VOLUME 3A

supporting the innovation agenda

APPENDICES

Martin Luther King, Jr. School Construction Project

JULY 31, 2012

Cambridge City Council Members
Mayor – Henrietta Davis
Vice Mayor – E. Denise Simmons
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Minka vanBeuzekom

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Construction Project Manager – Michael J. Black

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Alice Turkel

Cambridge Public Schools
Superintendent of Schools – Dr. Jeffrey Young
Deputy Superintendent – Dr. Carolyn L. Turner
Chief Operating Officer – James Maloney

City of Cambridge

Perkins Eastman

ACKNOWLEDGEMENTS

On behalf of the Perkins Eastman Team we would like to acknowledge and thank the leadership team identified on the cover of this Volume as well as those listed below, who participated and made the timely completion of the Feasibility Study for the Martin Luther King, Jr. School Construction Project possible. Many others, too numerous to name them all, also contributed to this document that will provide the appropriate framework for completing the design, documentation and construction that will transform the Martin Luther King, Jr. School into a true 21st century learning environment.

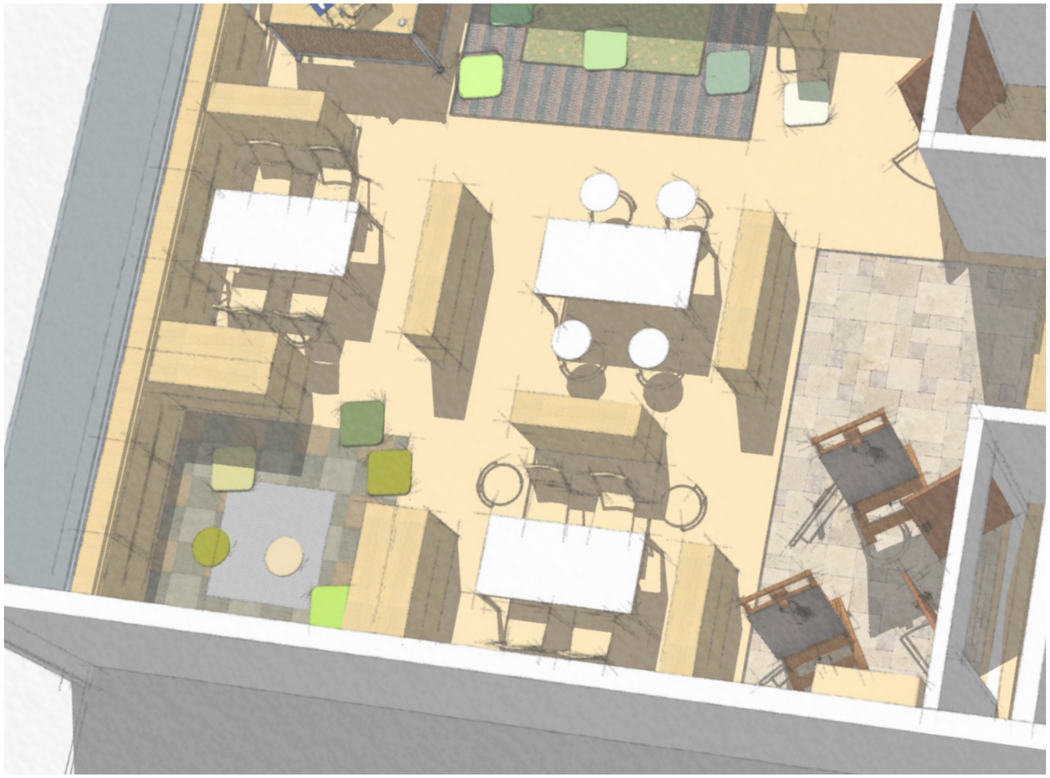
Cambridge Public Schools:
City of Cambridge Public School staff and administrators

Cambridge Human Services Department:
City of Cambridge Human Services Department staff and administrators.

Perkins Eastman Architects PC: Architecture, Educational Specification / Visioning, and FF&E:
Sean O'Donnell, John Pears, Jana Silsby, Alicia Caritano, Erik Dalen, and Jill Garzik

The Entire Design Consultant Team:
Acentech – Acoustics and Audiovisual
AKF – Mechanical, Electrical, Plumbing and Fire Protection Engineering
Boyes-Watson Architects – Community Outreach
Crabtree McGrath – Foodservice
Davis Langdon – Cost Estimating
Foley Buhl Roberts & Associates – Structural Engineering
Fuss & O'Neil EnviroScience, LLC – Hazardous Materials
In Posse – Net Zero
Linnean Solutions – Embodied Energy
Nitsch Engineering – Civil Engineering, Land Survey, and Traffic Engineering
School Scheduling Associates – Scheduling

Owner's Consultants:
CDM Smith – Environmental and Geotechnical Engineering
Stephen Turner Inc. – Commissioning



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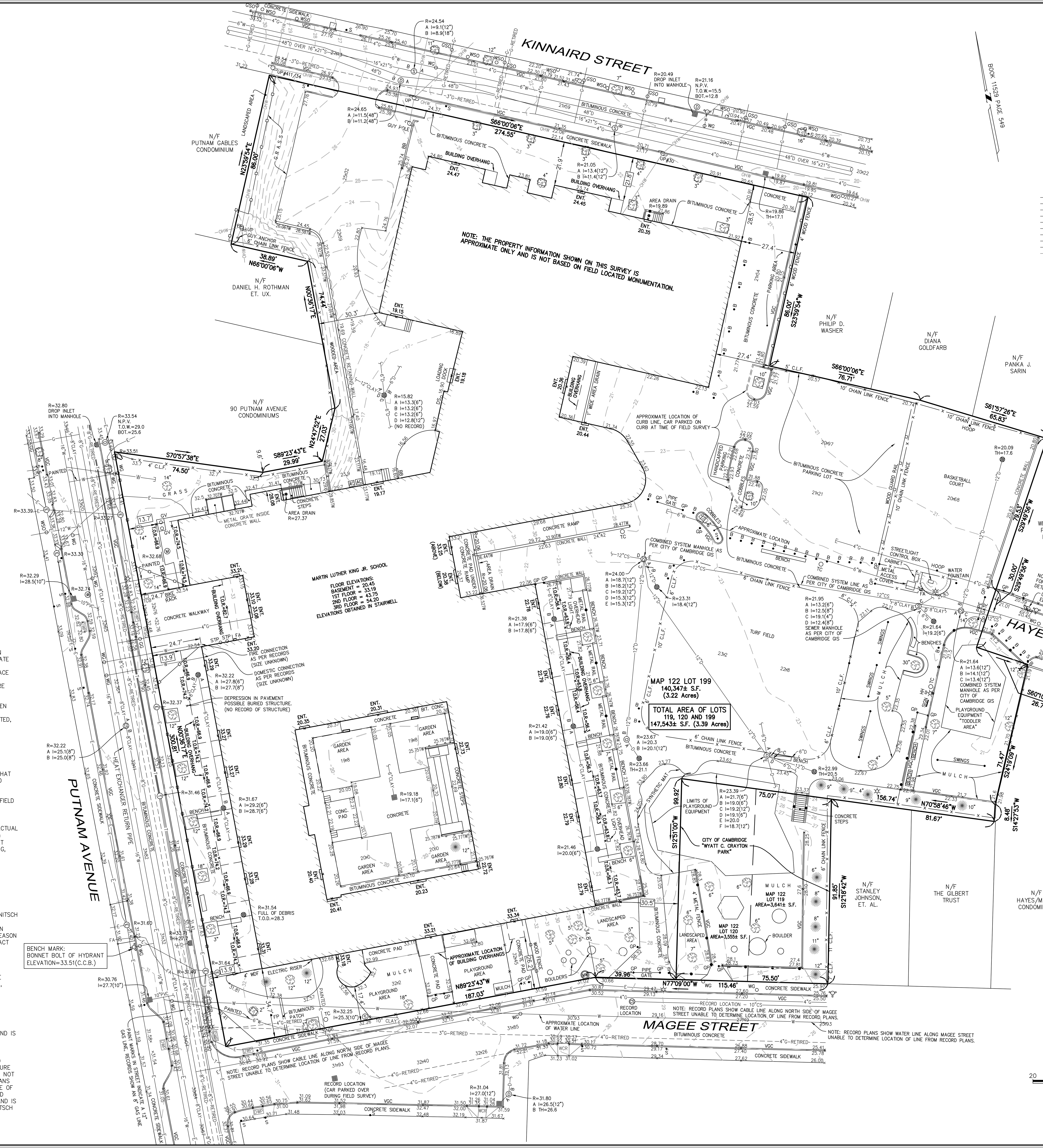
1.0 LAND SURVEY



LEGEND

- CATCH BASIN
- (CS) COMBINED SYSTEM MANHOLE
- (D) DRAIN MANHOLE
- (E) ELECTRIC MANHOLE
- (M) MISCELLANEOUS MANHOLE
- (S) SEWER MANHOLE
- (T) TELEPHONE MANHOLE
- (W) WATER MANHOLE
- HYDRANT
- UP#30 UTILITY POLE
- GV MISCELLANEOUS GATE VALVE
- GP GATE POST
- FP FLAG POLE
- FA FIRE ALARM CALL BOX
- S SIGN POST
- B BOLLARD
- TC TRASH CAN
- HH HAND HOLE
- LIGHT POST
- HOOP BASKETBALL HOOP
- WG WATER GATE
- GSO GAS SHUT OFF VALVE
- WSO WATER SHUT OFF VALVE
- —CS— UNDERGROUND COMBINED SYSTEM LINE
- —D— UNDERGROUND DRAINAGE LINE
- —E— UNDERGROUND ELECTRIC LINE
- —FA— UNDERGROUND FIRE ALARM LINE
- —G— UNDERGROUND GAS LINE
- — —G-RETIRED— — UNDERGROUND RETIRED GAS LINE
- —S— UNDERGROUND SEWER LINE
- —T— UNDERGROUND TELEPHONE LINE
- —W— UNDERGROUND WATER LINE
- —OHW— OVERHEAD WIRES
- ENT. BUILDING ENTRANCE ELEVATION
- CONC. CONCRETE
- BB BITUMINOUS BERM
- VGC VERTICAL GRANITE CURB
- R= RIM ELEVATION EQUALS
- I= INVERT ELEVATION EQUALS
- TH= TOP OF HOOD ELEVATION EQUALS
- T.O.W.= TOP OF WATER ELEVATION EQUALS
- T.O.D.= TOP OF DEBRIS ELEVATION EQUALS
- BOT.= BOTTOM OF STRUCTURE ELEVATION EQUALS
- N.P.V. NO PIPES VISIBLE
- C.C.B. CITY OF CAMBRIDGE BASE VERTICAL DATUM
- T.O.R.= TOP OF ROOF ELEVATION EQUALS
- C.L.F. CHAIN LINK FENCE
- WDF WOOD FENCE
- 30x93 SPOT GRADE ELEVATION
- 32.90TW TOP OF WALL ELEVATION
- DWP DETECTABLE WARNING PANEL
- WCR WHEELCHAIR RAMP
- 12" CONIFEROUS TREE WITH TRUNK DIAMETER
- 12" DECIDUOUS TREE WITH TRUNK DIAMETER
- ←24.7'→ SETBACK FROM FOUNDATION TO PROPERTY LINE
- ←[26.2']→ SETBACK FROM OVERHANG TO PROPERTY LINE

UTILITY INFORMATION STATEMENT

1. THE SUB-SURFACE UTILITY INFORMATION SHOWN HEREON IS COMPILED BASED ON FIELD SURVEY INFORMATION, RECORD INFORMATION AS SUPPLIED BY THE APPROPRIATE UTILITY COMPANIES, AND PLAN INFORMATION SUPPLIED BY THE CLIENT, IF ANY; THEREFORE WE CANNOT GUARANTEE THE ACCURACY OF SAID COMPILED SUB-SURFACE INFORMATION TO ANY CERTAIN DEGREE OF STATED TOLERANCE. ONLY PHYSICALLY LOCATED SUB-SURFACE UTILITY FEATURES FALL WITHIN NORMAL STANDARD OF CARE ACCURACIES.

2. THE LOCATIONS OF UNDERGROUND PIPES, CONDUITS, AND STRUCTURES HAVE BEEN DETERMINED FROM SAID INFORMATION, AND ARE APPROXIMATE ONLY. COMPILED LOCATIONS OF ANY UNDERGROUND STRUCTURES, NOT VISIBLY OBSERVED AND LOCATED, CAN VARY FROM THEIR ACTUAL LOCATIONS.

3. ADDITIONAL BURIED UTILITIES/STRUCTURES MAY BE ENCOUNTERED.

4. THE STATUS OF UTILITIES, WHETHER ACTIVE, ABANDONED, OR REMOVED, IS AN UNKNOWN CONDITION AS FAR AS OUR COMPILATION OF THIS INFORMATION.

5. IT IS INCUMBENT UPON INDIVIDUALS USING THIS INFORMATION TO UNDERSTAND THAT COMPILING UTILITY INFORMATION IS NOT EXACT, AND IS SUBJECT TO CHANGE BASED UPON VARYING PLAN INFORMATION RECEIVED AND ACTUAL LOCATIONS.

6. THE ACCURACY OF MEASURED UTILITY INVERTS AND PIPE SIZES IS SUBJECT TO FIELD CONDITIONS, THE ABILITY TO MAKE VISUAL OBSERVATIONS, DIRECT ACCESS TO THE VARIOUS ELEMENTS AND OTHER MATTERS.

7. THE PROPER UTILITY ENGINEERING/COMPANY SHOULD BE CONSULTED AND THE ACTUAL LOCATIONS OF SUBSURFACE STRUCTURES SHOULD BE VERIFIED IN THE FIELD (V.I.F.) BEFORE PLANNING FUTURE CONNECTIONS. CONTACT THE DIG SAFE CALL CENTER AT 1-888-344-7233, SEVENTY-TWO HOURS PRIOR TO EXCAVATION, BLASTING, GRADING, AND/OR PAVING.

NOTES

1.) THIS DOCUMENT IS AN INSTRUMENT OF SERVICE OF NITSCH ENGINEERING. IT IS ISSUED TO PERKINS EASTMAN FOR PURPOSES RELATED DIRECTLY AND SOLELY TO NITSCH ENGINEERING'S SCOPE OF SERVICES UNDER CONTRACT WITH PERKINS EASTMAN FOR TOPOGRAPHIC AND PROPERTY SURVEY AT THE MARTIN LUTHER KING, JR. SCHOOL IN CAMBRIDGE, MASSACHUSETTS. ANY USE OR REUSE OF THIS DOCUMENT FOR ANY REASON BY ANY PARTY FOR PURPOSES UNRELATED DIRECTLY AND SOLELY TO SAID CONTRACT AND PROJECT SHALL BE AT THE USER'S SOLE AND EXCLUSIVE RISK AND LIABILITY, INCLUDING LIABILITY FOR VIOLATION OF COPYRIGHT LAWS, UNLESS WRITTEN AUTHORIZATION IS GIVEN THEREFOR BY NITSCH ENGINEERING.

2.) THE PURPOSE OF THIS PLAN IS TO SHOW TOPOGRAPHY AND PROPERTY AS THE RESULT OF AN ON-THE-GROUND INSTRUMENT SURVEY WHICH OCCURRED IN MARCH, 2012.

3.) HORIZONTAL COORDINATES REFER TO AN ASSUMED SYSTEM.

4.) ELEVATION REFERS TO CITY OF CAMBRIDGE VERTICAL DATUM.

5.) THE PROPERTY INFORMATION SHOWN ON THIS SURVEY IS APPROXIMATE ONLY AND IS NOT BASED ON FIELD LOCATED MONUMENTATION.

6.) THE INFORMATION CONTAINED ON THE DISK OR ELECTRONIC DRAWING FILE ACCOMPANYING THIS PLAN MUST BE COMPARED TO THE SEALED AND SIGNED HARD COPY OF THE PLAN TO ENSURE THE ACCURACY OF ALL INFORMATION AND TO ENSURE NO CHANGES, ALTERATIONS, OR MODIFICATIONS HAVE BEEN MADE. RELIANCE SHALL NOT BE MADE ON A DOCUMENT TRANSMITTED BY COMPUTER OR OTHER ELECTRONIC MEANS UNLESS FIRST COMPARED TO THE ORIGINAL SEALED DOCUMENT ISSUED AT THE TIME OF THE SURVEY. DUE TO THE CRITICAL NATURE OF SURVEYING, DATA ACQUISITION, AND AUTOCAD PLAN DEVELOPMENT, IF CRITICAL DIMENSIONAL INFORMATION IS NEEDED AND IS NOT SPECIFICALLY SHOWN ON THE ELECTRONIC DRAWING FILE, PLEASE CONTACT NITSCH ENGINEERING.

GRAPHIC SCALE

20 10 0 20 40 60

SCALE: 1"=20'

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TOPOGRAPHIC PLAN OF LAND

MARTIN LUTHER KING, JR. SCHOOL
CAMBRIDGE, MASSACHUSETTS

PREPARED FOR:
PERKINS EASTMAN
50 FRANKLIN STREET, SUITE 402, BOSTON, MA 02110

REV.	COMMENTS	DATE
B	ADDED SETBACKS, REVISED AREAS	5/23/12
A	ADDED SETBACKS, REVISED AREAS	5/8/12

REVISIONS

PROJECT #	8837.2
FILE:	8837.2_TOPO1.dwg
SCALE:	1"=20'
DATE:	APRIL 25, 2012
DES./COMP:	PSL
FIELD BOOK:	539
DRAFTED BY:	TAL
CHECKED BY:	

SHEET: 1

EX-1

OF 1 REV. A

2.0 GEOTECHNICAL AND ENVIRONMENTAL EXECUTIVE SUMMARY

Summary of Geotechnical/Environmental Findings

Geotechnical Findings

CDM Smith has conducted subsurface exploration and laboratory testing programs and prepared a report presenting the investigation results and preliminary geotechnical design recommendations and construction considerations for the Upgrade/Replacement at the MLK Amigos School located in Cambridge, Massachusetts.

The MLK Amigos School is located in a residential area at 100 Putnam Avenue in Cambridge, Massachusetts. The existing cast-in-place concrete building houses two separate schools: the Martin Luther King, Jr. (MLK) School and the Amigos School. The proposed construction for the MLK Amigos School Upgrade/Replacement project includes the conversion of the existing MLK Amigos School building into a combined K through 5th lower school, and 6th through 8th upper school. The conversion will include separate entrances and interior spaces for each school. This conversion may include the demolition of the existing building and replacement with a new structure.

CDM Smith reviewed available geotechnical data and geologic information in the site vicinity, and conducted a subsurface exploration program, which included six (6) test borings drilled to depths ranging from 37 to 77 feet and one monitoring well. Geotechnical and environmental laboratory testing were conducted on select soil samples.

Based on the test borings conducted and our understanding of the local geology, subsurface soil conditions were interpreted and include miscellaneous fill, locally present organic soils, sand and gravel and marine clay overlying glacial till.

- Fill: Fill was encountered at all of the recent test boring locations and with variable content, including fine to coarse SAND or Clayey SILT to CLAY and SILT, with variable amount of gravel, trace amounts of asphalt, concrete and/or brick fragments. The Fill ranged from approximately 4.5 to 18 feet thick at the recent test boring locations.

- Organic Soils: An Organic Soils stratum was encountered at CDM-6 and is approximately 8.5 feet thick. The stratum consisted of approximately 4 feet of medium stiff to stiff, slightly organic SILT & CLAY, some fine to coarse sand, trace fine gravel, and a layer of very loose to medium dense, organic SAND, some silt, trace fine gravel.

- Sand and Gravel: Sand and Gravel stratum was encountered at CDM-MW-2 and is approximately 11.5 feet thick. The stratum consisted of dense, brown to gray, fine to coarse SAND, some fine to coarse gravel, trace clay & silt.

- Marine Clay: Marine Clay was encountered at all of the recent test boring locations. The upper portion of the marine clay layer generally consisted of about 15 to 25 feet crust, typically stiff soft to hard, brown to gray, Clayey SILT to CLAY & SILT, trace fine to coarse sand, trace gravel. Beneath the crust, the marine clay generally consisted of stiff to very soft, gray, Clayey SILT to CLAY & SILT. Where fully penetrated, the marine clay stratum thickness was approximately 48 feet and 66.5 feet.

- Glacial Till: Glacial Till was encountered at two of the recent test boring locations at depths of approximately 56 and 73.5 feet below ground surface. The stratum consisted of moist to wet, very dense, gray, fine to coarse GRAVEL and fine to coarse SAND, little clay & silt.

Groundwater levels were measured approximately 6.5 feet to 14.3 feet below ground surface (approximately El. 17.2 to El. 22.0) where encountered in the boreholes at the completion of drilling, and at 6.2 feet below ground surface (approximately El. 24.3) at monitoring well CDM-MW-2 on January, 27, 2012.

Based on the results of field and laboratory testing programs, our understanding of the site geology, and assuming that the project will include demolition of the existing school facility and design and construction of new school building similar in size to the existing structure with up to three stories, shallow foundation consisting of spread footing is recommended for support of the proposed facility.

For the purposes of preliminary design, it is assumed that the new building would be supported by spread footings with typical column loads of approximately 150 kips and 20-foot by 20-foot typical column spacing. The spread footings may be designed for a maximum bearing pressure of 2.0 tons per sq. ft. (tsf) bearing on naturally deposited, undisturbed Marine Clay or Sand and Gravel strata or compacted structural fill placed after the removal of existing fill, organic soils, or any loose or disturbed soils present at foundation subgrade level. Associated foundation settlement is estimated to be less than 1.5 inches with no more than 0.75 inches of differential settlement. However, if the existing site grades are raised greater than 1 foot, settlement of the site should be anticipated and evaluation of the resulting settlement and impacts on existing and proposed structures should be conducted. For the purpose of determining design earthquake forces for the proposed structures in accordance with Section 1613.5.3 of the Code, the site should be considered as Site Class “D”.

Lowest level slabs should be designed as slabs on grade or mat foundations bearing on a minimum of 12-inches of compacted structural fill over suitable bearing soil unless otherwise specified. For the purpose of design, the design groundwater level should be 5 feet below ground surface.

Over-excavation up to approximately 10 feet below the foundation subgrade level is anticipated to be necessary in some locations to remove unsuitable soils, including fill, organic soils, or other loose or disturbed soil, and replacement with structural fill.

Since demolition and excavation activities are anticipated to be made adjacent to existing roadways and utilities, protection of existing facilities is necessary. Pre-construction survey, settlement monitoring and vibration monitoring are recommended.

Additional geotechnical explorations and laboratory testing will be required for final design of this project, depending on the final building location, geometry and foundation loads.

Environmental Findings

CDM Smith conducted a site visit including a site walk and interview with an on-site employee. The purpose of the site visit was to determine whether or not any recognized environmental concerns (RECs) exist at the site. There is an approximately 20,000 gallon fuel oil underground storage tank (UST) located near the front entrance of the school along Putnam Street which may require removal during construction. There were no other RECs identified at the site which may impact future construction activities.

In addition, an Environmental Data Resources (EDR) report was obtained for the site. The EDR report contains certified Sanborn maps from 1888 to the present as well as a Radius Report summarizing other properties within a 1-mile radius which have been reported as sites of release. No issues of concern were identified based on a review of the information provided in this report.

During the soil boring program conducted in December 2011, CDM Smith collected soil samples from six boring locations. These samples were submitted for laboratory analysis to Alpha Analytical Laboratories in Westborough, MA. The samples were collected in what appeared to be historic fill soil, roughly the top 8 feet on the property.

The purpose of the sampling and analysis was to determine the quality of historic fill soils at the property in regard to their chemical characteristics. The chemical quality of the soils may impact its on-site reuse or off-site disposal which may have implications in regard to project cost and schedule. In addition, the sample data was used to evaluate whether there are any implications in regard to the Massachusetts Contingency Plan (MCP).

In order to obtain a comprehensive view of the soil quality, the approach was to analyze the samples for a range of potential contaminants of concern providing information that can be used to evaluate soil reuse and/or disposal. The following is a list of parameters analyzed and the number of samples for each analysis.

- RCRA 8 Metals (RCRA 8) - 10 samples
- Extractable Petroleum Hydrocarbons (EPH) - 7 samples
- Volatile Organics (VOCs) - 4 samples
- Semivolatile Organics (SVOCs) - 3 samples
- Polychlorinated Biphenyls (PCBs) - 3 samples
- Total Petroleum Hydrocarbons (TPH) - 3 samples

The results from the laboratory were compared to RCS-1 criteria. This is the reporting criteria established by MassDEP to indicate when they are to be informed of the presence of a site of release and in a more general way, where soils are formally regulated under the MCP. The RCS-1 criteria are the most stringent reporting criteria and are applicable to schools and residential land use. The data was below the RCS-1 criteria.

Therefore, based on our field observations and comparison of the data to the RCS-1 criteria, the property does not have a reportable condition under the MCP. Where some analytical parameters, particularly metals, were detected in the soil, they suggest either natural concentrations or mildly impacted urban fill soil that is safe to reuse on the property.

Any excess excavated soil will need to be stockpiled and each 500 cubic yard pile sampled and analyzed for off-site reuse or disposal in accordance with MassDEP and facility requirements. The soil may then be conveyed to a “less than RCS-1 facility” if available or to an unlined landfill. Where it can go at the time of construction will depend on facility availability, the chemical quality of the individual stockpiles and the physical quality considering the potential reuse.

3.0 DRAFT OPR: OWNER'S PROJECT REQUIREMENTS

Martin Luther King Jr. School Renovation Project

OWNER'S PROJECT REQUIREMENTS

STEPHEN TURNER INC.
Building Better Performance

OPR Review Documentation

Updated: May 15, 2012

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Introduction

The goal of this OPR is to capture what the owner wants and expects. It serves as the owner's way of communicating and aligning desires with the design team's conceptual thinking. The OPR is updated throughout the project beginning with the Design Phase and particularly on this project, the feasibility study. This documentation is a narrative description that describes what the owner views as a successful project, which in turn helps the project team deliver one by utilizing this document throughout the process. A preliminary outline of more detailed considerations is attached as an appendix.

Existing Building Description

This cast in place, reinforced concrete frame building was built in 1971 as a kindergarten through 8^{th} grade school. This two and three story building has a gross square footage of 159,400 square feet. There is a partial mechanical equipment basement with crawls spaces for distribution of mechanical plumbing systems. The column bay spacing is 20′- 0″ x 20′- 0″ with vertical interior clearance of 10′-0″. The exterior walls are a combination of grooved CMU walls on pre-cast concrete panels and cast-in-place concrete wall panels. The roof is flat with a single ply membrane and standing seam metal roof over the atrium.

General Project Description

The renovation project entails the conversion of an existing 159,400 square foot cast in place concrete structure building built in 1971 into a combined K through 5^{th} lower school and an expanded 6 through 8 upper school. Separate entrances and interior spaces are required for each school.

The first deliverable for the project is a feasibility study that shall provide the City a recommendation if the present building is capable of supporting all of the new programming envisioned or should the existing building be demolished and a new building designed. A full zoning analysis shall be part of the study recommendation and a detailed budget estimate.

Key Project Requirements

This Owner's Project Requirements document will record the project aspects that are important to address to ensure that the Owner is satisfied with the final project. The Owner's Project Requirements documentation is mutually beneficial to both the design team and the owner by documenting key project requirements, and supporting an integrated approach to project design and delivery. The Owner's Project Requirements will be used to guide the commissioning process throughout the project, including the first year of operation. Ultimately, the commissioning process seeks to verify and document that the final built project satisfies all the documented elements of the Owner's Project Requirements.

Listed below are some of the Owner's Project Requirements that were defined in the Designers RFP Bid 1565. The building will need to house approximately 650 students and 60 staff members during the school day. During early design, Stephen Turner Inc. will help the project team develop additional, project-specific elements of the Owner's Project Requirements.

In order to incorporate information being gathered by the design team in the feasibility phase, Stephen Turner Inc. proposes to work with the design team to determine what elements detailed below have already been addressed in their work with the owner's team. After the design team's progress to date is incorporated where appropriate into this document, then Stephen Turner Inc. proposes to develop answers to the remaining elements of this Owner's Project Requirements document, through a workshop, an email survey, or an online survey – or some combination of these.

The Owner's Project Requirements effort seeks to verify and document answers to this question: What are the measurable performance criteria that will determine if this project is a success or not? Stephen Turner Inc. will seek to ensure that every team member has an understanding of the Owner's Project Requirements. A review of requirements, core values and goals established to date is presented here and will be updated in future.

Overall Environmental & Sustainability Goals

The City of Cambridge seeks to lead by example in reducing and minimizing greenhouse gas emissions and other environmental impacts of its facilities. The City of Cambridge has a municipal standard of achieving at a minimum LEED Silver rating for this major municipal building project. A higher LEED rating will be sought if feasible. LEED for Schools is the rating system that will be focused on and used for this project. Net Zero is also being considered by the Owner, and after the feasibility study is complete the project will have narrowed down the EUI goal for the project. The intent is for environmental goals to be achieved in manner that ultimately provides a safe and healthy environment for building occupants with minimal negative impact on the local, regional and global environment. It is the Owner's objective that the Designer address and recommend in the feasibility study areas of possible actions to take that could provided Net Zero systems to the project.

The Commonwealth's Stretch Energy Code is in effect in Cambridge MA. This code requires higher energy efficiency levels in new construction and additions to residential and commercial buildings, and in major home renovations. Adopting this code increases the eligibility for state grant funding.

To reach the goals that the City of Cambridge has established, the team will be working together in the first preliminary and feasibility stages of the project to determine the best design process to move forward with.

The creative analysis process is comprised of:

1. Educational Programming – ongoing focus group meetings with the City of Cambridge and the School Department
2. Existing Conditions Investigations
3. Design Options
    a. Renovation
    b. Hybrid, renovation/addition
    c. New construction

Net Zero Workshop

The City and Schools committee held a Net Zero workshop in the preliminary stage of the project to discuss options with the design team for achieving their goal of a Net Zero school. Stephen Turner Inc. participated in this workshop; relevant results are incorporated into this Owner's Project Requirements document.

Sustainability & Environmental Elements

1. LEED for Schools 2009 - LEED Silver Certification minimum
    a. Sustainable Sites
    b. Water Efficiency
    c. Energy & Atmosphere
    d. Materials & Resource
    e. Indoor Environmental Quality
    f. Innovation & Design
2. Provides a safe and healthy environment for building occupants with minimal negative impact on the local, regional and global environment
3. Indoor Environmental Quality has a major impact on the quality of the learning environment through the following:
    a. Access to daylights and views

   b. Acoustics
   c. Indoor Air Quality
   d. Thermal comfort
   e. Controllability of systems
4. Address and recommend areas of possible actions to take that could provide Net Zero systems to the project

[Note – more elements to be added here throughout the remainder of the design process.]

Energy-Efficiency Goals

In addition to the Commonwealth Stretch Energy Code, other applicable codes include:

Code Type	Applicable Code (Model Code Basis)
Building	780 CMR: Massachusetts State Building Code, 8th Edition (2009 International Building Code) (2009 International Existing Building Code)
Fire Prevention	527 CMR: Massachusetts Fire Prevention Regulations
Accessibility	521 CMR: Massachusetts Architectural Access Board Regulations
Electrical	527 CMR 12.00: Massachusetts Electrical Code (2011 National Electrical Code)
Elevators	524 CMR: Massachusetts Elevator Code (2004 ASME A17.1)
Mechanical	2009 International Mechanical Code (IMC)
Plumbing	248 CMR: Massachusetts Plumbing Code
Energy Conservation	2009 International Energy Conservation Code & Stretch Energy Code

1. What special program and/or site parameters will influence energy use in this facility?

   a. A: (Project Manager – PM) There will be multiple non-school community use programs that will influence and effect energy use in this facility. As the project moves forward with Design these programs will be specified and their energy use will be considered.
2. What special landscaping features or influences on orientation will impact energy use in this facility?
   b. A: (Professional Engineer – PE) Various responses pending design options in progress that will be included in the options narratives in the Feasibility Study. This will be further clarified once the Preferred Option is selected.
3. What special construction features will influence energy use in this facility?
4. What are the project's energy-efficiency goals?
   c. To meet the current code, and reach a maximum of 30,000 BTU/sf/yr Energy Use Index (EUI) to achieve Net Zero building status.

Performance Criteria & Objectives

General

1. Has there been an established level of material quality, construction cost, and anticipated operational cost?
2. How will the project's specific goals and core values be implemented to make this a high-performance building?
3. Has the basic building program as it relates to the Owner's goals been documented?
4. Have the BOD Narratives been provided, and has commissioning review confirmed that they meet the Owners Project Requirements?

Systems (System Controls)

1. The following systems listed are to be commissioned per the RFP; this list has been marginally modified with information discussed during the feasibility study and will be more thoroughly updated throughout the design phase:
   a. Normal Power Systems
   b. Mechanical & Plumbing Systems
      i. Water to air
      ii. Water to water with induction
      iii. Water to water with radiant
   c. Operable Building Control Systems
   d. Audio & Visual Systems
   e. Telephone & Data Systems
   f. Building Security Systems
   g. Elevators & Conveyance Systems

- h. Schedules or Occupancy Sensor Lighting Controls
- i. Daylight Dimming Controls
- j. Emergency Power Generators & Automatic Transfer Switching
- k. Uninterruptible Power Supply Systems
- l. Life Safety Systems
- m. Equipment Sound Controls Systems & Testing
- n. Paging Systems
- o. Sustainable Building Materials
- p. Other Systems as identified

2. Redundancy
   - a. Emergency power
     - i. Building Heat
       - a) A: (PM) The Owner does not want to lose the building if boiler fails – assume multiple boilers will meet this need.
     - ii. Optional Loads – see also p. 12
       - a) A: (PM) None
       - b) Food refrigerators – Meeting minutes indicate this is required.
       - c) Elevator – (PM) n/a
       - d) Ethernet switchers – (PM) UPS rack in data closet if required
3. What are the warranty requirements?
   - a. A: (PM) 1 year
4. Are there specific efficiency targets, or operating features that are known for these commissioned systems?
5. What are the allowable operating tolerances in the facility's systems, for example, for space temperatures?
6. What specific building management system controls capabilities are required?
7. What are the systems integration requirements, especially across disciplines?

HVAC

VENTILATION

1. In addition to code, good engineering practice, and LEED requirements, there is a standing order regarding ASHRAE Standards, to be provided, that may pertain to or underscore the need for ASHRAE Standard 62.1 compliance and documentation

2. Program areas which imply odor or contaminant generation are identified in the section below, "Facility Space & Programming Elements to be considered (not all inclusive for final design):". In addition, mechanical spaces that include components such as water treatment (Dolphin system, for example) must be considered.
    a. What spaces or activities in the building are not listed in this section?
3. Natural ventilation considerations have not been formulated yet.
    a. What outdoor air quality or noise concerns limit the use of natural ventilation when weather is conducive?
        i. A: (PE) None known, School to confirm.

Heating Systems

1. Hot water production, condensing boilers, lower water temps increase productivity of boilers; requires gas source. No dual fuel tank; would allow radiant floor systems, high efficiency radiation zoning
2. Ground source heat rejection
3. Minimize # of fans, locate away from classroom & easily accessible for service
4. Program change impacts MEP systems
    a. Systems need flexibility
    b. Create infrastructure spines for flexibility for future use
5. Redundancy in systems load/sharing
6. Premium motors
7. CO_2 monitoring in some spaces per LEED credit, sensors only with no local read-outs

Cooling Systems

1. High performance, centralized with multiple unloading characteristics
2. Are there specific preferred manufacturers known for building systems?
    a. A: (PM) Other than the manufactures preference documented in feasibility meeting minutes there has been no preference to any other manufacturers at this time.
    b. McQuay not preferred, per meeting minutes
3. 4 pipe system
4. Variable flow pumps/drives
5. Radiant cooling system
6. Acoustical criteria removes equipment from rooms

ACOUSTICS

1. Acoustics isolation for music rooms
2. Other spaces that will require special acoustics design criteria:
    a. See per PE answers to OPR Questionnaire documented on p. 14
    b. For compliance with LEED for Schools 2009:
    IEQ. P3 – Minimum Acoustical Performance (prerequisite):
        - 0.6-second reverberation time for classrooms with volumes up to 20,000 ft^3
        - 1.5 second reverberation time for classrooms with volumes above 20,000 ft3
        - Background noise level goal: 45 dBA (L_{eq})

    IEQ. C9 – Enhanced Acoustical Performance (optional):
    Compliance with the sound isolation requirements referenced in ANSI S12.60-2002, excerpt for windows which must meet and Sound Transmission Class (STC) rating of at least 35:
        - STC 50 between adjacent learning spaces. This requirement is also needed for composite walls, including any interconnecting doors that may exist.
        - STC 45 between a learning space and adjacent corridor, staircase, office or conference room. This requirement is needed for the basic wall exclusive of the door. Doors need to be provided with full perimeter gaskets and drop bottom.
        - STC 60 for the music room walls.
        - Flooring/ceiling constructions above core learning spaces must achieve a minimum Impact Insulation Class (IIC) of 50.

    Improved background noise conditions:
        - Background noise level goal: 40 dBA (L_{eq}), or
        - Background noise level goal: 35 dBA (L_{eq}) – for 1 additional point

    c. Additional more stringent criteria may be established by Acentech, for more sound sensitive spaces such as Auditorium or music rooms. This will be determined during the early design phases of the project.

PLUMBING

1. Basic domestic system:
    a. Sanitary/storm
    b. Condensing hot water heaters
    c. Maximize recovery rates
    d. PVI tanks

2. Solar assist – preheat water, storage tanks, heaters on roof
3. Showers only for staff
4. Lavatory Load – low flow fixtures
5. NO waterless urinals
6. Time delay fixtures –too slow to deliver hot water; extend recirculation line closer to faucets – prefer no sensors
7. Reclaim/collect storm water – irrigation, greywater, roof drains to tank, clean and dye, use for flushing, make up water for dry spells
8. No steam heat
9. Dual flush toilets in high school only
10. Prefer Chicago system/lever in HS not mixed valve
11. Central tank for acid waste in science lab, pH adjustment preferred
12. Emergency shower/eyewash combo station in labs

Electrical

1. Incoming service vault preferred

Solar

1. AKF recommends PV systems be located onsite to serve the school, a remote PV system can be difficult to distribute or transmit power from remote location to school. This implies the project is pursuing NZEB:B, per Net Zero Workshop.
2. Photovoltaics shall be grid tied and metered to monitor the energy being produced.
3. Solar thermal – no design considerations developed yet.

Lighting

1. LED lighting shall be utilized as much as possible to include areas such as site lighting. There will be standardized light fixtures by June 2012.
2. Lighting controls shall consist of occupancy sensors for areas such as classrooms, janitor closets, etc. A lighting controls panel shall be used in areas such as corridors, gymnasium, etc.
3. Daylight harvest shall be utilized where suitable and shall be the dimmable type.
4. Lighting at stairwells, prefer wall mounted fixtures for easier accessibility
5. Occupancy sensors in program space only
6. Lighting presets not known yet, except daylight harvesting to dim electric lighting

Fire Alarm

1. Fire alarm system currently is configured for radio communications for the Cambridge Fire Department.

EMERGENCY GENERATOR

1. Exit and emergency lights on emergency generator
2. Freezers, refrigerator, boiler, pumps, and ejectors (needs to be reconciled by team)

AUDIO VISUAL

1. The school environment will rely heavily on wireless connectivity
2. Some rooms will need smart boards
3. The new environment should include conferencing and collaboration capabilities
4. The Learning Center should be centralized in the design and include:
    a. A center for upper and lower grades
    b. A media specialist
    c. Editing capabilities
    d. Movable shelving
5. Auditorium should be provided with a technology for capture and streaming of events.
6. There should be should integration of LAN network systems including control access, cameras and time clock systems.
7. The performance arts areas need the following capabilities:
    a. Sound playback
    b. Performance recording
    c. ENO boards
    d. Separate facilities K-5 and 6-8 classes
    e. Electronic music support
8. Learning commons will need a technical work room with bench
9. No server room is needed, all servers are remote and only switches are to be used
10. Editing area will need one instructor high-end station with large wall monitor
11. Audio sound booth with capacity for up to 4 students
12. Alcove is needed for student morning announcement videos
13. Library needs to be secured when not staffed
14. There is a need for separate community general purpose classroom for art activities
15. Two music rooms are needed for K-5 and 6-8 for music and chorus
16. A band and orchestra room is needed for grades 6-8.
17. Faculty requested having "side pods" in the auditorium to position video cameras
18. Faculty requested a mid-point location in the auditorium for portable audio mixer & lighting board

MAINTENANCE REQUIREMENTS (OPERATIONS)

1. What are the project documentation requirements? (e.g., electronic O&M manuals)
    a. A: (PM) Paper documentation is also required
2. Who is the owner's key maintenance officer?
3. What are the training requirements for the owner's personnel?
    a. A: (PM) Training should be included for all MEP equipment, kitchen equipment, and security equipment, etc.
4. No additional warranty requirements beyond the typical one-year-guarantee period have been identified.
5. What are the operational and maintenance criteria for the facility?
    a. The City Sustainability Coordinator made special mention during the Net Zero Workshop that the sustainability for this project must include a resulting building that does not exceed City's human resources available for operations and maintenance. It is important that the building requirements for Operations & Maintenance and Measurement & Verification stay within the City's resources
6. What equipment and system maintainability expectations, including limitations of operating and maintenance personnel, does the owner have?
7. What is the anticipated service life of the building?
    a. A: (PE) 50+ years
8. Other requirements:
    a. Centralized storage adjacent to Loading
    b. Outdoor storage
    c. Loading Dock separate from Food Service
    d. Maintenance closet on each floor
    e. Break room & Office

USER REQUIREMENTS (IEQ REQUIREMENTS)

1. Are there any general restrictions or limitations on this project?
2. Will there be any provisions made for future expansions or renovations of the buildings MEP systems?
3. Will original systems be expanded to serve future tenants or expansions?
4. What operating systems are being considered on this project?

Functional Uses & Occupancy Requirements

1. What other user and occupancy requirements for the spaces apply in addition to those listed below.
2. What are the time-occupancy schedule requirements for each space?

   a. MLK Jr. School is occupied 52 weeks per year 7am-11pm
   b. Saturdays & Sunday occupied occasionally – less than 50% of space occupied
   c. MLK Jr. school does not utilize food service during the summer break & other school breaks
3. What future occupancy requirements are currently under consideration?
4. Are occupancy-use changes in the future anticipated for the spaces created in this phase of the project?

FACILITY SPACE & PROGRAMMING ELEMENTS TO BE CONSIDERED (NOT ALL INCLUSIVE FOR FINAL DESIGN):

These elements and aspects may impact the design and commissioning of the systems included in the scope of the commissioning effort:

Lower School – Classroom Space

- JK – 2 spaces ***(acoustics)***
  - Capacity for 24 students in each space
  - Toilet, sink & bubbler in classroom (***odor or contaminant generation)***
- Kindergarten, Grade 1 – 4 spaces ***(acoustics)***
  - Capacity for 24 students in each space
  - Toilet, sink & bubbler in classroom (***odor or contaminant generation)***
- Grade 2-5 – 8 spaces
  - Capacity for 24 students in each space
  - Sink & bubbler
- Extended Learning Space – 14 spaces ***(acoustics)***
- Learning Center – 2 spaces
  - Capacity for 5 students in each space
- Resource Classroom – 3 spaces
  - Capacity for 8 students in each space

Lower School – Arts, Language & Instructional Support

- Chinese Enrichment (Ni Hao) – 2 spaces
  - Capacity for 24 students in each space
- Visual Art – 1 space ***(acoustics)***
  - Capacity for 24 students
- Laptop Cart Storage – 3 spaces
- De-escalation Room – 3 spaces ***(acoustics)***
  - Capacity for 1 student

- Teacher Work Room – 3 spaces
- Bookroom – 1 space
- Conference Room – 1 space ***(acoustics)***
- Coaching Office – 1 space

Lower School Administration

- Main Office
  - Clerk – 1 space
  - Community Liason – 1 space
  - Mailboxes – 1 space
  - Supply storage - 1 space
  - Workroom & copier – 1 space ***(odor or contaminant generation)***
- IEP/Conference Room – 1 space ***(acoustics)***
  - Bathroom – 1 space ***(odor or contaminant generation)***
- Iterant Staff – 1 space
- Principal's Office – 1 space
- Assistant Principal – 1 space
- Parent Resource Center – 1 space

Distributed Administration – Counseling

- Counseling – 1 space ***(acoustics)***
- Interns – 1 space

Upper School – Classroom Space

- Self Contained Classrooms – 3 spaces
  - Capacity for 12 students in each space
- 6^{th} Grade Math – 1 space
- 6th Grade Science – 1 space ***(odor or contaminant generation)***
  - Science Prep Room – 1 space
  - Capacity for 24 students
  - Grow Lights
  - Acid Neutralization
  - Outlets around perimeter and hanging points over lab area
  - Emergency eye wash, shower, floor drain

- Prep room storage for chemicals with vented cabinets
- 6th Grade ELA, Social, World Lang. – 2 spaces
  - Capacity for 24 students
- 7th Grade Math – 1 space
  - Capacity for 24 students
- 7th Grade Science – 1 space ***(odor or contaminant generation)***
  - Science Prep Room – 1 space
  - Capacity for 24 students
  - Grow Lights
  - Acid Neutralization
  - Outlets around perimeter and hanging points over lab area
  - Emergency eye wash, shower, floor drain
  - Prep room storage for chemicals with vented cabinets
- 7th Grade ELA, Social, World Language – 2 spaces
  - Capacity for 24 students
- 8th Grade Math – 1 space
  - Capacity for 24 students
- 8th Grade Science – 1 space ***(odor or contaminant generation)***
  - Capacity for 24 students
  - Science Prep room – 1 space
  - Grow Lights
  - Acid Neutralization
  - Outlets around perimeter and hanging points over lab area
  - Emergency eye wash, shower, floor drain
  - Prep room storage for chemicals with vented cabinets
- 8th Grade ELA, Social, World Language – 2 spaces
  - Capacity for 24 students
- Extended Learning Space – 15 spaces ***(acoustics)***

Upper School – Arts, Language and Instructional Support

- Visual art – 1 space
  - Kiln Room ***(odor or contaminant generation)***

    - Capacity 24 students
- De-Escalation Room – 3 spaces ***(acoustics)***
- Laptop Cart Storage – 1 space
- Teacher Workroom – 3 spaces
- Bookroom – 3 spaces
- Conference Room – 1 space ***(acoustics)***
- Coaching Office – 1 space

Upper School – Administration

- Main Office
    - Clerk – 1 space
    - Community Liason – 1 space
    - Mailboxes – 1 space
    - Supply storage - 1 space
    - Reception – 1 space
    - Workroom & copier – 1 space ***(odor or contaminant generation)***
- IEP/Conference Room – 1 space ***(acoustics)***
- Bathroom – 1 space ***(odor or contaminant generation)***
- Iterant Staff – 1 space
- Principal's Office – 1 space
- Assistant Principal – 1 space

Upper School – Distributed Administration – Counseling

- Counselor's Office – 1 space ***(acoustics)***
- Interns – 1 space

Human Services – Preschool

- Classrooms – 2 spaces
    - Capacity 20 students each space
- Bathrooms – 2 spaces ***(odor or contaminant generation)***
- Office – 1 space
- Pantry – 1 space
- Reception – 1 space
- Staff bathroom – 1 space ***(odor or contaminant generation)***

- Stroller storage -1 space
- General storage – 1 space
- Mudroom – 1 space

Human Services – Human Resources Program Dedicated Instructional Space

- After School Classroom – 2 spaces ***(acoustics)***
  - Capacity for 24 students each space
- Community School – 2 spaces
  - Capacity for 24 student each space
- Storage – 4 spaces
- Laptop Cart Storage – 1 space

Human Services – Administration (after school programs)

- Main Office
  - Office – 1 space
  - Conference room – 1 space ***(acoustics)***
  - Teacher workroom – 1 space

Shared Resources – Learning Commons ***(acoustics)***

- Flexible Instructional Space – 2 spaces
  - Capacity for 24 students in each space
- Small Group Room – 3 spaces
  - Capacity for 4 students in each space
- Multimedia Studio - spaces
  - Capacity for 24 students
- Book Stacks – 2 spaces
- Reading – 2 spaces
- Information – 2 spaces
- Workroom/Storage – 2 spaces
- Office – 2 spaces
- IT Workroom/Office – 1 space
- Telecomm Room – 3 spaces

Shared Resources – Gym/Health Center

- Multi-Purpose Gymnasium – 1 space ***(acoustics)***

  - Equipped with dividers
  - Access to natural light
- Small Gym – 1 space ***(acoustics)***
- Storage – 1 space
- P.E. Office – 1 space
- Locker Rooms – 2 spaces
- Fitness Center – 1 space ***(odor or contaminant generation) & (acoustics)***
  - 25 machines and ~9 resistance machines
- Health Classroom – 1 space
  - Capacity for 24 students
- Staff Changing Room/Shower – 1 space (***odor or contaminant generation)***

Shared Resources – Dining

- Dining – 2 spaces ***(odor or contaminant generation) & (acoustics)***
  - Improve ventilation & Lighting
  - Temperature Control & Automation
  - 1/3 Energy Consumption of a building is from food service
- Kitchen -1 space ***(odor or contaminant generation)***
  - Food prep
  - Dry storage
  - Ware washing
  - Refrigerator ***(emergency power)***
  - Freezer
  - Recycling ***(odor or contaminant generation)***
  - Office
  - Breakroom ***(odor or contaminant generation)***
    - Bathroom ***(odor or contaminant generation)***
  - Changing/locker room
- Servery – 1 space
- Food Lab – 1 space ***(odor or contaminant generation)***
  - Capacity for 24 students

Shared Resources – Auditorium

- Lobby – 1 space
- Auditorium – 1 space ***(acoustics)***
  - Capacity for 100
- Projection/Control Room – 1 space
- Stage – 1 space
- Scene & Prop Storage/Shop – 1 space
- Dressing Rooms – 2 spaces – 1 space
- Green Room – 1 space

Shared Resources – Performing Arts Instructional Space

- LS General Music Room – 1 space ***(acoustics)***
  - Capacity for 24
- US Chorus & General Music – 1 space ***(acoustics)***
  - Capacity for 24
- US Band & Orchestra – 1 space ***(acoustics)***
  - Capacity for 24
- Practice rooms – 2 spaces ***(acoustics)***
  - Capacity for 10
- Theater Classroom ***(acoustics)***

Shared Resources – Nurse's Suite

- Office – 1 space ***(acoustics)***
- Reception/waiting – 1 space
- Rest areas – 3 spaces
  - Nurse call button
- Bathroom – 1 space ***(odor or contaminant generation)***
- Storage – 1 space ***(emergency power)***

Shared Resources – Student Support Services

- Psychologist's office – 1 space ***(acoustics)***
- Speech therapist's office – 1 space
- OT/PO – 1 space ***(acoustics)***
  - Capacity for 6 students
  - Office

  - Storage

Shared Resources – Other

- Entry Lobby – 2 spaces
- Security/reception – 2 spaces
  - Include locking storage

Shared Resources – Building & Grounds

- Office, lunchroom – 1 space ***(odor or contaminant generation)***
- Toilet/shower/locker – 1 space ***(odor or contaminant generation)***
- General storage – 1 space
- Supply storage/receiving – 1 space
- Loading dock – 1 space
- Outdoor storage – 1 space
- Janitor's Closets – 5 spaces
- Distributed Storage – 5 spaces

Outdoor Spaces

- Entry plaza
- Grassy play space
- Hardscape play space
- Play structures
- Outdoor eating area
- Outdoor Classroom/Amphitheatre
- City Sprouts Garden

BELOW ARE SPACES THAT WERE IDENTIFIED IN THE FOCUS GROUP MEETINGS BUT NOT LISTED IN THE FACILITY SPACE PROGRAM:

- Adequate classrooms for all grades and subject teachers (35-40)
  - The Facility Space Program listed classrooms with capacity of 25 students
- Two Occupational Therapy/Physical Therapy Rooms
  - The Facility Space Program lists for only 1 space
- The Focus Groups discussed 1 cafeteria. The Facility Space Program lists 2.
- One auditorium with seating capacity for 700
  - The Facility Space Program shows a capacity of 100

- Bicycle racks for students and staff

Schedule & Limitations

10/1/2011	RFP received
6/1/2012	Submit Feasibility Study
8/3/2012	Design start
12/6/2013	Construction Start
9/1/2015	Move-in
7/1/2016	Ten-month warranty review
8/31/2016	New Cx close out

1. Consider and discuss any potential "road blocks" or difficulties that may hinder the project from meeting its scheduled goals and sustainability goals. (ex: money, time, permitting or entitlements, partnering limitations)

Budget Considerations & Limitations

1. What is the Project Budget?
2. What is the operating budget for the completed project?
    a. Salaries
    b. Energy
    c. Custodial
    d. Sewer
    e. Water
    f. Disposable supplies
    g. Capital projects (periodic renewal of building elements and systems)
    h. Future commissioning (continuous, recommissioning, or as needed)
        i. A: (PM) Future Recommissioning of this building will be approximately 3-5 years post occupancy.

APPENDIX ONE: DETAILED OPR CONSIDERATIONS

General:

1. Any special site requirements such as tank removal/remediation?
    a. A: (PM) Yes
2. For any portions of existing building reused, ACM or other remediation needed?
    a. A: (PM) Yes
3. Applicable Cambridge, school, DCAM or other regulations or requirements
4. LEED Silver minimum; LEED For Schools or LEED NC; Early scorecard draft available?
5. NET Zero - Site, annual net
6. Benchmarks reviewed at Net Zero Workshop (15,000 to 30,000 BTU/gsf/yr?)
7. Program/needs based EUI target
8. Energy, O&M, custodial, and periodic renewal budgets established?
9. Desired service life of the building
    a. A:(PM) 50+ years
10. Redundancy requirements
11. Building hardening or special security requirements
    a. A:(PM) No
12. Any sole source or special vendor limitations?

Systems:

NORMAL POWER

1. Double Neutral or other provisions for power quality
2. Harmonics Limits
3. Spare capacity requirements on service & distribution panels
4. Will M&V credit be targeted?
5. Metering –utility meter, or high end metering; BMS interface or remote monitoring capability (remote annunciation, email, text, phone capability)
6. Any sub-metering required for community space or other uses?
7. Design phase studies required
8. Testing requirements before turnover

9. TVSS requirements

EMERGENCY POWER

1. Fuel? -If diesel what fuel storage & leak detection requirements apply?
2. Any requirements for building heat? (If yes, boiler, pumps, airside, fans, all BAS equipment required to run heat)
3. Any critical spaces requiring AC during power outage (Data or EOC)
4. Access control?
5. Physical meters and or virtual totalizer meters, generator meters
6. Is BMS or other remote annunciation required on generator start?

UPS

1. What equipment other than Ethernet switches need UPS to avoid reboot after loss of normal power?

LIFE SAFETY SYSTEMS

1. Interconnects to lockdown or other systems
2. Any smoke control systems expected (Atrium, stairtower pressurization)
3. Fire detection
    a. Any special requirements beyond minimum code apply to this system?
    b. CO detection or other special detection systems?
4. Fire suppression
    a. Will any dry, pre-action, or Ansul systems be required
    b. Special suppression areas (data rooms, kitchen hood, etc.)

PAGING SYSTEMS

1. Interconnects to life safety or lock down systems
2. In addition to audio paging are visual or other alternate paging previsions required

BUILDING SECURITY SYSTEMS

1. Card access only, keys only, or combined?
2. Entry way security provisions
3. Internal systems?
    a. Classroom, admin and other space types entry/exists/automatic locking protocols
4. Sole source vendor?

5. Remote monitoring requirements
6. Alarming provisions, remote annunciation, direct police alarm
7. Interconnects with life safety or BMS systems
8. CCTV

Audio Visual

1. Integration if any with the paging systems, or dedicated to learning systems?
2. Local to each classroom only? Or centralized?
3. Interconnect with shade and electric light controls?

Tel/Data

1. Incoming telephone service requirements (fiber/copper, # of lines)
    a. Projected number of extensions
2. Incoming data service requirements (# of fiber strands, redundancy)
    a. Projected number of Ethernet drops
    b. Wireless, physical extent, # of networks, secure/guest
    c. Secure subnet requirements
        i. Security, CCTV, BMS, POS
        ii. BMS or life safety sub net/ vlan requirements

Elevators

1. Any requirements above code for vertical transportation
2. Escalators?

Lighting Controls

1. Outdoor
    a. On/off – timeclock, solar time clock or photocells or other
    b. On/off only or multiple scenes (high traffic vs. after hours security only)
2. Indoor
    a. Shade control
    b. Scene control
3. BMS integration
4. Light trespass or dark sky requirements

Sustainable Building Materials

1. Targeted LEED credits for recycled content materials & regional materials
2. Any recycled content materials beyond LEED
3. Any funding related Buy American requirements?
4. Low VOC, No VOC and other requirements

Mechanical

1. IAQ – ASHRAE Standard 62.1-2010
    a. Has outdoor air quality study at site commenced?
2. Thermal comfort – ASHRAE Standard 55-2010
3. Lighting – IESNA Handbook, or standards?
4. Acoustic – NC, RC or other criteria; source document?
5. Program areas that generate indoor air contaminates

Plumbing

1. Targeted LEED credits?
2. Rainwater reclaim?
3. Fixture preferences
    a. Not touchless per meeting minutes

BAS

1. Integration with existing systems for external access
2. Integration with existing lighting or other controls internally, if required

4.0 EXISTING CONDITIONS REPORTS

a. Architecture
b. Site Analyses
c. Traffic
d. Civil
e. Structural
f. MEP/FP
g. Food Service
h. Community Noise Conditions
i. Audiovisual
j. Hazardous Materials

Architecture:

Overview:

The Martin Luther King Jr. School is located at 100 Putnam Avenue, Cambridge MA. The building is a Brutalist concrete structure designed by Sert, Jackson and Associates that was built in 1971. The current program includes 662 students within the combined Martin Luther King Jr. School for grades JK-8, the Amigos school for grades JK-8, as well as the Martin Luther King Jr. Preschool. The existing three and four structure contains a partial mechanical equipment basement with crawl space and has a total gross square footage of approximately 159,400sf. The sloping urban 147,543 sf site is in a residential neighborhood of apartment buildings and single family homes and is bounded by Putnam Avenue to the West, Kinnaird Street to the North, and McGee Street to the South. The site contains parking, loading, playing fields, and is adjacent to a City of Cambridge playground that is utilized by the school and the City.

Following is an overview description of the building. This assessment was based upon visual inspections during various site visits in February through June 2012 and the following reference documents:

> *Martin Luther King Jr. Elementary School*: Original construction drawings prepared by Sert Jackson Architects dated June 25, 1968
>
> *Capital Needs Assessment of the King/Amigos Building*: prepared by EMG, Hung Valley Maryland, dated March 28, 2006.
>
> Refer to this document in the Appendix for a detailed evaluation of the existing building.

Photographs of existing conditions and existing floor plans are included at the end of this section.

Overall Organization:

The building is comprised of two distinct parts Parts "A" & "B". Part A fronts and is orthogonal to Putnam Avenue. Part B fronts and is orthogonal to Kinnaird Street. Part A is organized around a central courtyard that provides bountiful natural light into the building and houses a garden for the City Sprouts program. The main entrance lobby is accessed from Putnam Avenue and contains a double height space that connects to the lower level Cafeteria. This space features skylights a metal sculpture by Vusumuzi Maduna that depicts Martin Luther King Jr.'s Civil Rights journey. Part B (North Wing) houses the large and small Gymnasiums, Auditorium, Arts, Music, Computer, After School spaces and Offices.

Exterior Envelope:

The building exterior and interior aesthetic is dominated by the exposed concrete structure. Sections A & B noted above are readily apparent in their differing architectural language. Part A that fronts Putnam Avenue and Magee Street features smaller scaled bays, overhangs, and varying scales of glazing that respond to the residential neighborhood. The roof is punctuated by sloped light monitors. Part B that fronts Kinnaird Street, contains large unarticulated blocks without windows and are in direct contrast to the residential triple decker neighbors.

Existing Conditions - Architecture

Exterior wall finishes are a combination of: vertical grooved CMU (concrete masonry units), pre-cast concrete panels, and cast-in-place concrete; some walls are painted and some are unfinished concrete. The east rear wall contains a mural that depicts Martin Luther King's civil rights journey. Exterior walls at the service drive and loading dock are finished with T-111 plywood, as is the lower infilled area at the courtyard. The exterior walls are not insulated and do no not meet current energy codes, nor the goal for a Net Zero Energy Building that meets LEED Silver minimum requirements. The aluminum windows are a combination of fixed and operable panes, and contain some glass, insulated metal panels and plexiglass. The windows are in varying levels of deterioration and do not meet current standards energy/glazing. Classrooms corridors that face the courtyard have a combination of full height frameless obscured glass block units and windows noted above. Interior classroom corridors at the upper levels have high glass transoms. The main entry doors are insulated fiberglass doors in aluminum frames. Large steel frame sliding glass doors provide access from the cafeteria to the courtyard. Primary roofs are flat roofs with unballasted single-ply membrane, reportedly over rigid board insulation, concrete parapets that terminate in sheet metal flashing, internal roof drains (some of which were observed to be clogged) and, metal relief scuppers that drain to the ground ; the Property Conditions Assessment reports states that roofing is circa 2003. The sloped roofs are standing seam metal. There are curb-mounted skylights that bring natural light into the atrium, and sloped light monitors above the classrooms.

Structure:

The concrete structure varies in Part A and Part B. Part A is comprised of exposed reinforced concrete columns and beams with +/- 20'x20' bays that can more readily accommodate current seismic code requirements for existing buildings. The interior vertical clearance to the underside of the concrete slabs is +/-10'-6", and clearance at T beams is +/- 8'-6" presenting a challenge for integration of future mechanical infrastructure. Part B is comprised of unreinforced masonry walls with concrete beams that would be extremely costly to update to current seismic codes without great expense and therefore will not be considered for reuse. Refer to the Structural Existing Conditions report for a detailed description of the structural systems, floor levels and clearances.

Interior Architecture:

As currently configured, the existing building is ill-suited to meet the target student population of 740 students, the Educational Specification, Design Principles, and the Net Zero Energy goals for the Martin Luther King Jr. School Construction project that were developed during the Feasibility Study. The east and west orientation of classrooms coupled with the low existing floor to floor height of 10'-6", hampers optimizing natural light into the classrooms. Studies have shown that naturally lit classrooms where light levels and glare can be controlled foster better concentration and retention in student. The interior character of the building is also dominated by the exposed concrete structure and wall panels. In addition to having a cold aesthetic, the concrete makes for a poor and chaotic acoustic environment that do not meet the Acoustical Prerequisites for LEED for Schools.

Auditorium: The antiquated auditorium has a sloped floor with +/- 171 fixed wood and metal seats. The stage is raised.

Gymnasiums: There are two gymnasiums in the facility. The lower gymnasium is the smaller facility with no bleachers. The adjacent locker and support spaces have been repurposed as classrooms, support and storage. The upper gymnasium is the larger facility and contains telescoping wood bleachers and a full height folding partition.

Existing Conditions - Architecture

The sloping site, coupled with a high water table and no under slab drainage system makes the existing building prone to flooding. There has been reported water infiltration through exterior doors and also from ground water that has necessitated gym floor replacements over the years. Refer to the structural existing conditions report and geotechnical report for additional information regarding ground water.

Mechanical Tunnels: There are a series of underground mechanical tunnels that have also had reported and observed water infiltration that will require moisture mitigation should the tunnels be reused. The Owner does not want to retain these tunnels for mechanical infrastructure should the building/ tunnels be reused.

Refer to the MEPFP and Structural narratives for additional information.

Library: The library is an antiquated facility with low wood stacks and loose furniture and is lacking in technology.

Elevator: one hydraulic 1,500 pound / 95 feet per minute passenger elevator with the Elevator Machine Room located in the mechanical closet at the base of the shaft. Cab finishes painted wall panels, vinyl tile floors, and recessed ceiling fixtures.

Stairs: Interior stairs are constructed of cast-in-place concrete with closed risers, and wood handrails and vertical metal balusters.

Doors: stained solid core wood in painted metal frames.

Finishes: Interior finishes are worn and in need of replacement.

- Flooring: Lobbies – quarry tiles, corridors, vinyl tile, Common area rest rooms – quarry tile, Auditorium – concrete with carpet at aisles and in front of stage, Lower Gym – hardwood, Upper Gym – rubber sheet, Cafeteria – vinyl tile, Library – carpet, Kitchen –quarry tile, Offices – vinyl tile, Classrooms – vinyl tile.
- Walls: Lobbies – painted concrete, Corridors – painted drywall and painted CMU, Common Area Restrooms – painted CMU, Auditorium – Tectum and wood paneling, Lower Gymnasium – painted CMU, Upper Gymnasium – painted CMU, Cafeteria – painted CMU, Library – painted drywall, Kitchen – painted CMU, Offices – Painted CMU, Classrooms – Painted CMU
- Ceilings: Lobby – Tectum panels with painted concrete structure, Corridors - Tectum panels with painted concrete structure, Common Area Restrooms – Suspended ACT, Auditorium - Tectum panels with painted concrete structure, Lower Gymnasium – Tectum, Upper Gymnasium – Tecturm , Library Tectum panels with painted concrete structure, Kitchen – 12x12 metal ACT, Offices- Tectum panels with painted concrete structure, Classrooms – Tectum panels with painted concrete structure.
- Classrooms include wood casework for storage comprised of; closets cabinets and a countertop with a sink.

Code:

It is not determined at this time what portion(s), if any of the building will remain, so a full code review was beyond the scope of this initial study. Should it be determined that portions of the building will remain, a more detailed code analysis will be performed during Schematic Design. Based upon limited visual inspection, it was observed that several items do not appear to be accessible per current codes including but not limited to: adequate number of handicapped acce parking spaces, signage for handicapped vans, handrails that extend at the top and bottom of stairs, compliant handicapped stalls in toilet rooms,

Existing Conditions - Architecture

handicapped lavatories at common rest rooms, handicapped urinals at rest rooms, non-compliant railing, baluster and nosings at stairs, signals at elevators, listening devices in Auditorium, fire alarms, horns and strobes in auditorium, wheelchair seating at auditorium, etc.

Main Entrance on Putnam Avenue

View from Putnam Avenue

Unused Play Areas Adjacent to Classrooms on Putnam Avenue

Preschool at Magee Street

Existing Conditions - Architecture

Rear of Building looking towards Magee Street

Rear of Building from Parking Area at Kinnaird Street

Rear Entrance with Painted Murals

Deteriorated Windowless Façade at Kinnaird Street

Existing Conditions - Architecture

Courtyard Looking Towards Sliding Doors at Cafeteria

Courtyard / CitySprouts Gardens

Main Entry Lobby / Administration Area

Sculpture at Main Entry / Cafeteria Overlook

Existing Conditions - Architecture

Gymnasium

Cafeteria Facing Courtyard

Auditorium

Library

Existing Conditions - Architecture

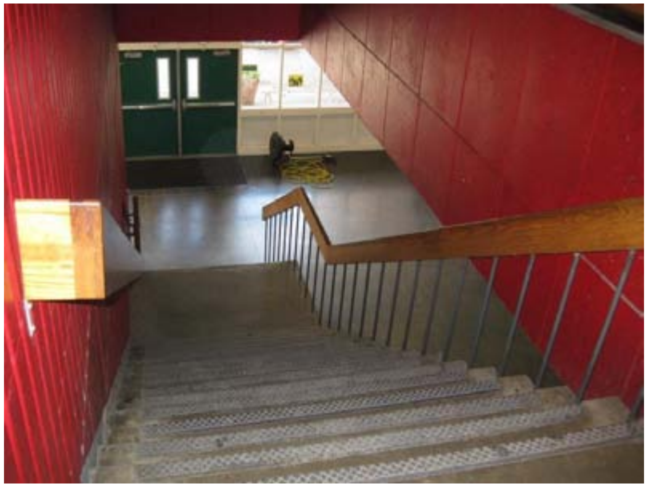
Corridor with Cubbies

Corridor with Lockers

Corridor with Glazing

Corridor at Courtyard

Existing Conditions - Architecture



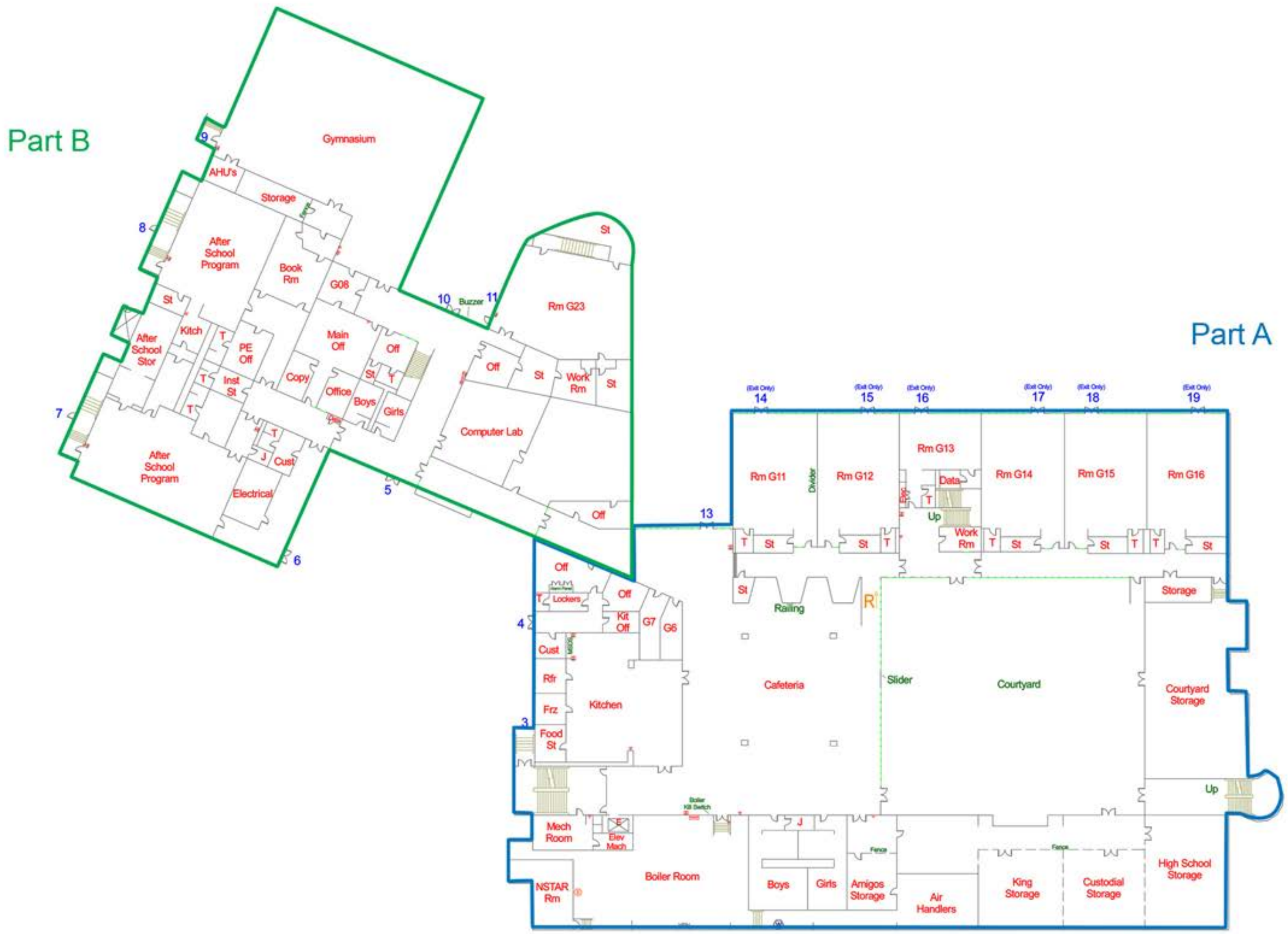
Egress Stair

Classroom with Light Monitor

Classroom

Classroom

Existing Conditions - Ground Floor Plan



Existing Conditions - 1st Floor Plan

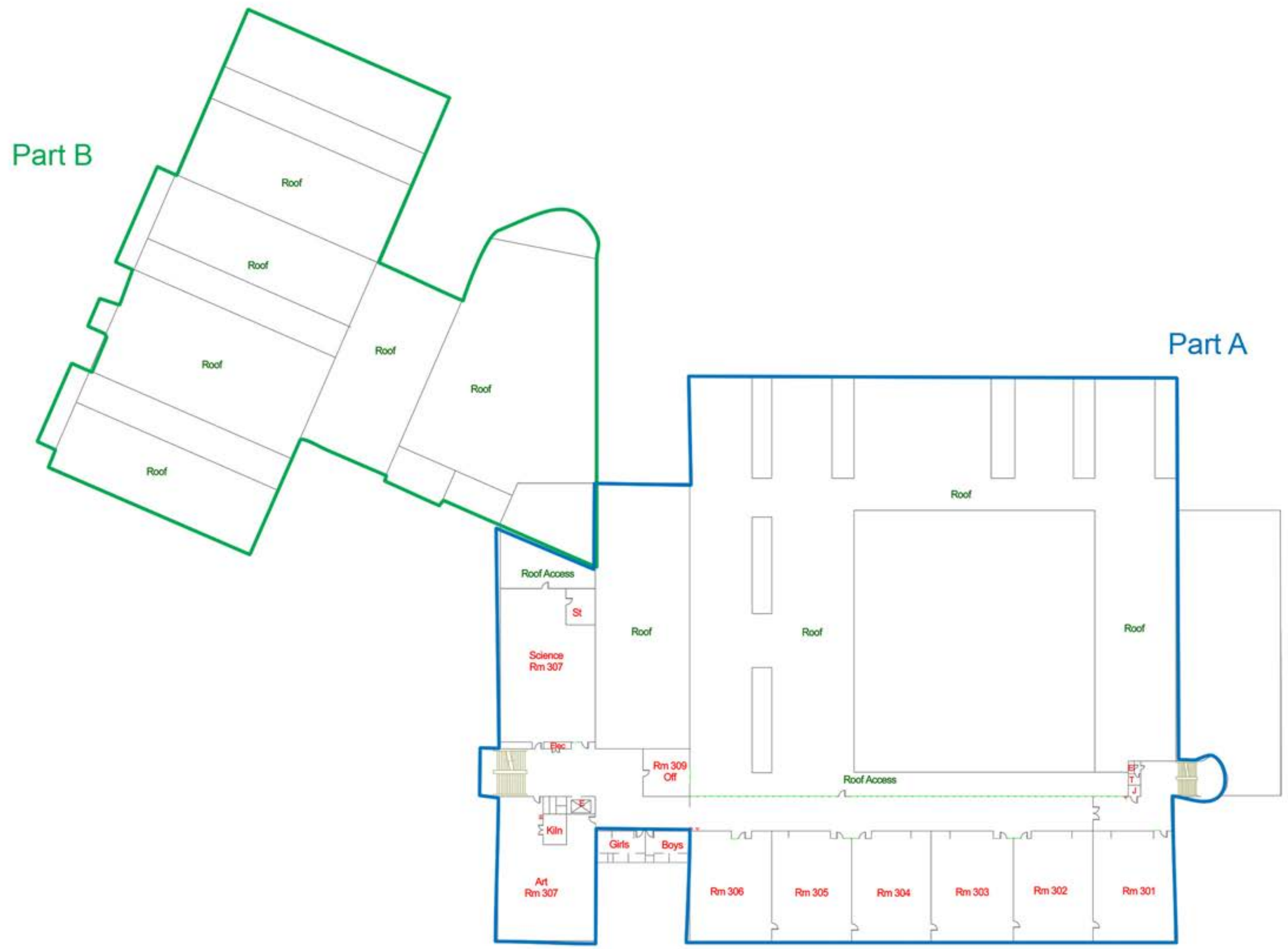
Existing Conditions - 2nd Floor Plan

Perkins Eastman

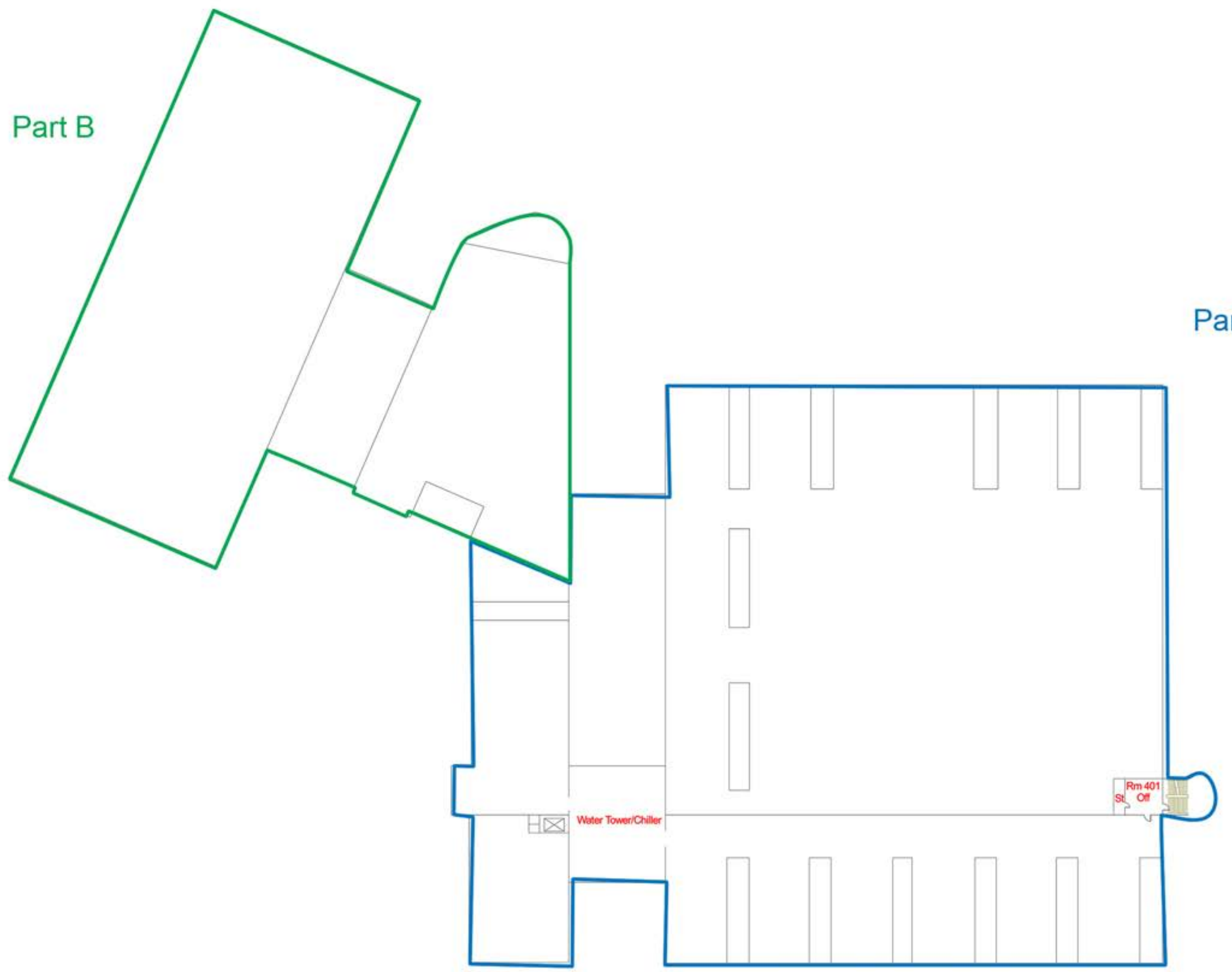
Martin Luther King Jr. School Construction Project

Feasibility Study
May 14, 2012

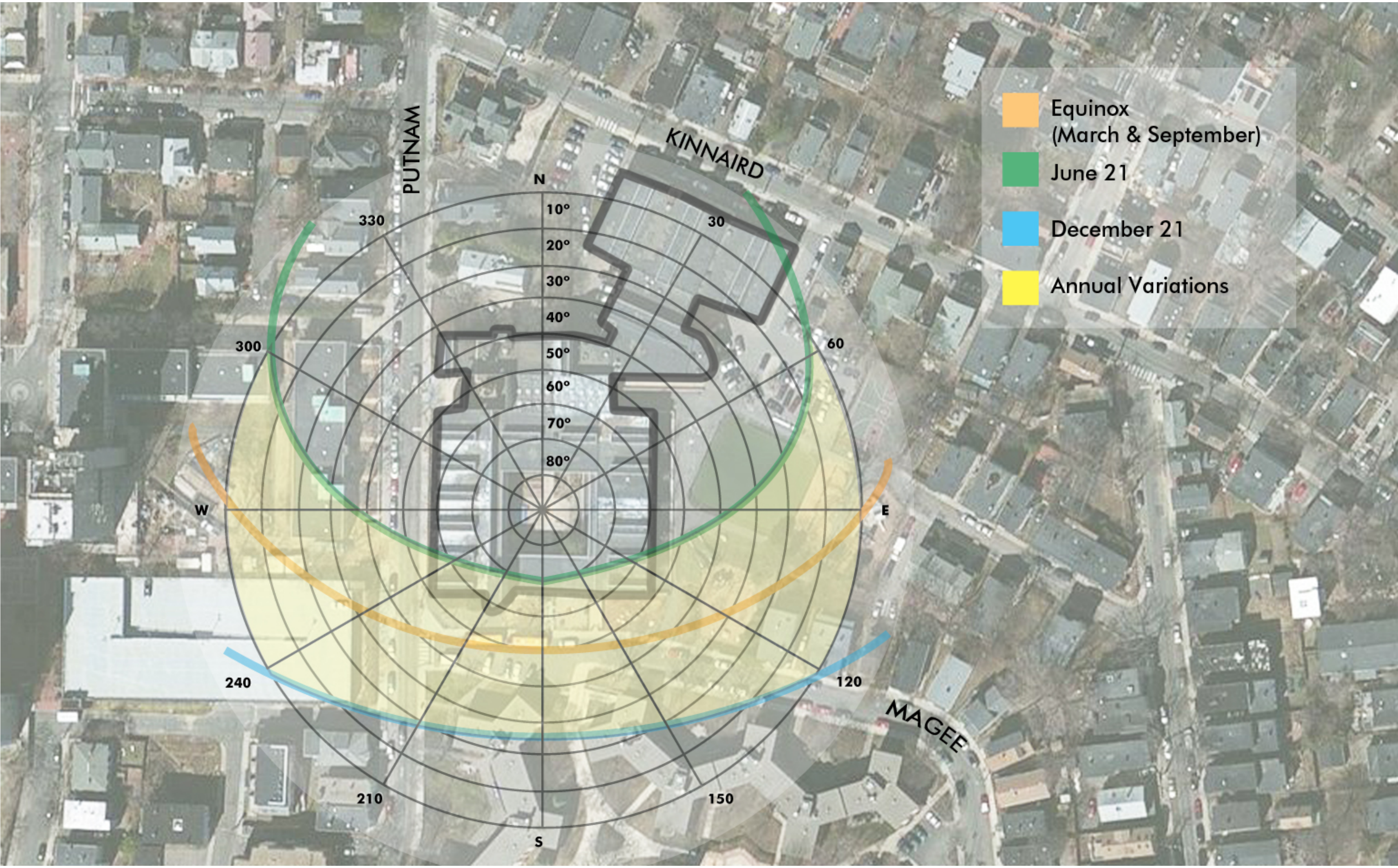
Existing Conditions - 3rd Floor Plan



Existing Conditions – Roof Plan

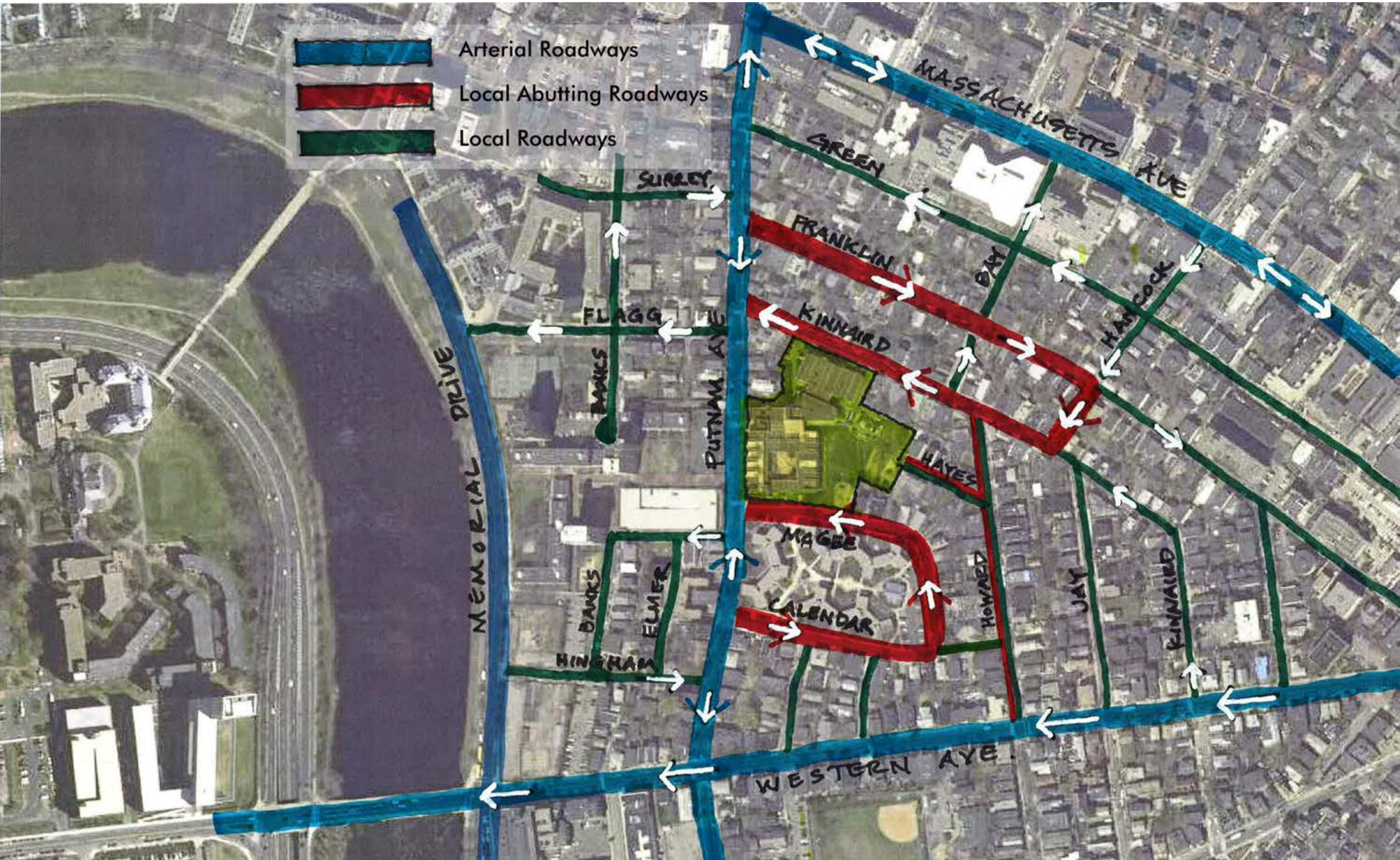


Solar Orientation



Use & Scale Diagram

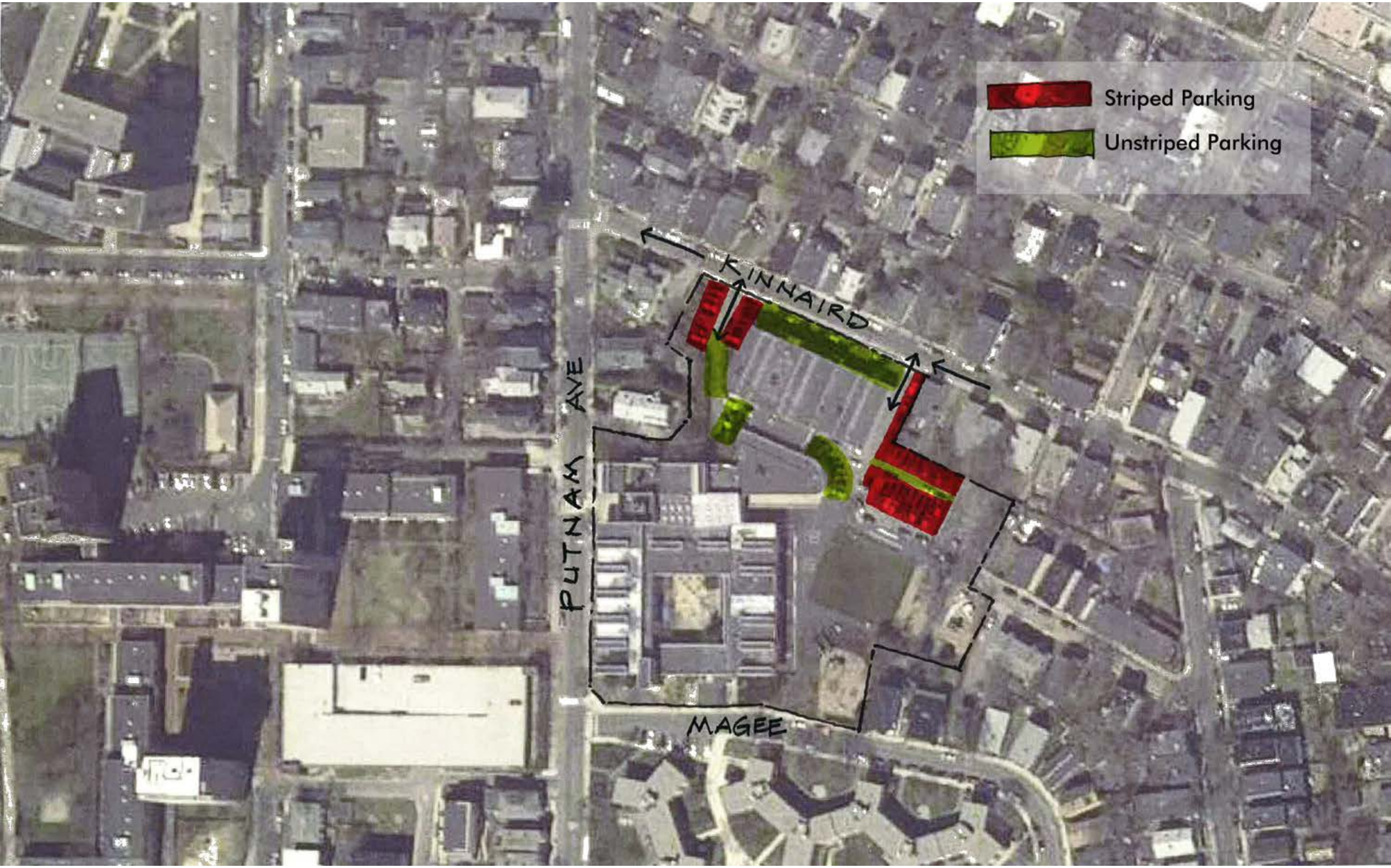
Macro Site Access



Morning Drop Off

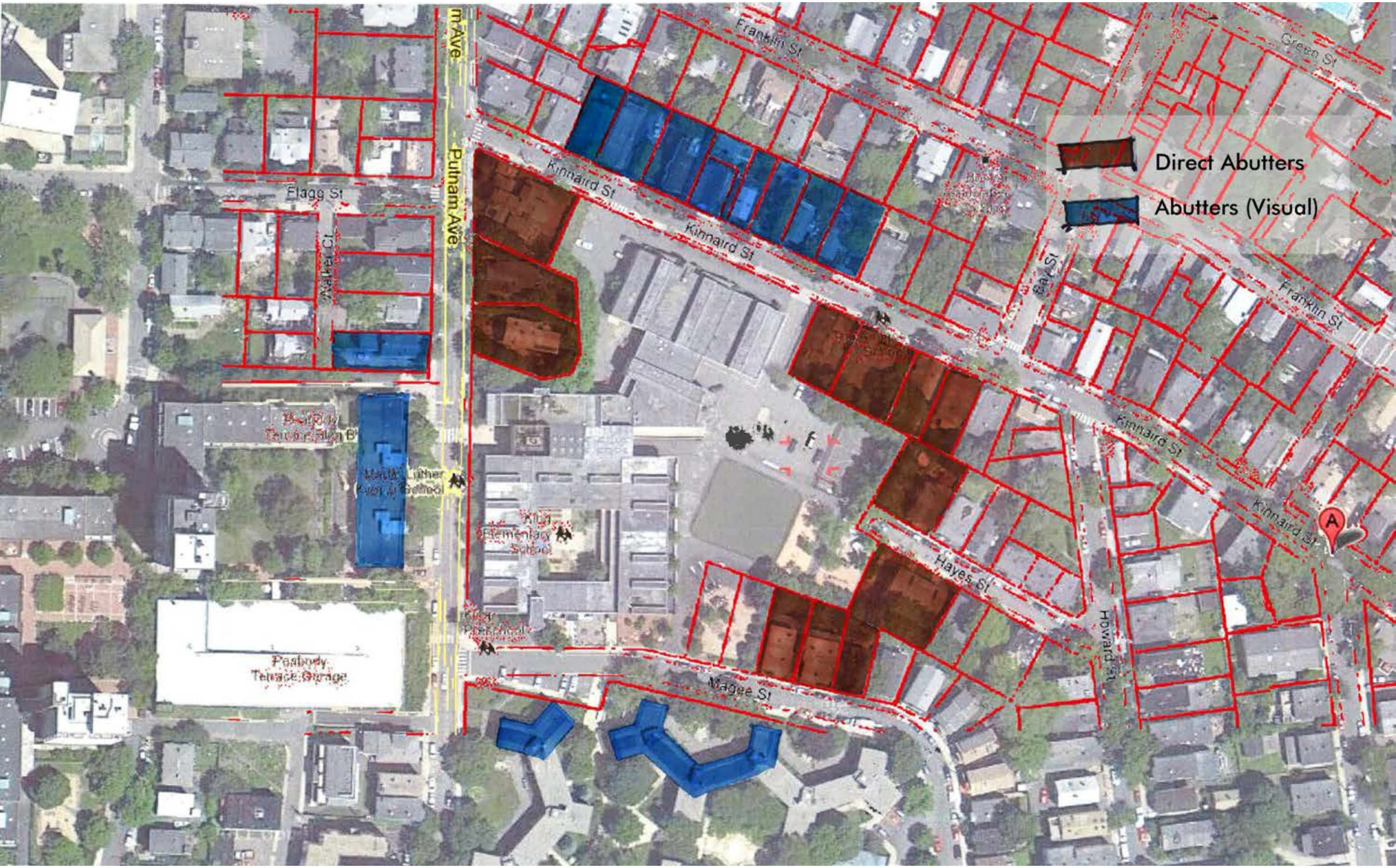
Afternoon Pick Up

Existing Parking On-Site



Street Frontage

Abutters

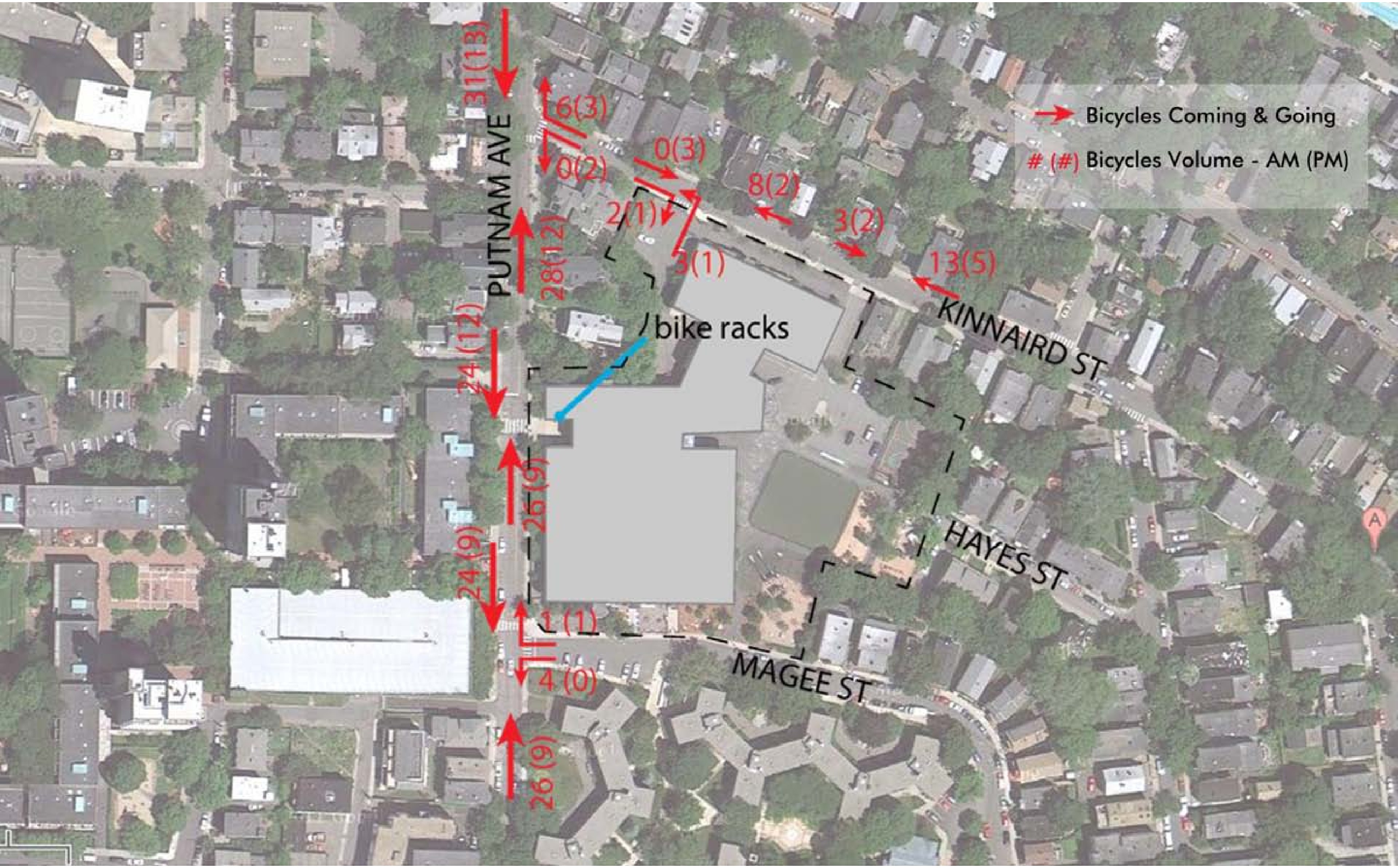

Direct Abutters
Abutters (Visual)
Franklin St
Green St
Kinnaird St
Flagg St
Putnam Ave
Bay St
Hayes St
Howard St
Magee St
Peabody Terrace Garage

Pervious/Impervious

Useable Outdoor Spaces

Site Grades

Existing Bicycle Traffic Analysis



Nitsch Engineering

Traffic Impact Study

Martin Luther King Jr. Middle School

Cambridge, MA

May 2012

Prepared for:

Perkins Eastman
50 Franklin Street, Suite 402, Boston MA, 02110

Submitted by:

Nitsch Engineering
186 Lincoln Street, Suite 200
Boston, MA 02111
Nitsch Engineering Project #8837.1

Building better communities with you.

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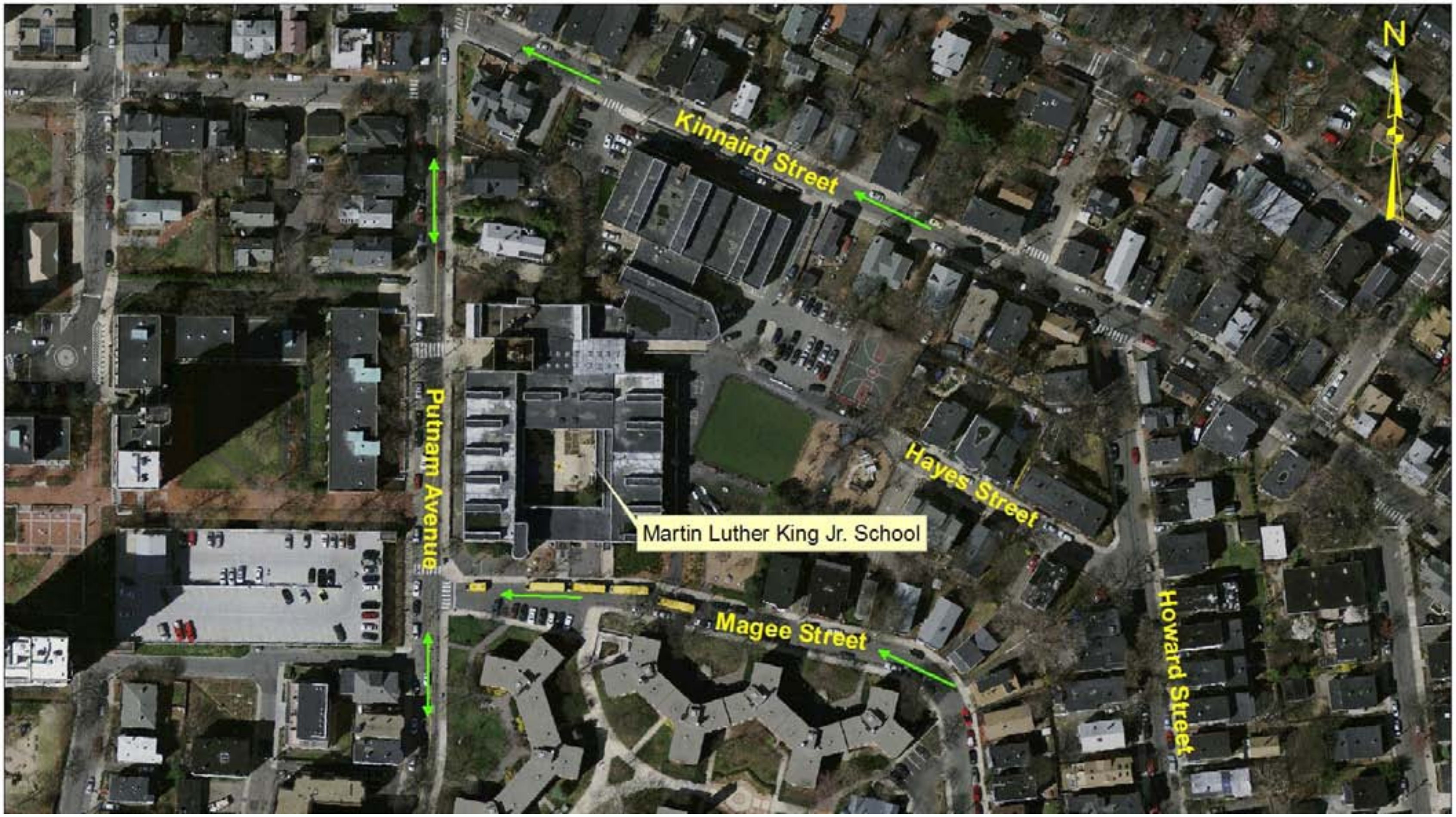
General/Site Location

The existing Martin Luther King Jr. (MLK) School is sited with its frontage on Putnam Avenue. The site is bounded on the south by Magee Street, on the north by Kinnaird Street and on the east by the properties located on Hayes Street. The main entrance to the existing building is located at 100 Putnam Avenue, and is 159,400 square feet. There is also an existing entrance to the preschool located on Magee Street. The existing MLK school building occupies most of the project site. There is a playground area located at the southeast corner of the site along Magee Street. Located at the rear of the building on the east side of the site are an artificial playfield, basketball court and a parking lot area. The existing school building currently serves the MLK School as well as the Amigos School. The MLK School has expanded academic hours, with the school running from 7:55 AM to 3:55 PM. The Amigos School hours are from 8:55 AM to 2:55 PM. There are 263 students currently attending the MLK School in pre-kindergarten through 8th grade, including 60 in the Upper School, 26 full-time teachers, and 79 total staff. The Amigos School serves 295 students in kindergarten through 5th grade, with 33 full-time teachers, and 76 total staff.

Figure 1 - Location Map



Putnam Avenue is an urban minor arterial roadway under the City of Cambridge jurisdiction; all other roadways are local roadways. The school site is surrounded primarily by residential land uses.

Field Reconnaissance

Nitsch Engineering conducted field reconnaissance on Wednesday, April 4, 2012 to observe traffic operations, geometric conditions, parking activity, pedestrian accommodations, signing, pavement markings, local site access/egress, and overall roadway and intersection conditions.

The following intersections were included in the study area:

- Putnam Avenue/Magee Street,
- Putnam Avenue at Kinnaird Street,
- Kinnaird Street at Site Driveways, and
- Putnam Avenue at Pedestrian Crossing

Below are the descriptions and photos of the study area intersections.

Putnam Avenue/Magee Street

This is a three-legged unsignalized intersection with Putnam Avenue approaching from the north and south, and Magee Street approaching from the east. Putnam Avenue consists of one travel lane in the northbound and southbound directions. Magee Street consists of one all-purpose lane in the westbound (WB) direction; eastbound traffic is prohibited as Magee Street is one-way. Opposing travel lanes on Putnam Avenue are separated by a faded double yellow centerline. Sidewalks are present along all roadways and a crosswalk is present across the Magee Street approach and across the east side of Putnam Avenue. However, the crosswalk does not align with the existing pedestrian ramps. Pedestrians using the ramp will enter the roadway off the crosswalk. A flashing speed limit sign is present on Putnam Avenue indicating that vehicles should travel 20 miles per hour (mph) when school is in session. The posted speed limit on Magee Street is 20 mph. On-street resident-only parking is allowed on the north side of Putnam Avenue in the vicinity of the intersection. One parking space on Magee Street adjacent to the intersection is prohibited from 7am to 4pm on weekdays so that buses can maneuver from Magee Street onto Putnam Avenue. Additional resident-only parking with no time restrictions is available further away from the intersection on both sides of the street. Putnam Avenue operates as the free movement, and Magee Street operates under “STOP” control. Intersection site distance was also observed during the site visit. When approaching Putnam Avenue from Magee Street, looking right you can see 200 feet to the pedestrian crossing, looking left you can see 640 feet to the intersection of Putnam Avenue and Western Avenue. These are both above the required minimum of 120 feet for a 20 mph roadway. The pavement throughout the study area is deteriorated with cracks from previous construction.

Magee Street Facing West

Misaligned Crosswalk at Magee Street

Putnam Avenue/Kinnaird Street

This is a three-legged unsignalized intersection with Putnam Avenue approaching from the north and south, and Kinnaird Street approaching from the east. Putnam Avenue consists of one travel lane in the northbound and southbound directions. Kinnaird Street consists of one all-purpose lane in the westbound (WB) direction; eastbound traffic is prohibited as Kinnaird Street is one-way. Sidewalks are present along all roadways and a crosswalk is present across the Kinnaird Street approach and the west side of the Putnam Avenue approach. A flashing speed limit sign is present on Putnam Avenue indicating that vehicles should travel 20 miles per hour (mph) when school is in session. The posted speed limit on Kinnaird Street is 20 mph. “SCHOOL” pavement markings are present on Kinnaird Street indicating the presence of a school zone. These pavement markings were once also present on Putnam Avenue but have now deteriorated to a condition where they are illegible. On-street resident-only parking is allowed on the north side of Putnam Avenue and the east side of Kinnaird Street in the vicinity of the intersection. Putnam Avenue operates as the free movement, and Kinnaird Street operates under “STOP” control. Intersection site distance was also observed during the site visit. When approaching Putnam Avenue from Kinnaird Street, looking right you can see 110 feet to the address at 57 Putnam Avenue, looking left you can see 50 feet to the intersection of Putnam Avenue and Flagg Street. These are both below the required minimum of 120 feet for a 20 mph roadway. However, if you pull the vehicle past the stop line, you can see beyond the required site distance in both directions before entering Putnam Avenue.

Kinnaird Street Facing West

Kinnaird Street/Site Driveways

The Site Driveways that lead to the school parking areas off of Kinnaird Street create three-legged unsignalized intersections with Kinnaird Street approaching from the east, and the school driveways approaching from the south. Kinnaird Street consists of one travel lane in the westbound (WB) direction; eastbound traffic is prohibited as Kinnaird Street is one-way. The School Driveways consist of one lane in the northbound and southbound directions. Sidewalks are present along all roadways. A crosswalk is present across the northern site driveway. Sidewalk material is present at street grade across the southern site driveway creating a pedestrian crossing without using a crosswalk. The posted speed limit on Kinnaird Street is 20 mph. “SCHOOL” pavement markings are present on Kinnaird Street indicating the presence of a school zone. On-street resident-only parking is allowed the east side of Kinnaird Street. Kinnaird Street operates as the free movement, and the site driveways operate under unsigned “STOP” control.

Kinnaird Street Facing West

<u>Putnam Avenue/Pedestrian Crossing</u>

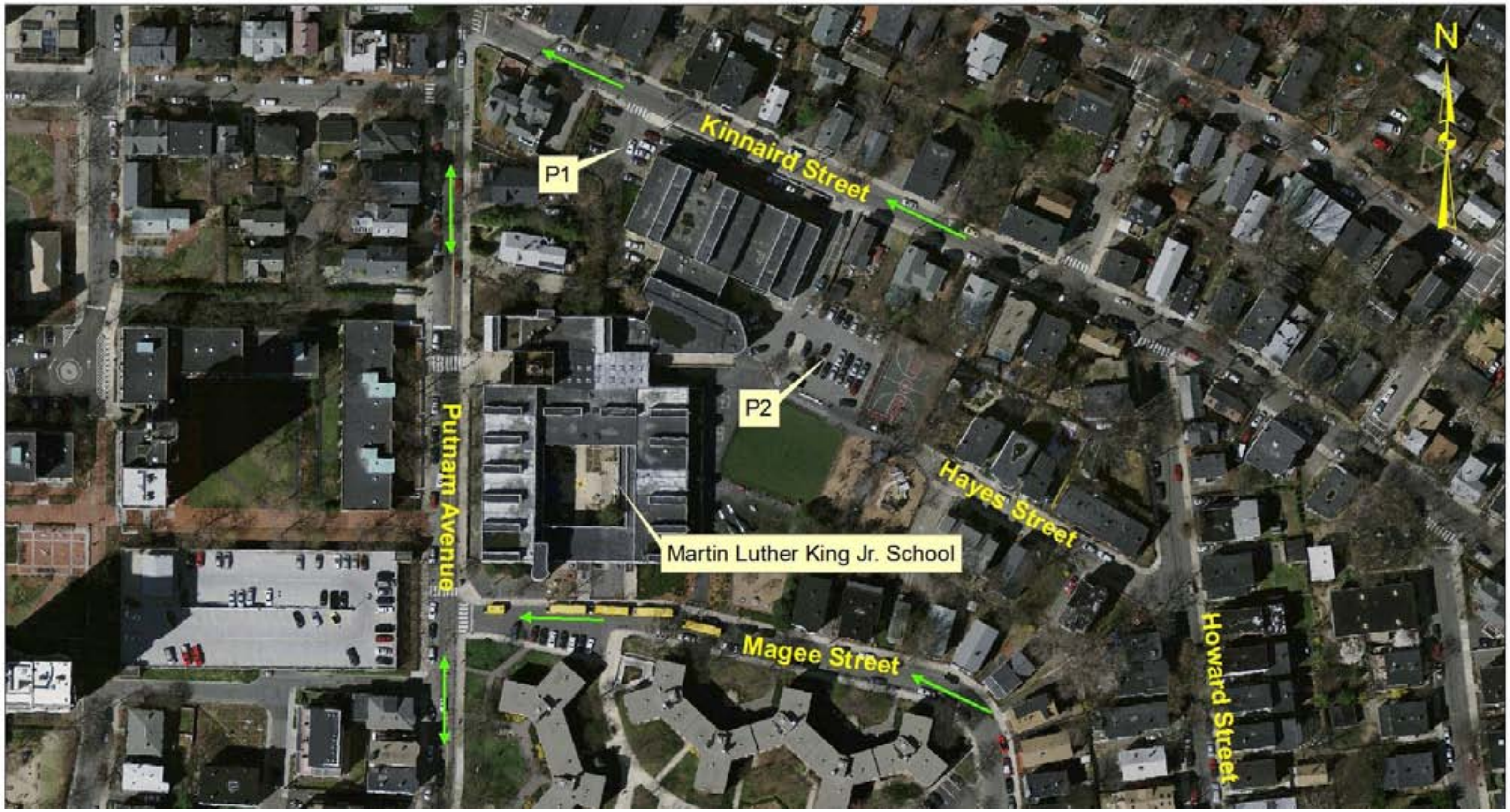
This is a signalized pedestrian crossing on Putnam Avenue directly across from the main entrance of the school. Buses and some vehicles drop students off on Putnam Avenue at this location. The pedestrian crossing stops traffic on Putnam Avenue. Putnam Avenue approaches the crossing from the north and south. Putnam Avenue consists of one travel lane in each direction. Sidewalks are present along all roadways and a crosswalk is present at the pedestrian signal. On-street resident-only parking is allowed on the north side of Putnam Avenue in the vicinity of the intersection. The signal is a two-phase signal, with the first phase allowing all vehicle movements, and the second phase allowing pedestrian movements. A sign on the southbound approach alerts drivers to the pedestrian crossing. However, no pedestrian warning sign is present on the northbound approach.

Putnam Avenue Facing North

Parking

Martin Luther King Jr. Middle School has two designated parking areas referred to as P1 – P2 in this report. Figure 2 shows the parking locations.

Figure 2 - Parking Locations



There are two parking lots off of Kinnaird Street being used by school traffic. The western parking lot had 20 designated spaces. However, 28 vehicles were observed parked in the lot, with vehicles double parked and parked on the curb. The eastern parking area had 29 spaces, with 60 vehicles parked in it. The double parking presents significant issues during the pick-up/drop-off, as vehicles must often wait a significant period of time for other vehicles to move before they are able to leave their spot. This requires drivers to coordinate closely with other vehicles and presents a safety hazard for users. A traffic cop was present directing traffic into and out of the lots. A summary of the existing parking spaces and the occupancy is shown in Table 1.

Table 1 - Existing Parking Occupancy

Lot	Number of Total Spaces	Number of Occupied Spaces	Percent Occupied
P1	20	28	140%
P2	29	60	207%
All	49	88	180%

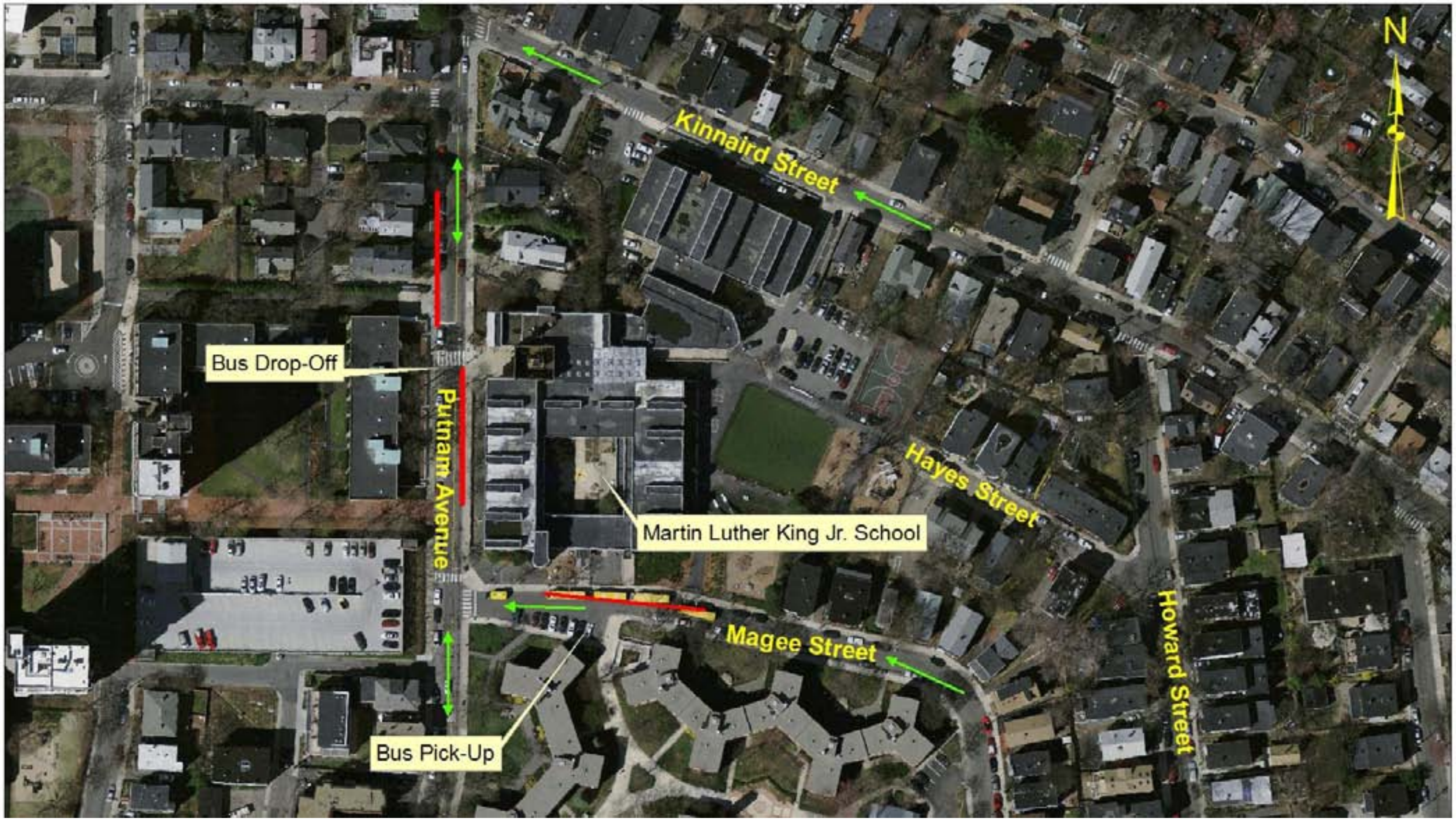
There are two bicycle racks located at the front entrance of the school adjacent to Putnam Avenue. They were both occupied, with three total bicycles at the time of the count. However, there were a number of additional bicycles attached to street signs on Putnam Avenue and Kinnaird Street. It is unclear if they were associated with the school or other local residents.

Bicycle Racks at Front Entrance

Bicycles on Street Signs

Pick-Up/Drop-Off

Figure 3 - Pick-Up/Drop-Off Locations



The bus drop-off area is separate from the bus pick-up area, as well as the parent pick-up/drop-off area. This is a preferred design as it reduces conflicts between buses and vehicles. The existing buses are currently dropping students off on Putnam Avenue in the morning and picking students up on Magee Street during the afternoon. During the morning, this causes significant levels of congestion on Putnam Avenue, as all vehicles must stop for the buses. Putnam Avenue is a busy roadway with high levels of background traffic in the neighborhood. One bus dropping off at the school causes a queue that extends past the adjacent intersections. The buses drop off at staggered times, and there were never more than three buses at a time during the morning peak. Parents typically drop students off on Kinnaird Street during the morning, although some vehicles were observed dropping students off on Putnam Avenue as well. Dropping students off on Putnam Avenue causes congestion as pedestrians use the mid-block crossing and stop traffic in both directions. The vehicles take less time to drop-off than the buses as there are fewer children crossing the street, but they still cause queuing on Putnam Avenue. The Kinnaird Street drop-off does not cause local traffic to back-up as there is limited traffic using Kinnaird Street aside from the school. Vehicles on Kinnaird Street were observed pulling up onto the sidewalk, blocking the path for pedestrians.

During the afternoon pick-up, buses queue along Magee Street to wait for students. The buses on Magee Street are pulled over out of the way of oncoming traffic, and do not cause back-ups on Magee Street. However, during the winter, with snow in the roadway this area becomes very narrow and can make it difficult for vehicles to maneuver around buses. The parent pick-up typically occurs on Kinnaird Street, with some other vehicles picking up on Magee Street and Hayes Street in the back of the school. Vehicles picking up on Magee Street typically use the designated parking areas adjacent to the roadway and were not seen blocking traffic. Vehicles picking up on Kinnaird Street would pull over onto the sidewalk or into the on-street parking areas and did not obstruct traffic on the roadway.

As part of the study, a bus-turn template was run to determine whether school buses could safely maneuver the intersection of Kinnaird Street at Putnam Street using the existing roadway configuration. From this template we were able to determine that in order for buses to maneuver that intersection, 1-2 parking spaces on Putnam Avenue across from Kinnaird Street, and on Kinnaird Street in the vicinity of Putnam Avenue, would need to be restricted during school hours. Even with the parking restrictions, it would still be a difficult turn for buses to make. In addition to the buses associated with the MLK School, a number of buses pick-up and drop-off local students in the study area for other schools. These buses were not included in the MLK count, but they do impact the adjacent intersections and were included in the later traffic analysis.

Many pedestrians were observed walking to school, however the existing sidewalk infrastructure was sufficient to handle the volume of students that were walking through. Students line up outside the school adjacent to Magee Street during the afternoon pick-up to load onto the buses. The existing school has sufficient frontage to contain all of the students during this time. Any proposed designs should retain enough space in front of the bus pick-up for 4 buses of students.

The longest queues observed during the site visit are shown in Table 2. The total pick-up/drop-off volume is shown in Table 3. The bus arrival and departure times are show in Table 4.

Table 2 - Pick-Up/Drop-Off Queues

Location	Vehicle Drop-Off (vehicles/feet*)	Vehicle Pick-Up (vehicles/feet*)	Bus Drop-Off (buses/feet*)	Bus Pick-Up (buses/feet*)
Putnam Avenue northbound	3/60	1/20	3/120	0/0
Putnam Avenue southbound	3/60	1/20	3/120	0/0
Magee Street	2/40	2/40	0/0	4/155
Kinnaird Street	11/220	8/160	0/0	0/0

*estimated from aerial and/or vehicle length calculation

Table 3 - Pick-Up/Drop-Off Volumes

Type	Vehicle Drop-Off	Vehicle Pick-Up	Bus Drop-Off	Bus Pick-Up
Putnam Avenue northbound	16	20	4	0
Putnam Avenue southbound	44	29	5	0
Magee Street	11	4	0	9
Kinnaird Street	47	28	0	0

Table 4 - Bus Arrival and Departure Times

Drop-Off		Pick-Up	
Arrive	**Depart**	**Arrive**	**Depart**
7:23 AM	7:24 AM	1:50 PM	2:01 PM
7:30 AM	7:31 AM	1:54 PM	2:02 PM
7:32 AM	7:34 AM	1:55 PM	2:02 PM
7:34 AM	7:37 AM	1:55 PM	2:04 PM
7:42 AM	7:44 AM	1:58 PM	2:06 PM
8:17 AM	8:18 AM	2:30 PM	3:02 PM
8:20 AM	8:25 AM	2:54 PM	3:03 PM
8:22 AM	8:26 AM	2:55 PM	3:04 PM
8:24 AM	8:28 AM	2:58 PM	3:09 PM

Traffic Volume Data

Turning Movement Counts (TMCs) were collected for the study intersections on Tuesday, April 3, 2012. Data collected included cars, heavy vehicles, and pedestrians from 6:45 AM to 9:30 AM and 1:15 PM to 3:30 PM. Based on the counts at the study area, the AM school peak hour is from 8:15 AM to 9:15 AM and the PM school peak hour is from 2:30 PM to 3:30 PM.

In addition to TMCs, Automatic Traffic Recorders (ATRs) were installed to collect the daily traffic volumes on Putnam Avenue, Magee Street, and Kinnaird Street.

Figures 4-7 show the 2012 Existing Volumes.

Speed Data

Nitsch Engineering analyzed speed data on Putnam Avenue, Magee Street and Kinnaird Street. The speed data was collected by the ATR counts. Table 5 shows the speed on these roadways over the course of the day.

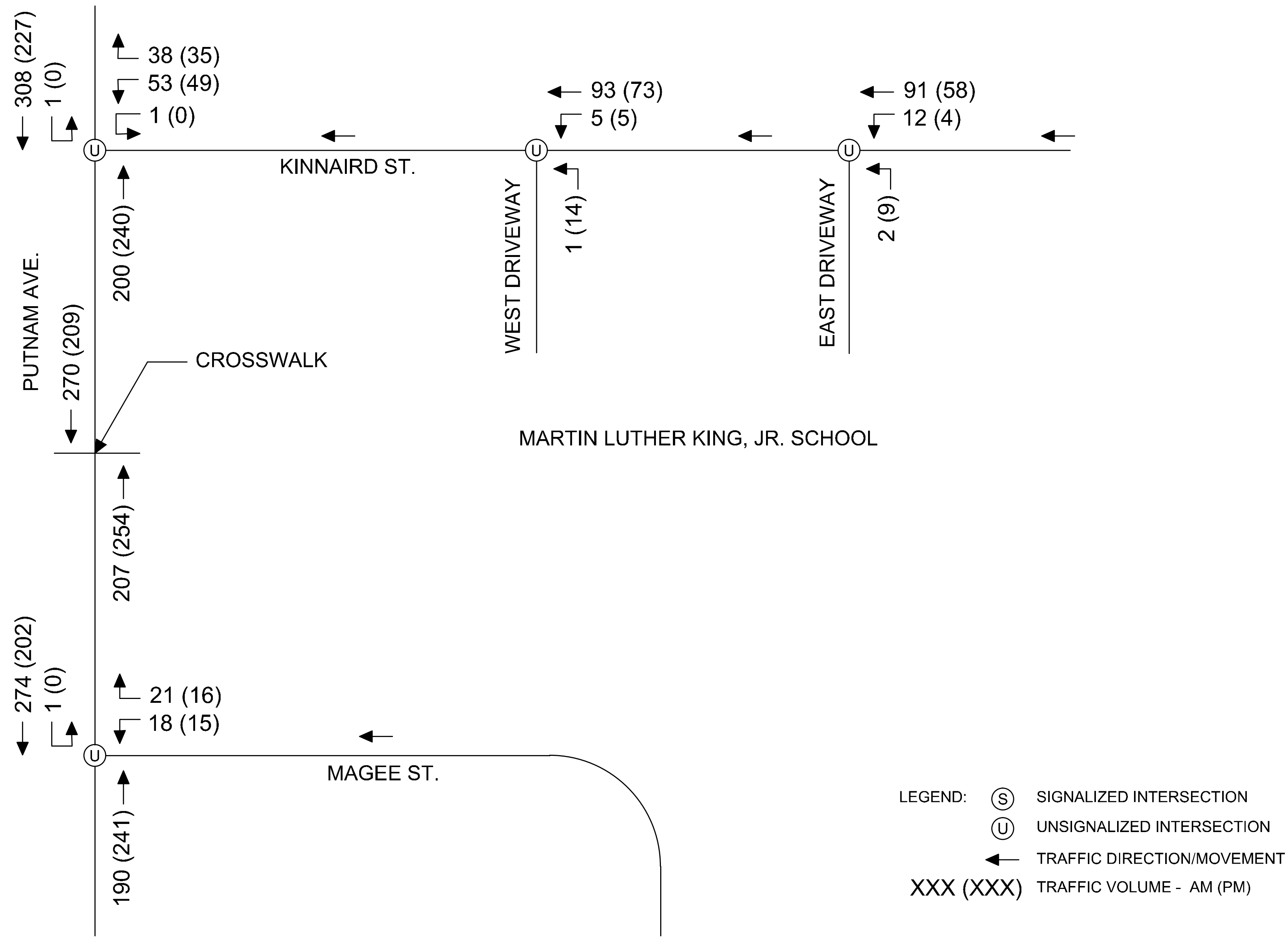
Table 5 - Speed Data

	Putnam Avenue, North of Pedestrian Crossing		Magee Street	Kinnaird Street
	Northbound	Southbound		
Average Speed (mph)	20	19	15	20
85th Percentile/Design Speed (mph)	25	24	19	25
10 mph Pace Speed	17-26	17-26	12-21	16-25

As shown in Table 5, the average speed on all roadways is under or at the posted speed limit of 20mph. In addition, the 85% design speed is within 5 mph of the posted speed limit indicating that speeding is not a significant issue in the study area. During school hours the roadways are too congested for vehicles to travel quickly. During off-peak hours the roadways do not see significant increases in speeding. During the nighttime hours the highest speeds were observed, but even at that time the 85th percentile speed remains at or below 30 mph on all roadways.

Seasonal Adjustment Rate

The TMCs and ATR data counts were performed during the month of April. There are no MassDOT permanent monthly count stations available in Cambridge, MA. Therefore, statewide data for urban arterials and local roadways was used to determine the seasonal adjustment rate. The statewide data shows that April is an above-average month for traffic on these roadways. In order to remain conservative, no seasonal adjustment factor was applied to the traffic volumes counted in April.



Nitsch Engineering

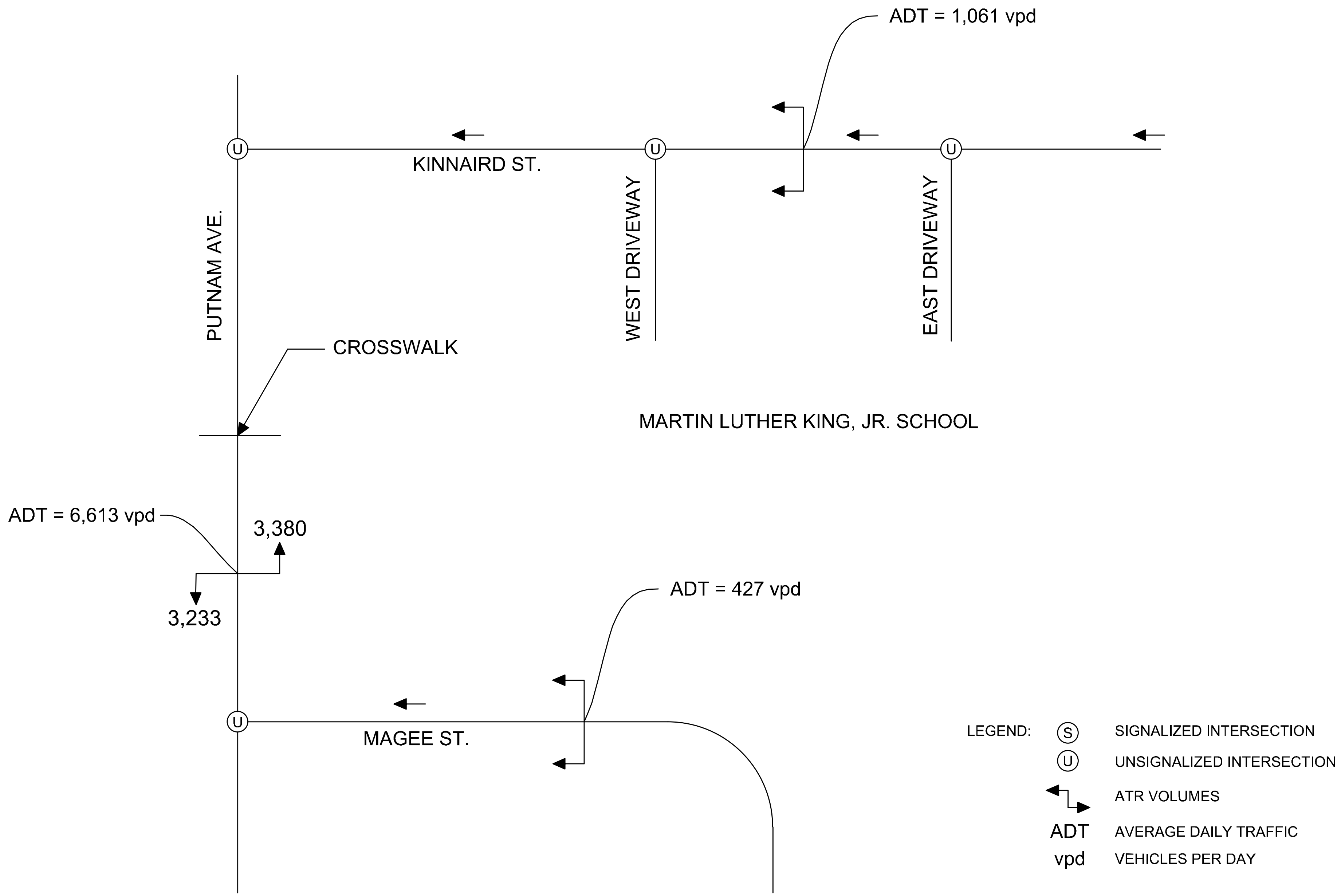
2012 EXISTING WEEKDAY TURNING MOVEMENT COUNTS

MARTIN LUTHER KING, JR. SCHOOL
CAMBRIDGE, MA

PREPARED FOR:
PERKINS EASTMAN
BOSTON, MA

NOT TO SCALE

FIGURE 4



Nitsch Engineering

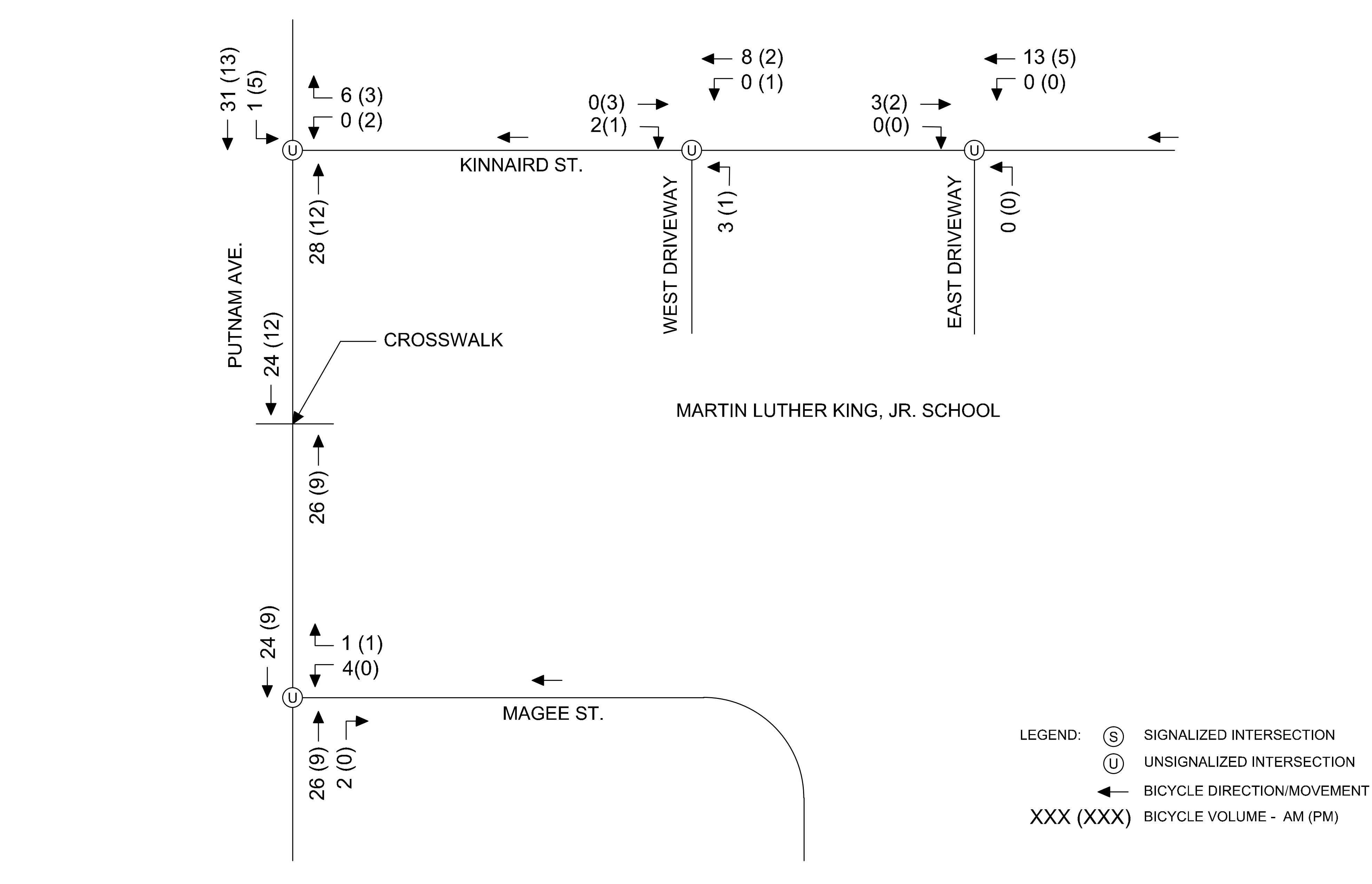
2012 EXISTING AUTOMATIC TRAFFIC RECORDER VOLUMES

MARTIN LUTHER KING, JR. SCHOOL
CAMBRIDGE, MA

PREPARED FOR:
PERKINS EASTMAN
BOSTON, MA

NOT TO SCALE

FIGURE 5



Nitsch Engineering

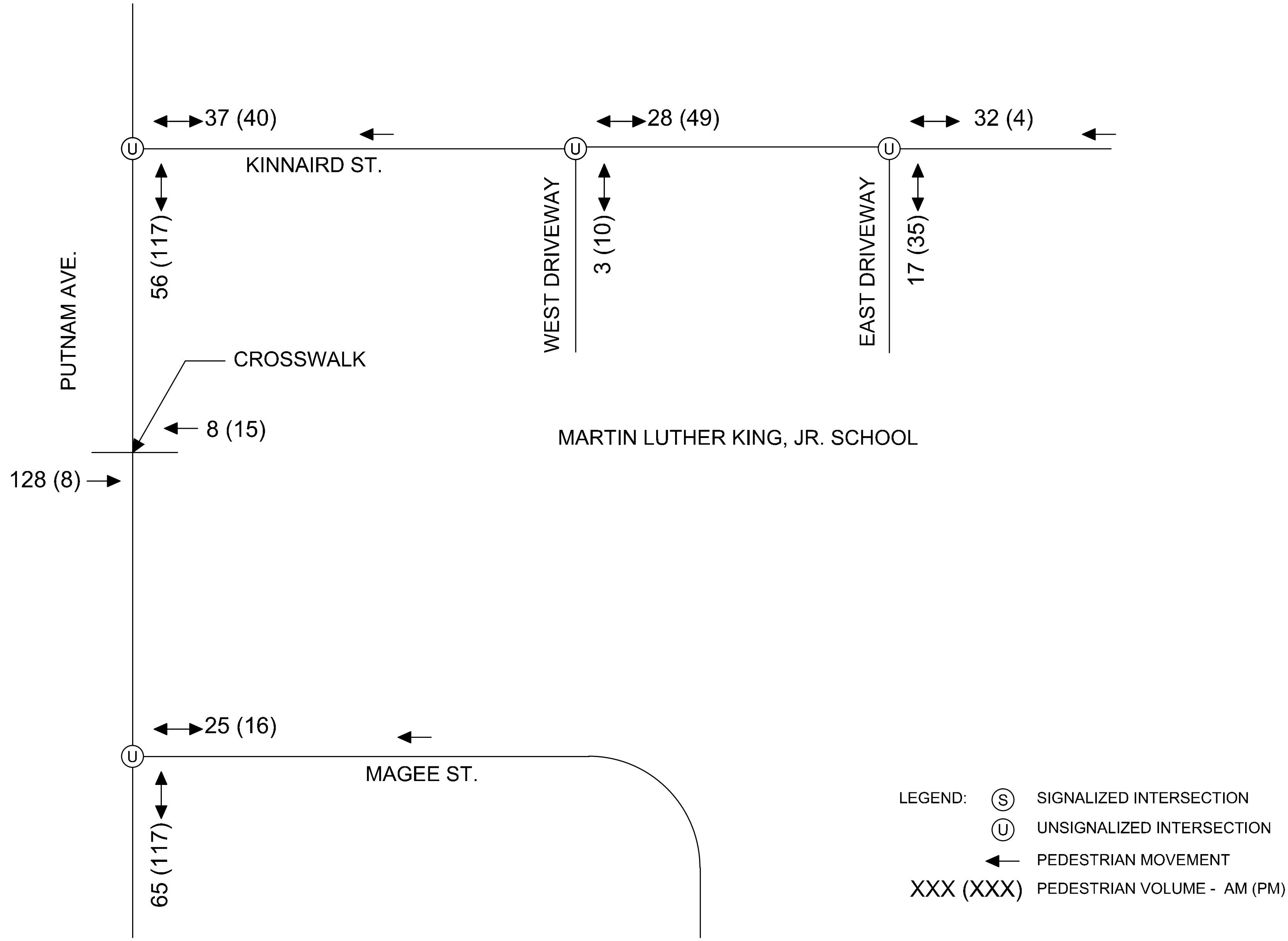
2012 EXISTING WEEKDAY BICYCLE COUNTS

MARTIN LUTHER KING, JR. SCHOOL
CAMBRIDGE, MA

PREPARED FOR:
PERKINS EASTMAN
BOSTON, MA

NOT TO SCALE

FIGURE 6



Nitsch Engineering

2012 EXISTING WEEKDAY PEDESTRIAN COUNTS

MARTIN LUTHER KING, JR. SCHOOL
CAMBRIDGE, MA

PREPARED FOR:
PERKINS EASTMAN
BOSTON, MA

NOT TO SCALE

FIGURE 7

Intersection Operations

A Level of Service (LOS) analysis is a quantitative assessment of traffic operations at an intersection. Nitsch Engineering conducted an LOS analysis at the study area intersections using the procedures outlined in the 2003 Highway Capacity Manual (HCM)[1]. The intersections were analyzed using SYNCHRO Version 6 computer software, which conforms to MassDOT requirements. The HCM bases its LOS results on average delay experienced by vehicles at intersections. The HCM categorizes LOS by alphabets A through F, with LOS A representing minimum delays and good service, and LOS F representing significant delays and poor service. MassDOT considers, LOS A, B, C and D as acceptable in urban/suburban areas, and LOS E and LOS F as unacceptable. Table 6 shows the LOS criteria for signalized and unsignalized intersections.

Table 6 – Level of Service Criteria for Intersections

Signalized Intersections		Unsignalized Intersections	
Level of Service[1]	Stopped Delay per Vehicle[1] (Seconds)	Level of Service[1]	Stopped Delay per Vehicle[1] (Seconds)
A	0 to 10	A	0 to 10
B	>10 to 20	B	>10 to 15
C	>20 to 35	C	>15 to 25
D	>35 to 55	D	>25 to 35
E	>55 to 80	E	>35 to 50
F	Over 80	F	Over 50
[1] Reference: 2000 Highway Capacity Manual, TRB			

2012 Existing Traffic Operations

Nitsch Engineering analyzed the existing year 2012 traffic operations at the study intersections. Table 7 summarizes the 2021 existing condition traffic operations.

[1] *2003 Highway Capacity Manual;* Transportation Research Board.

Table 7 - Level of Service Summary – 2012 Existing Conditions

NAME	MOVEMENT	AM PEAK HOUR				PM PEAK HOUR			
		V/C[1]	DELAY[2]	LOS[3]	95th Q[4]	V/C[1]	DELAY[2]	LOS[3]	95th Q[4]
Putnam Avenue/ Magee Street									
	WB L	0.13	13.4	B	11	0.11	12.6	B	9
	Intersection		1.4	A			1.2	A	
Putnam Avenue/ Kinnaird Street									
	WB L	0.29	16.1	C	30	0.31	17.8	C	32
	Intersection		3.1	A			3.3	A	
Kinnaird Street/ East School Driveway									
	WB LR	0	0	A	0	0.01	0.6	A	0
	NB L	0.1	2.5	A	8	0.04	10.2	B	3
	Intersection		1.2	B			2.7	A	
Kinnaird Street/ West School Driveway									
	WB L	0.01	0.8	A	1	0.02	0.4	A	1
	NB LR	0.01	9.7	A	0	0.07	15.9	C	5
	Intersection		1	A			0.5	A	
Putnam Avenue/ Pedestrian Crossing									
	NB T	0.01	0.7	A	1	0.01	0.8	A	0
	SB T	0.01	10.2	B	0	0.03	9.3	A	2
	Intersection		0.9	A			2.8	A	

[1] Volume to Capacity Ratio; [2] Vehicle Delay, measured in seconds; [3] Level Of Service; [4] 95th Percentile Queue (in feet)

Table 7 shows that under the existing conditions, all of the intersections and intersection approaches operate at acceptable LOS C or better. For an urban area like Cambridge, this is a very good LOS and indicates that the existing roadway infrastructure has sufficient capacity for the current school. Although there is some queuing during the pick-up/drop-off times, the traffic dissipates quickly and does not cause significant delay for other vehicles.

Signal Warrant Analyses

Nitsch Engineering performed signal warrant analyses at the study area based on the standard procedures outlined in the Manual for Uniform Traffic Control Devices (MUTCD). The analyses were performed to determine whether there was a need for a signal as a method of traffic control at the intersections of Putnam Avenue at Magee Street, and Putnam Avenue at Kinnaird Street. The analyses were performed based on existing year 2012 volumes. Based on the 2012 existing traffic volumes, none of the intersections meet any of the signal warrants. We do not recommend installing traffic signals at these locations.

Conclusions

The MLK School is located in an urban area with significant space constraints. There is no space on-site for bus or vehicle queuing during the pick-up/drop-off period, which causes some congestion on the local area roadways. Although there is queuing during the peak school hours, the local infrastructure is sufficient to handle the volume of traffic with minimal delay. The main issue that occurs is when vehicles stop in the roadway and prevent traffic from operating under normal conditions.

The existing bus drop-off takes place on Putnam Avenue, which is an urban minor arterial, indicating that it serves a significant level of local traffic. The bus drop-off can take 2-3 minutes per bus for students to unload, and all traffic on Putnam Avenue is stopped during this time. The existing bus pick-up occurs on Magee Street, a small local roadway. Buses pull over on the side of Magee allowing vehicle traffic to bypass during this time. Buses will typically get there well in advance of the pick-up and wait 20-30 minutes for students to load. It has been noted that during the winter, the snow on Magee Street can prevent buses from pulling over enough to allow through traffic. In addition, some of the parking on Magee Street is restricted during school hours to allow buses to maneuver safely onto Putnam Street. There are no site distance issues for vehicles turning from Magee Street onto Putnam Avenue.

The majority of the vehicular pick-up and drop-off takes place on Kinnaird Street. Some vehicles were observed using Putnam Avenue and Magee Street for this purpose, as there is no official designated area. Vehicles using Putnam Avenue for this purpose occasionally block through traffic. Vehicles using Magee Street for this purpose conflict with the buses. The preferred pick-up/drop-off scenario is to separate buses from vehicles so that they do not conflict with each other during this time. The vehicles using Kinnaird Street either pull into the on-street parking areas, or occasionally pull up onto the sidewalk in front of the school. They do not block traffic on Kinnaird Street, but they do block pedestrians from using the sidewalk. In addition, there are some site distance issues for vehicles turning from Kinnaird Street onto Putnam Avenue, although those can be mitigated by vehicles pulling ahead of the stop-line.

Parking is very congested at the site. There are a total of 49 designated parking spaces; however 88 vehicles were parked in the parking areas. This causes confusion for teachers and staff who are entering and exiting the site, as many vehicles block other vehicles from exiting during the peak hour. Drivers are forced to leave phone numbers in their car windshield, and may have to temporarily leave the school to move their cars out of the way. Two bike racks provide bicycle parking in front of the school, and they were both occupied during the site visit. In addition, many bikes were observed attached to neighborhood street signs, and while it was not clear whether the bicycles were associated directly with the school, it is an indication that there may be additional demand for bicycle racks in the area.

The signage in the area is generally adequate, however the pavement condition and pavement markings, particularly on Putnam Avenue, are deteriorated. The crosswalks are inconsistent with each other on Kinnaird Street, which can cause some confusion for users. The crosswalk across Magee is not aligned with the pedestrian ramp. Pedestrians that use the ramp will enter the roadway prior to the stop-line. This can cause safety concerns as vehicles will not anticipate them entering the roadway at that point.

Civil

Site Layout:
The existing MLK School is sited with its frontage on Putnam Avenue. The site is bounded on the south by Magee Street, to the north by Kinnaird Street and to the east by the properties located on Hayes Street. The main entrance to the existing building is located at 100 Putnam Avenue. There is also an existing entrance to the preschool located on Magee Street. The existing MLK school building occupies most of the project site. There is a playground area located at the southeast corner of the site along Magee Street. Located at the rear of the building on the east side of the site are an artificial playfield, basketball court and a parking lot area.

Refer to the Transportation Engineering narrative for more information about existing site circulation, parking and traffic patterns around the site.

Water Systems:
The existing MLK School domestic water service is a 4-inch cast iron water line that is fed off of the existing 16” cast iron water main that runs in Putnam Avenue. The City of Cambridge GIS shows a fire service line feeding the existing school building from the 16” water main in Putnam Avenue. According to the original design plans for the school that line is a 6” sprinkler and standpipe supply line and is fed from the 16” water main in Putnam Ave as shown on the Cambridge GIS system.

There are also other existing water mains in the area of the MLK School site. There is a 6” cast iron water main in Kinnaird Street to the north, a 6” cast iron water main in Magee Street to the south, and a 6” cast iron water main in Hayes Street to the east.

There is likely adequate fire protection volume and pressures in the existing 16” water line in Putnam Avenue. According to CWD, the static water pressure in the vicinity of the school is approximately 65 psi. However, a flow test will need to be performed to confirm that the existing water line will be sufficient for proposed fire and domestic water demands for the project. There are multiple fire hydrants located on all of the streets surrounding the MLK School site.

Sanitary Sewer:
The MLK School is currently serviced by an 8” cast iron sanitary sewer line that connects to the existing 8” sanitary sewer main located east of the school site in Hayes Street. The sewer main in Hayes Street continues east to Howard Street and eventually connects to the Western Avenue system.

There are also other existing sewer mains in the area of the MLK School site. There is an existing 8” sanitary main in Magee Street and also an existing 16”x12” sanitary sewer line in Kinnaird Steet. There are also combined sewer lines located in Putnam Avenue, Magee Street, Hayes Street and Kinnaird Street.

Existing Conditions – Civil

According to the City of Cambridge DPW (CDPW) there are no existing sanitary sewer issues with any of the existing systems in the vicinity of the MLK School site.

Site Topography/Drainage:

The existing MLK School building is located on an urban site that is 100% developed. With the exception of the small artificial grass play surface located at the rear of the school near Hayes Street, the entire site consists of impervious surface. The site topography slopes down from Magee Street and Putnam Avenue at the southwest corner of the site to a lower elevation at Kinnaird Street at the northeast corner of the site. The change in grade from the southwest corner to the northeast corner is approximately ten feet (10').

The site does not slope uniformly as described above and contains on-site low lying areas where runoff from the site is collected in multiple systems of catch basins and underground piping. These systems convey the collected runoff to the existing 12" combined sewer line in Hayes Street, the 8" combined sewer in Putnam Avenue, and to the existing storm sewer line in Kinnaird Street. The roof runoff from the existing school building is conveyed to the 12" combined sewer line in Hayes Street and the existing storm drain line in Kinnaird Street. According to our conversations with the CDPW there are no large scale drainage issues in the immediate vicinity of the MLK School site.

There are currently no measures being taken on the site to improve the stormwater quality of the collected runoff. Stormwater from the existing site is discharged untreated to the city systems as described above.

There may be possible groundwater issues in the area based on reports, by school officials, of multiple times when standing water has been observed in the open areas beneath the existing gymnasium space at the school. There were reports of three to four feet of standing water at various times. Based on a monitoring well installed by CDM Smith as part of their initial geotechnical study, the groundwater level in the well measured about 6.2' below the surface elevation (approximately elevation 24.3) on January 27, 2012. Measurements taken by CDM Smith while performing their boring excavations showed groundwater elevations that ranged from 6.5' to 14' below the surface (approximately elevation 17.2 to 22.0). The CDM Smith report recommends using a ground water design level of 5' below surface grade.

It was mentioned by the CDPW that the soils in the area of the MLK School contain high amounts of clay and are generally not well draining. Based on the preliminary geotechnical report by CDM Smith the site sits on a layer of fill that varies in thickness between 4.5' to 18'. Beneath the fill layer is a layer of marine clay. There are also small pockets of organic materials and sandy gravel in localized areas where the borings were taken. Refer to the Draft Geotechnical Report created by CDM Smith and dated February 3, 2012 for more detailed information about soils and groundwater conditions at the project site.

Gas Service:

The MLK School is currently serviced by a gas line of unknown size that connects to the existing 8" gas main located west of the school site in Putnam Avenue. The existing gas line exits the MLK School building in the vicinity of the main entrance on Putnam Avenue. There are also other existing gas mains in the area of the MLK School site. There is an existing 3" gas main in Kinnaird Street and an existing 4" gas main in Hayes Street.

Structural Report

Introduction

Foley Buhl Roberts & Associates, Inc. (FBRA) is collaborating with *Perkins Eastman (PE)* in the review and evaluation of structural issues/conditions at the Martin Luther King Jr. School in Cambridge, Massachusetts. The purpose of this report is to identify and describe the structural systems of the various parts of the facility and to comment on the structural issues/conditions observed. General comments relating to potential renovations, alterations and additions to the building (governed by the Massachusetts Existing Building Code (MEBC – 8th Edition) are presented as well.

Structural conditions at the Martin Luther King Jr. School were reviewed at the site on April 2, 2012.

The following documents were reviewed in the preparation of this Existing Conditions Structural Report:

Martin Luther King Jr. Elementary School: Structural Drawings S-1 to S-18, prepared by Nichols Norton and Zaldastani Structural Engineers, Boston, Massachusetts, dated June 25, 1968.

Martin Luther King Jr. Elementary School: Selected Architectural Drawings, prepared by Sert, Jackson and Associates Architects, Boston, Massachusetts, dated June 25, 1968.

Capital Needs Assessment of the King/Amigos Building (selected sections), prepared by EMG, Hunt Valley Maryland, dated March 28, 2006.

Preliminary Geotechnical Report and Environmental Evaluation, prepared by CDM Smith, Cambridge, Massachusetts, dated February 3, 2012.

No exploratory demolition or structural materials testing was conducted in conjunction with this existing conditions structural review. Subsurface soils conditions at the site were recently investigated by CDM Smith and summarized in the above-referenced report.

Photographs of existing conditions are included in the Appendix at the end of this report.

I. **General Description**

The Martin Luther King Jr. School is located at 100 Putnam Avenue in Cambridge, MA. The building is a three to four-story, reinforced concrete framed structure with a spread footing foundation, constructed as a K through 8 facility in 1971. The gross floor area is approximately 159,400 square feet.

The school is composed of two basic sections: Part A (South Wing) is a three and four-story classroom wing which also includes the Kitchen/Cafeteria, a Boiler Room, Mechanical Rooms and Storage Rooms at the Ground Floor level (El. 20’-2”). These spaces border the north, south and west sides of an exterior, central Courtyard (Photo No. 1). A raised section of Classrooms and Faculty Rooms (at El. 22’-6”) borders the east side of the Courtyard. The main entrance to the school is at the First Floor of Part A (El. 33’-0”), on the west side of the building. There is a reinforced concrete ramp extending from grade to this level on the east side of the building as well. The MLK Preschool is located at the south side of the First Floor. Classrooms and Administrative Offices are also located at this level. Additional Classrooms are located at the Second Floor (El. 43’-6”), bordering the east, west and north sides of the Courtyard and at the Third Floor (El. 54’-0”), along the west side of the Courtyard and at the north end of the wing. Upper level Classrooms in Part A are serviced by corridors, which overlook the Courtyard below. A two-story Atrium/Circulation area (with a mono-slope roof (former skylight)) separates the main Classroom block from offices and Classrooms along the north side of Part A (Photo No. 2). The Cooling Tower is located in an enclosure at the roof level, directly south of the sloped roof. Stairwells are located on the north and south ends of this wing (near the front/west side), and on the east side. The elevator is located just north of the Main Entry Lobby. A small loading area is located on the north end of Part A, adjacent to the west wall of Part B.

Linear (east-west), reinforced concrete light monitors have been incorporated into the flat roof construction of Part A (Photo Nos. 3 and 3A).

Cantilevered, Mechanical Rooms were constructed in Part A; there are three on the east side (Photo No. 4), between the First Floor and Second Floor (which cantilever 12’-6”) and three on the west side (Photo Nos. 5 and 5A), between the Second Floor and Third Floor (which also cantilever 12’-6”). The Mechanical Rooms project 10’-10” from the edge of the floor and are hung from the cantilevered floor above with 8” concrete walls on three sides and integral steel rod hangers. Rigid insulation, underlying a concrete topping slab has been provided at Second and Third Floor cantilevered construction, as the underside of these areas are exposed to the exterior. A similar approach was taken at the First Floor level, at the south end of Part A (over the original, Outdoor Play Area) and at the cantilevered sections along the east and west sides of the Courtyard.

Part B (North Wing) is home to the Industrial Arts, Computer and Music Departments at the Ground Floor (El. 20’-2”). The original Boys and Girls Locker Rooms at this level (below the Gymnasium) have been converted into Offices and After School Program spaces. The Exercise Room (Secondary Gymnasium) is located at the northeast end of the Ground Floor. The Gymnasium, upper Exercise Room and Auditorium are at the (Main) First Floor level (El. 33’-0”). Two, concrete framed, exterior (covered) stairways provide egress from the Gymnasium down to the exterior finished grade (El. 23..5'+/-) on the north side of this wing. The structured floor of the Auditorium slopes downward to El. 30'-6" at the front of the stage. The Second Floor of Part B consists of the Upper Gymnasium and Upper Auditorium spaces, as well as the roof of the Exercise Room.

As in Part A, linear (north-south), reinforced concrete light monitors have been incorporated into the flat roof construction of the Part B Gymnasium and Exercise Room (Secondary Gymnasium) roofs (Photo Nos. 6 and 6A). There are no monitors on the flat roof of the Auditorium.

The top surface of roof slabs in Parts A and B are (minimally) sloped to provide a positive pitch to roof drains. There are reinforced concrete parapets in a number of roof locations, ranging from 2'-0" to 3'-4" in height. Scuppers were observed at Part A roofs (Photo No. 7); however, some may not be original. Roofs are typically rubber membrane (adhered).

Utility tunnels (below the Ground Floor) were constructed at the south end of Part A (in the former Outdoor Play Area, now Storage) and at the northeast corner of Part A, extending below the corridor connecting into Part B.

Exterior walls consist of exposed, cast-in-place reinforced concrete panels and reinforced concrete columns and spandrel beams, infilled with a blend of vertically grooved, precast panels (anchored to a masonry (CMU) backup) and glazed construction (windows). Typical interior partitions (non – bearing) are custom, vertically grooved concrete block construction.

The Martin Luther King Jr. School was constructed on a sloping site (downwards, from the southwest to the northeast). The western side of Parts A and B are generally one-story below exterior grade (except at the aforementioned loading area).

Recent soil borings indicate that the subsurface soils are fill (as much as 18 feet deep), along with organic soils (locally present), sand and gravel (locally present) and marine clay (Boston blue clay) overlying glacial till. The upper clay layer is over-consolidated and stiffer than the soft (under-consolidated) clay layer below. Groundwater was encountered 6.5 to 10 feet below the existing grade, and is controlled by the Charles River (there is a gradient from the site, downwards to the river). Refer to the Preliminary Geotechnical Report of February 3, 2012 for additional information.

Based on FBRA's initial walk-through, the building generally appears to be in satisfactory structural condition. There are no signs of overstressed/failed members and no evidence of significant deterioration. Foundations appear to be performing satisfactorily. The is a history of water-related issues in the building, which is addressed later in this report.

II. Structural Systems Description

The design of the Martin Luther King Jr. School (in 1968) preceded the introduction of seismic codes in Massachusetts; the facility was designed and constructed in accordance with the Massachusetts Department of Public Safety, Board of Schoolhouse Structural Requirements. Structural design for snow drift loading and wind loads were required by that document. The reinforced concrete structure was likely designed under the older Working Stress Design Method, which is generally more conservative than today's Ultimate Strength Method.

Flat roof construction at the Martin Luther King Jr. School (Parts A and B) is typically reinforced concrete construction, with post-tensioned beams at the long span roofs of the Gymnasium, the Exercise Room and the Auditorium. Upper floor construction is typically reinforced concrete slabs, joists and beams, supported by reinforced concrete columns. Tectum ceiling panels were installed (between joists) for acoustical purposes. Lowest level floor construction is typically a concrete slab on grade (structural slab over utility tunnels). Foundations are conventional spread footings.

Structural Materials: All interior concrete, including the foundations and superstructure, is noted on the original Structural Drawings to have a minimum 28 day strength of 4,000 psi. Concrete for post-tensioned Gymnasium, Exercise Room and Auditorium roof beams is also 4,000 psi strength. Exterior concrete is noted to be 4,000 psi, air entrained. Typical, mild steel reinforcing is standard deformed bars, conforming to ASTM A 432, with a 60,000 psi minimum yield point. Prestressing strands conform to ASTM A 416-59T, with a minimum ultimate strength of 270 ksi.

Allowable Soil Bearing Pressure: Spread footings were proportioned on the basis of a 3.0 tons per square foot (TSF) allowable bearing pressure on natural soils. Representative structural calculations generally confirm these design allowable bearing pressures.

Design Live Loads: Design live loads are noted on the Structural Drawings (Drawing S-18) as follows:

Roofs – Basic Snow Load:	30 psf (35 psf required by the current MA Building Code (8th Edition))
Corridors and Stairs:	100 psf
Auditorium and Gymnasium:	100 psf
Large Classrooms (Over 900 SF):	100 psf
Classrooms (Under 900 SF):	70 psf

Representative structural calculations generally confirm these design live loads. Floor loads are appropriate and meet present Building Code requirements. There is no mention of seismic design loads on the Structural Drawings (not uncommon for buildings designed in the late 1960's).

Story Heights: Typical story heights in Part A are a relatively low 10'-6" (except 12'-10" for the majority of the Ground Floor (e.g. Cafeteria)); the "coffered" joist structure results in periodic higher ceilings where the structure is exposed. The Ground Floor to First Floor story height in Part B is

12'-10". The top of roof slab (measured from the finished floor) in the Gymnasium, Exercise Room and Auditorium spaces (measured from the finished floor) is 22'-3", 23'-4" and 21'-6", respectively.

Roof Construction: High roof construction over the Third Floor Classrooms in Part A consists of a 5" thick (minimum) reinforced concrete slab, integral with 8" wide by 19" deep reinforced concrete joists (24" minimum overall structural depth), spaced at 8'-0" o.c. The typical joist span is 27'-0". The slab is thickened at the edges and the top surface slopes to internal drains. Typically, there is a (minimum) 2'-0" high parapet (with control joints); however, there are breaks in the parapet (or scuppers) in some locations, to limit the potential depth of ponded water. Light monitors include integrated beams and are structural. Lower roofs (at the Third Floor level) are similarly framed. The steel framed shed roof (with individual skylights) over the Lobby/Circulation space below is structured with 6" x 10" steel tubes spaced at 8+/- feet on centers. All roofs were designed for a 30 psf basic snow load (35 psf required by the current code).

The flat roofs of Gymnasium and the Exercise Room in Part B are similarly framed, with 4" thick concrete slabs supported by integral, reinforced concrete joist with varying length spans. Joists at both roofs are supported by clear-spanning, deep wall/beams and post-tensioned reinforced concrete beams (integral with the light monitors). The Auditorium roof in Part B is structured with a 5" minimum thick slab spanning 8+/- feet to 30" deep, post-tensioned reinforced concrete beams. Beams are supported on 12" thick perimeter, unreinforced masonry bearing walls (joint reinforcing only) at all main spaces in Part B.

Second and Third Floor Construction – Part A: Floor construction typically consists of a 4" or 5" thick reinforced concrete slab, integral with 8" wide by 19" deep reinforced concrete joists (23" or 24" overall structural depth), spaced at 8'-0" o.c. Joist spans range from 23'-0 to 32'-0". Floors were typically designed for a 70 psf live load (including partitions) at small rooms (less than 900 SF) and 100 psf at large rooms (exceeding 900 SF).

First Floor Construction – Parts A and B: Floor construction in Part A is similar to the upper floors, typically consisting of a 5" thick reinforced concrete slab, integral with 8" wide by 19" deep reinforced concrete joists (24" overall structural depth), spaced at 8'-0" o.c. The slab reduces to 3½" thick at depressed floor areas (to accommodate floor finishes). The Gymnasium floor in Part B is similarly structured, with a 5" thick slab. The sloping floor of the Auditorium (Part B) is structured with a 12" thick, one-way reinforced concrete slab supported by reinforced concrete beams, columns and walls.

Ground Floor Construction – Parts A and B: Ground floor construction (including the (3'-8") depressed, Boiler Room floor) is typically a 5" thick, concrete slab on grade (underlain by a vapor barrier), reinforced with No. 3 bars spaced at 12" o.c. each way. A 5" thick reinforced concrete structural slab was constructed over the utility tunnels. The raised section of the Ground Floor (El. 22'-6") which borders the west side of the courtyard is framed with a 6" thick, reinforced concrete slab over a 4+/- feet deep crawl space. The slab is supported on a 12'-0" x 13'-6" grid of additional piers and footings. A section of slab in Part B (former Boy's Locker Room) is similarly framed, with a 6" thick structural slab over a crawl space.

Columns: Columns are typically reinforced concrete construction. Double columns (12" x 12") or linked, double columns were constructed in Part A, as required by the architectural and structural design. First Floor construction in Part B is supported by rectangular, reinforced concrete columns at the interior (size varies) and by concrete or (unreinforced) masonry bearing walls at the building perimeter. Above the First Floor, typical long span roof construction in Part B is supported by perimeter, unreinforced masonry bearing walls, as noted above.

Stairs and Stairway Enclosures: Stairs and stairway enclosures in Parts A and B are typically reinforced concrete construction (stair slabs and supporting walls).

Exterior Wall Construction: Typical exterior walls consist of exposed, cast-in-place reinforced concrete panels and reinforced concrete columns and spandrel beams, infilled with a blend of vertically grooved, precast panels (anchored to an unreinforced (joint reinforcing only) masonry (CMU) backup, 8" or 12" thick) and glazed construction (windows). Typical exterior wall construction is not insulated.

Foundations are typically continuous strip footings below perimeter frost walls or foundation walls and individual spread footings at interior column supports. As noted above, footings have been proportioned on the basis of a 3.0 tons per square foot allowable bearing capacity on natural soils. Reinforced concrete walls retaining earth are typically 12" thick. PVC waterstops were provided at concrete joints where the exterior grade is higher than the interior floor.

Expansion Joints: Part A and Part B are separated by a 1" wide expansion joint, extending across the connecting corridor at Column Line 8.7 (Photo Nos. 8 and 8A). The expansion joint is considerably undersized with respect to current Code requirements. An expansion joint was also provided where the exterior, reinforced concrete ramp on the east side of the building meets the First Floor construction.

Drainage: Per the original Structural Drawings, a perimeter and underslab drainage system was apparently provided at the Ground Floor/Foundation level of Part A (including the depressed, Boiler Room slab). It is not clear from the drawings if a similar system was provided in Part B.

***Fire Resistance**:* The reinforced concrete floor and roof construction is noncombustible and has a fire resistance rating that varies with the slab thickness (3½" to 12") and the depth of cover to reinforcing (typically ¾" minimum at slabs). The approximate fire ratings for floor and roof construction are as follows:

3½" thick slab areas:	1 Hour
4" thick slab areas:	1¼ Hours
5" thick or greater slab areas:	2 Hours

Accordingly, the building construction type classification ranges from Type 2A to Type 1B (Non-Combustible, Protected), under the current Building Code. Steel framed, sloped roof construction in Part A is not protected and has no fire resistance rating. The building is not sprinklered (with the exception of certain Ground Floor Storage Rooms).

Lateral Force Resistance - Seismic: The Martin Luther King Jr. School was designed and constructed prior to the introduction of seismic design codes in Massachusetts. There is no clearly defined lateral load resisting system in any of the parts of the facility, which is not uncommon with buildings designed in the late 1960's. Lateral force resistance in Part A is provided by the frame action of the reinforced concrete slabs, beams and columns in each direction. Interior and exterior (backup) masonry walls (non-bearing, unreinforced) provide a degree of lateral force resistance as well; however, the construction of these walls does not meet current Code requirements. In Part B, lateral forces are resisted by the (unreinforced) masonry walls of the Gymnasium, Exercise Room and Auditorium spaces. Reinforced concrete wall panels in the Gymnasium and the Exercise Room provide additional lateral force resistance in the east-west direction. Lateral force resistance and unreinforced masonry wall issues would need to be addressed in conjunction with a major renovation of the building; a complete seismic evaluation would be required.

III. Structural Condition/Comments

Structural Conditions at the Martin Luther King Jr. School were reviewed on April 2, 2012. Generally speaking, floor and roof construction appears to be in satisfactory condition; there is no evidence of structural distress that would indicate significantly overstressed, deteriorated or failed structural members.

Foundations appear to be performing adequately; there are no signs of significant, total or differential settlements.

There are groundwater and surface drainage issues in the Exercise Room (Secondary Gymnasium), the east entry to Part A and in the utility tunnels which extend from Part A to Part B (Photo No. 9). Similar issues may be present in the Part B crawl spaces, as noted in the March 28, 2006 EMG Report. The higher, Part A crawl space was found to be relatively dry during the April 2, 2012 site visit (Photo No. 9A).

Floors and roofs have been constructed in general accordance with the original Structural Drawings.

Structural/structurally related conditions observed during the April 2, 2012 site visit are noted below:

1. Exterior Walls: Conditions observed include the following:

   - Spalling of the exterior concrete surface was observed in several locations – repair is required (Photo Nos. 10 and 10A).

- If a full renovation of the building is undertaken, anchorage of the exterior precast panels to the masonry backup walls would need to be investigated (condition and strength). No spalled areas were observed on precast panel surfaces, suggesting that the anchors may be in satisfactory condition; however, it is not likely that the original anchors would satisfy current Code seismic requirements.

- If a full renovation of the building is undertaken, The anchorage/bracing of exterior, masonry backup walls as well as the height-to-thickness (H/T) ratios would need to be evaluated (per Code). Additional anchorage would be required. Additional bracing of walls may be required if H/T ratios are found to be non-compliant.

- The joint between the post-tensioned beam and the exterior walls of the Exercise Room have apparently failed, as significant efflorescence was observed (indicating moisture infiltration – see Photo No. 6 (Exterior) and Photo No. 11 (Interior)).

- Caulking between precast wall panels and exposed concrete columns and/or spandrel beams needs replacement in some areas.

- Caulking at the expansion joint between Parts A and B has failed (Photo No. 12).

2. Water Issues: During heavy rains, water reportedly enters the Exercise Room (Secondary Gym) through the exit door on the north side and at the entry to the space at the southwest corner. The latter location is adjacent to an exterior, paved ramp, where the original trench drain (located adjacent to the building) is unable to handle the volume of water during heavy rains. A similar condition occurs at the ramp to the east entry to Part A (Photo No. 13). Standing water was observed in the utility tunnel extending into Part B (Photo No. 9); reportedly, this is a common occurrence. The presence of standing water in the utility tunnels and crawl spaces presents moisture related concerns. As noted earlier in this report, a perimeter and underslab drainage system was apparently provided (per the original Structural Drawings) at the Ground Floor/Foundation level in Part A (including the depressed, Boiler Room slab). It is not clear from the drawings if a similar system was provided in Part B. Groundwater and surface drainage issues will need to be thoroughly investigated and evaluated if the building undergoes a major renovation in the future.

3. The condition of the slab on grade (Ground Floor) appears to be generally satisfactory. There were no signs of significant distress in floor finishes.

4. Snow Drifting: There are numerous drifting areas in the building (high/low roof conditions, light monitors, parapets, etc.). The school was designed and constructed in accordance with the Massachusetts Department of Public Safety, Board of Schoolhouse Structural Requirements. Structural design for snow drift loading was required by that document, so there should be no structural concerns. The structural evaluation of these conditions is beyond the scope of this Study, but will need to be addressed if the building is ultimately renovated.

5. Vertical cracks were observed in the west, reinforced concrete walls of the light monitors in the Part B Gymnasium. These cracks are likely shrinkage related and are not a structural concern.

6. Roof drains in Part A appear to be minimal. Several drains at the lower roof (north end, at the Third Floor level) were apparently blocked and water had ponded (2" to 3" deep). As there are parapets at all roofs, it is imperative that all roof drains and scuppers be maintained at all times to prevent blockage.

7. Floor Loading Issues: The original design live loads for the structured, upper floors of the school are appropriate and meet current Code requirements. There do not appear to be any issues relating to excessive loading. Floor construction is performing as intended; reinforced concrete slabs, beams, joists and columns appear to be in satisfactory condition.

8. Interior Masonry Walls: Interior (non-bearing) masonry walls are typically in satisfactory condition with only minor cracking observed in several areas. The anchorage/bracing of interior masonry walls (scheduled to remain) as well as their height-to-thickness (H/T) ratios will need to be evaluated (per Code) if the building is renovated in the future.

IV. Potential Renovations and Additions – Preliminary Comments

Building Code Requirements – Renovations and Additions

Renovations, alterations, repairs and additions to existing buildings in Massachusetts are governed by the provisions of the Massachusetts State Building Code (MSBC – 8th Edition) and the Massachusetts Existing Building Code (MEBC). These documents are based on amended versions of the 2009 *International Building Code (IBC)* and the 2009 *International Existing Building Code (IEBC)*, respectively.

The MEBC defines three (3) compliance methods for the repair, alteration, change of occupancy, addition or relocation of an existing building. The method of compliance is chosen by the Design Team (based on the project scope and cost considerations) and cannot be combined with other methods. In this case, there will be no change in occupancy, unless the building is ultimately designated as an Emergency Shelter.

Regardless of the compliance method chosen, the MEBC presently requires that buildings with unreinforced masonry walls be evaluated with respect to the provisions of Appendix A1 of the IEBC (applicable to this project). An assessment of masonry shear stresses, wall slenderness, parapets, wall anchorage, diaphragm anchorage, etc. is required; and the existing building must be capable of resisting at least 75% of the seismic loading required by the Code for new construction.

The *Prescriptive Compliance Method* (IEBC Chapter 3) duplicates Sections 3403 through 3411 of Chapter 34 in the IBC and prescribes specific minimum requirements for construction related to additions, alterations, repairs, fire escapes, glass replacement, change of occupancy, historic buildings, moved buildings and accessibility. A complete structural evaluation of the building is required by the Massachusetts Amendments. If the impact of the proposed alterations and additions to structural elements carrying gravity loads and lateral loads is minimal (less than 5% and 10% respectively), seismic upgrades to an existing building are generally not required, except for buildings with masonry walls in Massachusetts (as in this case), which must comply with the requirements of IEBC Appendix A1.

The *Work Area Compliance Method* (IEBC Chapters 4 through 12) is based on a proportional approach to compliance, where upgrades to an existing building are triggered by the type and extent of work. The Work Area Compliance Method includes requirements for three levels of alterations, in addition to requirements for repairs, changes in occupancy, additions, historic buildings or moved buildings. A complete seismic evaluation of the existing building is required for the following: Level 2 alterations where the demand to capacity ratio of lateral load resisting elements has been increased by more than 10%, all Level 3 alterations, a change in occupancy to a higher category and where structurally attached additions (vertical or horizontal) are planned. A full renovation of the Martin Luther King Jr. School would be classified as a Level 3 alteration. As the building has interior and exterior masonry walls, compliance with the requirements of IEBC Appendix A1 is also required.

The *Performance Compliance Method* (IEBC Chapter13) duplicates Section 3412 of Chapter 34 in the IBC and provides for evaluating a building based on fire safety, means of egress and general safety (19 parameters total). This method allows for the evaluation of the existing building to demonstrate that proposed alterations, while not meeting new construction requirements, will maintain existing conditions to at their current levels (at a minimum) or improve conditions, as required. A structural investigation and analysis of the existing building is required to determine the adequacy of the structural systems for the proposed alteration, addition or change of occupancy. A report of the investigation and evaluation, along with proposed compliance alternatives must be submitted to the code official for approval.

The design and construction of any proposed additions to the Martin Luther King Jr. School would be conducted in accordance with the Code for new construction. Proposed additions should be structurally separated from the existing facility by an expansion (seismic) joint to avoid an increase in gravity loads or lateral loads to existing structural elements.

Where proposed alterations to existing structural elements carrying gravity loads result in a stress increase of over 5%, the affected element will need to be reinforced or replaced to comply with the Code for new construction. Proposed alterations to existing structural elements carrying lateral load which result in an increase in the demand - capacity ratio of over 10% should be avoided, if possible. In Part B, this means that the removal of, or major alterations to the existing, unreinforced masonry walls should be minimized. If this is not avoidable, more significant seismic upgrades/reinforcing will be required, potentially including the addition of lateral force resisting elements (braces, shear walls, etc.) so the building can resist 75% of the seismic forces required by the Code for new construction. There are additional issues with the unreinforced masonry walls in Part B, as described on the following page.

Existing Conditions - Structural

A full renovation of the Martin Luther King Jr. School (or the full renovation of either Part A or Part B) would likely be conducted as under the *Work Area Compliance Method – Level 3 Alteration .* The MEBC would require the following scope of work:

Part A: Renovations to Part A would include the removal of all interior and exterior walls. All finishes and services would be removed as well, leaving only the basic concrete frame and foundations. With respect to the MEBC requirements, this project would be classified as a Level 3 Alteration (Chapter 8), with no change in use. As no lateral force resisting elements would be removed and no significant, additional mass would be anticipated (the total mass may actually be reduced), the demand-capacity ratio of the lateral force resisting system would remain the same or possibly decrease. Per Section 807.4.3.1 of the 2009 IEBC, as a substantial structural alteration would not be anticipated (less than 30% of the floor and roof construction will be altered), the existing building would need only to comply with the loads acceptable at the time of the original construction (the design preceded the introduction of seismic codes in Massachusetts). However, FBRA recommends that the renovated existing structure be at least capable of withstanding full wind loading and 50% of the seismic loads required by the code for new construction. The existing concrete frame may be capable of withstanding loads of this magnitude without supplementing the lateral force resisting system (e.g. new reinforced concrete or masonry or shear walls); however, that determination is beyond the scope of this Feasibility Study. Such voluntary improvements would be designed in accordance with Section 707.6 of the 2009 IEBC.

Part B: Typical roof construction in Part B consists of reinforced concrete slabs and beams (conventional and post-tensioned), supported by masonry bearing walls. The masonry bearing walls also provide lateral force resistance (wind and seismic loads). Concrete roof slabs and beams do not appear to be anchored to the supporting walls. The existing masonry wall construction does not meet current code requirements (they are unreinforced) and are inadequate by today's standards as bearing walls and as lateral force resisting elements. The slenderness ratios (height : thickness) do not meet current code requirements as well. The unreinforced masonry bearing walls in Part B would need to be supplemented/reinforced in all locations to meet the requirements of the Massachusetts Existing Building Code. Insulation would need to be provided as well. The impact on cost, function and aesthetics would be significant. The expansion joint is improperly constructed and sized; modifications would be required. In light of other, additional Architectural and MEP/Energy issues/constraints associated with the renovation of this wing, FBRA suggests that design options which retain this construction would be undesirable to pursue.

Foundation Considerations

Geotechnical matters were discussed in a meeting held on February 29, 2012. With respect to potential new construction on the site, the following issues were discussed:

- Groundwater was encountered 6.5 to 10 feet below the existing grade (in soil borings and an observation well), and is controlled by the Charles River (there is a gradient from the site, downwards to the river). Groundwater will be an issue during construction; temporary dewatering will be required. Perimeter and underslab drainage systems will be required. As water is a significant issue for design and construction, additional observation wells be installed at the north end of the site (Part B, in the area of the existing Gym).

- New construction can be supported on a spread footing foundation, with an allowable bearing pressure of 2.0 tons per square foot (similar to existing building foundations, designed for 3.0 tons per square foot).

- Lowest level floor construction can be a concrete slab on grade, similar to the existing Ground Floor slab construction.

- Structural fill will be required below all new footings, following the removal of unsuitable fills and soils. The existing soil materials could potentially be screened and used as ordinary fill (outside the building footprint) or perhaps in the lower zones below new slabs on grade, (reducing the amount of imported fill required).

- The site is considered to be Site Class D, for seismic design. Liquefaction is not an issue.

- Settlement (total and differential) in the soft clay layer will be an issue; particularly in a “Hybrid” scheme, where new construction will interface with existing construction. This will need to be considered in design. If existing grades are raised significantly, excessive settlement could result.

- It may be possible to crush demolished concrete elements on site and re-use in common fill (not structural fill), to avoid hauling it away. Noise may be an issue.

- Temporary lateral earth support may be required during construction. The Geotechnical Engineer (CDM Smith) recommends a pre-construction survey along with vibration monitoring during construction.

Demolition Considerations

As the existing building is cast-in-place reinforced concrete, demolition of all or part of the building will require a careful effort. Comments relating to the potential demolition are noted below:

- Particular care will need to be taken in the demolition of the Part B roof, as there are post-tensioned beams in the long-span roof construction (the post-tensioning strands may be unbonded) and the perimeter walls of the Auditorium, Gym and Exercise Room spaces are unstable, once the roof structure is removed.

- If Part A ultimately remains (the “Hybrid” scheme), a relatively clean place to begin Part B demolition would be at the existing expansion joint.

- Floor and roof construction in Part A is almost entirely supported by beams and columns; there are minimal, interior and exterior concrete bearing walls (e.g. Stair Nos. 1 and 2 are supported in part by concrete bearing walls). Long span roof construction in Part B is primarily supported by masonry bearing walls at the perimeter.

- The rooftop light monitors in Parts A and B are structural, and should not be removed/modified in a renovation, if possible.

- Parapets are structural in some cases and should not be removed/modified in a renovation, if possible.

- New openings in floor or roof slabs (Parts A and B) should be orientated/configured so the short dimension of the opening is parallel to the beams, if possible. Otherwise, supplemental steel framing (below the slab) will be required between joists/beams.

- Modifications which require cutting the concrete joists should be avoided, if possible. Otherwise, joists will be need to be headed off, or the affected area will need to be restructured.

- Interior masonry block walls are typically non-structural and can be removed (an exception is at south side of Stair No. 3 in Part A).

- The one-story high, reinforced concrete Mechanical Room projections on the east and west sides of Part A are structural (hung from the level above), but could be removed, if desired.

- The structured, exterior ramp to the First Floor of Part A on the east side of the building rests on bearing pads, and could be removed, if desired.

End of Existing Conditions Structural Report

APPENDIX - PHOTOGRAPHS

Photo No. – Central Courtyard – Part A

Photo No. 2 – Sloped Atrium Roof – Part A

Photo No. 3 – Rooftop Light Monitors – Part A

Photo No. 3A – Rooftop Light Monitors (Interior) – Part A

 **Photo No. 4 – Cantilevered Floors and Mechanical Rooms (East) - Part A**	 **Photo No. 5 – Cantilevered Floors and Mechanical Rooms (West) - Part A**
 **Photo No. 5A – Cantilevered Floors and Mechanical Rooms (West) - Part A**	 **Photo No. 6 – Light Monitor and End of Post-Tensioned Beam – Part B**

Photo No. 6A – Light Monitor in Gymnasium – Part B

Photo No. 7 – Rooftop Scupper – Part A

Photo No. 8 – Expansion Joint Between Parts A and B

Photo No. 8A – Expansion Joint (Closeup)

 **Photo No. 9 – Wet Crawl Space at Link to Part B**	 **Photo No. 9A – Dry Crawl Space at High (East) Side of Part A**
 **Photo No. 10 – Minor Concrete Spalling**	 **Photo No. 10A – Minor Concrete Spalling**

Photo No. 11 – Efflorescence/Leaking at Gymnasium Light Monitor – Part B

Photo No. 12 – Failed Caulking at Expansion Joint Between Part A and Part B

Photo No. 13 – Ramp Between Part A and Part B (Water Issues)

Existing Conditions - MEP/FP

HVAC

General Mechanical:

The school mechanical system is a two pipe hot and chilled water system with a manual change over based on seasonal operation.

Mechanical Room & Cooling Tower:

Boilers:

The mechanical room consists of three (3) oil fired hot water boilers. They appear to be original to the school. Only one boiler was in operation at the time of the site visit. It is assumed #2 Fuel Oil is used as the fuels source for the boilers. Further investigation would be required to determine the scope of the fuel oil system.

Chiller & Cooling Tower:

The existing chiller was not in operation at the time of the site visit. The chiller appears to be original to the building with the cooling tower located on the roof. This too appears to be original to the building. The unit was not in operation at the time of the visit. The cooling tower, associated dunnage and piping show areas of corrosion.

Gymnasiums & Locker Rooms:

The upper gymnasium mechanical systems consist of four (4) wall mounted H&V units. The units appear to be original to the building. The bottom of the intake plenum had been removed and the intake dampers were closed at the time of the visit.

The lower gymnasium mechanical systems consist of a ceiling hung H&V unit and supply air is introduced into the space via side wall registers. Exhaust is being provided by a dedicated roof mounted exhaust fan.

The boys and girls lockers room mechanical systems consist of a dedicated H&V unit. Exhaust is being provided by a dedicated roof mounted exhaust fan.

Classrooms:

The classrooms mechanical systems consist of floor mounted two pipe constant volume induction units. Ventilation is introduced via wall mounted intake louver located behind each unit. The units appear original to the building. The units observed were to be operational at the time of the site visit.

Existing Conditions - MEP/FP

Auditorium:

The auditorium mechanical systems consist of a dedicated roof mounted air handling unit. No information was available at the time of the site visit for this unit. A two pipe fan coil unit provided conditioned air behind the stage area. No further information was available at the time of the site visit.

Cafeteria & Kitchen:

The cafeteria mechanical systems consist of a dedicated air handling unit supplying conditioned air via floor registers. Return air is through wall mounted registers. No further information was available at the time of the site visit.

The kitchen mechanical systems consist of a dedicated air handling unit supplying conditioned ceiling registers. The kitchen exhaust hoods are on a dedicated exhaust system.

Multi-Media:

The library mechanical systems consist of floor mounted two pipe constant volume induction units. Ventilation is introduced via wall mounted intake louver located behind each unit. The units appear original to the building. The units observed were to be operational at the time of the site visit.

Computer Lab which was added some time after the original building appears to have a dedicated air handling supplying conditioned air via duct mounted registers.

Administration:

The administration areas mechanical systems consist of a dedicated roof mounted air handling unit. No information was available at the time of the site visit for this unit.

Industrial Arts:

The shop classrooms mechanical systems consist of ceiling mounted two pipe constant volume induction units. Ventilation is introduced via wall mounted intake louvers. The units appear original to the building.

Corridors & Lobbies:

The corridor mechanical systems consist of ceiling mounted two pipe fan coil units. No ventilation is introduced to these units. They appear to be operational at the time of the site visit.

Electrical

Normal Distribution:

The existing 4000A, 120/208-volt, 3-phase, 4-wire main switchboard is fed from an existing utility transformer located in a separate utility company transformer vault. The primary service is fed from a manhole located in Putnam Street. The main switchboard is “switch and fuse” type and appears to be original to the building. The main switchboard is located in the mechanical room on the Ground floor. It feeds panels for lighting, power, HVAC and kitchen equipment loads. Panels are located in dedicated closets near each stair to serve the nearby loads. The panels also appear to be original to the building.

Emergency Distribution:

There is an existing diesel fired 120/208-volt, 3-phase, 4-wire emergency generator located in the mechanical room directly in front of the main switchboard. It appears to be original to the building. It was not known at the time of the visit if the generator is exercised on a monthly or yearly basis. The emergency generator serves optional stand-by and emergency loads. The optional stand-by loads are fed from a motor control center via a separate automatic transfer switch. A separate tap feeds an emergency panel that feeds sub panels located throughout the school. The emergency panels are located in electric closets near each stair to energize a normally off emergency lighting system during a loss of normal power.

Lighting:

The Lighting appears to be mostly fluorescent T-12 technology that was installed as part of a lighting upgrade in an effort to save energy. The lighting appears to be automatically controlled via an area relay panel in the public areas such as corridors, restrooms, stairs, etc. Classrooms, offices, music room and gymnasium appear to only have manual controls. Exit signs are located all along the path of egress.

Fire Alarm

The fire alarm system appears to be a non-addressable, zoned fire alarm system. There are smoke detectors located in storage closets, electric closets, mechanical rooms, janitor’s closets, and similar type spaces. Combination horn/pull stations are located near each stair, corridors, entrance vestibules, gymnasium, etc.

Plumbing

The plumbing systems in the existing building are limited to domestic cold and hot water, sanitary, waste and vent, storm water and natural gas.

Domestic water is supplied through a 4" service that enters the building mechanical room from Putnam Street. The service is equipped with a 2" meter and 4" reduced pressure backflow preventer.

Domestic hot water is generated from a steam fired storage heater with a storage capacity of xxx gallons. The heater assembly includes a master thermostatic mixing valve and hot water recirculation pump.

Domestic cold, hot and hot water circulation piping distributes to the building through mains that run at the ground floor ceiling and to the upper floors thru multiple risers. Cold and hot water services are extended to the plumbing fixtures throughout the building. Piping is Type L copper with soldered joints and is insulated in most areas. Valves were not visible but are assumed to be older style gate valves. Piping appears in fair condition with minimal instances of leaks.

Sanitary, waste and vent systems originate at the various fixtures and extend down thru the building at stacks and collect below the building slab in a series of trunk mains and exit the building thru an 8" sanitary sewer to Hayes Street. Piping is a combination of bell and spigot and no-hub cast iron with some smaller individual drains in copper. Piping is in fair condition with minimal reports or evidence of leaks.

Storm water for the building consists of a series of roof drains and vertical leaders which extend down thru the building

Natural gas is supplied to the building from a main in Putnam Ave. Gas serves the existing emergency generator and also extends to minor uses in the science classrooms. The science rooms are equipped with emergency shut-off valves at the room entrance

Plumbing fixtures in the building are original to the building and consist of vitreous china water closets, urinals and lavatories with a mix of vitreous china and stainless steel drinking fountains. Mop service basins are of molded stone, showers are gang type. All fixtures appear in fair condition. However, the fixtures do not meet the low flow standards of today.

Fire Protection

The existing building is equipped with a partial sprinkler system and fire standpipe system.

The existing systems are supplied through a 6" fire service that enters the building main mechanical room from Putnam Street. This service is equipped with a 6" double check valve assembly and main alarm check valve assembly. Fire Department connections are located at the main entrance on Putnam, Street. A water motor gong is also located at the main entrance.

Automatic sprinkler protection is limited to the mechanical room. Standpipe protection consists of a 4” standpipe main that runs at the Ground Floor Level and extends to the upper floors at various riser locations and supplies fire department hose valves. The hose valves are 2 ½” non-restricting type in cabinets. The valves are fitted with 1 ½” reducers and 1 ½” hose. The hoses appear to be replaced on a regular basis.

The general condition of the existing fire protection systems is “good”; consistent with systems of similar age with no visible pipe deterioration, sags or leaks. As stated above, hose valves and cabinets are in fair condition.

Boiler Room

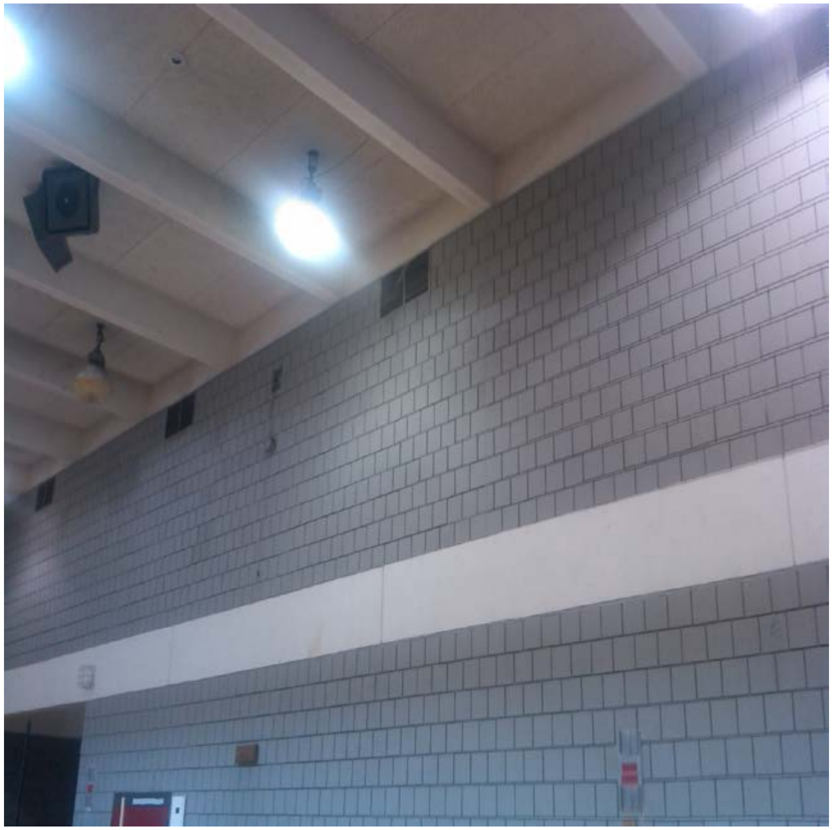
Cooling Tower

Existing Conditions - MEP/FP

Gymnasium H&V Unit

Computer Lab Ductwork

Fire Alarm Panel



Typical Gymnasium Lighting

Typical Exhaust Fan

Typical Rooftop Condensing Unit

Foodservice

Crabtree McGrath Associates, The Foodservice Consultant, completed a review of the existing kitchen and serving area and found the conditions to be poor and in need of complete replacement and reorganization. In general, the existing equipment that has failed has not been replaced; The ware wash room has been off line for some time with replacement parts no longer available; Various tables, sinks, and food preparation equipment has failed but not been replaced. With regard to health code, many violations exist due to the condition of the facility and the standards used during its original construction. Though very clean, the facility does not have adequate hand wash sinks within the kitchen or serving area.

The serving system is original 1968 construction. There have been no serving equipment upgrades over the years and not much of the original configuration has changed. The sneeze guards are not adequate to meet current health code mandates - In fact a portable sneeze guard have been added to mitigate the lack of sneeze protection in some instances. The serving line queue is difficult to monitor and control, the single serving line length and quantity of serving positions are inadequate.

The architectural finishes within the kitchen are in need of replacement but have held up well in some cases. Current regulations require that all surfaces be smooth, non porous, and easy to clean. The ceiling in this case does not meet this requirement, but the staff has performed a fantastic job keeping the kitchen clean.

There are many exposed pipes and electrical conduits running along the ceiling and on the walls of the kitchen and serving area. In all cases, these obstructions are difficult to clean and create places where dirt and grime collect.

Kitchen and Serving Area

The Kitchen Foodservice Program currently services a population of approximately 250 students, in multiple lunch waves. The program participation rate is approximately 61% or on average 154 meals per day. The kitchen and support spaces related to the kitchen total approximately 2,632 square feet, with the majority of that dedicated to the kitchen production area. The kitchen is an open style that is adequately sized and well organized, but utilization of the available space needs improvement.

Existing Conditions- Foodservice

The cooking exhaust hood is in place but vintage 1968. It utilizes mesh filters with a painted exterior body, and its materials and construction are no longer compliant with current NFPA 98 standards. The equipment beneath the hood consists of convection ovens and various pieces of decommissioned equipment. All other original cooking equipment has been removed.

The kitchen does not have an adequate number of hand sinks, and the one unit in the space lacks a proper faucet. Proper work surfaces are lacking, and the kitchen is void of adequate food preparation equipment.

The serving area was organized into two separate serving lines in the original configuration. Sneeze guards above hot food wells are intact but dated. The counters are not equipped with cold pans in the serving lines, thus requiring the operator to use time management for maintaining cold temperatures for chilled foods, meaning food can be displayed for only short periods of time before it can not longer be served. This method is not efficient, and a mechanical chilling system is recommended as part of an effective temperature maintenance program. Additionally, the serving line is inadequately supported by cold and hot food storage that is typically adjacent to the serving area.

Equipment is needed to support hot and cold food storage of prepared foods that are ready to eat. The placement of these items must be directly adjacent to the serving lines. The current operation relies upon the main walk-in cooler and the hot holding transport cabinets for this task. These are not convenient, or appropriate in the manner they are used.

The kitchen finishes are adequate but showing signs of ware. The quarry tile floors have held up well, but they are not slip resistant as with modern quarry tile: years of ware have polished them to a smooth finish. Walls are painted block that have held up well. The ceiling should be a smooth consistent surface and lighting levels are poor in some areas.

The walk in cooler and freezer is original to 1968 construction. The refrigerated room finishes are no longer compliant and they miss the mark in terms of energy efficiency. The lighting levels inside the rooms are inadequate and air circulation is poor. Finish upgrades are recommended.

This concludes this section of the report.

Existing Conditions – Community Noise Conditions

COMMUNITY NOISE CONDITIONS

Executive Summary

The existing community noise conditions were documented by performing a series of measurements at the Martin Luther King Jr. School site in Cambridge over a period of several days, in April 2012. Based on these measurements and in accordance with the Massachusetts DEP noise policy, it was determined that, for most locations, the maximum criteria for the control of exterior background noise levels will be **50 dBA**. In some specific areas, the maximum criteria will be lowered to **47 dBA**.

Ambient Sound Measurements

We measured sound levels in 5-minute increments in four locations at the Martin Luther King, Jr. School in Cambridge, from Friday morning, April 6 through the afternoon of April 10, 2012. The locations of the meters are shown in Figure 1 below. One measurement location is on the roof of the building, characterizing existing noise levels produced by rooftop mechanical equipment; the remaining three locations are on the grounds of the school. Measurements were attempted in a fifth location, but data was compromised in the field. (This location, in a playground, was not particularly critical, and we believe that the remaining locations adequately characterize the ambient sound levels at the school.)

The results of our measurements are plotted in Figure 2. Consistent with industry standards, the graph shows L90 levels: that is, the sound levels that are exceeded for 90% of each measurement period (in this case, 5 minutes). In other words, the graph shows the quietest 10% of sound in every 5-minute period over the course of our measurements.

Because Friday, April 6th was a holiday, we were not granted access to the roof until Monday, April 9, 2012; hence, data for measurement Location 1 is only available after Monday morning.

The purpose of our measurements was to characterize the existing background sound levels, both as a benchmark for comparison to future levels in the community as a result of the new school, and also as a reference to show compliance with state noise regulations.

Applicable Noise Regulations

The City of Cambridge has a noise regulation that limits noise levels at residential property lines to 60 dBA during the day on weekdays, and 50 dBA at night and on weekends.

Massachusetts DEP has a noise policy that limits new noise levels to 10 dB above ambient noise levels (at the time that the equipment creating such noise is operating), and also prohibits tonal noises.

Existing Conditions – Community Noise Conditions

Observations and Conclusions

In most locations and at most times, the existing ambient noise levels exceed 40 dBA. Thus, for most locations, our maximum criteria for the control of exterior background noise levels will be **50 dBA** (particularly equipment that operates at hours outside of 7am to 6pm M-F).

In one location, at night, measured levels dipped below 40 dBA, as shown on the attached graph. In this location and others near it, our criteria for exterior noise will be, at most, **47 dBA** (10 dB above the lowest ambient noise levels, in accordance with the MA DEP noise policy).

In some specific locations, the project may choose different (more stringent) criteria, in the interest of being a "good neighbor" and not increasing background sound levels to the point that might generate complaints. (A 10 dB increase corresponds to roughly a doubling of perceived loudness, which although allowable by law may not be acceptable to some abutters.) We will be available to assist you in establishing appropriate exterior noise criteria as the project develops.

Finally, it is noteworthy that rooftop noise levels did not change significantly at any point during the measurement period, and yet noise levels at other (even relatively nearby) sound level meters varied considerably. We conclude that existing rooftop equipment has little appreciable effect on the noise levels at the property lines of the School. This is consistent with our subjective observations on site – existing noise levels are dominated by traffic on the streets, children playing in the playgrounds, and other street-level activity. We do note that the cooling tower was not operational during our test (it typically does not get turned on until May 15th, according to staff at the school). The cooling tower is surrounded by a tall, heavy concrete barrier, and thus we do not expect its operation to significantly affect the noise levels at the property lines, either.

* * * * *

Please let us know if you have any questions about the information presented in this report.

Sincerely,

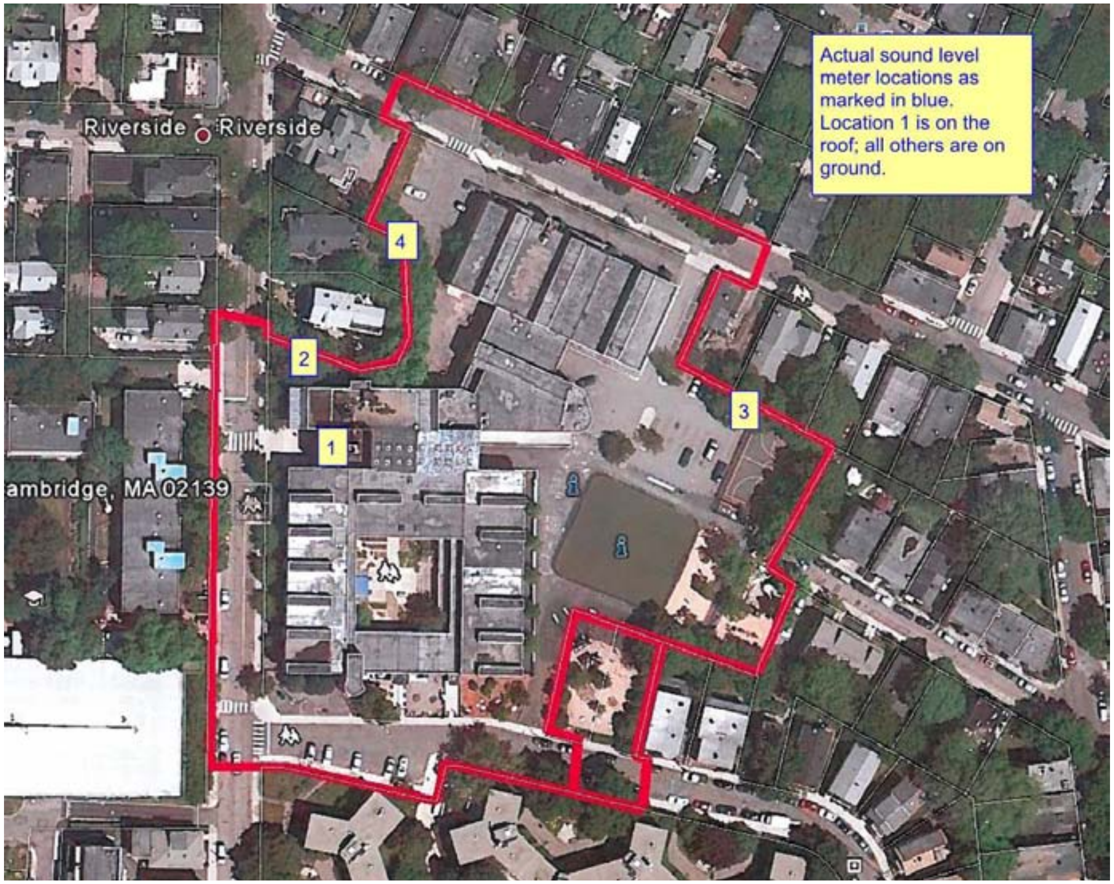
Acentech Incorporated

Ioana N. Pieleanu

Senior Consultant

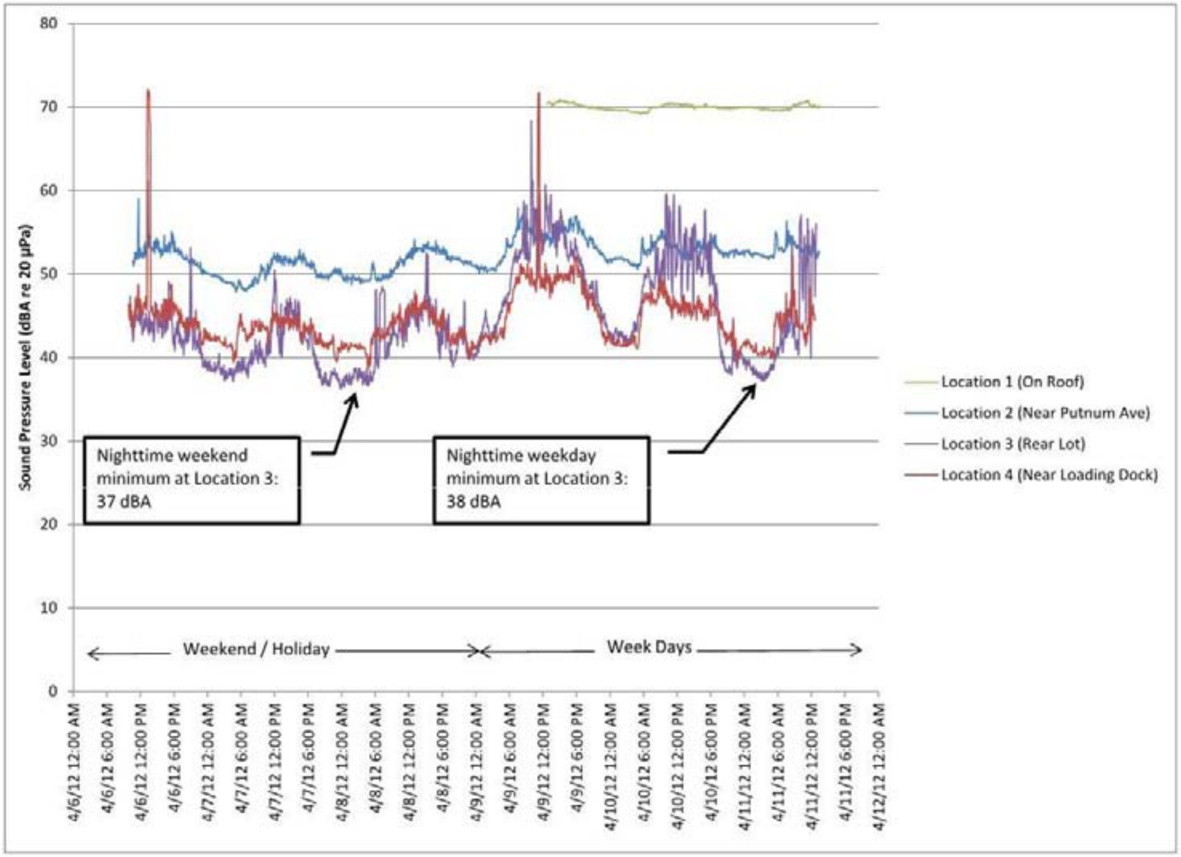
Existing Conditions – Community Noise Conditions

Figure 1: Measurement locations



Existing Conditions – Community Noise Conditions

Figure 2: Ambient sound levels, summary chart



Audiovisual Systems

General:

This existing condition report which "dove-tails" into the feasibility and programming reports describes the overall audiovisual system presently in use at the Martin Luther King School in Cambridge.

Acentech's Background:

Acentech is an independent consulting firm specializing in the design of advanced sound, audiovisual, broadcast, and videoconferencing systems. In order to provide unbiased consulting and design services, Acentech does not sell or install equipment and does not represent any dealer, distributor, or manufacturer.

Information Gathering:

The information assembled in the report was gathered during our meetings with the client and the design team. This report is not a programming effort for new and up-to date audiovisual systems.

Current Conditions:

The MLK School has worked very hard to adapt to the ever-changing technologies with current resources available. Much of the fixed systems are at or past their operational life expectancy and need to be replaced with current technologies. There are some items of equipment that can be re-cycled to other facilities during the renovation to the school, such as the video projectors and the few smart boards that exist. Item such as projections screens are for the most part of the wrong types for today technology. There is little to no audiovisual system meeting current ADA assistive listening standards for classrooms and other facilities.

Only a few classrooms have fixed audiovisual systems of various types, age, and capability. Most of the audiovisual systems do not meet current digital standards or have limited capabilities. Larger fixed systems such as in the auditorium are quite outdated and need of replacement.

While the school system is moving to Apple based computing systems for the classrooms the MLK School is still using an out-dated PC based laptop cart.

Hazardous Building Materials Visual Inspection

Dr. Martin Luther King, Jr. Middle School
Cambridge, Massachusetts

Perkins Eastman

Boston, Massachusetts

May 16, 2012

Fuss & O'Neill EnviroScience, LLC
50 Redfield Street, Suite 100
Boston, Massachusetts 02122

Project No. 20120050.A1E

FUSS & O'NEILL EnviroScience, LLC

May 16, 2012

Mr. Sean O'Donnell, AIA, LEED AP
Principal in Charge
Perkins Eastman
50 Franklin Street, Suite 402
Boston, MA 02110

Re: Hazardous Building Materials Visual Inspection
Proposed Architectural/Structural Assessment and Feasibility Study
Dr. Martin Luther King, Jr. Middle School, Cambridge, Massachusetts
Fuss & O'Neill EnviroScience, LLC No. 20120050.A1E

Dear Mr. O'Donnell:

Enclosed is the report for the hazardous building materials visual inspection conducted in response to proposed architectural/structural assessment and feasibility study for the Dr. Martin Luther King, Jr. Middle School located at 100 Putnam Avenue in Cambridge, Massachusetts.

The services were performed from April 17 to April 23, 2012 by Fuss & O'Neill EnviroScience, LLC licensed Asbestos Inspector(s) and included a visual asbestos inspection and lead-based paint screening. The information summarized in this document is for the above-mentioned materials only. The work was performed in accordance with our written proposal dated March 6, 2012.

If you have any questions regarding the contents of this report, please do not hesitate to contact me at (617) 282-4675, extension 4701. Thank you for this opportunity to have served your environmental needs.

Sincerely,

Robert L. May, Jr.
Vice President

RLM/ftc
Enclosure

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Perkins Eastman

Appendices

1 Introduction

On April 17 - 18, 2011 and April 23, 2012, Fuss & O'Neill EnviroScience, LLC (EnviroScience) representatives, Dustin A. Diedricksen and Jonathan Hand, performed a hazardous building materials visual inspection and lead-based paint screening as part of a feasibility study for the Dr. Martin Luther King, Jr. Middle School located on 100 Putnam Avenue in Cambridge, Massachusetts. Refer to *Appendix A* for a copy of each Asbestos Inspector license.

This preliminary hazardous building materials visual inspection was performed in response to proposed architectural/structural assessment and feasibility study for the Dr. Martin Luther King, Jr. Middle School project. The work was performed for Perkins Eastman in accordance with our written scope of services dated March 6, 2012.

EnviroScience's Asbestos Inspectors performed a visual survey of all areas of the school building made accessible by on-site custodial staff. Limited areas of the school were locked (e.g. computer lab, main office, nurse's office, etc.), and inventory of materials was estimated from architectural drawing set and by knowledge of custodial staff; access needs to be afforded to locked areas in order to verify materials present. It should be noted that as requested no bulk sampling was performed as part of this inspection.

All roofing materials have been excluded from probable cost estimate for hazardous building materials abatement due to information provided by Site contact. All roof areas were replaced more recently and EnviroScience was informed that older roofing materials had been removed prior to installation of newer rubber-membrane roofs. Investigation of possible concealed roofing materials should be completed prior to any disturbance to roofing areas, which may occur during anticipated renovation/demolition activities.

EnviroScience made visual observations at representative areas of the pipe tunnel positioned beneath the ground level of the school building. Note that all entry points to pipe tunnel were not accessible at the time of the investigation. All piping within observed areas of the tunnel system were insulated with rubber-foam thermal system insulation (TSI), which is not a suspect asbestos-containing material. Further investigation (at all access points) is required to appropriately characterize/confirm pipe coverings within the tunnel system.

2 Asbestos Inspection

A property Owner must ensure that performance of a thorough inspection for asbestos-containing materials (ACM) prior to possible disturbance of materials containing asbestos during renovation or demolition is conducted. This is a requirement of the U.S. Environmental Protection Agency (USEPA), National Emission Standards for Hazardous Air Pollutants (NESHAP) regulation 40 CFR Part 61, Sub-part M.

This includes Friable, Non-Friable Category I, and Non-Friable Category II ACM.

- A Friable Material is defined as material that contains greater than 1 percent asbestos, that when dry **can** be crumbled, pulverized, or reduced to powder by hand pressure.
- A Category I Non-Friable Material refers to material that contains greater than 1 percent asbestos (e.g. packings, gaskets, resilient floor coverings, asphalt roofing products, etc.) that when dry **can not** be crumbled, pulverized, or reduced to powder by hand pressure.
- A Category II Non-Friable Material refers to any non-friable material excluding Category I materials that contains greater than 1 percent asbestos that when dry **can not** be crumbled, pulverized, or reduced to powder by hand pressure.

Massachusetts Department of Environmental Protection (MassDEP) further defines the definition of asbestos-containing materials as any material containing 1 percent or more asbestos to be an ACM.

During this visual inspection bulk materials were not analyzed for asbestos content. However, consideration was made to distinguish suspect asbestos-containing materials (ACM) by appropriate (three) USEPA categories for purpose of determining appropriate sample budget. These categories are Thermal System Insulation (TSI), Surfacing (SURF) ACM, and Miscellaneous (MISC) ACM. TSI includes all materials used to prevent heat loss/gain or water condensation on mechanical systems. Examples of TSI include pipe insulation, boiler insulation, duct insulation, and mudded insulation on pipe fittings. Surfacing ACM includes all ACM that is sprayed, troweled, or otherwise applied to an existing surface. Surfacing ACM is commonly used for fireproofing, decorative, and acoustical applications. Miscellaneous materials include all ACM not listed as thermal or surfacing, such as linoleum, vinyl asbestos flooring, and ceiling tiles.

EnviroScience shall collect asbestos bulk samples at a later date as appropriate to scope of work (to be determined). Samples shall be collected in a manner sufficient to determine asbestos content and include homogenous building materials. The USEPA NESHAP regulation does not specifically identify a minimum number of samples to be collected; however, recommends the use of sampling protocols included in 40 CFR Part 763, Sub-Part E - Asbestos Containing Materials in Schools.

Samples of suspect asbestos containing materials shall be collected in accordance with United States Environmental Protection Agency (USEPA) recommendations and Asbestos Hazard Emergency Response Act (AHERA) protocols. The protocols included the following:

1. Surfacing Materials (SURF) such as plaster, spray-on fireproofing, etc. were collected in a randomly distributed manner representing each homogenous area based on the overall quantity represented by the sampling as follows:

    a. Three (3) samples collected from each homogenous area that is less than or equal to 1,000 square feet.

b. Five (5) samples collected from each homogenous area that is greater than 1,000 square feet but less than or equal to 5,000 square feet.

c. Seven (7) samples collected from each homogenous area that is greater than 5,000 square feet.

2. Thermal System Insulation (TSI) such as pipe insulation, tank insulation, etc. were collected in a randomly distributed manner representing each homogenous area. Three (3) samples collected from each material. Also, a minimum of one (1) sample of any patching materials applied to TSI presuming the patched area is less than 6 linear or square feet should be collected.

Miscellaneous Materials (MISC) of minimal quantity (e.g. floor tile, gaskets, construction mastics, etc.) shall have a minimum of two (2) samples collected as representative of each homogenous material type. Sampling will be conducted in a manner sufficient to determine asbestos content of the homogenous material as determined by the Asbestos Inspector.

The Asbestos Inspector shall collect samples and prepare proper chain of custody for transmission of samples to an accredited laboratory for analysis by Polarized Light Microscopy (PLM). Only samples of suspect ACM to be impacted by proposed scope of work will be collected as directed by the Architect.

2.1 Results of Visual Inspection

Table 1 lists building materials that are presumed to be **ACM** until sample results prove otherwise:

TABLE 1
Suspect Asbestos-Containing Materials from Visual Observation

LOCATION	MATERIAL TYPE	ESTIMATED QUANTITY
Typical Classrooms, Typical Hallways, Cafeteria, (3) Gymnasiums, Auditorium, Library, Teachers' Lounges, Typical Classrooms, Typical Hallways, etc.	Tectum Ceiling Panels	91,000 SF
Typical Classrooms, Typical Hallways, Cafeteria, (3) Gymnasiums, Auditorium, Library, Teachers' Lounges, Typical Classrooms, Typical	Black Mastic Associated with Tectum Ceiling Panels	91,000 SF

LOCATION	MATERIAL TYPE	ESTIMATED QUANTITY
Hallways, etc.		
Classroom Hallways, Cafeteria, Teachers' Lounges, Main Office, Nurse's Office, & ESL Room 113	Black and Brown Mottled 12x12 Vinyl Floor Tile	16,500 SF
	Black Mastic Associated with Black and Brown Mottled 12x12 Vinyl Floor Tile	
Typical Classrooms	White with Grey Splotches 12x12 Vinyl Floor Tile	53,000 SF
	Black Mastic Associated with White with Grey Splotches 12x12 Vinyl Floor Tile	
After School Program Classroom & Hallway outside P.E. Office (Ground Floor)	Off-White & Brown Mottled 12x12 Floor Tile (Mixed Pattern)	2,150 SF
	Red with White Splotches 12x12 Floor Tile (Mixed Pattern)	
	Yellow Mastic Associated with Mixed-Pattern 12x12 Floor Tile (Above)	
After School Program (next to Electrical), Amigos Main Office, & Library Office	Pink with Dark Pink & White Splotches 12x12 Floor Tile	2,150 SF
	Light Brown Mastic Associated with Pink with Dark Pink & White Splotches 12x12 Floor Tile	
Hallway outside Classroom 105 (First Floor)	Light Blue with Dark Blue & White Specks 12x12 Floor Tile (Mixed Pattern)	1,500 SF
	Dark Blue with Light Blue & White Specks 12x12 Floor Tile (Mixed Pattern)	
	Mastic Associated with Mixed-Pattern 12x12 Floor Tile (Above)	
Library	Grey Mottled 12x12 Floor Tile	2,600 SF

LOCATION	MATERIAL TYPE	ESTIMATED QUANTITY
	(Mixed Pattern)	
	Red Mottled 12x12 Floor Tile (Mixed Pattern)	
	Mastic Associated with Mixed-Pattern 12x12 Floor Tile (Above)	
2nd Floor Balcony Hallway	Blue with Dark Blue & White Splotches 12x12 Floor Tile (Mixed Pattern)	1,500 SF
	White with Blue & Purple Splotches 12x12 Floor Tile	
	Black Mastic Associated with Mixed-Pattern 12x12 Floor Tile (Above)	
Hallway outside Classroom 114 (First Floor)	White with Red, Yellow, & Blue Splotches 12x12 Floor Tile	1,500 SF
	Mastic Associated with 12x12 Floor Tile (Above)	
Kitchen and Typical Bathrooms	Adhesive Associated with 6" Terracotta Tile (Assumed)	6,000 SF
Throughout School	Fire Doors with Friable Core	100 EA
Boiler Room & Elevator Machine Room	Boiler Breeching (Friable Mag TSI)	300 SF
Boiler Room & Elevator Machine Room	Flue Cement	25 SF
Boiler Room	Assume Friable Door Insulation Associated with (2) Cylinder Boilers (at Interior)	200 SF
Boiler Room	Friable Door Gaskets Associated with (2) Cylinder Boilers	100 LF
Boiler Room	Interior Boiler Gaskets & Packings (Concealed)	2 Cylinder Boilers
Boiler Room	TSI Wrap (over Foam Rubber) Associated with Suspended Hot Water Tanks	400 SF
Boiler Room, Storage Room	Mag TSI Muffler Associated	35 LF Visible

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LOCATION	MATERIAL TYPE	ESTIMATED QUANTITY
Adjacent to Elevator Machine Room, & underneath Stairwell	with Emergency Generator	(Allowance for 150 LF Concealed)
Storage Room Adjacent to Elevator Machine Room	Mag TSI Debris on Floor	125 SF (Clean Entire Room)
Elevator Machine Room	Grey Door Caulking	20 LF
Boiler Room, Fan Room off Boiler, Amigos Kindergarten Hallway, Classroom G23, Classroom 208, Elevator Machine Room & Assume at Concealed Locations Throughout School	Mudded Fittings Associated with Fiberglass Pipe Insulation	500 EA Note: observed only foam-rubber pipe insulation at representative pipe tunnel locations (from access hatches)
Hallways Throughout School & Assume at Concealed Locations	Roof Drain Insulation and Mudded Fittings	40 EA
Boiler Room & Computer Lab off Library	Grey Duct-Seam Sealant	200 LF Allowance (assume at concealed locations)
Fan Room off Boiler Room, Gymnasium Fan Room & Assumed at Concealed Locations Throughout School	Red/Brown Duct-Seam Sealant	300 LF Allowance (assume at concealed locations)
Fan Room off Boiler Room, Fan Room near Room G4, 1st Floor Gymnasiums, HVAC Room for Auditorium & Assumed at Concealed Locations (e.g. Ceiling Plenum)	Green and White Cloth Vibration Isolator Associated with Ductwork Throughout School (Assume 2 Types)	25 Each
Ground Floor Gymnasium	Assume Flooring Felt and/or Mastic underneath Wood Floor	4,025 SF
Ground Floor Gymnasium	Brown (Toe Base) Vinyl Baseboard	275 LF
	Mastic Associated with Brown (Toe Base) Vinyl Baseboard	
1st Floor Gymnasiums	Assume Flooring Felt and/or Mastic underneath Rubber Floor Mat	7,600 SF

LOCATION	MATERIAL TYPE	ESTIMATED QUANTITY
		Note: rubber floor mat may contain mercury; it is recommended that sample is collected for Total/TCLP Mercury for waste characterization
1st Floor Gymnasiums	Assume Mastic Associated with Fiberglass Duct Insulation (Vertical Duct at Ceiling)	50 LF
Teachers' Lounges, Various Classrooms, Main Office, & Nurse's Office	4" Dark Brown Vinyl Baseboard	2,500 LF
	Dark Brown Mastic Associated with 4" Dark Brown Vinyl Baseboard	
Typical Classrooms	4" Black Vinyl Baseboard	8,000 LF
	Brown Mastic Associated with 4" Black Vinyl Baseboard	
	Tan Mastic Associated with 4" Black Vinyl Baseboard	
Partitioned Work Rooms	Newer (Shiny) 4" Black Vinyl Baseboard (at Partitioned Drywall Rooms)	600 LF
	White Mastic Associated with Newer (Shiny) 4" Black Vinyl Baseboard	
Auditorium	Assume Felt/Mastic Layer underneath Wood Stage	1,200 SF
Auditorium	Assume Mastic underneath Wood (Wall) Paneling	2,500 SF
Auditorium	Carpet Adhesive	2,500 SF
Auditorium	Vinyl Threshold	250 LF
Auditorium	Stage Lighting	100 LF (lighting rig/frame with cans)
Auditorium	Stage Curtain	1 EA
Typical Classrooms	Black Sink Undercoat	50 EA
Typical Classrooms	Grey Sink Undercoat	
Typical Classrooms	Adhesive Associated with	5,000 SF

LOCATION	MATERIAL TYPE	ESTIMATED QUANTITY
	Chalkboards/Tack Boards (Assumed)	
Science Classrooms	Assumed Composite Countertops	1,000 SF
Auditorium, Classroom G01 Storage, Bathrooms	Skim/Rough Coat Plaster Ceiling	6,500 SF
Classroom G23, Kitchen Area, Teachers' Lounges, & Offices	1x1 Ceiling Tile	5,000 SF
Classroom G23 & Offices (Assumed)	Brown Glue Daubs Associated with 1x1 Ceiling Tile	1,000 SF
Teachers' Lounges & Offices	2x2 Fissured and Dotted Ceiling Tile	1,500 SF
Typical Bathrooms	2x2 Mold-Resistant (White) Ceiling Tile	4,500 SF
Classroom G23, Hallway outside Gymnasium Fan Room, & Kitchen Bathroom	2x4 Fissured and Dotted Ceiling Tile	1,500 SF
Throughout School at Partitioning Walls	Drywall	7,000 SF
Throughout School	Joint Compound (Associated with Drywall Partitioning Walls)	7,000 SF
Ground Level Gymnasium	Brown Radiator Caulking	100 LF
Classroom G01 (After School Program)	Grey Louver Caulking	20 LF
Classroom G01 (After School Program)	Penetration Sealant at Duct	10 LF
Cafeteria	Sticky Black Window-Glazing Compound (Interior) Sticky White Window-Glazing Compound (Exterior)	Entire Window Bank Approx. 80' x 15' (1,200 SF) 1,200 SF
Cafeteria	Interior (Grey) Window Caulking	250 LF
Courtyard	Exterior (Grey) Caulking at Sidewalk	500 LF

LOCATION	MATERIAL TYPE	ESTIMATED QUANTITY
Classroom Hallways (Facing Courtyard)	Interior (White) Window Caulking at Awning-Type Window Inserts (at Window Curtain)	600 LF
Curved Stairwell	Interior (Black) Window Caulking	3 EA
Throughout School	Possible Skim Coat on Beams	50,000 SF
Exterior Windows	Exterior Window Caulking at Classroom/Hallway Windows (i.e. Window Curtains) (Assume 3 Types)	25,000 LF
Ground Floor Gymnasium, 1st Floor Gymnasiums, & Upper Classrooms	Window Caulking & Glazing Compound Associated with Clearstory Windows	200 EA
Exterior Doors	Tan Exterior Door Caulking (Assume 3 Types)	1,000 LF
Exterior at Unit Vents	Exterior Caulking at Unit Vents	1,500 LF
Stairwell	Sticky White Window Glazing	12 EA
Stairwell	Interior (Grey) Window Caulking	12 EA
Interior at Concrete Wall Panel, (Inset) Columns, and Beams	Interior Joint Caulking	15,000 LF
Exterior at Concrete Panels	Expansion Joint Caulking	31,000 LF
All Roofs	Presumed Built-Up Roofing Material underneath Rubber-Membrane Roofs	All Roofing Fields
All Roofs	Presumed (Concealed) Asphaltic Roofing Layers/Sealants (e.g. Coping Sealant, Lap-Seam Sealant, Penetration Sealants, etc.)	ALL Roofing Perimeters, Penetrations, and Raised Curbs/Parapets

2.2 Discussion

The USEPA, Occupational Safety and Health Administration (OSHA), and the Commonwealth of Massachusetts Department of Labor Standards (DLS) formerly known as the Division of Occupational Safety (DOS) defines any material that contains greater than one percent (>1%) asbestos, utilizing PLM, as being an ACM. The Commonwealth of Massachusetts Department of Environmental Protection (DEP) defines any material that contain equal to or greater than one percent (1%) asbestos as being an ACM. Materials that are identified as "none detected" are specified as not containing asbestos.

Materials that are identified as "none detected" are specified as not containing asbestos. Friable materials that are identified as containing less than ten percent (<10%) asbestos, are recommended to be analyzed further utilizing the EPA 400 point-counting technique to verify asbestos content by the USEPA. A property owner may elect to presume the results are asbestos containing based on the initial PLM results without the additional analysis by the EPA 400 point-counting technique. We requested laboratory confirmation of samples 517DD-54A-C and 517DD-55A-C, utilizing EPA 400 point-counting, based on initial PLM results showing trace amounts <1% Chrysotile with PLM.

Additionally, the USEPA has suggested that materials that are non-friable organically bound materials such as mastic adhesives, etc are recommended for further confirmatory analysis utilizing Transmission Electron Microscopy (TEM). Four (4) of the collected samples were recommended to be analyzed by TEM.

2.3 Conclusion

The materials determined to contain asbestos that will be impacted by any proposed renovation and or demolition work must be abated by a licensed asbestos abatement contractor prior to disturbance in building demolition or renovation. This includes both friable and non-friable ACM materials. This is a requirement of the Commonwealth of Massachusetts DLS, MassDEP and US EPA NESHAP standards for asbestos abatement.

EnviroScience recommends that a comprehensive scope of work and technical specification be developed as part of renovation plans for the site. We have provided a cost to develop the specifications for inclusion in the overall renovation plans. We have also developed an opinion of cost for the completer removal of all identified asbestos. Note the total cost is inclusive of removing all asbestos and a more limited scope can be tailored to any specific renovation work as necessary.

<u>Any suspect material encountered during renovation/demolition that is not identified in this report, as being non-ACM should be assumed to be ACM unless sample results prove otherwise.</u>

EnviroScience identified 106 homogeneous material types that are presumed to contain asbestos until sampled and analyzed with results proving otherwise. Representative sampling shall include collection of approximately 315 samples in order to meet required NESHAP standards for complete asbestos abatement.

3 Lead-Based Paint Determination

A lead based paint determination was performed for representative building components by Fuss & O'Neill EnviroScience, LLC (EnviroScience) representatives, Dustin A. Diedricksen and Jonathan Hand, on April 18, 2012. An X-ray fluorescence (XRF) analyzer was used to perform the lead based paint determination. The testing was conducted in accordance with the protocol outlined in the attached document: "Testing Procedures and Equipment" (*Appendix B*).

A RMD LPA-1 X-Ray Fluorescence (XRF) Analyzer, serial No. 1395, was utilized for the lead-based paint determination. The instrument was checked for proper calibration prior to each use as detailed by the manufacturer and the Performance Characteristic Sheet (PCS) developed for the instruments.

For the purpose of this lead-based paint determination, representative building components were tested according to limited scope of renovation work. Of course, individual repainting efforts are not discoverable in such a limited program. Lead-based paint issues involving properties that are not residential are regulated to a limited degree to worker protection involving paint disturbing work activities and waste disposal.

Worker protection is regulated by OSHA regulations as well as DLS regulations. These regulations involve air monitoring of workers to determine exposure levels when disturbing lead- containing paint. A lead-based paint determination cannot determine a safe level of lead but is intended to provide guidance as to the locations of what are considered industry standards for lead in paint. Contractors may then better determine exposure of workers to airborne lead by understanding the different concentrations of lead paint on representative components and surfaces. Air monitoring can then be performed during activities that disturb paint on representative surfaces.

The USEPA Resource Conservation and Recovery Act (RCRA) as well as MassDEP regulate disposal of lead-containing waste. Waste materials containing lead that will be impacted during renovation or demolition and result in waste for disposal must be tested using the Toxicity Characteristic Leachate Procedure (TCLP) analysis if lead is determined to be present in non-residential buildings. A TCLP sample is a representative sample of the intended waste stream. The results are compared to the level of greater than 5.0 mg/L that is considered hazardous lead waste. If the result is below the established level the material is not considered hazardous and may be disposed of as normal construction debris.

A level of lead paint exceeding 1.0 milligrams of lead per square centimeter (mg/cm^2) is considered toxic or dangerous for compliance with residential standards. For purpose of this lead based paint determination the level of 1.0 mg/cm^2 has been utilized as a threshold for areas where possible worker exposures may occur. The complete results of lead-based paint determination are included in *Appendix C*.

3.1 Results of Visual Inspection

The lead-based paint determination indicated consistent painting trends associated with representative building components that may be impacted by possible renovation work. Few painted components were determined to contain levels of lead (greater than 1.0 mg/cm^2) including the following:

TABLE 2
Lead Painted Building Components

LOCATION	ITEM	READING (mg/cm^2)
Ground Floor Gymnasium Hallway	Metal Stair Balusters	2.0
Elevator	Metal Elevator Door	1.0
Typical Classrooms at Ground Level	Metal Exterior Doors	0.2 – 1.1
Courtyard Balcony	Metal Exterior Door to Courtyard Balcony	1.3

3.2 Discussion

OSHA published a Lead in Construction Standard (OSHA Lead Standard) 29 CFR 1926.62 in May 1993. The OSHA Lead Standard has no set limit for the content of lead in paint below which the standards do not apply. The OSHA Lead Standards are task-based and are based on airborne exposure and blood lead levels.

The results of this survey are intended to provide guidance to contractors for occupational exposure control to lead. Building components containing lead levels above industry standards may cause exposures to lead above OSHA standards during demolition and renovation activities. A TCLP sample to characterize the expected waste that may result from possible selective demolition and/or renovation work was not collected as part of this preliminary feasibility study.

3.3 Conclusion

Contractors must be made aware that OSHA has not established a level of lead in a material below which 29 CFR 1926.62 does not apply. Contractors shall comply with exposure assessment criteria, interim worker protection and other requirements of the regulation as necessary to protect workers during any renovation work which will impact lead paint.

Lead paint was found on few building components including, but not limited to, metal doors and metal stair components. Note that metal materials containing lead paint may be recycled as scrap metal. EnviroScience understands that there are no proposed selective demolition or renovation activities scheduled at this time; the lead screening was carried out as part of a preliminary investigation for a project feasibility study. Note that any future work involving surface preparation of the identified painted surfaces shall be performed in accordance with OSHA worker protection requirements.

The building is presently characterized as commercial property, which is not subject to the Department of Public Health Child Lead Poisoning Prevention Program (CLPPP) 105 CMR 460.000 regulations. The property may be renovated using procedures required in accordance with OSHA regulation 29 CFR 1926.62 and DLS Regulation 454 CMR 22.11. In addition, the building is not considered a "child occupied facility" and therefore not subject to lead safe renovation requirements of 454 CMR 22.11.

Disclaimer: *The information contained in the survey report concerning the presence or absence of lead paint does not constitute a comprehensive lead inspection in accordance with Commonwealth of Massachusetts regulations 105 CMR 460. The surfaces tested represent only a portion of those surfaces that would be tested to determine whether the premises are in compliance with the aforementioned regulations, which are specific to a child occupied residence only and not applicable to a building of this type and use.*

4 Bulk Sample Analysis – Polychlorinated Biphenyls (PCBs)

4.1 Background

Sampling of building materials for polychlorinated biphenyls (PCBs) is presently not mandated by the USEPA. However, significant liability risk for improperly disposing of a PCB-containing waste material exists. Recent knowledge and awareness of PCBs within matrices such as caulking, glazing compounds, paints, adhesives, and ceiling tiles has become more prevalent especially among remediation contractors, waste haulers, and disposal facilities.

Many property owners have become subject to large changes in schedule, scope, and costs as a result of failure to identify these possible contaminants prior to renovation or demolition. We recommend testing for PCBs as a continuation of this architectural/structural assessment and feasibility study for the Dr. Martin Luther King, Jr. Middle School. This information will serve as useful to significant impact and potential requirements for planning required by the USEPA which must be implemented if PCBs are identified at a project site.

The USEPA requirements apply and require removal of PCBs once identified regardless of project intent as an unauthorized use of PCBs. In other words, if buildings are to remain for re-use and PCBs are identified, the USEPA still requires removal of the PCB materials once it is determined that PCBs are present. In addition to identification of source materials containing PCBs, if PCBs are present at certain concentrations, additional testing of adjacent surfaces in contact with PCB sources or which may have been contaminated from a source of PCBs (e.g. soil) must also be performed or remediated.

USEPA requirements apply only if PCBs are present in concentrations above a specified level. Presently materials containing PCBs at concentrations equal to or greater than (≥) 50 parts per million (ppm) or equivalent units of milligrams per kilogram (mg/kg) are regulated. Note materials containing less than (<) 50 ppm may also be regulated unless proven to be an "Excluded PCB Product". The definition of an Excluded PCB Product includes those products or source of the products containing <50 ppm concentration PCBs that were legally manufactured, processed, distributed in commerce, or used before October 1, 1984.

4.2 Results of Visual Inspection

Visual Inspection of Suspect PCB-Containing Source Materials

On April 18, 2012, EnviroScience's Representatives, Dustin A. Diedricksen and Jonathan Hand, performed a visual inspection of suspect PCB-containing source materials at that Dr. Martin Luther King, Jr. Middle School. It should be noted that as requested no PCB sampling was performed as part of this inspection.

The USEPA regulates materials containing ≥ 50 ppm. However if PCB greater than 1 ppm are present in a material it must be demonstrated (proven) that the materials containing < 50 ppm PCBs are an "Excluded PCB Product," which for this circumstance would be a product legally manufactured or used prior to October 1, 1984.

4.3 Results of Visual Inspection

The following source building materials are presumed to contain **PCBs** until sample results prove otherwise:

TABLE 3
Suspect PCB-Containing Source Materials from Visual Observation

LOCATION	MATERIAL TYPE	ESTIMATED QUANTITY
Typical Classrooms, Typical Hallways, Cafeteria, (3) Gymnasiums, Auditorium, Library, Teachers' Lounges, Typical Classrooms, Typical Hallways, etc.	Tectum Ceiling Panels	91,000 SF
Typical Classrooms, Typical Hallways, Cafeteria, (3) Gymnasiums, Auditorium, Library, Teachers' Lounges, Typical Classrooms, Typical Hallways, etc.	Black Mastic Associated with Tectum Ceiling Panels	91,000 SF
Elevator Machine Room	Grey Door Caulking	20 LF
Boiler Room & Computer Lab off Library	Grey Duct-Seam Sealant	200 LF Allowance (assume at concealed locations)

LOCATION	MATERIAL TYPE	ESTIMATED QUANTITY
Fan Room off Boiler Room, Gymnasium Fan Room & Assumed at Concealed Locations Throughout School	Red/Brown Duct-Seam Sealant	300 LF Allowance (assume at concealed locations)
Ground Floor Gymnasium	Assume Mastic underneath Wood Floor	4,025 SF
1st Floor Gymnasiums	Assume Mastic underneath Rubber Floor Mat	7,600 SF Note: rubber floor mat may contain mercury; it is recommended that sample is collected for Total/TCLP Mercury for waste characterization
1st Floor Gymnasiums	Assume Mastic Associated with Fiberglass Duct Insulation (Vertical Duct at Ceiling)	50 LF
Auditorium	Assume Mastic underneath Wood (Wall) Paneling	2,500 SF
Typical Classrooms	Adhesive Associated with Chalkboards/Tack Boards (Assumed)	5,000 SF
Classroom G23 & Offices (Assumed)	Brown Glue Daubs Associated with 1x1 Ceiling Tile	1,000 SF
Classroom G01 (After School Program)	Grey Louver Caulking	20 LF
Classroom G01 (After School Program)	Penetration Sealant at Duct	10 LF
Cafeteria	Sticky Black Window-Glazing Compound (Interior) Sticky White Window-Glazing Compound (Exterior)	Entire Window Bank Approx. 80' x 15' (1,200 SF) 1,200 SF
Cafeteria	Interior (Grey) Window Caulking	250 LF
Courtyard	Exterior (Grey) Caulking at Sidewalk	500 LF

LOCATION	MATERIAL TYPE	ESTIMATED QUANTITY
Classroom Hallways (Facing Courtyard)	Interior (White) Window Caulking at Awning-Type Window Inserts (at Window Curtain)	600 LF
Curved Stairwell	Interior (Black) Window Caulking	3 EA
Exterior Windows	Exterior Window Caulking at Classroom/Hallway Windows (i.e. Window Curtains) (Assume 3 Types)	25,000 LF
Ground Floor Gymnasium, 1st Floor Gymnasiums, & Upper Classrooms	Window Caulking & Glazing Compound Associated with Clearstory Windows	200 EA
Exterior Doors	Tan Exterior Door Caulking (Assume 3 Types)	1,000 LF
Exterior at Unit Vents	Exterior Caulking at Unit Vents	1,500 LF
Stairwell	Sticky White Window Glazing	12 EA
Stairwell	Interior (Grey) Window Caulking	12 EA
Interior at Concrete Wall Panel, (Inset) Columns, and Beams	Interior Joint Caulking	15,000 LF
Exterior at Concrete Panels	Expansion Joint Caulking	31,000 LF
All Roofs	Presumed Built-Up Roofing Material underneath Rubber-Membrane Roofs	All Roofing Fields
All Roofs	Presumed (Concealed) Asphaltic Roofing Layers/Sealants (e.g. Coping Sealant, Lap-Seam Sealant, Penetration Sealants, etc.)	ALL Roofing Perimeters, Penetrations, and Raised Curbs/Parapets

4.4 Conclusions

EnviroScience performed a visual inspection of suspect PCB-containing source materials only; no PCB sampling was performed as part of this inspection as requested. Therefore, this visual inspection serves as an initial bulk product characterization and does not provide recommendation for possible substrate removal that may result from PCB contamination.

EnviroScience recommends sampling of suspect PCB-containing materials with analysis method SW-846 8082 including extraction method 3540C (Soxhlet) prior to any potential disturbance from renovation or demolition work. Substrate sampling may be required if PCBs are found building materials. In other words, any porous substrate material in contact with a source material containing greater than 50 ppm PCB content must be sampled to determine possible PCB contamination (i.e. leaching from source material).

Photographs of suspect asbestos-containing materials are included in *Appendix D;* please see *Appendix E* for Field Notes.

We have included an estimate of probable construction cost for hazardous materials abatement in *Appendix F*. Estimated abatement costs are inclusive of presumed asbestos-containing materials and presumed PCB-containing source building materials only. Note that no cost has been included for PCB remediation associated with potentially impacted substrate materials. Fees for disposal of fluorescent lamps, lighting ballasts, and mercury-containing equipment have also been included within cost estimate.

Report prepared by Dustin A. Diedricksen.

Reviewed by:

Robert L. May, Jr.
Vice President

Stephen W. Connelly
Senior Vice President

FUSS & O'NEILL
EnviroScience, LLC

Appendix A

Inspector Licenses and Certifications

Commonwealth of Massachusetts

Department of Labor Standards

Heather E. Rowe, Director

Asbestos Inspector

DUSTIN A. DIEDRICKSEN

Eff. Date 04/26/12
Exp. Date 04/26/13
AI041867
Member of C.O.N.E.S.
nbr

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NB-RENEW

Commonwealth of Massachusetts

Department of Labor Standards

Heather E. Rowe, Director

Asbestos Inspector

JONATHAN L. HAND

Eff. Date 02/23/12

Exp. Date 03/07/13

AI041945

Member of C.O.N.E.S.

NB

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NB-RENEWAL

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Appendix B

Lead Paint Testing Procedures and Equipment

STANDARD OPERATING PROCEDURES
TESTING PROCEDURES AND EQUIPMENT
(Commonwealth of Massachusetts)

Massachusetts General Laws (M.G.L.) c. III, §190-199A 105CMR 460 with reference to lead based paint testing were consulted for this inspection. This regulation is administered by the Massachusetts Department of Public Health's Lead Poisoning Prevention Program. EnviroScience inspectors are licensed by the Commonwealth under this regulation.

This lead evaluation was either comprehensive or a determination. Both the proposed scope of work and the final report will note which type of evaluation was done. A comprehensive inspection means that representative painted surfaces were systematically evaluated on a room by room basis in accordance with the above referenced Massachusetts regulations.

A lead determination means that only a few surfaces were tested and that conclusions about untested areas cannot be reliably determined based on the limited testing that was done. A disclaimer will be employed in the report to note that the lead evaluation done is not in complete accordance with the testing protocol in the Massachusetts lead regulations.

Lead-based paint surfaces and components were identified by utilizing on-site x-ray fluorescence (XRF) instruments. EnviroScience Consultants, Inc. owns and maintains two different types of XRFs for testing for lead-based paint. These instruments are four (4) Radiation Monitoring Device LPA-1s (RMD) and a Scitec MAP 4 analyzer. Each of these instruments is operated in accordance with state and federal and manufacturer standards on the use of the instruments.

The federal government has developed Performance Characteristic Sheets (PCS) for each of the types of instruments cited above. Each instrument must be calibrated in accordance with these PCSs on a 1.0 milligram lead standard. Each of EnviroScience's instruments has one of these standards assigned to it. Some of the standards were purchased directly from the government and the others from the manufacturers of the instruments.

Readings (corrected for a substrate contribution, if applicable) of 1.0 mg/cm^2 or greater are considered to be dangerous levels of lead which must be abated (or in the case of certain metal components, just rendered intact) if a child under the age of six years has access to them and they are either on a defective surface, a chewable surface or a movable/impact surface on window components.

Prior to the start of any testing, a sketch of the building is drawn, and side designations are given to help identify exactly where readings were taken. Drawings depicting the room numbering scheme are located on the cover page(s) for the building(s) inspected. Each side of the building was labeled A, B, C or D. The "A" side of the unit is the side of primary entrance into a dwelling, and this room is always Room 1. Areas in the units include rooms, hallways, and closets. Areas are numbered in a clockwise fashion as building construction allows. This allows the inspector to indicate which substrate surface was tested. The type of hazard (if present) is described by circling the acronym on the testing form.

When more than one surface type was present on a side, the component tested was indicated with a number. If two windows were present on a building side, they were numbered left to right. Closet shelves and shelf supports were numbered top to bottom.

It is understood that the room layouts presented in the report are in conformance with the conditions that exist at the time the testing is performed. EnviroScience avoids labeling a room solely by its current functional use (i.e., living room, bedroom, etc.) since this use can change over time. Similarly, room layouts can change dramatically as dwellings are renovated and additions are built, incorporating existing rooms, or existing interior walls are moved or eliminated altogether.

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Appendix C

Lead Testing Field Data Sheets

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PG. 1/2

Project # 20120050 AIE Address MLK SCHOOL CAMBRIDGE, MA Date 4/18/12

Room	Side	Surface	Pb by XRF	Defective	Substrate*
Lower Gym Entry Amigos School		Stair Wall	0.1		Conc.
		Radiator	0.2		Metal
		Stair Tread/Riser	NC		Conc.
		Stair Baluster	2.0	Yes	Metal
		Stair Railing	0.0	Stain	Wood
Main Office		Window Bank Components	0.1		Metal
Lobby		Lobby Window System			
		Walls (Corrugated)	-0.2		Conc
G08		Door Frame	0.0		Metal
		Door	0.0	Stain	Wood
Lobby		Painted Baseboard	-0.1		Conc.
New Gym		CMU Wall Grey/Blue/Red	-0.2		Conc.
		Floor	0.0	Stain	Wood
		Radiator	-0.1		Metal
		Wall Behind Basketball Hoop	-0.1		Conc.
	A2	Door	-0.1		Wood
Cafeteria		Columns	0.2		Conc.
		Ceiling Beams	0.0		Conc.
	D	Window Bank Comp.	0.1		Metal
	ABC	Corrugated Conc. Walls	-0.1		Conc.
	ABC	Painted Baseboard	-0.2		Conc.
Boiler Room		Blue Boiler	-0.1		Metal
		Grey Cylinder Boilers (x2)	0.0		Metal
		Walls/Ceiling/Floor	NC		Conc.
		Generator	0.0		Metal
	C	Stair Components	0.0		Metal
	C	Door Frame/Louver	0.0		Metal
Elevator (Ground Floor)		Door	1.0	Yes	Metal
		Door Frame	-0.1		Metal
		Window Wall Int. Hallway	0.0		Metal
Teacher's Lounge	ABC	CMU Walls	0.0		Conc.
		Ceiling/Beams	-0.1		Conc.
	AC	Door Frame	0.0		Metal
G14 (Typical)	A	CMU Wall	0.1		Conc.
	B	Conc. Wall/Column	0.1		Conc.
		Ceiling Beam	-0.1		Conc.
	C	Door Frame	0.0		Metal
	C	Door (Green)	1.1		Metal
Kind. Hallway	A	Window Panel	-0.1		Metal

*P=Plaster S=Gypsum Wallboard (sheetrock) L=Lead Containing Alloy (No Coating) M=Metal A=Alumimum W=Wood V=Vinyl

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Project # 20120050.A1E Address MLK SCHOOL CAMBRIDGE, MA Date 4/18/12

Room	Side	Surface	Pb by XRF	Defective	Substrate*
	A	WINDOW BANK COMPONENTS	0.1	~~NA~~	METAL
		HALLWAY FIRE DOOR COMPONENTS	0.0		METAL
		HALLWAY FIRE DOOR	0.0		METAL
1st FLOOR MLK		CONCRETE HALLWAY WALL	0.2		CONC.
		CEILING/BEAM (HALL)	-0.2		CONC.
LIBRARY	A	WINDOW BANK COMP	0.3		METAL
CLASSROOMS		CORRUGATED WALLS	0.2		CONC.
		TERRACOTTA TILE (ENTRY)	0.2		CT
1st FL.		BALCONY RAIL/LOWER WALL	-0.2		WOOD
BALCONY		DRYWALL (110)	0.0		DRYWALL
	C	FEATURED METAL DOOR	-0.2		METAL
CLASSROOM 114		COLUMN	0.1		CONC.
	C	WINDOW COMPONENTS	-0.2		METAL
	D1	DOOR FRAME	0.1		METAL
	D	WALL (PARTITION)	-0.1		HOMASOTE
	A1	DOOR FRAME	0.0		METAL
		DOOR	0.1	STAIN	WOOD
1st Floor Gym		Floor	-0.1		Rubber
		wall	0.0		CMU
		Door Frame	0.0		M
~~1st~~ 2nd Floor MLK Hall		wall	0.2		C
		Column	0.1		C
		Door Frame	0.3		M
		Fire Door w/Frame	0.0		M
		Ext Door to Courtyard Balcony	1.3	Y	M
2nd Floor lobby		wall	0.1		C
		low wall	-0.2		W
		Door Frame	0.0		M
		lockers	-0.1		M
3rd Floor Hall		wall	-0.1		C
		Column	0.3		C
		Door Frame			M

*P=Plaster S=Gypsum Wallboard (sheetrock) L=Lead Containing Alloy (No Coating) M=Metal A=Alumimum W=Wood V=Vinyl

Appendix D

Photographs

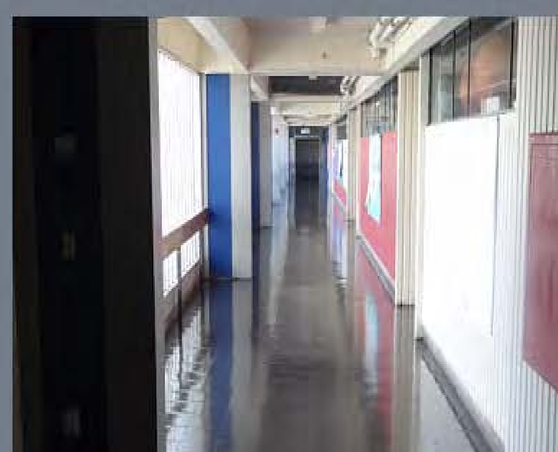
Tectum Ceiling Panels

Tectum Ceiling Panels

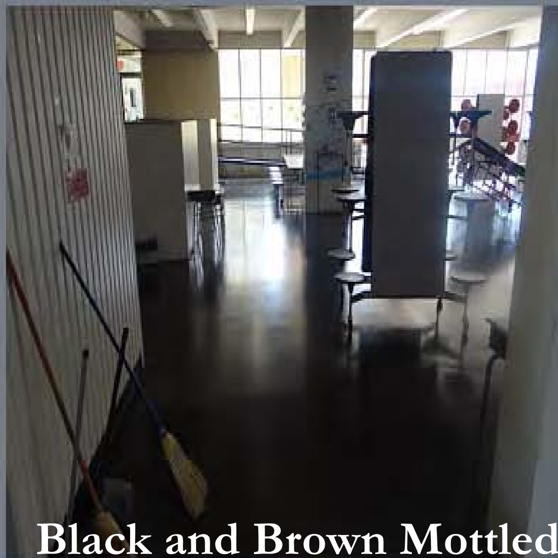
Tectum Wall Panels

Tectum Ceiling Panels

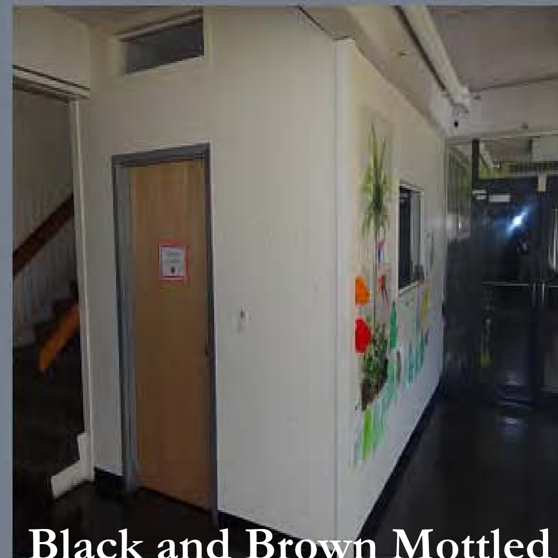
Black Mastic Associated with Tectum Ceiling Panels



Black and Brown Mottled 12x12 Vinyl Floor Tile



Black and Brown Mottled
12x12 Vinyl Floor Tile



Black and Brown Mottled
12x12 Vinyl Floor Tile

White with Grey Splotches
12x12 Vinyl Floor Tile

Off-White & Brown Mottled
12x12 Floor Tile
(Mixed Pattern) and Red with
White Splotches 12x12 Floor Tile
(Mixed Pattern)

Pink with Dark Pink & White
Splotches 12x12 Floor Tile

Light Blue with Dark Blue & White
Specks 12x12 Floor Tile (Mixed
Pattern) and Dark Blue with
Light Blue & White Specks
12x12 Floor Tile
(Mixed Pattern)

Grey Mottled 12x12 Floor Tile (Mixed Pattern) and Red Mottled 12x12 Floor Tile (Mixed Pattern)

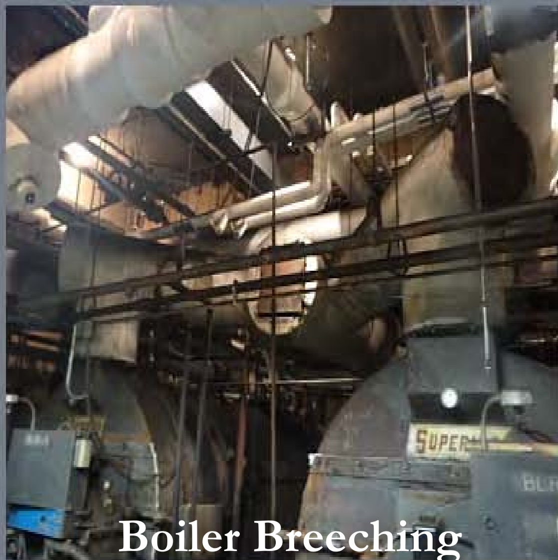
Blue with Dark Blue & White Splotches 12x12 Floor Tile (Mixed Pattern) and White with Blue & Purple Splotches 12x12 Floor Tile

Adhesive Associated with 6" Terracotta Tile (Assumed)

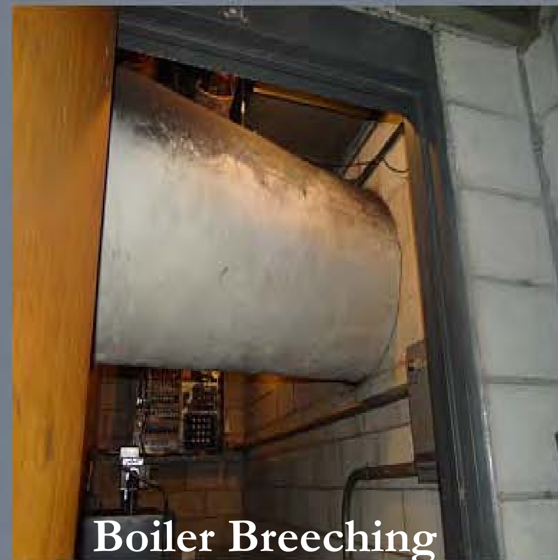
Fire Doors with Friable Core

Fire Doors with Friable Core

Fire Doors with Friable Core



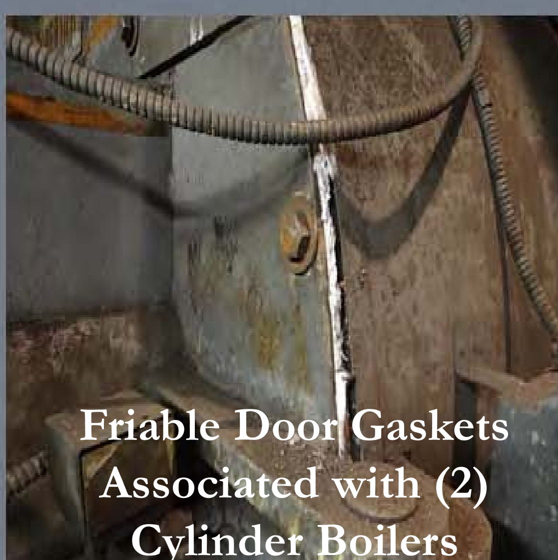
Boiler Breeching
(Friable Mag TSI)



Boiler Breeching
(Friable Mag TSI)

Flue Cement

Assume Friable Door Insulation Associated with (2) Cylinder Boilers (at Interior)



Friable Door Gaskets Associated with (2) Cylinder Boilers

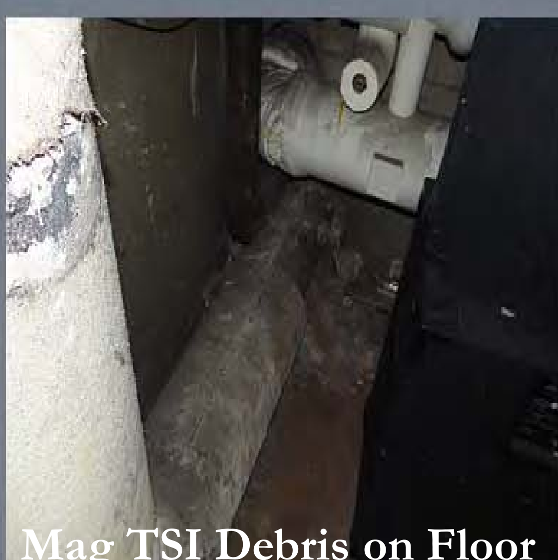
Interior Boiler Gaskets & Packings (Concealed)

TSI Wrap (over Foam Rubber) Associated with Suspended Hot Water Tanks

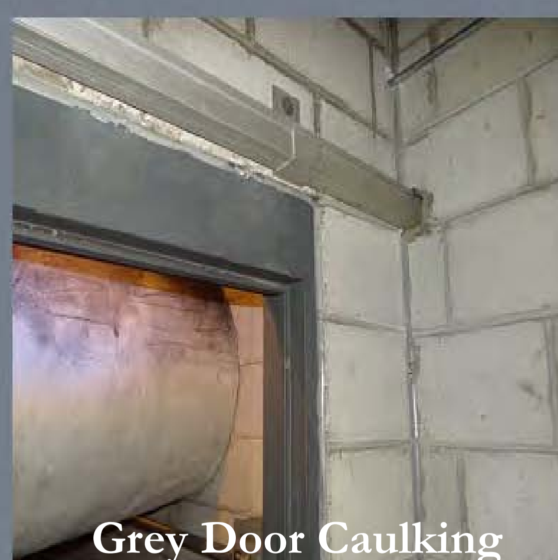
Mag TSI Muffler Associated with Emergency Generator (Underneath Stairwell)

Mag TSI Muffler Associated with Emergency Generator (Underneath Stairwell)

Mag TSI Muffler Associated with Emergency Generator (Underneath Stairwell)



Mag TSI Debris on Floor

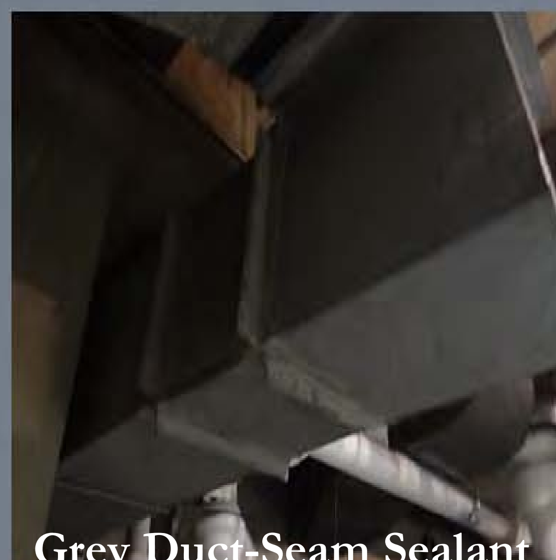


Grey Door Caulking

Mudded Fittings Associated with Fiberglass Pipe Insulation

Mudded Fittings Associated with Fiberglass Pipe Insulation

Roof Drain Insulation and Mudded Fittings



Grey Duct-Seam Sealant

Red/Brown Duct-Seam Sealant

Red/Brown Duct-Seam Sealant

Red/Brown Duct-Seam Sealant

Green and White Cloth Vibration Isolator Associated with Ductwork Throughout School (Assume 2 Types)

Green and White Cloth Vibration Isolator Associated with Ductwork Throughout School (Assume 2 Types)

Green and White Cloth Vibration Isolator Associated with Ductwork Throughout School (Assume 2 Types)

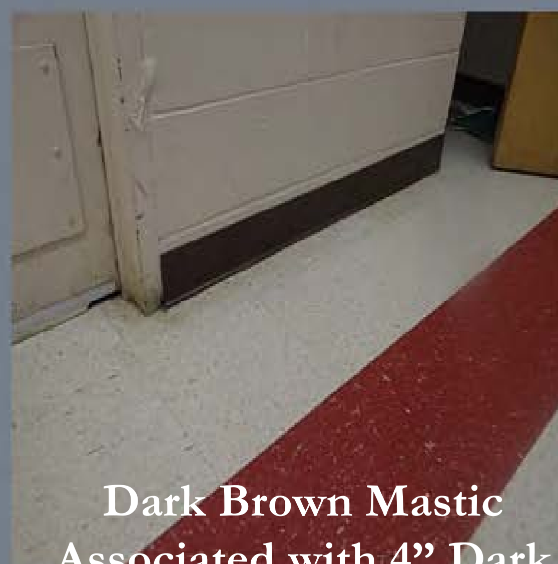
Assume Flooring Felt and/or Mastic underneath Wood Floor

Brown (Toe Base) Vinyl Baseboard & Mastic

Assume Flooring Felt and/or Mastic underneath Rubber Floor Mat

Assume Flooring Felt and/or Mastic underneath Rubber Floor Mat

Assume Mastic Associated with Fiberglass Duct Insulation (Vertical Duct at Ceiling)

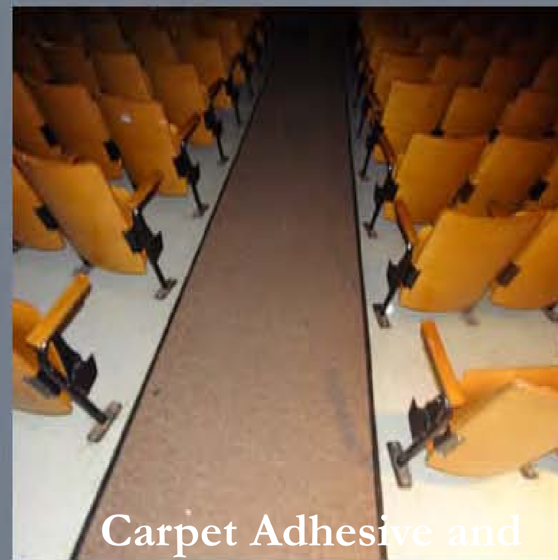


Dark Brown Mastic Associated with 4" Dark Brown Vinyl Baseboard

White Mastic Associated with Newer (Shiny) 4" Black Vinyl Baseboard

Assume Mastic underneath Wood (Wall) Paneling


Assume Felt/Mastic Underneath Wood Stage (Auditorium)


Carpet Adhesive and Vinyl Threshold


Stage Lighting


Stage Curtain


Black Sink Undercoat and Grey Sink Undercoat


Black Sink Undercoat and Grey Sink Undercoat

Adhesive Associated with Chalkboards/Tack Boards (Assumed)

Skim/Rough Coat Plaster Ceiling

Skim/Rough Coat Plaster Ceiling

Skim/Rough Coat Plaster Ceiling

Skim/Rough Coat Plaster Ceiling

1x1 Ceiling Tile and Brown Glue Daubs Associated with 1x1 Ceiling Tile

2x2 Mold-Resistant (White) Ceiling Tile

2x4 Fissured and Dotted Ceiling Tile

Drywall and Joint Compound (Associated with Drywall Partitioning Walls)

Brown Radiator Caulking

Grey Louver Caulking

Penetration Sealant at Duct

Sticky Black Window-Glazing Compound (Interior)

Sticky White Window-Glazing Compound (Exterior)

Sticky White Window-Glazing Compound (Exterior)

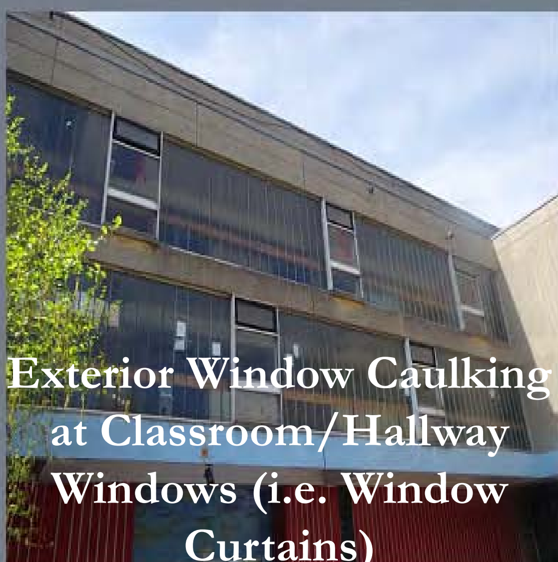
Interior (Grey) Window Caulking

Exterior (Grey) Caulking at Sidewalk

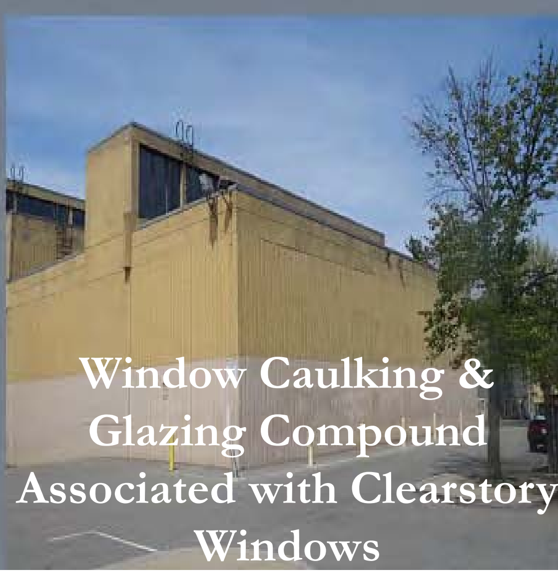
Interior (White) Window Caulking at Awning-Type Window Inserts (at Window Curtain)


Interior (Black) Window Caulking


Possible Skim Coat on Beams


Exterior Window Caulking at Classroom/Hallway Windows (i.e. Window Curtains)
(Assume 3 Types)

Exterior Window Caulking at Classroom/Hallway Windows (i.e. Window Curtains)
(Assume 3 Types)


Window Caulking & Glazing Compound Associated with Clearstory Windows


Window Caulking & Glazing Compound Associated with Clearstory Windows

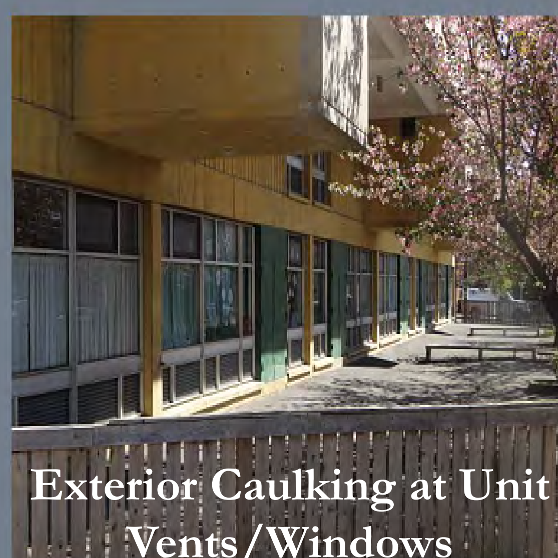
Window Caulking & Glazing Compound Associated with Clearstory Windows

Tan Exterior Door Caulking (Assume 3 Types)

Tan Exterior Door Caulking (Assume 3 Types)

Tan Exterior Door Caulking (Assume 3 Types)

Exterior Caulking at Unit Vents/Windows

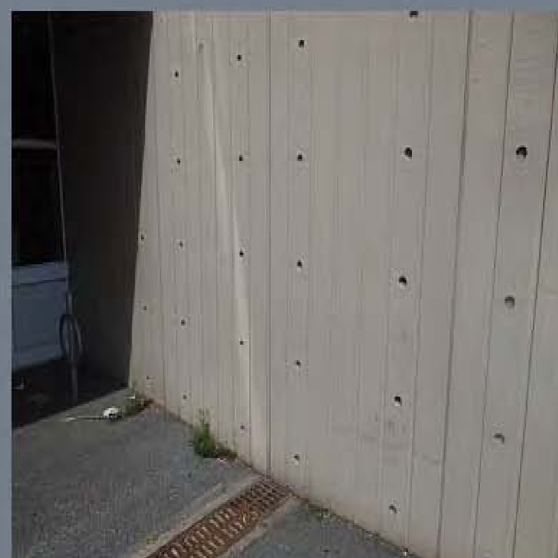


Exterior Caulking at Unit Vents/Windows

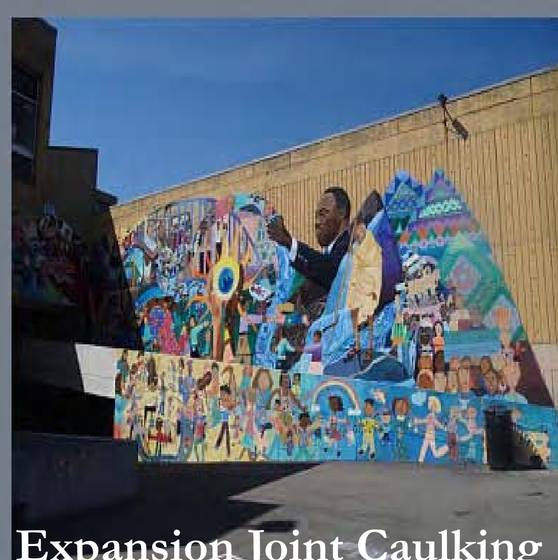

Sticky White Window Glazing


Interior Joint Caulking (2nd Type at Ground Floor)

Interior Joint Caulking (2nd Type at Ground Floor)


Expansion Joint Caulking


Expansion Joint Caulking


Expansion Joint Caulking


Expansion Joint Caulking


Expansion Joint Caulking


Expansion Joint Caulking


Presumed (Concealed) Asphaltic Roofing Layers/Sealants (e.g. Coping Sealant, Lap-Seam Sealant, Penetration Sealants, etc.)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Appendix E

Field Notes

2012 0050.A1E

4/17/12

MLK SCHOOL – CAMBRIDGE, MA → FEASABILITY STUDY

CAFETERIA (30 MIN.)

(1) – BLACK AND BROWN MOTTLED 12×12 FT
(2) – BLACK MASTIC A/W BLACK + BROWN MOTTLED 12×12 FT
(3) – SKIM COAT (POSSIBLY PAINT) ON CONCRETE BEAMS
(4)(5) – CAULKING AT CONCRETE CORRUGATED (POURED) WALL AND CONCRETE BEAMS (GREY)
(6) – TECTUM CEILING PANELS
(7) – ENTIRE WALL WINDOW BANK
↳ METAL FRAMES
↳ RUBBER WGC + SOME REPLACEMENT CAULKING
↳ REMAINING HAS STICKY BLACK WGC
(8) – BLACK STICKY CAULKING (SAME AS WGC) AT WINDOW (METAL) PANELS
(9) – GREY INTERIOR WINDOW CAULKING (AT WALL)
– CAULKING AT COLUMNS SET IN CONC. WALL AND AT BEAMS ABOVE PARTITIONING WALLS (GREY)
– INTERIOR DOOR (E.G. BATHROOMS) = MORTAR AT DOOR FRAMES

BOILER ROOM (1 – 1½ HOURS)

(10)(11)(12) – FRIABLE FIRE DOOR (DAMAGED) – 2 EA (DOUBLE DOORS)
(13) – GREY DUCT SEALANT
(14)(15)(16) – BOILER BREECHING – 300 SF
+ 2 CYLINDER BOILERS (17) (18)
↳ METAL JACKET W/ FIBERGLASS TSI UNDERNEATH
↳ ASSUME FRIABLE DOOR/INSULATION – 200 SF 4 DOORS
(19) ↳ GASKETS AT DOOR (ASSUME ACM) – 100 LF 4 DOORS
(20) MUDDED FITTING(S) A/W 3" FIBERGLASS PIPE INSULATION (28)
↳ EVIDENCE OF FITTINGS REMOVED
(22) RED/BROWN DUCT SEALANT AT AIR HANDLING ROOM OFF BOILER RM
(26) EXPANSION/HOT WATER TANK TSI WRAP (OVER FOAM RUBBER TSI) – 125 EA TAN
(23)(24) RED PIPE GASKETS THROUGHOUT (ALSO GREEN + BLACK) – 30 EA
↳ REPLACEMENT GASKETS HANGING FROM TEMPERATURE GAUGE – 10 EA
FIRE DOOR OFF FAN ROOM (HVAC SYSTEMS)
(25) VIBRATION CLOTH ISOLATORS (BOILER + HVAC AREAS)
ALLOWANCE =

✓

BOILER ROOM CONT.
(21) (22) GENERATOR MUFFLER TSI

TEACHERS' LOUNGE (G13) — CONCRETE (CMU) WALLS
— BLACK + BROWN MOTTLED 12×12 FT
— 4" DARK BROWN VINYL BASEBOARD
↳ DARK BROWN MASTIC A/W 4" VBB
— TECTUM CEILING PANELS
— CAULKING AT COLUMN
— CAULKING AT CONC. BEAM AND WALLS
— 2×2 CEILING TILE
— 1×1 CEILING TILE (SPLINE)
(37) DRYWALL + JOINT COMPOUND IN PHONE CLOSET
(37) (38) ROOF DRAIN MUDDED FITTINGS IN HALLWAY O/S TEACH. LOUNGE (FIBERGLASS TSI)

✓ AMIGOS KINDERGARTEN G LEVEL

ESL PARTITIONED ROOM
↳ DRYWALL + JC
(39) ↳ 4" BLACK VBB + TAN ADHESIVE

HALLWAY = BLACK + BROWN MOTTLED 12×12 + BLACK MASTIC (ON CONCRETE)
EXTERIOR WINDOW BANK AT HALL
↳ BLACK STICK WGC (SAME AS CAFE.)
↳ METAL (BOTTOM) WINDOW PANELS W/ WOOD INTERIOR
(40) ↳ MUDDED FITTINGS (6 VISIBLE AT CEILING)
CLASSROOMS
(41) G14 = WHITE W/ GREY SPLOTCHES 12×12 FT + BLACK MASTIC
(42) (43) ↳ BLACK SINK UNDERCOAT (1 EA)
↳ 4" BLACK VBB (ASSUME TAN MASTIC)
↳ TECTUM CEILING PANELS
↳ RUBBER WGC
↳ ASSUME CAULKING AT COLUMNS AND OUTER CONC. BEAMS
(44) ↳ INTERIOR WINDOW CAULKING
↳ FOAM WGC AT COAT CLOSET (FACING HALLWAY)

G16, G15 → SAME AS G14
G11, G12

COURTYARD O/S CAFETERIA - EXTERIOR
(45) - TAN EXTERIOR DOOR / LOUVER CAULKING → ~~ALSO AT CAFE~~
(46) - GREY DOOR CAULKING
(47) - EXTERIOR CAULK AT BEAM + WALL (SAME AS GREY DOOR)
(48) - WHITE EXTERIOR WGC (STICKY) AT CAFETERIA WINDOW BANK
(50) - GREY WINDOW CAULKING AT CAFETERIA WINDOWS (50)
(49) - WHITE CAULKING AT METAL WINDOW PANELS
(51) - CAULKING AT SIDEWALK GAP

G23
- TECTUM CEILING + WALL PANELS
- WHITE W/ GREY SPLOTCHES 12×12 FT
CLOSET - BLACK SINK UC (2 EA)
- 2×4 FISSURED + DOT CT
- 4" BLACK VBB + MASTIC
- MUDDED FITTINGS ABOVE ACT
- WALL / BEAM CAULKING
(61) (60) 1×1 ACT (HALL TO CLOSET) - SPLINE
STORAGE 1×1 ACT - STORAGE + MAIN HALL O/S CLASSROOM DOOR
↳ BROWN GLUE DAUBS
↳ GLUED CHALKBOARD

INSULATED FIRE DOOR - SOLID CORE FRIABLE
↳ ASSUME TRANSOM

NEW GYM (53)
(54) - TECTUM CEILING PANELS
(55) - CLEARSTORY WINDOWS (N/A) - 3'×8' ALUMINUM FRAME (22 EA)
↳ ASSUME INT / EXT CAULK
↳ WGL
(56) - ASSUME FLOORING FELT / MASTIC (CORING REQUIRED)
(58) - BROWN RIGHT ANGLE VBB + YELLOW MASTIC
(57) - EXPANSION JOINT CAULK
- MUDDED FITTING ON ROOF DRAIN

NEW GYM CONT.

(60) - BROWN RADIATOR CAULKING
- FIRE DOOR (INSULATED) (58) (59)

BATHROOMS - GYM HALLWAY - CMU WALLS
(63) - CERAMIC (TERRACOTTA) FLOOR TILE ADHESIVE (+)
(62) - 2x2 MOLD RESISTANT ACT (+)

FAN ROOM (G4 AREA) OFF GYM HALLWAY - GROUND LEVEL
- MUDDED FITTINGS
(64) - RED/BROWN DUCT-SEAM SEALANT
(65) - WHITE CLOTH VIBRATION ISOLATOR
(66) (67) - 2x4 FISSURED + DOT AT O/S HALLWAY (SHORT CEILING)

CLASSROOM BENEATH UPPER GYM (G01) FORMER BOYS LOCKER ROOM
- CONC. CEILING + CMU WALLS (NO TECTUM)
(68) (69) - PINK W/ DARK PINK + WHITE SPLOTCHES 12x12 FT + LIGHT BROWN MASTIC
(70) - 4" BLACK VBB + WHITE MASTIC
- ASSUME INSULATED DOORS
- CAULKING AT OUTER BEAMS
(71) (72) - LOUVER CAULKING (~~WHITE~~) (GREEN)
(73) - PENETRATION SEALANT AT DUCT
(74) (75) - GREY SINK UC (1 EA)
(76) - PLASTER CEILING IN BATHROOM STORAGE + SHOWER ROOM
- DRYWALL + JC AT STORAGE DOORS
- GLAZED BLOCKING (WALLS) AT SHOWER ROOM

HALLWAY O/S G12 + CLASSROOM AT END OF HALL
(77) - OFF-WHITE + ~~TAN~~ BROWN MOTTLED 12x12 FT] YELLOW MASTIC
- RED W/ WHITE SPLOTCHES 12x12 FT]
(78) - 4" BROWN VBB + TAN MASTIC
- BEAM/COLUMN CAULKING
- NO TECTUM CEILINGS
- GREY SINK UC - KITCHEN AREA
(80) - PLASTER CEILING AT KITCHEN AREA
(79) - ASSUME TACKBOARD MASTIC

GENERATOR
BOILER

(29) ELEVATOR MECH. ROOM + STORAGE ROOM
- BOILER BREECHING (30) (31) (32)
- MUDDED FITTINGS
(+) - GREY DOOR CAULKING (33)
(+) - FLUE CEMENT (STORAGE ROOM) (34)
- PIPING CONTINUES UNDER STAIRWELL (ACCESS PANEL FROM HALL) (35) (36)

(106) CURVED STAIRWELL - 1ST TO GROUND LEVEL
- BLACK WINDOW CAULKING + WGC

CLASS ROOM ~~101~~ + PRESCHOOL ROOM ACROSS HALL
- WHITE w/ GREY SPLOTCHES 12×12 FT (TYPICAL)
- BLACK 4" VBB (TYPICAL)
- TECTUM CEILING
- BEAM/COLUMN CAULKING
- BLACK SINK UC
- RUBBER WGC
- INT. WINDOW CAULKING (AT COLUMN) - WHITE

CLASSROOM 102 - SAA (101)
CLASSROOM 103 - SAA
CLASSROOM 104 - SAA
} ASSUME CHALKBOARDS
CLASSROOM 105 - SAA - BLACK + BROWN MOTTLED 12×12 FT IN BATHROOM ONLY

(80) HALLWAY O/S ROOM 105
✓ LIGHT BLUE w/ ~~BB~~ DARK BLUE + WHITE SPECKS 12×12 FT
✓ DARK BLUE w/ LIGHT BLUE + WHITE SPECKS 12×12 FT
TECTUM CT

LIBRARY 109A + FACULTY ROOM
(83) GREY MOTTLED 12×12 FT
RED MOTTLED 12×12 FT (DESIGN)
TECTUM CT
BEAM/COLUMN CAULK
MUDDED FITTINGS IN FACULTY ROOM
OFFICE = PINK w/ DARK PINK + WHITE SPLOTCHES 12×12 FT
↳ WHITE w/ GREY SPLOTCHES 12×12 FT (OFFICE + COMPUTER LAB)
↳ 1×1 ACT (SPLINE)
↳ BLACK SINK UC

CLASSROOMS 114, 115, 116 – SAME AS CLASSROOM 101
112, 111

CLASSROOM 113 – 1×1 ACT (SPLINE)
(ESL)
BLACK + BROWN MOTTLED 12×12 FT
DARK BROWN 4" VBB – DARK BROWN MASTIC (SAME AS G13)
BEAM/COLUMN CAULKING
DRYWALL + JC
TECTUM CT
~~[illegible]~~

HALLWAY O/S CLASSROOM 114
(84) – WHITE W/ RED, YELLOW, + BLUE SPLOTCHES 12×12 FT
– 4" BLACK VBB + WHITE MASTIC
– TECTUM CT
– RUBBER WGC AT WINDOW BANK
(52) – EXTERIOR CAULKING AT CURTAIN WINDOW WALL
– ROOF DRAIN MUDDED FITTINGS

110 – PARTITIONED ROOM (BUILT LAST SUMMER)
– 2×2 F+D CT
– 4" VBB BLACK
– DRYWALL + JC
(SAME AS ESL ROOM

107 – NURSE'S OFFICE
– TECTUM CT
– BEAM/COLUMN CAULK
– ~~Brown~~ BLACK + BROWN MOTTLED 12×12 FT
– DRYWALL + JC
– STICKY BLACK WGC
– DARK BROWN 4" VBB + DARK BROWN MASTIC

106 – SAME AS 107

(78) (79) FRONT
STAIRWAY
BLACK STICKY ~~[illegible]~~ WGC + GREY CAULK (AT COLUMN)

1ST FLOOR (RUBBER) GYM
- CMU WALL
- TECTUM CEILING
(94) (95) ½" THICK - 1" THICK RUBBER FLOORING (Hg)
(96) - CLEARSTORY WINDOWS (44 EA) SAME AS NEW GYM
(97) - 3 VIBRATION ISOLATORS -
(98) - DUCT INSULATION (ASSUME MASTIC)
- FELT/MASTIC A/W SLEEPER FLOOR

(85) AUDITORIUM
(89) - CARPET ADHESIVE
- VINYL THRESHOLD
(88) - ASSUME MASTIC BEHIND WOOD PANELING
(86) - TECTUM CEILING / BACK WALL (87)
(87) - PLASTER CEILINGS (DROP)
(90) - FELT AT STAGE
(92) - STAGE CURTAIN (NO FIRE CURTAIN)
(92) - STAGE LIGHTING → WIRE COATINGS
- 4" BLACK VBB - BROWN MASTIC
(91) PLASTER CEILING AT STAGE
(93) DUCT AT STAGE

AUDITORIUM BATHROOMS
SAME AS DOWNSTAIRS

CLASSROOM 201 } SAME AS 101
CLASSROOM 202
203
204
205
206

CLASSROOM 209 } SAME AS ABOVE, BUT MAY NOT HAVE SINKS
CLASSROOM 210
\# 209 → ALSO HAS CLEARSTORY WINDOWS - 9 EA - CURTAIN WALL

HALLWAY 2ND FLOOR MLK
- BLACK + BROWN MOTTLED 12x12 FT + BLACK MASTIC
- TECTUM CEILING TILE + BLACK MASTIC
- MUDDED FITTINGS AT ROOF DRAINS
- CURTAIN WINDOW WALL - EXTERIOR GREY CAULK + INT. RUBBER WGL
- CAULK AT BEAMS/COLUMNS

2ND FLOOR (MLK) – BALCONY HALLWAY – METAL PANEL CEILING, FG INS.

(99) – BLUE W/ DARK BLUE + WHITE SPLOTCHES 12×12 FT] BLACK MASTIC
- WHITE W/ BLUE + PURPLE SPLOTCHES 12×12 FT]
- 4" BLACK UBB + TAN MASTIC
- DRYWALL + JC (PARTITIONED ROOMS)
- TECTUM CT NEARER TO FRONT STAIRWELL

STAIRWELL A/B – STICKY WHITE WGC] BALCONY HALLWAY
GREY (INT.) WINDOW CAULKING]

PARTITIONED OFFICE AT FRONT ALSO (ROOM 206½)

BATHROOMS OFF HALL = LOCKED

CLASSROOM 211 – SAME AS 101
" 215+214+212+216 – SAME AS 209 (CLEARSTORY WINDOWS) – ALL HAVE SINKS
~~[illegible] – SAME AS 101~~

TEACHER'S LOUNGE – 2ND FLOOR
- BLACK + BROWN MOTTLED 12×12 FT + BLACK MASTIC
- TECTUM CT
- BEAM + COLUMN CAULK
- 4" DARK BROWN UBB + DARK BROWN MASTIC
- SINK UNDERCOAT (N/A) – ASSUMED
- 2×2 F+P ACT
- 1+1 ACT SPLINE

HALL O/S CLASSROOM 215

(100) – BLACK + BROWN MOTT 12×12 + BLACK MASTIC
- TECTUM CT + BLACK MASTIC (102) (103)
- CURTAIN WINDOW
  - ↳ EXT GREY CAULK
  - ↳ RUBBER WGC
  - (81) (82) ↳ WHITE INT CAULK @ AWNING WINDOW INSERT
- BEAM / COLUMN CAULK

PROJECTOR BOOTH
- BLACK + BR 12×12 FT
- MUDDED FITTINGS
- 4" DARK BROWN VBB + DARK BROWN MASTIC
- BEAM / COLUMN CAULKING
- INTERIOR DOOR CAULKING
- LOUVER CAULKING

HVAC ROOM FOR AUDITORIUM - ACCESS AT ~~ROOF~~
- (x2) VIBRATION ISOLATORS (GREEN)

ROOF AREA OFF PROJECTOR ROOM
- FLASHING CAULK AT COPING ON RUBBER ROOF
- DOOR CAULKING (EXTERIOR) - GREY + BLACK

CLASSROOM 205 - SAME AS 101 (OT PT) OCCUPATIONAL / PHYSICAL THERAPY
↳ MUDDED FITTINGS
↳ DRYWALL + JC

MUSIC ROOM - (207)
SAME AS 101

CLASSROOM 208 -
SAME AS 101 (NO SINK → DRYWALL AT PARTITIONING WALL)

COMPUTER LAB OFF LIBRARY (UNLOCKED + OUT OF SEQUENCE)
CLASSROOM 12x12 FT - TYPICAL VBB, ETC.
GREY DUCT SEALANT

MAIN OFFICE - 1x1 ACT
BLACK + BROWN - 12x12 FT

KITCHEN
- 6" TERRACOTTA FLOOR TILE
- VENT MASTIC - THROUGHOUT SCHOOL
- RED/BROWN DUCT-SEAM SEALANT
- METAL 1x1 PANEL CEILING (NON ACM)
- FREEZER WALL → METAL W/ WOOD

LOCKER AREA = BLACK + BROWN MOTTLED 12x12 FT
DARK BROWN VBB + DARK BR. MASTIC
1x1 ACT (SPLINE)

BATHROOM - 2x4 FTD CT
NEW TYPES {
ELECTRIC BLUE MOTTLED 12x12 FT
4" TAN VBB + TAN MASTIC
- DOOR CAULKING (WHITE)

CUSTODIAN ~~CLOSET~~ - MUDDED FITTINGS +
OFFICE BLACK + BROWN 12x12 + TYP. VBB ; 1x1 ACT

3RD FLOOR (MIK)

HALLWAY (100)

WINDOW FACING BALCONY

(101) ↳ STICKY BLACK WGC

↳ WHITE WINDOW CAULKING

BLACK + BROWN MOTTLED 12×12 FT + BLACK MASTIC

4" BLACK VBB + WHITE MASTIC

TECTUM CT + BLACK MASTIC (FELT)

DRYWALL + JC

CURTAIN WINDOW WALL - TYPICAL

SCIENCE 308

- TYPICAL CLASSROOM W/ CLEARSTORY + COMPOSITE COUNTERTOPS (ASSUME)

BATHROOMS - TYPICAL

307 - ART (LOCKED) - ASSUME TYPICAL

CONCRETE FLOOR

TECTUM

CLASSROOMS

302, 303, 304, 305, 306 - TYPICAL

CLEARSTORY WINDOWS - 9 EA ROOM

4TH FLOOR COUNSELOR ROOM - LOCKED

CARPET - ASSUME ADHESIVE

DRYWALL + JC

4" BLACK VBB

AMIGOS MAIN OFFICE

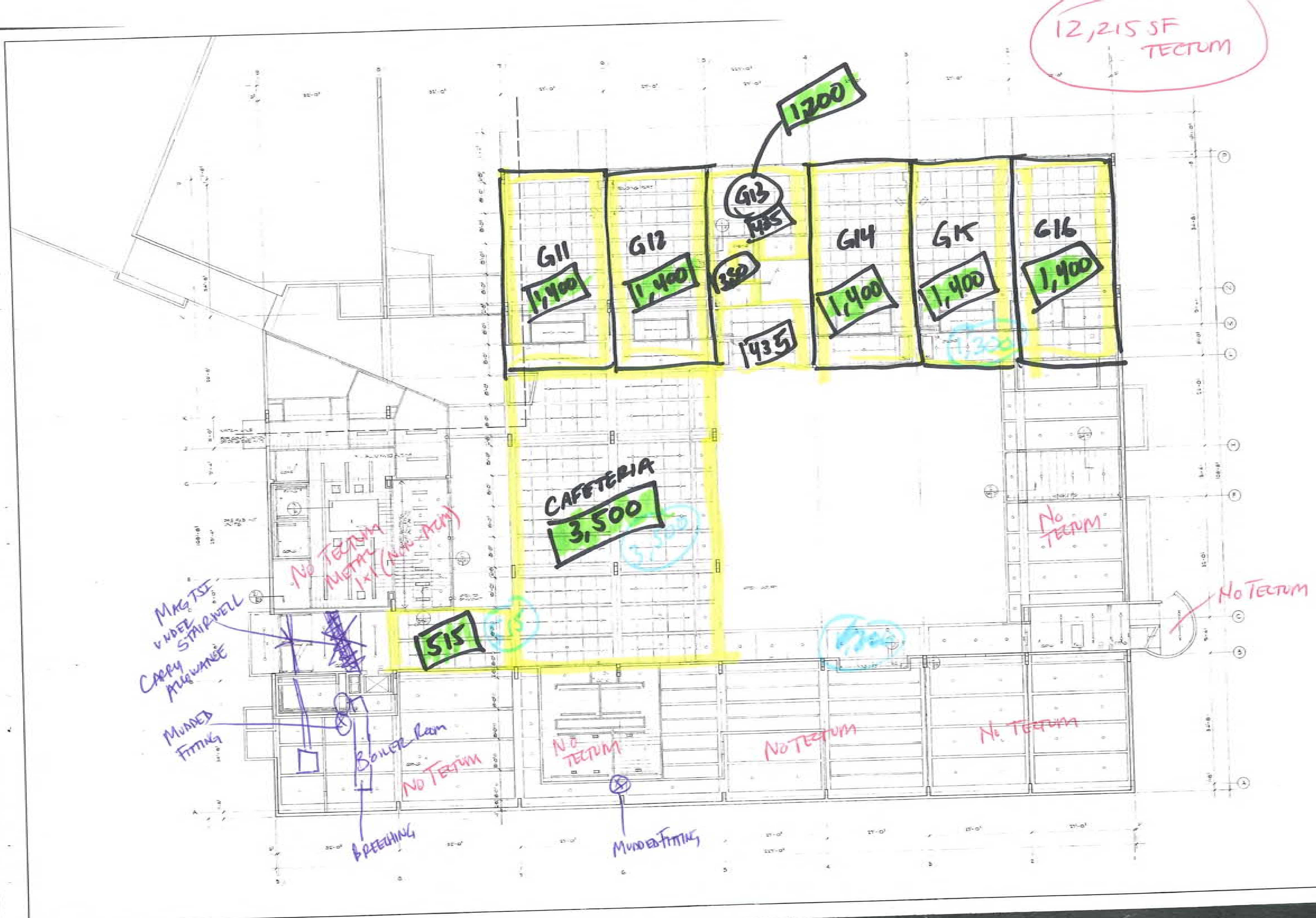
PINK 12x12 FT (SEE BEFORE)

DRYWALL + JC

4" BLACK VBB

104 - ROOF COPING

105 - ROOFS (RUBBER)



SERT, JACKSON AND ASSOCIATES ARCHITECTS
26 CHURCH STREET
CAMBRIDGE, MASS

PROJECT NO. 6509

MARTIN LUTHER KING, JR. ELEMENTARY SCHOOL
CAMBRIDGE, MASS.

REVISIONS

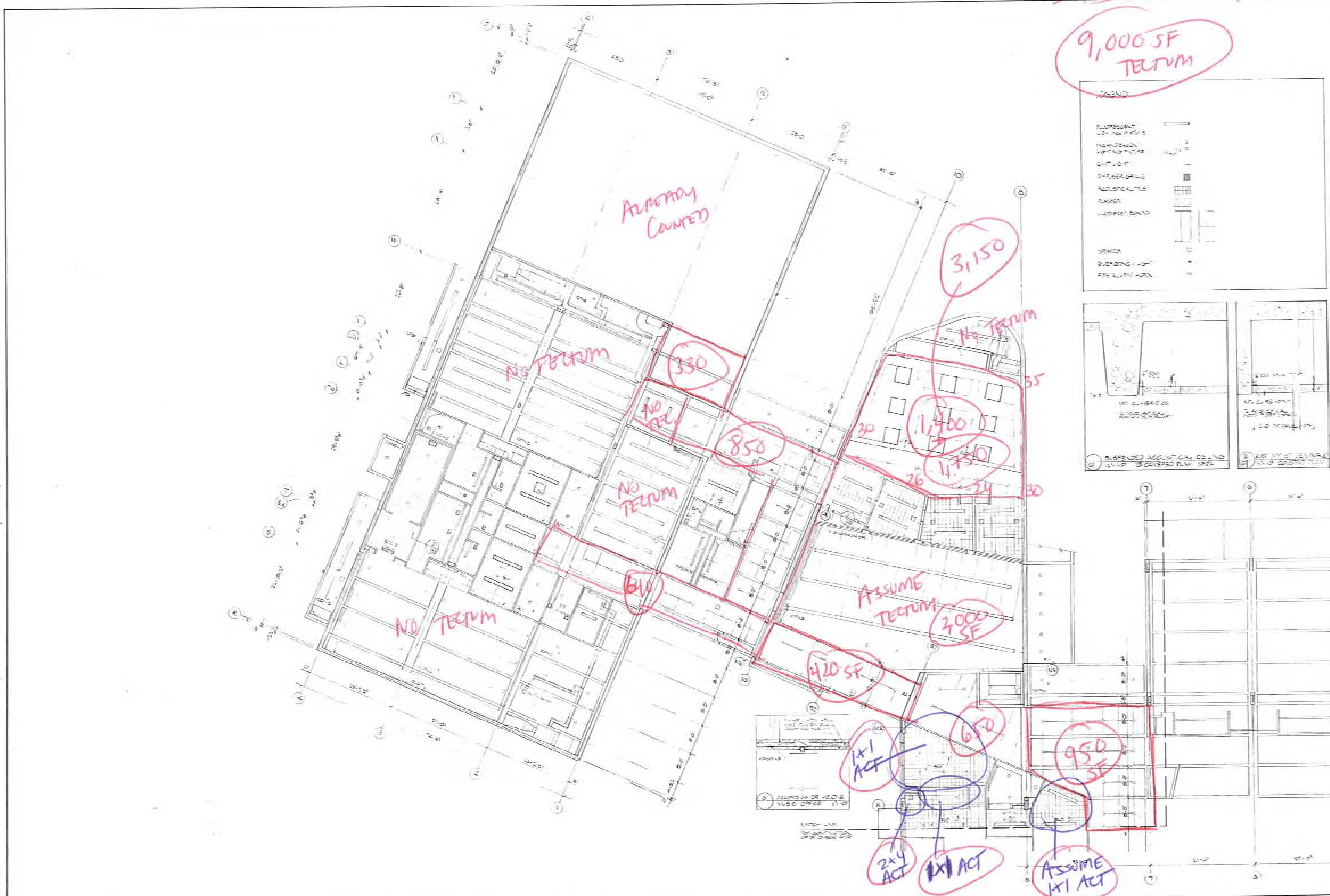
NO	DATE	SCOPE	BY

SHEET TITLE
GROUND FLOOR REFLECTED CEILING PLAN A

DETAILS NO.
LOCATED ON SHEET
DETAILED ON SHEET

DRAWN: JBH, DCM
CHECKED
APPROVED
DATE: 15 JUNE 1968
SCALE: 1/8" = 1'-0"

SHEET NO.
A-16



SERT, JACKSON AND ASSOCIATES ARCHITECTS
36 CHURCH STREET
CAMBRIDGE, MASS.

PROJECT NO. 6509

MARTIN LUTHER KING, JR. ELEMENTARY SCHOOL

CAMBRIDGE, MASS.

REVISIONS

NO.	DATE	SCOPE	BY

SHEET TITLE

GROUND FLOOR REFLECTED CEILING PLAN B

DETAIL NO.
LOCATED ON SHEET / DETAILED ON SHEET

DRAWN
CHECKED
APPROVED
DATE
SCALE
SHEET NO.

A-17

SERT, JACKSON AND ASSOCIATES ARCHITECTS
26 CHURCH STREET CAMBRIDGE, MASS.

PROJECT NO. 6509

MARTIN LUTHER KING, JR. ELEMENTARY SCHOOL
CAMBRIDGE, MASS.

REVISIONS

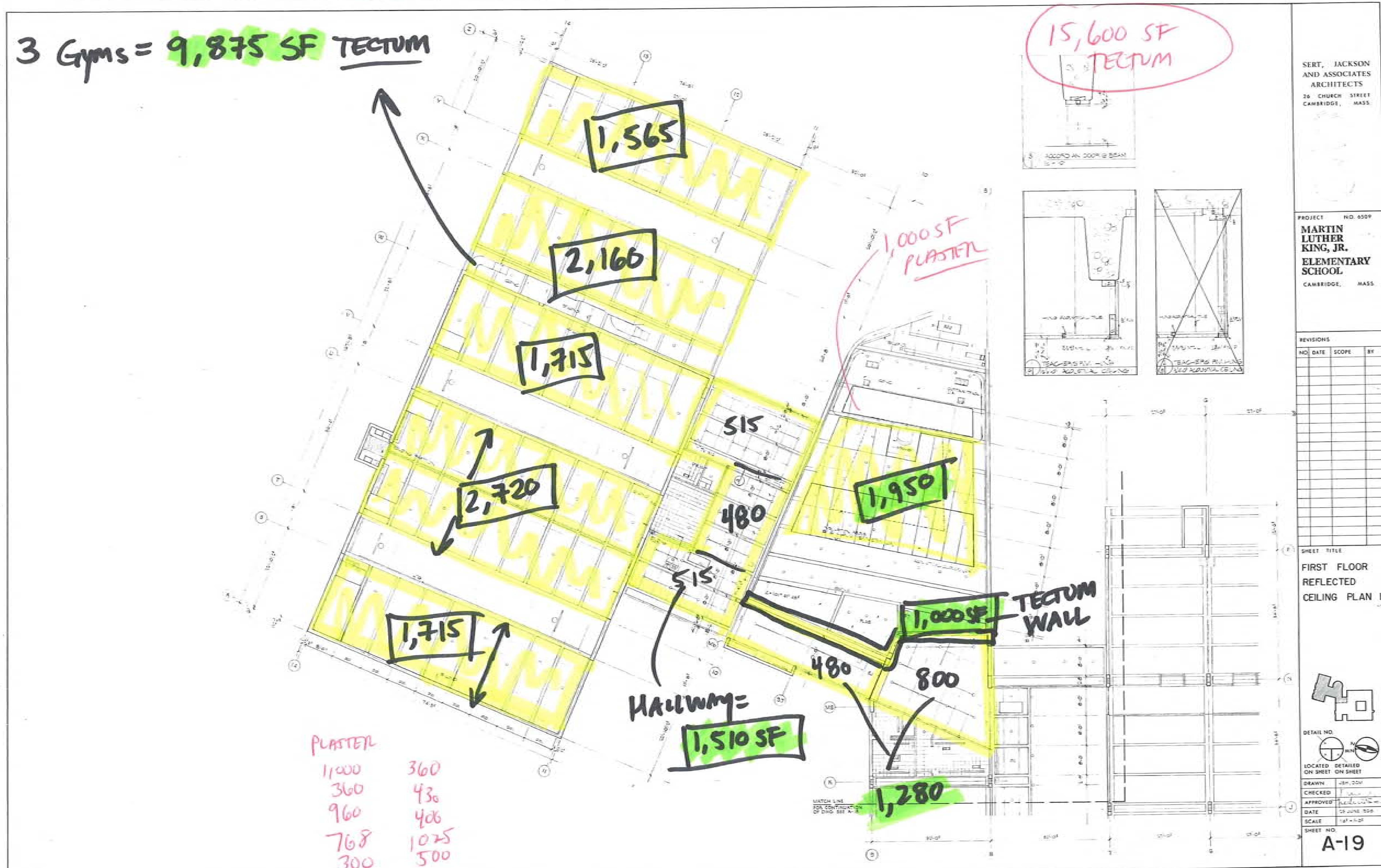
NO.	DATE	SCOPE	BY

SHEET TITLE

FIRST FLOOR REFLECTED CEILING PLAN A

DETAIL NO.
LOCATED ON SHEET DETAILED ON SHEET

DRAWN JBK, DCM
CHECKED
APPROVED
DATE 15 JUNE 1968
SCALE 1/8" = 1'-0"
SHEET NO.
A-18


3 Gyms = 9,875 SF TECTUM
15,600 SF TECTUM
1,565
2,160
1,715
2,720
1,715
515
480
515
1,950
1,000 SF PLASTER
1,000 SF
TECTUM WALL
480
800
HALLWAY = 1,510 SF
1,280
PLASTER
1,000
360
960
768
300
360
430
406
1025
500
SERT, JACKSON AND ASSOCIATES ARCHITECTS
26 CHURCH STREET CAMBRIDGE, MASS.
PROJECT NO. 6509
MARTIN LUTHER KING, JR. ELEMENTARY SCHOOL
CAMBRIDGE, MASS.
REVISIONS
NO DATE SCOPE BY
SHEET TITLE
FIRST FLOOR REFLECTED CEILING PLAN B
DETAIL NO.
LOCATED ON SHEET
DETAILED ON SHEET
DRAWN
CHECKED
APPROVED
DATE
SCALE
SHEET NO.
A-19

SERT, JACKSON AND ASSOCIATES ARCHITECTS
26 CHURCH STREET CAMBRIDGE, MASS.

PROJECT NO. 6509

MARTIN LUTHER KING, JR. ELEMENTARY SCHOOL
CAMBRIDGE, MASS.

REVISIONS

NO.	DATE	SCOPE	BY

SHEET TITLE

SECOND FLOOR REFLECTED CEILING PLAN

DETAIL NO.
LOCATED ON SHEET
DETAILED ON SHEET

DRAWN	JBH, DCM
CHECKED	
APPROVED	
DATE	25 JUNE 1968
SCALE	1/8"=1'-0"
SHEET NO.	A-20

SERT, JACKSON AND ASSOCIATES ARCHITECTS
26 CHURCH STREET
CAMBRIDGE, MASS.

PROJECT NO. 6509

MARTIN LUTHER KING, JR. ELEMENTARY SCHOOL

CAMBRIDGE, MASS.

REVISIONS

NO.	DATE	SCOPE	BY

SHEET TITLE

THIRD FLOOR REFLECTED CEILING PLAN A

DETAIL NO.

LOCATED ON SHEET / DETAILED ON SHEET

DRAWN: LSH, DCV

CHECKED

APPROVED

DATE: 25 JUNE 1968

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

SHEET NO.

A-21

FUSS & O'NEILL EnviroScience, LLC

Appendix F

Hazardous Materials Abatement Cost Estimate

Hazardous Materials Abatement Cost Estimate

A hazardous materials abatement cost estimate is provided below. Unit costs are based on current industry rates and are inclusive of all contractor costs. They do not include costs for design, monitoring, sampling, and other consultant fees.

Table 4
Estimated Cost for Hazardous Materials Abatement

MATERIAL	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
Cost Estimate for Asbestos Abatement			
Tectum Ceiling Panels	91,000 SF	$2/SF	$182,000
Black Mastic Associated with Tectum Ceiling Panels	91,000 SF	$5/SF	$455,000
Black and Brown Mottled 12x12 Vinyl Floor Tile	16,500 SF	$3/SF	$49,500
Black Mastic Associated with Black and Brown Mottled 12x12 Vinyl Floor Tile			
White with Grey Splotches 12x12 Vinyl Floor Tile	53,000 SF	$3/SF	$159,000
Black Mastic Associated with White with Grey Splotches 12x12 Vinyl Floor Tile			
Off-White & Brown Mottled 12x12 Floor Tile (Mixed Pattern)	2,150 SF	$3/SF	$6,450
Red with White Splotches 12x12 Floor Tile (Mixed Pattern)			
Yellow Mastic Associated with Mixed-Pattern 12x12 Floor Tile (Above)			

MATERIAL	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
Pink with Dark Pink & White Splotches 12x12 Floor Tile	2,150 SF	$3/SF	$6,450
Light Brown Mastic Associated with Pink with Dark Pink & White Splotches 12x12 Floor Tile			
Light Blue with Dark Blue & White Specks 12x12 Floor Tile (Mixed Pattern)	1,500 SF	$3/SF	$4,500
Dark Blue with Light Blue & White Specks 12x12 Floor Tile (Mixed Pattern)			
Mastic Associated with Mixed-Pattern 12x12 Floor Tile (Above)			
Grey Mottled 12x12 Floor Tile (Mixed Pattern)	2,600 SF	$3/SF	$7,800
Red Mottled 12x12 Floor Tile (Mixed Pattern)			
Mastic Associated with Mixed-Pattern 12x12 Floor Tile (Above)			
Blue with Dark Blue & White Splotches 12x12 Floor Tile (Mixed Pattern)	1,500 SF	$3/SF	$4,500
White with Blue & Purple Splotches 12x12 Floor Tile			
Black Mastic Associated with Mixed-Pattern 12x12 Floor Tile (Above)			
White with Red, Yellow, & Blue Splotches 12x12 Floor Tile	1,500 SF	$3/SF	$4,500
Mastic Associated with 12x12 Floor Tile (Above)			
Adhesive Associated with 6" Terracotta Tile (Assumed)	6,000 SF	$2/SF	$12,000

MATERIAL	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
Fire Doors with Friable Core	100 EA	$200/EA	$20,000
Boiler Breeching (Friable Mag TSI)	300 SF	$20/SF	$6,000
Flue Cement	25 SF	$10/SF	$250
Assume Friable Door Insulation Associated with (2) Cylinder Boilers (at Interior)	200 SF	$15/SF	$3,000
Friable Door Gaskets Associated with (2) Cylinder Boilers	100 LF	$10/LF	$1,000
Interior Boiler Gaskets & Packings (Concealed)	2 Cylinder Boilers	$3,500/EA	$7,000
TSI Wrap (over Foam Rubber) Associated with Suspended Hot Water Tanks	400 SF	$20/SF	$8,000
Mag TSI Muffler Associated with Emergency Generator	35 LF Visible (Allowance for 150 LF Concealed)	$20/LF	$3,700
Mag TSI Debris on Floor	125 SF (Clean Entire Room)	$20/SF	$2,500
Grey Door Caulking	20 LF	$10/LF	$200
Mudded Fittings Associated with Fiberglass Pipe Insulation	500 EA Note: observed only foam-rubber pipe insulation at representative pipe tunnel locations (from access hatches)	$50/EA	$25,000
Roof Drain Insulation and Mudded Fittings	40 EA	$75/EA	$3,000
Grey Duct-Seam Sealant	200 LF Allowance (assume at concealed locations)	$30/LF	$6,000
Red/Brown Duct-Seam Sealant	300 LF Allowance (assume at concealed locations)	$30/LF	$9,000

MATERIAL	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
Green and White Cloth Vibration Isolator Associated with Ductwork Throughout School (Assume 2 Types)	25 Each	$100/EA	$2,500
Assume Flooring Felt and/or Mastic underneath Wood Floor (Ground Floor Gymnasium)	4,025 SF	$5/SF	$20,125
Brown (Toe Base) Vinyl Baseboard & Mastic	275 LF	$3/LF	$825
Assume Flooring Felt/Mastic underneath Rubber Floor Mat (1st Floor Gymnasiums)	7,600 SF	$5/SF	$38,000
	Note: rubber floor mat may contain mercury; it is recommended that sample is collected for Total/TCLP Mercury for waste characterization	$15/SF	$114,000
Assume Mastic Associated with Fiberglass Duct Insulation (Vertical Duct at Ceiling)	50 LF	$30/LF	$1,500
4" Dark Brown Vinyl Baseboard	2,500 LF	$3/LF	$7,500
Dark Brown Mastic Associated with 4" Dark Brown Vinyl Baseboard			
4" Black Vinyl Baseboard	8,000 LF	$3/LF	$24,000
Brown Mastic Associated with 4" Black Vinyl Baseboard			
Tan Mastic Associated with 4" Black Vinyl Baseboard			
Newer (Shiny) 4" Black Vinyl Baseboard (at Partitioned Drywall Rooms)	600 LF	$3/LF	$1,800

MATERIAL	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
White Mastic Associated with Newer (Shiny) 4" Black Vinyl Baseboard			
Assume Felt/Mastic underneath Wood Stage (Auditorium)	1,200 SF	$5/SF	$6,000
Assume Mastic underneath Wood (Wall) Paneling (Auditorium)	2,500 SF	$5/SF	$12,500
Carpet Adhesive	2,500 SF	$2/SF	$5,000
Vinyl Threshold	250 LF	$3/LF	$750
Stage Lighting	100 LF (lighting rig/frame with cans)	$5/LF	$500
Stage Curtain	1 EA	$5,000/EA	$5,000
Black Sink Undercoat	50 EA	$150/EA	$7,500
Grey Sink Undercoat			
Adhesive Associated with Chalkboards/Tack Boards (Assumed)	5,000 SF	$5/SF	$25,000
Assumed Composite Countertops	1,000 SF	$10/SF	$10,000
Skim/Rough Coat Plaster Ceiling	6,500 SF	$7/SF	$45,500
1x1 Ceiling Tile	5,000 SF	$2/SF	$10,000
Brown Glue Daubs Associated with 1x1 Ceiling Tile	1,000 SF	$3/SF	$3,000
2x2 Fissured and Dotted Ceiling Tile	1,500 SF	$2/SF	$3,000
2x2 Mold-Resistant (White) Ceiling Tile	4,500 SF	$2/SF	$9,000
2x4 Fissured and Dotted Ceiling Tile	1,500 SF	$2/SF	$3,000
Drywall & Joint Compound (Associated with Drywall Partitioning Walls)	7,000 SF	$3/SF	$21,000
Brown Radiator Caulking	100 LF	$5/LF	$500

MATERIAL	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
Grey Louver Caulking	20 LF	$10/LF	$200
Penetration Sealant at Duct	10 LF	$10/LF	$100
Sticky Black Window-Glazing Compound (Interior)	Entire Window Bank Approx. 80’ x 15’ (1,200 SF)	$10,000/EA	$10,000
Sticky White Window-Glazing Compound (Exterior)			
Interior (Grey) Window Caulking	250 LF	$15/LF	$3,750
Exterior (Grey) Caulking at Sidewalk	500 LF	$10/LF	$5,000
Interior (White) Window Caulking at Awning-Type Window Inserts (at Window Curtain)	600 LF	$15/LF	$9,000
Interior (Black) Window Caulking	3 EA	$250/EA	$750
Possible Skim Coat on Beams	50,000 SF	$3/SF	$150,000
Exterior Window Caulking at Classroom/Hallway Windows (i.e. Window Curtains) (Assume 3 Types)	25,000 LF	$10/LF	$250,000
Window Caulking & Glazing Compound Associated with Clearstory Windows	200 EA	$250/EA	$50,000
Tan Exterior Door Caulking (Assume 3 Types)	1,000 LF	$10/LF	$10,000
Exterior Caulking at Unit Vents	1,500 LF	$10/LF	$15,000
Sticky White Window Glazing	12 EA	$250/EA	$3,000
Interior (Grey) Window Caulking	12 EA	$250/EA	$3,000
Interior Joint Caulking	15,000 LF	$10/LF	$150,000
Expansion Joint Caulking	31,000 LF	$10/LF	$310,000
Presumed Built-Up Roofing Material underneath Rubber-Membrane Roofs	All Roofing Fields	Not Included in Cost	

MATERIAL	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
Presumed (Concealed) Asphaltic Roofing Layers/Sealants (e.g. Coping Sealant, Lap-Seam Sealant, Penetration Sealants, etc.)	ALL Roofing Perimeters, Penetrations, and Raised Curbs/Parapets	Not Included in Cost	
Cost Estimate for PCB (Source Material) Abatement (Does NOT Include Cost for Substrate Removal)			
Tectum Ceiling Panels	91,000 SF	$3/SF	$273,000
Black Mastic Associated with Tectum Ceiling Panels	91,000 SF	$10/SF	$910,000
Grey Door Caulking	20 LF	$15/LF	$300
Grey Duct-Seam Sealant	200 LF Allowance (assume at concealed locations)	$30/LF	$6,000
Red/Brown Duct-Seam Sealant	300 LF Allowance (assume at concealed locations)	$30/LF	$9,000
Assume Mastic underneath Wood Floor	4,025 SF	$10/SF	$40,250
Assume Mastic underneath Rubber Floor Mat	7,600 SF Note: rubber floor mat may contain mercury; it is recommended that sample is collected for Total/TCLP Mercury for waste characterization	$10/SF	$76,000
Assume Mastic Associated with Fiberglass Duct Insulation (Vertical Duct at Ceiling)	50 LF	$15/LF	$750
Assume Mastic underneath Wood (Wall) Paneling	2,500 SF	$10/SF	$25,000
Adhesive Associated with Chalkboards/Tack Boards (Assumed)	5,000 SF	$10/SF	$50,000
Brown Glue Daubs Associated with 1x1 Ceiling Tile	1,000 SF	$10/SF	$10,000

MATERIAL	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
Grey Louver Caulking	20 LF	$15/LF	$300
Penetration Sealant at Duct	10 LF	$15/LF	$150
Sticky Black Window-Glazing Compound (Interior) & Sticky White Window-Glazing Compound (Exterior)	Entire Window Bank Approx. 80' x 15' (1,200 SF) 1,200 SF	$10,000/EA	$10,000
Interior (Grey) Window Caulking	250 LF	$20/LF	$5,000
Exterior (Grey) Caulking at Sidewalk	500 LF	$15/LF	$7,500
Interior (White) Window Caulking at Awning-Type Window Inserts (at Window Curtain)	600 LF	$20/LF	$12,000
Interior (Black) Window Caulking	3 EA	$200/EA	$600
Exterior Window Caulking at Classroom/Hallway Windows (i.e. Window Curtains) (Assume 3 Types)	25,000 LF	$15/LF	$375,000
Window Caulking & Glazing Compound Associated with Clearstory Windows	200 EA	$300/EA	$60,000
Tan Exterior Door Caulking (Assume 3 Types)	1,000 LF	$15/LF	$15,000
Exterior Caulking at Unit Vents	1,500 LF	$15/LF	$22,500
Sticky White Window Glazing	12 EA	$200/EA	$2,400
Interior (Grey) Window Caulking	12 EA	$200/EA	$2,400
Interior Joint Caulking	15,000 LF	$15/LF	$225,000
Expansion Joint Caulking	31,000 LF	$15/LF	$465,000
Presumed Built-Up Roofing Material underneath Rubber-Membrane Roofs	All Roofing Fields	Not Included in Cost	

MATERIAL	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
Presumed (Concealed) Asphaltic Roofing Layers/Sealants (e.g. Coping Sealant, Lap-Seam Sealant, Penetration Sealants, etc.)	ALL Roofing Perimeters, Penetrations, and Raised Curbs/Parapets	Not Included in Cost	
SUBTOTAL FOR ASBESTOS ABATEMENT		$2, 219,650	
SUBTOTAL FOR PCB (SOURCE MATERIAL) ABATEMENT*		$2,603,150	
SUBTOTAL FOR MERCURY FLOORING ABATEMENT		$114,000	
DISPOSAL OF FLUORESCENT BULBS & LIGHTING BALLASTS		$20,000	
DISPOSAL OF MERCURY-CONTAINING EQUIPMENT		$15,000	
COMBINED SUBTOTAL **ASBESTOS, PCB, & MERCURY ABATEMENT & DISPOSAL COSTS**		$4,971,800	
(~15%) CONTINGENCY		$745,770	
TOTAL		**$5,717,570**	

*Does not include removal of substrate materials as PCB-contaminated waste

5.0 DESIGN OPTIONS SYSTEMS RECOMMENDATIONS

a. Civil
b. Structural
c. MEP/FP
d. Food Services
e. Acoustical Goals
f. Audiovisual
g. Sustainability / Net Zero

Site / Civil Engineering

Nitsch Engineering has reviewed the three options being considered for this project, the Existing Modified Scheme, the Pi Scheme, and the Clover Scheme. For the most part, the utility systems and connection options for each scheme are very similar. The descriptions below will apply to each scheme with minor variations described where appropriate.

Water Systems:

Based on preliminary discussions with the Cambridge Water Department (CWD) all design schemes will require redundant feeds (two domestic water feeds and two fire service feeds). One set of feeds will connect to the existing 16-inch cast iron water main that runs in Putnam Avenue. As discussed in the existing conditions narrative there is an existing 4-inch cast iron domestic service and a 6-inch sprinkler and standpipe service that feeds the existing MLK School from Putnam Avenue. These services could be reused as part of this project if the plumbing engineer determines that they would provide adequate flows and pressures. Otherwise a new set of services would need to be connected to the Putnam Avenue main. If the existing connections are to be reused they should be protected in place during construction. If they are to be removed and replaced with new services the existing connections should be removed all the way to and cut out of the main in Putnam Avenue and replaced with a straight section of piping. The second set of feeds will connect to a new 8-inch loop between Hayes Street and Magee Street. This new 8-inch loop will be constructed as part of this project and will connect the 6-inch dead end line that currently terminates at the end of Hayes Street to the existing 6-inch water main in Magee Street.

The CWD will also require that the portion of the Magee Street water main that currently runs through the MLK School property (southwest corner) be relocated and replaced with a new 8-inch line outside of the property line and in the Magee Street right-of-way.

There is likely adequate fire protection volume and pressures in the existing 16” water line in Putnam Avenue. According to CWD, the static water pressure in the vicinity of the school is approximately 65 psi. However, a flow test will need to be performed to confirm that the existing water line will be sufficient for proposed fire and domestic water demands for the project.

There are multiple fire hydrants located on all of the streets surrounding the MLK School site that will remain.

Sanitary Sewer:
As stated in the existing conditions narrative, the MLK School is currently serviced by an 8” cast iron sanitary sewer line that connects to an 8” sanitary sewer main in Hayes Street. All design schemes should plan to continue to use the Hayes Street connection point. Other connection points may be available in Magee Street and Kinnaird Street but connecting to those lines would need to be discussed with the City of Cambridge DPW (CDPW).

All of the proposed schemes will provide food services within the building that will require the installation of a grease trap and associated piping and venting. The size of the grease trap will depend on the number of students meals served per day but will likely be approximately 5000-6000 gallons. The grease trap will likely be installed outside the building and will be connected into the proposed sanitary service to Hayes Street.

Site Grading/Drainage:
In all of the design schemes the proposed site grading should attempt to meet existing elevations of the surrounding streets as much as possible and create positive drainage away from the renovated/proposed building(s) to avoid sloping grades towards doorways and creating low spots close to the building structure(s). Proposed grading schemes should also not create situations where abutting properties would potentially receive more stormwater flow from the project site than they do under existing conditions.

There are three separate and distinct issues with regards to stormwater design that need to be addressed as part of the proposed project; Stormwater Quantity, Stormwater Quality, and Phosphorus Removal.

The City of Cambridge has a requirement that is used to control stormwater quantity leaving a proposed site. The City requires that stormwater runoff rates from the post development 25-year storm event be reduced to the pre-development 2-year storm event rate. The project will be required to mitigate flows as described above from any renovated portions of the existing building where the roof is modified and any modified areas of the project site. A new building option would require full mitigation from the entire site. Mitigation will require the project to construct a stormwater detention system to store and slowly release the stormwater runoff collected on the site. The proposed detention system would be located in the area of the existing turf field or in the open space/parking lot areas, proposed in all the design options, along Kinniard Street. Proposed detention systems would include perforated plastic pipe surrounded by crushed stone and geotextile fabric installed underground that would be used as volume to detain stormwater runoff from the site. Based on projects of similar size and site characteristics a system consisting of 300-350 linear feet of 48-inch perforated PVC pipe would be a good first approximation of system size that could be used for initial cost estimating purposes. Overflow from the underground system would be piped to the existing storm drain infrastructure in Kinnaird Street (referred to as the Flagg Street system by the City). The CDPW has requested that the stormwater design for this project attempt to have all flows tie into the Flagg Street system to remove the current stormwater flows from the combined sewer system in the area.

It should be assumed that all stormwater conveyance pipes will be 12” CPP pipe except the connection pipe to the Flagg Street system which would be RCP in lieu of CPP.

Stormwater quality will be addressed through the use of catch basins with deep sumps and hoods, green roofs, possible infiltration BMP’s, possible proprietary structural BMP’s (Stormceptor®) and an overall greening of the project site. The Massachusetts Stormwater Handbook requires that a volume of 1-inch multiplied by the impervious area on the site be treated by water quality BMP’s. The chosen BMP’s will be sized to treat the required volume of stormwater to meet these regulations.

Phosphorous removal will need to be addressed as part of the project. The EPA requires that an existing site, being redeveloped, be designed to remove 65% of phosphorus annually that would normally runoff the site and discharge into receiving waters. Phosphorus removal can be achieved through the use of infiltration BMP’s (underground pipe infiltration systems, rain gardens, etc…). Based on preliminary discussions with the CDPW and early geotechnical investigations high groundwater elevation and silt/clay heavy soils in this area may make infiltration BMP’s less viable on this site. More in-depth geotechnical analysis, perk testing, and infiltration testing will be required in the areas where infiltration BMP’s will be proposed to determine their feasibility for the project. Other methods of phosphorus removal would need to be explored if the infiltration BMP’s are not feasible such as:

- The use of proprietary phosphorus removal units such as a Jellyfish®.
- Rainwater Harvesting and Reuse: Collection of rainwater from all the roof areas, to be reused as make-up water for irrigation and/or toilet flushing would mitigate for stormwater quantity, quality, and phosphorus removal. Large capacity tanks and associated appurtenances (piping, pumps, etc…) would be required. Refer to Mechanical Narrative for more information.

- Injection Wells: The use of injection wells to return stormwater collected on-site back to the groundwater table would mitigate for stormwater quantity, quality, and phosphorus removal. Drilling injection wells, holding tanks and associated appurtenances (piping, pumps, etc…) would be required. Coordination with the geotechnical engineer would be required to determine if this solution is feasible for the project.

One other item of note is the long term dewatering for the project. Perimeter foundation drains and underslab drainage will be required around and under the lower levels of the building for all three design schemes. The City of Cambridge does not allow collected groundwater (from underslab drainage and/or perimeter drainage systems) to be discharged to its municipal storm water system. Therefore any groundwater that is collected in these type of systems will need to be discharged on site and not allowed to find its way to the municipal storm drains. Infiltration BMP's (if feasible) and/or rainwater harvesting and reuse are ways to accomplish this requirement.

Gas Service:

All three design schemes should plan for the gas service to come off of the existing 8" gas main located in Putnam Avenue. Other connection points may be available in Hayes Street and Kinnaird Street but connecting to those lines would need to be discussed with the gas company.

Green Roofs:

All three design schemes will include green roofs on the proposed building structures. A combination of extensive and intensive green roofs will be used. The extensive green roofs will be of the tray type green roof systems with minimal soil capacity. The more intensive green roofs will contain approximately 6 to 8-inches of planting materials. Refer to the attached sketches for locations of each green roof type being considered. The installation of the intensive type Green Roofs would also play a role in mitigating stormwater runoff quantity from the project site by providing some storage capacity within the soils of the green roofs. This storage capacity would likely offset the need for additional storage capacity elsewhere on site.

Design Options – Civil Engineering

Irrigation:

The intent of the project will be to choose drought resistant, native plant species on the majority of the site and green roofs that would require no irrigation. However, there may be portions of the site landscape such as street trees and/or portions of the intensive green roofs that would require some irrigation. This irrigation could be fed from an on-site rainwater collection tank if the rainwater reuse tanks are ultimately included in the project. All three design schemes should include an allowance for a standard irrigation system that would irrigate approximately:

- Existing Modified Option – 15,000 sf
- Pi Option – 18,000 sf
- Clover Option - 15,000 sf

Site Features:

The following is a list of proposed site features that should be noted for the purposes of cost estimating. The level of finish for the project shall be function over form and all materials chosen shall be durable and as maintenance free as possible. All three design schemes should include:

- Elementary Sized Basketball Court;
- Flag Pole;
- Architectural Precast Concrete Safety Bollards near pick up and drop off areas;
- Trash Receptacles around the site;
- Site Curbing shall be vertical granite curbing per City of Cambridge standards;
- Two (2) School Signs at Putnam Street Entrance;
- Miscellaneous Site Signage (handicap accessible signs, do not enter signs, traffic pattern signs, etc..);
- Playground equipment and surfacing for the Tot Lot at the preschool;
- Playground equipment and surfacing for the Lower School playground (existing playground equipment shall be retained for reuse, further coordination with the City shall be required);
- Site Furniture (benches);
- Porous Paving/Pavers in Plaza areas and Bituminous Pavements in Roadways/Parking Lots/Bus Drop Off Areas (all pavement and pavers shall be consistent with City of Cambride standards);

- Site Landscaping: The majority of the site will be grass and play areas for the students but there will be some areas of intensive plantings around the building and used as screening in the parking lot areas;
- Bicycle Racks (number of required bicycle racks shall be per City of Cambridge Standard); and
- Site fencing shall include chain link fencing (per City of Cambridge standards) around basketball court and ornamental screening fence at the property lines with direct abutters consistent with City of Cambridge zoning requirements (e.g. 6-foot high wooden plank fence).

Earthwork:

The Existing Modified option will require very little large scale cut/fill earthwork. The majority of the site will remain at the existing grades.

Both the Clover and Pi schemes will require earthwork to fill the area between Putnam Street and the new lower level of the proposed school buildings. The lower level of the school will be at the approximate grade of the existing lower levels of the current school building but will not extend all the way to Putnam Street as it currently does. The volume left open by the reduction in the lower level size in the new building schemes will need to be filled up the first floor elevation at Putnam Street. Based on preliminary floor plans and sketch models both options would require approximately 10,000 cubic yards of fill to bring this area up to the Putnam Street elevation.

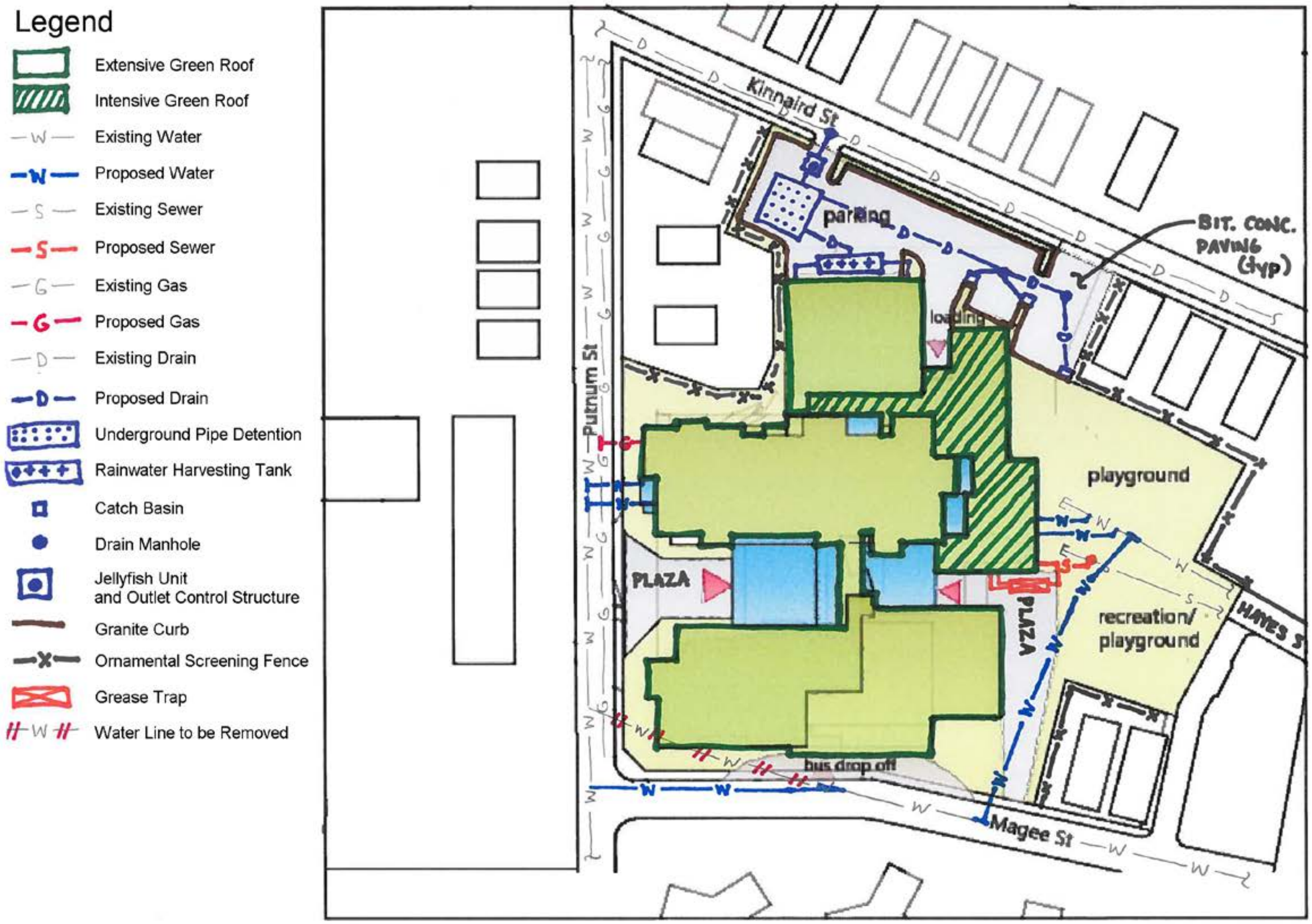
Site Circulation:

The three proposed schemes for the MLK School will maintain the existing circulation patterns within and around the project site. The proposed parking area will be maintained off of Kinnaird Street, with two entrances at their existing locations. The bus pick-up will continue to take place on Magee Street where an off-road dedicated bus lane will be provided adjacent to Magee. The bus drop-off will continue at the front entrance on Putnam Avenue, although it could take place on Magee Street using the new bus drop off area. Emergency Access will be provided from the parking area off of Kinnaird Street to Hayes Street in the rear of the school through the playground and recreation area. The Existing-Modified scheme provides a paved extension of the parking area so the emergency access is provided along the edge of the recreation/playground area. The Pi and Clover scenarios show the emergency access going through the middle of the recreation area. Loading will take place in the parking area off of Kinnaird Street under all proposed schemes.

Design Options – Civil Engineering: Existing Modified

Design Options – Civil Engineering: Pi

Design Options – Civil Engineering: Clover



STRUCTURAL REPORT

INTRODUCTION

Foley Buhl Roberts & Associates, Inc. (FBRA) is collaborating with *Perkins Eastman (PE)* in the study of design options for the Martin Luther King Jr. School in Cambridge, Massachusetts.

The purpose of this narrative is to summarize the basis of the structural design, describe the primary structural systems and provide structural quantities to be used in the preparation of the Conceptual Design cost estimate. Outline Structural Specifications have also been included. Proposed new construction and renovations will be designed and constructed under the provisions of the Massachusetts State Building Code (780 CMR – 8th Edition, based on the 2009 IBC) and the Massachusetts Existing Building Code (8th Edition, based on the 2009 IEBC). This Structural Narrative should be used in conjunction with the Conceptual Design Architectural documents and those of the other disciplines, as well as the FBRA *Existing Conditions Structural Report* of May 14, 2012.

DESIGN OPTIONS

Three design options have been studied:

The ***Existing Modified Option*** retains most of the existing Classroom Wing (Part A - South) and demolishes the existing Auditorium and Gymnasium Wing (Part B – North) to accommodate new construction. The new, four-level addition will be serviced by an east-west corridor and will include programmed common spaces such as the Large and Small Gymnasiums, the Kitchen/Cafeteria, the Auditorium and the Learning Commons, along with several classrooms and a Preschool. The total floor area is approximately 157,960 square feet.

The ***Clover Option*** is all new construction, requiring the full demolition of the existing building, except as noted below. Upper School, Lower School and the programmed common spaces are located around a central circulation area in this option. The new, four-level facility accommodates the sloping site, locating several of the larger common spaces (Large Gymnasium, Auditorium, Kitchen/Servery, etc.) at grade, along the (low) east side. Approximately 60 parking spaces will be provided below the building. Portions of the Basement and foundation construction in Part A of the existing building will be retained to reduce the extent of temporary lateral earth support along Putnam Avenue. The total floor area is approximately 157,425 square feet.

The ***Pi Option*** is all new construction, requiring the full demolition of the existing building, except as noted below. Upper School and Lower School spaces border a U-shaped corridor, with a centrally located Auditorium. The programmed common spaces are located along the east side of a linear, north-south corridor (Main Street) in this option. The new, four-level facility accommodates the sloping site, locating several of the larger common spaces (Large and Small Gymnasiums and Dining) at grade, along the (low) east side. Approximately 60 parking spaces will be provided below the building. Portions of the Basement, First Floor and foundation construction in Part A of the existing building will be retained to reduce the extent of temporary lateral earth support along Putnam Avenue. The total floor area is approximately 156,298 square feet.

New construction will be steel framed, for reasons of economy, performance, flexibility and speed of construction. Steel framing will be fire protected, as required to meet the requirements of Type 2A Construction. Foundations are expected to be conventional, shallow spread footing construction. Roof forms are typically flat (except for a portion of the roof in the Pi Option) and are pitched for drainage. The roof structure will be designed to accommodate a green roof system and photovoltaic (PV) panels. Exterior walls will be a combination of Aluminum Composite Panels (ACP), Trespa Panels and Terra Cotta Planks (all with a steel stud backup) and curtainwall. A Net Zero Energy facility is being pursued.

STRUCTURAL SYSTEMS – GENERAL DESCRIPTION

New construction will be steel framed, for reasons of economy, performance, flexibility and speed of construction. Typical floor construction will be a concrete slab on composite steel deck, supported by composite, structural steel beams and girders. Main roof areas will be framed with steel roof deck supported by structural steel beams and girders. A concrete slab on composite steel floor deck will be provided below rooftop equipment for acoustic purposes. Screens (visual and acoustic) surrounding the rooftop equipment will be structured with horizontal and vertical, galvanized HSS (tube) steel members, braced down to the main roof structure. Gymnasium roofs will be framed with acoustical steel deck, supported by structural steel purlins, which span to steel trusses. The Auditorium roof will be similarly structured, with standard, non-acoustical roof deck.

The new, steel framed construction will be classified as Type 2A (Noncombustible, Protected). Typical steel floor and roof members (beams, columns and bracing) and steel roof deck (except where the height exceeds 20 feet) require fire protection. Typical floor and roof steel framing will be surface prepped and be left unpainted, except exposed steel in the Gymnasium spaces, which will receive one shop coat of primer, compatible with the finish paint.

Typical columns will be wide flange sections or hollow steel tubes (HSS). Lateral stability for wind and seismic loads will be provided by steel bracing in each direction.

Foundations are expected to be conventional, shallow spread footing construction bearing on natural soils or compacted structural fill, per the February 3, 2012 *Preliminary Geotechnical Report and Environmental Evaluation,* prepared by CDM Smith. Lowest level floor construction will be a concrete slab on grade. Existing foundations will typically be removed and existing utilities will be removed and relocated to accommodate the new construction. Temporary lateral earth support and dewatering will be required during construction.

Exterior walls will be a combination of Aluminum Composite Panels (ACP), Trespa Panels and Terra Cotta Planks (all with a steel stud backup) and curtainwall.

The anticipated scope of structural work in the existing building for the Existing Modified Option is described later in this narrative.

BASIS OF STRUCTURAL DESIGN

Codes and Design Standards:

Building Code: Massachusetts Building Code – Eighth Edition (2009 IBC with Massachusetts Amendments)
Massachusetts Existing Building Code – Eighth Edition (2009 IEBC with Massachusetts Amendments)

Concrete: ACI 318 and ACI 301; listed standards, latest editions.

Structural Steel: AISC "Specification for Structural Steel Buildings" and AISC "Code of Standard Practice".

Steel Deck: Steel Deck Institute (SDI); listed standards, latest editions.

Design Loads/Parameters:

Live Loads:

Auditorium (Fixed Seating):	60 PSF
Classrooms (with partition allowance):	70 PSF
Corridors:	100 PSF
Flexible, Open Plan Areas (Including the Gymnasiums):	100 PSF
Stairs:	100 PSF
Mechanical Equipment Rooms:	150 PSF

Snow Loads:

Basic Ground Snow Load (Cambridge): 45 PSF (35 PSF Flat Roof Design Snow Load)

Wind Loads:

Basic Wind Speed (Cambridge): 105 MPH

Design Options - Structural

Seismic Parameters:

Short Period Spectral Response Acceleration(S_s):	0.28
1.0 Sec. Spectral Response Acceleration (S_1):	0.068
Seismic Occupancy Category	III
Seismic Design Category:	B
Site Class:	D
Structural System:	Building Frame System
Lateral Load Resisting System:	Concentrically Braced Frames (*Not Specifically Detailed for Seismic Resistance)*
Response Modification Factor (R):	3.0
System Overstrength Factor (Ω_0):	3.0
Deflection Amplification Factor (Cd):	3.0

Foundations:

The preliminary foundation design is based on an assumed allowable bearing capacity of 4.0 kips per square foot (2.0 TSF) on natural soils or compacted structural fill as recommended in the referenced, CDM Smith Preliminary Geotechnical Report.

Construction Classification:

New construction will be classified as Type 2A (Noncombustible, Protected), pending confirmation by the Design Team. Typical steel floor and roof members (beams, columns and bracing) and steel roof deck (except where the height exceeds 20 feet) require applied fire protection. All steel framed construction is considered to be *restrained.* In the Existing Modified Option, the fire resistance rating of the existing, reinforced concrete floor and roof structure meets the requirements of Type 2A construction.

Sustainable Design Considerations:

Sustainable design considerations will be incorporated into the building design; it is intended that the project will be designed to LEED Silver standards (minimum). Green roofs are proposed in nearly all areas.

STRUCTURAL SYSTEMS DESCRIPTION – NEW CONSTRUCTION (ALL OPTIONS)

A SUBSTRUCTURE

A10 Foundations (Refer to the Preliminary Geotechnical Engineering Report):

1. Groundwater was encountered 6.5 to 10 feet below the existing grade (in soil borings and an observation well), and is controlled by the Charles River (there is a gradient from the site, downwards to the river). Groundwater will be an issue during construction; temporary dewatering will be required. Perimeter and underslab drainage systems will be required at below grade areas.

2. New construction will be supported on a spread footing foundation, designed for an allowable bearing pressure of 2.0 TSF.

3. Lowest level floor construction will be a concrete slab on grade.

4. Structural fill will be required below all new footings, following the removal of unsuitable fills and soils. The existing soil materials can potentially be screened and used as ordinary fill (outside the building footprint) or perhaps in the lower zones below new slabs on grade, (reducing the amount of imported fill required).

5. The site is considered to be Site Class D, for seismic design. Liquefaction is not an issue.

6. Settlement (total and differential) in the soft clay layer will be an issue; particularly for the Existing Modified option, where new construction will interface with existing construction. This will need to be considered in design. If existing grades are raised significantly, excessive settlement could result.

7. It may be possible to crush demolished concrete elements on site and re-use in common fill (not structural fill), to avoid hauling it away. Noise may be an issue.

8. Temporary lateral earth support may be required during construction. The Geotechnical Engineer (CDM Smith) recommends a pre-construction survey along with vibration monitoring during construction.

9. Parking for approximately 60 cars will be provided below the building in the Clover and Pi Options. Portions of the Basement, First Floor and foundation construction in Part A of the existing building will be retained (the westernmost structural bay) to reduce the extent of temporary lateral earth support along Putnam Avenue.

A1010 Standard Foundations

- Typical perimeter frost wall: *16" thick, with an 8" wide masonry shelf (under study) with horizontal and vertical reinforcing each face (4.0+/- psf). The outside surface of perimeter foundation walls should receive a trowelled-on bituminous mastic.*

- Typical perimeter frost wall continuous footing: *2'- 6" wide, by 12" deep, with continuous reinforcing bars, plus dowels to the foundation wall (10.0+/- plf). The bottom of the footing will be placed 4'- 0" minimum below the exterior finish grade for frost protection.*

- Typical, average interior column footings: *12'- 0" x 12'- 0" x 2'- 8" deep, with 1700 pounds of reinforcing, based on a 900 square foot average structural bay. The bottom of the footing will be approximately 3'- 8" below the top of floor slab.*

- Typical, average perimeter column footings: *9'- 0" x 9'- 0" x 2'-2" deep, with 750 pounds of reinforcing, based on a 900 square foot average structural bay. The bottom of the footing will be approximately 5'-2" below the exterior finish grade.*

- Typical piers/pilasters at interior/perimeter columns: *24 inches square, reinforced concrete with 50 plf reinforcing.*

- Anchor Bolts: Anchor bolts at column base plates shall conform to ASTM F1554 – Grade 36 and shall be headed type, 18" long. Provide a minimum of four (4), ¾" diameter anchor bolts at all columns; additional bolts and/or larger diameter/longer bolts will be required at bracing locations.

A1020 Special Foundations

- Elevator pits: Elevator pit construction will consist of 12" thick, reinforced concrete walls and a 24" thick, reinforced concrete foundation mat, with an integral sump pit. Waterstops will be provided at all construction joints and all interior surfaces of the elevator pit will be waterproofed. Elevator shaft walls will be 100% solid grouted, reinforced CMU construction (8" thick).

- Foundations for the western end of the new building (Clover and Pi Options, adjacent to the below grade parking) may need special consideration, due to the adjacency of Putnam Avenue and the presumption that the existing soils in this zone consist of uncontrolled fill and are not suitable for bearing. Mini– piles or rammed aggregate piers may be required, to avoid the need to remove the existing fill and replace with compacted structural fill (temporary lateral earth support would be required). Alternately, the floors of the building may cantilever, to minimize/eliminate the need for foundations in this zone.

A1030 Slabs On Grade

Lowest Level Floor Construction will typically be a 5" thick concrete slab on grade, reinforced with welded wire fabric. The slab will be underlain by a vapor barrier, rigid insulation and 6" of compacted gravel fill. Saw cut control joints (1.25" deep) will be provided in each direction at each column line. Full depth isolation joints will be constructed around columns. Mechanical Room floors will be similar construction, with a 6" thick concrete slab on grade. Perimeter and underslab drainage will be provided at the lowest level, as previously noted.

- Welded wire fabric for slabs on grade: *6x6-W2.9xW2.9.*
- Slab On Grade Thermal Insulation: *R=5 extruded polystyrene foamed plastic board.*
- Slab On Grade Vapor Retarder: *ASTM E1745 Standard for Specification for Water Vapor Retarders Used In Contact With Soil or Granular Fill Under Concrete Slabs; Class A.*

A20 Below Grade Construction (Clover and PI Options)

A2020 Foundation Walls

- Cantilever retaining walls (along the western edge of the lowest level for the Clover and Pi options): *14" thick, with horizontal and vertical reinforcing each face (8.0 +/- psf).* Cantilever retaining walls are provided to facilitate backfilling below the level above (to the west) and to resist lateral earth pressures to reduce lateral loads imparted to the lateral force resisting system (bracing). As noted earlier, portions of the Basement, First Floor and foundation construction in Part A of the existing building will be retained to reduce the extent of temporary lateral earth support along Putnam Avenue.
- Cantilever retaining wall continuous footing: *7'- 6" wide, by 1'-6" deep, with 8.0 psf reinforcing. The bottom of the footing will be 2'-6" below the top of floor slab.*
- Foundation Wall Dampproofing: *ASTM D1227 Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; Type II , Class I, non-asbestos fibers.*

B SHELL

B10 Superstructure

Structural Bays/Spans: Typical structural bay size/configuration has not yet been determined; however, it is anticipated that rectangular structural bays will average approximately 900 square feet in area. Long span construction over the (Large and Small) Gymnasium and Auditorium spaces varies.

Story Heights: The preliminary story height for the upper levels has been established at 14'-0".

Steel Framing Connections: Type 2 simple framing connections (shear only); double clip angles typically.

Columns: Typical columns will be wide flange steel sections or steel tubes (HSS).

Lateral Force Resisting System: Lateral (wind and seismic) forces will be resisted by steel bracing, for reasons of economy, stiffness, reduced structural depth and smaller column sizes. Bracing members will be square or rectangular HSS sections. Brace configurations may include chevrons, inverted chevrons ("V"), or single diagonals in short bays, as required by structural and architectural considerations.

Expansion (Seismic) Joints: New construction in the Existing Modified Option will be separated from the existing, remaining construction (Part A – South Wing) by an expansion/seismic joint. Due to the relatively compact massing of the Clover and Pi Options, it does not appear that expansion/seismic joints will be required.

Fire Protection: As previously noted, new construction is classified at Type 2A Construction (Noncombustible, Protected). Typical steel floor and roof members (beams, columns and bracing) and steel roof deck (except where the height exceeds 20 feet) require fire protection. All steel framed construction is considered to be *restrained.*

B1010 Floor Construction

Second Floor and Third Floor Construction consists of a 4" (minimum) thick, normal weight concrete topping slab with welded wire fabric, on 2" deep, 18 gauge galvanized steel composite steel floor deck (6" minimum total slab thickness), supported by composite steel beams and girders. Slabs on steel deck will be placed at the required elevation, adding concrete to compensate for the deflection of the (unshored) steel framing (approximately ¾" average, additional concrete in each structural bay). Composite action between the steel beams/girders and the concrete slab on steel deck will be achieved by field welding ¾" diameter, 4½" long headed shear connectors to the top flanges. Vibration and sound transmission are special concerns for the Small Gymnasium floor construction in the Existing Modified Option; accordingly, this floor will be increased in stiffness. The floor in this Gymnasium may need to be depressed, to accommodate an acoustical, "floating" floor system.

- Welded wire fabric for slabs on composite steel deck: *6x6-W2.9xW2.9.*

- The estimated total weight of structural steel for the structured floor levels of the new construction (including beams, columns, bracing, plates, angles, miscellaneous frames, connections, etc., but excluding entry canopies, loose lintels, etc.) is as follows:

  Estimated Weight of Structural Steel: 13.5 PSF - Clover and Pi Options

  Estimated Weight of Structural Steel: 15.0 PSF – Existing Modified Option

B1020 Roof Construction

Typical Roof Construction consists of a 3" deep, 18 gauge, Type DR, galvanized steel roof deck, supported by wide flange steel beams and girders. As noise and vibration will be a concern where roof top mechanical equipment is located, these sections of the roof will be framed with a 4" (minimum) deep, regular weight concrete topping slab on a 2" deep, 18 gauge, composite type galvanized steel floor deck (6" minimum total slab thickness), supported by composite, wide flange steel beams and girders. Composite action between the steel beams/girders and the concrete slab on steel deck will be achieved by field welding ¾" diameter, 4½" long headed shear connectors to the top flanges. Roof drainage will be achieved by pitching the steel framing to low points at selected interior columns, wherever practical.

Gymnasium and Auditorium Roof Construction consists of a 3" deep, 18/20 gauge, galvanized, cellular acoustic deck, spanning to structural steel beams. Steel beams span to steel trusses (with a sloped top chord). Trusses clear span the Gymnasium floor below and are supported by 12" square, HSS steel columns. Steel framing for the Gymnasium roof will be Architecturally Exposed Structural Steel (A.E.S.S.). The Auditorium roof will be similarly structured (but not A.E.S.S.), with standard, non-acoustical roof deck.

- Welded wire fabric for slabs on composite steel deck: *6x6-W2.9xW2.9.*

- The estimated total weight of structural steel for the various roof areas of the new building (including beams, columns, trusses, bracing, plates, angles, miscellaneous frames, connections, etc., but excluding equipment screens, loose lintels, etc.) is as follows:

  Estimated Weight of Structural Steel: 13.5 PSF – Clover and Pi Options

  Estimated Weight of Structural Steel: 15.0 PSF – Existing Modified Option

B20 Exterior Enclosure

B2010 Exterior Walls

Exterior walls will be a combination of Aluminum Composite Panels (ACP), Trespa Panels and Terra Cotta Planks (all with a steel stud backup) and curtainwall. A masonry veneer “base” (also with a steel stud backup) may be provided. Exterior wall materials and details continue to be studied by the Project Team. In areas where a steel stud backup wall system is utilized, framing should be 16 gauge minimum studs, designed for an H/600 deflection limitation at masonry veneer or terra cotta plank conditions or H/360 elsewhere, as applicable. Vertical slip joints will be provided in the metal stud backup system at each level. Ties to the brick veneer (as applicable) will be installed at 16” o.c. horizontally and vertically. The estimated structural steel weights noted previously do not include allowances for horizontal girts, relieving angles, hangers, bracing, etc., as may be required to support and brace the exterior wall system. The Conceptual Design cost estimate should carry an allowance for these elements.

RENOVATION – ANTICIPATED SCOPE OF STRUCTURAL WORK (EXISTING MODIFIED OPTION)

The Existing Modified option retains most of the existing Classroom Wing (Part A - South) and demolishes the existing Auditorium and Gymnasium Wing (Part B – North) to accommodate new construction.

A full renovation option (retaining the existing North Wing (Part B) as well) was reviewed by the Design Team. Typical roof construction in Part B consists of reinforced concrete slabs and beams (conventional and post-tensioned), supported by masonry bearing walls. The masonry bearing walls also provide lateral force resistance (wind and seismic loads). Concrete roof slabs and beams do not appear to be anchored to the supporting walls. The existing masonry wall construction does not meet current code requirements (they are unreinforced) and are inadequate by today’s standards as bearing walls and as lateral force resisting elements. The slenderness ratios (height : thickness) do not meet current code requirements as well. The unreinforced masonry bearing walls in Part B would need to be supplemented/reinforced in all locations to meet the requirements of the Massachusetts Existing Building Code. Insulation would need to be provided as well. The impact on cost, function and aesthetics would be significant. The expansion joint is improperly constructed and sized; modifications would be required. In light of other, additional Architectural and MEP/Energy issues/constraints associated with this wing, design options which retained this construction were deemed undesirable to pursue.

Comments relating to new construction in the Existing Modified option are included in the preceding section. Comments relating to the removal of Part B and the renovation of Part A in this option are summarized below.

As the existing building is cast-in-place reinforced concrete, demolition of all or part of the building will require a careful effort. Comments relating to the potential demolition are noted below:

- Particular care will need to be taken in the demolition of the Part B roof, as there are post-tensioned beams in the long-span roof construction (the post-tensioning strands may be unbonded) and the perimeter walls of the Auditorium, Gym and Exercise Room spaces are unstable, once the roof structure is removed.

- Floor and roof construction in Part A is almost entirely supported by beams and columns; there are minimal, interior and exterior concrete bearing walls (e.g. Stair Nos. 1 and 2 are supported in part by concrete bearing walls).

- The rooftop light monitors in Part A are structural, and will not be removed/modified.

- Parapets in Part A are structural in some cases and will not be removed/modified.

- New openings in Part A floor or roof slabs should be orientated/configured so the short dimension of the opening is parallel to the beams, if possible. Otherwise, supplemental steel framing (below the slab) will be required between joists/beams. The Conceptual Design cost estimate should carry an allowance for supplemental steel framing at openings.

- Modifications which require cutting the concrete joists should be avoided, if possible. Otherwise, joists will be need to be headed off, or the affected area will need to be removed and restructured.

- Interior masonry block walls are typically non-structural and can be removed (an exception is at south side of Stair No. 3 in Part A).

- The one-story high, reinforced concrete Mechanical Room projections on the east and west sides of Part A are structural (hung from the level above), but could be removed, if desired.

- The structured, exterior ramp to the First Floor of Part A on the east side of the building rests on bearing pads, and can be removed, to accommodate the new layout.

The Part A renovation in the Existing Modified option will include the removal of all interior and exterior walls. All finishes and services will be removed as well, leaving only the basic concrete frame and foundations. With respect to the Massachusetts Existing Building Code/2009 IEBC, this project will be classified as a Level 3 Alteration (Chapter 8), with no change in use. As no lateral force resisting elements are being removed and no significant, additional mass is anticipated (the total mass may actually be reduced) the demand-capacity ratio of the lateral force resisting system will remain the same or possibly decrease. Per Section 807.4.3.1 of the 2009 IEBC, as a substantial structural alteration is not proposed (less than 30% of the floor and roof construction will be altered), the existing building need only comply with the loads acceptable at the time of the original construction (the design preceded the introduction of seismic codes in Massachusetts). However, FBRA recommends that the renovated existing structure be at least capable of withstanding full wind loading and 50% of the seismic loads required by the code for new construction. The existing concrete frame may be capable of withstanding loads of this magnitude without supplementing the lateral force resisting system (e.g. new reinforced concrete or masonry or shear walls); however, that determination is beyond the scope of this Feasibility Study. Such voluntary improvements would be designed in accordance with Section 707.6 of the 2009 IEBC.

Design Options - Structural

With regard to gravity loads, no change in use is proposed; accordingly, the existing floor construction is capable of supporting the required live loads. Roof construction was designed for a 30 PSF basic snow load (35 psf required by the current code), as well as drifting snow. The addition of a green roof system and/or photovoltaic (PV) panels could be an issue – further review/discussion is necessary.

As noted in the FBRA *Existing Conditions Structural Report,* the condition of the Part A structure and foundations is generally satisfactory; there are no significant structural issues that need to be addressed. Repairs to the structural frame are anticipated to be of a minor nature.

OUTLINE STRUCTURAL SPECIFICATIONS

Concrete:

- All concrete shall be normal weight, 4,000 psi at 28 days, except foundation walls and footings, which shall be normal weight, 3,000 psi and exterior (exposed) concrete (paving) which shall be normal weight, 4,500 psi.

- Portland Cement: ASTM C150, Type I or II.

- Fly Ash: ASTM C618, Class F. Replacement of cement content with fly ash is limited to 20% (by weight). Fly ash is not permitted in exterior, exposed concrete, or in concrete for slabs on grade and slabs on composite steel deck.

- All concrete shall be proportioned with 3/4” maximum aggregate, ASTM C 33, except 3/8” maximum aggregate shall be used at toppings less than 2” thick (e.g. metal pan stairs).

- All reinforcing shall be ASTM A 615 deformed bars, Grade 60.

- All welded wire fabric shall conform to ASTM A 185.

- Reinforcing bars, steel wire, welded wire fabric, and miscellaneous steel accessories shall contain a minimum of 25% (combined) post-industrial/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with Submittal Requirements.

- Concrete products manufactured within 500 miles (by air) of the project site shall be documented in accordance with Submittal Requirements.

- Cure all concrete by moisture retention methods, approved by Architect; curing compounds shall not be used.

Reinforced Concrete Masonry (Elevator Shaft):

- Masonry construction (elevator shaft) shall conform to ACI 530/ASCE 5/TMS 402 “Building Code Requirements for Masonry Structures”, latest edition.

- Masonry strength, f’m shall not be less than 1350 psi.

- Requirements for load bearing block strength shall be as required for specified masonry strength (f’m) but shall not be less than 2000 psi on the net area of the block.

- Grout shall conform to ASTM C476, Type Fine, and shall be of strength required for specified masonry strength (F’m) but not less than 3000 psi.

- Mortar for reinforced masonry shall conform to ASTM C 270 Type S and shall be of strength required for specified masonry strength (f’m) but not less than 1800 psi.

- Reinforcing bars shall conform to ASTM A 615 Grade 60 deformed bars. Lap all continuous bars 48 diameters.

- Joint reinforcing shall be 9 gauge ladder type conforming to ASTM A 82. Provide prefabricated corners and tees. Walls shall be reinforced horizontally with joint reinforcing at 16 inches on centers unless otherwise noted.

- Reinforcing bar, steel wire, welded wire fabric, and miscellaneous steel accessories shall contain a minimum of 25% (combined) post-industrial/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with Submittal Requirements.

- Masonry products manufactured within 500 miles (by air) of the project site shall be documented in accordance with Submittal Requirements.

- Elevator shaft walls shall be 100% solid grouted (all cores).

Structural Steel:

- Structural steel shapes shall conform to ASTM A 992, Fy = 50 ksi.

- Steel tubes (HSS) shall conform to ASTM A 500, Grade B, Fy=46 ksi.

- Structural steel plates and bars shall conform to ASTM A 36, Fy = 36 ksi.

- Steel members shall contain a minimum of 25% (combined) post-industrial/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the Submittal Requirements.

- Steel manufactured within 500 miles (by air) of the project site shall be documented in accordance with the Submittal Requirements.

- Anchor Bolts: Anchor bolts at column base plates shall conform to ASTM F1554 – Grade 36 and shall be headed type. Provide a minimum of four (4), ¾" diameter anchor bolts at all columns; additional bolts and/or larger diameter/longer bolts will be required at bracing locations.

- Bolted connections shall be ASTM A 325, Type N (bearing) bolts, except slip-critical bolts shall be used at lateral brace beam connections.

- Shop and field welding shall be AWS D1.1 E70XX electrodes.

- Shear connectors shall be ¾" diameter, 4½" long, headed Nelson studs conforming to ASTM A 108.

- Surface treatment for typical structural steel: SSPC Surface Preparation No. 3 (Power Tool Cleaning). Structural steel shall be left unpainted. .

- Structural steel for the Gymnasium roofs shall be Architecturally Exposed Structural Steel (A.E.S.S.) and shall meet the requirements of Section 10 of the AISC manual.

- Surface treatment for Architecturally Exposed Structural Steel: SSPC Surface Preparation No. 6 (Commercial Blast Cleaning). Exposed structural steel shall be primed with a premium architectural primer, compatible with the finish paint.

- All exterior, exposed structural steel shall be hot-dip galvanized (e.g. brick relieving angles (as applicable) and steel rooftop equipment supports).

Steel Deck:

- Typical steel roof deck shall be 3" deep, 18 gauge, Type DR, conforming to ASTM A 653, Grade 33 (minimum), galvanized in accordance with ASTM A 653, coating class G-60. Exposed steel roof deck in the Gymnasiums shall be 3" deep (18/20 gauge) cellular acoustic deck and shall have a factory applied primer on the exposed bottom surface.

- Steel floor deck shall be 2" deep, 18 gauge, composite type, conforming to ASTM A 653, Grade 33, galvanized in accordance with ASTM A 653, coating class G-60.

- All steel floor deck and roof deck accessories (pour stops, finish strips, closures, etc.) shall be the same finish as the deck; 18 gauge minimum.

- Steel deck shall contain a minimum of 25% (combined) post-industrial/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the Submittal Requirements.

- Steel deck manufactured within 500 miles (by air) of the project site shall be documented in accordance with the Submittal Requirements.

- Provide 14 gauge sump pans at all roof drains.

New Work

The following HAVC, Electrical, Plumbing and Fire Protection system descriptions are to provide basic concepts for the systems that will be installed in the Martin Luther King, Jr School. The system descriptions acknowledge the intent of the City of Cambridge, MA to build a Net Zero Energy Building. The systems will be also be designed to support the goal of achieving a minimum level of Silver certification under the LEED for Schools green building rating system.

The systems described in the narrative represent the mechanical, electrical, plumbing and fire protection systems that will be installed in the building under any of the proposed architectural schemes (Existing Modified, Pi and Clover schemes). Specific construction issues or concepts in each scheme that affect the MEP/FP systems are identified in the narratives.

The Mechanical and Electrical systems are to be planned based on the following guidelines:

- Minimizes energy consumption.
- Logical pathways for utilities that won't disrupt school life and programs as changes are made or upgrades occur.
- Flexibility to accommodate both known program elements and those yet to be identified.
- Standardization of building design guidelines so the building has an established energy budget.

In general, the building is anticipated to contain 149,747 square feet of space and will include Classrooms, Science Rooms, Student Support Services, Kitchen and Dining services, Gymnasium, Auditorium and Performing Arts Center.

HVAC

General Overview of HVAC Systems

As a result of the City of Cambridge's goal to achieve Net Zero Energy (NZE) operation, the HVAC systems will be designed with the primary goal of reducing energy, while still maintaining optimal space conditions and thermal comfort for an effective learning environment. Achieving net zero energy is not just about one year of operation, rather, the high performance built into the building needs to be retained so that the building continues to achieve net zero energy over time. Systems need to be reliable and maintainable and should provide long life in order to help insure the persistence of high performance. The systems we are proposing have been selected based on an analysis of several options for high performance HVAC systems that would meet the required energy performance target, achieve the required learning environment and minimize operating complexity and maintenance.

HVAC Systems Analysis

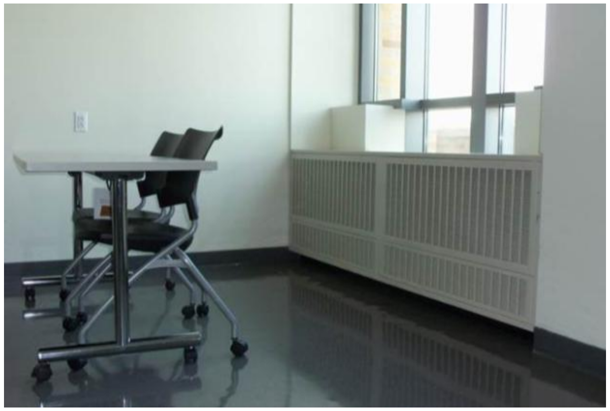
Three different HVAC system alternates were analyzed in a qualitative analysis. Systems were compared based on their ability to provide a quality indoor environment that would enhance the learning objectives of the school, the relative energy use and cost of the systems, the ease of maintenance and operations for the systems and the impact of integrating the systems into the building.

Design Options - MEP/FP

NZE buildings typically operate at annual energy intensities well below the energy code and standards such as ASHRAE 90.1. NZE buildings typically have annual energy use that is 50% to 70% below a building built to ASHRAE 90.1. This level of building energy performance requires high performance HVAC systems. One common system type to most NZE schools that have been built to date is an HVAC system utilizing geothermal heat pumps.

The three systems that were compared all utilized geothermal heat pumps in various configurations to provide heating and cooling to the school. The systems were selected based on performance parameters such as transport energy – the amount of energy required to move heating and cooling around the school, indoor environmental quality including thermal comfort, air quality and acoustics, maintenance and operations. All three systems analyzed utilized dedicated outside air systems to ensure quality ventilation of the building, good humidity and dehumidification control and the ability to provide ventilation to meet the actual demand rather than provide a constant amount of ventilation regardless of actual space occupancy. In general, large, assembly type spaces such as the auditorium, gymnasiums and cafeteria will be served by variable air volume (VAV) type air handling systems that receive chilled water and hot water from centrally located water-to-water geothermal heat pumps. The main variation in systems is in how spaces such as classrooms are treated. The three HVAC system alternates for classrooms that were analyzed are as follows:

- ***Water-to-air geothermal heat pumps with dedicated outside air system***. - Heat pumps would be located in utility closets with access from the corridor. Each classroom would have a dedicated heat pump. Conditioned outside air would be ducted to each heat pump as required for the ventilation needs of the space served.
- W***ater-to-water geothermal heat pumps with induction / displacement units and dedicated outside air system*** – Induction / displacement units would be located along the perimeter of each classroom and conditioned outside air (primary air) would be ducted to each unit. The units would have heating and cooling coils supplied by the water-to-water heat pumps.
- ***Water-to-water geothermal heat pumps with radiant panel heating and cooling and dedicated outside air system*** – Ceiling mounted radiant panels would be provided to provide room sensible heating and cooling. Conditioned outside air would be delivered to each room via displacement (low velocity air delivered at or near the floor and at temperatures just below room temperature).



Perimeter Induction / Displacement Unit

The systems were compared and ranked in a qualitative analysis with individual categories weighted based on their overall importance. The un-weighted and weighted comparison matrices are at the end of this section. The systems judged to be most appropriate for the MLK School based on our analysis is the perimeter induction / displacement system.

Proposed HVAC System

Based on our analysis of HVAC system options, we propose the following:

- Hybrid system of ground source water-to-water heat pumps for chilled water and hot water generation with supplemental gas fired condensing type boilers
- Perimeter Induction / Displacement air distribution in classroom areas
- Utilization of efficient total energy heat recovery for Dedicated Outside Air (DOAS) ventilation systems
- Variable Air volume systems for the Public Assembly Areas (Gymnasiums, Auditorium and Cafeteria)
- Demand Control Ventilation for classrooms, assembly areas and kitchen ventilation

For the Non-Assembly area HVAC systems, a perimeter induction / displacement system will be used to condition the space. These systems utilize conditioned 100% outside air required for ventilation to induce room air across heating & cooling coils to provide additional space conditioning without the need for a fan. The units are very quiet, do not require filters and generally operate without condensation on the coil. These systems utilize a displacement cooling approach which limits the heat gain seen in the occupied areas, therefore reducing cooling loads and energy use. Because the perimeter induction displacement units can be designed to occasionally operate with “wet coils” there is a reduced concern over humidity levels and condensation on the coils within the space as compared to other terminal cooling approaches such as chilled beam systems or radiant cooling panels. There are several benefits to the ability to use “wet-coils” in the space, including, the ability to limit supply air to ventilation requirements alone, no need to over cool the supply air to provide dehumidification and the ability to pursue natural ventilation when appropriate. The induction /displacement units can provide heating without a supply of primary air so off-hour heating can be accomplished without the need to operate centralized fan systems.

Programmatic Areas

a. Non-assembly spaces

The general layout of the non-assembly areas will be as follows. All Classrooms, Offices and Non-Assembly areas will be conditioned by perimeter induction/displacement units.

Ground source water-to-water heat pumps with vertical, closed loop geo-exchange wells will provide both chilled water and hot water, as a four pipe system to the perimeter induction/displacement units.

Dedicated rooftop Direct Outdoor Air Systems (DOAS) will supply conditioned or tempered air to the perimeter induction/displacement units at 66°F DB / 43 Dewpoint. The DOAS units will be equipped with supply and return fans, economizer dampers, a chilled water / hot water coil (seasonal changeover) as well as total energy recovery wheel. The units will also be sized to minimize face velocity and thus pressure drop across filters, coils and heat exchanger sections. The minimal face velocity and lower static pressures will help reduce fan power.

Supply airflow and capacity will be sized to meet the minimum ventilation requirements of the spaces served. The minimum outdoor air ventilation requirements for each non assembly area shall be based on the maximum of the International Mechanical Code Section 403.3 ventilation requirements, based on code occupancy densities, or 30% over the outdoor air requirement of ASHRAE 62.1-2007 Ventilation for Acceptable Indoor Air Quality, whichever is greater.

During heating season, the rooftop DOAS units will supply tempered ventilation air through the perimeter induction units, further space heating will be provided by running hot water through the perimeter induction unit hot water coils to add additional space heating as necessary. The perimeter units will satisfy the envelope / skin heating load of the space.

The DOAS will be able to modulate the ventilation air supply volume dependent on space occupancy, as determined by the CO2 sensor system. When classroom or office areas are unoccupied, but the DOAS system is in use, a variable volume terminal box within the distribution ductwork will throttle down the quantity of ventilation air to the space. During occupied hours, the minimum quantity of ventilation air supplied will be based on the ASHRAE 62 required cfm per square foot for classroom spaces. The actual air supplied to the space will be dependent on the air required to maintain the space temperature setpoint. This is expected to significantly reduce energy usage during hours that the building is only partially occupied, such as night and summer usage.

The proposed controls scheme for the classroom ventilation air supply will maintain setpoint within the space during all regularly occupied building hours. During time periods when students are out of the classroom, during the normally occupied school day, the ventilation supply air to the space will throttle up or down as required to maintain space temperature and CO2 setpoint.

b. Public Corridors

All public corridor areas will also be conditioned by displacement induction units, providing supplemental cooling and heating to the space or displacement air alone, depending on the corridors orientation and exterior wall area. These systems receive chilled and hot water from the water to water heat pump systems similar to the classrooms and ventilation air will be provided from the DOAS units that also serve the classrooms.

c. Public Assembly areas

Gymnasiums, Auditorium and Cafeteria will be served by variable volume rooftop units, providing heating and air conditioning for the assembly areas. These units will be equipped with supply and return fans, economizer dampers, a chilled water / hot water coil (seasonal changeover) as well as total energy recovery wheel. The units will also be sized to minimize face velocity and thus pressure drop across filters, coils and heat exchanger sections. The minimal face velocity and lower static pressures will help reduce fan power.

Each gymnasium will have a dedicated unit, which will also serve Locker rooms and stage area. The Locker rooms are to be negatively pressurized and all air removed from the lockers will be exhausted (not re-circulated). Code mandated outside ventilation requirements apply.

The Cafeteria and Auditorium will also have dedicated rooftop units with a similar arrangement to the Gymnasium Units.

The rooftop units serving the Gymnasium, Auditorium and Cafeteria will be variable air volume and will modulate the supply air flow based on the space load in order to provide proper thermal comfort in the space. In order to reduce energy use as much as possible, but also address potential air velocity and distribution issues within these large volume spaces, the systems will damper off ductwork sections or supply diffusers when the supply air goes below a certain flow thus maintaining appropriate velocity for an overhead distribution system under low-flow operation.

All rooftop units serving the Public Assembly areas shall have nominally 55°F air discharge (out of air conditioning unit and into the supply duct) in the cooling mode, and shall be equipped with un-housed airfoil plug type supply and return fans. All rooftop units will be equipped with MERV 13 filters, air flow stations and humidity control (to be compliant with ASHRAE-55).

All units shall have insulated double walls. Rooftop units will be provided with pre-filters with a minimum efficiency reporting value (MERV) of 7, and final filters having minimum efficiency reporting value (MERV) of 13.

Carbon dioxide occupancy sensors will be located in each assembly space to reduce the outside air intake when the spaces are not occupied. The minimum outside air intake ventilation rate that the carbon dioxide sensors can throttle the outside air intake rate down to is the space specific cfm per square foot requirements as defined in ASHRAE 62.1-2007.

The fresh air capacity will be the maximum of the International Mechanical Code Section 403.3 ventilation requirements as compared to 30% over the outdoor air requirement of ASHRAE 62.1-2007 Ventilation for Acceptable Indoor Air Quality with the exception of Cafeteria, Auditorium and Multi- Purpose Spaces which will provide ventilation rates equal to the maximum of the International Mechanical Code Section 403.3 ventilation requirements as compared to ASHRAE 62.1-02007 (without the 30% increase). The outside air ventilation rate is never permitted to drop below the space specific cfm per square foot times the space square footage.

Gymnasiums supply and return fans and air distribution ductwork will be designed for a maximum of 1.5 inches of w.c. external static pressure for supply air, and 1.0 inches of w.c. external static pressure for return air.

A humidity sensor(s) shall be utilized to maintain 60 +/- 2 % relative humidity conditions during occupied periods and 65 +/- 2% relative humidity conditions during unoccupied periods (after experiencing 70% relative humidity for at least 8 hours). Return duct humidity sensors shall be utilized during occupied periods. Space humidity sensors shall be utilized during unoccupied periods.

The Cafeteria and Auditorium areas will each be served by a single variable-volume rooftop unit (RTU) with supply and return fans, economizer dampers, a chilled water / hot water coil (seasonal changeover) as well as total energy recovery wheel. The RTU provides heating, cooling and ventilation for the cafeteria and auditorium spaces.

The Kitchen area will be conditioned by fan coil units located within the space. The fan coils will receive hot/chilled water from the water-to-water heat pumps serving the perimeter radiation units.

The Kitchen will receive minimum ventilation air from the main buildings DOAS unit.

The Kitchen hood will be variable flow, utilizing a demand control based kitchen hood exhaust system in place of switch control. The flow from the kitchen hood will be varied based on the intensity of cooking. This will be controlled by temperature and air quality sensors within the hood. When the air temperature under the hood increases or the air quality diminishes, the hood exhaust volume will increase.

Kitchen hood exhaust capacity shall be listed and labeled in accordance with UL 710.

There will be a separate kitchen hood make-up air unit located on the roof, which will provide tempered air to the hood, the volume of tempered air will vary, dependent on the exhaust flow to maintain the appropriate pressure relationship across the face of the hood. The make-up air will be tempered to 55°F (adjustable) during winter operation, as to avoid over cooling the kitchen workers operating at the face of the hood.

The Cafeteria and Auditorium will be provided with a hardwired space temperature sensor and space relative humidity sensor(s) to control the unit during unoccupied time periods. The unit will be provided with return air duct mounted temperature sensor and duct mounted relative humidity sensor to control the unit during occupied time periods.

The maximum heating discharge air temperature shall be nominally 95°F and the cooling discharge air temperature shall be nominally 55°F.

Cafeteria and Auditorium supply and return fans and air distribution ductwork will be designed for a maximum of 1.5 inches of w.c. external static pressure for supply air, and 1.0 inches of w.c. external static pressure for return air.

Inside Occupied Kitchen design temperatures: 72°F (Winter), 82°F (Summer).

Inside Occupied Cafeteria and Auditorium design temperatures: 72°F (Winter), 78°F (Summer).

The Kitchen Storeroom will be maintained at a space temperature between 50°F - 70 by an electrical heat pump system with the outdoor unit located next to the walk-ins air cooled condensing units. The Kitchen Storeroom will have both a space temperature sensor and a space relative humidity sensor integrated into the BMS/DDC network.

Locker Ventilation

The outside air component of the total supply air to the Corridors shall be exhausted by Toilet exhaust, Janitor’s Closet exhaust and the corridor roof-top packaged unit.

The Toilet exhaust system and Janitor’s Closet exhaust system will be combined. The component of the total air supplied to the Corridor that is not directly exhausted will be recirculated back to the ventilation unit.

The DOAS ventilation systems serving the Classrooms will have all of the supply air returned to the DOAS unit in order to utilize the total energy recovery wheels that recover both sensible and latent energy.

HVAC Design Requirements for Special Spaces

The Main Telecom Room, and all Intermediate Telecommunications Closets will be provided with a ductless split air-conditioning system that shall maintain a maximum of 75°F space temperature, and a maximum of 55% relative humidity, 24 hours a day, 7 days a week in accordance with ANSI/TIA/EIA – 569 - A. Space temperature sensors and space relative humidity sensors (which only monitor) will be located in the Main Telecom Room, and in all Intermediate Telecom Closets. Space temperature sensors and space relative humidity sensors will be integrated into the BMS/DDC system. The air conditioning equipment capacity for the Main Telecom Room shall be able to handle a load of

Electrical Distribution Rooms (EDR) and Elevator Machine Rooms will be provided with an independent split air-conditioning or exhaust system that shall maintain the space temperatures (24 hours a day, 7 days a week) in accordance with the equipment manufacturer's recommendations.

Hoistways of elevators will be provided with vents in the hoistway enclosures in order to prevent the accumulation of smoke and hot gases in case of fire. Hoistway enclosures may be vented in accordance with the following:

Location of vents:

a. The vents in the side of the hoistway enclosure below the electric elevator machine room floor or in the roof of all hoistways shall open either directly to the outer air or through noncombustible ducts to the outer air.
b. The vents in the wall or roof of an overhead electric elevator machine room through the smoke hole in the top of the elevator hoistway shall be vented to the outer air through noncombustible ducts.

The area of vents in all hoistways or the electric elevator machine room and the smoke hole will be at minimum 3-1/2 percent of the area of the hoistway or 3 square feet (0.28 m2) for each elevator car, whichever is greater. Such vents shall comply with the following requirements:

a. Open Vents. Of the total required vent area, not less than one-third will be permanently open or equipped with an openable hinged damper. The smoke hole shall be permanently open.
b. Closed Vents. The two-thirds closed portion of the required vent area either in all hoistway enclosures or in the electric elevator machine room may consist of windows or skylights glazed with annealed glass not more than 1/8-inch (3.2 mm) thick. A closed damper that opens upon the activation of a smoke detector placed at the top of the hoistway shall be considered closed.

An electric unit heater will be provided in the Water Meter Room and Crawl Spaces to maintain a minimum 50°F space temperature. Sloping top convectors will be used in Janitor's Closets that are located at the perimeter. Janitor Closets will be exhausted at airflow of 5 minutes per change.

Entrance Vestibules and Main Entrances will be provided with floor mounted recessed hot water cabinet heaters.

Special Education spaces will be maintained at 72ºF during the cooling season during occupied periods (as opposed to the 78ºF provided in other spaces).

Heating and Cooling Design Parameters

Heating and Cooling Systems will be designed in accordance with International Mechanical Code 2009, Heating and Cooling Load Calculations, LEED for Schools reference standards and Massachusetts Building Code 8th Edition using the following criteria:

Heating

The fresh air requirements per occupant shall be the maximum of the International Mechanical Code 2009 ventilation requirements as compared to 30% over the outdoor air requirement of ASHRAE 62.1-2007 Ventilation for Acceptable Indoor Air Quality with the exception of Cafeterias, Auditoriums and Multi-Purpose Spaces which shall be designed to provide ventilation rates equal to the maximum of the International Mechanical Code 2009 Section 403.3 ventilation requirements as compared to ASHRAE 62.1-04 (without the 30% increase).

Number of occupants based on International Mechanical Code2009 maximum occupancy per net floor area of occupied space (Table 403.3).

Inside ambient design parameters:

72°F DB

Outside ambient design parameters:

9°F DB (Based on Wind at 15 MPH)

Cooling

The fresh air requirements per occupant shall be the maximum of the International Mechanical Code 2009 Section 403.3 ventilation requirements as compared to 30% over the outdoor air requirement of ASHRAE 62.1-2007 Ventilation for Acceptable Indoor Air Quality with the exception of Cafeterias, Auditoriums and Multi-Purpose Spaces which shall be designed to provide ventilation rates equal to the maximum of the International Mechanical Code 2009 Section 403.3 ventilation requirements as compared to ASHRAE 62.1-2007 (without the 30% increase).

Inside ambient design parameters:

78°F DB, 45% RH

Outside ambient design parameters:

88°F DB, 74°F WB

Sizing of Equipment

Heating Capacity:

The heating capacity for rooftop units will be increased by 10% to account for duct losses (duct insulation losses, duct air leakage) and general building pick-up.

The water-to-water heat pump system will be supplemented with a condensing boiler to achieve heating in the most effective and efficient way possible while also minimizing the size of the well field to help control costs. Reserve capacity will be 25% to account for piping losses and pickup, capacity will be based on total connected capacity.

The water-to-water heat pump / condensing boiler heating system will also utilize the solar thermal hot water, whose primary purpose is to heat the domestic hot water, as a pre-heat for the building heating loop. Thus utilizing the solar thermal HW loop when it is not needed to meet the domestic water load.

Cooling Capacity:

The cooling capacity for roof top units will be increased by 10% to account for duct losses (duct insulation losses, duct air leakage) and general building pull-down.

Water-to-Water Heat Pumps will be provided with a reserve capacity of 25% to account for piping losses. Cooling capacity will be based on total connected capacity.

HVAC Capacities and Loads

The modular water-to-water heat pumps will be split into two banks, one serving the interior of the building, and thus able to be a pure water system and the second serving the Roof Top Units, and thus being a glycol based system. Each bank of water-to-water heat pumps will use the closed loop geothermal well as the heat rejection/addition device. The splitting of the systems into two separate loops, one with glycol and one without, removes the need for heat exchangers for the glycol loop and as a result reduces pumping energy associated with the pressure drop of the heat exchangers. Both water-to-water heat pump loops will be supplemented by the condensing boiler system. The system capacities are represented in the tables below.

Water-to-Water Heat Pumps

Type	Quantity	Modular Cooling Capacity	Total Cooling Capacity	Modular Heating Capacity	Total Heating Capacity
Water-to-Water modular heat pump	18	30 Tons	540 Tons	925 MBH	6480 MBH

Supplemental Boiler

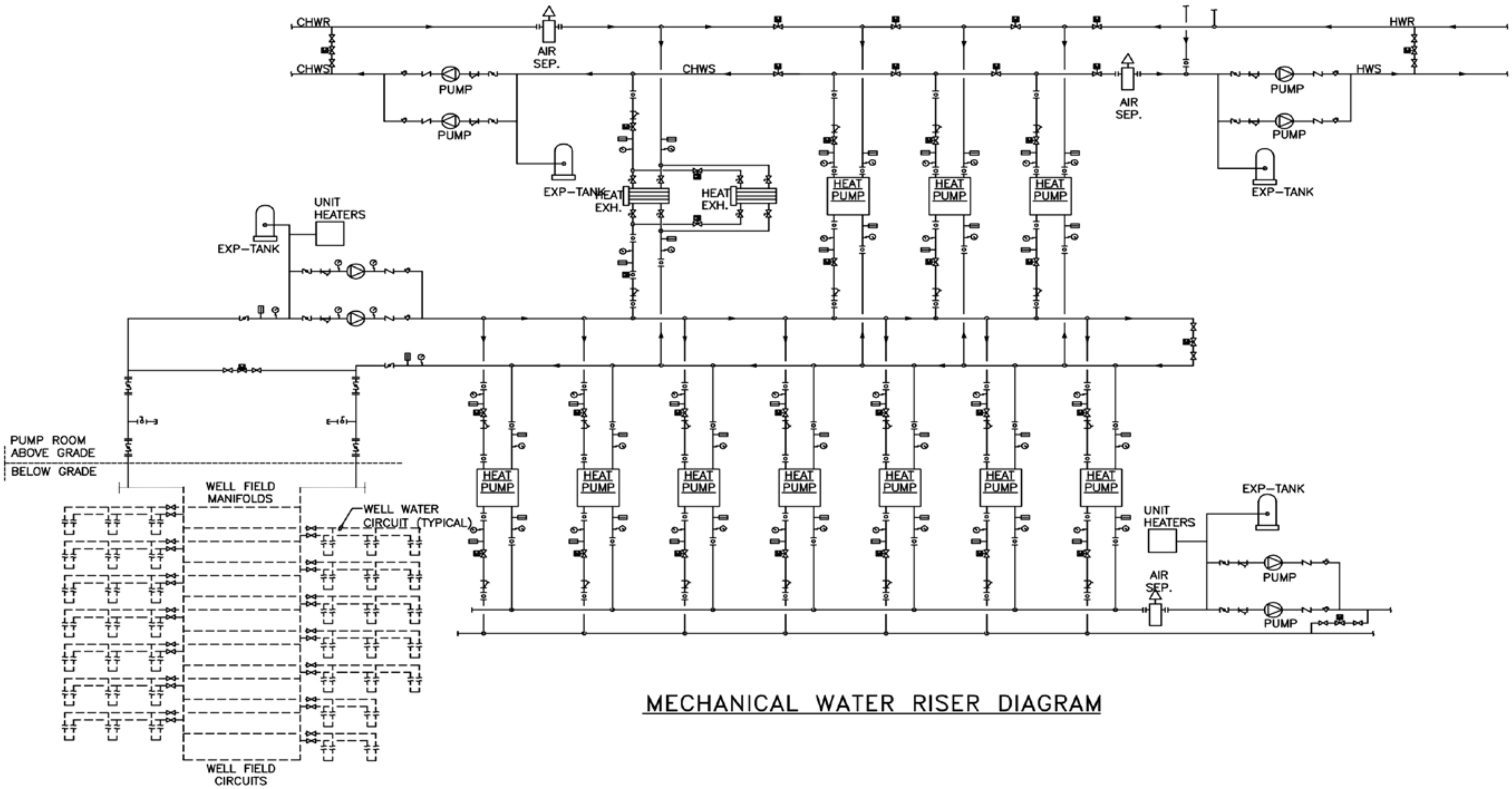
Boiler	Nominal Capacity (MBH)	Quantity	Total Heating Capacity (MBH)
Viessman Vitocrossal	6,600	1	6,600

Custom Roof Mounted HVAC Units

Area Served	Total Air Flow	Cooling Capacity (Tons)	Heating Capacity (MBH)
Cafeteria	6,000	20	50
Multi-Gymnasium	12,000	35	85
Small Gymnasium	6,000	20	50
Auditorium	6,000	20	50

Dedicated Outdoor Air System (DOAS)

Area Served	Total Air Flow	Cooling Capacity (Tons)	Heating Capacity (MBH)
DOAS Units	19,000	80	1100



MECHANICAL WATER RISER DIAGRAM

HVAC Systems Comparison Matrix

System Options	Indoor Environment			Energy			Cost	Operations				Impact	Rating
	Thermal Comfort	Acoustics	Ventilation	Low Transport Energy	Fast Response	Low Heating & Cooling Energy	Low Life-Cycle Cost	Reliability	Maintainability	Life Expectancy	Simplicity	Floor - to - floor limitations	
Water-to-air geothermal heat pumps with dedicated outside air system	1	1	1	1	3	1	3	3	3	1	3	1	22
Water-to-water geothermal heat pumps with induction / displacment units and dedicated outside air system	2	2	2	2	2	3	2	2	2	2	2	2	25
Water-to-water geothermal heat pumps with radiant panel heating and cooling and dedicated outside air system	3	3	3	3	1	2	1	1	1	3	1	3	25

Design Options - MEP/FP

HVAC Systems Weighted Comparison Matrix

System Options	Indoor Environment			Energy			Cost			Operations			Impact			Overall Rating
	Raw Score	Weighting	Score	Raw Score	Weighting	Score	Raw Score	Weighting	score	Raw Score	Weighting	Score	Raw Score	Weighting	Score	
Water-to-air geothermal heat pumps with dedicated outside air system	3	15%	0.45	5	25%	1.25	3	20%	0.6	10	35%	3.5	1	5%	0.05	5.85
Water-to-water geothermal heat pumps with induction / displacment units and dedicated outside air system	6	15%	0.9	7	25%	1.75	2	20%	0.4	8	35%	2.8	2	5%	0.1	5.95
Water-to-water geothermal heat pumps with radiant panel heating and cooling and dedicated outside air system	9	15%	1.35	6	25%	1.5	1	20%	0.2	6	35%	2.1	3	5%	0.15	5.3

Electrical

Normal Power Distribution Systems

A new secondary feeder shall be brought in from a new utility owned pad mounted transformer or utility transformer vault via a concrete encased ductbank to a new main switchboard to serve lighting, power and mechanical equipment throughout the school. The main switchboard will be rated 480/277 volt, 3-phase, 4-wire, 3000A. The switchboard will be service entrance rated with copper bussing and TVSS. The main circuit breaker shall be a fixed insulated-case, 100% rated with field adjustable LSIG settings. All feeder breakers shall be molded case type with field adjustable LSIG settings. The distribution switchboard will feed distribution and branch circuit panels located at various locations throughout the building. All switchgear and distribution equipment including transformers shall be mounted on a 4" high concrete housekeeping pad. All distribution equipment shall be provided by one manufacturer.

A 277/480V and 120/208V power distribution system will be provided to supply normal power to all lighting, receptacles, mechanical equipment, kitchen equipment, laboratory equipment, low-voltage systems, and other loads throughout the building.

The power distribution equipment will be installed primarily in the Main Electric Switchboard Room and electrical closets located on each level. There will be minimum one electrical closet per floor, centrally located to minimize the length of branch circuits. Additional panelboards will be provided in special load intensive areas such as the kitchen.

The power distribution equipment will consist of the following:

a. Main Distribution Switchboards installed in the Main Electric Switchboard Room to supply lighting, receptacles, and power panelboards located in each level's electrical closet, and for panels serving large mechanical loads. All panels shall be surface mounted in electric closets or flush mounted in finished spaces.

b. 277/480V lighting panels which will be circuit breaker type will also be installed in the Main Electric Switchboard Room and in each level's electrical closet. Lighting circuits on each level will be provided by the panel on the associated floor.

c. 120/208V receptacle panels via energy efficient self-cooling dry-type step down transformers to panels which will also be circuit breaker type, and installed in the Main Electric Switchboard Room and in each level's electrical closet, will provide branch circuits for receptacles and other miscellaneous loads on the associated floor.

d. 277/480V mechanical panels which will also be circuit breaker type and installed in the Main Switchboard Room, the Boiler Room, and various electrical closets throughout the building as required. They will provide branch circuits for mechanical loads such as fan-powered VAV boxes, electric unit heaters, cabinet unit heaters, and exhaust fans, etc.

e. 277/480V and 120/208V kitchen power panels shall be circuit breaker type and supply power for all kitchen equipment. A dedicated panel for all equipment beneath the kitchen exhaust hood will also be provided with provisions for emergency exhaust fan shut-down.

f. Panels supplying computer equipment will have transient voltage surge suppression (TVSS) devices.

Emergency Power Distribution Systems

A 250-400 kw diesel fired emergency generator will be located in the building near the main electric room. Two separate automatic transfer switches and distribution panels will be required for emergency and optional stand-by branches. A 260A, 277/480-volt ATS will be required for the emergency branch and a 100A, 277/480-volt ATS will be required for the optional stand-by branch. The emergency system distribution equipment shall be located in separate 2-hour rated rooms located on each floor and will provide branch circuits for the emergency system. All emergency system wiring shall be in conduit and physically separated from the normal systems. The optional stand-by branch distribution shall be feed panels located in the kitchen space for emergency backup power for refrigeration and freezer equipment.

Wiring Methods

All wiring will be installed in a conduit system including empty conduits for sound, data and communications wiring located above accessible ceilings. The minimum conduit size shall be ¾" for branch circuits, switch legs and control wiring. All feeder and branch circuits shall be installed in electrical metallic tubing (EMT) conduits. All exterior conduits shall be threaded, rigid galvanized steel conduit. EMT fittings shall be compression type. Set screw fittings shall not be permitted.

Complete systems of branch circuit wiring shall be provided for all lighting, power and miscellaneous requirements. Conductors are to be single conductor 600 volt, THHN/THWN insulation (with continuous color coding), copper, minimum #12 AWG. Larger conductors shall be provided to suit specific loads which exceed the capacity of the #12 conductors. #14 AWG conductors may be used for control circuits and fire alarm system. All wire #10 and smaller shall be spliced with threaded on plastic or nylon insulated connectors. #8 and larger shall be spliced with compression type connectors and insulated with electrical tape. Type MC metal clad cable may be utilized for "whips" to lighting fixtures.

Liquid tight flexible conduit shall be utilized for the final connections to motors, transformers and other vibrating equipment.

Fire Alarm System

The fire alarm system for the building shall be a new multiplex addressable, ADA compliant microprocessor based, voice evacuation system including all required power supplies, peripheral devices, elevator status panel, generator annunciator for a complete system in compliance strict compliance with Massachusetts State Building Code, NFPA 72 and all applicable local codes and standards. System shall be programmed, tested, and be in fully operational condition including all required hardware, software, raceways and interconnecting wiring. All fire alarm wiring shall be class "A" in conduit. System shall include automatic smoke detectors, manual pull stations, water flow and tamper switches to monitor the fire suppression system. Magnetic door holders and smoke detectors shall be provided at fire doors to release the doors in the event of a fire alarm. Duct smoke detectors shall also be provided in air handling equipment rated 2000 CFM or higher. The fire alarm system shall monitor the status of the kitchen hood suppression system. The fire alarm system shall have an elevator recall sequence to return the elevator to a designated level for evacuation.

Equipment and Locations:

a. Fire Alarm Control Panel (FACP) – Placed in the main lobby, near the main entrance

b. Printer –Placed in Custodian's Office

c. Remote Annunciator – Placed in the general office or rear entrance.

d. Manual Pull Station – Placed in accordance with Massachusetts State Building Code. Specifically, they shall be provided within 5'-0 of each door leading to legal exit in corridors, lobbies, places of assembly and as required to meet the travel limitations of 200'. The height of the manual pull stations shall be a minimum of 42" and a maximum of 48" measured vertically from the floor level of the activating handle. All manual pull stations shall be single-action type. False alarm stopper covers shall be provided over all manual pull stations.

e. Visual Annunciator (Strobes) – Placed in accordance with BC 907.9.1. Specifically, they shall be wall-mounted in places of instruction, corridors, places of assembly, library, shops, music rooms, toilets, and elsewhere where required by the Building Code. Strobes shall be unobstructed by other objects, visible from any position in the area and shall be a maximum of 15 ft from end of the corridor. Strobes shall be wall-mounted such that the entire strobe lens is located 96" above the finished floor or 6" below the ceiling, whichever is less in height. Strobe lights shall not be required in staircases. If three or more strobes are in the same room or adjacent space within the field of view, they shall be synchronized. Ceiling-mounted strobes are allowed where wall-mounted strobes cannot provide proper coverage.

f. Audible and Visual Notification Appliances (Speaker/Strobes) –Combination speaker/strobe type devices shall be installed in all locations throughout the building open to the public. Speaker/strobes shall be wall-mounted such that the entire lens is located 96" above the finished floor or 6" below the ceiling, whichever is less in height. All strobes are in the same room or adjacent space within the field of view shall be synchronized.

g. Smoke Detectors – Placed in all mechanical rooms, electrical switch gear rooms, electric closets, telecommunications room and closets, audio/video storage rooms, elevator lobbies, elevator machine rooms and elevator shafts if required by current state elevator code, storage rooms containing flammable materials (book storage, grounds equipment room, custodian's storage) and over fire doors where magnetic door holders are provided. Smoke detector layout shall comply with NFPA 72 and the Massachusetts State Building Code.

h. Metal Wire Guards – Provide in all gymnasiums and playrooms for visual and audible notification appliances.

i. Kitchen Hood Fire Suppression System (Ansul system) -Shall be interconnected to the fire alarm system and the activation of the fire suppression system shall be indicated as an alarm on the Fire Alarm System.

j. Master Box – located per local fire department regulations.

Lighting

Lighting fixtures will be installed throughout the building providing illumination levels in accordance ASHRAE 90.1 and all associated subsections for various spaces and the Massachusetts Energy Conservation Code.

The lighting fixtures will be high efficiency fluorescent, LED or HID. In general, fluorescent lamps will be low mercury super T-5 triphosphor type, with solid state electronic ballasts suited for the application. Compact Fluorescent lamps will be used in lieu of incandescent in down lights and in enclosed, explosion proof type incandescent globes, where necessary. Incandescent fixtures shall be limited to theatrical lighting in the Auditorium and controlled/dimmed with a dedicated theatrical dimming system.

General lighting in classrooms, other spaces of instruction, offices, and similar spaces will be pendant mounted, direct/indirect fixtures with 70-80% uplight and 20-30% downlight distribution. Light fixtures in storage rooms and mechanical/electrical rooms may be surface or pendant-mounted type. Kitchen light fixtures will be recessed, gasketed type, suitable for installation in suspended grid type ceilings and for use in wash down environments. Perimeter exterior offices with windows shall be provided with step-dim ballasts for 100%/50% light levels and wall mounted occupancy sensors to allow the occupant to turn lights to 50% light levels.

All non-emergency interior lighting will be controlled by programmable lighting relay control panels located adjacent to each lighting panel on every floor. Emergency corridor and stairway lighting throughout the building will also be automatically controlled with a Bodine GTD20A type device to transfer automatically from normal power to emergency power during a loss of power. Emergency lighting will also be provided in the electrical and telecommunications rooms as well as in the General Offices, Medical Suite, and Custodian's Office. LED Edge-lit exit signs shall be provided throughout the school to indicate the designated path of egress and connected to the emergency system.

A daylighting control system will be provided in classrooms and other applicable areas to allow for daylight energy savings. Classrooms and any other areas will be provided with photocell sensors that will automatically adjust the lighting levels based on the amount of daylight. Lighting in areas not implementing daylighting controls will be controlled by ceiling mounted occupancy sensors. In areas such as corridors, lobbies, restrooms. library, cafeteria, etc. the lighting will be only automatically controlled via the programmable lighting relay control panels.

Exterior lighting shall be provided for the building's façade. All exterior doors shall be provided with a light fixture connected to the emergency system for illumination from the building exit to the public way. Parking lot lighting shall be provided utilizing pole mounted LED light fixtures. The parking lot will be illuminated to achieve 1 fc minimum. All exterior lighting shall be controlled via the lighting control relay panel and an exterior photocell. All exterior lighting provided will be energy efficient, glare free, reduce sky glow and impact on nocturnal environment, durable and easy to maintain. Selection of luminaires will complement architectural features of the building.

Receptacles

Receptacles for educational use will be provided in classrooms, offices, and other spaces for typical room layouts. Convenience receptacles will be provided for cleaning and other functions. Special purpose receptacles will be provided as required by the respective equipment, such as in the kitchen.

Classrooms for general instruction shall be provided with the following minimum convenience outlets:

a. One 20A, 125 Volt, specification grade, duplex receptacle under the white or chalk board at the front teaching wall

b. One 20 Amp, 125 Volt, specification grade, quad receptacle located near the teacher's computer station at the front teaching wall.

c. One 20 Amp, 125 Volt, specification grade duplex receptacles at the rear wall.

d. Two 20 Amp, 125 Volt, specification grade duplex receptacles located on the window wall.

e. One 20 Amp, 125 Volt, specification grade duplex receptacle on the corridor-side wall near entry, for cleaning purposes.

f. Ten 20 Amp, 125 Volt, specification grade, duplex receptacles for computer stations, one printer and one scanner for the students use under the computer counter. Two dedicated circuits shall be provided for the ten receptacles. Receptacles shall be provided in a two-channel surface mounted raceway mounted under the computer counter.

Note: For kindergarten and classrooms, safety type tamper proof receptacles shall be installed.

Corridors, Lobbies, Mechanical/Electrical rooms and Roofs

Receptacles for maintenance, 20 Amp, 125 Volt, specification grade, duplex type, shall be provided so that all areas in the spaces are accessible by a 50' extension cord. Roof tops and toilet room receptacles shall be GFCI protected.

HVAC Equipment

Receptacles for servicing HVAC equipment, 20 Amp, 125 Volt, specification grade, duplex type, shall be installed within 25' of the equipment. Those receptacles shall not be connected to the load side of the HVAC equipment disconnecting means.

Main Telecommunication Room and IT Closets

A minimum of ten quad receptacles dedicated, 20 Amp, 125 Volt receptacles will be provided at the Main Telecommunications Room data racks and cabinets. The receptacles will be placed near the data racks and cabinets, a minimum of two quad receptacles for each rack or cabinet. Two 20 Amp, 208 Volt circuits with L6-20R twist lock receptacles will be provided in the Main Telecommunications Room at the main data racks.

Empty conduit systems

Junction boxes, pull boxes and empty raceways (EMT) with a pull string shall be provided throughout the school for the installation of data, voice, clock, sound, and audio visual and security systems. Quantity and locations shall be determined by the furniture, equipment and use of each room. Raceway shall extend from the junction boxes up the wall to 6" above an accessible ceiling. An insulated bushing shall be provided on each open end conduit. All communications wiring shall be provided and installed by the owner.

Lightning Protection System

A lightning protection system, with UL Master Label Certificate, shall be provided in accordance with NFPA 780 and UL96A. The lightning protection system shall consist of the following:

- Air Terminals (interception points) along the roof, roof perimeter, and selected roof mounted mechanical equipment.
- Ground rods (dissipation points) and down conductors (low-impedance conductors interconnecting the interception and dissipation points).

Energy Savings Strategies

A programmable lighting control relay system will be installed to automatically turn off all non-emergency interior lighting during unoccupied hours in all areas. Occupancy sensors will also be located in smaller individual rooms to maximize energy savings. Lighting controls shall minimize as much as possible the illumination of unoccupied spaces or spaces not requiring illumination during daylight hours. The lighting control system will be utilized for large open and public areas such as the lobby, corridors, library, gymnasium and the auditorium. Occupancy sensors will be utilized in smaller individual rooms such as classrooms, offices, storage and janitors closets.

A daylight harvesting system shall be utilized to automatically turn dim lighting in areas where the amount of measured daylight is sufficient.

LEED considerations

In an effort to provide for the accountability and optimization of building energy consumption, metering will be required for each type of load being served. Metering will need to be installed on the feeder breakers that serve the following loads:

- Lighting
- HVAC
- Power (Receptacles)
- Elevator(s)
- Kitchen Equipment

In addition to metering loads at the main switchboard, metering at the branch circuit level for each branch circuit shall be included to monitor the energy use for lighting, receptacles and equipment loads. This will allow a comparison to be made for different areas such as the lower school classrooms vs. upper school classrooms, or even 6th grade vs. 7th grade class rooms. It shall also provide indication of what the cooling, heating or ventilation energy usage is for panels serving mechanical loads. This level of metering shall utilize a product similar to the Square D Branch Circuit Power Meter (BCPM). Solid Core CT's shall be used for a high level of accuracy. All distribution as well as each lighting and power panel shall be provided with the BCPM system and networked together with an RS485 string to the energy dashboard.

A grid-connected, vendor provided photovoltaic system, utilizing net metering, shall be installed. The system shall include, but not be limited to, roof-mounted PV panels, wiring, inverters and disconnect switches. The exact quantity and locations of the inverters shall be determined on the quantity and location of the PV panels. The option of locating them locally on the roof as opposed to centrally in the electric room shall be considered. The system shall be installed to comply with NEC Article 690, the Uniform Solar Energy Code-ICC, UL 1703, IEEE 1547, and UL 1741. A design evaluation shall be performed to determine the load, available sunlight, and size of the PV array by the vendor.

Energy Metering will be provided to monitor the school's energy use in order to target inefficiencies and reduce energy costs. Dashboards will be provided throughout the school to inform and educate the staff, faculty, students, parents and the community about the school's sustainable initiatives and building resource use.

Classroom receptacle and lighting power will be metered on a classroom-by-classroom basis. Individual classroom energy performance will be displayed on the dashboard located in the wing the classroom is located in and will be shown relative to the other classrooms in that wing. In addition, the total classroom energy use for each individual wing will be compared to the total energy use for each of the other wings

Meters and Energy Dashboards will be provided for the following:

<u>Meters</u>

- Electric kitchen equipment
- Gas fired kitchen equipment
- Elevators
- Pumps
- RTU supply and return fans
- Boilers- gas fired

Equipment loads broken down as follows:

- Each Individual Classroom
- All other (administrative, health suite, gymnasium, etc.)

Lighting loads broken down as follows:

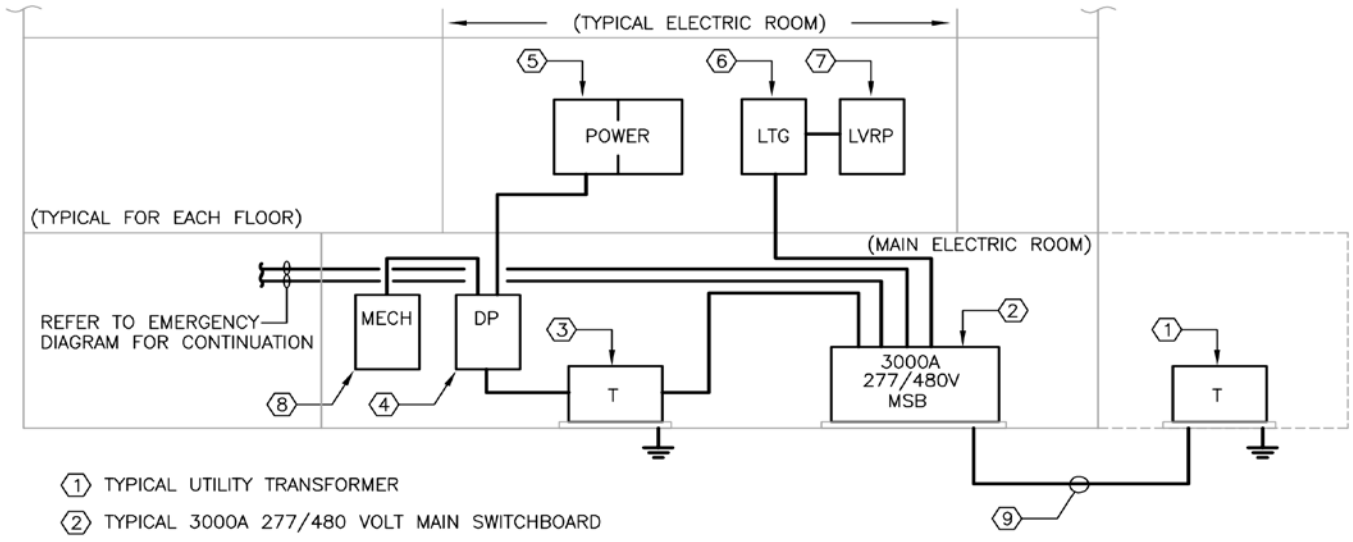
- Each Individual Classroom
- Kitchen/cafeteria lighting
- All other (admin, health suite, gymnasium, etc)
- Exterior lighting

Design Options - MEP/FP

Energy Dashboards (Touch screen).

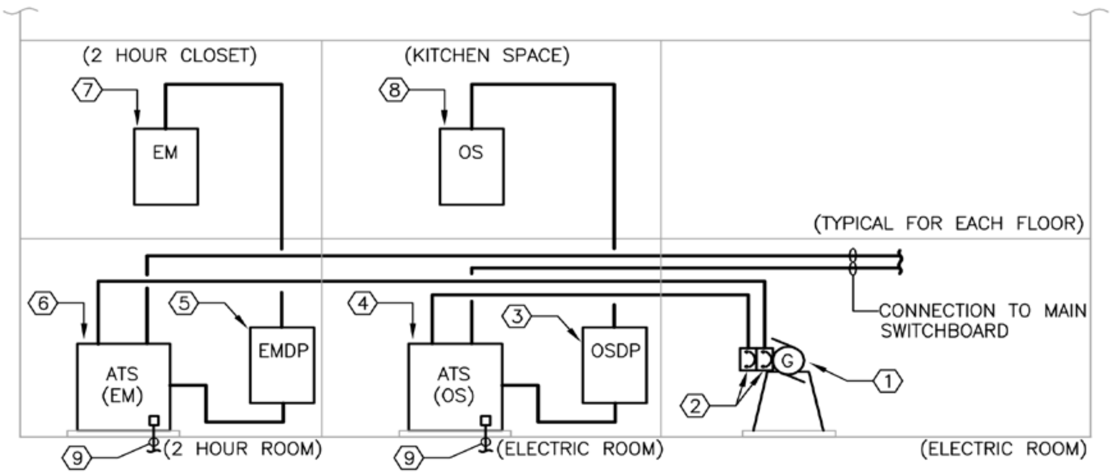
- Dashboards will be located in each wing identifying:
- Lighting and power use of each classroom
- Kitchen/Servery/Cafeteria (lighting, power, equipment)
- Elevators
- Mechanical Heating, Cooling and Ventilation
- Photovoltaics: realtime energy being produced.
- Whole Building

NORMAL POWER DISTRIBUTION



1. TYPICAL UTILITY TRANSFORMER
2. TYPICAL 3000A 277/480 VOLT MAIN SWITCHBOARD
3. TYPICAL TRANSFORMER
4. TYPICAL 120/208 VOLT DISTRIBUTION PANEL
5. TYPICAL 120/208 VOLT POWER PANEL
6. TYPICAL 277/480 VOLT LIGHTING PANEL
7. TYPICAL LIGHTING CONTROL PANEL
8. TYPICAL 277/480 VOLT MECHANICAL PANEL (LOCATED IN ELECTRICAL CLOSETS AS REQUIRED)
9. CONCRETE ENCASED DUCTBANK

EMERGENCY POWER DISTRIBUTION



1. TYPICAL 250–400 KILOWATT DIESEL FIRED EMERGENCY GENERATOR
2. TYPICAL CIRCUIT BREAKER (IN SEPARATE BARRIERED ENCLOSURES)
3. TYPICAL OPTIONAL STANDBY DISTRIBUTION PANEL
4. TYPICAL 100 AMP, 277/480 VOLT AUTOMATIC TRANSFER SWITCH FOR OPTIONAL STANDBY POWER
5. TYPICAL EMERGENCY DISTRIBUTION PANEL
6. TYPICAL 260 AMP 277/480 VOLT AUTOMATIC TRANSFER SWITCH FOR EMERGENCY POWER
7. TYPICAL EMERGENCY POWER PANEL
8. TYPICAL OPTIONAL STANDBY POWER PANEL
9. TO GENERATOR START SIGNAL

Plumbing

In General the plumbing systems include the following:

- Domestic water
- Sanitary waste and vent including sewage ejector.
- Acid Waste and Vent System
- Storm Water including sump pump and gray water
- Natural gas

Domestic Water:

The building will be served by new redundant 4 inch metered water services from the water mains in Putnam Avenue and Magee Street. The services will be protected by duplex reduced pressure backflow preventer assembly. The location of the point of entrance shall be coordinated with the site civil engineer.

Water will be distributed through mains and branches to plumbing fixtures and equipment.

The piping system shall be Type 'L' copper tube with wrought copper or brass fittings and lead free solder joints. Pipes 2 inch and larger may be joined by roll groove mechanical couplings.

The system will be designed to maintain a maximum velocity of 8 fps at design flow conditions.

Pressure reducing valves, if required, will be provided to limit pressure to approximately 50 psi at fixtures and equipment.

The domestic water system will be designed to prevent water hammer conditions by providing air chambers for fixtures and shock arrestors for quick closing valves.

A minimum of 30 psi will be provided at the most remote fixture.

Shutoff valves will be provided at each branch take-off, equipment connection and fixture battery.

Reclaimed storm water shall be used for flushing fixtures such as water closets and urinals. The water shall be collected and stored in a storm water cistern as described in the Storm Water section below. The storm water shall be filtered and dyed in accordance with the local codes and then pressurized thru duplex distribution pumps to the flushing fixtures. The gray water system shall be completely independent of the domestic water systems and identified as such. (Refer to gray water system schematic sketch).

A flat plate solar thermal system will be provided to produce domestic hot water for the building. A total of 36 flat plate panels will be provided, with a daily production of 11,000 BTU per panel. The panels will be located on the building's roof

Gas fired, condensing water type heaters will be provided as a back-up to the solar thermal system. The domestic hot water system will produce 140°F water, which will supply the kitchen. The storage tanks will be 130 gallon and will be provided with an electronic ignition. Temperature/pressure relief valve will be provided for the hot water heater.

Hot water temperature will be maintained throughout the system by circulation utilizing fractional horsepower pumps.

Internal water meters will be provided for cold water supplying domestic hot water system, hot water supplying the kitchen and the hot water return from the kitchen. Water meters will have pulse type output to provide connected to building automation system. Meter readings shall be done either at the meter's total registry or logging of the building automation system.

Sanitary Drainage and Vent Systems:

The sanitary waste collected from the plumbing fixtures and equipment will be drained, via gravity, through a connection to the site sanitary system. The locations of the point of exit shall be coordinated with the site civil engineer. At a minimum, there shall be (2) 6" sanitary sewers exiting the building

Sanitary waste collected from fixtures and equipment located below the level of the gravity system will drain to an ejector pit. The pit will be evacuated by duplex submersible sewage ejectors which will pump the waste to the site sanitary system. Pumps shall be minimum of 3 hp, 480 v, 3-phase 50 gpm @ 25 Ft of head

The sanitary drainage system within the building will be vented with terminations to atmosphere above the roof.

The above ground piping system shall be hubless service weight cast iron pipe and fittings with heavy duty neoprene gasketed couplings with stainless steel corrugated jackets and a minimum of (4) stainless steel clamps per coupling. Buried piping within the building shall be service weight hub and spigot cast iron soil pipe with neoprene gasketed joints. Sump pump and ejector discharge piping shall be schedule 40 galvanized steel pipe and fittings with either threaded or roll groove connections.

Piping in finished areas exposed at fixtures or by opened cabinet doors shall be chromium plated brass pipe with 125 pound SWP screwed chromium plated brass fittings.

Kitchen drainage will be provided with grease interceptors to remove fat/oil/grease, from the effluent prior to draining through the building sanitary system. Grease interceptors will be sized according to DEP requirements.

All kitchen sinks associated with food preparation or processing shall drain indirectly to a floor sink type of receptor. The receptor shall be 10-inch deep with dome and strainer. An air gap, twice the diameter of the pipe draining into the receptor will be maintained. Floor sinks shall sit 1-inch above the floor and shall be located under the sink where it will not be a tripping hazard.

Acid Waste System:

Acid waste effluent generated in the Science Classrooms will be piped independent of the sanitary waste system in an acid resistant waste and vent system. Effluent shall flow to a central pH Adjustment System consisting of a 150 gallon dilution/mix tank, acid/alkaline injection pumps, mixer, recorder, etc in compliance with the Massachusetts State Plumbing Code. Treated acid waste from the mix tank shall extend from the building out to the site sanitary main independent of the sanitary system in compliance with the State codes. The tank and the entire system shall be vented to atmosphere independent of the sanitary vent system. (Refer to Acid Waste System Schematic Sketch).

Pipe and fittings shall be Schedule 40 Polypropylene. Fittings for above ground pipe shall be mechanical joint. Fittings below grade will be fusion welded joints.

Storm Water System:

Rain water from roofs, plaza drains and area drains shall collect interior of the building and flow by gravity to a storm water cistern for re-use. Overflow from the cistern shall flow to the site storm drain. The locations of the point of exit shall be coordinated with the site civil engineer. At a minimum, there shall be (4) 10” storm drains exiting the building

A sump pit will be provided to collect the discharge from the foundation/footing/under slab drainage systems as well as any areaway/plenum drains that cannot drain by gravity. The clear water waste will be pumped to the gravity system by duplex submersible sump pumps. Pumps shall be minimum of 5 hp, 480 v, 3-phase 100 gpm @ 25 Ft of head.

Roofs with parapets shall include secondary roof drainage. This secondary system shall be independent of the primary drainage system and shall spill to grade.

Rain Water shall collect in a 40,000 gallon underground cistern for use in a rain water reclamation system. The reclaimed water shall be used for either irrigation needs or for use in flushing toilet room fixtures.

If the system is to be used for irrigation, the landscape/civil engineer shall connect to the cistern for distribution to the site.

If the system is to be used for flushing, it shall include a treatment component that will be located in the building. The treatment system will include filters, dye injection and pressurization pumps for distribution to the plumbing fixtures. See Domestic Water section above. (Refer to Gray Water System Schematic sketch).

The piping system above grade shall be hubless service weight cast iron pipe and fittings with heavy duty neoprene gasketed couplings with stainless steel corrugated jackets and minimum of (4) stainless clamps per couplings. Buried piping within the building shall be service weight hub and spigot cast iron soil pipe with neoprene gasketed joints.

Natural Gas System:

The building will be served by a new metered low pressure gas service. The service shall be coordinated with the utility and site/civil engineer. The meter assembly will be located on the exterior of the building. The gas service and meter shall be provided by the local gas company. The plumbing contractor shall connect to the house side of the meter.

Natural gas will be distributed through mains and branches to required mechanical equipment, water heaters and gas fired kitchen equipment

The piping system will be schedule 40 black steel with threaded connections for gas pressures below 2 PSI and welded connections for pressures 2 PSI and above. All piping 4 inches in diameter and larger shall have welded connections.

Plumbing Fixtures:

- Fixtures will be vitreous china, enamel coated cast iron or stainless steel, wall hung or counter top type with chrome plated brass trim and individual stop valves.
- Water closets in public restrooms shall be of the elongated type with open front seats and no lids.
- Sinks and other fixtures and equipment furnished by others will be provided with all required trim and connection to services.
- Fixtures and trim accessible to the handicapped will be provided where applicable.
- All fixtures will be provided with water conserving features.
- Water closet flush valves will be Dual Flush type.
- Urinals shall be pint flush type.
- Lavatory faucets will be low flow type with 0.25 GPM aerators.
- Exact type and finish of all fixtures shall be coordinated with the Architect.

Fixture quantities shall be in compliance with the Massachusetts State Plumbing Code as a minimum. The following table represents the minimum fixtures based on the current programming needs:

Minimum Facilities

Water Closets Female	Water Closets Male	Urinals	Lavatories Female	Lavatories Male	Showers	Drinking Fountains	Janitors Sinks
30	16	11	19	19	3	25	8

In addition to the core facilities included in the table above, all classrooms will be equipped with (1) stainless steel sink for hand washing. The classroom sink shall also include a water bubbler fitting

All Art Room classroom sinks shall be equipped with Solids Interceptors similar to J.R. Smith model 8710. The interceptors shall be located below the sink and shall have a removable cover for cleaning.

Science Room Sinks shall be equipped with swing-away type deck mounted emergency eyewash units similar to Speakman model SE 570. The eyewash units shall include point of use mixing valves located below the lab sink in the casework similar to Speakman model SE-TW-EW. Additionally, the sink faucets will be fitted with vacuum breaker spouts.

Emergency Showers shall be located in in each Science room within required travel distances. The shower outlets shall spill to floor drains located immediately adjacent to the unit and the floor drains shall include automatic trap priming devices to prevent sewer gases from migrating into the space.

Fire Protection

Water Supply:

All fire suppressions systems within the building will be supplied by redundant 8 inch fire services from the water mains located on Putnam Avenue and Magee Street. The point of entrance shall be coordinated with the site civil engineer. The services will be protected by a double check valve assembly for backflow prevention.

A fire department connection will be provided to allow fire department pumpers to augment the water supply if required. Sprinkler spacing shall be in accordance with the Massachusetts Building Code and NFPA 13.

If required, the building will be equipped with a fire water storage tank. The tank shall be an underground fiberglass tank sized to provide the sprinkler water demand and hose stream allowance for the building in compliance with NFPA-13 Ordinary Hazard Occupancy (30 min duration) and the Massachusetts State building Code 8th Edition. The tank shall be a 45,000 gallon tank and shall include all connections, manways, fill valves, overflows as required. (Refer to Attached sketch).

Additionally, if the tank system is required a 75 HP, 480v, 3-phase, 750 gpm fire pump rated at 60 psi shall be provided in compliance with NFPA-20. The pump system shall include a jockey pump, test header, relief valves and all associated controllers as required.

Code requirements for the storage tank shall be verified and the costs associated with this system shall be carried as a separate line item

Sprinkler:

The building will be protected throughout by an automatic wet sprinkler system. Each floor will be provided with a floor control valve assembly (FCVA) which will consist of an indicating type control valve with tamper switch, water flow switch, pressure gauge and test/drain valve.

In areas subject to freezing, such as the Loading Dock, dry sprinkler systems shall be provided. The dry systems shall include all dry alarm valves, compressors and appurtenances.

The systems shall be designed and hydraulically calculated in accordance with the following criteria:

Classification: Ordinary Hazard.

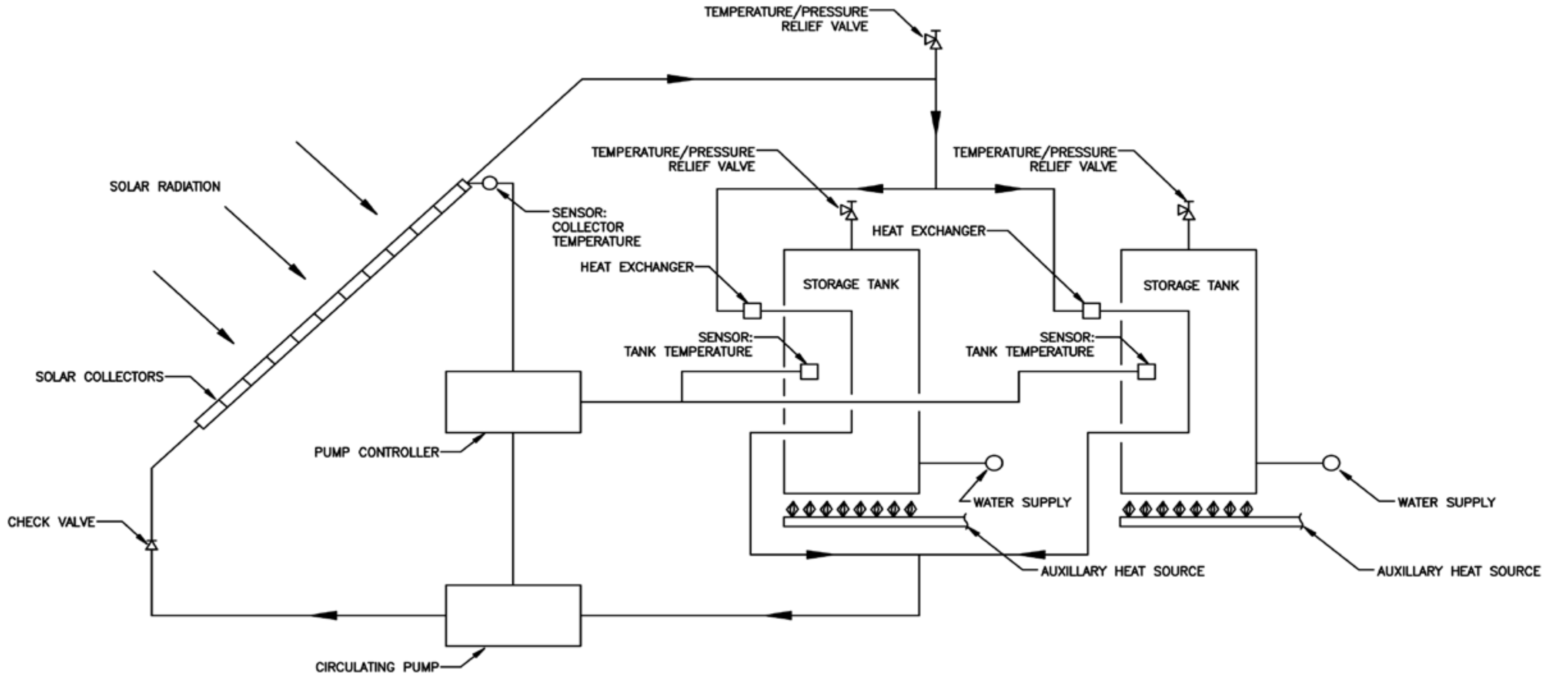
- Coverage: 130 sq ft per head.
- Density: 0.16 gpm per sq ft
- Area of application: 1,500 sq ft
- Hose allowance: 250 gpm
- Spaces: Storage rooms and mechanical spaces

Classification: Light Hazard

- Coverage: 225 sq ft per head
- Density: 0.10 gpm per sq ft
- Area of application: 1500 sq ft
- Hose allowance: 100 gpm
- Spaces: classrooms, offices, corridors, lobbies, auditoriums.

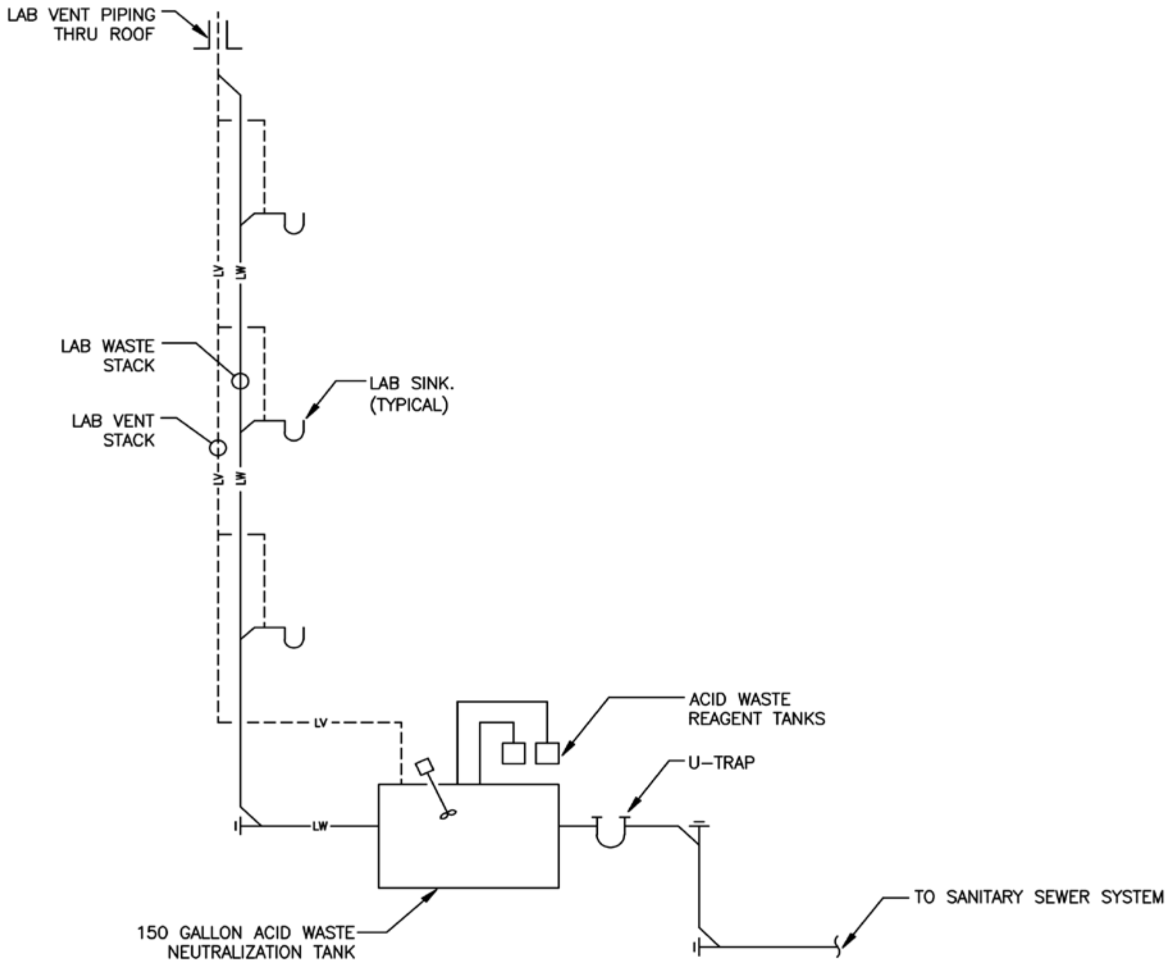
The piping system shall be Schedule 40 black steel pipe with malleable iron fittings and either threaded joints or roll groove mechanical couplings. Dry system piping shall be galvanized

In the Pi Scheme and the Clover Scheme, in areas with ceilings sprinkler piping will be run concealed and all heads shall be concealed type similar to Reliable model G4. In areas without ceilings, piping shall be exposed and painted with upright heads. All sprinklers shall be Quick Response type similar to Reliable model F1FR.

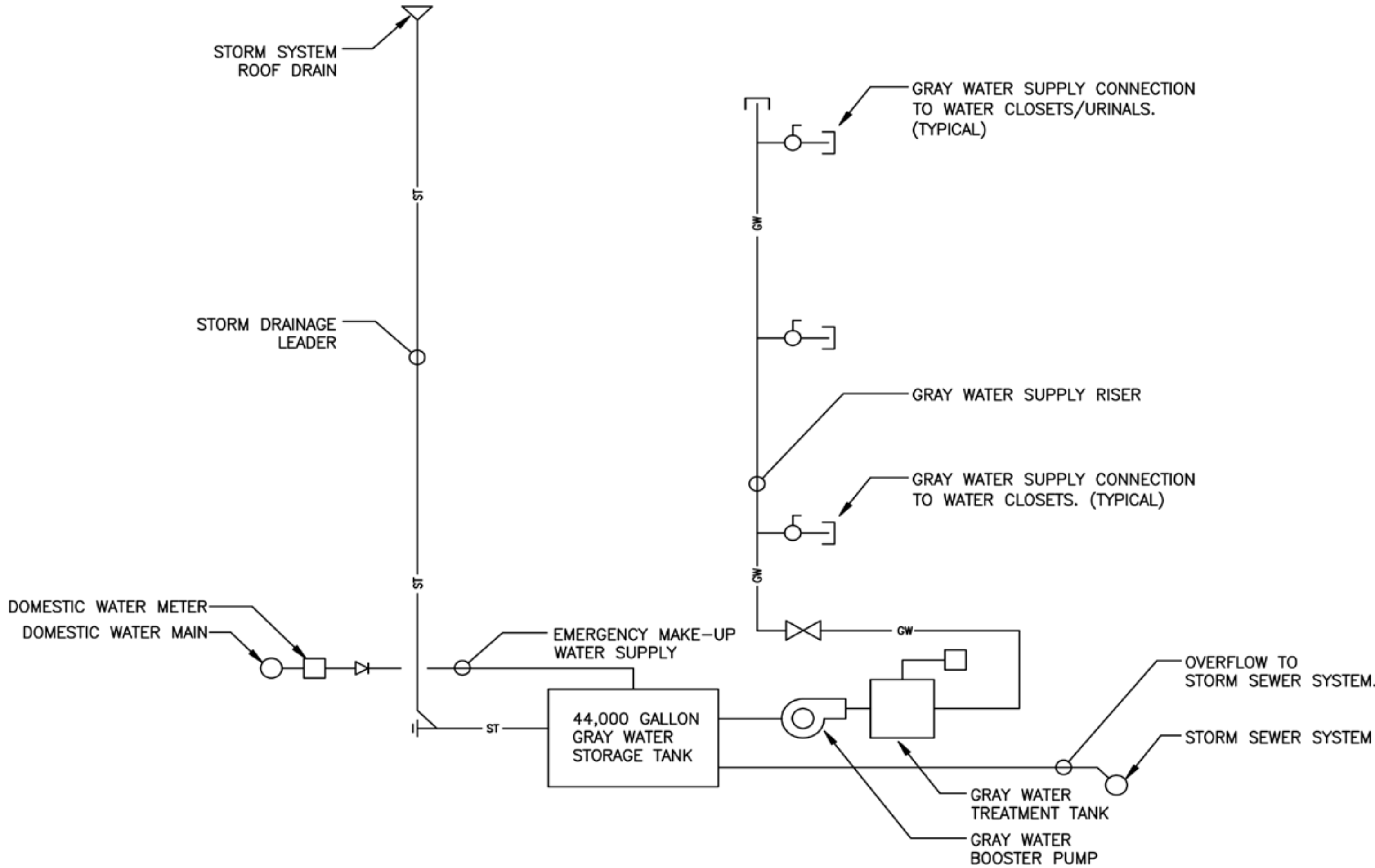


PUMP CIRCULATING SYSTEM, SERVICE WATER HEATING APPLICATION, DIRECT.
SCALE: N.T.S.

Design Options - MEP/FP

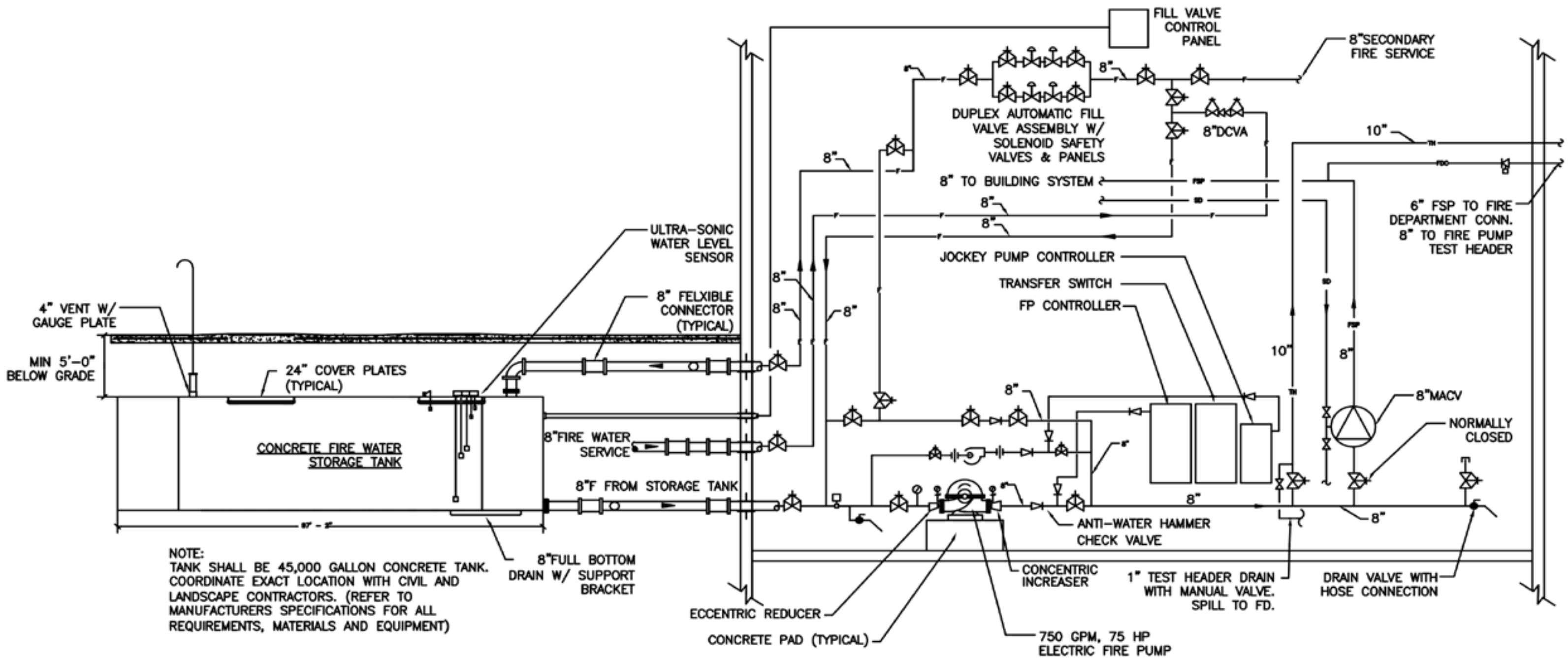


ACID WASTE PIPING SYSTEM RISER DIAGRAM
SCALE: N.T.S.



GRAY WATER PLUMBING SYSTEM RISER DIAGRAM

SCALE: N.T.S.



FIRE PUMP, STORAGE TANK AND ASSOCIATED PIPING AND EQUIPMENT
SCALE: N.T.S.

Foodservice

Kitchen and Food Preparation Area

The new kitchen facility shall include all the necessary components of a functional kitchen to include: a receiving area to be used as a staging point for the breakdown and distribution of delivered goods; refrigerated rooms for storage of refrigerated and frozen products are to be offered and sized to accommodate the needs of the facility; and dry goods storage for the keeping of canned, boxed, and other non-refrigerated food items. Food grade storage shelving and dunnage platforms shall be provided for dry goods storage and for storage of disposable items like plastic utensils, serving trays, and other paper related items.

Food preparation shall take place on stainless steel tables of various sizes and configurations. Tables may be fashioned with sinks, drawers, shelves, and overhead pot storage hook racks. Motorized food preparation equipment such as a food slicer, food cutter, and mixer shall be provided. Sizing of this equipment will be based on the scope of food preparation and tailored to fit the designed operation.

Cooking shall take place in a common location adjacent to both food storage and preparation. Equipment shall consist of standard pieces such as convection ovens, cooking kettles, braising pans, steamers, and open burner range tops. Adjustments shall be made to cooking equipment to suite the specific desired menu. The facility will include the necessary ware washing equipment to process ware, pots, trays, and pans.

Other support facilities located in or adjacent to the kitchen will include a staff toilet for men and women, a dedicated kitchen slop sink with enough space for the storage of mops, buckets and detergents. A clothes washer and dryer will be provided for the washing of mop heads, aprons, and kitchen hand towels. Typically grouped with this equipment are employee locker accommodations for the storage of personal items such as coats, handbags, or shoes.

In focus group meetings with the kitchen staff it was noted that the staff would be preparing meals from scratch as apposed the thaw and cook. Approximately 80% will be scratch and 20% will be processed. This will required that the cooler in this case be larger than the freezer. Fresh produce and locally sourced farm to table products will be utilized when possible. A small on site garden is expected to provide and additional source of scratch ingredients and will be utilized as a teaching tool.

Ware washing will take place as two separate functions: pot washing and dish washing. A three-compartment sink with equal sized drain-boards will provide a place for washing and sanitizing heavily soiled pots and pans; A dish machine will be used for washing and sanitizing reusable trays and utensils. The ware washer shall also be specified so that it will double as a utensil washer when appropriate. Mobile storage shelving for storing clean ware will be placed at various locations throughout the kitchen.

Other equipment typically required and specifically requested include:

- 20 and 30 quart mixer, automatic food slicer, and food processor
- A small blast chiller for preparing meals to be served at a later time and to quickly chill food through the danger zone. A blast chiller increases food safety as well as improves food quality.
- Four decks of combi ovens, a braising pan, and 40 gallon kettle
- Each kitchen must be provided with a mechanical means to wash and sanitize ware with a 180-degree rinse water process rather than a chemical rinse.

Serving Area

Serving will take place in two or three separate lines on various counters, organized into linear configurations, allowing for orderly and secure serving of food products. Counters are grouped into multiple hot food serving lines that will serve the typical school lunch. These lines shall include the necessary equipment needed to provide cold side offerings such as fruit, salads, and beverages. Salad bar portion will be the focal point of the serving are. Students will be encouraged to take second helpings from the salad bar thus it must be conveniently accessed to the cafeteria seating area.

Each of the lines will funnel into a common area large enough to accommodate the flow of traffic where the transaction is to take place. Mobile counters with tray slides will be provided to accept "Point of Sale" terminals, where students can check out using a code that is linked to a declining balance pre-paid system.

Serving line configurations will include a separation of cold and hot items as well as a separation of grade levels. Due to varying tray slide heights and menu needs, the K-4 students shall be served in a dedicated line. The 5th-8th grade level shall be served on the remaining two lines. In each instance, an adequate amount of mechanical cold pans and appropriate hot holding equipment will be provided.

LEED Checklist and Commercial Kitchens - Potential Points and Equipment Technology

The WEc4 Process water use reduction credit in LEED for Schools can be achived by specifying equipment that meets or exceeds the following criteria.

- No refrigeration equipment using once-through cooling with potable water.
- No garbage disposals.
- At least 4 process items where water use is at or below the levels set forth in the credit criteria.

This credit criterion consists of the following additional items.

- Boiler less steamer (one that uses less than 2 gallons per hour)
- Aerators for all hand sinks and prep sink faucets that limit water flow.
- A high efficiency clothes washer in the kitchen. (Typically have one in the kitchen dedicated to washing aprons, hand towels and mop heads. This washer is dedicated to the kitchen so that cross contamination is not a factor).
- A high efficiency sprayer at the pre rinse sprayer.
- A ware washer using 1 gallon or wash water per rack or less, and an efficient ice maker.

Other energy reduction considerations

- Open burner ranges - The typical range has five standing pilot lights. These pilots continue to consume energy even when the units are not in use. We will specify electronic pilot ignition systems for all equipment. The igniter makes it easy to light pilots and encourages staff to totally shut the unit down at the end of the day in an effort to conserve natural gas. *Each four-burner unit consumes on average 4000 to 6000 btu's per hour, that's more than 21 million btu's per year at an idle operating cost of $249. The upgrade to the ignition system had a pay back period of approximately 15 months.

- Steamers – We only consider high efficiency units. They are 70% more efficient and are approximately 20% more productive. Due to technical advances in burner technology. In the northeast the utility company may offer up to a $1000 rebate for each steamer purchased.
- Walk -in refrigerated rooms - The mechanical refrigeration systems for these rooms are typically controlled with simple time clock defrosts at the freezer coils. These work well but it is not an intelligent system. We specify a Smart Defrost system that is designed to defrost the refrigerated room only when they are needed. Typical time clock controlled electric defrost systems have four defrosts per day. Using a Smart Defrost system can reduce the number of defrosts from none to two per day. This system represents an average savings of 75% in energy. In addition to the smart defrost we recommend the use of PSC or ECM motors in all refrigeration room blower coils. These motors last longer and represent a 72% energy consumption reduction, and run quieter than traditional motors.
- Exhaust hoods - The typical hood system run at full capacity the entire time it is in operation. This is in most cases more than eight hours per day. We specify technologies that allow us to realize savings without restricting the type of hood availability. These systems are called Energy Management Systems or EMS. What EMS controls do is modulate the speed of the exhaust and MAU fan motors with variable frequency drives (VFD's). In simple terms the control system senses heat at the exhaust duct and increase or decreases the amount of exhaust rate based on demand rather than running at 100% capacity 100% of the time. EMS systems have been shown to significantly reduce the energy consumption and electrical demands associated with operating the hood systems. On average this represents a 62% reduction in electrical demand.
- In addition to electrical energy savings there would be an energy savings gained from the reduced heating load at the make up air units. Typically the average fan speed associated airflow of the MAU will drop 30% resulting in a significant amount of air that does not need to be heated. The average pay back for these systems is less than one year. In most cases the local utility will reimburse the owner for a portion of the added cost to include an EMS.
- Hood End Panels - Adding end skirts to the end of each hood would allow us to reduce the exhaust air volume and is also a way to improve capture and containment. Another benefit of end panels is to mitigate the negative effect that cross drafts can have on hood performance. Lastly less exhausted air means less make up air and a reduction in reheating that air in the winter.

Design Options - Foodservice

- Hood Lights - By replacing the incandescent light bulbs in exhaust hoods significant reductions in energy usage can be realized. Incandescent bulbs transform about 85% of energy they use into heat. The life spans of these lights are approximately 750 to 1000 hours. Consider the constant vibration at the hood and this is reduced even further. The initial cost of a 60 watt incandescent bulb is about 50 cents each and assuming the typical hood has eight lights in it we can calculate that these eight bulbs will cost about $525 dollars per year to operate.

- Compact fluorescent lights CFL's are much more efficient. They convert only about 25% of energy put into them into heat. The lifespan of a CFL is 7,500 to 10,000 hours but the initial cost is about $10 each. This initial high cost is quickly recovered since the cost to operate CFL is about $160 per year. Compact fluorescents should be specified for all new hoods going forward but consider the savings if the change was implemented to include all existing hoods system wide.

This concludes this section.

Following are acoustical goals for compliance with LEED for Schools 2009:

IEQ.P3 – Minimum Acoustical Performance (prerequisite):

- 0.6-second reverberation time for classrooms with volumes up to 20,000 ft^3;
- 1.5 second reverberation time for classrooms with volumes above 20,000 ft^3;
- Background noise level goal: 45 dBA (L_{eq}).

IEQ.C9 – Enhanced Acoustical Performance (optional):

Compliance with the sound isolation requirements referenced in ANSI S12.60-2002, except for windows which must meet and Sound Transmission Class (STC) rating of at least 35:

- STC 50 between adjacent learning spaces. This requirement is also needed for composite walls, including any interconnecting doors that may exist.
- STC 45 between a learning space and adjacent corridor, staircase, office or conference room. This requirement is needed for the basic wall exclusive of the door. Doors need to be provided with full perimeter gaskets and drop bottom.
- STC 60 for the music room walls.
- Floor/ceiling constructions above core learning spaces must achieve a minimum Impact Insulation Class (IIC) of 50.
- GWB partitions to run from floor to deck above.

Improved background noise conditions:

- Background noise level goal: 40 dBA (L_{eq}), or
- Background noise level goal: 35 dBA (L_{eq}) – for 1 additional point.

Note: Additional more stringent criteria may be established by the Design Team, for more sound sensitive spaces such as Auditorium or music rooms. These are to be determined during the subsequent design phases of the project.

Audiovisual Systems

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Design Options – Audiovisual Systems

GENERAL SUMMARY

GENERAL:

This feasibility report describes the audiovisual systems in for the Martin Luther King Jr. School building in Cambridge. The report defines the audiovisual system technologies utilized for the different spaces, and presents a budget for the systems. The program report also provides general costs for audiovisual system components and installation. The client should review this document for conformity to user needs. It must also be compiled with other related budgets such as network data distribution, furniture, millwork, electrical, and mechanical systems to provide a complete picture of the associated costs.

ACENTECH'S BACKGROUND

Acentech is an independent consulting firm specializing in the design of advanced sound, audiovisual and videoconferencing systems. In order to provide unbiased consulting and design services, Acentech does not sell or install equipment and does not represent any dealer, distributor, or manufacturer.

INFORMATION GATHERING:

This report is based upon our meetings with the Owner, Perkins Eastman, follow-up reports from Perkins Eastman, our experience on similar projects, and industry standards reflecting generally accepted design criteria. The design team and owner will review this draft report and provide comments, after which we will modify the report and it will become the basis of design for the audiovisual systems. This report is intended to be used as a starting point for discussions related to the specific needs of the School.

DEFINING ADD-ALTERNATES:

At this early stage of the project it is important to capture as much of the requirements as possible for the various rooms in the in the school. As the project moves forward we will update audiovisual system cost, along with any changes in needed capability. The School will need to determine their priorities in setting the Add-Alternate schedule for final purchase. We do expect at the time of final audiovisual systems design to have complete systems designs which would include selected and optional Add-Alternates. We will integrate into our design as much of the school's furnished equipment as reasonably possible as "Owner Furnished Equipment" (OFE).

INTRODUCTION

INFRASTRUCTURE VS. EQUIPMENT:

The distinction between infrastructure and equipment must be emphasized:

Infrastructure is part of the building construction and includes conduit, raceways, junction and device boxes, as well as electrical power and grounding required exclusively for audiovisual systems cabling and equipment. Properly designed AV infrastructure allows for not only the installation of the initially specified equipment, but for the evolution of the systems over many years. If proper infrastructure is provided, additional capabilities and equipment can be efficiently added later as technology progresses.

Equipment refers to the devices that can be connected through the infrastructure. Equipment includes microphones, loudspeakers, mixers, signal processing gear, video projectors, flat-panel displays, cameras, VCRs, DVD players, AV control systems, patch bays, equipment racks, and many other devices that comprise an AV system, including cabling interconnections to AV devices.

One thing is certain; equipment will continue to change over the life of the room as user needs and technology change. For this reason, a properly designed infrastructure is the key to the long-term success of a thoughtfully conceived AV design project because it governs what can and cannot be easily installed in the future.

EQUIPMENT NOTES AND DEFINITIONS:

This report is not a technical specification and is insufficient to bid or build an AV system. Except where useful to illustrate a standard of performance or a specific user requirement, equipment manufacturers and model numbers are not used.

Permanently-installed refers to equipment that will be part of the room systems and cannot easily be removed for use elsewhere.

Portable refers to equipment that will be available for connection at one or more locations, but will be not hard-wired to the system. Portable equipment can be disconnected by the user or technical personnel and stored or used with systems elsewhere in the facility.

Future Provisions refers to equipment that may be purchased and used or installed at a future date.

OFE (Owner Furnished Equipment) refers to equipment that will be either already owned, or may be purchased in the future as needs arise.

FBO (Furnished by Others or “by others”) refers to any service or equipment (e.g. lighting) required but not a part of the AV system design or installation.

LIGHTING AND ACOUSTICAL RECOMMENDATIONS

Lighting and room acoustic recommendations are guidelines only as related to the best performance of the audiovisual systems and should be reviewed by the architect and other consultants. These guidelines do not include considerations for the installation of the audiovisual equipment which should be considered as additional points of light and noise.

GENERAL TECHNOLOGY OVERVIEW

At this time audiovisual systems have begun a transition from analog-formatted signals to an all digital system. While there is some need to maintain compatibility and usability between both the analog and digital worlds, the transition is proceeding and the analog “sundown” (the discontinued use of analog video signals) is fast approaching. The School may be using of some analog VHS machines for playback. We strongly suggest that the School develop and implement a plan to transfer their VHS content (within copyright limitations) to an appropriate digital platform.

PRESENTATION SYSTEMS:

Presentation systems are the source, routing, and display devices that provide highly intelligible communication of speech, music, information, and graphics to groups of people. This includes equipment such as microphones, loudspeakers, video projectors, flat-panel displays, DVD players, computers, and the interfacing, mixing, routing and control equipment that connects these devices together and allows the user to select the appropriate sources and operate the system.

VIDEOCONFERENCE AND STREAMINGS SYSTEMS:

Videoconferencing, streaming (i.e. “Skype” and other formats), and classroom capture equipment (cameras, video encoding/decoding hardware, and related devices) are not provided as part of the base proposal. However, videoconference capability in both the conference rooms and classrooms are proposed as options that may be added. Infrastructure (conduit, junction boxes, camera niches, etc.) required to support this equipment should be included if there is any possibility that such capabilities may be desired in the future.

It is important to note that in the use of HDMI or DVI type digital video signals that recordings (including capture, streaming, and conferencing) and transmissions may not be possible if the electronic signal has a High-Definition Copy Protection (HDCP) signal present.

BROADCAST SYSTEMS:

Broadcast quality equipment and systems generally refer to audio and video devices (cameras, video recorders and editing equipment) of the highest quality, specifically designed for the recording, editing, and production at the commercial level, such as in cable and network television studios.

In general, broadcast quality equipment will be an order of magnitude more expensive than “professional” quality equipment. Such equipment is not anticipated for this project. Some level of production capability is expected.

MICROPHONE SYSTEMS (CLASSROOM - CONFERENCE ROOM TYPE):

Close microphone options include: The installation of gooseneck microphones in the conference tables or desks, either a dedicated microphone or a delegate type system. The downside is some small room effect may be introduced, the microphones will not be effective when a participant is standing, possible damage, and additional infrastructure requirements to support the cabling. The next best choice in the close microphone option would be the flush/semi-flush microphones in the conference tables or student desks. The downside is greater room effect will be introduced, the microphones will not be effective when a participant is standing, possible damage, and additional infrastructure requirements. It should also be noted that these microphones have a rather poor result in true usability since they have a tendency to pick up a significant amount of table/desk noise and can also be covered or interfere with the work area.

Distant Microphone options include: It should be noted that distant/ceiling microphones will be affected by room effects (reverberation) and ambient room noise. Flush microphones provide wide coverage patterns and a low profile so they do not interfere with sight lines for the participants, cameras, or projectors. The downside is because they are further away from the participants they are effected room conditions. Also, having large numbers of these microphones can increase sound multi-path issues. The next type are pendant type microphones which provide a more focused pattern requiring them to be closer to the subjects and used in greater numbers. The downside is they tend to interfere with visual sight lines of the participants, cameras, and projectors, a greater number are needed in a given space, periodic realignment is usually needed, and are still effected by room conditions. The last type are shotgun type microphones that provide the most focused pick-up pattern and thereby need to be located or clustered in specific locations to operate. It should be noted that this approach is rarely used and with mixed results. The downside is ceiling space, location, and microphone size requirements are significant and these systems are still prone to room conditions.

Design Options – Audiovisual Systems

ASSISTIVE LISTENING SYSTEMS:

Permanently installed Assistive Listening Systems (ALS) are required by the ADA (American with Disabilities Act), a 1990 federal law (2010 update) that forbids discrimination against persons who are hearing handicapped. ALS systems are required in rooms that include permanently installed sound systems and the content (voice and program) is part of the transmission of information.

AUDIOVISUAL CONTROL SYSTEMS:

Audiovisual control systems used in these facilities may be as simple as the handheld display control for very simple systems to more integrated control panels for the more complicated room systems.

Audiovisual control systems can be used to unify and simplify the operation of the various functions of the AV system. This may includes environmental controls such as lighting presets and shade and drape controls, as well as audiovisual functions such as system and projector power, source selection and media transport controls, volume controls, and many other operational functions identified by the design team before the equipment will be installed.

Advanced functions of the AV control system include multi-level password protection for system operation to prevent unauthorized use, control of automatic system shut-down sequences (to reduce unnecessary wear and tear), and a help system interface for user experiencing technical problems.

CONTROL SYSTEM MANAGEMENT NETWORK:

Networked AV management systems automate and streamline many technical support functions. Built-in reporting provides the ability to track resource usage for more effective purchasing, scheduling and resource allocation. These systems can reduce response times for service calls and technical supports issues, because system users and presenters can send help requests directly from the touch panels. Technicians can respond with built-in instant messaging, then service and control devices remotely.

COMPUTER AND NETWORK EQUIPMENT:

Computers (desk-tops, laptops, and i-Pad type devices), their monitors and peripheral equipment are assumed to be provided by the owner or covered under the information technology budget. Also, network devices such as LAN switches, routers, and servers are assumed to be provided by the owner or covered under the information technology budget.

CLASSROOMS (TOTAL 53)

DESCRIPTION:

The classrooms located throughout the building and are equipped with movable seating for 20 to 25 students and a teacher's station. These rooms will be equipped with audiovisual equipment to support presentations, including a single front interactive white-board with integrated video projector for their source materials including DVD, local computer, a laptop input, and i-Pad interface. The instructor will have access to a wireless microphone for sound reinforcement in the classroom and control of audio levels for reproduction of the various audio sources through recessed ceiling loudspeakers. The instructor will have full control of the audiovisual technology using a touch-button control panel at the teacher's station as well as remote support from the media center when needed. An assistive listening system will be provided in each classroom to meet the requirements of the Americans with Disabilities Act. Portable receivers will be stored centrally and issued to participants as required. These receivers are for use by the students with hearing impairments. The classrooms with this basic capability include:

- Lower school classrooms: 22
- Lower school arts and language: 3
- Upper school classrooms: 17
- Upper school arts and language: 1
- Human resources classrooms: 4
- Learning commons flex instruction: 2
- Music, chorus, and band: 3
- Vocational technology: 1
- Health classroom 1
- **TOTAL: 54**

Note: The music, chorus, and band classrooms will have upgraded sound playback loudspeaker system for greater audio fidelity.

AUDIOVISUAL SYSTEMS:

The audiovisual system for the classrooms will include the capabilities described above and will be detailed as the design process continues:

Refer to the budget section for estimated audiovisual equipment costs.

Design Options – Audiovisual Systems

ROOM LIGHTING:

Though not part of the audiovisual system design or installation, the classroom should have dimmable or controllable lighting with multiple zones for chalkboards, projection surface, presentation areas, and the student area. All lighting in the classrooms should use the same color temperature lighting. Special lighting may be considered to support presentation and future video events. Ambient light on the projection screens should not exceed 7 lumens.

ROOM ACOUSTICS:

Acoustical conditions should be reviewed by an acoustical consultant for acceptable background noise criteria (NC) and reverberation time (RT). Future recordings may be made in the classrooms and we recommend no higher than a NC-25 rating and a low reverb time. It should be noted that movable walls have limited isolation capabilities and there may be some acoustical issues between rooms when both sides are in use at the same time.

AUDIOVISUAL ELECTRICAL LOAD:

The electrical load for the audiovisual equipment in these classrooms is not expected to exceed 3,000 watts. A more detailed breakdown will be made as the project progresses.

GENERAL CONTRACTOR, OWNER, AND MISC. SCOPE:

The general contractor will supply all infrastructure requirements and the School will supply all LAN and workstation electronics.

AUDITORIUM

DESCRIPTION:

The Auditorium will be used for used for a variety of events including live music and theater performances, multimedia presentations with audio and video, and presentation/lecture type events.

The audiovisual system in the Auditorium will consist of a sound system used for speech reinforcement and program audio playback. It will include wired microphone inputs and four wireless microphones, an automatic microphone mixer (for simple presentations), a manually controlled digital mixing console (for production type events), and associated processing and amplifiers.

A central loudspeaker cluster will be located above and in front of the proscenium opening. It will be used for speech reinforcement and playback of audio. The loudspeaker system will provide uniform audio coverage through the audience area; allowing the system to provide high levels of speech intelligibility and musical clarity.

Connections for wired microphones and other audiovisual sources will be located on wall-mounted receptacle panels and within floor boxes. These will be located on the stage (upstage and downstage walls, and front face of the stage), the catwalk (if applicable), and the within the house. Audio press feeds will be available at receptacle panels.

An intercom system will be used for communication between production crew members at control locations, and relevant backstage spaces such as the Green Room, Theater Storage, Woodshop, dressing rooms, and other backstage areas. The typical intercom system includes either two or four channels. AV connection panels within the Auditorium will include receptacles for the connection of intercom beltpacks. Wall-mounted stations will be located in the other spaces. The system will be provided with four single-channel beltpacks and 2 dual-channel beltpacks with headsets and cables.

A high-brightness video projector will display motion video and still images onto a motorized projection screen. The system will support playback and distribution of digital and analog video formats including VGA, HDMI, DVI, composite, and S-Video. AV sources devices, housed in the main AV equipment rack, will include a high-definition DVD player (Blu-Ray), and will include owner-provided sources such as a cable television receiver or AppleTV. Additional audiovisual connections for portable AV equipment, such as a presenter's laptop computer, will be available on receptacle panels (two on stage floor-boxes, and one in the Control Booth). An integrated control system will allow components of the audiovisual system to be operated from selected uniform control points; one wireless panel for use at the auditorium house control position, the control booth, or at the Lectern, and a wall-mounted panel at the stage manager position on the stage. The control points will provide the end-user with easy control and configuration of the regular functions of the audiovisual system, such as:

The typical control system user interface is a color liquid crystal display (LCD) panel with a touch sensitive overlay. Graphics displayed on the panel will easily guide the user through the operation of the audiovisual system. A wireless assistive listening system is included to meet the requirements of the Americans with Disabilities Act. Portable receivers will be stored centrally and issued to participants as required. These receivers are for use by the students with hearing impairments.

AV system processing, switching, control, and amplification equipment will be located in equipment racks located in the Auditorium Control Booth.

AUDIOVISUAL SYSTEMS:

The audiovisual system for the classrooms will include the capabilities described above and will be detailed as the design process continues:

Refer to the budget section for estimated audiovisual equipment costs.

ROOM LIGHTING:

Though not part of the audiovisual system design or installation, the auditorium should have dimmable or controllable lighting with multiple zones. All lighting in the auditorium should use the same color temperature lighting. Special lighting may be considered to support presentation and production events. Ambient light on the projection screens should not exceed 7 lumens.

ROOM ACOUSTICS:

Acoustical conditions should be reviewed by an acoustical consultant for acceptable background noise criteria (NC) and reverberation time (RT). Recordings may be made in the auditorium and we recommend no higher than a NC-25 rating and a low reverb time.

AUDIOVISUAL ELECTRICAL LOAD:

The electrical load for the audiovisual equipment in the auditorium is not expected to exceed 10,000 watts. A more detailed breakdown will be made as the project progresses.

GENERAL CONTRACTOR, OWNER, AND MISC. SCOPE:

The general contractor will supply all infrastructure requirements and the School will supply all LAN and workstation electronics.

GYMNASIUM (TOTAL 2)

DESCRIPTION:

The sound system for each of the gymnasiums will provide for speech reinforcement and music playback. It will consist of distributed overhead loudspeakers covering the main gym floor and seating areas. The loudspeakers will be zoned accordingly.

Playback sources will include a CD player, MP3 connection, general paging and background music.

Volume controls and source selects controls will be wall-mounted. In addition, a wired microphone location will be located on the main floor for game announcements. A wireless microphone system with a hand-held transmitter will also be available.

The amplifier and audio processing equipment will be located in the equipment racks in a nearby equipment closet or other appropriate location. A small, portable equipment rack containing CD player and a portable mixer will be supplied for local source mixing and control.

AUDIOVISUAL SYSTEMS:

The audiovisual system for the gymnasiums will include the capabilities described above and will be detailed as the design process continues:

Refer to the budget section for estimated audiovisual equipment costs.

ROOM LIGHTING:

Though not part of the audiovisual system design or installation, the gymnasiums should have controllable lighting with multiple zones. All lighting.

ROOM ACOUSTICS:

Acoustical conditions should be reviewed by an acoustical consultant for acceptable background noise criteria (NC) and reverberation time (RT).

AUDIOVISUAL ELECTRICAL LOAD:

The electrical load for the audiovisual equipment in the auditorium is not expected to exceed 2,000 watts. A more detailed breakdown will be made as the project progresses.

GENERAL CONTRACTOR, OWNER, AND MISC. SCOPE:

The general contractor will supply all infrastructure requirements and the School will supply all LAN and workstation electronics.

DINING - CAFETERIA

DESCRIPTION:

The sound system for cafeteria will provide for speech reinforcement and music playback. It will consist of distributed overhead loudspeakers covering the seating areas. The loudspeakers will be zoned accordingly.

Playback sources will include a CD player, MP3 connection, general paging and background music.

Volume controls and source selects controls will be wall-mounted. In addition, a wired microphone location will be located on the main floor for announcements. A wireless microphone system with a hand-held transmitter will also be available.

The amplifier and audio processing equipment will be located in the equipment racks in a nearby equipment closet or other appropriate location.

AUDIOVISUAL SYSTEMS:

The audiovisual system for the cafeteria will include the capabilities described above and will be detailed as the design process continues:

Refer to the budget section for estimated audiovisual equipment costs.

ROOM LIGHTING:

Though not part of the audiovisual system design or installation, the cafeterai should have controllable lighting with multiple zones. All lighting.

ROOM ACOUSTICS:

Acoustical conditions should be reviewed by an acoustical consultant for acceptable background noise criteria (NC) and reverberation time (RT).

AUDIOVISUAL ELECTRICAL LOAD:

The electrical load for the audiovisual equipment in the cafeteria is not expected to exceed 1,500 watts. A more detailed breakdown will be made as the project progresses.

GENERAL CONTRACTOR, OWNER, AND MISC. SCOPE:

The general contractor will supply all infrastructure requirements and the School will supply all LAN and workstation electronics.

MULITMEDIA STUDIO

DESCRIPTION:

The multimedia studio is a suite of small spaces which include a small television studio space for multi-camera recordings, a sound booth for audio recordings, and a control room space for equipment and operators, and a small multi-station editing room.

The multimedia space will be equipped with a small two camera video production system and audio mixer and microphones for making recordings to digital formats. The control room will also include a digital encoder to provide live feeds to the classrooms over the school's LAN network.

The students will be able to edit their recorded material on computer based editing systems located in adjacent area.

AUDIOVISUAL SYSTEMS:

The audiovisual system for the multimedia area will include the capabilities described above and will be detailed as the design process continues:

Refer to the budget section for estimated audiovisual equipment costs.

ROOM LIGHTING:

Though not part of the audiovisual system design or installation, the multimedia area should have dimmable or controllable lighting with multiple zones. All lighting in the multimedia should use the same color temperature lighting. Special lighting may be considered to support presentation and production events. Ambient light on the projection screens should not exceed 7 lumens.

ROOM ACOUSTICS:

Acoustical conditions should be reviewed by an acoustical consultant for acceptable background noise criteria (NC) and reverberation time (RT). Recordings will be made in the multimedia area and we recommend no higher than a NC-25 rating and a low reverb time.

AUDIOVISUAL ELECTRICAL LOAD:

The electrical load for the audiovisual equipment in the multimedia area is not expected to exceed 10,000 watts. A more detailed breakdown will be made as the project progresses.

GENERAL CONTRACTOR, OWNER, AND MISC. SCOPE:

The general contractor will supply all infrastructure requirements and the School will supply all LAN and workstation electronics.

CONFERENCE AND GROUP ROOMS (TOTAL 7)

DESCRIPTION:

The conference and group rooms will support 8 to 12 people at a table with movable chairs. The conference and group rooms will have a presentation system for display of media from portable laptop computers and other portable video equipment.

AUDIOVISUAL SYSTEMS:

The audiovisual system for the conference and group rooms will include the capabilities described above and will be detailed as the design process continues:

Refer to the budget section for estimated audiovisual equipment costs.

ROOM LIGHTING:

Though not part of the audiovisual system design or installation, the conference and group rooms should have dimmable or controllable lighting. All lighting in the conference and group rooms should use the same color temperature lighting. Special lighting may be considered to support presentation and production events. Ambient light on the display screens should not exceed 7 lumens.

ROOM ACOUSTICS:

Acoustical conditions should be reviewed by an acoustical consultant for acceptable background noise criteria (NC) and reverberation time (RT).

AUDIOVISUAL ELECTRICAL LOAD:

The electrical load for the audiovisual equipment in the conference and group rooms is not expected to exceed 10,000 watts. A more detailed breakdown will be made as the project progresses.

GENERAL CONTRACTOR, OWNER, AND MISC. SCOPE:

The general contractor will supply all infrastructure requirements and the School will supply all LAN and workstation electronics.

ELECTRONIC INFORMATION DISPLAYS (TBD)

DESCRIPTION:

There are a variety of applications for electronic informational displays which include entry kiosk's, event and directional displays, stock ", and multi-panel branding displays. The new building offers a wide array of possible location for these displays and each of the options need to be explored with the owner.

AUDIOVISUAL EQUIPMENT: TO BE DETERMINED AT THIS TIME

OPTIONAL TECHNOLOGIES

DESCRIPTION:

The technologies described below represent a wide range of available options that the Martin Luther King School should consider on a room by room basis. Please be aware that some options may have impact on other selected technologies. Some of these options may require additional capabilities presently outside our scope of work. We will be available to discuss any of these options with the School and to assist in additional planning efforts.

INFORMATION DISPLAYS:

Digital signage helps to inform occupants of the day's events, broadcasts the vitality of the School, and extends the instructional technology experience and daily events to those at the School of Law. Large public displays form the basis of the proposed signage system: the final quantities and locations are yet to be determined. The displays will be control remotely from standard computer workstations. We recommend a system that would allow individual groups to create their own graphics and schedule details and submit the information to a display operations group or individual for final approval and posting to the designated display or displays. Each display could display different information or the same as determined by the School. Each display will be able to display both graphical information as well as live video (cable television) as pictured below. $2,500 each.

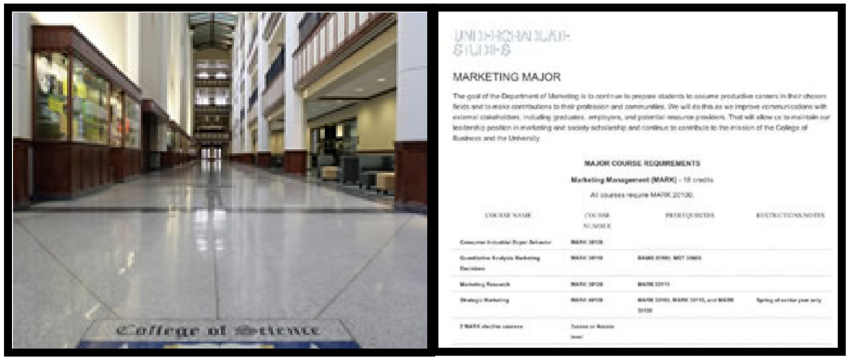
ROOM SCHEDULING DISPLAY:

The School may wish to consider adding a wall-mounted touchscreen as an interactive scheduling service to desired rooms. This screen could be used to display the current room status and to look up the day's events and its activities for a given room. These schedulers pull their information over the network with software "hooks" to programs such as the Outlook Exchange Server. Adding a scheduler to a given room would cost approximately $1,200.

ENTRY KIOSK:

The School may wish to consider adding a large kiosk or wall-mounted touchscreen as an interactive directory and way-finding service. This screen could be used by visitors to look up the day's events, learn more about the school and its activities, and to find specific faculty/staff, offices, or classrooms. An interactive touchscreen system (installed with custom software) added to the entry would cost approximately: $10,000

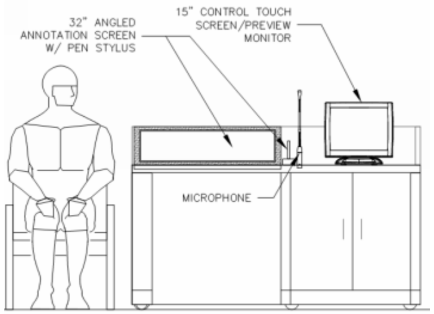
ELECTRONIC IMAGE DISPLAY:



Electronic image splitting provides the capability to display two or more images on a single display. This could be used to display two 4 by 3 aspect ratio images on a 16 by 9 display. This type of image splitting can also be very useful in videoconferencing and distance learning environments where there may only be a single display.

The cost for adding this option on a room by room basis would be approximately $12,000

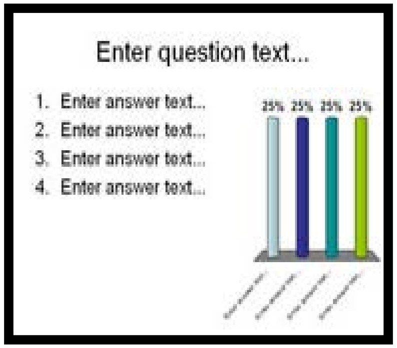
Design Options – Audiovisual Systems



ANNOTATION / ELECTRONIC WHITEBOARD:

The annotation tablet / electronic whiteboard is similar to a monitor with a graphical annotation pen embedded into the lectern. As an added advantage, the instructor does not have to turn his/her back to students to point to features or to annotate over the screen.

Adding this option on a room by room basis will range from $5:000 to $11,000.



STUDENT RESPONSE SYSTEMS:

Student response systems can be wired or wireless technology based on the classroom architecture and budget considerations. These systems are used in classrooms to engage students in the learning process and to assist instructors in developing more interactive classroom activities. The systems generally use the local classroom computer with a software application and a receiver (for wireless versions), which can gather the data from student transmitters and provide graphical feedback to the instructor and class. The wireless systems are the least expensive and easiest to install. Many educational institutions will install the receivers in classrooms and sell the transmitters to students through the campus bookstore. Adding this option on a room by room basis would cost approximately

$2,000.

VIDEO CONFERENCING & CLASSROOM CAPTURE:

Classroom or conference room videoconferencing and capture technologies involve the ability to provide communication with audio, video, and content (note: content with HDCP encryption cannot be recorded) either as a live interactive capability (one-to-one or a few to one to many) or as content for “on-demand” play back. This requires the addition of video camera(s), room microphones, special audio processors, video coders and/or capture units, and a distribution server/storage system. Adding this option on a room by room basis would cost approximately $25,000 to $75,000. Note: Depends on capabilities needed.

COLLABORATION TECHNOLOGY:

Collaboration Technology: Classroom collaboration technology typically includes software (provided by the School), such as Ciscos' WebEx, Smart Technologies' Bridgit, or Tidebreak's ClassSpot loaded onto a room PC. The PC interfaces with classroom/conference room audio and video systems to capture local participants and sends this information along with the local computers' content to one or more remote participants. Together the local site and participants can interact with exchange of voice, low resolution video and content. This technology allows two or more PC's to connect over the internet and participate in the review of a document or presentation. The video and audio is often of a lower quality than with a distance learning technology (see below) but provides an adequate and cost effective means of sharing computer data. Adding this option on a room by room basis would cost approximately $5,000. Note: requires video conference option to be also added.

AUDIO CONFERENCING:

Audio conferencing allows participants to interact with remote site using voice-only capabilities. Audio conferencing for small meeting rooms may be as simple as a table top device (shown to the right) or a more integrated system for larger spaces. Adding this option on a room by room basis would cost approximately $1,000 to $12,000.

ARCHITECTURAL – MECHANICAL/ELECTRICAL CONSIDERATIONS

ARCHITECTURAL:

The following items should be considered for proper coordination between audiovisual components and other trades:

Wall and Ceiling-Mounted Loudspeakers:

- Loudspeaker coverage patterns must not be obstructed.
- Structural support for mounting and hanging of loudspeakers.

AV Equipment Rack Locations:

- The location of the equipment rack within millwork will require proper coordination with the Architect.
- Proper installation and service access space for fixed rack locations.
- For in-wall or millwork mounting racks will need blocking and/or ventilation.
- Equipment racks in closets will need over-height doors.

Video/Data Display Systems:

- Support for the wall-mounted video displays will require further coordination with the Architect.
- Support for the ceiling suspended video projectors will require further coordination with the Architect.
- The mounting of the projection screens will require further coordination with the Architect.
- Coordination with the room curtains and lighting systems is required.

Connection Panel Locations:

- Connection panel locations will require further coordination with the electrical engineer and the Architect.

Wall-Mounted Antennas:

- Antennas for the assistive listening system and wireless microphones will be mounted on the wall.

Floor Box/Poke-Through and Wall-Mounted Connection Panel Locations:

- Floor-box and wall-mounted Connection panel locations will require further coordination with the electrical engineer and the Architect.

Hanging Microphones:

- Hanging microphones used for multimedia or videoconferencing should not be located near noisy objects (such as video projectors) or in direct path airflow originating at HVAC supply vents.

AV Millwork:

- AV equipment mounted in credenzas and/or lecterns will require proper coordination with the Architect.

MECHANICAL / ELECTRICAL:

The following items should be considered for proper coordination between audiovisual components and other trades:

AV Equipment Rack Locations:

- The location of electrical power, tel/data connections, and back-boxes and conduit will require proper coordination with the Architect and Mechanical/Electrical Engineer (MEP).
- Proper ventilation will be required to maintain proper cooling of sensitive audiovisual equipment.

Video/Data Display System:

- The location of electrical power, tel/data connections, and back-boxes and conduit will require proper coordination with the Architect and Mechanical/Electrical Engineer (MEP).
- Coordination with the room curtains and lighting systems is required.

Design Options – Audiovisual Systems

Connection Panel Locations:

- Connection panel locations will require further coordination with the electrical engineer and the Architect.

Wall-Mounted Antennas:

- Antennas for the assistive listening system and wireless microphones will be mounted on the wall.

Floor Box/Poke-Through and Wall-Mounted Connection Panel Locations:

- Floor-box and wall-mounted Connection panel locations will require further coordination with the electrical engineer and the Architect.

AV Millwork

- AV equipment mounted in credenzas and/or lecterns will require proper coordination with the Architect.
- Proper ventilation will be required to maintain proper cooling of sensitive audiovisual equipment.

AV Power Loads:

- The AC power supply to all audiovisual systems must be coordinated for panel loading and phasing.

BUDGET SUMMARY

BUDGET CONSIDERATIONS:

This feasibility level report presents the audiovisual system program for the Martin Luther King School project. This program will discuss audiovisual technologies for each of the different spaces. The intent of this program is to assist in calculating general costs for audiovisual equipment. The client is expected to review this document for conformity to user needs. It must also be compiled with other related budgets such as network data distribution, furniture, millwork, electrical and mechanical systems, as well as General Contractor and Construction Manager costs to provide a complete picture of the associated costs.

The installed costs of audiovisual systems are approximate, assume the use of new equipment installed professionally by a qualified audiovisual systems contractor, are provided with as-built documentation, and a one-year warranty covering parts and labor. The estimate totals do not include costs for requirements such as electrical power, conduit, lighting fixtures, blackboards, casework or any special architectural requirements. Technical administration and staffing, as well as vendor-supplied audiovisual service and maintenance beyond the initial one-year parts and installation warranty, are not included in this estimate.

The estimates assume that the labor costs are 35% greater than the total of equipment at list price. This figure accounts for equipment normally sold at some discount from list price and incorporates the costs associated with travel, installation, documentation, training and on-site maintenance for one year. Installation cost is the greatest variable and is heavily dependent on factors such as site conditions, divisions of work between audiovisual and other contractors, local market conditions and requirements for union labor.

BUDGET SUMMARY:

ROOM TYPE	QTY	BASE UNIT PRICE (MSRP)	EXT. PRICE BASE
Flat Classroom:	54	$38,000	$2,052,000
Auditorium:	1	$260,000	$260,000
Gymnasiums:	1	$19,500	$19,500
Cafeteria:	1	$15,500	$15,500
Multimedia Studio:	1	$225,000	$225,000
Conference & Group Rooms:	3	$9,000	$27,000
Electronic Information Displays:	1	$30,000	$30,000
Total Audiovisual Systems:			**$2,629,000**

Massing Study Sustainability Report

Cambridge Public Schools

Martin Luther King, Jr. School

Cambridge, Massachusetts

June 29, 2012

reinventing human habitats

Contents

Executive Summary

The Martin Luther King Jr. School in Cambridge, MA is scheduled to be replaced, either with a completely new building or with a combination of new and reuse and renovation of a portion of the existing building. As part of this project, the school district would like to have the new building be a net zero energy building. As part of the net zero energy effort the building and building site will need to produce as much energy as the building uses on an annual basis.

The design team has developed three different schemes for evaluation. This report evaluates each of the three schemes for several different performance potentials. These performance areas relate to either the ability of the scheme to produce energy onsite, or the ability of the scheme to reduce the energy used. Since this is a very limited land area site, every amount of energy saved by the building is less land area that is needed to produce energy onsite. This means that in many ways energy savings are more important than energy production.

This report reviews each of the three building schemes on the following general areas of building performance: building envelope, daylight, glare potential, solar radiation, natural ventilation, photovoltaic energy production and overall building energy usage. The analysis is comparative. In some categories preliminary data is available and has been presented, however, each scheme is ranked overall in terms of performance as high or best performance (3 points), medium (2 points) or lowest performance (1 point). These scores were then added to determine the overall score for the building scheme. Based on this analysis, the Pi scheme scores highest overall. If ranked strictly on the basis of renewable energy generation and annual energy use intensity, the Pi scheme also scores the best. Refer to the table below for the overall building score summary.

Study Summary			
Scheme	Bldg Energy Generated (kWh/yr)	Bldg Energy Used (kbtu/sf/yr)	Overall Score
Ex Mod	328,310	30.9	14.0
Clover	316,125	30.2	11.0
Pi	403,473	30.7	16.5

Preliminary Analysis

The existing Martin Luther King School in Cambridge Massachusetts is being studied for a potential renovation or replacement. The new school building is aiming to be a net zero energy school. In order to meet this goal, the building will need to produce as much energy on site on an annual basis as it uses. This means the project site much be studied to understand the potential for energy generation while the building must be designed to use less energy than standard schools and then the existing building. Other sections of this report will specifically address the site energy generation potential and the preliminary building energy usage. This section will address several other aspects of potential building performance that could reduce energy savings and improved indoor environmental quality. Areas of analysis are:

- Building Envelope
- Daylight
- Solar Radiation
- Natural Ventilation

Three strategies have been proposed for study. One of these strategies would utilize much of the existing building structure and would only replace the north wing with a new building. The second scheme has been named clover scheme. This scheme is a blockier scheme with multiple tiers of roofs and notches in the building on both the east and west sides. The third scheme is the Pi scheme. This scheme has a u shape that is thick on the east side and open to the west.

The preliminary analysis will provide a comparison between the schemes on the above listed areas. These are highlighted below and will be summarized in the conclusions.

Overall the climate in Cambridge, MA is a moderate, humid climate. Average winter days are in the 30-35 deg F range while summer days are in the 80-83 deg F range. Average humidity is around 72% in the morning and 57% in the afternoon. Precipitation is very even with around 3-4 inches of each month. With the colder winters, this precipitation results in snow, with January typically the snowiest month with about 13 inches of snow. The annual average snow total is 42 inches.

Existing Modified Massing Scheme

The first massing scheme would include much of the existing structure, with new construction replacing the north wing of the building. The remaining existing structure will be used for the majority of the classroom spaces. The new wing on the north side will contain the gymnasium spaces, the auditorium and the cafeteria/kitchen.

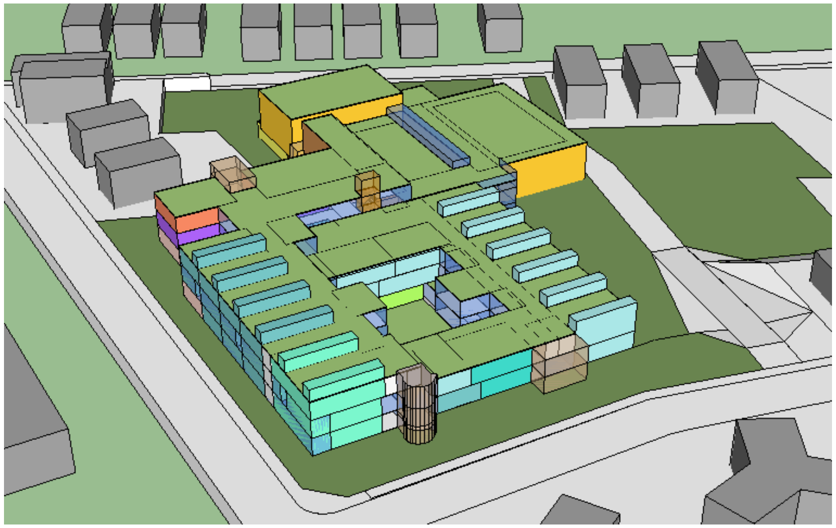
Building Envelope: The existing modified scheme provides 157,950 square feet of space. The building envelope is approximately 135,253 sf above ground. This is a 86% ratio of building envelope to floor area. This massing scheme has the lowest amount of building envelope to floor area. This means that this scheme will have a slightly less potential for impact from solar radiation, and based on the form, could have fewer opportunities for daylighting.

Daylight: Overall there is a high potential for daylight with this massing scheme. This existing structure has a courtyard and north facing roof monitors on the upper levels (second floor on the east and third floor on the west). The courtyard allows for additional daylight access to interior spaces that can benefit from daylight. The roof monitors allow the spaces below to be used with daylight only. The proposed new replacement wing contains mainly large spaces with access to perimeter walls for daylight.

Glare will need to be addressed with this scheme. Many of the classrooms have east/west facing windows, which means a very high potential for glare from low sun angles. Shading could be provided by either external shading devices or internal solar shades. Additionally glare should be addressed in all locations where there are glass ceilings or floor to ceiling glass.

Solar Radiation: This building has a high potential impact from solar radiation. The average daily building surface solar radiation during the school year is 138 kBtu/sf. Much of this time the building will be in heating mode so this load will help. The average daily summer solar radiation is 190 kBtu/sf and and will need to be offset by cooling.

Natural Ventilation: The natural ventilation potential of this scheme is medium/high. The courtyard limits the depth of the building in the classrooms areas to 59 feet, which increases the potential for natural ventilation, however, the low floor to ceiling heights limits air stratification/temperature difference for naturally enduced air movement. The gyms also have the potential for natural ventilation.



Clover Massing Scheme

The clover scheme would completely replace the exisitng structure with a new building. This scheme has notches in the plan on the east and west sides to allow for additional north and south windows. The majority of the classrooms face north or south. The auditorium and LS gym are located on the south façade while the US gym is located on the north. Like the existing modified scheme, this scheme leaves the kitchen and cafeteria on the lower level.

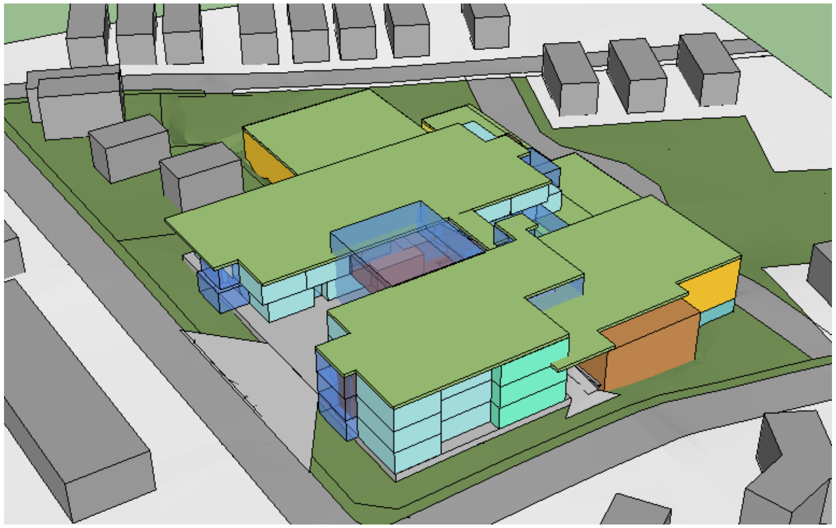
Building Envelope: The clover scheme provides 157,400 square feet of space. The building envelope is approximately 142,000 sf above ground. This is a 90% ratio of building envelope to floor area. This massing scheme has the highest amount of building envelope to floor area. This means that this scheme has a higher potential for impact from solar radiation, however this could also result in more opportunities for daylighting.

Daylight: Overall there is a medium potential for daylight with this massing scheme. The majority of the classrooms on this scheme have daylight access, however there are some that are burried in the center of the building. The Auditorium is located along the south façade and does not need daylight. The south façade is the best for daylight so it should be used for spaces that could best benefit from daylight. The locations of the gyms allow for both to be daylit.

Glare will need to be addressed with this scheme. While most of the classroom winodws face north or south and have a reduced glare issue, the large glass area in the center of the building will definintely need glare control. Overall the glare potential of this scheme is less than the ex. modified scheme.

Solar Radiation: This building has a medium potential impact from solar radiation. The average daily building surface solar radiation is 116 kBtu/sf for the school year. Much of this time the building will be in heating mode so this load will help. The average daily summer solar radiation is 155 kBtu/sf and and will need to be offset by cooling.

Natural Ventilation: The natural ventilation potential of this scheme is low. Overall, this building form is very thick. While many spaces have perimeter access, the depth of the floor plans does not allow air to flow through the building, thus limiting the potential for passive air movement much beyond 5-10 feet from the window. The gyms have the potential for some natural ventilation as well but many other spaces have no potential.



Pi Massing Scheme

The Pi scheme would also completely replace the exisitng structure with a new building. This scheme has u shape that opens to the west. The scheme allows for double loaded corridors for the classrooms so that each room has north or south facing windows. One gym is on the north side while the other is on the south east side. The auditorium is located in the center of the building with a west wall. Like both schemes, this scheme leaves the kitchen and cafeteria on the lower level.

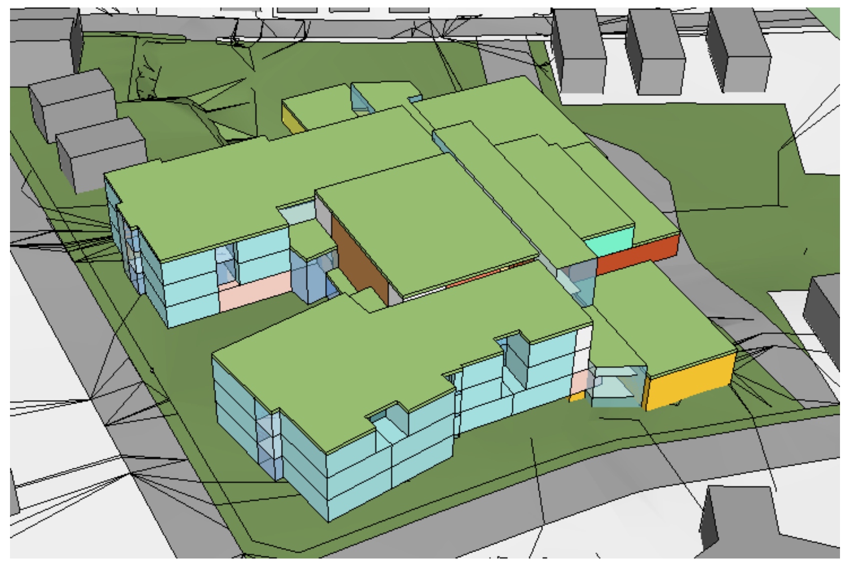
Building Envelope: The pi scheme provides 156,300 square feet of space. The building envelope is approximately 137,700 sf above ground. This is a 88% ratio of building envelope to floor area. Of the three schemes, this scheme has the mediium ratio of building envelope to floor area. This means this scheme has mediium potienal for impact from solar radiation.

Daylight: Overall there is a high potential for daylight with this massing scheme. Almost all classrooms on this scheme have daylight access, and have north or south windows, which are best for daylight. The Auditorium is located in the center of the building with a west wall so does not impact daylight access to other spaces that could benefit from the light. The locations of the gyms allow for both to be daylit.

This scheme has the lowest glare potential. There are limited spaces with east or west windows. There are also fewer spaces with floor to ceiling glass and few spaces with glass ceilings. However, some glare control will still be required in order to provide comfortable, well lit spaces.

Solar Radiation: This scheme has a med/low potential impact from solar radiation. The average daily building surface solar radiation is 121.5 kBtu/sf for the school year. Much of this time the building will be in heating mode so this load will help. The average daily summer solar radiation is 156 kBtu/sf and and will need to be offset by cooling. Fewer skylights helps this scheme.

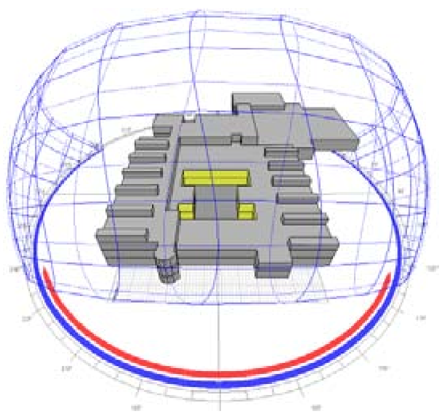
Natural Ventilation: The natural ventilation potential of this scheme is medium/low. The double loaded corridors of the classrooms could have some potential for natural air flows, however they are 86' deep so will not allow air to flow all the way through each wing. If the corridors are designed to maximize natural ventilation flows, air may move through the classrooms beyond the 5'-10' zone by the windows. The gyms have the potential for some natural ventilation as well, but some centrally located spaces have no potential.



Photovoltaic Feasibility Analysis

Photovoltaics (solar electric panels or PV) have been selected as the means for onsite energy generation to meet the net zero energy goal. Cambridge has an average of only 98 clear days, however there are many partly cloudy days with good solar access and PV provides a steady means for energy generation. While Cambridge is windier than the average US city, the wind speeds and consistency are not adequate to ensure economically feasible power production from wind.

Photovoltaic energy generation potential is based on several factors. Many of these are climate related, while the actual solar panels selected also have an impact. Currently the average solar panel can convert about 13-15% of the sun's energy to electricity while the best panels convert as much as 20%. The orientation and angle of the panels also has an impact on energy generation potential. Panels produce the most energy when they are mounted perpendicular to the sun. For this location, that would mean that our panels should be south facing and mounted at an angle of 30-40 degrees (fixed) for maximum generation per panel.



PV panels only produce energy when they are in full sun. This means that shading must be minimized at all costs. It is important that any panels mounted at an angle be spaced so that even at low sun angles the panels do not shade one another. While mounting panels at an angle of 30-40 degrees maximizes the energy generation potential of each panel, when evaluated on an energy generation per ground area required to mount the panels (kwh/sf), the spacing required to prevent shading reduces the energy generated per square foot. If the panels are mounted flat and lined up continuously across a surface, each panel will produce less energy per panel, but the kwh/sf will be maximized. Since this project has a limited sized site, the PV should be designed to maximize the kwh/sf.

Climate plays an important role in the solar energy generation potential. The amount of sun and the length of days impact how much energy a system can generate. Snow is also an issue in northern climates. Cambridge averages 42 inches of snow per year. In order to minimize the number of days of lost energy generation due to snow, it is recommended that the solar panels be mounted at a tilt of no less than 10 degrees. Mounting the panels at 10 degrees will provide a higher kwh/sf while limiting the number of days lost to snow. In addition, elevating the panels above the roof level will reduce losses due to snow drifts.

Based on preliminary calculations, this project is currently targeting an annual energy generation need of about 1,582,200 kWh/year. In the Boston area, PV panels mounted at 10 degrees can generally harvest approximately 1,061 kWh/year for every kW of peak capacity installed. Based on the preliminary annual energy use for the school, the PV array with the peak capacity of 1,490 kW is required. Using the most efficient PV panels currently on the market, this will require approximately 134,580 square feet of PV panels. To put this into perspective, the entire project site is only about 147,540 sf.

Existing Modified Massing Scheme

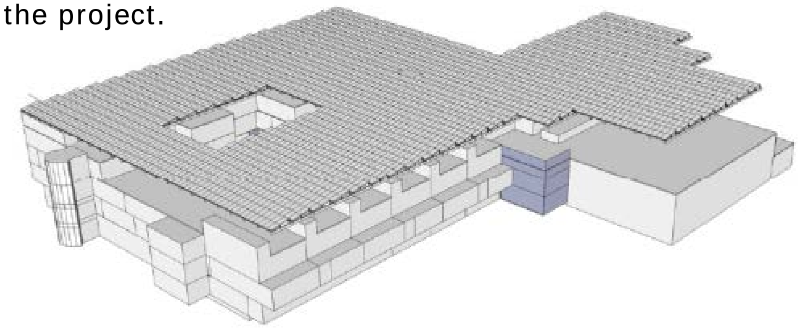
The roof is one of the best locations for pv panels. This location typically has great solar access and the panels have a minimal impact on people below.

Roof mounted PV works best when there is a large flat roof with no obstructions or mechanical equipment, etc that can cast shadows. The existing modified scheme does not provide this type of ideal surface. The existing roof monitors create shaded pockets on the roof that severely limit the usable roof area. The northern wing roof is also lower than the southern existing building wing. This height difference means that the southern wing often shades portions of the roof of the northern wing. The self shading of the building reduces the potential area for mounting PV in this scheme.

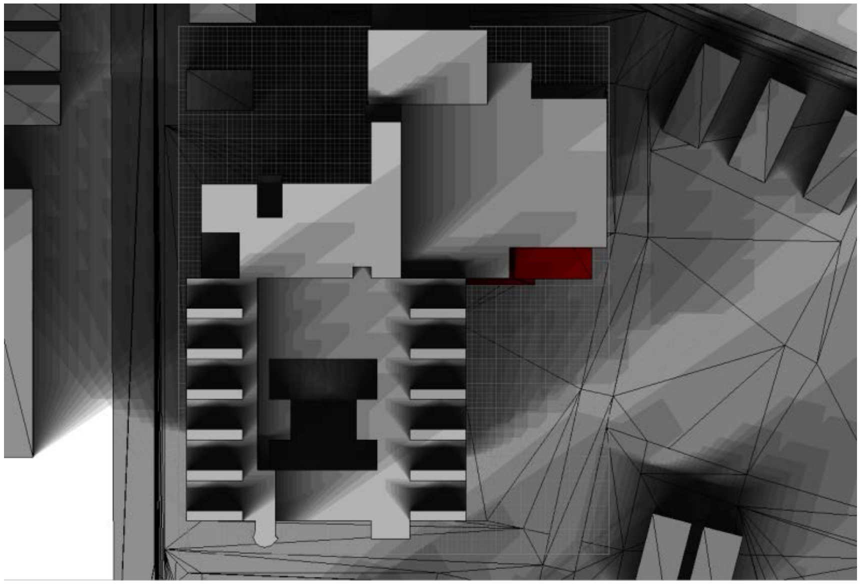
In order to reduce the self shading impact of this scheme, it is recommended that at a minimum, pv panels be mounted continuously across the top of the roof monitors. This will require some additional structural supports to span the gaps between monitors. This will have an impact on the daylight that enters the building through these monitors, however with the panels mounted at the recommended 10 degree tilt, there will be approximately 2'-6" of space between rows. The row spacing will still allow some daylight down into the roof monitor clerestory window.

A shading study was performed for the existing modified scheme in order to determine the potential impact of self shading and shading from existing neighboring structures. The results of this shading study can be found on the next page. The shading study reviews shading through the hours of 9am to 4pm for December, March and June (21^{st}). This range of dates covers the shortest day of the year (Dec.) where the sun angles are lowest in the sky, the average day of the year (March) and the longest day of the year (June) when the sun is highest in the sky. As expected, there is the least amount of shading in June as the sun is highest in the sky so the shadows tend to be short. December is the limiting month. The shadows are the longest, the shading potential is the greatest and the solar production is at it's lowest. The roof area that remains unshaded in December (including PV mounted across the top of roof monitors) is 27,715 sf.

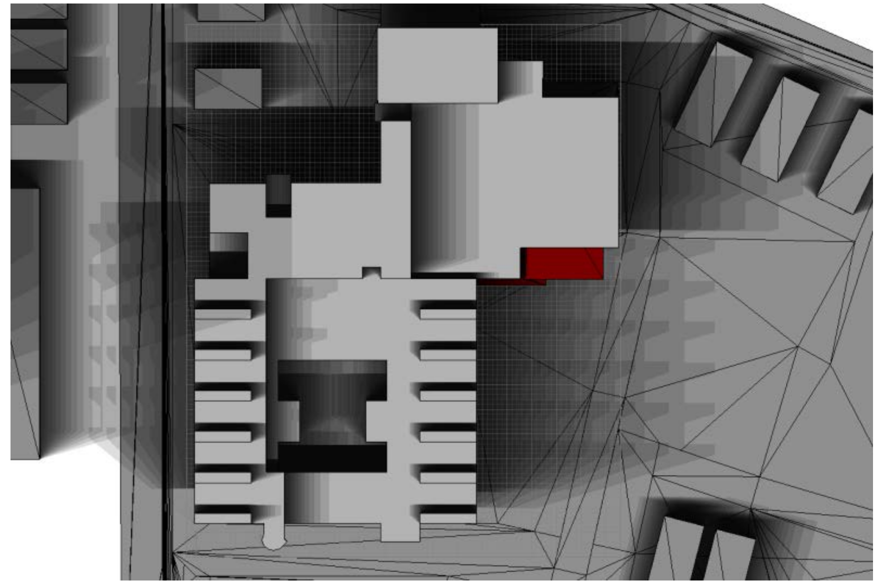
An alternate PV mounting was reviewed in order to eliminate self shading. This alternate would mount the PV at a continuous height plane in the shape of the building roof. (see below). This alternate increases the roof area for PV to 57,700 sf but adds significant cost to the project.



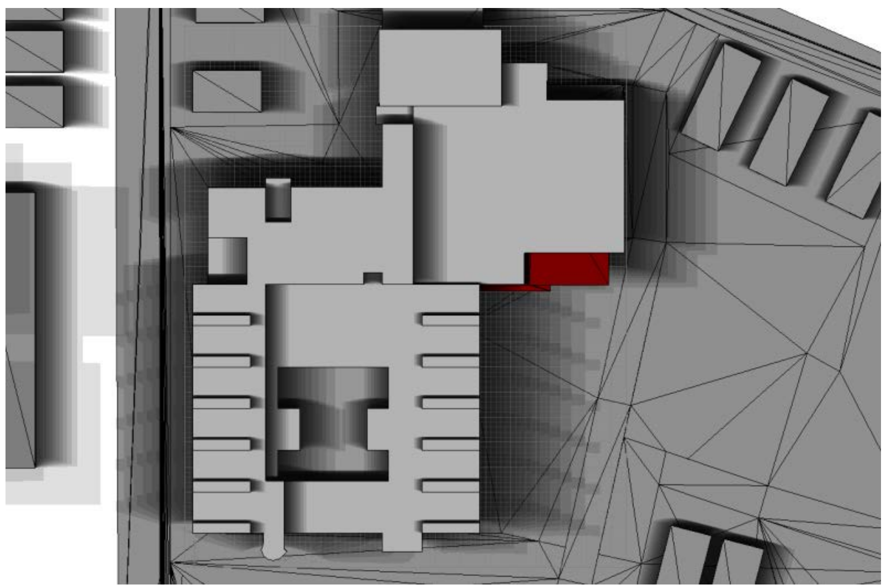
Existing Modified Roof PV Study - 10 degree panels		
Roof Area	Roof Area for PV (sf)	Energy Generated Annually (kwh)
Mounted On Roof* (worst month shading)	27,715	307,330



December 21st shade study:
9am to 4pm.
27,715 sf of available roof



March 21st shade study:
9am to 4pm.
31,500 sf of available roof



June 21st shade study:
9am to 4pm.
44,500 sf of available roof

Clover Massing Scheme

As discussed in the existing modified scheme, mounting PV panels on the roof is one of the best locations for PV panels. Not only does the roof typically have great solar access but the PV panels help shade the roof in the summer, and since they generate heat while making energy, they help create a warm zone on the roof in the winter.

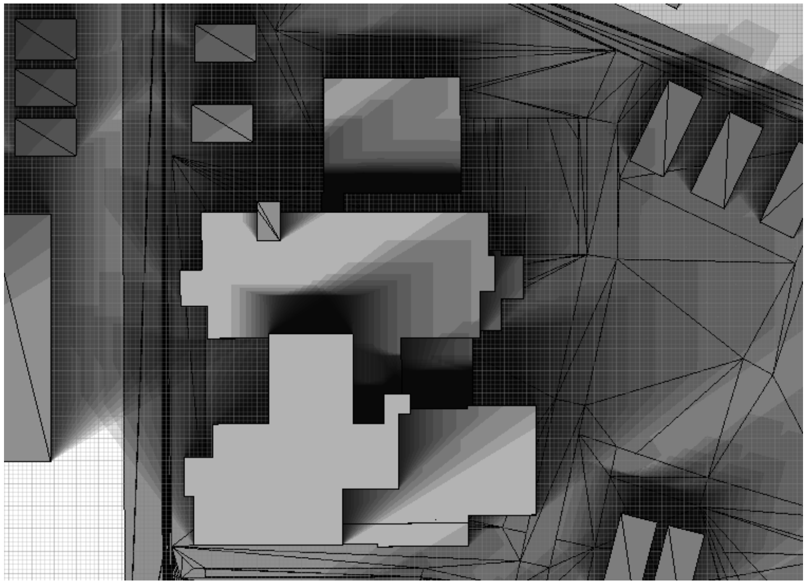
Roof mounted PV works best when there is a large flat roof with no obstructions or mechanical equipment, etc that can cast shadows. The clover scheme does a better job of providing large flat roofs, however there are still some tiered roofs that shade one another. The northern portion of the building has lower roof elevations than the southern portion of the building – thus creating shading issues which reduce the usable roof area for PV.

In order to maximize the potential mounting roof area, it is recommended that pv panels be run continously across the few small areas were there are indented pockets in the roof form. This will require some additional structural supports to span the gaps, but will maximize roof energy generation potential.

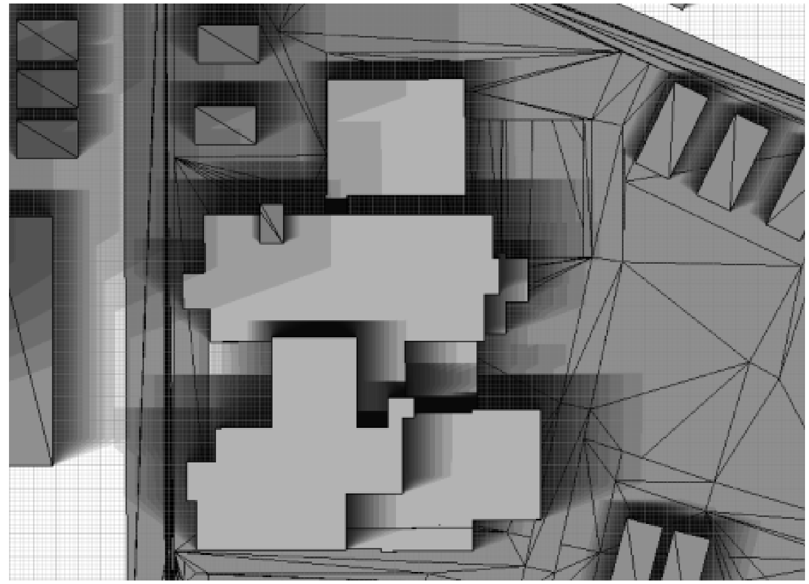
A shading study was performed for the clover scheme in order to determine the potential impact of self shading and shading from existing neighboring structures. The results of this shading study can be found on the next page. The shading study reviews shading through the hours of 9am to 4pm for December 21st, March 21st and June 21st. This range of dates covers the shortest day of the year (Dec.) where the sun angles are lowest in the sky, the average day of the year (March) and the longest day of the year (June) when the sun is highest in the sky. As expected, the there is the least amount of shading in June as the sun is highest in the sky so the shadows tend to be short. December is the limiting month. The shadows are the longest, the shading potential is the greatest and the solar production is at it's lowest. The roof area that remains unshaded in December (including PV mounted across the roof gaps) is 25,400 sf.

An alternate for PV mounted on a structural system that would cover the footprint of the majority of the roof surfaces was reviewed for this scheme. Given the number of different roof heights on this scheme, some portions of this PV structure would be very tall and would be costly to construct. This alternate increases the potential roof area for PV to 56,700 sf.

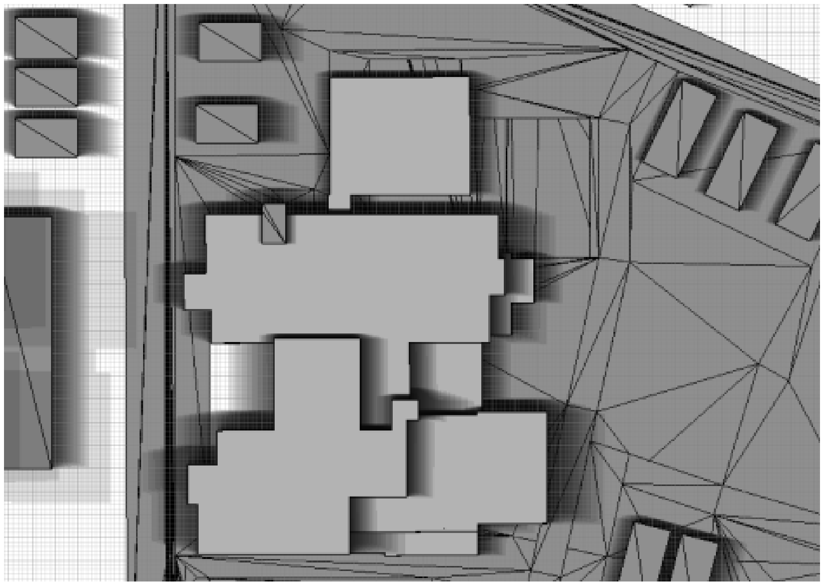
Clover Roof PV Study - 10 degree panels		
Roof Area	Roof Area for PV (sf)	Energy Generated Annually (kwh)
Mounted On Roof (worst month shading)	25,400	281,659



December 21st shade study:
9am to 4pm.
25,400 sf of available roof



March 21st shade study:
9am to 4pm.
37,780 sf of available roof



June 21st shade study:
9am to 4pm.
50,600 sf of available roof

Pi Massing Scheme

While these studies have reviewed the potential for mounting PV on the roof of each scheme, it is evident that none of the schemes will be able to produce enough energy for a net zero annual energy operation if the PV is only mounted on the roof. Other locations for PV will need to be added to the project regardless of which scheme is selected.

The Pi roof is closest to providing the ideal roof for PV - large and flat with no obstructions or mechanical equipment, etc that can cast shadows. The Pi Scheme has a large flat roof on the third floor that will allow a large area for PV. Like the other two schemes, the Pi scheme also has some tiered roofs that shade one another. There is a smaller northern portion of the building with a lower roof elevation than the southern portion of the building and a few smaller low roofs that will be unusable due to self shading issues.

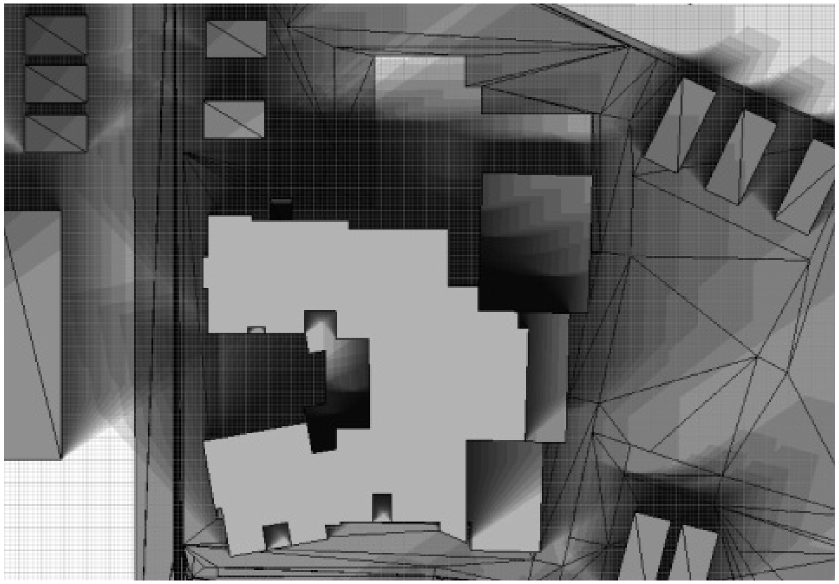
In order to maximize the potential mounting roof area, it is recommended that pv panels be run continously across the small areas were there are indented pockets in the roof form. This will require some additional structural supports to span the gaps, but will maximize roof energy generation potential.

A shading study was performed for the Pi scheme in order to determine the potential impact of self shading and shading from existing neighboring structures. The results of this shading study can be found on the next page. The shading study reviews shading through the hours of 9am to 4pm for December 21st, March 21st and June 21st. This range of dates covers the shortest day of the year (Dec.) where the sun angles are lowest in the sky, the average day of the year (March) and the longest day of the year (June) when the sun is highest in the sky. As expected, the there is the least amount of shading in June as the sun is highest in the sky so the shadows tend to be short. However, unlike the other two schemes, December is not the limiting month. March is the worst month for shadows for this scheme. This is due to shading from neighboring buildings. These shadows impact the roof in the later afternoon when the sun is setting near due west or further north. While this same impact is seen in the other schemes, the Pi scheme does the best job at not self shading so the impact of long shadows in December is minimized. The shadows from the western buildings end up resulting in more shaded roof area then the long December shadows. The roof area that remains unshaded in March (including PV mounted across the roof gaps) is 33,750 sf.

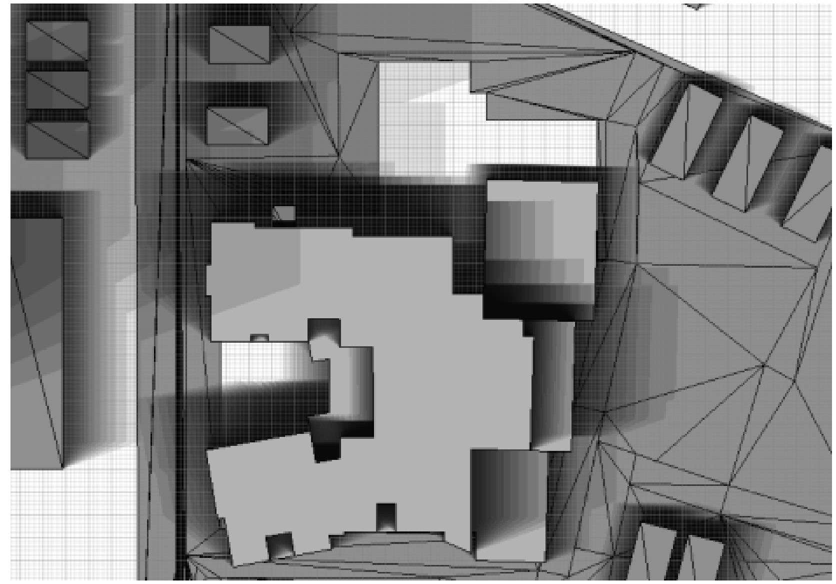
An alternate for PV mounted on a structural system that would cover the footprint of the majority of the roof surfaces was reviewed for this scheme This PV structure would be very tall and would be costly to construct. This alternate increases the roof area for PV to 67,400 sf.

An additional advantage of Pi is that it has the smallest building footprint which allows for the possibility of additional PV mounted on the site.

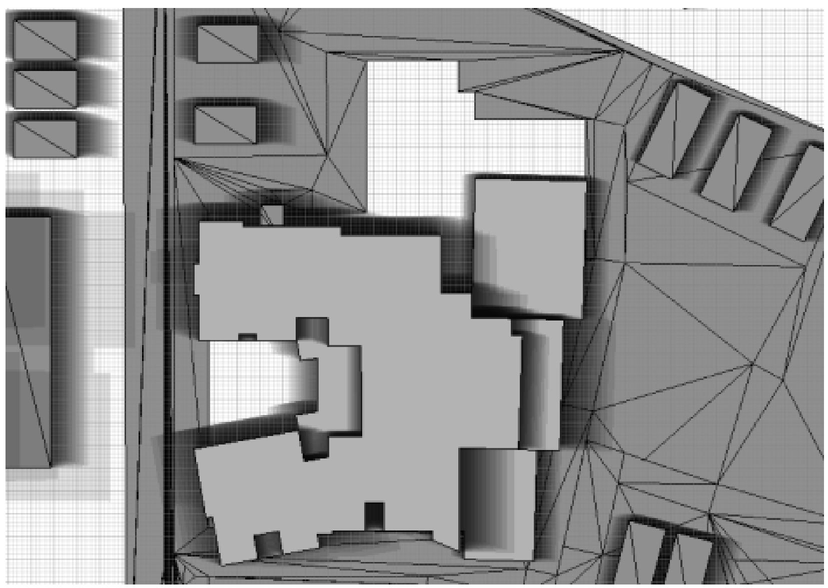
Pi Roof PV Study - 10 degree panels		
Roof Area	Roof Area for PV (sf)	Energy Generated Annually (kwh)
Mounted On Roof (worst month shading)	33,750	374,252



December 21st shade study:
9am to 4pm.
35,750 sf of available roof



March 21st shade study:
9am to 4pm.
33,750 sf of available roof



June 21st shade study:
9am to 4pm.
41,560 sf of available roof

Vertical Façade Mounted Solar Shade and PV

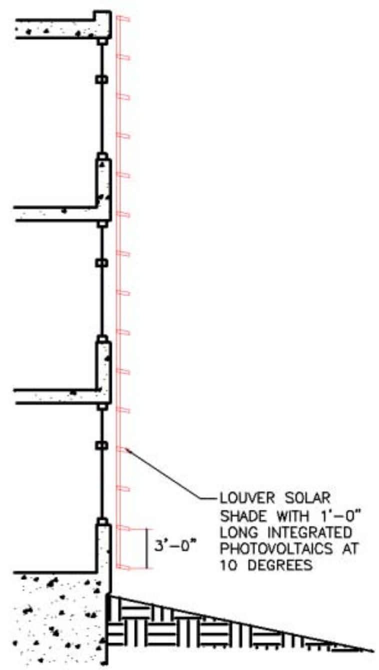
Due to limited roof areas and the limited space on the site for mounting PV panels, additional locations for mounting PV along the south façade where studied. This will also help reduce glare issues for daylighting. There are a few prodcuts that are available today that seemlessly integrate the PV into the shading system.

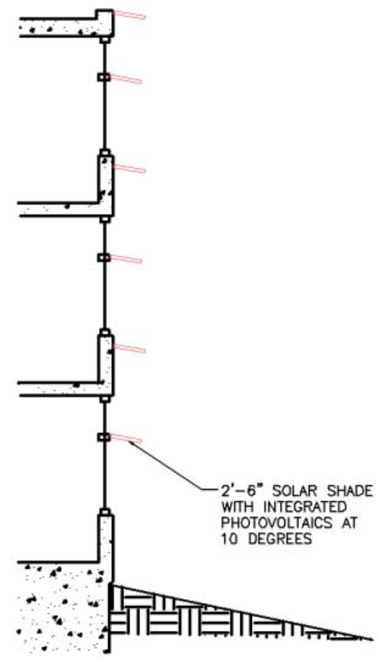
Two different options were considered for the shading system. Alternate 1 is a continous horizontal louver that runs along the entire south façade. This option uses a 1' wide shade spaced 3' vertically. Alternate 2 uses a wider shade mounted at a mid point for the window (could also be combined with an internal light shelf) and at the base of the window. This spacing is set to eliminate shading between PV panels. Both alternates allow for the same area of PV to be installed.

The potential energy generation is dependent on the length of the southern façade as well as the impact of building projections (shading) for each scheme. A preliminary analysis has been completed for each massing scheme to determine the potential for southern façade mounted PV energy generation. These results have been summarized in the table to the right.

Overall this is a good integrated strategy that should be considered for this project regardless of the selected building scheme. This strategy provides much needed additional space to mount PV and provides needed glare protection for better daylighting quality.

South Façade PV Study			
Scheme	Available Length on South Façade (ft)	Area of PV (sf)	Energy Generated Annually (kwh)
Ex Mod	140	2,100	20,979
Clover	230	3,450	34,466
Pi	195	2,925	29,221





Alternate 1 Alternate 2 Solar Shading with integrated PV

Photovoltaic Feasibility Summary

The amount of renewable energy that can be harvested on the project site is a function of the area available, the type and angle of mounting used and the efficiency of the PV panel. For this feasibility study, a mounting angle of 10 degrees has been selected in order balance annual output losses due to snow fall with the amount of area required for the system. The feasibility study is also based on utilizing the most efficient PV panel now available. In addition, the study assumes that roof mounting opportunities will be maximized through the use of structural supports that will elevate the PV in order to limit shading due to the building massing. Finally, the feasibility study accounts for mounting of PV panels on the south facing façade areas of the various massing schemes.

This approach will result in the maximum annual energy generation for a given system footprint. Based on this approach, the amount of PV that can be mounted on the building roof and façade will not generate enough energy to meet the annual energy needs and the shortfall will need to be made up with additional PV. Due to the magnitude of the shortfall, it is not likely that this PV can all be mounted on site and that additional, off-site locations will need to be found.

PV Feasibility Summary - 1,582,200 kWh/year Target						
Scheme	Max Roof Generation	South Façade Generation	Building Total	Max. Possible Percentage on Building	Shortfall based on 10 degree mounting angle	
	kWh/year	kWh/year	kWh/year		kWh/year	Square Feet
Ex Modified	307,330	20,979	328,310	20.8%	1,253,890	106,654
Clover	281,659	34,466	316,125	20.0%	1,266,075	107,691
Pi	374,252	29,221	403,473	25.5%	1,178,727	100,261

Energy Consumption Analysis

Relative energy performance for the three massing options was studied using the eQUEST energy modeling software tool. The massing information used in the modeling exercise was generated during the course of the feasibility study and is not necessarily the latest massing being presented by the project team. This is due to the fact that the massing schemes have continued to develop at the same time that the energy models were being developed.

The eQUEST energy modeling tool calculates annual energy use for a building based on typical year weather data and hourly calculations for 8,760 hours per year. *Building energy modeling is a comparative tool used for understanding the relative impact of alternate strategies on annual energy use and cost. At the conceptual level, the information gained should be considered qualitative rather than quantitative and should only be used to provide relative rankings of the energy performance for different alternates*.

For MLK School, the three massing options were modeled at a very conceptual basis using the Google Sketch-up drawings provided for that purpose. All three alternates were modeled with the same inputs for HVAC systems, lighting, equipment, occupancy and schedules. All alternates are based on a geothermal heat pump system using water-to-air heat pumps. The results of the energy modeling are shown below in terms of energy use intensity (EUI) which is in units of thousands of btu per square foot per year (kBtu/sf/year).

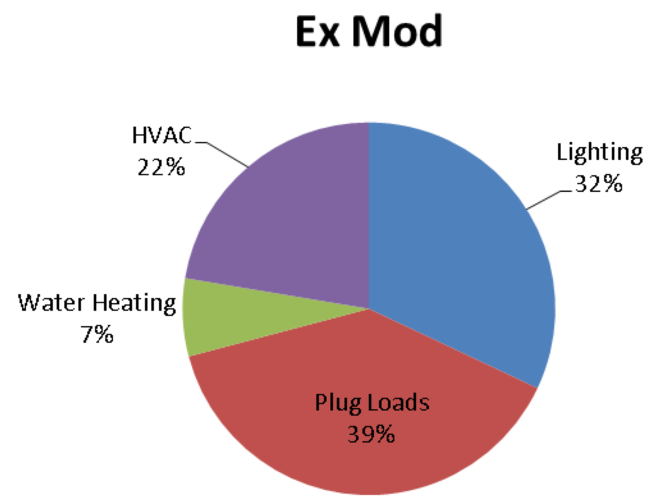
The conceptual energy modeling projects that the Clover alternate should use the least amount of energy followed by the Pi alternate and the Existing Modified alternate. As noted above, the modeling results should be used in a qualitative way to rank the performance of the schemes. From this analysis, it appears that the variation in annual energy usage between the three alternates is minimal and that the Clover alternate has a slight edge over the other two schemes.

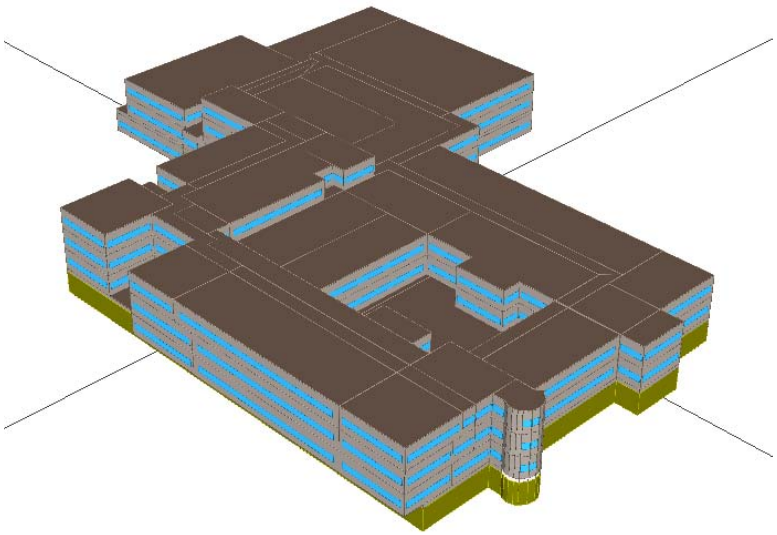
Energy Intensity		
Scheme	EUI (kBtu/sf/yr)	Variation from Clover
Clover	30.2	0.0%
Pi	30.7	1.7%
Ex Mod	30.9	2.3%

Existing Modified Massing Scheme

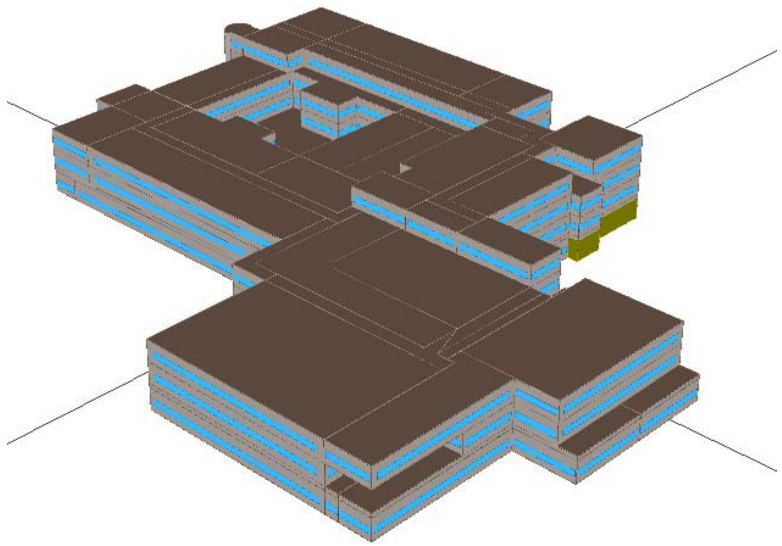
Overall, the Existing Modified Scheme has preformed the worst based on the preliminary energy model.

The predicted preliminary energy usage intensity for this scheme is 30.9 kBtu/sf/year. This is 2.3% higher than the lowest scheme. Overall the preliminary energy prediction for this building is 1,430,110 kWh annually which is about 2.7% more than the scheme with the lowest overall energy use (Clover). This scheme has the largest square footage, the highest energy intensity per square foot and the highest overall energy use.





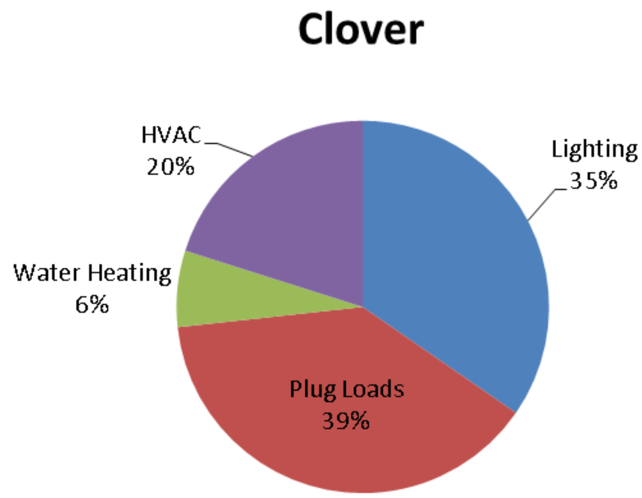
Southwest View

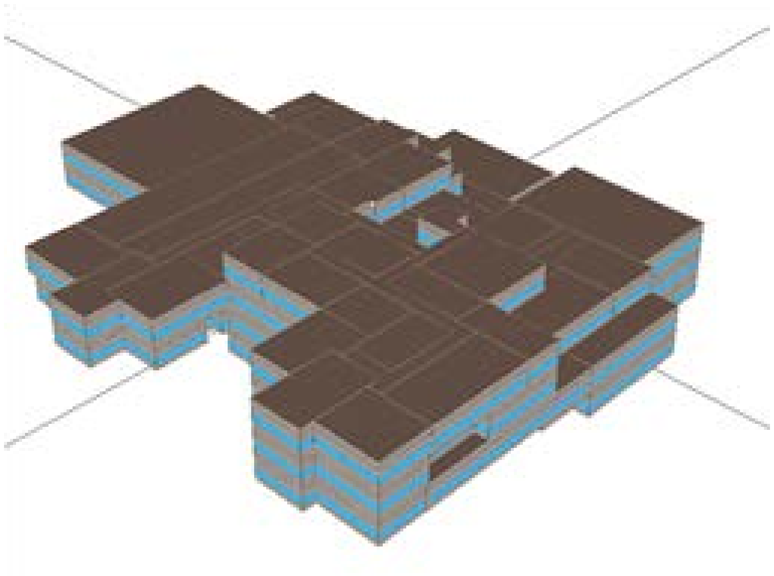


Northeast View

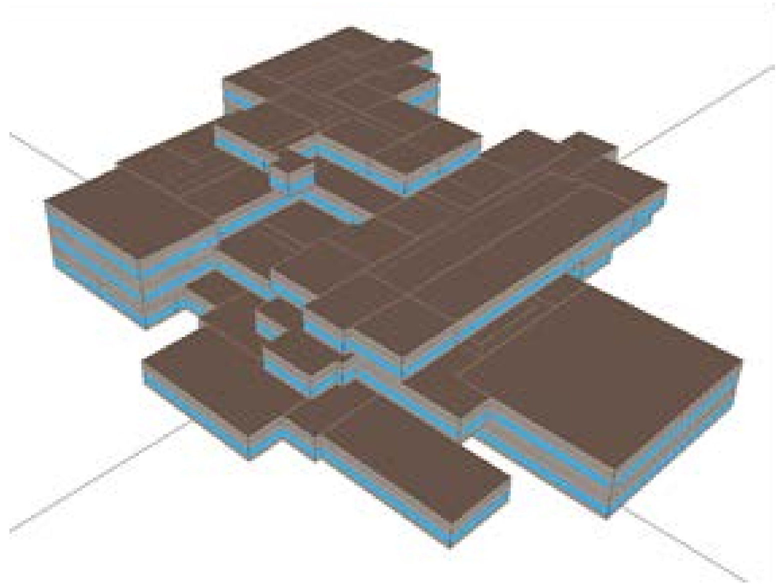
Clover Massing Scheme

Overall, the Clover Scheme has preformed the best in the preliminary energy model. The predicted preliminary energy usage intensity for this scheme is 30.2 kBtu/sf/year. This is the lowest energy intensity of all three schemes. Overall the preliminary energy prediction for this building is 1,392,980 kWh annually. This is the lowest annual energy total, and based on the building square footage has resulted in the lowest energy intensity.





Southwest View

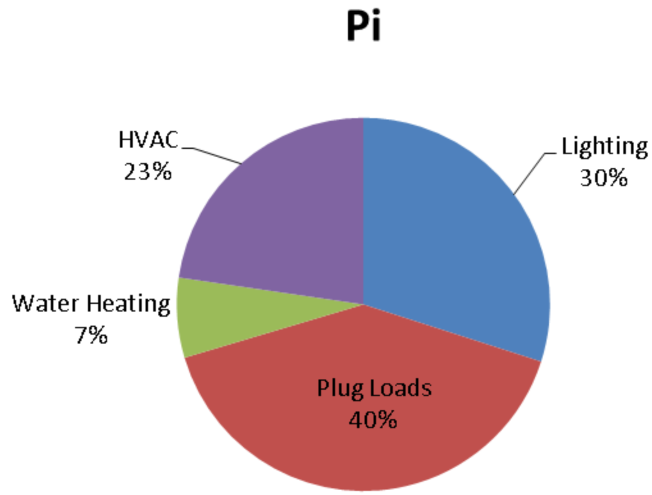


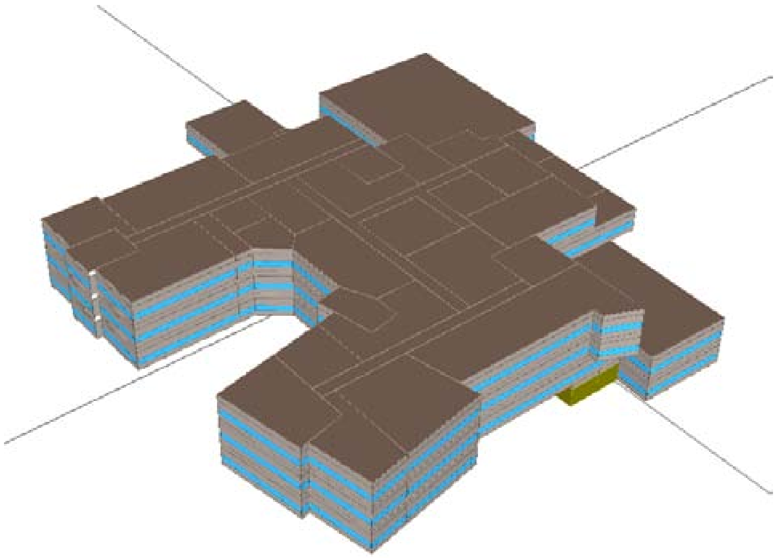
Northeast View

Pi Massing Scheme

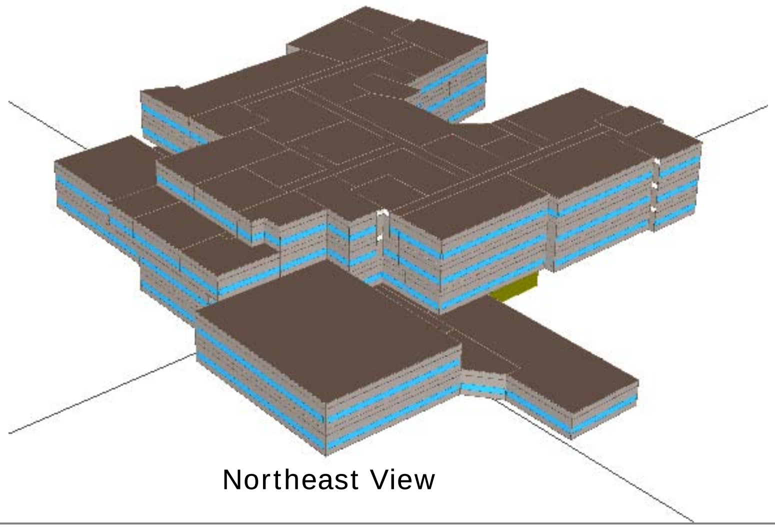
Overall, the Pi Scheme has preformed in the middle in the preliminary energy model.

The predicted preliminary energy usage intensity for this scheme is 30.7 kBtu/sf/year. This is 1.7% higher than the lowest scheme (Clover). Overall the preliminary energy prediction for this building is 1,405,900 kWh annually. The energy intensity for this building is in the middle and since this building has the smallest square footage, this resulted in an overall energy use that is less than 1% greater than the scheme with the lowest energy use (Clover).





Southwest View



Northeast View

Conclusions and Recommendations

The design team has developed three different schemes for evaluation. This report evaluates each of the three schemes for several different performance potentials. These performance areas relate to either the ability of the scheme to produce energy onsite, or the ability of the scheme to reduce the energy used. Since this is a very limited land area site, every amount of energy saved by the building is less land area that is needed to produce energy onsite. This means that in many ways energy savings are more important than energy production.

The analysis in this report is comparative. In some categories preliminary data is available and has been presented, however, each scheme is ranked overall based on a numerical ranking of 1 to 3 corresponding to the lowest (1), medium (2) and highest (3) levels of performance for a particular performance metric.

For this preliminary analysis, energy used by the building and energy generation potential are more important. Based on these rankings alone the Pi scheme is best with a score of 5, followed by Clover with a score of 4 and Existing Modified with a score of 3. At this preliminary stage, any of these schemes could be pursued and would have a relatively even chance for net zero energy success.

Each scheme has different strengths and challenges that should be noted and addressed as the design progresses.

Massing Study Summary													
Scheme	Building Envelope		Daylight	Glare	Solar Radiation (kBtu/sf)			Natural Ventilation	PV Potential (annual kWh)		Energy Intensity (kBtu/sf/yr)		Overall Score
	Rank	Ratio	Rank	Rank	Rank	Summer	School	Rank	Rank	kWH	Rank	EUI	
Ex Mod	3	86%	3	1	1	138	190	3	2	328,310	1	30.9	14.0
Clover	1	90%	2	1	2	116	155	1	1	316,125	3	30.2	11.0
Pi	2	88%	3	2	2.5	121	156	2	3	403,473	2	30.7	16.5

6.0 ARCHITECTURAL MATERIALS LIST

Design Options - Architecture

Architectural Materials

General Notes:

1. Refer to Room Data Sheets and Room by Room Ed Spec for additional information.
2. All products are Basis of Design for pricing only; actual product selections shall be “or equal”.
3. Refer to other systems narratives for additional information.

Component	Materials / Basis of Design	Comment
Foundation	Wall: Concrete Vapor Barrier: Fluid-applied waterproofing Insulation: Rigid R = 15 Drainage Mat: composite Drainage: Perforated PVC continuous perimeter foundation and underslab drains (@ 25’ o.c.)	Refer to structural and civil narratives for additional information
Structure	Beams: Steel, concrete at Modified Existing to remain (Part A) Columns: Steel @ new constuction, concrete at Modified Existing to remain (Part A) Slabs: Composite concrete deck Fireproofing: As required; Spray-on at concealed spaces, Intumescent at exposed	Refer to structural narrative for additional information Refer to structural narrative for additional information Integral waterproofing (Barrier One) and R-10 Rigid Insulation at slabs on grade
Exterior Wall	Cladding: Rainscreen system, Aluminum Composite Panel (ACP) by Alucobond , Trespa, & Terra Cotta Sheathing: 5/8” Exterior GWB (DensGlass)	ACP = 18% of wall Trespa + 24% of wall Terra Cotta Planks = 28% of wall

	Flashing: Thru-Wall Metal, Fabric Coated Copper Vapor Barrier: Fluid Applied (DuPont) weather barrier Insulation: Rigid R = 20 on outside; R10 closed cell spray foam on inside Metal Studs: Dietrich or equal GWB: 5/8" Abuse resistant, DensArmor Plus, formaldehyde free	
Roof	Vegetative Roof: American Hydrotech Garden Roof Assembly Membrane: TPO, white Insulation: Rigid, R= 40 Vapor Barrier: Coping: ACP – part of parapet	See Civil Diagrams for locations of Extensive and Intensive roofs
Curtainwall:	Frame: Anodized aluminum, Kawneer 1600 UT Glazing: Solarban 60 (2) Clear, Low E , Visible Light Transmission 70%	At Atriums & Extended Learning Areas. Adjust shading coefficient for exposure 50% Ceramic Frit @ East and West Elevations
Storefront:	Frame: Anodized aluminum, Kawneer Trifab 451 UT @ exterior, 451 at interior, Medium Stile Glazing: Solarban 60 (2) Clear, Low E, Visible Light Transmission 70% @ exterior	Only at entrance door system & at interior doors w/ windows.
Windows:	Material: Anodized Aluminum, operable, Kawneer Ultra Thermal Glazing: Solarban 60 (2) Clear, Low E, Visible Light Transmission 70% Sills: Solid Surface or Silestone	30% at classrooms

Design Options - Architecture

Sunshades	Colt Shadovoltaic Photovoltaic solar shades, anodized aluminum	Lightshelf at Interior also
Louvers	Anodized aluminum	
Stairs - Interior		
• Ornamental	Railings: Glass with Julius Blum aluminum railings and shoe Tread/Risers/Stringers: Steel Stringers w/ Terroxy Resin Systems by Terrazzo & Marble Supply Co.	Atrium @ floor openings; refer to Sketchup models for locations.
• Egress	Treads/Risers/Stringers: Concrete filled metal pan w/ steel stringers with rubber treads and risers Railings: Metal vertical balusters 4" oc.	Finish raw galvanized (no maintenance)
Elevator	Kone EcoSpace EB Machine-Room-less Traction Elevator Stainless steel cab panels; Forms + Surfaces	
Doors/Frames		
• Exterior	Entrances: see Storefront Other: Galvanized steel doors w/ galvanized hm frames (unpainted)	
• Interior	Interior: Solid core wood, stained Classrooms: glazed vision panels and 18" wide sidelight with integral blinds between glass. Hollow metal frames, raw galvanized finish	
• Overhead Coiling	Overhead Door, Stainless Steel / Glazed	Kitchen / Servery (open metal mesh) /Fitness/ Upper Gym
Hardware	Heavy Duty, Mortis	
Casework		
• Millwork / Architectural	Counters: Quart z surfacing, Zodiaq by DuPont	Main Office Administration Reception, Security

Woodwork	Cabinets: Veneer Plywood Stained	Reception, Library Check-in Desk, Cafeteria, Servery,
• Manufactured School Casework	Counters: Plastic laminate, Epoxy resin at Science Cabinets: Plastic Laminate by Case Systems Inc. Wilsonart Marker Board Laminate at Science Rooms	
Ceilings	Entry Lobbies/Cafeteria/Corridors/Egress Stairs: Armstrong Optima 2x 8, w/ 20% gwb soffits, w/ 10% decorative wood Servery: Armstrong Health Zone Ultima (scrubbable) 2x2 w/ 20% gwb soffits Classrooms/Offices/Toilet Rooms: Armstrong Ultima 2x2 w/ 20% gwb soffits Gymnasium & OT/PT: K-13 w/ integral color Learning Commons: Armstrong Optima 2x 8, w/ 20% gwb soffits, w/ 30% decorative wood Utility Areas: Armstrong Mesa 2x2, or painted structure	Custom wood 4x4 stained open ceiling grid, hung below ACT at Classrooms only.
Flooring	Entry Mats: recessed “Entry Level” by Interface, 2x2 carpet tile Public Spaces/ Cafeteria/Corridors: Terroxy Resin Systems by Terrazzo & Marble Supply Co. Auditorium: wood stage, Carpet Tile @ balance Classrooms/Nurse: Marmoleum by Forbo (linoleum) sheet De-Escalation Rooms: Carpet Tile Music Room: 2x2 Carpet Tile Gymnasium: AcerFlex Wood by Acer Flooring LLC Fitness Room & OT/PT: Nora Rubber 2 x 2 Tile Kitchen: Epoxy Learning Commons: Carpet Tile; static dissipative as	Underslab vapor barrier Stego System or equal. Integral waterproofing (Barrier One) at slabs on grade

	required at IT areas. Offices/Conference Rooms: Carpet Tile. Toilet Rooms: Porcelain Tile Plank 12x24 Utility Areas: Polished concrete	
Interior Partitions	GWB: 5/8" fire rated, abuse resistant Dens Armor Plus or equal, painted Framing: Steel studs CMU: gymnasium: 50% acoustic Proudfoot Souncell or equal and 50% Eagle Corporation Allied Concrete Products Insulation: as required by STC Acoustic Panels: Custom panels @ Entry Lobbies, Auditorium Learning Commons, Dining, Music Rooms: x% of walls Decorative Wood Panels: Custom panels @ Entry Lobbies, Auditorium, 50% of walls Protective Mats: Gymnasium, De-Escalation Rooms Toilet Rooms: Tile full height at wet walls and 5' returns within depth of toilet compartments Corner Guards: Stainless Steel Decorative Panels: Wood @ Lobby and Auditorium De-Escalation Rooms: wall padding by Fold Medal Safety Padding	Refer to Acoustical Goals narrative for additional information. Epoxy paint at toilet rooms and kitchens
Interior Glazing	Storefront: Anodized aluminum with ¼" laminated glass, Oldcastle system STC 45 glazed interior walls: ¼" laminated glass + 4" air space + ¼" glass-STC 45 frame	30% of walls (walls facing atriums) 10% of walls 10% of walls

	STC 50 glazed interior walls: ½" Laminated Glass + 4" Air Space + ¼" Glass - STC 50 frame Railings: Julius Blum glass railing w/ anodized aluminum railing	Main Lobby / Atrium
Specialties:		
• Fire Protection Specialties	Fire Extinguisher Cabinets: Semi Recessed, anodized aluminum cabinets	
• Operable Partitions	Motorized, Modernfold 941 or equal.	1 @ Cafeteria
• Signage	Mechanically fastened	
• Toilet Compartments	Phenolic	
• Visual Display Surfaces	Tackboard Assemblies: Cork Sheet by Forbo w/ Aluminum frame to match marker boards Marker Boards: LCS porcelain enamel finish by Claridge w/ Aluminum frame	
Equipment:		
• Appliances		Refer to Space by Space Ed Specs for additional information Preschool, Laundry, Food Lab, After School, Nurse, Staff Lunchrooms
• Gymnasium Equipment	Divider curtain: Roll-up by Draper or equal Basketball hoops Volleyball Nets Shot Clocks Score Boards	Refer to Space by Space Ed Specs for additional information
• Foodservice		Refer to Foodservice narrative

• Loading Dock	Lift	Receiving
• Lockers	Upper School (Grades 6-8) Corridors: Metal, single tier, 12”Wx15”Dx60”H; Pinnacle Storage Products, Corridor Series Locker Rooms: Metal Pinnacle Storage Products Athletic Series, 15”Wx15”D, 4 high	
• Cubbies	Preschool – Grade 5: Jonti-Craft “NEAT-n-TRIM LOCKERS” #2685JC; 60"W x 15"D x 50½" H	
• Locker Benches	Locker Rooms: Pinnacle Storage Products Accessories Series, Hardwood Bench w/Heavy Duty Bench Pedestals, leg finish to match lockers; 9½”W x 17½”H x length specified	
• Library Stack Systems		Included in furniture budget
Furnishings:		
• Bleachers	Large Gym only; Telescoping, motorized, HC seats, integral scoretable Hussey Seating Company, Maxam	
• Stage Curtains	Auditorium, Theatre Classroom	
• Window Treatments	Mechoshade Ecoveil	Manual at classrooms/Offices Conference rooms/ Preschool; Blackout shades Motorized at Gymnasium

7.0 OTHER SUSTAINABILITY / NET ZERO REPORTS

a. Building Envelope Guidelines
b. Solar Power Purchase Agreements
c. Solar Power Options
d. Letter regarding Carbon Accounting for Design Options

Martin Luther King, Jr. School
Building Envelope Design Guidelines

May 23, 2012

Building Orientation & Massing Guidelines:

- Where possible provide building orientation that favors south and north exposures. Avoid extensive west facing wall areas and large areas of west facing windows.
- Orient spaces with more critical visual tasks with south orientation (best) or north orientation in order to maximize daylight potential and minimize glare potential
- Where possible limit building floor plate depth so that occupied spaces are close enough to windows to allow for adequate day lighting. A general rule of thumb is that spaces should be no deeper than two times the ceiling height in order to ensure reasonable daylight penetration. If spaces are deeper, try to provide daylight apertures on both sides of the space to even out daylight levels. The ideal arrangement is a space with daylight apertures on both the south and north sides. This provides the best opportunities for daylight and also has the added benefit good potential for natural ventilation.

Building Envelope Performance Targets:

- Utilize glass with high visible light transmission (VLT) in order to maximize daylight potential for a given window area. Aim for VLT above 60%.
- Utilize glass with a high light to solar gain (LSG) ratio. This is the ratio of visible light transmission to solar radiation transmission (VLT/SHCG). Glass with higher LSG ratios typically utilizes spectrally selective coatings to maximize transmission of solar radiation in the visible spectrum and minimize solar radiation transmission in the infrared (heat) spectrum.
- Design building facades with an effective aperture (EA) of 0.18 to 0.20. The equation for effective aperture is EA = WWR x VLT where WWR = window to wall ratio and VLT = visible light transmittance. A window to wall ratio of 0.3 (30% glass) and VLT of 60% translates to an effective aperture of 0.18 (0.3 x 0.6). The equation can be re-written to WWR = EA/VLT.
- Provide exterior solar shading devices to prevent direct solar radiation through glazing from March 1st to October 15th to the extent possible.
- Design the building envelope to minimize air infiltration with a target of ≤ 0.25 cfm/sf wall area at 75 pa.
- Design and detail building envelope components and assemblies to eliminate thermal bridging.
- Select window and glazing systems with warm edge spacers and thermal isolation in order to improve overall assembly performance.
- Exceed ASHRAE 90.1-2010 prescriptive requirements. (see below)

ASHRAE 90.1 Envelope Prescriptive Requirements (Climate Zone 5A)

Building envelope performance is regulated by ASHRAE Standard 90.1 which is the basis for most energy codes. LEED energy performance is determined by the Performance Rating Method defined in Appendix G of ASHRAE 90.1. The baseline building envelope used for comparison is based on the prescriptive envelope requirements of the standard found in Section 5 which vary by climate zone, construction type and building type. Refer to attached Table 5.5-5 for Building Envelope Prescriptive Requirements for Climate Zone 5A (Massachusetts). The following are some specific issues to consider:

- Under 90.1, vertical glazing area is limited to 40% of the gross wall area. Buildings that have greater percentages of glazing are at a disadvantage when compared to the baseline prescriptive building.
- Prescriptive glazing performance values are for the entire assembly including the frame. Published glass performance is usually based on the center of glass and must be adjusted to account for the assembly – assembly 'U' values may be higher than center of glass 'U' values depending on the type of framing system used.
- Nonresidential steel framed walls in Climate Zone 5 require R-13 cavity insulation as well as R-7.5 continuous insulation.

Recommended Envelope Performance:

Envelope Component		ASHRAE 90.1-2010 (Climate Zone 5A)	Recommended
Roof (Insulation above deck)	Insulation R Value (R min.)	20 continuous	30 continuous
	U assembly (U max.)	0.048	0.032
Walls (Mass)	Insulation R Value (R min.)	11.4 continuous	19.0 continuous
	U assembly (U max.)	0.090	0.043
Glass (Metal framing, curtain wall / storefront)	U glass (U max.)	N/A	0.29w/0.27s
	U assembly (U max.)	0.45	0.43
	Solar Heat Gain Coefficient (SHGC max.)	0.40	0.27
	Visible Light Transmission	N/A	63%

Solar Power Purchase Agreements

A solar power purchase agreement allows for the design, build, ownership, operation and maintenance of a solar renewable energy system by a third party (seller) in return for an agreement by the system host site (buyer) to purchase all electricity generated by the system over the life of the agreement.

The seller amortizes the capital cost of the installation and pays for on-going operations and maintenance costs by a combination of tax incentives, depreciation, renewable energy incentives, sale of solar renewable energy credits (SRECs) and the sale of the electricity produced by the system.

Basic Elements

- Length of Agreement – 15 to 30 years, typically 20 years
- Cost of electricity – fixed unit price ($/kWh) with fixed annual escalation rate spelled out in the agreement. The initial rate is usually at or below current market rates for electricity
- System operations & maintenance - provided by the seller with costs included in the electricity price.
- Insurance – needs to be addressed by agreement – typically part of the costs covered by the sale of electricity.
- Warranty – provided by seller as pass through from installing contractor and equipment manufacturers.
- Replacement – longer term agreements may exceed the life expectancy of some of the system equipment – particularly inverters. The agreement needs to include cost allocation in future years for replacement.
- Environmental Attributes and Credits – most PPA's are in part financed through the sale of the renewable attributes of the power produced by the system. The power sold to the host facility or buyer is not typically "renewable" – it is regular electricity just as if purchased from the utility. The renewable attributes have a value independent of the electricity and are sold as solar renewable energy certificates (SRECs). If the host or buyer requires renewable energy, arrangements for lower cost RECs (usually wind power based) need to be included in the agreement.
- End of Term and Buyout Options - the agreement needs to spell out what happens to the installation at the end of the term of the agreement. Options include removal by the seller, renewal of the agreement or purchase of the system by the host. There also may be provisions for an early buyout of the system by the host facility owner.

Advantages

- Federal tax incentives and depreciation can be monetized by non-profit host facilities
- Little or no up-front costs
- Fixed electricity costs (with fixed escalation) for the life of the agreement
- Electric costs can be below current market rate
- No responsibility for design, build, operations and maintenance of the system

Disadvantages

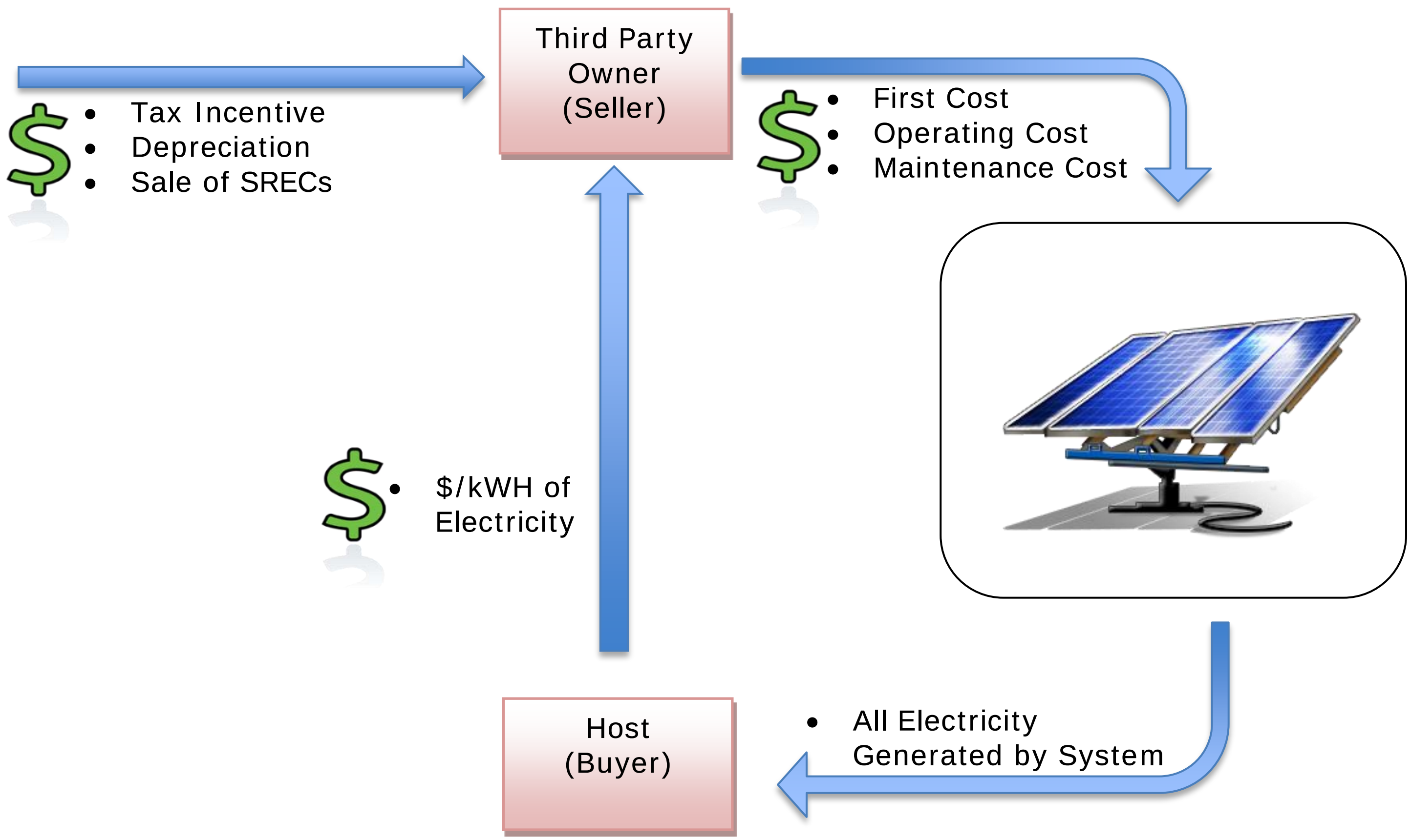
- Third party owns and has legal access to system.
- Transaction costs to implement agreement can be high (legal fees, etc.)
- Uncertainty over future – the arrangement may be advantageous today but what about in 15 years?

Seller:

- Is responsible for designing and building system
- Is responsible for financing the system
- Is responsible for operating and maintaining the system
- Is responsible for insuring the system
- Is responsible for replacing system components if they wear out prior to the end of the agreement
- Hold the warranty on the system components
- Owns the system

Buyer:

- Is responsible for providing the host facility for the system installation
- Is responsible for purchasing the electricity generated by the system based on the initial cost established by the agreement and plus the fixed annual escalation rate established by the agreement



in::posse reinventing human habitats

Solar Power Options

	Power Purchase Agreement	Outright Ownership
First Cost	Little or no first cost	Significant first cost ($5 to $9 million depending on type of system and mounting details)
Transaction costs	Can be significant	None
Operating & maintenance cost	Included in PPA	Paid by owner
Replacement of components at end of useful life	Can be accounted for in agreement and included in cost of electricity	Owner must pay for replacement if/when required
Responsibility for design & construction	Third Party is responsible	Owner is responsible
Ownership of system	Third Party	Owner
Monetization of tax incentives	Included	Not possible for non-profit owner
Sale of solar renewable energy credits (SRECs)	Typically part of the deal	Optional
Purchase of regular RECs required to achieve net zero energy	Yes - can be bundled into PPA	Maybe – only if SRECs are sold to reduce cost of system
Access to site by third parties	Access must be granted to third party for required operation & maintenance	None required except as controlled and managed by owner
Cost of electricity	Fixed cost with annual escalation	No cost for life of system
Future flexibility	None- locked into long term agreement	Retain flexibility by owning system

Perkins Eastman

ARCHITECTURE
CONSULTING
INTERIOR DESIGN
PLANNING
PROGRAMMING

07.24.12

Robert W. Healy
City Manager
City of Cambridge
795 Massachusetts Avenue
Cambridge, MA 02139

Re: Martin Luther King Jr School, Putnam Avenue
Carbon Accounting for Design Options

Dear Mr. Healy:

Based upon audience questions and comments at more than one of the four neighborhood meetings where Perkins Eastman presented the evolving studies and options during the MLK Jr. Feasibility Study process, it became apparent that certain attendees are concerned about the impact of Embodied Energy on the overall long-term sustainability of the project.

The City instructed Perkins Eastman to retain the services of an independent consultant capable of calculating and comparing the three proposed options to a "no-build" option, which retains the existing building largely "as-is", merely upgrading its thermal and mechanical performance by approximately 30% (Current Updated Building). It must be noted that this "hypothetical project" does not meet the program space needs of 740 students in 3 schools (preschool, preK-5, 6-8). Alterations and additions would be required to accommodate the increased student body, which is the design proposed as the Existing Modified Option.

In addition to the crucial issue of program-fit, this "no-build" scenario does not provide a building that could accommodate the City's Net-Zero requirement, begin to address the parking and associated open space issues, solve the seismic issues, re-orient the classrooms north/south for sun-control, increase the floor-to-floor heights or provide for natural light and ventilation to many underprovided spaces. This scenario was proposed and analyzed as a "base-line" for measuring the environmental performance of the new-build Clover and Pi (Preferred) Options which address all of these issues, or the Existing Modified Option which addresses some of these issues.

Perkins Eastman contacted the existing project MEP/FP engineers, the Net-Zero engineers and the project's proposed LEED consultants and determined that they were not properly equipped to perform this task. The LEED consultant, formerly of the Green Roundtable, recommended Jim Newman of LINNEAN Solutions to perform this specialized work. Coincidently, Mr. Newman is not only a Cambridge resident, but also a graduate of MIT. Prior to founding LINNEAN solutions, Mr. Newman was Director of Building Green.com, an online product and systems research and testing company. His bio is attached.

NORTH AMERICA
BOSTON, MA
CHARLOTTE, NC
CHICAGO, IL
NEW YORK, NY
PITTSBURGH, PA
SAN FRANCISCO, CA
STAMFORD, CT
TORONTO, ON
WASHINGTON, DC
SOUTH AMERICA
GUAYAQUIL, ECU
ASIA
MUMBAI, IND
SHANGHAI, PRC
MIDDLE EAST
DUBAI, UAE

PERKINS EASTMAN ARCHITECTS, PC
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SUITE 402
BOSTON, MA 02110
T. 617.449.4000
F. 617.449.4049

WWW.PERKINSEASTMAN.COM

Perkins Eastman and our engineers provided all the available project information to Mr. Newman, including drawings of the existing building, three-dimensional computer models depicting area, surface and volume of the proposed alternative options, and potential material and system selections. The City provided energy-use invoices to calculate existing energy use. Links to articles on the program used by LINNEAN Solutions include:
http://leedcasestudies.usgbc.org/overview.cfm?ProjectID=1385
http://leedcasestudies.usgbc.org/materials.cfm?ProjectID=1385
http://www.athenasmi.org/

The outcome of Mr. Newman's work is described in the attached Carbon Accounting for Martin Luther King Jr. School Design Options, dated 07.23.12. In summary, Mr. Newman concludes that by year 15, all three of the proposed design options surpass the "no-build" scenario for embodied carbon plus operational carbon emission reductions. After that point, both new options (Clover or Pi/Preferred) and the extensive renovation/addition option (Existing Modified Option), begin to perform progressively better and better on behalf of the environment as the years go by. Assuming an hypothetical 50-year life-expectancy for the building, a new building is substantially better for the environment than merely keeping the existing building, with all its programmatic, educational and design shortfalls.

When correcting for some of these significant deficiencies, as per the Existing Modified Option, the building becomes unrecognizable from its origins, equally intensive in construction effort, duration and disruption, and identical in cost to the Pi (Preferred) Option.

Given the unequivocal outcome of this carbon study by LINNEAN Solutions, Perkins Eastman strongly recommends the Pi (Preferred) Option over all others, as it provides all the benefits of the Existing Modified Option plus the added benefit of solving classrooms orientation, increasing floor-to-floor heights and then goes on to outperform all other options on all environmental measures, and does so for the same cost.

Sincerely,

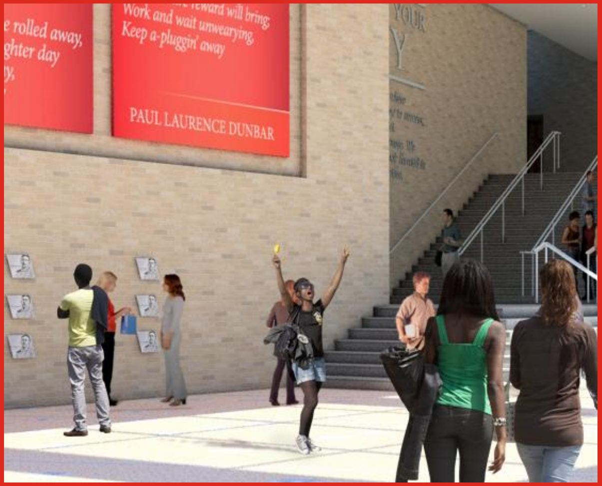
John R. A. Pears, RIBA
Managing Principal

cc: File/Alicia Caritano - PE
Richard Rossi; Michael Black – City of Cambridge

Enclosure Carbon Accounting for Martin Luther King Jr. School Design Options, dated 07.23.12
Bio for Jim Newman of LINNEAN Solutions

jp

8.0 POWER POINTS



Perkins Eastman

The City of Cambridge

File #5556 | Martin Luther King, Jr. School

February 24, 2012

Team Organization

- Steering Committee
- Design Team

Feasibility Study Process

- Three Step Process
- Meeting Schedule

Preliminary Focus Group Summary

Discussion

Perkins Eastman

Steering Committee & Design Team Introduction

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Developing the Feasibility Study

Instructional

- Two 20-student Classrooms w/adj. Bathrooms
- Teaching Kitchen

Administrative

- Office
- Reception Area
- Storage

Other

- Garden
- Outdoor Playground

Staff & Students

- XX
- XX

Use

- XX

Other

- XX

Spaces Identified for Potential Inclusion in the "Ed Spec"

Instructional

- XX
- XX

Administrative

- XX
- XX

Other

- XX

Attributes of Potential Spaces

Staff & Students

- XX
- XX

Use

- XX

Other

- XX

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Preliminary Focus Group Summary

Human Services: Pre-School

- Connection to the resources of the campus (Library, Small Gym)
- Nutrition as integrated learning opportunity (Garden, Food Preparation, Dining, Recycling)
- Appropriate, secure & welcoming arrival

Human Services: After School Programs

- Active After School, Community School & Youth Center programs planned to serve multiple schools
- Concurrent School-based after school programming
- Intergenerational education throughout the day, encourage children to stay on campus; Serve seniors as well.
- Zone the building for active Community & School Use (security, maintenance, storage)

City Sprouts

- Outdoor learning program integrated with curriculum
- Nutrition (cultivation, preparation, consumption, recycling…)

ICTS

- A "Learning Commons" for each school for integrated media access and formal & informal learning opportunities
- Class "Breakout" spaces: use all of the building
- Flexibility

Visual & Performing Arts

- Theater to house the larger school (students and faculty) plus 100 seats; Theater versus Auditorium; Professional or Educational?
- After school use of spaces requires separate storage

Special Needs

- Inclusionary with distributed "learning centers"
- 3 Developmental Delay/Life Skills rooms; OT/PT; Speech Therapy; De-escalation Room(s); Testing Room Office
- Specific environmental criteria for lighting & acoustics

Maintenance

- Indoor and Outdoor Storage
- Proper adjacencies and access; relative to loading/receiving
- Site design to facilitate maintenance

Health & Physical Education

- Two separate gyms, fitness room
- Teaching resources within gyms
- Project Adventure: climbing walls, ropes
- Zoned for active School, After School & Community Use

Perkins Eastman

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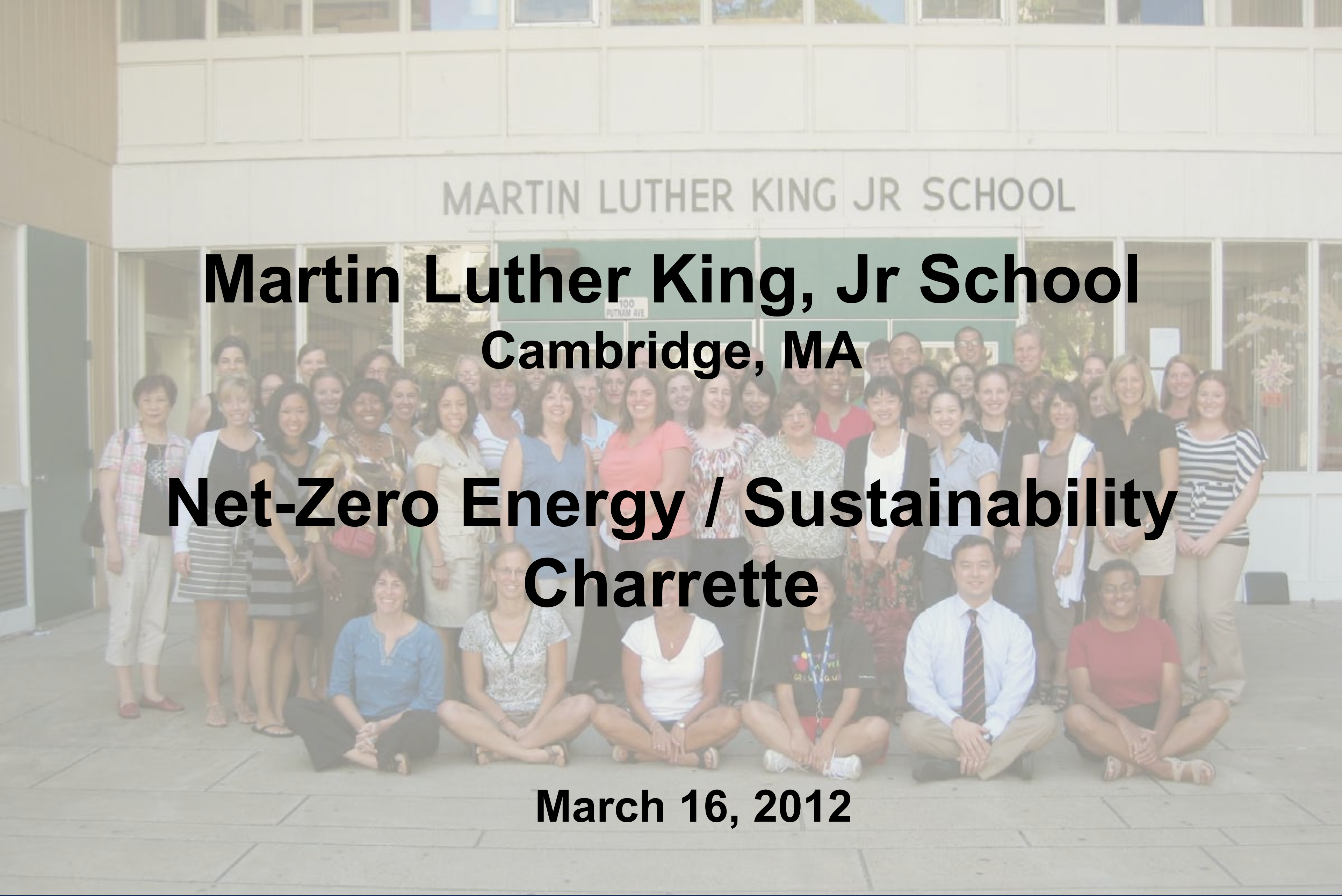


Martin Luther King, Jr School

Cambridge, MA

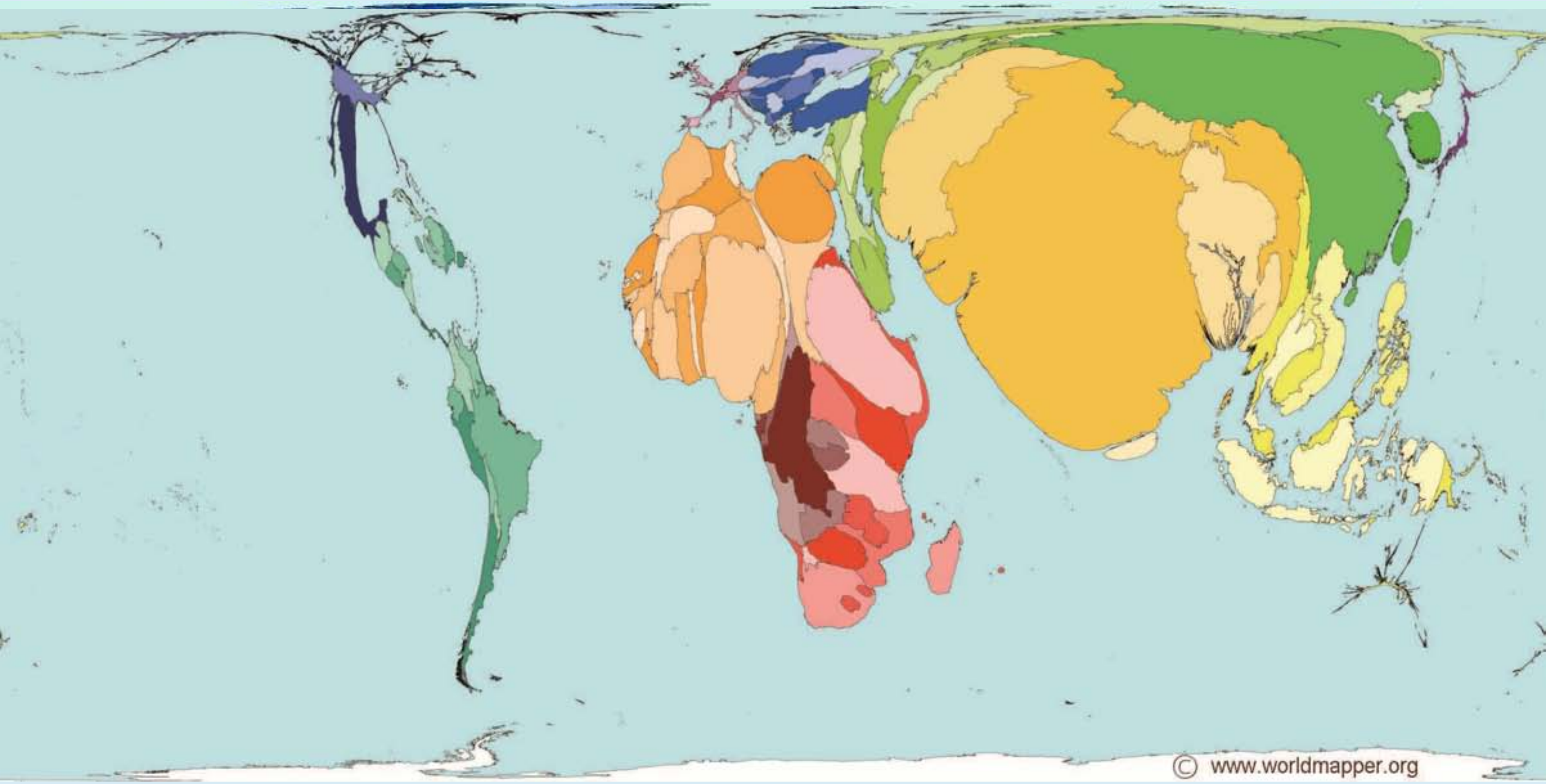
Net-Zero Energy / Sustainability Charrette

March 16, 2012

Net-Zero Energy / Sustainability Charrette – March 16, 2012

1. Introductions
2. Sustainability & LEED
3. What is net-zero energy?
4. Steps to achieving net-zero energy
5. What definition should we use?
6. The Energy Budget
7. Case studies – 2 NZE schools
8. How is energy used?
9. How could energy use be reduced?
10. How could NZE be integrated into the curriculum?
11. Are there other sustainability goals or opportunities?

The World We Live In……..



Environmental Impact of Buildings in the US

- **72% of total U.S. electricity consumption [1]**
- **40% of total U.S. primary energy use [2]**
- **39% of total U.S. greenhouse gas emissions [3]**
- **136 million tons of construction and demolition waste in the U.S. (approx. 2.8 lbs/person/day) [4]**
- **13.6% of potable water in the U.S. [5]**
- **40% (3 billion tons annually) of raw materials use globally [6]**

Response to Building Energy Consumption

- LEED Certifications
- Energy Star
- Green Building Initiative(Green Globes)
- 2030 Challenge
- Living Building Challenge

LEED® 2009 (V3)

- 6 Categories
- 8 Prerequisites
- 100 Credits
- 10 Bonus Credits
- 110 Total Possible Points

Four Levels of Certification

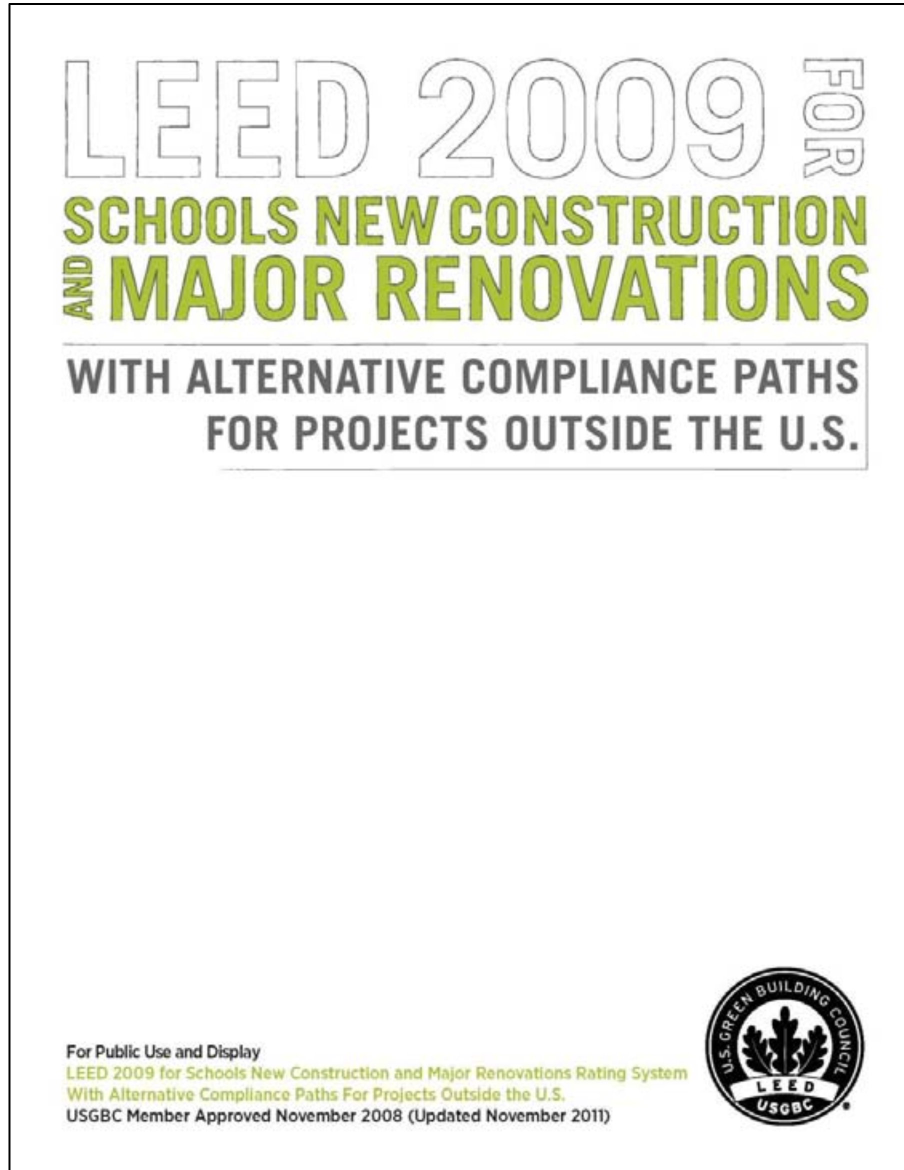
- LEED® Certified: 40-49 Points
- Silver Level: 50-59 Points
- Gold Level: 60-79 Points
- Platinum Level: 80+ Points

LEED:
Leadership in Energy & Environmental Design

1. **Sustainable Sites (SS)**
2. **Water Efficiency (WE)**
3. **Energy & Atmosphere (EA)**
4. **Materials & Resources (MR)**
5. **Indoor Environmental Quality (IEQ)**
6. **Innovation & Design (ID)**

LEED for Schools

- Specific version focused on schools
- School specific credits such as acoustical performance

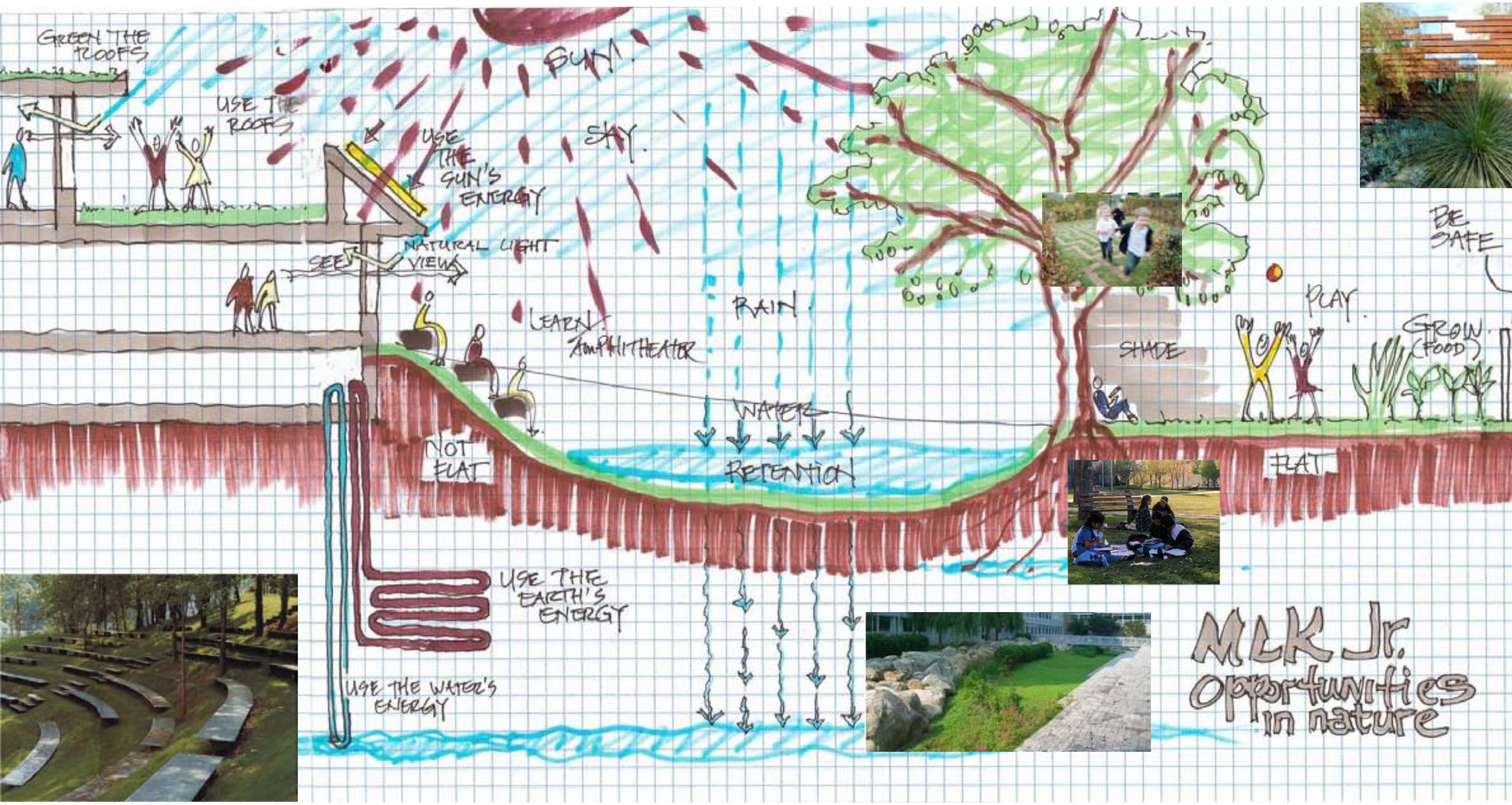

LEED 2009 FOR

SCHOOLS NEW CONSTRUCTION AND MAJOR RENOVATIONS

WITH ALTERNATIVE COMPLIANCE PATHS FOR PROJECTS OUTSIDE THE U.S.

For Public Use and Display
LEED 2009 for Schools New Construction and Major Renovations Rating System
With Alternative Compliance Paths For Projects Outside the U.S.
USGBC Member Approved November 2008 (Updated November 2011)

Sustainability comes Naturally



Natural Opportunities:

Growing and eating healthy food

Chronicle / Craig Lee

Natural Opportunities

Play, Relax and Learn

LEED for Schools

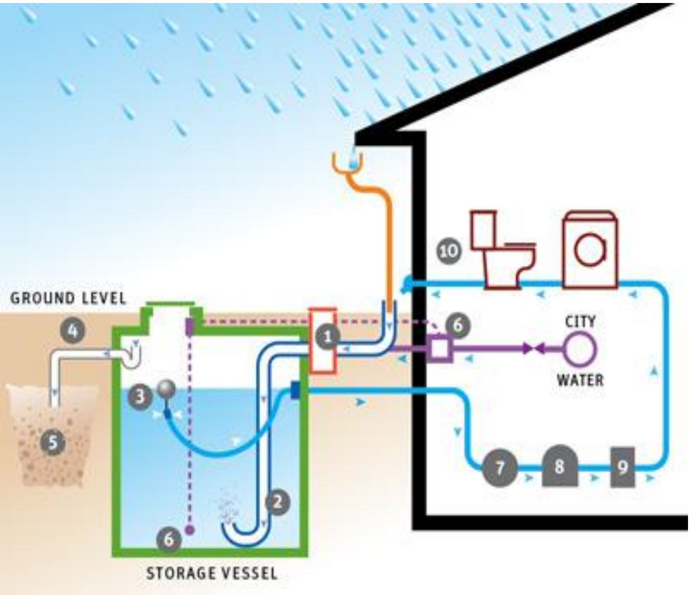
1. Sustainable Sites

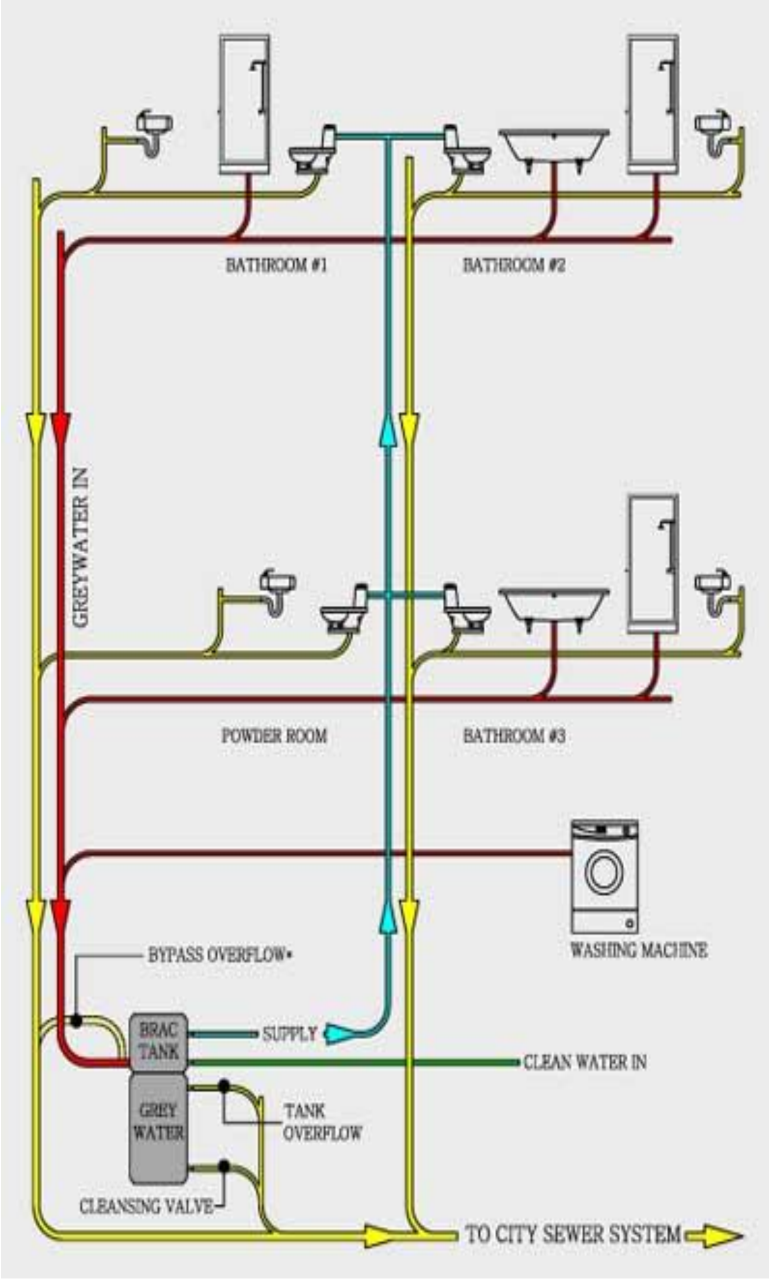
a) Community and Density – building where there are services & a real neighborhood, joint use of building
b) Open Space &/or Preservation of Habitat
c) Transportation –alternatives to driving & promoting fuel efficient vehicles and carpools
d) Storm water – quantity/quality control, erosion control
e) Light Pollution

LEED for Schools

2. Water Efficiency

a) Water use reduction
b) Waste water reduction (rainwater or greywater use)
c) Landscape – non potable water use reduction or elimination





LEED for Schools

3. Energy & Atmosphere

a) Energy Performance
b) Renewable Energy
c) Commissioning
d) Refrigerants
e) Measurement & Verification

LEED for Schools

4. Materials & Resources

a) Building reuse
b) Regional materials
c) Recycled/Recyclable materials

LEED for Schools

5. Indoor Environmental Quality

a) Non-toxic materials
b) Proper ventilation
c) Daylight & Views
d) Controllability of System by Users
e) Chemical & Pollutant Control & Green cleaning
f) Thermal Comfort
g) Accoustics

GREENGUARD®
Indoor Air Quality Certified

LEED for Schools

6. Innovation
    a) Building as a teaching tool
    b) ?
    c) ?

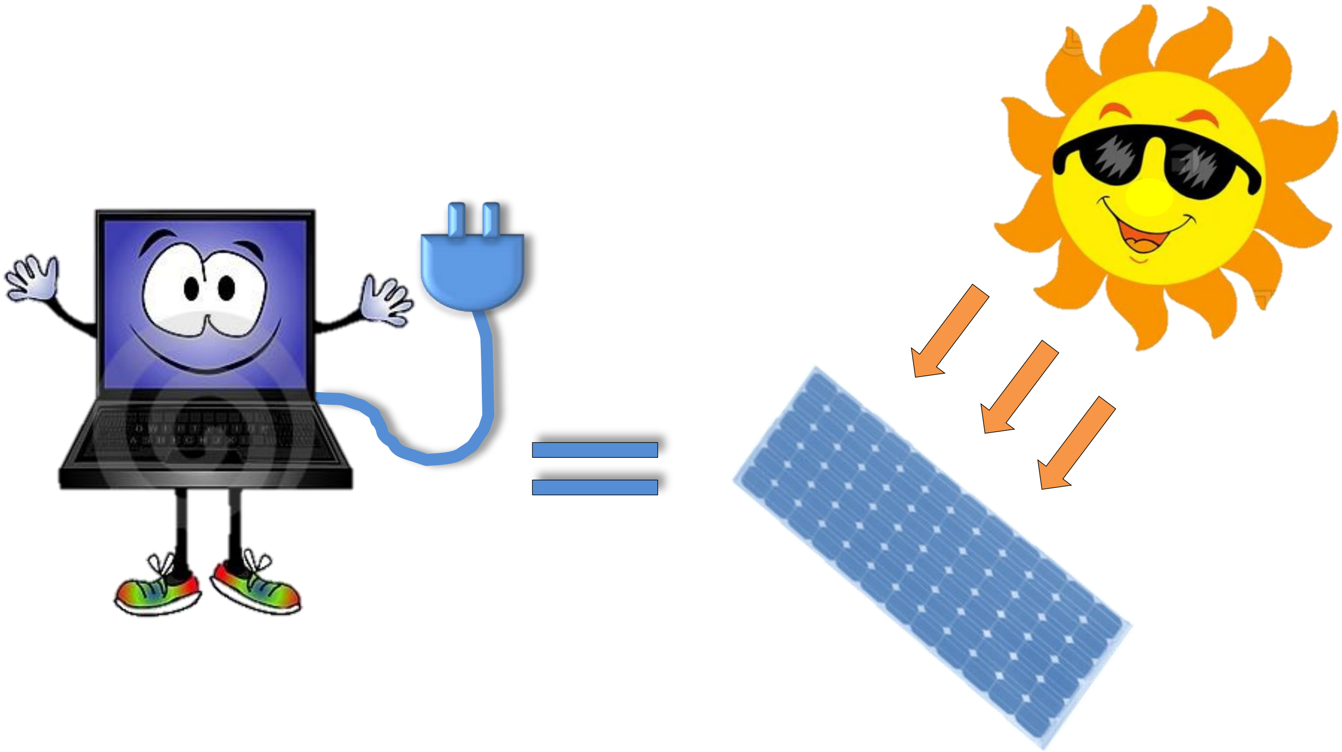
LEED vs. Net-Zero Energy

1. Sustainable Sites (SS) — Energy
2. Water Efficiency (WE) — Energy
3. Energy & Atmosphere (EA) — Energy
4. Materials & Resources (MR) — Energy
5. Indoor Environmental Quality (IEQ) — Energy
6. Innovation & Design (ID) — Energy?

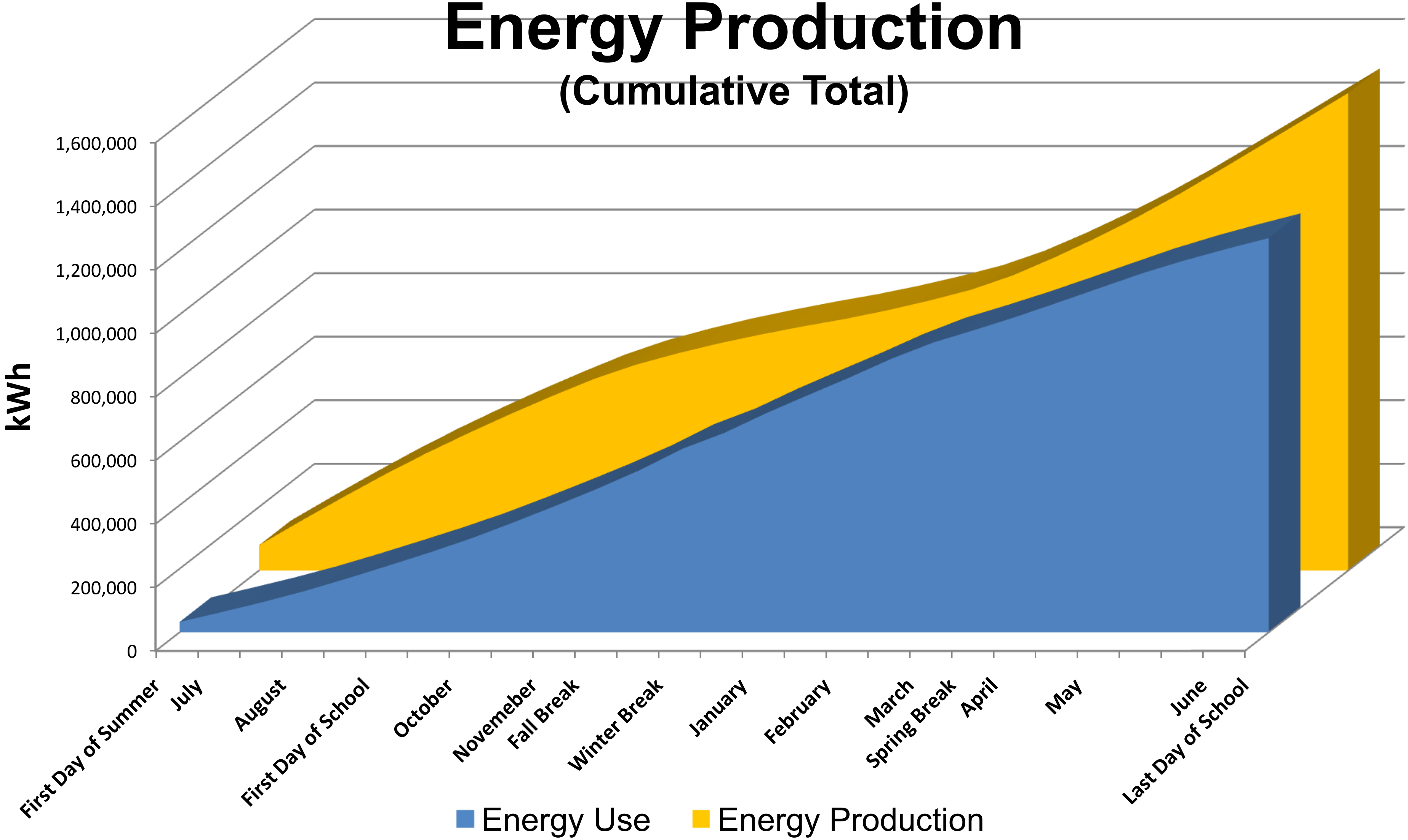
Net-Zero Energy

- A building that harvests as much energy from renewable sources as is uses from non-renewable source in one year

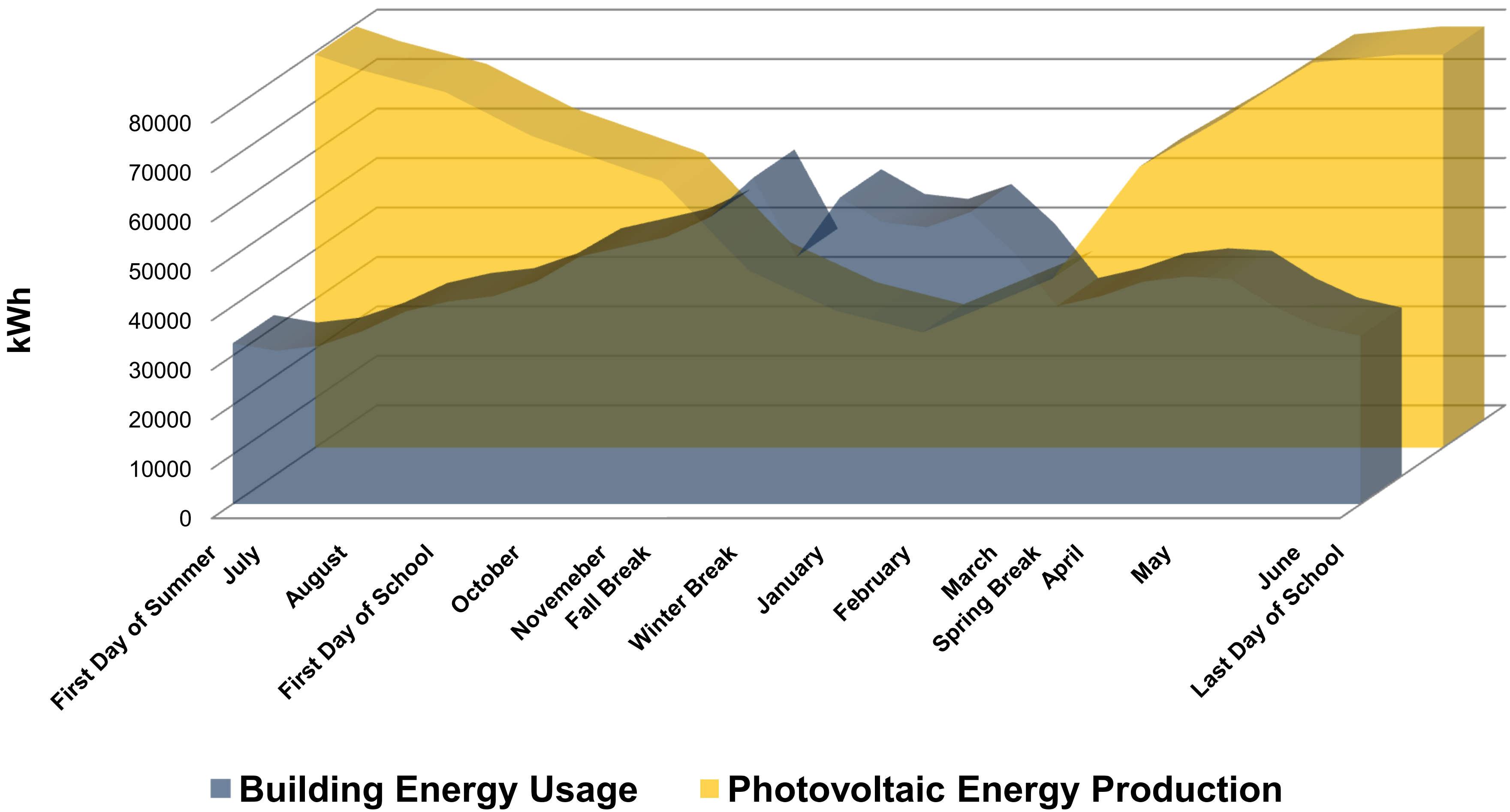
Energy Used = Energy Made



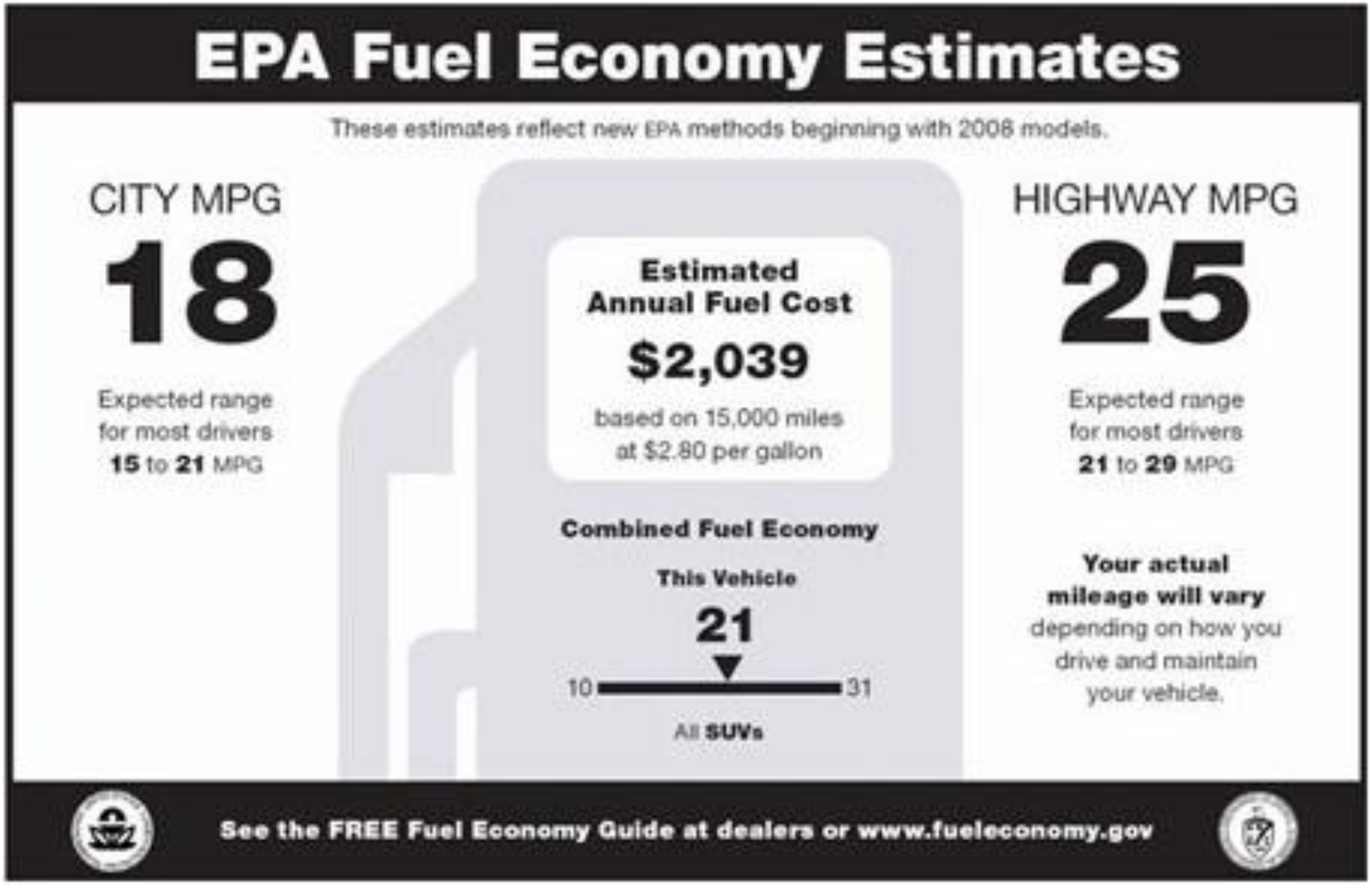
Annual Energy Use vs. Energy Production
(Cumulative Total)



Annual Energy Used vs. Energy Made



Energy in LEED vs. NZE




Z71
CHEVROLET
GMN-0789
FUEL
EFFICIENT
VEHICLE

Defining Net-Zero Energy:

Net-Zero Site Energy

Net-Zero Source Energy

Net-Zero Energy Cost

Net-Zero Energy Emissions

Zero Energy Buildings: A Critical Look at the Definition, NREL, June 2006

Net-Zero Energy Buildings: A Critical Look at the Definition, NREL, June 2006

How is energy harvested?

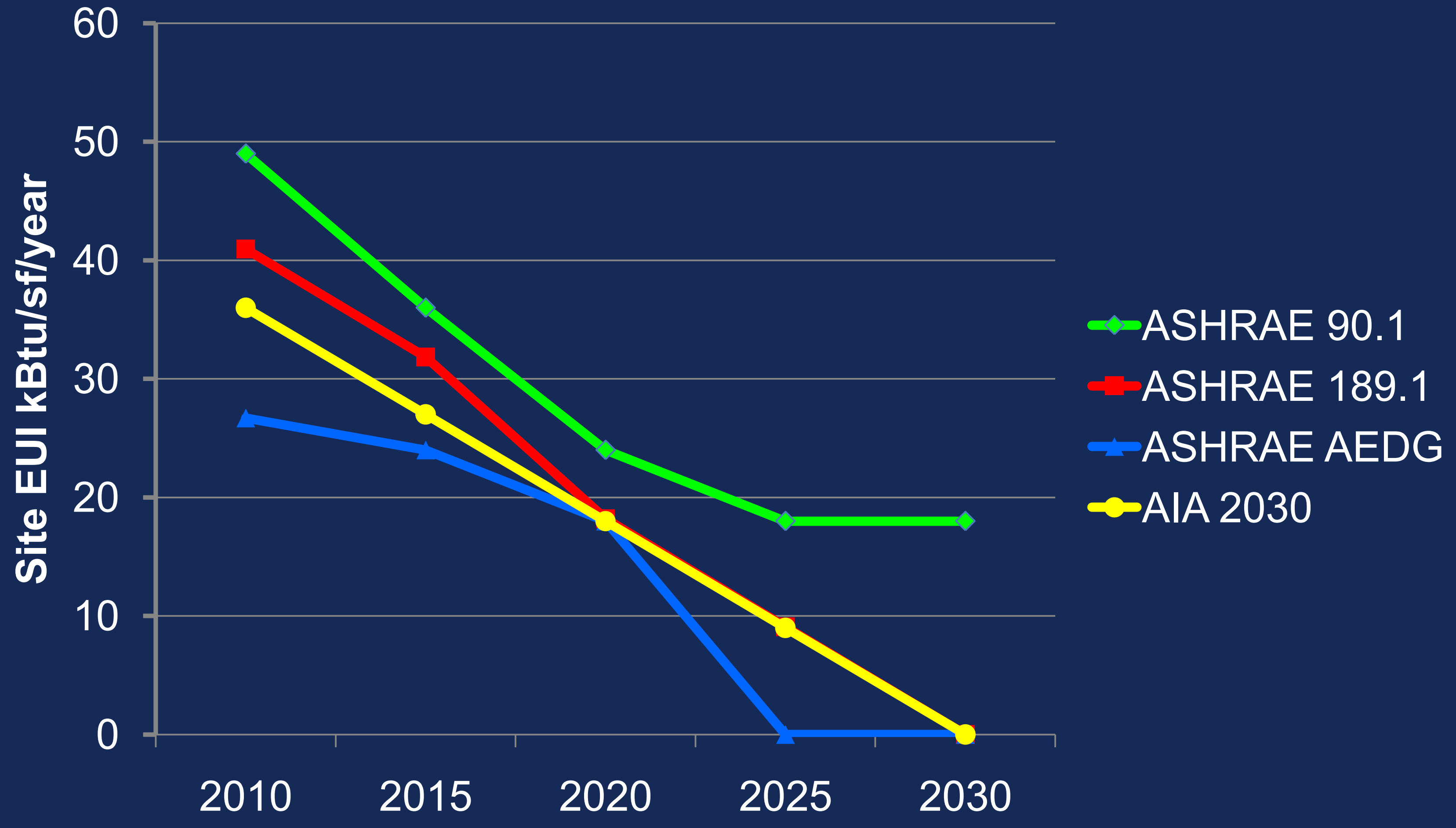
NZEB:A	Renewable energy harvested within the building footprint
NZEB:B	Renewable energy harvested within the building footprint and on the site
NZEB:C	Renewable energy harvested within the building footprint, on site or by renewable sources imported to the site
NZEB:D	Renewable energy harvested within building footprint and/or on site and supplemented by purchased renewable energy certificates

Net-Zero Energy Buildings: A Classification System Based on Renewable Energy Supply Options, NREL, June 2010

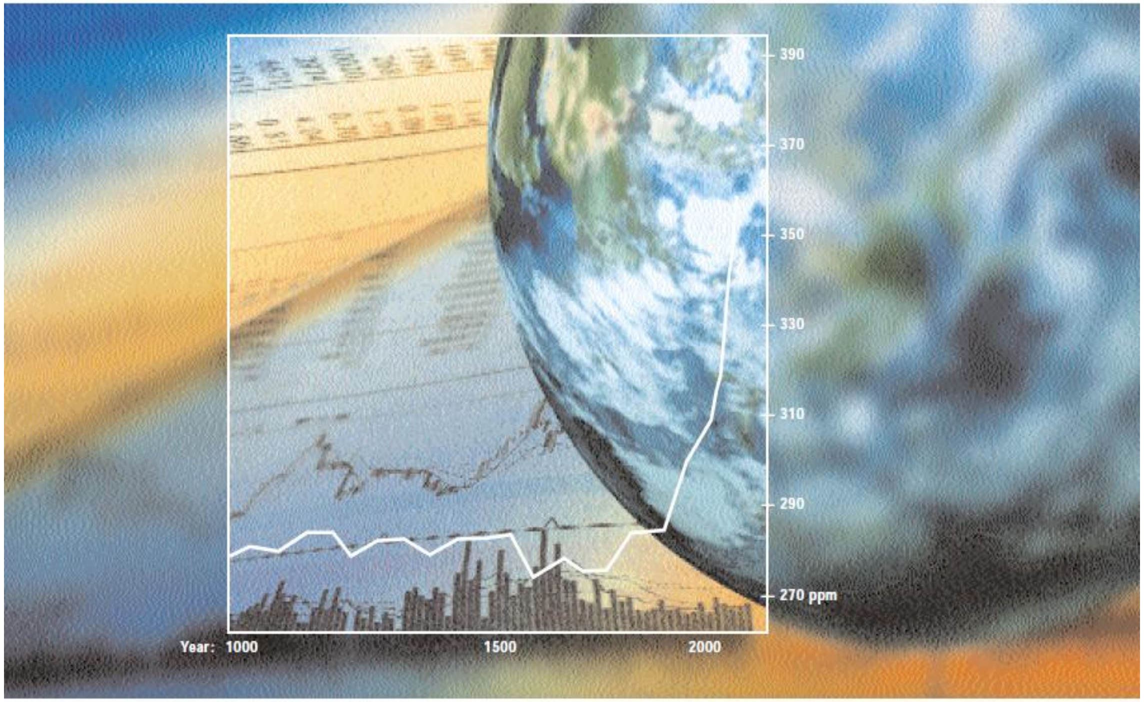
Living Futures NZE Certification

- Based on Living Building Challenge
- Requires site generated renewable energy (NZEB-A, NZEB-B)

The Future…

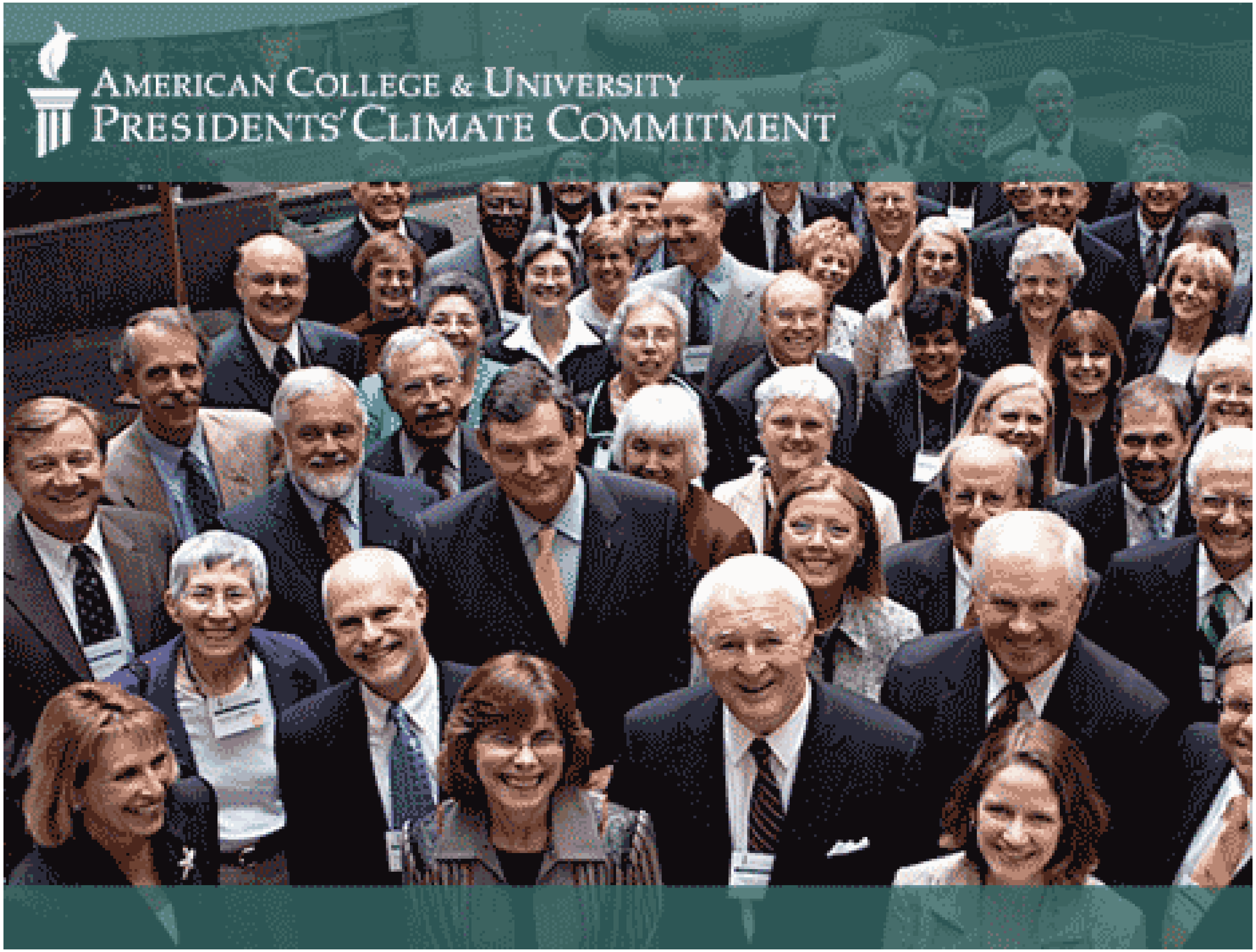

60
50
40
30
20
10
0
Site EUI kBtu/sf/year
2010
2015
2020
2025
2030
ASHRAE 90.1
ASHRAE 189.1
ASHRAE AEDG
AIA 2030

The Greenhouse Gas Protocol



A Corporate Accounting and Reporting Standard

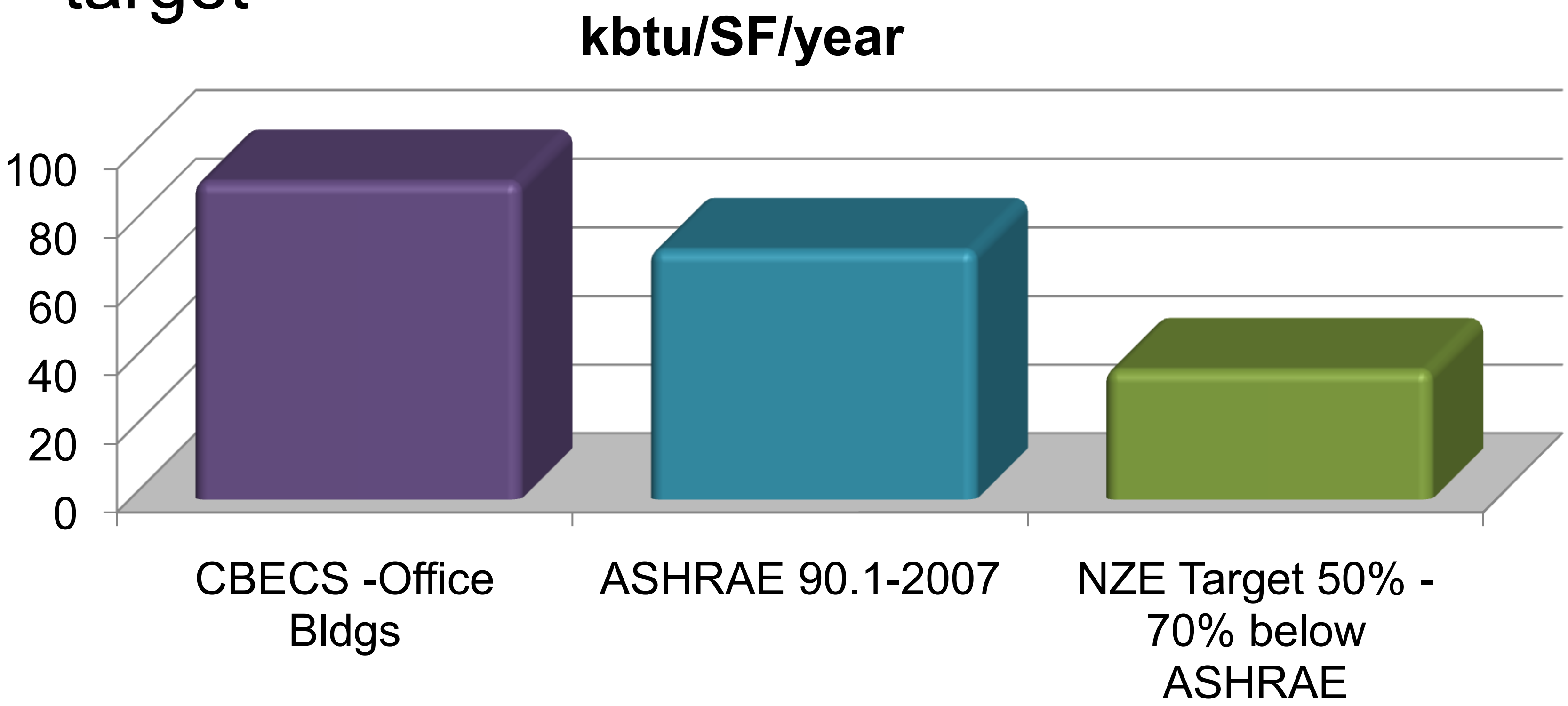
REVISED EDITION


AMERICAN COLLEGE & UNIVERSITY
PRESIDENTS' CLIMATE COMMITMENT

How Do We Hit the Target?

Net Zero Energy:
Living within an energy budget

- Establishing the budget / setting the performance target

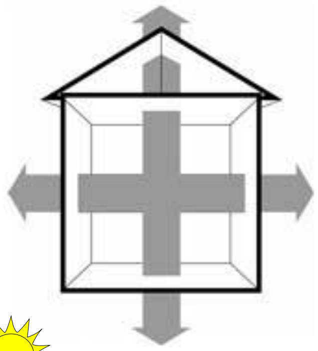


Rethinking Design…

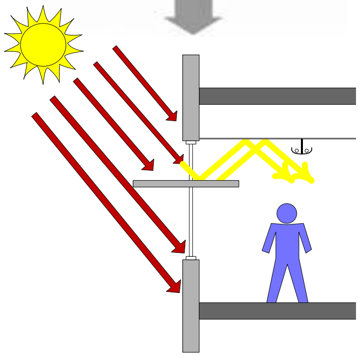
Traditional Approach
- Design for worst case
- Make sure it has enough capacity
- Focus on connected load
- Feedback to system
- Theoretical energy savings

Net-Zero Approach
- Design for performance
- Make sure it uses the least energy
- Focus on annual use
- Feedback to occupants
- Actual energy use

Steps to a NZEB



- Optimize the building
  - *Reduce loads & demands on systems*



- Optimize passive systems
  - *Reduce energy use*

- Optimize active systems
  - *Use energy efficiently*

- Engage the occupants
  - *Motivate positive behavior*

Net-Zero Energy:
WHAT DEFINITION SHOULD WE USE?

Defining Net-Zero Energy:

Net-Zero Site Energy

Net-Zero Source Energy

Net-Zero Energy Cost

Net-Zero Energy Emissions

Zero Energy Buildings: A Critical Look at the Definition, NREL, June 2006

Net-Zero Energy Buildings: A Critical Look at the Definition, NREL, June 2006

How is energy harvested?

NZEB:A	Renewable energy harvested within the building footprint
NZEB:B	Renewable energy harvested within the building footprint and on the site
NZEB:C	Renewable energy harvested within the building footprint, on site or by renewable sources imported to the site
NZEB:D	Renewable energy harvested within building footprint and/or on site and supplemented by purchased renewable energy certificates

Net-Zero Energy Buildings: A Classification System Based on Renewable Energy Supply Options, NREL, June 2010

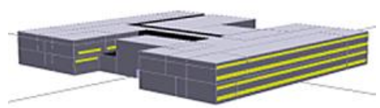
Net Zero Energy is a constantly moving target.

What are we aiming for?

Annual On-Site Energy Production	$\geq$	**Annual On-Site Energy Consumption**

On-Site Energy Production is usually the limiting factor.

Energy Budget



Energy Model

COST BUDGET TEMPLATE
DESIGN STAGE (SCHEMATIC, DD, CD)

TRADE BREAKDOWN COMPARISON SUMMARY

CSI DIVISION	DESCRIPTION	STANDARD SCA	NET ZERO ENERGY BUDGET	NET ZERO ENERGY CURRENT
01000	GENERAL REQUIREMENT			
02000	SITE WORK			
03000	CONCRETE			
04000	MASONRY			
05000	METALS			
06000	WOOD AND PLASTIC			
07000	THERMAL & MOISTURE PROTECTION			
08000	DOORS AND WINDOWS			
09000	FINISHES			
10000	SPECIALTIES			
11000	EQUIPMENT			
12000	FURNISHING			
14000	CONVEYING SYSTEM			
15300	FIRE PROTECTION			
15400	PLUMBING			
15500	HVAC			
16000	ELECTRICAL			
SUB TOTAL				
OVERHEAD AND PROFIT 10%				
SUB TOTAL				
DESIGN CONTINGENCY 10%				
TOTAL				
GROSS AREA				
COST PER SF				

Sample Cost Budget Template

ENERGY BUDGET TEMPLATE
DESIGN STAGE (SCHEMATIC, DD, CD)

CATEGORY BREAKDOWN COMPARISON SUMMARY

ENERGY CATEGORY	DESCRIPTION	STANDARD SCA (kBtu/Year)	NET ZERO ENERGY BUDGET (kBtu/Year)	NET ZERO ENERGY CURRENT (kBtu/Year)
Space Cooling	Primary cooling energy, except fans & pumps			
Space Heating	Primary heating energy, except fans & pumps			
Ventilation Fan Energy	Fan energy for supply, exhaust & return fans			
Pumps & Auxilliaries	Pumps and miscellaneous auxilliary HVAC equipment			
Miscellaneous Equip.	Plug load equipment including computers, copiers, TV's , etc			
Kitchen Loads	Kitchen equipment			
Area Lights	Interior lighting systems			
Exterior Lights	Exterior site lighting including parking, roadways and walkways			
Domestic H.W.	Energy for domestic hot water heating			
SUB TOTAL (kBtu/Year)				
CONTINGENCY (X%)				
TOTAL (kBtu/Year)				
PV CAPACITY (DC Peak kW)				
PV AREA (SF)				
PV COST ($)				

Sample Energy Budget Template

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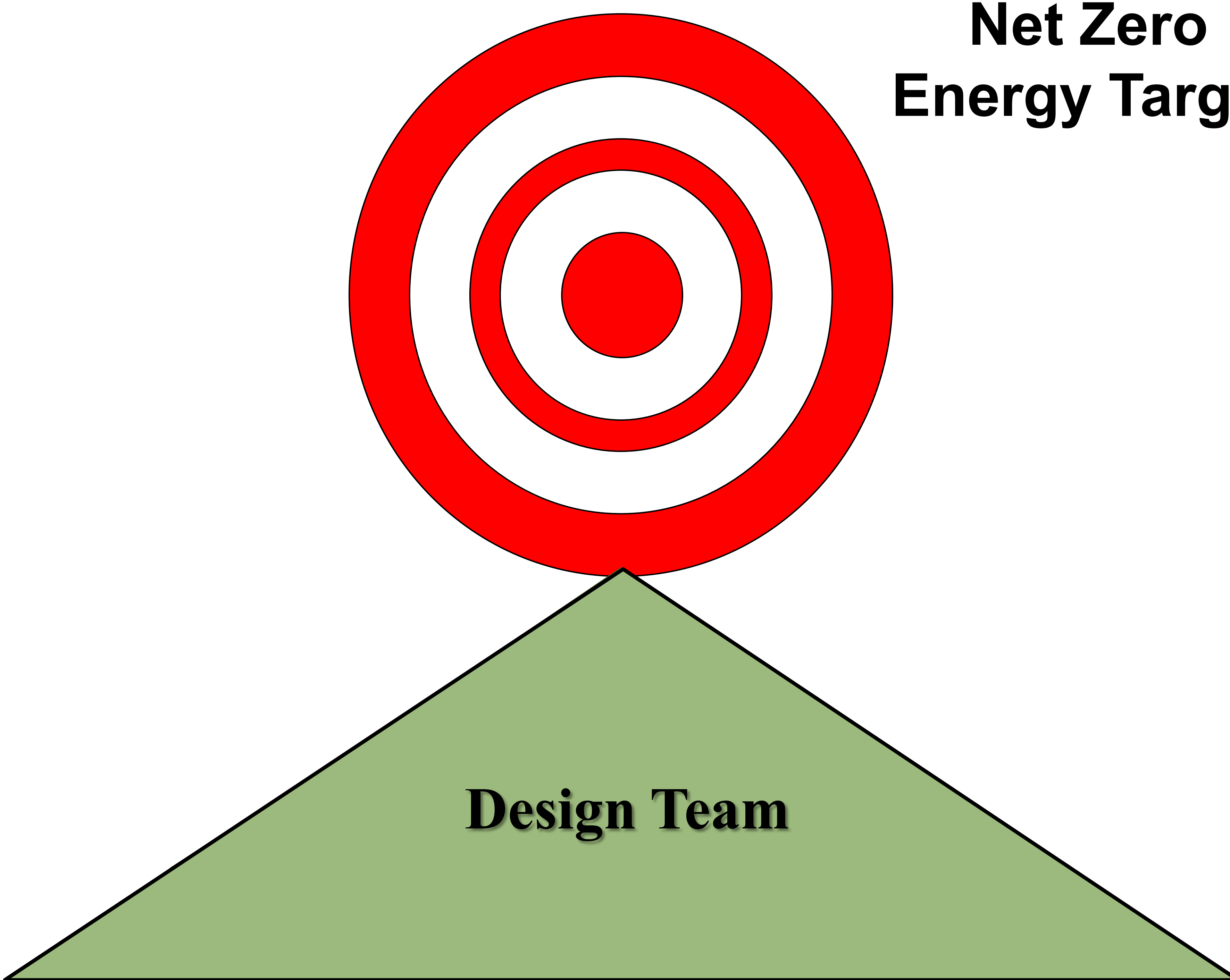
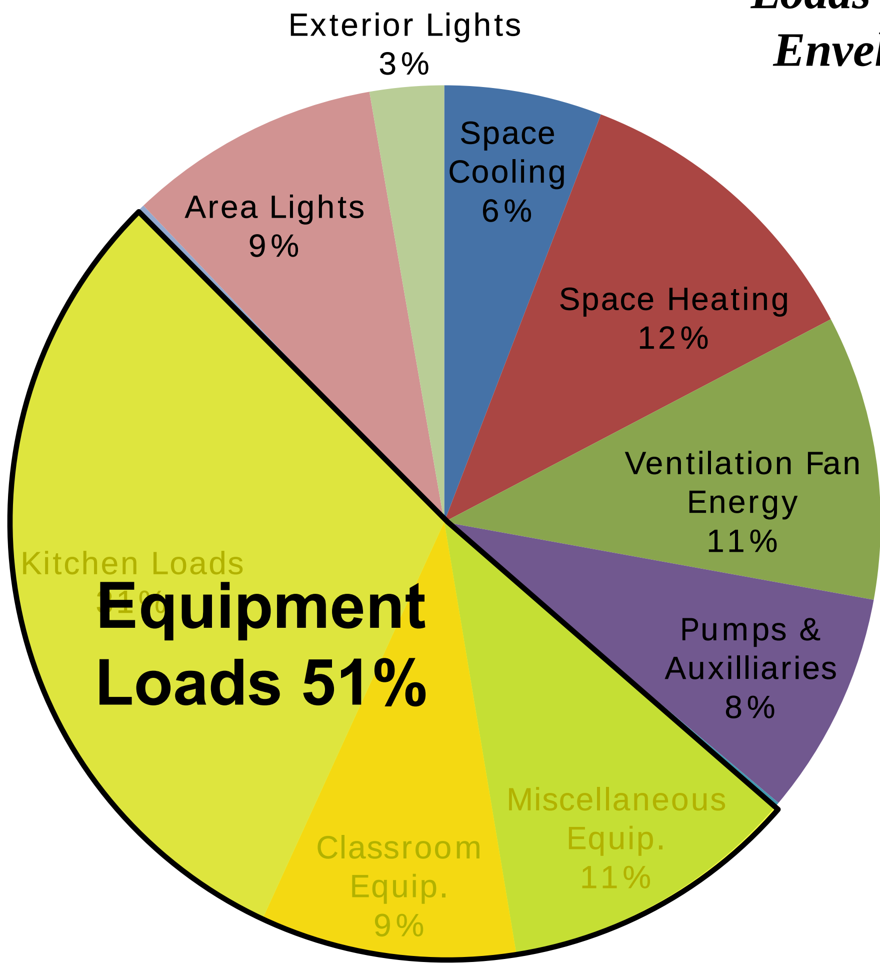
Courtesy SOM Architects

Net Zero Energy Target

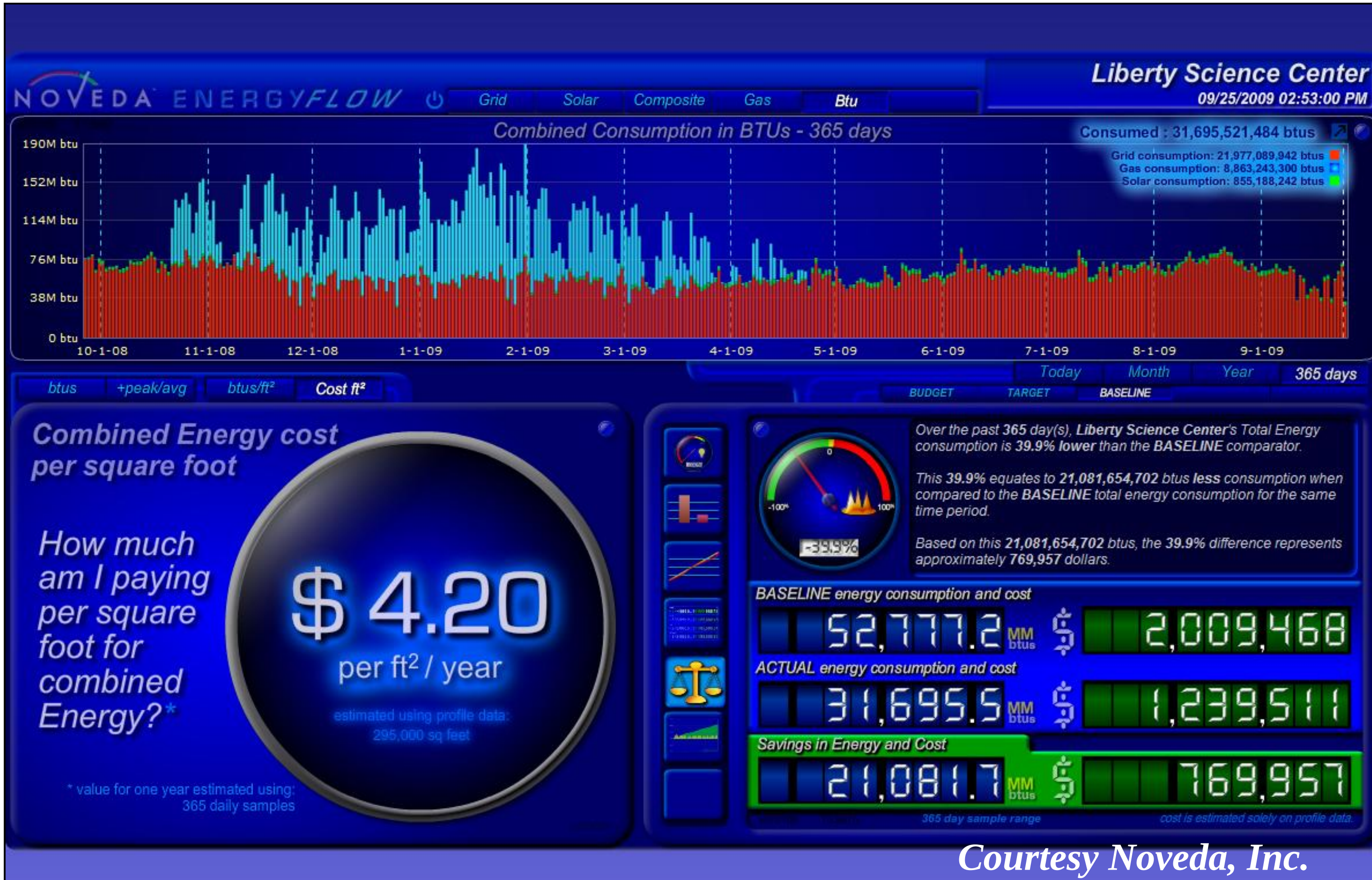


Impact of equipment loads

Example of the Impact of Plug Loads with Optimized Building Envelope, HVAC & Lighting Systems (PS62R)



Information for Occupants



Educating Owners & Occupants

- Design team needs to research how energy will be used
- Occupants need to be engaged during the design phase
- Design teams need to educate owners & occupants about the implications of operational (how much use) and programmatic (how much stuff) decisions

<u>Research, Engagement & Education</u>

Steps to a NZEB

- Research and investigation of expected & anticipated energy use due to owner equipment and program
- Education of owner about their role in getting to NZEB
- Engagement of the owner in reducing building energy needs

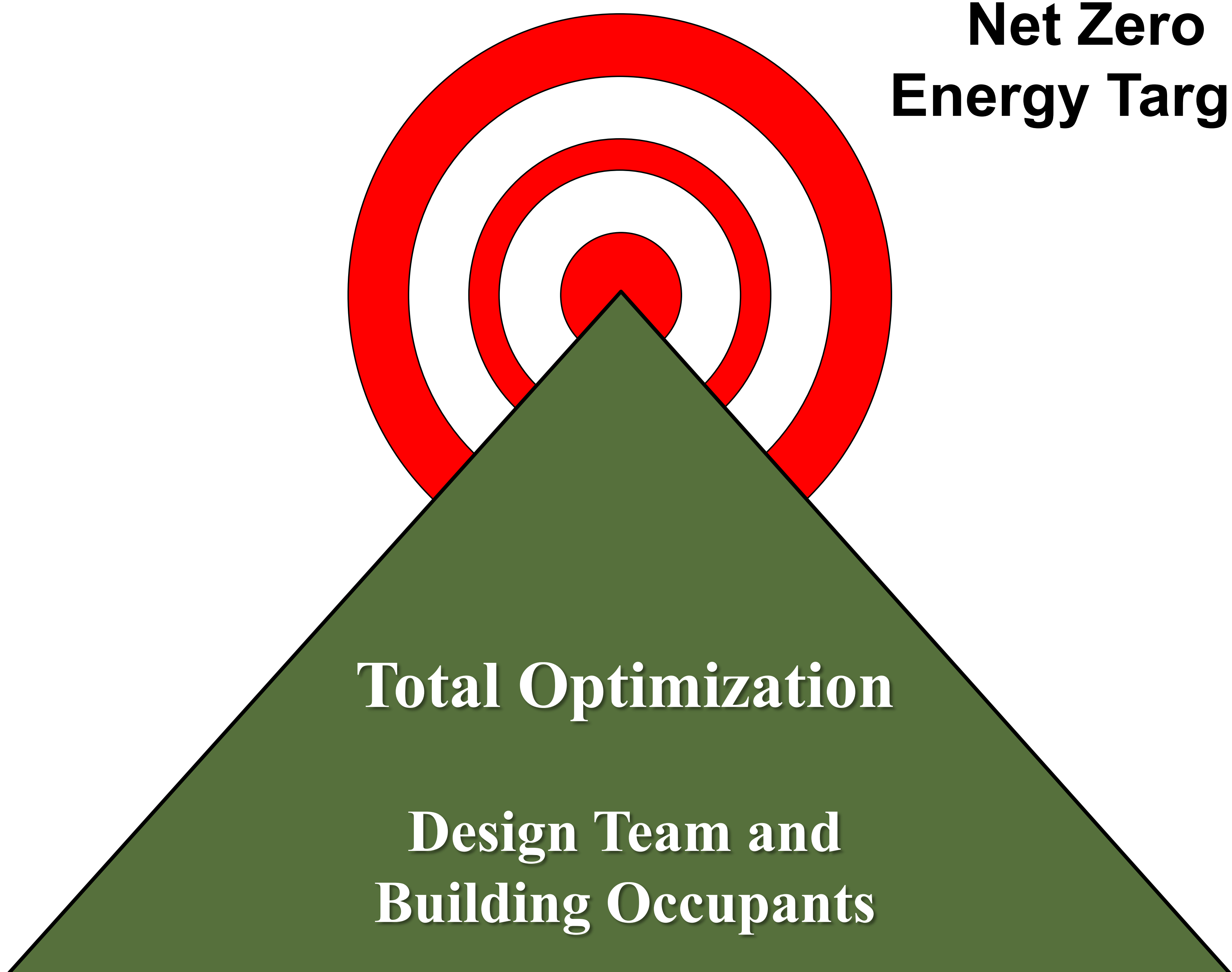
"If your idea of occupant engagement is a building dashboard – you have already lost the initiative. Occupant engagement must start during the design phase."

NZEB – Cost Multiplication

- The cost and payback of design strategies and options is impacted by the avoided cost of the renewable energy systems

- Cost of dishwasher in Net-Zero Energy building:
  - Dishwasher $ 500
  - PV to operate for one year $8,000
  - Total cost $8,500

Net Zero Energy Target



Net-Zero Energy: What would it take?

- Energy Use Intensity (EUI)
  - Measure of annual energy use per square foot of building area (kbtu/sf/year)
  - Commonly used metric to compare building energy performance between buildings
- Net-Zero Energy Schools
  - Low EUI = 18 kbtu/sf/year (little summer and after hour use)
  - More typical EUI = 30 kbtu/sf/year

Renewable Energy Harvesting Potential

- Maximum possible:
  - 2,700,000 kWh/year with site fully covered (140,000 sf)
  - 57.6 kbtu/sf/year
- Likely required:
  - 1,410,000 kWh/year with approximately 73,500 sf of PV
  - 30 kbtu/sf/year