

Shaker Elementary Schools Assessment Summary

PREPARED FOR:

Shaker Schools

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1 EXECUTIVE SUMMARY

Emerald Built Environments (Emerald) was requested by Shaker School District to perform an energy assessment of multiple elementary school buildings: Boulevard, Lomond, Mercer, and Onaway.

The intent of this assessment is to gather baseline data on building conditions and performance to better understand where resources for improvement are best directed and which strategies will bear the most fruit.

Recommendation for HVAC Retrofit: Based on the buildings' age, historic character, and the district's sustainability goals, Emerald recommends pursuing variable refrigerant flow (VRF) systems as the primary HVAC retrofit strategy. VRF technology provides high energy efficiency, low operating costs, and zoning flexibility while minimizing disruption to historic features. Its ability to deliver heating and cooling simultaneously, operate quietly, and integrate into phased renovation schedules makes it particularly well-suited for the district. In addition to efficiency gains, VRF systems align with the district's climate commitments and provide long-term operational value.

We anticipate an overall energy cost reduction of 15-20% compared to a traditional VAV system, as well as a lower overall installation cost. Our assumptions are based on the amount of rework required to accommodate installation of ductwork and space for traditional heating/cooling plant equipment. A summary of the findings is listed below, along with further recommendations.

The following summarizes the findings of the site visits and is indicative of all buildings.

- Buildings have central ventilation system, currently in disrepair at Onaway, Boulevard, and Lomond.
 - o The intent would be to correct deficiencies and utilize for future ventilation needs.
 - o Add cooling/ repair heating to create "DOAS" system – Dedicated Outdoor Air System
- Attic louvers and fans could be refurbished to allow for better heat removal from the attic.
- Controls systems could be improved.
 - o All remaining pneumatic systems should be replaced with modern BAS connected thermostats and heating valves.
- VFD's on heating water pumps with updated OA temp reset controls strategy would save energy
- Steam boilers could benefit from economizers and other efficiency upgrades
- Heating water boilers could be replaced with modern high-efficiency boilers
- All fluorescent lamps should be replaced with LED as they fail

2 OVERALL RECOMMENDATIONS TO CONSIDER

2.1 RECOMMENDED HVAC RETROFIT: VARIABLE REFRIGERANT FLOW (VRF) SYSTEMS

As part of the planned energy and sustainability retrofit of the elementary schools, we recommend the installation of variable refrigerant flow (VRF) systems as the new HVAC solution. This approach provides an ideal balance between preserving the historic character of the school buildings and delivering modern, high-performance heating and cooling.

Preservation of Historic Architecture: VRF technology requires minimal ductwork and piping, which reduces the need for invasive alterations to walls, ceilings, and finishes. This approach helps maintain the historic integrity of the building while discreetly integrating modern comfort systems.

Energy Efficiency and Sustainability: VRF systems deliver exceptional energy efficiency through variable capacity operation and advanced heat recovery, reducing energy use and greenhouse gas emissions. These systems provide significant long-term operating cost savings while aligning with the district's sustainability goals. **Comfort and Learning Environment:** The ability to control individual zones ensures that each classroom can be conditioned independently, providing optimal comfort for students and staff. Quiet operation reduces disruption, and precise temperature and humidity management support healthier indoor air quality.

Adaptability and Flexibility: VRF systems can be installed in phases and easily reconfigured as building spaces are repurposed, supporting long-term adaptability in a historic building setting.

Operational and Financial Value: VRF technology offers lower maintenance needs, extended equipment lifespan, and smart controls that allow facilities staff to monitor and optimize system performance remotely. The system may also qualify for rebates or incentives, improving total cost of ownership.

In summary, VRF technology offers a rare combination of historic preservation, sustainability, comfort, adaptability, and lifecycle value. By selecting this system, the district can preserve the heritage of the existing structures while advancing the district's modern energy performance goals.

Regarding HVAC, there are multiple opportunities to explore for potential improvement.

1. Continue to understand how to restore central ventilation system. This would include the ability to filter and temper outdoor air for both heating and cooling. It would also allow for better control of energy use during heating season
2. Continue to work on attic louvers and attic exhaust retrofit
3. Conversion to hot water heating system
 - a. This ECM will require substantial re-work of the existing heating system, currently provided by steam.
 - b. The scope would include replacing existing boilers and local space radiators.
 - c. Hot water boilers can achieve efficiencies up to 97% vs steam boilers of 83%
4. Investigate economizer for steam boilers



5. Investigate more efficient condensing boilers for heating water system
6. Ultrasonic leak detection for pneumatic systems
7. Investigate improved HVAC monitoring and controls, including new control valves for heating and new BAS connected thermostats. This would also allow for nighttime setback.
8. Replace fluorescent lamps with LED.
9. Plan for replacement of domestic hot water heaters with newer, high efficiency gas units.

2.2 ENERGY ANALYSIS

An energy model was constructed in Trane Trace™ 700 software, which is approved by LEED and the US DOE, and ASHRAE 90.1 Appendix G for energy modeling, and was used to calculate the energy consumption of the building.

An energy model was also constructed to take into account the change in HVAC System type as well as evaluate the current implemented ECM for reducing the fan run time near the beginning of the year. The building systems were assumed to operate

The following table summarizes the analysis results:

		<i>Summarize cost savings</i>	
	ACTUAL 2024 cost	VRF HP Costs	AHU Costs
Boulevard			
Electric kWh	\$ 21,616	\$ 27,704	\$ 28,549
Gas Therm	\$ 8,294	\$ 3,845	\$ 4,178
EUI	\$ 29,910	\$ 31,549	\$ 32,727
Lomond			
Electric kWh	\$ 27,088	\$ 34,766	\$ 36,736
Gas Therm	\$ 9,704	\$ 3,724	\$ 3,673
EUI	\$ 36,792	\$ 38,490	\$ 40,409
Mercer			
Electric kWh	\$ 21,220	\$ 36,031	\$ 41,271
Gas Therm	\$ 7,360	\$ 6,458	\$ 6,236
EUI	\$ 28,580	\$ 42,489	\$ 47,507
Onaway			
Electric kWh	\$ 24,198	\$ 22,906	\$ 26,158
Gas Therm	\$ 6,982	\$ 5,504	\$ 5,775
EUI	\$ 31,180	\$ 28,410	\$ 31,933



After preliminary discussions with the district VRF Systems, though cost effective and proven in the industry, may have some hurdles to overcome with OFCC funding.

Additional system types, such as 4-pipe fancoils using chilled and hot water, offer similar benefits to VRF in that smaller zoned equipment is used in the spaces and leverages piping, instead of ductwork. These systems offer comparable energy savings, shown at boulevard:

	ACTUAL	VRF HP Costs	AHU Costs	4 Pipe Fancoil
Boulevard	2024 cost			
Electric kWh	\$ 21,616	\$ 27,704	\$ 28,549	\$27,820
Gas Therm	\$ 8,294	\$ 3,845	\$ 4,178	\$4,500
EUI	\$ 29,910	\$ 31,549	\$ 32,727	\$32,320

With the models created, further analysis can be performed at either location with coordination from the design team once system options are further pursued.

We recommend the following as next steps:

1. Follow up with the OFCC on VRF system options and specific objections or clarifications to determine feasibility.
2. We would recommend including a preliminary energy modeling exercise for the next identified renovation.
 - a. Early energy modeling can help target specific system options and assist with drafting a narrative for preliminary budget exercises
3. Each property has its own unique features. Exploring multiple systems at each site may offer the best complete solution.

2.3 ENERGY SUMMARY – EXISTING BUILDINGS

The primary difficulty with performing energy comparisons with the existing buildings, is as follows:

1. The existing buildings do not have central cooling. Some sites have limited single zone split systems, but generally the buildings are nor cooled.
2. Ventilation – several buildings do not have a functioning ventilation system.

Adding cooling will increase energy use in the building therefore the existing conditions analysis is primarily attempting to validate the overall envelope and general utility use. Modeled results are within 10% overall from actual use. We can likely expect actual results to vary from predicted.

The intent however is to assure that modeled alternatives are using a valid base building and can be a reliable, relative comparison for energy use.

See appendix for individual building reports.



Boulevard Elementary Assessment

PREPARED FOR:

Shaker Schools

3 EXECUTIVE SUMMARY – BOULEVARD ELEMENTARY

Emerald Built Environments (Emerald) was requested by Shaker School District to perform an energy assessment of Boulevard Elementary located at 14900 Drexmore Rd. Shaker Heights, OH 44120. This assessment is being conducted as part of the financing requirements for OFCC Funding. The site was visited on two occasions, dated 2/18 and 4/25 of 2025.

The intent of this assessment is to gather baseline data on building conditions and performance to better understand where resources for improvement are best directed, and which strategies will bear the most fruit.

A summary of the findings is listed below, along with further recommendations. Any energy savings were calculated based on an average electricity rate of \$0.13/kWh and average natural gas energy rate of \$ 0.26/therm. The rates used were based on averaged data utility information as provided. Demand rates, taxes, and charges are included in the rates.

Energy Star's Target Finder website allows for quick comparison of the current building to its peers. The calculated EUI for this building was 75 for 2024. Target Finder shows that the average EUI for an elementary school with its size, occupancy levels, and use types, normalized for weather, would be 73. This shows that there is room for improvement. The location's Energy Star score of 46 shows that this location is operating better than 46% of its peers. An Energy Star score of 75 or better is needed for the building to qualify as Energy Star.

The following summarizes the findings of the site visits.

- Building has central ventilation system that could be repaired and likely combined with some sort of fresh air tempering for both heating and cooling.
- Attic louvers and fans could be refurbished to allow for better heat removal from the attic.
- Utilizing central vent system would likely reduce heating load during winter months with windows open.
- Controls systems could be improved. All remaining pneumatic systems could be replaced with modern BAS connected thermostats and heating valves.
- VFD's on heating water pumps with more modern controls strategy would save energy.
- Steam boilers could benefit from economizers and other efficiency upgrades.
- Heating water boilers could be replaced with modern high-efficiency boilers.
- All fluorescent lamps should be replaced with LED as they fail.

4 BUILDING OVERVIEW – BOULEVARD ELEMENTARY

The 2-story building is located on Drexmore Rd. Shaker Heights, OH, and was originally built around 1920. An addition was added in the 1990's. The total square footage is around 37,000 for both the original and the addition. Construction is masonry, typical of a school built around this time. Windows have been recently replaced and are currently double-paned and operable. The building has a shingled, black roof.

Building HVAC consists of a central ventilation system that is currently not working. The system does have a heating coil to warm outdoor air during the winter months, but there is no centralized mechanical cooling system. A handful of window and split systems are used in teachers' offices, and data rooms. Heating is provided by a steam boiler system for the original building portion. A hot water system provides heat for the addition. The system does not have VFD or any energy saving controls measures for the heating water pumps.

Most lighting in the school is provided by fluorescent T-8 lamps, although some areas do have a few LED lights.

Building controls are comprised of an antiquated pneumatic system and a modern BAS that provides monitoring for temperatures in key areas of the building. Using these readings, heating water temperature, and other parameters are controlled to maintain building comfort in the winter. Some individual thermostats provide feedback to their respective steam and water control valves, but their ability to control individual zones is largely unknown for the building.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) defines a Level I Energy Assessment as a preliminary analysis that involves a brief building survey accompanied by an operator; analysis of utility bills and historical energy use to identify potential cost saving opportunities including low cost / no cost measures and potential capital improvements for further study as part of a Level II or III Energy Assessment. A future Level II assessment could include a breakdown of energy use as well as a more detailed building survey and energy analysis. A future Level II analysis would identify and provide the savings and cost analysis of all practical measures that meet the owner's constraints and economic criteria. The assessment also includes a discussion of any effects on operation and maintenance procedures. It also lists potential capital-intensive improvements that require more thorough data collection and analysis, along with an initial judgment of potential cost savings.

Energy Star's Target Finder website allows for quick comparison of the current building to its peers. The calculated EUI for this building was 75 for 2024. Target Finder shows that the average EUI for an elementary school with its size, occupancy levels, and use types, normalized for weather, would be 73. This shows that there is room for improvement. The location's Energy Star score of 46 shows that this location is operating better than 46% of its peers. An Energy Star score of 75 or better is needed for the building to qualify as Energy Star.

This report is based on observations from our site visit and information provided by the owner. The following building systems were not evaluated with any performance verification or testing:

- Building envelope systems
- HVAC
- Electric gear and distribution



- Structural
- Life safety/ code violations

5 EXISTING CONDITIONS – BOULEVARD ELEMENTARY

5.1 ENVELOPE

The building envelope is largely constructed of masonry, typical of a school built around this time. Windows have been recently replaced and are currently double-paned and operable. The building has a shingled, black roof.

The interior of the building is also typical of an elementary school, with classrooms, a gymnasium, auditorium, cafeteria, administrative offices, and other typical amenities.

5.2 HVAC

Building HVAC consists of boilers and a central ventilation system that has limited operability. The ventilation system does have a heating coil to warm outdoor air during the winter months, but it is currently not working. There is no centralized mechanical cooling system. A handful of window and split systems are used in teachers' offices and data rooms.

Heating is provided by a steam boiler system for the original building portion. The hot water boilers are all approaching end of life at approximately 20 years, although the cast iron steam boilers (also 20 yrs old) will likely still provide another 5-10 years of life. A hot water system provides heat for the addition. The system does not have VFD or any energy saving controls measures for the heating water pumps. The central ventilation system is operated during the warmer months, but only for its cooling effect. During winter it is turned off.

5.3 LIGHTING

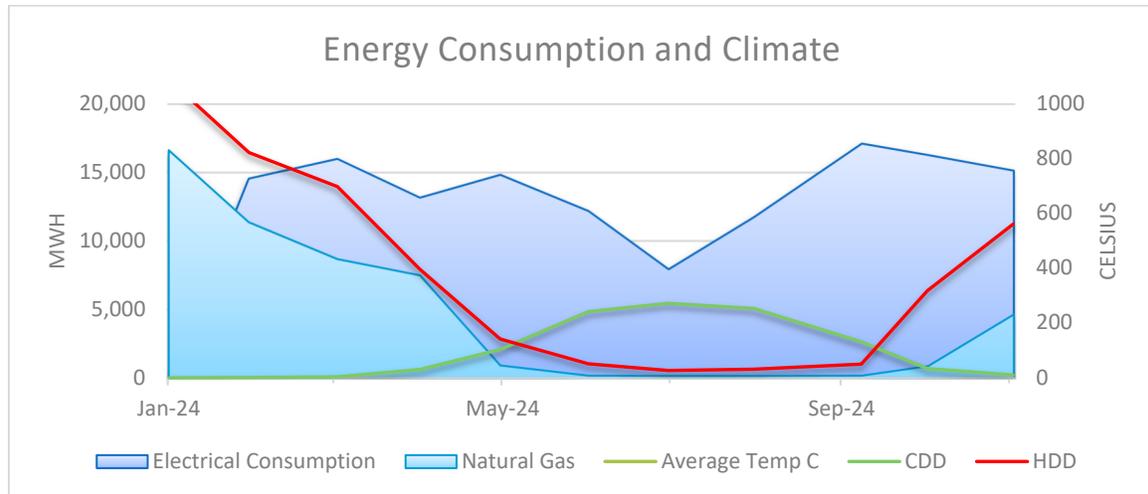
Most lighting in the school is provided by fluorescent T-8 lamps, although some areas do have a few LED lights. Most classrooms do not have occupancy/ vacancy sensors and require manual switches for turning on and off.

5.4 CONTROLS

Building controls are comprised of an antiquated pneumatic system and a modern BAS that provides monitoring for temperatures in key areas of the building. Using these readings, heating water temperature and other parameters are controlled to maintain building comfort in the winter. Some individual thermostats provide feedback to their respective steam and water control valves, but their ability to control individual zones is largely unknown for the building. Specifically, it is known that the radiators serving the gymnasium are still controlled pneumatically.

6 UTILITY SUMMARY – BOULEVARD ELEMENTARY

Data from the past 2 years of electricity and gas bills were given to Emerald for analysis. The data was compiled into a graph overlaid by weather data to show how temperature affects heating and cooling energy use. No anomalies were observed for this data based on field observations and conversations with Shaker Schools facilities teams.



This graph does indeed show a significant electricity decrease in the summer months, which is expected in an unconditioned school that does not have summer sessions. Natural gas consumption appears to be in alignment with heating load.

7 POTENTIAL AREAS OF CONCERN & RECOMMENDATIONS TO CONSIDER— BOULEVARD ELEMENTARY

7.1 OVERALL ITEMS OF NOTE

Regarding HVAC, there are multiple opportunities to explore for potential improvement:

1. Continue to understand how to restore central ventilation system. This would include the ability to filter and temper outdoor air for both heating and cooling. It would also allow for better control of energy use during heating season
2. Continue to work on attic louvers and attic exhaust retrofit
3. Install VFD's and a differential pressure control sequence for heating water pumps
4. Investigate economizer for steam boilers
5. Investigate more efficient condensing boilers for heating water system.
6. Ultrasonic leak detection for pneumatic systems



7. Investigate improved HVAC monitoring and controls, including new control valves for heating and new BAS connected thermostats. This would also allow for nighttime setback.
8. Replace fluorescent lamps with LED.
9. Plan for replacement of domestic hot water heaters with newer, high efficiency gas units.

Emerald is confident that implementing the items above as strategies for this and all other schools in the district will have a positive impact on energy and sustainability. Further design work is required to estimate savings regarding these strategies.



Lomond Elementary Assessment

PREPARED FOR:

Shaker Schools

8 EXECUTIVE SUMMARY – LOMOND ELEMENTARY

Emerald Built Environments (Emerald) was requested by Shaker School District to perform an energy assessment of Lomond Elementary located at 17917 Lomond Blvd. Shaker Heights, OH 44120. This assessment is being conducted as part of the financing requirements for OFCC Funding. The site was visited on two occasions, dated 2/13 and 4/29 of 2025.

The intent of this assessment is to gather baseline data on building conditions and performance to better understand where resources for improvement are best directed, and which strategies will bear the most fruit.

A summary of the findings is listed below, along with further recommendations. Any energy savings were calculated based on an average electricity rate of \$0.13/kWh and average natural gas energy rate of \$ 0.24/therm. The rates used were based on averaged data utility information as provided. Demand rates, taxes and charges are included in the rates.

Energy Star's Target Finder website allows for quick comparison of the current building its peers. The calculated EUI for this building was 76 for 2024. Target Finder shows that the average EUI for an elementary school with its size, occupancy levels, and use types, normalized for weather, would be 68. This shows that there is room for improvement. The location's Energy Star score of 38 shows that this location is operating better than 38% of its peers. An EnergyStar score of 75 or better is needed for the building to qualify as Energy Star.

The following summarizes the findings of the site visits:

- Building has central ventilation system that could be repaired and likely combined with some sort of fresh air tempering for both heating and cooling.
- Attic louvers and fans could be refurbished to allow for better heat removal from the attic.
- Utilizing central vent system would likely reduce heating load during winter months with windows open.
- Controls systems could be improved. All remaining pneumatic systems should be replaced with modern BAS connected thermostats and heating valves.
- Steam boilers could benefit from economizers and other efficiency upgrades
- Investigate more efficient condensing boilers for heating water system.
- All fluorescent lamps should be replaced with LED as they fail

9 BUILDING OVERVIEW – LOMOND ELEMENTARY

The 2-story building is located in Shaker Heights, OH, and was originally built around 1920. The total square footage is around 62,356. Construction is masonry, typical of a school built around this time. Windows have been recently replaced and are currently double-paned and operable. The building has a shingled, black roof.

Building HVAC consists of a central ventilation system that is currently not working. The system does have a heating coil to warm outdoor air during the winter months, but there is no centralized mechanical cooling system. A handful of window and split systems are used in teachers' offices and data rooms. Heating is provided by a steam boiler system for the building.

Most lighting in the school is provided by fluorescent T-8 lamps, although some areas do have a few LED lights.

Building controls are comprised of an antiquated pneumatic system and a modern BAS that provides monitoring for temperatures in key areas of the building. Using these readings, heating water temperature and other parameters are controlled to maintain building comfort in the winter. Some individual thermostats provide feedback to their respective steam and water control valves, but their ability to control individual zones is largely unknown for the building.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) defines a Level I Energy Assessment as a preliminary analysis that involves a brief building survey accompanied by an operator; analysis of utility bills and historical energy use to identify potential cost saving opportunities including low cost / no cost measures and potential capital improvements for further study as part of a Level II or III Energy Assessment. A future Level II assessment could include a breakdown of energy use as well as a more detailed building survey and energy analysis. A future Level II analysis would identify and provide the savings and cost analysis of all practical measures that meet the owner's constraints and economic criteria. The assessment also includes a discussion of any effects on operation and maintenance procedures. It also lists potential capital-intensive improvements that require more thorough data collection and analysis, along with an initial judgment of potential cost savings.

Energy Star's Target Finder website allows for quick comparison of the current building to those of its peers. The calculated EUI for this building was 76 for 2024. Target Finder shows that the average EUI for an elementary school with its size, occupancy levels, and use types, normalized for weather, would be 68. This shows that there is room for improvement. The location's Energy Star score of 38 shows that this location is operating better than 38% of its peers. An Energy Star score of 75 or better is needed for the building to qualify as Energy Star.

This report is based on observations from our site visit and information provided by the owner. The following building systems were not evaluated with any performance verification or testing:

- Building envelope systems
- HVAC
- Electric gear and distribution
- Structural
- Life safety/ code violations

10 EXISTING CONDITIONS – LOMOND ELEMENTARY

10.1 ENVELOPE

The building envelope is largely constructed of masonry, typical of a school built around this time. Windows have been recently replaced and are currently double-paned and operable. The building has a shingled, black roof.

The interior of the building is also typical of an elementary school, with classrooms, a gymnasium, auditorium, cafeteria, administrative offices, and other typical amenities.

10.2 HVAC

Building HVAC consists of boilers and a central ventilation system that has limited operability. The



ventilation system does have a heating coil to warm outdoor air during the winter months, but it is currently not working. There is no centralized mechanical cooling system. A handful of window and split systems are used in teachers' offices, and data rooms.

Heating is provided by a steam boiler system for the building. The cast iron steam boilers (also 20 yrs old) will likely still provide another 5-10 years of life. The central ventilation system is operated during the warmer months, but only for its cooling effect. During winter it is turned off. The attic and central ventilation system was in the process of being retrofitted, but the project was abandoned during Covid in favor of window fans in individual classrooms. Emerald is recommending continuing with the retrofit and re-use the system for ventilation.

10.3 LIGHTING

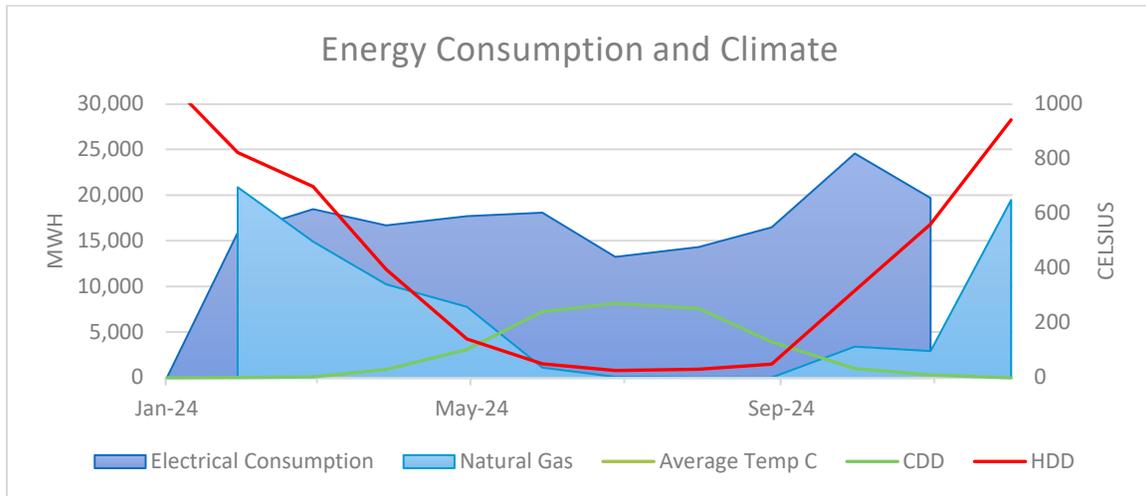
Most lighting in the school is provided by Fluorescent T-8 lamps, although some areas do have a few LED lights. Most classrooms do not have occupancy/ vacancy sensors and require manual switches for turning on and off.

10.4 CONTROLS

Building controls are comprised of an antiquated pneumatic system and a modern BAS that provides monitoring for temperatures in key areas of the building. Using these readings, heating water temperature and other parameters are controlled to maintain building comfort in the winter. Some individual thermostats provide feedback to their respective steam and water control valves, but their ability to control individual zones is largely unknown for the building. Specifically, it is known that the radiators serving the gymnasium are still controlled pneumatically.

11 UTILITY SUMMARY – LOMOND ELEMENTARY

Data from the past 2 years of electricity and gas bills were given to Emerald for analysis. The data was compiled into a graph overlaid by weather data to show how temperature affects heating and cooling energy use. No anomalies were observed for this data based on field observations and conversations with Shaker Schools facilities teams.



This graph does indeed show a significant electricity decrease in the summer months, which is expected in an unconditioned school that does not have summer sessions. Natural gas consumption appears to be in alignment with heating load.

12 POTENTIAL AREAS OF CONCERN & RECOMMENDATIONS TO CONSIDER – LOMOND ELEMENTARY

12.1 OVERALL ITEMS OF NOTE

Regarding HVAC, there are multiple opportunities to explore for potential improvement.

1. Continue to understand how to restore central ventilation system. This would include the ability to filter and temper outdoor air for both heating and cooling. It would also allow for better control of energy use during heating season
2. Continue to work on attic louvers and attic exhaust retrofit
3. Investigate economizer for steam boilers
4. Ultrasonic leak detection for pneumatic systems
5. Investigate improved HVAC monitoring and controls, including new control valves for heating and new BAS connected thermostats. This would also allow for nighttime setback.



6. Replace fluorescent lamps with LED.
7. Plan for replacement of domestic hot water heaters with newer, high efficiency gas units.

Emerald is confident that implementing the items above as strategies for this and all other schools in the district will have a positive impact on energy and sustainability. Further design work is required to estimate savings regarding these strategies.



Mercer Elementary Assessment

PREPARED FOR:

Shaker Schools

13 EXECUTIVE SUMMARY – MERCER ELEMENTARY

Emerald Built Environments (Emerald) was requested by Shaker School District to perform an energy assessment of Mercer Elementary located at 23325 Wimbledon Rd. Shaker Heights, OH 44120. This assessment is being conducted as part of the financing requirements for OFCC Funding. The site was visited on two occasions, dated 2/13 and 5/6 of 2025.

The intent of this assessment is to gather baseline data on building conditions and performance to better understand where resources for improvement are best directed, and which strategies will bear the most fruit.

A summary of the findings is listed below, along with further recommendations. Any energy savings were calculated based on an average electricity rate of \$0.12/kWh and average natural gas energy rate of \$0.26 /therm. The rates used were based on averaged data utility information as provided. Demand rates, taxes and charges are included in the rates.

Energy Star's Target Finder website allows for quick comparison of the current building to its peers. The calculated EUI for this building was 41 for 2024. Target Finder shows that the average EUI for an elementary school with its size, occupancy levels, and use types, normalized for weather, would be 63. This indicates better performance than the other elementary schools. The location's Energy Star score of 84 shows that this location is operating better than 84% of its peers. An Energy Star score of 75 or better is needed for the building to qualify as Energy Star.

The following summarizes the findings of the site visits:

- Building has central ventilation system that could be repaired and likely combined with some sort of fresh air tempering for both heating and cooling.
- Fix exhaust fans on lower ballasted roof.
- Utilizing central vent system would likely reduce heating load during winter months with windows open.
- Controls systems could be improved. All remaining pneumatic systems should be replaced with modern BAS connected thermostats and heating valves.
- Steam boilers could benefit from economizers and other efficiency upgrades
- Investigate more efficient condensing boilers for heating water system.
- All fluorescent lamps should be replaced with LED as they fail

14 BUILDING OVERVIEW – MERCER ELEMENTARY

The 2-story building is located in Shaker Heights, OH, and was originally built around 1920. The total square footage is around 81,000. Construction is masonry, typical of a school built around this time. Windows have been recently replaced and are currently double-paned and operable. The building has a shingled, black roof.

Building HVAC consists of a central ventilation system. The system does have a heating coil to warm outdoor air during the winter months, but there is no centralized mechanical cooling system. A handful of window and split systems are used in teachers' offices and data rooms. Heating is provided by a steam boiler system for the individual rooms.

Most lighting in the school is provided by fluorescent T-8 lamps, although some areas do have a few LED lights.

Building controls are comprised of an antiquated pneumatic system and a modern BAS that provides monitoring for temperatures in key areas of the building. Using these readings, heating water temperature and other parameters are controlled to maintain building comfort in the winter. Some individual thermostats provide feedback to their respective steam and water control valves, but their ability to control individual zones is largely unknown for the building.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) defines a Level I Energy Assessment as a preliminary analysis that involves a brief building survey accompanied by an operator; analysis of utility bills and historical energy use to identify potential cost saving opportunities including low cost / no cost measures and potential capital improvements for further study as part of a Level II or III Energy Assessment. A future Level II assessment could include a breakdown of energy use as well as a more detailed building survey and energy analysis. A future Level II analysis would identify and provide the savings and cost analysis of all practical measures that meet the owner's constraints and economic criteria. The assessment also includes a discussion of any effects on operation and maintenance procedures. It also lists potential capital-intensive improvements that require more thorough data collection and analysis, along with an initial judgment of potential cost savings.

Energy Star's Target Finder website allows for quick comparison of the current building to those of its peers. The calculated EUI for this building was 41 for 2024. Target Finder shows that the average EUI for an elementary school with its size, occupancy levels, and use types, normalized for weather, would be 63. This indicates better performance than the other elementary schools. The location's Energy Star score of 84 shows that this location is operating better than 84% of its peers. An Energy Star score of 75 or better is needed for the building to qualify as Energy Star.

This report is based on observations from our site visit and information provided by the owner. The following building systems were not evaluated with any performance verification or testing:

- Building envelope systems
- HVAC
- Electric gear and distribution
- Structural
- Life safety/ code violations

15 EXISTING CONDITIONS – MERCER ELEMENTARY

15.1 ENVELOPE

The building envelope is largely constructed of masonry, typical of a school built around this time. Windows have been recently replaced and are currently double-paned and operable. The building has a shingled, black roof.

The interior of the building is also typical of an elementary school, with classrooms, a gymnasium, auditorium, cafeteria, administrative offices, and other typical amenities.

15.2 HVAC

Building HVAC consists of boilers and a central ventilation system that has limited operability. The ventilation system does have a heating coil to warm outdoor air during the winter months, but it is currently not working. There is no centralized mechanical cooling system. A handful of window and split systems are used in teachers' offices and data rooms.

Heating is provided by a steam boiler system for the building. The cast iron steam boilers (also 20 yrs old) will likely still provide another 5-10 years of life. The central ventilation system is operable. The attic and central ventilation system was in the process of being retrofitted, but the project was abandoned during Covid in favor of window fans in individual classrooms. Emerald is recommending continuing with the retrofit and re-use the system for ventilation.

15.3 LIGHTING

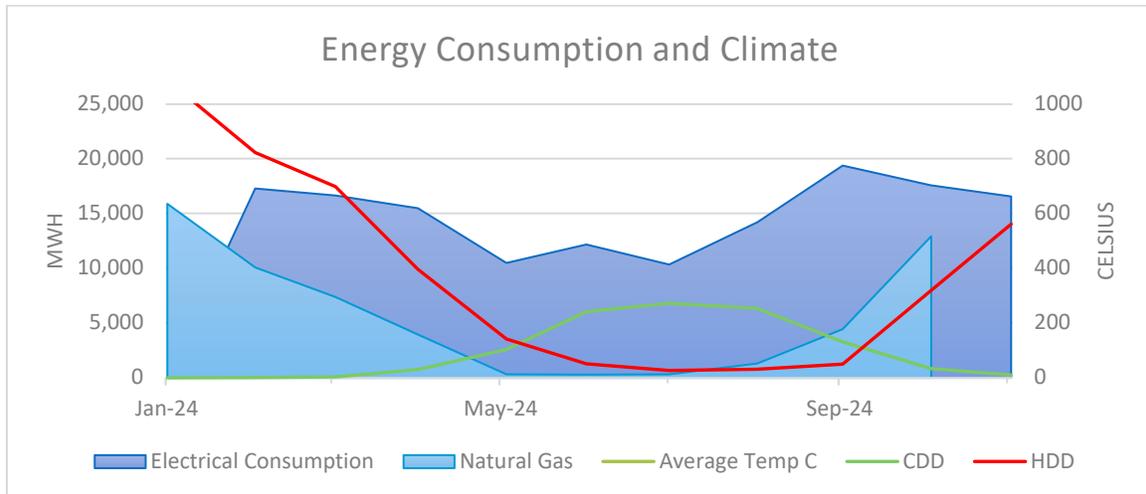
Most lighting in the school is provided by fluorescent T-8 lamps, although some areas do have a few LED lights. Most classrooms do not have occupancy/ vacancy sensors and require manual switches for turning on and off.

15.4 CONTROLS

Building controls are comprised of an antiquated pneumatic system and a modern BAS that provides monitoring for temperatures in key areas of the building. Using these readings, heating water temperature and other parameters are controlled to maintain building comfort in the winter. Some individual thermostats provide feedback to their respective steam and water control valves, but their ability to control individual zones is largely unknown for the building. Specifically, it is known that the radiators serving the gymnasium are still controlled pneumatically.

16 UTILITY SUMMARY – MERCER ELEMENTARY

Data from the past 2 years of electricity and gas bills were given to Emerald for analysis. The data was compiled into a graph overlaid by weather data to show how temperature affects heating and cooling energy use. No anomalies were observed for this data based on field observations and conversations with Shaker Schools facilities teams.



This graph does indeed show a significant electricity decrease in the summer months, which is expected in an unconditioned school that does not have summer sessions. Natural gas consumption appears to be in alignment with heating load.

17 POTENTIAL AREAS OF CONCERN & RECOMMENDATIONS TO CONSIDER – MERCER ELEMENTARY

17.1 OVERALL ITEMS OF NOTE

Regarding HVAC, there are multiple opportunities to explore for potential improvement:

1. Continue to understand how to restore central ventilation system. This would include the ability to filter and temper outdoor air for both heating and cooling. It would also allow for better control of energy use during heating season
2. Continue to work on attic louvers and attic exhaust retrofit
3. Investigate economizer for steam boilers
4. Ultrasonic leak detection for pneumatic systems
5. Investigate improved HVAC monitoring and controls, including new control valves for heating and new BAS connected thermostats. This would also allow for nighttime setback.



6. Replace fluorescent lamps with LED.
7. Plan for replacement of domestic hot water heaters with newer, high efficiency gas units.

Emerald is confident that implementing the items above as strategies for this and all other schools in the district will have a positive impact on energy and sustainability. Further design work is required to estimate savings regarding these strategies.



Onaway Elementary Assessment

PREPARED FOR:

Shaker Schools

18 EXECUTIVE SUMMARY – ONAWAY ELEMENTARY

Emerald Built Environments (Emerald) was requested by Shaker School District to perform an energy assessment of Onaway Elementary located at 3125 Woodbury Rd. Shaker Heights, OH 44120. This assessment is being conducted as part of the financing requirements for OFCC Funding. The site was visited on two occasions, dated 2/18 and 5/6 of 2025.

The intent of this assessment is to gather baseline data on building conditions and performance to better understand where resources for improvement are best directed, and which strategies will bear the most fruit.

A summary of the findings is listed below, along with further recommendations. Any energy savings were calculated based on an average electricity rate of \$0.10/kWh and average natural gas energy rate of 0.80 \$/therm. The rates used were based on averaged data utility information as provided. Demand rates, taxes, and charges are included in the rates.

Energy Star's Target Finder website allows for quick comparison of the current building to those of its peers. The calculated EUI for this building was 52 for 2024. Target Finder shows that the average EUI for an elementary school with its size, occupancy levels, and use types, normalized for weather, would be 61. This shows that the building is operating better than average, however there is likely room for improvement. The location's Energy Star score of 64 shows that this location is operating better than 64% of its peers. An Energy Star score of 75 or better is needed for the building to qualify as Energy Star.

The following summarizes the findings of the site visits:

- Building has central ventilation system that could be repaired and likely combined with some sort of fresh air tempering for both heating and cooling.
- Attic louvers and fans could be refurbished to allow for better heat removal from the attic.
- Utilizing central vent system would likely reduce heating load during winter months with windows open.
- Controls systems could be improved. All remaining pneumatic systems should be replaced with modern BAS connected thermostats and heating valves.
- VFD's on heating water pumps with more modern controls strategy would save energy
- Steam boilers could benefit from economizers and other efficiency upgrades
- Heating water boilers could be replaced with modern high-efficiency boilers
- All Fluorescent lamps should be replaced with LED as they fail

19 BUILDING OVERVIEW – ONAWAY ELEMENTARY

The 2-story building located in Shaker Heights, OH, and was originally built around 1920. An addition was added in the 1990's. The total square footage is around 58,000 for both the original and the addition. Construction is masonry, typical of a school built around this time. Windows have been recently replaced and are currently double-paned and operable. The building has a shingled, black roof.

Building HVAC consists of a central ventilation system that is currently not working. The system does have a heating coil to warm outdoor air during the winter months, but there is no centralized mechanical cooling system. A handful of window and split systems are used in teachers' offices, and data rooms. Heating is provided by a steam boiler system for the original building portion. A hot water system provides heat for the addition. The system does not have VFD or any energy saving controls measures for the heating water pumps.

Most lighting in the school is provided by fluorescent T-8 lamps, although some areas do have a few LED lights.

Building controls are comprised of an antiquated pneumatic system and a modern BAS that provides monitoring for temperatures in key areas of the building. Using these readings, heating water temperature and other parameters are controlled to maintain building comfort in the winter. Some individual thermostats provide feedback to their respective steam and water control valves, but their ability to control individual zones is largely unknown for the building.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) defines a Level I Energy Assessment as a preliminary analysis that involves a brief building survey accompanied by an operator; analysis of utility bills and historical energy use to identify potential cost saving opportunities including low cost / no cost measures and potential capital improvements for further study as part of a Level II or III Energy Assessment. A future Level II assessment could include a breakdown of energy use as well as a more detailed building survey and energy analysis. A future Level II analysis would identify and provide the savings and cost analysis of all practical measures that meet the owner's constraints and economic criteria. The assessment also includes a discussion of any effects on operation and maintenance procedures. It also lists potential capital-intensive improvements that require more thorough data collection and analysis, along with an initial judgment of potential cost savings.

Energy Star's Target Finder website allows for quick comparison of the current building to those of its peers. The calculated EUI for this building was 52 for 2024. Target Finder shows that the average EUI for an elementary school with its size, occupancy levels, and use types, normalized for weather would be 61. This shows that the building is operating better than average, however there is likely room for improvement. The location's energy star score of 64 shows that this location is operating better than 64% of its peers. An EnergyStar score of 75 or better is needed for the building to qualify as Energy Star.

This report is based on observations from our site visit and information provided by the owner. The following building systems were not evaluated with any performance verification or testing:

- Building envelope systems
- HVAC



- Electric gear and distribution
- Structural
- Life safety/ code violations

20 EXISTING CONDITIONS – ONAWAY ELEMENTARY

20.1 ENVELOPE

The building envelope is largely constructed of masonry, typical of a school built around this time. Windows have been recently replaced and are currently double-paned and operable. The building has a shingled, black roof.

The interior of the building is also typical of an elementary school, with classrooms, a gymnasium, auditorium, cafeteria, administrative offices, and other typical amenities.

20.2 HVAC

Building HVAC consists of boilers and a central ventilation system that has limited operability. The ventilation system does have a heating coil to warm outdoor air during the winter months, but it is currently not working. There is no centralized mechanical cooling system. A handful of window and split systems are used in teachers' offices, and data rooms.

Heating is provided by a steam boiler system for the original building portion. The hot water boilers are all approaching end of life at approximately 20 years, although the cast iron steam boilers (also 20 yrs old) will likely still provide another 5-10 years of life. A hot water system provides heat for the addition. The system does not have VFD or any energy saving controls measures for the heating water pumps. The central ventilation system is operated during the warmer months, but only for its cooling effect. During winter it is turned off.

20.3 LIGHTING

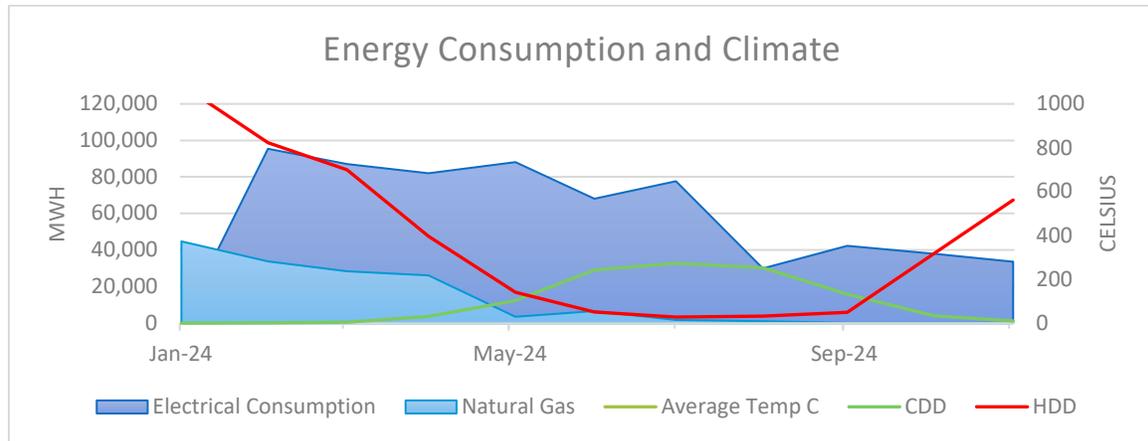
Most lighting in the school is provided by Fluorescent T-8 lamps, although some areas do have a few LED lights. Most classrooms do not have occupancy/ vacancy sensors and require manual switches for turning on and off.

20.4 CONTROLS

Building controls are comprised of an antiquated pneumatic system and a modern BAS that provides monitoring for temperatures in key areas of the building. Using these readings, heating water temperature and other parameters are controlled to maintain building comfort in the winter. Some individual thermostats provide feedback to their respective steam and water control valves, but their ability to control individual zones is largely unknown for the building. Specifically, it is known that the radiators serving the gymnasium are still controlled pneumatically.

21 UTILITY SUMMARY – ONAWAY ELEMENTARY

Data from the past 2 years of electricity and gas bills were given to Emerald for analysis. The data was compiled into a graph overlaid by weather data to show how temperature affects heating and cooling energy use. No anomalies were observed for this data based on field observations and conversations with Shaker Schools facilities teams.



This graph does indeed show a significant electricity decrease in the summer months, which is expected in an unconditioned school that does not have summer sessions. Natural gas consumption appears to be in alignment with heating load.

22 POTENTIAL AREAS OF CONCERN & RECOMMENDATIONS TO CONSIDER - ONAWAY ELEMENTARY

22.1 OVERALL ITEMS OF NOTE

Regarding HVAC, there are multiple opportunities to explore for potential improvement.

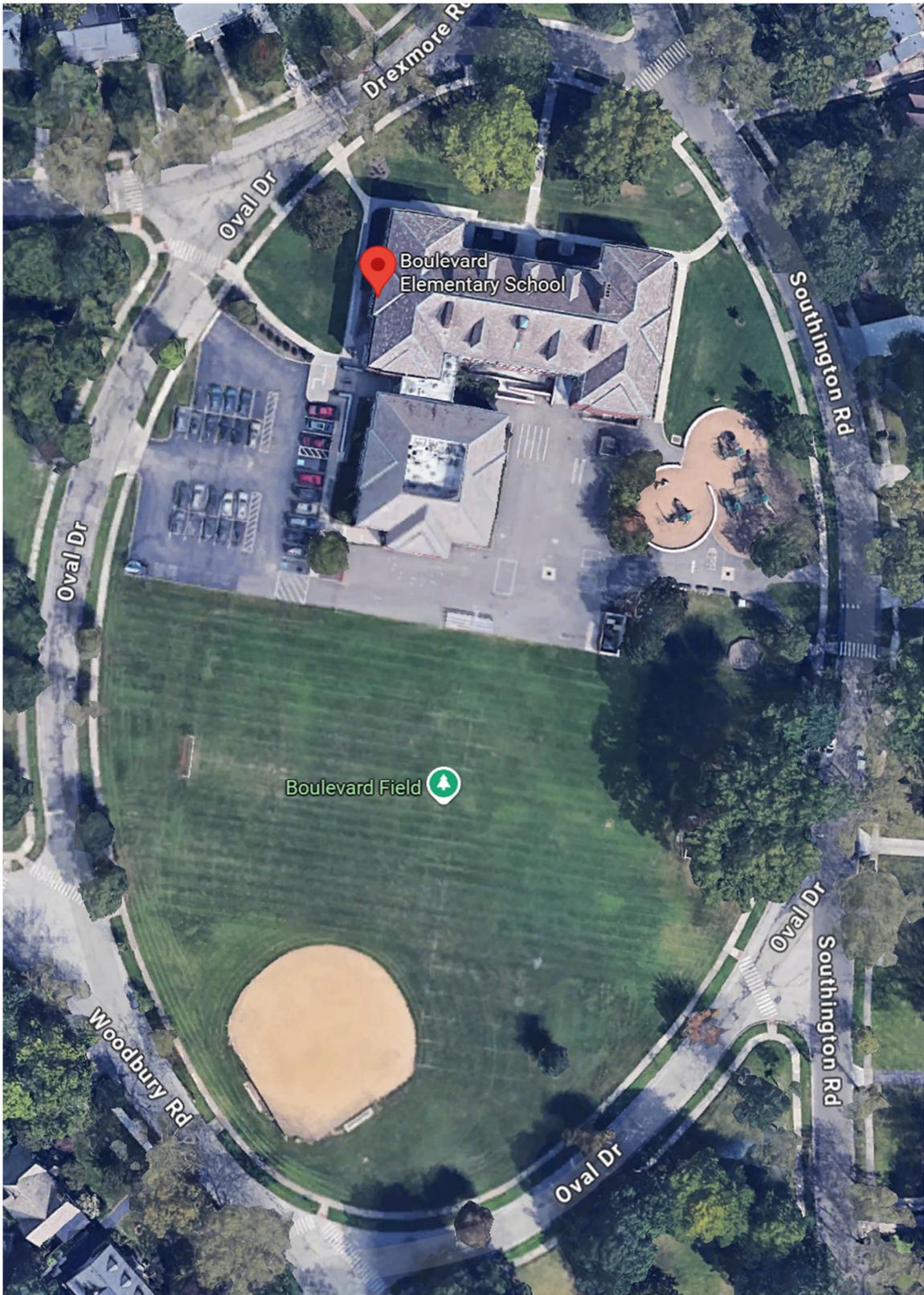
1. Continue to understand how to restore central ventilation system. This would include the ability to filter and temper outdoor air for both heating and cooling. It would also allow for better control of energy use during heating season
2. Continue to work on attic louvers and attic exhaust retrofit
3. Install VFD's and a differential pressure control sequence for heating water pumps
4. Investigate economizer for steam boilers
5. Investigate more efficient condensing boilers for heating water system.
6. Ultrasonic leak detection for pneumatic systems



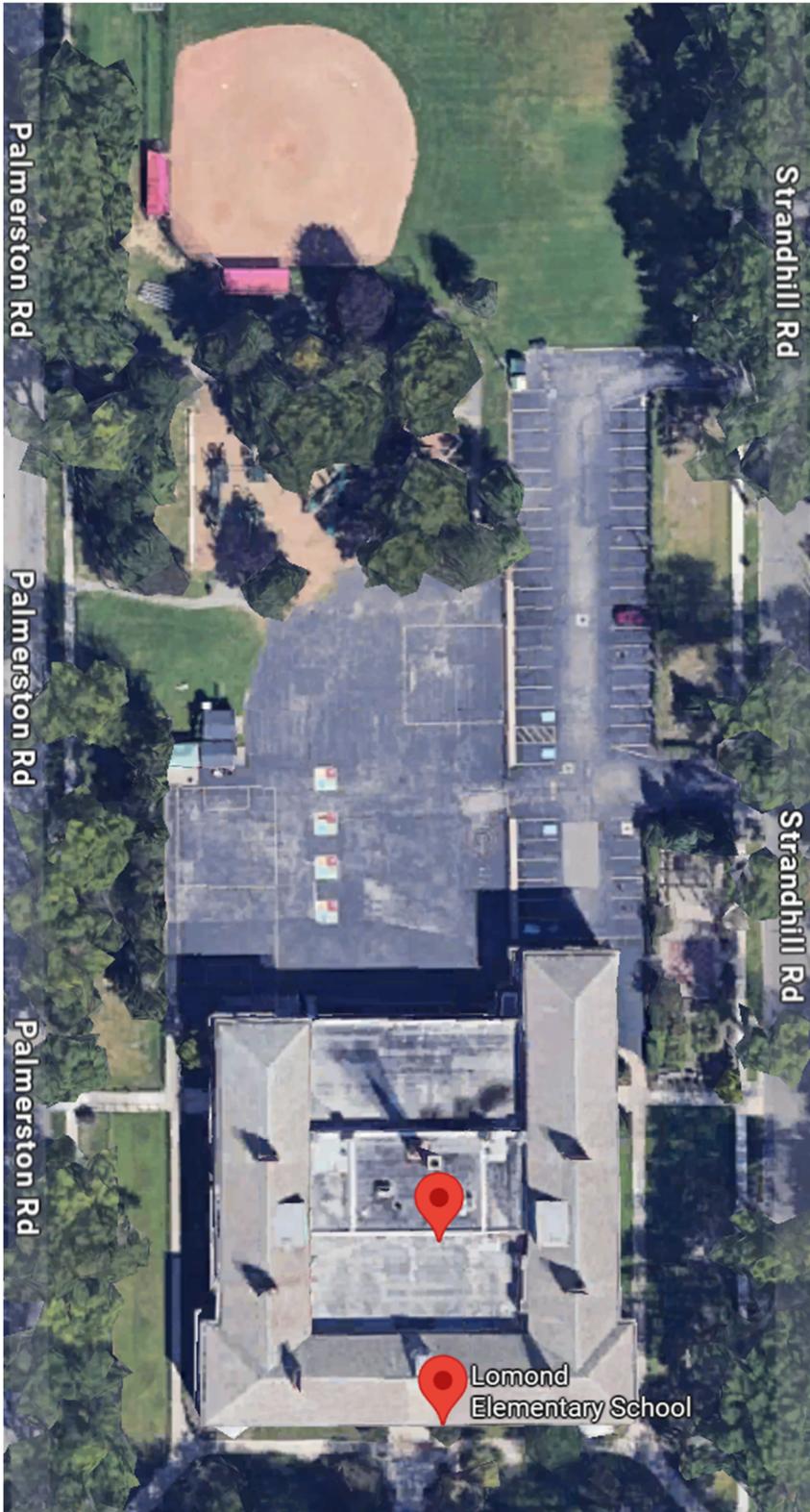
7. Investigate improved HVAC monitoring and controls, including new control valves for heating and new BAS connected thermostats. This would also allow for nighttime setback.
8. Replace fluorescent lamps with LED.
9. Plan for replacement of domestic hot water heaters with newer, high efficiency gas units.

Emerald is confident that implementing the items above as strategies for this and all other schools in the district will have a positive impact on energy and sustainability. Further design work is required to estimate savings regarding these strategies.

Boulevard



Lomond



Onaway



ENERGY CONSUMPTION SUMMARY

By EMERALD

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating		2,947,875		83.9 %	2,947,875	3,103,026
Other Htg Accessories	4,678		48	0.5 %	15,964	47,898
Heating Subtotal	4,678	2,947,875	48	84.4 %	2,963,839	3,150,925
Primary cooling						
Cooling Compressor				0.0 %	0	0
Tower/Cond Fans				0.0 %	0	0
Condenser Pump				0.0 %	0	0
Other Clg Accessories				0.0 %	0	0
Cooling Subtotal....				0.0 %	0	0
Auxiliary						
Supply Fans	22,021			2.1 %	75,156	225,491
Pumps	7,040			0.7 %	24,026	72,085
Stand-alone Base Utilities	8,862			0.9 %	30,247	90,749
Aux Subtotal....	37,922			3.7 %	129,429	388,326
Lighting						
Lighting	97,777			9.5 %	333,712	1,001,237
Receptacle						
Receptacles	24,944	15		2.4 %	85,147	255,439
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	165,320	2,947,890	48	100.0 %	3,512,128	4,795,926

* Note: Resource Utilization factors are included in the Total Source Energy value .

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 2						
Primary heating						
Primary heating	9,745	1,478,653		68.5 %	1,511,914	1,656,271
Other Htg Accessories	2,557		28	0.4 %	8,725	26,179
Heating Subtotal	12,302	1,478,653	28	68.9 %	1,520,640	1,682,450
Primary cooling						
Cooling Compressor	24,951			3.9 %	85,158	255,499
Tower/Cond Fans	35			0.0 %	121	362
Condenser Pump				0.0 %	0	0
Other Clg Accessories	12			0.0 %	39	118
Cooling Subtotal....	24,998			3.9 %	85,318	255,979
Auxiliary						
Supply Fans	60,207			9.3 %	205,486	616,520
Pumps	4,180			0.7 %	14,267	42,806
Stand-alone Base Utilities	8,862			1.4 %	30,247	90,749
Aux Subtotal....	73,249			11.3 %	250,000	750,075
Lighting						
Lighting	77,617			12.0 %	264,905	794,795
Receptacle						
Receptacles	24,944	15		3.9 %	85,147	255,439
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	213,109	1,478,668	28	100.0 %	2,206,010	3,738,737

* Note: Resource Utilization factors are included in the Total Source Energy value .

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 3						
Primary heating						
Primary heating		1,606,847		68.2 %	1,606,847	1,691,418
Other Htg Accessories	3,191		45	0.5 %	10,889	32,671
Heating Subtotal	3,191	1,606,847	45	68.7 %	1,617,736	1,724,088
Primary cooling						
Cooling Compressor	70,740			10.3 %	241,436	724,381
Tower/Cond Fans	4,978			0.7 %	16,990	50,977
Condenser Pump				0.0 %	0	0
Other Clg Accessories	131			0.0 %	446	1,338
Cooling Subtotal....	75,849			11.0 %	258,873	776,695
Auxiliary						
Supply Fans	22,580			3.3 %	77,067	231,223
Pumps	6,569			1.0 %	22,419	67,264
Stand-alone Base Utilities	8,862			1.3 %	30,247	90,749
Aux Subtotal....	38,011			5.5 %	129,732	389,236
Lighting						
Lighting	77,617			11.2 %	264,905	794,795
Receptacle						
Receptacles	24,944	15		3.6 %	85,147	255,439
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	219,611	1,606,862	45	100.0 %	2,356,393	3,940,254

* Note: Resource Utilization factors are included in the Total Source Energy value .

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

MONTHLY UTILITY COSTS

By EMERALD BUILT ENVIRONMENTS

Utility	----- Monthly Utility Costs -----												Total
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Alternative 1													
Electric													
On-Pk Cons. (\$)	2,292	2,073	2,349	1,949	1,944	849	839	882	1,800	2,142	2,155	2,217	21,492
Gas													
On-Pk Cons. (\$)	1,754	1,694	1,135	294	8	0	0	0	10	431	755	1,584	7,665
Monthly Total (\$):	4,046	3,767	3,484	2,243	1,952	849	839	882	1,810	2,572	2,910	3,802	29,156

Building Area = 48,809 ft²
 Utility Cost Per Area = 0.60 \$/ft²

Alternative 2													
Electric													
On-Pk Cons. (\$)	3,015	2,751	2,926	2,306	2,377	1,392	1,471	1,311	2,149	2,542	2,588	2,876	27,704
Gas													
On-Pk Cons. (\$)	806	776	520	221	38	3	0	4	33	294	413	737	3,845
Monthly Total (\$):	3,821	3,527	3,446	2,527	2,416	1,395	1,471	1,315	2,182	2,836	3,000	3,613	31,549

Building Area = 48,809 ft²
 Utility Cost Per Area = 0.65 \$/ft²

MONTHLY UTILITY COSTS

By EMERALD BUILT ENVIRONMENTS

Utility	Jan	Feb	Mar	Apr	----- May	----- June	----- July	----- Aug	Sept	Oct	Nov	Dec	Total
Alternative 3													
Electric													
On-Pk Cons. (\$)	1,809	1,635	1,921	1,925	3,365	2,834	3,520	2,765	3,066	2,118	1,838	1,753	28,549
Gas													
On-Pk Cons. (\$)	838	770	570	245	59	34	15	40	54	322	454	774	4,178
Monthly Total (\$):	2,647	2,406	2,490	2,171	3,425	2,868	3,535	2,805	3,121	2,440	2,293	2,527	32,727

Building Area = 48,809 ft²

Utility Cost Per Area = 0.67 \$/ft²

MONTHLY ENERGY CONSUMPTION

By EMERALD

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 1 Boulevard Elementary Existing													
Electric													
On-Pk Cons. (kWh)	17,635	15,948	18,066	14,994	14,956	6,529	6,457	6,782	13,850	16,475	16,574	17,056	165,320
On-Pk Demand (kW)	80	80	80	80	79	77	77	77	79	80	80	80	80
Gas													
On-Pk Cons. (therms)	6,746	6,514	4,366	1,131	31	0	0	1	37	1,656	2,904	6,093	29,479
On-Pk Demand (therms/hr)	21	23	20	14	2	0	0	0	5	14	16	20	23
Water													
Cons. (1000gal)	8	7	8	4	1	0	0	0	1	5	7	8	48

Energy Consumption

Building 71,957 Btu/(ft2-year)
 Source 98,259 Btu/(ft2-year)

Floor Area 48,809 ft2

Environmental Impact Analysis

CO2 298,830 lbm/year
 SO2 2,074 gm/year
 NOX 518 gm/year

MONTHLY ENERGY CONSUMPTION

By EMERALD

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 2 VRF w/Boiler & LED													
Electric													
On-Pk Cons. (kWh)	23,195	21,161	22,511	17,737	18,286	10,710	11,314	10,084	16,532	19,553	19,905	22,120	213,109
On-Pk Demand (kW)	88	89	92	90	100	102	102	101	100	91	89	89	102
Gas													
On-Pk Cons. (therms)	3,100	2,985	2,000	850	148	10	1	15	125	1,130	1,587	2,837	14,787
On-Pk Demand (therms/hr)	8	9	8	6	3	0	0	0	3	6	7	8	9
Water													
Cons. (1000gal)	4	4	4	3	1	0	0	1	1	3	4	4	28

Energy Consumption

Building 45,197 Btu/(ft2-year)
 Source 76,599 Btu/(ft2-year)

Floor Area 48,809 ft2

Environmental Impact Analysis

CO2 385,212 lbm/year
 SO2 2,673 gm/year
 NOX 668 gm/year

MONTHLY ENERGY CONSUMPTION

By EMERALD

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 3 AHU VAV w/ Boiler & LED													
Electric													
On-Pk Cons. (kWh)	13,916	12,579	14,773	14,810	25,887	21,797	27,079	21,266	23,586	16,293	14,139	13,485	219,611
On-Pk Demand (kW)	104	71	104	117	206	228	239	233	215	121	111	71	239
Gas													
On-Pk Cons. (therms)	3,223	2,963	2,192	944	228	132	57	155	209	1,240	1,748	2,978	16,069
On-Pk Demand (therms/hr)	11	12	11	9	6	2	1	2	7	9	10	11	12
Water													
Cons. (1000gal)	5	5	5	4	3	2	1	2	2	5	5	5	45

Energy Consumption

Building 48,278 Btu/(ft2-year)
 Source 80,728 Btu/(ft2-year)

Floor Area 48,809 ft2

Environmental Impact Analysis

CO2 396,964 lbm/year
 SO2 2,755 gm/year
 NOX 688 gm/year

MONTHLY UTILITY COSTS

By EMERALD BUILT ENVIRONMENTS

Utility	----- Monthly Utility Costs -----												Total
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Alternative 1													
Electric													
On-Pk Cons. (\$)	2,965	2,684	3,045	2,503	2,586	947	932	984	2,399	2,826	2,799	2,850	27,519
Gas													
On-Pk Cons. (\$)	2,534	2,431	1,543	283	3	0	0	0	14	540	1,053	2,279	10,680
Monthly Total (\$):	5,499	5,114	4,589	2,785	2,589	947	932	984	2,414	3,366	3,852	5,129	38,199

Building Area = 64,961 ft²
 Utility Cost Per Area = 0.59 \$/ft²

Alternative 2													
Electric													
On-Pk Cons. (\$)	3,870	3,510	3,807	3,047	2,971	1,453	1,503	1,292	2,683	3,435	3,479	3,714	34,766
Gas													
On-Pk Cons. (\$)	824	786	545	176	16	6	1	5	18	240	364	742	3,724
Monthly Total (\$):	4,695	4,296	4,353	3,222	2,987	1,459	1,504	1,298	2,701	3,675	3,843	4,456	38,490

Building Area = 64,961 ft²
 Utility Cost Per Area = 0.59 \$/ft²

MONTHLY UTILITY COSTS

By EMERALD BUILT ENVIRONMENTS

Utility	----- Monthly Utility Costs -----												Total
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Alternative 3													
Electric													
On-Pk Cons. (\$)	2,652	2,408	2,830	2,515	4,314	3,160	4,142	2,952	3,906	2,780	2,516	2,561	36,736
Gas													
On-Pk Cons. (\$)	779	713	509	185	11	7	3	13	24	288	421	719	3,673
Monthly Total (\$):	3,431	3,121	3,340	2,700	4,325	3,167	4,145	2,965	3,930	3,068	2,937	3,280	40,408

Building Area = 64,961 ft²

Utility Cost Per Area = 0.62 \$/ft²

MONTHLY ENERGY CONSUMPTION

By EMERALD BUILT ENVIRONMENTS

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 1 Lomond Elementary Existing													
Electric													
On-Pk Cons. (kWh)	22,806	20,646	23,425	19,252	19,893	7,288	7,168	7,566	18,457	21,737	21,528	21,922	211,688
On-Pk Demand (kW)	100	100	100	100	98	98	98	98	100	100	100	100	100
Gas													
On-Pk Cons. (therms)	10,558	10,127	6,431	1,177	12	0	0	0	60	2,249	4,388	9,498	44,500
On-Pk Demand (therms/hr)	41	44	39	30	4	0	0	0	9	31	34	40	44
Water													
Cons. (1000gal)	9	8	9	4	0	0	0	0	1	7	8	9	53

Energy Consumption

Building 79,624 Btu/(ft2-year)
Source 105,477 Btu/(ft2-year)

Floor Area 64,961 ft2

Environmental Impact Analysis

CO2 382,642 lbm/year
SO2 2,655 gm/year
NOX 664 gm/year

MONTHLY ENERGY CONSUMPTION

By EMERALD BUILT ENVIRONMENTS

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 2 VRF & LED													
Electric													
On-Pk Cons. (kWh)	29,772	27,003	29,287	23,437	22,854	11,179	11,559	9,942	20,640	26,423	26,765	28,571	267,432
On-Pk Demand (kW)	109	110	112	113	126	131	130	127	125	111	110	109	131
Gas													
On-Pk Cons. (therms)	3,435	3,275	2,272	732	68	26	5	22	73	998	1,516	3,093	15,515
On-Pk Demand (therms/hr)	12	13	11	8	3	1	0	0	4	9	10	12	13
Water													
Cons. (1000gal)	4	4	4	2	1	0	0	0	1	3	3	4	25

Energy Consumption

Building	37,935 Btu/(ft2-year)
Source	67,297 Btu/(ft2-year)
 Floor Area	 64,961 ft2

Environmental Impact Analysis

CO2	483,406 lbm/year
SO2	3,355 gm/year
NOX	838 gm/year

MONTHLY ENERGY CONSUMPTION

By EMERALD BUILT ENVIRONMENTS

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 3 AHU VAV & LED													
Electric													
On-Pk Cons. (kWh)	20,400	18,524	21,773	19,348	33,183	24,304	31,860	22,708	30,046	21,382	19,354	19,699	282,581
On-Pk Demand (kW)	100	101	102	160	287	326	331	319	287	161	149	100	331
Gas													
On-Pk Cons. (therms)	3,244	2,969	2,122	769	46	30	13	56	102	1,201	1,754	2,997	15,303
On-Pk Demand (therms/hr)	13	13	13	11	5	0	0	1	6	12	13	13	13
Water													
Cons. (1000gal)	6	5	6	4	1	1	1	1	1	5	5	6	42

Energy Consumption

Building	38,404 Btu/(ft2-year)
Source	69,341 Btu/(ft2-year)
 Floor Area	 64,961 ft2

Environmental Impact Analysis

CO2	510,788 lbm/year
SO2	3,545 gm/year
NOX	886 gm/year

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating		4,450,021		86.0 %	4,450,021	4,684,232
Other Htg Accessories	2,667		53	0.2 %	9,102	27,309
Heating Subtotal	2,667	4,450,021	53	86.2 %	4,459,123	4,711,542
Primary cooling						
Cooling Compressor				0.0 %	0	0
Tower/Cond Fans				0.0 %	0	0
Condenser Pump				0.0 %	0	0
Other Clg Accessories				0.0 %	0	0
Cooling Subtotal....				0.0 %	0	0
Auxiliary						
Supply Fans	28,926			1.9 %	98,725	296,205
Pumps	7,833			0.5 %	26,734	80,209
Stand-alone Base Utilities	8,862			0.6 %	30,247	90,749
Aux Subtotal....	45,621			3.0 %	155,705	467,163
Lighting						
Lighting	139,438			9.2 %	475,902	1,427,848
Receptacle						
Receptacles	23,961			1.6 %	81,781	245,366
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	211,688	4,450,021	53	100.0 %	5,172,510	6,851,919

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 2						
Primary heating						
Primary heating	30,739	1,551,535		67.2 %	1,656,449	1,947,968
Other Htg Accessories	2,353		25	0.3 %	8,031	24,095
Heating Subtotal	33,092	1,551,535	25	67.5 %	1,664,479	1,972,062
Primary cooling						
Cooling Compressor	24,318			3.4 %	82,998	249,019
Tower/Cond Fans	78			0.0 %	265	794
Condenser Pump				0.0 %	0	0
Other Clg Accessories	12			0.0 %	39	118
Cooling Subtotal....	24,407			3.4 %	83,302	249,931
Auxiliary						
Supply Fans	54,802			7.6 %	187,038	561,170
Pumps	3,244			0.5 %	11,071	33,215
Stand-alone Base Utilities	8,862			1.2 %	30,247	90,749
Aux Subtotal....	66,908			9.3 %	228,355	685,134
Lighting						
Lighting	119,064			16.5 %	406,364	1,219,215
Receptacle						
Receptacles	23,961			3.3 %	81,781	245,366
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	267,432	1,551,535	25	100.0 %	2,464,282	4,371,709

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 3						
Primary heating						
Primary heating		1,530,337		61.3 %	1,530,337	1,610,881
Other Htg Accessories	2,647		42	0.4 %	9,033	27,100
Heating Subtotal	2,647	1,530,337	42	61.7 %	1,539,370	1,637,981
Primary cooling						
Cooling Compressor	76,136			10.4 %	259,853	779,637
Tower/Cond Fans	5,441			0.7 %	18,569	55,714
Condenser Pump				0.0 %	0	0
Other Clg Accessories	92			0.0 %	315	945
Cooling Subtotal....	81,669			11.2 %	278,737	836,296
Auxiliary						
Supply Fans	40,155			5.5 %	137,048	411,184
Pumps	6,223			0.9 %	21,239	63,724
Stand-alone Base Utilities	8,862			1.2 %	30,247	90,749
Aux Subtotal....	55,240			7.6 %	188,534	565,658
Lighting						
Lighting	119,064			16.3 %	406,364	1,219,215
Receptacle						
Receptacles	23,961			3.3 %	81,781	245,366
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	282,581	1,530,337	42	100.0 %	2,494,786	4,504,517

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

MONTHLY UTILITY COSTS

By EMERALD BUILT ENVIRONMENTS

Utility	----- Monthly Utility Costs -----												Total
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Alternative 1													
Electric													
On-Pk Cons. (\$)	2,572	2,326	2,617	2,159	2,195	855	837	888	2,034	2,439	2,408	2,476	23,807
Gas													
On-Pk Cons. (\$)	1,649	1,574	1,004	199	3	0	0	0	7	363	655	1,474	6,928
Monthly Total (\$):	4,221	3,900	3,622	2,358	2,198	855	837	888	2,041	2,802	3,064	3,950	30,736

Building Area = 79,912 ft²
 Utility Cost Per Area = 0.38 \$/ft²

Alternative 2													
Electric													
On-Pk Cons. (\$)	4,004	3,661	3,954	3,250	3,167	1,375	1,492	1,287	2,882	3,553	3,574	3,833	36,031
Gas													
On-Pk Cons. (\$)	1,325	1,302	989	385	53	25	3	19	66	460	647	1,185	6,458
Monthly Total (\$):	5,329	4,963	4,942	3,635	3,219	1,400	1,495	1,306	2,948	4,013	4,221	5,018	42,489

Building Area = 79,912 ft²
 Utility Cost Per Area = 0.53 \$/ft²

MONTHLY ENERGY CONSUMPTION

By EMERALD BUILT ENVIRONMENTS

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 1 Mercer Elementary Existing													
Electric													
On-Pk Cons. (kWh)	21,433	19,387	21,811	17,991	18,295	7,123	6,974	7,399	16,950	20,325	20,069	20,635	198,392
On-Pk Demand (kW)	93	93	93	93	93	90	90	90	93	93	93	93	93
Gas													
On-Pk Cons. (therms)	10,308	9,835	6,276	1,247	16	0	0	0	44	2,271	4,096	9,210	43,303
On-Pk Demand (therms/hr)	46	49	44	32	6	0	0	0	5	37	40	45	49
Water													
Cons. (1000gal)	10	9	10	5	0	0	0	0	0	9	9	10	63

Energy Consumption

Building	62,661 Btu/(ft2-year)
Source	82,462 Btu/(ft2-year)
 Floor Area	 79,912 ft2

Environmental Impact Analysis

CO2	358,610 lbm/year
SO2	2,489 gm/year
NOX	622 gm/year

MONTHLY ENERGY CONSUMPTION

By EMERALD BUILT ENVIRONMENTS

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 2 VRF & LED													
Electric													
On-Pk Cons. (kWh)	33,363	30,507	32,947	27,082	26,390	11,456	12,431	10,726	24,020	29,606	29,786	31,946	300,259
On-Pk Demand (kW)	117	118	121	121	135	144	145	142	138	119	118	117	145
Gas													
On-Pk Cons. (therms)	5,096	5,008	3,802	1,481	203	96	12	74	253	1,769	2,488	4,556	24,838
On-Pk Demand (therms/hr)	16	18	15	10	5	2	0	1	6	11	12	16	18
Water													
Cons. (1000gal)	5	5	4	3	1	0	0	0	1	3	4	5	29

Energy Consumption

Building	43,906 Btu/(ft2-year)
Source	71,193 Btu/(ft2-year)
 Floor Area	 79,912 ft2

Environmental Impact Analysis

CO2	542,743 lbm/year
SO2	3,767 gm/year
NOX	941 gm/year

MONTHLY ENERGY CONSUMPTION

By EMERALD BUILT ENVIRONMENTS

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 3 AHU VAV & LED													
Electric													
On-Pk Cons. (kWh)	24,635	22,313	26,098	24,033	40,543	28,972	37,205	28,592	38,084	26,296	23,375	23,778	343,924
On-Pk Demand (kW)	120	121	170	185	325	363	377	370	339	192	177	120	377
Gas													
On-Pk Cons. (therms)	4,682	4,353	3,303	1,482	344	222	96	284	355	1,944	2,608	4,314	23,985
On-Pk Demand (therms/hr)	17	18	16	12	10	2	1	4	11	14	15	17	18
Water													
Cons. (1000gal)	8	7	8	7	4	3	2	3	4	8	8	8	70

Energy Consumption

Building	44,703 Btu/(ft2-year)
Source	75,665 Btu/(ft2-year)
Floor Area	79,912 ft2

Environmental Impact Analysis

CO2	621,671 lbm/year
SO2	4,314 gm/year
NOX	1,078 gm/year

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating		4,330,306		86.5 %	4,330,306	4,558,217
Other Htg Accessories	2,755		63	0.2 %	9,402	28,210
Heating Subtotal	2,755	4,330,306	63	86.7 %	4,339,708	4,586,427
Primary cooling						
Cooling Compressor				0.0 %	0	0
Tower/Cond Fans				0.0 %	0	0
Condenser Pump				0.0 %	0	0
Other Clg Accessories				0.0 %	0	0
Cooling Subtotal....				0.0 %	0	0
Auxiliary						
Supply Fans	31,882			2.2 %	108,812	326,469
Pumps	9,215			0.6 %	31,449	94,358
Stand-alone Base Utilities	8,862			0.6 %	30,247	90,749
Aux Subtotal....	49,958			3.4 %	170,508	511,576
Lighting						
Lighting	121,357			8.3 %	414,192	1,242,699
Receptacle						
Receptacles	24,322			1.7 %	83,011	249,057
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	198,392	4,330,306	63	100.0 %	5,007,419	6,589,759

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 2						
Primary heating						
Primary heating	37,019	2,483,819		74.4 %	2,610,164	2,993,619
Other Htg Accessories	1,758		29	0.2 %	6,000	18,002
Heating Subtotal	38,777	2,483,819	29	74.6 %	2,616,164	3,011,621
Primary cooling						
Cooling Compressor	28,219			2.7 %	96,311	288,961
Tower/Cond Fans	78			0.0 %	265	796
Condenser Pump				0.0 %	0	0
Other Clg Accessories	14			0.0 %	47	142
Cooling Subtotal....	28,310			2.8 %	96,623	289,899
Auxiliary						
Supply Fans	53,941			5.3 %	184,101	552,359
Pumps	4,189			0.4 %	14,297	42,896
Stand-alone Base Utilities	8,862			0.9 %	30,247	90,749
Aux Subtotal....	66,992			6.5 %	228,645	686,003
Lighting						
Lighting	141,858			13.8 %	484,161	1,452,628
Receptacle						
Receptacles	24,322			2.4 %	83,011	249,057
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	300,259	2,483,819	29	100.0 %	3,508,604	5,689,210

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 3						
Primary heating						
Primary heating		2,398,515		67.1 %	2,398,515	2,524,753
Other Htg Accessories	3,228		70	0.3 %	11,015	33,050
Heating Subtotal	3,228	2,398,515	70	67.5 %	2,409,530	2,557,802
Primary cooling						
Cooling Compressor	90,812			8.7 %	309,943	929,922
Tower/Cond Fans	6,693			0.6 %	22,844	68,539
Condenser Pump				0.0 %	0	0
Other Clg Accessories	114			0.0 %	390	1,170
Cooling Subtotal....	97,620			9.3 %	333,177	999,631
Auxiliary						
Supply Fans	57,700			5.5 %	196,929	590,845
Pumps	10,335			1.0 %	35,274	105,832
Stand-alone Base Utilities	8,862			0.9 %	30,247	90,749
Aux Subtotal....	76,897			7.4 %	262,449	787,426
Lighting						
Lighting	141,858			13.6 %	484,161	1,452,628
Receptacle						
Receptacles	24,322			2.3 %	83,011	249,057
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	343,924	2,398,515	70	100.0 %	3,572,328	6,046,545

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating		4,330,306		86.5 %	4,330,306	4,558,217
Other Htg Accessories	2,755		63	0.2 %	9,402	28,210
Heating Subtotal	2,755	4,330,306	63	86.7 %	4,339,708	4,586,427
Primary cooling						
Cooling Compressor				0.0 %	0	0
Tower/Cond Fans				0.0 %	0	0
Condenser Pump				0.0 %	0	0
Other Clg Accessories				0.0 %	0	0
Cooling Subtotal....				0.0 %	0	0
Auxiliary						
Supply Fans	31,882			2.2 %	108,812	326,469
Pumps	9,215			0.6 %	31,449	94,358
Stand-alone Base Utilities	8,862			0.6 %	30,247	90,749
Aux Subtotal....	49,958			3.4 %	170,508	511,576
Lighting						
Lighting	121,357			8.3 %	414,192	1,242,699
Receptacle						
Receptacles	24,322			1.7 %	83,011	249,057
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	198,392	4,330,306	63	100.0 %	5,007,419	6,589,759

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 2						
Primary heating						
Primary heating	37,019	2,483,819		74.4 %	2,610,164	2,993,619
Other Htg Accessories	1,758		29	0.2 %	6,000	18,002
Heating Subtotal	38,777	2,483,819	29	74.6 %	2,616,164	3,011,621
Primary cooling						
Cooling Compressor	28,219			2.7 %	96,311	288,961
Tower/Cond Fans	78			0.0 %	265	796
Condenser Pump				0.0 %	0	0
Other Clg Accessories	14			0.0 %	47	142
Cooling Subtotal....	28,310			2.8 %	96,623	289,899
Auxiliary						
Supply Fans	53,941			5.3 %	184,101	552,359
Pumps	4,189			0.4 %	14,297	42,896
Stand-alone Base Utilities	8,862			0.9 %	30,247	90,749
Aux Subtotal....	66,992			6.5 %	228,645	686,003
Lighting						
Lighting	141,858			13.8 %	484,161	1,452,628
Receptacle						
Receptacles	24,322			2.4 %	83,011	249,057
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	300,259	2,483,819	29	100.0 %	3,508,604	5,689,210

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 3						
Primary heating						
Primary heating		2,398,515		67.1 %	2,398,515	2,524,753
Other Htg Accessories	3,228		70	0.3 %	11,015	33,050
Heating Subtotal	3,228	2,398,515	70	67.5 %	2,409,530	2,557,802
Primary cooling						
Cooling Compressor	90,812			8.7 %	309,943	929,922
Tower/Cond Fans	6,693			0.6 %	22,844	68,539
Condenser Pump				0.0 %	0	0
Other Clg Accessories	114			0.0 %	390	1,170
Cooling Subtotal....	97,620			9.3 %	333,177	999,631
Auxiliary						
Supply Fans	57,700			5.5 %	196,929	590,845
Pumps	10,335			1.0 %	35,274	105,832
Stand-alone Base Utilities	8,862			0.9 %	30,247	90,749
Aux Subtotal....	76,897			7.4 %	262,449	787,426
Lighting						
Lighting	141,858			13.6 %	484,161	1,452,628
Receptacle						
Receptacles	24,322			2.3 %	83,011	249,057
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	343,924	2,398,515	70	100.0 %	3,572,328	6,046,545

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

MONTHLY UTILITY COSTS

By EMERALD BUILT ENVIRONMENTS

Utility	----- Monthly Utility Costs -----												Total
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Alternative 1													
Electric													
On-Pk Cons. (\$)	2,216	2,000	2,245	1,867	1,916	807	797	838	1,779	2,092	2,072	2,137	20,767
Gas													
On-Pk Cons. (\$)	1,611	1,535	908	153	1	0	0	0	5	291	587	1,444	6,535
Monthly Total (\$):	3,826	3,535	3,153	2,020	1,918	807	797	838	1,784	2,383	2,660	3,581	27,301

Building Area = 54,799 ft²
 Utility Cost Per Area = 0.50 \$/ft²

Alternative 2													
Electric													
On-Pk Cons. (\$)	2,561	2,342	2,471	1,978	1,935	990	1,059	933	1,766	2,177	2,231	2,463	22,906
Gas													
On-Pk Cons. (\$)	1,140	1,121	828	327	42	19	3	15	51	391	545	1,023	5,504
Monthly Total (\$):	3,701	3,464	3,299	2,306	1,977	1,009	1,061	948	1,816	2,568	2,776	3,486	28,411

Building Area = 54,799 ft²
 Utility Cost Per Area = 0.52 \$/ft²

MONTHLY UTILITY COSTS

By EMERALD BUILT ENVIRONMENTS

Utility	Jan	Feb	Mar	Apr	----- May	----- June	----- July	----- Aug	Sept	Oct	Nov	Dec	Total
Alternative 3													
Electric													
On-Pk Cons. (\$)	1,665	1,522	1,733	1,822	3,095	2,565	3,107	2,475	2,882	1,996	1,709	1,585	26,158
Gas													
On-Pk Cons. (\$)	1,123	1,045	786	350	96	59	28	72	93	460	622	1,042	5,775
Monthly Total (\$):	2,788	2,566	2,519	2,172	3,191	2,624	3,135	2,548	2,975	2,456	2,331	2,627	31,932

Building Area = 54,799 ft²

Utility Cost Per Area = 0.58 \$/ft²

MONTHLY ENERGY CONSUMPTION

By EMERALD BUILT ENVIRONMENTS

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 1 Onaway Elementary Existing													
Electric													
On-Pk Cons. (kWh)	22,155	20,004	22,449	18,669	19,163	8,072	7,973	8,377	17,794	20,922	20,724	21,366	207,668
On-Pk Demand (kW)	101	101	101	101	98	98	98	98	98	101	101	101	101
Gas													
On-Pk Cons. (therms)	5,554	5,292	3,130	528	5	0	0	0	16	1,003	2,025	4,980	22,533
On-Pk Demand (therms/hr)	24	25	23	17	2	0	0	0	3	19	19	23	25
Water													
Cons. (1000gal)	8	7	7	3	0	0	0	0	0	6	7	8	46

Energy Consumption

Building	54,054 Btu/(ft2-year)
Source	82,090 Btu/(ft2-year)
 Floor Area	 54,799 ft2

Environmental Impact Analysis

CO2	375,377 lbm/year
SO2	2,605 gm/year
NOX	651 gm/year

MONTHLY ENERGY CONSUMPTION

By EMERALD BUILT ENVIRONMENTS

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 2 VRF & LED													
Electric													
On-Pk Cons. (kWh)	25,609	23,422	24,711	19,784	19,351	9,898	10,589	9,326	17,658	21,775	22,313	24,628	229,064
On-Pk Demand (kW)	87	87	87	88	101	108	109	106	103	89	87	86	109
Gas													
On-Pk Cons. (therms)	3,931	3,867	2,855	1,129	145	65	9	52	175	1,347	1,878	3,528	18,980
On-Pk Demand (therms/hr)	12	14	12	8	4	1	0	1	5	8	9	12	14
Water													
Cons. (1000gal)	4	3	3	2	1	0	0	0	0	2	3	3	20

Energy Consumption

Building 48,903 Btu/(ft2-year)
 Source 79,264 Btu/(ft2-year)

Floor Area 54,799 ft2

Environmental Impact Analysis

CO2 414,052 lbm/year
 SO2 2,873 gm/year
 NOX 718 gm/year

MONTHLY ENERGY CONSUMPTION

By EMERALD BUILT ENVIRONMENTS

----- Monthly Energy Consumption -----

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 3 AHU VAV & LED													
Electric													
On-Pk Cons. (kWh)	16,654	15,218	17,334	18,223	30,945	25,652	31,074	24,754	28,822	19,959	17,089	15,852	261,576
On-Pk Demand (kW)	84	123	118	136	247	272	279	273	257	139	125	118	279
Gas													
On-Pk Cons. (therms)	3,872	3,602	2,709	1,206	331	203	96	250	319	1,585	2,147	3,593	19,912
On-Pk Demand (therms/hr)	13	14	13	11	8	3	1	5	9	11	12	13	14
Water													
Cons. (1000gal)	6	5	6	5	2	2	1	2	2	5	5	6	48

Energy Consumption

Building	52,628 Btu/(ft2-year)
Source	87,129 Btu/(ft2-year)
 Floor Area	 54,799 ft2

Environmental Impact Analysis

CO2	472,819 lbm/year
SO2	3,281 gm/year
NOX	820 gm/year

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating		2,253,316		76.1 %	2,253,316	2,371,912
Other Htg Accessories	4,502		46	0.5 %	15,366	46,102
Heating Subtotal	4,502	2,253,316	46	76.6 %	2,268,682	2,418,014
Primary cooling						
Cooling Compressor				0.0 %	0	0
Tower/Cond Fans				0.0 %	0	0
Condenser Pump				0.0 %	0	0
Other Clg Accessories				0.0 %	0	0
Cooling Subtotal....				0.0 %	0	0
Auxiliary						
Supply Fans	29,460			3.4 %	100,547	301,672
Pumps	6,784			0.8 %	23,153	69,466
Stand-alone Base Utilities	8,862			1.0 %	30,247	90,749
Aux Subtotal....	45,106			5.2 %	153,947	461,888
Lighting						
Lighting	132,935			15.3 %	453,707	1,361,257
Receptacle						
Receptacles	25,125			2.9 %	85,752	257,283
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	207,668	2,253,316	46	100.0 %	2,962,088	4,498,441

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 2						
Primary heating						
Primary heating	35,077	1,898,033		75.3 %	2,017,750	2,357,116
Other Htg Accessories	1,606		20	0.2 %	5,480	16,440
Heating Subtotal	36,682	1,898,033	20	75.5 %	2,023,229	2,373,556
Primary cooling						
Cooling Compressor	27,248			3.5 %	92,999	279,024
Tower/Cond Fans	69			0.0 %	235	705
Condenser Pump				0.0 %	0	0
Other Clg Accessories	14			0.0 %	47	142
Cooling Subtotal....	27,331			3.5 %	93,281	279,871
Auxiliary						
Supply Fans	35,160			4.5 %	120,000	360,035
Pumps	2,996			0.4 %	10,225	30,678
Stand-alone Base Utilities	8,862			1.1 %	30,247	90,749
Aux Subtotal....	47,018			6.0 %	160,472	481,463
Lighting						
Lighting	92,908			11.8 %	317,096	951,384
Receptacle						
Receptacles	25,125			3.2 %	85,752	257,283
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	229,064	1,898,033	20	100.0 %	2,679,830	4,343,555

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

ENERGY CONSUMPTION SUMMARY

By EMERALD BUILT ENVIRONMENTS

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 3						
Primary heating						
Primary heating		1,991,216		69.0 %	1,991,216	2,096,017
Other Htg Accessories	3,064		48	0.4 %	10,457	31,375
Heating Subtotal	3,064	1,991,216	48	69.4 %	2,001,674	2,127,393
Primary cooling						
Cooling Compressor	89,753			10.6 %	306,328	919,077
Tower/Cond Fans	6,575			0.8 %	22,442	67,333
Condenser Pump				0.0 %	0	0
Other Clg Accessories	140			0.0 %	476	1,429
Cooling Subtotal....	96,468			11.4 %	329,247	987,839
Auxiliary						
Supply Fans	28,108			3.3 %	95,932	287,824
Pumps	7,040			0.8 %	24,027	72,089
Stand-alone Base Utilities	8,862			1.1 %	30,247	90,749
Aux Subtotal....	44,010			5.2 %	150,206	450,663
Lighting						
Lighting	92,908			11.0 %	317,096	951,384
Receptacle						
Receptacles	25,125			3.0 %	85,752	257,283
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	261,576	1,991,216	48	100.0 %	2,883,975	4,774,561

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

	2024 Use	ACTUAL 2024 cost	Utility Rate \$/unit	EXISTING Model	%Deviation
Boulevard					
Electric kWh	166,053	\$ 21,616	0.13	165,320	-0.44%
Gas Therm	31,481	\$ 8,294	0.26	29,479	-6.79%
EUI	74	\$ 29,910		72	
Lomond				Model	
Electric kWh	210,316	\$ 27,088	0.13	211,688	0.65%
Gas Therm	40,370	\$ 9,704	0.24	44,500	9.28%
EUI	76	\$ 36,792		79	
Mercer				Model	
Electric kWh	178,974	\$ 21,220	0.12	198,392	9.79%
Gas Therm	28,368	\$ 7,360	0.26	26,648	-6.45%
EUI	41	\$ 28,580		42	
Onaway				Model	
Electric kWh	234,642	\$ 24,198	0.10	207,668	-12.99%
Gas Therm	23,683	\$ 6,982	0.29	22,533	-5.10%
EUI	52	\$ 31,180		54	