Doherty Memorial High School

299 Highland Street, Worcester, MA 01602

MSBA

60% Construction Documents Binder

August 5, 2021 – draft for review 08/02/21

MSBA
Massachusetts School Building Authority
40 Broad Street, Suite 500, Boston, MA 02111

OWNER
City of Worcester, MA
City Hall, 455 Main Street, Worcester, MA 01608

OPM
AECOM Tishman
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DESIGNER
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108 Grove Street, Suite 300, Worcester, MA 01605

Prepared by:

LPA|A

Red italics = to be included in final submission

6B.3 DESIGNER DELIVERABLES

6B.3.1 General Requirements

6B.1 SUMMARY COMMENTS

A. Basic Project Information Narrative

6B.1 SUMMARY COMMENTS

A. Basic Project Information Narrative

A. Basic Project Information Narrative

The Project Scope and Budget Agreement (PSBA) was executed on October 28, 2020, establishing MSBA's participation in the Doherty Memorial High School Project, consisting of a New Construction solution 1,670 student high school, configured for grades 9–12, to replace the existing Doherty Memorial High School. The proposed building is located on the existing site; on the east side of the current high school primarily where the current practice field is located. The existing Doherty HS will remain in use during the construction of the new facility, after which the existing high school will be demolished and any remaining sitework completed.

The following is an updated description of the project:

- Grades served: 9–12
- Size of site: 20 acres
- GSF of proposed building: 424,600 gross square feet
- Total project budget: $293,400,000.
- Alternates: N/A
- Construction Delivery Methodology: Ch. 149A Construction Manager @ Risk

Construction for the Early Site Enabling Phase began on site on May 3, 2021, and the regular weekly Steering Committee meetings were expanded to include team members of the Construction Management team at Fontaine/Dimeo. The meeting agendas were restructured to review both the design status and construction progress, in order to advance the project overall.

Steering Committee members include:

- K. Russell Adams, Assistant Commissioner DPW
- Maureen Binienda, Superintendent of Schools, Worcester Public Schools
- James Bedard, Director of Facilities, Worcester Public Schools
- Sally Maloney, DMHS Principal
- Eugene Caruso, Tishman AECOM, OPM

Additionally, the project team has continued to be proactive in its efforts to inform and educate the local community, staff/faculty and public at large relative to the proposed project. Numerous meetings have been held and presentations made to various Boards and Committees including:

- April 2, 2021 | Project Update and Site walk with City Parks Department

- April 7, 2020 | Building Automation System Commissioning Strategy Discussion
- April 7, 2020 | Site Walk with Nordic Ski Coordinator
- April 8, 2021 | Project Update with Building and Fire Departments
- April 15, 2021 | National Grid Coordination Meeting
- April 30, 2021 | Engineering and Technology Academy Update / Equipment Review
- May 3, 2021 | Conservation Commission Hearing
- May 18, 2020 | District IT Services Program Review
- May 18, 2020 | MSBA Designer Update Meeting
- May 18, 2020 | Plumbing Inspector Coordination Meeting
- May 20, 2021 | Worcester Energy and Asset Management Update Meeting
- June 16, 2021 | Landscape and Courtyard Program Review
- June 18, 2021 | LEED Owner Review and Pathway to Gold Strategy
- June 21, 2021 | Doherty "Living Lab" Program Kick-Off
- June 22, 2021 | Medical Suite and Clinic Review

Minutes documenting the above can be found in throughout this 60% CD submission.

The Fontaine/Dimeo team has also established a project website at DMHSBuildingProject.com which serves as a resource for the community for information on the status of the construction, as well as a central location where any member of the community can submit a question to the project team.

During the 60% CD phase, the development of the design, drawings and specifications was informed by a number of important issues including the following:

- LPA|A hosted several virtual meetings with school and district personnel to further develop the space needs and equipment requirements for the numerous specialized spaces in the building.
- Building upon the fossil fuel reduction studies completed during the DD phase and the City of Worcester's directive to align with the new Green Worcester Plan, LPA|A continued to work with our consulting engineers to refine and coordinate the updated HVAC design. The Steering Committee also made the decision to proceed with a fully electric kitchen, and the 60% CD drawings have been updated accordingly. Refer to Section 6B.3.1.I for updated Energy Calculations and projected fossil fuel use.

- Based on the public feedback received at the Sustainability Workshop and at previous public meetings, during the 60% CD phase, the project team studied the feasibility of achieving LEED Gold Certification, without redesign or adding significant cost or maintenance obligations to the project. Through this analysis, the project team determined that LEED Gold Certification would be possible with some additional, documentation and minor adjustments to the drawings and specifications. Refer to section 6B.3.1 for a copy of the updated LEED Scorecard.

- LPA|A held numerous coordination meetings with consultants from various disciplines to further develop and coordinate the drawings. These meetings resulted in coordination locations of structural members, the addition of chases for piping and ductwork, ceiling height coordination for overhead piping and ductwork, refined sizes and locations of electrical/Telcom/mechanical rooms, and coordination of rooftop equipment.

- The design team attended several meetings with the City's Building Department, Fire Department, and Inspectors throughout the 60% phase. Discussions at these meetings included the following topics:
    a) Emergency Generator Specifications
    b) Plumbing Code Variance for the number of fixtures in the athletic field support building
    c) Room and door numbering scheme
    d) Horizontal sliding fire/smoke barriers
    e) Emergency services access during construction and in the final design
    f) Building construction/fire resistance ratings
    g) Egress Calculations and Door Hardware Functions
    h) Roof Access, standpipe/roof hydrant locations
    i) Fire Department Connection, Fire Alarm Annunciator Panel locations and Fire Control Center
    j) PV panel disconnect location / Future Battery Storage
    k) Stair Pressurization
    l) Fire Suppression Systems / Fire Pump
    m) Science lab chemical storage
    n) Compliance with NFPA 285

  Based on discussions at these meetings, a variance request was submitted for a reduced number of plumbing fixtures at the athletic field support building. This Plumbing Code variance design request was submitted to the state on July 23, 2021, a copy of which is included in section 6B.3.3.K.

- The Project team held multiple virtual coordination meetings with the electrical utility, National Grid, to discuss the various electrical service options and PV interconnection requirements. It was determined that the school district would purchase and maintain a single 3750 kVA transformer to serve the school, which would allow the building to utilize the power from the PV array prior to feeding it back into the grid. This configuration does require the transformer cost be included in the construction budget maintenance requirements of the school, however the utility back-charges will not include the transformer cost or added maintenance costs, so is foreseen as cost neutral. The ability to use the power from the PV system directly represents a significant financial benefit to the district in long-term electricity costs. The Design Team has also engaged National Grid in a Direct Generation (DG) study to determine the impacts and interconnection requirements for the proposed rooftop PV array.

- The project team has discussed with Verizon interconnected of the school's telephone and interconnected data lines, and at this writing are awaiting their field team to review.

- The City Water Department has engaged their water infrastructure consultant, Tata & Howard to design the high service water line extension up to the proposed school in conjunction with the school's construction schedule. The current site documents indicate this proposed line and connections.

- The City and Design team submitted request for an amendment to the Order of Conditions for the Conservation Commission on April 14, 2021. This amendment request included the scope work for the Early Site Package, which expanded on the work already underway for the Site Enabling Package. Following this submission, the Conservation Commission held a hearing on May 3, 2021 to review the request, and voted at that meeting to issue the revised OOC. The revised OOC was recorded on May 27, 2021, and a copy of which is included in section 6B.3.3.L.

- The joint venture of Fontaine Bros. Inc. and Dimeo Construction has continued to take a hands-on role in the project. The CM team has continued to attend weekly project meetings with the Design Team and City Representatives, and provided valuable input/recommendations relative to construction phasing, budget, constructability, and the scope of the various early bid packages. Other discussion topics also included the following:
    - Consideration of additional Building Automation System Commissioning scope of work, extended beyond the Enhanced Commissioning scope and the initial year of occupancy

- Early buy-out strategies due to escalation, extensive lead times, market volatility and labor demands due to COVID-19 recovery.
- Collaboration on Value Management opportunities in advance of the 60% CD cost estimate.

▪ The second of the four proposed bid packages, Early Site Bid Package #2 was issued to the CM on June 22, 2021, and is integrated into the 60% CD Drawings and Specifications provided to the MSBA. This early bid package will allow the CM to complete site preparation, access roads, retaining walls, excavation, grading and utility work in advance of the Early Structural Bid Package #3, which will be issued concurrently with the 90% CD submission.

▪ LPA|A, Fontaine Brothers Inc. and Tishman AECOM have initiated a "Doherty as a Living Lab Program" in partnership with the Doherty Staff, Engineering and Technology Academy, the Worcester Public Schools Innovation Pathways Program, and Worcester Polytechnical Institute's Architecture and Design program. The goal of this program is to brainstorm and establish meaningful ways that the design and construction processes at Doherty can function as a "Living Lab" for these local construction and engineering students. Development of the content, curriculum and schedule for this program will continue through the summer, with the intent of launching in the Fall of 2021.

▪ The Design team and LPA|A have met with school and district representatives to establish requirements and locate safety equipment for the Chapter 74 Programs, in preparation for the Chapter 74 Safety Meeting that will take place 2 weeks after the 60% CD submission. This meeting has been scheduled for 08.16.2021, and a copy of the draft Floor Plan safety diagrams has been included in Section 6B.3.2.D

The above items are described in greater detail throughout the 60% CD submission, and related costs have been incorporated into the 60% CD cost estimates and Total Project Budget as appropriate.

6B.2 OPM DELIVERABLES

6B2.1 Submittal Review & Coordination

A. Approval of Designer Submission
B. CM at Risk's Review & Comments
C. Commissioning Agent's Review & Comments
D. District Response to MSBA DD Comments

6B.2 OPM DELIVERABLES

6B.2.1 Submittal Review & Coordination

A. Approval of Designer Submission

1. OPM Letter of Approval
2. OPM Deliverables Narrative

6B.2 OPM DELIVERABLES

6B.2.1 Submittal Review & Coordination

B. CM at Risk's Review & Comments

1. DD Review Comments & Response
2. 60% CD Review Comments

Project Name:	**Doherty Memorial High School - Design Development Estimate - Constructability Review Log - 3.15.2021 | Design Team Response 4.27.21**
Fontaine-Dimeo Project Number:	**2553**

DESIGN REVIEW NOTES

Item	Discipline	DWG/Spec	Schematic Design		Status (Open/Closed)
			CM Comment	Response	
1	Landscaping	L4-3	Will the Press Box Filming platform require a chairlift	Will be reviewed	Open
2	Landscaping	L2-2	Upper retaining wall at the top of the bleacher seating tagged W8 (CIP) should be W5 (Modular)	Tag of upper retaining wall will be corrected to to W5 (modular)	Open
3	Architectural / Structural	General	Coordinate Structural Drawings with Architectural Drawings at the Upper Auditorium. Structural do not have the seating risers detailed.	Auditorium seating riser details will be coordinated/developed for 60% Submission. Initial section is shown on S4.10.	Open
4	Structural	S3.12	Should there be 6" Concrete pads for RTU-14,15,16 & 17?	Prior coordination with Architect has led to the decision that concrete pads are not required at units 14, 15, 16 & 17. LPAA to review w/ Acoustical Engineer	Open
5	Civil	General	Coordination of roof run-off drainage from the new roof system. Possibility of splitting the underground system under the parking lot of Phase 3 in order to manage the new school building prior to completing Phase 3.	Additional detention system being designed per this recommendation. Will be included in the drawings for the upcoming Con.Comm. submission.	Open
6	Civil	General	Coordination of existing Switch with N-Grid (May need to be raised)	NE Response: This is being driven by Electrical/NGRID Corresponding Civil drawing adjustments will be completed following confirmation of switch status, LPA|A Response: N-Grid to advise as part of their review, schedule unknown-per last meeting w/ N-Grid appears that it will need to stay	Open
7	Structural	S4.03-S4.04	Coordinate TSL Elevations on cross sections	OK	
8	Electrical		EV charging stations are not indicated on site power drawing E.04. There is Spec Section 26 27 29 for them. We have included (2) Dual Stations	Location of EV charging stations will be coordinated with the Architect for the 60% submission	Open
9	Electrical	General	Need to list the sizing of the following feeders: Powered entrance gates, scoreboards, and site signs.	Now shown as "2-8". To be further coordinated with the 60% submission	Open
10	Electrical	General	The points on the TL risers do not exactly match the points on the TL plans. The notes on the T drawing series (number inside a circle) need to be checked. Example E3.3 Classroom A102. Note 1 is pointing at what looks like an AV rack. Note 1 is for a coiling door interface. Note 1 appears again to the right of Classroom B102 at the top of the corridor and is pointing at a security door contact. This situation is true on multiple drawings in set.	To be addressed with the 60% CD submission	Open
11	Electrical	E8.0A	SDP1 marked 480/277V, should this be 120/208V?	Revised to 120/208V.	Open
12	Electrical	E2.18	E2.18 Electric room E014 has an MDP2. There is no MDP2 on the riser. Have assumed this is MSB2.	Revised to MSB2	Open
13	Electrical	E2.18	E2.18 Electric room E189 has an MDP1. There is no MDP1 on the riser. Have assumed this is MSB1.	Revised to MSB1	Open
14	Electrical	E8.0H	ATS-LSB, HLSB, T-PRES & PLSB seem to be labeled ATS-LRS, LRS, T-PRS & PRS on the closet drawing E2.18	Revised.	Open
15	Electrical	E2.3	E2.3 has electrical closets in Rms B106 + 106.1 but they are not on the closet detail sheets E2.18 + E2.19	Closets changed to Telecom room, now shown on E3.18	Open
16	Electrical	E8.0F	On Riser E8.0F distribution panel DHG3 is indicated as located in Elec rm B002. It is not shown in the Closet detail for that room on E2.19	DHG3 will be added to the room.	Open
17	Electrical	E8.0E	On Riser E8.0E panel LG5A is indicated as located in Elec rm E014. It is not shown in the Closet detail for that room on E2.18	Now Shown.	Open

DESIGN REVIEW NOTES

Item	Discipline	DWG/Spec	Schematic Design		Status (Open/Closed)
			CM Comment	Response	
18	Electrical	E8.0E	Location for panelboard AV15 on riser E8.0E is missing from closets and power drawings.	The requirement for the panel will be coordinated with the TL drawings as the design progresses.	Open
19	Electrical	E2.18	Closet sheet E2.18 has closet E266 (also labeled E263) with T-DP23,DP23, HP23, P23A, P23B, L23. The closet is depicted on E2.10 as room E263. Equipment on the riser diagrams could not be located. E8.0F is the most likely location.	Shown on E8.0G.	Open
20	Electrical	E8.0A	Panelboard KHS on Riser E8.0A should be in the Kitchen. I could not locate it on E2.5 or E2.5A	KHS will be shown on the drawings.	Open
21	Electrical	General	On the power riser diagrams several of the IDFs are missing their room numbers.	IDFs will be coordinated with the Architectural drawings.	Open
22	Electrical	E3.18	Panelboards for IDFs are not shown on the IDF closet sheet E3.18 and are not labeled on the floor plans. Closet labels are not consistent between the Risers, Closet details E3.18 and E floor plans.	Panels will be coordinated together with room names.	Open
23	Architectural	General	Plaster Ceiling vs. Cement ceiling in the garage. Possible VE item to switch to ACT.	Acknowledged, can be reviewed if needed	Open
24	Structural	S4.02, 4.03, 4.04	Cross sections indicate a curb at the slab edge. Can this be eliminated and the LGMF run to the slab elevation?	Curb is required for Architectural flashing/insulation details.	Open
25	Arch / Structural	General	Drawings include ridging insulation under the entire SOG. We suggest just installing at the perimeter of the foundation only	There is no rigid insulation under the SOG	Open
26	Architectural	42000	Unit Masonry Spec 04 20 00: Hollow Metal doors and access panels should be installed by Carpenters, layout, rough in, infill with mortar by mason trade.	Scope of Work will be clarified	Open
27	Architectural	A2.0	Orientation demarcation “Letters” to show building zones do not match Key Plan	This will be coordinated for the 60% Submission	Open
28	Architectural	General	Beam penetration and MEP coordination for Parking Ceiling, appears ceiling system is tight to beams	To be addressed with the 60% CD submission	Open
29	Architectural	General	Provide finish details at curtain wall fire ratings, flooring to curtainwall area over firestopping needs a finish detail where full height curtainwall is exposed to the interior	Details on Sheet A6.23. Additional details to follow	Open
30	Architectural	A6.21	Exterior wall deflection system needs to be coordinated with the AVB system to construct properly and lap properly so that the AVB can manage the calculated deflection Ref details 4 and 5 on A6.21	Comment noted	Open
31	Architectural	6.30	Details 13 and 14 on A6.30: It appears that these details could be simplified with pour stop, bent plate and standard LGMF.	New detail has been developed for review	Open
32	Architectural	A6.21	Detail 17 on A6.21 shows the foundation perimeter insulation and drainage board extending up over the base brick coursing below grade. This would be 2 separate trades and impractical to come back to raise this up. Is this necessary?	Detail will be further reviewed based on comment	Open
33	Architectural	A6.21	Detail 10 on A6.21 shows insulation between the slab on grade and foundation wall below. Is this required?	Detail will be further reviewed based on comment	Open
34	Architectural	General	Acoustic Decking. If acoustic decking MEP Fasteners are going to be integral with the acoustic decking and a delegated design that the MEP File Trades need to buy and design too than this should be listed in the MEP Specs and detailed on the MEP drawings.	To be addressed with the 60% CD submission	Open
35	Architectural	General	Classroom numbering and identification needs be determined prior to 90% design.	Initial numbering was reviewed and approved by the School/District and Fire Department	Open

DESIGN REVIEW NOTES

Item	Discipline	DWG/Spec	Schematic Design		Status (Open/Closed)
			CM Comment	Response	
36	Architectural	A8.1	Typical classroom layout details coordinated for blocking for IT, furnishings and equipment, need dimensions on A8.1 and A8 Series	Blocking coordinated by the CM , and as part of the coordination, mock up classroom review, based on the final CD 's issued	Open
37	Architectural	A6.22	Bldg. Exp Joint details shown on A6.22 are hidden behind finishes, so that the expansion joint maybe 3" in the framing but the finish only has a caulk joint at approx. ¾"? Can the finishes support this and not move to a cracking/breaking point?	Expansion joint locations have changed. Comment noted for future detailing	Open
38	Electrical	General	Substation and Transformer Options to be determined. Should an allowance be carried for an upgrade?	Yes, discussions with National Grid are underway	Open
39	Architectural	A1.0	Note 11 calls out for 4" bottom track for all interior partitions. Could this be changed to standard 1.5" track?	City standard is to have a high leg track at all spaces, due to support needed w/ cleaning equipment.4" bottom track Scope of Work will be identified for locations not scheduled to receive millwork	Open
40	Architectural	A6.30	Detail 3 on A6.30 Roof Penetration Detail will need to be coordinated. Roofers will typically install the major roofing system in large sections and rolls. If all penetrations are installed prior this will add 500% more seams in the roofing system and reduce the quality of final product. Penetrations are typically made after the roofing system is in place and the interstitial space can be filled with spray foam to seal up the vapor barrier.	Comment noted	Open
41	Architectural	A7.11	Details on A7.11 : review construction sequence to ensure that railing code height is met; so that concrete is not placed too thick, need to account for construction tolerances.	To be coordinated with the 60% submission	Open
42	Architectural		Review CMU coordination with structural steel frame at CCL areas	To be coordinated with the 60% submission	Open
43	Architectural		Coordinate moisture mitigation strategy	FBI /LPAA/Owner can review, similar to past projects, may carry as a contingency	Open
44	Architectural	84413	Spec section 084413 Section 1.3 A item 14 says third party testing is to be paid for by this section. Section 3.4 A says Owner will engage third party testing agent. Please confirm testing is to be performed by Section 84413.	Clarification will be made. To be coordinated with the 60% submission	Open
45	MEP/Structural		Coordinate MEP/FP openings with structural engineer's requirements (i.e. Hilti sleeves, coring requirements, sleeve details, etc.)	Coordination meeting with MEP/Structural/FBI should take place for the 60% CD submission	Open
46	MEP/Structural	General	Coordinate Structural Requirements for MEP hangers and spacing. Will need to establish what can hang from deck and what needs to tie back to steel. All structural requirements will need to be incorporated in the MEP/FP scopes.	SEC Response: SEC will share loads and routing with LPA and Structural engineer. 230000 2.12 A. lists restrictions on hanging. LPA|A Response: Coordination meeting with MEP/Structural/FBI should take place for the 60% CD submission	Open
47	MEP/Architectural	General	Coordinate the use of Unistrut in ceiling height and soffit design.	To be coordinated with the 60% submission	Open
48	Architectural	General	Coordinate details regarding walls, misc., enclosures, and finished in order to avoid padding out walls due to the tight steel tolerances.	To be coordinated with the 60% submission	Open
49	Architectural	General	Coordinate details in order to avoid padding out finishes lining up with the roof edge due to the tight steel tolerances.	To be coordinated with the 60% submission	Open
50	Architectural	General	Coordinate tolerances for wall tile. Incorporate required wall prep with the Tile Trade Bidder specification.	Will review and coordinate based on the selected material-CM input on specific coordination between trade and nontrade contractors anticipated	Open
51	Architectural /Structural	General	Tall walls will need to be cold formed and not just standard metal studs (stud limiting height).	Current specification has all wall systems to require a stamped design submittal	Open

DESIGN REVIEW NOTES

Item	Discipline	DWG/Spec	Schematic Design		Status (Open/Closed)
			CM Comment	Response	
52	Architectural	General	Coordination of requirements on clear dimensions for Fire Doors and Coiling doors.	To be coordinated with the 60% submission	Open
53	Architectural	General	Coordinate location of all required Fire Rated Shafts.	To be coordinated with the 60% submission	Open
54	MEP/Architectural	General	Fume Hoods require fire wrap from point of discharge to the hood.	SEC will coordinate with LPA as to whether rated shafts and/or wrap is used.	Open
55	MEP/Architectural	General	Coordinate MEP /FP penetrations through rated stair shafts.	SEC will coordinate H & P with LPA|A	Open
56	Structural	General	Coordinate retaining wall design for backfilling (timing) requirements.	BDI Response: Backfill for retaining walls not to occur until walls achieve 28 day strength. LPA|A Response: CM coordination item, A/S team has addressed from a design end , Advise on proposed HES, mix design	Open
57	Structural	S1.01	Notes on S1.01 reference LW concrete and specifications call out NM concrete. Confirm NW concrete will be utilized on the project.	References to light-weight concrete have been removed. Slabs are to be normal weight concrete.	Open

6B.2 OPM DELIVERABLES

6B.2.1 Submittal Review & Coordination

C. Commissioning Agent's Review & Comments

1. DD Review Comments & Response
2. 60% CD Review Comments

Building Envelope Peer Review Comment Sheet

206 West Newberry Road
Bloomfield, CT 06002
Tel: (860) 286-9171
Fax: (860) 242-0236

The drawing review notes found below are for the above referenced project. General comments represent repeat issues that are not drawing or area specific. Specific comments listed below are referenced on the appropriate drawing with the reference number noted. The architect is asked to respond to the issues in the Architect's Comment column to allow for the tracking of these items during future reviews. Please do not treat these comments as directives, just questions or suggestions.

Project Name: MSBA Doherty High School
BVH Project Number: 21-20-180
Drawing Set: 100% DDs
Drawing Date:

Review Date: 3/2/2021
Reviewer: Paul D'Amore, Mike LaCrosse

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A1.0	3/2/2021	1	E8B, EM12, EC2, E6SC/A1.0 - We note that most all wall types allow for two-way drying through the entire wall assembly - a "flow-through" assembly. For the indicated wall types, which contain reservoir claddings, it is important to be sure that the designed air space is truly ventilated at the top and bottom of the cavity in order to decouple solar driven moisture vapor from the cladding to the inside. The wall assembly can likely handle it, but HVAC design is likely not anticipating solar driven moisture loading from the exterior. Some details we have seen in the DD set appear to demonstrate an open cavity at the top and bottom, we just recommend this be carried through in the impending details for every assembly type mentioned above.	An open cavity at the top and bottom will continue to be shown on future details	
A1.0	3/2/2021	2	EM12, EM12MP, EC2/A1.0 - Specs indicate a self-adhered air barrier membrane. Suggest the use of a fluid-applied product over masonry and above grade concrete substrates. Also note that specs indicate a vapor closed product while drawings indicate vapor permeable. Please clarify.	Fluid applied AB will be specified for use over masonry and above grade concrete surfaces	
A1.0	3/2/2021	3	EC2/A1.0 - This wall type calls for R-24 interior mineral wool insulation, but graphically indicates concrete.	The mineral wool note will be removed	
A3.1	3/2/2021	1	A3.1 - Wall Type E8MA is not represented on the wall types page A1.0, and the section through this wall (3/A6.4) makes no reference to E8MA.	The correct wall type will be labeled	
A3.10	3/2/2021	1	10/A3.10 - Plan details where the feature wall interfaces with surrounding envelope walls will be very important.	All wall interface details will be developed	

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A3.10	3/2/2021	2	1/A3.10 - Details are still developing, but based on what we see on A6.7, it appears the intent is to wrap air and thermal barriers around the entirety of the feature wall. Unless there is active heat inside of it, we worry that the ambient temperature within the cavity of the feature wall will reach temperatures cold enough for condensation. Consider an air barrier through the feature wall, in plane with whatever wall is set out the furthest. Can the rest be framed and built out, after air and thermal barrier integration?	Comment noted and suggested will be considered when detailing	
A3.19	3/2/2021	1	R-3-F/A3.19 & similar - As roof details develop for this project, be mindful of the acoustic metal deck in this roof type. Acoustic deck should be fully contained within the envelope. If decking translates from interior space to exterior space, such as at canopies, the perforations in the deck become conduits for air leakage.	Comment noted	
A3.19	3/2/2021	2	1/A3.19 - Detailing of the exterior parapet at this corner transition as well as at the parapet sitting over the field of the roof will be important to see.	Noted detail location will be developed	
A6.1	3/2/2021	1	We recommend adding details for typical curtain wall head and sill assemblies at each wall type. See 1/A6.1 for example	All curtain wall conditions will be detailed	
A6.1	3/2/2021	2	We recommend adding details for typical window head and sill assemblies at each wall type. See 1/A6.1 for example.	All window conditions will be detailed	
A6.1	3/2/2021	3	3/A6.1 - We recommend adding a section detail for the transition from wall type E8MP to E8B at the deflection joint.	Noted location will be detailed	
A6.1	3/2/2021	4	4/A6.1 - We recommend adding a detail for the transition from wall type E8B to EM12	Noted location will be detailed	
A6.2	3/2/2021	1	1/A6.2 - We recommend adding a detail showing the air barrier transition from the metal panel soffit to the head of the curtain wall assembly	Noted location will be detailed	
A6.2	3/2/2021	2	3/A6.2 and sim. - We recommend adding a detail showing the transition from the roof AVB to the head of the curtain wall.	Noted location will be detailed	
A6.3	3/2/2021	1	General Comment: With the exception of wall section 1/A6.3, all others featuring the parking garage do not indicate insulation across the garage ceiling. See A6.5 for example. We imagine thermal and air barrier separation of the garage from the rest of the building is intended. Otherwise CO transmission and heat loads would not be easily maintained. Please confirm. Assuming so, an air barrier across the garage ceiling will need to be established and thermal bridging via the perimeter concrete walls should be addressed.	Comment noted	

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A6.3	3/2/2021	2	A6.3 - We recommend adding details for the head and sill of the fiberglass sandwich panel assemblies for each wall type. How will the air barrier transition from the lower wall to the panel wall, and from the panel wall to the roof AVB?	Noted location will be detailed	
A6.3	3/2/2021	3	2 & 3/A6.3 - We recommend adding a detail for the expansion joint detail	Noted location will be detailed	
A6.4	3/2/2021	1	1/A6.4 - We caution against the interior wall type S4D over the exterior wall. While the batt insulation on the S4D wall is acoustical, its inherent R-value creates an undesirable ratio of insulation on the interior side of the sheathing. Ideally, for climate zone 5 there should be a ratio of 35%+ continuous exterior insulation to 65% or less interior insulation.	Comment noted	
A6.5	3/2/2021	1	2/A6.5 and sim. - We recommend adding a detail showing the transition from roof AVB on the lower roof to the wall AB.	Noted location will be detailed	
A6.6	3/2/2021	1	1/A6.6 and sim. - The detailing of this parapet seems to be incomplete. The typical wall to roof detail does not work here. In order to align with the rest of the roof to wall details, the wall AB would need to cut through the sheathing at the height of the roof deck and seal to the roof AVB. See 2/A6.6.	Noted location will be detailed	
A6.7	3/2/2021	1	5/A6.7 and sim. - We recommend adding a detail showing the skylight interface with the air barrier on the curb and the air barrier on the roof parapet.	Noted location will be detailed	
A6.7	3/2/2021	2	5/A6.7 - Potential for snow/ice buildup where this feature wall interfaces with the wall/curtain wall beyond at c.l. 17.	Comment noted	
A6.8	3/2/2021	1	3/A6.8 - There is concern about snow/ice build up at such a low sill. Other similar instances, not shown in section, exist as well.	Comment noted	
A6.8	3/2/2021	2	2/A6.8 - We recommend adding a detail for the skylight to curtain wall transition. A piece of wall AB will need to connect from the skylight blocking to the curtain wall blocking that could easily be missed if not pointed out.	Noted location will be detailed	
A6.10	3/2/2021	1	1/A6.10 - We recommend adding a detail showing the air barrier transition from metal panel soffit to curtain wall assembly.	Noted location will be detailed	
A6.10	3/2/2021	2	4/A6.10 - The typical wall to roof detail does not work here. In order to align with the rest of the roof to wall details, the wall AB would need to cut through the sheathing at the height of the roof deck and seal to the roof AVB. See 2/A6.6.	Noted location will be detailed	
A6.21	3/2/2021	1	9,15/A6.21 & similar - Recommend extended drip edges to put draining water further off the face of the brick to reduce staining and efflorescence. An inch or more is best.	Comment noted	

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A6.21	3/2/2021	2	13,15/A6.21 - How does the hollow frame get filled adequately with the door frame in place? Do they drill and fill the frames? If it isn't feasible then some other air seal will need to be made between frame and air barrier.	Frame is sprayed prior to installation. AB connection occurs at inside frame jamb/ head condition. Detail linework to be reviewed for clarity	
A6.21	3/2/2021	3	15/A6.21 - Is backer rod behind the relieving angle realistic? What does the relieving angle structurally attach to?	The backer rod behind the loose lintel is realistic. It provides a backer for the membrane flashing to bridge over the void. The lintel is bearing on the brick masonry 8" minimum each side of opening	
A6.21	3/2/2021	4	14/A6.21 - Could air barrier instead wrap into framing on either side of the EmSeal-like product rather than over it? This would eliminate need to provide slack in air barrier, which I'm not sure would be enough as drawn.	Air barrier will be shown wrapped into framing.	
A6.21	3/2/2021	5	14/A6.21 - As details develop consider how vertical and horizontal expansion joints will maintain air/water continuity where they interface with one another. This is often a weak point of expansion joint detailing. 3D details could be helpful.	Comment noted	
A6.21	3/2/2021	6	17/A6.21 - Assume this below grade brick will be sealed with a sealer similar to 8/A6.21? If so suggest indicating.	Sealer will be noted	
A6.21	3/2/2021	7	17/A6.21 - In order for the air barrier to be continuous the window receiver needs to be sealed to the sill flashing, the sill flashing needs to be sealed to the through wall flashing, and the through wall flashing needs to be sealed to the wall AB. We recommend adding text notes to call out these materials and remind the contractor that they need to be sealed to one another.	Noted location will be detailed	
A6.21	3/2/2021	8	6/A6.21 - Where does the under slab vapor retarder terminate? Difficult to tell.	Noted location will be detailed	
A6.21	3/2/2021	9	11/A6.21 - Detailing of the end dam looks good. We just recommend terminating the top edge of end dam flashing with compatible mastic/sealant.	Integral window flashing is now detailed	
A6.21	3/2/2021	10	8/A6.21 & sim. - Consider raising weep vents and through wall flashing detailing one course up. I would worry about weep blockage over time if located right at grade. If raised, suggest brick sealer be carried up one course above grade as well.	Weeps will be raised as suggested	
A6.21	3/2/2021	11	8/A6.21 & sim. - Suggest use of waterproofing on foundation wall, up to grade line, lapping onto sheathing. Vapor permeable air barrier is indicated on foundation.	Comment noted, detail components to be reviewed	
A6.21	3/2/2021	12	8/A6.21 - There is a bit of a thermal bridge through the top of the foundation wall that is only protected to the first two brick courses below grade.	Detailing satisfies 2018 IECC, C402.2.4 Slabs on grade perimeter insulation and ANSI/ASHRAE 96.1, Figure 5-S	

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A6.21	3/2/2021	13	8/A6.21 & sim. - Note that sub slab vapor barrier installers may have a difficult time turning product cleanly onto top of foundation, especially at corners, due to material thickness. Could specify a two-piece installation, sealed together on interior side of foundation.	A pre-installation meeting with the contractor and the manufacturer will be specified to address installation techniques	
A6.21	3/2/2021	14	12/A6.21 & similar - Will waterproofing be required down to the footing?	Waterproofing is only installed on below grade walls with occupied space on interior	
A6.21	3/2/2021	15	12,17/A6.21 & similar - Will there be an sub-slab horizontal insulation?	No, it is no longer required	
A6.22	3/2/2021	1	A6.22 - Details on this page largely do not appear ready for review. We have made a few comments, but will anticipate a closer look at these details once they are more developed.	Details noted are incomplete and will be further developed	
A6.22	3/2/2021	2	13/A6.22 - AB is not shown connecting in the corner. This is likely just a graphics error	Detail noted is incomplete and will be further developed	
A6.22	3/2/2021	3	15/A6.22 - No AVB shown on the sheathing parallel to c.l. 7E	Detail noted is incomplete and will be further developed	
A6.22	3/2/2021	4	16/A6.22 - Sheathing joints do not meet leaving the AB unsupported in the corner.	Detail noted is incomplete and will be further developed	
A6.22	3/2/2021	5	9/A6.22 - Insulation and sheathing shown out of plane.	Detail noted is incomplete and will be further developed	
A6.30	3/2/2021	1	1,2/A6.30 - Thermal bridging through the blocking at concrete slab edge.	Detail issue noted will be addressed in future submission	
A6.30	3/2/2021	2	3,4/A6.30 - How will prefab curb air seal to the roof AVB? How does the unit seal to the prefab curb?	Unit will be noted to be set in sealant	
A6.30	3/2/2021	3	7 & 9/A6.30 - We recommend wrapping the roof AVB entirely around the blocking for continuity with the ccSPF.	AVB will be detailed as wrapped	
A6.30	3/2/2021	4	11/A6.30 - Roof AVB should continue around blocking and meet the expansion joint on either side in order for the air barrier to be continuous.	A continuous connection will be detailed	
A6.30	3/2/2021	5	13,14/A6.30 - Low expanding ccSPF is not identified in 072100 as detail suggests. This foam will need to be a two-part foam for the size of the cavity to be filled.	07 21 00 will include spray foam	
A6.30	3/2/2021	6	13,14/A6.30 - Suggest extending transition membrane flashing 3" further at each end to provide overlap with primary wall air barrier and roof AVB.	This detail was successfully installed on a previous project. However, a new detail has been created for review	

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A6.30	3/2/2021	7	13 & 14/A6.30 - While we do like the approach of wrapping the wall AB under the parapet to connect to the roof AVB, sequencing of this detail will be important. The roof AVB is usually installed early on in order to provide temp waterproofing. However, in this scenario the wall sheathing and AB will need to be installed first, then the metal angle and then the roof AVB. Also the parapet will need to be built after the wall AVB is installed, so sheathing and AVB on the parapet will need to be installed at a different time then the rest of the wall.	This detail was successfully installed on a previous project. However, a new detail has been created for review	
SPECIFICATIONS					
014339	2/26/2021	1	014339 2.1 A - Is it worth clarifying this by calling it a "stand-alone" mockup, versus in-situ?	Clarification will be made	
014529	2/26/2021	1	014529 1.10 F 1 - Section says "Testing shall be performed and paid for and witnessed by the Construction Manager, Owner's Project Manager and Commissioning Agent" implying that all three would be responsible for performing and paying for this test. Please clarify.	Clarification will be made, Scope on ownership of all testiing to be reviewed between LPAA, opm, Owner and CM as part of the 60% submission	
014529	2/26/2021	2	014529 1.11 C 2 B - Should this read "Mock-ups and in-place testing…"?	Clarification will be made	
014529	2/26/2021	3	014529 1.11 C 2 D 1 - Are each of the described installation conditions to be incorporated into a single stand-alone mock-up, or are these to be in-situ mock-ups? Please clarify.	Clarification will be made	
070543	2/26/2021	1	070543 2.2 A - As applicable, ensure the engineer engaged for delegated design is held accountable for the impact of their designed system on surrounding envelope performance layers, such as the air barrier, drainage plane, and thermal barrier.	This Section will be deleted and the rain screen attachment components will be listed in each Section where accountability will be noted.	
071113	2/26/2021	1	071113 - Is this spec section relevant? We only noted waterproofing called out in the drawings.	Dampproofing location will be noted in Scope of Work	
072600	2/26/2021	1	072600 3.2 D- Suggest requirement that clusters of penetrations be sealed with manufacturer' liquid sealant rather than tape.	Comment noted	
072713	2/26/2021	1	072713 2.3 A 2 - Drawings indicate a vapor permeable air barrier membrane on all wall assemblies, which has been the basis of our review. However specifications indicate a vapor closed air barrier product. Please clarify.	A vapor permeable membrane will be used and clarified in the specification	
072713	2/26/2021	2	072713 3.4 D 2 - Quantitative air leakage testing of the AVB membrane (ASTM E783) are difficult to accurately perform in the field unless it is performed on a mock-up. Consider removing this test from the specs or requiring it on the mock-up instead.	Testing noted will be deleted from spec. Field inspections will be performed under Section 01 45 00 Quality Control. Manufacturer will be required to periodically review installation proceedures	

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
075400	2/26/2021	1	075400 2.4 A - Where is polyethylene sheet vapor retarder being utilized? We recommend the self-adhered roof AVB over all roof decks/substrate boards for its superiority in establishing an air barrier.	The polyethylene sheet vapor retarder referece is incorrect. Self adhered AVB will be specified.	
Division 8	3/2/2021		General Comment: In division 1 there are a number of tests to be engaged by the contractor and subcontractor. In division 8 the same or similar tests are to be engaged by the owner. We recommend clarifying if the testing is required by both the owner and contractor/sub, and if not who is responsible. We have identified further discrepancies between the two divisions in the comments below and we recommend using the same language in both divisions to avoid confusion.	Clarification will be made, Scope on ownership of all testiing to be reviewed between LPAA, opm, Owner and CM as part of the 60% submission	
084113	2/26/2021	1	084113 3.4 - Section 014529 specifies AAMA 501.1 testing on the aluminum storefronts, but it is not included in this section. Is it required?	Storefronts are only installed on the interior. No testing required. Reference will be removed.	
084113	2/26/2021	2	084113 3.4 - The timing and number of tests to be performed differs from section 014529. While these sections do not necessarily contradict one another, it could cause some confusion. We recommend using the same language in both sections.	Clarification will be made, Scope on ownership of all testiing to be reviewed between LPAA, opm, Owner and CM as part of the 60% submission	
084413	2/26/2021	1	084413 3.4 - Section 014529 specifies AAMA 501.1 testing on the aluminum curtain walls, but it is not included in this section. Is it required?	Clarification will be made	
084413	2/26/2021	2	084413 3.4 - The timing and number of tests to be performed differs from section 014529. While these sections do not necessarily contradict one another, it could cause some confusion. We recommend using the same language in both sections.	Clarification will be made	
084523	2/26/2021	1	084523 3.3 - Section 014529 specifies AAMA 501.1, 501.2, 502 and ASTM E783 and E1105 testing on the fiberglass sandwich panels, but section 084523 only specifies ASTM E1105. Which tests are required?	Clarification will be made	
084523	2/26/2021	2	084523 3.3 - We recommend adding the pressure that the sandwich panels should be tested at.	Recommendation noted	
085113	2/26/2021	1	085113 3.3 - Section 014529 specifies AAMA 501.1, 501.2, 502 and ASTM E783 and E1105 testing on the aluminum windows, but section 084523 only specifies AAMA 502. Which tests are required?	Clarification will be made	
085113	2/26/2021	2	085113 3.3 - We recommend specifying a specific test pressure, or at the very least specifying the performance class of window to be installed.	Clarification will be made	
085113	2/26/2021	3	085113 3.3 - The timing and number of tests to be performed differs from section 014529. While these sections do not necessarily contradict one another, it could cause some confusion. We recommend using the same language in both sections.	Clarification will be made	

Electrical Peer Review Comment Sheet

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The drawing review notes found below are for the above referenced project. General comments represent repeat issues that are not drawing or area specific. Specific comments listed below are referenced on the appropriate drawing with the reference number noted. The design engineer is asked to respond to the issues in the Engineer's Comment column to allow for the tracking of these items during future reviews. Please do not treat these comments as directives, just questions or suggestions.

Project Name: Dohery High School
BVH Project Number: 21-20-180
Drawing Set: 100% DD
Drawing Date: 2/18/2021

Review Date: 3/3/2021
Reviewer: JCK

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
E2.18	3/5/2021	1	Coordinate door swing and hardware with code requirements	Will be coordinated with the Architect.	
E8.0A	3/3/2021	1	Provide references to other sheets	Now provided.	
E8.0A	3/3/2021	2	Confirm AISC ratings of equipment	AIC ratings will be coordinated.	
E8.0A	3/3/2021	3	Confirm that the transformer will be owned and maintained by Owner	The City is in the process of confirming service option between primary and secondary metering and DG interconnection which will determine who owns the transformer. Meetings w/ Ngrid are ongoing	
E8.0A	3/3/2021	4	Move feeder tag to feeder	Moved.	
E8.0A	3/3/2021	5	panel shall be 208/120V	Voltage will be changed.	
E8.0A	3/3/2021	6	ATS- SDL1	Renamed to ATS-SDL1	
E8.0A	3/3/2021	7	Provide feeder size	Feeder size will be provided.	
E8.0A	3/3/2021	8	Provide UL listed reverse flow circuit breaker for PV system connection	Reverse flow circuit breaker will be provided.	
E8.0A	3/4/2021	9	Consider MCB instead of MLO if OCPD feeding the equipment is located in other room (typical)	MCB circuit breakers in series usually have a problem coordinating with each other in coordination studies.	
E8.0A	3/5/2021	10	Missing feeder tag	Feeder size will be provided.	
E8.0B	3/3/2021	1	Provide references to other sheets	Now provided.	
E8.0B	3/3/2021	2	Confirm AISC ratings of equipment	AIC ratings will be coordinated.	
E8.0B	3/4/2021	3	Consider MCB instead of MLO if OCPD feeding the equipment is located in other room (typical)	MCB circuit breakers in series usually have a problem coordinating with each other in coordination studies.	
E8.0C	3/3/2021	1	Provide references to other sheets	Now provided.	
E8.0C	3/3/2021	2	Confirm AISC ratings of equipment	AIC ratings will be coordinated.	
E8.0C	3/4/2021	3	Consider MCB instead of MLO if OCPD feeding the equipment is located in other room (typical)	MCB circuit breakers in series usually have a problem coordinating with each other in coordination studies.	
E8.0D	3/3/2021	1	Provide references to other sheets	Now provided.	
E8.0D	3/3/2021	2	Confirm AISC ratings of equipment	AIC ratings will be coordinated.	
E8.0D	3/4/2021	3	Consider MCB instead of MLO if OCPD feeding the equipment is located in other room (typical)	MCB circuit breakers in series usually have a problem coordinating with each other in coordination studies.	
E8.0E	3/3/2021	1	Provide references to other sheets	Now provided.	
E8.0E	3/3/2021	2	Confirm AISC ratings of equipment	AIC ratings will be coordinated.	
E8.0E	3/4/2021	3	Consider MCB instead of MLO if OCPD feeding the equipment is located in other room (typical)	MCB circuit breakers in series usually have a problem coordinating with each other in coordination studies.	
E8.0F	3/3/2021	1	Provide references to other sheets	Now provided.	
E8.0F	3/3/2021	2	Confirm AISC ratings of equipment	AIC ratings will be coordinated.	
E8.0F	3/4/2021	3	Consider MCB instead of MLO if OCPD feeding the equipment is located in other room (typical)	MCB circuit breakers in series usually have a problem coordinating with each other in coordination studies.	
E8.0G	3/3/2021	1	Provide references to other sheets	Now provided.	
E8.0G	3/3/2021	2	Confirm AISC ratings of equipment	AIC ratings will be coordinated.	
E8.0G	3/4/2021	3	Consider MCB instead of MLO if OCPD feeding the equipment is located in other room (typical)	MCB circuit breakers in series usually have a problem coordinating with each other in coordination studies.	
E8.0H	3/3/2021	1	Provide references to other sheets	Now provided.	
E8.0H	3/3/2021	2	Confirm AISC ratings of equipment	AIC ratings will be coordinated.	
E8.0H	3/3/2021	3	Panel GP1 and GP2 appears to be fed from 480/277 volt panel EDL1	Revised. Now fed from EDP1	
E8.0H	3/3/2021	4	125 amp feeder	Transformer changed to 112.5kVA	
E8.0H	3/3/2021	5	225 Amp feeder	Transformer changed to 112.5kVA	
E8.0H	3/4/2021	6	Consider MCB instead of MLO if OCPD feeding the equipment is located in other room (typical)	MCB circuit breakers in series usually have a problem coordinating with each other in coordination studies.	
E8.0I	3/3/2021	1	Provide references to other sheets	Now provided.	
E8.0I	3/3/2021	2	Confirm AISC ratings of equipment	AIC ratings will be coordinated.	
E8.0I	3/4/2021	3	Consider MCB instead of MLO if OCPD feeding the equipment is located in other room (typical)	MCB circuit breakers in series usually have a problem coordinating with each other in coordination studies.	

Mechanical Peer Review Comment Sheet

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BVH integrated services

The drawing review notes found below are for the above referenced project. General comments represent repeat issues that are not drawing or area specific. Specific comments listed below are referenced on the appropriate drawing with the reference number noted. The design engineer is asked to respond to the issues in the Engineer's Comment column to allow for the tracking of these items during future reviews. Please do not treat these comments as directives, just questions or suggestions.

Project Name: Doherty High School
BVH Project Number: 21-20-180
Drawing Set: 100% DD
Drawing Date: 2/18/2021

Review Date: 3/3/2021
Reviewer: DSM

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
General	3/5/2021	1	Highly recommend providing riser diagrams for air distributionns for each Building/Pod	As a majority of the POD duct distribution consists of central drops to floor by floor ductwork, riser diagrams may not be of much benefit.	
General	3/5/2021	2	Provide Key plan for clarifications	The drawings do have key plans in the title block.	
H3.12	3/5/2021	1	Given all of the equipment that is to be installed on the roof, has roof access been discussed with facilities personnel?	LPA|A- roof access has been reviewed with the District's Facilites department, and to be reviewed at the major stages as the drawings progress	
H3.13	3/5/2021	1	Given all of the equipment that is to be installed on the roof, has roof access been discussed with facilities personnel?	LPA|A- roof access has been reviewed with the District's Facilites department, and to be reviewed at the major stages as the drawings progress	
H6.	3/5/2021	1	Verify that separate signals are provided for each damper	For motorized dampers this is the case with the exception of small packaged units where the mixing box may have a singal actuator.	
H6.	3/5/2021	1	Recommend providing DP Sensors with manifold installations in order for TAB contractor to plug in simultaneously for calibration.	Will review for the 60% CD submission.	
H6.	3/5/2021	2	ERV not shown in the schedule	The custom and packaged rooftop units as well as the AHU have ERV components scheduled.	
H6.	3/5/2021	2	Are DP sensors required in these locations for PODs	What locations are being referenced?	
H6.	3/5/2021	3	MAU not shown in schedule	What locations are being referenced?	
H6.	3/5/2021	4	Recommend providing detail for Displacemnt system installions	Unit was in the process of being changed to hot water from gas.	
H7.	3/5/2021	1	Please verify that the the Hot Water coil can deliver design	Will confirm for the 60% CD submission	
H7.	3/5/2021	1	Not all pumps shown on drawing details are indicated in the schedule..IE P-10 thru 13	Correct. Pumps were being modified due to the electrificaiton change.	
H7.	3/5/2021	2	Schedule and notes conflicts with the specifications IE schedule based on Hakon	Will clarify. Hakon is an acceptable or equal	
H7.	3/5/2021	2	Exhaust Fans not shown on scheduled	We did clarify this in a note after DD submission. They will be added in later submissions.	
H7.	3/5/2021	3	35% Glycol mixture is indicated in the Specifications under 'System Water Treatment"	This is applicable to the chiller primary loops and RTU glycol loop.	
H7.	3/5/2021	3	Variable Air volume boxes not shown on schedule	They are in process of being selected and will be on future submissions. VAV's have been shown on the plans.	
H7.	3/5/2021	4	Heat Exchangers not shown on schedule	They are in process of being selected and will be on future submissions. VAV's have been shown on the plans.	
SPECIFICATIONS					
General	3/3/2021	1	Spec sections for the various equipment and services need to be broken out in the Table of Contents to avoid confusion or items that may get missed during buyout.	Will consider adding a table of contents.	
230000/1.02	3/5/2021	1	Please reference Spec.Section 019113 'Commissioning Requirements- Building & Envelope'	Section 01 91 00 was referenced. Will clarify with Architect.	
230000/1.03/J and 230000/1.09	3/5/2021	1	Recommend adding/edit "After the flushout period the units shall be fitted with ***NEW*** MERV 13 filters as specified"	We do note MERV 13 filters installed before and after flush out. But will add the word NEW.	

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
230000/1.06	3/5/2021	1	Coordinate training requirements to satisfy MSBA training requirements which will be located in 017900	This has been added.	
230000/2.24/B	3/5/2021	1	Provide clear and concise flushing procedures that also include requirements for dumping of chemicals that should state "Approval from local authorities is required"	Will review for 60% CD submission	
230000/2.24/C	3/5/2021	2	Conflict. 30% Glycol indicated in drawing schedule.	RTU glycol loop shall have 30% and the chiller-heater primary loops shall have 35%. Shall clarify.	
230000/2.28/PART 2/A	3/5/2021	1	Conflict. Haakon shown on drawing schedule.	Will clarify. Hakon is an acceptable equal	
230000/2.28/PART 2/I	3/5/2021	1	This section does not seem to apply to these units as Hot Gas reheat is shown in the schedule.	Units currently include a heat pipe however hot gas reheat technology is being develop this year. Final configuration at bid day could vary from heat pipe, additional wheel or hot gas reheat.	
230000/2.46/M/4	3/5/2021	1	Recommend raising reset temperature to reach 135 deg when OA temperatures fall below 25 deg	Low temp. system designed for lower water temp.	
230000/3.05/A/2	3/5/2021	1	Please reference Spec.Section 019113 'Commissioning Requirements- Building & Envelope'	Section 01 91 00 was referenced. Will clarify with Architect.	
230000/3.05/A/2	3/5/2021	2	Please reference Spec.Section 220000/1 'Plumbing'	Have added with respect to testing of plumbing flow meters/switches.	
230000/3.05/A/2	3/5/2021	1	Please add TAB requirements for adjustment of balancing valves installed in the recirculation loops for the domestic HW system as is identified in the Plumbing specifications.	This balancing work is under the plumbing division 220000.	
230000/3.05/A/2	3/5/2021	1	Recommend adding "Total flow measurements for reporting and flow meter calibration to be obtained via Ultra Sonic measuring device"	Will review for 60% CD submission	

General Specification Peer Review Comment Sheet

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Project Name: Doherty High School
BVH Project Number: 21-20-180
Drawing Set: 100% DD
Drawing Date: 2/18/2021

Review Date:
Reviewer:

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
17900	3/5/2021		Per MSBA requirements, a specific comprehensive list of equipment needs to be developed for training	This will be reviewed for the 60% CD submission	
017900	3/5/2021		Based MSBA requirements: in the construction documents, the Construction Manager/General Contractor will provide a draft training schedule for review and approval by the district, Owner's Project Manager, and Commissioning Consultant. This schedule should include each equipment item and system specified which requires training and should be submitted 180 days following the Notice to Proceed. The schedule should indicate trainings which will be conducted prior to substantial completion and duplicate sessions conducted following substantial completion (typically 6 months following substantial completion). The draft training schedule is to be resubmitted as required until approved.	This will be reviewed for the 60% CD submission	
017900	3/5/2021		The specifications should include the qualification that instructors shall have not less than five years of providing instructional training with similar scope and complexity or other experience level deemed appropriate by the project team. Resumes of the proposed trainers should be submitted along with (no later than) the training manuals		
017900	3/5/2021		Specify that training durations do not include travel time.	This will be clarified for the 60% CD submission	

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
17900	3/5/2021		Specify a professional video recording of each training session • Specify a professional videographer experienced in digital photography be responsible for recording all training. • Specify a standard format for the delivery and recording of each training. • Specify that the videographer will coordinate his schedule with the Construction Manager/General Contractor's training schedule and will be required to be available for each training. Training will not proceed without the videographer present. • The Construction Manager/General Contractor is to be assigned responsibility in thelproject specifications for all recording and delivery of six (6) copies of each recording to the district.	This will be reviewed for the 60% CD submission	
			Training Video Requirements: Construction Manager/General Contractor agree that the terms of their agreement with each subcontractor permit full recording by the district of all training sessions and subsequent unfettered use of the recordings by the district. Acknowledgement of district right to video record all trainings is to be addressed in the project specifications. • General: o Prior to the start of each training, confirm the area selected is suitable for instruction in terms of adequate space and lighting. o Prior to the start of each training module, suggest recording each chart/slide		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
17900	3/5/2021		containing learning objective and lesson outline. This will be the opening of each video and will assist future users of the video to understand the content they are about to view. • Video: Provide minimum 720 X 480 (480p) video resolution converted to mp4 format file type acceptable to district, on electronic media. o Electronic Media: Read-only format DVD-ROM disc acceptable to District, with commercial grade graphic label. o File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu. o File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in the Project Specifications. o Construction Manager and Trade Contractor File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to the Project Table of Contents: • Name of Construction Manager/General Contractor and Trade Contractor • Business Address • Business telephone number • Point of Contact, name and position • Email address • Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time. • Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording. Furnish additional portable lighting if required.	This will be reviewed for the 60% CD submission	

Plumbing Peer Review Comment Sheet

206 West Newberry Road
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The drawing review notes found below are for the below referenced project. General comments represent repeat issues that are not drawing or area specific. Specific comments listed below are referenced on the appropriate drawing with the reference number noted. The design engineer is asked to respond to the issues in the Engineer's Comment column to allow for the tracking of these items during future reviews. Please do not treat these comments as directives, just questions or suggestions.

Project Name: Doherty High School
BVH Project Number: 21-20-180
Drawing Set: 100% DD
Drawing Date: 2/18/2021

Review Date: 3/8/2021
Reviewer: DSM

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
General	3/3/2021	1	Recommend providing single line riser diagrams for all services (HW, CW, Sanitary Waste, Storm..etc) on dedicated drawing pages to avoid confusion	This is a good idea and we will consider implemented in this design. The building is massive though. All piping is shown on the plans with pipe sizes throughout. The plans speak for themselves. We have never done this on a project yet. With multiple roof levels and multiple pipe exits, it would be very diffucult to implement.	
General	3/3/2021	2	With the understanding that the project will be phased for occupation, we recommend providing looped connections for flushing purposes to avoid contamination from newly intoduced phases. Isolation and drain valves should be installed where bypass connections are installed.	This project is not phased for occupation. This is a new buidling that will be fully opened and occupied when construction is complete.	
P3.1	3/3/2021	1	Consider adding hose bibs for facilities in the mechanical room	The mechanical room has not been designed. There is an air handler in this room and the air compressor system. Hose bibs will be added when and where appropriate.	
P3.1	3/3/2021	2	Consider floor drains in the mechanical room	The mechanical room has not been designed. The design is waiting for HVAC design to ensure there is adequate space. Multiple floor drains will be added where appropriate...one for a condensate drain and one for an air complressor blow-off drain. We need to coordinate floor drain placement.	
P3.6	3/3/2021	1	Consider floor drains in the mechanical room	The mechanical room has not been designed. The design is waiting for HVAC design to ensure there is adequate space. Multiple floor drains will be added where appropriate.	
P3.6	3/3/2021	2	Consider adding hose bibs for facilities in the mechanical room	The mechanical room has not been designed. The design is waiting for HVAC design to ensure there is adequate space. Hose bibs will be added when and where appropriate.	
P3.6	3/3/2021	3	Recommend isolation valves at all branch lines. Balancing valves on return HW line.	OK. The HWR piping into the mechanical room has not beeen finished. We will add valves to the branches.	
P3.6	3/3/2021	4	Consider adding isolation valves at all branch lines	OK. These will be added. There are shut-off's to each bathroom group.	
P3.6	3/3/2021	5	Has this been coordinated within the TAB spec	Not yet. We need to determine the hot water return flow rates for this building, the size of the domestic hot water recirculating pumps and the quantity and size of the thermostatic mixing valves..	
P3.7	3/4/2021	1	Storm line through electrical room? Please review.	This piping will need to be relocated out of Electric 256.	
P3.9	3/4/2021	1	What is IMB? Please provide Key Plan for abbreviations.	These are "Ice Maker Boxes" and are in the spec. They have been added to the legend.	
P3.10	3/4/2021	1	Recommend isolation and drain valves at all take-offs from risers.	We have added shut-off valves. For the lines serving the science labs, drain valves have been added in Janitor D208 as these are at the base of the risers. The other lines serving the locker rooms and restrooms are not risers, so they will not drain, therefore drain valves were not added to these.	

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
P3.10	3/4/2021	2	GPM not listed. End-of-Main return location? Is this in the right location?	That will be added. There are smaller loops for the HWR system. The GPM is called out in the Plumbing Part Plan.	
P3.13	3/4/2021	1	Hoes bib need for mechanical room?	The third floor mechanical room D314 is not being used by the HVAC designer. Therefore, no hose bib required.	
P3.13	3/4/2021	2	Floor drain needed in mechanical room?	The third floor mechanical room D314 is not being used by the HVAC designer. Therefore, no floor drain required.	
P3.13	3/4/2021	3	What is note pointing to? Clarify.	The note was deleted.	
P3.17	3/4/2021	1	Has this been coordinated for the TAB contractor to balance in their spec section?	There is a testing and balancing section in the plumbing specification.	
P4.6	3/4/2021	1	End-of-Main 3/4 line with out balancing device.	This is the detail sheet. We still need to coordinate end of hot water main return water and balancing.	
P4.7	3/3/2021	1	Has it been discussed whether a bypass around the meter be provided?	No. We can disucss with the Worcester Water Dept. but ideally, they do not like bypassing the water meter. If it requires service, this will need to be performed on off hours when water use is not required.	
P4.8	3/3/2021	1	Has it been discussed whether a bypass around the meter be provided?	This detail is for the Outdoor Toilet and Storage Building. Same note as for drawing P4.7 applies.	
P4.9	3/3/2021	1	Air Compressor not shown in schedule	Air compressor is FF&E. It is not furnished and installed by the plumber.	
SPECIFICATIONS					
General	3/3/2021	1	Spec sections for the various equipment and services need to be broken out in the Table of Contents to avoid confusion or items that may get missed during buyout.	We can add a table of contents for the Plumbing section.	
220000/1	3/3/2021	1	Please reference Spec.Section 019113 'Commissioning Requirements- Building & Envelope'	This was added to section 1.2.H.5	
220000/2.42/I	3/3/2021	1	Coordinate training requirements to satisfy MSBA training requirements which will be located in 017900	This will need to be coordinated with the specification section.	
210001/1.3	3/3/2021		Delete reference 019115. Commissioning requirements including Building Envelope will be in one spec section 019113 'Commissioning Requirements- Building & Envelope'	Section 019100 Commissioning was deleted	
210001/1.17	3/3/2021		Coordinate training requirements to satisfy MSBA training requirements which will be located in 017900	A note was added, but we need to review this spec. section as well.	

Building Envelope Peer Review Comment Sheet

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BVH integrated services

The drawing review notes found below are for the above referenced project. General comments represent repeat issues that are not drawing or area specific. Specific comments listed below are referenced on the appropriate drawing with the reference number noted. The architect is asked to respond to the issues in the Architect's Comment column to allow for the tracking of these items during future reviews. Please do not treat these comments as directives, just questions or suggestions.

Project Name: MSBA Doherty High School
BVH Project Number: 21-20-180
Drawing Set: 60% CDs
Drawing Date: 7/8/2021

Review Date: 7/14/2021-7/23/21
Reviewer: Paul D'Amore, Mike LaCrosse

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
DD Review Comments 60% CD Backcheck					
A1.0	3/2/2021	1	E8B, EM12, EC2, E6SC/A1.0 - We note that most all wall types allow for two-way drying through the entire wall assembly - a "flow-through" assembly. For the indicated wall types, which contain reservoir claddings, it is important to be sure that the designed air space is truly ventilated at the top and bottom of the cavity in order to decouple solar driven moisture vapor from the cladding to the inside. The wall assembly can likely handle it, but HVAC design is likely not anticipating solar driven moisture loading from the exterior. Some details we have seen in the DD set appear to demonstrate an open cavity at the top and bottom, we just recommend this be carried through in the impending details for every assembly type mentioned above.	An open cavity at the top and bottom will continue to be shown on future details	**7/19/21 - Resolved - ventilation is shown at top and bottom of wall sections.**
A1.0	3/2/2021	2	EM12, EM12MP, EC2/A1.0 - Specs indicate a self-adhered air barrier membrane. Suggest the use of a fluid-applied product over masonry and above grade concrete substrates. Also note that specs indicate a vapor closed product while drawings indicate vapor permeable. Please clarify.	Fluid applied AB will be specified for use over masonry and above grade concrete surfaces	**7/14/21 - Resolved - Note that a fluid-applied product has been specified in drawings and specs and the vapor permeance characteristics have been clarified.**
A1.0	3/2/2021	3	EC2/A1.0 - This wall type calls for R-24 interior mineral wool insulation, but graphically indicates concrete.	The mineral wool note will be removed	**7/14/21 - Resolved - We note the change.**
A3.1	3/2/2021	1	A3.1 - Wall Type E8MA is not represented on the wall types page A1.0, and the section through this wall (3/A6.4) makes no reference to E8MA.	The correct wall type will be labeled	**7/14/21 - Resolved - We note the change.**
A3.10	3/2/2021	1	10/A3.10 - Plan details where the feature wall interfaces with surrounding envelope walls will be very important.	All wall interface details will be developed	**7/14/21 - Resolved - BVH notes the addition of the plan view on A6.7.**

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A3.10	3/2/2021	2	1/A3.10 - Details are still developing, but based on what we see on A6.7, it appears the intent is to wrap air and thermal barriers around the entirety of the feature wall. Unless there is active heat inside of it, we worry that the ambient temperature within the cavity of the feature wall will reach temperatures cold enough for condensation. Consider an air barrier through the feature wall, in plane with whatever wall is set out the furthest. Can the rest be framed and built out, after air and thermal barrier integration?	Comment noted and suggested will be considered when detailing	**7/14/21 - We note the path of the thermal barrier and anticipate the air barrier will be shown following the same planes. It will just need to be shown graphically as the drawings are updated. Otherwise, this simplified path way of these barriers looks great.**
A3.19	3/2/2021	1	R-3-F/A3.19 & similar - As roof details develop for this project, be mindful of the acoustic metal deck in this roof type. Acoustic deck should be fully contained within the envelope. If decking translates from interior space to exterior space, such as at canopies, the perforations in the deck become conduits for air leakage.	Comment noted	**7/14/21 - Resolved - Comment acknowledged. We will close this comment and provide any roof specific comments in relevant details as part of 60% CD and future reviews.**
A3.19	3/2/2021	2	1/A3.19 - Detailing of the exterior parapet at this corner transition as well as at the parapet sitting over the field of the roof will be important to see.	Noted detail location will be developed	**7/19/21 - No detail added yet**
A6.1	3/2/2021	1	We recommend adding details for typical curtain wall head and sill assemblies at each wall type. See 1/A6.1 for example	All curtain wall conditions will be detailed	**7/19/21 - Resolved - Curtain wall details have been added starting on page 6.23.**
A6.1	3/2/2021	2	We recommend adding details for typical window head and sill assemblies at each wall type. See 1/A6.1 for example.	All window conditions will be detailed	**7/19/21 - Resolved - Curtain wall details have been added starting on page 6.23.**
A6.1	3/2/2021	3	3/A6.1 - We recommend adding a section detail for the transition from wall type E8MP to E8B at the deflection joint.	Noted location will be detailed	**7/19/21 - Resolved - Detail 7/A6.26 has been added**
A6.1	3/2/2021	4	4/A6.1 - We recommend adding a detail for the transition from wall type E8B to EM12	Noted location will be detailed	**7/19/21 - Resolved - Detail 10/A6.26 has been added**
A6.2	3/2/2021	1	1/A6.2 - We recommend adding a detail showing the air barrier transition from the metal panel soffit to the head of the curtain wall assembly	Noted location will be detailed	**7/19/21 - Resolved - Detail 8/A6.26 has been added**
A6.2	3/2/2021	2	3/A6.2 and sim. - We recommend adding a detail showing the transition from the roof AVB to the head of the curtain wall.	Noted location will be detailed	**7/19/21 - Resolved - Detail 15/A6.30 has been added**
A6.3	3/2/2021	1	General Comment: With the exception of wall section 1/A6.3, all others featuring the parking garage do not indicate insulation across the garage ceiling. See A6.5 for example. We imagine thermal and air barrier separation of the garage from the rest of the building is intended. Otherwise CO transmission and heat loads would not be easily maintained. Please confirm. Assuming so, an air barrier across the garage ceiling will need to be established and thermal bridging via the perimeter concrete walls should be addressed.	Comment noted	**7/19/21 - Resolved - insulation and air barrier have been added to garage ceiling**
A6.3	3/2/2021	2	A6.3 - We recommend adding details for the head and sill of the fiberglass sandwich panel assemblies for each wall type. How will the air barrier transition from the lower wall to the panel wall, and from the panel wall to the roof AVB?	Noted location will be detailed	**7/19/21 - Resolved - Detail 1 & 8/A6.23 have been added.**

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A6.3	3/2/2021	3	2 & 3/A6.3 - We recommend adding a detail for the expansion joint detail	Noted location will be detailed	**7/19/21 - No detail added yet.**
A6.4	3/2/2021	1	1/A6.4 - We caution against the interior wall type S4D over the exterior wall. While the batt insulation on the S4D wall is acoustical, its inherent R-value creates an undesirable ratio of insulation on the interior side of the sheathing. Ideally, for climate zone 5 there should be a ratio of 35%+ continuous exterior insulation to 65% or less interior insulation.	Comment noted	**7/19/21 - Resolved - Accoustic insulation has been removed**
A6.5	3/2/2021	1	2/A6.5 and sim. - We recommend adding a detail showing the transition from roof AVB on the lower roof to the wall AB.	Noted location will be detailed	**7/19/21 - No detail added yet**
A6.6	3/2/2021	1	1/A6.6 and sim. - The detailing of this parapet seems to be incomplete. The typical wall to roof detail does not work here. In order to align with the rest of the roof to wall details, the wall AB would need to cut through the sheathing at the height of the roof deck and seal to the roof AVB. See 2/A6.6.	Noted location will be detailed	**7/19/21 - No change.**
A6.7	3/2/2021	1	5/A6.7 and sim. - We recommend adding a detail showing the skylight interface with the air barrier on the curb and the air barrier on the roof parapet.	Noted location will be detailed	**7/19/21 - No detail added yet**
A6.7	3/2/2021	2	5/A6.7 - Potential for snow/ice buildup where this feature wall interfaces with the wall/curtain wall beyond at c.l. 17.	Comment noted	**7/19/21 - No change. Please indicate whether there is intent to modify.**
A6.8	3/2/2021	1	3/A6.8 - There is concern about snow/ice build up at such a low sill. Other similar instances, not shown in section, exist as well.	Comment noted	**7/19/21 - Now detail 3/A6.10 - no change. Please indicate whether there is intent to modify.**
A6.8	3/2/2021	2	2/A6.8 - We recommend adding a detail for the skylight to curtain wall transition. A piece of wall AB will need to connect from the skylight blocking to the curtain wall blocking that could easily be missed if not pointed out.	Noted location will be detailed	**7/19/21 - Now detail 2/A6.9 - detail 20/A6.23 has been added for the curtain wall to ACM panel transition, but no detail has been added for the skylight head.**
A6.10	3/2/2021	1	1/A6.10 - We recommend adding a detail showing the air barrier transition from metal panel soffit to curtain wall assembly.	Noted location will be detailed	**7/19/21 - Now detail 1/A6.12 - no change.**
A6.10	3/2/2021	2	4/A6.10 - The typical wall to roof detail does not work here. In order to align with the rest of the roof to wall details, the wall AB would need to cut through the sheathing at the height of the roof deck and seal to the roof AVB. See 2/A6.6.	Noted location will be detailed	**7/19/21 - Now detail 4/A6.12 - There is no detail callout on this section although typical roof details on A6.30 have been modified.**
A6.21	3/2/2021	1	9,15/A6.21 & similar - Recommend extended drip edges to put draining water further off the face of the brick to reduce staining and efflorescence. An inch or more is best.	Comment noted	**7/19/21 - Now 12 & 17/A6.21 - no change. Please indicate whether there is intent to modify.**
A6.21	3/2/2021	2	13,15/A6.21 - How does the hollow frame get filled adequately with the door frame in place? Do they drill and fill the frames? If it isn't feasible then some other air seal will need to be made between frame and air barrier.	Frame is sprayed prior to installation. AB connection occurs at inside frame jamb/ head condition. Detail linework to be reviewed for clarity	**7/19/21 - Resolved - comments clarified spray foam is not the intended air seal. Drawings show caulk seal to the air barrier membrane.**

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A6.21	3/2/2021	3	15/A6.21 - Is backer rod behind the relieving angle realistic? What does the relieving angle structurally attach to?	The backer rod behind the loose lintel is realistic. It provides a backer for the membrane flashing to bridge over the void. The lintel is bearing on the brick masonry 8" minimum each side of opening	**7/19/21 - Resolved - understood**
A6.21	3/2/2021	4	14/A6.21 - Could air barrier instead wrap into framing on either side of the EmSeal-like product rather than over it? This would eliminate need to provide slack in air barrier, which I'm not sure would be enough as drawn.	Air barrier will be shown wrapped into framing.	**7/19/21 - Resolved - detail has been updated to show new path of the air barrier.**
A6.21	3/2/2021	5	14/A6.21 - As details develop consider how vertical and horizontal expansion joints will maintain air/water continuity where they interface with one another. This is often a weak point of expansion joint detailing. 3D details could be helpful.	Comment noted	**7/22/21 - Note detail 14 has been modified to show AVB wrapping into framing, and detail 15 has been added. Will a detail/ledger be added to emphasize wall/roof connection of expansion joint?**
A6.21	3/2/2021	6	17/A6.21 - Assume this below grade brick will be sealed with a sealer similar to 8/A6.21? If so suggest indicating.	Sealer will be noted	**7/19/21 - No change**
A6.21	3/2/2021	7	17/A6.21 - In order for the air barrier to be continuous the window receiver needs to be sealed to the sill flashing, the sill flashing needs to be sealed to the through wall flashing, and the through wall flashing needs to be sealed to the wall AB. We recommend adding text notes to call out these materials and remind the contractor that they need to be sealed to one another.	Noted location will be detailed	**7/19/21 - No change, now detail 11/A6.21**
A6.21	3/2/2021	8	6/A6.21 - Where does the under slab vapor retarder terminate? Difficult to tell.	Noted location will be detailed	**7/19/21 - No change, now detail 19/A6.21**
A6.21	3/2/2021	9	11/A6.21 - Detailing of the end dam looks good. We just recommend terminating the top edge of end dam flashing with compatible mastic/sealant.	Integral window flashing is now detailed	**7/22/21 - This 3D detail no longer appears to exist. Can it be reintroduced into the drawings.**
A6.21	3/2/2021	10	8/A6.21 & sim. - Consider raising weep vents and through wall flashing detailing one course up. I would worry about weep blockage over time if located right at grade. If raised, suggest brick sealer be carried up one course above grade as well.	Weeps will be raised as suggested	**7/19/21 - Resolved - weeps have been raised**
A6.21	3/2/2021	11	8/A6.21 & sim. - Suggest use of waterproofing on foundation wall, up to grade line, lapping onto sheathing. Vapor permeable air barrier is indicated on foundation.	Comment noted, detail components to be reviewed	**7/19/21 - Resolved - product changed to through wall flashing membrane**
A6.21	3/2/2021	12	8/A6.21 - There is a bit of a thermal bridge through the top of the foundation wall that is only protected to the first two brick courses below grade.	Detailing satisfies 2018 IECC, C402.2.4 Slabs on grade perimeter insulation and ANSI/ASHRAE 96.1, Figure 5-S	**7/19/21 - Resolved - Understood**
A6.21	3/2/2021	13	8/A6.21 & sim. - Note that sub slab vapor barrier installers may have a difficult time turning product cleanly onto top of foundation, especially at corners, due to material thickness. Could specify a two-piece installation, sealed together on interior side of foundation.	A pre-installation meeting with the contractor and the manufacturer will be specified to address installation techniques	**7/19/21 - Resolved - Understood**

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A6.21	3/2/2021	14	12/A6.21 & similar - Will waterproofing be required down to the footing?	Waterproofing is only installed on below grade walls with occupied space on interior	**7/19/21 - Resolved - understood**
A6.21	3/2/2021	15	12,17/A6.21 & similar - Will there be an sub-slab horizontal insulation?	No, it is no longer required	**7/19/21 - Resolved - Understood**
A6.22	3/2/2021	1	A6.22 - Details on this page largely do not appear ready for review. We have made a few comments, but will anticipate a closer look at these details once they are more developed.	Details noted are incomplete and will be further developed	**7/19/21 - Details on this page are still incomplete (no ledgers, and missing graphics). We've made some comments where appropriate.**
A6.22	3/2/2021	2	13/A6.22 - AB is not shown connecting in the corner. This is likely just a graphics error	Detail noted is incomplete and will be further developed	**7/19/21 - Now 17/A6.22 - incomplete AVB not shown**
A6.22	3/2/2021	3	15/A6.22 - No AVB shown on the sheathing parallel to c.l. 7E	Detail noted is incomplete and will be further developed	**7/19/21 - Now 18/A6.22 - no change**
A6.22	3/2/2021	4	16/A6.22 - Sheathing joints do not meet leaving the AB unsupported in the corner.	Detail noted is incomplete and will be further developed	**7/19/21 - Now 14/A6.22 - incomplete expansion joint detail**
A6.22	3/2/2021	5	9/A6.22 - Insulation and sheathing shown out of plane.	Detail noted is incomplete and will be further developed	**7/19/21 - Resolved - Now 9/A6.22**
A6.30	3/2/2021	1	1,2/A6.30 - Thermal bridging through the blocking at concrete slab edge.	Detail issue noted will be addressed in future submission	**7/19/21 - Resolved - spray foam added to curb**
A6.30	3/2/2021	2	3,4/A6.30 - How will prefab curb air seal to the roof AVB? How does the unit seal to the prefab curb?	Unit will be noted to be set in sealant	**7/19/21 - Resolved - detail change to show air barrier adhered to roof curb.**
A6.30	3/2/2021	3	7 & 9/A6.30 - We recommend wrapping the roof AVB entirely around the blocking for continuity with the ccSPF.	AVB will be detailed as wrapped	**7/19/21 - Resolved - Air barrier wraps entirely around blocking**
A6.30	3/2/2021	4	11/A6.30 - Roof AVB should continue around blocking and meet the expansion joint on either side in order for the air barrier to be continuous.	A continuous connection will be detailed	**7/19/21 - Resolved - Air barrier is continuous across expansion joint**
A6.30	3/2/2021	5	13,14/A6.30 - Low expanding ccSPF is not identified in 072100 as detail suggests. This foam will need to be a two-part foam for the size of the cavity to be filled.	07 21 00 will include spray foam	**7/19/21 - Resolved - Section 072131 added to the specs**
A6.30	3/2/2021	6	13,14/A6.30 - Suggest extending transition membrane flashing 3" further at each end to provide overlap with primary wall air barrier and roof AVB.	This detail was successfully installed on a previous project. However, a new detail has been created for review	**7/19/21 - Resolved - path of the air barrier changed**
A6.30	3/2/2021	7	13 & 14/A6.30 - While we do like the approach of wrapping the wall AB under the parapet to connect to the roof AVB, sequencing of this detail will be important. The roof AVB is usually installed early on in order to provide temp waterproofing. However, in this scenario the wall sheathing and AB will need to be installed first, then the metal angle and then the roof AVB. Also the parapet will need to be built after the wall AVB is installed, so sheathing and AVB on the parapet will need to be installed at a different time then the rest of the wall.	This detail was successfully installed on a previous project. However, a new detail has been created for review	**7/19/21 - Resolved - path of the air barrier changed**
60% CD REVIEW COMMENTS					
A1.0	7/21/2021	1	A1.0 - Insulated garage wall not included in exterior wall type details		

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A3.5	7/21/2021	1	A3.5 - There is some confusion whether or not rooms D107 & D108 are within the building envelope. Assuming they are supposed to be inside the envelope then the walls common to the garage should be exterior wall types with an air barrier and insulation. If they are supposed to be outside of the envelope than an air barrier and insulation should be shown on the ceiling in section 4/A6.1. Section details would be needed through the walls facing the garage to show termination of ceiling and insulation of walls above ceiling plane.		
A3.5	7/21/2021	2	A3.5 - The walls around the stair, elevator and vestibules should be exterior wall types with an air barrier and insulation. Details should be provided which show the transitions of these walls to the garage ceiling and to the garage floor.		
A3.5	7/21/2021	3	A3.5 - This wall along c.l. F from c.l. 3D to vest D110 has no interior space on either side, however it may be important to maintaining air barrier continuity from the vestibule to the water service room. The simplest way to maintain continuity would be to use the same interior air barrier and insulation method shown in detail 2/A6.3 at all the CMU walls (shown in blue). This would ensure that the interior spaces mentioned in comments 1 & 2 are within the building envelope, and that air barrier continuity is maintained between them and from floor to ceiling. However, this exterior wall type EM121 has an air barrier on the exterior side of the CMU, so continuity could be maintained by making connections to that air barrier (shown in red). We recommend adding details for these transitions if that method is chosen. The ceiling air barrier will also need to make a connection to the exterior air barrier, see comments on section 1/A6.5		
A3.6	7/21/2021	1	A3.6 - Wall type should be updated to reflect the wall layers as seen in section 2/A6.3		
A3.6	7/21/2021	2	A3.6 - Section 2/A6.13 does not show an air barrier or insulation on the wall like section 2/A6.3. However, in order for the envelope to be continuous the air barrier and insulation need to continue along all the garage walls that abut interior space.		
A5.13	7/23/2021	1	4/A5.13 - Details needed here this is conditioned to unconditioned space.		
A6.3	7/23/2021	1	1,2/A6.3 - Suggest enlarged details be developed for the circled conditions.		
A6.3	7/23/2021	2	3/A6.3 - Suggest detail call out here.		
A6.5	7/21/2021	1	1/A6.5 - The garage ceiling air barrier (not shown) will need to make a connection to the wall air barrier in order for it to be continuous. If the CMU is solid then the ceiling air barrier can just lap onto the interior surface of the CMU. If the CMU is hollow the air barrier will need to connect through a joint in materials.		

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A6.5	7/20/2021	2	3/A6.5 - We recommend sealing the air barrier to the overhead door hood to prevent air leakage through the garage ceiling.		
A6.7	7/20/2021	1	5/A6.7 - Path of the thermal barrier looks good, we assume the air barrier will follow the same path.		
A6.7	7/20/2021	2	3 & 4/A6.7 - Consider adding notes describing where the the transition from roof AB to wall AB is made		
A6.13	7/21/2021	1	2/A6.13 - Insulation and air barrier not shown like section 2/A6.3		
A6.21	7/22/2021	1	16/A6.21 - The air barrier is drawn lapping onto the edges of the drywall returns. Sequentially this does not work, and regardless it won't adhere well to the drywall. Suggest it terminate on the wood blocking and a backer rod and caulk bead be installed between it and the frame, before drywall is installed. As sketched.		
A6.22	7/21/2021	1	3/A6.22 - At inside corner details with metal panel cladding there is an opening at the panel joint in the corner. Will a trim piece be installed to cover the opening?		
A6.22	7/21/2021	2	6/A6.22 - Air barrier should extend into expansion joint opening.		
A6.22	7/21/2021	3	7/A6.22 - Neither bead of sealant contacts the air barrier wrapping into the door opening. We recommend a detail similar to 16/A6.21 with supplemental comments made by BVH.		
A6.22	7/22/2021	4	18/A6.22 - Air barrier graphic missing here.		
A6.23	7/20/2021		General Comment: The curtain walls use an engineered transition assembly (ETA) to seal from the frame to the rough opening. The path of the ETA wraps inward which will make for a difficult connection at corners, and reduces the effectiveness of the membrane by relying more on the sealant to keep water out, rather than the membrane itself. Instead we recommend wrapping the ETA membrane out and around the edge of the blocking, and overlapping it with the wall air barrier. See detail 14/A6.23 for example and sketch of the recommended path of the ETA. This comment applies to all curtain wall head, jamb and sill details. Doing so will also allow the central backer rod and caulk bead to make a direct seal from CW frame to AVB, creating a nice built-in redundancy.		
A6.23	7/19/2021	1	1/A6.23 - The fiberglass sandwich panel isn't directly sealed to the air barrier, it is interrupted by the roof membrane, and there doesn't appear to any sealant between the panel and the roof membrane, it is just fastened with screws. We recommend a direct seal between the panel and the air barrier.		
A6.23	7/20/2021	2	1/A6.23 - Although the fiberglass sandwich panel carries R-value, air that sits in this narrow air space will likely be far cooler than typical indoor ambient temperature and could potentially condense on very cold days toward the top of the parapet.		

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
A6.23	7/22/2021	3	1/A6.23 - Detail does not yet have ledger call outs. For instance, it isn't graphically or textually clear what is supposed to be within the framing of the parapet.		
A6.23	7/19/2021	4	8/A6.23 - Consider setting interior sill flashing in a bead of sealant for air barrier continuity.		
A6.23	7/23/2021	5	8/A6.23 - There are two layers of transition membrane shown wrapping into this opening. Only 1 is necessary.		
A6.23	7/23/2021	6	8/A6.23 - The sill pan and the back dam appear to be two separate pieces which creates a vulnerable point at the break. Can this be one piece?		
A6.23	7/19/2021	7	14/A6.23 - See general comment regarding ETAs at CW openings. We don't recommend wrapping the ETA membrane into the rough opening as drawn. Sketch reflects proposed installation for sill, jambs, and head.		
A6.23	7/19/2021	8	13/A6.23 & similar - We assume that the subframe extension can be attached after the center bead of sealant has been installed.		
A6.23	7/20/2021	9	12/A6.23 - Is reglet flashing necessary or can transition membrane just pickup from fluid applied and wrap around blocking? The through wall flashing could get term bar and water cut off mastic over top.		
A6.23	7/23/2021	10	8/A6.23 - Air barrier will not adhere to this piece of mineral wool. Suggest transition membrane first wrap the angle iron and blocking and then the mineral wool run up to it.		
A6.24	7/23/2021	1	A6.24 & A6.25 - Many details on these pages do not yet appear ready for review. We will revisit these pages in the next review/back check. That said, some comments are provided to help guide development of details.		
A6.24	7/21/2021	2	3/A6.24 & similar - What is supporting the air barrier membrane around the column? Detail 10/A6.25 similar.		
A6.24	7/20/2021	3	5/A6.24 & sim. - Neither bead of sealant makes contact with the air barrier, although its close. Suggest inner bead be set back slightly.		
A6.24	7/21/2021	4	8/A6.24 - Inside corner is incomplete, how will transition from brick to metal panel be made?		
A6.24	7/23/2021	5	3,4,8/A6.24 & similar - It doesn't appear feasible to fit interior insulation behind the column.		
A6.24	7/21/2021	6	18/A6.24 - How will air barrier be terminated to foundation wall and interface with waterproofing?		
A6.24	7/23/2021	7	6/A6.24 - Consider sealing steel transitions to avoid air bypasses.		
A6.25	7/21/2021	1	7 & 8/A6.25 - We recommend sealing angles together and sealing large angle to tube steel.		
A6.25	7/21/2021	2	13 & 20/A6.25 - Insulation, sealant and ETA not shown in these details. Still appear in development.		
A6.26	7/21/2021	1	3/A6.26 - Air barrier not supported at break in the sheathing		
DD SPECIFICATIONS COMMENTS 60% BACK CHECK					

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
014339	2/26/2021	1	014339 2.1 A - Is it worth clarifying this by calling it a "stand-alone" mockup, versus in-situ?	Clarification will be made	7/19/21 - No change
014529	2/26/2021	1	014529 1.10 F 1 - Section says "Testing shall be performed and paid for and witnessed by the Construction Manager, Owner's Project Manager and Commissioning Agent" implying that all three would be responsible for performing and paying for this test. Please clarify.	Clarification will be made, Scope on ownership of all testiing to be reviewed between LPAA, opm, Owner and CM as part of the 60% submission	**7/19/21 - Understood. Bear in mind MSBA is requiring ASTM E1105 water penetration testing to be present for windows and curtain walls. We leave this open because the testing scope still appears unconfirmed since it is in red text. Also as testing scope and ownership is discussed in this spec section, we will provide comments which may help clarify extent of scope.**
014529	2/26/2021	2	014529 1.11 C 2 B - Should this read "Mock-ups and in-place testing…"?	Clarification will be made	7/19/21 - No change
014529	2/26/2021	3	014529 1.11 C 2 D 1 - Are each of the described installation conditions to be incorporated into a single stand-alone mock-up, or are these to be in-situ mock-ups? Please clarify.	Clarification will be made	7/19/21 - No change
070543	2/26/2021	1	070543 2.2 A - As applicable, ensure the engineer engaged for delegated design is held accountable for the impact of their designed system on surrounding envelope performance layers, such as the air barrier, drainage plane, and thermal barrier.	This Section will be deleted and the rain screen attachment components will be listed in each Section where accountability will be noted.	**7/19/21 - Resolved - section deleted**
071113	2/26/2021	1	071113 - Is this spec section relevant? We only noted waterproofing called out in the drawings.	Dampproofing location will be noted in Scope of Work	**7/19/21 - Resolved - see 071113 1.2**
072600	2/26/2021	1	072600 3.2 D- Suggest requirement that clusters of penetrations be sealed with manufacturer' liquid sealant rather than tape.	Comment noted	**7/19/21 - Resolved - penetration sealing requirement added**
072713	2/26/2021	1	072713 2.3 A 2 - Drawings indicate a vapor permeable air barrier membrane on all wall assemblies, which has been the basis of our review. However specifications indicate a vapor closed air barrier product. Please clarify.	A vapor permeable membrane will be used and clarified in the specification	**7/19/21 - Resolved - specs have been clarified**
072713	2/26/2021	2	072713 3.4 D 2 - Quantitative air leakage testing of the AVB membrane (ASTM E783) are difficult to accurately perform in the field unless it is performed on a mock-up. Consider removing this test from the specs or requiring it on the mock-up instead.	Testing noted will be deleted from spec. Field inspections will be performed under Section 01 45 00 Quality Control. Manufacturer will be required to periodically review installation proceedures	**7/19/21 - Resolved - This section was re-written, refrence removed**
075400	2/26/2021	1	075400 2.4 A - Where is polyethylene sheet vapor retarder being utilized? We recommend the self-adhered roof AVB over all roof decks/substrate boards for its superiority in establishing an air barrier.	The polyethylene sheet vapor retarder referece is incorrect. Self adhered AVB will be specified.	**7/19/21 - Resolved - section updated**

Page	Markup Date	#	BVH Comments	Architect's Comments	BVH Back Check Comments
Division 8	3/2/2021		General Comment: In division 1 there are a number of tests to be engaged by the contractor and subcontractor. In division 8 the same or similar tests are to be engaged by the owner. We recommend clarifying if the testing is required by both the owner and contractor/sub, and if not who is responsible. We have identified further discrepancies between the two divisions in the comments below and we recommend using the same language in both divisions to avoid confusion.	Clarification will be made, Scope on ownership of all testiing to be reviewed between LPAA, opm, Owner and CM as part of the 60% submission	**7/19/21 - Resolved - Field quality control articles have been removed from division 8.**
084113	2/26/2021	1	084113 3.4 - Section 014529 specifies AAMA 501.1 testing on the aluminum storefronts, but it is not included in this section. Is it required?	Storefronts are only installed on the interior. No testing required. Reference will be removed.	**7/19/21 - Resolved - Understood**
084113	2/26/2021	2	084113 3.4 - The timing and number of tests to be performed differs from section 014529. While these sections do not necessarily contradict one another, it could cause some confusion. We recommend using the same language in both sections.	Clarification will be made, Scope on ownership of all testiing to be reviewed between LPAA, opm, Owner and CM as part of the 60% submission	**7/19/21 - Resolved - This section was re-written, refrence removed**
084413	2/26/2021	1	084413 3.4 - Section 014529 specifies AAMA 501.1 testing on the aluminum curtain walls, but it is not included in this section. Is it required?	Clarification will be made	**7/19/21 - Resolved - This section was re-written, refrence removed**
084413	2/26/2021	2	084413 3.4 - The timing and number of tests to be performed differs from section 014529. While these sections do not necessarily contradict one another, it could cause some confusion. We recommend using the same language in both sections.	Clarification will be made	**7/19/21 - Resolved - This section was re-written, refrence removed**
084523	2/26/2021	1	084523 3.3 - Section 014529 specifies AAMA 501.1, 501.2, 502 and ASTM E783 and E1105 testing on the fiberglass sandwich panels, but section 084523 only specifies ASTM E1105. Which tests are required?	Clarification will be made	**7/19/21 - Resolved - This section was re-written, refrence removed**
084523	2/26/2021	2	084523 3.3 - We recommend adding the pressure that the sandwich panels should be tested at.	Recommendation noted	**7/19/21 - Resolved - This section was re-written, refrence removed**
085113	2/26/2021	1	085113 3.3 - Section 014529 specifies AAMA 501.1, 501.2, 502 and ASTM E783 and E1105 testing on the aluminum windows, but section 084523 only specifies AAMA 502. Which tests are required?	Clarification will be made	**7/19/21 - Resolved - This section was re-written, refrence removed**
085113	2/26/2021	2	085113 3.3 - We recommend specifying a specific test pressure, or at the very least specifying the performance class of window to be installed.	Clarification will be made	**7/19/21 - Resolved - This section was re-written, refrence removed**
085113	2/26/2021	3	085113 3.3 - The timing and number of tests to be performed differs from section 014529. While these sections do not necessarily contradict one another, it could cause some confusion. We recommend using the same language in both sections.	Clarification will be made	**7/19/21 - Resolved - This section was re-written, refrence removed**

Fire Protection Peer Review Comment Sheet

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Project Name: Doherty Memorial High School
BVH Project Number: 21-20-180
Drawing Set: 60% CD
Drawing Date: 7/8/2021

Review Date: 7/29/21
Reviewer: JBA / DSM

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
FP-1.0	7/14/2021	1	Define all density and area requirements (light hazard, ordinary group 1, ordinary group 2, etc.)		
FP-1.0	7/14/2021	2	Verify whether FM Global requirements for densities and approvals are applicable.		
FP-1.3	7/14/2021	1	Is a building fire pump required to achieve 100 psi residual at top of standpipes, or has Fire Department waived this requirement, with pressure achieved by WFD pumper?		
FP-1.3	7/14/2021	2	Does this point mean anything?		
FP-1.4	7/14/2021	1	Coordinate with local FD as to whether hose valves should be at main or intermediate landings, typical.		
FP-1.4	7/19/2021	2	Is alarm check valve required at main fire service, in addition to backflow prevention?		
FP-4.1	7/14/2021	1	Assure that appropriate coverage is provided in the stair, typical all levels of all stairs.		
FP-4.1	7/19/2021	2	Is riser permitted in mechanical room, versus stair enclosure?		
FP-4.2	7/14/2021	1	Please clarify what type of clean agent system is required.		
FP-4.2	7/14/2021	2	Sprinkler lines are not permitted over the top of electrical switchgear.		
FP-4.2	7/19/2021	2	FP narrative says that IT room has both wet sprinklers (with high temperature heads) and clean agent system, but no sprinklers are indicated.		
FP-4.2	7/19/2021	4	Does hoistway require sprinklers?		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
FP-4.4	7/19/2021	1	Standpipes/hose valves for stage have not been indicated.		
FP-4.5	7/26/2021	1	Show air compressors required for dry systems.		
FP-4.6	7/19/2021	1	Does hoistway require sprinklers?		
FP-4.6	7/19/2021	2	Indicate FDC at this location.		
FP-4.8	7/19/2021	1	Does hoistway require sprinklers?		
FP-4.14	7/19/2021	1	Should sprinklers in this space be fed from a level 2 ZCV?		
FP-4.17	7/19/2021	1	Does hoistway require sprinklers?		

Plumbing Peer Review Comment Sheet

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Project Name: Doherty Memorial High School
BVH Project Number: 21-20-180
Drawing Set: 60% CD
Drawing Date: 7/8/2021

Review Date: 7/29/21
Reviewer: JBA / DSM

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
P2.1	7/20/2021	1	No piping connections indicated for FD-6		
P2.3	7/19/2021	1	Coordinate with site drawings, which show two gas/sand traps.		
P2.3	7/20/2021	2	Does any buried grease waste piping require heat tracing to keep grease from congealing?		
P2.3	7/20/2021	3	Mechanical room needs floor drains (with trap primers); coordination locations with mechanical.		
P2.3	7/20/2021	4	Consider a floor drain for recycle/trash room.		
P2.3	7/21/2021	5	Consider using acid waste running under boiler room for acid waste drains from condensing boilers and domestic water heaters, rather than local acid neutralizing tanks.		
P2.4	7/20/2021	1	Consider walk-off mat in depressed slab with floor drain at main entries, typical.		
P3.1	7/27/2021	1	Coordinate with mechanical and provide appropriate drainage for condensate pans at chilled beams, fan-powered VAV boxes, and fan coil units, typical all plans.		
P3.2	7/20/2021	1	Coordinate storm piping with structure and ceiling heights.		
P3.5	7/20/2021	1	Does any piping near garage door openings require heat tracing for freeze protection?		
P3.5	7/20/2021	2	Consider hose bibb and floor drain in recycle/trash.		
P3.5	7/20/2021	3	Is this C.O. above cooler accessible?		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
P3.5	7/20/2021	4	Please explain concept of installing triplex booster pump downstream of pressure reducing valves. If pressure needs boosting, then why does it need reducing first? If city water is over 80 psi (downstream of RPZ), it be appropriate to have PRV for lower floors, but not upper floors. Should there be separate low zone and high zone systems?		
P3.5	7/20/2021	5	There does not appear to be any 5" AW at this location.		
P3.6	7/20/2021	1	Is gas supply required to any kitchen appliances?		
P3.8	7/20/2021	1	Assure that storm drainage location is coordinated with structural braced frames, typical.		
P3.8	7/20/2021	2	What is purpose of BWV at 2nd floor ceiling, especially for overflow drainage, which discharges above grade?		
P3.9	7/20/2021	1	If this room is not heated, does any of this piping need heat-tracing for freeze protection?		
P3.12	7/20/2021	1	Recommend roof drains be tagged at roof level, as well as floor below, typical.		
P4.5	7/20/2021	1	Recommend domestic water heater boilers be tagged as DWH-1 & DWH-2, to avoid confusion with heating boilers HWB-1, 2 & 3 (which need tags).		
P4.5	7/20/2021	2	Verify that heating boilers will operate with only 8" WC gas pressure, and do not require 14" WC.		
P4.5	7/20/2021	3	Specify required capacities for gas meters.		
P4.5	7/20/2021	4	Do condensate drains from heating boilers and stacks, and piping through acid neutralizing tanks need to be specified here for work by plumber?		
P4.5	7/20/2021	5	Provide DCW make-up connection with RPZ backflow prevention (and meter?) to heating water system.		
P4.6	7/19/2021	1	No gas piping is shown.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
P4.6	7/20/2021	2	Why both interior and exterior grease interceptors? Interior units are troublesome to clean/service; avoid if possible.		
P4.6	7/20/2021	3	Does dishwasher or triple-compartment sink require 140 degF hot water?		
P4.7	7/21/2021	1	Why both interior and exterior grease interceptors? Interior units are troublesome to clean/service; avoid if possible.		
P4.7	7/21/2021	2	Sizes and arrangement not consistent with plans.		
P4.7	7/21/2021	3	35 psig seems low for 100 ft tall building.		
P4.7	7/21/2021	4	Is this also applicable to make-up for chilled water system?		
P4.8	7/21/2021	1	Not consistent with plan on P4.5 or detail at left, which show only a single regulator.		
P4.8	7/21/2021	2	Does utility distribution system require gas connection?		
P4.8	7/21/2021	3	Do tilting skillets require gas connections?		
P4.8	7/21/2021	4	If this information is used by gas company for service sizing, then it should also include the generators.		
P4.9	7/21/2021	1	If a refrigerated or desiccant air dryer is also being furnished, then detail should include piping for it.		
P4.9	7/21/2021	2	Detail should also include piping from bottom (drain) on flue pipe.		
P4.9	7/21/2021	3	Note that laboratory acid waste drainage line going to central acid neutralization, runs directly under the boiler room, and could be used for the boiler/water heater drainage without the local acid neutralizing kits		
P4.10	7/21/2021	1	Coordinate with structural; they show elevator pit, but not 84" deep sump basin installation.		
P4.11	7/20/2021	1	Sump pump SP-1 not scheduled.		
P4.11	7/20/2021	2	Recommend that all electric heat tracing be scheduled.		
P4.11	7/20/2021	3	Could not finds on plans where EWH-1 is located.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
P4.11	7/20/2021	4	Recommend that IMB-1 be scheduled and/or specified.		
P4.11	7/21/2021	5	Clarify make/model of pumps shipped with boilers.		
P4.11	7/21/2021	6	Please verify size/capacity for entire building.		
P4.11	7/21/2021	7	Not consistent with notes on P4.8, which requires welded fittings for 2 psig gas.		
P4.11	7/21/2021	8	Not consistent with detail on P4.10. Also should say "triplex."		

Mechanical Peer Review Comment Sheet

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Project Name: Doherty Memorial High School
BVH Project Number: 21-20-180
Drawing Set: 60% CD
Drawing Date: 7/8/2021

Review Date: 7/29/21
Reviewer: JBA / DSM

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Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
H3.1	7/20/2021	1	Assure that appropriately configured plenum is provided at louver connection.		
H3.1	7/21/2021	2	Ceiling chilled beams have not been scheduled.		
H3.1	7/21/2021	3	Fan-powered VAV system shown here, but piping plan seems to imply a VRF system.		
H3.1	7/21/2021	4	Plans need thermostats, CO2 sensors and occupancy sensors indicated. Typical of all floor plans.		
H3.1	7/21/2021	5	No FCUs have been scheduled.		
H3.1	7/27/2021	6	General - there are many notes, tags, sizes, etc. missing from several HVAC drawings. We assume these will be completed for the final drawings.		
H3.1	7/27/2021	7	Provide HVAC symbol list, abbreviations, and general notes.		
H3.1	7/27/2021	8	Recommend provide schematic airflow/riser diagrams with required supply, return and exhaust airflows at each level for each system.		
H3.2	7/27/2021	1	What is HVAC service for this room?		
H3.2	7/27/2021	2	CRAC units have not been scheduled.		
H3.2	7/27/2021	3	Assuming CRAC units are split DX, where are condensers located?		
H3.2	7/27/2021	4	Provide elevator machine room exhaust.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
H3.3	7/27/2021	1	Educational occupancies typically require division of large floor plates into multiple smoke compartment. Coordinate location of smoke barriers with architect, and provide smoke dampers with duct smoke detectors at ducts that cross smoke barriers as required. Typical all areas.		
H3.3	7/27/2021	2	Please indicate duct size up.		
H3.3	7/27/2021	3	What is HVAC service to IDF room? Typical of all IDF rooms throughout the building.		
H3.4	7/27/2021	1	Are any additional measures being implemented to provision for pandemic protocols at clinic spaces, such as higher air change rates, additional filtration, additional exhaust, UV disinfectant lighting, etc.?		
H3.5	7/27/2021	1	Domestic water heater vents are bought on plumbing plans; please coordinate and clarify scope for which sub-contractor.		
H3.5	7/27/2021	2	No sizes or tags shown; will there be a separate large scale plan of mechanical room?		
H3.5	7/27/2021	3	Assuming these are exhaust fans, assure that appropriate outdoor air intakes are provided for makeup air to garage, typical.		
H3.6	7/27/2021	1	Coordinate location of refrigeration condensing units to assure that accommodations are made for rejected heat if they are air-cooled and indoors. Suggest locating in garage.		
H3.6	7/27/2021	2	Provide elevator machine room exhaust.		
H3.9	7/27/2021	1	Clarify where these ducts go, and to what unit.		
H3.9	7/27/2021	2	Coordinate rated chase for boiler vents.		
H3.9	7/27/2021	3	Detailing of stairwell pressurization systems needs to be completed, typical all stairs/levels.		
H3.10	7/27/2021	1	Where is ductwork up to MAU-1?		
H3.11	7/27/2021	1	Please indicate duct sizes up and down.		
H3.13	7/27/2021	1	Coordinate location of ducts to not interfere with required clearance/working space for electrical rooms; typical all electrical rooms.		
H3.13	7/27/2021	2	Clarify where these ducts go, and to what unit.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
H3.13	7/27/2021	3	Show boiler vents through roof, and appropriate terminations.		
H3.14	7/27/2021	1	Clarify where these ducts go, and to what unit.		
H3.14	7/27/2021	2	MAU-1 has not been scheduled.		
H3.16	7/27/2021	1	Clarify where these ducts go, and to what unit.		
H3.17	7/27/2021	1	Clarify where these ducts go, and to what unit.		
H3.18	7/27/2021	1	Coordinate with plumbing to assure that all vents through roof are outside of these 25 foot circles.		
H3.20	7/27/2021	1	MAU-1 has not been scheduled.		
H4.1	7/21/2021	1	Major elements of distribution are missing, making a suitable review difficult. There does not appear to be any CHW distribution shown. No piping is shown to boilers and chillers, heat exchangers are not shown, etc. Typical of all piping floor plans.		
H4.1	7/21/2021	2	Seems to imply VRF system, but duct plans show a fan-powered VAV system.		
H4.1	7/27/2021	3	Final plans need to appropriately annotate refrigerant piping, branch selector boxes, etc.; typical all piping drawings.		
H4.1	7/27/2021	4	Hot water coils have not been scheduled.		
H4.1	7/27/2021	5	Do stairwells and exit doors have cabinet unit heaters, typical? None have been scheduled.		
H4.1	7/27/2021	6	Coordinate with plumbing and provide appropriate drainage for condensate pans at chilled beams, fan-powered VAV boxes, RTUs and fan coil units, typical all plans.		
H4.1	7/27/2021	7	Clarify whether grille at window sill is by HVAC or part of architectural enclosure, typical.		
H4.1	7/27/2021	8	Assure that displacement chilled beam unit and millwork has appropriate toe space for circulation to baseboard heating, typical.		
H4.1	7/27/2021	9	Assure that millwork allows for appropriate service access to baseboard piping/controls, typical.		
H4.1	7/27/2021	10	Recommend provide schematic/riser flow diagrams for each piping system.		
H4.5	7/27/2021	1	Recommend to provide a large scale detail plan of this mechanical room.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
H4.5	7/27/2021	2	Show distribution to unit heaters, typical.		
H4.12	7/27/2021	1	Complete refrigeration piping to ACHPs, typical.		
H4.14	7/27/2021	1	No gas piping shown to MAU-1.		
H5.1	7/27/2021	1	To avoid excess noise at outlet, recommend that manual volume damper be located at branch take-off from main.		
H5.1	7/27/2021	2	Consider using pressure independent control valves (PICV), and then balancing valve can be eliminated. With stacked coils served from a single PICV, still need manual balancing valve at each coil to equalize flow.		
H5.1	7/27/2021	3	Also provide detail for stacked coils if applicable.		
H5.1	7/27/2021	4	Provide details for chilled water piping to chilled beams, FCUs and FVAV units.		
H5.2	7/27/2021	1	Clarify on plans where this is applicable.		
H6.1	7/27/2021	1	Where is this applicable? Did not see ERV's on plans or schedules.		
H6.1	7/27/2021	2	Need detail for FVAV unit (with sensible cooling coil). Also include how primary air from DOAS is controlled.		
H6.1	7/27/2021	3	Missing control for displacement chilled beam unit. Include control from primary air from DOAS.		
H6.1	7/27/2021	4	Missing control for ceiling chilled beam unit. Include control for primary air from DOAS.		
H6.1	7/27/2021	5	Missing control for HWC.		
H6.1	7/27/2021	6	Clarify where occupancy sensor is by ATC, or using relay output from lighting control (coordinate with electrical), typical all zone controls.		
H6.1	7/27/2021	7	Clarify 2-position or modulating control for perimeter radiation.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
H6.2	7/27/2021	1	Unless a separate schematic flow/riser diagram is provided with the information, suggest that flowrates and temperatures be added at each pump and piece of equipment. Also indicated which pumps are run/standby, and if there are specific equipment/pumps which are expected to operate only in summer or winter. This will help immensely for the engineer of record, all reviewers, and the Owner to understand how the system is expected to operate.		
H6.2	7/27/2021	2	Clarify different flow rates and temperatures for only heat recovery mode, versus heat pump mode.		
H6.2	7/27/2021	3	Indicate separate 44 degF CHWS distribution to FCUs.		
H6.2	7/27/2021	4	These loops to chilled beams in pods require a 3-way mixing valve to generate 57 degF CHWS.		
H6.2	7/27/2021	5	Consider eliminating CHW cooling to FCUs for electrical rooms and cool with only DX. This would allow chillers to operate more efficiently to produce 55 degF glycol CHWS to heat exchanger, eliminate the separate 44 degF distribution, HX-2 would operate at 57 degF outlet and eliminate the separate mixing/pumping loops for the pods.		
H6.2	7/27/2021	6	If each pod requires only 80 gpm at 5.6 deg delta-T, then these pumps only need to flow 130-150 gpm (plus whatever the FCUs require) at 12-14 delta-T at the HX.		
H6.2	7/27/2021	7	If flow at chiller is 284 gpm (correct for 150 tons of 30% glycol at 14 deg delta-T), then why provide 3 pumps at 284 gpm each? It should be 1-run/1-standby at 284 gpm, or 2-run in parallel for a total of 284 gpm.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
H6.2	7/27/2021	8	Consider discharging heat recovery hot water to preheat domestic hot water, rather than heating loop, in order to maximize heat recovery during cooling season. Could provide heat exchangers for both heating hot water and domestic hot water, piped in series so that load is take to either one that has any demand.		
H6.2	7/27/2021	9	Chiller schedule indicates 212 gpm of HW flow during full heat recovery (with 150T cooling load), or only 100 gpm of HW flow during heat pump mode; why specify 401 gpm pumps?		
H6.2	7/27/2021	10	Consider 2-run/1-standby pumps, rather than 3-run/1-standby, as too many pumps in parallel tends to be less efficient operation.		
H6.2	7/27/2021	11	Pot feeder should be piped across suction and discharge of pumps to assure flow through pot.		
H6.2	7/27/2021	12	Unless buffer tanks also function as expansion tanks, need expansion tanks on the glycol chilled and hot water loops on the primary (chiller) side of HX-2 & HX-3.		
H6.2	7/27/2021	13	Recommend clarifying by stating specifically HX-1.		
H6.2	7/27/2021	14	Recommend clarifying by stating specifically HX-2.		
H6.3	7/27/2021	1	Should this be RTU-11		
H6.3	7/27/2021	2	Should this be RTU-18?		
H6.4	7/27/2021	1	Clarify by labeling with FC #, typical for all VRF systems.		
H6.4	7/27/2021	2	Also need to specify how primary air from DOAS is controlled (occupancy, CO2 etc.)		
H6.4	7/27/2021	3	Clarify what interface to BAS is required.		
H6.4	7/27/2021	4	"VARIABLE" typical.		
H6.5	7/27/2021	1	Need to complete tag number, to make it clear which model is used where, typical.		
H6.5	7/27/2021	2	Need to include model number, typical.		
H6.5	7/27/2021	3	Clarify which of these units (for admin area) has heat recovery capability.		
H6.5	7/27/2021	4	Specify heating capacity at what outdoor temperature, typical.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
H6.5	7/27/2021	5	Complete missing information, typical.		
H7.1	7/21/2021	1	Please include a column indicating area(s) served by each unit, and type of system (chilled beams, VRF, VAV, FVAV, etc.).		
H7.1	7/21/2021	2	Please complete airflow CFM.		
H7.1	7/21/2021	3	Also provide OA wet bulb temperatures.		
H7.1	7/21/2021	4	Need to indicate exhaust air DB/WB to specify proper wheel performance.		
H7.1	7/21/2021	5	Please clarify if this is leaving wheel condition, rather than mixed air. Mixed air would only be appropriate for units with return air.		
H7.1	7/21/2021	6	Should this be 0 CFM return airflow?		
H7.1	7/21/2021	7	Please coordinate condensing units with current ACHP tags.		
H7.1	7/21/2021	8	Confusing as to what these columns represent.		
H7.1	7/21/2021	9	Please complete MCA and MOP columns.		
H7.1	7/21/2021	10	Please verify rows and FPI; it seems odd that they are all the same.		
H7.1	7/21/2021	11	Clarify if there is a separate VFD for each motor, or a single VFD for multiple fan arrays.		
H7.1	7/21/2021	12	Clarify multiple or single point power connection for units 11, 18 & 19.		
H7.1	7/21/2021	13	Coordinate with schedule indicating Haakon as basis of design.		
H7.1	7/21/2021	14	Clarify if single point power connection also includes transformer and 120V power for lights/receptacles, or if that is separate electrical feed.		
H7.1	7/21/2021	15	Minimum what?		
H7.1	7/21/2021	16	Clarify intent of this column; all units appear to have 2 modules.		
H7.1	7/21/2021	17	Recommend specify unit at 480V, 3-phase.		
H7.1	7/21/2021	18	Need to specify D/X and hot water heating coil performance.		
H7.1	7/21/2021	19	Please complete all exhaust SP requirements.		
H7.1	7/21/2021	20	Complete Exhaust SP.		
H7.1	7/21/2021	21	Complete return air CFM		
H7.1	7/21/2021	22	Need to specify hot water coil performance.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
H7.1	7/21/2021	23	Coordinate ACHP tag numbers; not consistent with dwg H6.3.		
H7.1	7/21/2021	24	MCA and MOP seem high for only 5 and 1 HP fan motors.		
H7.1	7/21/2021	25	Should AHU-1 be indoor mounting?		
H7.1	7/21/2021	26	Shouldn't this unit be scheduled as matching outdoor unit to Valent AHU-1?		
H7.1	7/21/2021	27	Schedules are missing for: 1. CRAC units 2. MAU-1 3. Registers, grilles and diffusers 4. Blower coil units (if applicable) 5. Fan coil units (elec rooms) 6. HWCs		
H7.1	7/21/2021	28	If boiler discharge is 140 deg F, then outlet of HX cannot be more than 138 for EWT to coils.		
H7.1	7/27/2021	29	Recommend HW coils be selected for 30 degF delta-T to reduced require flowrates and pump sizes.		
H7.1	7/27/2021	30	Recommend that detail plan and section drawings be included for all RTUs, AHU-1 and MAU-1, indicating all sections, components, access doors, etc.		
H7.2	7/21/2021	1	This should be 44/58 from chiller.		
H7.2	7/21/2021	2	This cannot be much better than 2 degF of approach to primary (30% PG) side.		
H7.2	7/21/2021	3	Must be 130/110 to match output of chiller/heater.		
H7.2	7/21/2021	4	Cannot exceed 140 HWS temperature from boilers.		
H7.2	7/21/2021	5	These should be 30% PG		
H7.2	7/27/2021	6	Can this be ECM motor and controller?		
H7.2	7/27/2021	7	Is this available as ECM for 15 HP motors?		
H7.2	7/27/2021	8	See comments on H6.2, and verify appropriate GPM and head for each pump.		
H7.2	7/27/2021	9	Should this be "& P-10B?"		
H7.2	7/27/2021	10	Should this be 57 deg?		
H7.2	7/27/2021	11	Should this be "Indoor chilled water system, HX-2?"		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
H7.2	7/27/2021	12	For clarity, recommend configure schedule to indicate primary and secondary sides of HXs, and then indicate fluid, flows and temperatures for each side. Current arrangement can be confusing because glycol is not primary side for all three.		
H7.2	7/27/2021	13	Isn't all baseboard just water?		
H7.2	7/27/2021	14	Please clarify which is heat recovery mode from chilled water generation, and which is heat pump mode, making only hot water.		
H7.2	7/27/2021	15	Verify if this is available for heat pump type chillers.		
H7.3	7/27/2021	1	Coordinate temperatures in both schedule and notes, typical all FVAVs. Does this need to be 57 degF CHWS if using the same distribution that feeds the chilled beams?		
H7.3	7/27/2021	2	Complete for final drawings.		

Electrical Peer Review Comment Sheet

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BVH integrated services

The drawing review notes found below are for the above referenced project. General comments represent repeat issues that are not drawing or area specific. Specific comments listed below are referenced on the appropriate drawing with the reference number noted. The design engineer is asked to respond to the issues in the Engineer's Comment column to allow for the tracking of these items during future reviews. Please do not treat these comments as directives, just questions or suggestions.

Project Name: Doherty Memorial High School
BVH Project Number: 21-20-180
Drawing Set: 60% CD
Drawing Date: 7/8/2021

Review Date: 7/29/21
Reviewer: JBA / DSM

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Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
E0.3	7/26/2021	1	Need to schedule F1, F2, F3 & F4		
E0.4	7/26/2021	1	Is there any 120V convenience power required at selected poles?		
E0.4	7/26/2021	2	Are there any poles that require 120V power for security cameras or wifi?		
E0.5	7/26/2021	1	Exit signage missing.		
E0.5	7/26/2021	2	Provide power for lift.		
E0.5	7/27/2021	3	Is any fire alarm required in this building?		
E0.6	7/26/2021	1	Does this comply with utility requirements; do they want a vault, rather than a pad?		
E0.6	7/26/2021	2	Where is this detail applicable; clarify its use versus detail #1 on this page.		
E0.8	7/26/2021	1	Do any poles also require 120V power (separate raceway?) for convenience receptacle, wifi or security cameras?		
E0.10A	7/26/2021	1	Is lightning protection also required at structure next to football field, or sports lighting poles?		
E0.10A	7/27/2021	2	Recommend that grounding plan also be provided.		
E0.11	7/26/2021	1	Define size and quantity of all underground raceways this sheet and other underground conduit pathway drawings.		
E0.11	7/26/2021	2	Do all underground conduit pathway drawings also include raceways for technology systems?		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
E0.11	7/26/2021	3	Suggest provide typical section detail for depth of bury, bedding material, backfill, concrete encasement, etc. (and refer to plans for size/quantity).		
E0.11	7/26/2021	4	Shade key plan as appropriate for all conduit pathway drawings.		
E0.15	7/26/2021	1	Clarify meaning of dashed line box.		
E1.1	7/26/2021	1	Is another row of lighting appropriate in this room?		
E1.1	7/26/2021	2	Does code require that stairway lighting must have two different sources of power (2 different branches of power) for no single point of failure; typical all stair lighting?		
E1.2	7/26/2021	1	Is lighting needed in this area?		
E1.2	7/26/2021	2	Is any battery-powered emergency lighting required in this room?		
E1.4	7/26/2021	1	Is exterior lighting (including emergency) required at this exit?		
E1.5	7/26/2021	1	Is lighting required at generators?		
E1.5	7/26/2021	2	Is lighting required at dumpsters?		
E1.5	7/26/2021	3	Lighting missing in this area.		
E1.5	7/26/2021	4	Please provide appropriate emergency egress lighting in garage.		
E1.6	7/26/2021	1	Is battery-powered emergency lighting required in this room?		
E1.6	7/26/2021	2	Please provide appropriate emergency egress lighting in garage.		
E1.6	7/26/2021	3	Lighting missing from this area.		
E1.8	7/26/2021	1	Lighting missing from this area.		
E1.8	7/26/2021	2	Does access area require lighting at this level?		
E1.10	7/26/2021	1	Does this fixture need to be on emergency power?		
E1.12	7/26/2021	1	Is additional lighting required in this area?		
E1.14	7/26/2021	1	Provide service lighting at roof mechanical equipment as appropriate.		
E1.17	7/26/2021	1	Provide appropriate service lighting at rooftop mechanical equipment.		
E1.18	7/26/2021	1	Is additional lighting required in this area?		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
E2.1	7/26/2021	1	Provide appropriate convenience power in acid neutralization room.		
E2.1	7/27/2021	2	Recommend additional convenience receptacles in this corridor.		
E2.4	7/20/2021	1	Need power to heat tracing on plumbing drainage here.		
E2.4	7/27/2021	2	Are these at the ceiling of the stage? Should they show on another drawing?		
E2.4	7/27/2021	3	Should there be some convenience receptacles in the auditorium lobby?		
E2.4	7/27/2021	4	Is there a need for any floor boxes within the black box theater?		
E2.5	7/26/2021	1	Is there a compactor that requires power?		
E2.5	7/27/2021	2	Recommend convenience receptacles near generators.		
E2.5	7/27/2021	3	Is power needed for a gate?		
E2.5A	7/27/2021	1	Recommend kitchen panels be located on opposite (east) wall in "circulation" space, to decrease likelyhood of furniture being located in front of panels.		
E2.5A	7/27/2021	2	Office needs convenience power receptacles.		
E2.5B	7/27/2021	1	If cooler and blast chiller coils are on e-power, then associated condensing units must also be e-power.		
E2.5B	7/27/2021	2	Please complete these blank columns.		
E2.5C	7/27/2021	1	Coordinate equipment tags with 1-line diagram; not all match.		
E2.6	7/27/2021	1	Call out reference to large scale part plan.		
E2.6	7/27/2021	2	Recommend locating next to door in circulation space, to avoid storage in front of receptacle.		
E2.9	7/27/2021	1	Are any poke-through/floor boxes required for the possibility of electrified equipment in the middle of the room?		
E2.9	7/27/2021	2	Coordinate with architect if this wall needs additional furring for penetrations in 2-hour rated chase.		
E2.12	7/27/2021	1	Are any convenience receptacles required at catwalks?		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
E2.13	7/20/2021	1	Need power feed to lab hot water electric heat tracing, typical.		
E2.16	7/20/2021	1	Need power feed to lab hot water electric heat tracing, typical.		
E2.17	7/20/2021	1	Need power feed to lab hot water electric heat tracing, typical.		
E3.1	7/27/2021	1	Coordinate with mechanical to provide data drops at temperature control panels in locations required.		
E3.1	7/27/2021	2	Should these rooms have wifi?		
E3.1	7/27/2021	3	Are any cable trays required for low voltage cabling outside of main IT/Server rooms, or is all technology cabling run in J-hooks? Typical all technology plans.		
E3.4	7/27/2021	1	Is wifi required in this area?		
E3.5	7/27/2021	1	Is telephone and/or data drop required in this room?		
E3.8	7/27/2021	1	Is wifi required in this area?		
E3.10	7/27/2021	1	Is wifi required in gym?		
E3.12	7/27/2021	1	Is additional technology required in this area?		
E3.18	7/27/2021	1	Need to indicate power requirements within all IT rooms.		
E3.18	7/27/2021	2	Need to specify all interconnecting raceways and/or sleeves between IT rooms.		
E4.1	7/27/2021	1	Shade in key plans as appropriate for all E4.x drawings.		
E4.1	7/27/2021	2	Coordinate with fire protection and show all flow and tamper switches; typical all plans.		
E4.1	7/27/2021	3	Are additional AV devices required in this area?		
E4.1	7/27/2021	4	Coordinate with mechanical and show all required duct smoke detectors; typical all plans.		
E4.2	7/27/2021	1	Are any devices required in this room?		
E4.4	7/27/2021	1	Are alarm indicating devices required at this entry/exit, or elsewhere on the exterior of the building?		
E4.4	7/27/2021	2	Clarify what is this object.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
E4.4	7/27/2021	3	Recommend avoid using the term "by others" as can be interpreted as not in contract. Instead indicate by the division or trade contractor responsible for the work.		
E4.5	7/27/2021	1	Is any CO detection required for connection to FA system, or is it only to temperature control of ventilation system?		
E4.5	7/27/2021	2	Is any heat or rate of rise detection required in garage?		
E4.6	7/27/2021	1	Is smoke detection required in storage room?		
E4.6	7/27/2021	2	Is any CO detection required for connection to FA system, or is it only to temperature control of ventilation system?		
E4.6	7/27/2021	3	Is any heat or rate of rise detection required in garage?		
E4.8	7/27/2021	1	Is any detection or notification required in this area?		
E4.12	7/27/2021	1	Is any detection or notification required in this area?		
E4.12	7/27/2021	2	Are there specific requirements for smoke detection at the smoke vent openings? Do the smoke vents require power operation?		
E4.17	7/27/2021	1	Assure that all duct smoke detectors at or below rooftop mechanical equipment are indicated on plans.		
E5.1	7/27/2021	1	Shade in key plans as appropriate for all E5.x drawings.		
E5.1	7/27/2021	2	These E5.x series plans should also include power feeds to plumbing and fire protection equipment (dry system air compressor, water heaters, pumps, heat tracing, etc.)		
E5.1	7/27/2021	3	Final drawings should include a schedule of the all the PFP/HVAC equipment feeds, indicated panel, breaker, raceway/conductors and disconnect/starter/VFD.		
E5.1	7/27/2021	4	Assure that final drawings have all mechanical equipment tagged that requires power, typical all areas.		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
E5.16	7/27/2021	1	Coordinate with mechanical and verify if all equipment has a single point power connection, or separate feeds for different fans, etc.. Also verify whether there is a separate 120V power connection for lights and receptacles. Typical all equipment.		
E5.16	7/27/2021	2	Coordinate with mechanical and verify locations of smoke dampers that require power, typical all areas.		
E6.0	7/27/2021	1	We assume that final drawings will include significant additional information to clarify the scope.		
E6.1A	7/27/2021	1	Floor plans need to show locations of all inverters and enclosed circuit breakers, typical.		
E6.1B	7/27/2021	1	Floor plans need to show locations of all inverters and panelboards, typical.		
E6.1C	7/27/2021	1	Floor plan shows a transformer T-PV in main electric room, but not indicated on this 1-line.		
E6.1C	7/27/2021	2	Clarify location of this equipment, and also show on floor plans.		
E6.1C	7/27/2021	3	Verify this is 4-wire wye system and not 3-wire delta connection.		
E7.0	7/27/2021	1	Sample label should also include circuit number, typical all faceplates.		
E7.4	7/27/2021	1	Detail appears to not yet be complete.		
E7.6	7/27/2021	1	DX split systems sometimes get the indoor unit power fed directly from the outdoor unit. If this is applicable, has that power wiring covered elsewhere, or should it be part of this detail?		
E8.0A	7/26/2021	1	Consider MCB for non-emergency panels not in same room as source breaker (where selective coordination is not required); typical throughout distribution.		
E8.0A	7/26/2021	2	Tag seems to imply that this panel is part of legally required standby; should it be changed to better represent optional standby?		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
E8.0A	7/26/2021	3	Please coordinate AIC ratings (fed from 100 KAIC panel in same room); typical for all distribution.		
E8.0A	7/26/2021	4	This breaker indicated at 3000AF/2500AT on E8.0J.		
E8.0A	7/26/2021	5	Per LEED, all HVAC loads need to be separately metered; does multipoint metering in DP3D mean metering for each output breaker? Typical for all distribution to HVAC panels.		
E8.0A	7/26/2021	6	Clarify contractor scope (ductbank/raceways) vs. utility company scope (furnish and install primary conductors).		
E8.0A	7/26/2021	7	Please clarify utility metering requirements; none indicated.		
E8.0B	7/27/2021	1	If a VE alternate for aluminum feeders in larger sizes is being considered, suggest add an appropriate aluminum feeder schedule.		
E8.0D	7/27/2021	1	Where are items 2 and 3 applicable; none indicated?		
E8.0E	7/26/2021	1	Clarify if maintenance bypass is integral or external, and show appropriate connections if external.		
E8.0E	7/27/2021	2	Specify requirements for PDU (number, type/size of circuit breakers, etc.).		
E8.0H	7/26/2021	1	ATS tag missing.		
E8.0H	7/26/2021	2	Coordinate output feeder rating with input feeder sizes.		
E8.0H	7/26/2021	3	Is there any sub-distribution from legally required standby branch? What do these panels serve?		
E8.0H	7/27/2021	4	Coordinate equipment tags with plan on E2.5C; not all match.		
E8.0H	7/27/2021	5	Is a permanent load bank being provided? At a minimum, suggest that a breaker be provided in GPS for connection of a temporary load bank (for testing).		
E8.0J	7/27/2021	1	Coordinate frame and trip ratings with 1-line (indicates 2000AF/2000AT), and generator capacity (2 x 900A?)		

Page	Markup Date	#	BVH Comments	Engineer's Comments	BVH Back Check Comments
E8.0J	7/27/2021	2	Assure that appropriate load monitoring and automatic load shedding is specified, based on priorities for ATS's and SDL1.		
E8.2B	7/27/2021	1	Is a second remote annunciator required by the fire department at the east end of the building?		
E8.2B	7/27/2021	2	Is any fire alarm required at sports field building?		
E8.2B	7/27/2021	3	Assure that all nodes are also shown on floor plans, typical.		
E9.00	7/27/2021	1	Recommend that columns be added to specify CRI and color temperature for every fixture.		
E9.00	7/27/2021	2	Drawings E8.3D does not exist.		
E9.01	7/27/2021	1	Complete all panel schedules for final drawings, typical.		
E9.01	7/27/2021	2	Clarify panel rating versus main circuit breaker rating. Indicate MLO if there is no MCB, typical.		
E9.01	7/27/2021	3	Recommend that AIC rating be included on panel schedules, as well as 1-line, typical.		
E9.04	7/26/2021	1	Typical for all "emergency" lighting panels (ELxx) - These panels are fed from required standby ATS/distribution, rather than life safety branch.		
E9.18	7/27/2021	1	Should branch circuits from PDU at UPS be scheduled?		

6B.2 OPM DELIVERABLES

6B.2.1 Submittal Review & Coordination

D. District Response to MSBA DD Comments

Updated January 2021

APPENDIX 6A
MODULE 6 – DESIGN DEVELOPMENT REVIEW COMMENTS

This document has been updated by LPA|A with comments for the purpose of preparing a coordinated response from the District, OPM and LPA. District responses to specific MSBA comments are in red with 10-point Gothic A1 Light font.

District: *City of Worcester*
School: *Doherty High School*
Owner's Project Manager: *AECOM Tishman*
Designer Firm: *Lamoreaux Pagano Associates*
Submittal Received Date: *March 25, 2021*
Review Date: *March 25—April 13, 2021*
Reviewed by: *Gienapp Architects, K. Brown, Z. Pekelis and R. Hudson*
MSBA REVIEW COMMENTS

The following comments[1] on the Design Development submittal are issued pursuant to a project submittal review document for the proposed project and presented as a Design Development submission in accordance with the MSBA Module 6 Guidelines.

The PFA was executed on January 19, 2021.

Per the MSBA's letter to the City dated April 7, 2021, the MSBA has placed reimbursements for the Project on hold at this time because of the pending litigation related to the Project. If the City decides to proceed with the Project, the MSBA has agreed to continue to monitor the Project on a limited basis at this time. The MSBA is providing the City with its review comments on the Design Development submittal and notes that the Commissioning Consultant assigned to this Project has reviewed and issued comments as well. Neither the MSBA's and/or the Commissioning Consultant's receipt of the submittal nor the MSBA's and/or the Commissioning Consultant's transmittal of review comments to the City, however, shall be construed as an approval or endorsement of the City's decision to proceed with the Project while litigation is pending. The MSBA's comments reflect the MSBA's review of the documents submitted by the City and nothing more. Further, the City is proceeding at its own risk by incurring project costs while the litigation is pending, as MSBA reimbursement for these costs is tied to the disposition of the pending litigation.

The items listed below are to be included in each project submittal by the design team (OPM and Designer) to the extent that each item applies to the project, or the design team should include an explanation why an item doesn't apply. The project submittal may be rejected by MSBA if all items below are not fully addressed by the project team. Unless specifically stated otherwise in the review comments below, the OPM and Designer deliverables are included in the submission with no further comment from MSBA required.

6A.1 Summary Comments

•	Basic Project Information	
	○ Enrollment (describe grade configuration, design enrollment and number of PK students if applicable)	*1,670 students, grades 9-12*

[1] The written comments provided by the MSBA are solely for purposes of determining whether the submittal documents, analysis process, proposed planning concept and any other design documents submitted for MSBA review appear consistent with the MSBA's guidelines and requirements, and are not for the purpose of determining whether the proposed design and its process may meet any legal requirements imposed by federal, state or local law, including, but not limited to, zoning ordinances and by-laws, environmental regulations, building codes, sanitary codes, safety codes and public procurement laws or for the purpose of determining whether the proposed design and process meet any applicable professional standard of care or any other standard of care. Project Designers are obligated to implement detailed planning and technical review procedures to effect design criteria coordination, buildability, and technical adequacy of project concepts. Each city, town and regional school district shall be solely responsible for ensuring that its project development concepts comply with all applicable federal, state, and local law provisions. The MSBA recommends that each city, town and regional school district have its legal counsel review its development process and subsequent bid documents to ensure that it is in compliance with all provisions of federal, state and local law, prior to bidding. The MSBA shall not be responsible for any legal fees or costs of any kind that may be incurred by a city, town or regional school district in relation to MSBA requirements or the preparation and review of the project's planning process or plans and specifications.

	○ GSF area (describe approved GSF in the Project Funding Agreement and as currently proposed)	*PFA 421,858 GSF, DD Current 424,600 GSF*
	○ Project Type (all new, add/reno, reno)	*New construction*
	○ Delivery method (DBB, CMR). If CMR, describe contract status	*CMR*

- Project Budget Compliance:
  - The Project Funding Agreement ("PFA") has total project budget of $293,384,178. The submittal notes that the current total project budget is $293,234,808, and is within budget.
  - The PFA has an estimated construction cost of $238,910,676. The submittal notes that the OPM's current reconciled estimated construction cost is $238,895,657, and is within budget.
  - The (OPM/CMR)'s current construction cost estimate is $243,985,679 by (Fontaine + Dimeo). The Designer's current construction cost estimate is $238,895,657 by (AM Fogarty). It is noted that the Designer's current construction cost estimate is carried over to the OPM's current reconciled estimated construction cost, even though it is lower than the (OPM/CMR)'s current construction cost estimate. Please explain the reason in the response to these comments.

6A.2 OPM Deliverables:

	6A.2.1 OPM Submittal Review & Coordination	Comments
•	OPM's written Designer submission review, with recommendations to the Owner for one of the following (choose one):	
	☑ OPM approves the submission ☐ OPM approves the submission partially; reject remainder ☐ OPM rejects the submission ☐ OPM requires additional supporting information	
•	Coordinate design; include written recommendations to the Owner. Address each of the following items individually, and describe how the OPM evaluated each item.	
	○ Technical accuracy, coordination, & clarity	
	○ Efficiency & cost effectiveness	*Not explicitly addressed. Please address this in the next submission.* District Response: This will be addressed in the 60% CD Submission
	○ Operability	
	○ Constructability	
	○ Phasing	
	○ Bid ability	
	○ Site access during construction	
•	Coordinate Commissioning consultant's review.	
	○ Describe the commissioning consultant's review status.	*While the review itself has been included, there is no accompanying narrative describing the review's status. Provide additional information with the response to these comments.*

		District Response: The Commissioning Consultant has reviewed the 100% DD Drawings and Specifications and has provided review comments, which were included in Section 6A2.1.C of the DD binder.
	○ Include a copy of the commissioning consultant's review & project team's response to each item.	*The Commissioning Consultant's peer review is included; however, the project team has not responded to any of the comments provided. With the response to these comments, indicate when and how the project team will respond.* District Response: The design team has reviewed and implemented changes based on the Commissioning Consultant's Design Development Review comments. A copy of the responses to the Commissioning Consultant comments is included in this District Response and will also be included in the 60% CD submission.
	○ Describe the consideration and incorporation of commissioning consultant's recommendations into the current submittal.	*Not included. See note above.* District Response: The design team has reviewed and implemented changes based on the Commissioning Consultant's Design Development Review comments. A copy of the responses to the Commissioning Consultant comments is included in this District Response and will be included in the 60% CD submission.
•	Coordinate the District response to the MSBA comments of previous submittals.	
	○ Include a copy of the previous MSBA review & District response, including any supplemental submittals and reviews.	
	○ Provide documentation of comments addressed and comment resolution outstanding.	

	6A.2.2 Project Schedule	Comments
•	The OPM is responsible to submit a project schedule that conforms to the following requirements, whether the schedule is produced by the OPM or the CMR (if applicable). A schedule that is limited to construction tasks is not acceptable and will be rejected. All schedules should be presented in calendar days.	
•	Update project schedule: At a minimum, the schedule update should provide the same level of detail as was included in Exhibit C of the Project Funding Agreement, expanded and updated to include milestones for Design Development, Bidding, Construction, and Closeout. The updated schedule should include proposed critical path and construction milestone information. In addition to the construction milestones, the schedule must also include the following information as listed in MSBA Module 7, Schedule Activities:	

	○ Punch list start and end dates	
	○ Project Registration date with the US Green Building Council ("USGBC") or Collaboration for High Performance Schools ("CHPS")	
	○ Provisional/Design package submittal date to USGBC or CHPS	
	○ MSBA 50% DCAMM Notification submittal date and MSBA 100% DCAMM Standard Contractor Evaluation Form notification date	
	○ General Contractor/Construction Manager request for final payment	
	○ Commissioning Consultant inspection (substantial completion plus approximately 10 months)	
	○ Final Commissioning report to MSBA submittal date	
	○ Final Construction package to USGBC/CHPS including the Final Commissioning Report submittal date	
	○ Anticipated final Green School Program Certification letter from USGBC/CHPS issuance date	
	○ Commissioning Certificate of Completion submittal date to MSBA	
	○ Final reimbursement request submittal date to MSBA	
•	Include application submission and approval dates in the project schedule for the following approvals, coordinated with the Designer's submittal information. In addition, provide dates for any other state or federal approval not listed below (the following list is not a comprehensive itemization of required state approvals; other requirements may apply, and some items listed below might not be applicable to this project) Indicate "Non-Applicable" on the project schedule where appropriate.	*None of these items are listed on the Project Schedule. Please include all the items listed below on the Project Schedule in the next submission. Acknowledge in the response to this review.* District Response: Acknowledged.
	○ DESE - Special Education approval by Department of Elementary and Secondary Education	*See note*
	○ MHC – Project Notification Form and approvals by MA Historical Commission	*See note*
	○ OIG - Construction Manager at Risk approval by the Office of Inspector General	*See note*
	○ Executive Office of Energy and Environmental Affairs / EEA:	*See note*
	▪ MEPA - MA Environmental Policy Act by Energy & Environmental Affairs:	
	• ENF - Environmental Notification Form	*See note*
	• EIR - Environmental Impact Report	*See note*
	▪ Article 97 Land Disposition Policy approval by Energy & Environmental Affairs	*See note*
	○ MA DEP - Massachusetts Department of Environmental Protection	*See note*
	○ MA DOT - Massachusetts Department of Transportation	*See note*
	○ MA DPH - Massachusetts Department of Public Health	*See note*

	○ EPA –NPDES National Pollutant Discharge Elimination System Notice of Intent approval by the US Environmental Protection Agency	*See note*
	○ MAAB - Accessibility variances by MA Architectural Access Board	*See note*
•	Indicate all required state reviews or permits on the milestone schedule including actual or planned approval dates which are required in order to maintain the planned bidding and construction schedule and milestones indicated therein. For required state reviews or permits which have not been obtained on schedule, provide a separate (subnetwork) schedule depicting recovery actions to obtain required approvals in order to maintain the bidding and construction schedule.	*Not included. No reviews or permits are included in this project schedule. These should be included in the project schedule in the next submission. Acknowledge in the response to this review.* District Response: Acknowledged.
•	The schedule is to be updated and submitted to the MSBA with each OPM monthly report and as often as it is required to reflect any changes, including any changes to milestone dates, but must be submitted with each design submittal (DD, 60% CD, 90% CD). The schedule shall reflect any variances in the updated schedule relative to the baseline project schedule include with the Project Scope and Budget Agreement.	
•	Indicate the Design Development submission date to the MSBA and proposed 60% and 90% Construction Documents submittals submission dates. The schedule is to incorporate 21 calendar day required duration for the MSBA review of each submission, and a minimum 14 calendar days for the project team incorporation of the MSBA review comments as well as all others into the project documents prior to the next submission or finalizing project documents to make available to bidders. 35 calendar days between each MSBA design submission (DD, 60%, 90%) is the minimum acceptable duration; if the project team believes additional time is required for any or all the submissions the durations for these activities are to be increased accordingly.	*The project schedule includes submission dates for 100% DD, 60% CD, and 90% CD to the MSBA. However, the submission does not include a line item for the required 21 calendar day period to incorporate MSBA's review, or the 14 calendar days for the project team's incorporation of the MSBA's comments. There appears to be sufficient time for these required periods; however, they are not specifically identified. Please include these items in the next project schedule.* District Response: These items will be included in the project schedule for the 60% CD submission.

	6A.2.3 Project Scope and Budget	Comments
•	Develop project scope and budget, cost estimates and reconciliation:	
	○ OPM construction cost estimate using the Uniformat II Classification to Level 3, Showing unit rates and quantities; with escalation projected to the mid-point of construction; AND	
	○ OPM construction cost estimate using CSI MasterFormat 6-digit format to Level 3 and MGL c.149 s 44F (filed sub-bid) format showing unit rates and quantities; with escalation projected to the mid-point of construction.	
	○ OPM reconciliation of the OPM/CMR and Designer construction cost estimates including a description of the method to derive this reconciliation. Refer to this	

	link for an example of the Cost Estimate Reconciliation Form.	
	○ Updated Cost Estimate Comparison Form. Refer to this link for an example of the Cost Estimate Comparison Form.	
•	CMR (if applicable)	
	○ If the Owner has not yet contracted with a Construction Manager (CM), the OPM must develop a construction cost estimate as described above for comparison with the Designer's cost estimate.	
	○ If the Owner has given the CM a Notice to Proceed, the OPM must review cost estimates provided by the Designer and CM and provide a Designer's and CM's construction cost estimates reconciliation as described above.	
•	Updated project budget in the total project budget format, based on the reconciled construction cost estimate. If the reconciled estimate is not used for the updated project budget, provide an explanation.	
•	Describe any early-bid packages anticipated scope and schedule. Include any early-bid packages (if applicable) in the submittal to show a complete project. Provide bid tables for a completed sub-bid package.	
•	Value Engineering Recommendations (if any)	
	○ Provide the list of potential and accepted Value Engineering recommendations, and associated costs of each item.	*Included. It is unclear if these items have only been recommended, or if any have been accepted. Please clarify in the response to these comments.* District Response: These VE recommendations are for consideration at later phases, and were not required or accepted as of the DD Submission.
	○ Provide a copy of the Committee vote for any accepted Value Engineering recommendations.	*None provided. If no Value Engineering recommendations have been accepted, this is not applicable. (See note above.)*

6A.3 Designer Deliverables

	6A.3.1 General Requirements	Comments
•	Submit an updated work plan.	
•	Basis of Design narrative description for each of the following disciplines:	
	○ Architecture	
	○ Structural: narrative must include lateral bracing methods and how earthquake code requirements will be met	
	○ Civil	
	○ MEP + FP	
	○ Data/Comms./Security	
•	Building Code Analysis	
•	Provide a list of proprietary items under consideration.	

•	An interior color theory statement describing proposed paint and material selections and colors for typical and special spaces, why they have been selected and how these selections relate to exterior materials and colors. Confirm that color and material selections have been presented to and approved by the District.	
•	Confirm project registration with CHPS/USGBC.	
•	Structural calculations and required floor loads	
•	Energy model calculations	*The submission states that "the Green Engineer is currently compiling a DD level energy model…. the resultant calculations and report will be complete in April 2021." Please include this in the next submission.* District Response: A copy of the Design Development Energy Model Report is included in the District Response to these comments.
•	Life Cycle cost analysis for energy and water consuming devices	
•	Heat gain and loss calculations for Heating, Ventilating and Air Conditioning systems	
•	Calculations showing total electrical load	
•	Security and Visual access requirements:	
	○ Confirmation that the persons responsible for District's emergency procedures implementation, and responding emergency medical, fire protection, and police agency representatives have been consulted in the planning process and any associated requirements have been included in this project.	*The submission confirms that the Worcester Police Department have been consulted in the planning process but does not address if fire protection or emergency medical personnel have been contacted as part of the design process. Please address this in the response to this review, and include the information required in next submission.* District Response: The Worcester Fire Department has been consulted in the development of this project refer to the meeting minutes included in Section 6A3.1.M1 and 3, outlining the discussions that took place with Worcester Fire Department and Building Department representatives.
	○ Identify any other security related items particular to the District and/or the proposed project.	
	○ Verification that the following safety and security related issues have been reviewed and are in accordance with the Districts procedures as noted above:	
	▪ Main entrance design – describe District protocol for visitor entry and check-in related to the current design for visitors to remain in the vestibule versus a side sub-vestibule.	
	▪ Classroom lockset hardware - confirm hardware functions are compatible with the District's protocols related to lockdown.	
	▪ Classroom / Instructional spaces visibility - confirm that the inclusion of sidelights at entrance locations is compatible with the	

	District's current standards related to visibility from corridors and whether any related vision control option measures are to be incorporated.	
	▪ Alternative entry locations - confirm project includes site and building signage, as may be required by District's emergency procedures, to identify locations where first responders may more directly reach a person needing medical attention; Knox Boxes; Fire Alarm Control Panels, and provisions for building plans to be delivered to local fire and response agencies.	
•	Facility and Maintenance requirements:	
	○ Confirmation that the persons responsible for maintenance have been consulted in the planning process and any associated requirements have been considered for this project. Describe maintenance related items particular to the District and/or the proposed project.	
	○ Verification that at a minimum the following issues have been reviewed:	
	▪ Training hours and scheduling	*Not included in this submission. Please address this in the response to this review, and include the information required in next submission.* District Response: This item will be included in the 60% CD submission
	▪ HVAC systems	
	▪ Building Management Systems	*Not included in this submission. Please address this in the response to this review, and include the information required in next submission.* District Response: This item will be included in the 60% CD submission
	▪ Lighting fixtures and controls	
	▪ Cleaning procedures and materials	*Not included in this submission. Please address this in the response to this review, and include the information required in next submission.* District Response: This item will be included in the 60% CD submission.
	▪ Roof access	
	▪ Mechanical room access	
•	Quality Control narratives, supporting plans and documents demonstrating:	
	○ Ceiling clearances	
	○ Mechanical room and shaft sizes	
	○ Coordinate specifications and drawings	
	○ Filed sub-bid work	
	○ Scheduling	

	○ Equipment and power	*Included. The QC narratives appears to indicate several items regarding equipment and power are still under review.*
	○ Existing and new construction	*Not included in this submission. Please address this in the response to this review, and include the information required in next submission.* District Response: The project is New Construction. This item will be clarified in the 60% CD submission
	○ Phasing	

6A.3.2 Space Summary	Comments

Spaces	**PFA Space Summary**	**DD Space Summary**	**Difference to PFA**	**Comments**
Core Academic Spaces	102,835	102,835	-	No difference to PFA.
Special Education	32,230	32,230	-	No difference to PFA.
Art and Music	12,650	12,650	-	No difference to PFA.
Vocations & Technology	30,970	30,970		No difference to PFA.
Health and Physical Education	36,750	36,750	-	No difference to PFA.
Media Center	10,870	11,770	900	Increased by 900 nsf since PFA.
Auditorium/ Drama	17,910	17,910		No difference to PFA.
Dining and Food Service	15,670	15,670	-	No difference to PFA.
Medical	3,035	3,035	-	No difference to PFA.
Administration and Guidance	10,450	10,450	-	No difference to PFA.
Custodial and Maintenance	3,735	3,735	-	No difference to PFA.

Other	4,200	4,200	-	No difference to PFA.
Total Building Net	**281,305**	**282,205**	**900**	Increased by 900 nsf since PFA.
Non Programmed				
Other Occupied Rooms (Janitor's Closet)	605	805	200	Increased by 200 nsf since PFA.
Unoccupied MEP/FP	8,325	8,955	630	Increased by 630 nsf since PFA.
Unoccupied Closets, Supply Rooms & Storage	2,110	2,695	585	Increased by 585 nsf since PFA.
Toilet Rooms	6,890	6,890	-	No difference to PFA.
Circulation	95,385	95,385	-	No difference to PFA.
Remaining	27,238	27,665	427	Increased by 427 nsf since PFA.
Total Gross	**421,858**	**424,600**	**2,742**	Increased by 2,742 gsf since PFA.
Grossing Factor	**1.50**	**1.50**	**0**	

•	Updated space summary and signed certification that reflects the current design	
•	Comparison of the current design with the final educational program, and confirmation that there are no variations. If there are variations, the written summary must address the following:	
	○ Explanation of deviations within the space summary from the Project Funding Agreement. MSBA will either: ▪ MSBA accepts this variation to the approved project with no further action. ▪ Prior to the MSBA accepting this variation to the project, the Designer must describe in detail the reason for the change.	*533 nsf of Media Center space was ineligible for reimbursement at PFA. At DD it increased by 900nsf (1,350 gsf). The Gross Square footage of the project increased by 2,742 gsf.* *The MSBA will continue to monitor these ineligible square footage amounts through Module 6, and to continue to consider the total for the item ineligible at PFA Bid. This may result in a reduction to the grant. Please acknowledge in the response to this review.* District Response: Acknowledged
	○ The MSBA considers that deviations included changes in the size of a specific space, program area total nsf, space location, surrounding adjacencies of a space and/or the intended room purpose: ▪ The submittal must clearly call out deviations to location and surrounding adjacencies using redlines or "clouding". ▪ The explanation should clearly identify the basis of the change identifying both architectural and/or programmatic reasons. ▪ If the basis of the change is programmatic, the submittal should include a red-lined version of the educational plan included in the Project Funding Agreement.	
•	Regarding DESE approved SPED Spaces:	

	○ Include a copy of the most recent letter from DESE approving the current proposed SPED spaces	
	○ Confirm that the DESE approved SPED spaces have not deviated, using the definition above; or, ▪ If the District wishes to submit a change to its DESE approved submittal, it must a) confirm that all changes to SPED spaces are final; b) provide a new SPED submittal in the original submittal format (described in Module 4 Schematic Design Section 4.1.1 and Mod 4 Appendix 4B) clearly noting any changes with clouded floor plans and red-lined narratives and tables; and c) indicate how the project schedule can accommodate a potential DESE resubmittal and approval. Please provide a separate package for changes to DESE approved SPED spaces. ▪ If the District chooses not to change from the DESE approved submittal it should explain when and how the spaces will be returned to the approved size, configuration and location.	
•	Regarding DESE Approved Public Day Education Spaces:	
	○ Indicate "Not Applicable" if the project does not include DESE approved Public Day Education spaces.	*Not addressed in this submission. In the response to these comments, please clarify if DESE Approved Public Day Education spaces are part of this project.* District Response: DESE Approved Public Day Education spaces are not included in this Doherty project.
	○ If applicable, confirm that the DESE approved Public Day Education spaces have not deviated, using the definition above; or, ▪ If the District wishes to submit a change to its DESE approved submittal, it must a) confirm that all changes to Public Day Education spaces are final; b) provide a new submittal in the original submittal format, noting any changes with clouded floor plans and red-lined narratives and tables; and c)indicate how the project schedule can accommodate a potential DESE resubmittal and approval. Please provide a separate package for changes to Public Day Education Spaces. ▪ If the District chooses not to change from the DESE approved submittal it should confirm that the spaces are the same or explain when and how the spaces will be returned to the approved size, configuration and location.	
•	Regarding DESE approved Chapter 74 Program Spaces:	
	○ Indicate "Not Applicable" if the project does not include DESE approved Chapter 74 Spaces.	
	○ If applicable, confirm that the proposed Chapter 74 spaces conform to the current DESE Chapter 74 manual for Vocational Technical Education Programs.	

	○ Include a copy of the most recent letter from DESE approving the current proposed Chapter 74 Program spaces.	*While the submission includes a letter from DESE confirming that they have reviewed the District's Chapter 74 Programming Submission, the letter (dated to 2019) specifically states "the purpose of this letter is not to grant formal or final approval." The design team confirms in their narrative that they are continuing to coordinate with DESE to obtain their required approvals for the Chapter 74 spaces. Provide an update as part of the response to these review comments.* District Response: Worcester Public Schools intends to apply during the School Year 2022 New Program application cycle. The "Intent to Apply" letters will be submitted to DESE in September/October of 2021, followed by the Part A and Part B applications according to the DESE schedule.
	○ If applicable, confirm that the DESE approved Chapter 74 Program spaces have not deviated, using the definition above, or; ▪ If the District wishes to submit a change to its DESE approved submittal, it must a) confirm that all changes to Chapter 74 Program spaces are final; b) provide a new submittal in the original submittal format, noting any changes with clouded floor plans and red-lined narratives and tables; and c) indicate how the project schedule can accommodate a potential DESE resubmittal and approval. Please provide a separate package for changes to the Chapter 74 Programming. ▪ If the District chooses not to change from the DESE approved submittal it should explain when and how the spaces will be returned to the approved size, configuration and location.	

6A.3.3 Project Approvals		Comments
•	Describe the status of the following approvals. In addition, provide the status of any other state or federal approval not listed below (the following list is not a comprehensive itemization of required state approvals; other requirements may apply, and some items listed below may not be applicable to this project). Provide a copy of the appropriate application forms and/or approval letters where applicable. Indicate "Not Applicable" where appropriate and describe why each item is not applicable. For each agency approval required for this project, indicate the date when approval was received. All required approvals should have an associated approval date indicated in the 90% CD submission and prior to advertising for bids. Confirm that the required approvals are coordinated with the OPM's project schedule.	

	○ DESE – Special Education approval by Department of Elementary and Secondary Education	
	○ MHC – Project Notification Form and approvals by MA Historical Commission	
	○ OIG - Construction Manager at Risk approval by the Office of Inspector General	
	○ Executive Office of Energy and Environmental Affairs / EEA:	
	▪ MEPA - MA Environmental Policy Act by Energy & Environmental Affairs:	
	• ENF - Environmental Notification Form	
	• EIR - Environmental Impact Report	
	▪ Article 97 Land Disposition Policy approval by Energy & Environmental Affairs	
	○ MA DEP - Massachusetts Department of Environmental Protection	
	○ MA DOT - Massachusetts Department of Transportation	*Not addressed in this submission, please address this in the response to these comments.* District Response: DOT approval is not required. Notice of intent was filed, OOC was received for the Site Enabling work (Under local jurisdiction only).
	○ MA DPH - Massachusetts Department of Public Health	*The submission states that due in part to the inclusion of a Small Neighborhood Clinic (licensed by the MA DPH) this application process is currently ongoing. The design team confirms that they will update the MSBA as part of the 60% CD submission.* District response: Confirmed.
	○ EPA –NPDES National Pollutant Discharge Elimination System Notice of Intent approval by the US Environmental Protection Agency (or indicate as "by GC/CMR")	
	○ MAAB - Accessibility variances by MA Architectural Access Board	
•	Confirmation that the Project has undergone review and obtained all necessary approvals by any departments or Commonwealth agencies required by law to review the Project, including but not limited to the approvals listed above. Attached such documentation letters evidencing such reviews and approvals. In accordance with the Project Funding Agreement ("PFA") Section 4.12, the District must obtain such reviews or approvals prior to construction bids solicitation.	
•	For any required state reviews or permits for which approval has not been obtained as of the Design Development submission date, provide a status update including actions taken to date and actions planned to obtain the required state reviews and permit approval(s) in order to comply with the PFA Section 4.12 and maintain the projected schedule milestones listed in the OPM Deliverables.	

•	List all target dates for all local zoning approvals, testing and permits.	
•	Provide a certification that all applicable utility officials have been contacted by the Designer regarding each basic utility connection.	

	6A.3.4 Cost Estimates	Comments
•	Designer's construction cost estimate using the Uniformat II Classification to Level 3, Showing unit rates and quantities; with escalation projected to the mid-point of construction AND;	
•	Designer's construction cost estimate using CSI MasterFormat 6-digit format to Level 3 and MGL c.149 s 44F (filed sub-bid) format showing unit rates and quantities; with escalation projected to the mid-point of construction.	

	6A.3.5 Drawings (developed to Design Development progress level)	Comments
•	Half-size drawings only. Confirm that text, symbols, shading and all drawings content are legible.	*Due to the current COVID-19 situation, hard copies were not provided. MSBA may request hard copies at a later time for record.* District Response: Hard copies were provided to the OPM for eventual delivery to MSBA.
•	If applicable, include early bid package contract documents in the submittal to show a complete project.	*In most places in the submission, it appears there are four bid packages: three early bid packages and one 'final' trade bid package. However, in some locations, such as the Basic Project Information Narrative, it comments on the Site Enabling Bid Package as being "the first of four proposed early bid packages". Confirm there are a total of four bid packages and not four early bid packages with a final bid package (total of five bid packages).* District Response: There are a total of four bid packages planned for the Doherty project; three (3) early bid packages and one (1) final bid package. *The submission includes the 95% CD drawings of the first early bid package. Other early bid packages are not included as separate sets of drawings. All early bid packages should be included in future submissions. Please acknowledge in the response to this review.* District Response: The Early Site Bid Package #2 will be issued concurrently with the 60% CD submission, and the Early Concrete & Steel Bid Package #3 will be issued with the 90% CD Documents.
•	Cover Sheet showing a drawing list and a locations map (the project title should be visible when the drawings are rolled)	*Each set of the four sets have a drawing list identifying what drawings are within that set. However, there does*

		not appear to be a master drawing list. Consider adding a master drawing list for clarity. District Response: A Master Drawing list is provided in the specifications. *Additionally, some of the discipline sheets start with higher numbers. For example, the HVAC section starts on sheet H3.1 instead of H0.x or H1.x. This may be accurate, but when flipping through the sheets, it gives the impression that sheets are missing. Consider adjusting the numbering for clarity.* District Response: Acknowledged, for the DD set the typical notes and beginning drawings are not included. These will be updated for the 60% CD submission *The locations map does not appear to include any identifying information other than the word "SITE". Consider including other information, such as street names and the project address, for clarity.* District Response: Acknowledged.
•	Sheets containing all symbols, abbreviations and notes applicable to each discipline	
•	Site and Utility drawings should show the following:	*The civil plans show the site broken into three segments. The southern segment (which is on the top of the sheet) is aligned with the top of the page. Due to how the site is divided, the image does not require the whole sheet and is broken in the middle. However, there is no drawing title, break line, or other graphic feature indicating the end of the drawing making it look like it abruptly ends around mid-page. When viewing it electronically, it gives the impression that the rest of the page has not rendered, when in fact, it is done. Consider adding something at the bottom of the drawing for clarity especially if it will be viewed electronically.* District Response: All sheets include match lines, this will be considered for the 60% CD Submission.
	○ Proposed work layout	
	○ Existing and proposed contours	
	○ Building locations fixed and referenced from main survey baseline	*The building is located from the property line along the east side and a new concrete sidewalk along the north side. However, it is not clear if the sidewalk is sufficiently located from a baseline. This should be reviewed.* District Response: The offset dimension on the north side of the new building is to the property line, not to the new sidewalk.
	○ Floor elevations at each entrance/exit and key exterior grades at perimeter showing drainage away from the building	*Floor elevations are not shown on the grading plan. This should be reviewed and suggest they are included in the next submission.* District Response: This will be coordinated for the 60% CD submission.

	○ Site Benchmarks	
	○ Boring locations	
	○ Retaining walls	*There appears to be retaining walls on the civil plans; however, the submission does not include retaining wall details. This should be reviewed.* District Response: There are significant retaining walls on the project, and the exact type is being reviewed with the CM. Details will be added to the 60% CD submission
	○ All utilities existing and proposed, indicating location, elevation, composition and size e.g., gas and electric utility providers	
	○ Roads, laid out parking areas, walks, recreation areas, terraces and other site improvements	
	○ Plant materials with preliminary schedule	
•	Architectural drawings showing the following:	
	○ Demolition drawings	*Demolition drawings are limited to the building footprint on the civil existing plans. There are no drawings showing the height or other built elements of the existing building that will be demolished. This should be reviewed and clarified.* District Response: Refer to Specification Section 02 41 17, and Appendix H, Existing Building drawings for full electronic PDF files of the 1964 building contract drawings. Later improvements were provided to the Construction Manager for their reference and to be provided to the demolition contractor.
	○ Mobilization and enabling works	
	○ Floor Plans (minimum 1/8" = 1'-0" before reduction)	
	○ Internal partitions; appropriate thickness and dimensions to fix basic organizations; indicate fire rated partitions and smoke partitions	
	○ Key plans/overall plans where required	
	○ Building perimeter with exterior wall thicknesses and overall dimensions	
	○ Structural grid	
	○ Mechanical and electrical systems plan requirements	
	○ Building core; elevators, stairs, shafts, public toilets, with dimensions	
	○ Door swings	
	○ Finish floor elevations coordinated with exterior grade elevations at all interior to exterior transitions	*Finish floor elevations and grade elevations are not shown at the exterior doors. Consider adding this information for clarify.* District Response: Acknowledged
	○ Built-in furniture	
	○ Kitchen equipment	
	○ Furniture layout concept drawings	

•	Large scale plans showing key areas e.g. lobby, special spaces. Indicate floor surface materials (minimum 1/4" = 1'-0" before reduction)	
•	Roof plans showing the following:	
	○ Proposed systems type	
	○ Pitch and drainage pattern	
	○ Roof drains, gutters and scuppers	
	○ Skylights, penthouses, major equipment, chimneys	
	○ Roof access and ladders	
	○ Walk pads	
	○ Rooftop Solar Readiness area, PV support and interconnection pathways	*Photovoltaic panels are shown on the roof, but the roof details do not appear to include information for how the roof membrane may interact with the panel bases. This should be reviewed and addressed in the next submission.* District Response: Details will be provided in the 60% CD submission.
•	Building sections: One transverse and one longitudinal section. Indicate floor to ceiling heights and floor-to-floor heights. Label all spaces.	*Building sections do not show floor to ceiling heights and some spaces are missing labels. This should be reviewed and addressed in the next submission.* District Response: This will be coordinated for the 60% CD submission.
•	Building sections updated and coordinated with plans and elevations	
•	Building elevations showing the following:	
	○ Full height elevations including roof structures, e.g., mechanical equipment, chimneys, and penthouses	*It appears that notes are included identifying locations of mechanical equipment, but not all equipment are shown. For example, detail 1 on A5.2.* District Response: This will be coordinated for the 60% CD submission.
	○ Floor elevations, floor-to-floor height, and overall height related to benchmarks on site plans	*Overall height related to benchmarks are not included on the building elevations. This should be reviewed and addressed in the next submission.* District Response: This will be coordinated for the 60% CD submission.
	○ Windows, storefront, and curtain wall systems	
	○ All columns located on a centerline and coordinated with the structural drawings	
	○ Materials indicating major control and expansion joints, and divisions of materials where required	
	○ Exterior grades and topographical features in context	
•	Full height wall sections for main elevations and at special conditions. Show foundation and perimeter treatment, wall construction including insulation and supporting structure, fenestration and mechanical penetrations, and floor construction	*A few of the wall sections appear to be taller than the sheet, and so the bottom foundations do not completely appear. This should be reviewed so that the foundation and perimeter treatment can be communicated.* District Response: This will be coordinated for the 60% CD submission.

•	Interior elevations: Show at all spaces, e.g. library, lobby, and all typical spaces, e.g. classroom	
•	Reflected ceiling plans: Show prototypical structural, fire protection, mechanical and electrical information for classrooms and major spaces, including lighting layouts with ceiling height and material changes.	
•	Schedules:	
	○ Finishes	
	○ Doors	
	○ Windows	
	○ Equipment schedules; e.g., food service, instructional media	
	○ Partitions	
•	Structural concepts	
	○ Framing plans; typical floor framing, roof framing, special framing, show framing at major openings and member sizes	
	○ Floor and roof framing design loads	
	○ Foundation plan showing sizes and typical component locations	
	○ All columns and beams are identified (with typical sizes shown) on column and beam schedules or on drawings	
	○ Preliminary details including floor and roof deck	
	○ Details and locations for special and/or incidental structure features; e.g. tunnels, connecting bridges and unique architectural features	
	○ Connection to existing buildings at foundation and at key points at existing structure if applicable	*Not applicable*
	○ All construction joint and expansion joints locations coordinated with structural drawings	*While there are some references to construction and expansion joints, they do not appear to be coordinated with the architectural drawings. This should be reviewed.* District Response: Further information will be provided at the 60% CD submission
	○ Schedules (with dimensions) for all lintels, beams, joists, and columns. Coordinate dimensions of all elements listed in the schedules with dimensions depicted on the plans	
•	Fire Protection floor plans indicating wet or dry type systems, hose racks or cabinets and fire department tie-ins, including:	*The fire protection service room is shown on a 1/8" scale drawing which, in addition to being small, is covered with a hatch making it difficult to read. Consider showing this room differently for clarity.* District Response: This will be coordinated for the 60% CD submission.
	○ Typical sprinkler head layout	
	○ Sprinkler piping mains and size	*It is not clear if the sprinkler mains are included on the plans. Notes show up throughout the plans appearing to identify mains and their sizes, but it is very difficult to determine if there is a line present showing them. Consider adjusting the graphics to make them clearer.*

		District Response: This will be coordinated for the 60% CD submission.
	○ Sprinkler service location	*See comment above regarding the fire protection service room.*
	○ Fire pump where required	*Not applicable*
•	Plumbing and sanitary systems:	
	○ Floor plans indicating plumbing fixtures and special features rough-in locations, piping systems and principal items equipment approximate locations and sizes	*This information appears to be included; however, many notes, room names, and other items overlap making the information difficult to read. This should be reviewed.* District Response: This will be coordinated for the 60% CD submission.
•	Heating, Ventilating and Air Conditioning Systems:	
	○ Piping systems locations and approximate sizes, air handling systems and principal equipment items such as compressors or cooling towers	*The piping plans do not show approximate pipe sizes. Additionally, the piping line weight is very heavy making it difficult to distinguish separate lines. This should be reviewed.* District Response: This will be coordinated for the 60% CD submission.
	○ Mechanical rooms and fan rooms space requirements and locations. Indicate shaft requirements	*Mechanical rooms and shafts are shown with what appears to be full scale equipment; however, no further information is provided. For example, sizes, equipment identification, service space, etc. are not indicated on the plans. This should be reviewed and added prior to the next submission.* District Response: This will be coordinated for the 60% CD submission.
	○ Adequate ceiling heights exists at worst-case duct intersection	
	○ Ceiling diffusers/registers generally consistent with architectural reflected ceiling plan	*It does not appear that the diffusers and registers on the HVAC plans are consistent with the architectural plans. For example, in room A205 "9th Grade English", the HVAC plans show a register directly adjacent to the open door, but on the architectural plans, it is more centrally located. This should be reviewed and coordinated in the next submission.* District Response: This will be coordinated for the 60% CD submission.
•	Electrical Systems:	*Drawing set 4, which consists mostly of electrical plans, are very large files, which make it difficult to navigate electronically. Consider making the file size smaller.* District Response: Acknowledged.
	○ All services including those for special purposes shall be located and indicated	
	○ Light fixtures on electrical drawings generally consistent with architectural reflected ceiling plans	
	○ Switchgear and emergency generator	
	○ Electrical equipment locations are coordinated with site paving and grading	*Included; however, it appears some of the keynotes are out of order. For example, the generators are noted as note #9, but they should be note #7. This should be reviewed.*

		District Response: This will be coordinated for the 60% CD submission.
	○ All motorized equipment is generally consistent with electrical drawings	*See note below.*
	○ All power equipment has electrical connections	*It does not appear that some equipment, such as the HVAC equipment, are shown with electrical connections. HVAC equipment is not shown on the electrical power plans and the layout of the roof top equipment on section D from the lightning protection plan does not match the HVAC plans. This should be reviewed.* District Response: This will be coordinated for the 60% CD submission.
	○ Fire alarm system drawings showing all initiation and signaling devices, control panels, annunciator panels, etc.	
	○ Security and system drawings	*The drawings include diagrams for connecting cameras to the head end equipment, but it is not clear if there is a plan that shows all camera locations. This should be reviewed.* District Response: This will be coordinated for the 60% CD submission.
	○ Communications drawings showing chases, major equipment locations and any special distribution requirements	

	6A.3.6 Project Manual (developed to Design Development progress level)	Comments
•	If applicable, include early bid package contract documents in the submittal to show a complete project.	*Four early bid packages are proposed. Drawings for the first early bid package, Site Enabling Bid Package #1, are issued with the DD submission, but specifications are not included. Complete (drawings and specifications) early bid packages should be included in future submissions regardless of their level of development.* District Response: Specification packages will be provided at the 60%, and subsequent CD submissions
•	Outline Specifications (Short-Form / Preliminary Project Description; not full-length format) in the current CSI Master spec divisions.	*The submitted specification is a 3-part CSI specification rather than an outline specification (see the language to the left specifically noting "not full-length format)". Consequently, some of the comments below are related to the full specification, as presented, and may address a level of detail beyond what is normally considered design development topics. Consequently, the presentation of information does not correlate to the outline below. For future DD submissions, provide an outline specification as required. Please acknowledge in the response to his review.* District Response: The City publishes the full specifications as part of the Construction Manager selection process, and also to advance the early bid packages. The District acknowledges that only an outline

		is required, however the Doherty Specifications have been advanced to align with City requirements.
•	Geotechnical report including test boring holes locations and dates, soil investigation results including water levels, allowable solid bearing pressure, foundation type and footing and slabs bottom grades.	
•	Site work: clearing, drives, walks, parking areas, fences, excavation, backfill, planting, footings on earth, rock, piles, caissons, proposed bearing pressures, boring logs	
	○ Foundation walls; concrete types, reinforcing, waterproofing type and extent	
	○ Footing drains; type, drainage disposal	*Footing drains are not included in the Project Manual. This should be reviewed and included in the 60% CD submission.* District Response: This will be included in the 60% CD submission.
	○ Exterior Walls: superstructure, type, materials, brick type, alternate cladding, back-up materials, damp proofing material and extent, special features	
	○ Roof types, vapor barrier, insulation, flashings, all materials	
	○ Flashings; general types, all materials, weights, where each type is to be used	
	○ Sheet metal; gutters, leaders, other uses, except flashing	
	○ Windows; general types, materials, sub-frames, finish, glazing, screens	
	○ Rough openings for all doors and windows coordinated	*Rough openings for doors and windows are not included in the Project Manual. This should be reviewed.* District Response: This will be coordinated for the 60% CD submission.
	○ Doors, exterior and interior; types and thicknesses and fire rating identified if applicable	*Fire ratings for hollow metal doors and flush wood doors are not included in the Project Manual. Please include this information in the 60% CD submission.* District Response: This will be coordinated for the 60% CD submission.
	○ Steps, exterior; including platforms and landings' materials	
	○ Stairs, interior; including platforms, landings, walls, materials and finishes	
	○ Framing; wood, concrete or metal systems in accordance with general design	
	○ Partitions; materials, thicknesses, finishes	
	○ Cabinet and casework; types and materials	
	○ Food Service Equipment; provided equipment list	*A Food Service section is included; however, no information on food service equipment is provided in the Project Manual. This information should be included in the 60% CD submission.*

		District Response: This will be included in the 60% CD submission.
	○ Furring; lathing, plastering, materials and locations	
	○ Insulation thermal; types, thicknesses, application methods and locations	
	○ Acoustical treatments; types, thicknesses, application methods and locations	
	○ Interior finishes; materials for floors, walls, bases, wainscots, trim, ceilings, ceiling heights	
	○ Fire protection; standpipe systems, sprinkler systems, fire pumps and accessories	
	○ Water supply; source; main connection location will be made; type of pipe for service main; load requirements; load factors and pressures	
	○ Sanitary sewers; sewage disposal system, pipe and other materials.	
	○ Storm sewers; storm drainage disposal system (institution or local facility), pipe and other materials	
	○ Gas main; material, size, location. Interface with utility company.	
	○ Plumbing; systems such as wastes, vents, hot water, cold water, gas, air, oxygen, vacuum, main supply source, materials for each, water heaters, pumps, thermal insulation fixture quality, all special features	
	○ Heating, ventilating and air conditioning; heating type and refrigeration plants, boilers and cooling equipment types and capacities, fuel, burner type, fuel storage, heaters, feed water pumps and heaters, thermal insulation, heating medium type, supply and return piping, radiation, unit heaters, radiant heating, principal air conditioning equipment types, special features, supply, return and exhaust ductwork	*It appears that two or more separate documents were merged into Section 23 00 00; as a result, the part and paragraph numbering are out of sequence and there is some repeated information. This should be reviewed and corrected for the 60% CD submission.* District Response: This will be coordinated for the 60% CD submission.
	○ Electrical work; service connection, location, institution or public utility, overhead or underground, transformers including type and location, conduit and wiring types, fixtures types, main switchboard location, radio, fire alarm, telephone, public address, emergency lighting and wiring, emergency or other generators, special features, including Master TV, information retrieval and/or data processing system	
	○ Elevators, dumbwaiters and platform lifts; capacities, speed, travel in feet, landings, operation, controls, platform sizes, machine type and location, car and entrance finishes, signals	*Elevator travel in feet, platform size, and landings are not indicated in the Project Manual. This should be included in the 60% CD submission.* District Response: This will be included in the 60% CD submission. *Wheelchair lift speed and travel in feet are not indicated in the Project Manual. This should be included in the 60% CD submission.* District Response: This will be included the 60% CD submission.
	○ Other built-in equipment, types and materials	

	○ All "Work by others" specifications coordinated	
	○ Special features	

	6A.3.7 Project Coordination	Comments
•	All room names and numbers are coordinated between all disciplines.	
•	The structural, mechanical, or other disciplines, do not conflict with architectural plans or specifications.	*It does not appear that there are conflicts; however, additional coordination to confirm this is required. For example, as stated earlier, the mechanical diffusers on the architectural plans do not match the diffusers on the HVAC plans. This should be reviewed.* District Response: This will be coordinated for the 60% CD submission.
•	The finish grade elevations coordinated between all disciplines.	*Finish grade elevations are not shown on the architectural plans, especially at exterior doors. This should be reviewed.* District Response: This will be coordinated for the 60% CD submission.
•	Civil earthwork grading and excavation plans are coordinated with architectural and landscape plans.	
•	Structural dimensions match Architectural drawings.	
•	Column orientation matches Architectural drawings.	
•	Column grid lines match Architectural drawings.	
•	Column and bearing wall locations match Architectural drawings.	
•	Column locations coordinated with all other disciplines.	
•	Seismic detailing coordinates with Architectural drawings.	
•	Beams and columns are not protruding horizontally and vertically into stairwells, and other interior spaces.	
•	Beams and columns are not protruding horizontally and vertically into stairwells, and other interior spaces.	
•	Verify modular dimensions at vertical masonry construction.	*Dimensions are not shown, so it is difficult to confirm this; however, the masonry pattern appears to line up with the openings. Consider including dimension for clarity.* District Response: Acknowledged.
•	Room wall/floor/ceiling construction coordinated with architectural finishes.	
•	Mechanical equipment power requirements and physical locations, including special information as to who mounts, connects, tests, etc.	*It appears additional coordination is required. For example, it does not appear that the HVAC equipment shown on the electrical plans is coordinated. This should be reviewed.* District Response: This will be coordinated for the 60% CD submission.
•	Verify potential spatial conflicts in mechanical equipment.	*Dimensions of mechanical equipment and their spatial requirements are not shown on the plans; therefore,*

		coordination could not be confirmed. This should be reviewed. District Response: This will be coordinated for the 60% CD submission.
•	Equipment plan coordinates with architectural plans.	
•	All kitchen equipment with utility systems indicated.	
•	The Designer confirms that the project continues to comply with the MSBA High School Science Lab Guidelines and/or Recommendations of Best Practices for K-12 STEM learning Spaces.	

The Green Engineer
Sustainable Design Consulting

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Doherty Memorial High School

Design Development
Energy Analysis Report

DRAFT

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Executive Summary

The Doherty Memorial High School project includes the construction of a new 422,000 gsf high school for 1,670 students. The project will be located at 299 Highland Street in Worcester at the site of the existing Doherty Memorial High School. In addition to typical core and academic facilities, the program includes four Chapter 74 technical programs, an advanced academy for Biotechnology, and a legitimate stage Auditorium. The project will be fully air conditioned.

The City of Worcester and the MSBA have strong commitments to energy efficient sustainable design. To meet the current MSBA requirements for the additional 2% reimbursement, the project must earn a minimum of LEED-Schools v4 Certified certification and exceed the level of energy efficiency required in the current Massachusetts (base) energy code by 20%. Under these requirements, the project must attain a minimum of 14 points under the Optimize Energy Performance LEED credit.

The Green Engineer (TGE) performed a building performance analysis following ASHRAE 90.1-2013, Appendix G performance path. The results of the modeling indicate that the as-designed building is expected to show total LEED savings of **44.6%** as compared to the Massachusetts code compliant Baseline. The percentage annual site and source energy savings are estimated at **41.5%** and **36.7%**, respectively. Additionally, the greenhouse gas (GHG) emissions for the proposed design are estimated at **873.1** MTCO2e, corresponding to a **40.5%** reduction from the Baseline emissions.

In order to achieve LEED-Schools v4 Certified status and pursue an additional 2% funding from the MSBA, the project must exceed the Massachusetts base energy code (on a site or source basis) by 20%, which is currently being achieved by a comfortable margin. Performance attained by the design achieves **16 LEED** base points under the Optimize Energy Performance credit. LEED points are calculated according to the EApc95 Pilot Credit (Alternative Energy Performance Metric). The EApc95 optimizes the energy efficiency savings obtained with the use of Heat Pumps in the project. Along with the Annual Site Energy Savings, it considers the average Annual Source Energy Savings and GHG emission reductions, resulting in **38.6%** savings from these observations versus the **35.1%** energy-cost savings. Additionally, the energy-cost savings were calculated according to LEED Interpretation 10481 which grants an additional 6% energy cost-savings credit to projects using ASHRAE 90.1-2013 as the baseline.

The full text of this interpretation is contained in Appendix B and Appendix C. Additional observations and key energy conservation measures are provided in Section IV. A detailed table of energy model inputs is provided in Appendix A.

Figure 1: Performance Improvement for Key Metrics

I. Description of Alternatives

ASHRAE 90.1-2013 Baseline: The baseline building assumes the same form as the design case, while building system characteristics are adjusted to code minimum performance levels following the ASHRAE 90.1 appendix G performance rating methodology.

Design Case: The building as-designed. The design inputs are based on the Design Development Cost Estimate drawings and documents, and information provided by the design team. Every effort has been made to use reasonable assumptions for building components and systems where details were not available.

Please refer to Appendix-A for model inputs.

II. Energy Conservation Measures

The following ECM's have been identified for the project:

- Improved envelope assemblies and fenestration
- Reduced interior lighting power through the use of high efficiency LED fixtures
- High efficiency DOAS and VRF condensing units
- High efficiency single zone cooling units
- High efficiency energy recovery units
- Use of demand control ventilation is assumed, throughout significant portions of the building as indicated by the sequence of operation specifications.
- Supply air reset on all RTUs units

III. Simulation Results

Following are the simulation results obtained from the energy model iterations. The annual energy use and cost savings for the proposed design are based on energy efficiency strategies incorporated in the design to reduce the energy consumption in the building. The following tables summarize energy use and cost results for the Baseline and the Proposed Design. Also included are the estimated source energy savings and GHG emissions reduction for the design compared to the Baseline. Refer to Appendix-A for details of energy model inputs and assumptions.

Table 1: Site Energy by End-use

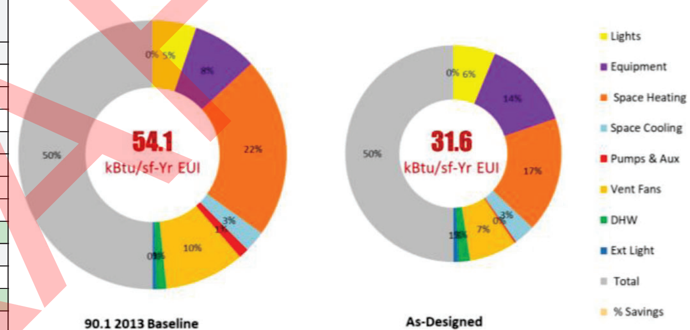
Site Energy Use Savings (MMBtu/Yr)											
Description	Lights	Equipment	Space Heating	Space Cooling	Pumps & Aux	Vent Fans	DHW	Ext Light	Total	% Savings	EUIs
Code Baseline	2,472	3,682	10,177	1,217	552	4,523	570	201	23,395	-	54.1
Design	1,719	3,682	4,718	877	59	1,956	474	201	13,687	41.5%	31.6

Table 2: Additional Performance Metrics

Energy Use, GHG Reduction and Cost Summary			
Description		Code Baseline	Design
Annual Site Energy Summary			
Electricity	kWh	3,639,123	2,525,928
Natural Gas	MMBtu	11,230	5,066
Total Site Energy use	MMBtu	23,395	13,687
Annual Energy Cost Reduction			
Electricity	$/year	$600,455	$416,778
Natural Gas	$/year	$136,669	$61,653
Total Energy Cost	$/year	**$737,124**	**$478,431**
Site Energy Cost Savings (%)			**35.1%**
Annual Source Energy Reduction			
Total Source Energy use	MMBtu	46,568	29,458
Source Energy Savings (%)			**36.7%**
Green House Gas (GHG) Reduction			
Total GHG Emissions	MTCO2e	1,467	**873**
40% Green Power Purchase Contract[1]	MTCO2e	1,117	630
100% Green Power Purchase (Future)[2]	MTCO2e	596	269
GHG Reduction without Green Power (%)			**40.5%**
EApc95 Compliance Path (Average of Source and GHG Savings %)			**38.6%**
Credit for LEED Interpretation 10481 (%)			**6.0%**
EAc Optimize Energy Performance Total Savings (%)			**44.6%**
LEED Points			**16**

1. Net building emissions after green power credits have been applied to electricity use based on city's existing contract.
2. Possible net emissions if green power offsets are used for 100% of electricity use.

Figure 2: EUI Comparison



IV. Discussion of Results:

Key Performance Advantages

- The design includes several energy efficiency measures that provide annual energy use savings for the project. Space heating, fans, and lighting are the three largest categories of end use savings for the project. Savings in these end uses can largely be attributed to high efficiency HVAC equipment and optimized control sequences while a high performing envelope contributes as well.
    - In particular, the use of heat pumps reduces the source energy use and emissions relative to the code baseline.
- A high performance envelope and low lighting power density minimize internal loads to the benefit of the heating and cooling plants. Optimized glazing allows more daylight into the building, reducing the need for electrical lighting relative to code glazing requirements.

Identified Performance Opportunities

- Controls sequences should maximize the operation of heat pumps as primary heat as much as possible.
- Targeting an LPD of 0.55 or lower. Current assumption is 0.6 W/ft^2.
- Specifying EnergyStar equipment as possible.
- Consider using oversized AHU cabinets to reduce internal static pressure and associated fan BHP requirements.

Key Assumptions

- Heating, cooling, and fan energy use is also highly sensitive to ventilation air requirements. This analysis assumes that specified ventilation rates are within 5% of ASHRAE 62.1 minimums at the system level, avoiding an overventilation penalty in the design. LEED has recently begun enforcing a code measure that states baseline case ventilation rates must equal ASHRAE 62.1, ventilation rate procedure values. ERU fan energy use is particularly sensitive to this requirement. Under minimum load conditions, a baseline case ventilation system serving classrooms draws lower fan power than the corresponding design case ERU, since the baseline VAV system will be operating at a lower total static pressure. This characteristic is amplified if the design specifies ventilation rates that exceed code minimums.
- The energy savings reported in this document are not final. Simulated results will evolve as the design progresses.

V. Key Design Clarifications:

Based on the level of the design development, TGE used the following assumptions:

- The location and use of chilled beams. Currently, the model assumes the use of chilled beams according to the Mechanical drawing plans.
- The location and use of VRF terminal units. Currently, the model assumes the use of VRF terminal units according to the Mechanical drawing plans.
- Currently, the model assumes hot water as the last stage of heat throughout the building to prioritize the lower-emission heat pumps as a source of heating energy. However, the sequence of operations indicates hot water is staged first in areas served by both radiation and air heat.
- Packaged RTU supply/ventilation outdoor air amounts, capacities, fan break horsepower, and efficiencies. The model currently assumes that the Packaged RTU schedule column for Outdoor Air represents the Supply Air and the column for Exhaust Air represents the Outdoor Air.
- Minimum fan and pump flow ratios either in the drawings or the specifications.

VI. Modeling Methodology

This phase of the energy modeling, based on the Design Development Cost Estimate set, and information provided by the design team, evaluates the performance of the proposed design against an ASHRAE 90.1-2013 compliant Baseline building, for LEEDv4. The modeling was performed in accordance with ASHRAE Standard 90.1-2013, Appendix G protocol.

The purpose of presenting this information is to provide a gauge for the project in terms of energy performance and an opportunity for the design team to review the energy model to refine the systems design to improve performance. The overall energy savings and estimated annual energy consumption for the project is likely to change as the design gets further refined, and the energy model inputs are reviewed and finalized.

The annual energy cost estimates are based on energy modeling results, using eQUEST version 3.65 modeling software. The eQUEST software uses the DOE-2.3 calculation engine to estimate annual energy consumption by simulating a year of building operations based on a typical weather year and user inputs. The geometry of the building is based on the AutoCAD floor plans, except that window positions are simplified based on a percentage glazing in each zone and exposure.

It is important to keep in mind the limitations of energy models when reviewing this information. The results are based on the current design assumptions and utility rates described within this report. Further, energy consumption is highly dependent on weather conditions, building operations and many other factors that are not accounted for under the energy code modeling protocol (ASHRAE 90.1-2013). Therefore, the numbers generated will not necessarily be an accurate prediction of actual energy costs, but should serve as an accurate comparison between design alternatives. **If utility budget estimates are of interest, historical comparisons have shown that actual building energy use typically exceeds energy code simulation values by approximately 30%.**

Occupancy and building operation:

The current model assumes the academic building to have a conventional school year schedule with a reduced summer program summarized in the following table.

Table 3: Summary Schedule

BUILDING OPERATING ASSUMPTIONS			
Status	**Regular Session**	**Summer Session**	**Weekends, Holidays, Out of Session**
Open	7am	8am	N/A
Close	4pm	3pm	N/A

Utility Rates:

The following EIA State Average Rates for electricity and natural gas have been used for estimating annual energy cost savings for the project since the project's utility rate structure has yet to be determined. The utility rates can be updated during the 100% CD model update, as needed:

Electricity: $0.1650 /kWh (2019 EIA Average for MA)

Gas: $12.17 /MBTU (2019 EIA Average for MA)

Appendix A: Model Input Summary

The envelope, internal load assumptions and HVAC system inputs in the energy model are based on the drawings and documents available to us and inputs from the design team.

Doherty Memorial High School DD Energy Model Inputs		
Building Envelope (Construction Assemblies)		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Roof	As per ASHRAE 90.1-2013 Appendix G Insulation entirely above deck R-value: 30 c.i. **Roof U-Value (assembly): 0.032**	15" Rigid at roof: 5.7 per inch (R-45 total) Roof Assembly R-value: 47.39 c.i. **Roof U-Value (assembly): .0.21**
Walls - Above Grade	Exterior wall : Steel Framed Walls Insulation as per ASHRAE 90.1-2013, Appendix G, R-13 + R-10 c.i. **Wall U-Value (assembly): 0.055**	Brick wall assembly: 3.625" brick veneer, 1.25" air space, 4" mineral wool (R 17 total); vapor barrier, 5/8" gyp board, mineral wool batt insulation (R-24)., 5/8" gyp board. **Wall Type E8B: U-VAlue (assembly): 0.021** Gym wall assembly: 3.625" brick veneer, 1.25" air space, 3.5" mineral wool (R 15 total); vapor barrier, CMU hollow block 11.625", 5/8" gyp board. **Wall Type EM12: U-Value (assembly): 0.049**
Slab on grade floors	F-0.520 ; R-15 for 24 in	Identical to baseline
Fenestration and Shading		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Vertical fenestration Area (% of Wall area)	22%, Table G3.1.1-2, Appendix G, ASHRAE 90.1-2013 requirements	25%
Vertical Glazing Description	As per Appendix G, ASHRAE 90.1-2013 requirements	Typical Insulating Glass Unit IG-1
Glazing Thermal Properties: U-Factor	Assembly U-Value - 0.42 (fixed)	Center of Glass U-Value: 0.24 (Winter) Assembly U-Value: 0.37
Glazing Thermal Properties: SHGC	0.4	0.28
Glazing Thermal Properties: VLT	0.44 (1.1 * SHGC, as per section C3.6)	0.7

HVAC (Air-Side)		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Space set-points	Cooling: 75F; Unoccupied 82F Heating: 70F; Unoccupied: 64F	
Hours of Operation	Regular School Schedule Classrooms: 7 a.m. to 4 p.m. (includes afterschool programs); Low use of facility during summer Summer classrooms are available 8 am to 3 pm, 5 days a week. Energy model accounts for weekends and holidays.	
Primary HVAC Type	System #7 VAV with reheat	Primary System Type: RTU with ERV + VAV terminal boxes
Other HVAC Type	System #3: PSZ-AC systems for single zone spaces (Cafe, Gym, Kitchen) System #9: Heating only for stairwells	VRF units (e.g., some office areas, nurse area, IT offices) Chilled beams (corridors, some office spaces) AHU for CLL lab space Single zone PVVT (Gymnasium, Kitchen exhaust area) Cooling-only PVV systems serving IDF room, teledata room, etc. Electric Unit Heaters serving stairwellls, mech, vestibules, etc.
Minimum Outdoor Air Criteria	Modeled as per ASHRAE 62.1	Modeled as per ASHRAE 62.1; CFMs modeled as per schedules
Unitary Cooling Capacity	System#3: Autosize	Per schedules
Unitary Heating Capacity	System#9: Autosize	Per schedules
Fan Operation	Per ASHRAE 90.1-2013, Section G3.1.2.5- Supply and return fans operate continuously whenever spaces are occupied and cycled to meet heating and cooling loads during unoccupied hours.	Fans on following occupancy schdeulde; cycle to meet load when unoccupied
HVAC Air-side Economizer Cycle	Economizer High-Limit Shutoff of 70 deg F.	Enthalpy Wheel economizer; high-limit shutoff of 70 deg F and 26 BTU/lb
Design Airflow Rates	System design supply air flow rates based on a supply-air-to-room-air temperature difference of 20 degF (Supply Air Temp 55 degF; Room Air Temperature 75 degF). VAV Terminals - 30% Turndown Ratio	See schedules (final values will reflect 62.1 calculations)
Fan Power	Supply and return total fan power: System #7: VAV- 0.000490 - 0.000951 kW/cfm includes ERV fan power System #3: PSZ – 0.000421 - 0.000816 kW/cfm; includes ERV fan power System #9: Cabinet Unit Heaters: 0.000054 kW/CFM	DOAS/RTU: 0.000181 - 0.00177 kW/cfm (332 kW total) Cooling-only PVV systems: Assuming .0001 kW/cfm VRF terminal units:Assuming 0.0001 kW/cfm Unit Heaters: Assuming 0.000054 kW/cfm Supply and return total fan power: 336 kW
Exhaust Air Energy Recovery	50% effectiveness for systems required by ASHRAE 90.1 2013 Table 6.5.6.1	AHUs and DOAS include ERV's with 45% - 81% effectiveness
Demand Control Ventilation	DCV is implemented where applicable according to ASHRAE 90.1-2013, Sections G3.1.2.6a and 6.4.3.8	DCV included throughout the building with the exception of exhaust-driven systems: AHU-1, RTU-5, RTU-6, RTU-8, RTU-12, RTU-13
Supply Air Temperature Reset Parameters	Air tempertature for cooling reset higher by 5F under minimum cooling load	Air tempertature reset settings for cooling: RTUs 1-4: 52-65F RTUs 5,6,8: 55-70F RTU 12, 13: 65-70F
HVAC (Water-side)		
Chilled Water		
Number of Chillers	2 water-cooled screw chillers	1 air-to-water scrol chiller
Chiller Capacity (Per Chiller)	auto-size based on load	150 tons
Chiller Efficiency	As per ASHRAE 90.1 2013, Table 6.8.1-3 minimum requirements Full Load 0.56 kW/Ton; COP of 6.28	Design will meet ASHRAE 90.1-2013 chiller efficiency requirements Modeled assumption: Full Load 0.56 kW/Ton, EER 21.43
Chilled Water Loop Supply Temperature	44F	45 -CHW loop temperature; 10F dT
Chilled Water (CHW) Loop Delta-T	12F	10F
CHW Loop Temp Reset Parameters	Reset based on OA Temp: 44F at 80F and above; 54F at 60F and below, and ramped linearly between 44F and 54F at temp between 80F and 60F.	As per sequence of operations
CHW Loop Configuration	Constant primary, Variable secondary	Variable primary
Total Design CHW Pump Power	As per ASHRAE 90.1 2013 allowance. Sum of primary and secondary: 22 W/gpm.	Modeled identical to baseline
Heat Rejection		
Hot Water		
Number of Boilers	2 (gas boilers with natural draft)	3 (gas boilers with natural draft)
Boiler Capacity (Per Boiler)	Autosized	Autosized
Boiler Efficiency	80%	93%
Boiler Water Loop Supply Temperature	180F	140F
Hot Water Loop Delta-T	50F dT	20F dT
HHW Loop Temp Reset Parameters	Warm Up: 180°F HW @ 0°F OA, 150°F HW @ 60°F OA, Occupied: 180°F HW @ 0°F OA, 150°F HW @ 60°F.	Occupied: 135°F HW @ 10°F OA, 100°F HW @ 60°F OA
HHW Loop Configuration	Variable primary	Constant primary, Variable secondary
HW Pump Power and Flow	19W/gpm; flow auto-size	19W/gpm; flow auto-size
Primary HHW Pump Speed Control	Variable speed pumps	Variable speed pumps

Domestic Hot Water		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Type and Quantity	2 gas-storage water heaters	2 gas-storage water heaters
Volume	650 gal each	650 gal each
Capacity	Autosized	1225 MBH each
Efficiency	Tank UA 19.86, Assumed 80% efficiency	Tank UA 19.86, 98% efficiency
Plumbing Fixture Flow Rates	Standard Flow	25% flow savings assumed
Lighting		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Interior Lighting Power Calc Method	Building Area Method	
Interior Lighting Power Density (Average)	0.87 W/SF as per ASHRAE 90.1-2013 Table 9.5.1	0.6; daylight dimming through sensor reduction taken
Miscellaneous		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Receptacle equipment	Classrooms - 1.0 W/SF Office - 1.0 W/SF Kitchen - 7.0 W/SF Cafeteria - 0.25 W/SF Media Center - 1.0 W/SF Auditorium - 1 W/SF IDF/Telecom rooms - 7.0 W/SF Breakout/conference - 1.0 W/SF Restrooms - 0.25 W/SF Corridors - 0.25 W/SF	

APPENDIX-B: LEED INTERPRETATION 10481

Rating System

LEED BD+C: New Construction, LEED BD+C: Core and Shell, LEED BD+C: Schools, LEED BD+C: Retail, LEED BD+C: Healthcare, LEED BD+C: Data Centers, LEED BD+C: Hospitality, LEED BD+C: Warehouses and Distribution Centers, LEED BD+C: Multifamily Midrise, LEED ID+C: Commercial Interiors, LEED ID+C: Retail, LEED ID+C: Hospitality
Rating System Version

v4 - LEED v4, v3 - LEED 2009
Ref Guide Name and Edition v4:

Interior Design and Construction, v4 edition
Building Design and Construction, v4 edition
Inquiry

Our project is subject to ASHRAE Standard 90.1-2013 for code compliance. To pursue Option 1: Whole Building Simulation, is there a methodology for documenting additional energy performance for LEED v4 projects regulated by ASHRAE Standard 90.1-2013 Ruling.

Yes, projects applying Option 1: Whole Building Simulation, and regulated by ASHRAE Standard 90.1-2013 may document additional energy performance improvement under LEED v4 EA credit Optimize Energy Performance as described below. The Appendix G modeling method must be used for the LEED submission, even if the Energy Cost Budget method is used to document local code compliance.

Projects may calculate the Equivalent ASHRAE 90.1-2010 Performance improvement as:
Equivalent performance Improvement = % better than ASHRAE 90.1-2013 + Additional Percent Savings

Where Additional Percent Savings is shown in Table 1:

Table 1: Additional Percent Savings for ASHRAE 90.1-2013

Project Type1 Additional Percent Savings
NC-Office 5%
NC-Retail (except restaurant/grocery) 5%
NC-School 6%
NC-Health Care 3%
NC-Restaurant / Grocery 3%
NC-Hospitality 5%
NC-Warehouse 1%
NC-Multifamily 3%
NC-All Other 2%
CS-Office 3%
CS-Retail (except restaurant/grocery) 3%
CS-School 6%
CS-Health Care 1%
CS-Restaurant / Grocery 2%
CS-Hospitality 3%
CS-Warehouse 0%
CS-Multifamily 1%
CS-All Other 1%
CI-Office 3%
CI-Retail (except restaurant/grocery) 4%
CI-School 6%

CI-Health Care 2%
CI-Restaurant / Grocery 3%
CI-Hospitality 4%
CI-Warehouse 0%
CI-Multifamily 1%
CI-All Other 2%

1 Mixed use buildings shall use the weighted average Additional Percent Savings based on the gross enclosed floor area associated with each building type. Unfinished spaces not submitted in the CS rating system shall use the CS values. Data center space must always be considered “All Other”.

APPENDIX-C: ALTERNATIVE ENERGY PERFORMANCE METRIC

The intent of this pilot alternative compliance path is to allow an alternate metric for documenting performance improvement when using Option 1. Whole Building Simulation as the compliance path in EA Prerequisite Minimum Energy Performance, EA Credit Optimize Energy Performance, and EA Credit Renewable Energy Production and to provide USGBC comparative data on metrics for energy performance. The ACP does not change any other aspect of the referenced prerequisites and credits.

Comply with all requirements of Option 1. Whole Building Energy Simulation. Calculate and report a metric from each of the required categories identified below. Refer to the credit specific documentation requirements below for details on the reporting requirements. For all metrics: unbundled RECs for the project building may not be used to adjust the source-to-site factors, GHG emission factors, Primary Energy Factors, or TDV Energy factors. For each energy source serving the building, the source-to-site factors, GHG emission factors, Primary energy factors, or TDV energy factors must be identical for the Baseline and Proposed building models. REQUIRED

CATEGORIES:

- Energy Sources. Complete one of the following (Required for all projects).
    - Source energy. The total source energy consumption shall be calculated for the baseline building performance rating and for the proposed building performance rating, and the percentage improvement shall be determined using source energy. Use the national average ENERGY STAR Source-Site Ratios for each building energy source from the Energy Star Portfolio Manager Technical Reference: Source Energy for projects in the U.S. and Canada. For international projects, use the U.S. source-to-site ratios or published source-to-site ratios for the country or multi-country region where the project is located.
    - Primary energy. The total primary energy shall be calculated for the baseline building performance rating and for the proposed building performance rating, and the percentage improvement shall be determined using the primary energy. Primary Energy Factors for each building energy source shall be determined consistently with ISO Standard 16346:2013 and published for the country or multi-country region where the project is located.
    - Local Equivalent. Alternate methods of calculating primary source energy factors will be considered on a case by case basis. Please provide a narrative and any relevant background data explaining how the primary source energy factors were developed and any third-party review of those calculations that have occurred. The narrative must address how the primary source energy factors account for extraction, transportation, transmission, generation efficiency, and losses (as applicable) from the point of extraction to delivery to the project site.

- Greenhouse gas emissions. The total greenhouse gas emissions, in terms of carbon dioxide equivalents, shall be calculated for the baseline building performance rating and for the proposed building performance rating, and the percentage improvement shall be determined using carbon dioxide equivalent emissions. Complete one of the following (Required for all projects):
    - Energy Star Factors: Greenhouse gas emission factors for each building energy source shall be determined from the ENERGY STAR Portfolio Manager Technical Reference: Greenhouse Gas Emissions using the national or regional averages (no credit may be claimed for offsite green power when using this approach). Applicable only for projects in the U.S. and Canada.
    - ISO 16346:2013: Greenhouse gas emission factors for each building energy source shall be determined consistently with ISO Standard 16346:2013 and published for the country or region where the project is located. Applicable internationally, including projects in the U.S. and Canada.

Using metrics of cost, energy sources, greenhouse gas emissions, and (if available) time dependent valuation: Average the percent savings of the two highest-performing metrics using equal weighting to determine percentage energy savings. Points are awarded according to Table 1. Points for percentage improvement in energy performance under EA credit Optimize Energy Performance. Projects may use the average of the two highest-performing metrics, or cost, whichever is higher, to achieve points under EA credit Optimize Energy Performance.

EA Credit Renewable Energy Production

Provide calculations demonstrating the percent renewable generation calculated using cost as a metric (where cost is calculated consistent with the methodology used for EA Prerequisite 2: Minimum energy performance). Provide supplemental calculations for percent renewable generation for each of the additional metrics reported for EA Prerequisite 2: Minimum energy performance (Energy Sources, Greenhouse Gas Emissions, and if applicable – TDV Energy). Provide a narrative describing how the renewable energy value in the numerator was calculated for each metric.

6B.2 OPM DELIVERABLES

6B2.2 Project Schedule

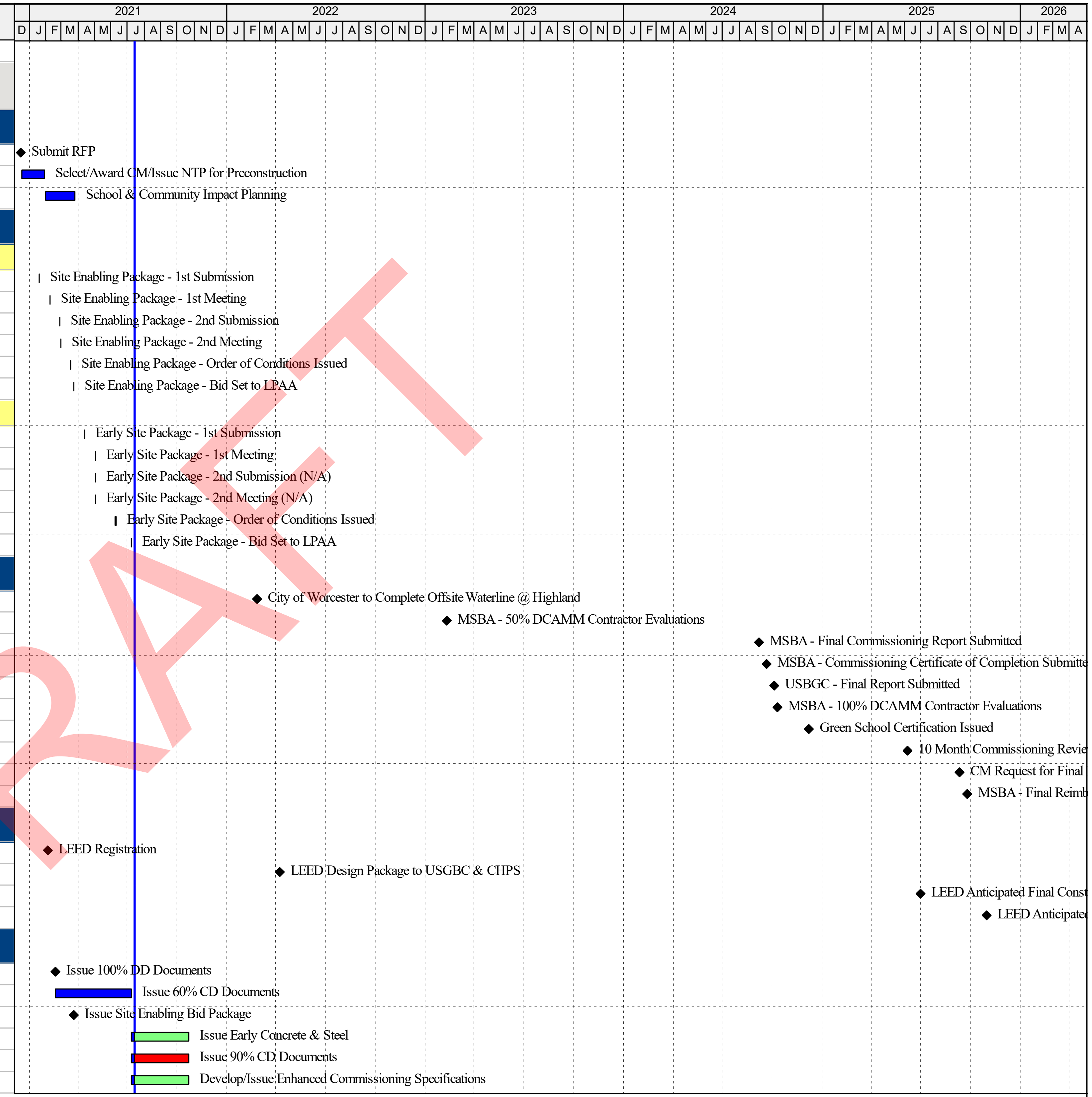
A. Project Schedule

B. Letter from City of Worcester

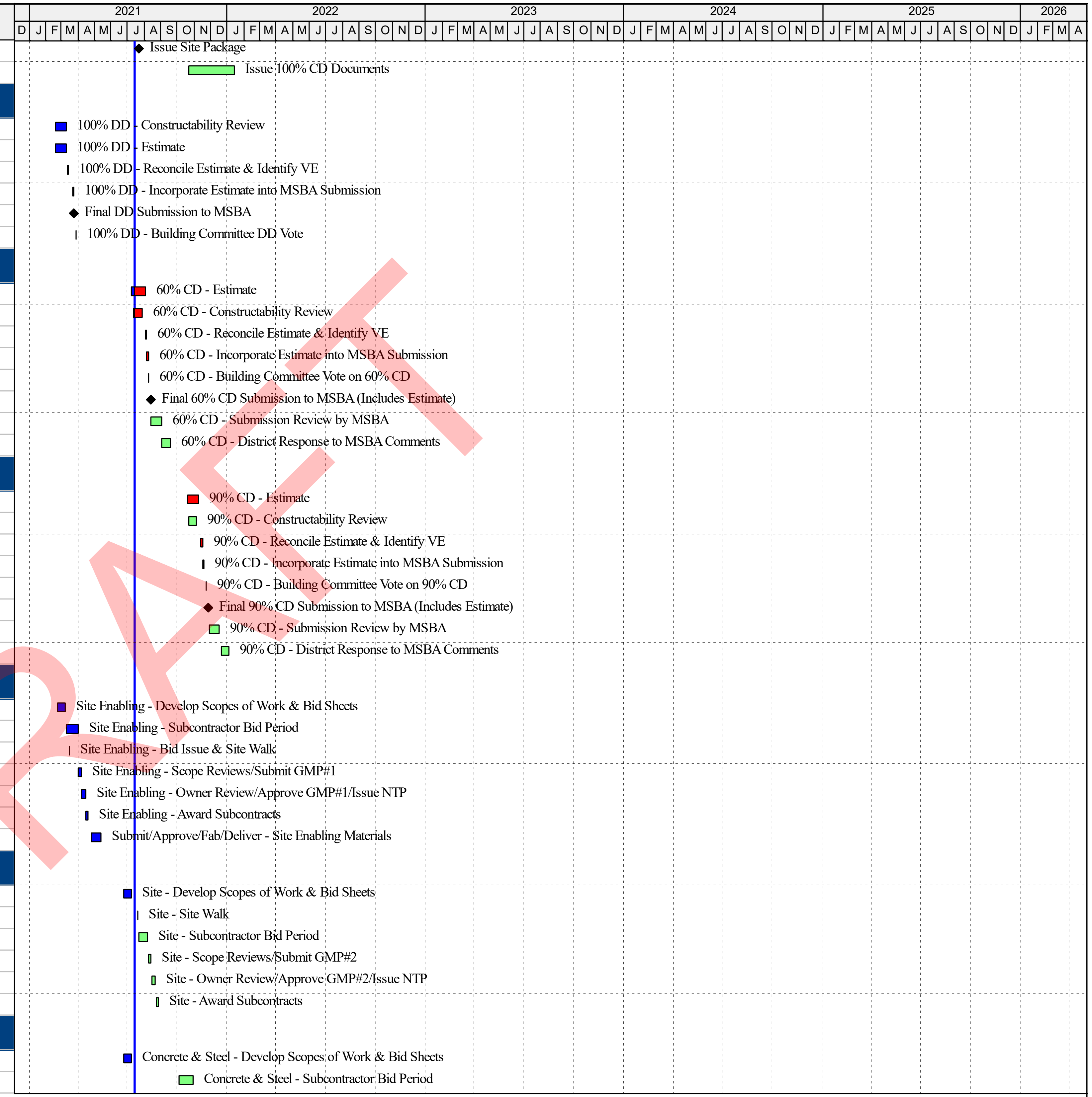
A. Project Schedule

PRECONSTRUCTION

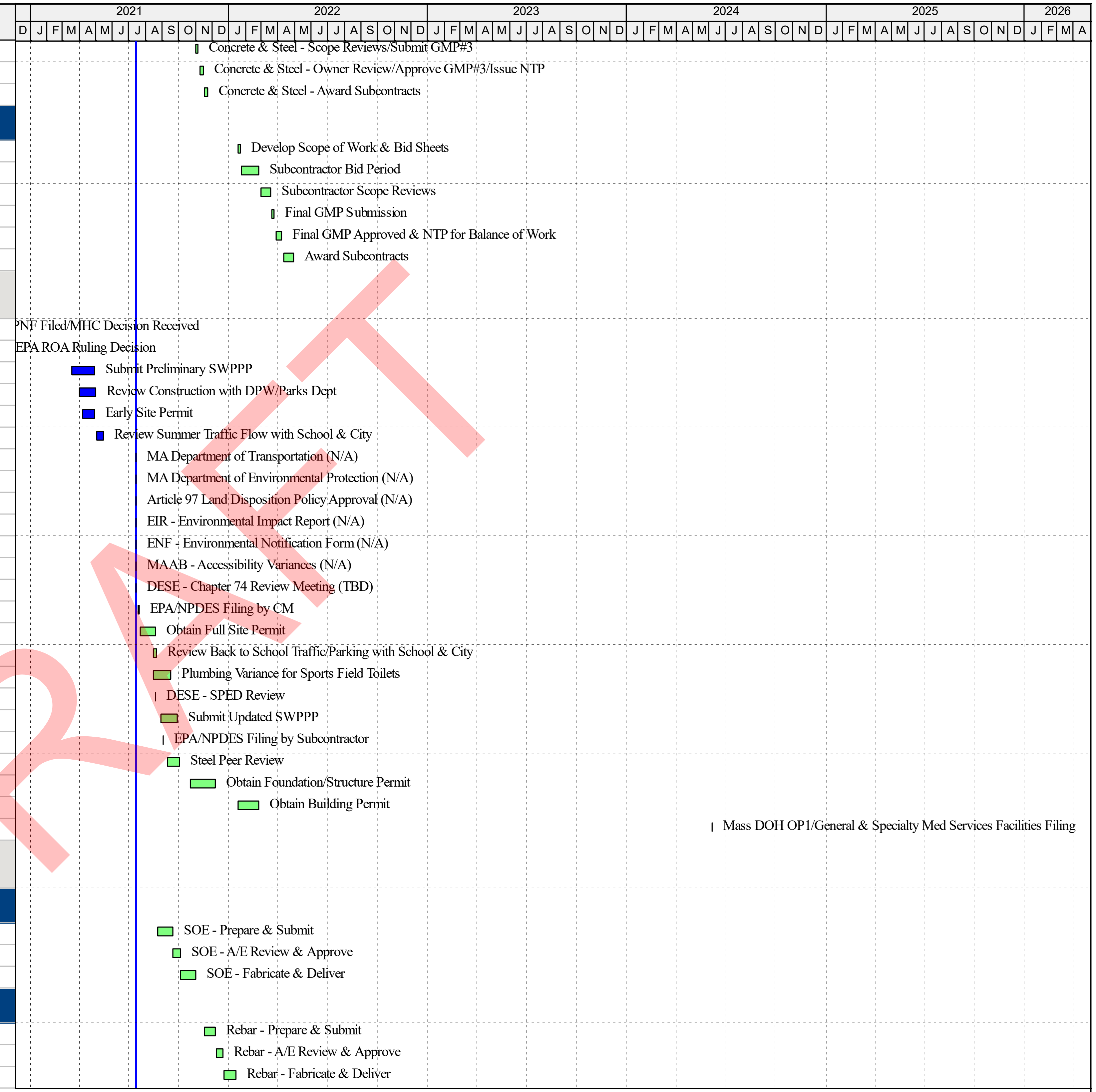
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
GENERAL PRECONSTRUCTION					
P01	Submit RFP	0	0	12/17/20 A	
P02	Select/Award CM/Issue NTP for Preconstruction	29	0	12/18/20 A	01/29/21 A
P03	School & Community Impact Planning	40	0	02/01/21 A	03/26/21 A
CONSERVATION COMMISSION SUBMISSIONS/REVIEWS					
Site Enabling Package					
P12.1	Site Enabling Package - 1st Submission	1	0	01/20/21 A	01/20/21 A
P12.2	Site Enabling Package - 1st Meeting	1	0	02/08/21 A	02/08/21 A
P12.3	Site Enabling Package - 2nd Submission	1	0	02/26/21 A	02/26/21 A
P12.4	Site Enabling Package - 2nd Meeting	1	0	03/01/21 A	03/01/21 A
P12.5	Site Enabling Package - Order of Conditions Issued	1	0	03/19/21 A	03/19/21 A
P12.6	Site Enabling Package - Bid Set to LPAA	1	0	03/25/21 A	03/25/21 A
Early Site Package					
P14.1	Early Site Package - 1st Submission	1	0	04/14/21 A	04/14/21 A
P14.2	Early Site Package - 1st Meeting	1	0	05/03/21 A	05/03/21 A
P14.3	Early Site Package - 2nd Submission (N/A)	0	0	05/04/21 A	05/04/21 A
P14.4	Early Site Package - 2nd Meeting (N/A)	0	0	05/04/21 A	05/04/21 A
P14.5	Early Site Package - Order of Conditions Issued	1	0	06/09/21 A	06/09/21 A
P14.6	Early Site Package - Bid Set to LPAA	1	0	07/08/21 A	07/08/21 A
OWNER MILESTONES					
O/MS10	City of Worcester to Complete Offsite Waterline @ Highland	0	0		02/25/22
O/MS1	MSBA - 50% DCAMM Contractor Evaluations	0	0	02/10/23 A	
O/MS2	MSBA - Final Commissioning Report Submitted	0	0	09/06/24*	
O/MS3	MSBA - Commissioning Certificate of Completion Submitted	0	0	09/20/24*	
O/MS4	USBGC - Final Report Submitted	0	0	10/04/24*	
O/MS5	MSBA - 100% DCAMM Contractor Evaluations	0	0	10/10/24*	
O/MS6	Green School Certification Issued	0	0	12/06/24*	
O/MS7	10 Month Commissioning Review	0	0	06/06/25*	
O/MS8	CM Request for Final Payment	0	0	09/10/25*	
O/MS9	MSBA - Final Reimbursement Request Submitted	0	0	09/24/25*	
LEED MILESTONES					
LEED1	LEED Registration	0	0	02/05/21 A	
LEED2	LEED Design Package to USGBC & CHPS	0	0	04/08/22*	
LEED3	LEED Anticipated Final Construction Package to USGBC & CHPS	0	0	06/30/25*	
LEED4	LEED Anticipated Final Green School Certification from USGBC & CHPS	0	0	10/30/25*	
CONSTRUCTION DOCUMENTS					
P10	Issue 100% DD Documents	0	0	02/18/21 A	
P11	Issue 60% CD Documents	99	0	02/19/21 A	07/08/21 A
P12	Issue Site Enabling Bid Package	0	0	03/25/21 A	
P14	Issue Early Concrete & Steel	75	71	07/09/21 A	10/21/21
P13	Issue 90% CD Documents	65	71	07/09/21 A	10/21/21
P13.1	Develop/Issue Enhanced Commissioning Specifications	65	71	07/09/21 A	10/21/21



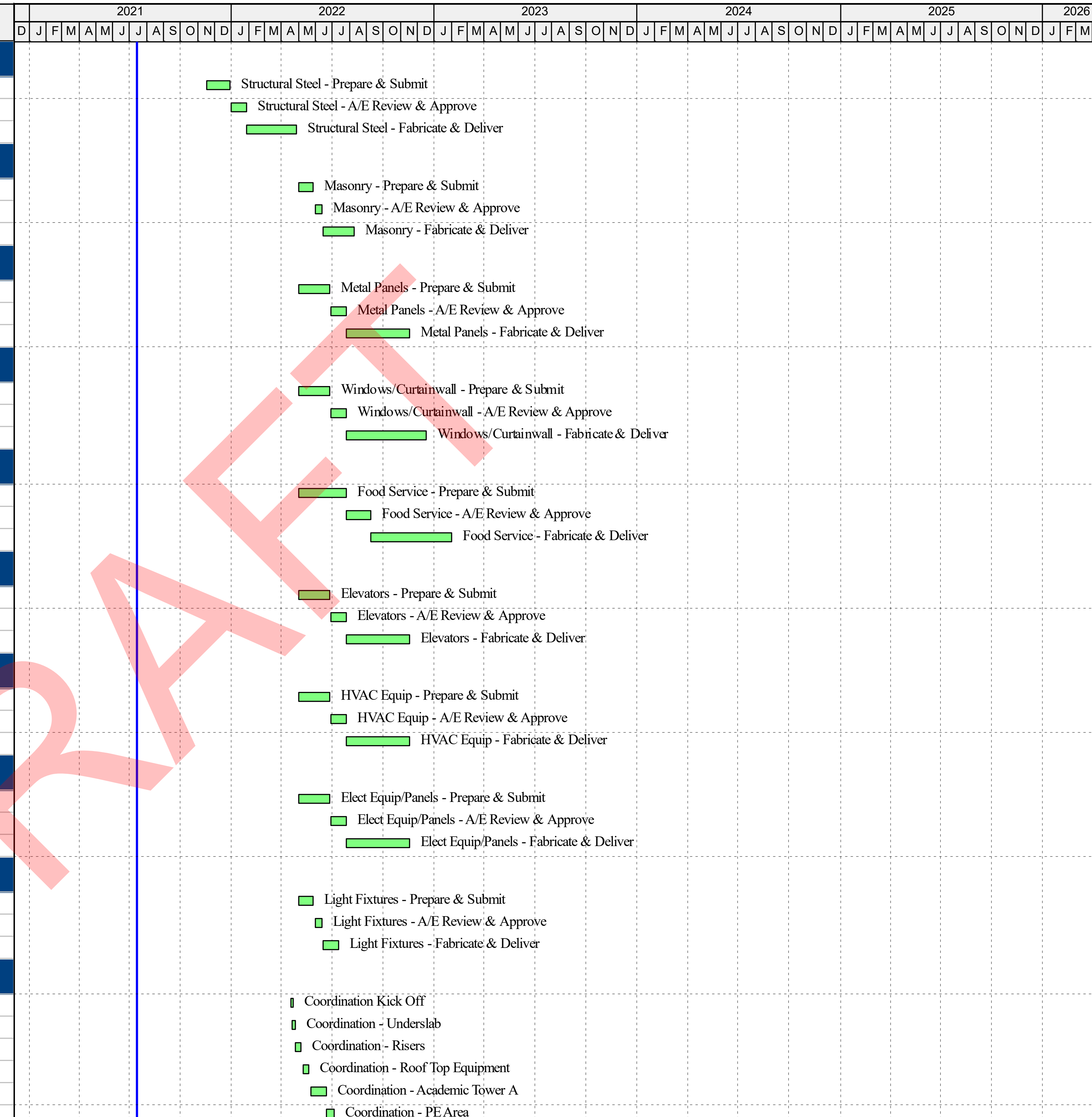
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
P16	Issue Site Package	0	0	07/22/21*	
P15	Issue 100% CD Documents	57	57	10/22/21	01/14/22
100% DD ESTIMATE/RECONCILIATION/SUBMISSION TO MSBA					
P20	100% DD - Constructability Review	10	0	02/18/21 A	03/11/21 A
P21	100% DD - Estimate	15	0	02/19/21 A	03/11/21 A
P22	100% DD - Reconcile Estimate & Identify VE	2	0	03/12/21 A	03/15/21 A
P23	100% DD - Incorporate Estimate into MSBA Submission	3	0	03/23/21 A	03/25/21 A
P25	Final DD Submission to MSBA	0	0		03/25/21 A
P24	100% DD - Building Committee DD Vote	1	0	03/29/21 A	03/29/21 A
60% CD ESTIMATE/RECONCILIATION/SUBMISSION TO MSBA					
P31	60% CD - Estimate	13	14	07/08/21 A	08/02/21
P30	60% CD - Constructability Review	10	10	07/13/21 A	07/27/21
P32	60% CD - Reconcile Estimate & Identify VE	2	2	08/03/21	08/04/21
P33	60% CD - Incorporate Estimate into MSBA Submission	3	3	08/05/21	08/09/21
P34	60% CD - Building Committee Vote on 60% CD	1	1	08/09/21	08/09/21
P35	Final 60% CD Submission to MSBA (Includes Estimate)	0	0		08/12/21*
P35a	60% CD - Submission Review by MSBA	15	15	08/13/21	09/02/21
P35b	60% CD - District Response to MSBA Comments	10	10	09/03/21	09/17/21
90% CD ESTIMATE/RECONCILIATION/SUBMISSION TO MSBA					
P40	90% CD - Estimate	13	13	10/21/21	11/08/21
P41	90% CD - Constructability Review	10	10	10/22/21	11/04/21
P42	90% CD - Reconcile Estimate & Identify VE	3	3	11/12/21	11/16/21
P43	90% CD - Incorporate Estimate into MSBA Submission	2	2	11/17/21	11/18/21
P44	90% CD - Building Committee Vote on 90% CD	1	1	11/23/21	11/23/21
P45	Final 90% CD Submission to MSBA (Includes Estimate)	0	0		11/26/21*
P45a	90% CD - Submission Review by MSBA	15	15	11/29/21	12/17/21
P45b	90% CD - District Response to MSBA Comments	10	10	12/20/21	01/04/22
GMP #1 - SITE ENABLING BID/AWARD PROCESS					
P50	Site Enabling - Develop Scopes of Work & Bid Sheets	10	0	02/23/21 A	03/09/21 A
P52	Site Enabling - Subcontractor Bid Period	15	0	03/10/21 A	04/02/21 A
P51	Site Enabling - Bid Issue & Site Walk	1	0	03/17/21 A	03/17/21 A
P53	Site Enabling - Scope Reviews/Submit GMP#1	2	0	04/02/21 A	04/07/21 A
P54	Site Enabling - Owner Review/Approve GMP#1/Issue NTP	2	0	04/08/21 A	04/15/21 A
P55	Site Enabling - Award Subcontracts	1	0	04/16/21 A	04/19/21 A
P56	Submit/Approve/Fab/Deliver - Site Enabling Materials	10	0	04/26/21 A	05/12/21 A
GMP #2 - EARLY PACKAGE (Site)					
P60	Site - Develop Scopes of Work & Bid Sheets	10	0	06/24/21 A	07/08/21 A
P61	Site - Site Walk	1	1	07/20/21	07/20/21
P62	Site - Subcontractor Bid Period	12	12	07/22/21	08/06/21
P63	Site - Scope Reviews/Submit GMP#2	5	5	08/09/21	08/13/21
P64	Site - Owner Review/Approve GMP#2/Issue NTP	5	5	08/16/21	08/20/21
P65	Site - Award Subcontracts	5	5	08/23/21	08/27/21
GMP #3 - EARLY PACKAGE (Concrete & Steel)					
P70	Concrete & Steel - Develop Scopes of Work & Bid Sheets	5	0	06/24/21 A	07/08/21 A
P72	Concrete & Steel - Subcontractor Bid Period	20	20	10/04/21	10/29/21



Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
P73	Concrete & Steel - Scope Reviews/Submit GMP#3	5	5	11/01/21	11/05/21
P74	Concrete & Steel - Owner Review/Approve GMP#3/Issue NTP	5	5	11/08/21	11/15/21
P75	Concrete & Steel - Award Subcontracts	5	5	11/16/21	11/22/21
FULL GMP PROCESS					
P80	Develop Scope of Work & Bid Sheets	5	5	01/17/22	01/21/22
P81	Subcontractor Bid Period	25	25	01/24/22	02/25/22
P82	Subcontractor Scope Reviews	15	15	02/28/22	03/18/22
P83	Final GMP Submission	5	5	03/21/22	03/25/22
P84	Final GMP Approved & NTP for Balance of Work	10	10	03/28/22	04/08/22
P85	Award Subcontracts	15	15	04/11/22	04/29/22
PERMITTING/REVIEWS					
PT11	MHC PNF Filed/MHC Decision Received	95	0	04/27/20 A	09/08/20 A
PT10	MEPA ROA Ruling Decision	1	0	10/23/20 A	10/23/20 A
PT9	Submit Preliminary SWPPP	20	0	03/19/21 A	04/28/21 A
PT6	Review Construction with DPW/Parks Dept	10	0	04/02/21 A	04/30/21 A
PT8	Early Site Permit	20	0	04/08/21 A	04/28/21 A
PT7	Review Summer Traffic Flow with School & City	10	0	05/03/21 A	05/14/21 A
PT16	MA Department of Transportation (N/A)	1	1	07/14/21	07/14/21
PT17	MA Department of Environmental Protection (N/A)	1	1	07/14/21	07/14/21
PT18	Article 97 Land Disposition Policy Approval (N/A)	1	1	07/14/21	07/14/21
PT19	EIR - Environmental Impact Report (N/A)	1	1	07/14/21	07/14/21
PT20	ENF - Environmental Notification Form (N/A)	1	1	07/14/21	07/14/21
PT21	MAAB - Accessibility Variances (N/A)	1	1	07/14/21	07/14/21
PT23	DESE - Chapter 74 Review Meeting (TBD)	1	1	07/14/21	07/14/21
PT14	EPA/NPDES Filing by CM	1	1	07/19/21*	07/19/21
PT2	Obtain Full Site Permit	20	20	07/22/21	08/18/21
PT5	Review Back to School Traffic/Parking with School & City	5	5	08/16/21	08/20/21
PT12	Plumbing Variance for Sports Field Toilets	22	22	08/16/21*	09/15/21
PT22	DESE - SPED Review	1	1	08/19/21*	08/19/21
PT4	Submit Updated SWPPP	20	20	08/30/21	09/27/21
PT15	EPA/NPDES Filing by Subcontractor	1	1	09/02/21	09/02/21
PT24	Steel Peer Review	16	16	09/10/21*	10/01/21
PT3	Obtain Foundation/Structure Permit	30	30	10/22/21	12/06/21
PT1	Obtain Building Permit	30	30	01/17/22	02/25/22
PT13	Mass DOH OP1/General & Specialty Med Services Facilities Filing	1	1	06/06/24	06/06/24
PROCUREMENT & COORDINATION					
SOE					
PRO10	SOE - Prepare & Submit	20	20	08/23/21	09/20/21
PRO11	SOE - A/E Review & Approve	10	10	09/21/21	10/04/21
PRO12	SOE - Fabricate & Deliver	20	20	10/05/21	11/01/21
Rebar					
PRO15	Rebar - Prepare & Submit	15	15	11/16/21	12/07/21
PRO16	Rebar - A/E Review & Approve	10	10	12/08/21	12/21/21
PRO17	Rebar - Fabricate & Deliver	15	15	12/22/21	01/13/22



Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
Steel					
PRO20	Structural Steel - Prepare & Submit	30	30	11/16/21	12/29/21
PRO21	Structural Steel - A/E Review & Approve	20	20	12/30/21	01/27/22
PRO22	Structural Steel - Fabricate & Deliver	65	65	01/28/22	04/28/22
Masonry					
PRO25	Masonry - Prepare & Submit	20	20	05/02/22	05/27/22
PRO26	Masonry - A/E Review & Approve	10	10	05/31/22	06/13/22
PRO27	Masonry - Fabricate & Deliver	40	40	06/14/22	08/09/22
Exterior Metal Panel System					
PRO30	Metal Panels - Prepare & Submit	40	40	05/02/22	06/27/22
PRO31	Metal Panels - A/E Review & Approve	20	20	06/28/22	07/26/22
PRO32	Metal Panels - Fabricate & Deliver	80	80	07/27/22	11/17/22
Windows/Curtainwall					
PRO35	Windows/Curtainwall - Prepare & Submit	40	40	05/02/22	06/27/22
PRO36	Windows/Curtainwall - A/E Review & Approve	20	20	06/28/22	07/26/22
PRO37	Windows/Curtainwall - Fabricate & Deliver	100	100	07/27/22	12/16/22
Food Service Equipment					
PRO40	Food Service - Prepare & Submit	60	60	05/02/22	07/26/22
PRO41	Food Service - A/E Review & Approve	30	30	07/27/22	09/07/22
PRO42	Food Service - Fabricate & Deliver	100	100	09/08/22	01/31/23
Elevators					
PRO45	Elevators - Prepare & Submit	40	40	05/02/22	06/27/22
PRO46	Elevators - A/E Review & Approve	20	20	06/28/22	07/26/22
PRO47	Elevators - Fabricate & Deliver	80	80	07/27/22	11/17/22
HVAC Equipment					
PRO50	HVAC Equip - Prepare & Submit	40	40	05/02/22	06/27/22
PRO51	HVAC Equip - A/E Review & Approve	20	20	06/28/22	07/26/22
PRO52	HVAC Equip - Fabricate & Deliver	80	80	07/27/22	11/17/22
Electrical Equipment					
PRO55	Elect Equip/Panels - Prepare & Submit	40	40	05/02/22	06/27/22
PRO56	Elect Equip/Panels - A/E Review & Approve	20	20	06/28/22	07/26/22
PRO57	Elect Equip/Panels - Fabricate & Deliver	80	80	07/27/22	11/17/22
Light Fixtures					
PRO60	Light Fixtures - Prepare & Submit	20	20	05/02/22	05/27/22
PRO61	Light Fixtures - A/E Review & Approve	10	10	05/31/22	06/13/22
PRO62	Light Fixtures - Fabricate & Deliver	20	20	06/14/22	07/12/22
Coordination					
CORD10	Coordination Kick Off	5	5	04/18/22	04/22/22
CORD21	Coordination - Underslab	5	5	04/19/22	04/25/22
CORD11	Coordination - Risers	10	10	04/25/22	05/06/22
CORD12	Coordination - Roof Top Equipment	10	10	05/09/22	05/20/22
CORD13	Coordination - Academic Tower A	20	20	05/23/22	06/20/22
CORD14	Coordination - PE Area	10	10	06/21/22	07/05/22



FONTAINE + DIMEO

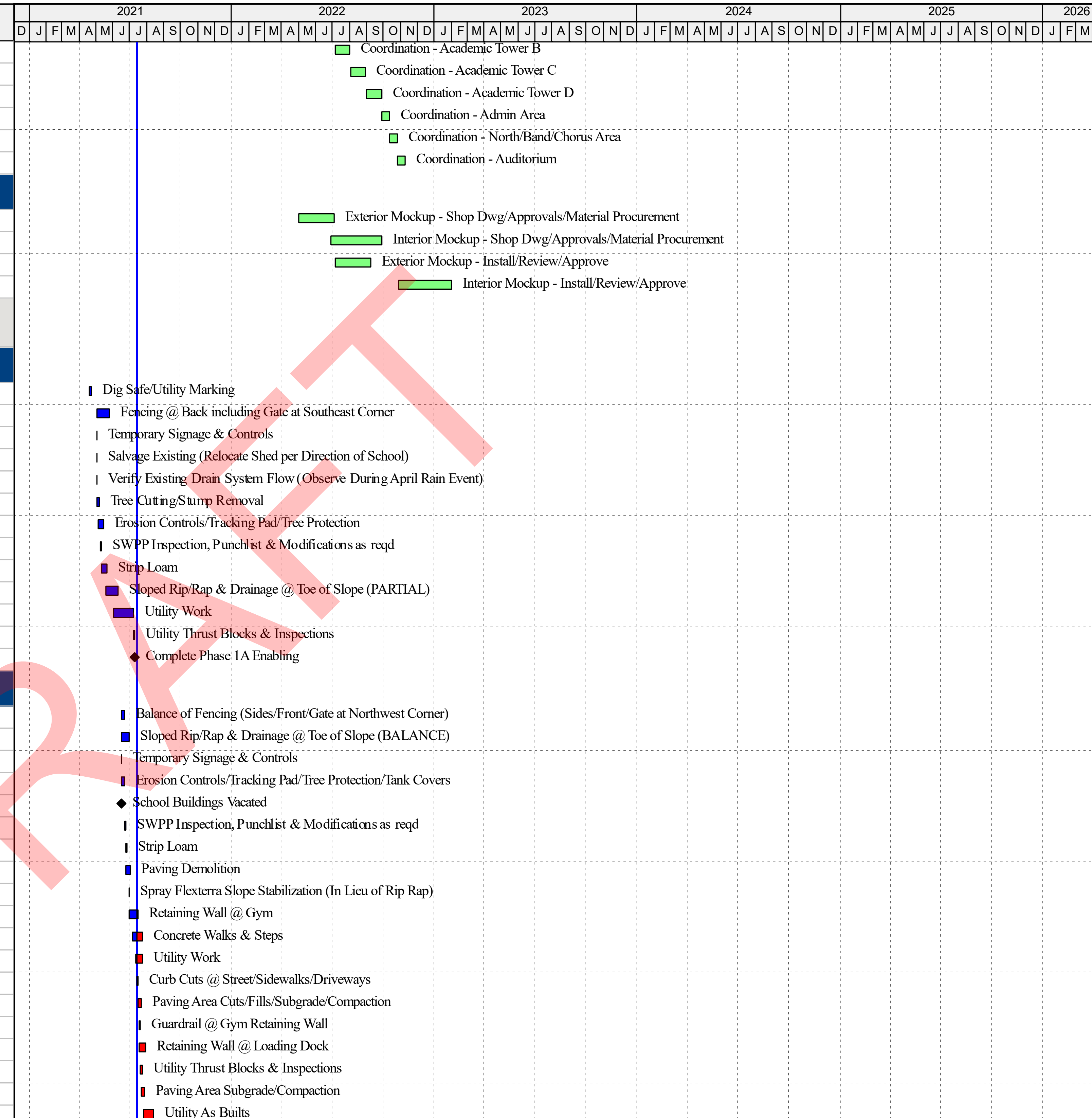
NEW DOHERTY MEMORIAL HIGH SCHOOL

60% CD Submission Schedule

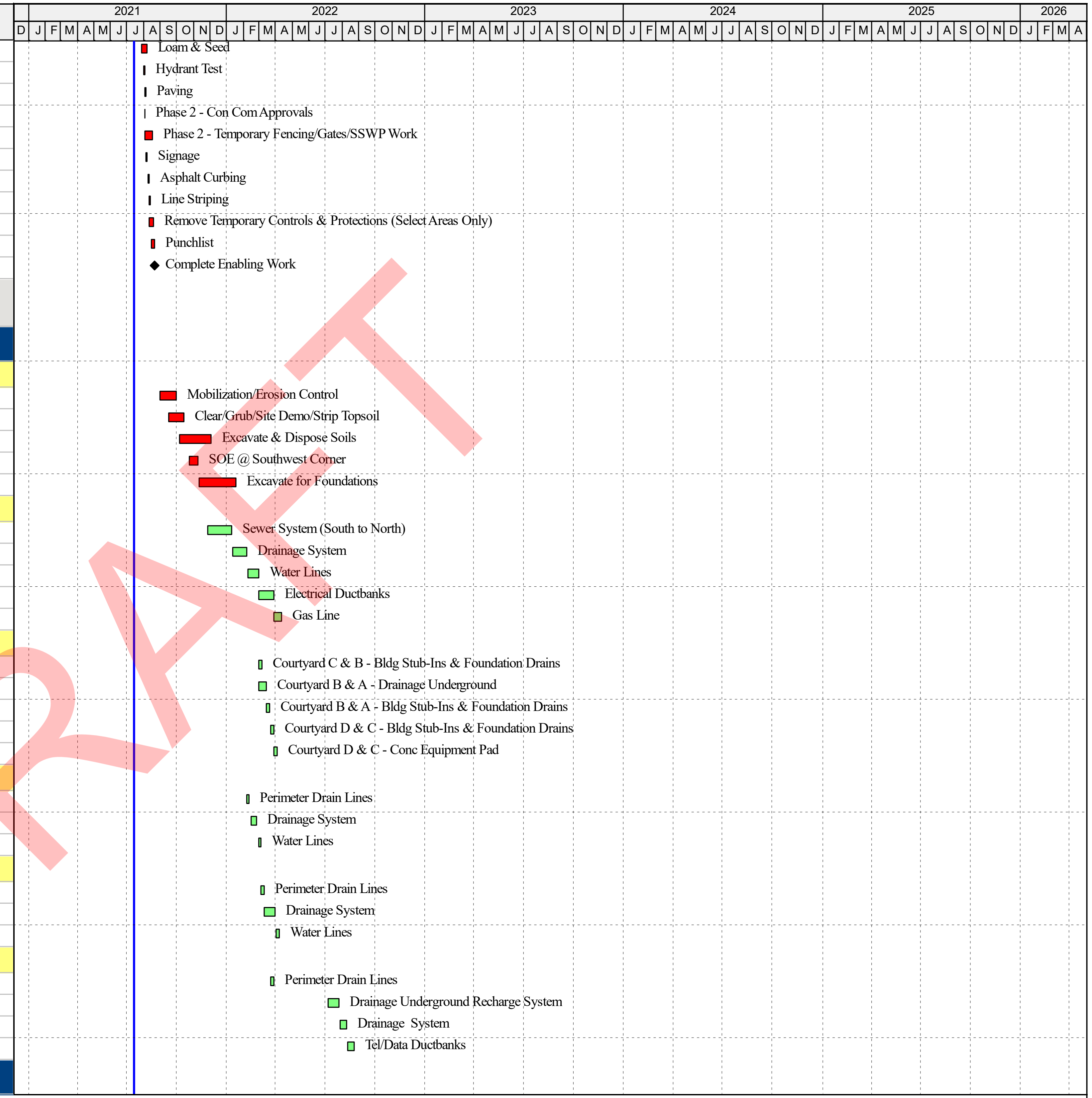
Data Date: 07/14/21
Run Date: 07/19/21

Schedule ID : **372-20F**
Construction Start Date : 05/03/21
Construction Completion Date : 7/16/25

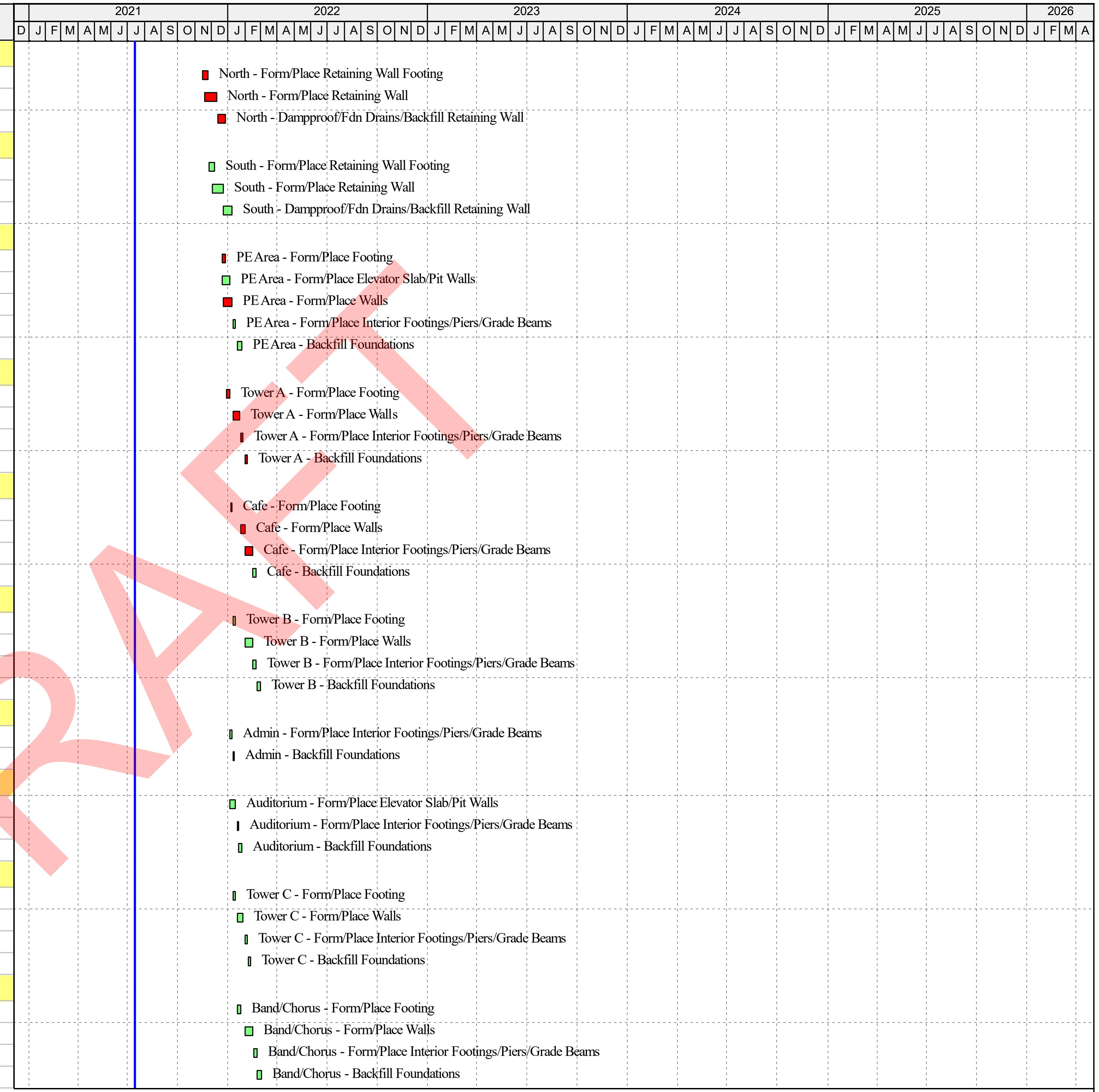
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
CORD15	Coordination - Academic Tower B	20	20	07/06/22	08/02/22
CORD16	Coordination - Academic Tower C	20	20	08/03/22	08/30/22
CORD17	Coordination - Academic Tower D	20	20	08/31/22	09/28/22
CORD18	Coordination - Admin Area	10	10	09/29/22	10/12/22
CORD19	Coordination - North/Band/Chorus Area	10	10	10/13/22	10/26/22
CORD20	Coordination - Auditorium	10	10	10/27/22	11/09/22
Mockups					
MU01	Exterior Mockup - Shop Dwg/Approvals/Material Procurement	45	45	05/02/22	07/05/22
MU03	Interior Mockup - Shop Dwg/Approvals/Material Procurement	65	65	06/28/22	09/28/22
MU02	Exterior Mockup - Install/Review/Approve	45	45	07/06/22	09/07/22
MU04	Interior Mockup - Install/Review/Approve	65	65	10/28/22	02/01/23
PHASE 1 - EARLY SITE ENABLING					
Phase 1A Enabling - 5/1/21 through 6/15/21					
EN10	Dig Safe/Utility Marking	5	0	04/19/21 A	04/23/21 A
EN11	Fencing @ Back including Gate at Southeast Corner	5	0	05/03/21 A	05/24/21 A
EN12	Temporary Signage & Controls	1	0	05/03/21 A	05/03/21 A
EN13	Salvage Existing (Relocate Shed per Direction of School)	1	0	05/03/21 A	05/03/21 A
EN14	Verify Existing Drain System Flow (Observe During April Rain Event)	1	0	05/03/21 A	05/03/21 A
EN18	Tree Cutting/Stump Removal	10	0	05/03/21 A	05/08/21 A
EN15	Erosion Controls/Tracking Pad/Tree Protection	3	0	05/05/21 A	05/14/21 A
EN16	SWPP Inspection, Punchlist & Modifications as reqd	2	0	05/10/21 A	05/11/21 A
EN17	Strip Loam	10	0	05/12/21 A	05/21/21 A
EN20	Sloped Rip/Rap & Drainage @ Toe of Slope (PARTIAL)	20	0	05/20/21 A	06/10/21 A
EN19	Utility Work	20	0	06/03/21 A	07/07/21 A
EN21	Utility Thrust Blocks & Inspections	3	0	07/08/21 A	07/10/21 A
EN22	Complete Phase 1A Enabling	0	0		07/10/21 A
Phases 1B/1C/1D Enabling - 6/16/21 through 8/20/21					
EN50	Balance of Fencing (Sides/Front/Gate at Northwest Corner)	4	0	06/16/21 A	06/21/21 A
EN51	Sloped Rip/Rap & Drainage @ Toe of Slope (BALANCE)	15	0	06/16/21 A	06/30/21 A
EN52	Temporary Signage & Controls	1	0	06/16/21 A	06/16/21 A
EN53	Erosion Controls/Tracking Pad/Tree Protection/Tank Covers	4	0	06/16/21 A	06/21/21 A
EN49	School Buildings Vacated	0	0	06/16/21 A	
EN54	SWPP Inspection, Punchlist & Modifications as reqd	2	0	06/22/21 A	06/23/21 A
EN56	Strip Loam	2	0	06/24/21 A	06/25/21 A
EN58	Paving Demolition	2	0	06/25/21 A	07/02/21 A
EN51.1	Spray Flexterra Slope Stabilization (In Lieu of Rip Rap)	1	0	06/30/21 A	06/30/21 A
EN60	Retaining Wall @ Gym	10	3	07/01/21 A	07/16/21
EN66	Concrete Walks & Steps	7	8	07/06/21 A	07/23/21
EN59	Utility Work	16	8	07/12/21 A	07/23/21
EN57	Curb Cuts @ Street/Sidewalks/Driveways	2	2	07/14/21	07/15/21
EN67	Paving Area Cuts/Fills/Subgrade/Compaction	4	4	07/16/21	07/21/21
EN65	Guardrail @ Gym Retaining Wall	2	2	07/19/21	07/20/21
EN61	Retaining Wall @ Loading Dock	10	10	07/19/21	07/30/21
EN62	Utility Thrust Blocks & Inspections	3	3	07/21/21	07/23/21
EN6.1	Paving Area Subgrade/Compaction	4	4	07/22/21	07/27/21
EN63	Utility As Builts	15	15	07/26/21	08/13/21



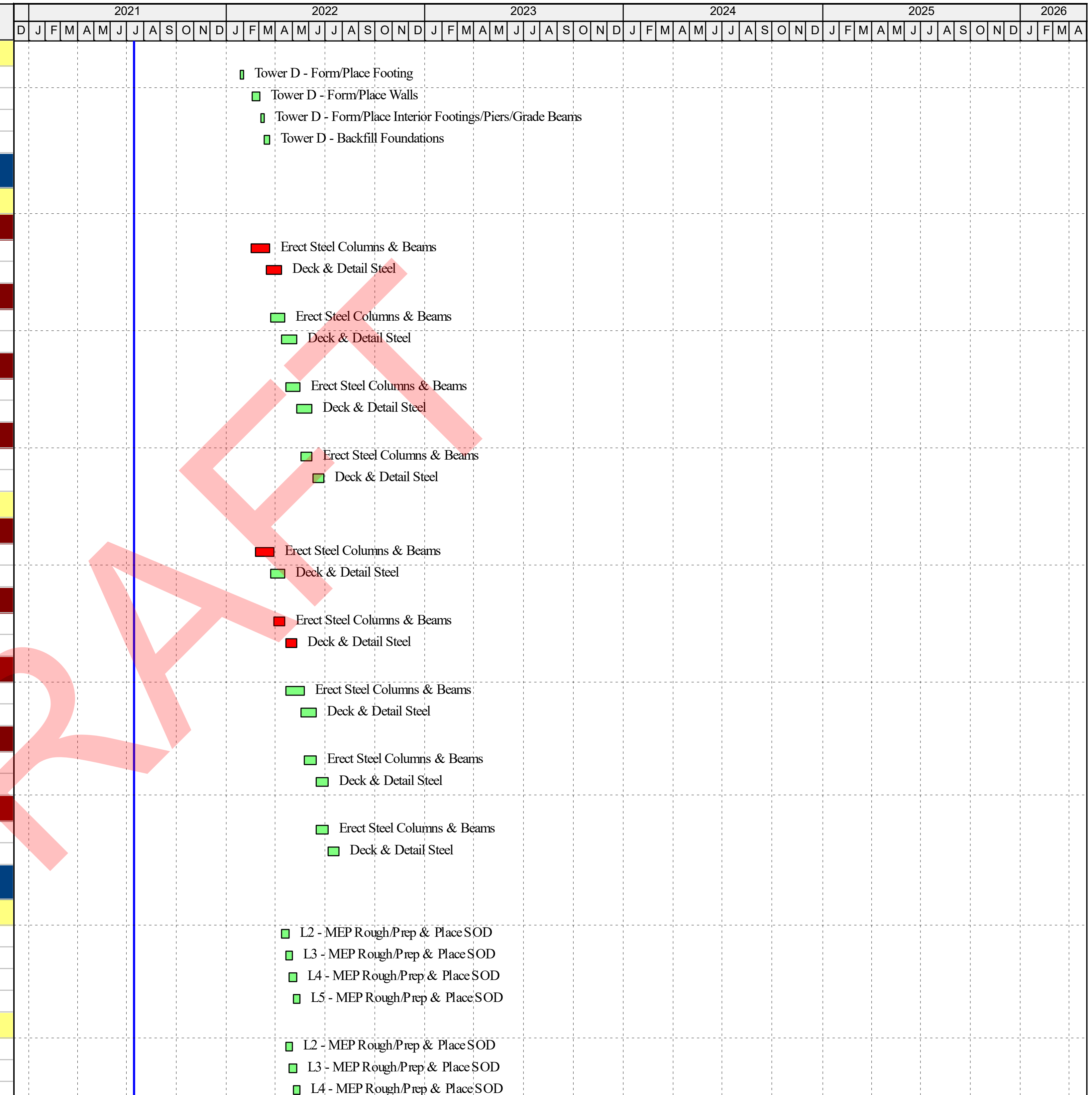
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
EN68	Loam & Seed	7	7	07/29/21	08/06/21
EN64	Hydrant Test	1	1	08/02/21	08/02/21
EN69	Paving	2	2	08/03/21	08/04/21
EN77	Phase 2 - Con Com Approvals	1	1	08/03/21	08/03/21
EN70	Phase 2 - Temporary Fencing/Gates/SSWP Work	10	10	08/04/21	08/17/21
EN71	Signage	2	2	08/05/21	08/06/21
EN72	Asphalt Curbing	2	2	08/10/21	08/11/21
EN73	Line Striping	2	2	08/12/21	08/13/21
EN74	Remove Temporary Controls & Protections (Select Areas Only)	5	5	08/12/21	08/18/21
EN75	Punchlist	5	5	08/16/21	08/20/21
EN76	Complete Enabling Work	0	0		08/20/21*
PHASE 2 - NEW SCHOOL BUILDING					
Mobilization/Site Prep/Utilities/Sitework					
MOBILIZATION/SITE PREP					
MOB1	Mobilization/Erosion Control	20	20	09/01/21*	09/29/21
MOB2	Clear/Grub/Site Demo/Strip Topsoil	20	20	09/16/21	10/13/21
MOB6	Excavate & Dispose Soils	40	40	10/07/21	12/03/21
MOB7	SOE @ Southwest Corner	12	12	10/25/21	11/09/21
MOB4	Excavate for Foundations	45	45	11/10/21	01/17/22
UTILITIES - EAST ACCESS ROAD					
UT10	Sewer System (South to North)	30	30	11/26/21	01/10/22
UT11	Drainage System	20	20	01/11/22	02/07/22
UT12	Water Lines	15	15	02/08/22	02/28/22
UT13	Electrical Ductbanks	20	20	03/01/22	03/28/22
UT14	Gas Line	10	10	03/29/22	04/11/22
UTILITIES - EAST COURTYARDS					
UT20	Courtyard C & B - Bldg Stub-Ins & Foundation Drains	5	5	03/01/22	03/07/22
UT21	Courtyard B & A - Drainage Underground	10	10	03/01/22	03/14/22
UT22	Courtyard B & A - Bldg Stub-Ins & Foundation Drains	5	5	03/15/22	03/21/22
UT23	Courtyard D & C - Bldg Stub-Ins & Foundation Drains	5	5	03/22/22	03/28/22
UT24	Courtyard D & C - Conc Equipment Pad	5	5	03/29/22	04/04/22
UTILITIES - SOUTH ACCESS ROAD & PARKING					
UT30	Perimeter Drain Lines	5	5	02/07/22	02/11/22
UT31	Drainage System	10	10	02/14/22	02/25/22
UT32	Water Lines	5	5	02/28/22	03/04/22
UTILITIES - WEST SIDE OF BUILDING					
UT40	Perimeter Drain Lines	5	5	03/04/22	03/10/22
UT41	Drainage System	15	15	03/11/22	03/31/22
UT42	Water Lines	5	5	04/01/22	04/07/22
UTILITIES - NORTH SIDE OF BUILDING					
UT50	Perimeter Drain Lines	5	5	03/22/22	03/28/22
UT51	Drainage Underground Recharge System	15	15	07/07/22	07/27/22
UT52	Drainage System	10	10	07/28/22	08/10/22
UT53	Tel/Data Ductbanks	10	10	08/11/22	08/24/22
Foundations					



Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
NORTH RETAINING WALL (Foundations)					
F01	North - Form/Place Retaining Wall Footing	8	8	11/15/21	11/24/21
F02	North - Form/Place Retaining Wall	15	15	11/19/21	12/10/21
F03	North - Dampproof/Fdn Drains/Backfill Retaining Wall	10	10	12/13/21	12/27/21
SOUTH RETAINING WALL (Foundations)					
F05	South - Form/Place Retaining Wall Footing	8	8	11/26/21	12/07/21
F06	South - Form/Place Retaining Wall	15	15	12/02/21	12/22/21
F07	South - Dampproof/Fdn Drains/Backfill Retaining Wall	10	10	12/23/21	01/07/22
PHYSICAL EDUCATION AREA (Foundations)					
F11	PE Area - Form/Place Footing	5	5	12/20/21	12/27/21
F10	PE Area - Form/Place Elevator Slab/Pit Walls	10	10	12/20/21	01/04/22
F12	PE Area - Form/Place Walls	10	10	12/23/21	01/07/22
F13	PE Area - Form/Place Interior Footings/Piers/Grade Beams	5	5	01/10/22	01/14/22
F14	PE Area - Backfill Foundations	7	7	01/17/22	01/25/22
ACADEMIC TOWER A (Foundations)					
F20	Tower A - Form/Place Footing	5	5	12/28/21	01/04/22
F21	Tower A - Form/Place Walls	10	10	01/10/22	01/21/22
F22	Tower A - Form/Place Interior Footings/Piers/Grade Beams	5	5	01/24/22	01/28/22
F23	Tower A - Backfill Foundations	5	5	01/31/22	02/04/22
CAFETERIA/KITCHEN AREA (Foundations)					
F30	Cafe - Form/Place Footing	3	3	01/05/22	01/07/22
F31	Cafe - Form/Place Walls	6	6	01/24/22	01/31/22
F32	Cafe - Form/Place Interior Footings/Piers/Grade Beams	10	10	02/01/22	02/14/22
F33	Cafe - Backfill Foundations	5	5	02/15/22	02/21/22
ACADEMIC TOWER B (Foundations)					
F40	Tower B - Form/Place Footing	5	5	01/10/22	01/14/22
F41	Tower B - Form/Place Walls	10	10	02/01/22	02/14/22
F42	Tower B - Form/Place Interior Footings/Piers/Grade Beams	5	5	02/15/22	02/21/22
F43	Tower B - Backfill Foundations	5	5	02/22/22	02/28/22
ADMINISTRATION AREA (Foundations)					
F50	Admin - Form/Place Interior Footings/Piers/Grade Beams	5	5	01/03/22	01/07/22
F51	Admin - Backfill Foundations	3	3	01/10/22	01/12/22
AUDITORIUM (Foundations)					
F60	Auditorium - Form/Place Elevator Slab/Pit Walls	10	10	01/03/22	01/14/22
F61	Auditorium - Form/Place Interior Footings/Piers/Grade Beams	3	3	01/17/22	01/19/22
F62	Auditorium - Backfill Foundations	5	5	01/20/22	01/26/22
ACADEMIC TOWER C (Foundations)					
F70	Tower C - Form/Place Footing	5	5	01/10/22	01/14/22
F71	Tower C - Form/Place Walls	10	10	01/17/22	01/28/22
F72	Tower C - Form/Place Interior Footings/Piers/Grade Beams	5	5	01/31/22	02/04/22
F73	Tower C - Backfill Foundations	5	5	02/07/22	02/11/22
NORTH/BAND/CHORUS AREA (Foundations)					
F80	Band/Chorus - Form/Place Footing	6	6	01/17/22	01/24/22
F81	Band/Chorus - Form/Place Walls	12	12	01/31/22	02/15/22
F82	Band/Chorus - Form/Place Interior Footings/Piers/Grade Beams	5	5	02/16/22	02/22/22
F83	Band/Chorus - Backfill Foundations	7	7	02/23/22	03/03/22



Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
ACADEMIC TOWER D (Foundations)					
F90	Tower D - Form/Place Footing	6	6	01/25/22	02/01/22
F91	Tower D - Form/Place Walls	12	12	02/16/22	03/03/22
F92	Tower D - Form/Place Interior Footings/Piers/Grade Beams	5	5	03/04/22	03/10/22
F93	Tower D - Backfill Foundations	7	7	03/11/22	03/21/22
Structural Steel					
Crane #1 Steel Erection					
SEQUENCE #1 - STEEL @ ACADEMIC TOWER A					
SS10	Erect Steel Columns & Beams	25	25	02/15/22	03/21/22
SS11	Deck & Detail Steel	20	20	03/15/22	04/11/22
SEQUENCE #5 - STEEL @ ACADEMIC TOWER C					
SS50	Erect Steel Columns & Beams	20	20	03/22/22	04/18/22
SS51	Deck & Detail Steel	20	20	04/12/22	05/09/22
SEQUENCE #4 - STEEL @ ACADEMIC TOWER B					
SS40	Erect Steel Columns & Beams	20	20	04/19/22	05/16/22
SS41	Deck & Detail Steel	20	20	05/10/22	06/07/22
SEQUENCE #6 - STEEL @ ACADEMIC TOWER D					
SS60	Erect Steel Columns & Beams	15	15	05/17/22	06/07/22
SS61	Deck & Detail Steel	15	15	06/08/22	06/28/22
Crane #2 Steel Erection					
SEQUENCE #2 - STEEL @ PHYSICAL EDUCATION AREA					
SS20	Erect Steel Columns & Beams	25	25	02/22/22	03/28/22
SS21	Deck & Detail Steel	20	20	03/22/22	04/18/22
SEQUENCE #3 - STEEL @ CAFETERIA/KITCHEN AREA					
SS30	Erect Steel Columns & Beams	15	15	03/29/22	04/18/22
SS31	Deck & Detail Steel	15	15	04/19/22	05/09/22
SEQUENCE #7 - STEEL @ AUDITORIUM					
SS70	Erect Steel Columns & Beams	25	25	04/19/22	05/23/22
SS71	Deck & Detail Steel	20	20	05/17/22	06/14/22
SEQUENCE #8 - STEEL @ ADMINISTRATION AREA					
SS80	Erect Steel Columns & Beams	15	15	05/24/22	06/14/22
SS81	Deck & Detail Steel	15	15	06/15/22	07/06/22
SEQUENCE #9 - STEEL @ NORTH/BAND/CHORUS AREA					
SS90	Erect Steel Columns & Beams	15	15	06/15/22	07/06/22
SS91	Deck & Detail Steel	15	15	07/07/22	07/27/22
Slabs On Deck (SOD)					
ACADEMIC TOWER A (SODs)					
SOD10	L2 - MEP Rough/Prep & Place SOD	10	10	04/12/22	04/25/22
SOD11	L3 - MEP Rough/Prep & Place SOD	10	10	04/19/22	05/02/22
SOD12	L4 - MEP Rough/Prep & Place SOD	10	10	04/26/22	05/09/22
SOD13	L5 - MEP Rough/Prep & Place SOD	10	10	05/03/22	05/16/22
PHYSICAL EDUCATION AREA (SODs)					
SOD20	L2 - MEP Rough/Prep & Place SOD	10	10	04/19/22	05/02/22
SOD21	L3 - MEP Rough/Prep & Place SOD	10	10	04/26/22	05/09/22
SOD22	L4 - MEP Rough/Prep & Place SOD	10	10	05/03/22	05/16/22



FONTAINE + DIMEO

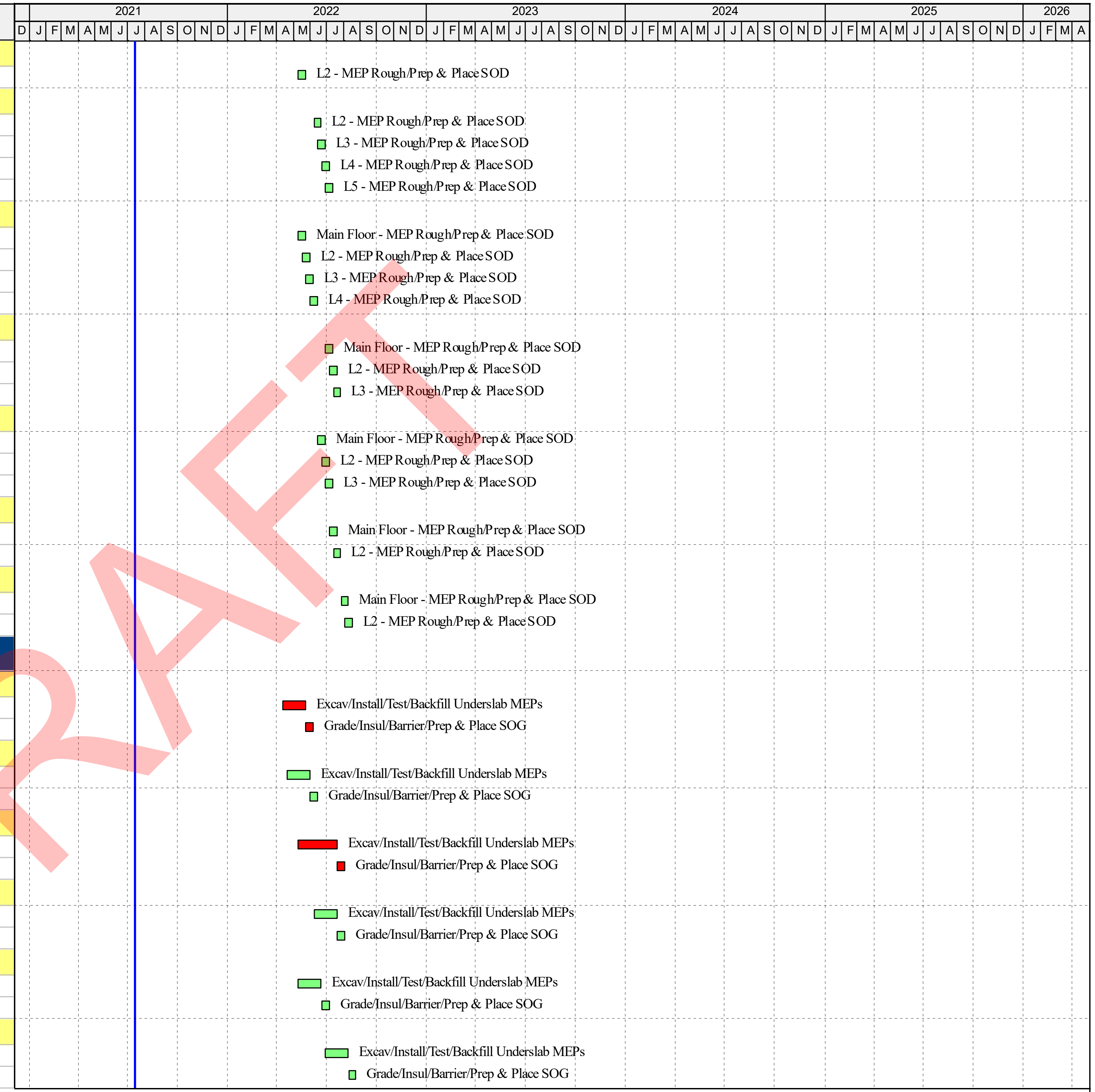
NEW DOHERTY MEMORIAL HIGH SCHOOL

60% CD Submission Schedule

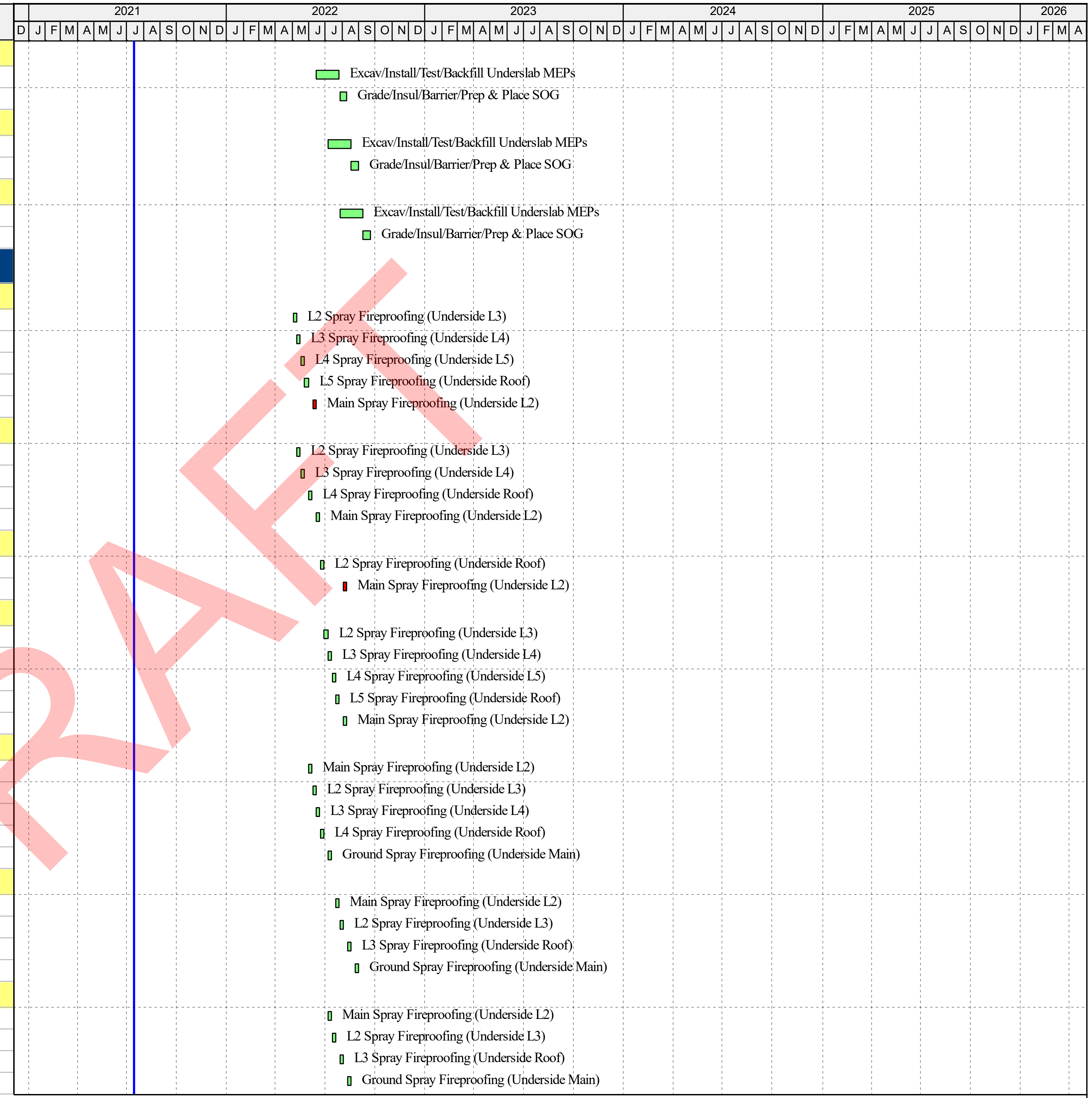
Data Date: 07/14/21
Run Date: 07/19/21

Schedule ID : **372-20F**
Construction Start Date : 05/03/21
Construction Completion Date : 7/16/25

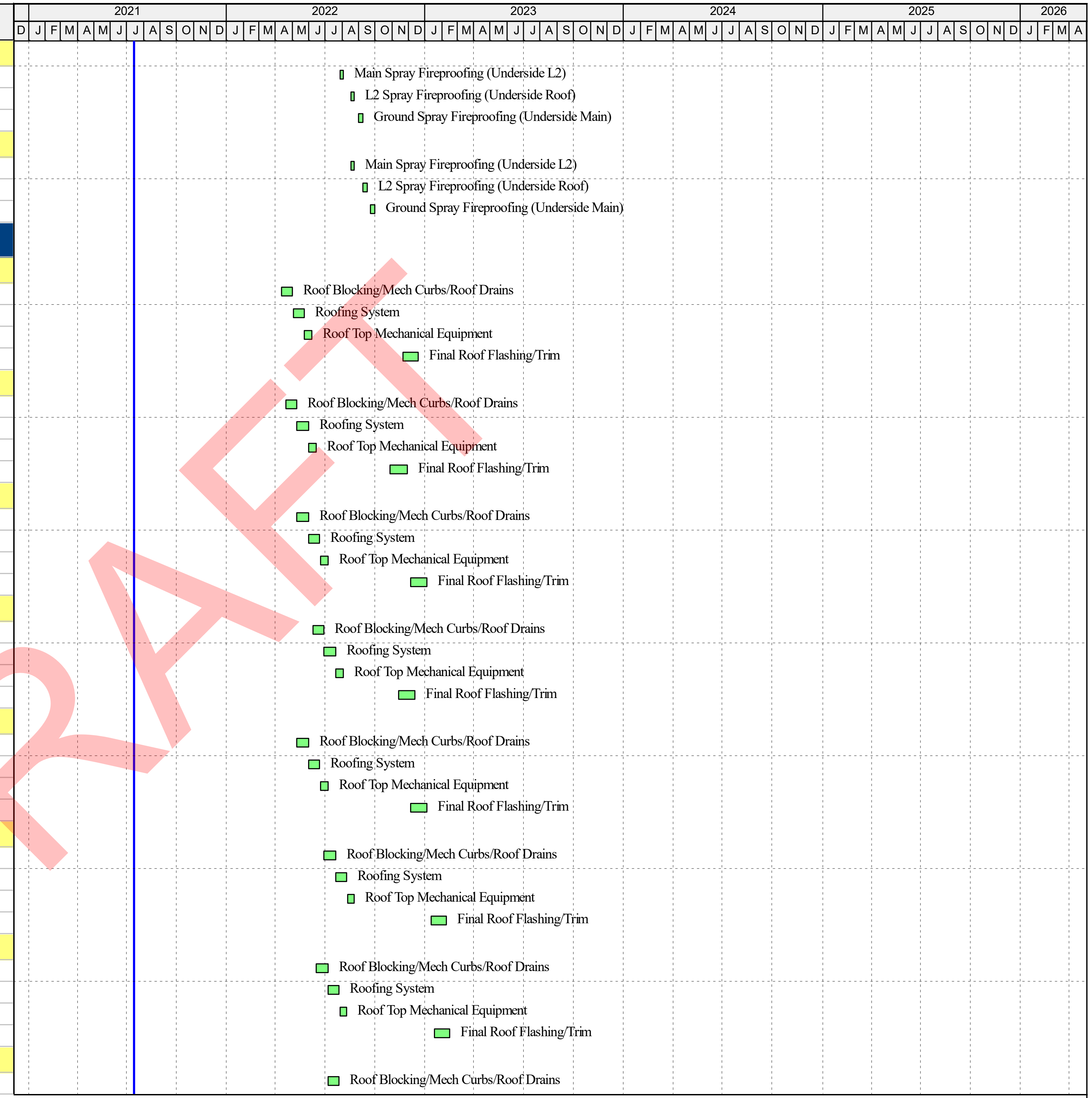
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
CAFETERIA/KITCHEN AREA (SODs)					
SOD30	L2 - MEP Rough/Prep & Place SOD	10	10	05/10/22	05/23/22
ACADEMIC TOWER B (SODs)					
SOD40	L2 - MEP Rough/Prep & Place SOD	10	10	06/08/22	06/21/22
SOD41	L3 - MEP Rough/Prep & Place SOD	10	10	06/15/22	06/28/22
SOD42	L4 - MEP Rough/Prep & Place SOD	10	10	06/22/22	07/06/22
SOD43	L5 - MEP Rough/Prep & Place SOD	10	10	06/29/22	07/13/22
ACADEMIC TOWER C (SODs)					
SOD50	Main Floor - MEP Rough/Prep & Place SOD	10	10	05/10/22	05/23/22
SOD51	L2 - MEP Rough/Prep & Place SOD	10	10	05/17/22	05/31/22
SOD52	L3 - MEP Rough/Prep & Place SOD	10	10	05/24/22	06/07/22
SOD53	L4 - MEP Rough/Prep & Place SOD	10	10	06/01/22	06/14/22
ACADEMIC TOWER D (SODs)					
SOD60	Main Floor - MEP Rough/Prep & Place SOD	10	10	06/29/22	07/13/22
SOD61	L2 - MEP Rough/Prep & Place SOD	10	10	07/07/22	07/20/22
SOD62	L3 - MEP Rough/Prep & Place SOD	10	10	07/14/22	07/27/22
AUDITORIUM (SODs)					
SOD70	Main Floor - MEP Rough/Prep & Place SOD	10	10	06/15/22	06/28/22
SOD71	L2 - MEP Rough/Prep & Place SOD	10	10	06/22/22	07/06/22
SOD72	L3 - MEP Rough/Prep & Place SOD	10	10	06/29/22	07/13/22
ADMINISTRATION AREA (SODs)					
SOD80	Main Floor - MEP Rough/Prep & Place SOD	10	10	07/07/22	07/20/22
SOD81	L2 - MEP Rough/Prep & Place SOD	10	10	07/14/22	07/27/22
NORTH/BAND/CHORUS AREA (SODs)					
SOD90	Main Floor - MEP Rough/Prep & Place SOD	10	10	07/28/22	08/10/22
SOD91	L2 - MEP Rough/Prep & Place SOD	10	10	08/04/22	08/17/22
Slabs on Grade (SOG)					
ACADEMIC TOWER A (SOG)					
SOG10	Excav/Install/Test/Backfill Underslab MEPs	30	30	04/12/22	05/23/22
SOG11	Grade/Insul/Barrier/Prep & Place SOG	10	10	05/24/22	06/07/22
PHYSICAL EDUCATION AREA (SOG)					
SOG20	Excav/Install/Test/Backfill Underslab MEPs	30	30	04/19/22	05/31/22
SOG21	Grade/Insul/Barrier/Prep & Place SOG	10	10	06/01/22	06/14/22
CAFETERIA/KITCHEN AREA (SOG)					
SOG30	Excav/Install/Test/Backfill Underslab MEPs	50	50	05/10/22	07/20/22
SOG31	Grade/Insul/Barrier/Prep & Place SOG	10	10	07/21/22	08/03/22
ACADEMIC TOWER B (SOG)					
SOG40	Excav/Install/Test/Backfill Underslab MEPs	30	30	06/08/22	07/20/22
SOG41	Grade/Insul/Barrier/Prep & Place SOG	10	10	07/21/22	08/03/22
ACADEMIC TOWER C (SOG)					
SOG50	Excav/Install/Test/Backfill Underslab MEPs	30	30	05/10/22	06/21/22
SOG51	Grade/Insul/Barrier/Prep & Place SOG	10	10	06/22/22	07/06/22
ACADEMIC TOWER D (SOG)					
SOG60	Excav/Install/Test/Backfill Underslab MEPs	30	30	06/29/22	08/10/22
SOG61	Grade/Insul/Barrier/Prep & Place SOG	10	10	08/11/22	08/24/22



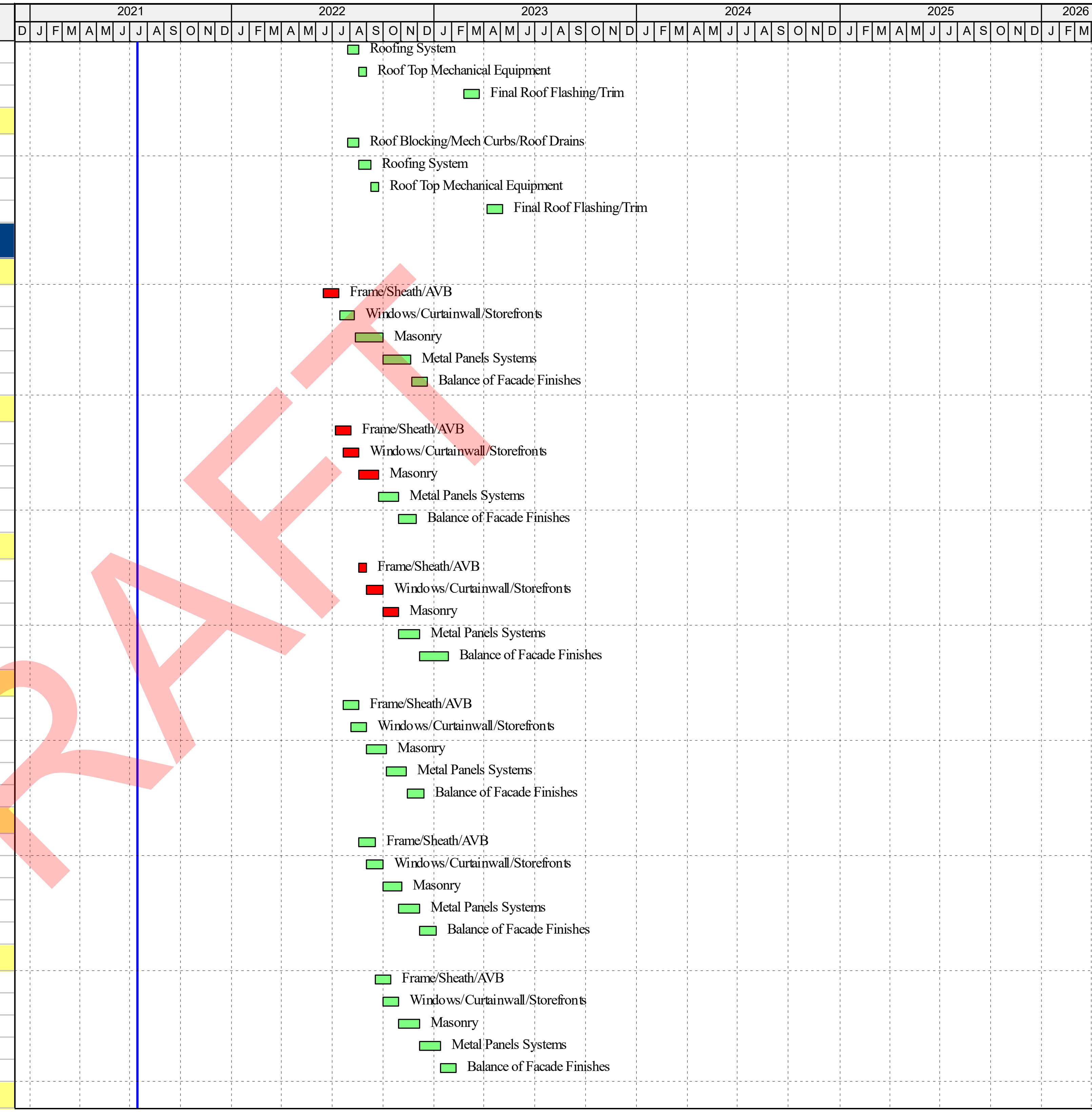
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
AUDITORIUM (SOG)					
SOG70	Excav/Install/Test/Backfill Underslab MEPs	30	30	06/15/22	07/27/22
SOG71	Grade/Insul/Barrier/Prep & Place SOG	10	10	07/28/22	08/10/22
ADMINISTRATION AREA (SOG)					
SOG80	Excav/Install/Test/Backfill Underslab MEPs	30	30	07/07/22	08/17/22
SOG81	Grade/Insul/Barrier/Prep & Place SOG	10	10	08/18/22	08/31/22
NORTH/BAND/CHORUS AREA (SOG)					
SOG90	Excav/Install/Test/Backfill Underslab MEPs	30	30	07/28/22	09/08/22
SOG91	Grade/Insul/Barrier/Prep & Place SOG	10	10	09/09/22	09/22/22
Fireproofing					
ACADEMIC TOWER A (Fireproofing)					
FP12	L2 Spray Fireproofing (Underside L3)	5	5	05/03/22	05/09/22
FP13	L3 Spray Fireproofing (Underside L4)	5	5	05/10/22	05/16/22
FP14	L4 Spray Fireproofing (Underside L5)	5	5	05/17/22	05/23/22
FP15	L5 Spray Fireproofing (Underside Roof)	5	5	05/24/22	05/31/22
FP11	Main Spray Fireproofing (Underside L2)	5	5	06/08/22	06/14/22
PHYSICAL EDUCATION AREA (Fireproofing)					
FP22	L2 Spray Fireproofing (Underside L3)	5	5	05/10/22	05/16/22
FP23	L3 Spray Fireproofing (Underside L4)	5	5	05/17/22	05/23/22
FP24	L4 Spray Fireproofing (Underside Roof)	5	5	06/01/22	06/07/22
FP21	Main Spray Fireproofing (Underside L2)	5	5	06/15/22	06/21/22
CAFETERIA/KITCHEN AREA (Fireproofing)					
FP32	L2 Spray Fireproofing (Underside Roof)	5	5	06/22/22	06/28/22
FP31	Main Spray Fireproofing (Underside L2)	5	5	08/04/22	08/10/22
ACADEMIC TOWER B (Fireproofing)					
FP42	L2 Spray Fireproofing (Underside L3)	5	5	06/29/22	07/06/22
FP43	L3 Spray Fireproofing (Underside L4)	5	5	07/07/22	07/13/22
FP44	L4 Spray Fireproofing (Underside L5)	5	5	07/14/22	07/20/22
FP45	L5 Spray Fireproofing (Underside Roof)	5	5	07/21/22	07/27/22
FP41	Main Spray Fireproofing (Underside L2)	5	5	08/04/22	08/10/22
ACADEMIC TOWER C (Fireproofing)					
FP51	Main Spray Fireproofing (Underside L2)	5	5	06/01/22	06/07/22
FP52	L2 Spray Fireproofing (Underside L3)	5	5	06/08/22	06/14/22
FP53	L3 Spray Fireproofing (Underside L4)	5	5	06/15/22	06/21/22
FP54	L4 Spray Fireproofing (Underside Roof)	5	5	06/22/22	06/28/22
FP50	Ground Spray Fireproofing (Underside Main)	5	5	07/07/22	07/13/22
ACADEMIC TOWER D (Fireproofing)					
FP61	Main Spray Fireproofing (Underside L2)	5	5	07/21/22	07/27/22
FP62	L2 Spray Fireproofing (Underside L3)	5	5	07/28/22	08/03/22
FP63	L3 Spray Fireproofing (Underside Roof)	5	5	08/11/22	08/17/22
FP60	Ground Spray Fireproofing (Underside Main)	5	5	08/25/22	08/31/22
AUDITORIUM (Fireproofing)					
FP71	Main Spray Fireproofing (Underside L2)	5	5	07/07/22	07/13/22
FP72	L2 Spray Fireproofing (Underside L3)	5	5	07/14/22	07/20/22
FP73	L3 Spray Fireproofing (Underside Roof)	5	5	07/28/22	08/03/22
FP70	Ground Spray Fireproofing (Underside Main)	5	5	08/11/22	08/17/22



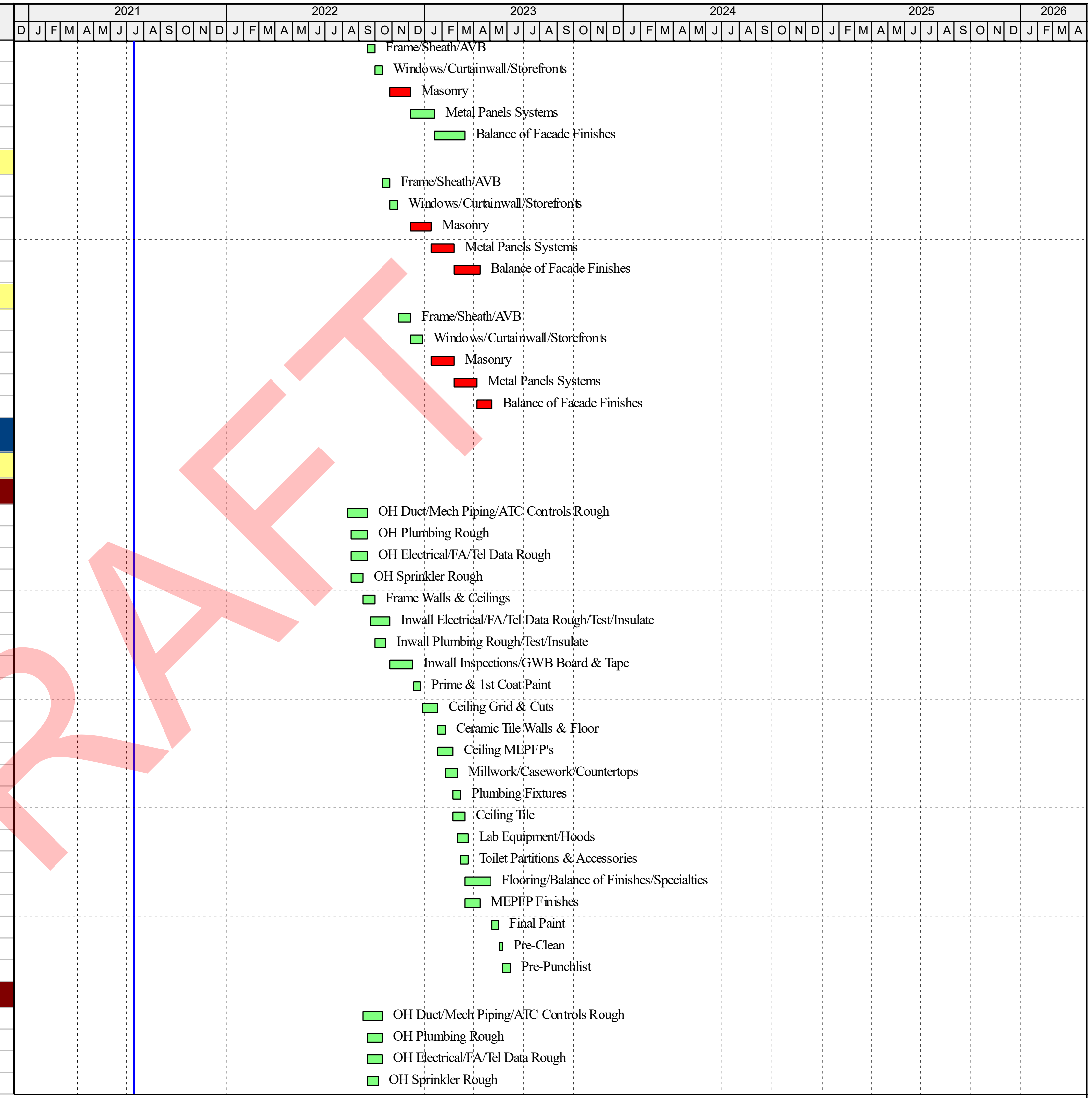
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
ADMINISTRATION AREA (Fireproofing)					
FP81	Main Spray Fireproofing (Underside L2)	5	5	07/28/22	08/03/22
FP82	L2 Spray Fireproofing (Underside Roof)	5	5	08/18/22	08/24/22
FP80	Ground Spray Fireproofing (Underside Main)	5	5	09/01/22	09/08/22
NORTH/BAND/CHORUS AREA (Fireproofing)					
FP91	Main Spray Fireproofing (Underside L2)	5	5	08/18/22	08/24/22
FP92	L2 Spray Fireproofing (Underside Roof)	5	5	09/09/22	09/15/22
FP90	Ground Spray Fireproofing (Underside Main)	5	5	09/23/22	09/29/22
Roofing					
ACADEMIC TOWER A (Roofing)					
R10	Roof Blocking/Mech Curbs/Roof Drains	15	15	04/12/22	05/02/22
R11	Roofing System	15	15	05/03/22	05/23/22
R12	Roof Top Mechanical Equipment	10	10	05/24/22	06/07/22
R13	Final Roof Flashing/Trim	20	20	11/21/22	12/19/22
PHYSICAL EDUCATION AREA (Roofing)					
R20	Roof Blocking/Mech Curbs/Roof Drains	15	15	04/19/22	05/09/22
R21	Roofing System	15	15	05/10/22	05/31/22
R22	Roof Top Mechanical Equipment	10	10	06/01/22	06/14/22
R23	Final Roof Flashing/Trim	20	20	10/28/22	11/28/22
CAFETERIA/KITCHEN AREA (Roofing)					
R30	Roof Blocking/Mech Curbs/Roof Drains	15	15	05/10/22	05/31/22
R31	Roofing System	15	15	06/01/22	06/21/22
R32	Roof Top Mechanical Equipment	10	10	06/22/22	07/06/22
R33	Final Roof Flashing/Trim	20	20	12/06/22	01/04/23
ACADEMIC TOWER B (Roofing)					
R40	Roof Blocking/Mech Curbs/Roof Drains	15	15	06/08/22	06/28/22
R41	Roofing System	15	15	06/29/22	07/20/22
R42	Roof Top Mechanical Equipment	10	10	07/21/22	08/03/22
R43	Final Roof Flashing/Trim	20	20	11/14/22	12/12/22
ACADEMIC TOWER C (Roofing)					
R50	Roof Blocking/Mech Curbs/Roof Drains	15	15	05/10/22	05/31/22
R51	Roofing System	15	15	06/01/22	06/21/22
R52	Roof Top Mechanical Equipment	10	10	06/22/22	07/06/22
R53	Final Roof Flashing/Trim	20	20	12/06/22	01/04/23
ACADEMIC TOWER D (Roofing)					
R60	Roof Blocking/Mech Curbs/Roof Drains	15	15	06/29/22	07/20/22
R61	Roofing System	15	15	07/21/22	08/10/22
R62	Roof Top Mechanical Equipment	10	10	08/11/22	08/24/22
R63	Final Roof Flashing/Trim	20	20	01/12/23	02/08/23
AUDITORIUM (Roofing)					
R70	Roof Blocking/Mech Curbs/Roof Drains	15	15	06/15/22	07/06/22
R71	Roofing System	15	15	07/07/22	07/27/22
R72	Roof Top Mechanical Equipment	10	10	07/28/22	08/10/22
R73	Final Roof Flashing/Trim	20	20	01/19/23	02/15/23
ADMINISTRATION AREA (Roofing)					
R80	Roof Blocking/Mech Curbs/Roof Drains	15	15	07/07/22	07/27/22



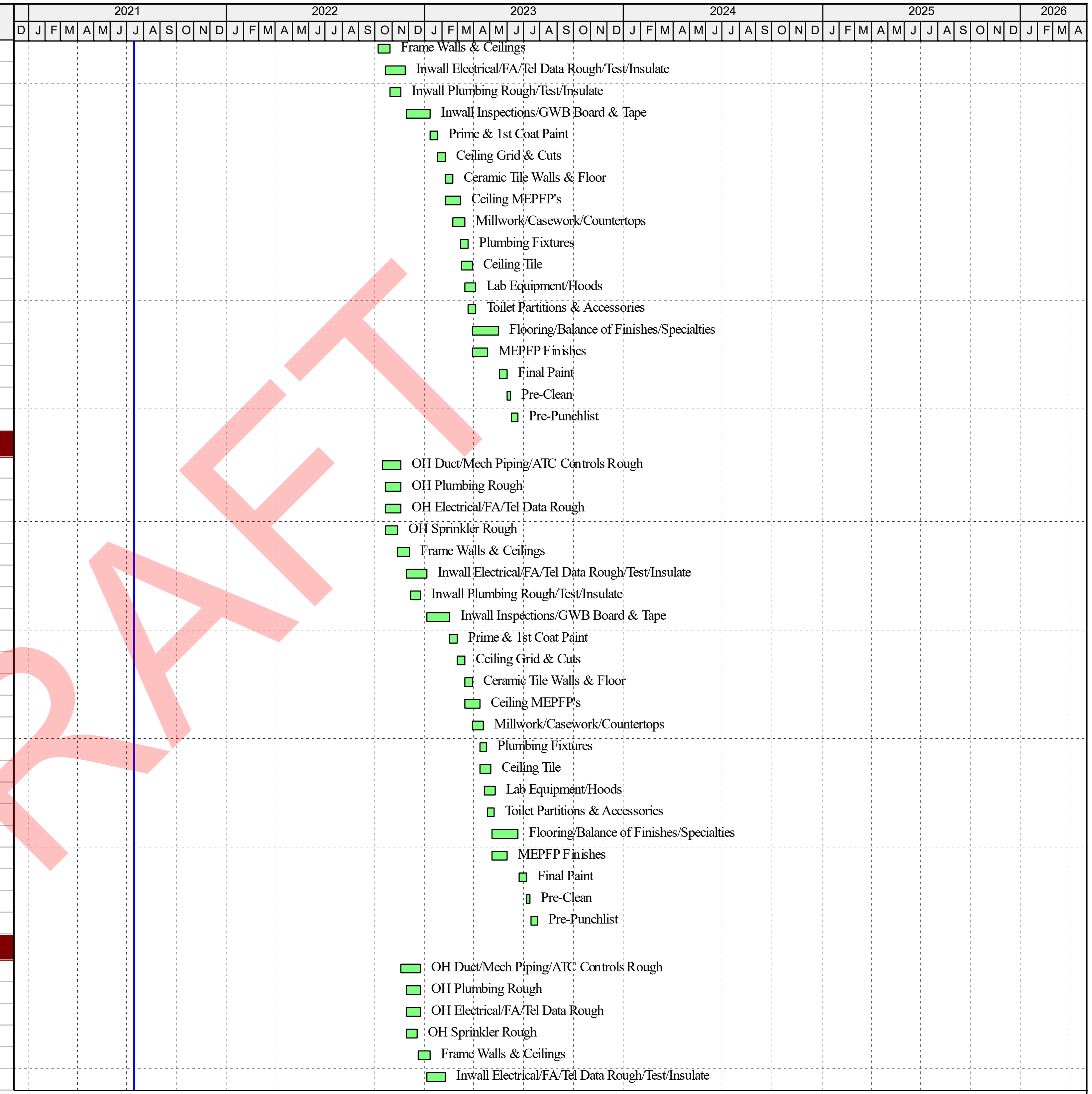
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
R81	Roofing System	15	15	07/28/22	08/17/22
R82	Roof Top Mechanical Equipment	10	10	08/18/22	08/31/22
R83	Final Roof Flashing/Trim	20	20	02/23/23	03/22/23
NORTH/BAND/CHORUS AREA (Roofing)					
R90	Roof Blocking/Mech Curbs/Roof Drains	15	15	07/28/22	08/17/22
R91	Roofing System	15	15	08/18/22	09/08/22
R92	Roof Top Mechanical Equipment	10	10	09/09/22	09/22/22
R93	Final Roof Flashing/Trim	20	20	04/06/23	05/03/23
Exterior Facade					
ACADEMIC TOWER A (Facade)					
EX10	Frame/Sheath/AVB	20	20	06/15/22	07/13/22
EX11	Windows/Curtainwall/Storefronts	20	20	07/14/22	08/10/22
EX12	Masonry	35	35	08/11/22	09/29/22
EX13	Metal Panels Systems	35	35	09/30/22	11/18/22
EX14	Balance of Facade Finishes	20	20	11/21/22	12/19/22
PHYSICAL EDUCATION AREA (Facade)					
EX20	Frame/Sheath/AVB	20	20	07/07/22	08/03/22
EX21	Windows/Curtainwall/Storefronts	20	20	07/21/22	08/17/22
EX22	Masonry	25	25	08/18/22	09/22/22
EX23	Metal Panels Systems	25	25	09/23/22	10/27/22
EX24	Balance of Facade Finishes	20	20	10/28/22	11/28/22
CAFETERIA/KITCHEN AREA (Facade)					
EX30	Frame/Sheath/AVB	10	10	08/18/22	08/31/22
EX31	Windows/Curtainwall/Storefronts	20	20	09/01/22	09/29/22
EX32	Masonry	20	20	09/30/22	10/27/22
EX33	Metal Panels Systems	25	25	10/28/22	12/05/22
EX34	Balance of Facade Finishes	35	35	12/06/22	01/25/23
ACADEMIC TOWER B (Facade)					
EX40	Frame/Sheath/AVB	20	20	07/21/22	08/17/22
EX41	Windows/Curtainwall/Storefronts	20	20	08/04/22	08/31/22
EX42	Masonry	25	25	09/01/22	10/06/22
EX43	Metal Panels Systems	25	25	10/07/22	11/10/22
EX44	Balance of Facade Finishes	20	20	11/14/22	12/12/22
ACADEMIC TOWER C (Facade)					
EX50	Frame/Sheath/AVB	20	20	08/18/22	09/15/22
EX51	Windows/Curtainwall/Storefronts	20	20	09/01/22	09/29/22
EX52	Masonry	25	25	09/30/22	11/03/22
EX53	Metal Panels Systems	25	25	10/28/22	12/05/22
EX54	Balance of Facade Finishes	20	20	12/06/22	01/04/23
ACADEMIC TOWER D (Facade)					
EX60	Frame/Sheath/AVB	20	20	09/16/22	10/13/22
EX61	Windows/Curtainwall/Storefronts	20	20	09/30/22	10/27/22
EX62	Masonry	25	25	10/28/22	12/05/22
EX63	Metal Panels Systems	25	25	12/06/22	01/11/23
EX64	Balance of Facade Finishes	20	20	01/12/23	02/08/23
AUDITORIUM (Facade)					



Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
EX70	Frame/Sheath/AVB	10	10	09/16/22	09/29/22
EX71	Windows/Curtainwall/Storefronts	10	10	09/30/22	10/13/22
EX72	Masonry	25	25	10/28/22	12/05/22
EX73	Metal Panels Systems	30	30	12/06/22	01/18/23
EX74	Balance of Facade Finishes	40	40	01/19/23	03/15/23
ADMINISTRATION AREA (Facade)					
EX80	Frame/Sheath/AVB	10	10	10/14/22	10/27/22
EX81	Windows/Curtainwall/Storefronts	10	10	10/28/22	11/10/22
EX82	Masonry	25	25	12/06/22	01/11/23
EX83	Metal Panels Systems	30	30	01/12/23	02/22/23
EX84	Balance of Facade Finishes	35	35	02/23/23	04/12/23
NORTH/BAND/CHORUS AREA (Facade)					
EX90	Frame/Sheath/AVB	15	15	11/14/22	12/05/22
EX91	Windows/Curtainwall/Storefronts	15	15	12/06/22	12/27/22
EX92	Masonry	30	30	01/12/23	02/22/23
EX93	Metal Panels Systems	30	30	02/23/23	04/05/23
EX94	Balance of Facade Finishes	20	20	04/06/23	05/03/23
Interior Finishes					
ACADEMIC TOWER A (Interior Finishes)					
L2 Interior Finishes (Tower A)					
A200	OH Duct/Mech Piping/ATC Controls Rough	25	25	08/11/22	09/15/22
A201	OH Plumbing Rough	20	20	08/18/22	09/15/22
A202	OH Electrical/FA/Tel Data Rough	20	20	08/18/22	09/15/22
A203	OH Sprinkler Rough	15	15	08/18/22	09/08/22
A204	Frame Walls & Ceilings	15	15	09/09/22	09/29/22
A205	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	09/23/22	10/27/22
A206	Inwall Plumbing Rough/Test/Insulate	15	15	09/30/22	10/20/22
A207	Inwall Inspections/GWB Board & Tape	30	30	10/28/22	12/09/22
A208	Prime & 1st Coat Paint	10	10	12/12/22	12/23/22
A209	Ceiling Grid & Cuts	20	20	12/27/22	01/24/23
A210	Ceramic Tile Walls & Floor	10	10	01/25/23	02/07/23
A211	Ceiling MEPFP's	20	20	01/25/23	02/21/23
A212	Millwork/Casework/Countertops	15	15	02/08/23	02/28/23
A213	Plumbing Fixtures	10	10	02/21/23	03/06/23
A214	Ceiling Tile	15	15	02/22/23	03/14/23
A215	Lab Equipment/Hoods	15	15	03/01/23	03/21/23
A216	Toilet Partitions & Accessories	10	10	03/07/23	03/20/23
A217	Flooring/Balance of Finishes/Specialties	35	35	03/15/23	05/02/23
A218	MEPFP Finishes	20	20	03/15/23	04/11/23
A219	Final Paint	10	10	05/03/23	05/16/23
A220	Pre-Clean	5	5	05/17/23	05/23/23
A221	Pre-Punchlist	10	10	05/24/23	06/07/23
L3 Interior Finishes (Tower A)					
A300	OH Duct/Mech Piping/ATC Controls Rough	25	25	09/09/22	10/13/22
A301	OH Plumbing Rough	20	20	09/16/22	10/13/22
A302	OH Electrical/FA/Tel Data Rough	20	20	09/16/22	10/13/22
A303	OH Sprinkler Rough	15	15	09/16/22	10/06/22

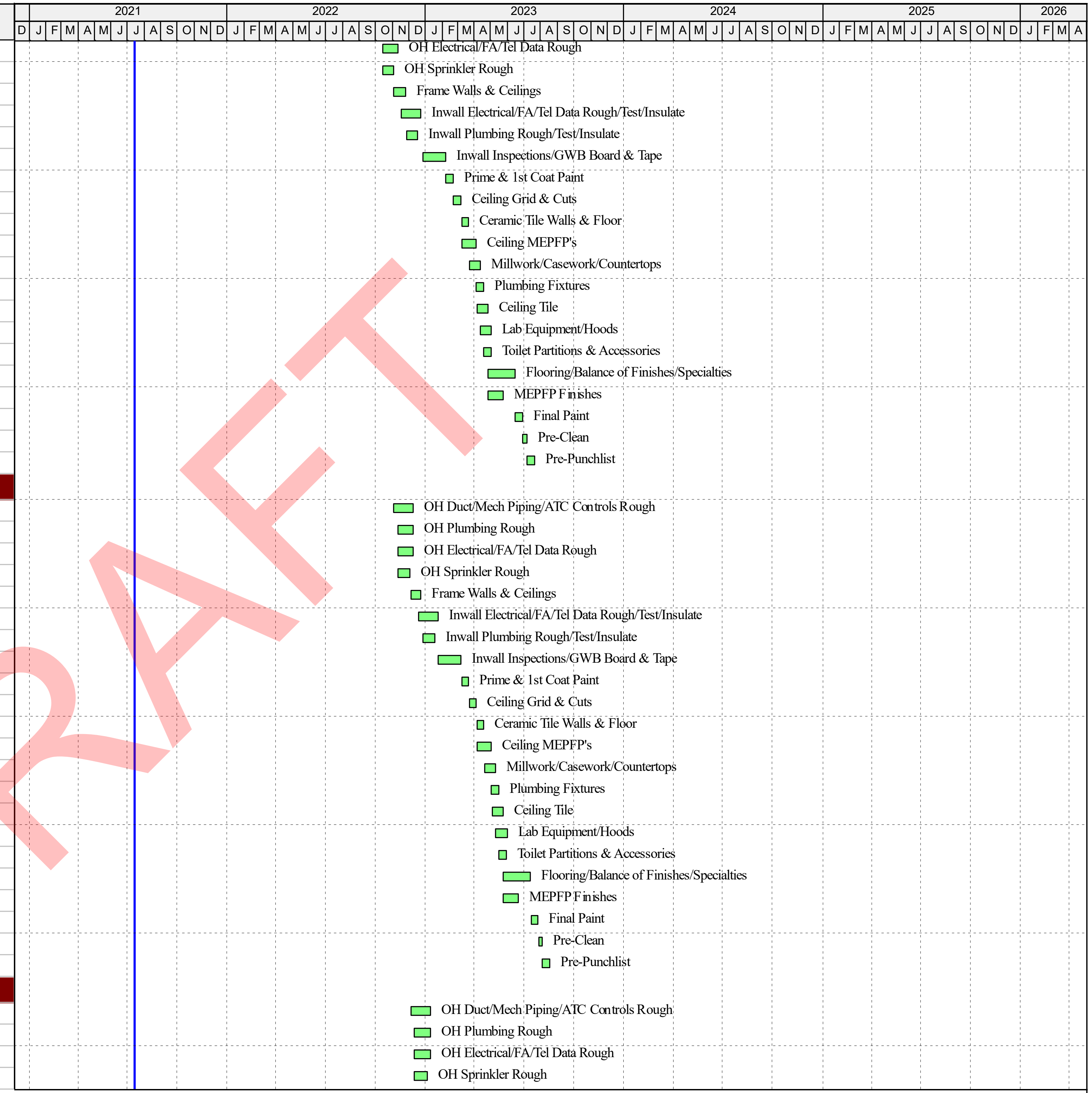


Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
A304	Frame Walls & Ceilings	15	15	10/07/22	10/27/22
A305	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	10/21/22	11/25/22
A306	Inwall Plumbing Rough/Test/Insulate	15	15	10/28/22	11/17/22
A307	Inwall Inspections/GWB Board & Tape	30	30	11/28/22	01/10/23
A308	Prime & 1st Coat Paint	10	10	01/11/23	01/24/23
A309	Ceiling Grid & Cuts	10	10	01/25/23	02/07/23
A310	Ceramic Tile Walls & Floor	10	10	02/08/23	02/21/23
A311	Ceiling MEPFP's	20	20	02/08/23	03/07/23
A312	Millwork/Casework/Countertops	15	15	02/22/23	03/14/23
A313	Plumbing Fixtures	10	10	03/07/23	03/20/23
A314	Ceiling Tile	15	15	03/08/23	03/28/23
A315	Lab Equipment/Hoods	15	15	03/15/23	04/04/23
A316	Toilet Partitions & Accessories	10	10	03/21/23	04/03/23
A317	Flooring/Balance of Finishes/Specialties	35	35	03/29/23	05/16/23
A318	MEPFP Finishes	20	20	03/29/23	04/25/23
A319	Final Paint	10	10	05/17/23	05/31/23
A320	Pre-Clean	5	5	06/01/23	06/07/23
A321	Pre-Punchlist	10	10	06/08/23	06/21/23
L4 Interior Finishes (Tower A)					
A400	OH Duct/Mech Piping/ATC Controls Rough	25	25	10/14/22	11/17/22
A401	OH Plumbing Rough	20	20	10/21/22	11/17/22
A402	OH Electrical/FA/Tel Data Rough	20	20	10/21/22	11/17/22
A403	OH Sprinkler Rough	15	15	10/21/22	11/10/22
A404	Frame Walls & Ceilings	15	15	11/11/22	12/02/22
A405	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	11/28/22	01/03/23
A406	Inwall Plumbing Rough/Test/Insulate	15	15	12/05/22	12/23/22
A407	Inwall Inspections/GWB Board & Tape	30	30	01/04/23	02/14/23
A408	Prime & 1st Coat Paint	10	10	02/15/23	02/28/23
A409	Ceiling Grid & Cuts	10	10	03/01/23	03/14/23
A410	Ceramic Tile Walls & Floor	10	10	03/15/23	03/28/23
A411	Ceiling MEPFP's	20	20	03/15/23	04/11/23
A412	Millwork/Casework/Countertops	15	15	03/29/23	04/18/23
A413	Plumbing Fixtures	10	10	04/11/23	04/24/23
A414	Ceiling Tile	15	15	04/12/23	05/02/23
A415	Lab Equipment/Hoods	15	15	04/19/23	05/09/23
A416	Toilet Partitions & Accessories	10	10	04/25/23	05/08/23
A417	Flooring/Balance of Finishes/Specialties	35	35	05/03/23	06/21/23
A418	MEPFP Finishes	20	20	05/03/23	05/31/23
A419	Final Paint	10	10	06/22/23	07/06/23
A420	Pre-Clean	5	5	07/07/23	07/13/23
A421	Pre-Punchlist	10	10	07/14/23	07/27/23
L5 Interior Finishes (Tower A)					
A500	OH Duct/Mech Piping/ATC Controls Rough	25	25	11/18/22	12/23/22
A501	OH Plumbing Rough	20	20	11/28/22	12/23/22
A502	OH Electrical/FA/Tel Data Rough	20	20	11/28/22	12/23/22
A503	OH Sprinkler Rough	15	15	11/28/22	12/16/22
A504	Frame Walls & Ceilings	15	15	12/19/22	01/10/23
A505	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	01/04/23	02/07/23



Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
A506	Inwall Plumbing Rough/Test/Insulate	15	15	01/11/23	01/31/23
A507	Inwall Inspections/GWB Board & Tape	30	30	02/08/23	03/21/23
A508	Prime & 1st Coat Paint	10	10	03/22/23	04/04/23
A509	Ceiling Grid & Cuts	10	10	04/05/23	04/18/23
A510	Ceramic Tile Walls & Floor	10	10	04/19/23	05/02/23
A511	Ceiling MEPFP's	20	20	04/19/23	05/16/23
A512	Millwork/Casework/Countertops	15	15	05/03/23	05/23/23
A513	Plumbing Fixtures	10	10	05/16/23	05/30/23
A514	Ceiling Tile	15	15	05/17/23	06/07/23
A515	Lab Equipment/Hoods	15	15	05/24/23	06/14/23
A516	Toilet Partitions & Accessories	10	10	05/31/23	06/13/23
A517	Flooring/Balance of Finishes/Specialties	35	35	06/08/23	07/27/23
A518	MEPFP Finishes	20	20	06/08/23	07/06/23
A519	Final Paint	10	10	07/28/23	08/10/23
A520	Pre-Clean	5	5	08/11/23	08/17/23
A521	Pre-Punchlist	10	10	08/18/23	08/31/23
Main Floor Parking Lot Finishes (Tower A)					
A100	Parking Lot Area Fit Out & Finishes	85	85	03/22/23	07/20/23
A101	Line Striping/Parking Equipment	20	20	07/21/23	08/17/23
A102	Pre-Clean	5	5	08/18/23	08/24/23
A103	Pre-Punchlist	5	5	08/25/23	08/31/23
ACADEMIC TOWER B (Interior Finishes)					
Main Floor Interior Finishes (Tower B)					
B100	OH Duct/Mech Piping/ATC Controls Rough	25	25	09/09/22	10/13/22
B101	OH Plumbing Rough	20	20	09/16/22	10/13/22
B102	OH Electrical/FA/Tel Data Rough	20	20	09/16/22	10/13/22
B103	OH Sprinkler Rough	15	15	09/16/22	10/06/22
B104	Frame Walls & Ceilings	15	15	10/07/22	10/27/22
B105	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	10/21/22	11/25/22
B106	Inwall Plumbing Rough/Test/Insulate	15	15	10/28/22	11/17/22
B107	Inwall Inspections/GWB Board & Tape	30	30	11/28/22	01/10/23
B108	Prime & 1st Coat Paint	10	10	01/11/23	01/24/23
B109	Ceiling Grid & Cuts	10	10	01/25/23	02/07/23
B110	Ceramic Tile Walls & Floor	10	10	02/08/23	02/21/23
B111	Ceiling MEPFP's	20	20	02/08/23	03/07/23
B112	Millwork/Casework/Countertops	15	15	02/22/23	03/14/23
B113	Plumbing Fixtures	10	10	03/07/23	03/20/23
B114	Ceiling Tile	15	15	03/08/23	03/28/23
B115	Lab Equipment/Hoods	15	15	03/15/23	04/04/23
B116	Toilet Partitions & Accessories	10	10	03/21/23	04/03/23
B117	Flooring/Balance of Finishes/Specialties	35	35	03/29/23	05/16/23
B118	MEPFP Finishes	20	20	03/29/23	04/25/23
B119	Final Paint	10	10	05/17/23	05/31/23
B120	Pre-Clean	5	5	06/01/23	06/07/23
B121	Pre-Punchlist	10	10	06/08/23	06/21/23
L2 Interior Finishes (Tower B)					
B200	OH Duct/Mech Piping/ATC Controls Rough	25	25	10/07/22	11/10/22
B201	OH Plumbing Rough	20	20	10/14/22	11/10/22

Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
B202	OH Electrical/FA/Tel Data Rough	20	20	10/14/22	11/10/22
B203	OH Sprinkler Rough	15	15	10/14/22	11/03/22
B204	Frame Walls & Ceilings	15	15	11/04/22	11/25/22
B205	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	11/18/22	12/23/22
B206	Inwall Plumbing Rough/Test/Insulate	15	15	11/28/22	12/16/22
B207	Inwall Inspections/GWB Board & Tape	30	30	12/27/22	02/07/23
B208	Prime & 1st Coat Paint	10	10	02/08/23	02/21/23
B209	Ceiling Grid & Cuts	10	10	02/22/23	03/07/23
B210	Ceramic Tile Walls & Floor	10	10	03/08/23	03/21/23
B211	Ceiling MEPFP's	20	20	03/08/23	04/04/23
B212	Millwork/Casework/Countertops	15	15	03/22/23	04/11/23
B213	Plumbing Fixtures	10	10	04/04/23	04/17/23
B214	Ceiling Tile	15	15	04/05/23	04/25/23
B215	Lab Equipment/Hoods	15	15	04/12/23	05/02/23
B216	Toilet Partitions & Accessories	10	10	04/18/23	05/01/23
B217	Flooring/Balance of Finishes/Specialties	35	35	04/26/23	06/14/23
B218	MEPFP Finishes	20	20	04/26/23	05/23/23
B219	Final Paint	10	10	06/15/23	06/28/23
B220	Pre-Clean	5	5	06/29/23	07/06/23
B221	Pre-Punchlist	10	10	07/07/23	07/20/23
L3 Interior Finishes (Tower B)					
B300	OH Duct/Mech Piping/ATC Controls Rough	25	25	11/04/22	12/09/22
B301	OH Plumbing Rough	20	20	11/11/22	12/09/22
B302	OH Electrical/FA/Tel Data Rough	20	20	11/11/22	12/09/22
B303	OH Sprinkler Rough	15	15	11/11/22	12/02/22
B304	Frame Walls & Ceilings	15	15	12/05/22	12/23/22
B305	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	12/19/22	01/24/23
B306	Inwall Plumbing Rough/Test/Insulate	15	15	12/27/22	01/17/23
B307	Inwall Inspections/GWB Board & Tape	30	30	01/25/23	03/07/23
B308	Prime & 1st Coat Paint	10	10	03/08/23	03/21/23
B309	Ceiling Grid & Cuts	10	10	03/22/23	04/04/23
B310	Ceramic Tile Walls & Floor	10	10	04/05/23	04/18/23
B311	Ceiling MEPFP's	20	20	04/05/23	05/02/23
B312	Millwork/Casework/Countertops	15	15	04/19/23	05/09/23
B313	Plumbing Fixtures	10	10	05/02/23	05/15/23
B314	Ceiling Tile	15	15	05/03/23	05/23/23
B315	Lab Equipment/Hoods	15	15	05/10/23	05/31/23
B316	Toilet Partitions & Accessories	10	10	05/16/23	05/30/23
B317	Flooring/Balance of Finishes/Specialties	35	35	05/24/23	07/13/23
B318	MEPFP Finishes	20	20	05/24/23	06/21/23
B319	Final Paint	10	10	07/14/23	07/27/23
B320	Pre-Clean	5	5	07/28/23	08/03/23
B321	Pre-Punchlist	10	10	08/04/23	08/17/23
L4 Interior Finishes (Tower B)					
B400	OH Duct/Mech Piping/ATC Controls Rough	25	25	12/05/22	01/10/23
B401	OH Plumbing Rough	20	20	12/12/22	01/10/23
B402	OH Electrical/FA/Tel Data Rough	20	20	12/12/22	01/10/23
B403	OH Sprinkler Rough	15	15	12/12/22	01/03/23



FONTAINE + DIMEO

NEW DOHERTY MEMORIAL HIGH SCHOOL

60% CD Submission Schedule

Data Date: 07/14/21
Run Date: 07/19/21

Schedule ID : **372-20F**
Construction Start Date : 05/03/21
Construction Completion Date : 7/16/25

Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
B404	Frame Walls & Ceilings	15	15	01/04/23	01/24/23
B405	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	01/18/23	02/21/23
B406	Inwall Plumbing Rough/Test/Insulate	15	15	01/25/23	02/14/23
B407	Inwall Inspections/GWB Board & Tape	30	30	02/22/23	04/04/23
B408	Prime & 1st Coat Paint	10	10	04/05/23	04/18/23
B409	Ceiling Grid & Cuts	10	10	04/19/23	05/02/23
B410	Ceramic Tile Walls & Floor	10	10	05/03/23	05/16/23
B411	Ceiling MEPFP's	20	20	05/03/23	05/31/23
B412	Millwork/Casework/Countertops	15	15	05/17/23	06/07/23
B413	Plumbing Fixtures	10	10	05/31/23	06/13/23
B414	Ceiling Tile	15	15	06/01/23	06/21/23
B415	Lab Equipment/Hoods	15	15	06/08/23	06/28/23
B416	Toilet Partitions & Accessories	10	10	06/14/23	06/27/23
B417	Flooring/Balance of Finishes/Specialties	35	35	06/22/23	08/10/23
B418	MEPFP Finishes	20	20	06/22/23	07/20/23
B419	Final Paint	10	10	08/11/23	08/24/23
B420	Pre-Clean	5	5	08/25/23	08/31/23
B421	Pre-Punchlist	10	10	09/01/23	09/15/23
L5 Interior Finishes (Tower B)					
B500	OH Duct/Mech Piping/ATC Controls Rough	25	25	01/04/23	02/07/23
B501	OH Plumbing Rough	20	20	01/11/23	02/07/23
B502	OH Electrical/FA/Tel Data Rough	20	20	01/11/23	02/07/23
B503	OH Sprinkler Rough	15	15	01/11/23	01/31/23
B504	Frame Walls & Ceilings	15	15	02/01/23	02/21/23
B505	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	02/15/23	03/21/23
B506	Inwall Plumbing Rough/Test/Insulate	15	15	02/22/23	03/14/23
B507	Inwall Inspections/GWB Board & Tape	30	30	03/22/23	05/02/23
B508	Prime & 1st Coat Paint	10	10	05/03/23	05/16/23
B509	Ceiling Grid & Cuts	10	10	05/17/23	05/31/23
B510	Ceramic Tile Walls & Floor	10	10	06/01/23	06/14/23
B511	Ceiling MEPFP's	20	20	06/01/23	06/28/23
B512	Millwork/Casework/Countertops	15	15	06/15/23	07/06/23
B513	Plumbing Fixtures	10	10	06/28/23	07/12/23
B514	Ceiling Tile	15	15	06/29/23	07/20/23
B515	Lab Equipment/Hoods	15	15	07/07/23	07/27/23
B516	Toilet Partitions & Accessories	10	10	07/13/23	07/26/23
B517	Flooring/Balance of Finishes/Specialties	35	35	07/21/23	09/08/23
B518	MEPFP Finishes	20	20	07/21/23	08/17/23
B519	Final Paint	10	10	09/11/23	09/22/23
B520	Pre-Clean	5	5	09/25/23	09/29/23
B521	Pre-Punchlist	10	10	10/02/23	10/13/23
ACADEMIC TOWER C (Interior Finishes)					
Ground Floor Interior Finishes (Tower C)					
C010	OH Duct/Mech Piping/ATC Controls Rough	25	25	10/14/22	11/17/22
C011	OH Plumbing Rough	20	20	10/21/22	11/17/22
C012	OH Electrical/FA/Tel Data Rough	20	20	10/21/22	11/17/22
C013	OH Sprinkler Rough	15	15	10/21/22	11/10/22
C014	Frame Walls & Ceilings	15	15	11/11/22	12/02/22

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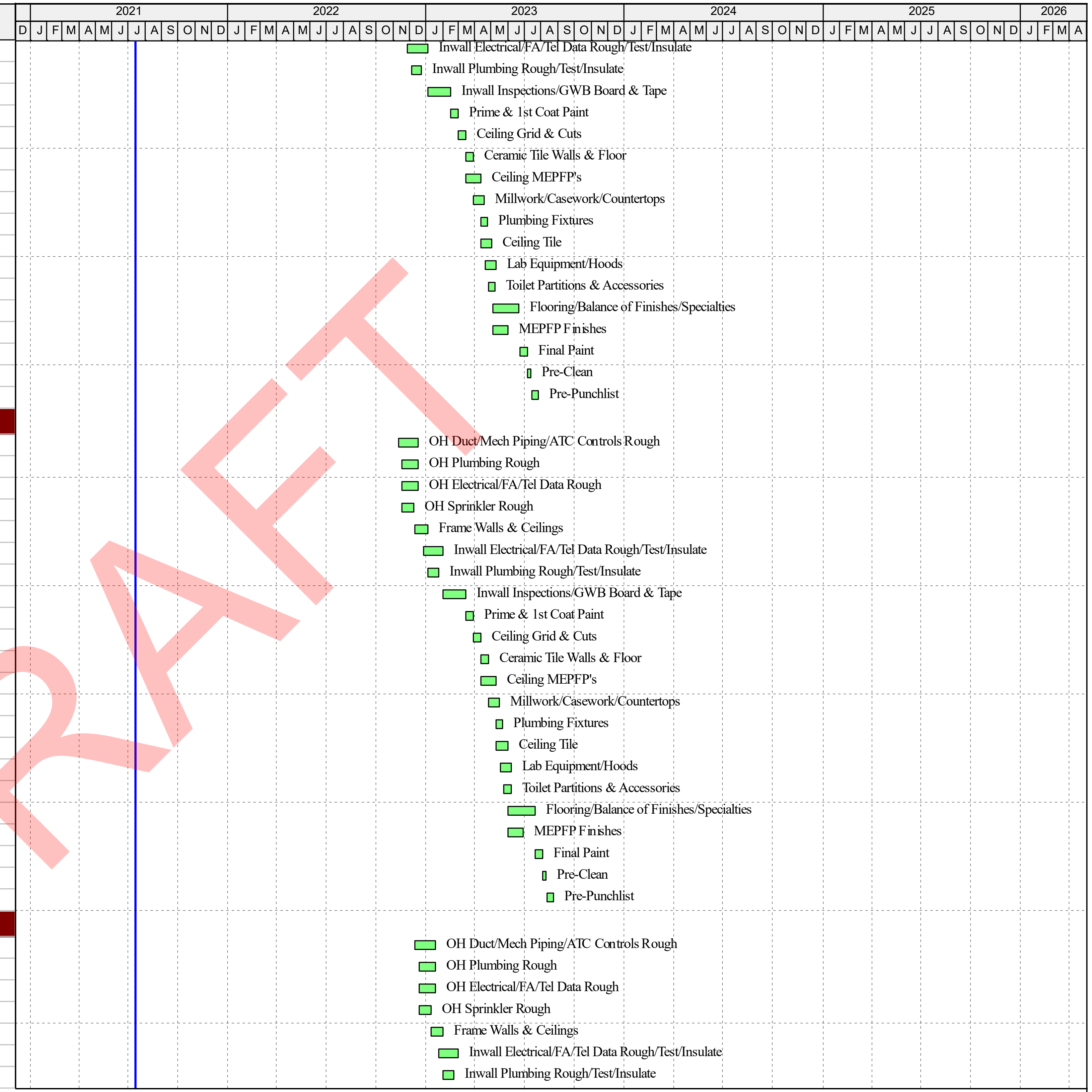
NEW DOHERTY MEMORIAL HIGH SCHOOL

60% CD Submission Schedule

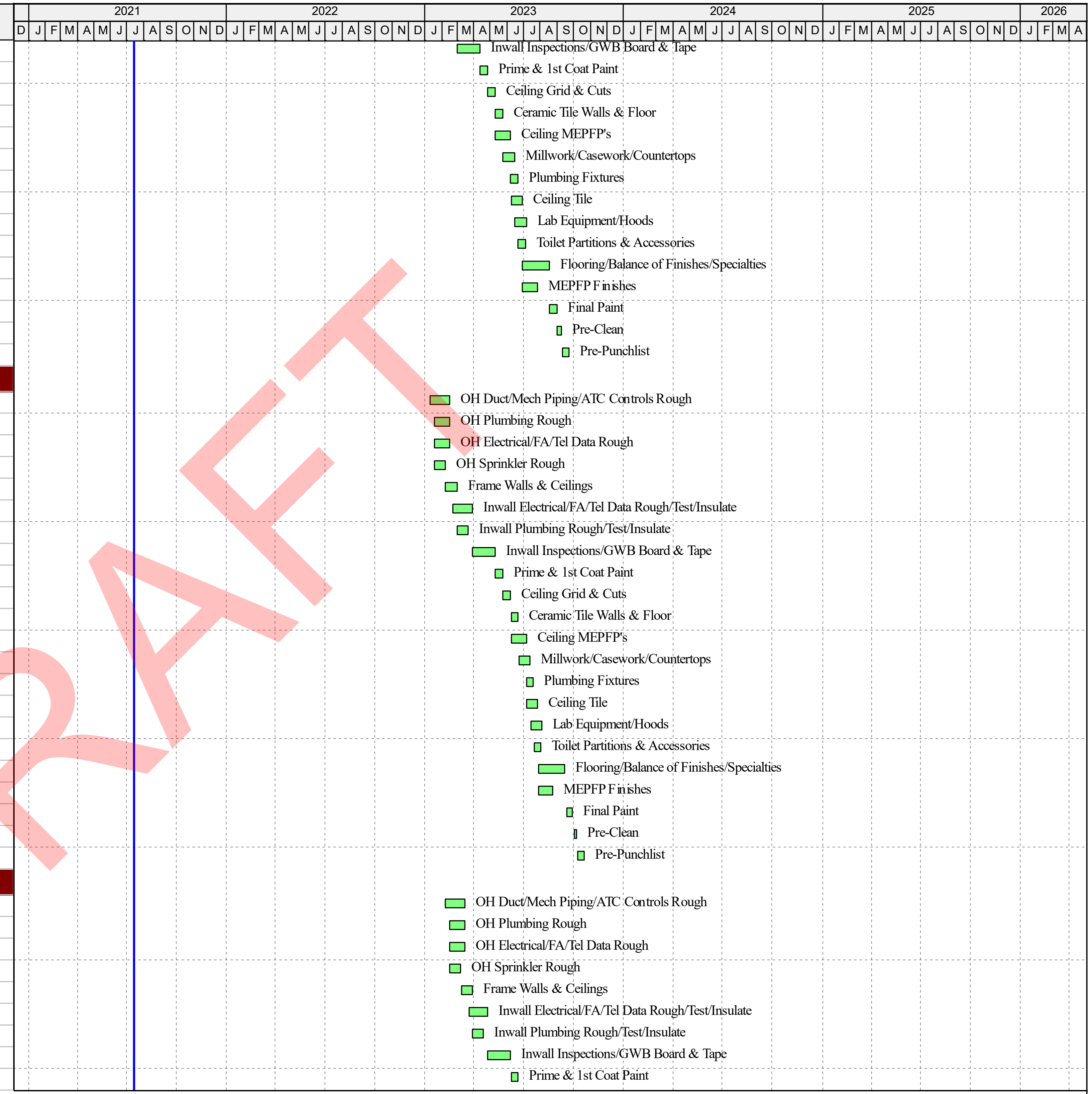
Data Date: 07/14/21
Run Date: 07/19/21

Schedule ID : **372-20F**
Construction Start Date : 05/03/21
Construction Completion Date : 7/16/25

Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
C015	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	11/28/22	01/03/23
C016	Inwall Plumbing Rough/Test/Insulate	15	15	12/05/22	12/23/22
C017	Inwall Inspections/GWB Board & Tape	30	30	01/04/23	02/14/23
C018	Prime & 1st Coat Paint	10	10	02/15/23	02/28/23
C019	Ceiling Grid & Cuts	10	10	03/01/23	03/14/23
C020	Ceramic Tile Walls & Floor	10	10	03/15/23	03/28/23
C021	Ceiling MEPFP's	20	20	03/15/23	04/11/23
C022	Millwork/Casework/Countertops	15	15	03/29/23	04/18/23
C023	Plumbing Fixtures	10	10	04/11/23	04/24/23
C024	Ceiling Tile	15	15	04/12/23	05/02/23
C025	Lab Equipment/Hoods	15	15	04/19/23	05/09/23
C026	Toilet Partitions & Accessories	10	10	04/25/23	05/08/23
C027	Flooring/Balance of Finishes/Specialties	35	35	05/03/23	06/21/23
C028	MEPFP Finishes	20	20	05/03/23	05/31/23
C029	Final Paint	10	10	06/22/23	07/06/23
C030	Pre-Clean	5	5	07/07/23	07/13/23
C031	Pre-Punchlist	10	10	07/14/23	07/27/23
Main Floor Interior Finishes (Tower C)					
C100	OH Duct/Mech Piping/ATC Controls Rough	25	25	11/11/22	12/16/22
C101	OH Plumbing Rough	20	20	11/18/22	12/16/22
C102	OH Electrical/FA/Tel Data Rough	20	20	11/18/22	12/16/22
C103	OH Sprinkler Rough	15	15	11/18/22	12/09/22
C104	Frame Walls & Ceilings	15	15	12/12/22	01/03/23
C105	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	12/27/22	01/31/23
C106	Inwall Plumbing Rough/Test/Insulate	15	15	01/04/23	01/24/23
C107	Inwall Inspections/GWB Board & Tape	30	30	02/01/23	03/14/23
C108	Prime & 1st Coat Paint	10	10	03/15/23	03/28/23
C109	Ceiling Grid & Cuts	10	10	03/29/23	04/11/23
C110	Ceramic Tile Walls & Floor	10	10	04/12/23	04/25/23
C111	Ceiling MEPFP's	20	20	04/12/23	05/09/23
C112	Millwork/Casework/Countertops	15	15	04/26/23	05/16/23
C113	Plumbing Fixtures	10	10	05/09/23	05/22/23
C114	Ceiling Tile	15	15	05/10/23	05/31/23
C115	Lab Equipment/Hoods	15	15	05/17/23	06/07/23
C116	Toilet Partitions & Accessories	10	10	05/23/23	06/06/23
C117	Flooring/Balance of Finishes/Specialties	35	35	06/01/23	07/20/23
C118	MEPFP Finishes	20	20	06/01/23	06/28/23
C119	Final Paint	10	10	07/21/23	08/03/23
C120	Pre-Clean	5	5	08/04/23	08/10/23
C121	Pre-Punchlist	10	10	08/11/23	08/24/23
L2 Interior Finishes (Tower C)					
C200	OH Duct/Mech Piping/ATC Controls Rough	25	25	12/12/22	01/17/23
C201	OH Plumbing Rough	20	20	12/19/22	01/17/23
C202	OH Electrical/FA/Tel Data Rough	20	20	12/19/22	01/17/23
C203	OH Sprinkler Rough	15	15	12/19/22	01/10/23
C204	Frame Walls & Ceilings	15	15	01/11/23	01/31/23
C205	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	01/25/23	02/28/23
C206	Inwall Plumbing Rough/Test/Insulate	15	15	02/01/23	02/21/23



Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
C207	Inwall Inspections/GWB Board & Tape	30	30	03/01/23	04/11/23
C208	Prime & 1st Coat Paint	10	10	04/12/23	04/25/23
C209	Ceiling Grid & Cuts	10	10	04/26/23	05/09/23
C210	Ceramic Tile Walls & Floor	10	10	05/10/23	05/23/23
C211	Ceiling MEPFP's	20	20	05/10/23	06/07/23
C212	Millwork/Casework/Countertops	15	15	05/24/23	06/14/23
C213	Plumbing Fixtures	10	10	06/07/23	06/20/23
C214	Ceiling Tile	15	15	06/08/23	06/28/23
C215	Lab Equipment/Hoods	15	15	06/15/23	07/06/23
C216	Toilet Partitions & Accessories	10	10	06/21/23	07/05/23
C217	Flooring/Balance of Finishes/Specialties	35	35	06/29/23	08/17/23
C218	MEPFP Finishes	20	20	06/29/23	07/27/23
C219	Final Paint	10	10	08/18/23	08/31/23
C220	Pre-Clean	5	5	09/01/23	09/08/23
C221	Pre-Punchlist	10	10	09/11/23	09/22/23
L3 Interior Finishes (Tower C)					
C300	OH Duct/Mech Piping/ATC Controls Rough	25	25	01/11/23	02/14/23
C301	OH Plumbing Rough	20	20	01/18/23	02/14/23
C302	OH Electrical/FA/Tel Data Rough	20	20	01/18/23	02/14/23
C303	OH Sprinkler Rough	15	15	01/18/23	02/07/23
C304	Frame Walls & Ceilings	15	15	02/08/23	02/28/23
C305	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	02/22/23	03/28/23
C306	Inwall Plumbing Rough/Test/Insulate	15	15	03/01/23	03/21/23
C307	Inwall Inspections/GWB Board & Tape	30	30	03/29/23	05/09/23
C308	Prime & 1st Coat Paint	10	10	05/10/23	05/23/23
C309	Ceiling Grid & Cuts	10	10	05/24/23	06/07/23
C310	Ceramic Tile Walls & Floor	10	10	06/08/23	06/21/23
C311	Ceiling MEPFP's	20	20	06/08/23	07/06/23
C312	Millwork/Casework/Countertops	15	15	06/22/23	07/13/23
C313	Plumbing Fixtures	10	10	07/06/23	07/19/23
C314	Ceiling Tile	15	15	07/07/23	07/27/23
C315	Lab Equipment/Hoods	15	15	07/14/23	08/03/23
C316	Toilet Partitions & Accessories	10	10	07/20/23	08/02/23
C317	Flooring/Balance of Finishes/Specialties	35	35	07/28/23	09/15/23
C318	MEPFP Finishes	20	20	07/28/23	08/24/23
C319	Final Paint	10	10	09/18/23	09/29/23
C320	Pre-Clean	5	5	10/02/23	10/06/23
C321	Pre-Punchlist	10	10	10/09/23	10/20/23
L4 Interior Finishes (Tower C)					
C400	OH Duct/Mech Piping/ATC Controls Rough	25	25	02/08/23	03/14/23
C401	OH Plumbing Rough	20	20	02/15/23	03/14/23
C402	OH Electrical/FA/Tel Data Rough	20	20	02/15/23	03/14/23
C403	OH Sprinkler Rough	15	15	02/15/23	03/07/23
C404	Frame Walls & Ceilings	15	15	03/08/23	03/28/23
C405	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	03/22/23	04/25/23
C406	Inwall Plumbing Rough/Test/Insulate	15	15	03/29/23	04/18/23
C407	Inwall Inspections/GWB Board & Tape	30	30	04/26/23	06/07/23
C408	Prime & 1st Coat Paint	10	10	06/08/23	06/21/23



FONTAINE + DIMEO

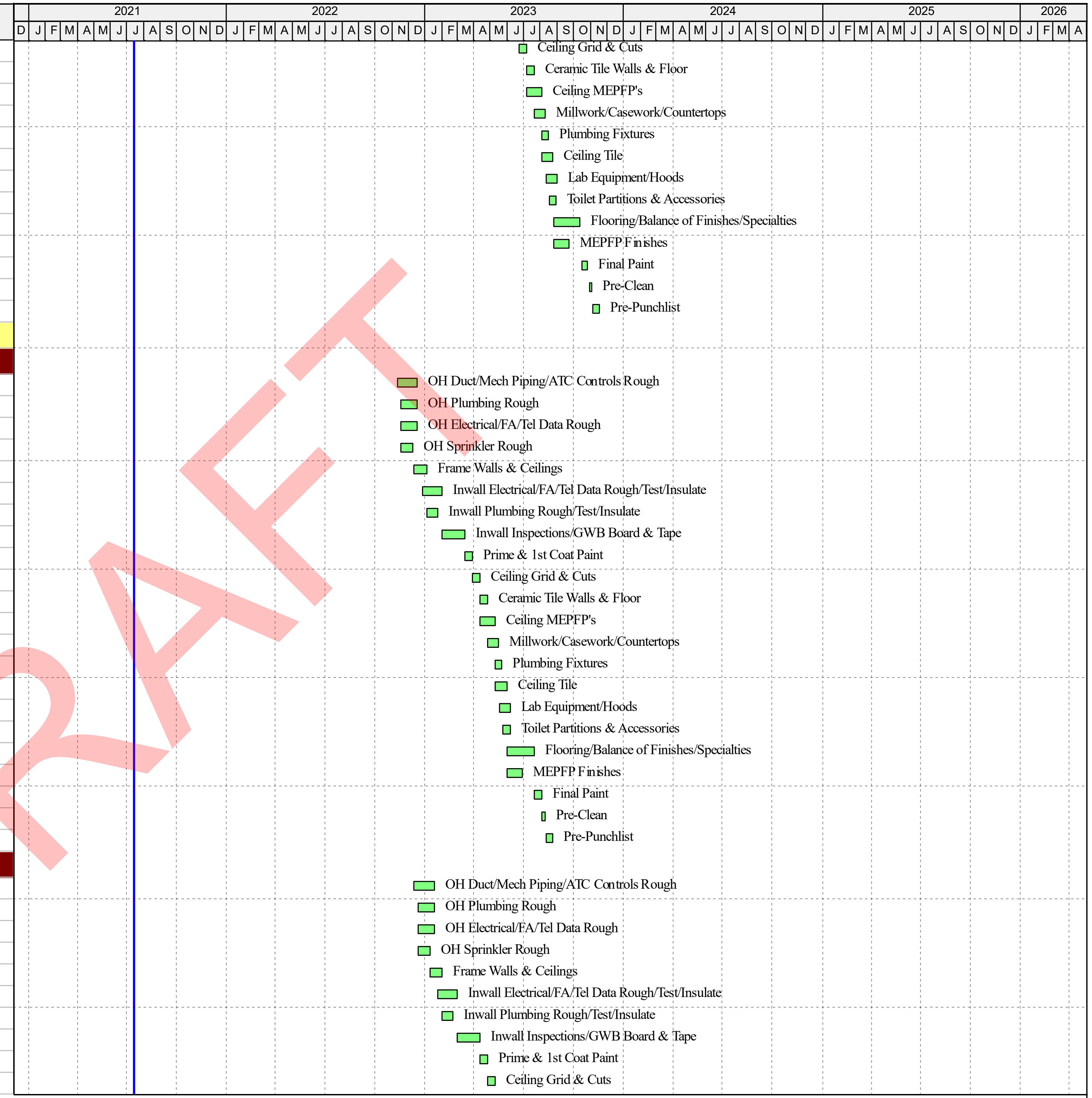
NEW DOHERTY MEMORIAL HIGH SCHOOL

60% CD Submission Schedule

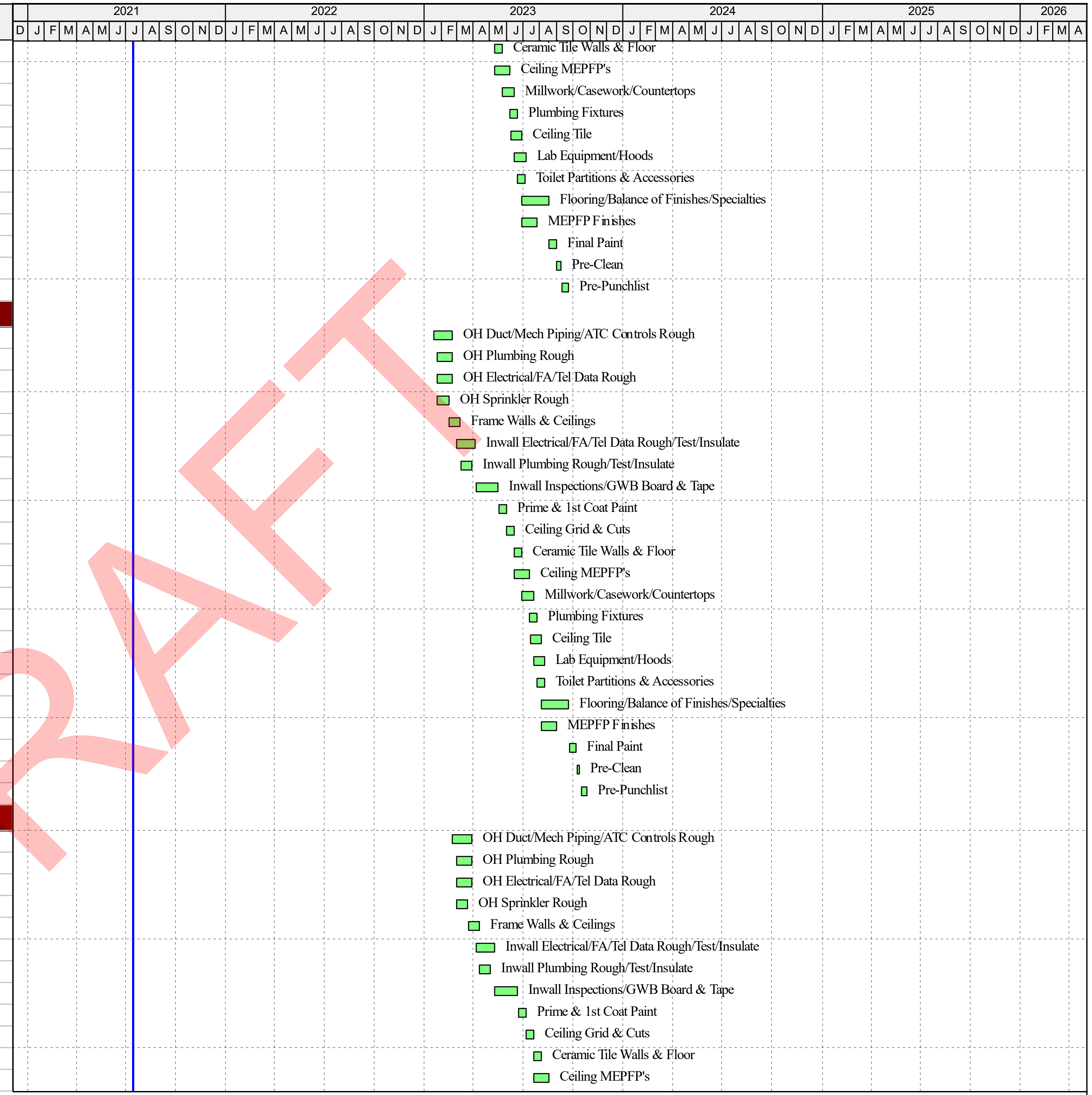
Data Date: 07/14/21
Run Date: 07/19/21

Schedule ID : **372-20F**
Construction Start Date : 05/03/21
Construction Completion Date : 7/16/25

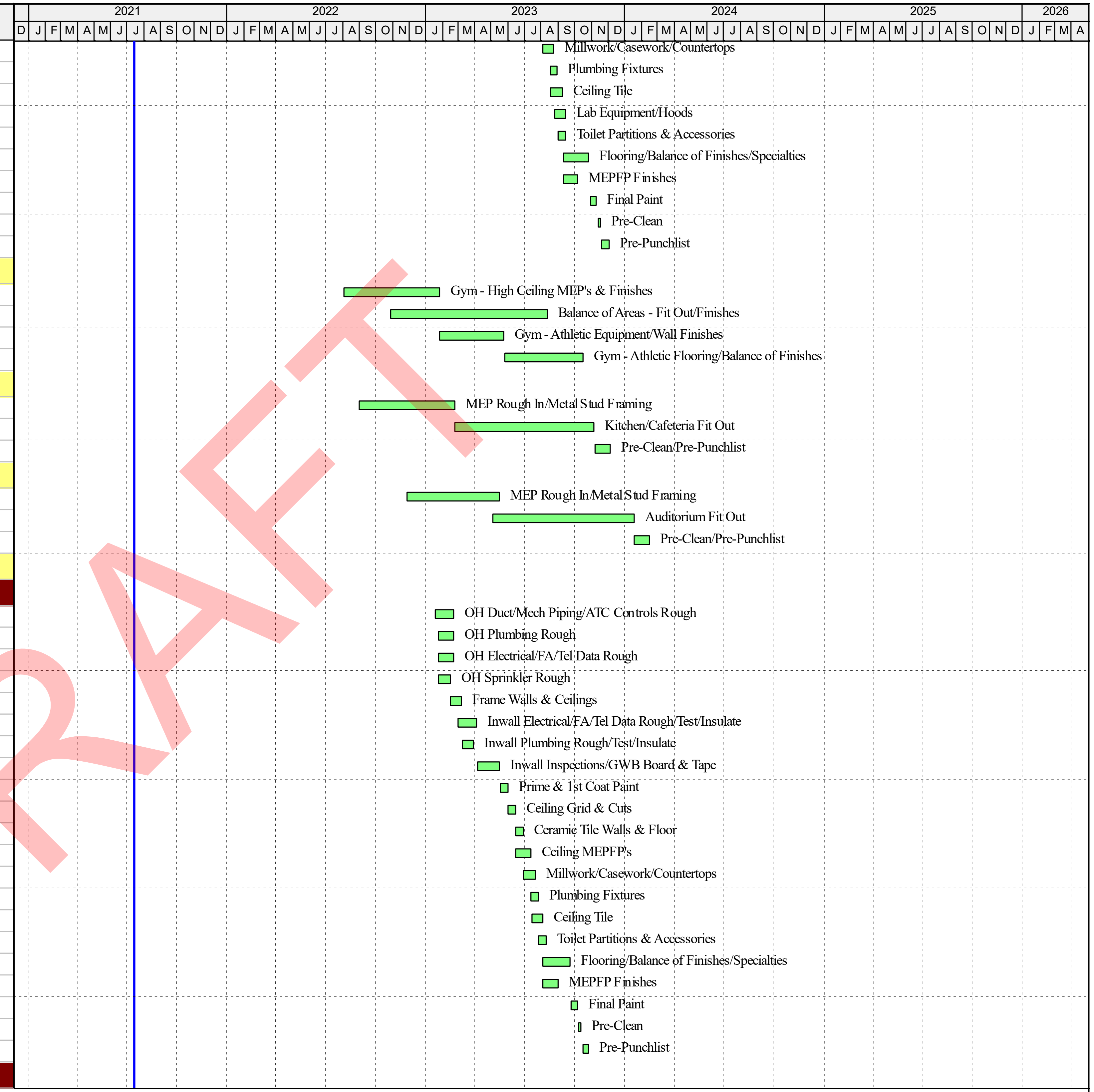
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
C409	Ceiling Grid & Cuts	10	10	06/22/23	07/06/23
C410	Ceramic Tile Walls & Floor	10	10	07/07/23	07/20/23
C411	Ceiling MEPFP's	20	20	07/07/23	08/03/23
C412	Millwork/Casework/Countertops	15	15	07/21/23	08/10/23
C413	Plumbing Fixtures	10	10	08/03/23	08/16/23
C414	Ceiling Tile	15	15	08/04/23	08/24/23
C415	Lab Equipment/Hoods	15	15	08/11/23	08/31/23
C416	Toilet Partitions & Accessories	10	10	08/17/23	08/30/23
C417	Flooring/Balance of Finishes/Specialties	35	35	08/25/23	10/13/23
C418	MEPFP Finishes	20	20	08/25/23	09/22/23
C419	Final Paint	10	10	10/16/23	10/27/23
C420	Pre-Clean	5	5	10/30/23	11/03/23
C421	Pre-Punchlist	10	10	11/06/23	11/17/23
ACADEMIC TOWER D (Interior Finishes)					
Ground Floor Interior Finishes (Tower D)					
D010	OH Duct/Mech Piping/ATC Controls Rough	25	25	11/11/22	12/16/22
D011	OH Plumbing Rough	20	20	11/18/22	12/16/22
D012	OH Electrical/FA/Tel Data Rough	20	20	11/18/22	12/16/22
D013	OH Sprinkler Rough	15	15	11/18/22	12/09/22
D014	Frame Walls & Ceilings	15	15	12/12/22	01/03/23
D015	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	12/27/22	01/31/23
D016	Inwall Plumbing Rough/Test/Insulate	15	15	01/04/23	01/24/23
D017	Inwall Inspections/GWB Board & Tape	30	30	02/01/23	03/14/23
D018	Prime & 1st Coat Paint	10	10	03/15/23	03/28/23
D019	Ceiling Grid & Cuts	10	10	03/29/23	04/11/23
D020	Ceramic Tile Walls & Floor	10	10	04/12/23	04/25/23
D021	Ceiling MEPFP's	20	20	04/12/23	05/09/23
D022	Millwork/Casework/Countertops	15	15	04/26/23	05/16/23
D023	Plumbing Fixtures	10	10	05/09/23	05/22/23
D024	Ceiling Tile	15	15	05/10/23	05/31/23
D025	Lab Equipment/Hoods	15	15	05/17/23	06/07/23
D026	Toilet Partitions & Accessories	10	10	05/23/23	06/06/23
D027	Flooring/Balance of Finishes/Specialties	35	35	06/01/23	07/20/23
D028	MEPFP Finishes	20	20	06/01/23	06/28/23
D029	Final Paint	10	10	07/21/23	08/03/23
D030	Pre-Clean	5	5	08/04/23	08/10/23
D031	Pre-Punchlist	10	10	08/11/23	08/24/23
Main Floor Interior Finishes (Tower D)					
D100	OH Duct/Mech Piping/ATC Controls Rough	25	25	12/12/22	01/17/23
D101	OH Plumbing Rough	20	20	12/19/22	01/17/23
D102	OH Electrical/FA/Tel Data Rough	20	20	12/19/22	01/17/23
D103	OH Sprinkler Rough	15	15	12/19/22	01/10/23
D104	Frame Walls & Ceilings	15	15	01/11/23	01/31/23
D105	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	01/25/23	02/28/23
D106	Inwall Plumbing Rough/Test/Insulate	15	15	02/01/23	02/21/23
D107	Inwall Inspections/GWB Board & Tape	30	30	03/01/23	04/11/23
D108	Prime & 1st Coat Paint	10	10	04/12/23	04/25/23
D109	Ceiling Grid & Cuts	10	10	04/26/23	05/09/23



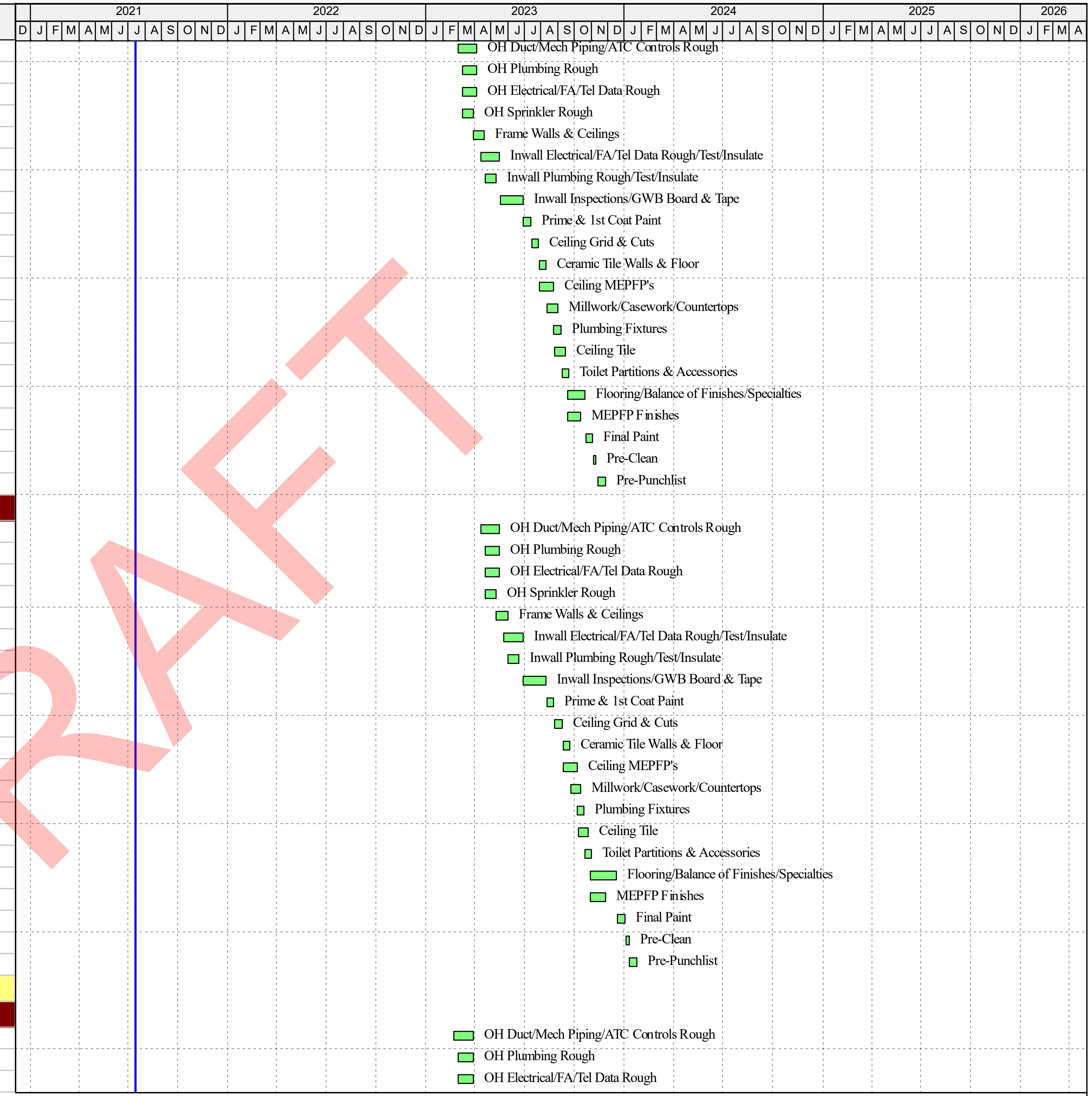
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
D110	Ceramic Tile Walls & Floor	10	10	05/10/23	05/23/23
D111	Ceiling MEPFP's	20	20	05/10/23	06/07/23
D112	Millwork/Casework/Countertops	15	15	05/24/23	06/14/23
D113	Plumbing Fixtures	10	10	06/07/23	06/20/23
D114	Ceiling Tile	15	15	06/08/23	06/28/23
D115	Lab Equipment/Hoods	15	15	06/15/23	07/06/23
D116	Toilet Partitions & Accessories	10	10	06/21/23	07/05/23
D117	Flooring/Balance of Finishes/Specialties	35	35	06/29/23	08/17/23
D118	MEPFP Finishes	20	20	06/29/23	07/27/23
D119	Final Paint	10	10	08/18/23	08/31/23
D120	Pre-Clean	5	5	09/01/23	09/08/23
D121	Pre-Punchlist	10	10	09/11/23	09/22/23
L2 Interior Finishes (Tower D)					
D200	OH Duct/Mech Piping/ATC Controls Rough	25	25	01/18/23	02/21/23
D201	OH Plumbing Rough	20	20	01/25/23	02/21/23
D202	OH Electrical/FA/Tel Data Rough	20	20	01/25/23	02/21/23
D203	OH Sprinkler Rough	15	15	01/25/23	02/14/23
D204	Frame Walls & Ceilings	15	15	02/15/23	03/07/23
D205	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	03/01/23	04/04/23
D206	Inwall Plumbing Rough/Test/Insulate	15	15	03/08/23	03/28/23
D207	Inwall Inspections/GWB Board & Tape	30	30	04/05/23	05/16/23
D208	Prime & 1st Coat Paint	10	10	05/17/23	05/31/23
D209	Ceiling Grid & Cuts	10	10	06/01/23	06/14/23
D210	Ceramic Tile Walls & Floor	10	10	06/15/23	06/28/23
D211	Ceiling MEPFP's	20	20	06/15/23	07/13/23
D212	Millwork/Casework/Countertops	15	15	06/29/23	07/20/23
D213	Plumbing Fixtures	10	10	07/13/23	07/26/23
D214	Ceiling Tile	15	15	07/14/23	08/03/23
D215	Lab Equipment/Hoods	15	15	07/21/23	08/10/23
D216	Toilet Partitions & Accessories	10	10	07/27/23	08/09/23
D217	Flooring/Balance of Finishes/Specialties	35	35	08/04/23	09/22/23
D218	MEPFP Finishes	20	20	08/04/23	08/31/23
D219	Final Paint	10	10	09/25/23	10/06/23
D220	Pre-Clean	5	5	10/09/23	10/13/23
D221	Pre-Punchlist	10	10	10/16/23	10/27/23
L3 Interior Finishes (Tower D)					
D300	OH Duct/Mech Piping/ATC Controls Rough	25	25	02/22/23	03/28/23
D301	OH Plumbing Rough	20	20	03/01/23	03/28/23
D302	OH Electrical/FA/Tel Data Rough	20	20	03/01/23	03/28/23
D303	OH Sprinkler Rough	15	15	03/01/23	03/21/23
D304	Frame Walls & Ceilings	15	15	03/22/23	04/11/23
D305	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	04/05/23	05/09/23
D306	Inwall Plumbing Rough/Test/Insulate	15	15	04/12/23	05/02/23
D307	Inwall Inspections/GWB Board & Tape	30	30	05/10/23	06/21/23
D308	Prime & 1st Coat Paint	10	10	06/22/23	07/06/23
D309	Ceiling Grid & Cuts	10	10	07/07/23	07/20/23
D310	Ceramic Tile Walls & Floor	10	10	07/21/23	08/03/23
D311	Ceiling MEPFP's	20	20	07/21/23	08/17/23



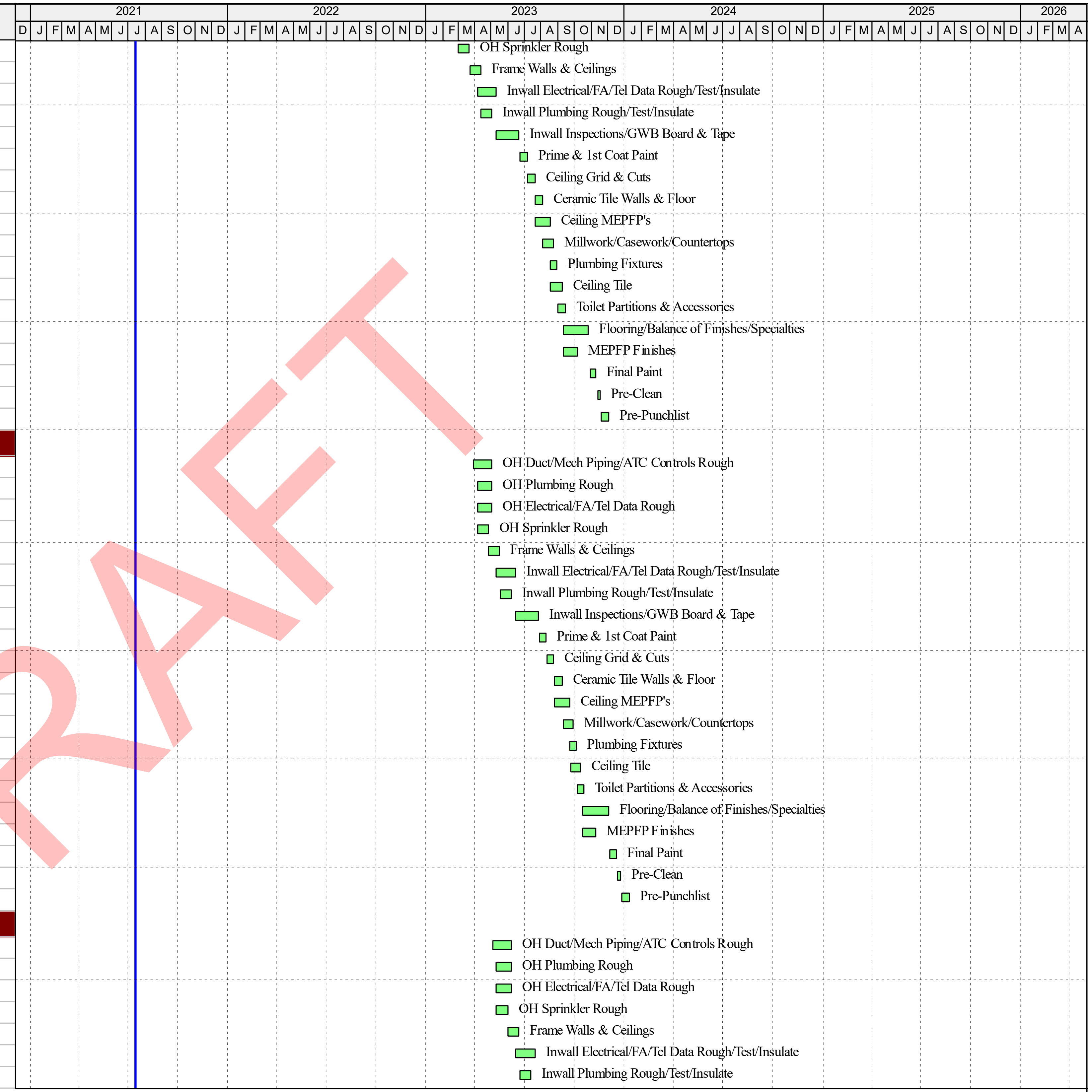
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
D312	Millwork/Casework/Countertops	15	15	08/04/23	08/24/23
D313	Plumbing Fixtures	10	10	08/17/23	08/30/23
D314	Ceiling Tile	15	15	08/18/23	09/08/23
D315	Lab Equipment/Hoods	15	15	08/25/23	09/15/23
D316	Toilet Partitions & Accessories	10	10	08/31/23	09/14/23
D317	Flooring/Balance of Finishes/Specialties	35	35	09/11/23	10/27/23
D318	MEPFP Finishes	20	20	09/11/23	10/06/23
D319	Final Paint	10	10	10/30/23	11/10/23
D320	Pre-Clean	5	5	11/13/23	11/17/23
D321	Pre-Punchlist	10	10	11/20/23	12/04/23
PHYSICAL EDUCATION AREA					
GYM10	Gym - High Ceiling MEP's & Finishes	120	120	08/04/22	01/25/23
GYM11	Balance of Areas - Fit Out/Finishes	200	200	10/28/22	08/11/23
GYM12	Gym - Athletic Equipment/Wall Finishes	85	85	01/26/23	05/24/23
GYM13	Gym - Athletic Flooring/Balance of Finishes	100	100	05/25/23	10/16/23
CAFETERIA/KITCHEN AREA					
CAF1	MEP Rough In/Metal Stud Framing	120	120	09/01/22	02/22/23
CAF2	Kitchen/Cafeteria Fit Out	180	180	02/23/23	11/06/23
CAF3	Pre-Clean/Pre-Punchlist	20	20	11/07/23	12/05/23
AUDITORIUM					
AUD1	MEP Rough In/Metal Stud Framing	120	120	11/28/22	05/16/23
AUD2	Auditorium Fit Out	180	180	05/03/23	01/17/24
AUD3	Pre-Clean/Pre-Punchlist	20	20	01/18/24	02/14/24
ADMINISTRATION AREA					
Ground Floor Interior Finishes (Admin)					
AD010	OH Duct/Mech Piping/ATC Controls Rough	25	25	01/18/23	02/21/23
AD011	OH Plumbing Rough	20	20	01/25/23	02/21/23
AD012	OH Electrical/FA/Tel Data Rough	20	20	01/25/23	02/21/23
AD013	OH Sprinkler Rough	15	15	01/25/23	02/14/23
AD014	Frame Walls & Ceilings	15	15	02/15/23	03/07/23
AD015	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	03/01/23	04/04/23
AD016	Inwall Plumbing Rough/Test/Insulate	15	15	03/08/23	03/28/23
AD017	Inwall Inspections/GWB Board & Tape	30	30	04/05/23	05/16/23
AD018	Prime & 1st Coat Paint	10	10	05/17/23	05/31/23
AD019	Ceiling Grid & Cuts	10	10	06/01/23	06/14/23
AD020	Ceramic Tile Walls & Floor	10	10	06/15/23	06/28/23
AD021	Ceiling MEPFP's	20	20	06/15/23	07/13/23
AD022	Millwork/Casework/Countertops	15	15	06/29/23	07/20/23
AD023	Plumbing Fixtures	10	10	07/13/23	07/26/23
AD024	Ceiling Tile	15	15	07/14/23	08/03/23
AD025	Toilet Partitions & Accessories	10	10	07/27/23	08/09/23
AD026	Flooring/Balance of Finishes/Specialties	35	35	08/04/23	09/22/23
AD027	MEPFP Finishes	20	20	08/04/23	08/31/23
AD028	Final Paint	10	10	09/25/23	10/06/23
AD029	Pre-Clean	5	5	10/09/23	10/13/23
AD030	Pre-Punchlist	10	10	10/16/23	10/27/23
Main Floor Interior Finishes (Admin)					



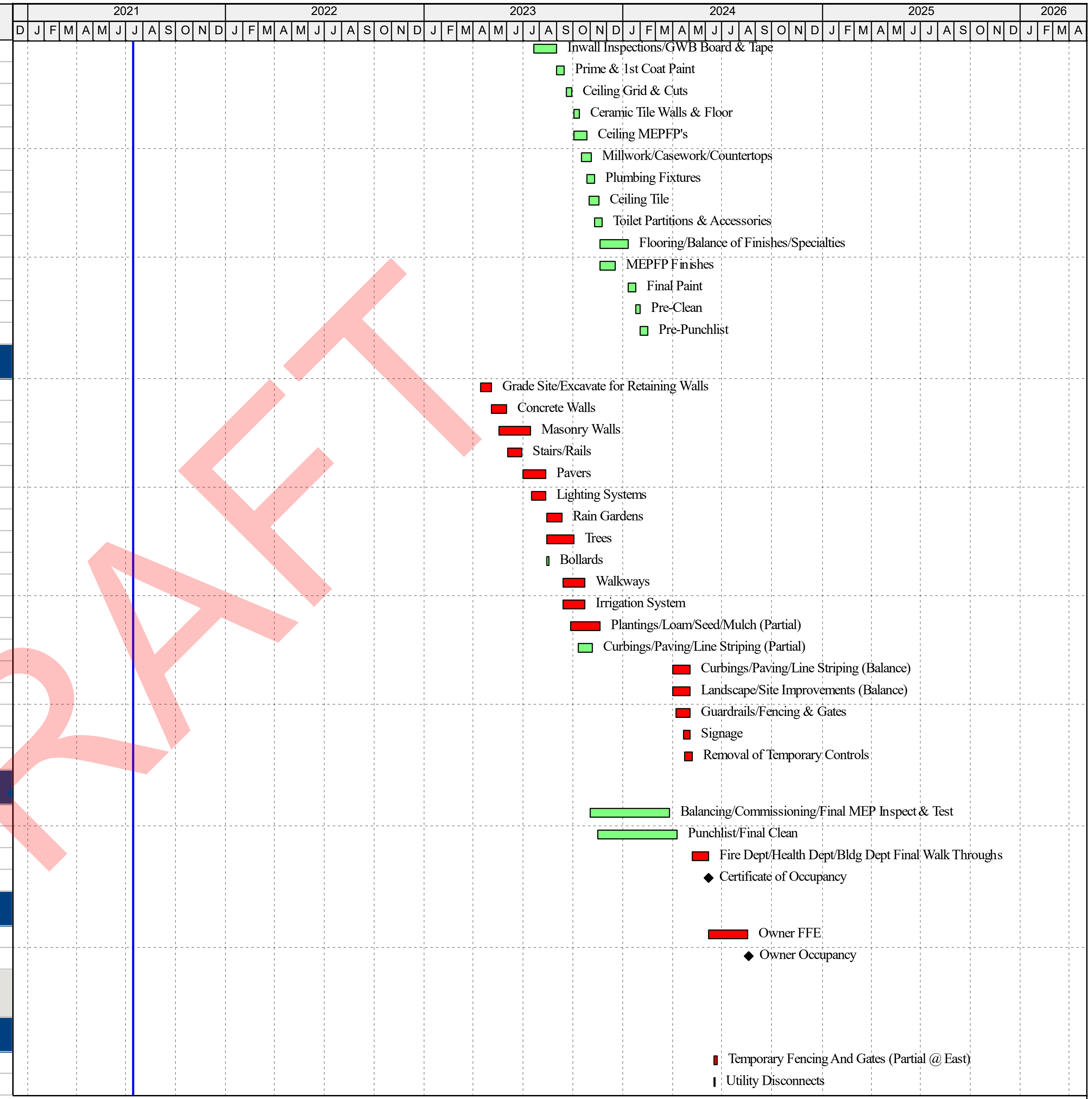
Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
AD100	OH Duct/Mech Piping/ATC Controls Rough	25	25	03/01/23	04/04/23
AD101	OH Plumbing Rough	20	20	03/08/23	04/04/23
AD102	OH Electrical/FA/Tel Data Rough	20	20	03/08/23	04/04/23
AD103	OH Sprinkler Rough	15	15	03/08/23	03/28/23
AD104	Frame Walls & Ceilings	15	15	03/29/23	04/18/23
AD105	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	04/12/23	05/16/23
AD106	Inwall Plumbing Rough/Test/Insulate	15	15	04/19/23	05/09/23
AD107	Inwall Inspections/GWB Board & Tape	30	30	05/17/23	06/28/23
AD108	Prime & 1st Coat Paint	10	10	06/29/23	07/13/23
AD109	Ceiling Grid & Cuts	10	10	07/14/23	07/27/23
AD110	Ceramic Tile Walls & Floor	10	10	07/28/23	08/10/23
AD111	Ceiling MEPFP's	20	20	07/28/23	08/24/23
AD112	Millwork/Casework/Countertops	15	15	08/11/23	08/31/23
AD113	Plumbing Fixtures	10	10	08/24/23	09/07/23
AD114	Ceiling Tile	15	15	08/25/23	09/15/23
AD115	Toilet Partitions & Accessories	10	10	09/08/23	09/21/23
AD116	Flooring/Balance of Finishes/Specialties	25	25	09/18/23	10/20/23
AD117	MEPFP Finishes	20	20	09/18/23	10/13/23
AD118	Final Paint	10	10	10/23/23	11/03/23
AD119	Pre-Clean	5	5	11/06/23	11/10/23
AD120	Pre-Punchlist	10	10	11/13/23	11/27/23
L2 Interior Finishes (Admin)					
AD200	OH Duct/Mech Piping/ATC Controls Rough	25	25	04/12/23	05/16/23
AD201	OH Plumbing Rough	20	20	04/19/23	05/16/23
AD202	OH Electrical/FA/Tel Data Rough	20	20	04/19/23	05/16/23
AD203	OH Sprinkler Rough	15	15	04/19/23	05/09/23
AD204	Frame Walls & Ceilings	15	15	05/10/23	05/31/23
AD205	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	05/24/23	06/28/23
AD206	Inwall Plumbing Rough/Test/Insulate	15	15	06/01/23	06/21/23
AD207	Inwall Inspections/GWB Board & Tape	30	30	06/29/23	08/10/23
AD208	Prime & 1st Coat Paint	10	10	08/11/23	08/24/23
AD209	Ceiling Grid & Cuts	10	10	08/25/23	09/08/23
AD210	Ceramic Tile Walls & Floor	10	10	09/11/23	09/22/23
AD211	Ceiling MEPFP's	20	20	09/11/23	10/06/23
AD212	Millwork/Casework/Countertops	15	15	09/25/23	10/13/23
AD213	Plumbing Fixtures	10	10	10/06/23	10/19/23
AD214	Ceiling Tile	15	15	10/09/23	10/27/23
AD215	Toilet Partitions & Accessories	10	10	10/20/23	11/02/23
AD216	Flooring/Balance of Finishes/Specialties	35	35	10/30/23	12/18/23
AD217	MEPFP Finishes	20	20	10/30/23	11/27/23
AD218	Final Paint	10	10	12/19/23	01/03/24
AD219	Pre-Clean	5	5	01/04/24	01/10/24
AD220	Pre-Punchlist	10	10	01/11/24	01/24/24
NORTH/BAND/CHORUS AREA					
Ground Floor Interior Finishes (North)					
N010	OH Duct/Mech Piping/ATC Controls Rough	25	25	02/22/23	03/28/23
N011	OH Plumbing Rough	20	20	03/01/23	03/28/23
N012	OH Electrical/FA/Tel Data Rough	20	20	03/01/23	03/28/23



Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
N013	OH Sprinkler Rough	15	15	03/01/23	03/21/23
N014	Frame Walls & Ceilings	15	15	03/22/23	04/11/23
N015	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	04/05/23	05/09/23
N016	Inwall Plumbing Rough/Test/Insulate	15	15	04/12/23	05/02/23
N017	Inwall Inspections/GWB Board & Tape	30	30	05/10/23	06/21/23
N018	Prime & 1st Coat Paint	10	10	06/22/23	07/06/23
N019	Ceiling Grid & Cuts	10	10	07/07/23	07/20/23
N020	Ceramic Tile Walls & Floor	10	10	07/21/23	08/03/23
N021	Ceiling MEPFP's	20	20	07/21/23	08/17/23
N022	Millwork/Casework/Countertops	15	15	08/04/23	08/24/23
N023	Plumbing Fixtures	10	10	08/17/23	08/30/23
N024	Ceiling Tile	15	15	08/18/23	09/08/23
N025	Toilet Partitions & Accessories	10	10	08/31/23	09/14/23
N026	Flooring/Balance of Finishes/Specialties	35	35	09/11/23	10/27/23
N027	MEPFP Finishes	20	20	09/11/23	10/06/23
N028	Final Paint	10	10	10/30/23	11/10/23
N029	Pre-Clean	5	5	11/13/23	11/17/23
N030	Pre-Punchlist	10	10	11/20/23	12/04/23
Main Floor Interior Finishes (North)					
N100	OH Duct/Mech Piping/ATC Controls Rough	25	25	03/29/23	05/02/23
N101	OH Plumbing Rough	20	20	04/05/23	05/02/23
N102	OH Electrical/FA/Tel Data Rough	20	20	04/05/23	05/02/23
N103	OH Sprinkler Rough	15	15	04/05/23	04/25/23
N104	Frame Walls & Ceilings	15	15	04/26/23	05/16/23
N105	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	05/10/23	06/14/23
N106	Inwall Plumbing Rough/Test/Insulate	15	15	05/17/23	06/07/23
N107	Inwall Inspections/GWB Board & Tape	30	30	06/15/23	07/27/23
N108	Prime & 1st Coat Paint	10	10	07/28/23	08/10/23
N109	Ceiling Grid & Cuts	10	10	08/11/23	08/24/23
N110	Ceramic Tile Walls & Floor	10	10	08/25/23	09/08/23
N111	Ceiling MEPFP's	20	20	08/25/23	09/22/23
N112	Millwork/Casework/Countertops	15	15	09/11/23	09/29/23
N113	Plumbing Fixtures	10	10	09/22/23	10/05/23
N114	Ceiling Tile	15	15	09/25/23	10/13/23
N115	Toilet Partitions & Accessories	10	10	10/06/23	10/19/23
N116	Flooring/Balance of Finishes/Specialties	35	35	10/16/23	12/04/23
N117	MEPFP Finishes	20	20	10/16/23	11/10/23
N118	Final Paint	10	10	12/05/23	12/18/23
N119	Pre-Clean	5	5	12/19/23	12/26/23
N120	Pre-Punchlist	10	10	12/27/23	01/10/24
L2 Interior Finishes (North)					
N200	OH Duct/Mech Piping/ATC Controls Rough	25	25	05/03/23	06/07/23
N201	OH Plumbing Rough	20	20	05/10/23	06/07/23
N202	OH Electrical/FA/Tel Data Rough	20	20	05/10/23	06/07/23
N203	OH Sprinkler Rough	15	15	05/10/23	05/31/23
N204	Frame Walls & Ceilings	15	15	06/01/23	06/21/23
N205	Inwall Electrical/FA/Tel Data Rough/Test/Insulate	25	25	06/15/23	07/20/23
N206	Inwall Plumbing Rough/Test/Insulate	15	15	06/22/23	07/13/23



Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
N207	Inwall Inspections/GWB Board & Tape	30	30	07/21/23	08/31/23
N208	Prime & 1st Coat Paint	10	10	09/01/23	09/15/23
N209	Ceiling Grid & Cuts	10	10	09/18/23	09/29/23
N210	Ceramic Tile Walls & Floor	10	10	10/02/23	10/13/23
N211	Ceiling MEPFP's	20	20	10/02/23	10/27/23
N212	Millwork/Casework/Countertops	15	15	10/16/23	11/03/23
N213	Plumbing Fixtures	10	10	10/27/23	11/09/23
N214	Ceiling Tile	15	15	10/30/23	11/17/23
N215	Toilet Partitions & Accessories	10	10	11/10/23	11/24/23
N216	Flooring/Balance of Finishes/Specialties	35	35	11/20/23	01/10/24
N217	MEPFP Finishes	20	20	11/20/23	12/18/23
N218	Final Paint	10	10	01/11/24	01/24/24
N219	Pre-Clean	5	5	01/25/24	01/31/24
N220	Pre-Punchlist	10	10	02/01/24	02/14/24
Site Improvements					
SIT10	Grade Site/Excavate for Retaining Walls	15	15	04/13/23	05/03/23
SIT11	Concrete Walls	20	20	05/04/23	06/01/23
SIT12	Masonry Walls	40	40	05/18/23	07/14/23
SIT13	Stairs/Rails	20	20	06/02/23	06/29/23
SIT14	Pavers	30	30	06/30/23	08/11/23
SIT15	Lighting Systems	20	20	07/17/23	08/11/23
SIT16	Rain Gardens	20	20	08/14/23	09/11/23
SIT17	Trees	35	35	08/14/23	10/02/23
SIT18	Bollards	5	5	08/14/23	08/18/23
SIT19	Walkways	30	30	09/12/23	10/23/23
SIT20	Irrigation System	30	30	09/12/23	10/23/23
SIT21	Plantings/Loam/Seed/Mulch (Partial)	40	40	09/26/23	11/20/23*
SIT22	Curbings/Paving/Line Striping (Partial)	20	20	10/10/23	11/06/23
SIT23	Curbings/Paving/Line Striping (Balance)	25	25	04/01/24*	05/03/24
SIT24	Landscape/Site Improvements (Balance)	25	25	04/01/24	05/03/24
SIT25	Guardrails/Fencing & Gates	20	20	04/08/24	05/03/24
SIT26	Signage	10	10	04/22/24	05/03/24
SIT27	Removal of Temporary Controls	10	10	04/24/24	05/07/24
Punchlist/Commissioning/Building Complete					
CL1	Balancing/Commissioning/Final MEP Inspect & Test	100	100	11/02/23	03/25/24
CL2	Punchlist/Final Clean	100	100	11/16/23	04/08/24
CL3	Fire Dept/Health Dept/Bldg Dept Final Walk Throughs	20	20	05/08/24	06/05/24
CL4	Certificate of Occupancy	0	0		06/06/24*
New Building Owner Occupancy					
CL5	Owner FFE	50	50	06/07/24	08/16/24
CL6	Owner Occupancy	0	0		08/19/24*
PHASES 3A & 3B - ABATE/DEMO & PARKING (All Work on					
Phase 3A/B - Mobilize/Abate/Demolition (All Work on 2 Shifts/6 days)					
P3-10	Temporary Fencing And Gates (Partial @ East)	5	5	06/17/24*	06/21/24
P3-11	Utility Disconnects	2	2	06/17/24	06/18/24



FONTAINE + DIMEO

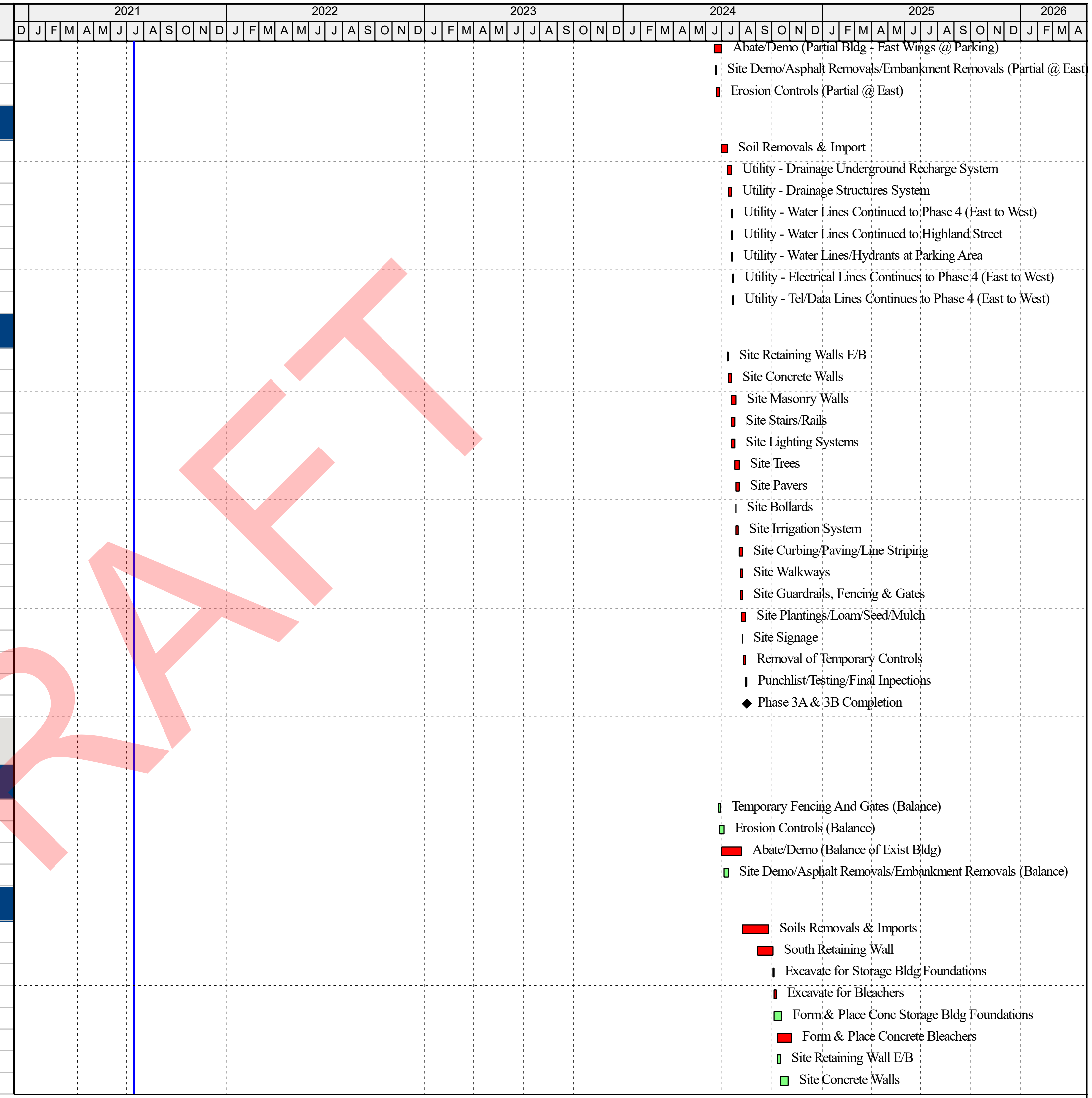
NEW DOHERTY MEMORIAL HIGH SCHOOL

60% CD Submission Schedule

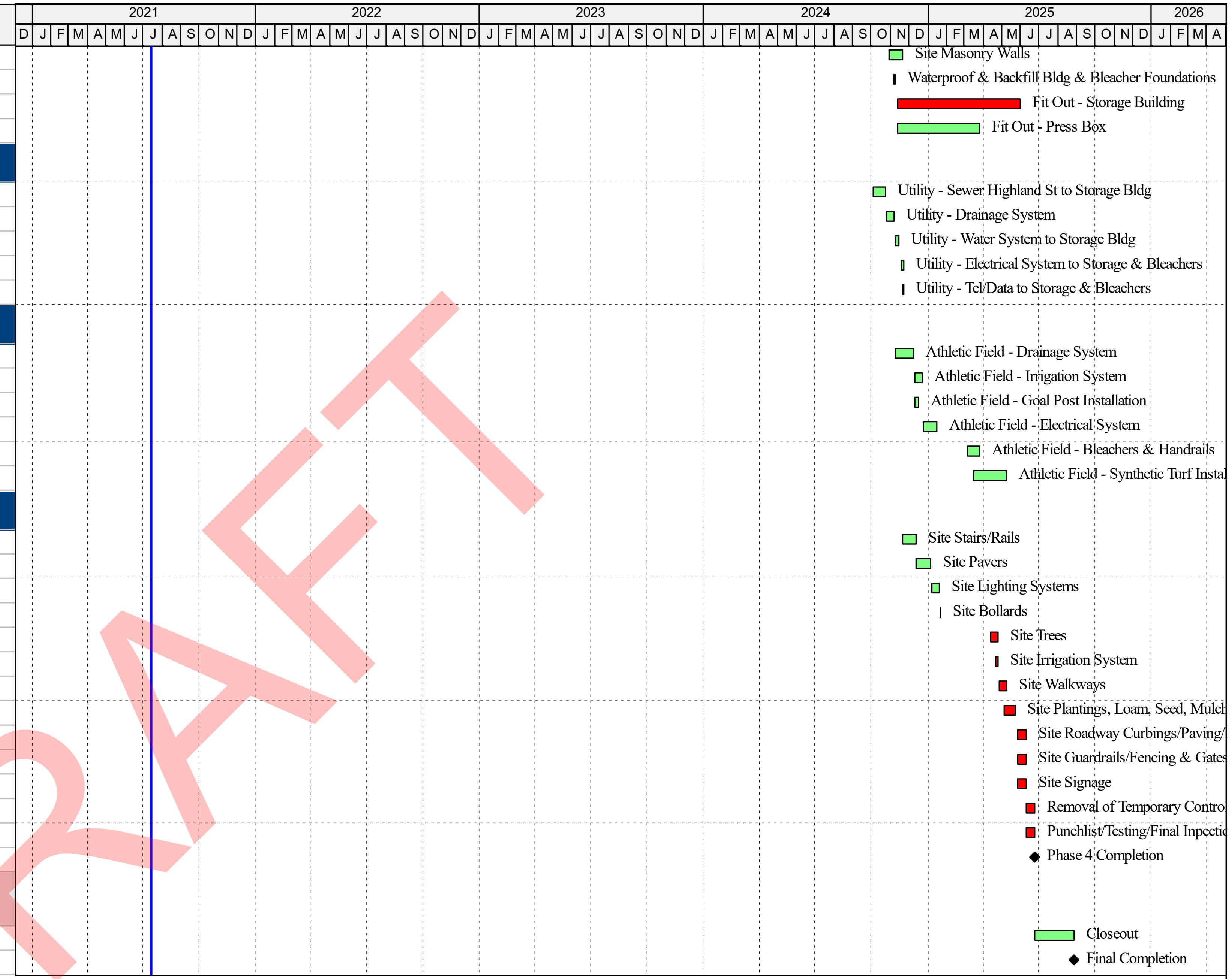
Data Date: 07/14/21
Run Date: 07/19/21

Schedule ID : **372-20F**
Construction Start Date : 05/03/21
Construction Completion Date : 7/16/25

Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
P3-12	Abate/Demo (Partial Bldg - East Wings @ Parking)	12	12	06/17/24	06/29/24
P3-13	Site Demo/Asphalt Removals/Embankment Removals (Partial @ East)	2	2	06/19/24	06/20/24
P3-14	Erosion Controls (Partial @ East)	5	5	06/20/24	06/25/24
Phase 3A/B - Site Prep/Utilities (All Work on 2 Shifts/6 days)					
P3-20	Soil Removals & Import	7	7	07/01/24	07/09/24
P3-21	Utility - Drainage Underground Recharge System	7	7	07/10/24	07/17/24
P3-22	Utility - Drainage Structures System	5	5	07/12/24	07/17/24
P3-23	Utility - Water Lines Continued to Phase 4 (East to West)	2	2	07/18/24	07/19/24
P3-24	Utility - Water Lines Continued to Highland Street	2	2	07/18/24	07/19/24
P3-25	Utility - Water Lines/Hydrants at Parking Area	2	2	07/18/24	07/19/24
P3-26	Utility - Electrical Lines Continues to Phase 4 (East to West)	2	2	07/20/24	07/22/24
P3-27	Utility - Tel/Data Lines Continues to Phase 4 (East to West)	2	2	07/20/24	07/22/24
Phase 3A/B - Balance of Parking Area Work (All Work on 2 Shifts/6 days)					
P3-40	Site Retaining Walls E/B	2	2	07/10/24	07/11/24
P3-41	Site Concrete Walls	5	5	07/12/24	07/17/24
P3-42	Site Masonry Walls	7	7	07/18/24	07/25/24
P3-43	Site Stairs/Rails	5	5	07/18/24	07/23/24
P3-44	Site Lighting Systems	5	5	07/18/24	07/23/24
P3-45	Site Trees	8	8	07/24/24	08/01/24
P3-46	Site Pavers	5	5	07/26/24	07/31/24
P3-47	Site Bollards	1	1	07/26/24	07/26/24
P3-48	Site Irrigation System	3	3	07/26/24	07/29/24
P3-49	Site Curbing/Paving/Line Striping	5	5	08/01/24	08/06/24
P3-50	Site Walkways	5	5	08/02/24	08/07/24
P3-51	Site Guardrails, Fencing & Gates	3	3	08/03/24	08/06/24
P3-54	Site Plantings/Loam/Seed/Mulch	7	7	08/05/24	08/12/24
P3-52	Site Signage	1	1	08/06/24	08/06/24
P3-53	Removal of Temporary Controls	3	3	08/09/24	08/12/24
P3-55	Punchlist/Testing/Final Inpections	3	3	08/13/24	08/15/24
P3-56	Phase 3A & 3B Completion	0	0		08/15/24*
PHASE 4 - SPORTS FIELDS & SITEWORK					
Phase 4 - Mobilize/Abate/Demolition (Balance)					
P4-01	Temporary Fencing And Gates (Balance)	5	5	06/24/24	06/28/24
P4-02	Erosion Controls (Balance)	5	5	06/27/24	07/03/24
P4-03	Abate/Demo (Balance of Exist Bldg)	25	25	07/01/24	08/05/24
P4-04	Site Demo/Asphalt Removals/Embankment Removals (Balance)	5	5	07/05/24	07/11/24
Phase 4 - Site/Site Concrete/Structures					
P4-10	Soils Removals & Imports	35	35	08/06/24	09/24/24
P4-11	South Retaining Wall	20	20	09/04/24	10/01/24
P4-12	Excavate for Storage Bldg Foundations	2	2	10/02/24	10/03/24
P4-13	Excavate for Bleachers	3	3	10/04/24	10/08/24
P4-14	Form & Place Conc Storage Bldg Foundations	10	10	10/04/24	10/17/24
P4-15	Form & Place Concrete Bleachers	20	20	10/09/24	11/05/24
P4-16	Site Retaining Wall E/B	5	5	10/09/24	10/15/24
P4-17	Site Concrete Walls	10	10	10/16/24	10/29/24



Activity ID	Activity Name	Dur	Rem Dur	Start	Finish
P4-18	Site Masonry Walls	15	15	10/30/24	11/20/24
P4-19	Waterproof & Backfill Bldg & Bleacher Foundations	3	3	11/06/24	11/08/24
P4-20	Fit Out - Storage Building	140	140	11/12/24	05/30/25
P4-21	Fit Out - Press Box	95	95	11/12/24	03/27/25
Phase 4 - Utilities					
P4-40	Utility - Sewer Highland St to Storage Bldg	15	15	10/04/24	10/24/24
P4-41	Utility - Drainage System	10	10	10/25/24	11/07/24
P4-42	Utility - Water System to Storage Bldg	5	5	11/08/24	11/15/24
P4-43	Utility - Electrical System to Storage & Bleachers	5	5	11/18/24	11/22/24
P4-44	Utility - Tel/Data to Storage & Bleachers	3	3	11/20/24	11/22/24
Phase 4 - Athletic Field					
P4-50	Athletic Field - Drainage System	20	20	11/08/24	12/09/24
P4-51	Athletic Field - Irrigation System	10	10	12/10/24	12/23/24
P4-52	Athletic Field - Goal Post Installation	5	5	12/10/24	12/16/24
P4-53	Athletic Field - Electrical System	15	15	12/24/24	01/15/25
P4-54	Athletic Field - Bleachers & Handrails	15	15	03/07/25	03/27/25
P4-55	Athletic Field - Synthetic Turf Installation	40	40	03/17/25*	05/09/25
Phase 4 - Balance of Site Improvements					
P4-60	Site Stairs/Rails	15	15	11/21/24	12/12/24
P4-61	Site Pavers	15	15	12/13/24	01/06/25
P4-62	Site Lighting Systems	10	10	01/07/25	01/20/25
P4-63	Site Bollards	2	2	01/21/25	01/22/25
P4-64	Site Trees	10	10	04/14/25*	04/25/25
P4-65	Site Irrigation System	5	5	04/21/25	04/25/25
P4-66	Site Walkways	10	10	04/28/25	05/09/25
P4-67	Site Plantings, Loam, Seed, Mulch	15	15	05/05/25	05/23/25
P4-68	Site Roadway Curbings/Paving/Line Striping	10	10	05/27/25	06/09/25
P4-69	Site Guardrails/Fencing & Gates	10	10	05/27/25	06/09/25
P4-70	Site Signage	10	10	05/27/25	06/09/25
P4-71	Removal of Temporary Controls	10	10	06/10/25	06/23/25
P4-72	Punchlist/Testing/Final Inpections	10	10	06/10/25	06/23/25
P4-73	Phase 4 Completion	0	0		06/23/25*
FINAL CLOSEOUT					
CLO1	Closeout	45	45	06/24/25	08/26/25
CLO2	Final Completion	0	0		08/27/25



6B.2 OPM DELIVERABLES

6B.2.2 Project Schedule

B. Letter from City of Worcester

DEPARTMENT OF PUBLIC WORKS AND PARKS
20 East Worcester Street
Worcester, Massachusetts 01604

Jay J. Fink, P.E., Commissioner

William A. Coyle, P.E., Deputy Commissioner

(508)929-1300 / (508)799-1448 Fax

Assistant Commissioners
K. Russell Adams, P.E., Engineering
Robert C. Antonelli, Jr., Parks, Recreation, & Cemetery
Jarrett B. Conner, Administration & Finance

Edward M. Augustus, Jr., City Manager

July 21, 2021

Sarah Przybylowicz
Project Coordinator
Massachusetts School Building Authority
40 Broad Street, Suite 500
Boston, MA 02109

RE: Doherty Memorial High School

This letter is to confirm that the Doherty Memorial High School project has undergone and obtained all necessary state and local reviews and approvals required for the project as indicated in the 60% Construction Document Project Schedule submission.

Very Truly Yours,

K. Russell Adams P.E.
Assistant Commissioner of Engineering

6B.2 OPM DELIVERABLES

6B2.3 Project Scope and Budget

A. OPM Construction Cost Comparison
B. OPM Reconciled Cost Estimate
C. CM at Risk Reconciled Cost Estimate
D. Updated Total Project Budget
E. Value Engineering Recommendations

A. OPM Construction Cost Comparison

B. OPM Reconciled Cost Estimate

C. CM at Risk Reconciled Cost Estimate

D. Updated Total Project Budget

E. Value Engineering Recommendations

6B.3 DESIGNER DELIVERABLES

6B3.1 General Requirements

A. Updated Work Plan
B. Basis of Design Narratives
C. Building Code Analysis
D. List of Proprietary Items
E. Interior Color Theory Statement
F. LEED v4 Project Registration & Scorecard
G. Structural Lateral Bracing & Seismic Design Narrative
H. Structural Calculations & Floor Loads
I. Updated Energy Calculations
J. Updated Life Cycle Cost Analysis Energy & Water Consuming Devices
K. Updated HVAC Heat Gain & Loss Calculations
L. Updated Electrical Load Calculations
M. Security & Visual Access Requirements
N. Facility & Maintenance Requirements
O. Quality Control Documents

6B.3 DESIGNER DELIVERABLES

6B.3.1 General Requirements

A. Updated Work Plan

PROJECT WORK PLAN:

- 60% CD drawings/specifications distributed to cost estimators | **July 8, 2021**
- MSBA 60% CD Binder Deliverables due from consultants | **July 15, 2021**
- Sitework Early Bid Package #2 issued to CM for bidding | **July 22, 2021**
- 60% CD cost estimate reconciliation meeting | **August 3, 2021**
- 60% CD submission delivered to MSBA | **August 12, 2021**
- CM, OPM and Commissioning 60% CD comments distributed to consultants | **August 12, 2021**
- Consultant responses to 60% CD comments due | **August 19, 2021**
- Midpoint 90% CD drawings/specifications (incorporating LPA redlines) due | **September 9, 2021**
- Structural Peer Review documents issued | **September 10, 2021**
- 90% CD drawings/specifications distributed to cost estimators | **October 21, 2021**
- Structural Early Bid Package #3 issued to CM for bidding | **October 21, 2021**
- 90% CD cost estimate reconciliation meeting | **November 16, 2021**
- 90% CD Phase/ Early Structural Bid Package #3 Submission to MSBA | **November 26. 2021**
- 100% CD Phase/Trade Contractor Final Bid Package #4 Submission to MSBA | **January 13, 2022**
- Trade Contractor Bidding Complete | **March 2022**

These milestones and dates have been coordinated with the OPM/CM and have been included into the Construction Managers detailed schedule, published in section 6B2.2

The CM's detailed schedule includes the agency reviews and permitting items

6B.3 DESIGNER DELIVERABLES

6B.3.1 General Requirements

B. Basis of Design Narratives

1. Architectural
2. Civil
3. Landscape
4. Structural
5. Fire Protection
6. Plumbing
7. HVAC
8. Electrical
9. Food Service
10. Acoustical
11. FF & E

GENERAL

The Architectural Basis of Design has been updated based on the 60% Construction Documents but remains in alignment with the preceding submissions. This includes the establishment of Sustainable Design Goals, Project Phasing, New Construction Scope of Work, and the preliminary selection of finishes.

COMMUNITY GOALS

The Doherty Memorial High School Visioning Sessions culminated in the definition of project goals and priorities for the re-imagined High School. Some of these goals and priorities have direct architectural implications that will help to establish the architectural basis of design. The following items are a summary of organizational or aesthetic architectural features which are desired in the new Doherty High School:

- An entry sequence which is welcoming yet secure.
- A prominent lobby space that enhances and encourages community use after school hours.
- Building organization that ensures the educational program is equally accessible to all
- Building features displaying student work, to encourage a sense of "Doherty Pride".
- Building massing and façade design that is sensitive to the surrounding neighborhood scale and park land.
- Integration of special education spaces as to increase inclusion and reduce potential stigma.
- An organization of classrooms to create 9th grade "communities" to assist the challenging transition into high school.
- Introduce and feature STEM spaces that the existing Doherty High School could not spatially support, such as Maker Spaces, Computer Science Classrooms, Science Labs and Chapter 74 vocational spaces.
- Featured spaces that will be used for collaboration.
- Careful consideration of daylighting interior spaces.
- Durable and low maintenance interior finishes, with a "timeless" color palette
- Integration of the history of Doherty Memorial High School, featuring its role in the City of Worcester
- Durable and low-maintenance exterior materials
- Landscaping and site features compatible with the adjacent park and residential street scape
- A multi-use field for physical education and athletics

PHASING

The new Doherty Memorial High School building will be constructed adjacent to the existing school, which will remain occupied until construction completion. Once the new building is complete, the existing building will be demolished, albeit in phases, but ultimately in its entirety. Any remaining site features (parking, driveways, athletic fields, etc.) would then be completed. The construction phasing is currently envisioned to be in four stages:

- Phase 1: Enabling Phase: Complete the school and immediate driveways essential for daily use.
    - Install perimeter fencing and erosion control
    - Install construction separation barrier between existing school and construction site
    - Install temporary parking, access road, and signage around existing school
    - Work was Implemented as part of the Site Enabling Bid Package # 1, issued April 1, 2021
- Phase 2: Building Construction
    - Maintain separation of existing school and construction site
    - Early Sitework Bid Package #2 was issued July 22, 2021
    - Structural Early Bid Package #3 will be issued October 21, 2021
    - Construct new school building
    - Prepare for moving to the new school and demolition of the existing school
- Phase 3: Existing Building Demolition & Site Construction
    - Maintain separation of new school and construction site
    - Phase 3A: Abate and demolish the existing gymnasium and academic building
    - Construct parking and access for use by student school year 2024
    - Phase 3B: Abate and demolish the existing auditorium
- Phase 4: Site Construction
    - Abate and demolish the remainder of the existing school
    - Construct sports field, bleachers, and support building
    - Complete all landscape work
    - Site Completion, Summer 2025

Refer to the following documents for additional information on phasing:

- Specification Section 01 12 00 Project Phasing Requirements
- Site Phasing Drawings included in Volume I of IV of the Design Development drawings
    - C1.2 Site Phasing Plan
- The Civil Basis of Design Narrative in Section 6B3.1.B Basis of Design Narratives

While there will be **temporary** construction impacts, most notably the loss of nearly all existing outdoor areas, they are primarily site-related, and the end result is a solution that meets the Educational Program requirements.

Proposed SF areas are approximately as follows:

- **New Construction = 424,600 GSF**
- **Demolition (existing building) = 167,000 GSF**

NEW CONSTRUCTION SCOPE OF WORK:

GENERAL:

- Work will begin with construction of a new building, including associated sitework infrastructure. It is anticipated that only temporary office trailers with limited parking and material laydown/storage be available on-site. During this time, the existing building would remain fully occupied and will function, internally, much like it does presently. Externally, construction access would impact vehicular traffic to the rear of the existing building and the PE/Athletic fields would be unavailable. We expect that the Contractor will access the site via a separate driveway on the east side of the site. Summer vacation months will be leveraged to maximize productivity for work (i.e. sitework such as repaving, new site utilities, drainage infrastructure, etc.) that would normally disturb school vehicular/pedestrian traffic and learning environment.

CIVIL:

- Refer to Nitsch Engineering Civil Basis of Design narrative in section 6B.3.1.B2.

LANDSCAPE:

- Refer to Studio 2112 Landscape Basis of Design narrative in section 6B.3.1.B3.

ARCHITECTURAL:

- ENVELOPE:
    - Masonry Veneer and Metal Composite Material Rainscreen systems are the primary exterior wall cladding materials. These materials are installed over continuous 3 ½ to 4" of mineral wool insulation over a metal stud back-up assembly consisting of thermally insulated Z-girts and fasteners, continuous and self-adhered air/vapor barrier (AVB), ½" exterior glass fiber reinforced gypsum board, and cold-formed metal stud framing filled with R-24 mineral wool insulation. AVB transitions to window/door openings and roof systems, rigid insulation, thermally broken standoff clips, metal furring, and joint sealants.
    - Vapor-permeable air barrier membrane is detailed to be tied into metal windows, through-wall flashing, roofing system and other exterior envelope elements to ensure a continuous air barrier system.
    - The building will comply with EA Prerequisite Fundamental Commissioning and Verification requirements. In addition, the building's thermal envelope will be commissioned to comply

with the requirements of LEED EA Credit Enhanced Commissioning, Option 2. The thermal envelope should be commissioned in accordance with ASHRAE Guideline 0-2005 and the National Institute of Building Sciences (NIBS) Guideline 3-2012, Exterior Enclosure Technical Requirements for the Commissioning Process, as they relate to energy, water, indoor environmental quality, and durability.

  - Windows and Curtainwall: Thermally broken aluminum systems, including 1" (min.) high performance insulating glass, perimeter joint sealants, insulated panels, screens, operable hardware, sheet metal work, air/vapor barrier (AVB) transitions, solar shading devices, window treatments and other accessories as required
  - Roofing: Adhered PVC roofing system throughout, including all membrane/flashing, roof edging, sheet metal work, insulation, roof vapor barrier, wood blocking and other roof accessories (ladders, hatches, etc.) as required
  - Exterior doors are thermally broken aluminum stile and rail type with insulated glazing unit lites in a thermally broken curtain wall system frame. Select utility and stair egress doors and frames are in galvanized and painted. There are also motorized coiling overhead doors to be installed at the CCL Shop, Under-building parking area, and the Receiving Area. The field support building will also have overhead coiling doors.
  - Fireproofing: Structural frame will be protected, in most areas, with applied cementitious fireproofing of varying densities. In limited areas (i.e. where steel is exposed to view) intumescent coating fireproofing will be utilized.

- INTERIOR:
  - Interior partitions: Metal stud and Gypsum Wall Board (GWB) assemblies as required for structural and acoustical requirements; Concrete Masonry Units CMU at Gymnasium, Locker Rooms, CCL suite and other high-abuse areas. Partitions to employ mineral wool sound batt insulation, additional GWB layers, resilient channels, acoustical sealant, and other means to meet required acoustical rating. Refer to drawings for wall types, STC ratings and U.L. test numbers for fire-rated construction where indicated.
  - Interior door frames, display cases and borrowed lites are typically painted hollow metal. Doors are solid-core wood veneer doors typical in academic areas; custom welded steel frames and borrowed lites; and lever type mortise hardware, electrified at exterior entries. All classroom door side lites are to have laminated glazing as well as a privacy shade for security. In lobby and community use areas, aluminum framed aluminum and solid-core wood veneer doors will be used in select high traffic and community use programed areas. At food service areas there are motorized overhead coiling doors and counter shutter doors.

- Interior Stairs
  - Typical stairs to be painted steel and concrete filled pans with rubber treads, risers and platforms. Handrails to be stainless steel; guard assemblies will include painted welded pickets and post.
  - The open community stair in the cafeteria, is a hybrids slab on grade and steel supported structure. The finishes will be durable and maintenance friendly. Guard and railings will match the lobby area
- Millwork/Casework:
  - Custom millwork to be of plastic laminate finish on MDF or particleboard substrate with solid surfacing material countertops (refer to Drawings for locations)
  - Casework to be of plastic laminate finish on MDF or particleboard substrate with plastic laminate countertops and backsplash.
  - Science Lab and Prep Room cabinetry to be of chemical resistant plastic laminate on MDF or Particleboard, with epoxy resin countertops and backsplash.
  - Music Classroom cabinetry to be composite wood substrate with acoustical-type backing and open metal grille doors
  - Window sills to be of solid surfacing material
  - Classroom units with storage shelving, tall wardrobe and material storage units, and countertop with pencil grille above the Chilled beam cabinets.
  - Wall paneling system at Auditorium and Lobby
  - Custom cabinetry at main Administrative offices, Media Center, School Store, Auditorium/Stage, Cafeteria and other locations as indicated on the plans.
  - Custom millwork display cases, history wall, cafeteria mural wall and sustainability display walls
- Finishes:
  - Lobby: Terrazzo tile flooring and base, plastic laminate panel system, ceramic tile or ceramic tile façade system to ceiling . Skylight, specialty ceiling and exposed structure above.
  - Cafeteria: Terrazzo tile flooring and base, a custom printed design accent wall on a plastic laminate system, ceramic tile façade system, ceramic wall tile to underside of ceiling. Microperforated metal plank ceiling suspended from structure above.
  - Corridors: Linoleum flooring and resilient base, wall tile to 7' with painted GWB above, ACT ceiling
  - Stairs: Terrazzo floors at landings and stair treads, ceramic wall tile to 7' with painted GWB above, ACT
  - Classrooms: Linoleum flooring, resilient base, painted GWB, ACT

- Kitchen: Seamless epoxy flooring/base, FRP wall paneling, washable ceiling tile system
- Administrative Offices, Media Center: Carpet tile flooring, resilient base, painted GWB, ACT
- Auditorium and Stage: Carpet (Auditorium aisles), Sealed concrete (auditorium seating) tempered hardboard (stage) and wood flooring (stage thrust). Plastic laminate panel system, custom millwork with architectural vinyl surface, acoustic wall panels, and painted GWB. Acoustic ceiling panels and exposed painted structure above
- Black Box: Painted Tempered hardboard floor, painted impact resistant GWB walls, acoustic wall panels, lighting grid suspended from exposed acoustic deck, painted black
- Gymnasium and Wellness: Resilient tongue and groove maple flooring system (competition court area), vented rubber base, painted CMU to 12' with impact-resistant GWB above, athletic wall pads, acoustical wall panels, painted acoustical cellular roof deck
- Weight Room: Resilient athletic flooring, rubber base, impact resistant GWB walls, athletic wall pads, wood fiber ACT
- Adaptive PE: Resilient athletic flooring, rubber base, impact resistant GWB walls, acoustic wall panels, athletic wall pads, painted acoustical cellular roof deck
- Locker Rooms: Seamless epoxy flooring/base, ceramic wall tile to ceiling, impact resistant GWB soffits, wood fiber ACT
- Shops/Vocational Rooms: Sealed concrete or seamless epoxy floors, resilient or epoxy base, Painted CMU or impact resistant GWB walls, wood fiber ACT, impact resistant GWB soffits, or exposed painted structure above
- Toilet Rooms: Seamless epoxy flooring and base, ceramic wall tile to ceiling, wood fiber ACT and impact resistant GWB soffits

- Elevator
  - Elevator #1: 4500 LB Traction passenger elevator; double-sided; 5-stop; 63' rise; 150 ft/min travel speed; standard stainless steel entrances and plastic laminate interior finish; rubber tile flooring. Controls and Signaling devices to conform to the regulations of the "Architectural Access Board" (521CMR)
  - Elevator #2: 4500 LB Traction passenger elevator; 5-stop; 60' rise; 150 ft/min travel speed; standard stainless steel entrances and plastic laminate interior finish; rubber tile flooring. Controls and Signaling devices to conform to the regulations of the "Architectural Access Board" (521CMR) Provide new Food Service equipment at Kitchen and Culinary Arts **(refer to Food Services Basis of Design narrative)**

- Demolish existing building in its entirety after new construction is complete and ready for occupancy

FIXTURES, FURNISHINGS & EQUIPMENT (FF&E)/TECHNOLOGY:

- Provide new FF&E throughout including furnishings, equipment, maintenance items, etc.
- Provide new Technology throughout, refer to the narrative in Section 6B.3.1.B.12

HAZARDOUS MATERIALS:

- Abate entire existing building prior to demolition, refer to DD Specifications Appendix G for Hazardous Material report.
- Provide radon mitigation system at Lower Level slab-on-grade areas

STRUCTURAL:

- Refer to the Structural Basis of Design narrative in Section 6B.3.1.B.4.

FIRE PROTECTION:

- Refer to the Fire Protection Basis of Design narrative in Section 6B.3.1.B.5

PLUMBING:

- Refer to the HVAC/Plumbing Basis of Design narrative in Section 6B.3.1.B.6

HVAC:

- The HVAC design has been updated significantly since the Schematic Design submission in response to the directive to reduce fossil fuel use. Refer to the Sustainable Design section in 6A3.1.F as well as the HVAC/Plumbing Basis of Design narrative in Section 6B.3.1.B7

ELECTRICAL:

- Refer to the Electrical Basis of Design narrative in Section 6B.3.1.B.8

AV & THEATRICAL SYSTEMS

- Refer to the Theatrical systems Basis of Design narrative in Section 6B.3.1.B.10

FOOD SERVICES:

- Refer to the Food Service Basis of Design narrative in Section 6B.3.1.B11

SUSTAINABLE DESIGN:

- Refer to section 6B3.1.I Updated Energy Calculations for advancement under this topic.

FILED SUB-BID CATEGORIES:

- Masonry
- Metal Fabrications
- Waterproofing, Damp-proofing, and Caulking
- Roofing and Flashing
- Metal Windows
- Glazing
- Tile
- Resilient Flooring
- Acoustical Ceilings
- Painting
- Conveying Systems
- Fire Protection
- Plumbing
- HVAC
- Electrical

Nitsch Engineering

370 Main Street, Suite 850
Worcester, MA 01608
T: 508-365-1030

www.nitscheng.com

MEMORANDUM

TO: Robert Para, AIA
Lamoureux Pagano Associates | Architects

FROM: Matthew T. Brassard, PE, ENV SP

DATE: July 15, 2021

RE: Doherty High School - Nitsch Project #13325
60% Construction Documents
& Early Site Bid Package
Basis of Design Report

CIVIL ENGINEERING BASIS OF DESIGN

Site Development Summary

The new Doherty High School will be constructed on the existing Doherty High School site at 299 Highland Street in Worcester, MA (the Site). The associated parcel is listed as Worcester Assessor's Office Parcel Number 11-INX-00001 and includes approximately 20 acres and is owned by the City of Worcester School Department. The project includes complete demolition of the exiting school, construction of a new school building, new access drives and parking facilities, and a new multi-use artificial turf athletic field.

The following is a descriptive summary of the site civil project elements and permitting requirements necessary to construct the project.

Zoning Conditions

The Site is located within the RS-7 Residential zoning district; single & two-family residential dwelling district with 7,000 sf minimum lot size. The existing school use is allowed by right in this district. No portion of the Site appears to be located within other zoning districts, historic districts, or other overlay districts.

Easements and other Property Limitations

Aside from a possible electric utility easement related to the existing electric service provided to the Site, there do not appear to be any easements, rights of way, historic registrations, or other encumbrances related to use on the Site, based on City of Worcester Assessor's data. The parcel was formally part of Elm Park and was conveyed to the City of Worcester for school use in 1961, as defined by a Massachusetts Supreme Judicial Court Decree (WCRD Book 4178, Page 415) related to the use of the parcel by the City of Worcester for school use. Based on the documents provided to us by the City of Worcester, the existing site appears to be available for development.

Soils

Based on National Resources Conservation Service (NRCS) data, the soils on the southern (upper) portion of Site consist of Paxton soil and areas to the north are mapped as Hinckley-Urban Land Complex. Paxton soil consists of glacial till and typically exhibits a shallow restrictive layer that can result in a seasonal perched water table and is classified as a Hydrologic Soil Group (HSG) C soil with relatively low permeability. Hinkley soil is more well-drained and is classified as an HSG-A soil and does not exhibit shallow or perched groundwater conditions. It is unclear where the transition between these two soils lies on the Site, as the area between these two mapped soils has been developed for the school. In general, the soils are not likely to represent a significant development constraint in terms of bearing capacity, workability, groundwater management, or erosion. The presence of glacial till soil typically associated with the Paxton Map Unit was generally confirmed by the results of the geotechnical report, including hydraulic conductivity values estimated at one test pit location. Refer to the geotechnical report for additional information related to soil conditions and refer to the project specifications for limitations on the use of the information contained therein.

It is likely that excavation activities on the southern portion of the site necessary to construct the project will require groundwater management / dewatering activities.

<u>Access Drives and Parking</u>

The Site will be accessed by two new curb cuts on Highland Street. The eastern curb cut will be the bus entrance (entrance-only access), primary access to the building service and loading areas, and access to the parking garage located within the school building. It will also serve as a site access loop around the rear of the building, providing capacity for Special Education bus drop-off / pick-up. The rear (south) portion of the loop drive will also connect to a small parking area that will provide parking for and access to the Newton Hill trail system. The western curb cut will provide direct access to the new athletic field and will also connect to the central area of the site for general parking needs and for parent drop-off of students. School buses and general site traffic will exit the Site via the western curb cut. The western curb cut includes one entrance lane and two exit lanes for dedicated right and left turns.

Striping modifications to Highland Street are proposed as a traffic mitigation measure. Dedicated turn lanes in the eastbound and westbound directions are proposed to lessen the impact of vehicles turning into the school on through traffic. Additional Highland Street striping and signage is proposed at the east school access drive to maintain a clear space at the entrance for school bus access. The project also includes relocation of two existing solar-powered Rectangular Rapid Flashing Beacons (RRFBs), proposed locations to be determined.

287 parking spaces will be provided on surface parking lots situated on the interior of the parent drop-off, bus loops, and south lot including a total of 11 handicapped accessible spaces distributed across the site. Additional parking will be provided in a parking garage located within the proposed building footprint. The surface parking areas and access drives will require a total of approximately 5.4 acres of full-depth asphalt paving, pedestrian plazas, walks, and other hardscape.

ADA-compliant pedestrian access will be provided from the east and west sides of the Site. See the Landscape narrative for a description of the pedestrian access and circulation system.

<u>Earth Moving</u>

Phased construction could result in separated cut and fill operations to facilitate construction of various aspects of the development as long-term soil stockpiling at the Site is not likely to be feasible. The final build-out will require excavation into the existing hillside on the south side of the developed portion of the parcel. Soil retention and site grading needs will require retaining walls across several areas of the site. The walls will vary in height and type although in most areas walls exceeding 4 to 5 feet in height will be designed in a tiered configuration to lessen their visual impact. The area immediately south of the new athletic fields will include spectator seating (bleachers) constructed into the existing slope, with flanking terraced walls to the east and west. See landscape design documents for a description of various wall types and for the configuration of the bleacher construction.

<u>Sanitary Sewer</u>

New sanitary sewer pipes and structures will be required including multiple building service connections, a dedicated kitchen service connection with an exterior grease trap vented to the building plumbing system, an exterior acid neutralization tank (potentially), a service connection to the restroom/storage building at the athletic field, and dedicated drains for the garage parking area and any portion of the new building equipped to receive/store vehicles and/or gasoline-powered equipment. The latter dedicated service connections will also require gas/oil separators. In this case two of these areas are present: the parking garage and the vehicle access at the north courtyard. The separator for the parking garage will be located outside of the building and the one at the north courtyard will be within the building as part of the plumbing system.

Water

A new galvanized ductile iron water service main (1,700LF+) will be required to provide domestic water and fire protection services to the site. Four new fire hydrants are also proposed. A water service connection for the restroom/storage building near the athletic field is also proposed. The water service design anticipates a 12"DICL water main extension from Park Avenue west on Highland Street to the Site. The water main extension will provide a connection to the municipal high pressure water system and will be completed by the City of Worcester (not part of the Project). See Drawings for locations and sizes.

Storm Drainage

A new stormwater management system that complies with the requirements of the MA DEP Stormwater Standards will be required for the project. The system will include provisions for peak flow management, groundwater recharge, and water quality treatment. The compact nature of the site layout and topographic constraints restrict stormwater management BMPs to structured/subsurface systems. Subsurface stormwater detention systems are proposed in the north courtyard area on the east side of the building under the central parking area, and beneath the new athletic field. Pretreatment of runoff from trafficked surfaces to these systems will be achieved by use of standard deep sump hooded catch basins and water quality structures (stormwater treatment units).

Connections from the existing hillside drainage system south of the site are also proposed to prevent runoff generated by Newton Hill from impacting the site via overland flow.

The stormwater management system for the project is designed to meet the Department of Environmental Protection's (DEP) Stormwater Management Standards. The corresponding DEP Standards and anticipated project compliance are listed below:

Department of Environmental Protection's Stormwater Management Standards

Project Type: The project site is previously developed and the proposed work will result in an increase in impervious area. Therefore, the project is considered a mix of new development and redevelopment under the DEP Stormwater Management Standards.

> **Standard 1:** No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.
>
> Compliance: The project will comply with this standard. There will be no untreated stormwater discharges from the site.
>
> Water quality treatment BMPs will be incorporated into the stormwater management system to provide adequate treatment of stormwater prior to discharge. These water quality BMPs will include Deep Sump Catch Basins as pretreatment BMPs and Proprietary Water Quality Structures as treatment BMPs.
>
> **Standard 2:** Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates.

Compliance: The project will comply with this standard. The stormwater management system will be designed to mitigate post-development peak discharge rates to less than pre-development levels for the 2-year, 10-year, 100-year 24-hour storm events. The project includes an increase in the impervious area resulting in a higher rate of runoff. Underground recharge/detention systems are included in the stormwater design to mitigate the increase in runoff rate.

Standard 3: Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater BMPs, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

Compliance: The project will comply with this standard. Stormwater retained in the stone base of the underground recharge/detention systems is sized to in accordance with the mitigation required for the increase in impervious cover presented by the Project.

Standard 4: Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

Compliance: The project will comply with this standard. Structured water quality BMPs will be incorporated into the design and sized to provide 80% TSS removal. A Long-Term Pollution Prevention Plan (post-construction) for the storm drainage system will be developed that will define suitable practices for post-construction source control and pollution prevention for the site. The plan will identify good housekeeping practices, provisions for storing materials and waste products inside or under cover, vehicle washing controls, requirements for routine inspection and maintenance of stormwater BMPs, spill prevention and response plans, provisions for landscaping maintenance, requirements for storage and use of fertilizers, herbicides, and pesticides, provisions for solid waste management, snow disposal and plowing plans relative to the proposed infiltration BMPs, winter road salt and/or sand use and storage restrictions, street sweeping schedules, provisions for preventing illicit discharges to the stormwater management system, training for personnel involved with implementing the plan, and a list of emergency contacts.

Standard 5: For land uses with higher potential pollutant loads…

Compliance: Not applicable. The project is not associated with Higher Potential Pollutant Loads (as defined under Standard 5 in Volume 1, Chapter 1 of the DEP Stormwater Management Handbook).

Standard 6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area…

Compliance: Not applicable. The site does not contain critical areas and will not discharge untreated stormwater to a sensitive resource area.

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

Compliance: The project is a combination of new development and redevelopment. The project will improve existing conditions and will comply with the Stormwater Management Standards.

Standard 8: A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

Compliance: The project will comply with this standard. Sedimentation and erosion controls will be incorporated as part of the design of this project and employed during site construction. Land disturbance will be kept to the reasonable minimum area necessary to construct each project phase and the phasing of the work will be planned so that only the areas actively being developed are exposed. All other areas should have natural vegetation preserved, have good temporary cover, or permanent vegetation established and/or pavements installed. Permanent structures, temporary or permanent vegetation and mulch/erosion netting should be employed as quickly as possible after land is disturbed. Disturbed areas will be protected from stormwater runoff by installing erosion control or stormwater management measures to prevent water from entering and running over disturbed areas, and to prevent erosion damage to downstream facilities. Perimeter control practices will be installed to isolate the construction site from surrounding areas. Siltation fence, temporary covers for drainage structures, and temporary settlement basins will be utilized where applicable.

The project will disturb more than one (1) acre of land and therefore a Notice of Intent (NOI) under the Environmental Protection Agency's (EPA) National Pollution Discharge Elimination System (NPDES) program will be required. As part of this application, the Applicant is required to prepare a Storm Water Pollution Prevention Plan (SWPPP) and implement the measures in the SWPPP. The SWPPP, which is to be kept onsite during the entire construction phase, includes erosion and sediment controls (stabilization practices and structural practices), temporary and permanent stormwater management measures, Contractor inspection schedules and reporting of all SWPPP features, materials management, waste disposal, offsite vehicle tracking, spill prevention and response, sanitation, and non-stormwater discharges.

Standard 9: A Long-Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

Compliance: The project will comply with this standard. An operations and maintenance plan including long-term BMP operation requirements will be prepared to assure proper maintenance and functioning of the proposed stormwater management system.

Standard 10: All illicit discharges to the stormwater management system are prohibited.

Compliance: The project will comply with this standard. There will be no illicit connections associated with this project.

Gas

Gas service for the new building will be provided via a connection to the existing gas main in Highland Street. This service pipe will run from the eastern site entrance, along the service road, and connect to the Mechanical Room via the service yard.

The MEP Engineer will coordinate with the local gas company to determine the building gas loads, required size of service, and if the gas main requires any upgrades. All new gas piping will be installed by the local gas company, and trenching, backfill, and surface restoration will be the responsibility of the Contractor. See the MEP section for additional information on the gas service.

Electric

See the Electrical Engineering section for additional information on the electric service.

Telecommunications

See the Electrical Engineering section for additional information on the telecommunications service.

Permitting

Wetland Protection Act (310 CMR 10.00)

The Wetlands Protection Act (WPA) ensures the protection of Massachusetts' inland and coastal wetlands, tidelands, great ponds, rivers, and floodplains. It regulates activities in coastal and wetland areas and contributes to the protection of ground and surface water quality, the prevention of flooding and storm damage, and the protection of wildlife and aquatic habitat. The City of Worcester Wetlands Protection Ordinance (WWPO) includes additional requirements and review thresholds beyond the WPA.

There are no wetlands onsite or within 100 feet of the site. However, there is work proposed within 100 feet of existing drainage inlet structures that ultimately drain to a wetland/waterbody, which triggers jurisdiction by the Worcester Conservation Commission. The project has received approval from the Worcester Conservation Commission (the Commission) for Phase 1 (Site Enabling Package). A Notice of Intent Amendment for the remaining site work (Early Site Package) was submitted in April 2021 and has also been approved by the Commission.

National Heritage and Endangered Species Program

A review of the MassGIS data for Natural Heritage and Endangered Species Program (NHESP) indicates that the project site is not a Priority Habitat of Rare Species or an Estimated Habitat of Rare Wildlife. Therefore, there are no permits required through the NHESP.

Floodplain

Floodplain information was obtained from the Flood Insurance Rate Map (FIRM) community map number 25027C0614E. The site is within a Zone X, which is identified as an area outside the 100-year floodplain. Therefore, there are no permits required with respect to the floodplain.

Environmental Protection Agency National Pollutant Discharge Elimination System Permit

The total disturbed area for the project will exceed one acre and therefore the project will be required to obtain a National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP) through the United States Environmental Protection Agency (EPA). A NPDES permit provides coverage for stormwater discharges from the site during the construction phase. To apply for a NPDES permit, the Owner and Contractor will each need to complete and submit a Notice of Intent (NOI) form to the EPA. Once the EPA receives both completed NOI forms, there is a 14-day waiting period until coverage begins. A NPDES permit must be obtained prior to the beginning of construction.

The NPDES permit requires that a Stormwater Pollution Prevention Plan (SWPPP) be prepared prior to submission of the NOI forms to the EPA. The SWPPP outlines the Contractor's requirements for onsite erosion and sediment control, including methods, source control, maintenance, and inspections.

Massachusetts Environmental Policy Act (MEPA) Regulations (301 CMR 11.00)

An evaluation of the MEPA Environmental Notification Form (ENF) review thresholds for the project was conducted during the Schematic Design phase and no review thresholds were triggered. This evaluation was again conducted based on the Design Development drawings and again no review thresholds were triggered. Therefore, an ENF is not required for the project.

The following pre-construction municipal, state, and federal permit applications/processes are required:

Agency / Dept	Permit / Description	Project Stage	Typical Duration
Worcester Conservation Commission	**Notice of Intent for Site Enabling Package** Local review for compliance with municipal standards	Completed - approved	-
Worcester Conservation Commission	**Notice of Intent Amendment for Early Site Package** Local review for compliance with municipal standards	Completed - approved	-
EPA	**Notice of Intent for Site Construction Activities** Submission required as part of the National Pollutant Discharge Elimination System (NPDES) for stormwater discharges from construction sites.	Draft Stormwater Pollution Prevention Plan (SWPPP) was included with WPA Notice of Intent. Final SWPPP adopted by Contractor and EPA NOI filed at least 14 days prior to initiation of construction activities.	<1 month

CONSTRUCTION DOCUMENTATION
Basis of Design for Doherty Memorial High School

July 15, 2021

Studio 2112 Landscape Architecture, Inc.
840 Summer St., Suite 102
Boston, Massachusetts 02127

SITE LANDSCAPE APPROACH

The Doherty Memorial High School is located in Worcester adjacent to Newton Hill, a park with wooded trails and public amenities. The landscape approach considers its sensitive location through the efficient use of site program, circulation, and terraced planted retaining walls designed to minimize visual impact. Building on the program developed in the schematic design phase, the landscape spaces fulfill a range of programmatic elements, while employing a consistent design language to create a unified campus feel for teachers and students.

SITE CIRCULATION - VEHICULAR

Buses and student/parent vehicle entries are separated to prevent back-ups and increase safety. Buses enter from Highland Street, east of the building and follow a ring road around the building to the main entry where students are dropped off at the front plaza. Continuing past the main entry buses exit onto Highland Street, west of the bus entry and main parking lot.

Students, visitors and staff enter from Highland Street, west of the building. The parking lot is designed to maximize spaces and minimize pedestrian/vehicular interaction. Staff who park in the garage will access counterclockwise around the south of the building. The student drop off and bus lanes are one-way and separated by a planted island. The separation of the two drop-off areas prevents back-ups and increases safety and efficiency.

SITE CIRCULATION – PEDESTRIAN

Two universally accessible pedestrian paths provide access from Highland Street to the main building entrance, accommodating the high proportion of students that walk to school (50%). The two paths converge near the northeast building corner and separate again into terraced stairs leading toward the building and an accessible sidewalk that follows the bus drive toward the building entrance. From the main entrance, an accessible walk continues along the bus loop around the south side of the building to the gym entrance.

Two universally accessible pedestrian paths provide access from the building to the athletic field. A pedestrian spine bisects the main parking lot and provides direct access from the primary building entrance to the athletic field. A sidewalk from the gym access connects to a path along the south side of the parking lot. This path leads to the service building and plaza adjacent to the athletic field. Another route stems south from this path to a set of stairs behind the service building that connects to the high side of the bleachers.

SITE ELEMENTS

Desired programmatic elements have been worked into the site layout in appropriate locations that respond to the site's topography and building footprint. The athletic field and service building are situated on the western side of the site. An adjacent tree-lined plaza provides space to gather and socialize. The bleachers to the south of the field are embedded into the topography adjacent to Newton Hill and can be approached from the top level via stairs or service building elevator, or by accessible ramp from the field level.

The pedestrian plaza at the main building entrance provides gathering space for students and serves as a central pedestrian circulation intersection. The concrete benches in the plaza act as attractive amenities and unobtrusive security measures. Planter beds with flowering trees in the plaza shade students, faculty, staff and visitors as they gather and circulate. Continuing north from the plaza along the building, terraced seat walls negotiate topographical change and create a place to sit and socialize. South of the main plaza, curved benches and planters form the perimeter of an outdoor dining area that is accessed from inside the building.

An outdoor dining area sits outside of the cafeteria and is secured at its perimeter by raised planter beds and a gate to the sidewalk. Fixed tables and chairs can accommodate up to 48 people at tables with additional seating at fixed benches along the side. A percentage of tables are set up for wheelchair access so that all students, faculty and guest can utilize the space.

A stepped retaining wall on the south side of the site carves a space for two vegetable garden beds and a fitness area.

Two landscape spaces are bounded on three sides by classrooms: an amenity courtyard, and a gated shop area. The courtyard design allows for group project work and gathering space; a raised platform offers opportunities for seating, exhibits, or theater. A seatwall with a planted slope backdrop leads toward the service road. In the gated shop area, seatwalls and a narrow planter bed provide attractive spaces for seating.

PLANTING

Trees and shrubs along the east ring road screen the service areas from Park Ave. Rows of trees are proposed along Highland Street, the east ring road, and the pedestrian path that bisects the parking lot to reinforce spatial geometry and provide shade. Flowering and grove trees add visual appeal throughout the site. Shrub and perennial beds line the main entry and parking bays.

Specific plant species are continuing to be developed and will carefully consider maintenance requirements and seasonal interest. In addition, planting will meet a rigorous metric for biodiversity, with the plant schedule to contain no more than 10% of each species, 20% of each family, and 30% of each genus. All plant material will be specified in accordance with the Asian Longhorn Beetle restrictions of the City.

BDI BOLTON & DiMARTINO, INC.
CONSULTING STRUCTURAL ENGINEERS
100 Grove Street Worcester, MA 01605
Tel. 508-756-8972

July 8, 2021

Doherty High School

299 Highland Street
Worcester, Massachusetts

<u>Basis of Design – Structural</u>

The Doherty Memorial High School consists of about 420,000 sq. ft. of multi-story school buildings and a small two-story comfort-building at the athletic fields. The school building conforms to Type IIA Construction.

It is assumed that the foundations will be concrete foundation walls and interior spread footings supported on natural glacial till or compacted structural fill with a bearing capacity of 6 ksf. The perimeter concrete foundation walls have wall pilasters and continuous wall footings. Our assumptions are based on Lahlaf Geotechnical Consulting, Inc.'s "Geotechnical Report," dated September 25, 2020. The foundation also includes fifteen-foot and eighteen-foot high, cantilevered retaining walls between the Ground Level and Main Level (18-foot) as well as along the high side of the Gymnasium Building (15-foot) to retain the soil as the grade rises between the Main Level and Level 2 at the rear of the site.

The slab-on-grade will be a 5" thick concrete slab-on-grade reinforced with welded-wire fabric (6x6-W2.9 W2.9), except at the parking area below the Gymnasium Building where the slab on grade will be 6" thick. Control joints, consisting of sawn cuts and construction joints, will be shown on the plans, and will be located at about 12 feet on center to minimize shrinkage cracks in the slab.

The framed slabs will be a 6 ½" thick normal-weight concrete composite slab supported on steel beams to provide a 1-hour rated slab. Select areas will need to be 2-hour rated slabs and will either be 7 ½" thick normal weight slabs with 3" composite metal deck, 6 ½" thick normal weight slabs with 2" composite metal deck, or sprayed with fire-proofing material. 3"-18 Gauge composite metal deck will be specified and the slab will be reinforced with welded wire fabric (6x6-W2.9 W2.9). The composite concrete slab is made composite with the steel beams by using shear studs, and "partial composite design" is used for the economy of installing fewer shear studs. ASTM A992, with yield strength of 50 ksi, will be specified for the structural steel. However, the beams will be selected on serviceability requirements to reduce the problems of vibrations and deflections, so they will not necessarily be fully stressed.

The roof framing will incorporate steel beams and long-span open web steel joists. Long-span joists will be limited to the Gymnasium roof. Concrete slabs will be placed below select HVAC roof units for sound attenuation. The roof steel pitches to the roof drains to reduce the amount of tapered insulation, where possible. The roof metal deck will be 1-1/2" (20 Gauge) Type B. The metal deck over the Gymnasium, Media Center, and Career Center will be 3" Cellular

Acoustic. The Classroom, Auditorium, and Gymnasium roofs will be designed to support photovoltaic equipment.

Wide-flange columns will be used at the multi-story Classroom buildings, Gymnasium building, and at the Auditorium due to their length and loading requirements. The columns will typically be W10 columns that will be spliced due to their length. One- and two-story columns located near the Administration area may be HSS tube columns to allow for the columns to be buried in the wall assembly.

The lateral stability of the buildings will be achieved with concentrically braced steel frames, ordinary steel moment frames, reinforced CMU walls, concrete floor diaphragms, and metal deck roof diaphragms. Steel braces will typically be HSS8x8 and HSS10x10 tubes and will resist the lateral loads in both tension and compression.

The buildings will be structurally isolated at several expansion joints; including isolating the Gymnasium Building, Science Classroom Building, as well as the three Classroom Buildings from the core Administration/Auditorium Building.

The two-story comfort building at the athletic fields will include concrete foundation walls similar to the main school building, including a full-height retaining wall on the high side of the building to allow on-grade access to both levels of the building. The slab-on-grade will be a 5" thick concrete slab-on-grade reinforced with welded wire fabric (6x6 W2.9 W2.9). The framed slab will be a 5" thick normal-weight concrete slab supported on steel beams. 2"- 18 Gauge composite metal deck will be specified and the slab will be reinforced with welded wire fabric (6x6 W2.9 W2.9). The mono-sloped roof will be framed with wide-flange steel beams and 1-½" metal roof deck (20 Gauge). Lateral stability of the comfort building will be achieved with reinforced CMU walls at the exterior walls of the building.

An Independent Structural Peer Review is being arranged and will be completed prior to completion of the Structural Construction Documents at the 90% CD Submission.

Bolton & DiMartino, Inc.

Christopher Tutlis, P.E.
President

Doherty High School – Worcester, Ma.
60% Construction Documents Phase FP Narrative
7-14-21

EXECUTIVE SUMMARY

This report summarizes the code required and recommended Fire Protection (FP) systems for an all-new high school at the existing Highland St. site. The main change from the design development phase FP narrative is that the IT server room will now have only a clean-agent fire suppression system. The high-temperature double interlock pre-action system previously planned to activate ***only if*** the clean agent system did not control the fire, and the room reached 350 F has been eliminated. This is based on the fact that electrical fires are low-smoke, low-heat, smoldering type fires that will never bring the room up to 350 F.

This narrative also includes several storage recommendations that will help minimize FP costs. The following work will be provided:

Installations:

- Provide a new underground FP service from the nearby Park Ave, high-pressure system. New service will be designed, installed, and entirely paid for by the City of Worcester as a separate endeavor from this school design and construction project.Provide a new, NFPA 13 (2013) wet sprinkler system through-out the building (except for IT server room and the underground parking garage), with 4, combination sprinkler-standpipe risers, 4, standpipe-only risers, and a zone-control-valve station on each floor for each wet-system sprinkler-standpipe riser (15 zones total) .

- Provide a new dry-system for the underground parking garage. System will have 2 risers.

- Provide a new clean-agent fire suppression system for the IT server room.

- Sprinkler system will be sized primarily for non-combustible, un-obstructed construction in spaces with ceilings, and non-combustible, obstructed construction in spaces without ceilings.

- Due to the size and amount of MEP utilities being supported by the building structure, pipe hanger spacing will, for pipe sizes 6” and larger, be closer than code maximum.
- Protect small isolated cold areas (i.e. walk-in coolers, loading dock) by “dry sprinklers” off of the wet system.

- Omit sprinklers under outside roof overhangs (other than the loading dock), as they are of completely non-or-limited combustible construction.

- Provide a hose-valve on both sides of the stage (stage is over 1,000 sqft.).

- Provide Class I stairwell standpipes per NFPA 14 (2013) through-out, as the highest floor level is 30’ or more above lowest fire department access. The Worcester Fire Department (WFD) has approved locating all standpipes hose-valves on main-landings. Standpipes in general will extend to a roof hydrant, unless the hydrant is waived by the WFD. In some locations standpipes are close enough together that a nearby roof hydrant can fully cover the "waived-hydrant" area. In other areas there is a personnel door at the roof level, with 2 hose valves just inside the roof-level door.

- Review available storage areas and storage needs. Re-organize storage to keep it confined to designated storage rooms, with appropriate FP coverage.

    1. Keep all storage heights less than 12', and top of storage a minimum of 18" below the sprinkler deflector level.
    2. Where large amounts of plastics or foam are stored (i.e. recycling room, gym storage and theatre set-storage), store materials in an enclosed room with a ceiling under 17' high. Store materials in solid piles, bin-boxes, single-row shelves, or back-to-back shelves, with top of storage under 12' high - for an "extra hazard group 2", (EH2) hazard rating. Where feasible, keep plastics storage rooms under 400 sqft. (to minimize the required hose demand.

- Connect new FP system alarms to a new central Fire Alarm Control Panel (FACP), provided under Electrical.

- New Kitchen Exhaust Hood and Hood FP system will be provided under kitchen equipment.

- Portable fire extinguishers per NFPA 10 provided by the General Contractor.

Maintenance:

- Train in-house personnel, and provide required, regular, sprinkler system and fire extinguisher inspections using in-house inspectors

- Provide additional required maintenance and testing of FP and fire extinguisher systems, alarms and flow via maintenance contract.

1. BUILDING DESCRIPTION:

The new Doherty High School (DoHS) will be a split-level, 6-story building with type 2A non-combustible construction - primarily steel, block, and brick. Total occupied building area is approximately 420,000 square feet, plus 44,000 sqft of parking garage. The building is split-level, and located on a side-hill, such that each next higher level is higher up on the hill.

The building is approximately 78% "light hazard" and 21% "ordinary hazard", and 1% "extra hazard".

"Ordinary hazard" areas would include (group 1) the main kitchen and kitchen service areas, and (group 2) boiler room, mechanical rooms, exterior loading docks, most storage-areas, construction craft labor shops, ETA shops, and the stage.

The recycling room, gym storage room, and theatre set storage (under 1% of the building), may contain significant amounts of group A plastics. We expect the recycled plastics, gym storage, and set storage materials may extend up to a height of 10' AFF, resulting in an EH-2 area. The construction craft-labor area will also contain several welding booths, with bottled oxygen and flammable gasses (propane and acetylene) stored in a small enclosed room. This area will also be extra hazard (EH-1).

Areas requiring special types of protection include the:

- stage (1 hose station on each side)
- kitchen hood exhausts (dry-agent packaged hood suppression by kitchen equipment)
- storage areas with shelves (aisle to aisle) over 30" deep would be considered "rack storage". Hazard level would depend on what materials are stored in that manner, and could vary from OH2 to EH2. We are at this time, unaware of any rack storage areas in the designed building.
- There will be no combustible concealed spaces in the all-new building except for the under bleacher area in the gym. This area will be protected by extended coverage sidewalls spraying down the slope under the open-bleachers.
- The Mass Building Code, (IBC 2015) permits unlimited miscellaneous wood blocking to be used inside walls for hanging railings, wall-mounted cabinets and accessories, etc. All other wood blocking (above ceilings, inside chases, etc) is specified to be Class A fire-retardant (NFPA 13 "limited combustible").

Any flammable liquids such as paints, thinners, and flammable science materials will be stored in listed flammable-cabinets. There are no other known special hazards in the building,

2. DESIGN RESPONSIBILITY

The design engineer of record for the fire protection system is Lily Kara Barak – of Sensible Solutions – Hadley, Ma. The design engineer of record for the fire alarm system is Azim Rawji – of ART Engineering Inc. – Worcester, Ma.

3. APPLICABLE REGULATIONS

The Mass. Building Code and Fire Prevention regulations primarily define *where* fire protection systems are required and the required system components.

Massachusetts is currently governed by the 2015 International Building Code, with Mass. Amendments listed in 780 CMR 9th Edition. Current building code requires the following in a facility of this sort:

1. Although the building is not high-rise by the IBC 2015 definition, it is high rise by the Mass Amendments definition. This affects several aspects of fire protection – most notably standpipe and fire pump requirements. A manual-wet standpipe system has been approved, and the fire pump has been waived, however, by the Worcester Building Dept, as permitted by CMR 780 104.10.

2. An Educational-use building over 12,000 square feet requires a sprinkler system "through-out" per NFPA 13. The system must be designed and installed per the 2013 edition of NFPA 13.

3. Water-sprinkler systems must be maintained per NFPA 25.

4. In a fully sprinkled building, Class I standpipes are required if a building's top floor is more than 30' above the lowest (adjacent) Fire Department vehicle access. The top floor levels in all of the multi-story portions of the building are more than 30 ft above lowest fire department access. Thus, stairwell standpipes ***are*** required through-out.

   A. Stages over 1,000 square feet require fire-hose stations on both sides of the stage. This stage is over 1,000 sqft, so stage hose stations will be provided.

   B. Class I standpipe hose stations are also required in the exit passageway of all areas containing "high-piled" (over 12') combustible storage. We are unaware of any high-piled storage areas in the building.

5. High-rise buildings have certain requirements that apply to all high rise building, and additional requirements that only apply to "very tall" buildings (whose building height is over 420 ft.) Doherty HS is ***not*** a very tall building, so those requirements are not listed here.

   A. High rise buildings (all)

      i. 403.3.3 In seismic categories C, D, E, and F, an automatic, on-site water supply is required. Supply shall be sized to provide 30 minutes flow at the most demanding sprinkler flow including hose streams. DoHS is seismic category B, so this does not apply.

      ii. 403.4.8,4 Electrically operated fire pumps are considered emergency power loads, and must be connected to an emergency generator, operating within 10 seconds of a power loss. This also no longer applies, due to the City Building Dept. permitting the fire pump to be omitted.

      iii. Fire pumps shall be located in a 2-hour-rated room, with direct access outside, or a 2-hour rated access. This also no longer applies, due to the City Building Dept. permitting the fire pump to be omitted.

Minor requirements include:

6. Identification signs with specific text messages must be installed on all equipment, valves, etc. (See "Fire Protection Systems Provided")

7. All critical system components must be monitored by listed Fire alarm control units, and all alarms, trouble signals, and supervisory signals must be automatically transmitted to the local fire dept. via approved means. Water flow alarms must also activate local Audio / visual alarms to trigger evacuation.

8. Kitchens with commercial cooking equipment under type 1 hood exhausts require fire suppression that also must be regularly tested and inspected.

9. Labeled, approved, and visible fire extinguishers are required in all E-use buildings. In buildings covered thru-out with quick response sprinklers, however, portable fire extinguishers are only required in the following locations:

   A. within 30' of commercial cooking equipment (type K);
   B. areas with flammable or combustible liquids; (type B)
   C. per NFPA 241 when structures are under construction / renovation;
   D. special hazard areas listed in the code (such as wood-working or auto repair areas - that would apply only to the CCL and ETA shop area of DoHS);
   E. as required by the local fire dept.

10. Areas where toxic gasses are used require gas leak detectors with distinct audio-visual emergency alarms, and automatic shut-down of gas supplies. There is no toxic gas storage in the building except in a central chemical storage room. Natural gas will be used to power HVAC and kitchen equipment, and there will be natural gas supplies in all science rooms, which are designed as an OH-2 hazard.

11. An unobstructed, readily accessible Fire Dept. Connection (FDC) that permits the Fire Dept. to pump extra water into the sprinkler and standpipe systems is required. As agreed with WFD, 2 FDCs will be provided. We currently show both on the main level – one outside the fire protection service entrance room, and one near the north corner of the gym. Locations must be approved by WFD. Each FDC will be 6", with 4, 2-1/2" inlets to meet the 1000 gpm standpipe demand. Threads will compatible with the fire dept.'s pumping trucks(2-1/2" NPT Siamese). .

The NFPA standards primarily define _how_ the Fire Protection Systems must perform and _how_ they will be installed. Requirements vary greatly by hazard type and building combustibility and are only briefly summarized here.

NFPA 13 2013 Edition – Sprinkler Systems

1. Sprinklers are required “through-out”, except where specifically permitted to be omitted. Throughout means not only occupied spaces, but in electrical / mechanical rooms, closets, walk-in-coolers, combustible concealed spaces, and several other spaces that the DoHS will ***not have*** such as attics and crawl-spaces.

2. Each wet Sprinkler “system” is limited to 52,000 sqft (light or ordinary hazard) or 40,000 sqft (extra hazard) on a single floor, per riser. This minimizes the area taken out of service in the event of an equipment failure, or fire. Areas on different floors are *not* added together – for example, up to 52,000 sqft on each of two floors can be served by a single riser. DoHS will have 4 combination sprinkler-standpipe risers, plus 2 dry risers to cover it’s 465,000 total sqft.

3. The number and spacing of sprinklers in any room, and the minimum amount of water each sprinkler must discharge is defined based on the room’s “hazard group”. The basic hazard groups in NFPA 13 are

    a. “Light hazard (Light)”,
    b. “Ordinary Hazard (OH-1 or OH-2) and
    c. “Extra Hazard (EH-1 or EH-2)”.
    d. Spaces used for storage have special classifications depending on what materials are stored and how they are stored.

4. Sprinkler piping may be sized based on hydraulic calculations or using pre-defined pipe schedules. All piping in this building is hydraulically designed.

5. In addition to the hazard rating of an area, the fire protection requirements also depend on whether the construction is

    a. “combustible” or “non-combustible”.
    b. “Obstructed” or “non-obstructed”.

    This sprinkler system is designed for predominately non-combustible, non-obstructed construction in spaces with ceilings, and non-combustible, obstructed construction in spaces without ceilings.

6. Sprinkler systems can be “wet” (piping always filled with water), “dry” (piping always filled with air, except in a fire), or one of several specialty types. NFPA recommends wet systems be used where-ever possible, as they provide the fastest response to a fire. A wet-system is provided for most of the building, a dry system for the under-building parking garage, and a clean-agent system for the IT server room.

7. Small isolated cold areas in DoHS will be sprinkled by “dry sprinklers” off of a wet system. This would apply to Walk-in freezers and coolers, and the loading dock. All other canopies are non-or-limited-combustible construction, and per NFPA 13, these canopies will not be sprinkled.

NFPA 14 – 2013 Edition - Standpipes

1. Stairwell standpipes (2-1/2" hose outlets *plus* 1-1/2" hose outlets located in all stairwells) ***are*** required for this school, as the "top floor-level" is more than 30' above lowest fire dept. access. Standpipes will be Class I (vs Class III), as the building is sprinkled through-out.

2. The stage is more than 1,000 sqft in area, so a stage hose station will be provided on each side.

3. Standpipes in general must be automatic, wet systems – with the following exceptions:

    a. Automatic dry systems if approved by AHJ, in areas subject to freezing

    b. Manual-wet standpipes permitted if building is ***not high-rise,*** and approved by the local fire department.

    In this instance, the City Building Dept., as permitted by CMR 780 104.10, has accepted the City and WFD's request to use a manual-wet standpipe system.

4. Stand-pipe piping will be hydraulically sized per NFPA 14. Captain Thomas Bull of the Worcester Fire Dept. stated WFD can provide 1500 gpm at 150 psi at the FDCs. The standpipe piping has been sized to provide code-required flows at the remote standpipe hose stations with 150 psi / 1500 gpm available at either FDC.

5. A 1-1/2" reducer and cap will be provided on all 2-1/2" Class I outlets.

NFPA 10 – Fire Extinguishers

1. Selection of fire extinguishers is based on the type and size of fires expected to occur.

2. Classes of fires:

    a. A – ordinary combustibles – wood, paper, cloth, rubber, many plastics
    b. B – Flammable liquids, greases, tar, oil, paints, solvents, alcohols, gasses.
    c. C - Energized electrical equipment
    d. D – combustible metals
    e. K - cooking oils

3. The size and quantity of extinguishers required is based on the room's hazard level. Room hazards are defined as:

a. Light hazard if has normal amounts of Class A materials, with less than 1 gallon/room class B

b. Ordinary Hazard if occasionally has more than normal amounts of Class A, and less than 5 gal/room class B

c. High hazard – storage, manufacturing, or packaging of Class As, or class B over 5 gal./room

4. Building structure is be protected by Class A extinguishers. Specific occupancies are protected by extinguishers with an appropriate class. Extinguishers can be "multi-purpose, for example, type ABC is very widely used.

5. Class B fires must be protected with large (over 10 lb) dry chemical medium, with minimum discharge of 1 lb/second.

6. Class K (cooking oil) fires must be protected with class K extinguisher. ID all K extinguishers "Activate FP system prior to using extinguisher"

7. Extinguishers should be inspected monthly to ensure they are in place, are full ("hefting" test), with no visible damage. They require annual minor maintenance and 6 and 12-year interval major maintenance / testing.

NFPA 25 – FP Maintenance

Current NFPA maintenance requirements are summarized below:

1. Annual, visual inspection (from the floor) of all sprinklers for: leaks; "loading" (accumulation of foreign materials such as grease, lint, paint, etc); corrosion; physical damage;

2. Annual visual inspection of the spare sprinkler cabinet to ensure it contains the proper type and quantity of sprinklers and wrenches.

3. Annual visual inspection (from the floor) of pipe and hangers for: leaks, corrosion, extra weight, damage.

4. Annual inspection (just before cold weather) of building to ensure all areas with water-filled piping have heat, and dampers, windows, etc. are all closed.

5. Monthly inspection of pressure gages for normal pressures, and damage.

6. Quarterly inspection and operational test of alarm devices (flow switches)..

7. Quarterly inspection of the hydraulic name-plates to ensure they are in place.

8. Monthly inspection and annual test of control valves,

9. Monthly inspection and annual testing of the back-flow preventor

10. Quarterly inspection of fire dept. connections.

11. Annual full-flow test out main drain.

12. Sprinkler testing – laboratory testing of a "representative sample (minimum 1% of total installed). Test after 20 years, then every 10 years there-after. If any tested samples fail – replace all sprinklers represented by that test sample.

Sprinkler system maintenance will increase the school's annual maintenance costs. This will be at least partially offset by the reduction in fire extinguisher maintenance, however, since far fewer extinguishers will be required once the sprinkler system is installed.

NFPA 241:

Since Oct, 2017, NFPA 241 has been adopted by the State of Massachusetts. Most of its requirements are common sense, though some will increase construction costs. Requirements are summarized here:

1.2.4 A fire safety program shall be included in all constructions, alteration, or demolition contracts. Per 7.1 this shall include at minimum:

1. Good housekeeping
2. On-site security
3. Installation of new FP systems as construction progresses
4. Preservation of existing systems during demolition (no existing systems at DoHS)
5. Organization and training of an on-site fire-brigade
6. Development of a pre-fire plan with the local FD
7. Rapid communication
8. Consideration of special hazards resulting from prior occupancy
9. Protection of existing structures and equipment from exposure fires caused by construction, alternation or demolition operations.

4.3.1 Temporary Enclosures: Only non-combustible panels, flame resistant tarps or approved materials with equivalent fire-retarding capacity shall be used.

4.3.4.1 All Temporary enclosures shall be equipped with a minimum of 1 fire extinguisher suitable for all classes of fires expected inside the enclosure.

4.3.4.2 Travel distance to a fire extinguisher from anywhere in the construction area shall not exceed 50 ft.

5.1 Hot Work – defined as work involving burning, welding, or a similar operation that is capable of initiating fires or explosions.

5.1.1 FP precautions, permits, and fire watches shall be per NFPA 51B.

5.1.3.1 Fire watches shall be assigned no other duties.

5.5.1.1, 2 and 5 Storage and handling of Flammable and combustible liquids: shall be per NFPA 30 – in approved safety containers, in areas posted "no smoking". Storage of class I and II liquids shall not exceed 60 gallons within 50 ft of the structure.

7.2.5: Guard service shall be provided where required by the local AHJ.
Security fences shall be provided where required by the local AHJ.
Entrances shall be secured where required by the AHJ

7.4 Fire Alarm reporting – There shall be a nearby, readily available public fire alarm box or telephone service with FD number and address conspicuously posted near each telephone.

7.5 Access for Fire Fighting: A command post with plans, emergency info, keys, communications, and equipment shall be provided at a suitable site location. The local AHJ may require an approved-type, locked key box installed in an accessible location.

7.5.5 Access roadways: The following may be relaxed by the local FD, if they feel fire-fighting / rescue operations would not be impaired:

Every building shall be accessible for FD apparatus. Min. standards: All-weather driving surface that can withstand live loads of FD trucks, min 240" wide, min 162" vertical clearance. The required width shall not be obstructed in any way – including by parked vehicles. Access roads shall extend to within 150 ft of all portions of the 1st floor exterior walls.

8.6.1.1 Fire walls and exit stairways – where required for the construction – shall be given priority for installation.

8.6.1.2 and .3 Fire doors with approved closing devices and hardware shall be installed as soon as is practicable, and shall not be obstructed from closing once installed.

4. FIRE PROTECTION SERVICE AND FIRE-FIGHTING SUMMARY

Water to the new school will be fed from two directions. A new 8" site main will loop around the new building, with both ends connecting to a new 12" branch from a 24" Park Ave, high-pressure main. The new 12" branch will be designed, installed, and entirely paid for by the City separately from this school's design and construction budget.

Site hydrants around the existing school will be removed, and new site hydrants are planned. See site plans for exact location and number of new hydrants. There will be a site hydrant within 100 ft. of both the east and west FDCs.

A 9-25-20 flow test performed by Cogswell Sprinkler on a 24", Park Ave high pressure main showed a static pressure of 134 psi and a residual pressure of 130 psi, with 2,726 gpm flowing. This is great flow and pressure, A new flow test will be performed by the successful bidder before installation of the new FP system.

Emergency vehicle access will be excellent, - with 100% of the building accessible to apparatus.

5. FIRE PROTECTION SYSTEMS TO BE INSTALLED

A new "wet-type" system will be installed through-out the occupied building, with a dry system for the under-building parking garage. Both systems will be per NFPA 13 (2013), with stairwell standpipe system per NFPA 14 (2013). A new clean agent system will be installed in the IT server room.

Sprinklers will be intermediate temperature throughout the building, except where a higher temperature rating is required by NFPA 13.

All spaces with ceilings will utilize concealed pendants at the request of Worcester Facilities. K-factor will be 5.6 in most areas, with K11.2 Light-listed extended coverage sprinklers used in ***some*** light hazard areas, and K11.2 OH-listed extended coverage sprinklers used in ***some*** ordinary hazard areas. All extended coverage sprinklers will have a 3/4" (larger-than-standard) thread size, to prevent accidental replacing of any EC sprinkler with a standard coverage sprinkler.

Areas with no ceilings will utilize exposed piping, with fusible link, upright sprinklers.

Mechanical and electrical spaces, walk-in coolers with auto-defrost, cooking areas, and the Art-kiln room will be covered by high temperature sprinklers, to prevent false activation in the event of a pressure relief valve blowing, or defroster / cooking heat,.

All exposed upright and pendant sprinklers in the gymnasium, mechanical spaces, storage areas, under-stairs, or installed under 12' AFF will have protective head-cages. Sidewalls under the bleachers will not have head cages.

All above-ceiling spaces are non-or-limited-combustible, so ***none*** of these are "combustible concealed spaces" requiring sprinklers. Some ceilings are not solid-and-continuous, however, so do require 2 (or more) levels of sprinklers. These include the cafeteria, auditorium, media center, career center, and band-choral-piano lab. In general, 1 level of sprinklers is at the deck, and one at the ceiling level (and in the cafeteria, there is a 3rd sprinkler-level in an accessible area below the seating risers). There is ***no*** accessible space under the stage, so no sprinklers there.

Walk-in coolers / freezers and the loading dock area are protected by dry sprinklers piped from wet-piping in heated space. The loading dock area will use ordinary-hazard-listed, extended coverage, dry sidewalls – Tyco DS-3 or equal. Other dry sprinklers will be pendant or sidewall, standard or extended coverage, as required by the area covered.

A new kitchen exhaust-hood will be provided, and a new, dry-agent, packaged fire suppression system provided as part of the kitchen equipment / hood package.

Interior piping systems will be schedule 40 threaded or grooved, black steel for pipe 2" and under, and schedule 10, grooved steel for pipe 2-1/2" and over. All pipe will be sized for a maximum water velocity of 25 fps.

Standpipes will be located in all required egress stairwells. All will have a hose valve station at each main landing. 5 of the 8 standpipes will terminate at a roof hydrant. A 6th roof hydrant will be fed by a horizontal standpipe off of standpipe riser 2. The roof hydrant has been waived by WFD at the 3 remaining standpipes, as their surrounding area is all within 150' of an adjacent roof-hydrant. See FP1.1 Keyplan for hydrant locations.

4 of the standpipes will be combination sprinkler – standpipe risers, with a hose valve and sprinkler zone control valve station on each floor that they serve. 4 remaining standpipes will be "standpipe-only" risers with a hose valve on each floor that they serve.

Seismic bracing to be provided will include riser-4-way bracing and main-longitudinal sway bracing thru-out. Where possible, sprinkler main hanger rods will be less than 6" long from point of attachment to top of pipe, eliminating the need for lateral bracing. Where this is not possible, all mains and cross mains will have both lateral and longitudinal seismic bracing. Per NFPA 13, branches 2-1/2" and over will have lateral bracing only. Branch lines carrying 2 or more sprinklers will also have end-of-line restraints.

Fire Protection Equipment and Controls Locations:

The fire protection service entrance, and backflow preventor, will be located in the FP Service room, located at the North side / east end of the parking garage. All 4 combination sprinkler standpipe wet-risers and all 4 standpipe only risers will be located in an enclosed stairwell. As approved by WFD, these risers will all have a hose valve at each stairwell main landing. All standpipes will have a supervised, riser control valve to facilitate maintenance or replacement of hose valves without draining the entire building. The lowest hose-valve on each riser will serve as that riser's "main drain".

All combination sprinkler-standpipe risers will also have zone-control valve stations for the sprinklers on each floor. Zone control valve stations are typically located above the stair-landing ceiling, and will all have a supervised control valve, check valve, pressure relief valve, pressure gages, flow-switch alarm, and test and drain (to a 2-1/2" drain riser) per NFPA 13.

The Auditorium Sprinkler-Standpipe riser will also have an additional control valve for the stage hose valves.

Per the Worcester Fire Dept. (WFD) standards, 2, new, Siamese FDCs will be provided. Both FDCs will be 6", with 4, 2-1/2" inlets each. The FDCs will serve both the sprinkler and standpipe systems, and the platform hose stations. At the request of the local fire dept, a blue beacon and water-flow bell will be located above each FDC, with a red beacon (provided by Fire Alarm contractor) over the door to the main annunciator.

Cross-contamination will be prevented by a new, double check valve backflow preventer installed on the new FP service entrance.

There is no smoke control system or exhaust required for this building, and none is provided. The only non-wet fire suppression systems in the building are the parking garage dry system, IT server room clean agent system, and the kitchen hood dry-agent system, located in the main kitchen.

Identification signs per NFPA 13 and the 9th Edition Building Code will be provided on:

1. All control valves – must state area served.
2. All test and drain valves and all auxiliary drains – must state area served.
3. Fire Dept. connections
4. Hose valves
5. Fire Suppression Control Room door
6. Spare sprinkler cabinet (typed list of sprinklers and their characteristics and use)
7. Hydraulics calculations signs at the service entrance

Sequence of Operations: All control valves will have continuously monitored tamper switches, and the main service entrance and all zone-control valve stations will each have a flow switch. Flow switch alarms will trigger all building notification devices and evacuation. Both tamper switch and flow switch activation will be communicated to the Worcester fire dept. See fire alarm narrative for details.

6. ACCEPTANCE CRITERIA

The following written certifications shall be provided (by the person noted) to all local AHJs.

The Fire Suppression Engineers of record will certify that the systems have been installed in compliance with the construction documents, and that submittal data was reviewed and is acceptable.

The owner will certify that as-built drawings have been received from the contractors, and that the engineer(s) have confirmed their reasonable accuracy.

The sprinkler contractor will provide completed NFPA 13 test and acceptance report(s) for each riser (above-ground reports) and for the FP-only underground service main (underground report). Reports will include the name, address, and telephone number of a person to contact for any system failures or emergencies.

If any portion of their system fails to operate satisfactorily, each contractor must repair or replace the faulty components. They must then retest those components individually, as well as retest all related system functions in the presence of the engineer and all AHJs.

The sprinkler contractor will also provide a signed letter certifying the sprinkler system is installed in full compliance with all laws, regulations, and the pre-approved narrative, and shall obtain written approval from all AHJs certifying that they have witnessed the final acceptance testing.

The site contractor (responsible for installing all underground piping) shall also provide NFPA test and acceptance reports, certifying that their main-loop piping has been installed, flushed, and pressure tested per NFPA.

SEAMAN ENGINEERING CORPORATION
P: 508-865-1400
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22 West St. Unit C, Millbury, MA 01527
seamanengineers.com

Date: July 15, 2021

To: Rob Para, AIA

Co: Lamoureux-Pagano Assoc. Architects, Inc. (via email)

From: Christopher Robinson P.E.

Re: Doherty Memorial High School, Worcester, MA: **Plumbing System Narrative – 60% Construction Drawings Submission**

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1. PLUMBING

Code Criteria Listing

International Building Code (IBC), 2015 Edition
International Mechanical Code (IMC), 2015 Edition
International Energy Conservation Code (IECC), 2015 Edition
Massachusetts State Building Code Amendments, Ninth Edition, 780 CMR
Massachusetts Architectural Access Board (MAAB), 521 CMR
NFPA 54, ANSI Z223.1: National Fuel Gas Code, 2018 Edition
Commonwealth of Massachusetts "Fuel Gas & Uniform State Plumbing Code", 248 CMR, 3/10/17
Massachusetts Elevator Code, 524 CMR which follows ASME A17.1-2013 Safety Code for Elevators and Escalators

Plumbing Fixtures and Fixture Count

Number of plumbing fixtures will distributed throughout the proposed facility to accommodate a population of 1670 students or 835 male students, 835 female students and 180 faculty/staff and shall be in accordance with 248 CMR Paragraph 10.10, Table 1.

Plumbing fixtures will be equipped with the following water conserving features (for 30% indoor water use reduction per LEED v4 Water Efficiency)

Water Closets:	Manual Flush Valve @ 1.28 GPF (Sloan #111-1.28 or equal)
Urinals:	Manual Low-Flow Flush Valve Style @ 0.125 GPF (Sloan #186-0.125 or equal)
Lavatories:	Metering Faucets, manual actuated with mixing tee, 0.35 GPM (Chicago #3400-E39VPABCP or equal)

	Solid Surface Lavatory System with electronic sensor faucets for 2 users (CCL Shop) - (Bradley Express #MG-2-IRP-LSD-2-TMA-CHAR or equal)
Showers:	Non-ADA Low Flow Institutional Shower Head, Ball Joint, Adjustable Spray, 1.5 GPM (Moen Commercial #8375EP15 or equal)
	ADA Compliant Hand Shower with 30" Glide Rail, Single Handle Shower Valve, 1.5 GPM (Moen Commercial #8346EP15 or equal)

Water closets and urinals will be commercial vitreous china, wall hung (ADA compliant where shown). Lavatories in restrooms will be commercial vitreous china, wall hung. lavatories in CCL Shop located in the locker room will be a multi-user lavatory system as described above. Lavatories in Adult Daily Living Restroom will be self-rimming counter mounted or under-mount vitreous china depending on the countertop material. Each floor includes at least one janitor's closet with a 3'x2' floor mounted mop service basin which is made from molded stone/sheet molding compound. On each floor throughout the school, alcove-recessed electric water coolers, in a high-low handicapped accessible configuration, will be installed. Currently, all water coolers will have integral bottle fillers mounted above the handicap cooler. Restrooms with more than one toilet, kitchen, mechanical room, garage and several classrooms will have floor drains with trap primer connections & valves. The trap primer connections will have an air gap installed to comply with the Worcester DPW – Water Division.

Shower stalls are made from mud-set tile. Non-handicap shower shall have a terrazzo base and the handicap shower stalls have tiled floors with a center floor drain. For non-handicap showers, a shower drain and shower valve with fixed showerhead will be installed (12 total). For handicap showers, a shower drain and shower valve with a hand shower on slide bar (ADA compliant) shall be provided for each (8 total).

Any rooms with sinks except art & science rooms will have a self-rimming stainless steel sink with gooseneck type faucets (Chicago#201-RSGN8AE35VPXKABCP or equal). Sinks located in classrooms which are piped off of the main domestic hot water system shall have point of use mixing valve to ensure the hot water temperature does not exceed 112°F. Hose bibs are provided in any bathroom that has a floor drain and the mechanical room and are box-mount style. Exterior non-freeze wall hydrants will be provided as requested by the owner as they are not required by code, but will be box mounted style. There will be a mixture of non-freeze wall hydrants and roof hydrants mounted at the roof to clean the HVAC equipment and solar panels.

The Kitchen Equipment Contractor will furnish kitchen fixtures and equipment that need to be installed and plumbed by the Plumbing Contractor. Although most of the hardware is provided, the Plumber must rough-in and installed the fixtures and equipment and make final piping connections to each.

Art Classrooms will be provided with one 31”x22”x10”deep and one 31”x19”x5.5” deep ADA compliant self-rimming stainless steel sinks with a faucet and drain each. Also, each Art Classroom will also be provided with one (1) 19”x18”x6.5”deep self-rimming stainless steel sink with a faucet and drain which is ADA compliant. The faucets shall be similar to Chicago Faucets model #201-RSGN8AE35VPXKABCP or equal. Each sink will be provided with a solids interceptor, in lieu of a p-trap, mounted in the base cabinet. A solids interceptor is designed to recover all types of solids which enhances sanitation through efficient prevention of clogged waste lines. All sinks will be provided with a cup strainer.

Science Classrooms will be provided with gooseneck faucets for the classrooms sinks with integral vacuum breakers and serrated nozzles. Science Classroom sinks with two faucets shown (fixture L1), shall have one faucet described above and a second faucet with has an aspirator connection on the spout (Chicago Faucets model #LWS3-C31-A or equal). The student table sinks and demonstration table sink in the classrooms, except for one, shall have deck mounted cold water only water faucets (Chicago Faucets model #LWS3-C11-A or equal). One sink in every science classroom (fixture L4) and prep room sinks shall have hot and cold water mixing faucets (Chicago Faucets model #LWM2-A13-F or equal).

There shall be emergency fixtures installed in all the Science Classrooms and Prep Rooms, the Chemical Storage Room, the pH Neutralizing Room, the CCL Lab, the ETA Shops and the Mechanical Room as required by code. There is a mixture of styles for these fixtures. Several emergency fixtures shall be wall-mounted, recessed combination eye/face wash and safety drench shower (Fixture L5 or P10, Chicago Faucets model #8420-NF or equal). In all other locations, the emergency fixtures shall be an exposed floor mounted combination eye/face wash and drench shower wheelchair accessible (Fixture L-6 or P20, Chicago Faucets model #8405-NF or equal). There are also recessed eyewash units (Fixture P-26) being installed in Maker Spaces, Adult Daily Living, and the CCL Classrooms which consists of a concealed eyewash unit that swings down for use.

Mop sinks throughout the school shall be floor mounted molded stone basins with 10” high walls. The specified Fiat model #MSB-3624, or equal, shall be overall outside dimensions of 36”x24”x10” and shall have a drain installed. Wall mounted, manual mop sink faucets shall be similar to Chicago Faucets model #445-897SRCXKCP, or equal. The sinks shall have the following accessories: mop hanger, hose and hose bracket.

There will also be an outdoor restroom and storage building for the playing fields. The bleachers were designed for 1500 seats. Per the MA Plumbing Code, the fixture requirements for Use Group A-5 Stadiums is toilets @ 1 per 30 for females and 1 per 60 for males, urinals @ 50% and lavatories @ 1 per 150. Therefore, for 750 women, this would require 25 toilets and 5 lavatories and for 750 men, this would require 7 toilets, 6 urinals and 5 lavatories.

After a variance hearing for the South Community High School, the MA Plumbing Board granted a 50% relief for a school stadium from the MA Plumbing Code requirement for stadiums as long as it provides:

- Fifty percent of the code required facilities within the ne proposed building for the stadium.
- Meeting potty-parity requirements.
- Not including restrooms in nearby schools.

We have designed the building for the following:
Females = 14 toilets and 5 lavatories
Males = 4 toilets, 4 urinals and 4 lavatories
Unisex/Gender Neutral = 2 toilets and 2 lavatories
This still requires us to go submit a variance with the MA State Plumbing Board and plead our case at a meeting.

Since the outdoor restroom and storage building is open to the general public, will have designed around stainless steel, abuse resistant plumbing fixtures. Water closets shall be similar to Acorn Engineering Company Dura-Ware model #2105-W-1-1.6GPF-FVCH-ADA Siphon Jet Toilet. Urinals shall be similar to Acorn Engineering Company Dura-Ware model #2158-W-1-FVCH Stainless Steel Urinal. Wall Hung Lavatories shall be similar to Acorn Engineering Company Dura-Ware model #1953-1-DMS-4-H24-GE-OF-LC 18" wide Lavatory. The fixtures have MFR furnished flush valves and faucets with the fixtures.

Roof Storm Drainage System

Roof is sloped to interior roof drains. The storm drain system will incorporate primary roof drains at low points and emergency overflow roof drains with 4" high internal water dams in case the primary roof drain fails (i.e. pipe blockage). The drawing indicate side-by-side roof drains, but bi-functional roof drains can also be utilized. The primary roof drains will be piped to internal rain leaders and combine below grade to several exit locations to connect to the site storm drainage system. The emergency roof drains will be piped to discharge independently from the primary building storm system and shall terminate a minimum of 18" above grade. A wall lip will be provided at the outlets without screens to keep water off of the building.

Since the building is fully air conditioned, the HVAC system will produce condensate. Per the MA Plumbing Code, this is considered "Clear Water Waste" and only 12.5 gallons per hour, or 300 gallons per day, may be discharged to the sanitary drainage system. Alternate discharge locations are outside or to the storm drain system. Pipe connections to the storm drains/rain leaders must be made using standpipes with vented p-traps connected to backwater valves to prevent back-ups.

Sanitary Drainage Systems

The sanitary sewer system within the building envelope to 10' beyond the building foundation wall shall be service weight cast iron and will drain by gravity. External to the building, underground PVC piping shall be used or other material as dictated by the site engineer. The entire building can be drained by gravity, so a sewerage ejector pump system is not required for the sanitary waste.

The science rooms and prep rooms have sinks, fume hoods and floor drains that discharge through a separate piping system since they are considered "Special Hazardous Waste" per code or Lab Waste. The pipe material can be PVC, CPVC, FRPP (fire retardant polypropylene) or PVDF (polyvinylidene fluoride) which are all resistant to a broad range of acids and corrosive chemicals, but each has different strengths and weaknesses with certain chemicals.

All waste from the science labs generating acids or bases in the waste stream shall be run through an active pH neutralizing system. The system description is as follows:
The laboratory waste pH neutralization system shall be a modified two-stage with two continuous, stirred tank reaction chambers in series, with an effluent pH monitor. Each treatment stage shall have bi-directional proportional pH control and have equal treatment capacity in order to provide full redundancy. The wastewater from the laboratory drain system shall flow by gravity from all spaces to one location. The wastewater shall flow into the first treatment tank. After mixing and treatment, the wastewater shall flow into the second tank for additional treatment as necessary. The wastewater shall then be periodically pumped or gravity discharged through an effluent monitoring assembly. The pH of the final treated effluent wastewater shall be monitored independently and shall be recorded on a circular chart recorder. The effluent monitoring assembly shall have a sampling port assembly. The wastewater shall then be discharged to the sewer. The pH neutralization system shall have provisions for temporary wastewater collection in the event the wastewater is out-of-spec. The system shall be supplied with the ability to switch between semi-batch treatment and continuous gravity discharge. The system shall be controlled by a central system control panel using Concorp proprietary control system and process technology, or approved equal. Acid resistant waste pipe and vent piping, noted above, shall be used. Note that all science rooms will be connected to the lab waste piping system.

In addition to a single large-capacity local grease trap at the dishwasher, pot sink and floor troughs, all waste requiring treatment (i.e. floor drains and floor sinks at or near the cooking line) from the kitchen shall be piped to a large exterior grease trap prior to discharge to the municipal sewer system. Fixtures that do not require treatment such as hand sinks, floor drains or floor sinks receiving clear water waste, prep sinks and discharge from disposers/food waste grinders, shall be piped to the sanitary sewer system.

The Garage, CCL Lab and Outdoor Storage Room floor drains are piped independently to outside gas/sand traps. The floor drain for the air compressor will also be piped to this system as it may contain oils. Gas/sand trap vents will run through the roof separate from other vents in the building.

In addition, there will be sumps installed at the base of the elevator shafts that will be piped to fiberglass sumps in an adjacent room. Automatic sump pumps rated for 50 GPM will be installed in these sumps so that they are outside of the elevator shaft and can be serviced easier. The sump pump discharge flows in to the garage waste systems (either in the garage or CCL Lab) as elevator hydraulic fluid may be in the effluent. These are required by the MA Elevator Code which follows ASME A17.1 2013

Several classrooms will have floor drains installed, including in CCL and ETA areas. The design team will confirm why these floor drains are being installed, then select the appropriate drain. Note that standard floor drains could be installed, but then there is no way to collect any solids or sediment that may be discharged to the drains. Also, it is assumed that there is no drainage outside of the range of pH required for a standard drainage system (i.e. no treatment required).

The outdoor restroom and storage building will have sanitary drainage and a garage drainage system installed (due to the overhead door). The main difference is that an interior oil-water separator will be used for the garage floor drain. This equipment has two vents that are piped through the roof independently.

There are several sanitary sewer exits from the building instead of combining all of the drains and exiting once. This is required for several reasons.

1) There are two levels that sanitary sewer lines are shown leaving the building. There are two on the Ground Floor and two on the Main Floor.

2) Due to water saving measures, low flow fixtures have had a negative impact on the sanitary sewer system creating clogged pipes. Reducing the overall drainage system length should theoretically reduce clogging within the building.

3) The building layout lends itself to multiple sewer exits.

4) Since this site is building on a hill, the entire building can drain by gravity. Therefore, wherever the sewer exit is located, it will always flow “down” to the street municipal sewer.

In an effort to prevent sanitary sewer stoppages or clogs, we recommend the following:

1) Keep the sanitary sewer runs as short as possible. In the current design, a distance of 250 feet is considered short.

2) Slope all sanitary drain lines with water closets piped to them at ¼” per foot (2%) below grade. This is only required for 2” or 3” drain lines per code, but the piping slope increases the drain line carry from a fixture.

3) Discuss toilet paper options with the owner as this will impact the drain line performance.

Above ground sanitary drainage and will be piped in cast iron with “no-hub” joints (3” or larger). Piping smaller than 3 inch will be piped in copper. Piping below floor shall be service weight cast iron hub and spigot with rubber gaskets.

Radon Systems

Each section of the building will have a radon system installed. The system consists of perforated PVC piping directly under a vapor barrier below the slab which is piped to a vertical riser to the roof. Above the roof, a radon fan is installed which provides a negative pressure below the slab. This captures the radon vapors and discharges them above the roof instead of rising through the floor. Each radon system (8 total) will have two fans, one primary and one back-up. The stainless steel piping at the roof will extend 10 feet above the roof (called a mast). Note that the stainless steel mast and radon fans will be furnished and installed by the HVAC contractor. The fans are monitored by the BMS (Building Management System).

Sub-Soil Drainage Systems

The sub-soil drainage systems will be installed by the site contractor as they do not connect to the municipal storm water drainage system. Most of the sub-soil drainage pipes will be installed below the proposed underground plumbing. There will be some coordination with this piping required, through due to the proposed pipe inverts.

Domestic Cold Water Service

New main 6” domestic water supply serving the building will enter in the Water Service Room next to the Fire Pump Room. The piping will start from Highland Street and run through the site serving various fire hydrants. The water line will connect to the high pressure water main in Park Avenue, which runs parallel to the site. A primary 6” Reduced Pressure Backflow Preventer will be provided to the main domestic water supply to protect the service (per the DEP regulation 310 CMR 22). There will be a 6” Reduced Pressure Backflow Preventer bypass around the primary backflow preventer so that it can be tested and the water serving the building will not by shut-off. Based on the site water pressure from Park Avenue, a high/low pressure reducing valve station be installed to ensure that the water pressure never exceeds 70 PSI (80 PSI is code maximum). Boiler water feed and make-up, and any other mechanical take-off's will branch off through a reduced pressure-principle backflow preventer. The science lab cold and hot water feeds will need to be protected water supplies, therefore a separate reduced pressure backflow preventers will be installed near the science rooms. Note that there are two "stacks" of science lab classrooms, so separate backflow preventers will be required to provide non-potable cold and hot water to these space (labelled LCW and LHW on plans).

Since this is a 6-story building, water pressure will be a major concern. Per the current plans, the elevation change from the street to the highest roof is 100 feet. The current measured water pressure, via flow test on the Highland Street municipal water main, is between 70-80 PSI. Note that with decent water pressure (65-80 PSI), this can feed 4-stories without a booster pump. If the domestic water service only has the reduced pressure backflow preventer installed and no pressure reducing valve station, then the anticipated water pressure at the exit of the domestic water service at the Main Level is 52 PSI. The fifth floor is 70 feet above this which has a hydrostatic water pressure drop of 30 PSI. Therefore, if piping water pressure drop is not considered, the maximum water pressure available at the fifth floor is 22 PSI. Water closet and urinal flush valves required 27 PSI minimum water pressure to operate. A water pressure booster pump system is required for this project. Based on the available information, a variable speed water pressure booster pump will be installed to raise the water pressure 18 PSI at the start of the piping system. There will be a skid with three (3) 7.5 HP booster pumps located in the Water Service Room that can be set to 70 PSI outlet pressure and will maintain it. Therefore, there will be adequate water pressure on all floors at any time of the year.

LEED recommends monitoring the water usage in multiple systems to determine how the water is used and how much water is used for the processes. For schools, water sub-meters are added to the domestic hot water system cold water feed and to the heating plant cold water feed. In this building, there will also be a chilled water plant, so multiple water feeds and sub-meters may be required.

There will be a site irrigation system installed for this site. This is piped before the domestic water service entrance building water meter and will have a separate water meter installed. The purpose is to meter water that does not go down the drain to the sewer treatment plant (different rate charge for water use). This will have an RPZ Backflow Preventer installed and a PRV, if required. There will be a separate piping system for the site irrigation system. Based on the street water pressure, this system will not require a water pressure booster pump.

The outdoor restroom and storage building will have a dedicated water service entrance off of the site domestic water loop. It will serve the plumbing fixtures within the building. There will be a water meter for this building. Note that this building is unheated, so all piping will be sloped to drain down in the winter. The water service will need to be protected during the winter unless all water can be drained from the above grade piping.

A protected water line will be run to the football field for watering stations around the field.

In Worcester, we are not concerned with water filtration or water softening. There are point-of-use water filters installed for some of the kitchen equipment (ice maker and combi-ovens), but these are mainly for odor and taste. A whole building system is not required.

The domestic cold water piping inside the building will be distributed in "L" type copper tube with wrought or cast copper fittings. Press-fit fittings are allowed as an alternate joining method to soldering. The piping will be insulated to prevent condensation. Note that polypropylene, an alternate piping material, is acceptable in MA, but it does not meet the flame spread and smoke development rating required and would need to be protected in plenum spaces with insulation.

Domestic Hot Water Service

Natural gas shall be the fuel source for two (2) high efficiency (96% - 98% thermal efficiency) gas-fired condensing boilers coupled to two (2) 650 gallon storage tanks. This system shall be used to support the buildings domestic hot water needs including the science rooms and the emergency plumbing fixtures. The domestic potable hot water distribution system will be recirculated from the furthest points in the school back to the storage tanks. Note that the science rooms will have non-potable water, therefore they cannot be circulated and will required electric heat trace cables & wiring to maintain temperature. The domestic hot water system will operate at 120°F and will serve all fixtures and appliances including mop sinks, classroom sinks, lavatories, and the kitchen equipment. Each lavatory faucet, hand sink faucet and classroom sinks must reduce the hot water temperature to 110°F at the outlet per code. For large bathroom groups, local mixing valves can be installed to reduce the water temperature in the hot water piping serving multiple lavatories, but this has currently not been shown. For single and back-to-back restrooms, point-of-use mixing valves will be installed at the lavatories.

The domestic hot water will be stored at 140°F in the storage tanks but will be reduced in temperature via a central thermostatic mixing valve in the mechanical room. This mixing valve will be digital type. Additional mixing valves will be installed on the emergency shower/eyewash system water feeds to the science room emergency fixtures as well as the kitchen, mechanical room, ETA Shop and CCL Lab emergency fixtures. These systems will provide 60°F - 70°F tempered water to these fixtures only and will incorporate a recirculation loop to maintain constant flow near the fixture inlet to minimize stagnation. Note that the emergency mixing valve will be piped off of the 140°F piping to utilize the full capacity of the storage tanks when serving the combination emergency showers.

The use of temperature maintenance heat trace may be more widespread throughout the school to maintain hot water temperatures closer to the fixtures. Note that typically, a faucet is turned on and there is a wait time for hot water to arrive. The heat trace will virtually eliminate the wait time so that hot water is immediately available. This will reduce water waste. This system will be designed in future design phases and must be coordinated with the Electrical Engineer. Note that a hot water recirculation system with pumps is being used for the hot water mains whenever possible. The heat trace will be installed on the run-outs from the hot water mains right to the connection at the fixture. Therefore, this is a hybrid system as it combines both systems.

There may be some remote sinks in the classroom wings that will have mini-tank point-of-use electric water heaters installed. These water heaters could serve one sink or multiple sinks. These will be mounted below the counter in the base cabinet and will ensure almost instantaneous hot water is available at these fixtures whereas there could be some delay if these were piped off of the central hot water system.

The outdoor restroom and storage building will have an 80 gallon electric water heater. It will deliver 120°F hot water to the mop sink and have a mixing valve nearby to deliver 110°F hot water to the public lavatories. It can be drained down in the winter and be disabled.

The domestic hot water piping inside the building will be distributed in “L” type copper tube with wrought or cast copper fittings. Press-fit fittings are allowed as an alternate joining method to soldering. The piping will be insulated to meet the International Energy Conservation Code. Note that polypropylene, an alternate piping material, is acceptable in MA, but it does not meet the flame spread and smoke development rating required and would need to be protected in plenum spaces with insulation.

Natural Gas System

Natural gas system to the site shall be installed by the site contractor in conjunction with the natural gas supplier, Eversource Gas Company. The gas meter and initial gas pressure regulators shall be installed by Eversource Gas Company. The Plumbers work will start at the outlet of the gas meter and be piping to the mechanical room, kitchen and science rooms to support various appliances and equipment.

The piping after the gas meter will be a pipe header with two piping feeds. One will run into the school and one will run below grade to the site standby generators (2 – 600 kW dual-fuel generators). These generators are 3,000 CFH each at full load and required a minimum gas pressure of 1 PSI. As noted, these are dual fuel with the primary fuel being diesel which is stored in a belly tank. The underground gas piping will be polyethylene, or another material that will not corrode.

In the building, each science room will have a master emergency Natural Gas Service Panel that controls the gas usage in the room, mounted near one of the corridor doors (i.e. the one closer to the Prep Room). There will be a manual gas shut-off valve and an electronic solenoid gas shut-off valve mounted in a recessed box above the service panel for use by the teacher or staff only (i.e. it is mounted higher than required per ADA). The solenoid valve shall be manually activated via a keyed start/stop button on the panel and can be instantly closed via a panic button on the panel or a remote panic button near the second egress door. The science room natural gas piping will serve individual gas turrets at the student tables and the fume hoods.

The boiler room has the bulk of the gas utilization equipment. There will be a dedicated gas main from the gas service entrance to the boiler room where an emergency shut-off valve will be installed. The gas main splits to serve the three (3) heating boilers and the two (2) domestic hot water boilers. Each of these gas lines has a gas sub-meter installed to monitor gas usage of both systems. These gas sub-meter readings are obtained by the BMS and will be reported for LEED Certification,

The kitchen does not have gas appliances any longer, so all gas piping for the kitchen has been removed.

In order to minimize the gas piping size, elevated gas pressure will be used for this building. Per Eversource Gas Company, elevated gas pressure is available, but proper submissions to them and the Plumbing Inspector for permitting is required. The proposed elevated gas pressure will most likely be 2 PSI. Since the Mechanical Room has the largest gas load, the elevated gas piping will run from the gas meter to the Mechanical room where a gas pressure reducer station will be installed to deliver low-pressure gas (i.e. under ½ PSI) to the equipment. The gas pressure reducer station will be have a gas pressure regulator with pressure sensing line and a relief valve, both of which will be vented outside. The elevated gas piping should be painted and labelled per code requirements to ensure that it is not disturbed.

Natural gas piping shall be screwed schedule 40 black steel piping on sizes 2” and under and welded on 2-1/2” and over. Press-fit fittings are allowed for low-pressure and elevated-pressure gas piping 4” and under (MegaPress or equal). Otherwise, all elevated pressure gas piping could be welded.

Compressed Air System

A compressed air system will be provided for the CCL Lab and ETA Shops. The air compressors and air receivers for both of these programs will be provided under the FF&E package and installed by the plumber. The air compressors are packaged units with an integral refrigerated air dryer and air filters. The air compressors are piped to air receiver tanks which is then piping to the distribution piping around the

CCL Lab and ETA Shops (separate piping loops). There shall be individual air piping drops to quick connect fittings installed or ceiling mounted air hose reels as shown or where directed. Note that the air pressure should be set to 125 PSI for the entire system. Air pressure reducing stations may be required for some equipment connected to this piping. In addition, the owner may install air filters on the outlets to protect pneumatic equipment.

Sustainable Opportunities:

Many of the proposed fixtures and control sequences noted above minimize water usage and conserve energy however, further optimization may be obtained by investigating the use of storm water recovery systems. These systems collect, filter and utilize storm water to supply water to water closets and urinals throughout the building. In addition, vacuum tube thermal solar panels mounted on the roof can be considered to supplement the building domestic hot water needs. A life cycle evaluation must be performed to ascertain the initial first costs, annual operating costs and projected savings associated with such a system.

Also, there is a higher efficient water closet available that is 1.1 GPF vs. 1.28 GPF. There is a concern that there will not be enough water discharged from these fixtures for drain line carry, thus creating blockages in the piping, leading to sewer back-ups. We feel that even though a LEED point could be gained, it is not worth the risk and aggravation.

End of Plumbing Narrative – 60% Construction Drawings Submission

HVAC 60% Construction Document

Basis of Design Narrative

For The

DOHERTY HIGH SCHOOL

IN

Worcester, MA

July 15, 2021

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I. HVAC NARRATIVE

A. DESIGN INTENT

The primary heating medium for the school is low temperature hot water generated by an air-cooled roof mounted heat recovery chiller-heater heat pump as well as high efficiency condensing gas fired hot water boilers located in a mechanical room. The hot water loop serves most all areas of the building either as primary heat or as backup to packaged rooftop heat pump units. The heating water is distributed to the fin-tube radiation, air handler units, cabinet and unit heaters and fan coil units located throughout the building.

In addition, heating for many areas is accomplished through the use of either packaged rooftop heat pump units or variable refrigerant flow (VRF) heat pumps and associated fan coil units.

Cooling for the building is supported by various types of systems based on space type and use varying from chilled water supported chilled beams and/or fan coil units, packaged air-cooled DX units and VRF heat pumps.

A brief description of the types of systems for the respective areas is as follows:

<u>Standard Classrooms</u>:

A high efficiency roof mounted air-cooled heat recovery chiller-heater heat pump supports a majority of the cooling needs of the classroom wings of the structure by supplying chilled water to displacement style chilled beams and ceiling mounted chilled beams located throughout these areas. The chiller-heater has a capacity of 150 cooling tons and generates both chilled water and hot water when either demand exists. The chiller incorporates multiple scroll type compressors for improved part load efficiency. The elevated chilled water temperature (58°F+/-) which the chilled beams require, also result in higher chiller efficiencies.

Glycol anti-freeze to water heat exchanger shall be provided between the chiller and the building chilled water loop. Pumps serving the chiller, secondary HX loop as well as the chilled beam loops shall be variable flow style to respond to the varying building cooling demands.

Chilled water for the chilled beams shall be mixed with the main secondary loop and delivered at an elevated 58°F+/- temperature to the classroom wing displacement type floor mounted chilled beams and ceiling chilled beams. Each chilled beam coil shall be controlled by a zone valve operated by the building energy management system (EMS) to respond to space temperature demands.

Outdoor ventilation air for the standard classrooms shall be provided via roof mounted dedicated outdoor air units (DOAS) of varying size with a minimum of one per classroom wing. The DOAS units shall be custom fabricated units incorporating total energy recovery wheels, hot water coils, DX cooling/heating coils, wrap around heat pipe coils and/or dual wheels. Each unit shall be coupled to roof mounted VRF type air cooled heat pumps with variable speed compressors for high full load (EER) and part load (IEER) energy efficiency ratings.

Supply air variable air volume (VAV) terminals connected to the chilled beams in each zoned space shall vary airflow based on Indoor Air Quality using space temperature, CO_2 and humidity information.

Heating for classrooms and spaces with exterior exposures shall be accomplished through the use of fin-tube radiation as the primary form of heat. Interior spaces shall incorporate VAV mounted hot water coils.

Science, Art Classrooms and Maker Spaces:

As these types of areas require high levels of outside air ventilation and exhaust they are supported off dedicated packaged VAV rooftop heat pumps units with total energy recovery wheels, hot water coils, cooling, heating and dehumidification cycles utilizing DX based system with hot gas reheat cycle. The units shall incorporate variable speed compressors for high full load (EER) and part load (IEER) energy efficiency ratings.

Variable air volume (VAV) terminals on both the supply air and exhaust air from each room connected to ceiling terminals. The VAV's shall control to maintain required space pressure relationships as well as Indoor Air Quality using space temperature and CO_2 information.

Heating for science shall be accomplished through a mix of fin-tube radiation as well as VAV mounted hot water coils. Heating and supplemental cooling for the art rooms shall be accomplished through fan powered FAV with both sensible cooling and heating coils.

Offices, Cafeteria and Media Center:

Spaces shall be supported by packaged VAV rooftop heat pump units with total energy recovery wheels, hot water coils, cooling, heating and dehumidification cycles utilizing DX based system with hot gas reheat cycle. The units shall incorporate variable speed compressors for high full load (EER) and part load (IEER) energy efficiency ratings.

Supply air variable air volume (VAV) terminals connected to each zoned space shall vary airflow based on Indoor Air Quality using space temperature, CO_2 and humidity information.

Heating and cooling for most administration offices as well as IT and nurses areas shall be accomplished via VRF fan coil heat pump units serving respective areas supplied with air from the respective packaged rooftop heat pump DOAS units. Heating for the Cafeteria and Media Center shall be accomplished via the packaged rooftop heat pump units as well as a mix of fin-tube radiation in spaces with exterior exposures as well as VAV mounted hot water coils.

Gymnasium and Auditorium:

Space shall be supported by packaged rooftop heat pump units with total energy recovery wheels, hot water coils, cooling and dehumidification cycles utilizing DX based system with hot gas reheat cycle. The systems shall control to vary total air volume, outdoor air volume as well as supply air temperature to control as a single zone VAV.

Exhaust and Other Systems:

Exhaust fans shall vent specific areas such as bathrooms, storage areas and the kitchen. All exhaust fans shall have efficient ECM motors which shall vary speed where applicable. Kitchen hood system shall have variable flow capabilities using smoke and/or heat sensors to vary exhaust airflow and associated make-up air based on cooking demand.

Exhaust fans for the science room fume hoods shall be of the high plume type. Fume hood fans shall service variable flow fume hoods fitted with sash velocity sensors and automatic exhaust duct dampers.

Controls:

The school is designed with a direct digital control (DDC) energy management system (EMS) that monitors and controls the HVAC equipment for efficient use. The system is designed on PC based architecture and adjustments are made on a graphics-based presentation of building systems. The system also supports maintenance and record keeping needs of the facility. Occupancy of the school is based on the standard school year with occupied/unoccupied conditions based on current school day practice. This is an adjustable feature that can be made to reflect additional operating needs and use of the school building by staff or others.

The adjustable operating schedule, in general, is from 7:00 a.m. to 5:00 p.m., five days per week. It is expected that the building or certain areas within the building will also be used several evenings a week and on weekends.

The Designer of Record will certify that the HVAC systems have been installed in accordance with the approved construction documents, in conformance with Commonwealth of Massachusetts State Building Code 780 CMR Chapter 13, ninth edition.

B. BASIS OF DESIGN

The HVAC systems and components are designed in accordance with the requirements of the Commonwealth of Massachusetts State Building Code - 9th Edition, 780 CMR, and conform to the energy conservation requirements of Chapter 13 of that code referencing IECC 2018 International Energy Conservation Code with Stretch Code Amendments as adopted by the City of Worcester.

The Doherty High School is located in Worcester, MA and the system design and loads comply with the criteria for Climate Zone 5A.

Interior design temperature set points are 72°F for heating and 75°F for cooling (for spaces with cooling cycles) during occupied conditions however setpoints in operation shall include a minimum 5 degree dead-band between cooling and heating such as 70°F heating and 75°F cooling. Space conditions are allowed to drop to 60°F during the heating season and rise to 85°F during the cooling season when spaces are in the unoccupied condition. Morning warm-up or cool-down period is optimized to achieve design space conditions at the commencement of occupied periods.

Most all areas shall be designed to control maximum indoor humidity levels to no greater than 55% RH at design indoor cooling space temperature. Slightly lower humidity levels near 50% shall be provided in the areas supported by the chilled beam system.

Design occupant levels by space are contained within the architectural documents included as part of the design development document submission.

C. HVAC SYSTEM CONTROLS

Heating and cooling systems of the Doherty High School shall be monitored and controlled by an Energy Management System (EMS) using Direct Digital Control (DDC) technology. The system shall be the most recent generation of products by Alerton, as provided by Automated Building Systems, Inc. the Owners current energy management system provider. Each system is monitored for conformance to spatial design conditions and design point settings are adjustable through the DDC system. The DDC system is based on PC architecture with the central monitoring and control station located adjacent to the boiler room. System shall be web based and accessible via password protection through internet browser software.

The HVAC systems are generally operated on a school day basis coinciding with the occupied/unoccupied schedule of the standard 180-day school year. In addition, the city intends to operate this school, to a certain extent, throughout the summer season for various school programs. Adjustments can be made through the DDC system to allow for usage during periods other than the usual school operating periods.

Space temperature is monitored by individual space sensors that transmit data to the central monitoring and control station. Space conditions are adjustable through DDC system and can be modified to meet individual needs. Local control of space conditions is limited to predefined adjustments in space temperature and to facilitate a 3-hour occupied override feature.

Most all systems include carbon dioxide (CO_2) indoor air quality (IAQ) sensors which optimize the fresh outdoor air ventilation levels in response to variations in space occupancies. All classrooms spaces as well as all high-density occupant areas shall incorporate CO_2 monitors for active demand ventilation control.

The building shall be connected to an emergency power source for operation of heating boilers and pumps during emergency conditions as well as other select system.

D. SYSTEMS AND EQUIPMENT CAPABILITIES

The buildings heating requirements will be satisfied through a combination of packaged rooftop heat pumps, VRF heat pump systems and a hydronic hot water loop fed by a 150-ton heat recovery chiller-heater heater pump and a high efficiency (93% AHRI Thermal Efficiency) natural gas-fired fire tube style condensing hot water boiler plant with a maximum design hot water supply temperature of 135°F. The boiler plant shall consist of three (3) gas-fired boilers each with a gross output capacity of 3.7 million BTUH (12 million BTUH total plant input) each as manufactured by Lochinvar - Crest series. Each boiler shall be fitted with a wet rotor in-line pump with ECM motor.

Classroom wing chilled beam systems as well as constant cooling loads experienced by spaces such as electrical rooms and IT rooms shall be supported by a 150-ton air-cooled heat recovery water chiller-heater heat pump incorporating multiple scroll compressors for improved part load performance. Due to the elevated chilled beam, water temperature (58°F+/-), higher system return water temperatures are expected resulting in higher chiller efficiencies. The chiller shall be fitted with integral variable speed pumps for both chilled and hot water side running to thermal buffer tanks prior to feeding the buildings chilled water and hot water loops.

Provide hydronic hot water and chilled water system pumps consisting of multiple sets of vertical in-line system pumps as manufactured by Grundfos, Armstrong or Taco. The system pumps shall divide the building with one set of pumps serving primarily the classroom wings and the other set of pumps supporting the other areas including main office, media, café, gym, shops, etc.. Hydronic system shall connect to 2-pipe cabinet heaters, unit heaters, air handler/RTU coils, VAV coils and fin-tube radiation located throughout the building. All terminals connected to the new system shall be designed to operate with a maximum water temperature of 130°F.

Three (3) plate and frame heat exchangers located in the boiler room shall support a 30% propylene glycol water loop supporting the chilled and hot water to the heat recovery chiller-heater as well as the hot water coils serving rooftop units and air handling unit coils. Each glycol loop shall include loop accessories such as air separator and expansion tank as well as an 18-gallon automatic glycol feed tank.

All pumps shall have premium efficient motors and be fitted with variable speed drives so that pump energy matches system flow demand. Wet rotor pumps shall be fitted with ECM motors for control of pump speed to match building load.

Packaged Rooftop air handlers serving all areas of the building utilize total energy recovery energy exchange (no ERV on kitchen make-up air), hot water heating coils, DX cooling/heating coils and DX reheat coils to facilitate pretreating, cooling, heating and dehumidification cycles. The cooling system consists of multiple high efficiency packaged air cooled DX units with inverter modulating scroll compressor technology and hot gas reheat and/or wrap around heat pipe dehumidification cycles. These units support all areas noted previously as being air conditioned as well as dehumidification for most all spaces.

Stair tower pressurization systems shall be provided in each stair tower qualified as high rise. This system shall be controlled by the building fire alarm system and include a graphic panel with manual override for fire department use.

Systems and their airflow capacities are as follows:

Abbreviations:
H&V – Heating & Ventilation; RTU – Rooftop Heating, Ventilation and Air Conditioning unit with DX Cooling and Hot Water Heating; ERV – Energy Recovery Ventilation; VAV- Variable Air Volume; AHU – Air Handling Unit

Refer to plans for unit size and configuration.

Supplemental ductless split systems are located in IT closets and other similar rooms requiring such. Cabinet and unit heaters are located at building entrances and other areas to mitigate drafts from entering internal building spaces.

E. TESTING

The HVAC equipment and systems are required to be tested and reports submitted for review and record as part of the construction document requirements. In addition, systems shall be properly commissioned by an independent 3rd party. Systems and equipment requiring testing and report submittal are:

a. Heating system includes all boilers, pumps, heat exchangers, heating coils, radiation, etc….

b. Heat recovery chiller-heater heat pump and associated pumps and heat exchangers.

c. Chilled water system and associated pumps and accessories.

d. Cooling system including DX split systems and packaged rooftop heat pump units.

e. All piped distribution systems are required to pass a hydrostatic test using water and the pressure medium at a test pressure of 150 percent of operation pressure. All hydronic heating and cooling systems will be tested and balanced. A testing, adjusting, and balancing (TAB) report will be prepared for each system and submitted for review and record to the architect and engineer. TAB shall be done by an independent testing and balancing contractor

f. All airside components of the HVAC systems shall operate as designed and conform to the specifications for airflow as defined in the contract documents. A testing, adjusting, and balancing (TAB) report will be prepared for each system and submitted for review and record to the architect and engineer. TAB shall be done by an independent testing and balancing contractor.

g. Ductwork shall be tested for leak integrity and performed in accordance with SMACNA standards.

h. Systems or equivalent components not meeting the design criteria of the contract documents shall be corrected and re-tested for conformance to contract documents at no additional cost to the owner.

i. Visual inspection of all equipment installations for conformance to contract documents with respect to sound, vibration and installation integrity. Manufacturers' recommendations for equipment installation will be followed. All HVAC systems will operate in accordance with the sequence of operation defined for that system.

j. Specialized testing shall occur for all stair tower pressurization systems and smoke control systems.

II. DESIGN PARAMETERS & LOADS

DESIGN CRITERIA

The HVAC systems and components are designed in accordance with the requirements of the Commonwealth of Massachusetts State Building Code - 9th Edition, 780 CMR, and conform to the energy conservation requirements of Chapter 13 of that code referencing IECC 2018 International Energy Conservation Code.

The Doherty High School is located in Worcester, MA and the systems design and loads comply with the criteria for Climate Zone 5A. Outdoor design conditions utilized were:

Heating Degrees Winter:	0°F
Cooling Degrees (db) Summer:	84°F (87°F used for peak load sizing**)
Cooling Degrees (wb) Summer:	71°F

**87°F was used for cooling design as it is more reflective of the urban temperatures experienced in Worcester as opposed to the 84°F temperature reported at the higher elevation Worcester Airport weather station as published by ASHRAE.

Interior design temperature set points are 72°F for heating and 75°F for cooling (for spaces with cooling cycles) during occupied conditions however setpoints in operation shall include a minimum 5 degree deadband between cooling and heating such as 70°F heating and 75°F cooling. Space conditions are allowed to drop to 60°F during the heating season and rise to 88°F during the cooling season when spaces are in the unoccupied condition. Morning warm-up or cool-down period is optimized to achieve design space conditions at the commencement of occupied periods.

Design occupant levels by space are contained within the architectural documents included as part of the approved design development documents.

Outside air ventilation requirements were based on the ICC International Mechanical Code 2015 as referenced by the building code as well as cross references to ASHRAE Ventilation Standard

62.1- current edition. Ventilation requirements are based on space use, room occupancy, square footage and ventilation effectiveness.

COOLING & HEATING LOADS

Cooling and heating load calculations were performed utilizing the design data referenced above. Hourly Climate data for Worcester, MA was selected for load and energy calculations in that it offers the most applicable environmental conditions for the project site.

The building heating and cooling load requirements under peak design load conditions as indicated above are estimated as follows and are preliminary pending further advancement of building plans for improved load estimation:

	Heating Load	Cooling Load	Tons
Building Loads	7,628,857 BTUH	9,052,222 BTUH	754

The estimates do not include localized cooling loads for tel/data and MDF rooms nor does it include tempered heating of the parking garage as applicable.

III. BUILDING CODE SUMMARY

The HVAC systems and components shall be designed in accordance with the requirements of the Commonwealth of Massachusetts State Building Code - 9th Edition, 780 CMR. In addition, the systems shall conform to the energy conservation requirements of Chapter 13 of that code which references the International Energy Conservation Code (IECC) 2018. Ventilation requirements shall meet or exceed those requirements of ASHRAE Standard 62.1 – 2016 with review of the recently released 2019 version.

However, we do understand that the 10th edition of the building code shall most likely be enforced at the time this project is permitted for construction. Although this is a code that has yet to be published, in anticipation of more stringent energy standards, we plan to have our design meet and, in most cases, exceed the current code requirements particularly with regard to ventilation and system efficiencies.

Special design consideration has been applied to select areas of the building which are classified as a high-rise structure. For these areas, stair tower pressurization systems have been applied as well as post fire floor smoke evacuation (for floors without adequate windows.

End of 60% Construction Document Basis of Design HVAC Narrative

38 Front St. FL 3, Worcester, MA 01608 Office: 508.797.0333

July 15, 2021

Doherty High Community School

299 Highland Street
Worcester, MA 01602

BASIS OF DESIGN – ELECRICAL SYSTEMS

A. ELECTRICAL SERVICE

1. Provide 4-4” Schedule 40 electrical primary duct bank to the utility company (NGRID) equipment coral located near Highland Street. The primary duct bank shall be encased in 3” of concrete.
2. Provide secondary electrical service conductors, main switchboard, and distribution equipment in the main electrical room. The electrical service shall be primary metered.
3. Provide 3750kVA, 13.8kV to 480/277V medium voltage padmount transformer and 3-2/0 AWG and 1-3 AWG GND 15kV medium voltage primary cables to the NGRID equipment coral.
4. The electrical service shall be 5000A, 65kAIC, 480/277V, 3-phase, 4-wire, fed by eleven sets of 4-750kCMIL copper cables in 11-4” Schedule 40 PVC conduits.
5. Provide 6-4” Schedule 40 PVC telecommunications underground duct system to the entrance facility. The telecommunications duct bank will be encased in 3” of concrete when running under vehicular traffic areas and roadways.
6. Coordinate with utility company to disconnect power to the existing building at the end of construction to facilitate demolition by the Construction Manager.

B. GROUNDING SYSTEM

1. Comply with UL 467.
2. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
3. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
4. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
5. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
6. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
7. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

8. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.

9. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

10. Grounding and Bonding for Piping:

    a. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

    b. Sprinkler Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main sprinkler service entrances to building. Connect grounding conductors to sprinkler service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

    c. Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

    d. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

11. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

12. Grounding for Lightning Protection System: Install 3/0 AWG copper grounding conductor, in conduit, to the building's main service equipment.

C. EMERGENCY POWER

1. Provide two bi-fuel diesel/natural gas backup generators to feed life safety, legally required standby and optional standby loads, as well as transfer and distribution equipment.

2. The generators shall be rated 600kW/750kVA, 480/277V, 3-phase, 4wire with duct mounted load back sized at 30% of the generator kW rating, fuel polishing system and 700-gallon fuel tank.

3. The generators will be housed in a factory standard Level 2 weatherproof sound attenuated enclosure furnished with steel platform and stairs.

4. The generators shall be integrated with the BMS system for alarm monitoring and reporting.

5. Provide generating paralleling switchgear.

6. Emergency equipment must be separated from normal and standby power equipment per the Massachusetts Electrical Code.

7. The emergency power system shall be divided into two branches:

   a. Life Safety Branch: all life safety branch equipment shall be installed in 2-hour rated rooms. All life safety branch feeders shall be 2-hour rated MI cables. The life safety branch shall supply power to:

      1) Egress and exit lighting.

      2) Alarm and alerting systems.

      3) Emergency communications systems.

      4) Elevator cab lighting.

      5) Automatic doors.

   b. Legally Required Standby Branch shall supply power to:

      1) Stair pressurization systems.

      2) Elevators.

   c. Optional Standby Branch: shall power the entire community side of the building. Additionally, the standby branch shall supply power to:

      1) Boilers, associated controls, and pumps to keep building from freezing.

      2) Telecom and server room lighting, power, and ac systems.

      3) Building management system (BMS).

      4) Power outlets at roof equipment, mechanical room, loading area, cafeteria, and kitchen.

      5) Radon fans on roof.

      6) Kitchen and cafeteria.

      7) Selected mechanical loads.

D. PANELBOARDS

1. Panelboards shall comply with UL 67, UL 50 and NEMA PB 1.

2. Panelboards for non-linear loads shall be UL listed, including heat rise tested, in accordance with UL 67, except with the neutral assembly installed and carrying 200 percent of the phase bus current during testing. Provide molded case circuit breakers in accordance with UL 489.

3. Surge Protection Device for non-linear panelboards: IEEE C62.41.1, IEEE C62.41.2, UL 1449 Third Edition, or most recent edition & NEC Article 285 -compliant and test devices according to IEEE C62.45, integrally mounted, bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL labeled with 200 kA short-circuit current rating (SCCR), and matching or exceeding the panelboard short-circuit rating, redundant suppression circuits, with thermally protected metal-oxide visitors.

E. INTERIOR DISTRIBUTION TRANSFORMERS

1. The interior distribution transformer shall be DOE 2016 compliant, ST20 and relevant NEMA, UL and IEEE standards; 200% rated neutral; 60Hz rated. All terminals, including those for changing taps, must be readily accessible by removing a front cover plate. Windings shall be continuous with terminations brazed or welded. 10kV BIL.
2. Insulation System: Shall be NOMEX-based with an Epoxy Co-polymer impregnant for lowest environmental impact, long term reliability and long-life expectancy.
   a. Class: 220 degrees C.
   b. Impregnant Properties for low emissions during manufacturing, highest reliability and life expectancy.
   c. Epoxy co-polymer.
   d. VOC: less than 1.65 lbs. /gal (low emissions during manufacturing).
   e. Water absorption (24hrs @25C): less than 0.05% (superior insulation, longer life).
   f. Chemical Resistance: Must have documented excellent performance rating by supplier.
   g. Dielectric Strength: minimum of 3200 volts/mil dry (for superior stress, overvoltage tolerance).
   h. Dissipation Factor: max. 0.02 @25C to reduce aging of insulation, extending useful life.
   i. Operating Temperature Rise: 130 degree C in a 40 degree C maximum ambient.
   j. Noise levels: Per NEMA ST-20.

F. ENCLOSED SWITCHES AND CIRCUIT BREAKERS

1. Circuit Breakers: Provide molded case circuit breakers in accordance with UL 489. Provide with solid neutral when grounded conductor is present.
2. Fusible Switch, 1200A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
3. Non-fusible Switch1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

G. POWER SYSTEM STUDIES

1. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
   a. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
   b. Calculate the maximum and minimum ground-fault currents.
   c. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.
   d. Comply with IEEE 1584 for performing Arc Flash Hazard Calculations.

H. SUB-METERING

1. All meters must be "Revenue quality." "Revenue quality" certified meters are the standard for accuracy and reliability of meters used to track energy bought or sold. These meters may either be electro-mechanical or solid-state based and are to be used for purposes of reporting generation data to meet the requirements of an energy savings performance contract. Metering and energy management systems (EMS) installed in a Commonwealth Facility require the capability of tracking building specific Energy Conservation Measures (ECMs) to allow Facility staff to effectively manage and monitor building systems. Such metering also allows state agencies to access information. Major pieces of equipment should be metered with a revenue quality meter and/or integrated into the EMS and the overall site metering plan.
2. Installed meters must be reflected on the existing one-line drawings or additional drawings showing the locations and connections shall be produced.
3. Electric metering will be ANSI C12.20- 2010 (Minimum 0.5% accuracy meters).
4. Current Transducers (0.3%) will comply with ANSI/IEEE C57.13-2008.
5. Meters shall have a kW and kWh remote output signal with an output signal interval of not more than once per minute.
6. Meters shall have either a non-resettable or password protected cumulative kWh register.
7. Provide BACnet/IP connection and wiring for integration with the BMS.
8. Provide loads for individual panels and loads monitored in the main switchboard as well as group loads as follows:
   a. Total Lighting Panels
   b. Total Power Panels
   c. Total HVAC Panels
   d. Total Building Power Consumption

I. GENERAL PURPOSE POWER

1. Provide three general purpose duplex receptacles and one double duplex receptacle for offices.
2. Provide two double duplex receptacles and eight general purpose power receptacles in classrooms.
3. Provide a duplex receptacle for each projector.
4. Provide one general purpose duplex receptacle in utility and storage rooms.
5. Multiple service floor outlets or fire rated poke-through devices shall be provided for equipment and appliances in the commons areas when the equipment is to be placed on worktables, counters, systems furniture, or cabinets that are not against fixed walls.
6. Multi-outlet raceway or surface mounted wiring devices shall be provided where it is not feasible to install recessed outlets.

7. All general-purpose receptacles in offices and classrooms shall be controlled via vacancy sensor and/or time clock integrated with the lighting control system.

J. WIRING

1. Provide wiring and connections for special outlets where required. All homerun circuits must contain no more than 3 phase conductors.
2. Conductors: Copper. Comply with NEMA WC 70.
3. Conductor Insulation: 90 degree rated; Comply with NEMA WC 70 for THHN, THWN-2 and XHHW-2.
4. Multi-conductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.
5. Emergency System Feeders: Emergency System Feeders: Mineral-insulated, metal-sheathed cable, Type MI.
6. Conductor insulation and multi-conductor cable applications and wiring methods:
   a. Service Entrance: Type XHHW-2, single conductors in raceway.
   b. Exposed Feeders: Type THHN-THWN-2, single conductors in raceway.
   c. Emergency System Feeders: Mineral-insulated, metal-sheathed cable, Type MI.
   d. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN-2, single conductors in raceway; Metal-clad cable, Type MC.
   e. Feeders Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN-THWN-2, single conductors in raceway.
   f. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN-2, single conductors in raceway; Metal-clad cable, Type MC.
   g. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN-2, single conductors in raceway; Metal-clad cable, Type MC.
   h. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN-2, single conductors in raceway.
   i. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, and strain relief device at terminations to suit application.
   j. Class 1 Control Circuits: Type THHN-THWN-2, in raceway.
   k. Class 2 Control Circuits: Type THHN-THWN-2, in raceway; Metal-clad cable, Type MC.
   l. Fire alarm circuits: Type FPLP, in raceway.
   m. Stair pressurization fan power and controls: Mineral-insulated, metal-sheathed cable, Type MI.

K. LIGHTING

1. Provide a high efficiency lighting system in all interior spaces as well as on the exterior of the building. The design aim is to deliver a lighting system with a light power density not

exceeding 0.5W/sq. ft. Linear direct/indirect fixtures shall be LED; recessed fixtures shall be LED; exterior light fixtures shall be LED.

2. Interior lighting shall be controlled with an automatic control device to shut off building lighting in all spaces. This automatic control device shall function on either:
   a. A scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times; or
   b. An occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space; or
   c. An unscheduled basis by occupant intervention.
3. Each space enclosed by ceiling-height partitions shall have at least one control device to independently control the general lighting within the space. Each control device shall be activated either manually by an occupant or automatically by sensing an occupant.
4. Each perimeter office space enclosed by ceiling-height partitions shall have a manual control to allow the occupant to uniformly reduce the connected lighting load by at least 50% or shall be provided with automatic daylighting controls.
5. Each perimeter classroom space shall have a manual control to allow the occupant to uniformly reduce the connected lighting load by at least 50% and shall be provided with automatic daylighting controls. The classrooms shall have the ability to dim or switch off lights at the presentation/teaching front wall. The lighting controls shall be integrated with the HVAC controls.
6. Provide LED emergency egress and exit lighting fed from the emergency life safety branch of the emergency/standby system.
7. Integrate lighting control system with the BMS system to optimize energy performance of the building.

L. EXTERIOR LIGHTING

1. Pedestrian walkways shall be designed for illuminance value at the ground plane of 0.6 foot-candles, the minimum illuminance shall not be lower than 0.15 foot-candles.
2. All parking lots shall be designed for illuminance value at the ground plane of 1.0 foot-candles, the minimum illuminance shall not be lower than 0.2 foot-candles.
3. Roadways shall be designed for illuminance value at the ground plane of 0.6 foot-candles, the minimum illuminance shall not be lower than 0.15 foot-candles.
4. Pedestrian walkway lighting shall be LED bollard fixtures; parking and roadway lighting shall be LED fixtures mounted on 20 ft. aluminum poles.

M. FIRE ALARM

1. Provide an addressable fire alarm system with voice evacuation and connection to the fire department. The fire alarm system shall comply with high rise codes.
2. Provide smoke control and smoke purge controls panels integrated with the fire alarm control system.
3. Provide fire alarm annunciator at building entry.

4. The design of the fire alarm system shall be based on engineering criteria as defined by NFPA 72 and The Massachusetts State Building Code 780 CMR. The system shall be supported by standby batteries. The batteries shall support 24-hours of full supervisory operation followed by 15 minutes of alarm.

5. Provide combination audiovisual signaling appliances as required per NFPA 72. Standalone devices may be used to augment combination units when necessary. The audiovisual notification appliances shall be in all egress pathways, classrooms, public and common areas. Provide visual devices in all offices. The devices shall be in compliance with the Americans with Disabilities Act (ADA).

6. Manual pull stations shall be located within 5 ft. of each means of egress and mounted at 44 in. above the floor to the activating lever of the box. The pull stations will mechanically latch upon operation and remain so until manually reset by a key common to all system locks.

7. Photoelectric smoke detectors shall be in all egress pathways spaced 30 feet on center, and 15 feet from all stairwells and opposing walls. Smoke detectors shall also be located at the top, bottom of each stairway; mechanical equipment; electrical; transformer; telephone equipment; elevator machine; or similar room and in each bedroom. Elevator recall smoke detectors will be in the elevator lobby on each floor.

8. Sprinkler tamper and flow devices shall be wired for trouble and alarm indication into the fire alarm control panel.

N. PUBLIC SAFETY RADIO DISTRIBUTED ANTENNA SYSTEM (DAS)

1. Provide a DAS system for the building. The building shall be both pre- and post-tested for fire and police department radio signal strength. At the request of this subcontractor, a test shall be scheduled with the Fire Department.

2. The radio test shall check the signal reception in several locations on the floor area. Signal strength shall be as required for clear reception throughout the building utilizing the type of handheld radio unit that is used by the Fire and Police Departments.

3. The DAS components include: Bi-Directional Amplifiers (BDA), Donor Antennas, Coverage Antennas, Coax Cable, Coax Connectors, Splitters, Combiners and Couplers.

4. Alarming: The BDA shall include the following outputs which shall interface to the fire alarm system. The integrator shall coordinate the installation of this alarm with the fire alarm contractor: Signal booster malfunction alarm, Loss of AC Power Alarm, Low Battery Alarm, Antenna Circuit Malfunction, and Charge Failure Alarm.

O. LIGHTINING PROTECTION SYSTEM

1. Provide Early Streamer Emission (ESE) lightning protection system.

2. Provide mast and grounding per the manufacturer’s requirements.

P. TELECOMMUNICATIONS CABLING INFRASTRUCTURE

1. Provide a telecommunications cabling infrastructure in compliance with the latest TIA standards. The utility company services will be terminated in a telecommunications entrance facility (EF). Fire rated plywood backboards, grounding, equipment racks, 110-type punch down blocks, patch panels, conduit sleeves, and corridor cable tray system will

be provided in the EF, the telecommunications equipment room (MDF) and the telecommunications rooms (IDF). The pathway system, racks and equipment will be sized for complete utilization of the service entrance cables and all data outlets plus room for future growth.

2. Data outlets will be provided in all administration areas and in bedrooms. Data horizontal cabling will be Category 6A, unshielded, twisted pair, 8 conductor copper cable from each jack to the nearest telecommunications closet. Each end of each cable will be labeled.

3. Backbone cables will be provided between the EF, TER and each TR. Copper backbone cables will be voice grade Category 3 cable. Optical fiber cables will be 12-strand (50/125μm) OM4 multimode laser optimized and 12-strand single mode fiber cables. The cables will be terminated in fiber optic patch panels at both ends. The circuits will be tested for insertion loss at both ends. High-resolution Optical Time Domain Reflectivity (OTDR) tests will be performed on each fiber at one end.

Q. PUBLIC ADDRESS & CLOCK SYSTEM

1. A public address (PA) and clock system will be provided throughout the building.

2. Speakers will be located in classrooms, administration areas, assembly areas and in public and common areas. Classroom speakers will be talk back type. Two emergency call stations will be provided in each classroom, as well as in all instructional and public areas.

3. The system will provide the front office with the ability to make announcements throughout the building premises, to a limited area, or to an individual room. Any telephone handset in the building will be capable of initiating a page. In the front office, the administrative staff can select whether they want to initiate or respond to a call via the PA attendant handset, make announcements or play background music through the speaker. The system will be capable of supporting multiple and simultaneous communications.

4. A master time & control system will be provided. The system will comprise a master clock that controls and synchronizes the time on peripheral clocks located throughout the school. The system will also control other peripheral devices such as bells, etc. and utilize the school public address system to sound pre-programmed tones for class changes. Clocks will be provided in classrooms, offices, public and assembly areas, and in administration areas.

R. DATA COMMUNICATIONS EQUIPMENT

1. Data communications equipment will comprise a server and storage farm, and 10/100/1000 Power-over-Ethernet (PoE) switches.

2. The servers and storage will provide a platform on which to run applications, like the school's enrollment and financial databases as well as student and teacher applications.

3. The switches will provide connection of a number of devices together (PCs, servers, printers, etc.) over a wired data system and control access to various parts of the network.

4. Provide data network switches based on HP Procurve 5400 series.

5. Provide access points in each classroom, instructional space, and in public and assembly spaces. Basis of design shall be Meraki MR55 with cloud management.

S. VOICE COMMUNICATIONS EQUIPMENT

1. Provide a voice communications system. The system will comprise of a voice-over-IP (VoIP) telephone switching system, voicemail, distribution infrastructure, and telephone handsets. Telephone handsets shall be provided in each classroom, in each administration office, gym, and cafe and in each telecommunications/electrical room.
2. Provide VoIP telephone system and handsets based on Mitel.

T. AUDIO-VIDEO SYSTEMS

1. Provide integrated audio-video systems in the following spaces:
   a. Media Center
   b. Weight Room
   c. Wellness Center

U. IN-CEILING INSTRUCTIONAL AUDIO SYSTEM

1. Provide speech reinforcement system in each classrooms and instructional space. The basis of design shall be Lightspeed Topcat In-Ceiling Instructional Audio System.
2. The speech reinforcement system shall consist of:
   a. Two pendant-style Flaxlike® teacher microphone utilizing Access Technology (1.9 GHz) for transmission.
   b. Wireless Media Connector utilizing Access Technology (1.9 GHz) to integrate with and wirelessly transmit all classroom multimedia to be played through the Topcat.
   c. In ceiling all-in-one whole group audio system to enable communication to the whole class with Access technology and integrated amplifier and speaker system.

V. IN-BUILDING CELLULAR AMPLIFICATION SYSTEM

1. Provide in-building cellular amplification system to amplify cellular signal within the building. Coverage shall include all classrooms, offices, public and common areas.
2. The system shall consist of:
   a. Donor antennas mounted outside of a building in order to capture strong signal from nearby towers. These antennas are placed on the roof or side of a building.
   b. Amplifier unit amplifies the signal captured from the cell tower.
   c. Broadcast antenna installed indoors and delivers the amplified cell signal to phones and other mobile devices.

W. HANDHELD RADIO AMPLIFICATION SYSTEM

1. Provide handheld radio amplification system for Motorola 3500 handheld radios. Furnish and install two Motorola SL5700 UHF 50W Digital Repeater.

X. SECURITY SYSTEMS

1. Provide an integrated video surveillance, access control and intrusion detection system by Genetec. The system will be integrated with the City's remote headend hub located at North High School.

2. The video surveillance system shall monitor all entry/exits, building perimeter, each stair landing, public spaces and all corridors. Video surveillance cameras shall be by Axis.
3. An access control system consisting of proximity card readers and key fobs will be provided at entry/egress doors. An electric lock and an intercom at the front door with the ability to release the front door from the administration office will be provided. Card readers shall be by HID.
4. The intrusion detection system shall monitor all exterior doors and ground floor windows. Door position switches will be provided on all exterior doors. Motion detectors will be provided in all rooms with windows accessible from the ground. Intrusion devices shall be by DMP.

Y. SOLAR PHOTOVOLTAIC SYSTEM

1. Provide 924.6kW DC STC/800kW AC STC roof mounted solar photovoltaic system.
2. The basis of design modules shall be LG 425W modules (Qty. 2,176)
3. The basis of design for the inverter shall be Solar Edge 100kW, 480V, (Qty. 8).
4. The basis of design for power optimizers shall be Solar Edge P860, (Qty. 1088).

Z. ELECTRIC VEHICLE CHARGING STATION

1. Provide four dual electric vehicle charging station to charge eight electrical vehicles simultaneously.
2. Basis of design shall be ChargePoint Model CT4021-GW1 Dual Port Bollard USA Gateway Station with Concrete Mounting Kit CY4001-CCM and cellular communications.

July 15, 2021

Doherty Memorial High School, Worcester, MA

Cafeteria Basis of Design:

The Doherty High School Food Service operation will consist of the kitchen, servery and seating area. The kitchen and servery will be 5,994 square feet to accommodate 1,670 students for grades 9 through 12 and facilitate three meal periods. Breakfast and lunch will be served daily.

The Cafeteria will have the typical components of a High School cafeteria. Dry and refrigerated storage will be provided. Stainless steel worktables for food preparation and workspace. Commercial grade cooking equipment with associated exhaust hoods, utility distribution system & fire suppression systems. The pot wash area will have a three-bay pot sink and a commercial grade conveyor dishmachine with ample storage for clean wares. In addition to these features, the kitchen will also have an integral blast-chiller section at the walk-in cooler. There will also be a dedicated milk-cooler adjacent to the servery for easy restocking. A dedicated Janitor's closet with mop sink and storage shelving. The servery will be a scramble type with customized serving counters that will provide four flexible points of service for the students. The serving counters will have back support work counters, reach-in refrigerators and heated cabinets for additional support. To expedite the students through the Servery space there will be air-curtain merchandisers and four (4) double sided POS stations.

All Food Service equipment, including exhaust hoods and fire suppression will be commercial grade and meet all NSF Standards, NFPA, UL and food equipment required codes.

Doherty High School

Audiovisual and Theatrical Systems Narrative

July 8, 2021

Auditorium

General

A. This proscenium theater will function as the main performance and presentation space for plays, musical theater, music performance, lectures and video presentations. Space is intended to function as both a performing arts space as well as an easy-to-use video presentation space.

Audiovisual System

A. Equipment

- Wireless microphones (4)
- Automatic microphone mixer
- Digital mixing console
- Digital signal processor
- CD/media player
- Permanent loudspeakers – center cluster and rear fill
- Portable loudspeakers
- Backstage audio monitoring and paging
- Backstage video monitoring
- Audio recording system, simple
- Production intercom system
- Electric, roll-down projection screen in proscenium
- Video inputs at stage and in-house mix position
- In-house mix position
- Audiovisual switcher
- Blu-ray player
- Video projector
- Touch panel control system
- Video, audio and category tie line systems
- Assistive listening system

Theatrical Lighting

A. Installed Equipment

- LED-based lighting system
- Motorized circuit breaker panels
- Ethernet-based control system
- Architectural lighting control
- Switched power distribution
- Control console with touch monitors

- Wireless remote control for console
- Theatrical lighting fixtures and accessories

Theatrical Rigging System

A. Equipment

- Counterweight rigging system with pipes 9 to 12 inches on center
- Stage curtains
- Cyclorama
- Scrim
- Flown folding acoustic ceiling panels with integrated LED lighting fixtures

<u>Black Box Theater</u>

General

A. This is a flexible performance space for classes, plays and other theatrical presentations. It is designed to be a re-configurable space, allowing the user to experiment with the relationship of audience and performer.

Audiovisual System

A. Equipment

- Wireless microphones
- Digital mixing console
- Digital signal processor
- CD/media player
- Effects playback computer and software
- Portable loudspeakers
- Backstage audio monitoring and paging
- Production intercom system
- Digital audio network
- Video, audio and category tie line systems
- Assistive listening system

Theatrical Lighting

A. Equipment

- LED lighting system
- Motorized circuit breaker panel
- Ethernet-based control system
- Architectural lighting control
- Switched power distribution
- Wireless remote control for console
- LED lighting fixtures

Theatrical Rigging System

A. Equipment

- Pipe grid over performance space

- Masking drapery

Theatrical Platforms and Seating

A. Equipment

- Portable platform, step and railing system
- Portable audience seating, stacking (under FF&E)

Cafeteria

General

A. Gathering and presentation space when not in use as a cafeteria.

Audiovisual System

A. Equipment

- Wireless microphones
- Automatic microphone mixer
- Digital signal processor
- CD/media player
- Permanent overhead loudspeakers
- Digital audio network
- Roll-down projection screen and video projector
- Audiovisual switcher
- Touch panel control
- Assistive listening system

Band and Chorus Classrooms

Audio System

A. Audio recording and program playback system to support music classes and rehearsals.

B. Equipment

- Recording microphone suspended from ceiling
- Digital mixer with integrated recording to solid state device
- CD/media playback
- Permanent wall-mounted loudspeakers
- Audio input from classroom presentation system
- Small rolling equipment rack at conductor location

Large Group Seminar

Audiovisual System

A. Audiovisual system to serve a training space. The room will be equipment with video presentation, program playback and speech reinforcement.

B. Equipment

- Wireless microphones
- Automatic microphone mixer
- Digital signal processor

- CD/media player
- Loudspeakers in ceiling
- Two projection screens and projectors showing the same content
- Audiovisual switcher
- Control panel and computer input at front of room in center
- Blu-ray player
- Equipment rack
- Assistive listening system

Gymnasium

Audio System

A. Audio program playback and voice reinforcement systems for gym classes and event usage.

B. Equipment

- Wireless microphones
- Portable equipment rack on wheels with mixer and plug-in stations near scorer's table
- Automatic microphone mixer
- Analog and Bluetooth auxiliary inputs for portable devices
- Remote volume controls
- Digital signal processor
- CD/media player
- Permanent loudspeakers overhead
- Digital audio network
- Assistive listening system

Athletic Field

Audio System

A. Audio system to support announcements and program playback for athletic events and practices.

B. Equipment

- Wireless microphones
- Equipment rack in restroom building
- Automatic microphone mixer
- Digital signal processor
- CD/media player
- Portable mixing console
- Loudspeakers on light poles and on top of press box
- Inputs for portable media players in press box
- Audio and category tie lines from press box to filming platform
- Assistive listening system

May 24, 2021

Mr. Robert Para
Lamoureux Pagano Architects
108 Grove Street, Suite 300
Worcester, MA 01605

e-mail: rpara@lpaa.com

SUBJECT: Doherty Memorial High School, Worcester, MA
Exterior Noise Sound Study

Dear Mr. Para,

We have completed a review of mechanical equipment associated with the proposed Doherty Memorial High School project located in Worcester, MA. In order to ensure that new mechanical equipment serving the school will comply with the Massachusetts DEP noise regulation, we have measured existing ambient sound levels at the site. This report discusses applicable noise regulations and presents our sound impact assessment. Our findings are presented herein.

Noise Regulations

In our analysis, we applied the following Commonwealth of Massachusetts Department of Environmental Protection (MassDEP) noise regulation (310 CMR 7.10).

Commonwealth of Massachusetts Department of Environmental Protection

Commonwealth of Massachusetts requirements under 310 CMR Section 7.10 qualitatively prohibit noise under some circumstances. Interpretation is provided in the Massachusetts Department of Environmental Quality Engineering's Policy 90-001 dated February 1, 1990; and in the Department of Environmental Protection (DEP) Form BWP AQ Sound. The Massachusetts policy limits new noise intrusions to 10 dBA over the existing ambient (L_{90}) sound level. Tonal sound, defined as any octave band level which exceeds the levels in adjacent octave bands by 3 dB or more, is also not allowed. These MassDEP noise guidelines are applicable both at the property lines and at the nearest inhabited buildings.

Existing Ambient Levels

Image 1 is an aerial photograph annotated to show the three sound monitoring locations, labelled SM1, SM2, and SM3. As shown, monitors were installed on the northeast property line (SM1), the southeast property line (SM2), and the northwest property line of the project site (SM3). Monitoring began on the afternoon of Tuesday, December 8th and concluded the afternoon of Wednesday, December 16th. Detailed measurement results are shown in the attached Figures.

Image 1—Site Aerial with Sound Monitor Locations

MassDEP documents state that the ambient sound level is the background A-weighted sound level that is exceeded 90% of the time, measured during equipment operating hours. The 90th percentile exceedance level is also known as the L90. As is typical, the quietest hourly L90 levels we measured were during the overnight hours when there is little traffic noise.

The average of the lowest hourly daytime and nighttime L90 values during the measurement period are shown below in Table 1. The definitions of daytime (7:00 AM to 10:00 PM) and nighttime (10:00 PM to 7:00 AM) used in this study are those used by the United States Environmental Protection Agency (USEPA).

Table 1 – Average Lowest Measured Hourly L90 Sound Levels (dBA)

Monitor	Average Lowest Daytime L90	Average Lowest Nighttime L90
SM1	46	35
SM2	46	37
SM3	44	36

Applicable Criteria

Based upon the ambient levels presented in Table 1, new equipment will need to produce sound levels below the MassDEP criteria presented in Table 2 (and produce no pure tones) to strictly comply with the state noise regulation.

Table 2 – Maximum Equipment Sound Level Criteria (dBA)

Location	Daytime MDEP Criteria	Nighttime MDEP Criteria
SM1	56	45
SM2	56	47
SM3	54	46

Project Noise Analysis

Estimated sound levels produced by the proposed Project have been calculated using Cadna-A environmental sound modeling software (Version 2021 MR1 DataKustic GmbH). The acoustic modeling requires equipment noise emission levels, the location of the sources, the location of the receptors, and adjustments for how the noise may propagate from the source to the receiver. The CadnaA sound modeling software uses algorithms and procedures described in International Standard ISO 9613-2:1996 "Acoustics- Attenuation of sound during propagation outdoors – Part 2: General method of calculation."

The following mechanical equipment were included in the computer model, with sound data attached to this report:

- One (1) Air Cooled Liquid Chiller (CH-1). Located on the roof.
- Twenty-two (22) Rooftop Air Handling Units (RTU-1 thru RTU-22). Located on the roof.
- One (1) Make Up Air Unit (MAU-1). Located on the roof.

Figure 1 presents the results of the acoustic modeling at thirteen residential locations surrounding the proposed school for daytime and nighttime equipment operation scenarios. The analysis indicates that project related sound is expected to vary between 18 and 43 dBA at the nearest residential locations during daytime hours and 15 to 39 dBA during nighttime hours. Full octave band data tables are presented in Appendix B.

<u>Equipment operation assumptions:</u>

- Daytime:
  - All rooftop equipment is operating at full capacity
  - Equipment only operates as needed for heating/cooling, not all equipment is expected to operate at the same time
- Nighttime:
  - As coordinated by the project mechanical engineer, all DOAS units will be shut-off during unoccupied periods. We identified those units as: RTU 1 thru 4, RTU 5, 6, 8, and RTU 11 thru 13.

Tables 3a and 3b present the results of acoustic modeling with project related sound alone and added to existing background sound levels (for compliance with MassDEP noise policy). Sound levels presented in these tables represent all rooftop equipment operating at full capacity, which is rarely expected to occur. Sound levels will typically be lower than the estimated levels presented below, particularly at night when the school is unoccupied. The analysis does not include any noise controls, such as rooftop barriers or screens. Full octave band data tables are presented in Appendix B.

Table 3a –Estimated Daytime Project Sound Levels at Receptor Locations (dBA)

Location	Daytime Project Sound Level	Daytime Project Sound Level plus Existing Background	Recommended Daytime Limit
R1	24	46	**56**
R2	27	46	**56**
R3	43	47	**56**
R4	42	47	**56**
R5	41	47	**56**
R6	39	45	**54**
R7	19	44	**54**
R8	29	46	**56**
R9	19	46	**56**
R10	18	46	**56**

Table 3b –Estimated Nighttime Project Sound Levels at Receptor Locations (dBA)

Location	Nighttime Project Sound Level	Nighttime Project Sound Level plus Existing Background	Recommended Nighttime Limit
R1	22	36	**45**
R2	24	36	**45**
R3	39	41	**45**
R4	39	40	**45**
R5	37	39	**45**
R6	35	39	**46**
R7	15	36	**46**
R8	23	37	**47**
R9	17	37	**47**
R10	16	37	**47**

Tonal Analysis

A tonal analysis was conducted on the estimated project sound levels plus background and tones at 1000 Hz are noted at locations R1/R2/R8/R9 according to the MassDEP tonal definition. However, these tones are not caused by project sound levels, but are part of the measured background sound levels at SM1 and SM2 as shown in the tables in Appendix B.

Conclusion

Based on our review, it is our opinion that new mechanical equipment sound emissions associated with the proposed school will comply with all applicable regulations, including the MassDEP tonal definition.

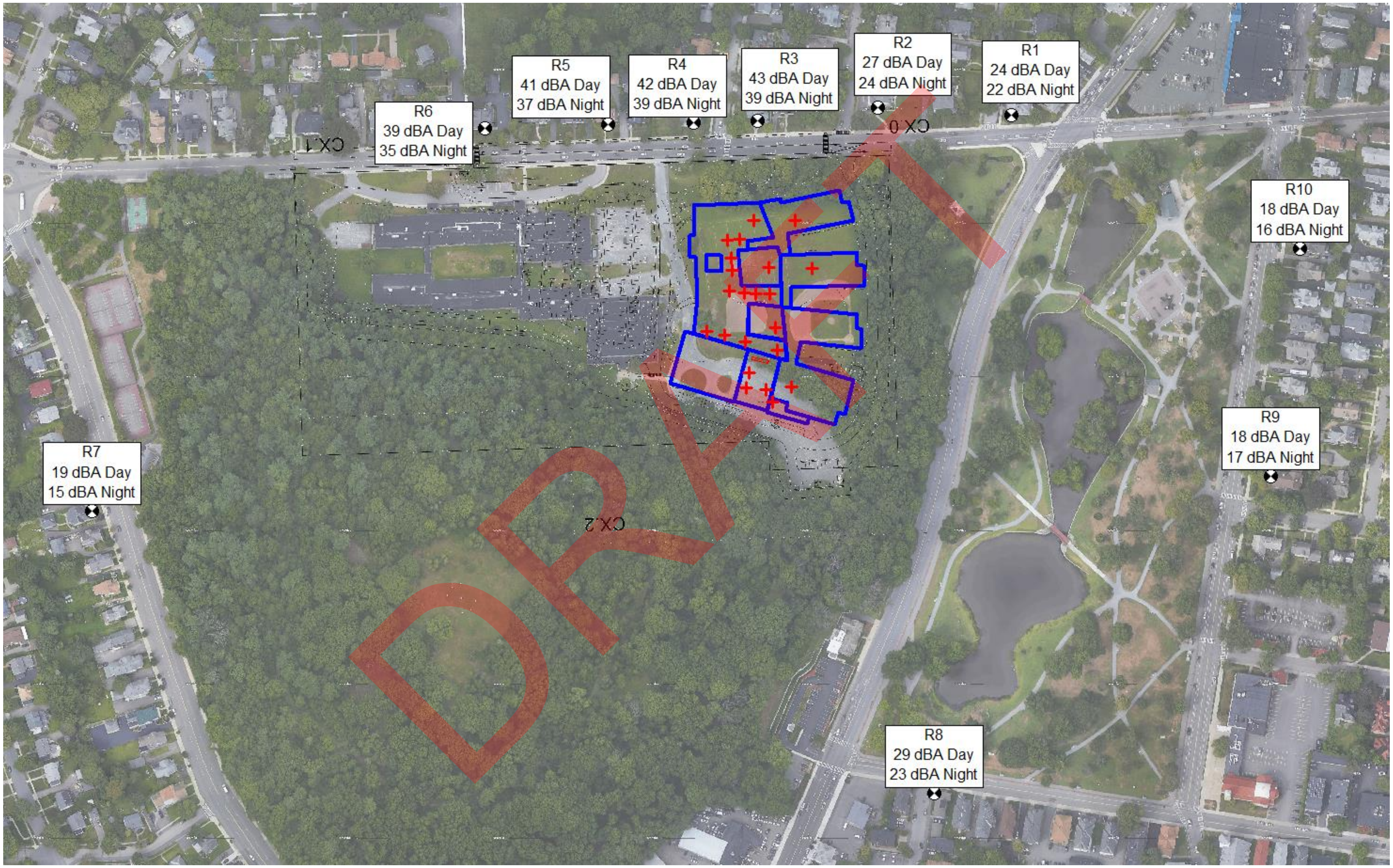
Sincerely,
CAVANAUGH TOCCI

Liam E. Maloney, *Staff Consultant*

Aaron M. Farbo, *Associate Principal Consultant*

20035 - Doherty High School Exterior HVAC Report 1d.docx

FIGURES



Estimated Project Related Daytime/Nighttime Sound Levels at Nearest Residential Locations

Figure 1

CAVANAUGHTOCCI

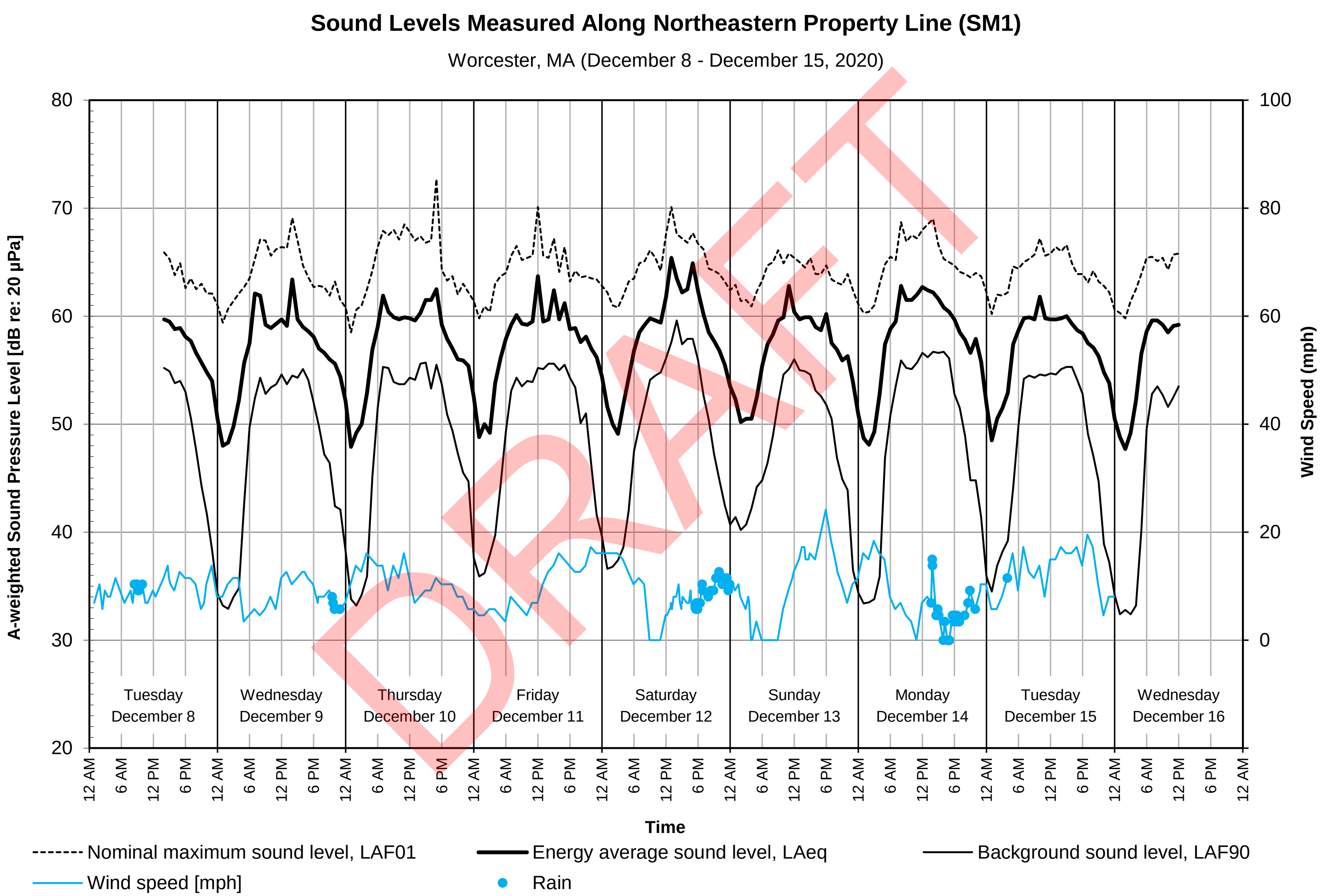


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Figure 2

CAVANAUGHTOCCI

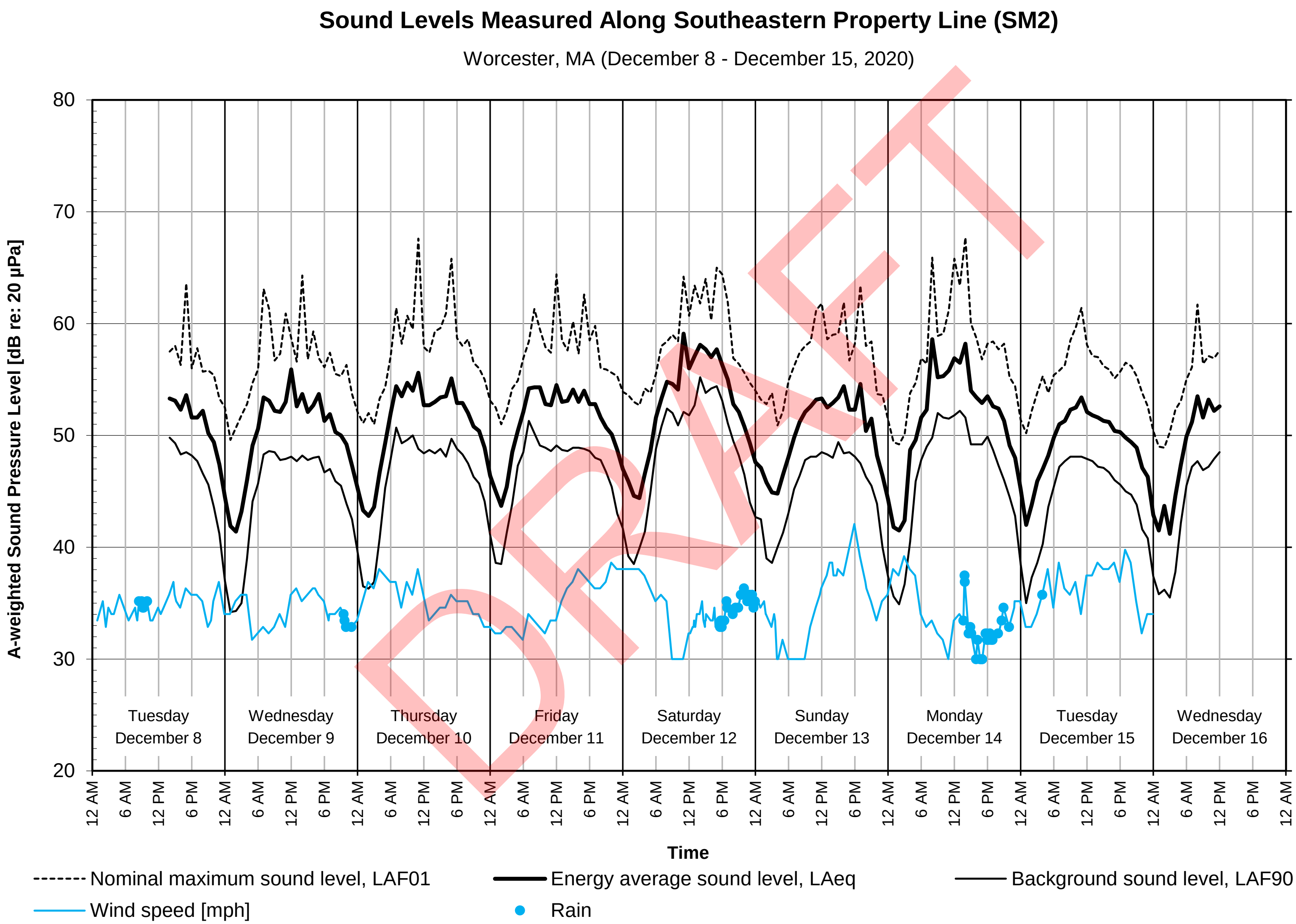

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Figure 3

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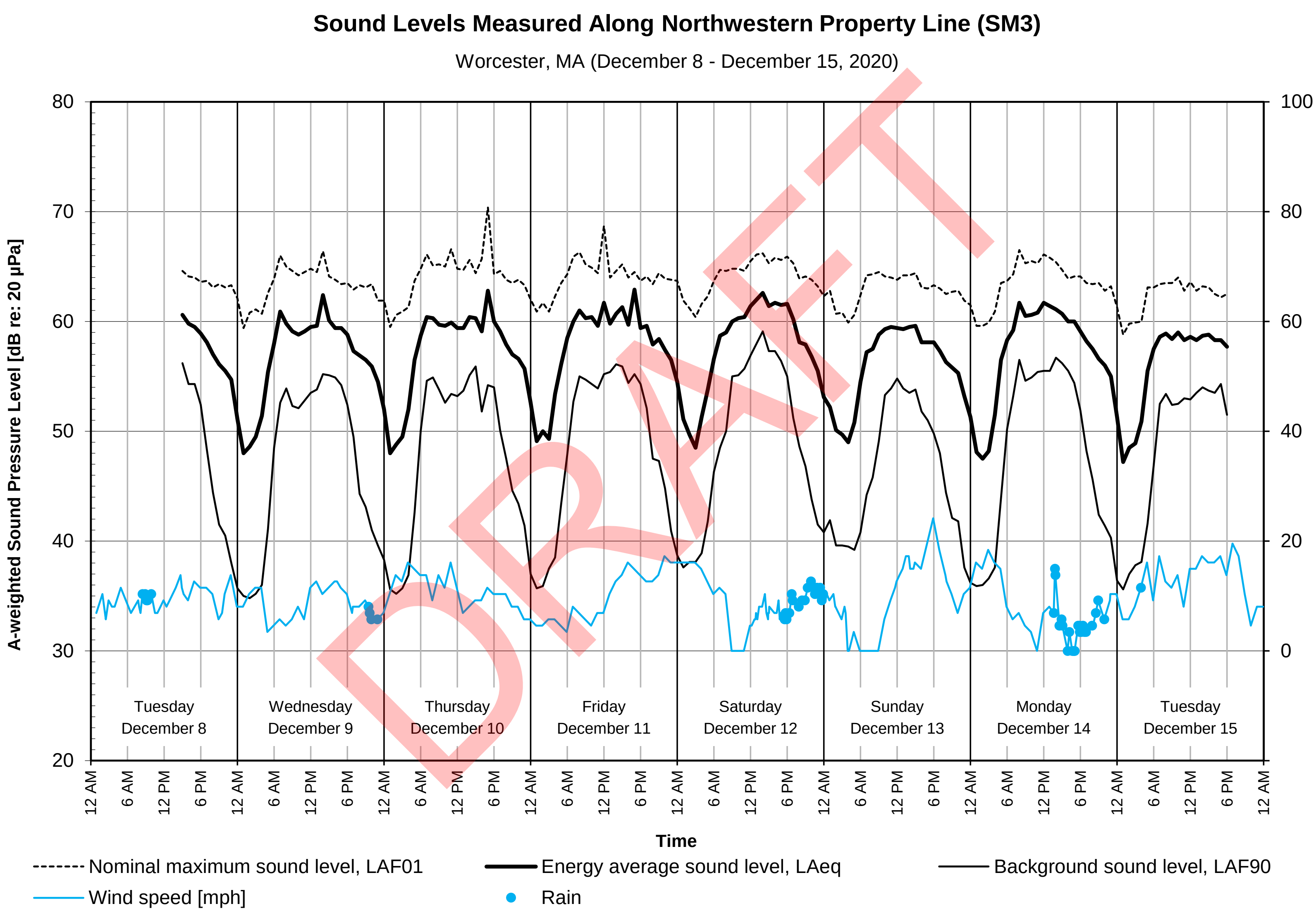

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Figure 4

CAVANAUGHTOCCI

APPENDIX A

Sound Measurement Terminology

SOUND MEASUREMENT TERMINOLOGY

In order to quantify the amplitude, frequency, and temporal characteristics of sound, various acoustical descriptors are used. The following is an introduction to acoustic terminology that is used in this report.

Sound Level

Sound levels are typically quantified using a logarithmic decibel (dB) scale. The use of a logarithmic scale helps to compress the wide range of human sensitivity to sound amplitude into a scale that ranges from approximately 0 to 180 dB. Note however, that the use of the logarithmic scale prevents simple arithmetic operations when combining the cumulative impact of sources. For example, two sources of equal sound level operated simultaneously results in a combined sound level that is only 3 dB higher than if only one source was operated alone. An important feature of the human perception of continuous sound is that an increase or decrease in sound pressure level by 3 dB or less is barely perceptible, and an increase or decrease by 10 dB is perceived as a doubling or halving of noise level.

A-weighting

Generally, the sensitivity of human hearing is restricted to the frequency range of 20 Hz to 20,000 Hz. However, the human ear is most sensitive to sound in the 500 Hz to 5,000 Hz frequency range. Above and below this range, the ear becomes progressively less sensitive. To account for this feature of human hearing, sound level meters incorporate filtering of acoustic signals that corresponds to the varying sensitivity of the human ear to sound at different frequencies. This filtering is called A-weighting. Sound level measurements that are obtained using this filtering are referred to as A-weighted sound levels and are signified by the identifier, dBA. A-weighted sound levels are widely used for evaluating human exposure to environmental sounds. To help place A-weighted sound levels in perspective, Figure A-1 contains a scale showing typical sound levels for common interior and environmental sound sources.

Spectral Characteristics – Octave and 1/3 Octave Band Sound Levels

To characterize a sound, it is often necessary to evaluate the frequency distribution of the sound energy. As mentioned before, the frequencies of most interest where human exposure is concerned range between 20 Hz and 20,000 Hz. This frequency range is commonly divided into octave bands, where an octave band is a range of frequencies. Each octave band is referred to by its center frequency and has a bandwidth of one octave (a doubling of frequency). To cover the full range of human hearing, it is necessary to measure sound in 10 separate octave bands. Typically, the lowest frequency band measured has a center frequency of 31.5 Hz. The next frequency band has a center frequency of 63 Hz. This geometric series continues to the highest frequency band that has a center frequency of 16,000 Hz. A set of octave band sound levels to describe a particular sound is called an octave band spectrum. Covering the full range of hearing, an octave band spectrum would have 10 values, one for each band. Under certain circumstances, more frequency resolution in acoustical data is needed to identify the presence of tonal sounds. A 1/3 octave band spectrum uses filters that divide each octave band into 3 separate frequency bands. Note that octave band and 1/3 octave band sound levels are not usually A-weighted, with their units being dB.

Environmental Noise Descriptors

Sound levels in the environment are continuously fluctuating and it is difficult to quantify these time-varying levels with single number descriptors. Statistical approaches, which use *percentile sound levels* and *equivalent sound levels*, are often used to quantify the temporal characteristics of environmental sound.

Percentile sound levels (L_n) are the A-weighted sound levels that are exceeded for specific percentages of time within a noise measurement interval. For example, if a measurement interval is one hour long, the 50th percentile sound level (L_{50}) is the A-weighted sound level that is exceeded for 30 minutes of that interval.

- L_{90} is the sound level in dBA exceeded 90 percent of the time during the measurement period. The 90th percentile sound level represents the nominally lowest level reached during the monitoring interval and is typically influenced by sound of relatively low level, but nearly constant duration, such as distant traffic or continuously operating industrial equipment. The L_{90} is often used in standards to quantify the existing background or residual sound level.

- L_{50} is the median sound level: the sound level in dBA exceeded 50 percent of the time during the measurement period.

- L_{10} is the sound level exceeded only 10 percent of the time. It is close to the maximum level observed during the measurement period. The L_{10} is sometimes called the intrusive sound level because it is caused by occasional louder noises like those from passing motor vehicles or aircraft.

By using percentile sound levels, it is possible to characterize the sound environment in terms of the steady-state background sound (L_{90}) and occasional transient sound (L_{10}).

The equivalent sound level (L_{eq}) is the energy average of the A weighted sound level for the measurement interval. Sounds of low level and long duration, as well as sounds of high level and short duration influence this sound level descriptor.

Noise levels at night generally produce greater annoyance than do the same levels which occur during the day. It is generally agreed that a given level of environmental noise during the day would appear to be 10 dBA louder at night – at least in terms of potential for causing community concern. The day night average sound level (Ldn) is a 24 hour average A-weighted sound level where a 10 dB "penalty" is applied to sound occurring between the hours of 10:00 p.m. and 7:00 a.m. The 10 dB penalty accounts for the heightened sensitivity of a community to noise occurring at night.

When a steady continuous sound is measured, the L_{10}, L_{50}, L_{90} and L_{eq} are all equal. For a constant sound level, such as from a power plant operating continuously for a 24-hour period, the L_{dn} is approximately 6 dBA higher than the directly measured sound level.

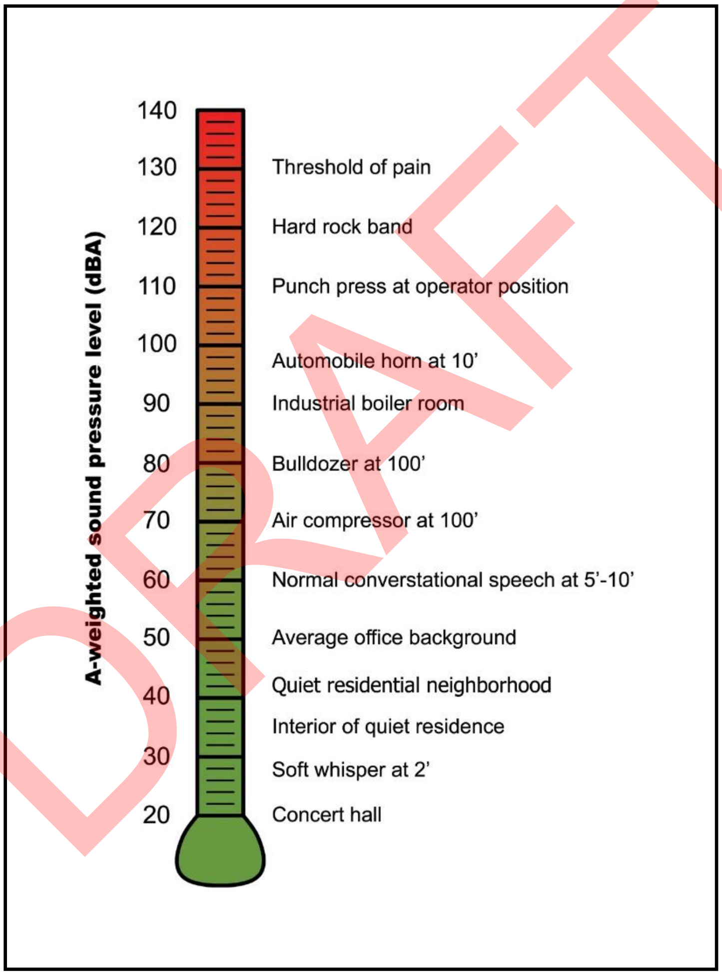

Figure A-1
Typical Sound Levels for Common Interior and Environmental Sources

APPENDIX B

Octave Band Computer

Modeling Results Tables

Receptor Name	Octave Band (Hz) Sound Levels (dB)								Overall dB(A)	Daytime Limit
	63	125	250	500	1000	2000	4000	8000		
R1	32	31	26	22	18	12	6	0	24	**56**
R2	35	33	30	25	21	16	10	0	27	**56**
R3	40	43	43	40	38	34	29	23	43	**56**
R4	39	43	43	40	37	33	27	20	42	**56**
R5	38	42	42	39	36	32	27	17	41	**56**
R6	35	39	39	36	35	30	24	12	39	**54**
R7	24	27	23	17	12	4	0	0	19	**54**
R8	26	32	30	25	24	21	14	0	29	**56**
R9	28	26	22	16	12	6	0	0	19	**56**
R10	28	25	21	15	12	6	0	0	18	**56**

Table B-1
Estimated Daytime Sound Levels from Computer Modeling (Equipment Only)
At Residential Receptor Locations (R1-R10)

Monitor Location	Octave Band (Hz) Sound Levels (dB)								Overall dB(A)
	63	125	250	500	1000	2000	4000	8000	
SM1	52	44	39	40	**43**	38	27	16	**46**
SM2	51	43	39	41	**44**	36	23	18	**46**
SM3	51	42	38	40	42	35	22	14	**44**

Table B-2
Existing Daytime Background Sound Levels at Sound Monitoring Locations SM1, SM2, and SM3
Tones at 1000 Hz noted in red text

Receptor Name	Octave Band (Hz) Sound Levels (dB)								Overall dB(A)	Daytime Limit
	63	125	250	500	1000	2000	4000	8000		
R1	52	44	39	40	**43**	38	27	16	46	**56**
R2	52	44	39	40	**43**	38	27	16	46	**56**
R3	52	46	44	43	44	39	31	24	47	**56**
R4	52	47	44	43	44	39	30	22	47	**56**
R5	52	46	43	42	44	39	30	20	47	**56**
R6	51	44	41	41	42	36	26	16	45	**54**
R7	51	42	38	40	42	35	22	14	44	**54**
R8	51	43	40	41	**44**	36	24	18	46	**56**
R9	51	43	39	41	**44**	36	23	18	46	**56**
R10	51	43	39	41	**44**	36	23	18	46	**56**

Table B-3
Estimated Daytime Sound Levels from Computer Modeling Plus Existing Background Sound
At Residential Receptor Locations (R1-R10)
Tones at 1000 Hz noted in red text (not caused by project equipment)

Receptor Name	Octave Band (Hz) Sound Levels (dB)								Overall dB(A)	Daytime Limit
	63	125	250	500	1000	2000	4000	8000		
R1	27	29	24	20	16	10	3	0	22	**45**
R2	29	30	24	23	18	12	5	0	24	**45**
R3	34	39	34	38	35	30	23	15	39	**45**
R4	34	39	35	38	35	29	22	13	39	**45**
R5	34	37	34	36	33	28	20	10	37	**45**
R6	31	34	32	33	31	27	20	9	35	**46**
R7	20	22	18	14	8	0	0	0	15	**46**
R8	23	25	26	20	17	13	6	0	23	**47**
R9	22	24	19	14	10	4	0	0	17	**47**
R10	21	23	18	14	10	4	0	0	16	**47**

Table B-4
Estimated Nighttime Sound Levels from Computer Modeling (Equipment Only)
At Residential Receptor Locations (R1-R10)

Monitor Location	Octave Band (Hz) Sound Levels (dB)								Overall dB(A)
	63	125	250	500	1000	2000	4000	8000	
SM1	47	39	35	33	31	23	17	14	**35**
SM2	46	40	34	35	33	26	15	14	**37**
SM3	47	40	35	34	32	25	18	14	**36**

Table B-5
Existing Nighttime Background Sound Levels at Sound Monitoring Locations SM1, SM2 and SM3

Receptor Name	Octave Band (Hz) Sound Levels (dB)								Overall dB(A)	Daytime Limit
	63	125	250	500	1000	2000	4000	8000		
R1	50	47	39	35	34	31	23	17	36	**45**
R2	50	47	39	35	34	31	23	17	36	**45**
R3	50	47	42	37	39	37	31	24	41	**45**
R4	50	47	42	38	39	36	30	23	40	**45**
R5	50	47	41	37	38	35	29	22	39	**45**
R6	50	47	41	37	36	35	29	22	39	**46**
R7	50	47	40	35	34	32	25	18	36	**46**
R8	48	46	40	35	35	33	26	15	37	**47**
R9	48	46	40	34	35	33	26	15	37	**47**
R10	48	46	40	34	35	33	26	15	37	**47**

Table B-6
Estimated Nighttime Sound Levels from Computer Modeling Plus Existing Background Sound
At Residential Receptor Locations (R1-R10)

The Total Project Budget identifies $4,200 per student or a total of $7,014,000 for FF&E/Technology. It is assumed at this time that the budget will be divided equally, at approximately $2,338,000 each, between the following three (3) categories:

- Furniture
- Equipment
- Technology

However, this distribution must be evaluated during the upcoming FF&E/Technology programming phase and will likely change. Specific areas subject to revision include the following:

- Student Technology devices: It is assumed that student and teacher Chromebooks will continue to be leased by the district, but any specialized desktop computers will be included in the FF&E Budget.
- Chapter 74 Program equipment: The design team will continue to refine the equipment lists for the proposed Chapter 74 Programs, Biotechnology Lab and CTE TV/Video editing studio.
- At this phase, the following table outlines the items currently assumed to be within the base contract and FF&E Budget, respectively.

FF&E BUDGET	BASE CONTRACT
a) Classroom Interactive Projectors including cabling for projectors. b) Flat Panel Display Technology– Collaborative and Interactive c) Servers, storage, firewall, etc. d) Document Cameras e) Desktop Computers (may be leased) f) Mobile Technology charging Carts g) Student and Teacher Mobile Technology (leased) h) Mobile Audio/Visual Equipment i) Printers j) Copiers (leased) k) Portable projector carts l) All equipment for Chapter 74 Programs/CTE Programs/Biotechnology Lab, including installation and connections m) Furniture n) Smallware	a) Category 6A cabling b) Fiber Optic Cabling between Main Technology rooms and Intermediate Technology rooms c) Environmental conditioning in all Technology equipment rooms. d) School Wide Public Address e) Master and Secondary Clock System f) Network Switch Electronics g) Telephone and Voicemail Equipment h) Classroom Speech Reinforcement i) Wireless Equipment j) Security – Intrusion, Access Control and Video Surveillance k) Audio-Video for large assembly spaces (Auditorium, Black box, Gym, Cafeteria, Media Center, Large Group Meeting Room). Refer to Audiovisual and Theatrical Systems Narrative in this section.

o) Toilet room dispensers p) Equipment special to clinic provided by the clinic q) Equipment special to IT spaces by the District IT	l) Provide power, data, exhaust and coordination of these utilities for the owner's equipment m) Fire extinguishers n) AED – cabinets and units

Other Equipment included in Base Contract:

Kitchen equipment is included in the base contract.

C. Building Code Analysis

Doherty Memorial High School

Worcester, Massachusetts

DRAFT

Code Report

July 13, 2021

Prepared By: Donald E. Contois, P.E.

RWS

Table of Contents

<u>Introduction</u>

This project includes the construction of a new high school building in Worcester, MA. This code summary is based on the progress architectural drawings received April 22, 2020. The following is a list of applicable codes:

Code Type	Applicable Code (Model Code Basis)
Building	780 CMR: Massachusetts State Building Code, 9th Edition (2015 International Building Code)
Fire Prevention	527 CMR: Massachusetts Fire Prevention Regulations (2015 NFPA 1) M.G.L. Chapter 148 Section 26G – Sprinkler Protection
Accessibility	521 CMR: Massachusetts Architectural Access Board Regulations
Electrical	527 CMR 12.00: Massachusetts Electrical Code (2020 National Electrical Code)
Elevators	524 CMR: Massachusetts Elevator Code (2013 ASME A17.1)
Mechanical	2015 International Mechanical Code (IMC)
Plumbing	248 CMR: Massachusetts Plumbing Code
Energy Conservation	2018 International Energy Conservation Code & Stretch Energy Code[A]

A. Massachusetts has adopted 2018 IECC, which became mandatory on November 1, 2020 based on the date the permit application is submitted.

1. Occupancy Classification:

Non-Separated Mixed Uses:

- Use Group A-1 (Auditorium)
- Use Group A-2 (Cafeteria)
- Use Group A-3 (Wellness Center)
- Use Group A-4 (Gymnasium)
- Use Group B (Office)
- Use Group E (Educational, Shops, and Laboratories)
- Use Group S-2 (Enclosed Parking Garage)
- Accessory Use Group S-1 (Storage)
- Accessory Use Group M (Grab N Go)

For the purposes of this report, the Auditorium, Cafeteria, Wellness Center, and Gymnasium could be used for non-school events and must be classified as a Use Groups A-1, A-2, A-3, and A-4 (780 CMR 303.1.3).

Note that this building contains hazardous materials. The hazardous materials will be maintained below the exempt limits per the control area, and therefore there is no Use Group H within the building (780 CMR 307.1, 414). The building will be one control area. Since there are science labs throughout the building, the following table, based on 780 CMR Table 414.2.2, shows the % of the maximum allowable quantity permitted on each floor. In addition, the *combination of all floors cannot go over 100% the maximum allowable quantities from 780 CMR Table 307.1(1).*

Floor	Percentage of the Maximum Allowable Quantity
Ground Floor	100%
Main	75%
Level 2	50%
Level 3	12.5%
Level 4	12.5%
Level 5	12.5%
Overall Building	100%

2. Min. Construction Type:

- Type IIA (modified from IB Construction) (noncombustible; 1 hour fire resistance rating) per 780 CMR 403.2.1.1(2)

403.2.1.1 Type of construction. The following reductions in the minimum *fire-resistance rating* of the building elements in Table 601 shall be permitted as follows:

1. For buildings not greater than 420 feet (128 000 mm) in *building height*, the *fire-resistance rating* of the building elements in Type IA construction shall be permitted to be reduced to the minimum *fire-resistance ratings* for the building elements in Type IB.

   Exception: The required *fire-resistance rating* of columns supporting floors shall not be reduced.

2. In other than Group F-1, M and S-1 occupancies, the *fire-resistance rating* of the building elements in Type IB construction shall be permitted to be reduced to the *fire-resistance ratings* in Type IIA.

Although Type IIA Construction requires the use of noncombustible materials, combustible materials are permitted per 780 CMR 603.1. Therefore, combustible millwork and blocking for handrails, millwork, cabinets, grab bars, etc. are permitted to be standard wood with no limit on the quantity and no fire retardant treatment (780 CMR 603.1(6 & 14)).

3. Height and Area Limitations:

The following tables summarizes the height and area limitations for the uses in the building based on Type IB Construction (modified to IIA Construction).

Code Reference	Use Group A-1		Use Group A-2 / A-3 / A-4 / B	
	Height	**Area**	**Height**	**Area**
780 CMR Tables 504.3, 504.4 & 506.2: Tabular Value	6 St. (180 ft)	Unlimited	12 St. (180 ft)	Unlimited
780 CMR Section 506.2 Frontage Increase (0.75 Increase)	-	-	-	-
Allowed Height and Area	**6 St. (180 ft)**	**Unlimited**	**12 St. (180 ft)**	**Unlimited**

Code Reference	Use Group E		Use Group S-2	
	Height	**Area**	**Height**	**Area**
780 CMR Tables 504.3, 504.4 & 506.2: Tabular Value	6 St. (180 ft)	Unlimited	12 St. (180 ft)	237,000 ft^2
780 CMR Section 506.2 Frontage Increase (0.75 Increase)	-	-	-	59,250 ft^2
Allowed Height and Area	**6 St. (180 ft)**	**Unlimited**	**12 St. (180 ft)**	**296,250 ft^2 Aggregate 888,750 ft^2**

Since the proposed building is 6 stories (~80') in height and ~150,000 ft^2 in footprint area, and ~425,000 ft^2 in aggregate area for the main building and 48,000 ft^2 for the garage, the building complies with the above height and area limitations with non-separated uses.

4. Fire Department Access:

All newly constructed facilities, buildings, or portions thereof are required to be provided with a fire department access road which may consist of roadways, fire lanes, parking lot lanes, or some combination thereof (527 CMR 1 Section 18.2.3.1). These access roads must have the following features,

- Must extend to within 50' of an exterior door that can be opened from the outside and provide access to the interior of the building
- No portion of the facility or exterior wall on the first story of a building is greater than 250' from fire department access roads measured along an approved route
- Multiple access roads can be required by the AHJ if it is determined that a single road can be significantly impaired by external factors
- Unobstructed minimum width of 20' unless constructed boulevard-style which a 10' minimum width is permitted
- Unobstructed vertical clearance of 13'-6"

If access roads cannot be provided due to location, topography, waterways, etc. the AHJ has the authority to require additional fire protection features (527 CMR 1 Section 18.2.3.1.4).

Full 24 foot wide access road is being provided around the building, except at Highland Street where the street provides access. No additional fire protection features should be required.

5. Fire Resistance Ratings:

The following fire resistance ratings are required in accordance with 780 CMR Table 601 and various sections of the code.

<table>
<tr><th colspan="2">Building Element</th><th>Fire Resistance Rating (Hrs)</th><th>Opening Protectives (Hrs)</th></tr>
<tr><td colspan="2">Primary Structural Frame[A]</td><td>1[B]</td><td>-</td></tr>
<tr><td colspan="2">Exterior Bearing Walls</td><td>1</td><td>-</td></tr>
<tr><td colspan="2">Interior Bearing Walls</td><td>1[B]</td><td>-</td></tr>
<tr><td colspan="2">Exterior Non-Bearing Walls</td><td colspan="2">Based on FSD</td></tr>
<tr><td colspan="2">Interior Non-Bearing Walls</td><td>0</td><td>-</td></tr>
<tr><td colspan="2">Floor Construction</td><td>1[B]</td><td>-</td></tr>
<tr><td colspan="2">Roof Construction (not including Primary Structural Frame)</td><td>1</td><td>-</td></tr>
<tr><td colspan="2">Appurtenant Rooms from Stage (780 CMR 410.5.1)</td><td>1</td><td>¾</td></tr>
<tr><td colspan="2">Appurtenant Rooms from Each Other (780 CMR 410.5.2)</td><td>1</td><td>¾</td></tr>
<tr><td colspan="2">Exit Access Corridors (780 CMR Table 1020.1)[C]</td><td>0</td><td>0</td></tr>
<tr><td colspan="2">Exit Stair Shafts (780 CMR 1023.2)[C,D]</td><td>2</td><td>1½</td></tr>
<tr><td colspan="2">Other Shafts (780 CMR 713.4)[E]</td><td>2</td><td>1½</td></tr>
<tr><td colspan="2">Elevator Machine Room (780 CMR 3005.4)</td><td>2</td><td>1½</td></tr>
<tr><td colspan="2">Emergency Electrical Closets (527 CMR 12.00 700-10(D)(2))</td><td>2[F]</td><td>1½</td></tr>
<tr><td rowspan="2">Electrical Closets</td><td>With Sprinklers</td><td colspan="2">0</td></tr>
<tr><td>Without Sprinklers (NFPA 13)</td><td colspan="2">2</td></tr>
</table>

A. Includes beams, trusses, floor members, etc. having a direct connection to the columns (780 CMR 202).

B. Not less than the fire resistance rating of the supported assembly.

C. Enclosures under open or enclosed stairs shall be protected by a 2 hour rated construction. Access from the space shall not be directly from the stairway enclosure (780 CMR 1011.7.3).

D. If exterior walls expose an exit stair at an angle of less than 180 degrees either the stair wall or adjacent wall must be 1 hour rated with 3/4 hour opening protectives for a distance of 10 feet from the stair wall (780 CMR Section 1023.7).

E. Shafts are not required to protect duct penetrations that connect only 2 floors, i.e. penetrate 1 floor assembly, as long as a fire damper is provided at the floor line and the penetration is firestopped (780 CMR 717.6.1).

F. No rating is required for the room when fully sprinklered, however a 2-hr rating is still required for the emergency feeder-circuit wiring and rooms containing an emergency generator (NFPA 110 Section 7.2.1.1).

Fire walls, fire barriers, fire partitions, smoke barriers, and smoke partitions, or any other wall required to have protected openings or penetrations must be identified with signs or stenciling within accessible concealed spaces (i.e. floor-ceiling, attic spaces) at 30 ft intervals (780 CMR 703.7).

Walls, which do not require a fire resistance rating such as the walls between classrooms, are not required to have the penetrations such as pipes, conduit, ducts, etc. protected with firestopping or dampers since 780 CMR 714 and 717 only apply to penetrations of fire resistance rated walls.

6. High Rise Requirements

The average height of the highest roof surface will be more than 70 feet above mean grade. Therefore, the building will be classified as a high-rise structure (780 CMR Section 202). This classification requires the building be equipped with the following features.

- Minimum bond strength of sprayed fire resistance materials must be 430 psf.
- Automatic sprinkler system (403.3)
  - Note that a secondary on-site water supply is not required since the building is Seismic Design Category B (403.3.3)
- Smoke detection in select spaces (403.4.1)
- Fire alarm system (403.4.2)
- Automatic standpipe system (403.4.3)
- Emergency voice/alarm communicating system (403.4.4)
- Emergency responder radio coverage or wired fire department communication system (403.4.5, 907.2.13, & 916.2)
- Fire command center
  - The room must be a minimum of 200 sqft with a minimum dimension of 10 ft (403.4.6 & 911.1.3)

- Manual or automatic smoke removal system for fire department operations in accordance with the options listed (403.4.7):

> **403.4.7 Smoke removal.** To facilitate smoke removal in post-fire salvage and overhaul operations, buildings and structures shall be equipped with natural or mechanical *ventilation* for removal of products of combustion in accordance with one of the following:
>
> 1. Easily identifiable, manually operable windows or panels shall be distributed around the perimeter of each floor at not more than 50-foot (15 240 mm) intervals. The area of operable windows or panels shall be not less than 40 square feet (3.7 m^2) per 50 linear feet (15 240 mm) of perimeter.
>
>   **Exceptions:**
>
>   1. In Group R-1 occupancies, each *sleeping unit* or suite having an *exterior wall* shall be permitted to be provided with 2 square feet (0.19 m^2) of venting area in lieu of the area specified in Item 1.
>   2. Windows shall be permitted to be fixed provided that glazing can be cleared by fire fighters.
> 2. Mechanical air-handling equipment providing one exhaust air change every 15 minutes for the area involved. Return and exhaust air shall be moved directly to the outside without recirculation to other portions of the building.
> 3. Any other *approved* design that will produce equivalent results.

- Standby power and emergency power systems for elevators, fire command center, and shaft pressurizing equipment (403.4.8)
  - Fuel line supplying the generator must be separated from the remainder of the building by 2 hour fire resistance rated construction (403.4.8.2).

- All exit stairs serving floors greater than 75 ft. in height above the lowest level of fire department access (Stairs 5, 6, and 7 serving Level 5) must be pressurized (403.5.4, 909.20.5, and 1023.11.1):

> **403.5.4 Smokeproof enclosures.** Every required *interior exit stairway* serving floors more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access shall be a *smokeproof enclosure* in accordance with Sections 909.20 and 1023.10.

- Luminous egress path markings (403.5.5)

- Openings in elevator hoistways greater than 75 ft. measured from the lowest floor served to the highest floor served must be protected by one of the following methods (IBC 3006.2 & 3006.3).

- Elevator lobbies separated by smoke partitions.
- Additional doors or curtains that resist the passage of smoke in accordance with UL 1784.
- Elevator hoistway pressurization.

Since none of the hoistways are more than 75 feet in height when measured per 780 CMR 3006.2(5), the elevator hoistways openings do not require protection.

3006.2 Hoistway opening protection required. Elevator hoistway door openings shall be protected in accordance with Section 3006.3 where an elevator hoistway connects more than three stories, is required to be enclosed within a shaft enclosure in accordance with Section 712.1.1 and any of the following conditions apply:

1. The building is not protected throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 or 903.3.1.2.
2. The building contains a Group I-1 Condition 2 occupancy.
3. The building contains a Group I-2 occupancy.
4. The building contains a Group I-3 occupancy.
5. The building is a high rise and the elevator hoistway is more than 75 feet (22 860 mm) in height. The height of the hoistway shall be measured from the lowest floor to the highest floor of the floors served by the hoistway.

Furthermore, because the building is Risk Category III (Group E with more than 250 occupants) per IBC Table 1604.5, these additional items are required:

- Wall assemblies making up exit enclosures and elevator hoistways must meet or exceed Soft Body Impact Classification Level 2 as described in test method ASTM C 1629/C 1629M, which can be met by construction with concrete/masonry walls (403.2.3.1 & 403.2.3.3)

- Face of wall assemblies, that are not exposed to the interior of the hoistway or exit enclosure, must be constructed according to one of these three methods, which can be met by construction with concrete/masonry walls (403.2.3.2 & 403.2.3.3)

    1. Wall assembly incorporates at least two layers of impact resistant construction board that meets or exceeds Hard Body Impact Classification Level 2 measured by ASTM C1629/C1629 M

    2. Wall assembly incorporates at least one layer of impact resistant construction board that meets or exceeds Hard Body

Impact Classification Level 3 measured by ASTM C1629/C1629 M

3. Wall assembly incorporates multiple layers of any material tested in tandem that meet or exceed Hard Body Impact Classification Level 3 measured by ASTM C1629/C1629 M

7. Exterior Wall Openings & Fire Resistance Rating:

The exterior wall rating requirements and opening limitations are based on the fire separation distance for each wall. The fire separation distance is measured perpendicular to the exterior wall to the centerline of a public street, an interior lot line, or an imaginary lot line between two buildings on the same lot (780 CMR 702.0).

Since the fire separation distance on all sides of the building is more than 20 ft., the exterior walls are not required to be rated and the allowable area of openings is not limited (780 CMR Table 602 note g and Table 705.8).

8. Vertical Floor Openings:

Vertical openings are required to comply with 780 CMR 712. There are multiple floor openings including exit stairs and mechanical chases that are fully enclosed in fire resistance rated shafts that comply with 780 CMR 713.

The building also contains an unprotected floor opening connecting Ground Level through Level 3. The gymnasium, wellness, cafeteria, media center, main lobby, and auditorium all connect the lower floors of the building. See the Appendix of this report for the alternative design approval for the design of these floor openings. The floor openings have designed to meet the intent of the code as being equivalent to a 2-story floor opening connecting Levels 1 and 2 as permitted by 780 CMR 712.1.9:

712.1.9 Two-story openings. In other than Groups I-2 and I-3, a vertical opening that is not used as one of the applications listed in this section shall be permitted if the opening complies with all of the items below:

1. Does not connect more than two stories.
2. Does not penetrate a horizontal assembly that separates fire areas or smoke barriers that separate smoke compartments.
3. Is not concealed within the construction of a wall or a floor/ceiling assembly.
4. Is not open to a corridor in Group I and R occupancies.
5. Is not open to a corridor on nonsprinklered floors.
6. Is separated from floor openings and air transfer openings serving other floors by construction conforming to required shaft enclosures.

The floor openings that connect down to the Ground Floor and up to the 3rd Floor will be separated from those floors by 2 hour fire resistance rated construction, which exceeds the required floor rating and meets the rating required for a shaft that connects 4 stories. Since these separations would limit the likelihood that the products of combustion would affect the means of egress on the other floors, the alternative design meets the intent of 780 CMR 712.1.9 and limits the impact a fire would have on more than 2 floors at a time. Note that 780 CMR 712.1.9 allows for egress to pass through the floor opening but not vertically within the floor opening. Therefore, the stairs have not been included as a required means of egress.

The center stair connecting Level 3 – Level 5 has been designed as an enclosed convenience stair that will be fully enclosed in 2 hour fire resistance rated construction. The stair enclosure incorporates a normally open fire rated accordion door that will close upon fire alarm activation including smoke detection provided in the area of the stair. Due to the unique nature of the stair and accordion fire doors, it has not been included as a required means of egress.

9. Finishes:

Interior Finish

The interior finish of walls and ceilings must comply with the following table:

Walls & Ceilings (IBC Table 803.11)

Building Component	Use Group A-1/A-2/ A-3/A-4	Use Group B/E	Use Group S-1/S-2
Exit Enclosures and Passageways	Class B	Class B	Class C
Corridors	Class C	Class C	Class C
Rooms & Enclosed Spaces	Class C	Class C	Class C

Note that where exit stairs and exit access corridors serve all use groups, the most restrictive interior finish is required.

<u>New Floor Finishes</u>
Since the building will be equipped with an automatic sprinkler system, traditional floor coverings such as wood, vinyl and other resilient floor coverings as well as carpeting passing the DOC FF-1 pill test are allowed throughout the building, including all exits, exit passageways and exit access corridors (780 CMR Section 804.4.2).

Exterior Finish
Exterior wall finishes must fully comply with the requirements of 780 CMR 14. Combustible materials are permitted to be used as an exterior wall finish for this building in accordance with 780 CMR Section 1406.0; however, all exterior wall finishes and architectural trim located greater than 40 feet above grade plane must be constructed of approved noncombustible materials and must be secured to the wall with metal or other approved noncombustible brackets (780

CMR Section 1406.2.2). Additionally, combustible exterior wall finish is limited to 10% of the exterior wall surface area where the fire separation distance is 5 ft or less.

The use of plastic materials as part of the exterior wall assembly (i.e. foam plastic insulation, exterior coatings and facings) must comply with 780 CMR 26 (780 CMR 1404.8). The wall assembly must be tested in accordance with 2012 Edition of NFPA 285 (780 CMR 2603.5.5). Note that this test standard is a full scale assembly test. We recommend confirming with the manufacturer that the foam plastic insulation is part of an approved NFPA 285 assembly or complies with one of the alternative standards listed in 780 CMR Section 2604.1.

10. Means of Egress:

The number of exits and egress capacity must be sufficient for the occupant load for the proposed floor plans, the (780 CMR Table 1004.1.2, Table 1006.3.1, and Section 1005.3).

As shown on Drawings A1.1 – A1.3, the building is provided with sufficient egress capacity for the proposed occupant load.

Where means of egress from floors above and below converge at an intermediate level, the capacity of the means of egress from the point of convergence shall not be less than the sum of the two floors (780 CMR 1005.6).

The only points of egress convergence is Stair 3 on the Main Level. The discharge doors provide capacity for 453 people, which is sufficient for the occupant load of the Ground Level and Level 2 required to use the stair.

<u>General Egress Requirements:</u>

- The required maximum exit travel distances for a fully sprinklered building are listed below (780 CMR Table 1017.2, Table 1006.2 & Section 1020.4)

Occupancy	Exit Travel Distance	Common Path of Travel	Dead-End
A-1/A-2/A-3/A-4	250 ft.	75 ft.	20 ft.
B	300 ft.	100 ft.	50 ft.
E/M	250 ft.	75 ft.	50 ft.
S-1	250 ft.	100 ft.	50 ft.
S-2	400 ft.	100 ft.	50 ft.

- Maximum dead-end corridor length must be less than the value above based on the most restrictive occupancy using the egress corridor or 2.5 times the least width of space (780 CMR 1020.4).

- All rooms or spaces with an occupant load greater than 49 people or a common path of travel distance greater than the value in the previous table must be provided with two egress doors swinging in the direction of egress and illuminated exit signs at each exit (780 CMR Table 1006.2.1 & Sections 1010.1.2.1 & 1013.1).

    - Boiler rooms require two means of egress if the room is greater than 500 sqft. and includes individual fuel-fired equipment greater than 400,000 Btuh input capacity. Also one of the two required exit access doorways is permitted to be a fixed ladder or alternating tread device (780 CMR Section 1006.2.2.1).

- Doors serving assembly or educational rooms with more than 49 people and doors along the path of egress travel from such rooms must be provided with panic hardware (780 CMR 1010.1.10). Doors from main electrical rooms must swing in the direction of egress with panic hardware where required by the Electrical Code (NFPA 70).

- All means of egress lighting and exit signs throughout the building must be provided with an emergency power supply to assure continued illumination for not less than 1.5 hours in case of primary power loss (780 CMR 1008.2 & 1008.3.4).

- Remote means of egress must be separated by ⅓ of the diagonal dimension of the room or space they serve (780 CMR 1007.1.1). The distance between exits must be measured in a straight line between exit doors.

- All exits must discharge to the exterior of the building except that a maximum of 50% of the number and capacity of the exit enclosures are allowed to exit through areas on the level of discharge if the exit enclosures discharge to a free and unobstructed path of travel to an exterior exit that is readily visible from the discharge of the exit enclosure; the entire area of the level of exit discharge is separated from areas below by construction consistent with the rating of the exit enclosure; and the egress path and all areas open to the egress path on the level of exit discharge must be fully sprinklered (780 CMR 1028.1).

- Stairways shall have intermediate handrails in such a way that the stairway minimum required capacity is within 30 inches of a handrail.

- Roof access from within a stair is required since the building is 4 or more stories in height (780 CMR 1011.12). Access to the unoccupied roofs can be via a ladder (780 CMR 1011.12 Exc.).

- A two-way communication system is required at each elevator landing on accessible floors that are one or more stories above or below the level of exit discharge (780 CMR 1009.8).

- At least one passenger elevator must be sized to accommodate the loading and transportation of an ambulance gurney or stretcher sized 24” wide by 84” long with 5” radius corners (524 CMR 17.40(1)).

11. Required Fire Protection Systems:

1. NFPA 13 sprinkler system (780 CMR Table 903.2 & M.G.L. c148 s26G)
2. Stage ventilation (780 CMR 410.3.7)
3. Voice fire alarm system (780 CMR 907.2.3)
4. Standpipe system (780 CMR 905.3.1 & 905.3.5)
    a. See the Appendix of this report for the approved code modification that allows the standpipes to be designed and installed as manual wet standpipes.
5. Fire extinguishers (527 CMR 1, Table 13.6.2(a) & 780 CMR 906.1).
    a. Fire extinguishers must be located throughout the building so that the maximum travel distance to an extinguisher is less than 75 feet (527 CMR 1, Table 13.6.2(a)).
    b. Fire extinguishers shall be within 30 feet of commercial cooking equipment (780 CMR 906.1(2)).
    c. Fire extinguishers shall be in areas where flammable or combustible liquids are stored, used or dispensed (780 CMR 906.1(3)).
6. Carbon monoxide detection in accordance with 780 CMR 915 and 527 CMR 1 chapter 13.
7. Emergency responder radio coverage (780 CMR 916)
8. Smoke Control Systems (780 CMR 403.5.4) – The stair pressurization system for the 3 exit stairs serving Level 5 must comply with 780 CMR 909 including the following major requirements:
    a. Rational Analysis Report (780 CMR 909.4) – A rational analysis report must be provided that describes the basis of design, sequence of operations, calculations, etc.
    b. Firefighter’s Smoke Control Panel (780 CMR 909.16) – A smoke control panel listed per UL 864 must be provided in the fire command center that includes the manual controls of the systems, indicator lights, air flow direction, and fan locations within the building. Generally the panel incorporates the information on a

diagram of the building. All fans and dampers must be provided with the means to verify operation such as fan is running / not running or damper is open / closed.

c. Shaft Pressurization (780 CMR 909.20.5, 909.20.6, & 909.21)

   i. Exit stairs must be pressurized to not less than 0.10"wc minimum and 0.35"wc maximum as measured in the stairwell with respect to the building, with all stairway doors closed (780 CMR 909.20.5).

   ii. Pressurization system must be independent from any other building ventilation system (780 CR 909.20.6.1). The ducts, fans, and wiring must be located outside the building, in the shaft being pressurized, or within the building as long as it is separated from the remainder of the building by 2 hour fire resistance rated construction.

d. Special Inspections (780 CMR 909.18.8) – A special inspector must perform inspections and witness testing throughout the construction process including verifying fire rated separations, proper supports, equipment locations, leakage tests, and functional testing.

12. Energy Code Provisions:

The project is subject to the provisions of the 2018 International Energy Conservation Code or ANSI/ASHRAE/IESNA 90.1 with Massachusetts Amendments (Massachusetts Energy Code). The City of Worcester has also adopted the Stretch Energy Code (780 CMR Appendix AA). The building must comply with the Stretch Code since the gross building area is over 100,000 sq. ft. (780 CMR AA103.2).

13. Plumbing Fixture Count

The Massachusetts Plumbing Code (248 CMR) regulates the number of plumbing fixtures required throughout buildings. The minimum number of plumbing fixtures is established by 248 CMR 10.10(18) Table 1 based on the building use and the expected population as determined by the local Plumbing Inspector per 248 CMR 10.10 (18)(2).

The Plumbing Inspector must approve the building population, however, the building population can generally be based on the designer's determination of the actual number of people expected within the building. The Plumbing Code expects that the building population will be divided evenly between male and female for the purpose of determining fixture counts. Any distribution other than 50/50 must be justified to the Plumbing Inspector.

The following analysis is based on the actual anticipated occupant load within the building:

Secondary Student Fixtures[1]

Floor	Occupancy	Water Closets		Male Urinals[2]	Lavatories (Each Sex)	Drinking Fountains	Service Sink
		Female	Male				
Ground	350 occ.[3]	1 per 30	1 per 90	1 per 90	1 per 90	1 per 75	1 per floor
	Required Fixtures	6	2	2	2	5	
	Provided Fixtures	6	3	3	3	4	
Main	600 occ.	1 per 30	1 per 90	1 per 90	1 per 90	1 per 75	1 per floor
	Required Fixtures	10	4	4	4	8	
	Provided Fixtures	10	4	6	5	8	
Level 2	450 occ.	1 per 30	1 per 90	1 per 90	1 per 90	1 per 75	1 per floor
	Required Fixtures	8	3	3	3	6	
	Provided Fixtures	8	4	4	4	6	
Level 3	425 occ.	1 per 30	1 per 90	1 per 90	1 per 90	1 per 75	1 per floor
	Required Fixtures	8	3	3	3	6	
	Provided Fixtures	9	4	4	4	6	
Level 4	350 occ.	1 per 30	1 per 90	1 per 90	1 per 90	1 per 75	1 per floor
	Required Fixtures	6	2	2	2	5	
	Provided Fixtures	7	3	4	3	6	
Level 5	275 occ.	1 per 30	1 per 90	1 per 90	1 per 90	1 per 75	1 per floor
	Required Fixtures	5	2	2	2	4	
	Provided Fixtures	5	2	3	2	4	

1. Fixtures designed to accommodate 2,450 students- expected enrollment is 1,670 students.
2. Urinals are required in addition to the water closets.
3. Does not include classrooms with dedicated toilet rooms.

Staff Fixtures

Classification	Actual Occupancy	Water Closets		Male Urinals[1]	Lavatories (Each Sex)	Drinking Fountains	Service Sink
		Female	Male				
General Staff	220 occ.	1 per 20	1 per 25	33%	1 per 40	-	1 per floor
	Required Fixtures	6	5	-	3		
	Provided Fixtures	10	10	-	10		
Kitchen Staff	10 occ.	1 per 20	1 per 25	-	1 per 40	-	1 per floor
	Required Fixtures	1	1		1		
	Provided Fixtures	1	1		1		

1. Urinals may be substituted for toilets up to the percentage shown of the required number of water closets.

Community Event Fixtures (assumes non-simultaneous use)

Classification	Occupancy	Water Closets		Male Urinals[1]	Lavatories (Each Sex)	Drinking Fountains	Service Sink
		Female	Male				
Gymnasium	1,500 occ.[2]	1 per 200	1 per 600	1 per 200	-	-	-
	Required Fixtures	4	2	4			
	Provided Fixtures	10	4	6	5	4	
Auditorium	1,000 occ.	1 per 200	1 per 600	1 per 200	-	-	-
	Required Fixtures	3	1	3			
	Provided Fixtures	6	2	4	3	4	
Cafeteria	1,000 occ.	1 per 200	1 per 600	1 per 200	-	-	-
	Required Fixtures	3	1	3			
	Provided Fixtures	6	2	4	3	4	

1. Urinals are required in addition to the water closets.
2. Includes bleachers only. Athletes assumed to use locker room fixtures.

14. Accessibility for Persons with Disabilities:

Massachusetts Architectural Access Board Regulations
All areas open to the general public are required to comply with the requirements of the Massachusetts Architectural Access Board (521 CMR). This section includes the following major provisions:

- All public entrances must be accessible (521 CMR 25.1).
- All public and common use areas must be accessible and provided with an accessible route thereto (521 CMR Section 12.2.2 and 20.1).
- Accessible toilet rooms must be provided (521 CMR 30.1).
- The maximum slope of a ramp cannot exceed 1:12 (8.3%) in accordance with 521 CMR 24.2.1.
- At least 5% with a minimum of 1 of the tables, study carrels, computer stations and fixed stating shall be accessible (521 CMR 12.5).
- Illuminated exit signs leading to an accessible exit must be provided with the international symbol of accessibility per the following interpretation issued by the MAAB (521 CMR 41.1.3).

REQUIREMENT FOR ILLUMINATED INTERNATIONAL SYMBOL OF ACCESSIBILITY IN EMERGENCY EGRESS SIGNAGE

On February 17, 2016, the Board voted to clarify the requirement for the illuminated International Symbol of Accessibility. The Board unanimously voted that all emergency egress signs that are required to be illuminated (per the International Building Code - 2009, Chapter 10, Section 1011 *et seq.* with Massachusetts amendments, per 780 CMR), and are part of an accessible means of emergency egress (as defined in 521 CMR, Section 5), shall be required to include the illuminated International Symbol of Accessibility.

American's with Disabilities Act
The ADA Guidelines are not enforced by the Commonwealth of Massachusetts, they can only be enforced through a civil lawsuit or complaint filed with the U.S. Department of Justice.

Although the provisions of the MAAB do not apply to employee only areas, the ADAAG requires that employee only work spaces must be designed to allow employees to approach, enter, and exit the work area. However, the work areas are not required be provided with accessible features (i.e. shelves, etc.).

15. Seismic-Bracing Requirements:

Seismic bracing has been included in the project scope for the HVAC, Fire Protection and Plumbing systems at the request of the local building authorities. Although not a code requirement in this specific instance (based on the Geotechnical Engineer's final report) the Owner has historically installed seismically-restrained MEP systems and determined that seismic bracing should be installed, particularly in light of the fact that the building may be used (informally) as a shelter.

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Appendix: Approved Alternative Designs / Code Modifications

D. List of Proprietary Items

The following is a list of proposed proprietary for Doherty Memorial High School items along with the reasons for their use, these proprietary items were approved as part of the earlier South High Community School project (as opposed to non-proprietary equivalent items). Following the precedent set in previous MSBA projects, during the Construction Document phase, the City will provide a letter from the City Manager approving the final list of proprietary items.

1. Alerton/ABS: Automatic Temperature Controls (ATC)
   Alerton/ABS ATC systems are used in other District buildings; staff/faculty has been extensively trained in their use. The proprietary specification will provide further consistency within the District and reduce long-term costs associated with parts inventory, maintenance, software updates and service contracts.

2. Lochinvar "Crest": Condensing boilers
   Lochinvar "Crest" condensing boilers are used in other buildings throughout the District. The proprietary specification will provide further consistency within the District and reduce long-term costs associated with parts inventory, maintenance and service contracts.

3. Genetec Enterprise Unified Security System: Access control and video surveillance (with AXIS Communications cameras and HID iClass / VertX / Edge EVO Access Control)
   Genetec systems are used in other buildings within the District. The proprietary specification will allow direct communication with the current software used and monitored by the District and City of Worcester Police Department. It will also reduce long-term costs associated with parts inventory, maintenance, software updates and service contracts.

4. Mosaic: Point of Sale system at Cafeteria
   Mosaic systems are used in Food Services areas in other buildings throughout the District. The proprietary specification will provide further consistency within the District and reduce long-term costs associated with parts inventory, maintenance, software updates and service contracts.

5. Corbin-Russwin: Non-interchangeable core key cylinders
   Corbin-Russwin cylinders are used throughout the District. The proprietary specification will provide further consistency within the District and reduce long-term costs associated with parts inventory, maintenance and service contracts.

6. ShoreTel: IP Telephone System

   ShoreTel systems are used in other buildings throughout the District. The proprietary specification will allow consistency/communication with, and future expansion of, the current IP telephone system. It will also reduce long-term costs associated with parts inventory, maintenance, software updates and service contracts.

7. Aruba / Hewlett Packard: Network Switches

   Aruba / Hewlett Packard network infrastructure is utilized throughout the District. The proprietary specification will provide further consistency within the District and reduce long-term IT costs associated with parts inventory, maintenance, software updates and service contracts.

8. Cisco "Meraki": Wireless access points

   Cisco "Meraki" equipment is utilized throughout the District. The proprietary specification will provide further consistency within the District and reduce long-term IT costs associated with parts inventory, maintenance, software updates and service contracts.

9. Dell: DELL PowerEdge Servers

   Dell Power Edge Servers are utilized throughout the District. The proprietary specification will provide further consistency within the District and reduce long-term IT costs associated with parts inventory, maintenance, software updates and service contracts.

10. Eaton: UPS Systems: Uninterrupted Power Supply

    Eaton 9PX or 5PX UPS systems are standard throughout the District. A proprietary specification will reduce long-term costs associated with parts inventory, maintenance, software updates and service contracts.

11. Epson: Document cameras

    Epson Document cameras will be utilized throughout the District. The proprietary specification will provide further consistency within the District and reduce long-term IT costs associated with parts inventory, maintenance, software updates and service contracts.

12. Epson “Brightlink”: Interactive ultra-short throw projectors

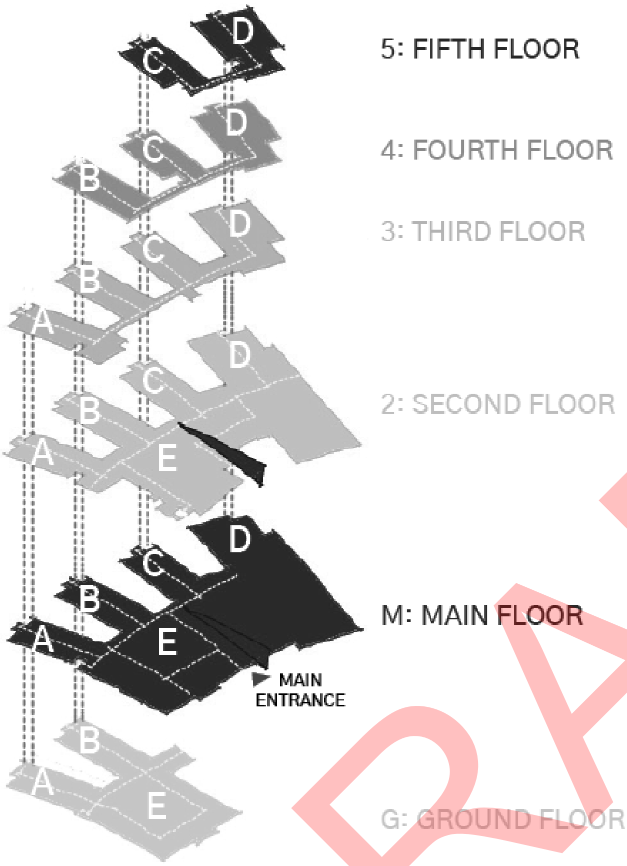
    Epson equipment is utilized throughout the District. The proprietary specification will provide further consistency within the District and reduce long-term IT costs associated with parts inventory, maintenance, software updates and service contracts.

E. Interior Color Theory Statement

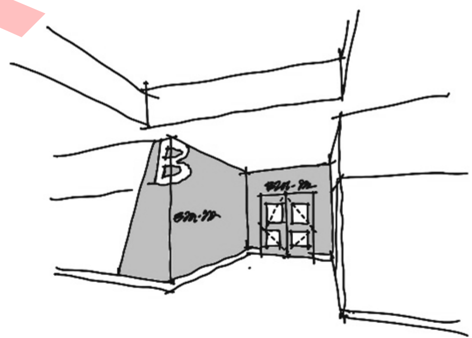
E. Interior Color Theory Statement

The Doherty Memorial High School design team's intent is to develop an interior design that reflects Doherty's unique culture and identity and is also sophisticated and timeless. Just as each program space is evident from the exterior fenestration, the interior spaces will be designed to appropriately express the scale and function of the spaces. It is our intent to provide an intuitive, warm, welcoming, navigable, durable, and easily maintained interior appropriate for both community and educational use.

The main entry highlights a multi-story sky-lit entry Lobby area that serves to provide functional space for not only students on a day-to-day basis, but also for community and after-hours events held in the Cafeteria, Gymnasium, Media Center, Wellness Center and Auditorium. The school colors, Burgundy and Gold will be featured in the new school interior design, most notably in the burgundy "Feature Wall." This monolithic burgundy wall will run the full length of the two-story main Lobby, and through to the exterior to further emphasize the main entrance. Surface materials in the Lobby and corridors are specified as durable and low maintenance products including terrazzo tile, epoxy resin and linoleum flooring, porcelain, and ceramic wall tile. Other finishes within the building will be selected to be similarly durable and will complement the school colors while maintaining a sophisticated palette. Generally, the plan will specify wood doors and millwork of the same color and species throughout the school, but use other materials such as flooring, paint, and wall tile finishes to lend distinction to each area. In this way, the school can provide an intimate team atmosphere appropriate for high school grade levels while, at the same time, tying together all areas with a cohesive palette of colors/materials. Additionally, the building design will highlight the school's proximity to Elm Park and Newton Hill through the use of strategic views and natural materials at these key focal points.



The interior signage concept is intended to reinforce the identities of the various academic floors and "pods" so that students and staff/faculty understand their location within the building and feel connected to the department or team space. Each pod has been designated with a letter and a floor number, to assist with orientation as the students traverse the long "central spine" corridor. To further enhance the identity of each pod, the "portal" to each classroom pod entrance will be identified by signage, soffits, and lighting, as well as a display case to feature student work.



The design team has also identified several areas for potential display of the Doherty Memorial High School history and culture. The entrance to the auditorium will feature a "Historical Timeline" outlining the history of the Doherty Quadrant, and notable alumni.

The two-story wall in the cafeteria also represents an opportunity for a "super graphic" that that will be custom printed on large format plastic laminate panels. The design team believes that the final imagery and design of these two displays would be an excellent opportunity to collaborate with the Doherty students.

The design team will also work with the school to identify items and murals from the existing school that will be relocated or reproduced in the new school. The current design calls for the relocation of the original Highlander images from the existing gymnasium.

Lastly, the design team is planning to include a sustainability display within the lobby to highlight the building's energy performance and history with Elm Park and Newton Hill. Careful attention will be given to specifying locally available materials, low VOC products, and materials with acoustical properties in order to meet or exceed our sustainable design goals as outlined in the LEED scorecard.

These preliminary color and material selections have been presented to and approved by the school and district, and will be advanced further as the Construction Documents progress. Following this narrative are several Interior Renderings, and a video walk through of the interior of the building is included in the digital submission. While all finish colors are not yet reflected in the model, the video illustrates the interior massing and relationships between core spaces, daylighting and views and general interior design concepts.

F. LEED v4 Project Registration & Scorecard

From: **LEED Info** leedinfo@usgbc.org
Subject: Thank you for your LEED Project Registration
Date: February 5, 2021 at 4:36 PM
To: carrie@greenengineer.com

LI

U.S. GREEN BUILDING COUNCIL

Dear Carrie Havey,

Your LEED project has been successfully registered in LEED Online.

Project ID	: 1000140873
Project Title	: Doherty Memorial High School
Project Rating System	: LEED v4 BD+C: SC
Registration Type	: Individual Project
Registration Date	: 02/05/2021
Project Location	: Worcester,MA,US,01602

You may now log into LEED Online to manage your project and begin the application process.The first time you log in, you will be presented with a set of 'Getting Started' information that will help you kick off the certification process. Further technical LEED assistance is available through the following resources:

- The help section of LEED Online
- LEED Resources & Tools : https://www.usgbc.org/leed
- LEED Reference Guides : www.usgbc.org/guides
- Subscribe to LEED Update, a quarterly e-newsletter from USGBC and GBCI : https://www.usgbc.org/account/subscriptions
- LEEDuser, a third-party resource that offers a variety of supplemental LEED advice: https://leeduser.buildinggreen.com

If you experience any problems, please contact the Green Business Certification Inc. (GBCI) at:

Phone : 1-800-795-1746
Email : http://www.gbci.org/contact

Please note, only projects registered through LEED Online v3 will be visible in your LEED Online v3 project list.If you have previously registered a project under LOv2, you will only be able to access those projects in LEED Online v2.

Thank you

Thank you,
GBCI

This is an automatically generated email. Please do not reply to this message.

LEEDv4 BD+C: Schools (LEEDv4 SC)
Project Scorecard

The Green Engineer
Sustainable Design Consulting

Project: **Doherty Memorial High School**
Address: **299 Highland Street, Worcester, MA 01602**
Date: **7/8/21**

	Yes	Maybe	No				
	0	0	1	**INTEGRATIVE PROCESS**		1	Responsible
D			1	IPc1	Integrative Process	1	Team

	Yes	Maybe	No				
	7	0	8	**LOCATION & TRANSPORTATION**		15	Responsible
D			N	LTc1	LEED for Neighborhood Development Location	15	Team
D	1			LTc2	Sensitive Land Protection	1	2112
D	2			LTc3	High Priority Site	1-2	Env. Eng.
D	2		3	LTc4	Surrounding Density and Diverse Uses	1-5	TGE
D	1		3	LTc5	Access to Quality Transit	1-4	LPA/TGE/ School
D			1	LTc6	Bicycle Facilities	1	LPA/2112
D			1	LTc7	Reduced Parking Footprint	1	LPA/Nitsch
D	1			LTc8	Green Vehicles	1	LPA/ ART

	Yes	Maybe	No				
	4	4	4	**SUSTAINABLE SITES**		12	Responsible
C	Y			SSpr1	Construction Activity Pollution Prevention	Req'd	Nitsch/CM
D	Y			SSpr2	Environmental Site Assessment	Req'd	Env. Eng.
D	1			SSc1	Site Assessment	1	2112, LPA, Nitsch
D		2		SSc2	Site Development - Protect or Restore Habitat	1-2	2112
D		1		SSc3	Open Space	1	2112
D			3	SSc4	Rainwater Management	2-3	Nitsch
D	2			SSc5	Heat Island Reduction	1-2	LPA/2112
D		1		SSc6	Light Pollution Reduction	1	ART/2112
D			1	SSc7	Site Master Plan	1	School
D	1			SSc8	Joint Use of Facilities	1	LPA/School

	Yes	Maybe	No				
	8	1	3	**WATER EFFICIENCY**		12	Responsible
D	Y			WEpr1	Outdoor Water Use Reduction	Req'd	2112
D	Y			WEpr2	Indoor Water Use Reduction	Req'd	SEC / LPA
D	Y			WEpr3	Building-level Water Metering	Req'd	School/SEC
D	1		1	WEc1	Outdoor Water Use Reduction	1-2	2112
D	4	1	2	WEc2	Indoor Water Use Reduction	1-7	SEC
D	2			WEc3	Cooling Tower Water Use	1-2	SEC
D	1			WEc4	Water Metering	1	SEC

	Yes	Maybe	No				
	25	6	0	**ENERGY & ATMOSPHERE**		31	Responsible
C	Y			EApr1	Fundamental Commissioning and Verification	Req'd	BVI
D	Y			EApr2	Minimum Energy Performance	Req'd	Team/TGE
D	Y			EApr3	Building-level Energy Metering	Req'd	School/SEC
D	Y			EApr4	Fundamental Refrigerant Management	Req'd	SEC
C	6			EAc1	Enhanced Commissioning	2-6	BVI
D	16			EAc2	Optimize Energy Performance	1-16	Team/TGE
D		1		EAc3	Advanced Energy Metering	1	ART/SEC
C		2		EAc4	Demand Response	1-2	School/ART
D	3			EAc5	Renewable Energy Production	1-3	School/ART
D		1		EAc6	Enhanced Refrigerant Management	1	SEC
C		2		EAc7	Green Power and Carbon Offsets	1-2	School

	Yes	Maybe	No				
	4	2	7	**MATERIALS & RESOURCES**		13	Responsible
D	Y			MRpr1	Storage & Collection of Recyclables	Req'd	School/LPA
C	Y			MRpr2	Construction and Demolition Waste Management Plan	Req'd	CM
C			5	MRc1	Building Life-Cycle Impact Reduction	2-5	LPA
C	1		1	MRc2	Building Product Disclosure & Optimization-EPD's	1-2	LPA/CM
C		1	1	MRc3	Building Product Disclosure & Optimization-Raw Materials	1-2	LPA/CM

	Yes	Maybe	No	Credit	Description	Points	Responsible
C	1	1		MRc4	Building Product Disclosure & Optimization-Material Ingredients	1-2	LPA/CM
C	2			MRc5	Construction and Demolition Waste Management	1-2	CM
	Yes	Maybe	No				
	8	3	5	**INDOOR ENVIROMENTAL QUALITY**		**16**	**Responsible**
D	Y			EQpr1	Minimum IAQ Performance	Req'd	SEC
D	Y			EQpr2	Environmental Tobacco Smoke (ETS) Control	Req'd	School
D	Y			EQpr3	Minimum Acoustical Performance	Req'd	Cavanaugh
D	2			EQc1	Enhanced IAQ Strategies	1-2	LPA /SEC
C	2	1		EQc2	Low-Emitting Materials	1-3	LPA/CM
C	1			EQc3	Construction IAQ Management Plan	1	CM
C	1	1		EQc4	IAQ Assessment	1-2	School/CM
D	1			EQc5	Thermal Comfort	1	SEC
D	1		1	EQc6	Interior Lighting	1-2	LPA/ART
D			3	EQc7	Daylight	1-3	LPA
D		1		EQc8	Quality Views	1	LPA
D			1	EQc9	Acoustic Performance	1	Cavanaugh
	Yes	Maybe	No				
	6	0	0	**INNOVATION**		**6**	**Responsible**
D	1			INc1.1	Innovation in Design: EB:O&M Starter Kit - Green Cleaning and Pest Management	1	Team
D	1			INc1.2	Innovation in Design: Purchasing, Lamps	1	Team
D	1			INc1.3	Innovation in Design: Green Building Education	1	Team
C	1			INc1.4	Innovation in Design: Occupant Comfort Survey, Safety First pilot credit, or other ID credit	1	Team
C	1			INc1.5	Innovation in Design Pilot: Integrative Analysis of Building Materials	1	Team
C	1			INc2	LEED Accredited Professional	1	TGE
	Yes	Maybe	No				
	3	1	0	**REGIONAL PRIORITY 01602**		**4**	**Responsible**
D	1			RPc1	Optimize Energy Performance (20%/8 pts)	1	TGE
D	1			RPc2	Renewable Energy Production (5%/2 pts)	1	TGE
D	1			RPc3	Cooling Tower and Process Water Use (2pts)	1	TGE
D				RPc4	Building Life-Cycle Impact Reduction (2pts)	1	TGE
D				RPc5	Rainwater Management (2 pts)	1	TGE
D		1		RPc6	Indoor Water Use Reduction (4 pts)	1	TGE
	Yes	Maybe	No				
	65	17	28	**PROJECT TOTALS (Certification Estimates)**		**110**	

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

6B.3 DESIGNER DELIVERABLES

6B.3.1 General Requirements

G. Structural Lateral Bracing & Seismic Design Narrative

BDI BOLTON & DiMARTINO, INC.
CONSULTING STRUCTURAL ENGINEERS
100 Grove Street Worcester, MA 01605
Tel. 508-756-8972

July 8, 2021

Doherty High School

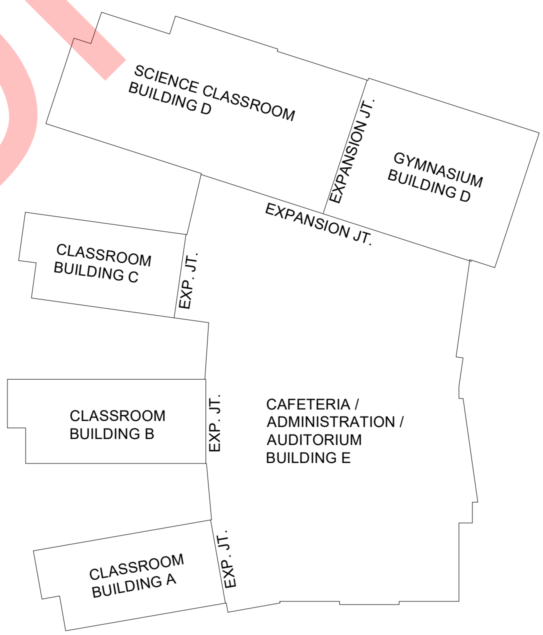
299 Highland Street
Worcester, Massachusetts

Seismic Narrative

The Doherty High School seismic force-resisting system is being designed to conform to the Massachusetts State Building Code, 9th Edition, as well as the International Building Code, 2015 Edition. The School will be separated into six seismically isolated buildings, consisting of (refer to Seismic Key Plan):

- Classroom Building A
- Classroom Building B
- Classroom Building C
- Science Classroom Building D
- Gymnasium Building D
- Cafeteria/Auditorium Building E

The seismic loads of the buildings will be resisted by concentrically braced steel frames, ordinary steel moment frames, concrete floor diaphragms, reinforced concrete masonry unit (CMU) walls, reinforced concrete foundation walls, and metal deck roof diaphragms.



SEISMIC KEY PLAN
NOT TO SCALE

The Seismic Force-Resisting System for the four Classroom buildings and Cafeteria/Auditorium will be “Steel Systems Not Specifically Detailed for Seismic Resistance, Excluding Cantilever Column Systems.” The System for the Gymnasium will be “Steel Systems Not Specifically Detailed for Seismic Resistance, Excluding Cantilever Column Systems,” with the use of “Intermediate Reinforced Masonry Shear Walls” at the perimeter of the Gymnasium.

Concentrically braced steel frames will typically consist of HSS8x8 and HSS10x10 tubes braces resisting lateral loads in both tension and compression. Frame layouts will include traditional diagonal braces and chevron braces.

Reinforced CMU walls will be located at the perimeter of the Gymnasium and lower Parking Garage will be detailed to conform to “Intermediate Reinforced Masonry Shear Walls.” The reinforced concrete foundation walls will be limited to the lowest level of the Gym building where the full height foundation/retaining walls are located. This building will be designed with horizontal stiffness differences between reinforced CMU/concrete and concentrically braced steel frames above the CMU at the roof level.

The project specific seismic design data includes:

Building Occupancy Risk Category:		III
Analysis Procedure:		Equivalent Lateral Force Procedure
Seismic Design Category:		B
Site Class (Geotech Report):		C
Seismic Importance Factor:		1.25
Location Factors:		Worcester, MA
S_s:	0.18	
S_1:	0.066	
F_a:	1.2	
F_v:	1.7	
S_{ms}:	0.216	
S_{m1}:	0.112	
S_{ds}:	0.144	
S_{d1}:	0.075	
Response Modification Factor (R):		3.0
Overstrength Factor (Ω):		3.0
Deflection Amplification Factor (C_d):		3.0
Seismic Response Factor (C_s):		0.06

6B.3 DESIGNER DELIVERABLES

6B.3.1 General Requirements

H. Structural Calculations & Floor Loads

BDI BOLTON & DiMARTINO, INC.
CONSULTING STRUCTURAL ENGINEERS
100 Grove Street Worcester, MA 01605
Tel. 508-756-8972

Doherty High School
Worcester, MA
Basic Design Loads Type IIA Construction (1 hour) + (2 hour)

Roof	
Live Load (Snow)	42
Roofing	3
Insulation	4
Ceiling	3
Mechanical	5
Framing	8
Solar Panels	20
Total (psf)	85

Dead Load =	43
Snow Load =	42
For Seismic:	
Snow = 0.2x42 = 8.4	9

Roof W/ Conc. Pads	
Live Load (Snow)	42
Roofing	3
Insulation	4
Ceiling	3
Mechanical	5
Framing	8
6" Concrete Slab	63
1 1/2"- 20 GA Comp Dk	2
Total (psf)	130

Dead Load =	88
Snow Load =	42
For Seismic:	
Snow = 0.2x42 = 8.4	9

1-hr Classrooms/ Offices NW	
Live Load	50
6 1/2" NW Conc Slab	60
3"- 18 GA Comp Dk	3
Mechanical	5
Ceiling	5
Framing	7
Partitions	15
Total (psf)	145

Live Load =	50
Dead Load =	95
Pre-Composite DL =	70
Total Load =	145

1-hr Open Floor NW	
Live Load	100
6 1/2" NW Conc Slab	60
3"- 18 GA Comp Dk	3
Mechanical	5
Ceiling	5
Framing	7
Total (psf)	180

Live Load =	100
Dead Load =	80
Pre-Composite DL =	70
Total Load =	180

2-hr Open Floor NW	
Live Load	100
7 1/2" NW Conc Slab	73
3"- 18 GA Comp Dk	3
Mechanical	5
Ceiling	5
Framing	7
Total (psf)	193

Live Load =	100
Dead Load =	93
Pre-Composite DL =	83
Total Load =	193

2-hr Weightroom NW	
Live Load	150
7 1/2" NW Conc Slab	73
3"- 18 GA Comp Dk	3
Mechanical	5
Ceiling	5
Framing	7
Flooring	3
Total (psf)	246

Live Load =	150
Dead Load =	96
Pre-Composite DL =	83
Total Load =	246

Auditorium Upper Slab	
Live Load	60
6 1/2" NW Conc Slab	200
3"- 18 GA Comp Dk	3
Mechanical	5
Ceiling	5
Framing	7
Total (psf)	280

Live Load =	60
Dead Load =	220
Pre-Composite DL =	210
Total Load =	280

Storage Building	
Live Load	100
5" NW Conc Slab	48
2"- 22 GA Comp Dk	2
Mechanical	5
Ceiling	5
Framing	7
Total (psf)	167

Live Load =	100
Dead Load =	67
Pre-Composite DL =	57
Total Load =	167

Cafeteria Upper Slab	
Live Load	60
6 1/2" NW Conc Slab	225
3"- 18 GA Comp Dk	3
Mechanical	5
Ceiling	5
Framing	7
Total (psf)	305

Live Load =	100
Dead Load =	245
Pre-Composite DL =	235
Total Load =	345

Doherty High	Type IIA Construction		Seismic Loads - Classroom Building A				3/10/2021
Tributary Areas							
Floors	**Area**	**DL (psf)**	**Weight (k)**			**Roof Load**	
Roof	10200	50	510			Snow (Seismic)	9
						Framing	6
3rd Floor	10250	90	923			Roofing	3
2nd Floor	10250	90	923			Insul/Mech/Ceiling	12
1st Floor	10250	90	923			Solar Panels	20
						Total (psf)	50
						Floor Load	
Walls	**Length**	**Trib Height**	**PSF**	**Weight (k)**		6 1/2" NW Conc	60
Roof	440	7.5	25	82.5		3" Mtl Dk	3
						Mech/Ceiling	10
3rd Floor	440	15	25	165.0		Framing	7
2nd Floor	440	15	25	165.0		Partitions	10
1st Floor	440	16.5	40	290.4		Total	90
						Seismic Coefficients	
Total Weight @ Each Level						Location	Worcester
	Floor	**Roof**	**Wall**	**Total**		S_s =	0.18
Roof		510	83	592.5		S_1 =	0.066
3rd Floor	923		165	1087.5		Site Class =	D
2nd Floor	923		165	1087.5			
1st Floor	923		290	1212.9		S_{MS} =	0.216
			Total W	3980.4		S_{M1} =	0.112
$S_{MS} = F_a S_s$	F_a =	1.2		S_{Ds} = 2/3 S_{MS}		S_{DS} =	0.144
$S_{M1} = F_v S_1$	F_v =	1.7		S_{D1} = 2/3 S_{M1}		S_{D1} =	0.075
				Steel not specifically designed for seismic			
						R =	3.0
						Ω_o =	3.0
$V = C_s W$	$C_s = S_{DS}/(R/I)$		C_s =	0.060		Cd =	3.0
Approximate Fundamental Period						I_E =	1.25
$T_a = C_t h_n^x$	C_t =	0.020	T_a =	0.45			
	x =	0.75					
	h_n =	63.5					
					Cs not to exceed =		0.07
Allowable Stress							
$V = 0.7\ C_s W$							
Shear Distribution							
Base Shear (k)	167.2						
Floor Level	**Floor Elev.**	**Weight**	**W_i x H_i**	**Shear (k)**	**Cumulative**		**Percentage**
Roof	63.50	593	37,623.75	42.6	42.6		0.26
3	48.0	1,088	52,200.00	59.1	101.8		0.35
2	33.0	1,088	35,887.50	40.7	142.4		0.24
1	18.0	1,213	21,832.20	24.7	167.2		0.15
		Total	147,543.45	167.2			

Doherty High	Type IIA Construction	Seismic Loads - Classroom Building B	3/10/2021

Tributary Areas

Floors	**Area**	**DL (psf)**	**Weight (k)**
Roof	11400	50	570
Level 4	11400	90	1026
Level 3	11400	90	1026
Level 2	11400	90	1026
Main Floor	11400	90	1026

Roof Load	
Snow (Seismic)	9
Framing	6
Roofing	3
Insul/Mech/Ceiling	12
Solar Panels	20
Total (psf)	50

Walls	**Length**	**Trib Height**	**PSF**	**Weight (k)**
Roof	475	7.5	30	106.9
Level 4	475	15	30	213.8
Level 3	475	15	30	213.8
Level 2	475	15	30	213.8
Main Floor	475	16.5	40	313.5

Floor Load	
6 1/2" NW Conc	60
3" Mtl Dk	3
Mech/Ceiling	10
Framing	7
Partitions	10
Total	90

Total Weight @ Each Level

	Floor	**Roof**	**Wall**	**Total**
Roof		570	107	676.9
Level 4	1026		214	1239.8
Level 3	1026		214	1239.8
Level 2	1026		214	1239.8
Main Floor	1026		314	1339.5
			Total W	5735.6

Seismic Coefficients

Location	Worcester
S_s =	0.18
S_1 =	0.066
Site Class =	D
S_{MS} =	0.216
S_{M1} =	0.112
S_{DS} =	0.144
S_{D1} =	0.075

$S_{MS} = F_a S_s$	F_a =	1.2		S_{Ds} = 2/3 S_{MS}
$S_{M1} = F_v S_1$	F_v =	1.7		S_{D1} = 2/3 S_{M1}

Steel not specifically designed for seismic

R =	3.0
Ω_o =	3.0
Cd =	3.0
I_E =	1.25

$V = C_s W$	$C_s = S_{DS}/(R/I)$	C_s =	0.060

Approximate Fundamental Period

$T_a = C_t h_n^x$	C_t =	0.020	T_a =	0.53
	x =	0.75		
	h_n =	79		

Cs not to exceed = 0.06

Allowable Stress

$V = 0.7\ C_s\ W$

Shear Distribution

Base Shear (k) 240.9

Floor Level	**Floor Elev.**	**Weight**	**W_i x H_i**	**Shear (k)**	**Cumulative**	**Percentage**
Roof	79.00	677	53,473.13	50.3	50.3	0.21
Level 4	63.0	1,240	78,104.25	73.5	123.8	0.30
Level 3	48.0	1,240	59,508.00	56.0	179.7	0.23
Level 2	33.0	1,240	40,911.75	38.5	218.2	0.16
Main Floor	18.0	1,340	24,111.00	22.7	240.9	0.09
		Total	256,108.13	240.9		

Doherty High	Type IIA Construction		Seismic Loads - Classroom Building C				3/10/2021
Tributary Areas							
Floors	**Area**	**DL (psf)**	**Weight (k)**			**Roof Load**	
Roof	9180	50	459			Snow (Seismic)	9
Level 5	9180	90	826			Framing	6
Level 4	9180	90	826			Roofing	3
Level 3	9180	90	826			Insul/Mech/Ceiling	12
Level 2	9180	90	826			Solar Panels	20
						Total (psf)	50
						Floor Load	
Walls	**Length**	**Trib Height**	**PSF**	**Weight (k)**		6 1/2" NW Conc	60
Roof	420	7.5	25	78.8		3" Mtl Dk	3
4th Floor	420	15	25	157.5		Mech/Ceiling	10
3rd Floor	420	15	25	157.5		Framing	7
2nd Floor	420	15	25	157.5		Partitions	10
1st Floor	420	15	40	252.0		Total	90
						Seismic Coefficients	
Total Weight @ Each Level						Location	Worcester
	Floor	**Roof**	**Wall**	**Total**		S_s =	0.18
Roof		459	79	537.8		S_1 =	0.066
5th Floor	826		158	983.7			
4th Floor	826		158	983.7		Site Class =	D
3rd Floor	826		158	983.7			
2nd Floor	826		252	1078.2		S_{MS} =	0.216
			Total W	4567.1		S_{M1} =	0.112
$S_{MS} = F_a S_s$	F_a =	1.2		S_{Ds} = 2/3 S_{MS}		S_{DS} =	0.144
$S_{M1} = F_v S_1$	F_v =	1.7		S_{D1} = 2/3 S_{M1}		S_{D1} =	0.075
				Steel not specifically designed for seismic			
						R =	3.0
						Ω_o =	3.0
$V = C_s W$	$C_s = S_{DS}/(R/I)$		C_s =	0.060		Cd =	3.0
Approximate Fundamental Period						I_E =	1.25
$T_a = C_t h_n^x$	C_t =	0.020	T_a =	0.51			
	x =	0.75					
	h_n =	75					
					Cs not to exceed =		0.06
Allowable Stress							
$V = 0.7\ C_s W$							
Shear Distribution							
Base Shear (k)	191.8						
Floor Level	**Floor Elev.**	**Weight**	**W_i x H_i**	**Shear (k)**	**Cumulative**		**Percentage**
Roof	75.00	538	40,331.25	40.9	40.9		0.21
5	60.0	984	59,022.00	59.8	100.7		0.31
4	45.0	984	44,266.50	44.9	145.5		0.23
3	30.0	984	29,511.00	29.9	175.4		0.16
2	15.0	1,078	16,173.00	16.4	191.8		0.09
		Total	189,303.75	191.8			

Doherty High	Type IIA Construction	Seismic Loads - Science Classroom Building D	3/10/2021

Tributary Areas

Floors	Area	DL (psf)	Weight (k)
Upper Stair Roof 86'	480	50	24
Upper Roof 76'	17700	50	885
Level 5 Floor 60'	17700	90	1593
Level 4 Floor 45'	17700	90	1593
Level 4 C. Roof 40'	6000	94	564
Level 3 C. Roof 30'	4080	94	384
Level 3 Floor 30'	17700	90	1593
Level 2 Floor 15'	27780	103	2861

Walls	Length	Trib Height	PSF	Weight (k)
High Stair Roof 86'	90	5	25	11.3
High Roof 76'	600	8	25	120.0
Level 5 Floor 60'	600	15.5	25	232.5
Level 4 Floor 45'	600	15	25	225.0
Level 4 C Roof 40'	150	12.5	25	46.9
Level 3 30'	600	15	25	225.0
Level 2 15' Classroom	600	15	40	360.0

Total Weight @ Each Level

	Floor	Roof	Wall	Total
High Stair Roof 86'		24	11	35.3
High Roof 76'		885	120	1005.0
Level 5 60'	1593		233	1825.5
Level 4 Floor 45'	1593		225	1818.0
Level 4 Roof 40'		564	47	610.9
Level 3 30'	1593	384	225.0	2201.5
Level 2 15'	2861		360.0	3221.3
			Total W	10682.2

Roof Load	
Snow (Seismic)	9
Framing	6
Roofing	3
Insul/Mech/Ceiling	12
Solar Panels	20
Total (psf)	50

Roof w/ Conc.	
Snow (Seismic)	9
6 1/2" NW Conc	60
3" Mtl Dk	3
Insul/Mech/Ceiling	10
Framing	12
Total	94

Floor Load Level 3-5	
6 1/2" NW Conc	60
3" Mtl Dk	3
Mech/Ceiling	10
Framing	7
Partitions	10
Total	90

Floor Load Level 2	
7 1/2" NW Conc	73
3" Mtl Dk	3
Mech/Ceiling	10
Framing	7
Partitions	10
Total	103

Seismic Coefficients	
Location	Worcester
S_s =	0.18
S_1 =	0.066
Site Class =	D
S_{MS} =	0.216
S_{M1} =	0.112
S_{DS} =	0.144
S_{D1} =	0.075
R =	3.0
Ω_o =	3.0
Cd =	3.0
I_E =	1.25

$S_{MS} = F_a S_s$	F_a =	1.2		S_{DS} = 2/3 S_{MS}
$S_{M1} = F_v S_1$	F_v =	1.7		S_{D1} = 2/3 S_{M1}
		Steel not specifically detailed for seismic		
$V = C_s W$	$C_s = S_{DS}/(R/I)$		C_s =	0.060
Approximate Fundamental Period				
$T_a = C_t h_n^x$	C_t =	0.020	T_a =	0.51
	x =	0.75		
	h_n =	76		

Allowable Stress
$V = 0.7\ C_s W$

Cs not to exceed = 0.06

Shear Distribution

Base Shear (k) 448.7

Floor Level	Floor Elev.	Weight	$W_i \times H_i$	Shear (k)	Cumulative	Percentage
High Stair Roof 86'	86.00	35	3,031.50	3.3	3.3	0.01
High Roof 76'	76.00	1,005	76,380.00	83.7	87.0	0.19
Level 5 60'	60.0	1,826	109,530.00	120.0	207.0	0.27
Level 4 45'	45.0	1,818	81,810.00	89.6	296.6	0.20
Level 4 Roof 40'	40.0	611	24,435.00	26.8	323.4	0.06
Level 3 30'	30.0	2,202	66,045.60	72.4	395.7	0.16
Level 2 15'	15.0	3,221	48,320.10	52.9	448.7	0.12
		Total	409,552.20	448.7		

Doherty High	Type IIA Construction		Seismic Loads - Gymnasium Building D				3/10/2021
						Roof Load	
Tributary Areas						Snow (Seismic)	9
Floors	**Area**	**DL (psf)**	**Weight (k)**			Framing	6
						Roofing	3
						Insul/Mech/Ceiling	12
Level 5 Gym Roof 50'	18000	50	900			Solar Panels	20
						Total (psf)	50
Level 2 Floor 15'	18000	103	1854				
Walls	**Length**	**Trib Height**	**PSF**	**Weight (k)**			
Level 5 Gym Roof 50'	550	17.5	40	385.0			
						Floor Load	
						6 1/2" NW Conc	60
						3" Mtl Dk	3
Level 2 15' Gym	420	25	100	1050.0		Mech/Ceiling	10
						Framing	7
Total Weight @ Each Level						Partitions	10
	Floor	**Roof**	**Wall**	**Total**		Total	90
						Floor Load	
Level 5 Gym Roof 50'		900	385	1285.0		7 1/2" NW Conc	73
Level 4 Floor 45'	0		0	0.0		3" Mtl Dk	3
Level 4 Roof 40'		0	0	0.0		Mech/Ceiling	10
Level 3 30'	0	0	0.0	0.0		Framing	7
Level 2 15'	1854		1050.0	2904.0		Partitions	10
						Total	103
			Total W	4189.0			
$S_{MS} = F_a S_s$	F_a =	1.2		$S_{DS} = 2/3\ S_{MS}$		**Seismic Coefficients**	
$S_{M1} = F_v S_1$	F_v =	1.7		$S_{D1} = 2/3\ S_{M1}$		Location	Worcester
						S_s =	0.18
		Steel not specifically detailed for seismic				S_1 =	0.066
						Site Class =	D
$V = C_s W$	$C_s = S_{DS}/(R/I)$		C_s =	0.060		S_{MS} =	0.216
						S_{M1} =	0.112
Approximate Fundamental Period						S_{DS} =	0.144
$T_a = C_t h_n^x$	C_t =	0.020	T_a =	0.38		S_{D1} =	0.075
	x =	0.75					
	h_n =	50				R =	3.0
						Ω_o =	3.0
Allowable Stress						Cd =	3.0
$V = 0.7\ C_s W$							
						I_E =	1.25
Shear Distribution							
Base Shear (k)	175.9				Cs not to exceed =		0.08

Floor Level	**Floor Elev.**	**Weight**	**W_i x H_i**	**Shear (k)**	**Cumulative**		**Percentage**
Level 5 Gym 50'	50.0	1,285	64,250.00	104.9	104.9		0.60
Level 4 45'	45.0	0	0.00	0.0	104.9		0.00
Level 4 Roof 40'	40.0	0	0.00	0.0	104.9		0.00
Level 3 30'	30.0	0	0.00	0.0	104.9		0.00
Level 2 15'	15.0	2,904	43,560.00	71.1	175.9		0.40
		Total	107,810.00	175.9			

Doherty High	Type IIA Construction		Seismic Loads - Auditorium Building E				3/10/2021
Tributary Areas							
Floors	**Area**	**DL (psf)**	**Weight (k)**			**Roof Load**	
Level 5 Roof 606'-6"	1650	50	83				
Level 5 Stage Roof 595'-0"	2300	50	115			Snow (Seismic)	9
Level 4 Roof 591'-6"	5050	50	253			Framing	6
Level 4 591'-0"	1500	90	135			Roofing	3
Level 4 Guid. Roof 586'-0"	1450	50	73			Insul/Mech/Ceiling	12
Level 4 Aud Roof 584'-0"	9900	50	495			Solar Panels	20
Level 3 Roof 576'-0"	20400	50	1020			Total (psf)	50
Level 3 576'-0"	6550	90	590				
Level 3 Catwalk 572'-6"	1100	90	99				
Level 3 Low Roof 570'-0"	2800	50	140			**Floor Load**	
Level 2 Floor 561'-0"	22700	90	2043			6 1/2" NW Conc	60
Level 2 Sloped Aud 561'-0"	3675	135	496			3" Mtl Dk	3
Main Floor 546'-0"	46850	90	4217			Mech/Ceiling	10
						Framing	7
						Partitions	10
						Total	90
Walls	**Length**	**Trib Height**	**PSF**	**Weight (k)**			
Level 5 Roof 606'-6"	140	7.5	25	26.3			
Level 5 Stage Roof 595'-0"	220	8	25	44.0			
Level 4 591'-0"	300	8	25	60.0			
Level 4 Guid. Roof 586'-0"	150	5	25	18.8			
Level 4 Aud Roof 584'-0"	300	5	25	37.5			
Level 3 576'-0"	400	15	25	150.0			
Level 3 Catwalk 572'-6"	100	7.5	15	11.3			
Level 3 Low Roof 570'-0"	100	6	25	15.0			
Level 2 561'-0"	420	15	25	157.5			
Main Floor 546'-0"	420	10	40	168.0			
						Seismic Coefficients	
Total Weight @ Each Level						Location	Worcester
	Floor	**Roof**	**Wall**	**Total**		S_s =	0.18
Level 5 Roof 606'-6"		83	26	108.8		S_1 =	0.066
Level 5 Stage Roof 595'-0"		115	44	159.0			
Level 4 591'-0"	135	253	60	447.5			
Level 4 Guid. Roof 586'-0"		73	18.8	91.3			
Level 4 Aud Roof 584'-0"		495	37.5	532.5			
Level 3 576'-0"	590	1020	150	1759.5		Site Class =	C
Level 3 Catwalk 572'-6"	99		11.3	110.3			
Level 3 Low Roof 570'-0"		140	15.0	155.0			
Level 2 561'-0"	2539		158	2696.6			
Main Floor 546'-0"	4217		168	4384.5		S_{MS} =	0.216
			Total W	10444.9		S_{M1} =	0.112
$S_{MS} = F_aS_s$	F_a =	1.2		S_{Ds} = 2/3 S_{MS}		S_{DS} =	0.144
$S_{M1} = F_vS_1$	F_v =	1.7		S_{D1} = 2/3 S_{M1}		S_{D1} =	0.075
				Steel not specifically designed for seismic			
						R =	3.0
						Ω_o =	3.0
$V = C_s W$	$C_s = S_{DS}/(R/I)$		C_s =	0.060		Cd =	3.0
Approximate Fundamental Period						I_E =	1.25
$T_a = C_t h_n^x$	C_t =	0.020	T_a =	0.53			
	x =	0.75					
	h_n =	78.5					
					Cs not to exceed =		0.06
Allowable Stress							
$V = 0.7 C_s W$							
Shear Distribution							
Base Shear (k)	438.7						

Floor Level	**Floor Elev.**	**Weight**	**W_i x H_i**	**Shear (k)**	**Cumulative**		**Percentage**
5 Roof 606'-6"	78.50	109	8,536.88	10.8	10.8		0.02
5 Stage Roof 595'-0"	67.00	159	10,653.00	13.5	24.3		0.03
4 591'-0"	63.0	448	28,192.50	35.7	60.0		0.08
4 Guid. Roof 586'-0"	58.0	91	5,292.50	6.7	66.7		0.02
4 Aud Roof 584'-0"	56.0	533	29,820.00	37.8	104.5		0.09
3 576'-0"	48.0	1,760	84,456.00	107.0	211.5		0.24
3 Catwalk 572'-6"	44.5	110	4,906.13	6.2	217.7		0.01
3 Low Roof 570'-0"	42.0	155	6,510.00	8.2	226.0		0.02
2 561'-0"	33.0	2,697	88,988.63	112.7	338.7		0.26
Main 546'-0"	18.0	4,385	78,921.00	100.0	438.7		0.23
		Total	346,276.63	438.7			

Doherty High	Type IIA Construction	Seismic Loads - Cafeteria Building E	3/10/2021

Tributary Areas

Floors	**Area**	**DL (psf)**	**Weight (k)**
Roof 621'-6"	3775	50	189
Level 5 Roof 606'-0"	375	50	19
Level 5 606'-0"	3775	90	340
Level 4 591'-0"	4100	90	369
Level 4 Roof 588'-0"	5750	50	288
Level 3 Roof 576'-0"	18100	50	905
Level 3 576'-0"	5600	90	504
Level 2 Roof 561'-0"	980	50	49
Level 2 561'-0"	20300	90	1827

Roof Load	
Snow (Seismic)	9
Framing	6
Roofing	3
Insul/Mech/Ceiling	12
Solar Panels	20
Total (psf)	50

Floor Load	
6 1/2" NW Conc	60
3" Mtl Dk	3
Mech/Ceiling	10
Framing	7
Partitions	10
Total	90

Walls	**Length**	**Trib Height**	**PSF**	**Weight (k)**
Roof 621'-6"	230	8	25	46.0
Level 5 606'-6"	230	15	25	86.3
Level 4 591'-0"	190	15	25	71.3
Level 4 Roof 588'-0"	220	6	25	33.0
Level 3 Café Roof	85	15	25	31.9
Level 3 576'-0"	420	10	25	105.0
Level 2 561'-0"	200	15	40	120.0

Total Weight @ Each Level

	Floor	**Roof**	**Wall**	**Total**
Roof 621'-6"		189	46	234.8
Level 5 606'-0"	340	19	86	444.8
Level 4 591'-0"	369	288	71	727.8
Level 4 Roof 588'-0"		288	33	320.5
Level 3 576'-0"	504	905	137	1545.9
Level 2 561'-0"	1827	49	120	1996.0
			Total W	5269.6

Seismic Coefficients

Location	Worcester
S_s =	0.18
S_1 =	0.066
Site Class =	C
S_{MS} =	0.216
S_{M1} =	0.112
S_{DS} =	0.144
S_{D1} =	0.075

$S_{MS} = F_a S_s$	F_a =	1.2	$S_{Ds} = 2/3\ S_{MS}$
$S_{M1} = F_v S_1$	F_v =	1.7	$S_{D1} = 2/3\ S_{M1}$

Steel not specifically designed for seismic

R =	3.0
Ω_o =	3.0
Cd =	3.0
I_E =	1.25

$V = C_s W$	$C_s = S_{DS}/(R/I)$	C_s = 0.060

Approximate Fundamental Period

$T_a = C_t h_n^x$	C_t =	0.020	T_a = 0.35
	x =	0.75	
	h_n =	45.33	

Cs not to exceed = 0.09

Allowable Stress

$V = 0.7\ C_s\ W$

Shear Distribution

Base Shear (k) 221.3

Floor Level	**Floor Elev.**	**Weight**	**W_i x H_i**	**Shear (k)**	**Cumulative**	**Percentage**
Roof 621'-6"	75.50	235	17,723.63	23.5	23.5	0.11
5 606'-0"	60.0	445	26,685.00	35.4	58.9	0.16
4 591'-0"	45.0	728	32,748.75	43.4	102.3	0.20
4 Roof 588'-0"	42.0	321	13,461.00	17.8	120.1	0.08
3 576'-0"	30.0	1,546	46,376.25	61.5	181.6	0.28
2 561'-0"	15.0	1,996	29,940.00	39.7	221.3	0.18
		Total	166,934.63	221.3		

South High													
Science Columns													
Column	Sci-	1											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
3 Roof	120	100	12.00	1	12.00	88	10.56	0	5	27.56	27.56	19.56	7.04
					12		11		5	27.56		19.56	7.04
										Total Load			
Column	Sci-	2											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
3 Roof	240	100	24.00	1	24.00	88	21.12	0	5	50.12	50.12	39.12	14.08
					24		21		5	50.12		39.12	14.08
										Total Load			
Column	Sci-	3											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
3 Roof	240	100	24.00	1	24.00	88	21.12	0	5	50.12	50.12	39.12	14.08
					24		21		5	50.12		39.12	14.08
										Total Load			
Column	Sci-	4											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
3 Roof	60	100	6.00	1	6.00	88	5.28	0	5	16.28	16.28	9.78	3.52
Lo Roof	50	60	3.00	1	3.00	23	1.15	0	0	4.15	4.15	3.40	0.77
					9		6		5	20.43		9.78	3.52
										Total Load			
Column	Sci-	5											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
3 Roof	210	100	21.00	1	21.00	88	18.48	0	5	44.48	44.48	34.23	12.32
Lo Roof	50	60	3.00	1	3.00	23	1.15	0	0	4.15	4.15	3.40	0.77
					24		20		5	48.63		34.23	12.32
										Total Load			
Column	Sci-	6											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Hi Roof	170	60	10.20	1	10.20	88	14.96	0	5	30.16	30.16	22.61	9.97
3 Roof	105	100	10.50	1	10.50	88	9.24	0	0	19.74	19.74	17.12	6.16
Lo Roof	90	60	5.40	1	5.40	23	2.07	0	0	7.47	7.47	6.12	1.38
					26		26		5	57.37		17.12	6.16
										Total Load			
Column	Sci-	7											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	60	100	6.00	1	6.00	88	5.28	0	5	16.28	16.28	9.78	3.52
					6		5		5	16.28		9.78	3.52
										Total Load			
Column	Sci-	8											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	60	100	6.00	1	6.00	88	5.28	0	5	16.28	16.28	9.78	3.52
					6		5		5	16.28		9.78	3.52
										Total Load			
Column	Sci-	9											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	175	100	17.50	1	17.50	88	15.40	0	5	37.90	37.90	28.53	10.27
					18		15		5	37.90		28.53	10.27
										Total Load			
Column	Sci-	10											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	210	42	8.82	1	8.82	43	9.03	0	5	22.85	22.85	15.65	6.02
5	0	100	0.00	0.77	0.00	66	0.00	0	0	0.00	22.85	0.00	0.00
5	210	50	10.50	0.77	8.06	81	17.01	0	15	40.07	62.92	23.05	11.34
4	0	100	0.00	0.62	0.00	66	0.00	0	0	0.00	62.92	0.00	0.00
4	210	50	10.50	0.62	6.47	81	17.01	0	15	38.48	101.40	21.86	11.34
3	0	100	0.00	0.55	0.00	66	0.00	0	0	0.00	101.40	0.00	0.00
3	210	50	10.50	0.55	5.76	81	17.01	0	15	37.77	139.17	21.33	11.34
					29		60		50	139.17		81.89	40.04
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3										
1	0.77	0.62	0.55										
2	0.50	0.50	0.50										
Column	Sci-	11											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	420	42	17.64	1	17.64	43	18.06	0	5	40.70	40.70	31.29	12.04
5	0	100	0.00	0.62	0.00	66	0.00	0	0	0.00	40.70	0.00	0.00
5	420	50	21.00	0.62	12.94	81	34.02	0	15	61.96	102.66	43.72	22.68
4	0	100	0.00	0.51	0.00	66	0.00	0	0	0.00	102.66	0.00	0.00
4	420	50	21.00	0.51	10.68	81	34.02	0	15	59.70	162.36	42.03	22.68
3	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	162.36	0.00	0.00
3	420	50	21.00	0.50	10.50	81	34.02	0	15	59.52	221.88	41.90	22.68
					52		120		50	221.88		158.94	80.08
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3										
1	0.62	0.51	0.46										
2	0.50	0.50	0.50										
Column	Sci-	12											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	420	42	17.64	1	17.64	43	18.06	0	5	40.70	40.70	31.29	12.04
5	0	100	0.00	0.62	0.00	66	0.00	0	0	0.00	40.70	0.00	0.00
5	420	50	21.00	0.62	12.94	81	34.02	0	15	61.96	102.66	43.72	22.68
4	0	100	0.00	0.51	0.00	66	0.00	0	0	0.00	102.66	0.00	0.00
4	420	50	21.00	0.51	10.68	81	34.02	0	15	59.70	162.36	42.03	22.68
3 Roof	120	100	12.00	1.00	12.00	66	7.92	0	0	19.92	182.28	16.92	5.28

3	420	50	21.00	0.50	10.50	81	34.02	0	15	59.52	241.80	41.90	22.68
					64		128		50	241.80		175.86	85.36
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
	5	**4**	**3**										
1	0.62	0.51	0.45										
2	0.50	0.50	0.50										
Column	**Sci-**		**13**										
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	420	42	17.64	1	17.64	43	18.06	0	5	40.70	40.70	31.29	12.04
5	0	100	0.00	0.62	0.00	66	0.00	0	0	0.00	40.70	0.00	0.00
5	420	50	21.00	0.62	12.94	81	34.02	0	15	61.96	102.66	43.72	22.68
4	0	100	0.00	0.51	0.00	66	0.00	0	0	0.00	102.66	0.00	0.00
4	420	50	21.00	0.51	10.68	81	34.02	0	15	59.70	162.36	42.03	22.68
3 Roof	240	100	24.00	1.00	24.00	66	15.84	0	0	39.84	202.20	33.84	10.56
3	420	50	21.00	0.50	10.50	81	34.02	0	15	59.52	261.72	41.90	22.68
2 Weight	330	150	49.50	0.50	24.75	66	21.78	0	0	46.53	308.25	40.34	14.52
2	330	50	16.50	0.50	8.25	81	26.73	0	0	34.98	343.23	32.92	17.82
					109		184		50	343.23		266.04	122.98
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
	5	**4**	**3**	**2**									
1	0.62	0.51	0.44	0.41									
2	0.50	0.50	0.50	0.50									
Column	**Sci-**		**14**										
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	210	42	8.82	1	8.82	43	9.03	0	5	22.85	22.85	15.65	6.02
5	0	100	0.00	0.77	0.00	66	0.00	0	0	0.00	22.85	0.00	0.00
5	210	50	10.50	0.77	8.06	81	17.01	0	15	40.07	62.92	23.05	11.34
4	0	100	0.00	0.62	0.00	66	0.00	0	0	0.00	62.92	0.00	0.00
4	210	50	10.50	0.62	6.47	81	17.01	0	15	38.48	101.40	21.86	11.34
3 Roof	450	100	45.00	1.00	45.00	66	29.70	0	0	74.70	176.10	63.45	19.80
3	210	50	10.50	0.50	5.25	81	17.01	0	15	37.26	213.36	20.95	11.34
2 Weight	660	150	99.00	0.50	49.50	66	43.56	0	0	93.06	306.42	80.69	29.04
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	306.42	0.00	0.00
					123		133		50	306.42		225.64	88.88
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
	5	**4**	**3**	**2**									
1	0.77	0.62	0.48	0.43									
2	0.50	0.50	0.50	0.50									
Column	**Sci-**		**15**										
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
3 Roof	650	100	65.00	1.00	65.00	66	42.90	0	5	112.90	112.90	91.65	28.60
3	0	50	0.00	0.54	0.00	81	0.00	0	0	0.00	112.90	0.00	0.00
2 Weight	330	150	49.50	0.50	24.75	66	21.78	0	0	46.53	159.43	40.34	14.52
2	320	100	32.00	0.50	16.00	81	25.92	0	0	41.92	201.35	37.92	17.28
					106		91		5	201.35		169.91	60.40
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
			3	**2**									
1			0.54	0.46									
2			0.50	0.50									
Column	**Sci-**		**16**										
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
4 Roof	510	100	51.00	1.00	51.00	66	33.66	0	10	94.66	94.66	71.91	22.44
4	0	50	0.00	1.00	0.00	81	0.00	0	0	0.00	94.66	0.00	0.00
3 Roof	315	100	31.50	0.51	16.10	66	20.79	0	10	46.89	141.55	32.87	13.86
3	0	50	0.00	0.51	0.00	81	0.00	0	0	0.00	141.55	0.00	0.00
2	630	100	63.00	0.50	31.50	66	41.58	0	0	73.08	214.63	65.21	27.72
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	214.63	0.00	0.00
					99		96		20	214.63		169.98	64.02
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
		4	**3**	**2**									
1		0.58	0.51	0.45									
2		0.50	0.50	0.50									
Column	**Sci-**		**17**										
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
2	510	100	51.00	0.58	29.69	66	33.66	0	0	63.35	63.35	55.93	22.44
2	0	50	0.00	0.58	0.00	81	0.00	0	0	0.00	63.35	0.00	0.00
					30		34		0	63.35		55.93	22.44
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
				2									
1				0.58									
2				0.50									
Column	**Sci-**		**18**										
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
4 Roof	510	100	51.00	1.00	51.00	66	33.66	0	10	94.66	94.66	71.91	22.44
4	0	50	0.00	1.00	0.00	81	0.00	0	0	0.00	94.66	0.00	0.00
2	200	100	20.00	0.53	10.63	66	13.20	0	0	23.83	118.49	21.17	8.80
2	0	50	0.00	0.53	0.00	81	0.00	0	0	0.00	118.49	0.00	0.00
					62		47		10	118.49		93.08	31.24
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
		4	**3**	**2**									
1		0.58	0.58	0.53									
2		0.50	0.50	0.50									
Column	**Sci-**		**19**										
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	90	42	3.78	1	3.78	43	3.87	0	5	12.65	12.65	6.71	2.58
5	90	100	9.00	1.04	9.37	66	5.94	0	0	15.31	27.96	12.96	3.96
5	0	50	0.00	1.04	0.00	81	0.00	0	15	15.00	42.96	0.00	0.00
4	90	100	9.00	0.81	7.28	66	5.94	0	0	13.22	56.18	11.40	3.96
4	0	50	0.00	0.81	0.00	81	0.00	0	15	15.00	71.18	0.00	0.00
3	90	100	9.00	0.71	6.36	66	5.94	0	0	12.30	83.47	10.71	3.96
3	0	50	0.00	0.71	0.00	81	0.00	0	5	5.00	88.47	0.00	0.00
					27		22		40	88.47		41.78	14.46
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
	5	**4**	**3**										
1	1.04	0.81	0.71										

2	0.50	0.50	0.50										
Column	**Sci-**	**20**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	580	42	24.36	1	24.36	43	24.94	0	5	54.30	54.30	43.21	16.63
5	130	100	13.00	0.56	7.30	66	8.58	0	0	15.88	70.18	14.05	5.72
5	450	50	22.50	0.56	12.63	81	36.45	0	15	64.08	134.26	45.92	24.30
4	130	100	13.00	0.50	6.50	66	8.58	0	0	15.08	149.34	13.46	5.72
4	450	50	22.50	0.50	11.25	81	36.45	0	15	62.70	212.04	44.89	24.30
3	130	100	13.00	0.50	6.50	66	8.58	0	0	15.08	227.12	13.46	5.72
3	450	50	22.50	0.50	11.25	81	36.45	0	15	62.70	289.82	44.89	24.30
					80		160		50	289.82		219.87	106.69
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
	5	**4**	**3**										
1	0.56	0.47	0.43										
2	0.50	0.50	0.50										
Column	**Sci-**	**21**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	0	100	0.00	0.54	0.00	66	0.00	0	0	0.00	61.10	0.00	0.00
5	660	50	33.00	0.54	17.88	81	53.46	0	0	71.34	132.44	66.87	35.64
4	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	132.44	0.00	0.00
4	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	202.40	65.84	35.64
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	202.40	0.00	0.00
3	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	272.36	65.84	35.64
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	272.36	0.00	0.00
2	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	342.32	65.84	35.64
					95		242		5	342.32		313.55	161.48
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
	5	**4**	**3**	**2**									
1	0.54	0.46	0.42	0.40									
2	0.50	0.50	0.50	0.50									
Column	**Sci-**	**22**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	0	100	0.00	0.54	0.00	66	0.00	0	0	0.00	61.10	0.00	0.00
5	660	50	33.00	0.54	17.88	81	53.46	0	0	71.34	132.44	66.87	35.64
4	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	132.44	0.00	0.00
4	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	202.40	65.84	35.64
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	202.40	0.00	0.00
3	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	272.36	65.84	35.64
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	272.36	0.00	0.00
2	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	342.32	65.84	35.64
					95		242		5	342.32		313.55	161.48
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
	5	**4**	**3**	**2**									
1	0.54	0.46	0.42	0.40									
2	0.50	0.50	0.50	0.50									
Column	**Sci-**	**23**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	0	100	0.00	0.54	0.00	66	0.00	0	0	0.00	61.10	0.00	0.00
5	660	50	33.00	0.54	17.88	81	53.46	0	0	71.34	132.44	66.87	35.64
4	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	132.44	0.00	0.00
4	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	202.40	65.84	35.64
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	202.40	0.00	0.00
3	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	272.36	65.84	35.64
2 Weight	330	150	49.50	0.50	24.75	66	21.78	0	0	46.53	318.89	40.34	14.52
2	330	50	16.50	0.50	8.25	81	26.73	0	0	34.98	353.87	32.92	17.82
					112		237		5	353.87		320.97	158.18
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
	5	**4**	**3**	**2**									
1	0.54	0.46	0.42	0.40									
2	0.50	0.50	0.50	0.50									
Column	**Sci-**	**24**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	450	42	18.90	1	18.90	43	19.35	0	5	43.25	43.25	33.53	12.90
5	0	100	0.00	0.60	0.00	66	0.00	0	0	0.00	43.25	0.00	0.00
5	450	50	22.50	0.60	13.58	81	36.45	0	15	65.03	108.28	46.63	24.30
4	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	108.28	0.00	0.00
4	450	50	22.50	0.50	11.25	81	36.45	0	15	62.70	170.98	44.89	24.30
3 Roof	210	100	21.00	0.50	10.50	66	13.86	0	0	24.36	195.34	21.74	9.24
3	450	50	22.50	0.50	11.25	81	36.45	0	15	62.70	258.04	44.89	24.30
2 Weight	660	150	99.00	0.50	49.50	66	43.56	0	0	93.06	351.10	80.69	29.04
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	351.10	0.00	0.00
					115		186		50	351.10		272.35	124.08
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
	5	**4**	**3**	**2**									
1	0.60	0.50	0.44	0.41									
2	0.50	0.50	0.50	0.50									
Column	**Sci-**	**25**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	480	42	20.16	1	20.16	43	20.64	0	15	55.80	55.80	35.76	13.76
5	480	100	48.00	0.59	28.43	66	31.68	0	15	75.11	130.91	53.00	21.12
5	0	50	0.00	0.59	0.00	81	0.00	0	0	0.00	130.91	0.00	0.00
4	480	100	48.00	0.50	24.00	66	31.68	0	15	70.68	201.59	49.68	21.12
4	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	201.59	0.00	0.00
3 Roof	420	100	42.00	1.00	42.00	66	27.72	0	0	69.72	271.31	59.22	18.48
3	240	50	12.00	0.50	6.00	81	19.44	0	15	40.44	311.75	23.94	12.96
2 Weight	330	150	49.50	0.50	24.75	66	21.78	0	0	46.53	358.28	40.34	14.52
2	330	100	33.00	0.50	16.50	66	21.78	0	0	38.28	396.56	34.16	14.52
					162		175		60	396.56		296.10	116.48
										Total Load			
Live Load Reduction-N			**K_{LL}**	4									
	5	**4**	**3**	**2**									
1	0.59	0.49	0.44	0.41									
2	0.50	0.50	0.50	0.50									
Column	**Sci-**	**26**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**

Roof	120	42	5.04	1	5.04	43	5.16	0	5	15.20	15.20	8.94	3.44
5	120	100	12.00	0.93	11.22	66	7.92	0	15	34.14	49.34	16.33	5.28
5	0	50	0.00	0.93	0.00	81	0.00	0	0	0.00	49.34	0.00	0.00
4 Roof	530	100	53.00	1.00	53.00	66	34.98	0	10	97.98	147.32	74.73	23.32
4	120	100	12.00	0.52	6.24	66	7.92	0	15	29.16	176.48	12.60	5.28
3 Roof	210	100	21.00	1.00	21.00	66	13.86	0	0	34.86	211.34	29.61	9.24
3	120	50	6.00	0.50	3.00	81	9.72	0	15	27.72	239.06	11.97	6.48
2	660	100	66.00	0.50	33.00	66	43.56	0	0	76.56	315.62	68.31	29.04
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	315.62	0.00	0.00
					132		123		60	315.62		222.49	82.08
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.93	0.52	0.48	0.43									
2	0.50	0.50	0.50	0.50									

Column	**Sci-**	**27**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
2	530	100	53.00	0.58	30.52	66	34.98	0	0	65.50	65.50	57.87	23.32
2	0	50	0.00	0.58	0.00	81	0.00	0	0	0.00	65.50	0.00	0.00
					31		35		0	65.50		57.87	23.32
										Total Load			
Live Load Reduction-N			K_{LL}	4									
				2									
1				0.58									
2				0.50									

Column	**Sci-**	**28**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
4 Roof	530	100	53.00	1.00	53.00	66	34.98	0	10	97.98	97.98	74.73	23.32
4	0	50	0.00	1.00	0.00	81	0.00	0	0	0.00	97.98	0.00	0.00
2	200	100	20.00	0.53	10.55	66	13.20	0	0	23.75	121.73	21.11	8.80
2	0	50	0.00	0.53	0.00	81	0.00	0	0	0.00	121.73	0.00	0.00
					64		48		10	121.73		95.84	32.12
										Total Load			
Live Load Reduction-N			K_{LL}	4									
		4	**3**	**2**									
1		0.58	0.58	0.53									
2		0.50	0.50	0.50									

Column	**Sci-**	**29**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	480	42	20.16	1	20.16	43	20.64	0	5	45.80	45.80	35.76	13.76
5	0	100	0.00	0.59	0.00	66	0.00	0	0	0.00	45.80	0.00	0.00
5	480	50	24.00	0.59	14.22	81	38.88	0	0	53.10	98.90	49.54	25.92
4	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	98.90	0.00	0.00
4	480	50	24.00	0.50	12.00	81	38.88	0	0	50.88	149.78	47.88	25.92
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	149.78	0.00	0.00
3	480	50	24.00	0.50	12.00	81	38.88	0	0	50.88	200.66	47.88	25.92
2	480	100	48.00	0.50	24.00	66	31.68	0	0	55.68	256.34	49.68	21.12
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	256.34	0.00	0.00
					82		169		5	256.34		230.74	112.64
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.59	0.49	0.45	0.42									
2	0.50	0.50	0.50	0.50									

Column	**Sci-**	**30**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	480	42	20.16	1	20.16	43	20.64	0	5	45.80	45.80	35.76	13.76
5	0	100	0.00	0.59	0.00	66	0.00	0	0	0.00	45.80	0.00	0.00
5	480	50	24.00	0.59	14.22	81	38.88	0	0	53.10	98.90	49.54	25.92
4	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	98.90	0.00	0.00
4	480	50	24.00	0.50	12.00	81	38.88	0	0	50.88	149.78	47.88	25.92
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	149.78	0.00	0.00
3	480	50	24.00	0.50	12.00	81	38.88	0	0	50.88	200.66	47.88	25.92
2	480	100	48.00	0.50	24.00	66	31.68	0	0	55.68	256.34	49.68	21.12
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	256.34	0.00	0.00
					82		169		5	256.34		230.74	112.64
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.59	0.49	0.45	0.42									
2	0.50	0.50	0.50	0.50									

Column	**Sci-**	**31**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	480	42	20.16	1	20.16	43	20.64	0	5	45.80	45.80	35.76	13.76
5	0	100	0.00	0.59	0.00	66	0.00	0	0	0.00	45.80	0.00	0.00
5	480	50	24.00	0.59	14.22	81	38.88	0	0	53.10	98.90	49.54	25.92
4	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	98.90	0.00	0.00
4	480	50	24.00	0.50	12.00	81	38.88	0	0	50.88	149.78	47.88	25.92
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	149.78	0.00	0.00
3	480	50	24.00	0.50	12.00	81	38.88	0	0	50.88	200.66	47.88	25.92
2 Weight	120	150	18.00	0.50	9.00	66	7.92	0	0	16.92	217.58	14.67	5.28
2	360	100	36.00	0.50	18.00	66	23.76	0	0	41.76	259.34	37.26	15.84
					85		169		5	259.34		232.99	112.64
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.59	0.49	0.45	0.42									
2	0.50	0.50	0.50	0.50									

Column	**Sci-**	**32**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	480	42	20.16	1	20.16	43	20.64	0	15	55.80	55.80	35.76	13.76
5	240	100	24.00	0.59	14.22	66	15.84	0	0	30.06	85.86	26.50	10.56
5	240	50	12.00	0.59	7.11	81	19.44	0	0	26.55	112.40	24.77	12.96
4	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	140.24	24.84	10.56
4	240	50	12.00	0.50	6.00	81	19.44	0	0	25.44	165.68	23.94	12.96
2	480	100	48.00	0.50	24.00	66	31.68	0	0	55.68	221.36	49.68	21.12
3	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	221.36	0.00	0.00
2 Weight	240	150	36.00	0.50	18.00	66	15.84	0	0	33.84	255.20	29.34	10.56
2	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	283.04	24.84	10.56
					113		155		15	283.04		239.67	103.04
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.59	0.49	0.45	0.42									
2	0.50	0.50	0.50	0.50									

Column Sci- **33**

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Load Combinations Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
2	480	100	48.00	0.59	28.43	66	31.68	0	0	60.11	60.11	53.00	21.12
3	0	50	0.00	0.59	0.00	81	0.00	0	0	0.00	60.11	0.00	0.00
2 Weight	120	150	18.00	0.50	9.00	66	7.92	0	0	16.92	77.03	14.67	5.28
2	360	100	36.00	0.50	18.00	66	23.76	0	0	41.76	118.79	37.26	15.84
					55		63		0	118.79		104.93	42.24
										Total Load			

Live Load Reduction-N			K_{LL}	4
			3	2
1			0.59	0.49
2			0.50	0.50

Column Sci- **34**

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Load Combinations Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	240	42	10.08	1	10.08	43	10.32	0	10	30.40	30.40	17.88	6.88
5	240	100	24.00	0.73	17.62	66	15.84	0	15	48.46	78.86	29.05	10.56
5	0	50	0.00	0.73	0.00	81	0.00	0	0	0.00	78.86	0.00	0.00
4 Roof	385	100	38.50	1.00	38.50	88	33.88	0	10	82.38	161.24	62.76	22.59
4	240	100	24.00	0.51	12.12	66	15.84	0	15	42.96	204.20	24.93	10.56
3	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	232.04	24.84	10.56
3	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	232.04	0.00	0.00
2	480	100	48.00	0.50	24.00	66	31.68	0	0	55.68	287.72	49.68	21.12
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	287.72	0.00	0.00
					114		123		50	287.72		209.14	82.27
										Total Load			

Live Load Reduction-N			K_{LL}	4
	5	4	3	2
1	0.73	0.51	0.48	0.44
2	0.50	0.50	0.50	0.50

Column Sci- **35**

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Load Combinations Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
2	385	100	38.50	0.63	24.34	66	25.41	0	0	49.75	49.75	43.67	16.94
2	0	50	0.00	0.63	0.00	81	0.00	0	0	0.00	49.75	0.00	0.00
					24		25		0	49.75		43.67	16.94
										Total Load			

Live Load Reduction-N			K_{LL}	4
				2
1				0.63
2				0.50

Column Sci- **36**

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Load Combinations Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
4 Roof	385	100	38.50	1.00	38.50	66	25.41	0	10	73.91	73.91	54.29	16.94
4	0	50	0.00	1.00	0.00	81	0.00	0	0	0.00	73.91	0.00	0.00
2	160	100	16.00	0.57	9.14	66	10.56	0	0	19.70	93.61	17.42	7.04
2	0	50	0.00	0.57	0.00	81	0.00	0	0	0.00	93.61	0.00	0.00
					48		36		10	93.61		71.70	23.98
										Total Load			

Live Load Reduction-N			K_{LL}	4
		4	3	2
1		0.63	0.63	0.57
2		0.50	0.50	0.50

Column Sci- **37**

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Load Combinations Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	120	42	5.04	1	5.04	43	5.16	0	5	15.20	15.20	8.94	3.44
5	120	100	12.00	0.93	11.22	66	7.92	0	15	34.14	49.34	16.33	5.28
5	0	50	0.00	0.93	0.00	81	0.00	0	0	0.00	49.34	0.00	0.00
4	120	100	12.00	0.73	8.81	66	7.92	0	15	31.73	81.07	14.53	5.28
4	0	50	0.00	0.73	0.00	81	0.00	0	0	0.00	81.07	0.00	0.00
2	120	100	12.00	0.65	7.74	66	7.92	0	10	25.66	106.73	13.73	5.28
3	0	50	0.00	0.65	0.00	81	0.00	0	0	0.00	106.73	0.00	0.00
2	120	100	12.00	0.59	7.11	66	7.92	0	5	20.03	126.76	13.25	5.28
2	0	50	0.00	0.59	0.00	81	0.00	0	0	0.00	126.76	0.00	0.00
					40		37		50	126.76		66.78	24.56
										Total Load			

Live Load Reduction-N			K_{LL}	4
	5	4	3	2
1	0.93	0.73	0.65	0.59
2	0.50	0.50	0.50	0.50

Column Sci- **38**

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Load Combinations Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	360	42	15.12	1	15.12	43	15.48	0	5	35.60	35.60	26.82	10.32
5	360	100	36.00	0.65	23.23	66	23.76	0	0	46.99	82.59	41.18	15.84
5	0	50	0.00	0.65	0.00	81	0.00	0	0	0.00	82.59	0.00	0.00
4	360	100	36.00	0.53	19.06	66	23.76	0	0	42.82	125.41	38.06	15.84
4	0	50	0.00	0.53	0.00	81	0.00	0	0	0.00	125.41	0.00	0.00
3	360	100	36.00	0.50	18.00	66	23.76	0	0	41.76	167.17	37.26	15.84
3	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	167.17	0.00	0.00
2	360	100	36.00	0.50	18.00	66	23.76	0	0	41.76	208.93	37.26	15.84
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	208.93	0.00	0.00
					93		111		5	208.93		180.58	73.68
										Total Load			

Live Load Reduction-N			K_{LL}	4
	5	4	3	2
1	0.65	0.53	0.48	0.45
2	0.50	0.50	0.50	0.50

Column Sci- **38A**

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Load Combinations Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	80	42	3.36	1	3.36	43	3.44	0	5	11.80	11.80	5.96	2.29
5	80	100	8.00	1.09	8.71	66	5.28	0	10	23.99	453.65	11.81	3.52
5	0	50	0.00	1.09	0.00	81	0.00	0	0	0.00	453.65	0.00	0.00
4	80	100	8.00	0.84	6.74	66	5.28	0	10	22.02	57.81	10.34	3.52
4	0	50	0.00	0.84	0.00	81	0.00	0	0	0.00	57.81	0.00	0.00
3	80	100	8.00	0.73	5.87	66	5.28	0	5	16.15	73.96	9.68	3.52
3	0	50	0.00	0.73	0.00	81	0.00	0	0	0.00	73.96	0.00	0.00
2	80	100	8.00	0.67	5.35	66	5.28	0	5	15.63	89.60	9.30	3.52
2	0	50	0.00	0.67	0.00	81	0.00	0	0	0.00	89.60	0.00	0.00
					30		25		35	89.60		47.09	16.37
										Total Load			

Live Load Reduction-N			K_{LL}	4
	5	4	3	2
1	1.09	0.84	0.73	0.67
2	0.50	0.50	0.50	0.50

Column	**Sci-**	**38B**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	240	42	10.08	1	10.08	43	10.32	0	5	25.40	25.40	17.88	6.88
5	240	100	24.00	0.73	17.62	66	15.84	0	0	33.46	238.06	29.05	10.56
5	0	50	0.00	0.73	0.00	81	0.00	0	0	0.00	238.06	0.00	0.00
4	240	100	24.00	0.59	14.22	66	15.84	0	0	30.06	88.91	26.50	10.56
4	0	50	0.00	0.59	0.00	81	0.00	0	0	0.00	88.91	0.00	0.00
3	240	100	24.00	0.53	12.71	66	15.84	0	0	28.55	117.46	25.37	10.56
3	0	50	0.00	0.53	0.00	81	0.00	0	0	0.00	117.46	0.00	0.00
2	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	145.30	24.84	10.56
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	145.30	0.00	0.00
					67		74		5	145.30		123.65	49.12
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.73	0.59	0.53	0.49									
2	0.50	0.50	0.50	0.50									

Column	**Sci-**	**38C**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	285	42	11.97	1	11.97	43	12.26	0	5	29.23	29.23	21.23	8.17
5	285	100	28.50	0.69	19.79	66	18.81	0	0	38.60	67.82	33.65	12.54
5	0	50	0.00	0.69	0.00	81	0.00	0	0	0.00	67.82	0.00	0.00
4	285	100	28.50	0.56	16.08	66	18.81	0	0	34.89	102.71	30.87	12.54
4	0	50	0.00	0.56	0.00	81	0.00	0	0	0.00	102.71	0.00	0.00
3	285	100	28.50	0.51	14.44	66	18.81	0	0	33.25	135.95	29.64	12.54
3	0	50	0.00	0.51	0.00	81	0.00	0	0	0.00	135.95	0.00	0.00
2	285	100	28.50	0.50	14.25	66	18.81	0	0	33.06	169.01	29.50	12.54
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	169.01	0.00	0.00
					77		87		5	169.01		144.88	58.33
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.69	0.56	0.51	0.47									
2	0.50	0.50	0.50	0.50									

Column	**Sci-**	**39**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	120	42	5.04	1	5.04	43	5.16	0	5	15.20	15.20	8.94	3.44
5	120	100	12.00	0.93	11.22	66	7.92	0	10	29.14	852.17	16.33	5.28
5	0	50	0.00	0.93	0.00	81	0.00	0	0	0.00	852.17	0.00	0.00
4	120	100	12.00	0.73	8.81	66	7.92	0	10	26.73	71.07	14.53	5.28
4	0	50	0.00	0.73	0.00	81	0.00	0	0	0.00	71.07	0.00	0.00
3	150	100	15.00	0.63	9.45	66	9.90	0	10	29.35	100.41	16.98	6.60
3	0	50	0.00	0.63	0.00	81	0.00	0	0	0.00	100.41	0.00	0.00
2	150	100	15.00	0.57	8.59	66	9.90	0	10	28.49	128.90	16.34	6.60
2	0	50	0.00	0.57	0.00	81	0.00	0	0	0.00	128.90	0.00	0.00
					43		41		45	128.90		73.13	27.20
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.93	0.73	0.63	0.57									
2	0.50	0.50	0.50	0.50									

Column	**Sci-**	**40**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	430	42	18.06	1	18.06	43	18.49	0	5	41.55	41.55	32.04	12.33
5	430	100	43.00	0.61	26.30	66	28.38	0	5	59.68	101.23	48.11	18.92
5	0	50	0.00	0.61	0.00	81	0.00	0	0	0.00	101.23	0.00	0.00
4	430	100	43.00	0.51	21.75	66	28.38	0	5	55.13	156.36	44.69	18.92
4	0	50	0.00	0.51	0.00	81	0.00	0	0	0.00	156.36	0.00	0.00
3	450	100	45.00	0.50	22.50	66	29.70	0	5	57.20	213.56	46.58	19.80
3	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	213.56	0.00	0.00
2	450	100	45.00	0.50	22.50	66	29.70	0	0	52.20	265.76	46.58	19.80
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	265.76	0.00	0.00
					111		135		20	265.76		217.98	89.77
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.61	0.51	0.46	0.43									
2	0.50	0.50	0.50	0.50									

Column	**Sci-**	**41**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	240	100	24.00	0.54	13.01	66	15.84	0	0	28.85	89.95	25.59	10.56
5	420	50	21.00	0.54	11.38	81	34.02	0	0	45.40	135.35	42.56	22.68
4	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	163.19	24.84	10.56
4	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	207.71	41.90	22.68
3	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	235.55	24.84	10.56
3	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	280.07	41.90	22.68
2	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	307.91	24.84	10.56
2	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	352.43	41.90	22.68
					120		228		5	352.43		317.53	151.88
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.54	0.46	0.42	0.40									
2	0.50	0.50	0.50	0.50									

Column	**Sci-**	**42**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	240	100	24.00	0.54	13.01	66	15.84	0	0	28.85	89.95	25.59	10.56
5	420	50	21.00	0.54	11.38	81	34.02	0	0	45.40	135.35	42.56	22.68
4	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	163.19	24.84	10.56
4	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	207.71	41.90	22.68
3	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	235.55	24.84	10.56
3	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	280.07	41.90	22.68
2	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	307.91	24.84	10.56
2	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	352.43	41.90	22.68
					120		228		5	352.43		317.53	151.88
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	**4**	**3**	**2**									
1	0.54	0.46	0.42	0.40									
2	0.50	0.50	0.50	0.50									

Column	**Sci-**	**43**											
											Load Combinations		
Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	240	100	24.00	0.54	13.01	66	15.84	0	0	28.85	89.95	25.59	10.56
5	420	50	21.00	0.54	11.38	81	34.02	0	0	45.40	135.35	42.56	22.68
4	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	163.19	24.84	10.56
4	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	207.71	41.90	22.68
3	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	235.55	24.84	10.56
3	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	280.07	41.90	22.68
2	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	307.91	24.84	10.56
2	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	352.43	41.90	22.68
					120		228		5	352.43		317.53	151.88
										Total Load			

Live Load Reduction-N		K_{LL}	4
	5	4	3	2
1	0.54	0.46	0.42	0.40
2	0.50	0.50	0.50	0.50

Column Sci- 44

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	Load Combinations $\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	660	42	27.72	1	27.72	43	28.38	0	15	71.10	71.10	49.17	18.92
5	240	100	24.00	0.54	13.01	66	15.84	0	de	#VALUE!	#VALUE!	25.59	10.56
5	420	50	21.00	0.54	11.38	81	34.02	0	0	45.40	#VALUE!	42.56	22.68
4	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	#VALUE!	24.84	10.56
4	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	#VALUE!	41.90	22.68
3	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	#VALUE!	24.84	10.56
3	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	#VALUE!	41.90	22.68
2	240	100	24.00	0.50	12.00	66	15.84	0	0	27.84	#VALUE!	24.84	10.56
2	420	50	21.00	0.50	10.50	81	34.02	0	0	44.52	#VALUE!	41.90	22.68
					120		228		15	#VALUE!		317.53	151.88
										Total Load			

Live Load Reduction-N		K_{LL}	4
	5	4	3	2
1	0.54	0.46	0.42	0.40
2	0.50	0.50	0.50	0.50

Column Sci- 45

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	Load Combinations $\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	900	42	37.80	1	37.80	43	38.70	0	5	81.50	81.50	67.05	25.80
5	900	100	90.00	0.50	45.00	66	59.40	0	0	104.40	185.90	93.15	39.60
5	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	185.90	0.00	0.00
4	900	100	90.00	0.50	45.00	66	59.40	0	0	104.40	290.30	93.15	39.60
4	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	290.30	0.00	0.00
3	660	100	66.00	0.50	33.00	66	43.56	0	0	76.56	366.86	68.31	29.04
3	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	366.86	0.00	0.00
2	660	100	66.00	0.50	33.00	66	43.56	0	0	76.56	443.42	68.31	29.04
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	443.42	0.00	0.00
					194		245		5	443.42		389.97	163.08
										Total Load			

Live Load Reduction-N		K_{LL}	4
	5	4	3	2
1	0.50	0.43	0.40	0.38
2	0.50	0.50	0.50	0.50

Column Sci- 46

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	Load Combinations $\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	330	42	13.86	1	13.86	43	14.19	0	5	33.05	33.05	24.59	9.46
5	0	100	0.00	0.66	0.00	66	0.00	0	0	0.00	33.05	0.00	0.00
5	330	50	16.50	0.66	10.94	81	26.73	0	20	57.67	90.72	34.93	17.82
4 Roof	530	100	53.00	1.00	53.00	66	34.98	0	10	97.98	188.70	74.73	23.32
4	330	100	33.00	0.50	16.50	66	21.78	0	20	58.28	246.98	34.16	14.52
3	330	100	33.00	0.50	16.50	66	21.78	0	5	43.28	290.26	34.16	14.52
3	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	290.26	0.00	0.00
2	660	100	66.00	0.50	33.00	66	43.56	0	0	76.56	366.82	68.31	29.04
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	366.82	0.00	0.00
					144		163		60	366.82		270.87	108.68
										Total Load			

Live Load Reduction-N		K_{LL}	4
	5	4	3	2
1	0.66	0.47	0.44	0.41
2	0.50	0.50	0.50	0.50

Column Sci- 47

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	Load Combinations $\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
2	530	100	53.00	0.58	30.52	66	34.98	0	0	65.50	65.50	57.87	23.32
2	0	50	0.00	0.58	0.00	81	0.00	0	0	0.00	65.50	0.00	0.00
					31		35		0	65.50		57.87	23.32
										Total Load			

Live Load Reduction-N		K_{LL}	4
				2
1				0.58
2				0.50

Column Sci- 48

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	Load Combinations $\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
4 Roof	530	100	53.00	1.00	53.00	66	34.98	0	10	97.98	97.98	74.73	23.32
4	0	50	0.00	1.00	0.00	81	0.00	0	0	0.00	97.98	0.00	0.00
2	200	100	20.00	0.53	10.55	66	13.20	0	0	23.75	121.73	21.11	8.80
2	0	50	0.00	0.53	0.00	81	0.00	0	0	0.00	121.73	0.00	0.00
					64		48		10	121.73		95.84	32.12
										Total Load			

Live Load Reduction-N		K_{LL}	4
		4	3	2
1		0.58	0.58	0.53
2		0.50	0.50	0.50

Column Sci- 49

Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	Load Combinations $\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	25	42	1.05	1	1.05	43	1.08	0	5	7.13	7.13	1.86	0.72
5	25	100	2.50	1.75	4.38	66	1.65	0	5	11.03	18.15	4.93	1.10
5	0	50	0.00	1.75	0.00	81	0.00	0	0	0.00	18.15	0.00	0.00
4	25	100	2.50	1.31	3.28	66	1.65	0	5	9.93	28.08	4.11	1.10
4	0	50	0.00	1.31	0.00	81	0.00	0	0	0.00	28.08	0.00	0.00
3 Roof	165	100	16.50	1.00	16.50	66	10.89	0	5	32.39	60.47	23.27	7.26
3	0	50	0.00	0.76	0.00	81	0.00	0	0	0.00	60.47	0.00	0.00
2	165	100	16.50	0.63	10.47	66	10.89	0	0	21.36	81.83	18.74	7.26
2	0	50	0.00	0.63	0.00	81	0.00	0	0	0.00	81.83	0.00	0.00
					36		26		20	81.83		52.91	17.44
										Total Load			

Live Load Reduction-N		K_{LL}	4
	5	4	3	2
1	1.75	1.31	0.76	0.63
2	0.50	0.50	0.50	0.50

Column	Sci-	50											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\,(reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	355	42	14.91	1	14.91	43	15.27	0	5	35.18	35.18	26.45	10.18
5	355	100	35.50	0.65	23.01	66	23.43	0	15	61.44	96.61	40.68	15.62
5	0	50	0.00	0.65	0.00	81	0.00	0	0	0.00	96.61	0.00	0.00
4	355	100	35.50	0.53	18.87	66	23.43	0	15	57.30	153.91	37.58	15.62
4	0	50	0.00	0.53	0.00	81	0.00	0	0	0.00	153.91	0.00	0.00
3 Roof	170	100	17.00	1.00	17.00	66	11.22	0	0	28.22	182.13	23.97	7.48
3	330	100	33.00	0.50	16.50	66	21.78	0	15	53.28	235.41	34.16	14.52
2	500	100	50.00	0.50	25.00	66	33.00	0	0	58.00	293.41	51.75	22.00
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	293.41	0.00	0.00
					115		128		50	293.41		214.59	85.42
										Total Load			

Live Load Reduction-N		K_{LL}	4
5	4	3	2
1	0.65	0.53	0.47	0.43
2	0.50	0.50	0.50	0.50

Column	Sci-	51											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\,(reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	0	100	0.00	0.54	0.00	66	0.00	0	0	0.00	61.10	0.00	0.00
5	660	50	33.00	0.54	17.88	81	53.46	0	0	71.34	132.44	66.87	35.64
4	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	132.44	0.00	0.00
4	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	202.40	65.84	35.64
3	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	202.40	0.00	0.00
3	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	272.36	65.84	35.64
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	272.36	0.00	0.00
2	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	342.32	65.84	35.64
					95		242		5	342.32		313.55	161.48
										Total Load			

Live Load Reduction-N		K_{LL}	4
5	4	3	2
1	0.54	0.46	0.42	0.40
2	0.50	0.50	0.50	0.50

Column	Sci-	52											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\,(reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	0	100	0.00	0.54	0.00	66	0.00	0	0	0.00	61.10	0.00	0.00
5	660	50	33.00	0.54	17.88	81	53.46	0	0	71.34	132.44	66.87	35.64
4	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	132.44	0.00	0.00
4	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	202.40	65.84	35.64
3	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	202.40	0.00	0.00
3	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	272.36	65.84	35.64
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	272.36	0.00	0.00
2	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	342.32	65.84	35.64
					95		242		5	342.32		313.55	161.48
										Total Load			

Live Load Reduction-N		K_{LL}	4
5	4	3	2
1	0.54	0.46	0.42	0.40
2	0.50	0.50	0.50	0.50

Column	Sci-	53											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\,(reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	0	100	0.00	0.54	0.00	66	0.00	0	0	0.00	61.10	0.00	0.00
5	660	50	33.00	0.54	17.88	81	53.46	0	0	71.34	132.44	66.87	35.64
4	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	132.44	0.00	0.00
4	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	202.40	65.84	35.64
3	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	202.40	0.00	0.00
3	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	272.36	65.84	35.64
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	272.36	0.00	0.00
2	660	50	33.00	0.50	16.50	81	53.46	0	0	69.96	342.32	65.84	35.64
					95		242		5	342.32		313.55	161.48
										Total Load			

Live Load Reduction-N		K_{LL}	4
5	4	3	2
1	0.54	0.46	0.42	0.40
2	0.50	0.50	0.50	0.50

Column	Sci-	54											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\,(reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Hi Roof	120	42	5.04	1	5.04	43	5.16	0	5	15.20	15.20	8.94	3.44
Main Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	330	100	33.00	0.54	17.88	66	21.78	0	0	39.66	115.96	35.19	14.52
5	330	50	16.50	0.54	8.94	81	26.73	0	0	35.67	151.64	33.44	17.82
4	330	100	33.00	0.50	16.50	66	21.78	0	0	38.28	189.92	34.16	14.52
4	330	50	16.50	0.50	8.25	81	26.73	0	0	34.98	224.90	32.92	17.82
3	330	100	33.00	0.50	16.50	66	21.78	0	0	38.28	263.18	34.16	14.52
3	330	50	16.50	0.50	8.25	81	26.73	0	0	34.98	298.16	32.92	17.82
2	330	100	33.00	0.50	16.50	66	21.78	0	0	38.28	336.44	34.16	14.52
2	330	50	16.50	0.50	8.25	81	26.73	0	0	34.98	371.42	32.92	17.82
					134		228		10	371.42		327.96	151.72
										Total Load			

Live Load Reduction-N		K_{LL}	4
5	4	3	2
1	0.54	0.46	0.42	0.40
2	0.50	0.50	0.50	0.50

Column	Sci-	55											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\,(reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Hi Roof	120	42	5.04	1	5.04	43	5.16	0	5	15.20	15.20	8.94	3.44
Main Roof	660	42	27.72	1	27.72	43	28.38	0	5	61.10	61.10	49.17	18.92
5	660	100	66.00	0.54	35.77	66	43.56	0	0	79.33	155.63	70.39	29.04
5	0	50	0.00	0.54	0.00	81	0.00	0	0	0.00	155.63	0.00	0.00
4	660	100	66.00	0.50	33.00	66	43.56	0	0	76.56	232.19	68.31	29.04
4	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	232.19	0.00	0.00
3	660	100	66.00	0.50	33.00	66	43.56	0	0	76.56	308.75	68.31	29.04
3	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	308.75	0.00	0.00
2	660	100	66.00	0.50	33.00	66	43.56	0	0	76.56	385.31	68.31	29.04
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	385.31	0.00	0.00
					168		208		10	385.31		333.43	138.52
										Total Load			

Live Load Reduction-N		K_{LL}	4
5	4	3	2
1	0.54	0.46	0.42	0.40
2	0.50	0.50	0.50	0.50

Column	Sci-	56											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	330	42	13.86	1	13.86	43	14.19	0	5	33.05	33.05	24.59	9.46
5	0	100	0.00	0.66	0.00	66	0.00	0	0	0.00	33.05	0.00	0.00
5	330	50	16.50	0.66	10.94	81	26.73	0	20	57.67	90.72	34.93	17.82
4 Roof	530	100	53.00	1.00	53.00	66	34.98	0	10	97.98	188.70	74.73	23.32
4	330	100	33.00	0.50	16.50	66	21.78	0	20	58.28	246.98	34.16	14.52
3	330	100	33.00	0.50	16.50	66	21.78	0	5	43.28	290.26	34.16	14.52
3	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	290.26	0.00	0.00
2	660	100	66.00	0.50	33.00	66	43.56	0	0	76.56	366.82	68.31	29.04
2	0	50	0.00	0.50	0.00	81	0.00	0	0	0.00	366.82	0.00	0.00
					144		163		60	366.82		270.87	108.68
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3	2									
1	0.66	0.47	0.44	0.41									
2	0.50	0.50	0.50	0.50									

Column	Sci-	57											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
2	530	100	53.00	0.58	30.52	66	34.98	0	0	65.50	65.50	57.87	23.32
2	0	50	0.00	0.58	0.00	81	0.00	0	0	0.00	65.50	0.00	0.00
					31		35		0	65.50		57.87	23.32
										Total Load			
Live Load Reduction-N			K_{LL}	4									
				2									
1				0.58									
2				0.50									

Column	Sci-	58											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
4 Roof	530	100	53.00	1.00	53.00	66	34.98	0	10	97.98	97.98	74.73	23.32
4	0	50	0.00	1.00	0.00	81	0.00	0	0	0.00	97.98	0.00	0.00
2	200	100	20.00	0.53	10.55	66	13.20	0	0	23.75	121.73	21.11	8.80
2	0	50	0.00	0.53	0.00	81	0.00	0	0	0.00	121.73	0.00	0.00
					64		48		10	121.73		95.84	32.12
										Total Load			
Live Load Reduction-N			K_{LL}	4									
		4	3	2									
1		0.58	0.58	0.53									
2		0.50	0.50	0.50									

Column	Sci-	59											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
3 Roof	60	100	6.00	1.00	6.00	66	3.96	0	5	14.96	14.96	8.46	2.64
3	0	50	0.00	1.22	0.00	81	0.00	0	0	0.00	14.96	0.00	0.00
2	60	100	6.00	0.93	5.61	66	3.96	0	10	19.57	34.53	8.17	2.64
2	0	50	0.00	0.93	0.00	81	0.00	0	0	0.00	34.53	0.00	0.00
					12		8		15	34.53		16.63	5.28
										Total Load			
Live Load Reduction-N			K_{LL}	4									
			3	2									
1			1.22	0.93									
2			0.50	0.50									

Column	Sci-	60											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	120	42	5.04	1	5.04	43	5.16	0	5	15.20	15.20	8.94	3.44
5	120	100	12.00	0.93	11.22	66	7.92	0	10	29.14	44.34	16.33	5.28
5	0	50	0.00	0.93	0.00	81	0.00	0	0	0.00	44.34	0.00	0.00
4	120	100	12.00	0.73	8.81	66	7.92	0	10	26.73	71.07	14.53	5.28
4	0	50	0.00	0.73	0.00	81	0.00	0	0	0.00	71.07	0.00	0.00
3 Roof	60	100	6.00	1.00	6.00	66	3.96	0	0	9.96	81.03	8.46	2.64
3	120	100	12.00	0.62	7.39	66	7.92	0	10	25.31	106.34	13.46	5.28
2	180	100	18.00	0.56	10.01	66	11.88	0	10	31.89	138.23	19.39	7.92
2	0	50	0.00	0.56	0.00	81	0.00	0	0	0.00	138.23	0.00	0.00
					48		45		45	138.23		81.11	29.84
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3	2									
1	0.93	0.73	0.62	0.56									
2	0.50	0.50	0.50	0.50									

Column	Sci-	61											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	240	42	10.08	1	10.08	43	10.32	0	5	25.40	25.40	17.88	6.88
5	0	100	0.00	0.73	0.00	66	0.00	0	0	0.00	25.40	0.00	0.00
5	240	50	12.00	0.73	8.81	81	19.44	0	15	43.25	68.65	26.05	12.96
4	0	100	0.00	0.59	0.00	66	0.00	0	0	0.00	68.65	0.00	0.00
4	240	50	12.00	0.59	7.11	81	19.44	0	15	41.55	110.20	24.77	12.96
3	0	100	0.00	0.53	0.00	66	0.00	0	0	0.00	110.20	0.00	0.00
3	240	50	12.00	0.53	6.35	81	19.44	0	15	40.79	150.99	24.21	12.96
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	150.99	0.00	0.00
2	240	50	12.00	0.50	6.00	81	19.44	0	15	40.44	191.43	23.94	12.96
					38		88		65	191.43		116.84	58.72
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3	2									
1	0.73	0.59	0.53	0.49									
2	0.50	0.50	0.50	0.50									

Column	Sci-	62											
											Load Combinations		
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	240	42	10.08	1	10.08	43	10.32	0	5	25.40	25.40	17.88	6.88
5	0	100	0.00	0.73	0.00	66	0.00	0	0	0.00	25.40	0.00	0.00
5	240	50	12.00	0.73	8.81	81	19.44	0	15	43.25	68.65	26.05	12.96
4	0	100	0.00	0.59	0.00	66	0.00	0	0	0.00	68.65	0.00	0.00
4	240	50	12.00	0.59	7.11	81	19.44	0	15	41.55	110.20	24.77	12.96
3	0	100	0.00	0.53	0.00	66	0.00	0	0	0.00	110.20	0.00	0.00
3	240	50	12.00	0.53	6.35	81	19.44	0	15	40.79	150.99	24.21	12.96
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	150.99	0.00	0.00
2	240	50	12.00	0.50	6.00	81	19.44	0	15	40.44	191.43	23.94	12.96
					38		88		65	191.43		116.84	58.72
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3	2									
1	0.73	0.59	0.53	0.49									
2	0.50	0.50	0.50	0.50									
Column	Sci-	63											

										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	240	42	10.08	1	10.08	43	10.32	0	5	25.40	25.40	17.88	6.88
5	0	100	0.00	0.73	0.00	66	0.00	0	0	0.00	25.40	0.00	0.00
5	240	50	12.00	0.73	8.81	81	19.44	0	15	43.25	68.65	26.05	12.96
4	0	100	0.00	0.59	0.00	66	0.00	0	0	0.00	68.65	0.00	0.00
4	240	50	12.00	0.59	7.11	81	19.44	0	15	41.55	110.20	24.77	12.96
3	0	100	0.00	0.53	0.00	66	0.00	0	0	0.00	110.20	0.00	0.00
3	240	50	12.00	0.53	6.35	81	19.44	0	15	40.79	150.99	24.21	12.96
2	0	100	0.00	0.50	0.00	66	0.00	0	0	0.00	150.99	0.00	0.00
2	240	50	12.00	0.50	6.00	81	19.44	0	15	40.44	191.43	23.94	12.96
					38		88		65	191.43		116.84	58.72
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3	2									
1	0.73	0.59	0.53	0.49									
2	0.50	0.50	0.50	0.50									

Column	Sci-	64											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Hi Roof	120	42	5.04	1	5.04	43	5.16	0	5	15.20	15.20	8.94	3.44
Main Roof	205	100	20.50	1	20.50	43	8.82	0	10	39.32	39.32	24.19	5.88
5	205	100	20.50	0.77	15.86	66	13.53	0	15	44.39	98.91	25.43	9.02
5	0	50	0.00	0.77	0.00	81	0.00	0	0	0.00	98.91	0.00	0.00
4	205	100	20.50	0.62	12.72	66	13.53	0	15	41.25	140.16	23.07	9.02
4	0	50	0.00	0.62	0.00	81	0.00	0	0	0.00	140.16	0.00	0.00
3	205	100	20.50	0.55	11.32	66	13.53	0	15	39.85	180.01	22.02	9.02
3	0	50	0.00	0.55	0.00	81	0.00	0	0	0.00	180.01	0.00	0.00
2	205	100	20.50	0.51	10.49	66	13.53	0	10	34.02	214.04	21.40	9.02
2	0	50	0.00	0.51	0.00	81	0.00	0	0	0.00	214.04	0.00	0.00
					76		68		70	214.04		125.05	45.40
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3	2									
1	0.77	0.62	0.55	0.51									
2	0.50	0.50	0.50	0.50									

Column	Sci-	65											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Hi Roof	50	42	2.10	1	2.10	43	2.15	0	5	9.25	9.25	3.73	1.43
Main Roof	120	100	12.00	1	12.00	43	5.16	0	15	32.16	32.16	14.16	3.44
5	120	100	12.00	0.93	11.22	66	7.92	0	15	34.14	75.55	16.33	5.28
5	0	50	0.00	0.93	0.00	81	0.00	0	0	0.00	75.55	0.00	0.00
4	120	100	12.00	0.73	8.81	66	7.92	0	15	31.73	107.28	14.53	5.28
4	0	50	0.00	0.73	0.00	81	0.00	0	0	0.00	107.28	0.00	0.00
3	120	100	12.00	0.65	7.74	66	7.92	0	15	30.66	137.94	13.73	5.28
3	0	50	0.00	0.65	0.00	81	0.00	0	0	0.00	137.94	0.00	0.00
2	120	100	12.00	0.59	7.11	66	7.92	0	10	25.03	162.97	13.25	5.28
2	0	50	0.00	0.59	0.00	81	0.00	0	0	0.00	162.97	0.00	0.00
					49		39		75	162.97		75.72	25.99
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3	2									
1	0.93	0.73	0.65	0.59									
2	0.50	0.50	0.50	0.50									

Column	Sci-	66											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Hi Roof	120	42	5.04	1	5.04	43	5.16	0	5	15.20	15.20	8.94	3.44
Main Roof	160	100	16.00	1	16.00	43	6.88	0	5	27.88	27.88	18.88	4.59
5	160	100	16.00	0.84	13.49	66	10.56	0	15	39.05	82.13	20.68	7.04
5	0	50	0.00	0.84	0.00	81	0.00	0	0	0.00	82.13	0.00	0.00
4	160	100	16.00	0.67	10.71	66	10.56	0	15	36.27	118.40	18.59	7.04
4	0	50	0.00	0.67	0.00	81	0.00	0	0	0.00	118.40	0.00	0.00
3	160	100	16.00	0.59	9.48	66	10.56	0	15	35.04	153.43	17.67	7.04
3	0	50	0.00	0.59	0.00	81	0.00	0	0	0.00	153.43	0.00	0.00
2	160	100	16.00	0.55	8.74	66	10.56	0	10	29.30	182.74	17.12	7.04
2	0	50	0.00	0.55	0.00	81	0.00	0	0	0.00	182.74	0.00	0.00
					63		54		65	182.74		101.87	36.19
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3	2									
1	0.84	0.67	0.59	0.55									
2	0.50	0.50	0.50	0.50									

Column	Sci-	67											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
Roof	180	42	7.56	1	7.56	43	7.74	0	5	20.30	20.30	13.41	5.16
5	180	100	18.00	0.81	14.56	66	11.88	0	0	26.44	412.21	22.80	7.92
5	0	50	0.00	0.81	0.00	81	0.00	0	20	20.00	432.21	0.00	0.00
4 Roof	180	100	18.00	1.00	18.00	66	11.88	0	10	39.88	106.62	25.38	7.92
4	120	100	12.00	0.59	7.11	66	7.92	0	20	35.03	141.65	13.25	5.28
3	120	100	12.00	0.56	6.67	66	7.92	0	10	24.59	166.24	12.93	5.28
3	0	50	0.00	0.56	0.00	81	0.00	0	0	0.00	166.24	0.00	0.00
2	240	100	24.00	0.51	12.21	66	15.84	0	10	38.05	204.30	25.00	10.56
2	0	50	0.00	0.51	0.00	81	0.00	0	0	0.00	204.30	0.00	0.00
					66		63		75	204.30		112.77	42.12
										Total Load			
Live Load Reduction-N			K_{LL}	4									
	5	4	3	2									
1	0.81	0.59	0.56	0.51									
2	0.50	0.50	0.50	0.50									

Column	Sci-	68											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
4 Roof	60	100	6.00	1.00	6.00	66	3.96	0	5	14.96	14.96	8.46	2.64
4	0	50	0.00	1.00	0.00	81	0.00	0	0	0.00	14.96	0.00	0.00
2	60	100	6.00	0.93	5.61	66	3.96	0	10	19.57	34.53	8.17	2.64
2	0	50	0.00	0.93	0.00	81	0.00	0	0	0.00	34.53	0.00	0.00
					12		8		15	34.53		16.63	5.28
										Total Load			
Live Load Reduction-N			K_{LL}	4									
		4	3	2									
1		1.22	1.22	0.93									
2		0.50	0.50	0.50									

Column	Sci-	69											
										Load Combinations			
Floor	TA (sf)	LL (psf)	ΣP_{LL} (k)	N	$\Sigma P_{LL\ (reduced)}$ (k)	DL (psf)	ΣP_{DL} (k)	ΣP_{Lat} (k)	ΣP_{Point} (k)	$\Sigma P_{LL}+\Sigma P_{DL}$ (k)	Floor Total	$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)	$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)
4 Roof	70	100	7.00	1.00	7.00	66	4.62	0	5	16.62	16.62	9.87	3.08
4	0	50	0.00	1.00	0.00	81	0.00	0	0	0.00	16.62	0.00	0.00
2	190	100	19.00	0.72	13.59	66	12.54	0	10	36.13	52.75	22.73	8.36

	2	0	50	0.00	0.72	0.00	81	0.00	0	0	0.00	52.75	0.00	0.00
						21		17		15	52.75		32.60	11.44
											Total Load			
	Live Load Reduction-N			**K_{LL}**	4									
			4	**3**	**2**									
	1		1.15	1.15	0.72									
	2		0.50	0.50	0.50									
	Column	**Sci-**	**70**											
											Load Combinations			
	Floor	**TA (sf)**	**LL (psf)**	**ΣP_{LL} (k)**	**N**	**$\Sigma P_{LL\ (reduced)}$ (k)**	**DL (psf)**	**ΣP_{DL} (k)**	**ΣP_{Lat} (k)**	**ΣP_{Point} (k)**	**$\Sigma P_{LL}+\Sigma P_{DL}$ (k)**	**Floor Total**	**$3/4\Sigma P_{LL}+\Sigma P_{DL}+3/4\Sigma P_{Lat}$ (k)**	**$2/3\ \Sigma P_{DL}-\Sigma PU_{plift}$ (k)**
	4 Roof	180	100	18.00	1.00	18.00	66	11.88	0	10	39.88	39.88	25.38	7.92
	4	0	50	0.00	1.00	0.00	81	0.00	0	0	0.00	39.88	0.00	0.00
	2	75	100	7.50	0.72	5.40	66	4.95	0	5	15.35	55.23	9.00	3.30
	2	0	50	0.00	0.72	0.00	81	0.00	0	0	0.00	55.23	0.00	0.00
						23		17		15	55.23		34.38	11.22
											Total Load			
	Live Load Reduction-N			**K_{LL}**	4									
			4	**3**	**2**									
	1		0.81	0.81	0.72									
	2		0.50	0.50	0.50									

I. Updated Energy Calculations

I.1 Energy Model Narrative

The Green Engineer developed at the DD level energy model, and updated this model based on input during the 60 % CD phase and comments from the City.

Included in this submission is the updated model, and the certification that the project will exceed the MSBA requirements for energy efficiency along with Life Cycle Cost Analysis calculations.

The study will be reviewed and updated at the 90%-100% submission

The Green Engineer
Sustainable Design Consulting

www.greenengineer.com

Doherty Memorial High School

60% CD MSBA Submission
Energy Analysis Report

July 16, 2021

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Table of Contents

Executive Summary

The Doherty Memorial High School project includes the construction of a new 422,000 gsf high school for 1,670 students. The project will be located at 299 Highland Street in Worcester at the site of the existing Doherty Memorial High School. In addition to typical core and academic facilities, the program includes four Chapter 74 technical programs, an advanced academy for Biotechnology, and a legitimate stage Auditorium. The project will be fully air conditioned.

The City of Worcester and the MSBA have strong commitments to energy efficient sustainable design. To meet the current MSBA requirements for the additional 2% reimbursement, the project must earn a minimum of LEED-Schools v4 Certified certification and exceed the level of energy efficiency required in the current Massachusetts (base) energy code by 20%. Under these requirements, the project must attain a minimum of 14 points under the Optimize Energy Performance LEED credit.

The Green Engineer (TGE) performed a building performance analysis following ASHRAE 90.1-2013, Appendix G performance path. The results of the modeling indicate that the as-designed building is expected to show total LEED savings of **46.6%** as compared to the Massachusetts code compliant Baseline. The percentage annual site and source energy savings are estimated at **46.5%** and **37.0%**, respectively. Additionally, the greenhouse gas (GHG) emissions for the proposed design are estimated at **820** MTCO2e, corresponding to a **44.1%** reduction from the Baseline emissions.

In order to achieve LEED-Schools v4 Certified status and pursue an additional 2% funding from the MSBA, the project must exceed the Massachusetts base energy code (on a site or source basis) by 20%, which is currently being achieved by a comfortable margin. Performance attained by the design achieves **16 LEED** base points under the Optimize Energy Performance credit. LEED points are calculated according to the EApc95 Pilot Credit (Alternative Energy Performance Metric). The EApc95 optimizes the energy efficiency savings obtained with the use of Heat Pumps in the project. Along with the Annual Site Energy Savings, it considers the average Annual Source Energy Savings and GHG emission reductions, resulting in **40.6%** savings from these observations versus the **33.9%** energy-cost savings. Additionally, the energy-cost savings were calculated according to LEED Interpretation 10481 which grants an additional 6% energy cost-savings credit to projects using ASHRAE 90.1-2013 as the baseline.

The full text of this interpretation is contained in Appendix B and Appendix C. Additional observations and key energy conservation measures are provided in Section IV. A detailed table of energy model inputs is provided in Appendix A.

Figure 1: Performance Improvement for Key Metrics

I. Description of Alternatives

ASHRAE 90.1-2013 Baseline: The baseline building assumes the same form as the design case, while building system characteristics are adjusted to code minimum performance levels following the ASHRAE 90.1 appendix G performance rating methodology.

Design Case: The building as-designed. The design inputs are based on the Design Development Cost Estimate drawings and documents, and information provided by the design team. Every effort has been made to use reasonable assumptions for building components and systems where details were not available.

Please refer to Appendix-A for model inputs.

II. Energy Conservation Measures

The following ECM's have been identified for the project:

- Improved envelope assemblies and fenestration
- Reduced interior lighting power through the use of high efficiency LED fixtures
- High efficiency DOAS and VRF condensing units
- High efficiency single zone cooling units
- High efficiency energy recovery units
- Heat Recovery Chiller
- Use of demand control ventilation is assumed, throughout significant portions of the building as indicated by the sequence of operation specifications.
- Supply air reset on all RTUs units

III. Simulation Results

Following are the simulation results obtained from the energy model iterations. The annual energy use and cost savings for the proposed design are based on energy efficiency strategies incorporated in the design to reduce the energy consumption in the building. The following tables summarize energy use and cost results for the Baseline and the Proposed Design. Also included are the estimated source energy savings and GHG emissions reduction for the design compared to the Baseline. Refer to Appendix-A for details of energy model inputs and assumptions.

Table 1: Site Energy by End-use

Site Energy Use Savings (MMBtu/Yr)											
Description	**Lights**	**Equip ment**	**Space Heating**	**Space Cooling**	**Pumps & Aux**	**Vent Fans**	**DHW**	**Ext Light**	**Total**	**% Savings**	**EUIs**
Code Baseline	2,472	3,682	10,120	1,217	552	4,523	570	201	23,338	-	53.9
Design	1,719	3,682	2,866	1,520	59	1,956	474	201	12,478	46.5%	28.8

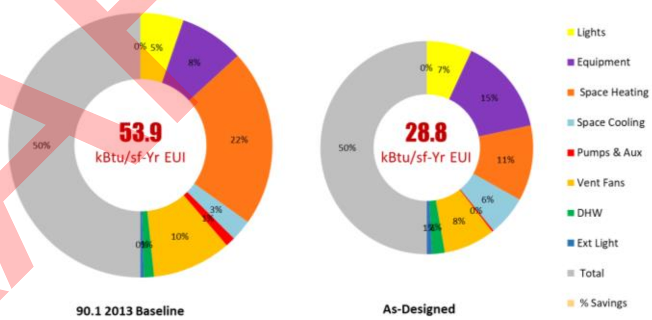
Table 2: Additional Performance Metrics

Energy Use, GHG Reduction and Cost Summary			
Description		**Code Baseline**	**Design**
Annual Site Energy Summary			
Electricity	kWh	3,639,123	2,714,401
Natural Gas	MMBtu	11,230	3,215
Total Site Energy use	MMBtu	23,338	12,478
Annual Energy Cost Reduction			
Electricity	$/year	$600,455	$447,876
Natural Gas	$/year	$136,669	$39,127
Total Energy Cost	$/year	**$737,124**	**$487,003**
		Site Energy Cost Savings (%)	**33.9%**
Annual Source Energy Reduction			
Total Source Energy use	MMBtu	46,568	29,315
		Source Energy Savings (%)	**37.0%**
Green House Gas (GHG) Reduction			
Total GHG Emissions	MTCO2e	1,467	**820**
40% Green Power Purchase Contract[1]	MTCO2e	1,117	559
100% Green Power Purchase (Future)[2]	MTCO2e	596	171
		GHG Reduction without Green Power (%)	**44.1%**
EApc95 Compliance Path (Average of Source and GHG Savings %)			**40.6%**
		Credit for LEED Interpretation 10481 (%)	**6.0%**
		EAc Optimize Energy Performance Total Savings (%)	**46.6%**
		LEED Points	**16**

1. Net building emissions after green power credits have been applied to electricity use based on city's existing contract.

2. Possible net emissions if green power offsets are used for 100% of electricity use.

Figure 2: EUI Comparison



IV. Discussion of Results:

Key Performance Advantages

- The design includes several energy efficiency measures that provide annual energy use savings for the project. Space heating, fans, and lighting are the three largest categories of end use savings for the project. Savings in these end uses can largely be attributed to high efficiency HVAC equipment and optimized control sequences while a high performing envelope contributes as well.
    - In particular, the use of heat pumps reduces the source energy use and emissions relative to the code baseline.
- A high performance envelope and low lighting power density minimize internal loads to the benefit of the heating and cooling plants. Optimized glazing allows more daylight into the building, reducing the need for electrical lighting relative to code glazing requirements.

Identified Performance Opportunities

- Controls sequences should maximize the operation of heat pumps as primary heat as much as possible.
- Targeting an LPD of 0.55 or lower. Current assumption is 0.6 W/ft^2.
- Specifying EnergyStar equipment as possible.
- Consider using oversized AHU cabinets to reduce internal static pressure and associated fan BHP requirements.

Key Assumptions

- Heating, cooling, and fan energy use is also highly sensitive to ventilation air requirements. This analysis assumes that specified ventilation rates are within 5% of ASHRAE 62.1 minimums at the system level, avoiding an overventilation penalty in the design. LEED has recently begun enforcing a code measure that states baseline case ventilation rates must equal ASHRAE 62.1, ventilation rate procedure values. ERU fan energy use is particularly sensitive to this requirement. Under minimum load conditions, a baseline case ventilation system serving classrooms draws lower fan power than the corresponding design case ERU, since the baseline VAV system will be operating at a lower total static pressure. This characteristic is amplified if the design specifies ventilation rates that exceed code minimums.
- The energy savings reported in this document are not final. Simulated results will evolve as the design progresses.

V. Key Design Clarifications:

Based on the level of the design development, TGE used the following assumptions:

- The location and use of chilled beams. Currently, the model assumes the use of chilled beams according to the Mechanical drawing plans.
- The location and use of VRF terminal units. Currently, the model assumes the use of VRF terminal units according to the Mechanical drawing plans.
- Currently, the model assumes hot water as the last stage of heat throughout the building to prioritize the lower-emission heat pumps as a source of heating energy. However, the sequence of operations indicates hot water is staged first in areas served by both radiation and air heat.
- Packaged RTU supply/ventilation outdoor air amounts, capacities, fan break horsepower, and efficiencies. The model currently assumes that the Packaged RTU schedule column for Outdoor Air represents the Supply Air and the column for Exhaust Air represents the Outdoor Air.
- Minimum fan and pump flow ratios either in the drawings or the specifications.

VI. Modeling Methodology

This phase of the energy modeling, based on the Design Development Cost Estimate set, and information provided by the design team, evaluates the performance of the proposed design against an ASHRAE 90.1-2013 compliant Baseline building, for LEEDv4. The modeling was performed in accordance with ASHRAE Standard 90.1-2013, Appendix G protocol.

The purpose of presenting this information is to provide a gauge for the project in terms of energy performance and an opportunity for the design team to review the energy model to refine the systems design to improve performance. The overall energy savings and estimated annual energy consumption for the project is likely to change as the design gets further refined, and the energy model inputs are reviewed and finalized.

The annual energy cost estimates are based on energy modeling results, using eQUEST version 3.65 modeling software. The eQUEST software uses the DOE-2.3 calculation engine to estimate annual energy consumption by simulating a year of building operations based on a typical weather year and user inputs. The geometry of the building is based on the AutoCAD floor plans, except that window positions are simplified based on a percentage glazing in each zone and exposure.

It is important to keep in mind the limitations of energy models when reviewing this information. The results are based on the current design assumptions and utility rates described within this report. Further, energy consumption is highly dependent on weather conditions, building operations and many other factors that are not accounted for under the energy code modeling protocol (ASHRAE 90.1-2013). Therefore, the numbers generated will not necessarily be an accurate prediction of actual energy costs, but should serve as an accurate comparison between design alternatives. **If utility budget estimates are of interest, historical comparisons have shown that actual building energy use typically exceeds energy code simulation values by approximately 30%.**

Occupancy and building operation:

The current model assumes the academic building to have a conventional school year schedule with a reduced summer program summarized in the following table.

Table 3: Summary Schedule

BUILDING OPERATING ASSUMPTIONS			
Status	**Regular Session**	**Summer Session**	**Weekends, Holidays, Out of Session**
Open	7am	8am	N/A
Close	4pm	3pm	N/A

Utility Rates:

The following EIA State Average Rates for electricity and natural gas have been used for estimating annual energy cost savings for the project since the project's utility rate structure has yet to be determined. The utility rates can be updated during the 100% CD model update, as needed:

Electricity: $0.1650 /kWh (2019 EIA Average for MA)

Gas: $12.17 /MBTU (2019 EIA Average for MA)

Appendix A: Model Input Summary

The envelope, internal load assumptions and HVAC system inputs in the energy model are based on the drawings and documents available to us and inputs from the design team.

Doherty Memorial High School DD Energy Model Inputs		
Building Envelope (Construction Assemblies)		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Roof	As per ASHRAE 90.1-2013 Appendix G Insulation entirely above deck R-value: 30 c.i. **Roof U-Value (assembly): 0.032**	15" Rigid at roof: 5.7 per inch (R-45 total) Roof Assembly R-value: 47.39 c.i. **Roof U-Value (assembly): .0.21**
Walls - Above Grade	Exterior wall : Steel Framed Walls Insulation as per ASHRAE 90.1-2013, Appendix G, R-13 + R-10 c.i. **Wall U-Value (assembly): 0.055**	Brick wall assembly: 3.625" brick veneer, 1.25" air space, 4" mineral wool (R 17 total); vapor barrier, 5/8" gyp board, mineral wool batt insulation (R-24)., 5/8" gyp board. **Wall Type E8B: U-VAlue (assembly): 0.021** Gym wall assembly: 3.625" brick veneer, 1.25" air space, 3.5" mineral wool (R 15 total); vapor barrier, CMU hollow block 11.625", 5/8" gyp board. **Wall Type EM12: U-Value (assembly): 0.049**
Slab on grade floors	F-0.520 ; R-15 for 24 in	Identical to baseline
Fenestration and Shading		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Vertical fenestration Area (% of Wall area)	22%, Table G3.1.1-2, Appendix G, ASHRAE 90.1-2013 requirements	25%
Vertical Glazing Description	As per Appendix G, ASHRAE 90.1-2013 requirements	Typical Insulating Glass Unit IG-1
Glazing Thermal Properties: U-Factor	Assembly U-Value - 0.42 (fixed)	Center of Glass U-Value: 0.24 (Winter) Assembly U-Value: 0.37
Glazing Thermal Properties: SHGC	0.4	0.28
Glazing Thermal Properties: VLT	0.44 (1.1 * SHGC, as per section C3.6)	0.7

HVAC (Air-Side)		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Space set-points	Cooling: 75F; Unoccupied 82F Heating: 70F; Unoccupied: 64F	
Hours of Operation	Regular School Schedule Classrooms: 7 a.m. to 4 p.m. (includes afterschool programs); Low use of facility during summer Summer classrooms are available 8 am to 3 pm, 5 days a week. Energy model accounts for weekends and holidays.	
Primary HVAC Type	System #7 VAV with reheat	Primary System Type: RTU with ERV + VAV terminal boxes
Other HVAC Type	System #3: PSZ-AC systems for single zone spaces (Cafe, Gym, Kitchen) System #9: Heating only for stairwells	VRF units (e.g., some office areas, nurse area, IT offices) Chilled beams (corridors, some office spaces) AHU for CLL lab space Single zone PVVT (Gymnasium, Kitchen exhaust area) Cooling-only PVV systems serving IDF room, teledata room, etc. Electric Unit Heaters serving stairwellls, mech, vestibules, etc.
Minimum Outdoor Air Criteria	Modeled as per ASHRAE 62.1	Modeled as per ASHRAE 62.1; CFMs modeled as per schedules
Unitary Cooling Capacity	System#3: Autosize	Per schedules
Unitary Heating Capacity	System#9: Autosize	Per schedules
Fan Operation	Per ASHRAE 90.1-2013, Section G3.1.2.5- Supply and return fans operate continuously whenever spaces are occupied and cycled to meet heating and cooling loads during unoccupied hours.	Fans on following occupancy schdeulde; cycle to meet load when unoccupied
HVAC Air-side Economizer Cycle	Economizer High-Limit Shutoff of 70 deg F.	Enthalpy Wheel economizer; high-limit shutoff of 70 deg F and 26 BTU/lb
Design Airflow Rates	System design supply air flow rates based on a supply-air-to-room-air temperature difference of 20 degF (Supply Air Temp 55 degF; Room Air Temperature 75 degF). VAV Terminals - 30% Turndown Ratio	See schedules (final values will reflect 62.1 calculations)
Fan Power	Supply and return total fan power: System #7: VAV- 0.000490 - 0.000951 kW/cfm includes ERV fan power System #3: PSZ – 0.000421 - 0.000816 kW/cfm; includes ERV fan power System #9: Cabinet Unit Heaters: 0.000054 kW/CFM	DOAS/RTU: 0.000181 - 0.00177 kW/cfm (332 kW total) Cooling-only PVV systems: Assuming .0001 kW/cfm VRF terminal units:Assuming 0.0001 kW/cfm Unit Heaters: Assuming 0.000054 kW/cfm Supply and return total fan power: 336 kW
Exhaust Air Energy Recovery	50% effectiveness for systems required by ASHRAE 90.1 2013 Table 6.5.6.1	AHUs and DOAS include ERV's with 45% - 81% effectiveness
Demand Control Ventilation	DCV is implemented where applicable according to ASHRAE 90.1-2013, Sections G3.1.2.6a and 6.4.3.8	DCV included throughout the building with the exception of exhaust-driven systems: AHU-1, RTU-5, RTU-6, RTU-8, RTU-12, RTU-13
Supply Air Temperature Reset Parameters	Air tempertature for cooling reset higher by 5F under minimum cooling load	Air tempertature reset settings for cooling: RTUs 1-4: 52-65F RTUs 5,6,8: 55-70F RTU 12, 13: 65-70F

HVAC (Water-side)		
Chilled Water		
Number of Chillers	2 water-cooled screw chillers	1 air-to-water scrol chiller
Chiller Capacity (Per Chiller)	auto-size based on load	150 tons
Chiller Efficiency	As per ASHRAE 90.1 2013, Table 6.8.1-3 minimum requirements Full Load 0.56 kW/Ton; COP of 6.28	Design will meet ASHRAE 90.1-2013 chiller efficiency requirements Modeled assumption: Full Load 0.56 kW/Ton, EER 21.43
Chilled Water Loop Supply Temperature	44F	45 -CHW loop temperature; 10F dT
Chilled Water (CHW) Loop Delta-T	12F	10F
CHW Loop Temp Reset Parameters	Reset based on OA Temp: 44F at 80F and above; 54F at 60F and below, and ramped linearly between 44F and 54F at temp between 80F and 60F.	As per sequence of operations
CHW Loop Configuration	Constant primary, Variable secondary	Variable primary
Total Design CHW Pump Power	As per ASHRAE 90.1 2013 allowance. Sum of primary and secondary: 22 W/gpm.	Modeled identical to baseline
Heat Rejection		
Hot Water		
Number of Boilers	2 (gas boilers with natural draft)	3 (gas boilers with natural draft)
Boiler Capacity (Per Boiler)	Autosized	Autosized
Boiler Efficiency	80%	93%
Boiler Water Loop Supply Temperature	180F	140F
Hot Water Loop Delta-T	50F dT	20F dT
HHW Loop Temp Reset Parameters	Warm Up: 180°F HW @ 0°F OA, 150°F HW @ 60°F OA, Occupied: 180°F HW @ 0°F OA, 150°F HW @ 60°F.	Occupied: 135°F HW @ 10°F OA, 100°F HW @ 60°F OA
HHW Loop Configuration	Variable primary	Constant primary, Variable secondary
HW Pump Power and Flow	19W/gpm; flow auto-size	19W/gpm; flow auto-size
Primary HHW Pump Speed Control	Variable speed pumps	Variable speed pumps

Domestic Hot Water		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Type and Quantity	2 gas-storage water heaters	2 gas-storage water heaters
Volume	650 gal each	650 gal each
Capacity	Autosized	1225 MBH each
Efficiency	Tank UA 19.86, Assumed 80% efficiency	Tank UA 19.86, 98% efficiency
Plumbing Fixture Flow Rates	Standard Flow	25% flow savings assumed
Lighting		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Interior Lighting Power Calc Method	Building Area Method	
Interior Lighting Power Density (Average)	0.87 W/SF as per ASHRAE 90.1-2013 Table 9.5.1	0.6; daylight dimming through sensor reduction taken
Miscellaneous		
Model Input Parameter / Energy Efficiency Measure	**Baseline ASHRAE 90.1-2013, Appendix G (VAV w/ Reheat)**	**Design Case (RTU w/ VAV)**
Receptacle equipment	Classrooms - 1.0 W/SF Office - 1.0 W/SF Kitchen - 7.0 W/SF Cafeteria - 0.25 W/SF Media Center - 1.0 W/SF Auditorium - 1 W/SF IDF/Telecom rooms - 7.0 W/SF Breakout/conference - 1.0 W/SF Restrooms - 0.25 W/SF Corridors - 0.25 W/SF	

APPENDIX-B: LEED INTERPRETATION 10481

Rating System

LEED BD+C: New Construction, LEED BD+C: Core and Shell, LEED BD+C: Schools, LEED BD+C: Retail, LEED BD+C: Healthcare, LEED BD+C: Data Centers, LEED BD+C: Hospitality, LEED BD+C: Warehouses and Distribution Centers, LEED BD+C: Multifamily Midrise, LEED ID+C: Commercial Interiors, LEED ID+C: Retail, LEED ID+C: Hospitality
Rating System Version

v4 - LEED v4, v3 - LEED 2009
Ref Guide Name and Edition v4:

Interior Design and Construction, v4 edition
Building Design and Construction, v4 edition
Inquiry

Our project is subject to ASHRAE Standard 90.1-2013 for code compliance. To pursue Option 1: Whole Building Simulation, is there a methodology for documenting additional energy performance for LEED v4 projects regulated by ASHRAE Standard 90.1-2013 Ruling.

Yes, projects applying Option 1: Whole Building Simulation, and regulated by ASHRAE Standard 90.1-2013 may document additional energy performance improvement under LEED v4 EA credit Optimize Energy Performance as described below. The Appendix G modeling method must be used for the LEED submission, even if the Energy Cost Budget method is used to document local code compliance.

Projects may calculate the Equivalent ASHRAE 90.1-2010 Performance improvement as:
Equivalent performance Improvement = % better than ASHRAE 90.1-2013 + Additional Percent Savings

Where Additional Percent Savings is shown in Table 1:

Table 1: Additional Percent Savings for ASHRAE 90.1-2013

Project Type1 Additional Percent Savings
NC-Office 5%
NC-Retail (except restaurant/grocery) 5%
NC-School 6%
NC-Health Care 3%
NC-Restaurant / Grocery 3%
NC-Hospitality 5%
NC-Warehouse 1%
NC-Multifamily 3%
NC-All Other 2%
CS-Office 3%
CS-Retail (except restaurant/grocery) 3%
CS-School 6%
CS-Health Care 1%
CS-Restaurant / Grocery 2%
CS-Hospitality 3%
CS-Warehouse 0%
CS-Multifamily 1%
CS-All Other 1%
CI-Office 3%
CI-Retail (except restaurant/grocery) 4%
CI-School 6%

CI-Health Care 2%
CI-Restaurant / Grocery 3%
CI-Hospitality 4%
CI-Warehouse 0%
CI-Multifamily 1%
CI-All Other 2%

1 Mixed use buildings shall use the weighted average Additional Percent Savings based on the gross enclosed floor area associated with each building type. Unfinished spaces not submitted in the CS rating system shall use the CS values. Data center space must always be considered “All Other”.

APPENDIX-C: ALTERNATIVE ENERGY PERFORMANCE METRIC

The intent of this pilot alternative compliance path is to allow an alternate metric for documenting performance improvement when using Option 1. Whole Building Simulation as the compliance path in EA Prerequisite Minimum Energy Performance, EA Credit Optimize Energy Performance, and EA Credit Renewable Energy Production and to provide USGBC comparative data on metrics for energy performance. The ACP does not change any other aspect of the referenced prerequisites and credits.

Comply with all requirements of Option 1. Whole Building Energy Simulation. Calculate and report a metric from each of the required categories identified below. Refer to the credit specific documentation requirements below for details on the reporting requirements. For all metrics: unbundled RECs for the project building may not be used to adjust the source-to-site factors, GHG emission factors, Primary Energy Factors, or TDV Energy factors. For each energy source serving the building, the source-to-site factors, GHG emission factors, Primary energy factors, or TDV energy factors must be identical for the Baseline and Proposed building models. REQUIRED

CATEGORIES:

- Energy Sources. Complete one of the following (Required for all projects).
    - Source energy. The total source energy consumption shall be calculated for the baseline building performance rating and for the proposed building performance rating, and the percentage improvement shall be determined using source energy. Use the national average ENERGY STAR Source-Site Ratios for each building energy source from the Energy Star Portfolio Manager Technical Reference: Source Energy for projects in the U.S. and Canada. For international projects, use the U.S. source-to-site ratios or published source-to-site ratios for the country or multi-country region where the project is located.
    - Primary energy. The total primary energy shall be calculated for the baseline building performance rating and for the proposed building performance rating, and the percentage improvement shall be determined using the primary energy. Primary Energy Factors for each building energy source shall be determined consistently with ISO Standard 16346:2013 and published for the country or multi-country region where the project is located.
    - Local Equivalent. Alternate methods of calculating primary source energy factors will be considered on a case by case basis. Please provide a narrative and any relevant background data explaining how the primary source energy factors were developed and any third-party review of those calculations that have occurred. The narrative must address how the primary source energy factors account for extraction, transportation, transmission, generation efficiency, and losses (as applicable) from the point of extraction to delivery to the project site.

- Greenhouse gas emissions. The total greenhouse gas emissions, in terms of carbon dioxide equivalents, shall be calculated for the baseline building performance rating and for the proposed building performance rating, and the percentage improvement shall be determined using carbon dioxide equivalent emissions. Complete one of the following (Required for all projects):
    - Energy Star Factors: Greenhouse gas emission factors for each building energy source shall be determined from the ENERGY STAR Portfolio Manager Technical Reference: Greenhouse Gas Emissions using the national or regional averages (no credit may be claimed for offsite green power when using this approach). Applicable only for projects in the U.S. and Canada.
    - ISO 16346:2013: Greenhouse gas emission factors for each building energy source shall be determined consistently with ISO Standard 16346:2013 and published for the country or region where the project is located. Applicable internationally, including projects in the U.S. and Canada.

Using metrics of cost, energy sources, greenhouse gas emissions, and (if available) time dependent valuation: Average the percent savings of the two highest-performing metrics using equal weighting to determine percentage energy savings. Points are awarded according to Table 1. Points for percentage improvement in energy performance under EA credit Optimize Energy Performance. Projects may use the average of the two highest-performing metrics, or cost, whichever is higher, to achieve points under EA credit Optimize Energy Performance.

EA Credit Renewable Energy Production

Provide calculations demonstrating the percent renewable generation calculated using cost as a metric (where cost is calculated consistent with the methodology used for EA Prerequisite 2: Minimum energy performance). Provide supplemental calculations for percent renewable generation for each of the additional metrics reported for EA Prerequisite 2: Minimum energy performance (Energy Sources, Greenhouse Gas Emissions, and if applicable – TDV Energy). Provide a narrative describing how the renewable energy value in the numerator was calculated for each metric.

J. Updated Life Cycle Cost Analysis Energy & Water Consuming Devices

ENERGY UTILITY RATE WORKAREA

Using the appropriate information collected in preparation of the water conservation survey (highlighted in red in the introduction section), please complete the following questions regarding utility rates. All required information is indicated by the light blue shaded cells.

What type of energy do you use to heat your domestic hot water?

2 — **1=ELECTRICITY** **2=NATURAL GAS**

Electricity

	Total Usage (kWh)	Total Cost ($)
Month 1		
Month 2		
Month 3		
Month 4		
Month 5		
Month 6		
Month 7		
Month 8		
Month 9		
Month 10		
Month 11		
Month 12	**1**	**$0**
Total	**1**	**$0**
Avg. Month	**0.083333333**	**$0**

Average Electricity Cost per kWh

$0.17

Natural Gas

	Total Usage (cu.ft.)	Total Cost ($)
Month 1		
Month 2		
Month 3		
Month 4		
Month 5		
Month 6		
Month 7		
Month 8		
Month 9		
Month 10		
Month 11		
Month 12	**1**	**$0.89**
Total	**1**	**$1**
Avg. Month	**0.083333333**	**$0**

Average Natural Gas Cost per cu.ft.

$0.8900

Fuel Oil

	Total Usage (gal)	Total Cost ($)
Month 1	**0**	**$0**
Month 2	**0**	**$0**
Month 3	**0**	**$0**
Month 4	**0**	**$0**
Month 5	**0**	**$0**
Month 6	**0**	**$0**
Month 7	**0**	**$0**
Month 8	**0**	**$0**
Month 9	**0**	**$0**
Month 10	**0**	**$0**
Month 11	**0**	**$0**
Month 12	**0**	**0**
Total	**0**	**$0**
Avg. Month	**0**	**$0**

Average Fuel Oil Cost per gallon

$0.00

WATER UTILITY RATE WORKAREA

Using the appropriate information collected in preparation of the water conservation survey (highlighted in red in the infroduction section), please complete the following questions regarding utility rates.

0 Enter 1 here if your water and wastewater/sewage bills are combined. Then enter combined data in the ***Water*** work area.

Water

	Total Usage (gallons)	Total Cost ($)
Month 1		
Month 2		
Month 3		
Month 4		
Month 5		
Month 6		
Month 7		
Month 8		
Month 9		
Month 10		
Month 11		
Month 12	**20,000**	**98**
Total	**20000**	**$98**
Avg. Month	**1666.666667**	**$8**

Average Water Cost per gallon
$0.0049

Wastewater/Sewer

	Total Usage (gallons)	Total Cost ($)
Month 1		
Month 2		
Month 3		
Month 4		
Month 5		
Month 6		
Month 7		
Month 8		
Month 9		
Month 10		
Month 11		
Month 12	**20,000**	**$209**
Total	**20000**	**$209**
Avg. Month	**1666.666667**	**$17**

Average Wastewater/Sewer Cost per gallon
$0.0104

SAVEnergy Action Plans

Attachment A - Water

Prepared By:	**Seaman Engineering Corporation**				
Agency:					
Facility:	**Doherty Memorial High Community School**				
Contact Name:					
Address:	**299 Highland Street**				
City	**Worcester**	State:	**MA**	Zip:	**01602**
Phone/Fax:					
Date of Audit:					
Buildings included in Survey	**Doherty Memorial High Community School**				
Water Provider(s):	**Worcester Department of Public Works**				
Number of Water Meters:	**1**				
Account/Meter Numbers:	**N/A**				

DOMESTIC WATER USE

Toilets

	Nameplate:	Fixture Type	GPF	Count	User Count Female	User Count Male	GPX	GPD
1	**P-1 & 2**	**valve**	**1.6**	**120**	**925**	**925**	**49.33333333**	**5920**
2							**0**	**0**
3							**0**	**0**
4							**0**	**0**
5							**0**	**0**
6							**0**	**0**
							Total GPD=	**5920**

Calculations:

GPF=Gallons per flush, estimated or measured
GPD=GPF x (3 x Female Count + 1 x Male Count)
= Average gallons per day for all toilets
GPX=GPD/Fixture Count
=Average gallons per day per fixture

Urinals

	Nameplate:	Fixture Type	GPF	Count	User Count Male	GPX	GPD
1	**P-3 & 4**	**valve**	**1.00**	**29**	**925**	**63.79310345**	**1850**
2						**0**	**0**
3						**0**	**0**
4						**0**	**0**
5						**0**	**0**
						Total GPD=	**1850**

Calculations:

GPD=GPF x (2 x Male Count)
=Average gallons per day urinals

Lavatory Sinks

	Nameplate:	Fixture Type	GPM	Count	User Count Female	User Count Male	Wash duration (min.)	GPD
1	**P-5, 6 & 21**	**faucet**	**0.8**	**92**	**925**	**925**	***0.17***	**880.6**
2							***0.17***	**0**
3							***0.17***	**0**
4							***0.17***	**0**
5							***0.17***	**0**
							Total Hand Washing GPD=	**880.6**

Assume 3 hand washings per 8 hour work day per male, 4 per female.
Unless otherwise indicated, assume 10 sec. of flow per hand washing.

Calculations:

GPM=Measured gallons per minute of faucet flow
GPD= 0.17 GPM x (3 x Male Count + 4 x Female Count)
=Average gallons per day for hand washing

	Nameplate:	Fixture Type	GPM	Count	Avg. time on Daily		GPD
	Other Sinks (janitor's closet, laundry, kitchen, etc.)						
1	**Classroom**	**faucet**	**2.2**	**210**	**8**	min.	**3696**
2	**Service**	**faucet**	**3**	**13**	**10**	min.	**390**
3	**Kitchen Sink**	**faucet**	**2**	**9**	**15**	min.	**270**
4	**Hand Sinks**	**faucet**	**1.5**	**6**	**5**	min.	**45**
				Total Non-Lavatory Washing GPD:			**4401**

Calculations:

GPD=Time On x GPM x Fixture Count
=Average gallons per day for other sink use.

Showers

	Location:	GPM	Count	Avg. Use per Day		daily GPD
1	**P-12 & 13**	**2.5**	**22**	**30**	min.	**1650**
2					min.	**0**
3					min.	**0**
4					min.	**0**
					Total GPD=	**1650**

Known Leaks

	Location:	GPM	Count	Avg. Time On		daily GPD
1	**None**	**1**	**0**	**2**	min.	**0**
2					min.	**0**
3					min.	**0**
4					min.	**0**
					Total GPD=	**0**

Calculations:

GPD= Time on x GPM x Fixture Count
=Average gallons per day for leaks

PLANT COOLING AND HEATING

Cooling Towers

Number: [redacted]
Age: [redacted] years
Size: [redacted]
% Blow down: [redacted] % Make-up [redacted]

Water Treatment Method: [redacted]

Evaporative Coolers

Number: [redacted]
Age: [redacted] years

Air Washers

Description: [redacted]

Humidifiers

Description: [redacted]

Boilers

Number:	**2**					
Age:	**0**	years	**/**	**1**		**Electricity**
Fuel Source:	**2**	**<<<<<<<< ENTER<**		**2**	**FOR**	**Nat. Gas**
Size:	**1250**		****	**3**		**Fuel Oil**

Lbs. Steam/hr.: **0.1**
Pressure: **200** psi
% Condensate return: **100%** % Boiler Blow-down: **2%**

Pumps

Number: [redacted]
Age: [redacted] years
Size: [redacted] hp

ONCE-THROUGH COOLING

Air Conditioners

Number of Units: [redacted]
Age: [redacted] years
Size: [redacted] tons **0** gallons

Other Once Through [redacted]

OTHER

	Quantity	Uses/day	Gallons/use	Total Usage per day
Dishwashers	**11**	**4**	**9**	**396** gal
Washing Machines	**3**	**2**	**23**	**138** gal
				534 gal

LANDSCAPE AND DECORATIVE USES

	Square Ft	Acres	Ft water/acre/yr	Acre-ft/yr
Turf Area (square feet)	**0**	**0**	**10**	**0**
Landscaped Area (square feet)	**0**	**0**	**10**	**0**

SUMMARY

TOTAL DAILY DOMESTIC WATER USAGE: **15236** gal/day **does not include boiler use or landscape use.*

TOTAL ANNUAL DOMESTIC WATER USAGE: **3,961,256** gal/yr **assumes 260 operational days per year (see Inputs & Assumptions sheet to change).*

Implementation Questions

Do you want to look at Waterless or Low-Flow urinals?

2	1=WATERLESS 2=LOW FLOW

Do you want to look at faucet replacement (with IR sensored faucets) or aerators only for restroom faucets?

1	1=AERATORS ONLY 2=FAUCET REPLACEMENT

Target Usage for Conserving Plumbing Fixtures

ULF Toilet	1.28	Gallons per flush
ULF Urinal	0.125	Gallons per flush
Waterless Urinal	0.001	Gallons per use *(uses just 2-3 gallons HOT water for cleaning, every 8500 uses)*
Faucet	0.35	Gallons per minute
Showerhead	1.5	Gallons per minute
Dishwasher	4.0	Gallons per load
Washing Machine	15.0	Gallons per load
Faucet Aerator	2.5	Gallons per minute

Assumptions

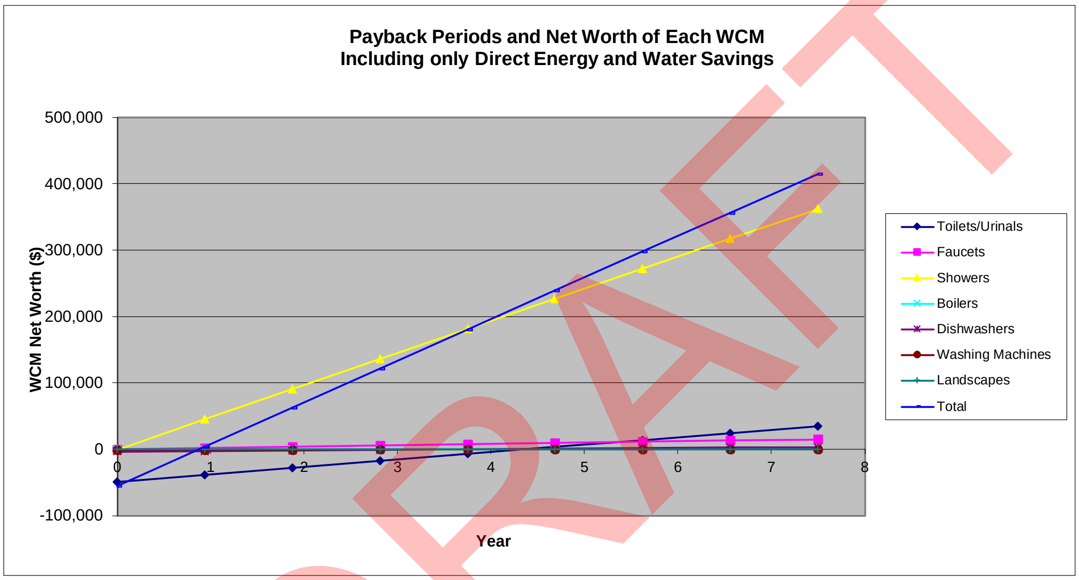
Hot Water Heating	0.2	kWh/gallon for Electrical hot water heaters
	0.5	cf gas/gallon for natural gas hot water heaters
Faucet	50%	of usage is hot water
Shower	60%	of usage is hot water
Dishwasher	100%	of usage is hot water
Wash Machine	25%	of usage is hot water
Leaks	5%	of usage is hot water
Water Treatment	0.58	kWh / 1,000 gallons treated - Indirect savings
UAF Gas	2.1%	of natural gas unaccounted for - Indirect savings
WW elec	2.85	kWh / 1,000 gallons treated - Indirect savings
Line Losses	14%	of Electricity lost in transmission - Indirect savings
IR Sensored Faucet	0.17	minutes per use
Heat in Boiler	362	Btu/lb - estimate
Heat of Propane gas	1,040	Btu/cf
Heat of Fuel oil	145,000	Btu/gal
Boiler Efficiency	95%	Default - 95% for electric, 80% for gas/oil 20 years or less, 70% for all others
Faucet Cleaning Use	50%	of non-restroom faucets' usage for cleaning (i.e. bucket filling) or other uses that will not be reduced by an aerator.
Landscape Savings	50%	of water reduced using ET watering techniques
Blowdown Reduction	20%	of Boiler blowdown reduced through process optimization
Heat of Electricity	3412	Btu=1 kWh
One Year	260	days (total work days assumed, not total calendar days)

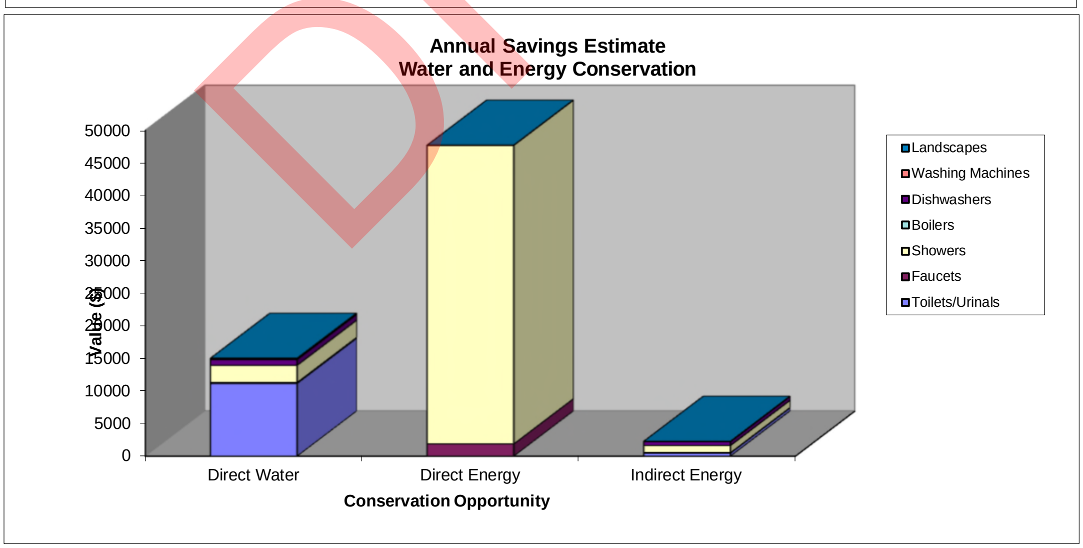
Cost Information

	Equipment	Labor	Total	
ULF Toilet Replacement	$220	$75	$295	
ULF Urinal Replacement	$350	$125	$475	
Waterless Urinals	$500	$125	$625	
Aerators	$8	$5	$13	
Sensored Faucets	$280	$50	$330	
Showerheads	$21	$10	$31	
Leak Detection			$0	
Once Thru Conversion			$0	
Cooling Water Reduction			$0	
Blowdown Reduction			$0	
Lawn Sprinkling reduction			50%	of water savings value
Washing Machine	$400	$25	$425	
Dishwasher	$250	$75	$325	

Potential Conservation Opportunities

Conservation Method	Number of Installations	Total Initial Cost ($)	Annual Savings ($) Direct Water	Direct Energy	Indirect Energy	Payback Period* (yrs) *Includes Direct Energy Only
Installation of ULF toilets and ULF urinals	149	$49,175	$11,171	$0	$494	4.40
Installation of automatic faucets	0	$0	$0	$0	$0	#N/A
Installation of faucet aerators	13	$169	$182	$5,605	$65	0.03
Low Flow showerhead	22	$682	$2,631	$45,817	$1,099	0.01
Boiler blowdown optimization	2	$0	$0	$3	$0	0.00
Efficient dishwashers	11	$3,575	$877	$0	$585	4.08
Efficient washing machines	3	$1,275	$191	$0	$38	6.66
Landscape irrigation optimization	#N/A	$0	$0	$0	$0	Annual
Total (excluding Landscape)		**$54,876**	**$15,052**	**$51,426**	**$2,280**	**0.83**





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seamanengineers.com

HVAC 60% Construction Document

Life Cycle Report

For The

DOHERTY HIGH SCHOOL

IN

WORCESTER, MA

July 15, 2021

Prepared by:

SEAMAN ENGINEERING CORPORATION
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Millbury, MA 01527
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TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

This report defines the Heating, Ventilating and Air Conditioning (HVAC) systems being designed for the new Doherty High School in Worcester, MA. The systems described herein are representative of the 60% Construction Documents. Building consists of a total project floor area of 421,858 GSF of building and 44,000 GSF of Garage.

The following briefly describes the building systems currently included in the 60% Construction Documents package:

The main heat source for the building is a heat recovery chiller heat pump unit. This unit is backed up by a high efficiency 93%+ gas-fired boiler plant. Both these systems supply hot water to fin-tube radiation, air handler coils and other water coils supporting the heating and ventilation needs of the building. Fin-tube radiation supports most classroom areas and other exterior perimeter areas with high percentages of glass. Packaged rooftop heat pump air handling systems support the administration, gym, café, theatre, media and lobby areas. Most all building areas have their ventilation, cooling and dehumidification needs supported by total energy recovery units distributing reclaimed and tempered air to each area via a VAV terminal box which varies airflow based on room cooling load and indoor air quality via CO_2 sensors. These units have refrigerant based dehumidification cycles which use hot gas from the refrigeration cycle for reheating. Most all systems, with the exception of the kitchen make-up air unit and garage purge ventilation system, incorporate total energy recovery technology using waste exhaust air to pretreat the incoming outdoor air.

A majority of the classroom spaces are supported with chilled beam displacement cooling technology. This feature utilizes floor level diffusers fitted with chilled water coils to introduce fresh air within the breathing zone of the spaces as well as to supplement the cooling provided from the associated dedicated outdoor air systems (DOAS). The chilled beams are supplied with chilled water via a packaged air-cooled heat recovery chiller which also provides hot water to the buildings heating loop.

The kitchen incorporates a demand control ventilation system on the kitchen exhaust and make-up air system. System uses temperature and/or infrared smoke sensors to modulate the exhaust air and associated make-up air in response to the hood challenge.

The following table summarizes the economic aspect of the proposed system. Life cycles were run based on 20 years however, life of equipment will vary such as boilers at 30 years, chillers and RTU's at 15 to 20 years and VRF systems at 15 years. Values below are in current dollars with no discount factor applied. An annual escalation rate for energy or maintenance costs was set at 3%.

We feel they HVAC annual energy operating costs presented are somewhat inflated at this early schematic stage of modeling as not all energy saving routines have been modeled and occupancy loads for swing spaces are preliminarily high until the program use becomes further defined.

ECONOMIC SUMMARY

	Installed Cost	Annual Energy Cost	Annual Maint.	20 year Life Cycle Cost
60% CD*	**$23,745,883**	**$498,008**	**$140,000**	**$60,690,147***

**Cost Estimates from A.M. Fogarty & Associates, Inc. DD estimate as 60% CD was not available.*
** Life cycle values indicated are from the DD submission as the 60% CD estimate was not available. Annual escalation rate of 3%. Annual Maintenance based on ASHARE and published studies at approximately $0.30 per SF baseline.*

II. DESIGN PARAMETERS & LOADS

A. DESIGN CRITERIA

The design criteria used for the development and sizing of the HVAC systems and components was as defined in the Commonwealth of Massachusetts State Building Code 780 CMR and applicably referenced ICC International Mechanical Code 2015. Worcester area outdoor peak design conditions were utilized correcting for the fact that the Worcester weather station is located at an airport at a higher elevation.

Interior design temperature set points are 70°F for heating and 75°F for cooling (for spaces with cooling) during occupied conditions. Indoor dehumidification setpoint for classroom spaces shall be set within a range of 50% to 55% RH. Space conditions are allowed to drop to 60°F during the heating season and rise to 85°F during the cooling season when spaces are in the unoccupied condition. Morning warm-up or cool-down period is optimized to achieve design space conditions at the commencement of occupied periods.

Outside air ventilation requirements were based on the ICC International Mechanical Code 2015 as referenced by the building code as well as cross references to ASHRAE Ventilation Standard 62.1-2016. System equipment efficiencies meet and, in most cases, exceed IECC International Energy Conservation Code 2018.

B. COOLING & HEATING LOADS

Cooling and heating load calculations were performed utilizing the design data referenced above. Climate data for Worcester, MA was selected for load and energy calculations. Summary output data can be found in Appendix C.

The building heating and cooling load requirements under peak design load conditions as indicated above are estimated as follows and are preliminary pending further advancement of building plans for improved load estimation:

	Heating Load	**Cooling Load**	**Tons**
Building Loads	**7,628,857 BTUH**	**9,052,222 BTUH**	**754**

The estimates do not include cooling loads for tel./data and MDF rooms or localized heating loads for mechanical rooms and vestibules as well as tempering for the parking garage.

III. ENERGY SIMULATIONS

Energy simulations noted within this report were run using Carrier HAP version 5.1 Hourly Analysis software. The results can be found in Appendix D.

There are various limitations to energy simulation programs especially in a building such as this where occupant loads can vary greatly day to day and space to space. In addition, there are modeling limitations regarding the hybrid plant and systems which incorporate heat recovery chiller modules, gas-fired boilers as well as VRF systems operating in tandem. We have listed some of our assumptions below, some of which may have been forced by program modeling limitations.

Note: Parking garage, MDF, IDF rooms and other small ancillary spaces are not included.

Assumptions:

- Occupancy times are from 7:00 AM to 5:00 PM Monday thru Friday with some common area spaces such as gymnasium also used 7AM to 3PM on Saturday all with varying occupant loading.
- Full occupancy was presumed for all areas except for the gymnasium and cafeteria spaces where partial occupancy was assumed for most time periods.
- Misc. power and lighting loads were not varied during occupancy however in reality this shall vary based on daylight dimming and occupancy controls thereby resulting in lower lighting and power loads overall as well as associated thermal load impact. Unoccupied power and lighting was modeled at 10%.
- School is occupied from September thru June. Office administration system and the media system are the only areas of the building which were modeled as occupied in July & August.
- Indoor space temperature setpoints are 75°F/85°F occ./unocc. cooling (in areas where cooling is supplied and 72°/60° occ./unocc. heating.
- Indoor space humidity dehumidification setpoint is 55% RH with a design range of 50% to 55%.
- Natural gas rate @ $0.90 per Therm
- Electric rate @ $0.17 per kW

IV. COST ESTIMATES

Cost estimates for the Design Development package were assembled utilizing the estimates prepared from A.M. Fogarty & Associates, Inc.

The 60% construction document cost estimate for the HVAC system was not available at the time of this report as such the DD estimate was utilized at $**23,745,883**.

Excerpts from the A.M. Fogarty & Associates, Inc. Design Development estimate are included in Appendix A.

Appendix A

COST ESTIMATES

(Refer to A.M. Fogarty & Associates, Inc. Design Development Estimate as the 60% CD Estimate was unavailable)

Appendix B

Major Equipment Data

HOT WATER BOILERS

HIGH EFFICIENCY BOILERS

CREST®

CONDENSING BOILER

SMART TOUCH™

WITH BACnet MSTP PROTOCOL, CASCADING SEQUENCER WITH CASCADE REDUNDANCY

6 INPUTS FROM 750,000 TO 2.0 MILLION BTU/HR

DIRECT-VENTING UP TO 100 FEET USING PVC, CPVC, POLYPROPYLENE OR STAINLESS STEEL

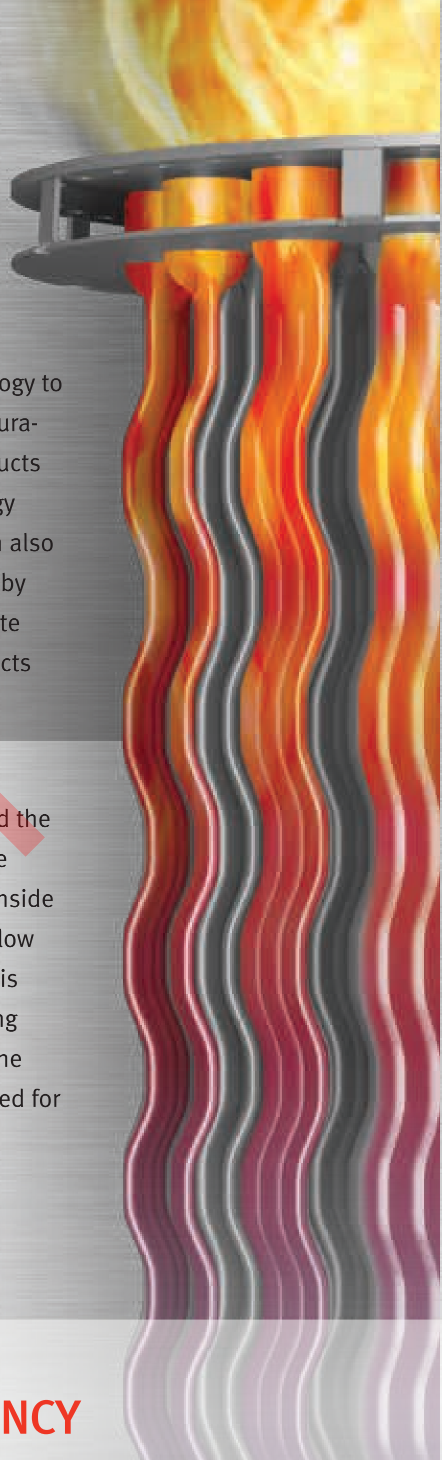
FLOW RATES FROM 18 TO 350 GPM

96.2% AHRI CERTIFIED™ www.ahridirectory.org

THERMAL EFFICIENCY

Lochinvar®

HIGH EFFICIENCY BOILERS & WATER HEATERS

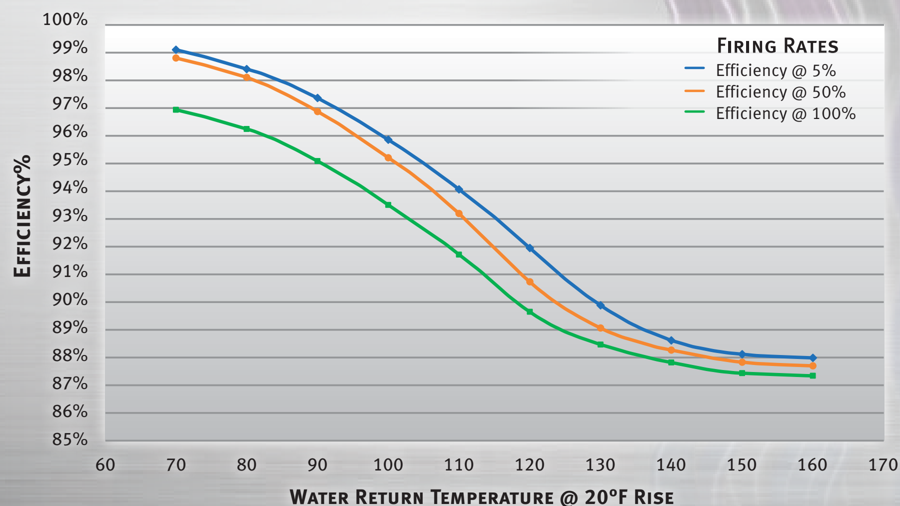


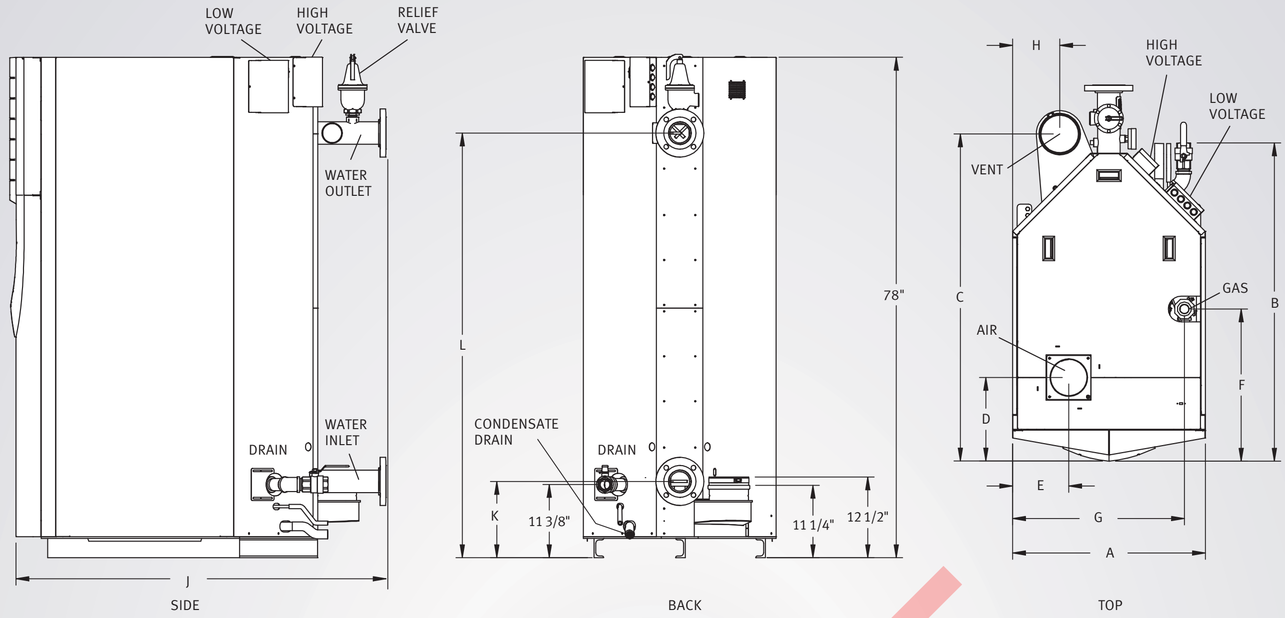
SUPERIOR FIRE-TUBE HEAT EXCHANGER DESIGN BOOSTS THERMAL EFFICIENCY

The CREST boiler takes fire-tube technology to a new level. The patented Wave™ configuration creates turbulence as flue gas products flow down the tube, scrubbing the energy from the flue products. The Wave design also enhances the life of the heat exchanger by allowing the tubes to flex, so they operate stress free with none of the adverse effects suffered by traditional fire-tube boilers.

Each fire tube is welded into the heat exchanger and surrounded by water, and the heat transfer process is enhanced by the water's counterflow. As water flows up inside the vessel, super-heated flue products flow down the fire tube. With one pass, heat is effectively captured, reaching condensing temperatures. At the top of the vessel, the combustion chamber is also water-backed for additional heat transfer.

CREST BOILER EFFICIENCY





Model Number	Input MBH Min	Input MBH Max	AHRI Thermal %	Output MBH	Net AHRI Rating MBH	Turndown	A	B	C	D	E	F	G	H	J	K	L	Gas Conn.	Water Inlet/ Outlet	Air Intake	Vent Size	Oper. Weight	Ship. Weight
FBN0751	50	750	96.2%	722	627	15:1	30"	49-1/2"	51"	13"	8-3/4"	23-3/4"	26-3/4"	7-3/8"	57-5/8"	11-7/8"	66-1/8"	1-1/4"	3"	6"	6"	1,768	1,560
FBN1001	50	1,000	96.2%	962	837	20:1	30"	49-3/8"	51"	13"	8-3/4"	23-1/8"	26- 3/4"	6-1/2"	57-5/8"	11-7/8"	66-1/8"	1-1/4"	3"	6"	6"	1,838	1,596
FBN1251	63	1,250	96.2%	1,203	1,046	20:1	30"	49-1/4"	51-3/8"	13"	8-3/4"	21-5/8"	26-3/4"	6-1/2"	57-3/4"	11-7/8"	66-1/8"	1-1/4"	3"	6"	8"	1,975	1,648
FBN1501	60	1,500	96.2%	1,443	1,255	25:1	30"	40-5/8"	62-3/8"	15 7/8"	9"	27-7/8"	26-7/8"	5-1/8"	68"	12-3/8"	65-3/8"	1-1/2"	4"	8"	8"	2,307	1,961
FBN1751	70	1,750	96.2%	1,684	1,464	25:1	30"	38-7/8"	61-1/2"	15 7/8"	9"	27-1/8"	27"	5-1/8"	68"	12-3/8"	65-3/8"	1-1/2"	4"	8"	8"	2,458	2,017
FBN2001	80	2,000	96.2%	1,924	1,673	25:1	30"	38-7/8"	61-1/2"	15 7/8"	9"	26-3/4"	27"	5-1/8"	68"	12-3/8"	65-3/8"	1-1/2"	4"	8"	8"	2,570	2,087

*NOTES: Change "N" to "L" for LP gas models. Indoor installation only. *Information subject to change without notice*

Smart Touch™ Features

SMART TOUCH Touchscreen Operating Control
Full-Color 8" Touchscreen LCD Display
Built-in Cascading Sequencer for up to 8 Boilers with Built-in Redundancy
- Cascade Multiple Sized Boilers
- Lead/Lag Cascade
- Efficiency Optimized Cascade

Front-End Loading Capability with Copper-Fin II® and Power-Fin® Boilers
Building Management System Integration with 0-10 VDC Input
BACnet MSTP Communications
Outdoor Reset Control with Outdoor Air Sensor
Password Security
Domestic Hot Water Prioritization
- DHW tank piped with priority in the boiler loop
- DHW tank piped as a zone in the system with the pumps controlled by the Smart System
- DHW Modulation Limiting
- Separately Adjustable SH/DHW Switching Times

Low Water Flow Safety Control & Indication
Inlet & Outlet Temperature Readout
Freeze Protection
Service Reminder
Time Clock
Data Logging
- Hours Running, Space Heating
- Hours Running, Domestic Hot Water
- Hours Running, Modulation Rate
- Ignition Attempts
- Last 10 Lockouts

Programmable System Efficiency Optimizers
- Night Setback
- Anti-Cycling
- Outdoor Air Reset Curve
- Ramp Delay
- Boost Temperature & Time
- Modulation Factor Control

Three Pump Control
- System Pump
- Boiler Pump
- Domestic Hot Water Pump

High-Voltage Terminal Strip
- 120 VAC / 60 Hertz / 1 Phase Power Supply
- System Pump, Boiler Pump and DHW Pump Power

Low-Voltage Terminal Strip
- 24 VAC Auxiliary Device Relay
- Auxiliary Proving Switch Contacts
- Alarm on Any Failure Contacts
- Runtime Contacts
- DHW Thermostat Contacts
- Unit Enable/Disable Contacts
- System Sensor Contacts
- DHW Tank Sensor Contacts
- Outdoor Air Sensor Contacts
- Cascade Contacts
- 0-10 VDC BMS External Control Contact
- 0-10 VDC Variable Speed Boiler Pump Control Contact

Optional Equipment

Wireless Outdoor Temperature Sensor
Alarm Bell
BMS Gateway - BACnet IP or LonWorks
Condensate Neutralization Kit
SMART TOUCH PC Software
Common Vent Kits
Electrical Options (Shipped Loose):
- 208V/3Ø/60Hz
- 480V/3Ø/60Hz
- 600V/3Ø/60Hz

Motorized Isolation Valve
Variable Speed Boiler Pump

Codes & Registrations

ANSI Z21.13/CSA Certified
ASME Certified, "H" Stamp / National Board
California Code Compliant
CSD1 / Factory Mutual / GE Gap Compliant
AHRI Certified

Standard Features

96.2% Thermal Efficiency (AHRI)
Up to 99% Thermal Efficiency in Low-Temp. Applications
Modulating Burner with up to 25:1 Turndown
Direct-Spark Ignition
Low-NOx Operation
Sealed Combustion
Air Inlet Filter w/Replacement Reminder
Low Gas Pressure Operation
Vertical and Horizontal Direct Venting
- Direct Vent up to 100 Feet
- PVC, CPVC, Polypropylene or AL29-4C

ASME "H" Stamped Heat Exchanger
316L Stainless Steel Fire Tubes
160 psi Working Pressure
On/Off Switch
Adjustable High Limit with Manual Reset
Low Water Cutoff with Manual Reset & Test
High & Low Gas Pressure Switches w/Manual Reset
Low Air Pressure Switches
Condensate Trap w/Blocked Drain Switch
Drain Valve
System Sensor
Outdoor Air Sensor
Inlet & Outlet Temperature Sensors
High-Voltage Terminal Strip
Low-Voltage Terminal Strip
Downstream Gas Test Cocks
50 psi ASME Relief Valve
Temperature & Pressure Gauge
Zero Clearances to Combustible Materials
10-Year Limited Warranty (See Warranty for Details)
1-Year Warranty on Parts (See Warranty for Details)

Lochinvar
HIGH EFFICIENCY BOILERS & WATER HEATERS

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Chiller-Heater Heat Pump

MULTISTACK

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ARA

AIR-SOURCE DHRC HEAT PUMP

Customer driven innovation is powerful... we built the most successful modular chiller company in the world based on the single premise that customers' needs come before our own. It's simple; there are many new technologies and products that appear in the marketplace over the course of a companies existence. Our powerful secret is to engage our customers, understand their needs, and select only the most disruptive technologies to develop into the next Multistack solution. Today, electrification is at the center of our development focus as we strive to meet the environmental sustainability challenge head on!

The Multistack Group are far more than just chiller manufacturers... our portfolio covers a broad range of HVAC products both modular and conventional... all focused on *customer driven innovation*!

ARA: an air-cooled heat pump with integrated DHRC (Dedicated Heat Recovery)

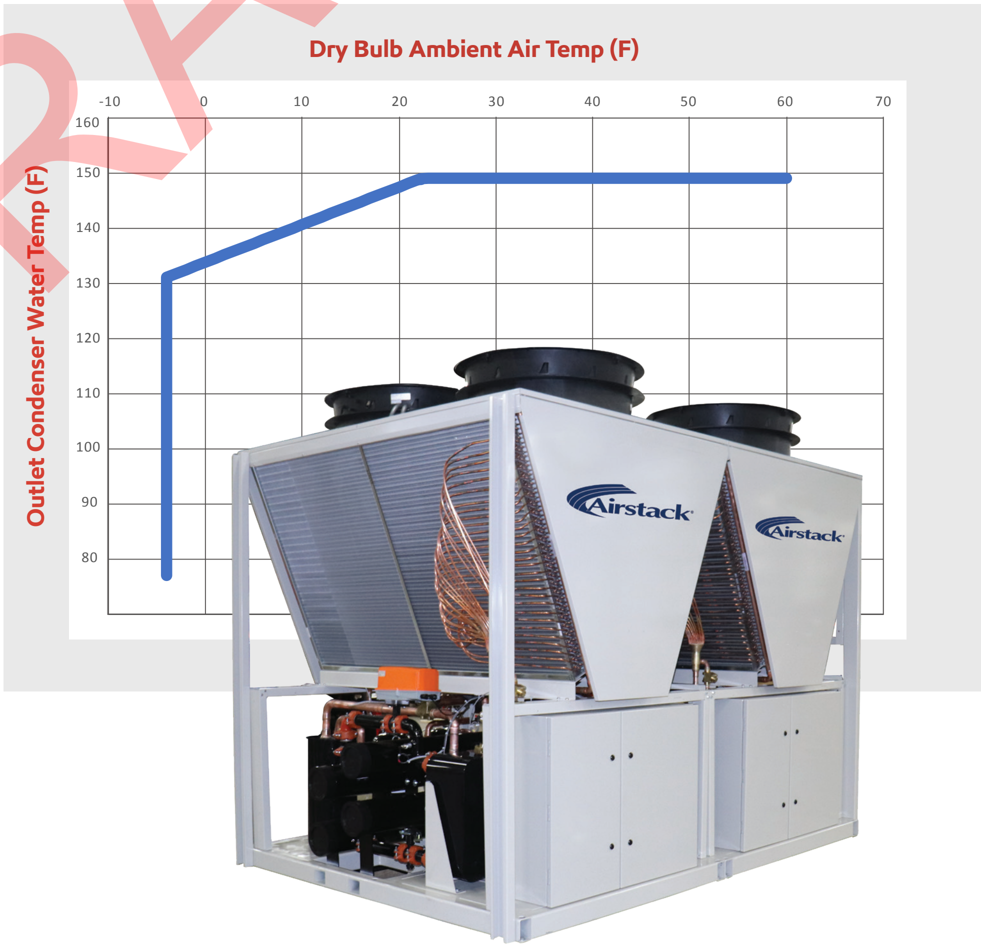
- 4-pipe system satisfies heating and cooling requirement
- Simultaneous load handled by integrated heat recovery heat exchanger
- Unneeded heat (not handled by DHRC) can be rejected to atmosphere
- Needed heat (not handled by DHRC) can be acquired from atmosphere.

Cutting edge refrigerant injection scrolls expand operating envelope

- Refrigerant injection provides 2 main benefits
  - Increases system capacity through additional sub-cooling
  - Ensures adequate compressor motor cooling at higher pressure ratios
- Delivers 130F+ HW at 0F outdoor ambient.
- Expanded envelope operation available in heating mode only

MultiPRO CORE Central Plant Controller is available with ARA

- CORE can control:
  - ARA operation
  - CHW pump(s)
  - HW pumps(s)
  - System bypass valve(s)
- CORE Central Plant Controller can be:
  - Factory mounted, wired, and tested
  - Or shipped loose for field installation



ARA

AIR-SOURCE
DHRC
HEAT PUMP

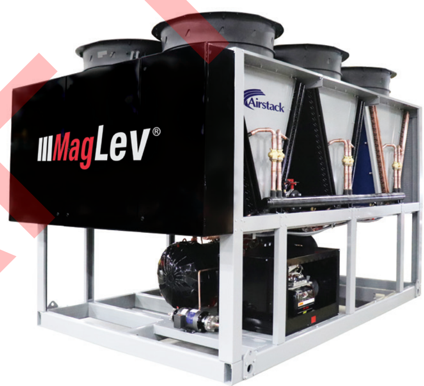
MULTISTACK®

WHAT'S NEW AT MULTISTACK®

From **Air** to **Water** and **Heating** to **Cooling: Multistack's** newest product line additions all bring integrated simplicity to building efficiency. The movement of the HVAC industry to whole system solutions echo **Multistack's** latest offerings with integrated free cooling, simultaneous heating and cooling, efficient variable speed designs, and cutting-edge controls. Contact your **Multistack** representative today to see how we can bring your design to the next level.

ACF

NEXT GEN
AIR-COOLED
MAGLEV



MSH

NEXT GEN
DHRC
MAGLEV

MultiPRO CORE

CENTRAL
PLANT
CONTROLLER

Packaged Roof-top Heat Pump Units

DATASHEET

VALENT DEDICATED OUTDOOR AIR SYSTEMS

OUTDOOR AIR EXPERTS

Valent was one of the first to specialize in high outdoor air units, which can be more challenging to design than recirculated air units.

ROBUST DESIGN

Valent uses quality components and can build in numerous configurations. Casings are sturdy, easy to maintain, have multiple access doors, and are well insulated.

DEDICATED SUPPORT

Our commitment to quality and extensive end-of-line testing reduce your need to call tech support but, if you do, we'll help with issues before and after the sale.

SHORT LEAD TIMES

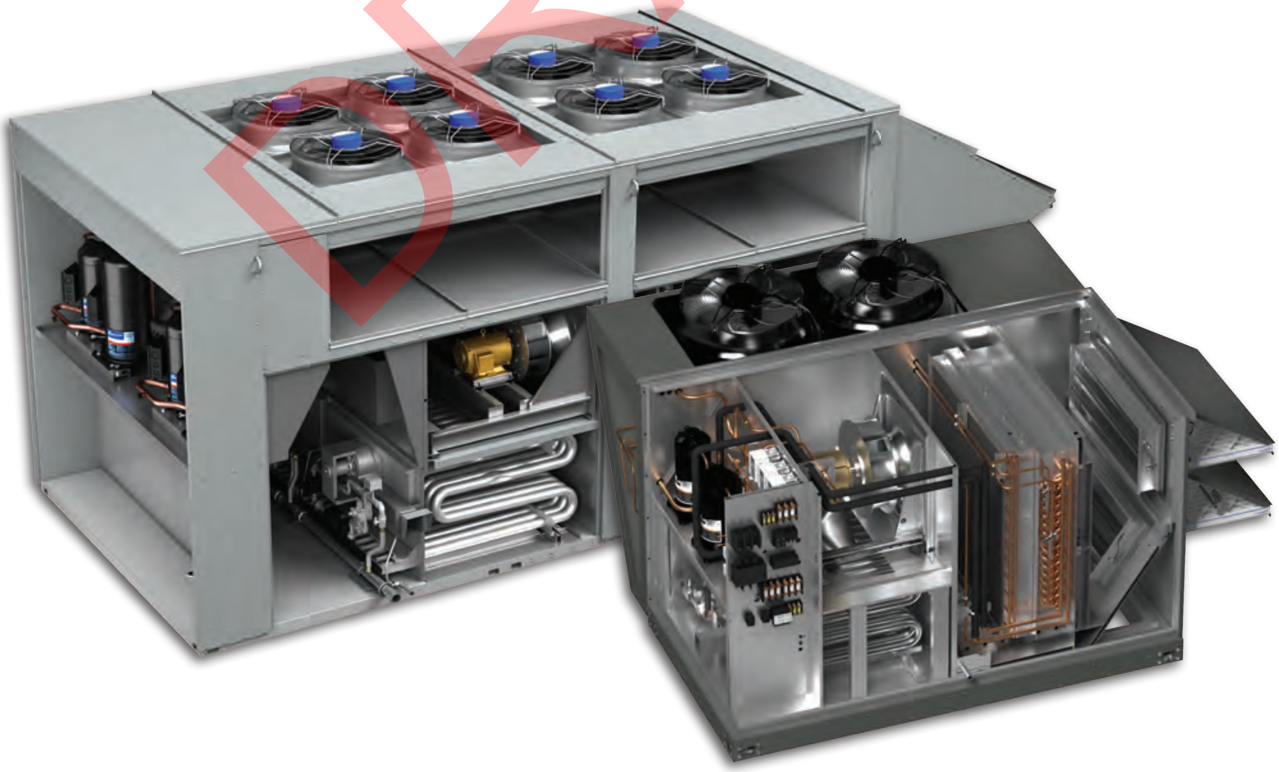
98% on-time shipping and Valent production capacity in four locations mean lead times are short, even in high-demand seasons.

EASY, EFFICIENT CONTROLS

Preconfigured control sequences, embedded web user interface, seamless interoperability, and on-screen refrigeration detail provide easy and reliable unit control.

HIGHLY CONFIGURABLE

Valent offers quality components in multiple configurations, including inverter compressors, ultra-quiet condenser fans, and up to 16:1 turndown furnaces.



VALENT UNITS AT A GLANCE

		VX, VXE CASING				VPR, VPRX, VPRE, VPRP, VPRC CASING				
		112	**212**	**312**	**352**	**V10**	**110**	**210**	**310**	**352**
AIRFLOW	**Minimum**[a] (cfm)	800	2,250	3,750	3,900	550	645	1,290	3,225	3,900
AIRFLOW	**Maximum**[a] (cfm)	5,750	9,500	16,000	18,000	3,000	4,300	8,000	12,100	18,000
COOLING TYPE		Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons
COOLING TYPE	**Packaged, air cooled**	5	15	25	30	4	5	10	25	30
		7.5	17.5	30	40	5	8	13	30	40
		10	20	40	50	6	10	16	35	50
		12.5	25	50	60	7	—	18	40	60
		15	30	—	70	—	—	20	—	70
		—	—	—	—	—	—	25	—	—
COOLING TYPE	**Split, air cooled**[b]	5	15	Not available	Not available	Not available	Not available	Not available	Not available	Not available
		7.5	17.5							
		10	20							
		12.5	25							
		15	30							
		—	—							
COOLING TYPE	**Chilled water**	Available	Available	Available	Available	Not available	Available	Available	Available	Available
COOLING TYPE	**Water source heat pump**	Not available	Not available	Not available	Not available	Not available	5	10	25	30
							8	13	30	40
							10	16	35	50
							—	18	40	60
							—	20	—	—
							—	25	—	—
COOLING TYPE	**Air source heat pump**	Available	Available	Not available	Not available	Not available	Not available	Not available	Not available	Not available
COOLING TYPE	**No cooling**	Option	Option	Option	Option	Option	Option	Option	Option	Option
COOLING COMPONENTS	**Digital Scroll compressor**	Standard	Standard	Standard	Standard	N/A	Standard	Standard	Standard	Standard
COOLING COMPONENTS	**Inverter scroll compressor**[c]	Option	Option	Option	Option	Standard	Option	Option	Option	Option
COOLING COMPONENTS	**Modulating hot gas reheat**	Option	Option	Option	Option	Option	Option	Option	Option	Option
COOLING COMPONENTS	**Staged AC condensing fans**	Standard	Standard	Standard	Standard	Not available	Standard	Standard	Standard	Standard
COOLING COMPONENTS	**Modulating EC condensing fans**[d]	Option	Option	Option	Option	Standard	Option	Option	Option	Option

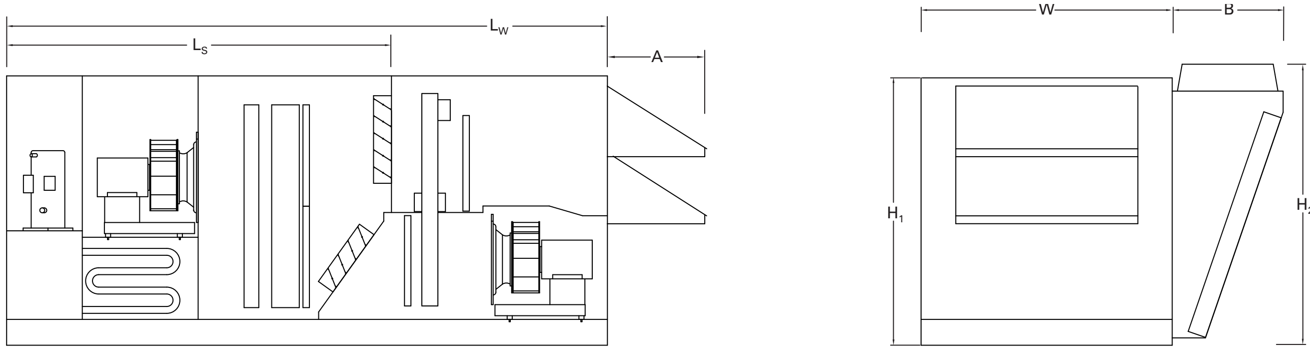
VALENT UNITS AT A GLANCE

		VX, VXE CASING				VPR, VPRX, VPRE, VPRP, VPRC CASING				
		112	**212**	**312**	**352**	**V10**	**110**	**210**	**310**	**352**
INDIRECT GAS FURNACE	**Minimum** (MBh)	100	300	600	600	75	100	200	400	600
	Maximum (MBh)	300	500	1,200	1,200	200	200	400	800	1,200
	Turndown (NG)	Up to 16:1	Up to 16:1	Up to 16:1	Up to 10:1	Up to 10:1	Up to 10:1	Up to 10:1	Up to 10:1	Up to 10:1
	Turndown (LP)	Up to 16:1	Up to 16:1	Up to 16:1	Up to 6:1	Up to 6:1	Up to 6:1	Up to 6:1	Up to 6:1	Up to 6:1
ELECTRIC HEAT	**Minimum** (kW)	15	35	35	50	Not available	10	15	40	50
	Maximum (kW)	60	120	240	200	Not available	50	125	150	200
OTHER HEAT	**Air source heat pump**	Available	Available	Not available	Not available	Not available	Not available	Not available	Not available	Not available
	Hot water	Option	Option	Option	Option	Not available	Option	Option	Option	Option
	Temperator	Not available	Not available	Not available	Not available	Not available	Option	Option	Option	Not available
	Steam coil	Option	Option	Option	Option	Not available	Option	Option	Option	Option
ENERGY RECOVERY	**Wheel** Polymer	Option	Option	Option	Option	Not available	Option	Option	Option	Option
	Wheel Aluminum	Not available	Not available	Not available	Not available	Not available	Option	Option	Option	Option
	Enthalpic plate	Not available	Not available	Not available	Not available	Not available	Option	Option	Option	Option
	Flat plate Aluminum	Not available	Not available	Not available	Not available	Not available	Option	Option	Option	Option
CONTROLS	**Full controls**	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard
	Heat-cool only	Option	Option	Option	Option	N/A	Option	Option	Option	Option
CONSTRUCTION	**Insulation**	2" double-wall R-13	2" double-wall R-13	2" double-wall R-13	2" double-wall R-13	2" double-wall R-13	2" double-wall R-13	2" double-wall R-13	2" double-wall R-13	2" double-wall R-13
	Exterior	Gray prepainted	Gray prepainted	Gray prepainted	Gray prepainted	Gray prepainted	Gray prepainted	Gray prepainted	Gray prepainted	Gray prepainted
	Interior	Galvanized	Galvanized	Galvanized	Galvanized	Galvanized	Galvanized	Galvanized	Galvanized	Galvanized
CERTIFICATION	**AHRI 1060**	Compliant	Compliant	Compliant	Compliant	Not applicable	Compliant	Compliant	Compliant	Compliant
	ASHRAE 90.1-2013	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant
	DOE AHRI 340/360	Compliant	Compliant	Compliant	Compliant	Not applicable	Compliant	Compliant	Compliant	Compliant

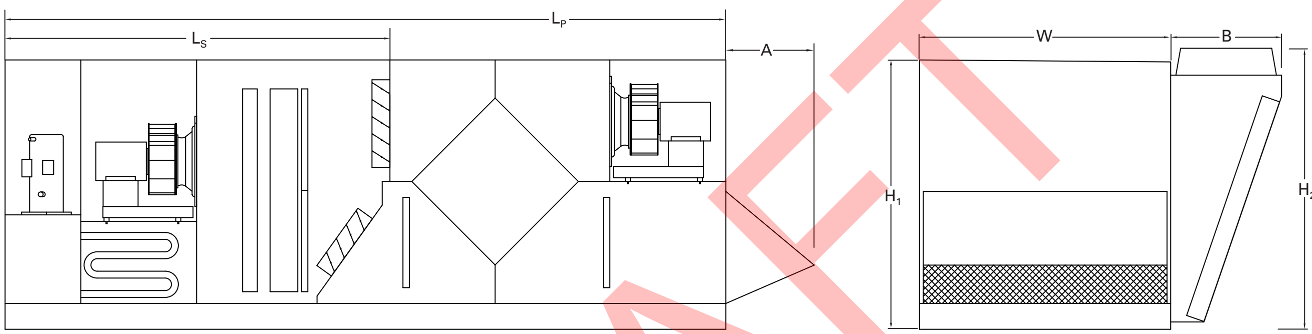
Refer to Valent CAPS® selection software or the Valent Mechanical IOMs for additional detail.
a Based on packaged DX cooling, indirect gas heating, 100% outdoor air, 1.5 in. wg supply external and 0.5 in. wg return air static pressure
b Not available on 575 V units with EC condensing fans; not available with air source heat pump or inverter scroll compressors
c Not available on 575 V units
d Not available on 575 V VPR/X/E/P/C nor 575 V VX/E-352 units

DIMENSIONS AND WEIGHTS

Elevations with and without energy recovery wheel



Elevations with sensible and enthalpic flat plate heat exchangers



DIMENSIONS (inches), WEIGHTS (pounds)														
		Height		Width	Length*	Length with wheel		Length with plate		Hood length	Condenser width	Nominal weight		
		H_1	H_2	W	L_S	L_W		L_p		A	B	VX/VPR	VPRE/VXE	VPRC
						Bottom return	Side return	Bottom return	Side return					
CASING	VX-112	60.2	65.9	52.5	98.6*	149.5*	180.5	N/A	N/A	22.1	33.9	2,700	3,400	N/A
	VX-212	73.1	76.2	68.2	109.0*	163.2*	197.3	N/A	N/A	27.1	30.1	4,500	5,100	N/A
	VX-312	98.8	101.3	98.0	155.2	247.9	N/A	N/A	N/A	38.3**	N/A	7,870	8,670	N/A
	VX-352	96.1	99.5	96.0	185.0	263.0	307.0	308.0	353.0	52.5	N/A	7,950	10,450	N/A
	VPR-V10	49.0	N/A	40.0	79.25	N/A	N/A	N/A	N/A	18.75	30.0	1,050	N/A	N/A
	VPR-110	58.0	55.5	49.0	119.0	158.0	185.0	197.0	224.0	21.5	30.0	1,900	2,700	2,900
	VPR-210	65.0	62.5	61.0	121.0	168.0	195.0	207.0	234.0	23.5	30.0	3,300	4,500	4,700
	VPR-310	85.0	82.5	68.0	131.0	178.0	205.0	242.0	269.0	33.5	30.0	4,500	5,900	6,400
	VPR-352	96.1	99.5	96.0	185.0	263.0	307.0	308.0	353.0	52.5	N/A	7,950	10,450	12,050

* Powered exhaust units with no energy recovery, whether bottom or side return, have the same length as the wheel units with bottom return. This applies to the VX-112 and VX-212.
** If the VX/E-312 has an exhaust fan, the exhaust blower bump-out will have a length of 53.7 inches.

Kitchen Hood System

INTELLI-HOOD®

Melink®

The Industry Standard in Kitchen Ventilation Controls

INTELLI-HOOD® Controls: The Industry Standard

The Melink Intelli-Hood controls are the industry standard for commercial kitchen ventilation systems. Mechanical engineers, foodservice consultants, energy service companies, and chain operators are specifying them on thousands of hoods for both new and existing facilities around the world.

Savings & Benefits

The Intelli-Hood controls reduce your exhaust and make-up fan speeds during idle, non-cooking conditions. **This yields fan energy savings of up to 97% and conditioned air savings of up to 70%. The result is a typical payback of 1- 3 years.**

More than 10,000 Installations Worldwide

Realizing the huge potential for fan energy and conditioned air savings, Melink pioneered the demand ventilation system for use in various food service facilities more than 23 years ago. Since then, we have completed more than 10,000 installations in:

- Restaurants
- Supermarkets
- Hotels
- K-12 Schools
- Colleges & Universities
- Hospitals
- Government Buildings
- Military Facilities
- Corporate Dining
- Clubs

Melink®

Melink's patented technology is the difference - providing superior performance and energy savings

Note: The red line represents an infrared beam that detects smoke and vapors inside the hood, increasing the fan speed to 100% only when necessary.

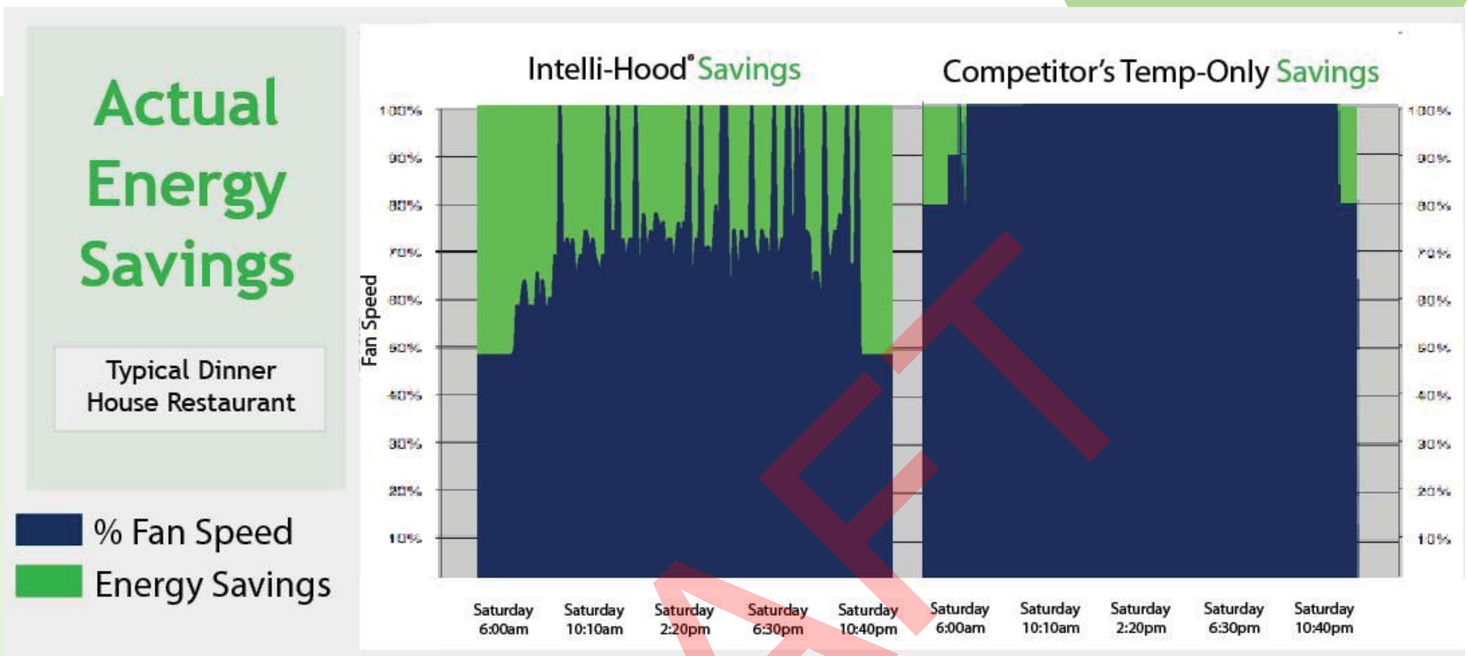
Intelli-Hood® Advantages

Melink pioneered demand ventilation controls for commercial kitchen hoods over 23 years ago. The advantages of this extensive experience & expertise are:

- Optic Sensors allow a lower minimum speed for greater energy savings
- Optic Sensors ensure robust capture and containment of all smoke
- Intelligent algorithms provide automatic daily calibration
- Plug and play cables eliminate installation problems
- Remote monitoring allows energy savings to be verified
- Melink national network of trained technicians is best in industry

INTELLI-HOOD® Saves up to 97% in Fan Energy and 70% in Conditioned Air

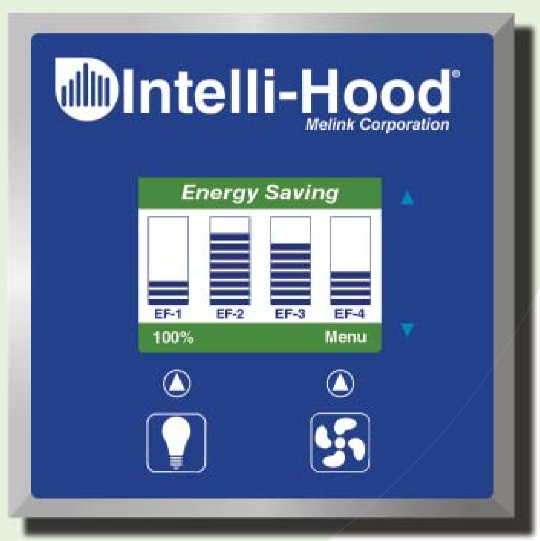
Most commercial kitchen hoods operate at 100% capacity all day long, even during idle, non-cooking conditions. Melink was the first to solve this industry problem through variable-speed control.



Simple to Install & Operate

The Intelli-Hood controls are easily installed on new hoods and retrofitted on existing hoods. The Temperature and Optic Sensors get mounted inside the hood/duct, and the Touchpad, System Controller, and Variable-Speed Drives typically get mounted in an end-cabinet or on a kitchen wall. The System Controller can control up to 30+ hoods with a Hood Controller on each hood.

To operate, the cook/chef simply presses the light and fan switch on the Keypad, and the system begins operating. When the cooking appliances are turned on, the fan speeds increase based on the exhaust air temperature. During actual cooking, the speeds increase to 100% until the smoke/vapor is removed.

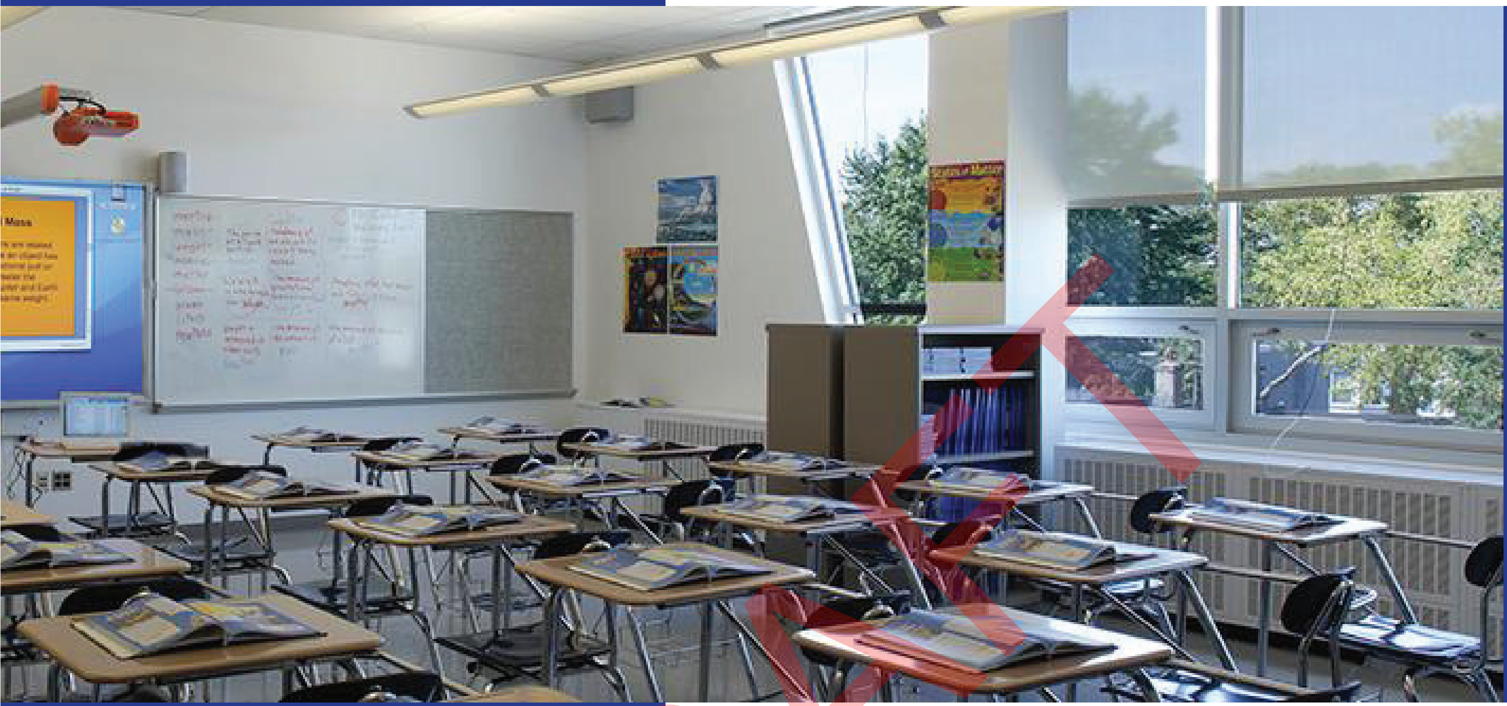


Touchpad

DISPLACEMENT CHILLED BEAMS

QLCI™ Designed by TROX®

Displacement Chilled Beams



Bookshelves and field modifiable sections among available accessories

Grill removes easily for maintenance

Threaded coil connections with flexible connectors for easy installation

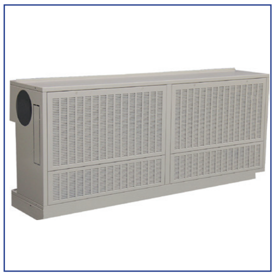
Drain pan with piping connections for condensate if necessary

THE ULTIMATE SOLUTION FOR CLASSROOM HVAC

The QLCI displacement chilled beam is ideally suited to address the unique demands of a classroom environment and to provide optimum comfort and improved indoor air quality.

- Displacement ventilation enhances the removal of space contaminants
- Terminals are designed to allow the supply of 100% outside air at (or near) the minimum ventilation rate for the room
- Patented design integrates induction nozzles to enable the delivery of primary air at conventional (50°F to 55°F) AHU supply temperatures
- Compliant with ANSI S12.60
- Energy efficient
- Rugged cabinet design
- Competitive first cost
- Low cost of operation
- Ideal for new and retrofit construction
- Guaranteed space ventilation

DESCRIPTION



APPLICATION
• Displacement ventilation enhances the removal of space respiratory contaminants
• Quiet operation making it an ideal classroom and patient room solution
• Designed to provide exceptional air quality and acoustical performance

NOMINAL SIZES
• 1500, 2000

SPECIAL FEATURES
• Patented design integrates nozzles to enable the delivery of primary air at conventional (50° to 55°F) AHU supply temperatures making the QLCI an ideal solution for humid climates
• Designed to allow supply of 100% outside air at (or near) the minimum ventilation rate for a classroom
• Primary air inlets allow connections of up to three terminals in a series

PARTS AND CHARACTERISTICS
• QLCI air conditioning terminal housed in appropriate architectural cabinet
• Duct connection
• A series of injection nozzles
• Integral heat transfer coil
• A perforated or louvered face
• Integral drain pan

CONSTRUCTION FEATURES
• Rugged cabinet design
• Front panels can be removed for maintenance using an allen wrench to loosen tamper resistant screws
• Drain pan with piping connections for removal of condensate if necessary
• Threaded coil fittings for easy installation with flexible connector
• Face panels shall be pencil-proof and at least 45% free area
• Top of cabinet is flat and is ideal for use as bookshelf or other storage

MATERIALS AND SURFACES
• Basic cabinets constructed of 16 gauge steel
• Unit painted with textured powder coat finish in (standard) color as selected by architect
• All internal sheet metal components are galvanized

INSTALLATION AND COMMISSIONING
• Easy installation
• Threaded coil fittings for easy installation with flexible connectors
• Front panels easily removable for maintenance

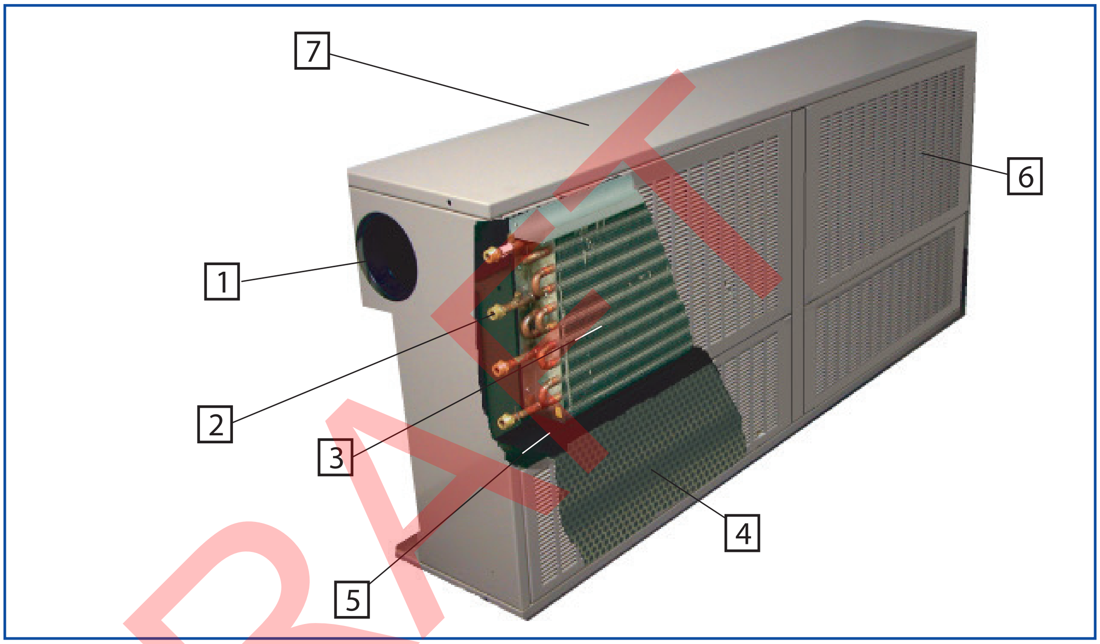
STANDARDS AND GUIDELINES
• Low noise levels conform to ANSI Standard S12.60
• ASHRAE Standard 62.1 Ventilation for Acceptable Air Quality mandates classrooms be supplied a minimum outdoor airflow during all occupied hours

MAINTENANCE
• There are no moving parts within the terminals
• Space temperature control is accomplished by the thermostatic sequencing and modulation of a pair of water valves (one chilled/one hot)
• The simple air handling unit configuration makes the system nearly maintenance free
• Occasional vacuuming of the coil may be required in some applications
• On rare occasion the condensate pan may require cleaning

TECHNICAL DATA

Nominal width	13 ½" or 16 ⅝"
Nominal Length	67 ¾" or 87 7/16"
Primary	60 - 210 CFM
Cooling capacity	Up to 8500 btu/h
Heating capacity	Up to 4500 btu/h
Primary air temperature	50°F to 65°F
Operating temperature	73°F to 77°F

Schematic illustration of the QLCI displacement chilled beam



1 Primary air inlet
2 Threaded coil fitting
3 Water coil
4 Perforated equalizing grill
5 Drain pan with piping connections
6 Removable face panels
7 Rugged cabinet

FUNCTION

Functional description

QLCI terminals are designed to provide air quality and acoustical performance similar to that of conventional displacement systems and are designed specifically for operation in North American climates. The units are fitted with a series of air injection nozzles which allow the supply of primary air to the terminals at conventional temperatures (50 to 55°F). These nozzles induce room air through a heat transfer (cooling and/or heating) coil to recondition the air prior to mixing with primary jets. The result is a constant volume (variable temperature) displacement supply of air to the classroom.

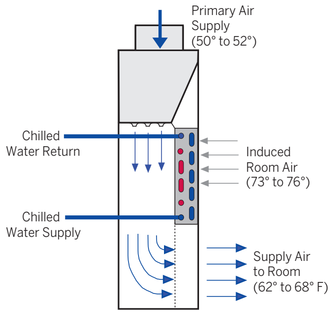
Benefits of displacement ventilation

Displacement conditioning provides several advantages over mixed air systems in classroom applications:

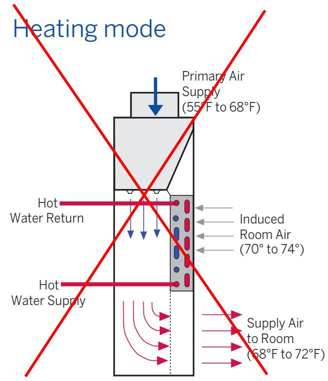
- Enhanced ventilation effectiveness
- More efficient removal of respiratory contaminants
- Reduced space noise levels
- Lower fan operation costs due to reduced outlet pressure and airflow requirements
- Increased economizer opportunities and chiller efficiencies

PRINCIPLE OF OPERATION

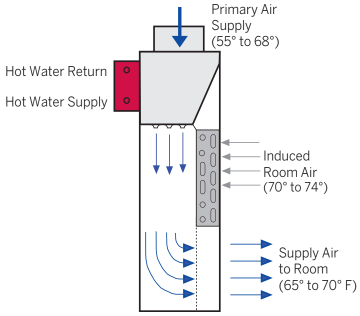
Cooling mode



Heating mode



Optional rear heat mode



INSTALLATION

QLCI terminals are designed to afford easy installation and easy access for maintenance. Most classroom installations will require QLCI terminals be installed along 75 to 80% of their external exposure to provide adequate space conditioning and ventilation at noise levels compliant with ANSI S12.60.

See Installation, Operation & Maintenance Manual for complete installation instructions.

Performance data

Size 1500 with 6" inlet and connections		Number of units ducted in series							
		1		1.5		2		3	
Primary air flow rate	Supply air flow rate	Airside pressure drop	Space NC level	Airside pressure drop	Space NC level	Airside pressure drop	Space NC level	Airside pressure drop	Space NC level
80	240	0.15	<15	0.17	<15	0.20	<15	0.29	19
100	300	0.23	<15	0.26	17	0.31	21	0.46	25
120	360	0.33	20	0.38	22	0.45	27	0.66	31
140	420	0.45	24	0.51	27	0.61	31	0.89	35
160	480	0.58	28	0.67	30	0.80	35	1.17	39

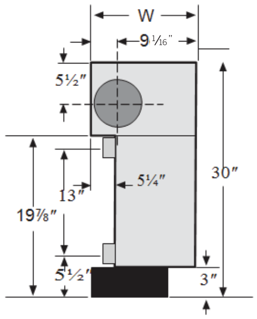
Size 1500 with 8" inlet and connections		Number of units ducted in series							
		1		1.5		2		3	
Primary air flow rate	Supply air flow rate	Airside pressure drop	Space NC level	Airside pressure drop	Space NC level	Airside pressure drop	Space NC level	Airside pressure drop	Space NC level
80	240	0.13	<15	0.14	<15	0.15	<15	0.18	19
100	300	0.21	<15	0.22	17	0.23	21	0.28	25
120	360	0.30	20	0.32	22	0.34	27	0.40	31
140	420	0.41	24	0.43	27	0.46	31	0.55	35
160	480	0.53	28	0.56	30	0.60	35	0.72	39

Size 2000 with 6" inlet and connections		Number of units ducted in series							
		1		1.5		2		3	
Primary air flow rate	Supply air flow rate	Airside pressure drop	Space NC level	Airside pressure drop	Space NC level	Airside pressure drop	Space NC level	Airside pressure drop	Space NC level
100	300	0.14	<15	0.17	16	0.22	20	0.37	24
120	360	0.20	18	0.25	21	0.32	25	0.53	29
140	420	0.27	23	0.34	25	0.43	30	0.72	34
160	480	0.35	27	0.44	29	0.56	34	0.94	38
180	540	0.44	30	0.56	33	0.71	37	1.18	41

Size 2000 with 8" inlet and connections		Number of units ducted in series							
		1		1.5		2		3	
100	300	0.12	<15	0.13	16	0.14	20	0.19	24
120	360	0.17	18	0.19	21	0.21	25	0.27	29
140	420	0.23	23	0.25	25	0.28	30	0.37	34
160	480	0.27	27	0.33	29	0.37	34	0.48	38
180	540	0.30	30	0.42	33	0.47	37	0.61	41

DIMENSIONS

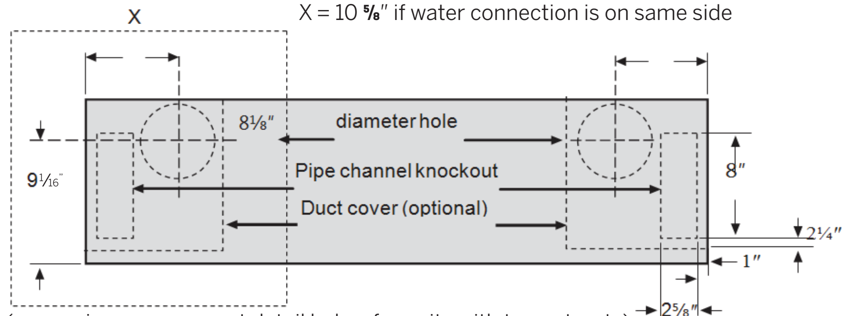
Side View



W = 13½" = Standard unit
W = 16⅝" = Unit with heater

Top View

X = 8 ⅜" if water connection is on opposite side
X = 10 ⅝" if water connection is on same side

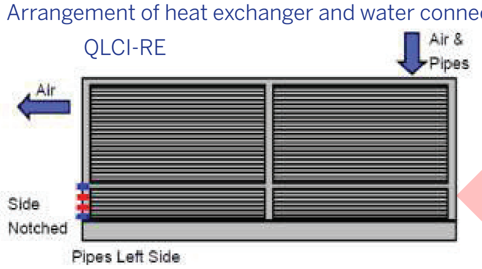


(see casing arrangement detail below for units with top cut-outs)

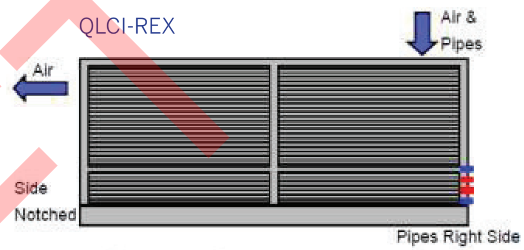
AIR AND WATER CONNECTIONS

Arrangement of heat exchanger and water connections

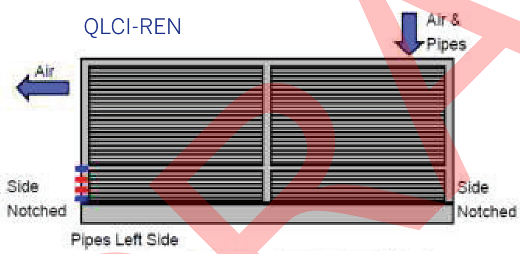
QLCI-RE



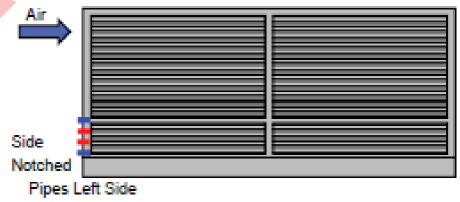
QLCI-REX



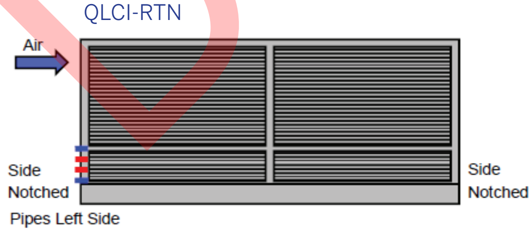
QLCI-REN



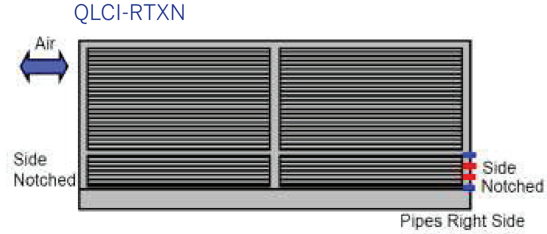
QLCI-RT



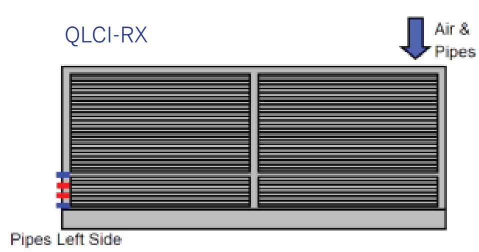
QLCI-RTN



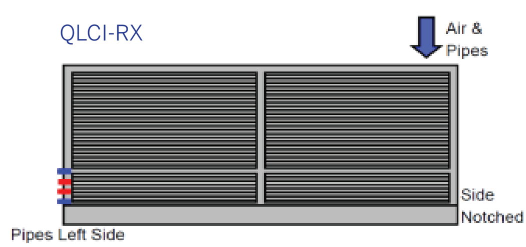
QLCI-RTXN



QLCI-RX



QLCI-RX



DESCRIPTION

This specification text describes the general properties of the product. Contact Carson Solutions for texts for QLCI variants.

Furnish and install QLCI, designed by TROX® displacement terminals in the models, sizes and configurations on plans and schedules.

SPECIAL FEATURES

- Active chilled beam for mounting under window
- Guaranteed space ventilation
- Compliant with ANSI S12.60 requirements
- Integral cooling and heating coil
- Vertical coil allows provision of gravity drain condensate tray
- Rugged construction for K-12 applications
- Low cost of operation
- Ideal for new and retrofit construction

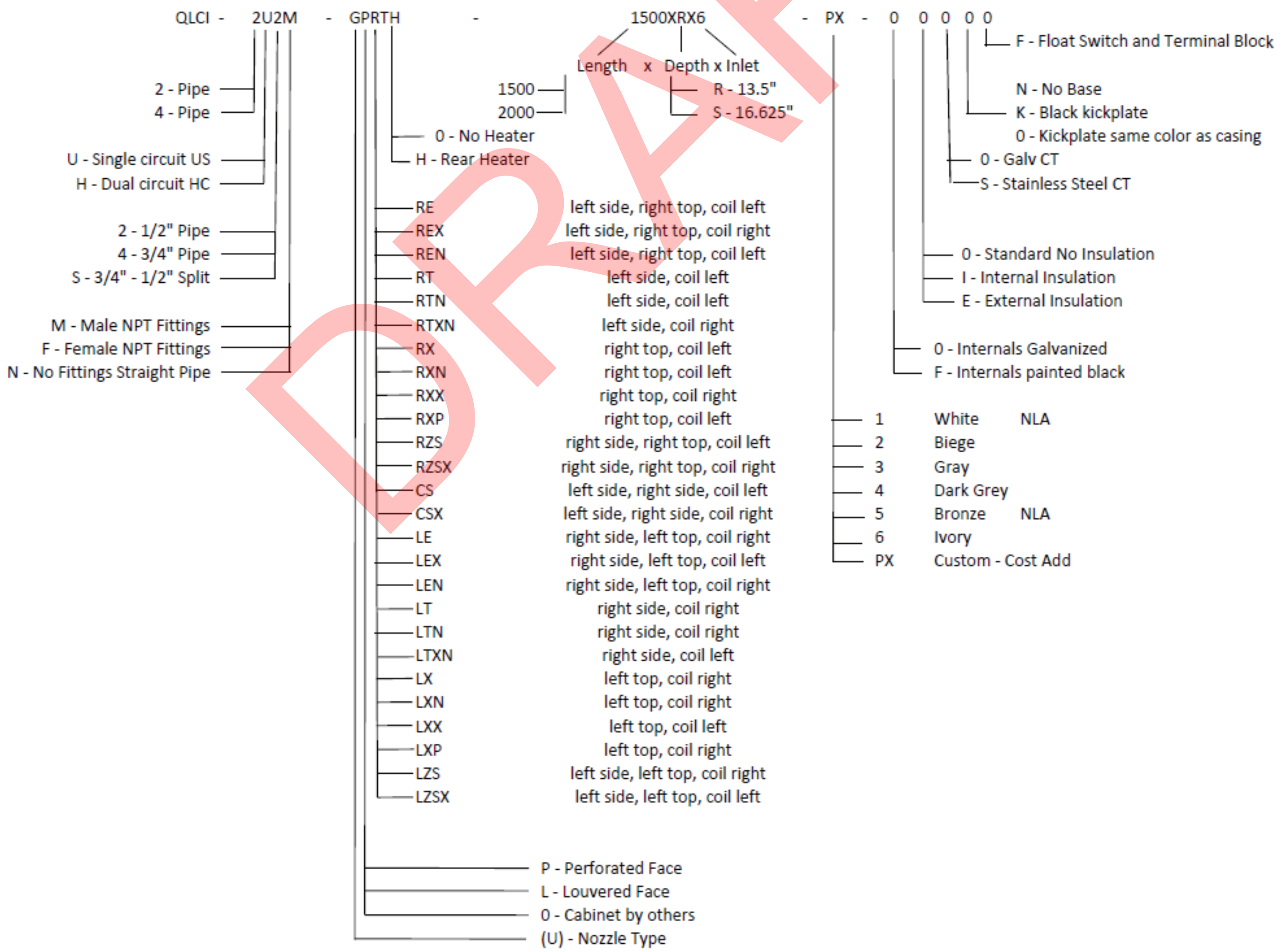
MATERIALS AND SURFACES

- Cabinet constructed of 16ga steel
- Internal components constructed of 20ga galvanized steel (unfinished)
- External surfaces finished in textured powder coat paint in one of four (4) standard RAL colors as selected by architect or a custom color (cost option)
- Finish is textured to hide small scratches and fingerprints
- Face panels shall be louvered (standard) or perforated

TECHNICAL DATA

- Nominal length: 1500, 2000 mm
- Length: 67 ¾ in, 87 7/16 in
- Width: 13 ½ in, 16 5/8 in
- Height: 30 in
- Primary air volume flow rate: 60-180 CFM
- Cooling capacity: up to 6800 btu/h
- Heating capacity: up to 4500 btu/h

ORDER CODE



Appendix C

Heating & Cooling Load Calculations

Air System Information

Air System Name	AHU-1 CCL		Number of zones	4	
Equipment Class	SPLT AHU		Floor Area	5900.0	ft²
Air System Type	VAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Peak zone sensible load
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	8.8	Tons	Load occurs at	Jul 1400	
Total coil load	105.8	MBH	OA DB / WB	86.5 / 70.9	°F
Sensible coil load	68.1	MBH	Entering DB / WB	84.5 / 69.6	°F
Coil CFM at Jul 1400	2248	CFM	Leaving DB / WB	55.4 / 54.2	°F
Max block CFM at Jul 1500	3974	CFM	Coil ADP	52.1	°F
Sum of peak zone CFM	3974	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.644		Resulting RH	52	%
CFM/Ton	254.9		Design supply temp.	55.0	°F
ft²/Ton	669.1		Zone T-stat Check	4 of 4	OK
BTU/(hr·ft²)	17.9		Max zone temperature deviation	0.0	°F
Water flow @ 12.0 °F rise	N/A				

Preheat Coil Sizing Data

Max coil load	95.0	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	2206	CFM	Ent. DB / Lvg DB	13.6 / 55.0	°F
Max coil CFM	3974	CFM			
Water flow @ 20.0 °F drop	9.51	gpm			

Supply Fan Sizing Data

Actual max CFM at Jul 1500	3974	CFM	Fan motor BHP	2.73	BHP
Standard CFM	3831	CFM	Fan motor kW	2.17	kW
Actual max CFM/ft²	0.67	CFM/ft²	Fan static	2.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	3360	CFM	CFM/person	84.00	CFM/person
CFM/ft²	0.57	CFM/ft²			

Load shown is for operating with energy wheel and no local space exhaust on. SEC

Air System Design Load Summary for AHU-1 CCL

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 07/16/2021
Prepared by: Seaman Engineering Corp. 06:21PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1400 COOLING OA DB / WB 86.5 °F / 70.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	95 ft²	1040	-	95 ft²	-	-
Wall Transmission	1345 ft²	479	-	1345 ft²	3647	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	95 ft²	234	-	95 ft²	1984	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	240 ft²	611	-	240 ft²	5184	-
Floor Transmission	5900 ft²	0	-	5900 ft²	10093	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	4130 W	14091	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	2950 W	10065	-	0	0	-
People	40	9800	8200	0	0	0
Infiltration	-	3860	5090	-	24163	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**40181**	**13290**	**-**	**45070**	**0**
Zone Conditioning	-	41274	13290	-	44608	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	613 CFM	0	-	604 CFM	0	-
Ventilation Load	2248 CFM	24879	25043	2206 CFM	132106	0
Supply Fan Load	2248 CFM	1992	-	2206 CFM	-1921	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**68144**	**38333**	**-**	**174792**	**0**
Central Cooling Coil	-	68144	37676	-	0	0
Preheat Coil	-	0	-	-	95048	-
Terminal Reheat Coils	-	0	-	-	79744	-
>> Total Conditioning	**-**	**68144**	**37676**	**-**	**174792**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	MAU-1 Kitchen		Number of zones	1	
Equipment Class	PKG ROOF		Floor Area	1743.0	ft²
Air System Type	SZCAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Heating Coil Sizing Data

Max coil load	366.4	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	6000	CFM	BTU/(hr·ft²)	210.2	
Max coil CFM	6000	CFM	Ent. DB / Lvg DB	0.0 / 58.7	°F
Water flow @ 20.0 °F drop	36.66	gpm			

Supply Fan Sizing Data

Actual max CFM at Des Htg	6000	CFM	Fan motor BHP	3.10	BHP
Standard CFM	5784	CFM	Fan motor kW	2.46	kW
Actual max CFM/ft²	3.44	CFM/ft²	Fan static	1.50	in wg

Outdoor Ventilation Air Data

Design airflow CFM	6000	CFM	CFM/person	600.00	CFM/person
CFM/ft²	3.44	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	NO COOLING DATA NO COOLING OA DB / WB			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	0 ft²	-	-	0 ft²	-	-
Wall Transmission	0 ft²	-	-	0 ft²	0	-
Roof Transmission	0 ft²	-	-	0 ft²	0	-
Window Transmission	0 ft²	-	-	0 ft²	0	-
Skylight Transmission	0 ft²	-	-	0 ft²	0	-
Door Loads	0 ft²	-	-	0 ft²	0	-
Floor Transmission	1743 ft²	-	-	1743 ft²	0	-
Partitions	0 ft²	-	-	0 ft²	0	-
Ceiling	0 ft²	-	-	0 ft²	0	-
Overhead Lighting	-	-	-	0	0	-
Task Lighting	-	-	-	0	0	-
Electric Equipment	-	-	-	0	0	-
People	-	-	-	0	0	0
Infiltration	-	-	-	-	0	0
Miscellaneous	-	-	-	-	0	0
Safety Factor	0% / 0%	-	-	0%	0	0
>> Total Zone Loads	**-**	**-**	**-**	**-**	**0**	**0**
Zone Conditioning	-	-	-	-	0	0
Plenum Wall Load	0%	-	-	0	0	-
Plenum Roof Load	0%	-	-	0	0	-
Plenum Lighting Load	0%	-	-	0	0	-
Return Fan Load	-	-	-	0 CFM	0	-
Ventilation Load	-	-	-	6000 CFM	374817	0
Supply Fan Load	-	-	-	6000 CFM	-8379	-
Space Fan Coil Fans	-	-	-	-	0	-
Duct Heat Gain / Loss	0%	-	-	0%	0	-
>> Total System Loads	**-**	**-**	**-**	**-**	**366439**	**0**
Central Heating Coil	-	-	-	-	366439	-
>> Total Conditioning	**-**	**-**	**-**	**-**	**366439**	**0**
Key:	**Positive values are clg loads** **Negative values are htg loads**			**Positive values are htg loads** **Negative values are clg loads**		

Air System Information

Air System Name	**Pod A - B Corridor Connectors**		Number of zones	**4**	
Equipment Class	**TERM**		Floor Area	**2812.0**	ft²
Air System Type	**VRF**		Location	**Worcester, Massachusetts**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**	Zone CFM Sizing	**Sum of space airflow rates**
Sizing Data	**Calculated**	Space CFM Sizing	**Individual peak space loads**

Cooling Coil Sizing Data

No cooling coil loads occurred during this calculation.

Heating Coil Sizing Data

Max coil load	**3.1**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**211**	CFM	Ent. DB / Lvg DB	**49.3 / 63.2**	°F
Max coil CFM	**211**	CFM			
Water flow @ 20.0 °F drop	**0.31**	gpm			

Ventilation Fan Sizing Data

Actual max CFM	**211**	CFM	Fan motor BHP	**0.15**	BHP
Standard CFM	**203**	CFM	Fan motor kW	**0.12**	kW
Actual max CFM/ft²	**0.08**	CFM/ft²	Fan static	**2.00**	in wg

Exhaust Fan Sizing Data

Actual max CFM	**211**	CFM	Fan motor BHP	**0.07**	BHP
Standard CFM	**203**	CFM	Fan motor kW	**0.06**	kW
Actual max CFM/ft²	**0.08**	CFM/ft²	Fan static	**1.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**211**	CFM	CFM/person	**0.00**	CFM/person
CFM/ft²	**0.08**	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 0900 COOLING OA DB / WB 75.2 °F / 67.5 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	1714 ft²	65292	-	1714 ft²	-	-
Wall Transmission	1117 ft²	312	-	1117 ft²	2944	-
Roof Transmission	700 ft²	123	-	700 ft²	1057	-
Window Transmission	1714 ft²	165	-	1714 ft²	34794	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	21 ft²	2	-	21 ft²	441	-
Floor Transmission	709 ft²	0	-	709 ft²	1238	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1856 W	6332	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	1406 W	4797	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	30	2382	-	9824	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**77054**	**2382**	**-**	**50299**	**0**
Zone Conditioning	-	74979	2382	-	49944	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	211 CFM	-196	-
Ventilation Load	0 CFM	0	0	211 CFM	4639	0
Ventilation Fan Load	0 CFM	0	-	211 CFM	-393	-
Space Fan Coil Fans	-	1481	-	-	-1481	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**76461**	**2382**	**-**	**52512**	**0**
Cooling Coil	-	0	0	-	0	0
Heating Coil	-	0	-	-	3057	-
Terminal Unit Cooling	-	76461	1714	-	0	0
Terminal Unit Heating	-	0	-	-	49455	-
>> Total Conditioning	**-**	**76461**	**1714**	**-**	**52512**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	**Pod B - C Corridor Connectors**	Number of zones	**4**
Equipment Class	**TERM**	Floor Area	**3347.0** ft²
Air System Type	**VRF**	Location	**Worcester, Massachusetts**

Sizing Calculation Information

Calculation Months	**Jan to Dec**	Zone CFM Sizing	**Sum of space airflow rates**
Sizing Data	**Calculated**	Space CFM Sizing	**Individual peak space loads**

Cooling Coil Sizing Data

No cooling coil loads occurred during this calculation.

Heating Coil Sizing Data

Max coil load	**3.6**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**251**	CFM	Ent. DB / Lvg DB	**49.3 / 63.2**	°F
Max coil CFM	**251**	CFM			
Water flow @ 20.0 °F drop	**0.36**	gpm			

Ventilation Fan Sizing Data

Actual max CFM	**251**	CFM	Fan motor BHP	**0.17**	BHP
Standard CFM	**242**	CFM	Fan motor kW	**0.14**	kW
Actual max CFM/ft²	**0.08**	CFM/ft²	Fan static	**2.00**	in wg

Exhaust Fan Sizing Data

Actual max CFM	**251**	CFM	Fan motor BHP	**0.09**	BHP
Standard CFM	**242**	CFM	Fan motor kW	**0.07**	kW
Actual max CFM/ft²	**0.08**	CFM/ft²	Fan static	**1.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**251**	CFM	CFM/person	**0.00**	CFM/person
CFM/ft²	**0.08**	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 0900 COOLING OA DB / WB 75.2 °F / 67.5 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	2361 ft²	84396	-	2361 ft²	-	-
Wall Transmission	1706 ft²	377	-	1706 ft²	4497	-
Roof Transmission	868 ft²	153	-	868 ft²	1311	-
Window Transmission	2361 ft²	227	-	2361 ft²	47928	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	48 ft²	1720	-	48 ft²	1459	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	2209 W	7537	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	1674 W	5710	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	33	2861	-	10648	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**100153**	**2861**	**-**	**65842**	**0**
Zone Conditioning	-	97968	2861	-	65915	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	251 CFM	-234	-
Ventilation Load	0 CFM	0	0	251 CFM	5524	0
Ventilation Fan Load	0 CFM	0	-	251 CFM	-467	-
Space Fan Coil Fans	-	1995	-	-	-1995	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**99963**	**2861**	**-**	**68742**	**0**
Cooling Coil	-	0	0	-	0	0
Heating Coil	-	0	-	-	3631	-
Terminal Unit Cooling	-	99963	0	-	0	0
Terminal Unit Heating	-	0	-	-	65111	-
>> Total Conditioning	**-**	**99963**	**0**	**-**	**68743**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	**Pod C - D Corridor Connectors**	Number of zones	**3**
Equipment Class	**TERM**	Floor Area	**2519.0** ft²
Air System Type	**VRF**	Location	**Worcester, Massachusetts**

Sizing Calculation Information

Calculation Months	**Jan to Dec**	Zone CFM Sizing	**Sum of space airflow rates**
Sizing Data	**Calculated**	Space CFM Sizing	**Individual peak space loads**

Cooling Coil Sizing Data

No cooling coil loads occurred during this calculation.

Heating Coil Sizing Data

Max coil load	**2.7**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**189**	CFM	Ent. DB / Lvg DB	**49.4 / 63.2**	°F
Max coil CFM	**189**	CFM			
Water flow @ 20.0 °F drop	**0.27**	gpm			

Ventilation Fan Sizing Data

Actual max CFM	**189**	CFM	Fan motor BHP	**0.13**	BHP
Standard CFM	**182**	CFM	Fan motor kW	**0.10**	kW
Actual max CFM/ft²	**0.08**	CFM/ft²	Fan static	**2.00**	in wg

Exhaust Fan Sizing Data

Actual max CFM	**189**	CFM	Fan motor BHP	**0.06**	BHP
Standard CFM	**182**	CFM	Fan motor kW	**0.05**	kW
Actual max CFM/ft²	**0.08**	CFM/ft²	Fan static	**1.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**189**	CFM	CFM/person	**0.00**	CFM/person
CFM/ft²	**0.08**	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 86.5 °F / 70.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	1732 ft²	56219	-	1732 ft²	-	-
Wall Transmission	2449 ft²	1215	-	2449 ft²	6455	-
Roof Transmission	828 ft²	573	-	828 ft²	1250	-
Window Transmission	1732 ft²	4462	-	1732 ft²	35160	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1663 W	5672	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	1260 W	4297	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	1257	2101	-	7649	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**73694**	**2101**	**-**	**50515**	**0**
Zone Conditioning	-	72570	2101	-	51117	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	189 CFM	-176	-
Ventilation Load	0 CFM	0	0	189 CFM	4166	0
Ventilation Fan Load	0 CFM	0	-	189 CFM	-352	-
Space Fan Coil Fans	-	1417	-	-	-1417	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**73987**	**2101**	**-**	**53339**	**0**
Cooling Coil	-	0	0	-	0	0
Heating Coil	-	0	-	-	2712	-
Terminal Unit Cooling	-	73987	654	-	0	0
Terminal Unit Heating	-	0	-	-	50627	-
>> Total Conditioning	**-**	**73987**	**654**	**-**	**53339**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	RTU-1 Pod A Classrooms		Number of zones	34	
Equipment Class	TERM		Floor Area	34271.0	ft²
Air System Type	ACB		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec
Sizing Data	Calculated

Cooling Coil Sizing Data

Total coil load	49.4	Tons	Load occurs at	Aug 1500	
Total coil load	592.5	MBH	OA DB / WB	87.0 / 71.0	°F
Total coil load	231.2	CFM/Ton	Entering DB / WB	79.8 / 65.6	°F
Sensible coil load	383.1	MBH	Leaving DB / WB	47.5 / 46.6	°F
Coil CFM at Aug 1500	11417	CFM	Bypass Factor	0.100	
Max coil CFM	11417	CFM			
Sensible heat ratio	0.647				
Water flow @ 10.0 °F rise	118.56	gpm			

Heating Coil Sizing Data

No heating coil loads occurred during this calculation.

Ventilation Fan Sizing Data

Actual max CFM	11417	CFM	Fan motor BHP	19.63	BHP
Standard CFM	11006	CFM	Fan motor kW	15.57	kW
Actual max CFM/ft²	0.33	CFM/ft²	Fan static	5.00	in wg

Exhaust Fan Sizing Data

Actual max CFM	11417	CFM	Fan motor BHP	5.89	BHP
Standard CFM	11006	CFM	Fan motor kW	4.67	kW
Actual max CFM/ft²	0.33	CFM/ft²	Fan static	1.50	in wg

Outdoor Ventilation Air Data

Design airflow CFM	11417	CFM	CFM/person	16.81	CFM/person
CFM/ft²	0.33	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	4541 ft²	66493	-	4541 ft²	-	-
Wall Transmission	14963 ft²	5287	-	14963 ft²	40566	-
Roof Transmission	8323 ft²	5950	-	8323 ft²	12929	-
Window Transmission	4541 ft²	13022	-	4541 ft²	103873	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	84 ft²	227	-	84 ft²	1814	-
Floor Transmission	12063 ft²	0	-	12063 ft²	22148	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	23990 W	81851	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	16371 W	55856	-	0	0	-
People	679	166353	139195	0	0	0
Infiltration	-	18083	23954	-	108500	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**413123**	**163149**	**-**	**289830**	**0**
Zone Conditioning	-	408991	163149	-	286012	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	11417 CFM	15943	-	11417 CFM	-15943	-
Ventilation Load	11417 CFM	36788	55959	11417 CFM	327040	0
Ventilation Fan Load	11417 CFM	53143	-	11417 CFM	-53143	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**514865**	**219108**	**-**	**543966**	**0**
Cooling Coil	-	383347	208859	-	0	0
Heating Coil	-	0	-	-	0	-
Terminal Unit Cooling	-	131810	8247	-	0	0
Terminal Unit Heating	-	0	-	-	543623	-
>> Total Conditioning	**-**	**515157**	**217106**	**-**	**543623**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Dedicated Outdoor Air System (DOAS) Sizing Summary for RTU-10 Admin/Nurse/IT

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 — 07/16/2021
Prepared by: Seaman Engineering Corp. — 06:22PM

Air System Information

Air System Name .... **RTU-10 Admin/Nurse/IT**
Equipment Class .... **TERM**
Air System Type .... **VRF**

Number of zones **39**
Floor Area .... **27274.0** ft²
Location .... **Worcester, Massachusetts**

Sizing Calculation Information

Calculation Months .... **Jan to Dec**
Sizing Data .... **Calculated**

Zone CFM Sizing .... **Sum of space airflow rates**
Space CFM Sizing .... **Individual peak space loads**

Cooling Coil Sizing Data

Total coil load .... **2.9** Tons
Total coil load .... **34.2** MBH
Total coil load .... **1454.9** CFM/Ton
Sensible coil load .... **34.2** MBH
Coil CFM at Aug 1500 .... **4147** CFM
Max coil CFM .... **4147** CFM
Sensible heat ratio **1.000**
Water flow @ 10.0 °F rise .... **N/A**

Load occurs at .... **Aug 1500**
OA DB / WB .... **87.0 / 71.0** °F
Entering DB / WB .... **80.2 / 66.8** °F
Leaving DB / WB .... **72.3 / 64.2** °F
Bypass Factor **0.100**

Heating Coil Sizing Data

Max coil load .... **53.9** MBH
Coil CFM at Des Htg .... **4147** CFM
Max coil CFM .... **4147** CFM
Water flow @ 20.0 °F drop .... **5.39** gpm

Load occurs at .... **Des Htg**
Ent. DB / Lvg DB .... **49.8 / 62.3** °F

Ventilation Fan Sizing Data

Actual max CFM .... **4147** CFM
Standard CFM .... **3998** CFM
Actual max CFM/ft² .... **0.15** CFM/ft²

Fan motor BHP .... **4.38** BHP
Fan motor kW .... **3.47** kW
Fan static .... **3.00** in wg

Exhaust Fan Sizing Data

Actual max CFM .... **4147** CFM
Standard CFM .... **3998** CFM
Actual max CFM/ft² .... **0.15** CFM/ft²

Fan motor BHP .... **2.14** BHP
Fan motor kW .... **1.70** kW
Fan static .... **1.50** in wg

Outdoor Ventilation Air Data

Design airflow CFM .... **4147** CFM
CFM/ft² .... **0.15** CFM/ft²

CFM/person .... **11.03** CFM/person

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 85.3 °F / 70.5 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	1529 ft²	51248	-	1529 ft²	-	-
Wall Transmission	3693 ft²	1813	-	3693 ft²	9734	-
Roof Transmission	10088 ft²	6327	-	10088 ft²	15235	-
Window Transmission	1529 ft²	3664	-	1529 ft²	31039	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	24 ft²	483	-	24 ft²	729	-
Floor Transmission	5387 ft²	0	-	5387 ft²	9150	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	19092 W	65140	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	24855 W	84803	-	0	0	-
People	376	92119	77080	0	0	0
Infiltration	-	4927	6305	-	33357	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**310525**	**83385**	**-**	**99244**	**0**
Zone Conditioning	-	307709	83385	-	97160	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	4147 CFM	5790	-	4147 CFM	-5790	-
Ventilation Load	4147 CFM	10431	14751	4147 CFM	92096	0
Ventilation Fan Load	4147 CFM	11857	-	4147 CFM	-11857	-
Space Fan Coil Fans	-	12050	-	-	-12050	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**347838**	**98136**	**-**	**159558**	**0**
Cooling Coil	-	32159	0	-	0	0
Heating Coil	-	0	-	-	53878	-
Terminal Unit Cooling	-	315828	96658	-	0	0
Terminal Unit Heating	-	0	-	-	105657	-
>> Total Conditioning	**-**	**347987**	**96658**	**-**	**159535**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	RTU-11 Lobby	
Equipment Class	PKG ROOF	
Air System Type	VAV	
Number of zones	3	
Floor Area	7470.0	ft²
Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec
Sizing Data	Calculated
Zone CFM Sizing	Peak zone sensible load
Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	24.1	Tons
Total coil load	288.8	MBH
Sensible coil load	226.3	MBH
Coil CFM at Jul 1500	9112	CFM
Max block CFM at Jun 1500	9834	CFM
Sum of peak zone CFM	10077	CFM
Sensible heat ratio	0.784	
CFM/Ton	378.6	
ft²/Ton	310.4	
BTU/(hr·ft²)	38.7	
Water flow @ 10.0 °F rise	N/A	
Load occurs at	Jul 1500	
OA DB / WB	87.0 / 71.0	°F
Entering DB / WB	76.4 / 62.9	°F
Leaving DB / WB	52.6 / 51.4	°F
Coil ADP	49.9	°F
Bypass Factor	0.100	
Resulting RH	47	%
Design supply temp.	55.0	°F
Zone T-stat Check	3 of 3	OK
Max zone temperature deviation	0.0	°F

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM at Jun 1500	9834	CFM
Standard CFM	9480	CFM
Actual max CFM/ft²	1.32	CFM/ft²
Fan motor BHP	10.15	BHP
Fan motor kW	8.05	kW
Fan static	3.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	1698	CFM
CFM/ft²	0.23	CFM/ft²
CFM/person	6.79	CFM/person

Air System Design Load Summary for RTU-11 Lobby

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 07/16/2021
Prepared by: Seaman Engineering Corp. 06:22PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	1830 ft²	97453	-	1830 ft²	-	-
Wall Transmission	136 ft²	41	-	136 ft²	358	-
Roof Transmission	5260 ft²	3761	-	5260 ft²	7944	-
Window Transmission	440 ft²	1152	-	440 ft²	8932	-
Skylight Transmission	1390 ft²	3011	-	1390 ft²	23352	-
Door Loads	144 ft²	5633	-	144 ft²	4376	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	5196 W	17729	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	3460 W	11805	-	0	0	-
People	250	61249	51250	0	0	0
Infiltration	-	1546	2273	-	9019	-2
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**203381**	**53523**	**-**	**53982**	**-2**
Zone Conditioning	-	197552	53523	-	53361	-2
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	9112 CFM	0	-	3514 CFM	0	-
Ventilation Load	1698 CFM	5928	9044	1698 CFM	56118	0
Supply Fan Load	9112 CFM	22826	-	3514 CFM	-3885	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**226306**	**62567**	**-**	**105595**	**-2**
Central Cooling Coil	-	226306	62493	-	0	0
Preheat Coil	-	0	-	-	0	-
Terminal Reheat Coils	-	0	-	-	105595	-
>> Total Conditioning	**-**	**226306**	**62493**	**-**	**105595**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for RTU-12&13 Auditorium

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 — 07/16/2021
Prepared by: Seaman Engineering Corp. — 06:22PM

Air System Information

Air System Name	RTU-12&13 Auditorium	
Equipment Class	PKG ROOF	
Air System Type	SZCAV	
Number of zones	1	
Floor Area	9240.0	ft²
Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec
Sizing Data	Calculated
Zone CFM Sizing	Sum of space airflow rates
Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	60.8	Tons
Total coil load	729.6	MBH
Sensible coil load	453.7	MBH
Coil CFM at Jul 1500	16018	CFM
Max block CFM	16018	CFM
Sum of peak zone CFM	16018	CFM
Sensible heat ratio	0.622	
CFM/Ton	263.5	
ft²/Ton	152.0	
BTU/(hr·ft²)	79.0	
Water flow @ 10.0 °F rise	N/A	
Load occurs at	Jul 1500	
OA DB / WB	87.0 / 71.0	°F
Entering DB / WB	77.7 / 65.9	°F
Leaving DB / WB	50.5 / 49.7	°F
Coil ADP	47.5	°F
Bypass Factor	0.100	
Resulting RH	55	%
Design supply temp.	55.0	°F
Zone T-stat Check	0 of 1	OK
Max zone temperature deviation	0.2	°F

Central Heating Coil Sizing Data

Max coil load	128.6	MBH
Coil CFM at Des Htg	16018	CFM
Max coil CFM	16018	CFM
Water flow @ 20.0 °F drop	N/A	
Load occurs at	Des Htg	
BTU/(hr·ft²)	13.9	
Ent. DB / Lvg DB	63.1 / 70.8	°F

Supply Fan Sizing Data

Actual max CFM	16018	CFM
Standard CFM	15442	CFM
Actual max CFM/ft²	1.73	CFM/ft²
Fan motor BHP	16.53	BHP
Fan motor kW	13.11	kW
Fan static	3.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	5375	CFM
CFM/ft²	0.58	CFM/ft²
CFM/person	5.66	CFM/person

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	3120 ft²	965	-	3120 ft²	8224	-
Roof Transmission	9240 ft²	6606	-	9240 ft²	13954	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	6468 W	22068	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	9240 W	31527	-	0	0	-
People	950	265997	256500	0	0	0
Infiltration	-	5714	4269	-	33331	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**332877**	**260769**	**-**	**55509**	**0**
Zone Conditioning	-	331183	260769	-	55632	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	16018 CFM	0	-	16018 CFM	0	-
Ventilation Load	5375 CFM	17323	15096	5375 CFM	117741	0
Supply Fan Load	16018 CFM	44737	-	16018 CFM	-44737	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**393243**	**275865**	**-**	**128636**	**0**
Central Cooling Coil	-	453713	275865	-	0	0
Central Heating Coil	-	-60471	-	-	128636	-
>> Total Conditioning	**-**	**393243**	**275865**	**-**	**128636**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for RTU-14 Common Corridor

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 — 07/16/2021
Prepared by: Seaman Engineering Corp. — 06:22PM

Air System Information

Air System Name	**RTU-14 Common Corridor**	Number of zones	**21**
Equipment Class	**PKG ROOF**	Floor Area	**18886.0** ft²
Air System Type	**VAV**	Location	**Worcester, Massachusetts**

Sizing Calculation Information

Calculation Months	**Jan to Dec**	Zone CFM Sizing	**Peak zone sensible load**
Sizing Data	**Calculated**	Space CFM Sizing	**Individual peak space loads**

Central Cooling Coil Sizing Data

Total coil load	**18.6**	Tons	Load occurs at	**Jul 1700**	
Total coil load	**223.4**	MBH	OA DB / WB	**85.3 / 70.5**	°F
Sensible coil load	**181.2**	MBH	Entering DB / WB	**78.0 / 62.9**	°F
Coil CFM at Jul 1700	**6708**	CFM	Leaving DB / WB	**52.1 / 50.7**	°F
Max block CFM at Jul 1700	**7048**	CFM	Coil ADP	**49.2**	°F
Sum of peak zone CFM	**7104**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.811**		Resulting RH	**44**	%
CFM/Ton	**360.3**		Design supply temp.	**55.0**	°F
ft²/Ton	**1014.3**		Zone T-stat Check	**21 of 21**	OK
BTU/(hr·ft²)	**11.8**		Max zone temperature deviation	**0.0**	°F
Water flow @ 10.0 °F rise	**N/A**				

Central Heating Coil Sizing Data

No central heating coil loads occurred during this calculation.

Preheat Coil Sizing Data

Max coil load	**11.0**	MBH	Load occurs at	**Apr 0200**	
Coil CFM at Apr 0200	**5328**	CFM	Ent. DB / Lvg DB	**53.0 / 55.0**	°F
Max coil CFM	**7048**	CFM			
Water flow @ 20.0 °F drop	**1.10**	gpm			

Supply Fan Sizing Data

Actual max CFM at Jul 1700	**7048**	CFM	Fan motor BHP	**9.70**	BHP
Standard CFM	**6794**	CFM	Fan motor kW	**7.69**	kW
Actual max CFM/ft²	**0.37**	CFM/ft²	Fan static	**4.00**	in wg

Return Fan Sizing Data

Actual max CFM at Jul 1700	**7048**	CFM	Fan motor BHP	**3.64**	BHP
Standard CFM	**6794**	CFM	Fan motor kW	**2.88**	kW
Actual max CFM/ft²	**0.37**	CFM/ft²	Fan static	**1.50**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**2508**	CFM	CFM/person	**25.08**	CFM/person
CFM/ft²	**0.13**	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 85.3 °F / 70.5 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	1416 ft²	37253	-	1416 ft²	-	-
Wall Transmission	1889 ft²	792	-	1889 ft²	5121	-
Roof Transmission	4708 ft²	2953	-	4708 ft²	7313	-
Window Transmission	1416 ft²	3911	-	1416 ft²	34074	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	6845 ft²	0	-	6845 ft²	3210	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	12625 W	43076	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	9111 W	31087	-	0	0	-
People	100	24500	20500	0	0	0
Infiltration	-	3186	6163	-	22182	-2
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**146757**	**26663**	**-**	**71900**	**-2**
Zone Conditioning	-	142686	26663	-	71006	-2
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	6708 CFM	8751	-	3827 CFM	-2448	-
Ventilation Load	2508 CFM	6464	15588	2508 CFM	56300	0
Supply Fan Load	6708 CFM	23335	-	3827 CFM	-6527	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**181236**	**42251**	**-**	**118330**	**-2**
Central Cooling Coil	-	181236	42207	-	0	0
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	0	-
Terminal Reheat Coils	-	0	-	-	118324	-
>> Total Conditioning	**-**	**181236**	**42207**	**-**	**118324**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	**RTU-15 Art Room DOAS**		Number of zones	**7**	
Equipment Class	**TERM**		Floor Area	**7492.0**	ft²
Air System Type	**ACB**		Location	**Worcester, Massachusetts**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**
Sizing Data	**Calculated**

Cooling Coil Sizing Data

Total coil load	**17.7**	Tons	Load occurs at	**Aug 1500**	
Total coil load	**212.8**	MBH	OA DB / WB	**87.0 / 71.0**	°F
Total coil load	**273.1**	CFM/Ton	Entering DB / WB	**76.1 / 63.1**	°F
Sensible coil load	**144.2**	MBH	Leaving DB / WB	**47.5 / 46.6**	°F
Coil CFM at Aug 1500	**4843**	CFM	Bypass Factor	**0.100**	
Max coil CFM	**4843**	CFM			
Sensible heat ratio	**0.678**				
Water flow @ 10.0 °F rise	**42.59**	gpm			

Heating Coil Sizing Data

No heating coil loads occurred during this calculation.

Ventilation Fan Sizing Data

Actual max CFM	**4843**	CFM	Fan motor BHP	**8.33**	BHP
Standard CFM	**4669**	CFM	Fan motor kW	**6.61**	kW
Actual max CFM/ft²	**0.65**	CFM/ft²	Fan static	**5.00**	in wg

Exhaust Fan Sizing Data

Actual max CFM	**4843**	CFM	Fan motor BHP	**2.50**	BHP
Standard CFM	**4669**	CFM	Fan motor kW	**1.98**	kW
Actual max CFM/ft²	**0.65**	CFM/ft²	Fan static	**1.50**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**4843**	CFM	CFM/person	**33.40**	CFM/person
CFM/ft²	**0.65**	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Sep 1300 COOLING OA DB / WB 79.8 °F / 67.4 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	703 ft²	15751	-	703 ft²	-	-
Wall Transmission	3523 ft²	378	-	3523 ft²	9286	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	703 ft²	408	-	703 ft²	14271	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	48 ft²	2354	-	48 ft²	1537	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	5244 W	17894	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	3746 W	12781	-	0	0	-
People	145	35524	29725	0	0	0
Infiltration	-	1483	4948	-	21749	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**86573**	**34673**	**-**	**46843**	**0**
Zone Conditioning	-	87887	34673	-	48075	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	4843 CFM	6763	-	4843 CFM	-6763	-
Ventilation Load	4843 CFM	12296	25116	4843 CFM	130335	0
Ventilation Fan Load	4843 CFM	22544	-	4843 CFM	-22544	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**129490**	**59790**	**-**	**149103**	**0**
Cooling Coil	-	133903	60121	-	0	0
Heating Coil	-	0	-	-	0	-
Terminal Unit Cooling	-	2278	36	-	0	0
Terminal Unit Heating	-	-6627	-	-	149103	-
>> Total Conditioning	**-**	**129554**	**60157**	**-**	**149103**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for RTU-16 Media Center

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 — 07/16/2021
Prepared by: Seaman Engineering Corp. — 06:22PM

Air System Information

Air System Name	RTU-16 Media Center		Number of zones	5	
Equipment Class	PKG ROOF		Floor Area	6971.0	ft²
Air System Type	VAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Peak zone sensible load
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	13.3	Tons	Load occurs at	Aug 1500	
Total coil load	159.4	MBH	OA DB / WB	87.0 / 71.0	°F
Sensible coil load	113.4	MBH	Entering DB / WB	77.8 / 64.7	°F
Coil CFM at Aug 1500	4410	CFM	Leaving DB / WB	53.1 / 52.0	°F
Max block CFM at Aug 1500	4715	CFM	Coil ADP	50.3	°F
Sum of peak zone CFM	4723	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.711		Resulting RH	51	%
CFM/Ton	331.9		Design supply temp.	55.0	°F
ft²/Ton	524.7		Zone T-stat Check	5 of 5	OK
BTU/(hr·ft²)	22.9		Max zone temperature deviation	0.0	°F
Water flow @ 10.0 °F rise	N/A				

Central Heating Coil Sizing Data

Max coil load	8.6	MBH	Load occurs at	May 0500	
Coil CFM at May 0500	3923	CFM	BTU/(hr·ft²)	1.2	
Max coil CFM	4715	CFM	Ent. DB / Lvg DB	51.7 / 53.8	°F
Water flow @ 20.0 °F drop	0.86	gpm			

Preheat Coil Sizing Data

Max coil load	7.5	MBH	Load occurs at	Apr 0200	
Coil CFM at Apr 0200	3872	CFM	Ent. DB / Lvg DB	53.1 / 55.0	°F
Max coil CFM	4715	CFM			
Water flow @ 20.0 °F drop	0.75	gpm			

Supply Fan Sizing Data

Actual max CFM at Aug 1500	4715	CFM	Fan motor BHP	4.87	BHP
Standard CFM	4546	CFM	Fan motor kW	3.86	kW
Actual max CFM/ft²	0.68	CFM/ft²	Fan static	3.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	2686	CFM	CFM/person	18.78	CFM/person
CFM/ft²	0.39	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	776 ft²	21011	-	776 ft²	-	-
Wall Transmission	456 ft²	187	-	456 ft²	1236	-
Roof Transmission	5483 ft²	3588	-	5483 ft²	8517	-
Window Transmission	776 ft²	1992	-	776 ft²	15891	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	4880 W	16649	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	4649 W	15862	-	0	0	-
People	143	35035	29315	0	0	0
Infiltration	-	3863	4668	-	23176	-4
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**98187**	**33983**	**-**	**48821**	**-4**
Zone Conditioning	-	92762	33983	-	48179	-4
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	4410 CFM	0	-	3491 CFM	0	-
Ventilation Load	2686 CFM	9451	12058	2686 CFM	59812	0
Supply Fan Load	4410 CFM	11206	-	3491 CFM	-6328	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**113419**	**46041**	**-**	**101663**	**-4**
Central Cooling Coil	-	113419	45999	-	0	0
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	551	-
Terminal Reheat Coils	-	0	-	-	101112	-
>> Total Conditioning	**-**	**113419**	**45999**	**-**	**101663**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for RTU-17 Kitchen

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 07/18/2021
Prepared by: Seaman Engineering Corp. 09:45AM

Air System Information

Air System Name	RTU-17 Kitchen		Number of zones	5	
Equipment Class	PKG ROOF		Floor Area	6155.0	ft²
Air System Type	VAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Peak zone sensible load
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	19.2	Tons	Load occurs at	Jul 1500	
Total coil load	229.9	MBH	OA DB / WB	87.0 / 71.0	°F
Sensible coil load	173.0	MBH	Entering DB / WB	80.0 / 64.6	°F
Coil CFM at Jul 1500	5927	CFM	Leaving DB / WB	52.0 / 50.7	°F
Max block CFM at Jan 2300	6067	CFM	Coil ADP	48.9	°F
Sum of peak zone CFM	6067	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.753		Resulting RH	40	%
CFM/Ton	309.4		Design supply temp.	55.0	°F
ft²/Ton	321.3		Zone T-stat Check	5 of 5	OK
BTU/(hr·ft²)	37.3		Max zone temperature deviation	0.0	°F
Water flow @ 10.0 °F rise	N/A				

Central Heating Coil Sizing Data

No central heating coil loads occurred during this calculation.

Preheat Coil Sizing Data

Max coil load	111.3	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	3033	CFM	Ent. DB / Lvg DB	19.8 / 55.0	°F
Max coil CFM	6067	CFM			
Water flow @ 20.0 °F drop	11.14	gpm			

Supply Fan Sizing Data

Actual max CFM at Jan 2300	6067	CFM	Fan motor BHP	8.35	BHP
Standard CFM	5849	CFM	Fan motor kW	6.62	kW
Actual max CFM/ft²	0.99	CFM/ft²	Fan static	4.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	2197	CFM	CFM/person	104.60	CFM/person
CFM/ft²	0.36	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	0 ft²	0	-	0 ft²	0	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	5993 ft²	0	-	5993 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	4304 W	14683	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	3078 W	10500	-	0	0	-
People	21	5145	4305	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	96000	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**126329**	**4305**	**-**	**0**	**0**
Zone Conditioning	-	126325	4305	-	-11	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	3927 CFM	0	-	1651 CFM	0	-
Ventilation Load	2197 CFM	25268	52561	2197 CFM	163807	0
Supply Fan Load	5927 CFM	21397	-	3033 CFM	-4744	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**172990**	**56866**	**-**	**159051**	**0**
Central Cooling Coil	-	172990	56872	-	0	0
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	111310	-
Terminal Reheat Coils	-	0	-	-	47741	-
>> Total Conditioning	**-**	**172990**	**56872**	**-**	**159051**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	**RTU-18 Cafeteria**	
Equipment Class	**PKG ROOF**	
Air System Type	**VAV**	
Number of zones	**2**	
Floor Area	**10075.0**	ft²
Location	**Worcester, Massachusetts**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**
Sizing Data	**Calculated**
Zone CFM Sizing	**Peak zone sensible load**
Space CFM Sizing	**Individual peak space loads**

Central Cooling Coil Sizing Data

Total coil load	**41.4**	Tons
Total coil load	**496.9**	MBH
Sensible coil load	**327.0**	MBH
Coil CFM at Jul 1600	**12262**	CFM
Max block CFM at Jul 1600	**13130**	CFM
Sum of peak zone CFM	**13132**	CFM
Sensible heat ratio	**0.658**	
CFM/Ton	**296.1**	
ft²/Ton	**243.3**	
BTU/(hr·ft²)	**49.3**	
Water flow @ 10.0 °F rise	**N/A**	
Load occurs at	**Jul 1600**	
OA DB / WB	**86.5 / 70.9**	°F
Entering DB / WB	**80.6 / 67.5**	°F
Leaving DB / WB	**55.0 / 53.9**	°F
Coil ADP	**52.2**	°F
Bypass Factor	**0.100**	
Resulting RH	**55**	%
Design supply temp.	**55.0**	°F
Zone T-stat Check	**2 of 2**	OK
Max zone temperature deviation	**0.0**	°F

Preheat Coil Sizing Data

Max coil load	**247.2**	MBH
Coil CFM at Des Htg	**7468**	CFM
Max coil CFM	**13130**	CFM
Water flow @ 20.0 °F drop	**N/A**	
Load occurs at	**Des Htg**	
Ent. DB / Lvg DB	**18.2 / 50.0**	°F

Supply Fan Sizing Data

Actual max CFM at Jul 1600	**13130**	CFM
Standard CFM	**12658**	CFM
Actual max CFM/ft²	**1.30**	CFM/ft²
Fan motor BHP	**0.00**	BHP
Fan motor kW	**0.00**	kW
Fan static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**5489**	CFM
CFM/ft²	**0.54**	CFM/ft²
CFM/person	**11.20**	CFM/person

Air System Design Load Summary for RTU-18 Cafeteria

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 07/16/2021
Prepared by: Seaman Engineering Corp. 06:22PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 86.5 °F / 70.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	2765 ft²	89912	-	2765 ft²	-	-
Wall Transmission	55 ft²	22	-	55 ft²	149	-
Roof Transmission	9660 ft²	6682	-	9660 ft²	15005	-
Window Transmission	2350 ft²	5845	-	2350 ft²	47376	-
Skylight Transmission	415 ft²	885	-	415 ft²	7171	-
Door Loads	48 ft²	2056	-	48 ft²	1500	-
Floor Transmission	8405 ft²	0	-	8405 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	5038 W	17188	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	5038 W	17188	-	0	0	-
People	490	120049	100450	0	0	0
Infiltration	-	13588	11903	-	85059	-31
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**273413**	**112353**	**-**	**156261**	**-31**
Zone Conditioning	-	266058	112353	-	147711	-31
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	12262 CFM	0	-	7468 CFM	0	-
Ventilation Load	5489 CFM	60927	57572	5489 CFM	392675	0
Supply Fan Load	12262 CFM	0	-	7468 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**326985**	**169925**	**-**	**540387**	**-31**
Central Cooling Coil	-	326985	169927	-	0	0
Preheat Coil	-	0	-	-	247152	-
Terminal Reheat Coils	-	0	-	-	293235	-
>> Total Conditioning	**-**	**326985**	**169927**	**-**	**540387**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	RTU-19 Pod D Science		Number of zones	19	
Equipment Class	PKG ROOF		Floor Area	21910.0	ft²
Air System Type	VAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Peak zone sensible load
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	55.8	Tons	Load occurs at	Aug 1500	
Total coil load	669.4	MBH	OA DB / WB	87.0 / 71.0	°F
Sensible coil load	419.2	MBH	Entering DB / WB	84.9 / 69.6	°F
Coil CFM at Aug 1500	12488	CFM	Leaving DB / WB	52.7 / 51.6	°F
Max block CFM at Aug 1400	14323	CFM	Coil ADP	49.1	°F
Sum of peak zone CFM	14452	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.626		Resulting RH	48	%
CFM/Ton	223.9		Design supply temp.	55.0	°F
ft²/Ton	392.8		Zone T-stat Check	19 of 19	OK
BTU/(hr·ft²)	30.6		Max zone temperature deviation	0.0	°F
Water flow @ 10.0 °F rise	N/A				

Central Heating Coil Sizing Data

Max coil load	7.1	MBH	Load occurs at	Mar 1600	
Coil CFM at Mar 1600	11227	CFM	BTU/(hr·ft²)	0.3	
Max coil CFM	14323	CFM	Ent. DB / Lvg DB	54.5 / 55.1	°F
Water flow @ 20.0 °F drop	0.71	gpm			

Preheat Coil Sizing Data

Max coil load	516.4	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	11147	CFM	Ent. DB / Lvg DB	10.5 / 55.0	°F
Max coil CFM	14323	CFM			
Water flow @ 20.0 °F drop	51.67	gpm			

Supply Fan Sizing Data

Actual max CFM at Aug 1400	14323	CFM	Fan motor BHP	24.63	BHP
Standard CFM	13808	CFM	Fan motor kW	19.54	kW
Actual max CFM/ft²	0.65	CFM/ft²	Fan static	5.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	11479	CFM	CFM/person	38.01	CFM/person
CFM/ft²	0.52	CFM/ft²			

Air System Design Load Summary for RTU-19 Pod D Science

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 — 07/16/2021
Prepared by: Seaman Engineering Corp. — 06:22PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	1272 ft²	24635	-	1272 ft²	-	-
Wall Transmission	6776 ft²	3215	-	6776 ft²	18371	-
Roof Transmission	7420 ft²	4855	-	7420 ft²	11526	-
Window Transmission	1272 ft²	3215	-	1272 ft²	25644	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	15337 W	52329	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	10955 W	37378	-	0	0	-
People	302	73989	61910	0	0	0
Infiltration	-	9894	13783	-	59362	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**209509**	**75693**	**-**	**114902**	**0**
Zone Conditioning	-	204523	75693	-	114096	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	2885 CFM	0	-	2340 CFM	0	-
Ventilation Load	11479 CFM	132319	174703	11147 CFM	708373	0
Supply Fan Load	12488 CFM	47585	-	11147 CFM	-35826	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**384427**	**250396**	**-**	**786643**	**0**
Central Cooling Coil	-	419194	250214	-	0	0
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	516391	-
Terminal Reheat Coils	-	-34767	-	-	270252	-
Zone Heating Unit Coils	-	0	-	-	0	-
>> Total Conditioning	**-**	**384427**	**250214**	**-**	**786643**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	RTU-2 Pod B Classrooms		Number of zones	39	
Equipment Class	TERM		Floor Area	36524.0	ft²
Air System Type	ACB		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec
Sizing Data	Calculated

Cooling Coil Sizing Data

Total coil load	58.4	Tons	Load occurs at	Aug 1500	
Total coil load	700.2	MBH	OA DB / WB	87.0 / 71.0	°F
Total coil load	233.9	CFM/Ton	Entering DB / WB	79.8 / 65.4	°F
Sensible coil load	459.2	MBH	Leaving DB / WB	47.5 / 46.5	°F
Coil CFM at Aug 1500	13649	CFM	Bypass Factor	0.100	
Max coil CFM	13649	CFM			
Sensible heat ratio	0.656				
Water flow @ 10.0 °F rise	140.12	gpm			

Heating Coil Sizing Data

No heating coil loads occurred during this calculation.

Ventilation Fan Sizing Data

Actual max CFM	13649	CFM	Fan motor BHP	23.47	BHP
Standard CFM	13158	CFM	Fan motor kW	18.62	kW
Actual max CFM/ft²	0.37	CFM/ft²	Fan static	5.00	in wg

Exhaust Fan Sizing Data

Actual max CFM	13649	CFM	Fan motor BHP	7.04	BHP
Standard CFM	13158	CFM	Fan motor kW	5.59	kW
Actual max CFM/ft²	0.37	CFM/ft²	Fan static	1.50	in wg

Outdoor Ventilation Air Data

Design airflow CFM	13649	CFM	CFM/person	18.49	CFM/person
CFM/ft²	0.37	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1300 COOLING OA DB / WB 85.2 °F / 70.5 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	5061 ft²	90634	-	5061 ft²	-	-
Wall Transmission	14847 ft²	4302	-	14847 ft²	39135	-
Roof Transmission	10160 ft²	5941	-	10160 ft²	15344	-
Window Transmission	5061 ft²	10865	-	5061 ft²	102738	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	42 ft²	93	-	42 ft²	882	-
Floor Transmission	1851 ft²	0	-	1851 ft²	2861	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	25567 W	87232	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	18746 W	63959	-	0	0	-
People	738	180807	151290	0	0	0
Infiltration	-	16723	24549	-	115058	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**460557**	**175839**	**-**	**276018**	**0**
Zone Conditioning	-	455904	175839	-	273813	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	13649 CFM	19060	-	13649 CFM	-19060	-
Ventilation Load	13649 CFM	36406	70488	13649 CFM	364341	0
Ventilation Fan Load	13649 CFM	63534	-	13649 CFM	-63534	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**574903**	**246327**	**-**	**555560**	**0**
Cooling Coil	-	450020	241051	-	0	0
Heating Coil	-	0	-	-	0	-
Terminal Unit Cooling	-	124789	4566	-	0	0
Terminal Unit Heating	-	0	-	-	554919	-
>> Total Conditioning	**-**	**574809**	**245617**	**-**	**554919**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	RTU-20 Common Corridor		Number of zones	22	
Equipment Class	PKG ROOF		Floor Area	16482.0	ft²
Air System Type	VAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Peak zone sensible load
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	18.4	Tons	Load occurs at	Jul 1600	
Total coil load	220.5	MBH	OA DB / WB	86.5 / 70.9	°F
Sensible coil load	186.2	MBH	Entering DB / WB	76.7 / 61.9	°F
Coil CFM at Jul 1600	7266	CFM	Leaving DB / WB	52.1 / 50.8	°F
Max block CFM at Jul 1600	7652	CFM	Coil ADP	49.4	°F
Sum of peak zone CFM	7706	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.845		Resulting RH	45	%
CFM/Ton	395.5		Design supply temp.	55.0	°F
ft²/Ton	897.2		Zone T-stat Check	22 of 22	OK
BTU/(hr·ft²)	13.4		Max zone temperature deviation	0.0	°F
Water flow @ 10.0 °F rise	N/A				

Central Heating Coil Sizing Data

No central heating coil loads occurred during this calculation.

Preheat Coil Sizing Data

Max coil load	15.1	MBH	Load occurs at	Mar 1100	
Coil CFM at Mar 1100	6349	CFM	Ent. DB / Lvg DB	52.7 / 55.0	°F
Max coil CFM	7652	CFM			
Water flow @ 20.0 °F drop	1.51	gpm			

Supply Fan Sizing Data

Actual max CFM at Jul 1600	7652	CFM	Fan motor BHP	10.53	BHP
Standard CFM	7377	CFM	Fan motor kW	8.35	kW
Actual max CFM/ft²	0.46	CFM/ft²	Fan static	4.00	in wg

Return Fan Sizing Data

Actual max CFM at Jul 1600	7652	CFM	Fan motor BHP	3.95	BHP
Standard CFM	7377	CFM	Fan motor kW	3.13	kW
Actual max CFM/ft²	0.46	CFM/ft²	Fan static	1.50	in wg

Outdoor Ventilation Air Data

Design airflow CFM	2586	CFM	CFM/person	78.37	CFM/person
CFM/ft²	0.16	CFM/ft²			

Air System Design Load Summary for RTU-20 Common Corridor

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 07/16/2021
Prepared by: Seaman Engineering Corp. 06:22PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 86.5 °F / 70.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	1426 ft²	38364	-	1426 ft²	-	-
Wall Transmission	6386 ft²	2470	-	6386 ft²	17314	-
Roof Transmission	6769 ft²	4682	-	6769 ft²	10515	-
Window Transmission	1426 ft²	3673	-	1426 ft²	29775	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	126 ft²	336	-	126 ft²	2722	-
Floor Transmission	4984 ft²	4154	-	4984 ft²	12964	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	11155 W	38060	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	8404 W	28673	-	0	0	-
People	33	8085	6765	0	0	0
Infiltration	-	7055	13820	-	44162	-2
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**135552**	**20585**	**-**	**117450**	**-2**
Zone Conditioning	-	130479	20585	-	115993	-2
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	7266 CFM	9445	-	5349 CFM	-4476	-
Ventilation Load	2220 CFM	7471	14607	2586 CFM	58239	0
Supply Fan Load	7266 CFM	25188	-	5349 CFM	-11936	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**172583**	**35192**	**-**	**157821**	**-2**
Central Cooling Coil	-	186194	34261	-	0	0
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	0	-
Terminal Reheat Coils	-	-13612	-	-	157697	-
>> Total Conditioning	**-**	**172583**	**34261**	**-**	**157697**	**0**
Key:	**Positive values are clg loads** **Negative values are htg loads**			**Positive values are htg loads** **Negative values are clg loads**		

Air System Sizing Summary for RTU-21 & 22 Gymnasium

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 | 07/16/2021
Prepared by: Seaman Engineering Corp. | 06:22PM

Air System Information

Air System Name	RTU-21 & 22 Gymnasium		Number of zones	1	
Equipment Class	PKG ROOF		Floor Area	18700.0	ft²
Air System Type	SZCAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	31.8	Tons	Load occurs at	Jul 1500	
Total coil load	381.9	MBH	OA DB / WB	87.0 / 71.0	°F
Sensible coil load	336.1	MBH	Entering DB / WB	76.1 / 64.7	°F
Coil CFM at Jul 1500	18958	CFM	Leaving DB / WB	59.0 / 57.9	°F
Max block CFM	18958	CFM	Coil ADP	57.1	°F
Sum of peak zone CFM	18958	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.880		Resulting RH	55	%
CFM/Ton	595.7		Design supply temp.	55.0	°F
ft²/Ton	587.6		Zone T-stat Check	1 of 1	OK
BTU/(hr·ft²)	20.4		Max zone temperature deviation	0.0	°F
Water flow @ 10.0 °F rise	N/A				

Central Heating Coil Sizing Data

Max coil load	499.6	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	18958	CFM	BTU/(hr·ft²)	26.7	
Max coil CFM	18958	CFM	Ent. DB / Lvg DB	65.5 / 90.8	°F
Water flow @ 20.0 °F drop	49.99	gpm			

Supply Fan Sizing Data

Actual max CFM	18958	CFM	Fan motor BHP	15.58	BHP
Standard CFM	18276	CFM	Fan motor kW	12.36	kW
Actual max CFM/ft²	1.01	CFM/ft²	Fan static	3.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	4566	CFM	CFM/person	76.10	CFM/person
CFM/ft²	0.24	CFM/ft²			

Air System Design Load Summary for RTU-21 & 22 Gymnasium

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	5490 ft²	91219	-	5490 ft²	-	-
Wall Transmission	9644 ft²	3275	-	9644 ft²	26147	-
Roof Transmission	17788 ft²	12717	-	17788 ft²	27631	-
Window Transmission	5490 ft²	12273	-	5490 ft²	97901	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	84 ft²	227	-	84 ft²	1814	-
Floor Transmission	17788 ft²	34871	-	17788 ft²	96055	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	12342 W	42110	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	9350 W	31902	-	0	0	-
People	60	14700	12300	0	0	0
Infiltration	-	34072	29409	-	204432	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**277367**	**41709**	**-**	**453979**	**0**
Zone Conditioning	-	267796	41709	-	441134	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	18958 CFM	0	-	18958 CFM	0	-
Ventilation Load	1254 CFM	4376	4071	4566 CFM	100635	0
Supply Fan Load	18958 CFM	42161	-	18958 CFM	-42161	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**314334**	**45780**	**-**	**499607**	**0**
Central Cooling Coil	-	336127	45780	-	0	0
Central Heating Coil	-	-21794	-	-	499607	-
>> Total Conditioning	**-**	**314334**	**45780**	**-**	**499607**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	RTU-23 Wellness & Adapt PE		Number of zones	8	
Equipment Class	PKG ROOF		Floor Area	12483.0	ft²
Air System Type	VAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Peak zone sensible load
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	18.1	Tons	Load occurs at	Aug 1500	
Total coil load	217.8	MBH	OA DB / WB	87.0 / 71.0	°F
Sensible coil load	165.6	MBH	Entering DB / WB	75.9 / 63.1	°F
Coil CFM at Aug 1500	6925	CFM	Leaving DB / WB	53.0 / 51.8	°F
Max block CFM at Aug 1400	7108	CFM	Coil ADP	50.4	°F
Sum of peak zone CFM	7123	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.760		Resulting RH	50	%
CFM/Ton	381.5		Design supply temp.	55.0	°F
ft²/Ton	687.8		Zone T-stat Check	8 of 8	OK
BTU/(hr·ft²)	17.4		Max zone temperature deviation	0.0	°F
Water flow @ 10.0 °F rise	N/A				

Central Heating Coil Sizing Data

Max coil load	26.2	MBH	Load occurs at	Mar 1600	
Coil CFM at Mar 1600	6588	CFM	BTU/(hr·ft²)	2.1	
Max coil CFM	7108	CFM	Ent. DB / Lvg DB	52.3 / 56.1	°F
Water flow @ 20.0 °F drop	2.62	gpm			

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM at Aug 1400	7108	CFM	Fan motor BHP	7.79	BHP
Standard CFM	6852	CFM	Fan motor kW	6.18	kW
Actual max CFM/ft²	0.57	CFM/ft²	Fan static	4.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	3413	CFM	CFM/person	35.56	CFM/person
CFM/ft²	0.27	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	897 ft²	21293	-	897 ft²	-	-
Wall Transmission	3059 ft²	1294	-	3059 ft²	8063	-
Roof Transmission	8884 ft²	5813	-	8884 ft²	13417	-
Window Transmission	897 ft²	2315	-	897 ft²	17951	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	12483 ft²	24471	-	12483 ft²	62415	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	8738 W	29814	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	6242 W	21296	-	0	0	-
People	96	23520	19680	0	0	0
Infiltration	-	9741	14734	-	56825	-1
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**139556**	**34414**	**-**	**158671**	**-1**
Zone Conditioning	-	130613	34414	-	155611	-1
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	6925 CFM	0	-	6497 CFM	0	-
Ventilation Load	3413 CFM	13856	18483	3413 CFM	73812	0
Supply Fan Load	6925 CFM	21130	-	6497 CFM	-21257	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**165600**	**52897**	**-**	**208166**	**-1**
Central Cooling Coil	-	165600	52197	-	0	0
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	0	-
Terminal Reheat Coils	-	0	-	-	208157	-
>> Total Conditioning	**-**	**165600**	**52197**	**-**	**208157**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for RTU-24 Locker room

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 07/16/2021
Prepared by: Seaman Engineering Corp. 06:22PM

Air System Information

Air System Name	RTU-24 Locker room		Number of zones	11	
Equipment Class	PKG ROOF		Floor Area	10019.0	ft²
Air System Type	VAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Peak zone sensible load
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	23.2	Tons	Load occurs at	Aug 1500	
Total coil load	278.4	MBH	OA DB / WB	87.0 / 71.0	°F
Sensible coil load	178.0	MBH	Entering DB / WB	84.4 / 69.3	°F
Coil CFM at Aug 1500	5640	CFM	Leaving DB / WB	54.0 / 52.9	°F
Max block CFM at Jul 1500	6805	CFM	Coil ADP	50.7	°F
Sum of peak zone CFM	6932	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.639		Resulting RH	51	%
CFM/Ton	243.1		Design supply temp.	55.0	°F
ft²/Ton	431.8		Zone T-stat Check	11 of 11	OK
BTU/(hr·ft²)	27.8		Max zone temperature deviation	0.0	°F
Water flow @ 10.0 °F rise	N/A				

Central Heating Coil Sizing Data

Max coil load	46.7	MBH	Load occurs at	Mar 1500	
Coil CFM at Mar 1500	5507	CFM	BTU/(hr·ft²)	4.7	
Max coil CFM	6805	CFM	Ent. DB / Lvg DB	53.1 / 61.2	°F
Water flow @ 20.0 °F drop	4.68	gpm			

Preheat Coil Sizing Data

Max coil load	228.3	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	5507	CFM	Ent. DB / Lvg DB	15.2 / 55.0	°F
Max coil CFM	6805	CFM			
Water flow @ 20.0 °F drop	22.85	gpm			

Supply Fan Sizing Data

Actual max CFM at Jul 1500	6805	CFM	Fan motor BHP	7.02	BHP
Standard CFM	6560	CFM	Fan motor kW	5.57	kW
Actual max CFM/ft²	0.68	CFM/ft²	Fan static	3.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	5246	CFM	CFM/person	38.57	CFM/person
CFM/ft²	0.52	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	3718 ft²	1376	-	3718 ft²	10080	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	10019 ft²	19641	-	10019 ft²	54103	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	7013 W	23929	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	5010 W	17092	-	0	0	-
People	136	33320	27880	0	0	0
Infiltration	-	3237	4192	-	19422	-1
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**98595**	**32072**	**-**	**83605**	**-1**
Zone Conditioning	-	99441	32072	-	81641	-1
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	1656 CFM	0	-	1566 CFM	0	-
Ventilation Load	5246 CFM	60070	68468	5246 CFM	321716	0
Supply Fan Load	5640 CFM	11929	-	5507 CFM	-11185	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**171439**	**100540**	**-**	**392173**	**-1**
Central Cooling Coil	-	178026	100411	-	0	0
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	228340	-
Terminal Reheat Coils	-	-6587	-	-	163832	-
>> Total Conditioning	**-**	**171439**	**100411**	**-**	**392173**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	**RTU-3 Pod C Classrooms**		Number of zones	**55**	
Equipment Class	**TERM**		Floor Area	**52593.0**	ft²
Air System Type	**ACB**		Location	**Worcester, Massachusetts**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**
Sizing Data	**Calculated**

Cooling Coil Sizing Data

Total coil load	**81.7**	Tons	Load occurs at	**Jul 1500**	
Total coil load	**980.6**	MBH	OA DB / WB	**87.0 / 71.0**	°F
Total coil load	**234.0**	CFM/Ton	Entering DB / WB	**79.9 / 65.4**	°F
Sensible coil load	**644.5**	MBH	Leaving DB / WB	**47.5 / 46.5**	°F
Coil CFM at Jul 1500	**19120**	CFM	Bypass Factor	**0.100**	
Max coil CFM	**19120**	CFM			
Sensible heat ratio	**0.657**				
Water flow @ 10.0 °F rise	**196.22**	gpm			

Heating Coil Sizing Data

No heating coil loads occurred during this calculation.

Ventilation Fan Sizing Data

Actual max CFM	**19120**	CFM	Fan motor BHP	**32.88**	BHP
Standard CFM	**18432**	CFM	Fan motor kW	**26.08**	kW
Actual max CFM/ft²	**0.36**	CFM/ft²	Fan static	**5.00**	in wg

Exhaust Fan Sizing Data

Actual max CFM	**19120**	CFM	Fan motor BHP	**9.86**	BHP
Standard CFM	**18432**	CFM	Fan motor kW	**7.82**	kW
Actual max CFM/ft²	**0.36**	CFM/ft²	Fan static	**1.50**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**19120**	CFM	CFM/person	**19.37**	CFM/person
CFM/ft²	**0.36**	CFM/ft²			

Air System Design Load Summary for RTU-3 Pod C Classrooms

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 07/16/2021
Prepared by: Seaman Engineering Corp. 06:22PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1400 COOLING OA DB / WB 86.5 °F / 70.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	6464 ft²	109607	-	6464 ft²	-	-
Wall Transmission	21391 ft²	7339	-	21391 ft²	56384	-
Roof Transmission	10665 ft²	7430	-	10665 ft²	16106	-
Window Transmission	6464 ft²	15914	-	6464 ft²	131219	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	42 ft²	107	-	42 ft²	882	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	36815 W	125611	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	29681 W	101271	-	0	0	-
People	987	241812	202335	0	0	0
Infiltration	-	25970	35768	-	158049	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**635059**	**238103**	**-**	**362640**	**0**
Zone Conditioning	-	628504	238103	-	361680	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	19120 CFM	26699	-	19120 CFM	-26699	-
Ventilation Load	19120 CFM	57714	100068	19120 CFM	510182	0
Ventilation Fan Load	19120 CFM	88997	-	19120 CFM	-88997	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**801914**	**338171**	**-**	**756166**	**0**
Cooling Coil	-	641146	336266	-	0	0
Heating Coil	-	0	-	-	0	-
Terminal Unit Cooling	-	161583	833	-	0	0
Terminal Unit Heating	-	0	-	-	756590	-
>> Total Conditioning	**-**	**802728**	**337100**	**-**	**756590**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Dedicated Outdoor Air System (DOAS) Sizing Summary for RTU-4 Pod D Classrooms

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 — 07/16/2021
Prepared by: Seaman Engineering Corp. — 06:22PM

Air System Information

Air System Name	**RTU-4 Pod D Classrooms**		Number of zones	**23**	
Equipment Class	**TERM**		Floor Area	**24820.0**	ft²
Air System Type	**ACB**		Location	**Worcester, Massachusetts**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**
Sizing Data	**Calculated**

Cooling Coil Sizing Data

Total coil load	**38.1**	Tons	Load occurs at	**Aug 1500**	
Total coil load	**457.4**	MBH	OA DB / WB	**87.0 / 71.0**	°F
Total coil load	**236.5**	CFM/Ton	Entering DB / WB	**79.9 / 65.2**	°F
Sensible coil load	**303.6**	MBH	Leaving DB / WB	**47.5 / 46.5**	°F
Coil CFM at Aug 1500	**9014**	CFM	Bypass Factor	**0.100**	
Max coil CFM	**9014**	CFM			
Sensible heat ratio	**0.664**				
Water flow @ 10.0 °F rise	**91.52**	gpm			

Heating Coil Sizing Data

No heating coil loads occurred during this calculation.

Ventilation Fan Sizing Data

Actual max CFM	**9014**	CFM	Fan motor BHP	**15.50**	BHP
Standard CFM	**8690**	CFM	Fan motor kW	**12.30**	kW
Actual max CFM/ft²	**0.36**	CFM/ft²	Fan static	**5.00**	in wg

Exhaust Fan Sizing Data

Actual max CFM	**9014**	CFM	Fan motor BHP	**4.65**	BHP
Standard CFM	**8690**	CFM	Fan motor kW	**3.69**	kW
Actual max CFM/ft²	**0.36**	CFM/ft²	Fan static	**1.50**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**9014**	CFM	CFM/person	**21.99**	CFM/person
CFM/ft²	**0.36**	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1300 COOLING OA DB / WB 85.2 °F / 70.5 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	4262 ft²	67051	-	4262 ft²	-	-
Wall Transmission	10741 ft²	3352	-	10741 ft²	28312	-
Roof Transmission	8538 ft²	5459	-	8538 ft²	12894	-
Window Transmission	4262 ft²	9008	-	4262 ft²	85179	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	42 ft²	93	-	42 ft²	882	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	17374 W	59279	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	12506 W	42670	-	0	0	-
People	410	100449	84050	0	0	0
Infiltration	-	12449	20155	-	85651	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**299809**	**104205**	**-**	**212919**	**0**
Zone Conditioning	-	295444	104205	-	212183	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	9014 CFM	12588	-	9014 CFM	-12588	-
Ventilation Load	9014 CFM	23733	49199	9014 CFM	240000	0
Ventilation Fan Load	9014 CFM	41960	-	9014 CFM	-41960	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**373725**	**153405**	**-**	**397636**	**0**
Cooling Coil	-	297933	153733	-	0	0
Heating Coil	-	0	-	-	0	-
Terminal Unit Cooling	-	75910	0	-	0	0
Terminal Unit Heating	-	0	-	-	397573	-
>> Total Conditioning	**-**	**373844**	**153733**	**-**	**397573**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for RTU-5 Pod A Science

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 — 07/16/2021
Prepared by: Seaman Engineering Corp. — 06:22PM

Air System Information

Air System Name	**RTU-5 Pod A Science**		Number of zones	**10**	
Equipment Class	**PKG ROOF**		Floor Area	**9264.0**	ft²
Air System Type	**VAV**		Location	**Worcester, Massachusetts**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**		Zone CFM Sizing	**Peak zone sensible load**
Sizing Data	**Calculated**		Space CFM Sizing	**Individual peak space loads**

Central Cooling Coil Sizing Data

Total coil load	**29.7**	Tons	Load occurs at	**Aug 1400**	
Total coil load	**356.1**	MBH	OA DB / WB	**86.5 / 70.9**	°F
Sensible coil load	**225.3**	MBH	Entering DB / WB	**83.4 / 68.7**	°F
Coil CFM at Aug 1400	**7070**	CFM	Leaving DB / WB	**52.8 / 51.7**	°F
Max block CFM at Sep 1400	**8395**	CFM	Coil ADP	**49.4**	°F
Sum of peak zone CFM	**8589**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.633**		Resulting RH	**50**	%
CFM/Ton	**238.3**		Design supply temp.	**55.0**	°F
ft²/Ton	**312.2**		Zone T-stat Check	**10 of 10**	OK
BTU/(hr·ft²)	**38.4**		Max zone temperature deviation	**0.0**	°F
Water flow @ 10.0 °F rise	**N/A**				

Central Heating Coil Sizing Data

Max coil load	**27.0**	MBH	Load occurs at	**May 0600**	
Coil CFM at May 0600	**6555**	CFM	BTU/(hr·ft²)	**2.9**	
Max coil CFM	**8395**	CFM	Ent. DB / Lvg DB	**53.9 / 57.9**	°F
Water flow @ 20.0 °F drop	**2.71**	gpm			

Preheat Coil Sizing Data

Max coil load	**345.2**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**6028**	CFM	Ent. DB / Lvg DB	**0.0 / 55.0**	°F
Max coil CFM	**8395**	CFM			
Water flow @ 20.0 °F drop	**34.54**	gpm			

Supply Fan Sizing Data

Actual max CFM at Sep 1400	**8395**	CFM	Fan motor BHP	**14.44**	BHP
Standard CFM	**8093**	CFM	Fan motor kW	**11.45**	kW
Actual max CFM/ft²	**0.91**	CFM/ft²	Fan static	**5.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**8321**	CFM	CFM/person	**50.43**	CFM/person
CFM/ft²	**0.90**	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1400 COOLING OA DB / WB 86.5 °F / 70.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	877 ft²	27288	-	877 ft²	-	-
Wall Transmission	3983 ft²	1660	-	3983 ft²	10799	-
Roof Transmission	1850 ft²	1184	-	1850 ft²	2874	-
Window Transmission	877 ft²	2159	-	877 ft²	18312	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	3273 ft²	0	-	3273 ft²	4181	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	6485 W	22126	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	4632 W	15804	-	0	0	-
People	165	40424	33825	0	0	0
Infiltration	-	4623	6378	-	28936	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**115268**	**40203**	**-**	**65101**	**0**
Zone Conditioning	-	114422	40203	-	64678	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	1839 CFM	0	-	0 CFM	0	-
Ventilation Load	5231 CFM	64616	90240	6028 CFM	448951	0
Supply Fan Load	7070 CFM	25574	-	6028 CFM	-17474	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**204612**	**130443**	**-**	**496155**	**0**
Central Cooling Coil	-	225334	130725	-	0	0
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	345210	-
Terminal Reheat Coils	-	-20722	-	-	150945	-
Zone Heating Unit Coils	-	0	-	-	0	-
>> Total Conditioning	**-**	**204612**	**130725**	**-**	**496155**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	RTU-6 Common Corridor		Number of zones	21	
Equipment Class	PKG ROOF		Floor Area	18664.0	ft²
Air System Type	VAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Peak zone sensible load
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	20.6	Tons	Load occurs at	Jul 1500	
Total coil load	246.9	MBH	OA DB / WB	87.0 / 71.0	°F
Sensible coil load	190.9	MBH	Entering DB / WB	77.9 / 63.4	°F
Coil CFM at Jul 1500	7107	CFM	Leaving DB / WB	52.1 / 50.8	°F
Max block CFM at Jun 1700	7473	CFM	Coil ADP	49.2	°F
Sum of peak zone CFM	7511	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.773		Resulting RH	47	%
CFM/Ton	345.4		Design supply temp.	55.0	°F
ft²/Ton	907.1		Zone T-stat Check	21 of 21	OK
BTU/(hr·ft²)	13.2		Max zone temperature deviation	0.0	°F
Water flow @ 10.0 °F rise	N/A				

Central Heating Coil Sizing Data

No central heating coil loads occurred during this calculation.

Preheat Coil Sizing Data

Max coil load	13.4	MBH	Load occurs at	Apr 0200	
Coil CFM at Apr 0200	6013	CFM	Ent. DB / Lvg DB	52.9 / 55.0	°F
Max coil CFM	7473	CFM			
Water flow @ 20.0 °F drop	1.34	gpm			

Supply Fan Sizing Data

Actual max CFM at Jun 1700	7473	CFM	Fan motor BHP	10.28	BHP
Standard CFM	7204	CFM	Fan motor kW	8.16	kW
Actual max CFM/ft²	0.40	CFM/ft²	Fan static	4.00	in wg

Return Fan Sizing Data

Actual max CFM at Jun 1700	7473	CFM	Fan motor BHP	3.86	BHP
Standard CFM	7204	CFM	Fan motor kW	3.06	kW
Actual max CFM/ft²	0.40	CFM/ft²	Fan static	1.50	in wg

Outdoor Ventilation Air Data

Design airflow CFM	2833	CFM	CFM/person	18.16	CFM/person
CFM/ft²	0.15	CFM/ft²			

Air System Design Load Summary for RTU-6 Common Corridor

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	1756 ft²	23772	-	1756 ft²	-	-
Wall Transmission	3085 ft²	962	-	3085 ft²	8364	-
Roof Transmission	5638 ft²	4031	-	5638 ft²	8758	-
Window Transmission	1756 ft²	5085	-	1756 ft²	40564	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	42 ft²	114	-	42 ft²	907	-
Floor Transmission	5816 ft²	0	-	5816 ft²	4448	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	12501 W	42652	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	9749 W	33263	-	0	0	-
People	156	38220	31980	0	0	0
Infiltration	-	5301	8349	-	31807	-2
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**153400**	**40329**	**-**	**94848**	**-2**
Zone Conditioning	-	147847	40329	-	93740	-2
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	7107 CFM	9260	-	4671 CFM	-3445	-
Ventilation Load	2833 CFM	9140	16008	2833 CFM	63674	0
Supply Fan Load	7107 CFM	24693	-	4671 CFM	-9186	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**190940**	**56337**	**-**	**144784**	**-2**
Central Cooling Coil	-	190940	55961	-	0	0
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	0	-
Terminal Reheat Coils	-	0	-	-	144778	-
>> Total Conditioning	**-**	**190940**	**55961**	**-**	**144778**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for RTU-7 Chorus/Band

Air System Information

Air System Name	**RTU-7 Chorus/Band**		Number of zones	**4**	
Equipment Class	**PKG ROOF**		Floor Area	**4756.0**	ft²
Air System Type	**VAV**		Location	**Worcester, Massachusetts**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**	Zone CFM Sizing	**Peak zone sensible load**
Sizing Data	**Calculated**	Space CFM Sizing	**Individual peak space loads**

Central Cooling Coil Sizing Data

Total coil load	**9.3**	Tons	Load occurs at	**Jul 1700**	
Total coil load	**111.1**	MBH	OA DB / WB	**85.3 / 70.5**	°F
Sensible coil load	**77.4**	MBH	Entering DB / WB	**77.1 / 65.0**	°F
Coil CFM at Jul 1700	**3217**	CFM	Leaving DB / WB	**54.0 / 53.0**	°F
Max block CFM at Jul 1700	**3469**	CFM	Coil ADP	**51.4**	°F
Sum of peak zone CFM	**3479**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.697**		Resulting RH	**53**	%
CFM/Ton	**347.6**		Design supply temp.	**55.0**	°F
ft²/Ton	**513.9**		Zone T-stat Check	**4 of 4**	OK
BTU/(hr·ft²)	**23.4**		Max zone temperature deviation	**0.0**	°F
Water flow @ 10.0 °F rise	**N/A**				

Central Heating Coil Sizing Data

Max coil load	**10.0**	MBH	Load occurs at	**May 0400**	
Coil CFM at May 0400	**2805**	CFM	BTU/(hr·ft²)	**2.1**	
Max coil CFM	**3469**	CFM	Ent. DB / Lvg DB	**50.6 / 54.0**	°F
Water flow @ 20.0 °F drop	**1.00**	gpm			

Preheat Coil Sizing Data

Max coil load	**31.2**	MBH	Load occurs at	**Apr 0100**	
Coil CFM at Apr 0100	**2722**	CFM	Ent. DB / Lvg DB	**54.0 / 65.0**	°F
Max coil CFM	**3469**	CFM			
Water flow @ 20.0 °F drop	**3.12**	gpm			

Supply Fan Sizing Data

Actual max CFM at Jul 1700	**3469**	CFM	Fan motor BHP	**1.90**	BHP
Standard CFM	**3344**	CFM	Fan motor kW	**1.51**	kW
Actual max CFM/ft²	**0.73**	CFM/ft²	Fan static	**2.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**1657**	CFM	CFM/person	**16.25**	CFM/person
CFM/ft²	**0.35**	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 85.3 °F / 70.5 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	1050 ft²	18597	-	1050 ft²	-	-
Wall Transmission	2745 ft²	996	-	2745 ft²	7442	-
Roof Transmission	3200 ft²	2007	-	3200 ft²	4971	-
Window Transmission	1050 ft²	2516	-	1050 ft²	21924	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	3329 W	11359	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	2136 W	7286	-	0	0	-
People	102	26740	24160	0	0	0
Infiltration	-	2737	3282	-	19059	-1
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**72238**	**27442**	**-**	**53396**	**-1**
Zone Conditioning	-	67588	27442	-	52874	-1
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	3217 CFM	0	-	2472 CFM	0	-
Ventilation Load	1657 CFM	5036	6266	1657 CFM	36924	0
Supply Fan Load	3217 CFM	4807	-	2472 CFM	-3762	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**77431**	**33708**	**-**	**86037**	**-1**
Central Cooling Coil	-	77431	33633	-	-3762	0
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	20635	-
Terminal Reheat Coils	-	0	-	-	69164	-
>> Total Conditioning	**-**	**77431**	**33633**	**-**	**86037**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	RTU-8 Blackbox		Number of zones	1	
Equipment Class	PKG ROOF		Floor Area	2734.0	ft²
Air System Type	SZCAV		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	7.4	Tons	Load occurs at	Jul 1500	
Total coil load	88.7	MBH	OA DB / WB	87.0 / 71.0	°F
Sensible coil load	60.0	MBH	Entering DB / WB	77.4 / 65.5	°F
Coil CFM at Jul 1500	2492	CFM	Leaving DB / WB	54.3 / 53.3	°F
Max block CFM	2492	CFM	Coil ADP	51.7	°F
Sum of peak zone CFM	2492	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.676		Resulting RH	55	%
CFM/Ton	337.2		Design supply temp.	55.0	°F
ft²/Ton	369.9		Zone T-stat Check	1 of 1	OK
BTU/(hr·ft²)	32.4		Max zone temperature deviation	0.0	°F
Water flow @ 10.0 °F rise	N/A				

Central Heating Coil Sizing Data

Max coil load	64.2	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	2492	CFM	BTU/(hr·ft²)	23.5	
Max coil CFM	2492	CFM	Ent. DB / Lvg DB	63.6 / 88.3	°F
Water flow @ 20.0 °F drop	N/A				

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM	2492	CFM	Fan motor BHP	2.57	BHP
Standard CFM	2403	CFM	Fan motor kW	2.04	kW
Actual max CFM/ft²	0.91	CFM/ft²	Fan static	3.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	830	CFM	CFM/person	16.60	CFM/person
CFM/ft²	0.30	CFM/ft²			

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 87.0 °F / 71.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	1100 ft²	12024	-	1100 ft²	-	-
Wall Transmission	581 ft²	164	-	581 ft²	1575	-
Roof Transmission	2734 ft²	1955	-	2734 ft²	4247	-
Window Transmission	1100 ft²	2879	-	1100 ft²	22968	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1914 W	6530	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	2734 W	9328	-	0	0	-
People	50	14750	22750	0	0	0
Infiltration	-	4270	3446	-	25619	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**51899**	**26196**	**-**	**54409**	**0**
Zone Conditioning	-	50254	26196	-	52812	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	2492 CFM	0	-	2492 CFM	0	-
Ventilation Load	830 CFM	2772	2518	830 CFM	18312	0
Supply Fan Load	2492 CFM	6961	-	2492 CFM	-6961	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**59987**	**28714**	**-**	**64163**	**0**
Central Cooling Coil	-	59987	28715	-	0	0
Central Heating Coil	-	0	-	-	64163	-
Preheat Coil	-	0	-	-	0	-
>> Total Conditioning	**-**	**59987**	**28715**	**-**	**64163**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	RTU-9 ETA SHOPS DOAS		Number of zones	8	
Equipment Class	TERM		Floor Area	12912.0	ft²
Air System Type	4P-FC		Location	Worcester, Massachusetts	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Cooling Coil Sizing Data

Total coil load	12.9	Tons	Load occurs at	Jul 1500	
Total coil load	154.7	MBH	OA DB / WB	87.0 / 71.0	°F
Total coil load	395.8	CFM/Ton	Entering DB / WB	80.4 / 67.9	°F
Sensible coil load	114.7	MBH	Leaving DB / WB	58.9 / 58.2	°F
Coil CFM at Jul 1500	5103	CFM	Bypass Factor	0.100	
Max coil CFM	5103	CFM			
Sensible heat ratio	0.741				
Water flow @ 10.0 °F rise	30.96	gpm			

Heating Coil Sizing Data

Max coil load	112.7	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	5103	CFM	Ent. DB / Lvg DB	42.0 / 63.2	°F
Max coil CFM	5103	CFM			
Water flow @ 20.0 °F drop	11.28	gpm			

Ventilation Fan Sizing Data

Actual max CFM	5103	CFM	Fan motor BHP	3.51	BHP
Standard CFM	4919	CFM	Fan motor kW	2.78	kW
Actual max CFM/ft²	0.40	CFM/ft²	Fan static	2.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	5103	CFM	CFM/person	32.71	CFM/person
CFM/ft²	0.40	CFM/ft²			

Air System Design Load Summary for RTU-9 ETA SHOPS DOAS

Project Name: Doherty High School Master Heat Pump V5 3-8-2021 07/16/2021
Prepared by: Seaman Engineering Corp. 06:22PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Apr 1800 COOLING OA DB / WB 64.5 °F / 59.8 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 0.0 °F / -1.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	0 ft²	0	-	0 ft²	0	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	12874 ft²	0	-	12874 ft²	1807	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	9038 W	30839	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	2557 W	8724	-	0	0	-
People	156	38220	31980	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**77783**	**31980**	**-**	**1807**	**0**
Zone Conditioning	-	78392	31980	-	1806	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	5103 CFM	0	-	5103 CFM	0	-
Ventilation Load	5103 CFM	-61129	-26064	5103 CFM	148746	0
Ventilation Fan Load	5103 CFM	9501	-	5103 CFM	-9501	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**26765**	**5916**	**-**	**141051**	**0**
Cooling Coil	-	0	0	-	0	0
Heating Coil	-	0	-	-	112726	-
Terminal Unit Cooling	-	35731	5918	-	0	0
Terminal Unit Heating	-	0	-	-	28324	-
>> Total Conditioning	**-**	**35731**	**5918**	**-**	**141050**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Appendix D

Life Cycle
&
Energy Analysis Data

Annual Cost Summary

Table 1. Annual Costs

Component	Doherty 60% CD ($)
Air System Fans	201,274
Cooling	215,457
Heating	21,965
Pumps	39,509
Heat Rejection Fans	0
HVAC Sub-Total	**478,205**
Lights	279,549
Electric Equipment	202,843
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	**482,392**
Grand Total	**960,597**

Table 2. Annual Cost per Unit Floor Area

Component	Doherty 60% CD ($/ft²)
Air System Fans	0.748
Cooling	0.800
Heating	0.082
Pumps	0.147
Heat Rejection Fans	0.000
HVAC Sub-Total	**1.776**
Lights	1.038
Electric Equipment	0.753
Misc. Electric	0.000
Misc. Fuel Use	0.000
Non-HVAC Sub-Total	**1.792**
Grand Total	**3.568**
Gross Floor Area (ft²)	269247.0
Conditioned Floor Area (ft²)	269247.0

Note: Values in this table are calculated using the Gross Floor Area.

Table 3. Component Cost as a Percentage of Total Cost

Component	Doherty 60% CD (%)
Air System Fans	21.0
Cooling	22.4
Heating	2.3
Pumps	4.1
Heat Rejection Fans	0.0
HVAC Sub-Total	**49.8**
Lights	29.1
Electric Equipment	21.1
Misc. Electric	0.0
Misc. Fuel Use	0.0
Non-HVAC Sub-Total	**50.2**
Grand Total	**100.0**

Table 1. Annual Costs

Component	Doherty 60% CD ($)
HVAC Components	
Electric	459,398
Natural Gas	18,825
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	**478,223**
Non-HVAC Components	
Electric	482,405
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Non-HVAC Sub-Total	**482,405**
Grand Total	**960,628**

Table 2. Annual Energy Consumption

Component	Doherty 60% CD
HVAC Components	
Electric (kWh)	2,702,344
Natural Gas (Therm)	20,916
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	2,837,678
Natural Gas (Therm)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	5,540,022
Natural Gas (Therm)	20,916
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0

Table 3. Annual Emissions

Component	Doherty 60% CD
CO2 Equivalent (lb)	0

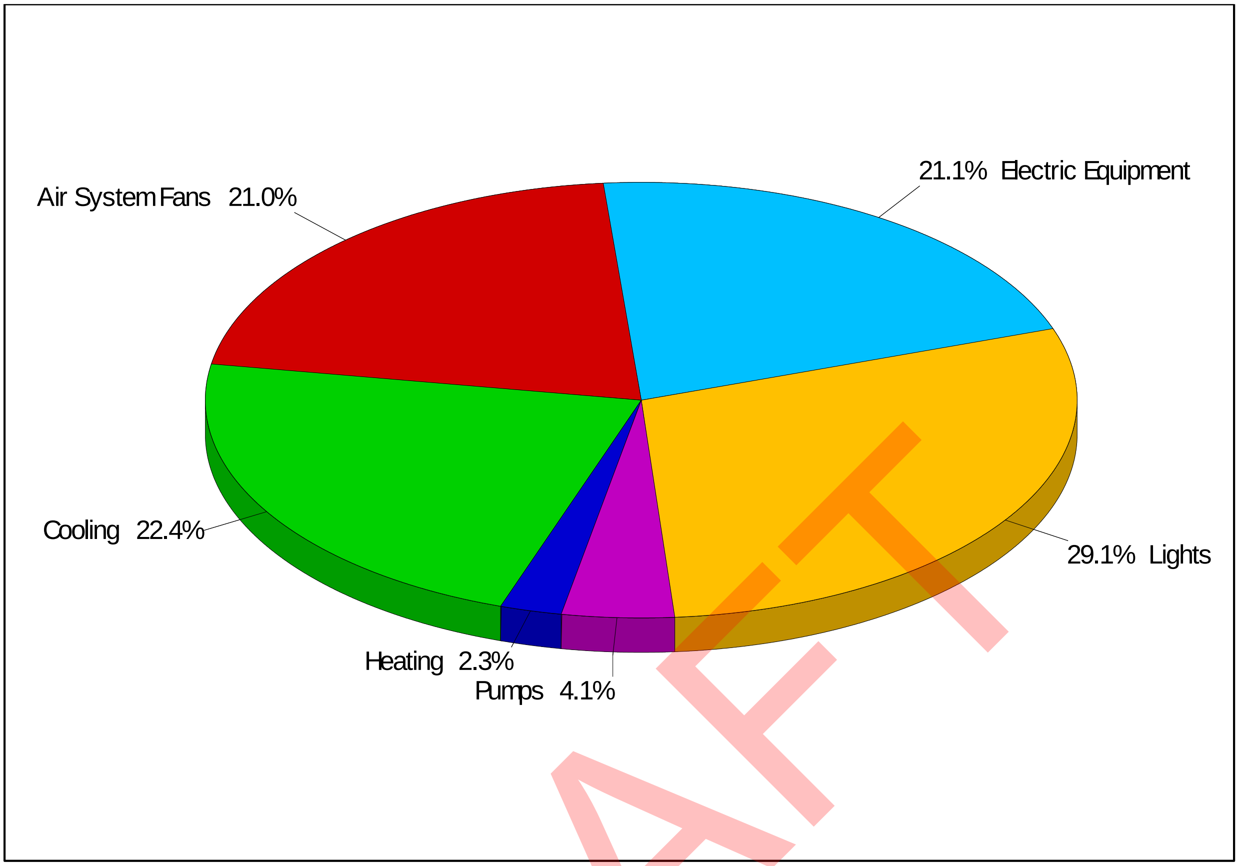
Table 4. Annual Cost per Unit Floor Area

Component	Doherty 60% CD ($/ft²)
HVAC Components	
Electric	1.706
Natural Gas	0.070
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Remote CW	0.000
HVAC Sub-Total	**1.776**
Non-HVAC Components	
Electric	1.792
Natural Gas	0.000
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Non-HVAC Sub-Total	**1.792**
Grand Total	**3.568**
Gross Floor Area (ft²)	269247.0
Conditioned Floor Area (ft²)	269247.0

Note: Values in this table are calculated using the Gross Floor Area.

Table 5. Component Cost as a Percentage of Total Cost

Component	Doherty 60% CD (%)
HVAC Components	
Electric	47.8
Natural Gas	2.0
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Remote CW	0.0
HVAC Sub-Total	**49.8**
Non-HVAC Components	
Electric	50.2
Natural Gas	0.0
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Non-HVAC Sub-Total	**50.2**
Grand Total	**100.0**

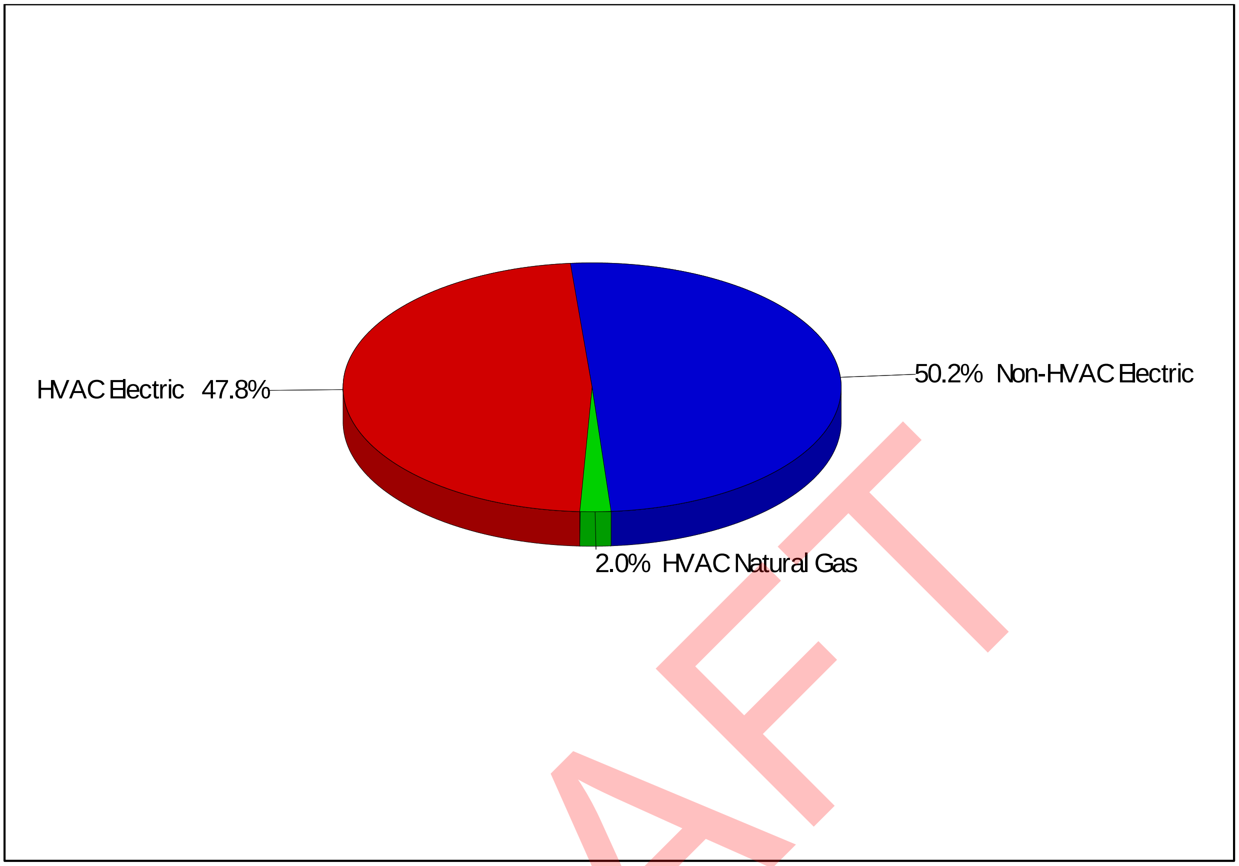


1. Annual Costs

Component	Annual Cost ($)	($/ft²)	Percent of Total (%)
Air System Fans	201,274	0.748	21.0
Cooling	215,457	0.800	22.4
Heating	21,965	0.082	2.3
Pumps	39,509	0.147	4.1
Heat Rejection Fans	0	0.000	0.0
HVAC Sub-Total	**478,205**	**1.776**	**49.8**
Lights	279,549	1.038	29.1
Electric Equipment	202,843	0.753	21.1
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	**482,392**	**1.792**	**50.2**
Grand Total	**960,597**	**3.568**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area .... **269247.0** ft²
Conditioned Floor Area **269247.0** ft²



1. Annual Costs

Component	Annual Cost ($/yr)	($/ft²)	Percent of Total (%)
HVAC Components			
Electric	459,398	1.706	47.8
Natural Gas	18,825	0.070	2.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Remote Chilled Water	0	0.000	0.0
HVAC Sub-Total	**478,223**	**1.776**	**49.8**
Non-HVAC Components			
Electric	482,405	1.792	50.2
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Non-HVAC Sub-Total	**482,405**	**1.792**	**50.2**
Grand Total	**960,628**	**3.568**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area .... **269247.0** ft²
Conditioned Floor Area **269247.0** ft²

1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	17,949,500	66.666
Heating Coil Loads	5,743,624	21.332
Grand Total	**23,693,120**	**87.998**

2. Energy Consumption by System Component

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
Air System Fans	4,039,689	15.004	14,427,462	53.585
Cooling	4,324,340	16.061	15,444,069	57.360
Heating	2,154,660	8.003	2,316,725	8.605
Pumps	792,974	2.945	2,832,050	10.518
Heat Rejection Fans	0	0.000	0	0.000
HVAC Sub-Total	**11,311,662**	**42.012**	**35,020,306**	**130.068**
Lights	5,610,707	20.839	20,038,240	74.423
Electric Equipment	4,071,181	15.121	14,539,930	54.002
Misc. Electric	0	0.000	0	0.000
Misc. Fuel Use	0	0.000	0	0.000
Non-HVAC Sub-Total	**9,681,887**	**35.959**	**34,578,170**	**128.426**
Grand Total	**20,993,549**	**77.971**	**69,598,476**	**258.493**

Notes:
1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
   Gross Floor Area .... **269247.0** ft²
   Conditioned Floor Area .... **269247.0** ft²

Life Cycle Data from DD submission as 60% CD Cost Estimate not available at time of calculation. SEC

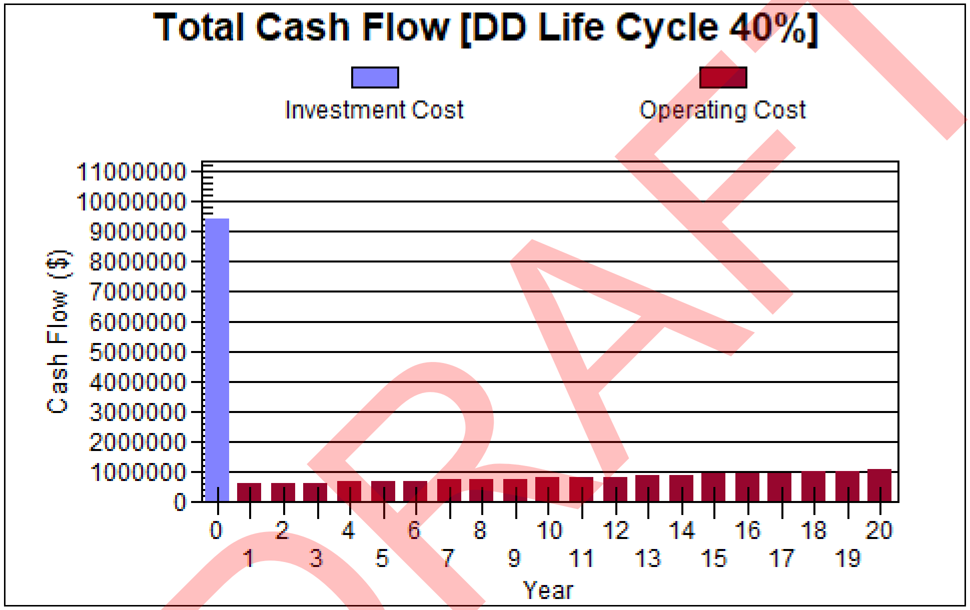
Cash Flow Details

Note: Payback program only allows installed cost up to $10 million. As such, payback was broken down into (2) 40% runs and (1) 20% run. Results were totaled within the report.

Doherty High DD 40%

DD Life Cycle 40%

Type of Analysis .... Simple Payback Analysis
Length of Analysis .... 20 yrs
Discount Rate .... 0.00 %



1A. Component Cash Flows [DD Life Cycle 40%], Actual Value

Year	Date	Cash Investment ($)	Loan Principal ($)	Loan Interest ($)	Total Investment Cost ($)	Annual Operating Cost ($)	Non-Annual Operating Cost ($)	Total Operating Cost ($)	Total Cash Flow ($)
0	Initial	9,498,353	0	0	9,498,353	0	0	0	9,498,353
1	1	0	0	0	0	621,740	0	621,740	621,740
2	2	0	0	0	0	640,392	0	640,392	640,392
3	3	0	0	0	0	659,604	0	659,604	659,604
4	4	0	0	0	0	679,392	0	679,392	679,392
5	5	0	0	0	0	699,774	0	699,774	699,774
6	6	0	0	0	0	720,767	0	720,767	720,767

Cash Flow Details

Project: Doherty High School DD Life Cycle
Prepared By: Seaman Engineering Corp.

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Year	Date	Cash Investment ($)	Loan Principal ($)	Loan Interest ($)	Total Investment Cost ($)	Annual Operating Cost ($)	Non-Annual Operating Cost ($)	Total Operating Cost ($)	Total Cash Flow ($)
7	7	0	0	0	0	742,390	0	742,390	742,390
8	8	0	0	0	0	764,662	0	764,662	764,662
9	9	0	0	0	0	787,602	0	787,602	787,602
10	10	0	0	0	0	811,230	0	811,230	811,230
11	11	0	0	0	0	835,566	0	835,566	835,566
12	12	0	0	0	0	860,633	0	860,633	860,633
13	13	0	0	0	0	886,452	0	886,452	886,452
14	14	0	0	0	0	913,046	0	913,046	913,046
15	15	0	0	0	0	940,437	0	940,437	940,437
16	16	0	0	0	0	968,651	0	968,651	968,651
17	17	0	0	0	0	997,710	0	997,710	997,710
18	18	0	0	0	0	1,027,641	0	1,027,641	1,027,641
19	19	0	0	0	0	1,058,471	0	1,058,471	1,058,471
20	20	0	0	0	0	1,090,225	0	1,090,225	1,090,225
Totals		9,498,353	0	0	9,498,353	16,706,385	0	16,706,385	26,204,738

1B. Present Worth Cash Flows [DD Life Cycle 40%]

Year	Date	Total Investment Cost ($)	Total Operating Cost ($)	Total Present Worth ($)
0	Initial	9,498,353	0	9,498,353
1	1	0	621,740	621,740
2	2	0	640,392	640,392
3	3	0	659,604	659,604
4	4	0	679,392	679,392
5	5	0	699,774	699,774
6	6	0	720,767	720,767
7	7	0	742,390	742,390
8	8	0	764,662	764,662
9	9	0	787,602	787,602
10	10	0	811,230	811,230
11	11	0	835,566	835,566
12	12	0	860,633	860,633
13	13	0	886,452	886,452
14	14	0	913,046	913,046
15	15	0	940,437	940,437
16	16	0	968,651	968,651
17	17	0	997,710	997,710

Cash Flow Details

Project: Doherty High School DD Life Cycle
Prepared By: Seaman Engineering Corp.

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Year	Date	Total Investment Cost ($)	Total Operating Cost ($)	Total Present Worth ($)
18	18	0	1,027,641	1,027,641
19	19	0	1,058,471	1,058,471
20	20	0	1,090,225	1,090,225
Totals		9,498,353	16,706,385	26,204,738

Cash Flow Details

Project: Doherty High School DD Life Cycle
Prepared By: Seaman Engineering Corp.

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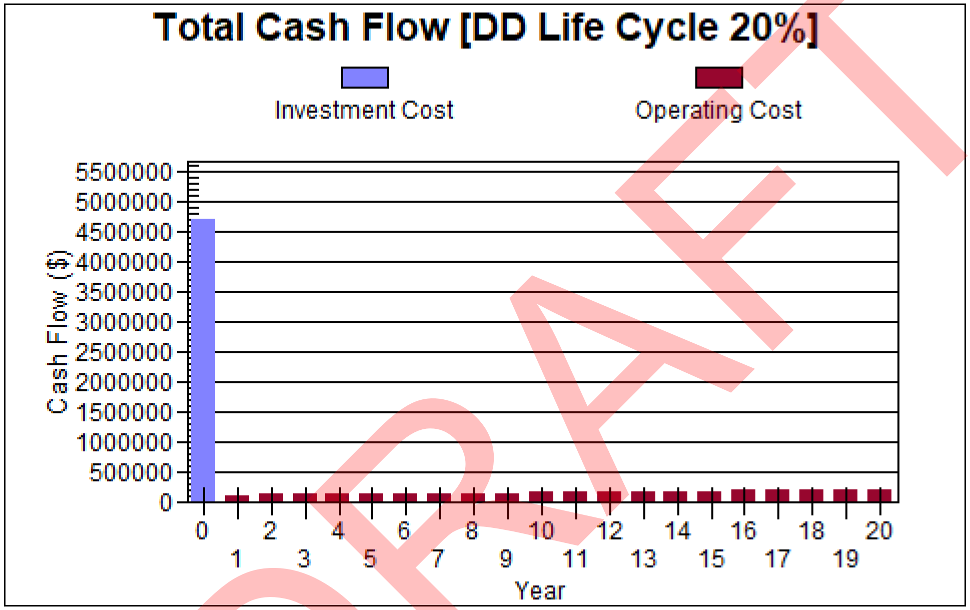
Doherty High DD 20%

DD Life Cycle 20%

Type of Analysis.......Simple Payback Analysis
Length of Analysis ....20 yrs
Discount Rate ....0.00 %



1A. Component Cash Flows [DD Life Cycle 20%], Actual Value

Year	Date	Cash Investment ($)	Loan Principal ($)	Loan Interest ($)	Total Investment Cost ($)	Annual Operating Cost ($)	Non-Annual Operating Cost ($)	Total Operating Cost ($)	Total Cash Flow ($)
0	Initial	4,749,177	0	0	4,749,177	0	0	0	4,749,177
1	1	0	0	0	0	131,427	0	131,427	131,427
2	2	0	0	0	0	135,370	0	135,370	135,370
3	3	0	0	0	0	139,431	0	139,431	139,431
4	4	0	0	0	0	143,614	0	143,614	143,614
5	5	0	0	0	0	147,922	0	147,922	147,922
6	6	0	0	0	0	152,360	0	152,360	152,360
7	7	0	0	0	0	156,931	0	156,931	156,931

Cash Flow Details

Year	Date	Cash Investment ($)	Loan Principal ($)	Loan Interest ($)	Total Investment Cost ($)	Annual Operating Cost ($)	Non-Annual Operating Cost ($)	Total Operating Cost ($)	Total Cash Flow ($)
8	8	0	0	0	0	161,639	0	161,639	161,639
9	9	0	0	0	0	166,488	0	166,488	166,488
10	10	0	0	0	0	171,482	0	171,482	171,482
11	11	0	0	0	0	176,627	0	176,627	176,627
12	12	0	0	0	0	181,926	0	181,926	181,926
13	13	0	0	0	0	187,383	0	187,383	187,383
14	14	0	0	0	0	193,005	0	193,005	193,005
15	15	0	0	0	0	198,795	0	198,795	198,795
16	16	0	0	0	0	204,759	0	204,759	204,759
17	17	0	0	0	0	210,902	0	210,902	210,902
18	18	0	0	0	0	217,229	0	217,229	217,229
19	19	0	0	0	0	223,746	0	223,746	223,746
20	20	0	0	0	0	230,458	0	230,458	230,458
Totals		4,749,177	0	0	4,749,177	3,531,494	0	3,531,494	8,280,671

1B. Present Worth Cash Flows [DD Life Cycle 20%]

Year	Date	Total Investment Cost ($)	Total Operating Cost ($)	Total Present Worth ($)
0	Initial	4,749,177	0	4,749,177
1	1	0	131,427	131,427
2	2	0	135,370	135,370
3	3	0	139,431	139,431
4	4	0	143,614	143,614
5	5	0	147,922	147,922
6	6	0	152,360	152,360
7	7	0	156,931	156,931
8	8	0	161,639	161,639
9	9	0	166,488	166,488
10	10	0	171,482	171,482
11	11	0	176,627	176,627
12	12	0	181,926	181,926
13	13	0	187,383	187,383
14	14	0	193,005	193,005
15	15	0	198,795	198,795
16	16	0	204,759	204,759
17	17	0	210,902	210,902
18	18	0	217,229	217,229

Cash Flow Details

Project: Doherty High School DD Life Cycle
Prepared By: Seaman Engineering Corp.

3/23/2021
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Year	Date	Total Investment Cost ($)	Total Operating Cost ($)	Total Present Worth ($)
19	19	0	223,746	223,746
20	20	0	230,458	230,458
Totals		4,749,177	3,531,494	8,280,671

SEAMAN ENGINEERING CORPORATION
P: 508-865-1400
F: 508-865-1401
22 West St. Unit C, Millbury, MA 01527
seamanengineers.com

MEMORANDUM

Date: July 15, 2021

To: Tom Angelo @ Eversource Gas Company

From: Christopher Robinson

Re: Doherty High School, 299 Highland Street, Worcester, MA – Gas Load Letter

---

The following information is provided for the natural gas distribution system to the proposed Doherty High School project.

1) Architect to provide site plan showing building location on the site.

2) Service Address: 299 Highland Street, Worcester, MA 01602

3) The gas meter is located on the north side of the fourth classroom pod, furthest away from the street. It faces the service area for the school that includes a loading dock area..

4) Square Footage of Building: 424,600 SF

   Square Footage of Parking Garage: 45,574 SF

5) There is one gas meter on this building and it serves the following:

   Gas-Fired Heating Boilers (3 total) = 4,000,000 BTUH each, 12,000,000 BTUH total

   Domestic Hot Water Boilers (2 total) = 1,250,000 BTUH each, 2,500,000 BTUH total

   Gas-Fired Generators (2 total) = 3,000,000 BTUH each, 6,000,000 BTUH total

   Science Lab Gas Turrets, 186 total @ 5 CFH each = 930,000 BTUH

   Grand Total Gas Load = 21,430,000 BTUH

6) The minimum gas pressure required at all other equipment is under 7.0" w.c.

   The minimum gas pressure required at the gas-fired generators is 1 PSI

   Therefore, we need 2 PSI at the outlet of the gas meter which will be reduced in the boiler room to 8"w.c. which will then be distributed through the school. A second pressure reducing valve will be installed for the gas-fired generators.

7) Property Owner Name & Address:

Worcester Public Schools
20 Irving Street,
Worcester, MA 01609

8) Construction Contract Name & Phone Number: TBD

9) Construction Timeline or when service will be required: TBD

K. Updated HVAC Heat Gain & Loss Calculations

K. HVAC Heat Gain & Loss Calculations

Refer to Section 6B.3.1.J.2 HVAC Design Development Life Cycle Report, Appendix C – Heating and Cooling Load Calculations.

L. Updated Electrical Load Calculations

ART Engineering
we build the future.
38 Front St. FL 3, Worcester, MA 01608 Office: 508.797.0333

July 15, 2021

Doherty High Community School
299 Highland Street
Worcester, MA 01602

ELECTRICAL LOAD ANALYSIS

	SF	VA/sf	Connected kVA	Demand Factor	Demand kVA
	424,600				
Interior Lighting		0.50	212.3	1.25	265.4
Exterior Lighting			10.0	1.25	12.5
Elevators			86.0	1.00	86.0
General Purpose Power		2.00	849.2	1st 10kVA	10.0
				Remainder	
				50%	419.6
Kitchen			791.7	0.65	514.6
HVAC			2149.4	0.80	1719.5
TOTAL			**4,098.6**		**3,027.6**

Load in kVA	**3,028**	**kVA**	
Total Load Current			
277Y/480V	**3,643**	**A**	
Proposed Service Size	**5,000**	**A**	**480V-3 Phase 4-Wire**

6B.3.1 General Requirements

M. Security & Visual Access Requirements

1. Security & Visual Access Requirements Narrative
2. Transmittal of 60% CD to Authorities having Jurisdiction

The District's School Safety Director and liaison to City of Worcester Police Department, Rob Pezzella, The Superintendent of Schools, and other school and District representatives were present at security-related programming meetings during the Feasibility Study, Schematic Design and Design Development phases. The City and LPA|A developed security protocols during the South High School design process. These policies and issues unique to the Doherty project were reviewed at these meetings, and have been incorporated into the documents. The Design Development drawings were issued to the City of Worcester Building Departments, who coordinates with the Worcester Fire Department. LPAA has discussed their review, and has requested and reviewed code interpretations of these departments, and have integrated responses into the documents. The 60% documents will be delivered to the Code and Fire Departments for their review. The Fire department reviews for emergency access around the building. Full site drawings were issued to the City Department of Public Works as part of the conservation commission amendment filing, that incudes utility and access reviews. The Department had no comments.

The District has identified a proprietary video surveillance system, manufactured by Genetec Inc., as part of the unified security system. Refer to Section 6B.3.1.D Proprietary Items and 6B.3.6 Project Manual and for a full list of proprietary specification items and related information.

The main entrance design complies with District protocol, for secure vestibule entry sequence discussed during the Security program meetings, as follows:

1. The secure main entrance vestibule is adjacent to, and has direct line of sight to, the main office.
2. The school bus drop-off and main parking area is viewable from the main office.
3. Entry is allowed through exterior/interior vestibule doors, utilizing timer-controlled electronic access control door hardware, at the beginning of each school day during a designated student arrival period (approximately 15 minutes). After school starts, exterior/interior vestibule doors will be automatically locked for the remainder of the day.
4. During the school day when exterior/interior vestibule doors are typically locked, access from the exterior to the main entry vestibule will be via a video entry station with intercom and remote access control hardware (monitored by main office administrative staff). Once allowed access into the secure main entry vestibule, visitors must use a second video entry station to be allowed access into the main office for sign-in and identity confirmation. A video entry station shall be provided at the outside door for non-school hours access.

The interior door sequencing and lockdown was also reviewed and was developed as follows:

1. Corridor-to-Classroom doors are proposed to have keyed classroom-function locksets; typical. Inside lever trim of classroom function locksets is always free for immediate exit.
2. Classroom-to-Classroom communicating doors are proposed to have a passage hardware set, to allow free passage of students though the classroom areas. This was a directive of the Worcester Fire Department and the District.
3. Classroom side-lites are proposed on the strike side of doors. Sidelite glazing will be laminated safety glazing and provided with a manually-operated privacy blind.
4. Classrooms and teaching spaces will be equipped with a public address system with the capability to transmit customizable audio/visual notifications as part of the District's lockdown protocol.
5. The main lobby area is scheduled to be separated from the academic areas with swing doors or horizontal sliding doors at the corridors leading to the main circulation spine. These corridor doors are designed to egress into the lobby, and the lobby side of these doors are capable of being locked from the lobby side. These doors are typically held open on magnetic release hold open devices that will close the doors during fire alarm. These lobby doors hold-open system will also be controlled by a relay, and can be released to close upon actuation of a panic switch, which will be located at the main office reception desk, (multiple locations) at the principal's office, and School Resource Officer's office. The swing and overhead doors to the Cafeteria, horizontal sliding doors at the central corridor, and Black Box corridor will also be programmed to close and lock upon actuation of the panic switch, isolating the Lobby from the balance of the Main Floor.
6. The Upper Lobby will also utilize (3) horizontal sliding doors that will be closed in case of fire alarm or panic switch activation (lockdown), in order to secure the upper lobby from the balance of the school. Card readers will be provided to allow passage through the accordion doors for egress. Two additional horizontal sliding doors are shown on the third level, to separate the upper floors from access via the open Upper Lobby stairs.
7. The main classroom pod corridors have a pair of outswing doors separating off the main corridor, similar to the lobby doors these doors are generally held open with magnetic hold opens, and can also be released and closed in an emergency situation, isolating each pod.
   Stair D2.2 also requires a unique electronic hardware set to prevent an intruder from accessing the upper floors, while still allowing safe egress. The door will be locked in case of a panic switch actuation, but will release in the case of a fire alarm or fire command center override.

Other Exterior doors operations were discussed as follows:

1. A video entry station shall be provided at the Loading Dock/Receiving area, 2nd floor Gymnasium entrance and exterior door at the Nurses suite. These doors will also be provided with electronic card reader system. Note that all doors with card readers will also be covered with security camera monitoring.
2. Select exit doors are to be provided will be equipped with electronic card access control hardware. These doors include the CCL and ETA shop doors to the courtyards, the 2nd floor gymnasium entrance.
3. The parking garage is for assigned teachers and staff only, and the entrance is to be equipped with a card reader and entrance arm, as well as a segmented garage door. The teachers will be assigned parking spaces and parking stickers. During the morning and afternoon entrance hours, the entrance gate and door will be open. At school opening hours the gate will come down and the card reader will be opened only with the card reader. At set periods after, and other hours, the garage door will be closed, and programmed to operate along with the traffic control arm (momentarily before the arm goes up) Exit will be on a free driving loop actuated when the cars drive over the loop.
4. The door from the garage to the school will have a card swipe on both sides, so teachers must swipe their cards to enter the school, and also need a card to exit to the parking area. Emergency exits are provided separately from the garage to the exterior without going through the school.
5. At the Chapter 74 trade courtyard, which serves as an exterior classroom, work and storage area, the vehicular access will have a gate with controlled access to enter and exit.

Building Security Diagrams had been issued and reviewed, and there have been no changes made or required at this date. Security plans were reviewed with the Building and Fire Departments. Further review will occur at the beginning of the 90% phase.

Video surveillance will be provided throughout the interior/exterior of the school. The District utilizes a proprietary unified security and video surveillance system that is tied into the main security server which will be hosted within the IT Services suite on the ground floor.

Requirements for Automated External Defibrillators (AED's) and other emergency medical devices, emergency-related signage (including directional signs, egress route wall signs, hazardous location identification, warning beacon identification, etc.), first responder Knox boxes, and related safety/security items had been reviewed with the appropriate authorities and City/District representatives. The 60% Documents will be provided to local authorities for further review and approval at the 90% CD phase.

The Fire Department is provided with electronic building plans of the school, which are incorporated into their data base for their reference.

Kathryn Crockett
Richard J. Lamoureux, Jr.
Eric D. Moore
Robert Para, Jr.

12 August 2021

Mr. David Horne, Assistant Building Commissioner
Captain Thomas Bull, Fire Prevention & Investigations (via Building Dept.)
Inspectional Services
Department of Building & Zoning
25 Meade Street
Worcester, MA 01610

RE: Doherty Memorial High School
60% Construction Documents

Dear Dave,

Enclosed are the 60% CD Drawings & Early Site Bid Package #2, and Code Report for review with your departments, and the Fire Department. Also, a thumb drives of the above referenced drawings. Please review and advise on any comments We would welcome a meeting to further review as needed.

The following is a general update on the schedule:

1. An Order of Conditions Amendment was filed with the Conservation Commission on 04/14/21 for the new school sitework, with a hearing on 5/4/21, and an Amended Order of Conditions was approved that night and issued and recorded on 6/2/21 (copy enclosed).
2. The project overview and building plans were presented to the Disability Commission on 7/21/20.
3. The building is not listed on the MACRIS list; therefore, the City did not need to file a demolition delay waiver with the Worcester Historical Commission, though the commission was included in the Massachusetts Historic Commissions project review and ruling.
4. It was reported that the City Water department has engaged their infrastructure consultant, Tata & Howard, to design, provide documents and bid to extend the high service water line up Highland Street to the site, in conjunction with the project's schedule.
5. The Early Site Bid Package #2 was issued on 7/22/21 concurrently with the 60% CD's, and work is scheduled to begin in August. The Steel and Foundation Documents are planned to be issued 10/21/21 and the Final Bid Package will be issued mid-January 2022.

Lamoureux Pagano Associates | Architects
108 Grove Street, Suite 300, Worcester MA 01605
508.752.2831 | www.lpaa.com

6. The Site Enabling Bid Package #1 is scheduled to be completed in August, and the erosion controls will be continued as part of the new work

Please feel free to contact me to discuss or if you have questions.

Sincerely,

Robert Para Jr., AIA
Project Architect
RP/aw

Encl: 1 Set 60% CD & Early Site Bid Package #2 Drawings
1 Copy of the Code Report, with the code drawings from the CD set
1 thumb drive containing pdfs of Drawing (above) & Specifications
Amended Order of Conditions 06/02/21

cc: K. Russell Adams, COW
Jim Bedard, School Dept. Facilities Director
Eugene Caruso, AECOM-Tishman
MSBA

N. Facility & Maintenance Requirements

Throughout the Feasibility Study, Schematic Design through 60% CD documents, the design team has continually been cognizant of the facility maintenance requirements for the new Doherty Memorial High School. The Worcester Public Schools Facilities Director, Jim Bedard has been an essential part of the project's Steering Committee since the initial phases of the project. The design team has also held several meetings with school and district custodial staff to review plans and requirements for building and grounds maintenance.

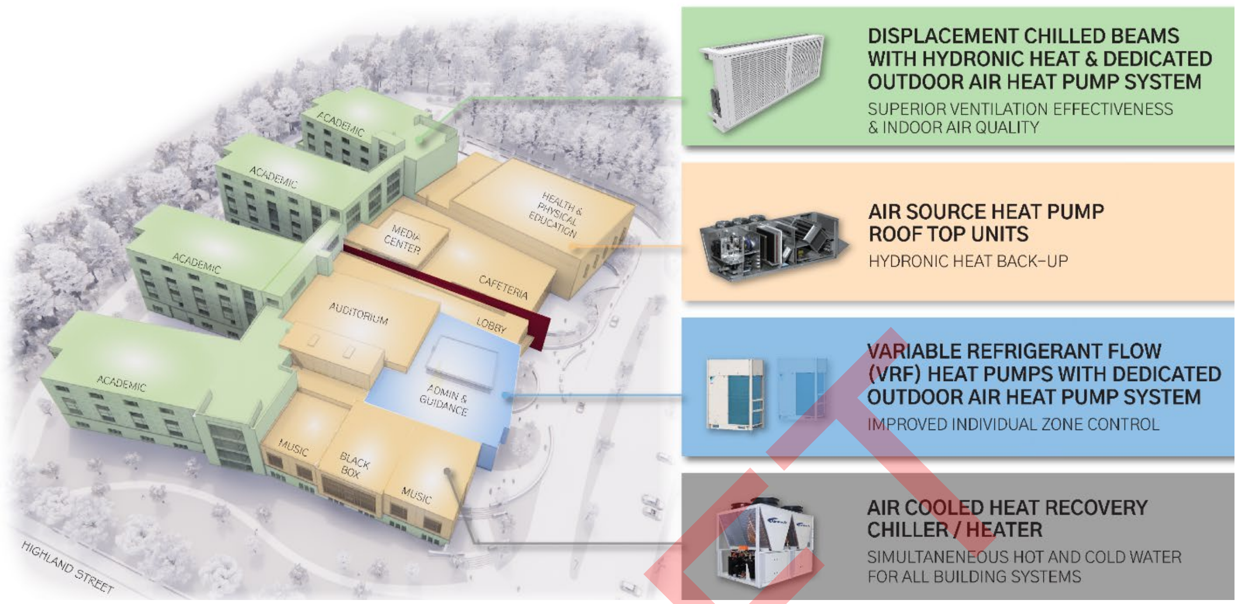
Based on this feedback, the design team has implemented the following aspects into the Design Development floor plans and specifications

1. Highly durable and cleanable materials are desired throughout the school, especially in high traffic areas. The finish schedule currently reflects terrazzo tile in the lobby and cafeteria, and durable linoleum flooring throughout most of the school. The corridors and high traffic areas will be protected by wall tile to 7'-0" above finish floor level. Locker rooms, toilet rooms and kitchen flooring will be a durable poured epoxy finish with integral cove base.
2. The Custodian office requires a toilet room with a shower and four staff workstations.
3. The receiving area requires an overhead door and a swing door equipped with a Video Entrance System and card reader. The recycle/trash room and receiving area shall be located with direct access to the loading dock. The receiving area will be shared with the Kitchen/Food services for deliveries.
4. The loading dock requires a ramp for dollies, space for a compactor, 15-yard recycling dumpster, and adequate clearance for two trucks to make deliveries.
5. A centralized mechanical room is desired near the loading dock/receiving area. One larger elevator to transport mechanical and maintenance equipment is provided near the mechanical room.
6. The "Shop" courtyard will require a 15-yard dumpster for construction debris, as well as protected electrical outlets and frost-free hose bibs.
7. Outdoor Storage for grounds maintenance equipment is provided on the second floor, within the parking garage and at the outdoor toilet building near the athletic field. The storage area in the outdoor building will house the equipment required to maintain the synthetic turf field.
8. The school and district facilities maintenance staff have a robust cleaning and maintenance regimen, which is supported by at least two Janitors closets on each floor, one of which is large enough to store and charge a large ride-on floor cleaner. The janitors' closets will be equipped with chemical dispensers that are independent from the water supply. Janitor storage areas will be equipped with dedicated charging outlets for charging large pieces of maintenance equipment.

9. Lighting shall be high efficiency LED lighting, with occupancy sensors and daylight sensors where required. Classrooms shall have dimming controls for the classroom lighting, as well as light filtering fabric roller shades.
10. The district will provide hand sanitizer, soap, paper towel and toilet paper dispensers, mounted to blocking provided by the general contractor. The contract documents will include grab bars, napkin dispensers / disposals and mirrors. Free-standing trash receptacles are preferred in toilet rooms and corridors.
11. Toilet rooms shall be equipped with manual push metered faucets and hard-wired automatic toilet flushers and electric hand driers.
12. Walk-out roof access doors are desired and provided at each roof level, minimizing roof hatches and ladders where access via a door not possible.
13. Wall mounted convenience lighting, power receptacles and frost-free hose bibs are desired on the roof, especially near HVAC equipment that will require maintenance.
14. The Design team also toured a new school in Manchester Connecticut that utilized the chilled beam systems as proposed for use on this project, and had positive feedback on the functionality and maintenance of these systems.

The building's mechanical systems have been selected to be resilient types of systems requiring minimal maintenance and be centrally located at the lower main roof, which has direct access from the corridors. Custom large air handlers were selected for the majority of the systems, all of which have easily accessible filters and controls within the units, as opposed to smaller units spread out throughout the building. Due to the COVID-19 pandemic, the Worcester Public School District is installing Bi-Polar ionization systems in new and existing schools. The displacement chilled beam cabinets were chosen specifically for the classrooms due to their compatibility with the ionization system, centralized maintenance, acoustic properties and superior indoor air quality.
Additionally, during the design development phase, the project team was tasked with reducing the fossil fuel usage of the building. After a series of studies and discussions with the District Facilities Director, the HVAC systems were redesigned to reduce fossil fuel usage using the following systems:

- A centralized Air-Cooled Heat Recovery Chiller for hydronic heating and cooling, with gas boiler backup.
- Air Source Heat Pump Roof Top Units with back-up hydronic heating
- Selective use of Variable Refrigerant Flow (VRF) heat pump with dedicated outdoor air heat pumps in Administrative areas.



The final DD HVAC design was able to reduce projected fossil fuel use by 85% while proving a comprehensive building system that can be readily maintained by the district over the school's 50-year lifespan.

The HVAC engineer, Sustainable design Engineer, and the independent review engineer doing the N-grid rebate programs have all analyzed the earlier systems projections on the mechanical and Electrical systems, and all are reporting the same range of efficiencies and energy usage.

A robust O&M training program will be built into the project specifications, which will include Building Management System Training/Commissioning, and Multi Vista 3D scans of the building prior to wall enclosure, and energy systems commissioning and training before and after occupancy. Requirements for training hours and scheduling will be developed as the project progresses to 90% Construction Documents.

The Construction Manager is in the process of soliciting proposals for additional advanced commissioning that incudes HVAC energy management systems review, and post construction reporting and monitoring systems integration.

The project team will continue to include the School and District Facilities personnel as the project progresses through construction documents. This ongoing coordination will soon involve our FF&E consultant, who will confirm the list of maintenance and grounds equipment that will be included in the FF&E Budget

O. Quality Control Documents

1. Architectural
2. Civil
3. Landscape
4. Structural
5. Fire Protection
6. Plumbing
7. HVAC
8. Electrical
9. Food Service
10. Phasing

This is to certify that Lamoureux Pagano Associates | Architects has conducted a program of quality control documentation with all sub-consultants to ensure that all systems are coordinated within the allotted space restraints.

Throughout the 60% CD phase, all major consultants (Site, Structural, Food Services, Fire Protection, Plumbing, HVAC, Electrical and A/V) provided electronic 3D Building Information Models (BIM) of their respective disciplines. These were linked into and coordinated with the Architectural REVIT model during design and will be fine-tuned in a clash detection process overseen by the CM's BIM Coordinator during the remainder of the Construction Document phases and physical construction to ensure that all systems work with one another. Additionally, the design team is utilizing Bluebeam Revu to communicate drawing redlines with consultants using real-time sessions. As the drawings are kept up-to-date throughout the design phase, this approach minimizes communication delays and increases the efficiency of coordination between disciplines.

The Ground floor to Main floor floor-to-floor dimension is 18'-0". This additional ceiling height is due to the extra ceiling height desired the Construction Craft Laborer and Engineering & Technology Shops, as well as for coordination with the existing topography and proposed grade access.

At the academic pods in the A, B, C and upper D wings, the floor-to-floor dimensions have been established at 15'-0" and the upper floor-to-roof dimension is 15'-8'". Window heads are typically set at 9'-10" above finished floor (AFF) and classroom ceilings at 10'-0" AFF. The 4'-6" or 5'-0" interstitial space is sufficient to accommodate all required Mechanical/Electrical/Plumbing (MEP) and structural systems. MEP mains are typically run in corridors where structural members are shallower. MEP crossings have been minimized and coordinated to provide adequate ceiling space. MEP floor penetrations and chases have been coordinated with structural members and architectural partitions to be as discrete as possible.

The "core and community use" spaces in the E and D wings include the Lobby, Auditorium, Music Classrooms, Black Box Theater, Gymnasium, Weight Room, Wellness Center, Adaptive PE, Cafeteria, Administration, Guidance Suite and Media Center. On the Main Floor, the floor-to-floor dimension typically aligns with the academic wing at 15'-0", but special two-story spaces, such as the Lobby, Auditorium, Cafeteria, Black Box Theater and Music Rooms have varied floor-to-roof dimensions (refer to the building sections for more details). Exposed ductwork is integrated with architectural design elements at the Physical Education spaces; it is located above the bottom chord of the structural steel joists so as to avoid conflicts with equipment (i.e., basketball backstops) and lighting.

On the second floor, the majority of spaces have the typical floor-to-roof dimension of 15'-0" with the exception of the Gymnasium, Wellness Room, Weight Room, Adaptive PE, and Media Center, and College and Career Center, which have varied floor-to-roof dimensions (refer to the building sections for more details). Mechanical roof top units are located to be screened from view from grade level. Required 25' radius zones for air intakes are indicated on HVAC drawings and have been coordinated with Plumbing vent locations.

The Fire Protection service room has been located on the Main floor, separate from the Main Mechanical room. The Mechanical room layout has been coordinated with the Plumbing water main service entrances and associated equipment, and the Boilers, pumps, tanks, and all other mechanical equipment to ensure that all required clearances are met. Shafts for duct work from the rooftop units to the lower levels of the Academic wing have been coordinated and adequately sized. Duct and pipe routing from the mechanical room on the main floor, through the Lobby (above the ceiling) to the academic wings has been coordinated. Shafts for chilled beam cabinet ductwork and piping have been located and sized at all spaces where required. The locations of electrical rooms, emergency electrical rooms, and Tele-communications rooms have been coordinated with the size of the required equipment and the electrical and data distribution requirements.

Coordination of drawings and specifications is ongoing and has been brought to a level to satisfy the 60% CD phase requirements. The specification table of contents has been updated to include all sections relevant in the project. The scope of work of each section and applicable product data has been incorporated into the project manual.

All filed sub-bid categories have been identified. The scope of work of the sections is included in the specifications. The coordination of the trades into the drawing details is ongoing and will be fully incorporated during the 90% CD phase. Specification section annotation will be included in appropriate details.

The project phasing will allow for the existing school to remain in operation throughout construction. To accomplish this, four major project phases are planned, and are fully outlined under Specifications section 01 12 00 project phasing, included in the contract drawings and shown on the project schedule:

- Phase 1 work is the Site Enabling work, which is currently underway. The scope includes excavations and added parking, access to roads around the existing school, and separation of the new school construction site from the existing site so the school can operate independently from the construction site.

- Phase 2 work includes the construction of the new school building, and related site work at this area to allow occupancy of the school.
- Phase 3 work includes partial demolition of the existing school to allow for construction of the school access and parking lot.
- Phase 4 work includes complete demolition of the existing school building, construction of the multipurpose athletic field, final site work and project completion. A demolition plan (AD1.0) has been added to the 60% CD drawing set to address the existing building, which will be fully demolished once the new building is ready for occupancy.

To support the phasing and to work within the tight timeline of the project, the design team anticipates a total of four bid packages. The site enabling package, Site Enabling Bid Package #1, was prepared along with the Design Development submission to include site access roads (including support of excavation), fences separating the existing school from the construction site and temporary parking, lighting, and site circulation. Construction for this phase of the project commenced on May 3, 2021. Also included under this phase was erosion controls, coordination with existing water service, new hydrants, and demolition of miscellaneous existing site features. This is underway to ensure that major site work will be completed in the summer months to limit disruption while school is in session.

The second bid package is the Early Site Bid Package #2 which was issued along with the 60% CD submission on July 22, 2021. The third bid package will be the Structural Early Bid Package #3 to be issued concurrently with the 90% CD submission. The final bid package will be the Trade Contractor Bid Package #4 issued with the 100% CD documents.

For the Fire protection service, as part of the SD phase, additional hydrant flow tests were conducted, and the Fire Protection Engineer generated a report outlining the options to meet code requirements for the standpipe system. In all options, a variance would be required to eliminate the fire pump, which was not desired by the Fire Department and the District due to long-term maintenance issues. The Authorities having jurisdiction ruled that if a new connection were made to the high service water line in Park Avenue, a variance would be considered to allow a manual standpipe system in lieu of a fire pump. The design team initiated further discussions with City DPW and Water Department, and the City has since committed to provide a new water line connection to the Park Avenue High Service water main to supply adequate pressure and flow to the new school to avoid the requirement for a fire pump. With this commitment, the building department granted a Variance. For more information, refer to the Fire Protection Basis of Design in Section 6B3.1.b and Fire Pump variance request in section 6.A.3.3.F of the Design Development binder.

An alternative design request was also pursued for the design of the main entrance lobby. Details of the alterative design and subsequent approval from the City of Worcester Building Commissioner were included in section 6A3.3G of the Design Development binder.

During the 60% CD phase the project team coordinated a request for variance from the MA plumbing code for the number of toilet fixtures provided in the athletic field support building. A copy of this variance request is included in section 6B.3.3.K.

Consulting engineers of record have coordinated with local utility providers and City departments relative to building services.

Discussions with National Grid, the electric utility, are ongoing. An application for new electrical service was made in March 2020, and several meetings been held to assess the best service requirements. It has been determined that the district will own and maintain one 3750 kVA transformer so that the building can utilize the power from the PV array prior to feeding any excess back into the grid. Additionally, in May of 2021 the project submitted a pre-application National Grid to engage in a Direct Generation (DG) study, to determine the connection requirements for the proposed PV array. The Electrical engineer is documenting the proposed electrical loads and PV production and will continue their coordination with National Grid.

Utility coordination is also underway with Eversource Energy regarding the proposed gas loads, both during and post construction.

Additional discussions with the other utility companies, Verizon (telephone provider) ComCast (Cable provider) the Worcester DPW, water, sewer, drainage, and traffic Departments have all been contacted, and discussions are included in the Basis of Design narratives found in section 6B3.1.B.

Nitsch Engineering

370 Main Street, Suite 850
Worcester, MA 01608
T: 508-365-1030

www.nitscheng.com

MEMORANDUM

TO: Robert Para, AIA
Lamoureux Pagano Associates | Architects

FROM: Matthew T. Brassard, PE, ENV SP

DATE: July 15, 2021

RE: Doherty High School - Nitsch Project #13325
60% Construction Documents
& Early Site Bid Package
Basis of Design Report

QUALITY CONTROL NARRATIVE
CIVIL ENGINEERING

Overall Site Development

During the Design Development phase, coordination was conducted between the Civil Engineer, Landscape Architect, and Architect related to the overall layout and grading of the major site elements, including the new building, roadways, parking lots, and athletic field. Constant communication via email and in-person and virtual coordination meetings were conducted with the Landscape Architect and Architect to review various design aspects of the project.

The Construction Manager for the project has begun to provide input on the project phasing approach which is being used by the design team to increase project efficiencies and maintain the overall project schedule.

Site Utilities

Building utility services have been coordinated with the Plumbing and Electrical Engineers to ensure exit locations and elevations are coordinated between the building and site. Since the Schematic Design Phase the roof drain and sanitary sewer foundation penetrations have been modified based on review by and input from the Plumbing Engineer. Underslab and perimeter foundation drainage has been coordinated with the Plumbing Engineer and Structural Engineer via the Architect. Exterior drain inlet locations, including retaining wall drains, have been coordinated with the Landscape Architect.

General Site Improvements

The Worcester Conservation Commission (the Commission) and the Worcester Department of Public Works (DPW) are the authorities having jurisdiction over the construction of the project. The design of the Phase 1 (Site Enabling Phase) site improvements have been reviewed and approved by the Commission and have been reviewed and commented on by DPW personnel (no formal DPW permit process or approval is required for the project).

The completed Design Development documents for the additional project phases (Early Site Package) has been reviewed with the DPW and submitted to approved by the Commission.

studio 2112
LANDSCAPE ARCHITECTURE

CONSTRUCTION DOCUMENTATION
Quality Control Narrative for Doherty Memorial High School

July 15, 2021

Studio 2112 Landscape Architecture, Inc.
840 Summer St., #102
Boston, Massachusetts 02127

SITE LANDSCAPE DEVELOPMENT

Extensive coordination was conducted amongst the Landscape Architect, Civil Engineer and Architect related to the overall layout and grading of the major site elements, including the new building, roadways, parking lots, walkways, plazas, courtyard, athletic field and bleachers. Coordination was conducted with the Electrical Engineer related to site lighting locations and fixtures. In addition to consistent correspondence via phone and email, multiple virtual coordination meetings were held with the Civil Engineer and Architect to review different design aspects of the project and progress those designs to a Construction Document stage. Additional coordination was conducted with the Irrigation Designer to provide design for irrigated planting areas.

PLANTING

Planting will be developed using the MassNRC's ALB Reforestation List and Do Not Plant Lists provided by the State web sources so as not to propose any plant material that is a known host for the Asian Longhorn Beetle. In addition, planting will meet a rigorous metric for biodiversity, with the plant schedule to contain no more than 10% of each species, 20% of each family, and 30% of each genus.

BDI BOLTON & DiMARTINO, INC.
CONSULTING STRUCTURAL ENGINEERS
100 Grove Street Worcester, MA 01605
Tel. 508-756-8972

July 8, 2021

Mr. Rob Para
Lamoureux Pagano and Associates, Architects
108 Grove Street
Worcester, MA 01608

Re: 60% CD Space Review
Doherty High School
Worcester, MA

Dear Mr. Para,

We have reviewed the Structural framing plans to verify that the structural system fits in the allocated architectural space. The Gymnasium roof framing provides 20’-0” clear below the roof framing. The corridor framing was sized to run ductwork and piping.

Please call this office if you wish to discuss these items or any other aspect of the project.

Bolton & DiMartino, Inc.

Christopher Tutlis, P.E.
President

SENSIBLE SOLUTIONS **_Engineering to Help You Grow_**
64 Knightly Rd Hadley, Ma. / PO Box 905 Brattleboro, VT 05302 _Cell Phone (413)427-7290_
E-mail: lkbarak@crocker.com

To: Rob Para
Christina Bazelmans
Rick Lamoureux
Christopher Lee

From: Lily Kara Barak

Date: 7-14-21

RE: Doherty HS 60% CD Quality Assurance and Fire Pump Certification

1. **FP design coordination and quality assurance**

   a. The FP 60% CD design has been coordinated with the architectural RCPs . We are in an on-going process of checking coordination with the 60% CD structural, electrical, and HVAC designs.

   b. We are aware that many ceiling designs are not yet finalized and may change. We will re-coordinate the FP design as the architectural designs evolve.

2. **Fire pumps:**

An automatic-wet standpipe system is required for high-rise buildings. As permitted by CMR 780, 104.10, however, the City Building Department is allowing the use of a manual wet standpipe system in the proposed building. Furthermore, they are allowing the fire pump to be omitted if a high-pressure-Park Ave FP service is installed. See the DD phase QC document dated 3-10-21 for more details re the basis for this decision.

The City has agreed to design, install, and pay for the new Park Ave FP service separately from the school's design and construction budget. Thus, this 60% CD phase design does not include a fire pump.

The FP contractor is required to provide a new flow test at the time of construction, to confirm the actual flow and pressure provided to the new school.

SEAMAN ENGINEERING CORPORATION
P: 508-865-1400
F: 508-865-1401
22 West St. Unit C, Millbury, MA 01527
seamanengineers.com

Date: July 15, 2021

To: Rob Para, AIA

Co: Lamoureux-Pagano Assoc. Architects, Inc. (via email)

From: Christopher Robinson P.E.

Re: Doherty Memorial High School, Worcester, MA: **Plumbing System Coordination Statement –60% Construction Drawing Submission**

---

1. PLUMBING

Mechanical Room C115

The Main Floor Mechanical Room provides adequate space and clearance for the domestic hot water system. This domestic hot water system includes two (2) hot water boilers, two (2) hot water storage tanks, a digital mixing valve station serving the building with recirculation pumps, a mixing valve station serving the emergency fixtures in the entire building with recirculation pump, and a recirculation pump system for the entire domestic hot water plant. The main concern for the boilers is placement is flue and combustion air piping routing and overall lengths. There is a vertical mechanical chase from the mechanical room up to the roof over the fifth floor for the boiler flues. Currently, the two (2) combustion air vents/intake location follows the flue vents up to the roof since there is enough room in the chase. The HVAC design is on-going, but it appears that everything fits. We do not recommend reducing the size of the mechanical room as it may need to be larger for the HVAC systems. The heating plant will take up a lot of room for the boilers, pumps and accessories.

Mechanical / Water Service Room D109

The domestic water service entrance will be along the walls of the room as it includes dual backflow preventers (probably stacked) and a pressure reducing valve station. At South HS, the pressure reducing valves were installed high overhead (out of reach). This room also requires the installation of a booster pump system due to the building height (i.e. we need to boost the water pressure for the top floor and roof). Finally, this room should have the site irrigation system piping and drop to outside, which has not been coordinated yet. The room was expanded to include the Fire Protection water service entrance on the opposite wall from the domestic water service and a door to the exterior. Based on the current layout, It does appear that everything will fit in this room.

pH Neutralization Room (Acid Neutral A017)

The pH Neutralizing Room will have a lot of equipment contained within. The room has an 123"L x 98"W x 102"Deep pit for the pH neutralizing tanks, mixing devices and pH sensing equipment. There will be an FRP grate covering the open portions of the pit. The support of the FRP grating still needs to be determined, but angles affixed to the sides of the concrete pit are likely with some support off of the tanks. There are two 15 gallon storage tanks on the floor, one for acid and one for alkali which are used to actively neutralize the effluent from the science labs and science prep rooms. These chemical tanks have a secondary containment system below them and metering pumps above which are piped to the tanks. The system also has a control panel which is mounted to the right of the door from room perspective. In addition, there will be a 2" reduced pressure backflow preventer for the CW and a 1-1/4" reduced pressure backflow preventer for the HW serving the science 9th and 10th grade classrooms and prep rooms. Finally, a combination emergency shower and eyewash is required in the room due to the chemicals. A floor drain will be installed in the room as well. This room is very crowded but it appears that all of these will fit as currently drawn.

End of Plumbing Coordination Statement – 60% CD Submission

SEAMAN ENGINEERING CORPORATION
P: 508-865-1400
F: 508-865-1401
22 West St. Unit C, Millbury, MA 01527
seamanengineers.com

Date: July 15, 2021

To: Eric Moore., AIA

Co: Lamoureux-Pagano Assoc. Architects, Inc. (via email)

From: Kevin R. Seaman, P.E. LEED® AP

Re: Doherty High School, Worcester: **HVAC System Coordination Statement – 60% Construction Document Submission**

The following certifies that the HVAC design has taken into account the various code required and manufacturer required service clearances and that the equipment reflected in the design has been configured to facilitate the proper service clearance. Specific allowances include but are not limited to the following:

Mechanical Room(s)

The Mechanical Room as well as various mechanical closets, provide adequate space and clearance for the mechanical components contained with them including hot water heating boilers, heat exchangers, thermal buffer tanks, pumps and associated variable speed drives and control panels associated with such. HVAC equipment lay-out within the space has been and continues to be coordinated with the other trades such as plumbing and electrical. Lay-out has also considered future replacement of the equipment.

Roof Top Equipment

The roof-top equipment has been located and configured to allow for safe and reasonable access to all serviceable components. This includes keeping equipment at least 10 feet from the edges of the roof as well as maintaining a minimum of 25 feet from associated air intakes to any "dirty" exhaust or plumbing vents.

Interior Equipment

Interior equipment has been located and configured to allow for safe and reasonable access to all serviceable components. All fresh air intakes have been kept a minimum of 25 feet from associated air intakes to any "dirty" exhaust or plumbing vents.

End of HVAC Coordination Statement

ART Engineering
we build the future.
38 Front Street FL 3, Worcester, MA 01608 Office: 508.797.0333

July 15, 2021

Mr. Robert Para Jr., AIA
Lamoureux Pagano Associates
108 Grove Street, Suite 300
Worcester, MA 01605

RE: Room Space Memo
Doherty High School
299 Highland Street
Worcester, MA 01602

Dear Mr. Para:

ART Engineering Corporation (ART) has reviewed the spaces allocated for the electric rooms, emergency electrical rooms and telecommunications rooms. The rooms are sized to meet our requirements.

Cordially,

Azim Rawji, P.E.

July 15, 2021

Doherty Memorial High School, Worcester, MA

Colburn Guyette Quality Control Statement:

This letter shall serve as notice that Colburn & Guyette performed the necessary professional services, was involved with design, specifications and coordination of associated architectural, HVAC, plumbing and electrical with the foodservice facilities from the schematic design process through the design development process on a regular basis, and witnessed that the work proceeded in accordance with the industry standards and all applicable codes. The project, to the best of my understanding, meets all applicable provisions of the U.S. Food Code and local health laws.

Sincerely,

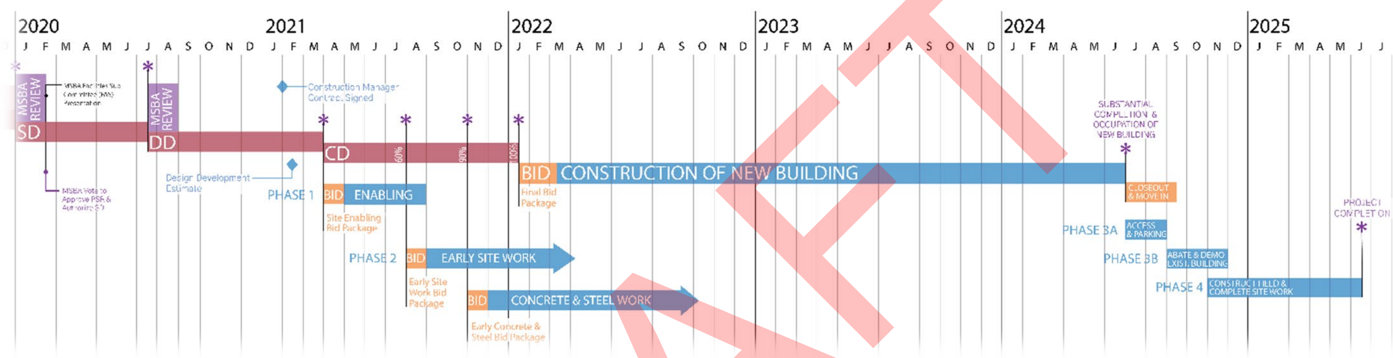
Peter McGillicuddy

Peter McGillicuddy
Senior Associate
Colburn Guyette

O. Quality Control Documents–Phasing

Construction phasing is a critical aspect of this project, as the existing building must remain functional and occupied throughout the construction of the new school building, and disruption to the student population must be minimized. Construction phasing is addressed throughout the Design Development submission; refer to the following documents for additional information:

- Specification Section 01 12 00 Project Phasing Requirements
- Site Phasing Drawings included in Volume I of IV of the Design Development drawings
    - C1.2 Site Phasing Plan
- The Civil Basis of Design Narrative in Section 6B3.1.B.2 Basis of Design Narratives



6B.3 DESIGNER DELIVERABLES

6B3.2 Space Summary

A. Space Summary Template
B. Comparison of Current Design with Final Design Program
C. Certification of Changes from DESE Approved SPED Spaces
D. DESE Approved Chapter 74 Program Spaces

6B.3.2 Space Summary

A. Updated Space Summary Template

1. Narrative of Changes & Designer Certification
2. Signed Space Summary Template

SPACE SUMMARY

Two signed copies of the educational space summary, reflecting the current design, are included in this section.

No variations to the Space Summary Template have been identified since the Design Development submission.

GROSSING FACTOR

The grossing factor remains at 1.50, which is unchanged from the SD and DD submission.

DESIGNER CERTIFICATION

This is an acknowledgement and certification that the sum of all programmed floor areas plus all other floor areas equal the gross floor area of the Final Design Program.

Rob Para Jr., AIA, Project Architect
Lamoureux Pagano Associates Architects

Proposed Space Summary - High Schools

UPDATED

Date: 8/12/2021 60% Construction Documents

DOHERTY MEMORIAL HIGH SCHOOL	Existing Conditions			PROPOSED: Existing to Remain/Renovated			PROPOSED: New			PROPOSED: Total			MSBA Guidelines (refer to MSBA Educational Program & Space Standard Guidelines)			
ROOM TYPE	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	Comments
CORE ACADEMIC SPACES			**49,686**			**0**			**102,835**			**0**			**80,000**	
Classroom - General	41	801	32,841				870	57	49,590				850	56	47,600	825 SF min - 950 SF max
Teacher Planning	5	295	1,475				405	12	4,860				100	56	5,600	
Department/Book Storage (included in gross)	141.2	5	706				0	0	0							
Common Rooms							1,000	10	10,000				500	4	2,000	3 x85% ut=20 Seats-1 per /day/student
Science Classroom / Lab	10	997	9,970				1,460	15	21,900				1,440	15	21,600	
Biotechnology Lab							1,690	1	1,690							
AVID Classroom	0	0	0				870	1	870							
Prep Room	2	378	756				265	6	1,590				200	15	3,000	
Shared Prep							450	5	2,250							
Central Chemical Storage Rm	2	369	738				210	1	210				200	1	200	
Small group room (EL)	2	873	1,746				870	4	3,480							
Language Lab	0	0	0				870	2	1,740							
Large Group Seminar Room	0	0	0				2,000	1	2,000							
Computer Science Classrooms	2	727	1,454				885	3	2,655							
SPECIAL EDUCATION			**5,340**			**0**			**32,230**			**0**			**14,620**	
(List classrooms of different sizes separately)																
SPED Planning	0	0	0				380	1	380							825-950 SF equal to surrounding classrooms
Self-Contained SPED **(Life Skills)**	1	449	449				870	2	1,740				950	12	11,400	
Therapeutic Planning	0	0	0				65	1	65							1/2 size Genl. Clrm.
Observation	0	0	0				90	1	90							1/2 size Genl. Clrm.
Adult Daily Living (ADL)	1	214	214				960	1	960							
Learning Disability Center			0				870	2	1,740							
SPED Adaptive PE (Sensory / Motor)	0	1	0				2,900	1	2,900							
STEP Classroom	2	834	1,668				890	4	3,560							
STEP Clinician	0	0	0				180	2	360							
Self-Contained SPED Toilet	1	39	39				85	3	255				60	12	720	
Resource Room **(Learning Center)**	6	441	2,646				870	8	6,960				500	5	2,500	
Small Group Room (Speech)			0				555	1	555							
OT/PT	1	324	324				825	1	825							
Inclusion SPED	0		0				870	12	10,440							
Vocational Learning Center	0	0	0				890	1	890							
SPED Office (Team Chair & Dept. Head)	0	0	0				150	2	300							
SPED Conference Room	0	0	0				210	1	210							
ART & MUSIC			**5,832**			**0**			**12,650**			**0**			**8,350**	
Art Classroom - **32 seats**	3	798	2,394				1,240	3	3,720				1,200	3	3,600	Assumed use - 25% Population - 5 times/week
Digital Arts Lab	0	0	0				1,215	1	1,215							
Art Workroom w/ Storage & kiln	1	180	180				160	4	640				150	3	450	
Band - 50 - 100 seats	1	1480	1,480				1,580	1	1,580				1,500	1	1,500	Assumed use - 25% Population - 5 times/week
Chorus - 50 - 100 seats	1	1009	1,009				1,580	1	1,580				1,500	1	1,500	
Piano Lab / Music Engineering Classroom	0	0	0				1060	1	1,060							
General Music Classroom							870	1	870							
Ensemble	0	0	0				160	2	320				200	1	200	
Music Practice	4	49	196				85	6	510				75	8	600	
Music Storage	3	191	573				365	2	730				500	1	500	
Teacher Planning	0	0	0				425	1	425							

Proposed Space Summary - High Schools

UPDATED

Date: 8/12/2021 — 60% Construction Documents

DOHERTY MEMORIAL HIGH SCHOOL	Existing Conditions			PROPOSED: Existing to Remain/Renovated			PROPOSED: New			PROPOSED: Total			MSBA Guidelines (refer to MSBA Educational Program & Space Standard Guidelines)			
ROOM TYPE	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	Comments
VOCATIONS & TECHNOLOGY			6,562			0			30,970			0			17,280	
Technology/Engineering Rooms													1,440	12	17,280	Assumed use - 100% Population - 5 times/week; 825 SF - 2,000 SF
Ch. 74 ETA Shop	2	926	1,852				2,475	3	7,425							
Teacher Planning	0	0	0				400	1	400							
Related Classroom / Computer Lab	4	872	3,488				930	4	3,720							
Teacher office	2	158	316				0	0	0							
ETA Storage	6	151	906				245	5	1,225							
ETA Common Room							620	1	620							
Ch. 74 Programming & Web Development Computer Labs							1,150	3	3,450							
Related Classroom/Lab							870	1	870							
Help Desk							170	1	170							
Storage							205	1	205							
									0							
Ch. 74 Marketing & Finance School Store (w/ Storage 300SF)							350	1	350							
Related Classroom							870	4	3,480							
Storage							85	1	85							
Ch. 74 Teacher Planning							595	1	595							
Ch. 74 Construction Craft Laborer							4,920	1	4,920							
Related Classroom							870	2	1,740							
Teacher office							215	1	215							
Lockers/Clean up							720	1	720							
Curriculum Storage							190	1	190							
Equipment Storage							590	1	590							
HEALTH & PHYSICAL EDUCATION			19,674			0			36,750			0			25,552	Excess PE Spaces Policy
Gymnasium	7,200	1	7,200				18,000	1	18,000				12,000	1	12,000	
Alt. PE **(Wellness / Project Adv.)**	1,486	1	1,486				3,210	1	3,210				3,000	1	3,000	
Fitness Room	220	1	220						0							
Fitness/ Exercise Room	269	1	269													
Weight Room w/ Storage and training room	842	3	2,526				3190	1	3,190							
Gym / Community-Storeroom	114	9	1,026				400	1	400				300	1	300	5.6 sf/student total
Locker Rooms - Boys / Girls w/ Toilets **(PE & Varsity)**	2,174	2	4,348				7,910	1	7,910				9,352	1	9,352	
Family Lockers/Toilets/Shower							250	1	250							
Outdoor Equipment Storage							460	1	460							
Phys. Ed. Storage	114	9	1,026				570	1	570				500	1	500	
Phys. Ed. Storage							195	1	195							
Athletic Director's Office							165	1	165				150	1	150	
Health Instructor's Office w/ Shower & Toilet	364	2	728				330	2	660				250	1	250	
Health Classroom (Heath Ed Teachers)	1	845	845				870	2	1,740							

Proposed Space Summary - High Schools

UPDATED

Date: 8/12/2021 **60% Construction Documents**

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MEDIA CENTER			**4,262**			**0**			**11,770**			**0**			**10,338**	
Media Center / Reading Room / Maker Space / Video Editing Studio / Small Group Rooms / **Collaboration / Seating / Archive**	1	2975	3,332				10,900	1	10,900				10,338	1	10,338	
Social Emotional Learning Center	310	3	930				870	1	870							
AUDITORIUM / DRAMA			**6,668**			**0**			**17,910**			**0**			**10,400**	Excess Auditorium Spaces Policy
Auditorium	1	4759	4,759				8,620	1	8,620				7,500	1	7,500	2/3 Enrollment @ 10 SF/Seat - 750 seats MAX
Stage	1	1909	1,909				2,555	1	2,555				1,600	1	1,600	
Theater Classroom / Performance							870	1	870							
Black Box Theater							2,985	1	2,985							
Auditorium / **Set** Storage							360	1	360				500	1	500	
Make-up / Dressing Rooms / **Green Room**							355	2	710				300	2	600	
Controls / Lighting / **Sound / Loading Loft**							170	3	510				200	1	200	
~~Performing~~ Arts Maker Space							1,300	1	1,300							
DINING & FOOD SERVICE			**7,919**			**0**			**15,670**			**0**			**13,156**	
Cafeteria / **Student Lounge**	1	4285	4,285				8,200	1	8,200				8,350	1	8,350	3 seatings - 15SF per seat
Chair / Table Storage	0	0	0				590	1	590				568	1	568	
Scramble Serving Area	1	551	551				2,540	1	2,540				600	1	600	
Kitchen	1	2586	2,586				3,555	1	3,555				2,970	1	2,970	1600 SF for first 300 + 1 SF/student Add'l
Staff Lunch Room	1	497	497				585	1	585				668	1	668	20 SF/Occupant
Satellite Grab & Go	0	0	0				200	1	200							
MEDICAL			**574**			**0**			**3,035**			**0**			**1,410**	
Medical Suite Toilet	1	30	30				60	4	240				60	1	60	
Nurses' Office / Waiting Room	1	125	125				570	1	570				250	1	250	
Interview Room	0	0	0						0				100	4	400	
Examination Room / Resting	3	85	255				100	5	500				100	7	700	
Resting Area (4 beds)	2	37	74				265	1	265							
Med Room							90	1	90							
Soiled/Jan.	0	0	0				130	1	130							
Clean Work	0	0	0				80	1	80							
Medical/wheelchair stor.	0	0	0				120	1	120							
Clinic Office	2	45	90				140	4	560							
Multipurpose	0	0	0				220	1	220							
Food Pantry/Clothing Distribution	0	0	0				260	1	260							

DRAFT

Proposed Space Summary - High Schools

UPDATED

Date: 8/12/2021 **60% Construction Documents**

DOHERTY MEMORIAL HIGH SCHOOL	Existing Conditions			PROPOSED: Existing to Remain/Renovated			PROPOSED: New			PROPOSED: Total			MSBA Guidelines (refer to MSBA Educational Program & Space Standard Guidelines)			
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ADMINISTRATION & GUIDANCE			**6,877**			**0**			**10,450**			**0**			**6,041**	
General Office / Waiting Room / Toilet	1,115	1	1,115				820	1	820				835	1	835	
Teachers' Mail and Time Room	0	0	0				125	1	125				100	1	100	
Duplicating Room	0	0	0				200	1	200				200	1	200	
Records Room **(Vault)**	121	1	121				155	1	155				200	1	200	
Principal's Office w/ Conference Area	256	1	256				285	1	285				375	1	375	
Principal's Secretary / Waiting			0						0				125	1	125	
IO Clerk	255	1	255				0	0	0							
Assistant Principal's Office - AP1	160	6	960				175	6	1,050				150	1	150	
Assistant Principal's Office - AP2			0										150	2	300	
AP Secretary			0				160	3	480							
AP Conference Rm			0				250	3	750							
Supervisory / Spare Office **MCAS Coord**	187	1	187				150	1	150				120	1	120	
Conference Room	420	2	840				370	1	370				450	1	450	
Small Conference/Hearing			0													
Guidance Office	83	6	498				155	12	1,860				150	9	1,350	
Guidance Waiting Room	550	1	550				370	1	370				100	1	100	
Guidance Storeroom			0				95	1	95				100	1	100	
College & Career Center	896	1	896				900	1	900				568	1	568	
School Psychologist Office	120	1	120				150	1	150							
Records Room			0				115	1	115				234	1	234	
Admin/Guidance Records Storage							500	1	500							
Guidance Conference Room	117	1	117				400	1	400							
Adjustment Counselor Office	133	4	532				170	4	680							
Teachers' Work Room			0										835	1	835	
School Resource Officer	0	0	0				150	1	150							
Security Office	0	0	0				95	1	95							
Job Placement Office (Tech Ed)		0	0				120	1	120							
Instructional Coach	430	1	430				155	2	310							
Instructional Coach/MCAS Conference Rm	0	0	0				320	1	320							
CUSTODIAL & MAINTENANCE			**1,940**			**0**			**3,735**			**0**			**2,878**	
Custodian's Office	1	280	280				375	1	375				150	1	150	
Custodian's Workshop	0	0	0				195	1	195				250	1	250	
Custodian's Storage	3	182	546				365	1	365				375	1	375	
Recycling Room / Trash	1	128	128				400	1	400				400	1	400	
Receiving and General Supply	1	433	433				585	1	585				568	1	568	
Storeroom			0				820	1	820				935	1	935	
Storeroom							200	1	200							
Network / Telecom Room			0				370	1	370				200	1	200	
Outdoor Equipment Storage	1	553	553				425	1	425							
OTHER			**0**			**0**			**4,200**			**0**			**0**	
Other (specify)									0							
Technical Services / IT							4,200	1	4,200							

DRAFT

Proposed Space Summary - High Schools

UPDATED

Date: 8/12/2021 **60% Construction Documents**

DOHERTY MEMORIAL HIGH SCHOOL	Existing Conditions			PROPOSED: Existing to Remain/Renovated			PROPOSED: New			PROPOSED: Total			MSBA Guidelines (refer to MSBA Educational Program & Space Standard Guidelines)			
ROOM TYPE	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	ROOM NFA[1]	# OF RMS	area totals	Comments
Total Building Net Floor Area (NFA)			**115,334**			**0**			**282,205**			**0**			**190,024**	
Proposed Student Capacity / Enrollment									1,670	162.00					**1,670**	162
NON-PROGRAMMED SPACES					% of GFA	**0**		% of GFA	**142,395**		% of GFA	**0**				
Janitors Closets					#DIV/0!			0%	805		#DIV/0!					Non-Programmed space areas are
					#DIV/0!			0%			#DIV/0!					required to be included in the
					#DIV/0!			0%			#DIV/0!					following submittals:
					#DIV/0!			0%			#DIV/0!					Schematic Design Submittal
Unoccupied MEP/FP Spaces					#DIV/0!			2%	8,955		#DIV/0!					Design Development Submittal
Unoccupied Closets, Supply Rooms & Storage Rooms					#DIV/0!			1%	2,695		#DIV/0!					60% Construction Documents
Toilet Rooms					#DIV/0!			2%	6,890		#DIV/0!					90% Construction Documents
Circulation (corridors, stairs, ramps & elevators)					#DIV/0!			22%	95,385		#DIV/0!					Final Construction Documents
Remaining[3]					#DIV/0!	**0**		7%	**27,665**		#DIV/0!	**0**				
Total Building Gross Floor Area (GFA)[2]			168,000			0			**424,600**			0			**270,540**	
Grossing factor (GFA/NFA)			**1.46**			**#DIV/0!**			**1.50**			**#DIV/0!**			**1.42**	

[1] **Individual Room Net Floor Area (NFA)** Includes the net square footage measured from the inside face of the perimeter walls and includes all specific spaces assigned to a particular program area including such spaces as non-communal toilets and storage rooms.

[2] **Total Building Gross Floor Area (GFA)** 'ootage measured from the outside face of exterior walls

[3] **Remaining** rea, it is assumed to equal the difference between the Total Building Gross Floor Area and area not accounted for above.

Architect Certification

I hereby certify that all of the information provided in this "Proposed Space Summary" is true, complete and accurate and, except as agreed to in writing by the Massachusetts School Building Authority, in accordance with the guidelines, rules, regulations and policies of the Massachusetts School Building Authority to the best of my knowledge and belief. A true statement, made under the penalties of perjury.

Name of Architect Firm: Lamoureux Pagano Associates | Architects

Name of Principal Architect: Kathryn Crockett, AIA, LEED AP, President

Signature of Principal Architect:

Date: 08/12/21

B. Comparison of Current Design with Final Design Program

B. Comparison of Current Design with Final Design Program

Since the Design Development Submission, the Design Team and the Steering Committee have hosted numerous virtual meetings with School, District and City representatives to confirm and further define the detailed requirements for each of the spaces within the proposed Doherty Memorial High School. This information was carefully documented and inserted into the Construction Documents and Room Data Sheets, which will serve as a reference throughout the design and construction process. The following Program Meetings were held during the 60% CD phase:

- April 2, 2021 | Project Update and Site walk with City Parks Department
- April 7, 2021 | Building Automation System Commissioning Strategy Discussion
- April 7, 2021 | Site Walk with Nordic Ski Coordinator
- April 8, 2021 | Project Update with Building and Fire Departments
- April 30, 2021 | Engineering and Technology Academy Update / Equipment Review
- May 18, 2020 | District IT Services Program Review
- May 20, 2021 | Worcester Energy and Asset Management Update Meeting
- June 16, 2021 | Landscape and Courtyard Program Review
- June 18, 2021 | LEED Owner Review and Pathway to Gold Strategy
- June 21, 2021 | Doherty "Living Lab" Program Kick-Off
- June 22, 2021 | Medical Suite and Clinic Review

Beyond the program advancements noted above, the following major elements were significantly advanced during 60% CD phase:

- Interior Design and Wayfinding Concepts
- Finish Schedule Development and Materials Research
- Lobby and Feature Wall Design
- Cafeteria Community Stair Design
- Millwork Design
- Media Center and Maker Space Development
- Auditorium Design and Layout
- Acoustic Requirements, including required acoustic panels and vertical separations
- ETA Shop Layout and Equipment List

The 60%CD documents are in alignment with the priorities and goals of the Final Design Program, which are summarized in the outline below:

ARCHITECTURAL CHARACTERISTICS

The design of the proposed Doherty Memorial High Community School was developed in response to the site, the City/District's programmatic needs, operating and maintenance capabilities, and the desire for a more fulfilling educational environment for the community as well as the school constituents. The following are key criteria that informed the design:

- Overall Context: The WPS progressive strategic goals, Doherty's deep history in the City's educational program, the location adjacent to an Olmsted designed park and near downtown, and the neighborhood vicinity all are key factors that guided the design development.
- Scale: Effectively modulate the building and site features to terrace the site grades as they elevate from Highland Street toward Newton Hill. Organize the building components to reduce the overall scale of the project by integrating exterior courtyards, considering the height of the building at Highland Street, and stepping the construction with the grades.
- Circulation: Provide a hierarchy of clear and easily recognizable circulation routes; both inside and outside of the building. Interior circulation is designed for safe and efficient flow of students transitioning between classes with core facilities centrally located and multiple connecting stairs. Lockers are located primarily in open areas of classroom pods to keep the main circulation spine clear of obstructions and bottlenecks. Exterior pedestrian circulation is designed to safely accommodate the large numbers of walkers to and from school on sidewalks and marked/raised crosswalks. Exterior vehicular circulation and parking is designed to separate bus traffic from staff/faculty, student and parent drivers.
- Flexibility: Provide capability for after-hours use of community spaces (Gym, Auditorium, Cafeteria/Kitchen, etc.) without allowing free access to the core academic part of the building. Develop classroom wings to be reassigned as needed to accommodate curriculum needs as they evolve over the decades.
- Daylighting: Views to the exterior were optimized as an orientation feature as well as for the majority of the spaces where natural daylight is desirable. The central lobby features a strong connection to an exterior courtyard on one side and the main circulation path to the parking and athletic field beyond. Academic Wings fan from a major circulation fan with views at each end and from the classrooms. Since the building is situated on the north side of Newton Hill, the focus will be to provide sun shading at the west side of the building where the strongest sun axis is anticipated.

- Construction impact: Minimize construction impact due to phasing for students and staff/faculty. Because the existing school is proposed to remain in use during construction of the new facility, the proposed building footprint must be far enough away from the existing school to allow construction traffic and emergency egress. Similarly, new construction will impact existing parking areas and utilities; temporary solutions are needed to mitigate their loss or interruption and will be a major tenet of further design phases.
- Safety and security: Comply with City/District safety and security guidelines. Refer to security and visual access requirements narrative included in this section.
- Sustainability: Achieve LEED-S v.4 certification (minimum) with the goal of 50-59 points for "Silver" rating.
- Materials: Provide interior and exterior materials that are durable, easily maintained and reflective of the contemporary educational program.
- Educational Organization: Develop 9th grade academy wing, fully integrated special education programs, faculty planning rooms, common rooms to support integrated projects and other curriculum opportunities, centralized core facilities easily separated for community use
- Entrances: Provide one major entrance for all with modulated visitor access through the administration reception area during school hours. Secondary gym entrance to support visiting team access and athletic program route to the athletic field.
- Campus experience: develop the site with clear parking and athletic field organization while amplifying outdoor learning experiences and connections to the adjacent park. Through judicious landscaping, reduce heat island effect of impervious area, provide biodiversity for low maintenance and sustainable planting, and strengthen park and neighborhood context.

In addition to the established programmatic goals, during the 60% CD phase, the Design team continued to develop and coordinate the HVAC design changes made to reduce overall fossil fuel consumption. The Steering Committee made the decision to proceed with a fully electric kitchen, and the 60% CD drawings have been updated accordingly. Refer to Section 6B.3.1.I for updated Energy Calculations and projected fossil fuel use.

C. Certification of Changes from DESE Approved SPED Spaces

C. Certification of Changes from DESE Approved SPED Spaces

This is an acknowledgement and certification that there have been no changes to the DESE Approved SPED spaces that would impact the location, desired adjacencies, required program, or intended use of the spaces.

Robert Para Jr., AIA
Lamoureux Pagano Associates | Architects

D. DESE Approved Chapter 74 Program Spaces

During the 60% CD phase, the design team worked with the School and District to further develop the educational spaces for the following Chapter 74 programs:

- Engineering & Technology Academy
- Construction Craft Laborer
- Computer Programming & Web Development
- Marketing Management & Finance

The classrooms and shops for these spaces conform to the current DESE Chapter 74 Manual for Vocational Technical Education Programs. The design team will continue to work with the school and district to further develop the plans, equipment lists, and coordinate MEP requirements through the Construction Document phases.

The district has received letters of general agreement from DESE regarding the proposed Ch. 74 Programs. In addition, the district intends to submit an "Intent to Apply" prior to October of 2021, and will proceed with the timeline for the School Year 2022 New Program Application cycle found on the Department of Education's website.

In accordance with MSBA policy, the design team has prepared floor plan diagrams of each Ch. 74 space for the Chapter 74 Safety Review Meeting, which has been scheduled for August 16, 2021.

Massachusetts Department of Elementary and Secondary Education

75 Pleasant Street, Malden, Massachusetts 02148-4906

Telephone: (781) 338-3000
TTY: N.E.T. Relay 1-800-439-2370

Jeffrey C. Riley
Commissioner

October 7, 2019

Mary Pichetti
Director of Capital Planning
Massachusetts School Building Authority
40 Broad Street, Suite 500
Boston, MA 02109

Dear Ms. Pichetti:

The Worcester Public Schools have notified the Department of Elementary and Secondary Education (“DESE”) of their intent to offer Chapter 74 Career/Vocational Technical Education (CTE) programs as part of a new facility at Doherty Memorial High School, which is the subject of a feasibility study being conducted in collaboration with the Massachusetts School Building Authority as part of its school construction grant program.

DESE staff members have reviewed the District’s Chapter 74 Programming Submission received via the Massachusetts School Building Authority. The information included plans for continuing and expanding existing programs, as well as for adding new programs.

Chapter 74 Program Offerings	Comments
Engineering	Expansion of existing program
Computer Programming and Web Development	New program
Construction Craft Laborer	New program
Marketing	New program

Note that the purpose of this letter is not to grant formal or final approval for these Chapter 74 programs, but to certify that the district has consulted with local stakeholders and analyzed labor market information during the initial planning stages of the new school building, and that DESE is in general agreement with their proposal going into the next phases of the project.

Sincerely,

Cliff Chuang
Senior Associate Commissioner, Educational Options, DESE

Cc: Jeff Wulfson, Deputy Commissioner, DESE
Judith Klimkiewicz, Management Consultant for Strategic Planning for CCTE, DESE
Marnie Jain, CCTE, DESE
Larry DeSalvatore, CCTE, DESE
Lisa Sandler, CCTE, DESE
John Jumpe, Director of Project Management, MSBA
Diane Sullivan, Director of Program Management. MSBA
Katie DeCristofaro, Capital Program Manager, MSBA
Katie Loeffler, Capital Program Manager, MSBA
Rebecca Whidden, Project Manager, MSBA
Jess Deleconio, Project Manager, MSBA
Allison Jones, Senior Project Coordinator, MSBA
Matthew Deninger, DESE Commissioner's Designee, MSBA Board of Directors

6B.3 DESIGNER DELIVERABLES

6B3.3 Project Approvals

A. Permitting Requirements Chart
B. DESE Approval Letter
C. MHC Approval
D. CM@Risk Approval by Office of Inspector General
E. MEPA Approval
F. MA DEP Approval
G. EPA NPDES Approval
H. MA DOT Approval
I. MA DPH Approval
J. MAAB Approval
K. Plumbing Code Variance Request
L. Conservation Commission (OOC)
M. Designer Certification of Required Approvals
N. Certification of Utility Coordination
O. Local Zoning Approvals, Testing, & Permits

6B.3.3 Project Approvals

A. Permitting Requirements Chart

A. Permitting Requirements Chart

#	AGENCY	PERMIT/ISSUE	COMMENTS	STATUS	FEE
1	Massachusetts DEP/Worcester Conservation Commission	WPA Form 4A Abbreviated Notice of Resource Area Delineation	Wetlands and Riverfront Areas have been flagged and located on the site plan	Not Required (no wetlands present on any of the sites)	NA
2	Worcester Conservation Commission	WPA Form 3 (NOI) Notice of Intent	NOI Filed for the enabling phase1/20/2021, Public Hearings held 2/08 and 2/26/2021. Order of conditions was approved. Main project filed 4/14/2021 order of conditions issued 06/02/21.	Complete	NA
3	Worcester Conservation Commission	WPA Form 5 Order of Conditions	Order of conditions issued for Enabling and main project.	Complete	N/A
4	Worcester Conservation Commission	WPA Form 8A, 8B Request for & Certificate of Compliance	Requested by Owner or Contractor at completion of project	Pending completion of work and as-built drawing	NA
5	US EPA	Stormwater Pollution Protection Plan (SWPPP) approval	NPDES NOI filing; draft SWPPP was filed with the NOI, and is published in the specification appendices I Completed for Phase 1	Pending prior to beginning of Main construction	NA
6	US EPA	National Pollutant Discharge Elimination System (NPDES) NOI for Discharge Associated with Construction Activity and Notice of Termination (NOT)	Filed by Contractor (NOI system) prior to construction and at project completion Completed for Phase 1	Pending; NOI at least 14 days prior to beginning of construction	NA
7	Environmental Notification Form (ENF/EIR) 301cmr 11.00	Executive Office of Energy and Environmental Affairs MEPA	MEPA ruling, ENF/EIR not required see 6A 3.3 F	Complete	NA
8	Project Notification Form for Historic Buildings or Archeological MHC 950 CMR	Massachusetts Historical Commission Project Notification Form	PNF Filed 4/27/2020 Supplemental information was requested and sent 6/04/2020 Response received see 6A 3.3 E	see response Complete	NA

#	AGENCY	PERMIT/ISSUE	COMMENTS	STATUS	FEE
9	City of Worcester– Demolition Delay Ordinance	Historical Commission	Demolition delay ordinance review not required as the site is not listed on the MACRIS list.	NA	NA
10	City of Worcester	Sewer Connection	Reviewed by DPW	Final input at permit application	TBD
11	Massachusetts DEP	Sewer Extension Permit	Not required	N/A	N/A
12	City of Worcester–Hydrant flow test	Water/Fire Department	Hydrant flow tests completed	Complete	TBD
13	National Grid	New electrical service for school	Work request number was issued 287 16373 N-Grid discussions are ongoing	Backcharge to be determined, Reviews underway	TBD
14	National Grid	Temporary electric service (if required)	Discussed temp service to be off the existing transformer at the school	By Contractor prior to construction	TBD
15	Eversource	Revised gas service and new meter for boilers	Gas loads provided and service/meter location to be reviewed	Review underway	TBD
16	State Plumbing Board	Elevated pressure gas service	Handled by the local Plumbing inspector	w/ permit application	NA
17	State Plumbing Board	Variance from State Building Code	Toilet fixture count at the field building - Pre-installation	Sent variance request 7/23/21 Hearing date 8/04/21	$86.00
18	National Grid	Comprehensive Design Approach rebate program	Independent energy modeling study Complete	Process will be underway until post occupancy	
19	Massachusetts DEP	Asbestos Removal Permit & Notifications	Requirements outlined in Hazardous Materials Identification Report.	Pending; beginning of construction or demolition	TBD
20	Massachusetts DEP	BWP AQ06 Notification	Filed by Contractor prior to construction	Pending; beginning of construction	TBD
21	City of Worcester	Project Review	Review by Interdepartmental Review Team (IRT) for compliance with municipal site design standards	IRT Meeting held 6/18/2020	NA

#	AGENCY	PERMIT/ISSUE	COMMENTS	STATUS	FEE
22	Massachusetts AAB Architectural Access Board	Application for Variance (if required)	Not Required	Not required	NA
23	City of Worcester	Disabilities Board	General review	Project review was conducted with the Board	NA
24	City of Worcester	Building Department (Including Electrical and Plumbing)	Final required for Building Permit filing	Reviewed during SD, DD, and will be forwarded with the 60% CD	NA
25	City of Worcester	Police (Schools Liaison Officer) /Fire Departments, School Resource Officer, DPW, Board of Health	Reviewed as part of program development, Will be reviewed 60% to 90%	60-90% scheduled	NA
26	City of Worcester	Parks Department	Reviewed	Ongoing construction updates	NA
27	City of Worcester	Demolition Permit	Filed by Contractor prior to construction.		TBD
28	City of Worcester	Building Permit, Certificate of Occupancy	Filed by Contractor prior to construction for each Phase		TBD

B. DESE Approval Letter

Massachusetts Department of Elementary and Secondary Education

75 Pleasant Street, Malden, Massachusetts 02148-4906

Telephone: (781) 338-3000
TTY: N.E.T. Relay 1-800-439-2370

Jeffrey C. Riley
Commissioner

August 19, 2020

Mary Pichetti
Director of Capital Planning
Massachusetts School Building Authority
40 Broad Street, Suite 500
Boston, MA 02109

Dear Ms. Pichetti:

We have reviewed the documentation that was submitted by the Worcester Public Schools on July 23, 2020 for the construction project at Doherty High School. We have done so in accordance with M.G.L. chapter 70B, section 6(6), which instructs us to certify "…that adequate provisions have been made in the school project for children with disabilities, as defined in section 1 of chapter 71B…".

We would like to make one suggestion for the district's consideration: to ensure that the Adult Daily Living space (labeled "G" on floor 2) is more included into one of the academic neighborhoods, consider swapping that space with the health classroom just above it. That said, the current configuration is not a violation of our regulations, and therefore the district may proceed with this plan as presented.

We are satisfied with the district's proposed plan and believe their special education plan will provide the community with an opportunity to serve its special education students well. The Massachusetts Department of Elementary and Secondary Education therefore certifies that this school project has been planned to adequately provide appropriate space to serve the programs and school populations referenced in M.G.L. chapter 70B, section 6(6) noted above.

Sincerely,

Matthew J. Deninger
DESE designee on the MSBA Board of Directors

Cc: Vani Rastogi-Kelly, Director, Public School Monitoring, DESE
Tim Gallagher, Assistant Director, Public School Monitoring, DESE
Amy Paulin, Supervisor, Public School Monitoring, DESE
Katie DeCristofaro, Capital Program Manager, MSBA
Katie Loeffler, Capital Program Manager, MSBA
Allison Sullivan, Senior Project Coordinator, MSBA
Christina Forde, Project Manager, MSBA

Sarah Przybylowicz, Project Coordinator, MSBA

C. Massachusetts Historical Commission Approval Review

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth

Massachusetts Historical Commission

September 8, 2020

K. Russell Adams
Assistant Commissioner of Engineering & Architectural Services
Department of Public Works & Parks
City of Worcester
20 East Worcester Street
Worcester, MA 01604

RE: Doherty Memorial High School, 299 Highland Street, Worcester, MA; MHC# RC. 67959

Dear Mr. Adams:

The Massachusetts Historical Commission (MHC) is in receipt of the additional information requested for the project referenced above. Staff of the MHC have reviewed the information submitted and have the following comments.

The proposed project consists of the demolition of the existing Doherty Memorial High School at 299 Highland Street in Worcester and the construction of a 420,000 square foot replacement school building, parking, fields, and site amenities. The existing school building will be demolished after the completion of the new building. The information provided indicates that the project will use funding from the Massachusetts School Building Authority (MSBA).

Review of MHC's files indicates that the existing Doherty Memorial High School is not included in the *Inventory of Historic and Archaeological Assets of the Commonwealth* nor in the State or National Registers of Historic Places. However, it is directly adjacent to Elm Park (WOR.EB), which is listed in the State and National Registers of Historic Places.

From the information submitted, the MHC understands that no trees within the property of Elm Park are proposed for removal and that the renderings of the proposed school building previously submitted did include the expected tree line. The MHC also understands that there will be a significant amount of tree planting and other landscaping around the new facility to screen it from the existing trails and other areas.

From the information and photographs submitted, it does not appear that the proposed new Doherty Memorial High School will have a greater visual impact on Elm Park (WOR.EB) than the existing school building. The MHC also understands that the existing stone walls will be rebuilt and the steps re-used as a landscape feature on site.

Review of MHC's files and the information submitted indicates that the project **as proposed** will have "no adverse effect" (950 CMR 71.07(2)(b)(2)) on Elm Park (WOR.EB). If project plans change, please provide revised scaled existing and proposed conditions project plans to MHC for review and comment.

These comments are offered to assist in compliance with M.G.L. Chapter 9, sections 26-27C, (950 CMR 71.00). Please do not hesitate to contact Linda Santoro of my staff if you have any questions.

Sincerely,

Brona Simon
State Historic Preservation Officer
Executive Director
Massachusetts Historical Commission

xc: MSBA
City of Worcester Parks Department
Robert Para Jr, Lamoureux Pagano Associates
Worcester Historical Commission
Carleen Miller

LPA|A

Kathryn Crockett
Richard J. Lamoureux, Jr.
Eric D. Moore
Robert Para, Jr.

27 April 2020

Full PNF provided in DD Submission

Massachusetts Historical Commission
220 Morrissey Boulevard
Boston, MA 02125

Re: Doherty Memorial High School
Worcester Massachusetts
Project Notification Form

To Whom It May Concern:

On behalf of the City of Worcester, please find attached the Massachusetts Historical Commission Project Notification Form for the Doherty Memorial High School located at 299 Highland Street, Worcester, Massachusetts, prepared by our office and Epsilon Associates Inc.

We have included reduced size drawings for this submission. If you require full size drawings, electronic file, or have any other questions, please feel free to contact me.

Sincerely,

Robert Para Jr., AIA
Project Architect

RPjr/rpjr

cc: K. Russell Adams, Asst. Commissioner, DPW
Worcester Historical Commission

1904/Agency Filings/MHC/MHC Cover Letter

DRAFT

Lamoureux Pagano Associates | Architects
108 Grove Street, Suite 300, Worcester MA 01605
508.752.2831 | www.lpaa.com

APPENDIX A
MASSACHUSETTS HISTORICAL COMMISSION
220 MORRISSEY BOULEVARD
BOSTON, MASS. 02125
617-727-8470, FAX: 617-727-5128

PROJECT NOTIFICATION FORM

Project Name: Doherty Memorial High School

Location / Address: 299 Highland Street

City / Town: Worcester

Project Proponent

Name: Robert Para Jr., AIA Lamoureux Pagano Associates Architects (Project Architect)

Address: 108 Grove Street, Suite 300

City/Town/Zip/Telephone: Worcester, MA 01605 Tel: 508-752-2831

Agency license or funding for the project (list all licenses, permits, approvals, grants or other entitlements being sought from state and federal agencies).

Agency Name	Type of License or funding (specify)
Massachusetts School Building Authority (MSBA)	MA Grant Funding

Project Description (narrative):

This Project includes New Construction of a 420,000 square foot, 1670 student replacement High School building, related access, parking, fields and site amenities. The existing school was constructed in 1964 for 1500 students and will remain occupied through the phased construction, and demolished over the summer/fall of 2024 after completion of the new building. Refer to the attached site, floor plan and building images.

The City engaged in a feasibility study based on the detailed Massachusetts School Building Authority (MSBA) process, which included reviewing the possibility of renovation/additions of the existing school building, new construction on the existing site, study of available properties in the district that could support the new school program. From this study the few sites in the district that showed potential, were further reviewed along with the existing site. This study concluded that phased new construction at the existing Doherty Memorial High School site was the preferred option. The Feasibility Study was conducted using a transparent public meeting process, and voted on by the City's standing Building Committee. See attachment A. Executive Summary from the Feasibility Study. The full Feasibility Study is available for review on the City's and School's web sites. See: https://worcesterschools.org/school-subpage/doherty-memorial-high-school-building-project/ and http://www.worcesterma.gov/investing-in-education.

Does the project include demolition? If so, specify nature of demolition and describe the building(s) which are proposed for demolition.

The project scope will include the complete demolition of the existing 1964 school and site features. The existing building is a three-story, 170,000 square foot High School and is a steel frame, brick and aluminum façade type construction, which is typical of the aesthetic and construction type of the 1960's. The existing building and systems are vintage to the original construction. The feasibility study concluded that renovations or additions and renovations of the existing building would adequately meet the new schools program needs.

Does the project include rehabilitation of any existing buildings? If so, specify nature of rehabilitation and describe the building(s) which are proposed for rehabilitation.

No.

Does the project include new construction? If so, describe (attach plans and elevations if necessary).

The proposed new school building is increased in size from the existing building in order to accommodate the larger enrollment, additional vocational programs, an Advanced Academy, and the need to bring all the program spaces up to compliance with the MSBA guidelines, and the Worcester Public School District's long term strategic goals. This high school project is the fourth of the five high schools (including the Worcester Technical High School) in the City to be updated. The new school will be five stories, with four academic wings and core facilities. The Auditorium, Gymnasium, Cafeteria and Medical Suite are positioned in the school so that they may be securely accessed by the community after hours for sports, arts, or "nightlife" academics.

The site design concept is developed to be sensitive to the surrounding neighborhood and adjacent Park. The scope of work includes development of the streetscape and plantings along Highland Street, incorporating rebuilding the existing stone wall. The landscape design also includes a planted berm along the east side of the building access road to act as a buffer between the existing East–West trail and the service areas of the building.

Refer to the following attached site plan, floor plans and conceptual building images, and documents that have been developed to the level appropriate for the current Schematic Design phase of the project.

A. Executive Summary from Feasibility Study
B. Existing Site Plan with Keyed Images
C. Existing Site Photos
D. Proposed Site Graphics
E. Proposed Floor Plans
F. Massing Model / Conceptual Material Rendering

APPENDIX A (continued)

To the best of your knowledge, are any historic or archaeological properties known to exist within the project's area of potential impact? If so, specify.

The project site was part of Newton Hill Park until in 1961, when 20 Acres were transferred through the State Supreme Judicial Court to the School Department, with discussions that as a school, the land would continue to be in public use.

The existing Doherty High School building/site is **not** listed on either the Massachusetts Cultural Resource Information System (MACRIS) or the National Register of Historic Places. The adjacent park, Elm Park and

Newton Hill are on both MACRIS and the National Register NRIND 07/01/1970 3, NRMRA 03/05/1980 3. The National Register listing of the park does not include the Doherty school property. Attached for reference is copy of the 1964 contract site plan drawing that shows that the majority of the 20 Acre site was re-developed as part of the 1964 school development.

A review of the Massachusetts Historical Commission's online archaeological base maps conducted on April 23, 2020 revealed no recorded sites located on the project site. One recorded site (19-WR-187) was identified within the project's vicinity. The area of the proposed new construction was previously disturbed with the construction of the existing parking lots, access drives and athletic fields; therefore, the project site is unlikely to yield significant archaeological resources.

Refer to the following attachments:

G. Developed Area Diagram of 1964 Site Plan
H. Elm Park National Register of Historic Places
I. Doherty Memorial High School Deed and Deed Plan

DRAFT

What is the total acreage of the project area?

Woodland	7.5 acres	Productive Resources:	
Wetland	0.0 acres	Agriculture	0.0 acres
Floodplain	0.0 acres	Forestry	0.0 acres
Open space	4.0 acres	Mining/Extraction	0.0 acres
Developed	8.5 acres	Total Project Acreage	20.00 acres

What is the acreage of the proposed new construction? 13.5 acres

What is the present land use of the project area?
School building, parking access and practice sports fields.

Please attach a copy of the section of the USGS quadrangle map which clearly marks the project location.
Refer to attachment J.

This Project Notification Form has been submitted to the MHC in compliance with 950 CMR 71.00.

Signature of Person submitting this form: ____________ Date: 4/29/2020

Name: K. Russell Adams PE., Assistant Commissioner

7/1/93

K. Russell Adams P.E.
Assistant Commissioner of Engineering & Architectural Services
City of Worcester, Department of Public Works & Parks

Address: 20 East Worcester Street

City/Town/Zip: Worcester MA, 01604

Telephone: (508) 929-1300 e-mail AdamsK@worcesterma.gov

REGULATORY AUTHORITY

950 CMR 71.00: M.G.L. c. 9, §§ 26-27C as amended by St. 1988, c. 254.

D. CM@Risk Approval by Office of Inspector General

The Commonwealth of Massachusetts
Office of the Inspector General

GLENN A. CUNHA
INSPECTOR GENERAL

JOHN W. McCORMACK
STATE OFFICE BUILDING
ONE ASHBURTON PLACE
ROOM 1311
BOSTON, MA 02108
TEL: (617) 727-9140
FAX: (617) 723-2334

May 11, 2020

DRAFT

Paul J. Moosey, Commissioner
Department of Public Works and Parks
City of Worcester
20 East Worcester Street
Worcester, MA 01604

Re: Application to Use the Construction Management At-Risk Alternative Delivery Method for the Doherty Memorial High School Project

Dear Mr. Moosey:

On April 23, 2020, pursuant to M.G.L. c. 149A and 945 CMR 2.00, the city of Worcester ("Worcester") submitted an application to use the construction management at-risk ("CM at-risk") alternative delivery method for the Doherty Memorial High School project.

Based on all the information provided, Worcester has met the statutory requirements for using the CM at-risk delivery method. Accordingly, the Office of the Inspector General ("Office") is issuing this notice to proceed to use the CM at-risk delivery method as specified in M.G.L. c. 149A, §§ 1-13, and to use the plan and procedures submitted.

This approval is conditioned on Worcester using a CM at-risk firm that the Division of Capital Asset Management and Maintenance ("DCAMM") has certified, as well as DCAMM-certified trade contractors. Therefore, Worcester must require each CM at-risk firm to supply both a certificate of eligibility and an update statement during both the prequalification phase and the technical proposal phase of the selection process. In addition, Worcester must require each trade contractor to supply a certificate of eligibility and an update statement during the prequalification phase and again at the bidding phase of the selection process. Worcester must reject as invalid all contractors' statements of qualifications, proposals and bids that do not provide such certificates of eligibility or update statements.

If, during the course of the project, Worcester changes its owner's project manager or designer, please submit information about the new project manager or designer to the Office. Also, if Worcester decides not to proceed with the CM at-risk delivery method, please notify the Office.

Please feel free to contact me or Kerri-Anne Hollingshead, Policy Analyst, if you have any questions or concerns.

Sincerely,

Glenn A. Cunha
Inspector General

cc: K. Russell Adams, Assistant Commissioner, Department of Public Works and Parks

E. MA Environmental Policy Act Response

The Commonwealth of Massachusetts

Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Charles D. Baker
GOVERNOR

Karyn E. Polito
LIEUTENANT GOVERNOR

Kathleen A. Theoharides
SECRETARY

Tel: (617) 626-1000
Fax: (617) 626-1181
http://www.mass.gov/eea

Full Request for Advisory Opinion provided in DD Submission

October 23, 2020

Carleen Miller
cjmiller21@charter.net

Re: Doherty Memorial High School Building Project, Worcester, MA

Dear Ms. Miller:

On behalf of Secretary Theoharides, I write to respond to your letter of August 3, 2020, in which you requested an advisory opinion as to whether review under the Massachusetts Environmental Policy Act (MEPA) is required for the above project. You provided additional information in an email sent on September 12, 2020. The MEPA Office consulted with the City of Worcester (Project Proponent) and the City's consultants on August 31, 2020 and September 28, 2020 and received responses to information requests on September 4, 14, and October 1, 2020.

According to your August 3 letter, the project includes the phased construction of a new public high school with associated site work, parking, on-site access roadways, and a synthetic turf athletic field. The new school is proposed to be located adjacent to, and will replace, the existing Doherty Memorial High School which will remain in use until the new school is constructed; at that time, it will be demolished. The project site is generally bounded by Highland Street to the north and Elm Park, which is listed in the State and National Registers of Historic Places, on the remaining three sides. The project does not contain wetland resource areas and it is not located in Priority and/or Estimated Habitat as mapped by the Division of Fisheries and Wildlife's (DFW) Natural Heritage and Endangered Species Program (NHESP) or an Area of Critical Environmental Concern (ACEC).

Under MEPA regulations at 301 CMR 11.00, MEPA review is required when a project requires an Agency Action (including a Permit, Land Transfer, or Financial Assistance) and meets or exceeds one or more MEPA review thresholds. According to your letter, and as confirmed in correspondence from the City's consultants, the project will utilize Financial Assistance from the Massachusetts School Building Authority (MSBA). MSBA funding qualifies as State Financial Assistance which confers broad scope MEPA jurisdiction over the project.

Your letter identified concerns regarding the potential environmental impacts of the project and indicated the project may meet or exceed MEPA review thresholds pertaining to the creation of at least 5 acres of new impervious area (301 CMR 11.03(1)(a)(2) (10 acres); 301 CMR 11.03(1)(b)(2) (5 acres)); New discharge to an Outstanding Resource Water (ORW) (301 CMR 11.03(5)(a)(5)); cutting of at least five public shade trees of 14 or more inches in diameter at breast height (301 CMR 11.03(6)(b)(2)(b)); elimination of 300 or more linear feet (lf) of stone wall (301 CMR 11.03(6)(b)(2)(c)); and conversion of land protected in accordance with Article 97 of the Amendments to the Constitution of the Commonwealth (Article 97) (301 CMR 11.03(1)(b)(3)). Your letter also identified project segmentation concerns regarding potential improvements at Weatherell Park/Duffy Field.

At the request of the MEPA Office, the City's consultants provided additional information that addressed the review thresholds at 301 CMR 11.03. According to this information, potential environmental impacts of the project include the alteration of 15 acres of land (including creation of 3.4 net new acres of impervious area), generation of 126 new average daily vehicle trips (adt), construction of 125 new parking spaces, and elimination of 90 linear feet (lf) of stone wall. The project will not discharge to an ORW. The information acknowledged that the project will cut approximately 12 trees but noted they do not qualify as public shade trees as they are not located within the public street frontage.[1] The information also noted that the increase in water use and wastewater generation is projected to be under the volumes identified in the MEPA review thresholds. This information indicated that potential improvements to Weatherell Park/Duffy Field are not related to the Doherty Memorial High School Project and would be developed under the purview of the City Parks and Recreational Department the Parks Department and subject to a separate public planning process. Additionally, based on consultations with the Proponent, it is my understanding that no plans currently exist for development of the Weatherell Park/Duffy Field. The City's consultants provided correspondence from the Massachusetts Historical Commission (MHC) which states that the project will have "no adverse effect" (950 CMR 71.07(2)(b)(2)) on the adjacent Elm Park.

The City's consultants have indicated that Article 97 restrictions are not applicable to the project site, and provided, as supporting documentation, a Title Opinion (dated August 23, 2019) and Deed Covenant review letter (dated December 2, 2019) from the City Solicitor noting that the 20-acre parcel on which the existing high school is located (and upon which the proposed high school will be built) was transferred to the School Department "for school purposes" by a Supreme Judicial Court decision in 1961. The City Solicitor's letter indicates that the project does not propose any change in use of the parcel and that, accordingly, no vote of the state legislature is required for the project. In a prior letter of September 12, 2020, you indicated that the City has been unable to locate records regarding the 1960's declaration of surplus from the Parks Department for the 20-acre parcel or any records regarding the transfer of the parcel to the City of Worcester School Department. To the extent these factors affect the legal status of the project site under Article 97 of the Amendments to the Constitution changes, the Proponent should consult with the MEPA Office to determine the need for MEPA review.

* * * * *

[1] The information did not clarify whether the trees are each 14 or more inches in diameter at breast height (dbh), which is another prerequisite for triggering the MEPA review threshold at 301 CMR 11.03(6)(b)(2)(b).

Based on the information provided in your letter and by the City's consultants, the project does not appear to meet or exceed any MEPA review thresholds. Thus, while the project requires a State Agency Action in the form of MSBA funding, no MEPA review is required under 301 CMR 11.03.

If you have any questions regarding this matter, please contact Page Czepiga, Assistant Director, at page.czepiga@mass.gov.

Sincerely,

Tori T. Kim
Tori T. Kim
Assistant Secretary

cc: Christina Bazelmans (LPA|A) (via email)
Russell Adams (City of Worcester) (via email)

F. MA Department of Environmental Protection Approval

MA DEP wetlands review is not required.

The project was filed with the Local Conservation Commission for the enabling site work around the school and was amended with the main project work and order of conditions were issued.

The process was as requested by the commission at a preliminary review.

Refer to the Civil Engineering narrative 6B3.1, the permitting requirements chart 6B.3.3 A and the NOI/OOC documents are filed in the project manual appendices and 6B.3.3 L. Conservation Commission (OOC)

The DEP has jurisdiction over the existing building's demolition and hazardous materials removal. Requirements are outlined under specifications section 02 28 20 ASBESTOS REMEDIATION.

G. US Environmental Protection Agency NPDES Approval

Refer to the Civil Basis of Design in Section 6B.3.1.B.2 for detailed information on the Environmental Protection Agency National Pollutant Discharge Elimination System Permit process. Additionally, a Draft Stormwater Pollution Prevention Plan (SWPPP) is included as Appendix I of the 60% CD and Early Site Bid Package #2 specifications, for both the enabling site work around the school and for the main building project.

For the Site Enabling Bid Package #1, the NPDES was filed and for the Final Bid Package the NPDES NOI will be submitted by the Construction Manager at Risk 14 days prior to the start of construction.

H. MA Department of Transportation Approval

Refer to the Civil Basis of Design in Section 6B.3.1.B.2 and the permit requirements chart for detailed requirements.

The project is not subject to any MDOT reviews or approvals.

6B.3 DESIGNER DELIVERABLES

6B.3.3 Project Approvals

I. MA Department of Public Health Approval

Doherty Memorial High School will include a Medical Suite which will contain the school nurse facilities as well as an outpatient health clinic run by community partner Family Health Center of Worcester, which operates the health clinic out of the existing DMHS.

The clinic portion will be licensed by the Department of Public Health (DPH) and will comply with the new OP1 General & Specialty Medical Services Facilities checklist. In the 60% CD phase, the project team met with Family Health Center of Worcester (FHCW) representatives to review the new OP1 Checklist in preparation for a preliminary plan review with the DPH. The cost of construction for the clinic portion of the project is estimated to be less than $2,000,000, so the project would qualify for the Self Certification Review Process.

The Self-Certification review process is intended to be a one-part review. The licensee and architect submit the 100% Construction Document plans, Compliance Checklists, and combined Licensee's and Architect's Affidavit. The Department of Public Health (DPH) review should be complete within 30 days of the submission of a completed application.

Filing for this project would occur prior to occupancy by the operating agency. The project team has reviewed in detail the plan and requirements for the Family Health Center, as the district has similar facilities in many of their buildings, including the existing Doherty Memorial High School.

Refer to the following website for additional information regarding the DPH Plan Review and approval process. https://www.mass.gov/service-details/self-certification-review-process

A copy of the OP1 checklist is included following this narrative.

COMPLIANCE CHECKLIST

OP1_General & Specialty Medical Services Facilities

The following checklist is intended to be used in the plan review applications for health care facilities submitted to the Massachusetts Department of Public Health. This checklist summarizes and references the applicable requirements from the Licensure Regulations and the 2018 Edition of the FGI Guidelines for Design and Construction of Outpatient Facilities. Applicants must verify compliance of the plans submitted to the Department with all referenced requirements from the Licensure Regulations and FGI Guidelines when completing this Checklist. A separate Checklist must be completed for each nursing unit, hospital or clinic department, or clinical suite.

Other jurisdictions, regulations and codes may have additional requirements which are not included in this checklist, such as:

- NFPA 101 Life Safety Code (2012) and applicable related standards contained in the appendices of the Code
- State Building Code (780 CMR)
- Accreditation requirements of The Joint Commission
- CDC Guidelines for Preventing the Transmission of Mycobacterium Tuberculosis in Health Care Facilities
- USP 797 & Regulations of the Massachusetts Board of Registration in Pharmacy
- Occupational Safety & Health Standards (OSHA)
- Accessibility Guidelines of the Americans with Disabilities Act (ADA)
- Architectural Access Board Regulations (521 CMR)
- Local Authorities having jurisdiction.

Instructions:

1. All requirement lines must be completed according to the following instructions and included in the plan submissions for Self-Certification Process or Abbreviated Review Process.
2. This checklist must be completed by the project architect or engineer based on the design actually reflected in the plans at the time of completion of the checklist.
3. Each requirement line (___) of this Checklist must be completed exclusively with one of the following marks, unless otherwise directed in the checklist. If a functional space is not affected by a renovation project, the mark “E” may be indicated on the requirement line (___) before the name of the functional space (associated requirements on indented lines below that name, or associated MEP requirements do not have to be completed in this case). If more than one functional space serves a given required function (e.g. patient room or exam room), that clarification should be provided in the Project Narrative, and the requirement lines are understood to only address the functional spaces that are involved in the project.

X = Requirement is met, for new space, for renovated space, or for existing direct support space for an expanded service.

E = Requirement relative to an existing suite or area that has been *licensed* for its designated function, is *not affected* by the construction project and *does not pertain to a required direct support space* for the specific service affected by the project. “E” must not be used for an existing required support space associated with a new patient care room or area.

☒ = Check box under section titles or individual requirements lines for optional services or functions that are not included in the project area.

W = Waiver requested for specific section of the Regulations or FGI Guidelines, where hardship in meeting requirement can be demonstrated (a Physical Plant Waiver Form must be completed for each waiver request). An explicit floor plan or plan detail must be attached to each waiver request.

4. All room functions marked with "X" must be shown on the plans with the same name labels as in this checklist.
5. Mechanical, electrical & plumbing requirements are only partially mentioned in this checklist. The relevant section of the FGI Guidelines must be used for project compliance with all MEP requirements and for waiver references.
6. Oxygen, vacuum, medical air, waste anesthesia gas disposal and instrument air outlets (if required) are identified respectively by the abbreviations "OX", "VAC", "MA", “WAGD” & “IA”.
7. Requirements referenced with “FI” result from formal interpretations from the FGI Interpretations Task Group.
8. The location requirements including asterisks (*) refer to the definitions of the Glossary in the beginning section of the FGI Guidelines and reproduced in this checklist.

Facility Name: ______________________

DoN Project Number: (if applicable) ______________________

Facility Address: ______________________

Satellite Name: (if applicable) ______________________

Building/Floor Location: ______________________

Satellite Address: (if applicable) ______________________

Submission Dates:

Initial Date:

Revision Date:

Project Description: ______________________

	Architectural Requirements	**Building Systems Requirements**	
2.2	**GENERAL & SPECIALTY MEDICAL SERVICES FACILITIES**		
2.2-2	**ACCOMMODATIONS FOR CARE OF PATIENTS OF SIZE**		
2.1-2.1.1.2	☐ check if <u>not</u> included in project (only if a Patient Handling & Movement Assessment that determines that the outpatient service does not have a need for expanded-capacity lifts & architectural details that support movement of patients of size in patient areas is attached to the Project Narrative)		
2.1-2.1.2	Location:		
	___ spaces designated for care of or use by patients of size are provided in locations to accommodate population expected to be served by facility		
2.1-2.5	___ Handwashing stations		
2.1-2.5.2	___ downward static force required for handwashing stations designated for patients of size accommodates maximum patient weight of patient population		
2.1-2.6	___ Patient toilet room		
2.1-2.6.1	___ expanded-capacity toilet		
	___ mounted min. 36” from finished wall to centerline of toilet on both sides (for caregiver assistance with lifts)		
	or		
2.1-2.6.2	___ regular toilet	Ventilation:	
	___ mounted min. 44” from centerline of toilet on both sides to finished walls to allow for positioning of expanded-capacity commode over toilet	___ Min. 10 air changes per hour ___ Exhaust ___ Negative pressure ___ No recirculating room units	Table 8.1/ Policy
2.1-2.6.3	___ rectangular clear floor area min. 46” wide extends 72” from front of toilet		
2.1-2.7	___ Single-patient exam/observation room		
2.1-2.7.1	Space Requirements:		
2.1-2.7.1.1(1)	___ min. 5'-0" clearance at foot of expanded-capacity exam table	Ventilation: ___ Min. 4 air changes per hour	Table 8.1/ Policy
(2)	___ min. 3'-0" clearance on non-transfer side of expanded- capacity exam table	Power: ___ Each exam table is served by at least one duplex receptacle	2.2-8.3.6.2
(3)(a)	___ min. 5’-0” on transfer side of expanded-capacity exam table with ceiling- or wall-mounted lift		
	or		
(3)(b)	___ min. 7’-0” on transfer side of expanded-capacity exam table in rooms without ceiling- or wall-mounted lift		
2.1-2.8	___ Equipment & supply storage		
2.1-2.9	___ Waiting areas		
2.1-2.9.1	___ seating for persons of size be provided in waiting areas in outpatient facilities		

Architectural Requirements | **Building Systems Requirements**

2.1-2.9.2
___ waiting areas be sized to accommodate expanded-capacity furniture required for patients & visitors of size

2.1-2.10.1
___ All plumbing fixtures, handrails, grab bars, patient lift, equipment, built-in furniture & other furnishings designed to accommodate maximum patient weight

2.1-2.10.2
Door Openings:

2.1-2.10.2.1
___ all door openings used for path of travel to public areas & areas where care will be provided for patients of size have min. clear width of 45.5” to provide access for expanded-capacity wheelchairs

2.1-2.10.2.2
___ door openings to toilet rooms designated for patients of size have min. clear width of 45.5”

2.2-3.2.1
EXAMINATION ROOMS

2.2-3.2.1.2
(may serve as both examination & treatment spaces)

2.1-3.2.1.1(1)(b)
___ Provisions to preserve patient privacy from observation from outside exam room

2.1-3.2.1.2
___ Single-patient examination room

☐ check if not included in project

Space Requirements:

(2)(a)
___ min. clear floor area of 80 sf

___ room size allows min. clearance 2’-8” at each side & at foot of exam table or recliner

___ room arrangement shown in the plans for each exam room (Layout #1)

(1)(b)
___ room arranged with particular placement of exam table, recliner or chair to accommodate type of patient being served

☐ check if not included in project

___ room arrangement shown in the plans (Layout #2)

___ proposed room arrangement to accommodate type of patient being served is explained in Project Narrative

(3)
Exam Room Features:

(a) ___ portable or fixed exam light

(b) ___ storage for supplies

(c) ___ accommodations for written or electronic documentation

(d) ___ space for visitor’s chair

(e) ___ handwashing station

Ventilation:

___ Min. 4 air changes per hour — Table 8.1/ Policy

Power:

___ Each exam table is served by at least one duplex receptacle — 2.2-8.3.6.2

	Architectural Requirements	Building Systems Requirements	
2.1-3.2.1.2	___ Single-patient exam/observation room ☐ check if not included in project		
(1)(a)	___ immediately accessible* to nurse or control station & toilet room		
	Space Requirements:		
(2)(a)	___ min. clear floor area of 80 sf		
	___ room size allows min. clearance 2'-8" at each side & at foot of exam table or recliner	Ventilation: ___ Min. 4 air changes per hour	Table 8.1/ Policy
	___ room arrangement shown in the plans for each exam room (Layout #1)	Power: ___ Each exam table is served by at least one duplex receptacle	2.2-8.3.6.2
(1)(b)	___ particular placement of exam table, recliner or chair ☐ check if not included in project		
	___ room arrangement shown in the plans (Layout #2)		
	___ proposed room arrangement to accommodate type of patient being served is explained in Project Narrative		
(3)	Exam Room Features:		
(a)	___ portable or fixed exam light		
(b)	___ storage for supplies		
(c)	___ accommodations for written or electronic documentation		
(d)	___ space for visitor's chair		
(e)	___ handwashing station		
(2)(b)	___ Single-patient exam room for specialty clinical services (ENT or Eye examinations) ☐ check if not included in project		
	Space Requirements:		
	___ min. clear floor area 100 sf		
	___ min. clearance 3'-6" at sides, head or foot of exam table/chair as needed for staff expected work positions	Ventilation: ___ Min. 4 air changes per hour	Table 8.1/ Policy
	___ min. clearance 1'-0" at sides, head or foot of exam table or chair other than work positions	Power: ___ Each exam table is served by at least one duplex receptacle	2.2-8.3.6.2
(3)	Exam Room Features:		
(a)	___ portable or fixed exam light		
(b)	___ storage for supplies		
(c)	___ accommodations for written or electronic documentation		
(d)	___ space for visitor's chair		
(e)	___ handwashing station		
2.2-3.8	**SUPPORT AREAS FOR GENERAL & SPECIALTY MEDICAL SERVICES FACILITIES**		
2.1-3.8.11.2	___ Clean workroom or clean work area		
(1)	___ work counter		
(2)	___ handwashing station	Ventilation:	
(3)	___ storage for clean & sterile supplies	___ Min. 4 air changes per hour ___ Positive pressure	Table 8.1/ Policy
	or		

	Architectural Requirements	**Building Systems Requirements**	
2.1-3.8.11.3	___ Clean supply room or clean supply area	Ventilation:	
	___ used only for storage & holding as part of system for distribution of clean & sterile materials	___ Min. 4 air changes per hour ___ Positive pressure	Table 8.1/ Policy
2.2-3.8.12	___ Soiled holding room		
140.204	___ patient care does not involve disposal of fluid waste	Ventilation: ___ Min. 10 air changes per hour	Table 8.1/
2.1-3.8.12.1	___ does not have direct connection with clean workrooms or clean supply rooms	___ Exhaust ___ Negative pressure ___ No recirculating room units	Policy
140.204	___ handwashing station		
2.1-3.8.12.3(2)	___ space for separate covered containers for waste & soiled linen		
	or		
	___ Soiled workroom	Ventilation:	
2.1-3.8.12.1	___ does not have direct connection with clean workrooms or clean supply rooms	___ Min. 10 air changes per hour ___ Exhaust	Table 8.1/
140.204	___ handwashing station	___ Negative pressure	Policy
2.1-3.8.12.3(2)	___ space for separate covered containers for waste & soiled linen	___ No recirculating room units	
140.204	___ clinical service sink		
2.2-3.8.13	___ Equipment & supply storage		
2.2-4.2	___ Medication safety zones ☐ check if <u>not</u> included in project (only if a pharmacy is provided)		
2.1-3.8.8.1(2)	Design Promoting Safe Medication Use:		
(a)	___ medication safety zones located out of circulation paths		
(e)	___ sharps containers placed at height that allows users to see top of container		
2.1-3.8.8.2			
(1)	___ medication preparation room	Ventilation:	
(a)	___ work counter ___ handwashing station ___ lockable refrigerator ___ locked storage for controlled drugs ___ sharps containers ☐ check if not included in project	___ Min. 4 air changes per hour	Table 8.1
(b)	___ self-contained medication dispensing units ☐ check if not included in project	Lighting: ___ Task lighting	2.1-2.8.8.1(2)(d)
	or		
(2)	___ automated medication-dispensing unit		
(a)	___ located at nurse station, in clean workroom or in alcove	Lighting: ___ Task lighting	2.1-3.8.8.1(2)(d)
(b)	___ handwashing station or hand sanitation dispenser provided next to stationary med.-dispensing units		
(c)	___ countertop or cart provided adjacent* to stationary med.-dispensing units		

	Architectural Requirements	Building Systems Requirements	
2.2-3.10	**SUPPORT AREAS FOR PATIENTS**		
2.2-3.10.2	___ Patient toilet room		
2.2-3.10.2.2	(may also serve waiting areas)		
2.2-3.10.2.1	___ readily accessible* from exam rooms		
2.1-3.10.2.1	___ located to permit access from patient care areas without passing through publicly accessible areas	Ventilation: ___ Min. 10 air changes per hour ___ Exhaust ___ Negative pressure ___ No recirculating room units	Table 8.1/ Policy
2.1-3.10.2.2	___ toilet & handwashing station		
2.2-4.1	**LABORATORY SERVICES**		
	___ Laboratory services provided on-site ___ Compliance Checklist OP2 has been submitted **or** ___ Laboratory services provided off-site		
2.2-4.1.8	**SPECIMEN COLLECTION & STORAGE**		
2.2-4.1.8.1	Specimen Collection:		
(1)	___ dedicated specimen collection toilet room ___ accessible without reentering waiting room or leaving clinical services area **or** ___ patient toilet room used for specimen collection ___ accessible without reentering waiting room or leaving clinical services area	Ventilation: ___ Min. 10 air changes per hour ___ Exhaust ___ Negative pressure ___ No recirculating room units	Table 8.1/ Policy
(2)	___ dedicated blood collection area **or** ___ exam rooms used for blood collection		
2.2-4.1.8.2	___ Specimen storage		
(1)	___ accommodations for storage of blood, urine & other specimens		
(2)	___ blood storage facilities meet requirements of CLIA standards for blood banks		
§493.1103(c)(1)	___ blood specimen stored in monitored refrigerator **or** ___ blood storage conditions prevent deterioration of blood specimens		
2.2-4.3	**STERILE PROCESSING** ☐ check if <u>not</u> included in project (only if only disposable instruments & supplies are used)		
2.2-4.3.2	___ Facilities for on-site sterile processing are provided ___ Compliance Checklist OP4 has been submitted **or**		
2.2-4.3.3	___ Sterile processing is performed off-site ___ Section 2.1-4.3.3 below is completed		

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	Architectural Requirements	**Building Systems Requirements**	
2.1-4.3.3	___ Support areas for outpatient facilities using off-site sterile processing ☐ check if <u>not</u> included in project (only if sterile processing services are provided on-site & Compliance Checklist OP4 has been submitted)		
2.2-4.3.3.1	___ area for breakdown (receiving/unpacking) of clean/sterile supplies		
2.2-4.3.3.1	___ area for on-site storage of clean & sterile supplies		
2.1-4.3.2.4(1)	___ storage for sterile & clean instruments & supplies		
(a)	___ separate equipment & supply storage room **or** ___ designated equipment & supply storage area in clean workroom		
2.1-4.3.3.3 2.2-4.3.3.2(2)	___ room with flush-type device for gross decontamination & holding of soiled instruments (may be combined with soiled workroom)		
2.1-3.8.12.1	___ does not have direct connection with clean workrooms or clean supply rooms		
2.1-3.8.12.2(1) (a)	___ handwashing station	Ventilation:	
(b)	___ flushing-rim clinical service sink or equivalent flushing-rim fixture	___ Min. 10 air changes per hour ___ Exhaust	Table 8.1
(c)	___ work counter	___ Negative pressure	
(d)	___ space for separate covered containers for waste & soiled linen	___ No recirculating room units	
2.2-4.4	**LINEN SERVICES** ☐ check if <u>not</u> included in project (only if no linens are used in the facility)		
2.1-4.4.2	___ Dedicated on-site linen processing area		
2.1-4.4.2.1(1)	___ area large enough for washer, dryer & any plumbing equipment needed to meet temperature requirements		
2.1-4.4.2.1(2)	___ area divided into distinct soiled area (sorting & washing) & clean area (drying & folding)		
2.1-4.4.2.2	___ storage for laundry supplies		
2.1-4.4.2.3	___ clean linen storage		
2.1-4.4.2.4	___ handwashing station		
	or		
2.1-4.4.3	___ Outpatient facility uses off-site laundry services		
2.1-4.4.3.1	___ soiled linen holding area or dedicated area for soiled laundry carts		
2.1-4.4.3.2	___ clean linen storage area or dedicated area for clean linen carts		

	Architectural Requirements	Building Systems Requirements	
2.2-5.3	**ENVIRONMENTAL SERVICES**		
2.1-5.3.1	___ Environmental services room		
2.1-5.3.1.1(3)	(may serve more than one clinical service area on same floor)	Ventilation:	
		___ Min. 10 air changes per hour	Table 8.1/ Policy
2.1-5.3.1.1(1)	___ min. one ES room per floor	___ Exhaust	
2.1-5.3.1.2(1)	___ service sink or floor-mounted mop sink		
2.1-5.3.1.2(2)	___ provisions for storage of supplies & housekeeping equipment	___ Negative pressure ___ No recirculating room units	
2.1-5.3.1.2(3)	___ handwashing station or hand sanitation dispenser		
2.2-5.4	**ENGINEERING & MAINTENANCE SERVICES**		
2.1-5.4.2.1	___ Equipment rooms for HVAC, telecom. & electrical equipment		
2.1-5.4.2.2	___ secured with controlled access		
2.1-5.4.3	___ Building maintenance supplies & equipment storage room (may be shared)		
2.2-6.2	**PUBLIC AREAS**		
2.1-6.2.1	___ Vehicular drop-off & pedestrian entrance		
2.1-6.2.1.1	___ min. of one building entrance reachable from grade level		
2.1-6.2.1.2	___ building entrances used to reach outpatient services are clearly marked		
2.1-6.2.1.3	___ building entrances used to reach outpatient services located so patients need not go through other activity areas (except for shared lobbies in multi-occupancy buildings)		
2.1-6.2.2	___ Reception		
	___ reception & information counter, desk or kiosk provided either at main entry or at each clinical service		
2.1-6.2.3	___ Waiting area		
2.1-6.2.3.2	___ visible from staff area either by camera or direct staff sight line		
2.1-6.2.4	___ Public toilet room		
2.1-6.2.4.2	(may be located off public corridor in multi-tenant building)	Ventilation: ___ Min. 10 air changes per hour	Table 8.1
2.1-6.2.4.1	___ readily accessible* from waiting area without passing through patient care or staff work areas	___ Exhaust ___ Negative pressure ___ No recirculating room units	
2.1-6.2.5	___ Provisions for telephone access		
	___ access to make local phone calls		
2.1-6.2.6	___ Provisions for drinking water		
2.1-6.2.7.1	___ Wheelchair storage		
	☐ check if <u>not</u> included in project		
	___ located out of required corridor width		
	___ directly accessible* to entrance		
	___ provided for at least one wheelchair		
2.1-6.2.7.2	___ Wheelchair parking space		
	___ designated area for at least one patient-owned wheelchair in non-public area		
	___ located out of any required egress width or other required clearance		

Architectural Requirements | **Building Systems Requirements**

2.2-6.3 **ADMINISTRATIVE AREAS**
2.1-6.3.2 ___ Interview space
☐ check if not included in project
(2) (may be combined with consultation room)
(1) ___ separate from public areas
2.1-6.3.3 ___ Office space for business, administrative & professional staffs

2.1-6.3.5 ___ Medical records space
___ provisions made for securing medical records of all media types used by facility
2.1-6.3.5.1 ___ location restricted to staff access to maintain confidentiality of record

2.1-6.3.5.2 Space Requirements:
(1) ___ space provided for medical records management
(2) ___ physical space for electronic storage of forms or documents

2.1-6.3.6 ___ Storage for office equipment & supplies

2.2-6.4 **SUPPORT AREAS FOR STAFF**
2.1-6.4.1 ___ Staff lounge
☐ check if not included in project
___ handwashing station
2.1-6.4.2 ___ Storage for staff personal effects
___ locking drawers cabinets or lockers
___ readily accessible* to individual work areas

*LOCATION TERMINOLOGY:

Directly accessible: Connected to the identified area or room through a doorway, pass-through, or other opening without going through an intervening room or public space

Adjacent: Located next to but not necessarily connected to the identified area or room

Immediately accessible: Available either in or adjacent to the identified area or room

Readily accessible: Available on the same floor or in the same clinic as the identified area or room

Architectural Details & MEP Requirements

2.1-7.2.2 **ARCHITECTURAL DETAILS**
CORRIDOR WIDTH:
2.1-7.2.2.1 ___ Min. 44”
IBC 1018.2 **or**
___ Detailed code review incorporated in Project Narrative

421 CMR 6.00 ___ Corridors include turning spaces for wheelchairs
2.1-7.2.2.2 CEILING HEIGHT:
(1) ___ Min ceiling height 7'-6"in corridors & in normally unoccupied spaces
___ Min. ceiling height 7’-10” in other areas

2.1-7.2.2.3 DOORS & DOOR HARDWARE:
(1) Door Type:
(a) ___ doors between corridors, rooms, or spaces subject to occupancy swing type or sliding doors
(b) ___ sliding doors
☐ check if not included in project
___ manual or automatic sliding doors comply with NFPA 101
___ detailed code review incorporated in Project Narrative
___ no floor tracks
(2) Door Opening:
(a) ___ min. 34” clear door width
___ min. 83.5” clear door height

(3) Door Swing:
(a) ___ doors do not swing into corridors except doors to non-occupiable spaces (e.g. environmental services rooms & electrical closets) & doors with emergency breakaway hardware
(4) ___ Lever hardware or push/pull latch hardware

(5) Doors for Patient Toilet Facilities:
(a) ___ door that swings outward
or
___ door equipped with emergency rescue hardware (permits quick access from outside the room to prevent blockage of the door)
or
___ sliding door (not pocket door)

(b) ___ toilet room opens onto public area or corridor
☐ check if not included in project
___ visual privacy is maintained

2.1-7.2.2.8 HANDWASHING STATIONS:
(3)
(a) ___ Handwashing station countertops made of porcelain, stainless steel, solid-surface materials or impervious plastic laminate assembly
(b) ___ Countertops substrate
☐ check if not included in project
___ marine-grade plywood (or equivalent material) with impervious seal
(4) ___ Handwashing station casework
☐ check if not included in project
___ designed to prevent storage beneath sink
(5) ___ Provisions for drying hands
☐ check if not included in project
(only at hand scrub facilities)
(a) ___ hand-drying device does not require hands to contact dispenser
(b) ___ hand-drying device is enclosed to protect against dust or soil
(6) ___ Liquid or foam soap dispensers

2.1-7.2.2.9 GRAB BARS:
(1) ___ Grab bars anchored to sustain concentrated load 250 pounds
(3) ___ Ends of grab bars constructed to prevent snagging clothes of patients staff & visitors

2.1-7.2.3 **SURFACES**
2.1-7.2.3.1 FLOORING & WALL BASES:
(1) ___ Flooring surfaces cleanable & wear-resistant for location
(3) ___ Smooth transitions provided between different flooring materials
(4) ___ Flooring surfaces including those on stairways are stable, firm & slip-resistant
(5) ___ Floors & wall bases of all areas subject to frequent wet cleaning are constructed of materials that are not physically affected by germicidal or other types of cleaning solutions

2.1-7.2.3.2 WALLS & WALL PROTECTION:
(1)(a) ___ Wall finishes are washable
(1)(b) ___ Wall finishes near plumbing fixtures are smooth, scrubbable & water-resistant
(2) ___ Wall surfaces in areas routinely subjected to wet spray or splatter (e.g. environmental services rooms) are monolithic or have sealed seams that are tight & smooth

2.1-7.2.3.3 CEILINGS:
(1) ___ Ceilings provided in all areas except mechanical, electrical & communications equipment rooms
(a) ___ Ceilings cleanable with routine housekeeping equipment
(b) ___ Acoustic & lay-in ceilings where used do not create ledges or crevices
2.1-7.2.4.3 ___ Privacy curtains in patient care areas are washable

2.1-8.2 **HEATING VENTILATION & AIR-CONDITIONING (HVAC) SYSTEMS**
2.1-8.2.1.3/ Policy ___ Ventilation rates meet requirements of Table 8.1 in Part 3 ASHRAE Standard 170 (Policy based on input from Facility Guidelines Institute)

2.2-8.3 **ELECTRICAL SYSTEMS**
2.2-8.3.4 EMERGENCY EGRESS LIGHTING
___ Automatic emergency lighting
or
___ Facility has total floor area of not more than 1,000 sf, is located at grade level & has direct access to exits to grade

J. MA Architectural Access Board Approval

No variances are required for this project from the MAAB.

The Team had reviewed the project with the Director of Human Rights and Disabilities and Office of the City Manager earlier in the project's development.

K. Plumbing Code Variance Request

K. Plumbing Code Variance

Following the precedent set by the South High Community School project, the project team is aware that a Plumbing Code Variance will be required for relief on the number of fixtures to be provided at the outdoor toilet and storage building near the athletic field.

During the 60% CD phase, the project team met with the City of Worcester Plumbing Inspector and Building Inspector to obtain the required approvals for the proposed plumbing code variance. Following this narrative is a copy of the Variance request that was submitted to the State Board of Examiners of Plumbers and Gas Fitters on July 23, 2021.

Kathryn Crockett
Richard J. Lamoureux, Jr.
Eric D. Moore
Robert Para, Jr.

23 July 2021

Commonwealth of Massachusetts
Division of Professional Licensure
Board of State Board of Examiners of Plumbers and Gas Fitters
1000 Washington Street, Suite 710
Boston, Massachusetts 02118

Re: Doherty Memorial High School
Variance from State Plumbing Code
Toilet fixture count at the field building – Pre-installation

To Whom It May Concern:

Please find enclosed the variance application along with the application fee payment for the above referenced project.

Please feel free to contact me with any questions or concerns regarding this request for variance.

Sincerely,

Robert Para Jr., AIA
Project Architect

RP/aw

cc: Eugene Caruso, AECOM Tishman
Chris Robinson, Seaman Engineering
K. Russell Adams, City of Worcester
Jim Bedard, Worcester School Department

I:\PROJECTS\2019\1904-Doherty High School\CORRESPONDENCE\Owner\1904CO-STATE

Commonwealth of Massachusetts

Division of Professional Licensure

Board of State Board of Examiners of Plumbers and Gas Fitters

1000 Washington Street • Boston • Massachusetts • 02118-6100

VARIANCE FROM STATE PLUMBING CODE

PRE-INSTALLATION

$86.00 application fee payable to "Commonwealth of Massachusetts"

DO NOT USE THIS APPLICATION IF PLUMBING WORK HAS BEEN COMPLETED

PLEASE PRINT CLEARLY

(Section1) APPLICANT INFORMATION:

Applicant Name: Kevin R. Seaman	Firm Name (if applicable): Seaman Engineering Corporation		Date: 07/21/21
Title or Position with Firm (if applicable): President, P.E., LEED AP	Type of Work: New Construction: ◉ Renovation: ○		
Street Address: 22 West Street, Unit C	City/Town: Millbury	State: MA	Zip Code: 01527
Cell Phone:	Work Phone: (508) 865-1400	Email: kevin@seamanengineers.com	

ALL OF THE FOLLOWING ITEMS MUST BE INITIALED.
IF LEFT BLANK, THE FORM WILL BE DEEMED INCOMPLETE AND WILL NOT BE ACCEPTED.

1. I have included with this application **written documentation** that the local Board of Health has been petitioned regarding this variance request.* (Variance requests for City of Boston must include petition to Inspectional Services) Note: No Board of Health petition is required for buildings owned, used or leased by the State of Massachusetts.	INITIAL BELOW KRS
2. I have included all necessary supporting documentation regarding this variance request.	INITIAL BELOW KRS
3. I have included a non refundable check for $86.00 payable to the Commonwealth of Massachusetts. Note: No payment is required for buildings owned, used or leased by the State of Massachusetts.	INITIAL BELOW KRS
4. The unusual or extraordinary circumstance or established hardship that warrants special terms or conditions is clearly stated in (Section 5) on the second page of this application	INITIAL BELOW KRS
5. I understand that this variance request is for one instance at the location information stated in (Section 3) of this application.	INITIAL BELOW KRS
6. I certify that the plumbing work relevant to the information stated in (Section 5) has not yet been performed.	INITIAL BELOW KRS

* "Additionally, any response by the Board of Health or Health Department must be provided, however, the Board may waive this requirement so long as the petition was made in a timely manner."

(Section 2) OWNER OF THE PROPERTY WHERE THE VARIANCE IS LOCATED: (Please leave blank if information is the same as in Section (1))

Individual Name:	Firm Name (if applicable):		
Maureen Binienda	Worcester Public Schools		

Street Address:	City/Town:	State:	Zip Code:
20 Irving Street	Worcester	MA	01609

Cell Phone:	Work Phone:	Email:
	(508) 799-3115	BiniendaM@worcesterschools.net

(Section 3) LOCATION OF VARIANCE: (Please leave blank if this information is the same as in Section (2))

Name of proposed or current occupier of the building:		
Doherty Memorial High School		
Street Address:	**City/Town:**	**Zip Code:**
299 Highland Street	Worcester	01602

(Section 4) ADDITIONAL INFORMATION:

Plumber's Name (if available):	Plumbing Firm Name (if available):	Work Phone:

Name of Plumbing Inspector:	Date Inspector was informed of this Variance Request:
Domenic Decillis Jr.	May 18, 2021
Plumbing Code Section(s) Relevant to this Variance Request: 248 CMR 10.10 (18) Table 1	
Has Plumbing Work Begun at the Location of this Variance Request: Yes: ○ No: ◉	Date Work Began:

(Section 5) VARIANCE INFORMATION: (Please explain in detail the established hardship relative to this variance request)

See Attached Letter from Worcester Public Schools Superintendent Maureen Binienda for the details of this Variance Request.

Also attached is a letter from Amanda Wilson, the City of Worcester Director of Housing and Health Inspections.

☑ By checking this box - I hereby certify under pains and penalties of perjury that the information entered on this application request, including supporting documentation, is true and accurate and is filed in accordance with Chapter 142, section 13 of the General Laws and 248 CMR, the Massachusetts State Plumbing Code. I certify that all work performed prior to this request for a variance meets the requirements of 248 CMR and that I am only seeking a variance for work that has not yet commenced. I also certify that I understand that this is a request for the Board to allow an exception to the requirements of the Massachusetts State Plumbing Code and does not constitute an appeal of an inspector's decision.

Signature of Applicant Kevin R. Seaman Sealed by Kevin Seaman 6:30 am,Jul 22,2021 **Date:** 7/21/21

Worcester Public Schools

Worcester, Massachusetts

Office of the Superintendent
Maureen F. Binienda
Superintendent

Dr. John E. Durkin Administration Building
20 Irving Street
Worcester, Massachusetts 01609-2493

Tel. (508) 799-3115
FAX (508) 799-3119
biniendam@worcesterschools.net

Domenic Decillis Jr.
Worcester Plumbing Inspector.
Inspectional Services
25 Meade Street
Worcester, MA 01610

Dear Mr. Decillis Jr.,

The purpose of this letter is to inform the Plumbing Board of the proposed use of the new Game Field proposed for Doherty Memorial High School. The outdoor game field will be a new artificial turf field with lighting and bleachers designed to seat 1500 students. The School District has requested a bleacher capacity of 1500 seats for outdoor assemblies and Pep Rallies. Outdoor assemblies and Pep Rallies would take place during school hours for a limited duration (1-2 hours), which would allow the students and faculty to return indoors to utilize the bathroom facilities.

The artificial turf game field will be used for practices and games for Soccer, Field Hockey and Football. Currently all games are hosted at Foley Stadium, as the existing Doherty Memorial site does not have a competition game field. Historically, spectator attendance at these games has been very low; it is expected that 1500 seats are more than adequate to support the maximum number of expected game attendees.

Referencing 248 CMR 10.00: Uniform State Plumbing Code, the following number of fixtures would be required if the new Game Field was classified as a Stadium with 1500 spectators:

Excerpt from 248 CMR 10.10 (18) Table 1:

Building Clarification	Use Group	Toilets		Urinals Males	Lavatories Each Sex
		Females	Males		
Stadiums *etc.*	A-5	1 per 30	1 per 60	50%	1 per 150

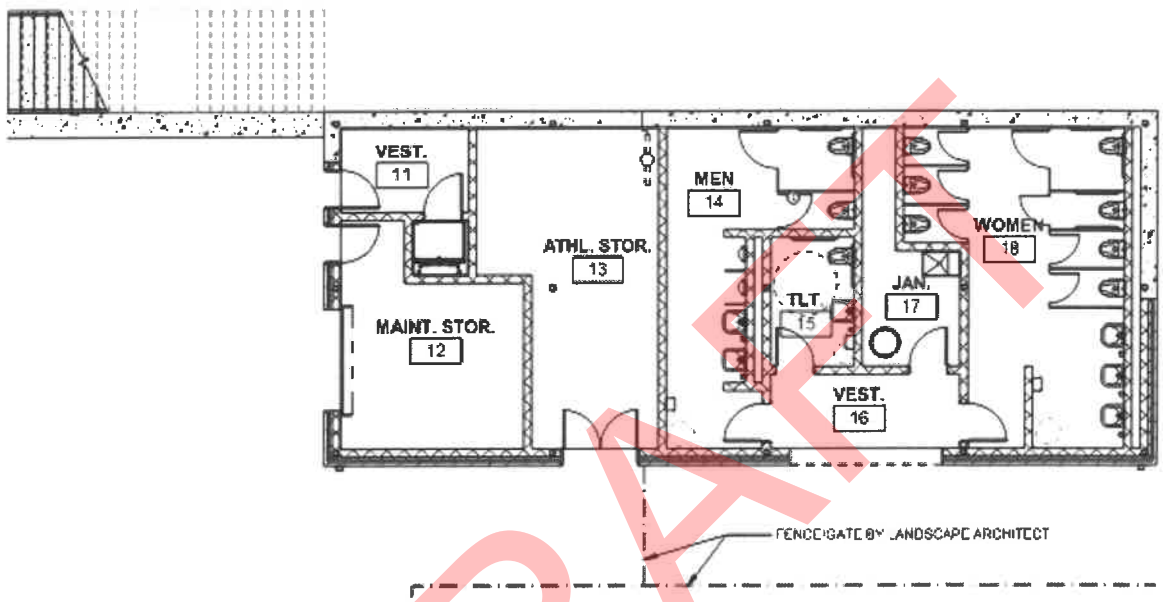
Assumed 1500 Total Spectators (not anticipated)
750 Women = 25 Toilets, 5 Lavatories
750 Men = 7 Toilets, 6 Urinals, 5 Lavatories
Total: 38 Fixtures (Toilets & Urinals)

An outdoor toilet building large enough to accommodate 38 fixtures would not fit within the limited site area available and would represent a significant maintenance burden to the Worcester Public Schools. After a previous variance hearing for the South Community High School, the MA Plumbing

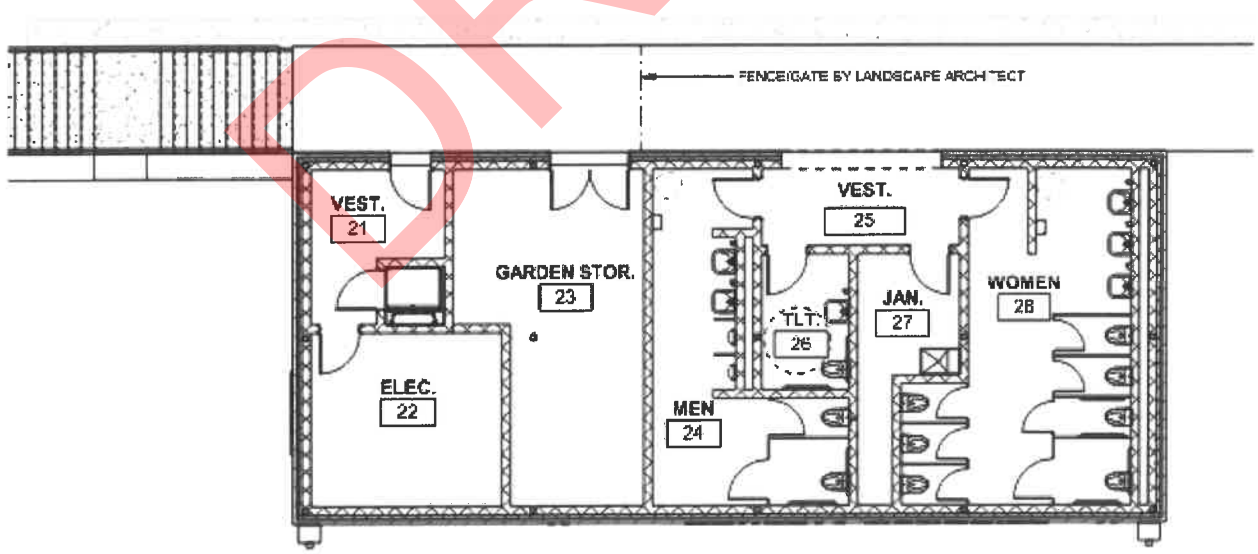
Board granted a 50% relief for a school stadium from the MA Plumbing Code requirement for stadiums as long as it:

- Provides fifty percent of the code required facilities within the new proposed building for the stadium.
- Meets "potty-parity" requirements.
- Does not include restrooms in nearby schools.

The Project is requesting the same variance to provide a reduced number of fixtures, which would still



Outdoor Toilet & Storage Building – First Floor

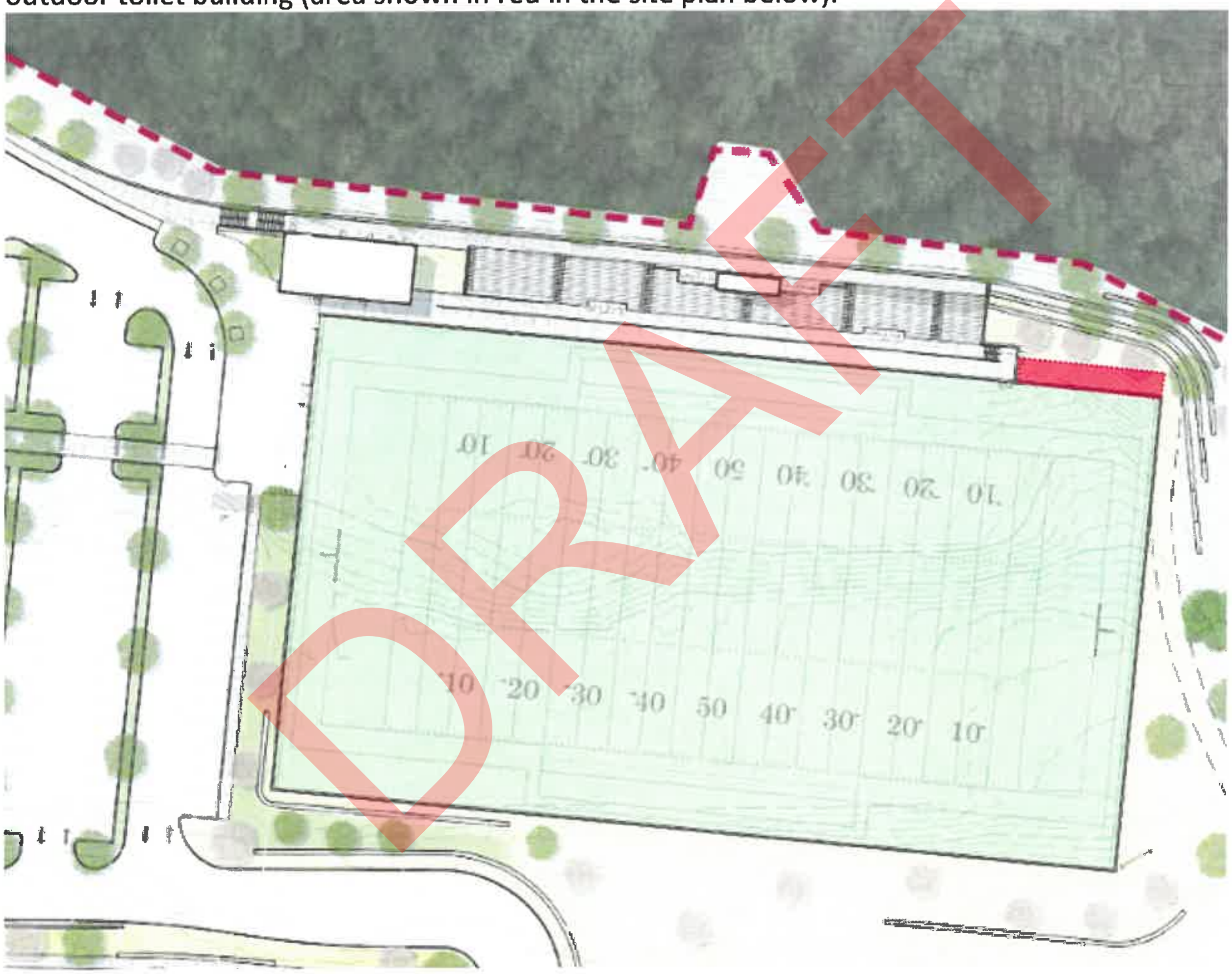


adequately support the proposed use of the field and number of spectators.

Proposed Number of Fixtures:
Men = (4) Toilets, (4) Urinals, (4) Lavatories

Women = (14) Toilets, (6) Lavatories
Gender-Neutral = (2) Toilets, (2) Lavatories
Total: 24 Fixtures
Based on the 248 CMR 10.00, the proposed number of fixtures would support an attendance of approximately 900 spectators, which is greater than 50% of the maximum capacity and which also far exceeds the average number of spectators that typically attend Doherty Memorial High School sporting events. Additionally, the project proposes the inclusion of two accessible, single-occupancy, gender-neutral restrooms (one on each level) available for use by any individual, or as family restrooms.

In the case of the infrequent event with greater attendance, there is adequate space near the field to provide temporary outdoor toilets to supplement the number of permanent fixtures proposed for the outdoor toilet building (area shown in red in the site plan below).



Partial Site Plan

Please feel free to reach out with any questions or comments.
Sincerely,

Maureen Binienda
Superintendent
Worcester Public Schools

City of Worcester
Department of Inspectional Services
Worcester, Massachusetts

Timothy McInerney
Director of Inspectional Services

David C. Horne
Deputy Building Commissioner

Amanda M. Wilson, Director
Housing/Health Inspections

DRAFT

July 9, 2021

Lamoureux Pagano Associates, the architect for the City of Worcester, is constructing the new replacement Doherty High School at 299 Highland Street Worcester, MA 01602 and requests a variance from CMR 248, 10:10 table 1, to eliminate/or reduce the number of plumbing fixtures. Specifically, the variance is to eliminate/or reduce the number of plumbing fixtures in the new field house due to lack of space and number of spectators attending games or pep rallies. See the attached variance application and letter from the architect and Superintendent of Schools.

The City of Worcester is requesting a variance from the Massachusetts State Plumbing and Fuel Gas Code at the following address, 299 Highland Street, Worcester, MA.

The Department of Inspectional Services, Housing and Health Inspections is in agreement with the request for the variance.

The Department of Inspectional Services, Plumbing & Gas Unit is in agreement with the request for the variance and respectfully seeks concurrence from the State Board of Examiners Plumbers and Gas Fitters.

Thank you in advance for your consideration.

Sincerely,

Amanda Wilson, MPA
City of Worcester
Director Housing and Health Inspections
Department of Inspectional Services
25 Meade Street
Worcester, MA 01610
508-799-1198 ext. 33007
wilsona@worcesterma.gov

L. Conservation Commission Order of Conditions

Notice of Intent Application Form Only
Full filing is available upon request

Notice of Intent Application Form
City of Worcester Wetlands Protection Ordinance

*To be filled out if the only trigger for review is 1) proximity (100-ft or less) to any existing or proposed inlet to any storm drain, catch basin, or other storm drain system component discharging to any lake, pond, river, stream, or wetland (see City of Worcester Wetlands Protection Ordinance) &/or 2) Isolated Land Subject to Flooding trigger (when stricter than the Wetlands Protection Act trigger). If other triggers are applicable – please fill out WPA NOI Form instead and indicate that it is filed both under the Wetlands Protection Act **and** the Ordinance.*

A. General Information

1. Project Location:

a. Street Address: 299 Highland Street
b. City/Town: Worcester
c. Zip Code: 01602
d. Assessors Map/Plat Number: 11-INX
e. Parcel /Lot Number: 00001

2. Is any portion of the proposed project jurisdictional under the Massachusetts Wetland Protection Act M.G.L. c. 131, §40?

☐ Yes ☒ No

If yes, please file the Wetlands Protection Act Form 3 - Notice of Intent instead of this form

3. Applicant:

a. First Name: Russell
b. Last Name: Adams
c. Company: City of Worcester Department of Public Works
d. Mailing Address: 20 East Worcester Street
e. City/Town: Worcester
f. State: MA
g. Zip Code: 01604
h. Phone Number: 508-929-1300
i. Fax Number:
j. Email address: AdamsK@worcesterma.gov

4. Property owner (if different from applicant):

☐ Check if more than one owner

If there is more than one property owner, please attach a list of these property owners not listed on this form.

Same as applicant
a. First Name
b. Last Name
c. Company
d. Mailing Address
e. City/Town
f. State
g. Zip Code
h. Phone Number
i. Fax Number
j. Email address

5. Representative (if any):

a. Firm: Nitsch Engineering
b. Contact Person First Name: Jared
c. Contact Person Last Name: Gentilucci, PE, CPESC, LEED AP BD+C
d. Mailing Address: 370 Main Street, Suite 850
e. City/Town: Worcester
f. State: MA
g. Zip Code: 01608
h. Phone Number: 508 365 1032
i. Fax Number:
j. Email address: jgentilucci@nitscheng.com

DRAFT

Notice of Intent Application Form
City of Worcester Wetlands Protection Ordinance

To be filled out if the only trigger for review is 1) proximity (100-ft or less) to any existing or proposed inlet to any storm drain, catch basin, or other storm drain system component discharging to any lake, pond, river, stream, or wetland (see City of Worcester Wetlands Protection Ordinance) &/or 2) Isolated Land Subject to Floo trigger (when stricter than the Wetlands Protection Act trigger). If other triggers are applicable – please fill out WPA NOI Form instead and indicate that it is filed both under the Wetlands Protection Act ***and*** *the Ordinance.*

6. Is any portion of the proposed project jurisdictional under the Massachusetts Wetland Protection Act M.G.L. c. 131, §40?

☐ Yes ☒ No

If yes, please file the Wetlands Protection Act Form 3 - Notice of Intent instead of this form

7. Which provision of the City of Worcester Wetland Protection Ordinance is this project being filed under?

☒ The proposed project is located within 100 feet of any existing or proposed storm drain, catch basin or storm drain component.

☐ The proposed project includes impacts to Isolated Lands Subject to Flooding (an isolated depression or closed basin without an inlet or an outlet which at least once a year confines standing water to a volume of at least 1/8 acre-foot)

8. Describe current site conditions:

The 20-acre+/- site is currently developed with the existing Doherty Memorial High School, parking and access facilities, site and building utility services, and athletic fields.

9. General Project Description:

The project includes earth moving, utility system modifications, drainage component installation, and parking and access paving construction on the portion of the project site immediately surrounding the existing school building. The site improvements are temporary, are being constructed to enable construction of a new school building on the easterly portion of the site, and will be demolished following completion of the new school building. Construction of the new school building, demolition of the existing school, and construction of additional site improvements will be included in a separate Notice of Intent application.

10. List distance/s to, number and type of storm drain system components within 100-ft of the project:

Site disturbance will occur in close proximity to numerous existing and proposed drainage system inlets. Refer to project drawings.

11. Does this application meet the requirements of the Massachusetts Stormwater Policy?

☐ Yes (If yes, please attach a Stormwater Management Form) No

☒ Not Applicable. Explain why: The completed site is an interim condition that will facilitate a subsequent site construction project to be permitted under a separate Notice of Intent application.

☐

12. Property recorded at the Registry of Deeds for:

Worcester	415
a. County	c. Page Number
4178	
b. Book	d. Certificate # (if registered land)

13. Total Fee Paid (from the City of Worcester Statement of Fee Calculation Form to be completed and included with this application)

N/A

a. Total Fee Paid

B. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Notice of Intent and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Conservation Commission will place notification of this Notice in a local newspaper at the expense of the applicant in accordance with the Wetlands Protection Ordinance.

	1/11/2021
Signature of Applicant	Date
Signature of Property Owner (if different)	Date
Nitsch Engineering Matthew Brassard, PE	1/20/2021
Signature of Representative (if any)	Date

K. Russell Adams, P.E.
Assistant Commissioner of Engineering & Architectural Services

DRAFT

Nitsch Engineering

370 Main Street, Suite 850
Worcester, MA 01608
T: 508-365-1030

www.nitscheng.com

AFFIDAVIT OF SERVICE

Under the City of Worcester Wetlands Protection Ordinance

I, Jared Gentilucci, PE, hereby certify under the pains and penalties that at least one week prior to the public hearing, we gave notification to abutters in compliance with Section 5(a) of the City of Worcester Wetlands Protection Ordinance, the second paragraph of Massachusetts General Laws Chapter 131, Section 40, and the DEP guide to Abutter Notification dated April 8, 1994, in connection to the following matter:

Submission of a Notice of Intent to the City of Worcester Conservation Commission for enabling work to prepare the site for the future construction of the new Doherty High School located at 299 Highland Street was filed on January 20, 2021. The project includes the reconfiguration and regrading of existing paved areas, new pavement to provide adequate access around the existing building and parking for the existing school, storm drainage system improvements, and relocation of select utilities.

The form of notification and the list of abutters to whom it was given is included with this Affidavit of Service.

Jared Gentilucci, PE

1/20/21
Date

DRAFT

NOTIFICATION TO ABUTTERS
UNDER THE CITY OF WORCESTER WETLANDS PROTECTION ORDINANCE

In accordance with the City of Worcester Wetlands Protection Ordinance (WWPO), Section 5(a), you are hereby notified of the following:

A. The name of the Applicant is the City of Worcester Department of Public Works.

B. The Applicant has filed a Notice of Intent with the Worcester Conservation Commission to perform work within 100 feet of an existing or proposed storm drain, catch basin, or storm drain component.

   The project consists of enabling work to prepare the site for the future construction of the new Doherty High School. Site improvements include reconfiguration and regrading of existing paved areas, new pavement to provide adequate access around the existing building and parking for the existing school, storm drainage system improvements, and relocation of select utilities. Construction of the new Doherty High School building and associated site work will be covered under a future filing with the Worcester Conservation Commission.

C. The location of the proposed activity is 299 Highland Street, Worcester, MA.

D. This application may be viewed from 8:30 am to 2:00 pm at the Division of Planning and Regulatory Services, City Hall, 455 Main Street, Room 404, Worcester, MA. Contact Phone Number- 508-799-1400 x31440.

E. Notice of the public hearing, including its date, time, and place, will be published at least five business days prior to the hearing in the Worcester Telegram & Gazette.

F. Agenda for the public hearing, including its date, time, and place, will be posted on the City website (http://www.worcesterma.gov/planning-regulatory/boards/conservation-commission) not less than 48 hours prior to the hearing.

G. A digital copy of the Notice of Intent may be obtained from the applicant's representative: Please contact Jared Gentilucci at Nitsch Engineering, Inc. at (508) 365-1032 or jgentilucci@nitscheng.com between 9:00 am and 5:00 pm, Monday through Friday.

The Public Hearing for the proposed project is scheduled to be held during the Worcester Conservation Commission meeting on Monday, February 8, 2021 at 5:30 PM.

Edward M. Augustus, Jr.
City Manager

Timothy J. McGourthy
Chief Financial Officer

Samuel E. Konieczny
City Assessor

CITY OF WORCESTER

Administration & Finance

Certified Abutters List

A list of 'parties in interest' shall be attached to the application form and shall include the names and addresses. All such names and addresses shall be obtained from the most recent applicable tax list maintained by the City's Assessing Department. The Assessing Department certifies the list of names and addresses.

Total Count: 24

Parcel Address: 299 Highland Street
Assessor's Map-Block-Lot(s): 11-INX-00001

Owner: City of Worcester School Department
Owner Mailing: 20 Irving Street
Worcester, MA 01609

Petitioner (if other than owner): Jared Gentilucci/ Nitsch Engineering
Petitioner Mailing Address: 370 Main Street
Worcester, MA 01608
Petitioner Phone: 508-365-1032

Planning: ____ Zoning: ____ Liquor License: ____ ConComm: X
Historical: ____ Cannabis: ____ Other: ____

11-INX-00001	CITY OF WORCESTER SCHOOL DEPT	20 IRVING ST	WORCESTER MA 01609
11-010-00010	JEREMIAH'S INN INC	1059 MAIN ST	WORCESTER MA 01603
11-011-00004	SANCHIRICO MARIE E	0290 HIGHLAND ST	WORCESTER MA 01602
11-008-00023	SURRETTE DIANE M + ROBERT E	0264 HIGHLAND ST	WORCESTER MA 01602
11-010-00017	BIGWOOD JOHN T +	0278 HIGHLAND ST	WORCESTER MA 01602
11-010-00018	SWARTZ CONRAD M +	0390 MAIN ST	WORCESTER MA 01608
11-008-00007	PHAM MELINDA	0272 HIGHLAND ST	WORCESTER MA 01602
11-010-00004	GUILD SAINT AGNES WORCESTER INC	0405 GROVE ST	WORCESTER MA 01605
11-011-00006	COMEAUX CHRISTOPHER M	0286 HIGHLAND ST	WORCESTER MA 01609
11-011-00005	DUNN JOAN M	0288 HIGHLAND ST	WORCESTER MA 01602
11-012-4A2-2	PAGAN JUAN B RIVAS + FALCON	316A HIGHLAND ST	WORCESTER MA 01602
11-012-4A2-1	AZIZIAN VARAZDAT + HASMIK J	316B HIHGLAND ST	WORCESTER MA 01602
11-012-0004A	GIAQUINTO NICOLA	0318 HIGHLAND ST	WORCESTER MA 01602
11-012-00003	SAKAJ ARIAN	0320 HIGHLAND ST	WORCESTER MA 01602
11-012-003-1	CAULEY COLLEEN MARIE	0322 HIGHLAND ST	WORCESTER MA 01602
11-012-6A+6B	KASHUK GERALD A TRUSTEE	0005 SUBURBAN RD	WORCESTER MA 01602
02-INX-00001	CITY OF WORCESTER	455 MAIN ST PARKS DEPT	WORCESTER MA 01608
11-INX-0002A	SPENCER SAVINGS BANK	0176 MAIN ST	SPENCER MA 01562
11-011-00002	KASHUK GERALD A TRUSTEE	0005 SUBURBAN RD	WORCESTER MA 01602

11-011-00003	WRIGHT GEORGE E + DONNA F	0298 HIGHLAND ST	WORCESTER MA 01602
11-012-00002	NESTELBAUM MARIE TRUSTEE	0016 BEECHING ST	WORCESTER MA 01602
11-012-00001	BLASE RICHARD M	0328 HIGHLAND ST	WORCESTER MA 01608
11-013-00012	330 HIGHLAND STREET WORCESTER	0330 HIGHLAND ST	WORCESTER MA 01602
11-INX-00002	CITY OF WORCESTER	455 MAIN ST PARKS DEPT	WORCESTER MA 01608

This is to certify that the above is a list of abutters to Assessor's Map-Block-Lot(s) 11-INX-00001 as cited above.

Certified by: Samuel E. Konieczny

Signature

1/13/2021

Date

Edward M. Augustus, Jr.
City Manager

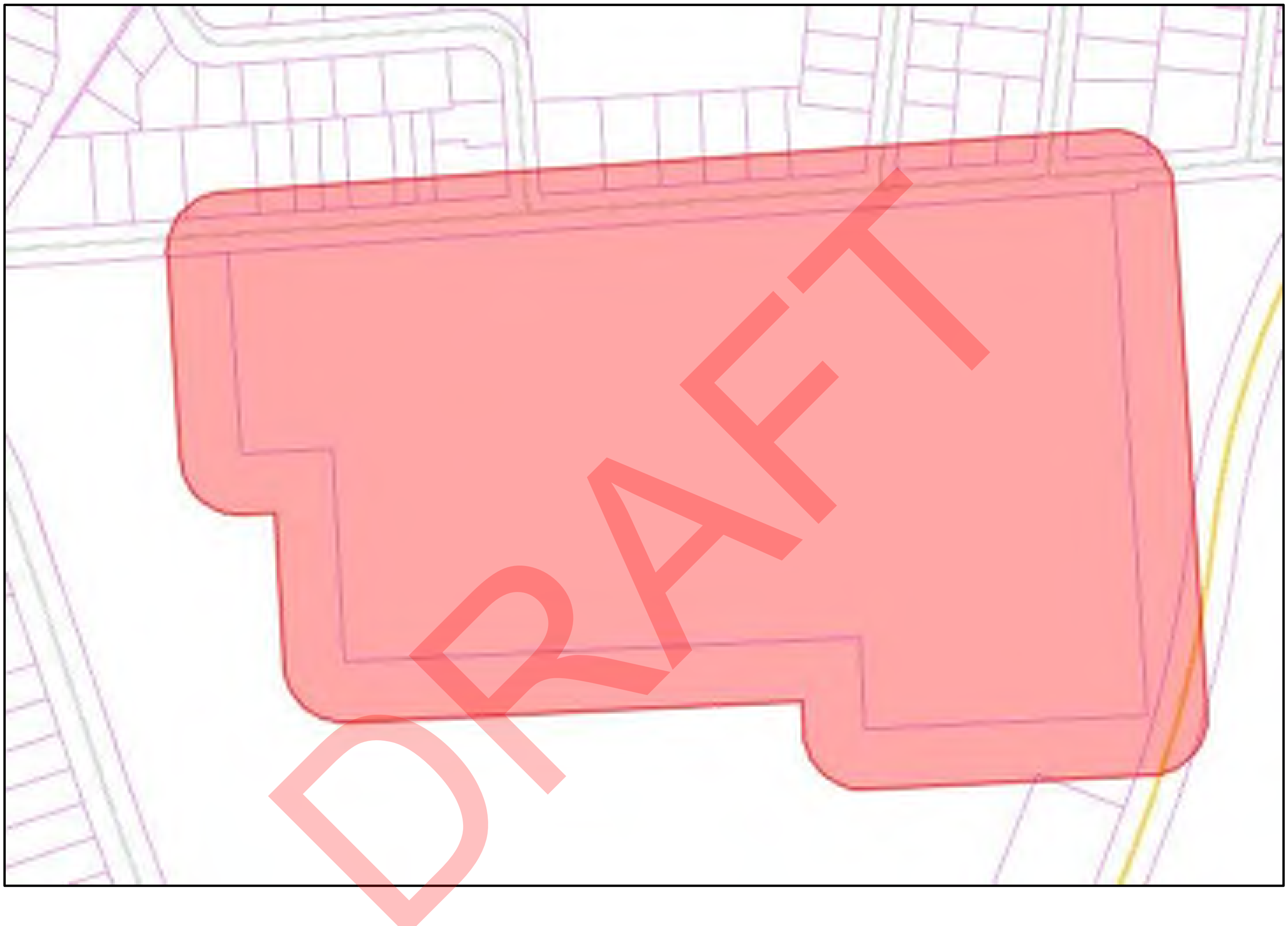
Timothy J. McGourthy
Chief Financial Officer

Samuel E. Konieczny
City Assessor

CITY OF WORCESTER

Administration & Finance

Abutters Map



Coversheet and Table of Contents Only
Full Stormwater report is available upon request

Nitsch Engineering

January 20, 2021
Revised February 23, 2021
Revised February 26, 2021

STORMWATER REPORT

For

DOHERTY MEMORIAL HIGH SCHOOL
299 Highland Street – Worcester, MA

Prepared for:

City of Worcester
Department of Public Works
20 East Worcester Street
Worcester, MA 01604

Prepared by:

NITSCH ENGINEERING, INC.
370 Main Street, Suite 850
Worcester, MA 01608

NITSCH PROJECT #13325
COMMONWEALTH OF MASSACHUSETTS
JARED E. GENTILUCCI
CIVIL
No. 48079
REGISTERED
PROFESSIONAL ENGINEER
2/26/21

Nitsch Project #13325

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APPENDICES

City of Worcester, Massachusetts
Conservation Commission
Order of Conditions

Conservation Commission File Number:

CC-2021-007

City of Worcester Wetlands Protection Ordinance & Wetlands Protection Regulations - September, 1990; as amended (City's General Revised Ordinance Part I, Chapter 6)

A. General Information

1. From:

City of Worcester
Conservation Commission

2. This issuance is for (check one): ☒ Order of Conditions ☐ Amended Order of Conditions

3. To: Applicant:

a. First Name:
b. Last Name:
c. Organization: City of Worcester Department of Public Works and Parks
d. Mailing Address: 20 East Worcester Street
e. City/Town: Worcester
f. State: MA
g. Zip Code: 01604

4. Property Owner (if different from applicant):

a. First Name:
b. Last Name:
c. Organization:
d. Mailing Address:
e. City/Town:
f. State:
g. Zip Code:

5. Project Location:

a. Street Address: 299 Highland Street (Doherty High School)
b. City/Town: Worcester
c. Assessors Map/Plat Number: 11-INX
d. Parcel/Lot Number: -00001

Latitude and Longitude, if known: d. Latitude e. Longitude

6. Project Description: To perform temporary site improvements in preparation for future construction, including earthmoving, utility system modifications, drainage component installation, parking modifications, paving, and to perform related site work.

7. Conservation Commission Review Trigger: The activities shall occur within the Stormwater Protection Zone.

8. Property recorded at the Registry of Deeds for (attach additional information if more than one parcel):

Worcester	
a. County	b. Certificate Number (if registered land)
4178	415
c. Book	d. Page

9. Dates:

1/20/2021	3/1/2021	3/18/2021
a. Date Notice of Intent Filed	b. Date Public Hearing Closed	c. Date of Issuance

10. Final Approved Plans and Other Documents (attach additional plan or document references as needed):

Doherty Memorial High School: Site Enabling Package
a. Plan Title

Lamoureux Pagano Associates (Architect); Nitsch Engineering (P.E.)	Jared E. Gentilucci, P.E.
b. Prepared By	c. Signed and Stamped by
2/23/2021 (Drain Revisions)	1:20
d. Final Revision Date	e. Scale

NOI Application Materials; Stormwater Report (Gentilucci)	1/20/21; 2/23/21
f. Additional Plan or Document Title	g. Date

B. Findings

11. Findings pursuant to the City of Worcester Wetlands Protection Ordinance:

Following the review of the above-referenced Notice of Intent and based on the information provided in this application and presented at the public hearing, this Commission finds that the areas in which work is proposed is significant to the following interests of the Wetlands Protection Ordinance. Check all that apply:

☒ Public Water Supply	☒ Erosion and Sedimentation Control	☒ Prevention of Pollution
☒ Private Water Supply	☒ Fisheries	☒ Protection of Wildlife Habitat
☒ Groundwater Supply	☒ Storm Damage Prevention	☒ Flood Control

12. This Commission hereby finds the project, as proposed, is: (check one of the following boxes)

Approved subject to:

☒ the following conditions which are necessary in accordance with the performance standards set forth in the wetlands regulations. This Commission orders that all work shall be performed in accordance with the Notice of Intent referenced above, the following General Conditions, and any other special conditions attached to this Order. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, these conditions shall control.

B. Findings (cont.)

Denied because:

☐ The proposed work cannot be conditioned to meet the performance standards set forth in the wetland regulations. Therefore, work on this project may not go forward unless and until a new Notice of Intent is submitted which provides measures which are adequate to protect the interests of the Ordinance, and a final Order of Conditions is issued. **A description of the performance standards which the proposed work cannot meet is attached to this Order.**

☐ The information submitted by the applicant is not sufficient to describe the site, the work, or the effect of the work on the interests identified in the Wetlands Protection Act. Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides sufficient information and includes measures which are adequate to protect the Ordinance's interests, and a final Order of Conditions is issued. **A description of the specific information which is lacking and why it is necessary is attached to this Order.**

C. General Conditions Under Wetlands Protection Ordinance

The following conditions are only applicable to Approved projects.

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Order.

2. The Order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.

3. This Order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.

4. The work authorized hereunder shall be completed within three years from the date of this Order unless either of the following apply:
   a. the work is a maintenance dredging project as provided for in the Act; or
   b. the time for completion has been extended to a specified date more than three years, but less than five years, from the date of issuance. If this Order is intended to be valid for more than three years, the extension date and the special circumstances warranting the extended time period are set forth as a special condition in this Order.

5. This Order may be extended by the issuing authority for one or more periods of up to three years each upon application to the issuing authority at least 30 days prior to the expiration date of the Order.
6. If this Order constitutes an Amended Order of Conditions, this Amended Order of Conditions does not extend the issuance date of the original Final Order of Conditions and the Order will expire on _______ unless extended in writing by the Department.

7. Any fill used in connection with this project shall be clean fill. Any fill shall contain no trash, refuse, rubbish, or debris, including but not limited to lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles, or parts of any of the foregoing.

8. This Order is not final until all administrative appeal periods from this Order have elapsed, or if such an appeal has been taken, until all proceedings before the Department have been completed.

9. No work shall be undertaken until the Order has become final and then has been recorded in the Registry of Deeds for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land upon which the proposed work is to be done. In the case of the registered land, the Final Order shall also be noted on the Land Court Certificate of Title of the owner of the land upon which the proposed work is done. The recording information shall be submitted to the Conservation Commission on the form at the end of this Order, which form must be stamped by the Registry of Deeds, prior to the commencement of work.

10. A sign shall be displayed at the site not less then two square feet or more than three square feet in size bearing the words "City of Worcester Conservation Commission File Number **CC-2021-007**."

11. Within thirty (30) days of completion of the work described herein, the applicant shall submit a Request for Certificate of Compliance to the Conservation Commission.

12. The work shall conform to the plans and special conditions referenced in this order.

13. Any change to the plans identified in Condition #12 above shall require the applicant to inquire of the Conservation Commission in writing whether the change is significant enough to require the filing of a new Notice of Intent.

14. The Agent or members of the Conservation Commission shall have the right to enter and inspect the area subject to this Order at reasonable hours to evaluate compliance with the conditions stated in this Order, and may require the submittal of any data deemed necessary by the Conservation Commission or Department for that evaluation.

15. This Order of Conditions shall apply to any successor in interest or successor in control of the property subject to this Order and to any contractor or other person performing work conditioned by this Order.

16. All sedimentation barriers shall be maintained in good repair until all disturbed areas have been fully stabilized with vegetation or other means. At no time shall sediments be deposited in a wetland or water body. During construction, the applicant or his/her designee shall inspect the erosion controls on a daily basis and shall remove accumulated sediments as needed. The applicant shall immediately control any erosion problems that occur at the site and shall also immediately notify the Conservation Commission, which reserves the right to require additional erosion and/or damage prevention controls it may deem necessary. Sedimentation barriers shall serve as the limit of work unless another limit of work line has been approved by this Order.

17. The Commission orders that all work shall be performed in accordance with the following conditions and with the Notice of Intent referenced above. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, the conditions shall control.

18. The special conditions relating to municipal ordinance or bylaw are as follows (if you need more space for additional conditions, attach a text document): **See Attachment A.**

ATTACHMENT A

Worcester Conservation Commission

Special Order of Conditions

City of Worcester Wetlands Protection Ordinance & City of Worcester Wetlands Protection Regulations

(City of Worcester Revised Ordinance Part I, Chapter 6)

299 Highland Street (AKA Doherty High School) (CC-2021-007)

Project Description: To perform temporary site improvements in preparation for future construction, including earthmoving, utility system modifications, drainage component installation, parking modifications, paving, and to perform related site work. To occur within the Stormwater Protection Zone.

Waivers Granted: N/A

Table of Contents:

Notes:

- **Office of the Commission** is located at the Division of Planning and Regulatory Services (455 Main Street 4th floor, Worcester, MA), which can be contacted by e-mailing planning@worcesterma.gov or calling 508-799-1400 ext. 31440.
- **Asterisked (*) conditions** are standard conditions of approval for all projects.
- **SWPPP reports** shall be provided to the Office of the Commission at least monthly.
- **Infiltration unit** shall be installed prior to paving and shall be inspected by the Office of the Commission prior to backfilling.
- **Cement trucks** shall not discharge washout effluent within 30' of a catchbasin**.**

I. Conditions to Meet Prior to and During Construction

21. Person Responsible for Compliance with the Order of Conditions* – A person shall be designated to be responsible to monitor compliance with the Order of Conditions. Their name and contact information (24/7) shall be provided to the Office of the Commission prior to start of any activity. This person shall conduct:
    a) periodic inspections to assure the adequacy and continued effectiveness of erosion and sediment controls;
    b) inspections of said controls following 0.5-inch or greater rain events, or after a heavy snow melt.
22. Contract* - This Order of Conditions and all approved plans shall be included as part of any contract and subcontract and shall be posted in a prominently displayed location in the supervisory office on site during all phases of construction.
23. Notification* - The applicant shall notify the Office of the Commission a minimum of 48 hours prior to the start of any activity.

II. Conditions to Meet Before the Start of Any Activity

24. Stormwater Pollution Prevention Plan (SWPPP)* – That one (1) copy of the SWPPP submitted to the EPA in compliance with the NPDES permit requirements, if applicable, shall be provided to the Office of the Commission prior to commencement of work.
25. Tree Cutting* – Tree cutting is allowed following installation of erosion and sediment controls; otherwise, it may be allowed, prior to such installation, with the explicit permission of the Commission or its Agents.
26. Trees To Remain* – All trees to remain post construction shall be marked on site as shown on the approved plan so that the Commission or its representative can verify them before any clearing takes place.
27. Pre-Construction Conference* -
    a) The Conservation Commission or its Agents shall conduct a pre-construction conference prior to commencement of activities in each phase of the project. Phasing, if any, shall conform to the approved plans.
    b) The property owner / applicant and any person performing work that is subject to this Order are responsible for understanding and complying with the requirements of this Order, the Wetlands Protection Act, 310 CMR 10.00 and City of Worcester Wetlands Protection Ordinance and Regulations. Said persons shall acknowledge such in writing prior to commencement of activities.
28. Inspections Prior to Site Preparation and Site Work* - Erosion and sediment controls shall be installed and verified, in compliance with final approved plans, by the Commission or its Agents prior to the commencement of any excavation, grubbing and/or stumping of vegetation, grading, construction, or other site preparation.
29. Construction Schedule* - Submit a Construction Schedule consistent with Work Sequencing plans provided to the Office of the Commission prior to the start of any activities.

III. Stormwater Management System

30. Catch Basins* –
    a) The paved roadways and parking lots shall be bermed and shall be installed with standard City of Worcester catch basins.

b) Prior to start of activity on site that causes soil erosion and sedimentation, catch basin filter traps shall be installed in the existing and new catch basins.

c) Catch basins shall be cleaned as warranted during construction to keep them clear of sediment, and minimum twice a year thereafter.

31. Construction Timing – The stormwater management system (underground infiltration system) and all associated drainage piping, inverts, and outlets as proposed in the project plans shall be constructed and be operating as designed prior to final paving.

32. Stormwater Management System Maintenance* – The stormwater management system shall be maintained in accordance with the approved design plans and Operation and Maintenance Plan on file with the Office of the Commission. The system shall be maintained in good hydraulic condition (e.g. any accumulated silt/sediment shall be removed; the system shall be kept free of any litter, refuse, or other extraneous matter, etc.). **This condition shall extend in perpetuity beyond the issuance of the Certificate of Compliance**.

IV. Conditions to Meet During Construction

33. Limit of Work* – No removal, filling, dredging or altering of jurisdictional areas shall take place outside the approved work under this Order of Condition.

34. Work Sequencing* – Activities shall take place in accordance with all phasing and sequencing shown on the plan and/or provided in the application materials on file with the Office of the Commission and shall follow any lot opening restrictions otherwise provided herein.

35. Infiltration Unit Inspection - Prior to back-filling, the applicant shall request and have conducted an inspection by the Commission or its Agents in order to verify the installation of the infiltration unit was conducted in a manner consistent with that provided on the approved plans.

36. Erosion Stabilization -

a) *Erosion and Sediment Controls** - All erosion and sediment controls shall be monitored, maintained, and adjusted for the duration of the project to prevent adverse impacts to jurisdictional areas. Additional erosion and sediment controls may be utilized on site as needed.

b) *Off Site Impacts** - There shall be no off-site erosion, flooding, ponding, or flood-related damage from runoff caused by the project activities.

c) *Unanticipated Drainage or Erosion** - The applicant shall control any unanticipated drainage and/or erosion conditions that may cause damage to jurisdictional areas and/or abutting or downstream properties. Said control measures shall be implemented immediately upon need. The Office of the Conservation Commission shall be notified if such conditions arise and of the measures utilized.

d) *Soil Stabilization due to Delay in Work** - If there is an interruption of more than 10, but less than 60 days between completion of grading and revegetation, the applicant shall sow all disturbed areas with annual rye grass to prevent erosion. If soils are to be exposed for longer than 60 days, a temporary cover of rye or other grass should be established following US Soil Conservation Services procedures, as recently amended, to prevent erosion and sedimentation. Once final grading is complete, loaming and seeding of final cover should be completed promptly.

e) *Grading of Slopes**-

i. >40% Slope – Slopes shall not exceed those specified in the plans approved by the Conservation Commission. Any slope equal to or greater than 40% (1 vertical to 2 1/2 horizontal) shall be stabilized with erosion control matting.

ii. <40% Slope – Final grades of vegetated areas shall not exceed a slope of 1 vertical to 2 1/2 horizontal (40%) and shall be stabilized to prevent erosion, particularly during the construction period.

f) *Stockpile Maintenance** - Any stockpiling of loose materials shall be properly stabilized to prevent erosion into and sedimentation of jurisdictional areas. Preventative controls such as haybales or erosion control matting shall be implemented to prevent such an occurrence.

g) *Stockpile Location* – In no case shall any soil or excavated material be stockpiled within 50 feet of any wetland, floodplain, or storm drain inlet.

h) *Site Stabilization Prior to Winter** - Prior to winter, exposed soils shall be stabilized (e.g. with demonstrated vegetative growth, impermeable barriers, erosion control blankets, etc.).

37. Invasive Insects* -

a) *Plantings* – No trees to be planted shall be species susceptible to the Asian Longhorned Beetle or Emerald Ash Borer.

b) *Wood Removal* – All tree, brush & wood removal shall adhere to the most recently amended requirements set forth by the Massachusetts Department of Conservation & Recreation for any project located in the Asian Longhorned Beetle Quarantine Zone.

38. Dust Control* - Provisions for dust control shall be provided during all construction and demolition activities. Such provisions shall be conducted in compliance with all City of Worcester Water Use Restrictions, if in effect, during such activities.

39. Dewatering* – If dewatering is required,

a) Notice of such activities shall be given to the Office of the Commission within 24 hours of commencement;

b) There shall be no discharge of untreated dewatered stormwater or groundwater to jurisdictional areas either by direct or indirect discharge to existing drainage systems;

c) Any discharge to surface waters or drainage structures must be visibly free of sediment;

d) To the maximum extent practicable, proposed dewatering activities should be located outside of the 100' buffer. If such activities must be located within the 100' buffer, they shall be monitored at all times when the pumps are running;

e) Dewatering activities shall be confined within an area of secondary containment at all times.

40. Cement Truck Washing - Cement trucks shall not discharge washout effluent directly to any resource area, the 30' buffer thereto, or into any drainage system. Designated washout areas shall be located out of the 100 buffer zone to any wetland.

41. Construction Monitoring Reports –

a) Copies of SWPPP reports shall be provided to the Office of the Commission during all earthwork and drainage construction, at the frequency specified by the SWPPP report, but not to be less than once per month. Such reports shall include an evaluation of all existing erosion and sedimentation controls, as well as stormwater management system/s performance as well as solutions employed and/or recommendations to fix areas found to be deficient, if any.

42. Spill Prevention* -

a) No fuel, oil, or other pollutants shall be stored in any resource area or the buffer zone thereto, unless specified in this Order;

b) No refueling shall take place within resource areas or 100-ft to a resource area;

c) The applicant shall take all necessary precautions to prevent discharge or spillage of fuel, oil or other pollutants onto any part of the site;

d) A spill kit shall be present on site at all times.

V. Conditions to Meet at Completion of Project

43. Site Stabilization* - All disturbed areas shall be properly stabilized with well-established perennial vegetation or other approved methods before the project is considered complete.

44. Erosion and Sediment Controls* - Erosion and sediment controls shall not be removed from the site until all disturbed areas have been stabilized with final vegetative cover and approval has been received from the Commission or its Agents to do so. The controls must then be removed within two weeks of receipt of that certification.

45. Certificate of Compliance* - Upon completion of the project, the applicant shall request in writing a Certificate of Compliance from the Commission. If the project has been completed in accordance with plans stamped by a registered professional engineer, architect, landscape architect, or land surveyor, certification must include a written statement by such professional certifying the same.

    a) If the project required compliance with the Massachusetts Stormwater Standards and/or work was conducted within Riverfront Area or Bordering Land Subject to Flooding, a certified as-built plan-of-land shall be provided showing final grades, resource areas, and all constructed improvements;

    b) If permanent markers were required, the certified as-built plan-of-land shall depict their location.

46. Deed Condition – Condition numbered 32 shall extend beyond the Certificate of Compliance, in perpetuity, and shall be referred to in all future deeds to this property.

VI. General Conditions

47. Change in Ownership* - If a change in ownership takes place while this Order is still in effect, it is the responsibility of the new owner to notify the Commission of the change and to provide the name of the person responsible for compliance with the Order.

48. Conservation Agent's Power to Act* - With respect to all conditions, except _____, the Conservation Commission designates the Conservation Agent, as its Agent with full powers to act on its behalf in administering and enforcing this Order, unless the Agent determines approval from the Commission is appropriate.

49. Right to Inspect* - A member of the Conservation Commission or its Agent may enter and inspect the property and the activity that are the subjects of this Order at all reasonable times, with or without probable cause or prior notice, and until a Certificate of Compliance is issued, for the purpose of evaluating compliance with this Order (and other applicable laws and regulations).

50. Changes to the Plan or Errors & Omissions* -

    (a) If any plan, calculation, or other data presented to the Office of the Commission is in error or have omissions, and are deemed significant by the Commissioners or their Agents, all work will stop at the discretion of the Commission, until the discrepancies have been rectified to the Commission's satisfaction.

    (b) The applicant must notify the Commission in writing of any changes in the plans or implementation of the proposed activity where mandated by any local, state, or federal agencies having jurisdiction over the proposed activity. If, in the opinion of the Commission, any changes in the plans or implementation of the proposed activity so require, then the Commission may modify, amend or rescind this Order in a way consistent with:

- M.G.L. Chapter 131, Section 40,
- 310 CMR 10.00, *Wetlands Protection*,
- the City of Worcester's *Wetlands Protection Ordinance*, and
- the Commission's *Wetlands Protection Regulations*

If any provisions of any conditions, or application thereof is held to be invalid, such invalidity shall not affect any other provisions of this Order. If the Commission deems that a proposed change is major or substantial, a new hearing may be required.

51. Liability* - The applicant shall indemnify and save harmless the Commonwealth, the City of Worcester, the Conservation Commission, and its Agents against all sites, claims or liabilities of every name and nature arising at any time out of or in consequence of the acts of the Commission or its Agents in the performance of the work covered by this Order and/or failure to comply with the terms and conditions or this Order whether by itself or its employees or subcontractors.

C. Signatures

This Order is valid for three years, unless otherwise specified as a special condition pursuant to General Conditions #4, from the date of issuance.

3/18/2021
1. Date of Issuance

Please indicate the number of members who will sign this form.
This Order must be signed by a majority of the Conservation Commission.

4/6
2. Number of Signers

The Order must be mailed by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the property owner, if different from applicant.

The names typed below represent the intent to sign the foregoing document in accordance with MGL Chapter 110G §9

Duly authorized by Ch.110G and recorded at Worcester Registry of Deeds in Book 62537 Page 329.

Signatures:

Joseph Charpentier	
Devin Canton	
Amanda Amory	Holly Jones
by hand delivery on	by certified mail, return receipt requested, on 3/18/2021
Date	Date

D. Appeals

Appeal from a decision of the Conservation Commission shall be taken in accordance with law to the Superior Court or other body of competent jurisdiction. Any such appeal shall be taken within ten (10) days from the date from the receipt of such decision and shall not relieve the individual of the responsibility of taking an appeal to Department of Environmental Protection if such is required under said regulations.

No work may proceed until the appeal on the Commission's decision on a Notice of Intent has been decided and all appeal periods have elapsed.

E. Recording Information

Prior to commencement of work, this Order of Conditions must be recorded in the Registry of Deeds for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land subject to the Order of Conditions. The recording information on this page shall be submitted to the Conservation Commission listed below.

Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Conservation Commission

Please be advised that the Order of Conditions for the Project at:

Project Location | Conservation Commission File Number

Has been recorded at the Registry of Deeds of:

County | Book | Page

for: Property Owner

and has been noted in the chain of title of the affected property in:

Book | Page

In accordance with the Order of Conditions issued on:

Date

If recorded land, the instrument number identifying this transaction is:

Instrument Number

If registered land, the document number identifying this transaction is:

Document Number

Signature of Applicant

Nitsch Engineering

Amended Order of Conditions Request
Full filing is available upon request

370 Main Street, Suite 850
Worcester, MA 01608
T: 508-365-1030

www.nitscheng.com

April 14, 2021

Conservation Commission Members
c/o Mr. Joseph Charpentier, Chair
Worcester Conservation Commission
City Hall, Room 404
455 Main Street
Worcester, MA 01608

RE: Nitsch Project #13325
Amended Order of Conditions
299 Highland Street
Doherty Memorial High School
Worcester, MA

Dear Commissioners,

Nitsch Engineering is requesting an Amendment to the Order of Conditions (OOC), #CC-2021-007, for the Doherty Memorial High School project at 299 Highland Street (the Project). The request for an amendment is being filed on behalf of the Worcester Department of Public Works per the City of Worcester Application Submission Requirements. The applicant and owner's information is as follows:

City of Worcester, Department of Public Works & Parks
c/o K. Russell Adams, PE
Assistant Commissioner of Engineering & Architecture Services
20 East Worcester Street
Worcester, MA 01604

As indicated in the Notice of Intent (NOI) application materials submitted for the Project, the existing school building will be occupied while the new school building is constructed. The corresponding Project construction will be separated into two main overall components, each of which will be issued for construction as a separate and distinct construction document package:

Site Enabling Package (SEP)
The SEP is "Phase 1" of the Project. During this phase construction will occur in the area around the existing school building for temporary site improvements necessary for the daily operation of the occupied school while the new school building is constructed. Nitsch Engineering submitted an NOI for the SEP on January 20, 2021 and met with the Commission on February 8, 2021 and March 1, 2021. A site walk with some of the Commission members was also conducted on February 23, 2021. The OOC for the SEP was issued on March 18, 2021.

Early Site Package (ESP)
The ESP project is the complete project construction, in phases, including construction of the new school building; building utility services; and site access, circulation, and parking facilities as outlined on the phasing plans included in the drawing set. Following completion of the new school, staged demolition of the existing school building will commence to allow for construction of the main parking and access areas, and final construction of the proposed athletic field and related facilities.

The previously approved SEP construction is scheduled to commence on May 1st, 2021 and be completed by August 15th, 2021 prior to the start of the 2021-2022 school year in order to meet the MSBA process schedule established for the Project. The complexities of the ESP building and site design (relative to the SEP) prohibited simultaneous completion of both packages in time to maintain this schedule. The materials included with the NOI application and referenced by the OOC pertain to the SEP project phase only. The subject of the proposed amendment is the site construction required to complete the ESP project phases, representing the complete construction of the Project.

The enclosed materials are hereby presented to the Commission for review, approval, and inclusion in the official record for the Project:

1. Design Development civil engineering and landscape architecture drawings for the ESP detailing complete construction of the Project;
2. Project phasing plans prepare by the Construction Manager showing erosion and sediment control measures;
3. A Stormwater Report for the stormwater management system designed for the completed Project;
4. Abutter notification materials related to the OOC amendment request;
5. A copy of the recorded OOC; and
6. A copy of the previously approved plans.

Thank you for the opportunity to present this amendment request for your consideration. We look forward to presenting the Project at the upcoming Conservation Commission meeting on May 3, 2021.

Very truly yours,

Nitsch Engineering, Inc.

Representative:

Jared E. Gentilucci, PE, CPESC, LEED AP BD+C
Project Manager
Nitsch Engineering

Applicant/Owner:

5/14/2021

K. Russell Adams, PE
Assistant Commissioner of Engineering & Architecture Services
City of Worcester, Department of Public Works and Parks

MTB/jeg

Coversheet and Table of Contents OnlyFull Stormwater report is available upon request

Nitsch Engineering

April 14, 2021

STORMWATER REPORT

Early Site Package

For

DOHERTY MEMORIAL HIGH SCHOOL
299 Highland Street – Worcester, MA

DRAFT

Prepared for:

City of Worcester
Department of Public Works
20 East Worcester Street
Worcester, MA 01604

Prepared by:

NITSCH ENGINEERING, INC.
370 Main Street, Suite 850
Worcester, MA 01608

Nitsch Project #13325

NITSCH PROJECT #13325

COMMONWEALTH OF MASSACHUSETTS
JARED E.
GENTILUCCI
CIVIL
No. 48079
REGISTERED
PROFESSIONAL ENGINEER

4/14/21

Building better communities with you.

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FIGURES

APPENDICES

City of Worcester, Massachusetts
Conservation Commission
Order of Conditions

Conservation Commission File Number:
CC-2021-025
CC-2021-007

City of Worcester Wetlands Protection Ordinance & Wetlands Protection Regulations - September, 1990; as amended (City's General Revised Ordinance Part I, Chapter 6)

A. General Information

1. From:

City of Worcester
Conservation Commission

2. This issuance is for (check one): ☐ Order of Conditions ☒ Amended Order of Conditions

3. To: Applicant:

a. First Name:
b. Last Name:
c. Organization: City of Worcester Department of Public Works and Parks
d. Mailing Address: 20 East Worcester Street
e. City/Town: Worcester
f. State: MA
g. Zip Code: 01604

4. Property Owner (if different from applicant):

a. First Name:
b. Last Name:
c. Organization:
d. Mailing Address:
e. City/Town:
f. State:
g. Zip Code:

5. Project Location:

a. Street Address: 299 Highland Street (Doherty High School)
b. City/Town: Worcester
c. Assessors Map/Plat Number: 11-INX
d. Parcel/Lot Number: -00001

Latitude and Longitude, if known: d. Latitude e. Longitude

6. Project Description: To perform temporary site improvements in preparation for future construction, including earthmoving, utility system modifications, drainage component installation, parking modifications, paving, and to perform related site work.

7. Conservation Commission Review Trigger: The activities shall occur within the Stormwater Protection Zone.

8. Property recorded at the Registry of Deeds for (attach additional information if more than one parcel):

Worcester	
a. County	b. Certificate Number (if registered land)
4178	415
c. Book	d. Page

9. Dates:

4/14/2021; 1/20/2021	5/4/2021; 3/1/2021	AOOC: 6/2/2021 OOC: 3/18/2021
a. Date Notice of Intent Filed	b. Date Public Hearing Closed	c. Date of Issuance

10. Final Approved Plans and Other Documents (attach additional plan or document references as needed):

Doherty Memorial High School: Early Site Package
a. Plan Title

Lamoureux Pagano Associates (Architect); Nitsch Engineering (P.E.)	Jared E. Gentilucci, P.E.
b. Prepared By	c. Signed and Stamped by
4/14/2021	1:20
d. Final Revision Date	e. Scale
NOI Application Materials; Stormwater Report (Gentilucci)	4/14/2021
f. Additional Plan or Document Title	g. Date

B. Findings

11. Findings pursuant to the City of Worcester Wetlands Protection Ordinance:

Following the review of the above-referenced Notice of Intent and based on the information provided in this application and presented at the public hearing, this Commission finds that the areas in which work is proposed is significant to the following interests of the Wetlands Protection Ordinance. Check all that apply:

☒ Public Water Supply ☒ Erosion and Sedimentation Control ☒ Prevention of Pollution

☒ Private Water Supply ☒ Fisheries ☒ Protection of Wildlife Habitat

☒ Groundwater Supply ☒ Storm Damage Prevention ☒ Flood Control

12. This Commission hereby finds the project, as proposed, is: (check one of the following boxes)

Approved subject to:

☒ the following conditions which are necessary in accordance with the performance standards set forth in the wetlands regulations. This Commission orders that all work shall be performed in accordance with the Notice of Intent referenced above, the following General Conditions, and any other special conditions attached to this Order. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, these conditions shall control.

B. Findings (cont.)

Denied because:

☐ The proposed work cannot be conditioned to meet the performance standards set forth in the wetland regulations. Therefore, work on this project may not go forward unless and until a new Notice of Intent is submitted which provides measures which are adequate to protect the interests of the Ordinance, and a final Order of Conditions is issued. **A description of the performance standards which the proposed work cannot meet is attached to this Order.**

☐ The information submitted by the applicant is not sufficient to describe the site, the work, or the effect of the work on the interests identified in the Wetlands Protection Act. Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides sufficient information and includes measures which are adequate to protect the Ordinance's interests, and a final Order of Conditions is issued. **A description of the specific information which is lacking and why it is necessary is attached to this Order.**

C. General Conditions Under Wetlands Protection Ordinance

The following conditions are only applicable to Approved projects.

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Order.

2. The Order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.

3. This Order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.

4. The work authorized hereunder shall be completed within three years from the date of this Order unless either of the following apply:
   a. the work is a maintenance dredging project as provided for in the Act; or
   b. the time for completion has been extended to a specified date more than three years, but less than five years, from the date of issuance. If this Order is intended to be valid for more than three years, the extension date and the special circumstances warranting the extended time period are set forth as a special condition in this Order.

5. This Order may be extended by the issuing authority for one or more periods of up to three years each upon application to the issuing authority at least 30 days prior to the expiration date of the Order.
6. If this Order constitutes an Amended Order of Conditions, this Amended Order of Conditions does not extend the issuance date of the original Final Order of Conditions and the Order will expire on _______ unless extended in writing by the Department.

7. Any fill used in connection with this project shall be clean fill. Any fill shall contain no trash, refuse, rubbish, or debris, including but not limited to lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles, or parts of any of the foregoing.

8. This Order is not final until all administrative appeal periods from this Order have elapsed, or if such an appeal has been taken, until all proceedings before the Department have been completed.

9. No work shall be undertaken until the Order has become final and then has been recorded in the Registry of Deeds for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land upon which the proposed work is to be done. In the case of the registered land, the Final Order shall also be noted on the Land Court Certificate of Title of the owner of the land upon which the proposed work is done. The recording information shall be submitted to the Conservation Commission on the form at the end of this Order, which form must be stamped by the Registry of Deeds, prior to the commencement of work.

10. A sign shall be displayed at the site not less then two square feet or more than three square feet in size bearing the words "City of Worcester Conservation Commission File Number **CC-2021-025**."

11. Within thirty (30) days of completion of the work described herein, the applicant shall submit a Request for Certificate of Compliance to the Conservation Commission.

12. The work shall conform to the plans and special conditions referenced in this order.

13. Any change to the plans identified in Condition #12 above shall require the applicant to inquire of the Conservation Commission in writing whether the change is significant enough to require the filing of a new Notice of Intent.

14. The Agent or members of the Conservation Commission shall have the right to enter and inspect the area subject to this Order at reasonable hours to evaluate compliance with the conditions stated in this Order, and may require the submittal of any data deemed necessary by the Conservation Commission or Department for that evaluation.

15. This Order of Conditions shall apply to any successor in interest or successor in control of the property subject to this Order and to any contractor or other person performing work conditioned by this Order.

16. All sedimentation barriers shall be maintained in good repair until all disturbed areas have been fully stabilized with vegetation or other means. At no time shall sediments be deposited in a wetland or water body. During construction, the applicant or his/her designee shall inspect the erosion controls on a daily basis and shall remove accumulated sediments as needed. The applicant shall immediately control any erosion problems that occur at the site and shall also immediately notify the Conservation Commission, which reserves the right to require additional erosion and/or damage prevention controls it may deem necessary. Sedimentation barriers shall serve as the limit of work unless another limit of work line has been approved by this Order.

17. The Commission orders that all work shall be performed in accordance with the following conditions and with the Notice of Intent referenced above. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, the conditions shall control.

18. The special conditions relating to municipal ordinance or bylaw are as follows (if you need more space for additional conditions, attach a text document): **See Attachment A.**

ATTACHMENT A

Worcester Conservation Commission

Special Order of Conditions

City of Worcester Wetlands Protection Ordinance & City of Worcester Wetlands Protection Regulations

(City of Worcester Revised Ordinance Part I, Chapter 6)

299 Highland Street (AKA Doherty High School) (CC-2021-025, Amendment to CC-2021-007)

Project Description: To construct, in phases, a new high school building, related athletic fields, driveways, drainage systems, and parking facilities, to demolish existing site improvements, and conduct associated grading and site work. To occur within the Stormwater Protection Zone.

Waivers Granted: N/A

Table of Contents:

DRAFT

Notes:

- **Office of the Commission** is located at the Division of Planning and Regulatory Services (455 Main Street 4th floor, Worcester, MA), which can be contacted by e-mailing planning@worcesterma.gov or calling 508-799-1400 ext. 31440.
- **Asterisked (*) conditions** are standard conditions of approval for all projects.
- **Revised plans** required to include planting plan for rain garden and dewatering detail.
- **SWPPP reports** shall be provided to the Office of the Commission at least monthly.
- **Infiltration units** shall be installed prior to paving and shall be inspected by the Office of the Commission prior to backfilling.
- **Cement trucks** shall not discharge washout effluent within 30' of a catchbasin.
- **Project shall follow approved phasing**, with inspections and notification prior to beginning each phase to ensure substantial completion/stabilization within each phase before moving on.

I. Conditions to Meet Prior to and During Construction

21. Person Responsible for Compliance with the Order of Conditions* – A person shall be designated to be responsible to monitor compliance with the Order of Conditions. Their name and contact information (24/7) shall be provided to the Office of the Commission prior to start of any activity. This person shall conduct:

    a) periodic inspections to assure the adequacy and continued effectiveness of erosion and sediment controls;

    b) inspections of said controls following 0.5-inch or greater rain events, or after a heavy snow melt.

22. Contract* - This Order of Conditions and all approved plans shall be included as part of any contract and subcontract and shall be posted in a prominently displayed location in the supervisory office on site during all phases of construction.

23. Notification* - The applicant shall notify the Office of the Commission a minimum of 48 hours prior to the start of work within a new phase, as defined by plans dated 4/14/2021, page C1.2 "Site Phasing Plan," or subsequently approved plans.

II. Conditions to Meet Before the Start of Any Activity

24. Revised plans – That one digital and one to-scale copy of revised plans shall be provided to the Office of the Commission, prior to commencement of work, showing the below changes. These plans shall be considered the final revised plans approved for the project -

    a) Provide detail for dewatering with double erosion control details.

    b) Provide planting plan for rain gardens.

25. Stormwater Pollution Prevention Plan (SWPPP)* – That one (1) copy of the SWPPP submitted to the EPA in compliance with the NPDES permit requirements, if applicable, shall be provided to the Office of the Commission prior to commencement of work.

26. Tree Cutting* – Tree cutting is allowed following installation of erosion and sediment controls; otherwise, it may be allowed, prior to such installation, with the explicit permission of the Commission or its Agents.

27. Trees To Remain* – All trees to remain post construction shall be marked on site as shown on the approved plan so that the Commission or its representative can verify them before any clearing takes place.

28. Pre-Construction Conference* -

    a) The Conservation Commission or its Agents shall conduct a pre-construction conference prior to commencement of activities in each phase of the project. Phasing, if any, shall conform to the approved plans.

    b) The property owner / applicant and any person performing work that is subject to this Order are responsible for understanding and complying with the requirements of this Order, the Wetlands Protection Act, 310 CMR 10.00 and City of Worcester Wetlands Protection Ordinance and Regulations. Said persons shall acknowledge such in writing prior to commencement of activities.

29. Inspections Prior to Site Preparation and Site Work* - Erosion and sediment controls shall be installed and verified, in compliance with final approved plans, by the Commission or its Agents prior to the commencement of any excavation, grubbing and/or stumping of vegetation, grading, construction, or other site preparation.

30. Construction Schedule* - Submit a Construction Schedule consistent with Work Sequencing plans provided to the Office of the Commission prior to the start of any activities.

III. Stormwater Management System

31. Catch Basins* –

a) The paved roadways and parking lots shall be bermed and shall be installed with standard City of Worcester catch basins.

b) Prior to start of activity on site that causes soil erosion and sedimentation, catch basin filter traps shall be installed in the existing and new catch basins.

c) Catch basins shall be cleaned as warranted during construction to keep them clear of sediment, and minimum twice a year thereafter.

32. Construction Timing – The stormwater management system (underground infiltration system) and all associated drainage piping, inverts, and outlets as proposed in the project plans shall be constructed and be operating as designed prior to final paving.

33. Stormwater Management System Maintenance* – The stormwater management system shall be maintained in accordance with the approved design plans and Operation and Maintenance Plan on file with the Office of the Commission. The system shall be maintained in good hydraulic condition (e.g. any accumulated silt/sediment shall be removed; the system shall be kept free of any litter, refuse, or other extraneous matter, etc.). **This condition shall extend in perpetuity beyond the issuance of the Certificate of Compliance**.

IV. Conditions to Meet During Construction

34. Limit of Work* – No removal, filling, dredging or altering of jurisdictional areas shall take place outside the approved work under this Order of Condition.

35. Work Sequencing* – Activities shall take place in accordance with all phasing and sequencing shown on the plan and/or provided in the application materials on file with the Office of the Commission and shall follow any lot opening restrictions otherwise provided herein.

36. Inspections Prior to Site Preparation and Site Work* - Erosion and sediment controls shall be installed and verified, in compliance with final approved plans, by the Commission or its Agents prior to the commencement of activity. Said inspection shall be conducted prior to work beginning in each subsequent phase to ensure substantial completion and stabilization within each phase before opening new phase.

37. Infiltration Unit Inspection - Prior to back-filling, the applicant shall request and have conducted an inspection by the Commission or its Agents in order to verify the installation of the infiltration unit was conducted in a manner consistent with that provided on the approved plans.

38. Erosion Stabilization -

a) *Erosion and Sediment Controls** - All erosion and sediment controls shall be monitored, maintained, and adjusted for the duration of the project to prevent adverse impacts to jurisdictional areas. Additional erosion and sediment controls may be utilized on site as needed.

b) *Off Site Impacts** - There shall be no off-site erosion, flooding, ponding, or flood-related damage from runoff caused by the project activities.

c) *Unanticipated Drainage or Erosion** - The applicant shall control any unanticipated drainage and/or erosion conditions that may cause damage to jurisdictional areas and/or abutting or downstream properties. Said control measures shall be implemented immediately upon need. The Office of the Conservation Commission shall be notified if such conditions arise and of the measures utilized.

d) _Soil Stabilization due to Delay in Work_* - If there is an interruption of more than 10, but less than 60 days between completion of grading and revegetation, the applicant shall sow all disturbed areas with annual rye grass to prevent erosion. If soils are to be exposed for longer than 60 days, a temporary cover of rye or other grass should be established following US Soil Conservation Services procedures, as recently amended, to prevent erosion and sedimentation. Once final grading is complete, loaming and seeding of final cover should be completed promptly.

e) _Grading of Slopes_*-

   i. >40% Slope – Slopes shall not exceed those specified in the plans approved by the Conservation Commission. Any slope equal to or greater than 40% (1 vertical to 2 1/2 horizontal) shall be stabilized with erosion control matting.

   ii. <40% Slope – Final grades of vegetated areas shall not exceed a slope of 1 vertical to 2 1/2 horizontal (40%) and shall be stabilized to prevent erosion, particularly during the construction period.

f) _Stockpile Maintenance_* - Any stockpiling of loose materials shall be properly stabilized to prevent erosion into and sedimentation of jurisdictional areas. Preventative controls such as haybales or erosion control matting shall be implemented to prevent such an occurrence.

g) _Stockpile Location_ – In no case shall any soil or excavated material be stockpiled within 50 feet of any wetland, floodplain, or storm drain inlet.

h) _Site Stabilization Prior to Winter_* - Prior to winter, exposed soils shall be stabilized (e.g. with demonstrated vegetative growth, impermeable barriers, erosion control blankets, etc.).

39. Invasive Insects* -

   a) _Plantings_ – No trees to be planted shall be species susceptible to the Asian Longhorned Beetle or Emerald Ash Borer.

   b) _Wood Removal_ – All tree, brush & wood removal shall adhere to the most recently amended requirements set forth by the Massachusetts Department of Conservation & Recreation for any project located in the Asian Longhorned Beetle Quarantine Zone.

40. Dust Control* - Provisions for dust control shall be provided during all construction and demolition activities. Such provisions shall be conducted in compliance with all City of Worcester Water Use Restrictions, if in effect, during such activities.

41. Dewatering* – If dewatering is required,

   a) Notice of such activities shall be given to the Office of the Commission within 24 hours of commencement;

   b) There shall be no discharge of untreated dewatered stormwater or groundwater to jurisdictional areas either by direct or indirect discharge to existing drainage systems;

   c) Any discharge to surface waters or drainage structures must be visibly free of sediment;

   d) To the maximum extent practicable, proposed dewatering activities should be located outside of the 100' buffer. If such activities must be located within the 100' buffer, they shall be monitored at all times when the pumps are running;

   e) Dewatering activities shall be confined within an area of secondary containment at all times.

42. Cement Truck Washing - Cement trucks shall not discharge washout effluent directly to any resource area, the 30' buffer thereto, or into any drainage system. Designated washout areas shall be located out of the 100 buffer zone to any wetland.

43. Construction Monitoring Reports –

a) Copies of SWPPP reports shall be provided to the Office of the Commission during all earthwork and drainage construction, at the frequency specified by the SWPPP report, but not to be less than once per month. Such reports shall include an evaluation of all existing erosion and sedimentation controls, as well as stormwater management system/s performance as well as solutions employed and/or recommendations to fix areas found to be deficient, if any.

44. Spill Prevention* -

a) No fuel, oil, or other pollutants shall be stored in any resource area or the buffer zone thereto, unless specified in this Order;

b) No refueling shall take place within resource areas or 100-ft to a resource area;

c) The applicant shall take all necessary precautions to prevent discharge or spillage of fuel, oil or other pollutants onto any part of the site;

d) A spill kit shall be present on site at all times.

V. Conditions to Meet at Completion of Project

45. Site Stabilization* - All disturbed areas shall be properly stabilized with well-established perennial vegetation or other approved methods before the project is considered complete.

46. Erosion and Sediment Controls* - Erosion and sediment controls shall not be removed from the site until all disturbed areas have been stabilized with final vegetative cover and approval has been received from the Commission or its Agents to do so. The controls must then be removed within two weeks of receipt of that certification.

47. Certificate of Compliance* - Upon completion of the project, the applicant shall request in writing a Certificate of Compliance from the Commission. If the project has been completed in accordance with plans stamped by a registered professional engineer, architect, landscape architect, or land surveyor, certification must include a written statement by such professional certifying the same.

a) If the project required compliance with the Massachusetts Stormwater Standards and/or work was conducted within Riverfront Area or Bordering Land Subject to Flooding, a certified as-built plan-of-land shall be provided showing final grades, resource areas, and all constructed improvements;

b) If permanent markers were required, the certified as-built plan-of-land shall depict their location.

48. Deed Condition – Condition numbered 33 shall extend beyond the Certificate of Compliance, in perpetuity, and shall be referred to in all future deeds to this property.

VI. General Conditions

49. Change in Ownership* - If a change in ownership takes place while this Order is still in effect, it is the responsibility of the new owner to notify the Commission of the change and to provide the name of the person responsible for compliance with the Order.

50. Conservation Agent's Power to Act* - With respect to all conditions, except _____, the Conservation Commission designates the Conservation Agent, as its Agent with full powers to act on its behalf in administering and enforcing this Order, unless the Agent determines approval from the Commission is appropriate.

51. Right to Inspect* - A member of the Conservation Commission or its Agent may enter and inspect the property and the activity that are the subjects of this Order at all reasonable times, with or without probable cause or prior notice, and until a Certificate of Compliance is issued, for the purpose of evaluating compliance with this Order (and other applicable laws and regulations).

52. Changes to the Plan or Errors & Omissions* -

(a) If any plan, calculation, or other data presented to the Office of the Commission is in error or have omissions, and are deemed significant by the Commissioners or their Agents, all work will stop at the discretion of the Commission, until the discrepancies have been rectified to the Commission's satisfaction.

(b) The applicant must notify the Commission in writing of any changes in the plans or implementation of the proposed activity where mandated by any local, state, or federal agencies having jurisdiction over the proposed activity. If, in the opinion of the Commission, any changes in the plans or implementation of the proposed activity so require, then the Commission may modify, amend or rescind this Order in a way consistent with:

- M.G.L. Chapter 131, Section 40,
- 310 CMR 10.00, *Wetlands Protection*,
- the City of Worcester's *Wetlands Protection Ordinance*, and
- the Commission's *Wetlands Protection Regulations*

If any provisions of any conditions, or application thereof is held to be invalid, such invalidity shall not affect any other provisions of this Order. If the Commission deems that a proposed change is major or substantial, a new hearing may be required.

53. Liability* - The applicant shall indemnify and save harmless the Commonwealth, the City of Worcester, the Conservation Commission, and its Agents against all sites, claims or liabilities of every name and nature arising at any time out of or in consequence of the acts of the Commission or its Agents in the performance of the work covered by this Order and/or failure to comply with the terms and conditions or this Order whether by itself or its employees or subcontractors.

C. Signatures

This Order is valid for three years, unless otherwise specified as a special condition pursuant to General Conditions #4, from the date of issuance.

6/2/2021
1. Date of Issuance

Please indicate the number of members who will sign this form.
This Order must be signed by a majority of the Conservation Commission.

4/6
2. Number of Signers

The Order must be mailed by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the property owner, if different from applicant.

The names typed below represent the intent to sign the foregoing document in accordance with MGL Chapter 110G §9

Duly authorized by Ch.110G and recorded at Worcester Registry of Deeds in Book 62537 Page 329.

Signatures:

Joseph Charpentier	
Devin Canton	
Amanda Amory	Holly Jones

by hand delivery on	by certified mail, return receipt requested, on
6/2/2021	
Date	Date

D. Appeals

Appeal from a decision of the Conservation Commission shall be taken in accordance with law to the Superior Court or other body of competent jurisdiction. Any such appeal shall be taken within ten (10) days from the date from the receipt of such decision and shall not relieve the individual of the responsibility of taking an appeal to Department of Environmental Protection if such is required under said regulations.

No work may proceed until the appeal on the Commission's decision on a Notice of Intent has been decided and all appeal periods have elapsed.

E. Recording Information

Prior to commencement of work, this Order of Conditions must be recorded in the Registry of Deeds for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land subject to the Order of Conditions. The recording information on this page shall be submitted to the Conservation Commission listed below.

Worcester
Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Worcester
Conservation Commission

Please be advised that the Order of Conditions for the Project at:

299 Highland Street — CC-2021-025, CC-2021-007
Project Location — Conservation Commission File Number

Has been recorded at the Registry of Deeds of:

Worcester — 65390 — 368
County — Book — Page

for: City of Worcester Department of Public Works and Parks
Property Owner

and has been noted in the chain of title of the affected property in:

Book ________ Page ________

In accordance with the Order of Conditions issued on:

6/2/21
Date

If recorded land, the instrument number identifying this transaction is:

Instrument Number

If registered land, the document number identifying this transaction is:

Document Number

Signature of Applicant

M. Designer Certification of Required Approvals

M. Designer Certification of Required Approvals

The Project has undergone or is in the process of obtaining all necessary approvals by any departments or agencies of the Commonwealth required by law to review the Project, including but not limited to the approvals listed previously in this submission. Refer to Section 6B.3.3 A. Permitting Requirements Chart for a summary and status of all required reviews and approvals.

N. Certification of Utility Coordination

1. Narrative of Coordination
2. Electrical Utility Coordination

N. Certification of Utility Coordination

The design team has shared the 60% Construction site documents with National Grid (Electrical Utility), have had meetings with N-Grid representatives, and have met on site to review the project and requirements. Refer to the following letter from ART Engineering.

The design team has also shared the proposed Utility Plans with Eversource (Gas Utility). The gas loads for the existing and proposed buildings were reviewed and reported there is adequate supply for the new facility (which will be less than the existing facility). Need to confirm capacity for when both buildings are in use and being heated with gas (which will occur during 2023-2024 as the new building is finished and the existing school is still occupied by students and staff/faculty).

The design team has had meetings with the City Department of Public Works on city utilities, including the Water Department to review the requirement to install a new high service water line connection to the Park Avenue high service water main. The City has engaged their water infrastructure consultant, Tata and Howard, who is in the process of designing, and will implement the construction in conjunction with the School's schedule under separate City budget.

38 Front Street FL 3, Worcester, MA 01608 Office: 508.797.0333

July 15, 2021

Mr. Robert Para Jr., AIA
Lamoureux Pagano Associates
108 Grove Street, Suite 300
Worcester, MA 01605

RE: Utility Company Contacts
Doherty High School
299 Highland Street
Worcester, MA 01602

Dear Mr. Para:

ART Engineering Corporation (ART) has contacted National Grid, Verizon, and Spectrum relative to the proposed Doherty High School Project.

National Grid requested a site plan, load calculations, one-line diagram and easement documents in order perform their work. The work order number for the new electric service is 29716373 and the DG Case number is 00340607. The work order is on hold until the City of Worcester finalizes the electrical service options presented by NGRID. The contact person is Heather R. Mills who can be reached at 508-860-6130 or by email at Heather.Mills@nationalgrid.com.

The contact Person for Verizon is Beth Smith a Surveyor who can be reached at 508-847-8647

The contact Person for Spectrum is Kenneth Bachand an Account Exec. who can be reached at 413-388-1812

Cordially,

Azim Rawji, P.E.

O. Local Zoning Approvals, Testing, & Permits

O. Local Zoning Approvals, Testing & Permits

The City of Worcester projects are exempt from local zoning reviews.

6B.3 DESIGNER DELIVERABLES

6B3.4 Designer Cost Estimate

6B.3 DESIGNER DELIVERABLES

6B.3.4 Designer Cost Estimate

6B.3 DESIGNER DELIVERABLES

6B3.5 Drawings

A. 60% CD Drawing List

Document 00 01 15
LIST OF DRAWINGS

SITE SURVEY

EX1.0	Existing Conditions Plan
EX1.1	Compiled Existing Conditions Plan
EX1.2	Existing Conditions Plan
EX1.3	Existing Conditions Plan

CIVIL

C1.0	Civil Notes, Legend, and Abbreviations
C1.1	Overall Site Key Plan
C1.2	Site Phasing Plan
C2.0	Erosion and Sediment Control Plan
C2.1	Erosion and Sediment Control Plan
C2.2	Erosion and Sediment Control Plan
C3.0	Site Demolition Plan
C3.1	Site Demolition Plan
C3.2	Site Demolition Plan
C4.0	Roadway and Parking Layout Plan
C4.1	Roadway and Parking Layout Plan
C4.2	Roadway and Parking Layout Plan
C5.0	Roadway Striping and Signage Plan
C5.1	Roadway Striping and Signage Plan
C5.2	Roadway Striping and Signage Plan
C6.0	Grading Plan
C6.1	Grading Plan
C6.2	Grading Plan
C6.3	ADA Ramp Grading
C7.0	Site Utility Plan
C7.1	Site Utility Plan
C7.2	Site Utility Plan
C8.0	Site Drainage Plan
C8.1	Site Drainage Plan
C8.2	Site Drainage Plan
C9.0	Roadway and Utility Profiles
C9.1	Roadway and Utility Profiles
C9.2	Roadway and Utility Profiles
C9.3	Roadway and Utility Profiles
C10.0	Civil Details

C10.1	Civil Details
C10.2	Civil Details
C10.3	Civil Details
C10.4	Civil Details
C10.5	Civil Details

LANDSCAPE

L0-0	Drawing Key
L0-1	East Side Tree Protection + Preparation
L2-1	Materials
L2-2	Materials
L2-3	Materials
L2-4	Materials - Enlargements
L2-5	Materials - Enlargements
L3-1	Planting
L3-2	Planting
L3-3	Planting
L3-4	Soils Diagram
L3-5	Mulch
L4-1	Details
L4-2	Details
L4-3	Bleacher Details
L4-4	Field Details
L4-5	Planting Details
IR-1	Irrigation Layout Plan
IR-2	Irrigation Layout Plan
IR-3	Irrigation Details

STRUCTURAL

S1.01	Typical Details and General Notes
S1.02	Typical Details
S1.03	Typical Details
S3.01	Ground Level Foundation Plan Section AB
S3.02	Ground Level Foundation Plan Section E
S3.03	Main Floor Framing Plan Sections AB
S3.04	Main Floor Framing Plan Section E
S3.05	Main Floor Foundation Plan Section CD
S3.06	Main Floor Foundation Plan Section DE
S3.07	Level 2 Framing Plan Section AB
S3.08	Level 2 Framing Plan Section E

S3.09	Level 2 Framing Plan Section CD
S3.10	Level 2 Framing Plan Section DE
S3.11	Level 3 Framing Plan Section AB
S3.12	Level 3 Framing Plan Section E
S3.13	Level 3 Framing Plan Section CD
S3.14	Level 3 Framing Plan Section DE
S3.15	Level 4 Framing Plan Section AB
S3.16	Level 4 Framing Plan Section E
S3.17	Level 4 Framing Plan Section CD
S3.18	Level 4 Framing Plan Section DE
S3.19	Level 5 Framing Plan Section AB
S3.20	Level 5 Framing Plan Section CD
S3.21	Level 5 Framing Plan Section DE
S3.22	Roof Level Framing Plan Section CD
S4.01	Sections
S4.02	Sections
S4.03	Sections
S4.04	Sections
S4.05	Sections
S4.06	Sections
S4.07	Sections
S4.08	Sections
S4.09	Sections
S4.10	Sections
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****Indicates Trade Sub Bid (TSB) Section**

B. Geotechnical Report

The Geotechnical Report can be found in the following Appendices included in Volume IV of the Specifications.

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6B3.7 Project Coordination

A. Project Coordination Certification

A. Project Coordination Certification

A. Certification

This is to certify that Lamoureux Pagano Associates Architects has conducted a program of project coordination with all sub-consultants to ensure that all systems are coordinated within the allotted space restraints. Refer to the narratives for each discipline in Section 6B3.1 O. Quality Control Documents. LPA|A certifies the following coordination items have been completed to the extent required for the 60% CD phase:

- Details are accurately cross-referenced to the correct plan sheet
- The structural, mechanical, or other disciplines, do not conflict with architectural plans or specifications.
- Structural dimensions match architectural drawings
- Column orientation matches architectural drawings.
- Column grid lines match architectural drawings.
- Column and bearing wall locations match architectural drawings
- Column locations are coordinated with all other disciplines
- Seismic detailing coordinates with architectural drawings
- Beams and columns protruding horizontally and vertically into stairwells, and other interior spaces are shown.
- The finish grade elevations are coordinated between all disciplines.
- Mechanical equipment power requirements and physical locations are shown, including special information as to who mounts, connects, tests, etc.
- Potential spatial conflicts in mechanical equipment have been identified.
- Room wall/floor/ceiling construction is coordinated with the finish schedule.
- Civil earthwork grading and excavation plans are coordinated with architectural and landscape plans.
- Civil plans were coordinated at all exits and stairs
- All room numbers are coordinated between all disciplines.
- Equipment plan coordinates with architectural plans.
- Chapter 74 programs equipment requirements were coordinated with the electrical and mechanical consultants
- All kitchen equipment is connected to utilities.
- Acoustic separations and requirements were coordinated
- Standby and emergency power requirements was coordinated between consultants
- Coordination of the phased bid documents and work of the disciplines to be included in the early packages

To facilitate the coordination efforts listed above, all major consultants (Site, Structural, Food Services, Fire Protection, Plumbing, HVAC, Electrical and A/V) have provided 3D electronic models of their respective disciplines for Design Development, and will continue to update their BIM models for further coordination at 90% and 100% Construction Documents. Coordination with the Architectural REVIT model has been begun by the CM's BIM Coordinator, at this stage to coordinate the early site bidding work, and their work will continue through construction to ensure that all systems work with one another.

The project continues to comply with the MSBA High School Science Lab Guidelines and/or Recommendations of Best Practices for K-12 STEM learning Spaces.