Lexington High School

PBC Meeting

03/27/2025

smma dw DORE + WHITTIER Turner

Turner Construction Update (5 minutes)

Site Features – Introduction (5 minutes)

- ❑ Bicycle Parking
- ❑ Alternative Modes of Transport & Infrastructure
- ❑ Field Materials
- ❑ Bleacher System
- ❑ Fencing

Electrical Design – Introduction & Discussion (25 minutes)

- ❑ Generator Load List & Size of Diesel Generator
- ❑ Electrical Service Calcs
- ❑ Lighting – lighting control, classroom lighting, interior lighting approach, building & site lighting
- ❑ Lightning Protection System – **confirm today**

HVAC Design – Discussion (30 minutes)

- ❑ LCCA for HVAC Options
- ❑ Basis of Design HVAC System

Plumbing Design – Discussion (5 minutes)

- ❑ Electric Water Heater vs. Domestic Heat Pump with Electric Back Up

Building Design – Confirmation (5 minutes)

- ❑ Define Assumed Floor to Floor Heights & Typical Ceiling Heights

smma

Turner Construction's Estimating & Involvement

Turner has provided the following since starting work in January 2025

- Turner Estimating vetted PSR Estimates
- Provided Logistical and Schedule verification for
  - Geothermal
  - Building duration
- Vetted SMMA Mass Timber estimates
- Provide Estimates for 4 different HVAC Options (Central Ground Source Heat Pump with 4 Pipe CHW/HW, Central Air Source Heat Pump with 4-Pipe CHW/HW, Hybrid Ground Source and Air Source and VRF Air Source Heat Pumps with distributed FCUs)
- Geothermal – Logistics and Pricing. On existing fields, on new site or under existing school. This is also a big part of HVAC options in #4 above. Coordinated discussions with multiple well drillers to validate logistics.
- Central office estimates
- Field House estimates – 7 different versions
- Provide estimates for 3 different plumbing options (Domestic Air Source Heat Pump System, Domestic Water Source Heat Pump System and Domestic Water Electric Storage System.
- Electrical Temp service planning
- Provided estimates for Community submissions (Thrive, SMMA 2015 Master plan, etc)
- Door/Hardware/Security options
- Provided guidance on steel vs concrete structure

Turner Construction Update (5 minutes)

Site Features – Introduction (5 minutes)

- ❑ Bicycle Parking
- ❑ Alternative Modes of Transport & Infrastructure
- ❑ Field Materials
- ❑ Bleacher System
- ❑ Fencing

Electrical Design – Introduction & Discussion (25 minutes)

- ❑ Generator Load List & Size of Diesel Generator
- ❑ Electrical Service Calcs
- ❑ Lighting – lighting control, classroom lighting, interior lighting approach, building & site lighting
- ❑ Lightning Protection System – **confirm today**

HVAC Design – Discussion (30 minutes)

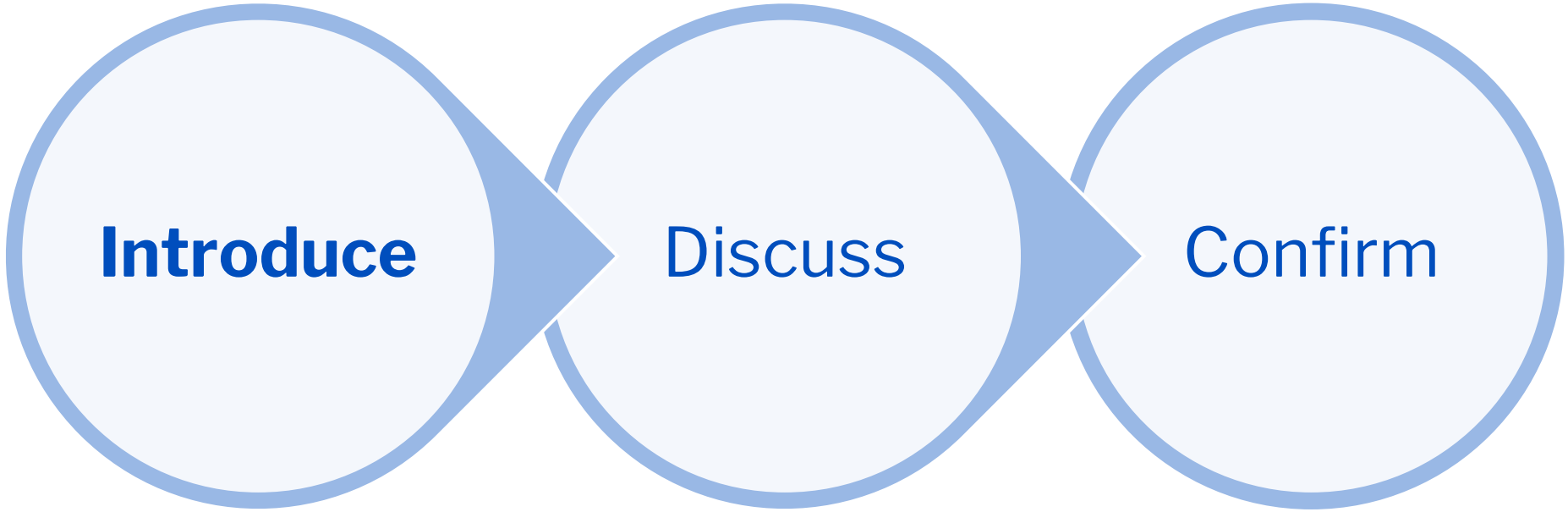
- ❑ LCCA for HVAC Options
- ❑ Basis of Design HVAC System

Plumbing Design – Discussion (5 minutes)

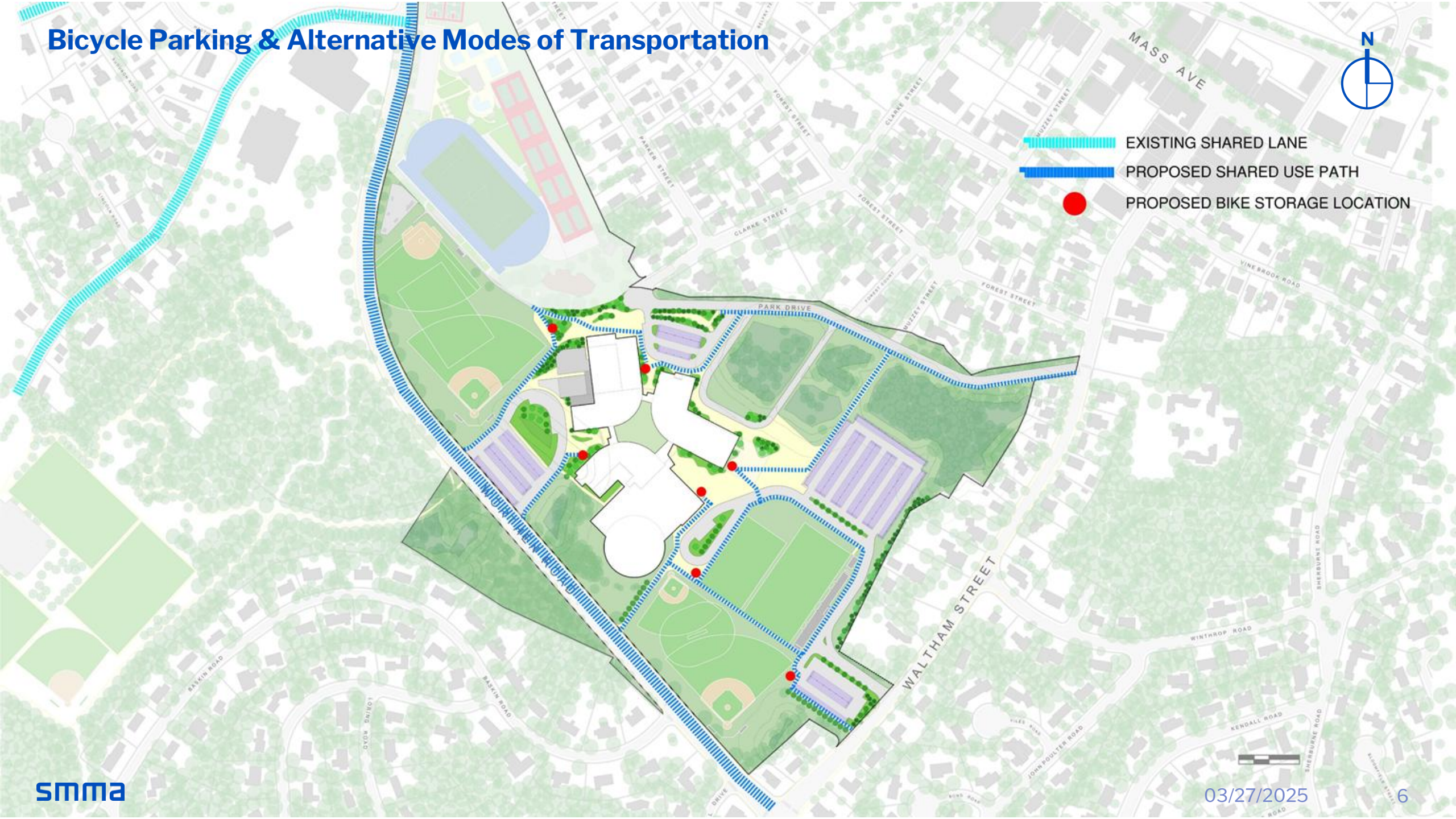
- ❑ Electric Water Heater vs. Domestic Heat Pump with Electric Back Up

Building Design – Confirmation (5 minutes)

- ❑ Define Assumed Floor to Floor Heights & Typical Ceiling Heights


Introduce
Discuss
Confirm
March 27, 2025
March 31, 2025
April 10, 2025

Bicycle Parking & Alternative Modes of Transportation



Athletic Field Material

Natural Turf (Seed or Sod)

Pros

- Natural Aesthetics
- Cooler Surface
- Environmental Benefits
  - Carbon sequestration, reduce excess stormwater runoff
- Cost Effective to Install

Cons

- High Maintenance
  - mowing, watering, fertilizing, pest control
- Water Usage
- Durability Issues
  - Overuse and excessive traffic lead to compaction and bare spots; saturated soils/standing water limit playability
- Inconsistent Surface
- Pesticide and Fertilizer Use
- **Seed Requires 2 Full Growing Seasons Before Use**
- **Sod Requires a Minimum of 2-3 Weeks for Root Establishment Prior To Use**

Synthetic Turf

Pros

- Low Maintenance
- Durability
- Consistent Appearance
- Long-Term Cost Effectiveness
- **Able to Use Field Immediately**

Cons

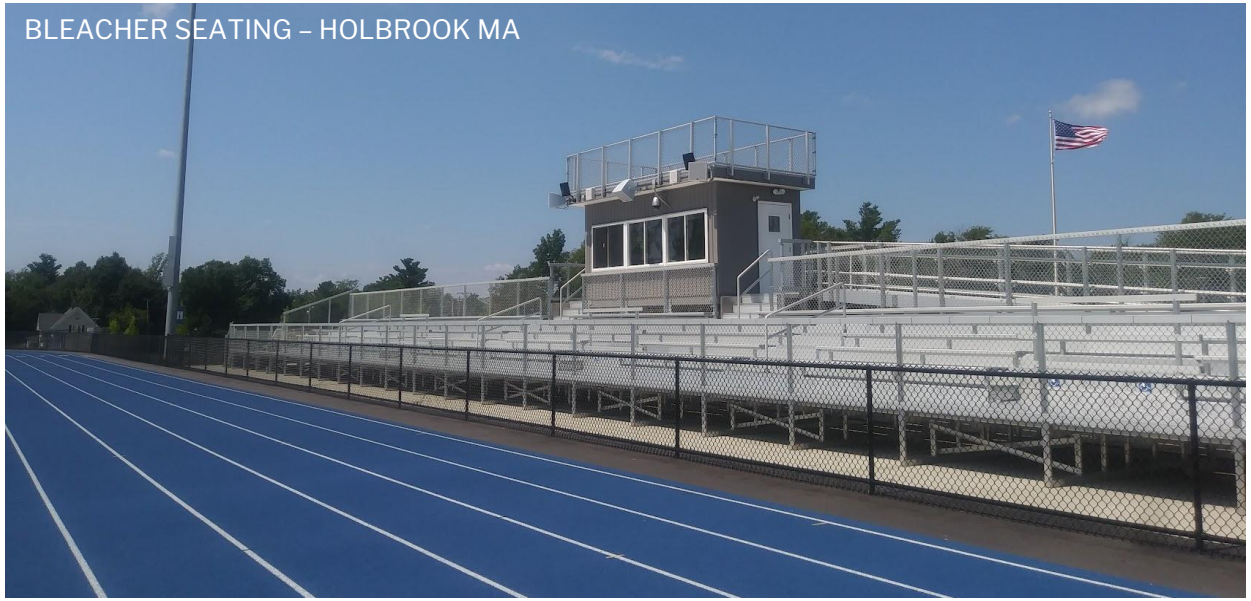
- High Initial Cost
- Heat Retention
- Environmental Impact

***Additional relevant information can also be found in the Town of Lexington Comprehensive Study of Athletic and Outdoor Recreation Facilities 2021-2022*

Bleacher Systems

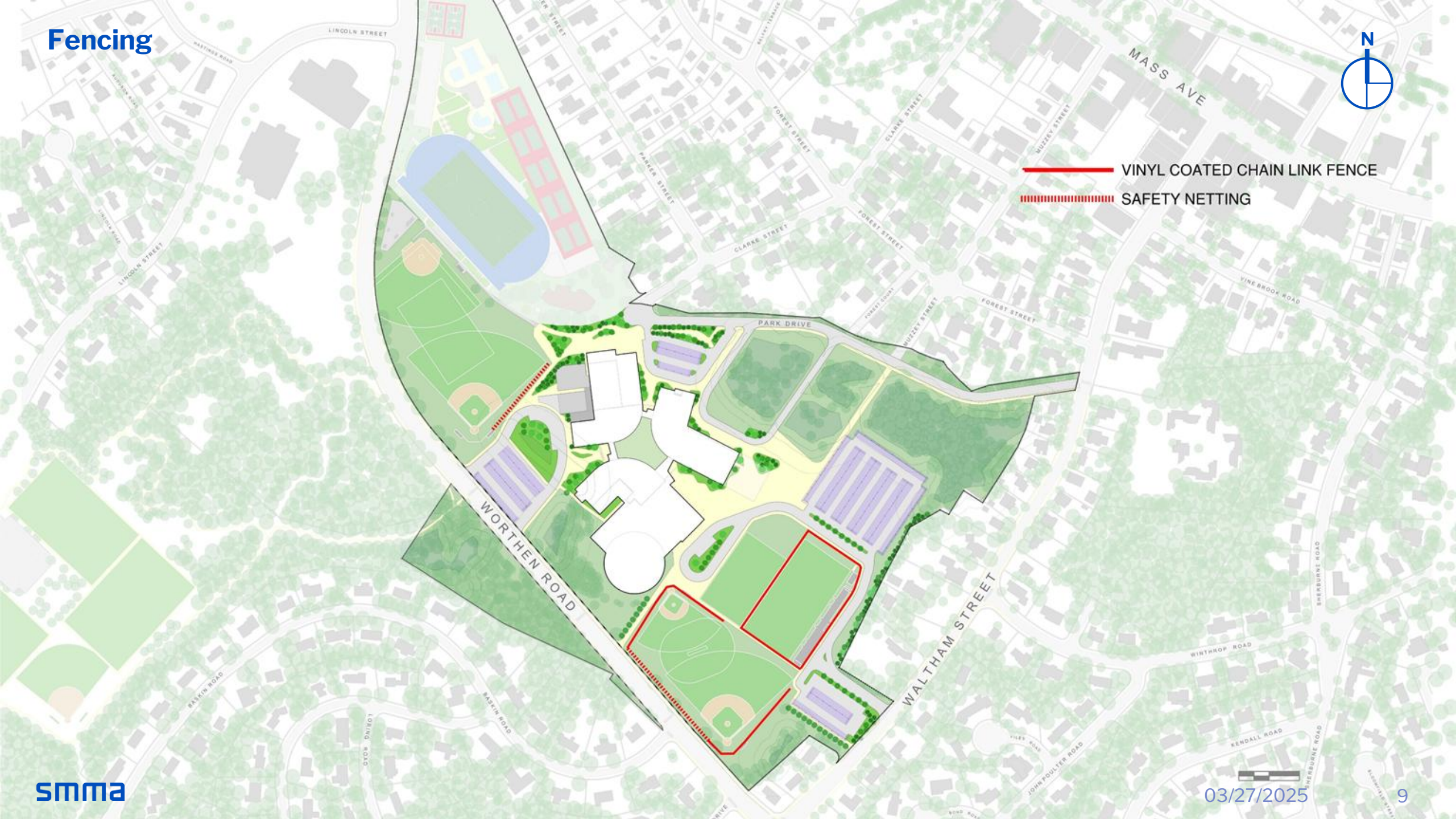

EXISTING BLEACHER SYSTEM – LEXINGTON MA


TERRACED SEATING – ROCKLAND MA


BLEACHER SEATING – HOLBROOK MA


BLEACHER SEATING WITH INDIVIDUAL MOLDED SEATS

Fencing


N
VINYL COATED CHAIN LINK FENCE
SAFETY NETTING
PARK DRIVE
WORTHEN ROAD
WALTHAM STREET
MASS AVE
LINCOLN STREET
CLARKE STREET
FOREST STREET
VINEBROOK ROAD
WINTHROP ROAD
KENDALL ROAD
SHERBURNE ROAD
BASKIN ROAD
LORING ROAD
JOHN POULTER ROAD

Turner Construction Update (5 minutes)

Site Features – Introduction (5 minutes)

- ❑ Bicycle Parking
- ❑ Alternative Modes of Transport & Infrastructure
- ❑ Field Materials
- ❑ Bleacher System
- ❑ Fencing

Electrical Design – Introduction & Discussion (25 minutes)

- ❑ Generator Load List & Size of Diesel Generator
- ❑ Electrical Service Calcs
- ❑ Lighting – lighting control, classroom lighting, interior lighting approach, building & site lighting
- ❑ Lightning Protection System – **confirm today**

HVAC Design – Discussion (30 minutes)

- ❑ LCCA for HVAC Options
- ❑ Basis of Design HVAC System

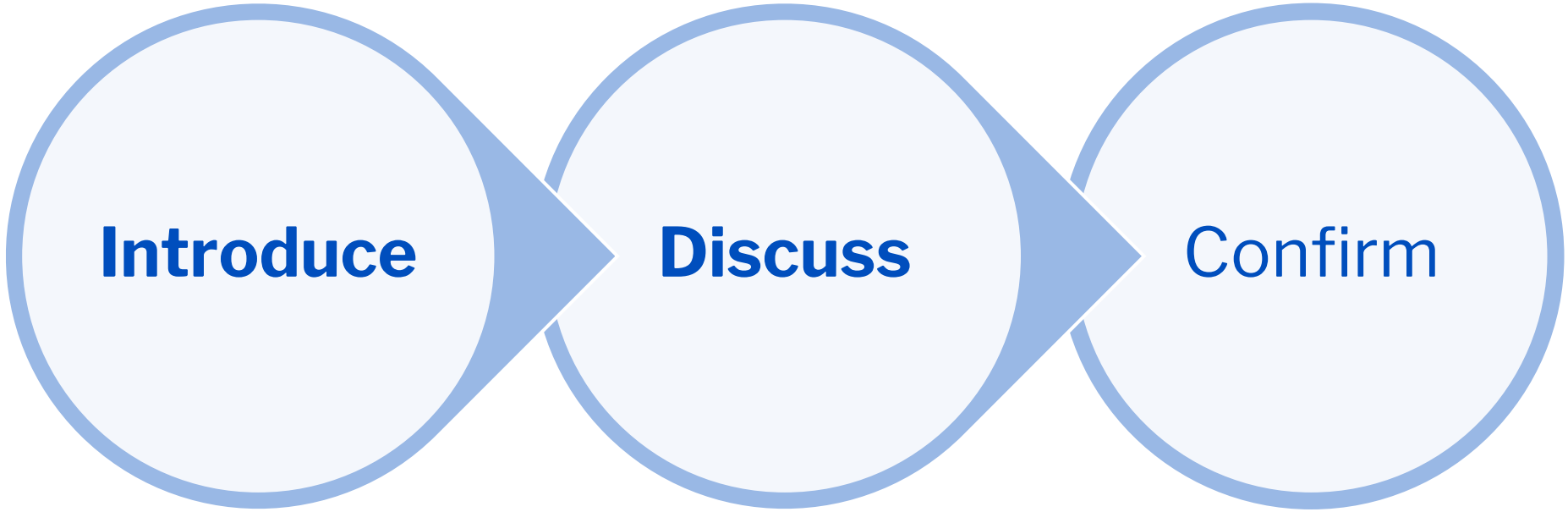
Plumbing Design – Discussion (5 minutes)

- ❑ Electric Water Heater vs. Domestic Heat Pump with Electric Back Up

Building Design – Confirmation (5 minutes)

- ❑ Define Assumed Floor to Floor Heights & Typical Ceiling Heights

smma


Introduce
Discuss
Confirm
March 27, 2025
March 27, 2025
May 8, 2025

Town Shelter Requirements

Town of Lexington's Integrated Building Design Checklist

Resilience Levels

LEVEL 1: **Public Safety (Police, Fire, Public Services) -** No interruption of essential services.

LEVEL 2: **Town Shelter -** Full electrical and thermal power necessary for life safety, ~~food prep / refrigeration~~, lighting, internet connectivity and charging stations. Operational 24/7. Islanded operation maximizing use of on-site solar and storage.
[AT GYMNASIUM & FIELD HOUSE]

LEVEL 3: **Continued Operation -** Full electrical and thermal power necessary for providing healthy conditions during extreme heat/cold conditions, providing lighting, internet connectivity, and plug load charging. Operational during normal occupied hours. Smart load reduction in emergencies, mobile or on-site backup generation to carry load for continued operation.
[AT REST OF BUILDING]

LEVEL 4: **Asset Preservation -** Provide power to hold building temperature, provide light and manage building systems

Town of Lexington's Integrated Building Design Checklist

Tiered Standby / Resilience Loads	Description	Backup Power Sources
Level 1: Life Safety Loads	No interruption of life safety services including emergency lighting, internet connectivity, security system, fire alarm system, sprinkler system, and building automation.	- 350kW Diesel Generator
Level 2: Town Shelter (Gym & Fieldhouse)	Full electrical and thermal power for life safety, lighting, internet connectivity and charging stations. Operational 24/7. Islanded operation maximizing use of on-site solar and storage.	- 3500 kW Solar System - 2000 kW / 8000 kWh Battery - 900 kW Diesel Generator
Level 3: Continued Operation (Rest of Building)	Full electrical and thermal power for providing healthy conditions during extreme heat/cold conditions, providing lighting, internet connectivity, and plug load charging. Operational during normal occupied hours. Smart load reduction in emergencies, mobile or on-site backup generation to carry load for continued operation.	- 3500kW Solar System - 2000kW / 8000kWh Battery - 900kW Diesel Generator
Level 4: Asset Preservation	Provide power to hold building temperature, provide light and manage building systems	- 3500kW Solar System - 2000kW / 8000kWh Battery - 900kW Diesel Generator

Notes:
1. Level 1 is code-required, aligning with NEC Article 700 emergency systems.
2. Level 2-4 are resilience enhancements, supported by the same resilient microgrid strategy.
3. Load shedding and control logic will be in place for level 2 and 3, especially when solar isn't producing or battery is depleted.
4. Preliminary sizes of backup power sources will continue to be evaluated as the design progresses.

Electrical Design / Emergency Power Strategy for Level 2 Town Shelter Operations

Level 2 Summary - Space/Service	Power Provided	Roll-up Generator Connection (Pin Sleeve)
Critical Life Safety Systems	**Yes**	**Yes (Docking Station)**
Building Freeze Protection	**Yes**	No
Refrigerators / Freezers (kitchen, break rooms, etc.)	**Yes**	No
Field House (HVAC, Lighting, Plug Load)	**Yes**	No
Gymnasium (HVAC, Lighting, Plug Load)	**Yes**	No
Two classrooms adjacent to Fieldhouse / Gym.	**Yes**	No
Locker Rooms (including hot water plumbing)	**Yes**	**Yes (Docking Station)**
HVAC and plumbing - Entire Building	No	No
General Building Plug Load	No	No
Kitchen Power	No	**Yes (Docking Station)**
Auditorium Systems	No	No
Building Non-Emergency Lighting	No	No

Notes:
1. Pin Sleeve = Quick connect port for mobile generator deployment.
2. Life Safety Systems require a temporary generator docking station per NEC Article 700.
3. Load shedding and control logic will be in place for level 2 and 3, especially when solar isn't producing or battery is depleted.

Electrical Design / Emergency Power Strategy for Level 3 Continued Operations

Level 3 Summary - Space/Service	Power Provided	Roll-up Generator Connection (Pin Sleeve)
Essential Operations		
- Lighting & HVAC - Building	**Yes (Reduced)**	
- Lighting & HVAC – Gym/Fieldhouse (Reduced)	**Yes (Reduced)**	
- Classrooms (Teacher outlet, smartboard, speech)	**Yes (Reduced)**	
- Electric Water Coolers	**Yes (Water)**, No (Compressor)	
Restrooms		
- Flush valves and sinks	**Yes**	
- Hot Water	No	**Yes (Hot Water)**
- Hand dryers and outlets	No	
Building & Admin Support		
- Admin Suite (desk outlet and printers)	**Yes (Reduced)**	
- IT Support Suite	**Yes**	
- Building Systems (pumps, septic, loading dock)	**Yes**	
- Refrigerators & Freezers	**Yes**	
- 20% of Hallway Outlets	**Yes (Reduced)**	
Instructional / Specialized Rooms		
- Media Center (Staff desk outlets)	**Yes (Reduced)**	
- Music Rooms	**Yes (Reduced)**	
- Classroom Equipment (Kilns, chargers, printers)	No	
Fully Powered Down		
- Kitchen Equipment	No	**Yes (Kitchen)**
- Fieldhouse & Gym plug load and tech	No	
- Auditorium plug load and tech	No	

Notes:

1. Pin Sleeve = Quick connect port for mobile generator deployment.
2. Load shedding and control logic will be in place for level 2 and 3, especially when solar isn't producing or battery is depleted.

- Medium Voltage Distribution with Primary Metering
- Utility Coordination Ongoing
- Exploring Load Shedding Strategies

Pad-mounted Switchgear

Pad-mounted Transformer

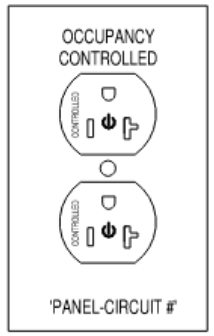
Main Switchboard(s)

Electrical Design / Electrical Service Calculations

Category	Details	Implication / Strategy
Existing Utility Service	**1,500 kW** service from Waltham St.	Must upgrade to support new building+ future needs.
Max Available Upgrade	**2,500 kW** (Lexington Substation)	Hard cap without costly infrastructure expansion.
New Total Connected Load	**7,075 kW** (HVAC Option 1)	Shows need for aggressive load shedding.
Diversified Load Estimate	**3,473 kW** (with load shedding)	Still above cap.
Peak Demand Estimate	**2,300 kW – 3,500 kW** (at EUI of 25)	Energy model output. Realistic demand range for all 4 HVAC Options
Renewable System Size	**3,500 kW PV** (Net Zero goal), 2000 kW Battery	Complicates interconnection, adds export load.
EV Charging Load	20 spots / 10 chargers	Currently carried in service calculations.
Future Considerations	Expanded building footprint, Future EV Capacity	Highlights the need to preserve capacity now.
Utility Upgrade Impact	Requires 2 new feeders from Waltham (not Lexington)	Lexington substation lacks capacity; upgrade enables growth.
Cost	Estimated **$18M** Eversource capital investment for new feeders	**Not a direct project cost**; Town may be partially backcharged based on actual need. Shared cost model will reflect only what is required for the school, with offsets potential tied to downtown Lexington Station Upgrade.
Benefits of Upgrade	Underground service, primary metering, MV distribution	Maximize export capability, additional resiliency, lower utility rate

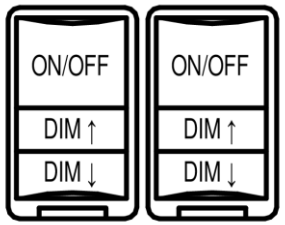
Notes:
1. Load shedding strategy will be presented to utility in load letter, including connected load, anticipated operations, and future needs.
2. Utility will apply their own diversity factor and determine feasibility.
3. Medium voltage distribution enhances future-proofing and supports microgrid infrastructure.

CONFIRM

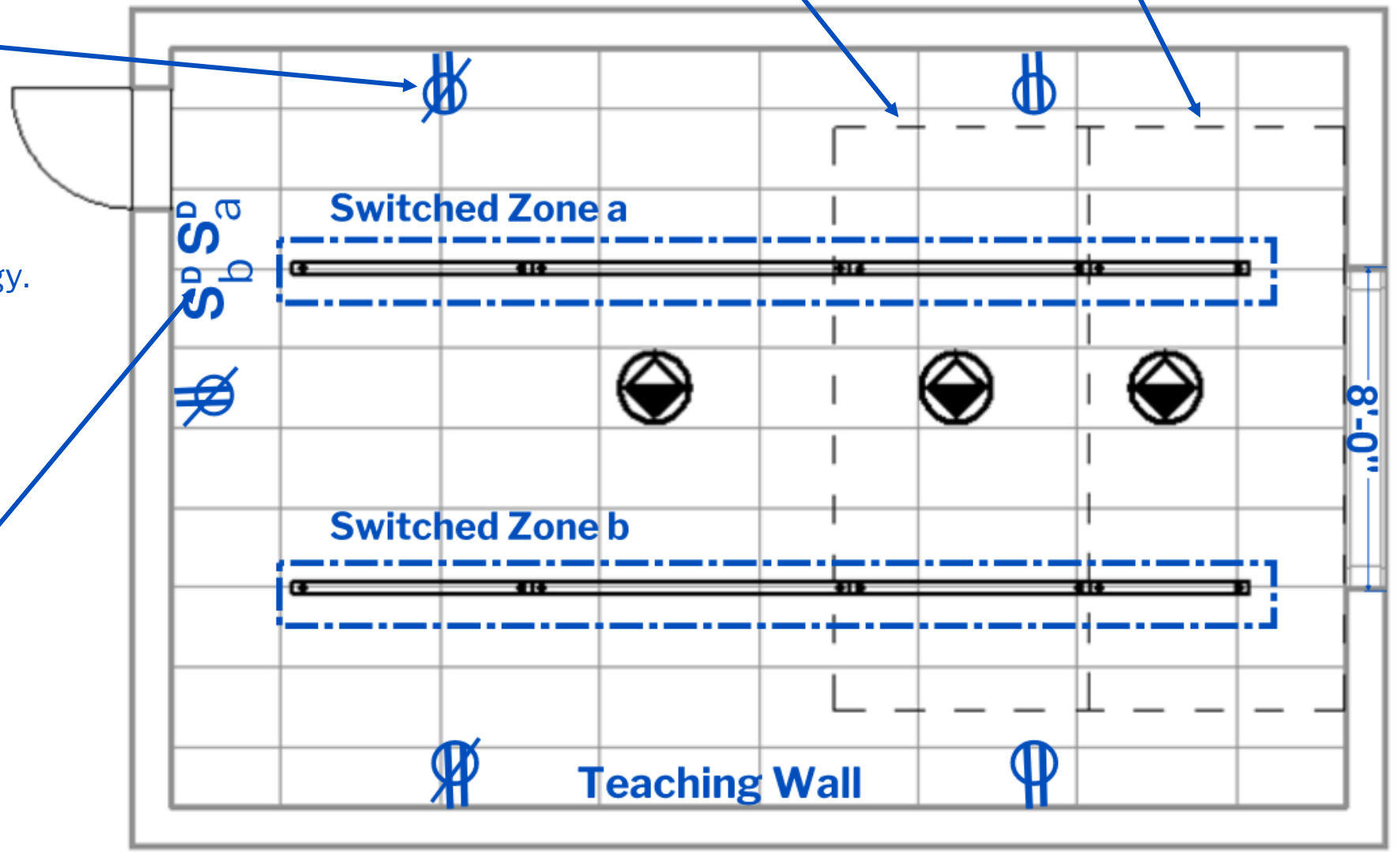


Recap

- No interest in wireless technology.
- No interest in batteries.
- BACnet/IP integration.
- Code compliant and demand response ready.
- No teaching wall switch.



Zone A / Zone B



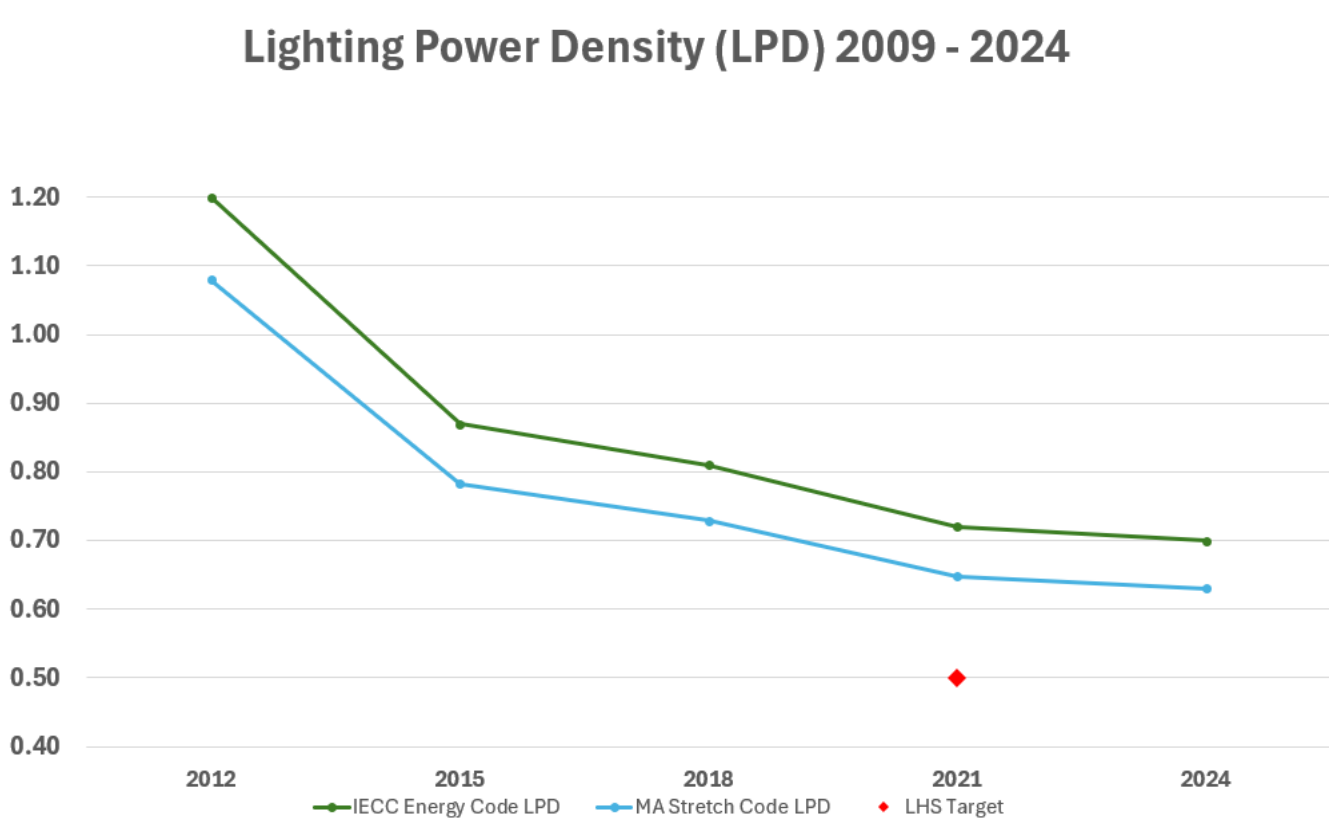
Classroom B211

CONFIRM

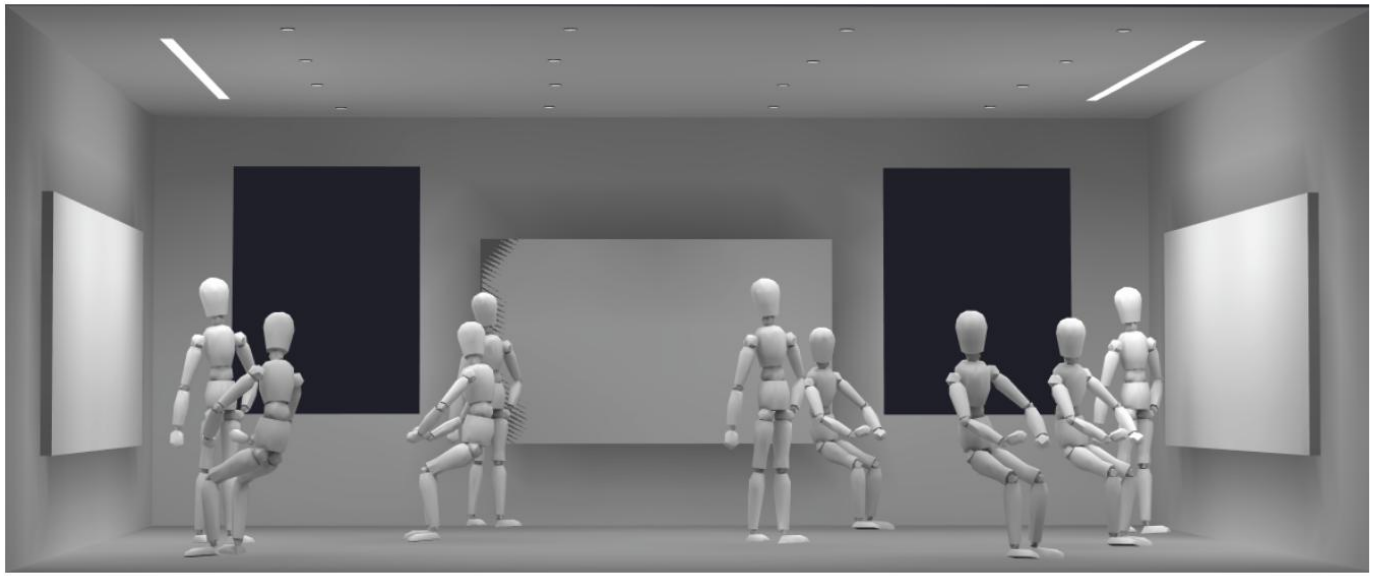
Solutions	Description	Advantages	Challenges
Option 1 – Centralized Distribution System (**Recommended**)	• Localized room controllers within controlled space • Networked controllers communicate back to central system	• Greatly reduces wiring complexity and installation cost. • Localized failures limit disruptions to individual rooms • Simplified troubleshooting and maintenance	• Decentralizes maintenance compared to relay panels
Option 2 – Centralized Relay Panels	• Lighting relays centralized in electrical rooms • Homeruns for power, dimming, and sensor wiring	• Centralized maintenance • Uniform control for large, consistent-use areas	• Significant increase in wiring, conduit, and installation cost • Complex troubleshooting due to centralized configuration
Option 3 – DALI (Digital Addressable Lighting Interface)	• Digital protocol assigning unique addresses to individual fixtures • Minimal wiring. Single control cable for multiple fixtures	• Highly flexible and adaptable for future changes • Simplified wiring reduces installation labor	• Requires DALI compatible fixtures • Specialized commissioning expertise required • Difficult maintenance

Electrical Design / Lighting Goals

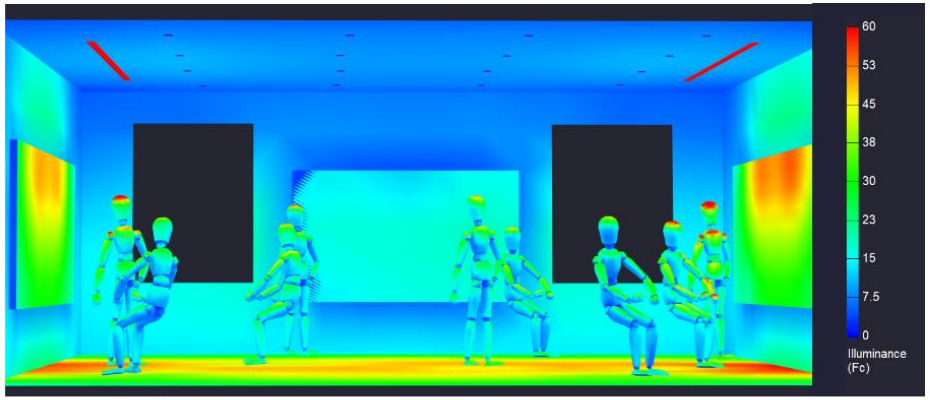
- **Support Flexible and Evolving Classrooms**
  - Multiple Teaching walls with dedicated vertical illumination
- **Leveraging Cutting-Edge, Maintainable Technology**
  - Highly efficient LED fixtures
  - Optics, louvers and beam spreads selected to reduce glare and boost comfort
  - Recessed lighting and standard fixture lengths for easier maintenance
- **Enhance the Visual Environment for Learning**
  - 40 fc target at desks for visual acuity
  - Teaching wall lighting improves focus and comfort
  - Interior space finish coordination to optimize reflectance
- **Circadian-Supportive Lighting**
  - CCT: 3500K color temperature for core school hours (9am – 2pm)
- **Meet and Exceed Energy Code Standards**
  - Lighting Power Density Goal: 0.5 watts per square foot



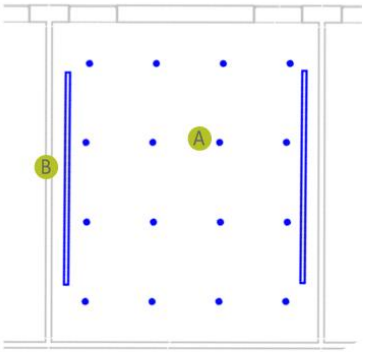
Classroom Lighting / *Scheme B1 : Downlights & Wallwasher*



Photometric Views



Photometric Views



Plan Layout

ENERGY CONSUMPTION

LOW — HIGH

LPD = 0.43 W/SQFT

GLARE CONTROL

LOW — HIGH

Lens Brightness = 18 UGR

VISUAL QUALITY

LOW — HIGH

Layers of Light = 2
Averge Illuminance = 46 fc
Contrast Ratio = 2.58 Avg./Min.
White Board 1 Average Illuminance = 35 fc
White Board 1Contrast Ratio = 1.64Avg./Min.
White Board 2 Average Illuminance = 32 fc
White Board 2 Contrast Ratio = 1.58 Avg./Min
White Board 3 Average Illuminance = 18 fc
White Board 3 Contrast Ratio = 1.11 Avg./Min

COST

LOW — HIGH

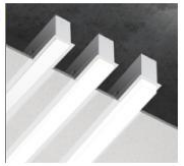
Cost = $10 /SQFT

A

Mounting Height = 10'-0"
Delivered Lumens = 2135 Lumens
Beam Spread = 80 Degrees

Recessed Downlight

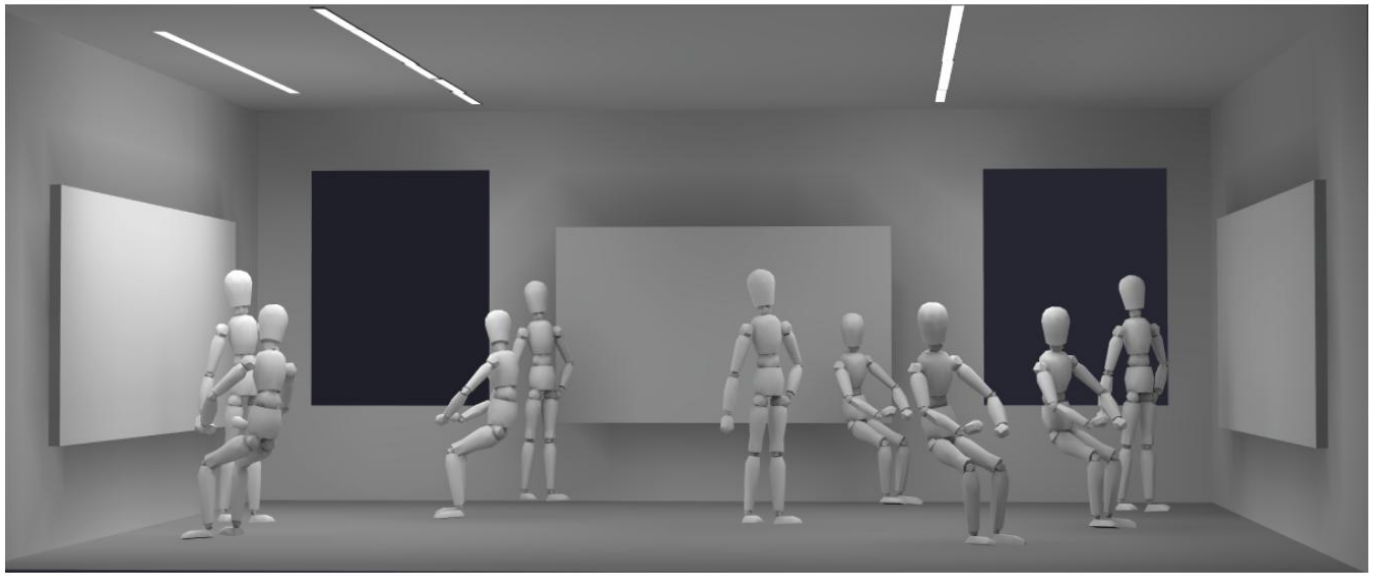
B



Mounting Height = 10'-0"
Delivered Lumens = 500 Lumens/FT
Beam Spread = Asymmetric Wallwash

Recessed Linear Wallwasher

Classroom Lighting / *Scheme C.1 : Recessed Linears & Wallwasher*



Photometric Views

ENERGY CONSUMPTION

LOW — HIGH

LPD = 0.47 W/SQFT

GLARE CONTROL

LOW — HIGH

Lens Brightness Lensed = 12017 CD.SQM
Lens Brightness Louvered = 10742 CD.SQM

VISUAL QUALITY

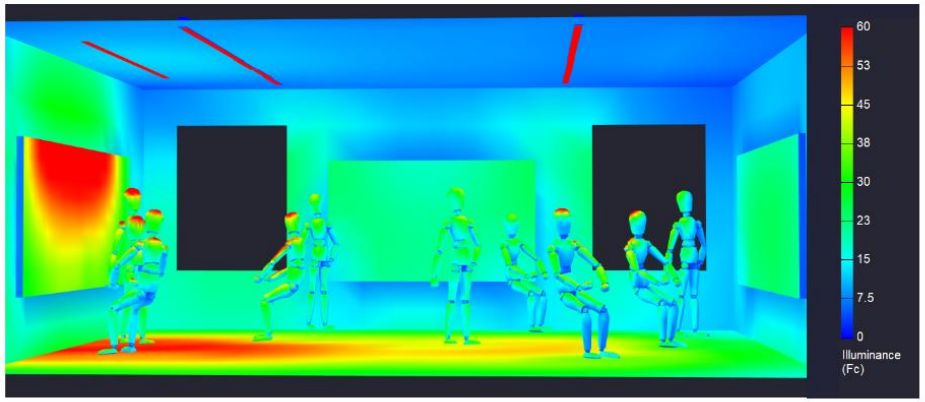
LOW — HIGH

Layers of Light = 2
Averge Illuminance = 44 fc
Contrast Ratio = 1.66Avg./Min.
White Board 1 Average Illuminance = 46 fc
White Board 1 Contrast Ratio = 1.63 Avg./Min.
White Board 2 Average Illuminance = 22 fc
White Board 2 Contrast Ratio = 1.47 Avg./Min
White Board 3 Average Illuminance = 20 fc
White Board 3 Contrast Ratio = 1.26v Avg./Min

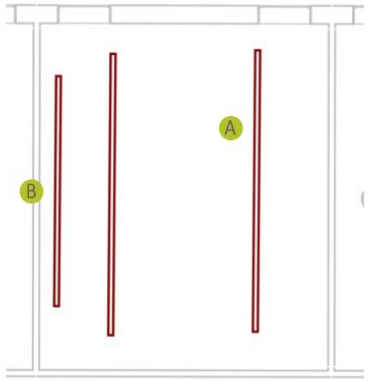
COST

LOW — HIGH

Cost Lensed = $10/SQFT
Cost Louvered = $12/SQFT

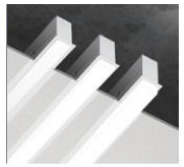


Photometric Views



Plan Layout

A

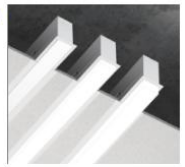


Recessed Lensed Linear Slot

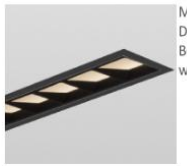
Mounting Height =10'-0"
Delivered Lumens = 750 Lumens/FT
Beam Spread = High-Efficiency Lambertian Optic

Recessed Louvered Linear Slot

B



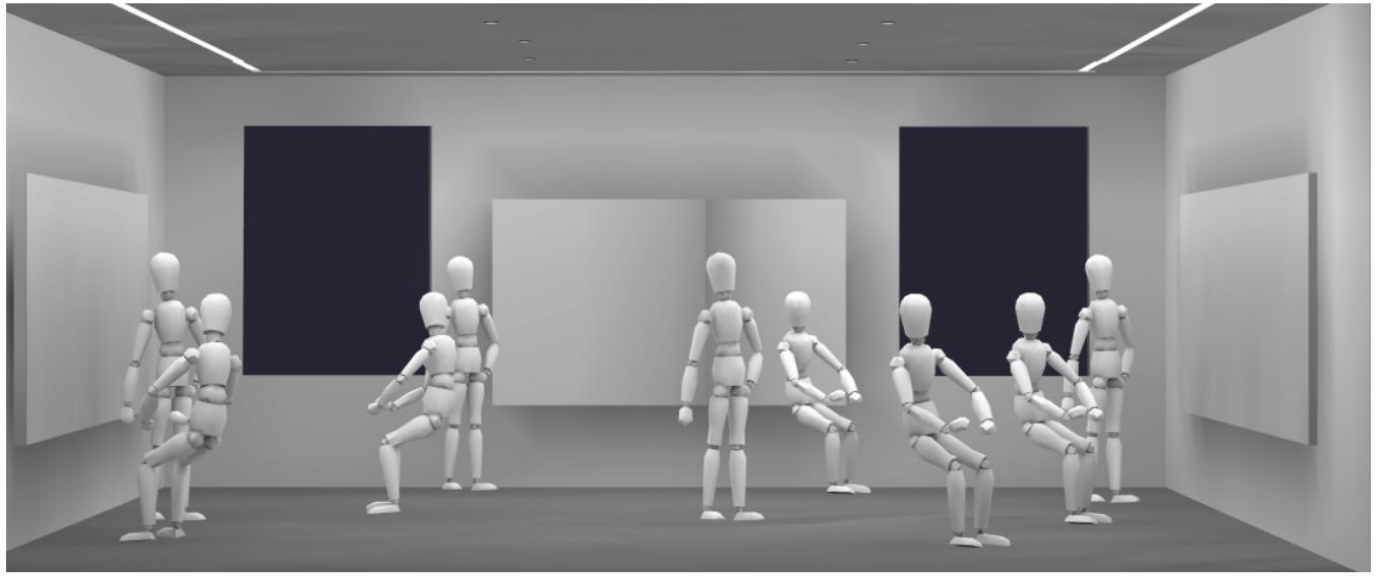
Recessed Linear Lensed Wallwasher



Mounting Height = 10'-0"
Delivered Lumens = 500 Lumens/FT
Beam Spread = Asymmetric Wall-wash

Recessed Linear Louvered Wallwasher

Classroom Lighting / *Scheme D : Downlights & Recessed Linear*



Photometric Views

ENERGY CONSUMPTION

LOW — HIGH

LPD = 0.50 W/SQFT

GLARE CONTROL

LOW — HIGH

Lens Brightness = 5608 CD.SQM

Lens Brightness Louvered = 4827 CD.SQM

VISUAL QUALITY

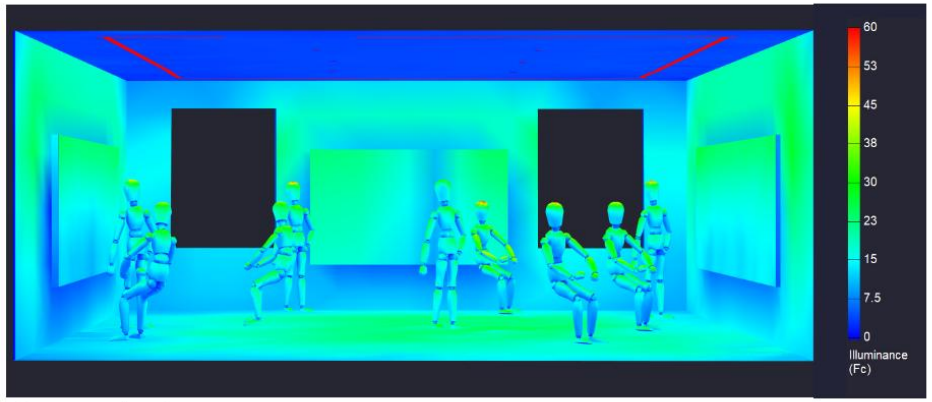
LOW — HIGH

Layers of Light = 2
Averge Illuminance = 37 fc
Contrast Ratio = 2.07 Avg./min
White Board 1 Average Illuminance = 23fc
White Board 1 Contrast Ratio = 1.28 Avg./Min
White Board 2 Average Illuminance = 22 fc
White Board 2 Contrast Ratio = 1.22 vAvg./Min
White Board 3 Average Illuminance = 20 fc
White Board 3 Contrast Ratio = 2.03 Avg./Min.

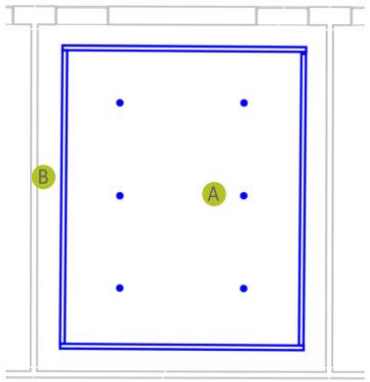
COST

LOW — HIGH

Cost Lensed = $14/SQFT
Cost Louvered = $16/SQFT



Photometric Views



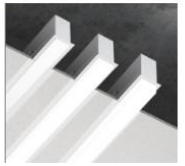
Plan Layout

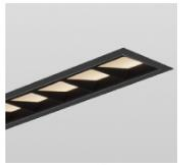
A

Mounting Height = 10'-0"
Delivered Lumens = 2135 Lumens
Beam Spread = 80 Degrees

Recessed Downlight

B





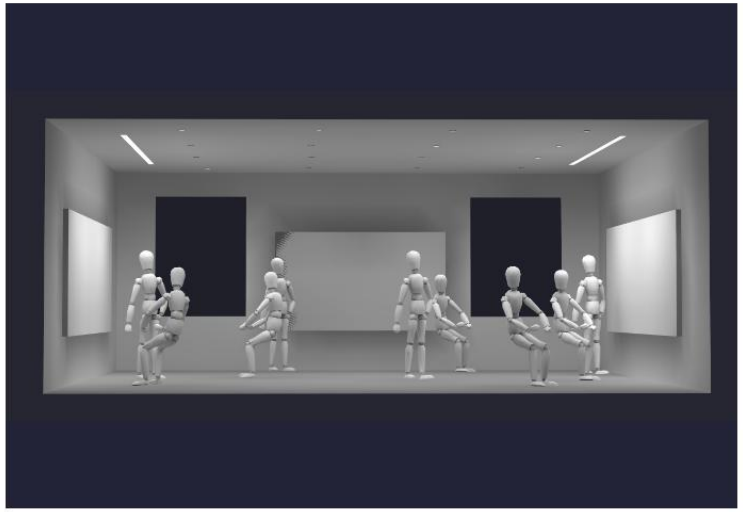
Mounting Height = 10'-0"
Delivered Lumens = 350 Lumens/FT
Beam Spread = Asymmetric Wall-wash

Recessed Linear Lensed

Recessed Linear Louvered

Classroom Lighting/ *Analysis Summary - Ideal Schemes*

Scheme B.1 : Downlight + Wallwashers at Two Whiteboards



ENERGY CONSUMPTION

LOW — HIGH — LPD = 0.43 W/SQFT ✓

GLARE CONTROL

LOW — HIGH — Lens Brightness = 18 UGR

VISUAL QUALITY

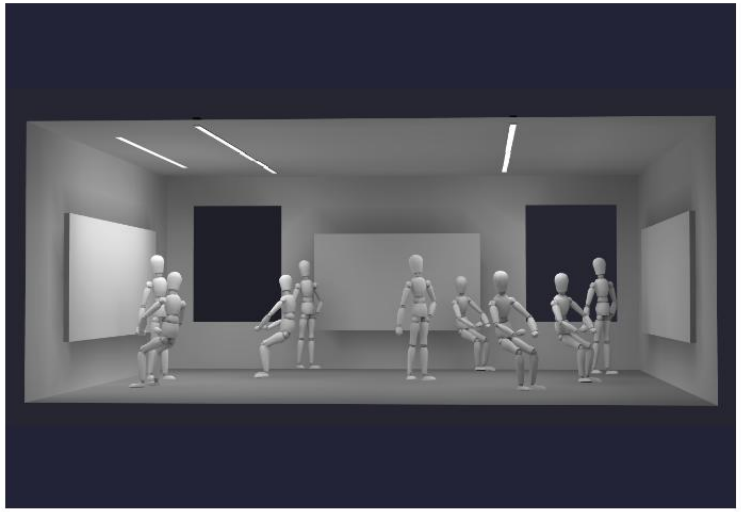
LOW — HIGH

Layers of Light = 2
Averge Illuminance = 46 fc
Contrast Ratio = 2.58 Avg./Min.
White Board 1 Average Illuminance = 35 fc
White Board 1Contrast Ratio = 1.64Avg./Min.
White Board 2 Average Illuminance = 32 fc
White Board 2 Contrast Ratio = 1.58 Avg./Min
White Board 3 Average Illuminance = 18 fc
White Board 3 Contrast Ratio = 1.11 Avg./Min ✓

COST

LOW — HIGH — Cost = $10 /SQFT ✓

Scheme C.1 : Recessed Linears & Wallwashers at Two Whiteboards



ENERGY CONSUMPTION

LOW — HIGH — LPD = 0.47 W/SQFT

GLARE CONTROL

LOW — HIGH

Lens Brightness Lensed = 12017 CD.SQM
Lens Brightness Louvered = 10742 CD.SQM

VISUAL QUALITY

LOW — HIGH

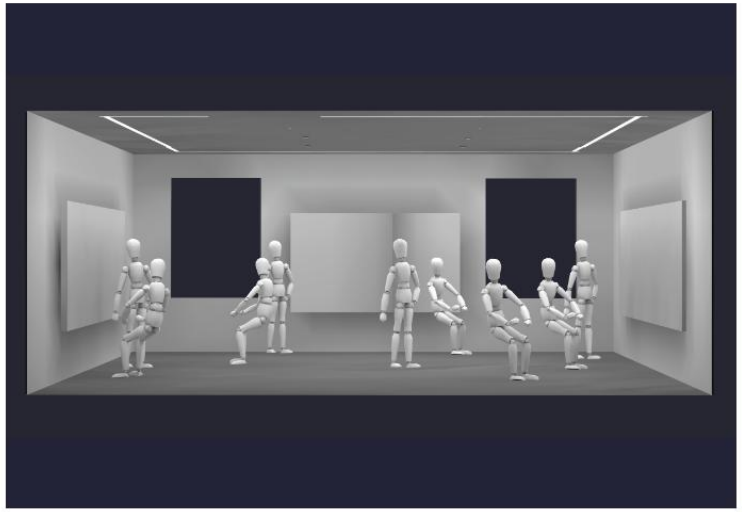
Layers of Light = 2
Averge Illuminance = 44 fc
Contrast Ratio = 1.66Avg./Min.
White Board 1 Average Illuminance = 46 fc
White Board 1 Contrast Ratio = 1.63 Avg./Min.
White Board 2 Average Illuminance = 22 fc
White Board 2 Contrast Ratio = 1.47 Avg./Min
White Board 3 Average Illuminance = 20 fc
White Board 3 Contrast Ratio = 1.26v Avg./Min

COST

LOW — HIGH

Cost Lensed = $10/SQFT
Cost Louvered = $12/SQFT

Scheme D : Downlights & Recessed Linear



ENERGY CONSUMPTION

LOW — HIGH — LPD = 0.50 W/SQFT

GLARE CONTROL

LOW — HIGH

Lens Brightness = 5608 CD.SQM
Lens Brightness Louvered = 4827 CD.SQM ✓

VISUAL QUALITY

LOW — HIGH

Layers of Light = 2
Averge Illuminance = 37 fc
Contrast Ratio = 2.07 Avg./min
White Board 1 Average Illuminance = 23fc
White Board 1 Contrast Ratio = 1.28 Avg./Min
White Board 2 Average Illuminance = 22 fc
White Board 2 Contrast Ratio = 1.22 vAvg./Min
White Board 3 Average Illuminance = 20 fc
White Board 3 Contrast Ratio = 2.03 Avg./Min. ✓

COST

LOW — HIGH

Cost Lensed = $14/SQFT
Cost Louvered = $16/SQFT

- **Goals**
  - Highly efficient, LED technology
  - Full cutoff optics & glare control
  - Dark Sky & LEED compliant
  - Aluminum pole, steel base

- **Accent & Design Lighting Features**
  - Illuminated school signage
  - Uplighting for flagpole

Area Light

Wall Sconce

Post Top

Bollard

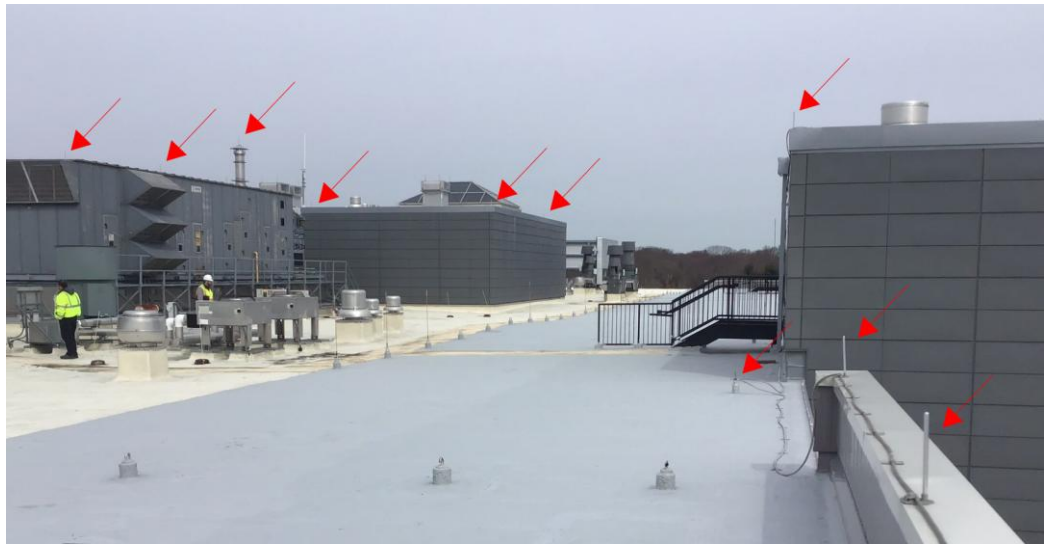
Lightning Protection vs. Prevention System

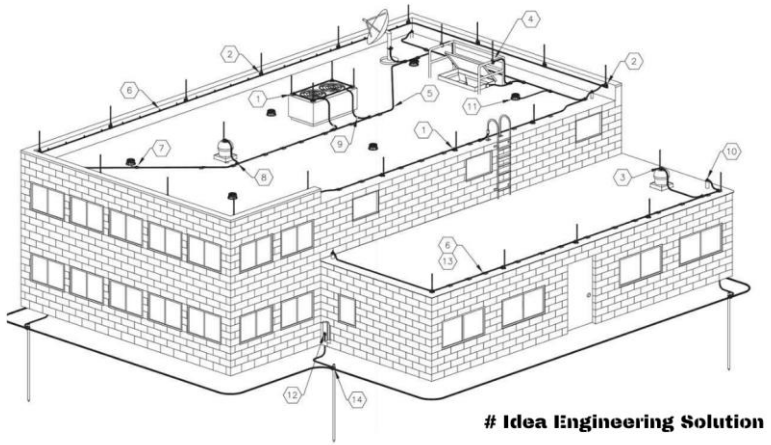
Confirm

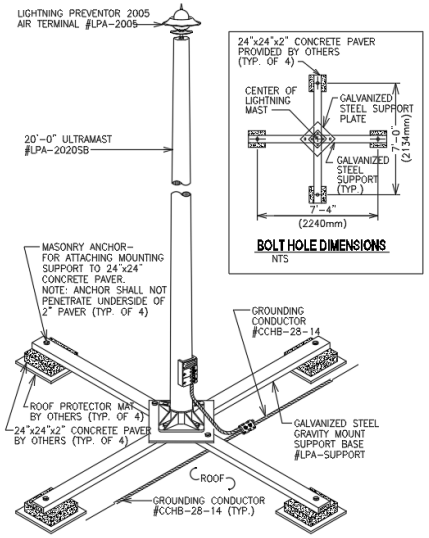
March 27, 2025

CONFIRM

Both systems compliant with NFPA 780 Standard for Lightning Protection Systems







Turner Construction Update (5 minutes)

Site Features – Introduction (5 minutes)

- ❑ Bicycle Parking
- ❑ Alternative Modes of Transport & Infrastructure
- ❑ Field Materials
- ❑ Bleacher System
- ❑ Fencing

Electrical Design – Introduction & Discussion (25 minutes)

- ❑ Generator Load List & Size of Diesel Generator
- ❑ Electrical Service Calcs
- ❑ Lighting – lighting control, classroom lighting, interior lighting approach, building & site lighting
- ❑ Lightning Protection System – **confirm today**

HVAC Design – Discussion (30 minutes)

- ❑ LCCA for HVAC Options
- ❑ Basis of Design HVAC System

Plumbing Design – Discussion (5 minutes)

- ❑ Electric Water Heater vs. Domestic Heat Pump with Electric Back Up

Building Design – Confirmation (5 minutes)

- ❑ Define Assumed Floor to Floor Heights & Typical Ceiling Heights

smma


Introduce
Discuss
Confirm
March 13, 2025
March 27, 2025
April 10, 2025

Life Cycle Cost Analysis Update

Summary HVAC Systems Installation Costs & Incentives

(MassSave and IRA – Construction Incentives)

HVAC System Type	Estimated Installation Costs	Estimated Incentives [MassSave]	Estimated Installation Costs with Incentives [MassSave]	Estimated Incremental costs (savings)	Estimated IRA Incentives	Incremental PV Area (SF) [Parking Canopy]
Code baseline - [boilers/Chiller]	$69,586,840					
***1-Ground Source HP* (BOD)**	$73,789,000	($7,181,500)	**$66,607,500**	($2,979,340)	($17,336,700)	
2-Air Source to Water HP	$54,620,000	($1,707,000)[3]	**$52,913,000**	($16,673,840)		~11,000 SF [1 parking strip]
3-Hybrid 1 and 2	$64,241,000	($4,189,750)	**$60,051,250**	($9,535,590)	($8,668,350)	
4-Air Source VRF HP	$53,425,000	($2,203,500)	**$51,221,500**	($18,365,340)		~16,000 SF [1 ½ parking strip]

Notes:

1. System Costs($) based on the PSR Cost Estimates. Total system costs includes all HVAC equipment. GSHP System Costs includes bores/wells/casings for the GSHP system.
2. Code Baseline system: Natural gas boilers and chillers (VAV/water cooled) – ASHRAE App G system #7.
3. AtWHP (central air source) using $150/ton. Eversource may apply custom [higher] incentives upon review/approval.
4. Associated Costs include:
   - Option 1 and 3: existing site fields re-construction at $2,800,000 and temporary heating plant at $3,200,000 for option 1. Option 3 associated costs are 50% lower, as the GSHP system is ½ the size of option 1.
   - Option 2 and 4: Incremental parking solar PV canopy area and costs vs. BOD required for NZE annual energy usage.

Life Cycle Cost Analysis Update

Preliminary SD LCCA Analysis Summary

Estimated 75-year LCCA Costs as Net Present Value

HVAC System	Installation Cost	Replacement Cost	Maintenance Cost	Energy Cost	Total 75-year LCCA Costs	Total 75-year LCCA w/ Construction Incentives and Associated Costs	
						MassSave	IRA
Code Baseline	$69,586,840	$46,041,831	$4,691,113	$38,599,898	$158,920,000		
1-Ground Source HP	$73,789,000	$19,246,00	$4,010,000	$26,267,000	$123,312,000	**$116,131,000**	**$98,794,300**
2-Air Source to Water HP	$54,620,000	$20,157,00	$4,010,000	$27,799,000	$106,586,000	**$104,879,000**	
3-Hybrid 1 and 2	$64,241,000	$19,701,000	$4,010,000	$27,089,000	$115,041,000	**$110,852,000**	**$102,183,650**
4-Air Source VRF HP	$53,425,000	*$18,561,000*[4]	$3,416,000	$28,368,000	$103,770,000	***$101,567,000***	

Notes:

1. Installation costs are based on the PSR project cost estimates. Replacement costs are specific to each system, based on ASHRAE useful life data and using unit costs for equipment and labor, brought forward as Net Present Value (NPV) costs. Maintenance costs are estimated to include third-party service to systems, but not in-house routine maintenance.
2. Energy costs based on energy modeling analysis, using the 2023-24 Lexington utility bills' average [blended] annual $0.24/kWh (baseline $1.40/Therm), with a 3% cost escalation rate. The energy costs do not include peak load reductions expected from the project's Solar PV/Battery Storage sytems. Peak demand costs are approximately 50% of Lexington's annual utility costs. The battery storage peak load reduction will bring utility energy costs benefits. The Total 75 yr. LCCA Cost is the sum of Installation, Replacement, Maintenance and Energy costs. Net Present Value modeled on a 75-year lifecycle cost, 3% cost depreciation.
3. Construction Incentives include MassSave NZE Path 1, Heat Pumps Incentives, POE incentives. and IRA (as applicable to the GSHP system) . Post-occupancy annual incentives (revenues) are not included: Demand Response and peak load reduction utility incentive programs, and potential annual Renewable Energy Certificate (REC) for the GSHP.
4. ASHP Replacement Costs includes 15-year end of life replacements (5) over the 75-year LCCA.
5. Associated Costs include:
   - Option 1 and 3: existing site fields re-construction at $2,800,000 and temporary heating plant at $3,200,000 for option 1. Option 3 associated costs are 50% lower, as the GSHP system is ½ the size of option 1.
   - Option 2 and 4: Incremental parking solar PV canopy area and costs vs. BOD required for NZE annual energy usage.

Life Cycle Cost Analysis Update

Summary Incremental Costs & Paybacks

Installation Incremental Cost & Payback Summary Relative to HVAC Systems Code Baseline Costs				
HVAC System	**Estimated Incremental Costs (Savings)**		***Estimated Annual Energy Costs Savings***	***Estimated Payback***
	Incl. MassSave	**Incl. IRA**		**Vs. Baseline**
Code Baseline [ASHRAE system 7]				
1-Ground Source HP (BOD)	($2,979,340)	($20,316,040)	$415,234	0 yr.
2-Air Source to Water HP	($16,673,840)		$363,654	0 yr.
3-Hybrid Option 1 and 2	($9,535,590)	($18,203,940)	$387,580	0 yr.
4-Air Source VRF HP (refrig.)	($18,365,340)		$344,514	0 yr.

Notes:

1. Energy Savings: based on total annual kWh savings, using the average 2023-24 $0.24/kWh (utility bills). Peak demand savings not included (in progress)
2. Incremental Costs are based on the PSR Cost Estimates and include materials and labors and are based on a per cost comparison to the analysis system baseline (ASHRAE 90.1-2019 App G).
3. Code Baseline system: Natural gas boilers and water-cooled chillers (VAV) – ASHRAE App G system #7.
4. Associated Costs include:
    - Option 1 and 3: existing site fields re-construction at $2,800,000 and temporary heating plant at $3,200,000 for option 1. Option 3 associated costs are 50% lower, as the GSHP system is ½ the size of option 1.
    - Option 2 and 4: Incremental parking solar PV canopy area and costs vs. BOD required for NZE annual energy usage.

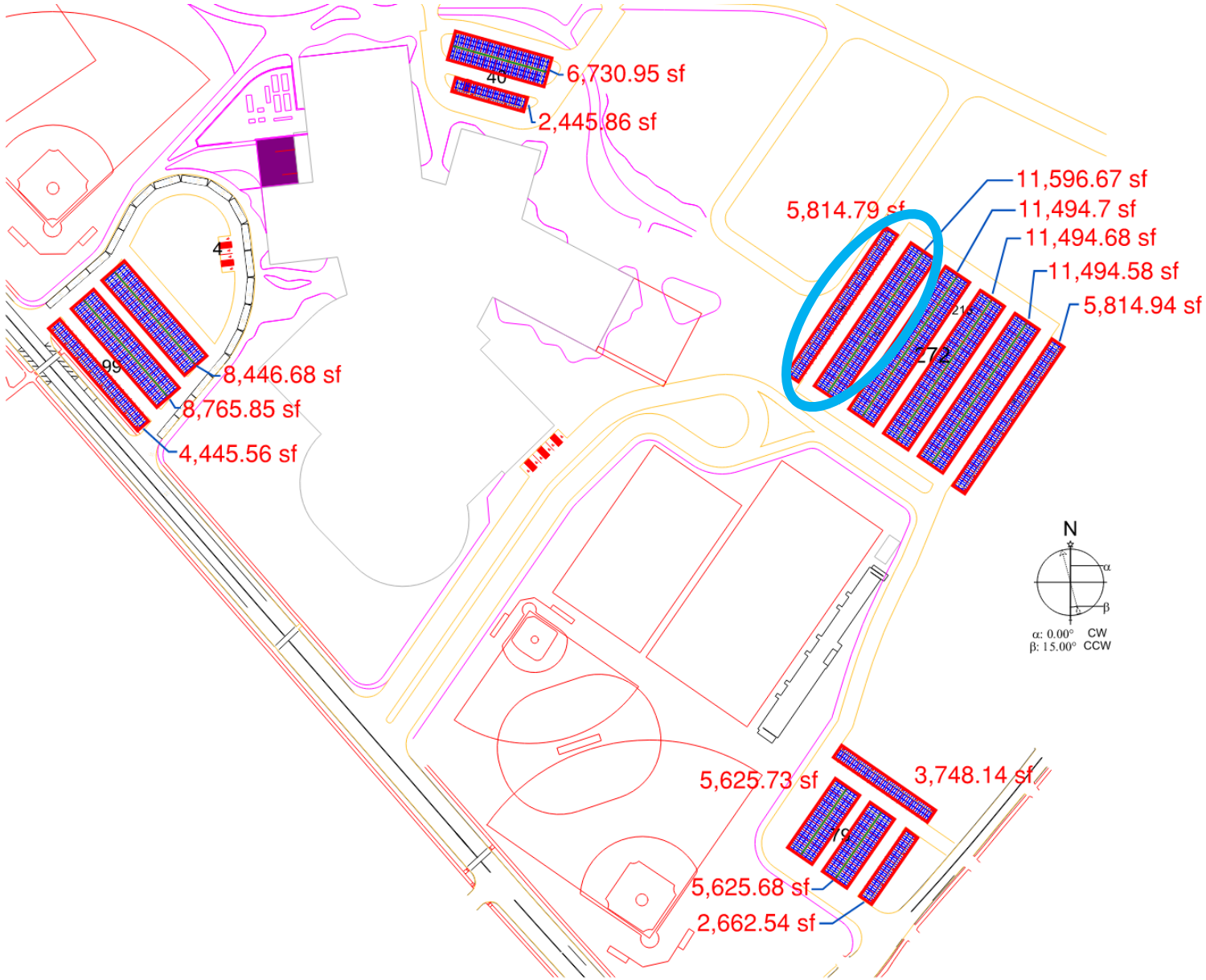
Life Cycle Cost Analysis Update

Incentive Program	Incentives			
	Option 1 GSHP	**Option 2 AtWHP**	**Option 3 Hybrid (1,2)**	**Option 4 ASHP/VRF**
Mass Save				
NZE - <25EUI – Path 1 (1A)	$1,018,000	$763,500	$1,018,000	$763,500
Post occupancy verification	$763,500	$763,500	$763,500	
Heat Pump Systems	$5,400,000	*$180,000*[4]	*$2,790,000*[4]	$1,440,000
Total Potential Incentives -MassSave	**$7,181,500**	**$1,707,000**	**$4,189,750**[4]	**$2,203,500**
Inflation Reduction Act				
Ground Source Heat Pumps	$17,336,700	N/A	$8,668,350	N/A

Notes:

1. Preliminary load is estimated as 1,200 Ton based on proposed high school program, including AHUs and DOAS units
2. Mass Save Incentive subject to approval for custom AHUs and DOAS units.
3. ASHP/VRF using $1,200/ton.
4. AtWHP (central air source) using $150/ton. Eversource may apply custom [higher] incentives upon review/approval.
5. IRA Incentive up to 30% for GSHP requires compliance with Prevailing Wage and Apprenticeship criteria. Incentive can extend to cover complete system (borehole field and building systems) depending on compliance. Additional IRA Incentive for GSHP system possible through the use of domestic content (from 2 to 10%)
6. GSHP cost basis is from PSR estimate and carries full geothermal cost.

Translating PV into Site Area



Turner Construction Update (5 minutes)

Site Features – Introduction (5 minutes)

- ❑ Bicycle Parking
- ❑ Alternative Modes of Transport & Infrastructure
- ❑ Field Materials
- ❑ Bleacher System
- ❑ Fencing

Electrical Design – Introduction & Discussion (25 minutes)

- ❑ Generator Load List & Size of Diesel Generator
- ❑ Electrical Service Calcs
- ❑ Lighting – lighting control, classroom lighting, interior lighting approach, building & site lighting
- ❑ Lightning Protection System – **confirm today**

HVAC Design – Discussion (30 minutes)

- ❑ LCCA for HVAC Options
- ❑ Basis of Design HVAC System

Plumbing Design – Discussion (5 minutes)

- ❑ Electric Water Heater vs. Domestic Heat Pump with Electric Back Up

Building Design – Confirmation (5 minutes)

- ❑ Define Assumed Floor to Floor Heights & Typical Ceiling Heights

smma


Introduce
Discuss
Confirm
February 20, 2025
March 27, 2025
April 10, 2025

Domestic Hot Water Options

- Air source heat pump system
- Water source heat pump system
  From geothermal
- Solar thermal
  Drain back system
- Electric storage type

- LCCA for each system

Life Cycle Cost Analysis Update – Solar Hot Water System

Preliminary SD LCCA Analysis Summary

Estimated 75-year LCCA Costs as Net Present Value

Domestic Hot Water (DHW) System	Installation Cost	Replacement Cost	Maintenance Cost	Energy Cost	Total 75-year LCCA	EUI (kBtu/SF/Yr.)
Code Baseline-Electric HW Tanks	$409,000	$766,494	$148,509	$1,253,529	$2,578,000	1.2
DHW – Air Source HP	**$810,000**	**$521,724**	**$371,273**	**$626,764**	**$2,330,000**	**0.6**
DHW -Ground Source HP	$485,000	$302,543	$207,913	$417,843	$1,413,000	0.4
DHW- Solar HW System	$1,653,000	$1,045,821	$445,527	$62,676	$3,207,000	(1.2)

Notes:

1. Installation costs are based on the PSR and recent Turner's project cost estimates, as well as at each design phase.
2. Replacement costs are specific to each system, based on ASHRAE useful life data and using unit costs for equipment and labor, brought forward as Net Present Value (NPV) costs.
3. Maintenance costs are estimated to include third-party service to systems, but in-house routine maintenance.
4. Energy costs are based on energy modeling analysis, using the 2023-24 Lexington utility bills, with an average [blended] annual $0.24/kWh, with a 3% cost escalation rate.
5. Total 75 yr. LCCA Cost is the sum of Installation, Replacement, Maintenance and Energy costs. Present Value modeled on a 75-year lifecycle cost, 3% cost depreciation.
6. Costs of the displaced solar PV panels from roof to parking canopy are included in the solar HW system option.

Life Cycle Cost Analysis Update- Solar Hot Water

Summary Incremental Costs & Paybacks

Preliminary SD Incremental Cost & Payback Summary Relative to PSR DHW Systems Code Baseline Costs			
DHW System	***Incremental Costs***	***Estimated Annual Energy Costs Savings***	***Estimated Payback***
Code Baseline-Electric HW tanks			
DHW – Air Source HP (BOD)	***$401,000[3]***	**$21,102**	**19 yrs.**
DHW -Ground Source HP	$76,000	$28,136	3 yrs.
DHW- Solar HW System	$1,244,000	$40,094	31 yrs.

Notes:

1. Energy Savings: based on total annual kWh savings, using the average 2023-24 $0.24/kWh (utility bills).
2. Incremental Costs are based on the PSR and recent Turner's cost estimates and include materials and labors and are based on a per cost comparison to the analysis system baseline (BOD Air Source HP).
3. Air Source HP system costs (Incremental cost) already included into the PSR BOD estimate

Turner Construction Update (5 minutes)

Site Features – Introduction (5 minutes)

- ❑ Bicycle Parking
- ❑ Alternative Modes of Transport & Infrastructure
- ❑ Field Materials
- ❑ Bleacher System
- ❑ Fencing

Electrical Design – Introduction & Discussion (25 minutes)

- ❑ Generator Load List & Size of Diesel Generator
- ❑ Electrical Service Calcs
- ❑ Lighting – lighting control, classroom lighting, interior lighting approach, building & site lighting
- ❑ Lightning Protection System – **confirm today**

HVAC Design – Discussion (30 minutes)

- ❑ LCCA for HVAC Options
- ❑ Basis of Design HVAC System

Plumbing Design – Discussion (5 minutes)

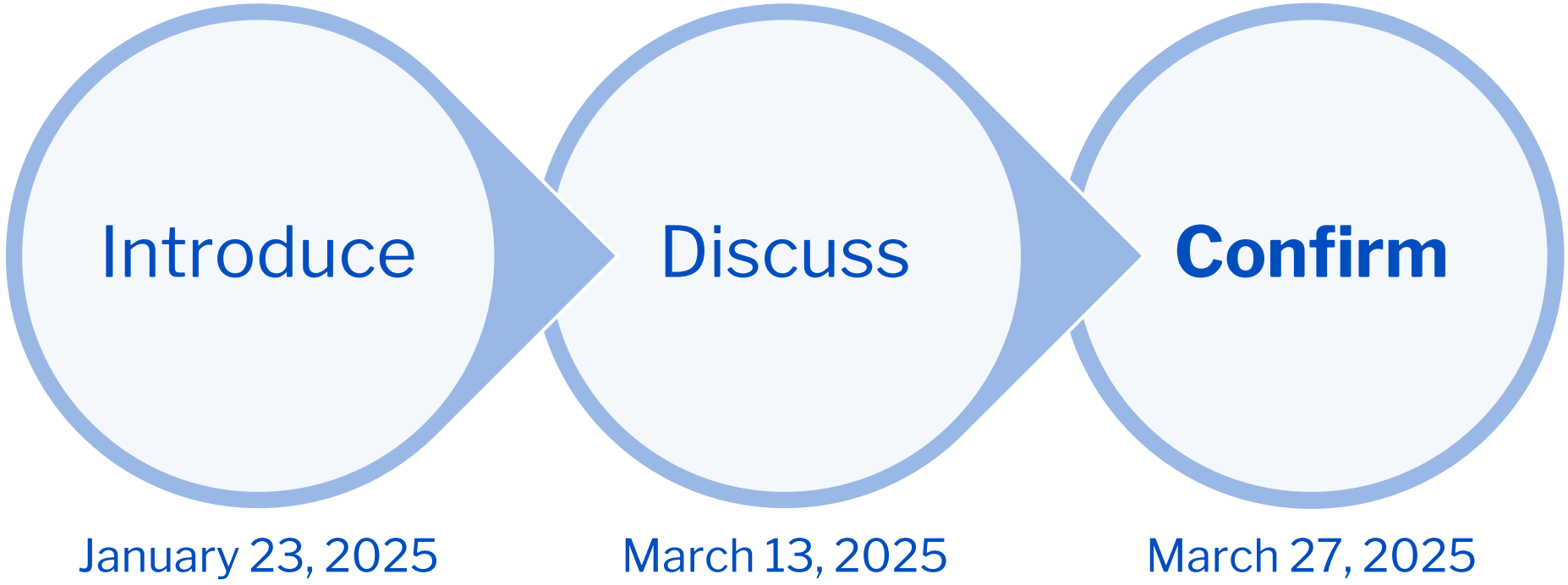
- ❑ Electric Water Heater vs. Domestic Heat Pump with Electric Back Up

Building Design – Confirmation (5 minutes)

- ❑ Define Assumed Floor to Floor Heights & Typical Ceiling Heights

smma

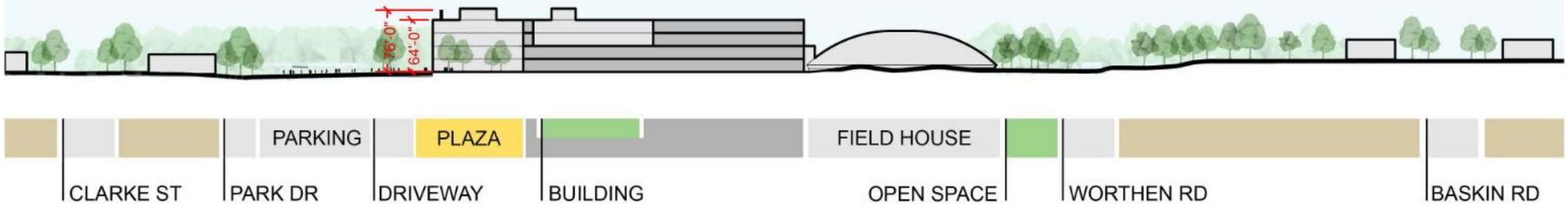
Define Assumed Floor to Floor Heights and Typical Ceiling Heights



Floor to Floor Heights

Impact on Total Building Height

16’-0” floor to floor height
= 64’-0” building height to top of roof*
+ 12’-0” mechanical roof screen
= 76’-0” height to top of screen



SECTION B

0 100' 200' 500' 1000'

* Zoning building height is defined by the vertical distance between the lower elevation (defined as the natural grade of land at the point of measurement prior to disturbance for construction) and the upper elevation (defined as the highest point of any ridge, gable, other roof surface, or parapet). The lower elevation has yet to determined.

Eye-Level View from Clarke Street / Park Drive

Floor to Floor Heights

Schematic Design Considerations

- Mechanical system has yet to be selected
    - Ductwork size is not impacted by use of either ground source or air source heat pumps
    - Every classroom requires a dedicated fan coil unit
    - VRF cassette systems are effective in smaller plenums, but are noisy and not ideal for instructional spaces and are more often used in office spaces
- The structural beam sizes have yet to be designed
- The Level 1 survey elevation has yet to be finalized
- The optimal finish ceiling heights have yet to be determined

- 2/24/25 DPF/LPS Design Meeting Confirmation: 16’-0” floor to floor should be carried forward as the height while the design team looks for potential opportunities for height reductions as more of the major elements listed above are detailed

Ceiling cassette example

Thank you.