EXECUTIVE SUMMARY:
AIR CONDITIONING STUDY

GENERAL

The purpose of this study is to develop an air conditioning systems report for the 8 elementary schools in District 97. We surveyed each school and assembled 10 different air conditioning system options that would be appropriate for these facilities. The option descriptions, ranging from window air conditioning units to Packaged Rooftop Units with Individual Variable Air Volume Boxes, contain advantages, disadvantages, expected service life (normal system life expectancy), and associated costs. This report was presented to FAC at the November 12, 2013 meeting. Each option was discussed in detail and through this process, 6 options were eliminated.

Options 1, 2, and 3 were eliminated mainly due to the poor thermal comfort and humidity issues, as they require the existing unit vents to run simultaneously to provide code-required outside air. These options also scored the lowest for noise level.

Option 10 was eliminated due to the extensive interior demolition, structural reinforcing, and new ceiling configuration required to accommodate new ductwork and piping installed throughout the building to reach the classrooms.

Options 4 and 5 were eliminated due to poor noise level scores.

FAC indicated that with Option 6, it might be necessary to implement another options such as Option 4 in some locations due to site-specific conditions at particular schools or even individual rooms. The design team concurs with this observation.

The following is a cost estimate of the remaining options assuming the option is implemented at all elementary schools. The amount includes both estimated installation costs and architectural/engineering fees.

COST ESTIMATE FOR AIR CONDITIONING AT EIGHT ELEMENTARY SCHOOLS

Option 6 Self-contained Vertical Stand-up Unit Ventilators - Free Blow:	$15,335,000
Option 7 Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution:	$19,215,000
Option 8 Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow:	$22,175,000
Option 9 Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution:	$27,040,000

A cost summary per school is located on page 003 of the report. We have grayed out the options which were eliminated. More detailed costs breakdowns for each system and school are located within the report.

CONTROLS UPGRADE

In addition to the air conditioning system report, we were asked to review and evaluate the existing temperature control systems. In general, the majority of each facility is being controlled by pneumatic control systems. This is older and obsolete technology. Some issues we observed during our survey were windows that were left open (a potential security issue) in an attempt to cool classrooms, and mechanical systems still operating after normal school hours.

We have provided a cost estimate to replace the existing system with a direct digital control system. Below is a cost estimate that would convert all of the elementary schools to be controlled by a DDC system. A cost summary per school is located on page 003 of the report.

Upgrade HVAC Control System for entire facility – 8 schools: $3,095,000

It is important to understand that should an air conditioning option be pursued, the new equipment will come with the DDC system. Therefore, at FAC request, we have provided a cost with each AC option at each facility to upgrade the controls in the remaining areas of the building. So there is estimated cost information provided to only upgrade the controls for the existing building system, controls for the classrooms being air conditioned (this is included in the total estimated A/C project cost), or a combination of the two. Please refer to the attached spreadsheets for further detail.

END OF EXECUTIVE SUMMARY

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AIR CONDITIONING SUMMARY

As part of this air conditioning report, we reviewed the existing HVAC system at each of the elementary buildings. We reviewed the major pieces of equipment by collecting the manufacturers name plate information, and performing a visual condition assessment. This information can be used as a tool to assist the owner in understanding the major equipment within each facility and helping to prioritize equipment replacement over time.

We have developed 10 air conditioning system options for each of the elementary schools. A spreadsheet is included for each school that identifies the installation cost, annual maintenance cost, annual estimated energy usage, replacement cost, life cycle cost, and a relative sound level comparison for each option. While initial cost is a major factor in determining system selection, other performance factors such as humidity control, sound and type of maintenance should be considered when identifying the best system for the district. Please note that the installation cost in the report only includes costs to provide air condition to classrooms that are currently not air conditioned or have window air conditioners. Rooms such as offices, corridors, break rooms, etc. are not included.

Page 003 is a cost summary for each building.

CONTROLS SUMMARY

As part of our survey, we reviewed the existing control systems in each building. The majority of each building's HVAC equipment is controlled by a pneumatic control system. Overall, the systems are older and are experiencing some operational issues. Control issues were observed by noticing the wide range of temperatures throughout the buildings and by observing HVAC systems which were operating after normal occupied hours. Replacement of the pneumatic control system with a direct digital control (DDC) system will increase system operating efficiency and can greatly improve overall control of the HVAC system.

The following spreadsheet (Page 003) identifying replacement control system costs was developed in conjunction with a temperature control contractor who is familiar with both pneumatic and DDC systems. The costs were generated by reviewing each school and the existing components in the HVAC systems.

Oak Park Elementary School District 97
Air Conditioning System Options and Controls Cost Summary

			Beye		Hatch		Holmes		Irving		Lincoln		Longfellow		Mann		Whittier	
Air Conditioning System Option	HVAC Noise Level Comparison	Life Expectancy (yrs)	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building
Option 1: Window Air Conditioners	F	10	$565,000	$290,000	$455,000	$240,000	$475,000	$275,000	$455,000	$275,000	$505,000	$280,000	$540,000	$310,000	$440,000	$245,000	$520,000	$380,000
Option 2: Ductless Split System	D	15	$1,145,000	$290,000	$925,000	$240,000	$955,000	$275,000	$925,000	$275,000	$1,020,000	$280,000	$1,055,000	$310,000	$890,000	$245,000	$1,050,000	$380,000
Option 3: Ducted Split System	D	15	$1,955,000	$290,000	$1,575,000	$240,000	$1,630,000	$275,000	$1,575,000	$275,000	$1,735,000	$280,000	$1,775,000	$310,000	$1,520,000	$245,000	$1,790,000	$380,000
Option 4: Under the Window Self-Contained Unit Ventilator	D	15	$2,115,000	$290,000	$1,700,000	$240,000	$1,760,000	$275,000	$1,700,000	$275,000	$1,880,000	$280,000	$1,915,000	$310,000	$1,645,000	$245,000	$1,935,000	$380,000
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	D	20	$3,135,000	$275,000	$2,540,000	$225,000	$2,625,000	$260,000	$2,540,000	$260,000	$2,800,000	$265,000	$2,825,000	$295,000	$2,450,000	$230,000	$2,875,000	$365,000
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	C	15	$2,210,000	$290,000	$1,780,000	$240,000	$1,845,000	$275,000	$1,780,000	$275,000	$1,965,000	$280,000	$2,005,000	$310,000	$1,720,000	$245,000	$2,030,000	$380,000
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	B	15	$2,760,000	$290,000	$2,235,000	$240,000	$2,310,000	$275,000	$2,235,000	$275,000	$2,465,000	$280,000	$2,505,000	$310,000	$2,160,000	$245,000	$2,545,000	$380,000
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	C	20	$3,195,000	$275,000	$2,585,000	$225,000	$2,675,000	$260,000	$2,585,000	$260,000	$2,840,000	$265,000	$2,875,000	$295,000	$2,495,000	$230,000	$2,925,000	$365,000
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	B	20	$3,905,000	$275,000	$3,145,000	$225,000	$3,255,000	$260,000	$3,145,000	$260,000	$3,470,000	$265,000	$3,505,000	$295,000	$3,035,000	$230,000	$3,580,000	$365,000
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	A	20	$4,560,000	$290,000	$3,670,000	$240,000	$3,800,000	$275,000	$3,670,000	$275,000	$4,050,000	$280,000	$4,090,000	$310,000	$3,545,000	$245,000	$4,180,000	$380,000
Controls Option: Upgrade HVAC control system on current existing building systems.	- -	- -	$390,000		$330,000		$385,000		$375,000		$390,000		$415,000		$330,000		$480,000	

1. While the estimates provided are based on our experience with construction costs of these or similar systems, they are conceptual estimates with only general information known at this point. As we engage on an actual project, more definition of the system and specific field conditions will reveal the true scope of work, potentially resulting in a variance from this Order of Magnitude budget.
2. Installation costs only include classrooms that are not currently air conditioned or have window air conditioners. Offices, corridors, break rooms, etc. are not included.
3. Air conditioning system repair or replacement cost for existing systems is not included.
4. Estimated costs have been rounded to the nearest 1,000.
5. Shaded options have been eliminated during the FAC review on 11/12/2013.
6. The estimated size of the chilled water plants were estimated to only serve the classrooms that are currently not air conditioned or classrooms that have window air conditioners.
7. Estimates above exclude Legal, Utility, Surveyor, Geotechnical, Environmental, and Abatement fees; Reimbursables are not included. There is no escalation factor included.
8. Controls cost do not include A/E fees. Fees need to be calculated after a scope of work is established.

HVAC NOISE LEVEL COMPARISON DATA

Rating	**Sound Level**	**Options**
A	< 35 dBA	10
B	35-42 dBA	7,9
C	42-50 dBA	6,8
D	50-55 dBA	2[b],3[b],4,5
F	> 55 dBA	1

[a] The options list can achieve this rating if careful design is implemented

[b] The split systems themselves are extremely quiet, but because the unit ventilators must remain in the classroom, the overall HVAC system noise is quite high.

General

An air conditioning summary sheet was developed (this table is located within the tab of each school) from information which was collected or calculated for each of the schools. This summary includes six (6) different categories for each air conditioning system option mentioned and was generated to assist the school district in determining which option it best for them. This summary is divided into the following categories: Installation Cost Opinion, Annual Maintenance Cost, Annual Estimated Energy Usage, Replacement Cost, Life Cycle Cost, and Relative Sound Level Comparison. A description of each category is described below.

Installation Cost Opinion

A cost opinion was generated for each air conditioning option which includes mechanical, electrical, and general trade's costs. These costs were developed using data collected from the current bidding environment and from historical pricing on similar type projects.

Annual Maintenance Cost

Annual maintenance cost includes the preventative maintenance, cleaning, and normal repair which is conducted to detect and prevent equipment failure and keep materials and systems in working order. We assembled pricing for this portion of the report consulting with reputable mechanical contractors that regularly work in the school market and are familiar with these types of HVAC systems.
Properly executed maintenance programs that target energy efficiency have been shown to save 5% to 20% on energy bills without significant capital investment. Additionally, preventive maintenance can reduce building operating cost by extending the life of equipment and reduce liability and risk associated with the health and safety of building occupants.

Annual Estimated Energy Usage

The energy modeling software used was developed by Trane (Trace 700 version 6.2.10.0) for estimating the annual electrical energy usage of the different air conditioning options identified in the report. A simplified building model was created composed of three (3) 800 sq. ft. classrooms one on first floor with a south exterior facing wall, another classroom on the second floor with a west exterior facing wall, and a the last classroom on the third floor with a roof exposure and an east exterior facing wall. Building envelope properties such as the wall, roof, and window construction was assumed based on past experience working in similar buildings. The Trane program defaults such as building occupancy scheduling and room temperatures were used in the model. The total energy usage identified in the report was calculated by averaging the energy usage of all the rooms and then was extrapolated to simulate energy usage for each system option and building. Since each building is different this type of simplified energy modeling is not an accurate way to calculate energy consumption and system efficiency (due to the small sample size of rooms). This estimate was assembled to give a relative energy usage for each system option.

Replacement Cost

Replacement cost reserves are often overlooked in mechanical LCC estimates. For example window air-conditioning units have a 10 year estimated service life, self-contained unit ventilators have an estimated service life expectancy of 15 years, and reciprocating compressors and chillers are expected to operate for 20 years. This should be considered when selecting any system.
The estimated service life is a time value established by the American Society of Heating, Refrigeration and Air-conditioning Engineers that reflects the expected life of a specific component. Equipment life is highly variable because of the diverse equipment applications, the preventative maintenance given, the environment, and the technical advancements of new equipment. Replacement costs along with maintenance costs are real costs of any mechanical installation and are included in the LCC analysis.

Life Cycle Cost

Life Cycle Costing (LCC) is an economic analysis that can be used in the selection of alternatives that impact both pending and future cost. LCC analysis is used to evaluate alternative systems which are evaluated on the basis of cost. The accompanying LCC compares initial investment options and identifies the least cost investment alternative for a thirty year period.

In this case, the LCC method is being evaluated to help choose between alternative air-conditioning systems to cool the classrooms. To be a candidate project for this LCC analysis, the system must meet minimum performance requirements for the occupant, in this case thermal comfort.

Systems with the lowest LCC may have a higher first cost than alternative systems. Systems with lower maintenance costs, longer equipment life, and/or energy savings could prove to be a better value over time.
The LCC of the current project alternatives is the sum of its initial investment cost, I, present value of energy cost E, the present value of maintenance cost M, the present value of replacement cost R, minus the present value of salvage S. Salvage value is assumed to be $0 for current project.

$$LCC = I + E + M + R - S$$

An implicit assumption in the LCC analysis is that all the alternatives considered for a particular project will be capable of satisfying the minimum performance requirements for that project.
The computation comparison is located in the table for each school in the Air Conditioning System Options Performance & Cost Summary. Although LCC is a major factor in decision making the overall system should be considered, things such as potentially high humidity levels in rooms (which will be present at times with Option 1 through Option 3), sound levels, and the type of maintenance required must be considered.

HVAC Noise Level Comparison

HVAC systems add noise to classrooms that impede teacher-to-student, student-to-teacher, and student-to-student communication. In elementary schools, noise is a critical issue because students are still learning language skills that inhibit the ability to use context to fill in gaps of communication. When coupled with the fact that a fraction of the students come from homes where English is a second language, that 5%-10% of the student population have a permanent hearing loss, and that for much of the year, upwards of 30% of students can have a temporary hearing loss from colds, flu, or ear infections, the need for a quiet HVAC system is clear.

There are a number of standards related to HVAC noise that have been developed. The most comprehensive standard, ANSI/ASA S12.60-20101 requires that sound levels from HVAC equipment be kept to less than 35 dBA in the classroom. Several states and cities have adopted S12.60 into the requirements for educational facilities, but Illinois and Oak Park have not. LEED for Schools and the Collaborative for High Performance School (CHPS) rating system, require HVAC noise levels be under 45 dBA and performance points are given for reducing noise levels below 45 dBA.

As a note, the existing unit ventilators used in most classrooms to bring in and heat fresh air, produce sound levels of 40-55 dBA in the room depending upon the fan speed and proximity to the unit ventilator.

Rating	Sound Level	Options[a]
A	< 35 dBA	10
B	35-42 dBA	7,9
C	42-50 dBA	6,8
D	50-55 dBA	2[b],3[b],4,5
F	> 55 dBA	1

[a] The options list can achieve this rating if careful design is implemented

[b] The split systems themselves are extremely quiet, but because the unit ventilators must remain in the classroom, the overall HVAC system noise is quite high.

Oak Park Elementary School District 97
Beye Elementary School
Air Conditioning System Options Performance & Costs Summary

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	HVAC Noise Level Comparison
Option 1: Window Air Conditioners*	$453,477	$10,800	$24,600	$162,344	$1,270,459	F
Option 2: Ductless Split System*	$917,419	$14,400	$20,004	$457,036	$1,993,639	D
Option 3: Ducted Split System*	$1,566,040	$14,400	$21,276	$491,450	$2,701,890	D
Option 4: Under the Window Self-Contained Unit Ventilator	$1,693,699	$10,800	$22,116	$675,167	$2,974,262	D
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	$2,526,089	$12,600	$24,444	$584,158	$3,789,621	D
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	$1,772,773	$10,800	$22,896	$731,997	$3,125,628	C
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	$2,223,300	$10,800	$24,000	$772,725	$3,638,769	B
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	$2,570,761	$12,600	$23,940	$614,180	$3,854,324	C
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	$3,143,268	$12,600	$25,428	$624,187	$4,466,336	B
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	$3,670,488	$9,900	$24,492	$390,284	$4,699,355	A

* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

Air Conditioning System Option	HVAC Noise Level Comparison	Life Expectancy (yrs)	BEYE					
			Estimated Installation Cost	Estimated Life Cycle Cost	Construction Contingency (15%)	A/E Fees	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building
Option 1: Window Air Conditioners	F	10	$453,477	$1,270,459	$68,022	$45,631	**$567,130**	$289,031
Option 2: Ductless Split System	D	15	$917,419	$1,993,639	$137,613	$89,678	**$1,144,710**	$289,031
Option 3: Ducted Split System	D	15	$1,566,040	$2,701,890	$234,906	$153,080	**$1,954,027**	$289,031
Option 4: Under the Window Self-Contained Unit Ventilator	D	15	$1,693,699	$2,974,262	$254,055	$165,559	**$2,113,313**	$289,031
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	D	20	$2,526,089	$3,789,621	$378,913	$232,400.19	**$3,137,403**	$274,031
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	C	15	$1,772,773	$3,125,628	$265,916	$173,289	**$2,211,977**	$289,031
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	B	15	$2,223,300	$3,638,769	$333,495	$204,544	**$2,761,338**	$289,031
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	C	20	$2,570,761	$3,854,324	$385,614	$236,510	**$3,192,885**	$274,031
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	B	20	$3,143,268	$4,466,336	$471,490	$289,181	**$3,903,939**	$274,031
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	A	20	$3,670,488	$4,699,355	$550,573	$337,685	**$4,558,746**	$289,031
Controls Option: Upgrade HVAC control system on current existing building systems.	- -	- -	$338,331	- -	$50,750	- -	$389,081	- -

Oak Park Elementary School District 97
Hatch Elementary School
Air Conditioning System Options Performance & Costs Summary

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	HVAC Noise Level Comparison
Option 1: Window Air Conditioners*	$365,301	$8,700	$19,817	$130,777	$1,023,426	F
Option 2: Ductless Split System*	$739,032	$11,600	$16,114	$368,168	$1,605,987	D
Option 3: Ducted Split System*	$1,261,533	$11,600	$17,139	$395,890	$2,176,522	D
Option 4: Under the Window Self-Contained Unit Ventilator	$1,364,369	$8,700	$17,816	$543,885	$2,395,933	D
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	$2,034,905	$10,150	$19,691	$470,572	$3,052,750	D
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	$1,428,067	$8,700	$18,444	$589,664	$2,517,867	C
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	$1,790,992	$8,700	$19,333	$622,473	$2,931,230	B
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	$2,070,891	$10,150	$19,285	$494,756	$3,104,872	C
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	$2,532,077	$10,150	$20,484	$502,818	$3,597,882	B
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	$2,956,782	$7,975	$19,730	$314,395	$3,785,592	A

* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

Air Conditioning System Option	HVAC Noise Level Comparison	Life Expectancy (yrs)	HATCH					
			Estimated Installation Cost	Estimated Life Cycle Cost	Construction Contingency (15%)	A/E Fees	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building
Option 1: Window Air Conditioners	F	10	$365,301	$1,023,426	$54,795	$36,758	**$456,855**	$238,002
Option 2: Ductless Split System	D	15	$739,032	$1,605,987	$110,855	$74,365	**$924,252**	$238,002
Option 3: Ducted Split System	D	15	$1,261,533	$2,176,522	$189,230	$124,040	**$1,574,803**	$238,002
Option 4: Under the Window Self-Contained Unit Ventilator	D	15	$1,364,369	$2,395,933	$204,655	$133,367	**$1,702,391**	$238,002
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	D	20	$2,034,905	$3,052,750	$305,236	$198,912	**$2,539,053**	$223,002
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	C	15	$1,428,067	$2,517,867	$214,210	$139,594	**$1,781,871**	$238,002
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	B	15	$1,790,992	$2,931,230	$268,649	$175,069	**$2,234,710**	$238,002
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	C	20	$2,070,891	$3,104,872	$310,634	$202,430	**$2,583,954**	$223,002
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	B	20	$2,532,077	$3,597,882	$379,812	$232,951	**$3,144,840**	$223,002
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	A	20	$2,956,782	$3,785,592	$443,517	$272,024	**$3,672,323**	$238,002
Controls Option: Upgrade HVAC control system on current existing building systems.	- -	- -	$287,958	- -	$43,194	- -	$331,152	- -

Oak Park Elementary School District 97
Holmes Elementary School
Air Conditioning System Options Performance & Costs Summary

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	HVAC Noise Level Comparison
Option 1: Window Air Conditioners*	$377,898	$9,000	$20,500	$135,286	$1,058,716	F
Option 2: Ductless Split System*	$764,516	$12,000	$16,670	$380,864	$1,661,366	D
Option 3: Ducted Split System*	$1,305,034	$12,000	$17,730	$409,541	$2,251,575	D
Option 4: Under the Window Self-Contained Unit Ventilator	$1,411,416	$9,000	$18,430	$562,639	$2,478,552	D
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	$2,105,074	$10,500	$20,370	$486,799	$3,158,018	D
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	$1,477,311	$9,000	$19,080	$609,997	$2,604,690	C
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	$1,852,750	$9,000	$20,000	$643,937	$3,032,307	B
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	$2,142,301	$10,500	$19,950	$511,817	$3,211,936	C
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	$2,619,390	$10,500	$21,190	$520,156	$3,721,947	B
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	$3,058,740	$8,250	$20,410	$325,237	$3,916,129	A

* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

Air Conditioning System Option	HVAC Noise Level Comparison	Life Expectancy (yrs)	HOLMES					
			Estimated Installation Cost	Estimated Life Cycle Cost	Construction Contingency (15%)	A/E Fees	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building
Option 1: Window Air Conditioners	F	10	$377,898	$1,058,716	$56,685	$38,026	**$472,608**	$273,177
Option 2: Ductless Split System	D	15	$764,516	$1,661,366	$114,677	$76,929	**$956,123**	$273,177
Option 3: Ducted Split System	D	15	$1,305,034	$2,251,575	$195,755	$127,567	**$1,628,356**	$273,177
Option 4: Under the Window Self-Contained Unit Ventilator	D	15	$1,411,416	$2,478,552	$211,712	$137,966	**$1,761,095**	$273,177
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	D	20	$2,105,074	$3,158,018	$315,761	$205,771	**$2,626,606**	$258,177
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	C	15	$1,477,311	$2,604,690	$221,597	$144,407	**$1,843,315**	$273,177
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	B	15	$1,852,750	$3,032,307	$277,912	$181,106	**$2,311,769**	$273,177
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	C	20	$2,142,301	$3,211,936	$321,345	$209,410	**$2,673,056**	$258,177
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	B	20	$2,619,390	$3,721,947	$392,909	$240,984	**$3,253,282**	$258,177
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	A	20	$3,058,740	$3,916,129	$458,811	$281,404	**$3,798,955**	$273,177
Controls Option: Upgrade HVAC control system on current existing building systems.	- -	- -	$333,546	- -	$50,032	- -	$383,577	- -

Oak Park Elementary School District 97
Irving Elementary School
Air Conditioning System Options Performance & Costs Summary

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	HVAC Noise Level Comparison
Option 1: Window Air Conditioners*	$365,301	$8,700	$19,817	$130,777	$1,023,426	F
Option 2: Ductless Split System*	$739,032	$11,600	$16,114	$368,168	$1,605,987	D
Option 3: Ducted Split System*	$1,261,533	$11,600	$17,139	$395,890	$2,176,522	D
Option 4: Under the Window Self-Contained Unit Ventilator	$1,364,369	$8,700	$17,816	$543,885	$2,395,933	D
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	$2,034,905	$10,150	$19,691	$470,572	$3,052,750	D
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	$1,428,067	$8,700	$18,444	$589,664	$2,517,867	C
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	$1,790,992	$8,700	$19,333	$622,473	$2,931,230	B
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	$2,070,891	$10,150	$19,285	$494,756	$3,104,872	C
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	$2,532,077	$10,150	$20,484	$502,818	$3,597,882	B
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	$2,956,782	$7,975	$19,730	$314,395	$3,785,592	A

* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

Air Conditioning System Option	HVAC Noise Level Comparison	Life Expectancy (yrs)	IRVING					
			Estimated Installation Cost	Estimated Life Cycle Cost	Construction Contingency (15%)	A/E Fees	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building
Option 1: Window Air Conditioners	F	10	$365,301	$1,023,426	$54,795	$36,758	**$456,855**	$274,053
Option 2: Ductless Split System	D	15	$739,032	$1,605,987	$110,855	$74,365	**$924,252**	$274,053
Option 3: Ducted Split System	D	15	$1,261,533	$2,176,522	$189,230	$123,315	**$1,574,077**	$274,053
Option 4: Under the Window Self-Contained Unit Ventilator	D	15	$1,364,369	$2,395,933	$204,655	$133,367	**$1,702,391**	$274,053
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	D	20	$2,034,905	$3,052,750	$305,236	$198,912	**$2,539,053**	$259,053
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	C	15	$1,428,067	$2,517,867	$214,210	$139,594	**$1,781,871**	$274,053
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	B	15	$1,790,992	$2,931,230	$268,649	$175,069	**$2,234,710**	$274,053
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	C	20	$2,070,891	$3,104,872	$310,634	$202,430	**$2,583,954**	$259,053
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	B	20	$2,532,077	$3,597,882	$379,812	$232,951	**$3,144,840**	$259,053
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	A	20	$2,956,782	$3,785,592	$443,517	$272,024	**$3,672,323**	$274,053
Controls Option: Upgrade HVAC control system on current existing building systems.	- -	- -	$325,307	- -	$48,796	- -	$374,103	- -

Oak Park Elementary School District 97
Lincoln Elementary School
Air Conditioning System Options Performance & Costs Summary

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	HVAC Noise Level Comparison
Option 1: Window Air Conditioners*	$403,091	$9,600	$21,867	$144,305	$1,129,297	F
Option 2: Ductless Split System*	$815,484	$12,800	$17,781	$406,254	$1,772,124	D
Option 3: Ducted Split System*	$1,392,036	$12,800	$18,912	$436,844	$2,401,680	D
Option 4: Under the Window Self-Contained Unit Ventilator	$1,505,511	$9,600	$19,659	$600,149	$2,643,789	D
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	$2,245,412	$11,200	$21,728	$519,252	$3,368,552	D
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	$1,575,798	$9,600	$20,352	$650,664	$2,778,336	C
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	$1,976,267	$9,600	$21,333	$686,866	$3,234,461	B
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	$2,285,121	$11,200	$21,280	$545,938	$3,426,066	C
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	$2,794,016	$11,200	$22,603	$554,833	$3,970,077	B
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	$3,262,656	$8,800	$21,771	$346,919	$4,177,205	A

* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

Air Conditioning System Option	HVAC Noise Level Comparison	Life Expectancy (yrs)	LINCOLN					
			Estimated Installation Cost	Estimated Life Cycle Cost	Construction Contingency (15%)	A/E Fees	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building
Option 1: Window Air Conditioners	F	10	$403,091	$1,129,297	$60,464	$40,561	**$504,116**	$281,759
Option 2: Ductless Split System	D	15	$815,484	$1,772,124	$122,323	$82,058	**$1,019,865**	$281,759
Option 3: Ducted Split System	D	15	$1,392,036	$2,401,680	$208,805	$136,072	**$1,736,913**	$281,759
Option 4: Under the Window Self-Contained Unit Ventilator	D	15	$1,505,511	$2,643,789	$225,827	$147,164	**$1,878,501**	$281,759
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	D	20	$2,245,412	$3,368,552	$336,812	$219,489	**$2,801,713**	$266,759
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	C	15	$1,575,798	$2,778,336	$236,370	$154,034	**$1,966,202**	$281,759
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	B	15	$1,976,267	$3,234,461	$296,440	$193,180	**$2,465,887**	$281,759
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	C	20	$2,285,121	$3,426,066	$342,768	$210,231	**$2,838,120**	$266,759
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	B	20	$2,794,016	$3,970,077	$419,102	$257,049	**$3,470,168**	$266,759
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	A	20	$3,262,656	$4,177,205	$489,398	$300,164	**$4,052,219**	$281,759
Controls Option: Upgrade HVAC control system on current existing building systems.	- -	- -	$341,008	- -	$51,151	- -	$392,159	- -

Oak Park Elementary School District 97
Longfellow Elementary School
Air Conditioning System Options Performance & Costs Summary

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	HVAC Noise Level Comparison
Option 1: Window Air Conditioners*	$433,091	$9,600	$21,867	$144,305	$1,129,297	F
Option 2: Ductless Split System*	$845,484	$12,800	$17,781	$406,254	$1,772,124	D
Option 3: Ducted Split System*	$1,422,036	$12,800	$18,912	$436,844	$2,401,680	D
Option 4: Under the Window Self-Contained Unit Ventilator	$1,535,511	$9,600	$19,659	$600,149	$2,643,789	D
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	$2,275,412	$11,200	$21,728	$519,252	$3,368,552	D
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	$1,605,798	$9,600	$20,352	$650,664	$2,778,336	C
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	$2,006,267	$9,600	$21,333	$686,866	$3,234,461	B
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	$2,315,121	$11,200	$21,280	$545,938	$3,426,066	C
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	$2,824,016	$11,200	$22,603	$554,833	$3,970,077	B
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	$3,292,656	$8,800	$21,771	$346,919	$4,177,205	A

* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

Air Conditioning System Option	HVAC Noise Level Comparison	Life Expectancy (yrs)	LONGFELLOW					
			Estimated Installation Cost	Estimated Life Cycle Cost	Construction Contingency (15%)	A/E Fees	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building
Option 1: Window Air Conditioners	F	10	$433,091	$1,129,297	$64,964	$43,580	**$541,634**	$311,075
Option 2: Ductless Split System	D	15	$845,484	$1,772,124	$126,823	$85,077	**$1,057,383**	$311,075
Option 3: Ducted Split System	D	15	$1,422,036	$2,401,680	$213,305	$139,004	**$1,774,345**	$311,075
Option 4: Under the Window Self-Contained Unit Ventilator	D	15	$1,535,511	$2,643,789	$230,327	$150,096	**$1,915,933**	$311,075
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	D	20	$2,275,412	$3,368,552	$341,312	$209,338	**$2,826,062**	$296,075
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	C	15	$1,605,798	$2,778,336	$240,870	$157,890	**$2,004,558**	$311,075
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	B	15	$2,006,267	$3,234,461	$300,940	$196,113	**$2,503,319**	$311,075
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	C	20	$2,315,121	$3,426,066	$347,268	$212,991	**$2,875,380**	$296,075
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	B	20	$2,824,016	$3,970,077	$423,602	$259,809	**$3,507,428**	$296,075
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	A	20	$3,292,656	$4,177,205	$493,898	$302,924	**$4,089,479**	$311,075
Controls Option: Upgrade HVAC control system on current existing building systems.	- -	- -	$360,500	- -	$54,075	- -	$414,575	- -

Oak Park Elementary School District 97
Mann Elementary School
Air Conditioning System Options Performance & Costs Summary

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	HVAC Noise Level Comparison
Option 1: Window Air Conditioners*	$352,705	$8,400	$19,133	$126,267	$988,135	F
Option 2: Ductless Split System*	$713,548	$11,200	$15,559	$355,473	$1,550,608	D
Option 3: Ducted Split System*	$1,218,031	$11,200	$16,548	$382,239	$2,101,470	D
Option 4: Under the Window Self-Contained Unit Ventilator	$1,317,322	$8,400	$17,201	$525,130	$2,313,315	D
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	$1,964,736	$9,800	$19,012	$454,345	$2,947,483	D
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	$1,378,823	$8,400	$17,808	$569,331	$2,431,044	C
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	$1,729,233	$8,400	$18,667	$601,008	$2,830,153	B
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	$1,999,481	$9,800	$18,620	$477,696	$2,997,807	C
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	$2,444,764	$9,800	$19,777	$485,479	$3,473,817	B
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	$2,854,824	$7,700	$19,049	$303,554	$3,655,054	A

* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

Air Conditioning System Option	HVAC Noise Level Comparison	Life Expectancy (yrs)	MANN					
			Estimated Installation Cost	Estimated Life Cycle Cost	Construction Contingency (15%)	A/E Fees	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building
Option 1: Window Air Conditioners	F	10	$352,705	$988,135	$52,906	$35,491	**$441,101**	$246,167
Option 2: Ductless Split System	D	15	$713,548	$1,550,608	$107,032	$71,801	**$892,382**	$246,167
Option 3: Ducted Split System	D	15	$1,218,031	$2,101,470	$182,705	$119,063	**$1,519,799**	$246,167
Option 4: Under the Window Self-Contained Unit Ventilator	D	15	$1,317,322	$2,313,315	$197,598	$128,768	**$1,643,688**	$246,167
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	D	20	$1,964,736	$2,947,483	$294,710	$192,053	**$2,451,499**	$231,167
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	C	15	$1,378,823	$2,431,044	$206,824	$134,780	**$1,720,427**	$246,167
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	B	15	$1,729,233	$2,830,153	$259,385	$169,033	**$2,157,651**	$246,167
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	C	20	$1,999,481	$2,997,807	$299,922	$195,449	**$2,494,852**	$231,167
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	B	20	$2,444,764	$3,473,817	$366,715	$224,918	**$3,036,397**	$231,167
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	A	20	$2,854,824	$3,655,054	$428,224	$262,644	**$3,545,691**	$246,167
Controls Option: Upgrade HVAC control system on current existing building systems.	- -	- -	$289,058	- -	$43,359	- -	$332,417	- -

Oak Park Elementary School District 97
Whittier Elementary School
Air Conditioning System Options Performance & Costs Summary

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	HVAC Noise Level Comparison
Option 1: Window Air Conditioners*	$415,687	$9,900	$22,550	$148,815	$1,164,588	F
Option 2: Ductless Split System*	$840,968	$13,200	$18,337	$418,950	$1,827,502	D
Option 3: Ducted Split System*	$1,435,537	$13,200	$19,503	$450,496	$2,476,732	D
Option 4: Under the Window Self-Contained Unit Ventilator	$1,552,558	$9,900	$20,273	$618,903	$2,726,407	D
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	$2,315,582	$11,550	$22,407	$535,478	$3,473,819	D
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	$1,625,042	$9,900	$20,988	$670,997	$2,865,159	C
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	$2,038,025	$9,900	$22,000	$708,331	$3,335,538	B
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	$2,356,531	$11,550	$21,945	$562,998	$3,533,130	C
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	$2,881,329	$11,550	$23,309	$572,172	$4,094,141	B
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	$3,364,614	$9,075	$22,451	$357,760	$4,307,742	A

* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

Air Conditioning System Option	HVAC Noise Level Comparison	Life Expectancy (yrs)	WHITTIER					
			Estimated Installation Cost	Estimated Life Cycle Cost	Construction Contingency (15%)	A/E Fees	Total Estimated A/C Project Cost	Estimated Cost to Upgrade Controls in remainder of building
Option 1: Window Air Conditioners	F	10	$415,687	$1,164,588	$62,353	$41,829	**$519,869**	$382,159
Option 2: Ductless Split System	D	15	$840,968	$1,827,502	$126,145	$84,622	**$1,051,735**	$382,159
Option 3: Ducted Split System	D	15	$1,435,537	$2,476,732	$215,331	$140,324	**$1,791,191**	$382,159
Option 4: Under the Window Self-Contained Unit Ventilator	D	15	$1,552,558	$2,726,407	$232,884	$151,763	**$1,937,204**	$382,159
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	D	20	$2,315,582	$3,473,819	$347,337	$213,034	**$2,875,952**	$367,159
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	C	15	$1,625,042	$2,865,159	$243,756	$158,848	**$2,027,646**	$382,159
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	B	15	$2,038,025	$3,335,538	$305,704	$199,217	**$2,542,946**	$382,159
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	C	20	$2,356,531	$3,533,130	$353,480	$216,801	**$2,926,811**	$367,159
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	B	20	$2,881,329	$4,094,141	$432,199	$265,082	**$3,578,611**	$367,159
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	A	20	$3,364,614	$4,307,742	$504,692	$309,544	**$4,178,851**	$382,159
Controls Option: Upgrade HVAC control system on current existing building systems.	- -	- -	$419,313	- -	$62,897	- -	$482,209	- -

Oak Park Elementary School District 97
Replacement of Existing Pneumatic HVAC Control System
with Direct Digital Controls Costs

School	Total Cost
Beye Elementary School	$389,081
Hatch Elementary School	$331,152
Holmes Elementary School	$383,577
Irving Elementary School	$374,103
Lincoln Elementary School	$392,159
Longfellow Elementary School	$414,575
Mann Elementary School	$332,417
Whittier Elementary School	$482,209

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Exterior elevation of a vintage school with vertical unit ventilators louvers.

Interior view of a vintage school with vertical unit ventilators - free blown.

Vertical stand-up unit ventilators - ducted.

Vertical stand-up unit ventilators -free blown.