August 6, 2007
RFS 05-4830

Mr. Ken MacLean
Amsler Mashek MacLean Architects, Inc.
65 Long Wharf
Boston, Massachusetts 02210

MECHANICAL
ELECTRICAL
PLUMBING
FIRE PROTECTION
TELECOMMUNICATIONS
STRUCTURAL
CIVIL
COMMISSIONING

Re: YMCA of Martha's Vineyard
Geothermal Heat Pump Analysis

Dear Ken:

Rist-Frost-Shumway Engineering (RFS) was retained by Amsler Mashek MacLean Architects, Inc. to provide engineering services to perform a life cycle cost analysis to compare a geothermal heat pump design approach versus the present HVAC system design for heating and cooling of the new YMCA building on Martha's Vineyard. The life cycle cost analysis was completed using Trane® Trace 700 Energy Modeling software.

SYSTEM DESCRIPTIONS

A code minimum baseline design was modeled per ASHRAE 90.1 as a reference for the two (2) competing alternatives. The baseline design (Alternative #1) assumes an oil-fired boiler, air-cooled DX cooling, constant volume air distribution systems, all with code minimum equipment efficiencies. The present design (Alternative #2) assumes an oil-fired boiler, air-cooled DX cooling, variable volume air distribution systems, energy recovery, and higher efficiency equipment. The geothermal design (Alternative #3) is equivalent to Alternative #2 except uses geothermal heat pumps to provide primary heating and cooling for the building in lieu of oil-fired boilers and air-cooled DX cooling. The assumed efficiencies of the geothermal heat pumps are 17.5 EER in cooling mode with a 3.5 COP in heating mode.

SYSTEMS AND UTILITY COSTS

The construction manager's estimate for the current design was used as the basis for determining the cost of the other two (2) alternatives. The code minimum baseline system is assumed to be $100,000 less than the current design and the geothermal heat pump system is assumed to be $250,000 more than the current design.

The cost of fuel oil was taken from Energy Information Administration statistics and is assumed at $2.20 per gallon. The cost of utility electric was determined from the Cape Light Compact supplier price plus the NSTAR delivery charges ($0.15 per kWH, $2.99 per kVA).

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RFS engineering

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Page 2

SUMMARY OF RESULTS

The geothermal heat pump system showed a 22% decrease in overall energy use versus the design building with a 65% decrease in primary heating energy and a 35% decrease in primary cooling energy. This relates to an energy cost savings of approximately $5500 per year and a simple payback of 45-years. The following table indicates the first cost and the 25-year life cycle cost associated with each of the three systems.

Alternate No.	System Type	First Cost	Life Cycle Cost
1	Code Min. Baseline Building	$1,030,000	$2,045,400
2	Design Building	$1,130,000	$1,972,500
3	Geothermal Building	$1,380,000	$2,172,100

The results of the life cycle cost analysis are attached for your reference. The analysis for each system includes an economic summary sheet and two (2) energy consumption sheets.

If you should have any questions or comments, please do not hesitate to contact our office.

Sincerely,

RIST-FROST-SHUMWAY ENGINEERING, P.C.

Theodore K. Lempka, P.E.
Senior Mechanical Engineer

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Enclosures

TRACE® 700 Economic Summary

By RFS

Project Information

Weather file	Providence, Rhode Island
Project Name	Marthas Vineyard YMCA
Location	Oak Buffs MA
Building Owner	YMCA
User	EMK
Company	RFS
Comments	Life Cycle Cost Analysis

Alternative 1 - - MVYMCA - ASHRAE 90 1 Baseline Building
Alternative 2 - - Design Building
Alternative 3 - - Geothermal Analysis

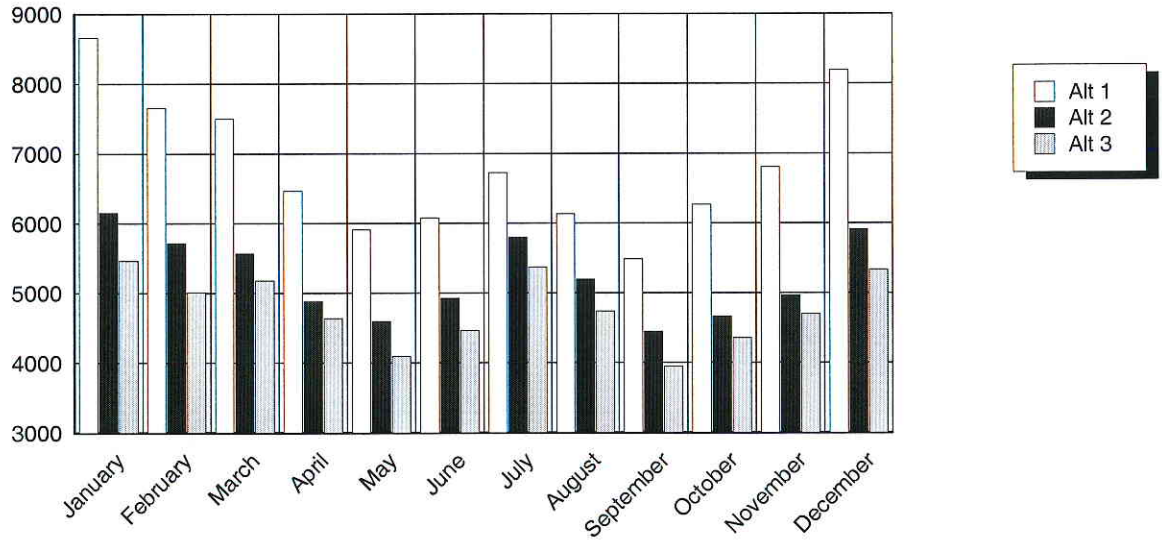
Economic Summary

Alternative Number	Installed Cost	First Year Util.Cost	Final Year Util. Cost	First Year Maint. Cost	Final Year Maint. Cost	Life Cycle Cost
1	1,030,000.00	81,868.51	81,868.51	30,000.00	30,000.00	2,045,435.01
2	1,130,000.00	62,817.12	62,817.12	30,000.00	30,000.00	1,972,504.73
3	1,380,000.00	57,261.68	57,261.68	30,000.00	30,000.00	2,172,077.77

Economic Comparison of the Alternatives

Alt. - Alt.	First Cost Difference	Simple Payback	Net Present Value	Life Cycle Payback	Internal Rate of Return
2 - 1	100,000.00	5.2 yrs	72,930.28	7.8 yrs	18.8 %
3 - 1	350,000.00	14.2 yrs	-126,642.76	Does not pay back	4.9 %
3 - 2	250,000.00	45.0 yrs	-199,573.03	Does not pay back	Does not pay back

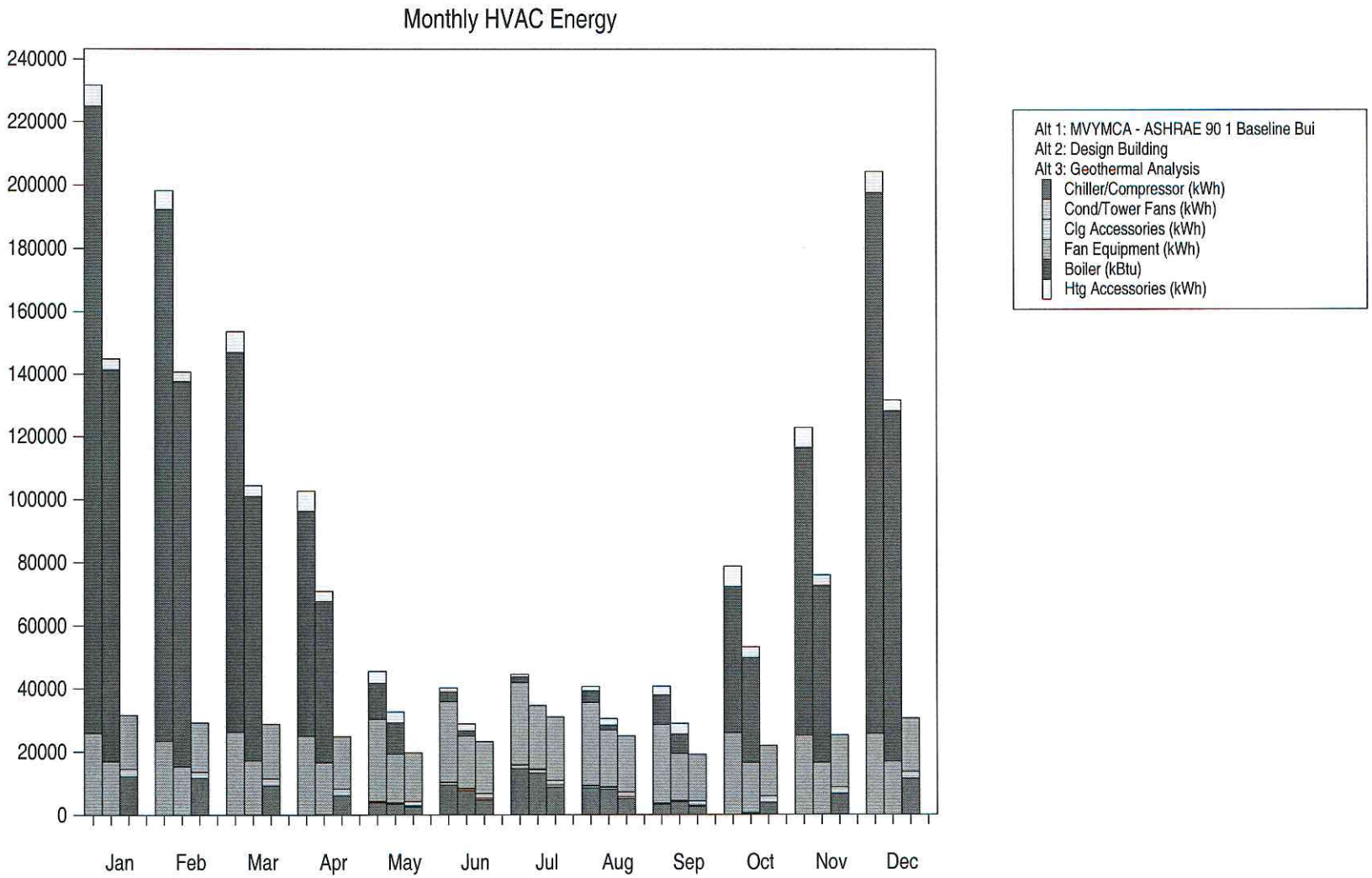
Monthly Utility Costs



Equipment Energy Consumption by Alternative

	Elect Cons. (kWh)	Oil Cons. (kBtu)	Water Cons. (1000 gals)	Percent of Total Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative: 1 - MVYMCA - ASHRAE 90 1 Baseline Building						
Primary heating		899,196		30.8%	899,196	946,522
Other Htg Accessories	37,069		81	4.3%	126,517	379,589
Cooling Compressor	40,439			4.7%	138,017	414,093
Tower/Cond Fans	3,125			0.4%	10,665	31,999
Other Clg Accessories	661			0.1%	2,257	6,772
Supply Fans	305,650			35.7%	1,043,183	3,129,862
Pumps	18,002			2.1%	61,441	184,342
Stand-alone Base Utilities	1	8,760		0.3%	8,762	9,228
Lighting	169,723			19.8%	579,265	1,737,969
Receptacles	14,750			1.7%	50,343	151,045
Totals**	**589,420**	**907,956**	**81**	**100.0%**	**2,919,647**	**6,991,421**
Alternative: 2 - Design Building						
Primary heating		601,230		27.4%	601,230	632,874
Other Htg Accessories	23,682		48	3.7%	80,825	242,500
Cooling Compressor	37,814			5.9%	129,058	387,211
Tower/Cond Fans	2,784			0.4%	9,501	28,507
Other Clg Accessories	1,414			0.2%	4,827	14,482
Supply Fans	200,093			31.1%	682,918	2,048,958
Pumps	10,581			1.7%	36,114	108,354
Stand-alone Base Utilities	1	8,760		0.4%	8,762	9,228
Lighting	169,723			26.4%	579,265	1,737,969
Receptacles	18,042			2.8%	61,579	184,755
Totals**	**464,134**	**609,990**	**48**	**100.0%**	**2,194,080**	**5,394,840**
Alternative: 3 - Geothermal Analysis						
Primary heating	62,179			12.4%	212,216	636,713
Other Htg Accessories	15,391			3.1%	52,530	157,605
Cooling Compressor	23,516			4.7%	80,261	240,806
Tower/Cond Fans	2,951		142	0.6%	10,071	30,217
Other Clg Accessories	226			0.1%	771	2,314
Supply Fans	200,093			40.0%	682,918	2,048,958
Pumps	5,951			1.2%	20,310	60,936
Stand-alone Base Utilities	1	8,760		0.5%	8,762	9,228
Lighting	169,723			33.9%	579,265	1,737,969
Receptacles	18,042			3.6%	61,579	184,755
Totals**	**498,073**	**8,760**	**142**	**100.0%**	**1,708,684**	**5,109,502**

** Note: Resource Utilization factors are included in the Total Source Energy value.*


Monthly HVAC Energy
240000
220000
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Alt 1: MVYMCA - ASHRAE 90 1 Baseline Bui
Alt 2: Design Building
Alt 3: Geothermal Analysis
Chiller/Compressor (kWh)
Cond/Tower Fans (kWh)
Clg Accessories (kWh)
Fan Equipment (kWh)
Boiler (kBtu)
Htg Accessories (kWh)