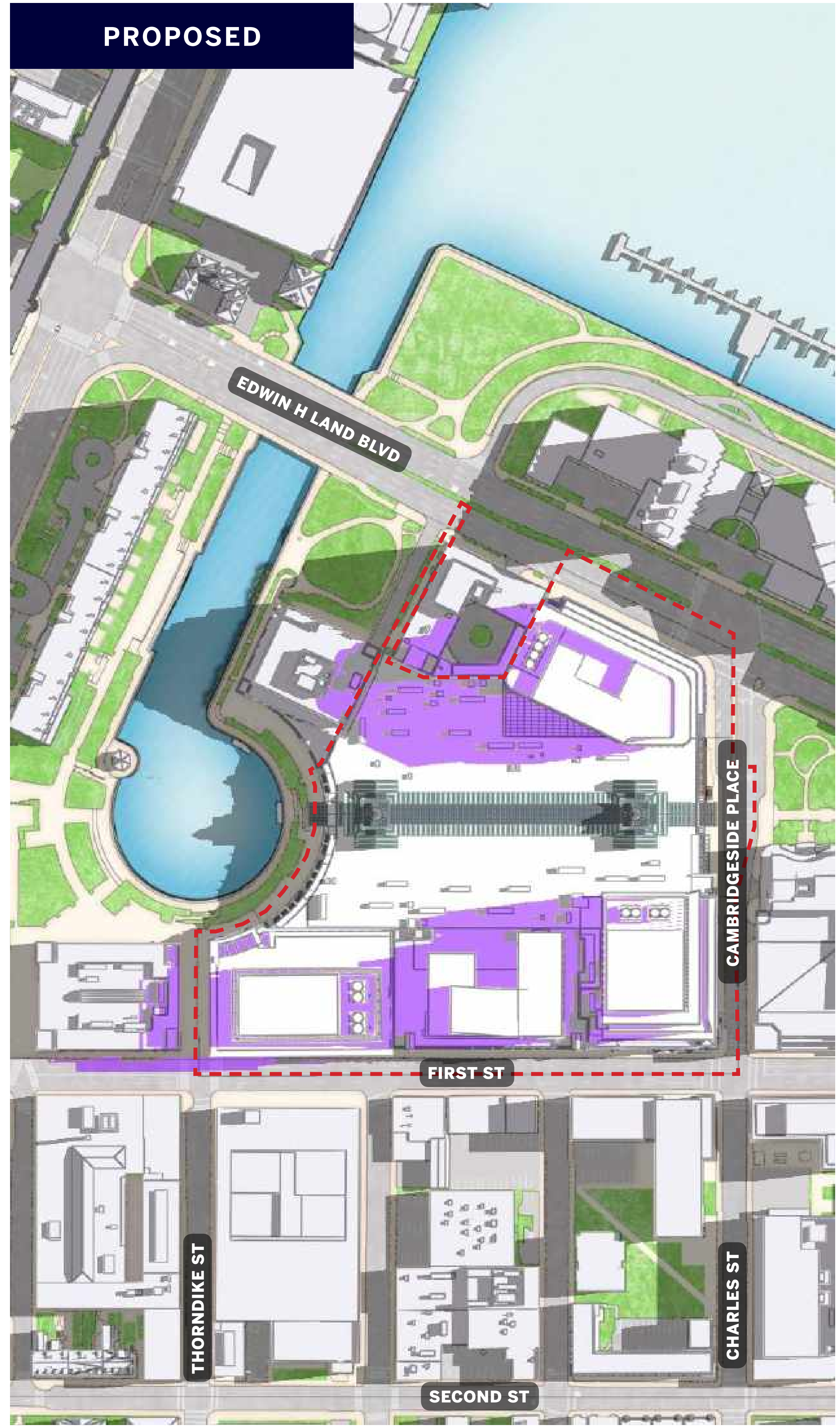
PUD BOUNDARY
GREEN SPACE
EXISTING SHADOW
NET NEW SHADOW

NEW ENGLAND DEVELOPMENT

ELKUS | MANFREDI ARCHITECTS





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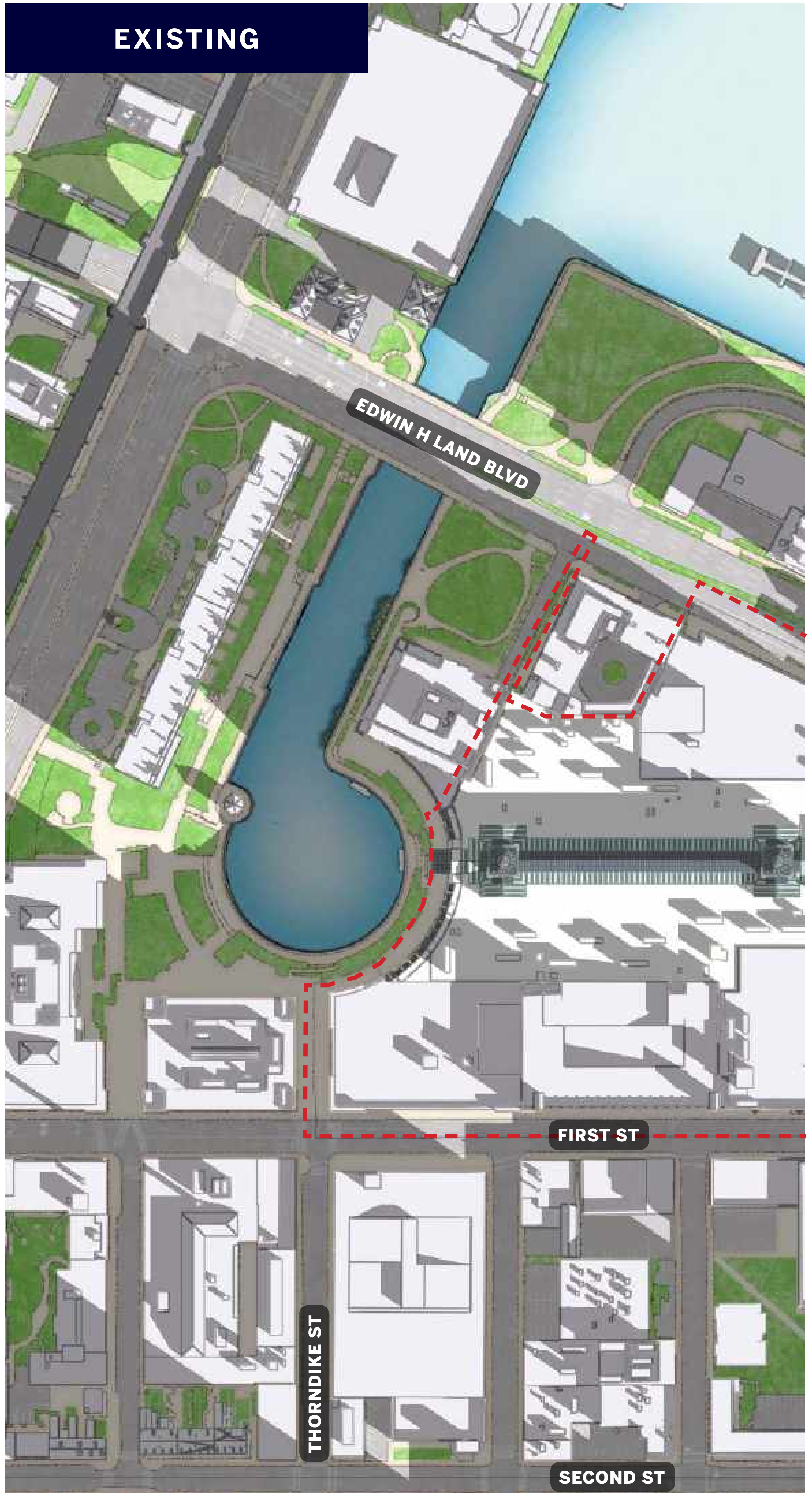
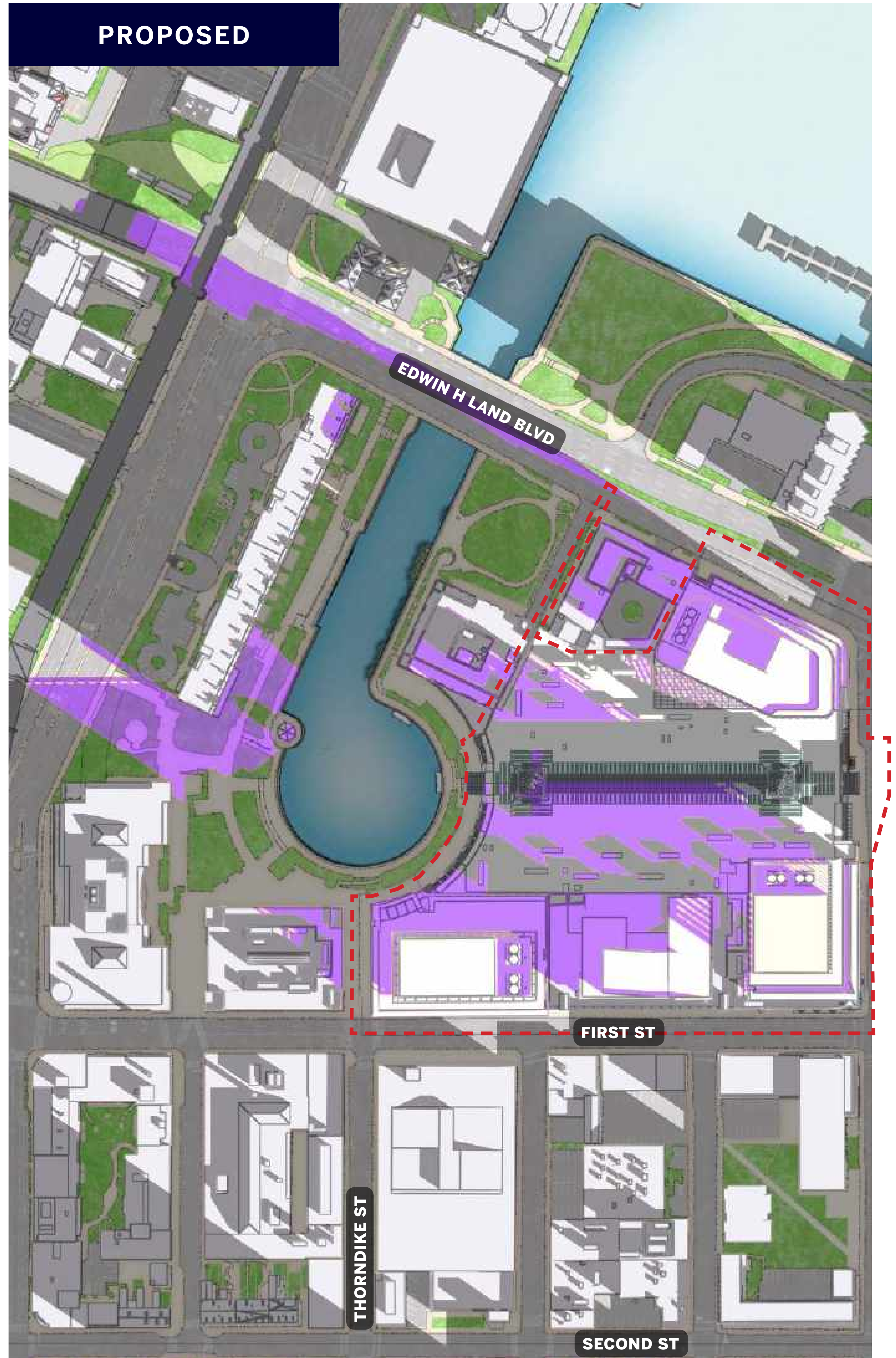
NEW ENGLAND DEVELOPMENT

ELKUS | MANFREDI ARCHITECTS





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EXISTING SHADOW
NET NEW SHADOW

NEW ENGLAND DEVELOPMENT

ELKUS | MANFREDI ARCHITECTS

Appendix F

Utilities Report

Utilities Report

CambridgeSide 2.0
Cambridge, Massachusetts

August 2020

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

1.0 INTRODUCTION

CambridgeSide is surrounded by a dense network of City-owned and private utilities. These utilities have served the existing facility for the past 30 years and with the Project's proposed energy and water conservation measures described in the Masterplan Special Permit will have adequate capacity to serve the proposed Project. These networks are shown on Exhibits UP.1 to UP.3 in Volume II. With the exception of the proposed interceptor drain, described in Section 4.2.1 no increases in infrastructure capacities are required in the abutting streets.

2.0 WASTEWATER INFRASTRUCTURE

As shown on Exhibit UP.3 in Volume II, existing wastewater flows from CambridgeSide are split over five (5) sewer connections to the City's separated sewers in the abutting streets. The First Street buildings and the Core Food Court discharges to the 12-inch sewer in First Street and the remainder of existing facility connects to the 24-inch sewer in Land Boulevard. Both of those trunk sewers connect to the 25-inch by 29-inch sewer in Binney Street which connects to the MWRA system Cambridge Branch sewer at Cardinal Medeiros Avenue and Bristol Street and from there into the larger MWRA network. As described more fully in Section 4.2.1 the Cambridge Branch Sewer serves combined sewer areas in parts of Cambridge and Somerville which during larger storms results in surcharging that sewer and the City's Binney Street sewer.

The proposed buildings will connect their sewer services to the existing sewer infrastructure in the adjacent streets which have adequate capacity to handle the Project's wastewater flows. The 60 First Street, 80 & 90 First Street and 110 First Street buildings will connect to the 12-inch sewer in First Street. The 10 CambridgeSide building will connect to the existing 8-inch sewer in Cambridgeside Place which flows to the 24-inch sewer in Land Boulevard. New sewer service connections will be adequately sized to carry the anticipated daily flow. The Applicant will continue to work with the Cambridge Department of Public Works (CDPW) to coordinate the new sewer service connections to the existing sewer mains.

As shown in Tables 1 and 2 below, existing and proposed wastewater flows for CambridgeSide have been calculated per building based on 310 CMR 15.203 Title 5 System Sewage Flow Design Criteria.

Table 1 Existing Wastewater Flow Estimate

Building/Use	GLA (sf)	Number of Seats	Generation Rate	Flow (gpd)
60 First Street				
retail	120,000	-	50 gpd per 1,000 SF	6,000
	120,000			**6,000**
110 First Street				
retail	107,500	-	50 gpd per 1,000 SF	5,375
	107,500			**5,375**
20 CambridgeSide				
restaurant	5,700	219	35 gpd per seat	7,665
retail	91,800	-	50 gpd per 1,000 SF	4,590

Building/Use	GLA (sf)	Number of Seats	Generation Rate	Flow (gpd)
	97,500	**219**		**12,255**
Mall				
office	140,000	-	75 gpd per 1,000 SF	10,500
restaurant	15,120	432	35 gpd per seat	15,120
restaurant (fast food)	20,350	768	20 gpd per seat	15,360
retail	139,230	-	50 gpd per 1,000 SF	10,727
	314,700	**432**		**47,942**
			Project Total	**71,572**

Table 2 Proposed Wastewater Flow Estimate

Building/Use	GLA (sf)	Number of Seats	Number of Bedrooms	Generation Rate	Flow (gpd)
60 First Street					
office/lab	165,000	-	-	75 gpd per 1,000 SF	12,375
restaurant	10,000	290	-	35 gpd per seat	10,150
restaurant (fast food)	11,000	120	-	20 gpd per seat	2,400
retail	7,000	-	-	50 gpd per 1,000 SF	350
	193,000	**410**	**-**		**25,275**
80 & 90 First Street					
family dwelling	175,000	-	281	110 gpd per bedroom	30,910
office	85,000	-	-	75 gpd per 1,000 SF	6,375
restaurant (fast food)	6,000	50	-	20 gpd per seat	1,000
retail	2,000	-	-	50 gpd per 1,000 SF	100
	268,000	**50**	**281**		**38,385**
110 First Street					
office/lab	300,000	-	-	75 gpd per 1,000 SF	22,500
restaurant (fast food)	12,000	130	-	20 gpd per seat	2,600
retail	4,000	-	-	50 gpd per 1,000 SF	200
	316,000	**130**	**-**		**25,300**
20 CambridgeSide					
office/lab	325,000		-	75 gpd per 1,000 SF	24,375
restaurant (fast food)	6,000	50	-	20 gpd per seat	1,000
retail	2,000		-	50 gpd per 1,000 SF	100

Building/Use	GLA (sf)	Number of Seats	Number of Bedrooms	Generation Rate	Flow (gpd)
	333,000	**50**	**-**		**25,475**
Mall					
office	140,000	-	-	75 gpd per 1,000 SF	10,500
restaurant	15,120	432	-	35 gpd per seat	15,120
restaurant (fast food)	30,350	1,278	-	20 gpd per seat	25,560
retail	214,530	-	-	50 gpd per 1,000 SF	10,727
	400,000	**1,710**	**-**		**61,907**
				Project Total	**176,342**

Per 314 CMR 12.04, any new sewer connection or extension where proposed flows exceed 15,000 gallons per day (gpd) shall require that four gallons of infiltration and/or inflow (I/I) be removed for each gallon of new flow to be generated by the new sewer connection or extension. Table 3 below shows the estimated I/I removal required per building.

Table 3 Required I/I Removal Per Building

Building	Existing Wastewater Flow (gpd)	Proposed Wastewater Flow (gpd)	Increase Wastewater Flow (gpd)	I/I Removal Requirement (gallons)
60 First Street	6,000	25,275	19,275	77,100
80 & 90 First Street	0	38,385	38,385	153,540
110 First Street	5,375	25,300	19,925	79,700
20 CambridgeSide	12,255	25,475	13,220	52,880
Mall	47,942	61,907	13,965	55,860
Total	**71,572**	**176,342**	**104,770**	**419,080**

As part of the Applicant team's continuing to work with the City departments during the Project planning and design, it was learned that the CDPW has a long-pending I/I removal project in Land Boulevard. That pending project consists of disconnecting the City's storm drainage systems from the MWRA Marginal Conduit which is further discussed in Section 4.2.1.

3.0 WATER INFRASTRUCTURE

Domestic water and fire protection services in the PUD-8 District are provided by infrastructure owned and maintained by the Cambridge Water Department (CWD). There are several existing water mains adjacent to CambridgeSide that are listed below and shown on Exhibit UP.1 in Volume II. These mains are interconnected and provide a loop completely around CambridgeSide.

- 12-inch ductile iron main in Cambridgeside Place
- 12-inch cast iron main in First Street
- 12-inch cast iron main in Land Boulevard
- 12-inch cast iron main in Thorndike Way

Per initial communication with the CWD, there are no known low-pressure concerns within the Project vicinity and the existing water mains currently serving CambridgeSide have adequate capacity to handle the Project's demand. Hydrant flow tests will be conducted to determine the capacity and pressures in the water mains adjacent to the site. If it is determined that there is inadequate pressure to provide the required flows to the proposed buildings, a fire booster pump will be provided. The domestic water demand for the Project is approximately 194,000 gpd, based on the Title 5 calculations with an additional 10% consumption factor. The Project will incorporate water conserving plumbing fixtures to lower the baseline water demands to meet LEED requirements.

4.0 STORMWATER INFRASTRUCTURE

4.1 EXISTING CONDITIONS

In the existing conditions, the site is almost entirely impervious covered by buildings. The site's area drains, and roof drains are connected to the City's stormwater collection system in three general subwatersheds, Refer to Figure 1, Pre-Development Watershed Map. The northern portion of the Core roof discharges directly to the Lechmere Canal, the First Street buildings to the City's drain in First Street which discharges at Thorndike Way to a large culvert emptying to the Lechmere Canal. The remainder of the site discharges rainwater runoff to the Land Boulevard City drains which connect at five (5) locations into the MWRA 5-foot by 6-foot Marginal Conduit. Section 4.2.1 describes the proposed disconnections of the City's drains from the MWRA Marginal Conduit. The existing stormwater infrastructure is shown on Exhibit UP.3 in Volume II.

4.2 PROPOSED CONDITIONS

Since the Project is the redevelopment of an existing urban center there is almost no change in the runoff from the site itself. However, there is a proposed change in the destination of that runoff. As shown on Figure 2, Post-Development Watershed Map under the proposed conditions there are still three general watersheds, however the watershed area that discharged to the MWRA Marginal Conduit under the existing conditions is redirected via the Land Boulevard interceptor drain, described in Section 4.2.1, which ultimately discharges to the Charles River.

The Project's stormwater management system will generally consist of area drains, tree box filters, deep sump, hooded catch basins, manholes and underground pipes. The Project site has limited opportunity to infiltrate stormwater due to the location of the existing underground garage, which is to be maintained, under the site. Infiltration BMPs such as tree box filters and permeable pavers will be incorporated into the stormwater management system where feasible, which will improve upon existing conditions. In addition, with the initial phase of the Project there will be drainage improvements in Canal Park to make the pedestrian/bike pathways more all- weather friendly. These canal-side improvements will employ infiltrative phosphorus removal drainage systems to improve water quality in the Charles River. As part of the future First Street projects and the pocket park construction scupper drains, deeper tree boxes, interconnected infiltration drains will be implemented to further reduce runoff. The Applicant will continue to work with the CDPW to ensure that the Project's stormwater management system complies with City's standards.

4.2.1 Land Boulevard Interceptor Drain

One of the Project's significant benefits is the Land Boulevard interceptor drain which will be constructed to meet the I/I removal requirement per 314 CMR 12.04. As shown on Exhibit UP.3 in Volume II, a new infiltrative drain in Land Boulevard will intercept five (5) existing storm drain connections to the 5'x6' MWRA Marginal Conduit (a combined sewer) and re-direct stormwater runoff to the existing infrastructure located at the intersection of Binney Street and Land Boulevard which ultimately discharges to the Charles River. Based on the MassDEP 1-year 6-hour storm event (1.72 inches of rain) approximately 400,000 gallons of stormwater runoff will be removed from the MWRA Marginal Conduit. Refer to Attachment 2, for I/I Removal Calculations.

As described above and summarized here the Project discharges its runoff to three City systems, directly to the Lechmere Canal, into the First Street Drain and into the Land Boulevard drains. Per the CDPW Stormwater Standards, we evaluated these drains for the 2-year to 100-year 24-hour storm events. The Lechmere Canal and First Street tributary areas are only slightly benefitted by on-site measures allowed by the reduced building footprints; however, the new Land Boulevard Interceptor Drain has significant benefits as shown in Table 4 below.

Table 4 Land Boulevard Drainage/Separation Work

	Existing Reach 3R To MWRA Marginal Conduit			Proposed Reach 4R To CAM 017 Outfall		
24-Hour Storm Event	Peak Runoff Rate (cfs)	Peak Runoff Volume (acre-feet)	Peak Runoff Volume (gallons)	Peak Runoff Rate (cfs)	Peak Runoff Volume (acre-feet)	Peak Runoff Volume (gallons)
2-year	33.54	2.598	845,639	31.65	2.939	957,837
10-year	55.11	4.384	1,416,893	51.77	4.035	1,314,895
25-year	68.63	5.459	1,778,937	63.50	5.214	1,699,098
100-year	89.45	7.181	2,340,089	84.91	6.920	2,255,037

As shown in Table 4 the City's drainage system in Land Boulevard not only discharges the regulatory I/I credit volume of roughly 400,000 gallons, but in storm events delivers whatever volume the four (4) connections to the MWRA marginal conduit and the one (1) connection to the Binney Street sewer can hydraulically deliver. That volume depends upon several complex peaking factors in components of the wastewater system, but it is certainly greater than a million gallons.

The existing trunk sewers in Land Boulevard and First Street which serve the Project are separated sewers (i.e. they do not receive stormwater discharges). They discharge to the 25-inch by 29-inch City sewer in Binney Street, which connects to the MWRA Cambridge Branch sewer and then to the MWRA DeLauri Pump Station and the North Metropolitan sewer system. The Cambridge Branch sewer serves combined sewer areas of Cambridge and Somerville. During storms the combined wastewater and stormwater flows in the MWRA Cambridge Branch Sewer can surcharge the system and cause an overflow through the Binney Street regulator into the MWRA Marginal Conduit and then to the Prison Point CSO facility. In larger storm events the overflow can exceed the hydraulic capacity of the overflow system and the MWRA Marginal Conduit. In those instances, the Binney Street regulator also discharges excess untreated flows to the Charles River through the CAM 017 outfall.

The proposed interceptor drain reduces stormwater discharges to the MWRA marginal conduit to zero; thus, reducing any dry-weather, small storm flows that could end up at the Deer Island wastewater treatment plant for unnecessary treatment. It also will have a significant hydraulic benefit to the system in larger storms. If we assume that the multiple connections would deliver between the 10-year and 25-year storm event runoff then approximately 1,500,000 gallons would be eliminated from potential overflow at the Prison Point CSO facility. More importantly, the available hydraulic capacity of the MWRA marginal conduit will not be reduced by the peak discharge from the Land Boulevard drainage system as it is now. That gained capacity will relieve the Binney Street overflow system and reduce the need for that system to discharge untreated CSO's to the CAM 017 outfall.

As shown on Exhibit UP.3 in Volume II, the interceptor drain is designed to capture, infiltrate and treat low flows and infiltrate a portion of all flows. While its nominal design capacity is the 10-year storm, it is oversized in order to have settling velocities in small (street-washer) storms and could carry the 25-year storm without surcharging from connected catch basins. As indicated in Table 4 and demonstrated in the supporting calculations in Appendix D of the EENF, the proposed interceptor drain reduces the peak discharge rates to the CAM 017 outfall from the existing discharges to the MWRA Marginal Conduit by 5-6% and reduces the volume reaching the Charles River by 4% in large storms to 8% in smaller events. The increased infiltration on small storms is a result of lower velocities and larger residence time in the infiltration sections of the system.

The system velocities in the 10-year storm, 5.73 inches of rainfall, the so-called urban first flush rainfall of 1.00 inches and the former arithmetic average precipitation of 0.33 inches were all analyzed for settling of suspended solids in the runoff. In the 10-year design storm all velocities are under 5 feet per second (fps) and would have cleansing velocities, that is, while they would continue to infiltrate stormwater, they could carry suspended solids.

In order to determine the efficiency of the in-line infiltration design it is important to look at smaller precipitation events that occur frequently. These smaller rainfalls tend to have heavy suspended solids concentration (less dilution of gutter/street sediments). We used current National Oceanic and Atmospheric Administration (NOAA) daily rainfall amounts which range from a trace to 2.6 inches. These have a 100% probability of occurring each year. Thus the 0.33-inch and 1.00-inch rainfalls were analyzed to represent more than half of the events which occur. In those storms the velocities are by design, very low, 0.1-0.2 fps and 0.5-0.8 fps respectively.

Those velocities allow longer residence times in the infiltration pipe sections with higher resulting infiltration percentages. The initial analysis has shown significant removal of particle associated with phosphorous and bacteria in the infiltrated stormwater. The final design is exploring common garden soil amendment quantities of alum ($AlSO_4$) to add to the filter box in order to not only remove phosphorous from the discharge waters to the Charles River by infiltration, but by fixing them in the immediate pipe box soil by ion exchange and removal from the groundwater flow.

The proposed Land Boulevard interceptor drain will provide enough I/I mitigation for the core mall and three redeveloped buildings. The entire Land Boulevard mitigation project will be delivered with the first buildings in the Project (i.e. 20 CambridgeSide and 60 First Street). At the beginning of the new First Street buildings (i.e. 80 & 90 and 110 First Street) the Applicant will review actual occupancy of the core mall and 20 CambridgeSide and 60 First Street redeveloped buildings to determine if additional mitigation is still needed. If so, the Applicant will work with the City to locate another City I/I removal project that the Applicant would implement to remove an additional 25,451 gallons.

4.3 CITY OF CAMBRIDGE STORMWATER STANDARDS

In addition to the MassDEP Stormwater Management Standards the Project will need to comply with the City of Cambridge Stormwater Management Standards outlined in Section 3.3 of the CDPW Wastewater and Stormwater Management Guidance document, dated May 2008. Many of the City's stormwater standards have been adopted from the MassDEP Stormwater Management Policy. It should also be noted that when one or more of the City's standards cannot be met, the Applicant may demonstrate that an equivalent level of environmental protection will be provide. The following summarizes the Project's compliance with the City of Cambridge Stormwater Management Standards:

Standard 1: No New Untreated Discharges

Standard 1 requires that no new stormwater conveyances (i.e. outfalls) may discharge untreated stormwater directly to the municipal drainage system in Cambridge. No new untreated stormwater conveyances are proposed for the Project. Full compliance with this standard will be achieved.

Standard 2: Peak Rate Attenuation

Standard 2 requires stormwater management systems be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates for the 2, 10, 25 and 100-year 24-hour storm events. To determine the peak rate of discharge for pre-development and post-development conditions, runoff hydrographs were generated for the storm events using the SCS TR-20 Method (refer to Attachment 1).

The following table summarizes the pre- and post-development peak runoff discharge rates determined in the hydrologic/hydraulic analyses performed for the Project's hydrologic study area and are based on NOAA Atlas 14 precipitation depths.

Table 5 Comparison of Peak Runoff Rates

Point of Analysis	Peak Runoff Rates (cfs)											
	2-year, 24-hour Storm Event (3.25 inches)			10-year, 24-hour Storm Event (5.13 inches)			25-year, 24-hour Storm Event (6.31 inches)			100-year, 24-hour Storm Event (8.13 inches)		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
1L	64.72	62.15	-2.57	106.38	101.96	-4.42	132.46	125.80	-6.66	172.55	165.63	-6.96

* cfs = cubic feet per second

As shown in Table 5 above, post-development peak runoff rates for the Project are less than pre-development for each storm event. Full compliance with this standard will be achieved.

Standard 3: Stormwater Volume

The post-development discharge hydrograph for the 25-year 24-hour rainfall event must be less than or equal to the 2-year 24-hour rainfall event pre-development discharge hydrograph. The total volume of runoff generated between the pre-development 2-year 24-hour storm discharge and the post-development 25-year 24-hour storm discharge must be retained or discharge on-site. This requirement ensures that during an event up to and equal to the 25-year 24-hour rainfall event the municipal drainage system will not receive discharge in excess of the pre-development 2-year 24-hour rainfall event.

Since approximately 90% of the 8.2-acre Project site contains existing buildings and an underground parking garage the site has a limited opportunity to implement BMPs. However, it should be noted that there will be a decrease in the post-development 25-year 24-hour storm discharge by implementing infiltration BMPs where feasible. In addition, the Project will significantly improve upon existing conditions by removing 11.47 acres from discharging into the MWRA Marginal Conduit. Compliance with this standard will be achieved to the maximum extent practicable.

Standard 4: Recharge to Groundwater

Standard 4 requires that the loss of annual recharge to groundwater be or minimized to the maximum extent practicable through the use of infiltration measures including environmentally sensitive site design, low impact development (LID) techniques, stormwater BMPs and good operation and maintenance. At a minimum, the annual recharge from the post- development site shall approximate the annual recharge from pre-development conditions based on soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

There will be no loss of annual recharge to groundwater since the Project will not increase impervious area However, it should be noted that the Project will increase groundwater recharge by implementing infiltration BMPs where feasible.

Standard 5: No Negative Impact on Abutting Properties

Standard 5 requires that there are no negative impacts from drainage on abutting properties. Concentrated discharges from land development, including from stormwater practices, must not be discharged onto adjacent developed property without adequate conveyance in a natural stream or stormwater drainage system. Since the Project will not generate an increase in stormwater runoff or volume the Project will not impact abutting properties. Full compliance with this standard will be achieved.

Standard 6: Water Quality

For new development, stormwater management systems must follow the stormwater runoff treatment train prescribed for the site conditions and remove at minimum 80% of the average annual post construction load of Total Suspended Solids (TSS), as well as remove trash to the maximum extent practicable. It is presumed that this standard is met when:

- Suitable practices for source control and pollution prevention are identified and thereafter are implemented and maintained.
- Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
- 80% TSS removal is achieved and treatment is provided in accordance with the prescribed treatment train.
- Stormwater management BMPs are maintained as designed.

Although redevelopment projects are not required to achieve 80% removal of TSS, the Project will improve upon existing stormwater quality by incorporating infiltration BMPs where feasible.

Standard 7: Redevelopment Projects

Redevelopment of previously developed sites mist meet the Stormwater Management Standards to the maximum extent practicable. All redevelopment projects must also improve upon existing conditions. The

Project is considered a redevelopment since there will be no increase in impervious area. The Project will improve existing conditions by incorporating infiltration BMPs where feasible and removing 11.47 acres from discharging into the MWRA Marginal Conduit.

Standard 8: Erosion and Sedimentation Control / Operation and Maintenance (O&M) Plan

Standard 8 requires a plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented. In addition, Standard 8 also requires that all stormwater management systems have an O&M Plan to ensure that the system function as designed. Full compliance with this standard will be achieved. A site-specific Erosion Control Plan and O&M Plan will be developed and submitted to the CDPW as part of the Stormwater Control Permit.

Standard 9: Land Uses with Higher Potential Pollutant Loads

Stormwater discharges from land uses with higher potential for pollutant loads (hot spots) require the use of specific source control and pollution prevention measures and specific stormwater BMPs approved by the CDPW for such use. Standard 9 is applicable to the Project. The Project will generate more than 1,000 vehicle trips per day and therefore may be considered a hot spot. The Project will incorporate specific structural BMPs where feasible. Compliance with this standard will be achieved to the maximum extent practicable.

Standard 10: Protection of Critical Areas

Stormwater discharges near or discharging to critical areas require the use of specific source control and pollution measures and the specific stormwater BMPs approved by the CDPW for such discharges. The following areas are considered critical areas:

- Shellfish Growing Areas
- Bathing Beaches
- Outstanding Resource Waters or Special Resource Waters
- Recharge Areas for Public Water Supplies
- Cold Water Fisheries
- Charles River Buffer Zone (1,000-foot zone around the Charles River in Cambridge)

Standard 10 is applicable to the Project since it is located within 1,000 feet from the Charles River. The Project will incorporate specific structural BMPs where feasible. Compliance with this standard will be achieved to the maximum extent practicable.

Standard 11: Prohibition of Illicit Discharge

Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. All illicit discharges to the stormwater management system are prohibited. To the best of the owner's and engineer's knowledge, no illicit discharges exist on Site and no illicit discharges will be incorporated as part of the Project into the proposed stormwater management system. Full compliance with this standard will be achieved.

4.4 CHARLES RIVER TMDL

According to the Massachusetts Year 2014 Integrated List of Waters by the Massachusetts Department of Environmental Protection (MassDEP), the segment of the Charles River in the Project vicinity, identified as

MA72-38 (formerly part of segment MA72-08), is listed as impaired for chlorophyll-a, combined biota/habitat bioassessments, DDT, dissolved oxygen saturation, escherichia coli, excess algal growth, nutrient/eutrophication biological indicators, oil and grease, dissolved oxygen, PCB in fish tissue, total phosphorous, salinity, secchi disk transparency, sediment screening value, taste and odor and water temperature.

There are two TMDLs that apply to the segment of the Charles River within the Project vicinity:

- Final Pathogen TMDL for the Charles River Watershed, dated January 2007.
- Final TMDL for Nutrients in the Lower Charles River Basin, dated June 2007.

In response to the TMDL the City requires that projects within the watershed treat stormwater to reduce the phosphorous load by 65% from the existing condition. As discussed in Section 4.2.1 above the Land Boulevard Interceptor Drain will have low velocities during small rainfall events which will allow longer residence times in the infiltration pipe sections with higher resulting infiltration percentages. The initial analysis has shown significant removal of particle associated with phosphorous and bacteria in the infiltrated stormwater and will meet the City's 65% phosphorous load reduction requirement.

5.0 PRIVATE UTILITIES

CambridgeSide is serviced by existing gas, electric and telecom infrastructure in Land Boulevard and First Street. These private utilities feed on-site transformers, switchgear, meters and distribution networks serving the CambridgeSide tenants. Most of this equipment along with the fire pump rooms are located in or just off the service court areas and loading docks on First Street and Land Boulevard. Refer to Exhibit UP.2 in Volume II.

Eversource supplies gas service to CambridgeSide. The existing gas meters located in the First Street service area provide gas to the food court tenants and the existing gas meters located in the Land Boulevard service area provide gas to 20 CambridgeSide and the Mall. 60 First Street and 110 First Street both have their own gas meters that are located next to their electrical vaults. At this time, it is anticipated the existing gas meters for the food court tenants and the Mall will remain. 60 First Street, 80 & 90 First Street, 110 First Street and 20 CambridgeSide will have gas meters dedicated to each building.

Eversource also provides electrical service to CambridgeSide and is fed from two primary electrical vaults: one located in the Land Boulevard service area which provides service to the Mall and 20 CambridgeSide, and the second in the First Street service area which provides service to the Mall and the Upper Garage. The Project team has coordinated with Eversource, which has confirmed in writing that the existing electrical infrastructure is adequate to serve the Project. 60 First Street, 80 & 90 First Street and 110 First Street will have electrical vaults dedicated to each building.

Existing telecom service to the Mall is fed with a dedicated feed that enters the electrical vault located in the Land Boulevard service area and is anticipated to remain. 60 First Street, 80 + 90 First Street, 110 First Street and 20 CambridgeSide will have telecom infrastructure dedicated to each building.

LEGEND:

HYDROLOGIC STUDY AREA

SUBCATCHMENT AREA

1S SUBCATCHMENT ID

* DISCHARGE POINT

1R FIRST STREET (4.06 ACRES)

2R LECHMERE CANAL (6.54 ACRES)

3R MWRA COMBINED SEWER (11.47 ACRES)

N

0 80' 160'

SCALE: 1" = 160'

TETRA TECH
www.tetratech.com
100 Nickerson Road
Marlborough, MA 01752
Phone: (508) 786-2200 Fax:(508) 786-2201

New England Development

CambridgeSide 2.0
Cambridge, Massachusetts

Pre-Development Watershed Map

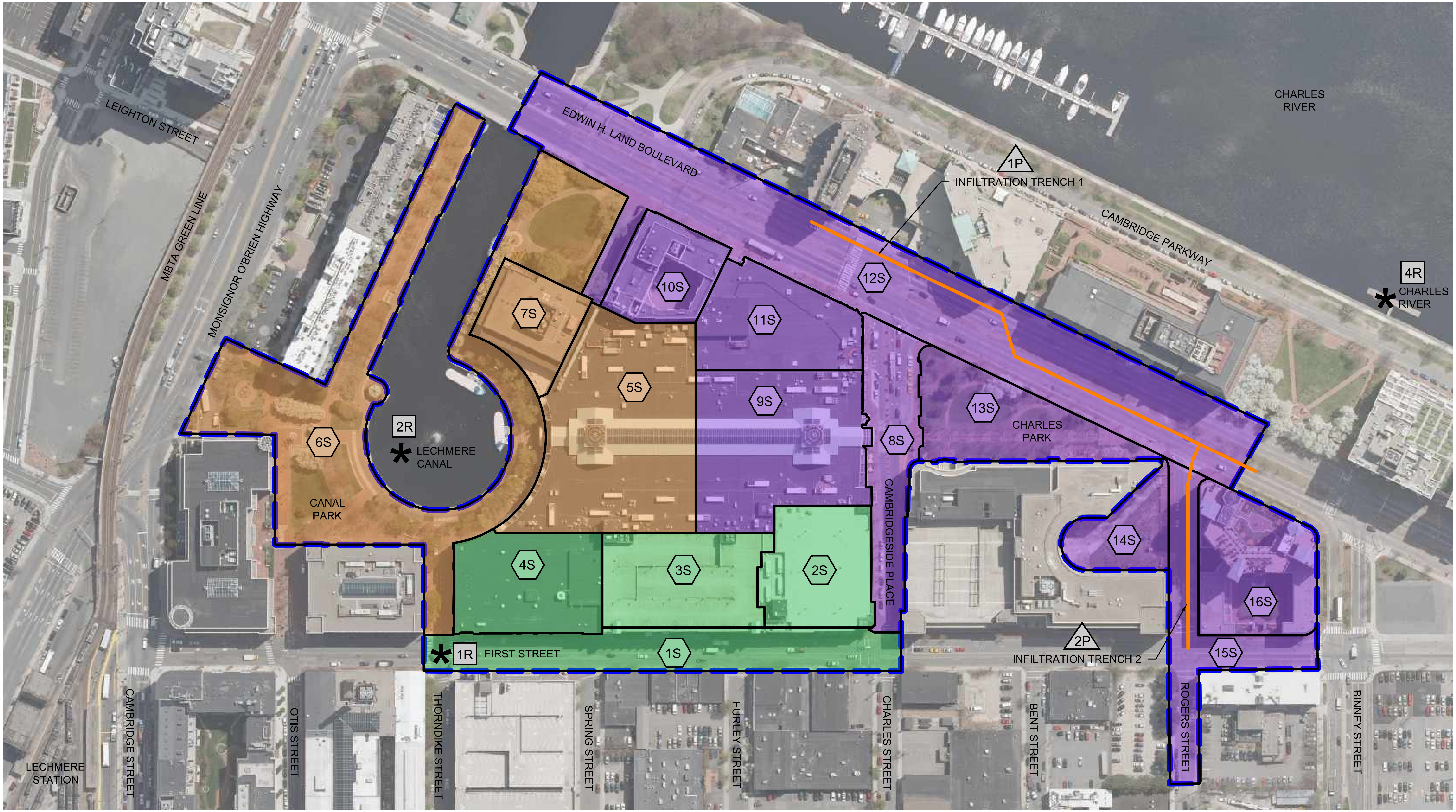
Project No.:	143-3659-18001
Date:	July 2020
Designed By:	SJW

Supplemental

Figure 1

Bar Measures 1 inch

6/17/2020 8:40:56 AM - \\TTS011FS1\PROJECTS\3659\143-3659-18001\CAD\SUPPORTFILES\STORMWATER\EXISTING WATERSHED MAP.DWG - WHITE, SARA



LEGEND:

(blue dashed line)	HYDROLOGIC STUDY AREA
(black line)	SUBCATCHMENT AREA
1S	SUBCATCHMENT ID
*	DISCHARGE POINT
1R	FIRST STREET (4.06 ACRES)
2R	LECHMERE CANAL (6.54 ACRES)
4R	CHARLES RIVER (11.47 ACRES)
(orange line)	PROPOSED INFILTRATION TRENCH

0 80' 160'
SCALE: 1" = 160'

TETRA TECH
www.tetratech.com
100 Nickerson Road
Marlborough, MA 01752
Phone: (508) 786-2200 Fax:(508) 786-2201

New England Development
CambridgeSide 2.0
Cambridge, Massachusetts

Post-Development Watershed Map

Project No.:	143-3659-18001
Date:	July 2020
Designed By:	SJW

Supplemental
Figure 2

Bar Measures 1 inch

Attachment 1

Pre vs. Post Runoff Calculations

CambridgeSide
Cambridge, Massachusetts

Comparison of Peak Runoff Rates

Design Point 1L - Project Total

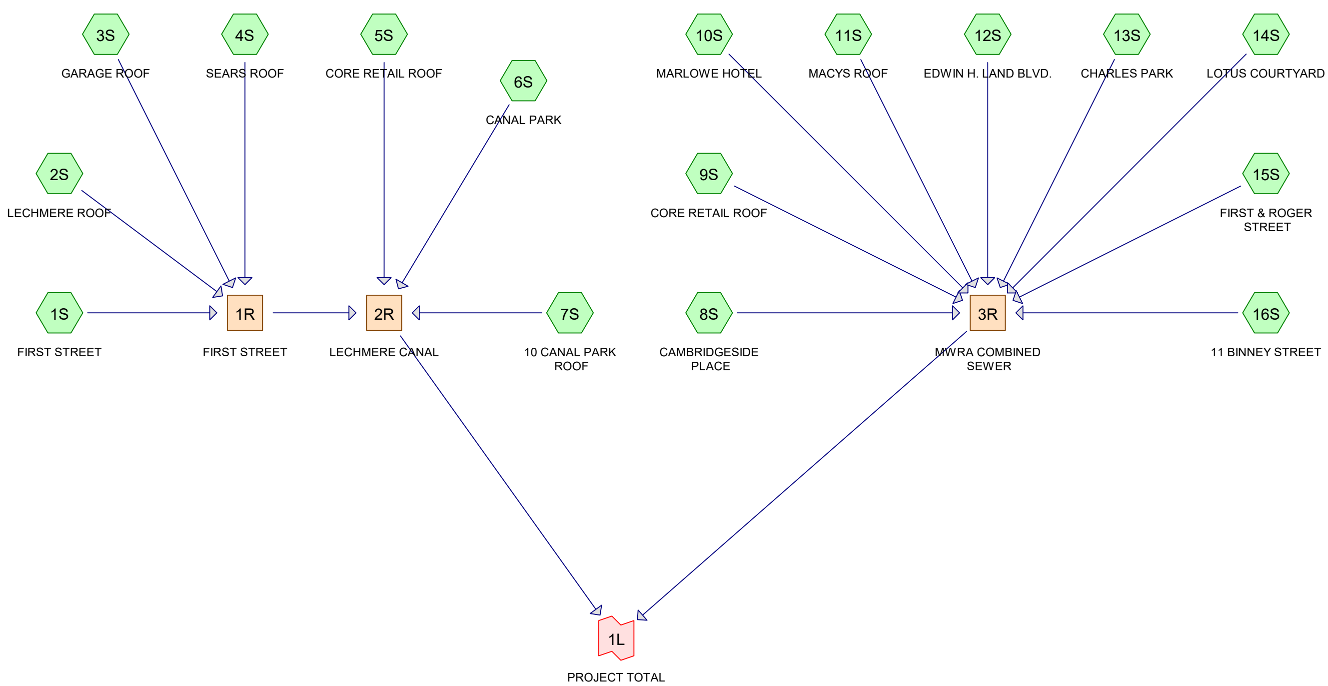
24-hour Storm Event (years)	Peak Runoff (cfs)		
	Pre	Post	Δ
2	64.72	62.15	-2.57
10	106.38	101.96	-4.42
25	132.46	125.80	-6.66
100	172.55	165.63	-6.92

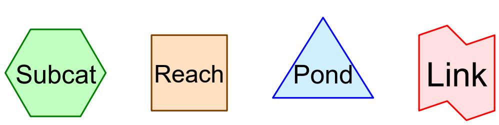
Comparison of Peak Runoff Volumes

Design Point 1L - Project Total

24-hour Storm Event (years)	Peak Runoff Volume (acre-feet)		
	Pre	Post	Δ
2	5.00	4.80	-0.20
10	8.38	8.15	-0.23
25	10.53	10.28	-0.24
100	13.84	13.58	-0.26

Pre-Development HydroCAD® Report





Routing Diagram for Pre-Development
Prepared by Tetra Tech, Inc., Printed 2/12/2020
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.740	74	>75% Grass cover, Good, HSG C (6S, 12S, 13S, 14S, 16S)
10.040	98	Pavement (1S, 6S, 8S, 10S, 12S, 13S, 14S, 15S, 16S)
9.290	98	Roof (2S, 3S, 4S, 5S, 7S, 9S, 10S, 11S, 16S)
22.070	**95**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: FIRST STREET Runoff Area=1.160 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=3.66 cfs 0.292 af

Subcatchment 2S: LECHMERE ROOF Runoff Area=0.890 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=2.81 cfs 0.224 af

Subcatchment 3S: GARAGE ROOF Runoff Area=1.050 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=3.31 cfs 0.264 af

Subcatchment 4S: SEARS ROOF Runoff Area=0.960 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=3.03 cfs 0.241 af

Subcatchment 5S: CORE RETAIL ROOF Runoff Area=2.110 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=6.66 cfs 0.531 af

Subcatchment 6S: CANAL PARK Runoff Area=3.860 ac 68.13% Impervious Runoff Depth=2.21"
Tc=6.0 min CN=90 Runoff=9.91 cfs 0.712 af

Subcatchment 7S: 10 CANAL PARK ROOF Runoff Area=0.570 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=1.80 cfs 0.143 af

Subcatchment 8S: CAMBRIDGESIDE Runoff Area=0.860 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=2.71 cfs 0.216 af

Subcatchment 9S: CORE RETAIL ROOF Runoff Area=1.640 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=5.18 cfs 0.412 af

Subcatchment 10S: MARLOWE HOTEL Runoff Area=0.620 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=1.96 cfs 0.156 af

Subcatchment 11S: MACYS ROOF Runoff Area=0.940 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=2.97 cfs 0.236 af

Subcatchment 12S: EDWIN H. LAND BLVD. Runoff Area=4.040 ac 91.34% Impervious Runoff Depth=2.80"
Tc=6.0 min CN=96 Runoff=12.33 cfs 0.942 af

Subcatchment 13S: CHARLES PARK Runoff Area=1.000 ac 25.00% Impervious Runoff Depth=1.44"
Tc=6.0 min CN=80 Runoff=1.67 cfs 0.120 af

Subcatchment 14S: LOTUS COURTYARD Runoff Area=0.470 ac 44.68% Impervious Runoff Depth=1.80"
Tc=6.0 min CN=85 Runoff=0.99 cfs 0.071 af

Subcatchment 15S: FIRST & ROGER Runoff Area=0.880 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=2.78 cfs 0.221 af

Subcatchment 16S: 11 BINNEY STREET Runoff Area=1.020 ac 85.29% Impervious Runoff Depth=2.59"
Tc=6.0 min CN=94 Runoff=2.97 cfs 0.220 af

Reach 1R: FIRST STREET	Inflow=12.81 cfs 1.021 af Outflow=12.81 cfs 1.021 af
Reach 2R: LECHMERE CANAL	Inflow=31.18 cfs 2.407 af Outflow=31.18 cfs 2.407 af
Reach 3R: MWRA COMBINED SEWER	Inflow=33.54 cfs 2.595 af Outflow=33.54 cfs 2.595 af
Link 1L: PROJECT TOTAL	Inflow=64.72 cfs 5.002 af Primary=64.72 cfs 5.002 af

Total Runoff Area = 22.070 ac Runoff Volume = 5.002 af Average Runoff Depth = 2.72"
12.42% Pervious = 2.740 ac 87.58% Impervious = 19.330 ac

Summary for Subcatchment 1S: FIRST STREET

Runoff = 3.66 cfs @ 12.08 hrs, Volume= 0.292 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	1.160	98	Pavement
	1.160		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 2S: LECHMERE ROOF

Runoff = 2.81 cfs @ 12.08 hrs, Volume= 0.224 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.890	98	Roof
	0.890		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 3S: GARAGE ROOF

Runoff = 3.31 cfs @ 12.08 hrs, Volume= 0.264 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	1.050	98	Roof
	1.050		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 4S: SEARS ROOF

Runoff = 3.03 cfs @ 12.08 hrs, Volume= 0.241 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.960	98	Roof
	0.960		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 5S: CORE RETAIL ROOF

Runoff = 6.66 cfs @ 12.08 hrs, Volume= 0.531 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	2.110	98	Roof
	2.110		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 6S: CANAL PARK

Runoff = 9.91 cfs @ 12.09 hrs, Volume= 0.712 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	2.630	98	Pavement
	1.230	74	>75% Grass cover, Good, HSG C
	3.860	90	Weighted Average
	1.230		31.87% Pervious Area
	2.630		68.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 7S: 10 CANAL PARK ROOF

Runoff = 1.80 cfs @ 12.08 hrs, Volume= 0.143 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.570	98	Roof
	0.570		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 8S: CAMBRIDGESIDE PLACE

Runoff = 2.71 cfs @ 12.08 hrs, Volume= 0.216 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.860	98	Pavement
	0.860		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 9S: CORE RETAIL ROOF

Runoff = 5.18 cfs @ 12.08 hrs, Volume= 0.412 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	1.640	98	Roof
	1.640		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 10S: MARLOWE HOTEL

Runoff = 1.96 cfs @ 12.08 hrs, Volume= 0.156 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.120	98	Pavement
*	0.500	98	Roof
	0.620	98	Weighted Average
	0.620		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11S: MACYS ROOF

Runoff = 2.97 cfs @ 12.08 hrs, Volume= 0.236 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.940	98	Roof
	0.940		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 12S: EDWIN H. LAND BLVD.

Runoff = 12.33 cfs @ 12.08 hrs, Volume= 0.942 af, Depth= 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	3.690	98	Pavement
	0.350	74	>75% Grass cover, Good, HSG C
	4.040	96	Weighted Average
	0.350		8.66% Pervious Area
	3.690		91.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 13S: CHARLES PARK

Runoff = 1.67 cfs @ 12.09 hrs, Volume= 0.120 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.250	98	Pavement
	0.750	74	>75% Grass cover, Good, HSG C
	1.000	80	Weighted Average
	0.750		75.00% Pervious Area
	0.250		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 14S: LOTUS COURTYARD

Runoff = 0.99 cfs @ 12.09 hrs, Volume= 0.071 af, Depth= 1.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.210	98	Pavement
	0.260	74	>75% Grass cover, Good, HSG C
	0.470	85	Weighted Average
	0.260		55.32% Pervious Area
	0.210		44.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 15S: FIRST & ROGER STREET

Runoff = 2.78 cfs @ 12.08 hrs, Volume= 0.221 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.880	98	Pavement
	0.880		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 16S: 11 BINNEY STREET

Runoff = 2.97 cfs @ 12.08 hrs, Volume= 0.220 af, Depth= 2.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.240	98	Pavement
*	0.630	98	Roof
	0.150	74	>75% Grass cover, Good, HSG C
	1.020	94	Weighted Average
	0.150		14.71% Pervious Area
	0.870		85.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach 1R: FIRST STREET

Inflow Area = 4.060 ac,100.00% Impervious, Inflow Depth = 3.02" for 2 YEAR event
Inflow = 12.81 cfs @ 12.08 hrs, Volume= 1.021 af
Outflow = 12.81 cfs @ 12.08 hrs, Volume= 1.021 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: LECHMERE CANAL

Inflow Area = 10.600 ac, 88.40% Impervious, Inflow Depth = 2.73" for 2 YEAR event
Inflow = 31.18 cfs @ 12.08 hrs, Volume= 2.407 af
Outflow = 31.18 cfs @ 12.08 hrs, Volume= 2.407 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: MWRA COMBINED SEWER

Inflow Area = 11.470 ac, 86.84% Impervious, Inflow Depth = 2.72" for 2 YEAR event
Inflow = 33.54 cfs @ 12.08 hrs, Volume= 2.595 af
Outflow = 33.54 cfs @ 12.08 hrs, Volume= 2.595 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 1L: PROJECT TOTAL

Inflow Area = 22.070 ac, 87.58% Impervious, Inflow Depth = 2.72" for 2 YEAR event
Inflow = 64.72 cfs @ 12.08 hrs, Volume= 5.002 af
Primary = 64.72 cfs @ 12.08 hrs, Volume= 5.002 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: FIRST STREET Runoff Area=1.160 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=5.82 cfs 0.473 af

Subcatchment 2S: LECHMERE ROOF Runoff Area=0.890 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=4.47 cfs 0.363 af

Subcatchment 3S: GARAGE ROOF Runoff Area=1.050 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=5.27 cfs 0.428 af

Subcatchment 4S: SEARS ROOF Runoff Area=0.960 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=4.82 cfs 0.391 af

Subcatchment 5S: CORE RETAIL ROOF Runoff Area=2.110 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=10.59 cfs 0.860 af

Subcatchment 6S: CANAL PARK Runoff Area=3.860 ac 68.13% Impervious Runoff Depth=4.00"
Tc=6.0 min CN=90 Runoff=17.44 cfs 1.287 af

Subcatchment 7S: 10 CANAL PARK ROOF Runoff Area=0.570 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=2.86 cfs 0.232 af

Subcatchment 8S: CAMBRIDGESIDE Runoff Area=0.860 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=4.32 cfs 0.351 af

Subcatchment 9S: CORE RETAIL ROOF Runoff Area=1.640 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=8.23 cfs 0.669 af

Subcatchment 10S: MARLOWE HOTEL Runoff Area=0.620 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=3.11 cfs 0.253 af

Subcatchment 11S: MACYS ROOF Runoff Area=0.940 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=4.72 cfs 0.383 af

Subcatchment 12S: EDWIN H. LAND BLVD. Runoff Area=4.040 ac 91.34% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=96 Runoff=19.97 cfs 1.569 af

Subcatchment 13S: CHARLES PARK Runoff Area=1.000 ac 25.00% Impervious Runoff Depth=3.01"
Tc=6.0 min CN=80 Runoff=3.52 cfs 0.251 af

Subcatchment 14S: LOTUS COURTYARD Runoff Area=0.470 ac 44.68% Impervious Runoff Depth=3.49"
Tc=6.0 min CN=85 Runoff=1.90 cfs 0.137 af

Subcatchment 15S: FIRST & ROGER Runoff Area=0.880 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=4.42 cfs 0.359 af

Subcatchment 16S: 11 BINNEY STREET Runoff Area=1.020 ac 85.29% Impervious Runoff Depth=4.44"
Tc=6.0 min CN=94 Runoff=4.92 cfs 0.377 af

Reach 1R: FIRST STREET	Inflow=20.38 cfs 1.655 af Outflow=20.38 cfs 1.655 af
Reach 2R: LECHMERE CANAL	Inflow=51.27 cfs 4.035 af Outflow=51.27 cfs 4.035 af
Reach 3R: MWRA COMBINED SEWER	Inflow=55.11 cfs 4.348 af Outflow=55.11 cfs 4.348 af
Link 1L: PROJECT TOTAL	Inflow=106.38 cfs 8.383 af Primary=106.38 cfs 8.383 af

Total Runoff Area = 22.070 ac Runoff Volume = 8.383 af Average Runoff Depth = 4.56"
12.42% Pervious = 2.740 ac 87.58% Impervious = 19.330 ac

Summary for Subcatchment 1S: FIRST STREET

Runoff = 5.82 cfs @ 12.08 hrs, Volume= 0.473 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	1.160	98	Pavement
	1.160		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 2S: LECHMERE ROOF

Runoff = 4.47 cfs @ 12.08 hrs, Volume= 0.363 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.890	98	Roof
	0.890		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 3S: GARAGE ROOF

Runoff = 5.27 cfs @ 12.08 hrs, Volume= 0.428 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	1.050	98	Roof
	1.050		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 4S: SEARS ROOF

Runoff = 4.82 cfs @ 12.08 hrs, Volume= 0.391 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.960	98	Roof
	0.960		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 5S: CORE RETAIL ROOF

Runoff = 10.59 cfs @ 12.08 hrs, Volume= 0.860 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	2.110	98	Roof
	2.110		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 6S: CANAL PARK

Runoff = 17.44 cfs @ 12.09 hrs, Volume= 1.287 af, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	2.630	98	Pavement
	1.230	74	>75% Grass cover, Good, HSG C
	3.860	90	Weighted Average
	1.230		31.87% Pervious Area
	2.630		68.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 7S: 10 CANAL PARK ROOF

Runoff = 2.86 cfs @ 12.08 hrs, Volume= 0.232 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.570	98	Roof
	0.570		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 8S: CAMBRIDGESIDE PLACE

Runoff = 4.32 cfs @ 12.08 hrs, Volume= 0.351 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.860	98	Pavement
	0.860		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 9S: CORE RETAIL ROOF

Runoff = 8.23 cfs @ 12.08 hrs, Volume= 0.669 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	1.640	98	Roof
	1.640		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 10S: MARLOWE HOTEL

Runoff = 3.11 cfs @ 12.08 hrs, Volume= 0.253 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.120	98	Pavement
*	0.500	98	Roof
	0.620	98	Weighted Average
	0.620		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11S: MACYS ROOF

Runoff = 4.72 cfs @ 12.08 hrs, Volume= 0.383 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.940	98	Roof
	0.940		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 12S: EDWIN H. LAND BLVD.

Runoff = 19.97 cfs @ 12.08 hrs, Volume= 1.569 af, Depth= 4.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	3.690	98	Pavement
	0.350	74	>75% Grass cover, Good, HSG C
	4.040	96	Weighted Average
	0.350		8.66% Pervious Area
	3.690		91.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 13S: CHARLES PARK

Runoff = 3.52 cfs @ 12.09 hrs, Volume= 0.251 af, Depth= 3.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.250	98	Pavement
	0.750	74	>75% Grass cover, Good, HSG C
	1.000	80	Weighted Average
	0.750		75.00% Pervious Area
	0.250		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 14S: LOTUS COURTYARD

Runoff = 1.90 cfs @ 12.09 hrs, Volume= 0.137 af, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.210	98	Pavement
	0.260	74	>75% Grass cover, Good, HSG C
	0.470	85	Weighted Average
	0.260		55.32% Pervious Area
	0.210		44.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 15S: FIRST & ROGER STREET

Runoff = 4.42 cfs @ 12.08 hrs, Volume= 0.359 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.880	98	Pavement
	0.880		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 16S: 11 BINNEY STREET

Runoff = 4.92 cfs @ 12.08 hrs, Volume= 0.377 af, Depth= 4.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.240	98	Pavement
*	0.630	98	Roof
	0.150	74	>75% Grass cover, Good, HSG C
	1.020	94	Weighted Average
	0.150		14.71% Pervious Area
	0.870		85.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach 1R: FIRST STREET

Inflow Area = 4.060 ac,100.00% Impervious, Inflow Depth = 4.89" for 10 YEAR event
Inflow = 20.38 cfs @ 12.08 hrs, Volume= 1.655 af
Outflow = 20.38 cfs @ 12.08 hrs, Volume= 1.655 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: LECHMERE CANAL

Inflow Area = 10.600 ac, 88.40% Impervious, Inflow Depth = 4.57" for 10 YEAR event
Inflow = 51.27 cfs @ 12.08 hrs, Volume= 4.035 af
Outflow = 51.27 cfs @ 12.08 hrs, Volume= 4.035 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: MWRA COMBINED SEWER

Inflow Area = 11.470 ac, 86.84% Impervious, Inflow Depth = 4.55" for 10 YEAR event
Inflow = 55.11 cfs @ 12.08 hrs, Volume= 4.348 af
Outflow = 55.11 cfs @ 12.08 hrs, Volume= 4.348 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 1L: PROJECT TOTAL

Inflow Area = 22.070 ac, 87.58% Impervious, Inflow Depth = 4.56" for 10 YEAR event
Inflow = 106.38 cfs @ 12.08 hrs, Volume= 8.383 af
Primary = 106.38 cfs @ 12.08 hrs, Volume= 8.383 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: FIRST STREET Runoff Area=1.160 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=7.18 cfs 0.587 af

Subcatchment 2S: LECHMERE ROOF Runoff Area=0.890 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=5.51 cfs 0.450 af

Subcatchment 3S: GARAGE ROOF Runoff Area=1.050 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=6.50 cfs 0.531 af

Subcatchment 4S: SEARS ROOF Runoff Area=0.960 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=5.94 cfs 0.486 af

Subcatchment 5S: CORE RETAIL ROOF Runoff Area=2.110 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=13.05 cfs 1.068 af

Subcatchment 6S: CANAL PARK Runoff Area=3.860 ac 68.13% Impervious Runoff Depth=5.15"
Tc=6.0 min CN=90 Runoff=22.13 cfs 1.656 af

Subcatchment 7S: 10 CANAL PARK ROOF Runoff Area=0.570 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=3.53 cfs 0.288 af

Subcatchment 8S: CAMBRIDGESIDE Runoff Area=0.860 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=5.32 cfs 0.435 af

Subcatchment 9S: CORE RETAIL ROOF Runoff Area=1.640 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=10.15 cfs 0.830 af

Subcatchment 10S: MARLOWE HOTEL Runoff Area=0.620 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=3.84 cfs 0.314 af

Subcatchment 11S: MACYS ROOF Runoff Area=0.940 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=5.82 cfs 0.476 af

Subcatchment 12S: EDWIN H. LAND BLVD. Runoff Area=4.040 ac 91.34% Impervious Runoff Depth=5.84"
Tc=6.0 min CN=96 Runoff=24.72 cfs 1.965 af

Subcatchment 13S: CHARLES PARK Runoff Area=1.000 ac 25.00% Impervious Runoff Depth=4.06"
Tc=6.0 min CN=80 Runoff=4.74 cfs 0.339 af

Subcatchment 14S: LOTUS COURTYARD Runoff Area=0.470 ac 44.68% Impervious Runoff Depth=4.60"
Tc=6.0 min CN=85 Runoff=2.48 cfs 0.180 af

Subcatchment 15S: FIRST & ROGER Runoff Area=0.880 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=5.44 cfs 0.445 af

Subcatchment 16S: 11 BINNEY STREET Runoff Area=1.020 ac 85.29% Impervious Runoff Depth=5.60"
Tc=6.0 min CN=94 Runoff=6.14 cfs 0.476 af

Reach 1R: FIRST STREET	Inflow=25.12 cfs 2.054 af Outflow=25.12 cfs 2.054 af
Reach 2R: LECHMERE CANAL	Inflow=63.83 cfs 5.066 af Outflow=63.83 cfs 5.066 af
Reach 3R: MWRA COMBINED SEWER	Inflow=68.63 cfs 5.459 af Outflow=68.63 cfs 5.459 af
Link 1L: PROJECT TOTAL	Inflow=132.46 cfs 10.525 af Primary=132.46 cfs 10.525 af

Total Runoff Area = 22.070 ac Runoff Volume = 10.525 af Average Runoff Depth = 5.72"
12.42% Pervious = 2.740 ac 87.58% Impervious = 19.330 ac

Summary for Subcatchment 1S: FIRST STREET

Runoff = 7.18 cfs @ 12.08 hrs, Volume= 0.587 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	1.160	98	Pavement
	1.160		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 2S: LECHMERE ROOF

Runoff = 5.51 cfs @ 12.08 hrs, Volume= 0.450 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.890	98	Roof
	0.890		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 3S: GARAGE ROOF

Runoff = 6.50 cfs @ 12.08 hrs, Volume= 0.531 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	1.050	98	Roof
	1.050		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 4S: SEARS ROOF

Runoff = 5.94 cfs @ 12.08 hrs, Volume= 0.486 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.960	98	Roof
	0.960		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 5S: CORE RETAIL ROOF

Runoff = 13.05 cfs @ 12.08 hrs, Volume= 1.068 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	2.110	98	Roof
	2.110		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 6S: CANAL PARK

Runoff = 22.13 cfs @ 12.08 hrs, Volume= 1.656 af, Depth= 5.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	2.630	98	Pavement
	1.230	74	>75% Grass cover, Good, HSG C
	3.860	90	Weighted Average
	1.230		31.87% Pervious Area
	2.630		68.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 7S: 10 CANAL PARK ROOF

Runoff = 3.53 cfs @ 12.08 hrs, Volume= 0.288 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.570	98	Roof
	0.570		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 8S: CAMBRIDGESIDE PLACE

Runoff = 5.32 cfs @ 12.08 hrs, Volume= 0.435 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.860	98	Pavement
	0.860		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 9S: CORE RETAIL ROOF

Runoff = 10.15 cfs @ 12.08 hrs, Volume= 0.830 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	1.640	98	Roof
	1.640		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 10S: MARLOWE HOTEL

Runoff = 3.84 cfs @ 12.08 hrs, Volume= 0.314 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.120	98	Pavement
*	0.500	98	Roof
	0.620	98	Weighted Average
	0.620		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11S: MACYS ROOF

Runoff = 5.82 cfs @ 12.08 hrs, Volume= 0.476 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.940	98	Roof
	0.940		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 12S: EDWIN H. LAND BLVD.

Runoff = 24.72 cfs @ 12.08 hrs, Volume= 1.965 af, Depth= 5.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	3.690	98	Pavement
	0.350	74	>75% Grass cover, Good, HSG C
	4.040	96	Weighted Average
	0.350		8.66% Pervious Area
	3.690		91.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 13S: CHARLES PARK

Runoff = 4.74 cfs @ 12.09 hrs, Volume= 0.339 af, Depth= 4.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.250	98	Pavement
	0.750	74	>75% Grass cover, Good, HSG C
	1.000	80	Weighted Average
	0.750		75.00% Pervious Area
	0.250		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 14S: LOTUS COURTYARD

Runoff = 2.48 cfs @ 12.09 hrs, Volume= 0.180 af, Depth= 4.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.210	98	Pavement
	0.260	74	>75% Grass cover, Good, HSG C
	0.470	85	Weighted Average
	0.260		55.32% Pervious Area
	0.210		44.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 15S: FIRST & ROGER STREET

Runoff = 5.44 cfs @ 12.08 hrs, Volume= 0.445 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.880	98	Pavement
	0.880		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 16S: 11 BINNEY STREET

Runoff = 6.14 cfs @ 12.08 hrs, Volume= 0.476 af, Depth= 5.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.240	98	Pavement
*	0.630	98	Roof
	0.150	74	>75% Grass cover, Good, HSG C
	1.020	94	Weighted Average
	0.150		14.71% Pervious Area
	0.870		85.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach 1R: FIRST STREET

Inflow Area = 4.060 ac,100.00% Impervious, Inflow Depth = 6.07" for 25 YEAR event
Inflow = 25.12 cfs @ 12.08 hrs, Volume= 2.054 af
Outflow = 25.12 cfs @ 12.08 hrs, Volume= 2.054 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: LECHMERE CANAL

Inflow Area = 10.600 ac, 88.40% Impervious, Inflow Depth = 5.74" for 25 YEAR event
Inflow = 63.83 cfs @ 12.08 hrs, Volume= 5.066 af
Outflow = 63.83 cfs @ 12.08 hrs, Volume= 5.066 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: MWRA COMBINED SEWER

Inflow Area = 11.470 ac, 86.84% Impervious, Inflow Depth = 5.71" for 25 YEAR event
Inflow = 68.63 cfs @ 12.08 hrs, Volume= 5.459 af
Outflow = 68.63 cfs @ 12.08 hrs, Volume= 5.459 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 1L: PROJECT TOTAL

Inflow Area =	22.070 ac, 87.58% Impervious, Inflow Depth = 5.72"	for 25 YEAR event	
Inflow =	132.46 cfs @ 12.08 hrs, Volume=	10.525 af	
Primary =	132.46 cfs @ 12.08 hrs, Volume=	10.525 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: FIRST STREET Runoff Area=1.160 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=9.26 cfs 0.763 af

Subcatchment 2S: LECHMERE ROOF Runoff Area=0.890 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=7.10 cfs 0.585 af

Subcatchment 3S: GARAGE ROOF Runoff Area=1.050 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=8.38 cfs 0.690 af

Subcatchment 4S: SEARS ROOF Runoff Area=0.960 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=7.66 cfs 0.631 af

Subcatchment 5S: CORE RETAIL ROOF Runoff Area=2.110 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=16.84 cfs 1.387 af

Subcatchment 6S: CANAL PARK Runoff Area=3.860 ac 68.13% Impervious Runoff Depth=6.93"
Tc=6.0 min CN=90 Runoff=29.30 cfs 2.230 af

Subcatchment 7S: 10 CANAL PARK ROOF Runoff Area=0.570 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=4.55 cfs 0.375 af

Subcatchment 8S: CAMBRIDGESIDE Runoff Area=0.860 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=6.87 cfs 0.565 af

Subcatchment 9S: CORE RETAIL ROOF Runoff Area=1.640 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=13.09 cfs 1.078 af

Subcatchment 10S: MARLOWE HOTEL Runoff Area=0.620 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=4.95 cfs 0.408 af

Subcatchment 11S: MACYS ROOF Runoff Area=0.940 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=7.50 cfs 0.618 af

Subcatchment 12S: EDWIN H. LAND BLVD. Runoff Area=4.040 ac 91.34% Impervious Runoff Depth=7.65"
Tc=6.0 min CN=96 Runoff=32.03 cfs 2.576 af

Subcatchment 13S: CHARLES PARK Runoff Area=1.000 ac 25.00% Impervious Runoff Depth=5.75"
Tc=6.0 min CN=80 Runoff=6.63 cfs 0.479 af

Subcatchment 14S: LOTUS COURTYARD Runoff Area=0.470 ac 44.68% Impervious Runoff Depth=6.34"
Tc=6.0 min CN=85 Runoff=3.36 cfs 0.248 af

Subcatchment 15S: FIRST & ROGER Runoff Area=0.880 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=7.02 cfs 0.579 af

Subcatchment 16S: 11 BINNEY STREET Runoff Area=1.020 ac 85.29% Impervious Runoff Depth=7.41"
Tc=6.0 min CN=94 Runoff=8.00 cfs 0.630 af

Reach 1R: FIRST STREET Inflow=32.41 cfs 2.669 af
Outflow=32.41 cfs 2.669 af

Reach 2R: LECHMERE CANAL Inflow=83.10 cfs 6.662 af
Outflow=83.10 cfs 6.662 af

Reach 3R: MWRA COMBINED SEWER Inflow=89.45 cfs 7.181 af
Outflow=89.45 cfs 7.181 af

Link 1L: PROJECT TOTAL Inflow=172.55 cfs 13.843 af
Primary=172.55 cfs 13.843 af

Total Runoff Area = 22.070 ac Runoff Volume = 13.843 af Average Runoff Depth = 7.53"
12.42% Pervious = 2.740 ac 87.58% Impervious = 19.330 ac

Summary for Subcatchment 1S: FIRST STREET

Runoff = 9.26 cfs @ 12.08 hrs, Volume= 0.763 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	1.160	98	Pavement
	1.160		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 2S: LECHMERE ROOF

Runoff = 7.10 cfs @ 12.08 hrs, Volume= 0.585 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.890	98	Roof
	0.890		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 3S: GARAGE ROOF

Runoff = 8.38 cfs @ 12.08 hrs, Volume= 0.690 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	1.050	98	Roof
	1.050		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 4S: SEARS ROOF

Runoff = 7.66 cfs @ 12.08 hrs, Volume= 0.631 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.960	98	Roof
	0.960		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 5S: CORE RETAIL ROOF

Runoff = 16.84 cfs @ 12.08 hrs, Volume= 1.387 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	2.110	98	Roof
	2.110		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 6S: CANAL PARK

Runoff = 29.30 cfs @ 12.08 hrs, Volume= 2.230 af, Depth= 6.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	2.630	98	Pavement
	1.230	74	>75% Grass cover, Good, HSG C
	3.860	90	Weighted Average
	1.230		31.87% Pervious Area
	2.630		68.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 7S: 10 CANAL PARK ROOF

Runoff = 4.55 cfs @ 12.08 hrs, Volume= 0.375 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.570	98	Roof
	0.570		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 8S: CAMBRIDGESIDE PLACE

Runoff = 6.87 cfs @ 12.08 hrs, Volume= 0.565 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.860	98	Pavement
	0.860		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 9S: CORE RETAIL ROOF

Runoff = 13.09 cfs @ 12.08 hrs, Volume= 1.078 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	1.640	98	Roof
	1.640		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 10S: MARLOWE HOTEL

Runoff = 4.95 cfs @ 12.08 hrs, Volume= 0.408 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.120	98	Pavement
*	0.500	98	Roof
	0.620	98	Weighted Average
	0.620		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11S: MACYS ROOF

Runoff = 7.50 cfs @ 12.08 hrs, Volume= 0.618 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.940	98	Roof
	0.940		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 12S: EDWIN H. LAND BLVD.

Runoff = 32.03 cfs @ 12.08 hrs, Volume= 2.576 af, Depth= 7.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	3.690	98	Pavement
	0.350	74	>75% Grass cover, Good, HSG C
	4.040	96	Weighted Average
	0.350		8.66% Pervious Area
	3.690		91.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 13S: CHARLES PARK

Runoff = 6.63 cfs @ 12.09 hrs, Volume= 0.479 af, Depth= 5.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.250	98	Pavement
	0.750	74	>75% Grass cover, Good, HSG C
	1.000	80	Weighted Average
	0.750		75.00% Pervious Area
	0.250		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 14S: LOTUS COURTYARD

Runoff = 3.36 cfs @ 12.09 hrs, Volume= 0.248 af, Depth= 6.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.210	98	Pavement
	0.260	74	>75% Grass cover, Good, HSG C
	0.470	85	Weighted Average
	0.260		55.32% Pervious Area
	0.210		44.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 15S: FIRST & ROGER STREET

Runoff = 7.02 cfs @ 12.08 hrs, Volume= 0.579 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.880	98	Pavement
	0.880		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 16S: 11 BINNEY STREET

Runoff = 8.00 cfs @ 12.08 hrs, Volume= 0.630 af, Depth= 7.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.240	98	Pavement
*	0.630	98	Roof
	0.150	74	>75% Grass cover, Good, HSG C
	1.020	94	Weighted Average
	0.150		14.71% Pervious Area
	0.870		85.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach 1R: FIRST STREET

Inflow Area = 4.060 ac,100.00% Impervious, Inflow Depth = 7.89" for 100 YEAR event
Inflow = 32.41 cfs @ 12.08 hrs, Volume= 2.669 af
Outflow = 32.41 cfs @ 12.08 hrs, Volume= 2.669 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: LECHMERE CANAL

Inflow Area = 10.600 ac, 88.40% Impervious, Inflow Depth = 7.54" for 100 YEAR event
Inflow = 83.10 cfs @ 12.08 hrs, Volume= 6.662 af
Outflow = 83.10 cfs @ 12.08 hrs, Volume= 6.662 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: MWRA COMBINED SEWER

Inflow Area = 11.470 ac, 86.84% Impervious, Inflow Depth = 7.51" for 100 YEAR event
Inflow = 89.45 cfs @ 12.08 hrs, Volume= 7.181 af
Outflow = 89.45 cfs @ 12.08 hrs, Volume= 7.181 af, Atten= 0%, Lag= 0.0 min

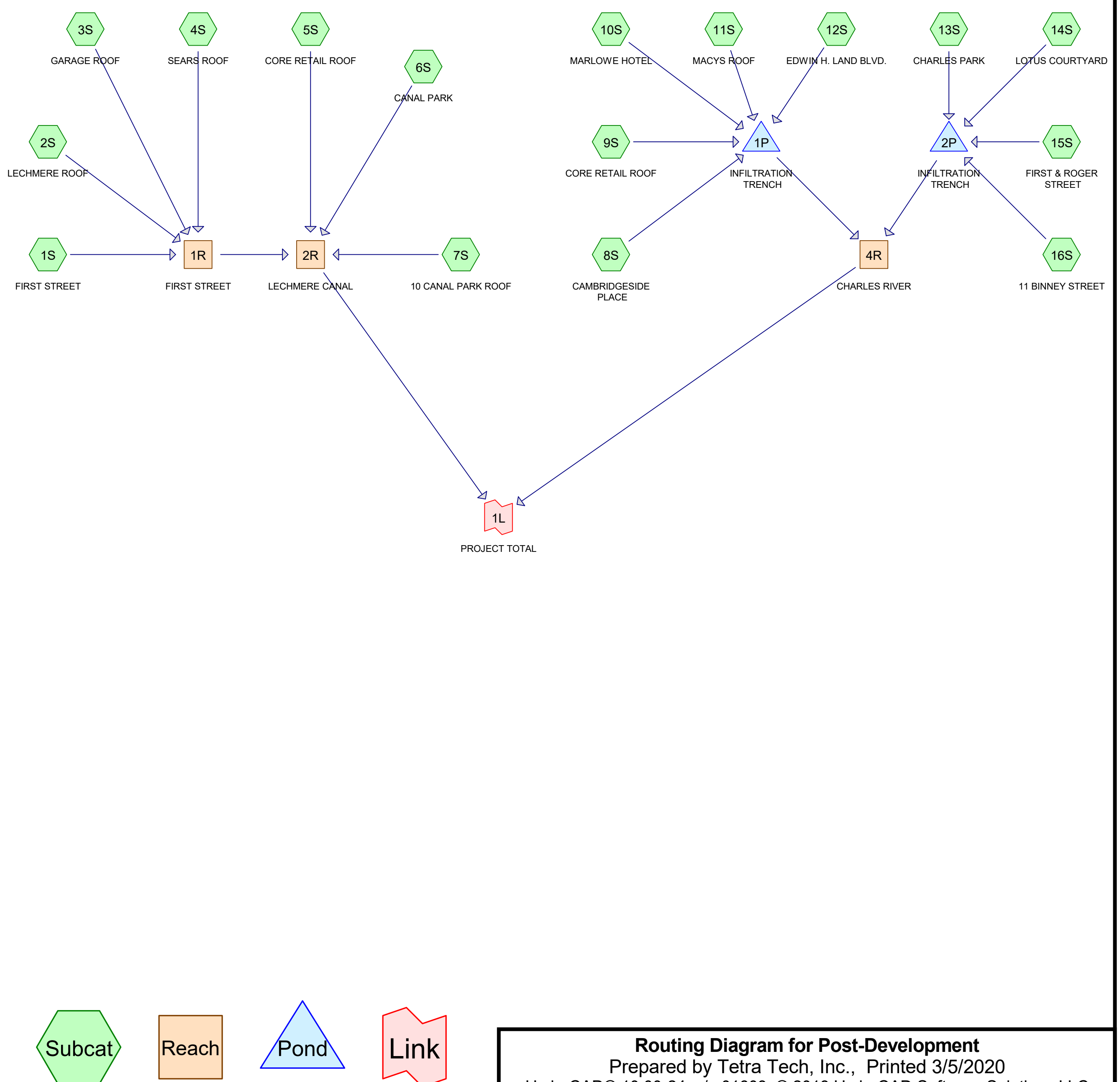
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 1L: PROJECT TOTAL

```
Inflow Area =      22.070 ac, 87.58% Impervious, Inflow Depth =  7.53"   for 100 YEAR event
Inflow      =     172.55 cfs @  12.08 hrs, Volume=        13.843 af
Primary     =     172.55 cfs @  12.08 hrs, Volume=        13.843 af, Atten= 0%, Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Post-Development HydroCAD® Report



Routing Diagram for Post-Development
Prepared by Tetra Tech, Inc., Printed 3/5/2020
HydroCAD® 10.00-24 s/n 01603 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.740	74	>75% Grass cover, Good, HSG C (6S, 12S, 13S, 14S, 16S)
10.140	98	Pavement (1S, 6S, 8S, 10S, 12S, 13S, 14S, 15S, 16S)
9.190	98	Roof (2S, 3S, 4S, 5S, 7S, 9S, 10S, 11S, 16S)
22.070	**95**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: FIRST STREET Runoff Area=1.260 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=3.98 cfs 0.317 af

Subcatchment 2S: LECHMERE ROOF Runoff Area=0.840 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=2.65 cfs 0.211 af

Subcatchment 3S: GARAGE ROOF Runoff Area=1.000 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=3.16 cfs 0.251 af

Subcatchment 4S: SEARS ROOF Runoff Area=0.960 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=3.03 cfs 0.241 af

Subcatchment 5S: CORE RETAIL ROOF Runoff Area=2.110 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=6.66 cfs 0.531 af

Subcatchment 6S: CANAL PARK Runoff Area=3.860 ac 68.13% Impervious Runoff Depth=2.21"
Tc=6.0 min CN=90 Runoff=9.91 cfs 0.712 af

Subcatchment 7S: 10 CANAL PARK ROOF Runoff Area=0.570 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=1.80 cfs 0.143 af

Subcatchment 8S: CAMBRIDGESIDE Runoff Area=0.860 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=2.71 cfs 0.216 af

Subcatchment 9S: CORE RETAIL ROOF Runoff Area=1.640 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=5.18 cfs 0.412 af

Subcatchment 10S: MARLOWE HOTEL Runoff Area=0.620 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=1.96 cfs 0.156 af

Subcatchment 11S: MACYS ROOF Runoff Area=0.940 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=2.97 cfs 0.236 af

Subcatchment 12S: EDWIN H. LAND BLVD. Runoff Area=4.040 ac 91.34% Impervious Runoff Depth=2.80"
Tc=6.0 min CN=96 Runoff=12.33 cfs 0.942 af

Subcatchment 13S: CHARLES PARK Runoff Area=1.000 ac 25.00% Impervious Runoff Depth=1.44"
Tc=6.0 min CN=80 Runoff=1.67 cfs 0.120 af

Subcatchment 14S: LOTUS COURTYARD Runoff Area=0.470 ac 44.68% Impervious Runoff Depth=1.80"
Tc=6.0 min CN=85 Runoff=0.99 cfs 0.071 af

Subcatchment 15S: FIRST & ROGER Runoff Area=0.880 ac 100.00% Impervious Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=2.78 cfs 0.221 af

Subcatchment 16S: 11 BINNEY STREET Runoff Area=1.020 ac 85.29% Impervious Runoff Depth=2.59"
Tc=6.0 min CN=94 Runoff=2.97 cfs 0.220 af

Reach 1R: FIRST STREET Inflow=12.81 cfs 1.021 af
Outflow=12.81 cfs 1.021 af

Reach 2R: LECHMERE CANAL Inflow=31.18 cfs 2.407 af
Outflow=31.18 cfs 2.407 af

Reach 4R: CHARLES RIVER Inflow=31.65 cfs 2.393 af
Outflow=31.65 cfs 2.393 af

Pond 1P: INFILTRATION TRENCH Peak Elev=7.67' Storage=2,781 cf Inflow=25.14 cfs 1.963 af
Discarded=0.17 cfs 0.129 af Primary=23.50 cfs 1.834 af Outflow=23.67 cfs 1.963 af

Pond 2P: INFILTRATION TRENCH Peak Elev=5.79' Storage=644 cf Inflow=8.40 cfs 0.632 af
Discarded=0.06 cfs 0.074 af Primary=8.20 cfs 0.558 af Outflow=8.26 cfs 0.632 af

Link 1L: PROJECT TOTAL Inflow=62.15 cfs 4.800 af
Primary=62.15 cfs 4.800 af

Total Runoff Area = 22.070 ac Runoff Volume = 5.002 af Average Runoff Depth = 2.72"
12.42% Pervious = 2.740 ac 87.58% Impervious = 19.330 ac

Summary for Subcatchment 1S: FIRST STREET

Runoff = 3.98 cfs @ 12.08 hrs, Volume= 0.317 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	1.260	98	Pavement
	1.260		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 2S: LECHMERE ROOF

Runoff = 2.65 cfs @ 12.08 hrs, Volume= 0.211 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.840	98	Roof
	0.840		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 3S: GARAGE ROOF

Runoff = 3.16 cfs @ 12.08 hrs, Volume= 0.251 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	1.000	98	Roof
	1.000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 4S: SEARS ROOF

Runoff = 3.03 cfs @ 12.08 hrs, Volume= 0.241 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.960	98	Roof
	0.960		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 5S: CORE RETAIL ROOF

Runoff = 6.66 cfs @ 12.08 hrs, Volume= 0.531 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	2.110	98	Roof
	2.110		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 6S: CANAL PARK

Runoff = 9.91 cfs @ 12.09 hrs, Volume= 0.712 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	2.630	98	Pavement
	1.230	74	>75% Grass cover, Good, HSG C
	3.860	90	Weighted Average
	1.230		31.87% Pervious Area
	2.630		68.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 7S: 10 CANAL PARK ROOF

Runoff = 1.80 cfs @ 12.08 hrs, Volume= 0.143 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.570	98	Roof
	0.570		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 8S: CAMBRIDGESIDE PLACE

Runoff = 2.71 cfs @ 12.08 hrs, Volume= 0.216 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.860	98	Pavement
	0.860		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 9S: CORE RETAIL ROOF

Runoff = 5.18 cfs @ 12.08 hrs, Volume= 0.412 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	1.640	98	Roof
	1.640		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 10S: MARLOWE HOTEL

Runoff = 1.96 cfs @ 12.08 hrs, Volume= 0.156 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.120	98	Pavement
*	0.500	98	Roof
	0.620	98	Weighted Average
	0.620		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11S: MACYS ROOF

Runoff = 2.97 cfs @ 12.08 hrs, Volume= 0.236 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.940	98	Roof
	0.940		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 12S: EDWIN H. LAND BLVD.

Runoff = 12.33 cfs @ 12.08 hrs, Volume= 0.942 af, Depth= 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	3.690	98	Pavement
	0.350	74	>75% Grass cover, Good, HSG C
	4.040	96	Weighted Average
	0.350		8.66% Pervious Area
	3.690		91.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 13S: CHARLES PARK

Runoff = 1.67 cfs @ 12.09 hrs, Volume= 0.120 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.250	98	Pavement
	0.750	74	>75% Grass cover, Good, HSG C
	1.000	80	Weighted Average
	0.750		75.00% Pervious Area
	0.250		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 14S: LOTUS COURTYARD

Runoff = 0.99 cfs @ 12.09 hrs, Volume= 0.071 af, Depth= 1.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.210	98	Pavement
	0.260	74	>75% Grass cover, Good, HSG C
	0.470	85	Weighted Average
	0.260		55.32% Pervious Area
	0.210		44.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 15S: FIRST & ROGER STREET

Runoff = 2.78 cfs @ 12.08 hrs, Volume= 0.221 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.880	98	Pavement
	0.880		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 16S: 11 BINNEY STREET

Runoff = 2.97 cfs @ 12.08 hrs, Volume= 0.220 af, Depth= 2.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.25"

	Area (ac)	CN	Description
*	0.240	98	Pavement
*	0.630	98	Roof
	0.150	74	>75% Grass cover, Good, HSG C
	1.020	94	Weighted Average
	0.150		14.71% Pervious Area
	0.870		85.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach 1R: FIRST STREET

Inflow Area = 4.060 ac,100.00% Impervious, Inflow Depth = 3.02" for 2 YEAR event
Inflow = 12.81 cfs @ 12.08 hrs, Volume= 1.021 af
Outflow = 12.81 cfs @ 12.08 hrs, Volume= 1.021 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: LECHMERE CANAL

Inflow Area = 10.600 ac, 88.40% Impervious, Inflow Depth = 2.73" for 2 YEAR event
Inflow = 31.18 cfs @ 12.08 hrs, Volume= 2.407 af
Outflow = 31.18 cfs @ 12.08 hrs, Volume= 2.407 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: CHARLES RIVER

Inflow Area = 11.470 ac, 86.84% Impervious, Inflow Depth = 2.50" for 2 YEAR event
Inflow = 31.65 cfs @ 12.11 hrs, Volume= 2.393 af
Outflow = 31.65 cfs @ 12.11 hrs, Volume= 2.393 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: INFILTRATION TRENCH

Inflow Area = 8.100 ac, 95.68% Impervious, Inflow Depth = 2.91" for 2 YEAR event
Inflow = 25.14 cfs @ 12.08 hrs, Volume= 1.963 af
Outflow = 23.67 cfs @ 12.11 hrs, Volume= 1.963 af, Atten= 6%, Lag= 1.7 min
Discarded = 0.17 cfs @ 12.01 hrs, Volume= 0.129 af
Primary = 23.50 cfs @ 12.11 hrs, Volume= 1.834 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 7.67' @ 12.11 hrs Surf.Area= 3,100 sf Storage= 2,781 cf

Plug-Flow detention time= 3.6 min calculated for 1.963 af (100% of inflow)
Center-of-Mass det. time= 3.6 min (768.1 - 764.5)

Volume	Invert	Avail.Storage	Storage Description
#1	5.20'	2,519 cf	**48.0" W x 48.0" H Box Crushed Stone** L= 775.0' S= 0.0025 '/' 12,400 cf Overall - 6,104 cf Embedded = 6,296 cf x 40.0% Voids
#2	5.70'	5,478 cf	**36.0" Round Pipe Storage** Inside #1 L= 775.0' S= 0.0025 '/' 6,104 cf Overall - 1.0" Wall Thickness = 5,478 cf
		7,997 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	5.70'	**36.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	5.20'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.17 cfs @ 12.01 hrs HW=7.14' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=23.47 cfs @ 12.11 hrs HW=7.67' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 23.47 cfs @ 4.78 fps)

Summary for Pond 2P: INFILTRATION TRENCH

Inflow Area = 3.370 ac, 65.58% Impervious, Inflow Depth = 2.25" for 2 YEAR event
Inflow = 8.40 cfs @ 12.09 hrs, Volume= 0.632 af
Outflow = 8.26 cfs @ 12.10 hrs, Volume= 0.632 af, Atten= 2%, Lag= 0.9 min
Discarded = 0.06 cfs @ 11.66 hrs, Volume= 0.074 af
Primary = 8.20 cfs @ 12.10 hrs, Volume= 0.558 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 5.79' @ 12.10 hrs Surf.Area= 1,050 sf Storage= 644 cf

Plug-Flow detention time= 4.8 min calculated for 0.632 af (100% of inflow)
Center-of-Mass det. time= 4.8 min (795.5 - 790.8)

Volume	Invert	Avail.Storage	Storage Description
#1	4.20'	744 cf	**36.0" W x 36.0" H Box Crushed Stone** L= 350.0' S= 0.0025 '/' 3,150 cf Overall - 1,290 cf Embedded = 1,860 cf x 40.0% Voids
#2	4.70'	1,100 cf	**24.0" Round Pipe Storage** Inside #1 L= 350.0' S= 0.0025 '/' 1,290 cf Overall - 1.0" Wall Thickness = 1,100 cf
		1,843 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	4.70'	**36.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	4.20'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 11.66 hrs HW=5.08' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=8.19 cfs @ 12.10 hrs HW=5.79' TW=0.00' (Dynamic Tailwater)
└**1=Orifice/Grate** (Orifice Controls 8.19 cfs @ 3.55 fps)

Summary for Link 1L: PROJECT TOTAL

Inflow Area = 22.070 ac, 87.58% Impervious, Inflow Depth = 2.61" for 2 YEAR event
Inflow = 62.15 cfs @ 12.10 hrs, Volume= 4.800 af
Primary = 62.15 cfs @ 12.10 hrs, Volume= 4.800 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: FIRST STREET Runoff Area=1.260 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=6.33 cfs 0.514 af

Subcatchment 2S: LECHMERE ROOF Runoff Area=0.840 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=4.22 cfs 0.343 af

Subcatchment 3S: GARAGE ROOF Runoff Area=1.000 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=5.02 cfs 0.408 af

Subcatchment 4S: SEARS ROOF Runoff Area=0.960 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=4.82 cfs 0.391 af

Subcatchment 5S: CORE RETAIL ROOF Runoff Area=2.110 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=10.59 cfs 0.860 af

Subcatchment 6S: CANAL PARK Runoff Area=3.860 ac 68.13% Impervious Runoff Depth=4.00"
Tc=6.0 min CN=90 Runoff=17.44 cfs 1.287 af

Subcatchment 7S: 10 CANAL PARK ROOF Runoff Area=0.570 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=2.86 cfs 0.232 af

Subcatchment 8S: CAMBRIDGESIDE Runoff Area=0.860 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=4.32 cfs 0.351 af

Subcatchment 9S: CORE RETAIL ROOF Runoff Area=1.640 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=8.23 cfs 0.669 af

Subcatchment 10S: MARLOWE HOTEL Runoff Area=0.620 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=3.11 cfs 0.253 af

Subcatchment 11S: MACYS ROOF Runoff Area=0.940 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=4.72 cfs 0.383 af

Subcatchment 12S: EDWIN H. LAND BLVD. Runoff Area=4.040 ac 91.34% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=96 Runoff=19.97 cfs 1.569 af

Subcatchment 13S: CHARLES PARK Runoff Area=1.000 ac 25.00% Impervious Runoff Depth=3.01"
Tc=6.0 min CN=80 Runoff=3.52 cfs 0.251 af

Subcatchment 14S: LOTUS COURTYARD Runoff Area=0.470 ac 44.68% Impervious Runoff Depth=3.49"
Tc=6.0 min CN=85 Runoff=1.90 cfs 0.137 af

Subcatchment 15S: FIRST & ROGER Runoff Area=0.880 ac 100.00% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=98 Runoff=4.42 cfs 0.359 af

Subcatchment 16S: 11 BINNEY STREET Runoff Area=1.020 ac 85.29% Impervious Runoff Depth=4.44"
Tc=6.0 min CN=94 Runoff=4.92 cfs 0.377 af

Reach 1R: FIRST STREET Inflow=20.38 cfs 1.655 af
Outflow=20.38 cfs 1.655 af

Reach 2R: LECHMERE CANAL Inflow=51.27 cfs 4.035 af
Outflow=51.27 cfs 4.035 af

Reach 4R: CHARLES RIVER Inflow=51.77 cfs 4.117 af
Outflow=51.77 cfs 4.117 af

Pond 1P: INFILTRATION TRENCH Peak Elev=8.40' Storage=4,562 cf Inflow=40.35 cfs 3.225 af
Discarded=0.17 cfs 0.147 af Primary=37.44 cfs 3.078 af Outflow=37.61 cfs 3.225 af

Pond 2P: INFILTRATION TRENCH Peak Elev=6.19' Storage=962 cf Inflow=14.76 cfs 1.123 af
Discarded=0.06 cfs 0.084 af Primary=14.52 cfs 1.039 af Outflow=14.58 cfs 1.123 af

Link 1L: PROJECT TOTAL Inflow=101.96 cfs 8.152 af
Primary=101.96 cfs 8.152 af

Total Runoff Area = 22.070 ac Runoff Volume = 8.383 af Average Runoff Depth = 4.56"
12.42% Pervious = 2.740 ac 87.58% Impervious = 19.330 ac

Summary for Subcatchment 1S: FIRST STREET

Runoff = 6.33 cfs @ 12.08 hrs, Volume= 0.514 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	1.260	98	Pavement
	1.260		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 2S: LECHMERE ROOF

Runoff = 4.22 cfs @ 12.08 hrs, Volume= 0.343 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.840	98	Roof
	0.840		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 3S: GARAGE ROOF

Runoff = 5.02 cfs @ 12.08 hrs, Volume= 0.408 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	1.000	98	Roof
	1.000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 4S: SEARS ROOF

Runoff = 4.82 cfs @ 12.08 hrs, Volume= 0.391 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.960	98	Roof
	0.960		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 5S: CORE RETAIL ROOF

Runoff = 10.59 cfs @ 12.08 hrs, Volume= 0.860 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	2.110	98	Roof
	2.110		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 6S: CANAL PARK

Runoff = 17.44 cfs @ 12.09 hrs, Volume= 1.287 af, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	2.630	98	Pavement
	1.230	74	>75% Grass cover, Good, HSG C
	3.860	90	Weighted Average
	1.230		31.87% Pervious Area
	2.630		68.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 7S: 10 CANAL PARK ROOF

Runoff = 2.86 cfs @ 12.08 hrs, Volume= 0.232 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.570	98	Roof
	0.570		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 8S: CAMBRIDGESIDE PLACE

Runoff = 4.32 cfs @ 12.08 hrs, Volume= 0.351 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.860	98	Pavement
	0.860		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 9S: CORE RETAIL ROOF

Runoff = 8.23 cfs @ 12.08 hrs, Volume= 0.669 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	1.640	98	Roof
	1.640		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 10S: MARLOWE HOTEL

Runoff = 3.11 cfs @ 12.08 hrs, Volume= 0.253 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.120	98	Pavement
*	0.500	98	Roof
	0.620	98	Weighted Average
	0.620		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11S: MACYS ROOF

Runoff = 4.72 cfs @ 12.08 hrs, Volume= 0.383 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.940	98	Roof
	0.940		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 12S: EDWIN H. LAND BLVD.

Runoff = 19.97 cfs @ 12.08 hrs, Volume= 1.569 af, Depth= 4.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	3.690	98	Pavement
	0.350	74	>75% Grass cover, Good, HSG C
	4.040	96	Weighted Average
	0.350		8.66% Pervious Area
	3.690		91.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 13S: CHARLES PARK

Runoff = 3.52 cfs @ 12.09 hrs, Volume= 0.251 af, Depth= 3.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.250	98	Pavement
	0.750	74	>75% Grass cover, Good, HSG C
	1.000	80	Weighted Average
	0.750		75.00% Pervious Area
	0.250		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 14S: LOTUS COURTYARD

Runoff = 1.90 cfs @ 12.09 hrs, Volume= 0.137 af, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.210	98	Pavement
	0.260	74	>75% Grass cover, Good, HSG C
	0.470	85	Weighted Average
	0.260		55.32% Pervious Area
	0.210		44.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 15S: FIRST & ROGER STREET

Runoff = 4.42 cfs @ 12.08 hrs, Volume= 0.359 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.880	98	Pavement
	0.880		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 16S: 11 BINNEY STREET

Runoff = 4.92 cfs @ 12.08 hrs, Volume= 0.377 af, Depth= 4.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.13"

	Area (ac)	CN	Description
*	0.240	98	Pavement
*	0.630	98	Roof
	0.150	74	>75% Grass cover, Good, HSG C
	1.020	94	Weighted Average
	0.150		14.71% Pervious Area
	0.870		85.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach 1R: FIRST STREET

Inflow Area = 4.060 ac,100.00% Impervious, Inflow Depth = 4.89" for 10 YEAR event
Inflow = 20.38 cfs @ 12.08 hrs, Volume= 1.655 af
Outflow = 20.38 cfs @ 12.08 hrs, Volume= 1.655 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: LECHMERE CANAL

Inflow Area = 10.600 ac, 88.40% Impervious, Inflow Depth = 4.57" for 10 YEAR event
Inflow = 51.27 cfs @ 12.08 hrs, Volume= 4.035 af
Outflow = 51.27 cfs @ 12.08 hrs, Volume= 4.035 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: CHARLES RIVER

Inflow Area = 11.470 ac, 86.84% Impervious, Inflow Depth = 4.31" for 10 YEAR event
Inflow = 51.77 cfs @ 12.11 hrs, Volume= 4.117 af
Outflow = 51.77 cfs @ 12.11 hrs, Volume= 4.117 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: INFILTRATION TRENCH

Inflow Area = 8.100 ac, 95.68% Impervious, Inflow Depth = 4.78" for 10 YEAR event
Inflow = 40.35 cfs @ 12.08 hrs, Volume= 3.225 af
Outflow = 37.61 cfs @ 12.11 hrs, Volume= 3.225 af, Atten= 7%, Lag= 1.9 min
Discarded = 0.17 cfs @ 11.88 hrs, Volume= 0.147 af
Primary = 37.44 cfs @ 12.11 hrs, Volume= 3.078 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 8.40' @ 12.11 hrs Surf.Area= 3,100 sf Storage= 4,562 cf

Plug-Flow detention time= 3.0 min calculated for 3.224 af (100% of inflow)
Center-of-Mass det. time= 3.0 min (757.5 - 754.5)

Volume	Invert	Avail.Storage	Storage Description
#1	5.20'	2,519 cf	**48.0" W x 48.0" H Box Crushed Stone** L= 775.0' S= 0.0025 '/' 12,400 cf Overall - 6,104 cf Embedded = 6,296 cf x 40.0% Voids
#2	5.70'	5,478 cf	**36.0" Round Pipe Storage** Inside #1 L= 775.0' S= 0.0025 '/' 6,104 cf Overall - 1.0" Wall Thickness = 5,478 cf
		7,997 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	5.70'	**36.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	5.20'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.17 cfs @ 11.88 hrs HW=7.15' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=37.39 cfs @ 12.11 hrs HW=8.39' TW=0.00' (Dynamic Tailwater)
└**1=Orifice/Grate** (Orifice Controls 37.39 cfs @ 5.59 fps)

Summary for Pond 2P: INFILTRATION TRENCH

Inflow Area = 3.370 ac, 65.58% Impervious, Inflow Depth = 4.00" for 10 YEAR event
Inflow = 14.76 cfs @ 12.09 hrs, Volume= 1.123 af
Outflow = 14.58 cfs @ 12.10 hrs, Volume= 1.123 af, Atten= 1%, Lag= 0.8 min
Discarded = 0.06 cfs @ 11.28 hrs, Volume= 0.084 af
Primary = 14.52 cfs @ 12.10 hrs, Volume= 1.039 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 6.19' @ 12.10 hrs Surf.Area= 1,050 sf Storage= 962 cf

Plug-Flow detention time= 3.5 min calculated for 1.123 af (100% of inflow)
Center-of-Mass det. time= 3.5 min (783.0 - 779.5)

Volume	Invert	Avail.Storage	Storage Description
#1	4.20'	744 cf	**36.0" W x 36.0" H Box Crushed Stone** L= 350.0' S= 0.0025 '/' 3,150 cf Overall - 1,290 cf Embedded = 1,860 cf x 40.0% Voids
#2	4.70'	1,100 cf	**24.0" Round Pipe Storage** Inside #1 L= 350.0' S= 0.0025 '/' 1,290 cf Overall - 1.0" Wall Thickness = 1,100 cf
		1,843 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	4.70'	**36.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	4.20'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 11.28 hrs HW=5.08' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=14.50 cfs @ 12.10 hrs HW=6.19' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 14.50 cfs @ 4.15 fps)

Summary for Link 1L: PROJECT TOTAL

Inflow Area = 22.070 ac, 87.58% Impervious, Inflow Depth = 4.43" for 10 YEAR event
Inflow = 101.96 cfs @ 12.10 hrs, Volume= 8.152 af
Primary = 101.96 cfs @ 12.10 hrs, Volume= 8.152 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: FIRST STREET Runoff Area=1.260 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=7.79 cfs 0.638 af

Subcatchment 2S: LECHMERE ROOF Runoff Area=0.840 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=5.20 cfs 0.425 af

Subcatchment 3S: GARAGE ROOF Runoff Area=1.000 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=6.19 cfs 0.506 af

Subcatchment 4S: SEARS ROOF Runoff Area=0.960 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=5.94 cfs 0.486 af

Subcatchment 5S: CORE RETAIL ROOF Runoff Area=2.110 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=13.05 cfs 1.068 af

Subcatchment 6S: CANAL PARK Runoff Area=3.860 ac 68.13% Impervious Runoff Depth=5.15"
Tc=6.0 min CN=90 Runoff=22.13 cfs 1.656 af

Subcatchment 7S: 10 CANAL PARK ROOF Runoff Area=0.570 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=3.53 cfs 0.288 af

Subcatchment 8S: CAMBRIDGESIDE Runoff Area=0.860 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=5.32 cfs 0.435 af

Subcatchment 9S: CORE RETAIL ROOF Runoff Area=1.640 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=10.15 cfs 0.830 af

Subcatchment 10S: MARLOWE HOTEL Runoff Area=0.620 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=3.84 cfs 0.314 af

Subcatchment 11S: MACYS ROOF Runoff Area=0.940 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=5.82 cfs 0.476 af

Subcatchment 12S: EDWIN H. LAND BLVD. Runoff Area=4.040 ac 91.34% Impervious Runoff Depth=5.84"
Tc=6.0 min CN=96 Runoff=24.72 cfs 1.965 af

Subcatchment 13S: CHARLES PARK Runoff Area=1.000 ac 25.00% Impervious Runoff Depth=4.06"
Tc=6.0 min CN=80 Runoff=4.74 cfs 0.339 af

Subcatchment 14S: LOTUS COURTYARD Runoff Area=0.470 ac 44.68% Impervious Runoff Depth=4.60"
Tc=6.0 min CN=85 Runoff=2.48 cfs 0.180 af

Subcatchment 15S: FIRST & ROGER Runoff Area=0.880 ac 100.00% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=98 Runoff=5.44 cfs 0.445 af

Subcatchment 16S: 11 BINNEY STREET Runoff Area=1.020 ac 85.29% Impervious Runoff Depth=5.60"
Tc=6.0 min CN=94 Runoff=6.14 cfs 0.476 af

Reach 1R: FIRST STREET Inflow=25.12 cfs 2.054 af
Outflow=25.12 cfs 2.054 af

Reach 2R: LECHMERE CANAL Inflow=63.83 cfs 5.066 af
Outflow=63.83 cfs 5.066 af

Reach 4R: CHARLES RIVER Inflow=63.50 cfs 5.214 af
Outflow=63.50 cfs 5.214 af

Pond 1P: INFILTRATION TRENCH Peak Elev=8.98' Storage=5,911 cf Inflow=49.84 cfs 4.019 af
Discarded=0.17 cfs 0.156 af Primary=45.39 cfs 3.863 af Outflow=45.56 cfs 4.019 af

Pond 2P: INFILTRATION TRENCH Peak Elev=6.41' Storage=1,139 cf Inflow=18.79 cfs 1.440 af
Discarded=0.06 cfs 0.089 af Primary=18.54 cfs 1.351 af Outflow=18.60 cfs 1.440 af

Link 1L: PROJECT TOTAL Inflow=125.80 cfs 10.281 af
Primary=125.80 cfs 10.281 af

Total Runoff Area = 22.070 ac Runoff Volume = 10.525 af Average Runoff Depth = 5.72"
12.42% Pervious = 2.740 ac 87.58% Impervious = 19.330 ac

Summary for Subcatchment 1S: FIRST STREET

Runoff = 7.79 cfs @ 12.08 hrs, Volume= 0.638 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	1.260	98	Pavement
	1.260		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 2S: LECHMERE ROOF

Runoff = 5.20 cfs @ 12.08 hrs, Volume= 0.425 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.840	98	Roof
	0.840		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 3S: GARAGE ROOF

Runoff = 6.19 cfs @ 12.08 hrs, Volume= 0.506 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	1.000	98	Roof
	1.000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 4S: SEARS ROOF

Runoff = 5.94 cfs @ 12.08 hrs, Volume= 0.486 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.960	98	Roof
	0.960		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 5S: CORE RETAIL ROOF

Runoff = 13.05 cfs @ 12.08 hrs, Volume= 1.068 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	2.110	98	Roof
	2.110		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 6S: CANAL PARK

Runoff = 22.13 cfs @ 12.08 hrs, Volume= 1.656 af, Depth= 5.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	2.630	98	Pavement
	1.230	74	>75% Grass cover, Good, HSG C
	3.860	90	Weighted Average
	1.230		31.87% Pervious Area
	2.630		68.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 7S: 10 CANAL PARK ROOF

Runoff = 3.53 cfs @ 12.08 hrs, Volume= 0.288 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.570	98	Roof
	0.570		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 8S: CAMBRIDGESIDE PLACE

Runoff = 5.32 cfs @ 12.08 hrs, Volume= 0.435 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.860	98	Pavement
	0.860		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 9S: CORE RETAIL ROOF

Runoff = 10.15 cfs @ 12.08 hrs, Volume= 0.830 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	1.640	98	Roof
	1.640		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 10S: MARLOWE HOTEL

Runoff = 3.84 cfs @ 12.08 hrs, Volume= 0.314 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.120	98	Pavement
*	0.500	98	Roof
	0.620	98	Weighted Average
	0.620		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11S: MACYS ROOF

Runoff = 5.82 cfs @ 12.08 hrs, Volume= 0.476 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.940	98	Roof
	0.940		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 12S: EDWIN H. LAND BLVD.

Runoff = 24.72 cfs @ 12.08 hrs, Volume= 1.965 af, Depth= 5.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	3.690	98	Pavement
	0.350	74	>75% Grass cover, Good, HSG C
	4.040	96	Weighted Average
	0.350		8.66% Pervious Area
	3.690		91.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 13S: CHARLES PARK

Runoff = 4.74 cfs @ 12.09 hrs, Volume= 0.339 af, Depth= 4.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.250	98	Pavement
	0.750	74	>75% Grass cover, Good, HSG C
	1.000	80	Weighted Average
	0.750		75.00% Pervious Area
	0.250		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 14S: LOTUS COURTYARD

Runoff = 2.48 cfs @ 12.09 hrs, Volume= 0.180 af, Depth= 4.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.210	98	Pavement
	0.260	74	>75% Grass cover, Good, HSG C
	0.470	85	Weighted Average
	0.260		55.32% Pervious Area
	0.210		44.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 15S: FIRST & ROGER STREET

Runoff = 5.44 cfs @ 12.08 hrs, Volume= 0.445 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.880	98	Pavement
	0.880		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 16S: 11 BINNEY STREET

Runoff = 6.14 cfs @ 12.08 hrs, Volume= 0.476 af, Depth= 5.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.31"

	Area (ac)	CN	Description
*	0.240	98	Pavement
*	0.630	98	Roof
	0.150	74	>75% Grass cover, Good, HSG C
	1.020	94	Weighted Average
	0.150		14.71% Pervious Area
	0.870		85.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach 1R: FIRST STREET

Inflow Area = 4.060 ac,100.00% Impervious, Inflow Depth = 6.07" for 25 YEAR event
Inflow = 25.12 cfs @ 12.08 hrs, Volume= 2.054 af
Outflow = 25.12 cfs @ 12.08 hrs, Volume= 2.054 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: LECHMERE CANAL

Inflow Area = 10.600 ac, 88.40% Impervious, Inflow Depth = 5.74" for 25 YEAR event
Inflow = 63.83 cfs @ 12.08 hrs, Volume= 5.066 af
Outflow = 63.83 cfs @ 12.08 hrs, Volume= 5.066 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: CHARLES RIVER

Inflow Area = 11.470 ac, 86.84% Impervious, Inflow Depth = 5.46" for 25 YEAR event
Inflow = 63.50 cfs @ 12.11 hrs, Volume= 5.214 af
Outflow = 63.50 cfs @ 12.11 hrs, Volume= 5.214 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: INFILTRATION TRENCH

```
Inflow Area =      8.100 ac,  95.68% Impervious,  Inflow Depth =   5.95"    for  25 YEAR event
Inflow      =     49.84 cfs @  12.08 hrs,  Volume=          4.019 af
Outflow     =     45.56 cfs @  12.12 hrs,  Volume=          4.019 af,  Atten= 9%,  Lag= 2.1 min
Discarded   =      0.17 cfs @  11.80 hrs,  Volume=          0.156 af
Primary     =     45.39 cfs @  12.12 hrs,  Volume=          3.863 af
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 8.98' @ 12.12 hrs Surf.Area= 3,100 sf Storage= 5,911 cf

Plug-Flow detention time= 2.8 min calculated for 4.018 af (100% of inflow)
Center-of-Mass det. time= 2.8 min (753.5 - 750.6)

Volume	Invert	Avail.Storage	Storage Description
#1	5.20'	2,519 cf	**48.0" W x 48.0" H Box Crushed Stone**
			L= 775.0' S= 0.0025 '/'
			12,400 cf Overall - 6,104 cf Embedded = 6,296 cf x 40.0% Voids
#2	5.70'	5,478 cf	**36.0" Round Pipe Storage** Inside #1
			L= 775.0' S= 0.0025 '/'
			6,104 cf Overall - 1.0" Wall Thickness = 5,478 cf
		7,997 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	5.70'	**36.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	5.20'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.17 cfs @ 11.80 hrs HW=7.14' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=45.37 cfs @ 12.12 hrs HW=8.98' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 45.37 cfs @ 6.42 fps)

Summary for Pond 2P: INFILTRATION TRENCH

```
Inflow Area =      3.370 ac,  65.58% Impervious,  Inflow Depth =   5.13"    for  25 YEAR event
Inflow      =     18.79 cfs @  12.08 hrs,  Volume=          1.440 af
Outflow     =     18.60 cfs @  12.10 hrs,  Volume=          1.440 af,  Atten= 1%,  Lag= 0.7 min
Discarded   =      0.06 cfs @  10.94 hrs,  Volume=          0.089 af
Primary     =     18.54 cfs @  12.10 hrs,  Volume=          1.351 af
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 6.41' @ 12.10 hrs Surf.Area= 1,050 sf Storage= 1,139 cf

Plug-Flow detention time= 3.1 min calculated for 1.440 af (100% of inflow)
Center-of-Mass det. time= 3.1 min (777.7 - 774.7)

Volume	Invert	Avail.Storage	Storage Description
#1	4.20'	744 cf	**36.0" W x 36.0" H Box Crushed Stone** L= 350.0' S= 0.0025 '/' 3,150 cf Overall - 1,290 cf Embedded = 1,860 cf x 40.0% Voids
#2	4.70'	1,100 cf	**24.0" Round Pipe Storage** Inside #1 L= 350.0' S= 0.0025 '/' 1,290 cf Overall - 1.0" Wall Thickness = 1,100 cf
		1,843 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	4.70'	**36.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	4.20'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 10.94 hrs HW=5.08' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=18.51 cfs @ 12.10 hrs HW=6.41' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 18.51 cfs @ 4.45 fps)

Summary for Link 1L: PROJECT TOTAL

Inflow Area = 22.070 ac, 87.58% Impervious, Inflow Depth = 5.59" for 25 YEAR event
Inflow = 125.80 cfs @ 12.10 hrs, Volume= 10.281 af
Primary = 125.80 cfs @ 12.10 hrs, Volume= 10.281 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: FIRST STREET Runoff Area=1.260 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=10.06 cfs 0.828 af

Subcatchment 2S: LECHMERE ROOF Runoff Area=0.840 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=6.71 cfs 0.552 af

Subcatchment 3S: GARAGE ROOF Runoff Area=1.000 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=7.98 cfs 0.658 af

Subcatchment 4S: SEARS ROOF Runoff Area=0.960 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=7.66 cfs 0.631 af

Subcatchment 5S: CORE RETAIL ROOF Runoff Area=2.110 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=16.84 cfs 1.387 af

Subcatchment 6S: CANAL PARK Runoff Area=3.860 ac 68.13% Impervious Runoff Depth=6.93"
Tc=6.0 min CN=90 Runoff=29.30 cfs 2.230 af

Subcatchment 7S: 10 CANAL PARK ROOF Runoff Area=0.570 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=4.55 cfs 0.375 af

Subcatchment 8S: CAMBRIDGESIDE Runoff Area=0.860 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=6.87 cfs 0.565 af

Subcatchment 9S: CORE RETAIL ROOF Runoff Area=1.640 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=13.09 cfs 1.078 af

Subcatchment 10S: MARLOWE HOTEL Runoff Area=0.620 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=4.95 cfs 0.408 af

Subcatchment 11S: MACYS ROOF Runoff Area=0.940 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=7.50 cfs 0.618 af

Subcatchment 12S: EDWIN H. LAND BLVD. Runoff Area=4.040 ac 91.34% Impervious Runoff Depth=7.65"
Tc=6.0 min CN=96 Runoff=32.03 cfs 2.576 af

Subcatchment 13S: CHARLES PARK Runoff Area=1.000 ac 25.00% Impervious Runoff Depth=5.75"
Tc=6.0 min CN=80 Runoff=6.63 cfs 0.479 af

Subcatchment 14S: LOTUS COURTYARD Runoff Area=0.470 ac 44.68% Impervious Runoff Depth=6.34"
Tc=6.0 min CN=85 Runoff=3.36 cfs 0.248 af

Subcatchment 15S: FIRST & ROGER Runoff Area=0.880 ac 100.00% Impervious Runoff Depth=7.89"
Tc=6.0 min CN=98 Runoff=7.02 cfs 0.579 af

Subcatchment 16S: 11 BINNEY STREET Runoff Area=1.020 ac 85.29% Impervious Runoff Depth=7.41"
Tc=6.0 min CN=94 Runoff=8.00 cfs 0.630 af

Reach 1R: FIRST STREET Inflow=32.41 cfs 2.669 af
Outflow=32.41 cfs 2.669 af

Reach 2R: LECHMERE CANAL Inflow=83.10 cfs 6.662 af
Outflow=83.10 cfs 6.662 af

Reach 4R: CHARLES RIVER Inflow=84.91 cfs 6.920 af
Outflow=84.91 cfs 6.920 af

Pond 1P: INFILTRATION TRENCH Peak Elev=10.37' Storage=7,807 cf Inflow=64.44 cfs 5.245 af
Discarded=0.17 cfs 0.167 af Primary=60.62 cfs 5.078 af Outflow=60.79 cfs 5.245 af

Pond 2P: INFILTRATION TRENCH Peak Elev=6.73' Storage=1,380 cf Inflow=25.01 cfs 1.936 af
Discarded=0.06 cfs 0.094 af Primary=24.77 cfs 1.842 af Outflow=24.83 cfs 1.936 af

Link 1L: PROJECT TOTAL Inflow=165.63 cfs 13.582 af
Primary=165.63 cfs 13.582 af

Total Runoff Area = 22.070 ac Runoff Volume = 13.843 af Average Runoff Depth = 7.53"
12.42% Pervious = 2.740 ac 87.58% Impervious = 19.330 ac

Summary for Subcatchment 1S: FIRST STREET

Runoff = 10.06 cfs @ 12.08 hrs, Volume= 0.828 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	1.260	98	Pavement
	1.260		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 2S: LECHMERE ROOF

Runoff = 6.71 cfs @ 12.08 hrs, Volume= 0.552 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.840	98	Roof
	0.840		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 3S: GARAGE ROOF

Runoff = 7.98 cfs @ 12.08 hrs, Volume= 0.658 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	1.000	98	Roof
	1.000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 4S: SEARS ROOF

Runoff = 7.66 cfs @ 12.08 hrs, Volume= 0.631 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.960	98	Roof
	0.960		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 5S: CORE RETAIL ROOF

Runoff = 16.84 cfs @ 12.08 hrs, Volume= 1.387 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	2.110	98	Roof
	2.110		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 6S: CANAL PARK

Runoff = 29.30 cfs @ 12.08 hrs, Volume= 2.230 af, Depth= 6.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	2.630	98	Pavement
	1.230	74	>75% Grass cover, Good, HSG C
	3.860	90	Weighted Average
	1.230		31.87% Pervious Area
	2.630		68.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 7S: 10 CANAL PARK ROOF

Runoff = 4.55 cfs @ 12.08 hrs, Volume= 0.375 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.570	98	Roof
	0.570		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 8S: CAMBRIDGESIDE PLACE

Runoff = 6.87 cfs @ 12.08 hrs, Volume= 0.565 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.860	98	Pavement
	0.860		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 9S: CORE RETAIL ROOF

Runoff = 13.09 cfs @ 12.08 hrs, Volume= 1.078 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	1.640	98	Roof
	1.640		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 10S: MARLOWE HOTEL

Runoff = 4.95 cfs @ 12.08 hrs, Volume= 0.408 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.120	98	Pavement
*	0.500	98	Roof
	0.620	98	Weighted Average
	0.620		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11S: MACYS ROOF

Runoff = 7.50 cfs @ 12.08 hrs, Volume= 0.618 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.940	98	Roof
	0.940		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 12S: EDWIN H. LAND BLVD.

Runoff = 32.03 cfs @ 12.08 hrs, Volume= 2.576 af, Depth= 7.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	3.690	98	Pavement
	0.350	74	>75% Grass cover, Good, HSG C
	4.040	96	Weighted Average
	0.350		8.66% Pervious Area
	3.690		91.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 13S: CHARLES PARK

Runoff = 6.63 cfs @ 12.09 hrs, Volume= 0.479 af, Depth= 5.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.250	98	Pavement
	0.750	74	>75% Grass cover, Good, HSG C
	1.000	80	Weighted Average
	0.750		75.00% Pervious Area
	0.250		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 14S: LOTUS COURTYARD

Runoff = 3.36 cfs @ 12.09 hrs, Volume= 0.248 af, Depth= 6.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.210	98	Pavement
	0.260	74	>75% Grass cover, Good, HSG C
	0.470	85	Weighted Average
	0.260		55.32% Pervious Area
	0.210		44.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 15S: FIRST & ROGER STREET

Runoff = 7.02 cfs @ 12.08 hrs, Volume= 0.579 af, Depth= 7.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.880	98	Pavement
	0.880		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 16S: 11 BINNEY STREET

Runoff = 8.00 cfs @ 12.08 hrs, Volume= 0.630 af, Depth= 7.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.13"

	Area (ac)	CN	Description
*	0.240	98	Pavement
*	0.630	98	Roof
	0.150	74	>75% Grass cover, Good, HSG C
	1.020	94	Weighted Average
	0.150		14.71% Pervious Area
	0.870		85.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach 1R: FIRST STREET

Inflow Area = 4.060 ac,100.00% Impervious, Inflow Depth = 7.89" for 100 YEAR event
Inflow = 32.41 cfs @ 12.08 hrs, Volume= 2.669 af
Outflow = 32.41 cfs @ 12.08 hrs, Volume= 2.669 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: LECHMERE CANAL

Inflow Area = 10.600 ac, 88.40% Impervious, Inflow Depth = 7.54" for 100 YEAR event
Inflow = 83.10 cfs @ 12.08 hrs, Volume= 6.662 af
Outflow = 83.10 cfs @ 12.08 hrs, Volume= 6.662 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: CHARLES RIVER

Inflow Area = 11.470 ac, 86.84% Impervious, Inflow Depth = 7.24" for 100 YEAR event
Inflow = 84.91 cfs @ 12.11 hrs, Volume= 6.920 af
Outflow = 84.91 cfs @ 12.11 hrs, Volume= 6.920 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: INFILTRATION TRENCH

Inflow Area = 8.100 ac, 95.68% Impervious, Inflow Depth = 7.77" for 100 YEAR event
Inflow = 64.44 cfs @ 12.08 hrs, Volume= 5.245 af
Outflow = 60.79 cfs @ 12.11 hrs, Volume= 5.245 af, Atten= 6%, Lag= 1.7 min
Discarded = 0.17 cfs @ 11.73 hrs, Volume= 0.167 af
Primary = 60.62 cfs @ 12.11 hrs, Volume= 5.078 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 10.37' @ 12.11 hrs Surf.Area= 3,100 sf Storage= 7,807 cf

Plug-Flow detention time= 2.6 min calculated for 5.244 af (100% of inflow)
Center-of-Mass det. time= 2.7 min (749.1 - 746.4)

Volume	Invert	Avail.Storage	Storage Description
#1	5.20'	2,519 cf	**48.0" W x 48.0" H Box Crushed Stone**
			L= 775.0' S= 0.0025 '/'
			12,400 cf Overall - 6,104 cf Embedded = 6,296 cf x 40.0% Voids
#2	5.70'	5,478 cf	**36.0" Round Pipe Storage** Inside #1
			L= 775.0' S= 0.0025 '/'
			6,104 cf Overall - 1.0" Wall Thickness = 5,478 cf
		7,997 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	5.70'	**36.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	5.20'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.17 cfs @ 11.73 hrs HW=7.15' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=60.49 cfs @ 12.11 hrs HW=10.36' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 60.49 cfs @ 8.56 fps)

Summary for Pond 2P: INFILTRATION TRENCH

Inflow Area = 3.370 ac, 65.58% Impervious, Inflow Depth = 6.89" for 100 YEAR event
Inflow = 25.01 cfs @ 12.08 hrs, Volume= 1.936 af
Outflow = 24.83 cfs @ 12.09 hrs, Volume= 1.936 af, Atten= 1%, Lag= 0.6 min
Discarded = 0.06 cfs @ 10.26 hrs, Volume= 0.094 af
Primary = 24.77 cfs @ 12.09 hrs, Volume= 1.842 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 6.73' @ 12.09 hrs Surf.Area= 1,050 sf Storage= 1,380 cf

Plug-Flow detention time= 2.6 min calculated for 1.935 af (100% of inflow)
Center-of-Mass det. time= 2.7 min (771.6 - 768.9)

Volume	Invert	Avail.Storage	Storage Description
#1	4.20'	744 cf	**36.0" W x 36.0" H Box Crushed Stone** L= 350.0' S= 0.0025 '/' 3,150 cf Overall - 1,290 cf Embedded = 1,860 cf x 40.0% Voids
#2	4.70'	1,100 cf	**24.0" Round Pipe Storage** Inside #1 L= 350.0' S= 0.0025 '/' 1,290 cf Overall - 1.0" Wall Thickness = 1,100 cf
		1,843 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	4.70'	**36.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	4.20'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 10.26 hrs HW=5.08' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=24.72 cfs @ 12.09 hrs HW=6.73' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 24.72 cfs @ 4.85 fps)

Summary for Link 1L: PROJECT TOTAL

Inflow Area = 22.070 ac, 87.58% Impervious, Inflow Depth = 7.38" for 100 YEAR event
Inflow = 165.63 cfs @ 12.10 hrs, Volume= 13.582 af
Primary = 165.63 cfs @ 12.10 hrs, Volume= 13.582 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Attachment 2

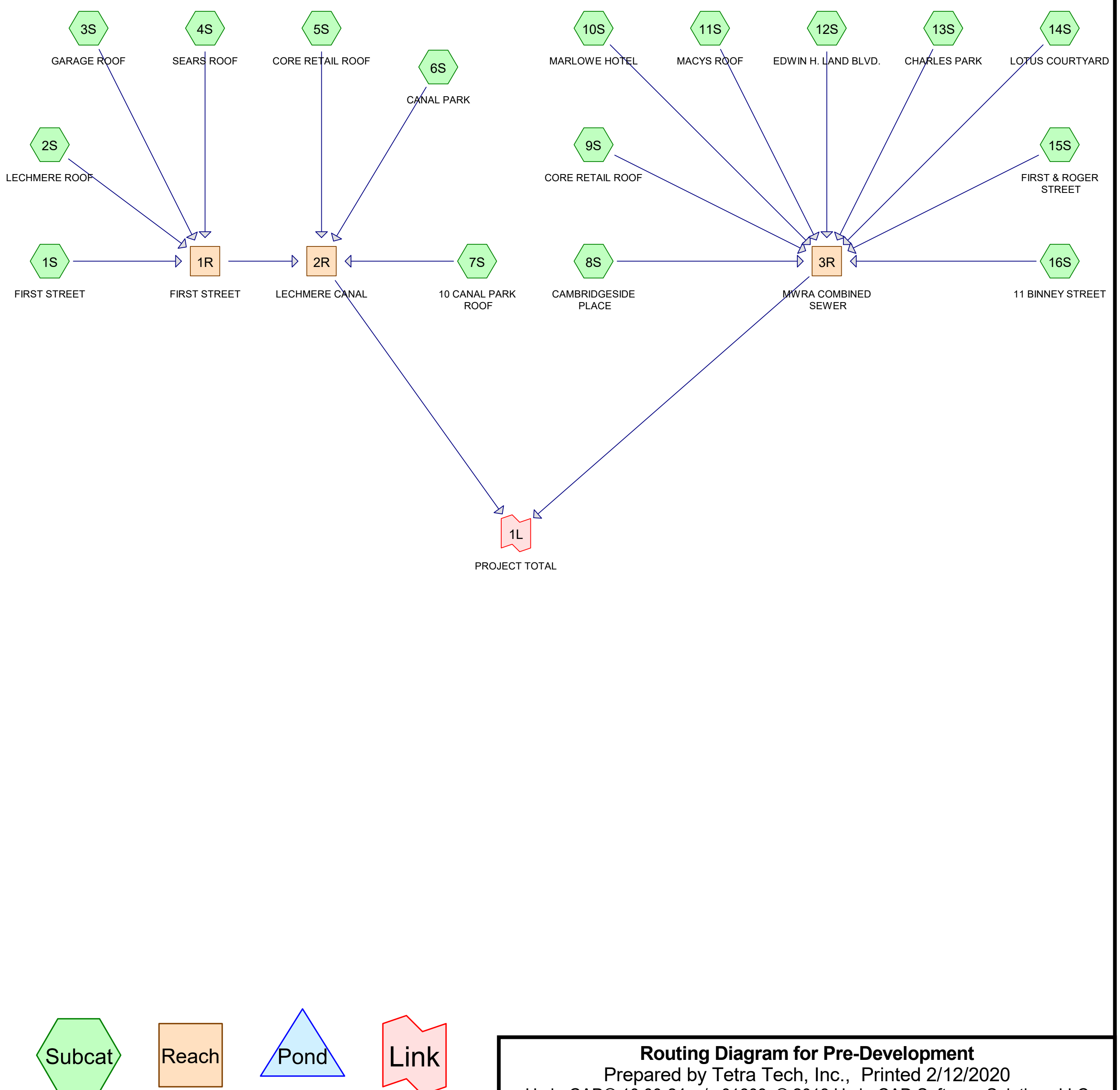
Infiltration/Inflow (I/I) Removal Calculations

CambridgeSide - Infiltration/inflow (I/I) Removal Estimate

Subcatchment		Impervious Area (acres)	Pervious Area[2] (acres)	Total Area (acres)	Runoff Volume[3] (acre-feet)	Runoff Volume (cubic-feet)	Runoff Volume (gallons)
8S	CambridgeSide Place	0.86	0.00	0.86	0.107	4,661	34,866
9S	Core Retail	1.64	0.00	1.64	0.205	8,930	66,800
10S	Marlowe Hotel	0.62	0.00	0.62	0.077	3,354	25,091
11S	Macys	0.94	0.00	0.94	0.117	5,097	38,125
12S	Edwin H. Land Boulevard	3.69	0.35	4.04	0.439	19,123	143,049
13S	Charles Park	0.25	0.75	1.00	0.033	1,437	10,753
14S	Lotus Courtyard	0.21	0.26	0.47	0.023	1,002	7,495
15S	Rogers Street & First Street	0.88	0.00	0.88	0.110	4,792	35,844
16S	11 Binney Street	0.87	0.15	1.02	0.097	4,225	31,608
		9.96	**1.51**	**11.47**	**1.208**	**52,620**	**393,629**

Notes:

1. I/I removal estimate is based on MassDEP 1-year 6-hour storm event (1.72 inches of rain).
2. Assumes pervious areas are HSG C with 75% or more grass cover.
3. Runoff calculated by the SCS TR-20 method with HydroCAD, Version 10.0 software.



Routing Diagram for Pre-Development
Prepared by Tetra Tech, Inc., Printed 2/12/2020
HydroCAD® 10.00-24 s/n 01603 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.740	74	>75% Grass cover, Good, HSG C (6S, 12S, 13S, 14S, 16S)
10.040	98	Pavement (1S, 6S, 8S, 10S, 12S, 13S, 14S, 15S, 16S)
9.290	98	Roof (2S, 3S, 4S, 5S, 7S, 9S, 10S, 11S, 16S)
22.070	**95**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: FIRST STREET Runoff Area=1.160 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=2.66 cfs 0.145 af

Subcatchment 2S: LECHMERE ROOF Runoff Area=0.890 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=2.04 cfs 0.111 af

Subcatchment 3S: GARAGE ROOF Runoff Area=1.050 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=2.41 cfs 0.131 af

Subcatchment 4S: SEARS ROOF Runoff Area=0.960 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=2.20 cfs 0.120 af

Subcatchment 5S: CORE RETAIL ROOF Runoff Area=2.110 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=4.83 cfs 0.263 af

Subcatchment 6S: CANAL PARK Runoff Area=3.860 ac 68.13% Impervious Runoff Depth=0.86"
Tc=6.0 min CN=90 Runoff=5.48 cfs 0.277 af

Subcatchment 7S: 10 CANAL PARK ROOF Runoff Area=0.570 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=1.31 cfs 0.071 af

Subcatchment 8S: CAMBRIDGESIDE Runoff Area=0.860 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=1.97 cfs 0.107 af

Subcatchment 9S: CORE RETAIL ROOF Runoff Area=1.640 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=3.76 cfs 0.205 af

Subcatchment 10S: MARLOWE HOTEL Runoff Area=0.620 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=1.42 cfs 0.077 af

Subcatchment 11S: MACYS ROOF Runoff Area=0.940 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=2.15 cfs 0.117 af

Subcatchment 12S: EDWIN H. LAND BLVD. Runoff Area=4.040 ac 91.34% Impervious Runoff Depth=1.30"
Tc=6.0 min CN=96 Runoff=8.45 cfs 0.439 af

Subcatchment 13S: CHARLES PARK Runoff Area=1.000 ac 25.00% Impervious Runoff Depth=0.40"
Tc=6.0 min CN=80 Runoff=0.58 cfs 0.033 af

Subcatchment 14S: LOTUS COURTYARD Runoff Area=0.470 ac 44.68% Impervious Runoff Depth=0.60"
Tc=6.0 min CN=85 Runoff=0.45 cfs 0.023 af

Subcatchment 15S: FIRST & ROGER Runoff Area=0.880 ac 100.00% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=98 Runoff=2.02 cfs 0.110 af

Subcatchment 16S: 11 BINNEY STREET Runoff Area=1.020 ac 85.29% Impervious Runoff Depth=1.14"
Tc=6.0 min CN=94 Runoff=1.90 cfs 0.097 af

Reach 1R: FIRST STREET	Inflow=9.30 cfs 0.507 af Outflow=9.30 cfs 0.507 af
Reach 2R: LECHMERE CANAL	Inflow=20.90 cfs 1.118 af Outflow=20.90 cfs 1.118 af
Reach 3R: MWRA COMBINED SEWER	Inflow=22.66 cfs 1.209 af Outflow=22.66 cfs 1.209 af
Link 1L: PROJECT TOTAL	Inflow=43.56 cfs 2.326 af Primary=43.56 cfs 2.326 af

Total Runoff Area = 22.070 ac Runoff Volume = 2.326 af Average Runoff Depth = 1.26"
12.42% Pervious = 2.740 ac 87.58% Impervious = 19.330 ac

Summary for Subcatchment 1S: FIRST STREET

Runoff = 2.66 cfs @ 3.08 hrs, Volume= 0.145 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	1.160	98	Pavement
	1.160		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 2S: LECHMERE ROOF

Runoff = 2.04 cfs @ 3.08 hrs, Volume= 0.111 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	0.890	98	Roof
	0.890		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 3S: GARAGE ROOF

Runoff = 2.41 cfs @ 3.08 hrs, Volume= 0.131 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	1.050	98	Roof
	1.050		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 4S: SEARS ROOF

Runoff = 2.20 cfs @ 3.08 hrs, Volume= 0.120 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	0.960	98	Roof
	0.960		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 5S: CORE RETAIL ROOF

Runoff = 4.83 cfs @ 3.08 hrs, Volume= 0.263 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	2.110	98	Roof
	2.110		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 6S: CANAL PARK

Runoff = 5.48 cfs @ 3.09 hrs, Volume= 0.277 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	2.630	98	Pavement
	1.230	74	>75% Grass cover, Good, HSG C
	3.860	90	Weighted Average
	1.230		31.87% Pervious Area
	2.630		68.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 7S: 10 CANAL PARK ROOF

Runoff = 1.31 cfs @ 3.08 hrs, Volume= 0.071 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	0.570	98	Roof
	0.570		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 8S: CAMBRIDGESIDE PLACE

Runoff = 1.97 cfs @ 3.08 hrs, Volume= 0.107 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	0.860	98	Pavement
	0.860		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 9S: CORE RETAIL ROOF

Runoff = 3.76 cfs @ 3.08 hrs, Volume= 0.205 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	1.640	98	Roof
	1.640		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 10S: MARLOWE HOTEL

Runoff = 1.42 cfs @ 3.08 hrs, Volume= 0.077 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	0.120	98	Pavement
*	0.500	98	Roof
	0.620	98	Weighted Average
	0.620		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11S: MACYS ROOF

Runoff = 2.15 cfs @ 3.08 hrs, Volume= 0.117 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	0.940	98	Roof
	0.940		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 12S: EDWIN H. LAND BLVD.

Runoff = 8.45 cfs @ 3.09 hrs, Volume= 0.439 af, Depth= 1.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	3.690	98	Pavement
	0.350	74	>75% Grass cover, Good, HSG C
	4.040	96	Weighted Average
	0.350		8.66% Pervious Area
	3.690		91.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 13S: CHARLES PARK

Runoff = 0.58 cfs @ 3.11 hrs, Volume= 0.033 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	0.250	98	Pavement
	0.750	74	>75% Grass cover, Good, HSG C
	1.000	80	Weighted Average
	0.750		75.00% Pervious Area
	0.250		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 14S: LOTUS COURTYARD

Runoff = 0.45 cfs @ 3.10 hrs, Volume= 0.023 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	0.210	98	Pavement
	0.260	74	>75% Grass cover, Good, HSG C
	0.470	85	Weighted Average
	0.260		55.32% Pervious Area
	0.210		44.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 15S: FIRST & ROGER STREET

Runoff = 2.02 cfs @ 3.08 hrs, Volume= 0.110 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	0.880	98	Pavement
	0.880		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 16S: 11 BINNEY STREET

Runoff = 1.90 cfs @ 3.09 hrs, Volume= 0.097 af, Depth= 1.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-year Rainfall=1.72"

	Area (ac)	CN	Description
*	0.240	98	Pavement
*	0.630	98	Roof
	0.150	74	>75% Grass cover, Good, HSG C
	1.020	94	Weighted Average
	0.150		14.71% Pervious Area
	0.870		85.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach 1R: FIRST STREET

Inflow Area = 4.060 ac,100.00% Impervious, Inflow Depth = 1.50" for 1-year event
Inflow = 9.30 cfs @ 3.08 hrs, Volume= 0.507 af
Outflow = 9.30 cfs @ 3.08 hrs, Volume= 0.507 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: LECHMERE CANAL

Inflow Area = 10.600 ac, 88.40% Impervious, Inflow Depth = 1.27" for 1-year event
Inflow = 20.90 cfs @ 3.09 hrs, Volume= 1.118 af
Outflow = 20.90 cfs @ 3.09 hrs, Volume= 1.118 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: MWRA COMBINED SEWER

Inflow Area = 11.470 ac, 86.84% Impervious, Inflow Depth = 1.26" for 1-year event
Inflow = 22.66 cfs @ 3.09 hrs, Volume= 1.209 af
Outflow = 22.66 cfs @ 3.09 hrs, Volume= 1.209 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

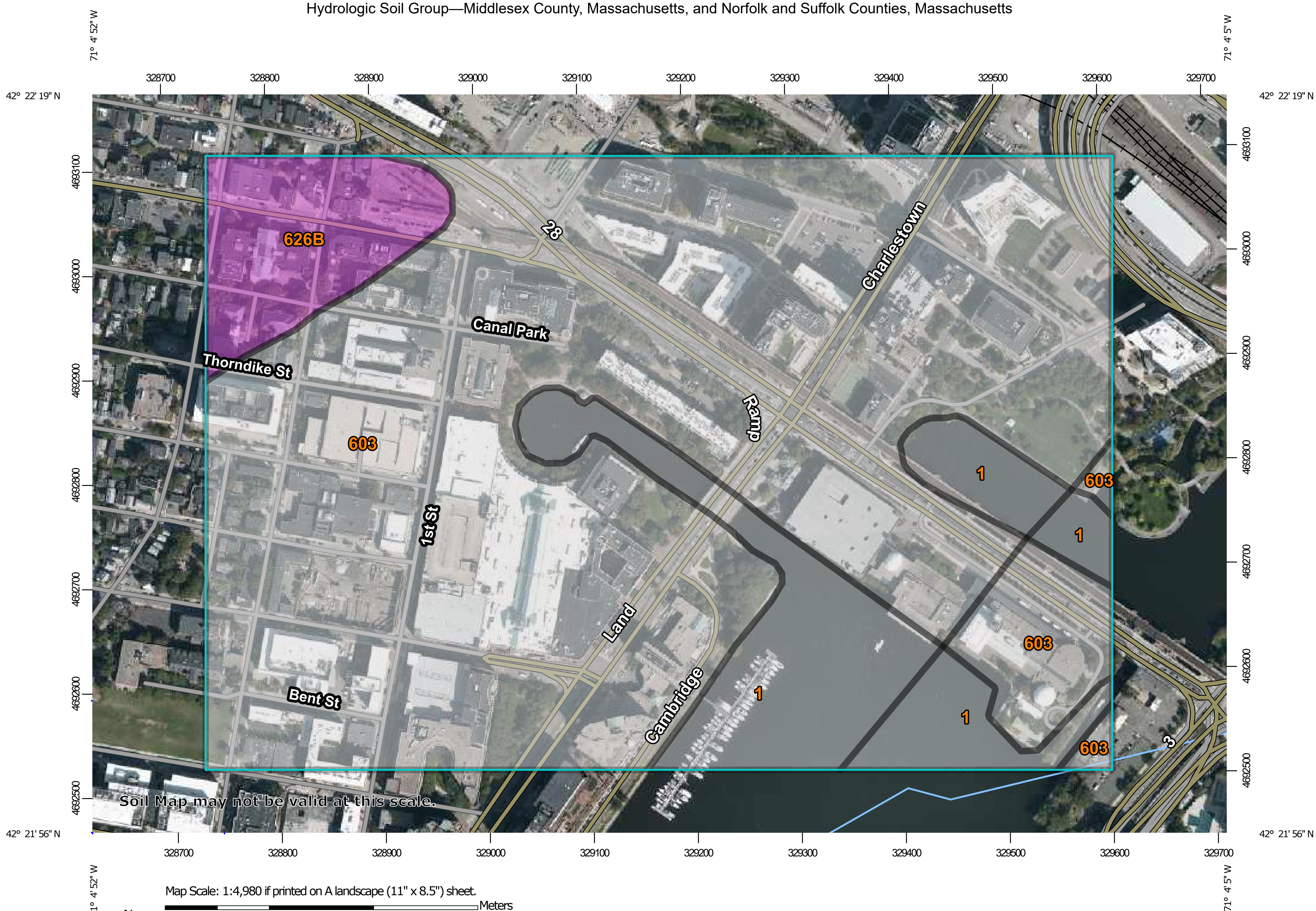
Summary for Link 1L: PROJECT TOTAL

Inflow Area = 22.070 ac, 87.58% Impervious, Inflow Depth = 1.26" for 1-year event
Inflow = 43.56 cfs @ 3.09 hrs, Volume= 2.326 af
Primary = 43.56 cfs @ 3.09 hrs, Volume= 2.326 af, Atten= 0%, Lag= 0.0 min

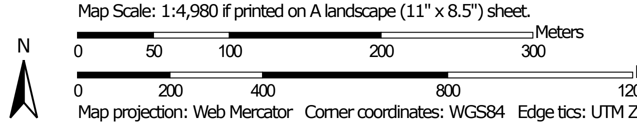
Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Attachment 3

Supporting Documentation



Map Scale: 1:4,980 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 19, Sep 12, 2019

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 15, Sep 12, 2019

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 11, 2019—Oct 5, 2019

MAP LEGEND

MAP INFORMATION

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		13.4	10.5%
603	Urban land, wet substratum		95.4	74.9%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	8.2	6.5%
Subtotals for Soil Survey Area			**117.0**	**91.9%**
Totals for Area of Interest			**127.3**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		4.6	3.6%
603	Urban land, wet substratum, 0 to 3 percent slopes		5.7	4.5%
Subtotals for Soil Survey Area			**10.3**	**8.1%**
Totals for Area of Interest			**127.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: MA

Data description

Data type: Precipitation depth **Units:** English **Time series type:** Partial duration

Select location

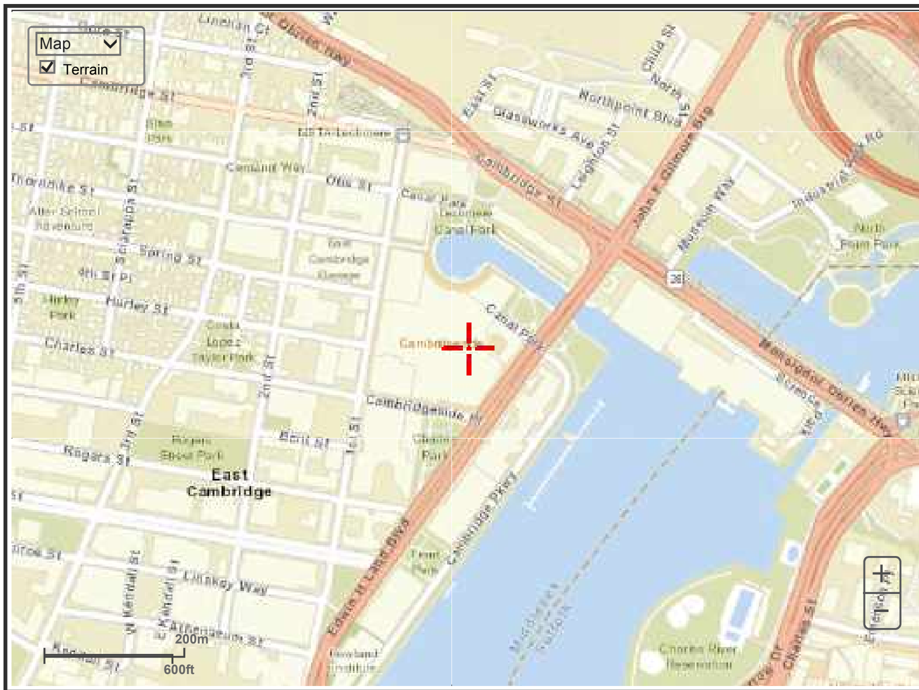
1) Manually:

a) By location (decimal degrees, use "-" for S and W): Latitude: Longitude: Submit

b) By station (list of MA stations): Select station

c) By address 100 Cambridgeside Pl, Cambridge, M

2) Use map (if ESRI interactive map is not loading, try adding the host: **https://js.arcgis.com/** to the firewall, or contact us at hdsc.questions@noaa.gov):



a) Select location
Move crosshair or double click

b) Click on station icon
Show stations on map

Location information:
Name: Cambridge, Massachusetts, USA*
Latitude: 42.3678°
Longitude: -71.0757°
Elevation: 7.71 ft **

* Source: ESRI Maps
** Source: USGS

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 10, Version 2

PF tabular PF graphical Supplementary information Print page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years) 1	2	5	10	25	50	100	200	500	1000
5-min	**0.300** (0.243-0.370)	**0.370** (0.298-0.456)	**0.484** (0.389-0.599)	**0.578** (0.462-0.721)	**0.708** (0.545-0.938)	**0.809** (0.609-1.10)	**0.909** (0.663-1.30)	**1.05** (0.715-1.54)	**1.24** (0.807-1.89)	**1.39** (0.877-2.16)
10-min	**0.425** (0.344-0.524)	**0.524** (0.423-0.646)	**0.685** (0.551-0.849)	**0.819** (0.654-1.02)	**1.00** (0.773-1.33)	**1.15** (0.863-1.56)	**1.29** (0.940-1.84)	**1.49** (1.01-2.18)	**1.76** (1.14-2.68)	**1.96** (1.24-3.06)
15-min	**0.500** (0.404-0.616)	**0.617** (0.497-0.760)	**0.806** (0.648-0.999)	**0.964** (0.769-1.20)	**1.18** (0.909-1.56)	**1.35** (1.01-1.84)	**1.52** (1.11-2.17)	**1.75** (1.19-2.56)	**2.07** (1.35-3.15)	**2.31** (1.46-3.60)
30-min	**0.681** (0.550-0.838)	**0.840** (0.678-1.04)	**1.10** (0.884-1.36)	**1.32** (1.05-1.64)	**1.61** (1.24-2.14)	**1.84** (1.39-2.51)	**2.07** (1.51-2.97)	**2.40** (1.63-3.51)	**2.84** (1.85-4.33)	**3.17** (2.01-4.95)
60-min	**0.861** (0.695-1.06)	**1.06** (0.858-1.31)	**1.40** (1.12-1.73)	**1.67** (1.33-2.08)	**2.05** (1.58-2.71)	**2.34** (1.76-3.19)	**2.63** (1.92-3.77)	**3.05** (2.07-4.46)	**3.61** (2.35-5.50)	**4.04** (2.55-6.29)
2-hr	**1.11** (0.903-1.36)	**1.38** (1.12-1.70)	**1.83** (1.48-2.25)	**2.20** (1.77-2.73)	**2.71** (2.11-3.57)	**3.11** (2.36-4.21)	**3.50** (2.58-5.00)	**4.11** (2.80-5.94)	**4.91** (3.20-7.40)	**5.52** (3.50-8.51)
3-hr	**1.29** (1.06-1.57)	**1.61** (1.32-1.97)	**2.14** (1.74-2.62)	**2.57** (2.07-3.17)	**3.17** (2.47-4.16)	**3.63** (2.77-4.91)	**4.09** (3.03-5.82)	**4.82** (3.29-6.92)	**5.77** (3.77-8.64)	**6.49** (4.13-9.94)
6-hr	**1.68** (1.38-2.04)	**2.09** (1.72-2.53)	**2.75** (2.25-3.35)	**3.30** (2.68-4.05)	**4.06** (3.18-5.28)	**4.65** (3.56-6.22)	**5.23** (3.89-7.36)	**6.14** (4.21-8.73)	**7.33** (4.80-10.9)	**8.23** (5.25-12.5)
12-hr	**2.17**	**2.67**	**3.49**	**4.17**	**5.10**	**5.82**	**6.54**	**7.61**	**9.03**	**10.1**

	(1.80-2.60)	(2.21-3.21)	(2.87-4.21)	(3.41-5.07)	(4.02-6.57)	(4.48-7.70)	(4.87-9.08)	(5.25-10.7)	(5.94-13.2)	(6.46-15.1)
24-hr	**2.62** (2.18-3.12)	**3.25** (2.71-3.88)	**4.28** (3.55-5.13)	**5.13** (4.23-6.20)	**6.31** (5.01-8.07)	**7.22** (5.59-9.48)	**8.13** (6.10-11.2)	**9.51** (6.58-13.3)	**11.3** (7.49-16.4)	**12.7** (8.17-18.8)
2-day	**2.97** (2.50-3.53)	**3.77** (3.16-4.47)	**5.07** (4.23-6.03)	**6.14** (5.09-7.36)	**7.62** (6.10-9.71)	**8.76** (6.85-11.5)	**9.91** (7.52-13.7)	**11.8** (8.19-16.3)	**14.3** (9.46-20.5)	**16.2** (10.4-23.7)
3-day	**3.26** (2.75-3.85)	**4.12** (3.47-4.87)	**5.52** (4.63-6.55)	**6.68** (5.56-7.97)	**8.28** (6.65-10.5)	**9.51** (7.47-12.4)	**10.7** (8.19-14.7)	**12.8** (8.92-17.6)	**15.6** (10.3-22.2)	**17.7** (11.4-25.6)
4-day	**3.54** (2.99-4.16)	**4.42** (3.74-5.21)	**5.86** (4.93-6.93)	**7.06** (5.90-8.40)	**8.71** (7.01-11.0)	**9.98** (7.86-13.0)	**11.2** (8.60-15.4)	**13.4** (9.34-18.3)	**16.3** (10.8-23.0)	**18.4** (11.9-26.6)
7-day	**4.29** (3.65-5.02)	**5.20** (4.42-6.10)	**6.70** (5.67-7.88)	**7.94** (6.67-9.39)	**9.65** (7.81-12.1)	**11.0** (8.66-14.1)	**12.3** (9.41-16.6)	**14.5** (10.1-19.6)	**17.4** (11.6-24.4)	**19.6** (12.7-28.1)
10-day	**4.98** (4.26-5.81)	**5.92** (5.05-6.91)	**7.45** (6.33-8.73)	**8.72** (7.36-10.3)	**10.5** (8.49-13.0)	**11.8** (9.36-15.1)	**13.2** (10.1-17.6)	**15.3** (10.8-20.6)	**18.2** (12.2-25.4)	**20.4** (13.2-29.0)
20-day	**6.97** (6.00-8.06)	**7.99** (6.87-9.26)	**9.66** (8.27-11.2)	**11.0** (9.38-12.9)	**13.0** (10.5-15.8)	**14.4** (11.4-18.0)	**15.9** (12.1-20.6)	**17.8** (12.6-23.7)	**20.4** (13.7-28.0)	**22.3** (14.5-31.3)
30-day	**8.61** (7.44-9.92)	**9.70** (8.37-11.2)	**11.5** (9.86-13.3)	**13.0** (11.0-15.1)	**15.0** (12.2-18.1)	**16.6** (13.1-20.4)	**18.1** (13.7-23.1)	**19.9** (14.1-26.2)	**22.2** (14.9-30.2)	**23.9** (15.6-33.3)
45-day	**10.7** (9.27-12.2)	**11.8** (10.3-13.6)	**13.7** (11.8-15.8)	**15.3** (13.1-17.7)	**17.5** (14.3-21.0)	**19.1** (15.1-23.4)	**20.8** (15.7-26.2)	**22.4** (15.9-29.2)	**24.4** (16.5-33.0)	**25.9** (16.9-35.9)
60-day	**12.4** (10.8-14.2)	**13.6** (11.9-15.6)	**15.6** (13.5-17.9)	**17.2** (14.8-19.9)	**19.5** (16.0-23.3)	**21.2** (16.8-25.8)	**23.0** (17.3-28.7)	**24.4** (17.5-31.8)	**26.3** (17.8-35.4)	**27.7** (18.1-38.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in CSV format: Precipitation frequency estimates Submit

Main Link Categories:
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CambridgeSide 2.0 - Phosphorous Removal Calculations

<u>MA MS4 General Permit Appendix F Attachment 3</u>

Method to determine the phosphorous load reduction for a structural BMP with a known storage volume when the contributing drainage area has impervious and pervious surfaces.

Step 1: Determine BMP type and identify contributing impervious and pervious drainage areas

BMP Type = Infiltration Trench
Infiltration Rate = 2.41 inches/hour

Impervious Area Characteristics

ID	Land Use	Area (acres)
IA1	COM	9.96

Pervious Area Characteristics

ID	Area (acres)	Hydrologic Soil Group (HSG)
PA1	1.51	C

Step 2: Calculate available BMP storage volume

BMP-Volume (ft^3) = 9,840 ft^3

Step 3: Convert BMP storage volume into runoff from contributing impervious area in inches

Solution Iteration 1

$\text{BMP-Volume (IA-in)}_1$ = (BMP-Volume (ft^3) / IA (acre)) x (12 in/ft / 43,560 ft^2/acre)

$\text{BMP-Volume (IA-in)}_1$ = 0.27 inches

Step 4: Calculate runoff volume from all pervious surfaces BMP-Volume (PA-ft^3) for an event with the size of BMP Volume (IA-in)

BMP-Volume (PA-ft^3) = Σ PA x runoff depth $_{(PA1,\ PA2 \ldots PAn)}$ x 3,630 ft^3/acre-in

PA1 runoff depth* = 0.02 inches

BMP-Volume (PA-ft^3) = 110 ft^3

* runoff depth taken from MA MS4 General Permit Appendix F, Table 3-3.

Step 5: Calculate BMP volume available for treating only impervious runoff by subtracting BMP-Volume (PA-ft^3) from BMP-Volume (ft^3) and convert BMP volume into inches of impervious surface runoff, BMP-Volume $(\text{IA-in})_2$

BMP-Volume $(\text{IA-ft}^3)_2$ = BMP-Volume (ft^3) - BMP-Volume $(\text{PA-ft}^3)_1$

BMP-Volume $(\text{IA-ft}^3)_2$ = 9,730 ft^3

BMP-Volume $(\text{IA-in})_2$ = (BMP-Volume $(\text{IA-ft}^3)_2$ / IA (acre)) x (12 in/ft / 43,560 ft^2/acre)

BMP-Volume $(\text{IA-in})_2$ = 0.27 inches

Step 6: Calculate percentage of differences between BMP-Volume $(\text{IA-in})_1$ and BMP-Volume $(\text{IA-in})_2$

BMP-Volume $(\text{IA-in})_1$ = 0.27 inches
BMP-Volume $(\text{IA-in})_2$ = 0.27 inches

If difference is less than 5% proceed to step 7, if difference is 5% or greater update BMP-Volume (IA-in) with BMP-Volume (IA-in)a

Step 7: Use BMP performance curve to determine the percentage of P load

BMP-Volume $(\text{IA-in})_{net}$ = 0.27 inches
IR = 2.41 inches/hour

BMP Reduction (%-P) = 70 %

Step 8: Calculate the cumulative P load reductions by proposed BMP (BMP-Reduction$_{s-P}$) in lbs

Phosphorous Load to BMP

BMP Subarea ID	Land Use	Area (acres)	P export Rate (lb/acre/yr)	BMP Load (lb/yr)
IA1	Commercial	9.96	1.78	17.73
PA1	Landscape (HSG C)	1.51	0.21	0.32
	Total	**11.47**		**18.05**

* phosphorus load export rates taken from MA MS4 General Permit Appendix F, Attachment 3, Table 3-1

BMP Load = 18.05 lb/yr
Required BMP-Reduction = 11.73 lb/yr *** City of Cambridge requires a 65% reduction*

BMP-Reduction$_{lbs-P}$ = BMP Load x (BMP Reduction (%-P) /100)

BMP-Reduction$_{lbs-P}$ = 12.63 lb/yr

CambridgeSide
100 Cambridgeside Place
Cambridge, Massachusetts

MassDEP Standard No. 3 - Groundwater Recharge Calculations

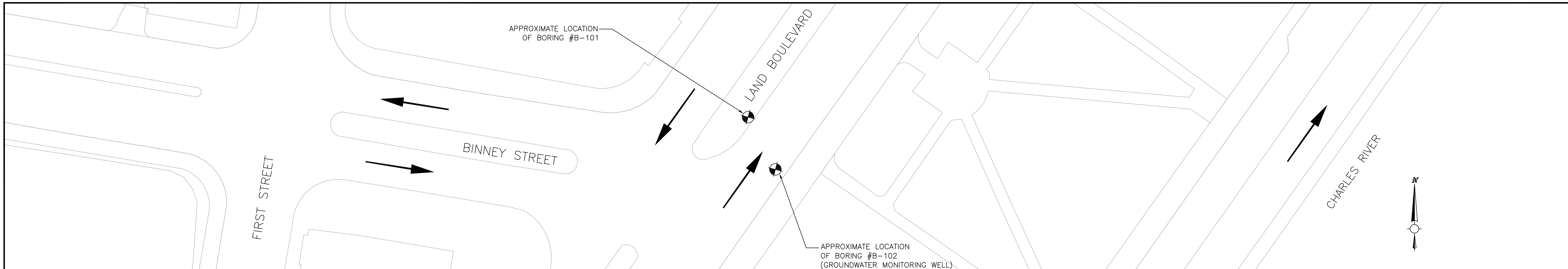
Drawdown Time

$$Time_{drawdown} = \frac{Rv}{(K)\ (Bottom\ Area)}$$

Where: $Time_{drawdown}$ = time it takes the basin to drain completely (hours)
Rv = storage volume (cubic feet)
K = saturated hydraulic conductivity (feet/hour)
Bottom Area = bottom area of recharge structure (square feet)

Subsurface Infiltration Trench	Rv (cf)	K (in/hr)	K (ft/hr)	Bottom Area (sf)	Drawdown Time (hr)
1P	7,997	2.41	0.20083	3,100	12.8
2P	1,843	2.41	0.20083	1,050	8.7

Notes:
1.) Per the 2008 Massachusetts Stormwater Handbook Volume 1, Chapter 1, page 7, infiltration structures must be able to drain fully within 72 hours.
2.) Refer to Volume 3, Chapter 1, page 25 of the 2008 Massachusetts Stormwater Handbook for drawdown analysis guidelines.



FIELD TEST BORING LOG — SHEET 1/2

S E A CONSULTANTS, INC.
Science / Engineering / Architecture
215 First Street
Cambridge, MA 02142

PROJECT: Bending Weir
LOCATION: Land Blvd at Binney St, Cambridge MA
CLIENT: City of Cambridge, MA
WEATHER: Showers AM, 50°

BORING NO: B-101
PROJECT NO: 2003332.02A

Ground Elevation:
Date Started: 01/28/11
Date Finished: 01/31/11
Driller: Technical Drilling Services
Soil Engineer/Geologist: Matthew Zirolli

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION TIME
1/31/11	11.2'	--	30 minutes

Depth ft.	PID (ppm)	Sample No.	Pen/Rec (in/in)	Depth ft.	Blows/6 inches	Strata	Visual Identification of Soil and/or Rock Sample
0	0.0	S-1	24/18	0 - 2	10-8-7-3	FILL: Sand, Gravel, Brick	**S-1: FILL**: Fine sand and nonplastic fines, some brick and asphalt pieces, little subrounded gravel, damp, medium dense, dark brown. (SP)
2	0.0	S-2	24/0	2 - 4	2-2-2-2		**S-2: No Recovery.**
4	0.0	S-3	24/7	4 - 6	0-2-2-2		**S-3: FILL**: Fine to medium sand and brick fragments, some nonplastic fines, little subangular gravel, damp, loose, dark brown & red brick in color. (SP)
6	0.0	S-4	24/4	6 - 8	1-1-1-1	12.0'	**S-4: FILL**: Fine to medium sand, some nonplastic fines, some brick fragments, little angular gravel, trace glass fragments, damp, loose, dark brown & red brick in color. (SP)
14	0.0	S-5	24/13	14 - 16	11-6-6-4	Fine to Medium SAND	**S-5: SAND:** Fine to medium sand, some subrounded gravel, trace coarse sand and nonplastic fines, damp, medium dense, dark gray. (SP)
18	0.0	S-6	24/8	18 - 20	17-10-8-7		**S-6: SAND:** Fine to coarse sand, some subangular gravel, trace nonplastic fines, medium dense, wet, light gray-brown. (SW)
23	0.0	S-7	12/7	23 - 24	12-9	24.0'	**S-7: SAND:** Fine to medium sand, some nonplastic fines, organic odor, wet, medium dense, light gray. (SM)
	0.0	S-7A	12/6	24 - 25	5-7	CLAY (cont.)	**S-7A: CLAY:** Moderately plastic clay fines, stiff, wet, greenish-gray. (CH) Torvane: 0.25 - 0.20 - 0.15 ton / ft^2 Penetrometer: 0.15 - 0.20 - 0.15 ton / ft^2

Notes:

ABBREVIATIONS USED	PROPORTIONS	GRANULAR SOILS BLOWS/FT	GRANULAR SOILS DENSITY	COHESIVE SOILS BLOWS/FT	COHESIVE SOILS DENSITY	EQUIPMENT USED	CASING	SAMPLER	CORE
D=Dry C=Cored W=Washed									
HSA=Hollow Stem Auger	Trace 0 to 10%	0-4	V. LOOSE	<2	V. SOFT				
SS=Split Spoon V=Vane	Little 10 to 20%	4-10	LOOSE	2-4	SOFT	TYPE	HSA	SS	-
BGS=Below Ground Surface	Some 20 to 35%	10-30	M. DENSE	4-8	M. STIFF	ID SIZE (IN)	3 1/4	1 3/8	-
FJ=Flush Joint V=Vane	And 35 to 50%	30-50	DENSE	8-15	STIFF	HAMMER WT (LB)	-	140	-
WOR=Weight of Rod		>50	V. DENSE	15-30	V. STIFF	HAMMER FALL (IN)	-	30	-
WOH=Weight of Hammer				>30	HARD				

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FIELD TEST BORING LOG — SHEET 2/2

S E A CONSULTANTS, INC.
Science / Engineering / Architecture
215 First Street
Cambridge, MA 02142

PROJECT: Bending Weir
LOCATION: Land Blvd at Binney St, Cambridge MA
CLIENT: City of Cambridge, MA
WEATHER: Showers AM, 50°

BORING NO: B-101
PROJECT NO: 2003332.02A

Ground Elevation:
Date Started: 01/28/11
Date Finished: 01/31/11
Driller: Technical Drilling Services
Soil Engineer/Geologist: Matthew Zirolli

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION TIME
1/31/11	11.2'	--	30 minutes

Depth ft.	PID (ppm)	Sample No.	Pen/Rec (in/in)	Depth ft.	Blows/6 inches	Strata	Visual Identification of Soil and/or Rock Sample
28	0	S-8	24/24	28 - 30	6-5-4-4		**S-8: CLAY:** Moderately plastic clay fines, stiff, wet, greenish gray. (CH) Torvane: 0.25 - 0.20 - 0.20 ton / ft^2 Penetrometer: 0.50 - 0.25 - 0.25 ton / ft^2
33	0.0	S-9	24/24	33 - 35	3-2-4-5		**S-9: CLAY:** Moderately plastic clay fines, medium stiff, wet, greenish-gray. (CH) Torvane: 0.20 - 0.25 - 0.15 ton / ft^2 Penetrometer: 0.50 - 0.25 - 0.50 ton / ft^2
38	0.0	S-10	24/24	38 - 40	2-4-5-5		**S-10: CLAY:** Moderately plastic clay fines, stiff, wet, greenish-gray. (CH) Torvane: 0.15 - 0.20 - 0.15 ton / ft^2 Penetrometer: 0.50 - 0.75 - 0.50 ton / ft^2
43	0.0	S-11	24/24	43 - 45	3-3-5-5	Medium Stiff to Stiff CLAY	**S-11: CLAY:** Moderately plastic clay fines, medium stiff to stiff, wet, greenish-gray. (CH) Torvane: 0.25 - 0.20 - 0.15 ton / ft^2 Penetrometer: 0.50 - 0.50 - 0.50 ton / ft^2
48	0.0	S-12	24/24	48 - 50	2-4-5-4		**S-12: CLAY:** Moderately plastic clay fines, stiff, wet, greenish-gray. (CH) Torvane: 0.25 - 0.15 - 0.15 ton / ft^2 Penetrometer: 0.25 - 0.50 - 0.25 ton / ft^2
53	0.0	S-13	24/24	53 - 55	1-1-1-1		**S-13: CLAY:** Moderately plastic clay fines, soft, wet, greenish-gray. (CH) Torvane: 0.15 - 0.10 - 0.10 ton / ft^2 Penetrometer: 0.25 - 0.50 - 0.25 ton / ft^2
58	0.0	S-14	24/24	58 - 60	1-2-5-5	60.0'	**S-14: CLAY:** Moderate plastic clay fines, stiff, wet, greenish-gray. (CH) Torvane: 0.20 - 0.25 - 0.15 ton / ft^2 Penetrometer: 0.50 - 0.25 - 0.25 ton / ft^2
							Bottom of Boring @ 60.0' bgs.

Notes:

ABBREVIATIONS USED	PROPORTIONS	GRANULAR SOILS BLOWS/FT	GRANULAR SOILS DENSITY	COHESIVE SOILS BLOWS/FT	COHESIVE SOILS DENSITY	EQUIPMENT USED	CASING	SAMPLER	CORE
D=Dry C=Cored W=Washed									
HSA=Hollow Stem Auger	Trace 0 to 10%	0-4	V. LOOSE	<2	V. SOFT				
SS=Split Spoon V=Vane	Little 10 to 20%	4-10	LOOSE	2-4	SOFT	TYPE	HSA	SS	-
BGS=Below Ground Surface	Some 20 to 35%	10-30	M. DENSE	4-8	M. STIFF	ID SIZE (IN)	3 1/4	1 3/8	-
FJ=Flush Joint V=Vane	And 35 to 50%	30-50	DENSE	8-15	STIFF	HAMMER WT (LB)	-	140	-
WOR=Weight of Rod		>50	V. DENSE	15-30	V. STIFF	HAMMER FALL (IN)	-	30	-
WOH=Weight of Hammer				>30	HARD				

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FIELD TEST BORING LOG — SHEET 1 of 1

S E A CONSULTANTS, INC.
Science / Engineering / Architecture
215 First Street, Suite 320
Cambridge, MA 02142

PROJECT: Bending Weir
LOCATION: Land BLVD @ Binney St.
CLIENT: Cambridge MA
WEATHER: Cloudy 50's

BORING NO: B-102
PROJECT NO: 203332.02A

Ground Elevation: unknown
Date Started: 4/12/2011
Date Finished: 4/12/2011
Driller: Joe D
Soil Engineer/Geologist: Will Weddig

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION TIME

Depth (ft)	PID (ppm)	Sample No.	Pen/Rec (in/in)	Depth (ft)	Blows/6 inches	Strata	Visual Identification of Soil and/or Rock Sample
0		n.a.	n.a.	0-6"	Auger	Road	6" Asphalt
6		n.a.	n.a.	0'6" - 6'	Auger	Fill	Sandy Fill - Sandy Fill with trace gravel. Dry, Brown
10		S-1	24/10	10'-12'	16-10-5-4	Fill	Fill: Well graded sand with little medium to large gravel Brown, wet, medium dense
15		S-2	24/6	15'-17'	26-10-10-8	Fill	Fill: Well graded sand with some medium to large gravel Gray, wet, medium dense
17		S-3	24/6	17-19	11-10-12-23	Fill 19.5'	Fill: Well graded sand with some medium to large gravel Gray, wet, medium dense
20		S-4	24/14	20-22	13-15-18-21	Sand	Sand: Fine to medium sand with trace gravel gray, wet, dense
22		S-5	24/18	22-24	22-16-23-23	Sand 25'	Sand: Fine to medium sand with trace gravel gray, wet, dense
25		S-6	24/20	25-27	5-6-5-8	Clay	**Clay:** Boston Blue Clay, stiff Torvane = .45 P.P. = .6 and .8
28		S-7	24/19	28-30	Tube	Clay	**Tube from 28'-30' R=19" (5" from top of tube)**
30		S-8	24/18	30-32	5-5-4-4	Clay	**Clay:** Boston Blue Clay, stiff Torvane = .42 P.P. = .5
35		S-9	24/18	35-37	Tube	Clay	**Tube from 37'-39' R=18" (6" from top of tube)**
37		S-10	24/24	37-39	4-3-2-2	Clay	**Clay:** Boston Blue Clay, medium stiff Torvane = .45 P.P. = 1.2
43		S-11	24/24	43-45	2-3-4-4	Clay	**Clay:** Boston Blue Clay, medium stiff Torvane = .58 P.P. = .8
							End of Boring at 45'

Notes: 30' Well was installed at this location. Roadbox is apx. 4ft off of curb into the street and 8 feet from the crosswalk.

ABBREVIATIONS USED	PROPORTIONS	GRANULAR SOILS BLOWS/FT	GRANULAR SOILS DENSITY	COHESIVE SOILS BLOWS/FT	COHESIVE SOILS CONSISTENCY	EQUIPMENT USED	CASING	SAMPLER	CORE
D=Dry C=Cored W=Washed									
HSA=Hollow Stem Auger	Trace 0 to 10%	0-4	V. LOOSE	<2	V. SOFT				
SS=Split Spoon V=Vane	Little 10 to 20%	4-10	LOOSE	2-4	SOFT	TYPE	HSA	SS	
BGS=Below Ground Surface	Some 20 to 35%	10-30	M. DENSE	4-8	M. STIFF	ID SIZE (IN)	3-3/4"	1.375"	
FJ=Flush Joint V=Vane	And 35 to 50%	30-50	DENSE	8-15	STIFF	HAMMER WT (LB)		140	
WOR=Weight of Rod		>50	V. DENSE	15-30	V. STIFF	HAMMER FALL (IN)		30"	
RQD=Rock Quality Designation				>30	HARD				

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RECORD SET

MWH
BOSTON
MASSACHUSETTS

KLEINFELDER · S E A
Bright People. Right Solutions.
MANCHESTER, NEW HAMPSHIRE ROCKY HILL, CONNECTICUT
CAMBRIDGE, MASSACHUSETTS

Scale	AS NOTED
Date	MARCH 2014
Job No.	1007289
Designed by	DHC
Drawn by	KAP
Checked by	KMR
Approved by	

No.	Description	Date
	REVISIONS	

THE WORKS
CAMBRIDGE DEPARTMENT OF PUBLIC

CITY OF CAMBRIDGE, MASSACHUSETTS

CAM 017 COMBINED SEWER OVERFLOW REGULATOR IMPROVEMENTS AND DRAINAGE INSTALLATION

GENERAL
SOIL BORING DETAILS

Sheet No. G-3
File No.