

SUNDOWN M RANCH YAKIMA, WASHINGTON

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Photo credit: <http://www.sundown.org/>

BUILDING CHARACTERISTICS

The Sundown M Ranch, located just northwest of Yakima, Washington, is a drug and alcohol rehabilitation center for both youths and adults. The 134,880 ft² (12,531 m²) complex was built in several phases beginning in 1985 with the adult facility totaling 77,300 ft² (7,181 m²), followed by a family annex of 20,650 ft² (1,918 m²) in 1990, a 39,730 ft² (3,661 m²) youth facility in 1992, and the 7,200 ft² (669 m²) administration building in 1995. The facility also provides laundry and food services for the patients. The buildings are stick-built wood frame, low-rise residential style. The buildings are well insulated and use primarily fluorescent lighting.

The residences are occupied 24 hours per day, while other facilities are normally occupied during normal office hours except for the gym that has an intermittent occupation pattern.

GEOTHERMAL HEAT PUMP SYSTEM CHARACTERISTICS

A process schematic is shown in Figure 1.

Geothermal Source Description

The complex is served by two production wells at ca 57°F (13.9°C) and one injection well. The main well is approximately 200 ft (61 m) deep, and provides 360 gpm (22.7 L/s) via a 15-hp (11 kW) submersible pump. The

second well is 187 ft (57 m) deep and supplies 260 gpm (16.4 L/s). It has a 15-hp (11 kW) submersible pump. After passing through the heat pump, the water is injected or used for irrigation during the summer months. The well pumps are run 24-hours per day at constant speed. Flow is controlled through the use of throttling valves. There are also two domestic water wells on the property. In addition to use for heating and cooling and domestic purposes, the wells together can supply a maximum of 1,100 gpm (69.4 L/s) for fire protection.

Heating, Ventilation, and Air Conditioning (HVAC) System Description

The various facilities are served by a combination of heat pumps and heat pump unit ventilators (Figure 2). Water is circulated in an open loop to each building. Circulating pumps serve to boost the flow through the various buildings. A total of 297 heat pumps supply the complex comprised of 257 1-ton (3.5 kW) heat pump unit ventilators, 12 3-ton (10.5 kW) units, and 28 5-ton (17.6 kW) units for a total of 433 tons (1,523 kW). In addition, there are four 5-ton (17.6 kW) water-to-water heat pumps in the adult building for hot water and two 5-ton (17.6 kW) units with back-up electric water heaters serving the youth facility (Figure 3). There is a 1,000 gallon (3785 L) hot water storage tank in the adult facility.

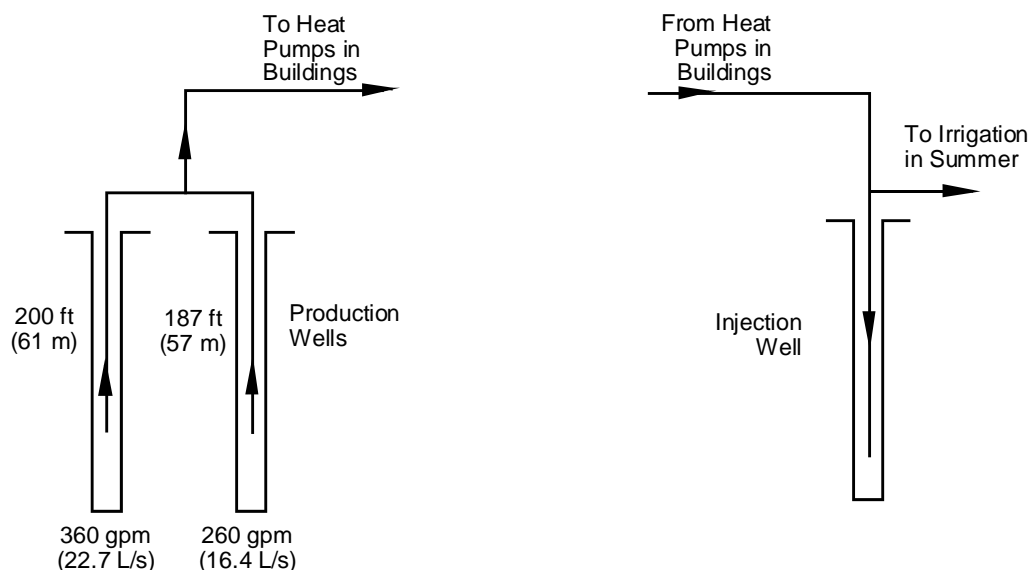


Figure 1. Process schematic of Sundown M Ranch.

SELECTION OF THE GEOTHERMAL HEAT PUMP SYSTEM

The geothermal heat pump system was selected upon the recommendation of the serving utility, Pacific Power and Light; the availability of adequate supplies of reliable warm water; a desire for energy efficiency; and a guaranteed reduction in electrical rates by the serving utility if the heat pump system was installed. They were also very interested in having the ability to provide individual room control.

OPERATING HISTORY

The system has been built-out over 14 years, with additional buildings added every few years. The system has performed as expected, and has experienced few operating problems. The fact that for each subsequent phase of the build-out, the decision has been to continue with geothermal heat pumps is a good indication of the system's excellent operational performance.

OPERATION AND MAINTENANCE ISSUES

The system is operated and maintained by in-house staff. Since the well pumps are not equipped with variable speed drives, the pumps must be operated 24 hours per day. Flow is controlled by use of a throttling valve. In summer use, the water coming out of the loop is used for irrigation purposes and in certain cases this can reduce the water available to the loop to the extent that the system does experience some high head problems on the heat pumps.

Each heat pump has a valve that opens or closes depending on whether the heat pump is on. The heat pumps and unit ventilation have outdoor air access and are controlled by thermostats.



Figure 2. Console heat pump.



Figure 3. Water to water heat pump.

The one on-going operational problem has been associated with the injection well. The well tends to plug up and will not accept the return flow. This in turn causes a pressure build up in the injection system and often results in broken PVC pipes. Because of this, the well is now cleaned every six months by reversing the flow. Chlorine is also added to kill organic material that is the source of the plugging.

Since going into operation in 1985, compressors have been replaced on 11 unit ventilators and 3 heat pumps. Three fan motors have also been replaced. Once a month they change filters and back flush the coils on each heat pump, and check the screens going into each unit ventilator.

Every six months, they do a thorough inspection of all heat pumps and unit ventilators including coils, fans and motors, water flow, and operation. Once a year, they do a thorough cleaning of the heat pumps and coils.

Annual maintenance costs are running \$0.12 to \$0.15 ft² (\$1.29-\$1.61/m²).

SYSTEM ECONOMICS

Because of the phased build-out of the system over the past 14 years, there are no records available in relation to overall system costs. The owners, however, feel that the system has been very economic to operate, and the annual maintenance costs of \$0.12 to \$0.15/ft² (\$1.29 to \$1.61/m²) is very acceptable.

SATISFACTION WITH THE SYSTEM

The owners and operators of the complex seem to be very satisfied with the system. It has been economic to operate, requires only normal maintenance and a very few units have required repair or replacement. Operational staff indicated that there was less than 100 percent satisfaction on

the part of some patients due to the fact that the units do not provide instantaneous heat. They get on the average of one complaint per month.

OVERALL SUMMARY

Building Description:

Location: Yakima, WA

Occupancy: Drug rehabilitation

Gross Floor Area: 134,880 ft² (12,531 m²), multiple buildings

Type of Construction: New

Completion Date: 1985-1995

July Avg. High Temp.: 87°F (30.6°C)

Jan Avg. Low Temp.: 21°F (-6.1°C)

Annual Heating Degree Days: 6012°F-day (3340°C-day)

Annual Cooling Degree Days: 465°F-day (258°C-day)

Interior System:

Total Installed Heat Pump Capacity: 433 tons (1523 kW)

No. of Heat Pump Units: 297 water-to-air, 5 water-to-water

Heat Pump Capacities: 1, 3 and 8.5 ton (3.5, 10.5 and 17.5 kW) water-to-air; 5 tons (17.5 kW) water-to-water

Ground-Source System:

Type: Open loop

Mean Groundwater Temp.: 57°F (13.9°C)

Configuration: 2 production wells, 1 injection well

Well Depths: 187-200 ft (57-61 m)

Pumping Rates: 620 gpm total (39 L/s)

Economic Analysis:

Installed Geothermal HVAC Capital Cost:
unavailable

Total Annual Building Energy Use:
20.07 kWh/ft² (216 kWh/m²)

Annual Maintenance Costs:
\$0.12-\$0.15/ft² (\$1.29-\$1.61/m²)