

LONGWOOD AT OAKMONT HEALTHCARE CENTER

GROUND SOURCE HEAT PUMP ANALYSIS FOR THE LOONGWOOD AT OAKMONT HEALTHCARE CENTER



TYLER LOBB
AE SENIOR THESIS – SPRING 2008
MECHANICAL OPTION
THE PENNSYLVANIA STATE UNIVERSITY

PENNSTATE





Presentation Outline

Project and Building Background

Building Existing Conditions

Mechanical System Redesign

- Goals and Objectives

- GSHP

- Building Energy Utilization

- Economic Analysis

Electrical Breadth: Power System Changes

Construction Breadth: GSHP Well Field Analysis

Redesign Conclusions



Project and Building Background

Building Logistics

- Location: 500 Route 909 Verona, PA 15147
- Building Occupant: Presbyterian Senior Care
- Occupancy/Function Type: Senior Care Facility
- Size: 45,000 SF
- Date of Construction: November 2007 – July 2008
- Cost: Roughly 11 million dollars
- Delivery Method: Design-Bid-Build



Project and Building Background

Project Team:

- Owner – Presbyterian Senior Care
- General Contractor – Mistick Construction (www.mistickconstruction.com)
- Architect – Reese, Lower, Patrick, and Scott, Ltd. (www.rlps.com)
- MEP Engineer – Reese Engineering Inc. (www.reeseinc.com)
- Structural Engineer – Zug and Associates
- Civil Engineer – Gateway Engineering Inc. (www.gatewayengineering.net)
- Landscape Architects – Victor – Wetzel Associates
- Food Services – S.S. Kemp and Co. (www.sskemp.com)



Project and Building Background

Healthcare Center

- Private/Semi-Private Resident Rooms
- Offices
- Public Gathering Spaces
- Kitchens
- Beauty Shop



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Building Existing Conditions

Energy Recovery Unit

- Supply Ventilation Air Throughout Building
- “Room Neutral” - 79 F DB (Cooling) & 34 F DB (Heating)
- Distributed to Water Source Heat Pumps
- Fully Conditioned to Desired Set Point



Building Existing Conditions

Water Source Heat Pump

- Located in Virtually Every Space
- Perform Final Conditioning to Occupant Set Point
- ½ - 10 Nominal Ton Units
- Use Water Loop to Either Heat or Cool Air



Building Existing Conditions

Cooling Tower

- Closed Circuit, 325 Ton, Blow Through, Axial Fan
- Cools Water Loop

Boilers

- Gas-Fired Boilers Heat Water Loop
- Three Boilers, One is Used as Backup

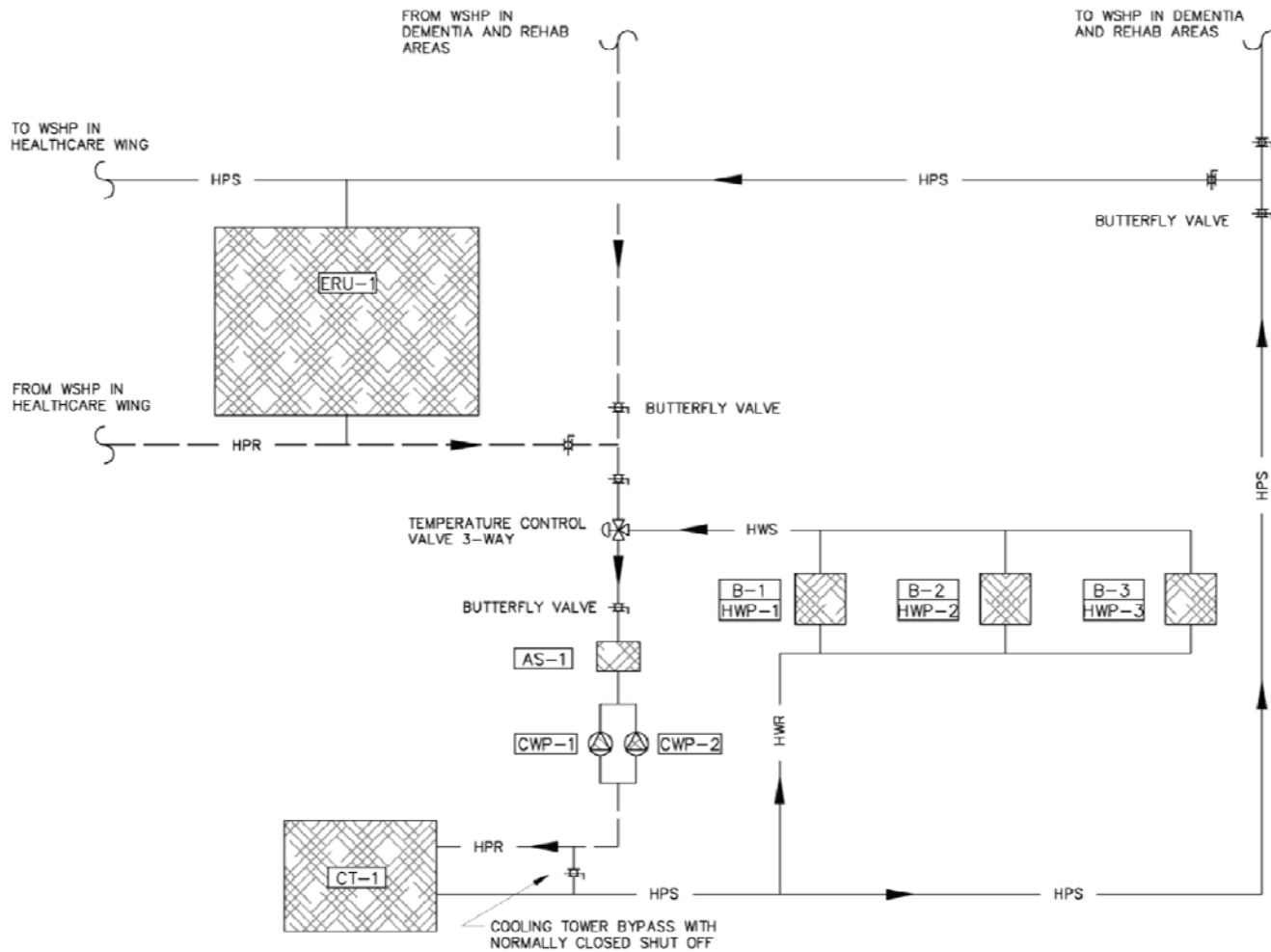
Pumps

- Two Centrifugal Pumps Circulate Water Loop



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Mechanical System Redesign

Goals and Objectives

- Increase Energy Efficiency
- Fulfill Needs and Budget of Client
- Compare WSHP System Versus GSHP System
- Limit Negative Effects on Other Systems



Mechanical System Redesign

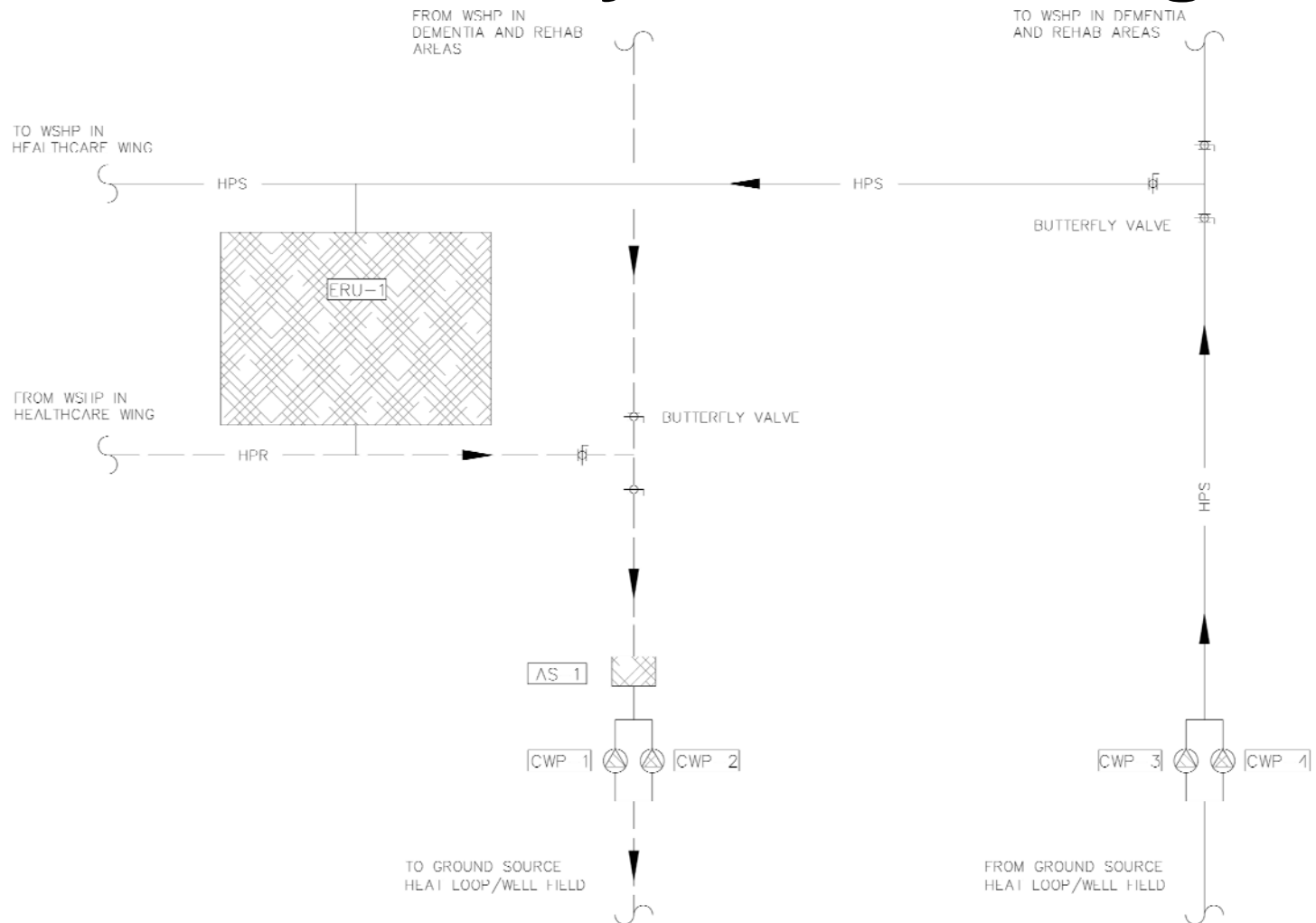
Ground Source Heat Pump System

- Utilizes Earth's Underground Temperature to Transfer Heat
- Can Both Heat and Cool
- Numerous Up-Front Hurdles
- Potentially High Operating Cost Savings



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Mechanical System Redesign





Mechanical System Redesign

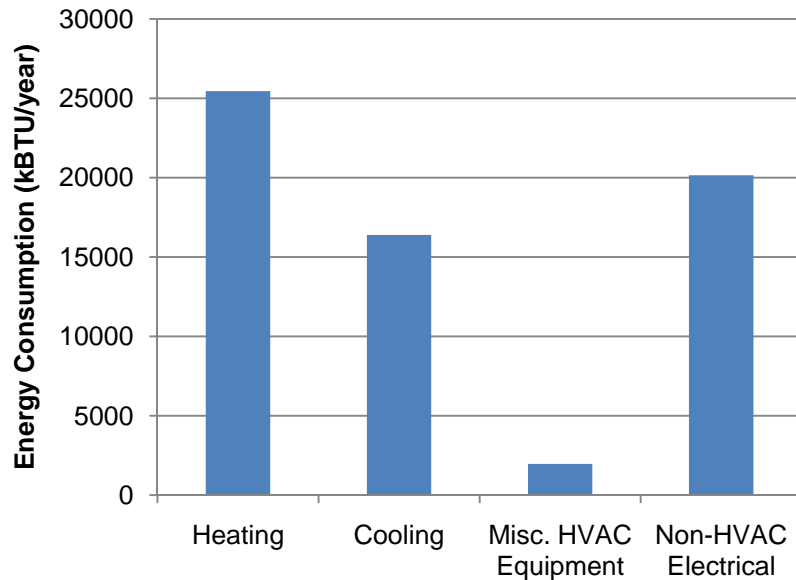
Building Energy Utilization

- Mechanical Load Remains Same
- Efficiency for Conditioning Load Increases
- Decrease in Heating and Cooling Energy Usage
- 23% Decrease in Energy Building Consumption

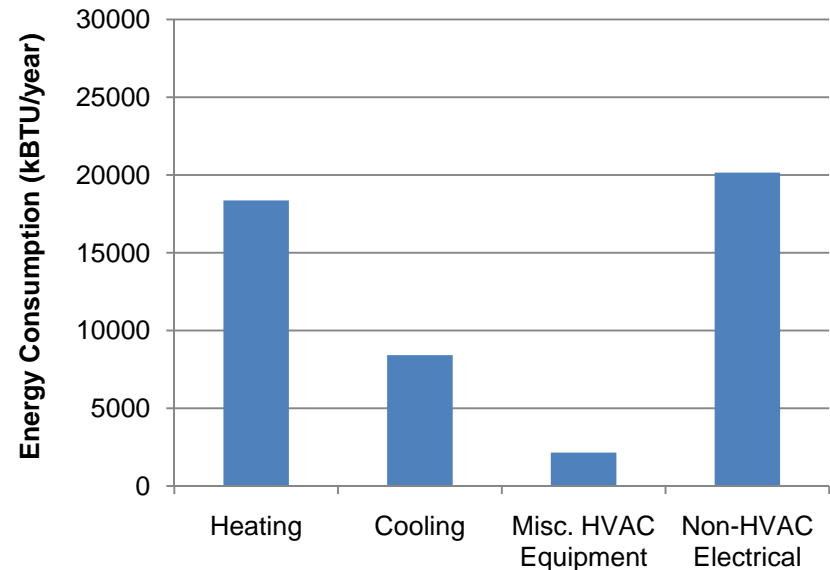


Mechanical System Redesign

Annual Building Energy Utilization



Redesigned Annual Building Energy Utilization





Mechanical System Redesign

Economic Analysis

Initial Cost Comparison

Equipment	Existing WSHP System (\$)	Redesign GSHP System (\$)
Cooling Tower	43200	0
Gas-Fired Boilers	72900	0
Circulating Pumps	15360	30720
Ground Piping (Excavation/Installation)	0	294750
Equivalent Electrical Savings	4040	0
TOTAL	135500	325470

More Than Twice as Expensive Up-Front



Mechanical System Redesign

Economic Analysis

20 Year Cost Analysis

Cost Description	WSHP System Costs (\$)	GSHP System Costs (\$)
Utility Cost	1538400	1205400
Initial Cost	135500	325470
TOTAL	1673900	1530870

- Roughly 10% Cheaper
- Payback Period of 11 Years



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Electrical Breadth Power System Changes

Mechanical System Power Redesign

- Electrical Driven Equipment Added and Removed
- Panel Boards Resized
- Feeders and Conduit Resized Accordingly
- Voltage Drop Checked



Electrical Breadth Power System Changes

Cost Analysis of Power Changes

Conductor Savings	\$1,130
Conduit Savings	\$2,910
Total	\$4,040

Electrical Cost Savings Due to Mechanical Redesign



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Construction Breadth GSHP Well Field Analysis

Effects of Redesigned System

- Impact on Construction Schedule
- Physical Properties of Site
- Size and Location of Well Field



Construction Breadth GSHP Well Field Analysis





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Redesign Conclusions

- Higher Initial Costs
- Annual Utility Savings
- Reasonable Payback Period
- Significant Savings Over 20 Years

Redesign Seems Beneficial Pending Owner



Acknowledgments

Thank You!

AE Department

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Questions?

