



Lincoln School - Financial Assessment

Summary Report by Maclay Architects

in collaboration with Energy Balance, Inc.,
SMMA, Daedalus Projects, Inc

Lincoln, MA
8/15/2018

www.maclayarchitects.com

MaclayArchitects Energy Balance, Inc.

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EXECUTIVE SUMMARY

Energy and Financial Analysis

Maclay Architects, with Energy Balance, Inc., were asked to provide energy modeling and financial analysis of varying levels of energy performance. This energy and financial analysis also looked at the following building designs:

- Existing Building
- Renovation of the Existing Building
- A1.1 Design from SMMA (Dated 1/8/18)
- A3.4 Design from SMMA (Dated 1/8/18)
- B6 Design from SMMA (Dated 1/8/18)

This analysis uses preliminary assessments to provide relative differences between each design over thirty years. There are additional savings beyond 30 years that are not reflected in the following analysis that will be significant.

To determine energy use intensity (EUI)¹ for each design the team modeled each to four energy levels.

3. Renovation of Existing and Additions to Stretch Code
4. Stretch Code Plus - Additions and Renovation
5. Net Zero Ready (NZR)- Additions and Renovation
6. Net Zero - with Solar²

Incremental construction costs for each level of added energy performance was broken out and added to cumulative annual operational energy costs to compare 30-year costs across each design option. To compare each building design to each other the team used the Renovation of the Existing Building as the baseline for each incremental cost.

While the operating costs for Net Zero Ready are estimated to be larger than Stretch Code and Stretch Code Plus, there are two measures that should be considered. First, the options are not exact equals. The NZR and NZ buildings use air source heat pumps (Variable Refrigerant Flow-VRF), in the full building, which will provide cooling throughout all spaces. The Stretch Code and Stretch Code Plus include similar cooling in part of the building and lowered levels of effective cooling in the remainder of

1. Energy Usage Intensity (EUI) is a term that refers to the amount of energy a building uses related to its size. A building's EUI is expressed as kBtu/sf-yr and is akin to a car's fuel mileage.

2. The numbers carried are based on current solar pricing, however, solar regulations and pricing are in a state of change so it is not possible to know the pricing at the time when a possible solar system might be built for the school. Further study of solar is recommended. See the Appendix for more information on the price of solar assumed in this analysis.

the building. Secondly, while it is impossible to know what fuel escalation rates will be in the future, overall new energy sources are trending toward using renewable energy to produce electricity with an increasingly smart grid. Thus, the net zero option is an investment in the most likely cost effective infrastructure of the future.

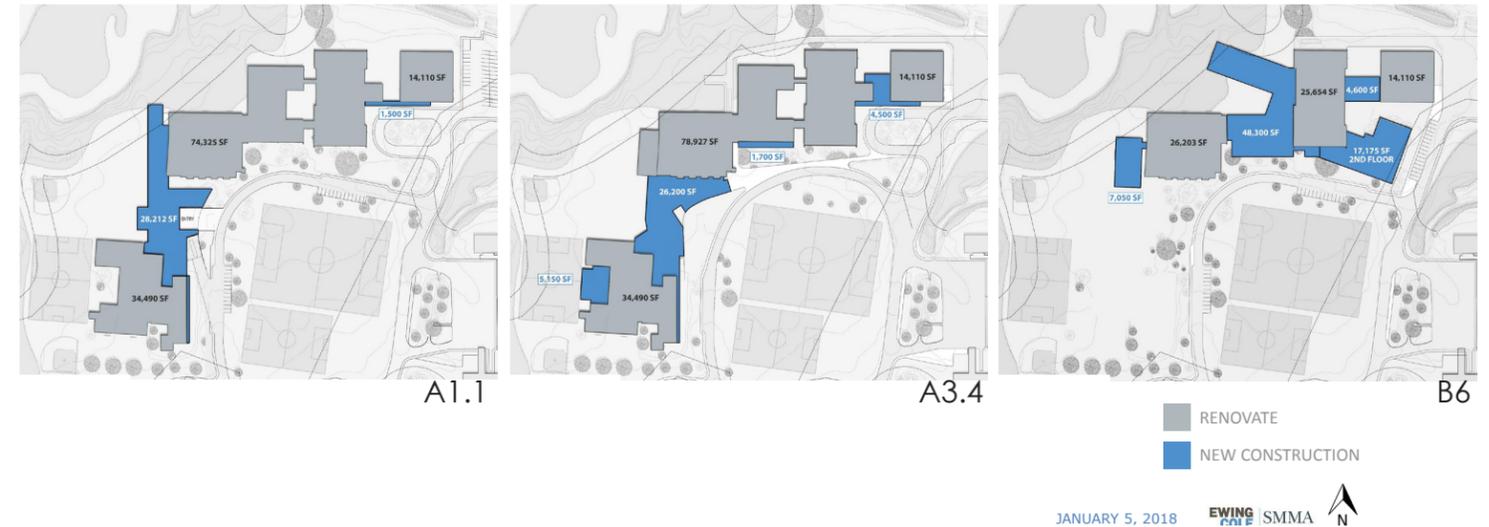
RECOMMENDATION

In all three building designs, Net Zero with Solar is the least cost option over thirty years and beyond.

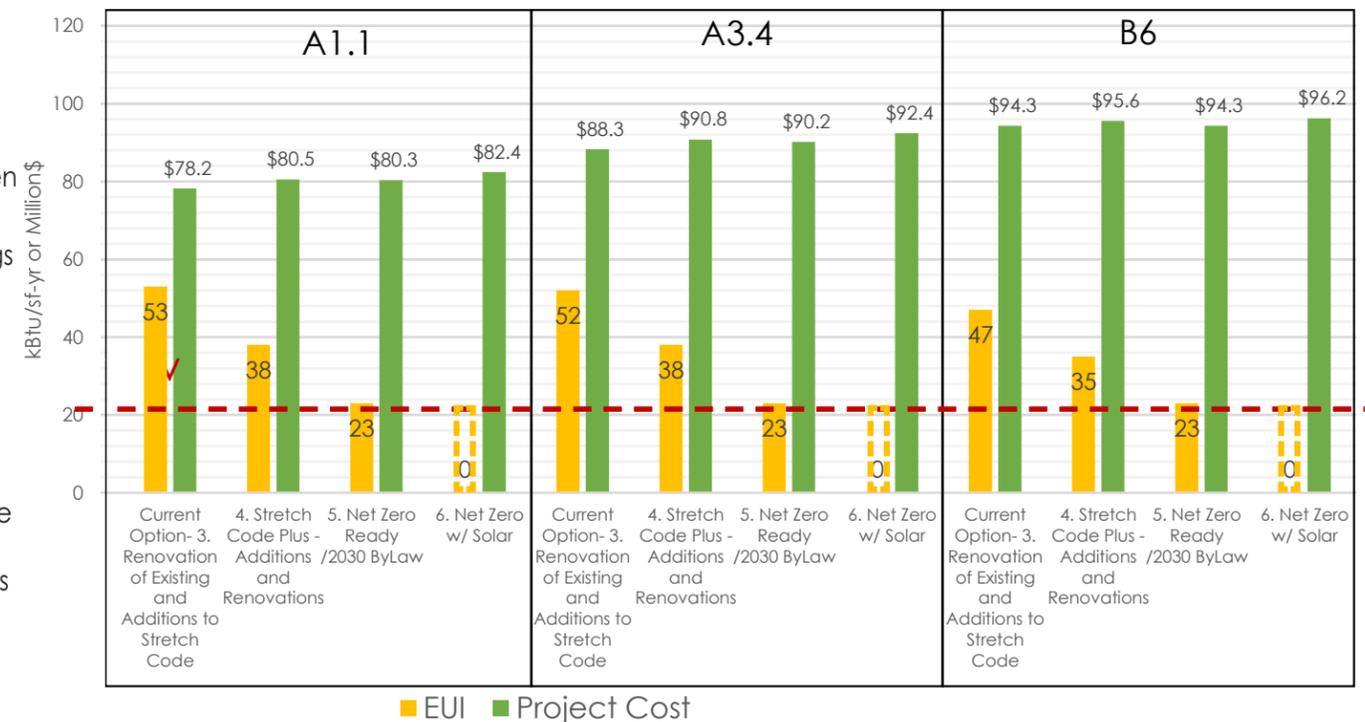
The Net Zero buildings compared to the base renovation (3. Renovations of existing and additions to Stretch Code), saves \$1 million, \$1.4 million, and \$4.3 million over thirty years for A1.1, A3.4 and B6 respectively. When the Net Zero buildings are compared to the Stretch Code Plus or Net Zero Ready buildings, additional savings will occur.

Overall Summary Conclusions:

- For all building designs, the least cost are the Net Zero buildings with solar photovoltaics, which saves between \$1-4.3 million over 30 years, with B6 saving the most.
- The Net Zero buildings have an average annual savings above the Stretch Code buildings of \$34,000-\$144,000, with B6 having the highest average yearly energy savings.
- Over 30 years, design B6 has the lowest energy and incremental capital costs, however, the total project costs and EUIs for all building designs are similar.
- Building design B6 has the lowest energy costs because it is a more efficient use of floor area and volume. The two-story design is a more efficient envelope and it has proportionally more new construction which is more energy efficient than the renovated parts.



Project Cost and EUI Comparison
*no financing included



Financial Assessment

In order to determine the financial implications of renovating the Lincoln School to Stretch Code, Stretch Code Plus, Net Zero Ready, and Net Zero, Maclay Architects and Energy Balance, Inc., were hired to analyze three building designs by SMMA. By determining the incremental capital costs to build to each energy level and the associated operational energy costs, a financial analysis provides additional information to the project team and client to make the project the most prudent investment for the Town of Lincoln.

The following table summarizes the Energy Usage Intensity (EUI)¹ of each of the options compared to the project cost.

The existing building EUI of 65 kBtu/sf-yr is based on the information provided by the Lincoln School. The 2030 bylaw EUI target of 22 kBtu/sf-yr is based on the May 21st 2018 Webex with SMMA and the Town's Energy Committee where there was agreement on all Target Finder inputs [Option C (B6)]. The resulting Target Finder's Median Site EUI of 110.1 kBtu/sf-yr. The Town 2030 Bylaw 80% reduction then brings down the goal to an EUI of 22 kBtu/sf-yr.

In order to reach the 2030 bylaw goal EUI of 22 kBtu/sf-yr, the envelope and mechanical systems have been cost optimized for a building EUI of 23 kBtu/sf-yr. On-site renewable energy, Solar Photovoltaics in this case, will reduce the energy consumption to below the 2030 bylaw level with an EUI goal of 9 kBtu/sf-yr.

The total project cost and incremental energy costs, were determined by Daedalus Project, Inc. In order to compare the three different building designs, the team used the baseline of 2. Renovation only of the existing building to determine incremental costs. Total project costs use a different baseline: 2. Renovation of Existing and Addition

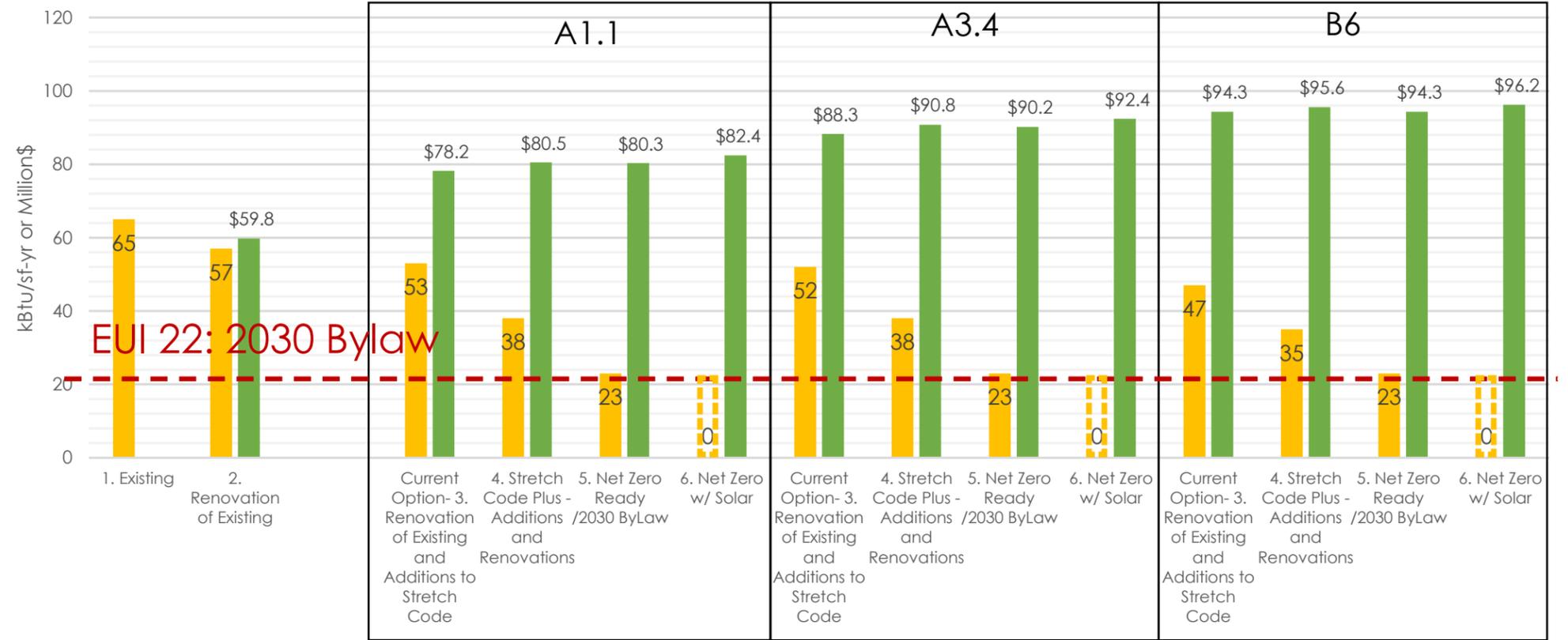
The solar photovoltaic size needed to offset the Net Zero Ready energy use for each design option was determined from the energy model by Energy Balance, Inc. The cost of the system is estimated on \$2.50/watt installed², with the array fitting on the roofs and on solar carports on site. *Solar Design Associates 8/9/16 Town of Lincoln Solar PV Analysis*, calculated the area for solar photovoltaics at the Lincoln School to be adequate to install the size needed for each design option. Further solar study will be required to finalize the approach, location, and size of the system.

1. Energy Usage Intensity (EUI) is a term that refers to the amount of energy a building uses related to its size. A building's EUI is expressed as kBtu/sf-yr and is akin to a car's fuel mileage.

2. Solar cost are \$2.50/watt and financed at the same rates as the building. The cost of solar was developed through conversations with Steven Strong at Solar Design Associates: \$1.75-\$2 for that size system roof mounted, \$2.25-\$2.50 for ground mounted, and \$2.75-\$3.25 for carports. This price is the best guess at the time of the report and should be studied further.

Project Cost and EUI Comparison

*no financing included



EUI 22: 2030 Bylaw

■ EUI ■ Project Cost

	Current Option-2. Renovations of Existing	Current Option-3. Renovation of Existing and Additions to Stretch Code	4. Stretch Code Plus - Additions and Renovations	5. Net Zero Ready /2030 ByLaw	6. Net Zero w/ solar	PV size	\$ for PV
Existing EUI	65						
Repair Only							
Total Project Cost	\$49.1						
Predicted EUI	57						
Renovation Only							
Total Project Cost	\$59.8						
Predicted EUI	57						
Option A1.1A							
Total Project Cost		\$78.2	\$80.5	\$80.3	\$82.4	850 kW	\$2.1
Predicted EUI		53	38	23	0		
Option A3.4							
Total Project Cost		\$88.3	\$90.8	\$90.2	\$92.4	860 kW	\$2.2
Predicted EUI		52	36	23	0		
Option B6.1							
Total Project Cost		\$94.3	\$95.6	\$94.3	\$96.2	770 kW	\$1.9
Predicted EUI		47	35	23	0		

Note - Cost in millions and EUI in kBtu/sf-yr

22 80% reduction from New England School EUI - 2030 Bylaw (metric to meet by 2020)

Source: based on the May 21st 2018 Webex with the Town's Energy Committee where we agreed on all Target Finder inputs [Option C (B6)]. The resulting Target Finder's Median Site EUI of 110.1. The Town 2030 Bylaw 80% reduction then brings down the goal to an EUI of 22. <https://www.eia.gov/consumption/commercial/>



Lincoln School - Financial Assessment

Lincoln, MA

Project Cost and EUI Comparison

August 15, 2018

Energy Balance, Inc. MaclayArchitects

30-year Capital and Energy Cost Analysis

The graphs on the next three pages summarize each design to the various energy levels compared to the total bonded project cost and the incremental bond costs with energy costs.

The left graphs show the total building and bond cost and the to energy costs. The right graph shows the incremental building cost for each option and the energy costs.

The graphs break out capital costs for envelope energy upgrades and mechanical system upgrades (green), bond interest (red) and 30-year energy costs (blue), for each option. The Net Zero building also have the cost of solar (purple) and the solar bond interest (pink).

The cumulative savings over 30 years for the Net Zero buildings above the Stretch Code ranges from \$1 million to \$4.3 million. The building lifespan would be beyond the 30 years examined in this graph, therefore the operational savings will continue to increase over time and be even greater.¹

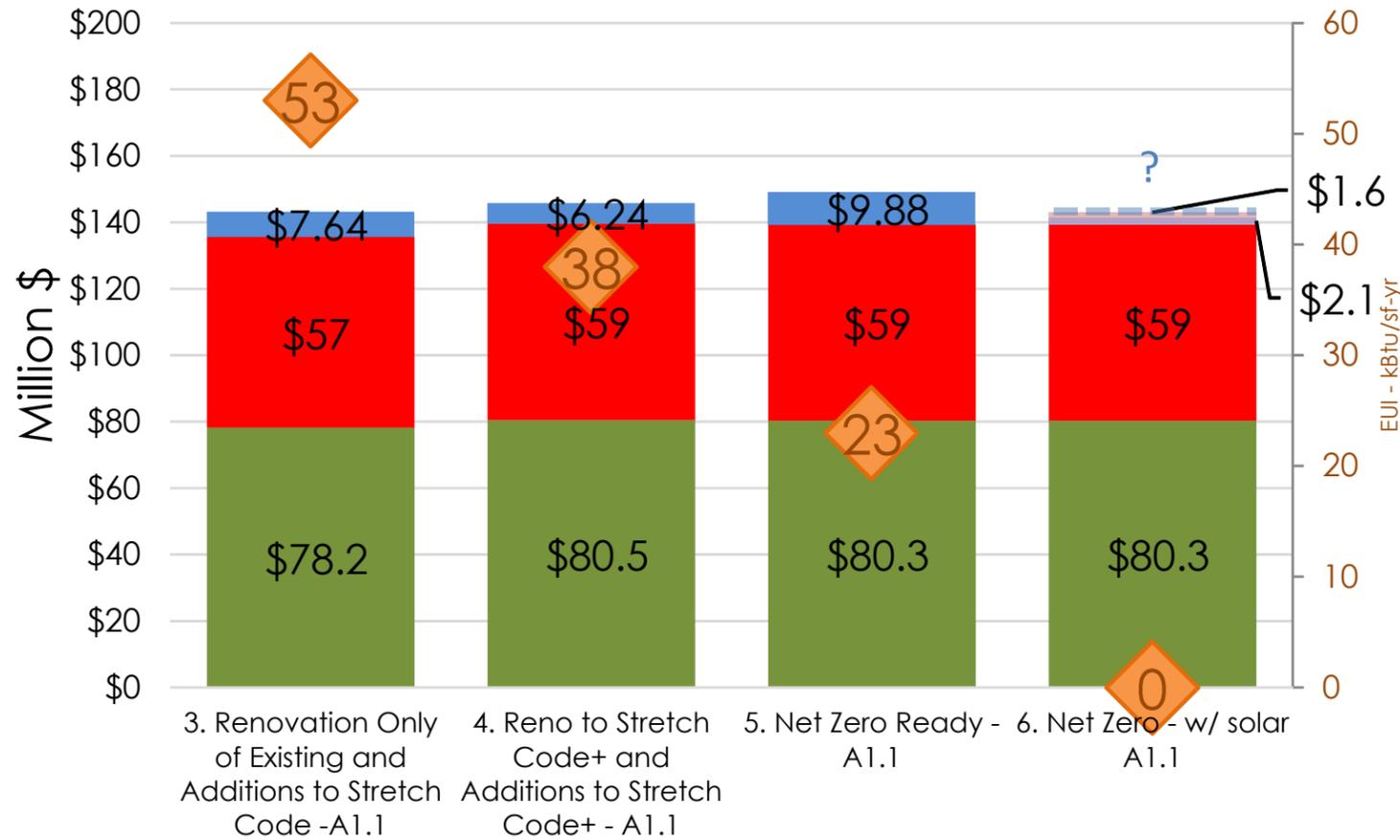
This analysis assumes a 2% fuel escalation rate, 4% bond rate, and a 0% discount rate. See the Appendix of this report for additional detailed information.

¹. It should be noted that energy savings are less than they would be in many other regions of the US because current electricity costs are relatively expensive and natural gas prices are relatively inexpensive.



A1.1

30-year Present Value of Energy and Total Bond Costs w/ EUI

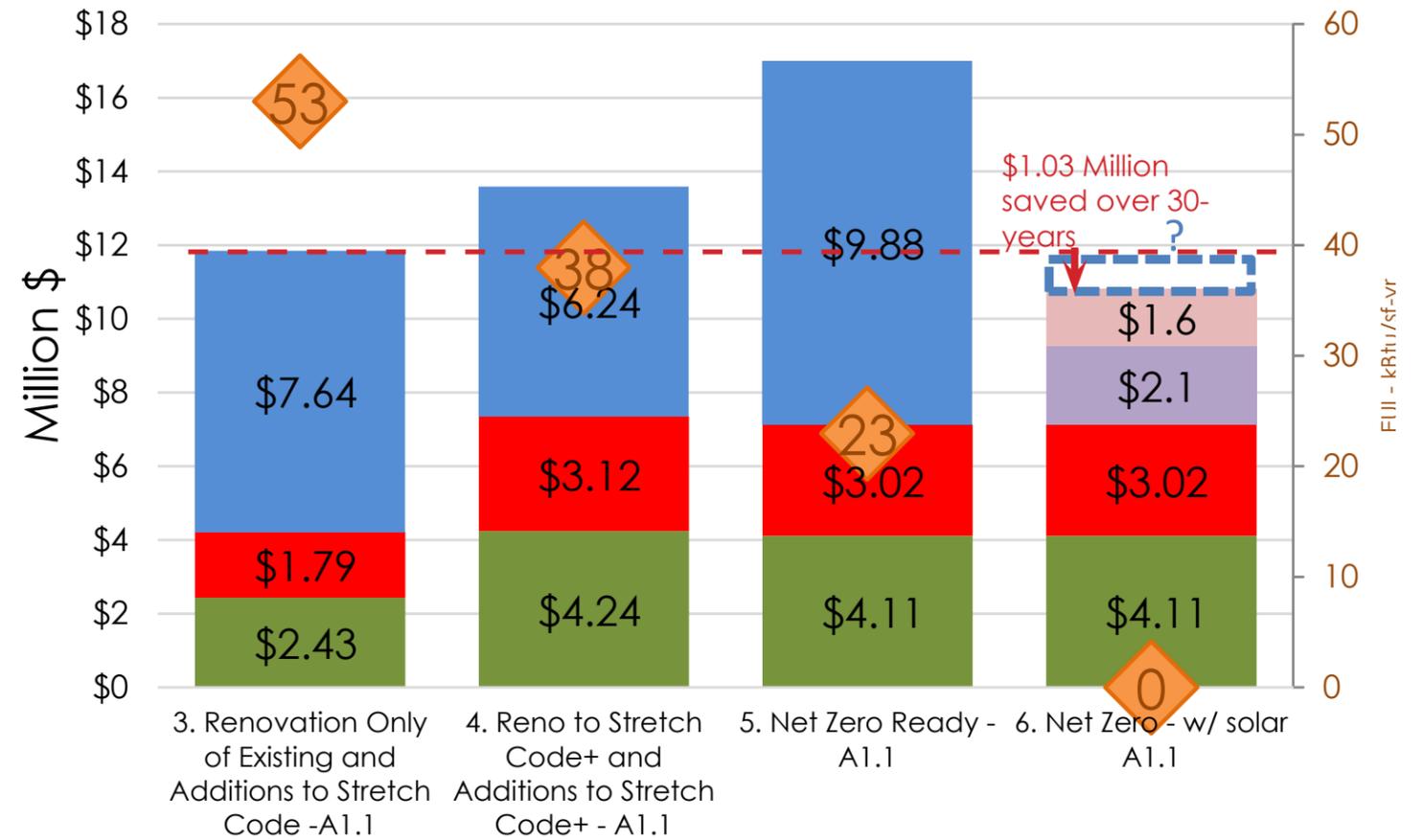


- Building Cost
- Building Bond Interest
- Solar Cost
- Solar Bond Interest
- Energy Costs
- ◆ EUI

Source: Maclay Architects

A1.1

30-year Present Value of Energy and Incremental Bond Costs w/ EUI



- Building Cost
- Building Bond Interest
- Solar Cost
- Solar Bond Interest
- Energy Costs
- ◆ EUI

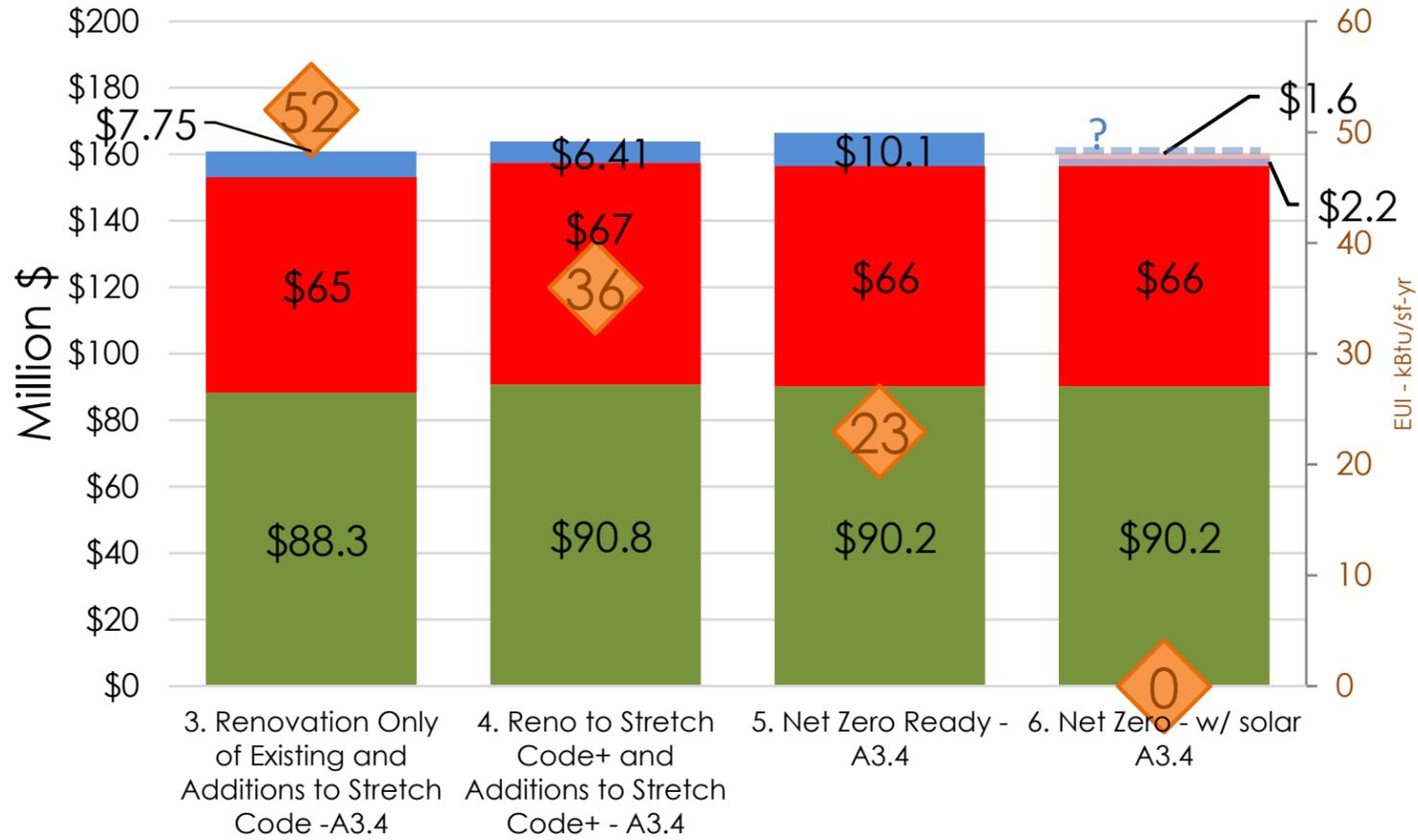
Source: Maclay Architects

Average annual savings of \$34,000



A3.4

30-year Present Value of Energy and Total Bond Costs w/ EUI

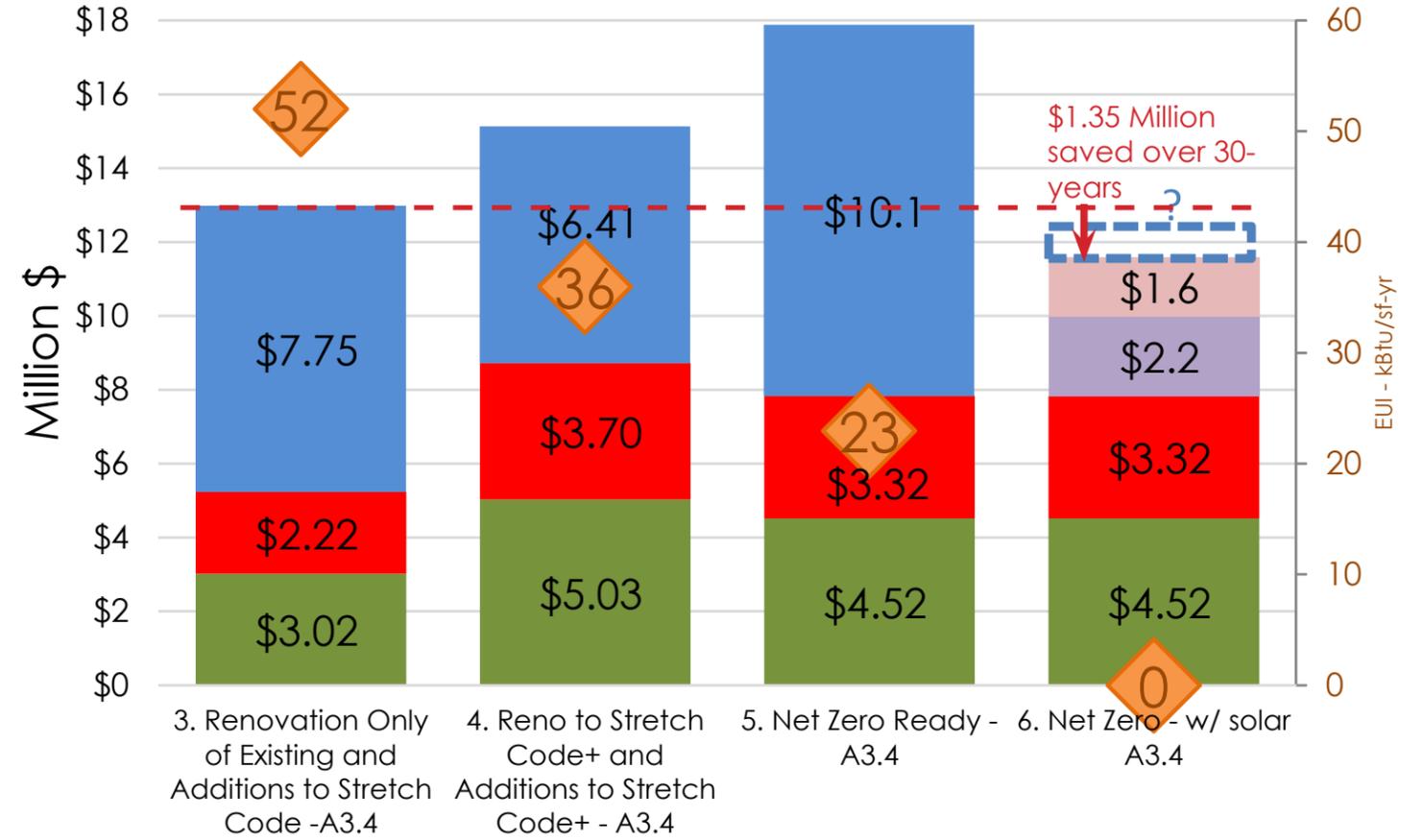


- Building Cost
- Building Bond Interest
- Solar Cost
- Solar Bond Interest
- Energy Costs
- ◆ EUI

Source: Maclay Architects

A3.4

30-year Present Value of Energy and Incremental Bond Costs w/ EUI



- Building Cost
- Building Bond Interest
- Solar Cost
- Solar Bond Interest
- Energy Costs
- ◆ EUI

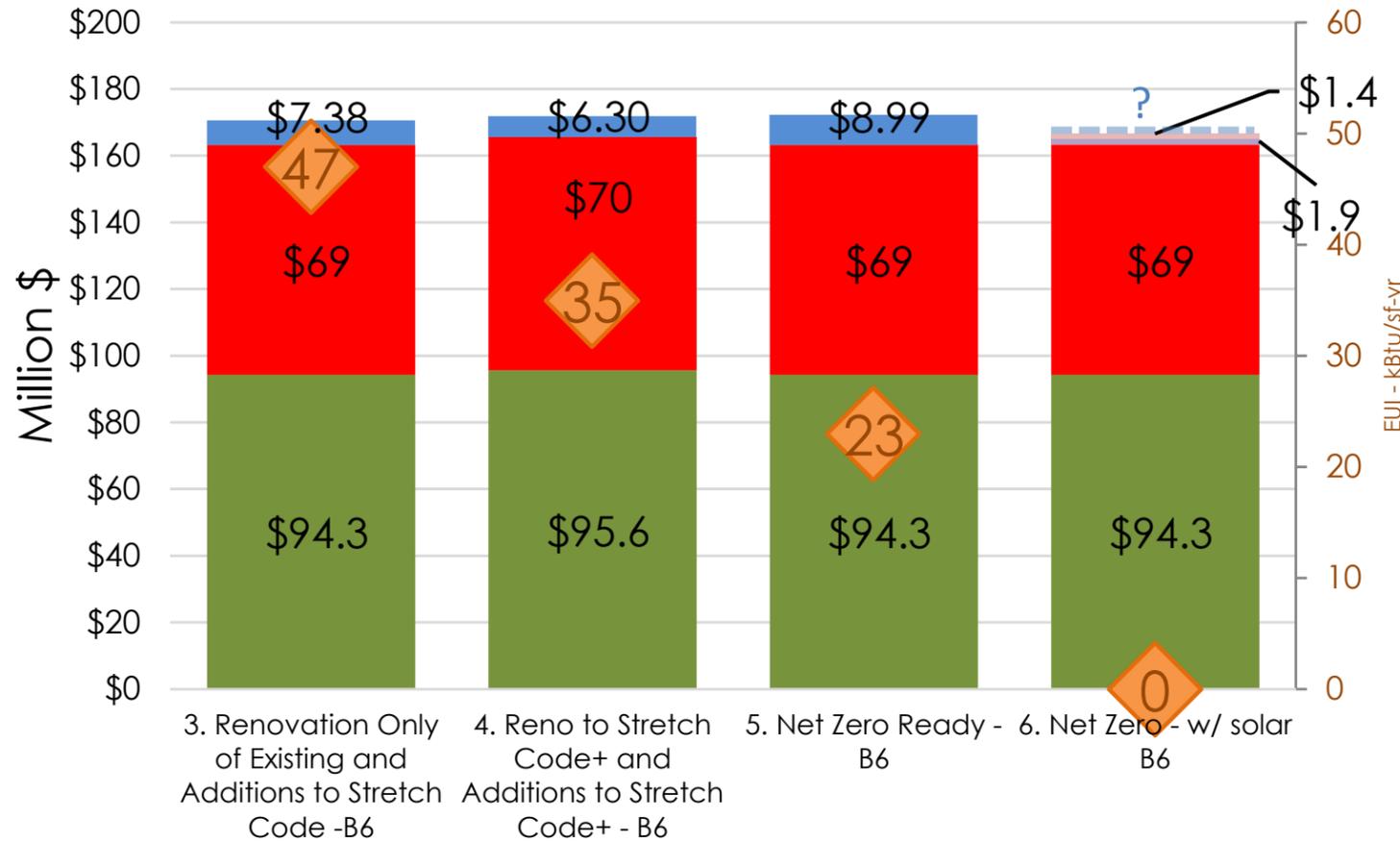
Source: Maclay Architects

Average annual savings of \$45,000



B6

30-year Present Value of Energy and Total Bond Costs w/ EUI

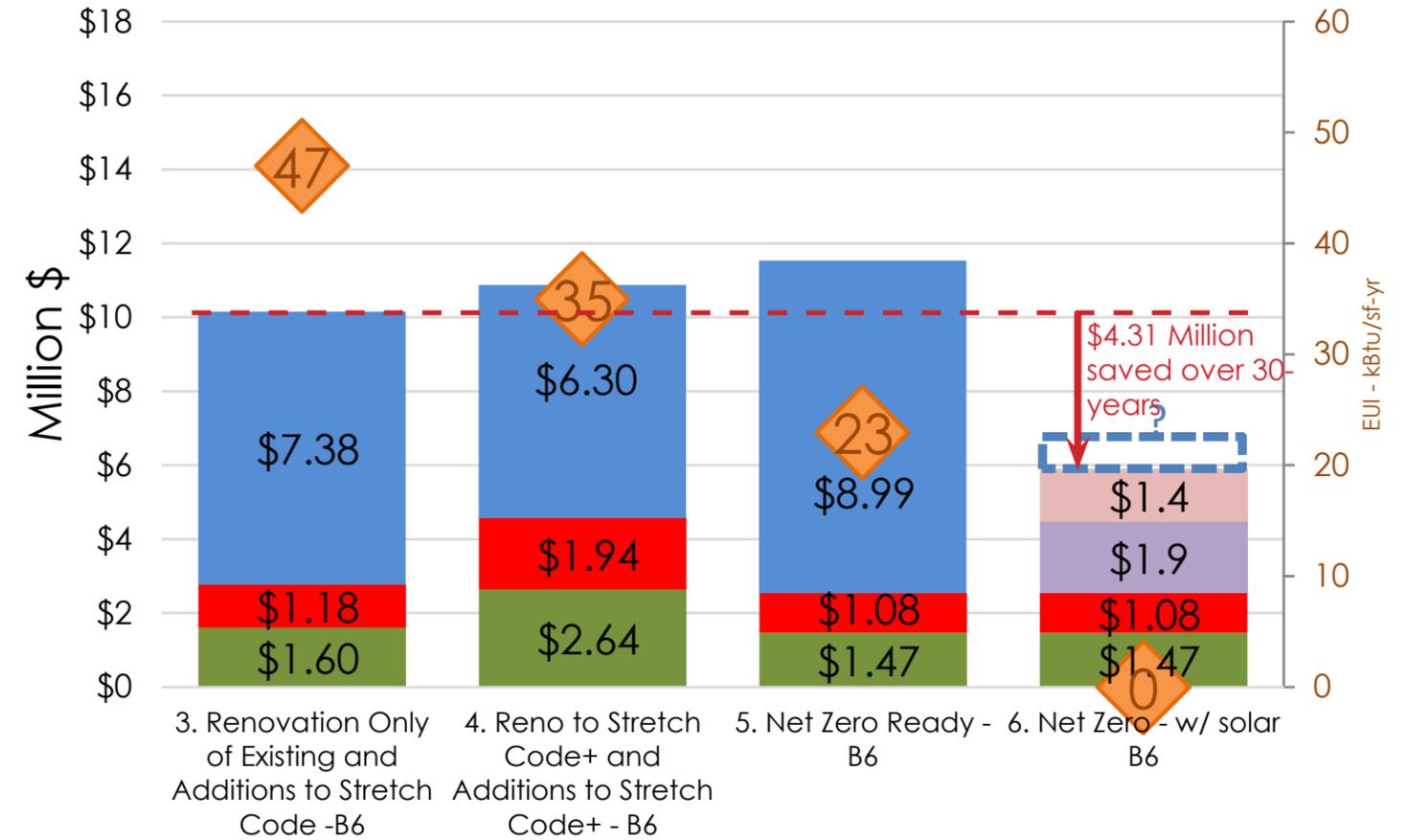


- Building Cost
- Building Bond Interest
- Solar Cost
- Solar Bond Interest
- Energy Costs
- ◆ EUI

Source: Maclay Architects

B6

30-year Present Value of Energy and Incremental Bond Costs w/ EUI



- Building Cost
- Building Bond Interest
- Solar Cost
- Solar Bond Interest
- Energy Costs
- ◆ EUI

Source: Maclay Architects

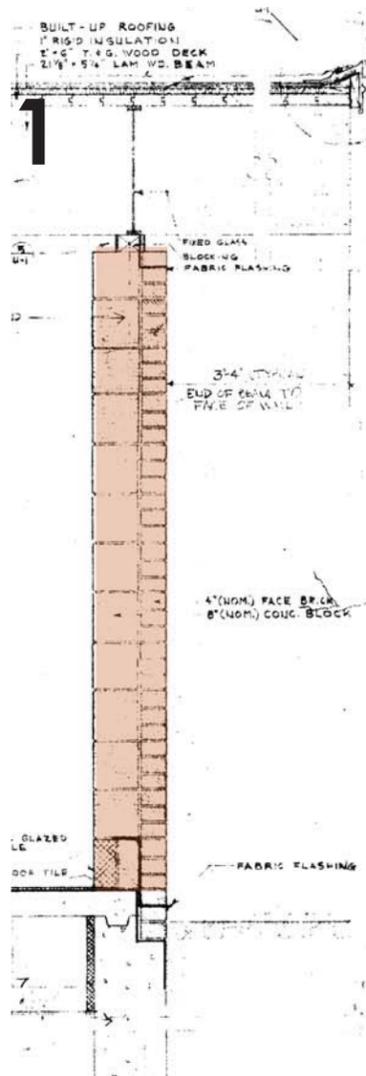
Average annual savings of \$144,000



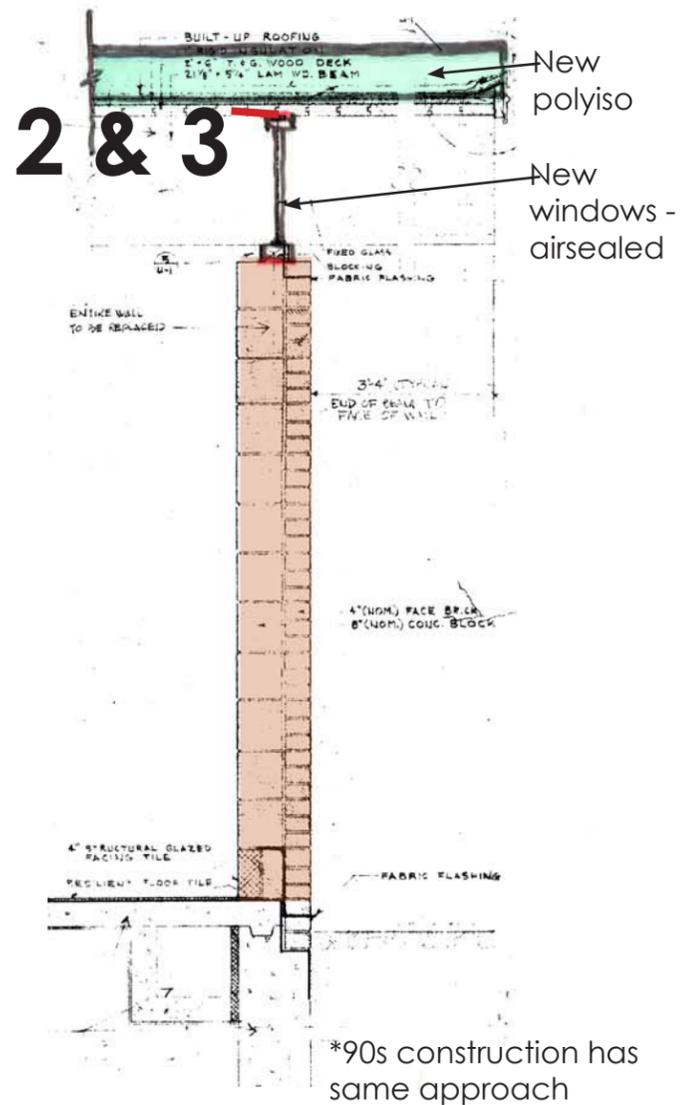
Appendix

- Wall assembly Diagrams Renovation
- Wall assembly Diagrams Additions
- Modeling Assumptions
- Energy Model Results
- Financial Assessment Assumptions
- SMMA design options examined - 1/8/18
- Incremental Cost Estimate Summary- Daedalus Projects, Inc.
- Detailed Cost Estimate - Daedalus Projects, Inc.

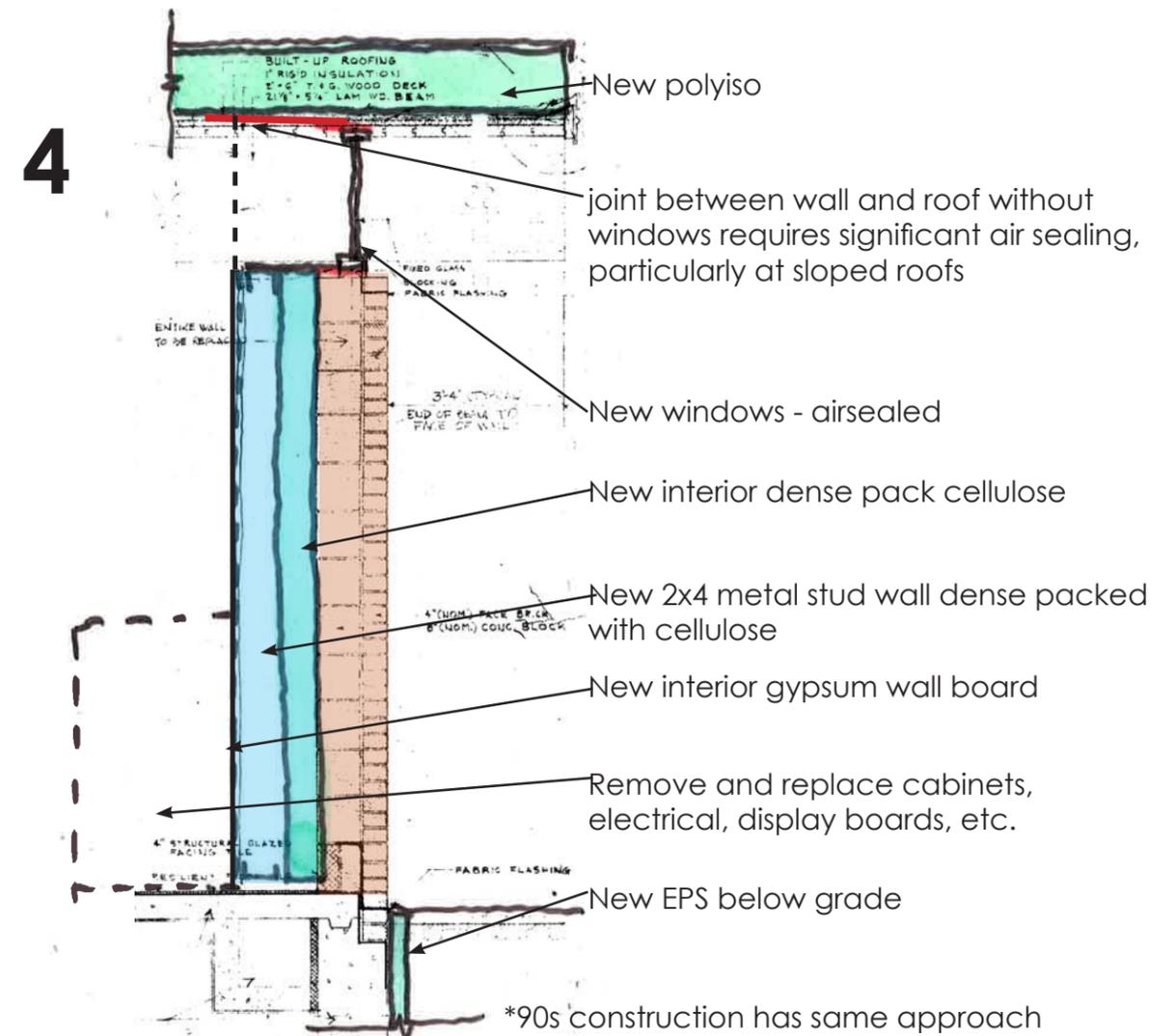




Existing
No change to envelope



Renovation
 Roof - New 5" polyiso on top of existing metal or wood deck, new membrane, all roofs except Reed Gym (no change)
 Walls - no change
 Reed Gym - R-18 (3" insulated metal panel or equivalent) for 50% of the wall; bottom of Reed gym walls no added insulation
 Windows/Doors/Skylights - Replace all see Energy Matrix for model
 Airseal - around windows when replacing
 Other -

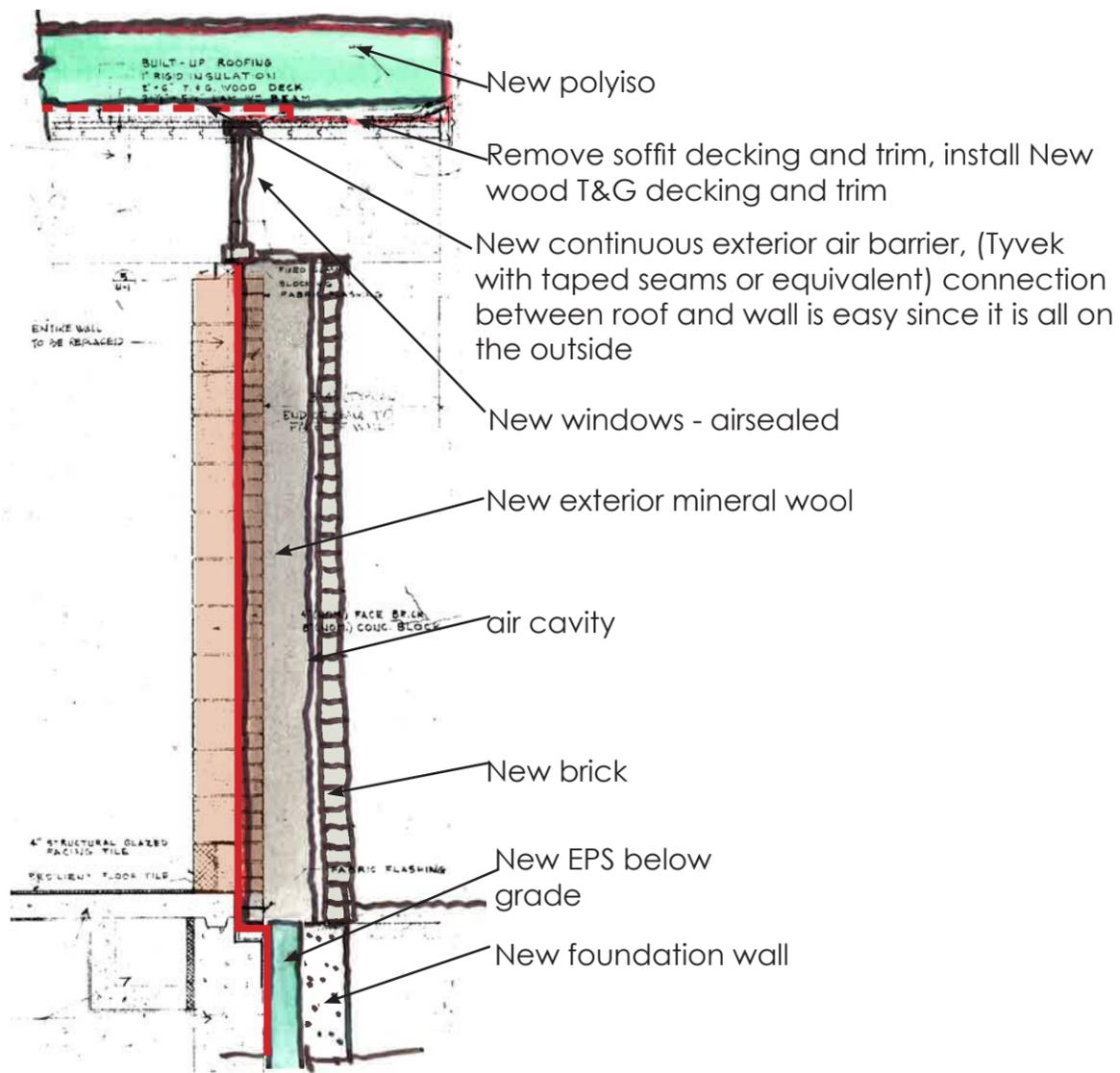


Renovation to Stretch Code+
 Roof - New 7" polyiso on top of existing metal or wood deck, new membrane, all roofs except Reed Gym (no change)
 Walls - 8" interior dense pack cellulose, metal stud wall, new gypsum wall board throughout
 Reed Gym - 4" mineral fiber exterior of CMU with masonry cladding
 Windows/Doors/Skylights - Replace all see Energy Matrix for model
 Foundations - Excavate to expose exterior foundation wall install 2" EPS to 48" below grade, backfill. Reed Gym only - new foundation wall to support new masonry
 Airseal - around windows when replacing, interior connections of wall and roof, difficult air sealing due to inconsistent air barrier on interior walls and difficult roof/wall connection and therefore expensive
 Other - At new stud walls at interior side of exterior walls:
 1. Relocate all electrical switches, outlets, boxes, etc to new interior stud wall
 2. New base at new walls
 3. Patch existing ceilings to install new walls
 4. Remove and reinstall existing visual display surfaces
 5. Remove all interior casework and rebuild new



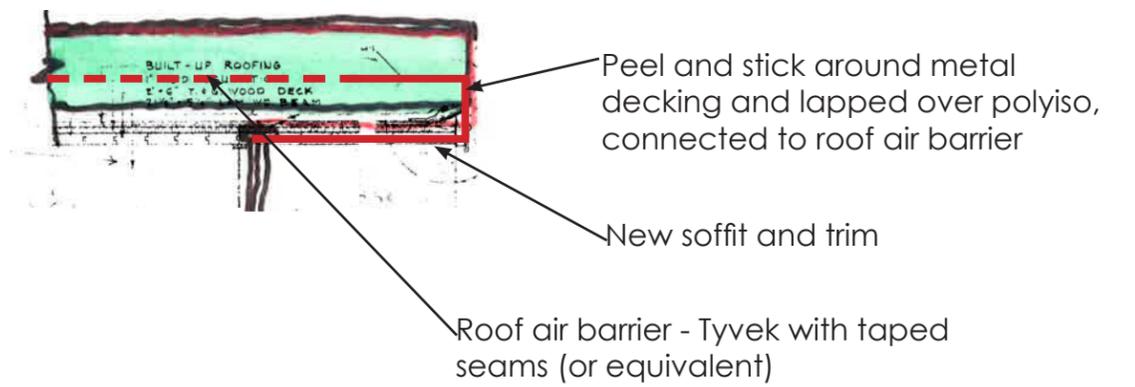
5a

w/ wood decking



5b

w/ metal deck



(All other conditions the same as 5a)

Renovation to Net Zero Ready

Roof - New 9" polyiso on top of existing metal or wood deck, new membrane, all roofs except Reed Gym (no change)

Walls - Remove brick, install 8" mineral wool, FERRO 8" Heavy Duty Rap-Tie or equivalent, install new brick

Reed Gym - 8" exterior mineral fiber behind masonry cladding

Foundations - Excavate to expose exterior foundation wall install 4" EPS to 48" below grade, pour new 9" foundation wall and footing to support cladding, backfill

Windows/Doors/Skylights - Replace all see Energy Matrix for model

Airseal - from exterior, wrap around soffit to roof deck, therefore simple and effective

Other - Boiler/dehumidification room may not be needed (or smaller)



3

Additions to Stretch

Roof - 5" polyiso, membrane roof

Walls - 2" continuous mineral fiber exterior, 3.5" batt in steel stud, masonry cladding;

Windows/Doors/Skylights - see Energy Matrix for model

Foundation - 2" on frost wall to footing, continuous with 2" EPS sub slab insulation

Airseal - continuous exterior air barrier

Other -

4

Additions to Stretch Code +

Roof - 7" polyiso, membrane roof

Walls - 3.5" continuous mineral fiber exterior, 5.5" batt in steel stud, masonry cladding;

Windows/Doors/Skylights - see Energy Matrix for model

Foundation - 2" on frost wall to footing, continuous with 2" EPS sub slab insulation

Airseal - continuous exterior air barrier

Other -

5

Additions to Net Zero Ready

Roof - 9" polyiso, membrane roof

Walls - exterior insulation -8" continuous mineral fiber, FERRO 8" Heavy Duty Rap-Tie or equivalent, masonry cladding

Windows/Doors/Skylights - see Energy Matrix for model

Foundation - 4" on frost wall to footing, continuous with 4" EPS sub slab insulation

Airseal - continuous exterior air barrier

Other - New boiler/dehumidification room not included (or smaller)



Energy Model Assumptions

Modeling Parameters for Lincoln Additions (per SMMA)

- Wall heights, ft 14
- Window/wall 30%
- Connector walls all glass
- LPD = existing 1.2 wsf reno/new 0.6 wsf

students	7-10 with pre-K kindergarten
students without pre-K staff nose count (peak)	660
typical staff count (average)	160
Buck to confirm	

Lincoln School
180115

Assumptions for Energy Modeling

1

Notes on EUI, kBtu/sq.ft.-yr.	
New England CBECs schools average	150
2030 target from Town/Net Zero Ready	25-30
"in between" estimate	40
Stretch code estimate	50-60
Actual Lincoln School most recent yr	75

2

Existing

1

Building Enclosure	Existing	Renovation Only	Renovation Only of Existing and Additions to Stretch Code	Reno to Stretch Code+ and Additions to Stretch Code+	Net Zero Ready
Fiat ceiling / sloped ceiling	Assume all existing roofs are effective R-12; Reed gym R-20 new PVC roof on top of tectum	5" polyiso R-30 on top of metal or wood deck, membrane -- all roofs; Reed roof stays as is, 4" polyiso	5" polyiso on top of metal or wood deck, membrane -- all roofs (Stretch code is R-30 which would be 5" polyiso); Reed roof stays as is, 4" polyiso	7" polyiso on top of metal or wood deck, membrane -- all roofs except Reed; Reed roof stays as is, 4" polyiso	R-60 -- 9" min. polyiso insulation, membrane, mechanically fastened, except leave Reed gym roof as is.
Existing walls above grade	R-3 older parts of the building, R-5 1994 parts	R-3 older parts of the building, R-5 1994 parts; upper portion of Reed gym will get R-18 (3" insulated metal panels or equivalent R-value with other construction) for 50% of the wall; bottom of Reed gym walls no added insulation	Additions: 2" cont. mineral fiber (R-8) exterior of 3.5" batt in steel stud (R-5 effective in studs), masonry cladding; existing walls no changes. Reed as noted to left	Existing: 4" polyiso interior insulation and in Additions: 3.5" cont. mineral fiber (R-14) exterior of 5.5" batt in steel stud (R-7 effective in studs), masonry cladding. Reed walls all insulated with 4" mineral fiber (R-16) exterior of CMU with brick cladding.	R-34 exterior insulation - 8" mineral fiber behind brick cladding; in Reed gym masonry all with 8" mineral fiber behind brick cladding
Slab edge and frost wall	no insulation; no effective slab edge insulation on 1990's additions	no insulation	Additions only: 2" on frost wall to footing, continuous with sub slab insulation	Existing: bury 2" EPS to 24" below grade, but it is bridged so not effective. 2" EPS to footing in Additions	4" EPS slab edge insulation to footing in existing and in Additions
Under slab	no insulation, except 2" under 1990's additions	no insulation, except 2" under 1990's additions	Additions only: 2" EPS under entire slab, continuous with slab-edge insulation, continuous with wall insulation	Existing: no insulation; Additions: 2" under all slab	4" under new slab, continuous with wall insulation in Additions; none in existing
Windows	double glass - R-1.8	AL TB low-e, low SHGC 0.30 EFCO 5600 U-0.38 all locations, including replacing kalwall panels w/new better insulated kalwall panels -- (2-3/4" System U-0.23; SHGC .25)	AL TB low-e, low SHGC 0.30 EFCO 5600 U-0.38 all locations, including replacing kalwall panels w/new better insulated kalwall panels -- (2-3/4" System U-0.23; SHGC .25)	AL TB low-e, low SHGC 0.30 EFCO 5600 U-0.38 all locations, including replacing kalwall panels w/new better insulated kalwall panels -- (4" System U-0.08; SHGC .04)	R-5 Alpen fiberglass frame, Heat Mirror tripane, low SHGC 0.25; 4" Kalwall system U-0.08, SHGC 0.04
Doors existing, entries and basement	uninsulated. Steel frames - R-2	New insulated door, hollow metal steel frames - R-2; entrances thermally broken ALTB storefront R-2	New insulated door, hollow metal steel frames - R-2; entrances thermally broken ALTB storefront R-2	New insulated door, hollow metal steel frames - R-2; entrances thermally broken ALTB storefront R-2	classroom insulated with thermally broken frames, R-5; entrances ALTB storefront R-2
Skylights	Single plastic-R-1	replace with double plastic -- R 1.8, SHGC-0.7, VLT-0.7	replace with R 1.8, SHGC--0.7 in existing; also in new TBD. If new are Velux U=42 SHGC-0.22, VLT-0.52	replace with R 1.8, SHGC--0.7 in existing; also in new TBD. If new are Velux U=42 SHGC-0.22, VLT-0.52	Wasco Lumira Aerogel skylight, U-0.22, SHGC 0.55, VLT--48
Air leakage rate	0.40 cfm75/sq.ft.shell (6 sides)	0.35 cfm75/sq.ft.-above grade shell	Existing to 0.35 cfm75/sq.ft.-above grade shell; Additions to 0.30 cfm75/sq.ft.	Existing to 0.30 cfm75/sq.ft.-above grade shell and Additions to 0.25 cfm75/sq.ft.	0.10 cfm75/sq.ft.-above grade shell

Systems and Equipment

Existing

Renovation Only

Renovation Only of Existing and Additions to Stretch Code

Net Zero Ready

Heating	unit ventilators, hot water, 2 boiler plants, gas, 80%, 94 wing served by penthouse AHU, split Dx. auditorium. Has custom H&V AHU's	consolidate boiler plant, new 90% boiler, new distribution, radiant panels in all ceilings	consolidate boiler plant, new 90% boiler, new distribution, radiant panels in all ceilings	consolidate boiler plant, new 90% boiler, new distribution, radiant panels in all ceilings	Air source heat pump, wall mounted in classrooms and open spaces; ducted to serve several rooms for small offices; central ASHP system or less expensive distributed smaller ASHP systems -- COP=2.7 for heating; heat recovery system ASHP makes cooling available all spaces
Cooling	94 media center, admin split AHU	From boiler, big recirc loop, water	From boiler, big recirc loop, water	for aud., media, admin and special ed	heat pump water heating, distributed, minimal recirc.; booster on kitchen hot water
Service Hot Water	Unit vents do run, might be blocked off	Unit vents do run, might be blocked off	From boiler, big recirc loop, water	From boiler, big recirc loop, water	Distributed ultra-high 85% efficiency ERV's, no heating coils or DX cooling. Oversized wheels to 85% effective in larger spaces; all CO2 modulating; dehumidification not required with ASHPs
Ventilation	Unit vents do run, might be blocked off	Unit vents do run, might be blocked off	From boiler, big recirc loop, water	From boiler, big recirc loop, water	heat pump water heating, distributed, minimal recirc.; booster on kitchen hot water
Lighting Equipment Controls	mixed fluorescent 1.2 wsf	mixed fluorescent 1.2 wsf	0.70EF; booster on kitchen hot water	0.70EF; booster on kitchen hot water	ASHP systems -- COP=2.7 for heating; heat recovery system ASHP makes cooling available all spaces
Kitchen	one warming kitchen, and one kitchen with a hood; now gas stove and cooking with full 6' or 7' commercial hood	one warming kitchen, and one kitchen with a hood; now gas stove and cooking with full 6' or 7' commercial hood	full kitchen, 5000 cfm hood; 710 student, 60% eat hot lunch, breakfast but no cooking; Melink controlled hood and 80% gas fired MAU	full kitchen, 5000 cfm hood; 710 student, 60% eat hot lunch, breakfast but no cooking; Melink controlled hood and 80% gas fired MAU	Use ASHP central control system w/BACNET to DDC which is for ventilation system primarily full kitchen, 5000 cfm hood with shutoff damper; 710 student, 60% eat hot lunch, breakfast but no cooking; Melink controlled hood and electric or ASHP(?) MAU



Financial Assessment Assumptions

- 4% bond rate (per Buckner Creel Lincoln School)
- 30-year loan (per Buckner Creel Lincoln School)
- \$2.50/watt solar financed at the same rates as above (per Steven Strong at Solar Design Associates: \$1.75-\$2 for that size system roof mounted, \$2.25-\$2.50 for ground mounted, and \$2.75-\$3.25 for carports)
- The Town of Lincoln Solar PV Analysis 8/9/16 by Solar Design Associates shows room on the existing roofs (excluding Reed Gym) is 461 kW and parking structures are an additional 433 kW for a total capacity of 894 kW on site, enough capacity for all options to be Net Zero.
- Option 6. *Net Zero with Solar* has no energy costs (assumes meters/connection charges the same for all options and 1 to 1 credit for each kWh produced)
- Electricity starts at \$0.2208/kWh (per FY 17 commodity + utility delivery charges - per Buckner Creel Lincoln School)
- Natural Gas starts at \$1.397/therm (per FY 17 commodity + utility delivery charges - per Buckner Creel Lincoln School)
- Fuel escalation 2%/yr
- Nominal inflation rate equals the nominal discount rate, therefore 0% used - 2018 dollars

Energy Model Results

Energy Balance, Inc. performed the hourly energy simulation for each design option and renovation level.

Lincoln School Options

2/6/2018

Design Option	1		2		3		4		5	
	Existing		Renovation		Reno Only of Existing + Additions to stretch code		Reno to Stretch CodePlus + Additions to Stretch CodePlus		Net Zero Ready	
	E		R1		R1+AS		RSP + ASP		NZR	
	Natural Gas (Therms)	Electric (kWh)	Natural Gas (Therms)	Electric (kWh)	Natural Gas (Therms)	Electric (kWh)	Natural Gas (Therms)	Electric (kWh)	Electric Heat Pump - heat and cool (kWh)	Other Electric (kWh)
Existing	73,000	503,000	67,000	361,000	x	x	x	x	x	x
A1.1	x	x	x	x	70,000	410,000	46,000	406,000	672,000	431,000
A3.4	x	x	x	x	68,000	435,000	45,000	431,000	667,000	455,000
B6	x	x	x	x	56,000	470,000	37,000	469,000	548,000	456,000



Lincoln Public Schools Ballfield Road Campus

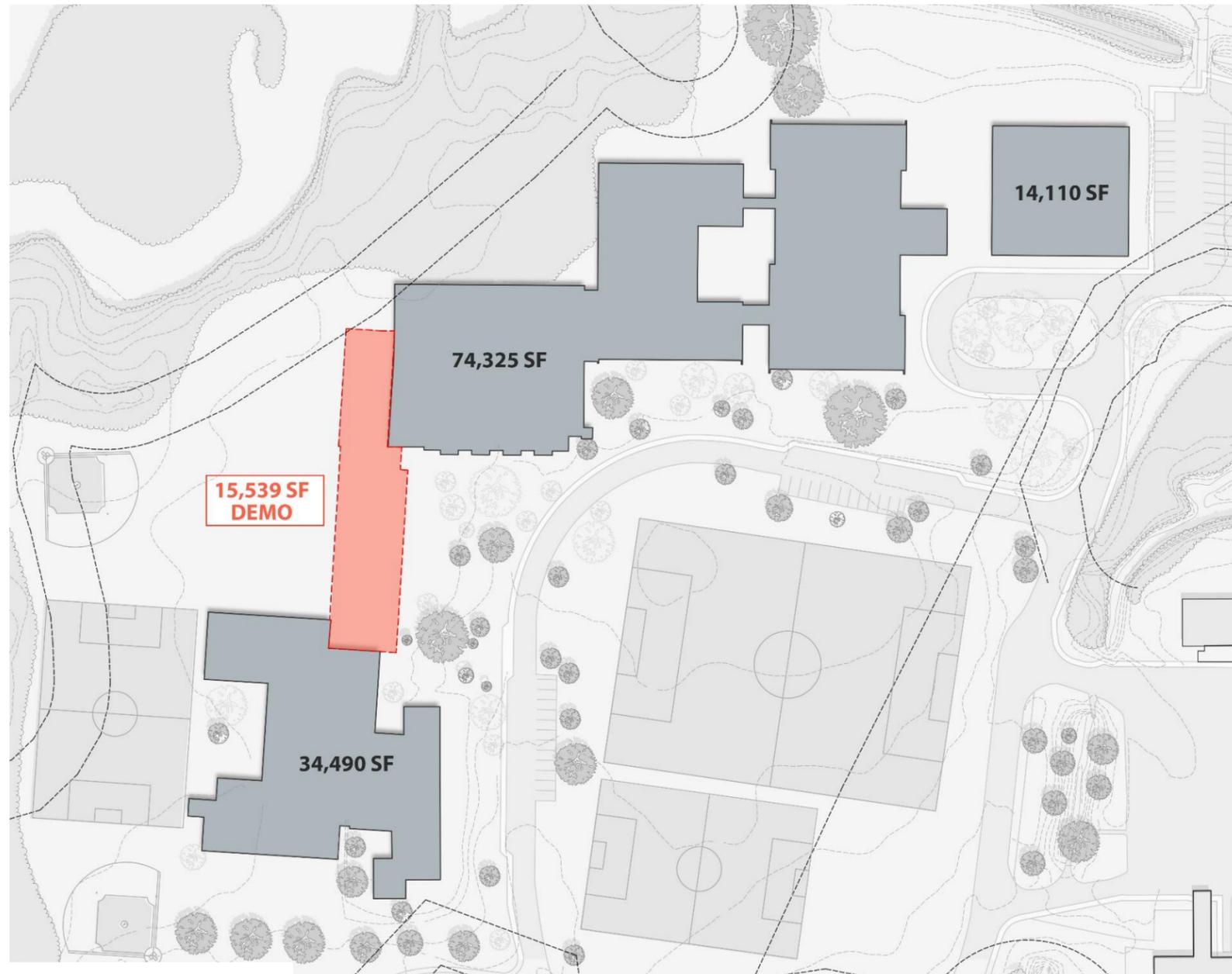
Cost Support Diagrams Conceptual Alternatives

JANUARY 8, 2018

	EXISTING	DEMO	RENO	NEW	Total Diagram
	SF	SF	SF	SF	SF
Option A1.1	138,464	15,539	122,925	29,712	152,637
Option A3.4	138,464	10,937	127,527	37,550	165,077
Option B6	138,464	72,497	65,967	77,125	143,092

EWING
COLE | SMMA





15,539 SF
DEMO

74,325 SF

14,110 SF

34,490 SF

- RENOVATE
- DEMOLITION

OPTION A1.1 JANUARY 5, 2018

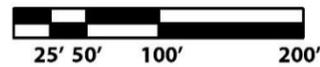
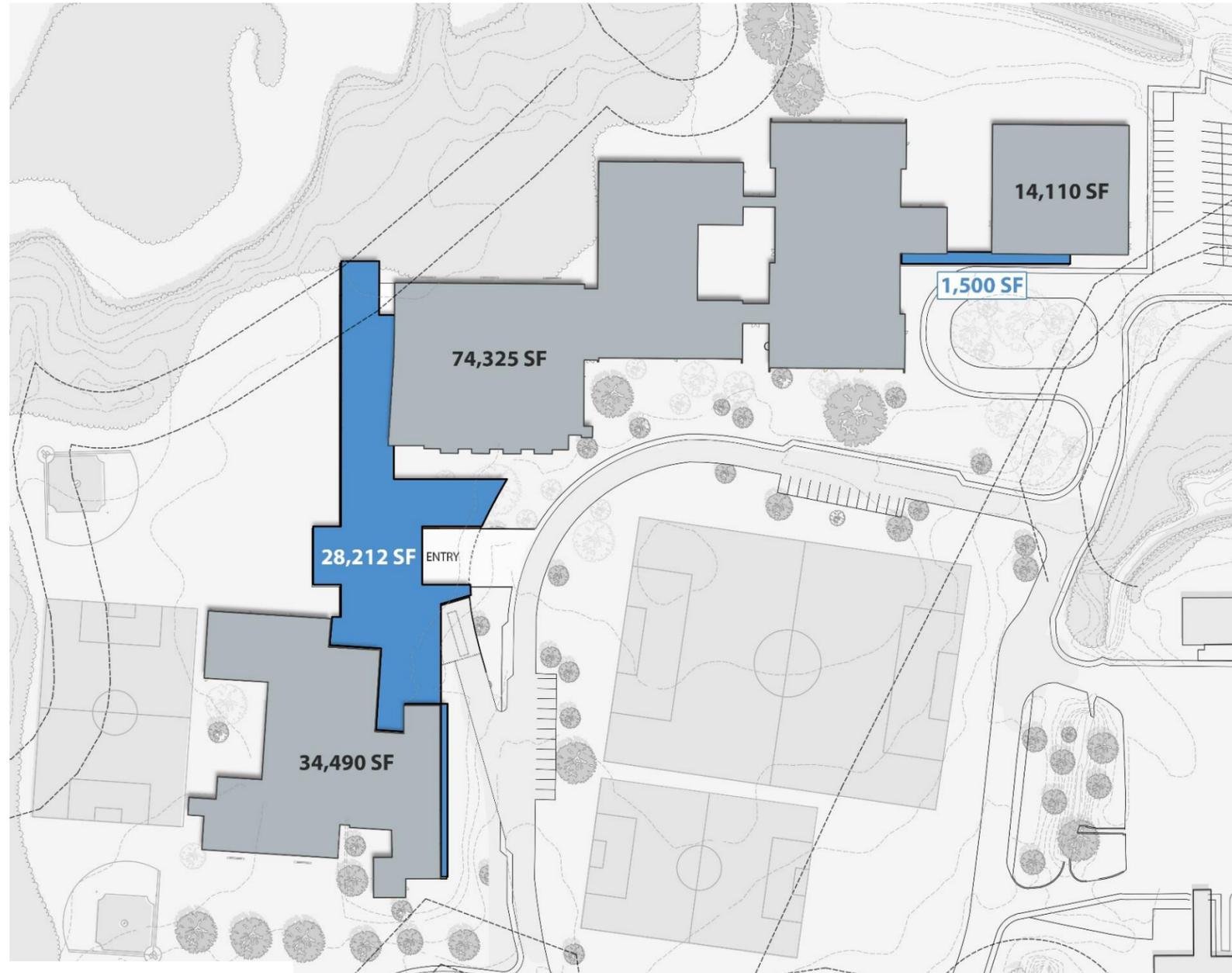
EWING COLE | SMMA



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OPTION A1.1 JANUARY 5, 2018

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- RENOVA TE
- NEW CONSTRUCTION

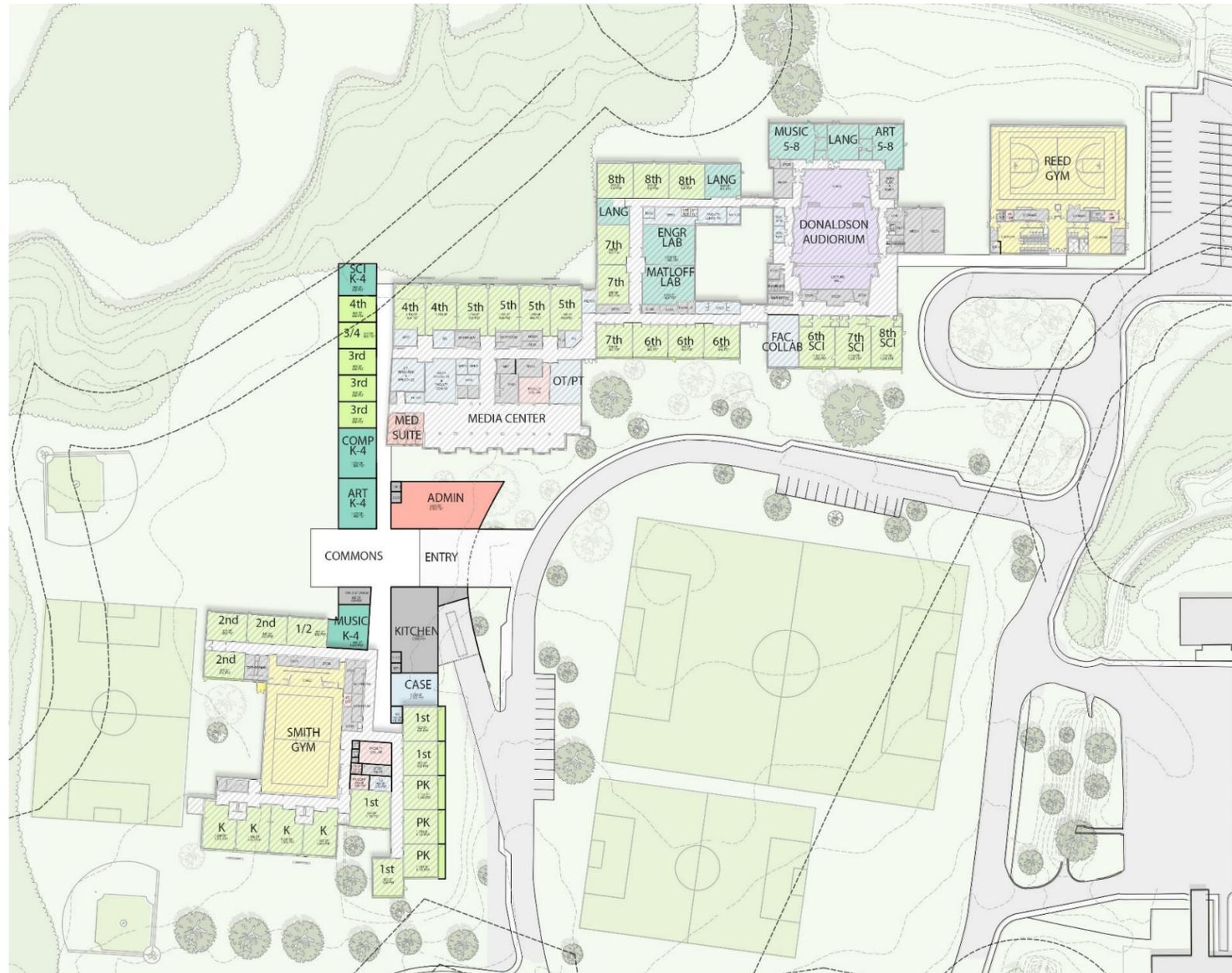


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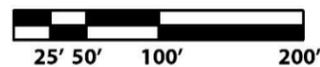
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- ADMIN/ FACULTY
- STUDENT SUPPORT
- MEDIA CENTER
- GYM/ MULTI-PURPOSE
- FACULTY SUPPORT
- CLASSROOMS
-GRADE LEVEL & TEAM TEACHING
- SPECIALS
-ART, MUSIC, LANGUAGE, MEDIA,
INFORMATION, COMUTING &
TECHNOLOGY
- PERFORMING ARTS
- SERVICES



OPTION A1.1 JANUARY 5, 2018

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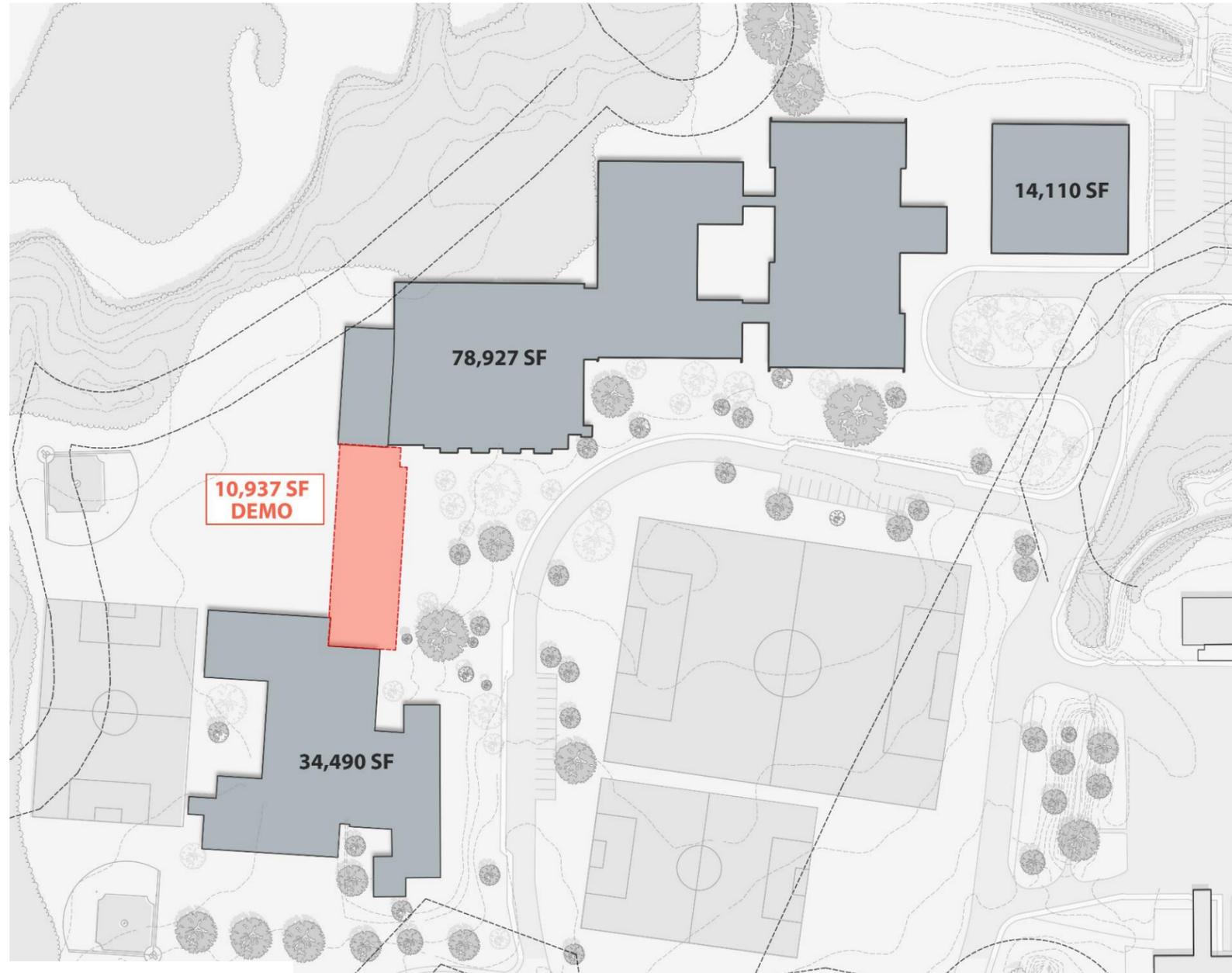


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OPTION A3.4 JANUARY 5, 2018

- RENOVATE
- DEMOLITION

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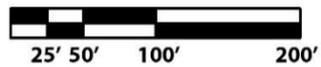
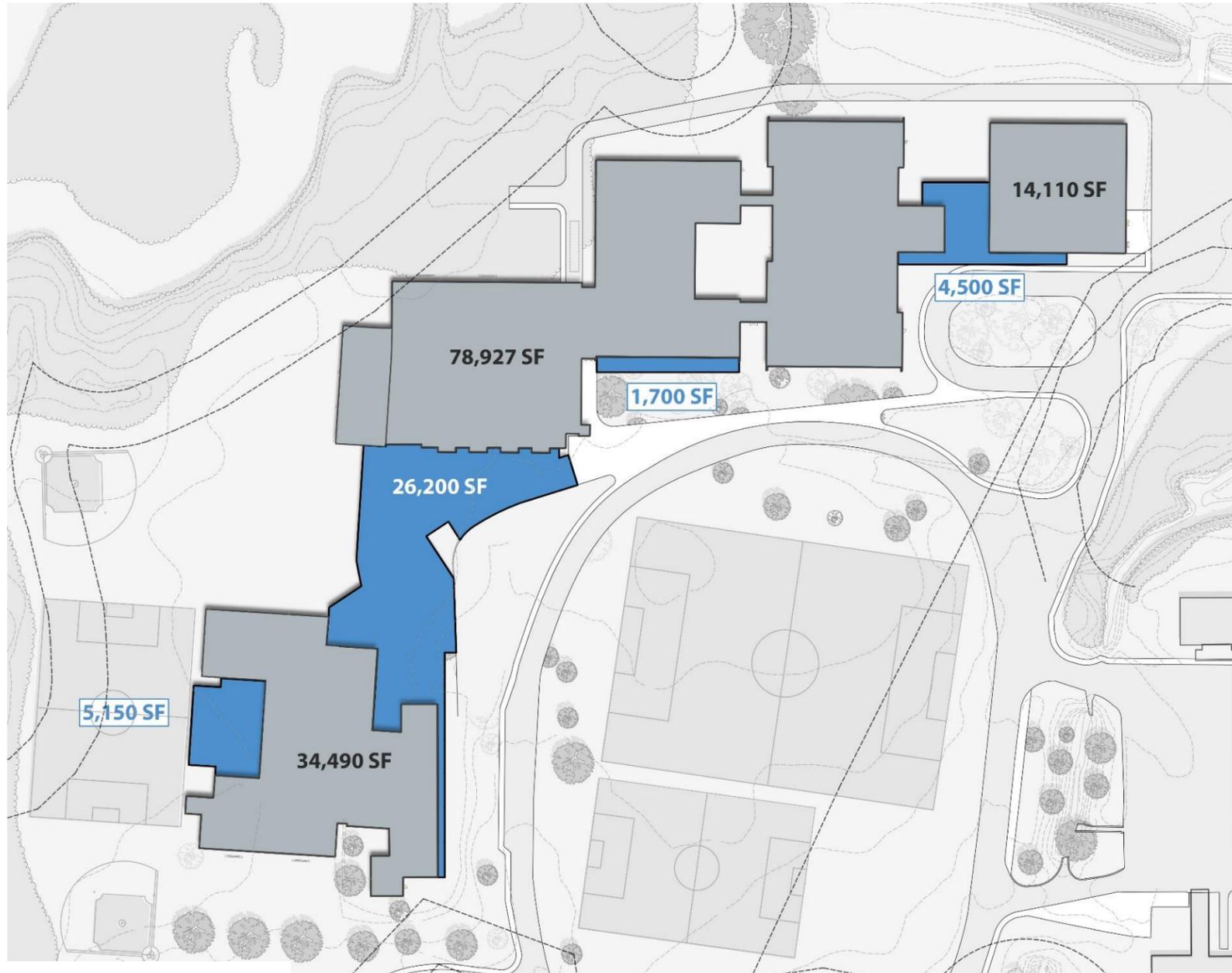


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OPTION A3.4 JANUARY 5, 2018

EWING COLE | SMMA



- RENOVATE
- NEW CONSTRUCTION

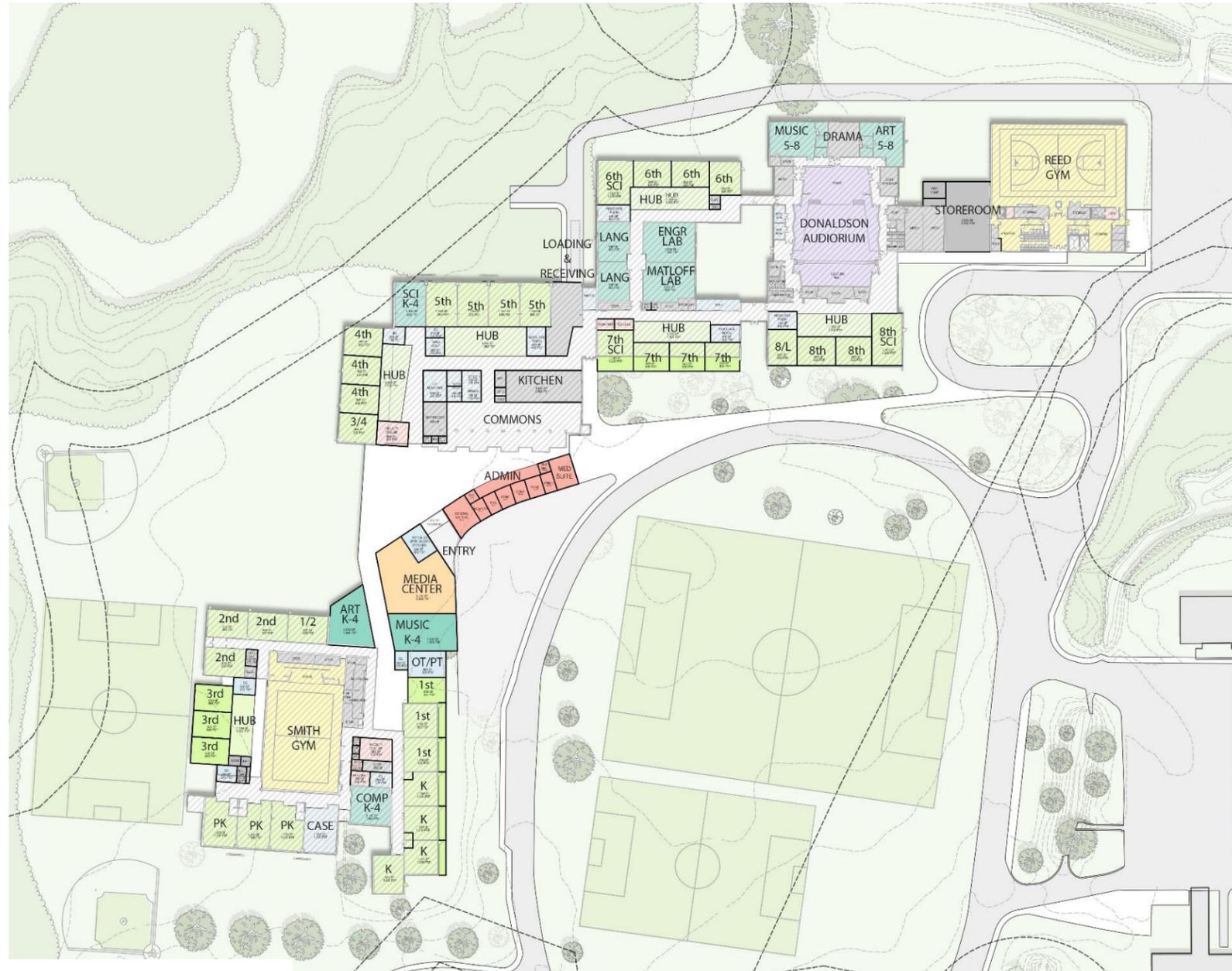


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- ADMIN/ FACULTY
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OPTION A3.4 JANUARY 5, 2018

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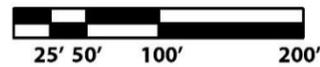
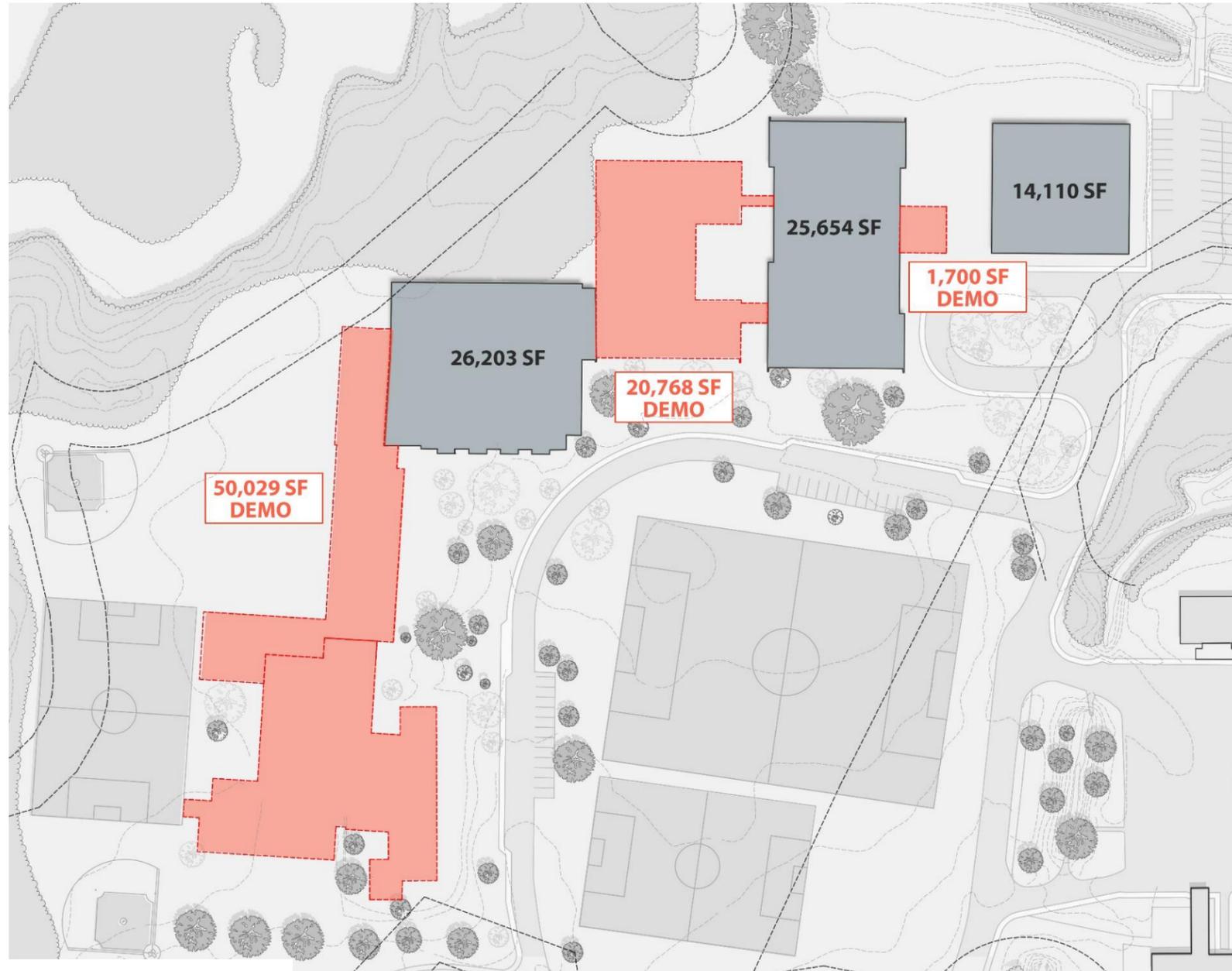


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OPTION B6

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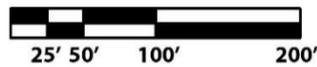
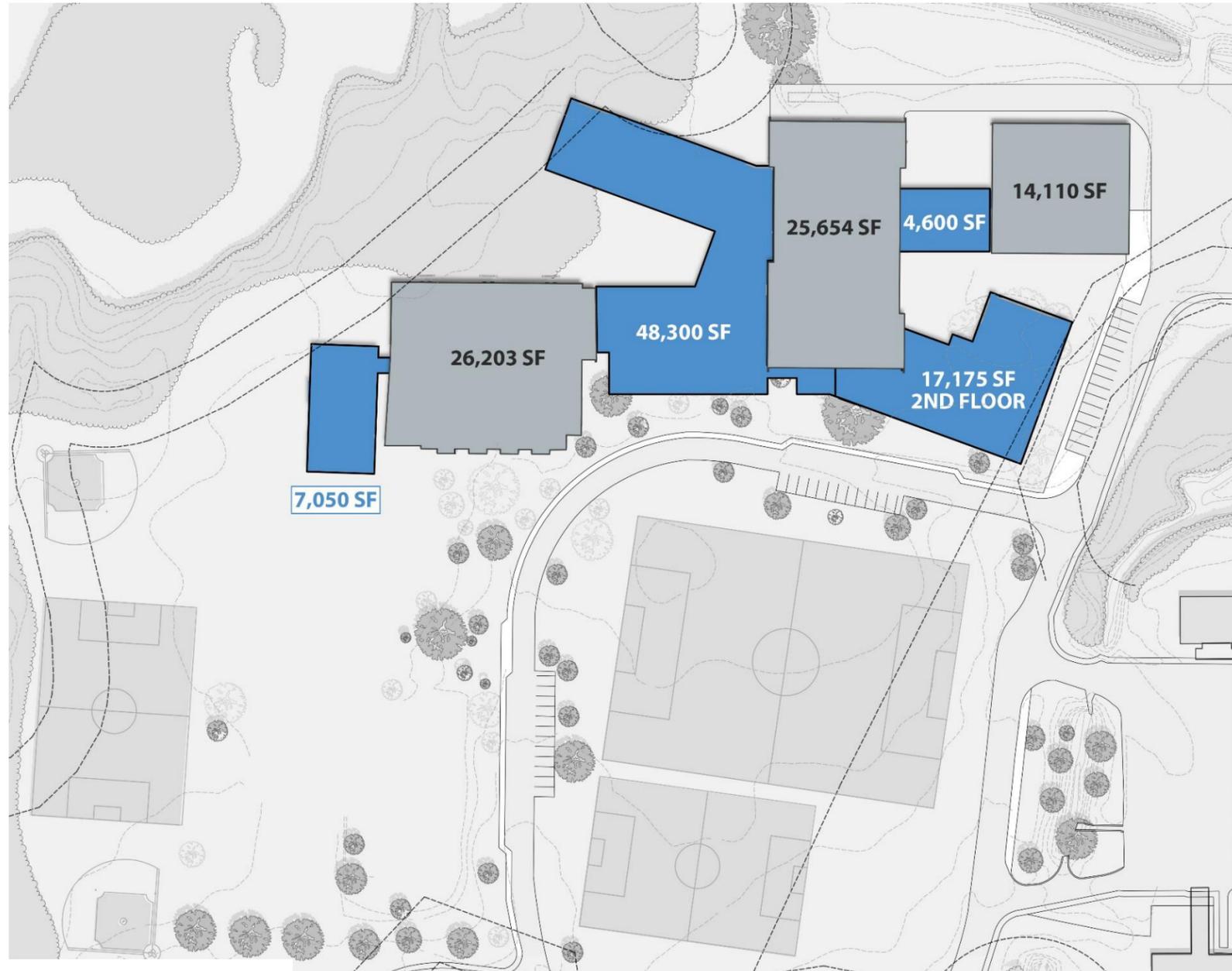


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- RENOVATE
- NEW CONSTRUCTION

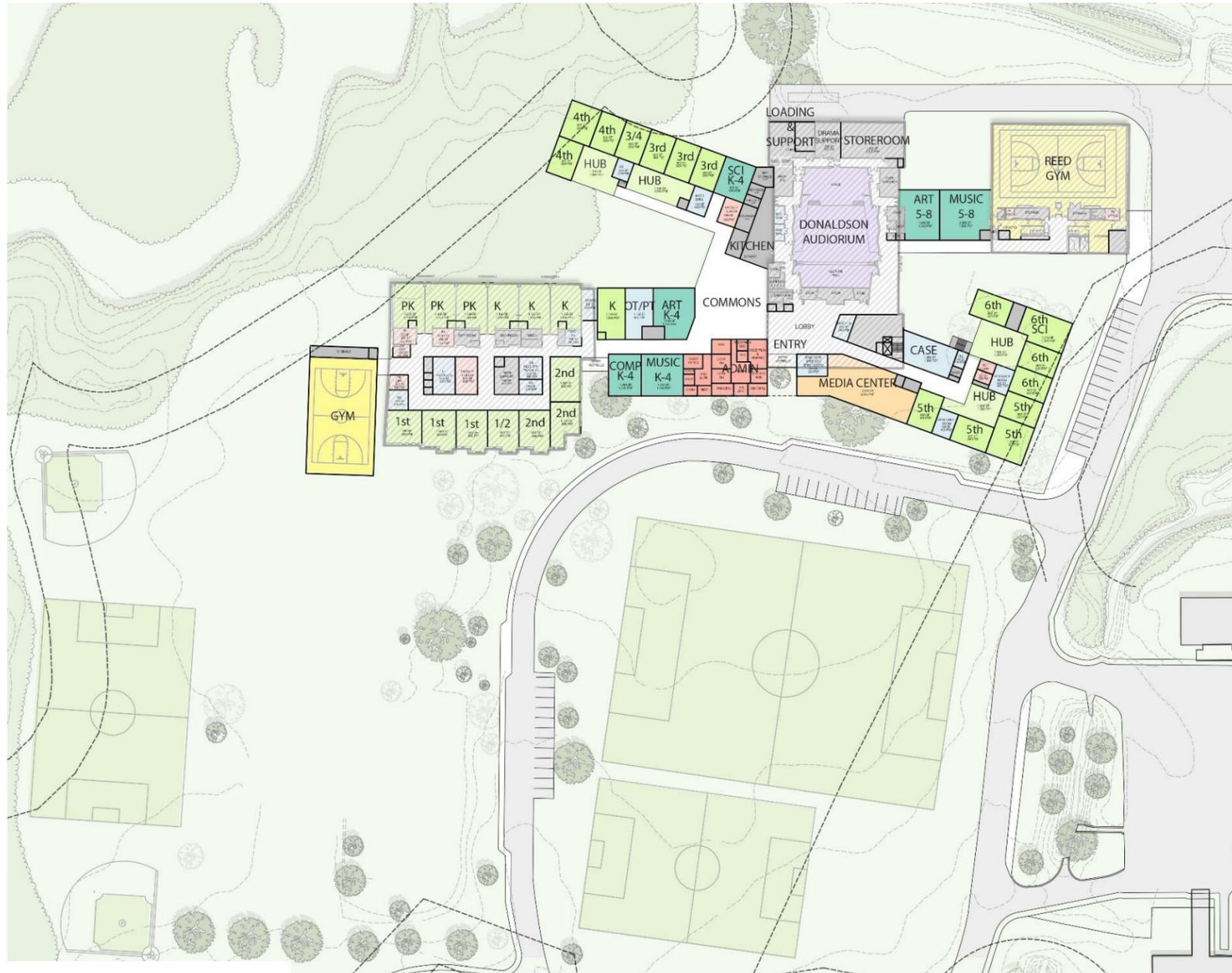


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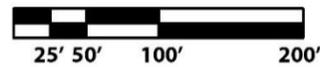
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OPTION B6

JANUARY 5, 2018

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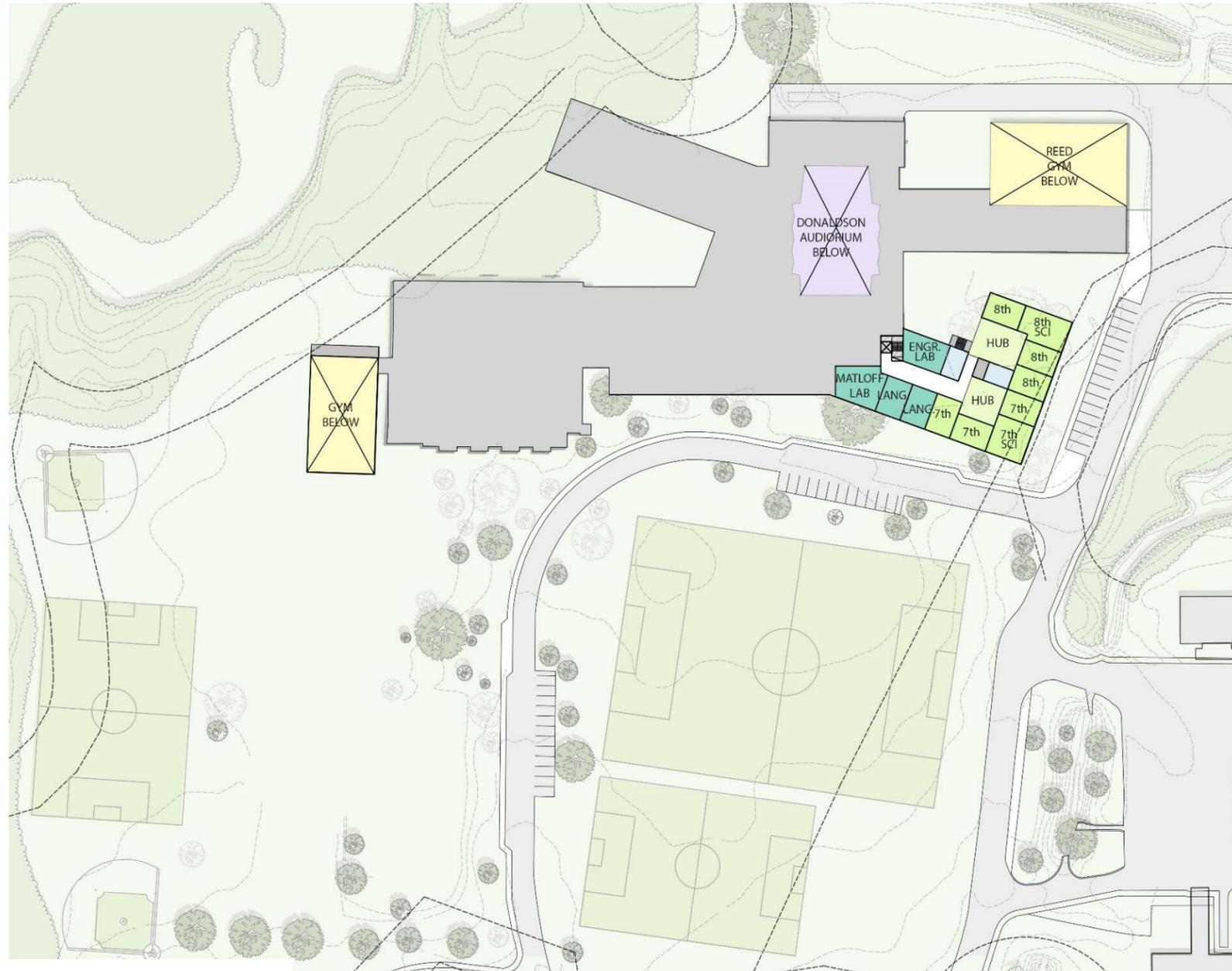


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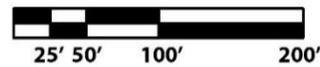
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OPTION B6

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Cost Estimate - Summary

Cost estimates were prepared by Daedalus Projects Inc. for the building envelope and mechanical systems to compare the additional capital costs for the proposed energy upgrades for all options. Option 2 - Renovation of the existing building geometry was used as the baseline comparison that each design was compared to. This accounted for variations in new versus renovation square footage, and provided the most accurate comparison.

Building Component	1. Existing	2. Renovation	Added Cost	Category Added Cost	
Envelope	Windows	Double glass R1.8	replace all -AL TB low-e, low SHGC 0.30 EFCO 5600 U-0.38 all locations, including replacing kalwall panels w/new better insulated Kalwall panels -- (2-3/4" System U-0.23; SHGC .25)	\$718	\$7,358
	Skylights	Single plastic R1	Replace with double plastic, R 1.8 SHGC 0.7, VLT 0.7	\$218	
	Doors	uninsulated, Steel frames - R-2	New insulated door, hollow metal steel frames - R-2; entrances thermally broken ALTB storefront R-2	\$1,738	
	Air/Vapor Barrier	Infiltration 0.40 CFM75/sf gross envelope	Infiltration 0.35 CFM75/sf gross envelope (\$1/sf)	\$313	
	Insulation Roof	Roof - R12, Reed Gym R20	5" polyiso on all roofs except Reed Gym	\$3,985	
	Insulation Walls Existing	Walls: R-3-5	no change	\$0	
	Insulation Walls Reed Gym	Reed Gym Walls: R-3-6	upper portion of Reed gym will get R-18 (3" insulated metal panels or equivalent R-value with other construction) for 50% of the wall; bottom of Reed gym walls no added insulation	\$386	
	Insulation Walls Additions	none	none	\$0	
	Foundation Existing	Foundation	no change	\$0	
	Foundation Additions	none	none	\$0	
Other					
Mech	Ventilation	Unit vents do run, might be blocked off	semi-conditioned DOAS, distributed ERVs by wing with DX cooling and 70% eff, enthalpy wheel, hot water coil, MERV8-13 filters, and VAV box/classroom, CO2 modulated	\$2,239	\$8,546
	Envelope Commissioning	none	none	\$61	
	Domestic Hot Water	From boiler, big recirc loop, 0.70EF	From boiler, big recirc loop, 0.70EF	\$203	
	Kitchen	full 6' or 7' commercial hood	Melink controlled hood and 80% gas fired MAU	\$61	
	Controls	mixed:94 wing has DDC balance, pneumatic	Full DDC system	\$1,027	
	Heating	unit ventilators, hot water, 2 boiler plants, gas, 80%, 94 wing served by penthouse AHU, split Dx, auditorium. Has custom H&V AHU's	consolidate boiler plant, new 90% boiler, new distribution, radiant panels in all ceilings	\$4,665	
	Cooling	94 media center, admin split AHU	for aud., media, admin and special ed	\$290	
Total Added Cost			\$15,904		



DESIGN A1.1A

Building Component		3. Renovation Only of Existing and Additions to Stretch Code -A1.1	Added Cost	Category Added Cost	Building Component		4. Reno to Stretch Code+ and Additions to Stretch Code+ - A1.1	Added Cost	Category Added Cost	Building Component		5. Net Zero Ready - A1.1	Added Cost	Category Added Cost	
Envelope	Windows	replace all -AL TB low-e, low SHGC 0.30 EFCO 5600 U-0.38 all locations, including replacing kalwall panels w/new better insulated Kalwall panels -- (2-3/4" System U-0.23; SHGC .25)	\$224	\$1,292	Windows	replace all -AL TB low-e, low SHGC 0.30 EFCO 5600 U-0.38 all locations, including replacing kalwall panels w/new better insulated Kalwall panels -- (4" System U-0.08; SHGC .04)	\$249	\$3,098	Windows	replace all -R-5 Alpen fiberglass frame, Heat Mirror tripane, low SHGC 0.25; 4" Kalwall system U-0.08, SHGC 0.04	\$177	\$4,917	Skylights	replace with R 1.8, SHGC--0.7 in existing; also in new TBD. If new are Velux U=.42 SHGC-0.22, VLT-0.52	\$0
	Skylights	replace with R 1.8, SHGC--0.7 in existing; also in new TBD. If new are Velux U=.42 SHGC-0.22, VLT-0.52	\$0		Skylights	replace with R 1.8, SHGC--0.7 in existing; also in new TBD. If new are Velux U=.42 SHGC-0.22, VLT-0.52	\$0		Skylights	Wasco Lumira Aerogel skylight, U-0.22, SHGC 0.55, VLT--48	\$59				
	Doors	New insulated door, hollow metal steel frames - R-2; entrances thermally broken ALTB storefront R-2	\$419		Doors	New insulated door, hollow metal steel frames - R-2; entrances thermally broken ALTB storefront R-2	\$419		Doors	classroom insulated with thermally broken frames, R-5; entrances ALTB storefront R-2	\$420				
	Air/Vapor Barrier	Infiltration 0.35 CFM75/sf gross envelope (added \$1/sf of floor area)	\$87		Air/Vapor Barrier	Infiltration 0.30 CFM75/sf gross envelope (added \$1/sf of floor area)	\$87		Air/Vapor Barrier	Infiltration 0.10 CFM75/sf gross envelope (added \$1/sf of floor area)	\$87				
	Insulation Roof	5" polyiso on all roofs except Reed Gym	\$445		Insulation Roof	7" polyiso on all roofs except Reed Gym	\$477		Insulation Roof	9" polyiso on all roofs except Reed Gym	\$511				
	Insulation Walls Existing	no change	\$0		Insulation Walls Existing	8" interior dense pack cellulose, metal stud wall, new gypsum wall board throughout	\$805		Insulation Walls Existing	Remove brick, install 8" mineral wool, FERRO 8" Heavy Duty Rap-Tie or equivalent, install new brick	\$2,099				
	Insulation Walls Reed Gym	upper portion of Reed gym will get R-18 (3" insulated metal panels or equivalent R-value with other construction) for 50% of the wall; bottom of Reed gym walls no added insulation	\$0		Insulation Walls Reed Gym	4" mineral fiber (R-16) exterior of CMU with masonry cladding	\$257		Insulation Walls Reed Gym	8" mineral fiber exterior of CMU with masonry cladding	\$264				
	Insulation Walls Additions	2" continuous mineral fiber exterior, 3.5" batt in steel stud,	\$11		Insulation Walls Additions	3.5" continuous mineral fiber exterior, 5.5" batt in steel stud,	\$18		Insulation Walls Additions	exterior insulation -8" continuous mineral fiber, FERRO 8" Heavy Duty Rap-Tie or equivalent,	\$14				
	Foundation Existing	no change	\$0		Foundation Existing	Excavate to expose exterior foundation wall install 2" EPS to 48" below grade, backfill. Reed Gym only - new foundation wall to support new masonry	\$152		Foundation Existing	Excavate to expose exterior foundation wall install 4" EPS to 48" below grade, pour new 9" foundation wall to support cladding, backfill	\$828				
	Foundation Additions	2" on frost wall to footing, continuous with 2" EPS sub slab insulation	\$106		Foundation Additions	2" on frost wall to footing, continuous with 2" EPS sub slab insulation	\$106		Foundation Additions	4" on frost wall to footing, continuous with 4" EPS sub slab insulation	\$185				
Other			Other	At new stud walls at interior side of exterior walls: 1. Relocate all electrical switches, outlets, boxes, etc to new interior stud wall 2. New base at new walls 3. Patch existing ceilings to install new walls 4. Remove and reinstall existing visual display surfaces 5. Remove all interior casework and rebuild new	\$528	Other	1. Boiler/dehumidification room may not be needed (or smaller) 2. Remove soffit and finishes in existing 3. New soffits/trim in existing building	\$273							
Mech	Ventilation	semi-conditioned DOAS, distributed ERVs by wing with DX cooling and 70% eff, enthalpy wheel, hot water coil, MERV8-13 filters, and VAV box/classroom, CO2 modulated	\$322	\$1,141	Ventilation	semi-conditioned DOAS, distributed ERVs by wing with DX cooling and 70% eff, enthalpy wheel, hot water coil, MERV8-13 filters, and VAV box/classroom, CO2 modulated	\$322	\$1,141	Ventilation	Distributed ultra-high 85% efficiency ERV's, no heating coils or DX cooling, Oversized wheels to 85% effective in larger spaces; all CO2 modulating; dehumidification not required with ASHPs	-\$106	-\$804	Envelope Commissioning	none	\$0
	Envelope Commissioning	none	\$0		Envelope Commissioning	full envelope commissioning	\$0		Envelope Commissioning	full envelope commissioning	\$0				
	Domestic Hot Water	From boiler, big recirc loop, 0.70EF	\$0		Domestic Hot Water	From boiler, big recirc loop, 0.70EF	\$0		Domestic Hot Water	heat pump water heating, distributed, minimal recirc.	-\$68				
	Kitchen	Melink controlled hood and 80% gas fired MAU	\$0		Kitchen	Melink controlled hood and 80% gas fired MAU	\$0		Kitchen	Melink controlled hood and electric or ASHP(?) MAU	-\$7				
	Controls	Full DDC system	\$148		Controls	Full DDC system	\$148		Controls	Use ASHP central control system w/BACNET to DDC which is for ventilation system primarily	\$308				
	Heating	consolidate boiler plant, new 90% boiler, new distribution, radiant panels in all ceilings	\$671		Heating	consolidate boiler plant, new 90% boiler, new distribution, radiant panels in all ceilings	\$671		Heating	Air source heat pump, wall mounted in classrooms and open spaces; ducted to serve several rooms for small offices; central ASHP system or less expensive distributed smaller ASHP systems -- COP=2.7 for heating; heat recovery system	-\$1,891				
Cooling	for aud., media, admin and special ed	\$0	Cooling	for aud., media, admin and special ed	\$0	Cooling	ASHP makes cooling available all spaces	\$960							
Total Added Cost				\$2,433	Total Added Cost				\$4,239	Total Added Cost				\$4,113	



DESIGN A3.4

Building Component	3. Renovation Only of Existing and Additions to Stretch Code -A3.4	Added Cost	Category Added Cost	Building Component	4. Reno to Stretch Code+ and Additions to Stretch Code+ - A3.4	Added Cost	Category Added Cost	Building Component	5. Net Zero Ready - A3.4	Added Cost	Category Added Cost	
Envelope	Windows	replace all -AL TB low-e, low SHGC 0.30 EFCO 5600 U-0.38 all locations, including replacing kalwall panels w/new better insulated Kalwall panels -- (2-3/4" System U-0.23; SHGC .25)	\$212	\$1,492	Windows	replace all -AL TB low-e, low SHGC 0.30 EFCO 5600 U-0.38 all locations, including replacing kalwall panels w/new better insulated Kalwall panels -- (4" System U-0.08; SHGC .04)	\$237	\$3,503	Windows	replace all -R-5 Alpen fiberglass frame, Heat Mirror tripane, low SHGC 0.25; 4" Kalwall system U-0.08, SHGC 0.04	\$166	\$5,006
	Skylights	replace with R 1.8, SHGC--0.7 in existing; also in new TBD. If new are Velux U=.42 SHGC-0.22, VLT-0.52	\$0		Skylights	replace with R 1.8, SHGC--0.7 in existing; also in new TBD. If new are Velux U=.42 SHGC-0.22, VLT-0.52	\$0		Skylights	Wasco Lumira Aerogel skylight, U-0.22, SHGC 0.55, VLT--48	\$59	
	Doors	New insulated door, hollow metal steel frames - R-2; entrances thermally broken ALTB storefront R-2	\$433		Doors	New insulated door, hollow metal steel frames - R-2; entrances thermally broken ALTB storefront R-2	\$433		Doors	classroom insulated with thermally broken frames, R-5; entrances ALTB storefront R-2	\$434	
	Air/Vapor Barrier	Infiltration 0.35 CFM75/sf gross envelope (added \$1/sf of floor area)	\$88		Air/Vapor Barrier	Infiltration 0.30 CFM75/sf gross envelope (added \$1/sf of floor area)	\$88		Air/Vapor Barrier	Infiltration 0.10 CFM75/sf gross envelope (added \$1/sf of floor area)	\$88	
	Insulation Roof	5" polyiso on all roofs except Reed Gym	\$647		Insulation Roof	7" polyiso on all roofs except Reed Gym	\$681		Insulation Roof	9" polyiso on all roofs except Reed Gym	\$716	
	Insulation Walls Existing	no change	\$0		Insulation Walls Existing	8" interior dense pack cellulose, metal stud wall, new gypsum wall board throughout	\$823		Insulation Walls Existing	Remove brick, install 8" mineral wool, FER0 8" Heavy Duty Rap-Tie or equivalent, install new brick	\$2,147	
	Insulation Walls Reed Gym	upper portion of Reed gym will get R-18 (3" insulated metal panels or equivalent R-value with other construction) for 50% of the wall; bottom of Reed gym walls no added insulation	\$0		Insulation Walls Reed Gym	4" mineral fiber (R-16) exterior of CMU with masonry cladding	\$257		Insulation Walls Reed Gym	8" mineral fiber exterior of CMU with masonry cladding	\$264	
	Insulation Walls Additions	2" continuous mineral fiber exterior, 3.5" batt in steel stud,	\$11		Insulation Walls Additions	3.5" continuous mineral fiber exterior, 5.5" batt in steel stud,	\$17		Insulation Walls Additions	exterior insulation -8" continuous mineral fiber, FER0 8" Heavy Duty Rap-Tie or equivalent,	\$13	
	Foundation Existing	no change	\$0		Foundation Existing	Excavate to expose exterior foundation wall install 2" EPS to 48" below grade, backfill. Reed Gym only - new foundation wall to support new masonry	\$145		Foundation Existing	Excavate to expose exterior foundation wall install 4" EPS to 48" below grade, pour new 9" foundation wall to support cladding, backfill	\$722	
	Foundation Additions	2" on frost wall to footing, continuous with 2" EPS sub slab insulation	\$101		Foundation Additions	2" on frost wall to footing, continuous with 2" EPS sub slab insulation	\$101		Foundation Additions	4" on frost wall to footing, continuous with 4" EPS sub slab insulation	\$176	
Other			Other	At new stud walls at interior side of exterior walls: 1. Relocate all electrical switches, outlets, boxes, etc to new interior stud wall 2. New base at new walls 3. Patch existing ceilings to install new walls 4. Remove and reinstall existing visual display surfaces 5. Remove all interior casework and rebuild new	\$721	Other	1. Boiler/dehumidification room may not be needed (or smaller) 2. Remove soffit and finishes in existing 3. New soffits/trim in existing building	\$221				
Mech	Ventilation	semi-conditioned DOAS, distributed ERVs by wing with DX cooling and 70% eff, enthalpy wheel, hot water coil, MERV8-13 filters, and VAV box/classroom, CO2 modulated	\$431	\$1,526	Ventilation	semi-conditioned DOAS, distributed ERVs by wing with DX cooling and 70% eff, enthalpy wheel, hot water coil, MERV8-13 filters, and VAV box/classroom, CO2 modulated	\$431	\$1,526	Ventilation	Distributed ultra-high 85% efficiency ERV's, no heating coils or DX cooling. Oversized wheels to 85% effective in larger spaces; all CO2 modulating; dehumidification not required with ASHPs	-\$15	-\$485
	Envelope Commissioning	none	\$0		Envelope Commissioning	full envelope commissioning	\$0		Envelope Commissioning	full envelope commissioning	\$0	
	Domestic Hot Water	From boiler, big recirc loop, 0.70EF	\$0		Domestic Hot Water	From boiler, big recirc loop, 0.70EF	\$0		Domestic Hot Water	heat pump water heating, distributed, minimal recirc.	-\$68	
	Kitchen	Melink controlled hood and 80% gas fired MAU	\$0		Kitchen	Melink controlled hood and 80% gas fired MAU	\$0		Kitchen	Melink controlled hood and electric or ASHP(?) MAU	-\$7	
	Controls	Full DDC system	\$198		Controls	Full DDC system	\$198		Controls	Use ASHP central control system w/BACNET to DDC which is for ventilation system primarily	\$365	
	Heating	consolidate boiler plant, new 90% boiler, new distribution, radiant panels in all ceilings	\$897		Heating	consolidate boiler plant, new 90% boiler, new distribution, radiant panels in all ceilings	\$897		Heating	Air source heat pump, wall mounted in classrooms and open spaces; ducted to serve several rooms for small offices; central ASHP system or less expensive distributed smaller ASHP systems -- COP=2.7 for heating; heat recovery system	-\$1,773	
Cooling	for aud., media, admin and special ed	\$0	Cooling	for aud., media, admin and special ed	\$0	Cooling	ASHP makes cooling available all spaces	\$1,013				
Total Added Cost			\$3,018	Total Added Cost			\$5,029	Total Added Cost			\$4,521	



DESIGN B6.1

Building Component		3. Renovation Only of Existing and Additions to Stretch Code -B6	Added Cost	Category Added Cost	Building Component		4. Reno to Stretch Code+ and Additions to Stretch Code+ - B6	Added Cost	Category Added Cost	Building Component		5. Net Zero Ready - B6	Added Cost	Category Added Cost
Envelope	Windows	replace all -AL TB low-e, low SHGC 0.30 EFCO 5600 U-0.38 all locations, including replacing kalwall panels w/new better insulated Kalwall panels -- (2-3/4" System U-0.23; SHGC .25)	\$166	\$772	Envelope	Windows	replace all -AL TB low-e, low SHGC 0.30 EFCO 5600 U-0.38 all locations, including replacing kalwall panels w/new better insulated Kalwall panels -- (4" System U-0.08; SHGC .04)	\$141	\$1,808	Envelope	Windows	replace all -R-5 Alpen fiberglass frame, Heat Mirror tripane, low SHGC 0.25; 4" Kalwall system U-0.08, SHGC 0.04	\$54	\$2,533
	Skylights	replace with R 1.8, SHGC--0.7 in existing; also in new TBD. If new are Velux U=.42 SHGC-0.22, VLT-0.52	\$0			Skylights	replace with R 1.8, SHGC--0.7 in existing; also in new TBD. If new are Velux U=.42 SHGC-0.22, VLT-0.52	\$0			Skylights	Wasco Lumira Aerogel skylight, U-0.22, SHGC 0.55, VLT--48	\$59	
	Doors	New insulated door, hollow metal steel frames - R-2; entrances thermally broken ALTB storefront R-2	\$758			Doors	New insulated door, hollow metal steel frames - R-2; entrances thermally broken ALTB storefront R-2	\$758			Doors	classroom insulated with thermally broken frames, R-5; entrances ALTB storefront R-2	\$759	
	Air/Vapor Barrier	Infiltration 0.35 CFM75/sf gross envelope (added \$1/sf of floor area)	\$74			Air/Vapor Barrier	Infiltration 0.30 CFM75/sf gross envelope (added \$1/sf of floor area)	\$74			Air/Vapor Barrier	Infiltration 0.10 CFM75/sf gross envelope (added \$1/sf of floor area)	\$74	
	Insulation Roof	5" polyiso on all roofs except Reed Gym	-\$415			Insulation Roof	7" polyiso on all roofs except Reed Gym	-\$389			Insulation Roof	9" polyiso on all roofs except Reed Gym	-\$360	
	Insulation Walls Existing	no change	\$0			Insulation Walls Existing	8" interior dense pack cellulose, metal stud wall, new gypsum wall board throughout	\$373			Insulation Walls Existing	Remove brick, install 8" mineral wool, FERRO 8" Heavy Duty Rap-Tie or equivalent, install new brick	\$973	
	Insulation Walls Reed Gym	upper portion of Reed gym will get R-18 (3" insulated metal panels or equivalent R-value with other construction) for 50% of the wall; bottom of Reed gym walls no added insulation	\$0			Insulation Walls Reed Gym	4" mineral fiber (R-16) exterior of CMU with masonry cladding	\$257			Insulation Walls Reed Gym	8" mineral fiber exterior of CMU with masonry cladding	\$264	
	Insulation Walls Additions	2" continuous mineral fiber exterior, 3.5" batt in steel stud,	\$26			Insulation Walls Additions	3.5" continuous mineral fiber exterior, 5.5" batt in steel stud,	\$41			Insulation Walls Additions	exterior insulation -8" continuous mineral fiber, FERRO 8" Heavy Duty Rap-Tie or equivalent,	\$33	
	Foundation Existing	no change	\$0			Foundation Existing	Excavate to expose exterior foundation wall install 2" EPS to 48" below grade, backfill. Reed Gym only - new foundation wall to support new masonry	\$120			Foundation Existing	Excavate to expose exterior foundation wall install 4" EPS to 48" below grade, pour new 9" foundation wall to support cladding, backfill	\$353	
Foundation Additions	2" on frost wall to footing, continuous with 2" EPS sub slab insulation	\$163	Foundation Additions	2" on frost wall to footing, continuous with 2" EPS sub slab insulation	\$163	Foundation Additions	4" on frost wall to footing, continuous with 4" EPS sub slab insulation	\$284						
Other			Other	At new stud walls at interior side of exterior walls: 1. Relocate all electrical switches, outlets, boxes, etc to new interior stud wall 2. New base at new walls 3. Patch existing ceilings to install new walls 4. Remove and reinstall existing visual display surfaces 5. Remove all interior casework and rebuild new	\$270	Other	1. Boiler/dehumidification room may not be needed (or smaller) 2. Remove soffit and finishes in existing 3. New soffits/trim in existing building	\$40						
Mech	Ventilation	semi-conditioned DOAS, distributed ERVs by wing with DX cooling and 70% eff, enthalpy wheel, hot water coil, MERV8-13 filters, and VAV box/classroom, CO2 modulated	\$234	\$828	Mech	Ventilation	semi-conditioned DOAS, distributed ERVs by wing with DX cooling and 70% eff, enthalpy wheel, hot water coil, MERV8-13 filters, and VAV box/classroom, CO2 modulated	\$234	\$828	Mech	Ventilation	Distributed ultra-high 85% efficiency ERV's, no heating coils or DX cooling, Oversized wheels to 85% effective in larger spaces; all CO2 modulating; dehumidification not required with ASHPs	-\$179	-\$1,062
	Envelope Commissioning	none	\$0			Envelope Commissioning	full envelope commissioning	\$0			Envelope Commissioning	full envelope commissioning	\$0	
	Domestic Hot Water	From boiler, big recirc loop, 0.70EF	\$0			Domestic Hot Water	From boiler, big recirc loop, 0.70EF	\$0			Domestic Hot Water	heat pump water heating, distributed, minimal recirc.	-\$68	
	Kitchen	Melink controlled hood and 80% gas fired MAU	\$0			Kitchen	Melink controlled hood and 80% gas fired MAU	\$0			Kitchen	Melink controlled hood and electric or ASHP(?) MAU	-\$7	
	Controls	Full DDC system	\$107			Controls	Full DDC system	\$107			Controls	Use ASHP central control system w/BACNET to DDC which is for ventilation system primarily	\$262	
	Heating	consolidate boiler plant, new 90% boiler, new distribution, radiant panels in all ceilings	\$487			Heating	consolidate boiler plant, new 90% boiler, new distribution, radiant panels in all ceilings	\$487			Heating	Air source heat pump, wall mounted in classrooms and open spaces; ducted to serve several rooms for small offices; central ASHP system or less expensive distributed smaller ASHP systems -- COP=2.7 for heating; heat recovery system	-\$1,987	
Cooling	for aud., media, admin and special ed	\$0	Cooling	for aud., media, admin and special ed	\$0	Cooling	ASHP makes cooling available all spaces	\$917						
Total Added Cost				\$1,600	Total Added Cost				\$2,636	Total Added Cost				\$1,471



Lincoln School - Financial Assessment

Lincoln, MA



Incremental Cost Estimate B6
August 15, 2018
Energy Balance, Inc. MaclayArchitects