



# **Northwest Elementary School -- Ground Source Heat Pump Project**

Funded by the Kansas State Energy Office as the recipient of the Department of Energy Formula Grant funding, under provisions of the American Recovery and Reinvestment Act of 2009.



# Northwest Elementary School

- Gross Square Footage 44,320
- Main Building Constructed 1957
- Annex Constructed 1964
- 18 Classrooms
- Library
- Gymnasium/Lunchroom With Stage
- Kitchen
- Support Areas
- Enrollment 338

# Heating – Main Building

- Heat -Gas-fired steam boiler replaced in 2001.
- Piping – Original, well past expected life span.
- Original unit ventilators in classrooms and offices, steam radiators in hallways.
- Many of the outside air intake dampers and louvers are no longer operating.
- Two steam heating only air handling units serve the gymnasium. (only one operates)
- Kitchen is served by a packaged DX unit located on a pedestal in front of school.



09/23/20

# Heating -- Annex

- Original two pipe hot water system. (1964)
- Original unit ventilators.

# Control System

- Original Pneumatic Control System.

Bryant

12-98

09/23/20



# Air Conditioning

- Classrooms and offices are cooled by window air conditioners installed in 1995.
- Gymnasium is served by a ground mounted gas fired packaged DX unit with air ductwork mounted tight to roof structure. (2005)
- Kitchen is served by a packaged DX cooling unit mounted on a pedestal at the front of the school. (2001)



09/23/20



09/23/2010

# Teaching Environment

- The window air conditioners are five years beyond their normal life expectancy.
- The noise level from the old window air conditioners and some of the unit ventilators is beyond acceptable noise level for classrooms and offices.
- Comfort in some classrooms is a hit or miss matter.

# Maintenance Requirements

- 1967 boiler in the annex is beyond normal life expectancy.
- Window air conditioners are beyond normal life expectancy.
- Piping for steam and hot water systems are beyond normal life expectancy and require constant repair.

# Maintenance Requirements (Continued)

- Domestic hot water distribution system is beyond normal life expectancy and requires constant repair
- Steam heating air handling units in gym – one not operating and parts not available
- Old unit ventilators are noisy and repair parts are not available so home fixes are required



09/23/20



2a

09/23/20

# Why upgrade HVAC now?

- The school was scheduled for mechanical upgrade.
- The Energy Office Grant Award was available to offset initial cost. (\$212,000)
- The local electric utility will award \$20,000 to the project.

# Site Visitations

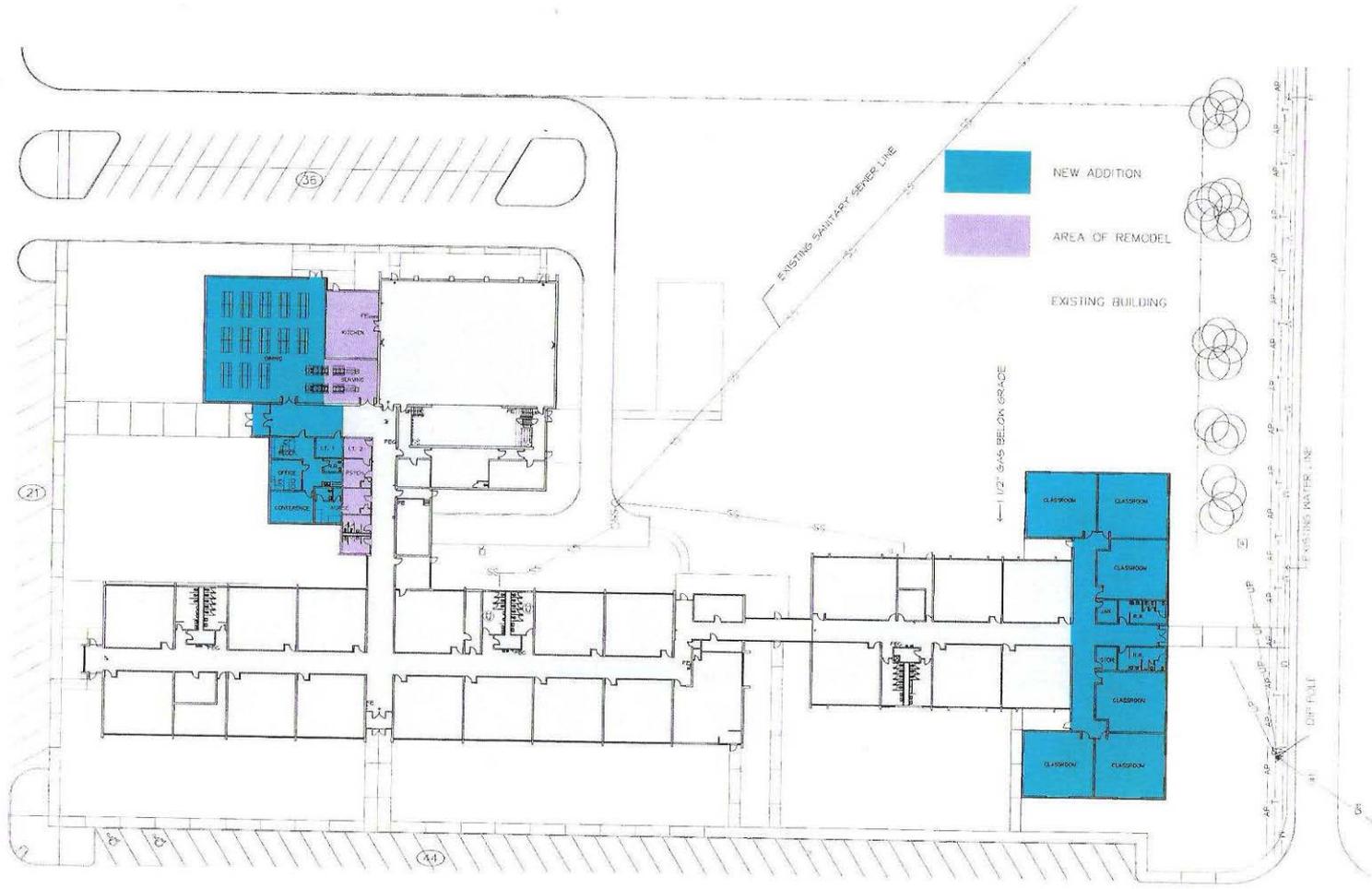
- Scott City USD High School.
- Scott City USD Elementary School.
- Pitman, Oklahoma Elementary School.
- Baptist Church in Woodward, OK.
- Climatedmaster Factory in Oklahoma City where units are manufactured.

# Benefits of Ground Source Heat Pumps

- Simultaneously heat and cool different rooms within the school with distributed heat pumps.
- Very quiet for classroom operation.
- Requires less mechanical room space.
- No outside equipment to protect and hide.
- Ground Heat Exchanger life expectancy is 40+ years.
- Maintenance on individual heat pumps will not curtail operation in other classrooms.

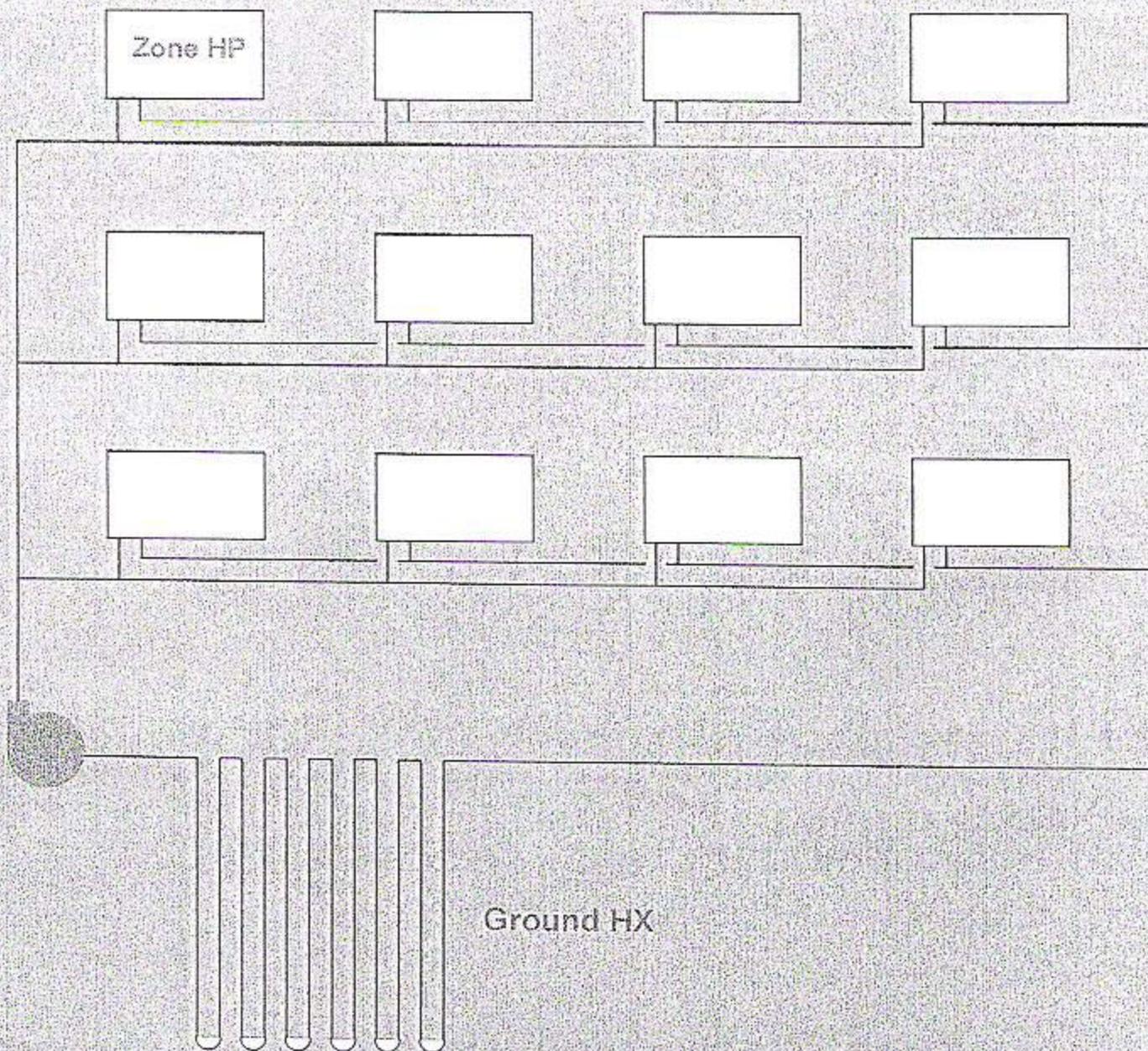
# GSHPS Offer Savings

- The United States Department of Energy predicts a 25% to 40% savings over 4 pipe system.
- Lower peak demand, lowers operating costs.
- Water heated with waste heat from air conditioning.



# NORTHWEST ELEMENTARY

# Ground-Loop Heat Pump System



# Geothermal Heat Pump Efficiency

**1 unit of energy  
from the grid**

**Yields:  
4-6 units of energy  
for the building**

**Plus:  
3-5 units of energy  
from the earth**

**400-600% Efficient**

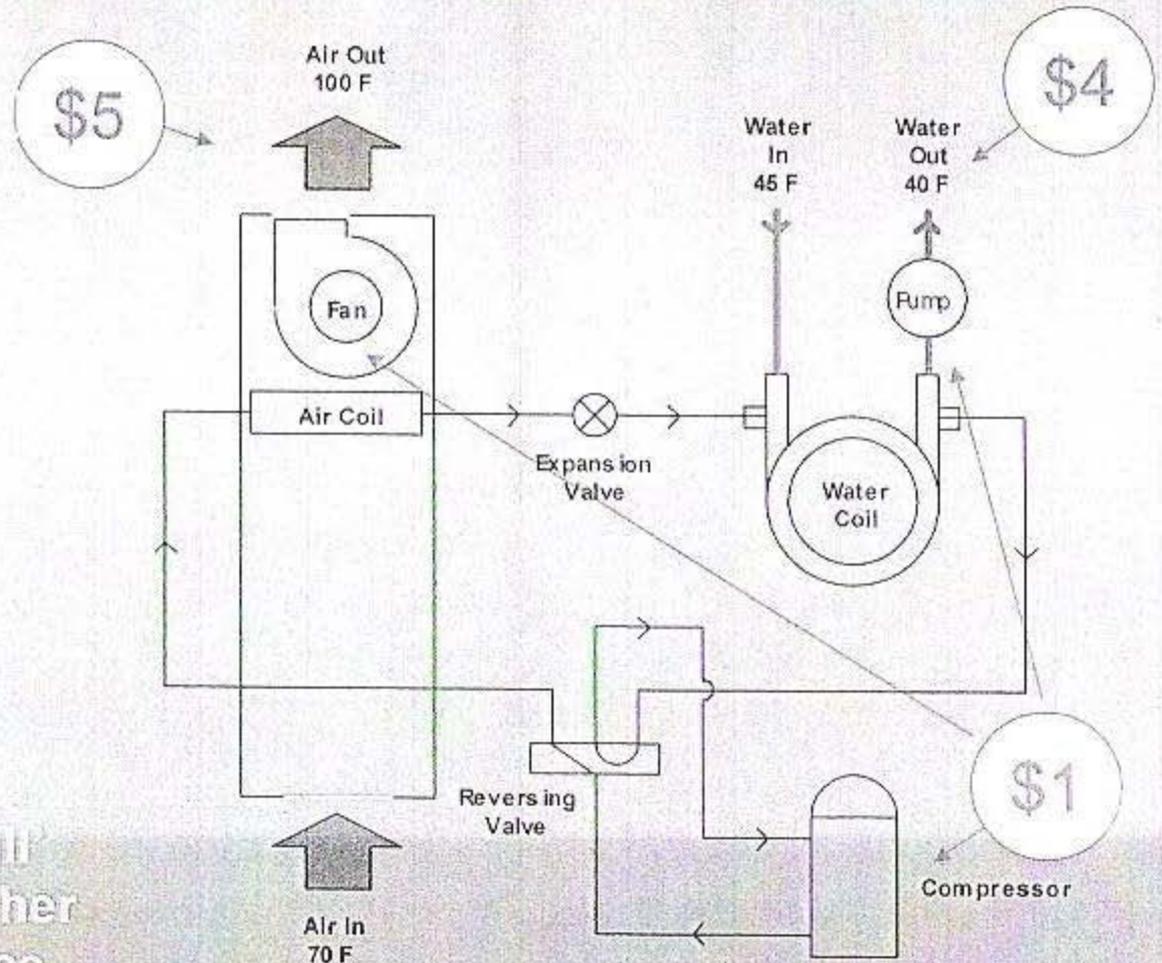
# Geothermal Heat Pumps Exchange Heat between Air and Water

\$1 Worth of Electricity to Operate the Compressor and Fan

Moves \$4 Worth of Heat from the Water

Delivering \$5 Worth of Heat into the Air

Heating Mode Shown



Heat can be pumped uphill meaning delivered at a higher temperature than the source

Energy Source	Demand/ Capacity Qty	Unit	Consumption /Production Qty	Unit	Annual Cost * in Dollars	Consumption /Production in MMBtu's	Annual Cost * per MMBtu
Pre-Project							
Electricity	1,584.98	KW	250,339	KWH	\$26,159		-
Natural Gas					\$86,651	9,955	\$8.70
							-
							-
Totals					\$ 112,810 -	9,955 -	\$8.70 -
Post Project							
Electricity	2,298.20	KW	362,991.55	KWH	\$37,930		-
					\$43,325	4,977.5	\$8.70
							-
							-
Totals					\$ 81,255 -	4977.5 -	\$8.70 -
Savings (Pre-Project minus Post Project)							
	-703.22	KW	-12,652.55	KWH	-\$11,771		-
					\$43,315		-
							-
							-
Totals					\$ 31,544 -	-	-

\*Annual Cost of traditional energy sources = most recent 12 months of utility/fuel bills; Annual Cost of renewable energy source = (estimated lifetime operating costs) / (estimated lifetime), do not include project cost. Do not adjust for inflation.

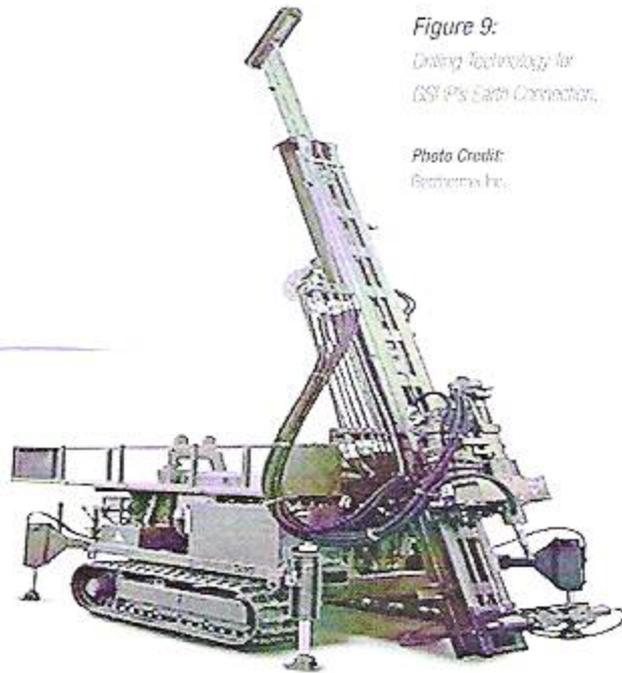
#### SIMPLE PAYBACK CALCULATION

\$ 850,000 - Total Cost of Project  
 \$ 31,544 - Total Annual Cost Savings (from above)  
 25 - Simply Payback in Years

#### GHG REDUCTIONS (Carbon Equivalents)

217,9 Tons

<http://www.epa.gov/cleanenergy/energy-resources/calculator.html>



**Figure 9:**  
*Drilling Technology for  
DSF P's Earth Connection.*

**Photo Credit:**  
Boschma Inc.



09/23/20



09/23/20



09/23/20



