1.0 Executive Summary

The West Virginia Alumni Center was originally designed with a central plant mechanical system that included duel fuel (natural gas primary) hot water boilers for heating water and air-cooled chillers for chilled water. The heating water was distributed to each of 9 rooftop AHU's for heating and to VAV boxes for reheat. The chilled water was also distributed to each of the rooftop AHU's. When this design went out to bid the price estimates were much higher than expected and a cheaper design had to be implemented.

The resulting design was a low first-cost, higher annual energy cost system when compared with the central plant design. The new design utilized packaged rooftop AHU's with direct expansion cooling and natural gas furnace heating. Because the new design emphasized first-cost considerations, the benefits of higher first-cost, lower annual energy cost alternatives were not readily explored.

To explore the impact of the installation of a system with a potentially higher first cost and potentially lower annual energy cost an analysis of a ground source heat pump system with a dedicated outdoor air system was conducted for this report. The current packaged rooftop AHU system was replaced with water-to-air heat pumps that reject/gain heat from the earth and a parallel system that provides ventilation air.

The system was then optimized to use appropriately sized ground loops that minimize construction cost and do not significantly add to the construction schedule. Additionally the impact of removing existing mechanical equipment and replacing it with new mechanical equipment on the electrical distribution system was analyzed.

Trane Trace 700 was then used to determine the annual energy use of the original design, existing design and the new proposed heat pump design. The monetary and scheduling impact of the borehole drilling was also calculated along with the monetary impact of the electrical system changes.

After all analysis was complete a 20-year life-cycle cost analysis was conducted to determine the simple payback period of implementing the new design. The 7% increase in capital cost was found to be paid back by energy savings and maintenance savings in approximately 5 years as shown below. With such a quick payback period it was determine that the implementation of the ground source heat pump system with a parallel dedicated outdoor air system would be a worthwhile investment and could be a successfully implemented design.

System	Capital Cost	Maintenance and Replacement	Energy Costs	Total Present Value Cost	Savings	Simple Payback
As-Designed	$1,420,000	$218,000	$1,351,600	$2,989,600	-	N/A
Redesign	$1,515,000	$96,000	$998,200	$2,609,200	$380,400	4.99