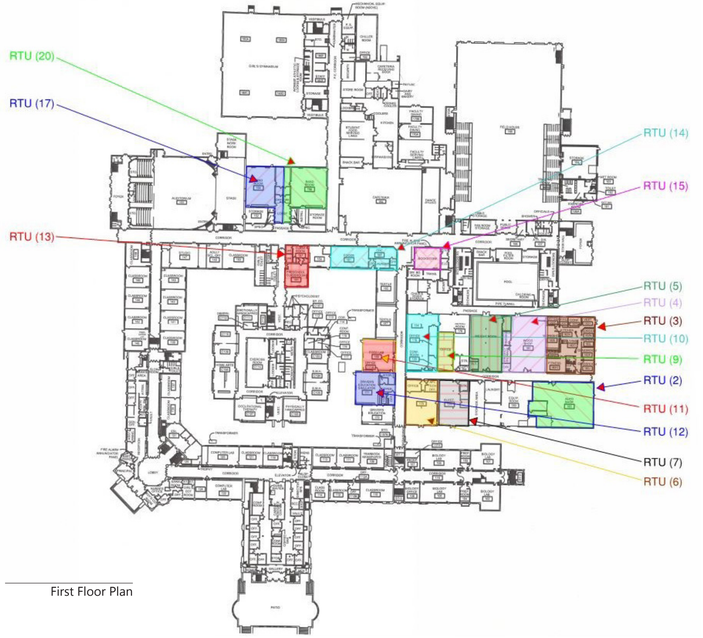
ROOF TOP UNIT ZONES

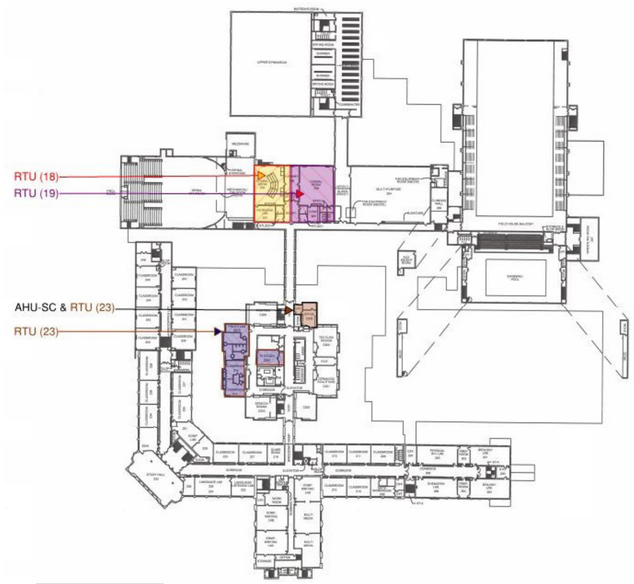
MAINE EAST HIGH SCHOOL



First Floor Plan

ROOF TOP UNIT ZONES

MAINE EAST HIGH SCHOOL



Second Floor Plan

ROOF TOP UNIT RECOMMENDATIONS

The ASHRAE median service life for packaged roof top units is 15 years. Roof top units are exposed to the elements which accelerates corrosion and reduces their useful service life. Therefore, the units recommended for replacement are for RTUs greater than 15 years in age. Please reference the RTU Cost Estimates section for pricing details.

The cost estimate tables below for recommended replacements encompass any associated mechanical, electrical, plumbing, controls, equipment, contracting, demolition, and installation costs. The anticipated start year for replacements is 2019. It should be noted that two costs will be shown for future recommendations. For example, if an item is recommended for replacement from 2019 – 2020 then the 2019 costs and the 2020 inflated costs would be shown. A 3% inflation was utilized. Cost estimates were determined by referencing our experience with similar systems and the areas served by these systems. Cost estimates are as follows:

ROOF TOP UNIT COST ESTIMATES (1 TO 2 YEARS) & (6 TO 10 YEARS)

Recommended Replacement Timeframe	Year Installed	Reference Tag	Make	Roof Location	Area Served	Heating	Cooling	Toonage	Year 2019 Cost	Year 2020 Cost	Year 2024 Cost	Year 2028 Cost
2019 - 2020	1984	10	Carrier	H	Rm. 174 & Offices	None	DX	10	$35,000	$36,050		
	1994	17	York	O	Band Room 154	Natural Gas	DX	8	$35,000	$36,050		
	1994	20	York	O	Band Rm. 158	Natural Gas	DX	9	$35,000	$36,050		
	1995	9	Trane	H	Office Near Xerox Rm.	Natural Gas	DX	3	$10,000	$10,300		
	1995	18	Carrier	O	Choral Rm. 254	Natural Gas	DX	9	$35,000	$36,050		
	2002	2	Trane	W	Rm. 185 - Auto Shop	Duct Mtd. HW Reheat	DX	13	$45,000	$46,350		
	2002	4	Trane	W	Rm. 180 - Wood Shop	Duct Mtd. HW Reheat	DX	13	$45,000	$46,350		
	2002	5	Trane	W	Weight Room	Duct Mtd. HW Reheat	DX	10	$35,000	$36,050		
	2002	6	Trane	H	Rm 175 & Nearby Offices	Duct Mtd. HW Reheat	DX	8	$35,000	$36,050		
	2002	7	Trane	H	Rm. 177	Duct Mtd. HW Reheat	DX	9	$35,000	$36,050		
	2002	11	Trane	H	Rm. 169 - Food Lab	Natural Gas	DX	8	$35,000	$36,050		
	2002	12	Trane	H	Rm. 171	Natural Gas	DX	8	$35,000	$36,050		
	2002	13	Trane	K	Rm. 155, 157	Natural Gas	DX	5	$20,000	$20,600		
	2002	14	Trane	K	Rm. 161	Natural Gas	DX	8	$35,000	$36,050		
	2002	15	Trane	K	Bookstore	Natural Gas	DX	5	$20,000	$20,600		
	TBD	TBD	TBD	TBD	Fieldhouse	Natural Gas	DX	TBD	$750,000	$772,500		
2024 - 2028	2005	19	Lennox	O	Choral Rm. 258	Natural Gas	DX	21			$75,000	$84,413
	2008	23	Carrier	H	Rm's. C208, C215, C216, C217	Natural Gas	DX	6			$25,000	$28,137
	2009	3	Carrier	W	Offices, Kitchen/Living	Natural Gas	DX	20			$75,000	$84,413
								TOTALS:	$1,240,000	$1,277,200	$175,000	$196,964

AIR HANDLING UNIT COST ESTIMATES (1 TO 2 YEARS) & (6 TO 10 YEARS)

Recommended Replacement Timeframe	AHU	Location	Service	Existing System Type	Recommended System Type	Year 2019 Cost	Year 2020 Cost	Year 2024 Cost	Year 2028 Cost
2019 - 2020	AHU-S7	LRC Attic	LRC - All Floors	Multizone	VAV AHU	$900,000	$927,000		
	AHU-SC	Center Court Mech.	Psych, C112, C117	Three Zone	VAV AHU	$90,000	$92,700		
	AHU-SD	Center Court Mech.	TV Studio & Comp. Lab	Two-Zone	Two Zone VAV	$70,000	$72,100		
	AHU-SE	Center Court Mech.	Exercise Rm.	Single Zone	VAV AHU	$60,000	$61,800		
	AHU-SG	Sub Pool Mech.	Pool Locker Rms.	Single Zone	VAV AHU	$90,000	$92,700		
	AHU-SH	Pool Mech.	Pool	Single Zone	Pool Dehumidification Unit	$80,000	$82,400		
	AHU-SJ	Pool Mech.	Pool	Single Zone	Pool Dehumidification Unit	$80,000	$82,400		
	AH-SK	P.E. Equip. Rm.	Kitchen	Four Zone	VAV AHU	$100,000	$103,000		
	AH-SL	P.E. Equip. Rm.	Faculty Dining	Three Zone	VAV AHU	$160,000	$164,800		
	AHU-SM	Girl's Gym	Girl's Gym	Single Zone	VAV RTU	$115,000	$118,450		
	AHU-SN	Girl's Gym	Girl's Gym	Single Zone	VAV RTU	$115,000	$118,450		
	AHU-SO	Girl's Gym	Girl's Gym	Single Zone	VAV RTU	$115,000	$118,450		
	AHU-SP	Girl's Gym	Girl's Gym	Single Zone	VAV RTU	$115,000	$118,450		
	AHU-S2	2nd Fl. Fan Equip. Rm.	Multi-Purpose	Single Zone	VAV AHU	$250,000	$257,500		
	AHU-S1	2nd Fl. Fan Equip. Rm.	Faculty Dining	Single Zone	VAV AHU	$85,000	$87,550		
	Copy Room	Copy Room	Copy Room	Single Zone With Cond. Unit	CV AHU	$60,000	$61,800		
	Foyer	Foyer	Foyer	Single Zone	CV AHU	$60,000	$61,800		
2024 - 2028	AH-1	Attic	8 Zones	Multizone	Convert to VAV AHU			$110,000	$123,806
	AH-2	Attic	6 Zones	Multizone	Convert to VAV AHU			$85,000	$95,668
	AH-3	Attic	12 Zones	Multizone	Convert to VAV AHU			$160,000	$180,081
	AH-4	Attic	11 Zones	Multizone	Convert to VAV AHU			$150,000	$168,826
	AH-5	Attic	9 Zones	Multizone	Convert to VAV AHU			$125,000	$140,689
					TOTALS:	$2,545,000	$2,621,350	$630,000	$709,071

CENTER COURT UNIT VENTILATOR COST ESTIMATES - 2 RECOMMENDATIONS (1 TO 2 YEARS)

UV	Location	Service	Area Served (ft2) or Quantity	Existing System Type	Recommended System Type	Year 2019 Cost	Year 2020 Cost
UV	Center Court	Center Court	12,798	Two-Pipe UV	FCU-DOAS	$600,000	$618,000
OR							
UV	Center Court	Center Court	20	Two-Pipe UV	Vertical Change Air UVs	$500,000	$515,000

MAIN CHILLER UNIT VENTILATOR COST ESTIMATES - 2 RECOMMENDATIONS (6 TO 10 YEARS)

UV	Location	Service	Area Served (ft2) or Quantity	Existing System Type	Recommended System Type	Year 2019 Cost	Year 2020 Cost
UV	Main Chiller UV Zones	Main Chiller UV Zones	38,574	Four-Pipe UV	FCU-DOAS	$1,500,000	$1,688,263
OR							
UV	Main Chiller UV Zones	Main Chiller UV Zones	42	Four-Pipe UV	Vertical Change Air UVs	$1,000,000	$1,125,509

SCIENCE WING UNIT VENTILATOR COST ESTIMATES - 2 RECOMMENDATIONS (6 TO 10 YEARS)

UV	Location	Service	Area Served (ft2) or Quantity	Existing System Type	Recommended System Type	Year 2019 Cost	Year 2020 Cost
UV	Science Wing	Science Wing	21,400	Two-Pipe UV	FCU-DOAS	$900,000	$1,012,958
OR							
UV	Science Wing	Science Wing	17	Two-Pipe UV	Vertical Change Air UVs	$425,000	$478,341

EXHAUST FANS: (5 TO 10 YEARS)

According to ASHRAE, the median useful service life for indoor centrifugal exhaust fans is twenty-five (25) years and the median useful service life for roof mounted exhaust fans is twenty (20) years. According to the available existing engineering drawings on file, there are approximately (52) exhaust fans that have already, or will exceed their ASHRAE recommended service life within the next ten years. Therefore, it is recommended to upgrade these exhaust fans with a like for like replacement within the 5 to 10-year timeframe. This estimate also includes the cost to replace AHU-S11's separate exhaust fan. The costs estimates are as follows:

- 2024 Cost: $ 250,000
- 2028 Cost: $ 287,000

Center Court Pumps: (1 to 2 Years)

Tag	Service	Recommended Replacement Type	Year 2019 Cost	Year 2020 Cost
P-FT1	Center Court FTRs	Like For Like	$5,000	$5,150
P-FT2	Center Court FTRs	Like For Like	$5,000	$5,150
P-UV1	Center Court UVs	Like For Like	$8,000	$8,240
P-UV2	Center Court UVs	Like For Like	$8,000	$8,240
		TOTALS:	$26,000	$26,780

MAIN CHILLER VALVES: (1 TO 2 YEARS)

- 2019 Cost: $50,000
- 2020 Cost: $51,500

TOTAL MECHANICAL COST ESTIMATES

Category	Recommended Replacement Timeframe	Equipment Type	Year 2019 Cost	Year 2020 Cost
Mechanical	2019	Main Chiller Valves	$50,000	
	2019 - 2020	AHUs	$2,545,000	
	2024 - 2028	AHUs		$630,000
	2019 - 2020	Center Court UVs	$500,000	
	2024 - 2028	Main Chiller UVs		$1,000,000
	2024 - 2028	Science Wing UVs		$425,000
	2024 - 2028	Exhaust Fans		$250,000
	2019 - 2020	Center Court Chiller Pumps	$26,000	
	2019 - 2020	RTUs	$1,240,000	
	2024 - 2028	RTUs		$175,000
		TOTALS	$4,361,000	$2,480,000

Note: The Unit Ventilator costs above are for the direct replacement option of unit ventilators. The alternate Unit Ventilator replacement costs are shown on pages 88 and 89.

This report section will review the existing electrical systems at Maine East High School. Subsections will include: primary distribution, secondary distribution, receptacle and lighting panelboards, lighting systems, and fire alarm.

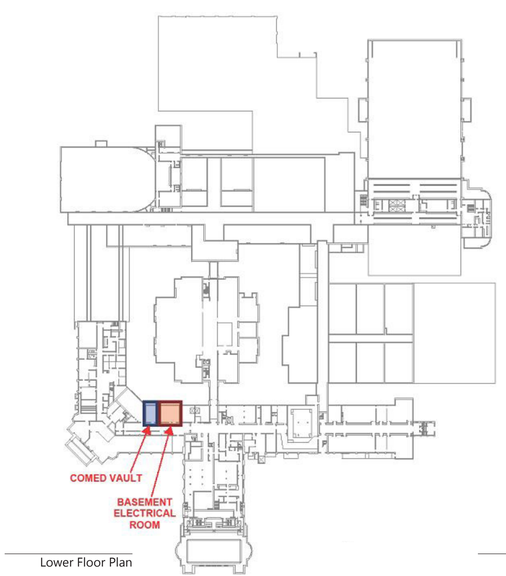
Once the existing systems are described, we will present recommendations for the upgrade of each system, if required, along with an estimated cost of replacement. These recommendations are based on our understanding of the current local electrical and life-safety codes, as well as observation of what similar facilities have implemented in recent projects. The recommendations are not to be used in place of a fully-designed system. Detailed designs for replacement may be further evaluated at a later date.

Determinations are made regarding service life by visually evaluating the equipment, determining the availability of replacement parts, and comparing the known age of the equipment to what the average service life may be for a similar unit. There is no exact standard for what the service life is of a given piece of electrical equipment due to the myriad of environmental and maintenance factors that can impact the health of elements like copper busses, switches, transformers, enclosures, and the like. Our understanding of service life is then based around the observed average age of similar equipment when it was replaced.

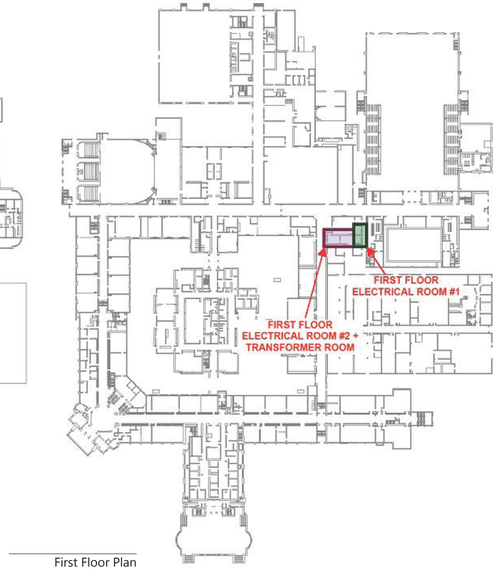
Recommendations will be presented in two groups:

1. Health Life Safety (2019) – These items are considered the most critical to maintain the health of the existing electrical system, or in some cases the most beneficial to occupants. Recommendations in this category often address safety risks for building occupants or maintenance personnel.
2. 1 to 2 Years (2019 to 2020) – Equipment in this category should be considered for replacement within the next couple of years or routine maintenance should be performed as soon as possible.
3. 3-5 year (2021-2023): These items typically represent equipment or systems that should be upgraded for compliance with electrical codes, or certain equipment that may be aged beyond the anticipated service life, but is not expected to be a significant safety risk.

On the next page is a map indicating the naming designations of various sections of the school. These names will be referenced throughout this report.



Lower Floor Plan



First Floor Plan

ComEd Vault Switchgear

Secondary Cables to Basement Electrical Room

BUILDING PRIMARY ELECTRICAL DISTRIBUTION

The primary electrical distribution system for Maine East is provided by two pole-mounted medium-voltage switches from ComEd, one originating from Dempster Street, one from Potter Street. These two feeders are connected to a ComEd-owned automatic-throwover (ATO) switch. A feeder from load side of the ATO then connects to the main switchgear, located in the school's basement. The main switchgear consists of primary metering and distribution hardware to split the service out to six transformers, which step down the voltage to either 120/208V, 3-phase, or 277/480V, 3-phase.

The vault switchgear is in good condition, and has been relatively recently installed. Therefore, no adjustments are required for this portion of the distribution system.

The building's electrical distribution areas are described in detail in the following sections.

Basement Electrical Room Switchboard

Live-front Distribution Equipment – Basement

BASEMENT ELECTRICAL ROOM

The distribution switchboard in the basement electrical room is fed from a step-down transformer outside the building. The switchboard is rated for 1200A at 120/208V, 3-phase.

The first section of this switchboard contains two 'main' circuit breakers, one of which serves as the main disconnecting means for the normal power distribution sections, while the other provides a 300A disconnecting means for an 'emergency' panelboard that feeds emergency and exit lighting. The second and third sections each have a board containing normal power distribution breakers for smaller panels and equipment. The switchboard was manufactured by Erickson Electrical Equipment Co, with breakers from Westinghouse (now owned by Eaton). The switchboard is fairly old, however it still appears to be in acceptable condition.

Some distribution equipment can be found in this room outside of the switchboard, mounted along the walls. While some of the oldest pieces of equipment are no longer functional, there are a few live-front enclosures that still see active use, such as fuse panels for lighting.

HEALTH LIFE SAFETY (0 TO 1 YEAR) RECOMMENDATION FOR BASEMENT ELECTRICAL ROOM

We strongly recommend the replacement of all existing live-front equipment as soon as possible. Virtually all such equipment can be replaced by a dead-front equivalent, providing much greater safety to maintenance personnel and anyone else who may need to access the equipment.

We recommend to exercise the existing switchboard breakers to verify proper operation and reduce risk of becoming stuck in a certain position at an inopportune time. Additionally, we recommend annual thermal inspections of the switchboard, distribution panels, and other equipment in order to more easily identify problematic areas of unwanted heat buildup in the system.

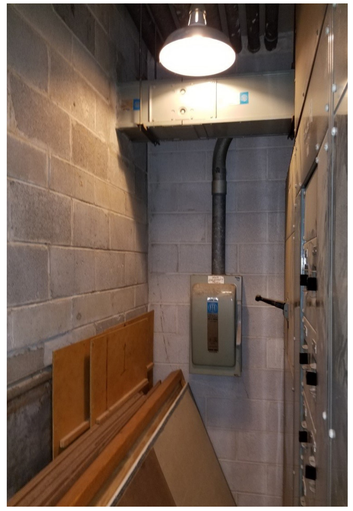
The switchboard room currently has several items scattered about the floor, obstructing access to most of the room's electrical equipment. It is recommended to find suitable storage for these items and maintain a minimum 36 inch front clearance for all electrical equipment.

3 TO 5 YEAR RECOMMENDATION FOR BASEMENT ELECTRICAL ROOM

OSHA 2015 regulations require the application of an arc flash label that provides information on arc flash protection boundary, incident energy, working distance, PPE class, and available short circuit information for all electrical equipment. It is recommended to perform an arc flash study and apply the labels in a timely manner to comply.

It is recommended to inspect the switchboard and all outgoing feeder cables for cloth-insulated wire. Should cloth wire be encountered, it is best to replace it quickly with a thermoplastic equivalent. Doing so reduces risks associated with older insulation such as excessive heat, brittleness, and potential exposure to asbestos.

Switchboard and Disconnect Switch



FIRST FLOOR ELECTRICAL ROOM #1

The distribution switchboard in the first floor electrical room south of the bookstore is fed from three single-phase transformers in the room directly north, accessible from First Floor Electrical Room #2. The switchboard is rated for 2000A at 120/208V, 3-phase.

The first section of this switchboard contains the 'main' circuit breaker for all the distribution breakers in the next two board sections. Most of the circuit breakers in the switchboard appear to feed a lighting panel, based on the labeling. The entire switchboard was manufactured by I-T-E circuit breaker company. The switchboard is fairly old, however it still appears to be in acceptable condition for use.

Some branch circuit panels can be found in this room outside of the switchboard, mounted along the walls. The majority of the outgoing feeders are routed outside of this room.

1 TO 2 YEAR RECOMMENDATION FOR FIRST FLOOR ELECTRICAL ROOM #1

We recommend to exercise the existing switchboard breakers to verify proper operation and reduce risk of becoming stuck in a certain position at an inopportune time. Additionally, we recommend annual thermal inspections of the switchboard, distribution panels, and other equipment in order to more easily identify problematic areas of unwanted heat buildup in the system.

The switchboard room currently has several items obstructing access to most of the room's electrical equipment. It is recommended to find suitable storage for these items and maintain a minimum 36 inch front clearance for all electrical equipment.

3 TO 5 YEAR RECOMMENDATION FOR FIRST FLOOR ELECTRICAL ROOM #1

OSHA 2015 regulations require the application of an arc flash label that provides information on arc flash protection boundary, incident energy, working distance, PPE class, and available short circuit information. It is recommended to perform an arc flash study and apply the labels in a timely manner to comply.

It is recommended to inspect the switchboard and all outgoing feeder cables for cloth-insulated wire. Should cloth wire be encountered, it is best to replace it quickly with a thermoplastic equivalent. Doing so reduces risks associated with older insulation such as excessive heat, brittleness, and potential exposure to asbestos.

Switchboard – First Floor Electrical Room #2

Indoor Transformers Feeding First Floor Electrical Room

FIRST FLOOR ELECTRICAL ROOM #2

The distribution switchboard in the first floor electrical room west of the bookstore is fed from three single-phase step-down transformers in a room immediately east. The switchboard is rated for 120/208V, 3-phase. At the time of survey, we were unable to verify the current rating of the main breaker or switchboard bus.

The first four sections of this switchboard contain (23) power distribution breakers, which generally feed smaller power distribution boards or branch circuit panels. The fifth section contains the main circuit breaker for the board and the incoming feeder wires from the transformers. The switchboard was manufactured by I-T-E circuit breaker company. The switchboard appears to be in less satisfactory condition than other such units in the school.

The transformers that feed this room and First Floor Electrical Room #1 are accessible through this room. Since there is 12.47kV live wire run in this room without conduit, it is important to keep the area off-limits to non-qualified personnel.

1 TO 2 YEAR RECOMMENDATION FOR FIRST FLOOR ELECTRICAL ROOM #2

We recommend to exercise the existing switchboard breakers to verify proper operation and reduce risk of becoming stuck in a certain position at an inopportune time. Additionally, we recommend annual thermal inspections of the switchboard, distribution panels, and other equipment in order to more easily identify problematic areas of unwanted heat buildup in the system.

The switchboard room currently has several items obstructing access to most of the room's electrical equipment. It is recommended to find suitable storage for these items and maintain a 36 inch minimum front clearance for all electrical equipment.

3 TO 5 YEAR RECOMMENDATION FOR FIRST FLOOR ELECTRICAL ROOM #2

This switchboard is at or past its expected lifespan and does not appear to be in as good a condition as the other switchboards encountered in the facility. Due to the inherent reliability issues of the unit being beyond its expected lifespan along with the difficulty of obtaining relevant parts, it is recommended to replace this substation in the coming years.

During the replacement process, it is recommended to inspect the switchboard and all outgoing feeder cables for cloth-insulated wire. Should cloth wire be encountered, it is best to replace it quickly with a thermoplastic equivalent. Doing so reduces risks associated with older insulation such as excessive heat, brittleness, and potential exposure to asbestos.

When the new switchboard is in place, OSHA 2015 regulations require the application of an arc flash label that provides information on arc flash protection boundary, incident energy, working distance, PPE class, and available short circuit information. It is recommended to perform an arc flash study and apply the labels in a timely manner to comply.

Lighting Panelboards - Auditorium

Panel Recessed in Corridor

BUILDING PANELBOARDS

The school's load centers are distributed throughout the school, only a few are located in the switchboard rooms where the main power distribution resides. The condition of the panels are varied, many having been replaced over the course of the facility's history from live-front fuse panels to newer units from Square-D, I-T-E, and Erickson, though a few live-front units still remain. Almost all panelboards are three-phase units, with supply voltages that are either 120/208V or 277/480V throughout the school. Many panelboards are recessed-type, found in the facility corridors

HEALTH LIFE SAFETY (0 TO 1 YEAR) RECOMMENDATION FOR BUILDING PANELBOARDS

We recommend annual thermal inspections of the distribution panels in order to more easily identify problematic areas of unwanted heat buildup in the system.

As mentioned, live-front equipment is inherently dangerous and is not code-compliant. It is highly recommended to replace all such equipment with a dead-front equivalent as soon as possible.

3 TO 5 YEAR RECOMMENDATION FOR BUILDING PANELBOARDS

Other panelboard candidates for replacement may be determined based on thermal scans or maintenance requirements over time. Building staff may have knowledge of specific problematic panelboards that can be replaced to create a more reliable distribution system, and panels that have high thermal readings may be experiencing material deterioration that is most easily alleviated through replacement.

It is recommended to replace all older panelboards in a given area as the spaces are renovated in the future with new units. If possible, it would be beneficial to install the new panelboards with additional spare circuit capacity for future use.

Any panelboards fed via cloth-insulated wiring should be re-fed with equivalent thermoplastic-insulated wire as replacements occur.

OSHA 2015 regulations require the application of an arc flash label that provides information on arc flash protection boundary, incident energy, working distance, PPE class, and available short circuit information. It is recommended to perform an arc flash study and apply the labels as soon as possible to comply.

Fire Alarm Control Panel

Fire Alarm Pull StationElectrical Room

FIRE ALARM

The building contains a Siemens fire alarm system with a Cerberus Pyrotronics 'MXL' main fire alarm control panel, consisting of audio, visual, heat detector, smoke detector, duct smoke detectors, and pull station devices. The system is outdated and does not meet present code in certain areas.

1 TO 2 YEAR RECOMMENDATIONS FOR FIRE ALARM SYSTEM

The requirement of addressable devices requires the installation of new expansion cards in the existing fire alarm panel. There is not enough space in the existing fire alarm panel to install new cards, and due to the magnitude of new code requirements, it is recommended to install a completely new system that meets all requirements.

Exit Sign

Emergency Lighting – Ceiling Mounted

LIGHTING

The lighting system within the building consists primarily of T8 and T12 fluorescent fixtures within the corridors, classrooms, common spaces, and offices, using troffer, surface-mount, and pendant fixtures. Some corridors in the basement have retrofitted LED lamps in the T8 sockets. Control is performed mostly through toggle switches and contactors, with a dimming system used in the auditorium area. Lighting throughout most of the facility is 277V, with the exception of the center core area and emergency lighting, which uses 120V.

Many mechanical spaces within the building, including all substation rooms, use screw-in lamp types which house either CFL lamps, incandescent lamps, or LED retrofit lamps. Each electrical room that was surveyed had poor light levels, aside from the ComEd vault room in the basement.

EMERGENCY AND EXIT LIGHTING

The building uses individual battery back-up for most emergency and exit lighting, and does not have a backup generator. Emergency fixtures are powered from "emergency" panels, fed from a separate breaker in the basement electrical room switchboard. The existing exit signs house mostly fluorescent and LED retrofit lamps, and the emergency lights vary between incandescent, halogen, and LED units. The emergency lights are typically either wall or ceiling-mount with two light heads, along with some remote heads mounted on walls.

1 TO 2 YEAR RECOMMENDATIONS FOR LIGHTING SYSTEM

The primary recommendation for the lighting system is the conversion of all fixtures, including emergency and exit lighting, to LED. LED technology carries significant benefits and cost-savings in energy usage and maintenance that in many cases will turn into a payback to the facility over time. Fixtures that have been retrofitted with LED T8 tube replacements should eventually be removed and replaced with fixtures that contain integrated LEDs and drivers, due to the higher quality and longer life of a dedicated fixture.

Another lighting recommendation is to expand the capabilities of the lighting control system to implement more modern technologies such as daylight harvesting in corridors and exterior areas, occupancy sensing in offices and other interior rooms, and more precise zoned controls. The new controls will offer additional energy savings for the school, and provide an extra level of precision for staff to customize the light output for the facility.

Cost estimates for recommended replacements encompass any associated demolition, general contracting, installation, and equipment costs. Inflation was accounted for by adding a 3% increase per year. Cost estimates were determined by referencing our experience with similar systems and the areas served by these systems. Cost estimates are as follows:

MAIN SWITCHBOARD REPLACEMENT COSTS

Per the existing system description, only the F1-2 switchboard is recommended to be replaced in the next five years. The costs are given for the basement and F1-1 switchboardfor informative purpose .

Recommended Replacement Timeframe	Switchboard	Location	Year 2022 Cost	Year 2024 Cost
2022 - 2024	F1-2	West of Bookstore	**$168,826**	**$179.108**

DISTRIBUTION PANEL REPLACEMENT

The variety of panel conditions makes a sweeping cost to replace all existing units inadvisable and not particularly applicable for this facility. Costs for individual panel replacement when a given space is renovated can be estimated at $2,000 for a 100A panel, $3,000 for a 200A panel, and $5,000 for a 400A panel, including labor and material. The number of panels on each floor is as follows:

Floor	Panels
Basement	34
1F	99
2F	30
3F	18
Attic	1

CLOTH WIRING REPLACEMENT

The cost to install new conduit and thermoplastic-insulated wiring in place of cloth wiring, on an average per-linear-foot basis and including labor, is estimated to be as follows:

Ampacity	Cost (per linear foot)
65	$19.5
100	$30
150	$50
200	$67
400	$134
600	$200
800	$267
1000	$334
1200	$400

THERMAL INSPECTIONS

The estimated cost for complete thermal inspections in the facility is **$35,000** in 2019 dollars.

ARC FLASH STUDY

The cumulative approximate cost for the arc fault and coordination study for the school's switchboards and distribution panels is **$20,000** in 2019 dollars. This is assuming that the study is done concurrent with a switchboard replacement.

EXERCISING OF SWITCHES AND OTHER PREVENTATIVE MAINTENANCE

The cost to perform maintenance as described in this report is approximately **$10,000** in 2019 dollars.

LIGHTING

The cost to replace lighting is variable depending on the type and number of fixtures selected, as well as the level of control desired in the new system. We consider a square-foot cost of $10/ft2 to replace the existing system with new LED fixtures. Modern controls are included as well, consisting of daylight harvesting in corridors and exterior areas, occupancy sensing and dimming in interior classrooms and offices, and basic zoned control. Since the school is about **670,000** ft2, the total cost of the retrofit is estimated to be **$6,700,000** in 2019 dollars.

FIRE ALARM

The estimated cost of completing a replacement of the fire alarm system sufficient to bring the facility up to code is approximately **$1,500,000**. This new system includes a complete one-way speaker system installed throughout the school.

FINAL COST ESTIMATES

Catergory	Recommended Replacement Timeframe	Equipment Type	Year 2019 Cost	Year 2021 Cost	Year 2024 Cost
Electrical	2021 - 2023	Main Switchboard Replacement		$168,826	
	2019	Thermal Inspections	$35,000		
	2021 - 2023	Arc Flash Study	$10,000	$22,510	
	2019	Switch Exercise & Preventative Maintenance	$2,233,333		
	2019 thru 2024	LED Lighting & Controls	$900,000	$2,369,343	$2,589,045
	2019 - 2020	Fire Alarm	$900,000		
		TOTALS:	**$3,178,333**	**$2,560,680**	**$2,589,045**

MECHANICAL, ELECTRICAL, PLUMBING, AND FIRE PROTECTION CONDITIONS
PLUMBING ASSESSMENT
MAINE EAST HIGH SCHOOL

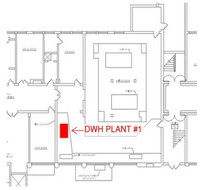
This report section will overview the existing plumbing systems at Maine East High School. The sections will include: domestic cold-water distribution, domestic hot water distribution, domestic hot water recirculation, domestic hot water generation, and recommendations.

The system replacement recommendation(s) follow each equipment's existing conditions description. To determine the recommendations, our experience with similar systems and the ASHRAE median service life tables were utilized. Estimated equipment service life, according to the 2015 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbook, is defined as the economic life of a system or component, or the amount of time it remains in its original service application. The remaining service life values reported in this document are based off the ASHRAE Equipment Life Expectancy Chart, as well as the ASHRAE Preventative Maintenance Guidebook, which use median years to provide an indication of expected equipment service life. Many factors effect equipment service life and with any average, some systems may have lifetimes far from average. However, these median lifetimes provide a reasonable basis for establishing the remaining useful life of existing systems.

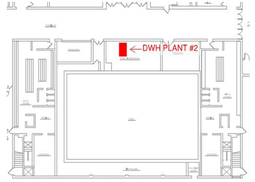
Equipment recommended for replacement is categorized into the following four groups:

1. Health Life Safety – Equipment or systems in this category present health, life, or safety risks to building occupants and may not be up to current code standards. Systems in this category are recommended to be replaced as soon as possible.
2. 1 to 2 Years (2019 to 2020) – Equipment in this category should be considered for replacement within the next couple of years.
3. 3 to 5 Years (2021 to 2023) – Replacement of equipment in this category is less pressing than equipment listed in categories 1-2, but should still be considered for replacement within this timeframe.
4. 5 to 10 Years (2024 to 2028) – Replacement of equipment in this category is not an immediate need, but is still recommended for replacement within this timeframe.

Domestic Hot Water Plant Locations



Lower Floor Plan



First Floor Plan

Domestic Hot Water Plants

Plant #1

Domestic hot water for Maine East is provided by two (2) domestic hot water plants. One plant is located in the main building basement mechanical area (replaced in 2002) and the other plant is located in the pool equipment mechanical room (replaced in 2016).

DOMESTIC HOT WATER PLANTS

The domestic hot water plant in the main building basement mechanical room is comprised of one (1) 500-gallon water heater with steam driven heat exchanger. The water heater and localized piping were replaced in 2002. This plant serves approximately half of the building's domestic hot water load. The pictures on the right show the equipment and location of the domestic hot water plant.

The domestic hot water plant in the pool equipment room is comprised of two (2) 800-MBH high-efficiency gas-fired domestic water heaters and one (1) 500-gallon hot water storage tank. The water heaters and storage tank and localized piping were replaced in 2016. This plant serves approximately half of the building's domestic hot water load, including the cafeteria conveyor dishwasher. The pictures on the right show the equipment and location of the domestic hot water plant.

6 TO 10 YEAR RECOMMENDATION

Due to average life expectancy, the water heater system should be planned to be replaced in six (6) to ten (10) year range.

However, note that if mechanical absorption chillers are replaced, then the steam-driven water heater plant would be impacted and recommended to be replaced with that mechanical scope. Separate chiller report study is being prepared.

Sample of Failed Existing Galvanized Piping

The existing original domestic water is galvanized piping. The existing original isolation valves are stem-operated valves. Hot water return piping is without adequate balancing.

DOMESTIC COLD WATER AND HOT WATER DISTRIBUTION AND RECIRCULATION

The existing original domestic cold and hot water piping is galvanized piping in various levels of failure. Galvanized piping in domestic water systems corrodes overtime and generates corrosion and rust debris. Corroded pipe walls and pipe debris settle in piping creating restrictions and impacting function of isolation valves, balancing valves, check valves, faucet aerators, shower-head flow restrictors, etc. The debris materials settle at horizontal sections of pipe and piping at/near fixtures because the pipe diameter is smaller and the debris carried with water flow.

Pipe fails via mechanisms such as pitting, pin-hole leaks, and loss of pipe thickness at threaded fittings. Also, failure of threaded fittings can result in significant leak and release a high flow rate via open pipe fitting. The threading process itself cuts away pipe wall and significantly reduces pipe wall thickness and then further corrosion over time occurs.

The existing original isolation valves may or may not properly operate when isolation is necessary for repair or remodel work.

The existing hot water recirculation path is impacted by corrosion, failed isolation valves, failed check valves, and failed balancing valves. Additionally, Maine East High School, it was observed that the original hot water return branch piping is without any check valves and without any balancing valves. Therefore, the ability to balance the hot water delivery and return pipe paths is not possible. Balancing the pipe paths permits adjustment of the shorter pipe runs to be equivalent to longer pipe runs. Without the ability to balance, the shorter pipe runs (i.e. path of least resistance) flows easy – while the longer pipe runs do not flow any recirculation flow to maintain hot water through the longer circuits (i.e. paths).

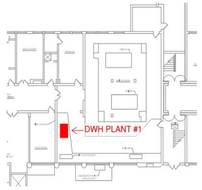
1 TO 2 YEAR RECOMMENDATION

Due to the fact that the piping is a) galvanized, b) corroding and generating rust/debris, especially on a water shut-downs, c) isolation valves failed/failing, d) check valves fowled/failed/failing or not present, e) balancing valves fowled/failed/failing or not present, and f) the resultant impact on the ability to balance the hot water recirculation the domestic cold water and hot water piping is recommended to be replaced. If replacement is necessary to be phased, the immediate focus should be on replacement of common horizontal piping, isolation valves, check valves, and balancing valves.

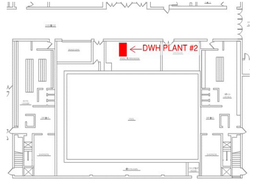
DOMESTIC HOT WATER PLANTS

MAINE EAST HIGH SCHOOL

Domestic Hot Water Plant Locations



Lower Floor Plan



First Floor Plan

Domestic Hot Water Plants

Plant #1

Domestic hot water for Maine East is provided by two (2) domestic hot water plants. One plant is located in the main building basement mechanical area (replaced in 2002) and the other plant is located in the pool equipment mechanical room (replaced in 2016).

DOMESTIC HOT WATER PLANTS

The domestic hot water plant in the main building basement mechanical room is comprised of one (1) 500-gallon water heater with steam driven heat exchanger. The water heater and localized piping were replaced in 2002. This plant serves approximately half of the building's domestic hot water load. The pictures on the right show the equipment and location of the domestic hot water plant.

The domestic hot water plant in the pool equipment room is comprised of two (2) 800-MBH high-efficiency gas-fired domestic water heaters and one (1) 500-gallon hot water storage tank. The water heaters and storage tank and localized piping were replaced in 2016. This plant serves approximately half of the building's domestic hot water load, including the cafeteria conveyor dishwasher. The pictures on the right show the equipment and location of the domestic hot water plant.

6 TO 10 YEAR RECOMMENDATION

Due to average life expectancy, the water heater system should be planned to be replaced in six (6) to ten (10) year range.

However, note that if mechanical absorption chillers are replaced, then the steam-driven water heater plant would be impacted and recommended to be replaced with that mechanical scope. Separate chiller report study is being prepared.

THERMOSTATIC MIXING VALVES

MAINE EAST HIGH SCHOOL

Existing Lavatories without TMV's

Master Mixing Valve to be Replaced

Thermostatic mixing valves are intended to limit hot temperature downstream of the valve. Per Code for this project, lavatories and showers require a thermostatic mixing valve either upstream of a group of fixtures or at each fixture.

THERMOSTATIC MIXING VALVES

Thermostatic mixing valves are generally present at showers either with an upstream master mixing thermostatic mixing valve or at the shower valve body. Some components such as temperature gauges are non-functional due to age.
Thermostatic mixing valves are generally not present at existing original lavatory installations.

The master thermostatic mixing at the main building basement mechanical room requiring repair or replacement.

HEALTH LIFE SAFETY RECOMMENDATION

For basic scald protection, thermostatic mixing valves are required and shall be immediately implemented.

Existing thermostatic mixing valves in need of repair shall be repaired/replaced as part of necessary regular maintenance program.

PLUMBING COST ESTIMATES

MAINE EAST HIGH SCHOOL

The cost estimate tables below for recommended replacements encompass any associated mechanical, electrical, plumbing, controls, equipment, contracting, demolition, and installation costs. The anticipated start year for replacements is 2019, but if necessary can be sooner. A 3% inflation amount was added for each year. Cost estimates were determined by referencing our experience with similar systems and the areas served by these systems. Cost estimates are as follows:

Category	Recommended Replacement Timeframe	Existing System Type	Location	Service	Recommended System Type	Year 2019 Cost	Year 2024 Cost
Plumbing	Health Life Safety (ASAP)	Thermostatic Mixing Valves (TMV)	WH Mech Room	WH Master Mixer	New TMV	$8,000	
			At Fixtures	Fixtures	New TMV	$40,000	
	2019 - 2020	Domestic Cold/Hot Water Distribution and Circulation	Throughout	Tunnel	New Copper Pipe	$60,000	
				Basement	New Copper Pipe	$600,000	
				1st Floor	New Copper Pipe	$1,200,000	
				2nd Floor	New Copper Pipe	$470,000	
				3rd Floor	New Copper Pipe	$225,000	
	2024 - 2028	Domestic Hot Water Plants	Boiler Room	West Side	Hi-Efficiency WH Type		$200,000
	2024 - 2028	Fire Protection	Throughout	Entire Building	Automatic Sprinklers		$1,550,000
						TOTALS:	**$2,603,000**	**$1,750,000**

MEP COST ESTIMATES

MAINE EAST HIGH SCHOOL

The table below shows the total estimated replacement costs for each discipline as if they were implemented on the first recommended replacement timeframe year. For example, equipment that was recommended for replacement from 2019 to 2021 would have the 2019 inflated cost shown.

Category	Recommended Replacement Timeframe	Existing System Type	Year 2019 Cost	Year 2021 Cost	Year 2024 Cost
Mechanical	2019	Main Chiller Valves	$50,000		
	2019 - 2020	AHUs	$2,545,000		
	2024 - 2028	AHUs			$630.000
	2019 - 2020	Center Court UVs	$500,000		
	2024 - 2028	Main Chiller UVs			$1,000,000
	2024 - 2028	Science Wing UVs			$425,000
	2024 - 2028	Exhaust Fans			$250,000
	2019 - 2020	Center Court Chiller Pumps	$26,000		
	2019 - 2020	RTUs	$1,240,000		
	2024 - 2028	RTUs			$175,000
Electrical	2021 - 2023	Main Switchboard Replacement		$168,826	
	2019	Thermal Inspections	$35,000		
	2021 - 2023	Arc Flash Study		$22,510	
	2019	Switch Exercise & Preventative Maintenance	$10,000		
	2019 thru 2024	LED Lighting & Controls	$2,233,333	$2,369,343	$2,589,045
	2019 - 2020	Fire Alarm	$900,000		
Plumbing	Health Life Safety (ASAP)	Thermostatic Mixing Valves (TMV)	$48,000		
	2019 - 2020	Domestic Cold/Hot Water Distribution and Circulation	$2,555,000		
	2024 - 2028	Domestic Hot Water Plants			$200,000
	2024 - 2028	Fire Protection			$1,550,000
		TOTALS:	**$10,142,333**	**$2,560,680**	**$6,819,045**
		TOTAL:	**$19,522,058**		

Note: See Budget Estimates in Part 3 for total building cost.

ASHRAE MEDIAN SERVICE LIFE TABLE

MAINE EAST HIGH SCHOOL

Equipment Type	Equipment Tag	Service	Approximate Unit Age as of 2018 (Years)	ASHRAE Median Service Life (Years)
Space Heating Steam Boilers	B-1, B-2	Steam to Building	15	38
Domestic Hot Water Boilers		Half of Building - Located in Basement	16	10
		Half of Building - Located in Pool Equipment Rm.	2	10
Chillers		Science Wing	19	38
		Center Court	23	38
	CH-1, CH-2	Main	15	38
Pumps (** Denotes In-House Tag Assignment)	P-1	Science Wing UVs	19	25
	P-2	Science Wing UVs	19	25
	P-3	Science Wing Cooling Tower	19	25
	**P-UV1	Center-Court UVs	50	25
	**P-UV2	Center-Court UVs	50	25
	**P-FT1	Center-Court FTRs	50	25
	**P-FT2	Center-Court FTRs	50	25
	**P-CW	Center-Court Cooling Tower	23	25
	**P-CHW	Center-Court Chiller	23	25
	P-CH1	Main Chiller Primary CHW Loop	15	25
	P-CH2	Main Chiller Primary CHW Loop	15	25
	P-1	Main Chiller Secondary CHW Loop	15	25
	P-2	Main Chiller Secondary CHW Loop	15	25
	P-CT1	Main Chiller Cooling Tower	15	25
	P-CT2	Main Chiller Cooling Tower	15	25

MECHANICAL, ELECTRICAL, PLUMBING, AND FIRE PROTECTION CONDITIONS

ASHRAE MEDIAN SERVICE LIFE TABLE

MAINE EAST HIGH SCHOOL

Equipment Type	Equipment Tag	Service	Approximate Unit Age as of 2018 (Years)	ASHRAE Median Service Life (Years)
Air Handling Units	AHU-S7	LRC - All Floors	50	30
	AHU-SC	Psych, C112, C117	50	30
	AHU-SD	TV Studio & Comp. Lab	50	30
	AHU-SE	Exercise Rm.	50	30
	AHU-SG	Pool Locker Rms.	50	30
	AHU-SH	Pool	50	30
	AHU-SJ	Pool	50	30
	AH-SK	Kitchen	50	30
	AH-SL	Faculty Dining	50	30
	AHU-SM	Girl's Gym	50	30
	AHU-SN	Girl's Gym	50	30
	AHU-SO	Girl's Gym	50	30
	AHU-SP	Girl's Gym	50	30
	AHU-S2	Multi-Purpose	67	30
	AHU-S1	Faculty Dining	67	30
	Copy Room	Copy Room	50	30
	Foyer	Foyer	50	30
	AH-1	1928 Original Classrooms	14	25
	AH-2	1928 Original Classrooms	14	25
	AH-3	1928 Original Classrooms	14	25
	AH-4	1928 Original Classrooms	14	25
	AH-5	1928 Original Classrooms	14	25
	AH-6	Auditorium	16	25
	AH-7	Cafeteria	16	25
	AHU-S11	North Basement Classrooms	4	25

ASHRAE MEDIAN SERVICE LIFE TABLE

MAINE EAST HIGH SCHOOL

Equipment Type	Equipment Tag	Service	Approximate Unit Age as of 2018 (Years)	ASHRAE Median Service Life (Years)
Roof Top Units (Reference Report for Associated Tag)	10	Rm. 174 & Offices	34	15
	17	Band Room 154	24	15
	20	Band Rm. 158	24	15
	9	Office Near Xerox Rm.	23	15
	18	Choral Rm. 254	23	15
	2	Rm. 185 - Auto Shop	16	15
	4	Rm. 180 - Wood Shop	16	15
	5	Weight Room	16	15
	6	Rm 175 & Nearby Offices	16	15
	7	Rm. 177	16	15
	11	Rm. 169 - Food Lab	16	15
	12	Rm. 171	16	15
	13	Rm. 155, 157	16	15
	14	Rm. 161	16	15
	15	Bookstore	16	15
	19	Choral Rm. 258	13	15
	23	Rm's. C208, C215, C216, C217	10	15
	3	Offices, Kitchen/Living	9	15

ASHRAE MEDIAN SERVICE LIFE TABLE

MAINE EAST HIGH SCHOOL

Equipment Type	Equipment Tag	Service	Approximate Unit Age as of 2018 (Years)	ASHRAE Median Service Life (Years)
Unit Ventilators		Center Court	50	20
		Science Wing	19	20
		Remainder	16	20
Heat Exchangers	*LRC-HX1	LRC AHU	50	20
	*LRC-HX2	LRC Fin Tube Radiators	50	20
	*CC-HX1	Center Court UVs	50	20
	*CC-HX2	Center Court Fin Tube Radiators	50	20
	*SW-HX	Science Wing UVs	19	20
	HX-1	Remainder of UVs and AHUs	16	20
	HX-2	Remainder of UVs and AHUs	16	20