

TABLE OF CONTENTS

ENERGY AUDIT REPORT

FOR

PINE HALL

HOME MENTAL HEALTH CENTER

TINLEY PARK, ILLINOIS

May 7, 1980

PREPARED BY

THE ENERGY MANAGEMENT UNIT

OF THE

CAPITAL DEVELOPMENT BOARD

STATE OF ILLINOIS

3RD FLOOR/WILLIAM G. STRATTON BUILDING
401 SOUTH SPRING STREET
SPRINGFIELD, ILLINOIS 62706

Printed By The Authority Of The State Of Illinois

40-5-7-80 Printing Order Number 12

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
2.0 RECOMMENDATIONS	2
2.1 Changes in Operations and Maintenance Procedures	2
2.2 Retrofit Recommendations	5
2.2.1 Primary recommendations	5
2.2.2 Additional recommendations	5
3.0 ANALYSIS AND CONCEPTUAL DESIGN	6
3.1 Energy Use Analysis	6
3.2 Description of Existing Facility	6
3.2.1 Location, climate context, and immediate site conditions	6
3.2.2 Configuration, envelope, construction and condition	8
3.2.3 Description of heating, ventilation, air conditioning, hot water, lighting, and electrical power systems	8
3.2.3.1 Heating system	8
3.2.3.2 Ventilation system	9
3.2.3.3 Air conditioning system	9
3.2.3.4 Hot water system	9
3.2.3.5 Lighting system	9
3.2.3.6 Electrical power system	9
3.3 Retrofit Recommendations (Delineated)	10
3.3.1 Close off outside air supply to the North section during unoccupied times	10
3.3.2 Convert selected incandescent fixtures to fluorescent fixtures	10

	<u>Page</u>
3.3.3 Cover selected glass areas with insulated panels	10
3.3.4 Add insulation to the face brick wall areas on the interior side	11
3.4 Retrofit Projects Not Recommended	11
4.0 STATEMENT OF AUDITORS' QUALIFICATIONS AND FINANCIAL INTERESTS	12
APPENDIX	A-1

The audits are being conducted by the Energy Management Unit of the Capital Development Board in cooperation with the building operating personnel. Audit teams are making on-site inspections of all facilities containing a minimum of 50,000 gross square feet of space and similar buildings which are obvious energy wasters.

The findings of each audit are summarized in a report which includes specific recommendations for 1) changes in operations and maintenance procedures and 2) remodeling and renovation (retrofit) projects designed to reduce energy consumption. Recommendations for Pine Hall at New Mental Health Center are contained in Section 2.8 of this report.

The Capital Development Board gratefully acknowledges the valuable assistance rendered by Chief Engineer Larry Feak and his staff during the on-site energy audit performed by the staff of the Energy Management Unit.

The Energy Audit team on this project consisted of Walter Claypool, P.E., Supervisor of the Energy Management Unit and B.J. Mills, Energy Management Engineer.

1.0 INTRODUCTION

The achievement of energy independence is one of our nation's most important goals, and one in which the states can play an important role. As part of the effort in Illinois, the Capital Development Board will conduct Class A energy audits of 12 million gross square feet of state facilities. These audits have been funded by the U.S. Department of Energy in cooperation with the Illinois Institute of Natural Resources.

The audits are being conducted by the Energy Management Unit of the Capital Development Board in cooperation with the building operating personnel. Audit teams are making on-site inspections of all facilities containing a minimum of 50,000 gross square feet of space and smaller buildings which are obvious energy wasters.

The findings of each audit are summarized in a report which includes specific recommendations for 1) changes in operations and maintenance procedures and 2) remodeling and renovation (retrofit) projects designed to reduce energy consumption. Recommendations for Pine Hall at Howe Mental Health Center are contained in Section 2.0 of this report.

The Capital Development Board gratefully acknowledges the valuable assistance rendered by Chief Engineer Larry Funk and his staff during the on-site energy audit performed by the staff of the Energy Management Unit.

The Energy Audit team on this project consisted of Walter Claypool, P.E., Supervisor of the Energy Management Unit and B.J. Mills, Energy Management Engineer.

2.0 RECOMMENDATIONS

2.1 Changes in Operations and Maintenance Procedures

The following recommendations can be implemented by the existing building staff at minimal cost for a total savings the first year of \$1,096 and a fifteen year cumulative savings of \$40,332.

Implementation of these recommendations will save an estimated 288.57 million BTU per year.

<u>Description</u>	<u>BTU Savings Per Year (x 10⁶)</u>	<u>Savings (First Year)</u>	<u>Cumulative Savings (15 years)</u>
Replace worn or missing weather-stripping on all exterior entrance doors	160.37	\$ 558	\$20,819
Reset space temperature to 65°F in the North section during the heating season	116.24	404	15,080
Delamp decorative core lighting and wall lamps in the dining area of the North section	<u>11.96</u>	<u>134</u>	<u>4,433</u>
Totals	288.57	\$1,096	\$40,332

11. Regularly clean all incandescent lamp and fluorescent fixture reflectors and lenses.
12. Turn off coffee pots, food warmers, and other cafeteria equipment when not in use.
13. Regularly check and recalibrate exterior lighting time clocks to ensure that lighting is only on when necessary.
14. Incandescent lighting should be turned off when not in use. Fluorescent lighting should be left on if it is to be used within the next 20 minutes, otherwise it should be turned off as areas are vacated.

15. Turn off all domestic hot water circulating pumps when not in use, if possible.

The following is a list of supplementary operating and maintenance changes recommended to effect additional energy savings. It is not possible to quantify the savings which will result from implementing these changes.

1. A specific maintenance schedule should be established and diligently followed to ensure that all components of the building are maintained at maximum efficiency.
2. A record of the schedule of operation and the energy required by the building should be kept for each month. This will be a valuable indicator of the impacts of schedule changes on energy consumption.
3. Clean all fan blades and scrolls regularly.
4. Lubricate all fan and motor bearings regularly.
5. Replace worn fan belts and adjust tension of new belts correctly for optimum operation.
6. Inspect all ductwork for air leakage and seal all leaks by taping.
7. Clean all finned tube coils in air handling units and fan coil units regularly.
8. Inspect and repair insulation on all hot water piping.
9. Operate drapes and blinds to permit sunlight (when available) to enter the windows in the winter, and the opposite in the summer.
10. When repainting, use light colored paint on ceilings, walls, and floors to increase the illumination level in the space, thereby permitting turning off of some fixtures.
11. Regularly clean all electrical lamp and fluorescent fixture reflectors and lenses.
12. Turn off coffee pots, food warmers, and other cafeteria equipment when not in use.
13. Regularly check and recalibrate exterior lighting time clocks to assure that lighting is only on when necessary.
14. Incandescent lighting should be turned off when not in use. Fluorescent lighting should be left on if it is to be used within the next 20 minutes, otherwise it should be turned off as areas are vacated.

15. Turn off all domestic hot water circulating pumps when not in use. Install timers to do so automatically, if possible.
16. Turn off electrical power to refrigerated drinking fountains during winter.
17. Keep stairway, corridor, and exit doors closed at all times.

Project Description	Life Savings Per Year (x 10 ⁶)	Total Project Cost	Level Year Savings	Payback Period (Years)
Close off outside air supply to the North section during unoccupied times	451	\$ 1,972	\$ 1,763	1.12
Convert selected incandescent fixtures to fluorescent fix- tures	387	11,994	4,305	2.76
Total	838	\$13,966	\$ 6,068	2.30

Payback for Primary Recommendations

2.2.2 Additional Recommendations

Cover selected glass areas
with insulated panels

Add insulation in the floor
which will result in the
interior side

Payback for Primary Recommendations

NOTE 1:

Additional Recommendations do not meet present funding guidelines; however, they are of long range savings potential and should be incorporated whenever funds are available.

NOTE 2:

The payback periods shown were calculated using a discount rate of 10% as recommended by the Department of Energy Document 76/130, "Life Cycle Costing Emphasizing Energy Conservation." The payback rate on bond proceeds of 6.6% was employed in calculating debt service. The Fixed Principle and Variable Interest Rate Method. Variable fuel escalation rate is based on the document "A Model to Evaluate the Direct Cost and Benefits of Coal Conversion" dated March 10, 1980, and prepared by the University of Illinois Office of Long Range Planning and Economic Analysis, were used to compare the projected savings. Project costs are in millions of dollars.

Detailed descriptions of the projects appear in Section 1.2.

2.2 Retrofit Recommendations

	<u>Project Description</u>	<u>BTU Savings Per Year (x 10⁶)</u>	<u>FY82 Project Cost</u>	<u>First Year Savings</u>	<u>15 Year Cumulative Savings</u>	<u>Payback Period (Years)</u>
2.2.1	Primary Recommendations					
	Close off outside air supply to the North section during unoccupied times	457	\$ 1,972	\$ 1,763	\$ 65,888	.87
	Convert selected incandescent fixtures to fluorescent fixtures	357	11,994	4,306	142,562	2.16
	Total	814	\$13,966	\$ 6,069	\$208,450	
			Payback for Primary Recommendations			1.78
2.2.2	Additional Recommendations					
	Cover selected glass areas with insulated panels	1,438	\$60,348	\$ 5,543	\$207,226	7.94
	Add insulation to the face brick wall areas on the interior side	901	\$47,600	\$ 3,475	\$129,888	9.85

NOTE 1: Additional Recommendations do not meet present funding guidelines; however, they are effective methods of lowering energy consumption and should be incorporated whenever funds are available.

NOTE 2: The payback periods shown were computed using a discount rate of 10% as recommended by the U.S. Department of Energy Document 76/130, "Life Cycle Costing Emphasizing Energy Conservation". An interest rate on bond proceeds of 6.61% was employed in calculating debt service payments by the Fixed Principle and Variable Interest Rate Method. Variable fuel escalation rates, as recommended in the document "A Model to Evaluate the Direct Cost and Benefits of Coal Conversion Projects", dated March 10, 1980, and prepared by the University of Illinois Office of Long Range Planning and Economic Analysis, were used to compute the projected savings. Project costs are in FY82 dollars.

Detailed descriptions of the retrofit projects appear in Section 3.3.

3.0 ANALYSIS AND CONCEPTUAL DESIGN

3.1 Energy Use Analysis

Natural gas is burned in the boilers at the power plant of Tinley Park Mental Health Center to provide steam for the heating coils, absorber, and converters serving the radiant ceiling panel system.

Electricity is used for building lighting and motor loads and to provide power for convenience outlets.

Current costs for energy are as follows:

Natural gas \$.284/therm*
(\$2.84/million BTU)

Electricity \$.0324/KWH**
(\$9.49/million BTU)

*Therm = 100,000 BTU

**KWH = Kilowatt hour = 3413 BTU

3.2 Description of Existing Facility

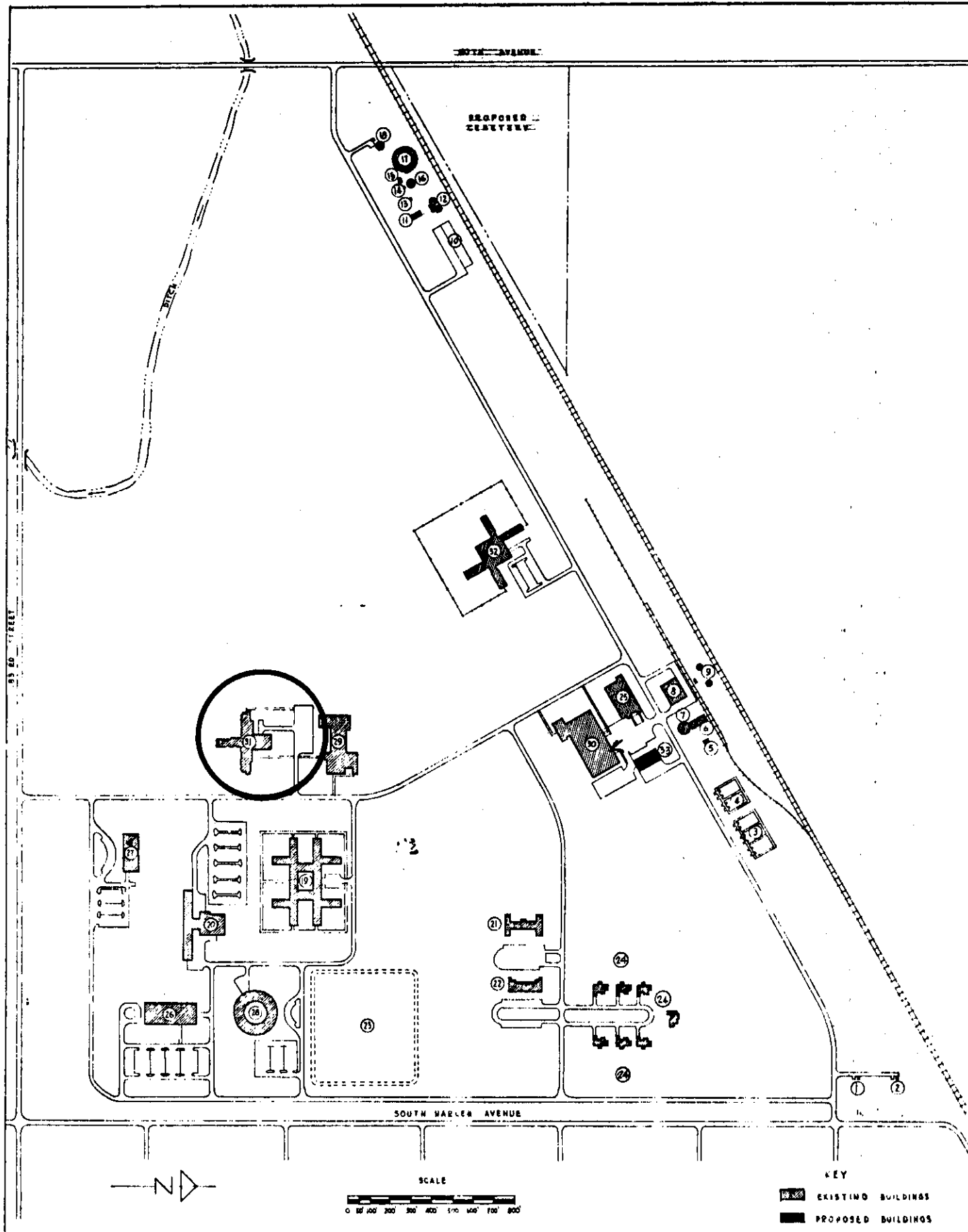
3.2.1 Location, climate context, and immediate site conditions

Pine Hall is located in the Howe Mental Health Center in Tinley Park, Illinois. Tinley Park is 20 miles east of Joliet at the intersection of Interstate 80 and Route 43 in Cook County. The climate is typically continental with generally cold winters and very warm and humid summers, but with some relief due to the influx of cool Canadian air. Mean temperatures and precipitation are as follows:

	Jan.	Feb.	March	April	May	June
Temp:	25.9	27.6	37.3	50.3	61.2	70.9
Precip:	1.52	1.40	2.28	3.55	3.71	3.49
	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temp:	75.0	73.2	65.9	54.9	40.1	28.7
Precip:	3.06	2.80	2.50	2.50	2.02	1.64

Annual average temperature is 50.90°F and annual average precipitation is 30.99 inches. Average annual heating degree days are 6578.

The immediate site of Pine Hall is surrounded by large grassy open areas and a parking lot to the North. Pine Hall is located on the Southeast corner of Howe Mental Health Center. The following page shows a plot plan with Pine Hall encircled.



DATE	PLOT PLAN OF TINLEY PARK MENTAL HEALTH CENTER TINLEY PARK - ILLINOIS	FILE NO.
OCT. 1966		415

3.2.2 Configuration, envelope, construction and condition

Pine Hall, a 56,757 gross square foot building, houses mildly retarded adults who were moved here from a nursing home which closed in Aurora. The structure is cross-shaped with the south, east and west arms having one zig-zag exposure each. These wings are two stories high over a partial basement. The North section is one-story over a crawl space and contains the main entrance. The mechanical equipment room is located in the basement and the fanroom penthouse sits atop the two-story section. The cooling tower is located on top of the North section and is surrounded by high metal fencing. The walls are made up of either face brick sections or concrete panels. Behind the four inch face brick is a 1/2 inch air space and six inches of structural clay tile with 3/4 inch plaster as the interior finish. The concrete panels are backed up by a 1 1/2 inch air space, one inch of insulation, and 3 5/8 inches of structural glazed tile. The glass areas are 3/16 inch sheet glass windows in metal sashes with a vertically pivoted operable section. There are heavy draperies between the screens and glass. Other windows are non-operable 3/16 inch sheet glass, also with draperies. The roof is a built-up type over 1 1/2 inch rigid insulation on a five inch concrete deck, with an air space and metal radiant ceiling panels as the interior finish.

The building was sound and well maintained.

3.2.3 Description of heating, ventilation, air conditioning, hot water, lighting and electrical power systems

3.2.3.1 Heating system

Pine Hall is heated by a radiant panel ceiling system utilizing a hot water reset schedule which varies the temperature of the hot water inversely with the outdoor temperature. Hot water for the system is generated with low-pressure steam via a shell and tube converter located in the basement mechanical equipment room. The steam is supplied to the building from the central boiler plant where it is generated by three natural gas-fired boilers with a total available steam output of 180,000 x 10⁶ pounds per hour. Several circulating pumps distribute the hot water through the panels. There is a Honeywell pneumatic temperature control system. The space temperature is maintained at 75°F and 65°F in unoccupied wings on the second floor. Hot water is also supplied to heating coils in four multi-zone air handling units in order to temper the air provided for ventilation purposes.

3.2.3.2 Ventilation system

Ventilation is provided in Pine Hall by the four multi-zone air handling units located in the penthouse fanroom. These units are a hot deck/cold deck type which temper the mix of outside air and return air to maintain a 67°F discharge temperature during the heating season and 56°F during the cooling season at the respective zones.

3.2.3.3. Air conditioning system

Pine Hall is air conditioned by two 81 ton Carrier steam absorption units which supply chilled water to coils in the radiant ceiling panels and the cold deck of the four multi-zone air handling units. The associated chilled water system is comprised of two 7 1/2 hp chilled water pumps and two ten hp condenser water pumps. The cooling tower is located on the roof of the North section. The maintained space temperature is 75°F.

3.2.3.4 Hot water system

Domestic hot water for Pine Hall is supplied from the central boiler plant at approximately 120°F and tempered to 110°F for use at the building.

3.2.3.5 Lighting system

The lighting system at Pine Hall is a mixture of incandescent and fluorescent fixtures. Incandescent fixtures are located in the dining area, corridors, and service areas. The remainder of the lighting is fluorescent. The parking lot lights are mercury vapor and are operated by a timeclock. Lighting levels were within recommended ranges and lights were generally off in unoccupied rooms.

3.2.3.6 Electrical power system

Electrical power is supplied to Pine Hall by a 4,160 volt primary. In the basement electrical vault, there is a 400 KVA transformer with a secondary of 120/208 volts. The electrical service is provided by Commonwealth Edison.

3.3 Retrofit Recommendations (Delineated)

3.3.1 Close off outside air supply to the North section during unoccupied times

Air handling unit AC-1 serves the North section of Pine Hall and uses 54% outside air as required for proper operation of several exhaust hoods in the kitchen area. Since this area is occupied only during the daytime, it is recommended that a low leakage outside air damper, all associated controls, and a timeclock be installed in order to close off the outside air supply during the unoccupied times. The estimated annual energy savings resulting from implementing this recommendation would be 457 million BTU or a dollar savings of \$1,763 the first year. The cumulative savings over a 15 year period is estimated to be \$65,888.

The estimated cost of implementing this recommendation is \$1,972. The discounted payback period for the cost incurred in implementing this change is calculated to be .87 years.

3.3.2 Convert selected incandescent fixtures to fluorescent fixtures

The dining area and corridors of patient residence areas contain incandescent fixtures with 200 watt bulbs. It is recommended that these incandescent lamps be replaced with fluorescent conversion lamps which utilize the existing fixture. Footcandle levels would remain the same since the levels of illumination were observed at the time of the site visit to be within recommended ranges. The estimated annual energy savings resulting from implementing this change would be 357 million BTU or a dollar savings the first year of \$4,306. The cumulative savings over a 15 year period is estimated to be \$142,562.

The estimated cost of implementing this recommendation is \$11,994. The discounted payback period for the cost incurred is calculated to be 2.16 years.

3.3.3 Cover selected glass areas with insulated panels

At present the building envelope contains approximately 25% glass area in the form of single pane windows, most with operable sections which allow infiltration. It is recommended that panels containing 1 1/2 inches of urethane insulation be installed over selected glass

4.0 STATEMENT OF

The Capital
engineers.

None of the
of the comp
for purcha

areas on the exterior of the building. The estimated annual energy savings would be 1.438 billion BTU or a dollar savings of \$5,543 the first year. The cumulative savings over a 15 year period would be \$207,226.

The estimated cost of implementing this recommendation would be \$60,348. The discounted payback period for the cost incurred is calculated to be 7.94 years.

3.3.4 Add insulation to the face brick wall areas on the interior side

The existing face brick wall areas of Pine Hall have a .24 U-factor. It is recommended that insulating panels consisting of 1 1/2 inches of urethane foam bonded to skins of gypsum board and reflective foil be installed on the interior side of the face brick wall areas to achieve a .07 U-factor. The overall U-factor for the total wall assembly would then be below that as recommended by ASHRAE 90-75 for buildings of this type. The estimated annual energy savings resulting from implementation of this recommendation would be 901 million BTU or a dollar savings the first year of \$3,475. The cumulative savings over a 15 year period would be \$129,888.

The estimated cost of implementing this change is \$47,600. The discounted payback period for the cost incurred is calculated to be 9.85 years.

3.4 Retrofit Projects Not Recommended

The following project was considered for its energy conservation potential.

The replacement of the two steam absorption machines with an electric centrifugal chiller was considered but found to be not cost effective because of an excessive payback period.

4.0 STATEMENT OF AUDITORS' QUALIFICATIONS AND FINANCIAL INTERESTS

The Capital Development Board's audit team consisted of two engineers.

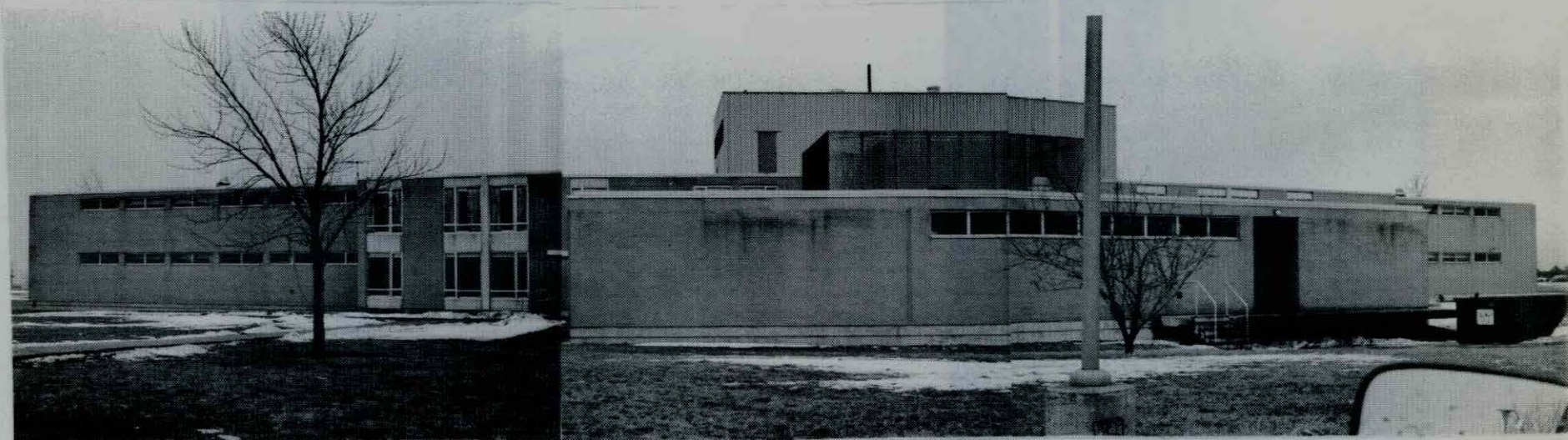
None of the audit team members has any financial interest in any of the companies who manufacture equipment or materials recommended for purchase under any of the retrofit recommendations.

APPENDIX

APPENDIX

MONTHLY EXPENDITURE

A-2

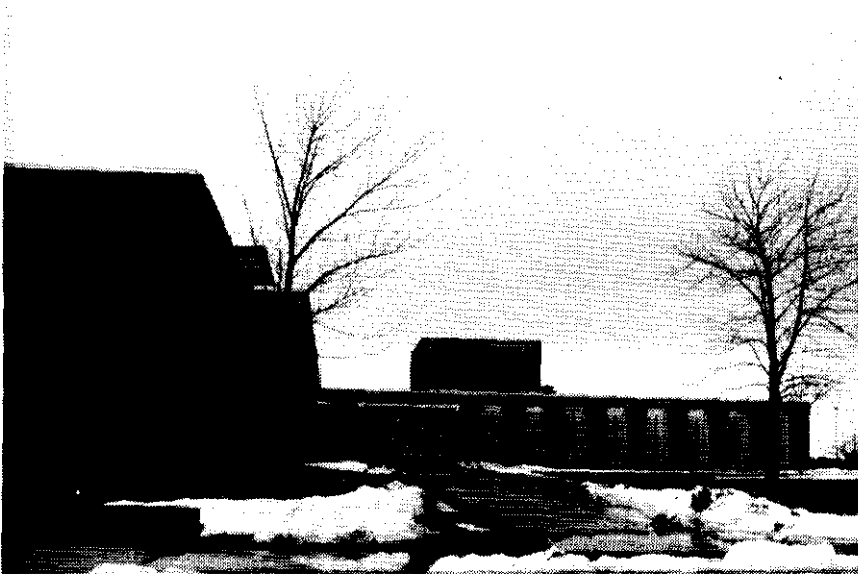


A-2

NORTH EXPOSURE



SOUTHEAST EXPOSURE
SHOWING ZIG-ZAG WINDOW
CONFIGURATION



EAST EXPOSURE OF
DINING AREA