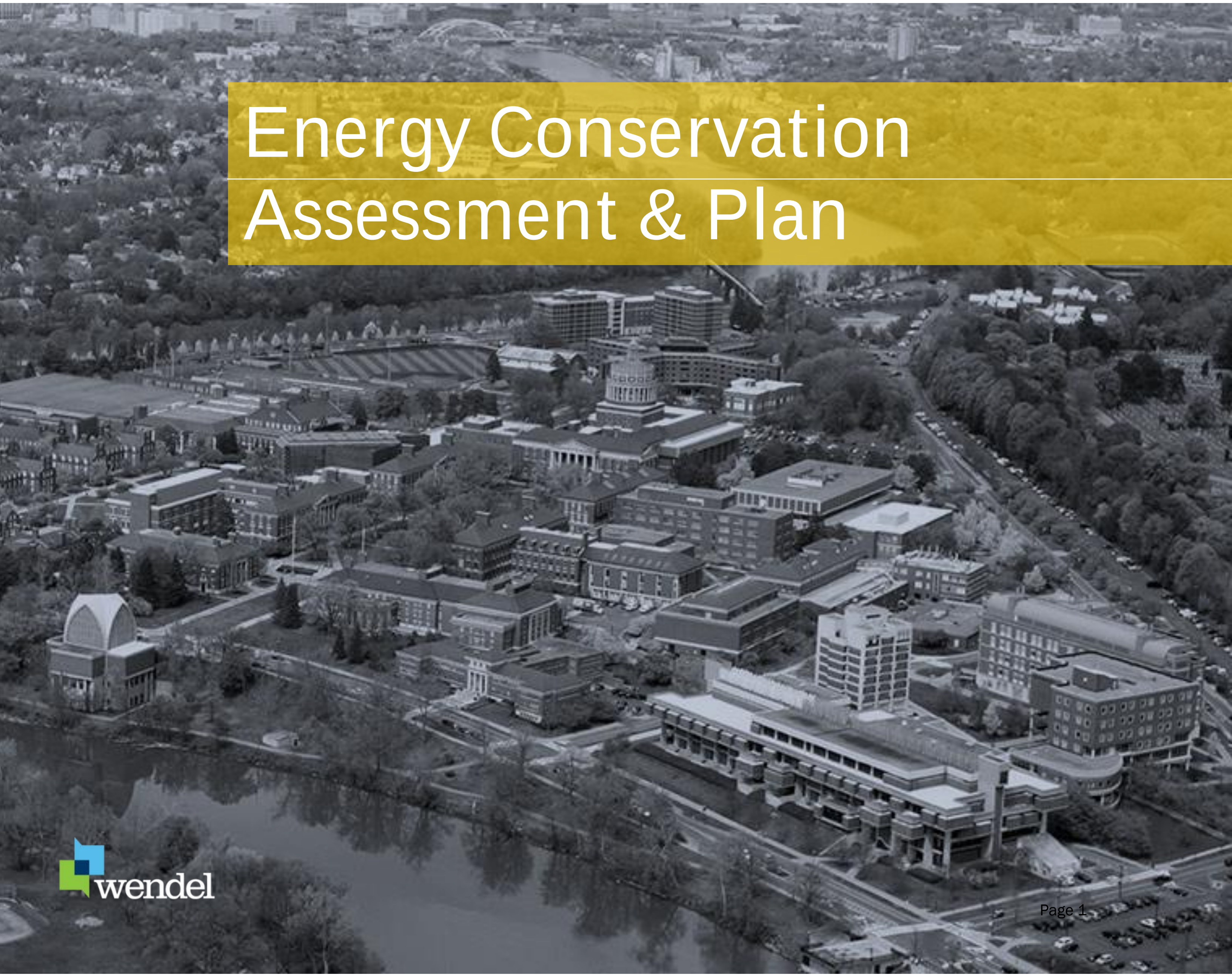
UNIVERSITY OF ROCHESTER

Final Report | October 2021

V11 - Revised 1/10/2022



Energy Conservation Assessment & Plan

contents

Section A

Executive Summary

Executive Summary

The transformation and distribution of energy is important to the growth of the University and our impact on the environment. Improving system efficiency, as our infrastructure ages and grows to meet new demands, is essential to controlling both capital expenses and operating costs. In the spirit of Meliora (Ever Better) we have been inspired by previous projects and best practices to develop a comprehensive strategy that will allow us to reduce purchased energy and lower greenhouse gas emissions.

Vision

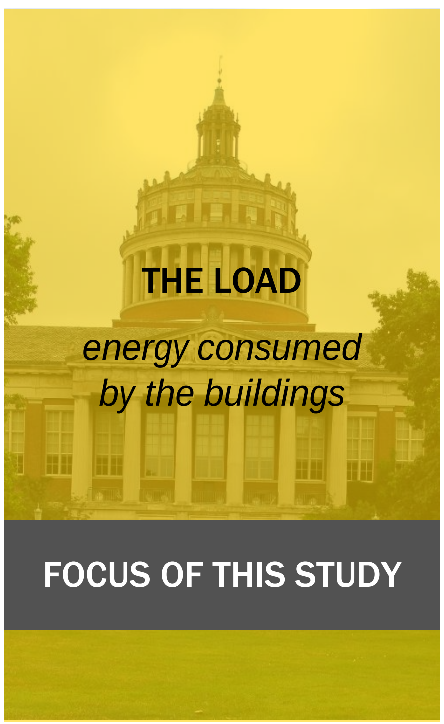
A sustainable utility and energy system which balances reliability, economics, and efficiency.

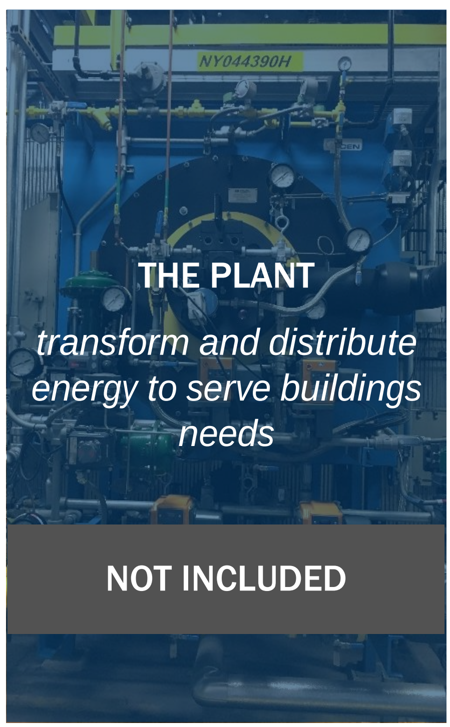
Study Goals

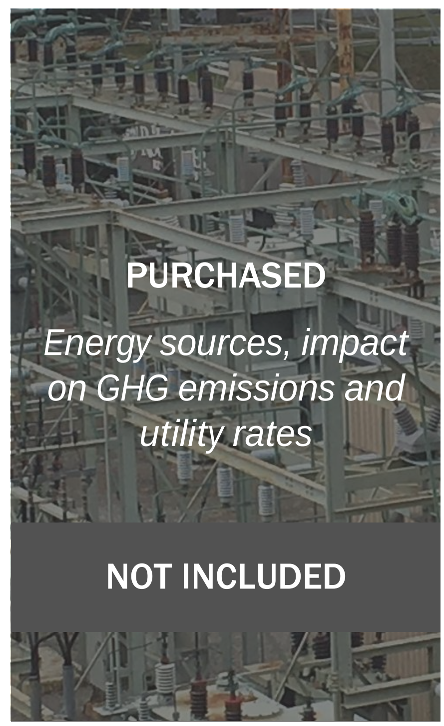
Provide information which can be used to plan for energy conservation across campus. This includes projected capital costs, energy, and greenhouse gas emissions (GHG) savings. The study also provides supporting information and procedures to guide the execution of energy conservation measures (ECM).

Methodology / Scope of the Study

This Energy Conservation Assessment and Plan outlines a series of steps to identify, develop and implement energy conservation focused improvements on campus which balances sustainability with fiscal responsibility. The study primarily focused on River Campus and the Medical Campus, however the results of the study, including the process and technical recommendations, may apply to all UR Campuses.







As energy moves through the distribution system it is transmitted and transformed via equipment such as pumps, boilers, chillers, and generators, etc. Each step through the system results in additional energy losses which are multiplied by preceding losses, with an effect analogous to compound interest. Therefore, lowering energy consumption in the building reduces our purchase energy by the amount saved in the building plus that of all the transformational losses that were avoided along the way. To achieve this compounded savings this report will focus primarily on building level energy conservation. As a result, the focus of the Energy Conservation Assessment and Plan is reducing THE LOAD within the buildings.

This Plan is divided into three task sections:

1. **Execution Process for delivering Energy Conservation Project** - A detailed procedure for how projects will be identified, validated, developed and implemented. This section also provides options for funding, identifies external funding sources, and provides key financial metrics to qualify potential projects for investment.

2. **Potential Energy Conservation Measures (ECMs)** - **T**he major energy consuming systems on University Buildings are lighting systems and HVAC systems. Due to the unique requirements of the University buildings, simultaneous heating and cooling, ventilation comprise a significant portion of a building's energy usage. Also due to the age of the University, it is common to find inefficiencies from aging infrastructure, specifically legacy HVAC controls and steam systems. The following are a list of common Energy Conservation improvements for University Buildings.

    1. Lighting Upgrades to LED
    2. HVAC Controls Upgrades and Retro-Commissioning
    3. Laboratory Ventilation Optimization
    4. Heat Recovery Heat Pumps
    5. Photovoltaic systems

3. **Energy Data Analytics, and Reporting / Dashboard** - A detailed plan for the Energy Management Information System (EMIS) system including requirements, and qualifications for various energy dashboard platforms. The objective is to develop a solution to increase awareness of energy usage in a visual easy to use dashboard which also has functionality to assist in billing, energy management and predictive analytics.

ECM Execution Process

The assessment of these ECMs was completed in three parts.

Part 1 | A detailed technical assessment of a limited number of conservation measures including Lighting, Laboratory HVAC systems, Heat Recovery Systems, and Photovoltaic Systems for select buildings. The detailed investigation has resulted in actionable projects which the University can further develop to help start this program. Additional energy savings measures including controls upgrades, and steam to hot water conversions were not included in this task but are measures that would realize additional savings to the University.

For select buildings, a Retro-Commissioning scoping survey was performed. This survey briefly reviewed building systems and noted observations which would indicate that the building may benefit from a retro-commissioning project and what the savings potential may be.

Part 2 | The results of the detailed technical assessments are extrapolated based on building use and area to other buildings on campus. This outlines the potential for energy savings for these common measures across campus.

Part 3 | This analysis projects the expectations for a complete energy conservation program. This analysis includes estimates for HVAC Controls Upgrades, Retro-Commissioning, and photovoltaic systems. The objective of this effort is to provide the University with realistic targets for energy conservation goals over the next 10 years.

ECM Evaluation Method

The team evaluated the potential cost and savings associated with likely Energy Conservation Measures (ECMs) which may be included in future projects. The evaluation of these ECMs was on a campus-based approach where select representative areas are evaluated than extrapolated to estimate the potential cost/savings across the campus. The following is a list of ECMs, and the selected buildings used to establish the representative areas.

ECM	# Buildings	Building Names
Laboratory Controls	3	Kornberg, Del Monte, BMEO
Lighting Upgrades	6	Kornberg, ACF, Wilder, Fauver, Schlegel, Wallis
Heat Recovery	3	Kornberg, Del Monte, BMEO
Retro-Commissioning	3	RRL, Douglass, Danforth
PV Rooftops	51	ESM, MC, RC, SC

ECM Results for Recommended ECMs in buildings evaluated

ECM	Annual Avoided Building Energy Costs[1]	Annual Avoided CO2	Project Capital Cost	Simple Payback	Page Number
	Dollars	Metric Tons	Dollars	Years	#
Lighting Upgrades Recommended	$139,466	131	$1,674,741	12.0	34, 43, 44
Laboratory Controls Recommended	$215,997	594	$814,114	3.8	52, 57, 58
Heat Recovery Heat Pumps	$390,167	1,437	$2,247,127	5.8	59, 69, 70
Retro-Commissioning (Median)[2]	$153,627	485	$254,430	1.7	92, 100, 101
Total	$899,257	2,648	$4,990,412	5.5	27, 32, 33

(1) Annual Avoided Building Energy Costs - this is the purchased utility cost plus overhead for internal delivery.

(2) Retro-Commissioning (Median) – the median value is determined by calculating the median of the high and low values presented in the Total Project Summary.

Result Summary for Solar Rooftop Assessment

ECM	Annual Avoided Building Energy Costs[1]	Annual Avoided CO2	Project Capital Cost	Simple Payback	Page Number
	Dollars	Metric Tons	Dollars	Years	#
PV Rooftops	$1,150,464	1,827	$21,857,109	19.0	71, 82, 83

(1) Annual Avoided Building Energy Costs – this is the purchased utility cost plus overhead for internal delivery.

Note that the economics for solar projects vary based on available incentive programs and procurement models. The information provided here should be considered conservative for planning purposes. A summary of incentive programs and procurement models are provided, which may provide a more favorable return on investment. The conclusion to draw from this analysis is when a roof is being considered for replacement, the project team should consider a photovoltaic array and utilize this document to benchmark the potential size and production before exploring incentive programs.

A summary of incentive programs can be found on pages: 87-90

ECM Results for Recommended ECMs extrapolated across campus

ECM	Annual Avoided Building Energy Costs[1]	Annual Avoided CO2 [3]	Project Capital Cost	Simple Payback	Page Number
	Dollars	Metric Tons	Dollars	Years	#
Lighting Upgrades Recommended	$1,391,084	2,650	$20,221,963	14.5	34, 715
Laboratory Controls Recommended	$930,581	3,043	$5,981,652	6.4	52,717
Heat Recovery Heat Pumps	$1,591,123	6,250	$14,538,192	9.1	59, 719
Retro-Commissioning (Median)[2]	$2,905,259	9,205	$4,183,386	1.4	92, 721
Total	$6,818,048	21,149	$44,925,193	6.6	108, 115

(1) *Annual Avoided Building Energy Costs – this is the purchased utility cost plus overhead for internal delivery.*

(2) *RCx median value is determined by calculating the median of the high and low values presented in the Total Project Summary.*

(3) *See "Extrapolated Project Impact Summary" table on page 117 for total emission savings calculations. These proportionally distributed to individual ECMs according to the ECM's energy savings.*

Energy Management and Data Analytics Software

Energy Management and Data Analytics Software

UR seeks to leverage software to track, analyze, optimize and report energy usage.

Phase I – Energy Management Information System (EMIS)

This software tracks, coordinates and analyzes building energy usage data, energy conservation measures, facilitates communication to stakeholders and the community. There are multiple views into the system presenting varying levels of detail by login credentials plus public facing portals without passwords.

The EMIS integrates all of the following functions and services:

- Metering - data consolidation, historical data, and tools (verification, alarm, etc.).
- Analytics - analytic graphs and reports that analyze where and how our energy is consumed.
- Dashboard - communication for students, faculty, and staff.
- Funding - reports to verify energy savings on energy conservation projects for external incentives.
- Operational Data - potential to expand dashboards for building managers insight into operational data.
- Improved energy management resulting in reduced energy consumption and costs.
- Student and faculty engagement in our energy to support academic and student interests.
- Improved UEM administrative efficiency.

As part of the study, EMIS requirements were determined, and vendors were identified. This enabled UR to issue an RFP to solicit EMIS vendors. Wendel assisted UR during the selection process and eSight Energy was selected and implemented as URs new EMIS. See Page 102 for more detail.

Energy Management Information System Energy Savings Estimate.
The EMIS system does not reduce energy consumption simply by being installed. The savings come from utilizing a tool to help identify opportunities, facilitate projects and help measure results. Studies by the US Department of Energy have shown that on average organizations exhibit about a 4% energy savings one year after implementing an EMIS as part of an overall effective strategy to reduce energy consumption. The savings listed below are based on a more conservative estimate of 1% local campus energy savings. One could think of this more as a goal as it still requires action from stakeholders to make reality.

Source: https://betterbuildingssolutioncenter.energy.gov/sites/default/files/EMIS_in_2019--Are_Building_Analytics_Ready_to_Go_Mainstream.pdf

Result Summary for Phase 1 Energy Management Information System

ECM	Annual Avoided Building Energy Costs[1]	Annual Avoided CO2	Project Capital Cost	Simple Payback	Page Number
	Dollars	Metric Tons	Dollars	Years	#
EMIS System	$368,753	1,865	$1,426,399	4	102, 107

(1) Annual Avoided Building Energy Costs – this is the purchased utility cost plus overhead for internal delivery.

Phase II – Fault Detection and Diagnostics (FDD) software.
The EMIS operates primarily at the building level. UR has determined that the next phase of this process is to implement FDD software at the equipment level. FDD is software that works in conjunction with the Building Automation Systems to analyze the operation of the HVAC equipment such as Air Handlers, Pumps, Terminal units, etc. to determine if the equipment is operating correctly and efficiently. It will notify operators when there are faults or concerns with equipment operation so these can be addressed. This has been shown to have a substantial improvement in building energy efficiency and human comfort. While FDD software was outside the scope of this plan, it was identified as a near future area to investigate.

Executive Summary Conclusion

The University should invest in an **Energy Management Information System** which will provide better visibility into building energy usage and direct actions to manage and reduce energy consumption. The University will benefit from the implementation of key **Energy Conservation Measures.** Among them, **Retro-commissioning** can act as a gateway for developing building specific ECMs not identified in this report. Sustained long term savings will be achieved through a balance between transformative changes such as H**eat Recovery Heat Pumps** and **LED Lighting** and operational improvements such as **Retro-commissioning and Laboratory Ventilation Optimization**

Section B

System Overview

Overview

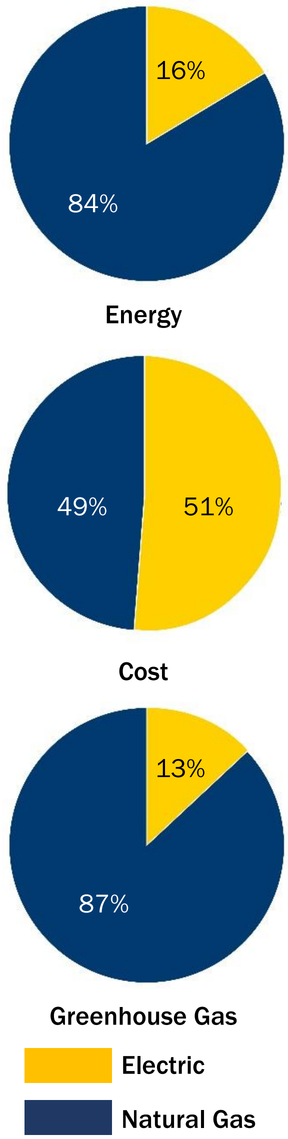


Figure B1- Summary charts of total utilities FY18

The University's connected campus consumes over 3 Million mmBtus of energy annually, which equates to approximately 19,500 homes. This energy usage is comprised of two major sources: electric and natural gas. Effective management of these resources require a balance between energy usage, energy cost and Greenhouse Gas (GHG) impacts.

	ENERGY (mmBtu)	COST ($)	GHG (MT CO2e)
ELECTRIC	504,976	$9,205,600	19,867
NATURAL GAS	2,568,000	$8,782,560	136,155

Table B1- Summary of total utilities FY18

The Central Utilities Plant transforms these utility energy resources into usable energy sources for our buildings primarily through the Central Utilities Plan and the Mid Campus Chiller Plant.

The Central Utility Plant primarily consumes natural gas and provides electricity, steam, hot water and chilled water. The Mid Campus Chiller Plant consumes electricity and provides chilled water to the medical campus. These utilities are provided to the buildings via the University's utility distribution system.

The transformation of energy from purchased utilities (i.e. electric and natural gas) to usable utilities (i.e. chilled water and hot water) has inherent efficiency losses. Therefore, by saving energy at the building level, more purchased energy is actually saved. The following chart shows the relationship between building energy usage and the purchased energy needed to provide those utilities.

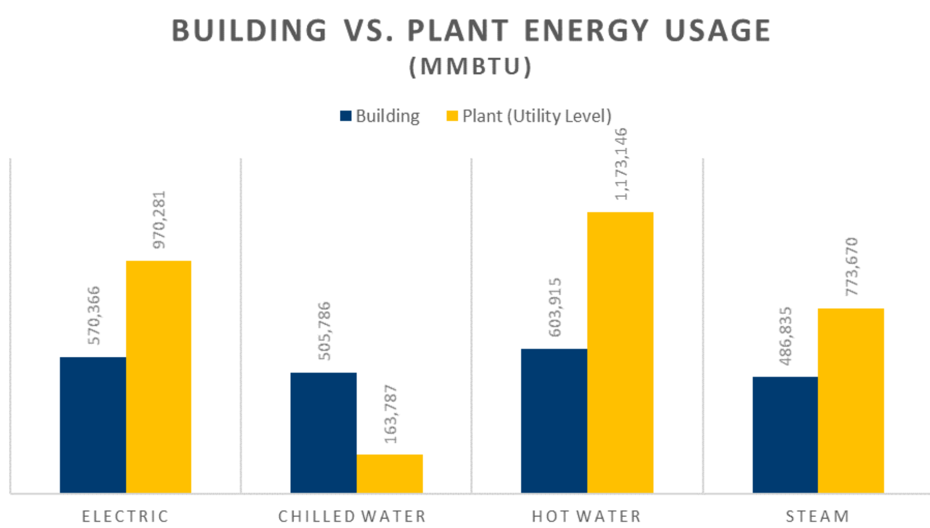
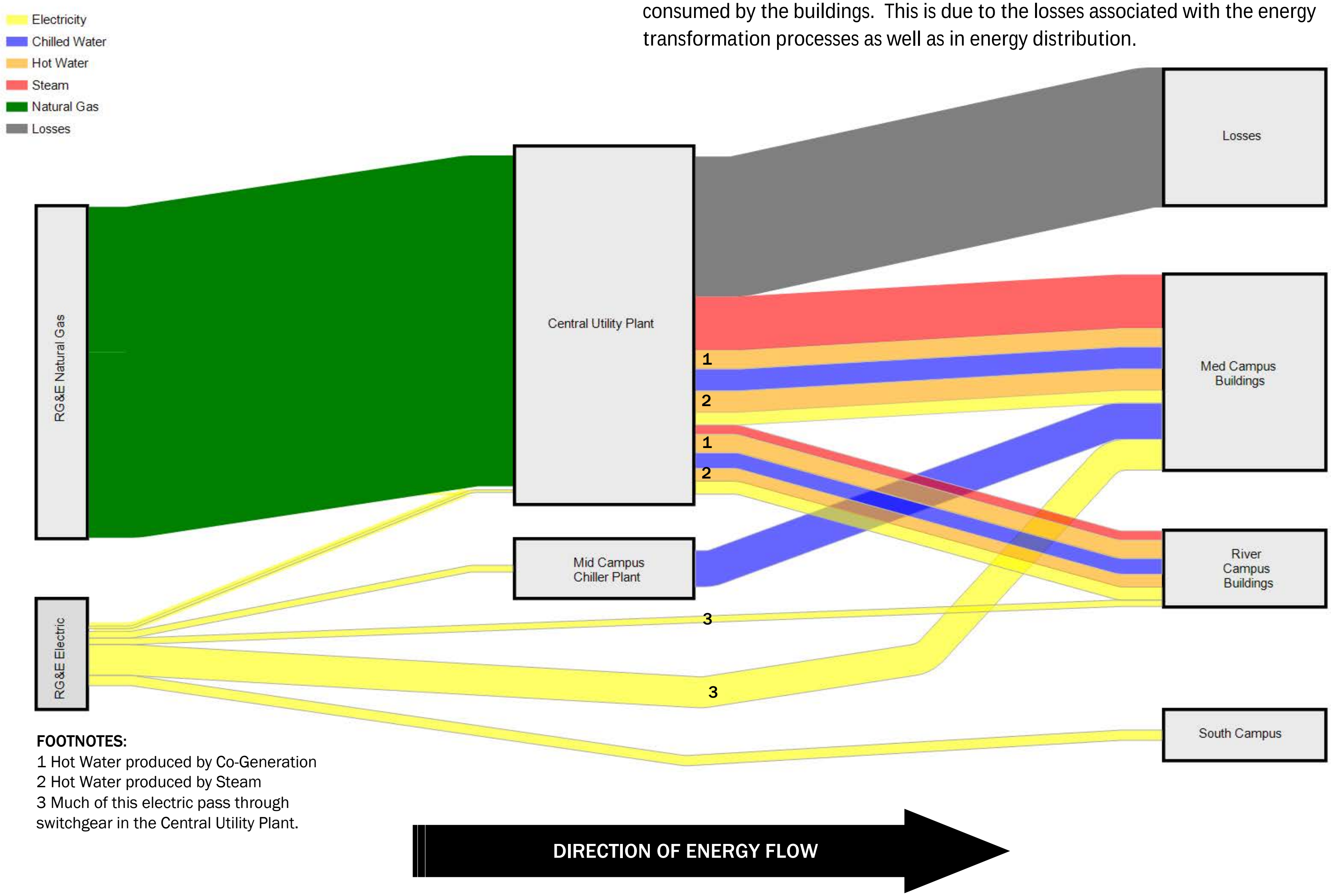


Figure B2 - Summary of projected input energy (plant) vs. consumed energy (building)

University at Rochester

In this Sankey diagram shown (below) the widths of the bars are proportional to the magnitude of the energy flow the bar represents. As you can see from the Sankey diagram (below) there is more energy coming into the plant than what is consumed by the buildings. This is due to the losses associated with the energy transformation processes as well as in energy distribution.



FOOTNOTES:
1 Hot Water produced by Co-Generation
2 Hot Water produced by Steam
3 Much of this electric pass through switchgear in the Central Utility Plant.

Figure B3 – Sankey Chart of Energy Flow

The following are conversion factors, efficiencies, billing rates and emissions rates used to assess changes to energy usages on campus. Data sources are as follows:

- Conversion Rates | industry standards
- Building to Plant Ratios | 2018 plant and building utility data reflected in the Sankey chart above.
- Building Utility Rates | Provided by UR.
- Purchased Utility Rates | Provided by UR.
- Emissions Rates | eGRID 2018 for electric and industry standard conversions for Natural Gas.

BUILDING UTILITY RATES are defined as the fully burdened utility rate, paid by the buildings, which includes purchased utility cost plus the overhead costs associated with the UR/UEM generation & distribution system. This is the rate applied to the projected saving when assessing the return on investment associated with a project impacting a building's capital and operating budgets.

PURCHASED UTILITY RATES are defined as the rates paid by UR to the utility service providers. This includes the commodity and delivery of utilities to UR. This is the rate applied to the projected saving when assessing the return on investment associated with a project impacting UEM's capital and operating budgets.

Conversion Rates		
Electric	0.003412	mmBtu per kWh
Chilled Water	12,000	Btu per tonhr
Steam	1,194	Btu/lb
Boiler System Efficiency	72%	-
Plant Efficiency Ratios		
Chilled Water	49%	Portion of CHW produced by electric chillers
Chiller Elec.	0.65	kW/ton
Chiller Steam.	0.0037	mmBtu/Tonhr
Chiller NG.	0.0052	mmBtu/Tonhr
Total Heating System Eff.	67%	
Building Utility Rates		
Electric	$0.09	$/kWh
Chilled Water	$6.28	$/ton-day
Chilled Water	$21.81	$/mmBtu
Steam	$14.60	$/mmBtu
Hot Water	$10.50*	$/mmBtu (Note: $14.60 to be used in future)
Purchased Utility Rates		
Electric	$0.0650	$/kWh
Natural Gas	$3.210	$/dTh
Natural Gas	$3.210	$/mmBtu
CO2 Emissions Rates		
Electric	295.94	lb/MWh, (0.1342 MTCO2/MWh), (0.03936 MTCO2/mmBTU)
Nat. Gas	116.38	lb/mmBtu, (1.800 MTCO2/MWh), (0.5279 MTCO2/mmBTU)

Table B2 - Summary of utility rates

**The steam rate and the hot water rate are the same per mmBTU with steam being evaluated at 1,000 BTU/lb The all in building steam and hot water rate fluctuates every month, with $14 to $15 per mmBTU typical.*

Section C

Execution Process

Task 1

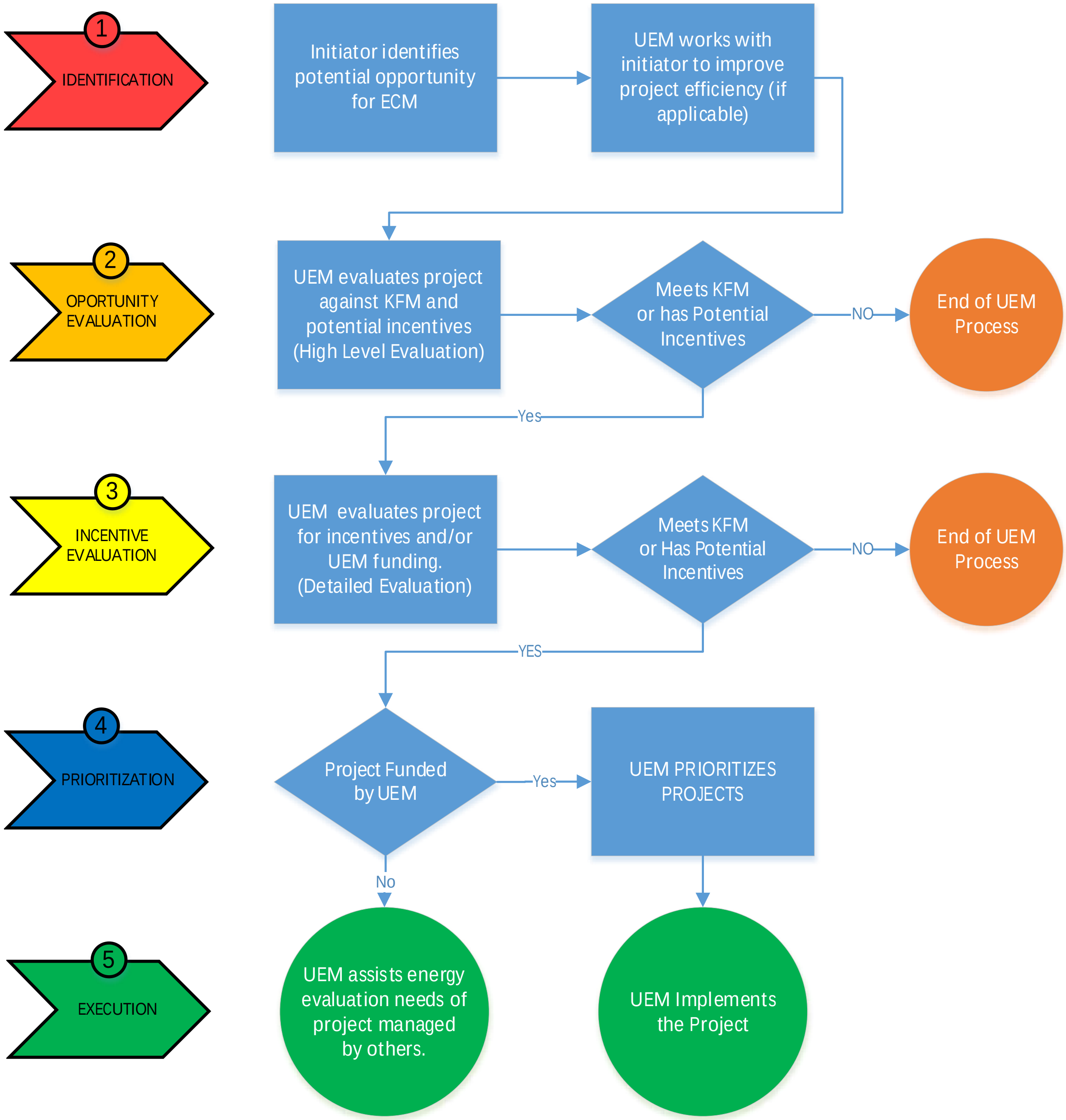
EXECUTION PROCESS (TASK1)

The goal of the Energy Conservation Assessment and Plan is to optimize (or minimize) energy usage and consumption to reduce our impact on the environment and reduce UR operating expenses. This reduction in consumption can occur at University buildings, utility generation facilities, and other energy sources, Collaboration between departments to cost effectively increase energy efficiency will create a win-win solution that will benefit the University.

This section expands on the overall strategy by outlining an execution plan to take ideas from concept to a potential opportunity through to a completed project. The following steps are part of the process:

1. Identification of opportunities, which can come from multiple stakeholder groups.
2. High-level evaluation of those opportunities against identified key financial metrics (KFMs)[1] and funding opportunities to quickly identify viable projects.
3. Provide a detailed evaluation of viable potential opportunities against various incentive programs to determine if the opportunity qualifies for additional financial incentives.
    - Evaluation against KFMs will be reviewed in detail during this phase.
4. Prioritization – Evaluation of opportunities based on KFMs.
5. Outlining of the execution process necessary to implement screened opportunities and ensure that projects are completed that meet the overall Energy Management & Conservation Plan requirements.

[1] *Key Financial Metrics are defined in Step 2 of this section.*



UEM – Utilities and Energy Management
KFM – Key Financial Metrics
ECM – Energy Conservation Measure

Figure C1 – Process flow chart showing the decision-making process for assessing projects.

STEP 1 | IDENTIFICATION OF OPPORTUNITIES

UEM engineers will manage an on-going effort to identify opportunities for energy savings. This effort will be comprised of efforts internal to UEM as well as working with potential opportunity initiators outside of UEM. These outside initiators could include facility managers & supervisors and outside energy advisors. The goal of these efforts would be to develop opportunities for energy savings within the University building systems.

OPPORTUNITY: *Is defined as an idea for energy conservation which may develop into energy conservation measures (i.e. energy savings projects)*

There are three ways an opportunity may be identified and brought to the UEM Energy Engineer for consideration.

Option 1 | A small group of opportunities, also referred to as seed ECMS , are identified as part of the energy conservation and management plan. These opportunities will be prequalified/prescreened as part of the plan. In addition, the plan will outline facilities and systems that will likely provide the best next level of opportunities to be further defined and screened based on building and system types across the campus.

Option 2 | A stakeholder (facility director, project manager or other) identifies an opportunity that they would like to be reviewed by the UEM Energy Engineer. The reasons for review may include:

- Evaluation of a design idea or value engineered options to assess the long-term cost/benefit analysis.
- Evaluation of incentives options for a project
- Evaluation of an opportunity to be implemented by UEM as an Energy Conservation Measure.

Option 3 | UEM or their consultants, may identify an opportunity either through daily operations or via targeted engineering studies.

STEP 2 | EVALUTION OF THE OPPORTUNITIES

The UEM Energy Engineer will gather information and review the opportunity with the initiator and other stakeholders to further develop the opportunity and potentially improve the project efficiency. The UEM Energy Engineer will then perform a high level evaluation of the project to determine if the project is likely to meet the KFMs (Note: The KFMs are defined below).

The UEM Energy Engineer will then review the project to determine if there are incentives available. If the project meets the KFMs, including potential incentives, then UEM will sponsor the project under the Energy Solutions Initiative and move into a more detailed assessment of the project. If the project does not meet the KFMs it may be pursued as a Capital Project, at which point UEM would provide support recommending energy efficient solutions and assist with possible funding either through incentives or covering the incremental costs of the energy efficiency improvements.

STEP 2 (cont.) | DEFINITION OF KEY FINANCIAL METRICS (KFMs)

The KFMs can be defined in several ways. The following are several options for stakeholder consideration. A Primary KFM based on simple payback and a Secondary KFM bounded by carbon reduction goals were selected.

Primary Metric | Simple Payback

Projects will be evaluated first based on the cost of energy saved at the <u>building level</u> vs. the total project cost. A Target Simple Payback Period would be established. Projects that exceed the limit would not be considered. Projects that meet the criteria will be prioritized from the lowest to highest simple payback. Funding will be limited based on available funds for the fiscal year.

- Target Simple Payback Period | Goal - Less than 10 years
  - Total project cost include material, labor, engineering, project management and other costs. The impact of incentives would be included in the payback calculation (see below for further details).
  - Utility rates are updated annually.

Secondary Metric | GHG Emissions

Projects will also be evaluated based on the total project cost vs. the greenhouse gases (GHG), in carbon dioxide equivalent (CO_2e), saved <u>at the plant</u>. Projects with similar simple paybacks will be evaluated based on the best \$/MTCO2e.

STEP 3 | INCENTIVE PROGRAM EVALUATION

Incentive programs are available from various agencies to help incentivize the implementation of energy efficient projects and reduce energy consumption and greenhouse gas emissions. These incentives can provide reductions to the costs of a project, enhancing the projects ability to meet key financial metrics.

In New York State, the bulk of the energy efficiency incentive programs are managed by the New York State Energy Research & Development Authority (NYSERDA). The electric and gas utilities across the state also offer certain incentives for energy efficiency improvements to clients in their service territory. For the University of Rochester, Rochester Gas & Electric, a combined gas and electric utility, is the utility that would provide these incentives.

The following is a listing of current applicable incentive programs offered by NYSERDA and RG&E as of November 2020.

New York State Energy Research & Development Authority (NYSERDA)

- **REV Campus Challenge**

  Program description: The REV Campus Challenge program is available to two- and four-year public and private colleges in New York State. The program provides its members with a range of benefits including:

  - Gain access to member-exclusive programs and competitions, including NYSERDA's FlexTech Program and any future programs launched under the REV Campus Challenge
  - Receive recognition for clean energy accomplishments
  - Engage with a diverse network of peers, from sharing stories about successes and struggles, to learning best practices and pitfalls from other institutions, to attending educational member workshops and events
  - Access helpful resources selected by the REV Campus Challenge for their relevance to clean energy and sustainability at New York State colleges and universities

  Goals and Commitments:

  The REV Campus Challenge recognizes the diversity of New York State's colleges and universities and understands that one specific clean energy goal may not be a best fit for every Challenge member.

  There are no pre-determined institutional targets, goals, or commitments associated with the REV Campus Challenge. Recognition will be obtained by making progress toward and achieving individual campus clean energy goals.

  Note: UR has the distinction of being a REV Campus Challenge Leader and was recently featured in a spot light article which can be found here: https://www.nyserda.ny.gov/All-Programs/Programs/REV-Campus-Challenge/Membership-Information/Meet-the-Members

  Program Website: https://www.nyserda.ny.gov/All-Programs/Programs/CampusChallenge

- **Flexible Technical Assistance (FlexTech) Program**

Program description: The FlexTech program shares the cost to produce an objective, site-specific, and targeted study on how best to implement clean energy and/or energy efficiency technologies. A NYSERDA FlexTech Consultant can work with the university to complete the energy study.

For universities to take advantage of the FlexTech program they must be members of the REV Campus Challenge. The University of Rochester is a REV Campus Challenge member. REV Campus Challenge members receive additional benefits above the normal FlexTech program. These additional benefits include a higher cost share for members – 60% NYSERDA cost share for members as opposed to 50% for non-members on most studies. FlexTech provides cost-shared funding up to $500,000 for REV Campus Challenge members to work with energy consultants to better understand and pursue clean energy opportunities on their campuses and develop future action plans. Integrate energy efficiency into capital planning projects and make cost-effective, data-driven decisions that meet campus' clean energy goals.

	Technical Assistance Services	Standard NYSERDA: Cost Share	REV Campus Challenge Member: NYSERDA Cost Share [1,2]	NYSERDA Cost Share Cap per Project
Primary Services	Level 1+ Energy Study			up to $10,000 per building
	Targeted or Comprehensive Energy Study Targeted or Comprehensive RCx Study Climate Action Plan or Sustainability Plan Clean Heating and Cooling Study Energy Master Planning Energy Advisor Services	50%	60%	up to $500,000 or 10% Annual Energy Expenditure, which ever is less
	Energy Storage (ES)	75%	75%	up to $100,000 or 10% Annual Energy Expenditure, whichever is less
	The following supporting services are eligible if completed in combination with any of the primary services above.			
Supporting Services [2]	Investigation of renewable energy technologies			
	Complete greenhouse gas emission inventory	50%	60%	
	Installation of permanent meters or permanent sub-meters			$10,000
	Establish reporting protocol and report to voluntary third-party certification organizations	REV CC Only		
	Utilize a student intern	REV CC Only	up to $10,000 of intern fees	
	Develop curriculum/student clean energy engagements	REV CC Only	75%	$10,000

1. Colleges and Universities must be REV Campus Challenge members to receive a cost-share of any kind.
2. Supporting Services are only eligible for a NYSERDA cost-share if completed in combination with a Primary Service.

Chart C1 – NYSERDA Technical Assistance Services

Program Website: https://www.nyserda.ny.gov/All-Programs/Programs/FlexTech-Program

Program Contact: flextech@nyserda.ny.gov

- ## NY-Sun Program

Program description: The New York State Energy Research and Development Authority (NYSERDA) provides financial incentives and financing options through the NY-Sun Incentive Program for the installation of new grid-connected solar photovoltaic (solar electric) systems.

Funding for the program has been allocated by the New York State Public Service Commission through the Clean Energy Fund (CEF) with additional funding made available through the Regional Greenhouse Gas Initiative. Incentives are granted on a first-come, first-served basis, and applications will be accepted through December 31, 2023, or until funds are fully committed.

The program relies on contractors and builders to implement new solar electric systems for customers seeking incentives through the program. Contractors are responsible for the contract with the customer, while builders are responsible for the installation of the system. A company approved as both a contractor and builder is responsible for all aspects of the project. Before a contractor and builder can work together, they must establish a contractor-builder relationship agreement through the program.

Incentives are only available for new solar electric systems that are designed and installed by participating contractors and builders. Incentives in the nonresidential and commercial/industrial programs will allow for payment assignment and/or full assignments.

Program Website: https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun

Program Contact: info@nyserda.ny.gov

- ### Real Time Energy Management (RTEM) Program

Program description: RTEM is a cutting-edge technology that continuously sends your site's live and historical performance data to an advanced cloud-based or on-site system. RTEM technologies analyze that data and recommend actionable insights, resulting in lower operating and utility costs, and lead to a smarter building with greater comfort, appeal and marketability. For industrial customers, RTEM helps improve the bottom line by limiting energy consumption while maintaining productivity.

RTEM helps you transform the way you manage, consume and buy energy. NYSERDA will cost share up to 30% of your overall RTEM capital expenses plus 20% - 30% of the RTEM service fees for up to five years and provide the tools and support you need to reap the benefits of building performance optimization.

UR is a qualified self-directed RTEM Service Vendor. The OSISoft PI system is a qualified RTEM System Vendor owned by UR. If a new Digital Control System (DCS) or Building Automation System (BAS) project at UR is utilizing the PI system in some fashion it is a good candidate for RTEM incentives.

The current version of the program is ending June 30th 2021. No new applications can be accepted to the current version. The new version needs to be researched to see how applicable it is to UR. It will focus on tenant spaces which may not suite UR.

Program Website: https://www.nyserda.ny.gov/All-Programs/Programs/Real-Time-Energy-Management

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E: Cody.Glavey-Weiss@nyserda.ny.gov

- ### Energy Advisor Program

Program description: The NYSERDA Energy Advisor Program is an extension of the FlexTech program. The difference is the Energy Advisor Program is a high level FlexTech application with a high level scope of work defined to be accomplished over a period of 12 - 24 months. An estimated total budget is also defined. Once approved by NYSERDA and the work scopes become more defined, periodic work plans for each scope of work item with a more detailed description and budget. Work plans are submitted and approved via email with the NYSERDA project manager.

Program Website: https://www.nyserda.ny.gov/All-Programs/Programs/FlexTech-Program

Program Contact: Tiffany Nicolella

P: 518-862-1090 x 3548 | E: Tiffany.Nicolella@nyserda.ny.gov

- ### On-Site Energy Manager Program

  Program description: NYSERDA's On-Site Energy Manager (OSEM) program offers a 75 percent cost-share for industrial and commercial facilities or multifamily buildings to hire a dedicated, full-time on-site energy manager. Projects may include operations and maintenance improvements, energy efficiency upgrades, water saving improvements, and more. The energy manager can be either a new permanent hire or a contractor. You may select a contractor from NYSERDA's current list of Flexible Technical Assistance (FlexTech) Consultants.

  Program Website: https://www.nyserda.ny.gov/all-programs/programs/On-site-energy-manager

  Program Contact:

  E: on-site-energy-manager@nyserda.ny.gov

- ### Community Thermal Systems

  Program Opportunity: Heat pumps are frequently installed to serve the needs of a single building. To leverage economy-of-scale and to expand clean energy options for customers who have insufficient footprint space to serve their own needs, heat pumps can be integrated with a network of distribution pipes to serve multiple buildings in a configuration referred to as Community Thermal or District Thermal.

  Community Thermal systems can address the needs of new construction projects as well as retrofits of existing buildings, and can be applicable to single-owner campuses such as:

  - Colleges/universities
  - Medical campuses
  - Residential complexes
  - Or even multi-owner nodes (such as downtown corridors).

  NYSERDA has been authorized to administer a $15 million program to support development and demonstration of low-carbon Community Thermal Systems installations.

  This program drives exploration of business models that can cost-effectively grow this market to scale through support for:

  - Scoping
  - Design
  - Construction

  NYSERDA has a total of $15,000,000 available under this PON and plans to award multiple contracts over multiple rounds. NYSERDA is accepting proposals in the following categories:

Category	Total NYSERDA Funds Available**	Maximum NYSERDA Funding Per Award	Total Project Cost Share Required
Category A: Site-Specific Scoping Study	$2,000,000	$100,000	Not Required
Category B: Site-Specific Design Study	$4,000,000	$500,000	50%

Category C: Site-Specific Implementation Project	$8,000,000	$4,000,000	50%
Category D: Market Studies/Best Practice Guidebooks	$1,000,000	$250,000	Not Required

Wendel, in collaboration with the University of Rochester, submitted an application to NYSERDA under this program in March of 2021. It is anticipated that NYSERDA will be making selections of winning proposals and announcing for the first round of applications sometime in May of 2021.

***NYSERDA reserves the right to reallocate funds among categories and to close any given category while keeping remaining categories open.*

Program Website: https://www.nyserda.ny.gov/Researchers-and-Policymakers/Clean-Heating-and-Cooling/Clean-Thermal-District-Systems

Program Contact:

P: 518-862-1090 Ext 3377 | E: Dana.Levy@nyserda.ny.gov

Rochester Gas & Electric (RG&E)

• Commercial and Industrial Rebate Program

Program description: The RG&E Commercial and Industrial Rebate Program is designed to help businesses save energy and money by offering rebates to make projects more affordable and shorten payback periods. Upgrading to newer energy efficient equipment can reduce operational costs and enhance the reliability, safety, comfort, and appearance of a business. Rebates are available for retrofits, add-ons, major renovation, and new construction projects.

The RG&E commercial and industrial rebate program is broken into two parts, Prescriptive Rebates and Custom Rebates.

Prescriptive Rebates:

Lighting

- Interior and exterior LED lamps and fixtures
- Lighting controls

HVAC & Plumbing

- Steam traps and steam trap surveys
- Pipe Insulation
- Unitary HVAC, heat pumps, split systems
- Boilers, furnaces and unit heaters
- Infrared heaters
- Water heaters
- Controls – DCV, thermostats, boiler reset
- Energy management system - guest room
- VFD's for fans and pumps
- Tune-ups – boilers and chillers

Process Systems

- Compressed air – VSD compressors, air dryers, zero-loss drains

Kitchen Equipment & Refrigeration

- Ovens
- Insulated holding cabinets
- Fryers
- Griddles
- Steamers
- Ice-makers
- Dishwashers
- Cooler and freezer door strips
- EC motors for refrigeration
- Controls - evaporator fan, anti-condensation

Prescriptive rebates are based on the specific systems being applied for and the rebate values are described on RG&E's website in their Rebate Catalogs.

Custom Rebates:

For projects not listed under the prescriptive programs but have energy savings, they may qualify under a custom rebate program. Examples of equipment that may qualify for a custom rebate include but are not limited to:

- Building envelope improvements
- Energy management systems
- Lighting and lighting controls (non-prescriptive)
- Laundry equipment
- Combined heat and power (CHP)
- Refrigeration system improvements
- Process related equipment
- Heat recovery
- Snow-making equipment

For custom rebates, the current incentive rates effective January 3, 2020 are: $0.13 per kWh saved and $1.50 per therm saved.

Program Website:
https://www.rge.com/wps/portal/rge/saveenergy/businesssolutions/commercialandindustrial/rebates

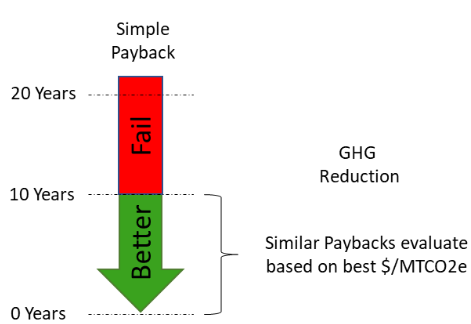
Program Contact: Franklin Energy

P: 888-316-8023 | E: clenergysavings@franklinenergy.com

STEP 4 | EVALUATING AND PRIORITIZING PROJECTS

UEM will evaluate and prioritize potential projects for energy savings against KFMs. The KFMs will consider several factors as defined in Step 2 and culminate with an effective simple payback for each opportunity. Each project will be evaluated against an effective simple payback of no more than 10 years. Projects with the lowest primary KFM will be prioritized first, subject to funding availability, logistics, and impact on reliability.

For individual projects, which do not pass the KFMs but have non-energy benefits or will be incorporated into larger building projects, additional capital can be provided by the facility or department to bring the project within the KFMs. Conversely the incremental cost associated with enhancement to an existing project, which is in development, may be considered, should the incremental cost and savings pass the KFM.



STEP 5 | EXECUTION PROCESS

STEP 5A | EXECUTION PROCESS OF UEM MANAGED PROJECTS

Design Phase

Once a project has been approved and funded for execution, UEM will generate design, specification, and construction documents in accordance with the University of Rochester Design Standards. As part of the execution phase, UEM will develop 50% and 90% design packages for key stakeholder reviews. The 50% design submission will include construction cost estimates based on either pricing obtained on past projects of a similar nature or from estimates provided by contractor walk-throughs. Savings calculations and analysis will be more rigorous than what was provided during the Investigation phase. Schematic plans and preliminary outline specs will also be included in the 50% package. UEM will submit the 50% design package for review so a determination can be made early on if the project should proceed with finalization of design. UEM will not proceed to development of the 90% until authorization and approval of the 50% is obtained by key stakeholders.

Upon approval of the 50% design package, UEM will develop and submit the 90% design package to key stakeholders for review. The 90% design package will include finalized savings analysis and calculations, updated installation labor and material costs, finalized plans and specs, documentation that may be required to secure a commitment for utility incentives, and the design and implementation requirements for future performance management and monitoring.

Upon approval of the 90% submission, UEM will then finalize installation costs and develop a construction cost proposal. The construction cost proposal represents submission of the final design (100% design). Installation costs included in the construction cost proposal will be, whenever possible, based on obtaining competitive pricing from at least three qualified bidders.

If this is not possible (in the case of building management control system upgrades) UEM will ensure that the pricing obtained is firm, final, and at fair market value (by making comparisons to similar work done in other buildings by either the same or alternative companies). When competitive bid pricing is possible, UEM will generally recommend the bidder that provides the best value to the University. Projects will not go out to bid until the bid list is reviewed and approved by UEM and key stakeholders.

Implementation Phase

Projects implemented under this program will vary in size from small to potentially large projects. UEM shall provide or obtain, as part of the Implementation phase, all services associated with the procurement, installation and commissioning of new equipment and systems based on the needs, size, and complexity of the project.

These services may include the following:

- CA Services - UEM or their designee will provide contract administration services as necessary during the construction phase of the project.
- CM Services - UEM or their designee will provide construction management services as necessary during the life cycle (i.e. pre-construction, construction) of the project. Based on the size and complexity of the project this may require a part-time or a full-time construction manager.
- Technical Support Services During Construction - UEM or their designee will provide technical support services during the construction period to support construction activities, as necessary.

- Technical Support Services During Start-up and Commissioning – UEM or their designee will provide technical support to oversee and assist with start-up, commissioning, and training.

UEM's responsibilities during Implementation may include:

- Construction sub-contractor, selection, and award with UR stakeholder review and approval
- Obtaining all required permits and approvals
- Securing utility incentives and facilitating final documentation and inspections
- Construction management and administration activities
- Commissioning and functional testing, including all associated documentation
- Ensuring all performance monitoring protocols and measurement tools are in place, active and effectively demonstrating savings
- Project close-out and turnover to facility operations personnel. This includes all as-builts, O&M manuals and other system/equipment documentation regarding operation, maintenance, and warranty
- Training of facility operations and building personnel

Based on the size and complexity of the project these UEM responsibilities may be delegated as appropriate.

Performance Management Phase

The intent of Performance Management is to provide the University with diagnostic tools for the purposes of maintaining and monitoring system efficiencies and performance post-implementation. The protocols and diagnostic tools must meet the requirements of the key stakeholders and any providers of incentives including but not limited to the electric and gas utility, Rochester Gas & Electric.

This will be addressed as early on as possible in the Identification and Design phases of the program so they can be identified, accepted, and designed prior to incorporation during the Implementation phase. The methodology employed will vary depending on the complexity of the energy saving measure, however the fundamental activities will most likely include:

- Utility Review and Acceptance: UEM will identify an appropriate methodology for on-going measurement and verification and obtain acceptance from both key stakeholders and Rochester Gas & Electric (for purposes of securing incentives) prior to the Implementation phase.
- Trending: During the Implementation phase, UEM will define which equipment, system trends and operating profiles shall be monitored for purposes of demonstrating on-going performance parameters. UEM will verify and document, during commissioning, that all trends are defined, archived, and accessible within the Building Management System.
- Reporting: UEM will define a format for concise reporting of performance for individual measures and aggregate projects. This may include designing quick view graphic displays, easily accessible from the EMIS, which provide a concise summary of performance data being monitored.
- Training: UEM will provide training to the Operations staff, as well as all primary stakeholders within each building, on use and interpretation.
- Building Level Performance: UEM will provide a projected range of building level energy use, by commodity, and perform a post construction analysis to demonstrate the actual savings captured due to the interactive effects of all measures implemented within a building.

STEP 5B | EXECUTION PROCESS OF UEM ASSISTED PROJECTS

Design Phase

UEM will assist non-UEM projects during the design phase by providing consulting support on energy efficient approaches and technologies that may be used to enhance a projects overall energy efficiency and carbon reduction.

UEM will also assist in applying for and obtaining grant, incentive, or rebate funds as appropriate for energy efficient technologies used in the project.

Implementation Phase

UEM will assist during the implementation phase by providing technical support on energy approaches and technologies as requested during construction, start-up and commissioning activities.

Performance Management Phase

The intent of Performance Management is to provide the University with diagnostic tools for the purposes of maintaining and monitoring system efficiencies and performance post-implementation. The protocols and diagnostic tools must meet the requirements of the key stakeholders and any providers of incentives including but not limited to the electric and gas utility, Rochester Gas & Electric.

This will be addressed as early on as possible in the Identification and Design phases of the program so they can be identified, accepted, and designed prior to incorporation during the Implementation phase. The methodology employed will vary depending on the complexity of the energy saving measure, however the fundamental activities will most likely include:

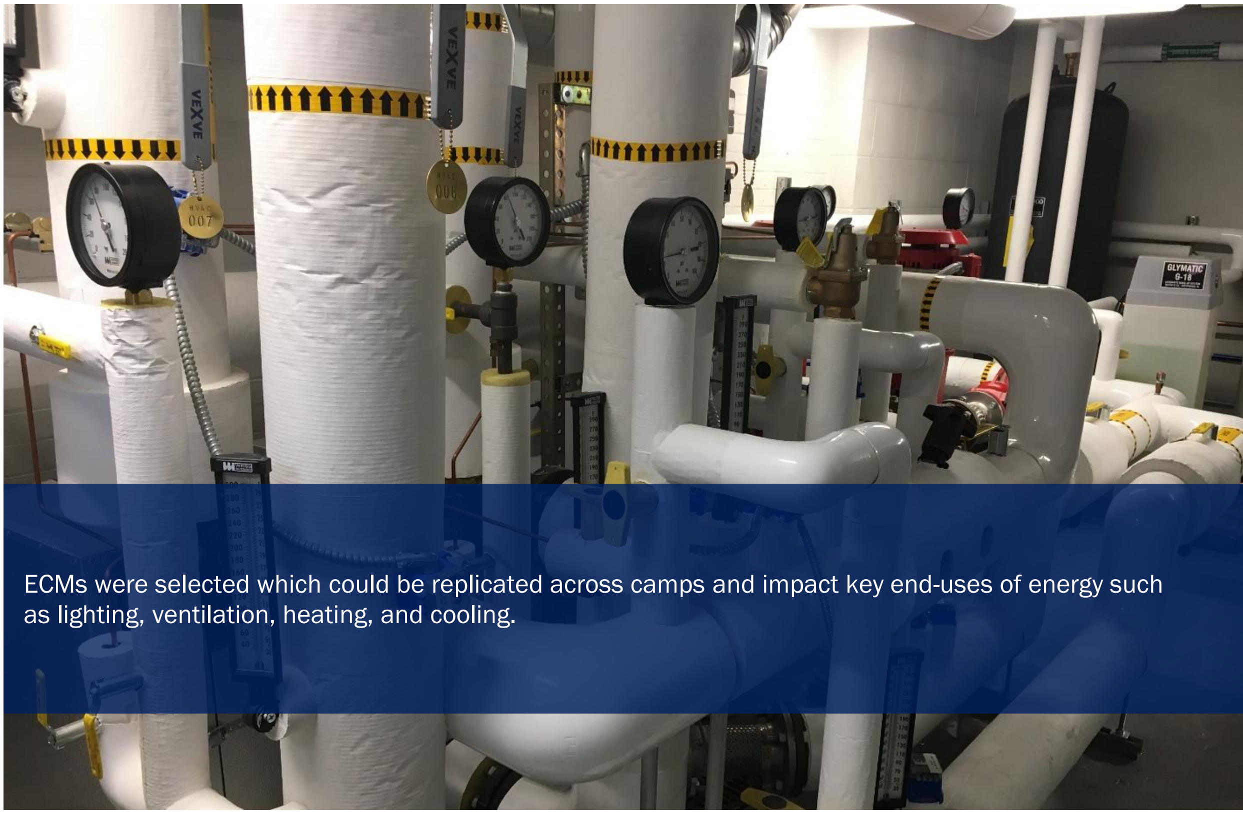
- Utility Review and Acceptance: UEM will identify an appropriate methodology for on-going measurement and verification and obtain acceptance from both key stakeholders and Rochester Gas & Electric (for purposes of securing incentives) prior to the Implementation phase.
- Trending: During the Implementation phase, UEM will define which equipment, system trends and operating profiles shall be monitored for purposes of demonstrating on-going performance parameters. UEM will verify and document, during commissioning, that all trends are defined, archived, and accessible within the Building Management System.
- Reporting: UEM will define a format for concise reporting of performance for individual measures and aggregate projects. This may include designing quick view graphic displays, easily accessible from the BMS, which provide a concise summary of performance data being monitored.
- Training: UEM will provide training to the Operations staff, as well as all primary stakeholders within each building, on use and interpretation.
- Building Level Performance: UEM will provide a projected range of building level energy use, by commodity, and perform a post construction analysis to demonstrate the actual savings captured due to the interactive effects of all measures implemented within a building.

Section D

Evaluation of Potential ECMs

Task 2

TASK 2 | EVALUATION OF POTENTIAL ECMS



ECMs were selected which could be replicated across camps and impact key end-uses of energy such as lighting, ventilation, heating, and cooling.

This section outlines Energy Conservation Measures (ECMs) within the UR buildings. To understand the potential cost / savings associated with ECMs, a strategy was developed by Wendel, UR and NYSERDA, to perform a detailed investigation on key ECMs for representative buildings and extrapolate those results across the other campus buildings (see section 6 for the extrapolation). The following ECMs were selected at the buildings indicated.

LIGHTING | Six (6) representative buildings were selected which have different building uses. Please see the table below for a list of the building. The lighting survey comprised of a review of reflective ceiling plans and a room-by-room walkthrough to confirm fixture types. Lighting loggers were placed in select spaces. This coupled with facility staff interviews were used to establish run hours. ASHRAE Level 2 calculations were performed, and cost estimates were developed based on recent pricing for material and labor from similar projects. Results from the six (6) buildings will determine an existing and proposed watts per square foot as well as cost per square foot. This data was used to extrapolate the savings and cost across the remaining campus buildings.

Building Abbreviation	Type
Ambulatory Care Facility	Hospital
Fauver	Office/Sports
Kornberg	Lab/Research
Schlegel Hall	Classroom/Office
Wallis	Office
Wilder	Dorm

STEAM TO HOT WATER CONVERSION | ON HOLD (because input study was delayed due to Covid-19)

LABORATORY HVAC SYSTEMS | Three (3) representative lab buildings were selected. Please see the table below for a list of the buildings. Wendel performed a detailed review of each of the selected laboratory facilities, and working collaboratively with UR EH&S staff, assessed two scenarios for target air change rates. Wendel evaluated the energy savings potential of reducing air flow using ASHRAE Level 2 HVAC calculation models. Cost estimates were developed based on recent pricing for material and labor from similar projects and extrapolated on a square footage basis to the rest of campus.

Building Abbreviation	Type
Del Monte	Lab/Research
GCHaS	Classroom/Lab/Office
Kornberg	Lab/Research

HVAC RETRO-COMMISSIONING PLAN| Three (3) representative lab buildings were selected by using the existing metering system to identify large simultaneous heating and cooling loads and higher than anticipated EUIs. Please see the table below for a list of the buildings. Wendel performed a scoping survey to provide preliminary justification for investment in a Retro-Commissioning Project. Wendel evaluated the energy savings potential using rule of thumb estimates. Cost Estimates were developed based on recent pricing for material and labor from similar projects and extrapolated on a square footage basis to the rest of campus.

Building	Type
Rush Rhees Library	Library
Danforth Dining Hall	Dining, Kitchens
Fredrick Douglass Commons	Classrooms, Dining, Kitchens

HEAT RECOVERY SYSTEMS | Three (3) representative lab buildings were selected by using the existing metering system to identify large simultaneous heating and cooling loads. Please see the table below for a list of the buildings. Wendel evaluated options for a Heat Recovery Chiller or Heat Pump. Wendel evaluated the energy savings potential using ASHRAE Level 2 HVAC calculation models. Cost Estimates were developed based on recent pricing for material and labor from similar projects and extrapolated on a square footage basis to the rest of campus.

Building Abbreviation	Type
Del Monte	Lab/Research
GCHaS	Classroom/Lab/Office
KMRB	Lab/Research

PHOTOVOLTAIC SYSTEMS (PV) | Wendel reviewed information regarding roof ages and evaluate the cost benefit of providing a PV system on roofs as they are replaced. The analysis used roof area, assumptions for spacing and available percentage roof space, as well as PV Watts energy productions estimates for one building were completed. The results from the one building were then proportioned to all of potential solar buildings. Cost estimates based on current typical costs per Watt installed.

Wendel also performed a deep analysis for one building currently in design for a major retrofit project. Wendel assessed current option for financial assistance and provide production estimates, opinion of probable costs and a summary of currently available rebate programs.

UNIVERSITY OF ROCHESTER

ENERGY CONSERVATION MEASURE (ECM)

PROJECT IMPACT SUMMARY

for the ECMs Surveyed and Recommended

	Plant Level Summary			
	Building Level Energy Savings			
A	Electrical Energy Savings	1,093	mmBtu/Year	= E x .003412
B	Chilled Water Savings	19,983	mmBtu/Year	from detailed summary recommended total
C	Steam Savings	29,244	mmBtu/Year	from detailed summary recommended total
D	**Total Energy Savings**	**50,321**	**mmBtu/Year**	
	Building Level Utility Savings			
E	Electrical Energy Savings	320,440	kWh/Year	from detailed summary recommended total
F	Chilled Water Savings	1,665,278	Ton-Hour/Year	= B x 1,000,000 / 12,000
G	Steam Savings	24,492	klbs/Year	= C x 1,000,000 / 1,194(BTU/lb) / 1,000
H	Water Savings	-	kGal/Year	from detailed summary recommended total
	Purchased Utility Savings			
I	Electrical Energy Savings	851,413	kWh/Year	= E (F x 49% from electric chillers x .916kW/ton)
J	Natural Gas Savings	47,995	mmBtu/Year	= C / 67% [HTG eff. (F x 51% from electric steam x .0052mmBtu/ton)
K	**Total Energy Savings**	**50,900**	mmBtu/Year	= I x .003412 J
L	**Cost to Savings Ratio (Cost/mmBtu)**	**$98**		cost from detailed summary recommended total / K
	Building Cost Savings ($)			
M	Electrical Dollar Savings	$28,840	Per Year	= E x Building Electric Rate
N	Chilled Water Dollar Savings	$435,748	Per Year	= F x Building Chilled Water Rate
O	Steam Dollar Savings	$426,960	Per Year	= G x Building Steam Rate
P	**Simple Payback**	**6**	Years	cost from detailed summary recommended total / (M N O)
	Purchased Utility Cost Savings ($)			
Q	Electrical Dollar Savings	$55,342	Per Year	= I x Utility Electric Rate
R	Natural Gas Savings	$154,065	Per Year	= J x Utility Natural Gas Rate
S	Avoided Carbon Tax	$132,396	Per Year	= W x Y
T	**Simple Payback**	**15**	Years	cost from detailed summary recommended total / (Q R S)
	Impact on CO2e Emissions			
U	Electrical Emissions Savings	114	MT CO2e	= I /1000 x 295.94 lbs/MWh x 0.000453592 [lbs to MT
V	Natural Gas Emissions Savings	2,534	MT CO2e	= J x 116.38 lbs/mmBtu x 0.000453592 [lbs to MT
W	**Total Emissions Savings**	**2,648**	MT CO2e	= U V
X	**Cost to Savings Ratio (Cost/CO2e)**	**$1,885**		cost from detailed summary recommended total / (U)
Y	Carbon Tax Assumed to be:	$50.00	Per MT CO2e	

Table 1-2

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM)
ENERGY SAVINGS SUMMARY
10/4/2021

Selection[4] (Y)es (N)o (O)ption	Line No.	Building	Energy Conservation Measure	Total Measure Cost[1] ($)	Building Electric Savings (kWh)	Building Chilled Water Savings (mmBtu)	Building Steam Savings (mmBtu)	Total Building Savings (mmBtu)	Emissions Reduction (MT of CO_2)[5]	Cost / mmBtu Saved	Line No.
Y	1	Kornberg	Lighting Upgrades | Option A	$850,838	612,702	65	-331	1,825	57	$466	1
O	2	Kornberg	Lighting Upgrades | Option B	$1,145,668	784,624	84	-424	2,337	73	$490	2
O	3	ACF	Lighting Upgrades | Option A	$656,793	657,653	30	-444	1,830	54	$359	3
Y	4	ACF	Lighting Upgrades | Option B	$673,351	790,176	36	-533	2,198	65	$306	4
N	5	Wilder Hall	Lighting Upgrades | Option A	$75,937	16,598	0	-10	47	1	$1,628	5
O	6	Wilder Hall	Lighting Upgrades | Option B	$75,937	16,598	0	-10	47	1	$1,628	6
N	7	Fauver Stadium	Lighting Upgrades | Option A	$31,694	17,791	2	-10	53	2	$598	7
O	8	Fauver Stadium	Lighting Upgrades | Option B	$47,210	18,587	2	-10	55	2	$853	8
N	9	Schlegel Hall	Lighting Upgrades | Option A	$214,466	134,945	14	-73	402	13	$534	9
O	10	Schlegel Hall	Lighting Upgrades | Option B	$230,651	140,276	15	-76	418	13	$552	10
Y	11	Wallis Hall	Lighting Upgrades | Option A	$150,553	98,975	11	-53	295	9	$511	11
O	12	Wallis Hall	Lighting Upgrades | Option B	$189,192	109,605	12	-59	326	10	$580	12
O	13	Kornberg	Laboratory Airflow Optimization | Option A	$396,668	44,444	1,108	1,443	2,703	136	$147	13
Y	14	Kornberg	Laboratory Airflow Optimization | Option B	$396,668	48,514	1,233	1,703	3,102	159	$128	14
O	15	Del Monte	Laboratory Airflow Optimization | Option A	$234,246	122,805	2,762	3,537	6,717	337	$35	15
Y	16	Del Monte	Laboratory Airflow Optimization | Option B	$234,246	124,439	2,813	3,619	6,856	344	$34	16
O	17	BMEO	Laboratory Airflow Optimization | Option A	$183,200	58,553	398	509	1,107	54	$166	17
Y	18	BMEO	Laboratory Airflow Optimization | Option B	$183,200	88,370	626	884	1,811	91	$101	18
Y	19	Kornberg	Heat Recovery Heat Pump	$922,885	-770,069	5,662	8,173	11,207	626	$82	19
Y	20	Del Monte	Heat Recovery Heat Pump	$752,029	-557,929	4,062	5,876	8,034	449	$94	20
Y	21	BMEO	Heat Recovery Heat Pump	$572,213	-448,516	3,273	4,733	6,476	362	$88	21
O	22	Eastman	Eastman Campus Rooftop Solar	$1,066,718	738,717	0	0	2,521	99	$423	22
O	23	Medical	Medical Campus Rooftop Solar	$9,739,809	5,905,583	0	0	20,150	793	$483	23
O	24	River	River Campus Rooftop Solar	$7,947,170	4,818,644	0	0	16,441	647	$483	24
O	25	South	South Campus Rooftop Solar	$3,103,412	2,148,787	0	0	7,332	288	$423	25
O	26	DDH	Retrocommissioning | Best Case	$18,200	41,050	140	281	561	30	$32	26
Y	27	DDH	Retrocommissioning | Median	$24,400	35,919	123	246	491	26	$50	27
O	28	DDH	Retrocommissioning | Worse Case	$30,600	30,788	105	211	421	22	$73	28
O	29	RRL	Retrocommissioning | Best Case	$78,380	394,099	2,037	5,038	8,420	480	$9	29
Y	30	RRL	Retrocommissioning | Median	$165,130	295,947	1,413	3,473	5,896	334	$28	30
O	31	RRL	Retrocommissioning | Worse Case	$251,880	197,795	789	1,908	3,372	189	$75	31
O	32	FDC	Retrocommissioning | Best Case	$36,600	2,390	763	1,679	2,450	144	$15	32
Y	33	FDC	Retrocommissioning | Median	$64,900	1,912	668	1,454	2,129	125	$30	33
O	34	FDC	Retrocommissioning | Worse Case	$93,200	1,434	573	1,230	1,808	106	$52	34
				Total Measure Cost[1] ($)	Annual Electric Savings (kWh)	Annual Chilled Water Savings (mmBtu)	Annual Fuel Savings (mmBtu)	Total Annual Savings (mmBtu)	Emissions Reduction (mT of CO_2)	Cost / mmBtu Saved	
			Total Selected Project[4]:	$4,990,412	320,440	19,983	29,244	50,321	2,648	$99	
			Project Contingency (included in Total Measure Cost)[2]:	$191,002							
NOTES:			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	$191,002							

1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below: Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by the Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Emissions savings based on rates outlined in section 2.

Table 1-3

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM)
PAYBACK SUMMARY | BUILDING UTILITY COST
10/4/2021

Selection[4] (Y)es (N)o (O)ption	Building	Line No.	Energy Conservation Measure	Total Measure Cost[1] ($)	Annual Electric Savings[5] ($)	Annual Chilled Water Savings[5] ($)	Annual Steam Savings[5] ($)	Annual O&M Savings ($)	Total Annual Savings[5] ($)	Simple Payback Period	Purchased Utility Electric Savings[6]	Purchased Utility Nat. Gas Savings[6]	Purchased Utility Payback Period[7]	Line No.
Y	Kornberg	1	Lighting Upgrades | Option A	$850,838	$55,143	$1,422	-$4,831	$8,391	$60,126	14.2	$39,938	-$1,537	22.2	1
O	Kornberg	2	Lighting Upgrades | Option B	$1,145,668	$70,616	$1,821	-$6,186	-$1,146	$65,105	17.6	$51,145	-$1,968	23.3	2
O	ACF	3	Lighting Upgrades | Option A	$656,793	$59,189	$646	-$6,481	$3,036	$56,390	11.6	$42,799	-$2,103	16.1	3
Y	ACF	4	Lighting Upgrades | Option B	$673,351	$71,116	$776	-$7,787	$5,628	$69,732	9.7	$51,423	-$2,527	13.8	4
N	Wilder Hall	5	Lighting Upgrades | Option A	$75,937	$1,494	$10	-$153	-$180	$1,172	64.8	$1,080	-$50	73.7	5
O	Wilder Hall	6	Lighting Upgrades | Option B	$75,937	$1,494	$10	-$153	-$180	$1,172	64.8	$1,080	-$50	73.7	6
N	Fauver Stadiun	7	Lighting Upgrades | Option A	$31,694	$1,601	$41	-$140	$71	$1,574	20.1	$1,160	-$45	28.4	7
O	Fauver Stadiun	8	Lighting Upgrades | Option B	$47,210	$1,673	$43	-$147	-$354	$1,215	38.9	$1,212	-$47	40.5	8
N	Schlegel Hall	9	Lighting Upgrades | Option A	$214,466	$12,145	$313	-$1,064	-$176	$11,218	19.1	$8,796	-$339	25.4	9
O	Schlegel Hall	10	Lighting Upgrades | Option B	$230,651	$12,625	$326	-$1,106	$91	$11,936	19.3	$9,144	-$352	26.2	10
Y	Wallis Hall	11	Lighting Upgrades | Option A	$150,553	$8,908	$230	-$780	$1,251	$9,608	15.7	$6,452	-$248	24.3	11
O	Wallis Hall	12	Lighting Upgrades | Option B	$189,192	$9,864	$254	-$864	$165	$9,419	20.1	$7,144	-$275	27.5	12
O	Kornberg	13	Laboratory Airflow Optimization | Option A	$396,668	$4,000	$24,164	$21,072	$0	$49,236	8.1	$4,803	$7,690	31.8	13
Y	Kornberg	14	Laboratory Airflow Optimization | Option B	$396,668	$4,366	$26,886	$24,867	$0	$56,120	7.1	$5,283	$9,022	27.7	14
O	Del Monte	15	Laboratory Airflow Optimization | Option A	$234,246	$11,052	$60,221	$51,634	$0	$122,907	1.9	$12,752	$18,876	7.4	15
Y	Del Monte	16	Laboratory Airflow Optimization | Option B	$234,246	$11,200	$61,333	$52,838	$0	$125,371	1.9	$12,946	$19,307	7.3	16
O	BMEO	17	Laboratory Airflow Optimization | Option A	$183,200	$5,270	$8,671	$7,434	$0	$21,374	8.6	$4,493	$2,718	25.4	17
Y	BMEO	18	Laboratory Airflow Optimization | Option B	$183,200	$7,953	$13,648	$12,906	$0	$34,507	5.3	$6,825	$4,672	15.9	18
Y	Kornberg	19	Heat Recovery Heat Pump	$922,885	-$69,306	$123,458	$119,320	-$3,150	$170,321	5.4	-$40,276	$43,110	325.6	19
Y	Del Monte	20	Heat Recovery Heat Pump	$752,029	-$50,214	$88,576	$85,788	-$2,520	$121,631	6.2	-$29,250	$30,989	432.4	20
Y	BMEO	21	Heat Recovery Heat Pump	$572,213	-$40,366	$71,362	$69,109	-$1,890	$98,215	5.8	-$23,501	$24,964	391.1	21
O	Eastman	22	Eastman Campus Rooftop Solar	$1,066,718	$66,485	$0	$0	-$4,048	$62,436	17.1	$48,017	$0	22.2	22
O	Medical	23	Medical Campus Rooftop Solar	$9,739,809	$531,503	$0	$0	-$32,362	$499,140	19.5	$383,863	$0	25.4	23
O	River	24	River Campus Rooftop Solar	$7,947,170	$433,678	$0	$0	-$26,406	$407,272	19.5	$313,212	$0	25.4	24
O	South	25	South Campus Rooftop Solar	$3,103,412	$193,391	$0	$0	-$11,775	$181,616	17.1	$139,671	$0	22.2	25
O	DDH	26	Retrocommissioning | Best Case	$18,200	$3,695	$3,062	$4,100	$0	$10,856	1.7	$2,911	$1,443	4.2	26
Y	DDH	27	Retrocommissioning | Median	$24,400	$3,233	$2,679	$3,587	$0	$9,499	2.6	$2,547	$1,263	6.4	27
O	DDH	28	Retrocommissioning | Worse Case	$30,600	$2,771	$2,296	$3,075	$0	$8,142	3.8	$2,183	$1,082	9.4	28
O	RRL	29	Retrocommissioning | Best Case	$78,380	$35,469	$44,411	$73,560	$0	$153,440	0.5	$29,134	$25,549	1.4	29
Y	RRL	30	Retrocommissioning | Median	$165,130	$26,635	$30,810	$50,708	$0	$108,154	1.5	$21,677	$17,618	4.2	30
O	RRL	31	Retrocommissioning | Worse Case	$251,880	$17,802	$17,210	$27,856	$0	$62,868	4.0	$14,220	$9,688	10.5	31
O	FDC	32	Retrocommissioning | Best Case	$36,600	$215	$16,648	$24,509	$0	$41,372	0.9	$1,474	$8,572	3.6	32
Y	FDC	33	Retrocommissioning | Median	$64,900	$172	$14,567	$21,235	$0	$35,974	1.8	$1,278	$7,432	7.5	33
O	FDC	34	Retrocommissioning | Worse Case	$93,200	$129	$12,486	$17,961	$0	$30,576	3.0	$1,082	$6,291	12.6	34
			Total Selected Project[4]:	**$4,990,412**	**$28,840**	**$435,748**	**$426,960**	**$7,710**	**$899,257**	**5.5**	**$55,342**	**$154,065**	**23.8**	
			Project Contingency (included in Total Measure Cost)[2]:	**$191,002**										
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	**$191,002**										

1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below: Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Cost savings based on the by BUILDING UTILITY RATES are defined as the fully burdened utility rate, paid by the buildings, please refer to Section 2 for additional details regarding the applied utility rates.
6. Cost savings based on the by PURCHASED UTILITY RATES are defined as the rates paid by UR to the utility service providers, please refer to Section 2 for additional details regarding the applied utility rates.
7. PURCHASED UTILITY PAYBACK PERIOD this is the payback period based on the cost sayings applying the PURCHASED UTILITY RATES

Section D

Evaluation of Potential ECMs

Lighting

Lighting Improvements

ECM# 01

This side-by-side comparison of a lighting retrofit. The left shows an existing system, the right shows a comprehensive retrofit lighting solution which provides:

- 50% reduction in lighting energy consumption.
- Reduced maintenance costs.
- Integrated occupancy and daylight sensors.
- Retrofit approach with modern appearance.
- Less capital cost compared to a full fixture replacement.

Lighting projects are often the engine that drive energy conservation projects. Typical lighting retrofit projects will provide a 50% reduction in energy usages associated with lighting systems. Savings can be further enhanced by incorporating advance lighting controls such as occupancy sensors, vacancy sensors and daylighting harvesting.

A BASE LIGHTING PROJECT will address lighting opportunities by leveraging low cost retrofit solutions to reduce energy and O&M costs. The benefit of this approach is the savings generated by the lighting improvements, which can be used to offset the cost of more expensive improvements (such as HVAC upgrades). The trade-off is the existing fixtures are reused without any improvements to aesthetics or controls.

Conversely, many Universities have requested a VALUE-ADD LIGHTING PROJECT and the market has responded with many manufacturers now providing retrofit kits that will upgrade fixtures while also improving aesthetics and controls. The trade-off here is that these improvements typically are more expensive, leaving less capital for other improvements.

It has been our experience that most projects balance both a BASE LIGHTING PROJECT and a VALUE-ADD LIGHTING PROJECT approach, where through collaboration with stakeholder's areas such as mechanical rooms will only utilize a BASE LIGHITNG PROJECT solution, while labs and office may utilize a VALUE-ADD LIGHTING PROJECT solution. We believe the University will likely leverage some variation of both solutions as projects are developed across the campus.

INVESTIGATION

Wendel evaluated six (6) University of Rochester buildings to investigate the existing lighting systems and determine opportunities to save energy. The six buildings where selected by the University and Wendel based on the following criteria:

- Differing use types that which are representative of the major space types found within the University.
- Buildings that are accessible
- Buildings with an area less than 200,000 sqft.

A lighting survey was performed by reviewing reflective ceiling plans and a walkthrough (partial room by room) to confirm existing fixture types, quantities and lighting controls. During the survey, quantities and conditions of existing lighting fixtures were documented. The current level of energy efficiency was evaluated, and upgrades were identified.

INVESTIGATION APPROACH

Wendel conducted a survey of the lighting system to identify fixture types, assess type of lighting system, quantify the number of each fixture type, assess space types, and run hours. Wendel performed field surveys of all accessible spaces. We were not able to enter high risk laboratories or each residence room. In these instances, we will use available drawings and nearby representative spaces to extrapolate fixture counts to those spaces. These site visits were done in collaboration with the facility staff. We utilized lighting loggers to determine operating schedules and control. All captured data was incorporated into the baseline energy model to simulate existing building conditions and will incorporate the system's effects on other building system's consumption.

Map Ref.	Campus	Building Name	Building Type	Area	% LED
1	Medical Campus	Kornberg	Lab Research	235,914	<5%
2	Medical Campus	Ambulatory Care Facility (ACF)	Hospital	224,609	<5%
3	River Campus	Wilder Hall	Dorm	78,822	~30%
4	River Campus	Fauver Stadium	Office/Sports	63,097	~70%
5	River Campus	Schlegel & Gleason Hall	Classroom/Office	115,832	~20%
6	River Campus	Wallis Hall	Office	49,598	~5%

Table E1: Building Information

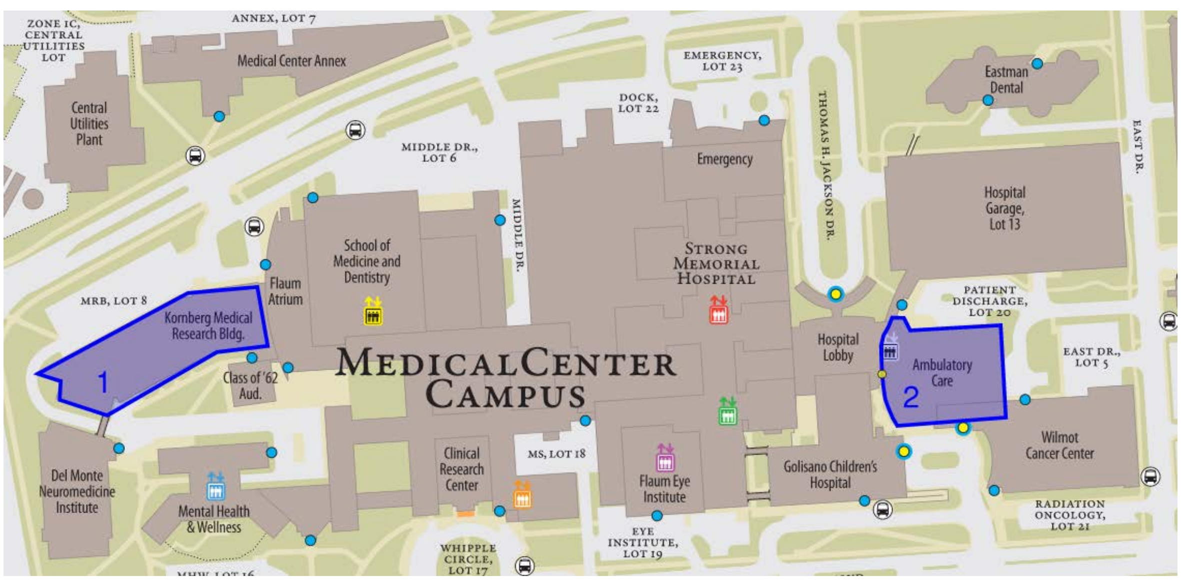


Figure E1: Buildings for Lighting Study on Medical Campus Map

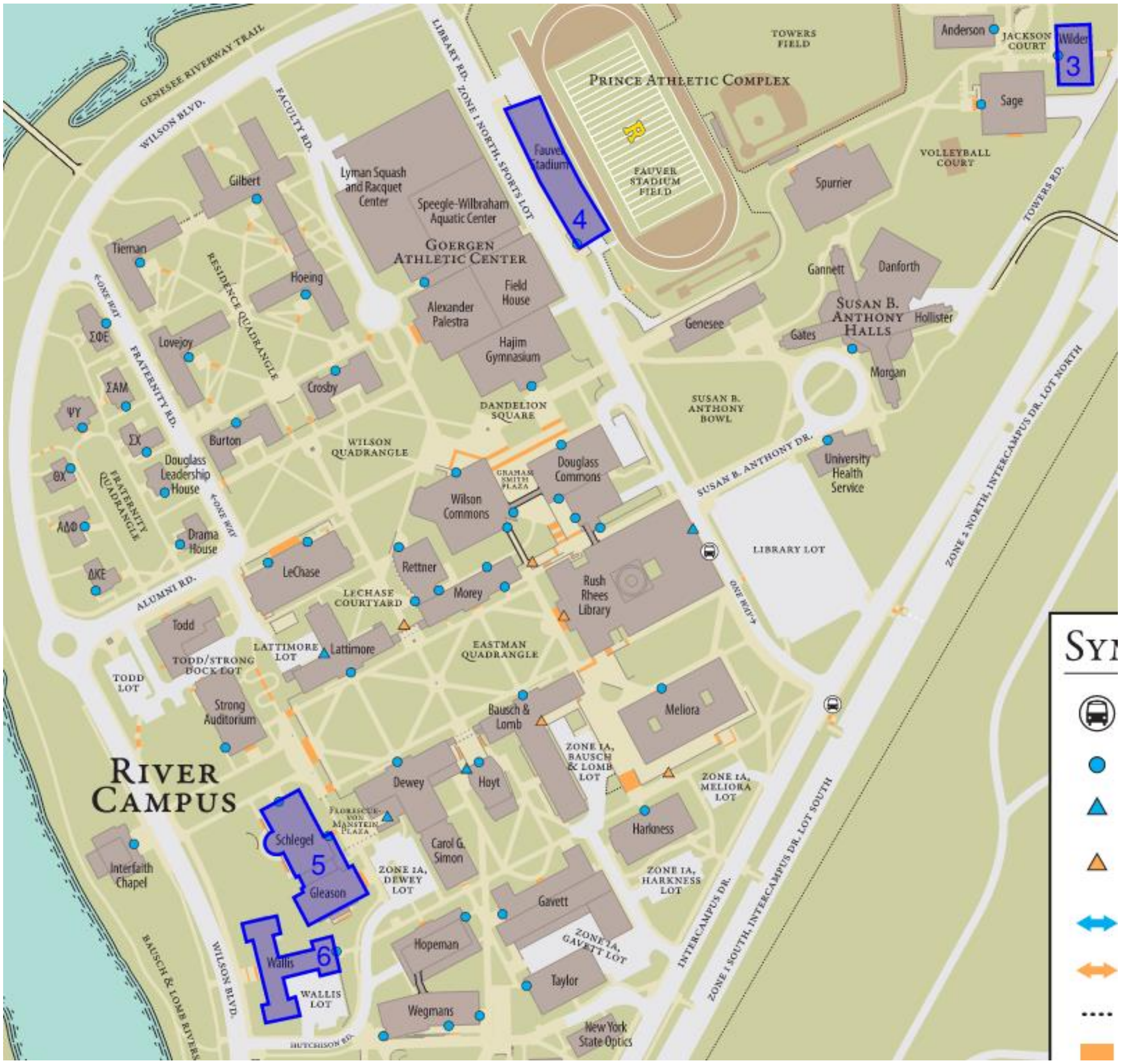


Figure E2: Buildings for Lighting Study on River Campus

EXISTING CONDITIONS

Kornberg Medical Research Building is a five (5) story building containing research laboratories and offices. The facility has several ceiling types including open, drop and drywall with drop ceilings being the most widespread.

Lighting fixtures at the facility primarily consist of two or four 4-foot T8 fluorescent linear tubes housed in recessed troffers or box fixtures in lab spaces and restrooms. Offices utilize two (2) T8 fluorescent U-bend tubes housed in 2x2 recessed troffers. Hallways are lit by 4-foot T8 fluorescent linear tubes in multiple different fixture types, including pendant box fixtures, wall mounted fixtures utilizing direct/indirect lighting and recessed troffers along the perimeter of the corridors. Recessed can lights utilizing two (2) pin based compact fluorescent lamps were also found thought the research building.

There is a mixture of manual and automatic lighting controls. Lab spaces typically have manual on/off switches. Offices and restrooms utilize wall mounted occupancy sensors that turn on when the space becomes occupied.

Ambulatory Care facility is a seven (7) story building with a penthouse, its primary function is as a hospital. The facility has several ceiling types including open, drop and drywall with drop ceilings being the most widespread.

Lighting fixtures at the facility utilize 4-foot linear fluorescent lamps(2 to 4 per fixture), or pin base compact fluorescent lamps. The fixture types at the facility vary by space. Offices and patient care rooms have troffer fixtures and recessed can fixtures. Restrooms have wall mounted fixtures.

There is a mixture of manual and automatic lighting controls. Labs, exam rooms, work rooms and procedure rooms typically have manual on / off switches. Offices utilize a mix of manual switching and wall mounted occupancy sensors and corridors are controlled by ceiling mounted occupancy sensors.

Wilder Hall is a ten (10) story building containing dormitory suites for student living. A mixture of different ceiling types exists including open ceilings in the basement, drop ceiling in offices and common areas, and spline ceiling found sporadically.

The first floor offices, hallways, and common areas have been upgraded to LED fixtures. Each floor has an elevator lobby, a kitchen and a trash room. All lighting in these common areas have been upgraded to LED lamps or fixtures. Stairwell lighting has been updated to LED wafers mounted to the walls. Dorm suites were occupied during the site visit, however there was access to one suite. This suite was found to have four (4) square canopy lights in the hallways, and fluorescent T8 linear lamps in the bathroom.

Common areas have a mixture of on/off switches and automatic lighting controls. Dorm lighting is controlled by on/off switches.

Fauver Stadium is a three (3) story building containing offices and athletic facilities. The facility has several ceiling types including open, drop and drywall.

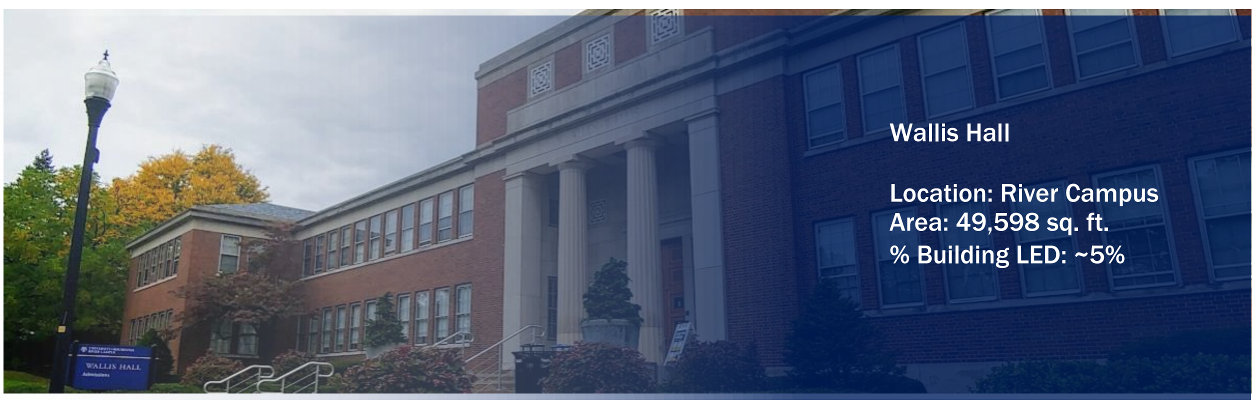
Majority of this building has already been converted to LED. Lighting fixtures at the facility utilize 4-foot linear fluorescent lamps, 2 to 4 per fixture. The fixture types and mounting style vary by space.

There is a mixture of manual and automatic lighting controls. Corridors and common areas utilize occupancy sensors. Offices utilize a mix of manual switching and wall mounted occupancy sensors.

Schlegel Hall a four (4) story building that contains lecture halls, offices and seminar rooms. The southern part of the building is named Gleason Hall, which also contains lecture halls and offices. The facility has several ceiling types including drop, drywall, and spline.

This building has a wide variety of luminaire fixtures. Offices generally contain two to four 4-foot T8 fluorescent linear tubes housed in recessed troffer fixtures. Lecture halls utilize T8 fluorescent linear indirect lighting above a parabolic ceiling, and recessed fixtures along the perimeter of the room. Recessed can lights utilizing one to two pin based compact fluorescent lamps are commonly found in hallways and classrooms.

There is a mixture of manual and automatic lighting controls. Most offices utilize occupancy sensors. Lecture halls have manual on/off switches that control specific light fixtures.



Wallis Hall a three (3) story building that contains offices including the University Presidential Office. The facility has a mixture of drop ceiling and spline ceiling.

This building has a wide variety of lighting fixtures. Lighting fixtures at the facility utilize 4-foot linear fluorescent lamps (2 to 4 per fixture) or pin base compact fluorescent lamps.

Offices utilize a mix of manual on/off switching and occupancy sensors.

PROPOSED MODIFICATIONS:

The recommended lighting upgrade focuses on optimizing the current lighting system by replacing or retrofitting less efficient fixtures. For the purposes of this study, two options were evaluated.

The first option, BASE LIGHTING PROJECT, includes mostly lamp replacements, which is typically more cost effective than new fixtures. Under a LED tube retrofit condition, the existing fixture body is left in place, the ballast is removed, and the internal components are replaced with energy efficient Type-C LED tubes with remote drivers. A new fixture is only recommended in this option if a fixture was noticed to be in poor condition. With a retrofit, significant energy savings can be realized at a much lower cost than a complete fixture replacement.

The second option, VALUE-ADD LIGHTING PROJECT, includes retrofit kits and new fixtures. Under Option 2, retrofit solutions are proposed for majority of recessed fixtures, while new fixtures are recommended for surface or pendant mounted interior fixtures and all exterior fixtures. Lamp replacement is only recommended if a fixture was in excellent condition, if the fixture was decorative in nature, or an uncommon fixture that seemed to have been specifically chosen for the space.

For both options, wall mounted occupancy sensors are recommended in offices, and ceiling mounted occupancy sensors are recommended in restrooms and classrooms that do not currently have them. Occupancy sensors are not recommended in classrooms with specific lighting controls.

We have summarized the lighting options with a table showing the common fixtures, as well as pictures of existing conditions as well as suggestions for options 1 and option 2.

DESIGN & CONSTRUCTION CONSIDERATIONS

The intent of the ECM is to reduce the electrical energy consumption of the overall lighting system, while providing an aesthetically pleasing lighting plan that will maintain or improve the working environment for its occupants.

- The proposed upgrades will follow industry standard guidelines to ensure that proper lighting levels are maintained for the various illuminated areas, while maximizing the energy efficiency of the lighting system. These lighting levels have been selected based on criteria established by the Illuminating Engineering Society (IES).
- Retrofits may require access above a drop ceiling. Therefore, these improvements may require testing of ceiling tiles and fire proofing to verify the absence of any potential asbestos containing material (ACM) behind the drop ceiling.
- Lens covers will be cleaned and reused. Damaged lens covers will be replaced in kind.
- Daylight harvesting may be required per New York State Energy Code depending on the level of alteration.
- New fixtures, located in place of existing fixtures, in suspended ceilings, may require additional supports per current codes.
- Emergency power for egress lighting is assumed to be provided by an emergency circuit powered by the building's emergency generators. Actual emergency lighting will need to be confirmed relative to requirements of NFPA 101.
- It is recommended that sample lighting be installed during the design to review color temperature and illumination prior to final design.

OPERATION & MAINTENANCE IMPACT

The longer service life of LEDs will reduce both capital costs and maintenance time, allowing personnel to concentrate on maintaining critical equipment. Maintenance savings are presented and reflect annual material cost savings only. Savings achieved from:

- Longer life of LED lamps

ENERGY IMPACT

The proposed improvements save energy by replacing the existing lighting sources (lamps) with new lighting sources (LED lamps) which use less input energy (watts) to produce light (lumens). Additionally, sensors, controls and dimming systems further reduce the runtime and/or load of the lighting system. The fundamental intent is to provide the same amount of light, when needed, with less input energy.

STUDENT / OCCUPANT IMPACT

Lighting can have many positive impacts on student health and well-being. Some of the benefits of LED lighting in schools are the improvements of school safety and the reduction of eye strain and other difficulties associated with lighting. Installing newer LED light fixtures can reduce the risk of exposure to harmful contaminants such as Polychlorinated Biphenyls (PCBs).

Table 1-4

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM) - LIGHTING
ENERGY SAVINGS SUMMARY
10/4/2021

Selection[4] (Y)es (N)o (O)ption	Line No.	Building	Energy Conservation Measure	Total Measure Cost[1] ($)	Building Electric Savings (kWh)	Building Chilled Water Savings (mmBtu)	Building Steam Savings (mmBtu)	Total Building Savings (mmBtu)	Emissions Reduction (MT of CO_2)[5]	Cost / mmBtu Saved	Line No.
Y	1	Kornberg	Lighting Upgrades | Option A	$850,838	612,702	65	-331	1,825	57	$466	1
O	2	Kornberg	Lighting Upgrades | Option B	$1,145,668	784,624	84	-424	2,337	73	$490	2
O	3	ACF	Lighting Upgrades | Option A	$656,793	657,653	30	-444	1,830	54	$359	3
Y	4	ACF	Lighting Upgrades | Option B	$673,351	790,176	36	-533	2,198	65	$306	4
N	5	Wilder Hall	Lighting Upgrades | Option A	$75,937	16,598	0	-10	47	1	$1,628	5
O	6	Wilder Hall	Lighting Upgrades | Option B	$75,937	16,598	0	-10	47	1	$1,628	6
N	7	Fauver Stadium	Lighting Upgrades | Option A	$31,694	17,791	2	-10	53	2	$598	7
O	8	Fauver Stadium	Lighting Upgrades | Option B	$47,210	18,587	2	-10	55	2	$853	8
N	9	Schlegel Hall	Lighting Upgrades | Option A	$214,466	134,945	14	-73	402	13	$534	9
O	10	Schlegel Hall	Lighting Upgrades | Option B	$230,651	140,276	15	-76	418	13	$552	10
Y	11	Wallis Hall	Lighting Upgrades | Option A	$150,553	98,975	11	-53	295	9	$511	11
O	12	Wallis Hall	Lighting Upgrades | Option B	$189,192	109,605	12	-59	326	10	$580	12
				Total Measure Cost[1] ($)	Annual Electric Savings (kWh)	Annual Chilled Water Savings (mmBtu)	Annual Fuel Savings (mmBtu)	Total Annual Savings (mmBtu)	Emissions Reduction (mT of CO_2)	Cost / mmBtu Saved	
			Total Selected Project[4]:	$1,674,741	1,501,853	111	-918	4,318	131	$388	
			Project Contingency (included in Total Measure Cost)[2]:	$60,900							
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	$60,900							

NOTES:

1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below: Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by the Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Emissions savings based on rates outlined in section 2.

Table 1-5

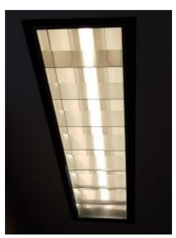
UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM) - LIGHTING
PAYBACK SUMMARY | BUILDING UTILITY COST 10/4/2021

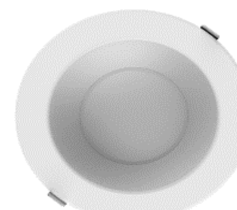
Selection[4] (Y)es (N)o (O)ption	Building	Line No.	Energy Conservation Measure	Total Measure Cost[1] ($)	Annual Electric Savings[5] ($)	Annual Chilled Water Savings[5] ($)	Annual Steam Savings[5] ($)	Annual O&M Savings ($)	Total Annual Savings[5] ($)	Simple Payback Period	Purchased Utility Electric Savings[6]	Purchased Utility Nat. Gas Savings[6]	Purchased Utility Payback Period[7]	Line No.
Y	Kornberg	1	Lighting Upgrades | Option A	$850,838	$55,143	$1,422	-$4,831	$8,391	$60,126	14.2	$39,938	-$1,537	22.2	1
O	Kornberg	2	Lighting Upgrades | Option B	$1,145,668	$70,616	$1,821	-$6,186	-$1,146	$65,105	17.6	$51,145	-$1,968	23.3	2
O	ACF	3	Lighting Upgrades | Option A	$656,793	$59,189	$646	-$6,481	$3,036	$56,390	11.6	$42,799	-$2,103	16.1	3
Y	ACF	4	Lighting Upgrades | Option B	$673,351	$71,116	$776	-$7,787	$5,628	$69,732	9.7	$51,423	-$2,527	13.8	4
N	Wilder Hall	5	Lighting Upgrades | Option A	$75,937	$1,494	$10	-$153	-$180	$1,172	64.8	$1,080	-$50	73.7	5
O	Wilder Hall	6	Lighting Upgrades | Option B	$75,937	$1,494	$10	-$153	-$180	$1,172	64.8	$1,080	-$50	73.7	6
N	Fauver Stadium	7	Lighting Upgrades | Option A	$31,694	$1,601	$41	-$140	$71	$1,574	20.1	$1,160	-$45	28.4	7
O	Fauver Stadium	8	Lighting Upgrades | Option B	$47,210	$1,673	$43	-$147	-$354	$1,215	38.9	$1,212	-$47	40.5	8
N	Schlegel Hall	9	Lighting Upgrades | Option A	$214,466	$12,145	$313	-$1,064	-$176	$11,218	19.1	$8,796	-$339	25.4	9
O	Schlegel Hall	10	Lighting Upgrades | Option B	$230,651	$12,625	$326	-$1,106	$91	$11,936	19.3	$9,144	-$352	26.2	10
Y	Wallis Hall	11	Lighting Upgrades | Option A	$150,553	$8,908	$230	-$780	$1,251	$9,608	15.7	$6,452	-$248	24.3	11
O	Wallis Hall	12	Lighting Upgrades | Option B	$189,192	$9,864	$254	-$864	$165	$9,419	20.1	$7,144	-$275	27.5	12
			Total Selected Project[4]:	**$1,674,741**	**$135,167**	**$2,428**	**-$13,398**	**$15,270**	**$139,466**	**12.0**	**$97,813**	**-$4,312**	**17.9**	
			Project Contingency (included in Total Measure Cost)[2]:	**$60,900**										
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	**$60,900**										

1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below: Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Cost savings based on the by BUILDING UTILITY RATES are defined as the fully burdened utility rate, paid by the buildings, please refer to Section 2 for additional details regarding the applied utility rates.
6. Cost savings based on the by PURCHASED UTILITY RATES are defined as the rates paid by UR to the utility service providers, please refer to Section 2 for additional details regarding the applied utility rates.
7. PURCHASED UTILITY PAYBACK PERIOD this is the payback period based on the cost sayings applying the PURCHASED UTILITY RATES

Total Selected and Optional Porojects	Total Measure Cost	Annual Electric Savings	Annual Chilled Water Savings	Annual Steam Savings	Annual O&M Savings	Total Annual Savings	Simple Payback	Purchased Utility Electric Savings	Purchased Utility Nat Gas Savings	Purchased Utility Payback Period
	$2,067,179	$151,915	$2,831	($14,888)	$13,741	$153,600	13.5	$109,941	($4,788)	19.7

Building	Existing	Option 1: Proposed Re-Lamp	Option 2: Proposed Retrofit or New Fixture
Fauver KMRB Schlegel	 2 to 3 Lamp 1x2 Recessed Troffer	 Re-Lamp - 2 to 3 Linear LED Tubes	 Retrofit - Metalux 1x2 LED Troffer
Fauver Wilder	 1 to 2 Lamp 4' T8 or T12 Linear Pendants	 Re-Lamp - 1 to 2 Linear LED Tubes	 New Fixture - Philips Linear Pendant
Fauver KMRB	 1 to 2 Lamp 4' T8 or T12 Surface Mounted Box	 Re-Lamp - 1 to 2 Linear LED Tubes	 New Fixture - Philips Linear Surface Mount
KMRB	 1 to 2 Lamp 4' T8 Vapor Proff Fixture	 Re-Lamp - 2 to 3 Linear LED Tubes	 New Fixture - Philips Vapor Proof Fixture

Building	Existing	Option 1: Proposed Re-Lamp	Option 2: Proposed Retrofit or New Fixture
ACF Fauver KMRB Schlegel Wallis Wilder	 1 to 2 Lamp Wrap and or Strip Fixture	 Re-Lamp - 1 to 2 Linear LED Tubes	 New Fixture - Philips Strip Fixture
ACF Fauver KMRB Schlegel Wallis	 2x4 Recessed Troffers	 Re-Lamp - 1 to 4 Linear LED Tubes	 Retrofit - Philips EvoKit
KMRB	 2x2 Recessed Troffers	 Re-Lamp - 2 U Bend LED Tubes	 Retrofit - Philips EvoKit
ACF Fauver KMRB Schlegel Wallis	 1x4 Recessed Troffers	 Re-Lamp - 1 to 3 Linear LED Tubes	 Retrofit - Philips EvoKit Custom Order

Building	Existing	Option 1: Proposed Re-Lamp	Option 2: Proposed Retrofit or New Fixture
KMRB	 Direct/Indirect Wall Mounted	 Re-Lamp - 1 to 2 Linear LED Tubes	 New Fixture - Philips Linear Surface Mount
ACF KMRB	 Indirect Cove Lighting	 Re-Lamp - 1 to 3 Linear LED Tubes	N/A
Schlegel	 Wall Wash Recessed Can Lights	 Re-Lamp - 1 LED Lamp	 Retrofit - RAB Adjustable Recessed Can Light
ACF Fauver KMRB Schlegel Wallis	 6 , 8 , & 10 Recessed Can Lights	 Re-Lamp - 1 to 3 LED Lamp	 Retrofit - RAB Recessed Can Light

Building	Existing	Option 1: Proposed Re-Lamp	Option 2: Proposed Retrofit or New Fixture
Wallis	 4 Recessed Can Light	 Re-Lamp - 1 LED MR-16	 Retrofit - RAB Recessed Can Light
Wallis Wilder	 1x4, 2x2, & 2x4 Box Fixtures	 Re-Lamp - 1 to 4 Linear LED Tubes	New Fixture - RAB LED Panel with Surface Mounting Kit
Wilder	 Indoor Square Canopy Light	N/A	 New Fixture - RAB LED Square Surface Mount
ACF	 Decorative Wall Sconce	 Re-Lamp - 1 LED Lamp	N/A

Building	Existing	Option 1: Proposed Re-Lamp	Option 2: Proposed Retrofit or New Fixture
Schlegel	 Decorative Wall Sconce	 Re-Lamp - 1 LED Lamp	N/A
Wallis	 Screw in PAR Lamps	 Re-Lamp - Screw in LED PAR Lamp	N/A
Wallis Wilder	  Screw in Incandescent or CFL Lamps	 Re-Lamp - Screw in LED Lamp	N/A
Wallis	 MR-16 Spot Light	 7W LED MR-16	 Retrofit - RAB Adjustable Recessed Can Light

Building	Existing	Option 1: Proposed Re-Lamp	Option 2: Proposed Retrofit or New Fixture
Schlegel	 Small Flood Light	N/A	 New Fixture - LED Small Flood Light
Fauver	 Large Flood Light	N/A	 New Fixture - LED Flood Light
KMRB Schlegel Wilder	 Small Wall Pack	N/A	 New Fixture - LED Small Wall Pack
Fauver	 Wall Pack	N/A	 New Fixture - LED Wall Pack

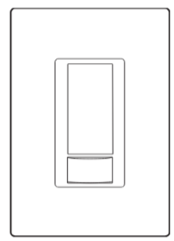
Building	Existing	Option 1: Proposed Re-Lamp	Option 2: Proposed Retrofit or New Fixture
Wilder	 Exterior Square Canopy	N/A	 New Fixture - LED Canopy
ACF Schlegel Wallis	No Sensor	 Ceiling Sensor	N/A
ACF Fauver Schlegel Wallis	No Sensor	 Wall Sensor Switch	N/A

Table 3: LED Lighting Options

Section D

Evaluation of Potential ECMs

Laboratory Airflow Optimization

ECM 3| Lab HVAC Systems

Procedure for Optimizing Lab Ventilation

Reduce airflow to the minimum of the following conditions:
- Air Change Rate Minimum Requirements
- Space Cooling load
- Face velocity requirement of fume hood

OPPORTUNITY

Laboratories require ventilation air to maintain a safe working environment. The volume of ventilation air required is based on the use of the lab, the volume of the lab space, the number of fume hoods in the lab, and the occupancy status of the lab. Wendel met with facility operations personnel for Kornberg, Del Monte, & BMEO to review the existing lab controls, fume hoods, and laboratory space usage of varying lab spaces within each building. An opportunity exists to reduce the air changes in these spaces by recalibrating the general exhaust valves as necessary to meet the minimum required laboratory ventilation in air changes per hour based on the laboratory's chemical safety classification. Potential energy savings will be realized by reducing the amount of air exhausted by from the space which then allows for reduced supply air rates, saving heating, cooling and fan energy.

INVESTIGATION APPROACH

Wendel reviewed all the mechanical plans and conducted site visits and interviews with UR staff to determine the current state of lab use within the building. Laboratory fume hoods, and supply air systems were studied to determine the current air changes per hour (ACH) for each lab space (both occupied and unoccupied). The exhaust from the lab fume hoods was determined to be higher than necessary in many of the lab spaces to maintain the minimum lab ACH requirement during occupied hours.

Baseline energy use of these areas was modeled from current sequences of operation and trends obtained from the building management system. Reduced ventilation rates based on current lab ACH requirements were calculated and modeled to determine potential energy reduction. The calculation in the Appendix outlines the results of our investigation and analysis in detail. The following is an overview of the key variables and investigation approach.

EXISTING SYSTEMS

The research laboratories at the University of Rochester utilize variable volume fume hoods to achieve the necessary air changes for a safe lab environment. Specific site conditions are indicated below, which were based on Wendel's field survey, review of existing design drawings, and review of existing building management system setpoints and trending reports. Please note, Kornberg & Del Monte are combined below since the controls sequence, era of construction, and configuration were found to be identical.

KORNBERG MEDICAL RESEARCH BUILDING (Kornberg) & MEDICAL RESEARCH BUILDING EXTENSION (Del Monte)

The research laboratories at KMRB and Del Monte were observed to include variable volume fume hoods with advanced controls. The advanced controls included sash face velocity control, automatic sash closing actuators, and occupancy-based air change rates. Currently, most of the spaces are commissioned as a Chemical Safety Level CSL3, with air change rates of 10 air changes /hour (ACH) when occupied and 6 ACH when unoccupied. There are limited spaces which operate as a CSL2 classification, with occupied air change rates of 8 ACH and unoccupied air change rates of 4 ACH.

Wendel worked with University EH&S to determine if the chemical safety classifications were appropriate based on the current utilization of the individual lab spaces. It was determined that further investigation would be required, space by space, to determine if lower air change rates per hour can be applied.

Figure E3 KMRB – Lab Controls and Fume hood

GOERGEN HALL (BMEO)

The research laboratories at BMEO were observed to include constant volume fume hoods with advanced controls. The advanced controls included sash face velocity control and occupancy-based air change rates. Currently the spaces are commissioned as a Chemical Safety Level CSL3, with air change rates of 10 air changes /hour when occupied and 6 air changes / hour when unoccupied. It is important to note that Wendel's site visit was limited to only one (1) laboratory (unoccupied at the time) due to staff requests. It is Wendel's understanding that this laboratory was representative of the construction and controls type found throughout the facility. Wendel worked with University EH&S to determine if the chemical safety classifications were appropriate based on the current utilization of the individual lab spaces. It was determined that further investigation would be required, space by space, to determine if lower air change rates per hour can be applied.

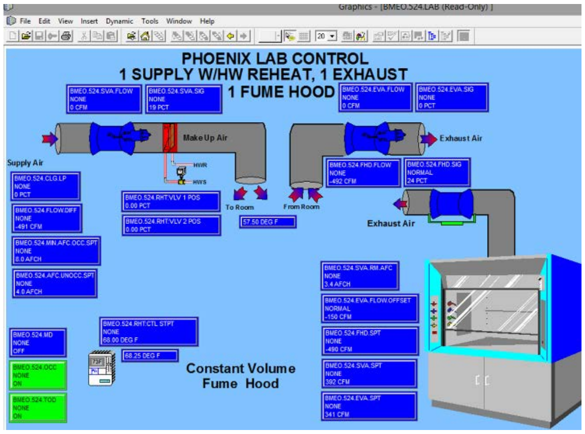


Figure E4 BMEO – Lab Controls and Fume hood

PROPOSED CHANGES

Since additional evaluation would be required in conjunction with University EH&S, Wendel elected to present two (2) scenarios should it be determined that the spaces are operating below the current chemical safety classification. These scenarios include Scenario 1, utilizing a chemical safety classification of CSL2, and Scenario 2, which utilizes design levels observed at peer institutions. In both scenarios, the general exhaust valves will be rebalanced to reduce the total ventilation airflow utilized by each building. Supply air will be balanced based on an offset from the newly adjusted general exhaust in order to maintain pre-retrofit room pressurization set point. The general exhaust valves will be rebalanced based on the following criteria per scenario:

Scenario 1 | Chemical Safety Level 2 (CSL2)

Wendel evaluated the savings potential associated with lowering the Chemical Safety Level (CSL) from CSL3 (existing) to CSL2. CSL2 laboratory spaces require 8 air changes per hour (ACH) when occupied and 4 air changes per hour (ACH) when unoccupied per the University of Rochester's Environmental Health and Safety Department. At the time of the study, current space classification could not be verified to determine the total quantity of spaces that could be reduced from CSL3 to CSL2. Please note, occupied and unoccupied air change rates were increased, from the 8 ACH / 4 ACH minimum, in order to ensure that space cooling loads can be maintained. An adjustment of minimum supply airflow of 1 CFM/sf was utilized to account for this. Please refer to the Appendix for more details.

Scenario 2 | Peer Institutions

Wendel evaluated the savings potential associated with reducing the minimum occupied and unoccupied air changes per hour (ACH) to align more closely with peer institutions with similar type and use laboratory facilities. The proposed air changes per hour (ACH) set points utilized an occupied and unoccupied air change rates of 6 ACH and 4 ACH, respectively. At the time of the study, current space classifications and uses could not be verified to determine the total quantity of spaces that could be reduced from the current CSL 3 classification as per the University of Rochester's Environmental Health and Safety Department. Please note, occupied air change rates were increased, from the 6 ACH minimum, in order to ensure that space loads can be maintained. An adjustment of minimum supply airflow of 1 CFM/sf was utilized to account for this. Please refer to the Appendix for more details.

DESIGN & OPERATION ASSUMPTIONS

The following design and existing condition assumptions were made in the development of the proposed scenarios and are key considerations in the project cost presented. The University of Rochester warrants that, to the best of the University's knowledge, the following assumptions are accurate.

- Existing fume hood, general exhaust, and supply air terminal devices are in good working order and free of defects or programming issues.
- All existing duct work is connected and free of major defects.
- Typical laboratories load design does not exceed 1 cfm/ft^2 when occupied.
- Building is unoccupied between the hours of 11 pm and 6 am.
- Ceiling tiles will be removed by contractor to allow for access to air flow devices
- Fireproofing and insulating materials above the ceiling are free of ACM.
- ACM may be present in mastic on terminal devices and duct joints.

IMPACT ON THE END USER

The new system will continue to maintain a safe work environment. The end users will not notice any difference in operation. Careful construction coordination with lab occupants would be critical as most of the work would be above the ceiling to the air distribution system and at the fume hoods. This work would cause temporary disruption to the lab space possibly affecting lab activities and/or experiments.

OPERATION AND MAINTENANCE

No new O&M costs or savings.

Table 1-6

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM) - LABRATORY AIRFLOW OPTIMIZATION
ENERGY SAVINGS SUMMARY
10/4/2021

Selection[4] (Y)es (N)o (O)ption	Line No.	Building	Energy Conservation Measure	Total Measure Cost[1] ($)	Building Electric Savings (kWh)	Building Chilled Water Savings (mmBtu)	Building Steam Savings (mmBtu)	Total Building Savings (mmBtu)	Emissions Reduction (MT of CO_2)[5]	Cost / mmBtu Saved	Line No.
O	13	Kornberg	Laboratory Airflow Optimization | Option A	$396,668	44,444	1,108	1,443	2,703	136	$147	13
Y	14	Kornberg	Laboratory Airflow Optimization | Option B	$396,668	48,514	1,233	1,703	3,102	159	$128	14
O	15	Del Monte	Laboratory Airflow Optimization | Option A	$234,246	122,805	2,762	3,537	6,717	337	$35	15
Y	16	Del Monte	Laboratory Airflow Optimization | Option B	$234,246	124,439	2,813	3,619	6,856	344	$34	16
O	17	BMEO	Laboratory Airflow Optimization | Option A	$183,200	58,553	398	509	1,107	54	$166	17
Y	18	BMEO	Laboratory Airflow Optimization | Option B	$183,200	88,370	626	884	1,811	91	$101	18
				Total Measure Cost[1] ($)	Annual Electric Savings (kWh)	Annual Chilled Water Savings (mmBtu)	Annual Fuel Savings (mmBtu)	Total Annual Savings (mmBtu)	Emissions Reduction (mT of CO_2)	Cost / mmBtu Saved	
			Total Selected Project[4]:	$814,114	261,323	4,672	6,206	11,769	594	$69	
			Project Contingency (included in Total Measure Cost)[2]:	$29,604							
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	$29,604							

NOTES:

1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below: Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by the Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Emissions savings based on rates outlined in section 2.

Table 1-7

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM) - LABRATORY AIRFLOW OPTIMIZATION
PAYBACK SUMMARY | BUILDING UTILITY COST 10/4/2021

Selection[4] (Y)es (N)o (O)ption	Building	Line No.	Energy Conservation Measure	Total Measure Cost[1] ($)	Annual Electric Savings[5] ($)	Annual Chilled Water Savings[5] ($)	Annual Steam Savings[5] ($)	Annual O&M Savings ($)	Total Annual Savings[5] ($)	Simple Payback Period	Purchased Utility Electric Savings[6]	Purchased Utility Nat. Gas Savings[6]	Purchased Utility Payback Period[7]	Line No.
O	Kornberg	13	Laboratory Airflow Optimization | Option A	$396,668	$4,000	$24,164	$21,072	$0	$49,236	8.1	$4,803	$7,690	31.8	13
Y	Kornberg	14	Laboratory Airflow Optimization | Option B	$396,668	$4,366	$26,886	$24,867	$0	$56,120	7.1	$5,283	$9,022	27.7	14
O	Del Monte	15	Laboratory Airflow Optimization | Option A	$234,246	$11,052	$60,221	$51,634	$0	$122,907	1.9	$12,752	$18,876	7.4	15
Y	Del Monte	16	Laboratory Airflow Optimization | Option B	$234,246	$11,200	$61,333	$52,838	$0	$125,371	1.9	$12,946	$19,307	7.3	16
O	BMEO	17	Laboratory Airflow Optimization | Option A	$183,200	$5,270	$8,671	$7,434	$0	$21,374	8.6	$4,493	$2,718	25.4	17
Y	BMEO	18	Laboratory Airflow Optimization | Option B	$183,200	$7,953	$13,648	$12,906	$0	$34,507	5.3	$6,825	$4,672	15.9	18
			Total Selected Project[4]:	**$814,114**	**$23,519**	**$101,867**	**$90,611**	**$0**	**$215,997**	**3.8**	**$25,054**	**$33,001**	**14.0**	
			Project Contingency (included in Total Measure Cost)[2]:	**$29,604**										
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	**$29,604**										

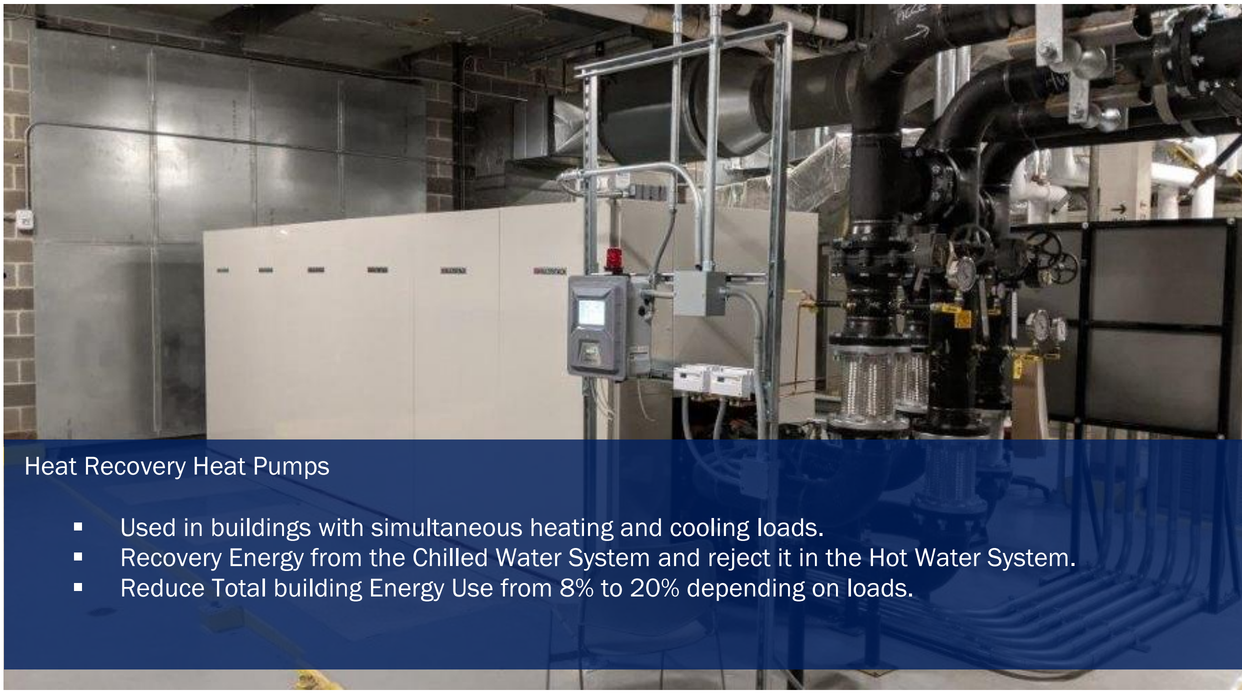
1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below: Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Cost savings based on the by BUILDING UTILITY RATES are defined as the fully burdened utility rate, paid by the buildings, please refer to Section 2 for additional details regarding the applied utility rates.
6. Cost savings based on the by PURCHASED UTILITY RATES are defined as the rates paid by UR to the utility service providers, please refer to Section 2 for additional details regarding the applied utility rates.
7. PURCHASED UTILITY PAYBACK PERIOD this is the payback period based on the cost sayings applying the PURCHASED UTILITY RATES

Section D

Evaluation of Potential ECMs

Heat Recovery Heat Pump

ECM 5 | Heat Recovery Heat Pumps

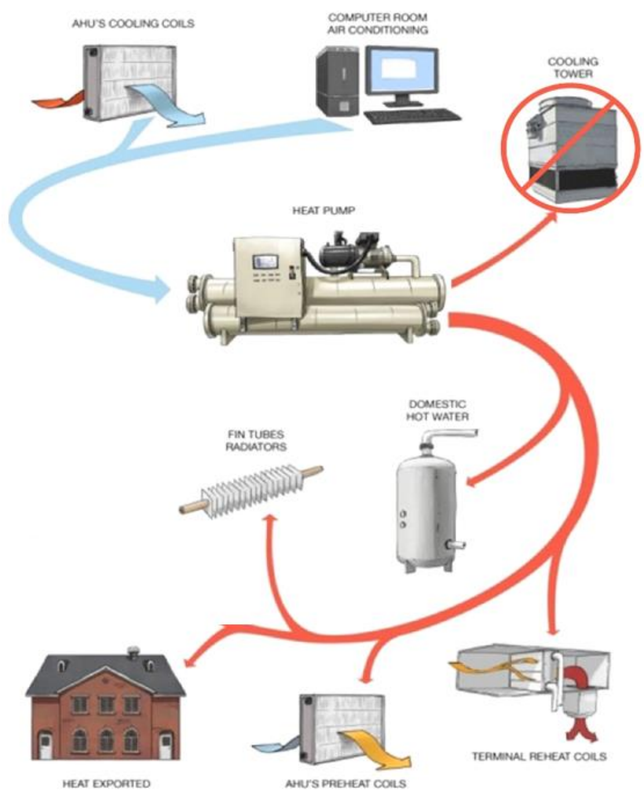


Heat Recovery Heat Pumps

- Used in buildings with simultaneous heating and cooling loads.
- Recovery Energy from the Chilled Water System and reject it in the Hot Water System.
- Reduce Total building Energy Use from 8% to 20% depending on loads.

OPPORTUNITY

Heating and cooling systems consume a large portion of a building's total energy usage. This is due to the fact that these systems must generate or remove the amount of heat required to keep a space at its operating temperatures. For instance, a cooling coil absorbs heat from a room and expels it somewhere else, normally outside, or an electric heating coil that converts electricity directly into heat. These heating and cooling processes are occurring all throughout a building at any given time, generating and removing heat as needed. Different rooms will require various heating or cooling processes and depending on the systems in place, one room can be cooling while the room next to may be heating. This is particularly true in buildings with high ventilation loads, where reheat is utilized extensively to prevent sub-cooling the occupied spaces. The University of Rochester has several such buildings, with a high volume of ventilation airflow and extensive reheat usage, especially in the summer conditions. In situations where simultaneous heating and cooling is a common occurrence, savings through a heat recovery system can be realized.



Instead of directly generating or removing heat from spaces in this situation, the heat can be transferred between these spaces. For example, a cooling coil absorbing heat can transfer this heat into the heating system, which in turn will heat the room rather than using steam or hot water. This transfer or recovery of heat in a building leads to direct energy savings, as the transferring of heat is a more efficient process than the generation and removal of heat. This transferring of heat can be performed by a heat recovery chiller.

The heat recovery chiller or heat pumps differ from conventional chillers in the way in which the absorbed heat is removed from their system. A conventional chiller removes heat through cooling towers or condensers, which expel the heat outside of the building. Heat recovery heat pumps will use the heating hot water system of a building in order expel heat, with a smaller sized condenser or cooling tower reject heat, if needed. This results in savings associated with the reclamation of heat energy.

INVESTIGATION APPROACH

A review of the initial utility history for the selected buildings showed a simultaneous heating and cooling load. After further investigation, it was determined that these simultaneous loads are necessary due to the outside air that is utilized by the laboratory spaces. Our team created a model of the existing systems, which would be impacted by the heat recovery chiller. This allowed us to see where supplemental heating and cooling would be needed on both the existing and proposed case. Please refer to the Appendix 3 for technical details regarding this analysis.

All impacted pumps were surveyed and information such as motor nameplate, pump name plate, operating pressure, position of triple duty valves or circuit setters, and type of motor control were collected. Please refer to the Heat Recovery Chiller ECM Appendix section for technical details regarding this analysis.

EXISTING SYSTEMS

The buildings at University of Rochester, specifically research laboratories such as Kornberg, Del Monte

, & BMEO have simultaneous heating and cooling needs throughout the year that can be leveraged through the utilization of a heat recovery chillers (water-water heat pump). The following summarizes simultaneous loads observed in each building, which shows year-round heating needs and cooling during summer and shoulder seasons. Additional site-specific details can be found by building.

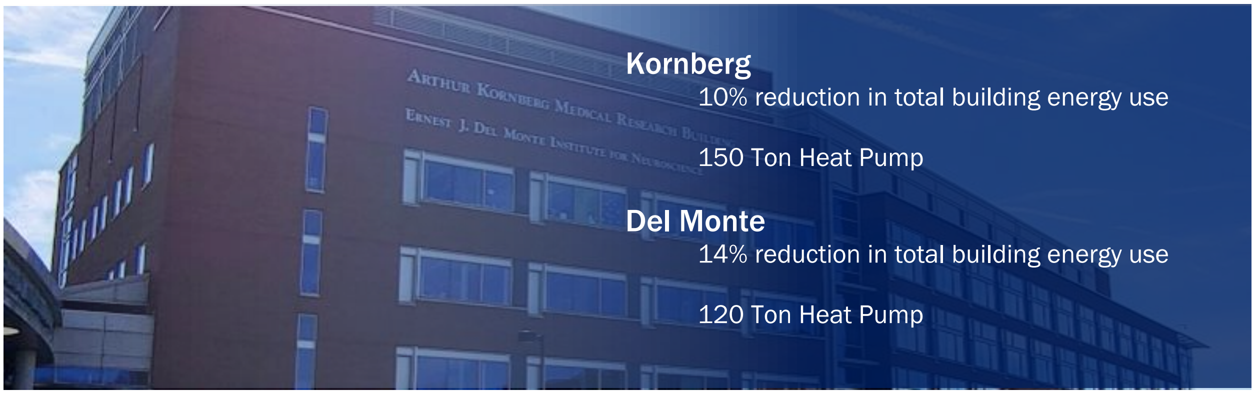
The energy calculations for these buildings were developed utilizing utility data from campus meters, and making conservative adjustments for:

- Coincidence factors
- Interactions with other energy conservation projects that will reduce heating and cooling loads.

These adjustment factors and assumptions are listed in the calculations provided along with this report.

Please note, Kornberg & Del Monte are combined below since the system configuration and controls sequence were found to be similar.

KORNBERG MEDICAL RESEARCH BUILDING (Kornberg) & MEDICAL RESEARCH BUILDING (Del Monte)



The existing heating systems at Kornberg & Del Monte were observed to be hot water distribution systems, which is produced by both local steam to hot water heat exchangers and a separate hot water tie point to the district co-generation plant on campus. Both heating loads (metered independently) were considered when determining the heating loads of the facility and the potential for the heat recovery heat pumps heat rejection. Both buildings have year-round heating needs, with seasonal cooling during the summer and shoulder seasons.

Space for the proposed heat recovery heat pumps and supporting equipment /infrastructure was identified in both basements where primary heating equipment is located. An opportunity exists to combine these systems and to consolidate heat recovery capabilities to a single location. Additional piping infrastructure will be required to tie in the heating and/or cooling loops.

Figure E5 Kornberg - Heat Recovery Impact on Heating (below)

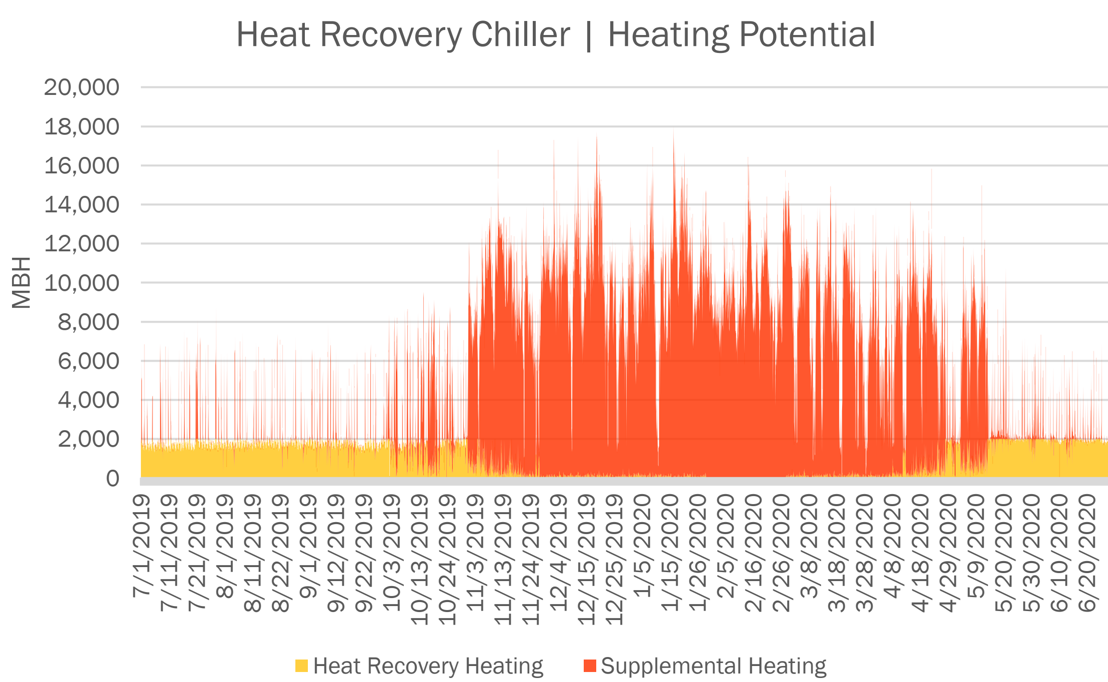


Figure E6 Kornberg - Heat Recovery Impact on Cooling (below)

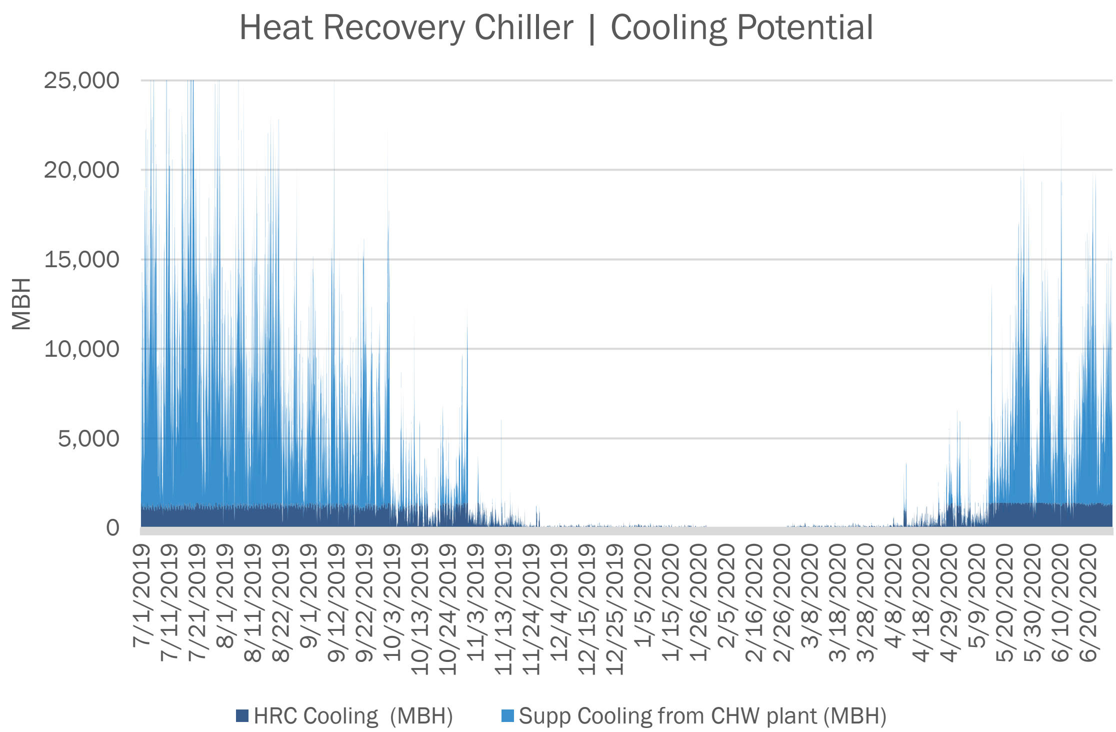


Figure E7 Del Monte - Heat Recovery Impact on Heating (below)

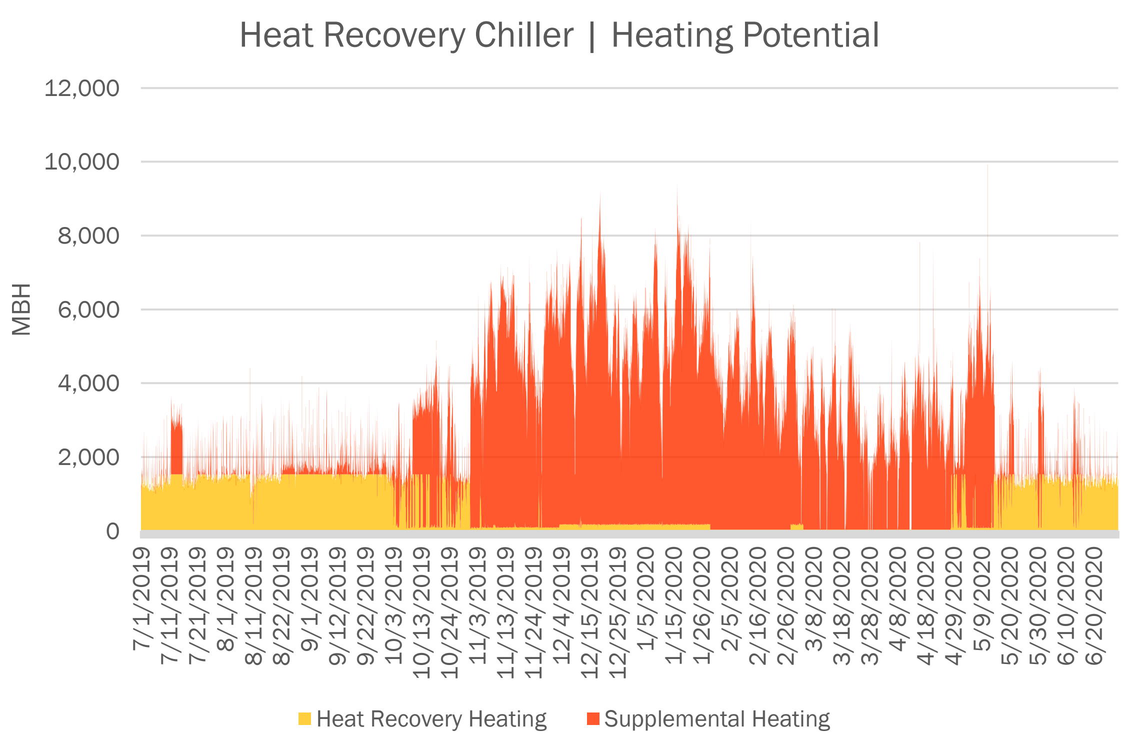
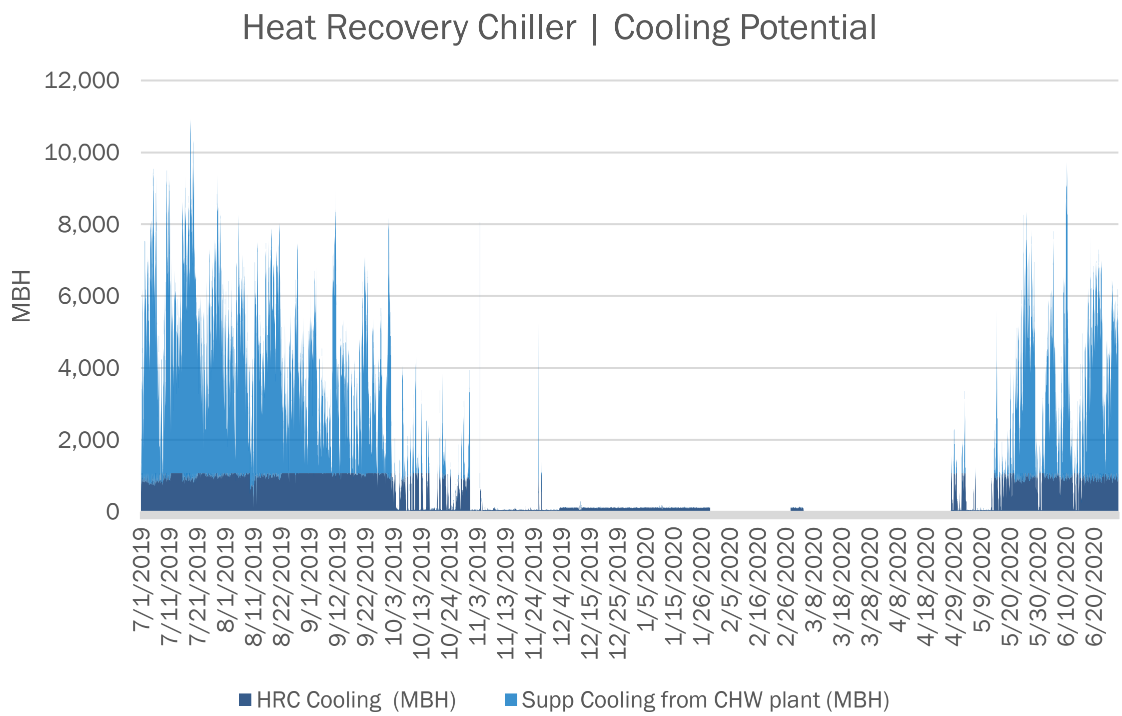


Figure E8 Del Monte - Heat Recovery Impact on Cooling (below)



GOERGEN HALL (BMEO)

The existing heating systems at BMEO was observed to be hot water distribution systems, which is produced by local steam to hot water heat exchangers. The primary heating load from the hot water heating loop was considered when determining the potential for the heat recovery heat pumps heat rejection. BMEO has year-round heating needs, with seasonal cooling during the summer and shoulder seasons. Additionally, there is a sub-cooled chiller which provided lower chilled water to the basement clean room.

Space for the proposed heat recovery chiller and supporting equipment /infrastructure was identified in the basement where primary heating equipment is located. At this time, the loads associated with the clean room have not been integrated due to the extreme operating temperature as compared to more typical air handling equipment.

Figure E9 BMEO - Heat Recovery Impact on Heating (below)

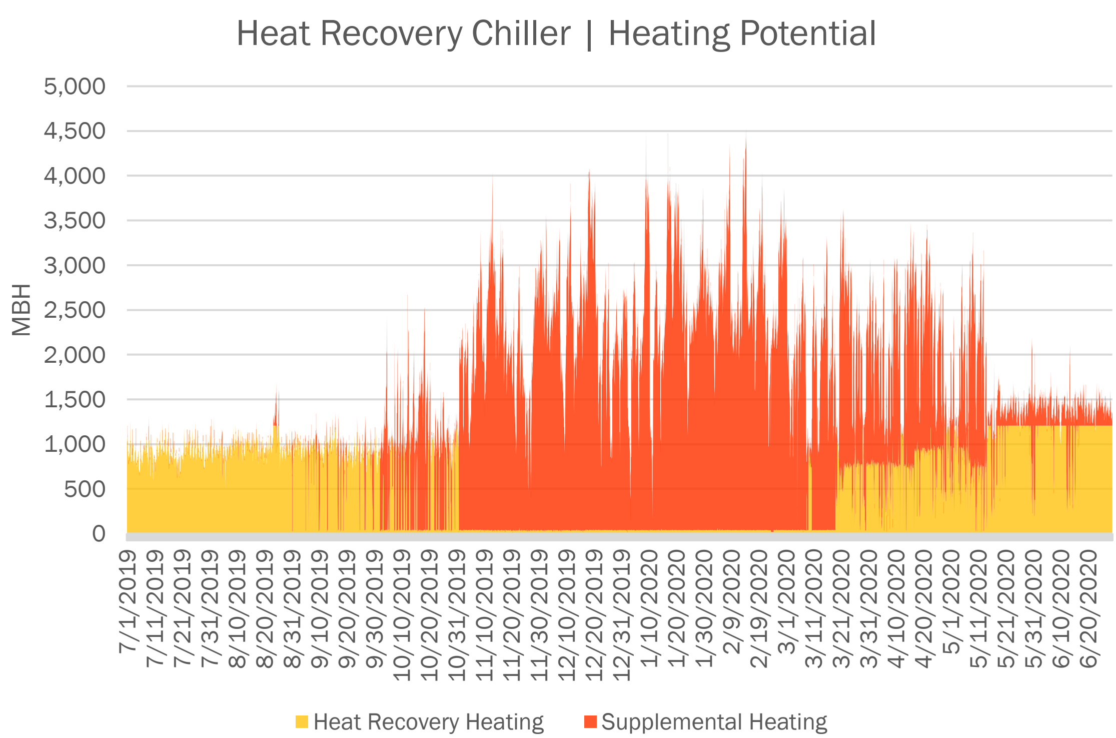
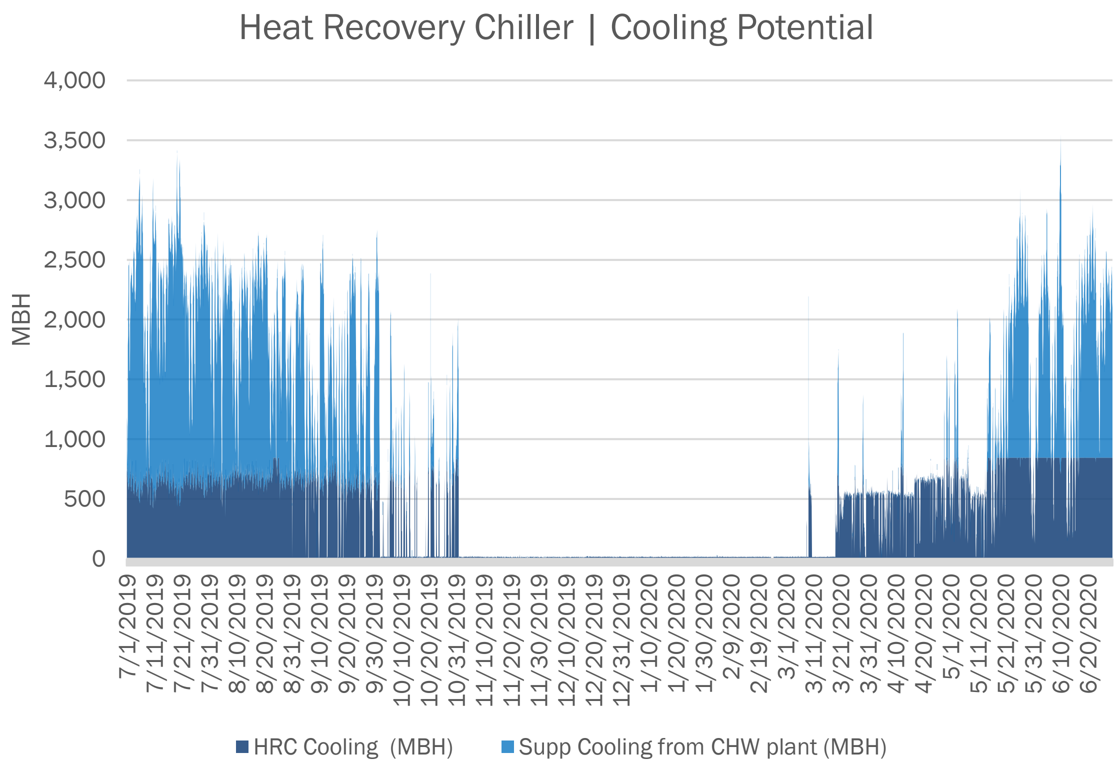
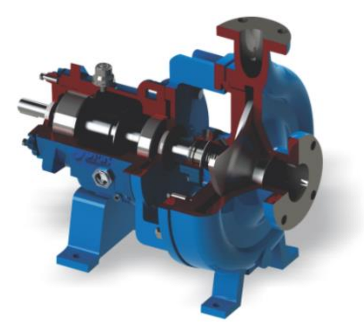


Figure E10 BMEO - Heat Recovery Impact on Chiller (below)



PROPOSED CHANGES



Heat recovery heat pumps are only viable in a situation where there is simultaneous heating and cooling needs. Ensuring that the University of Rochester buildings met these criteria was the first step in going forward with the recommendation of a heat recovery chiller. The building's utility profiles, provided in hourly data and presented in Section B, demonstrate that the selected buildings have these conditions. The following is an outline of design considerations in the development of this Assessment and Plan. Please refer to the appendix for scope of work details.

Supplemental Chilled Water and Steam Heat Exchangers

Meeting the load demand is the most important concern when designing a system which uses a heat recovery chiller. This is more complicated than a conventional heating/cooling system in that the heat recovery chiller is providing both aspects, rather than having a dedicated system for each utility individually. This means that the chiller that is specified must have enough cooling capacity to provide all of the cooling needs for the building, while also providing enough heating capacity for the building. Satisfying both of these criteria is a challenge as heat recovery heat pumps come in specific sizes and capacities which may be too small or too large for the application. In order to solve this without under sizing, or over sizing and installing additional chillers, a backup source of additional capacity is connected to the system. In the case for the University of Rochester, the heat recovery heat pumps will supplement the existing chilled water and hot water producing systems, reducing the overall usage of the existing equipment. This connection will be made in series, with the existing return chilled water and hot water piping to pre-cool or pre-heat the return chilled and hot water.

Condensing Unit

Similar to meeting the load demand for the system, it is also important when designing the heat recovery chiller to ensure that the loads being designed to will exist. In order for the cooling capacity to exist, the heat recovery chiller requires somewhere to transfer the heat on the heating side. This case is most evident in the summer during a hot day. In this example, the demand for heating will greatly reduce, meaning that the amount of heat being discharged from the chiller will also reduce. As the amount of heat being discharged from the chiller decreases, the amount of capacity on the cooling side will decrease, possibly bringing it to zero. Factoring this into design, backup heat dissipation equipment can be added. For the evaluated buildings, the base hot water heating load provides sufficient capacity during the summer to ensure continuous operation of the heat recovery chillers and production of chilled water.

Operating Temperature & Reset Schedule

Another key consideration is operating temperature of the heating loop. Since the heat recovery chiller will be retrofitted into an existing building's infrastructure, our team chose an operating temperature for peak heating of 140°F. The intended operation of the heat recovery chiller is to take place during shoulder and cooling seasons, where the hot water system is anticipated to have lower operating temperatures. While the chiller will not be operating at its ideal condition, using this as the peak design temperature will help make sure the new equipment will operate well with the remaining systems. In cases where warmer hot water is required, through building requirements or seasonal considerations, heat recovery chillers may be specified for a different refrigerant capable of hot water temperatures of up to 175°F. The chiller is capable to operate on reset schedule, which will improve the chillers performance and optimize the heating and cooling operation.

Constant Volume Primary System

The proposed system will utilize a constant volume primary pumping system that is connected to the existing chilled water system in a primary / secondary arrangement. The hot water piping will be interconnected in parallel to both a plate and frame heat exchanger and the existing hot water return piping in a side stream configuration. Special consideration was given to this system relative to a constant volume primary system (chilled water side), primary / secondary system (hot water side), or a variable volume primary system. Both systems present design challenges regarding minimum flow rates through equipment, head loss, operating pressures and additional balancing valves. These challenges were taken into consideration as we developed the system schematics. The proposed piping arrangement will interface to the existing primary/secondary system, allowing capacity to be modulated local to the chiller control through staging of the heat recovery chiller compressors. Variable frequency drives and differential pressure control will still be utilized for making adjustments to system pressure variations as well as adjust flowrate as needed by the hot water and chiller water reset schedules.

Electrical Upgrades

The primary electrical service for Kornberg, Del Monte, & BMEO are located in the penthouse mechanical spaces. Electrical power will need to be routed from the penthouse to the proposed location of the heat recovery chiller in the basement mechanical spaces.

Code Compliance

The intended project has been reviewed by a Professional Engineer Licensed in the State of New York. The proposed design meets New York Building Code with the following items given special consideration.

- Electrical connections/breaker sizing
- Refrigerant alarm and exhaust system
- Fire Protection and sprinkler relocation
- Through penetrations
- Hazardous material
- Energy Conservation Code

DESIGN & OPERATION ASSUMPTIONS

The following existing conditions and design assumptions were made in the development of this project and are key considerations in the project cost presented. The University of Rochester warrants that, to the best of the University's knowledge, the following design assumptions are accurate.

- The existing building automation control system is in good, operating condition. All existing temperature sensors and control points are properly commissioned and calibrated for reuse.
- The existing water in the hot water loop and chilled water loop is treated and existing piping throughout the facility is in good condition and will remain.
- Existing hot water and chilled water distribution piping in the existing central chilled water and hot water plants will remain for reuse where possible.
- Existing shut off valves are operational and in working condition.
- Existing steam-to-hot water heat exchangers, control valves, shut off valves, and piping will remain for reuse.
- Existing steam control valves at steam-to-hot water heat exchangers are fully operational and will fully close.
- The existing medium to low pressure steam pressure reducing station and distribution piping will remain.
- Hydronic balancing of the hot water and chilled water piping throughout the facility will remain as is.
- It is assumed the University of Rochester buildings can accommodate a temporary mechanical and electrical shut down during construction. Mechanical shutdowns will be planned with University personnel in advanced and timed during a period of low user activity and favorable weather conditions. Temporary heating and cooling is not included.

IMPACT ON THE END USER

Building occupants will not be affected by this measure once constructed and in operation.

OPERATION AND MAINTENANCE

Annual and Preventative Maintenance

A summary of proposed equipment can be found below:

Proposed Equipment:

- (1) Heat Recovery Chiller
- (2) Primary Chilled Water Pump
- (2) Primary Hot Water Pump

Avoided Future Capital Cost

As part of this project, no equipment is anticipated to be removed. Therefore, avoided future capital costs have not been calculated in association with this measure.

Table 1-8

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM) - HEAT RECOVERY HEATPUMPS
ENERGY SAVINGS SUMMARY
10/4/2021

Selection[4] (Y)es (N)o (O)ption	Line No.	Building	Energy Conservation Measure	Total Measure Cost[1] ($)	Building Electric Savings (kWh)	Building Chilled Water Savings (mmBtu)	Building Steam Savings (mmBtu)	Total Building Savings (mmBtu)	Emissions Reduction (MT of CO_2)[5]	Cost / mmBtu Saved	Line No.
Y	19	Kornberg	Heat Recovery Heat Pump	$922,885	-770,069	5,662	8,173	11,207	626	$82	19
Y	20	Del Monte	Heat Recovery Heat Pump	$752,029	-557,929	4,062	5,876	8,034	449	$94	20
Y	21	BMEO	Heat Recovery Heat Pump	$572,213	-448,516	3,273	4,733	6,476	362	$88	21
				Total Measure Cost[1] ($)	Annual Electric Savings (kWh)	Annual Chilled Water Savings (mmBtu)	Annual Fuel Savings (mmBtu)	Total Annual Savings (mmBtu)	Emissions Reduction (mT of CO_2)	Cost / mmBtu Saved	
			Total Selected Project[4]:	$2,247,127	-1,776,514	12,997	18,782	25,717	1,437	$87	
			Project Contingency (included in Total Measure Cost)[2]:	$81,714							
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	$81,714							

NOTES:

1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below: Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by the Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Emissions savings based on rates outlined in section 2.

Table 1-9

UNIVERSITY OF ROCHESTER

ENERGY CONSERVATION MEASURE (ECM) - HEAT RECOVERY HEATPUMPS

PAYBACK SUMMARY | BUILDING UTILITY COST 10/4/2021

Selection[4] (Y)es (N)o (O)ption	Building	Line No.	Energy Conservation Measure	Total Measure Cost[1] ($)	Annual Electric Savings[5] ($)	Annual Chilled Water Savings[5] ($)	Annual Steam Savings[5] ($)	Annual O&M Savings ($)	Total Annual Savings[5] ($)	Simple Payback Period	Purchased Utility Electric Savings[6]	Purchased Utility Nat. Gas Savings[6]	Purchased Utility Payback Period[7]	Line No.
Y	Kornberg	19	Heat Recovery Heat Pump	$922,885	-$69,306	$123,458	$119,320	-$3,150	$170,321	**5.4**	-$40,276	$43,110	**325.6**	19
Y	Del Monte	20	Heat Recovery Heat Pump	$752,029	-$50,214	$88,576	$85,788	-$2,520	$121,631	**6.2**	-$29,250	$30,989	**432.4**	20
Y	BMEO	21	Heat Recovery Heat Pump	$572,213	-$40,366	$71,362	$69,109	-$1,890	$98,215	**5.8**	-$23,501	$24,964	**391.1**	21
			Total Selected Project[4]:	**$2,247,127**	**-$159,886**	**$283,396**	**$274,217**	**-$7,560**	**$390,167**	**5.8**	**-$93,027**	**$99,064**	**372.2**	
			Project Contingency (included in Total Measure Cost)[2]:	**$81,714**										
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	**$81,714**										

1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below:
   Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Cost savings based on the by BUILDING UTILITY RATES are defined as the fully burdened utility rate, paid by the buildings, please refer to Section 2 for additional details regarding the applied utility rates.
6. Cost savings based on the by PURCHASED UTILITY RATES are defined as the rates paid by UR to the utility service providers, please refer to Section 2 for additional details regarding the applied utility rates.
7. PURCHASED UTILITY PAYBACK PERIOD this is the payback period based on the cost sayings applying the PURCHASED UTILITY RATES

Section D

Evaluation of Potential ECMs

Rooftop Solar

ECM 6 | Photovoltaic Systems

POTENTIAL GENERATING CAPACITY FROM ROOF TOP SOLAR

River Campus | 4,540,000 kWh
Cost | $8 Million
Medical Campus | 5,565,000 kWh
Cost | $10 Million
Eastman Campus | 700,000 kWh
Cost | $1 Million

Solar Photovoltaics (PV) panels transfer light energy into electrical energy. Energy produced by the array would offset the energy used by the building electrical system that it is attached to. This simple process for generating renewable energy has been implemented worldwide. The application of this technology for a site, campus or community requires an in depth understanding of both the technical requirements as well as financial assistance programs in the form of incentives, grants, feed in tariffs and other financing considerations such as power purchase agreements.

INVESTIGATION APPROACH

To assess the potential of photovoltaic systems, and to provide usable insight for future capital plans, the team completed an assessment of the 4 campuses (Part 1). Each building on campus was evaluated for potential open roof space and preliminary analysis of the potential energy production and implementation costs was performed. The intent informs future planning efforts and work into capital plans for solar installations which may align with roof replacements.

For Part 2 of the solar evaluation at the Orthopedic Ambulatory Care building, we further assessed the details and outlined the current financial assistance programs available, the team took a deep dive into the active project the University had and presented analysis and considerations regarding various incentive programs available at this time.

Map Ref.	Campus	Square Footage of Occupiable Roof Space
1	Medical Campus	495,923
2	River Campus	404,647
3	Eastman Campus	62,034
4	South Campus	180,445
6	Orthopedic Ambulatory Care	135,768

Table E5 – Summary of estimated roof space – kW DC and kWh are based on usable sqft.

DESIGN & CONSTRUCTION CONSIDERATIONS

For any solar system, the following items should be further considered:

- Raw land or roof space would be needed for the solar array.
- If roof space is used, condition of the roof and a structural analysis would need to be taken into consideration.
- Depending on the size of the array, electrical switch gear and interconnection to the grid may be required.

PART 1 | CAMPUS ASSESSMENT

Wendel evaluated four (4) campus for potential roof mounted solar PV installations. The campus approach was taken due to differing electrical configurations and potential sizes affected the interconnection process and rebates.

The campus solar evaluations were done by identifying buildings where rooftop space was available. Solar array sizes were based on available square footage and de-rated for roof edge offsets and roof space being partially occupied by rooftop HVAC equipment. Array sizes were then run through the NYSERDA VDER calculation for power production and savings.

Wendel evaluated each roof in the respective campus for a cursory look to see if the roof would be applicable for solar panels. Roofs that were not flat or if the building was older were ruled out and the space was not counted. Below are maps and breakdowns of the square feet per building that were used in the calculations for potential renewable energy and associated costs.

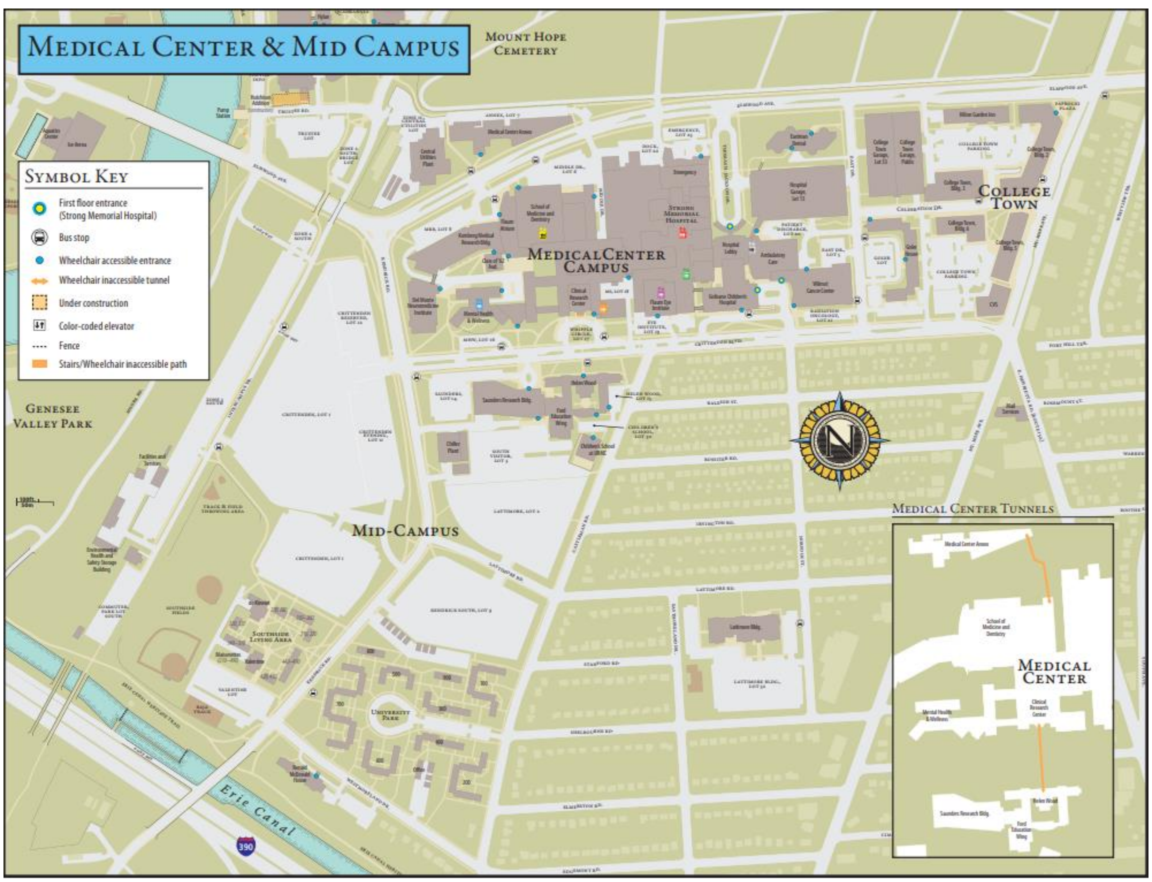


Figure E11 – Map of Medical Campus

Table E6: Breakdown of Roof Space for Medical Campus Map

Name of Building	Solar-Friendly Roof[1]	Est. sqft	Usable Area	kW DC Roof Capacity	kWh Produced Annually
Children's School at URMC	N	N/A	N/A	0.0	0
School of Nursing (Helen Wood Hall)	Y	42,153	21,077	406.7	502,280
Saunders Research Building	Y	44,307	22,154	428.0	527,946
Central Utilities Plant	Y	14,964	7,482	144.4	178,306
Medical Center Annex	Y	36,813	18,407	355.0	438,650
Goler House	Y	31,939	15,970	308.2	380,573
Ernest J. Del Monte Neuromedicine Institute	Y	20,149	10,075	194.0	240,088
Arthur KornBerg Medical Research Building (KMRB)	Y	37,960	18,980	366.3	452,317
School of Medicine and Dentistry	Y	77,838	38,919	751.0	927,489
Strong Memorial Hospital	Y	131,166	65,583	1,265.6	1,562,926
Wilmot Cancer Center	Y	43,299	21,650	418.0	515,935
Eastman Institute for Oral Health	Y	15,335	7,668	148.0	182,726

Total Recommended for Solar Roof Space	495,923	area
Usable Area Percentage	50%	usable area
Usable Area	247,962	sqft
PV Module Area	17	sqft/module
PV Modules Watts	335	W
Total Number of Panels	14,283	#of panels
Total Rated DC Power	4,785	kW Capacity
DC to AC Rated Power Ratio	90%	%
AC Rated Power	4,306	kW Capacity
kWh produced annually per kW of DC rated power	1,235	kWh
kWh produced annually	5,905,583	kWh

1 | "Solar Friendly" indicates roof areas which could accept a solar system without major changes. Roofs with major mechanical equipment comprising a high percentage of the roof, historic roofs or angled roofs requiring a penetrating mounting system are excluded.

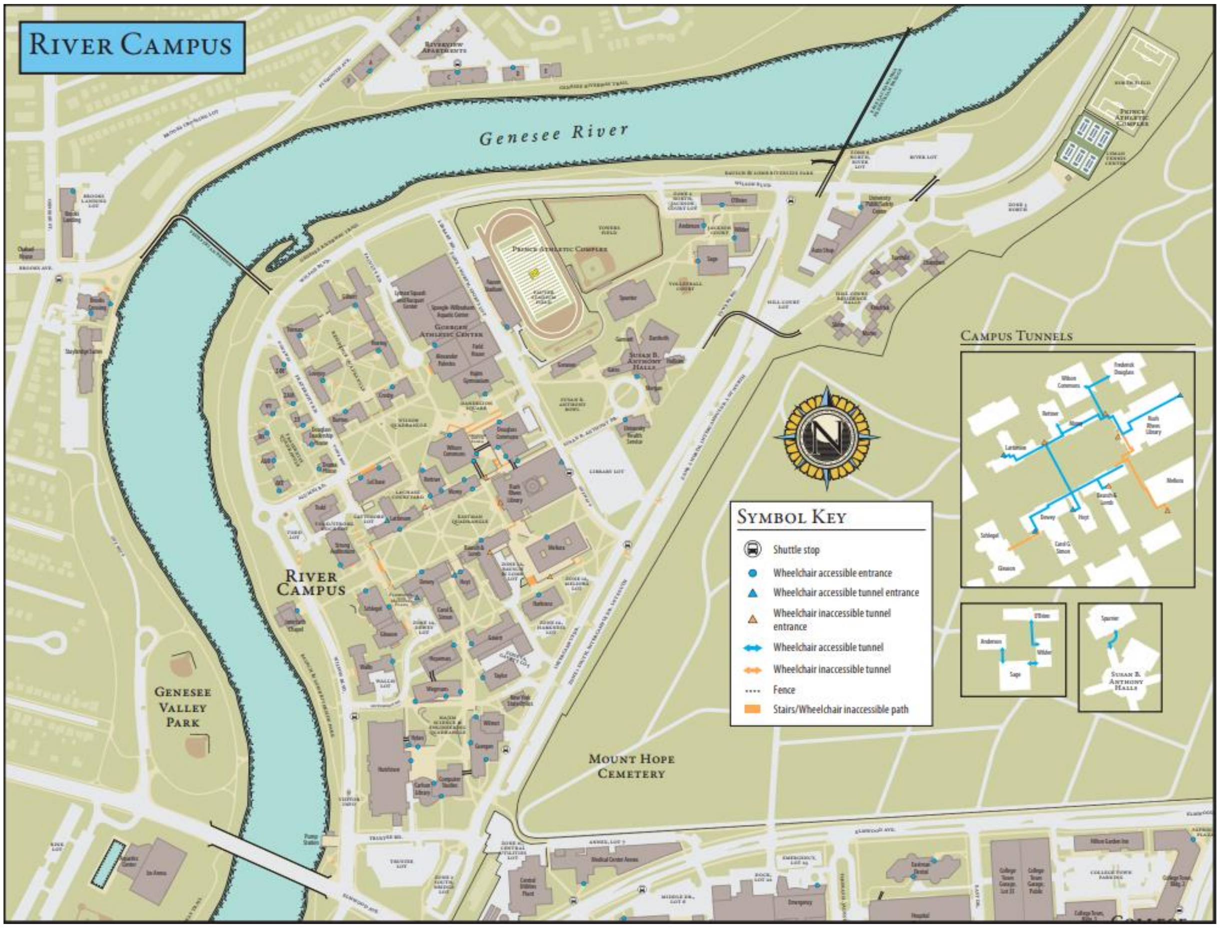


Figure E12 – Map of River Campus

Table E7: Breakdown of Roof Space for River Campus					
Name of Building	Solar-Friendly Roof[1]	Est. sqft	Usable Area	kW DC Roof Capacity	kWh Produced Annually
Riverview Apartments	N	N/A	N/A	0.0	0
Brooks Landing Business Center	Y	15,691	7,846	151.4	186,968
Staybridge Suites	N	N/A	N/A	0.0	0
Chambers House	N	N/A	N/A	0.0	0
Fairchild House	N	N/A	N/A	0.0	0
Gale House	N	N/A	N/A	0.0	0
Kendrick House	N	N/A	N/A	0.0	0
Munro House	N	N/A	N/A	0.0	0
Slater House	N	N/A	N/A	0.0	0
University Public Safety Center 2	N	N/A	N/A	0.0	0
Interfaith Chapel	Y	2,260	1,130	21.8	26,929
O'Brien Hall	Y	16,283	8,142	157.1	194,022
Wilder Hall	Y	4,494	2,247	43.4	53,549
Anderson Hall	Y	9,989	4,995	96.4	119,025

Sage Art Center	Y	5,085	2,543	49.1	60,591
Spurrier Hall	Y	4,274	2,137	41.2	50,927
Susan B. Anthony Hall	Y	27,564	13,782	266.0	328,442
Hillside Market			0	0.0	0
University Health Service	Y	8,817	4,409	85.1	105,060
Robert B. Goergen Athletic Center	Y	97,763	48,882	943.3	1,164,908
Gilbert Hall	N	N/A	N/A	0.0	0
Tiernan Hall	N	N/A	N/A	0.0	0
Lovejoy Hall	N	N/A	N/A	0.0	0
Burton Hall	N	N/A	N/A	0.0	0
Crosby Hall	N	N/A	N/A	0.0	0
Hoeing Hall	N	N/A	N/A	0.0	0
Fraternity Quad	N	N/A	N/A	0.0	0
Todd Union	Y	2,033	1,017	19.6	24,224
Strong Auditorium	Y	5,075	2,538	49.0	60,472
LeChase Hall	Y	3,855	1,928	37.2	45,935
Lattimore Hall	Y	1,500	750	14.5	17,873
Morey Hall	N	N/A	N/A	0.0	0
Rettner Hall	Y	6,506	3,253	62.8	77,523
Wilson Commons	Y	7,234	3,617	69.8	86,198
Fredrick Douglass Commons	Y	11,055	5,528	106.7	131,727
Rush Rhees Library	N	N/A	N/A	0.0	0
Meliora Hall	Y	28,098	14,049	271.1	334,805
Harkness Hall	Y	13,346	6,673	128.8	159,026
Bausch & Lomb Hall	Y	7,438	3,719	71.8	88,628
Elizabeth Hoyt Hall	Y	6,982	3,491	67.4	83,195
Dewey Hall	N	N/A	N/A	0.0	0
Carol G. Simon Hall	N	N/A	N/A	0.0	0
Schlegel Hall (Inclusive of Gleason Hall)	Y	4,822	2,411	46.5	57,457
Wallis Hall	Y	3,167	1,584	30.6	37,737
Hopeman Engineering Building	N	N/A	N/A	0.0	0
Wegmans Hall	Y	10,546	5,273	101.8	125,662
Gavett Hall	Y	5,930	2,965	57.2	70,660
Taylor Hall	Y	12,646	6,323	122.0	150,685
NYS Center for Advanced Technology	Y	4,393	2,197	42.4	52,345
Wilmot Building	N	N/A	N/A	0.0	0
Robert B. Goergen Hall	Y	12,117	6,059	116.9	144,382
Hylan Building	Y	2,731	1,366	26.4	32,542
Hutchison Hall	Y	38,268	19,134	369.2	455,987
Computer Studies Building	Y	21,539	10,770	207.8	256,651
Carlson Library	Y	3,146	1,573	30.4	37,487

Total Recommended for Solar Roof Space	404,647	**area**	
Usable Area Percentage	**50%**	**usable area**	

Usable Area	202,324	sqft	
PV Module Area	**17**	**sqft/module**	
PV Modules Watts	335	W	
Total Number of Panels	**11,655**	**#of panels**	
Total Rated DC Power	3,904	kW Capacity	
DC to AC Rated Power Ratio	**90%**	**%**	
DC to AC Rated Power	3,514	kW Capacity	
kWh produced annually per kW of DC rated power	**1,235**	**kWh**	
kWh produced annually	4,818,644	kWh	

1 | "Solar Friendly" indicates roof areas which could accept a solar system without major changes. Roofs with major mechanical equipment comprising a high percentage of the roof, historic roofs or angled roofs requiring a penetrating mounting system are excluded.

2 | University Public Safety Center – there is only a slight angle on this building, while not ideal we would recommend a structural engineer review before implementing a solar project.

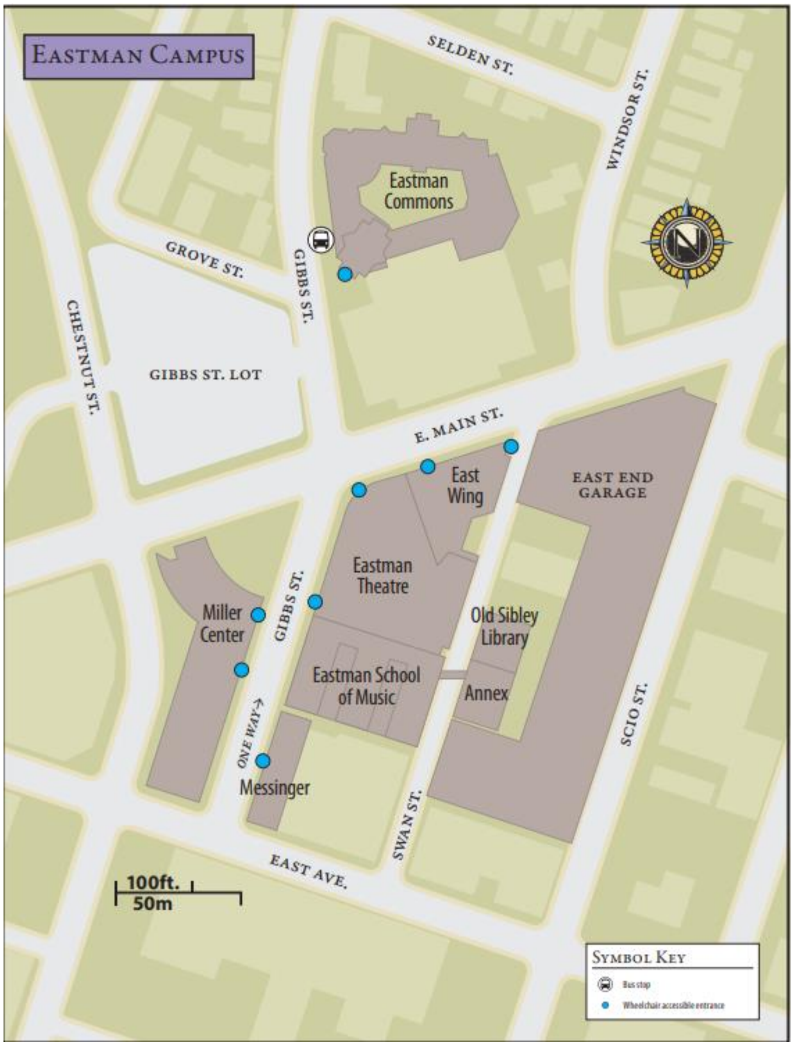


Figure E13 – Map of Eastman Campus

Table E8: Breakdown of Roof Space for Eastman Campus					
Name of Building	Solar-Friendly Roof[1]	Est. sqft	Usable Area	kW DC Roof Capacity	kWh Produced Annually
Miller Center Max of Eastman Place Sibley Music Library	Y	23,997	11,999	231.5	285,939
Messinger Hall	Y	6,518	3,259	62.9	77,666
Eastman Theatre Kodak Hall at Eastman Theatre Howard Hanson Hall Kilbourn Hall Eastman School of Music The Cave Schmitt Organ Recital Hall	Y	17,357	8,679	167.5	206,820

Annex	Y	7,270	3,635	70.1	86,627
Eastman Student Living Center[2] Eastman Dining Center[2]	N	N/A	N/A	0.0	0
Spot Coffee	Y	6,892	3,446	66.5	82,123

Total Recommended for Solar Roof Space	62,034	area
Usable Area Percentage	50%	**usable area**
Usable Area	31,017	sqft
PV Module Area	17	**sqft/module**
PV Modules Watts	335	W
Total Number of Panels	1,787	**#of panels**
Total Rated DC Power	599	kW Capacity
DC to AC Rated Power Ratio	90%	**%**
DC to AC Rated Power	539	kW Capacity
kWh produced annually per kW of DC rated power	1,235	**kWh**
kWh produced annually	738,717	kWh

1 | "Solar Friendly" indicates roof areas which could accept a solar system without major changes. Roofs with major mechanical equipment comprising a high percentage of the roof, historic roofs or angled roofs requiring a penetrating mounting system are excluded.

2 | Eastman Student Living Center– Very little flat roof space. Large tower blocking most of the roof throughout the day.

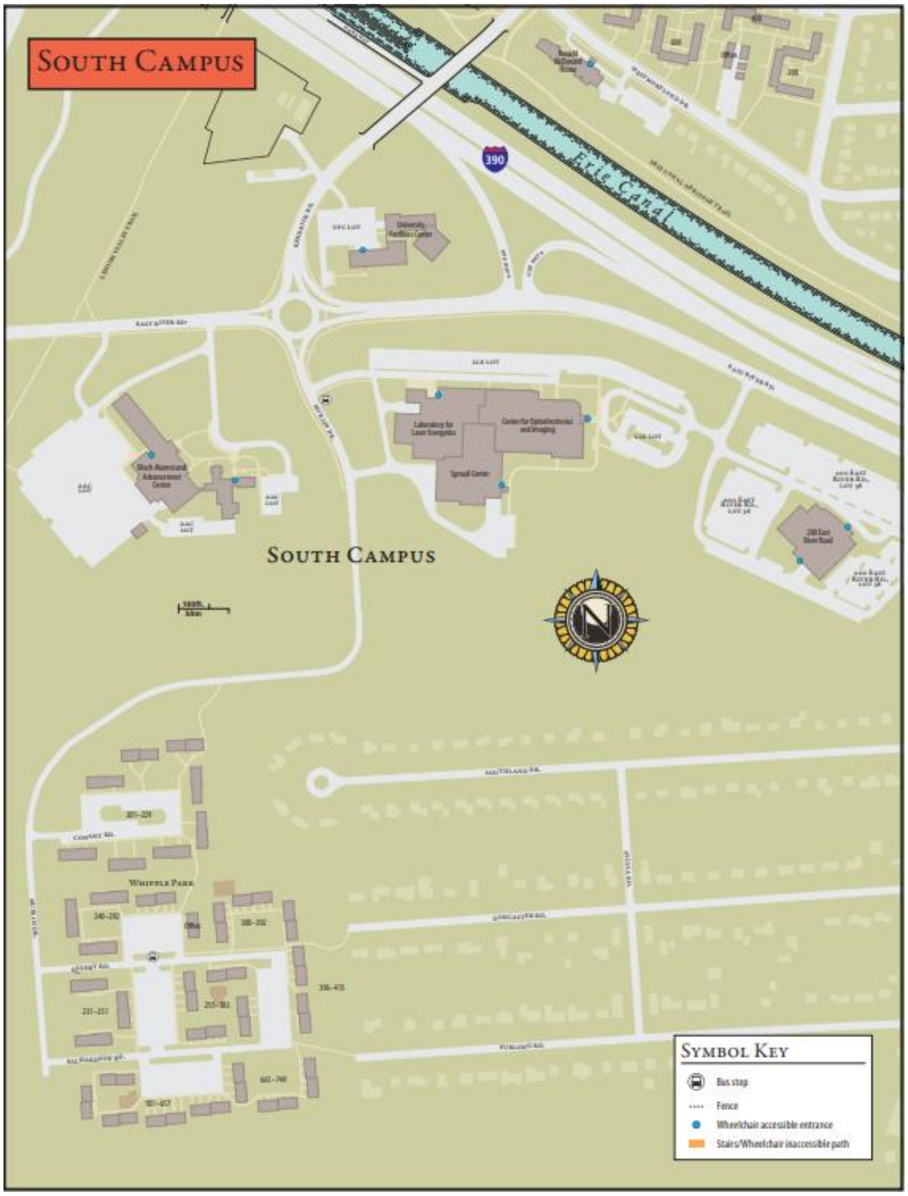


Figure E14 – Map of Eastman Campus

Table E9: Breakdown of Roof Space for South Campus

Name of Building	Solar-Friendly Roof[1]	Est. sqft	Usable Area	kW DC Roof Capacity	kWh Produced Annually
Larry and Cindy Bloch Alumni and Advancement Center	Y	40,094	20,047	386.9	477,745
University Facilities and Service Building	Y	28,525	14,262	275.2	339,893
Laboratory for Laser Energetics Center for Optoelectronics and Imaging	Y	111,826	55,913	1079.0	1,332,478
Total Recommended for Solar Roof Space		180,445	area		
Usable Area Percentage		50%	usable area		

Usable Area	90,223	sqft
PV Module Area	17	**sqft/module**
PV Modules Watts	335	W
Total Number of Panels	5,197	**#of panels**
Total Rated DC Power	1,741	kW Capacity
DC to AC Rated Power Ratio	90%	**%**
DC to AC Rated Power	1,567	kW Capacity
kWh produced annually per kW of DC rated power	1,235	**kWh**
kWh produced annually	2,148,787	kWh

STRATEGY/ACTION STEPS FOR IMPLEMENTATION

1. As building roofs are considered for replacement, please consult this list to assess if the roof is a good candidate for solar.
2. Perform an engineering review to determine if the building's roofs has the structural capacity to hold the solar arrays.
3. Develop a preliminary/conceptual design for a photovoltaic system.
4. Release an RFP for a turn-key solar installation. The RFP should consider both direct ownership and power purchase agreements project delivery options.

Table 1-10

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM) - ROOFTOP SOLAR
ENERGY SAVINGS SUMMARY
10/4/2021

Selection[4] (Y)es (N)o (O)ption	Line No.	Building	Energy Conservation Measure	Total Measure Cost[1] ($)	Building Electric Savings (kWh)	Building Chilled Water Savings (mmBtu)	Building Steam Savings (mmBtu)	Total Building Savings (mmBtu)	Emissions Reduction (MT of CO_2)[5]	Cost / mmBtu Saved	Line No.
O	22	Eastman	Eastman Campus Rooftop Solar	$1,066,718	738,717	0	0	2,521	99	$423	22
O	23	Medical	Medical Campus Rooftop Solar	$9,739,809	5,905,583	0	0	20,150	793	$483	23
O	24	River	River Campus Rooftop Solar	$7,947,170	4,818,644	0	0	16,441	647	$483	24
O	25	South	South Campus Rooftop Solar	$3,103,412	2,148,787	0	0	7,332	288	$423	25
	Subtotal			$21,857,109	13,611,731	0	0	46,444	1,827	$471	
				Total Measure Cost[1] ($)	Annual Electric Savings (kWh)	Annual Chilled Water Savings (mmBtu)	Annual Fuel Savings (mmBtu)	Total Annual Savings (mmBtu)	Emissions Reduction (mT of CO_2)	Cost / mmBtu Saved	
			Total Selected Project[4]:	$0	0	0	0	0	0	0	
			Project Contingency (included in Total Measure Cost)[2]:	$0							
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	$0							

NOTES:

1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below: Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by the Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Emissions savings based on rates outlined in section 2.

Table 1-11

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM) - **ROOFTOP SOLAR**
PAYBACK SUMMARY | BUILDING UTILITY COST 10/4/2021

Selection[4] (Y)es (N)o (O)ption	Building	Line No.	Energy Conservation Measure	Total Measure Cost[1] ($)	Annual Electric Savings[5] ($)	Annual Chilled Water Savings[5] ($)	Annual Steam Savings[5] ($)	Annual O&M Savings ($)	Total Annual Savings[5] ($)	Simple Payback Period	Purchased Utility Electric Savings[6]	Purchased Utility Nat. Gas Savings[6]	Purchased Utility Payback Period[7]	Line No.
O	Eastman	22	Eastman Campus Rooftop Solar	$1,066,718	$66,485	$0	$0	-$4,048	$62,436	17.1	$48,017	$0	22.2	22
O	Medical	23	Medical Campus Rooftop Solar	$9,739,809	$531,503	$0	$0	-$32,362	$499,140	19.5	$383,863	$0	25.4	23
O	River	24	River Campus Rooftop Solar	$7,947,170	$433,678	$0	$0	-$26,406	$407,272	19.5	$313,212	$0	25.4	24
O	South	25	South Campus Rooftop Solar	$3,103,412	$1,225	$0	$0	-$11,775	$181,616	17.1	$139,671	$0	22.2	25
	Subtotal			$21,857,109	$1,225,057	$0	$0	-$74,591	$1,150,464	19.0	$884,763	$0	24.7	
			Total Selected Project[4]:	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**0**	**$0**	**$0**	**0**	
			Project Contingency (included in Total Measure Cost)[2]:	**$0**										
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	**$0**										

1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below:
   Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Cost savings based on the by BUILDING UTILITY RATES are defined as the fully burdened utility rate, paid by the buildings, please refer to Section 2 for additional details regarding the applied utility rates.
6. Cost savings based on the by PURCHASED UTILITY RATES are defined as the rates paid by UR to the utility service providers, please refer to Section 2 for additional details regarding the applied utility rates.
7. PURCHASED UTILITY PAYBACK PERIOD this is the payback period based on the cost sayings applying the PURCHASED UTILITY RATES

PART 2 | DEEP DIVE - Orthopedic Ambulatory Care

PROJECT BACKGROUND

The potential Photovoltaic system is outlined as follows:

- Roof mounted solar system, with an area of 3 acres.
- Total Photovoltaic System capacity is estimated at 750kW DC. This size is constrained based on available area as well as the limit for nonresidential MEGABLOCK incentive program.
- The Photovoltaic system will be connected behind the meter on the building side of the utility meter.
- The Photovoltaic system will offset the building's electrical usage first with excess energy generation transmitted to the grid.
- The roof structure is assumed to be able to accommodate the additional load of the PV system including racking. This needs to be verified during design.

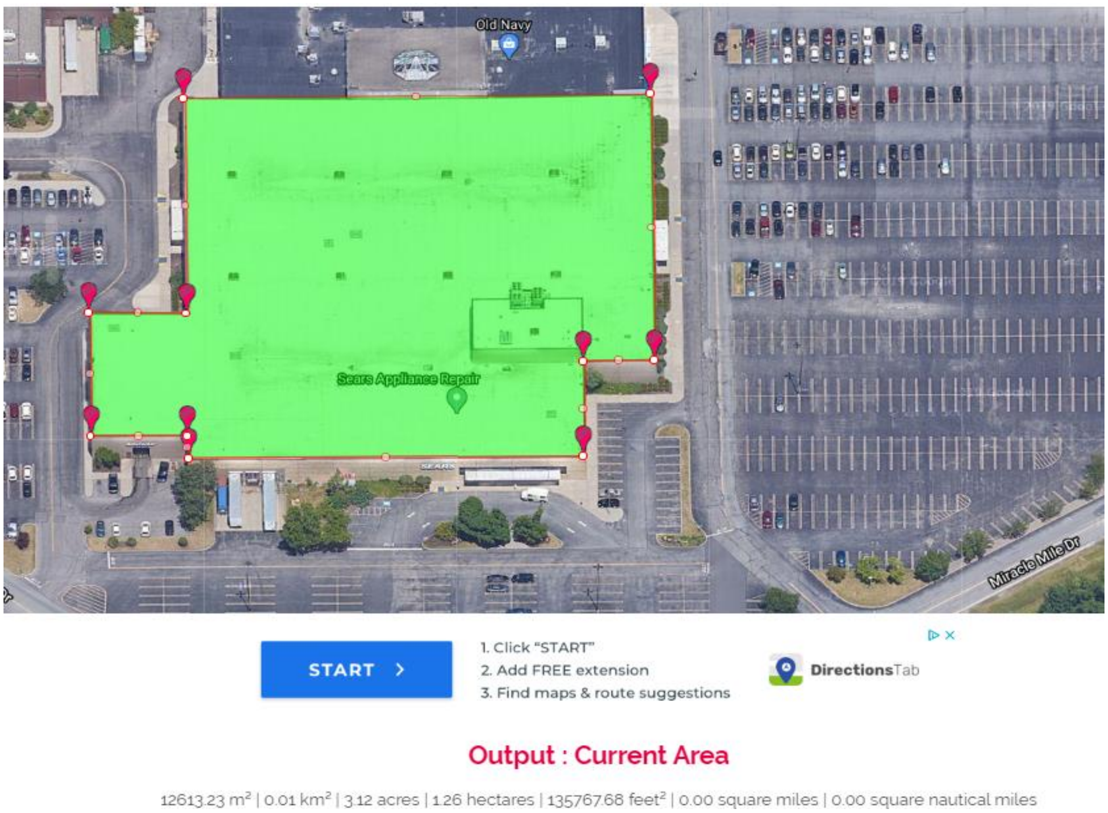


Figure E15 – Aria view of the project site. This is the existing Sears store that will be converted into the new facility. This information is as of July 2020.

EXAMPLE PROJECT

NET BENEFIT

- The **Photovoltaic System is anticipated to generate 925,646kWh** of energy annually.and was calculated for this site using the online tool, *PVWatts*.
- Carbon offset 106.6 MT CO2e (based on eGRID2018 for region NYUP)
- Social Cost of Carbon
  - Low End: $5,042.18 (based on NYISO)
  - High End: $25,451.18 (based on NYSERDA)
  - Additional Data Point: $5,536.80 (based on US EPA)

Rates for reference regarding the Social Cost of Carbon

- *U.S. EPA: $51.94/metric Ton CO_2*
- *NYISO: $47.30/metric Ton CO_2*

- *NYSERDA: $27.41/MWh (Converts to $238.75/metric Ton CO_2)*

OPTION A | NO EXPORT

Summary

- Total Cost AFTER INCENTIVES: $1,336,875
- Annual Savings: $60,167

Solar Energy Consumption

Applying the background information, the following are initial energy production estimates:

- All solar energy generated (925,646kWh) is used on site to **offset an annual utility cost of $60,167**. This was calculated based on an assumed utility rate of $.065/kWh.

Applicable Incentives:

- NYSERDA NYSUN MEGABLOCK | 750kW at a rate of $0.35/W which equates to $262,500 paid directly to the NYSERDA approved Contractor.
- NYSERDA VALUE STACK | not applicable for this Option.
- NYSERDA ENERGY STORAGE | not applicable currently.

The anticipated project cost breaks down as follows:

- $1,900 per kW installed by NYSERDA APPROVED electrical subcontractor (based on recent project for a similar scope)
  - $350 per kW NYSERDA MEGABLOCK INCENTIVE paid to contractor
  - $1,550 per kW Installed cost after incentive
  - X 1.15% (15% markup for CM or GC, assumed that this contract would fall into the larger building project)
- **$1,782.50 per kW final cost to University of Rochester**
- Extrapolating the cost to a 750 kW system results in **$1,336,875 total project cost** AFTER Incentives paid to Contractor. Note that this assumes a ballasted racking system with no additional structural modifications.

OPTION B | WITH NET ENERGY EXPORT

Summary

Total Cost AFTER INCENTIVES: $1,336,875
Annual Savings: $65,294.32

Solar Energy Consumption

Applying the background information, the following are Initial energy production estimates:

- **Anticipated building energy usage is 459,528kWh annual.** This was determined by using CBECS classification for a medical outpatient facility in the Mid-Atlantic region. This statistic is a median number that represents existing buildings. Since the proposed building is to be renovated a discount percentage of 15% lower energy usage was calculated. This was used as the new building will have to meet new energy and building codes placing the buildings proposed usage below the median. The portion of the solar energy generated, and used on site, will equate to an annual finical benefit of **$29,*869*.32**. This was calculated based on an assumed utility rate of $.065/kWh.
- The anticipated **exported energy to the gird is anticipated to be 466,117 kWh.**

Applicable Incentives:

- NYSERDA NYSUN MEGABLOCK | 750 kW at a rate of $0.35/W which equates to $262,500 paid directly to the NYSERDA approved Contractor.
- NYSERDA VALUE STACK | Calculated rate for exported energy is $.076/kWh. This is an annual value of $35,425.
- NYSERDA ENERGY STORAGE | not applicable currently.

The anticipated project cost breaks down as follows:

- $1,900 per kW installed by NYSERDA APPROVED electrical subcontractor (based on recent project for a similar scope)
- -$350 per kW NYSERDA MEGABLOCK INCENTIVE paid to contractor
- $1,550 per kW Installed cost after incentive
- X 1.15% (15% markup for CM or GC, assumed that this contract would fall into the larger building project)
- **$1,782.50 per kW final cost to University of Rochester**
- **$1,336,875 total project cost AFTER Incentives paid to Contractor.** Note that this assumes a ballasted racking system with no additional structural modifications.

INCENTIVE PROGRAMS

There are four programs which were reviewed. **We have highlighted in bold key items for each program**. These are as follows:

- NYSERDA Megawatt block program through NY Sun
- The Value Stack (VDER or Value of Distributed Energy Resources)
- NYSERDA Retail Energy Storage Incentive Program
- Community Solar Program (Not Applicable, since this is a subscription-based program and environmental attributes are retained by the utility.)

NY MEGAWATT BLOCK

Summary of the Program

The New York State Energy Research and Development Authority (NYSERDA) provides financial incentives and financing options through the NY Sun Incentive Program for the installation of new grid-connected solar photovoltaic (solar electric) systems or residential solar photovoltaic systems.

Funding for the program has been allocated by the New York State Public Service Commission through the Clean Energy Fund (CEF) with additional funding made available through the Regional Greenhouse Gas Initiative. Incentives are granted on a first-come, first-served basis, and **applications will be accepted through December 31, 2023**, or until funds are fully committed.

The residential and nonresidential program relies on contractors and builders to implement new solar electric systems for customers seeking incentives through the program. Contractors are responsible for the contract with the customer, while builders are responsible for the installation of the system. A company that is approved as both a contractor and builder is responsible for all aspects of the project. Before a contractor and builder can work together, they must establish a contractor-builder relationship agreement through the program.

Visit nyserda.ny.gov/find-a-solar-contractor for a list of approved contractors.

Incentive Structure

Solar incentives are available on a first-come, first-served basis and are based on direct current (DC) module wattage ratings at standard test conditions (nameplate rating).

The program is based on a megawatt (MW) block model an incentive structure designed to provide certainty and transparency around incentive levels account for regional market differences clarify that New York State intends to phase out cash incentives in a reasonable time frame and eliminate those incentives sooner in regions where market conditions can support it, based on market penetration, demand, and payback.

The MW block approach allocates megawatt targets to specific regions of the State, breaks those targets into blocks, and assigns incentives per block. Incentives are awarded based on the block in effect at the time of submission. Once all blocks within a region/sector are fully subscribed, the incentive is no longer available to that region/sector. NYSERDA will monitor market conditions and MW block subscription and adjust accordingly. NYSERDA will notify stakeholders in advance of any planned changes. Regional MW Blocks and Sectors   The balance of the State (Upstate)   Residential up to 25kW   **Nonresidential up to 750kW**   Commercial/Industrial 750kW to 7.5MW

Project Incentives Cap

Project incentives are capped at the following system sizes:

Sector	PV System Size Cap
Residential	25kW DC
Nonresidential	750kW DC
Commercial/Industrial	7.5MW DC

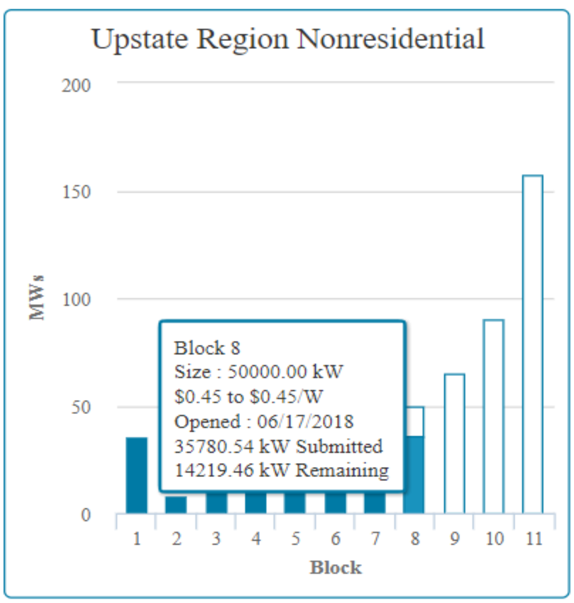
Projects larger than 750kW in the Upstate NY region are not eligible for nonresidential incentives and must be submitted to the commercial/industrial program. Residential projects calculated to offset more than 110% of the systems annual electric usage are not eligible for incentives or financing. New construction residential systems must not to exceed 110% of the calculated yearly projected kilowatt-hour of electric usage. These caps do not apply to nonresidential and commercial/ industrial projects.

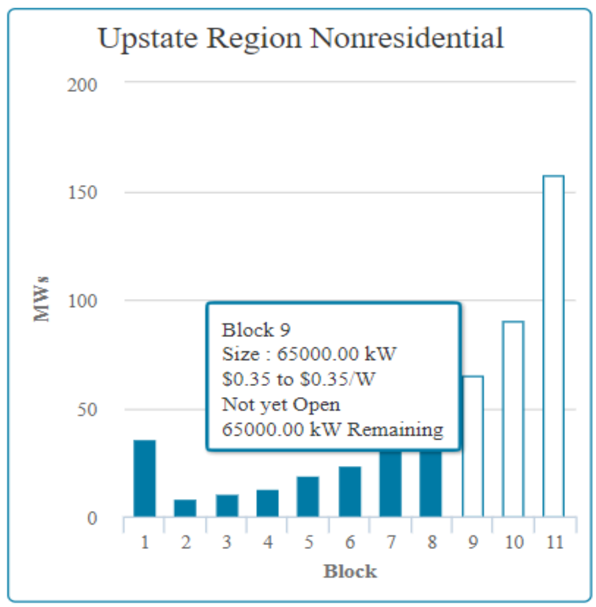
All residential and **nonresidential projects have 365 days from the project approval date (the date project is marked approved in the portal) to complete the system installation** and submit for final project invoice approval.

System Size Cap

The system size was chosen at 750kw. This was done to maximize the Megawatt block direct to contractor payment by staying in the Non-residential block.

The current block for Non-Residential is valued at $0.45 watt ($450 kW) of DC rated solar installations. **To be conservative, based on the project's timeline, it is anticipated that the next block with a lower value of $0.35 a watt ($350 kW) should be applied.**





The application process through this program is **reliant on the NYSERDA approved contractor for the submission** and completion of the of the necessary documentation to receive the direct to contractor incentive. **The payment of the incentive is direct to the contractor.**

Below is a list of required documentation that is needed to achieve submitted status for the incentive and lock in the incentive.

1. **Documents to Reach Submitted Status**
    a. Required for All Projects: Must Submit with Project Application
    b. Project application signed by customer and payee, if applicable
    c. Site map (site plan)
    d. Site photos
    e. Electrical drawing
    f. Customer utility bill - only required for NYPA and municipality owned utilities

2. **Additional Items Required for Residential and Nonresidential Projects**
    a. Shading report

3. **Additional Items Required for Nonresidential and Commercial/Industrial Projects**
    a. If Coordinated Electric System Interconnection Review (CESIR) required: Final CESIR, proof of 25% interconnection upgrade payment and if in C/I, proof of planning and zoning approvals
    b. If no CESIR required: signed and executed interconnection agreement
    c. Coastal Assessment
    d. SEQRA and lead agency, SEQRA Negative Declaration for C/I

4. **Documents Not Required with Submission: Must be Available Upon Request Required for All Projects**
    a. Customer agreement
    b. Customer utility bill
    c. Permits - required with project invoice submission
    d. Environmental assessment - for projects more than 4,000 square feet
    e. Clipboard energy efficiency assessment - for residential projects only
    f. Nonresidential and C/I energy assessment - for nonresidential or C/I projects only projects only
    g. Construction photos of the completed installation

THE VALUE STACK (VDER or Value of Distributed Energy Resources)

SUMMARY OF THE PROGRAM

In support of Reforming the Energy Vision, the New York State Public Service Commission established a mechanism to transition to a new way to compensate distributed energy resources (DER), like solar power. This mechanism, called the Value of Distributed Energy Resources (VDER) or the Value Stack, replaces net energy metering (net metering or NEM). VDER compensates projects based on when and where they provide electricity to the grid.

The value stack compensation methodology increases renewable energy projects by compensating producers for more than just energy supply costs. The breakdown of these compensations is detailed in the community solar option section below.

NYSERDA provides a calculator that helps prospective solar producers evaluate the financial aspects of the value stack.

Reference:https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Contractors/Value-of-Distributed-Energy-Resources/Solar-Value-Stack-Calculator

ELIGIBILITY REQUIREMENTS

VDER has a size limitation of 5 MW that is currently in place per site/ meter.

Calculating Projected Credits:

As part of NY Sun, solar bill credits in New York State are calculated through the Value of Distributed Energy Resources Program (VDER) set forth by the New York Public Service Commission (NYPSC). For every kWh of energy that the community solar project delivers to the grid, the utility will determine its value through five criteria, which make up the 'Value Stack':

- LMP = Location Marginal Pricing. Standard/publicly available price of energy in the local market. A value of energy produced by solar that changes with the energy market. Varies by NYISO Zone.
- C = Capacity. The cost of resources required to deliver energy to your utility plus other charges such as backup. This value also changes with the energy market. Varies by utility territory.
- E = The environmental benefits of Solar Production and guaranteed by the NYSERDA. This value is fixed for the full 25-year project life.
- DRV = Demand Reduction Value. Based on the generators average hourly output during summer peak hours. May appear monthly or only during the summer months depending on project configuration. Varies by utility territory.
- CC = Community Credit. Provided to projects participating in the Community Solar program. This value is fixed for the full 25-year project life. (The Community Credit does not apply to Orange and Rockland and Central Hudson projects.)

APPLICATION PROCESS

There is no official application process, the value stack compensation methodology is determined during the interconnection process and application with the utility.

Section D

Evaluation of Potential ECMs

Retro-Commissioning

ECM 4 | Retro-Commissioning

Retro-Commissioning

- Completed in existing buildings to develop optimization strategies and improvements.
- Includes calibration, functional performance testing, and implementation of improvement strategies.

OPPORTUNITY

Proper setup and operation of HVAC systems and equipment is critical to maintaining occupant comfort, providing proper ventilation and operating the systems as efficiently as possible. Wendel conducted a preliminary evaluation of the operation of the HVAC Systems in Rush Rhees Library, Danforth Dining Hall, and Fredrick Douglass Commons. This evaluation was performed both remotely and on-site as follows The operation of the equipment was evaluated which included observation of operation remotely through the BMS graphical display and reviewing trends. Once some operational items were identified through the remote evaluation, Wendel worked with University personnel, during an on-site working session to, determine additional operational issues and efficiency opportunities.

Wendel identified areas of potential improvements that require further investigation through Retro-Commissioning which includes ventilation optimization, space temperature control optimization and HVAC equipment optimization. The following is a high-level overview of observations which informed our recommendations for RCx ECMs.

- Air Handling Unit operation appears to present opportunities for energy savings based on the following:
  - Adjust sequences and setpoints for discharge air temperature and static pressure reset.
- Building zone and spaces appear to be missing control points to allow for more efficient control such as:
  - Incorporate CO2 sensors to allow for demand-controlled ventilation.
  - Incorporate occupancy sensor for HVAC system control in conference rooms and other variable occupancy spaces.
  - Set back temperatures of spaces during unoccupied times
  - Adjust operation of kitchen hood ventilation rates.
  - Program Dual Duct Boxes for independent Air Valve operation to reduce air flow based on cooling/heating need.
- Additional observations of building systems
  - Interlock Fin Tube Radiation with space terminal air boxes to prevent simultaneous heating and cooling.
  - Heat Pumps and Walk in Coolers condensers sink with the chilled water system.

INVESTIGATION APPROACH

Three buildings were evaluated as follows:

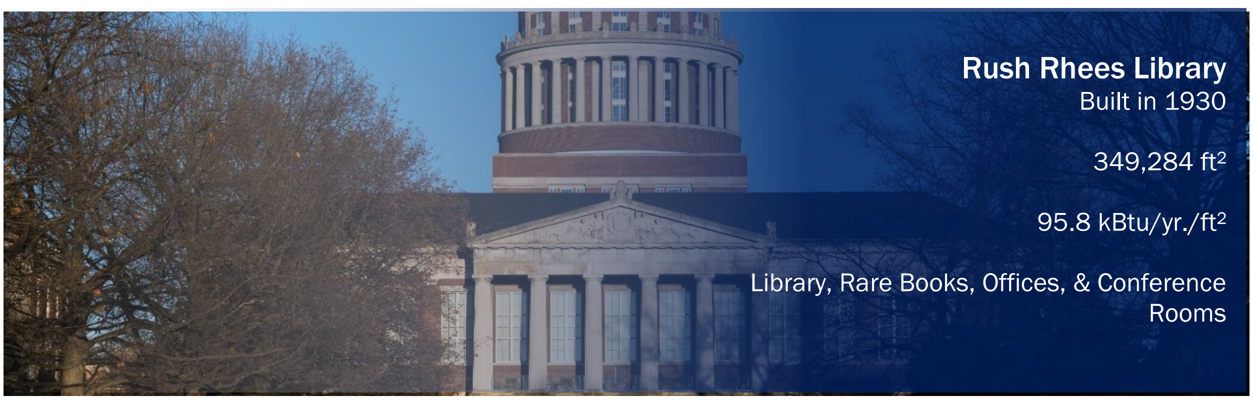
- Part 1 | interview facility staff | Wendel and UR team met to discuss equipment, control systems and strategies associated with the buildings selected.
- Part 2 | review drawings and control system | Wendel review drawings and the control systems. We identified items of interests and summarized observations.
- Part 3 | Site Visit | brief field survey of the building to identify systems that may not be operating as intended or field deficiencies.
- Part 4 | Summarize Results | assess based on observations likely ECMs along with likely costs and savings.

Please note that the intent of this scoping survey is to provide a reasonable, building specific, expectation of the results of a retro-commissioning. The retro-commissioning effort will determine actual deficiencies, energy savings and costs.

EXISTING SYSTEMS

The buildings at University of Rochester incorporate several systems and mechanical equipment to provide a safe and comfortable environment for students, staff, and other building occupants. The interactive operation between these systems is controlled and sequenced through the Building Management System (BMS). A summary of the buildings included in the scoping survey, specifically the mechanical systems and BMS, can be found below:

RUSH RHEES LIBRARY



The existing heating and cooling systems at Rush Rhees Library are primarily served by the Central Utilities Plant (CUP), receiving both district steam and chilled water.

The district steam is converted to heating hot water using three (3) steam to hot water heat exchangers. Additional hot water equipment is in-service for the glycol pre-heat loop and snow melt system for exterior walkways. Hot water system equipment includes:

- Three (3) primary hot water pumps on 3 different steam to hot water systems.
- One (1) snow melt pump.
- Hot water to glycol heat exchanger for specific pre-heat coils.
- Hot water radiation systems

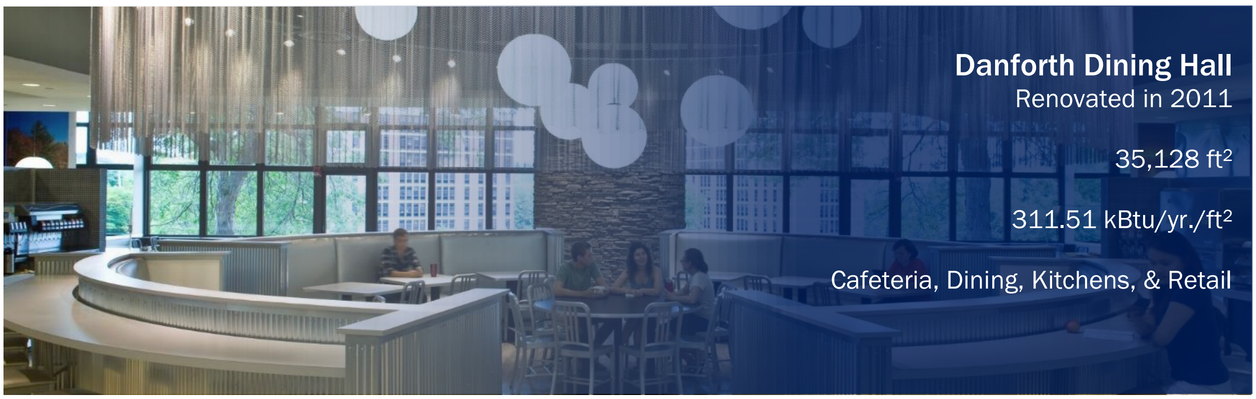
Chilled water is distributed through the building to central air handling units and fan coil units through two (2) chilled water pumps. Airside conditioning and ventilation is provided through seven (7) central air handling units and various air terminal devices, fan coil units, and heat pump units. Airside equipment includes:

- Seven (7) Air Handling Units
- DDU boxes for most spaces.

- Unitary Air Handlers
- Seventeen (17) Heat pump units.
- Seventeen (17) Fan Coil Units.

Regarding the Building Management System, the Rush Rhees Library utilizes systems from both ALC WebCTRL and Siemens Apogee. Between both systems, all major equipment is controlled by the BMS with the ability to trend all critical points. Wendel was able to remotely access both systems during the RCx scoping survey to observe existing system operation.

DANFORTH DINING HALL



The existing heating and cooling systems at Danforth Dining Hall are primarily served by the Central Utilities Plant (CUP), receiving both district steam and chilled water.

The district steam is converted to heating hot water using steam to hot water heat exchangers. Additional hot water equipment is in-service for the glycol pre-heat loop. Hot water system equipment includes:

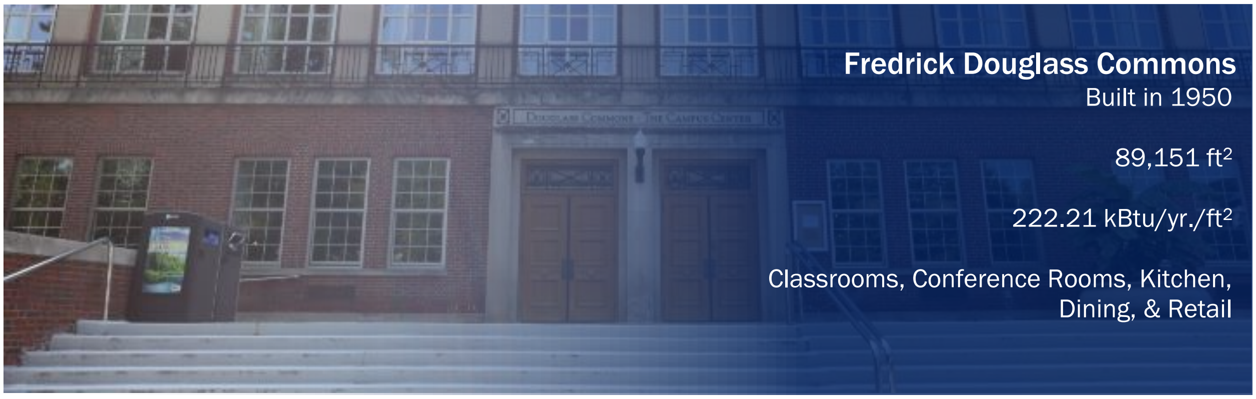
- 2 primary hot water pumps.
- 2 domestic hot water pumps.
- Hot water to glycol heat exchanger for specific pre-heat coils.
- Finned tube hot water radiation system

Chilled water is distributed through the building to a central air handling unit through one (1) chilled water pump. Airside conditioning and ventilation is provided through one (1) central air handling unit and various air terminal devices. Airside equipment includes:

- One (1) Air Handling Unit
- VAV boxes for most spaces.
- Unitary Air Handlers

Regarding the Building Management System, the Danforth Dining Hall utilizes systems from Schneider Electric Ecostruxure and Siemens Apogee. Through these systems, all major equipment is controlled by the BMS with the ability to trend all critical points. Wendel was able to remotely access both systems during the RCx scoping survey to observe existing system operation.

FREDRICK DOUGLASS COMMONS



The existing heating and cooling systems at Frederick Douglass Commons are primarily served by the Central Utilities Plant (CUP), receiving both district steam and chilled water.

The district steam is converted to heating hot water using steam to hot water heat exchangers. Additional hot water equipment is in-service for the glycol pre-heat loop and snow melt system for exterior walkways. Hot water system equipment includes:

- 4 primary hot water pumps.
- 4 Domestic Hot water pumps
- 1 snow melt pumps.
- Hot water to glycol heat exchanger for specific pre-heat coils.
- 4 hot water cabinet unit heaters.
- 1 finned tube hot water radiation systems.

Chilled water is distributed through the building to central air handling units and rooftop units through one (1) chilled water pump. Airside conditioning and ventilation is provided through five (5) central air handling units, four (4) rooftop units, and various air terminal devices. Airside equipment includes:

- VAV boxes for most spaces.
- Unitary Air Handlers
- 2 self-contained air conditioning units.
- 7 Door air curtains heaters.

Regarding the Building Management System, the Frederick Douglass Commons utilizes ALC WebCTRL. Through this systems, all major equipment is controlled by the BMS with the ability to trend all critical points. Wendel was able to remotely access both systems during the RCx scoping survey to observe existing system operation.

PROPOSED MEASURES FOR INVESTIGATION

The following is a description of the preliminary RCx ECMs identified as part of the scoping survey. For each RCx ECM we have identified the scope and the reasoning for their recommendation. These recommendations are in addition to any potential deficiencies that may be identified during the point-to-point and functional performance testing that will be completed in the field. Initial recommended modifications, by building, are included in the tables below. The measures identified during the scoping survey and indicated below were utilized as a basis for projecting the savings potential for extrapolation across the campus.

Rush Rhees Library

ECM #	ECM Name	Reasoning
1	Dual Duct Box Temperature Set Back	The terminal units (VAV's and DDUs) have no night temperature setback. All space is 24/7. Trending shows all spaces have constant set points that are manually changed.
2	Dual Duct Box Independent Air Valve Operation - Min/Max airflow	Dual Duct Boxes are set up for independent damper operation but are not operating that way. Set Damper positions according for need for cooling/heating demand along with max/min instead of discharge air temp with full air flow.
3	AHU | Static Pressure Reset	Reset Discharge air Static Pressure set point based on feedback from airflow to terminal units.
4	AHU | Discharge Air Reset	Reset Discharge air temperature based on OA and calls for cooling/heating.
5	Interlock Fin tube with Cooling Coil Valve/Radiation loop set point adjustment	Reset HW Radiation loop downward when calls for cooling are required. This was observed happening in shoulder seasons. May be harder to do with some of the terminal air units being on the siemens system and the radiation loop being hand valves.
6	Hot Water Pump VFD	Hot Water Pump running at constant speed. Install VFD
7	AHU | DCV	Current OA operations are based on ability to economize OAT VS Cooling Deck DAT (10-30% Damper 24/7). Recommend reviewing space requirements and implementing DCV sequences where applicable.

Table E2 - Summary of potential Retro-Commissioning Based ECMs.

Danforth Dining Hall

ECM #	ECM Name	Reasoning
1	Interlock Fin tube with Cooling Coil Valve/Radiation loop set point adjustment	Reset HW Radiation loop downward when calls for cooling are required. This was observed happening in shoulder seasons.
2	Night Set Back For temperature	The terminal units (VAV's) have no night temperature setback. All spaces are 24/7. Trending shows all spaces have constant set points that are manually changed.
3	AHU | Discharge Air Reset	Reset Discharge air Static Pressure set point based on feedback from airflow to terminal units.
4	AHU | DCV	Air Handling Unit could benefit from demand control ventilation sequences and or adjustments to the sequences to optimize reductions. Current OA operations are based time of day but is in covid protocol.

Table E3 - Summary of potential Retro-Commissioning Based ECMs.

Fredrick Douglass Commons

ECM #	ECM Name	Reasoning
1	Interlock Fin tube with Cooling Coil Valve/Radiation loop set point adjustment	Reset HW Radiation loop downward when calls for cooling are required. This was observed happening in shoulder seasons.
2	Night Set Back For temperature	The terminal units (VAV's) have no night temperature setback. All spaces are 24/7. Trending shows all spaces have constant set points that are manually changed.
3	DCV set point adjustment for RTU 1-4	Revise CO2 setpoint up from 750 PPM
4	Retune Hood captive air systems	Captive air systems reduce Exhaust based on temperature. The hoods have had issues with smoke capture since installation. Proper capture will reduce exhaust and OA needed to make up.
5	AHU | DCV	Air Handling Units could benefit from demand control ventilation sequences and or adjustments to the sequences to optimize reductions. Current OA operations are based time of day but is in covid protocol.

Table E4 - Summary of potential Retro-Commissioning Based ECMs.

DESIGN & OPERATION ASSUMPTIONS

The following existing conditions and design assumptions were made in the development of this project and are key considerations in the project cost presented. The University of Rochester warrants that, to the best of the University's knowledge, the following design assumptions are accurate.

- The existing building automation control system is in overall good, operating condition. All existing temperature sensors and control points will be verified through point-to-point check-out and calibration.
- The existing major HVAC equipment is in good, operating condition.
- The existing major HVAC equipment and spaces served are capable of operating within the proposed sequence of operations changes.
- The existing equipment and space level controllers have available spare inputs and/or outputs and can accommodate addition controls points necessary for proposed sequence adjustments. The need for replacement controllers will need to be evaluated during the point-to-point testing portion of the RCx process.
- It is assumed the University of Rochester buildings can accommodate a temporary mechanical shut down during construction. Mechanical shutdowns will be planned with University personnel in advanced and timed during a period of low user activity and favorable weather conditions. Temporary heating and cooling is not included.

IMPACT ON THE END USER

Building occupants will not be affected by this measure once constructed and in operation.

OPERATION AND MAINTENANCE

Annual and Preventative Maintenance

A summary of proposed equipment can be found below:

Proposed Equipment:

- Carbon Dioxide Sensors (quantity unknown)
  - New or additional CO_2 sensors may be required to implement proposed strategies.
- Captive Air Kitchen Hood Systems
  - Additional controls and sensors will require annual and preventative maintenance to ensure proper operation.

Avoided Future Capital Cost

As part of this project, no equipment is anticipated to be removed. Therefore, avoided future capital costs have not been calculated in association with this measure.

Table 1-12

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE - RETRO-COMMISSIONING
(ECM) ENERGY SAVINGS SUMMARY
10/4/2021

Selection[4] (Y)es (N)o (O)ption	Line No.	Building	Energy Conservation Measure	Total Measure Cost[1] ($)	Building Electric Savings (kWh)	Building Chilled Water Savings (mmBtu)	Building Steam Savings (mmBtu)	Total Building Savings (mmBtu)	Emissions Reduction (MT of CO_2)[5]	Cost / mmBtu Saved	Line No.
O	26	DDH	Retrocommissioning | Best Case	$18,200	41,050	140	281	561	30	$32	26
Y	27	DDH	Retrocommissioning | Median	$24,400	35,919	123	246	491	26	$50	27
O	28	DDH	Retrocommissioning | Worse Case	$30,600	30,788	105	211	421	22	$73	28
O	29	RRL	Retrocommissioning | Best Case	$78,380	394,099	2,037	5,038	8,420	480	$9	29
Y	30	RRL	Retrocommissioning | Median	$165,130	295,947	1,413	3,473	5,896	334	$28	30
O	31	RRL	Retrocommissioning | Worse Case	$251,880	197,795	789	1,908	3,372	189	$75	31
O	32	FDC	Retrocommissioning | Best Case	$36,600	2,390	763	1,679	2,450	144	$15	32
Y	33	FDC	Retrocommissioning | Median	$64,900	1,912	668	1,454	2,129	125	$30	33
O	34	FDC	Retrocommissioning | Worse Case	$93,200	1,434	573	1,230	1,808	106	$52	34
				Total Measure Cost[1] ($)	Annual Electric Savings (kWh)	Annual Chilled Water Savings (mmBtu)	Annual Fuel Savings (mmBtu)	Total Annual Savings (mmBtu)	Emissions Reduction (mT of CO_2)	Cost / mmBtu Saved	
			Total Selected Project[4]:	$254,430	333,778	2,204	5,173	8,516	485	$30	
			Project Contingency (included in Total Measure Cost)[2]:	$18,784							
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	$18,784							

NOTES:

1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below: Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by the Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Emissions savings based on rates outlined in section 2.

Table 1-13

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM) - RETRO-COMMISSIONING
PAYBACK SUMMARY | BUILDING UTILITY COST 10/4/2021

Selection[4] (Y)es (N)o (O)ption	Building	Line No.	Energy Conservation Measure	Total Measure Cost[1] ($)	Annual Electric Savings[5] ($)	Annual Chilled Water Savings[5] ($)	Annual Steam Savings[5] ($)	Annual O&M Savings ($)	Total Annual Savings[5] ($)	Simple Payback Period	Purchased Utility Electric Savings[6]	Purchased Utility Nat. Gas Savings[6]	Purchased Utility Payback Period[7]	Line No.
O	DDH	26	Retrocommissioning | Best Case	$18,200	$3,695	$3,062	$4,100	$0	$10,856	1.7	$2,911	$1,443	4.2	26
Y	DDH	27	Retrocommissioning | Median	$24,400	$3,233	$2,679	$3,587	$0	$9,499	2.6	$2,547	$1,263	6.4	27
O	DDH	28	Retrocommissioning | Worse Case	$30,600	$2,771	$2,296	$3,075	$0	$8,142	3.8	$2,183	$1,082	9.4	28
O	RRL	29	Retrocommissioning | Best Case	$78,380	$35,469	$44,411	$73,560	$0	$153,440	0.5	$29,134	$25,549	1.4	29
Y	RRL	30	Retrocommissioning | Median	$165,130	$26,635	$30,810	$50,708	$0	$108,154	1.5	$21,677	$17,618	4.2	30
O	RRL	31	Retrocommissioning | Worse Case	$251,880	$17,802	$17,210	$27,856	$0	$62,868	4.0	$14,220	$9,688	10.5	31
O	FDC	32	Retrocommissioning | Best Case	$36,600	$215	$16,648	$24,509	$0	$41,372	0.9	$1,474	$8,572	3.6	32
Y	FDC	33	Retrocommissioning | Median	$64,900	$172	$14,567	$21,235	$0	$35,974	1.8	$1,278	$7,432	7.5	33
O	FDC	34	Retrocommissioning | Worse Case	$93,200	$129	$12,486	$17,961	$0	$30,576	3.0	$1,082	$6,291	12.6	34
			Total Selected Project[4]:	**$254,430**	**$30,040**	**$48,056**	**$75,530**	**$0**	**$153,627**	**1.7**	**$25,502**	**$26,313**	**4.9**	
			Project Contingency (included in Total Measure Cost)[2]:	**$18,784**										
			Pricing Escalation Reserve (included in Total Measure Cost)[3]:	**$18,784**										

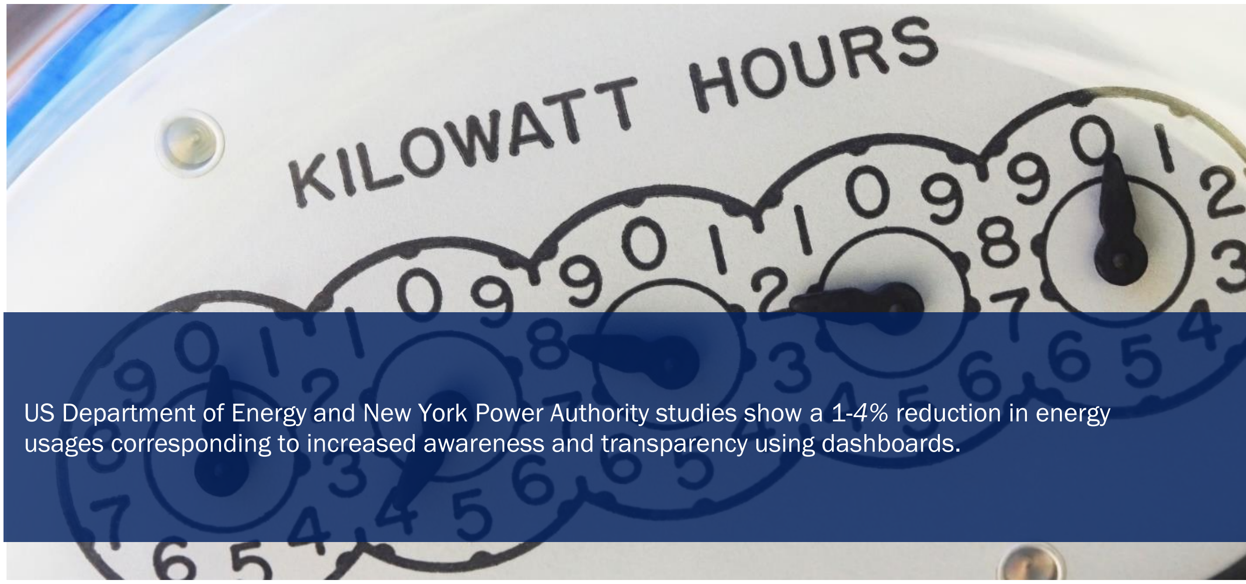
1. TOTAL MEASURE COST includes direct construction costs (subcontractor material and labor) and DOES include contingency and fees for services described below:
   Energy, Electrical and Mechanical engineering, Construction documents, Financing assistance services, Subcontractor coordination and administration
2. This is the project contingency which is managed by Owner.
3. Pricing Escalation Reserve: is a fund established to help offset market variations in pricing over the approval and design period.
4. Total Selected Project is based on the Y or Yes values in the Selection Column.
5. Cost savings based on the by BUILDING UTILITY RATES are defined as the fully burdened utility rate, paid by the buildings, please refer to Section 2 for additional details regarding the applied utility rates.
6. Cost savings based on the by PURCHASED UTILITY RATES are defined as the rates paid by UR to the utility service providers, please refer to Section 2 for additional details regarding the applied utility rates.
7. PURCHASED UTILITY PAYBACK PERIOD this is the payback period based on the cost sayings applying the PURCHASED UTILITY RATES

Section E

ENERGY DATA AND ANALYSIS

Task 3

TASK 3 | ENERGY DATA ANALYSIS



US Department of Energy and New York Power Authority studies show a 1-4% reduction in energy usages corresponding to increased awareness and transparency using dashboards.

The University of Rochester (UR) currently has about 800 energy meters connected to an OSISoft PI data acquisition and analytics data repository system (PI). These electric, natural gas, hot water, chilled water, and domestic water meters represent about 9 million square feet of the University's total 12 million gross square feet. In addition to meter information some of the building and utility plant data is collected and analyzed in PI. The current system does not have several key functionalities, including the necessary analytics capabilities needed to make strategic decisions, data transparency for University stakeholders, greenhouse gas (GHG) emissions tracking, measurement and verification, and communication of energy conservation efforts.

UR, in coordination with Wendel, has developed a plan to integrate an energy management information system (EMIS) into its existing infrastructure and processes in support of achieving its energy conservation and GHG reduction goals. The EMIS software is intended to track, coordinate, and analyze energy usage data and energy conservation measures, as well as facilitate communication to stakeholders and the broader community, thereby filling the gaps left by the current system. The energy conservation strategy, of which the EMIS will be a key component, consists of three pillars: Visibility, Leadership and Impact.

The EMIS will consist of a dashboard which will serve multiple end-use functions including:

- Public dashboard to display energy use, associated carbon emissions and communicate goals and progress to our community
- Analytics for energy use and related carbon emission to help target and drive conservation efforts, including weather normalization and baseline capabilities.
- Measurement and Verification capabilities to substantiate energy and carbon savings to our stakeholders (M&V)
- Meter Verification Validation and Editing (VVE)
- Reporting with built-in and custom capabilities
- Meter data integration of our campus owned interval data sub-meters
- Utility account data import from commercial utility meter accounts

Energy Conservation Strategy Pillars

- Alarming of suspected failed meters or suspicious energy use
- Energy conservation project tracking and reporting
- Access control for users and groups incorporation single-sign-on

POTENTIAL VENDORS

There are a host of vendors that provide EMIS solutions. The University put together a list of potential vendors able to meet the University's needs to provide the EMIS. Six (6) vendors provided bids to the University. These vendors are listed below:

- eSightenergy https://www.esightenergy.com/us/
- Watchwire by Energy Watch https://energywatch-inc.com/
- Custom PI Solution by DSA https://www.dsainc.com/
- BuildingOS by Lucid https://buildingos.com/
- Custom PI Solution by Rovisys https://www.rovisys.com/
- Energy Manager by Dude Solutions https://www.dudesolutions.com/products/energy-manager

SYSTEM COMPARISON

Each of the vendors provide EMIS solutions through a variety of different approaches. Some of the solutions are custom PI-based systems, similar to the University's existing infrastructure. Other vendors provide prepackaged, software solutions that are able to integrate with PI but are not PI-based themselves. Two (2 of the potential systems are PI-based systems, the remaining four (4) are not PI-based systems.

Custom PI Solutions – DSA & Rovisys

Utilizing a PI-based solution has several advantages over packaged solutions. These advantages include not needing new software packages to support, increase PI capabilities, support for future initiatives, GIS integration, complete control by the University, and full customization. Despite the advantages, there are several negatives to going with a PI-based system, including more development time and effort, log-ins required for public dashboard, users are limited to UR domain emails, and a lack of packaged reports, analytics, and tools available with other solutions. DSA and Rovisys provide nearly identical services.

Packaged Solutions – eSight, Watchwire, Lucid BuildingOS, & Dude Energy Manager

Packaged solution vendors provide a different set of advantages and disadvantages. The positives of going with a packaged solution is pre-configured tools, analytics, and reports, ease of access to web-based public dashboard, ease of use, and automatic product updates. Dude is the only solution with the additional advantage of reading all meter values directly, thereby removing the meters completely from PI. Some negatives of the packaged solutions include the need to maintain connections with the existing PI system, less flexibility, and training required to learn new system. A table outlining the relative advantages and weaknesses of each of the systems is provided below:

Feature Summary Table

Vendor	eSight	DSA	Energy Watch	Rovisys	LCS	Dude	Best in Class
Product	eSight	PI	WW	PI	Bldg OS	Dude	-
Hosted	Local	Local	Cloud	Local	Cloud	Cloud	WW
Direct to Meters	No	Yes	No	Yes	No	Yes	Dude
Meter Alarming	■ ■	■ ■ ■	■	■ ■ ■	■ ■	■ ■ ■	PI
Meter VVE	■ ■ ■	■ ■ ■	■ ■	■ ■ ■	■ ■ ■	■ ■ ■	eSight
Billing Module	■ ■ ■	■	■ ■ ■	■■	■ ■	■ ■ ■	eSight
Utility Data Import	■ ■ ■	■ ■ ■	■ ■ ■	■■	■ ■ ■	■ ■ ■	non-pi
Reporting	■ ■ ■	■ ■	■ ■	■■	■ ■ ■	■ ■ ■	Lucid
M&V	■ ■ ■	■ ■	■ ■ ■	■ ■	■ ■ ■	■■	eSight
Savings Tracking	■ ■ ■	■ ■	■ ■ ■	■	■ ■ ■	■ ■ ■	eSight

Analytics	■ ■ ■	■■	■■	■■	■■ ■	■ ■ ■	Lucid
Public Dashboards	■ ■ ■	■	■ ■	■	■■ ■	■ ■	Lucid
UR Dashboards	■ ■	■ ■	■ ■	■ ■	■ ■ ■	■ ■	
Additional Abilities	-	■ ■ ■	-	■ ■ ■	-	-	DSA, Rov
Strength	Well Rounded	PI	Ease, Billing	Process	Dash boards	Inte-gration	-
Weakness	None	Dashbrd, Difficulty	Dashbrd	Dashbrd, Difficulty	Cost	Cost, Complex	-

Legend

-	Not available	Importance	
■	Functional, but limited capability	Low Importance	
■■	Functional	Medium Importance	
■■■	Functional, well done, easy to use	High Importance	

OPINION OF PROBABLE COST

Costs were obtained from each of the proposed vendors listed above. Costs for each system were broken up into initial cost, annual cost, and five-year cost for the program. The team also evaluated the additional costs of PI upgrades, if required. The costs for each of the vendors is presented in the table below. The costs in the table do not include any potential rebates or incentives.

Table 1. System and PI Upgrades Costs

Vendor	eSight	DSA	Energy Watch	Rovisys	LCS	Dude
Initial Cost	$79k	$122k	$58k	$265k	$24k	$121k
Annual Cost	$43k	$0	$53k	$0	$116k	$191k
Five-Year Cost	$294k	$122k	$323k	$265k	$604k	$1,076k
Additional PI Costs (Initial)	$0	$0	$37.5k	$0	$0	$0
Additional PI Costs (Annual)	$0	$50k	$5.6k	$50k	$0	$0
Total Five-Year Cost	$294k	$372k	$389k	$515k	$604k	$1,076k

ROAD MAP

The roll out of the EMIS includes vendor selection, information gathering, and implementation. The implementation will take place over three project phases.

1. Phase I - UR purchases the EMIS software
2. Phase II - UR configures the software specifically for its campus.
    a. building information
    b. assigning meters to specific buildings
    c. adding users & groups
    d. setting up views, reports, etc.
3. Phase III - UR works in units of blocks (sub-phases) on two fronts in parallel.
    a. Identify and capitalize on energy opportunities in areas of the campus which are already sub-metered.
    b. Install meters in the unmetered areas of the campus.
    c. Add additional software components as necessary to accommodate new meters.

Below is a tentative schedule for the EMIS implementation:

Task	Start	Duration	End
Vendor Selection	03/01/2020	0	03/01/2020
Information Gathering	03/02/2020	20	03/30/2020
Phase I	03/31/2020	65	06/30/2020
Phase II	09/01/2020	64	11/30/2020
Phase III	01/01/2021	650	06/30/2023

SAVINGS SUMMARY

The EMIS will facilitate the achievement of energy savings for the University. The EMIS system will direct building managers and system operators to operational improvements which will result in a reduction in energy usage. Energy savings are based on 1% of the University's annual electricity usage. These savings have been approved by Rochester Gas & Electric for the purpose of providing rebates for the installed equipment. A calculation of the estimated savings can be found in Appendix 5.

The savings will undergo measurement and verification (M&V) according to the International Performance Measurements & Verification Protocol (IPMVP). The University will track energy conservation efforts and provide a summary of before and after conditions. The M&V strategy document can be found in Appendix 5.

RESULTS

The University used the information and processes gathered here to select and EMIS vendor and begin implementation. eSight Energy was selected as the vendor which most closely matched the RFP requirements also had the lowest five-year total cost. The system was installed and configured in FY21 and is expected to be available to the UR community in FY22.

UNIVERSITY OF ROCHESTER

ENERGY CONSERVATION MEASURE (ECM)

ENERGY DATA ANAYLSIS PROJECT IMPACT SUMMARY

projected results for the Part 1 | Energy Management Information Systems (EMIS)

	Plant Level Summary			
	Building Level Energy Savings			
A	Electrical Energy Savings	5,525	mmBtu/Year	= E x .003412
B	Chilled Water Savings		mmBtu/Year	Not used
C	Steam Savings	17,229	mmBtu/Year	from EXTRAPOLATION Total
D	**Total Energy Savings**	**22,754**	**mmBtu/Year**	
	Building Level Utility Savings			
E	Electrical Energy Savings	1,619,294	kWh/Year	from Technical Appendix 6
F	Chilled Water Savings		Ton-Hour/Year	Not used
G	Steam Savings	17,229	klbs/Year	= C x 1,000,000 / 1,194(BTU/lb) / 1,000
H	Water Savings	-	kGal/Year	from detailed summary recommended total
	Purchased Utility Savings			
I	Electrical Energy Savings	1,619,294	kWh/Year	from Technical Appendix 6
J	Natural Gas Savings	25,681	mmBtu/Year	from Technical Appendix 6
K	**Total Energy Savings**	**31,206**	**mmBtu/Year**	= I x .003412 J
L	**% Savings of Total Utilities**	**1.0%**		Total Energy Usage / K
	Implementation Cost Estimate ($)			
M	EMIS Software	$109,491	one-time	from UR and outlined in Section E
N	RG&E Rebate	-$106,824	one-time	from UR and outlined in Section E
O	Repair Budget	$1,423,732	Projected	Estimated by repair projects with a 7 year payback.
P	**Total Capital Costs**	**$1,426,399**	**Projected**	
	Annual Building Cost / Savings ($)			Total Annual Building Savings **$368,753**
Q	Electrical Dollar Savings	$145,737	Per Year	= E x Building Electric Rate
R	Chilled Water Dollar Savings	$0	Per Year	= F x Building Chilled Water Rate
S	Steam Dollar Savings	$251,536	Per Year	= G x Building Steam Rate
T	Annual Fees (less 30% Incentive)	-$28,520	Per Year	Annual cost to EMIS service provider
U	**Simple Payback**	**4**	**Years**	cost from EXTRAPOLATION Total / (M N O)
	Annual Purchased Utility Cost / Savings ($)			Total Annual Utility Savings **$309,443**
V	Electrical Dollar Savings	$105,254	Per Year	= I x Utility Electric Rate
W	Natural Gas Savings	$82,435	Per Year	= J x Utility Natural Gas Rate
X	Avoided Carbon Tax	$93,234	Per Year	= AC x AE
Y	Annual Fees (less 30% Incentive)	-$28,520	Per Year	Annual cost to EMIS service provider
Z	**Simple Payback**	**6**	**Years**	cost from EXTRAPOLATION Total / (Q R S)
	Impact on CO2e Emissions			
AA	Electrical Emissions Savings	217	MT CO2e	= I /1000 x 295.94 lbs/MWh x 0.000453592 [lbs to
AB	Natural Gas Emissions Savings	1,647	MT CO2e	MT = J x 116.38 lbs/mmBtu x 0.000453592 [lbs to MT
AC	**Total Emissions Savings**	**1,865**	MT CO2e	= U V
AD	**% Savings of Total GHG Emissions**	**1.2%**		cost from detailed summary recommended total / (U)

AE Carbon Tax Assumed to be: $50.00 Per MT CO2e

Section F

EXTRAPOLATED RESULTS

EXTRAPOLATED RESULTS

A 10 Year Energy Conservation Program

- $68,208,701 Capital Costs
- 14% Reduction in Total Utilities (from 2019 Utilities)
- 17.5% GHG Emissions Reductions (from 2019 Utilities)
- $8,411,856 in Energy Cost Savings

The strategy for this Energy Conservation Assessment and Plan focused on a deep dive into select energy conservation measures (ECMs) at representative buildings. The results of that analysis are presented in the ECM section of this report. The results (costs and savings) from the representative buildings were then extrapolated across similar buildings that were not part of the deep dive. The result of this analysis provides a road map and sets expectations for cost, savings, and greenhouse gas emissions reduction from investment in energy conservation on campus.

SUMMARY OF BUILDINGS SURVEYED

Building Abbreviation	Type	Area	Lighting	Labs	Heat Recovery	RCX Scoping
Ambulatory Care Facility	Hospital	224,609	X			
Del Monte	Lab/Research	152,227		X	X	
Fauver	Office/Sports	63,097	X			
GCHaS	Patient Care	271,861		X	X	
KMRB	Lab/Research	235,914	X	X	X	
Schlegel Hall	Classroom/Office	115,832	X			
Wallis	Office	49,598	X			
Wilder	Dorm	78,822	X			
Danforth Dining Hall	Cafeteria, Dining, Kitchens	35,128				X
Fredrick Douglass Commons	Dining, Classrooms	89,151				X
Rush Rhees Library	Library, Offices	349,284				X

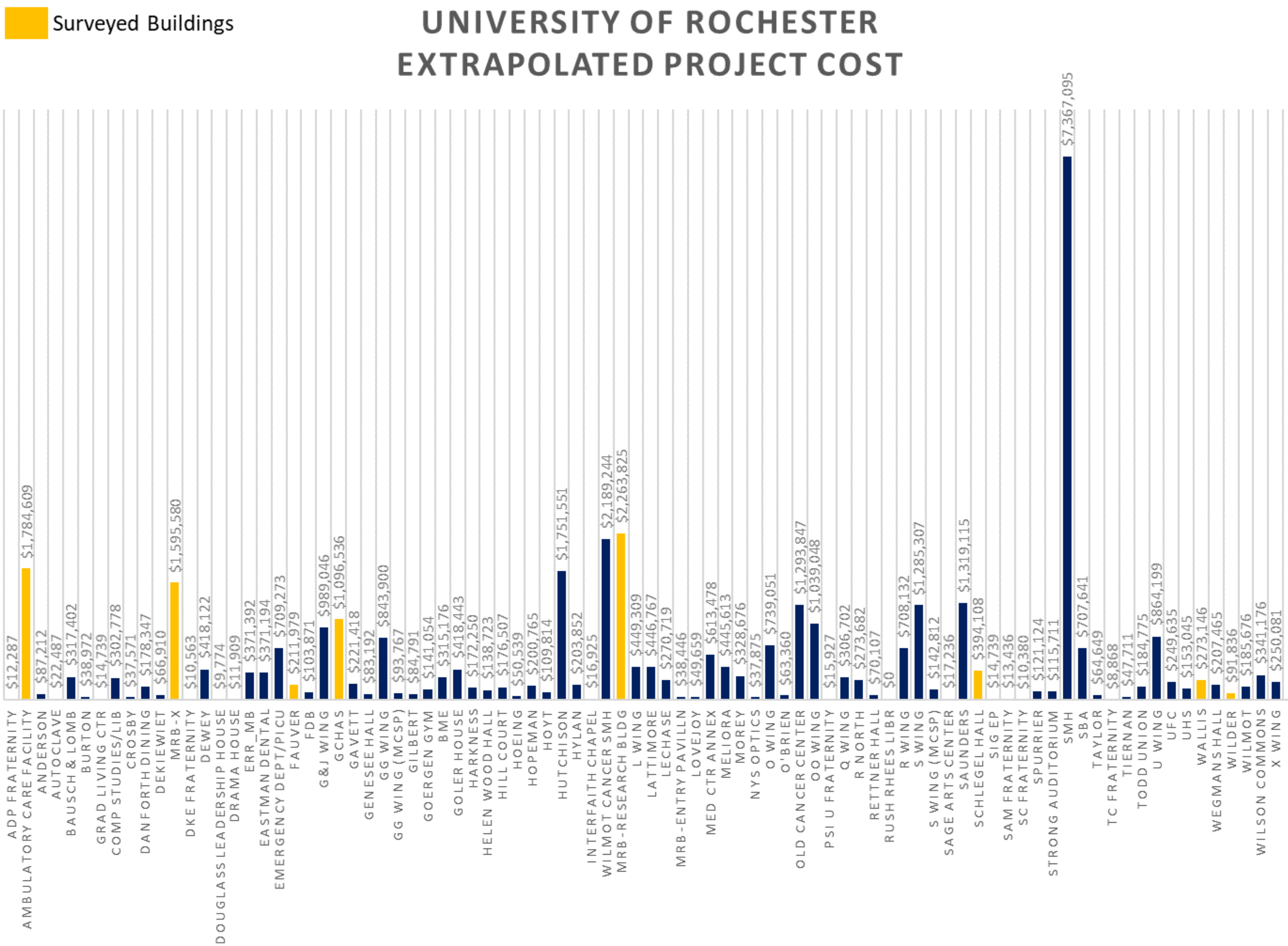
Extrapolation of Deep Dive ECMs | The follow charts highlight how project costs and savings were extrapolated. It should be noted that other ECMs, such as controls improvements, HVAC system upgrades and other common ECMs will further enhance these projects. Project savings and costs were extrapolated based on similar building types. The team used a savings per square foot and cost per square foot estimate for each building. These are also reviewed and adjust for reasonableness by reviewing overall % savings by building.

Table E.1 | Current Building Energy Usage Summary

SURVEYED BUILDINGS																
Line #	Building Name	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Current Total Energy Use (mmBtu)	Building EUI kBtu/sqft	Energy Cost/sqft	Projected Savings	Savings/sqft	Lighting	Labs	Heat Recovery
1	Ambulatory Care Facility	224,609	4,740,048	51,190	19,472	2,587	0	$412,980.89	52,975	235.86	$1.84	$0	0%	X		
2	Ernest J Del Monte Neuromedicine Institute	152,227	5,667,756	60,981	19,852	2,526	0	$479,602.06	59,280	389.42	$3.15	$0	0%		X	X
3	Fauver Stadium	63,097	256,300	557	922	0	0	$21,245.32	1,957	31.01	$0.34	$0	0%	X		
4	obert B Goergen Hall for Biomedical Engineering and Optic	271,861	5,232,009	69,473	4	35,819	0	$497,305.25	73,684	271.03	$1.83	$0	0%		X	X
5	Kornberg Medical Research Building	235,914	9,501,958	107,634	40,778	2,526	47	$824,894.54	106,771	452.58	$3.50	$0	0%	X	X	X
6	Schlegel Hall (Includes Gleason Wing)	115,832	887,929	4,489	0	1,885	0	$69,098.18	6,208	53.59	$0.60	$0	0%	X		
7	Wallis Hall	49,598	444,629	3,828	5,557	1,553	0	$56,579.84	9,730	196.17	$1.14	$0	0%	X		
8	Wilder Hall	78,822	339,414	0	0	3,749	0	$37,066.29	4,907	62.25	$0.47	$0	0%	X		

EXTRAPOLATION																
Line #	Building Name	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Building Energy Usage	Building EUI kBtu/sqft	Energy Cost/sqft	Projected Savings	Savings/sqft	Lighting	Labs	Heat Recovery
1	Alpha Delta Phi	10,546	68,996	0	0	559	0	$6,814.17	794	75.33	$0.65	$0	0%	X		
2	Ambulatory Care Facility	224,609	4,740,048	51,190	19,472	2,587	0	$412,980.89	52,975	235.86	$1.84	$0	0%	X		
3	Anderson Hall	74,853	344,265	0	0	3,069	0	$34,992.26	4,243	56.69	$0.47	$0	0%	X		
4	Autoclave Building	5,618	332,848	0	4,263	0	0	$38,434.77	5,399	961.05	$6.84	$0	0%	X		
5	Bausch and Lomb Hall	114,228	1,584,872	35,079	7,752	0	0	$140,425.15	23,262	203.65	$1.23	$0	0%	X	X	X
6	Burton Hall	33,449	160,602	0	0	1,996	0	$18,327.94	2,544	76.06	$0.55	$0	0%	X		
8	Computer Studies Building (Carlson Library)	108,965	1,506,571	12,810	0	5,350	0	$125,169.83	14,180	130.13	$1.15	$0	0%	X	X	X
9	Crosby Hall	32,247	132,184	0	0	1,862	0	$15,862.98	2,313	71.73	$0.49	$0	0%	X		
10	Danforth Dining Center	35,128	882,673	7,162	411	5,470	241	$83,067.82	11,197	318.75	$2.36	$0	0%	X		x
11	De Kiewiet Tower	57,428	387,848	0	0	0	0	$27,149.36	1,323	23.04	$0.47	$0	0%	X		
12	Ernest J Del Monte Neuromedicine Institute	152,227	5,667,756	60,981	19,852	2,526	0	$479,602.06	59,280	389.42	$3.15	$0	0%	X	X	X
13	Delta Kappa Epsilon	9,066	29,645	0	0	465	0	$3,725.90	566	62.45	$0.41	$0	0%	X		
14	Dewey Hall	122,890	953,165	9,457	4,901	0	0	$84,648.49	10,877	88.51	$0.69	$0	0%	X		
15	Douglass Leadership House (Formerly: DU, Medieval House	8,389	35,476	0	0	359	0	$3,757.77	480	57.22	$0.45	$0	0%	X		
16	Drama House	10,221	30,607	0	0	483	0	$3,855.87	587	57.44	$0.38	$0	0%	X		
17	East River Road Medical Building	92,078	2,104,586	0	0	0	1,294	$147,321.05	8,475	92.04	$1.60	$0	0%	X		
18	Eastman Dental Center	92,029	1,414,307	20,056	6,559	0	1	$123,409.79	17,162	186.48	$1.34	$0	0%	X		
19	Emergency Department	175,848	4,991,867	19,340	10,157	13,079	0	$433,001.71	45,838	260.67	$2.46	$0	0%	X		
20	Fauver Stadium	63,097	256,300	557	922	0	0	$21,245.32	1,957	31.01	$0.34	$0	0%	X		
21	Fredric Douglass Dinning Center	89,151	1,604,478	14,450	0	10,174	168	$149,240.37	19,978	224.09	$1.67	$0	0%	X		
22	SMD: G&J Wing	245,211	4,058,737	0	0	0	0	$284,111.59	13,848	56.48	$1.16	$0	0%	X		
23	Golisano Childrens Hospital at Strong	271,861	5,232,009	69,473	4	35,819	0	$497,305.25	73,684	271.03	$1.83	$0	0%	X		
24	Gavett Hall	79,685	1,266,970	20,812	9,574	0	0	$123,841.39	19,891	249.62	$1.55	$0	0%	X	X	X
25	Genesee Hall	71,403	531,510	7,781	0	5,066	0	$55,625.75	9,121	127.73	$0.78	$0	0%	X		
26	SMD: GG Wing	106,212	2,210,213	79,476	17,321	19,047	0	$288,269.43	66,798	628.91	$2.71	$0	0%	X		X
27	SMD: GG Wing (MCSP)	11,801	245,579	8,831	1,925	2,116	0	$32,029.94	7,422	628.91	$2.71	$0	0%	X		X
28	Gilbert Hall	72,775	411,496	0	0	3,359	0	$40,729.17	4,763	65.45	$0.56	$0	0%	X		
29	Goergen Athletics Center	244,044	3,213,807	9,513	2,148	6,373	0	$255,747.20	22,226	91.07	$1.05	$0	0%	X		
30	obert B Goergen Hall for Biomedical Engineering and Optic	113,427	2,584,883	25,056	5	16,064	0	$239,389.15	32,105	283.04	$2.11	$0	0%	X	X	X
31	Goler House	359,144	0	0	0	11,739	0	$41,674.63	11,739	32.69	$0.12	$0	0%	X		
32	Harkness Hall	61,990	386,027	2,913	1,547	1,343	0	$37,443.65	5,046	81.40	$0.60	$0	0%	X	X	X
33	Helen Wood Hall	119,064	874,192	16,880	0	4,996	0	$79,873.05	12,840	107.84	$0.67	$0	0%	X		
34	Hill Court	151,494	640,033	0	0	10,092	0	$80,628.91	12,276	81.03	$0.53	$0	0%	X		
35	Hoeing Hall	43,377	163,912	0	0	3,035	0	$22,248.09	3,594	82.86	$0.51	$0	0%	X		

36	Hopeman Engineering Building	72,252	750,957	7,858	0	3,321	0	$64,796.59	8,146	112.75	$0.90	$0	0%	X	X	X
37	Hoyt Hall	19,940	234,585	3,969	2,239	0	0	$24,590.24	4,182	209.73	$1.23	$0	0%	X		x
38	Hutchison Hall	313,148	9,232,963	131,724	581	58,466	47	$863,299.36	128,533	410.45	$2.76	$0	0%	X	X	X
39	Hylan Building	59,914	572,798	15,912	191	4,399	0	$57,281.43	11,127	185.72	$0.96	$0	0%	X		
40	Interfaith Chapel	29,283	239,236	2,243	0	2,376	0	$25,306.93	3,838	131.07	$0.86	$0	0%	X		
41	James P. Wilmot Cancer Center (SMH)	275,536	4,568,850	64,781	10,657	14,825	0	$413,908.43	59,728	216.77	$1.50	$0	0%	X		x
42	Kornberg Medical Research Building	235,914	9,501,958	107,634	40,778	2,526	0	$824,894.54	106,723	452.38	$3.50	$0	0%	X	X	X
43	SMD: L Wing	777,371	1,280,639	0	0	0	0	$89,644.73	4,370	5.62	$0.12	$0	0%	X		
44	Lattimore Hall	81,124	985,930	18,239	66	8,206	0	$99,401.89	16,889	208.19	$1.23	$0	0%	X		x
45	LeChase Hall	79,567	578,810	2,786	0	2,526	0	$49,640.89	5,304	66.66	$0.62	$0	0%	X		
46	Levine Pavilion	66,517	1,117,178	16,444	569	2,526	0	$90,112.95	11,643	175.04	$1.35	$0	0%	X		
47	Lovejoy Hall	42,622	291,236	0	0	2,526	0	$29,354.69	3,520	82.59	$0.69	$0	0%	X		
48	Medical Center Annex	79,099	1,619,642	7,864	4,924	2,526	0	$140,261.89	15,241	192.68	$1.77	$0	0%	X	X	X
49	Meliora Hall	130,970	1,932,773	17,626	6,475	2,526	0	$168,235.55	20,672	157.84	$1.28	$0	0%	X		
50	Morey Hall	59,681	237,434	11,621	14,026	2,526	0	$76,032.64	20,709	347.00	$1.27	$0	0%	X		x
51	New York State Optics	4,383	108,481	1,890	0	2,526	0	$16,667.70	3,441	785.01	$3.80	$0	0%	X	X	X
52	SMD: O Wing	183,231	3,032,834	0	0	0	0	$212,298.38	10,348	56.48	$1.16	$0	0%	X		
53	O'Brien Hall	54,381	373,480	2,398	0	2,526	0	$35,246.06	4,491	82.59	$0.65	$0	0%	X		
54	SMH: Old Cancer Center	162,842	2,695,367	44,297	6,840	4,639	0	$231,905.73	33,433	205.31	$1.42	$0	0%	X		x
55	SMD: OO Wing	148,368	2,455,792	19,466	3,255	4,081	0	$199,038.17	21,321	143.71	$1.34	$0	0%	X		x
56	Psi Upsilon	13,670	41,417	0	0	502	0	$4,681.29	643	47.06	$0.34	$0	0%	X		
57	SMD: Q Wing	76,040	1,258,611	0	0	0	0	$88,102.77	4,294	56.48	$1.16	$0	0%	X		
58	R-Wing North	67,853	850,016	0	0	0	0	$59,501.12	2,900	42.74	$0.88	$0	0%	X		
59	Rettner Hall	20,605	353,312	4,386	0	2,319	0	$33,209.91	4,788	232.36	$1.61	$0	0%	X		
60	Rush Rhees Library	349,284	2,174,743	29,867	26,057	0	0	$246,406.74	42,079	120.47	$0.71	$0	0%	X		
61	R-Wing	175,565	1,349,335	40,940	1,552	11,863	0	$144,369.01	29,810	169.79	$0.82	$0	0%	X		
62	SMD: S Wing	318,662	6,631,166	88,790	23,373	22,852	0	$633,254.55	94,423	296.31	$1.99	$0	0%	X		
63	SMD: S Wing (MCSP)	35,407	736,796	9,866	2,597	2,539	0	$70,361.62	10,491	296.31	$1.99	$0	0%	X		
64	Sage Art Center	29,821	307,198	0	0	2,868	0	$31,685.26	3,916	131.32	$1.06	$0	0%	X		
65	Saunders Research Building	194,523	1,356,944	15,867	0	10,106	0	$131,751.97	19,306	99.25	$0.68	$0	0%	X	X	X
66	Schlegel Hall (Includes Gleason)	115,832	887,929	4,489	0	1,885	0	$69,098.18	6,208	53.59	$0.60	$0	0%	X		
67	Sigma Phi Epsilon (Formerly CLC)	12,650	107,679	0	0	570	0	$9,561.03	937	74.10	$0.76	$0	0%	X		
68	Sigma Alpha MU	11,532	51,417	0	0	405	0	$5,036.94	580	50.33	$0.44	$0	0%	X		
69	Sigma Chi	8,909	61,171	0	0	541	0	$6,202.52	750	84.15	$0.70	$0	0%	X		
70	Spurrier Gymnasium	56,012	144,252	0	0	1,785	0	$16,433.02	2,277	40.65	$0.29	$0	0%	X		
71	Strong Auditorium	43,131	31,867	0	14,594	0	5,290	$54,038.56	19,993	463.54	$1.25	$0	0%	X		X
72	Strong Memorial Hospital	1,030,971	23,723,418	297,981	63,177	37,327	0	$2,034,115.89	267,267	259.24	$1.97	$0	0%	X		X
73	Susan B. Anthony Hall	179,432	1,321,447	5,307	0	9,055	0	$124,944.56	15,092	84.11	$0.70	$0	0%	X		
74	Taylor Hall	11,739	235,690	714	1,743	0	0	$22,726.99	2,753	234.52	$1.94	$0	0%	X		X
75	Theta Chi	7,611	44,549	0	0	492	0	$4,866.77	644	84.68	$0.64	$0	0%	X		
76	Tiernan Hall	40,950	213,665	0	0	2,483	0	$23,771.20	3,212	78.44	$0.58	$0	0%	X		
77	Todd Union	54,307	201,727	1,472	1,845	0	0	$20,752.53	2,957	54.45	$0.38	$0	0%	X		
78	SMD: U Wing	214,258	3,546,406	0	0	0	0	$248,248.42	12,100	56.48	$1.16	$0	0%	X		
79	University Facilities Center	214,258	324,454	0	0	0	1,231	$22,711.78	2,338	10.91	$0.11	$0	0%	X		
80	University Health Services	27,790	261,097	1,483	0	3,178	0	$29,641.35	4,496	161.78	$1.07	$0	0%	X		X
81	Valentine Tower	57,428	467,753	0	0	0	0	$32,742.71	1,596	27.79	$0.57	$0	0%	X		
82	Wallis Hall	49,598	444,629	3,828	5,557	1,553	0	$56,579.84	9,730	196.17	$1.14	$0	0%	X		X
83	Wegmans Hall	60,976	833,752	7,518	0	1,198	0	$63,036.56	6,208	101.81	$1.03	$0	0%	X		
84	Wilder Tower	78,822	339,414	0	0	3,749	0	$37,066.29	4,907	62.25	$0.47	$0	0%	X		
85	James P. Wilmot Cancer Center (SMD)	275,536	1,001,642	11,676	0	4,608	0	$87,127.21	11,388	41.33	$0.32	$0	0%	X	X	X
86	Wilson Commons	104,338	2,240,639	12,699	6,117	0	0	$179,271.20	17,419	166.95	$1.72	$0	0%	X		X
87	SMD: X Wing	62,002	1,026,256	0	0	0	0	$71,837.92	3,502	56.48	$1.16	$0	0%	X		


Surveyed Buildings
UNIVERSITY OF ROCHESTER
EXTRAPOLATED PROJECT COST
$12,287
$1,784,609
$87,212
$22,487
$317,402
$38,972
$14,739
$302,778
$37,571
$178,347
$66,910
$1,595,580
$10,563
$418,122
$9,774
$11,909
$371,392
$371,194
$709,273
$211,979
$103,871
$989,046
$1,096,536
$221,418
$83,192
$843,900
$93,767
$84,791
$141,054
$315,176
$418,443
$172,250
$138,723
$176,507
$50,539
$200,765
$109,814
$1,751,551
$203,852
$16,925
$2,189,244
$2,263,825
$449,309
$446,767
$270,719
$38,446
$49,659
$613,478
$445,613
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$37,875
$739,051
$63,360
$1,293,847
$1,039,048
$15,927
$306,702
$273,682
$70,107
$0
$708,132
$1,285,307
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$17,236
$1,319,115
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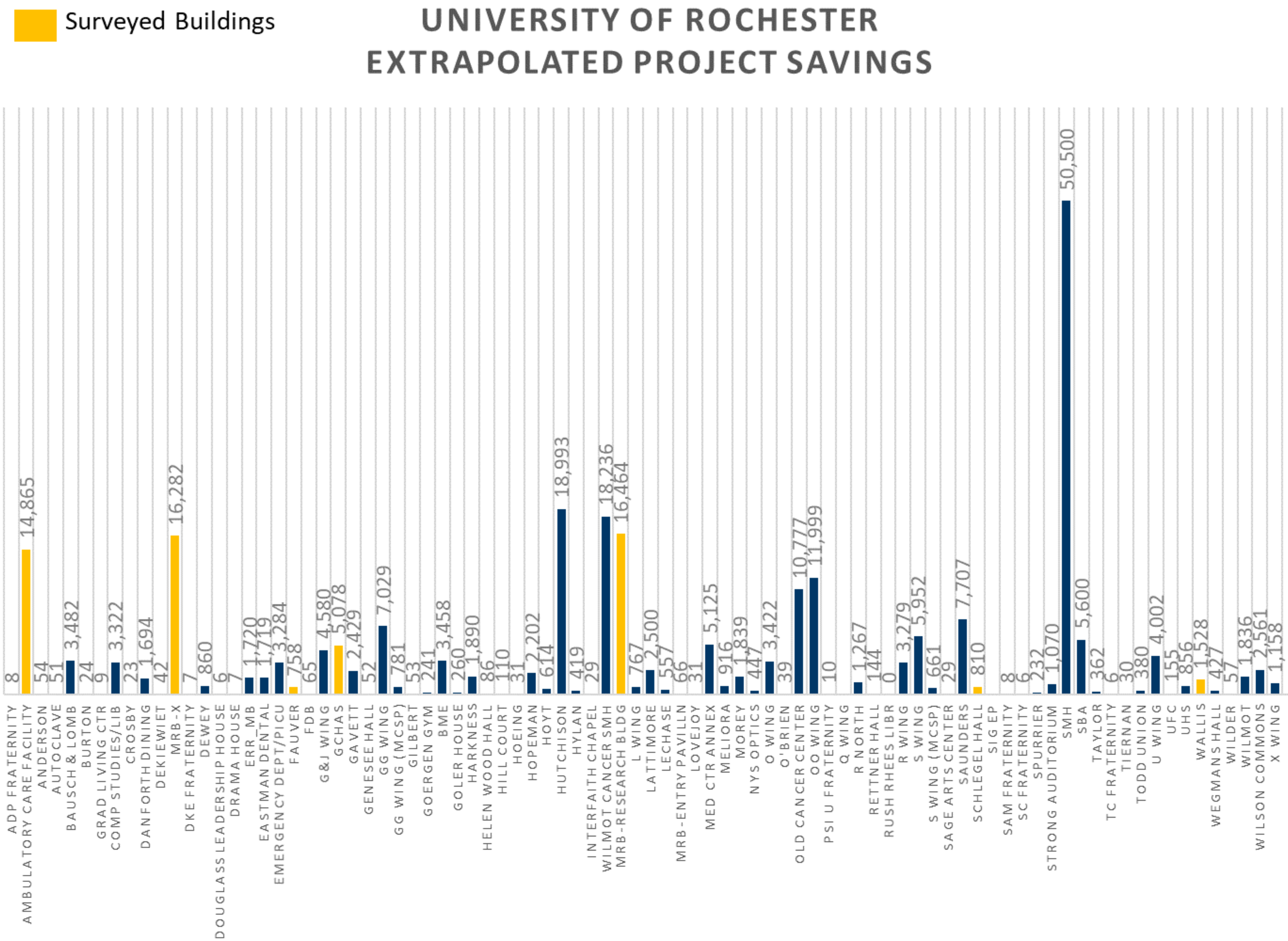
$14,739
$13,436
$10,380
$121,124
$115,711
$7,367,095
$707,641
$64,649
$8,868
$47,711
$184,775
$864,199
$249,635
$153,045
$273,146
$207,465
$91,836
$185,676
$341,176
$250,081
ADP FRATERNITY
AMBULATORY CARE FACILITY
ANDERSON
AUTOCLAVE
BAUSCH & LOMB
BURTON
GRAD LIVING CTR
COMP STUDIES/LIB
CROSBY
DANFORTH DINING
DEKIEWIET
MRB-X
DKE FRATERNITY
DEWEY
DOUGLASS LEADERSHIP HOUSE
DRAMA HOUSE
ERR_MB
EASTMAN DENTAL
EMERGENCY DEPT/PICU
FAUVER
FDB
G&J WING
GCHAS
GAVETT
GENESEE HALL
GG WING
GG WING (MCSP)
GILBERT
GOERGEN GYM
BME
GOLER HOUSE
HARKNESS
HELEN WOOD HALL
HILL COURT
HOEING
HOPEMAN
HOYT
HUTCHISON
HYLAN
INTERFAITH CHAPEL
WILMOT CANCER SMH
MRB-RESEARCH BLDG
L WING
LATTIMORE
LECHASE
MRB-ENTRY PAVILLN
LOVEJOY
MED CTR ANNEX
MELIORA
MOREY
NYS OPTICS
O WING
O'BRIEN
OLD CANCER CENTER
OO WING
PSI U FRATERNITY
Q WING
R NORTH
RETTNER HALL
RUSH RHEES LIBR
R WING
S WING
S WING (MCSP)
SAGE ARTS CENTER
SAUNDERS
SCHLEGEL HALL
SIG EP
SAM FRATERNITY
SC FRATERNITY
SPURRIER
STRONG AUDITORIUM
SMH
SBA
TAYLOR
TC FRATERNITY
TIERNAN
TODD UNION
U WING
UFC
UHS
WALLIS
WEGMANS HALL
WILDER
WILMOT
WILSON COMMONS
X WING


Surveyed Buildings
UNIVERSITY OF ROCHESTER
EXTRAPOLATED PROJECT SAVINGS
50,500
18,993
18,236
16,464
16,282
14,865
11,999
10,777
7,707
7,029
5,952
5,600
5,125
5,078
4,580
4,002
3,482
3,458
3,422
3,322
3,284
3,279
2,561
2,500
2,429
2,202
1,890
1,839
1,836
1,720
1,719
1,694
1,528
1,267
1,158
1,070
ADP FRATERNITY
AMBULATORY CARE FACILITY
ANDERSON
AUTOCLAVE
BAUSCH & LOMB
BURTON
GRAD LIVING CTR
COMP STUDIES/LIB
CROSBY
DANFORTH DINING
DEKIEWIET
MRB-X
DKE FRATERNITY
DEWEY
DOUGLASS LEADERSHIP HOUSE
DRAMA HOUSE
ERR_MB
EASTMAN DENTAL
EMERGENCY DEPT/PICU
FAUVER
FDB
G&J WING
GCHAS
GAVETT
GENESEE HALL
GG WING
GG WING (MCSP)
GILBERT
GOERGEN GYM
BME
GOLER HOUSE
HARKNESS
HELEN WOOD HALL
HILL COURT
HOEING
HOPEMAN
HOYT
HUTCHISON
HYLAN
INTERFAITH CHAPEL
WILMOT CANCER SMH
MRB-RESEARCH BLDG
L WING
LATTIMORE
LECHASE
MRB-ENTRY PAVILLN
LOVEJOY
MED CTR ANNEX
MELIORA
MOREY
NYS OPTICS
O WING
O'BRIEN
OLD CANCER CENTER
OO WING
PSI U FRATERNITY
Q WING
R NORTH
RETTNER HALL
RUSH RHEES LIBR
R WING
S WING
S WING (MCSP)
SAGE ARTS CENTER
SAUNDERS
SCHLEGEL HALL
SIG EP
SAM FRATERNITY
SC FRATERNITY
SPURRIER
STRONG AUDITORIUM
SMH
SBA
TAYLOR
TC FRATERNITY
TIERNAN
TODD UNION
U WING
UFC
UHS
WALLIS
WEGMANS HALL
WILDER
WILMOT
WILSON COMMONS
X WING

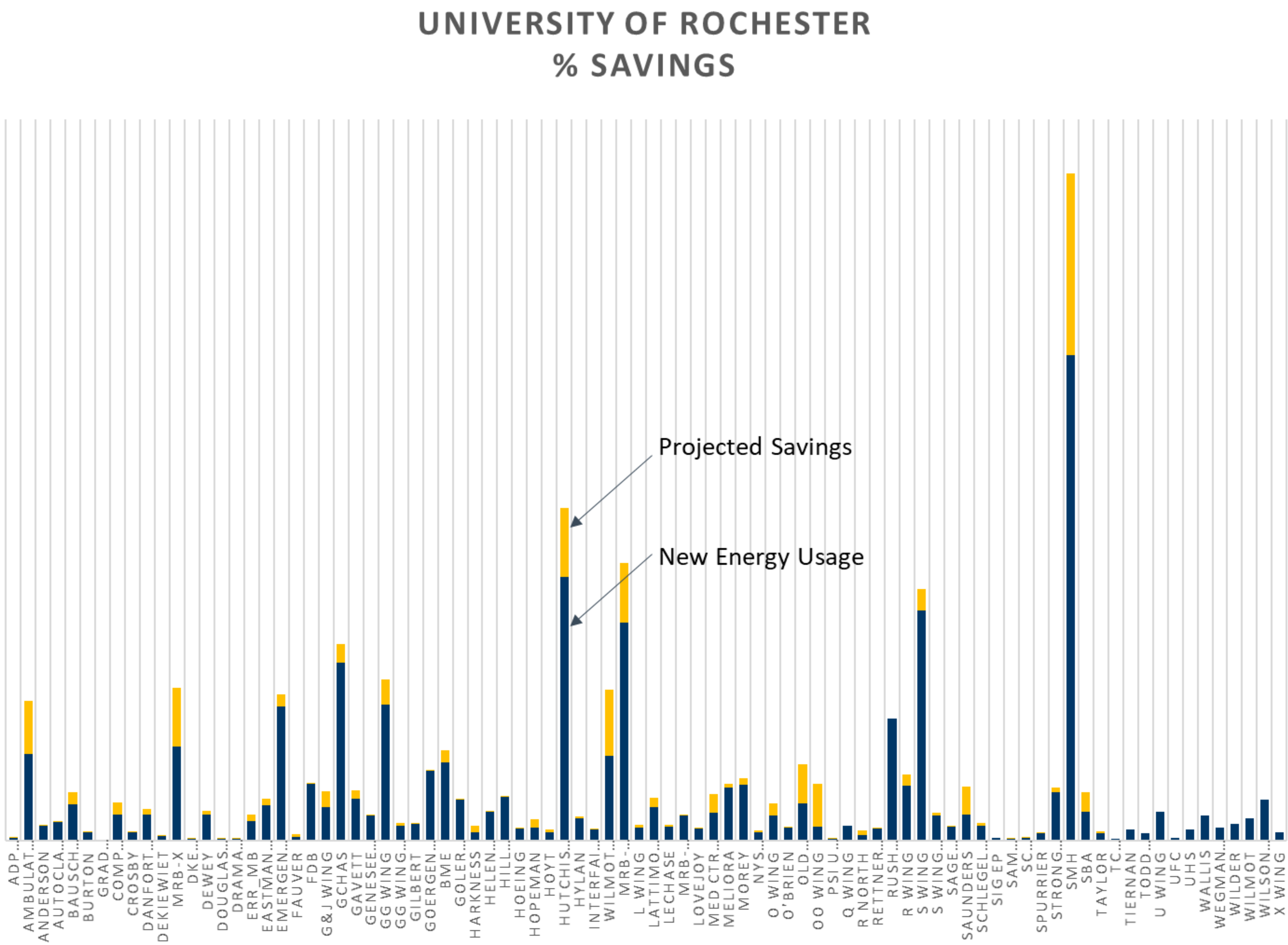

UNIVERSITY OF ROCHESTER
% SAVINGS
Projected Savings
New Energy Usage
ADP...
AMBULAT...
ANDERSON
AUTOCLA...
BAUSCH...
BURTON
GRAD...
COMP...
CROSBY
DANFORT...
DEKIEWIET
MRB-X
DKE...
DEWEY
DOUGLAS...
DRAMA...
ERR_MB
EASTMAN...
EMERGEN...
FAUVER
FDB
G&J WING
GCHAS
GAVETT
GENESEE...
GG WING
GG WING...
GILBERT
GOERGEN...
BME
GOLER...
HARKNESS
HELEN...
HILL...
HOEING
HOPEMAN
HOYT
HUTCHIS...
HYLAN
INTERFAI...
WILMOT...
MRB-...
L WING
LATTIMO...
LECHASE
MRB-...
LOVEJOY
MED CTR...
MELIORA
MOREY
NYS...
O WING
O'BRIEN
OLD...
OO WING
PSI U
Q WING
R NORTH
RETTNER...
RUSH...
R WING
S WING
S WING...
SAGE...
SAUNDERS
SCHLEGEL...
SIG EP
SAM...
SC...
SPURRIER
STRONG...
SMH
SBA
TAYLOR
TC...
TIERNAN
TODD...
U WING
UFC
UHS
WALLIS
WEGMAN...
WILDER
WILMOT
WILSON...
X WING

Table E.2 | Projected Energy Savings and Capital Cost Summary

SURVEYED BUILDINGS																
Tag #	Building Name	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Project Cost	Cost/sqft	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	Projected Savings (mmBtu)	Savings/sqft (kBtu/sqft)
1	Ambulatory Care Facility	Hospital	224,609	4,740,048	51,190	19,472	2,587	1	$412,980.89	$656,793	$2.92	790,176.4	0	0	2,696	12.00
2	Ernest J Del Monte Neuromedicine Institute	Lab/Research	152,227	5,667,756	60,981	19,852	2,526	10	$479,602.06	$986,275	$6.48	-433,490.1	6,875	9,495	14,891	97.82
3	Fauver Stadium	Office/Sports	63,097	256,300	557	922	0	18	$21,245.32	$31,694	$0.50	17,790.7	0	0	61	0.96
4	Robert B Goergen Hall for Biomedical Engineering and Optic	Classroom/Lab/Office	271,861	5,232,009	69,473	4	35,819	25	$497,305.25	$755,412	$2.78	-360,146.2	3,899	5,617	8,287	30.48
5	Kornberg Medical Research Building	Lab/Research	235,914	9,501,958	107,634	40,778	2,526	37	$824,894.54	$2,170,391	$9.20	-108,852.6	6,895	9,876	16,399	69.51
6	Schlegel Hall (Includes Gleason Wing)	Classroom/Office	115,832	887,929	4,489	0	1,885	53	$69,098.18	$214,466	$1.85	134,945.1	0	0	460	3.98
7	Wallis Hall	Office	49,598	444,629	3,828	5,557	1,553	66	$56,579.84	$150,553	$3.04	98,974.7	0	0	338	6.81
8	Wilder Hall	Dorm	78,822	339,414	0	0	3,749	68	$37,066.29	$75,937	$0.96	16,597.6	0	0	57	0.72

EXTRAPOLATION																
Tag #	Building Name	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Project Cost	Cost/sqft	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	Projected Savings (mmBtu)	Savings/sqft (kBtu/sqft)
1	Alpha Delta Phi	Dorm	10,546	68,996	0	0	559	0	$6,814.17	$10,160	$0.96	2,220.7	0	0	8	0.72
2	Ambulatory Care Facility	Hospital	224,609	4,740,048	51,190	19,472	2,587	1	$412,980.89	$1,792,999	$7.98	320,330.0	8,141	10,745	19,979	88.95
3	Anderson Hall	Dorm	74,853	344,265	0	0	3,069	2	$34,992.26	$72,113	$0.96	15,761.8	0	0	54	0.72
4	Autoclave Building	Autoclave	5,618	332,848	0	4,263	0	3	$38,434.77	$22,918	$4.08	19,350.8	56	56	178	31.64
5	Bausch and Lomb Hall	Classroom/Lab/Office	114,228	1,584,872	35,079	7,752	0	4	$140,425.15	$480,978	$4.21	-54,537.8	2,774	3,496	6,084	53.26
6	Burton Hall	Dorm	33,449	160,602	0	0	1,996	5	$18,327.94	$32,225	$0.96	7,043.4	0	0	24	0.72
8	Computer Studies Building (Carlson Library)	Library/Classroom/Office/Lab	108,965	1,506,571	12,810	0	5,350	7	$125,169.83	$474,944	$4.36	-52,025.0	2,646	3,335	5,804	53.26
9	Crosby Hall	Dorm	32,247	132,184	0	0	1,862	8	$15,862.98	$31,067	$0.96	6,790.3	0	0	23	0.72
10	Danforth Dining Center	Dining/Kitchen	35,128	882,673	7,162	411	5,470	9	$83,067.82	$408,242	$11.62	-71,348.8	966	1,463	2,185	62.20
11	De Kiewiet Tower	Office/Dorm	57,428	387,848	0	0	0	10	$27,149.36	$82,476	$1.44	60,751.2	571	571	1,349	23.50
12	Ernest J Del Monte Neuromedicine Institute	Lab/Research	152,227	5,667,756	60,981	19,852	2,526	11	$479,602.06	$1,607,259	$10.56	90,846.3	8,389	11,009	19,707	129.46
13	Delta Kappa Epsilon	Dorm	9,066	29,645	0	0	465	12	$3,725.90	$8,734	$0.96	1,909.0	0	0	7	0.72
14	Dewey Hall	Classroom/Office	122,890	953,165	9,457	4,901	0	13	$84,648.49	$431,126	$3.51	349,355.9	1,222	1,222	3,636	29.59
15	Douglass Leadership House (Formerly: DU, Medieval House	Dorm	8,389	35,476	0	0	359	14	$3,757.77	$8,082	$0.96	1,766.5	0	0	6	0.72
16	Drama House	Dorm	10,221	30,607	0	0	483	15	$3,855.87	$9,847	$0.96	2,152.2	0	0	7	0.72
17	East River Road Medical Building	Medical	92,078	2,104,586	0	0	0	16	$147,321.05	$374,831	$4.07	431,878.9	1,128	1,215	3,816	41.44
18	Eastman Dental Center	Medical	92,029	1,414,307	20,056	6,559	0	17	$123,409.79	$374,632	$4.07	431,649.1	1,127	1,214	3,814	41.44
19	Emergency Department	Hospital	175,848	4,991,867	19,340	10,157	13,079	18	$433,001.71	$715,842	$4.07	824,790.4	2,153	2,320	7,288	41.44
20	Fauver Stadium	Office/Sports	63,097	256,300	557	922	0	19	$21,245.32	$184,506	$2.92	221,975.8	0	0	757	12.00
21	Fredric Douglass Dinning Center	Kitchen/Dining	89,151	1,604,478	14,450	0	10,174	20	$149,240.37	$150,788	$1.69	20,684.5	668	1,454	2,193	24.60
22	SMD: G&J Wing	Hospital	245,211	4,058,737	0	0	0	21	$284,111.59	$998,206	$4.07	1,150,128.6	3,003	3,236	10,163	41.44
23	Golisano Childrens Hospital at Strong	Hospital	271,861	5,232,009	69,473	4	35,819	22	$497,305.25	$1,106,692	$4.07	1,275,125.9	3,329	3,587	11,267	41.44
24	Gavett Hall	Engineering/Offices/Lab/Classroom/Offices	79,685	1,266,970	20,812	9,574	0	23	$123,841.39	$441,370	$5.54	-38,045.4	1,935	2,439	4,244	53.26
25	Genesee Hall	Dorm	71,403	531,510	7,781	0	5,066	24	$55,625.75	$68,789	$0.96	15,035.3	0	0	51	0.72
26	SMD: GG Wing	Hospital	106,212	2,210,213	79,476	17,321	19,047	25	$288,269.43	$847,867	$7.98	151,476.6	3,850	5,081	9,447	88.95
27	SMD: GG Wing (MCSP)	Hospital	11,801	245,579	8,831	1,925	2,116	26	$32,029.94	$398,041	$33.73	16,830.7	428	565	1,050	88.95
28	Gilbert Hall	Dorm	72,775	411,496	0	0	3,359	27	$40,729.17	$70,111	$0.96	15,324.2	0	0	52	0.72
29	Goergen Athletics Center	Athletics/Gymnasium/Pool/Fieldhouse	244,044	3,213,807	9,513	2,148	6,373	28	$255,747.20	$237,962	$0.98	275,588.0	2,427	2,427	5,794	23.74
30	Robert B Goergen Hall for Biomedical Engineering and Optic	Classroom/Lab/Office	113,427	2,584,883	25,056	5	16,064	29	$239,389.15	$480,060	$4.23	-54,155.4	2,754	3,472	6,041	53.26
31	Goler House	Apartments	359,144	0	0	0	11,739	30	$41,674.63	$345,997	$0.96	75,625.0	0	0	258	0.72
32	Harkness Hall	Engineering/Classroom/Lab/Office	61,990	386,027	2,913	1,547	1,343	31	$37,443.65	$421,080	$6.79	-29,596.9	1,505	1,897	3,302	53.26
33	Helen Wood Hall	Office/Dorm	119,064	874,192	16,880	0	4,996	32	$79,873.05	$197,408	$1.66	146,815.7	416	833	1,750	14.70
34	Hill Court	Dorm	151,494	640,033	0	0	10,092	33	$80,628.91	$145,948	$0.96	31,900.1	0	0	109	0.72
35	Hoeing Hall	Dorm	43,377	163,912	0	0	3,035	34	$22,248.09	$41,789	$0.96	9,133.9	0	0	31	0.72
36	Hopeman Engineering Building	Engineering/Classroom/Lab/Office	72,252	750,957	7,858	0	3,321	35	$64,796.59	$432,847	$5.99	-34,496.5	1,755	2,211	3,848	53.26
37	Hoyt Hall	Auditorium/Office	19,940	234,585	3,969	2,239	0	36	$24,590.24	$424,377	$21.28	27,282.9	310	487	890	44.61
38	Hutchison Hall	Lab/Classroom/Office	313,148	9,232,963	131,724	581	58,466	37	$863,299.36	$1,899,598	$6.07	-692,448.9	12,266	16,223	26,126	83.43
39	Hylan Building	Classroom/Office	59,914	572,798	15,912	191	4,399	38	$57,281.43	$223,483	$3.73	180,823.4	210	419	1,246	20.79
40	Interfaith Chapel	Assembly/Office	29,283	239,236	2,243	0	2,376	39	$25,306.93	$35,049	$1.20	38,198.8	102	205	438	14.94
41	James P. Wilmot Cancer Center (SMH)	Hospital	275,536	4,568,850	64,781	10,657	14,825	40	$413,908.43	$2,199,537	$7.98	392,960.5	9,987	13,181	24,509	88.95
42	Kornberg Medical Research Building	Lab/Research	235,914	9,501,958	107,634	40,778	2,526	41	$824,894.54	$2,281,924	$9.67	91,036.6	9,241	12,222	21,773	92.29

Table E.2 | Projected Energy Savings and Capital Cost Summary

SURVEYED BUILDINGS																
Tag #	Building Name	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Project Cost	Cost/sqft	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	Projected Savings (mmBtu)	Savings/sqft (kBtu/sqft)
43	SMD: L Wing	Hospital	777,371	1,280,639	0	0	0	42	$89,644.73	$390,483	$0.50	219,186.4	0	0	748	0.96
44	Lattimore Hall	Classroom/Office	81,124	985,930	18,239	66	8,206	43	$99,401.89	$634,601	$7.82	96,783.9	1,783	2,219	4,333	53.41
45	LeChase Hall	Classroom/Office	79,567	578,810	2,786	0	2,526	44	$49,640.89	$279,139	$3.51	226,195.8	791	791	2,354	29.59
46	Levine Pavilion	Assembly/Conference	66,517	1,117,178	16,444	569	2,526	45	$90,112.95	$64,859	$0.98	75,114.7	661	661	1,579	23.74
47	Lovejoy Hall	Dorm	42,622	291,236	0	0	2,526	46	$29,354.69	$41,062	$0.96	8,974.9	0	0	31	0.72
48	Medical Center Annex	Office/Lab	79,099	1,619,642	7,864	4,924	2,526	47	$140,261.89	$666,847	$8.43	-82,756.9	3,098	4,098	6,914	87.41
49	Meliora Hall	Classroom/Office	130,970	1,932,773	17,626	6,475	2,526	48	$168,235.55	$488,526	$3.73	395,274.0	458	916	2,723	20.79
50	Morey Hall	Classroom/Office	59,681	237,434	11,621	14,026	2,526	49	$76,032.64	$572,614	$9.59	81,658.6	927	1,457	2,662	44.61
51	New York State Optics	Office/Lab	4,383	108,481	1,890	0	2,526	50	$16,667.70	$366,932	$83.72	-3,661.3	242	317	546	124.57
52	SMD: O Wing	Hospital	183,231	3,032,834	0	0	0	51	$212,298.38	$745,895	$4.07	859,417.4	2,244	2,418	7,594	41.44
53	O'Brien Hall	Dorm	54,381	373,480	2,398	0	2,526	52	$35,246.06	$52,390	$0.96	11,451.0	0	0	39	0.72
54	SMH: Old Cancer Center	Hospital	162,842	2,695,367	44,297	6,840	4,639	53	$231,905.73	$1,299,930	$7.98	232,240.4	5,902	7,790	14,485	88.95
55	SMD: OO Wing	Hospital	148,368	2,455,792	19,466	3,255	4,081	54	$199,038.17	$1,082,305	$7.29	524,180.0	6,003	7,586	15,377	103.64
56	Psi Upsilon	Dorm	13,670	41,417	0	0	502	55	$4,681.29	$13,170	$0.96	2,878.5	0	0	10	0.72
57	SMD: Q Wing	Hospital	76,040	1,258,611	0	0	0	56	$88,102.77	$309,543		292,225.7				
58	R-Wing North	Hospital	67,853	850,016	0	0	0	57	$59,501.12	$276,217	$4.07	260,764.2	156	221	1,267	18.67
59	Rettner Hall	Classroom/Office	20,605	353,312	4,386	0	2,319	58	$33,209.91	$72,287	$3.51	41,118.0	0	0	140	6.81
60	Rush Rhees Library	Library/Office/Classroom	349,284	2,174,743	29,867	26,057	0	59	$246,406.74	$165,130	$0.47	0.0	0	0	0	0.00
61	R-Wing	Hospital	175,565	1,349,335	40,940	1,552	11,863	60	$144,369.01	$714,690	$4.07	674,707.3	404	571	3,277	18.67
62	SMD: S Wing	Hospital	318,662	6,631,166	88,790	23,373	22,852	61	$633,254.55	$1,297,211	$4.07	1,224,639.4	734	1,036	5,948	18.67
63	SMD: S Wing (MCSP)	Hospital	35,407	736,796	9,866	2,597	2,539	62	$70,361.62	$144,135	$4.07	136,071.0	82	115	661	18.67
64	Sage Art Center	Gallery/Office	29,821	307,198	0	0	2,868	63	$31,685.26	$29,078	$0.98	8,408.3	0	0	29	0.96
65	Saunders Research Builidng	Lab/Research	194,523	1,356,944	15,867	0	10,106	64	$131,751.97	$1,334,038	$6.86	247,510.3	2,790	4,019	7,653	39.34
66	Schlegel Hall (Includes Gleason)	Classroom/Office	115,832	887,929	4,489	0	1,885	65	$69,098.18	$432,060	$3.73	231,147.1	0	0	789	6.81
67	Sigma Phi Epsilan (Formerly CLC)	*Dorm*	12,650	107,679	0	0	570	66	$9,561.03	$12,187		2,663.7				
68	Sigma Alpha MU	Dorm	11,532	51,417	0	0	405	67	$5,036.94	$11,110	$0.96	2,428.3	0	0	8	0.72
69	Sigma Chi	Dorm	8,909	61,171	0	0	541	68	$6,202.52	$8,583	$0.96	1,876.0	0	0	6	0.72
70	Spurrier Gymnasium	Gymnasium/Classroom/Office	56,012	144,252	0	0	1,785	69	$16,433.02	$144,483	$2.58	65,254.4	0	0	223	3.98
71	Strong Auditorium	Assembly	43,131	31,867	0	14,594	0	70	$54,038.56	$392,056	$9.09	-58,996.3	519	751	1,069	24.78
72	Strong Memorial Hospital	Hospital	1,030,971	23,723,418	297,981	63,177	37,327	71	$2,034,115.89	$7,405,606	$7.18	2,138,084.2	17,799	25,394	50,488	48.97
73	Susan B. Anthony Hall	Dorm	179,432	1,321,447	5,307	0	9,055	72	$124,944.56	$671,446	$3.74	-199,918.4	2,573	3,708	5,599	31.20
74	Taylor Hall	Office/Machine Shop	11,739	235,690	714	1,743	0	73	$22,726.99	$393,787	$33.55	4,058.6	141	204	360	30.63
75	Theta Chi	Dorm	7,611	44,549	0	0	492	74	$4,866.77	$7,332	$0.96	1,602.6	0	0	5	0.72
76	Tiernan Hall	Dorm	40,950	213,665	0	0	2,483	75	$23,771.20	$39,451	$0.96	8,622.8	0	0	29	0.72
77	Todd Union	Office/Post Office	54,307	201,727	1,472	1,845	0	76	$20,752.53	$190,521	$3.51	108,371.7	0	0	370	6.81
78	SMD: U Wing	Hospital	214,258	3,546,406	0	0	0	77	$248,248.42	$872,203	$4.07	823,408.4	493	697	3,999	18.67
79	University Facilities Center	Offices/Utility	214,258	324,454	0	0	0	78	$22,711.78	$307,710	$1.44	45,116.4	0	0	154	0.72
80	University Health Services	Office/Medical	27,790	261,097	1,483	0	3,178	79	$29,641.35	$447,494	$16.10	9,608.1	335	484	851	30.63
82	Wallis Hall	Office	49,598	444,629	3,828	5,557	1,553	81	$56,579.84	$524,001	$10.56	17,148.0	597	864	1,519	30.63
83	Wegmans Hall	Classroom/Office	60,976	833,752	7,518	0	1,198	82	$63,036.56	$213,918	$3.51	121,679.9	0	0	415	6.81
84	Wilder Tower	Dorm	78,822	339,414	0	0	3,749	83	$37,066.29	$75,937	$0.96	16,597.6	0	0	57	0.72
85	James P. Wilmot Cancer Center (SMD)	Office/Classroom/Lab	275,536	1,001,642	11,676	0	4,608	84	$87,127.21	$315,940	$1.15	89,564.1	634	896	1,836	6.66
86	Wilson Commons	Dining/Commons/Office	104,338	2,240,639	12,699	6,117	0	85	$179,271.20	$526,474	$5.05	-150,166.1	1,256	1,817	2,560	24.54
87	SMD: X Wing	Hospital	62,002	1,026,256	0	0	0	86	$71,837.92	$252,397	$4.07	238,277.2	143	202	1,157	18.67
		EXTRAPOLATION TOTAL	10,351,862	143,429,796	#######	344,026	411,955	3,661	12,774,262	$44,925,193	$4.34	14,739,454	134,123	175,813	359,180	34.70

See Appendix 7 for tables broken down by ECM

UNIVERSITY OF ROCHESTER
ENERGY CONSERVATION MEASURE (ECM)

EXTRAPOLATED PROJECT IMPACT SUMMARY

for the extracted results of the ECMs Surveyed

	Plant Level Summary			
	Building Level Energy Savings			
A	Electrical Energy Savings	50,291	mmBtu/Year	= E x .003412
B	Chilled Water Savings	134,123	mmBtu/Year	from EXTRAPOLATION Total
C	Steam Savings	175,813	mmBtu/Year	from EXTRAPOLATION Total
D	**Total Energy Savings**	**360,227**	**mmBtu/Year**	
	Building Level Utility Savings			
E	Electrical Energy Savings	14,739,454	kWh/Year	from detailed summary recommended total
F	Chilled Water Savings	11,176,899	Ton-Hour/Year	= B x 1,000,000 / 12,000
G	Steam Savings	175,813	klbs/Year	= C x 1,000,000 / 1,194(BTU/lb) / 1,000
H	Water Savings	-	kGal/Year	from detailed summary recommended total
	Purchased Utility Savings			
I	Electrical Energy Savings	18,303,204	kWh/Year	= E (F x 49% from electric chillers x .916kW/ton)
J	Natural Gas Savings	291,629	mmBtu/Year	= C / 67% [HTG eff. (F x 51% from electric steam x .0052mmBtu/
K	**Total Energy Savings**	**354,080**	**mmBtu/Year**	ton) = I x .003412 J
L	**% Savings of Total Utilities**	**11.5%**		Total Energy Usage / K
	Building Cost Savings ($)			
M	Electrical Dollar Savings	$1,326,551	Per Year	= E x Building Electric Rate
N	Chilled Water Dollar Savings	$2,924,622	Per Year	= F x Building Chilled Water Rate
O	Steam Dollar Savings	$2,566,875	Per Year	= G x Building Steam Rate
P	**Simple Payback**	**7**	**Years**	cost from EXTRAPOLATION Total / (M N O)
	Purchased Utility Cost Savings ($)			
Q	Electrical Dollar Savings	$1,189,708	Per Year	= I x Utility Electric Rate
R	Natural Gas Savings	$936,131	Per Year	= J x Utility Natural Gas Rate
S	Avoided Carbon Tax	$1,057,425	Per Year	= W x Y
T	**Simple Payback**	**14**	**Years**	cost from EXTRAPOLATION Total / (Q R S)
	Impact on CO2e Emissions			
U	Electrical Emissions Savings	2,457	MT CO2e	= I /1000 x 295.94 lbs/MWh x 0.000453592 [lbs to MT
V	Natural Gas Emissions Savings	18,692	MT CO2e	= J x 116.38 lbs/mmBtu x 0.000453592 [lbs to MT
W	**Total Emissions Savings**	**21,149**	MT CO2e	= U V
X	**% Savings of Total GHG Emissions**	**13.6%**		cost from detailed summary recommended total / (U)
Y	Carbon Tax Assumed to be:	$50.00	Per MT CO2e	

UNIVERSITY OF ROCHESTER

ENERGY CONSERVATION MEASURE (ECM)

SUMMARY OF ENERY SAVINGS BY PROJECT TYPES

ENERGY CONSERVATION MEASURES Building Level Energy Savings from Lighting/Heat Pumps/Labs/RCX (Extrapolated)[1]				
Electrical Energy Savings	50,291	mmBtu/Year	14,739,454	kWh/Year
Chilled Water Savings	134,123	mmBtu/Year	11,176,899	ton-hrs/Year
Steam/Hot Water Savings	175,813	mmBtu/Year	175,813	mmBtu/Year
Total Energy Savings	**360,227**	**mmBtu/Year**		
ENERGY DATA ANAYLSIS Building Level Energy Savings from EMIS Project[2]				
Electrical Energy Savings	5,525	mmBtu/Year	1,619,294	kWh/Year
Chilled Water Savings		mmBtu/Year	-	ton-hrs/Year
Steam/Hot Water Savings	17,229	mmBtu/Year	17,229	mmBtu/Year
Total Energy Savings	**17,247**	**mmBtu/Year**		
RENEWABLE ENERGY GENERATION Building Level Energy Savings from Photovoltaic Systems[3]				
Electrical Energy Savings	46,443	mmBtu/Year	13,611,731	kWh/Year

(1) From EXTRAPOLATED PROJECT IMPACT SUMMARY

(2) From ENERGY DATA ANAYLSIS PROJECT IMPACT SUMMARY

(3) From Table 1-2 | ENERGY SAVINGS SUMMARY

UNIVERSITY OF ROCHESTER

ENERGY CONSERVATION MEASURE (ECM)

OVERALL ENERGY CONSERVATION VISION IMPACT SUMMARY

for the extrapolated results of the ECMs Surveyed, EMIS system, PV Systems

	Plant Level Summary			
	Building Level Energy Savings			
A	Electrical Energy Savings	102,259	mmBtu/Year	= E x .003412
B	Chilled Water Savings	134,123	mmBtu/Year	from SUMMARY OF ENERY SAVINGS BY PROJECT TYPES, subtotal
C	Steam Savings	193,042	mmBtu/Year	from SUMMARY OF ENERY SAVINGS BY PROJECT TYPES, subtotal
D	**Total Energy Savings**	**429,424**	**mmBtu/Year**	
	Building Level Utility Savings			
E	Electrical Energy Savings	29,970,480	kWh/Year	from SUMMARY OF ENERY SAVINGS BY PROJECT TYPES, subtotal
F	Chilled Water Savings	11,176,899	Ton-Hour/Year	= B x 1,000,000 / 12,000
G	Steam Savings	193,042	klbs/Year	= C x 1,000,000 / 1,194(BTU/lb) / 1,000
H	Water Savings	-	kGal/Year	from SUMMARY OF ENERY SAVINGS BY PROJECT TYPES
	Purchased Utility Savings			
I	Electrical Energy Savings	33,534,230	kWh/Year	= E (F x 49% from electric chillers x .916kW/ton)
J	Natural Gas Savings	317,310	mmBtu/Year	= C / 67% [HTG eff. (F x 51% from electric steam x .0052mmBtu/ton)
K	**Total Energy Savings**	**431,729**	**mmBtu/Year**	= I x .003412 J
L	**% Savings of Total Utilities**	**14.0%**		Total Energy Usage / K
	Implementation Cost Estimate ($)			
M	ENERGY CONSERVATION MEASURES	$44,925,193	one-time	cost from EXTRAPOLATION Total
N	ENERGY DATA ANAYLSIS	$1,426,399	one-time	cost from ENERGY DATA ANAYLSIS PROJECT IMPACT SUMMARY
O	RENEWABLE ENERGY GENERATION	$21,857,109	one-time	cost from Table 1-2 | ENERGY SAVINGS SUMMARY
P	**Total Capital Costs**	**$68,208,701**		
	Annual Building Cost / Savings ($)			
Q	Electrical Dollar Savings	$2,697,343	Per Year	= E x Building Electric Rate
R	Chilled Water Dollar Savings	$2,924,622	Per Year	= F x Building Chilled Water Rate
S	Steam Dollar Savings	$2,818,411	Per Year	= G x Building Steam Rate
T	Annual Fees (less 30% Incentive)	-$28,520	Per Year	Annual cost to EMIS service provider
U	**Simple Payback**	**8**	**Years**	cost from EXTRAPOLATION Total / (M N O)
	Annual Purchased Utility Cost / Savings ($)			
V	Electrical Dollar Savings	$2,179,725	Per Year	= I x Utility Electric Rate
W	Natural Gas Savings	$1,018,565	Per Year	= J x Utility Natural Gas Rate
X	Avoided Carbon Tax	$1,364,604	Per Year	= AC x AE
Y	Annual Fees (less 30% Incentive)	-$28,520	Per Year	Annual cost to EMIS service provider
Z	**Simple Payback**	**15**	**Years**	cost from EXTRAPOLATION Total / (Q R S)
	Impact on CO2e Emissions			
AA	Electrical Emissions Savings	4,502	MT CO2e	= I /1000 x 295.94 lbs/MWh x 0.000453592 [lbs to MT
AB	Natural Gas Emissions Savings	22,791	MT CO2e	= J x 116.38 lbs/mmBtu x 0.000453592 [lbs to MT
AC	**Total Emissions Savings**	**27,292**	MT CO2e	= U V
AD	**% Savings of Total GHG Emissions**	**17.5%**		cost from detailed summary recommended total / (U)

AE	Carbon Tax Assumed to be:	$50.00	Per MT CO2e

Technical Appendix 1

Lighting ECM

Calculations (Savings Summary & Calculation)
- Kornberg
- ACF
- Wilder Hall
- Fauver Stadium
- Schlegel Hall
- Wallis Hall
- BMEO

Kornberg Medical Research Building (KMRB)

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	229.6	Avg. kW/Month
Electrical Consumption Savings	785,314	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(529.6)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(5,296)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	-$1,146	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Kornberg Medical Research Building (KMRB)
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: Large Office (LOfc)
Nearest City: Buffalo
System Type: VAV Econ
% of Building Cooled: 6% of
Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.200
HVACc: 0.044
HVACg: -0.015

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings	228.7	kW
Total Annual Lighting Savings kWh	784,624	kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	229.6
Electric Consumption Savings (kWh)	785,314
Fuel Savings (mmBtu)	(529.6)

Notes

(1) Based on NY Tech Manual Method: Version 6.1
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Kornberg Medical Research Building (KMRB)
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor
Lighting = 0.9 — Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Kornberg Medical Research Building (KMRB)

EEM 1.1 - Lighting Upgrades

Measure Details

					A	B	C	D			E	F	G	H	L	P	Q	R
		Lighting Description									Energy Use							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
1	AAT8TR1	1-F30T8/1-EB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	5,758	90%	32	24	60	60	1.920	1.440	1.728	1.296	0.432	11,056	8,292	2,764
2	ARCANSI	1-CFL23	1-LED7/R	(1) Rab: C6R7/10/189FAUNVW	2,816	90%	23	7	76	76	1.748	0.532	1.573	0.479	1.094	4,922	1,498	3,424
3	AT12VAP	1-F34T12/1-MB	1-LED18/NF	(1) PHILIPS: WT470C LED23S/840 PSU WB L1300	2,112	90%	34	18	32	32	1.088	0.576	0.979	0.518	0.461	2,298	1,216	1,081
4	AT8VAP	1-F32T8/1-MB	1-LED18/NF	(1) PHILIPS: WT470C LED23S/840 PSU WB L1300	2,112	90%	32	18	32	32	1.024	0.576	0.922	0.518	0.403	2,162	1,216	946
5	BBBT8	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & ICN-2P16-TLED-N	2,112	90%	31	14	48	48	1.488	0.672	1.339	0.605	0.734	3,142	1,419	1,723
6	BBBT8COVE	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & ICN-2P16-TLED-N	2,816	90%	31	14	4	4	0.124	0.056	0.112	0.050	0.061	349	158	191
7	BBBT8TR1	2-F17T8/1-EB	1-LED10/R	(1) METALUX: 12EN-LD2-08-UNV-L840-CD1-U	5,913	90%	31	10	4	4	0.124	0.040	0.112	0.036	0.076	733	237	497
8	BBT8TR1	2-F25T8/1-EB	2-LED8.5T8/RL	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & ICN-3P16-TLED-N	5,913	90%	46	18	1	1	0.046	0.018	0.041	0.016	0.025	272	106	166
9	BBT8WM	2-F25T8/1-EB	1-LED31/NF	(1) PHILIPS: FSS330L-835-UNV-DIM-SWZDT	2,346	90%	46	31	24	24	1.104	0.744	0.994	0.670	0.324	2,590	1,746	845
10	BRCAN8PLH	2-CFQ26/1-SMB	1-LED10/R	(1) Rab: C8R10/15/229FAUNVW	3,860	90%	66	10	251	251	16.566	2.510	14.909	2.259	12.650	63,942	9,688	54,254
11	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	3,603	90%	59	24	83	83	4.897	1.992	4.407	1.793	2.615	17,643	7,177	10,466
12	BT8/INDIRECT	2-F32T8/1-EB	1-LED14/NF	(1) PHILIPS: SM530C LED19S/940	5,913	90%	59	14	184	184	10.856	2.576	9.770	2.318	7.452	64,192	15,232	48,960
13	BT8BX	2-F32T8/1-EB	1-LED36/NF	(1) RAB: EZPAN2X4-30N/D10 & SMKEZPAN2X4	5,851	90%	59	36	346	346	20.414	12.456	18.373	11.210	7.162	119,445	72,882	46,563
14	BT8BX1	2-F32T8/1-EB	1-LED36/NF	(1) RAB: EZPAN1X4-17/D10 & SMKEZPAN1X4	5,357	90%	59	36	39	39	2.301	1.404	2.071	1.264	0.807	12,327	7,521	4,805
15	BT8COVE	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	2,816	90%	59	24	88	88	5.192	2.112	4.673	1.901	2.772	14,619	5,947	8,672
16	BT8IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	2,772	90%	59	24	200	200	11.800	4.800	10.620	4.320	6.300	32,705	13,304	19,401
17	BT8TR1	2-F32T8/1-EB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	2,508	90%	59	24	127	127	7.493	3.048	6.744	2.743	4.001	18,795	7,645	11,149
18	BT8TR1/VP	2-F32T8/1-EB	1-LED18/NF	(1) PHILIPS: WT470C LED23S/840 PSU WB L1300	2,942	90%	59	18	149	149	8.791	2.682	7.912	2.414	5.498	25,866	7,891	17,975
19	BT8U	2-F32T8U/1-EB	1-LED25/R	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	2,089	90%	59	25	248	248	14.632	6.200	13.169	5.580	7.589	30,567	12,952	17,615
20	BT8WM/IND	2-F32T8/1-EB	1-LED14/NF	(1) PHILIPS: SM530C LED19S/940	3,218	90%	59	14	97	97	5.723	1.358	5.151	1.222	3.929	18,418	4,370	14,048
21	CT8BX1	3-F32T8/1-EB	1-LED36/NF	(1) RAB: EZPAN1X4-17/D10 & SMKEZPAN1X4	2,816	90%	90	36	84	84	7.560	3.024	6.804	2.722	4.082	21,287	8,515	12,772

Kornberg Medical Research Building (KMRB)

EEM 1.1 - Lighting Upgrades

Measure Details

		Lighting Description			A	B	C	D			Energy Use E	F	G	H	L	P	Q	R
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
22	CT8BX1 2S	3-F32T8/2-EB	2-LED32T8/R	(2) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G 4	2,816	90%	120	27	8	8	0.960	0.216	0.864	0.194	0.670	2,703	608	2,095
23	CT8TR	3-F32T8/1-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G 4	2,682	90%	90	27	7	7	0.630	0.189	0.567	0.170	0.397	1,689	507	1,183
24	CT8TR1	3-F32T8/1-EB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	2,816	90%	90	24	708	708	63.720	16.992	57.348	15.293	42.055	179,417	47,845	131,573
25	CT8TR1 2s	3-F32T8/2-EB	2-LED32T8/R	(2) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G 4	2,856	90%	120	27	1,394	1,394	167.280	37.638	150.552	33.874	116.678	477,703	107,483	370,220
26	HPS150WP	1-HPS150/1-CWA	1-LED51FL/NF	(1) RAB: W3455L	2,816	90%	190	51	1	1	0.190	0.051	0.171	0.046	0.125	535	144	391
27	LED	LED	LEAVE AS IS	LEAVE AS IS	1,877	90%	15	15	6	6	0.090	0.090	0.081	0.081	0.000	169	169	0
28	WP	1-HPS70/1-CWA	1-LED20WP/NF	(1) RAB: WPLED18N/PC	2,816	90%	95	20	4	4	0.380	0.080	0.342	0.072	0.270	1,070	225	845
	TOTAL:								4,305	4,305	358.1	104.1	322.3	93.7	228.7	1,130,617	345,993	784,624

Kornberg Medical Research Building (KMRB)

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	AAT8TR1	1	$7.00	20,000	$121	1	$115.00	70,000	$568	-$447	1	$25.00	50,000	$173	1	$25.00	50,000	$173	$0	-$447
2	ARCANSI	1	$4.00	1,000	$856	1	$66.00	50,000	$282	$574	0	$0.00	0	$0	0	$0.00	0	$0	$0	$574
3	AT12VAP	1	$7.00	20,000	$24	1	$175.00	70,000	$169	-$145	1	$25.00	50,000	$34	0	$0.00	0	$0	$34	-$112
4	AT8VAP	1	$7.00	20,000	$24	1	$175.00	70,000	$169	-$145	1	$25.00	50,000	$34	0	$0.00	0	$0	$34	-$112
5	BBBT8	2	$7.00	20,000	$71	2	$17.00	70,000	$49	$22	1	$25.00	50,000	$51	1	$25.00	50,000	$51	$0	$22
6	BBBT8COVE	2	$7.00	20,000	$8	2	$17.00	70,000	$5	$2	1	$25.00	50,000	$6	1	$25.00	50,000	$6	$0	$2
7	BBBT8TR1	2	$7.00	20,000	$17	2	$200.00	50,000	$189	-$173	1	$25.00	50,000	$12	0	$0.00	0	$0	$12	-$161
8	BBT8TR1	2	$7.00	20,000	$4	2	$55.00	70,000	$9	-$5	1	$25.00	50,000	$3	1	$25.00	50,000	$3	$0	-$5
9	BBT8WM	2	$7.00	20,000	$39	1	$175.00	70,000	$141	-$101	1	$25.00	50,000	$28	0	$0.00	0	$0	$28	-$73
10	BRCAN8PLH	2	$10.00	15,000	$1,292	1	$66.00	50,000	$1,279	$13	1	$30.00	50,000	$581	0	$0.00	0	$0	$581	$594
11	BT8	2	$7.00	20,000	$209	1	$17.00	70,000	$73	$137	1	$25.00	50,000	$150	1	$25.00	50,000	$150	$0	$137
12	BT8/INDIRECT	2	$7.00	20,000	$762	1	$150.00	70,000	$2,331	-$1,570	1	$25.00	50,000	$544	0	$0.00	50,000	$0	$544	-$1,026
13	BT8BX	2	$7.00	20,000	$1,417	1	$200.00	60,000	$6,748	-$5,331	1	$25.00	50,000	$1,012	0	$0.00	0	$0	$1,012	-$4,319
14	BT8BX1	2	$7.00	20,000	$146	1	$200.00	60,000	$696	-$550	1	$25.00	50,000	$104	0	$0.00	0	$0	$104	-$446
15	BT8COVE	2	$7.00	20,000	$173	2	$17.00	70,000	$120	$53	1	$25.00	50,000	$124	1	$25.00	50,000	$124	$0	$53
16	BT8IND	2	$7.00	20,000	$388	2	$17.00	70,000	$269	$119	1	$25.00	50,000	$277	1	$25.00	50,000	$277	$0	$119
17	BT8TR1	2	$7.00	20,000	$223	1	$115.00	70,000	$523	-$300	1	$25.00	50,000	$159	0	$0.00	0	$0	$159	-$141
18	BT8TR1/VP	2	$7.00	20,000	$307	1	$175.00	70,000	$1,096	-$789	1	$25.00	50,000	$219	0	$0.00	0	$0	$219	-$570
19	BT8U	2	$7.00	20,000	$363	1	$75.00	70,000	$555	-$192	1	$25.00	50,000	$259	0	$0.00	0	$0	$259	$67
20	BT8WM/IND	2	$7.00	20,000	$219	1	$150.00	70,000	$669	-$450	1	$25.00	50,000	$156	0	$0.00	50,000	$0	$156	-$294
21	CT8BX1	3	$7.00	20,000	$248	1	$200.00	60,000	$788	-$540	1	$25.00	50,000	$118	0	$0.00	0	$0	$118	-$422

Kornberg Medical Research Building (KMRB)

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
22	CT8BX1 2S	3	$7.00	20,000	$24	1	$115.00	70,000	$37	-$13	2	$50.00	50,000	$45	0	$0.00	0	$0	$45	$32
23	CT8TR	3	$7.00	20,000	$20	1	$115.00	70,000	$31	-$11	1	$25.00	50,000	$9	0	$0.00	0	$0	$9	-$2
24	CT8TR1	3	$7.00	20,000	$2,093	1	$115.00	70,000	$3,275	-$1,182	1	$25.00	50,000	$997	0	$0.00	0	$0	$997	-$185
25	CT8TR1 2s	3	$7.00	20,000	$4,180	1	$115.00	70,000	$6,540	-$2,360	2	$50.00	50,000	$7,962	0	$0.00	0	$0	$7,962	$5,602
26	HPS150WP	1	$15.00	24,000	$2	1	$290.00	50,000	$16	-$15	1	$25.00	50,000	$1	0	$0.00	0	$0	$1	-$13
27	LED	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
28	WP	1	$15.00	24,000	$7	1	$290.00	100,000	$33	-$26	1	$25.00	50,000	$6	0	$0.00	0	$0	$6	-$20
	TOTAL:				$13,235				$26,663	-$13,427				$13,064				$783	$12,281	-$1,146

MATERIAL & LABOR COST ESTIMATE

Project : Kornberg Medical Research Building (KMRB)
Project # : 402805
Measure : EEM 1.1 - Lighting Upgrades
Date : 04/06/21

Estimated by: DB2
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	(1) METALUX: 12EN-LD2-08-UNV-L840-CD1-U	4	EA	$400.00	$1,600	$105.00	$420	$2,020.00
2	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	895	EA	$116.68	$104,425	$61.14	$54,723	$159,147.50
3	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	248	EA	$75.00	$18,600	$59.50	$14,756	$33,356.00
4	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	7	EA	$115.00	$805	$59.50	$417	$1,221.50
5	(1) PHILIPS: FSS330L-835-UNV-DIM-SWZDT	24	EA	$175.00	$4,200	$84.00	$2,016	$6,216.00
6	(1) PHILIPS: SM530C LED19S/940	281	EA	$150.00	$42,150	$84.00	$23,604	$65,754.00
7	(1) PHILIPS: WT470C LED23S/840 PSU WB L1300	213	EA	$175.00	$37,275	$84.00	$17,892	$55,167.00
8	(1) Rab: C6R7/10/189FAUNVW	76	EA	$66.00	$5,016	$49.00	$3,724	$8,740.00
9	(1) Rab: C8R10/15/229FAUNVW	251	EA	$66.00	$16,566	$49.00	$12,299	$28,865.00
10	(1) RAB: EZPAN1X4-17/D10 & SMKEZPAN1X4	123	EA	$200.00	$24,600	$105.00	$12,915	$37,515.00
11	(1) RAB: EZPAN2X4-30N/D10 & SMKEZPAN2X4	346	EA	$200.00	$69,200	$105.00	$36,330	$105,530.00
12	(1) RAB: W3455L	1	EA	$290.00	$290	$119.00	$119	$409.00
13	(1) RAB: WPLED18N/PC	4	EA	$290.00	$1,160	$119.00	$476	$1,636.00
14	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	371	EA	$55.20	$20,478	$56.00	$20,776	$41,254.00
15	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & ICN-2P16-TLED-N	52	EA	$59.00	$3,068	$52.50	$2,730	$5,798.00
16	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & ICN-3P16-TLED-N	1	EA	$135.00	$135	$49.00	$49	$184.00
17	(2) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	1,402	EA	$115.00	$161,230	$85.00	$119,170	$280,400.00
18	LEAVE AS IS	6	EA	$0.00	$0	$0.00	$0	$0.00
			SUBTOTALS:	Materials:	$510,798	Labor:	$322,415	$833,213.00
							TOTAL:	$833,213.00

wendel

Ambulatory Care Facility

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	174.2	Avg. kW/Month
Electrical Consumption Savings	790,944	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(604.9)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(6,049)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	$5,628	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Ambulatory Care Facility
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: Multi Family Low Rise
Nearest City: Buffalo
System Type: AC with gas heat
% of Building Cooled: 6%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.142
HVACc: 0.014
HVACg: -0.017

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings	173.7	kW
Total Annual Lighting Savings kWh	790,722	kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	174.2
Electric Consumption Savings (kWh)	790,944
Fuel Savings (mmBtu)	(604.9)

Notes

(1) Based on NY Tech Manual Method: Version 6.1
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Ambulatory Care Facility
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor

Lighting = 0.9 Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Ambulatory Care Facility

EEM 1.1 - Lighting Upgrades

Measure Details

		Lighting Description									Energy Use							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	A Total Annual Hours	B Coincidence Factor	C Existing Luminaire Watts	D New Luminaire Watts	# of Existing Units	# of New Units	E Total Existing Connected kW	F Total New Connected kW	G Existing Peak kW Demand	H Proposed Peak kW Demand	L Lighting Monthly kW Savings	P Total Existing Lighting Annual kWh	Q Total New Lighting Annual kWh	R Total Annual Lighting Savings kWh
1	APLH/SCONCE	1-CFQ26/1-SMB	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & ICF-2S13-H1-LD	5,398	90%	33	9	52	52	1.716	0.468	1.544	0.421	1.123	9,263	2,526	6,737
2	BBBT8TR	2-F17T8/1-EB	1-LED25/R	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	2,816	90%	31	25	20	20	0.620	0.500	0.558	0.450	0.108	1,746	1,408	338
3	BRCAN6PLH	2-CFQ26/1-SMB	1-LED7/R	(1) Rab: C6R7/10/189FAUNVW	5,309	90%	66	7	1,370	1,370	90.420	9.590	81.378	8.631	72.747	480,000	50,909	429,091
4	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	4,027	90%	59	24	192	192	11.328	4.608	10.195	4.147	6.048	45,613	18,554	27,059
5	BT8D/IND/WM	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	7,446	90%	59	24	24	24	1.416	0.576	1.274	0.518	0.756	10,544	4,289	6,255
6	BT8TR1	2-F32T8/1-EB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	3,169	90%	59	24	102	102	6.018	2.448	5.416	2.203	3.213	19,070	7,757	11,313
7	BT8WM	2-F32T8/1-EB	1-LED31/NF	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	3,867	90%	59	31	172	172	10.148	5.332	9.133	4.799	4.334	39,238	20,617	18,622
8	COVE	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	2,300	90%	59	24	51	51	3.009	1.224	2.708	1.102	1.607	6,922	2,816	4,106
9	CRCAN10/PLH	3-CFQ26/1-SMB	1-LED14/R	(1) RAB: DLED6AR14YN	7,446	90%	99	14	66	66	6.534	0.924	5.881	0.832	5.049	48,652	6,880	41,772
10	CT8TR	3-F32T8/1-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	2,766	90%	90	27	1,037	1,037	93.330	27.999	83.997	25.199	58.798	258,194	77,458	180,736
11	CT8TR 2s	3-F32T8/2-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	2,769	90%	120	27	242	242	29.040	6.534	26.136	5.881	20.255	80,417	18,094	62,323
12	LED DEC	LED	LEAVE AS IS	LEAVE AS IS	7,446	90%	20	20	35	35	0.700	0.700	0.630	0.630	0.000	5,212	5,212	0
13	SENSORS	None	Occupancy Sensor	LUTRON						72					-0.306		-2,372	2,372
	TOTAL:								3,363	3,435	254.3	60.9	228.9	54.8	173.7	1,004,871	214,149	790,722

Ambulatory Care Facility

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	APLH/SCONCE	1	$10.00	15,000	$187	1	$38.00	50,000	$213	-$26	1	$30.00	50,000	$168	1	$25.00	50,000	$140	$28	$2
2	BBBT8TR	2	$7.00	20,000	$39	2	$75.00	70,000	$121	-$81	1	$25.00	50,000	$28	0	$0.00	0	$0	$28	-$53
3	BRCAN6PLH	2	$10.00	15,000	$9,697	1	$66.00	50,000	$9,600	$97	1	$30.00	50,000	$4,364	0	$0.00	0	$0	$4,364	$4,461
4	BT8	2	$7.00	20,000	$541	1	$17.00	70,000	$188	$353	1	$25.00	50,000	$387	1	$25.00	50,000	$387	$0	$353
5	BT8D/IND/WM	2	$7.00	20,000	$125	2	$17.00	70,000	$87	$38	1	$25.00	50,000	$89	1	$25.00	50,000	$89	$0	$38
6	BT8TR1	2	$7.00	20,000	$226	1	$115.00	70,000	$531	-$305	1	$25.00	50,000	$162	0	$0.00	0	$0	$162	-$143
7	BT8WM	2	$7.00	20,000	$466	1	$125.00	70,000	$1,188	-$722	1	$25.00	50,000	$333	0	$0.00	0	$0	$333	-$390
8	COVE	2	$7.00	20,000	$82	1	$17.00	70,000	$28	$54	1	$25.00	50,000	$59	1	$25.00	50,000	$59	$0	$54
9	CRCAN10/PLH	3	$10.00	15,000	$983	1	$66.00	50,000	$649	$334	1	$30.00	50,000	$295	0	$0.00	0	$0	$295	$629
10	CT8TR	3	$7.00	20,000	$3,012	1	$115.00	70,000	$4,713	-$1,701	1	$25.00	50,000	$1,434	0	$0.00	0	$0	$1,434	-$266
11	CT8TR 2s	3	$7.00	20,000	$704	1	$115.00	70,000	$1,101	-$397	2	$50.00	50,000	$1,340	0	$0.00	0	$0	$1,340	$943
12	LED DEC	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
13	SENSORS																			
	TOTAL:				$16,062				$18,418	-$2,356				$8,658				$675		$5,628

MATERIAL & LABOR COST ESTIMATE

Project : Ambulatory Care Facility
Project # : 402805
Measure : EEM 1.1 - Lighting Upgrades
Date : 04/06/21

Estimated by: DB2
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & ICF-2S13-H1-LD	52	EA	$63.00	$3,276	$49.00	$2,548	$5,824.00
2	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	102	EA	$115.00	$11,730	$59.50	$6,069	$17,799.00
3	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	20	EA	$150.00	$3,000	$59.50	$1,190	$4,190.00
4	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	1,279	EA	$115.00	$147,085	$59.50	$76,101	$223,185.50
5	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	172	EA	$125.00	$21,500	$84.00	$14,448	$35,948.00
6	(1) Rab: C6R7/10/189FAUNVW	1,370	EA	$66.00	$90,420	$49.00	$67,130	$157,550.00
7	(1) RAB: DLED6AR14YN	66	EA	$66.00	$4,356	$49.00	$3,234	$7,590.00
8	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	267	EA	$43.53	$11,622	$57.34	$15,309	$26,931.00
9	LEAVE AS IS	35	EA	$0.00	$0	$0.00	$0	$0.00
10	LUTRON - MS-OPS6M2-DV-WH	53	EA	$49.00	$2,597	$90.00	$4,770	$7,367.00
11	LUTRON - LRF2-OCR2B-P-WH	19	EA	$55.00	$1,045	$120.00	$2,280	$3,325.00
			SUBTOTALS:	Materials:	$296,631	Labor:	$193,079	$489,709.50
							TOTAL:	$489,709.50

wendel

Wilder Hall

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	10.2	Avg. kW/Month
Electrical Consumption Savings	16,602	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(12.7)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(127)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	-$180	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Wilder Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: Multi Family Low Rise
Nearest City: Buffalo
System Type: AC with gas heat
% of Building Cooled: 6%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.142
HVACc: 0.014
HVACg: -0.017

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings	10.1	kW
Total Annual Lighting Savings kWh	16,598	kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	10.2
Electric Consumption Savings (kWh)	16,602
Fuel Savings (mmBtu)	(12.7)

Notes

(1) Based on NY Tech Manual Method: Version 6.1
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Wilder Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor
Lighting = 0.9 Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS:	Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.
L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Wilder Hall

EEM 1.1 - Lighting Upgrades

Measure Details

		Lighting Description										Energy Use							
					A	B	C	D			E	F	G	H	L	P	Q	R
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
1	AT8	1-F32T8/1-MB	1-LED12T8/RL	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	8,760	90%	32	12	10	10	0.320	0.120	0.288	0.108	0.180	2,803	1,051	1,752
2	AT8S	1-F32T8/1-MB	1-LED26/NF	(1) PHILIPS: FSS440L-830-UNV-DIM-SWZDT	1,314	90%	32	26	4	4	0.128	0.104	0.115	0.094	0.022	168	137	32
3	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	1,596	90%	59	24	16	16	0.944	0.384	0.850	0.346	0.504	1,506	613	894
4	BT8BX	2-F32T8/1-EB	1-LED36/NF	(1) RAB: EZPAN2X4-30N/D10 & SMKEZPAN2X4	1,314	90%	59	36	8	8	0.472	0.288	0.425	0.259	0.166	620	378	242
5	BT8BX/P	2-F32T8/1-EB	1-LED20/NF	(1) PHILIPS SP532P LED29S/940 PSD PI5 SM2 L1410 WH	2,816	90%	59	20	8	8	0.472	0.160	0.425	0.144	0.281	1,329	451	879
6	BT8IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	6,388	90%	59	24	6	6	0.354	0.144	0.319	0.130	0.189	2,261	920	1,341
7	BT8WM	2-F32T8/1-EB	1-LED31/NF	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	1,112	90%	59	31	48	48	2.832	1.488	2.549	1.339	1.210	3,149	1,654	1,494
8	CFLSI	1-CFL13	1-LEDSI/R	(1) PHILLIPS: A19/LED/9W	1,314	90%	13	9	3	3	0.039	0.027	0.035	0.024	0.011	51	35	16
9	CT8IND	3-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	1,314	90%	90	24	1	1	0.090	0.024	0.081	0.022	0.059	118	32	87
10	HPS70WP	1-HPS70/1-CWA	1-LED20WP/NF	(1) RAB: WPLED18N/PC	3,690	0%	95	20	1	1	0.095	0.020	0.000	0.000	0.000	351	74	277
11	LED 2x2	LED	LEAVE AS IS	LEAVE AS IS	8,760	90%	24	24	25	25	0.600	0.600	0.540	0.540	0.000	5,256	5,256	0
12	LED BT8IND	LED	LEAVE AS IS	LEAVE AS IS	7,540	90%	30	30	7	7	0.210	0.210	0.189	0.189	0.000	1,583	1,583	0
13	LED SI	LED	LEAVE AS IS	LEAVE AS IS	1,314	90%	7	7	5	5	0.035	0.035	0.032	0.032	0.000	46	46	0
14	LEDBT8	LED	LEAVE AS IS	LEAVE AS IS	6,212	90%	15	15	21	21	0.315	0.315	0.284	0.284	0.000	1,957	1,957	0
15	LEDCAN	LED	LEAVE AS IS	LEAVE AS IS	1,314	90%	12	12	7	7	0.084	0.084	0.076	0.076	0.000	110	110	0
16	LEDCIR/WM	LED	LEAVE AS IS	LEAVE AS IS	8,760	90%	5	5	66	66	0.330	0.330	0.297	0.297	0.000	2,891	2,891	0
17	LEDSI	LED	LEAVE AS IS	LEAVE AS IS	5,913	90%	7	7	3	3	0.021	0.021	0.019	0.019	0.000	124	124	0
18	SQCPY	2-CFI23/1	1-LED9/NF	(1) RAB: SK9SYYW	1,136	89%	46	9	228	228	10.488	2.052	9.356	1.831	7.526	11,917	2,332	9,585
	TOTAL:								467	467	17.8	6.4	15.9	5.7	10.1	36,241	19,644	16,598

Wilder Hall

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	AT8	1	$7.00	20,000	$31	1	$17.00	70,000	$21	$9	1	$25.00	50,000	$44	1	$25.00	50,000	$44	$0	$9
2	AT8S	1	$7.00	20,000	$2	1	$125.00	70,000	$9	-$8	1	$25.00	50,000	$3	0	$0.00	0	$0	$3	-$5
3	BT8	2	$7.00	20,000	$18	1	$17.00	70,000	$6	$12	1	$25.00	50,000	$13	1	$25.00	50,000	$13	$0	$12
4	BT8BX	2	$7.00	20,000	$7	1	$200.00	60,000	$35	-$28	1	$25.00	50,000	$5	0	$0.00	0	$0	$5	-$22
5	BT8BX/P	2	$7.00	20,000	$16	1	$150.00	70,000	$48	-$33	1	$25.00	50,000	$11	0	$0.00	0	$0	$11	-$21
6	BT8IND	2	$7.00	20,000	$27	2	$17.00	70,000	$19	$8	1	$25.00	50,000	$19	1	$25.00	50,000	$19	$0	$8
7	BT8WM	2	$7.00	20,000	$37	1	$125.00	70,000	$95	-$58	1	$25.00	50,000	$27	0	$0.00	0	$0	$27	-$31
8	CFLSI	1	$4.00	5,000	$3	1	$5.52	15,000	$1	$2	0	$0.00	0	$0	0	$0.00	0	$0	$0	$2
9	CT8IND	3	$7.00	20,000	$1	3	$17.00	70,000	$1	$0	1	$25.00	50,000	$1	1	$0.00	0	$0	$1	$1
10	HPS70WP	1	$15.00	24,000	$2	1	$290.00	100,000	$11	-$8	1	$25.00	50,000	$2	0	$0.00	0	$0	$2	-$7
11	LED 2x2	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
12	LED BT8IND	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
13	LED SI	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
14	LEDBT8	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
15	LEDCAN	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
16	LEDCIR/WM	1	$0.00	20,000	$0	1	$0.00	20,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
17	LEDSI	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
18	SQCPY	1	$4.00	15,000	$69	1	$75.00	100,000	$194	-$125	0	$0.00	0	$0	0	$0.00	0	$0	$0	-$125
	TOTAL:				$214				$441	-$228				$124				$76		-$180

MATERIAL & LABOR COST ESTIMATE

Project : Wilder Hall
Project # : 402805
Measure : EEM 1.1 - Lighting Upgrades
Date : 04/06/21

Estimated by: DB2
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	(1) PHILIPS SP532P LED29S/940 PSD PI5 SM2 L1410 WH	8	EA	$150.00	$1,200	$84.00	$672	$1,872.00
2	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	10	EA	$42.00	$420	$49.00	$490	$910.00
3	(1) PHILIPS: FSS440L-830-UNV-DIM-SWZDT	4	EA	$125.00	$500	$84.00	$336	$836.00
4	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	48	EA	$125.00	$6,000	$84.00	$4,032	$10,032.00
5	(1) PHILLIPS: A19/LED/9W	3	EA	$11.05	$33	$17.50	$53	$85.65
6	(1) RAB: EZPAN2X4-30N/D10 & SMKEZPAN2X4	8	EA	$200.00	$1,600	$105.00	$840	$2,440.00
7	(1) RAB: SK9SYYW	228	EA	$75.00	$17,100	$84.00	$19,152	$36,252.00
8	(1) RAB: WPLED18N/PC	1	EA	$290.00	$290	$119.00	$119	$409.00
9	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	23	EA	$47.91	$1,102	$56.00	$1,288	$2,390.00
10	LEAVE AS IS	134	EA	$0.00	$0	$0.00	$0	$0.00
			SUBTOTALS:	Materials:	$28,245	Labor:	$26,982	$55,226.65
							TOTAL:	**$55,226.65**

wendel

Fauver Stadium

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	5.3	Avg. kW/Month
Electrical Consumption Savings	18,592	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(14.2)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(142)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	-$354	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Fauver Stadium
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: Multi Family Low Rise
Nearest City: Buffalo
System Type: AC with gas heat
% of Building Cooled: 6%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.142
HVACc: 0.014
HVACg: -0.017

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings	5.2	kW
Total Annual Lighting Savings kWh	18,587	kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	5.3
Electric Consumption Savings (kWh)	18,592
Fuel Savings (mmBtu)	(14.2)

Notes

(1) Based on NY Tech Manual Method: Version 6.1
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Fauver Stadium
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor

Lighting = 0.9 — Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Fauver Stadium

EEM 1.1 - Lighting Upgrades

Measure Details

		Lighting Description									Energy Use							
					A	B	C	D			E	F	G	H	L	P	Q	R
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
1	A8T8BX/INDIRECT	1-F96T8/1-EB	2-LED14/NF	(2) PHILIPS: SM530C LED19S/940	939	90%	58	28	1	1	0.058	0.028	0.052	0.025	0.027	54	26	28
2	A8T8BX/WM/INDIRECT	1-F96T8/1-EB	1-LEDBX/NF	(2) PHILIPS: SM530C LED19S/940	1,877	90%	58	28	4	4	0.232	0.112	0.209	0.101	0.108	435	210	225
3	AAAT8TR1	1-F17T8/1-EB	1-LED10/R	(1) METALUX: 12EN-LD2-08-UNV-L840-CD1-U	8,760	90%	20	10	3	3	0.060	0.030	0.054	0.027	0.027	526	263	263
4	AAT8TR1	1-F30T8/1-EB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	1,877	90%	32	24	1	1	0.032	0.024	0.029	0.022	0.007	60	45	15
5	ALEDT8	1-LEDT8	LEAVE AS IS	LEAVE AS IS	1,314	90%	15	0	2	2	0.030	0.000	0.027	0.000	0.027	39	0	39
6	AT12BX/P	1-F34T12/1-MB	1-LED14/RF	(1) PHILIPS: SP531P LED15S/940	1,095	90%	34	14	6	6	0.204	0.084	0.184	0.076	0.108	223	92	131
7	AT12BX/WM	1-F34T12/1-MB	1-LED14/NF	(1) PHILIPS: SP531P LED15S/940	6,466	90%	34	14	3	3	0.102	0.042	0.092	0.038	0.054	660	272	388
8	AT12BX/WM/INDIRECT	1-F34T12/1-MB	1-LED14/NF	(1) PHILIPS: SP531P LED15S/940	1,877	90%	34	14	1	1	0.034	0.014	0.031	0.013	0.018	64	26	38
9	AT12TR1	1-F34T12/1-MB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	1,877	90%	34	24	11	11	0.374	0.264	0.337	0.238	0.099	702	496	206
10	AT8S/WM	1-F32T8/1-MB	1-LED26/NF	(1) PHILIPS: FSS440L-830-UNV-DIM-SWZDT	1,877	90%	32	26	1	1	0.032	0.026	0.029	0.023	0.005	60	49	11
11	BBT8BX/P	2-F25T8/1-EB	1-LED20/NF	(1) PHILIPS SP532P LED29S/940 PSD PI5 SM2 L1410 WH	8,760	90%	46	20	2	2	0.092	0.040	0.083	0.036	0.047	806	350	456
12	BRCAN8PLH	2-CFQ26/1-SMB	1-LED10/R	(1) Rab: C8R10/15/229FAUNVW	1,314	90%	66	10	4	4	0.264	0.040	0.238	0.036	0.202	347	53	294
13	BT12BX/P	2-34T12/1-MB	1-LED20/NF	(1) PHILIPS SP532P LED29S/940 PSD PI5 SM2 L1410 WH	3,598	90%	68	20	8	8	0.544	0.160	0.490	0.144	0.346	1,957	576	1,382
14	BT12BX/SM/INDIRECT	2-34T12/1-MB	1-LED14/NF	(1) PHILIPS: SM530C LED19S/940	1,877	90%	68	14	7	7	0.476	0.098	0.428	0.088	0.340	894	184	710
15	BT12BX/WM/INDIRECT	2-34T12/1-MB	1-LED14/NF	(1) PHILIPS: SM530C LED19S/940	1,877	90%	68	14	1	1	0.068	0.014	0.061	0.013	0.049	128	26	101
16	BT12IND	2-34T12/1-MB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	1,877	90%	68	24	3	3	0.204	0.072	0.184	0.065	0.119	383	135	248
17	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	1,314	90%	59	24	1	1	0.059	0.024	0.053	0.022	0.032	78	32	46
18	BT8BX/D/IND	2-F32T8/1-EB	1-LED20/NF	(1) PHILIPS SP532P LED29S/940 PSD PI5 SM2 L1410 WH	8,760	90%	59	20	2	2	0.118	0.040	0.106	0.036	0.070	1,034	350	683
19	BT8BX/P	2-F32T8/1-EB	1-LED20/NF	(1) PHILIPS SP532P LED29S/940 PSD PI5 SM2 L1410 WH	939	90%	59	20	10	10	0.590	0.200	0.531	0.180	0.351	554	188	366
20	BT8IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	1,877	90%	59	24	3	3	0.177	0.072	0.159	0.065	0.095	332	135	197
21	BT8SM/INDIRECT	2-F32T8/1-EB	1-LED14/NF	(1) PHILIPS: SM530C LED19S/940	2,860	90%	59	14	7	7	0.413	0.098	0.372	0.088	0.284	1,181	280	901

Fauver Stadium

EEM 1.1 - Lighting Upgrades

					A	B	C	D			E	F	G	H	L	P	Q	R
					Measure Details													
		Lighting Description									Energy Use							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
22	BT8TR1	2-F32T8/1-EB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	2,628	90%	59	24	1	1	0.059	0.024	0.053	0.022	0.032	155	63	92
23	BT8U	2-F32T8U/1-EB	1-LED25/R	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	1,877	90%	59	25	1	1	0.059	0.025	0.053	0.023	0.031	111	47	64
24	BT8UTR	2-F32T8U/1-EB	1-LED25/R	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	1,877	90%	59	25	1	1	0.059	0.025	0.053	0.023	0.031	111	47	64
25	BT8W	2-F32T8/1-EB	1-LED31/NF	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	3,254	90%	59	31	5	5	0.295	0.155	0.266	0.140	0.126	960	504	456
26	CT8TR	3-F32T8/1-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	1,877	90%	90	27	45	45	4.050	1.215	3.645	1.094	2.552	7,602	2,281	5,322
27	D(B)T8TR	2-F32T8/1-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	2,628	90%	59	27	5	5	0.295	0.135	0.266	0.122	0.144	775	355	420
28	HPS150WP	1-HPS150/1-CWA	1-LED51FL/NF	(1) RAB: W3455L	3,690	0%	190	51	1	1	0.190	0.051	0.000	0.000	0.000	701	188	513
29	HPS400FL	1-HPS400/1-CWA	1-LED164FL/NF	(1) RAB: FXLED150TN/PCT	3,690	0%	465	164	4	4	1.860	0.656	0.000	0.000	0.000	6,863	2,421	4,443
30	HPS50PHONE	1-HPS50/1-CWA	LEAVE AS IS	LEAVE AS IS	3,690	0%	60	60	1	1	0.060	0.060	0.000	0.000	0.000	221	221	0
31	LED	LED	LEAVE AS IS	LEAVE AS IS	1,904	90%	15	15	189	189	2.835	2.835	2.552	2.552	0.000	5,399	5,399	0
32	LED Vanity	LED	LEAVE AS IS	LEAVE AS IS	1,117	90%	15	15	8	8	0.120	0.120	0.108	0.108	0.000	134	134	0
33	LED/1x4P	LED	LEAVE AS IS	LEAVE AS IS	1,229	90%	15	15	45	45	0.675	0.675	0.608	0.608	0.000	829	829	0
34	LED/1x4S	LED	LEAVE AS IS	LEAVE AS IS	909	90%	15	15	29	29	0.435	0.435	0.392	0.392	0.000	396	396	0
35	LED2x2BX	LED	LEAVE AS IS	LEAVE AS IS	1,314	90%	30	30	1	1	0.030	0.030	0.027	0.027	0.000	39	39	0
36	LED8x8BX	LED	LEAVE AS IS	LEAVE AS IS	1,314	90%	60	60	1	1	0.060	0.060	0.054	0.054	0.000	79	79	0
37	LEDBT8INC	LED	LEAVE AS IS	LEAVE AS IS	8,760	90%	15	15	3	3	0.045	0.045	0.041	0.041	0.000	394	394	0
38	LEDCAN	LED	LEAVE AS IS	LEAVE AS IS	5,913	90%	12	12	12	12	0.144	0.144	0.130	0.130	0.000	851	851	0
39	LEDCYL/P	LED	LEAVE AS IS	LEAVE AS IS	1,314	90%	20	20	8	8	0.160	0.160	0.144	0.144	0.000	210	210	0
40	LEDFL	LED	LEAVE AS IS	LEAVE AS IS	3,690	0%	20	20	1	1	0.020	0.020	0.000	0.000	0.000	74	74	0
41	LEDP	LED	LEAVE AS IS	LEAVE AS IS	3,222	90%	20	20	3	3	0.060	0.060	0.054	0.054	0.000	193	193	0

Fauver Stadium

EEM 1.1 - Lighting Upgrades

					A	B	C	D			E	F	G	H	L	P	Q	R
		Lighting Description			Measure Details						Energy Use							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
42	LEDS	LED	LEAVE AS IS	LEAVE AS IS	5,913	90%	15	15	1	1	0.015	0.015	0.014	0.014	0.000	89	89	0
43	LEDW	LED	LEAVE AS IS	LEAVE AS IS	1,877	90%	15	15	2	2	0.030	0.030	0.027	0.027	0.000	56	56	0
44	LEDWP	LED	LEAVE AS IS	LEAVE AS IS	3,690	90%	25	25	1	1	0.025	0.025	0.023	0.023	0.000	92	92	0
45	SENSORS	None	Occupancy Sensor	LUTRON - MS-OPS6M2-DV-WH						27					-0.087	0	-485	485
	TOTAL:								449	476	15.7	8.5	12.3	6.9	5.2	36,853	18,266	18,587

Fauver Stadium

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
					BB				DD	FF				HH				JJ	LL	NN
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	A8T8BX/INDIRECT	1	$7.00	20,000	$0	2	$150.00	70,000	$4	-$4	1	$25.00	50,000	$0	0	$0.00	50,000	$0	$0	-$3
2	A8T8BX/WM/INDIRECT	1	$7.00	20,000	$3	2	$150.00	70,000	$32	-$30	1	$25.00	50,000	$4	0	$0.00	50,000	$0	$4	-$26
3	AAAT8TR1	1	$7.00	20,000	$9	1	$200.00	50,000	$105	-$96	1	$25.00	50,000	$13	0	$0.00	0	$0	$13	-$83
4	AAT8TR1	1	$7.00	20,000	$1	1	$115.00	70,000	$3	-$2	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	-$2
5	ALEDT8	1	$0.00	0	$0	1	$0.00	0	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
6	AT12BX/P	1	$7.00	20,000	$2	1	$150.00	70,000	$14	-$12	1	$25.00	50,000	$3	0	$0.00	0	$0	$3	-$8
7	AT12BX/WM	1	$7.00	20,000	$7	1	$150.00	70,000	$42	-$35	1	$25.00	50,000	$10	0	$0.00	0	$0	$10	-$25
8	AT12BX/WM/INDIRECT	1	$7.00	20,000	$1	1	$150.00	70,000	$4	-$3	1	$25.00	50,000	$1	0	$0.00	0	$0	$1	-$2
9	AT12TR1	1	$7.00	20,000	$7	1	$115.00	70,000	$34	-$27	1	$25.00	50,000	$10	0	$0.00	0	$0	$10	-$16
10	AT8S/WM	1	$7.00	20,000	$1	1	$125.00	70,000	$3	-$3	1	$25.00	50,000	$1	0	$0.00	0	$0	$1	-$2
11	BBT8BX/P	2	$7.00	20,000	$12	1	$150.00	70,000	$38	-$25	1	$25.00	50,000	$9	0	$0.00	0	$0	$9	-$17
12	BRCAN8PLH	2	$10.00	15,000	$7	1	$66.00	50,000	$7	$0	1	$30.00	50,000	$3	0	$0.00	0	$0	$3	$3
13	BT12BX/P	2	$7.00	20,000	$20	1	$150.00	70,000	$62	-$42	1	$25.00	50,000	$14	0	$0.00	0	$0	$14	-$27
14	BT12BX/SM/INDIRECT	2	$7.00	20,000	$9	1	$150.00	70,000	$28	-$19	1	$25.00	50,000	$7	0	$0.00	0	$0	$7	-$12
15	BT12BX/WM/INDIRECT	2	$7.00	20,000	$1	1	$150.00	70,000	$4	-$3	1	$25.00	50,000	$1	0	$0.00	0	$0	$1	-$2
16	BT12IND	2	$7.00	20,000	$4	2	$17.00	70,000	$3	$1	1	$25.00	50,000	$3	1	$25.00	50,000	$3	$0	$1
17	BT8	2	$7.00	20,000	$1	1	$17.00	70,000	$0	$1	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$1
18	BT8BX/D/IND	2	$7.00	20,000	$12	1	$150.00	70,000	$38	-$25	1	$25.00	50,000	$9	0	$0.00	0	$0	$9	-$17
19	BT8BX/P	2	$7.00	20,000	$7	1	$150.00	70,000	$20	-$14	1	$25.00	50,000	$5	0	$0.00	0	$0	$5	-$9
20	BT8IND	2	$7.00	20,000	$4	2	$17.00	70,000	$3	$1	1	$25.00	50,000	$3	1	$25.00	50,000	$3	$0	$1
21	BT8SM/INDIRECT	2	$7.00	20,000	$14	1	$150.00	70,000	$43	-$29	1	$25.00	50,000	$10	0	$0.00	50,000	$0	$10	-$19

Fauver Stadium

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
22	BT8TR1	2	$7.00	20,000	$2	1	$115.00	70,000	$4	-$2	1	$25.00	50,000	$1	0	$0.00	0	$0	$1	-$1
23	BT8U	2	$7.00	20,000	$1	1	$75.00	70,000	$2	-$1	1	$25.00	50,000	$1	0	$0.00	0	$0	$1	$0
24	BT8UTR	2	$7.00	20,000	$1	1	$75.00	70,000	$2	-$1	1	$25.00	50,000	$1	0	$0.00	0	$0	$1	$0
25	BT8W	2	$7.00	20,000	$11	1	$125.00	70,000	$29	-$18	1	$25.00	50,000	$8	0	$0.00	0	$0	$8	-$10
26	CT8TR	3	$7.00	20,000	$89	1	$115.00	70,000	$139	-$50	1	$25.00	50,000	$42	0	$0.00	0	$0	$42	-$8
27	D(B)T8TR	2	$7.00	20,000	$9	1	$115.00	70,000	$22	-$12	1	$25.00	50,000	$7	0	$0.00	0	$0	$7	-$6
28	HPS150WP	1	$15.00	24,000	$2	1	$290.00	50,000	$21	-$19	1	$25.00	50,000	$2	0	$0.00	0	$0	$2	-$17
29	HPS400FL	1	$15.00	24,000	$9	1	$445.00	100,000	$66	-$56	1	$25.00	50,000	$7	0	$0.00	0	$0	$7	-$49
30	HPS50PHONE	1	$0.00	0	$0	1	$0.00	0	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
31	LED	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
32	LED Vanity	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
33	LED/1x4P	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
34	LED/1x4S	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
35	LED2x2BX	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
36	LED8x8BX	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
37	LEDBT8INC	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
38	LEDCAN	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
39	LEDCYL/P	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
40	LEDFL	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
41	LEDP	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0

Fauver Stadium

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
					BB				DD	FF				HH				JJ	LL	NN
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
42	LEDS	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
43	LEDW	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
44	LEDWP	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
45	SENSORS																			
	TOTAL:				$247				$771	-$524				$176				$7		-$354

MATERIAL & LABOR COST ESTIMATE

Project : Fauver Stadium
Project # : 402805
Measure : EEM 1.1 - Lighting Upgrades
Date : 04/06/21

Estimated by: DB2
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	(1) METALUX: 12EN-LD2-08-UNV-L840-CD1-U	3	EA	$200.00	$600	$105.00	$315	$915.00
2	(1) PHILIPS SP532P LED29S/940 PSD PI5 SM2 L1410 WH	22	EA	$150.00	$3,300	$84.00	$1,848	$5,148.00
3	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	13	EA	$116.92	$1,520	$82.12	$1,068	$2,587.50
4	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	2	EA	$75.00	$150	$59.50	$119	$269.00
5	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	50	EA	$115.00	$5,750	$59.50	$2,975	$8,725.00
6	(1) PHILIPS: FSS440L-830-UNV-DIM-SWZDT	1	EA	$125.00	$125	$84.00	$84	$209.00
7	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	5	EA	$125.00	$625	$84.00	$420	$1,045.00
8	(1) PHILIPS: SM530C LED19S/940	15	EA	$150.00	$2,250	$84.00	$1,260	$3,510.00
9	(1) PHILIPS: SP531P LED15S/940	10	EA	$150.00	$1,500	$84.00	$840	$2,340.00
10	(1) Rab: C8R10/15/229FAUNVW	4	EA	$66.00	$264	$49.00	$196	$460.00
11	(1) RAB: FXLED150TN/PCT	4	EA	$445.00	$1,780	$119.00	$476	$2,256.00
12	(1) RAB: W3455L	1	EA	$290.00	$290	$119.00	$119	$409.00
13	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	7	EA	$56.57	$396	$56.00	$392	$788.00
14	(2) PHILIPS: SM530C LED19S/940	5	EA	$300.00	$1,500	$84.00	$420	$1,920.00
15	LEAVE AS IS	307	EA	$0.00	$0	$0.00	$0	$0.00
14	LUTRON - MS-OPS6M2-DV-WH	27	EA	$49.00	$1,323	$90.00	$2,430	$3,753.00
			SUBTOTALS:	Materials:	$21,373	Labor:	$12,962	$34,334.50
							TOTAL:	**$34,334.50**

wendel

Schlegel Hall

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	39.0	Avg. kW/Month
Electrical Consumption Savings	140,315	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(107.3)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(1,073)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	$91	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Schlegel Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: Multi Family Low Rise
Nearest City: Buffalo
System Type: AC with gas heat
% of Building Cooled: 6%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.142
HVACc: 0.014
HVACg: -0.017

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings 38.9 kW
Total Annual Lighting Savings kWh 140,276 kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	39.0
Electric Consumption Savings (kWh)	140,315
Fuel Savings (mmBtu)	(107.3)

Notes

(1) Based on NY Tech Manual Method: Version 6.1
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Schlegel Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor
Lighting = 0.9 Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Schlegel Hall

EEM 1.1 - Lighting Upgrades

Measure Details

					A	B	C	D			E	F	G	H	L	P	Q	R
		Lighting Description									**Energy Use**							
Measure #	**Fixture code**	**Existing Equipment**	**Replacement Equipment**	**Replacement Model #**	**Total Annual Hours**	**Coincidence Factor**	**Existing Luminaire Watts**	**New Luminaire Watts**	**# of Existing Units**	**# of New Units**	**Total Existing Connected kW**	**Total New Connected kW**	**Existing Peak kW Demand**	**Proposed Peak kW Demand**	**Lighting Monthly kW Savings**	**Total Existing Lighting Annual kWh**	**Total New Lighting Annual kWh**	**Total Annual Lighting Savings kWh**
1	AAAT8	1-F17T8/1-EB	1-LED7T8/RL	(1) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & ICN-2P16-TLED-N	2,346	90%	20	7	2	2	0.040	0.014	0.036	0.013	0.023	94	33	61
2	AAAT8TR1	1-F17T8/1-EB	1-LED10/R	(1) METALUX: 12EN-LD2-08-UNV-L840-CD1-U	2,346	90%	20	10	1	1	0.020	0.010	0.018	0.009	0.009	47	23	23
3	AAT8TR1	1-F30T8/1-EB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	2,346	90%	32	24	7	7	0.224	0.168	0.202	0.151	0.050	526	394	131
4	ACAN8PLV	1-CFQ26/1-SMB	1-LED10/R	(1) Rab: C8R10/15/229FAUNVW	5,913	90%	33	10	15	15	0.495	0.150	0.446	0.135	0.311	2,927	887	2,040
5	ARCAN6PLH	1-CFQ26/1-SMB	1-LED7/R	(1) Rab: C6R7/10/189FAUNVW	3,684	90%	33	7	16	16	0.528	0.112	0.475	0.101	0.374	1,945	413	1,532
6	ARCAN6PLV	1-CFQ26/1-SMB	1-LED7/R	(1) Rab: C6R7/10/189FAUNVW	2,346	90%	33	7	34	34	1.122	0.238	1.010	0.214	0.796	2,633	558	2,074
7	ARCAN8PLH	1-CFQ26/1-SMB	1-LED10/R	(1) Rab: C8R10/15/229FAUNVW	5,913	90%	33	10	8	8	0.264	0.080	0.238	0.072	0.166	1,561	473	1,088
8	ARCAN8PLV	1-CFQ26/1-SMB	1-LED10/R	(1) Rab: C8R10/15/229FAUNVW	5,913	90%	33	10	10	10	0.330	0.100	0.297	0.090	0.207	1,951	591	1,360
9	ARCAN8WW	1-CFQ26/1-SMB	1-LED14/R	(1) RAB: DLED6AR14YN	5,913	90%	33	14	4	4	0.132	0.056	0.119	0.050	0.068	781	331	449
10	AT8/INDIRECT	1-F32T8/1-MB	1-LED12T8/RL	(1) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	2,346	90%	32	12	53	53	1.696	0.636	1.526	0.572	0.954	3,980	1,492	2,487
11	AT8TR1	1-F32T8/1-MB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	2,229	90%	32	24	176	176	5.632	4.224	5.069	3.802	1.267	12,554	9,416	3,139
12	BBBT8	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & ICN-2P16-TLED-N	2,346	90%	31	14	56	56	1.736	0.784	1.562	0.706	0.857	4,073	1,840	2,234
13	BBBT8/WW	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & ICN-2P16-TLED-N	2,346	90%	31	14	6	6	0.186	0.084	0.167	0.076	0.092	436	197	239
14	BBT8W/D/IND	2-F25T8/1-EB	2-LED8.5T8/RL	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & ICN-3P16-TLED-N	2,346	90%	46	18	7	7	0.322	0.126	0.290	0.113	0.176	756	296	460
15	BRCAN10PLH	2-CFQ26/1-SMB	1-LED20/R	(1) Rab: C9.5R20/25/329FAUNVW	5,792	90%	66	20	76	76	5.016	1.520	4.514	1.368	3.146	29,053	8,804	20,249
16	BRCAN6PLH	2-CFQ26/1-SMB	1-LED7/R	(1) Rab: C6R7/10/189FAUNVW	3,484	90%	66	7	32	32	2.112	0.224	1.901	0.202	1.699	7,359	781	6,579
17	BRCAN6PLV	2-CFQ26/1-SMB	1-LED7/R	(1) Rab: C6R7/10/189FAUNVW	5,913	90%	66	7	5	5	0.330	0.035	0.297	0.032	0.266	1,951	207	1,744
18	BRCAN8/WW	2-CFQ26/1-SMB	1-LED14/R	(1) RAB: DLED6AR14YN	5,913	90%	66	14	10	10	0.660	0.140	0.594	0.126	0.468	3,903	828	3,075
19	BRCAN8PLH	2-CFQ26/1-SMB	1-LED10/R	(1) Rab: C8R10/15/229FAUNVW	2,610	90%	66	10	168	168	11.088	1.680	9.979	1.512	8.467	28,945	4,386	24,560
20	BT12UTR	2-F34T8U/1-EB	1-LED25/R	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	1,877	90%	68	25	1	1	0.068	0.025	0.061	0.023	0.039	128	47	81
21	BT12W/WM	2-34T12/1-MB	1-LED26/NF	(1) PHILIPS: FSS436L-835-UNV-DIM-SWZDT	7,337	90%	68	26	26	26	1.768	0.676	1.591	0.608	0.983	12,971	4,959	8,011

Schlegel Hall

EEM 1.1 - Lighting Upgrades

Measure Details

					A	B	C	D			E	F	G	H	L	P	Q	R
		Lighting Description									**Energy Use**							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
22	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	2,280	90%	59	24	156	156	9.204	3.744	8.284	3.370	4.914	20,987	8,537	12,450
23	BT8IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	1,312	90%	59	24	58	58	3.422	1.392	3.080	1.253	1.827	4,491	1,827	2,664
24	BT8TR	2-F32T8/1-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	939	90%	59	27	4	4	0.236	0.108	0.212	0.097	0.115	222	101	120
25	BT8TR1	2-F32T8/1-EB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	3,387	90%	59	24	22	22	1.298	0.528	1.168	0.475	0.693	4,397	1,789	2,608
26	BT8UTR	2-F32T8U/1-EB	1-LED25/R	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	2,145	90%	59	25	7	7	0.413	0.175	0.372	0.158	0.214	886	375	511
27	BT8W/D/IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	2,346	90%	59	24	7	7	0.413	0.168	0.372	0.151	0.221	969	394	575
28	BT8W/P	2-F32T8/1-EB	1-LED31/NF	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	7,337	90%	59	31	2	2	0.118	0.062	0.106	0.056	0.050	866	455	411
29	BT8WM	2-F32T8/1-EB	1-LED31/NF	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	1,877	90%	59	31	8	8	0.472	0.248	0.425	0.223	0.202	886	466	420
30	CT12TR	3-FT3412/1-MB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	1,652	90%	102	27	5	5	0.510	0.135	0.459	0.122	0.338	842	223	619
31	CT8TR	3-F32T8/1-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	1,972	90%	90	27	107	107	9.630	2.889	8.667	2.600	6.067	18,989	5,697	13,292
32	CT8TR 2s	3-F32T8/2-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	1,554	90%	120	27	18	18	2.160	0.486	1.944	0.437	1.507	3,356	755	2,601
33	FLOOD	1-HPS150/1-CWA	1-LED42FL/NF	(1) RAB: FFLED39TN/PCT	3,690	0%	190	42	5	5	0.950	0.210	0.000	0.000	0.000	3,506	775	2,731
34	HPS70WP	1-HPS70/1-CWA	1-LED20WP/NF	(1) RAB: WPLED18N/PC	2,314	90%	95	20	8	8	0.760	0.160	0.684	0.144	0.540	1,759	370	1,389
35	LED	LED	LEAVE AS IS	LEAVE AS IS	4,108	90%	15	15	35	35	0.525	0.525	0.473	0.473	0.000	2,157	2,157	0
36	PENDANT	1-HPS70/1-CWA	LEAVE AS IS	LEAVE AS IS	3,690	0%	95	95	1	1	0.095	0.095	0.000	0.000	0.000	351	351	0
37	WALL SCONCE	2-CFQ26/1-SMB	2-LED PLV/RL	(2) PHILIPS: 8.5PL-C/T LED/26V-3500 IF 4P & (1) ICF-2S13-H1-LD	3,018	45%	66	18	12	12	0.792	0.216	0.356	0.097	0.259	2,390	652	1,739
38	WM SCONCE	1-HPS70/1-CWA	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & ICF-2S13-H1-LD	8,760	90%	95	9	21	21	1.995	0.189	1.796	0.170	1.625	17,476	1,656	15,821
39	SENSORS	None	Occupancy Sensor	LUTRON - MS-OPS6M2-DV-WH						37					-0.133		-708	708
	TOTAL:								1,189	1,226	66.8	22.4	58.8	19.8	38.9	203,102	62,827	140,276

Schlegel Hall

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	AAAT8	1	$7.00	20,000	$2	1	$17.00	70,000	$1	$1	1	$25.00	50,000	$2	1	$25.00	50,000	$2	$0	$1
2	AAAT8TR1	1	$7.00	20,000	$1	1	$200.00	50,000	$9	-$9	1	$25.00	50,000	$1	0	$0.00	0	$0	$1	-$7
3	AAT8TR1	1	$7.00	20,000	$6	1	$115.00	70,000	$27	-$21	1	$25.00	50,000	$8	1	$25.00	50,000	$8	$0	-$21
4	ACAN8PLV	1	$10.00	15,000	$59	1	$66.00	50,000	$117	-$58	1	$30.00	50,000	$53	0	$0.00	0	$0	$53	-$5
5	ARCAN6PLH	1	$10.00	15,000	$39	1	$66.00	50,000	$78	-$39	1	$30.00	50,000	$35	0	$0.00	0	$0	$35	-$3
6	ARCAN6PLV	1	$10.00	15,000	$53	1	$66.00	50,000	$105	-$52	1	$30.00	50,000	$48	0	$0.00	0	$0	$48	-$4
7	ARCAN8PLH	1	$10.00	15,000	$32	1	$66.00	50,000	$62	-$31	1	$30.00	50,000	$28	0	$0.00	0	$0	$28	-$3
8	ARCAN8PLV	1	$10.00	15,000	$39	1	$66.00	50,000	$78	-$39	1	$30.00	50,000	$35	0	$0.00	0	$0	$35	-$3
9	ARCAN8WW	1	$12.00	15,000	$19	1	$66.00	50,000	$31	-$12	1	$30.00	50,000	$14	0	$0.00	0	$0	$14	$2
10	AT8/INDIRECT	1	$7.00	20,000	$44	1	$17.00	70,000	$30	$13	1	$25.00	50,000	$62	1	$0.00	0	$0	$62	$76
11	AT8TR1	1	$7.00	20,000	$137	1	$115.00	70,000	$645	-$507	1	$25.00	50,000	$196	0	$0.00	0	$0	$196	-$311
12	BBBT8	2	$7.00	20,000	$92	2	$17.00	70,000	$64	$28	1	$25.00	50,000	$66	1	$25.00	50,000	$66	$0	$28
13	BBBT8/WW	2	$7.00	20,000	$10	2	$17.00	70,000	$7	$3	1	$25.00	50,000	$7	1	$25.00	50,000	$7	$0	$3
14	BBT8W/D/IND	2	$7.00	20,000	$11	2	$55.00	70,000	$26	-$14	1	$25.00	50,000	$8	0	$0.00	0	$0	$8	-$6
15	BRCAN10PLH	2	$10.00	15,000	$587	1	$72.00	50,000	$634	-$47	1	$30.00	50,000	$264	0	$0.00	0	$0	$264	$217
16	BRCAN6PLH	2	$10.00	15,000	$149	1	$66.00	50,000	$147	$1	1	$30.00	50,000	$67	0	$0.00	0	$0	$67	$68
17	BRCAN6PLV	2	$10.00	15,000	$39	1	$66.00	50,000	$39	$0	1	$30.00	50,000	$18	0	$0.00	0	$0	$18	$18
18	BRCAN8/WW	2	$10.00	15,000	$79	1	$66.00	50,000	$78	$1	1	$30.00	50,000	$35	0	$0.00	0	$0	$35	$36
19	BRCAN8PLH	2	$10.00	15,000	$585	1	$66.00	50,000	$579	$6	1	$30.00	50,000	$263	0	$0.00	0	$0	$263	$269
20	BT12UTR	2	$7.00	20,000	$1	1	$75.00	70,000	$2	-$1	1	$25.00	50,000	$1	0	$0.00	0	$0	$1	$0
21	BT12W/WM	2	$7.00	20,000	$134	1	$125.00	70,000	$341	-$207	1	$25.00	50,000	$95	0	$0.00	0	$0	$95	-$112

Schlegel Hall

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Savings
					BB				DD	FF				HH				JJ	LL	NN
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
22	BT8	2	$7.00	20,000	$249	1	$17.00	70,000	$86	$163	1	$25.00	50,000	$178	1	$25.00	50,000	$178	$0	$163
23	BT8IND	2	$7.00	20,000	$53	2	$17.00	70,000	$37	$16	1	$25.00	50,000	$38	1	$25.00	50,000	$38	$0	$16
24	BT8TR	2	$7.00	20,000	$3	1	$115.00	70,000	$6	-$4	1	$25.00	50,000	$2	0	$0.00	0	$0	$2	-$2
25	BT8TR1	2	$7.00	20,000	$52	1	$115.00	70,000	$122	-$70	1	$25.00	50,000	$37	0	$0.00	0	$0	$37	-$33
26	BT8UTR	2	$7.00	20,000	$11	1	$75.00	70,000	$16	-$6	1	$25.00	50,000	$8	0	$0.00	0	$0	$8	$2
27	BT8W/D/IND	2	$7.00	20,000	$11	1	$17.00	70,000	$4	$8	1	$25.00	50,000	$8	1	$25.00	50,000	$8	$0	$8
28	BT8W/P	2	$7.00	20,000	$10	1	$125.00	70,000	$26	-$16	1	$25.00	50,000	$7	0	$0.00	0	$0	$7	-$9
29	BT8WM	2	$7.00	20,000	$11	1	$125.00	70,000	$27	-$16	1	$25.00	50,000	$8	0	$0.00	0	$0	$8	-$9
30	CT12TR	3	$7.00	20,000	$9	1	$115.00	70,000	$14	-$5	1	$25.00	50,000	$4	0	$0.00	0	$0	$4	-$1
31	CT8TR	3	$7.00	20,000	$222	1	$115.00	70,000	$347	-$125	1	$25.00	50,000	$105	0	$0.00	0	$0	$105	-$20
32	CT8TR 2s	3	$7.00	20,000	$29	1	$115.00	70,000	$46	-$17	2	$50.00	50,000	$56	0	$0.00	0	$0	$56	$39
33	FLOOD	1	$15.00	24,000	$12	1	$400.00	100,000	$74	-$62	1	$25.00	50,000	$9	0	$0.00	0	$0	$9	-$53
34	HPS70WP	1	$15.00	24,000	$12	1	$290.00	100,000	$54	-$42	1	$25.00	50,000	$9	0	$0.00	0	$0	$9	-$33
35	LED	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
36	PENDANT	1	$15.00	24,000	$2	1	$0.00	100,000	$0	$2	1	$25.00	50,000	$2	0	$0.00	50,000	$0	$2	$4
37	WALL SCONCE	2	$10.00	15,000	$48	1	$38.00	20,000	$69	-$21	1	$30.00	50,000	$22	1	$25.00	50,000	$18	$4	-$17
38	WM SCONCE	1	$10.00	15,000	$123	1	$38.00	20,000	$350	-$227	1	$30.00	50,000	$110	1	$25.00	50,000	$92	$18	-$208
39	SENSORS																			
	TOTAL:				$2,973				$4,377	-$1,404				$1,913				$418		$91

MATERIAL & LABOR COST ESTIMATE

Project :	Schlegel Hall	Estimated by:	DB2
Project # :	402805	Checked by:	
Measure :	EEM 1.1 - Lighting Upgrades	Approved by:	
Date :	04/06/21	File:	Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost Labor & Material
				Unit Price	Total	Unit Price	Total	
1	(1) METALUX: 12EN-LD2-08-UNV-L840-CD1-U	1	EA	$200.00	$200	$105.00	$105	$305.00
2	(1) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	53	EA	$42.00	$2,226	$49.00	$2,597	$4,823.00
3	(1) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & ICN-2P16-TLED-N	2	EA	$42.00	$84	$49.00	$98	$182.00
4	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & ICF-2S13-H1-LD	21	EA	$63.00	$1,323	$49.00	$1,029	$2,352.00
5	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	205	EA	$115.85	$23,750	$81.37	$16,681	$40,431.00
6	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	8	EA	$75.00	$600	$59.50	$476	$1,076.00
7	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	134	EA	$115.00	$15,410	$59.50	$7,973	$23,383.00
8	(1) PHILIPS: FSS436L-835-UNV-DIM-SWZDT	26	EA	$125.00	$3,250	$84.00	$2,184	$5,434.00
9	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	10	EA	$125.00	$1,250	$84.00	$840	$2,090.00
10	(1) Rab: C6R7/10/189FAUNVW	87	EA	$66.00	$5,742	$49.00	$4,263	$10,005.00
11	(1) Rab: C8R10/15/229FAUNVW	201	EA	$66.00	$13,266	$49.00	$9,849	$23,115.00
12	(1) Rab: C9.5R20/25/329FAUNVW	76	EA	$72.00	$5,472	$49.00	$3,724	$9,196.00
13	(1) RAB: DLED6AR14YN	14	EA	$66.00	$924	$49.00	$686	$1,610.00
14	(1) RAB: FFLED39TN/PCT	5	EA	$400.00	$2,000	$119.00	$595	$2,595.00
15	(1) RAB: WPLED18N/PC	8	EA	$290.00	$2,320	$119.00	$952	$3,272.00
16	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	221	EA	$46.46	$10,268	$56.00	$12,376	$22,644.00
17	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & ICN-2P16-TLED-N	62	EA	$59.00	$3,658	$52.50	$3,255	$6,913.00
18	(2) PHILIPS: 8.5PL-C/T LED/26V-3500 IF 4P & (1) ICF-2S13-H1-LD	12	EA	$63.00	$756	$49.00	$588	$1,344.00
19	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & ICN-3P16-TLED-N	7	EA	$110.00	$770	$49.00	$343	$1,113.00
20	LEAVE AS IS	36	EA	$0.00	$0	$0.00	$0	$0.00
23	LUTRON - MS-OPS6M2-DV-WH	17	EA	$49.00	$833	$90.00	$1,530	$2,363.00
21	LUTRON - LRF2-OCR2B-P-WH	20	EA	$55.00	$1,100	$120.00	$2,400	$3,500.00
			SUBTOTALS:	Materials:	$95,202	Labor:	$72,544	$167,746.00
							TOTAL:	$167,746.00

wendel

Wallis Hall

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	30.3	Avg. kW/Month
Electrical Consumption Savings	109,636	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(83.8)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(838)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	$165	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Wallis Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: Multi Family Low Rise
Nearest City: Buffalo
System Type: AC with gas heat
% of Building Cooled: 6%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.142
HVACc: 0.014
HVACg: -0.017

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings	30.2	kW
Total Annual Lighting Savings kWh	109,605	kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	30.3
Electric Consumption Savings (kWh)	109,636
Fuel Savings (mmBtu)	(83.8)

Notes

(1) Based on NY Tech Manual Method: Version 6.1
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Wallis Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor
Lighting = 0.9 Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Wallis Hall

EEM 1.1 - Lighting Upgrades

Measure Details

					A	B	C	D			E	F	G	H	L	P	Q	R
		Lighting Description									Energy Use							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
1	60WINC	1-I60	1-LEDSI/RL	(1) PHILLIPS: A19/LED/9W	1,314	90%	60	9	1	1	0.060	0.009	0.054	0.008	0.046	79	12	67
2	AAAAT5STRIP	1-F14T5/1-EB	LEAVE AS IS	LEAVE AS IS	1,877	90%	14	0	1	1	0.014	0.000	0.013	0.000	0.013	26	0	26
3	AAT5 STRIP	1-F24T5/1-EB	LEAVE AS IS	LEAVE AS IS	1,877	90%	24	0	1	1	0.024	0.000	0.022	0.000	0.022	45	0	45
4	AHAL PAR 30 6" CAN	1-PAR30	1-LED7/R	(1) Rab: C6R7/10/189FAUNVW	2,816	90%	60	7	6	6	0.360	0.042	0.324	0.038	0.286	1,014	118	895
5	ARCAN4PAR30	1-PAR30	1-LED7/R	(1) Rab: C6R7/10/189FAUNVW	2,816	90%	60	7	12	12	0.720	0.084	0.648	0.076	0.572	2,027	237	1,791
6	ARCAN6PLV	1-CFQ26/1-SMB	1-LED7/R	(1) Rab: C6R7/10/189FAUNVW	3,650	90%	33	7	26	26	0.858	0.182	0.772	0.164	0.608	3,131	664	2,467
7	AT5CAB	1-F54T5/1-EB	LEAVE AS IS	LEAVE AS IS	1,877	90%	59	0	1	1	0.059	0.000	0.053	0.000	0.053	111	0	111
8	AT8BX1	1-F32T8/1-MB	1-LED36/NF	(1) RAB: EZPAN1X4-17/D10 & SMKEZPAN1X4	5,913	90%	32	36	29	29	0.928	1.044	0.835	0.940	-0.104	5,487	6,173	-686
9	AT8TR1	1-F32T8/1-MB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	5,913	90%	32	24	35	35	1.120	0.840	1.008	0.756	0.252	6,623	4,967	1,656
10	B8T12S	2-F96T8/1-EB	1-LED62/NF	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	2,102	90%	116	62	5	5	0.580	0.310	0.522	0.279	0.243	1,219	652	568
11	BBBT8	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & ICN-2P16-TLED-N	2,319	90%	31	14	17	17	0.527	0.238	0.474	0.214	0.260	1,222	552	670
12	BRCAN6PLH	2-CFQ26/1-SMB	1-LED7/R	(1) Rab: C6R7/10/189FAUNVW	4,224	90%	66	7	53	53	3.498	0.371	3.148	0.334	2.814	14,774	1,567	13,207
13	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	2,229	90%	59	24	4	4	0.236	0.096	0.212	0.086	0.126	526	214	312
14	BT8BX	2-F32T8/1-EB	1-LED36/NF	(1) RAB: EZPAN2X4-30N/D10 & SMKEZPAN2X4	2,503	90%	59	36	6	6	0.354	0.216	0.319	0.194	0.124	886	541	345
15	BT8IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	2,853	90%	59	24	25	25	1.475	0.600	1.328	0.540	0.788	4,209	1,712	2,497
16	BT8TR	2-F32T8/1-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	2,732	90%	59	27	29	29	1.711	0.783	1.540	0.705	0.835	4,674	2,139	2,535
17	BT8TR1	2-F32T8/1-EB	1-LED24/R	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	2,924	90%	59	24	71	71	4.189	1.704	3.770	1.534	2.237	12,249	4,983	7,266
18	BT8U.5	2-F31T8U/1-EB	1-LED25/R	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	2,816	90%	59	25	4	4	0.236	0.100	0.212	0.090	0.122	665	282	383
19	BT8W	2-F32T8/1-EB	1-LED31/NF	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	2,747	90%	59	31	57	57	3.363	1.767	3.027	1.590	1.436	9,237	4,853	4,384
20	BT8W DEC	2-F32T8/1-EB	1-LED31/NF	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	1,877	90%	59	31	13	13	0.767	0.403	0.690	0.363	0.328	1,440	756	683

Wallis Hall

EEM 1.1 - Lighting Upgrades

					A	B	C	D			E	F	G	H	L	P	Q	R
					Measure Details													
		Lighting Description									Energy Use							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
21	CFLSI	1-CFL13	1-LEDSI/R	(1) PHILLIPS: A19/LED/9W	2,346	90%	13	9	19	19	0.247	0.171	0.222	0.154	0.068	580	401	178
22	CT8TR	3-F32T8/1-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT /7/G4	3,374	90%	90	27	71	71	6.390	1.917	5.751	1.725	4.026	21,557	6,467	15,090
23	CT8TR 2s	3-F32T8/2-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT /7/G4	2,791	90%	120	27	121	121	14.520	3.267	13.068	2.940	10.128	40,524	9,118	31,406
24	D(B)T8BX	2-F32T8/1-EB	1-LED36/NF	(1) RAB: EZPAN2X4-30N/D10 & SMKEZPAN2X4	1,877	90%	59	36	2	2	0.118	0.072	0.106	0.065	0.041	222	135	86
25	D(B)T8TR	2-F32T8/1-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT /7/G4	2,816	90%	59	27	61	61	3.599	1.647	3.239	1.482	1.757	10,134	4,637	5,496
26	DT8TR	4-F32T8/2-EB	1-LED27/R	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT /7/G4	2,816	90%	112	27	20	20	2.240	0.540	2.016	0.486	1.530	6,307	1,520	4,787
27	HPS150WP	1-HPS150/1-CWA	1-LED51FL/NF	(1) RAB: W3455L	3,690	0%	190	51	2	2	0.380	0.102	0.000	0.000	0.000	1,402	376	1,026
28	HPS250FL	1-HPS250/1-CWA	1-LED79FL/NF	(1) RAB: FXLED78TN/PCT	3,690	0%	295	79	1	1	0.295	0.079	0.000	0.000	0.000	1,089	292	797
29	INCSI	1-I60	1-LEDSI/RL	(1) PHILLIPS: A19/LED/9W	2,315	90%	60	9	3	3	0.180	0.027	0.162	0.024	0.138	417	63	354
30	LARGE PENDANT 4SI	4-I100	4-LEDSI/RL	(4) PHILLIPS: A19/LED/9W	5,913	90%	400	36	1	1	0.400	0.036	0.360	0.032	0.328	2,365	213	2,152
31	LED	LED	LEAVE AS IS	LEAVE AS IS	2,738	90%	15	15	24	24	0.360	0.360	0.324	0.324	0.000	986	986	0
32	LED S	LED	LEAVE AS IS	LEAVE AS IS	1,314	90%	15	15	2	2	0.030	0.030	0.027	0.027	0.000	39	39	0
33	LED80FL	LED	LEAVE AS IS	LEAVE AS IS	3,690	0%	80	80	1	1	0.080	0.080	0.000	0.000	0.000	295	295	0
34	LEDBRCAN6	LED	LEAVE AS IS	LEAVE AS IS	5,913	90%	12	12	7	7	0.084	0.084	0.076	0.076	0.000	497	497	0
35	MR16	1-MR16	1-LEDMR16/RL	(1) PHILIPS MR16/GU10/PAR16	4,468	90%	50	7	15	15	0.750	0.105	0.675	0.095	0.581	3,351	469	2,882
36	PAR20	1-PAR20	1-LED14/RL	(1) PHILIPS: 14PAR38/COR/927/F25/DIM/120V T20 6/1FB	2,816	90%	50	14	3	3	0.150	0.042	0.135	0.038	0.097	422	118	304
37	PAR20 RCAN4	1-MR20	1-LED14/NF	(1) RAB: G4R14940120W	2,816	90%	75	14	4	4	0.300	0.056	0.270	0.050	0.220	845	158	687
38	PAR30	1-PAR30	1-LED14/RL	(1) PHILIPS: 14PAR38/COR/927/F25/DIM/120V T20 6/1FB	2,647	90%	60	14	15	15	0.900	0.210	0.810	0.189	0.621	2,382	556	1,826
39	PLH	1-CFQ26/1-SMB	1-LED PLH/RL	PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	1,314	90%	33	9	2	2	0.066	0.018	0.059	0.016	0.043	87	24	63
40	SENSORS	None	Occupancy Sensor	Lutron	0					118					-0.398		-3,248	3,248
	TOTAL:								770	888	52.2	17.6	46.3	15.6	30.2	163,142	53,537	109,605

Wallis Hall

EEM 1.1 - Lighting Upgrades

		BB				DD				FF	HH				JJ				LL	NN
		Operation and Maintenance																		
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	60WINC	1	$4.00	1,000	$5	1	$5.52	15,000	$0	$5	0	$0.00	0	$0	0	$0.00	0	$0	$0	$5
2	AAAAT5STRIP	1	$0.00	0	$0	1	$0.00	0	$0	$0	1	$0.00	0	$0	1	$0.00	0	$0	$0	$0
3	AAT5 STRIP	1	$20.00	20,000	$2	1	$20.00	20,000	$2	$0	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	$0
4	AHAL PAR 30 6" CAN	1	$5.00	1,500	$56	1	$66.00	50,000	$22	$34	1	$0.00	0	$0	0	$0.00	0	$0	$0	$34
5	ARCAN4PAR30	1	$5.00	1,500	$113	1	$66.00	50,000	$45	$68	1	$0.00	0	$0	0	$0.00	0	$0	$0	$68
6	ARCAN6PLV	1	$10.00	15,000	$63	1	$66.00	50,000	$125	-$62	1	$30.00	50,000	$57	0	$0.00	0	$0	$57	-$5
7	AT5CAB	1	$4.00	20,000	$0	1	$0.00	70,000	$0	$0	1	$20.00	50,000	$1	1	$0.00	50,000	$0	$1	$1
8	AT8BX1	1	$7.00	20,000	$60	1	$200.00	60,000	$572	-$512	1	$25.00	50,000	$86	0	$0.00	0	$0	$86	-$426
9	AT8TR1	1	$7.00	20,000	$72	1	$115.00	70,000	$340	-$268	1	$25.00	50,000	$103	0	$0.00	0	$0	$103	-$164
10	B8T12S	2	$30.00	18,000	$35	2	$175.00	70,000	$53	-$18	1	$25.00	50,000	$5	0	$0.00	0	$0	$5	-$12
11	BBBT8	2	$7.00	20,000	$28	2	$17.00	70,000	$19	$8	1	$25.00	50,000	$20	1	$25.00	50,000	$20	$0	$8
12	BRCAN6PLH	2	$10.00	15,000	$298	1	$66.00	50,000	$295	$3	1	$30.00	50,000	$134	0	$0.00	0	$0	$134	$137
13	BT8	2	$7.00	20,000	$6	1	$17.00	70,000	$2	$4	1	$25.00	50,000	$4	1	$25.00	50,000	$4	$0	$4
14	BT8BX	2	$7.00	20,000	$11	1	$200.00	60,000	$50	-$40	1	$25.00	50,000	$8	0	$0.00	0	$0	$8	-$32
15	BT8IND	2	$7.00	20,000	$50	2	$17.00	70,000	$35	$15	1	$25.00	50,000	$36	1	$25.00	50,000	$36	$0	$15
16	BT8TR	2	$7.00	20,000	$55	1	$115.00	70,000	$130	-$75	1	$25.00	50,000	$40	0	$0.00	0	$0	$40	-$35
17	BT8TR1	2	$7.00	20,000	$145	1	$115.00	70,000	$341	-$196	1	$25.00	50,000	$104	0	$0.00	0	$0	$104	-$92
18	BT8U.5	2	$12.00	24,000	$11	1	$75.00	70,000	$12	-$1	1	$0.00	50,000	$0	0	$0.00	0	$0	$0	-$1
19	BT8W	2	$7.00	20,000	$110	1	$125.00	70,000	$280	-$170	1	$25.00	50,000	$78	0	$0.00	0	$0	$78	-$92
20	BT8W DEC	2	$7.00	20,000	$17	1	$125.00	70,000	$44	-$26	1	$25.00	50,000	$12	0	$0.00	0	$0	$12	-$14

Wallis Hall

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
					BB				DD	FF				HH				JJ	LL	NN
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
21	CFLSI	1	$4.00	5,000	$36	1	$5.52	15,000	$16	$19	0	$0.00	0	$0	0	$0.00	0	$0	$0	$19
22	CT8TR	3	$7.00	20,000	$251	1	$115.00	70,000	$394	-$142	1	$25.00	50,000	$120	0	$0.00	0	$0	$120	-$22
23	CT8TR 2s	3	$7.00	20,000	$355	1	$115.00	70,000	$555	-$200	2	$50.00	50,000	$675	0	$0.00	0	$0	$675	$475
24	D(B)T8BX	2	$7.00	20,000	$3	1	$200.00	60,000	$13	-$10	1	$25.00	50,000	$2	0	$0.00	0	$0	$2	-$8
25	D(B)T8TR	2	$7.00	20,000	$120	1	$115.00	70,000	$282	-$162	1	$25.00	50,000	$86	0	$0.00	0	$0	$86	-$76
26	DT8TR	4	$7.00	20,000	$79	1	$115.00	70,000	$93	-$14	2	$50.00	50,000	$113	0	$0.00	0	$0	$113	$99
27	HPS150WP	1	$15.00	24,000	$5	1	$290.00	50,000	$43	-$38	1	$25.00	50,000	$4	0	$0.00	0	$0	$4	-$35
28	HPS250FL	1	$15.00	24,000	$2	1	$400.00	100,000	$15	-$12	1	$25.00	50,000	$2	0	$0.00	0	$0	$2	-$11
29	INCSI	1	$4.00	1,000	$28	1	$5.52	15,000	$3	$25	0	$0.00	0	$0	0	$0.00	0	$0	$0	$25
30	LARGE PENDANT 4SI	1	$4.00	1,000	$24	1	$5.52	15,000	$2	$21	0	$0.00	0	$0	0	$0.00	0	$0	$0	$21
31	LED	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
32	LED S	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
33	LED80FL	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
34	LEDBRCAN6	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
35	MR16	1	$5.00	2,000	$168	1	$15.00	25,000	$40	$127	1	$0.00	0	$0	0	$0.00	0	$0	$0	$127
36	PAR20	1	$5.00	1,500	$28	1	$12.00	25,000	$4	$24	1	$0.00	0	$0	0	$0.00	0	$0	$0	$24
37	PAR20 RCAN4	1	$5.00	2,000	$28	1	$75.00	50,000	$17	$11	0	$0.00	0	$0	0	$0.00	0	$0	$0	$11
38	PAR30	1	$5.00	1,500	$132	1	$12.00	25,000	$19	$113	1	$0.00	0	$0	0	$0.00	0	$0	$0	$113
39	PLH	1	$10.00	15,000	$2	1	$38.00	50,000	$2	$0	1	$30.00	50,000	$2	1	$25.00	50,000	$1	$0	$0
40	SENSORS																			
	TOTAL:				$2,398				$3,863	-$1,465				$1,690				$61		$165

MATERIAL & LABOR COST ESTIMATE

Project : Wallis Hall
Project # : 402805
Measure : EEM 1.1 - Lighting Upgrades
Date : 04/06/21

Estimated by: DB2
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	(1) PHILIPS MR16/GU10/PAR16	15	EA	$15.00	$225	$17.50	$263	$487.50
2	(1) PHILIPS: 14PAR38/COR/927/F25/DIM/120V T20 6/1FB	18	EA	$12.00	$216	$14.00	$252	$468.00
3	(1) PHILIPS: EvoKit CLKE 1x4 32L 24W 835 UNV SWZ P1	106	EA	$115.00	$12,190	$67.59	$7,165	$19,354.50
4	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	4	EA	$75.00	$300	$59.50	$238	$538.00
5	(1) PHILIPS: EVOKIT/2X4/P/36L/27W/835/2/SWZDT/7/G4	302	EA	$115.00	$34,730	$59.50	$17,969	$52,699.00
6	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	75	EA	$140.00	$10,500	$84.00	$6,300	$16,800.00
7	(1) PHILLIPS: A19/LED/9W	23	EA	$11.05	$254	$17.50	$403	$656.65
8	(1) Rab: C6R7/10/189FAUNVW	97	EA	$66.00	$6,402	$49.00	$4,753	$11,155.00
9	(1) RAB: EZPAN1X4-17/D10 & SMKEZPAN1X4	29	EA	$200.00	$5,800	$105.00	$3,045	$8,845.00
10	(1) RAB: EZPAN2X4-30N/D10 & SMKEZPAN2X4	8	EA	$200.00	$1,600	$105.00	$840	$2,440.00
11	(1) RAB: FXLED78TN/PCT	1	EA	$400.00	$400	$119.00	$119	$519.00
12	(1) RAB: G4R14940120W	4	EA	$75.00	$300	$49.00	$196	$496.00
13	(1) RAB: W3455L	2	EA	$290.00	$580	$119.00	$238	$818.00
14	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	29	EA	$56.66	$1,643	$56.00	$1,624	$3,267.00
15	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & ICN-2P16-TLED-N	17	EA	$59.00	$1,003	$52.50	$893	$1,895.50
16	(4) PHILLIPS: A19/LED/9W	1	EA	$44.20	$44	$17.50	$18	$61.70
17	LEAVE AS IS	37	EA	$0.68	$25	$0.00	$0	$25.00
18	PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	2	EA	$38.00	$76	$43.00	$86	$162.00
19	LUTRON - MS-OPS6M2-DV-WH	114	EA	$49.00	$5,586	$90.00	$10,260	$15,846.00
20	LUTRON - LRF2-OCR2B-P-WH	4	EA	$55.00	$220	$210.00	$840	$1,060.00
			SUBTOTALS:	Materials:	$82,094	Labor:	$55,500	$137,593.85
							TOTAL:	$137,593.85

wendel

Kornberg Medical Research Building (KMRB)

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	182.2	Avg. kW/Month
Electrical Consumption Savings	631,818	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(330.9)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(3,309)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	$8,391	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Kornberg Medical Research Building (KMRB)
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: University (Univ)
Nearest City: Buffalo
System Type: VAV Econ
% of Building Cooled: 90%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.200
HVACc: 0.104
HVACg: -0.012

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings	171.9	kW
Total Annual Lighting Savings kWh	612,702	kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	182.2
Electric Consumption Savings (kWh)	631,818
Fuel Savings (mmBtu)	(330.9)

Notes

(1) Based on NY Tech Manual Method: Version 7
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Kornberg Medical Research Building (KMRB)
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor

Lighting = 0.9 Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Kornberg Medical Research Building (KMRB)

EEM 1.1 - Lighting Upgrades

Measure Details

Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	A Total Annual Hours	B Coincidence Factor	C Existing Luminaire Watts	D New Luminaire Watts	# of Existing Units	# of New Units	E Total Existing Connected kW	F Total New Connected kW	G Existing Peak kW Demand	H Proposed Peak kW Demand	L Lighting Monthly kW Savings	P Total Existing Lighting Annual kWh	Q Total New Lighting Annual kWh	R Total Annual Lighting Savings kWh
		Lighting Description									Energy Use							
1	AAT8TR1	1-F30T8/1-EB	1-LED8.5T8/RL	(1) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	5,758	90%	32	8.5	60	60	1.920	0.510	1.728	0.459	1.269	11,056	2,937	8,119
2	ARCANSI	1-CFL23	1-LEDSI/RL	(1) PHILLIPS: A19/LED/9W	2,816	90%	23	9	76	76	1.748	0.684	1.573	0.616	0.958	4,922	1,926	2,996
3	AT12VAP	1-F34T12/1-MB	1-LED12T8/RL	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,112	90%	34	12	32	32	1.088	0.384	0.979	0.346	0.634	2,298	811	1,487
4	AT8VAP	1-F32T8/1-MB	1-LED12T8/RL	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,112	90%	32	12	32	32	1.024	0.384	0.922	0.346	0.576	2,162	811	1,352
5	BBBT8	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	2,112	90%	31	14	48	48	1.488	0.672	1.339	0.605	0.734	3,142	1,419	1,723
6	BBBT8COVE	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	2,816	90%	31	14	4	4	0.124	0.056	0.112	0.050	0.061	349	158	191
7	BBBT8TR1	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	5,913	90%	31	14	4	4	0.124	0.056	0.112	0.050	0.061	733	331	402
8	BBT8TR1	2-F25T8/1-EB	2-LED8.5T8/RL	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	5,913	90%	46	18	1	1	0.046	0.018	0.041	0.016	0.025	272	106	166
9	BBT8WM	2-F25T8/1-EB	2-LED8.5T8/RL	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	2,346	90%	46	18	24	24	1.104	0.432	0.994	0.389	0.605	2,590	1,014	1,577
10	BRCAN8PLH	2-CFQ26/1-SMB	2-LED PLH/RL	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	3,860	90%	66	18	251	251	16.566	4.518	14.916	4.068	10.848	63,942	17,439	46,504
11	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	3,603	90%	59	24	83	83	4.897	1.992	4.407	1.793	2.615	17,643	7,177	10,466
12	BT8/INDIRECT	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	5,913	90%	59	24	184	184	10.856	4.416	9.770	3.974	5.796	64,192	26,112	38,080
13	BT8BX	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	5,851	90%	59	24	346	346	20.414	8.304	18.373	7.474	10.899	119,445	48,588	70,857
14	BT8BX1	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	5,357	90%	59	24	39	39	2.301	0.936	2.071	0.842	1.229	12,327	5,014	7,312
15	BT8COVE	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,816	90%	59	24	88	88	5.192	2.112	4.673	1.901	2.772	14,619	5,947	8,672
16	BT8IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,772	90%	59	24	200	200	11.800	4.800	10.620	4.320	6.300	32,705	13,304	19,401
17	BT8TR1	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,508	90%	59	24	127	127	7.493	3.048	6.744	2.743	4.001	18,795	7,645	11,149
18	BT8TR1/VP	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,942	90%	59	24	149	149	8.791	3.576	7.912	3.218	4.694	25,866	10,522	15,344
19	BT8U	2-F32T8U/1-EB	2-LED13UT8/RL	(2) PHILIPS: 13T8-6U/MAS/24-835/IF20/P 10/1 & (1) ICN-2P16-TLED-N	2,089	90%	59	26	248	248	14.632	6.448	13.169	5.803	7.366	30,567	13,470	17,097

Kornberg Medical Research Building (KMRB)

EEM 1.1 - Lighting Upgrades

Measure Details

		Lighting Description									Energy Use							
					A	B	C	D			E	F	G	H	L	P	Q	R
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
20	BT8WM/IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	3,218	90%	59	24	97	97	5.723	2.328	5.151	2.095	3.056	18,418	7,492	10,926
21	CT8BX1	3-F32T8/1-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,816	90%	90	36	84	84	7.560	3.024	6.804	2.722	4.082	21,287	8,515	12,772
22	CT8BX1 2S	3-F32T8/2-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (2) ICN-3P16-TLED-N	2,816	90%	90	36	8	8	0.720	0.288	0.648	0.259	0.389	2,027	811	1,216
23	CT8TR	3-F32T8/1-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,682	90%	90	36	7	7	0.630	0.252	0.567	0.227	0.340	1,689	676	1,014
24	CT8TR1	3-F32T8/1-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,816	90%	90	36	708	708	63.720	25.488	57.348	22.939	34.409	179,417	71,767	107,650
25	CT8TR1 2s	3-F32T8/2-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (2) ICN-3P16-TLED-N	2,856	90%	90	36	1,394	1,394	125.460	50.184	112.914	45.166	67.748	358,277	143,311	214,966
26	HPS150WP	1-HPS150/1-CWA	1-LED42FL/NF	(1) RAB: (1) FFLED39TN/PCT	2,816	90%	190	42	1	1	0.190	0.042	0.171	0.038	0.133	535	118	417
27	LED	LED	Leave As Is	LEAVE AS IS	1,877	90%	15	15	6	6	0.090	0.090	0.081	0.081	0.000	169	169	0
28	WP	1-HPS70/1-CWA	1-LED20WP/NF	(1) RAB: (1) WPLED18N/PC	2,816	90%	95	20	4	4	0.380	0.080	0.342	0.072	0.270	1,070	225	845
	TOTAL:								4,305	4,305	316.1	125.1	284.5	112.6	171.9	1,010,515	397,814	612,702

Kornberg Medical Research Building (KMRB)

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	AAT8TR1	1	$7.00	20,000	$121	1	$18.00	70,000	$89	$32	1	$25.00	50,000	$173	1	$25.00	50,000	$173	$0	$32
2	ARCANSI	1	$4.00	1,000	$856	1	$5.52	15,000	$79	$777	0	$0.00	0	$0	0	$0.00	0	$0	$0	$777
3	AT12VAP	1	$7.00	20,000	$24	1	$17.00	70,000	$16	$7	1	$25.00	50,000	$34	1	$25.00	50,000	$34	$0	$7
4	AT8VAP	1	$7.00	20,000	$24	1	$17.00	70,000	$16	$7	1	$25.00	50,000	$34	1	$25.00	50,000	$34	$0	$7
5	BBBT8	2	$7.00	20,000	$71	2	$17.00	70,000	$49	$22	1	$25.00	50,000	$51	1	$25.00	50,000	$51	$0	$22
6	BBBT8COVE	2	$7.00	20,000	$8	2	$17.00	70,000	$5	$2	1	$25.00	50,000	$6	1	$25.00	50,000	$6	$0	$2
7	BBBT8TR1	2	$7.00	20,000	$17	2	$17.00	70,000	$11	$5	1	$25.00	50,000	$12	1	$25.00	50,000	$12	$0	$5
8	BBT8TR1	2	$7.00	20,000	$4	2	$55.00	70,000	$9	-$5	1	$25.00	50,000	$3	1	$25.00	50,000	$3	$0	-$5
9	BBT8WM	2	$7.00	20,000	$39	2	$55.00	70,000	$88	-$49	1	$25.00	50,000	$28	1	$25.00	50,000	$28	$0	-$49
10	BRCAN8PLH	2	$10.00	15,000	$1,292	2	$38.00	50,000	$1,473	-$181	1	$30.00	50,000	$581	1	$20.00	50,000	$388	$194	$13
11	BT8	2	$7.00	20,000	$209	2	$17.00	70,000	$145	$64	1	$25.00	50,000	$150	1	$25.00	50,000	$150	$0	$64
12	BT8/INDIRECT	2	$7.00	20,000	$762	2	$17.00	70,000	$528	$233	1	$25.00	50,000	$544	1	$25.00	50,000	$544	$0	$233
13	BT8BX	2	$7.00	20,000	$1,417	2	$17.00	70,000	$983	$434	1	$25.00	50,000	$1,012	1	$25.00	50,000	$1,012	$0	$434
14	BT8BX1	2	$7.00	20,000	$146	2	$17.00	70,000	$101	$45	1	$25.00	50,000	$104	1	$25.00	50,000	$104	$0	$45
15	BT8COVE	2	$7.00	20,000	$173	2	$17.00	70,000	$120	$53	1	$25.00	50,000	$124	1	$25.00	50,000	$124	$0	$53
16	BT8IND	2	$7.00	20,000	$388	2	$17.00	70,000	$269	$119	1	$25.00	50,000	$277	1	$25.00	50,000	$277	$0	$119
17	BT8TR1	2	$7.00	20,000	$223	2	$17.00	70,000	$155	$68	1	$25.00	50,000	$159	1	$25.00	50,000	$159	$0	$68
18	BT8TR1/VP	2	$7.00	20,000	$307	2	$17.00	70,000	$213	$94	1	$25.00	50,000	$219	1	$25.00	50,000	$219	$0	$94
19	BT8U	2	$15.00	20,000	$777	2	$25.00	70,000	$370	$407	1	$25.00	50,000	$259	1	$25.00	50,000	$259	$0	$407

Kornberg Medical Research Building (KMRB)

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Savings
					BB				DD	FF				HH				JJ	LL	NN
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
20	BT8WM/IND	2	$7.00	20,000	$219	2	$17.00	70,000	$152	$67	1	$25.00	50,000	$156	1	$25.00	50,000	$156	$0	$67
21	CT8BX1	3	$7.00	20,000	$248	3	$17.00	70,000	$172	$76	2	$50.00	50,000	$473	2	$50.00	50,000	$473	$0	$76
22	CT8BX1 2S	3	$7.00	20,000	$24	3	$17.00	70,000	$16	$7	2	$50.00	50,000	$45	2	$25.00	50,000	$23	$23	$30
23	CT8TR	3	$7.00	20,000	$20	3	$17.00	70,000	$14	$6	1	$25.00	50,000	$9	1	$25.00	50,000	$9	$0	$6
24	CT8TR1	3	$7.00	20,000	$2,093	3	$17.00	70,000	$1,452	$641	1	$25.00	50,000	$997	1	$25.00	50,000	$997	$0	$641
25	CT8TR1 2s	3	$7.00	20,000	$4,180	3	$17.00	70,000	$2,900	$1,280	2	$50.00	50,000	$7,962	2	$25.00	50,000	$3,981	$3,981	$5,260
26	HPS150WP	1	$30.00	24,000	$4	1	$400.00	100,000	$11	-$8	1	$180.00	50,000	$10	0	$0.00	0	$0	$10	$2
27	LED	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
28	WP	1	$15.00	24,000	$7	1	$290.00	100,000	$33	-$26	1	$25.00	50,000	$6	0	$0.00	0	$0	$6	-$20
	TOTAL:				$13,652				$9,474	$4,178				$13,427				$9,215	$4,213	$8,391

MATERIAL & LABOR COST ESTIMATE

Project : Kornberg Medical Research Building (KMRB)
Project # : 402805
Measure : EEM 1.1 - Lighting Upgrades
Date : 04/06/21

Estimated by: DB2
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	64	EA	$42.00	$2,688	$49.00	$3,136	$5,824.00
2	(1) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	60	EA	$43.00	$2,580	$49.00	$2,940	$5,520.00
3	(1) PHILLIPS: A19/LED/9W	76	EA	$36.05	$2,740	$17.50	$1,330	$4,069.80
4	(1) RAB: (1) FFLED39TN/PCT	1	EA	$400.00	$400	$119.00	$119	$519.00
5	(1) RAB: (1) WPLED18N/PC	4	EA	$290.00	$1,160	$119.00	$476	$1,636.00
6	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,313	EA	$59.00	$77,467	$56.00	$73,528	$150,995.00
7	(2) PHILIPS: 13T8-6U/MAS/24-835/IF20/P 10/1 & (1) ICN-2P16-TLED-N	248	EA	$59.00	$14,632	$52.50	$13,020	$27,652.00
8	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	56	EA	$59.00	$3,304	$52.50	$2,940	$6,244.00
9	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	251	EA	$96.00	$24,096	$49.00	$12,299	$36,395.00
10	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	25	EA	$135.00	$3,375	$49.00	$1,225	$4,600.00
11	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	799	EA	$83.88	$67,024	$59.50	$47,541	$114,564.50
12	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (2) ICN-3P16-TLED-N	1,402	EA	$101.00	$141,602	$85.00	$119,170	$260,772.00
13	LEAVE AS IS	6	EA	$0.00	$0	$0.00	$0	$0.00
			SUBTOTALS:	Materials:	$341,068	Labor:	$277,724	$618,791.30
							TOTAL:	$618,791.30

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Ambulatory Care Facility

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	152.4	Avg. kW/Month
Electrical Consumption Savings	666,334	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(443.9)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(4,439)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	$3,036	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Ambulatory Care Facility
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: Hospital (Hosp)
Nearest City: Buffalo
System Type: VAV Econ
% of Building Cooled: 90%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.200
HVACc: 0.044
HVACg: -0.015

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings 143.8 kW
Total Annual Lighting Savings kWh 657,653 kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	152.4
Electric Consumption Savings (kWh)	666,334
Fuel Savings (mmBtu)	(443.9)

Notes

(1) Based on NY Tech Manual Method: Version 7
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Ambulatory Care Facility
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor
Lighting = 0.9 Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Ambulatory Care Facility

EEM 1.1 - Lighting Upgrades

Measure Details

					A	B	C	D			E	F	G	H	L	P	Q	R
		Lighting Description									Energy Use							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
1	APLV/SCONCE	1-CFQ26/1-SMB	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	5,398	90%	33	9	52	52	1.716	0.468	1.544	0.421	1.123	9,263	2,526	6,737
2	BBBT8TR	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	2,816	90%	31	14	20	20	0.620	0.280	0.558	0.252	0.306	1,746	788	957
3	BRCAN6PLH	2-CFQ26/1-SMB	2-LED PLH/RL	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	5,309	90%	66	18	1,370	1,370	90.420	24.660	81.378	22.194	59.184	480,000	130,909	349,091
4	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	4,027	90%	59	24	192	192	11.328	4.608	10.195	4.147	6.048	45,613	18,554	27,059
5	BT8D/IND/WM	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	7,446	90%	59	24	24	24	1.416	0.576	1.274	0.518	0.756	10,544	4,289	6,255
6	BT8TR1	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	3,169	90%	59	24	102	102	6.018	2.448	5.416	2.203	3.213	19,070	7,757	11,313
7	BT8WM	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	3,867	90%	59	24	172	172	10.148	4.128	9.133	3.715	5.418	39,238	15,961	23,277
8	COVE	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,300	90%	59	24	51	51	3.009	1.224	2.708	1.102	1.607	6,922	2,816	4,106
9	CRCAN10/PLH	3-CFQ26/2-SMB	3-LED PLH/RL	(3) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (2) ICF-2S13-H1-LD	7,446	90%	99	27	66	66	6.534	1.782	5.881	1.604	4.277	48,652	13,269	35,383
10	CT8TR	3-F32T8/1-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,766	90%	90	36	1,037	1,037	93.330	37.332	83.997	33.599	50.398	258,194	103,278	154,916
11	CT8TR 2s	3-F32T8/2-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (2) ICN-3P16-TLED-N	2,769	90%	90	36	242	242	21.780	8.712	19.602	7.841	11.761	60,313	24,125	36,188
12	LED DEC	LED	Leave As Is	LEAVE AS IS	7,446	90%	20	20	35	35	0.700	0.700	0.630	0.630	0.000	5,212	5,212	0
	SENSORS	None	Occupancy Sensor	LUTRON						69					-0.306		-2,372	2,372
TOTAL:									3,363	3,432	247.0	86.9	222.3	78.2	143.8	984,767	327,113	657,653

Ambulatory Care Facility

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	APLV/SCONCE	1	$10.00	15,000	$187	1	$38.00	50,000	$213	-$26	1	$30.00	50,000	$168	1	$20.00	50,000	$112	$56	$30
2	BBBT8TR	2	$7.00	20,000	$39	2	$17.00	70,000	$27	$12	1	$25.00	50,000	$28	1	$25.00	50,000	$28	$0	$12
3	BRCAN6PLH	2	$10.00	15,000	$9,697	2	$38.00	50,000	$11,055	-$1,358	1	$30.00	50,000	$4,364	1	$20.00	50,000	$2,909	$1,455	$97
4	BT8	2	$7.00	20,000	$541	2	$17.00	70,000	$376	$166	1	$25.00	50,000	$387	1	$25.00	50,000	$387	$0	$166
5	BT8D/IND/WM	2	$7.00	20,000	$125	2	$17.00	70,000	$87	$38	1	$25.00	50,000	$89	1	$25.00	50,000	$89	$0	$38
6	BT8TR1	2	$7.00	20,000	$226	2	$17.00	70,000	$157	$69	1	$25.00	50,000	$162	1	$25.00	50,000	$162	$0	$69
7	BT8WM	2	$7.00	20,000	$466	2	$17.00	70,000	$323	$143	1	$25.00	50,000	$333	1	$25.00	50,000	$333	$0	$143
8	COVE	2	$7.00	20,000	$82	2	$17.00	70,000	$57	$25	1	$25.00	50,000	$59	1	$25.00	50,000	$59	$0	$25
9	CRCAN10/PLH	3	$10.00	15,000	$983	3	$38.00	50,000	$1,120	-$138	2	$60.00	50,000	$1,179	2	$20.00	50,000	$393	$786	$649
10	CT8TR	3	$7.00	20,000	$3,012	3	$17.00	70,000	$2,090	$922	1	$25.00	50,000	$1,434	1	$25.00	50,000	$1,434	$0	$922
11	CT8TR 2s	3	$7.00	20,000	$704	3	$17.00	70,000	$488	$215	2	$50.00	50,000	$1,340	2	$25.00	50,000	$670	$670	$886
12	LED DEC	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
	SENSORS																			
	TOTAL:				$16,062				$15,993	$69				$9,543				$6,576		$3,036

MATERIAL & LABOR COST ESTIMATE

Project : Ambulatory Care Facility
Project # : 402805
Measure : EEM 1.1 - Lighting Upgrades
Date : 04/06/21

Estimated by: DB2
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	52	EA	$58.00	$3,016	$49.00	$2,548	$5,564.00
2	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	541	EA	$59.00	$31,919	$56.00	$30,296	$62,215.00
3	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	20	EA	$59.00	$1,180	$52.50	$1,050	$2,230.00
4	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	1,370	EA	$96.00	$131,520	$49.00	$67,130	$198,650.00
5	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,037	EA	$76.00	$78,812	$59.50	$61,702	$140,513.50
6	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (2) ICN-3P16-TLED-N	242	EA	$101.00	$24,442	$85.00	$20,570	$45,012.00
7	(3) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (2) ICF-2S13-H1-LD	66	EA	$154.00	$10,164	$49.00	$3,234	$13,398.00
8	LEAVE AS IS	35	EA	$0.00	$0	$0.00	$0	$0.00
9	LUTRON - MS-OPS6M2-DV-WH	50	EA	$49.00	$2,450	$90.00	$4,500	$6,950.00
10	LUTRON - LRF2-OCR2B-P-WH	19	EA	$55.00	$1,045	$110.00	$2,090	$3,135.00
			SUBTOTALS:	Materials:	$284,548	Labor:	$193,120	$477,667.50
							TOTAL:	$477,667.50

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Wilder Hall

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	10.8	Avg. kW/Month
Electrical Consumption Savings	16,732	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(10.5)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(105)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	-$180	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Wilder Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: College Dormitory
Nearest City: Buffalo
System Type: Fan coil with chiller and hot water boiler
% of Building Cooled: 90%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.200
HVACc: 0.027
HVACg: -0.014

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings	10.1	kW
Total Annual Lighting Savings kWh	16,598	kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	10.8
Electric Consumption Savings (kWh)	16,732
Fuel Savings (mmBtu)	(10.5)

Notes

(1) Based on NY Tech Manual Method: Version 7
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Wilder Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor
Lighting = 0.9 Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Wilder Hall

EEM 1.1 - Lighting Upgrades

Measure Details

Lighting Description											Energy Use							
					A	B	C	D			E	F	G	H	L	P	Q	R
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
1	AT8	1-F32T8/1-MB	1-LED12T8/RL	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	8,760	90%	32	12	10	10	0.320	0.120	0.288	0.108	0.180	2,803	1,051	1,752
2	AT8S	1-F32T8/1-MB	1-LED26/NF	(1) PHILIPS: FSS440L-830-UNV-DIM-SWZDT	1,314	90%	32	26	4	4	0.128	0.104	0.115	0.094	0.022	168	137	32
3	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	1,596	90%	59	24	16	16	0.944	0.384	0.850	0.346	0.504	1,506	613	894
4	BT8BX	2-F32T8/1-EB	1-LED36/NF	(1) RAB: EZPAN2X4-30N/D10 & SMKEZPAN2X4	1,314	90%	59	36	8	8	0.472	0.288	0.425	0.259	0.166	620	378	242
5	BT8BX/P	2-F32T8/1-EB	1-LED20/NF	(1) PHILIPS SP532P LED29S/940 PSD PI5 SM2 L1410 WH	2,816	90%	59	20	8	8	0.472	0.160	0.425	0.144	0.281	1,329	451	879
6	BT8IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	6,388	90%	59	24	6	6	0.354	0.144	0.319	0.130	0.189	2,261	920	1,341
7	BT8WM	2-F32T8/1-EB	1-LED31/NF	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	1,112	90%	59	31	48	48	2.832	1.488	2.549	1.339	1.210	3,149	1,654	1,494
8	CFLSI	1-CFL13	1-LEDSI/R	(1) PHILLIPS: A19/LED/9W	1,314	90%	13	9	3	3	0.039	0.027	0.035	0.024	0.011	51	35	16
9	CT8IND	3-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	1,314	90%	90	24	1	1	0.090	0.024	0.081	0.022	0.059	118	32	87
10	HPS70WP	1-HPS70/1-CWA	1-LED20WP/NF	(1) RAB: WPLED18N/PC	3,690	0%	95	20	1	1	0.095	0.020	0.000	0.000	0.000	351	74	277
11	LED 2x2	LED	LEAVE AS IS	LEAVE AS IS	8,760	90%	24	24	25	25	0.600	0.600	0.540	0.540	0.000	5,256	5,256	0
12	LED BT8IND	LED	LEAVE AS IS	LEAVE AS IS	7,540	90%	30	30	7	7	0.210	0.210	0.189	0.189	0.000	1,583	1,583	0
13	LED SI	LED	LEAVE AS IS	LEAVE AS IS	1,314	90%	7	7	5	5	0.035	0.035	0.032	0.032	0.000	46	46	0
14	LEDBT8	LED	LEAVE AS IS	LEAVE AS IS	6,212	90%	15	15	21	21	0.315	0.315	0.284	0.284	0.000	1,957	1,957	0
15	LEDCAN	LED	LEAVE AS IS	LEAVE AS IS	1,314	90%	12	12	7	7	0.084	0.084	0.076	0.076	0.000	110	110	0
16	LEDCIR/WM	LED	LEAVE AS IS	LEAVE AS IS	8,760	90%	5	5	66	66	0.330	0.330	0.297	0.297	0.000	2,891	2,891	0
17	LEDSI	LED	LEAVE AS IS	LEAVE AS IS	5,913	90%	7	7	3	3	0.021	0.021	0.019	0.019	0.000	124	124	0
18	SQCPY	2-CFl23/1	1-LED9/NF	(1) RAB: SK9SYYW	1,136	89%	46	9	228	228	10.488	2.052	9.356	1.831	7.526	11,917	2,332	9,585
	TOTAL:								467	467	17.8	6.4	15.9	5.7	10.1	36,241	19,644	16,598

Wilder Hall

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	AT8	1	$7.00	20,000	$31	1	$17.00	70,000	$21	$9	1	$25.00	50,000	$44	1	$25.00	50,000	$44	$0	$9
2	AT8S	1	$7.00	20,000	$2	1	$125.00	70,000	$9	-$8	1	$25.00	50,000	$3	0	$0.00	0	$0	$3	-$5
3	BT8	2	$7.00	20,000	$18	1	$17.00	70,000	$6	$12	1	$25.00	50,000	$13	1	$25.00	50,000	$13	$0	$12
4	BT8BX	2	$7.00	20,000	$7	1	$200.00	60,000	$35	-$28	1	$25.00	50,000	$5	0	$0.00	0	$0	$5	-$22
5	BT8BX/P	2	$7.00	20,000	$16	1	$150.00	70,000	$48	-$33	1	$25.00	50,000	$11	0	$0.00	0	$0	$11	-$21
6	BT8IND	2	$7.00	20,000	$27	2	$17.00	70,000	$19	$8	1	$25.00	50,000	$19	1	$25.00	50,000	$19	$0	$8
7	BT8WM	2	$7.00	20,000	$37	1	$125.00	70,000	$95	-$58	1	$25.00	50,000	$27	0	$0.00	0	$0	$27	-$31
8	CFLSI	1	$4.00	5,000	$3	1	$5.52	15,000	$1	$2	0	$0.00	0	$0	0	$0.00	0	$0	$0	$2
9	CT8IND	3	$7.00	20,000	$1	3	$17.00	70,000	$1	$0	1	$25.00	50,000	$1	1	$0.00	0	$0	$1	$1
10	HPS70WP	1	$15.00	24,000	$2	1	$290.00	100,000	$11	-$8	1	$25.00	50,000	$2	0	$0.00	0	$0	$2	-$7
11	LED 2x2	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
12	LED BT8IND	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
13	LED SI	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
14	LEDBT8	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
15	LEDCAN	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
16	LEDCIR/WM	1	$0.00	20,000	$0	1	$0.00	20,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
17	LEDSI	1	$0.00	50,000	$0	1	$0.00	20,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
18	SQCPY	1	$4.00	15,000	$69	1	$75.00	100,000	$194	-$125	0	$0.00	0	$0	0	$0.00	0	$0	$0	-$125
	TOTAL:				$214				$441	-$228				$124				$76		-$180

MATERIAL & LABOR COST ESTIMATE

Project : Wilder Hall
Project # : 402805
Measure : EEM 1.1 - Lighting Upgrades
Date : 04/06/21

Estimated by: DB2
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost Labor & Material
				Unit Price	Total	Unit Price	Total	
1	(1) PHILIPS SP532P LED29S/940 PSD PI5 SM2 L1410 WH	8	EA	$150.00	$1,200	$84.00	$672	$1,872.00
2	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	10	EA	$42.00	$420	$49.00	$490	$910.00
3	(1) PHILIPS: FSS440L-830-UNV-DIM-SWZDT	4	EA	$125.00	$500	$84.00	$336	$836.00
4	(1) PHILIPS: FSS440L-835-UNV-DIM-SWZDT	48	EA	$125.00	$6,000	$84.00	$4,032	$10,032.00
5	(1) PHILLIPS: A19/LED/9W	3	EA	$11.05	$33	$17.50	$53	$85.65
6	(1) RAB: EZPAN2X4-30N/D10 & SMKEZPAN2X4	8	EA	$200.00	$1,600	$105.00	$840	$2,440.00
7	(1) RAB: SK9SYYW	228	EA	$75.00	$17,100	$84.00	$19,152	$36,252.00
8	(1) RAB: WPLED18N/PC	1	EA	$290.00	$290	$119.00	$119	$409.00
9	(2) PHILIPS: 12T8/48-3500/IF/10-1 & ICN-3P16-TLED-N	23	EA	$47.91	$1,102	$56.00	$1,288	$2,390.00
10	LEAVE AS IS	134	EA	$0.00	$0	$0.00	$0	$0.00
			SUBTOTALS:	Materials:	$28,245	Labor:	$26,982	$55,226.65
							TOTAL:	$55,226.65

wendel

Fauver Stadium

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	5.3	Avg. kW/Month
Electrical Consumption Savings	18,249	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(9.6)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(96)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	$71	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Fauver Stadium
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: University (Univ)
Nearest City: Buffalo
System Type: VAV Econ
% of Building Cooled: 90%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.200
HVACc: 0.104
HVACg: -0.012

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings	5.0	kW
Total Annual Lighting Savings kWh	17,697	kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	5.3
Electric Consumption Savings (kWh)	18,249
Fuel Savings (mmBtu)	(9.6)

Notes

(1) Based on NY Tech Manual Method: Version 7
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Fauver Stadium
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor

Lighting = 0.9 Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Fauver Stadium

EEM 1.1 - Lighting Upgrades

Measure Details

		Lighting Description									Energy Use							
					A	B	C	D			E	F	G	H	L	P	Q	R
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
1	A8T8BX/INDIRECT	1-F96T8/1-EB	2-LED12T8/R	(2) PHILIPS: 12T8/48-3500/IF/10-1 & 8' to 4' Retrofit Kit & (1) ICN-3P16-TLED-N	939	90%	58	24	1	1	0.058	0.024	0.052	0.022	0.031	54	23	32
2	A8T8BX/WM/INDIRECT	1-F96T8/1-EB	2-LED12T8/R	(2) PHILIPS: 12T8/48-3500/IF/10-1 & 8' to 4' Retrofit Kit & (1) ICN-3P16-TLED-N	1,877	90%	58	24	4	4	0.232	0.096	0.209	0.086	0.122	435	180	255
3	AAAT8TR1	1-F17T8/1-EB	1-LED7T8/RL	(1) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	8,760	90%	20	7	3	3	0.060	0.021	0.054	0.019	0.035	526	184	342
4	AAT8TR1	1-F30T8/1-EB	1-LED8.5T8/RL	(1) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	1,877	90%	32	8.5	1	1	0.032	0.009	0.029	0.008	0.021	60	16	44
5	ALEDT8	1-LEDT8	LEAVE AS IS	LEAVE AS IS	1,314	90%	15	15	2	2	0.030	0.030	0.027	0.027	0.000	39	39	0
6	AT12BX/P	1-F34T12/1-MB	1-LED12T8/RL	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,095	90%	34	12	6	6	0.204	0.072	0.184	0.065	0.119	223	79	145
7	AT12BX/WM	1-F34T12/1-MB	1-LED12T8/RETRO	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	6,466	90%	34	12	3	3	0.102	0.036	0.092	0.032	0.059	660	233	427
8	AT12BX/WM/INDIRECT	1-F34T12/1-MB	1-LED12T8/RETRO	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	34	12	1	1	0.034	0.012	0.031	0.011	0.020	64	23	41
9	AT12TR1	1-F34T12/1-MB	1-LED12T8/RETRO	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	34	12	11	11	0.374	0.132	0.337	0.119	0.218	702	248	454
10	AT8S/WM	1-F32T8/1-MB	1-LED12T8/RETRO	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	32	11	1	1	0.032	0.011	0.029	0.010	0.019	60	21	39
11	BBT8BX/P	2-F25T8/1-EB	2-LED10T8/RL	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	8,760	90%	46	30	2	2	0.092	0.060	0.083	0.054	0.029	806	526	280
12	BRCAN8PLH	2-CFQ26/1-SMB	2-LED PLH/RL	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	1,314	90%	66	18	4	4	0.264	0.072	0.238	0.065	0.173	347	95	252
13	BT12BX/P	2-34T12/1-MB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	3,598	90%	68	24	8	8	0.544	0.192	0.490	0.173	0.317	1,957	691	1,266
14	BT12BX/SM/INDIRECT	2-34T12/1-MB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	68	24	7	7	0.476	0.168	0.428	0.151	0.277	894	315	578
15	BT12BX/WM/INDIRECT	2-34T12/1-MB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	68	24	1	1	0.068	0.024	0.061	0.022	0.040	128	45	83
16	BT12IND	2-34T12/1-MB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	68	24	3	3	0.204	0.072	0.184	0.065	0.119	383	135	248
17	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,314	90%	59	24	1	1	0.059	0.024	0.053	0.022	0.032	78	32	46
18	BT8BX/D/IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	8,760	90%	59	24	2	2	0.118	0.048	0.106	0.043	0.063	1,034	420	613
19	BT8BX/P	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	939	90%	59	24	10	10	0.590	0.240	0.531	0.216	0.315	554	225	329
20	BT8IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	59	24	3	3	0.177	0.072	0.159	0.065	0.095	332	135	197
21	BT8SM/INDIRECT	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,860	90%	59	24	7	7	0.413	0.168	0.372	0.151	0.221	1,181	481	701
22	BT8TR1	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,628	90%	59	24	1	1	0.059	0.024	0.053	0.022	0.032	155	63	92
23	BT8U	2-F32T8U/1-EB	2-LED13UT8/RL	(2) PHILIPS: 13T8-6U/MAS/24-835/IF20/P 10/1 & (1) ICN-2P16-TLED-N	1,877	90%	59	26	1	1	0.059	0.026	0.053	0.023	0.030	111	49	62
24	BT8UTR	2-F32T8U/1-EB	2-LED13UT8/RL	(2) PHILIPS: 13T8-6U/MAS/24-835/IF20/P 10/1 & (1) ICN-2P16-TLED-N	1,877	90%	59	26	1	1	0.059	0.026	0.053	0.023	0.030	111	49	62
25	BT8W	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	3,254	90%	59	24	5	5	0.295	0.120	0.266	0.108	0.158	960	390	569

Fauver Stadium

EEM 1.1 - Lighting Upgrades

Measure Details

Lighting Description											Energy Use							
					A	B	C	D			E	F	G	H	L	P	Q	R
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
26	CT8TR	3-F32T8/1-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	90	36	45	45	4.050	1.620	3.645	1.458	2.187	7,602	3,041	4,561
27	D(B)T8TR	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,628	90%	59	24	5	5	0.295	0.120	0.266	0.108	0.158	775	315	460
28	HPS150WP	1-HPS150/1-CWA	1-LED42FL/NF	(1) RAB: (1) FFLED39TN/PCT	3,690	0%	190	42	1	1	0.190	0.042	0.000	0.000	0.000	701	155	546
29	HPS400FL	1-HPS400/1-CWA	1-LED164FL/NF	(1) RAB: (1) FXLED150TN/PCT	3,690	0%	465	164	4	4	1.860	0.656	0.000	0.000	0.000	6,863	2,421	4,443
30	HPS50PHONE	1-HPS50/1-CWA	LEAVE AS IS	LEAVE AS IS	3,690	0%	60	60	1	1	0.060	0.060	0.000	0.000	0.000	221	221	0
31	LED	LED	Leave As Is	LEAVE AS IS	1,904	90%	15	15	189	189	2.835	2.835	2.552	2.552	0.000	5,399	5,399	0
32	LED Vanity	LED	Leave As Is	LEAVE AS IS	1,117	90%	12	12	8	8	0.096	0.096	0.086	0.086	0.000	107	107	0
33	LED/1x4P	LED	Leave As Is	LEAVE AS IS	1,229	90%	12	12	45	45	0.540	0.540	0.486	0.486	0.000	663	663	0
34	LED/1x4S	LED	Leave As Is	LEAVE AS IS	909	90%	12	12	29	29	0.348	0.348	0.313	0.313	0.000	316	316	0
35	LED2x2BX	LED	Leave As Is	LEAVE AS IS	1,314	90%	24	24	1	1	0.024	0.024	0.022	0.022	0.000	32	32	0
36	LED8x8BX	LED	Leave As Is	LEAVE AS IS	1,314	90%	60	60	1	1	0.060	0.060	0.054	0.054	0.000	79	79	0
37	LEDBT8INC	LED	Leave As Is	LEAVE AS IS	8,760	90%	15	15	3	3	0.045	0.045	0.041	0.041	0.000	394	394	0
38	LEDCAN	LED	Leave As Is	LEAVE AS IS	5,913	90%	12	12	12	12	0.144	0.144	0.130	0.130	0.000	851	851	0
39	LEDCYL/P	LED	Leave As Is	LEAVE AS IS	1,314	90%	20	20	8	8	0.160	0.160	0.144	0.144	0.000	210	210	0
40	LEDFL	LED	Leave As Is	LEAVE AS IS	3,690	0%	20	20	1	1	0.020	0.020	0.000	0.000	0.000	74	74	0
41	LEDP	LED	Leave As Is	LEAVE AS IS	3,222	90%	20	20	3	3	0.060	0.060	0.054	0.054	0.000	193	193	0
42	LEDS	LED	Leave As Is	LEAVE AS IS	5,913	90%	15	15	1	1	0.015	0.015	0.014	0.014	0.000	89	89	0
43	LEDW	LED	Leave As Is	LEAVE AS IS	1,877	90%	15	15	2	2	0.030	0.030	0.027	0.027	0.000	56	56	0
44	LEDWP	LED	Leave As Is	LEAVE AS IS	3,690	0%	25	25	1	1	0.025	0.025	0.000	0.000	0.000	92	92	0
45	SENSORS	None	Occupancy Sensor	LUTRON - MS-OPS6M2-DV-WH						27					0.085		-529	529
	TOTAL:								449	476	15.5	8.7	12.0	7.1	5.0	36,574	18,877	17,697

Fauver Stadium

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Saving
					BB				DD	FF				HH				JJ	LL	NN
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	A8T8BX/INDIRECT	1	$30.00	18,000	$2	2	$17.00	70,000	$0	$1	1	$25.00	50,000	$0	1	$25.00	50,000	$0	$0	$1
2	A8T8BX/WM/INDIRECT	1	$30.00	18,000	$13	2	$17.00	70,000	$4	$9	1	$25.00	50,000	$4	1	$25.00	50,000	$4	$0	$9
3	AAAT8TR1	1	$7.00	20,000	$9	1	$17.00	70,000	$6	$3	1	$25.00	50,000	$13	1	$25.00	50,000	$13	$0	$3
4	AAT8TR1	1	$7.00	20,000	$1	1	$18.00	70,000	$0	$0	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$0
5	ALEDT8	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
6	AT12BX/P	1	$7.00	20,000	$2	1	$17.00	70,000	$2	$1	1	$25.00	50,000	$3	1	$25.00	50,000	$3	$0	$1
7	AT12BX/WM	1	$7.00	20,000	$7	1	$17.00	70,000	$5	$2	1	$25.00	50,000	$10	1	$25.00	50,000	$10	$0	$2
8	AT12BX/WM/INDIRECT	1	$7.00	20,000	$1	1	$17.00	70,000	$0	$0	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$0
9	AT12TR1	1	$7.00	20,000	$7	1	$17.00	70,000	$5	$2	1	$25.00	50,000	$10	1	$25.00	50,000	$10	$0	$2
10	AT8S/WM	1	$7.00	20,000	$1	1	$17.00	70,000	$0	$0	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$0
11	BBT8BX/P	2	$7.00	20,000	$12	2	$55.00	70,000	$28	-$15	1	$25.00	50,000	$9	1	$25.00	50,000	$9	$0	-$15
12	BRCAN8PLH	2	$10.00	15,000	$7	2	$38.00	50,000	$8	-$1	1	$30.00	50,000	$3	1	$20.00	50,000	$2	$1	$0
13	BT12BX/P	2	$7.00	20,000	$20	2	$17.00	70,000	$14	$6	1	$25.00	50,000	$14	1	$25.00	50,000	$14	$0	$6
14	BT12BX/SM/INDIRECT	2	$7.00	20,000	$9	2	$17.00	70,000	$6	$3	1	$25.00	50,000	$7	1	$25.00	50,000	$7	$0	$3
15	BT12BX/WM/INDIRECT	2	$7.00	20,000	$1	2	$17.00	70,000	$1	$0	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$0
16	BT12IND	2	$7.00	20,000	$4	2	$17.00	70,000	$3	$1	1	$25.00	50,000	$3	1	$25.00	50,000	$3	$0	$1
17	BT8	2	$7.00	20,000	$1	2	$17.00	70,000	$1	$0	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$0
18	BT8BX/D/IND	2	$7.00	20,000	$12	2	$17.00	70,000	$9	$4	1	$25.00	50,000	$9	1	$25.00	50,000	$9	$0	$4
19	BT8BX/P	2	$7.00	20,000	$7	2	$17.00	70,000	$5	$2	1	$25.00	50,000	$5	1	$25.00	50,000	$5	$0	$2
20	BT8IND	2	$7.00	20,000	$4	2	$17.00	70,000	$3	$1	1	$25.00	50,000	$3	1	$25.00	50,000	$3	$0	$1
21	BT8SM/INDIRECT	2	$7.00	20,000	$14	2	$17.00	70,000	$10	$4	1	$25.00	50,000	$10	1	$25.00	50,000	$10	$0	$4
22	BT8TR1	2	$7.00	20,000	$2	2	$17.00	70,000	$1	$1	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$1
23	BT8U	2	$15.00	20,000	$3	2	$25.00	70,000	$1	$1	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$1
24	BT8UTR	2	$15.00	20,000	$3	2	$25.00	70,000	$1	$1	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$1
25	BT8W	2	$7.00	20,000	$11	2	$17.00	70,000	$8	$3	1	$25.00	50,000	$8	1	$25.00	50,000	$8	$0	$3

Fauver Stadium

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Saving
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
26	CT8TR	3	$7.00	20,000	$89	3	$17.00	70,000	$62	$27	1	$25.00	50,000	$42	1	$25.00	50,000	$42	$0	$27
27	D(B)T8TR	2	$7.00	20,000	$9	2	$17.00	70,000	$6	$3	1	$25.00	50,000	$7	1	$25.00	50,000	$7	$0	$3
28	HPS150WP	1	$30.00	24,000	$5	1	$400.00	100,000	$15	-$10	1	$180.00	50,000	$13	0	$0.00	0	$0	$13	$3
29	HPS400FL	1	$30.00	24,000	$18	1	$445.00	100,000	$66	-$47	1	$180.00	50,000	$53	0	$0.00	0	$0	$53	$6
30	HPS50PHONE	1	$0.00	0	$0	1	$0.00	0	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
31	LED	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
32	LED Vanity	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
33	LED/1x4P	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
34	LED/1x4S	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
35	LED2x2BX	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
36	LED8x8BX	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
37	LEDBT8INC	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
38	LEDCAN	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
39	LEDCYL/P	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
40	LEDFL	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
41	LEDP	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
42	LEDS	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
43	LEDW	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
44	LEDWP	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
45	SENSORS																			
	TOTAL:				$273				$269	$4				$234				$166		$71

MATERIAL & LABOR COST ESTIMATE

Project : Fauver Stadium
Project # : 402805
Measure : EEM 1.1 - Lighting Upgrades
Date : 04/06/21

Estimated by: DB2
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	22	EA	$42.00	$924	$49.00	$1,078	$2,002.00
2	(1) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	3	EA	$42.00	$126	$49.00	$147	$273.00
3	(1) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	1	EA	$43.00	$43	$49.00	$49	$92.00
4	(1) RAB: (1) FFLED39TN/PCT	1	EA	$400.00	$400	$119.00	$119	$519.00
5	(1) RAB: (1) FXLED150TN/PCT	4	EA	$445.00	$1,780	$119.00	$476	$2,256.00
6	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	53	EA	$59.00	$3,127	$56.00	$2,968	$6,095.00
7	(2) PHILIPS: 12T8/48-3500/IF/10-1 & 8' to 4' Retrofit Kit & (1) ICN-3P16-TLED-N	5	EA	$84.00	$420	$70.00	$350	$770.00
8	(2) PHILIPS: 13T8-6U/MAS/24-835/IF20/P 10/1 & (1) ICN-2P16-TLED-N	2	EA	$59.00	$118	$52.50	$105	$223.00
9	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	4	EA	$96.00	$384	$49.00	$196	$580.00
10	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	2	EA	$135.00	$270	$60.00	$120	$390.00
11	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	45	EA	$76.00	$3,420	$59.50	$2,678	$6,097.50
12	LEAVE AS IS	307	EA	$0.00	$0	$0.00	$0	$0.00
14	LUTRON - MS-OPS6M2-DV-WH	27	EA	$49.00	$1,323	$90.00	$2,430	$3,753.00
			SUBTOTALS:	Materials:	$12,335	Labor:	$10,716	$23,050.50
							TOTAL:	$23,050.50

Schlegel Hall

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	40.0	Avg. kW/Month
Electrical Consumption Savings	140,696	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(73.7)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(737)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	-$176	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Schlegel Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: University (Univ)
Nearest City: Buffalo
System Type: VAV Econ
% of Building Cooled: 90%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.200
HVACc: 0.104
HVACg: -0.012

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings	37.7	kW
Total Annual Lighting Savings kWh	136,439	kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	40.0
Electric Consumption Savings (kWh)	140,696
Fuel Savings (mmBtu)	(73.7)

Notes

(1) Based on NY Tech Manual Method: Version 7
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Schlegel Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor
Lighting = 0.9 Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Schlegel Hall

EEM 1.1 - Lighting Upgrades

					A	B	C	D			E	F	G	H	L	P	Q	R
							Measure Details											
		Lighting Description									Energy Use							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
1	AAAT8	1-F17T8/1-EB	1-LED7T8/RL	(1) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	2,346	90%	20	7	2	2	0.040	0.014	0.036	0.013	0.023	94	33	61
2	AAAT8TR1	1-F17T8/1-EB	1-LED7T8/RL	(1) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	2,346	90%	20	7	1	1	0.020	0.007	0.018	0.006	0.012	47	16	31
3	AAT8TR1	1-F30T8/1-EB	1-LED8.5T8/RL	(1) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	2,346	90%	32	9	7	7	0.224	0.060	0.202	0.054	0.148	526	140	386
4	ACAN8PLV	1-CFQ26/1-SMB	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	5,913	90%	33	9	15	15	0.495	0.135	0.446	0.122	0.324	2,927	798	2,129
5	ARCAN6PLH	1-CFQ26/1-SMB	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	3,684	90%	33	9	16	16	0.528	0.144	0.475	0.130	0.346	1,945	530	1,415
6	ARCAN6PLV	1-CFQ26/1-SMB	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	2,346	90%	33	9	34	34	1.122	0.306	1.010	0.275	0.734	2,633	718	1,915
7	ARCAN8PLH	1-CFQ26/1-SMB	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	5,913	90%	33	9	8	8	0.264	0.072	0.238	0.065	0.173	1,561	426	1,135
8	ARCAN8PLV	1-CFQ26/1-SMB	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	5,913	90%	33	9	10	10	0.330	0.090	0.297	0.081	0.216	1,951	532	1,419
9	ARCAN8WW	1-CFQ26/1-SMB	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	5,913	90%	33	9	4	4	0.132	0.036	0.119	0.032	0.086	781	213	568
10	AT8/INDIRECT	1-F32T8/1-MB	1-LED12T8/RL	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,346	90%	32	12	53	53	1.696	0.636	1.526	0.572	0.954	3,980	1,492	2,487
11	AT8TR1	1-F32T8/1-MB	1-LED12T8/RL	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,229	90%	32	12	176	176	5.632	2.112	5.069	1.901	3.168	12,554	4,708	7,846
12	BBBT8	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	2,346	90%	31	14	56	56	1.736	0.784	1.562	0.706	0.857	4,073	1,840	2,234
13	BBBT8/WW	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	2,346	90%	31	14	6	6	0.186	0.084	0.167	0.076	0.092	436	197	239
14	BBT8W/D/IND	2-F25T8/1-EB	2-LED8.5T8/RL	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	2,346	90%	46	18	7	7	0.322	0.126	0.290	0.113	0.176	756	296	460
15	BRCAN10PLH	2-CFQ26/1-SMB	2-LED PLH/RL	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	5,792	90%	66	18	76	76	5.016	1.368	4.514	1.231	3.283	29,053	7,923	21,129
16	BRCAN6PLH	2-CFQ26/1-SMB	2-LED PLH/RL	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	3,484	90%	66	18	32	32	2.112	0.576	1.901	0.518	1.382	7,359	2,007	5,352
17	BRCAN6PLV	2-CFQ26/1-SMB	2-LED PLH/RL	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	5,913	90%	66	18	5	5	0.330	0.090	0.297	0.081	0.216	1,951	532	1,419
18	BRCAN8/WW	2-CFQ26/1-SMB	2-LED PLH/RL	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	5,913	90%	66	18	10	10	0.660	0.180	0.594	0.162	0.432	3,903	1,064	2,838
19	BRCAN8PLH	2-CFQ26/1-SMB	2-LED PLH/RL	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	2,610	90%	66	18	168	168	11.088	3.024	9.979	2.722	7.258	28,945	7,894	21,051

Schlegel Hall

EEM 1.1 - Lighting Upgrades

Measure Details

					A	B	C	D			E	F	G	H	L	P	Q	R
		Lighting Description									**Energy Use**							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
20	BT12UTR	2-F34T12U/1-EB	2-LED13UT8/RL	(2) PHILIPS: 13T8-6U/MAS/24-835/IF20/P 10/1 & (1) ICN-2P16-TLED-N	1,877	90%	68	26	1	1	0.068	0.026	0.061	0.023	0.038	128	49	79
21	BT12W/WM	2-34T12/1-MB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	7,337	90%	68	24	26	26	1.768	0.624	1.591	0.562	1.030	12,971	4,578	8,393
22	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,280	90%	59	24	156	156	9.204	3.744	8.284	3.370	4.914	20,987	8,537	12,450
23	BT8IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,312	90%	59	24	58	58	3.422	1.392	3.080	1.253	1.827	4,491	1,827	2,664
24	BT8TR	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	939	90%	59	24	4	4	0.236	0.096	0.212	0.086	0.126	222	90	131
25	BT8TR1	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	3,387	90%	59	24	22	22	1.298	0.528	1.168	0.475	0.693	4,397	1,789	2,608
26	BT8UTR	2-F32T8U/1-EB	2-LED13UT8/RL	(2) PHILIPS: 13T8-6U/MAS/24-835/IF20/P 10/1 & (1) ICN-2P16-TLED-N	2,145	90%	59	26	7	7	0.413	0.182	0.372	0.164	0.208	886	390	496
27	BT8W/D/IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,346	90%	59	24	7	7	0.413	0.168	0.372	0.151	0.221	969	394	575
28	BT8W/P	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	7,337	90%	59	24	2	2	0.118	0.048	0.106	0.043	0.063	866	352	514
29	BT8WM	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	59	24	8	8	0.472	0.192	0.425	0.173	0.252	886	360	526
30	CT12TR	3-F34T12/1-MB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,652	90%	102	36	5	5	0.510	0.180	0.459	0.162	0.297	842	297	545
31	CT8TR	3-F32T8/1-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,972	90%	90	36	107	107	9.630	3.852	8.667	3.467	5.200	18,989	7,596	11,394
32	CT8TR 2s	3-F32T8/2-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (2) ICN-3P16-TLED-N	1,554	90%	90	36	18	18	1.620	0.648	1.458	0.583	0.875	2,517	1,007	1,510
33	FLOOD	1-HPS150/1-CWA	1-LED42FL/NF	(1) RAB: (1) FFLED39TN/PCT	3,690	0%	190	42	5	5	0.950	0.210	0.000	0.000	0.000	3,506	775	2,731
34	HPS70WP	1-HPS70/1-CWA	1-LED20WP/NF	(1) RAB: (1) WPLED18N/PC	2,314	90%	95	20	8	8	0.760	0.160	0.684	0.144	0.540	1,759	370	1,389
35	LED	LED	Leave As Is	LEAVE AS IS	4,108	90%	15	15	35	35	0.525	0.525	0.473	0.473	0.000	2,157	2,157	0
36	PENDANT	1-HPS70/1-CWA	LEAVE AS IS	LEAVE AS IS	3,690	0%	95	95	1	1	0.095	0.095	0.000	0.000	0.000	351	351	0
37	WALL SCONCE	2-CFQ26/1-SMB	2-LED PLH/RL	PHILIPS: 8.5PL-C/T LED/26V-3500 IF 4P & (1) ICF-2S13-H1-LD	3,018	45%	66	18	12	12	0.792	0.216	0.356	0.097	0.259	2,390	652	1,739
38	WM SCONCE	1-HPS70/1-CWA	1-LED20WP/NF	(1) RAB: (1) WPLED18N/PC	8,760	90%	95	20	21	21	1.995	0.420	1.796	0.378	1.418	17,476	3,679	13,797
39	SENSORS	None	Occupancy Sensor	Lutron						37					-0.133		-786	786
	TOTAL:								1,189	1,226	66.2	23.1	58.3	20.5	37.7	202,263	65,825	136,439

Schlegel Hall

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
					BB				DD	FF				HH				JJ	LL	NN
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	AAAT8	1	$7.00	20,000	$2	1	$17.00	70,000	$1	$1	1	$25.00	50,000	$2	1	$25.00	50,000	$2	$0	$1
2	AAAT8TR1	1	$7.00	20,000	$1	1	$17.00	70,000	$1	$0	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$0
3	AAT8TR1	1	$7.00	20,000	$6	1	$18.00	70,000	$4	$2	1	$25.00	50,000	$8	1	$25.00	50,000	$8	$0	$2
4	ACAN8PLV	1	$10.00	15,000	$59	1	$38.00	50,000	$67	-$8	1	$30.00	50,000	$53	1	$20.00	50,000	$35	$18	$9
5	ARCAN6PLH	1	$10.00	15,000	$39	1	$38.00	50,000	$45	-$6	1	$30.00	50,000	$35	1	$20.00	50,000	$24	$12	$6
6	ARCAN6PLV	1	$10.00	15,000	$53	1	$38.00	50,000	$61	-$7	1	$30.00	50,000	$48	1	$20.00	50,000	$32	$16	$9
7	ARCAN8PLH	1	$10.00	15,000	$32	1	$38.00	50,000	$36	-$4	1	$30.00	50,000	$28	1	$20.00	50,000	$19	$9	$5
8	ARCAN8PLV	1	$10.00	15,000	$39	1	$38.00	50,000	$45	-$6	1	$30.00	50,000	$35	1	$20.00	50,000	$24	$12	$6
9	ARCAN8WW	1	$12.00	15,000	$19	1	$38.00	20,000	$45	-$26	1	$30.00	50,000	$14	1	$20.00	50,000	$9	$5	-$21
10	AT8/INDIRECT	1	$7.00	20,000	$44	1	$17.00	70,000	$30	$13	1	$25.00	50,000	$62	1	$25.00	50,000	$62	$0	$13
11	AT8TR1	1	$7.00	20,000	$137	1	$17.00	70,000	$95	$42	1	$25.00	50,000	$196	1	$25.00	50,000	$196	$0	$42
12	BBBT8	2	$7.00	20,000	$92	2	$17.00	70,000	$64	$28	1	$25.00	50,000	$66	1	$25.00	50,000	$66	$0	$28
13	BBBT8/WW	2	$7.00	20,000	$10	2	$17.00	70,000	$7	$3	1	$25.00	50,000	$7	1	$25.00	50,000	$7	$0	$3
14	BBT8W/D/IND	2	$7.00	20,000	$11	2	$55.00	70,000	$26	-$14	1	$25.00	50,000	$8	1	$25.00	50,000	$8	$0	-$14
15	BRCAN10PLH	2	$10.00	15,000	$587	2	$38.00	50,000	$669	-$82	1	$30.00	50,000	$264	1	$20.00	50,000	$176	$88	$6
16	BRCAN6PLH	2	$10.00	15,000	$149	2	$38.00	50,000	$169	-$21	1	$30.00	50,000	$67	1	$20.00	50,000	$45	$22	$1
17	BRCAN6PLV	2	$10.00	15,000	$39	2	$38.00	50,000	$45	-$6	1	$30.00	50,000	$18	1	$20.00	50,000	$12	$6	$0
18	BRCAN8/WW	2	$10.00	15,000	$79	2	$38.00	20,000	$225	-$146	1	$30.00	50,000	$35	1	$20.00	50,000	$24	$12	-$134
19	BRCAN8PLH	2	$10.00	15,000	$585	2	$38.00	50,000	$667	-$82	1	$30.00	50,000	$263	1	$20.00	50,000	$175	$88	$6

Schlegel Hall

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

					BB				DD	FF				HH				JJ	LL	NN
		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
20	BT12UTR	2	$15.00	20,000	$3	2	$25.00	70,000	$1	$1	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	$1
21	BT12W/WM	2	$7.00	20,000	$134	2	$17.00	70,000	$93	$41	1	$25.00	50,000	$95	1	$25.00	50,000	$95	$0	$41
22	BT8	2	$7.00	20,000	$249	2	$17.00	70,000	$173	$76	1	$25.00	50,000	$178	1	$25.00	50,000	$178	$0	$76
23	BT8IND	2	$7.00	20,000	$53	2	$17.00	70,000	$37	$16	1	$25.00	50,000	$38	1	$25.00	50,000	$38	$0	$16
24	BT8TR	2	$7.00	20,000	$3	2	$17.00	70,000	$2	$1	1	$25.00	50,000	$2	1	$25.00	50,000	$2	$0	$1
25	BT8TR1	2	$7.00	20,000	$52	2	$17.00	70,000	$36	$16	1	$25.00	50,000	$37	1	$25.00	50,000	$37	$0	$16
26	BT8UTR	2	$15.00	20,000	$23	2	$25.00	70,000	$11	$12	1	$25.00	50,000	$8	1	$25.00	50,000	$8	$0	$12
27	BT8W/D/IND	2	$7.00	20,000	$11	2	$17.00	70,000	$8	$4	1	$25.00	50,000	$8	1	$25.00	50,000	$8	$0	$4
28	BT8W/P	2	$7.00	20,000	$10	2	$17.00	70,000	$7	$3	1	$25.00	50,000	$7	1	$25.00	50,000	$7	$0	$3
29	BT8WM	2	$7.00	20,000	$11	2	$17.00	70,000	$7	$3	1	$25.00	50,000	$8	1	$25.00	50,000	$8	$0	$3
30	CT12TR	3	$7.00	20,000	$9	3	$17.00	70,000	$6	$3	2	$50.00	50,000	$17	2	$50.00	50,000	$17	$0	$3
31	CT8TR	3	$7.00	20,000	$222	3	$17.00	70,000	$154	$68	1	$25.00	50,000	$105	1	$25.00	50,000	$105	$0	$68
32	CT8TR 2s	3	$7.00	20,000	$29	3	$17.00	70,000	$20	$9	2	$50.00	50,000	$56	2	$25.00	50,000	$28	$28	$37
33	FLOOD	1	$15.00	24,000	$12	1	$400.00	100,000	$74	-$62	1	$25.00	50,000	$9	0	$0.00	0	$0	$9	-$53
34	HPS70WP	1	$30.00	24,000	$23	1	$290.00	100,000	$54	-$31	1	$180.00	50,000	$67	0	$0.00	0	$0	$67	$36
35	LED	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
36	PENDANT	1	$15.00	24,000	$2	1	$15.00	24,000	$2	$0	1	$25.00	50,000	$2	1	$25.00	50,000	$2	$0	$0
37	WALL SCONCE	2	$10.00	15,000	$48	2	$38.00	20,000	$138	-$89	1	$30.00	50,000	$22	1	$20.00	50,000	$14	$7	-$82
38	WM SCONCE	1	$15.00	24,000	$115	1	$290.00	100,000	$533	-$419	1	$25.00	50,000	$92	0	$0.00	0	$0	$92	-$327
39	SENSORS																			
	TOTAL:				$2,991				$3,657	-$667				$1,964				$1,474		-$176

MATERIAL & LABOR COST ESTIMATE

Project : Schlegel Hall
Project # : 402805
Measure : EEM 1.1 - Lighting Upgrades
Date : 04/06/21

Estimated by: DB2
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	229	EA	$42.00	$9,618	$49.00	$11,221	$20,839.00
2	(1) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	3	EA	$42.00	$126	$49.00	$147	$273.00
3	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	87	EA	$58.00	$5,046	$49.00	$4,263	$9,309.00
4	(1) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	7	EA	$43.00	$301	$49.00	$343	$644.00
5	(1) RAB: (1) FFLED39TN/PCT	5	EA	$400.00	$2,000	$119.00	$595	$2,595.00
6	(1) RAB: (1) WPLED18N/PC	29	EA	$290.00	$8,410	$119.00	$3,451	$11,861.00
7	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	283	EA	$59.00	$16,697	$56.00	$15,848	$32,545.00
8	(2) PHILIPS: 13T8-6U/MAS/24-835/IF20/P 10/1 & (1) ICN-2P16-TLED-N	8	EA	$59.00	$472	$52.50	$420	$892.00
9	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	62	EA	$59.00	$3,658	$52.50	$3,255	$6,913.00
10	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	291	EA	$96.00	$27,936	$49.00	$14,259	$42,195.00
11	(2) PHILIPS: 8.5T8/MAS/36-835/IF13/P 10/1 & (1) ICN-3P16-TLED-N	7	EA	$135.00	$945	$49.00	$343	$1,288.00
12	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	112	EA	$79.35	$8,887	$59.50	$6,664	$15,551.00
13	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (2) ICN-3P16-TLED-N	18	EA	$101.00	$1,818	$85.00	$1,530	$3,348.00
14	LEAVE AS IS	36	EA	$0.00	$0	$3.31	$119	$119.00
15	PHILIPS: 8.5PL-C/T LED/26V-3500 IF 4P & (1) ICF-2S13-H1-LD	12	EA	$96.00	$1,152	$49.00	$588	$1,740.00
16	LUTRON - MS-OPS6M2-DV-WH	17	EA	$49.00	$833	$90.00	$1,530	$2,363.00
17	LUTRON - LRF2-OCR2B-P-WH	20	EA	$55.00	$1,100	$120.00	$2,400	$3,500.00
			SUBTOTALS:	Materials:	$88,999	Labor:	$66,976	$155,975.00
							TOTAL:	$155,975.00

wendel

Wallis Hall

Lighting Upgrades

Measure Summary		
Electrical Energy Savings		
Electrical Demand Savings	27.6	Avg. kW/Month
Electrical Consumption Savings	101,710	kWh/Year
Fossil Fuel Energy Savings		
Fossil Fuel Savings	(53.3)	mmBtu/Year
Fuel Conversion	10.000	Therms/mmBtu
Natural Gas Savings	(533)	Therms/Year
Water Savings		
Water Consumption Savings	-	kGal/Year
O&M Savings		
Annual O&M Savings	$1,251	/Year

EEM 1.1

Assumptions & Sample Calculations

Project: Wallis Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

BUILDING ASSUMPTIONS

Building Type: University (Univ)
Nearest City: Buffalo
System Type: VAV Econ
% of Building Cooled: 90%
% of Building Heated: 90%

HVAC FACTORS (reference NY TRM ver. 7 Appendix D)

HVACd: 0.200
HVACc: 0.104
HVACg: -0.012

Electric: HVAC Electric Demand kW Savings = HVACd x Total Annual Demand Savings (kW) x % of Building Cooled x 4/12 Cooling Months/Year
HVAC Electric Consumption kWh Savings = HVACc x Total Annual Lighting Savings kWh x % of Building Cooled x 4/12 cooling months/year

Fuel[3] HVAC Gas Consumption mmBtu Savings = HVACg x Total Annual Lighting Savings kWh x % of Building Heated / 10 (therms per mmBtu) x (6 /12 heating months per year)

Measure Savings (without HVAC interactive effects)

Lighting Monthly kW Savings	26.0	kW
Total Annual Lighting Savings kWh	98,632	kWh

Total Savings with HVAC Interactive Effects

Total Savings	
Avg. Monthly Demand Savings (kW)	27.6
Electric Consumption Savings (kWh)	101,710
Fuel Savings (mmBtu)	(53.3)

Notes

(1) Based on NY Tech Manual Method: Version 7
(2) Total Annual kW Savings (incl. HVAC Correction) only accounts for demand savings associated with 4 summer months
(3) HVACg assumes Natural Gas usage. Assume 10 therms = 1 mmBtu; Savings reported in mmBtu

Assumptions & Sample Calculations

Project: Wallis Hall
Project #: 402805
Measure: EEM 1.1 - Lighting Upgrades
Date: 4/6/2021

Assumptions

Coincidence Factor
Lighting = 0.9 — Per Energy Savings Calculation and Cost Analysis Handbook Ver. 2

Measure Savings

LIGHTING:

A	Average Annual Hours = ∑(Total Annual Hours per Fixture Code on FRCR) / # New Units
B	Coincidence Factor = See Above
C	Existing Luminaire Watts = Watts/Fixture per NYSERDA Wattage Table Fixture Code
D	New Luminaire Watts = Watts/Fixture per Cut Sheet
E	Total Existing Connected kW = Existing Luminaire Watts x # Existing Units / 1000W/kW
F	Total New Connected kW = Existing Luminaire Watts x # New Units / 1000W/kW
G	Existing Peak kW Demand = Coincidence Factor x Total Existing Connected kW
H	Proposed Peak kW Demand = Coincidence Factor x Total New Connected kW
L	Lighting Monthly kW Savings = Existing Peak kW Demand - Proposed Peak kW Demand
P	Total Existing Lighting Annual kWh = Total Annual Hours x Total Existing Connected kW
Q	Total New Lighting Annual kWh = Total Annual Hours x Total New Connected kW
R	Total Annual Lighting Savings kWh = Total Existing Lighting Annual kWh - Total New Lighting Annual kWh

SENSORS: Sensor savings based on 15% kWh reduction and 5% kW reduction in spaces that do not currently have occupancy sensors.

L	Sensor kW Savings = Σ(Total Proposed Connected KW x 5%)
Q	Sensor kWh Savings = Σ(Annual Hours per Fixture Code on FRCR x Total Proposed Connected KW x 15%)

MAINTENANCE:

AA	Maintenance Effort Required (Man-hours) = Old Lamp Unit Labor Hours Required x Lamps Per Fixture x # of Existing Units
BB	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of Existing Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
CC	Maintenance Effort Required (Man-hours) = New Lamp Unit Labor Hours Required x Lamps Per Fixture x # of New Units
DD	Maintenance Cost Per Year = Total Annual Hours x Lamps Per Fixture x # of New Units / Lamp Life (hours) x (Cost Per Lamp + Cost Per Lamp Disposal)
EE	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
FF	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
GG	Maintenance Effort Required (Man-hours) = Old Ballast Unit Labor Hours Required x Ballasts Per Fixture x # of Existing Units
HH	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of Existing Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
II	Maintenance Effort Required (Man-hours) = New Ballast Unit Labor Hours Required x Ballast Per Fixture x # of Existing Units
JJ	Maintenance Cost Per Year = Total Annual Hours x Ballasts Per Fixture x # of New Units / Ballast Life (hours) x (Cost Per Ballast + Cost Per Ballast Disposal)
KK	Maintenance Effort Saved (Man-hours) = Current Maintenance Effort Required (Man-hours) - Proposed Maintenance Effort Required (Man-hours)
LL	Total Lamp Savings = Current Maintenance Cost Per Year - Proposed Maintenance Cost Per Year
MM	Maintenance Effort Saved (Man-hours) = Lamp Maintenance Effort Saved (Man-hours) + Ballast Maintenance Effort Saved (Man-hours)
NN	Maintenance Savings = Lamp Total Lamp Savings + Ballast Total Lamp Savings

Wallis Hall

EEM 1.1 - Lighting Upgrades

Measure Details

					A	B	C	D			E	F	G	H	L	P	Q	R
		Lighting Description									Energy Use							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
1	60WINC	1-I60	1-LEDSI/RL	(1) PHILLIPS: A19/LED/9W	1,314	90%	60	9	1	1	0.060	0.009	0.054	0.008	0.046	79	12	67
2	AAAAT5STRIP	1-F14T5/1-EB	LEAVE AS IS	LEAVE AS IS	1,877	90%	14	14	1	1	0.014	0.014	0.013	0.013	0.000	26	26	0
3	AAT5 STRIP	1-F24T5/1-EB	1-LED8T5/RL	(1) PHILIPS: 8T5HE/22-835/IF10/G/DIM 10/1 & (1) ICN-2S28-T	1,877	90%	24	8	1	1	0.024	0.008	0.022	0.007	0.014	45	15	30
4	AHAL PAR 30 6" CAN	1-PAR30	1-LED12/RL	(1) PHILIPS: 12PAR30L/EC/F25/940/DIM/120V 6/1	2,816	90%	60	12	6	6	0.360	0.072	0.324	0.065	0.259	1,014	203	811
5	ARCAN4PAR30	1-PAR30	1-LED12/RL	(1) PHILIPS: 12PAR30L/EC/F25/940/DIM/120V 6/1	2,816	90%	60	12	12	12	0.720	0.144	0.648	0.130	0.518	2,027	405	1,622
6	ARCAN6PLV	1-CFQ26/1-SMB	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	3,650	90%	33	9	26	26	0.858	0.234	0.772	0.211	0.562	3,131	854	2,277
7	AT5CAB	1-F54T5/1-EB	1-LED14T5/RL	(1) PHILIPS: 14T5HE/46-835/IF20/G/DIM 10/1 & (1) ICN-2S28-T	1,877	90%	59	14	1	1	0.059	0.014	0.053	0.013	0.041	111	26	84
8	AT8BX1	1-F32T8/1-MB	1-LED12T8/RL	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	5,913	90%	32	12	29	29	0.928	0.348	0.835	0.313	0.522	5,487	2,058	3,430
9	AT8TR1	1-F32T8/1-MB	1-LED12T8/RL	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	5,913	90%	32	12	35	35	1.120	0.420	1.008	0.378	0.630	6,623	2,483	4,139
10	B8T12S	2-F96T8/1-EB	4-LED12T8/R	(4) PHILIPS: 12T8/48-3500/IF/10-1 & 8' to 4' Retrofit Kit & (1) ICN-3P16-TLED-N	2,102	90%	116	86	5	5	0.580	0.430	0.522	0.387	0.135	1,219	904	315
11	BBBT8	2-F17T8/1-EB	2-LED7T8/RL	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	2,319	90%	31	14	17	17	0.527	0.238	0.474	0.214	0.260	1,222	552	670
12	BRCAN6PLH	2-CFQ26/1-SMB	2-LED PLH/RL	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	4,224	90%	66	18	53	53	3.498	0.954	3.148	0.859	2.290	14,774	4,029	10,745
13	BT8	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,229	90%	59	24	4	4	0.236	0.096	0.212	0.086	0.126	526	214	312
14	BT8BX	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,503	90%	59	24	6	6	0.354	0.144	0.319	0.130	0.189	886	360	526
15	BT8IND	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,853	90%	59	24	25	25	1.475	0.600	1.328	0.540	0.788	4,209	1,712	2,497
16	BT8TR	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,732	90%	59	24	29	29	1.711	0.696	1.540	0.626	0.914	4,674	1,901	2,773
17	BT8TR1	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,924	90%	59	24	71	71	4.189	1.704	3.770	1.534	2.237	12,249	4,983	7,266
18	BT8U.5	2-F31T8U/1-EB	1-LED/NF	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	2,816	90%	59	25	4	4	0.236	0.100	0.212	0.090	0.122	665	282	383
19	BT8W	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,747	90%	59	24	57	57	3.363	1.368	3.027	1.231	1.796	9,237	3,757	5,479

Wallis Hall

EEM 1.1 - Lighting Upgrades

					A	B	C	D			E	F	G	H	L	P	Q	R
		Lighting Description			Measure Details						Energy Use							
Measure #	Fixture code	Existing Equipment	Replacement Equipment	Replacement Model #	Total Annual Hours	Coincidence Factor	Existing Luminaire Watts	New Luminaire Watts	# of Existing Units	# of New Units	Total Existing Connected kW	Total New Connected kW	Existing Peak kW Demand	Proposed Peak kW Demand	Lighting Monthly kW Savings	Total Existing Lighting Annual kWh	Total New Lighting Annual kWh	Total Annual Lighting Savings kWh
20	BT8W DEC	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	59	24	13	13	0.767	0.312	0.690	0.281	0.410	1,440	586	854
21	CFLSI	1-CFL13	1-LEDSI/RL	(1) PHILLIPS: A19/LED/9W	2,346	90%	13	9	19	19	0.247	0.171	0.222	0.154	0.068	580	401	178
22	CT8TR	3-F32T8/1-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	3,374	90%	90	36	71	71	6.390	2.556	5.751	2.300	3.451	21,557	8,623	12,934
23	CT8TR 2s	3-F32T8/2-EB	3-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (2) ICN-3P16-TLED-N	2,791	90%	90	36	121	121	10.890	4.356	9.801	3.920	5.881	30,393	12,157	18,236
24	D(B)T8BX	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	1,877	90%	59	24	2	2	0.118	0.048	0.106	0.043	0.063	222	90	131
25	D(B)T8TR	2-F32T8/1-EB	2-LED12T8/RL	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,816	90%	59	24	61	61	3.599	1.464	3.239	1.318	1.922	10,134	4,122	6,012
26	DT8TR	4-F32T8/1-EB	4-LED12T8/RL	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	2,816	90%	112	48	20	20	2.240	0.960	2.016	0.864	1.152	6,307	2,703	3,604
27	HPS150WP	1-HPS150/1-CWA	1-LED42FL/NF	(1) RAB: (1) FFLED39TN/PCT	3,690	0%	190	42	2	2	0.380	0.084	0.000	0.000	0.000	1,402	310	1,092
28	HPS250FL	1-HPS250/1-CWA	1-LED79FL/NF	(1) RAB: (1) FXLED78TN/PCT	3,690	0%	295	79	1	1	0.295	0.079	0.000	0.000	0.000	1,089	292	797
29	INCSI	1-I60	1-LEDSI/RL	(1) PHILLIPS: A19/LED/9W	2,315	90%	60	9	3	3	0.180	0.027	0.162	0.024	0.138	417	63	354
30	LARGE PENDANT 4SI	4-I100	1-LEDSI/RL	(1) PHILLIPS: A19/LED/13W	5,913	90%	400	52	1	1	0.400	0.052	0.360	0.047	0.313	2,365	307	2,058
31	LED	LED	Leave As Is	LEAVE AS IS	2,738	90%	15	15	24	24	0.360	0.360	0.324	0.324	0.000	986	986	0
32	LED S	LED	Leave As Is	LEAVE AS IS	1,314	90%	15	15	2	2	0.030	0.030	0.027	0.027	0.000	39	39	0
33	LED80FL	LED	Leave As Is	LEAVE AS IS	3,690	0%	80	80	1	1	0.080	0.080	0.000	0.000	0.000	295	295	0
34	LEDBRCAN6	LED	Leave As Is	LEAVE AS IS	5,913	90%	12	12	7	7	0.084	0.084	0.076	0.076	0.000	497	497	0
35	MR16	1-MR16	1-LEDMR16/RL	(1) PHILIPS MR16/GU10/PAR16	4,468	90%	50	7	15	15	0.750	0.105	0.675	0.095	0.581	3,351	469	2,882
36	PAR20	1-PAR20	1-LED6.5/RL	(1) PHILIPS: LEDspot 50W PAR20 865 100-240V 25D ND SO	2,816	90%	50	6.5	3	3	0.150	0.020	0.135	0.018	0.117	422	55	367
37	PAR20 RCAN4	1-PAR20	1-LED6.5/RL	(1) PHILIPS: LEDspot 50W PAR20 865 100-240V 25D ND SO	2,816	90%	50	6.5	4	4	0.200	0.026	0.180	0.023	0.157	563	73	490
38	PAR30	1-PAR30	1-LED12/RL	(1) PHILIPS: 12PAR30L/EC/F25/940/DIM/120V 6/1	2,647	90%	60	12	15	15	0.900	0.180	0.810	0.162	0.648	2,382	476	1,906
39	PLH	1-CFQ26/1-SMB	1-LED PLH/RL	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	1,314	90%	33	9	2	2	0.066	0.018	0.059	0.016	0.043	87	24	63
40	SENSORS	None	Occupancy Sensor	Lutron	0					118					-0.398		-3,248	3,248
	TOTAL:								770	888	48.4	18.6	42.9	16.5	26.0	152,729	54,097	98,632

Wallis Hall

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
					BB				DD	FF				HH				JJ	LL	NN
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
1	60WINC	1	$4.00	1,000	$5	1	$5.52	15,000	$0	$5	0	$0.00	0	$0	0	$0.00	0	$0	$0	$5
2	AAAAT5STRIP	1	$0.00	15,000	$0	1	$0.00	15,000	$0	$0	1	$0.00	0	$0	0	$0.00	0	$0	$0	$0
3	AAT5 STRIP	1	$7.00	20,000	$1	1	$17.00	20,000	$2	-$1	1	$25.00	50,000	$1	1	$25.00	50,000	$1	$0	-$1
4	AHAL PAR 30 6" CAN	1	$5.00	1,500	$56	1	$20.00	25,000	$14	$43	1	$0.00	0	$0	1	$0.00	0	$0	$0	$43
5	ARCAN4PAR30	1	$5.00	1,500	$113	1	$20.00	25,000	$27	$86	1	$0.00	0	$0	1	$0.00	0	$0	$0	$86
6	ARCAN6PLV	1	$10.00	15,000	$63	1	$38.00	50,000	$72	-$9	1	$30.00	50,000	$57	1	$20.00	50,000	$38	$19	$10
7	AT5CAB	1	$4.00	20,000	$0	1	$25.00	70,000	$1	$0	1	$20.00	50,000	$1	1	$25.00	50,000	$1	$0	$0
8	AT8BX1	1	$7.00	20,000	$60	1	$17.00	70,000	$42	$18	1	$25.00	50,000	$86	1	$25.00	50,000	$86	$0	$18
9	AT8TR1	1	$7.00	20,000	$72	1	$17.00	70,000	$50	$22	1	$25.00	50,000	$103	1	$25.00	50,000	$103	$0	$22
10	B8T12S	2	$30.00	18,000	$35	4	$17.00	70,000	$10	$25	1	$25.00	50,000	$5	1	$25.00	50,000	$5	$0	$25
11	BBBT8	2	$7.00	20,000	$28	2	$17.00	70,000	$19	$8	1	$25.00	50,000	$20	1	$25.00	50,000	$20	$0	$8
12	BRCAN6PLH	2	$10.00	15,000	$298	2	$38.00	50,000	$340	-$42	1	$30.00	50,000	$134	1	$20.00	50,000	$90	$45	$3
13	BT8	2	$7.00	20,000	$6	2	$17.00	70,000	$4	$2	1	$25.00	50,000	$4	1	$25.00	50,000	$4	$0	$2
14	BT8BX	2	$7.00	20,000	$11	2	$17.00	70,000	$7	$3	1	$25.00	50,000	$8	1	$25.00	50,000	$8	$0	$3
15	BT8IND	2	$7.00	20,000	$50	2	$17.00	70,000	$35	$15	1	$25.00	50,000	$36	1	$25.00	50,000	$36	$0	$15
16	BT8TR	2	$7.00	20,000	$55	2	$17.00	70,000	$38	$17	1	$25.00	50,000	$40	1	$25.00	50,000	$40	$0	$17
17	BT8TR1	2	$7.00	20,000	$145	2	$17.00	70,000	$101	$44	1	$25.00	50,000	$104	1	$25.00	50,000	$104	$0	$44
18	BT8U.5	2	$15.00	24,000	$14	2	$75.00	70,000	$24	-$10	1	$0.00	50,000	$0	0	$0.00	0	$0	$0	-$10
19	BT8W	2	$7.00	20,000	$110	2	$17.00	70,000	$76	$34	1	$25.00	50,000	$78	1	$25.00	50,000	$78	$0	$34

Wallis Hall

EEM 1.1 - Lighting Upgrades

Operation and Maintenance

		Current Lamps				Proposed Lamps				Lamp Savings	Current Electronics				Proposed Electronics				Electronics Savings	Total Savings
					BB				DD	FF				HH				JJ	LL	NN
Measure #	Fixture code	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Lamps Per Fixture	Cost Per Lamp	Lamp Life (hours)	Maintenance Cost Per Year	Total Lamp Savings	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Ballasts Per Fixture	Cost Per Ballast	Ballast Life (hours)	Maintenance Cost Per Year	Total Electronics Savings	Maintenance Savings
20	BT8W DEC	2	$7.00	20,000	$17	2	$17.00	70,000	$12	$5	1	$25.00	50,000	$12	1	$25.00	50,000	$12	$0	$5
21	CFLSI	1	$4.00	15,000	$12	1	$5.52	15,000	$16	-$5	0	$0.00	0	$0	0	$0.00	0	$0	$0	-$5
22	CT8TR	3	$7.00	20,000	$251	3	$17.00	70,000	$175	$77	1	$25.00	50,000	$120	1	$25.00	50,000	$120	$0	$77
23	CT8TR 2s	3	$7.00	20,000	$355	3	$17.00	70,000	$246	$109	2	$50.00	50,000	$675	2	$25.00	50,000	$338	$338	$446
24	D(B)T8BX	2	$7.00	20,000	$3	2	$17.00	70,000	$2	$1	1	$25.00	50,000	$2	1	$25.00	50,000	$2	$0	$1
25	D(B)T8TR	2	$7.00	20,000	$120	2	$17.00	70,000	$83	$37	1	$25.00	50,000	$86	1	$25.00	50,000	$86	$0	$37
26	DT8TR	4	$7.00	20,000	$79	4	$17.00	70,000	$55	$24	2	$50.00	50,000	$113	2	$50.00	50,000	$113	$0	$24
27	HPS150WP	1	$30.00	24,000	$9	1	$400.00	100,000	$30	-$20	1	$180.00	50,000	$27	0	$0.00	0	$0	$27	$6
28	HPS250FL	1	$30.00	24,000	$5	1	$400.00	100,000	$15	-$10	1	$180.00	50,000	$13	0	$0.00	0	$0	$13	$3
29	INCSI	1	$4.00	1,000	$28	1	$5.52	15,000	$3	$25	0	$0.00	0	$0	0	$0.00	0	$0	$0	$25
30	LARGE PENDANT 4SI	1	$4.00	1,000	$24	1	$5.52	15,000	$2	$21	0	$0.00	0	$0	0	$0.00	0	$0	$0	$21
31	LED	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
32	LED S	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
33	LED80FL	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
34	LEDBRCAN6	1	$0.00	50,000	$0	1	$0.00	50,000	$0	$0	0	$0.00	0	$0	0	$0.00	0	$0	$0	$0
35	MR16	1	$5.00	2,000	$168	1	$11.00	25,000	$29	$138	1	$0.00	0	$0	0	$0.00	50,000	$0	$0	$138
36	PAR20	1	$5.00	1,500	$28	1	$15.00	25,000	$5	$23	1	$0.00	0	$0	1	$0.00	0	$0	$0	$23
37	PAR20 RCAN4	1	$5.00	2,000	$28	1	$11.00	25,000	$5	$23	1	$0.00	0	$0	0	$0.00	50,000	$0	$0	$23
38	PAR30	1	$5.00	1,500	$132	1	$20.00	25,000	$32	$101	1	$0.00	0	$0	1	$0.00	0	$0	$0	$101
39	PLH	1	$10.00	15,000	$2	1	$38.00	50,000	$2	$0	1	$30.00	50,000	$2	1	$20.00	50,000	$1	$1	$0
40	SENSORS																			
	TOTAL:				$2,383				$1,574	$809				$1,726				$1,284		$1,251

MATERIAL & LABOR COST ESTIMATE

Project :	Wallis Hall	Estimated by:	DB2
Project # :	402805	Checked by:	
Measure :	EEM 1.1 - Lighting Upgrades	Approved by:	
Date :	04/06/21	File:	Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	(1) PHILIPS MR16/GU10/PAR16	15	EA	$11.00	$165	$17.50	$263	$427.50
2	(1) PHILIPS: 12PAR30L/EC/F25/940/DIM/120V 6/1	33	EA	$45.00	$1,485	$14.00	$462	$1,947.00
3	(1) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	64	EA	$42.00	$2,688	$49.00	$3,136	$5,824.00
4	(1) PHILIPS: 14T5HE/46-835/IF20/G/DIM 10/1 & (1) ICN-2S28-T	1	EA	$50.00	$50	$30.10	$30	$80.10
5	(1) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	28	EA	$58.00	$1,624	$49.00	$1,372	$2,996.00
6	(1) PHILIPS: 8T5HE/22-835/IF10/G/DIM 10/1 & (1) ICN-2S28-T	1	EA	$42.00	$42	$30.10	$30	$72.10
7	(1) PHILIPS: EVOKIT/2X2/P/32L/25W/835/2/G4	4	EA	$150.00	$600	$105.00	$420	$1,020.00
8	(1) PHILIPS: LEDspot 50W PAR20 865 100-240V 25D ND SO	7	EA	$23.43	$164	$14.00	$98	$262.00
9	(1) PHILLIPS: A19/LED/13W	1	EA	$160.00	$160	$17.50	$18	$177.50
10	(1) PHILLIPS: A19/LED/9W	23	EA	$11.05	$254	$17.50	$403	$656.65
11	(1) RAB: (1) FFLED39TN/PCT	2	EA	$400.00	$800	$119.00	$238	$1,038.00
12	(1) RAB: (1) FXLED78TN/PCT	1	EA	$400.00	$400	$119.00	$119	$519.00
13	(2) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	268	EA	$59.00	$15,812	$56.00	$15,008	$30,820.00
14	(2) PHILIPS: 7T8/MAS/24-835/IF10/P 10/1 & (1) ICN-2P16-TLED-N	17	EA	$59.00	$1,003	$52.50	$893	$1,895.50
15	(2) PHILIPS: 8.5PL-C/T LED/26H-3500 IF 4P & (1) ICF-2S13-H1-LD	53	EA	$96.00	$5,088	$49.00	$2,597	$7,685.00
16	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (1) ICN-3P16-TLED-N	91	EA	$96.22	$8,756	$60.27	$5,485	$14,240.50
17	(3) PHILIPS: 12T8/48-3500/IF/10-1 & (2) ICN-3P16-TLED-N	121	EA	$101.00	$12,221	$85.00	$10,285	$22,506.00
18	(4) PHILIPS: 12T8/48-3500/IF/10-1 & 8' to 4' Retrofit Kit & (1) ICN-3P16-TLED-N	5	EA	$93.00	$465	$63.00	$315	$780.00
19	LEAVE AS IS	35	EA	$0.00	$0	$0.00	$0	$0.00
15	LUTRON - MS-OPS6M2-DV-WH	114	EA	$49.00	$5,586	$90.00	$10,260	$15,846.00
16	LUTRON - LRF2-OCR2B-P-WH	4	EA	$55.00	$220	$120.00	$480	$700.00
			SUBTOTALS:	Materials:	$57,583	Labor:	$51,910	$109,492.85
							TOTAL:	**$109,492.85**

wendel

Technical Appendix 1

Lighting ECM

Cut Sheets

TrueLine, suspended

SP532P LED29S/940 PSD PI5 SM2 L1410 WH

TrueLine DIRECT/INDIRECT OC - LED Module, system flux 2900 lm - 940 neutral white - Power supply unit with DALI interface - Push-in connector 5-pole - Suspension set 2-wire - 1410 mm - White RAL 9003 - Signal white

Architects need a lighting solution that matches the interior architecture of the property they are working on. They want a light line with an elegant design and very high light levels. Specifiers need luminaires that enable them to save energy while at the same time providing the right level of light, in compliance with office lighting norms. TrueLine, suspended is able to meet both sets of requirements. TrueLine is also available in recessed and surface-mounted versions.

Warnings and Safety

- The product is IPX0 & as such is not protected against water ingress & as such we strongly recommend that The environment in which The luminaire is to be installed is suitably checked
- If The above advice is not taken and The luminaires are subject to water ingress, Philips / Signify cannot guarantee safe failure & product warranty will become void

Product data

General Information	
Number of light sources	1 pc
Lamp family code	LED29S [LED Module, system flux 2900 lm]
Beam angle of light source	- °
Light source color	940 neutral white
Light source replaceable	No
Number of gear units	1 unit
Gear	GRT [Gear tray (without gear)]

Driver/power unit/transformer	Power supply unit with DALI interface
Driver included	Yes
Optic type	-
Optical cover/lens type	Polymethyl methacrylate bowl/cover
Luminaire light beam spread	100°
Control interface	DALI
Connection	Push-in connector 5-pole
Cable	Cable 1.5 m with push-in connector 5-pole
Protection class IEC	Safety class I

data subject to change

TrueLine, suspended

Mounting	Suspension set 2-wire
Standard RAL color	Signal white
Glow-wire test	Temperature 650 °C, duration 5 s
Flammability mark	For mounting on normally flammable surfaces
CE mark	CE mark
ENEC mark	ENEC mark
UL mark	-
Warranty period	5 years
Constant light output	No
Number of products on MCB of 16 A type B	24
Photobiological risk	Photobiological risk group 1 @ 200mm to EN62471
EU RoHS compliant	Yes
Service tag	Yes
Product family code	SP532P [TrueLine DIRECT/INDIRECT OC]
Unified glare rating CEN	13

Light Technical

Saturated Red (R9)	>50

Operating and Electrical

Input Voltage	220 to 240 V
Input Frequency	50 to 60 Hz
Initial CLO power consumption	- W
Inrush current	19 A
Inrush time	0.28 ms
Power Factor (Min)	0.9

Controls and Dimming

Dimmable	Yes

Mechanical and Housing

Housing Material	Aluminum
Reflector material	-
Optic material	-
Optical cover/lens material	Polymethyl methacrylate
Gear tray material	Steel
Fixation material	Stainless steel
Optical cover/lens finish	Frosted
Overall length	1409 mm
Overall width	55 mm
Overall height	88 mm

Length	1410 mm
Color	White RAL 9003
Dimensions (Height x Width x Depth)	88 x 55 x 1409 mm (3.5 x 2.2 x 55.5 in)

Approval and Application

Ingress protection code	IP20 [Finger-protected]
Mech. impact protection code	IK02 [0.2 J standard]

Initial Performance (IEC Compliant)

Initial luminous flux (system flux)	2900 lm
Luminous flux tolerance	+/-10%
Initial LED luminaire efficacy	149 lm/W
Init. Corr. Color Temperature	4000 K
Init. Color Rendering Index	>90
Initial chromaticity	(0.38, 0.38) SDCM <3
Initial input power	19.5 W
Power consumption tolerance	+/-10%

Over Time Performance (IEC Compliant)

Control gear failure rate at median useful life 50000 h	5 %
Lumen maintenance at median useful life* 50000 h	L85

Application Conditions

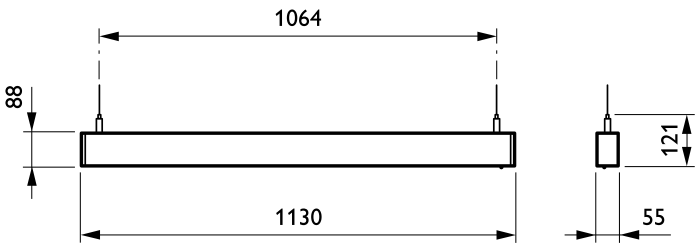
Ambient temperature range	+10 to +40 °C
Performance ambient temperature Tq	25 °C
Maximum dim level	1%
Suitable for random switching	No

Product Data

Full product code	871869996347700
Order product name	SP532P LED29S/940 PSD PI5 SM2 L1410 WH
EAN/UPC - Product	8718699963477
Order code	910505100140
Numerator - Quantity Per Pack	1
Numerator - Packs per outer box	1
Material Nr. (12NC)	910505100140
Net Weight (Piece)	4.000 kg

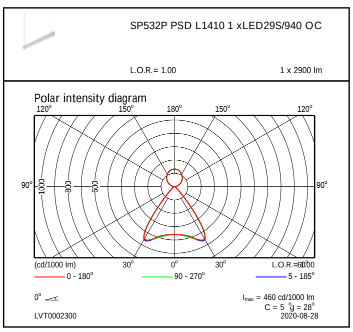
F 650°C IK 02

Dimensional drawing

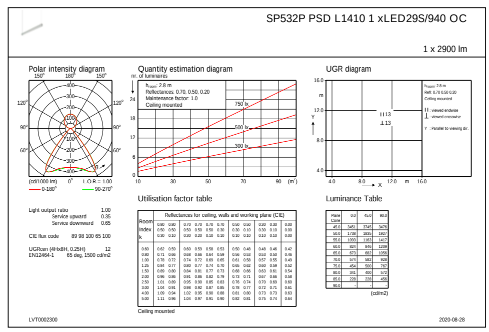


TrueLine suspended SP530P-SP533P

Photometric data



OFPC1_SP532PPSDL14101xLED29S940OC



IFGU1_SP532PPSDL14101xLED29S940OC

PHILIPS

Lighting

TrueLine, surface mounted

SM530C LED19S/940 PSD PI5 L1410 WH

TrueLine OC - LED Module, system flux 1900 lm - 940 neutral white - Power supply unit with DALI interface - Push-in connector 5-pole - 1410 mm - White RAL 9003 - Signal white

Architects need a lighting solution that matches the interior architecture of the property they are working on. They want a light line with an elegant design and very high light levels. Specifiers need luminaires that enable them to save energy while at the same time providing the right level of light, in compliance with office lighting norms. And office workers want visually comfortable lighting conditions that help them perform better. TrueLine Recessed is able to meet all these different requirements. TrueLine is also available in recessed and suspended versions.

Warnings and Safety

- The product is IPX0 & as such is not protected against water ingress & as such we strongly recommend that The environment in which The luminaire is to be installed is suitably checked
- If The above advice is not taken and The luminaires are subject to water ingress, Philips / Signify cannot guarantee safe failure & product warranty will become void

Product data

General Information	
Number of light sources	1 pc
Lamp family code	LED19S [LED Module, system ux 1900 lm]
Beam angle of light source	- °
Light source color	940 neutral white
Light source replaceable	No

Number of gear units	1 unit
Driver/power unit/transformer	Power supply unit with DALI interface
Driver included	Yes
Optic type	-
Optical cover/lens type	Polymethyl methacrylate bowl/cover
Luminaire light beam spread	100°
Control interface	DALI

TrueLine, surface mounted

Connection	Push-in connector 5-pole
Cable	-
Protection class IEC	Safety class I
Standard RAL color	Signal white
Glow-wire test	Temperature 650 °C, duration 5 s
Flammability mark	For mounting on normally flammable surfaces
CE mark	CE mark
ENEC mark	ENEC mark
UL mark	-
Warranty period	5 years
Constant light output	No
Number of products on MCB of 16 A type B	24
Photobiological risk	Photobiological risk group 1 @ 200mm to EN62471
EU RoHS compliant	Yes
Service tag	Yes
Product family code	SM530C [TrueLine OC]
Unified glare rating CEN	16

Light Technical

Saturated Red (R9)	>50

Operating and Electrical

Input Voltage	220 to 240 V
Input Frequency	50 to 60 Hz
Initial CLO power consumption	- W
Inrush current	19 A
Inrush time	0.28 ms
Power Factor (Min)	0.9

Controls and Dimming

Dimmable	Yes

Mechanical and Housing

Housing Material	Aluminum
Reflector material	-
Optic material	-
Optical cover/lens material	Polymethyl methacrylate
Fixation material	Steel
Optical cover/lens finish	Frosted
Overall length	1410 mm
Overall width	55 mm
Overall height	88 mm
Length	1410 mm
Color	White RAL 9003
Dimensions (Height x Width x Depth)	88 x 55 x 1410 mm (3.5 x 2.2 x 55.5 in)

Approval and Application

Ingress protection code	IP20 [Finger-protected]
Mech. impact protection code	IK02 [0.2 J standard]

Initial Performance (IEC Compliant)

Initial luminous flux (system flux)	1900 lm
Luminous flux tolerance	+/-10%
Initial LED luminaire efficacy	144 lm/W
Init. Corr. Color Temperature	4000 K
Init. Color Rendering Index	>90
Initial chromaticity	(0.38, 0.38) SDCM <3
Initial input power	13 W
Power consumption tolerance	+/-10%

Over Time Performance (IEC Compliant)

Control gear failure rate at median useful life 50000 h	5 %
Lumen maintenance at median useful life* 50000 h	L85

Application Conditions

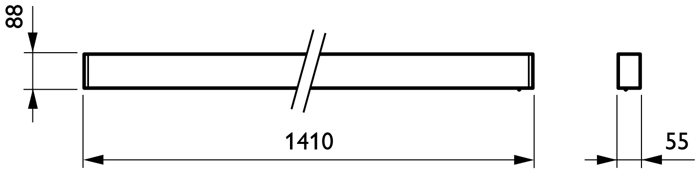
Ambient temperature range	+10 to +40 °C
Performance ambient temperature Tq	25 °C
Maximum dim level	1%
Suitable for random switching	No

Product Data

Full product code	871869996333000
Order product name	SM530C LED19S/940 PSD PI5 L1410 WH
EAN/UPC - Product	8718699963330
Order code	910505100126
Numerator - Quantity Per Pack	1
Numerator - Packs per outer box	1
Material Nr. (12NC)	910505100126
Net Weight (Piece)	4.000 kg

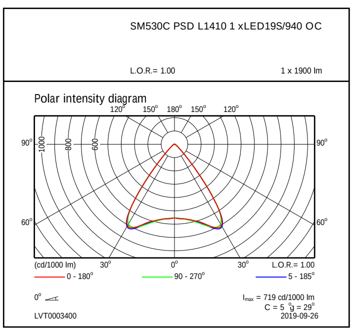
data subject to change

Dimensional drawing

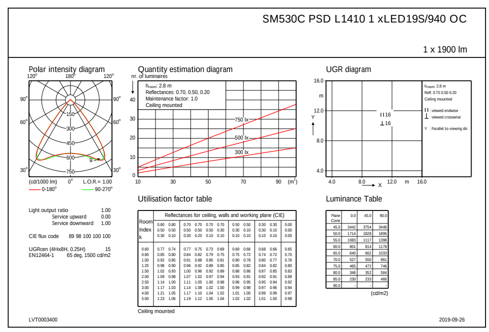


TrueLine surface-mounted SM530C-SM534C

Photometric data



OFPC1_SM530CPSDL14101xLED19S940OC



IFGU1_SM530CPSDL14101xLED19S940OC

Day-Brite CFI by signify

Linear

FluxStream strip

FSS 2', 3', 4', & 8'

Control options available

Day-Brite / CFI FluxStream LED strip is a high performing luminaire delivering smooth diffuse light ideal for light industrial, commercial and residential applications with unparalleled energy efficiency.

Project:	
Location:	
Cat.No:	
Type:	
Lumens:	Qty:
Notes:	

Ordering guide - standard & wireless controls

example: FSS440L840-UNV-DIM

Series	Length (nominal)	Lumens[2] (nominal)	Color temp. (K)	Voltage	Driver	Options
FSS			–	–	–	
FSS FluxStream strip	**2** 2' length	**20L** 2000 lumens **30L** 3000 lumens	**830** 80 CRI, 3000K **835** 80 CRI, 3500K **840** 80 CRI, 4000K **850**[3] 80 CRI, 5000K	**UNV** Universal voltage 120-277V **120**[4] 120V **277**[4] 277V **347**[5] 347V	**DIM**[12] Dimming **SDIM**[6,7] Step dimming to 40% input power **XDIM**[4,6,7] MarkX phase dimming **DALI**[8] DALI	**EMLED**[5,6,9] Factory wired Bodine BSL310LP integral emergency pack. Nominal 1100lm **LSXR10** 120-347V motion sensor, factory installed on end cap **LSXR10ADC**[10] 120-347V motion sensor with photocell and hi/lo trim dimming, factory installed on end cap **GTD/E**[13] UL924 listed Bodine GTD factory installed on driver input **GTD/SNSR**[13,14] UL924 listed Bodine GTD factory installed between driver & sensor **IAP**[10,11] Integral Interact Pro RF sensor, enables wireless connected lighting control **IAO**[10] Integral Interact Office daylighting and occupancy sensor, enables wireless connected lighting control **IAI**[15] Integral Interact Industry daylighting and occupancy sensor, enables wireless connected lighting control **SWZDT**[10] Integral sensor, daylighting and occupancy, advanced grouping, with dwell time **PAF** Paint after fabrication for extra corrosion resistance (white) **BK** Matte black paint color **ST** Satin aluminum paint color
	3 3' length	**30L** 3000 lumens				
	4 4' length	**30L** 3000 lumens **40L** 4000 lumens **55L** 5500 lumens **70L** 7000 lumens				
	8[1] 8' length	**60L** 6000 lumens **80L** 8000 lumens **110L** 11000 lumens **140L** 14000 lumens				

1 8' is tandem (2) 4' lenses with single piece 8' body.
2 Nominal delivered lumens at 25°C ambient.
3 Not available in 3' model.
4 XDIM option must be specified with 120V or 277V option only.
5 347V with EMLED only available in 8' models.
6 Not available in 2' or 3' model.
7 Not available in 4' 70L model or 8' 140L model.
8 DALI available up to 80L models only, consult factory for other options.
9 EMLED on 8' models illuminates 4' section in emergency mode.
10 Available with DIM driver option only.
11 Not available in 8' 110L or 140L models.
12 Integral controls options dimmable to 5% via wireless wall switch (see p.2). Non-integral controls configurations are 0-10V dimmable to 1%.
13 Must be installed in conjunction with a UL1008 device.
14 Must be ordered with an integral sensing option.
15 High bay motion detector. Motion sensing zone is extremely limited if used below 15' mounting height.

Ordering guide - PoE controls

example: FSS440L840-LV-POE-IAO

Series	Length (nominal)	Lumens[17] (nominal)	Color temp. (K)	Voltage	Driver	Options
FSS			–	LV –	POE –	
FSS FluxStream Strip	**4** 4' length	**30L** 3000 lumens **40L** 4000 lumens **60L** 6000 lumens	**830** 80 CRI, 3000K **835** 80 CRI, 3500K **840** 80 CRI, 4000K **850** 80 CRI, 5000K	**LV** Low voltage	**POE** Power over ethernet	**IAO** Integral Interact Office daylighting and occupancy sensor, enables wired connected lighting control **EMPOE**[18] 600lm integral emergency driver and battery pack. **PAF** Paint after fabrication for extra corrosion resistance (white) **BK** Matte black paint color **ST** Satin aluminum paint color
	8 8' length[16]	**60L** 6000 lumens				

16 8' is tandem (2) 4' lenses with single piece 8' body.
17 Nominal delivered lumens at 25°C ambient.
18 EMLED on 8' models illuminates 4' section in emergency mode.

Accessories (order separately)

- **FSSD2L** - 2' Diffuse replacement lens
- **FSSD3L** - 3' Diffuse replacement lens
- **FSSD4L** - 4' Diffuse replacement lens (order two for 8' models)
- **FSSWG4** - 4' wire guard (order two for 8' models)
- **FSTH** - Sliding hanger bracket (set of two)
- **LSXR10** - Low bay PIR motion sensor, 120-277V (not available with PoE)
- **LSXR10ADC** - Low bay PIR motion sensor with photocell and hi/lo trim dimming, 120-277V (not available with PoE)
- **FSSDEK** - Decorative plastic end cap (set of two)

(See last page for details and more options)

General notes

Many luminaire components, such as reflectors, refractors, lenses, sockets, lampholders, and LEDs are made from various types of plastics which can be adversely affected by airborne contaminants. If sulfur based chemicals, petroleum based products, cleaning solutions, or other contaminants are expected in the intended area of use, consult factory for compatibility.

PAF (Paint after fabrication) option is required for all products that will be used in a damp or humid location, such as under a canopy or covered parking area.

interact ready.

FSS FluxStream LED strip

2', 3', 4' and 8'

Features
- Compact design for installation in tight spaces.
- Frosted acrylic diffuser provides wide light distribution and superior glare control.
- Diffuser and LED plate snap into place allowing tool-free access to LED boards and driver.
- 2', 3', 4' and 8' tandem lengths available to accommodate many field applications.
- Up to 100,000 hour predicted L70 LED lumen maintenance provides long service life to reduce maintenance costs.
- Can be surface mounted on ceilings or walls, or suspended via chain, pendants or cables.
- Wall mountable - ADA compliant.
- Ideal for cold applications (-20°C).
- Continuous row mounting using standard end caps. No extra parts needed.
- 7/8" knock out provided at each end and on base of luminaire. Note: Center knockout is covered and not useable in 4' version with EMLED option.
- Multiple driver options available with 0-10V as standard.
- Enclosed lens minimizes penetration of dust, insects, and other debris into the LED compartment.
- 8' tandem unit is two 4' optical assemblies with a center mullion on a single full length chassis.
- Integral controls options include sensor mounted in control module extension mounted on fixture end (see dimension drawing).
- Fluxstream luminaires are Designlights Consortium® qualifed. Please see the DLC QPL list for exact catalog numbers www.designlights.org/QPL.
- 5 year manufacturer's limited warranty. Visit signify.com/warranties for complete warranty information.

Finish
- Baked white acrylic matte high reflectance paint finish.
- PAF (Paint after fabrication) option, which is required for all products that will be used in damp or humid locations, such as a canopy or covered parking area, provides extra corrosion resistance.

Shielding
- Contoured frosted acrylic lens.

Electrical
- LED boards and drivers are RoHS (Restriction of Hazardous Substances) compliant. Total system life rated at 50,000 hours. Predicted L70 lifetime based on LED manufacturer's supplied LM-80 data and in-situ laboratory testing.
- Integral emergency driver with EMLED option. To estimate lumen output in emergency mode, multiply emergency pack wattage by efficacy, then by 1.10.
- The GTD/E option is used to bypass wall switches and allow luminaire operation on auxiliary power. Generator transfer requires installation in conjunction with a UL1008 listed device.
- The GTD/SNSR option is used to bypass integrated sensor control in the event of utility power loss. Generator transfer requires installation in conjunction with a UL1008 listed device.

Materials
- Heavy gauge cold rolled steel housing, LED plate, and end caps.

Labels
- cETLus listed.
- Suitable for damp locations.

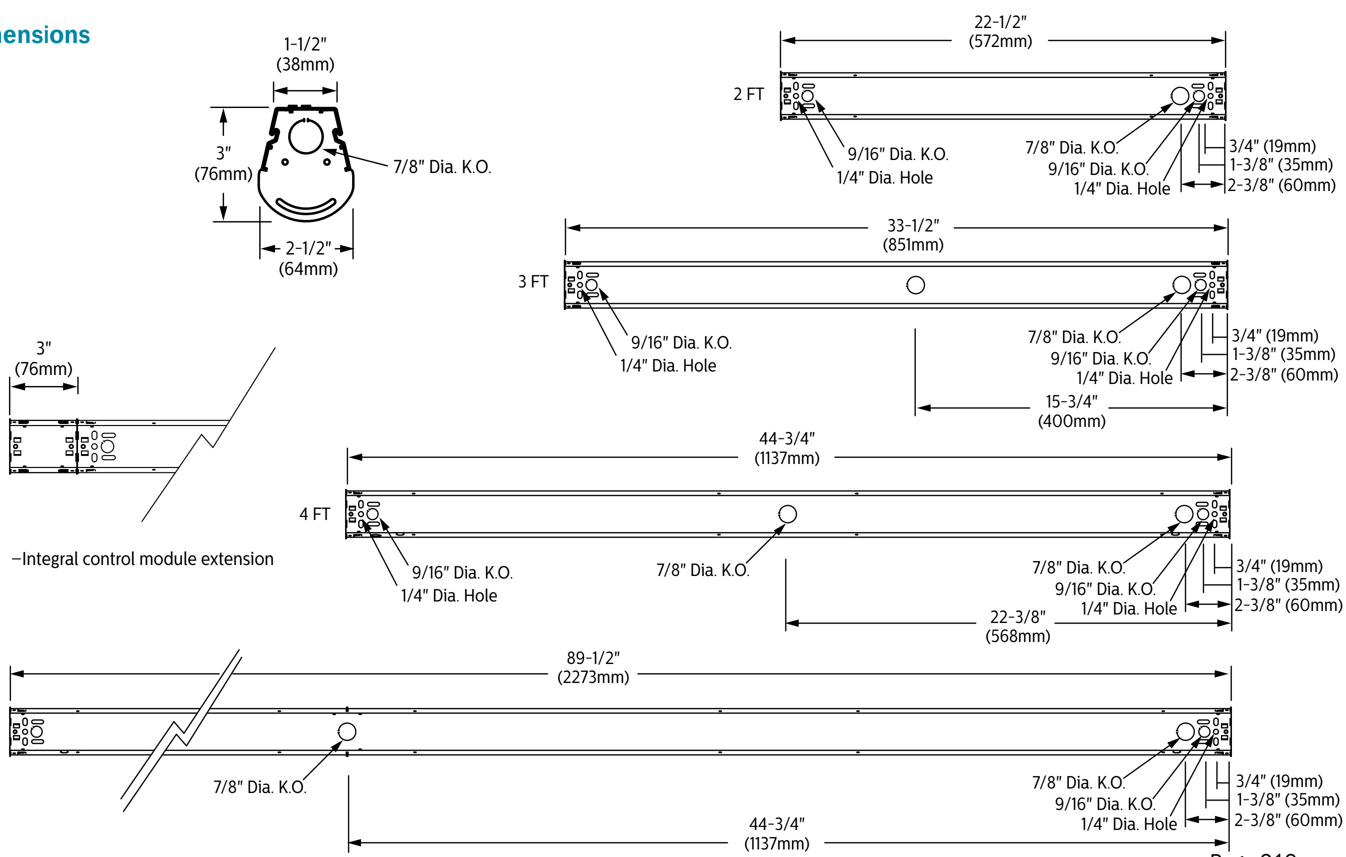
Performance data

Fixture	Lumens	Wattage	Efficacy
FSS220L	2000lm	17W	123lm/w
FSS330L	3000lm	26W	119lm/w
FSS440L	4000lm	31W	133lm/w
FSS455L	5500lm	45W	129lm/w
FSS470L	7000lm	58W	126lm/w

Ambient temperature data

Configuration	Ambient
FSS470L	-20°C to 30°C
FSS8110L	-20°C to 35°C
FSS8140L	-20°C to 25°C
EMLED option	Minimum 0°C
All others	-20°C to 40°C

Dimensions



FSS FluxStream LED strip

2', 3', 4' and 8'

Wireless Controls Options

SpaceWise DT (SWZDT)

- Standalone daylight and occupancy sensing with advanced grouping and dwell time
- Commissioning via compatible Android phone and Philips Field App
- Dimming via compatible Zigbee wireless wall switch only (see link below for details)
- Register for the commissioning app at http://registration.componentcloud.philips.com/appregistration/
- Integral sensing options may not be combined
- For more information including recommended switches, refer to the following: –

SWZDT – www.usa.lighting.philips.com/systems/lighting-systems/spacewise

FluxStream strip shown with integral sensor

Interact Pro (IAP)

- Interact Pro brings the power of connected lighting to **small and medium businesses** without the complexity usually associated with connected lighting.
- Interact Pro includes an app, a portal and a broad portfolio of wireless Luminaires, lamps and retrofit kits all working on the same system.
- Commissioning via Interact Pro App (Android or iPhone)
- Prepare commissioning remotely via Interact Pro portal
- Requires compatible Interact Pro Gateway and internet connectivity for commissioning
- Compatible with UID8451/10 ZigBee Greenpower wireless dimmer switch
- Compatible with wireless Occ sensor (OCC SENSOR IA CM IP42 WH 10/1) or wireless Day/Occ sensor (OCC MULTI SENSOR IA CM WH 10/1)
- For more information on Interact Pro visit: www.interact-lighting.com/pro
- For more information on Interact Ready visit: www.philips.com/interact-ready

Interact Office (IAO)

- A wireless IoT connected lighting solution for **large enterprises** that span across multiple floors, buildings and require multiple gateways.
- View all your projects under one dashboard and easily compare insights from multiple projects in one view.
- Compatible Zigbee Green Power wall dimmer and wireless Occupancy or Daylight & Occupancy sensors available.
- Use Interact Office software and insights to increase building efficiency, achieve building wide integration and optimize space through occupancy analytics.
- Supports advanced IoT Apps on wayfinding, room/desk reservation and offers open APIs
- Requires compatible Interact Office Gateway and internet connectivity for commissioning.
- For more information on Interact Office Wireless, visit: www.interact-lighting.com/office or www.usa.lighting.philips.com/systems/system-areas/offices

Interact Industry (IAI)

- A wireless IoT connected lighting solution for large warehouses, gymnasiums and industrial facilities that require multiple gateways.
- View all your projects under one dashboard and easily compare insights from multiple projects in one view.
- Combine Interact Office and Interact Industry sensors on a single project and for a common dashboard view.
- Compatible Zigbee Green Power wall dimmer.
- Maximize energy savings with integrated sensors and integration with BMS.
- Use Interact Industry software and insights to reduce maintenance cost by remotely configuring and managing the system, creating flexible lighting zones, insights on lamp burn hours etc. Optimize warehouse operations with real time occupancy analytics and minimize potential bottlenecks.
- Requires compatible Interact Gateway and internet connectivity for commissioning.
- For more information on Interact Industry Wireless, visit: www.interact-lighting.com/en-us/what-is-possible/interact-industry

Wired Controls Options

Interact Office Wired (PoE)

- PoE based IoT connected lighting solution for large enterprises that span across multiple floors, buildings and require multiple gateways.
- Use Interact Office software and insights to increase building efficiency, achieve building wide integration and optimize space through occupancy analytics.
- Supports advanced IoT Apps on Personal Control, Space Management, wayfinding, room/desk reservation and offers open APIs for light control and data exchange.
- PoE lighting controller is accessible from below.
- Integral sensor option for occupancy sensing (PIR) and/or daylight harvesting available for additional energy savings.
- Optional integral emergency controller and battery pack provides 600lm nominal output. Test switch and indicator light mounted on side of chassis on one end.
- Emergency battery has a 3 month pre-installed shelf life, and must be stored and installed in environments of 20C to 30C (-4F to 86F) ambient, and 45-85% relative humidity.
- For more information on Interact Office Wired, visit: www.interact-lighting.com/office or www.usa.lighting.philips.com/systems/system-areas/offices

FSS FluxStream LED strip

2', 3', 4' and 8'

Photometry

2' FluxStream LED strip, 2000 nominal delivered lumens

LER - 123

Catalog No.	FSS220L840-UNV-DIM
Test No.	37164
S/MH	1.2
Lamp Type	LED
Lumens	2034
Input Watts	17

Comparative yearly lighting energy cost per 1000 lumens – **$1.95** based on 3000 hrs. and $.08 pwr KWH.

The photometric results were obtained in the Day-Brite laboratory which is NVLAP accredited by the National Institute of Standards and Technology.

Photometric values based on test performed in compliance with LM-79.

Candlepower

Angle	End	45	Cross	Back-45
0	644	644	644	644
5	635	641	646	641
15	610	618	626	618
25	520	567	585	567
35	451	474	495	474
45	371	403	432	403
55	284	324	362	324
65	191	243	288	243
75	96	167	218	167
85	18	105	155	105

Light Distribution

Degrees	Lumens	% Luminaire
0-30	493	24.2
0-40	790	38.9
0-60	1391	68.4
0-90	1910	93.9
90-180	124	6.1
0-180	2034	100

Average Luminance

Zone	End	45°	Cross
45	15155	12916	12955
55	14048	11583	11859
65	12449	10173	10781
75	9646	8758	9839
85	4206	7611	9181

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pfc =	20							
Ceil		80			70		50	
Wall	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	114	114	114	108	108
1	106	100	94	102	96	93	92	88
2	95	86	79	92	83	77	80	73
3	86	76	67	83	73	66	69	63
4	79	67	57	77	65	56	61	55
5	72	59	50	69	57	50	55	47
6	67	54	45	65	52	44	50	41
7	61	48	40	59	47	39	45	38
8	57	44	35	56	42	34	41	34
9	54	40	32	53	40	32	38	30
10	51	38	30	49	37	29	35	29

3' FluxStream LED strip, 3000 nominal delivered lumens

LER - 119

Catalog No.	FSS330L840-UNV-DIM
Test No.	37132
S/MH	1.3
Lamp Type	LED
Lumens	3045
Input Watts	26

Comparative yearly lighting energy cost per 1000 lumens – **$2.02** based on 3000 hrs. and $.08 pwr KWH.

The photometric results were obtained in the Day-Brite laboratory which is NVLAP accredited by the National Institute of Standards and Technology.

Photometric values based on test performed in compliance with LM-79.

Candlepower

Angle	End	45	Cross	Back-45
0	982	982	982	982
5	966	978	980	978
15	927	943	948	943
25	849	869	884	869
35	738	772	795	772
45	609	655	690	655
55	435	505	554	505
65	293	356	414	356
75	148	232	301	232
85	28	129	201	129

Light Distribution

Degrees	Lumens	% Luminaire
0-30	759	24.9
0-40	1241	40.8
0-60	2187	71.8
0-90	2918	95.8
90-180	127	4.2
0-180	3045	100

Average Luminance

Zone	End	45°	Cross
45	16859	14162	13823
55	14686	12197	12138
65	13174	10098	10376
75	10412	8269	9110
85	4882	6455	7980

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pfc =	20							
Ceil		80			70		50	
Wall	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	115	115	115	109	109
1	107	101	96	103	98	93	93	90
2	96	88	81	93	85	79	81	76
3	88	77	68	84	75	67	70	65
4	80	68	58	78	66	57	63	56
5	73	60	51	70	58	51	56	48
6	68	55	45	66	53	45	51	44
7	63	48	40	60	47	40	46	39
8	58	45	36	56	44	35	42	34
9	55	40	33	53	40	33	39	32
10	51	38	30	50	38	30	36	29

FSS FluxStream LED strip

2', 3', 4' and 8'

Photometry

4' FluxStream LED strip, 4000 nominal delivered lumens

LER - 133

Catalog No.	FSS440L840-UNV-DIM
Test No.	37259
S/MH	1.3
Lamp Type	LED
Lumens	4130
Input Watts	31

Comparative yearly lighting energy cost per 1000 lumens – **$1.80** based on 3000 hrs. and $.08 pwr KWH.

The photometric results were obtained in the Day-Brite laboratory which is NVLAP accredited by the National Institute of Standards and Technology.

Photometric values based on test performed in compliance with LM-79.

Candlepower

Angle	End	45	Cross	Back-45
0	1272	1272	1272	1272
5	1250	1265	1277	1265
15	1199	1221	1237	1221
25	1098	1130	1157	1130
35	957	1005	1044	1005
45	791	860	910	860
55	606	690	758	690
65	382	481	598	481
75	194	326	416	326
85	36	196	289	196

Light Distribution

Degrees	Lumens	% Luminaire
0-30	986	23.9
0-40	1614	39.1
0-60	2886	69.9
0-90	3905	94.6
90-180	225	5.4
0-180	4130	100

Average Luminance

Zone	End	45°	Cross
45	16754	14171	13847
55	15678	12712	12618
65	13207	10415	11375
75	10615	8873	9550
85	5052	7511	8720

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pfc =	20							
Ceil	80			70			50	
Wall	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	114	114	114	108	108
1	106	101	95	103	97	93	92	89
2	95	86	80	93	84	78	80	75
3	86	76	67	83	73	66	69	64
4	80	67	57	77	65	56	61	55
5	72	59	51	70	57	50	56	47
6	68	54	45	65	53	44	50	42
7	63	48	40	59	47	39	46	38
8	57	44	35	56	44	34	41	34
9	54	40	32	53	40	32	38	30
10	51	38	30	49	37	29	35	28

4' FluxStream LED strip, 5500 nominal delivered lumens

LER - 129

Catalog No.	FSS455L840-UNV-DIM
Test No.	37262
S/MH	1.3
Lamp Type	LED
Lumens	5759
Input Watts	45

Comparative yearly lighting energy cost per 1000 lumens – **$1.86** based on 3000 hrs. and $.08 pwr KWH.

The photometric results were obtained in the Day-Brite laboratory which is NVLAP accredited by the National Institute of Standards and Technology.

Photometric values based on test performed in compliance with LM-79.

Candlepower

Angle	End	45	Cross	Back-45
0	1788	1788	1788	1788
5	1757	1777	1792	1777
15	1685	1715	1736	1715
25	1544	1585	1623	1585
35	1346	1408	1462	1408
45	1113	1202	1271	1202
55	852	960	1055	960
65	575	712	828	712
75	272	443	610	443
85	50	259	389	259

Light Distribution

Degrees	Lumens	% Luminaire
0-30	1384	24
0-40	2264	39.3
0-60	4043	70.2
0-90	5478	95.1
90-180	281	4.9
0-180	5759	100

Average Luminance

Zone	End	45°	Cross
45	23558	19796	19347
55	22047	17697	17574
65	19887	15425	15749
75	14898	12084	14023
85	7023	9926	11749

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pfc =	20							
Ceil	80			70			50	
Wall	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	115	115	115	108	108
1	106	101	95	103	97	93	93	89
2	95	86	80	93	84	78	80	75
3	86	76	68	83	73	66	69	64
4	80	67	57	77	66	56	61	55
5	72	59	51	70	58	50	56	47
6	68	54	45	65	53	44	50	42
7	63	48	40	60	47	39	46	38
8	57	44	35	56	44	34	41	34
9	54	40	32	53	40	32	38	30
10	51	38	30	49	37	29	36	29

4' FluxStream LED strip, 7000 nominal delivered lumens

LER - 126

Catalog No.	FSS470L840-UNV-DIM
Test No.	37265
S/MH	1.3
Lamp Type	LED
Lumens	7275
Input Watts	58

Comparative yearly lighting energy cost per 1000 lumens – **$1.90** based on 3000 hrs. and $.08 pwr KWH.

The photometric results were obtained in the Day-Brite laboratory which is NVLAP accredited by the National Institute of Standards and Technology.

Photometric values based on test performed in compliance with LM-79.

Candlepower

Angle	End	45	Cross	Back-45
0	2211	2211	2211	2211
5	2176	2199	2217	2199
15	2088	2124	2148	2124
25	1914	1966	2010	1966
35	1672	1750	1813	1750
45	1379	1502	1580	1502
55	1058	1204	1317	1204
65	714	898	1041	898
75	339	592	776	592
85	63	344	524	344

Light Distribution

Degrees	Lumens	% Luminaire
0-30	1714	23.6
0-40	2809	38.6
0-60	5028	69.1
0-90	6879	94.6
90-180	396	5.4
0-180	7275	100

Average Luminance

Zone	End	45°	Cross
45	29203	24745	24050
55	27371	22192	21938
65	24688	19451	19793
75	18540	16135	17825
85	8824	13174	15831

Coefficients of Utilization

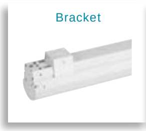
EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

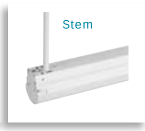
pfc =	20							
Ceil	80			70			50	
Wall	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	114	114	114	108	108
1	106	100	95	103	97	93	92	89
2	95	86	79	92	83	78	80	73
3	86	76	67	83	73	66	69	63
4	79	67	57	77	65	56	61	55
5	72	59	50	69	57	48	55	47
6	67	54	44	65	52	44	50	41
7	61	47	40	59	46	39	45	38
8	57	44	35	56	42	34	40	34
9	54	40	32	52	40	32	38	30
10	51	37	29	49	37	29	35	28

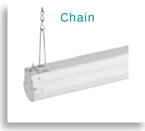
FSS FluxStream LED strip

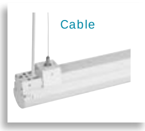
2', 3', 4' and 8'

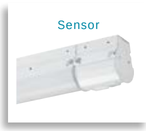
Accessories

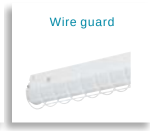












Accessory Catalog Code	Description	
FSTH	Sliding hanger bracket (pair)	
SV5F12	12" Stem and canopy kit	White stem and canopy kit, 1/4" trade size (1/2" O.D.) locknuts included. Works with 9/16" k.O. on base of housing.
SV5F18	18" Stem and canopy kit	
SV5F24	24" Stem and canopy kit	
SV5F36	36" Stem and canopy kit	
SV5F48	48" Stem and canopy kit	
FKR-126	Chain hanger set (pair)	Includes two 5' heavy duty link chains with "V" hooks. Attaches to base of housing.
DACHxx	Adjustable cable hanger kit (single)	Works with 1/4" hole on base of housing or FSTH hanger bracket. **xx**=cable length in inches, enter 48" to 180" lengths in 12" increments
DACHxx-1-SC	Adjustable cable hanger kit with white straight 18/3 cord (single)	
DACHxx-1-CC	Adjustable cable hanger kit with white coiled 18/3 cord (single)	
DACHxx-2-SC	Adjustable cable hanger kit with white straight 18/4 cord (single)	
DACHxx-2-CC	Adjustable cable hanger kit with white coiled 18/4 cord (single)	
DACHxx-1D-SC	Adjustable cable hanger kit with white straight 18/5 cord with dimming leads (single)	
LSXR10	Low bay pir motion sensor (120-277v)	
LSXR10ADC	Low bay pir motion sensor with photocell and hi/lo trim dimming (120-277v)	
FSSWG4	4' Wire guard (order two for 8' models)	
FSSD2L	2' Diffuse replacement lens	
FSSD3L	3' Diffuse replacement lens	
FSSD4L	4' Diffuse replacement lens (order two for 8' models)	
FSSDEK	Decorative plastic end cap (set of two)	

Signify North America Corporation
200 Franklin Square Drive,
Somerset, NJ 08873
Telephone 855-486-2216

Signify Canada Ltd.
281 Hillmount Road,
Markham, ON, Canada L6C 2S3
Telephone 800-668-9008

www.day-brite.com

Pacific LED gen4

WT470C LED23S/840 PSU WB L1300

PACIFIC LED WATERPROOF - 840 neutral white - Power supply unit - Wide beam - Screw connection with pug and socket

PacificLED gen4 is a highly efficient and reliable LED waterproof luminaire that offers an excellent quality of light, with a uniform light distribution without visible striping or color artefacts. The range offers modular construction to enable ease of upgrade and maintenance.;The new optical system provides distortion-free lighting with improved visual guidance, which makes it ideally suited to general industry, warehouses and parking areas. The range also offers the option of multiple optics to ensure an optimized lighting scheme for a wide range of applications.;For industrial applications, PacificLED gen4 offers an open product architecture with toolless access to the gear tray and an innovative end-cap design with built-in connector for fast and easy installation. The single-piece mounting clamp ensures no small, loose components which could affect the primary production process.

Product data

General Information	
Beam angle of light source	120 °
Light source color	840 neutral white
Light source replaceable	Yes
Number of gear units	1 unit
Driver/power unit/transformer	Power supply unit
Driver included	Yes
Optic type	Wide beam
Luminaire light beam spread	110° x 110°
Connection	Screw connection with pug and socket
Cable	-
Protection class IEC	Safety class I

Glow-wire test	Temperature 850 °C, duration 5 s
Flammability mark	For mounting on easily flammable surfaces
CE mark	CE mark
ENEC mark	ENEC mark
Warranty period	5 years
Remarks	*-Per Lighting Europe guidance paper “Evaluating performance of LED based luminaires - January 2018”: statistically there is no relevant difference in lumen maintenance between B50 and for example B10. Therefore, the median useful life (B50) value also represents the B10 value.
Constant light output	No

Pacific LED gen4

Number of products on MCB of 16 A type B	32
EU RoHS compliant	Yes
Product family code	WT470C [PACIFIC LED WATERPROOF]
Unified glare rating CEN	19

Operating and Electrical

Input Voltage	220-240 V
Input Frequency	50 to 60 Hz
Inrush current	15.1 A
Inrush time	0.23 ms
Power Factor (Min)	0.96

Controls and Dimming

Dimmable	No

Mechanical and Housing

Housing Material	Polycarbonate
Reflector material	-
Optic material	Polycarbonate
Optical cover/lens material	Polycarbonate
Fixation material	Steel
Optical cover/lens finish	Clear
Overall length	1321 mm
Overall width	96 mm
Overall height	108 mm
Color	White
Dimensions (Height x Width x Depth)	108 x 96 x 1321 mm (4.3 x 3.8 x 52 in)

Approval and Application

Ingress protection code	IP66 [Dust penetration-protected, jet-proof]
Mech. impact protection code	IK08 [5 J vandal-protected]

Initial Performance (IEC Compliant)

Initial luminous flux (system flux)	2300 lm
Luminous flux tolerance	+/-7%
Initial LED luminaire efficacy	140 lm/W
Init. Corr. Color Temperature	4000 K
Init. Color Rendering Index	>80
Initial chromaticity	(0.38, 0.38) SDCM <3
Initial input power	16.4 W
Power consumption tolerance	+/-11%

Over Time Performance (IEC Compliant)

Control gear failure rate at median useful life 50000 h	5 %
Control gear failure rate at median useful life 100000 h	10 %
Lumen maintenance at median useful life* 50000 h	L80

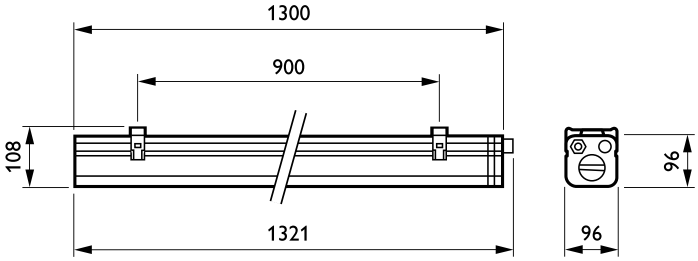
Application Conditions

Ambient temperature range	-25 to +45 °C
Performance ambient temperature Tq	25 °C
Suitable for random switching	Not applicable

Product Data

Full product code	871869637914100
Order product name	WT470C LED23S/840 PSU WB L1300
EAN/UPC - Product	8718696379141
Order code	910925863791
Numerator - Quantity Per Pack	1
Numerator - Packs per outer box	1
Material Nr. (12NC)	910925863791
Net Weight (Piece)	2.610 kg

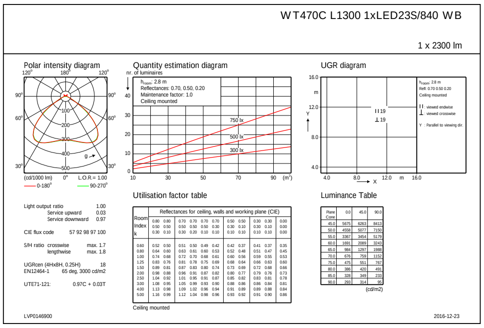
Dimensional drawing



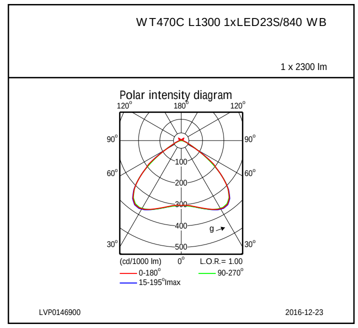
Pacific LED WT470C-WT482C

Pacific LED gen4

Photometric data



IFGU1_WT470CL13001xLED23S840WB



IFPC1_WT470CL13001xLED23S840WB


RAB
EZPAN®
More options, same incredible energy savings and price.
The affordable, ultra-low-profile LED panel is available in 2’x2’, 2’x4’ and now 1’x4’.

EDGE-LIT PANELS

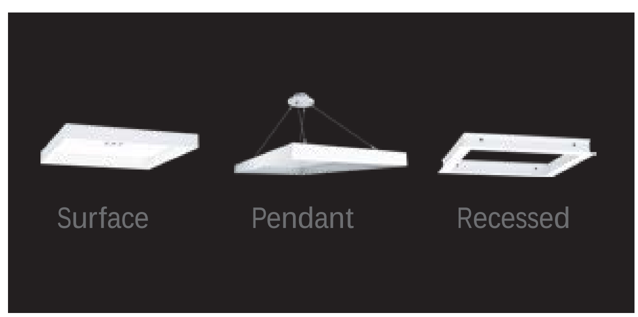
RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty

- Ultra efficient, up to 117 lm/W, reducing energy costs by up to 73%
- Perfect for shallow plenums
- Even and diffuse ambient illumination, ideal for spaces where glare-free lighting is required
- Offered in three sizes and five wattages:
  1x4 (17W,30W and 40W), 2x2 (17W, 30W and 40W) and 2x4 (30W, 40W and 50W)
- 0-10V dimmable driver, standard
- Emergency battery backup option available
- Available with factory-installed Lightcloud lighting control system Controller
- Microwave occupancy sensor available
- Available with integrated SmartShift™ circadian control

SmartShift-enabled EZPANs will adjust light levels and color temperature to match the natural pattern of the sun...a soft glow in the morning, energizing light during the day, and a warm hue in the evening.

An NEC-compliant junction box with flying leads makes wiring as simple as twisting a few wire nuts, and integral T-bar clips secure EZPAN to standard T-bar systems.

With a height just under 2", the EZPAN is an ideal solution for shallow plenums.



The EZPAN is available in three standard sizes (1x4, 2x2 and 2x4) for use in T-bar grids. We also offer three mounting kits for surface, pendant and recessed applications.

Performance - EZPAN

1 x 4

	40W 5000K	40W 4000K	40W 3500K	40W 3000K	30W 5000K	30W 4000K	30W 3500K	30W 3000K	17W 5000K	17W 4000K	17W 3500K	17W 3000K
Input Watts	40	40	40	40	31	32	32	31	20	20	20	20
Lumens	4,539	4,402	4,481	4,332	3,576	3,468	3,530	3,413	2,294	2,224	2,264	2,189
Efficacy (lm/W)	115	109	112	109	115	109	112	109	116	111	114	111
Color Accuracy (CRI)	81	82	83	81	81	82	83	81	81	82	83	81

2 x 2

	40W 5000K	40W 4000K	40W 3500K	40W 3000K	30W 5000K	30W 4000K	30W 3500K	30W 3000K	17W 5000K	17W 4000K	17W 3500K	17W 3000K
Input Watts	40	41	41	40	32	32	32	31	20	20	20	20
Lumens	4,708	4,542	4,571	4,518	3,643	3,515	3,537	3,496	2,181	2,104	2,118	2,093
Efficacy (lm/W)	117	112	112	114	114	110	109	111	108	104	104	106
Color Accuracy (CRI)	82	82	83	80	82	82	83	81	82	82	83	81

2 x 4

	50W 5000K	50W 4000K	50W 3500K	50W 3000K	40W 5000K	40W 4000K	40W 3500K	40W 3000K	30W 5000K	30W 4000K	30W 3500K	30W 3000K
Input Watts	50	51	51	50	40	41	41	41	32	32	33	32
Lumens	5,500	5,539	5,260	5,245	4,703	4,736	4,498	4,485	3,722	3,748	3,559	3,549
Efficacy (lm/W)	110	110	104	105	116	116	109	111	117	116	110	111
Color Accuracy (CRI)	82	81	83	81	82	81	83	81	82	81	83	81

Performance data is based on test performed at 120V.

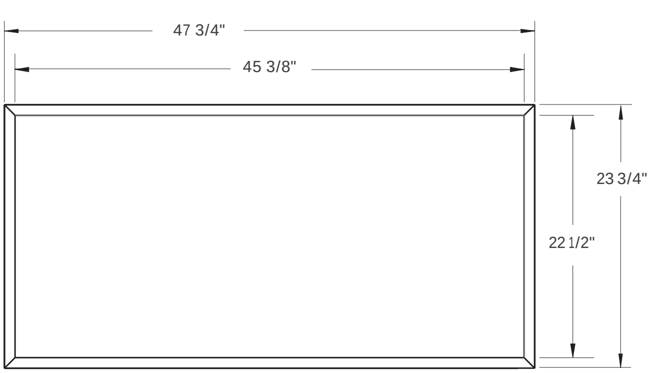
Performance - EZPAN with SmartShift

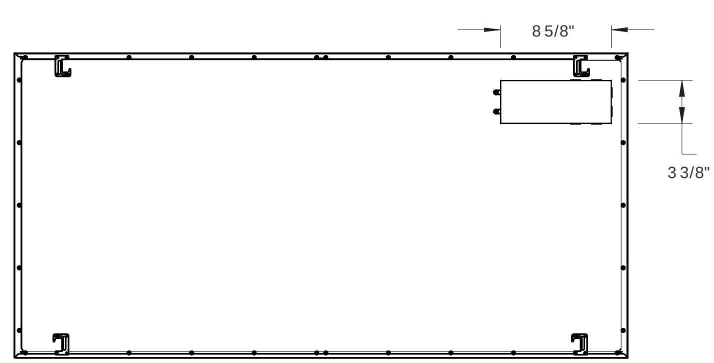
Note: SmartShift is the most advanced—yet easiest to use—circadian lighting system, which syncs white color tuning with the local sunrise and sunset. SmartShift is configurable down to the individual fixture for precision control and customization.

	1 x 4 2700K - 6000K	2 x 2 2700K - 6000K	2 x 4 2700K - 6000K
Input Watts	45.8 - 46.5	45.5 - 46.6	46 - 47.6
Lumens	5,123 - 5,335	5,265 - 5,747	5,517 - 5,929
Efficacy (lm/W)	111.6 - 114.9	115.3 - 123.7	119.8 - 125.1
Color Accuracy (CRI)	83- 87	82- 86	82- 86

Dimensions and weights

EZPAN 2x4 - Weights Standard: 10.63 lbs

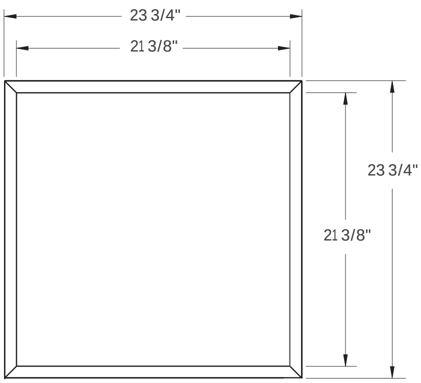


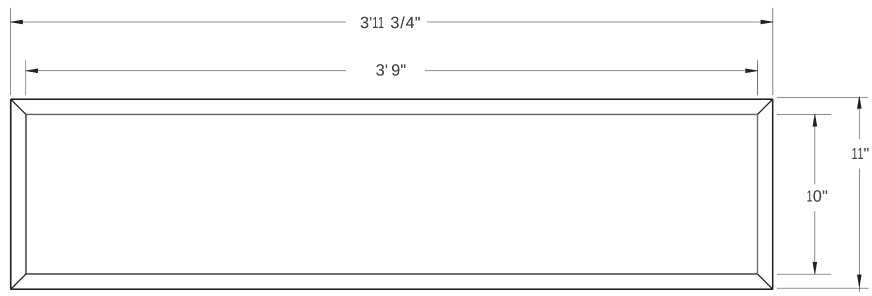


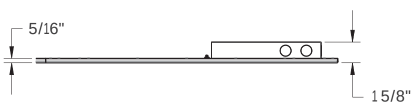
Dimensions and weights *(Cont.)*

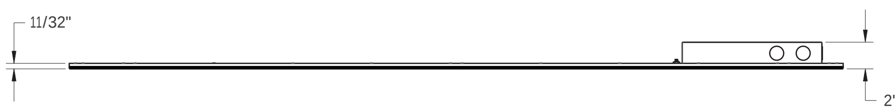
EZPAN 2x2
Weights
Standard: 6.22 lbs

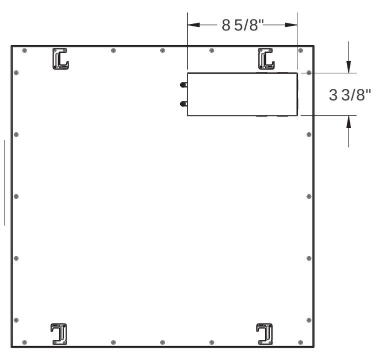
EZPAN 1x4
Weights
Standard: 6.24 lbs

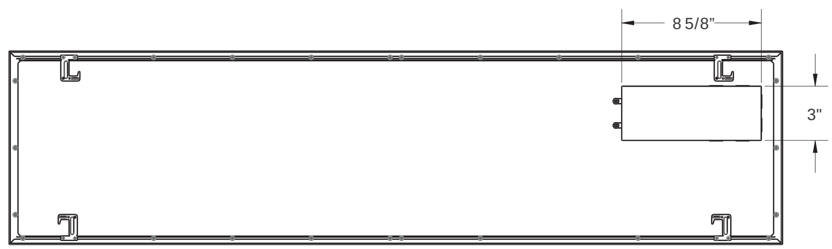












Mounting Accessory Kits

Surface Mounting Kits

SMKEZPAN - 1X4 Surface Mounting Kit

SMEKZPAN - 2X2 Surface Mounting Kit

SMKEZPAN - 2X4 Surface Mounting Kit

Pendant Mounting Kits

PMKEZPAN - 1X4 Pendant Mounting Kit

PMKEZPAN - 2X2 Pendant Mounting Kit

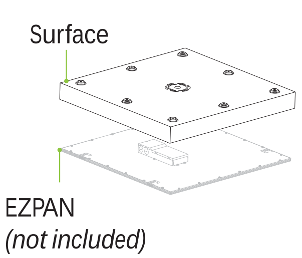
PMKEZPAN - 2X4 Pendant Mounting Kit

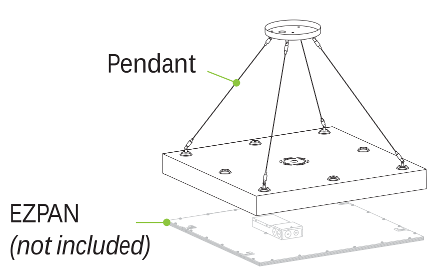
Recessed Drywall Mounting Kits

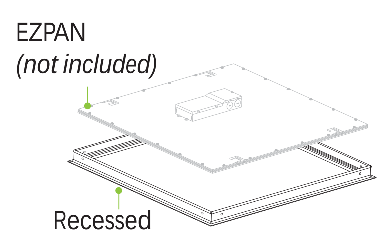
RMKPANEL - 1X4 Recessed Mounting Kit

RMKPANEL - 2X2 Recessed Mounting Kit

RMKPANEL - 2X4 Recessed Mounting Kit







Ordering information

Product Family	Size		Wattage	Color Temp.	Dimming (standard)	Control Options	Other Options
EZPAN		—			/D10		
	2X4 2' x 4'		**50** 50W (2' x 4')	**Blank** 5000K	**/D10** 0-10V Dimming	**Blank** No sensor	**Blank** None
	2X2 2' x 2'		**40** 40W (2' x 4', 2' x 2', 1' x 4')	**N** 4000K		**/LC** Lightcloud Controller	**/E2** Emergency Battery Backup
	1X4 1 'x 4'		**30** 30W (2' x 4', 2' x 2', 1' x 4')	**YN** 3500K			
			17 17W (2'x 2', 1' x 4')	**Y** 3000K			

Product Family	Size	Dimming (standard)	Smart	Control Options
EZPAN		/D10	/SS	/LC
SmartShift	**2X4** 2' x 4'	**/D10** 0-10V Dimming	**/SS** SmartShift	**/LC** Lightcloud Controller
	2X2 2' x 2'			
	1X4 1 'x 4'			

Product Family	Size
SMKEZPAN	
Surface Mount Kit	**2X4** 2' x 4'
	2X2 2' x 2'
	1X4 1' x 4'

Product Family	Size
PMKEZPAN	
Pendant Mount Kit	**2X4** 2' x 4'
	2X2 2' x 2'
	1X4 1' x 4'

Product Family	Size
RMKPANEL	
Recessed Mount Kit	**2X4** 2' x 4'
	2X2 2' x 2'
	1X4 1' x 4'

FXLED105TN/PCT

RAB | Outdoor

Color: Bronze   Weight: 25.0 lbs

Project:

Type:

Prepared By:

Date:

Driver Info

Type	Constant Current
120V	0.89A
208V	0.58A
240V	0.50A
277V	0.44A
Input Watts	109.80W
Efficiency	96%

LED Info

Watts	105.00W
Color Temp	4000K (Neutral)
Color Accuracy	74 CRI
L70 Lifespan	100,000
Lumens	15,099
Efficacy	137.5 LPW

Technical Specifications

Listings

UL Listing:

Suitable for wet locations. Suitable for ground mounting.

IESNA LM-79 & LM-80 Testing:

RAB LED luminaires and LED components have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80.

DLC Listed:

This product is listed by Design Lights Consortium (DLC) as an ultra-efficient premium product that qualifies for the highest tier of rebates from DLC Member Utilities.DLC Product Code: P0000175Z

LED Characteristics

Lifespan:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations

LEDs:

Multip-chip, high-output, long-life LEDs

Color Consistency:

3-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color

Color Stability:

LED color temperature is warrantied to shift no more than 200K in CCT over a 5-year period

Color Uniformity:

RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2017.

Construction

IP Rating:

Ingress Protection rating of IP66 for dust and water

EPA:

2

Maximum Ambient Temperature:

Suitable for use in 40°C (104°F)

Effective Projected Area:

EPA = 2

Cold Weather Starting:

Minimum starting temperature is -40°C (-40°F)

Thermal Management:

Superior thermal management with external "Air-Flow" fins

Lens:

Tempered glass lens

Housing:

Die-cast aluminum housing and door frame

Mounting:

Heavy-duty Trunnion mount with stainless steel hardware

Reflector:

Specular, vacuum-metalized polycarbonate

Gaskets:

High-temperature silicone gaskets

FXLED105TN/PCT

RAB | Outdoor

Technical Specifications (continued)

Construction

Finish:

Formulated for high durability and long-lasting color

Green Technology:

Mercury and UV free. RoHS-compliant components.

Electrical

Drivers:

Two Drivers, Constant Current, Class 2, 1400mA, 100-277V, 50/60Hz, 0.8A, Power Factor 99%

THD:

6.72% at 120V, 7.8% at 277V

Power Factor:

99.5% at 120V, 92.6% at 277V

Note:

All values are typical (tolerance +/- 10%)

Photocell:

120-277V twistlock photocell included. Photocell is compatible with 120V - 277V.

Optical

NEMA Type:

NEMA Beam Spread of 6H x 6V

Sensor Characteristics

Field & Beam Angles:

Horizontal Beam Angle (50%): 91.8°, Vertical Beam Angle (50%): 73.5° Horizontal Field Angle (10%): 121.0°, Vertical Field Angle (10%): 108.0°

Other

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

Patents:

The design of FXLED105 is protected by patents pending in US, Canada, China, Taiwan and Mexico

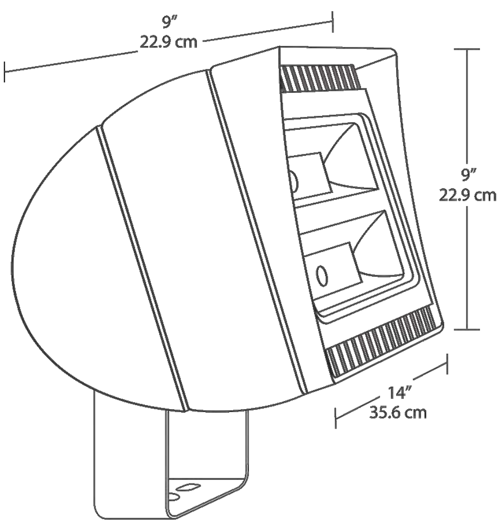
Equivalency:

Equivalent to 750W Pulse Start Metal Halide

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Dimensions



Features

- 66% energy cost savings vs. HID
- NEMA Type - 6H x 6V
- "Air-Flow" technology heat dissipation
- 100,000-hour LED lifespan
- 5-Year, No-Compromise Warranty

Need help? Tech help line: **(888) 722-1000** Email: **custserv@rablighting.com** Website: **www.rablighting.com**

 Note: Specifications are subject to change at any time without notice

FXLED105TN/PCT

Ordering Matrix

Family	Wattage	Mounting	Color Temp	Finish	Driver	Options	Other Option
FXLED	105	T	N			/PCT	
	78 = 78W **105 =** 105W **125 =** 125W **150 =** 150W	**SF =** Slipfitter **T =** Trunnion	**Blank =** 5000K (Cool) **N =** 4000K (Neutral) **Y =** 3000K (Warm)	**Blank =** Bronze **W =** White	**Blank =** Standard **/D10 =** 0-10V Dimming **/BL =** Bi-Level **/480 =** 480V	**Blank =** No Option **/LC =** Lightcloud® Control **/PCT =** 100-277V Twistlock **/PCT4 =** 480V Twistlock	**Blank =** Standard **USA =** BAA Compliant

Need help? Tech help line: **(888) 722-1000** Email: **custserv@rablighting.com** Website: **www.rablighting.com**

FXLED78T

RAB

Color: Bronze   Weight: 20.9 lbs

Project:	Type:
Prepared By:	**Date:**

Driver Info

Type	Constant Current
120V	0.78A
208V	0.45A
240V	0.39A
277V	0.34A
Input Watts	78.5W

LED Info

Watts	78W
Color Temp	5100K (Cool)
Color Accuracy	75 CRI
L70 Lifespan	100,000 Hours
Lumens	9,989
Efficacy	127.2 lm/W

Technical Specifications

Listings

UL Listed:

Suitable for wet locations. Suitable for mounting within 1.2m (4ft) of the ground.

IESNA LM-79 & IESNA LM-80 Testing:

RAB LED luminaires and LED components have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80.

DLC Listed:

This product is listed by Design Lights Consortium (DLC) as an ultra-efficient premium product that qualifies for the highest tier of rebates from DLC Member Utilities. DLC Product Code: P0000170A

Performance

Lifespan:

100,000-Hour LED lifespan based on IES LM-80 results and TM-21 calculations

Electrical

Driver:

Constant Current, Class 2, 120-277V, 50/60 Hz, 120V: 0.66A, 208V: 0.38A, 240V: 0.33A, 277V: 0.29A

THD:

6.12% at 120V, 7.79% at 277V

Power Factor:

99.8% at 120V, 94.9% at 277V

Note:

All values are typical (tolerance +/- 10%)

LED Characteristics

LEDs:

Long-life, high-efficacy, surface-mount LEDs

Color Stability:

LED color temperature is warrantied to shift no more than 200K in color temperature over a 5-year period

Color Uniformity:

RAB's range of Correlated Color Temperature follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2017.

Construction

IP Rating:

Ingress Protection rating of IP66 for dust and water

EPA:

2

Ambient Temperature:

Suitable for use in up to -40°C (-40°F) to 40°C (104°F)

FXLED78T

Technical Specifications (continued)

Construction

Lens:

Tempered glass lens included

Housing:

Die-cast aluminum housing and door frame

Mounting:

Heavy-duty Trunnion mount with stainless steel hardware

Finish:

Formulated for high durability and long-lasting color

Other

Equivalency:

Equivalent to 250W Metal Halide

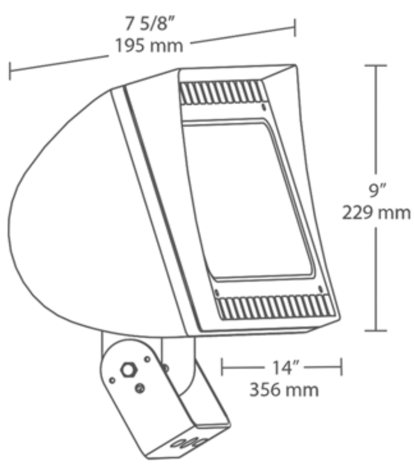
Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Dimensions



Features

- 66% energy cost savings vs. HID
- NEMA Type - 6H x 6V
- "Air-Flow" technology heat dissipation
- 100,000-hour LED lifespan
- 5-Year, No-Compromise Warranty

Ordering Matrix

Family	Wattage	Mounting	Color Temp	Finish	Driver	Options	Other Option
FXLED	78	T					
	78 = 78W **105** = 105W **125** = 125W **150** = 150W	**SF** = Slipfitter **T** = Trunnion	**Blank** = 5000K (Cool) **N** = 4000K (Neutral) **Y** = 3000K (Warm)	**Blank** = Bronze **W** = White	**Blank** = Standard **/D10** = 0-10V Dimming **/BL** = Bi-Level **/480** = 480V	**Blank** = No Option **/LC** = Lightcloud® Control **/PCT** = 100-277V Twistlock **/PCT4** = 480V Twistlock	**Blank** = Standard **USA** = BAA Compliant

FFLED39N/PCS2

RAB | Outdoor

Rectangular shaped LED floodlight designed to replace 150W Metal Halide. patent-pending "Air-Flow" technology ensures long LED and driver lifespan. Use for building façades lighting, sign lighting, LED landscape lighting and instant-on security lighting.

Color: Bronze   Weight: 12.8 lbs

Project:	Type:
Prepared By:	**Date:**

Driver Info

Type	Constant Current
120V	N/A
208V	0.23A
240V	0.20A
277V	0.16A
Input Watts	42.00W
Efficiency	93%

LED Info

Watts	39.00W
Color Temp	4000K (Neutral)
Color Accuracy	75 CRI
L70 Lifespan	100,000
Lumens	5,641
Efficacy	134.3 LPW

Technical Specifications

Listings

UL Listing:

Suitable for wet locations. Suitable for mounting within 1.2m (4ft) of the ground.

Title 24 Compliant:

An FFLED flood light can be used with a motion sensor or photocell control option to comply with 2016 Title 24 Part 6 Section 130.2 (a,b,c)

DLC Listed:

This product is listed by Design Lights Consortium (DLC) as an ultra-efficient premium product that qualifies for the highest tier of rebates from DLC Member Utilities.DLC Product Code: P0000173J

LED Characteristics

Lifespan:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations

LEDs:

Long-life, high-efficacy surface-mount LEDs

Color Consistency:

3-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color

Color Stability:

LED color temperature is warrantied to shift no more than 200K in CCT over a 5-year period

Color Uniformity:

RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for (SSL) Products, ANSI C78.377-2017.

Electrical

Driver:

Constant Current, Class 2, 120-277V, 50-60Hz, 120V: 0.35A, 208V: 0.23A, 240V: 0.13A, 277V: 0.11A

THD:

8.94% at 120V, 16.82% at 277V

Power Factor:

99.1% at 120V, 92% at 277V

Note:

All values are typical (tolerance +/- 10%)

Photocell:

277V Swivel Photocell Included. Photocell is compatible with 208V-277V.

Construction

Lens:

Soda lime silica clear glass

Housing:

Die-cast aluminum housing, lens frame and mounting arm

Mounting:

Heavy-duty mounting arm with "O" ring seal & stainless steel screw

IP Rating:

Ingress Protection rating of IP66 for dust and water

Maximum Ambient Temperature:

Suitable for use in 40°C (104°F)

Cold Weather Starting:

Minimum starting temperature is -40°C (-40°F)

Technical Specifications (continued)

Construction

Effective Projected Area:

EPA = 0.65

Green Technology:

Mercury and UV free. RoHS-compliant components.

Finish:

Formulated for high durability and long-lasting color

Other

Equivalency:

Equivalent to 250W Metal Halide

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

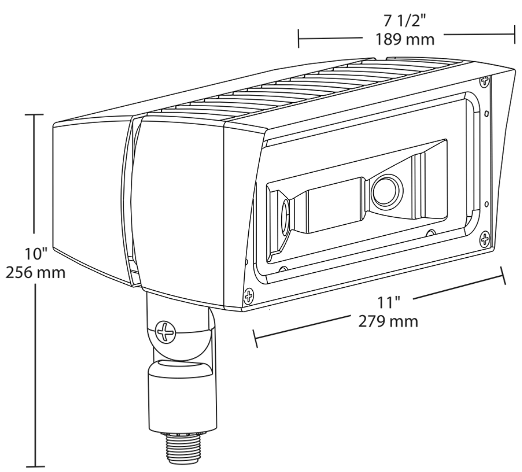
Patents:

The FFLED design is protected by U.S. Pat. D643,147, Canada Pat. 140798, China Pat. ZL201130171304.1, Mexico Pat. 36757 and pending patent in Taiwan.

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Dimensions



Features

- Ultra-efficient LED and optical design
- Replaces 150W MH floodlights
- 100,000-hour life based on LM-80 results and TM-21 calculations
- "Air-Flow" technology heatsink
- 5-Year, No-Compromise Warranty

FFLED39N/PCS2

Ordering Matrix

Family	Wattage	Mounting	Color Temp	NEMA Type	Finish	Driver	Options	Other Options
FFLED	39		N				/PCS2	
	18 = 18W **26 =** 26W **39 =** 39W **52 =** 52W **80 =** 80W	**Blank =** Swivel Arm **SF =** Slipfitter **T =** Trunnion	**Blank =** 5000K (Cool) **N =** 4000K (Neutral) **Y =** 3000K (Warm)	**Blank =** 7H x 6V **B55 =** 5H x 5V **B44 =** 4H x 4V	**Blank =** Bronze **W =** White	**Blank =** On/Off [1] **/D10 =** 0-10V Dimming **/480 =** 480V On/Off [2] **/E =** 120-277V Battery Backup **/EC =** Cold Start Battery Backup	**Blank =** No Option **/PC =** 120V Photocell **/PC2 =** 277V Photocell **/PCS =** 120V Swivel Photocell **/PCS2 =** 277V Swivel Photocell **/PCS4 =** 480V Swivel Photocell **/PCU =** 120-277V Button Photocell **/MS =** Mini Sensor **/STL3 =** Stealth Sensor	**Blank =** Standard **USA =** BAA Compliant

[1] Dimming Driver for 18W, 26W & 39W models only
[2] Not available for 80W models

Need help? Tech help line: **(888) 722-1000** Email: **custserv@rablighting.com** Website: **www.rablighting.com**

 Note: Specifications are subject to change at any time without notice

WPLED18N

RAB

Project:	**Type:**
Prepared By:	**Date:**

Ultra-high efficiency LED 18 Watt wall pack. patent-pending thermal management system. 100,000 hour L70 lifespan. 5-year, no-compromise warranty.

Color: Bronze | Weight: 7.5 lbs

Driver Info

Type	Constant Current
120V	0.17A
208V	0.11A
240V	0.09A
277V	0.08A
Input Watts	20.5W

LED Info

Watts	18W
Color Temp	4000K (Neutral)
Color Accuracy	71 CRI
L70 Lifespan	100,000 Hours
Lumens	2,659
Efficacy	129.7 lm/W

Technical Specifications

Listings

UL Listed:

Suitable for wet locations. Suitable for mounting within 1.2m (4ft) of the ground.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities. DLC Product Code: P00001769

IESNA LM-79 & LM-80 Testing:

RAB LED luminaires and LED components have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80.

Performance

Lifespan:

100,000-Hour LED lifespan based on IES LM-80 results and TM-21 calculations

LED Characteristics

LED:

Multi-chip, high-output, long-life LED

Color Consistency:

3-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color

Color Stability:

LED color temperature is warrantied to shift no more than 200K in color temperature over a 5-year period

Color Uniformity:

RAB's range of Correlated Color Temperature follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2017.

Construction

Maximum Ambient Temperature:

Suitable for use in up to 40°C (104°F)

Cold Weather Starting:

Minimum starting temperature is -40°C (-40°F)

Thermal Management:

Superior heat sinking with external Air-Flow fins

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color

Reflector:

Semi-specular, vacuum-metalized polycarbonate

Gaskets:

High-temperature silicone gaskets

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WPLED18N

Technical Specifications (continued)

Construction

Housing:

Die-cast aluminum housing, lens frame and mounting arm

Mounting:

Heavy-duty mounting arm with "O" ring seal & stainless steel screws

Green Technology:

Mercury and UV free. RoHS-compliant components.

Other

Equivalency:

Equivalent to 100W Metal Halide

Patents:

The design of WPLED18 is protected by US patent D608,040, Canada patent 138280, and China patent CN301649064S

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

Replacement:

Replaces 150W Metal Halide

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Optical

BUG Rating:

B1 U0 G0

Electrical

Driver:

Constant Current, Class 2, 100-277V, 50/60 Hz, 4 kV surge protection, 500mA, 100-240VAC: 0.3-0.15A, 277VAC: 0.15A, Power Factor: 99%

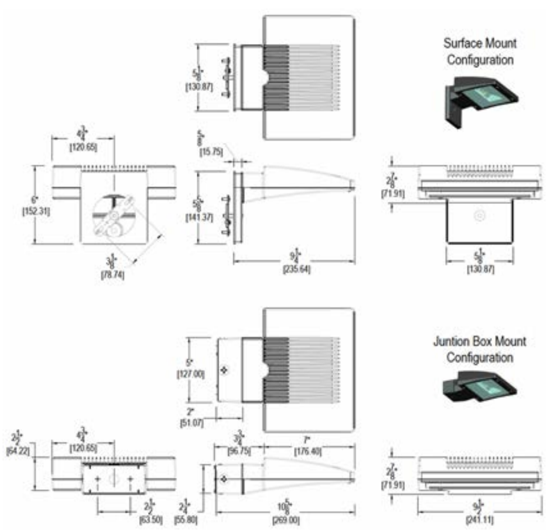
THD:

9.77% at 120V, 18.41% at 277V

Power Factor:

99.2% at 120V, 91.5% at 277V

Dimensions



Features

Ultra-high efficiency LED 18 Watt wall pack

Replaces 150W Metal Halide Wall packs

100,00-Hour LED Lifespan

5-Year, No-Compromise Warranty

Ordering Matrix

Family	Wattage	Color Temp	Finish	Emergency Battery Backup	Options	Other Options
WPLED	18	N				
	18 = 18W	**Blank =** 5000K (Cool) **N =** 4000K (Neutral) **Y =** 3000K (Warm)	**Blank =** Bronze **W =** White	**Blank =** No Battery Backup **/E =** Standard Battery Backup **/EC =** Battery Backup with Cold Start	**Blank =** No Option **/PCS =** 120V Swivel Photocell **/PC =** 120V Button Photocell **/PC2 =** 277V Button Photocell	**USA =** BAA Compliant **Blank =** Standard

W34-55L

RAB

Ultra-economy wall pack with traditional look.

Color: Bronze

Weight: 9.4 lbs

Project:

Type:

Prepared By:

Date:

Driver Info

Type	Constant Current
120V	0.43A
208V	0.26A
240V	0.22A
277V	0.19A
Input Watts	51.1W

LED Info

Watts	50W
Color Temp	5000K (Cool)
Color Accuracy	83 CRI
L70 Lifespan	50,000 Hours
Lumens	5,375
Efficacy	105.2 lm/W

Technical Specifications

Listings

UL Listed:

Suitable for wet locations. Suitable for mounting within 4 feet of the ground.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities. DLC Product Code: P57TGKTN

Performance

Lifespan:

50,000-Hour LED lifespan based on IES LM-80 results and TM-21 calculations

Electrical

Driver:

Constant Current, Class 2, 120-277V, 50/60Hz, 120V: 0.43A, 208V: 0.26A, 240V: 0.22A, 277V: 0.19A

THD:

6.1% at 120V, 7% at 277V

Power Factor:

99.7% at 120V, 96.7% at 277V

Note:

All values are typical (tolerance +/- 10%)

LED Characteristics

LEDs:

Long-life, high-efficacy, surface-mount LEDs

Color Uniformity:

RAB's range of Correlated Color Temperature follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2017.

Construction

Housing:

Die-cast aluminum

Lens:

Glass

Reflector:

Specular aluminum

Cold Weather Starting:

Minimum starting temperature is -40°C (-40°F)

Maximum Ambient Temperature:

Suitable for use in up to 40°C (104°F)

Technical Specifications (continued)

Construction

Mounting:

Die-cast backbox with four (4) conduit entry points and knockout pattern for junction box or direct wall mounting. Hinged door for easy re-assembly.

Green Technology:

Mercury and UV free. RoHS-compliant components.

Finish:

Formulated for high durability and long-lasting color

Other

Replacement:

Replaces up to 175W Metal Halide

Equivalency:

Equivalent to 150W Metal Halide

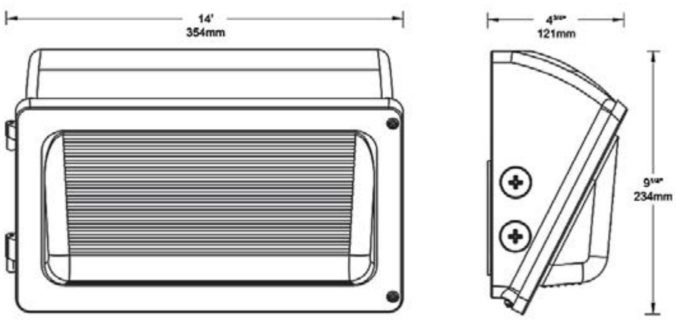
5 Yr Limited Warranty:

The RAB 5-year, limited warranty covers light output, driver performance and paint finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Dimensions



Features

- Economy-grade wall pack with traditional look
- Covers footprint of medium-sized HID wall packs
- Available in various lumen packages
- Integrated 0-10V dimming
- 50,000-Hour LED lifespan

Ordering Matrix

Family		Lumen Package		CRI/Color Temp	Voltage	Options
W34	–	55L	–			
		55L = 5400lm, 51W **70L =** 7200lm, 69W **90L =** 9100lm, 87W		**Blank =** 80 CRI / 5000K **830 =** 80 CRI / 3000K	**Blank =** 120-277V, 0-10V Dimming **/480 =** 480V, 0-10V Dimming	**Blank =** No Option **/PCU =** 120-277V Button Photocell **/MVS =** 120-277V Microwave Sensor **/LC =** 120-277V Lightcloud® Control

Need help? Tech help line: **(888) 722-1000** Email: **custserv@rablighting.com** Website: **www.rablighting.com**

Metalux

Catalog #		Type
Project		
Comments		Date
Prepared by		

DESCRIPTION

The Encounter™ redefines ambient lighting by being the first fixture to blend modern contemporary styling with the innovative WaveStream™ technology to deliver exceptional performance and superior energy savings. Encounter's highly efficient LED system with advance optical design delivers an unparalleled combination of optimal light uniformity for enhanced visual comfort and superior efficiency for greater energy savings.

Encounter is compatible with all of today's popular ceiling systems and available in a variety of configurations for application versatility. Its perfect balance of form and function make it an ideal choice for commercial office spaces, schools, hospitals, retail and other indoor ambient applications.

12EN
LED

1' X 2' TROFFER
LED MODULE

Specification Grade Troffer

Connected Systems
CLICK HERE

SPECIFICATION FEATURES

Construction
Shallow 3-1/16" deep housing is extruded aluminum frame and injected molded composite end plates. End plates are securely attached with screws for strength and rigidity and the elimination of gaps. End plates have accessory grid-lock feature for safety and convenience. Four auxiliary fixture end suspension points are provided. Large access plate for supply connection.

Controls
Metalux LED luminaires come standard with 0-10V dimming drivers (1% standard).

Options compatible with Eaton's Connected Lighting Systems:

- WaveLinx sensor
- LumaWatt Pro sensor
- SVPD sensor
- DLVP sensor and driver
- Fifth Light DALI driver

Other options include step-dimming and 3rd party drivers. Refer to the Connected Lighting options page and ordering information for more details.

Electrical
Long-life LED system coupled with electrical driver to deliver optimal performance. LED's available in 3000K, 3500K, 4000K or 5000K with a minimum CRI of 80. Projected life is 100,000 hours at 92% lumen output. Electronic drivers are available for 120-277V applications.

Emergency Battery Pack Option
Optional 120V-277V integral emergency battery pack is available in 7-watts to meet critical life-safety lighting requirements. The 90-minute batteries provide constant power to the LED system, ensuring code-compliance. A test switch/indicator button can be tested safely from the ground using a laser pointer, while the patented EZ Key prevents accidental discharge of the battery during construction. Emergency/generator transfer options available – see ordering information for details.

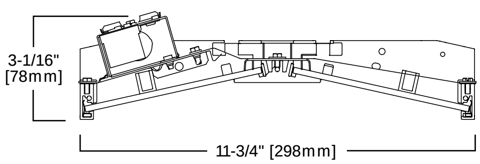
Driver Access
Drivers can be accessed via plenum.

Finish
Durable frame has high reflectance baked matte white enamel finish for luminous uniformity.

Optics
Precision formed optical assembly with positively retained high optical grade acrylic lenses provide a directed optical distribution using WaveStream technology.

Compliance
Components are UL recognized. Indoor luminaires are cULus listed for 25° C ambient environments, RoHS compliant, and comply with IESNA LM-79. LEDs comply with LM-80 standards.

Warranty
Five-year warranty.

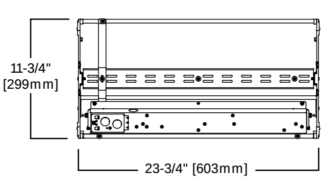


CERTIFICATION DATA

cULus - 1598 and 2043**
Damp Location Listed
IC Rated
LM79/LM80 Compliant
ROHS Compliant
NOM Compliant

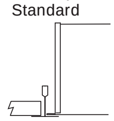
*See Drywall Frame Kit Accessory in Ordering Information section.
**Fixture construction is suitable for use in Air-handling and plenum rated spaces in accordance with Section 300.22 (C) of the National Electrical Code, Section 4.3.11.2.6.5 of NFPA 90A and Section 602.2.1.4 of ICC.

MOUNTING DATA

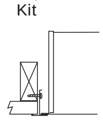


CEILING COMPATIBILITY

G
Grid/Lay-in
Standard



F
Drywall Frame
Kit



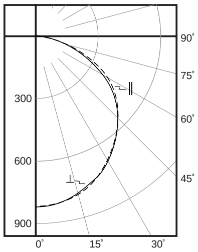
Ceiling Type	Trim Type
Exposed Grid	G
Concealed T	G or T
Slot Grid	G or T
Flange	*

LINEAR DISCONNECT
Safe and convenient means of disconnecting power

EATON
Powering Business Worldwide

PS519066EN
May 4, 2018 1:53 PM

PHOTOMETRICS



12EN-LD2-23-UNV-L835-CD1-U

Electronic Driver

Linear LED 3500K

Spacing criterion: (II) 1.3 x mounting height, (⊥) 1.3 x mounting height

Lumens: 2395

Input Watts: 20.5W

Efficacy: 116.8 lm/W

Test Report: 12EN-LD2-23-UNV-L835-CD1-U.IES

Candlepower

Angle	Along II	45°	Across ⊥
0	822	822	822
5	814	820	823
10	802	808	811
15	785	789	792
20	761	764	767
25	731	733	736
30	698	697	698
35	656	655	657
40	613	608	608
45	565	556	554
50	512	498	497
55	452	438	435
60	389	370	371
65	319	299	300
70	247	232	212
75	173	158	141
80	104	94	110
85	42	47	47
90	0	0	0

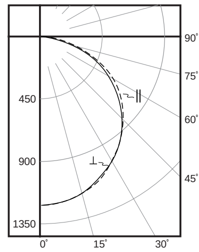
Coefficients of Utilization

Effective floor cavity reflectance 20%

rc	80%				70%				50%			30%			10%			0%
rw	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	119	119	119	119	116	116	116	116	111	111	111	106	106	106	102	102	102	100
1	109	104	99	95	106	101	97	94	97	94	91	93	90	88	90	87	85	83
2	99	90	83	77	96	88	82	76	85	79	75	81	77	73	78	75	71	69
3	90	79	71	64	87	77	70	63	74	68	62	72	66	61	69	64	60	58
4	82	70	61	54	80	69	60	54	66	59	53	64	57	52	61	56	52	49
5	75	62	53	46	73	61	53	46	59	52	46	57	50	45	55	49	45	43
6	70	56	47	40	68	55	47	40	53	46	40	52	45	40	50	44	39	37
7	64	51	42	36	63	50	42	36	48	41	35	47	40	35	46	39	35	33
8	60	46	38	32	58	46	37	32	44	37	31	43	36	31	42	36	31	29
9	56	42	34	29	55	42	34	28	41	33	28	40	33	28	39	32	28	26
10	52	39	31	26	51	39	31	26	38	31	26	37	30	26	36	30	25	24

Zonal Lumen Summary

Zone	Lumens	% Fixture
0-30	638	26.7
0-40	1049	43.8
0-60	1872	78.2
0-90	2395	100.0
0-180	2395	100.0



12EN-LD2-35-UNV-L835-CD1-U

Electronic Driver

Linear LED 3500K

Spacing criterion: (II) 1.3 x mounting height, (⊥) 1.3 x mounting height

Lumens: 3560

Input Watts: 31.5W

Efficacy: 113.0 lm/W

Test Report: 12EN-LD2-35-UNV-L835-CD1-U.IES

Candlepower

Angle	Along II	45°	Across ⊥
0	1223	1223	1223
5	1210	1219	1224
10	1193	1201	1206
15	1167	1173	1178
20	1131	1135	1139
25	1088	1090	1094
30	1037	1036	1037
35	977	974	974
40	913	904	904
45	840	826	824
50	762	741	737
55	673	648	644
60	576	549	550
65	476	446	445
70	366	346	312
75	259	232	209
80	153	141	166
85	63	71	71
90	0	0	0

Coefficients of Utilization

Effective floor cavity reflectance 20%

rc	80%				70%				50%			30%			10%			0%
rw	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	119	119	119	119	116	116	116	116	111	111	111	106	106	106	102	102	102	100
1	109	104	99	95	106	101	97	94	97	94	91	93	90	88	90	87	85	83
2	99	90	83	77	96	88	82	76	85	79	75	81	77	73	78	75	71	69
3	90	79	71	64	87	77	70	63	74	68	62	72	66	61	69	64	60	58
4	82	70	61	54	80	69	60	54	66	59	53	64	57	52	61	56	52	49
5	75	62	53	46	73	61	53	46	59	52	46	57	50	45	55	49	45	43
6	70	56	47	40	68	55	47	40	53	46	40	52	45	40	50	44	39	37
7	64	51	42	36	63	50	42	36	48	41	35	47	40	35	46	39	35	33
8	60	46	38	32	58	46	37	32	44	37	31	43	36	31	42	36	31	29
9	56	42	34	29	55	42	34	28	41	33	28	40	33	28	39	32	28	26
10	52	39	31	26	51	39	31	26	38	31	26	37	30	26	36	30	25	24

Zonal Lumen Summary

Zone	Lumens	% Fixture
0-30	949	26.7
0-40	1559	43.8
0-60	2783	78.2
0-90	3560	100.0
0-180	3560	100.0

LUMEN MAINTENANCE

Ambient Temperature	TM-21 Lumen Maintenance (100,0000 hours)	Theoretical L70 (Hours)
25°C	> 92%	> 130,000

Non-IC data

ENERGY AND PERFORMANCE DATA BY CATALOG NUMBER

Stock or MTO*	Catalog Logic (Curved)	Delivered Lumens	Watts	Efficacy (LPW)
MTO	12EN-LD2-08-UNV-L830-CD1-U	807	9.9	82
MTO	12EN-LD2-08-UNV-L835-CD1-U	832	9.9	84
MTO	12EN-LD2-08-UNV-L840-CD1-U	849	9.9	86
MTO	12EN-LD2-08-UNV-L850-CD1-U	924	9.9	93
MTO	12EN-LD2-13-UNV-L830-CD1-U	1305	12.2	107
MTO	12EN-LD2-13-UNV-L835-CD1-U	1345	12.2	110
MTO	12EN-LD2-13-UNV-L840-CD1-U	1372	12.2	112
MTO	12EN-LD2-13-UNV-L850-CD1-U	1493	12.2	122
MTO	12EN-LD2-17-UNV-L830-CD1-U	1719	15.7	109
MTO	12EN-LD2-17-UNV-L835-CD1-U	1772	15.7	113
MTO	12EN-LD2-17-UNV-L840-CD1-U	1807	15.7	115
MTO	12EN-LD2-17-UNV-L850-CD1-U	1967	15.7	125
MTO	12EN-LD2-23-UNV-L830-CD1-U	2323	20.5	113
MTO	12EN-LD2-23-UNV-L835-CD1-U	2395	20.5	117
MTO	12EN-LD2-23-UNV-L840-CD1-U	2443	20.5	119
MTO	12EN-LD2-23-UNV-L850-CD1-U	2658	20.5	130
MTO	12EN-LD2-27-UNV-L830-CD1-U	2706	24.0	113
MTO	12EN-LD2-27-UNV-L835-CD1-U	2790	24.0	116
MTO	12EN-LD2-27-UNV-L840-CD1-U	2846	24.0	119
MTO	12EN-LD2-27-UNV-L850-CD1-U	3097	24.0	129
MTO	12EN-LD2-31-UNV-L830-CD1-U	3084	27.7	111
MTO	12EN-LD2-31-UNV-L835-CD1-U	3179	27.7	115
MTO	12EN-LD2-31-UNV-L840-CD1-U	3243	27.7	117
MTO	12EN-LD2-31-UNV-L850-CD1-U	3529	27.7	127
MTO	12EN-LD2-35-UNV-L830-CD1-U	3453	31.4	110
MTO	12EN-LD2-35-UNV-L835-CD1-U	3560	31.4	113
MTO	12EN-LD2-35-UNV-L840-CD1-U	3631	31.4	116
MTO	12EN-LD2-35-UNV-L850-CD1-U	3952	31.4	126
MTO	12EN-LD2-39-UNV-L830-CD1-U	3856	35.4	109
MTO	12EN-LD2-39-UNV-L835-CD1-U	3975	35.4	112
MTO	12EN-LD2-39-UNV-L840-CD1-U	4055	35.4	115
MTO	12EN-LD2-39-UNV-L850-CD1-U	4412	35.4	125

*Made to order (MTO) requires a typical two week lead time.

ORDERING INFORMATION

SAMPLE NUMBER: 12EN-LD2-13-UNV-L835-CD1-SVPD1-U

Rating
Blank=Standard
ATW-SW4=Chicago Rated (5)

Series
12EN=1' x 2' Encounter Series

Air
[Blank]=Standard
A=Air (Vented) (6)

Lamp Type
LD2=LED 2.0

MTO Lumen Outputs
08=800 Lumens
13=1300 Lumens
17=1700 Lumens
23=2300 Lumens
27=2700 Lumens
31=3100 Lumens
35=3500 Lumens
39=3900 Lumens

Optics
Blank=Standard

Voltage (1)
UNV=Universal Voltage 120-277
347V=347 Volt (4)
48V=48 Volt Low-voltage (Class 2) (C)

Options
Emergency
EL7W=7-watt, 120V-277V emergency battery pack installed (2)
ELV7W=7-watt, DLVP-compatible low voltage emergency battery pack installed (C)
GTR2=Bodine Generator Transfer Relay (7)
ETR2=Iota Emergency Transfer Relay (7)
ETRD=Iota Emergency Transfer Relay with dimming control (7)

CCT
L830=3000K
L835=3500K
L840=4000K
L850=5000K

Flex
A3/8-4/18GDIM=3/8" Flex with 0-10V Dimming Leads
Multiple other configurations available. See below for details.

Driver Type
CD=0-10V Dimming Driver (1%-100% Dimming)
SR=Sensor-ready Dimming Driver for LWIPD1 option (1%-100% Dimming) (B)
5LTD=Fifth Light DALI Driver (10%-100% Dimming) (3), (E)
5LTHD=Fifth Light Dimming Driver (1%-100% Dimming) (E)
LV1=DLVP Dimming Driver (0%-100% Dimming) (C)
SD=Step Dimming Driver (50% or 100% Dimming) (3)
LH=Lutron HiLume (LDE1 series) 1%-100% EcoSystem Driver with Soft-on Fade to Black dimming (F)
L5=Lutron 5 Series (LDE5-Series) 5%-100% EcoSystem Driver (F)
LU=Lutron HiLume (L3D series) 1%-100% EcoSystem/3-wire Driver (F)

Number of Drivers
1=1 Driver

Integrated Sensing Systems
SWPD1=WaveLinx Wireless Integrated Sensor (A)
LWIPD1=LumaWatt Pro Wireless Integrated Sensor (B)
LWTPD1=LumaWatt Pro Wireless Tile-mount Sensor (B)
SLVPD1=DLVP Low-voltage Integrated Sensor (C)
SVPD1=0-10V Stand-alone Integrated Sensor (D)

Connected Systems
CLICK HERE

Packaging
U=Unit Pack
PALC=Job Pack, in carton

ACCESSORIES

T3A END E.Q. BRACKET PARTS BAG (Standard with fixture)
DF-12-W=1' x 2' Drywall Frame Kit
DF10P-C_=Decorator Dimmer, 0-10V
SF10P-_=Decorator Slide Dimmer, 0-10V
ISHH-01=Programming Remote for Integrated Sensor (D)
ISHH-02=Personal Control Remote for Integrated Sensor (D)

NOTES: (1) Products also available in non-US voltages and frequencies for international markets. (2) With integral test switch/indicator/laser test. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 7=700 lumens). IES-format photometry for luminaire under emergency operation available. (3) 800, 1300, 1700, 2300, 2700 and 3100 lumen packages not available with Step-dim or 5LTD option. (4) 347V emergency option not available. (5) Chicago rated version does not allow for row mounting. (6) Air version is vented but does not meet air handling requirements; a 6% reduction in delivered lumens is experienced with this option. (7) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others). GTR2 and ETR2 options include 2 relays on fixtures with dimming drivers. ETRD option only requires one relay when used on a dimming fixture. Must specify voltage as 120V or 277V when ordering these devices. (8) HCD driver not available in 800 lumen package.

Integrated Sensing and Control System Options
NOTES: Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (A) Consult WaveLinx system pages for additional details and compatibility. (B) Consult LumaWatt Pro system pages for additional details and compatibility. (C) Consult DLVP system pages for additional details and compatibility. (D) Consult SVPD series system pages for additional details and compatibility. (E) Consult Fifth Light system pages for additional details and compatibility. (F) Consult Marketplace ptions - Lutron system pages for additional details and compatibility. Compatible only with driver series shown, and may require two or more drivers. Requires field commissioning to operate or dim. Contact Lutron at www.lutron.com.

Flexible Metal Conduit Options
Flex options available for 0-10V dimming control, DALI dimming control, emergency and night light functions. 72-inch factory-installed and pre-wired to driver, fitted to luminaire housing access plate with 90° enclosed FMC connector. Not all options may be combined and installation ratings vary by type.
A3/8-4/18GDIM series notes: Factory installed dimming option 3/8" flexible metal conduit with 2-#18 power and ground wires and 2-#18 UL-listed jacketed 0-10V +/- control wires. Meets UL 66, 83, 1479, 1569, 1581, 2556. NEC® 250.118, 300.22(C), 392, 396, 330, 501, 502, 503, 530, 504, 505, 518, 520, 530, 645, 72; Federal Specification A-A-59544 (formerly J-C-30B); all applicable OSHA and HUD Requirements. UL Classified 1-, 2-, and 3-hour through penetration with applicable fire stop product (not included). May be surface mounted, fished and/or embedded in plaster. Cable tray and approved raceway rated, install per NEC®; Environmental Air-Handling Space Installation per NEC® 300.22(C).

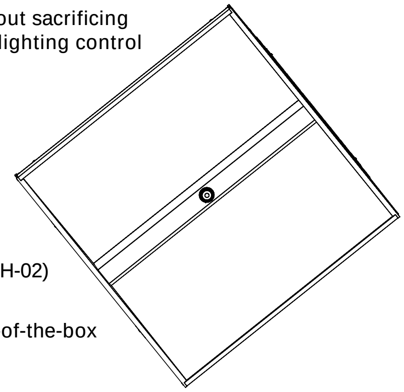
Specifications & dimensions subject to change without notice. Consult your Eaton Representative for availability and ordering information.

SHIPPING DATA

Catalog No.	Wt.
12EN-LD2-13	8 lbs.

Eaton
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.eaton.com/lighting

INTEGRATED SENSOR



The Encounter and Encounter HP with Integrated Sensor technology provides automatic energy savings without sacrificing performance. Traditionally, these types of energy savings required coordination between the luminaire and a lighting control system. The Encounter delivers superior lighting with integrated occupancy and daylighting controls.

Capture the benefits of traditional lighting controls, without complicated coverage planning or special wiring. Ideal for new construction or retrofit, the Encounter delivers automatic ON to an energy saving light level, while ensuring lighting is turned OFF when the space is unoccupied.

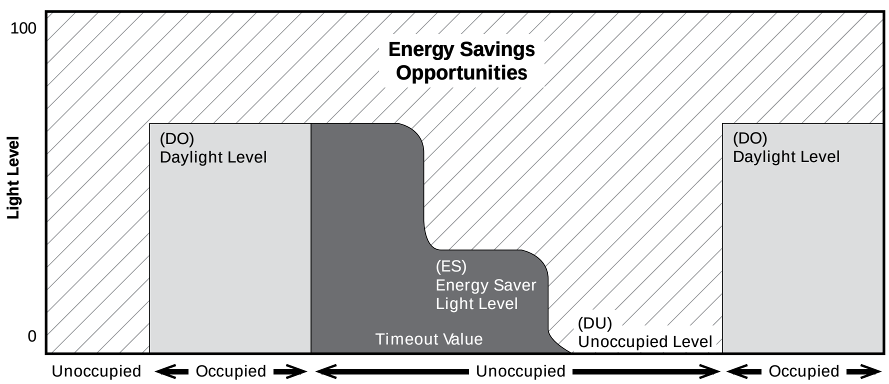
The integral daylight sensor reduces the need for special daylight zone planning. Each luminaire will automatically adjust the light level based on reflected light beneath the sensor in a closed loop method.

Occupied daylight light levels and unoccupied light levels can be adjusted using the integrated sensor programming remote (Catalog Number: ISHH-01). The integrated sensor personal remote (Catalog Number: ISHH-02) provides code compliant manual raise, lower, ON, OFF control.

The Encounter with Integrated Sensor is easy to install with no special wiring and ensures energy savings out-of-the-box with default control settings.

How it works:

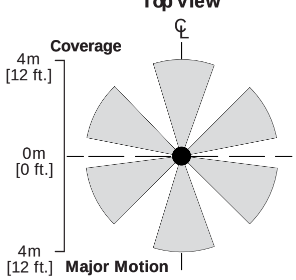
- As the user enters the space controlled by the integral sensor, the lighting turns ON to the default daylight level.
- Lighting will remain at that the daylight level until the space is unoccupied. This will start the occupancy timeout period (default 20 minutes).
- If the space remains unoccupied for half of the timeout period, the lighting will automatically reduce to the Energy Saver light level. This adjustable light level is typically half of the occupied daylight level.
- At the end of the timeout period the lighting will go to the unoccupied light level. This adjustable light level uses the OFF default setting.



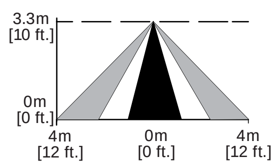
Target light level default: 500 lux at 8 ft.

Coverage

Top View



Side View



Reccomended Mounting Height 8–12 ft.

Optional Remote Controls

ISHH-01 Programming Remote

ISHH-02 Personal Control Remote

PHILIPS

Recessed

EvoKit LED Retrofit Kit

1'x4' fixture

Project:

Location:

Cat.No:

Type:

Lamps: Qty:

Notes:

EvoKit 1x4 is Engineered to Order (ETO) only. Please submit Custom ETO request form at the bottom of this page to your local Philips Representative.

Ordering guide

Example: 1EVK432L840UNV

Family	Air function	Length (nominal)	Lumens[1] (nominal)	Color temp. (K)	Voltage	Options
1EVK		4			UNV	
1EVK 1 ft. wide Evokit	**Blank** Static **H** Air return	**4** 4' length	**23L** 2300 lumens **32L** 3200 lumens **40L** 4000 lumens	**835** 80 CRI, 3500K **840** 80 CRI, 4000K	**UNV** Universal voltage 120-277	**SNS200**[2] Philips EasySense SNS200 advanced grouping daylight and occupancy sensor **SWZDT**[2] SpaceWise DT

1) Nominal delivered lumens.
2) Integral sensing options (SNS200, SWZDT) may not be combined.

Application

- Acrylic diffuser available in ribbed and configurations provides even illumination with comfortable appeal
- Standard and base configurations available in multiple lumen packages to suit the needs of various applications
- Lambertian distribution creates uniform horizontal and vertical illuminance on the work plane and reduces scalloping on the walls
- CRI 80 minimum color rendering with balanced spectrum
- LEDs coupled with standard dimming provide prolonged lumen maintenance. Optional integral sensors contribute further to LED lumen maintenance
- Designed to retrofit most 1'x4' NEMA GRID fluorescent fixtures. Due to the variability of existing fixture types in the field it is recommended to install a sample prior to installation to ensure proper fit

Intertek

Enclosure

- Opal acrylic diffuser provides visually comfortable lumenance without compromise to luminaire efficacy
- Diffuser requires no frames or fasteners and can be easily removed from below without the use of tools

Construction/Finish

- Luminaire finish is matte white polyester powder coat for high quality, durable finish
- Earthquake cable provided
- Integral control options include sensors mounted in one endcap

General notes

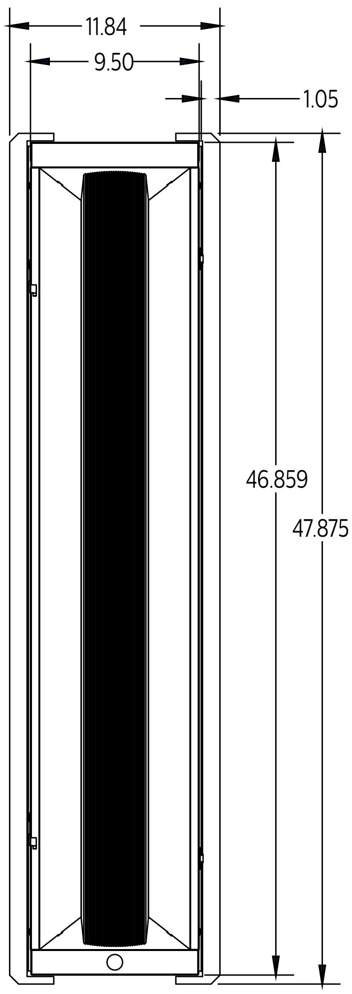
- All accessories are field installed
- Many luminaire components, such as reflectors, refractors, lenses, sockets, lampholders, and LEDs are made from various types of plastics which can be adversely affected by airborne contaminants. If sulfur based chemicals, pertroleum based products, cleaning solutions, or other contaminants are expected in the intended area of use, consult factory for compatibility

Electrical

- Integral sensor options for occupancy sensing and/or daylight harvesting are available for additional energy savings with no reduction of life or increase in installation labor
- Standard configurations provide up to 126 LPW, and are available in 3500 or 4000K color temperatures
- LED boards are accessible from below by removal of the lens. Lens removal is tool-free by compressing the sides and pushing to one end
- LED driver is accessible from below by unhinging the doorframe and lowering enclosure
- Five year limited luminaire warranty includes LED boards and driver. Visit www.philips.com/warranties for complete warranty information
- TM-21 predicted L70 lumen maintenance greater than 70,000 hours
- cETLus listed to UL and CSA standards, suitable for damp locations

EvoKit LED retrofit kit

Dimensions

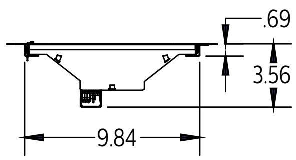


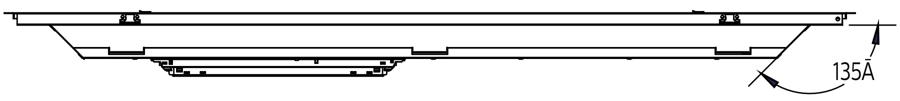
All measurements shown are in Inches. Sketches are intended to show approximate dimensions for use in determining if existing fixture will be compatible. It is recommended the verify the fixture to be retrofitted will accommodate these dimensions. Philips also recommends a trial installation prior to ordering project quantities to ensure proper fit. There is a wide variability of 1x4 troffers in the marketplace. The depicted sketches may not fit all products. The ETO specification form below should be utilized to inform factory of any variations to the product that need to be made.

SpaceWise DT (SWZDT)

- Commissioning via compatible Android phone and Philips Field App
- Dimming via compatible wireless wall switch only (see below)
- Register for the commissioning app at http://registration.componentcloud.philips.com/appregistration/
- Integral sensing options (SNS200, SWZDT) may not be combined
- For more information including recommended switches, refer to the following –

SWZDT – www.lightingproducts.philips.com documents/webdb2/DayBrite/pdf/SWZDT_sensor.pdf





EvoKit LED retro t kit

Photometry

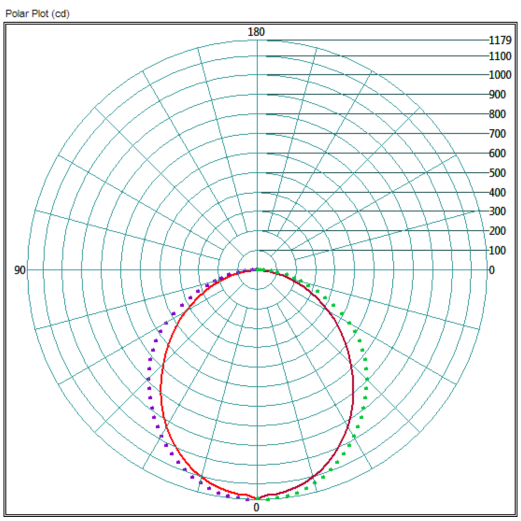
1'x4' EvoKit

Photometric Measurements

Total Luminous Flux (lm)	Electrical Power (W)	Luminous E cacy (lm/W)	Test Distance (m)
3275.7	25.90	126.47	6.82

Zonal lumen summary

	Summary Zonal Lumens	Zonal Lumens - % Lamp	Zonal Lumens - % Fixture
0 to 30	900.11	27.48	27.48
0 to 40	1460.79	44.60	44.60
0 to 60	2565.91	78.33	78.33
0 to 90	3275.04	99.98	99.98
40 to 90	1814.25	55.39	55.39
90 to 180	0.63	0.02	0.02
0 to 180	3275.67	100.00	100.00



philips.com/evokit

Philips Lighting North America Corporation
200 Franklin Square Drive, Somerset, NJ 08873
Tel. 855-486-2216

Philips Lighting Canada Ltd.
281 Hillmount Rd, Markham, ON, Canada L6C 2S3
Tel. 800-668-9008

Philips EvoKit LED REQUEST FOR VARIANT / ETO

Note: The intent of the feasibility assessment is to give a quick yes/no based on degree of complexity and the size of the opportunity. In order for an ETO request to proceed beyond feasibility assessment management approval is required. No Engineering work will commence until a project has received formal management approval.

Request Date ______________________________

Requestor Name ______________________________

Customer Name ______________________________

Job Name ______________________________

Job Location ______________________________

Philips Contact (CPM or Inside Sales) ______________________________

Phone Number ______________________________

E-mail Address ______________________________

Are there other EvoKit Fixtures included on this order? Yes ☐ No ☐

Quote # (If Started) ______________________________

Estimated Size of Job ________________ Units/Footage ________________

Product Family ______________________________

Modification Required (Enter Description to the Best of Your Ability) ______________________________

____

Estimated On-Site Requirement Date ______________________________

Ship To Address

Name ______________________________

Address Line 1 ______________________________

Address Line 2 ______________________________

City ______________________________

State/Province ________________ Zip Code/Postal ________________

Full Description of Custom Requirements: (Use as Much Detail as Possible Including Lumen Package, CCT, CRI, Efficacy Target, Ceiling Details, em/bp Requirements, etc.) ______________________________

____

Is DLC required? Yes ☐ No ☐

If Yes - List All Product Types Required ____

Skus: ____

Note: Lead time from ‘release date’ to ‘date required to ship’ must be verified by Engineering prior to factory release.

philips.com/evokit

Philips Lighting North America Corporation
200 Franklin Square Drive, Somerset, NJ 08873
Tel. 855-486-2216

Philips Lighting Canada Ltd.
281 Hillmount Rd, Markham, ON, Canada L6C 2S3
Tel. 800-668-9008

PHILIPS

Recessed

EvoKit LED
Retrofit Kit Gen 4

LED

Project:

Location:

Cat.No:

Type:

Lamps: Qty:

Notes:

Philips EvoKit LED retrofit kit gen 4 is an energy efficient LED alternative to traditional linear fluorescent troffers. Not only does it offer energy savings[1], it also helps reduce maintenance costs due to its long lifetime. Simple construction helps decrease the installation time meaning you can have an LED solution in your ceiling in just minutes.

Ordering guide (continued on next page)

Product Number	12NC	Description	Watts[3]	Volts	Lumen Maintenance (Hrs.)[2]	Approx. Lumens[3]	Color Temp. (K)	Efficacy	Diffusor
Dimming: 0-10V									
515692	929000781813	EvoKit 2x2 P 23L 17W 835 2 0-10 7 G4	17	120-277	70,000	2300	3500	134	Ribbed
515759	929000782213	EvoKit 2x2 P 23L 17W 840 2 0-10 7 G4	17	120-277	70,000	2300	4000	137	Ribbed
♦ 516005	929000783313	EvoKit 2x2 P 32L 24W 835 2 0-10 7 G4	24	120-277	70,000	3200	3500	132	Ribbed
♦ 515940	929000782713	EvoKit 2x2 P 32L 24W 840 2 0-10 7 G4	24	120-277	70,000	3200	4000	135	Ribbed
516237	929000785513	EvoKit 2x4 P 30L 22W 835 2 0-10 7 G4	22	120-277	70,000	3000	3500	135	Ribbed
516039	929000783613	EvoKit 2x4 P 30L 22W 840 2 0-10 7 G4	22	120-277	70,000	3000	4000	137	Ribbed
♦ 516286	929000786013	EvoKit 2x4 P 36L 27W 835 2 0-10 7 G4	27	120-277	70,000	3600	3500	135	Ribbed
♦ 516328	929000786413	EvoKit 2x4 P 36L 26W 840 2 0-10 7 G4	26	120-277	70,000	3600	4000	137	Ribbed
♦ 516427	929000787413	EvoKit 2x4 P 42L 32W 835 2 0-10 7 G4	32	120-277	70,000	4200	3500	134	Ribbed
♦ 516369	929000786813	EvoKit 2x4 P 42L 31W 840 2 0-10 7 G4	31	120-277	70,000	4200	4000	136	Ribbed
516534	929000788513	EvoKit 2x4 P 47L 36W 835 2 0-10 7 G4	36	120-277	70,000	4700	3500	132	Ribbed
516476	929000787913	EvoKit 2x4 P 47L 35W 840 2 0-10 7 G4	35	120-277	70,000	4700	4000	135	Ribbed
517482	929000798813	EvoKit 2x2 P 32L 24W 835 2 0-10 7 G4 SM	24	120-277	70,000	3200	3500	132	Smooth
517466	929000798613	EvoKit 2x2 P 32L 24W 840 2 0-10 7 G4 SM	24	120-277	70,000	3200	4000	135	Smooth
517508	929000799013	EvoKit 2x4 P 36L 27W 835 2 0-10 7 G4 SM	27	120-277	70,000	3600	3500	135	Smooth
517516	929000799113	EvoKit 2x4 P 36L 26W 840 2 0-10 7 G4 SM	26	120-277	70,000	3600	4000	137	Smooth
517540	929000799413	EvoKit 2x4 P 42L 32W 835 2 0-10 7 G4 SM	32	120-277	70,000	4200	3500	134	Smooth
517524	929000799213	EvoKit 2x4 P 42L 31W 840 2 0-10 7 G4 SM	31	120-277	70,000	4200	4000	136	Smooth

See footnotes on the last page.

RoHS[†] COMPLIANT

DLC QPL LISTED PREMIUM[‡]

CLASSIFIED C UL US

EvoKit LED retrofit kit gen 4

Ordering guide (continued from previous page)

Product Number	12NC	Description	Watts	Volts	Lumen Maintenance (Hrs.)[2]	Approx. Lumens[3]	Color Temp. (K)	Efficacy	Diffusor
Driver: 0-10V dimming									
515643	929000781613	EvoKit 2x2 P 23L 17W 850 2 0-10 7 G4	17	120-277	70,000	2300	5000	138	Ribbed
515981	929000783113	EvoKit 2x2 P 32L 24W 850 2 0-10 7 G4	24	120-277	70,000	3200	5000	135	Ribbed
516260	929000785813	EvoKit 2x4 P 36L 26W 850 2 0-10 7 G4	26	120-277	70,000	3600	5000	139	Ribbed
516401	929000787213	EvoKit 2x4 P 42L 31W 850 2 0-10 7 G4	31	120-277	70,000	4200	5000	138	Ribbed
516518	929000788313	EvoKit 2x4 P 47L 34W 850 2 0-10 7 G4	34	120-277	70,000	4700	5000	136	Ribbed
Driver: 120V Mark 10 dimming									
515650	929000781713	EvoKit 2x2 P 23L 19W 835 1 MK10 7 G4	19	120	70,000	2478	3500	130	Ribbed
515742	929000782113	EvoKit 2x2 P 23L 19W 840 1 MK10 7 G4	19	120	70,000	2526	4000	132	Ribbed
515999	929000783213	EvoKit 2x2 P 32L 25W 835 1 MK10 7 G4	25	120	70,000	3224	3500	130	Ribbed
515932	929000782613	EvoKit 2x2 P 32L 25W 840 1 MK10 7 G4	25	120	70,000	3295	4000	133	Ribbed
516229	929000785413	EvoKit 2x4 P 30L 26W 835 1 MK10 7 G4	26	120	70,000	3304	3500	127	Ribbed
516187	929000785013	EvoKit 2x4 P 30L 23W 840 1 MK10 7 G4	23	120	70,000	2928	4000	130	Ribbed
516278	929000785913	EvoKit 2x4 P 36L 29W 835 1 MK10 7 G4	29	120	70,000	3686	3500	128	Ribbed
516310	929000786313	EvoKit 2x4 P 36L 29W 840 1 MK10 7 G4	29	120	70,000	3769	4000	131	Ribbed
516419	929000787313	EvoKit 2x4 P 42L 34W 835 1 MK10 7 G4	34	120	70,000	4303	3500	128	Ribbed
516351	929000786713	EvoKit 2x4 P 42L 34W 840 1 MK10 7 G4	34	120	70,000	4399	4000	131	Ribbed
516526	929000788413	EvoKit 2x4 P 47L 38W 835 1 MK10 7 G4	38	120	70,000	4831	3500	128	Ribbed
516468	929000787813	EvoKit 2x4 P 47L 38W 840 1 MK10 7 G4	38	120	70,000	4934	4000	130	Ribbed
Driver: 277V Mark 10 dimming									
● 515700	929000781913	EvoKit 2x2 P 23L 19W 835 5 MK10 7 G4	19	277	70,000	2300	3500	121	Ribbed
● 515767	929000782313	EvoKit 2x2 P 23L 21W 840 5 MK10 7 G4	21	277	70,000	2526	4000	123	Ribbed
● 516021	929000783513	EvoKit 2x2 P 32L 26W 835 5 MK10 7 G4	26	277	70,000	3200	3500	124	Ribbed
515965	929000782913	EvoKit 2x2 P 32L 25W 840 5 MK10 7 G4	26	277	70,000	3200	4000	127	Ribbed
● 516252	929000785713	EvoKit 2x4 P 30L 25W 835 5 MK10 7 G4	25	277	70,000	3000	3500	120	Ribbed
● 516211	929000785313	EvoKit 2x4 P 30L 25W 840 5 MK10 7 G4	25	277	70,000	3000	4000	122	Ribbed
● 516294	929000786113	EvoKit 2x4 P 36L 30W 835 5 MK10 7 G4	30	277	70,000	3687	3500	123	Ribbed
516336	929000786513	EvoKit 2x4 P 36L 29W 840 5 MK10 7 G4	28	277	70,000	3600	4000	126	Ribbed
● 516443	929000787613	EvoKit 2x4 P 42L 35W 835 5 MK10 7 G4	35	277	70,000	4303	3500	124	Ribbed
516385	929000787013	EvoKit 2x4 P 42L 33W 840 5 MK10 7 G4	33	277	70,000	4200	4000	127	Ribbed
● 516559	929000788713	EvoKit 2x4 P 47L 38W 835 5 MK10 7 G4	38	277	70,000	4700	3500	125	Ribbed
516492	929000788113	EvoKit 2x4 P 47L 37W 840 5 MK10 7 G4	37	277	70,000	4700	4000	127	Ribbed
Dimming: 0-10V at 347V									
515718	929000782013	EvoKit 2x2 P 23L 18W 835 6 0-10 7 G4	18	347	70,000	2300	3500	128	Ribbed
515866	929000782413	EvoKit 2x2 P 23L 18W 840 6 0-10 7 G4	18	347	70,000	2300	4000	130	Ribbed
515973	929000783013	EvoKit 2x2 P 32L 24W 835 6 0-10 7 G4	24	347	70,000	3200	3500	135	Ribbed
515890	929000782513	EvoKit 2x2 P 32L 24W 840 6 0-10 7 G4	24	347	70,000	3200	4000	135	Ribbed
516302	929000786213	EvoKit 2x4 P 36L 27W 835 6 0-10 7 G4	27	347	70,000	3600	3500	133	Ribbed
516344	929000786613	EvoKit 2x4 P 36L 26W 840 6 0-10 7 G4	26	347	70,000	3600	4000	136	Ribbed
516450	929000787713	EvoKit 2x4 P 42L 31W 835 6 0-10 7 G4	31	347	70,000	4200	3500	138	Ribbed
516393	929000787113	EvoKit 2x4 P 42L 31W 840 6 0-10 7 G4	31	347	70,000	4200	4000	136	Ribbed
516567	929000788813	EvoKit 2x4 P 47L 36W 835 6 0-10 7 G4	36	347	70,000	4700	3500	132	Ribbed
516500	929000788213	EvoKit 2x4 P 47L 35W 840 6 0-10 7 G4	35	347	70,000	4700	4000	135	Ribbed

See footnotes on the last page.

EvoKit LED retrofit kit gen 4

Ordering guide (continued from previous page)

Product Number	12NC	Description	Watts	Volts	Lumen Maintenance (Hrs.)[2]	Approx. Lumens[3]	Color Temp. (K)	Efficacy	Diffusor
Dimming: SR									
516013	929000783413	EvoKit 2x2 P 32L 25W 835 2 SR 7 G4	25	120-277	70,000	3200	3500	129	Ribbed
♦ 515957	929000782813	EvoKit 2x2 P 32L 24W 840 2 SR 7 G4	24	120-277	70,000	3200	4000	132	Ribbed
516245	929000785613	EvoKit 2x4 P 30L 23W 835 2 SR 7 G4	23	120-277	70,000	3000	3500	131	Ribbed
516203	929000785213	EvoKit 2x4 P 30L 23W 840 2 SR 7 G4	23	120-277	70,000	3000	4000	133	Ribbed
516435	929000787513	EvoKit 2x4 P 42L 32W 835 2 SR 7 G4	32	120-277	70,000	4200	3500	132	Ribbed
♦ 516377	929000786913	EvoKit 2x4 P 42L 32W 840 2 SR 7 G4	32	120-277	70,000	4200	4000	134	Ribbed
516542	929000788613	EvoKit 2x4 P 47L 36W 835 2 SR 7 G4	36	120-277	70,000	4700	3500	130	Ribbed
516484	929000788013	EvoKit 2x4 P 47L 36W 840 2 SR 7 G4	36	120-277	70,000	4700	4000	132	Ribbed
517557	929000799513	EvoKit 2x4 P 42L 32W 835 2 SR 7 G4 SM	32	120-277	70,000	4200	3500	132	Smooth
517532	929000799313	EvoKit 2x4 P 42L 32W 840 2 SR 7 G4 SM	32	120-277	70,000	4200	4000	134	Smooth
517490	929000798913	EvoKit 2x2 P 32L 25W 835 2 SR 7 G4 SM	25	120-277	70,000	3200	3500	129	Smooth
517474	929000798713	EvoKit 2x2 P 32L 24W 840 2 SR 7 G4 SM	24	120-277	70,000	3200	4000	132	Smooth
EvoKit with Air Return									
515494	929000781013	EvoKit 2x2 A 23L 17W 835 2 0-10 7 G4	17	120-277	70,000	2300	3500	134	Ribbed
515544	929000781113	EvoKit 2x2 A 23L 17W 840 2 0-10 7 G4	17	120-277	70,000	2300	4000	136	Ribbed
515551	929000781213	EvoKit 2x2 A 32L 24W 835 2 0-10 7 G4	24	120-277	70,000	3200	3500	135	Ribbed
515585	929000781513	EvoKit 2x2 A 32L 25W 835 2 SR 7 G4	24	120-277	70,000	3200	3500	130	Ribbed
515569	929000781313	EvoKit 2x2 A 32L 24W 840 2 0-10 7 G4	24	120-277	70,000	3200	4000	135	Ribbed
515577	929000781413	EvoKit 2x2 A 32L 24W 840 2 SR 7 G4	24	120-277	70,000	3200	4000	133	Ribbed
516054	929000783813	EvoKit 2x4 A 30L 22W 835 2 0-10 7 G4	22	120-277	70,000	3000	3500	135	Ribbed
516062	929000783913	EvoKit 2x4 A 30L 23W 835 2 SR 7 G4	23	120-277	70,000	3000	3500	132	Ribbed
516195	929000785113	EvoKit 2x4 A 30L 22W 840 2 0-10 7 G4	22	120-277	70,000	3000	4000	138	Ribbed
516047	929000783713	EvoKit 2x4 A 30L 22W 840 2 SR 7 G4	22	120-277	70,000	3000	4000	136	Ribbed
516088	929000784013	EvoKit 2x4 A 36L 27W 835 2 0-10 7 G4	27	120-277	70,000	3600	3500	135	Ribbed
516096	929000784113	EvoKit 2x4 A 36L 26W 840 2 0-10 7 G4	26	120-277	70,000	3600	4000	137	Ribbed
516120	929000784413	EvoKit 2x4 A 42L 31W 835 2 0-10 7 G4	32	120-277	70,000	4200	3500	134	Ribbed
516138	929000784513	EvoKit 2x4 A 42L 32W 835 2 SR 7 G4	32	120-277	70,000	4200	3500	132	Ribbed
516104	929000784213	EvoKit 2x4 A 42L 31W 840 2 0-10 7 G4	31	120-277	70,000	4200	4000	136	Ribbed
516112	929000784313	EvoKit 2x4 A 42L 31W 840 2 SR 7 G4	36	120-277	70,000	4200	4000	135	Ribbed
516161	929000784813	EvoKit 2x4 A 47L 36W 835 2 0-10 7 G4	36	120-277	70,000	4700	3500	132	Ribbed
516179	929000784913	EvoKit 2x4 A 47L 36W 835 2 SR 7 G4	36	120-277	70,000	4700	3500	131	Ribbed
516146	929000784613	EvoKit 2x4 A 47L 35W 840 2 0-10 7 G4	35	120-277	70,000	4700	4000	135	Ribbed
516153	929000784713	EvoKit 2x4 A 47L 35W 840 2 SR 7 G4	35	120-277	70,000	4700	4000	134	Ribbed

See footnotes on the last page.

EvoKit LED retrofit kit gen 4

EvoKit with SpaceWise DT technology

Product Number	12NC	Description	Watts	Volts	Lumen Maint. (Hrs.)[2]	Approx. Lumens[3]	Color Temp. (K)	Efficacy	Diffusor
♦ 518332	929001709313	EvoKit 2x2 P 32L 25W 835 2 SWZDT 7 G4	25	120-277	70,000	3200	3500	129	Ribbed
♦ 518324	929001709213	EvoKit 2x2 P 32L 24W 840 2 SWZDT 7 G4	24	120-277	70,000	3200	4000	132	Ribbed
518407	929001710013	EvoKit 2x4 P 30L 23W 835 2 SWZDT 7 G4	23	120-277	70,000	3000	3500	131	Ribbed
518415	929001710113	EvoKit 2x4 P 30L 23W 840 2 SWZDT 7 G4	23	120-277	70,000	3000	4000	133	Ribbed
♦ 518423	929001710213	EvoKit 2x4 P 42L 32W 835 2 SWZDT 7 G4	32	120-277	70,000	4200	3500	132	Ribbed
♦ 518431	929001710313	EvoKit 2x4 P 42L 32W 840 2 SWZDT 7 G4	32	120-277	70,000	4200	4000	134	Ribbed
518449	929001710413	EvoKit 2x4 P 47L 36W 835 2 SWZDT 7 G4	36	120-277	70,000	4700	3500	130	Ribbed
518456	929001710513	EvoKit 2x4 P 47L 36W 840 2 SWZDT 7 G4	36	120-277	70,000	4700	4000	132	Ribbed
518316	929001709113	EvoKit 2x2 A 32L 25W 835 2 SWZDT 7 G4	25	120-277	70,000	3200	3500	130	Ribbed
518308	929001709013	EvoKit 2x2 A 32L 24W 840 2 SWZDT 7 G4	24	120-277	70,000	3200	4000	133	Ribbed
518357	929001709513	EvoKit 2x4 A 30L 23W 835 2 SWZDT 7 G4	23	120-277	70,000	3000	3500	132	Ribbed
518340	929001709413	EvoKit 2x4 A 30L 22W 840 2 SWZDT 7 G4	22	120-277	70,000	3000	4000	136	Ribbed
518373	929001709713	EvoKit 2x4 A 42L 32W 835 2 SWZDT 7 G4	32	120-277	70,000	4200	3500	132	Ribbed
518365	929001709613	EvoKit 2x4 A 42L 31W 840 2 SWZDT 7 G4	31	120-277	70,000	4200	4000	135	Ribbed
518399	929001709913	EvoKit 2x4 A 47L 36W 835 2 SWZDT 7 G4	36	120-277	70,000	4700	3500	131	Ribbed
518381	929001709813	EvoKit 2x4 A 47L 35W 840 2 SWZDT 7 G4	35	120-277	70,000	4700	4000	134	Ribbed

See footnotes on page 9. Please refer to Philips.com/Spacewise for more detailed specification sheets as well as a list of compatible wireless dimming switches.

Features

- Occupancy sensing, daylight harvesting and task tuning in one device
- Granular dimming (occupancy sharing)
- Dwell time
- Scene setting
- Configuration of sensor parameters– if desired – using NFC or IR via intuitive Android-based Philips field apps
- Quick task tuning in the field to optimize light and power levels
- Enables auto-off/manual-on and auto-off/ partial-on application
- DLC qualified: Listed on the QPL for Networked Lighting Controls

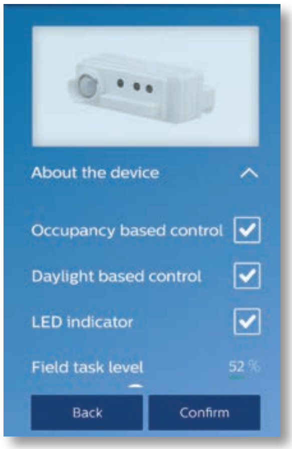
Benefits

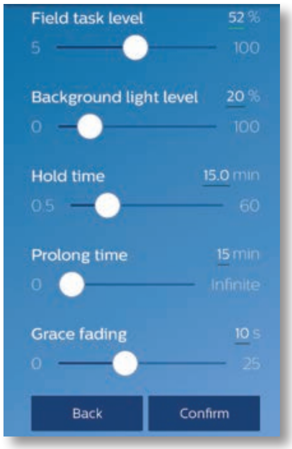
- Installation savings - integral wireless controls factory installed. No need to order separate components.
- Minimal startup and configuration expertise - savings on labor time & effort
- Deep energy savings & code compliance strategies
- Faster ROI with attractive payback periods (varies depending on luminaire choices)

Applications

- Conference rooms
- Individual offices
- Open offices
- Classrooms
- Storage and break areas
- Restrooms
- Lobbies

New configuration tool





Sensor parameters can be configured via Philips field apps. Two versions are available:

1. NFC – This app allows configuring sensor parameters only when you can physically access the sensor with a smartphone.
2. IR – This app allows configuring sensor parameters plus enables grouping to a wireless switch, which can be done with the IR feature of applicable phones from floor level.

You must first register for the app to receive a username and password, then download Philips field apps from the Google Play Store.

Refer to the website for registration details:

www.usa.lighting.philips.com/support/support/tools/

EvoKit LED retrofit kit gen 4

Application

- A highly efficient, visually comfortable, architecturally styled LED retrofit kit designed to replace recessed linear fluorescent troffers.
- Unique modular design offers refreshing new look in the ceiling when compared to traditional fluorescent luminaires.
- Single light bar combined with slanted troffer helps reflect light to reduce glare and provide uniform light distribution making it ideal for applications such as offices, schools, healthcare and retail.
- Excellent color rendering with a CRI above 80.
- Extremely high efficacies up to 138 lumens per watt.
- LEDs are an excellent source for use with controls since dimming or frequent switching does not degrade the performance or life of the source.
- Designed for use with standard grid (NEMA “G”) or Narrow Grid (NEMA “NFG”) ceiling T-Grids.
- High efficiency source and luminaire design help significantly reduce energy consumption and more easily comply with known energy codes.
- Helps meet regulation requirements such as ASHRAE 90.1 and Title 24 when matched with suitable controls.

Construction/Finish

- Simple design allows for quick installation in existing luminaire without the need to break the ceiling plenum.
- Constructed using galvanized steel which helps fight rust and makes for more durable product.
- Integrated ceiling tabs for securement within the ceiling for areas prone to extreme conditions
- Minimum depth of only 3" necessary to allow proper clearance and installation of the EvoKit.
- Retrofit kit is powder coated after fabrication with high quality, durable finish to ensure no unfinished edges and avoid future potential of corrosion.
- Components fit together easily without the need for tools during installation.

Electrical

- Multiple driver options available
  - Philips Advance Xitanium SR driver allows flexibility to integrate a range of control options.
  - 0-10V dimming satisfies universal voltage requirements
- 5-year limited warranty includes all components of the retrofit kit, including driver, LED board and nonelectrical components.***
- Listed with UL and Design Lights Consortium‡ to ensure quality performance and safety standards are met.
- High efficiency LEDs have a minimum 70,000 hour rated life (L_{70}).

Enclosure

- Diffuser requires no frames or fasteners and can be easily removed from below without tools if needed.

Accessories

- Suitable for use with Philips 503441 emergency backup.
- Suitable for use with a wide range of control systems.
- Appropriate for new construction when used with standard listed lensed or parabolic troffers.

Prod. No.	Description
517987	EvoKit 2x4 replacement lens ribbed
517748	EvoKit 2x4 replacement lens smooth
517979	EvoKit 2x2 replacement lens ribbed
517755	EvoKit 2x2 replacement lens smooth
503441	EvoKit field installed emergency battery backup (requires the use of bracket)
517730	EvoKit emergency battery backup bracket (brackets come in packs of 4)

EvoKit with new SimpleSet technology for wireless lumen level programming

EvoKit with new SimpleSet technology allows the maximum lumen level to be set prior to installation using a smartphone-based app without requiring power to the luminaire. Available in the 0-10V and SR versions only. The app can be downloaded at Google Play. Please contact your Philips representative for the current list of approved Android smartphones. Distributors can set lumen levels prior to shipping, and contractors can set lumen levels prior to installation. Lumen level is quickly and easily set in two steps:

Step 1: Place the smartphone next to the NFC antenna on the driver.

Step 2: Follow the on-screen instructions.

EvoKit LED retrofit kit gen 4

EvoKit with air return

The air return versions of EvoKit are suitable for retrofitting listed air return troffers.

2x2 air return data

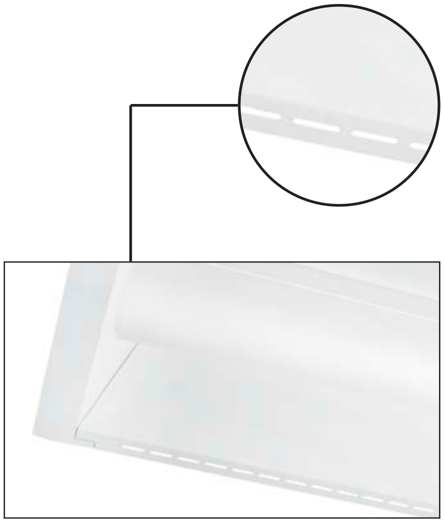
Return Air Volume, SCFM.	61	69	80	97	112	131
Negative Static Pressure, in. H_20	0.11	0.15	0.20	0.30	0.40	0.55
**Noise Criteria (NC)	17	21	25	31	34	38

Note: 24 total air slots, each 30mm x 6mm.

2x4 air return data

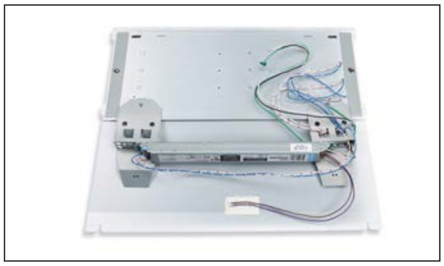
Return Air Volume, SCFM.	105	119	128	162	259	272
Negative Static Pressure, in. H_20	0.05	0.08	0.10	0.20	0.45	0.55
**Noise Criteria (NC)	<15	32	32	36	38	40

Note: 50 total air slots, each 30mm x 6mm.



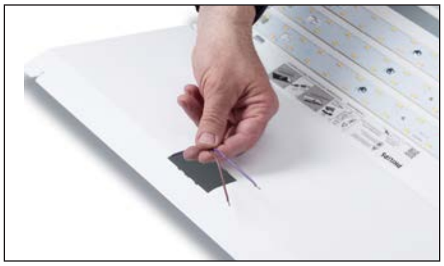
EvoKit Sensor Ready (SR) with Philips Advance Xitanium SR for connected lighting solutions

EvoKit SR is a new platform that allows users to choose different control platforms to suit their needs and budget; from simple occupancy and daylight sensing to cloud-connected data-reporting sensing. This empowers users to fine-tune their energy use for reduced energy costs. Various Philips EasySense, SpaceWise and other SR certified controls are available. Please refer to Philips.com/Evokit for details. Contact your Philips representative for a current list of additional approved sensors. Sensors are connected in the field with just a few simple steps:



Step 1: Evokit SR is shipped with a plate covering the sensor hole. There are two wires secured to the back of the plate.

Step 2: The plate can be removed before or after you install EvoKit SR. Just gently slide the plate to one end and remove.



Step 3. Remove the two wires that were secured to the back of the plate.

Step 4: Take these two wires and insert them into the sensor. They are not polarity sensitive.

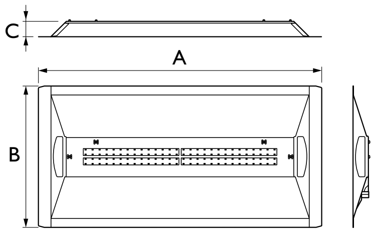
Step 5: Insert the sensor back into the hole. The sensor may or may not require a socket.

Commercial Product Name	Order Code
EasySense EVO102	514877
EasySense EVO200	516575
EasySense EVO300	517763

EvoKit LED retrofit kit gen 4

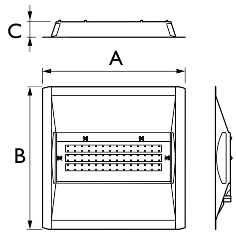
Dimensions 2x4

A Face Plate Length	B Face Plate Width	C Height
47.83"	23.9"	2.95"



Dimensions 2x2

A Face Plate Length	B Face Plate Width	C Height
23.9"	23.9"	2.95"



2'x2' EvoKit, P 23L 17W 835 2 0-10 7 G4, 2,202 delivered lumens

Catalog No.	515692
Test No.	x223L
S/MH	1.2
Lamp Type	LED
Lumens/Watt	131
Input Watts	17

Comparative yearly lighting energy cost per 1000 lumens - $1.83 based on 3000 hours and $0.08/kWh

The photmetric results were obtained in the Design Lights Consortium Test Lab which is NVLAP accredited by the National Institute of Standards and Technology

Photometric values based on tests performed in compliance with LM-79

Candlepower

Angle	End	Cross	Back–45
0	800	800	0
5	799	796	0
10	785	784	0
15	763	765	0
20	733	738	0
25	695	704	0
30	650	663	0
35	600	617	0
40	545	569	0
45	486	519	0
50	427	468	0
55	365	418	0
60	304	367	0
65	243	313	0
70	182	255	0
75	124	192	0
80	71	126	0
85	26	60	0

Coefficients of Utilization
EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pcc	80			70			50	
pw	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	115	115	115	111	111
1	108	104	98	106	101	96	96	93
2	97	90	82	95	88	81	84	79
3	90	79	70	86	77	69	73	68
4	81	69	60	80	68	59	66	58
5	76	63	53	72	60	53	58	52
6	69	56	46	68	55	46	54	46
7	65	51	41	63	50	41	48	40
8	59	46	38	58	46	38	45	36
9	56	42	34	55	41	34	40	34
10	53	40	32	52	39	30	38	30

Light Distribution

Degrees	Lumens	% Luminaire
0-30	609	27.7
0-40	984	44.7
0-60	1709	77.6
0-90	2202	100

Average Luminance

Angle	End	45°	Cross
45	5897	6110	6297
55	5463	5913	6259
65	4936	5867	6356
75	4122	5880	6369
85	2597	5689	5953

2'x2' EvoKit, P 32L 24W 835 2 0-10 7 G4, 3,062 delivered lumens

Catalog No.	516005
Test No.	x232L
S/MH	1.2
Lamp Type	LED
Lumens/Watt	129
Input Watts	24

Comparative yearly lighting energy cost per 1000 lumens - $1.86 based on 3000 hours and $0.08/kWh

The photmetric results were obtained in the Design Lights Consortium Test Lab which is NVLAP accredited by the National Institute of Standards and Technology

Photometric values based on tests performed in compliance with LM-79

Candlepower

Angle	End	Cross	Back–45
0	1112	1112	0
5	1109	1102	0
10	1090	1082	0
15	1060	1052	0
20	1018	1010	0
25	966	959	0
30	903	901	0
35	832	836	0
40	756	768	0
45	674	699	0
50	591	630	0
55	506	559	0
60	421	486	0
65	338	410	0
70	254	328	0
75	173	238	0
80	99	148	0
85	37	51	0

Coefficients of Utilization
EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pcc	80			70			50	
pw	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	115	115	115	111	111
1	108	104	98	106	101	96	96	93
2	97	90	82	95	88	81	84	79
3	90	79	70	86	77	69	73	67
4	81	69	60	80	68	59	66	58
5	76	63	53	72	60	53	58	52
6	69	56	46	68	55	46	54	46
7	65	51	41	63	50	41	48	40
8	59	46	38	58	46	38	45	36
9	56	42	34	55	41	34	40	34
10	53	40	32	52	39	30	38	30

Light Distribution

Degrees	Lumens	% Luminaire
0-30	846	27.6
0-40	1369	44.7
0-60	2377	77.6
0-90	3062	100

Average Luminance

Angle	End	45°	Cross
45	8183	8270	8488
55	7572	7953	8358
65	6858	7768	8336
75	5744	7440	7901
85	3651	5398	4985

EvoKit LED retrofit kit gen 4

2'x4' EvoKit, P 30L 22W 835 2 0-10 7 G4, 2,758 delivered lumens

Catalog No.	516237
Test No.	x430L
S/MH	1.2
Lamp Type	LED
Lumens/Watt	133
Input Watts	21

Comparative yearly lighting energy cost per 1000 lumens - $1.80 based on 3000 hours and $0.08/kWh

The photmetric results were obtained in the Design Lights Consortium Test Lab which is NVLAP accredited by the National Institute of Standards and Technology

Photometric values based on tests performed in compliance with LM-79

Candlepower

Angle	End	45	Cross	Back–45
0	952	952	952	952
5	937	948	962	946
15	899	911	927	907
25	824	838	855	832
35	585	613	642	604
45	445	488	531	480
55	648	700	762	686
65	299	369	413	362
75	156	239	263	232
85	35	79	78	67

Coefficients of Utilization
EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pcc	80			70			50	
pw	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	115	115	115	111	111
1	108	103	97	105	101	96	95	93
2	97	89	81	94	86	81	83	78
3	89	78	69	86	76	68	72	67
4	81	68	59	79	68	58	65	57
5	75	61	52	72	59	52	57	51
6	68	55	46	67	54	46	53	45
7	64	50	40	61	48	40	47	40
8	59	46	36	57	45	36	44	35
9	56	41	34	54	40	34	40	33
10	52	39	30	51	38	30	36	29

Light Distribution

Degrees	Lumens	% Luminaire
0-30	731	26.5
0-40	1189	43.1
0-60	2092	75.9
0-90	2758	100

Average Luminance

Angle	End	45°	Cross
45	4125	4319	4526
55	3864	4239	4613
65	3524	4350	4864
75	3004	4607	5066
85	2007	4500	4471

2'x4' EvoKit, P 36L 27W 835 2 0-10 7 G4, 3,368 delivered lumens

Catalog No.	516286
Test No.	x436L
S/MH	1.3
Lamp Type	LED
Lumens/Watt	132
Input Watts	26

Comparative yearly lighting energy cost per 1000 lumens - $1.82 based on 3000 hours and $0.08/kWh

The photmetric results were obtained in the Design Lights Consortium Test Lab which is NVLAP accredited by the National Institute of Standards and Technology

Photometric values based on tests performed in compliance with LM-79

Candlepower

Angle	End	45	Cross	Back–45
0	1167	1167	1167	1167
5	1149	1161	1180	1159
15	1103	1117	1136	1111
25	1012	1027	1048	1019
35	883	901	925	890
45	718	749	783	738
55	548	596	645	586
65	370	450	502	441
75	195	290	320	282
85	45	87	93	82

Coefficients of Utilization
EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pcc	80			70			50	
pw	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	115	115	115	111	111
1	108	103	97	105	101	96	95	93
2	97	89	81	94	86	81	83	78
3	89	78	69	86	77	68	73	67
4	81	68	59	79	68	58	65	57
5	75	61	52	72	60	52	57	51
6	68	56	46	67	55	46	53	45
7	64	50	40	61	50	40	47	40
8	59	46	36	57	45	36	44	35
9	56	41	34	54	41	34	40	33
10	52	39	30	51	38	30	36	29

Light Distribution

Degrees	Lumens	% Luminaire
0-30	896	26.6
0-40	1456	43.2
0-60	2559	76.0
0-90	3368	100

Average Luminance

Angle	End	45°	Cross
45	5063	5281	5517
55	4758	5181	5606
65	4363	5306	5915
75	3758	5574	6159
85	2550	4992	5340

EvoKit LED retrofit kit gen 4

2'x4' EvoKit, P 42L 32W 835 2 0-10 7 G4, 4,134 delivered lumens

Catalog No.	516427
Test No.	x442L
S/MH	1.3
Lamp Type	LED
Lumens/Watt	131
Input Watts	32

Comparative yearly lighting energy cost per 1000 lumens - $1.83 based on 3000 hours and $0.08/kWh

The photmetric results were obtained in the Design Lights Consortium Test Lab which is NVLAP accredited by the National Institute of Standards and Technology

Photometric values based on tests performed in compliance with LM-79

Candlepower

Angle	End	45	Cross	Back–45
0	1435	1435	1435	1435
5	1414	1428	1451	1424
15	1359	1375	1396	1364
25	1247	1264	1288	1249
35	1087	1109	1135	1089
45	888	924	961	902
55	676	734	791	714
65	457	552	614	535
75	242	358	392	341
85	56	122	117	104

Coefficients of Utilization
EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pcc	80			70			50	
pw	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	115	115	115	111	111
1	108	103	97	105	101	96	95	93
2	97	89	81	94	86	81	83	78
3	89	78	69	86	77	68	73	67
4	81	68	59	79	68	58	65	57
5	75	61	53	72	60	52	57	51
6	68	56	46	67	55	46	53	45
7	64	50	40	61	50	40	47	40
8	59	46	36	57	45	36	44	35
9	56	41	34	54	41	34	40	33
10	52	39	30	51	38	30	36	29

Light Distribution

Degrees	Lumens	% Luminaire
0-30	1102	26.7
0-40	1790	43.3
0-60	3143	76.0
0-90	4134	100

Average Luminance

Angle	End	45°	Cross
45	4688	4877	5077
55	4403	4775	5147
65	4033	4881	5427
75	3484	5171	5655
85	2412	5244	5021

2'x4' EvoKit, P 47L 36W 835 2 0-10 7 G4, 4,662 delivered lumens

Catalog No.	516534
Test No.	x447L
S/MH	1.3
Lamp Type	LED
Lumens/Watt	131
Input Watts	36

Comparative yearly lighting energy cost per 1000 lumens - $1.83 based on 3000 hours and $0.08/kWh

The photmetric results were obtained in the Design Lights Consortium Test Lab which is NVLAP accredited by the National Institute of Standards and Technology

Photometric values based on tests performed in compliance with LM-79

Candlepower

Angle	End	45	Cross	Back–45
0	1616	1616	1616	1616
5	1593	1609	1634	1604
15	1534	1548	1574	1536
25	1408	1425	1451	1408
35	1230	1250	1280	1227
45	1007	1041	1085	1016
55	767	827	893	805
65	519	624	693	603
75	277	405	443	384
85	68	139	133	119

Coefficients of Utilization
EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pcc	80			70			50	
pw	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	115	115	115	111	111
1	108	103	97	105	101	96	95	93
2	97	89	81	94	86	81	83	78
3	89	78	69	86	77	68	73	67
4	81	68	59	79	68	58	65	57
5	75	61	52	72	60	52	57	51
6	68	56	46	67	55	46	53	45
7	64	50	40	61	50	40	47	40
8	59	46	36	57	45	36	44	35
9	56	41	34	54	41	34	40	33
10	52	39	30	51	38	30	36	29

Light Distribution

Degrees	Lumens	% Luminaire
0-30	1241	26.6
0-40	2017	43.3
0-60	3543	76.0
0-90	4662	100

Average Luminance

Angle	End	45°	Cross
45	5317	5496	5727
55	4990	5386	5813
65	4587	5511	6119
75	3990	5849	6384
85	2913	5968	5711

EvoKit LED retrot kit gen 4

Energy saving solution – EvoKit 2'x4'

Estimated lighting costs using a standard 3 lamp T8 troer			
Present Wattage		85	W
× Annual operating hours		4,380	hrs
	=	372,300	Watt-Hours
÷ 1,000	=	372.3	kWh per year
× kWh rate of $0.10	=	$37.23	per year
× 125 xtures		$4,653.75	annual energy cost per space

Estimated lighting costs using a Philips 42L 2x4 Evokit G4			
Present Wattage		31	W
× Annual operating hours		4,380	hrs
	=	135,780	Watt-Hours
÷ 1,000	=	135.78	kWh per year
× kWh rate of $0.10	=	$13.58	per year
× 125 xtures		$1,697.25	annual energy cost per space
Total estimated annual savings◊		$2,956.50	

◊ Based on 125 xtures per space operating 4,380 hours a year. 125 xtures is roughly equivalent to a 10,000 square foot space. kWh rates will vary.

FOOTNOTES:

1) Please refer to the energy saving chart above for details.
2) L_{70} 72,000 hours @ 35°C based on TM21 and LM80.
3) Based on photometric testing consistent with IES LM-79. Actual wattage may dier by +/- 10%. Actual initial lumen output may vary between -10 and +10% of the rated lumens.

♦ Made to s0tock product (Contact your Philips sales representative for stock availability and lead time).

*** Please visit www.philips.com/warranties for full details.

† Restrictions on Hazardous Substances (RoHS) is a European directive (2002/95/EC) designed to limit the content of 6 substances [lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE)] in electrical and electrical products. For products used in North America, compliance with RoHS is voluntary and self-certified.

‡ Evokit luminaires are Design Lights Consortium qualied. Please see the DLC QPL list for exact catalog numbers (http://www.designlights.org/QPL).

● These SKUs do not meet DLC Premium qualication criteria. Evokit luminaires are Design Lights Consortium qualied. Please see the DLC QPL list for exact catalog numbers (http://www.designlights.org/QPL).

philips.com/evokit

Philips Lighting North America Corporation
200 Franklin Square Drive, Somerset, NJ 08873
Tel. 855-486-2216

Philips Lighting Canada Ltd.
281 Hillmount Rd, Markham, ON, Canada L6C 2S3
Tel. 800-668-9008

G4R14940120W

RAB

UPC: 019813513003

UL LISTED

Color: White   Weight: 1.0 lbs

Project:	Type:
Prepared By:	Date:

Driver Info

Type	Constant Current
120V	0.14A
208V	N/A
240V	N/A
277V	N/A
Input Watts	14W

LED Info

Watts	14W
Color Temp	4000K (Neutral)
Color Accuracy	90 CRI
L70 Lifespan	50,000 Hours
Lumens	1,050
Efficacy	75 lm/W

Technical Specifications

Listings

UL Listed:

Suitable for wet locations

ENERGY STAR V2.2:

This product is ENERGY STAR® Version 2.2 Certified.

Energy Star Model Number:

DLG0009

NEC Compliant:

Suitable for use in closets. Compliant with NEC Sec. 410.16 (A)(1) and 410.16 (C5).

California Title 24:

Can be used to conform with the requirements of California Title 24 Part 6.

Electrical

Dimming Driver:

TRIAC compatible dimmer with dimming as low as 5%. See dimmer compatibility guide here.

Power Factor:

≥0.9

Remote Driver:

Die-cast metal driver / junction box with a hinged cover.
Listed for 12AWG and 14AWG conduit.
Includes two metal knockouts for wiring.
Quick connectors included.
Plenum rated cable connector to connect from module to remote driver box.

PF:

≥0.9

Input Voltage:

120V

Operating Frequency (Hz):

60Hz

Performance

Lifespan:

50,000-Hour LED lifespan based on IES LM-80 results and TM-21 calculations

Construction

IC Rated:

Suitable for direct contact with insulation.
Type IC inherently protected, suitable for direct contact to air permeable insulation and cULus listed for damp locations.
Not for use in direct contact with spray foam insulation, consult NEMA LSD57-2013.

Air Tight:

Housing certified Air Tight as per ASTM E283

G4R14940120W

Technical Specifications (continued)

Construction

Housing:

Precision die-cast aluminum

Aperture:

4" Round

Adjustable Lens:

With a 30° tilt and can rotate 360°

Trim Style:

Smooth Trrim

Cold Weather Starting:

The minimum starting temperature is -30°C (-22°F)

Maximum Ambient Temperature:

Suitable for use in up to 35°C (95°F)

Green Technology:

Mercury and UV free. RoHS-compliant components.

Mounting:

Robust retention clips spring loaded tabs ensure the fixture is securely installed. Can be installed in 1/4" to 1 1/2" thick ceilings.

Lens:

Diffuse Polystyrene lens produces smooth uniform light that is glare free

Finish:

Matte White

Optical

Beam Angle:

38° narrow beam spread for accent lighting

LED Characteristics

LEDs:

Long-life, high-efficacy, surface-mount LEDs

Wattage Equivalency:

100W Incandescent

R9 Value:

High color performance with R9 greater than or equal to 50

Flicker:

Silent and flicker free operations of less than 30%

Other

Template:

Template included for easy ceiling cut out

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

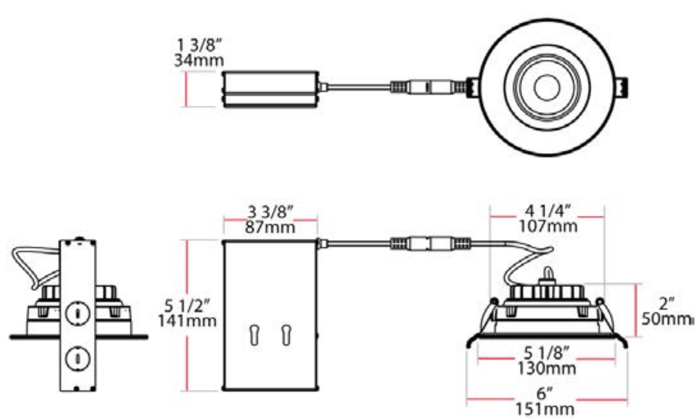
Minimum Compartment Size

Length x Width x Height [in]	Lamp Quantity
47.8 x 23.8 x 3.0	4

Case and Pallet Dimensions

	QTY	LENGTH (in)	WIDTH (in)	HEIGHT (in)
CASE	6	10.43	9.84	7.28
PALLET	576	6.61	5.04	44.88

Dimension

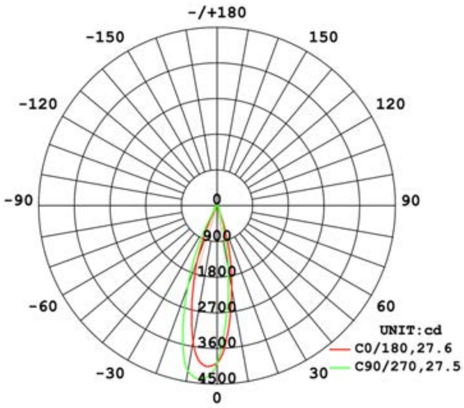


 Note: Specifications are subject to change at any time without notice

G4R14940120W

RAB

Light Distribution



Features

- Adjustable lens with 32 degree tilt and 360 degree rotation
- No recessed housing or J-box required
- New construction or retrofit applications
- UL wet location rated
- Spring loaded retention clips
- Robust, die cast aluminum construction
- IC and airtight rated
- 5-Year, No-Compromise Warranty

Ordering Matrix

Family	Size	Shape	Wattage	CRI/Color Temp	Voltage	Finish
G	4	R	14	940	120	W
	2 = 2" **3** = 3" **4** = 4"	**R** = Round	**5** = 400lm **8** = 600lm **14** = 1050lm	**940** = 90 CRI, 4000K (Neutral) **930** = 90 CRI, 3000K (Warm) **927** = 90 CRI, 2700K (Residential Warm)	**120** = 120V	**W** = White

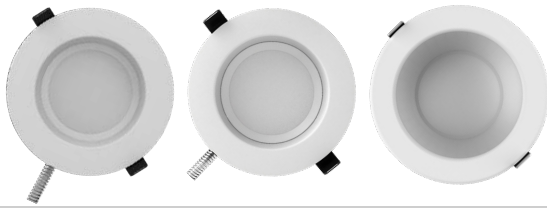
Performance Downlight
Field-Adjustable

RAB

6"

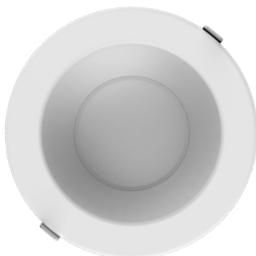
FIELD ADJUSTABLE

9W/12W | 14W/18W | 7W/10W/18W



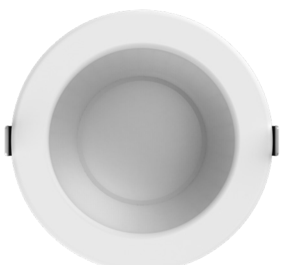
8"

FIELD ADJUSTABLE



9.5"

FIELD ADJUSTABLE



Features
- High Performance LEDs for commercial applications
- Replacement for traditional Compact Fluorescent recessed downlights
- Compatible with new construction or retrofit installations
- UL wet and Energy Star rated
- Meets air-tight requirements
- Lumen and CCT Selectable
- Matte white smooth trim finish
- Available in 3 CCTs: 3000K, 3500K, 4000K
- 0-10V dimmable
- Spring loaded retention clips
- 5-Year, No-Compromise Warranty

Project:	Type:
Prepared by:	Date:

Technical Specifications

CCT and Lumen Selectable:
Choose lumen output and color temperature before installation with integrated switch

UL Listed & UL Classified
Suitable for wet locations

Energy Star V2.2:
This product is Energy Star® Version 2.2 Certified.

California Title 24:
Can be used to conform with the requirements of California Title 24 Part 6

Dimming Driver:
Driver includes dimming control wiring for 0-10V dimming systems. Requires seperate 0-10V DC dimming circuit. Dims as low as 10%

Input Voltage:
120V through 277V

Operating Frequency:
50/60Hz

Lifespan:
50,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations

LEDs:
Long-life, high-e□cacy surface-mount LEDs

R9 Value:
High color performance with R9 greater than or equal to 50

Flicker:
Silent and flicker free operations of less than 30%

IC Rated:
Suitable for direct contact with insulation

Air Tight:
Housing certified Air Tight as per ASTM E283

Trim:
Smooth Trim

Housing:
Constructed from durable steel sheet metal

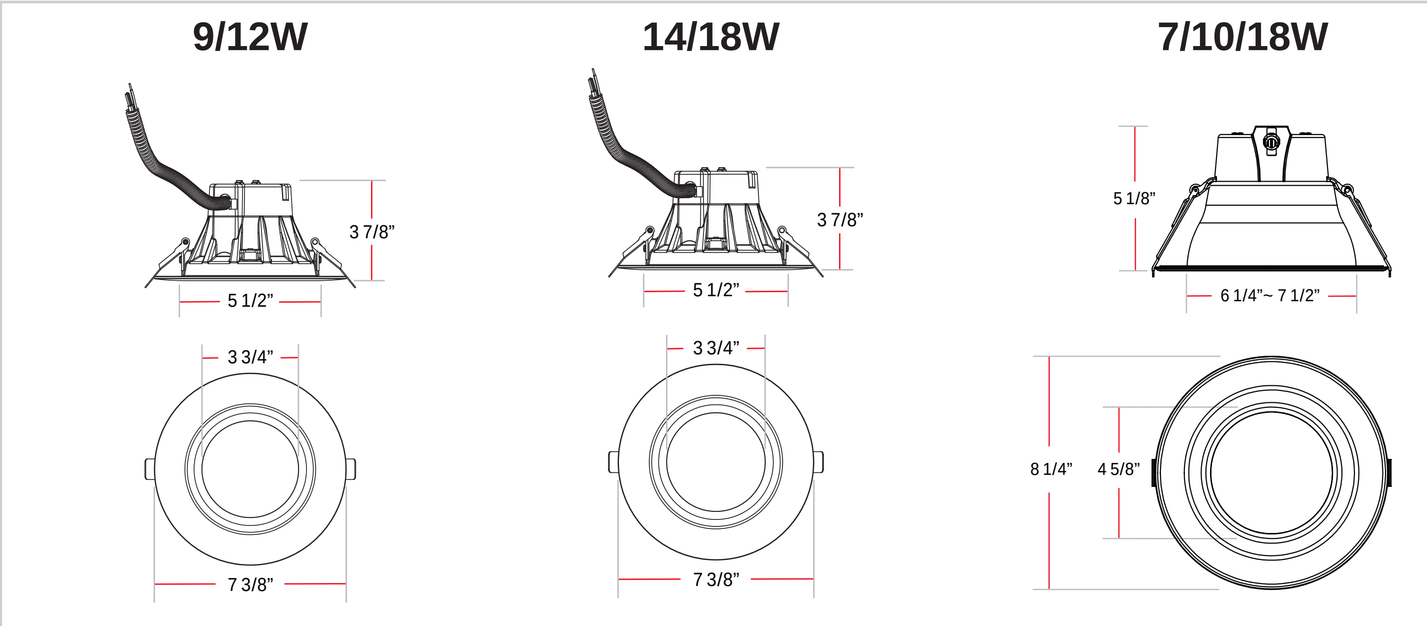
Maximum Ambient Temperature:
Suitable for use in 40°C (104°F)

Finish:
Matte White

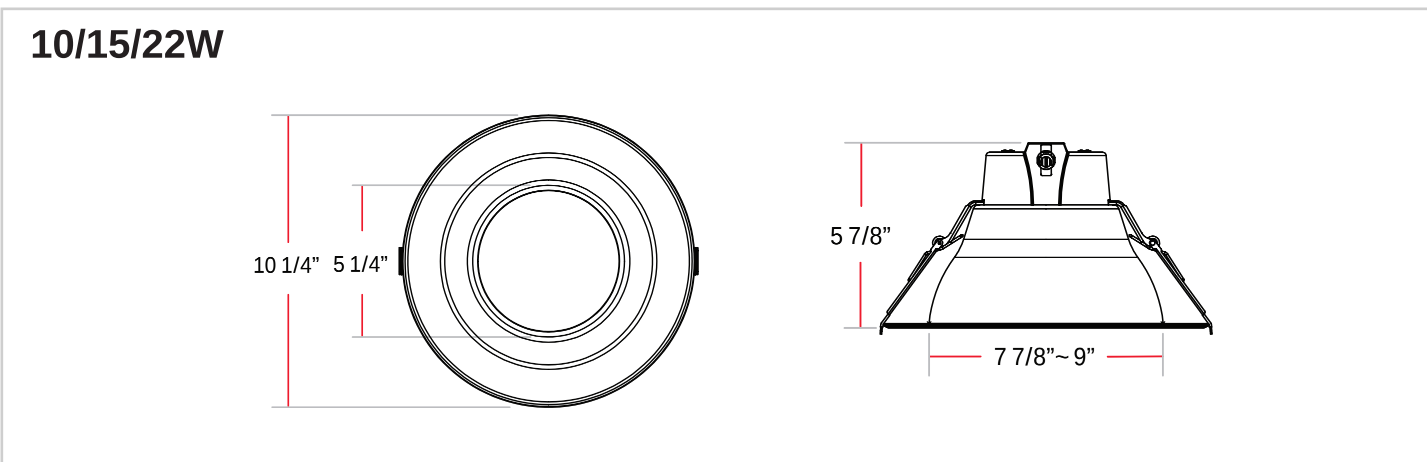
Dimensions

RAB

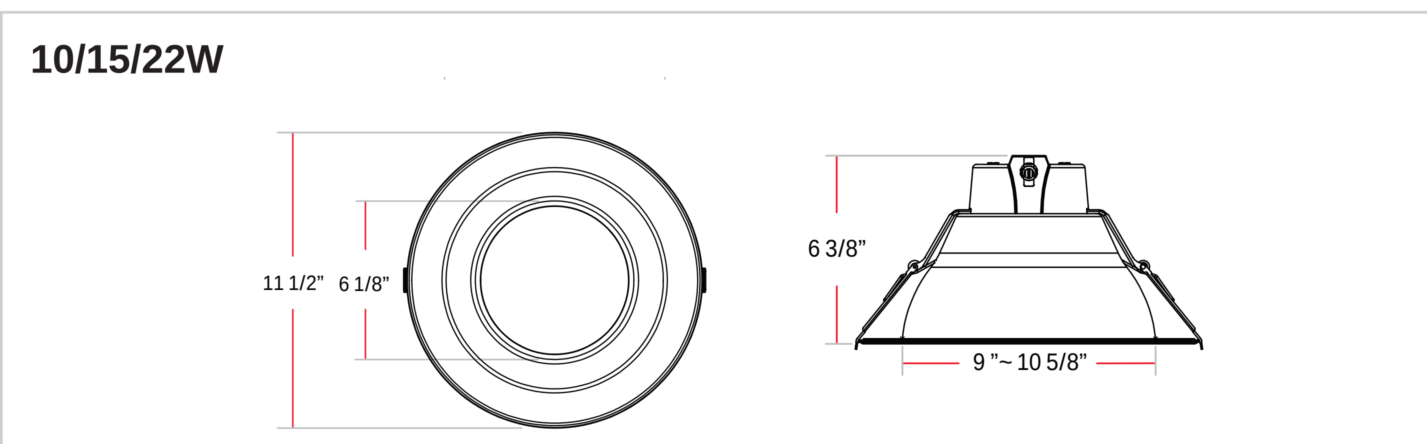
6"



8"



9.5"

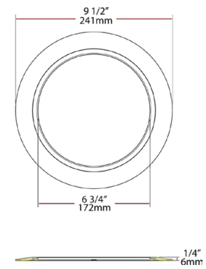
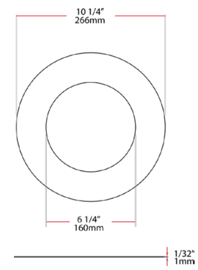
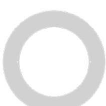
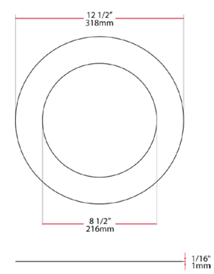
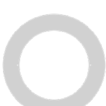
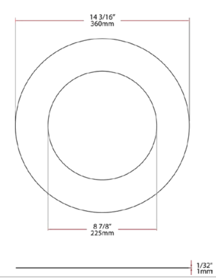


Performance

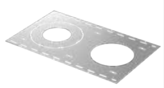
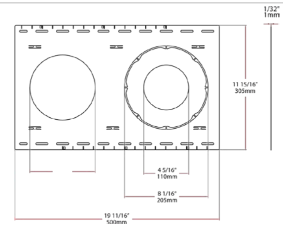
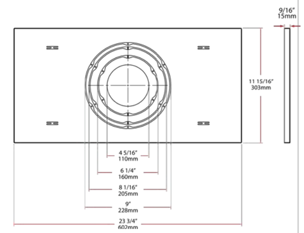
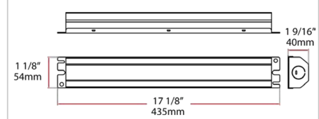
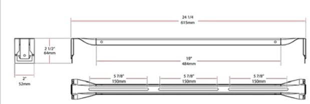
RAB

2 Lumen Output	Size	Wattage	Lumens	Efficacy (lm/W)	Color Accuracy (CRI)
C6R9/129FAUNVW 3000K 3500K 4000K	6"	9/12	700 lm 900 lm	78	90
C6R14/189FAUNVW 3000K 3500K 4000K	6"	14/18	1200 lm 1500 lm	86	90
3 Lumen Output	**Size**	**Wattage**	**Lumens**	**Efficacy (lm/W)**	**Color Accuracy (CRI)**
C6R7/10/189FAUNVW 3000K 3500K 4000K	6"	7/10/18	700 lm 1000 lm 1500 lm	100	90
C8R10/15/229FAUNVW 3000K 3500K 4000K	8"	10/15/22	1000 lm 1500 lm 2000 lm	100	90
C9.5R20/25/329FAUNVW 3000K 3500K 4000K	9.5"	20/25/32	2000 lm 2500 lm 3000 lm	100	90

Accessories

Images	SKU Number	Description	Construction	Dimensions	Case Qty
		Goof Rings - Plastic			
	**DL6-8GOOF/R/P**	6" Goof Ring for 6" Downlight - 2 Lumen Output Models	Robust Polycarbonate construction. Matte White Finish		
		Goof Rings - Metal			
	DL8-10GOOF/R/M	10" Goof Ring for 8" Downlight - 3 Lumen Output Model	High-quality steel construction White powder coat finish		
	**DL10-12GOOF/R/M**	12" Goof Ring for 9.5" Downlight - 3 Lumen Output Model	High-quality steel construction White powder coat finish		
	**DL12-14GOOF/R/M**	12" Goof Ring for 9.5" Downlight - 3 Lumen Output Model	High-quality steel construction White powder coat finish		

Accessories

			Mounting Plates		
	**DLPLATE/SJ**	New Construction Plate for Stud/ Joist mounting for use with 4", 6" smooth and baffle models	Sturdy galvanized steel construction		10
	**DLPLATE/T**	New Construction or Remodel Plate for T-Grid ceilings for use with 4", 6" smooth and baffle models	Sturdy galvanized steel construction		10
			Emergency Driver		
	**DRI-25-EMGR-DC**	Emergency Driver	Sturdy galvanized steel construction		4
	**BRACKET_TG_DRI**	T-Grid bracket for Emergency Driver	Sturdy galvanized steel construction		12

Ordering Matrix

RAB

Product	Size	Shape	Wattage	CRI/Color Temp	Voltage	Finish
C		R		9FA	UNV	W

Size
- **6** 6"
- **8** 8"
- **9.5** 9.5"

Shape
- **R** Round

Wattage
- **700lm-1500lm** 7/10/18
- **700lm-900lm** 9/12
- **1000lm-2000lm** 10/15/22
- **1200lm-1500lm** 14/18
- **2000lm-3000lm** 20/25/32

CRI/Color Temp
- 9FA **90 CRI, Field Adjustable**

Voltage
- **120-277V** UNV

Finish
- **W** White

DLED6AR14YN

RAB

Now, more is less. Economical retrofit downlights with more to offer. Available in standard or adjustable heads.

Color: White

Weight: 1.0 lbs

Project:	**Type:**
Prepared By:	**Date:**

Driver Info

Type	Constant Current
120V	0.104A
208V	N/A
240V	N/A
277V	N/A
Input Watts	12.40W

LED Info

Watts	14W
Color Temp	3500K (Warm Neutral)
Color Accuracy	89 CRI
L70 Lifespan	50,000 Hours
Lumens	980
Efficacy	79 lm/W

Technical Specifications

Listings

UL Classified:

Suitable for damp locations

ENERGY STAR V2.0:

This product is ENERGY STAR® Version 2.0 Certified.

IESNA LM-79 & IESNA LM-80 Testing:

RAB LED luminaires and LED components have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80.

CEC Status:

Not lawful for sale in California

Electrical

Driver:

Constant Current, Class 2, 50/60 Hz, 120V: 0.104A

THD:

11.75% at 120V

Power Factor:

99.3% at 120V

Dimming:

TRIAC and ELV dimming compatibility. See dimmer compatibility guide here.

Construction

Ambient Temperature:

-20°C to 40°C

Housing:

Precision, die-cast aluminum

Installation:

Torsion springs for secure installation

Socket Adapter:

Edison 26 Medium Base Socket adapter included in box

Lens:

Frosted acrylic lens

Finish:

Chip and fade-resistant polyester powder coat finish

DLED6AR14YN

Technical Specifications (continued)

Construction

Green Technology:

Mercury and UV free. RoHS-compliant components.

LED Characteristics

LEDs:

Multi-chip, high-output, long-life LEDs

Performance

Lifespan:

50,000-Hour LED lifespan based on IES LM-80 results and TM-21 calculations

Optical

Adjustable Range:

38° range

Other

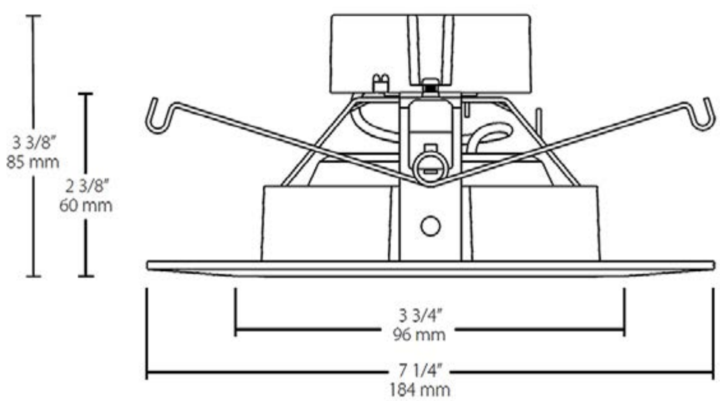
Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Dimensions



Features

- Superior thermal management with heat-dissipating fins
- Specification-grade 90 CRI standard
- Edison E26 Medium Base socket adapter included
- 5-Year, No-Compromise Warranty

Ordering Matrix

Family	Size	Shape	Wattage	Color Temp
DLED	6	AR	14	YN
	6 = 6" **4** = 4"	**R** = Round **AR** = Adjustable Round	**9** = 9W **11** = 11W **14** = 14W	**YN** = 3500K (Warm Neutral) **Y** = 3000K (Warm) **YY** = 2700K (Residential Warm)

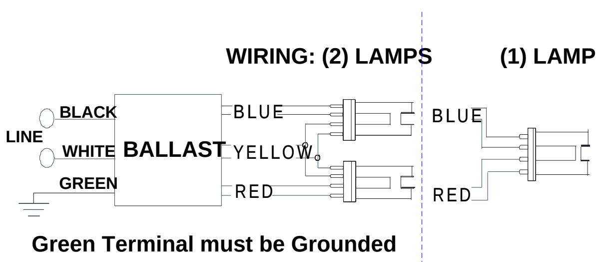
PHILIPS ADVANCE

Electrical Specifications

ICF-2S13-H1-LD@120	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F .
* CFQ13W/G24Q	1	13	0/-18	0.13	16	1.00	10	0.96	1.5	6.25
CFQ13W/G24q	2	13	0/-18	0.25	29	1.00	10	0.99	1.5	3.45
CFS10W/GR10Q	1	10	0/-18	0.11	13	1.05	15	0.96	1.5	8.08
CFS10W/GR10Q	2	10	0/-18	0.19	23	0.95	15	0.97	1.5	4.13
CFS16W/GR10q	1	16	0/-18	0.14	17	1.00	12	0.96	1.5	5.88
CFTR13W/GX24Q	1	13	0/-18	0.13	16	1.00	10	0.96	1.5	6.25
CFTR13W/GX24Q	2	13	0/-18	0.25	29	1.00	10	0.99	1.5	3.45

Wiring Diagram



Green Terminal must be Grounded

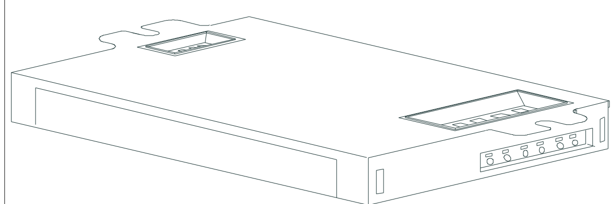
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 08/15/2006

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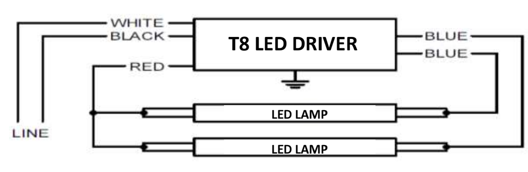
PHILIPS
ADVANCE

ICN-2P16-TLED-N	
Brand Name	**CENTIUM**
Driver Type	**T8 LED Electronic**
Lamp Connection	**Parallel**
Input Voltage	**120-277V**
Input Frequency	**50/60 Hz**
Status	**Active**

Electrical Specifications

Compatible Lamp Information							Driver Specifications @120V/@277V					
T8 LED Lamp Brand	T8 LED Lamp Description	T8 LED Lamp Product No.	T8 LED Lamp Model No.	T8 LED Lamp Ordering Code	Bare Lamp Watts (W)	Nom. Initial Lumens	Min. Start Temp (°F/°C)	Num. of Lamps	Input Current (A)	Input Power (W)	Max THD%	Power Factor
Philips	LED InstantFit T8 - 4'	453589 453597 453605 453613	9290011239 9290011240 9290011241 9290011242	12T8/48-3000 IF 10/1 12T8/48-3500 IF 10/1 12T8/48-4000 IF 10/1 12T8/48-5000 IF 10/1	12	1500 1500 1600 1650	-13/-25	2	0.21/0.09	25	10	0.99/0.96
								1	0.11/0.06	14	15	0.98/0.90
Philips	LED InstantFit T8 - 4' High Output	456897 456905 456913 456921	9290011585 9290011586 9290011587 9290011588	15T8/48-3000 IF 10/1 15T8/48-3500 IF 10/1 15T8/48-4000 IF 10/1 15T8/48-5000 IF 10/1	15	2000 2000 2100 2100	-13/-25	2	0.28/0.12	33	10	0.99/0.97
								1	0.17/0.08	20	15	0.99/0.94
Philips	LED InstantFit T8 - 4' High Output	434860 434878 434886 434894	9290002880 9290002881 9290002882 9290002883	16.5T8/48-3000 IF 10/1 16.5T8/48-3500 IF 10/1 16.5T8/48-4000 IF 10/1 16.5T8/48-5000 IF 10/1	16.5	2000 2000 2100 2150	-13/-25	2	0.33/0.14	40	10	0.99/0.97
								1	0.17/0.08	20	15	0.99/0.94
Philips	LED InstantFit T8 U-Bent -6" High Output	452664 452672 452680 452698	9290011196 9290011197 9290011198 9290011199	16.5T8/22.5-3000 IF-6U 10/1 16.5T8/22.5-3500 IF-6U 10/1 16.5T8/22.5-4000 IF-6U 10/1 16.5T8/22.5-5000 IF-6U 10/1	16.5	2000 2000 2100 2150	-13/-25	2	0.33/0.14	40	10	0.99/0.97
								1	0.17/0.08	20	15	0.99/0.94
Philips	LED InstantFit T8 - 3'	452052 452060 452078 452086	9290011183 9290011184 9290011185 9290011186	10.5T8/36-3000 IF 10/1 10.5T8/36-3500 IF 10/1 10.5T8/36-4000 IF 10/1 10.5T8/36-5000 IF 10/1	10.5	1100 1160 1200 1270	-13/-25	2	0.20/0.09	24	10	0.99/0.95
								1	0.11/0.05	13	15	0.98/0.89
Philips	LED InstantFit T8 - 2'	452011 452029 452037 452045	9290011179 9290011180 9290011181 9290011182	8.5T8/24-3000 IF 10/1 8.5T8/24-3500 IF 10/1 8.5T8/24-4000 IF 10/1 8.5T8/24-5000 IF 10/1	8.5	950 1040 1050 1100	-13/-25	2	0.18/0.08	21	10	0.99/0.94
								1	0.10/0.05	12	15	0.98/0.88

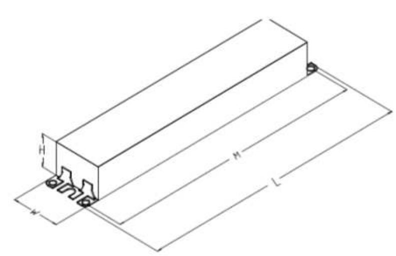
Wiring Diagram



Diag. 64

Standard Lead Length (inches)		
	in.	cm.
Black	24	61.0
White	24	61.0
Blue	28	71.1
Red	43	109.2

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.5 "	1.3 "	1.0 "	8.9 "
9 1/2	1 3/10	1	8 9/10
24.1 cm	3.3 cm	2.5 cm	22.6 cm

RoHS COMPLIANT

Revised: 07/28/15

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PHILIPS
ADVANCE

ICN-2P16-TLED-N	
Brand Name	**CENTIUM**
Driver Type	**T8 LED Electronic**
Lamp Connection	**Parallel**
Input Voltage	**120-277V**
Input Frequency	**50/60 Hz**
Status	**Active**

Electrical Specifications

Notes:

Section I - Physical Characteristics
1.1 Driver shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.
1.2 Driver shall be provided with integral leads color coded per ANSI C82.11.

Section II - Performance Requirements
2.1 Driver shall energize compatible LED lamps within 1 second after mains power is applied.
2.2 Driver shall provide Independent Lamp Operation (ILO) allowing remaining lamp(s) to maintain full light output when one or more lamps fail.
2.3 Driver shall contain auto restart circuitry in order to restart lamps without resetting power.
2.4 Driver shall operate from a 50Hz or 60 Hz AC input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency).
2.5 Driver shall be high frequency electronic type and operate lamps at frequencies above 42 kHz to avoid interference with infrared devices and eliminate visible flicker
2.6 Driver shall have a Power Factor of 0.94 or above when operating the maximum rated number of compatible lamps, and 0.88 or above when operating the minimum rated number of compatible lamps.
2.7 Driver input current shall Total Harmonic Distortion (THD) of 10% or less when operating the maximum rated number of compatible lamps and 15% or less when operating the minimum rated number of compatible lamps.
2.8 Driver shall have a Class A sound rating.
2.9 Driver shall have a minimum starting temperature of -13°F / -25°C.
2.10 Driver shall tolerate sustained open circuit and short circuit output conditions.
2.11 Driver shall be capable of operating lamps remotely and in tandem for wire lengths up to 20 ft.
2.12 Driver shall be suitable of operation in up to a 45°C ambient temperature.

Section III - Regulatory Requirements
3.1 Driver shall not contain any Polychlorinated Biphenyl (PCB).
3.2 Driver shall be Underwriters Laboratories (UL) Recognized, Class P, and suitable for Damp and Dry conditions; and CSA Certified where applicable.
3.3 Driver shall comply with ANSI C62.41 Category A Transient protection.
3.4 Driver shall comply with the requirements of the Federal Communication Commission (FCC) rules and regulations, Title 47, CFR part 15, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
3.5 Driver shall comply with NEMA 410 for in-rush current limits.

Section IV - Other
4.1 Driver shall be manufactured in a factory certified to ISO 9001 Quality System Standards.
4.2 Driver shall carry a five year warranty from date of manufacture against defects in material and workmanship when operating in a 45°C ambient

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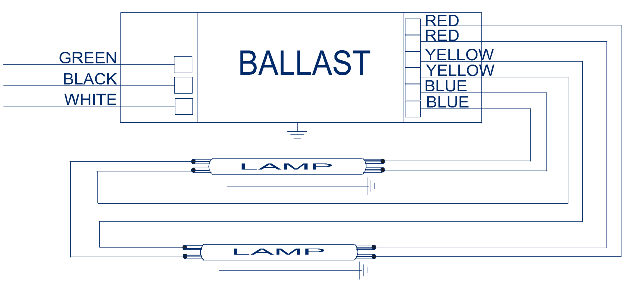
Electrical Specifications

ICN-2S28-T@120	
Brand Name	**CENTIUM T5**
Ballast Type	**Electronic**
Starting Method	**Programmed Start**
Lamp Connection	**Series**
Input Voltage	**120-277**
Input Frequency	**50/60 HZ**
Status	**Active**

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (℉/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F14T5	1	14	0/-18	0.14	17	1.07	15	0.98	1.7	6.29
F14T5	2	14	0/-18	0.27	32	1.06	10	0.98	1.7	3.31
F21T5	1	21	0/-18	0.19	23	1.03	15	0.98	1.7	4.48
F21T5	2	21	0/-18	0.38	46	1.02	10	0.98	1.7	2.22
F28T5	1	28	0/-18	0.27	31	1.00	10	0.98	1.7	3.23
* F28T5	2	28	0/-18	0.51	62	1.00	10	0.98	1.7	1.61
F28T5/ES (25W)	1	25	0/-18	0.24	28	1.00	10	0.98	1.7	3.57
F28T5/ES (25W)	2	25	0/-18	0.47	56	1.00	10	0.98	1.7	1.79
F35T5	1	35	0/-18	0.34	39	1.00	10	0.98	1.7	2.56
F35T5	2	35	0/-18	0.64	77	1.00	10	0.98	1.7	1.30

Wiring Diagram



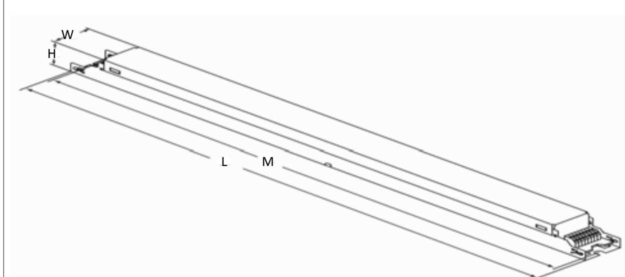
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0	0
White	0	0
Blue	0	0
Red	0	0
Yellow	0	0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White		0
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
14.17 "	1.18 "	1.06 "	13.78 "
14 17/100	1 9/50	1 3/50	13 39/50
36 cm	3 cm	2.7 cm	35 cm

RoHS COMPLIANT

Revised 05/31/13

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PHILIPS
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ICN-2S28-T@120	
Brand Name	**CENTIUM T5**
Ballast Type	**Electronic**
Starting Method	**Programmed Start**
Lamp Connection	**Series**
Input Voltage	**120-277**
Input Frequency	**50/60 HZ**
Status	**Active**

Electrical Specifications

Notes:

Section I - Physical Characteristics
1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.
1.2 Ballast shall be provided with integral leads or poke-in wire trap connectors color-coded per ANSI C82.11.

Section II - Performance
2.1 Ballast shall be Programmed Start.
2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.
2.3 Ballast shall operate from 50/60 Hz input source of _____________ (120V through 277V, 347V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency).
2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.
2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.
2.6 Ballast shall have a minimum ballast factor of 1.0 for primary lamp application.
2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.
2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.
2.9 Ballast shall have a Class A sound rating.
2.10 Ballast shall have a minimum starting temperature of _______ {-18C (0F) or -29C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.
2.11 Ballast shall provide Lamp EOL Protection Circuit.
2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions.
2.13 Four-lamp ballast shall have (semi-independent or independent) lamp operation.

Section III - Regulatory
3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).
3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.
3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.
3.4 Ballast shall comply with ANSI C82.11 where applicable.
3.5 Ballast shall comply with applicable requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, for Non-Consumer equipment.
3.6 Ballast shall comply with UL Type CC rating.
3.7 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other
4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.
4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.
4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

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Revised 05/31/13

Data is based upon tests performed by Philips Lighting Electronic N.A. in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

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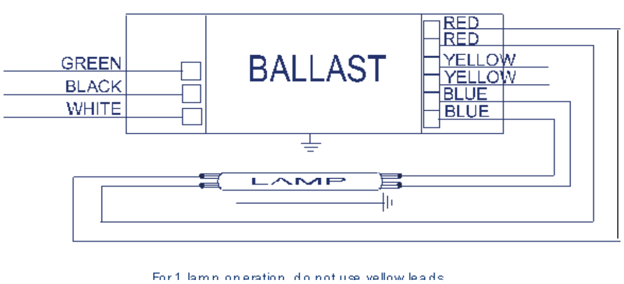
PHILIPS
ADVANCE

ICN-2S28-T@277	
Brand Name	**CENTIUM T5**
Ballast Type	**Electronic**
Starting Method	**Programmed Start**
Lamp Connection	**Series**
Input Voltage	**120-277**
Input Frequency	**50/60 HZ**
Status	**Active**

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F14T5	1	14	0/-18	0.07	18	1.07	15	0.90	1.7	5.94
F14T5	2	14	0/-18	0.12	32	1.06	10	0.95	1.7	3.31
F21T5	1	21	0/-18	0.09	23	1.03	15	0.95	1.7	4.48
F21T5	2	21	0/-18	0.17	45	1.02	10	0.98	1.7	2.27
* F28T5	1	28	0/-18	0.12	31	1.00	10	0.95	1.7	3.23
F28T5	2	28	0/-18	0.23	61	1.00	10	0.98	1.7	1.64
F28T5/ES (25W)	1	25	0/-18	0.11	28	1.00	10	0.95	1.7	3.57
F28T5/ES (25W)	2	25	0/-18	0.20	55	1.00	10	0.98	1.7	1.82
F35T5	1	35	0/-18	0.15	39	1.00	10	0.95	1.7	2.56
F35T5	2	35	0/-18	0.28	75	1.00	10	0.95	1.7	1.33

Wiring Diagram



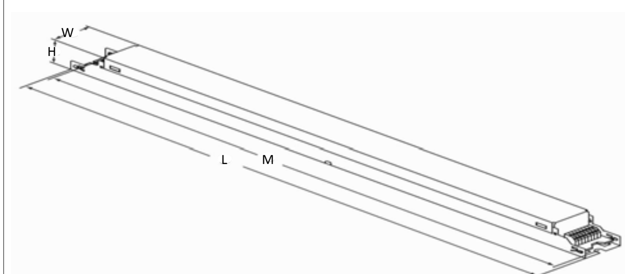
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0	0
White	0	0
Blue	0	0
Red	0	0
Yellow	0	0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White		0
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
14.17 "	1.18 "	1.06 "	13.78 "
14 17/100	1 9/50	1 3/50	13 39/50
36 cm	3 cm	2.7 cm	35 cm

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Revised 05/31/13

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PHILIPS
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ICN-2S28-T@277	
Brand Name	**CENTIUM T5**
Ballast Type	**Electronic**
Starting Method	**Programmed Start**
Lamp Connection	**Series**
Input Voltage	**120-277**
Input Frequency	**50/60 HZ**
Status	**Active**

Electrical Specifications

Notes:

Section I - Physical Characteristics
1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.
1.2 Ballast shall be provided with integral leads or poke-in wire trap connectors color-coded per ANSI C82.11.

Section II - Performance
2.1 Ballast shall be Programmed Start.
2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.
2.3 Ballast shall operate from 50/60 Hz input source of _____________ (120V through 277V, 347V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency).
2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.
2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.
2.6 Ballast shall have a minimum ballast factor of 1.0 for primary lamp application.
2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.
2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.
2.9 Ballast shall have a Class A sound rating.
2.10 Ballast shall have a minimum starting temperature of _______ {-18C (0F) or -29C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.
2.11 Ballast shall provide Lamp EOL Protection Circuit.
2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions.
2.13 Four-lamp ballast shall have (semi-independent or independent) lamp operation.

Section III - Regulatory
3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).
3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.
3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.
3.4 Ballast shall comply with ANSI C82.11 where applicable.
3.5 Ballast shall comply with applicable requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, for Non-Consumer equipment.
3.6 Ballast shall comply with UL Type CC rating.
3.7 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other
4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.
4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.
4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

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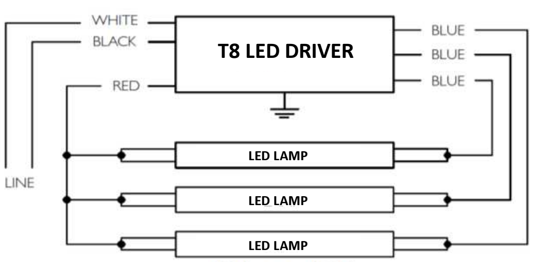
ADVANCE

ICN-3P16-TLED-N	
Brand Name	**CENTIUM**
Driver Type	**T8 LED Electronic**
Lamp Connection	**Parallel**
Input Voltage	**120-277V**
Input Frequency	**50/60 Hz**
Status	**Active**

Electrical Specifications

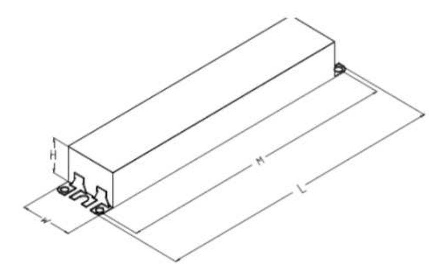
Compatible Lamp Information							Driver Specifications @120V/@277V						
T8 LED Lamp Brand	**T8 LED Lamp Description**	**T8 LED Lamp Product No.**	**T8 LED Lamp Model No.**	**T8 LED Lamp Ordering Code**	**Bare Lamp Watts (W)**	**Nom. Initial Lumens**	**Min. Start Temp (°F/°C)**	**Num. of Lamps**	**Input Current (A)**	**Input Power (W)**	**Max THD%**	**Power Factor**
Philips	LED InstantFit T8 - 4'	453589 453597 453605 453613	9290011239 9290011240 9290011241 9290011242	12T8/48-3000 IF 10/1 12T8/48-3500 IF 10/1 12T8/48-4000 IF 10/1 12T8/48-5000 IF 10/1	12	1500 1500 1600 1650	-13/-25	3 2	0.33/0.15 0.25/0.11	40 30	10 15	0.99/0.96 0.99/0.93
Philips	LED InstantFit T8 - 4' High Output	456897 456905 456913 456921	9290011585 9290011586 9290011587 9290011588	15T8/48-3000 IF 10/1 15T8/48-3500 IF 10/1 15T8/48-4000 IF 10/1 15T8/48-5000 IF 10/1	15	2000 2000 2100 2100	-13/-25	3 2	0.43/0.19 0.41/0.18	51 49	10 15	0.99/0.97 0.99/0.97
Philips	LED InstantFit T8 - 4' Ultra High Output	463133 463141 463158	9290012267 9290012268 9290012269	16.5T8 LED/48-3500 IF 10/1 UHO 16.5T8 LED/48-4000 IF 10/1 UHO 16.5T8 LED/48-5000 IF 10/1 UHO	16.5	2400 2500 2500	-13/-25	3 2	0.45/0.20 0.52/0.23	56 62	10 15	0.99/0.97 0.99/0.97
Philips	LED InstantFit T8 - 3'	452052 452060 452078 452086	9290011183 9290011184 9290011185 9290011186	10.5T8/36-3000 IF 10/1 10.5T8/36-3500 IF 10/1 10.5T8/36-4000 IF 10/1 10.5T8/36-5000 IF 10/1	10.5	1100 1160 1200 1270	-13/-25	3 2	0.31/0.14 0.23/0.11	36 28	10 15	0.99/0.95 0.99/0.93
Philips	LED InstantFit T8 - 2'	452011 452029 452037 452045	9290011179 9290011180 9290011181 9290011182	8.5T8/24-3000 IF 10/1 8.5T8/24-3500 IF 10/1 8.5T8/24-4000 IF 10/1 8.5T8/24-5000 IF 10/1	8.5	950 1040 1050 1100	-13/-25	3 2	0.27/0.12 0.21/0.10	32 25	10 15	0.99/0.94 0.99/0.91



Diag. 65

Standard Lead Length (inches)		
	in.	cm.
Black	24	61.0
White	24	61.0
Blue	28	71.1
Red	42	106.7

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.5 "	1.3 "	1.0 "	8.9 "
9 1/2	1 3/10	1	8 9/10
24.1 cm	3.3 cm	2.5 cm	22.6 cm

CLASSIFIED c UL US   c CSA US   c RU US   RoHS COMPLIANT

Revised: 07/27/16

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PHILIPS ADVANCE

ICN-3P16-TLED-N	
Brand Name	**CENTIUM**
Driver Type	**T8 LED Electronic**
Lamp Connection	**Parallel**
Input Voltage	**120-277V**
Input Frequency	**50/60 Hz**
Status	**Active**

Electrical Specifications

Notes:

Section I - Physical Characteristics
1.1 Driver shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.
1.2 Driver shall be provided with integral leads color coded per ANSI C82.11.

Section II - Performance Requirements
2.1 Driver shall energize compatible LED lamps within 1 second after mains power is applied.
2.2 Driver shall provide Independent Lamp Operation (ILO) allowing remaining lamp(s) to maintain full light output when one or more lamps fail.
2.3 Driver shall contain auto restart circuitry in order to restart lamps without resetting power.
2.4 Driver shall operate from a 50Hz or 60 Hz AC input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency).
2.5 Driver shall be high frequency electronic type and operate lamps at frequencies above 42 kHz to avoid interference with infrared devices and eliminate visible flicker
2.6 Driver shall have a Power Factor of 0.90 or above when operating either the maximum or minimum rated number of compatible lamps.
2.7 Driver input current shall Total Harmonic Distortion (THD) of 10% or less when operating the maximum rated number of compatible lamps and 15% or less when operating the minimum rated number of compatible lamps.
2.8 Driver shall have a Class A sound rating.
2.9 Driver shall have a minimum starting temperature of -13°F / -25°C.
2.10 Driver shall tolerate sustained open circuit and short circuit output conditions.
2.11 Driver shall be capable of operating lamps remotely and in tandem for wire lengths up to 20 ft.
2.12 Driver shall be suitable of operation in up to a 45°C ambient temperature.

Section III - Regulatory Requirements
3.1 Driver shall not contain any Polychlorinated Biphenyl (PCB).
3.2 Driver shall be Underwriters Laboratories (UL) Recognized, and suitable for Damp and Dry conditions; and CSA Certified where applicable.
3.3 Driver shall comply with ANSI C62.41 Category A Transient protection.
3.4 Driver shall comply with the requirements of the Federal Communication Commission (FCC) rules and regulations, Title 47, CFR part 15, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
3.5 Driver shall comply with NEMA 410 for in-rush current limits.

Section IV - Other
4.1 Driver shall be manufactured in a factory certified to ISO 9001 Quality System Standards.
4.2 Driver shall carry a five year warranty from date of manufacture against defects in material and workmanship when operating in a 45°C ambient

Philips Lighting N.A.
10275 West Higgins Road • Rosemont, IL 60018 • www.philips.com/advance
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Lighting

Accent with higher performance LED retrofits

MR16/GU10/PAR16

Philips MR16 Dimmable LED Lamps provide ambient level light to illuminate hard to maintain applications. Increased transformer compatability allows for operation on a wider range of transformers. Available in dimmable and non-dimmable versions, these lamps are ideal for track and open recessed fixtures in retail, hospitality and residential spaces.

Benefits
- Long life properties-- lowers maintenance costs by reducing re-lamp frequency
- Will not fade colors, avoids inventory spoilage
- Contains no mercury
- Emits virtually no UV/IR light in the beam
- 3-year or 5-year limited warranty depending upon operating hours

Features
- Available in dimmable* and non-dimmable versions
- Provides quality white light and a crisp, uniform beam
- 7W and 7W HO MRX16s are suitable for use in many enclosed fixtures
- 40,000-hour rated average life⁺ for 7W MRX16
- Instant-on light
- [*]Dimmable when using leading edge dimmers (see Philips Website: www.philips.com/ledtechguide for compatible leading edge dimmers.)
- ⁺Rated average life based on engineering testing and probability analysis.

Application
- Ideal for accent and ambient lighting in retail and hospitality spaces.

data subject to change

MR16/GU10/PAR16

Versions

GU5.3 MR16

GU5.3 MR16

GU5.3 MR16

GU5.3 MR16

GU5.3 MR16

GU5.3 MR16

LEDSpot GU5.3 MR16

E26 PAR16

E26 PAR16

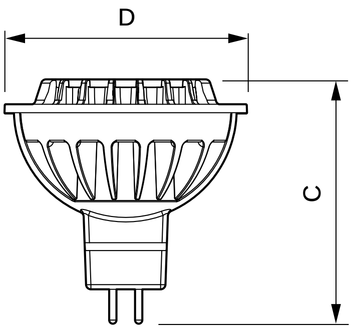
GU10 PAR16

GU5.3 MR16

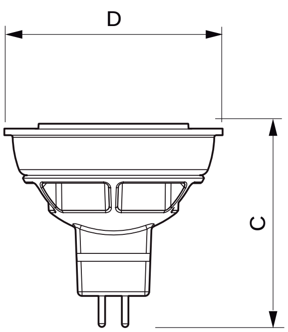
GU5.3 MR16

data subject to change

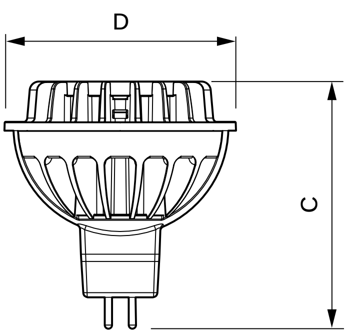
Dimensional drawing



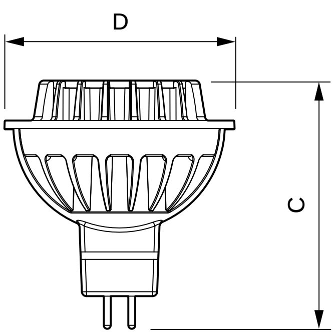
Product	D	C
7MR16/F35 2700 DIM AF2 10/1	51 mm	51 mm
BC7MR16/AMB/F35/3000 DIM 12V	51 mm	51 mm
7MR16/F35 4000 DIM AF2 10/1	51 mm	51 mm
7MR16/F25 4000 DIM AF2 10/1	51 mm	51 mm
7MR16/F25 3000 DIM AF2 10/1	51 mm	51 mm
7MR16/LED/S15/827/DIM AF2 10/1	51 mm	51 mm
7MR16/LED/S15/840/DIM AF2 10/1	51 mm	51 mm
7MR16/LED/S15/830/DIM AF2 10/1	51 mm	51 mm
7MR16/LED/F35/830/DIM AF2 10/1	51 mm	51 mm
7MR16/LED/F35/827/DIM AF2 10/1	51 mm	51 mm
7MR16/LED/F25/830/DIM AF2 10/1	51 mm	51 mm
7MR16/LED/F25/840/DIM AF2 10/1	51 mm	51 mm
7MR16/LED/F25/827/DIM AF2 10/1	51 mm	51 mm
7MR16/LED/F35/840/DIM AF2 10/1	51 mm	51 mm
7MR16/F35 3000 DIM AF2 10/1	51 mm	51 mm



Product	D	C
6.5MR16/F36/2700 DIM 12V	50 mm	50 mm



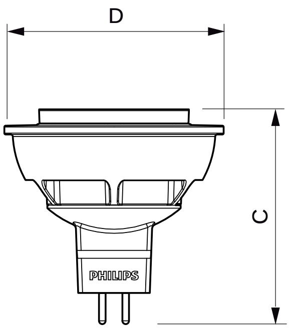
Product	D	C
7MR16/F36 2700 DIM HO	50 mm	54 mm
7MR16/F36 3000 DIM HO	50 mm	54 mm
7MR16/F24 2700 DIM HO	50 mm	54 mm
7MR16/F24 3000 DIM HO	50 mm	54 mm



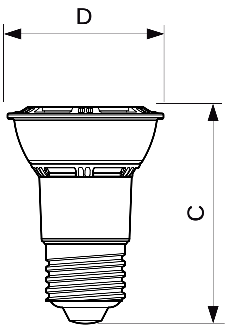
Product	D	C
8.5MRX16/F35 4000 DIM AF 10/1	51 mm	55 mm
8.5MRX16/F25 4000 DIM AF 10/1	51 mm	55 mm
8.5MRX16/F35 3000 DIM AF 10/1	51 mm	55 mm
8.5MRX16/F25 2700 DIM AF 10/1	51 mm	55 mm
8.5MRX16/F25 3000 DIM AF 10/1	51 mm	55 mm
8.5MRX16/F35 2700 DIM AF 10/1	51 mm	55 mm

data subject to change

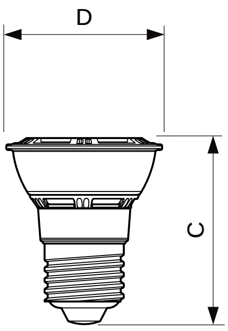
Dimensional drawing



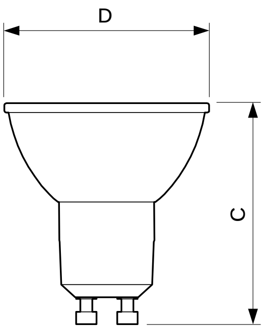
Product	D	C
6.5MR16/F25/2700-2200 DIM 12V	51 mm	50 mm
6.6MR16/F25/3000 DIM 12V	51 mm	51 mm
6.6MR16/F35/3000 DIM 12V	51 mm	51 mm
6.5MR16/F35/2700-2200 DIM 12V	51 mm	50 mm
6.4MR16/F25/3000 DIM 12V	51 mm	51 mm
6.4MR16/F35/3000 DIM 12V	51 mm	51 mm



Product	D	C
AmbientLED PAR16 7W 35D 830 D	50 mm	70 mm



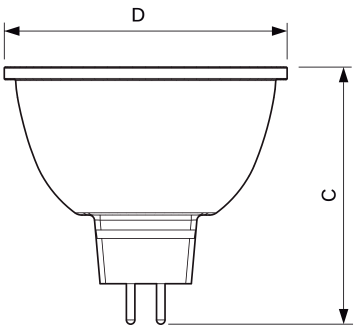
Product	D	C
AmbientLED PAR16S 7W 35D 830 D	50 mm	60 mm



Product	D	C
4.5GU10/LEDCLA/F35/830/DIM 10/1	50 mm	53 mm

data subject to change

Dimensional drawing



Product	D	C
7MR16 ExpertColor S10 930 D 10/1	51 mm	46 mm
7MR16 ExpertColor S10 940 D 10/1	51 mm	46 mm
7MR16 ExpertColor F35 930 D 10/1	51 mm	46 mm
7MR16 ExpertColor F25 927 D 10/1	51 mm	46 mm
7MR16 ExpertColor F35 927 D 10/1	51 mm	46 mm
7MR16 ExpertColor F35 940 D 10/1	51 mm	46 mm
7MR16 ExpertColor F25 940 D 10/1	51 mm	46 mm
7MR16 ExpertColor Retail F35 930 10/1	51 mm	46 mm
7MR16 ExpertColor Retail S10 930 10/1	51 mm	46 mm
7MR16 ExpertColor S10 927 D 10/1	51 mm	46 mm
7MR16 ExpertColor Retail F25 930 10/1	51 mm	46 mm
7MR16 ExpertColor F25 930 D 10/1	51 mm	46 mm

General Information	
Switching Cycle	50000X
Light Technical	
Llmf At End Of Nominal Lifetime (Nom)	70 %

Approval and Application

Order Code	Full Product Name	Energy Consumption kWh/ 1000 h	Energy Efficiency Label (EEL)
929000263004	7MR16/F24 2700 DIM HO	8 kWh	A+
929000263104	7MR16/F24 3000 DIM HO	8 kWh	A+
929000263304	7MR16/F36 2700 DIM HO	8 kWh	A
929000263404	7MR16/F36 3000 DIM HO	8 kWh	A+
929001123104	6.5MR16/F36/2700 DIM 12V	7 kWh	A
929001127804	6.5MR16/F25/2700-2200 DIM 12V	- kWh	Not applicable
929001127904	6.5MR16/F35/2700-2200 DIM 12V	7 kWh	Not applicable
929001149804	8.5MRX16/F25 2700 DIM AF 10/1	9 kWh	Not applicable
929001149904	8.5MRX16/F25 3000 DIM AF 10/1	- kWh	Not applicable
929001150004	8.5MRX16/F25 4000 DIM AF 10/1	9 kWh	Not applicable
929001150104	8.5MRX16/F35 2700 DIM AF 10/1	9 kWh	Not applicable
929001150204	8.5MRX16/F35 3000 DIM AF 10/1	9 kWh	Not applicable
929001150304	8.5MRX16/F35 4000 DIM AF 10/1	9 kWh	Not applicable
929001151804	6.6MR16/F25/3000 DIM 12V	7 kWh	Not applicable
929001151834	6.4MR16/F25/3000 DIM 12V	-	Not applicable
929001152204	6.6MR16/F35/3000 DIM 12V	7 kWh	Not applicable
929001152234	6.4MR16/F35/3000 DIM 12V	-	Not applicable
929001152534	7MR16/LED/S15/827/DIM AF2 10/1	8 kWh	Not applicable
929001152634	7MR16/LED/S15/830/DIM AF2 10/1	8 kWh	Not applicable
929001152734	7MR16/LED/S15/840/DIM AF2 10/1	8 kWh	Not applicable
929001152834	7MR16/LED/F25/827/DIM AF2 10/1	8 kWh	Not applicable
929001152904	7MR16/F25 3000 DIM AF2 10/1	8 kWh	A
929001152934	7MR16/LED/F25/830/DIM AF2 10/1	8 kWh	Not applicable
929001153004	7MR16/F25 4000 DIM AF2 10/1	8 kWh	A
929001153034	7MR16/LED/F25/840/DIM AF2 10/1	8 kWh	Not applicable
929001153104	7MR16/F35 2700 DIM AF2 10/1	8 kWh	A
929001153134	7MR16/LED/F35/827/DIM AF2 10/1	8 kWh	Not applicable
929001153204	7MR16/F35 3000 DIM AF2 10/1	8 kWh	A
929001153234	7MR16/LED/F35/830/DIM AF2 10/1	8 kWh	Not applicable
929001153304	7MR16/F35 4000 DIM AF2 10/1	8 kWh	A
929001153334	7MR16/LED/F35/840/DIM AF2 10/1	8 kWh	Not applicable
929001208003	BC7MR16/AMB/F35/3000 DIM 12V	-	-
929001245403	AmbientLED PAR16 7W 35D 830 D	-	Not applicable
929001245605	AmbientLED PAR16S 7W 35D 830 D	-	Not applicable
929001300604	4.5GU10/LEDCLA/F35/830/DIM 10/1	-	Not applicable
929001341704	7MR16 ExpertColor S10 927 D 10/1	-	-
929001341804	7MR16 ExpertColor S10 930 D 10/1	-	-
929001341904	7MR16 ExpertColor S10 940 D 10/1	-	-
929001342604	7MR16 ExpertColor Retail S10 930 10/1	-	-
929001342004	7MR16 ExpertColor F25 927 D 10/1	-	-
929001342104	7MR16 ExpertColor F25 930 D 10/1	-	-
929001342204	7MR16 ExpertColor F25 940 D 10/1	-	-
929001342304	7MR16 ExpertColor F35 927 D 10/1	-	-
929001342404	7MR16 ExpertColor F35 930 D 10/1	-	-
929001342504	7MR16 ExpertColor F35 940 D 10/1	-	-
929001342704	7MR16 ExpertColor Retail F25 930 10/1	-	-

data subject to change

Order Code	Full Product Name	Energy Consumption kWh/ 1000 h	Energy Efficiency Label (EEL)
929001342804	7MR16 ExpertColor Retail F35 930 10/1	-	-

Controls and Dimming

Order Code	Full Product Name	Dimmable
929000263004	7MR16/F24 2700 DIM HO	Yes
929000263104	7MR16/F24 3000 DIM HO	Yes
929000263304	7MR16/F36 2700 DIM HO	Yes
929000263404	7MR16/F36 3000 DIM HO	Yes
929001123104	6.5MR16/F36/2700 DIM 12V	Yes
929001127804	6.5MR16/F25/2700-2200 DIM 12V	Yes
929001127904	6.5MR16/F35/2700-2200 DIM 12V	Yes
929001149804	8.5MRX16/F25 2700 DIM AF 10/1	Yes
929001149904	8.5MRX16/F25 3000 DIM AF 10/1	Yes
929001150004	8.5MRX16/F25 4000 DIM AF 10/1	Yes
929001150104	8.5MRX16/F35 2700 DIM AF 10/1	Yes
929001150204	8.5MRX16/F35 3000 DIM AF 10/1	Yes
929001150304	8.5MRX16/F35 4000 DIM AF 10/1	Yes
929001151804	6.6MR16/F25/3000 DIM 12V	Yes
929001151834	6.4MR16/F25/3000 DIM 12V	Yes
929001152204	6.6MR16/F35/3000 DIM 12V	Yes
929001152234	6.4MR16/F35/3000 DIM 12V	Yes
929001152534	7MR16/LED/S15/827/DIM AF2 10/1	Yes
929001152634	7MR16/LED/S15/830/DIM AF2 10/1	Yes
929001152734	7MR16/LED/S15/840/DIM AF2 10/1	Yes
929001152834	7MR16/LED/F25/827/DIM AF2 10/1	Yes
929001152904	7MR16/F25 3000 DIM AF2 10/1	Yes
929001152934	7MR16/LED/F25/830/DIM AF2 10/1	Yes
929001153004	7MR16/F25 4000 DIM AF2 10/1	Yes
929001153034	7MR16/LED/F25/840/DIM AF2 10/1	Yes
929001153104	7MR16/F35 2700 DIM AF2 10/1	Yes
929001153134	7MR16/LED/F35/827/DIM AF2 10/1	Yes
929001153204	7MR16/F35 3000 DIM AF2 10/1	Yes
929001153234	7MR16/LED/F35/830/DIM AF2 10/1	Yes
929001153304	7MR16/F35 4000 DIM AF2 10/1	Yes
929001153334	7MR16/LED/F35/840/DIM AF2 10/1	Yes
929001208003	BC7MR16/AMB/F35/3000 DIM 12V	Yes
929001245403	AmbientLED PAR16 7W 35D 830 D	Yes
929001245605	AmbientLED PAR16S 7W 35D 830 D	Yes
929001300604	4.5GU10/LEDCLA/F35/830/DIM 10/1	Yes
929001341704	7MR16 ExpertColor S10 927 D 10/1	Yes
929001341804	7MR16 ExpertColor S10 930 D 10/1	Yes
929001341904	7MR16 ExpertColor S10 940 D 10/1	Yes
929001342604	7MR16 ExpertColor Retail S10 930 10/1	No
929001342004	7MR16 ExpertColor F25 927 D 10/1	Yes
929001342104	7MR16 ExpertColor F25 930 D 10/1	Yes
929001342204	7MR16 ExpertColor F25 940 D 10/1	Yes
929001342304	7MR16 ExpertColor F35 927 D 10/1	Yes
929001342404	7MR16 ExpertColor F35 930 D 10/1	Yes
929001342504	7MR16 ExpertColor F35 940 D 10/1	Yes
929001342704	7MR16 ExpertColor Retail F25 930 10/1	No
929001342804	7MR16 ExpertColor Retail F35 930 10/1	No

Operating and Electrical

Order Code	Full Product Name	Input Frequency	Voltage (Nom)	Wattage Equivalent	Power (Rated) (Nom)	Starting Time (Nom)
929000263004	7MR16/F24 2700 DIM HO	50 to 60 Hz	12 V	40 W	7 W	0.1 s
929000263104	7MR16/F24 3000 DIM HO	50 to 60 Hz	12 V	40 W	7 W	0.1 s
929000263304	7MR16/F36 2700 DIM HO	50 to 60 Hz	12 V	40 W	7 W	0.5 s
929000263404	7MR16/F36 3000 DIM HO	50 to 60 Hz	12 V	40 W	7 W	0.5 s
929001123104	6.5MR16/F36/2700 DIM 12V	50 to 60 Hz	12 V	35 W	6.5 W	0.5 s
929001127804	6.5MR16/F25/2700-2200 DIM 12V	50 to 60 Hz	12 V	35 W	6.5 W	0.5 s
929001127904	6.5MR16/F35/2700-2200 DIM 12V	50 to 60 Hz	12 V	35 W	6.5 W	0.5 s
929001149804	8.5MRX16/F25 2700 DIM AF 10/1	60 Hz	12 V	50 W	8.5 W	0.5 s
929001149904	8.5MRX16/F25 3000 DIM AF 10/1	60 Hz	12 V	50 W	8.5 W	0.5 s
929001150004	8.5MRX16/F25 4000 DIM AF 10/1	60 Hz	12 V	50 W	8.5 W	0.5 s
929001150104	8.5MRX16/F35 2700 DIM AF 10/1	60 Hz	12 V	50 W	8.5 W	0.5 s
929001150204	8.5MRX16/F35 3000 DIM AF 10/1	60 Hz	12 V	50 W	8.5 W	0.5 s
929001150304	8.5MRX16/F35 4000 DIM AF 10/1	60 Hz	12 V	50 W	8.5 W	0.5 s
929001151804	6.6MR16/F25/3000 DIM 12V	60 Hz	12 V	35 W	6.6 W	0.5 s
929001151834	6.4MR16/F25/3000 DIM 12V	-	12 V	35 W	6.4 W	0.5 s

Order Code	Full Product Name	Input Frequency	Voltage (Nom)	Wattage Equivalent	Power (Rated) (Nom)	Starting Time (Nom)
929001152204	6.6MR16/F35/3000 DIM 12V	60 Hz	12 V	35 W	6.6 W	0.5 s
929001152234	6.4MR16/F35/3000 DIM 12V	-	12 V	35 W	6.4 W	0.6 s
929001152534	7MR16/LED/S15/827/DIM AF2 10/1	-	12 V	35 W	7 W	0.5 s
929001152634	7MR16/LED/S15/830/DIM AF2 10/1	-	12 V	35 W	7 W	0.5 s
929001152734	7MR16/LED/S15/840/DIM AF2 10/1	-	12 V	35 W	7 W	0.5 s
929001152834	7MR16/LED/F25/827/DIM AF2 10/1	-	12 V	50 W	7 W	0.5 s
929001152904	7MR16/F25 3000 DIM AF2 10/1	-	12 V	35 W	7 W	0.5 s
929001152934	7MR16/LED/F25/830/DIM AF2 10/1	-	12 V	50 W	7 W	0.5 s
929001153004	7MR16/F25 4000 DIM AF2 10/1	-	12 V	35 W	7 W	0.5 s
929001153034	7MR16/LED/F25/840/DIM AF2 10/1	-	12 V	50 W	7 W	0.5 s
929001153104	7MR16/F35 2700 DIM AF2 10/1	-	12 V	35 W	7 W	0.5 s
929001153134	7MR16/LED/F35/827/DIM AF2 10/1	-	12 V	50 W	7 W	0.5 s
929001153204	7MR16/F35 3000 DIM AF2 10/1	-	12 V	35 W	7 W	0.5 s
929001153234	7MR16/LED/F35/830/DIM AF2 10/1	-	12 V	50 W	7 W	0.5 s
929001153304	7MR16/F35 4000 DIM AF2 10/1	-	12 V	35 W	7 W	0.5 s
929001153334	7MR16/LED/F35/840/DIM AF2 10/1	-	12 V	50 W	7 W	0.5 s
929001208003	BC7MR16/AMB/F35/3000 DIM 12V	-	12 V	50 W	7 W	0.5 s
929001245403	AmbientLED PAR16 7W 35D 830 D	60 Hz	120 V	50 W	7 W	0.5 s
929001245605	AmbientLED PAR16S 7W 35D 830 D	60 Hz	120 V	50 W	7 W	0.5 s
929001300604	4.5GU10/LEDCLA/F35/830/DIM 10/1	60 Hz	120 V	50 W	4.5 W	0.5 s
929001341704	7MR16 ExpertColor S10 927 D 10/1	-	12 V	30 W	7 W	0.5 s
929001341804	7MR16 ExpertColor S10 930 D 10/1	-	12 V	30 W	7 W	0.5 s
929001341904	7MR16 ExpertColor S10 940 D 10/1	-	12 V	30 W	7 W	0.5 s
929001342604	7MR16 ExpertColor Retail S10 930 10/1	-	12 V	30 W	7 W	0.5 s
929001342004	7MR16 ExpertColor F25 927 D 10/1	-	12 V	42 W	7 W	0.5 s
929001342104	7MR16 ExpertColor F25 930 D 10/1	-	12 V	42 W	7 W	0.5 s
929001342204	7MR16 ExpertColor F25 940 D 10/1	-	12 V	42 W	7 W	0.5 s
929001342304	7MR16 ExpertColor F35 927 D 10/1	-	12 V	42 W	7 W	0.5 s
929001342404	7MR16 ExpertColor F35 930 D 10/1	-	12 V	42 W	7 W	0.5 s
929001342504	7MR16 ExpertColor F35 940 D 10/1	-	12 V	42 W	7 W	0.5 s
929001342704	7MR16 ExpertColor Retail F25 930 10/1	-	12 V	42 W	7 W	0.5 s
929001342804	7MR16 ExpertColor Retail F35 930 10/1	-	12 V	42 W	7 W	0.5 s

General Information

Order Code	Full Product Name	Cap-Base	Nominal Lifetime (Nom)	Rated Lifetime (Hours)
929000263004	7MR16/F24 2700 DIM HO	GU5.3	40000 h	40000 h
929000263104	7MR16/F24 3000 DIM HO	GU5.3	40000 h	40000 h
929000263304	7MR16/F36 2700 DIM HO	GU5.3	40000 h	40000 h
929000263404	7MR16/F36 3000 DIM HO	GU5.3	40000 h	40000 h
929001123104	6.5MR16/F36/2700 DIM 12V	GU5.3	25000 h	25000 h
929001127804	6.5MR16/F25/2700-2200 DIM 12V	GU5.3	25000 h	25000 h
929001127904	6.5MR16/F35/2700-2200 DIM 12V	GU5.3	25000 h	25000 h
929001149804	8.5MRX16/F25 2700 DIM AF 10/1	GU5.3	25000 h	25000 h
929001149904	8.5MRX16/F25 3000 DIM AF 10/1	GU5.3	25000 h	25000 h
929001150004	8.5MRX16/F25 4000 DIM AF 10/1	GU5.3	25000 h	25000 h
929001150104	8.5MRX16/F35 2700 DIM AF 10/1	GU5.3	25000 h	25000 h
929001150204	8.5MRX16/F35 3000 DIM AF 10/1	GU5.3	25000 h	25000 h
929001150304	8.5MRX16/F35 4000 DIM AF 10/1	GU5.3	25000 h	25000 h

Order Code	Full Product Name	Cap-Base	Nominal Lifetime (Nom)	Rated Lifetime (Hours)
929001151804	6.6MR16/F25/3000 DIM 12V	GU5.3	25000 h	25000 h
929001151834	6.4MR16/F25/3000 DIM 12V	GU5.3	25000 h	25000 h
929001152204	6.6MR16/F35/3000 DIM 12V	GU5.3	25000 h	25000 h
929001152234	6.4MR16/F35/3000 DIM 12V	GU5.3	25000 h	25000 h
929001152534	7MR16/LED/S15/827/DIM AF2 10/1	GU5.3	40000 h	40000 h
929001152634	7MR16/LED/S15/830/DIM AF2 10/1	GU5.3	40000 h	40000 h
929001152734	7MR16/LED/S15/840/DIM AF2 10/1	GU5.3	40000 h	40000 h
929001152834	7MR16/LED/F25/827/DIM AF2 10/1	GU5.3	25000 h	25000 h
929001152904	7MR16/F25 3000 DIM AF2 10/1	GU5.3	40000 h	40000 h
929001152934	7MR16/LED/F25/830/DIM AF2 10/1	GU5.3	25000 h	25000 h

Order Code	Full Product Name	Cap-Base	Nominal Lifetime (Nom)	Rated Lifetime (Hours)
929001153004	7MR16/F25 4000 DIM AF2 10/1	GU5.3	40000 h	40000 h
929001153034	7MR16/LED/F25/840/DIM AF2 10/1	GU5.3	25000 h	25000 h
929001153104	7MR16/F35 2700 DIM AF2 10/1	GU5.3	40000 h	40000 h
929001153134	7MR16/LED/F35/827/DIM AF2 10/1	GU5.3	25000 h	25000 h
929001153204	7MR16/F35 3000 DIM AF2 10/1	GU5.3	40000 h	40000 h
929001153234	7MR16/LED/F35/830/DIM AF2 10/1	GU5.3	25000 h	25000 h
929001153304	7MR16/F35 4000 DIM AF2 10/1	GU5.3	40000 h	40000 h
929001153334	7MR16/LED/F35/840/DIM AF2 10/1	GU5.3	25000 h	25000 h
929001208003	BC7MR16/AMB/F35/3000 DIM 12V	GU5.3	25000 h	25000 h
929001245403	AmbientLED PAR16 7W 35D 830 D	E26	25000 h	25000 h
929001245605	AmbientLED PAR16S 7W 35D 830 D	E26	25000 h	25000 h
929001300604	4.5GU10/LEDCLA/F35/830/DIM 10/1	GU10	25000 h	25000 h
929001341704	7MR16 ExpertColor S10 927 D 10/1	GU5.3	40000 h	40000 h

Order Code	Full Product Name	Cap-Base	Nominal Lifetime (Nom)	Rated Lifetime (Hours)
929001341804	7MR16 ExpertColor S10 930 D 10/1	GU5.3	40000 h	40000 h
929001341904	7MR16 ExpertColor S10 940 D 10/1	GU5.3	40000 h	40000 h
929001342604	7MR16 ExpertColor Retail S10 930 10/1	GU5.3	40000 h	40000 h
929001342004	7MR16 ExpertColor F25 927 D 10/1	GU5.3	40000 h	40000 h
929001342104	7MR16 ExpertColor F25 930 D 10/1	GU5.3	40000 h	40000 h
929001342204	7MR16 ExpertColor F25 940 D 10/1	GU5.3	40000 h	40000 h
929001342304	7MR16 ExpertColor F35 927 D 10/1	GU5.3	40000 h	40000 h
929001342404	7MR16 ExpertColor F35 930 D 10/1	GU5.3	40000 h	40000 h
929001342504	7MR16 ExpertColor F35 940 D 10/1	GU5.3	40000 h	40000 h
929001342704	7MR16 ExpertColor Retail F25 930 10/1	GU5.3	40000 h	40000 h
929001342804	7MR16 ExpertColor Retail F35 930 10/1	GU5.3	40000 h	40000 h

Light Technical (1/2)

Order Code	Full Product Name	Beam Angle (Nom)	Color Code	Correlated Color Temperature (Nom)	Color Rendering Index (Nom)	Light Distribution	Luminous Flux (Nom)	Luminous Flux (Rated) (Nom)
929000263004	7MR16/F24 2700 DIM HO	24 °	827	2700 K	80	Medium beam 24°	500 lm	500 lm
929000263104	7MR16/F24 3000 DIM HO	24 °	830	3000 K	80	Medium beam 24°	510 lm	510 lm
929000263304	7MR16/F36 2700 DIM HO	36 °	827	2700 K	80	Medium beam 36°	500 lm	500 lm
929000263404	7MR16/F36 3000 DIM HO	36 °	830	3000 K	80	Medium beam 36°	510 lm	510 lm
929001123104	6.5MR16/F36/2700 DIM 12V	36 °	827	2700 K	80	Medium beam 36°	450 lm	450 lm
929001127804	6.5MR16/F25/2700-2200 DIM 12V	25 °	822-827	2200-2700 K	80	Medium beam 25°	410 lm	410 lm
929001127904	6.5MR16/F35/2700-2200 DIM 12V	35 °	822-827	2200-2700 K	80	Medium beam 35°	410 lm	410 lm
929001149804	8.5MRX16/F25 2700 DIM AF 10/1	25 °	827	2700 K	80	Medium beam 25°	635 lm	635 lm
929001149904	8.5MRX16/F25 3000 DIM AF 10/1	25 °	830	3000 K	80	Medium beam 25°	660 lm	660 lm
929001150004	8.5MRX16/F25 4000 DIM AF 10/1	25 °	840	4000 K	80	Medium beam 25°	710 lm	710 lm
929001150104	8.5MRX16/F35 2700 DIM AF 10/1	35 °	827	2700 K	80	Medium beam 35°	635 lm	635 lm
929001150204	8.5MRX16/F35 3000 DIM AF 10/1	35 °	830	3000 K	80	Medium beam 35°	660 lm	660 lm
929001150304	8.5MRX16/F35 4000 DIM AF 10/1	35 °	840	4000 K	80	Medium beam 35°	710 lm	710 lm
929001151804	6.6MR16/F25/3000 DIM 12V	25 °	830	3000 K	80	Medium beam 25°	395 lm	395 lm
929001151834	6.4MR16/F25/3000 DIM 12V	25 °	830	3000 K	80	Medium beam 24°	450 lm	450 lm
929001152204	6.6MR16/F35/3000 DIM 12V	35 °	830	3000 K	80	Medium beam 35°	395 lm	395 lm
929001152234	6.4MR16/F35/3000 DIM 12V	35 °	830	3000 K	80	Medium beam 36°	450 lm	450 lm
929001152534	7MR16/LED/S15/827/DIM AF2 10/1	15 °	827	2700 K	80	Narrow beam 15°	500 lm	-
929001152634	7MR16/LED/S15/830/DIM AF2 10/1	15 °	930	3000 K	90	Narrow beam 15°	500 lm	-
929001152734	7MR16/LED/S15/840/DIM AF2 10/1	15 °	940	4000 K	90	Narrow beam 15°	530 lm	-
929001152834	7MR16/LED/F25/827/DIM AF2 10/1	25 °	827	2700 K	80	Medium beam 25°	500 lm	500 lm
929001152904	7MR16/F25 3000 DIM AF2 10/1	24 °	930	3000 K	90	Medium beam 24°	440 lm	-
929001152934	7MR16/LED/F25/830/DIM AF2 10/1	25 °	930	3000 K	90	Medium beam 25°	500 lm	500 lm

Order Code	Full Product Name	Beam Angle (Nom)	Color Code	Correlated Color Temperature (Nom)	Color Rendering Index (Nom)	Light Distribution	Luminous Flux (Nom)	Luminous Flux (Rated) (Nom)
929001153004	7MR16/F25 4000 DIM AF2 10/1	24 °	940	4000 K	90	Medium beam 24°	460 lm	-
929001153034	7MR16/LED/F25/840/DIM AF2 10/1	25 °	940	4000 K	90	Medium beam 25°	530 lm	530 lm
929001153104	7MR16/F35 2700 DIM AF2 10/1	36 °	827	2700 K	80	Medium beam 36°	420 lm	-
929001153134	7MR16/LED/F35/827/DIM AF2 10/1	35 °	827	2700 K	80	Medium beam 36°	500 lm	500 lm
929001153204	7MR16/F35 3000 DIM AF2 10/1	36 °	930	3000 K	90	Medium beam 36°	440 lm	-
929001153234	7MR16/LED/F35/830/DIM AF2 10/1	35 °	930	3000 K	90	Medium beam 35°	500 lm	500 lm
929001153304	7MR16/F35 4000 DIM AF2 10/1	36 °	940	4000 K	90	Medium beam 36°	460 lm	-
929001153334	7MR16/LED/F35/840/DIM AF2 10/1	35 °	940	4000 K	90	Medium beam 35°	530 lm	530 lm
929001208003	BC7MR16/AMB/F35/3000 DIM 12V	35 °	830	3000 K	80	-	500 lm	500 lm
929001245403	AmbientLED PAR16 7W 35D 830 D	35 °	830	3000 K	80	-	500 lm	500 lm
929001245605	AmbientLED PAR16S 7W 35D 830 D	35 °	830	3000 K	80	-	500 lm	500 lm
929001300604	4.5GU10/LEDCLA/F35/830/DIM 10/1	35 °	830	3000 K	80	-	400 lm	400 lm
929001341704	7MR16 ExpertColor S10 927 D 10/1	10 °	927	2700 K	95	-	430 lm	430 lm
929001341804	7MR16 ExpertColor S10 930 D 10/1	10 °	930	3000 K	95	-	460 lm	460 lm
929001341904	7MR16 ExpertColor S10 940 D 10/1	10 °	940	4000 K	95	-	460 lm	460 lm
929001342604	7MR16 ExpertColor Retail S10 930 10/1	10 °	930	3000 K	90	-	430 lm	430 lm
929001342004	7MR16 ExpertColor F25 927 D 10/1	25 °	927	2700 K	95	-	430 lm	430 lm
929001342104	7MR16 ExpertColor F25 930 D 10/1	25 °	930	3000 K	95	-	460 lm	460 lm
929001342204	7MR16 ExpertColor F25 940 D 10/1	25 °	940	4000 K	95	-	460 lm	460 lm
929001342304	7MR16 ExpertColor F35 927 D 10/1	35 °	927	2700 K	95	-	430 lm	430 lm
929001342404	7MR16 ExpertColor F35 930 D 10/1	35 °	930	3000 K	95	-	460 lm	460 lm
929001342504	7MR16 ExpertColor F35 940 D 10/1	35 °	940	4000 K	95	-	460 lm	460 lm
929001342704	7MR16 ExpertColor Retail F25 930 10/1	25 °	930	3000 K	90	-	430 lm	430 lm
929001342804	7MR16 ExpertColor Retail F35 930 10/1	35 °	930	3000 K	90	-	430 lm	430 lm

Light Technical (2/2)

Order Code	Full Product Name	Luminous Intensity (Nom)	Rated Beam Angle
929000263004	7MR16/F24 2700 DIM HO	2400 cd	24 °
929000263104	7MR16/F24 3000 DIM HO	2500 cd	24 °
929000263304	7MR16/F36 2700 DIM HO	1300 cd	36 °
929000263404	7MR16/F36 3000 DIM HO	1350 cd	36 °
929001123104	6.5MR16/F36/2700 DIM 12V	900 cd	36 °
929001127804	6.5MR16/F25/2700-2200 DIM 12V	1800 cd	25 °
929001127904	6.5MR16/F35/2700-2200 DIM 12V	900 cd	35 °
929001149804	8.5MRX16/F25 2700 DIM AF 10/1	3100 cd	25 °
929001149904	8.5MRX16/F25 3000 DIM AF 10/1	3250 cd	25 °
929001150004	8.5MRX16/F25 4000 DIM AF 10/1	3350 cd	25 °
929001150104	8.5MRX16/F35 2700 DIM AF 10/1	1650 cd	35 °
929001150204	8.5MRX16/F35 3000 DIM AF 10/1	1700 cd	35 °
929001150304	8.5MRX16/F35 4000 DIM AF 10/1	1750 cd	35 °
929001151804	6.6MR16/F25/3000 DIM 12V	1800 cd	25 °
929001151834	6.4MR16/F25/3000 DIM 12V	1800 cd	25 °
929001152204	6.6MR16/F35/3000 DIM 12V	1000 cd	35 °
929001152234	6.4MR16/F35/3000 DIM 12V	1000 cd	35 °
929001152534	7MR16/LED/S15/827/DIM AF2 10/1	2800 cd	15 °
929001152634	7MR16/LED/S15/830/DIM AF2 10/1	2950 cd	15 °
929001152734	7MR16/LED/S15/840/DIM AF2 10/1	3050 cd	15 °
929001152834	7MR16/LED/F25/827/DIM AF2 10/1	2400 cd	25 °

Order Code	Full Product Name	Luminous Intensity (Nom)	Rated Beam Angle
929001152904	7MR16/F25 3000 DIM AF2 10/1	2200 cd	24 °
929001152934	7MR16/LED/F25/830/DIM AF2 10/1	2500 cd	25 °
929001153004	7MR16/F25 4000 DIM AF2 10/1	2300 cd	24 °
929001153034	7MR16/LED/F25/840/DIM AF2 10/1	2600 cd	25 °
929001153104	7MR16/F35 2700 DIM AF2 10/1	1150 cd	36 °
929001153134	7MR16/LED/F35/827/DIM AF2 10/1	1320 cd	35 °
929001153204	7MR16/F35 3000 DIM AF2 10/1	1200 cd	36 °
929001153234	7MR16/LED/F35/830/DIM AF2 10/1	1350 cd	35 °
929001153304	7MR16/F35 4000 DIM AF2 10/1	1250 cd	36 °
929001153334	7MR16/LED/F35/840/DIM AF2 10/1	1400 cd	35 °
929001208003	BC7MR16/AMB/F35/3000 DIM 12V	1350 cd	35 °
929001245403	AmbientLED PAR16 7W 35D 830 D	1000 cd	35 °
929001245605	AmbientLED PAR16S 7W 35D 830 D	1000 cd	35 °
929001300604	4.5GU10/LEDCLA/F35/830/DIM 10/1	750 cd	35 °
929001341704	7MR16 ExpertColor S10 927 D 10/1	4600 cd	10 °
929001341804	7MR16 ExpertColor S10 930 D 10/1	5000 cd	10 °
929001341904	7MR16 ExpertColor S10 940 D 10/1	5000 cd	10 °
929001342604	7MR16 ExpertColor Retail S10 930 10/1	4600 cd	10 °
929001342004	7MR16 ExpertColor F25 927 D 10/1	2200 cd	25 °
929001342104	7MR16 ExpertColor F25 930 D 10/1	2350 cd	25 °
929001342204	7MR16 ExpertColor F25 940 D 10/1	2350 cd	25 °

data subject to change

Order Code	Full Product Name	Luminous Intensity (Nom)	Rated Beam Angle
929001342304	7MR16 ExpertColor F35 927 D 10/1	1300 cd	35 °
929001342404	7MR16 ExpertColor F35 930 D 10/1	1400 cd	35 °
929001342504	7MR16 ExpertColor F35 940 D 10/1	1400 cd	35 °
929001342704	7MR16 ExpertColor Retail F25 930 10/1	2200 cd	25 °
929001342804	7MR16 ExpertColor Retail F35 930 10/1	1300 cd	35 °

Mechanical and Housing

Order Code	Full Product Name	Bulb Shape
929000263004	7MR16/F24 2700 DIM HO	MR16
929000263104	7MR16/F24 3000 DIM HO	MR16
929000263304	7MR16/F36 2700 DIM HO	MR16
929000263404	7MR16/F36 3000 DIM HO	MR16
929001123104	6.5MR16/F36/2700 DIM 12V	MR16
929001127804	6.5MR16/F25/2700-2200 DIM 12V	MR16
929001127904	6.5MR16/F35/2700-2200 DIM 12V	MR16
929001149804	8.5MRX16/F25 2700 DIM AF 10/1	MR16
929001149904	8.5MRX16/F25 3000 DIM AF 10/1	MR16
929001150004	8.5MRX16/F25 4000 DIM AF 10/1	MR16
929001150104	8.5MRX16/F35 2700 DIM AF 10/1	MR16
929001150204	8.5MRX16/F35 3000 DIM AF 10/1	MR16
929001150304	8.5MRX16/F35 4000 DIM AF 10/1	MR16
929001151804	6.6MR16/F25/3000 DIM 12V	MR16
929001151834	6.4MR16/F25/3000 DIM 12V	MR16
929001152204	6.6MR16/F35/3000 DIM 12V	MR16
929001152234	6.4MR16/F35/3000 DIM 12V	MR16
929001152534	7MR16/LED/S15/827/DIM AF2 10/1	MR16
929001152634	7MR16/LED/S15/830/DIM AF2 10/1	MR16
929001152734	7MR16/LED/S15/840/DIM AF2 10/1	MR16
929001152834	7MR16/LED/F25/827/DIM AF2 10/1	MR16
929001152904	7MR16/F25 3000 DIM AF2 10/1	MR16
929001152934	7MR16/LED/F25/830/DIM AF2 10/1	MR16
929001153004	7MR16/F25 4000 DIM AF2 10/1	MR16
929001153034	7MR16/LED/F25/840/DIM AF2 10/1	MR16
929001153104	7MR16/F35 2700 DIM AF2 10/1	MR16
929001153134	7MR16/LED/F35/827/DIM AF2 10/1	MR16
929001153204	7MR16/F35 3000 DIM AF2 10/1	MR16
929001153234	7MR16/LED/F35/830/DIM AF2 10/1	MR16
929001153304	7MR16/F35 4000 DIM AF2 10/1	MR16
929001153334	7MR16/LED/F35/840/DIM AF2 10/1	MR16
929001208003	BC7MR16/AMB/F35/3000 DIM 12V	MR16
929001245403	AmbientLED PAR16 7W 35D 830 D	PAR16
929001245605	AmbientLED PAR16S 7W 35D 830 D	PAR16
929001300604	4.5GU10/LEDCLA/F35/830/DIM 10/1	PAR16
929001341704	7MR16 ExpertColor S10 927 D 10/1	MR16
929001341804	7MR16 ExpertColor S10 930 D 10/1	MR16
929001341904	7MR16 ExpertColor S10 940 D 10/1	MR16
929001342604	7MR16 ExpertColor Retail S10 930 10/1	MR16
929001342004	7MR16 ExpertColor F25 927 D 10/1	MR16
929001342104	7MR16 ExpertColor F25 930 D 10/1	MR16
929001342204	7MR16 ExpertColor F25 940 D 10/1	MR16
929001342304	7MR16 ExpertColor F35 927 D 10/1	MR16
929001342404	7MR16 ExpertColor F35 930 D 10/1	MR16
929001342504	7MR16 ExpertColor F35 940 D 10/1	MR16
929001342704	7MR16 ExpertColor Retail F25 930 10/1	MR16
929001342804	7MR16 ExpertColor Retail F35 930 10/1	MR16

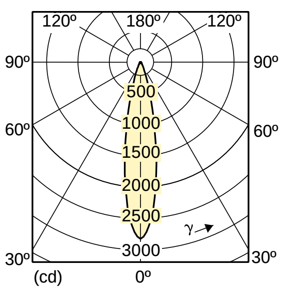
Temperature

Order Code	Full Product Name	T-Case Maximum (Nom)
929000263004	7MR16/F24 2700 DIM HO	110 °C
929000263104	7MR16/F24 3000 DIM HO	110 °C
929000263304	7MR16/F36 2700 DIM HO	110 °C
929000263404	7MR16/F36 3000 DIM HO	110 °C
929001123104	6.5MR16/F36/2700 DIM 12V	85 °C
929001127804	6.5MR16/F25/2700-2200 DIM 12V	-
929001127904	6.5MR16/F35/2700-2200 DIM 12V	-
929001149804	8.5MRX16/F25 2700 DIM AF 10/1	105 °C
929001149904	8.5MRX16/F25 3000 DIM AF 10/1	105 °C
929001150004	8.5MRX16/F25 4000 DIM AF 10/1	105 °C
929001150104	8.5MRX16/F35 2700 DIM AF 10/1	105 °C
929001150204	8.5MRX16/F35 3000 DIM AF 10/1	105 °C
929001150304	8.5MRX16/F35 4000 DIM AF 10/1	105 °C
929001151804	6.6MR16/F25/3000 DIM 12V	100 °C
929001151834	6.4MR16/F25/3000 DIM 12V	100 °C
929001152204	6.6MR16/F35/3000 DIM 12V	100 °C
929001152234	6.4MR16/F35/3000 DIM 12V	100 °C
929001152534	7MR16/LED/S15/827/DIM AF2 10/1	92 °C
929001152634	7MR16/LED/S15/830/DIM AF2 10/1	92 °C
929001152734	7MR16/LED/S15/840/DIM AF2 10/1	92 °C
929001152834	7MR16/LED/F25/827/DIM AF2 10/1	92 °C
929001152904	7MR16/F25 3000 DIM AF2 10/1	92 °C
929001152934	7MR16/LED/F25/830/DIM AF2 10/1	92 °C
929001153004	7MR16/F25 4000 DIM AF2 10/1	92 °C
929001153034	7MR16/LED/F25/840/DIM AF2 10/1	92 °C
929001153104	7MR16/F35 2700 DIM AF2 10/1	92 °C
929001153134	7MR16/LED/F35/827/DIM AF2 10/1	92 °C
929001153204	7MR16/F35 3000 DIM AF2 10/1	92 °C
929001153234	7MR16/LED/F35/830/DIM AF2 10/1	92 °C
929001153304	7MR16/F35 4000 DIM AF2 10/1	92 °C

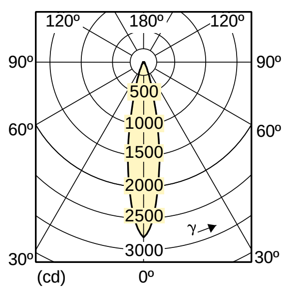
Order Code	Full Product Name	T-Case Maximum (Nom)
929001153334	7MR16/LED/F35/840/DIM AF2 10/1	92 °C
929001208003	BC7MR16/AMB/F35/3000 DIM 12V	102 °C
929001245403	AmbientLED PAR16 7W 35D 830 D	85 °C
929001245605	AmbientLED PAR16S 7W 35D 830 D	85 °C
929001300604	4.5GU10/LEDCLA/F35/830/DIM 10/1	80 °C
929001341704	7MR16 ExpertColor S10 927 D 10/1	92 °C
929001341804	7MR16 ExpertColor S10 930 D 10/1	92 °C
929001341904	7MR16 ExpertColor S10 940 D 10/1	92 °C
929001342604	7MR16 ExpertColor Retail S10 930 10/1	90 °C

Order Code	Full Product Name	T-Case Maximum (Nom)
929001342004	7MR16 ExpertColor F25 927 D 10/1	92 °C
929001342104	7MR16 ExpertColor F25 930 D 10/1	92 °C
929001342204	7MR16 ExpertColor F25 940 D 10/1	92 °C
929001342304	7MR16 ExpertColor F35 927 D 10/1	92 °C
929001342404	7MR16 ExpertColor F35 930 D 10/1	92 °C
929001342504	7MR16 ExpertColor F35 940 D 10/1	92 °C
929001342704	7MR16 ExpertColor Retail F25 930 10/1	90 °C
929001342804	7MR16 ExpertColor Retail F35 930 10/1	90 °C

Light Distribution Diagrams



7-40W MR16 GU5.3 /827 2700K 24D



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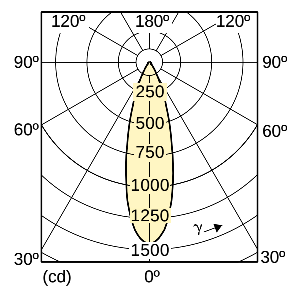

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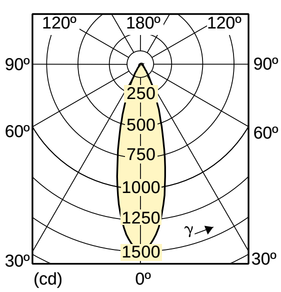

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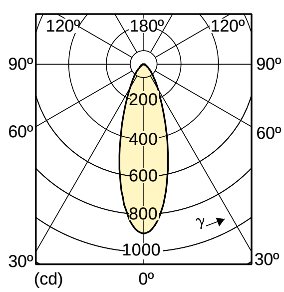

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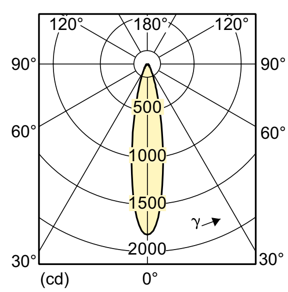

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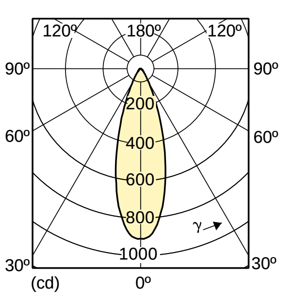

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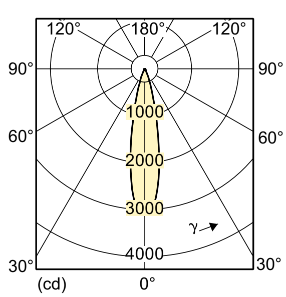

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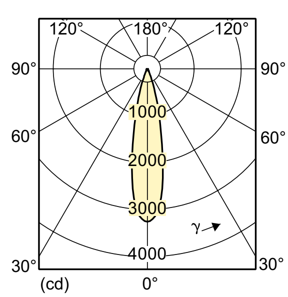

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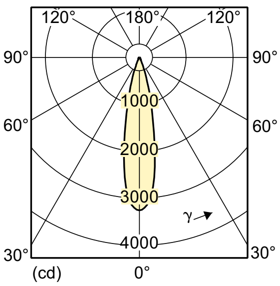
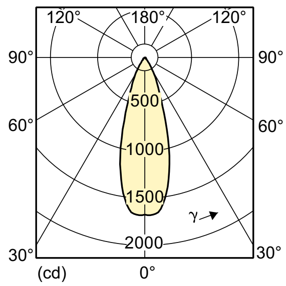
data subject to change

Light Distribution Diagrams





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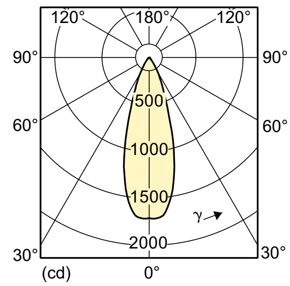

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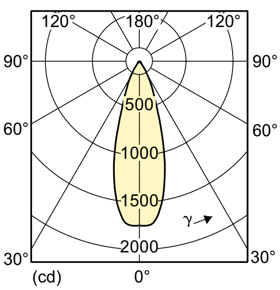

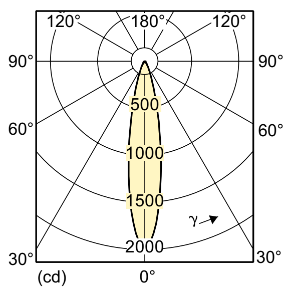

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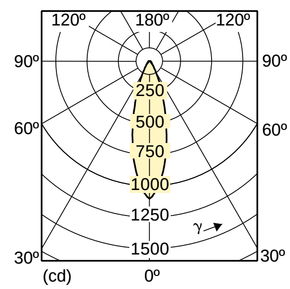

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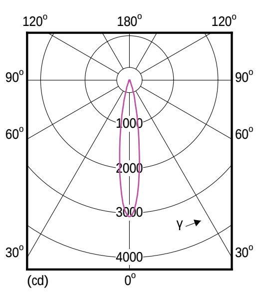
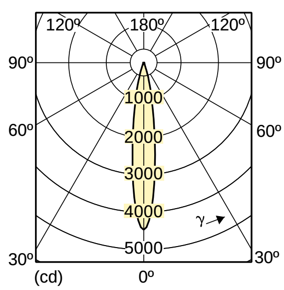
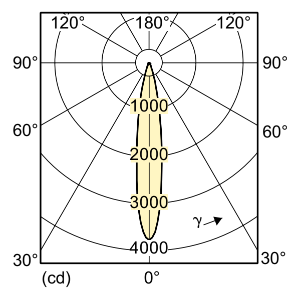
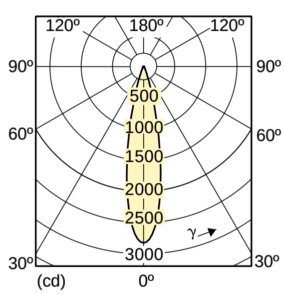
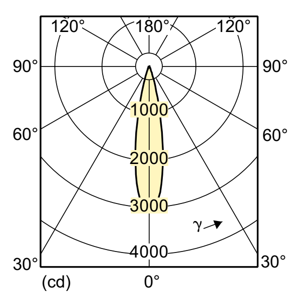


LEDspot Master 50W G5.3 MR16 927 15D DIM



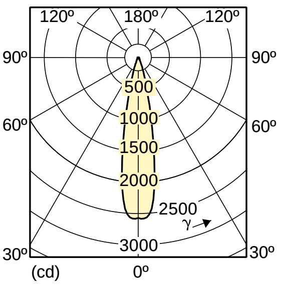


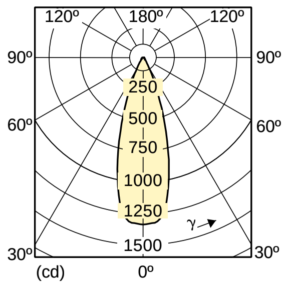


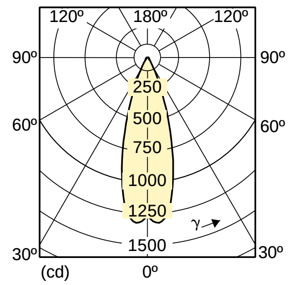


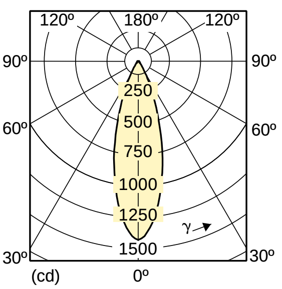
data subject to change

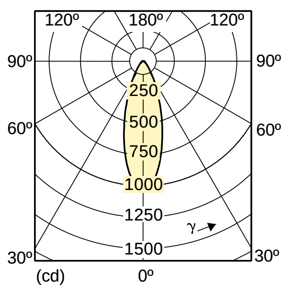
Light Distribution Diagrams

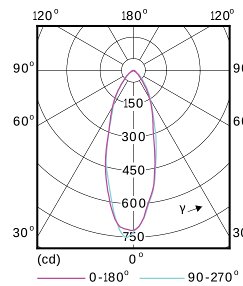


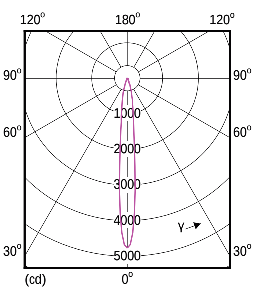


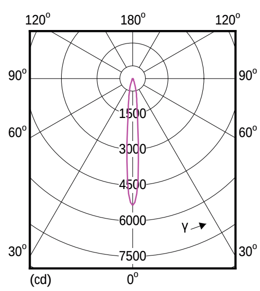


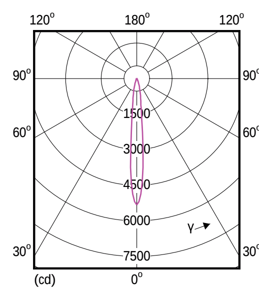












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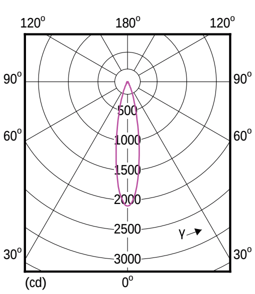
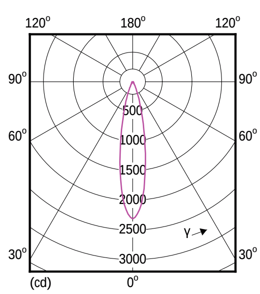
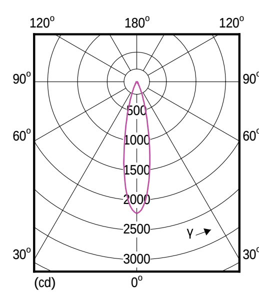
LEDSpots MR16 7W 930 460lm 10D

LEDSpots MR16 7W 940 460lm 10D







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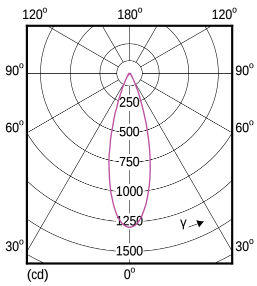
data subject to change

Light Distribution Diagrams



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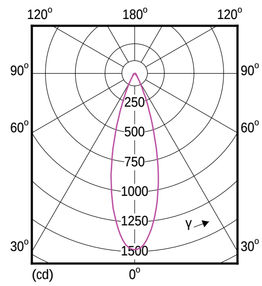

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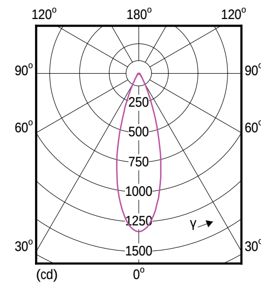

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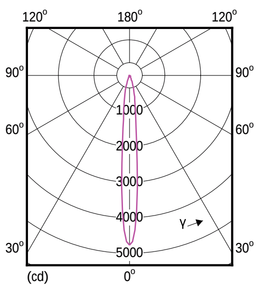

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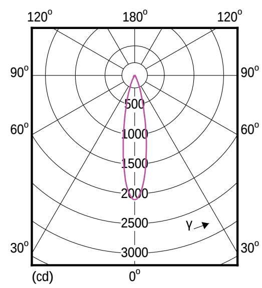

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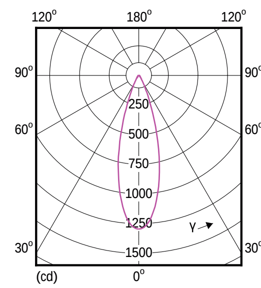

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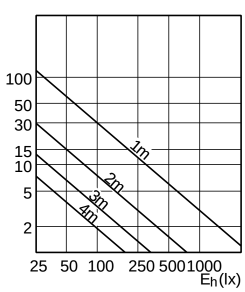
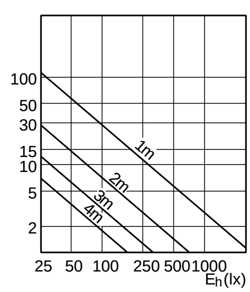
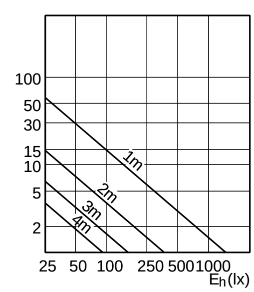
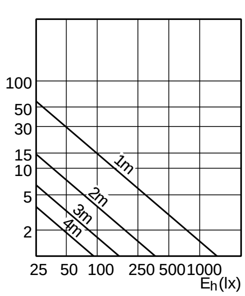
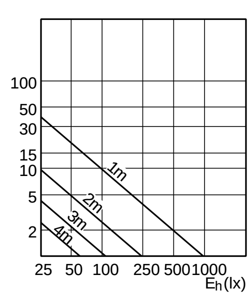
Accent Diagrams

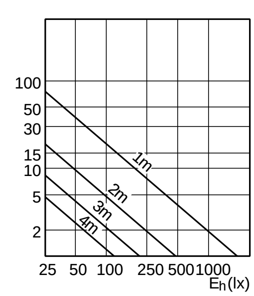












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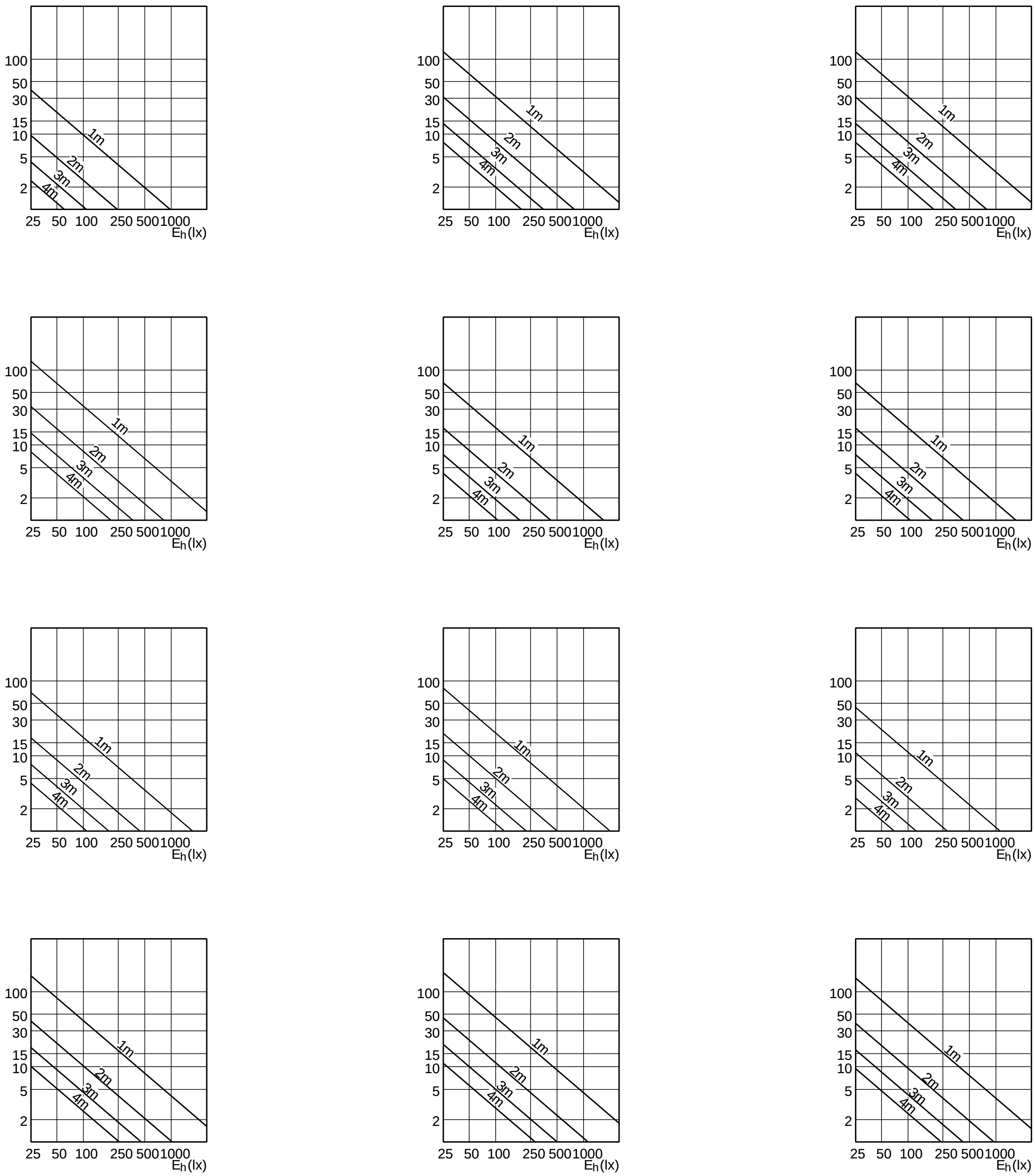

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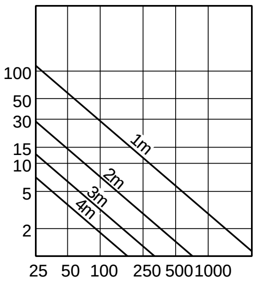

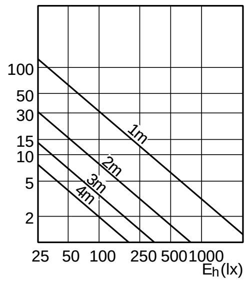

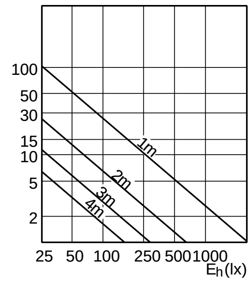

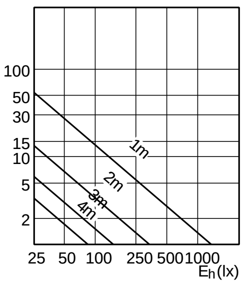

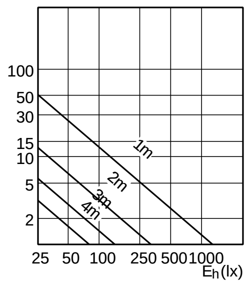

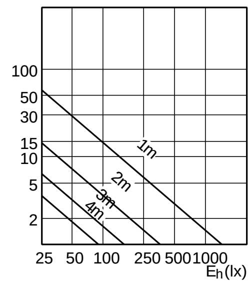

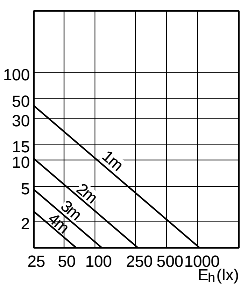

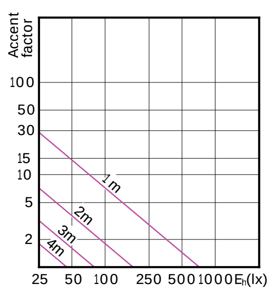

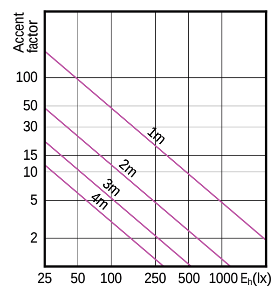

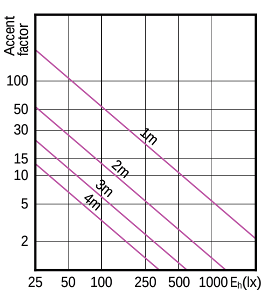

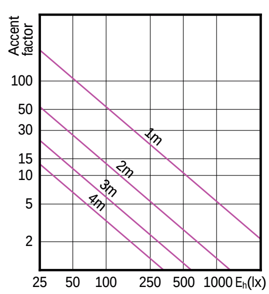

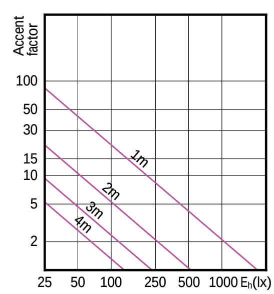

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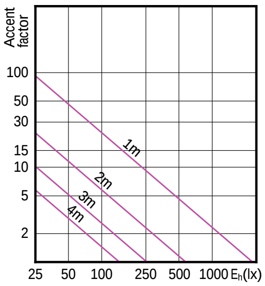
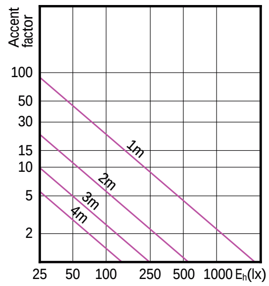
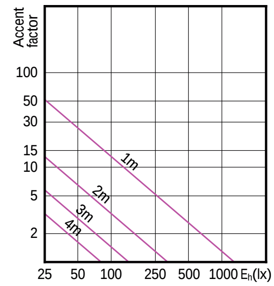
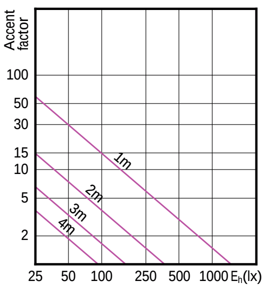
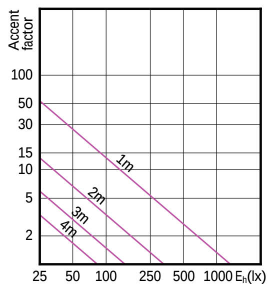
Accent Diagrams

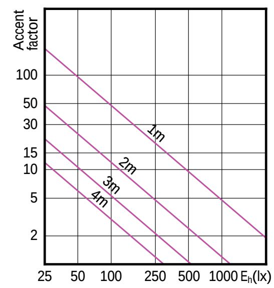


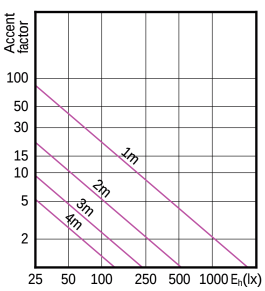


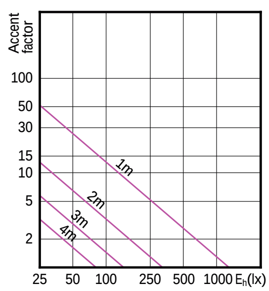




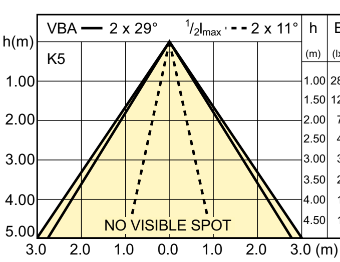




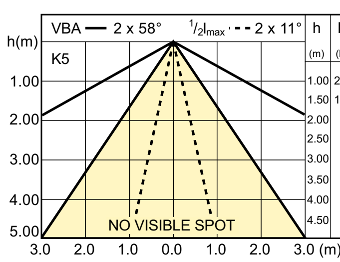




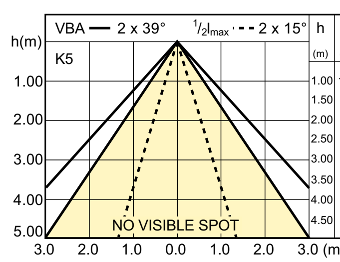
Beam Diagrams



h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	2825	1.11	0.39	0.35
1.50	1255	1.66	0.58	0.53
2.00	706	2.22	0.78	0.71
2.50	452	2.77	0.97	0.88
3.00	314	3.33	1.17	1.06
3.50	231	3.88	1.36	1.23
4.00	177	4.43	1.56	1.41
4.50	139	4.99	1.75	1.59



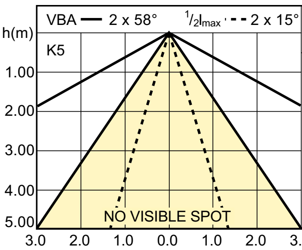
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	2800	3.20	0.39	0.35
1.50	1245	4.80	0.58	0.53
2.00	700	6.40	0.78	0.71
2.50	448	8.00	0.97	0.88
3.00	311	9.60	1.17	1.06
3.50	229	11.20	1.36	1.23
4.00	175	12.80	1.56	1.41
4.50	138	14.40	1.75	1.59



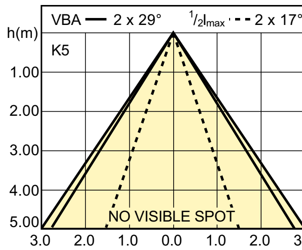
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	1456	1.62	0.54	0.50
1.50	647	2.43	0.80	0.75
2.00	364	3.24	1.07	1.00
2.50	233	4.05	1.34	1.25
3.00	162	4.86	1.61	1.50
3.50	119	5.67	1.88	1.75
4.00	91	6.48	2.14	1.99
4.50	72	7.29	2.41	2.24

data subject to change

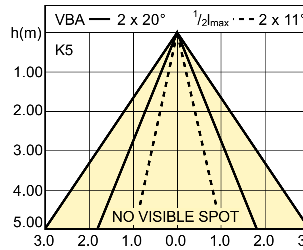
Beam Diagrams



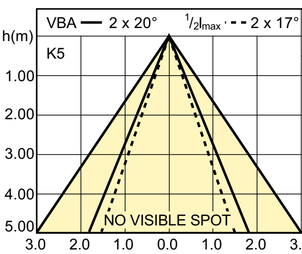
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	1491	3.20	0.54	0.50
1.50	663	4.80	0.80	0.75
2.00	373	6.40	1.07	1.00
2.50	239	8.00	1.34	1.25
3.00	166	9.60	1.61	1.50
3.50	122	11.20	1.88	1.75
4.00	93	12.80	2.14	1.99
4.50	74	14.40	2.41	2.24



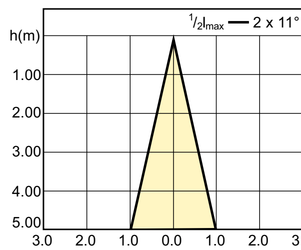
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	902	1.11	0.61	0.54
1.50	401	1.66	0.92	0.80
2.00	226	2.22	1.22	1.07
2.50	144	2.77	1.53	1.34
3.00	100	3.33	1.83	1.61
3.50	74	3.88	2.14	1.88
4.00	56	4.43	2.45	2.14
4.50	45	4.99	2.75	2.41



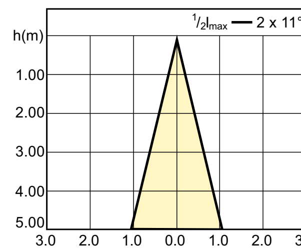
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	1815	0.73	0.39	0.39
1.50	807	1.09	0.58	0.58
2.00	454	1.46	0.78	0.78
2.50	290	1.82	0.97	0.97
3.00	202	2.18	1.17	1.17
3.50	148	2.55	1.36	1.36
4.00	113	2.91	1.56	1.56
4.50	90	3.28	1.75	1.75



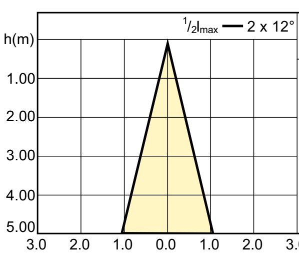
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	908	0.73	0.61	0.57
1.50	404	1.09	0.92	0.86
2.00	227	1.46	1.22	1.15
2.50	145	1.82	1.53	1.43
3.00	101	2.18	1.83	1.72
3.50	74	2.55	2.14	2.01
4.00	57	2.91	2.45	2.29
4.50	45	3.28	2.75	2.58



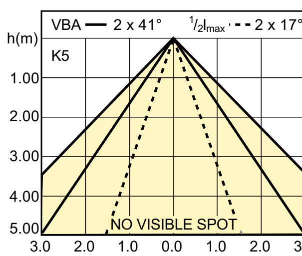
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	3100		0.39	0.39
1.50	1378		0.58	0.58
2.00	775		0.78	0.78
2.50	496		0.97	0.97
3.00	344		1.17	1.17
3.50	253		1.36	1.36
4.00	194		1.56	1.56
4.50	153		1.75	1.75



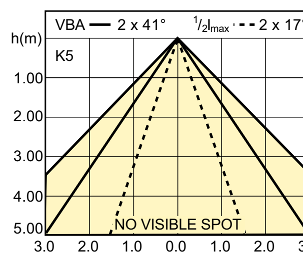
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	3100		0.43	0.39
1.50	1378		0.64	0.58
2.00	775		0.85	0.78
2.50	496		1.06	0.97
3.00	344		1.28	1.17
3.50	253		1.49	1.36
4.00	194		1.70	1.56
4.50	153		1.91	1.75



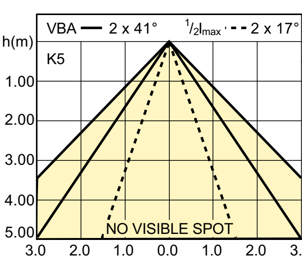
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	3250		0.43	0.39
1.50	1444		0.64	0.58
2.00	813		0.85	0.78
2.50	520		1.06	0.97
3.00	361		1.28	1.17
3.50	265		1.49	1.36
4.00	203		1.70	1.56
4.50	160		1.91	1.75



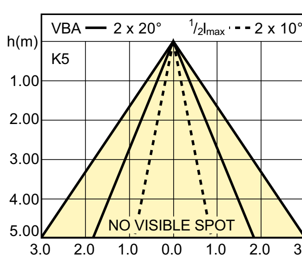
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	1671	1.74	0.61	0.57
1.50	743	2.61	0.92	0.86
2.00	418	3.48	1.22	1.15
2.50	267	4.35	1.53	1.43
3.00	186	5.22	1.83	1.72
3.50	136	6.09	2.14	2.01
4.00	104	6.95	2.45	2.29
4.50	83	7.82	2.75	2.58



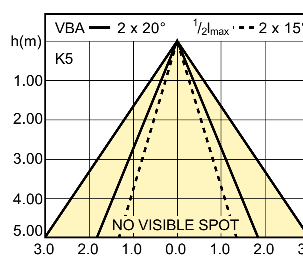
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	1706	1.74	0.61	0.57
1.50	758	2.61	0.92	0.86
2.00	427	3.48	1.22	1.15
2.50	273	4.35	1.53	1.43
3.00	190	5.22	1.83	1.72
3.50	139	6.09	2.14	2.01
4.00	107	6.95	2.45	2.29
4.50	84	7.82	2.75	2.58



h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	1736	1.74	0.61	0.57
1.50	772	2.61	0.92	0.86
2.00	434	3.48	1.22	1.15
2.50	278	4.35	1.53	1.43
3.00	193	5.22	1.83	1.72
3.50	142	6.09	2.14	2.01
4.00	108	6.95	2.45	2.29
4.50	86	7.82	2.75	2.58

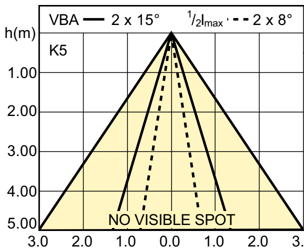


h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	1980	0.73	0.35	0.35
1.50	880	1.09	0.53	0.53
2.00	495	1.46	0.71	0.71
2.50	317	1.82	0.88	0.88
3.00	220	2.18	1.06	1.06
3.50	162	2.55	1.23	1.23
4.00	124	2.91	1.41	1.41
4.50	98	3.28	1.59	1.59

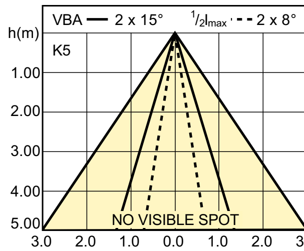


h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.00	1102	0.73	0.54	0.50
1.50	490	1.09	0.80	0.75
2.00	276	1.46	1.07	1.00
2.50	176	1.82	1.34	1.25
3.00	122	2.18	1.61	1.50
3.50	90	2.55	1.88	1.75
4.00	69	2.91	2.14	1.99
4.50	54	3.28	2.41	2.24

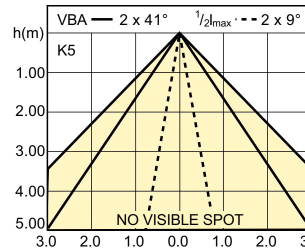
Beam Diagrams



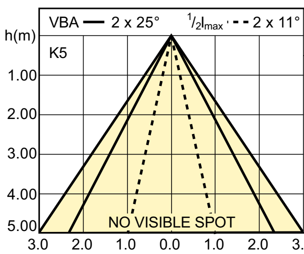
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.00	4048	0.54	0.28	0.28
1.50	1799	0.80	0.42	0.42
2.00	1012	1.07	0.56	0.56
2.50	648	1.34	0.70	0.70
3.00	450	1.61	0.84	0.84
3.50	330	1.88	0.98	0.98
4.00	253	2.14	1.12	1.12
4.50	200	2.41	1.26	1.26



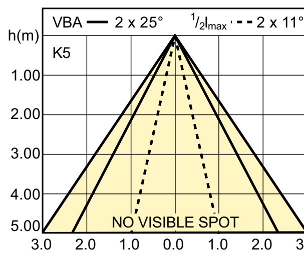
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.00	4465	0.54	0.28	0.28
1.50	1984	0.80	0.42	0.42
2.00	1116	1.07	0.56	0.56
2.50	714	1.34	0.70	0.70
3.00	496	1.61	0.84	0.84
3.50	364	1.88	0.98	0.98
4.00	279	2.14	1.12	1.12
4.50	220	2.41	1.26	1.26



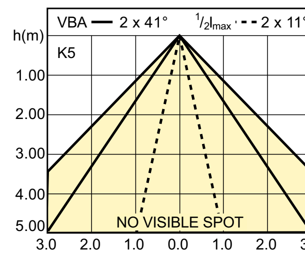
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.00	3767	1.74	0.32	0.28
1.50	1674	2.61	0.48	0.42
2.00	942	3.48	0.63	0.56
2.50	603	4.35	0.79	0.70
3.00	419	5.22	0.95	0.84
3.50	307	6.09	1.11	0.98
4.00	235	6.95	1.27	1.12
4.50	186	7.82	1.43	1.26



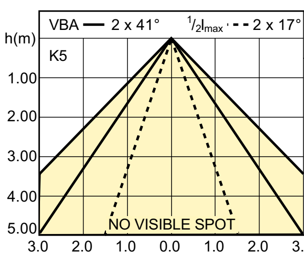
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.00	2828	0.93	0.39	0.39
1.50	1257	1.40	0.58	0.58
2.00	707	1.87	0.78	0.78
2.50	452	2.33	0.97	0.97
3.00	314	2.80	1.17	1.17
3.50	231	3.26	1.36	1.36
4.00	177	3.73	1.56	1.56
4.50	140	4.20	1.75	1.75



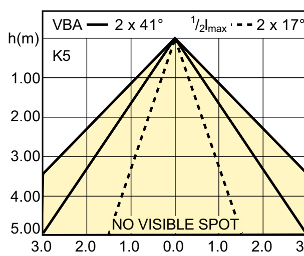
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.00	3088	0.93	0.39	0.39
1.50	1372	1.40	0.58	0.58
2.00	772	1.87	0.78	0.78
2.50	494	2.33	0.97	0.97
3.00	343	2.80	1.17	1.17
3.50	252	3.26	1.36	1.36
4.00	193	3.73	1.56	1.56
4.50	152	4.20	1.75	1.75



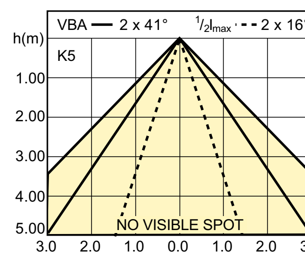
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.00	2569	1.74	0.39	0.39
1.50	1142	2.61	0.58	0.58
2.00	642	3.48	0.78	0.78
2.50	411	4.35	0.97	0.97
3.00	285	5.22	1.17	1.17
3.50	210	6.09	1.36	1.36
4.00	161	6.95	1.56	1.56
4.50	127	7.82	1.75	1.75



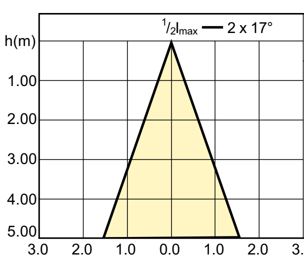
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.00	1337	1.74	0.61	0.57
1.50	594	2.61	0.92	0.86
2.00	334	3.48	1.22	1.15
2.50	214	4.35	1.53	1.43
3.00	149	5.22	1.83	1.72
3.50	109	6.09	2.14	2.01
4.00	84	6.95	2.45	2.29
4.50	66	7.82	2.75	2.58



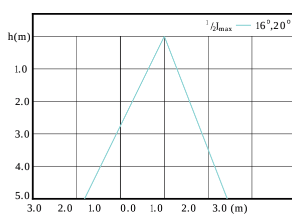
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.00	1266	1.74	0.61	0.57
1.50	563	2.61	0.92	0.86
2.00	317	3.48	1.22	1.15
2.50	203	4.35	1.53	1.43
3.00	141	5.22	1.83	1.72
3.50	103	6.09	2.14	2.01
4.00	79	6.95	2.45	2.29
4.50	63	7.82	2.75	2.58



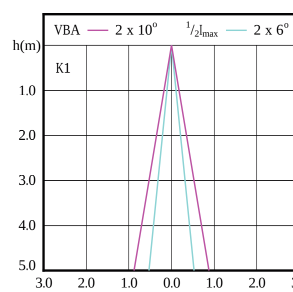
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.00	1431	1.74	0.57	0.57
1.50	636	2.61	0.86	0.86
2.00	358	3.48	1.15	1.15
2.50	229	4.35	1.43	1.43
3.00	159	5.22	1.72	1.72
3.50	117	6.09	2.01	2.01
4.00	89	6.95	2.29	2.29
4.50	71	7.82	2.58	2.58



h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.00	1038		0.61	0.57
1.50	461		0.92	0.86
2.00	260		1.22	1.15
2.50	166		1.53	1.43
3.00	115		1.83	1.72
3.50	85		2.14	2.01
4.00	65		2.45	2.29
4.50	51		2.75	2.58



h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	718		0.65	0.59
1.5	319		0.98	0.89
2.0	180		1.30	1.19
2.5	115		1.63	1.48
3.0	80		1.95	1.78
3.5	59		2.28	2.08
4.0	45		2.60	2.37
4.5	35		2.93	2.67

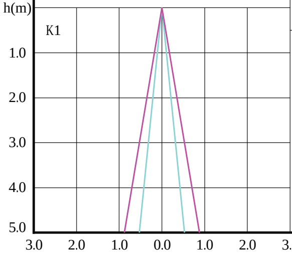


h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	4766	0.35	0.21	0.21
1.5	2118	0.53	0.32	0.32
2.0	1191	0.71	0.42	0.42
2.5	763	0.88	0.53	0.53
3.0	530	1.06	0.63	0.63
3.5	389	1.23	0.74	0.74
4.0	298	1.41	0.84	0.84
4.5	235	1.59	0.95	0.95

data subject to change

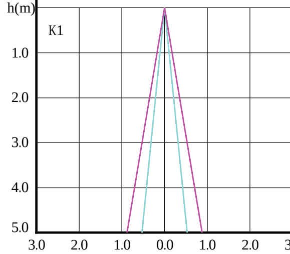
Beam Diagrams

VBA — 2 x 10° $^{1}/_{2}I_{max}$ — 2 x 6°



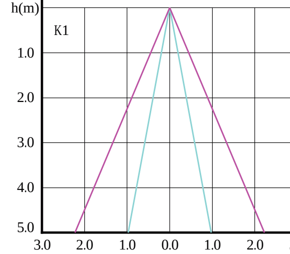
h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	5345	0.35	0.21	0.21
1.5	2376	0.53	0.32	0.32
2.0	1336	0.71	0.42	0.42
2.5	855	0.88	0.53	0.53
3.0	594	1.06	0.63	0.63
3.5	436	1.23	0.74	0.74
4.0	334	1.41	0.84	0.84
4.5	264	1.59	0.95	0.95

VBA — 2 x 10° $^{1}/_{2}I_{max}$ — 2 x 6°



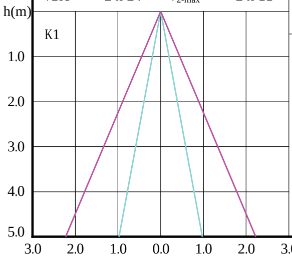
h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	5314	0.35	0.21	0.21
1.5	2362	0.53	0.32	0.32
2.0	1329	0.71	0.42	0.42
2.5	850	0.88	0.53	0.53
3.0	590	1.06	0.63	0.63
3.5	434	1.23	0.74	0.74
4.0	332	1.41	0.84	0.84
4.5	262	1.59	0.95	0.95

VBA — 2 x 24° $^{1}/_{2}I_{max}$ — 2 x 11°



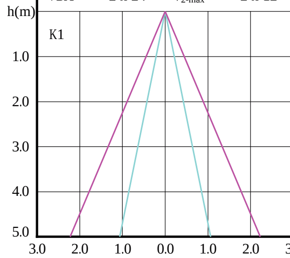
h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	2096	0.89	0.39	0.39
1.5	932	1.34	0.58	0.58
2.0	524	1.78	0.78	0.78
2.5	335	2.23	0.97	0.97
3.0	233	2.67	1.17	1.17
3.5	171	3.12	1.36	1.36
4.0	131	3.56	1.56	1.56
4.5	104	4.01	1.75	1.75

VBA — 2 x 24° $^{1}/_{2}I_{max}$ — 2 x 11°



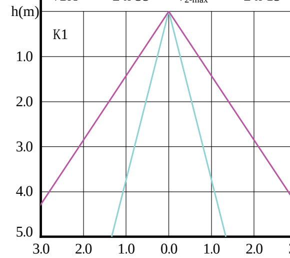
h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	2307	0.89	0.39	0.39
1.5	1025	1.34	0.58	0.58
2.0	577	1.78	0.78	0.78
2.5	369	2.23	0.97	0.97
3.0	256	2.67	1.17	1.17
3.5	188	3.12	1.36	1.36
4.0	144	3.56	1.56	1.56
4.5	114	4.01	1.75	1.75

VBA — 2 x 24° $^{1}/_{2}I_{max}$ — 2 x 12°



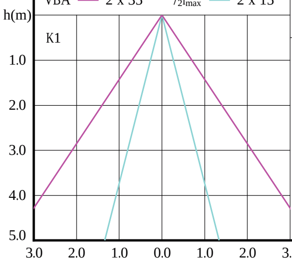
h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	2219	0.89	0.43	0.39
1.5	986	1.34	0.64	0.58
2.0	555	1.78	0.85	0.78
2.5	355	2.23	1.06	0.97
3.0	247	2.67	1.28	1.17
3.5	181	3.12	1.49	1.36
4.0	139	3.56	1.70	1.56
4.5	110	4.01	1.91	1.75

VBA — 2 x 35° $^{1}/_{2}I_{max}$ — 2 x 15°



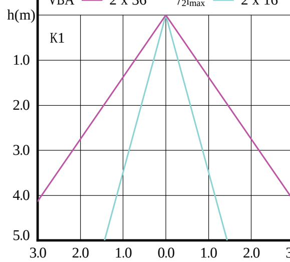
h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	1294	1.40	0.54	0.50
1.5	575	2.10	0.80	0.75
2.0	324	2.80	1.07	1.00
2.5	207	3.50	1.34	1.25
3.0	144	4.20	1.61	1.50
3.5	106	4.90	1.88	1.75
4.0	81	5.60	2.14	1.99
4.5	64	6.30	2.41	2.24

VBA — 2 x 35° $^{1}/_{2}I_{max}$ — 2 x 15°



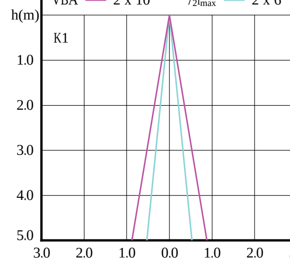
h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	1482	1.40	0.54	0.50
1.5	659	2.10	0.80	0.75
2.0	371	2.80	1.07	1.00
2.5	237	3.50	1.34	1.25
3.0	165	4.20	1.61	1.50
3.5	121	4.90	1.88	1.75
4.0	93	5.60	2.14	1.99
4.5	73	6.30	2.41	2.24

VBA — 2 x 36° $^{1}/_{2}I_{max}$ — 2 x 16°



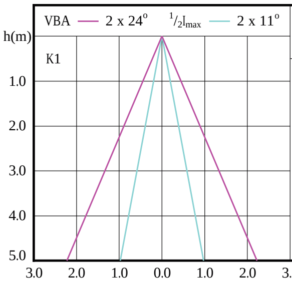
h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	1331	1.45	0.57	0.54
1.5	592	2.18	0.86	0.80
2.0	333	2.91	1.15	1.07
2.5	213	3.63	1.43	1.34
3.0	148	4.36	1.72	1.61
3.5	109	5.09	2.01	1.88
4.0	83	5.81	2.29	2.14
4.5	66	6.54	2.58	2.41

VBA — 2 x 10° $^{1}/_{2}I_{max}$ — 2 x 6°



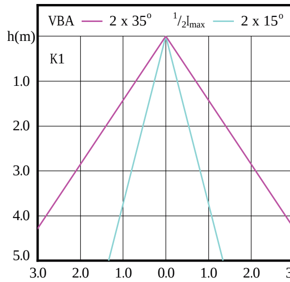
h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	4766	0.35	0.21	0.21
1.5	2118	0.53	0.32	0.32
2.0	1191	0.71	0.42	0.42
2.5	763	0.88	0.53	0.53
3.0	530	1.06	0.63	0.63
3.5	389	1.23	0.74	0.74
4.0	298	1.41	0.84	0.84
4.5	235	1.59	0.95	0.95

VBA — 2 x 24° $^{1}/_{2}I_{max}$ — 2 x 11°



h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	2096	0.89	0.39	0.39
1.5	932	1.34	0.58	0.58
2.0	524	1.78	0.78	0.78
2.5	335	2.23	0.97	0.97
3.0	233	2.67	1.17	1.17
3.5	171	3.12	1.36	1.36
4.0	131	3.56	1.56	1.56
4.5	104	4.01	1.75	1.75

VBA — 2 x 35° $^{1}/_{2}I_{max}$ — 2 x 15°



h (m)	E_0 (lx)	d(m) VBA	d(m) $^{1}/_{2}I_{max}$	d(m) $^{1}/_{2}E_0$
1.0	1294	1.40	0.54	0.50
1.5	575	2.10	0.80	0.75
2.0	324	2.80	1.07	1.00
2.5	207	3.50	1.34	1.25
3.0	144	4.20	1.61	1.50
3.5	106	4.90	1.88	1.75
4.0	81	5.60	2.14	1.99
4.5	64	6.30	2.41	2.24

data subject to change

PHILIPS
Lighting

A smooth design solution for a seamless look

PAR30/PAR20 LED

Philips PAR30S LED Single Optic Lamps with AirFlux Technology provide superior lighting aesthetics and optimal thermal efficiency in a sleek, lightweight design.

Benefits
- Will not fade colors, avoids inventory spoilage
- Lowers maintenance costs by reducing re-lamp frequency
- 5-year limited warranty**
- ** For details see: http://www.usa.lighting.philips.com/connect/tools_literature/warranties.wpd

Features
- Retail Optic reduces glare to improve shopper experience
- 25,000-hour rated average life*
- 12W PAR30S saves 63 watts when compared to a 75W halogen PAR30S
- 83 CRI for excellent color rendering
- Virtually UV/IR free in the beam
- Contains no mercury

Application
- Ideal for general and accent lighting in retail,hospitality and office spaces.

data subject to change

PAR30/PAR20 LED

Versions

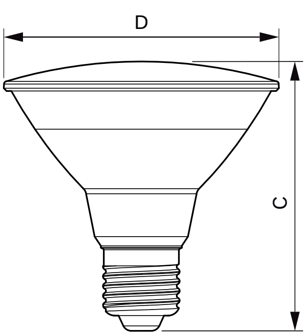
LEDspot E27 PAR30S

LEDspot PAR20 E27

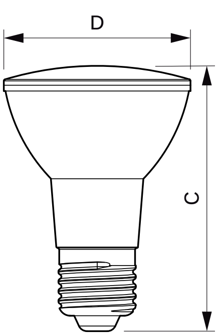
Single Contact Medium Screw PAR
3.75 inch/95mm Long

Single Contact Medium Screw PAR
3.75 inch/95mm Short

Dimensional drawing



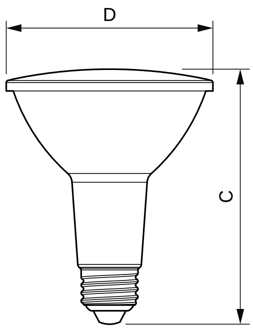
Product	D	C
LEDspot 70W PAR30S 827 100-277V 25D ND	93 mm	91 mm
LEDspot 70W PAR30S 865 100-277V 25D ND	93 mm	91 mm



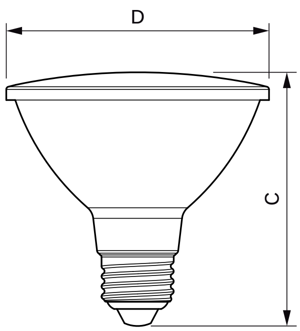
Product	D	C
LEDspot 50W PAR20 865 100-240V 25D ND SO	63 mm	89 mm

data subject to change

Dimensional drawing



Product	D	C
9.4PAR30L/COR/930/F25/DIM/120V T20 6/1FB	97 mm	119 mm
9.4PAR30L/COR/930/F40/DIM/120V T20 6/1FB	97 mm	119 mm



Product	D	C
9.4PAR30S/COR/930/F25/DIM/120V T20 6/1FB	97 mm	94 mm
9.4PAR30S/COR/930/F40/DIM/120V T20 6/1FB	97 mm	94 mm

Approval and Application	
Energy Consumption kWh/1000 h	- kWh
Energy Efficiency Label (EEL)	Not applicable
Operating and Electrical	
Input Frequency	50 to 60 Hz
Starting Time (Nom)	0.5 s
General Information	
Nominal Lifetime (Nom)	25000 h
Light Technical	
Llmf At End Of Nominal Lifetime (Nom)	70 %

Controls and Dimming

Order Code	Full Product Name	Dimmable
929001389612	LEDspot 70W PAR30S 827 100-277V 25D ND	No
929001929512	LEDspot 70W PAR30S 865 100-277V 25D ND	No
929001929412	LEDspot 50W PAR20 865 100-240V 25D ND SO	No
929002045404	9.4PAR30L/COR/930/F25/DIM/120V T20 6/1FB	Yes
929002045504	9.4PAR30L/COR/930/F40/DIM/120V T20 6/1FB	Yes
929002045604	9.4PAR30S/COR/930/F25/DIM/120V T20 6/1FB	Yes
929002045704	9.4PAR30S/COR/930/F40/DIM/120V T20 6/1FB	Yes

Operating and Electrical

PAR30/PAR20 LED

Order Code	Full Product Name	Voltage (Nom)	Wattage Equivalent	Power (Rated) (Nom)
929001389612	LEDspot 70W PAR30S 827 100-277V 25D ND	100-277 V	70 W	9 W
929001929512	LEDspot 70W PAR30S 865 100-277V 25D ND	100-277 V	70 W	9 W
929001929412	LEDspot 50W PAR20 865 100-240V 25D ND SO	100-240 V	50 W	6.5 W
929002045404	9.4PAR30L/COR/930/F25/DIM/120V T20 6/1FB	120 V	75 W	9.4 W
929002045504	9.4PAR30L/COR/930/F40/DIM/120V T20 6/1FB	120 V	75 W	9.4 W
929002045604	9.4PAR30S/COR/930/F25/DIM/120V T20 6/1FB	120 V	75 W	9.4 W
929002045704	9.4PAR30S/COR/930/F40/DIM/120V T20 6/1FB	120 V	75 W	9.4 W

General Information

Order Code	Full Product Name	Cap-Base	Switching Cycle
929001389612	LEDspot 70W PAR30S 827 100-277V 25D ND	E27	25000X
929001929512	LEDspot 70W PAR30S 865 100-277V 25D ND	E27	25000X
929001929412	LEDspot 50W PAR20 865 100-240V 25D ND SO	E27	25000X
929002045404	9.4PAR30L/COR/930/F25/DIM/120V T20 6/1FB	E26	50000X
929002045504	9.4PAR30L/COR/930/F40/DIM/120V T20 6/1FB	E26	50000X
929002045604	9.4PAR30S/COR/930/F25/DIM/120V T20 6/1FB	E26	50000X
929002045704	9.4PAR30S/COR/930/F40/DIM/120V T20 6/1FB	E26	50000X

Light Technical

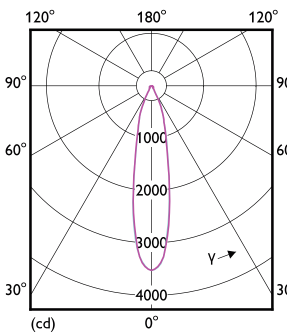
Order Code	Full Product Name	Beam Angle (Nom)	Color Code	Correlated Color Temperature (Nom)	Color Rendering Index (Nom)	Luminous Flux (Nom)	Luminous Intensity (Nom)
929001389612	LEDspot 70W PAR30S 827 100-277V 25D ND	25 °	827	2700 K	80	900 lm	3300 cd
929001929512	LEDspot 70W PAR30S 865 100-277V 25D ND	25 °	865	6500 K	80	900 lm	3300 cd
929001929412	LEDspot 50W PAR20 865 100-240V 25D ND SO	25 °	865	6500 K	80	525 lm	1500 cd
929002045404	9.4PAR30L/COR/930/F25/DIM/120V T20 6/1FB	25 °	930	3000 K	90	850 lm	2910 cd
929002045504	9.4PAR30L/COR/930/F40/DIM/120V T20 6/1FB	40 °	930	3000 K	90	850 lm	1315 cd
929002045604	9.4PAR30S/COR/930/F25/DIM/120V T20 6/1FB	25 °	930	3000 K	90	850 lm	2910 cd
929002045704	9.4PAR30S/COR/930/F40/DIM/120V T20 6/1FB	40 °	930	3000 K	90	850 lm	1315 cd

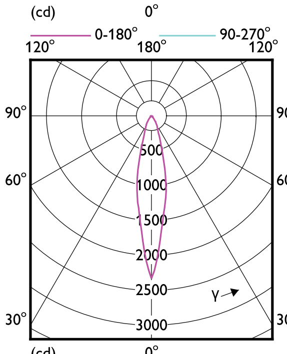
Mechanical and Housing

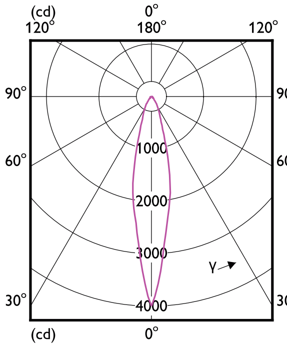
Order Code	Full Product Name	Bulb Shape
929001389612	LEDspot 70W PAR30S 827 100-277V 25D ND	PAR30S
929001929512	LEDspot 70W PAR30S 865 100-277V 25D ND	PAR30S
929001929412	LEDspot 50W PAR20 865 100-240V 25D ND SO	PAR20
929002045404	9.4PAR30L/COR/930/F25/DIM/120V T20 6/1FB	PAR30L
929002045504	9.4PAR30L/COR/930/F40/DIM/120V T20 6/1FB	PAR30L
929002045604	9.4PAR30S/COR/930/F25/DIM/120V T20 6/1FB	PAR30S
929002045704	9.4PAR30S/COR/930/F40/DIM/120V T20 6/1FB	PAR30S

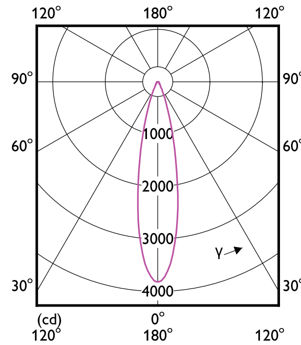
Temperature

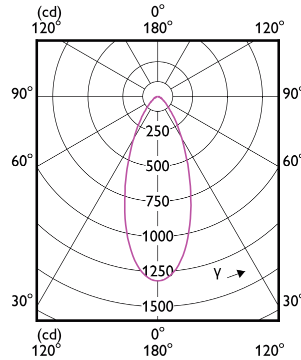
Order Code	Full Product Name	T-Case Maximum (Nom)
929001389612	LEDspot 70W PAR30S 827 100-277V 25D ND	80 °C
929001929512	LEDspot 70W PAR30S 865 100-277V 25D ND	75 °C
929001929412	LEDspot 50W PAR20 865 100-240V 25D ND SO	75 °C
929002045404	9.4PAR30L/COR/930/F25/DIM/120V T20 6/1FB	80 °C
929002045504	9.4PAR30L/COR/930/F40/DIM/120V T20 6/1FB	80 °C
929002045604	9.4PAR30S/COR/930/F25/DIM/120V T20 6/1FB	80 °C
929002045704	9.4PAR30S/COR/930/F40/DIM/120V T20 6/1FB	80 °C

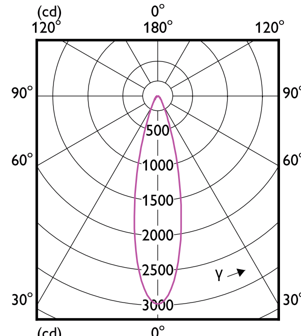


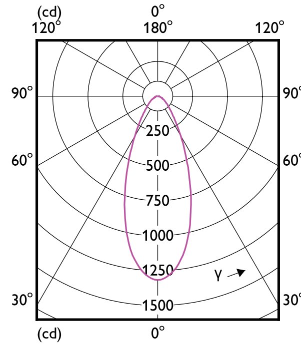




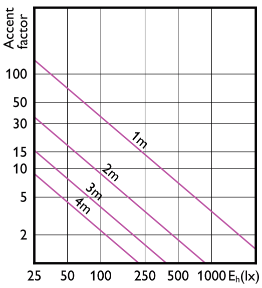




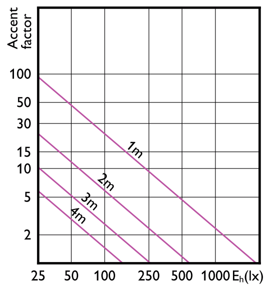




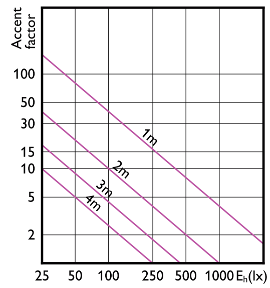
Accent Diagrams



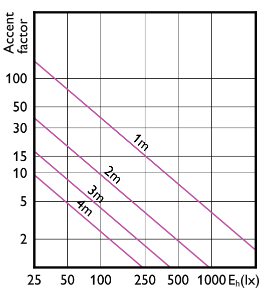
LEDspot_70W_E27_PAR30S_827_25°



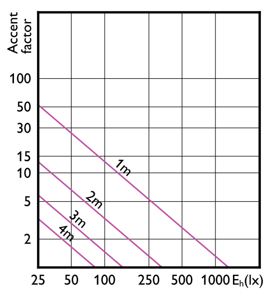
LEDspot PAR20 14-90W 1300lm 25D 6500K E27



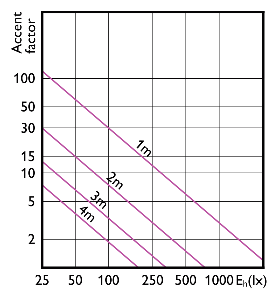
LEDspot PAR30Sd 9-75W 950lm 25D 6500K E27



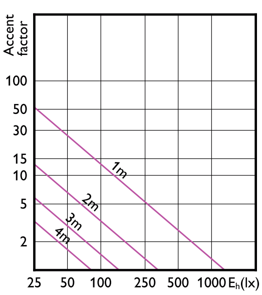
LEDspots 9,4W PAR30L E26 930 25D



LEDspots 9,4W PAR30L E26 930 40D

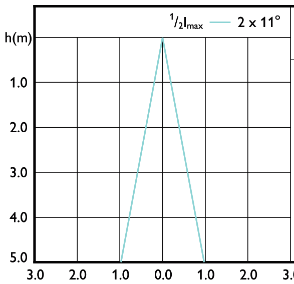


LEDspots 9,4W PAR30S E26 930 25D



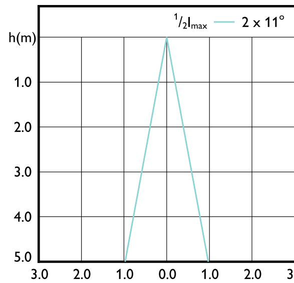
LEDspots 9,4W PAR30S E26 930 40D

Beam Diagrams



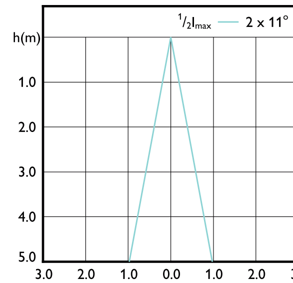
h (m)	E_0 (lx)	VBA	d(m) $^1/_2 I_{max}$	d(m) $^1/_2 E_0$
1.0	3516		0.39	0.39
1.5	1563		0.58	0.58
2.0	879		0.78	0.78
2.5	563		0.97	0.97
3.0	391		1.17	1.17
3.5	287		1.36	1.36
4.0	220		1.56	1.56
4.5	174		1.75	1.75

LEDspot_70W_E27_PAR30S_827_25°



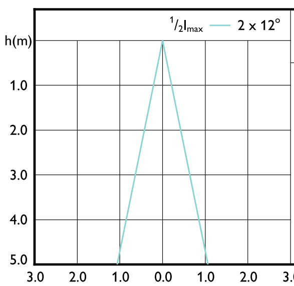
h (m)	E_0 (lx)	VBA	d(m) $^1/_2 I_{max}$	d(m) $^1/_2 E_0$
1.0	2328		0.39	0.35
1.5	1035		0.58	0.53
2.0	582		0.78	0.71
2.5	373		0.97	0.88
3.0	259		1.17	1.06
3.5	190		1.36	1.23
4.0	146		1.56	1.41
4.5	115		1.75	1.59

LEDspot PAR20 14-90W 1300lm 25D 6500K E27



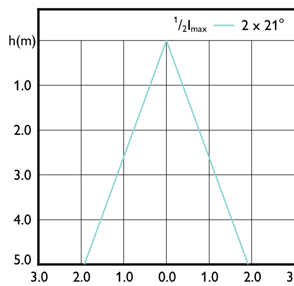
h (m)	E_0 (lx)	VBA	d(m) $^1/_2 I_{max}$	d(m) $^1/_2 E_0$
1.0	3991		0.39	0.35
1.5	1774		0.58	0.53
2.0	998		0.78	0.71
2.5	639		0.97	0.88
3.0	443		1.17	1.06
3.5	326		1.36	1.23
4.0	249		1.56	1.41
4.5	197		1.75	1.59

LEDspot PAR30Sd 9-75W 950lm 25D 6500K E27



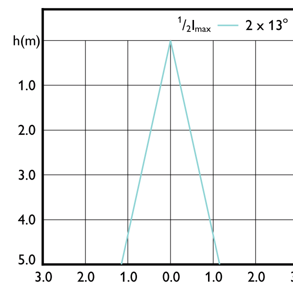
h (m)	E_0 (lx)	VBA	d(m) $^1/_2 I_{max}$	d(m) $^1/_2 E_0$
1.0	3814		0.43	0.39
1.5	1695		0.64	0.58
2.0	954		0.85	0.78
2.5	610		1.06	0.97
3.0	424		1.28	1.17
3.5	311		1.49	1.36
4.0	238		1.70	1.56
4.5	188		1.91	1.75

LEDspots 9,4W PAR30L E26 930 25D



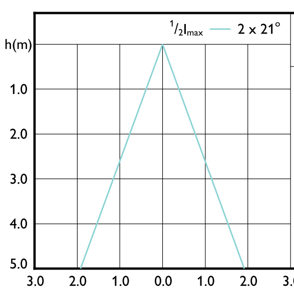
h (m)	E_0 (lx)	VBA	d(m) $^1/_2 I_{max}$	d(m) $^1/_2 E_0$
1.0	1315		0.77	0.69
1.5	584		1.15	1.03
2.0	329		1.54	1.38
2.5	210		1.92	1.72
3.0	146		2.30	2.07
3.5	107		2.69	2.41
4.0	82		3.07	2.75
4.5	65		3.45	3.10

LEDspots 9,4W PAR30L E26 930 40D



h (m)	E_0 (lx)	VBA	d(m) $^1/_2 I_{max}$	d(m) $^1/_2 E_0$
1.0	2978		0.46	0.46
1.5	1324		0.69	0.69
2.0	745		0.92	0.92
2.5	476		1.15	1.15
3.0	331		1.39	1.39
3.5	243		1.62	1.62
4.0	186		1.85	1.85
4.5	147		2.08	2.08

LEDspots 9,4W PAR30S E26 930 25D



h (m)	E_0 (lx)	VBA	d(m) $^1/_2 I_{max}$	d(m) $^1/_2 E_0$
1.0	1315		0.77	0.69
1.5	584		1.15	1.03
2.0	329		1.54	1.38
2.5	210		1.92	1.72
3.0	146		2.30	2.07
3.5	107		2.69	2.41
4.0	82		3.07	2.75
4.5	65		3.45	3.10

LEDspots 9,4W PAR30S E26 930 40D

PHILIPS

Lighting

Everything you value in a Halogen PAR30 with the benefits of LED. Accent your merchandise or space without distraction.

LED PAR30 S/L

Philips LED spots with a single optic beam, provide a clean beam that's free from shadows with beam angles from 15 and 40 degrees to suit every general lighting application.

Benefits

- Up to 80% energy saving compared with halogen lamps
- Lower maintenance costs
- Will not cause fading or damage

Features

- Lifetime of upto 40,000 hours
- Emit virtually no UV/IR light in the beam
- Upto CRI95
- Ranging between 3 to 5-year limited warranty
- Contains no mercury

data subject to change

LED PAR30 S/L

Application
- Hotels, restaurants, bars, cafés, lobbies
- Museums, exhibitions
- Retail shops

Versions

PAR30L

PAR30S

PAR30S

E26 PAR30L

E26 PAR30S

PAR30S E26

PAR30L E26

PAR30S

Versions

PAR30S

PAR30S

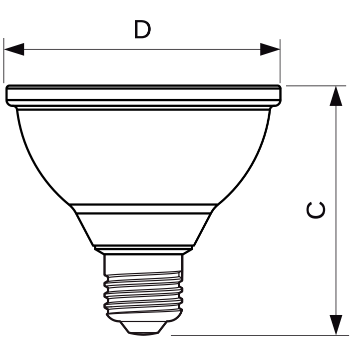
LEDspot PAR30L E26

LEDspot PAR30S E26

Single Contact Medium Screw PAR

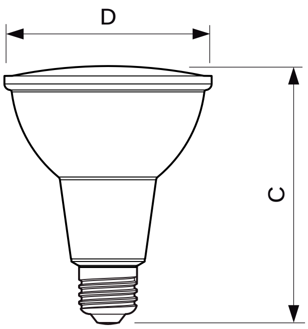
3.75 inch/95mm Short

Dimensional drawing

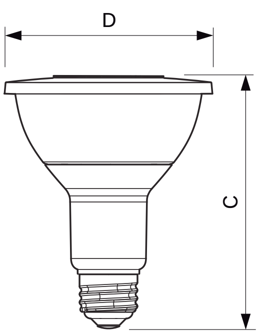


Product	D	C
12PAR30S/AMB/F40/830/DIM ULW	95 mm	95 mm

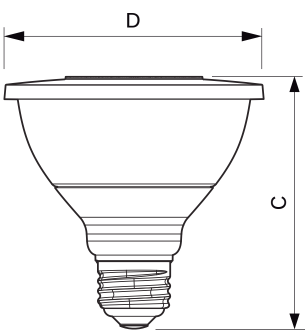
Dimensional drawing



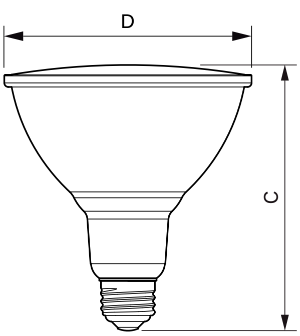
Product	D	C
12PAR30L/AMB/F25/830/DIM ULW	95 mm	115 mm



Product	D	C
12PAR30L/EXPERTCOLOR RETAIL/S10/930/DIM	94.8 mm	116.1 mm
12PAR30L/EXPERTCOLOR RETAIL/F25/930/DIM	94.8 mm	116.1 mm
12PAR30L/EXPERTCOLOR RETAIL/F40/930/DIM	94.8 mm	116.1 mm
12PAR30L/EXPERTCOLOR/F25/927/DIM	94.8 mm	93.1 mm
12PAR30L/EXPERTCOLOR/F40/927/DIM	94.8 mm	93.1 mm
12PAR30L/EXPERTCOLOR/F25/940/DIM	94.8 mm	116.1 mm
12PAR30L/EXPERTCOLOR/F40/940/DIM	94.8 mm	116.1 mm

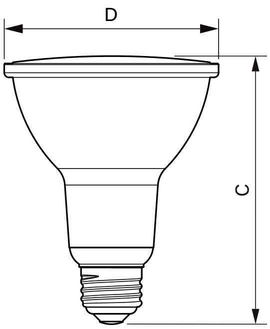


Product	D	C
12PAR30S/EXPERTCOLOR RETAIL/F25/930/DIM	94.8 mm	93.1 mm
12PAR30S/EXPERTCOLOR RETAIL/S10/930/DIM	94.8 mm	93.1 mm
12PAR30S/EXPERTCOLOR RETAIL/F40/930/DIM	94.8 mm	93.1 mm
12PAR30S/EXPERTCOLOR RETAIL/F25/930/DIMB	94.8 mm	93.1 mm
12PAR30S/EXPERTCOLOR/S10/927/DIM	94.8 mm	93.1 mm
12PAR30S/EXPERTCOLOR/F40/940/DIM	120.7 mm	134.6 mm
12PAR30S/EXPERTCOLOR/F25/927/DIM B	94.8 mm	116.1 mm
12PAR30S/EXPERTCOLOR/F40/927/DIM	94.8 mm	116.1 mm
12PAR30S/EXPERTCOLOR/S10/940/DIM/120V	94.8 mm	93.1 mm
12PAR30S/EXPERTCOLOR/F25/940/DIM	120.7 mm	134.6 mm
12PAR30S/EXPERTCOLOR/F25/927/DIM	94.8 mm	93.1 mm
12PAR30S/MAS/927/F40/DIM/EC/120V B 6/1FB	94.8 mm	93.1 mm

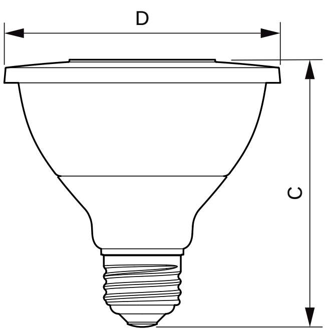


Product	D	C
10PAR30S/LED/830/F25/DIM/ULW/120V 6/1FB	94 mm	93 mm
10PAR30S/LED/827/F25/DIM/ULW/120V 6/1FB	94 mm	93 mm
10PAR30S/LED/827/F40/DIM/ULW/120V 6/1FB	94 mm	93 mm
10PAR30S/LED/840/F25/DIM/ULW/120V 6/1FB	94 mm	93 mm
10PAR30S/LED/840/F40/DIM/ULW/120V 6/1FB	94 mm	93 mm
10PAR30S/LED/830/F40/DIM/ULW/120V 6/1FB	94 mm	93 mm

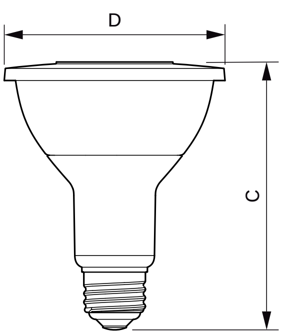
Dimensional drawing



Product	D	C
10PAR30L/LED/827/F40/DIM/ULW/120V 6/1FB	94 mm	118 mm
10PAR30L/LED/827/F25/DIM/ULW/120V 6/1FB	94 mm	118 mm
10PAR30L/LED/840/F25/DIM/ULW/120V 6/1FB	94 mm	118 mm
10PAR30L/LED/830/F40/DIM/ULW/120V 6/1FB	94 mm	118 mm
10PAR30L/LED/840/F40/DIM/ULW/120V 6/1FB	94 mm	118 mm
10PAR30L/LED/830/F25/DIM/ULW/120V 6/1FB	94 mm	118 mm



Product	D	C
11.3PAR30S/PER/930/F40/DIM/120V 6/1FBT20	94.8 mm	93.1 mm
11.3PAR30S/PER/930/F25/DIM/120V 6/1FBT20	94.8 mm	93.1 mm



Product	D	C
11.3PAR30L/PER/930/F40/DIM/120V 6/1FBT20	94.8 mm	116.1 mm
11.3PAR30L/PER/930/F25/DIM/120V 6/1FBT20	94.8 mm	116.1 mm

Controls and Dimming	
Dimmable	Yes
Operating and Electrical	
Voltage (Nom)	120 V
Wattage Equivalent	75 W
Starting Time (Nom)	0.5 s
General Information	
Cap-Base	E26
Light Technical	
Llmf At End Of Nominal Lifetime (Nom)	70 %

Operating and Electrical

LED PAR30 S/L

Order Code	Full Product Name	Input Frequency	Power (Rated) (Nom)
471037	12PAR30L/EC RETAIL/S10/930/DIM 6/1	60 Hz	12 W
471045	12PAR30L/EC RETAIL/F25/930/DIM 6/1	60 Hz	12 W
471052	12PAR30L/EC RETAIL/F40/930/DIM 6/1	60 Hz	12 W
471060	12PAR30S/EC RETAIL/S10/930/DIM 6/1	60 Hz	12 W
470914	12PAR30S/EC/F40/927/DIM/120V 6/1	60 Hz	12 W
470970	12PAR30L/EC/F25/940/DIM/120V 6/1	60 Hz	12 W
470988	12PAR30L/EC/F40/940/DIM/120V 6/1	60 Hz	12 W
471078	12PAR30S/EC RETAIL/F25/930/DIM 6/1	60 Hz	12 W
471086	12PAR30S/EC RETAIL/F40/930/DIM 6/1	60 Hz	12 W
470898	12PAR30S/EC/S10/927/DIM/120V 6/1	60 Hz	12 W
470954	12PAR30L/EC/F25/927/DIM/120V 6/1	60 Hz	12 W
470962	12PAR30L/EC/F40/927/DIM/120V 6/1	60 Hz	12 W
471789	12PAR30S/EXPERTCOLOR/ S10/940/DIM/120V	60 Hz	12 W
471094	12PAR30S/EC RETAIL/F25/930/DIM 6/1	60 Hz	12 W
467829	12PAR30L/AMB/F25/830/DIM ULW	50 to 60 Hz	12 W
467910	12PAR30S/AMB/F40/830/DIM ULW	50 to 60 Hz	12 W
529768	10PAR30S/LED/827/F25/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529776	10PAR30S/LED/830/F25/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529784	10PAR30S/LED/840/F25/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529792	10PAR30S/LED/827/F40/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529800	10PAR30S/LED/830/F40/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529818	10PAR30S/LED/840/F40/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529701	10PAR30L/LED/827/F25/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529719	10PAR30L/LED/830/F25/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529727	10PAR30L/LED/840/F25/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529735	10PAR30L/LED/827/F40/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529743	10PAR30L/LED/830/F40/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
529750	10PAR30L/LED/840/F40/DIM/ULW/ 120V 6/1FB	50 to 60 Hz	10 W
470906	12PAR30S/EC/F25/927/DIM/120V 6/1	60 Hz	12 W
470922	12PAR30S/EC/F25/927/DIM/120V B 6/1	60 Hz	12 W
470930	12PAR30S/EC/F25/940/DIM/120V 6/1	60 Hz	12 W
470948	12PAR30S/EC/F40/940/DIM/120V 6/1	60 Hz	12 W
535419	11.3PAR30L/PER/930/F25/DIM/120V 6/1FBT20	60 Hz	11.3 W
535427	11.3PAR30L/PER/930/F40/DIM/120V 6/1FBT20	60 Hz	11.3 W
535393	11.3PAR30S/PER/930/F25/DIM/120V 6/1FBT20	60 Hz	11.3 W
535400	11.3PAR30S/PER/930/F40/DIM/120V 6/1FBT20	60 Hz	11.3 W
547687	12PAR30S/MAS/927/F40/DIM/EC/120V B 6/1FB	60 Hz	12 W

General Information

Order Code	Full Product Name	Nominal Lifetime (Nom)	Rated Lifetime (Hours)	Switching Cycle
471037	12PAR30L/EC RETAIL/ S10/930/DIM 6/1	25000 h	25000 h	50000X
471045	12PAR30L/EC RETAIL/ F25/930/DIM 6/1	25000 h	25000 h	50000X
471052	12PAR30L/EC RETAIL/ F40/930/DIM 6/1	25000 h	25000 h	50000X
471060	12PAR30S/EC RETAIL/ S10/930/DIM 6/1	25000 h	25000 h	50000X
470914	12PAR30S/EC/F40/927/DIM/ 120V 6/1	40000 h	40000 h	50000X
470970	12PAR30L/EC/F25/940/DIM/ 120V 6/1	40000 h	40000 h	50000X
470988	12PAR30L/EC/F40/940/DIM/ 120V 6/1	40000 h	40000 h	50000X
471078	12PAR30S/EC RETAIL/ F25/930/DIM 6/1	25000 h	25000 h	50000X
471086	12PAR30S/EC RETAIL/ F40/930/DIM 6/1	25000 h	25000 h	50000X
470898	12PAR30S/EC/S10/927/DIM/ 120V 6/1	40000 h	40000 h	50000X
470954	12PAR30L/EC/F25/927/DIM/ 120V 6/1	40000 h	40000 h	50000X
470962	12PAR30L/EC/F40/927/DIM/ 120V 6/1	40000 h	40000 h	50000X
471789	12PAR30S/EXPERTCOLOR/ S10/940/DIM/120V	40000 h	40000 h	50000X
471094	12PAR30S/EC RETAIL/ F25/930/DIM 6/1	25000 h	25000 h	50000X
467829	12PAR30L/AMB/F25/830/DIM ULW	25000 h	25000 h	50000X
467910	12PAR30S/AMB/F40/830/DIM ULW	25000 h	25000 h	50000X

Order Code	Full Product Name	Nominal Lifetime (Nom)	Rated Lifetime (Hours)	Switching Cycle
529768	10PAR30S/LED/827/F25/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
529776	10PAR30S/LED/830/F25/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
529784	10PAR30S/LED/840/F25/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
529792	10PAR30S/LED/827/F40/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
529800	10PAR30S/LED/830/F40/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
529818	10PAR30S/LED/840/F40/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
529701	10PAR30L/LED/827/F25/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
529719	10PAR30L/LED/830/F25/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
529727	10PAR30L/LED/840/F25/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
529735	10PAR30L/LED/827/F40/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
529743	10PAR30L/LED/830/F40/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X

Order Code	Full Product Name	Nominal Lifetime (Nom)	Rated Lifetime (Hours)	Switching Cycle
529750	10PAR30L/LED/840/F40/DIM/ULW/120V 6/1FB	25000 h	25000 h	25000X
470906	12PAR30S/EC/F25/927/DIM/120V 6/1	40000 h	40000 h	50000X
470922	12PAR30S/EC/F25/927/DIM/120V B 6/1	40000 h	40000 h	50000X
470930	12PAR30S/EC/F25/940/DIM/120V 6/1	40000 h	40000 h	50000X
470948	12PAR30S/EC/F40/940/DIM/120V 6/1	40000 h	40000 h	50000X
535419	11.3PAR30L/PER/930/F25/DIM/120V 6/1FBT20	25000 h	25000 h	50000X
535427	11.3PAR30L/PER/930/F40/DIM/120V 6/1FBT20	25000 h	25000 h	50000X
535393	11.3PAR30S/PER/930/F25/DIM/120V 6/1FBT20	25000 h	25000 h	50000X
535400	11.3PAR30S/PER/930/F40/DIM/120V 6/1FBT20	25000 h	25000 h	50000X
547687	12PAR30S/MAS/927/F40/DIM/EC/120V B 6/1FB	40000 h	40000 h	50000X

Light Technical (1/2)

Order Code	Full Product Name	Beam Angle (Nom)	Color Code	Correlated Color Temperature (Nom)	Color Rendering Index (Nom)	Luminous Flux (Nom)	Luminous Flux (Rated) (Nom)	Luminous Intensity (Nom)
471037	12PAR30L/EC RETAIL/S10/930/DIM 6/1	10 °	930	3000 K	90	880 lm	880 lm	10000 cd
471045	12PAR30L/EC RETAIL/F25/930/DIM 6/1	25 °	930	3000 K	90	880 lm	880 lm	4500 cd
471052	12PAR30L/EC RETAIL/F40/930/DIM 6/1	40 °	930	3000 K	90	880 lm	880 lm	2000 cd
471060	12PAR30S/EC RETAIL/S10/930/DIM 6/1	10 °	930	3000 K	90	880 lm	880 lm	10000 cd
470914	12PAR30S/EC/F40/927/DIM/120V 6/1	40 °	927	2700 K	95	850 lm	850 lm	1800 cd
470970	12PAR30L/EC/F25/940/DIM/120V 6/1	25 °	940	4000 K	95	950 lm	950 lm	4800 cd
470988	12PAR30L/EC/F40/940/DIM/120V 6/1	40 °	940	4000 K	95	950 lm	950 lm	2100 cd
471078	12PAR30S/EC RETAIL/F25/930/DIM 6/1	25 °	930	3000 K	90	880 lm	880 lm	4500 cd
471086	12PAR30S/EC RETAIL/F40/930/DIM 6/1	40 °	930	3000 K	90	880 lm	880 lm	2000 cd
470898	12PAR30S/EC/S10/927/DIM/120V 6/1	10 °	927	2700 K	95	850 lm	850 lm	10000 cd
470954	12PAR30L/EC/F25/927/DIM/120V 6/1	25 °	927	2700 K	95	850 lm	850 lm	4200 cd
470962	12PAR30L/EC/F40/927/DIM/120V 6/1	40 °	927	2700 K	95	850 lm	850 lm	1800 cd
471789	12PAR30S/EXPERTCOLOR/S10/940/DIM/120V	10 °	940	4000 K	95	950 lm	950 lm	10500 cd
471094	12PAR30S/EC RETAIL/F25/930/DIM 6/1	25 °	930	3000 K	90	880 lm	880 lm	4500 cd
467829	12PAR30L/AMB/F25/830/DIM ULW	25 °	830	3000 K	80	850 lm	850 lm	3300 cd
467910	12PAR30S/AMB/F40/830/DIM ULW	40 °	830	3000 K	80	850 lm	850 lm	1500 cd
529768	10PAR30S/LED/827/F25/DIM/ULW/120V 6/1FB	25 °	827	2700 K	80	800 lm	800 lm	3300 cd
529776	10PAR30S/LED/830/F25/DIM/ULW/120V 6/1FB	25 °	830	3000 K	80	850 lm	850 lm	3300 cd

data subject to change

LED PAR30 S/L

Order Code	Full Product Name	Beam Angle (Nom)	Color Code	Correlated Color Temperature (Nom)	Color Rendering Index (Nom)	Luminous Flux (Nom)	Luminous Flux (Rated) (Nom)	Luminous Intensity (Nom)
529784	10PAR30S/LED/840/F25/DIM/ULW/120V 6/1FB	25 °	841	4000 K	80	850 lm	850 lm	3300 cd
529792	10PAR30S/LED/827/F40/DIM/ULW/120V 6/1FB	40 °	827	2700 K	80	800 lm	800 lm	1600 cd
529800	10PAR30S/LED/830/F40/DIM/ULW/120V 6/1FB	40 °	830	3000 K	80	850 lm	850 lm	1600 cd
529818	10PAR30S/LED/840/F40/DIM/ULW/120V 6/1FB	40 °	841	4000 K	80	850 lm	850 lm	1600 cd
529701	10PAR30L/LED/827/F25/DIM/ULW/120V 6/1FB	25 °	827	2700 K	80	800 lm	800 lm	3300 cd
529719	10PAR30L/LED/830/F25/DIM/ULW/120V 6/1FB	25 °	830	3000 K	80	850 lm	850 lm	3300 cd
529727	10PAR30L/LED/840/F25/DIM/ULW/120V 6/1FB	25 °	841	4000 K	80	850 lm	850 lm	3300 cd
529735	10PAR30L/LED/827/F40/DIM/ULW/120V 6/1FB	40 °	827	2700 K	80	800 lm	800 lm	1600 cd
529743	10PAR30L/LED/830/F40/DIM/ULW/120V 6/1FB	40 °	830	3000 K	80	850 lm	850 lm	1600 cd
529750	10PAR30L/LED/840/F40/DIM/ULW/120V 6/1FB	40 °	841	4000 K	80	850 lm	850 lm	1600 cd
470906	12PAR30S/EC/F25/927/DIM/120V 6/1	25 °	927	2700 K	95	850 lm	850 lm	4200 cd
470922	12PAR30S/EC/F25/927/DIM/120V B 6/1	25 °	927	2700 K	95	850 lm	850 lm	4200 cd
470930	12PAR30S/EC/F25/940/DIM/120V 6/1	25 °	940	4000 K	95	950 lm	950 lm	4800 cd
470948	12PAR30S/EC/F40/940/DIM/120V 6/1	40 °	940	4000 K	95	950 lm	950 lm	2100 cd
535419	11.3PAR30L/PER/930/F25/DIM/120V 6/1FBT20	25 °	930	3000 K	90	850 lm	850 lm	4500 cd
535427	11.3PAR30L/PER/930/F40/DIM/120V 6/1FBT20	40 °	930	3000 K	90	850 lm	850 lm	2000 cd
535393	11.3PAR30S/PER/930/F25/DIM/120V 6/1FBT20	25 °	930	3000 K	90	850 lm	850 lm	4500 cd
535400	11.3PAR30S/PER/930/F40/DIM/120V 6/1FBT20	40 °	930	3000 K	90	850 lm	850 lm	2000 cd
547687	12PAR30S/MAS/927/F40/DIM/EC/120V B 6/1FB	40 °	927	2700 K	95	850 lm	850 lm	1315 cd

Light Technical (2/2)

Order Code	Full Product Name	Rated Beam Angle
471037	12PAR30L/EC RETAIL/S10/930/DIM 6/1	10 °
471045	12PAR30L/EC RETAIL/F25/930/DIM 6/1	25 °
471052	12PAR30L/EC RETAIL/F40/930/DIM 6/1	40 °
471060	12PAR30S/EC RETAIL/S10/930/DIM 6/1	10 °
470914	12PAR30S/EC/F40/927/DIM/120V 6/1	40 °
470970	12PAR30L/EC/F25/940/DIM/120V 6/1	25 °
470988	12PAR30L/EC/F40/940/DIM/120V 6/1	40 °
471078	12PAR30S/EC RETAIL/F25/930/DIM 6/1	25 °
471086	12PAR30S/EC RETAIL/F40/930/DIM 6/1	40 °
470898	12PAR30S/EC/S10/927/DIM/120V 6/1	10 °
470954	12PAR30L/EC/F25/927/DIM/120V 6/1	25 °
470962	12PAR30L/EC/F40/927/DIM/120V 6/1	40 °

Order Code	Full Product Name	Rated Beam Angle
471789	12PAR30S/EXPERTCOLOR/S10/940/DIM/120V	10 °
471094	12PAR30S/EC RETAIL/F25/930/DIM 6/1	25 °
467829	12PAR30L/AMB/F25/830/DIM ULW	25 °
467910	12PAR30S/AMB/F40/830/DIM ULW	40 °
529768	10PAR30S/LED/827/F25/DIM/ULW/120V 6/1FB	25 °
529776	10PAR30S/LED/830/F25/DIM/ULW/120V 6/1FB	25 °
529784	10PAR30S/LED/840/F25/DIM/ULW/120V 6/1FB	25 °
529792	10PAR30S/LED/827/F40/DIM/ULW/120V 6/1FB	40 °
529800	10PAR30S/LED/830/F40/DIM/ULW/120V 6/1FB	40 °
529818	10PAR30S/LED/840/F40/DIM/ULW/120V 6/1FB	40 °
529701	10PAR30L/LED/827/F25/DIM/ULW/120V 6/1FB	25 °
529719	10PAR30L/LED/830/F25/DIM/ULW/120V 6/1FB	25 °

data subject to change

Order Code	Full Product Name	Rated Beam Angle
529727	10PAR30L/LED/840/F25/DIM/ULW/120V 6/1FB	25 °
529735	10PAR30L/LED/827/F40/DIM/ULW/120V 6/1FB	40 °
529743	10PAR30L/LED/830/F40/DIM/ULW/120V 6/1FB	40 °
529750	10PAR30L/LED/840/F40/DIM/ULW/120V 6/1FB	40 °
470906	12PAR30S/EC/F25/927/DIM/120V 6/1	25 °
470922	12PAR30S/EC/F25/927/DIM/120V B 6/1	25 °
470930	12PAR30S/EC/F25/940/DIM/120V 6/1	25 °
470948	12PAR30S/EC/F40/940/DIM/120V 6/1	40 °
535419	11.3PAR30L/PER/930/F25/DIM/120V 6/1FBT20	25 °
535427	11.3PAR30L/PER/930/F40/DIM/120V 6/1FBT20	40 °
535393	11.3PAR30S/PER/930/F25/DIM/120V 6/1FBT20	25 °
535400	11.3PAR30S/PER/930/F40/DIM/120V 6/1FBT20	40 °
547687	12PAR30S/MAS/927/F40/DIM/EC/120V B 6/1FB	40 °

Mechanical and Housing

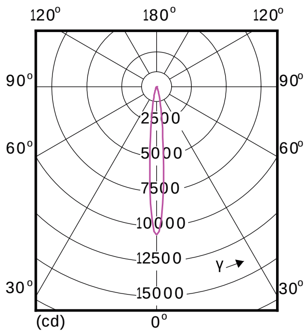
Order Code	Full Product Name	Bulb Shape
471037	12PAR30L/EC RETAIL/S10/930/DIM 6/1	PAR30L
471045	12PAR30L/EC RETAIL/F25/930/DIM 6/1	PAR30L
471052	12PAR30L/EC RETAIL/F40/930/DIM 6/1	PAR30L
471060	12PAR30S/EC RETAIL/S10/930/DIM 6/1	PAR30S
470914	12PAR30S/EC/F40/927/DIM/120V 6/1	PAR30S
470970	12PAR30L/EC/F25/940/DIM/120V 6/1	PAR30L
470988	12PAR30L/EC/F40/940/DIM/120V 6/1	PAR30L
471078	12PAR30S/EC RETAIL/F25/930/DIM 6/1	PAR30S
471086	12PAR30S/EC RETAIL/F40/930/DIM 6/1	PAR30S
470898	12PAR30S/EC/S10/927/DIM/120V 6/1	PAR30S
470954	12PAR30L/EC/F25/927/DIM/120V 6/1	PAR30L
470962	12PAR30L/EC/F40/927/DIM/120V 6/1	PAR30L
471789	12PAR30S/EXPERTCOLOR/S10/940/DIM/120V	PAR30S
471094	12PAR30S/EC RETAIL/F25/930/DIM 6/1	PAR30S
467829	12PAR30L/AMB/F25/830/DIM ULW	PAR30L
467910	12PAR30S/AMB/F40/830/DIM ULW	PAR30S
529768	10PAR30S/LED/827/F25/DIM/ULW/120V 6/1FB	PAR30S
529776	10PAR30S/LED/830/F25/DIM/ULW/120V 6/1FB	PAR30S
529784	10PAR30S/LED/840/F25/DIM/ULW/120V 6/1FB	PAR30S
529792	10PAR30S/LED/827/F40/DIM/ULW/120V 6/1FB	PAR30S
529800	10PAR30S/LED/830/F40/DIM/ULW/120V 6/1FB	PAR30S
529818	10PAR30S/LED/840/F40/DIM/ULW/120V 6/1FB	PAR30S
529701	10PAR30L/LED/827/F25/DIM/ULW/120V 6/1FB	PAR30L
529719	10PAR30L/LED/830/F25/DIM/ULW/120V 6/1FB	PAR30L
529727	10PAR30L/LED/840/F25/DIM/ULW/120V 6/1FB	PAR30L
529735	10PAR30L/LED/827/F40/DIM/ULW/120V 6/1FB	PAR30L
529743	10PAR30L/LED/830/F40/DIM/ULW/120V 6/1FB	PAR30L
529750	10PAR30L/LED/840/F40/DIM/ULW/120V 6/1FB	PAR30L
470906	12PAR30S/EC/F25/927/DIM/120V 6/1	PAR30S
470922	12PAR30S/EC/F25/927/DIM/120V B 6/1	PAR30S
470930	12PAR30S/EC/F25/940/DIM/120V 6/1	PAR30S
470948	12PAR30S/EC/F40/940/DIM/120V 6/1	PAR30S
535419	11.3PAR30L/PER/930/F25/DIM/120V 6/1FBT20	PAR30L
535427	11.3PAR30L/PER/930/F40/DIM/120V 6/1FBT20	PAR30L
535393	11.3PAR30S/PER/930/F25/DIM/120V 6/1FBT20	PAR30S
535400	11.3PAR30S/PER/930/F40/DIM/120V 6/1FBT20	PAR30S
547687	12PAR30S/MAS/927/F40/DIM/EC/120V B 6/1FB	PAR30S

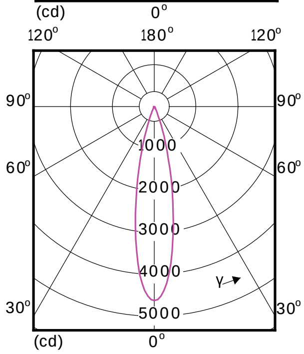
Temperature

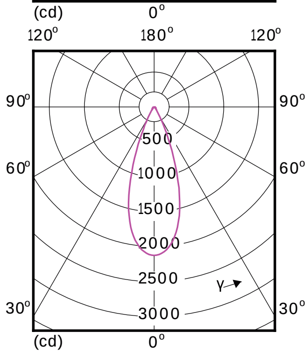
Order Code	Full Product Name	T-Case Maximum (Nom)
471037	12PAR30L/EC RETAIL/S10/930/DIM 6/1	85 °C
471045	12PAR30L/EC RETAIL/F25/930/DIM 6/1	85 °C
471052	12PAR30L/EC RETAIL/F40/930/DIM 6/1	85 °C
471060	12PAR30S/EC RETAIL/S10/930/DIM 6/1	90 °C
470914	12PAR30S/EC/F40/927/DIM/120V 6/1	90 °C
470970	12PAR30L/EC/F25/940/DIM/120V 6/1	85 °C
470988	12PAR30L/EC/F40/940/DIM/120V 6/1	85 °C
471078	12PAR30S/EC RETAIL/F25/930/DIM 6/1	90 °C
471086	12PAR30S/EC RETAIL/F40/930/DIM 6/1	90 °C
470898	12PAR30S/EC/S10/927/DIM/120V 6/1	90 °C
470954	12PAR30L/EC/F25/927/DIM/120V 6/1	85 °C
470962	12PAR30L/EC/F40/927/DIM/120V 6/1	85 °C
471789	12PAR30S/EXPERTCOLOR/S10/940/DIM/120V	90 °C
471094	12PAR30S/EC RETAIL/F25/930/DIM 6/1	90 °C
467829	12PAR30L/AMB/F25/830/DIM ULW	85 °C
467910	12PAR30S/AMB/F40/830/DIM ULW	85 °C
529768	10PAR30S/LED/827/F25/DIM/ULW/120V 6/1FB	70 °C
529776	10PAR30S/LED/830/F25/DIM/ULW/120V 6/1FB	70 °C
529784	10PAR30S/LED/840/F25/DIM/ULW/120V 6/1FB	70 °C
529792	10PAR30S/LED/827/F40/DIM/ULW/120V 6/1FB	70 °C
529800	10PAR30S/LED/830/F40/DIM/ULW/120V 6/1FB	70 °C
529818	10PAR30S/LED/840/F40/DIM/ULW/120V 6/1FB	70 °C
529701	10PAR30L/LED/827/F25/DIM/ULW/120V 6/1FB	67 °C
529719	10PAR30L/LED/830/F25/DIM/ULW/120V 6/1FB	67 °C
529727	10PAR30L/LED/840/F25/DIM/ULW/120V 6/1FB	67 °C
529735	10PAR30L/LED/827/F40/DIM/ULW/120V 6/1FB	67 °C
529743	10PAR30L/LED/830/F40/DIM/ULW/120V 6/1FB	67 °C
529750	10PAR30L/LED/840/F40/DIM/ULW/120V 6/1FB	67 °C
470906	12PAR30S/EC/F25/927/DIM/120V 6/1	90 °C
470922	12PAR30S/EC/F25/927/DIM/120V B 6/1	90 °C
470930	12PAR30S/EC/F25/940/DIM/120V 6/1	90 °C
470948	12PAR30S/EC/F40/940/DIM/120V 6/1	90 °C
535419	11.3PAR30L/PER/930/F25/DIM/120V 6/1FBT20	85 °C
535427	11.3PAR30L/PER/930/F40/DIM/120V 6/1FBT20	85 °C

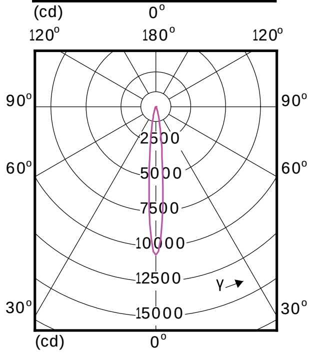
data subject to change

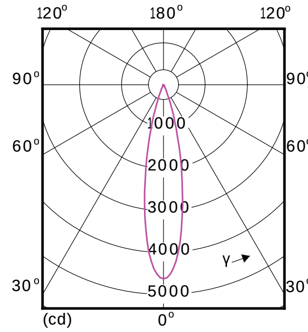
Order Code	Full Product Name	T-Case Maximum (Nom)
535393	11.3PAR30S/PER/930/F25/DIM/120V 6/1FBT20	90 °C
535400	11.3PAR30S/PER/930/F40/DIM/120V 6/1FBT20	90 °C
547687	12PAR30S/MAS/927/F40/DIM/EC/120V B 6/1FB	90 °C

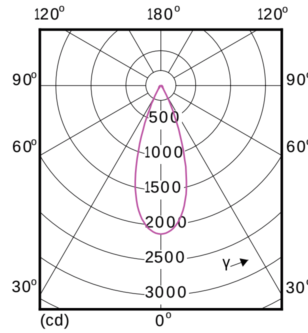


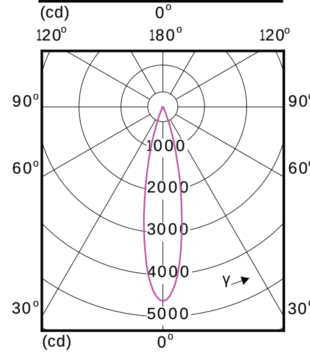


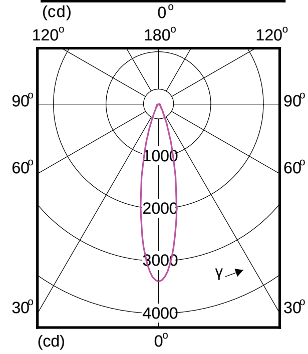


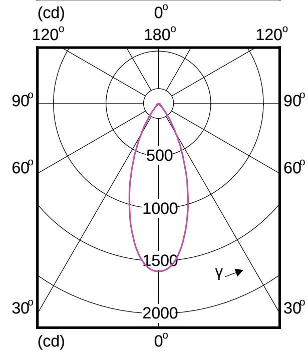


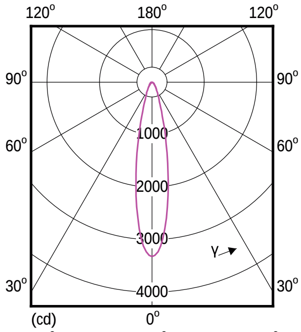


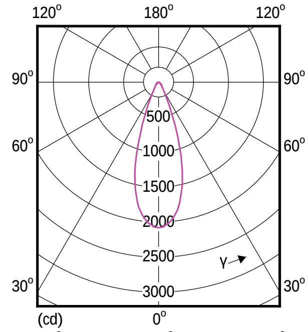


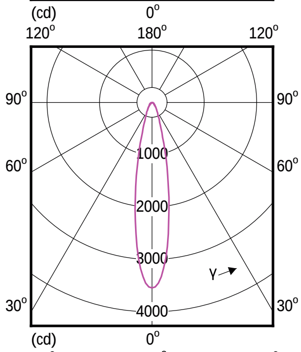


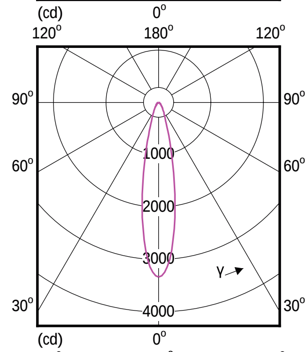


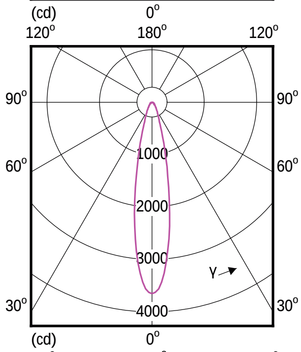


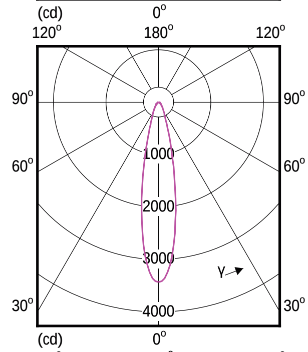


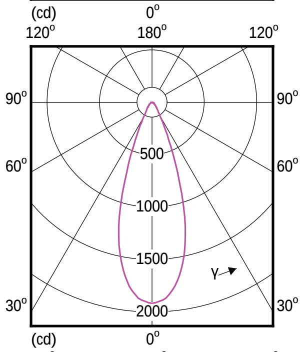


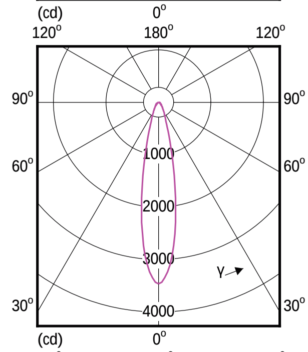


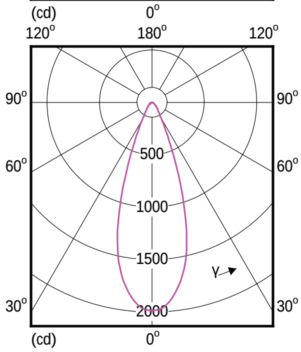


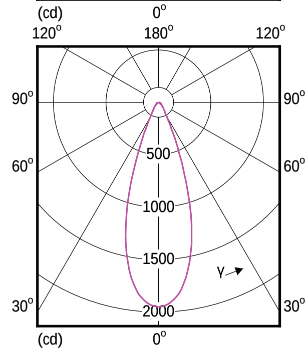




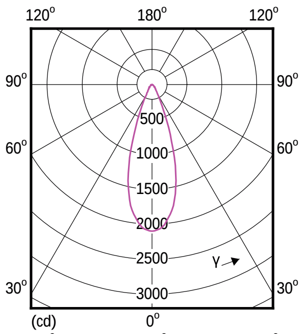


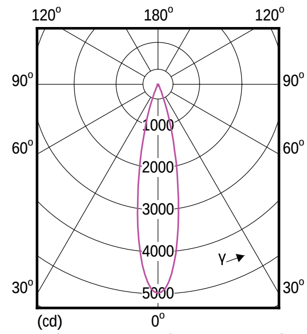


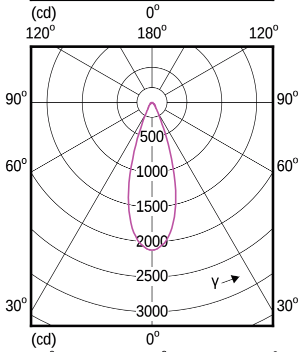


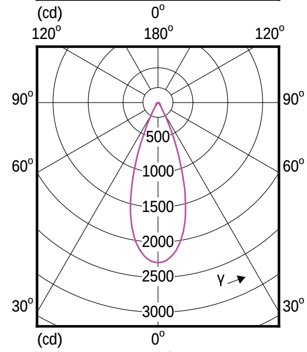


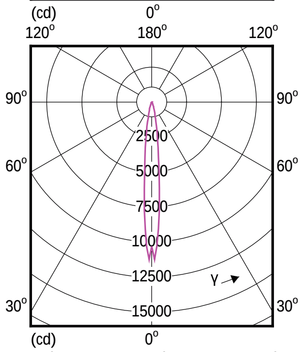
data subject to change

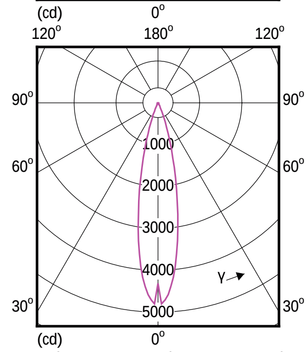


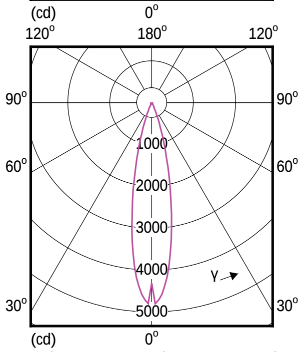


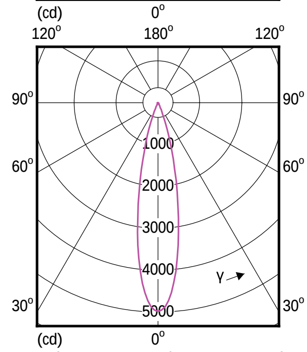


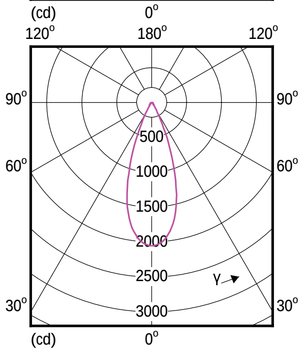


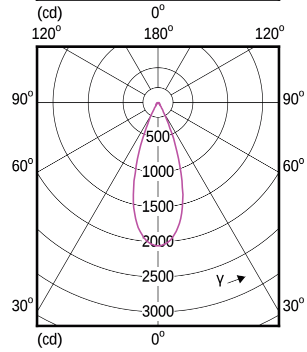












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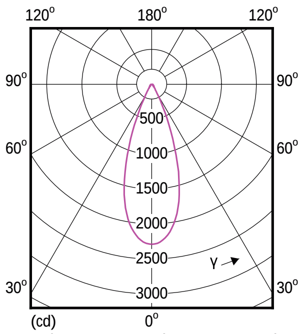
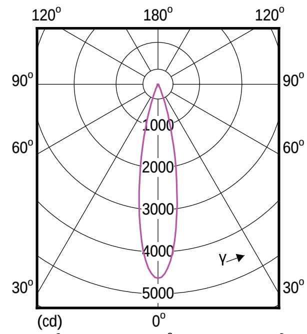
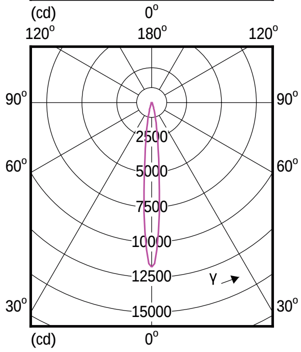
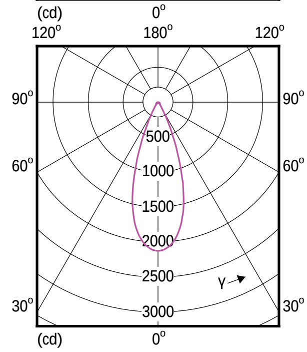
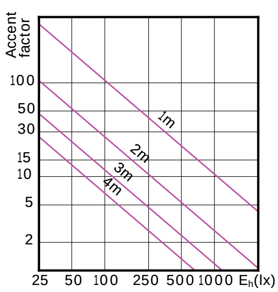








Accent Diagrams



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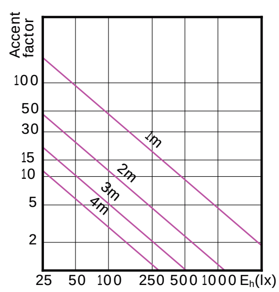

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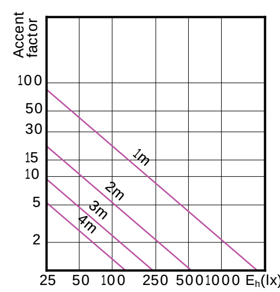

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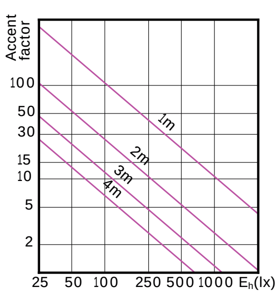

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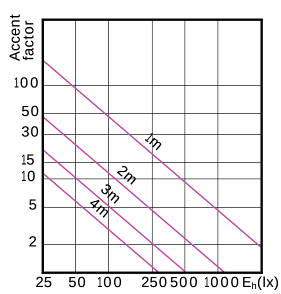
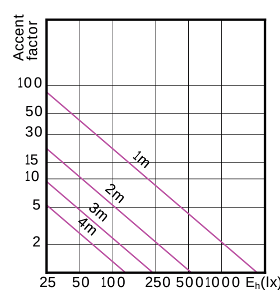


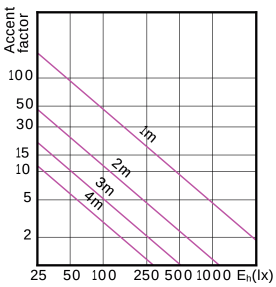
PAR30S 120V 12-75W 25D 3000K E26 D WH



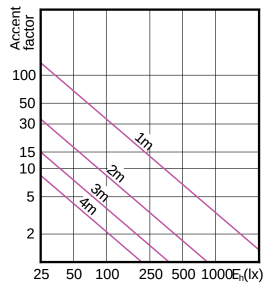
PAR30S 120V 12-75W 900lm 40D 3000K E26 D

data subject to change

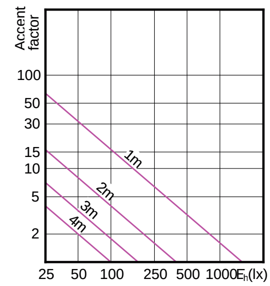
Accent Diagrams



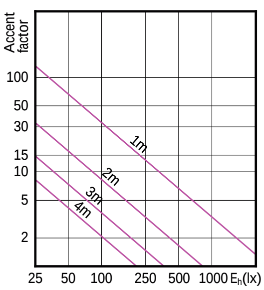
PAR30S 120V 12-75W 25D 3000K E26 D BL



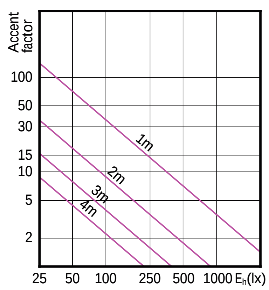
LEDspot 12-75W E26 PAR30L 830 850lm 25D



LEDspot 12-75W E26 PAR30S 830 850lm 40D



10-75W E26 PAR30S 25D 827 2700K



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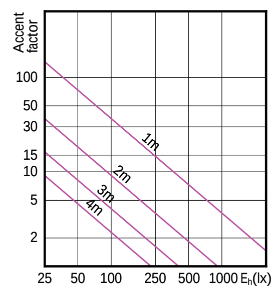

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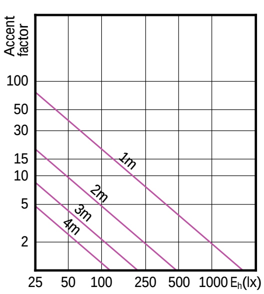

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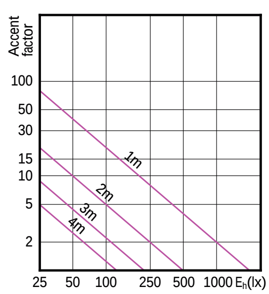

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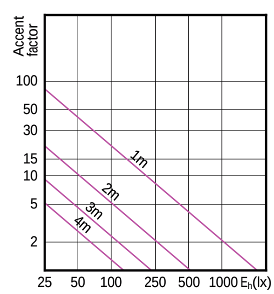

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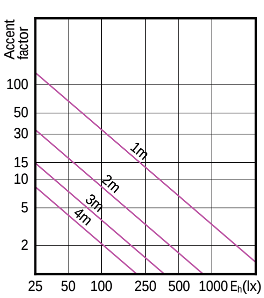

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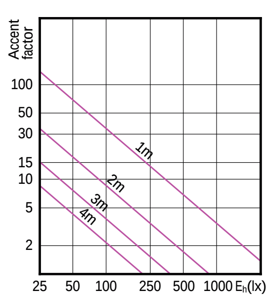
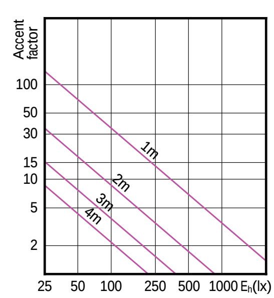


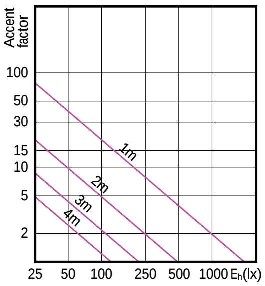
10-75W E26 PAR30L 25D 830 3000K



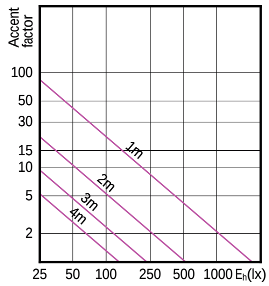
10-75W E26 PAR30L 25D 840 4000K

data subject to change

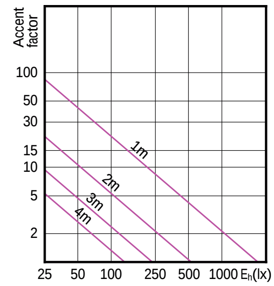
Accent Diagrams



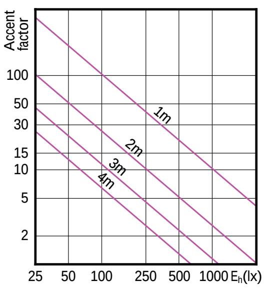
10-75W E26 PAR30L 40D 827 2700K



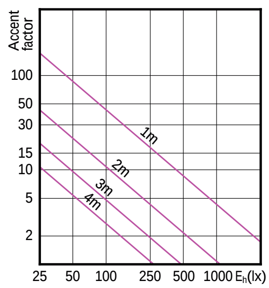
10-75W E26 PAR30L 40D 830 3000K



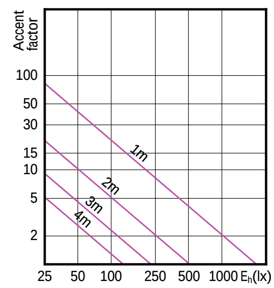
10-75W E26 PAR30L 40D 840 4000K



PAR30S 12W 850lm 10D 2700K E26



PAR30S 12W 850lm 25D 2700K E26



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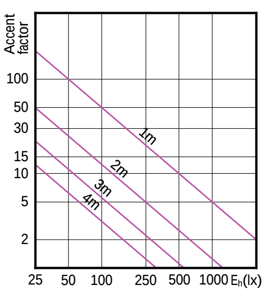

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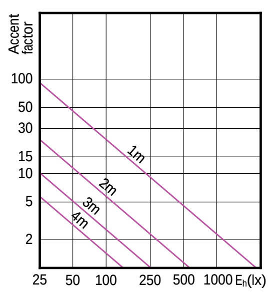

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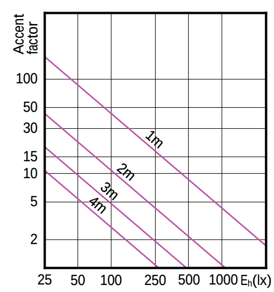

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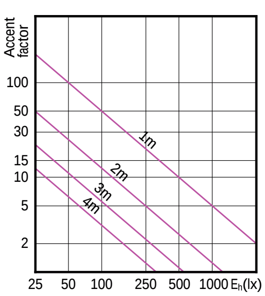
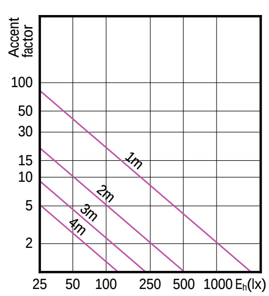
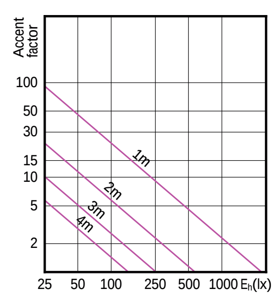


PAR30L 12W 850lm 40D 2700K E26



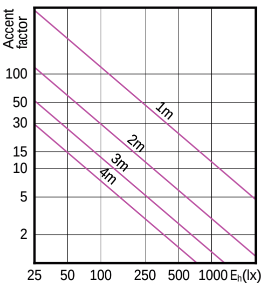
PAR30L 12W 950lm 25D 4000K E26



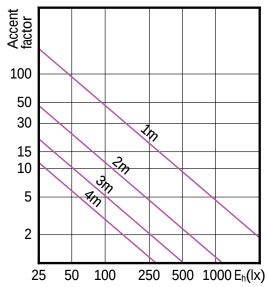
PAR30L 12W 950lm 40D 4000K E26

data subject to change

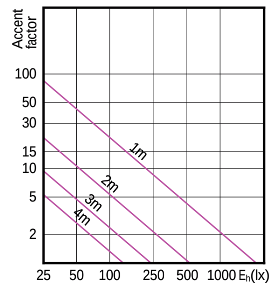
Accent Diagrams



PAR30S 12W 950lm 10D 4000K E26

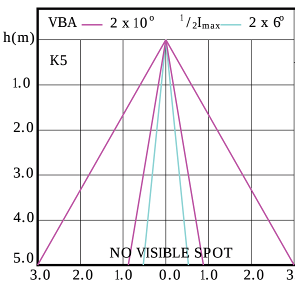


LEDspot E26 25°



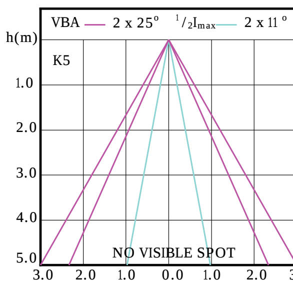
LEDspot E26 40°

Beam Diagrams



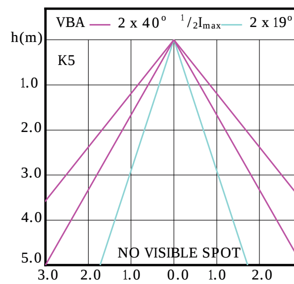
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.0	10587	0.35	0.21	0.21
1.5	4705	0.53	0.32	0.32
2.0	2647	0.71	0.42	0.42
2.5	1694	0.88	0.53	0.53
3.0	1176	1.06	0.63	0.63
3.5	864	1.23	0.74	0.74
4.0	662	1.41	0.84	0.84
4.5	523	1.59	0.95	0.95

PAR30L 120V 12-75W 900lm 10D 3000K E26 D



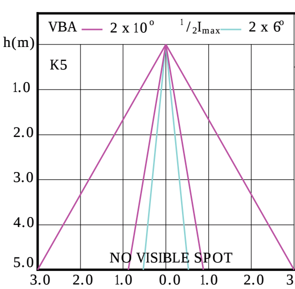
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.0	4618	0.93	0.39	0.39
1.5	2052	1.40	0.58	0.58
2.0	1154	1.87	0.78	0.78
2.5	739	2.33	0.97	0.97
3.0	513	2.80	1.17	1.17
3.5	377	3.26	1.36	1.36
4.0	289	3.73	1.56	1.56
4.5	228	4.20	1.75	1.75

PAR30L 120V 12-75W 900lm 25D 3000K E26 D



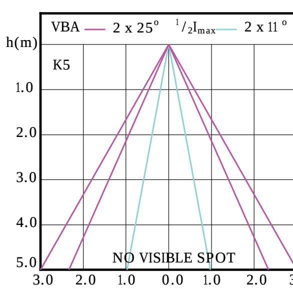
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.0	2122	1.68	0.69	0.61
1.5	943	2.52	1.03	0.92
2.0	530	3.36	1.38	1.22
2.5	339	4.20	1.72	1.53
3.0	236	5.03	2.07	1.83
3.5	173	5.87	2.41	2.14
4.0	133	6.71	2.75	2.45
4.5	105	7.55	3.10	2.75

PAR30L 120V 12-75W 900lm 40D 3000K E26 D



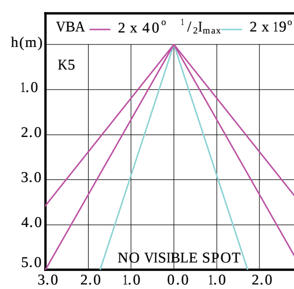
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.0	10587	0.35	0.21	0.21
1.5	4705	0.53	0.32	0.32
2.0	2647	0.71	0.42	0.42
2.5	1694	0.88	0.53	0.53
3.0	1176	1.06	0.63	0.63
3.5	864	1.23	0.74	0.74
4.0	662	1.41	0.84	0.84
4.5	523	1.59	0.95	0.95

PAR30S 120V 12-75W 900lm 10D 3000K E26 D



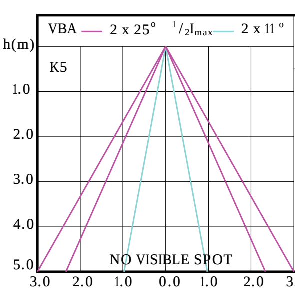
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.0	4618	0.93	0.39	0.39
1.5	2052	1.40	0.58	0.58
2.0	1154	1.87	0.78	0.78
2.5	739	2.33	0.97	0.97
3.0	513	2.80	1.17	1.17
3.5	377	3.26	1.36	1.36
4.0	289	3.73	1.56	1.56
4.5	228	4.20	1.75	1.75

PAR30S 120V 12-75W 25D 3000K E26 D WH



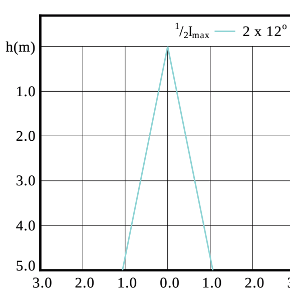
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.0	2122	1.68	0.69	0.61
1.5	943	2.52	1.03	0.92
2.0	530	3.36	1.38	1.22
2.5	339	4.20	1.72	1.53
3.0	236	5.03	2.07	1.83
3.5	173	5.87	2.41	2.14
4.0	133	6.71	2.75	2.45
4.5	105	7.55	3.10	2.75

PAR30S 120V 12-75W 900lm 40D 3000K E26 D



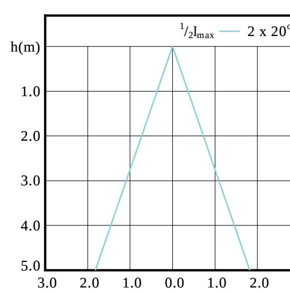
h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.0	4618	0.93	0.39	0.39
1.5	2052	1.40	0.58	0.58
2.0	1154	1.87	0.78	0.78
2.5	739	2.33	0.97	0.97
3.0	513	2.80	1.17	1.17
3.5	377	3.26	1.36	1.36
4.0	289	3.73	1.56	1.56
4.5	228	4.20	1.75	1.75

PAR30S 120V 12-75W 25D 3000K E26 D BL



h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.0	3384		0.43	0.39
1.5	1504		0.64	0.58
2.0	846		0.85	0.78
2.5	541		1.06	0.97
3.0	376		1.28	1.17
3.5	276		1.49	1.36
4.0	212		1.70	1.56
4.5	167		1.91	1.75

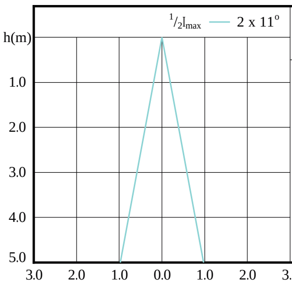
LEDspot 12-75W E26 PAR30L 830 850lm 25D



h (m)	E_0 (lx)	d(m) VBA	d(m) $\frac{1}{2}I_{max}$	d(m) $\frac{1}{2}E_0$
1.0	1595		0.73	0.65
1.5	709		1.09	0.97
2.0	399		1.46	1.30
2.5	255		1.82	1.62
3.0	177		2.18	1.95
3.5	130		2.55	2.27
4.0	100		2.91	2.60
4.5	79		3.28	2.92

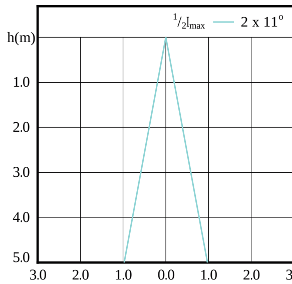
LEDspot 12-75W E26 PAR30S 830 850lm 40D

Beam Diagrams



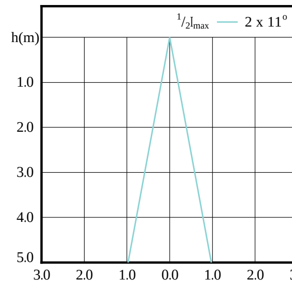
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	3315		0.39	0.39
1.5	1473		0.58	0.58
2.0	829		0.78	0.78
2.5	530		0.97	0.97
3.0	368		1.17	1.17
3.5	271		1.36	1.36
4.0	207		1.56	1.56
4.5	164		1.75	1.75

10-75W E26 PAR30S 25D 827 2700K



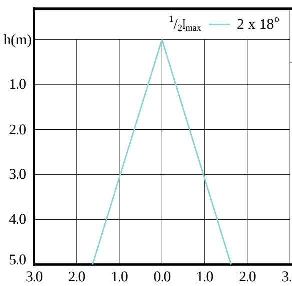
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	3538		0.39	0.35
1.5	1572		0.58	0.53
2.0	884		0.78	0.71
2.5	566		0.97	0.88
3.0	393		1.17	1.06
3.5	289		1.36	1.23
4.0	221		1.56	1.41
4.5	175		1.75	1.59

10-75W E26 PAR30S 25D 830 3000K



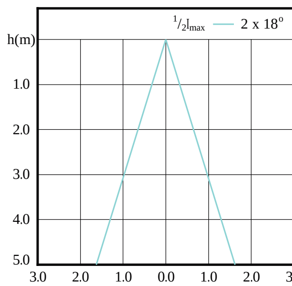
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	3645		0.39	0.35
1.5	1620		0.58	0.53
2.0	911		0.78	0.71
2.5	583		0.97	0.88
3.0	405		1.17	1.06
3.5	298		1.36	1.23
4.0	228		1.56	1.41
4.5	180		1.75	1.59

10-75W E26 PAR30S 25D 840 4000K



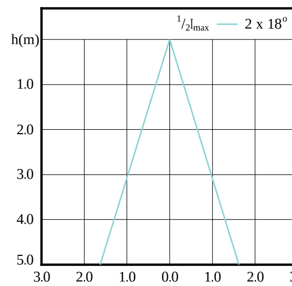
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	1915		0.65	0.61
1.5	851		0.97	0.92
2.0	479		1.30	1.22
2.5	306		1.62	1.53
3.0	213		1.95	1.83
3.5	156		2.27	2.14
4.0	120		2.60	2.45
4.5	95		2.92	2.75

10-75W E26 PAR30S 40D 827 2700K



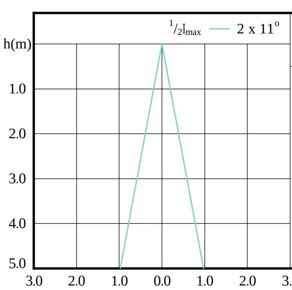
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	1985		0.65	0.61
1.5	882		0.97	0.92
2.0	496		1.30	1.22
2.5	318		1.62	1.53
3.0	221		1.95	1.83
3.5	162		2.27	2.14
4.0	124		2.60	2.45
4.5	98		2.92	2.75

10-75W E26 PAR30S 40D 830 3000K



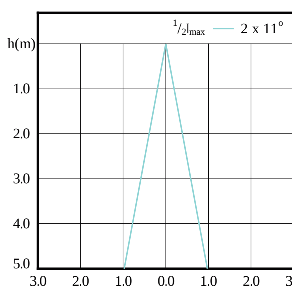
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	2077		0.65	0.61
1.5	923		0.97	0.92
2.0	519		1.30	1.22
2.5	332		1.62	1.53
3.0	231		1.95	1.83
3.5	170		2.27	2.14
4.0	130		2.60	2.45
4.5	103		2.92	2.75

10-75W E26 PAR30S 40D 840 4000K



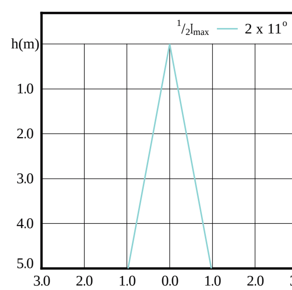
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	3328		0.39	0.39
1.5	1479		0.58	0.58
2.0	832		0.78	0.78
2.5	532		0.97	0.97
3.0	370		1.17	1.17
3.5	272		1.36	1.36
4.0	208		1.56	1.56
4.5	164		1.75	1.75

10-75W E26 PAR30L 25D 827 2700K



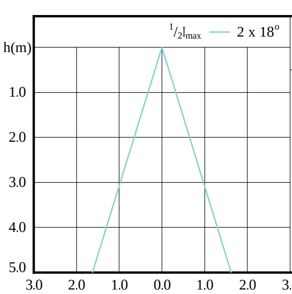
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	3425		0.39	0.39
1.5	1522		0.58	0.58
2.0	856		0.78	0.78
2.5	548		0.97	0.97
3.0	381		1.17	1.17
3.5	280		1.36	1.36
4.0	214		1.56	1.56
4.5	169		1.75	1.75

10-75W E26 PAR30L 25D 830 3000K



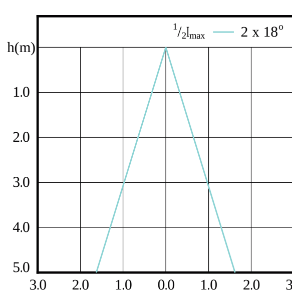
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	3455		0.39	0.39
1.5	1536		0.58	0.58
2.0	864		0.78	0.78
2.5	553		0.97	0.97
3.0	384		1.17	1.17
3.5	282		1.36	1.36
4.0	216		1.56	1.56
4.5	171		1.75	1.75

10-75W E26 PAR30L 25D 840 4000K



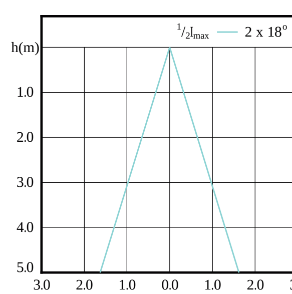
h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	1947		0.65	0.61
1.5	865		0.97	0.92
2.0	487		1.30	1.22
2.5	312		1.62	1.53
3.0	216		1.95	1.83
3.5	159		2.27	2.14
4.0	122		2.60	2.45
4.5	96		2.92	2.75

10-75W E26 PAR30L 40D 827 2700K



h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	2096		0.65	0.61
1.5	932		0.97	0.92
2.0	524		1.30	1.22
2.5	335		1.62	1.53
3.0	233		1.95	1.83
3.5	171		2.27	2.14
4.0	131		2.60	2.45
4.5	104		2.92	2.75

10-75W E26 PAR30L 40D 830 3000K

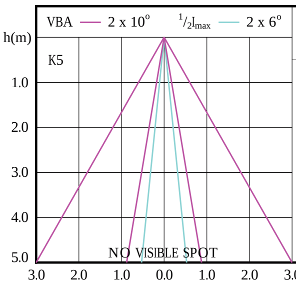


h (m)	E_0 (lx)	d(m) VBA	d(m) $^1/_2I_{max}$	d(m) $^1/_2E_0$
1.0	2113		0.65	0.61
1.5	939		0.97	0.92
2.0	528		1.30	1.22
2.5	338		1.62	1.53
3.0	235		1.95	1.83
3.5	173		2.27	2.14
4.0	132		2.60	2.45
4.5	104		2.92	2.75

10-75W E26 PAR30L 40D 840 4000K

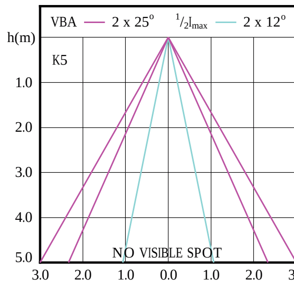
data subject to change

Beam Diagrams



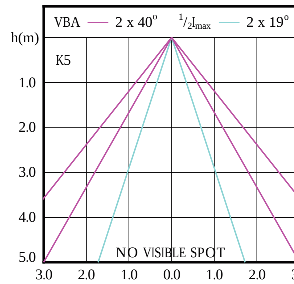
h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	10277	0.35	0.21	0.21
1.5	4568	0.53	0.32	0.32
2.0	2569	0.71	0.42	0.42
2.5	1644	0.88	0.53	0.53
3.0	1142	1.06	0.63	0.63
3.5	839	1.23	0.74	0.74
4.0	642	1.41	0.84	0.84
4.5	508	1.59	0.95	0.95

PAR30S 12W 850lm 10D 2700K E26



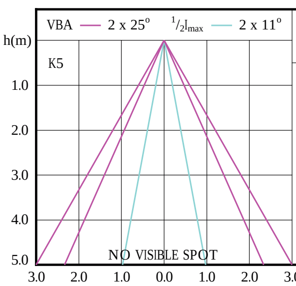
h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	4308	0.93	0.43	0.43
1.5	1915	1.40	0.64	0.64
2.0	1077	1.87	0.85	0.85
2.5	689	2.33	1.06	1.06
3.0	479	2.80	1.28	1.28
3.5	352	3.26	1.49	1.49
4.0	269	3.73	1.70	1.70
4.5	213	4.20	1.91	1.91

PAR30S 12W 850lm 25D 2700K E26



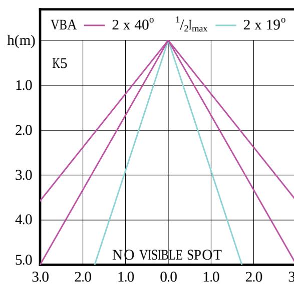
h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	2049	1.68	0.69	0.61
1.5	911	2.52	1.03	0.92
2.0	512	3.36	1.38	1.22
2.5	328	4.20	1.72	1.53
3.0	228	5.03	2.07	1.83
3.5	167	5.87	2.41	2.14
4.0	128	6.71	2.75	2.45
4.5	101	7.55	3.10	2.75

PAR30S 12W 850lm 40D 2700K E26



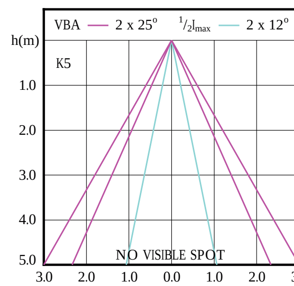
h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	4974	0.93	0.39	0.39
1.5	2211	1.40	0.58	0.58
2.0	1243	1.87	0.78	0.78
2.5	796	2.33	0.97	0.97
3.0	553	2.80	1.17	1.17
3.5	406	3.26	1.36	1.36
4.0	311	3.73	1.56	1.56
4.5	246	4.20	1.75	1.75

PAR30S 12W 950lm 25D 2700K E26



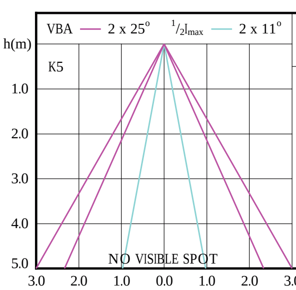
h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	2286	1.68	0.69	0.61
1.5	1016	2.52	1.03	0.92
2.0	571	3.36	1.38	1.22
2.5	366	4.20	1.72	1.53
3.0	254	5.03	2.07	1.83
3.5	187	5.87	2.41	2.14
4.0	143	6.71	2.75	2.45
4.5	113	7.55	3.10	2.75

PAR30S 12W 950lm 40D 2700K E26



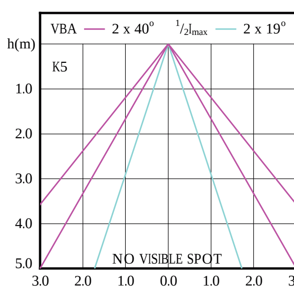
h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	4308	0.93	0.43	0.43
1.5	1915	1.40	0.64	0.64
2.0	1077	1.87	0.85	0.85
2.5	689	2.33	1.06	1.06
3.0	479	2.80	1.28	1.28
3.5	352	3.26	1.49	1.49
4.0	269	3.73	1.70	1.70
4.5	213	4.20	1.91	1.91

PAR30L 12W 850lm 25D 2700K E26



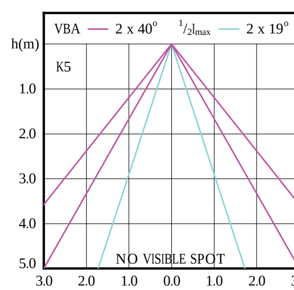
h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	4974	0.93	0.39	0.39
1.5	2211	1.40	0.58	0.58
2.0	1243	1.87	0.78	0.78
2.5	796	2.33	0.97	0.97
3.0	553	2.80	1.17	1.17
3.5	406	3.26	1.36	1.36
4.0	311	3.73	1.56	1.56
4.5	246	4.20	1.75	1.75

PAR30L 12W 850lm 40D 2700K E26



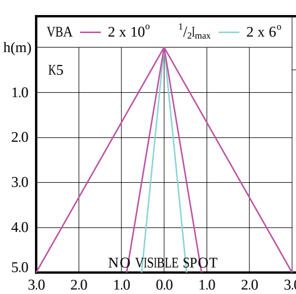
h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	2049	1.68	0.69	0.61
1.5	911	2.52	1.03	0.92
2.0	512	3.36	1.38	1.22
2.5	328	4.20	1.72	1.53
3.0	228	5.03	2.07	1.83
3.5	167	5.87	2.41	2.14
4.0	128	6.71	2.75	2.45
4.5	101	7.55	3.10	2.75

PAR30L 12W 950lm 25D 4000K E26



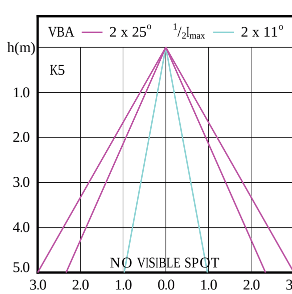
h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	2286	1.68	0.69	0.61
1.5	1016	2.52	1.03	0.92
2.0	571	3.36	1.38	1.22
2.5	366	4.20	1.72	1.53
3.0	254	5.03	2.07	1.83
3.5	187	5.87	2.41	2.14
4.0	143	6.71	2.75	2.45
4.5	113	7.55	3.10	2.75

PAR30L 12W 950lm 40D 4000K E26



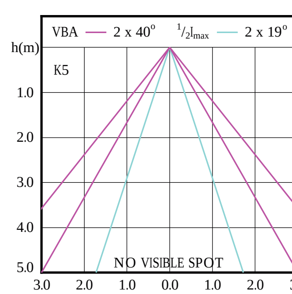
h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	11764	0.35	0.21	0.21
1.5	5228	0.53	0.32	0.32
2.0	2941	0.71	0.42	0.42
2.5	1882	0.88	0.53	0.53
3.0	1307	1.06	0.63	0.63
3.5	960	1.23	0.74	0.74
4.0	735	1.41	0.84	0.84
4.5	581	1.59	0.95	0.95

PAR30S 12W 950lm 10D 4000K E26



h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	4618	0.93	0.39	0.39
1.5	2052	1.40	0.58	0.58
2.0	1154	1.87	0.78	0.78
2.5	739	2.33	0.97	0.97
3.0	513	2.80	1.17	1.17
3.5	377	3.26	1.36	1.36
4.0	289	3.73	1.56	1.56
4.5	228	4.20	1.75	1.75

LEDspot E26 25°



h	E_0	d(m)		
(m)	(lx)	VBA	$^{1}/_{2}I_{max}$	$^{1}/_{2}E_0$
1.0	2122	1.68	0.69	0.61
1.5	943	2.52	1.03	0.92
2.0	530	3.36	1.38	1.22
2.5	339	4.20	1.72	1.53
3.0	236	5.03	2.07	1.83
3.5	173	5.87	2.41	2.14
4.0	133	6.71	2.75	2.45
4.5	105	7.55	3.10	2.75

LEDspot E26 40°

data subject to change

PHILIPS

LED

InstantFit PL lamps

This is real compatibility

Philips InstantFit LED lamps make the transition to LED from CFL lamps as simple as replacing a lamp. With both vertical and horizontal options and a wide array of color temperatures, the InstantFit LED lamps can quickly and effectively replace compact fluorescent lamps. The horizontal version includes a rotatable end cap to ensure the light is correctly aimed.

Benefits

- Proven over 40% energy savings[1] over fluorescent means a satisfed customer and no time wasted going back to a job
- Lifetime delivered — average life rating of 50,000 hours[2]
- Easy replacement — Replace conventional 32W and 26W 4-pin (PL-C & PL-T) lamps
  Replace conventional 13W 2-pin and 4-pin (PL-S & PL-C) lamps

Features

- Rotatable end cap — ensures proper lamp alignment inside the fixture (Horizontal SKUs only)
- Long life — 50,000 hour life[2] means less maintenance than fluorescent
- Proven product history and a company with a long history of innovation and reliability in the lighting industry
- Dimmable – many Philips LED PL-type lamps are dimmable

Philips LED InstantFit PL lamps

Ordering, Electrical and Technical Data (Subject to change without notice)

Product No.	Model No.	DLC Product ID	Ordering Code	Volts (Depending on Ballast)	Bare Lamp Watts	Avg. System Watts	Equiv. Watts	Base	CRI	Color Temp. (K)	Lumens	Life[2]	Beam Angle
InstantFit LED 2-pin lamps (13W replacements)[3]													
52951-1	9290018628	N/A	5PL-S/LED/13H/827/IF5/P/2P	120-277	5	5	13	GX23	82	2700	580	50,000	180°
52956-0	9290018629	N/A	5PL-S/LED/13H/830/IF5/P/2P	120-277	5	5	13	GX23	82	3000	580	50,000	180°
52957-8	9290018630	N/A	5PL-S/LED/13H/835/IF5/P/2P	120-277	5	5	13	GX23	82	3500	580	50,000	180°
52958-6	9290018631	N/A	5PL-S/LED/13H/840/IF5/P/2P	120-277	5	5	13	GX23	82	4000	580	50,000	180°
53230-9	9290018845	N/A	5PL-C/LED/13H/827/IF5/P/2P	120-277	5	5	13	GX23-2	82	2700	520	50,000	150°
53231-7	9290018846	N/A	5PL-C/LED/13H/830/IF5/P/2P	120-277	5	5	13	GX23-2	82	3000	550	50,000	150°
53233-3	9290018847	N/A	5PL-C/LED/13H/835/IF5/P/2P	120-277	5	5	13	GX23-2	82	3500	550	50,000	150°
53234-1	9290018848	N/A	5PL-C/LED/13H/840/IF5/P/2P	120-277	5	5	13	GX23-2	82	4000	580	50,000	150°
53235-8	9290018849	N/A	5PL-C/LED/13V/827/IF5/P/2P	120-277	5	5	13	GX23-2	82	2700	520	50,000	150°
53236-6	9290018850	N/A	5PL-C/LED/13V/830/IF5/P/2P	120-277	5	5	13	GX23-2	82	3000	550	50,000	150°
53237-4	9290018851	N/A	5PL-C/LED/13V/835/IF5/P/2P	120-277	5	5	13	GX23-2	82	3500	550	50,000	150°
53238-2	9290018852	N/A	5PL-C/LED/13V/840/IF5/P/2P	120-277	5	5	13	GX23-2	82	4000	580	50,000	150°
InstantFit LED 4-pin lamps (13W replacements)[3]													
53239-0	9290018853	N/A	5.5PL-C/LED/13H/827/IF5/P/4P	14-60	5.5	7	13	G24q	82	2700	520	50,000	150°
53240-8	9290018854	N/A	5.5PL-C/LED/13H/830/IF5/P/4P	14-60	5.5	7	13	G24q	82	3000	550	50,000	150°
53241-6	9290018855	N/A	5.5PL-C/LED/13H/835/IF5/P/4P	14-60	5.5	7	13	G24q	82	3500	550	50,000	150°
53242-4	9290018856	N/A	5.5PL-C/LED/13H/840/IF5/P/4P	14-60	5.5	7	13	G24q	82	4000	580	50,000	150°
53243-2	9290018857	N/A	5.5PL-C/LED/13V/827/IF5/P/4P	14-60	5.5	7	13	G24q	82	2700	520	50,000	150°
53244-0	9290018858	N/A	5.5PL-C/LED/13V/830/IF5/P/4P	14-60	5.5	7	13	G24q	82	3000	550	50,000	150°
53245-7	9290018859	N/A	5.5PL-C/LED/13V/835/IF5/P/4P	14-60	5.5	7	13	G24q	82	3500	550	50,000	150°
53246-5	9290018860	N/A	5.5PL-C/LED/13V/840/IF5/P/4P	14-60	5.5	7	13	G24q	82	4000	580	50,000	150°
InstantFit LED 4-pin lamps (26W replacements)													
45836-4	9290013880	P227UKPG	8.5PL-C/T LED/26H-2700 IF 4P	100-277, 347	8.5	10.5	26	G24q/GX24	>80	2700	900	50,000	120°
45837-2	9290013881	PYHS75V7	8.5PL-C/T LED/26H-3000 IF 4P	100-277, 347	8.5	10.5	26	G24q/GX24	>80	3000	900	50,000	120°
45838-0	9290013882	P1956NU5	8.5PL-C/T LED/26H-3500 IF 4P	100-277, 347	8.5	10.5	26	G24q/GX24	>80	3500	900	50,000	120°
45839-8	9290013883	PUK7J4AA	8.5PL-C/T LED/26H-4000 IF 4P	100-277, 347	8.5	10.5	26	G24q/GX24	>80	4000	950	50,000	120°
45840-6	9290013884	PW2GPMX6	10.5PL-C/T LED/26V-2700 IF 4P	100-277, 347	10.5	14.5	26	G24q/GX24	>80	2700	1200	50,000	120°
45841-4	9290013885	PGPTBMF9	10.5PL-C/T LED/26V-3000 IF 4P	100-277, 347	10.5	14.5	26	G24q/GX24	>80	3000	1200	50,000	120°
45842-2	9290013886	PZ1KKRNR	10.5PL-C/T LED/26V-3500 IF 4P	100-277, 347	10.5	14.5	26	G24q/GX24	>80	3500	1200	50,000	120°
45843-0	9290013887	PV2HQGZW	10.5PL-C/T LED/26V-4000 IF 4P	100-277, 347	10.5	14.5	26	G24q/GX24	>80	4000	1300	50,000	120°
InstantFit LED 4-pin lamps (32W replacements)													
47606-9	9290018197	PIADVYIP	12PLC/T LED/32H/827/IF/4P/DIM 1PK 10/1	100-277, 347	12	15	32	G24q/GX24	>80	2700	1300	50,000	120°
47607-7	9290018198	PO8NB9Q1	12PLC/T LED/32H/830/IF/4P/DIM 1PK 10/1	100-277, 347	12	15	32	G24q/GX24	>80	3000	1350	50,000	120°
47608-5	9290018199	PZHF15J0	12PLC/T LED/32H/835/IF/4P/DIM 1PK 10/1	100-277, 347	12	15	32	G24q/GX24	>80	3500	1400	50,000	120°
47609-3	9290018200	PT5IC4ON	12PLC/T LED/32H/840/IF/4P/DIM 1PK 10/1	100-277, 347	12	15	32	G24q/GX24	>80	4000	1450	50,000	120°
47610-1	9290018201	PUS3MZTV	12PLC/T LED/32V/827/IF/4P/DIM 1PK 10/1	100-277, 347	12	15	32	G24q/GX24	>80	2700	1350	50,000	120°
47611-9	9290018202	PEIZQ8AS	12PLC/T LED/32V/830/IF/4P/DIM 1PK 10/1	100-277, 347	12	15	32	G24q/GX24	>80	3000	1400	50,000	120°
47612-7	9290018203	PJG8ADHK	12PLC/T LED/32V/835/IF/4P/DIM 1PK 10/1	100-277, 347	12	15	32	G24q/GX24	>80	3500	1450	50,000	120°
47613-5	9290018204	PFKH6AQA	12PLC/T LED/32V/840/IF/4P/DIM 1PK 10/1	100-277, 347	12	15	32	G24q/GX24	>80	4000	1500	50,000	120°
InstantFit LED 4-Pin long compact (PL-L) - 2' high output[3]													
45663-2	929001151304	Not DLC	16.5PL-LED/24-3000 IF 10/1	120-277	16.5	21.0	n/a	2G11	82	3000	1900	40,000	160°
45664-0	929001151404	Not DLC	16.5PL-LED/24-3500 IF 10/1	120-277	16.5	21.0	n/a	2G11	82	3500	2000	40,000	160°
45665-7	929001151504	Not DLC	16.5PL-LED/24-4000 IF 10/1	120-277	16.5	21.0	n/a	2G11	82	4000	2100	40,000	160°

Many lamps claim compatibility. InstantFit proves it.

Philips LED InstantFit PL lamps

Shipping Data (Subject to change without notice)

Product Number	SKU UPC (0-46677)	Outer Bar Code (5-00-46677)	Case Qty.	Case Weight (lbs.)	Case Cube (cu. Ft.)	Pallet Qty	Lamps/ SKU	SKUs per Layer	Layers High	SKU Dimensions (W x D x H) (In.)	Case Dimensions (W x D x H) (In.)	Pallet Dimensions (W x D x H) (In.)
InstantFit LED 2-pin lamps (13W replacements)												
52951-1	52951-2	52951-7	20	2.25	0.12	7920	1	1320	6	0.9 x 1.3 x 6.6	5.7 x 4.9 x 7.2	47.2 x 39.4 x 49.2
52956-0	52956-7	52956-2	20	2.25	0.12	7920	1	1320	6	0.9 x 1.3 x 6.6	5.7 x 4.9 x 7.2	47.2 x 39.4 x 49.2
52957-8	52957-4	52957-9	20	2.25	0.12	7920	1	1320	6	0.9 x 1.3 x 6.6	5.7 x 4.9 x 7.2	47.2 x 39.4 x 49.2
52958-6	52958-1	52958-6	20	2.25	0.12	7920	1	1320	6	0.9 x 1.3 x 6.6	5.7 x 4.9 x 7.2	47.2 x 39.4 x 49.2
53230-9	53230-7	53230-2	20	3.18	0.195	4760	1	680	7	8.2 x 6.6 x 6.2	8.2 x 6.6 x 6.2	48.0 x 40.6 x 49.2
53231-7	53231-4	53231-9	20	3.18	0.195	4760	1	680	7	8.2 x 6.6 x 6.2	8.2 x 6.6 x 6.2	48.0 x 40.6 x 49.2
53233-3	53233-8	53233-3	20	3.18	0.195	4760	1	680	7	8.2 x 6.6 x 6.2	8.2 x 6.6 x 6.2	48.0 x 40.6 x 49.2
53234-1	53234-5	53234-0	20	3.18	0.195	4760	1	680	7	8.2 x 6.6 x 6.2	8.2 x 6.6 x 6.2	48.0 x 40.6 x 49.2
53235-8	53235-2	53235-7	20	2.97	0.285	3600	1	400	9	10.2 x 8.2 x 5.4	11.2 x 8.2 x 5.4	48.0 x 39.8 x 54.0
53236-6	53236-9	53236-4	20	2.97	0.285	3600	1	400	9	10.2 x 8.2 x 5.4	11.2 x 8.2 x 5.4	48.0 x 39.8 x 54.0
53237-4	53237-6	53237-1	20	2.97	0.285	3600	1	400	9	10.2 x 8.2 x 5.4	11.2 x 8.2 x 5.4	48.0 x 39.8 x 54.0
53238-2	53238-3	53238-8	20	2.97	0.285	3600	1	400	9	10.2 x 8.2 x 5.4	11.2 x 8.2 x 5.4	48.0 x 39.8 x 54.0
InstantFit LED 4-pin lamps (13W replacements)												
53239-0	53239-0	53239-5	20	3.18	0.195	4760	1	680	7	8.2 x 6.6 x 6.2	8.2 x 6.6 x 6.2	48.0 x 40.6 x 49.2
53240-8	53240-6	53240-1	20	3.18	0.195	4760	1	680	7	8.2 x 6.6 x 6.2	8.2 x 6.6 x 6.2	48.0 x 40.6 x 49.2
53241-6	53241-3	53241-8	20	3.18	0.195	4760	1	680	7	8.2 x 6.6 x 6.2	8.2 x 6.6 x 6.2	48.0 x 40.6 x 49.2
53242-4	53242-0	53242-5	20	3.18	0.195	4760	1	680	7	8.2 x 6.6 x 6.2	8.2 x 6.6 x 6.2	48.0 x 40.6 x 49.2
53243-2	53243-7	53243-2	20	2.97	0.285	3600	1	400	9	10.2 x 8.2 x 5.4	11.2 x 8.2 x 5.4	48.0 x 39.8 x 54.0
53244-0	53244-4	53244-9	20	2.97	0.285	3600	1	400	9	10.2 x 8.2 x 5.4	11.2 x 8.2 x 5.4	48.0 x 39.8 x 54.0
53245-7	53245-1	53245-6	20	2.97	0.285	3600	1	400	9	10.2 x 8.2 x 5.4	11.2 x 8.2 x 5.4	48.0 x 39.8 x 54.0
53246-5	53246-8	53246-3	20	2.97	0.285	3600	1	400	9	10.2 x 8.2 x 5.4	11.2 x 8.2 x 5.4	48.0 x 39.8 x 54.0
InstantFit LED 4-pin lamps (26W replacements)												
45836-4	45836-2	45836-7	10	2.26	0.113	3250	1	650	5	1.3 x 1.3 x 6.4	8 x 3.4 x 7.2	47.2 x 39.4 x 41.6
45837-2	45837-9	45837-4	10	2.26	0.113	3250	1	650	5	1.3 x 1.3 x 6.4	8 x 3.4 x 7.2	47.2 x 39.4 x 41.6
45838-0	45838-6	45838-1	10	2.26	0.113	3250	1	650	5	1.3 x 1.3 x 6.4	8 x 3.4 x 7.2	47.2 x 39.4 x 41.6
45839-8	45839-3	45839-8	10	2.26	0.113	3250	1	650	5	1.3 x 1.3 x 6.4	8 x 3.4 x 7.2	47.2 x 39.4 x 41.6
45840-6	45840-9	45840-4	10	2.55	0.129	2100	1	350	6	2 x 2 x 4.9	11 x 4.5 x 4.5	47.2 x 39.4 x 39.8
45841-4	45841-6	45841-1	10	2.55	0.129	2100	1	350	6	2 x 2 x 4.9	11 x 4.5 x 4.5	47.2 x 39.4 x 39.8
45842-2	45842-3	45842-8	10	2.55	0.129	2100	1	350	6	2 x 2 x 4.9	11 x 4.5 x 4.5	47.2 x 39.4 x 39.8
45843-0	45843-0	45843-5	10	2.55	0.129	2100	1	350	6	2 x 2 x 4.9	11 x 4.5 x 4.5	47.2 x 39.4 x 39.8
InstantFit LED 4-pin lamps (32W replacements)												
47606-9	47606-9	74760-4	10	2.26	0.113	3250	1	650	5	1.3 x 1.3 x 6.4	8 x 3.4 x 7.2	47.2 x 39.4 x 41.6
47607-7	47607-6	74760-1	10	2.26	0.113	3250	1	650	5	1.3 x 1.3 x 6.4	8 x 3.4 x 7.2	47.2 x 39.4 x 41.6
47608-5	47608-3	74760-8	10	2.26	0.113	3250	1	650	5	1.3 x 1.3 x 6.4	8 x 3.4 x 7.2	47.2 x 39.4 x 41.6
47609-3	76090-0	74760-5	10	2.26	0.113	3250	1	650	5	1.3 x 1.3 x 6.4	8 x 3.4 x 7.2	47.2 x 39.4 x 41.6
47610-1	76106-6	74761-1	10	2.55	0.129	2100	1	350	6	2 x 2 x 4.9	11 x 4.5 x 4.5	47.2 x 39.4 x 39.8
47611-9	76113-3	74761-8	10	2.55	0.129	2100	1	350	6	2 x 2 x 4.9	11 x 4.5 x 4.5	47.2 x 39.4 x 39.8
47612-7	76120-0	74761-5	10	2.55	0.129	2100	1	350	6	2 x 2 x 4.9	11 x 4.5 x 4.5	47.2 x 39.4 x 39.8
47613-5	76137-7	74761-2	10	2.55	0.129	2100	1	350	6	2 x 2 x 4.9	11 x 4.5 x 4.5	47.2 x 39.4 x 39.8
InstantFit LED 4-Pin long compact (PL-L) - 2' high output												
45663-2	45663-4	45663-9	10	4.7	0.30	1200	1	150	8	23.3 x 0.5 x 4.3	23.3 x 5.0 x 4.3	47.3 x 39.4 x 40.2
45664-0	45664-1	45664-6	10	4.7	0.30	1200	1	150	8	23.3 x 0.5 x 4.3	23.3 x 5.0 x 4.3	47.3 x 39.4 x 40.2
45665-7	45665-8	45665-3	10	4.7	0.30	1200	1	150	8	23.3 x 0.5 x 4.3	23.3 x 5.0 x 4.3	47.3 x 39.4 x 40.2

Philips LED InstantFit PL lamps

Energy saving solution

Estimated lighting costs using a standard 26W PL-C CFL lamp			
Present Wattage		26	W
× Annual operating hours		4,000	hrs
	=	104,000	Watt-Hours
÷ 1,000	=	104	kWh per year
× kWh rate of $0.11	=	$11.44	per year
× 100 lamps		$1,144.00	annual energy cost per space

Estimated lighting costs using a Philips 8.5W PL-C/T LED lamp			
Present Wattage		8.5	W
× Annual operating hours		4,000	hrs
	=	34,000	Watt-Hours
÷ 1,000	=	34	kWh per year
× kWh rate of $0.11	=	$3.74	per year
× 100 lamps		$374.00	annual energy cost per space
Total estimated annual savings◊		$770.00	

◊ Based on 100 lamps per space operating at 4,000 hours per year

1. Using 2 26W CFL 4-pin lamps on a programmed-start ballast = 52 system watts. Using 2 Philips LED InstantFit 4-pin lamps on a programmed-start ballast = 21 system watts. 52 - 21 = 31 watts saved; 31W/52W = 60% energy saved.

2. Tested to B50 L70 Requirement. This is de￼ned as the number of hours when 50% of a large group of identical lamps drops below 70% of its initial lumens.

3. This product is not DLC certi￼ed or does not have a DLC category.

WARNINGS AND CAUTIONS

- Before replacing, turn o￼ power and let lamp cool to avoid electrical shock or burn
- Not for use in totally enclosed or recessed luminaries (￼xtures)
- This device is not intended for use with emergency exit ￼xtures or emergency lights

CAUTION: Risk of electric shock – Do not use where directly exposed to water

NOTES: This device complies with Part 15 of the FCC rule. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any changes or modi￼cations not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This Class B complies with Canadian ICES-005.

Not all products are quali￼ed on the DLC QPL. To view our DLC quali￼ed products, please consult the DLC Quali￼ed Products List at www.designlights.org/search.

PLt-15116BN 04/18 philips.com/lighting

Philips Lighting North America Corporation
200 Franklin Square Drive, Somerset, NJ 08873
Tel. 855-486-2216

Philips Lighting Canada Ltd.
281 Hillmount Rd, Markham, ON, Canada L6C 2S3
Tel. 800-668-9008

PHILIPS

Lighting

Attractive, dimmable, LED alternative to popular incandescent

LED A19-A21

Philips A19/A21 LED lamps are the smart alternative to standard incandescent. The unique lamp design provides omni-directional light with excellent dimming performance.

Benefits

- Long life -- lowers maintenance costs by reducing re-lamp frequency
- Excellent color consistancy with available high 90+ color rendering (CRI)
- Certain offerings feature a warm glow effect that provides an incandescent-like glow, while maintaining CRI throughout dimming range

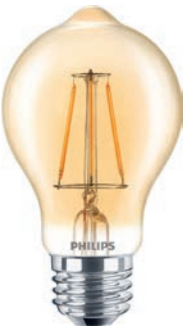
Features

- Available smooth dimming options
- Tradional look and feel of size, shape, and material
- Up to 25,000-hour rated average life
- Instant on
- ENERGY STAR certified options

Application

- Hotels/Motels
- Restaurants
- Residential & Assisted Living

Versions

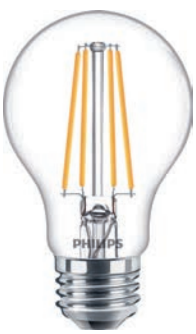


E26 A19 Amber

E26 A19 Frosted

E26 A19

E26 A21



Single Contact Medium Screw A19 (A19) Clear

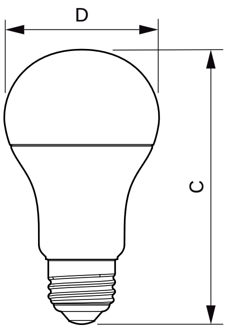
E26 A19 FR

Single Contact Medium Screw A19 (A19) Frosted

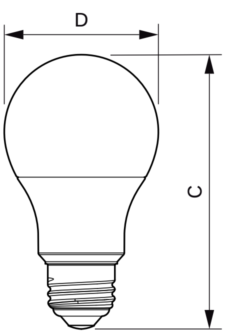
Single Contact Medium Screw A19 (A19) Frosted

LED A19-A21

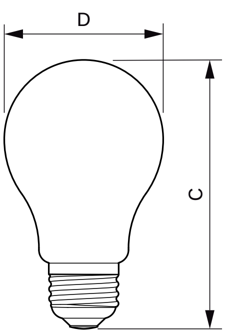
Dimensional drawing



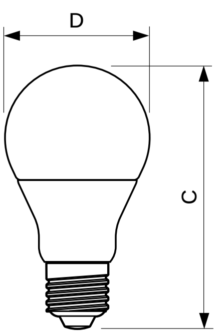
Product	D	C
12.5A19/LED/850/FR/P/ND 4/2FB	60 mm	110 mm
11A19/LED/827/FR/P/ND 4/2FB	60 mm	110 mm
10A19/LED/850/FR/P/ND 4/2FB	60 mm	110 mm



Product	D	C
6.5A19/LED/827/FR/P/ND 4/2FB	60 mm	110 mm
10A19/LED/827/FR/P/ND 4/2FB	60 mm	110 mm
9A19/LED/850/FR/P/ND 4/2FB	60 mm	110 mm
5.5A19/LED/850/FR/P/ND 4/2FB	60 mm	110 mm

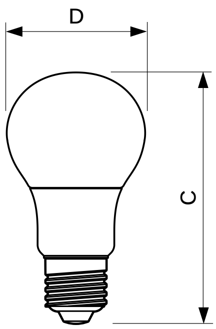


Product	D	C
8.5A19/PER/850/CL/G/DIM 6/1CT	60 mm	103 mm

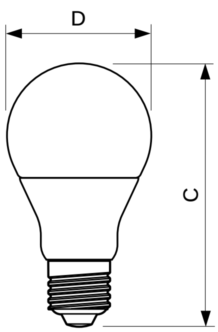


Product	D	C
18A21/LED/950/P/E26/ND 6/1FB T20	78 mm	140 mm
18A21/LED/927/P/E26/ND 6/1FB T20	78 mm	140 mm
8.8A19/PER/927-22/P/E26/WG 6/1FB T20	62.5 mm	111.5 mm
5A19/PER/927-22/P/E26/WG 6/1FB T20	62.5 mm	111.5 mm

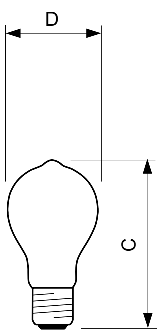
Dimensional drawing



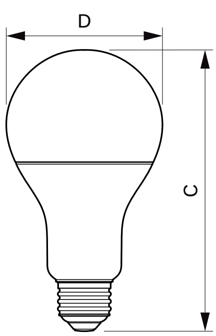
Product	D	C
9A19/LED/927/P/E26/ND 6/1FB T20	61 mm	108 mm
9A19/LED/950/P/E26/ND 6/1FB T20	61 mm	108 mm



Product	D	C
BC10A19/AMB/927/DIM 120V	61.4 mm	109.8 mm



Product	D	C
4.5A19b/LEDFilament/820/CL-A/DIM 120V	60 mm	106 mm



Product	D	C
16A21/PER/927-22/P/E26/WG 6/1FB T20	78 mm	140 mm
12.2A21/PER/927-22/P/E26/WG 6/1FB T20	78 mm	140 mm

LED A19-A21

Operating and Electrical	
Starting Time (Nom)	0.5 s

General Information	
Cap-Base	E26

Light Technical	
Llmf At End Of Nominal Lifetime (Nom)	70 %

Approval and Application

Order Code	Full Product Name	Energy Consumption kWh/ 1000 h
461665	4.5A19b/LEDFilament/820/CL-A/DIM 120V	- kWh
465187	BC10A19/AMB/927/DIM 120V 4/1	-
479963	9A19/LED/927/P/E26/ND 6/1FB T20	-
479971	9A19/LED/950/P/E26/ND 6/1FB T20	-
479989	18A21/LED/927/P/E26/ND 6/1FB T20	-
479997	18A21/LED/950/P/E26/ND 6/1FB T20	-
479469		-
479485	16A21/PER/927-22/P/E26/WG 6/1FB T20	-
478644	8.5A19/PER/850/CL/G/DIM 6/1CT	-

Order Code	Full Product Name	Energy Consumption kWh/ 1000 h
479428		-
479444	8.8A19/PER/927-22/P/E26/WG 6/1FB T20	-
548214	6.5A19/LED/827/FR/P/ND 4/2FB	-
548222	10A19/LED/827/FR/P/ND 4/2FB	-
462184	5.5A19/LED/850/FR/P/ND 4/2FB	-
548230	9A19/LED/850/FR/P/ND 4/2FB	-
462969	11A19/LED/827/FR/P/ND 4/2FB	-
463000	10A19/LED/850/FR/P/ND 4/2FB	-
548248	12.5A19/LED/850/FR/P/ND 4/2FB	-

Controls and Dimming

Order Code	Full Product Name	Dimmable
461665	4.5A19b/LEDFilament/820/CL-A/DIM 120V	Yes
465187	BC10A19/AMB/927/DIM 120V 4/1	Yes
479963	9A19/LED/927/P/E26/ND 6/1FB T20	No
479971	9A19/LED/950/P/E26/ND 6/1FB T20	No
479989	18A21/LED/927/P/E26/ND 6/1FB T20	No
479997	18A21/LED/950/P/E26/ND 6/1FB T20	No
479469		Yes
479485	16A21/PER/927-22/P/E26/WG 6/1FB T20	Yes
478644	8.5A19/PER/850/CL/G/DIM 6/1CT	Yes

Order Code	Full Product Name	Dimmable
479428		Yes
479444	8.8A19/PER/927-22/P/E26/WG 6/1FB T20	Yes
548214	6.5A19/LED/827/FR/P/ND 4/2FB	No
548222	10A19/LED/827/FR/P/ND 4/2FB	No
462184	5.5A19/LED/850/FR/P/ND 4/2FB	No
548230	9A19/LED/850/FR/P/ND 4/2FB	No
462969	11A19/LED/827/FR/P/ND 4/2FB	No
463000	10A19/LED/850/FR/P/ND 4/2FB	No
548248	12.5A19/LED/850/FR/P/ND 4/2FB	No

Operating and Electrical

Order Code	Full Product Name	Input Frequency	Voltage (Nom)	Wattage Equivalent	Power (Rated) (Nom)
461665	4.5A19b/LEDFilament/820/CL-A/DIM 120V	50 or 60 Hz	110-130 V	32 W	4.5 W
465187	BC10A19/AMB/927/DIM 120V 4/1	60 Hz	120 V	60 W	10 W
479963	9A19/LED/927/P/E26/ND 6/1FB T20	60 Hz	120 V	60 W	9 W
479971	9A19/LED/950/P/E26/ND 6/1FB T20	60 Hz	120 V	60 W	9 W

Order Code	Full Product Name	Input Frequency	Voltage (Nom)	Wattage Equivalent	Power (Rated) (Nom)
479989	18A21/LED/927/P/E26/ND 6/1FB T20	60 Hz	120 V	100 W	18 W
479997	18A21/LED/950/P/E26/ND 6/1FB T20	60 Hz	120 V	100 W	18 W
479469		60 Hz	120 V	75 W	12.2 W
479485	16A21/PER/927-22/P/E26/WG 6/1FB T20	60 Hz	120 V	100 W	16 W
478644	8.5A19/PER/850/CL/G/DIM 6/1CT	50 to 60 Hz	120 V	60 W	8.5 W

LED A19-A21

Order Code	Full Product Name	Input Frequency	Voltage (Nom)	Wattage Equivalent	Power (Rated) (Nom)
479428		60 Hz	120 V	40 W	5 W
479444	8.8A19/PER/927-22/P/E26/WG 6/1FB T20	60 Hz	120 V	60 W	8.8 W
548214	6.5A19/LED/827/FR/P/ND 4/2FB	60 Hz	120 V	40 W	6.5 W
548222	10A19/LED/827/FR/P/ND 4/2FB	60 Hz	120 V	60 W	10 W
462184	5.5A19/LED/850/FR/P/ND 4/2FB	60 Hz	120 V	40 W	5.5 W
548230	9A19/LED/850/FR/P/ND 4/2FB	60 Hz	120 V	60 W	9 W
462969	11A19/LED/827/FR/P/ND 4/2FB	60 Hz	120 V	75 W	11 W
463000	10A19/LED/850/FR/P/ND 4/2FB	60 Hz	120 V	75 W	10 W
548248	12.5A19/LED/850/FR/P/ND 4/2FB	60 Hz	120 V	100 W	12.5 W

General Information

Order Code	Full Product Name	Nominal Lifetime (Nom)	Rated Lifetime (Hours)	Switching Cycle
461665	4.5A19b/LEDFilament/820/CL-A/DIM 120V	15000 h	15000 h	20000X
465187	BC10A19/AMB/927/DIM 120V 4/1	25000 h	25000 h	50000X
479963	9A19/LED/927/P/E26/ND 6/1FB T20	10950 h	10950 h	50000X
479971	9A19/LED/950/P/E26/ND 6/1FB T20	10950 h	10950 h	50000X
479989	18A21/LED/927/P/E26/ND 6/1FB T20	10950 h	10950 h	50000X
479997	18A21/LED/950/P/E26/ND 6/1FB T20	10950 h	10950 h	50000X
479469		15000 h	15000 h	50000X
479485	16A21/PER/927-22/P/E26/WG 6/1FB T20	15000 h	15000 h	50000X
478644	8.5A19/PER/850/CL/G/DIM 6/1CT	15000 h	15000 h	20000X
479428		15000 h	15000 h	50000X
479444	8.8A19/PER/927-22/P/E26/WG 6/1FB T20	15000 h	15000 h	50000X
548214	6.5A19/LED/827/FR/P/ND 4/2FB	11000 h	11000 h	50000X
548222	10A19/LED/827/FR/P/ND 4/2FB	11000 h	11000 h	50000X
462184	5.5A19/LED/850/FR/P/ND 4/2FB	11000 h	11000 h	50000X
548230	9A19/LED/850/FR/P/ND 4/2FB	11000 h	11000 h	50000X
462969	11A19/LED/827/FR/P/ND 4/2FB	11000 h	11000 h	50000X
463000	10A19/LED/850/FR/P/ND 4/2FB	11000 h	11000 h	50000X
548248	12.5A19/LED/850/FR/P/ND 4/2FB	11000 h	11000 h	50000X

Light Technical

Order Code	Full Product Name	Beam Angle (Nom)	Color Code	Correlated Color Temperature (Nom)	Color Rendering Index (Nom)	Luminous Flux (Nom)	Luminous Flux (Rated) (Nom)
461665	4.5A19b/LEDFilament/820/CL-A/DIM 120V	-	820	2000 K	80	350 lm	350 lm
465187	BC10A19/AMB/927/DIM 120V 4/1	-	927	2700 K	90	800 lm	800 lm
479963	9A19/LED/927/P/E26/ND 6/1FB T20	250 °	927	2700 K	90	800 lm	800 lm
479971	9A19/LED/950/P/E26/ND 6/1FB T20	250 °	950	5000 K	90	800 lm	800 lm
479989	18A21/LED/927/P/E26/ND 6/1FB T20	250 °	927	2700 K	90	1500 lm	1500 lm
479997	18A21/LED/950/P/E26/ND 6/1FB T20	250 °	950	5000 K	90	1500 lm	1500 lm
479469		250 °	922-927	2200-2700 K	90	1100 lm	1100 lm
479485	16A21/PER/927-22/P/E26/WG 6/1FB T20	250 °	922-927	2200-2700 K	90	1600 lm	1600 lm
478644	8.5A19/PER/850/CL/G/DIM 6/1CT	-	850	5000 K	80	800 lm	800 lm
479428		250 °	922-927	2200-2700 K	90	450 lm	450 lm

Order Code	Full Product Name	Beam Angle (Nom)	Color Code	Correlated Color Temperature (Nom)	Color Rendering Index (Nom)	Luminous Flux (Nom)	Luminous Flux (Rated) (Nom)
479444	8.8A19/PER/927-22/P/E26/WG 6/1FB T20	250 °	922-927	2200-2700 K	90	800 lm	800 lm
548214	6.5A19/LED/827/FR/P/ND 4/2FB	150 °	827	2700 K	80	450 lm	450 lm
548222	10A19/LED/827/FR/P/ND 4/2FB	150 °	827	2700 K	80	800 lm	800 lm
462184	5.5A19/LED/850/FR/P/ND 4/2FB	150 °	850	5000 K	80	450 lm	450 lm
548230	9A19/LED/850/FR/P/ND 4/2FB	150 °	850	5000 K	80	800 lm	800 lm
462969	11A19/LED/827/FR/P/ND 4/2FB	150 °	827	2700 K	80	1000 lm	1000 lm
463000	10A19/LED/850/FR/P/ND 4/2FB	150 °	850	5000 K	80	1000 lm	1000 lm
548248	12.5A19/LED/850/FR/P/ND 4/2FB	150 °	850	5000 K	80	1500 lm	1500 lm

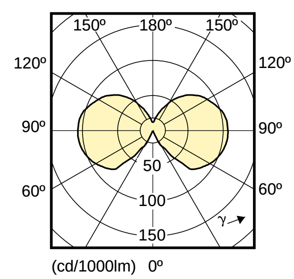
Mechanical and Housing

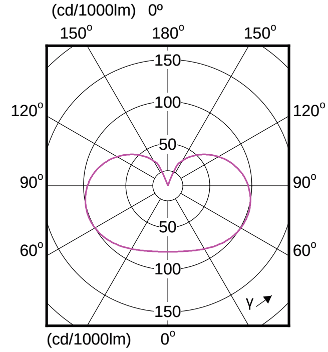
Order Code	Full Product Name	Bulb Finish	Bulb Shape
461665	4.5A19b/LEDFilament/820/CL-A/DIM 120V	Amber	A19 (A19)
465187	BC10A19/AMB/927/DIM 120V 4/1	Frosted (FR)	A19 (A19)
479963	9A19/LED/927/P/E26/ND 6/1FB T20	Frosted (FR)	A19 (A19)
479971	9A19/LED/950/P/E26/ND 6/1FB T20	Frosted (FR)	A19 (A19)
479989	18A21/LED/927/P/E26/ND 6/1FB T20	Frosted (FR)	A21 (A21)
479997	18A21/LED/950/P/E26/ND 6/1FB T20	Frosted (FR)	A21 (A21)
479469		Frosted (FR)	A21 (A21)
479485	16A21/PER/927-22/P/E26/WG 6/1FB T20	Frosted (FR)	A21 (A21)
478644	8.5A19/PER/850/CL/G/DIM 6/1CT	Clear (CL)	A19 (A19)

Order Code	Full Product Name	Bulb Finish	Bulb Shape
479428		Frosted (FR)	A19 (A19)
479444	8.8A19/PER/927-22/P/E26/WG 6/1FB T20	Frosted (FR)	A19 (A19)
548214	6.5A19/LED/827/FR/P/ND 4/2FB	Frosted (FR)	A19 (A19)
548222	10A19/LED/827/FR/P/ND 4/2FB	Frosted (FR)	A19 (A19)
462184	5.5A19/LED/850/FR/P/ND 4/2FB	Frosted (FR)	A19 (A19)
548230	9A19/LED/850/FR/P/ND 4/2FB	Frosted (FR)	A19 (A19)
462969	11A19/LED/827/FR/P/ND 4/2FB	Frosted (FR)	A19 (A19)
463000	10A19/LED/850/FR/P/ND 4/2FB	Frosted (FR)	A19 (A19)
548248	12.5A19/LED/850/FR/P/ND 4/2FB	Frosted (FR)	A19 (A19)

Temperature

Order Code	Full Product Name	T-Case Maximum (Nom)
461665	4.5A19b/LEDFilament/820/CL-A/DIM 120V	-
465187	BC10A19/AMB/927/DIM 120V 4/1	85 °C
479963	9A19/LED/927/P/E26/ND 6/1FB T20	75 °C
479971	9A19/LED/950/P/E26/ND 6/1FB T20	75 °C
479989	18A21/LED/927/P/E26/ND 6/1FB T20	75 °C
479997	18A21/LED/950/P/E26/ND 6/1FB T20	75 °C
479469		75 °C
479485	16A21/PER/927-22/P/E26/WG 6/1FB T20	85 °C
478644	8.5A19/PER/850/CL/G/DIM 6/1CT	40 °C
479428		65 °C
479444	8.8A19/PER/927-22/P/E26/WG 6/1FB T20	80 °C
548214	6.5A19/LED/827/FR/P/ND 4/2FB	65 °C
548222	10A19/LED/827/FR/P/ND 4/2FB	85 °C
462184	5.5A19/LED/850/FR/P/ND 4/2FB	65 °C
548230	9A19/LED/850/FR/P/ND 4/2FB	80 °C
462969	11A19/LED/827/FR/P/ND 4/2FB	80 °C
463000	10A19/LED/850/FR/P/ND 4/2FB	75 °C
548248	12.5A19/LED/850/FR/P/ND 4/2FB	80 °C





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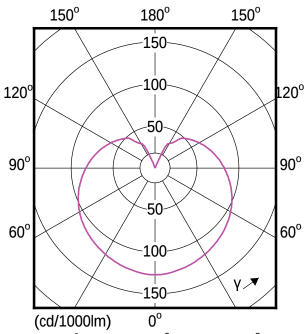
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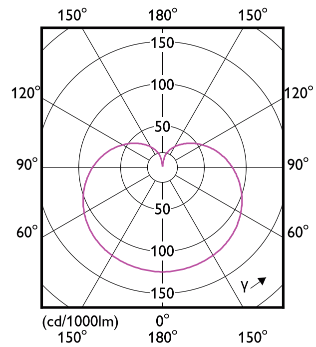
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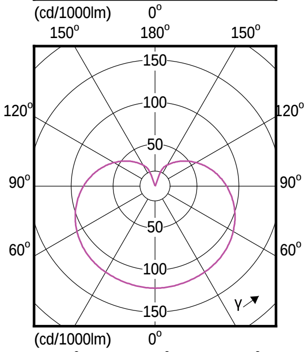
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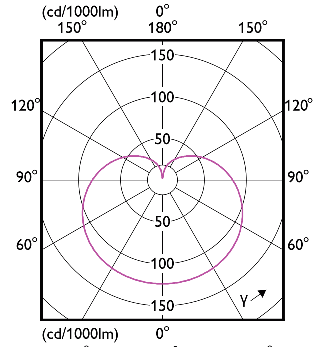
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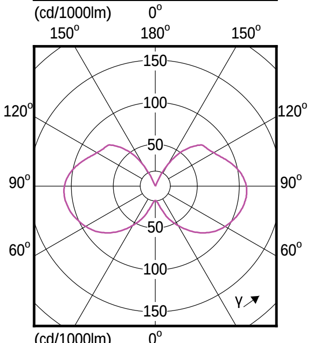
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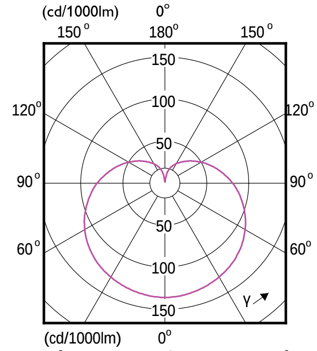
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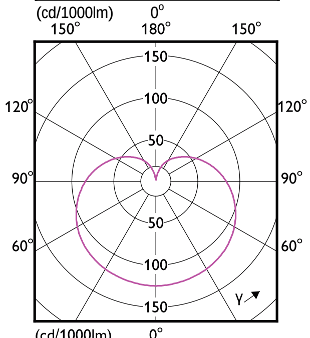
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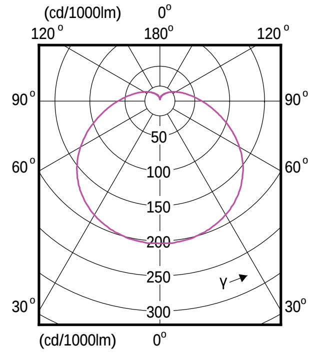
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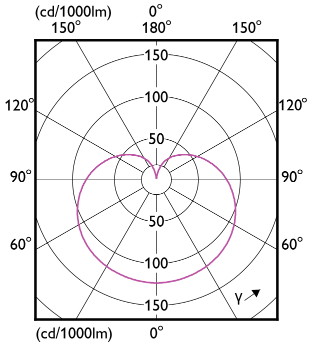
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PHILIPS
Lighting

Affordability and energy savings - all in one lamp

CorePro LEDtube InstantFit T5

The CorePro LED Type A - Ballast Driven InstantFit TLED is a great LED solution suitable for replacing T5 fluorescent lamps using the existing ballast.

Benefits

- Offers lowest cost of installation and easiest upgrade fluorescent T5 to LED technology
- True T5 size fits conventional applications
- 2ft and 3ft lamps operate on both HE and HO ballasts

Features

- Average life rating of 50,000 hours
- Philips proprietary safety features
- DLC, NSF and RoHS listed
- Wide beam angle for cove and direct/indirect applications

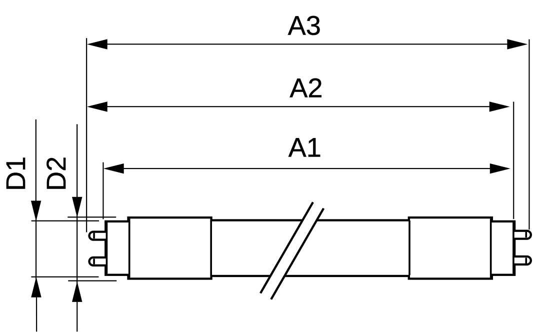
Application

- Education facilities and Offices
- Industrial and warehouses
- Parking lots and covered car parks
- Cove lighting

Versions

LEDtube G5

Dimensional drawing



Product	D1	D2	A1	A2	A3
11T5HE/34-840/IF15/G/DIM 10/1	15.3 mm	18.4 mm	847.8 mm	854.9 mm	862 mm
11T5HE/34-830/IF14/G/DIM 10/1	15.3 mm	18.4 mm	847.8 mm	854.9 mm	862 mm
11T5HE/34-850/IF15/G/DIM 10/1	15.3 mm	18.4 mm	847.8 mm	854.9 mm	862 mm
11T5HE/34-835/IF14/G/DIM 10/1	15.3 mm	18.4 mm	847.8 mm	854.9 mm	862 mm
14T5HE/46-830/ IF20/G/DIM 10/1	15.3 mm	18.4 mm	1147.8 mm	1154.9 mm	1162 mm
8T5HE/22-850/IF10/G/DIM 10/1	15.3 mm	18.4 mm	547.8 mm	554.9 mm	562 mm
14T5HE/46-840/IF21/G/DIM 10/1	15.3 mm	18.4 mm	1147.8 mm	1154.9 mm	1162 mm
14T5HE/46-835/ IF20/G/DIM 10/1	15.3 mm	18.4 mm	1147.8 mm	1154.9 mm	1162 mm
8T5HE/22-835/IF10/G/DIM 10/1	15.3 mm	18.4 mm	547.8 mm	554.9 mm	562 mm
8T5HE/22-840/IF10/G/DIM 10/1	15.3 mm	18.4 mm	547.8 mm	554.9 mm	562 mm
14T5HE/46-850/IF21/G/DIM 10/1	15.3 mm	18.4 mm	1147.8 mm	1154.9 mm	1162 mm
8T5HE/22-830/IF10/G/DIM 10/1	15.3 mm	18.4 mm	547.8 mm	554.9 mm	562 mm

Controls and Dimming

Dimmable	Yes

Operating and Electrical

Input Frequency	40000-110000 Hz
Starting Time (Nom)	0.5 s

General Information

Cap-Base	G5
Nominal Lifetime (Nom)	50000 h
Rated Lifetime (Hours)	50000 h
Switching Cycle	50000X

Light Technical

Beam Angle (Nom)	200 °
Color Rendering Index (Nom)	82
Llmf At End Of Nominal Lifetime (Nom)	70 %
Rated Beam Angle	200 °

Temperature

T-Ambient (Max)	45 °C
T-Ambient (Min)	-20 °C
T-Case Maximum (Nom)	70 °C
T-Storage (Max)	65 °C
T-Storage (Min)	-40 °C

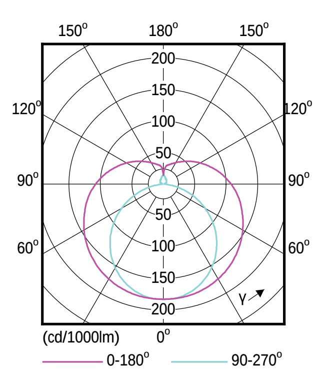
Operating and Electrical

Order Code	Full Product Name	Voltage (Nom)	Power (Rated) (Nom)
476416	8T5HE/22-830/IF10/G/DIM 10/1	40-60 V	8 W
476424	8T5HE/22-835/IF10/G/DIM 10/1	40-60 V	8 W
476432	8T5HE/22-840/IF10/G/DIM 10/1	40-60 V	8 W
476440	8T5HE/22-850/IF10/G/DIM 10/1	40-60 V	8 W
476457	11T5HE/34-830/IF14/G/DIM 10/1	50-80 V	11 W
476465	11T5HE/34-835/IF14/G/DIM 10/1	50-80 V	11 W
476473	11T5HE/34-840/IF15/G/DIM 10/1	50-80 V	11 W
476481	11T5HE/34-850/IF15/G/DIM 10/1	50-80 V	11 W
476499	14T5HE/46-830/IF20/G/DIM 10/1	70-105 V	14 W
476507	14T5HE/46-835/IF20/G/DIM 10/1	70-105 V	14 W
476515	14T5HE/46-840/IF21/G/DIM 10/1	70-105 V	14 W
476523	14T5HE/46-850/IF21/G/DIM 10/1	70-105 V	14 W

Light Technical

Order Code	Full Product Name	Color Code	Correlated Color Temperature (Nom)	Luminous Flux (Nom)	Luminous Flux (Rated) (Nom)
476416	8T5HE/22-830/IF10/G/DIM 10/1	830	3000 K	1000 lm	1000 lm
476424	8T5HE/22-835/IF10/G/DIM 10/1	835	3500 K	1000 lm	1000 lm
476432	8T5HE/22-840/IF10/G/DIM 10/1	841	4000 K	1050 lm	1050 lm
476440	8T5HE/22-850/IF10/G/DIM 10/1	850	5000 K	1050 lm	1050 lm
476457	11T5HE/34-830/IF14/G/DIM 10/1	830	3000 K	1400 lm	1400 lm
476465	11T5HE/34-835/IF14/G/DIM 10/1	835	3500 K	1400 lm	1400 lm
476473	11T5HE/34-840/IF15/G/DIM 10/1	841	4000 K	1500 lm	1500 lm
476481	11T5HE/34-850/IF15/G/DIM 10/1	850	5000 K	1500 lm	1500 lm
476499	14T5HE/46-830/IF20/G/DIM 10/1	830	3000 K	2000 lm	2000 lm

Order Code	Full Product Name	Color Code	Correlated Color Temperature (Nom)	Luminous Flux (Nom)	Luminous Flux (Rated) (Nom)
476507	14T5HE/46-835/IF20/G/DIM 10/1	835	3500 K	2000 lm	2000 lm
476515	14T5HE/46-840/IF21/G/DIM 10/1	841	4000 K	2100 lm	2100 lm
476523	14T5HE/46-850/IF21/G/DIM 10/1	850	5000 K	2100 lm	2100 lm



data subject to change

PHILIPS

Lighting

A TLED solution for your application

T8

Our TLEDs are available in InstantFit (Type A / Type C) or MainsFit (Ballast bypass / Type B) versions. The InstantFit lamps work on a broad variety of ballasts and LED drivers. Only InstantFit has over 15,000 lamp & ballast combinations delivering even light output, energy savings and a long lifetime. Our MainsFit products feature a double-ended design, simplifying installation while a proprietary safety circuit minimizes a shock risk. Lamp sizes range from 2-foot to 8-foot and U-bend with a variety of lumen outputs.

Benefits

- Minimizes overall lighting costs
- Offers cheapest and easiest upgrade to LED lighting technology
- Excellent compatibility with existing ballasts

Features

- InstantFit works with over 350 ballasts and drivers
- Lifetime of up to 70,000 hours & a limited warranty of up to 7-years
- Plug-and-play, ballast bypass or UL Type C options available
- Shatter-resistant, polycarbonate tubes avialable
- All T8 replacement TLEDs are NSF certified and most are DLC certified

Application

- Office and Shopping
- Industrial and warehouses
- Parking lots and covered car parks

data subject to change

Versions

LEDTube, 13 W

LEDtube G13

G13

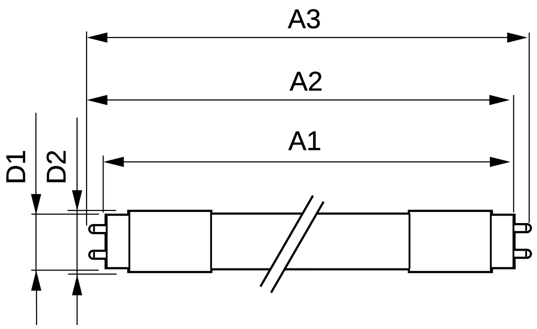
2G13

G13

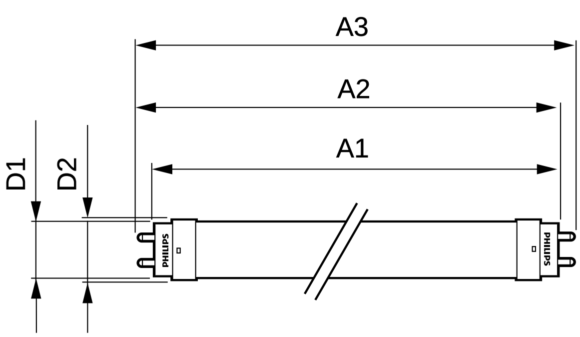
FA8

R17d (RDC)

Dimensional drawing



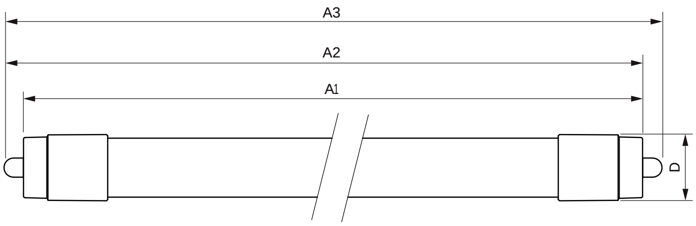
Product	D1	D2	A1	A2	A3
9.5T8/MAS/48-840/IF16/P 10/1	25.7 mm	28 mm	1198.1 mm	1205.2 mm	1212.3 mm
9.5T8/MAS/48-850/IF16/P 10/1	25.7 mm	28 mm	1198.1 mm	1205.2 mm	1212.3 mm
7T8/MAS/24-850/IF11/P 10/1	25.7 mm	26.3 mm	588.6 mm	595.7 mm	602.8 mm
7T8/MAS/24-840/IF11/P 10/1	25.7 mm	26.3 mm	588.6 mm	595.7 mm	602.8 mm
7T8/MAS/24-835/IF10/P 10/1	25.7 mm	26.3 mm	588.6 mm	595.7 mm	602.8 mm
8.5T8/MAS/36-835/IF13/P 10/1	25.7 mm	26.3 mm	893.4 mm	900.5 mm	907.6 mm
8.5T8/MAS/36-850/IF14/P 10/1	25.7 mm	26.3 mm	893.4 mm	900.5 mm	907.6 mm
7T8/MAS/24-830/IF10/P 10/1	25.7 mm	26.3 mm	588.6 mm	595.7 mm	602.8 mm
8.5T8/MAS/36-840/IF14/P 10/1	25.7 mm	26.3 mm	893.4 mm	900.5 mm	907.6 mm
8.5T8/MAS/36-830/IF13/P 10/1	25.7 mm	26.3 mm	893.4 mm	900.5 mm	907.6 mm
10T8/MAS/48-840/IF16/P 25/1	25.7 mm	26.3 mm	1198.1 mm	1205.2 mm	1212.3 mm
13T8/MAS/48-840/IF21/P/DIM 25/1	25.7 mm	26.3 mm	1198.1 mm	1205.2 mm	1212.3 mm
9.5T8/MAS/48-840/IF16/P 25/1	25.7 mm	28 mm	1198.1 mm	1205.2 mm	1212.3 mm
9.5T8/MAS/48-835/IF15/P 10/1	25.7 mm	28 mm	1198.1 mm	1205.2 mm	1212.3 mm
9.5T8/MAS/48-830/IF15/P 10/1	25.7 mm	28 mm	1198.1 mm	1205.2 mm	1212.3 mm



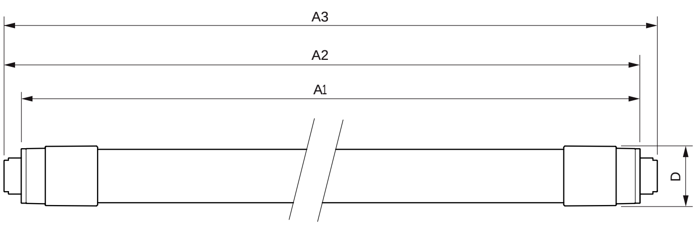
Product	D1	D2	A1	A2	A3
12T8/MAS/48-850/MF18/G 10/1	25.7 mm	28 mm	1198 mm	1205 mm	1212 mm
12T8/MAS/48-840/MF18/G 10/1	25.7 mm	28 mm	1198 mm	1205 mm	1212 mm
12T8/MAS/48-835/MF17/G 10/1	25.7 mm	28 mm	1198 mm	1205 mm	1212 mm
12T8/PER/48-850/BB18/G 10/1 FB	25.7 mm	28 mm	1198 mm	1205 mm	1212 mm
12T8/MAS/48-830/MF17/G 10/1	25.7 mm	28 mm	1198 mm	1205 mm	1212 mm

data subject to change

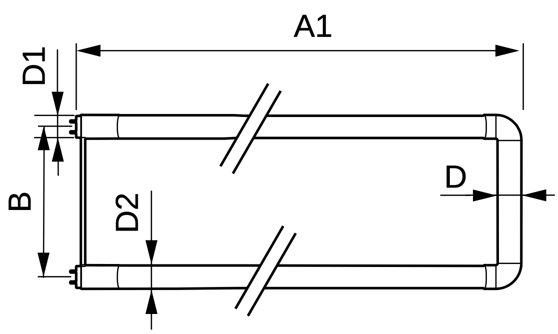
Dimensional drawing



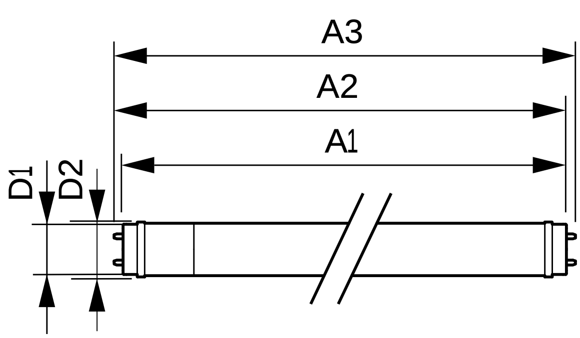
Product	D1	D2	A1	A2	A3
34T8/COR/96-840/ MF42/G/FA8 10/1	28 mm	27.9 mm	2369.8 mm	2378.7 mm	2387.8 mm
34T8/COR/96-850/ MF42/G/FA8 10/1	28 mm	27.9 mm	2369.8 mm	2378.7 mm	2387.8 mm



Product	D1	D2	A1	A2	A3
44T8HO/COR/96-850/ MF54/G/R17d 10/1	28 mm	27.8 mm	2369.8 mm	2378.7 mm	2387.8 mm
44T8HO/COR/96-840/ MF54/G/R17d 10/1	28 mm	27.8 mm	2369.8 mm	2378.7 mm	2387.8 mm



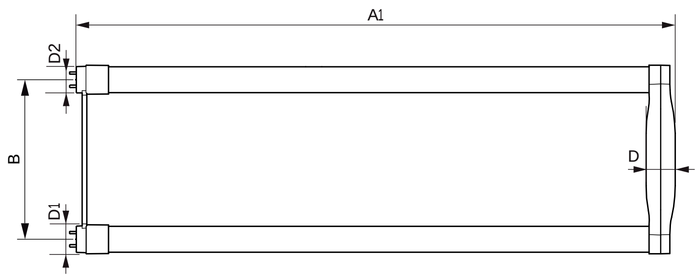
Product	D1	D2	A1	A2	A3
13T8-6U/MAS/24-835/IF20/P 10/1	25.7 mm	28 mm	152 mm	570 mm	27.8 mm
13T8-6U/MAS/24-840/IF21/P 10/1	25.7 mm	28 mm	152 mm	570 mm	27.8 mm
13T8-6U/MAS/24-830/IF20/P 10/1	25.7 mm	28 mm	152 mm	570 mm	27.8 mm
13T8-6U/MAS/24-850/IF21/P 10/1	25.7 mm	28 mm	152 mm	570 mm	27.8 mm



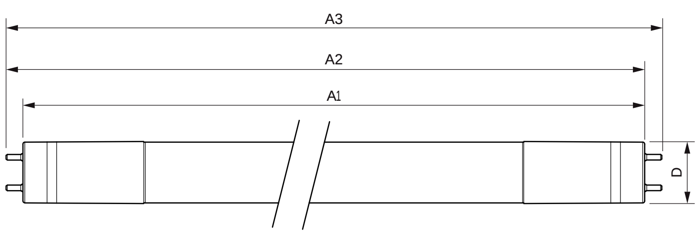
Product	D1	D2	A1	A2	A3
10T8/COR/48-850/IF16/G 25/1	25.7 mm	28 mm	1198.1 mm	1205.2 mm	1212.3 mm
10T8/COR/48-840/IF16/G 25/1	25.7 mm	28 mm	1198.1 mm	1205.2 mm	1212.3 mm

T8

Dimensional drawing



Product	D1	D2	B	A1	D
15.5T8-6U/COR/24-830/MF20/G 10/1	25.7 mm	28.1 mm	152 mm	570 mm	27.9 mm
15.5T8-6U/COR/24-850/MF21/G 10/1	25.7 mm	28.1 mm	152 mm	570 mm	27.9 mm
15.5T8-6U/COR/24-835/MF20/G 10/1	25.7 mm	28.1 mm	152 mm	570 mm	27.9 mm
15.5T8-6U/COR/24-840/MF21/G 10/1	25.7 mm	28.1 mm	152 mm	570 mm	27.9 mm



Product	D	A1	A2	A3
11.5T8/COR/36-850/MF14/G 10/1	25.9 mm	894.3 mm	900.5 mm	908.8 mm
11.5T8/COR/36-840/MF14/G 10/1	25.9 mm	894.3 mm	900.5 mm	908.8 mm
8.5T8/COR/24-850/MF11/G 10/1	25.9 mm	589.5 mm	595.7 mm	604 mm
11.5T8/COR/36-830/MF13/G 10/1	25.9 mm	894.3 mm	900.5 mm	908.8 mm
11.5T8/COR/36-835/MF13/G 10/1	25.9 mm	894.3 mm	900.5 mm	908.8 mm

General Information

Switching Cycle	50000X

Light Technical

Llmf At End Of Nominal Lifetime (Nom)	70 %

Temperature

T-Ambient (Min)	-20 °C
T-Storage (Max)	65 °C
T-Storage (Min)	-40 °C

Controls and Dimming

Order Code	Full Product Name	Dimmable
540807	10T8/MAS/48-840/IF16/P 25/1	No
540799	13T8/MAS/48-840/IF21/P/DIM 25/1	Yes
473974	9.5T8/MAS/48-830/IF15/P 10/1	No
473982	9.5T8/MAS/48-835/IF15/P 10/1	No
473990	9.5T8/MAS/48-840/IF16/P 10/1	No
540807		No
474007	9.5T8/MAS/48-850/IF16/P 10/1	No
532671	12T8/MAS/48-830/MF17/G 10/1	No
532689	12T8/MAS/48-835/MF17/G 10/1	No
532697	12T8/MAS/48-840/MF18/G 10/1	No
532705	12T8/PER/48-850/BB18/G 10/1 FB	No
532705	12T8/MAS/48-850/MF18/G 10/1	No

Order Code	Full Product Name	Dimmable
535484	8.5T8/COR/24-850/MF11/G 10/1	No
535492	11.5T8/COR/36-830/MF13/G 10/1	No
535500	11.5T8/COR/36-835/MF13/G 10/1	No
535518	11.5T8/COR/36-840/MF14/G 10/1	No
535526	11.5T8/COR/36-850/MF14/G 10/1	No
535534	15.5T8-6U/COR/24-830/MF20/G 10/1	No
535542	15.5T8-6U/COR/24-835/MF20/G 10/1	No
535559	15.5T8-6U/COR/24-840/MF21/G 10/1	No
535567	15.5T8-6U/COR/24-850/MF21/G 10/1	No
539858	8.5T8/MAS/36-830/IF13/P 10/1	No
539874	8.5T8/MAS/36-840/IF14/P 10/1	No
539882	8.5T8/MAS/36-850/IF14/P 10/1	No

data subject to change

Order Code	Full Product Name	Dimmable
539866	8.5T8/MAS/36-835/IF13/P 10/1	No
541813	7T8/MAS/24-830/IF10/P 10/1	No
541821	7T8/MAS/24-835/IF10/P 10/1	No
541839	7T8/MAS/24-840/IF11/P 10/1	No
541847	7T8/MAS/24-850/IF11/P 10/1	No
541854	13T8-6U/MAS/24-830/IF20/P 10/1	No
541862	13T8-6U/MAS/24-835/IF20/P 10/1	No
541870	13T8-6U/MAS/24-840/IF21/P 10/1	No
541888	13T8-6U/MAS/24-850/IF21/P 10/1	No
541986	10T8/COR/48-840/IF16/G 25/1	No
541994	10T8/COR/48-850/IF16/G 25/1	No
545269	34T8/COR/96-840/MF42/G/FA8 10/1	No
545277	34T8/COR/96-850/MF42/G/FA8 10/1	No
545285	44T8HO/COR/96-840/MF54/G/R17d 10/1	No
545293	44T8HO/COR/96-850/MF54/G/R17d 10/1	No

Operating and Electrical

Order Code	Full Product Name	Input Frequency	Voltage (Max)	Voltage (Min)	Voltage (Nom)	Power (Rated) (Nom)	Starting Time (Nom)
540807	10T8/MAS/48-840/IF16/P 25/1	20000-120000 Hz	347 V	120 V	277 V	10 W	0.5 s
540799	13T8/MAS/48-840/IF21/P/DIM 25/1	20000-120000 Hz	347 V	120 V	277 V	13 W	0.5 s
473974	9.5T8/MAS/48-830/IF15/P 10/1	50 to 60 Hz	-	-	120-277, 347 V	9.5 W	0.5 s
473982	9.5T8/MAS/48-835/IF15/P 10/1	50 to 60 Hz	-	-	120-277, 347 V	9.5 W	0.5 s
473990	9.5T8/MAS/48-840/IF16/P 10/1	50 to 60 Hz	-	-	120-277, 347 V	9.5 W	0.5 s
540807		50 to 60 Hz	-	-	120-277, 347 V	9.5 W	0.5 s
474007	9.5T8/MAS/48-850/IF16/P 10/1	50 to 60 Hz	-	-	120-277, 347 V	9.5 W	0.5 s
532671	12T8/MAS/48-830/MF17/G 10/1	50 to 60 Hz	-	-	120-277 V	12 W	0.5 s
532689	12T8/MAS/48-835/MF17/G 10/1	50 to 60 Hz	-	-	120-277 V	12 W	0.5 s
532697	12T8/MAS/48-840/MF18/G 10/1	50 to 60 Hz	-	-	120-277 V	12 W	0.5 s
532705	12T8/PER/48-850/BB18/G 10/1 FB	50 to 60 Hz	-	-	120-277 V	12 W	0.5 s
532705	12T8/MAS/48-850/MF18/G 10/1	50 to 60 Hz	-	-	120-277 V	12 W	0.5 s
535484	8.5T8/COR/24-850/MF11/G 10/1	50 to 60 Hz	-	-	120-277 V	8.5 W	0.9 s
535492	11.5T8/COR/36-830/MF13/G 10/1	50 to 60 Hz	-	-	120-277 V	11.5 W	0.9 s
535500	11.5T8/COR/36-835/MF13/G 10/1	50 to 60 Hz	-	-	120-277 V	11.5 W	0.9 s
535518	11.5T8/COR/36-840/MF14/G 10/1	50 to 60 Hz	-	-	120-277 V	11.5 W	0.9 s
535526	11.5T8/COR/36-850/MF14/G 10/1	50 to 60 Hz	-	-	120-277 V	11.5 W	0.9 s
535534	15.5T8-6U/COR/24-830/MF20/G 10/1	50 to 60 Hz	-	-	120-277 V	15.5 W	0.9 s
535542	15.5T8-6U/COR/24-835/MF20/G 10/1	50 to 60 Hz	-	-	120-277 V	15.5 W	0.9 s
535559	15.5T8-6U/COR/24-840/MF21/G 10/1	50 to 60 Hz	-	-	120-277 V	15.5 W	0.9 s
535567	15.5T8-6U/COR/24-850/MF21/G 10/1	50 to 60 Hz	-	-	120-277 V	15.5 W	0.9 s
539858	8.5T8/MAS/36-830/IF13/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	8.5 W	0.5 s
539874	8.5T8/MAS/36-840/IF14/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	8.5 W	0.5 s
539882	8.5T8/MAS/36-850/IF14/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	8.5 W	0.5 s
539866	8.5T8/MAS/36-835/IF13/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	8.5 W	0.5 s
541813	7T8/MAS/24-830/IF10/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	7 W	0.5 s
541821	7T8/MAS/24-835/IF10/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	7 W	0.5 s
541839	7T8/MAS/24-840/IF11/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	7 W	0.5 s
541847	7T8/MAS/24-850/IF11/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	7 W	0.5 s
541854	13T8-6U/MAS/24-830/IF20/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	13 W	0.5 s
541862	13T8-6U/MAS/24-835/IF20/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	13 W	0.5 s
541870	13T8-6U/MAS/24-840/IF21/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	13 W	0.5 s
541888	13T8-6U/MAS/24-850/IF21/P 10/1	20K to 120K Hz	-	-	120-277, 347 V	13 W	0.5 s
541986	10T8/COR/48-840/IF16/G 25/1	25000-105000 Hz	-	-	120-277, 347 V	10 W	0.5 s
541994	10T8/COR/48-850/IF16/G 25/1	25000-105000 Hz	-	-	120-277, 347 V	10 W	0.5 s
545269	34T8/COR/96-840/MF42/G/FA8 10/1	50 to 60 Hz	-	-	120-277 V	34 W	0.5 s
545277	34T8/COR/96-850/MF42/G/FA8 10/1	50 to 60 Hz	-	-	120-277 V	34 W	0.5 s
545285	44T8HO/COR/96-840/MF54/G/R17d 10/1	50 to 60 Hz	-	-	120-277 V	44 W	0.5 s
545293	44T8HO/COR/96-850/MF54/G/R17d 10/1	50 to 60 Hz	-	-	120-277 V	44 W	0.5 s

General Information

Order Code	Full Product Name	Cap-Base	Nominal Lifetime (Nom)	Rated Lifetime (Hours)
540807	10T8/MAS/48-840/IF16/P 25/1	G13	70000 h	70000 h
540799	13T8/MAS/48-840/IF21/P/DIM 25/1	G13	70000 h	70000 h
473974	9.5T8/MAS/48-830/IF15/P 10/1	G13	70000 h	70000 h
473982	9.5T8/MAS/48-835/IF15/P 10/1	G13	70000 h	70000 h
473990	9.5T8/MAS/48-840/IF16/P 10/1	G13	70000 h	70000 h
540807		G13	70000 h	70000 h
474007	9.5T8/MAS/48-850/IF16/P 10/1	G13	70000 h	70000 h
532671	12T8/MAS/48-830/MF17/G 10/1	G13	50000 h	50000 h
532689	12T8/MAS/48-835/MF17/G 10/1	G13	50000 h	50000 h
532697	12T8/MAS/48-840/MF18/G 10/1	G13	50000 h	50000 h
532705	12T8/PER/48-850/BB18/G 10/1 FB	G13	50000 h	50000 h
532705	12T8/MAS/48-850/MF18/G 10/1	G13	50000 h	50000 h
535484	8.5T8/COR/24-850/MF11/G 10/1	G13	50000 h	50000 h
535492	11.5T8/COR/36-830/MF13/G 10/1	G13	50000 h	50000 h
535500	11.5T8/COR/36-835/MF13/G 10/1	G13	50000 h	50000 h
535518	11.5T8/COR/36-840/MF14/G 10/1	G13	50000 h	50000 h
535526	11.5T8/COR/36-850/MF14/G 10/1	G13	50000 h	50000 h
535534	15.5T8-6U/COR/24-830/MF20/G 10/1	2G13	50000 h	50000 h
535542	15.5T8-6U/COR/24-835/MF20/G 10/1	2G13	50000 h	50000 h
535559	15.5T8-6U/COR/24-840/MF21/G 10/1	2G13	50000 h	50000 h
535567	15.5T8-6U/COR/24-850/MF21/G 10/1	2G13	50000 h	50000 h
539858	8.5T8/MAS/36-830/IF13/P 10/1	G13	70000 h	70000 h
539874	8.5T8/MAS/36-840/IF14/P 10/1	G13	70000 h	70000 h
539882	8.5T8/MAS/36-850/IF14/P 10/1	G13	70000 h	70000 h
539866	8.5T8/MAS/36-835/IF13/P 10/1	G13	70000 h	70000 h
541813	7T8/MAS/24-830/IF10/P 10/1	G13	70000 h	70000 h
541821	7T8/MAS/24-835/IF10/P 10/1	G13	70000 h	70000 h
541839	7T8/MAS/24-840/IF11/P 10/1	G13	70000 h	70000 h
541847	7T8/MAS/24-850/IF11/P 10/1	G13	70000 h	70000 h
541854	13T8-6U/MAS/24-830/IF20/P 10/1	G13	70000 h	70000 h
541862	13T8-6U/MAS/24-835/IF20/P 10/1	G13	70000 h	70000 h
541870	13T8-6U/MAS/24-840/IF21/P 10/1	G13	70000 h	70000 h
541888	13T8-6U/MAS/24-850/IF21/P 10/1	G13	70000 h	70000 h
541986	10T8/COR/48-840/IF16/G 25/1	G13	50000 h	50000 h
541994	10T8/COR/48-850/IF16/G 25/1	G13	50000 h	50000 h
545269	34T8/COR/96-840/MF42/G/FA8 10/1	FA8	50000 h	50000 h
545277	34T8/COR/96-850/MF42/G/FA8 10/1	FA8	50000 h	50000 h
545285	44T8HO/COR/96-840/MF54/G/R17d 10/1	R17D	50000 h	50000 h
545293	44T8HO/COR/96-850/MF54/G/R17d 10/1	R17D	50000 h	50000 h

Light Technical

Order Code	Full Product Name	Beam Angle (Nom)	Color Code	Correlated Color Temperature (Nom)	Color Rendering Index (Nom)	Luminous Flux (Nom)	Luminous Flux (Rated) (Nom)	Rated Beam Angle
540807	10T8/MAS/48-840/IF16/P 25/1	-	841	4000 K	82	1600 lm	1600 lm	-
540799	13T8/MAS/48-840/IF21/P/DIM 25/1	-	841	4000 K	82	2100 lm	2100 lm	-
473974	9.5T8/MAS/48-830/IF15/P 10/1	180 °	830	3000 K	80	1500 lm	1500 lm	180 °
473982	9.5T8/MAS/48-835/IF15/P 10/1	180 °	835	3500 K	80	1500 lm	1500 lm	180 °
473990	9.5T8/MAS/48-840/IF16/P 10/1	180 °	841	4000 K	80	1600 lm	1600 lm	180 °
540807		180 °	841	4000 K	80	1500 lm	1500 lm	180 °
474007	9.5T8/MAS/48-850/IF16/P 10/1	180 °	850	5000 K	80	1600 lm	1600 lm	180 °
532671	12T8/MAS/48-830/MF17/G 10/1	240 °	830	3000 K	80	1700 lm	1700 lm	240 °
532689	12T8/MAS/48-835/MF17/G 10/1	240 °	835	3500 K	80	1700 lm	1700 lm	240 °

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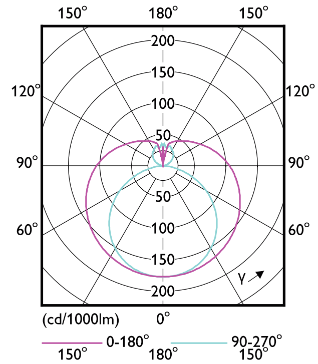
Order Code	Full Product Name	Beam Angle (Nom)	Color Code	Correlated Color Temperature (Nom)	Color Rendering Index (Nom)	Luminous Flux (Nom)	Luminous Flux (Rated) (Nom)	Rated Beam Angle
532697	12T8/MAS/48-840/MF18/G 10/1	240 °	841	4000 K	80	1800 lm	1800 lm	240 °
532705	12T8/PER/48-850/BB18/G 10/1 FB	240 °	850	5000 K	80	1800 lm	1800 lm	240 °
532705	12T8/MAS/48-850/MF18/G 10/1	240 °	850	5000 K	80	1800 lm	1800 lm	240 °
535484	8.5T8/COR/24-850/MF11/G 10/1	180 °	850	5000 K	82	1150 lm	1150 lm	180 °
535492	11.5T8/COR/36-830/MF13/G 10/1	180 °	830	3000 K	82	1300 lm	1300 lm	180 °
535500	11.5T8/COR/36-835/MF13/G 10/1	180 °	835	3500 K	82	1300 lm	1300 lm	180 °
535518	11.5T8/COR/36-840/MF14/G 10/1	180 °	841	4000 K	82	1400 lm	1400 lm	180 °
535526	11.5T8/COR/36-850/MF14/G 10/1	180 °	850	5000 K	82	1400 lm	1400 lm	180 °
535534	15.5T8-6U/COR/24-830/MF20/G 10/1	180 °	830	3000 K	82	2000 lm	2000 lm	180 °
535542	15.5T8-6U/COR/24-835/MF20/G 10/1	180 °	835	3500 K	82	2000 lm	2000 lm	180 °
535559	15.5T8-6U/COR/24-840/MF21/G 10/1	180 °	841	4000 K	82	2100 lm	2100 lm	180 °
535567	15.5T8-6U/COR/24-850/MF21/G 10/1	180 °	850	5000 K	82	2100 lm	2100 lm	180 °
539858	8.5T8/MAS/36-830/IF13/P 10/1	180 °	830	3000 K	80	1300 lm	1300 lm	180 °
539874	8.5T8/MAS/36-840/IF14/P 10/1	180 °	841	4000 K	80	1400 lm	1400 lm	180 °
539882	8.5T8/MAS/36-850/IF14/P 10/1	180 °	850	5000 K	80	1400 lm	1400 lm	180 °
539866	8.5T8/MAS/36-835/IF13/P 10/1	180 °	835	3500 K	80	1300 lm	1300 lm	180 °
541813	7T8/MAS/24-830/IF10/P 10/1	180 °	830	3000 K	80	1100 lm	1100 lm	180 °
541821	7T8/MAS/24-835/IF10/P 10/1	180 °	835	3500 K	80	1100 lm	1100 lm	180 °
541839	7T8/MAS/24-840/IF11/P 10/1	180 °	841	4000 K	80	1150 lm	1150 lm	180 °
541847	7T8/MAS/24-850/IF11/P 10/1	180 °	850	5000 K	80	1150 lm	1150 lm	180 °
541854	13T8-6U/MAS/24-830/IF20/P 10/1	180 °	830	3000 K	80	2000 lm	2000 lm	180 °
541862	13T8-6U/MAS/24-835/IF20/P 10/1	180 °	835	3500 K	80	2000 lm	2000 lm	180 °
541870	13T8-6U/MAS/24-840/IF21/P 10/1	180 °	841	4000 K	80	2100 lm	2100 lm	180 °
541888	13T8-6U/MAS/24-850/IF21/P 10/1	180 °	850	5000 K	80	2100 lm	2100 lm	180 °
541986	10T8/COR/48-840/IF16/G 25/1	-	841	4000 K	82	1600 lm	1600 lm	-
541994	10T8/COR/48-850/IF16/G 25/1	-	850	5000 K	82	1600 lm	1600 lm	-
545269	34T8/COR/96-840/MF42/G/FA8 10/1	240 °	841	4000 K	82	4200 lm	4200 lm	240 °
545277	34T8/COR/96-850/MF42/G/FA8 10/1	240 °	850	5000 K	82	4200 lm	4200 lm	240 °
545285	44T8HO/COR/96-840/MF54/G/R17d 10/1	240 °	841	4000 K	82	5400 lm	5400 lm	240 °
545293	44T8HO/COR/96-850/MF54/G/R17d 10/1	240 °	850	5000 K	82	5400 lm	5400 lm	240 °

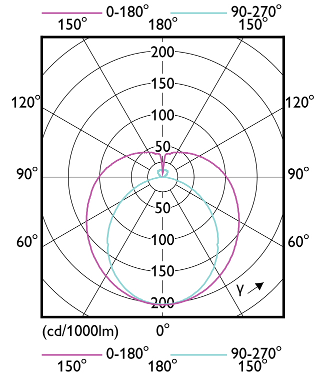
Temperature

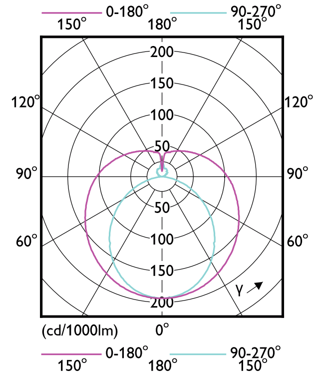
Order Code	Full Product Name	T-Ambient (Max)	T-Case Maximum (Nom)
540807	10T8/MAS/48-840/IF16/P 25/1	45 °C	50 °C
540799	13T8/MAS/48-840/IF21/P/DIM 25/1	45 °C	50 °C
473974	9.5T8/MAS/48-830/IF15/P 10/1	55 °C	55 °C
473982	9.5T8/MAS/48-835/IF15/P 10/1	55 °C	55 °C
473990	9.5T8/MAS/48-840/IF16/P 10/1	55 °C	55 °C
540807		55 °C	55 °C
474007	9.5T8/MAS/48-850/IF16/P 10/1	55 °C	55 °C
532671	12T8/MAS/48-830/MF17/G 10/1	45 °C	70 °C
532689	12T8/MAS/48-835/MF17/G 10/1	45 °C	70 °C
532697	12T8/MAS/48-840/MF18/G 10/1	45 °C	70 °C
532705	12T8/PER/48-850/BB18/G 10/1 FB	45 °C	70 °C
532705	12T8/MAS/48-850/MF18/G 10/1	45 °C	70 °C
535484	8.5T8/COR/24-850/MF11/G 10/1	45 °C	50 °C

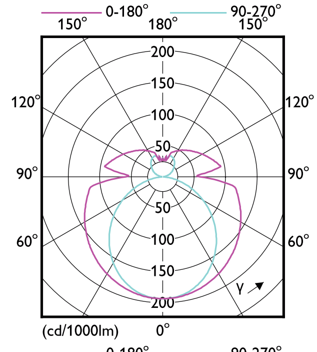
Order Code	Full Product Name	T-Ambient (Max)	T-Case Maximum (Nom)
535492	11.5T8/COR/36-830/MF13/G 10/1	45 °C	50 °C
535500	11.5T8/COR/36-835/MF13/G 10/1	45 °C	50 °C
535518	11.5T8/COR/36-840/MF14/G 10/1	45 °C	50 °C
535526	11.5T8/COR/36-850/MF14/G 10/1	45 °C	50 °C
535534	15.5T8-6U/COR/24-830/MF20/G 10/1	45 °C	51 °C
535542	15.5T8-6U/COR/24-835/MF20/G 10/1	45 °C	51 °C
535559	15.5T8-6U/COR/24-840/MF21/G 10/1	45 °C	51 °C
535567	15.5T8-6U/COR/24-850/MF21/G 10/1	45 °C	51 °C
539858	8.5T8/MAS/36-830/IF13/P 10/1	45 °C	50 °C

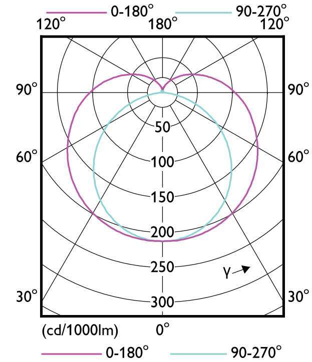
Order Code	Full Product Name	T-Ambient (Max)	T-Case Maximum (Nom)
539874	8.5T8/MAS/36-840/IF14/P 10/1	45 °C	50 °C
539882	8.5T8/MAS/36-850/IF14/P 10/1	45 °C	50 °C
539866	8.5T8/MAS/36-835/IF13/P 10/1	45 °C	50 °C
541813	7T8/MAS/24-830/IF10/P 10/1	45 °C	50 °C
541821	7T8/MAS/24-835/IF10/P 10/1	45 °C	50 °C
541839	7T8/MAS/24-840/IF11/P 10/1	45 °C	50 °C
541847	7T8/MAS/24-850/IF11/P 10/1	45 °C	50 °C
541854	13T8-6U/MAS/24-830/IF20/P 10/1	45 °C	50 °C
541862	13T8-6U/MAS/24-835/IF20/P 10/1	45 °C	50 °C
541870	13T8-6U/MAS/24-840/IF21/P 10/1	45 °C	50 °C
541888	13T8-6U/MAS/24-850/IF21/P 10/1	45 °C	50 °C
541986	10T8/COR/48-840/IF16/G 25/1	45 °C	50 °C
541994	10T8/COR/48-850/IF16/G 25/1	45 °C	50 °C
545269	34T8/COR/96-840/MF42/G/FA8 10/1	45 °C	45 °C
545277	34T8/COR/96-850/MF42/G/FA8 10/1	45 °C	45 °C
545285	44T8HO/COR/96-840/MF54/G/ R17d 10/1	45 °C	55 °C
545293	44T8HO/COR/96-850/MF54/G/ R17d 10/1	45 °C	55 °C

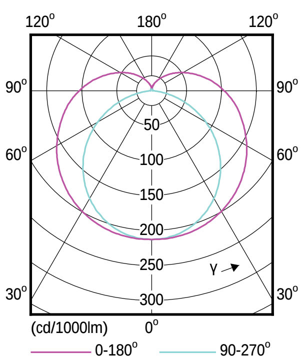


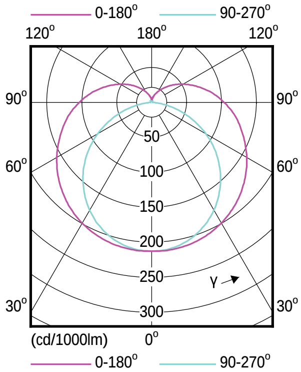












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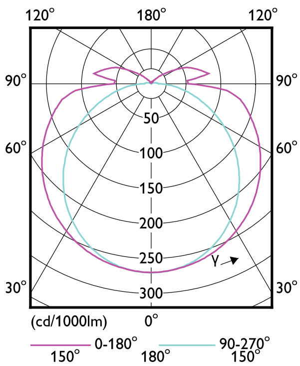
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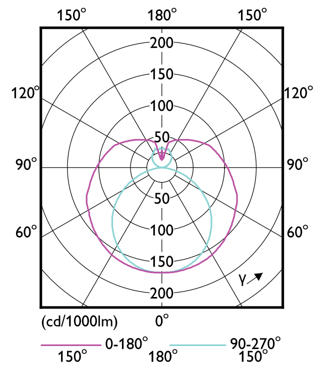
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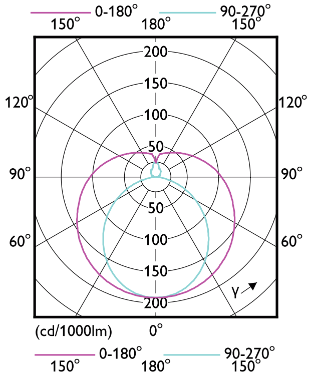
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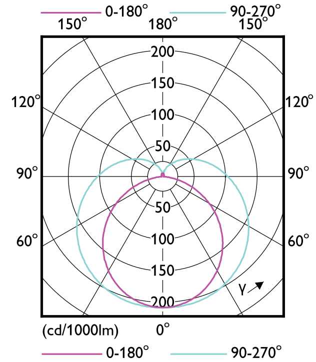
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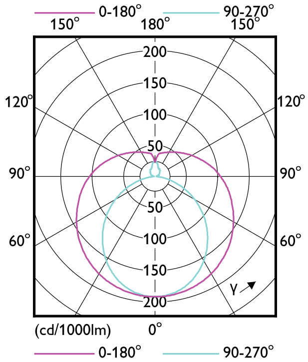
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VAN1LED12W

RAB

Low-profile vandalproof fixture replaces traditional incandescent luminaires delivering impressive energy savings.

Color: White   Weight: 1.2 lbs

Project:	Type:
Prepared By:	Date:

Driver Info

Type	Constant Current
120V	0.103A
208V	N/A
240V	N/A
277V	N/A
Input Watts	12.9W

LED Info

Watts	12W
Color Temp	5000K (Cool)
Color Accuracy	85 CRI
L70 Lifespan	50,000 Hours
Lumens	1,570
Efficacy	121.7 lm/W

Technical Specifications

Listings

UL Listed:

Suitable for Wet Locations. Covered Ceiling Mount Only.

IESNA LM-79 & IESNA LM-80 Testing:

RAB LED luminaires and LED components have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities. DLC Product Code: P4Y3N513

Electrical

Driver:

AC board, 50/60 Hz., 120V: 103 mA

THD:

11.2% at 120V

Power Factor:

99.4% at 120V

Dimmer Compatibility:

TRIAC/ELV dimming capable. See dimmer compatibility guide here.

Surge Protection:

2.5kV

Construction

Cold Weather Starting:

The minimum starting temperature is -30°C (-22°F)

Ambient Temperature:

Suitable for use in up to 45°C (113°F)

Housing:

Precision steel housing

Mounting:

Ceiling mount to recessed junction with knockout template. Tamperproof screws.

Lens:

Vandalproof, frosted polycarbonate drop lens

Gaskets:

High-temperature silicone gaskets

VAN1LED12W

RAB

Technical Specifications (continued)

Construction

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color

Green Technology:

Mercury and UV free. RoHS-compliant components.

Performance

Lifespan:

50,000-Hour LED lifespan based on IES LM-80 results and TM-21 calculations

LED Characteristics

LEDs:

120V long-lfe LEDs

Color Stability:

RAB LEDs exceed industry standards for chromatic stability

Color Uniformity:

RAB's range of Correlated Color Temperature follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2017.

Other

Optional Sensor:

VAN1LED is compatible with occupancy sensors. Click here to see all occupancy sensor accessories.

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

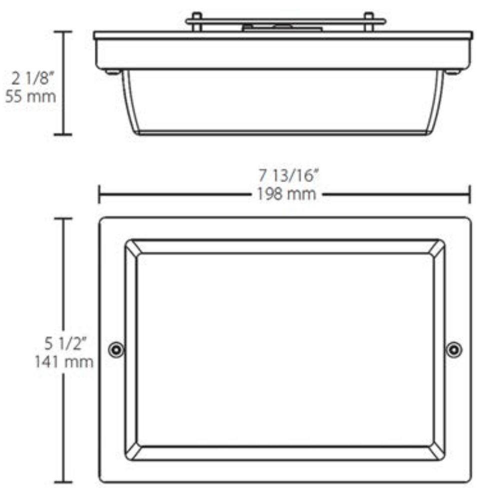
Equivalency:

Equivalent to 70W Metal Halide

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Dimensions



Features

- Vandalproof polycarbonate drop lens
- Ultra efficiency
- Low-profile design

VAN1LED12W

Ordering Matrix

Family	Wattage	Color Temp	Finish
VAN1LED	12		W
	6 = 6W **12 =** 12W	**Blank =** 5000K (Cool) **N =** 4000K (Neutral) **Y =** 3000K (Warm)	**W =** White

SK9SYYW

RAB

Low-maintenance, high-efficiency LED retrofit fixture installs on standard junction boxes.

Color: White

Weight: 1.2 lbs

Project:	Type:
Prepared By:	Date:

Driver Info

Type	Constant Current
120V	0.08A
208V	N/A
240V	N/A
277V	N/A
Input Watts	9.40W

LED Info

Watts	9W
Color Temp	2700K (Residential Warm)
Color Accuracy	85 CRI
L70 Lifespan	100,000 Hours
Lumens	719
Efficacy	76.5 lm/W

Technical Specifications

Listings

UL Listed:

Suitable for damp locations. For indoor use only.

IESNA LM-79 & LM-80 Testing:

RAB LED luminaires and LED components have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80.

LED Characteristics

LEDs:

120V long-life LEDs with integrated driver technology and TRIAC and ELV dimming down to 5%. See compatibility guide here. Power Factor 98.9%, 3 kV surge protection

Color Consistency:

3-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color

Color Stability:

LED color temperature is warrantied to shift no more than 200K in color temperature over a 5-year period

Color Uniformity:

RAB's range of Correlated Color Temperature follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2017.

Performance

Lifespan:

100,000-Hour LED lifespan based on IES LM-80 results and TM-21 calculations

Construction

Housing:

Precision die-cast aluminum construction

Mounting:

Simple slide-n-lock mounting bracket mounts to 3 1/2" and 4" round or octagon boxes with mounting screws 2 3/4" and 3 1/2" on center

Lens:

Vandal resistant polycarbonate diffusion lens

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color

Green Technology:

Mercury and UV free. RoHS-compliant components.

Other

Equivalency:

Equivalent to 60W Incandescent, replaces up to 100W Incandescent

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

SK9SYYW

Technical Specifications (continued)

Other

Buy American Act Compliance:

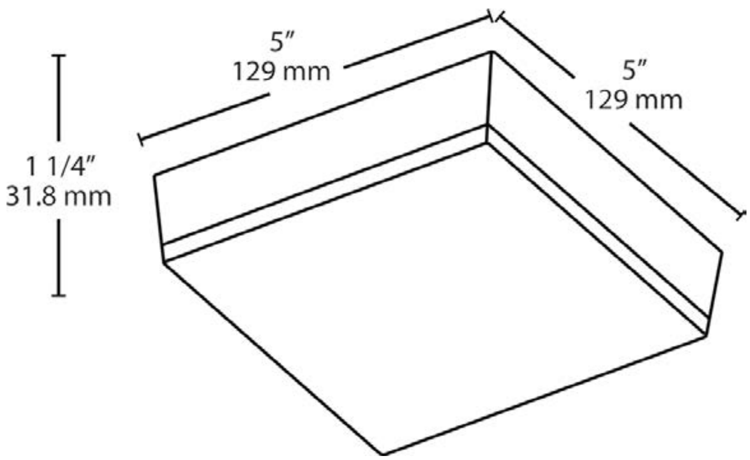
RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Electrical

THD:

13.8% at 120V

Dimensions



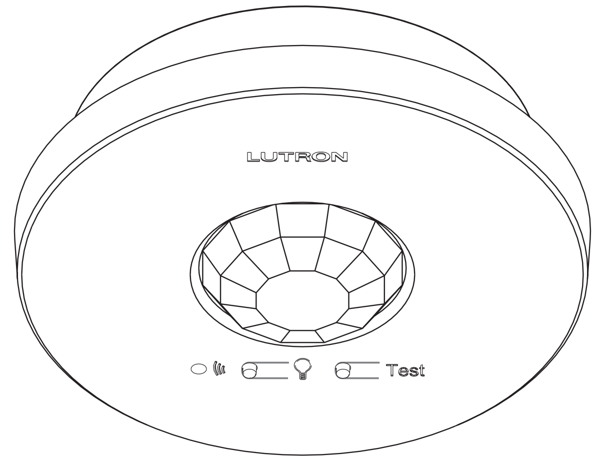
Features

- Contemporary low-profile design
- Mounts flush to ceilings or walls
- Replaces up to 100W incandescent
- Vandal-resistant diffusion lens provides smooth light with no glare
- 100,000-Hour LED Lifespan, 5-year, no-compromise warranty

Ordering Matrix

Family	Wattage	Shape	Color Temp	Finish
SK	9	S	YY	W
	9 = 9W	**R** = Round **S** = Square	**YN** = 3500K (Warm Neutral) **Y** = 3000K (Warm) **YY** = 2700K (Residential Warm)	**W** = White

Radio Powr Savr Wireless Occupancy / Vacancy Ceiling Sensor



Lutron Radio Powr Savr occupancy / vacancy sensors are wireless, battery-powered, passive infrared (PIR) sensors that automatically control lights via RF communication to compatible dimming and switching devices. These sensors detect the heat (IR radiation of 9.5 µm) from people moving within an area to determine when the space is occupied. The sensors then wirelessly transmit the appropriate commands to the associated dimming and switching devices to turn the lights on or off automatically. They combine both convenience and exceptional energy savings potential along with ease of installation.

Features

- Wireless occupancy sensor has 3 settings available: Auto-On / Auto-Off, Auto-On Low-Light / Auto-Off, and Manual-On / Auto-Off
- Auto-On Low-Light feature will turn lights on automatically only if there is less than approximately 10 Lux (1 fc) of ambient light
- Vacancy-only model available to meet California (U.S.A.) Title 24 requirements
- Uses Clear Connect technology
- Passive infrared motion detection with exclusive Lutron XCT Technology for fine motion detection
- 360° coverage ranges from 324 ft^2 (30.2 m^2) to 676 ft^2 (62.4 m^2), depending on mounting height
- Simple and intuitive adjustments available for Timeout, Auto-On, and Activity settings
- Supports advanced occupancy features, such as dependent occupancy groups and customizable occupied / unoccupied presets in some systems
- Multiple sensors can be added for extended coverage. Refer to product specification submittal of receiving device to determine system limits
- Lens illuminates during test mode to verify ideal locations
- Multiple ceiling-mount methods available for different ceiling materials
- Front accessible test buttons make programming easy
- 10-year battery life design
- RoHS compliant

Models Available

- LRF__-OCR2B-P-WH
  - WH — Color Code
  - OCR — Occupancy and Vacancy
  - __ — Frequency / Channel Code
- LRF2-VCR2B-P-WH
  - VCR — Vacancy Only
  - 2 — Available for Channel Code 2 Only

Frequency / Channel Codes

Available

2 = 431.0 – 437.0 MHz (U.S.A., Canada, Mexico, Brazil)
3 = 868.125 – 869.850 MHz (Europe, U.A.E.)
4 = 868.125 – 868.4755 MHz (China, Singapore)
5 = 865.5 – 866.5 MHz (India)
6 = 312.3 – 314.8 MHz (Japan)
7 = 433.05 – 434.79 MHz (Hong Kong, Macau)

Color Code

WH = White

Compatible RF Devices

- For use with Lutron products only
- Supports simultaneous association with multiple Lutron Clear Connect devices and / or systems*

* Contact Lutron Customer Service at www.lutron.com/support for frequency / channel code compatibility with your particular geographic region, and for integrating with other Lutron lighting and shading products.

Job Name:	Model Numbers:
Job Number:	

Specifications

Regulatory

- Lutron Quality Systems Registered to ISO 9001:2008

Regulatory Approvals

LRF2- (USA and Canada)

- cULus Listed
- FCC certified
- IC certified
- Meets CA (U.S.A.) Energy Commission Title 24 requirements
- COFETEL certified
- ANATEL certified
- SUTEL certified

LRF3-

- CE marked (European Union)
- TRA type approval (United Arab Emirates)
- CITC type approval (Saudi Arabia)

LRF4-

- SRRC type approval (Mainland China)
- iDA registered (Singapore)

LRF5-

- WPC Type (India)

LRF6-

- 007YUUL0689

LRF7-

- FCC

Power / Performance

- Operating voltage: 3 V -
- Operating current: 14 μA nominal
- Requires one CR 123 lithium battery
- 10-year battery life
- Non-volatile memory (saved changes are stored during power loss)

Environment

- Temperature: 32 ˚F to 104 ˚F (0 ˚C to 40 ˚C)
- For indoor use only
- Relative humidity: less than 90% non-condensing

Warranty

- 5-Year Limited Warranty. For additional Warranty information, please visit www.lutron.com/TechnicalDocumentLibrary/Sensor_Warranty.pdf

RF Range

LRF2-, LRF3-, LRF4-, LRF5-, LRF7-

Local load controls must be located within 60 ft (18 m) line-of-sight, or 30 ft (9 m) through walls, of a sensor.

LRF6-

Local load controls must be located within 40 ft (12.2 m) line-of-sight, or 23 ft (7 m) through walls, of a sensor.

Sensor Coverage Test

- Front accessible test button
- Lens illuminates orange in response to motion during test mode and is visible from 60 ft (18 m)

Wireless Communication Test

- Front accessible test button
- Turn associated loads on and off

Timeout Options

- 1 minute*
- 5 minutes
- 15 minutes (default setting)
- 30 minutes

Auto-On Options (Occupancy Versions Only)

- *Enabled*: Sensor turns lights ON and OFF automatically (default setting).
- *Low Light*: Sensor turns lights ON automatically only in low ambient light conditions; sensor turns lights OFF automatically.
- *Disabled***: Lights must be turned ON manually from dimming or switching device; sensor turns lights OFF automatically.

Activity Options

- *Low Activity*: (default setting)
- *Medium Activity*:
- *High Activity*:

* Intended for use in high-activity, briefly occupied areas only.

** During the 15-second grace period that begins when the lights are automatically turned off, the lights will automatically turn back on in response to motion. This grace period is provided as a safety and convenience feature in the event the lights turn off while the room is still occupied, so that the user does not need to manually turn the lights back on. After 15 seconds, the grace period expires and the lights must be manually turned on.

Job Name:

Job Number:

Model Numbers:

Installation Overview

Sensor Setup

- Sensor setup is available as a service by Lutron. For more information see the Sensor Layout and Tuning service document (Lutron P/N 3601235).

Sensor Placement

- To detect motion, the sensor requires line-of-sight of room occupants. The sensor must have an unobstructed view of the room. DO NOT mount behind or near tall cabinets, shelves, hanging fixtures, ceiling fans, etc. The sensor cannot see through glass objects such as patio- or shower doors.
- Hot objects and moving air currents can affect the performance of the sensor. To ensure proper operation, the sensor should be mounted at least 4 ft (1.2 m) away from HVAC vents and halogen or incandescent bulbs that are below the ceiling line.
- The performance of the sensor depends on a temperature differential between the ambient room temperature and that of room occupants. Warmer rooms may reduce the ability of the sensor to detect occupants.
- Devices emitting Radio Frequency (RF) energy can affect the performance of sensors. To ensure proper operation, sensors should be mounted at least 4 ft (1.2 m) away from devices that emit radio waves (e.g., microwave ovens, wireless routers, or other non-Clear Connect wireless devices). When using Clear Connect - Type X lamps or fixtures, ensure sensor is mounted at a distance of 2 ft (0.6 m) or greater from the lamp or fixture.
- For additional information on placing sensors, please see the Occupancy / Vacancy Sensor Design and Application Guide (P/N 368-3197) located at www.lutron.com

Mounting

Temporary mounting is optional to test sensor coverage and wireless communication before permanently installing the sensor.

Drop Ceiling (Compressed Fiber Ceiling Tile)

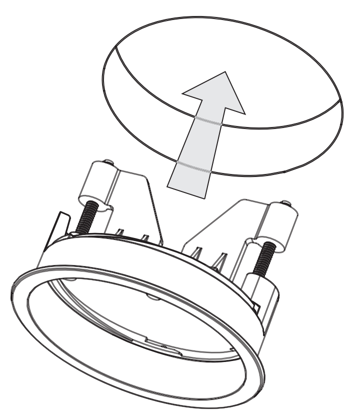
The mounting wire is provided for both temporary and permanent mounting of the sensor to ceiling tiles. It is designed to allow temporary mounting, testing, and repositioning (if necessary) of the sensor without damaging a ceiling tile. Once the final position of the sensor has been chosen, the mounting wire should be twisted together to permanently secure the sensor in place.

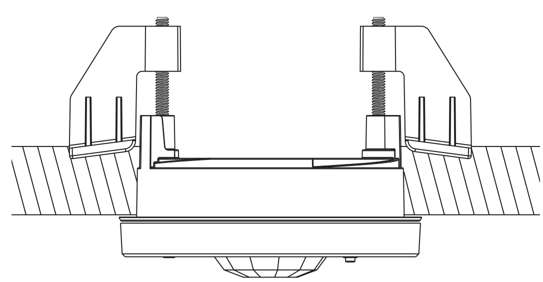
Solid Ceiling (Drywall, Plaster, Concrete, or Wood)

- Temporary mounting: Ten (10) temporary mounting strips can be purchased in the kit, L-CMDPIRKIT, for temporarily mounting and testing the sensor.
- Permanent mounting: Screws and anchors (for drywall or plaster) provided to mount the sensor.

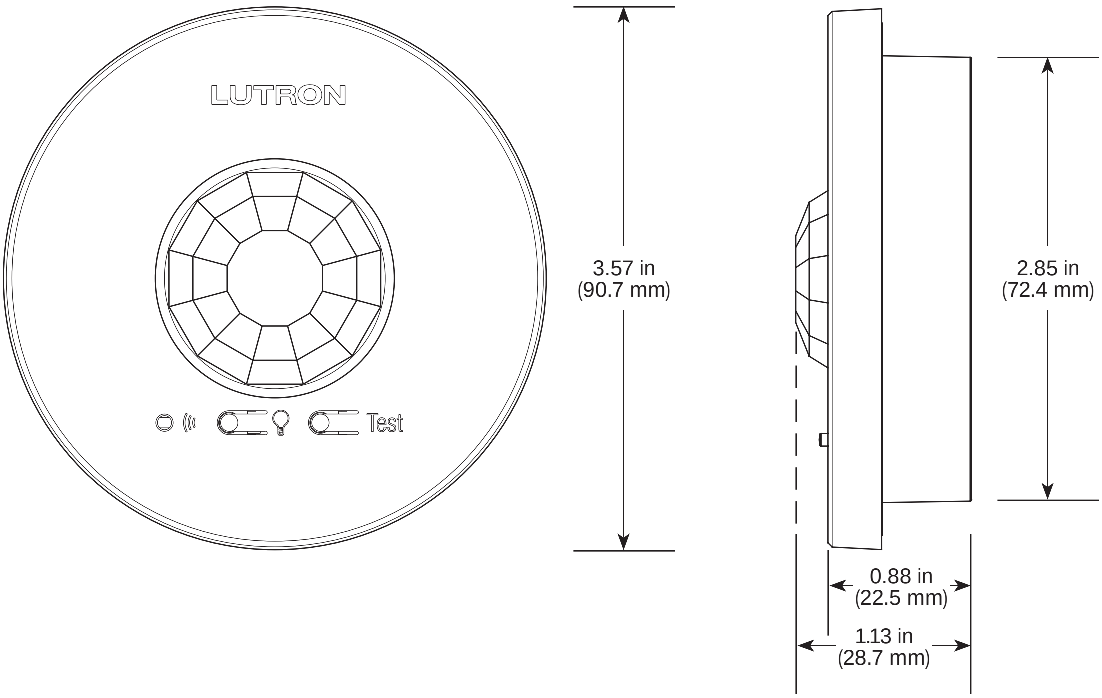
Recess-Mount

- Do not recess-mount sensor in a metal surface.
- Recess-mounting ring requires an opening of 3 in (76 mm) in diameter.
- Recess-mounting ring secures internally to ceiling. Sensor twists into the recess mounting ring and sits flush with ceiling (see image below).
- Recess-mounting ring purchased as a separate kit: L-CRMK-WH.





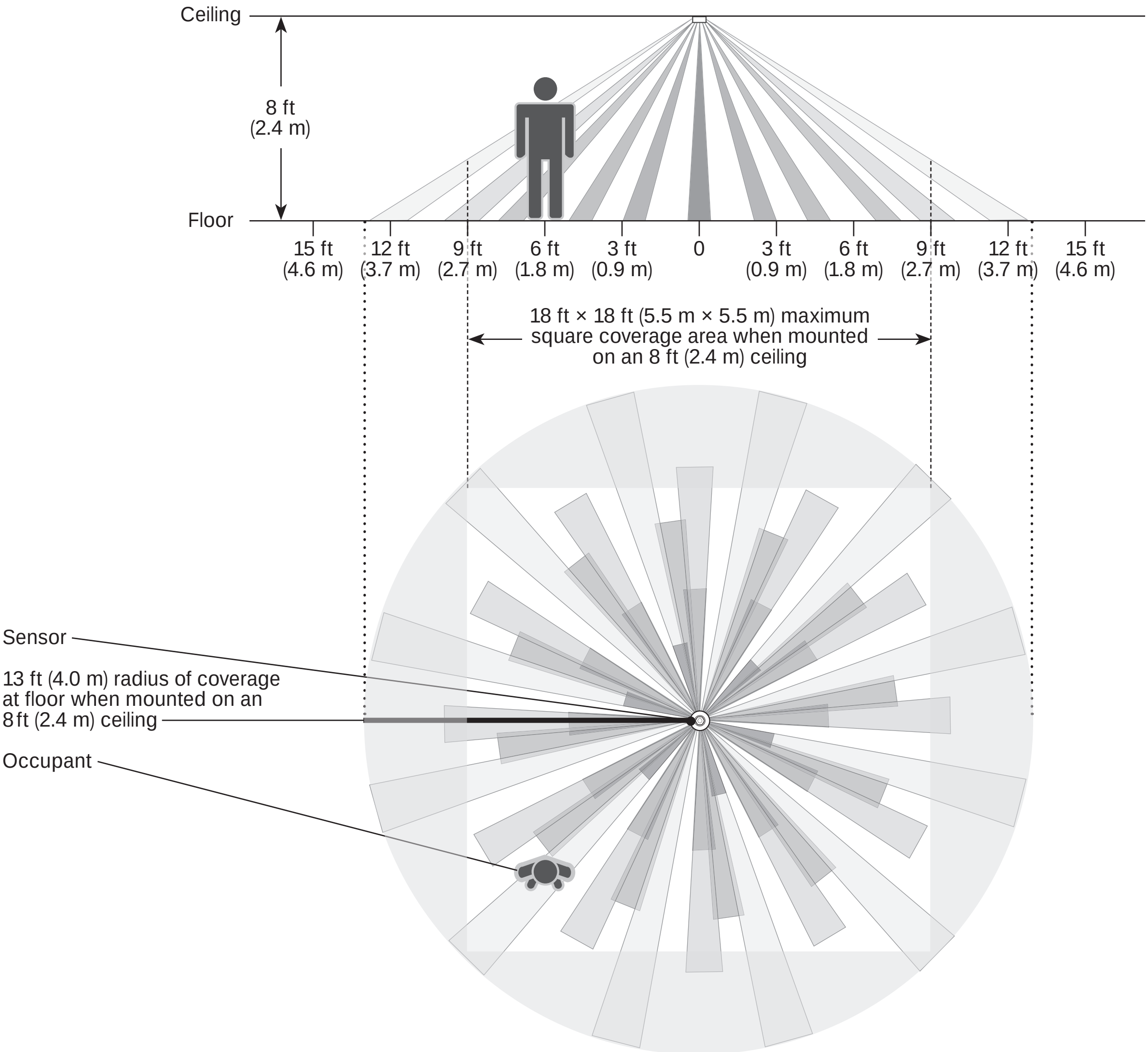
Dimensions



Job Name:	Model Numbers:
Job Number:	

Coverage Diagrams

Per NEMA WD7 test method



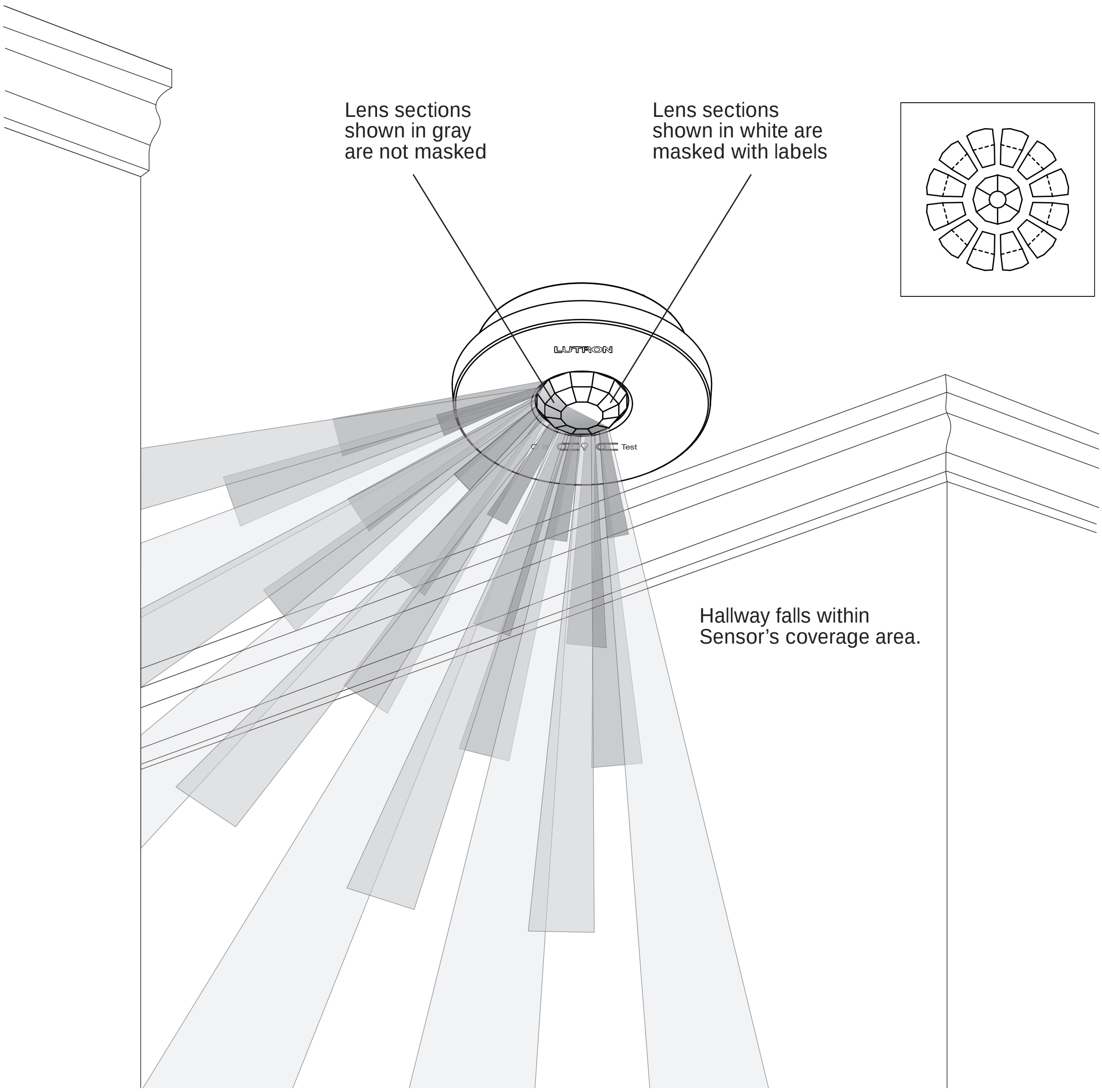
Sensor Coverage Chart (for sensor mounted in center of room)

Ceiling Height	Maximum Square Coverage Area*	
8 ft (2.4 m)	18 ft × 18 ft (5.5 m × 5.5 m)	324 ft^2 (30.2 m^2)
9 ft (2.7 m)	20 ft × 20 ft (6.1 m × 6.1 m)	400 ft^2 (37.2 m^2)
10 ft (3.0 m)	22 ft × 22 ft (6.7 m × 6.7 m)	484 ft^2 (44.9 m^2)
12 ft (3.7 m)	26 ft × 26 ft (7.9 m × 7.9 m)	676 ft^2 (62.4 m^2)

* 12 ft (3.7 m) is the recommended maximum mounting height

Lens Masking

Whenever possible, the sensor should be installed in a location where it cannot view areas outside the intended space, such as hallways or adjacent rooms. If this situation cannot be avoided, portions of the lens may be masked to block the view of the sensor into undesired areas. Ten (10) PIR Lens Masks may be purchased in the kit, L-CMDPIRKIT.



Job Name:

Job Number:

Model Numbers:

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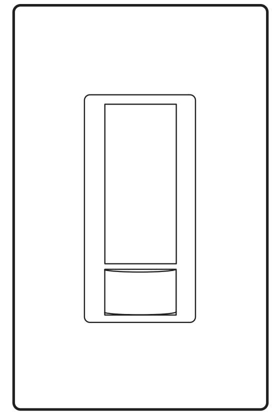
Maestro sensor switch

The Lutron Maestro occupancy sensor switch combines a Maestro switch with a passive infrared occupancy or vacancy sensor. The sensor detects the heat from occupants moving within an area to determine whether the space is occupied. Based on the feedback from the sensor, the occupancy sensor switch will adjust the load accordingly.



MS-OPS2	MS-VPS2
MS-OPS2H-XX-C	MS-VPS5M
MS-OPS5M	MS-VPS6M2-DV
MS-OPS5MH-XX-C	MS-VPS6M2U-DV
MS-OPS6M2-DV	UMS-VPS6M2-DV
MS-OPS6M2U-DV	
UMS-OPS6M2-DV	

Features

- Passive infrared sensors with exclusive Lutron XCT Technology for fine motion detection
- 180° sensor field-of-view
- Up to 30 ft x 30 ft (9 m x 9 m) [900 ft^2 (81 m^2)] major motion coverage and 20 ft x 20 ft (6 m x 6 m) [400 ft^2 (36 m^2)] minor motion coverage
- Occupancy version can be set to Auto-ON / Auto-OFF or Manual-ON / Auto-OFF
- Vacancy version available to meet CA Title 24 requirements
- Adjustable timeout (1, 5, 15, or 30 minutes) and high/low sensitivity adjustment
- Load types: incandescent, halogen, ELV, MLV, CFL, LED, magnetic fluorescent, electronic fluorescent, and fan.

Note: "XX" in model number represents color/finish code.

Models available

MS-OPS2-XX[1]
MS-OPS2H-XX-C[2]
MS-OPS5M-XX[3]
MS-OPS5MH-XX-C[2]
MS-OPS6M2-DV-XX
MS-OPS6M2U-DV-XX
UMS-OPS6M2-DV-XX
MS-VPS2-XX[1]
MS-VPS5M-XX[3]
MS-VPS6M2-DV-XX
MS-VPS6M2U-DV-XX
UMS-VPS6M2-DV-XX

1 For clamshell packaging, add an "H" after the "2". Available in AL, IV, LA, and WH.
2 Clamshell packaged product for Canada. Available in AL, IV, LA, and WH.
3 For clamshell packaging, add an "H" after the "M". Available in AL, IV, LA, and WH.

Job Name:	Model Numbers:
Job Number:	

Specifications

Regulatory Approvals

- UL® Listed to U.S. and Canadian safety requirements.
- NOM Certification (MS- models only).

Power

- 120 V ~ 50 / 60 Hz*
- 120 – 277 V ~ 50 / 60 Hz*

Key Design Features

- All lighting loads
- Crush/tamper resistant lens
- Smart ambient light detection
- Adaptive switching algorithm for extended relay life
- XCT Technology for fine motion detection
- Lutron patented Softswitch

Environment

- Ambient operating temperature: 32 °F to 104 °F (0 °C to 40 °C), 0% – 90% humidity, non-condensing. Indoor use only.

Warranty

- 5-Year Limited Warranty. For additional Warranty information, please visit www.lutron.com/TechnicalDocumentLibrary/Sensor_Warranty.pdf

Additional Information

- When using MS-OPS2, MS-OPS5M, MS-OPS6M2-DV, MS-VPS2, MS-VPS5M, or MS-VPS6M2-DV on GFI-controlled circuits, please see Lutron P/N 048440 on www.lutron.com
- For Maestro Occupancy sensing dimmer models, please see Lutron P/N 369270 on www.lutron.com
- For use with MA-AS, MSC-AS, MA-AS-277, or MSC-AS-277 to control the load from more than two locations, please see Lutron P/N 048435 on www.lutron.com
- For more information, please see www.lutron.com/occvacsensors
- Lutron Customer Assistance: 1.844.LUTRON1

Advanced Features

Switching

- Standard zero cross—maximizes relay life by switching at the point of minimum energy on the AC power curve
- Adaptive zero cross—maximizes relay life by switching at the point of minimum energy on the AC power curve. Actively adapts to variations in relay timing
- Lutron Patented Softswitch circuit—eliminates arcing at mechanical contacts when loads are switched. Extends relay life to an average of 1,000,000 cycles (on/off) for resistive, capacitive, or inductive sources

XCT Technology

Advanced sensing technology for fine motion detection ensures that the lights stay on while the room is occupied, and that the sensor does not turn on falsely when there is no occupancy in the room. For more information, see www.lutron.com/TechnicalDocumentLibrary/white%20paper%20XCT%204-23-09%20B.pdf

* Maximum current ratings for individual models are provided in the Selection Matrix on page 4.

Custom Settings

Ambient Light Detection

Lights turn on only if natural light in room is low.

- Smart—Ambient light threshold adjusts precisely to the user's preference.

Instructions: If switch turns on when there is enough natural light, or if switch does not turn on when there is not enough natural light, press the large button within 5 seconds of entering the room. Over time, this interaction will "teach" the switch your preferred setting.

- Presets—high, medium, low, and disabled.

Sensor Operation

- Occupancy/Vacancy: Auto-ON / Auto-OFF or Manual-ON / Auto-OFF
- Vacancy only: Manual-ON / Auto-OFF only

Timeout Options

(See **Additional Features** on page 5 for default settings)

- 1 Minute
- 5 Minutes
- 15 Minutes
- 30 Minutes

Sensitivity Options

- High sensitivity (default)
- Low sensitivity

Auto-ON Options

(MS-OPS and UMS-OPS only)

- Occupancy (default): Auto-ON / Auto-OFF
- Vacancy*: Manual-ON / Auto-OFF
- Low Light: Lights turn on only if needed (if ambient light is below threshold)

* There is a 15-second grace period that begins when the lights are automatically turned off, during which the lights will automatically turn back on in response to motion. This grace period is provided as a safety and convenience feature in the event that the lights turn off while the room is still occupied, so that the user does not need to manually turn the lights back on. After 15 seconds, the grace period expires and the lights must be manually turned on.

Manual Off-While-Occupied Options

(MS-OPS and UMS-OPS only—see **Additional Features** on page 5 for default setting)

- Enabled
  - When the occupancy sensor switch is manually turned off, the occupancy sensor switch will not turn the lights back on automatically while the room is occupied.
  - Once the room is vacated, the Auto-ON feature returns to normal operation after the timeout period has expired.
  - This may be the preference in conference rooms or classrooms while viewing presentations. This feature requires motion to keep the lights off.
- Disabled
  - When the occupancy sensor switch is manually turned off, the Auto-ON feature will return to normal operation after 25 seconds.
  - This may be the preference if the user always wants the lights to turn on upon entering and the lights to turn off when the room is vacant.

Selection Matrix

Model Number[1]	Vacancy only[2] (Title 24 compliant)	Single-pole only	Works with standard mechanical 3-way switch[3]	Works with companion switch[3, 4]	All lighting loads (120 V~ only)	All lighting loads (120–277 V~ only)	Fan (120 V~)	Light + Fan (120 V~)	Neutral wire optional*	Minimum load required	Relevant wiring diagram
		Single-pole / 3-way capability			Max current rating				Off-state power		
MS-OPS2-XX		✓			2 A				✓		1
MS-OPS2H-XX-C		✓			2 A				✓		1
MS-OPS5M-XX			✓	✓	5 A		3 A	3 A	✓		2, 3, 5
MS-OPS5MH-XX-C			✓	✓	5 A		3 A	3 A	✓		2, 3, 5
MS-OPS6M2-DV-XX			✓	✓		6 A	3 A	3 A	✓		2–6
MS-OPS6M2U-DV-XX			✓	✓		6 A	3 A	3 A	✓		7–11
UMS-OPS6M2-DV-XX[5]			✓	✓		6 A	3 A	3 A	✓		2–6
MS-VPS2-XX	✓	✓			2 A				✓		1
MS-VPS5M-XX	✓		✓	✓	5 A		3 A	3 A	✓		2, 3, 5
MS-VPS6M2-DV-XX	✓		✓	✓		6 A	3 A	3 A	✓		2–6
MS-VPS6M2U-DV-XX	✓		✓	✓		6 A	3 A	3 A	✓		7–11
UMS-VPS6M2-DV-XX[5]	✓		✓	✓		6 A	3 A	3 A	✓		2–6

1 XX in model number represents color/finish code.

2 Occupancy sensors can be configured as Auto-ON / Auto-OFF or Manual-ON / Auto-OFF.
Vacancy sensors are configured as Manual-ON / Auto-OFF only.

3 Standard mechanical 3-way switch cannot be combined with companion switch.

4 Companion switch MA-AS, MSC-AS, MA-AS-277, or MSC-AS-277 is required for multi-location installations (more than two locations controlling the same lighting circuit). Up to nine companion switches may be connected.

5 BAA-compliant models.

* Note: Neutral is optional only for retrofit or replacement applications when ground connection is available. Connect green-sleeve wire to ground when a neutral connection is not available. When a neutral connection is available, remove the green sleeve and connect the white wire to neutral. Please note that a ground or neutral wire is required for product to function. If neither wire is present, consult a licensed electrician.

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Additional Features

Model Number[1]	Crush/tamper-resistant lens	Ambient light detection	Switching	XCT technology	Manual off-while-occupied default setting	Default timeout (minutes)
MS-OPS2-XX	✓	Smart	Adaptive	✓	Disabled	5
MS-OPS2H-XX-C	✓	Smart	Adaptive	✓	Disabled	5
MS-OPS5M-XX	✓	Smart	Adaptive	✓	Disabled	5
MS-OPS5MH-XX-C	✓	Smart	Adaptive	✓	Disabled	5
MS-OPS6M2-DV-XX	✓	Smart	Adaptive	✓	Enabled	15
MS-OPS6M2U-DV-XX	✓	Smart	Adaptive	✓	Enabled	15
UMS-OPS6M2-DV-XX		Presets	Adaptive	✓	Enabled	5
MS-VPS2-XX	✓	Smart	Adaptive	✓		5
MS-VPS5M-XX	✓	Smart	Adaptive	✓		5
MS-VPS6M2-DV-XX	✓	Smart	Adaptive	✓		15
MS-VPS6M2U-DV-XX	✓	Smart	Adaptive	✓		15
UMS-VPS6M2-DV-XX		Presets	Adaptive	✓		5

[1] XX in model number represents color/finish code.

Placement and Operation

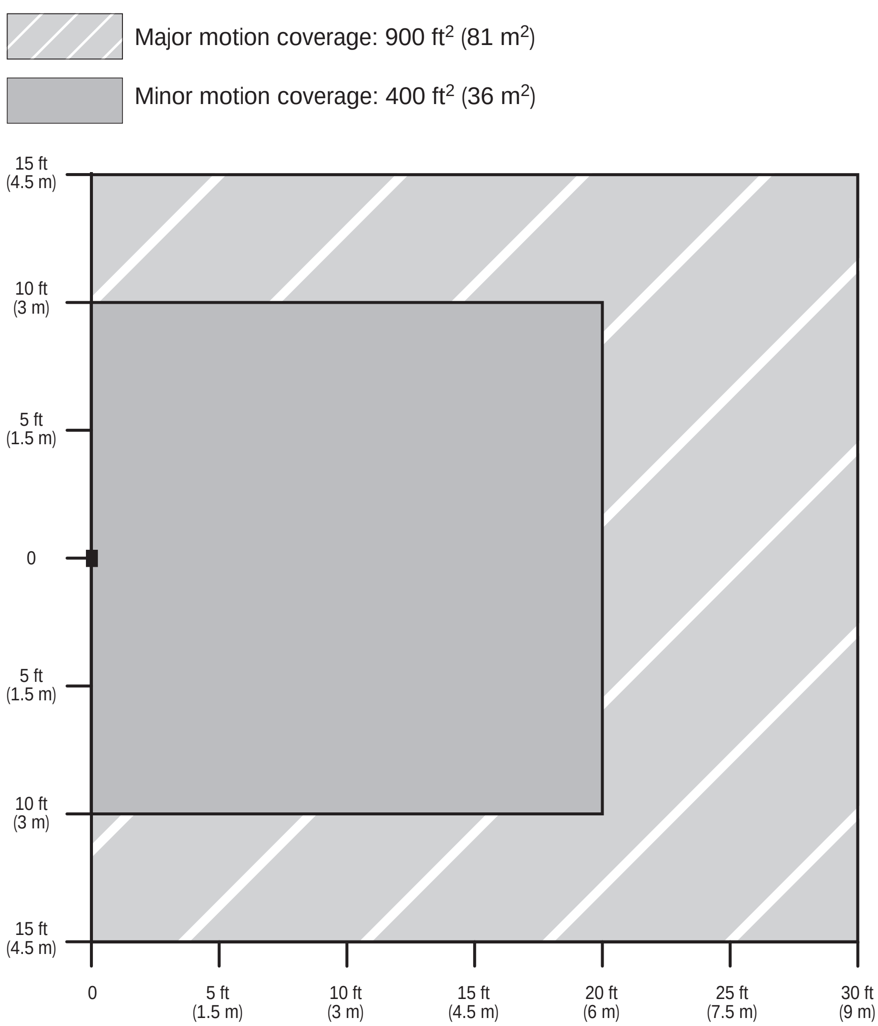
- The ability of the occupancy sensor switch to detect motion requires line-of-sight of room occupants. The occupancy sensor switch must have an unobstructed view of the room.
- Hot objects and moving air currents can affect the performance of the occupancy sensor switch.
- The performance of the occupancy sensor switch depends on a temperature differential between the ambient room temperature and that of room occupants. Warmer rooms may reduce the ability of the occupancy sensor switch to detect occupants.

Definitions

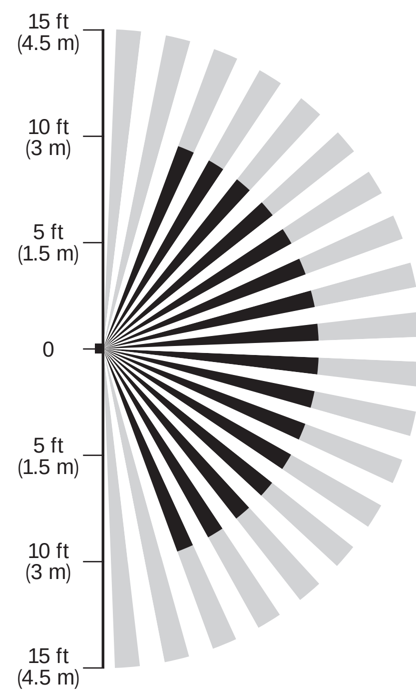
Major motion: movement of a person entering or passing through an area.

Minor motion: movement of a person occupying an area and engaging in small activities (e.g., reaching for a telephone, turning the pages of a book, opening a file folder, picking up a coffee cup).

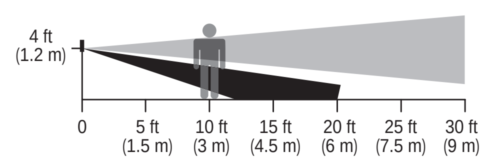
NEMA WD7 Coverage



Horizontal Beam Diagram



Vertical Beam Diagram

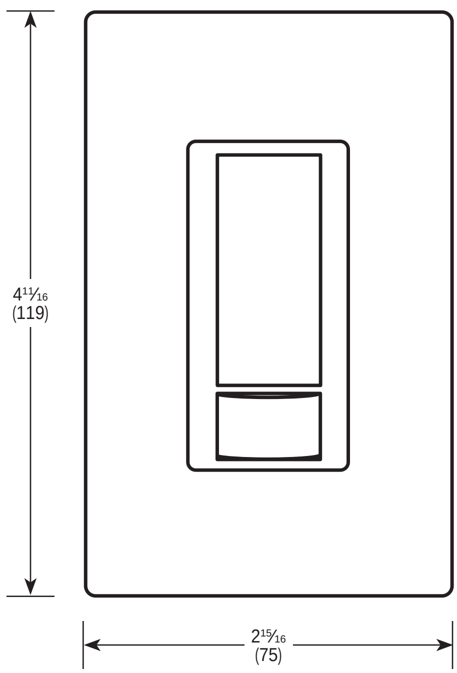


Job Name:	Model Numbers:
Job Number:	

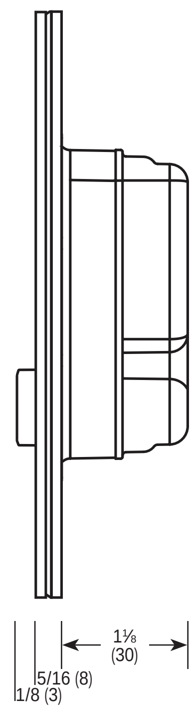
Dimensions

Measurements shown as: in (mm).

Front View



Side View

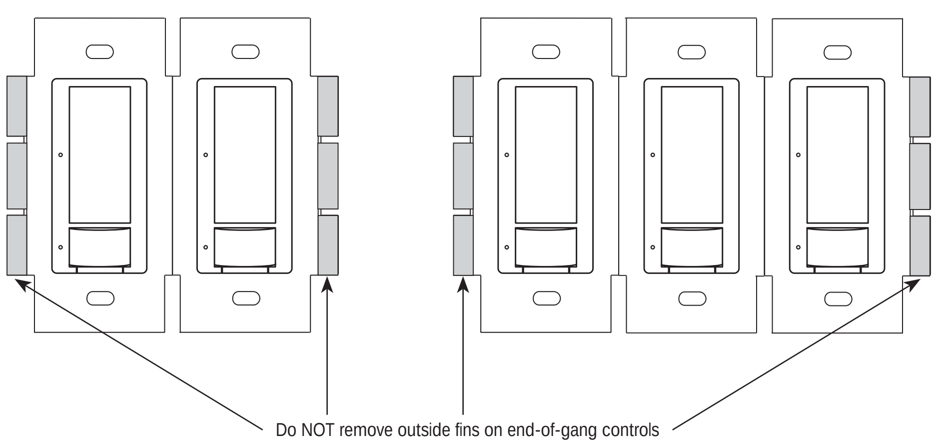


Ganging

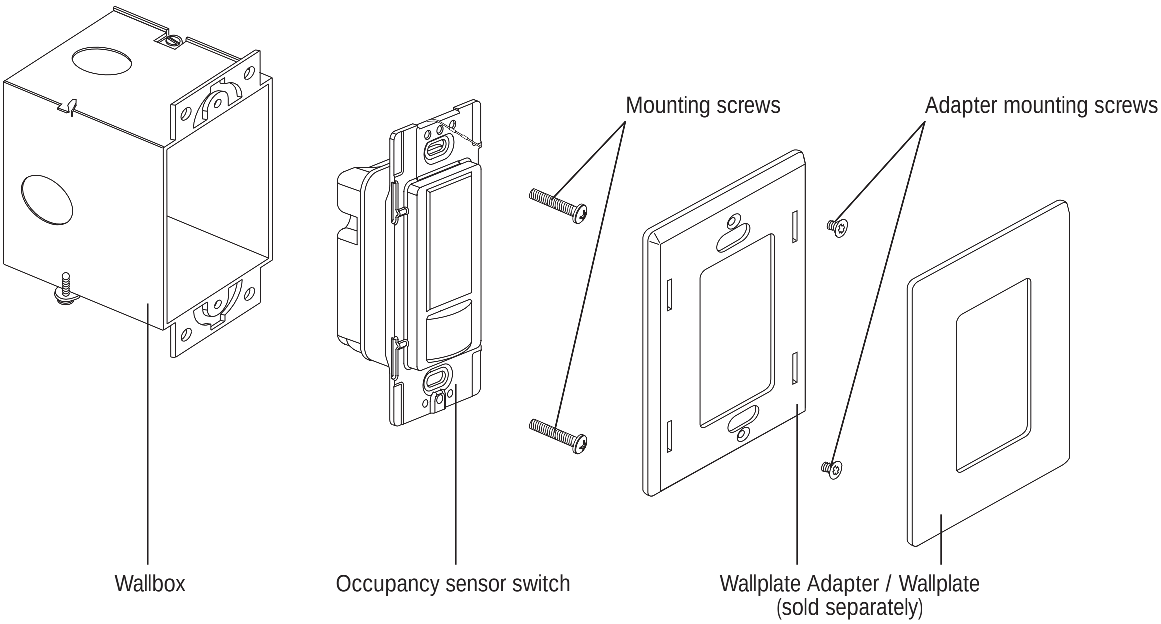
When ganging with other controls in the same wallbox, remove inside fins (UMS-OPS6M-DV and UMS-VPS6M-DV only).

Each control has inside fins removed

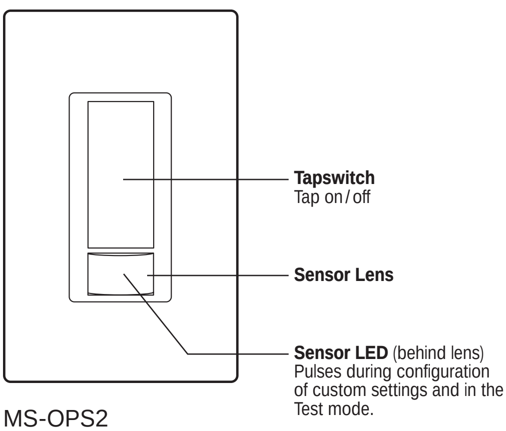
Middle of Gang control has all fins removed



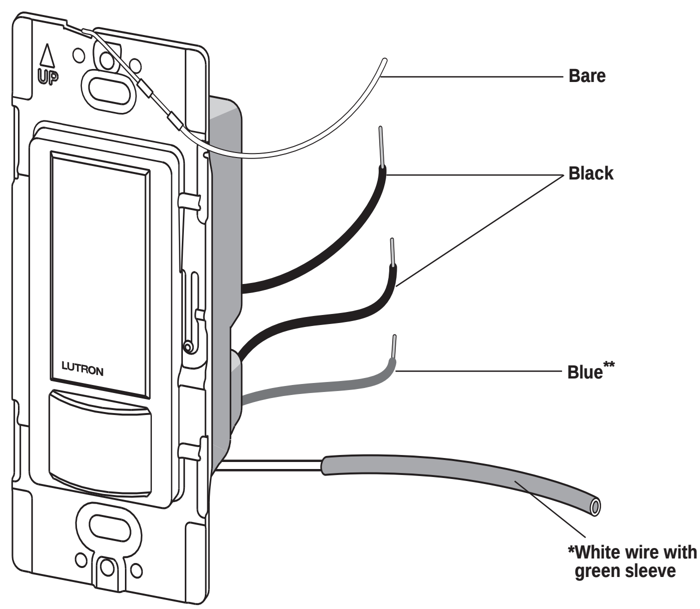
Mounting



Operation



MS-OPS2
MS-OPS5M
MS-OPS6M2-DV
MS-OPS6M2U-DV
UMS-OPS6M2-DV
MS-VPS2
MS-VPS5M
MS-VPS6M2-DV
MS-VPS6M2U-DV
UMS-VPS6M2-DV



***Note:** For MS-OPS6M2U-DV-XX and MS-VPS6M2U-DV-XX wire will be green wire covered by white sleeve.

* ***Note:** Blue wire not on models: MS-OPS2, MS- VPS2.

Job Name:	Model Numbers:	
Job Number:		

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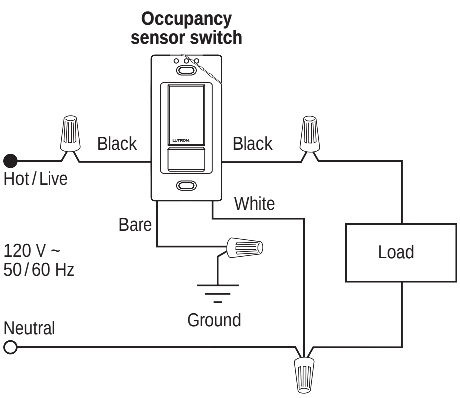
Wiring Diagrams

Wiring Diagram 1- with Neutral

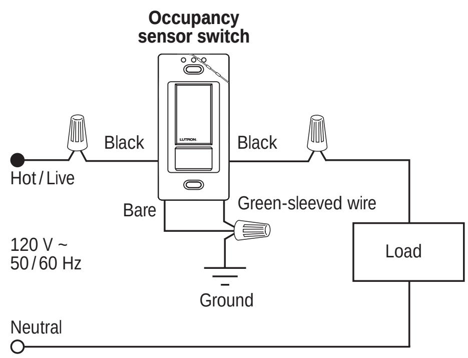
Single Location Installation (120 V ~)
-OPS2 and -VPS2



Note: When a neutral connection is available, remove the green sleeve and connect the white wire to neutral.

Wiring Diagram 1- without Neutral

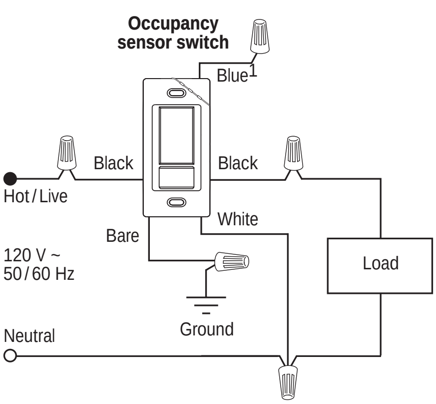
Single Location Installation (120 V ~)
-OPS2 and -VPS2



Note: Connect green-sleeved wire to ground only in retrofit and replacement applications.

Wiring Diagram 2 - with Neutral

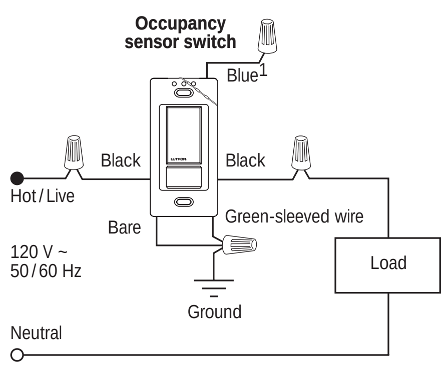
Single Location Installation (120 V ~)[1]
-OPS5M, -OPS6M2-DV, -VPS5M, -VPS6M2-DV



Note: When a neutral connection is available, remove the green sleeve and connect the white wire to neutral.

Wiring Diagram 2 - without Neutral

Single Location Installation (120 V ~)[1]
-OPS5M, -OPS6M2-DV, -VPS5M, -VPS6M2-DV



Note: Connect green-sleeved wire to ground only in retrofit and replacement applications.

1 When using controls in single location installations, tighten the blue terminal or cap blue wire. Do not connect the blue terminal / wire to any other wire or to ground.

2 Only one occupancy sensor switch can be used per multi-location circuit.

3 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).

Continued on next page...

Job Name:	Model Numbers:
Job Number:	

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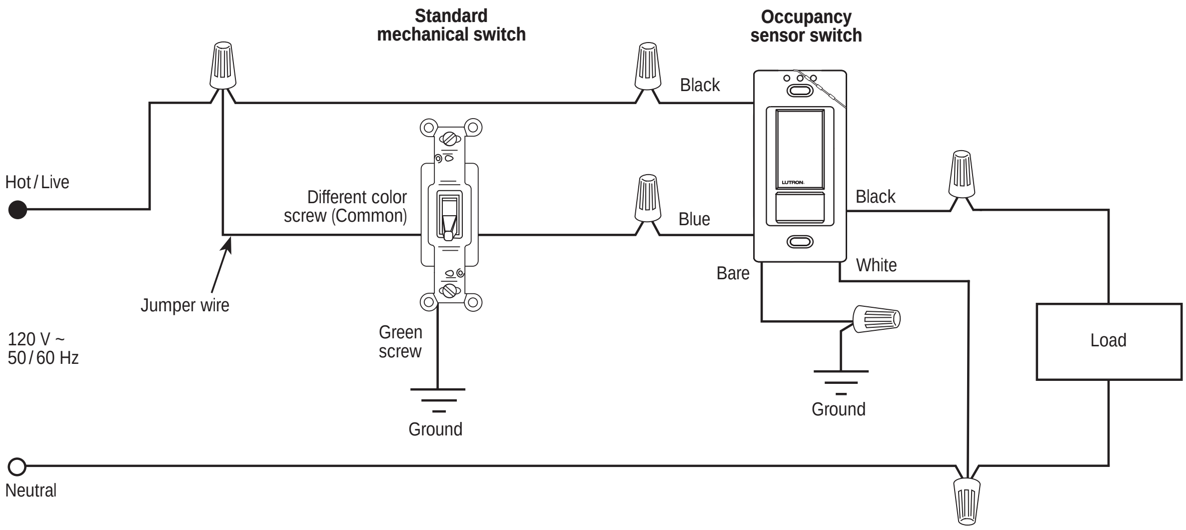
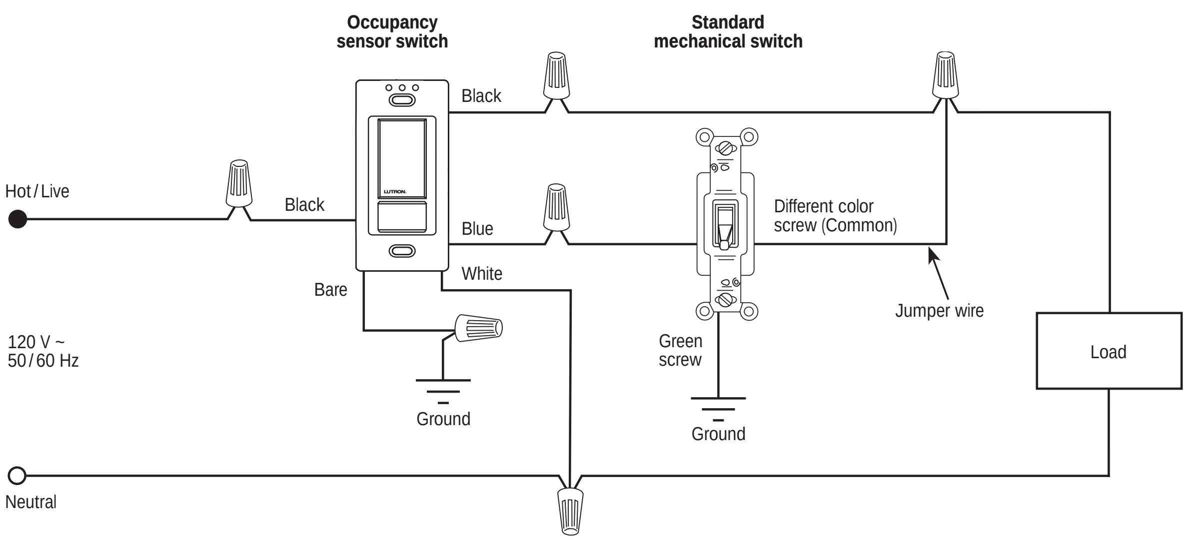
Wiring Diagrams *(continued)*

Wiring Diagram 3 - with Neutral

3-way Installation with Standard Mechanical Switch (120 V ~)[2, 3]
-OPS5M, -OPS6M2-DV, -VPS5M, -VPS6M2-DV



OR



Note: When a neutral connection is available, remove the green sleeve and connect the white wire to neutral.

1 When using controls in single location installations, tighten the blue terminal or cap blue wire. Do not connect the blue terminal/wire to any other wire or to ground.

2 Only one occupancy sensor switch can be used per multi-location circuit.

3 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).

Continued on next page...

Job Name:

Job Number:

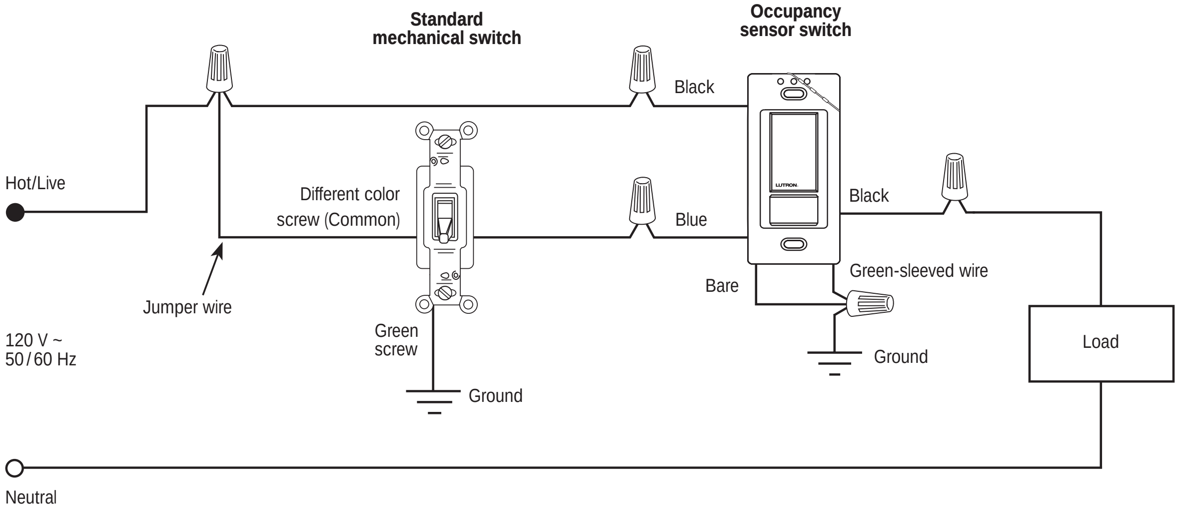
Model Numbers:

Wiring Diagrams *(continued)*

Wiring Diagram 3 - without Neutral

3-way Installation with Standard Mechanical Switch (120 V ~)[2, 3]

-OPS5M, -OPS6M2-DV, -VPS5M, -VPS6M2-DV



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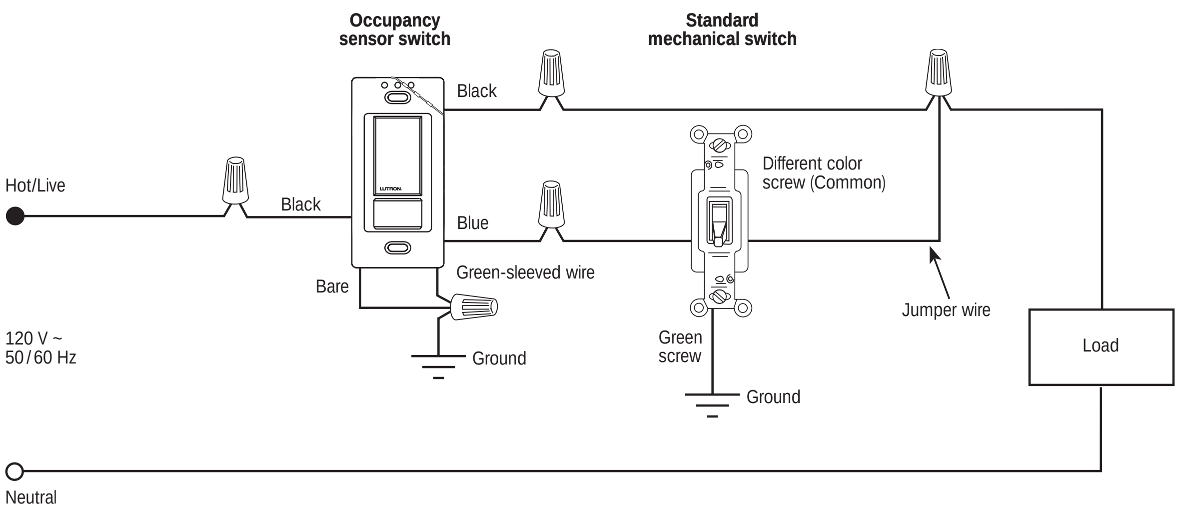


Note: Connect green-sleeved wire to ground only in retrofit and replacement applications.

1 When using controls in single location installations, tighten the blue terminal or cap blue wire. Do not connect the blue terminal / wire to any other wire or to ground.

2 Only one occupancy sensor switch can be used per multi-location circuit.

3 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).

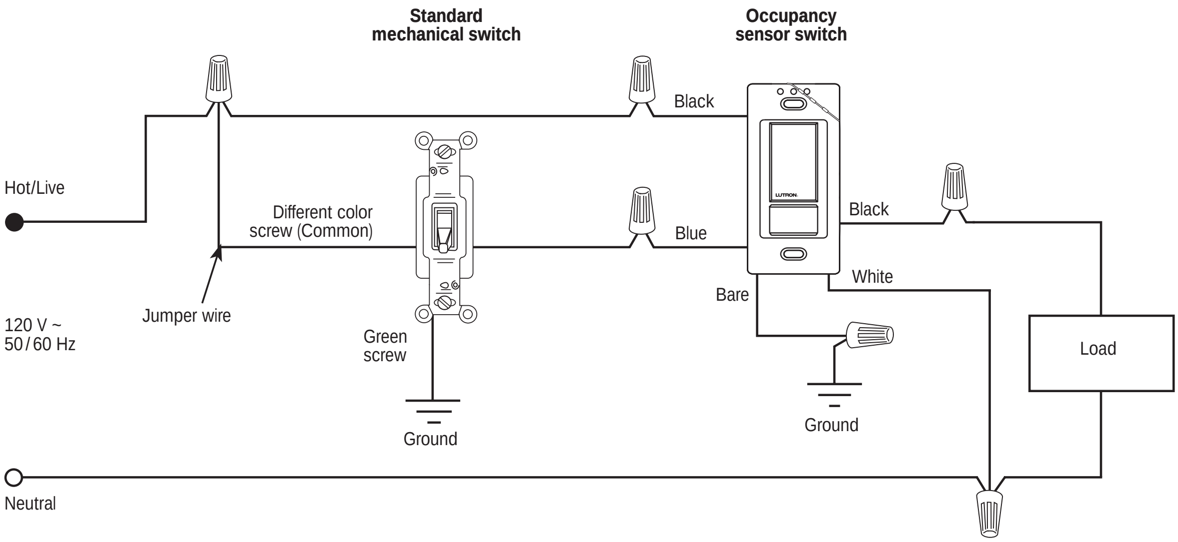
Continued on next page...

Job Name:	Model Numbers:
Job Number:	

Wiring Diagrams *(continued)*

Wiring Diagram 4 - with Neutral

3-way Installation with Standard Mechanical Switch (277 V ~)[1, 2, 3] -OPS6M2-DV, -VPS6M2-DV



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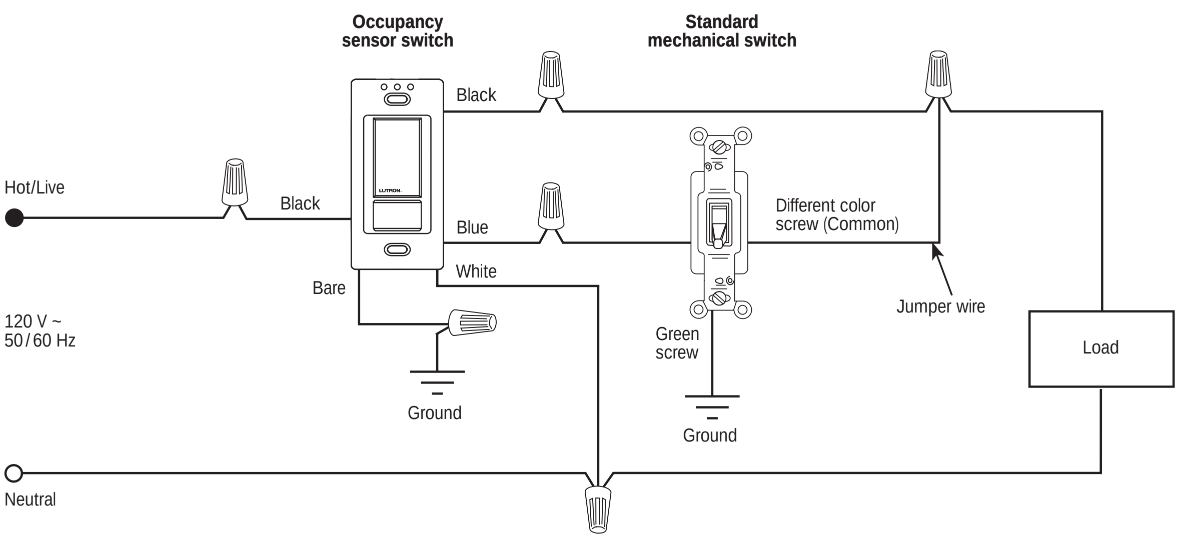


Note: When a neutral connection is available, remove the green sleeve and connect the white wire to neutral.

1 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).

2 Only one occupancy sensor switch can be used per multi-location circuit.

3 Fan load applies to 120 V ~ only (not for 277 V ~).

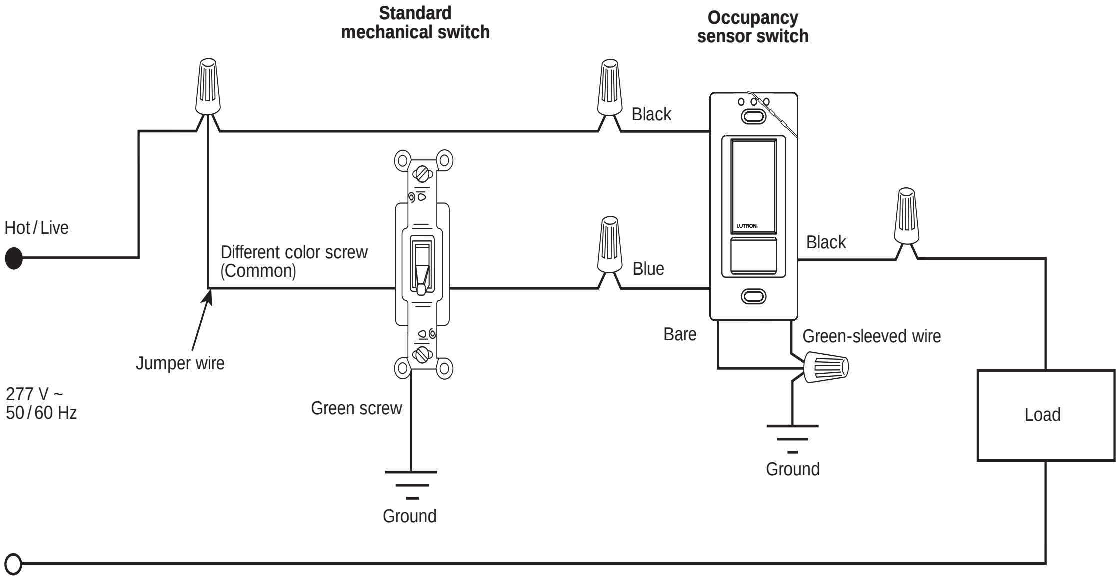
4 Occupancy sensor switch can be installed in any location.

Continued on next page...

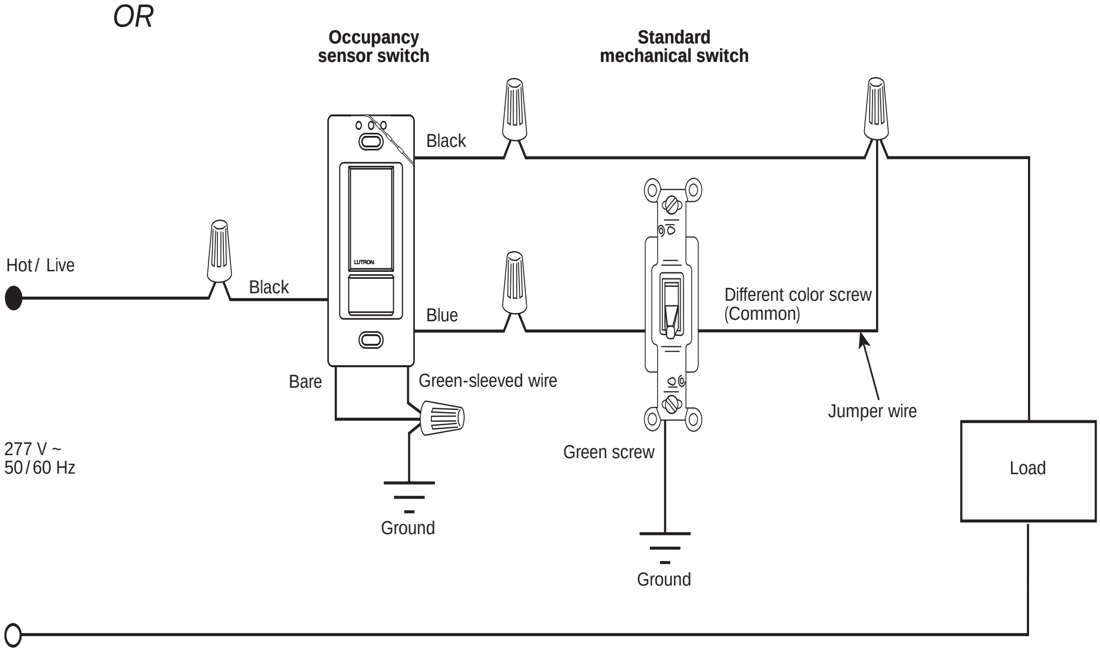
Wiring Diagrams *(continued)*

Wiring Diagram 4 - without Neutral

3-way Installation with Standard Mechanical Switch (277 V ~)[1, 2, 3]
-OPS6M2-DV, -VPS6M2-DV



OR



Note: Connect green-sleeved wire to ground only in retrofit and replacement applications.

1 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).

2 Only one occupancy sensor switch can be used per multi-location circuit.

3 Fan load applies to 120 V ~ only (not for 277 V ~).

4 Occupancy sensor switch can be installed in any location.

Continued on next page...

Job Name:	Model Numbers:
Job Number:	

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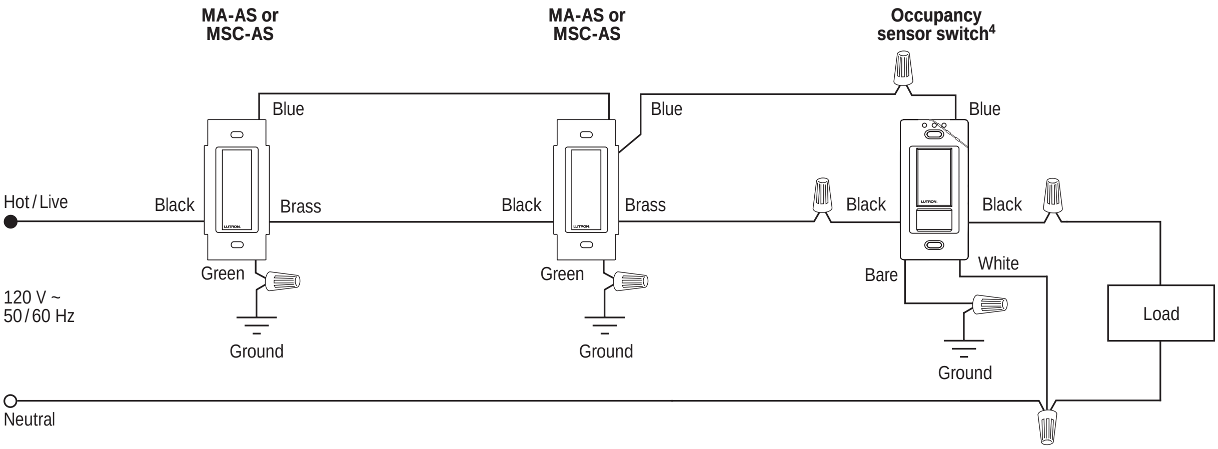
Wiring Diagrams *(continued)*

Wiring Diagram 5 - with Neutral

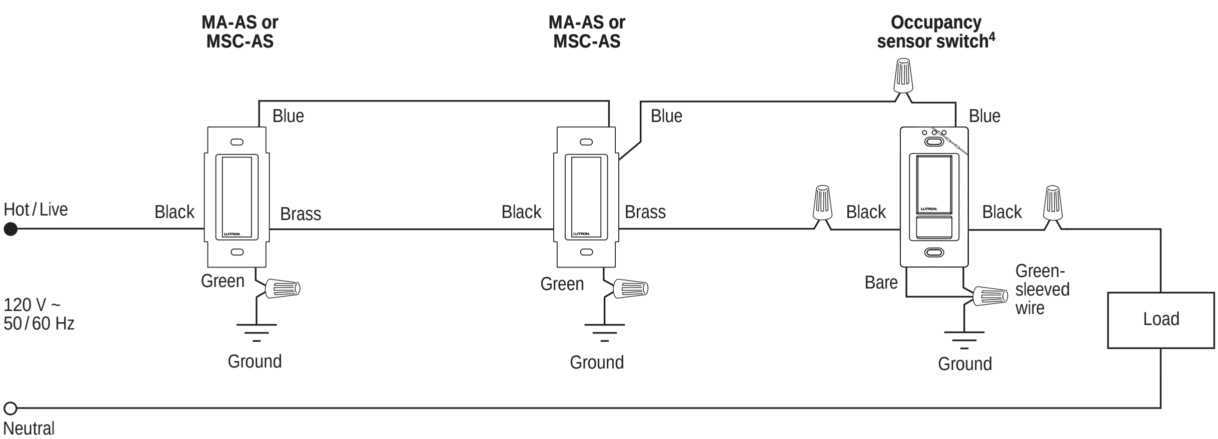
Multi-Location Installation (120 V ~)[1, 2, 4]
-OPS5M, -OPS6M2-DV, -VPS5M, -VPS6M2-DV with MA-AS or MSC-AS



Note: When a neutral connection is available, remove the green sleeve and connect the white wire to neutral.

Wiring Diagram 5 - without Neutral

Multi-Location Installation (120 V ~)[1, 2, 4]
-OPS5M, -OPS6M2-DV, -VPS5M, -VPS6M2-DV with MA-AS or MSC-AS



Note: Connect green-sleeved wire to ground only in retrofit and replacement applications.

1 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).
2 Only one occupancy sensor switch can be used per multi-location circuit.
3 Fan load applies to 120 V ~ only (not for 277 V ~).
4 Occupancy sensor switch can be installed in any location.

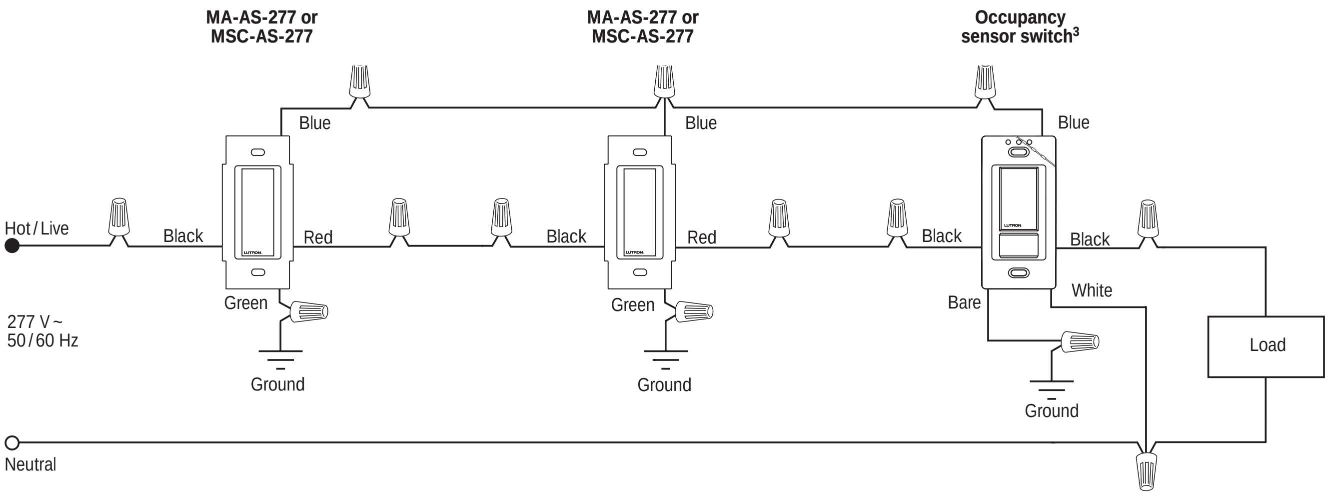
Continued on next page...

Job Name:	Model Numbers:
Job Number:	

Wiring Diagrams *(continued)*

Wiring Diagram 6 - with Neutral

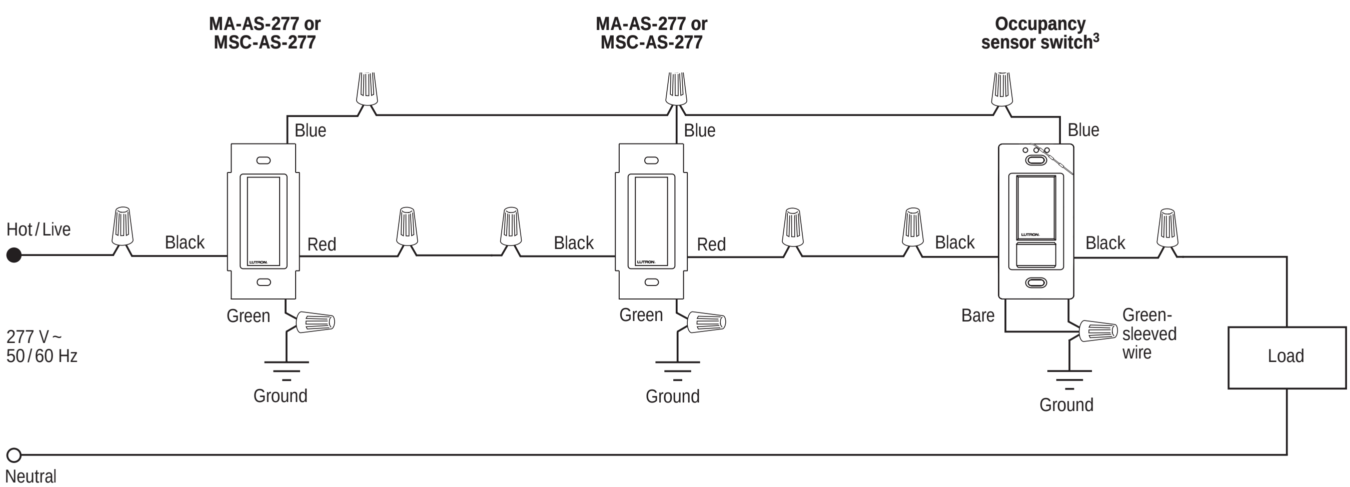
Multi-Location Installation (277 V ~)[1, 2, 3, 4]
-OPS6M2-DV, -VPS6M2-DV with MA-AS-277 or MSC-AS-277



Note: When a neutral connection is available, remove the green sleeve and connect the white wire to neutral.

Wiring Diagram 6 - without Neutral

Multi-Location Installation (277 V ~)[1, 2, 3, 4]
-OPS6M2-DV, -VPS6M2-DV with MA-AS-277 or MSC-AS-277



Note: Connect green-sleeved wire to ground only in retrofit and replacement applications.

1 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).
2 Only one occupancy sensor switch can be used per multi-location circuit.
3 Fan load applies to 120 V ~ only (not for 277 V ~).
4 Occupancy sensor switch can be installed in any location.

Continued on next page...

Job Name:	Model Numbers:	
Job Number:		

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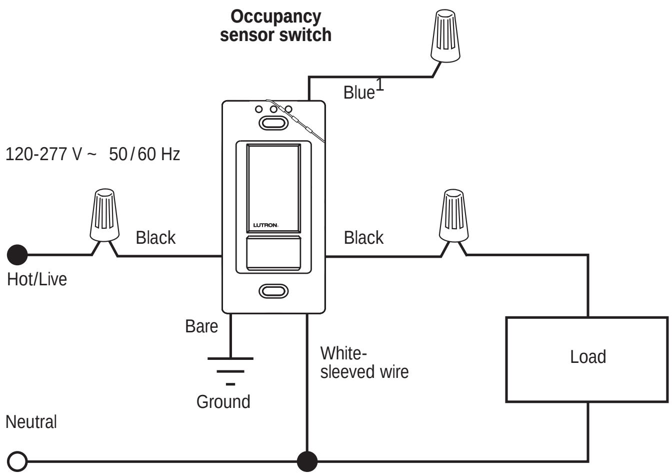
Wiring Diagrams *(continued)*

Wiring Diagram 7 - with Neutral

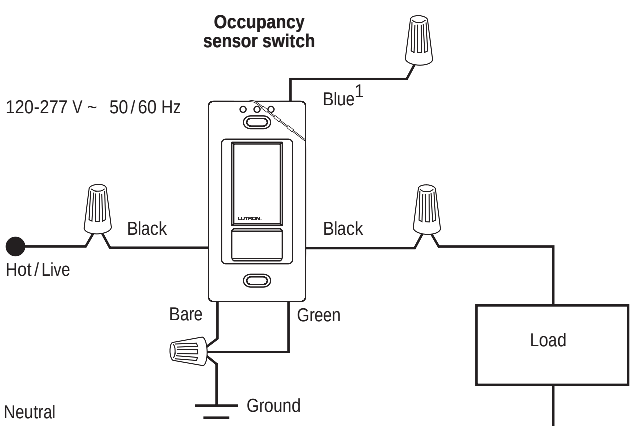
Single Location Installation (120-277 V ~)[1, 2]
-OPS6M2U-DV, -VPS6M2U-DV



Note: When a neutral connection is available, connect the white-sleeved wire to neutral.

Wiring Diagram 7 - without Neutral

Single Location Installation (120-277 V ~)[1, 2]
-OPS6M2U-DV, -VPS6M2U-DV



Note: Remove white sleeve and connect green wire to ground only in retrofit and replacement applications.

1 When using controls in single location installations, tighten the blue terminal or cap blue wire. Do **NOT** connect the blue terminal / wire to any other wire or to ground.
2 Fan load applies to 120 V ~ only (not for 277 V ~).
3 Only one occupancy sensor switch can be used per multi-location circuit.
4 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).

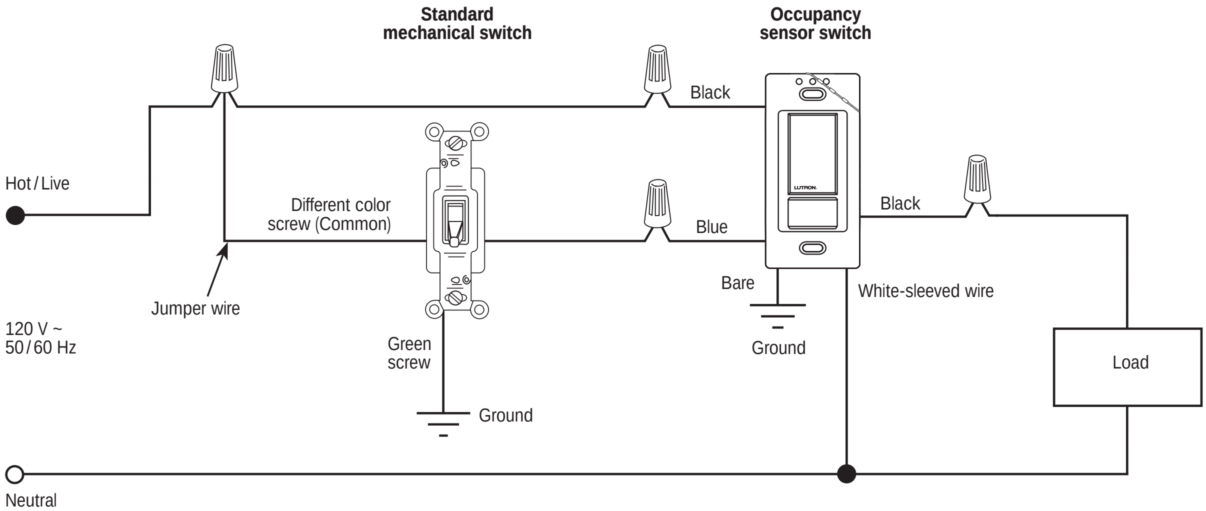
Continued on next page...

Job Name:	Model Numbers:
Job Number:	

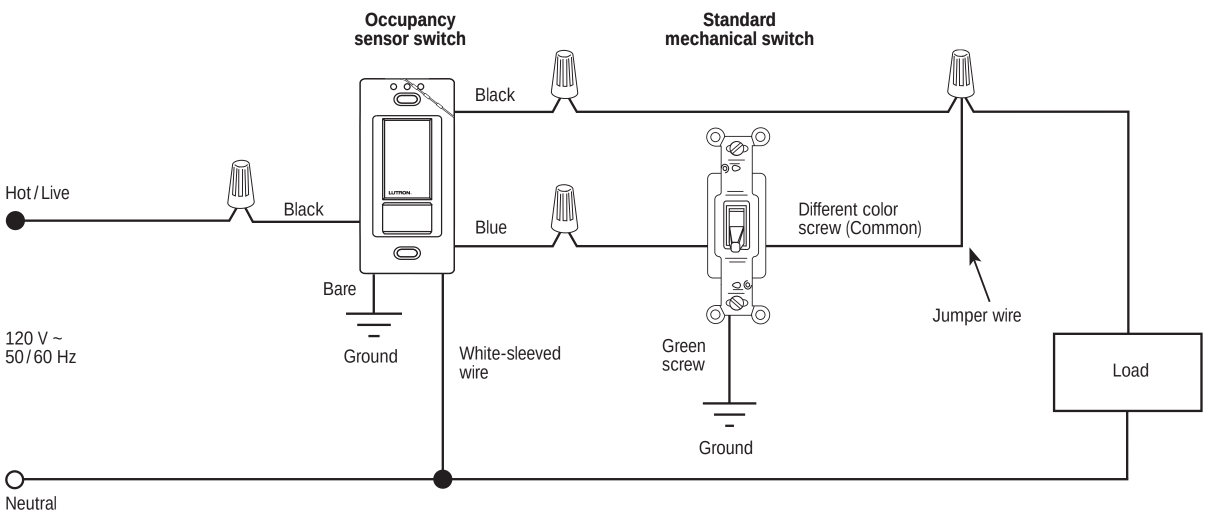
Wiring Diagrams *(continued)*

Wiring Diagram 8 - with Neutral

3-way Installation with Standard Mechanical Switch (120 V ~)[3, 4] -OPS6M2U-DV, -VPS6M2U-DV



OR



Note: When a neutral connection is available, connect the white-sleeved wire to neutral.

1 When using controls in single location installations, tighten the blue terminal or cap blue wire. Do **NOT** connect the blue terminal/wire to any other wire or to ground.

2 Fan load applies to 120 V ~ only (not for 277 V ~).

3 Only one occupancy sensor switch can be used per multi-location circuit.

4 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).

Continued on next page...

Job Name:	Model Numbers:	
Job Number:		

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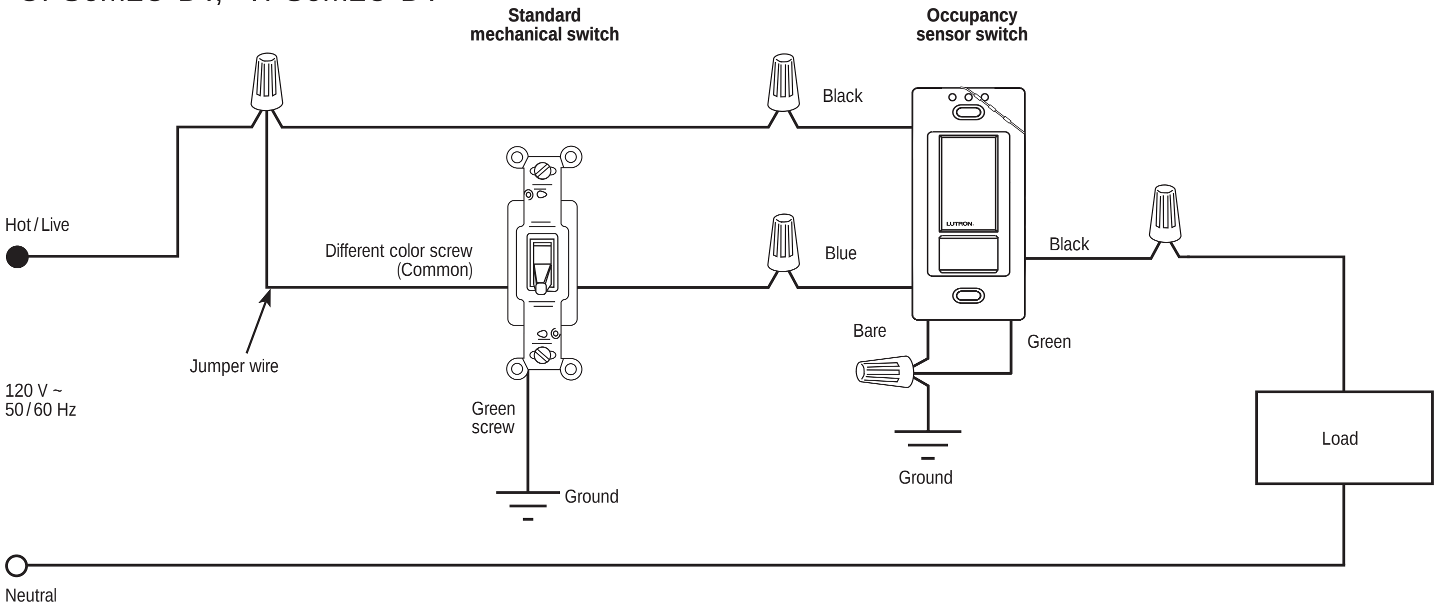
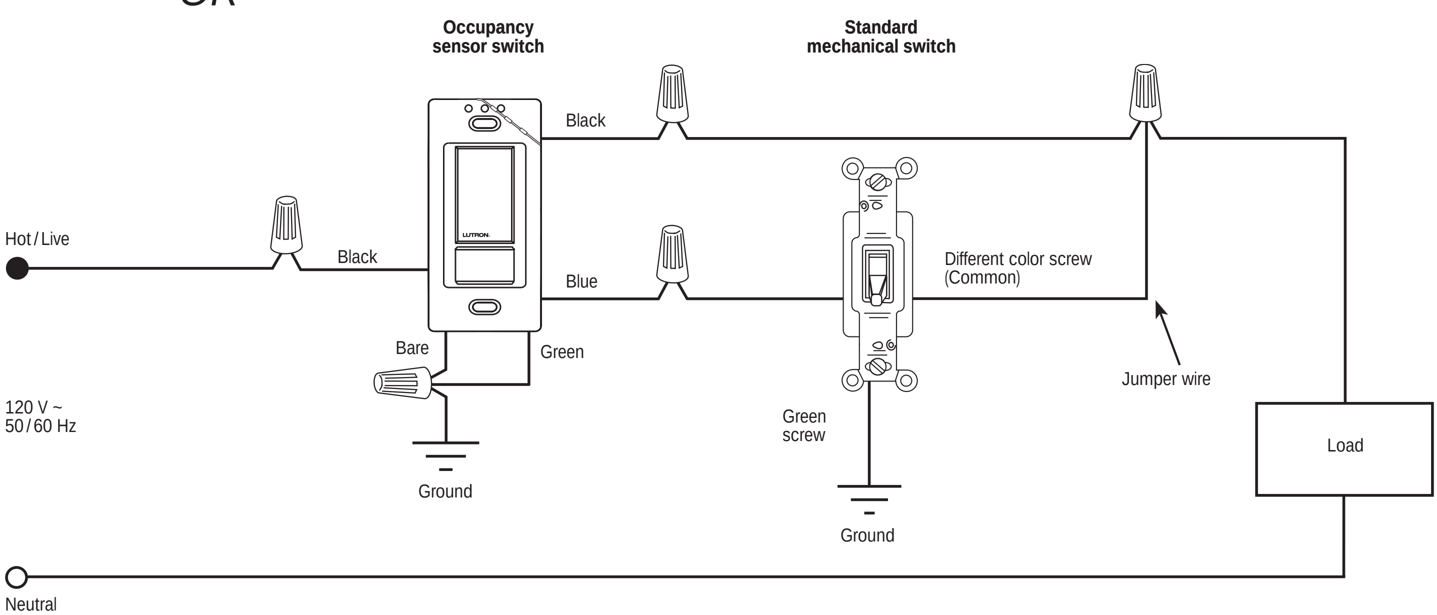
Wiring Diagrams *(continued)*

Wiring Diagram 8 - without Neutral

3-way Installation with Standard Mechanical Switch (120 V ~)[3, 4]
-OPS6M2U-DV, -VPS6M2U-DV



OR



Note: Remove white sleeve and connect green wire to ground only in retrofit and replacement applications.

1 When using controls in single location installations, tighten the blue terminal or cap blue wire. Do **NOT** connect the blue terminal / wire to any other wire or to ground.

2 Fan load applies to 120 V ~ only (not for 277 V ~).

3 Only one occupancy sensor switch can be used per multi-location circuit.

4 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).

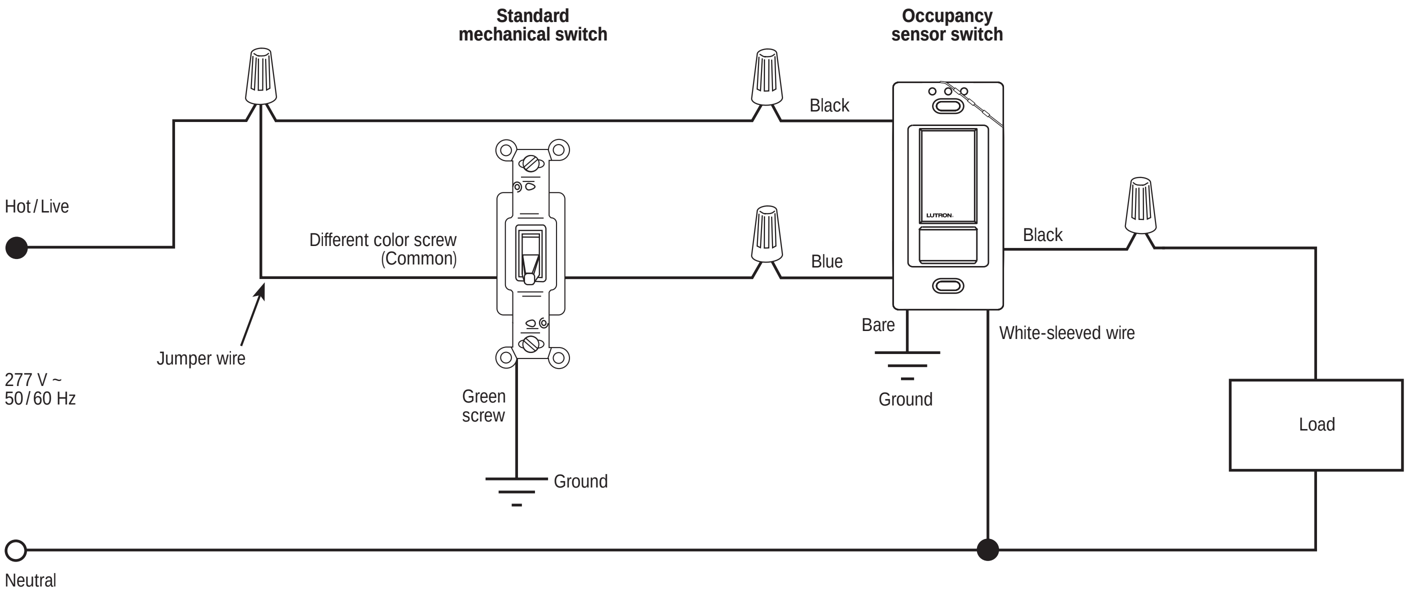
Continued on next page...

Job Name:	Model Numbers:	
Job Number:		

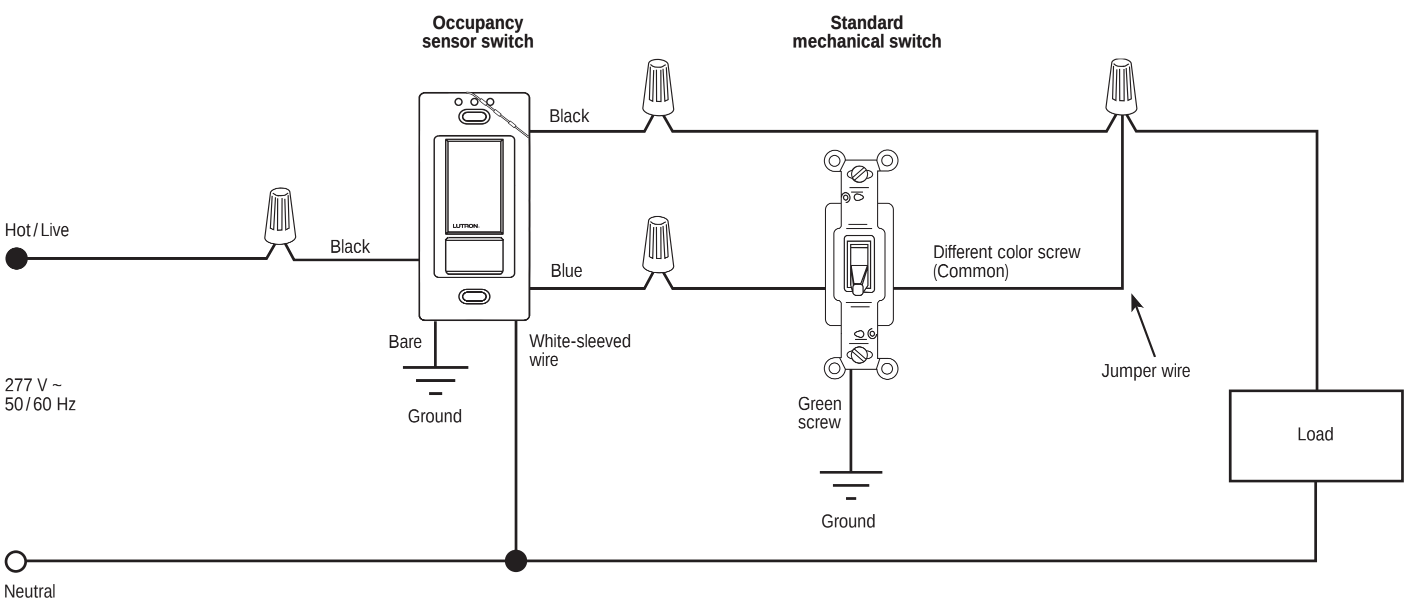
Wiring Diagrams *(continued)*

Wiring Diagram 9 - with Neutral

3-way Installation with Standard Mechanical Switch (277 V ~)[1, 2, 3]
-OPS6M2U-DV, -VPS6M2U-DV



OR



Note: When a neutral connection is available, connect the white-sleeved wire to neutral.

1 Only one occupancy sensor switch can be used per multi-location circuit.
2 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).
3 Fan load applies to 120 V ~ only (not for 277 V ~).

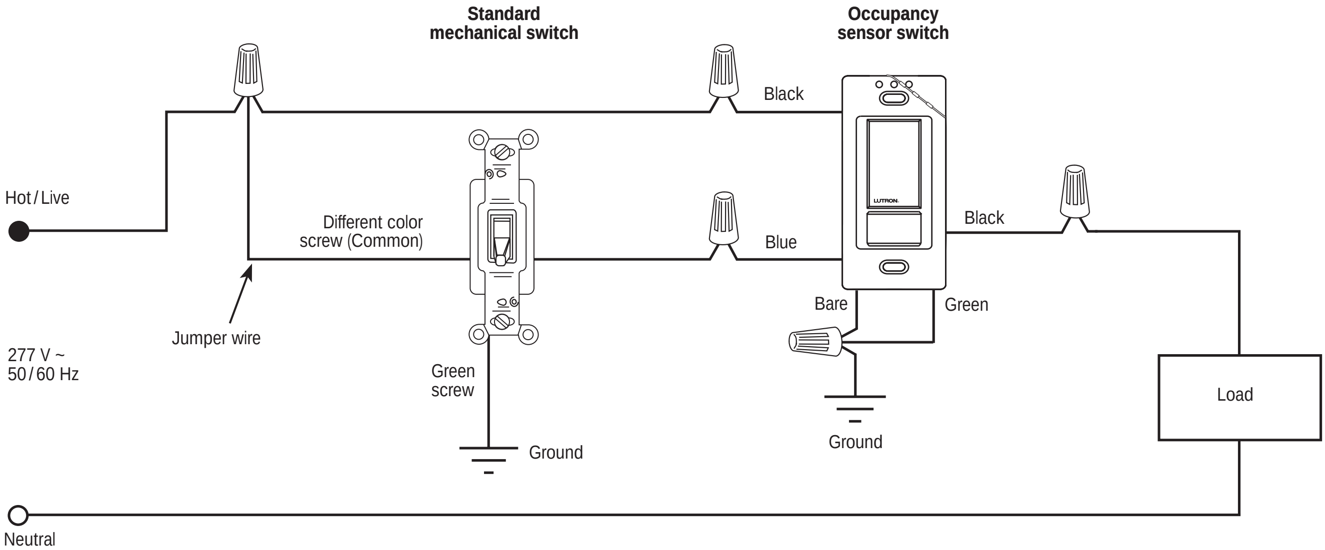
Continued on next page...

Job Name:	Model Numbers:
Job Number:	

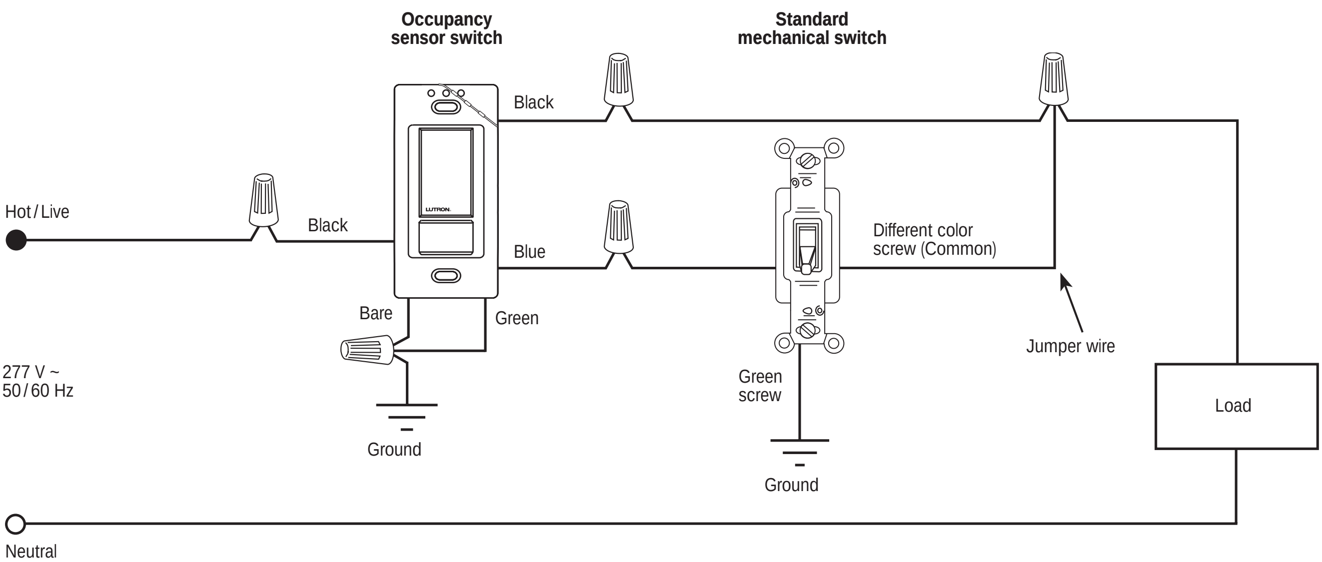
Wiring Diagrams *(continued)*

Wiring Diagram 9 - without Neutral

3-way Installation with Standard Mechanical Switch (277 V ~)[1, 2, 3]
-OPS6M2U-DV, -VPS6M2U-DV



OR



Note: Remove white sleeve and connect green wire to ground only in retrofit and replacement applications.

1 Only one occupancy sensor switch can be used per multi-location circuit.

2 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).

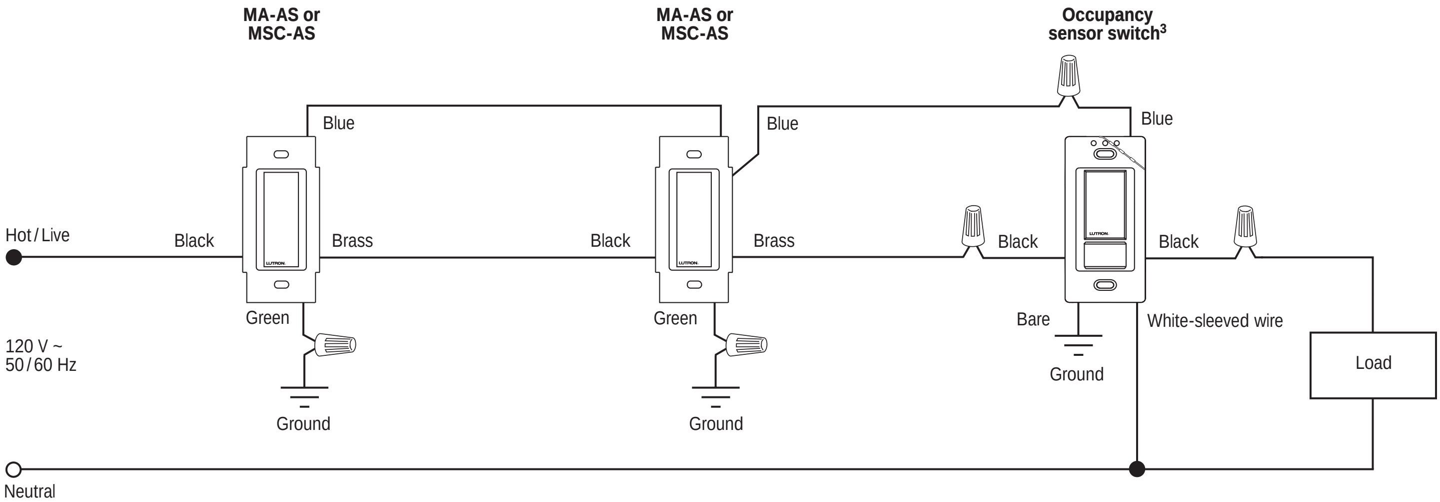
3 Fan load applies to 120 V ~ only (not for 277 V ~).

Continued on next page...

Wiring Diagrams *(continued)*

Wiring Diagram 10 - with Neutral

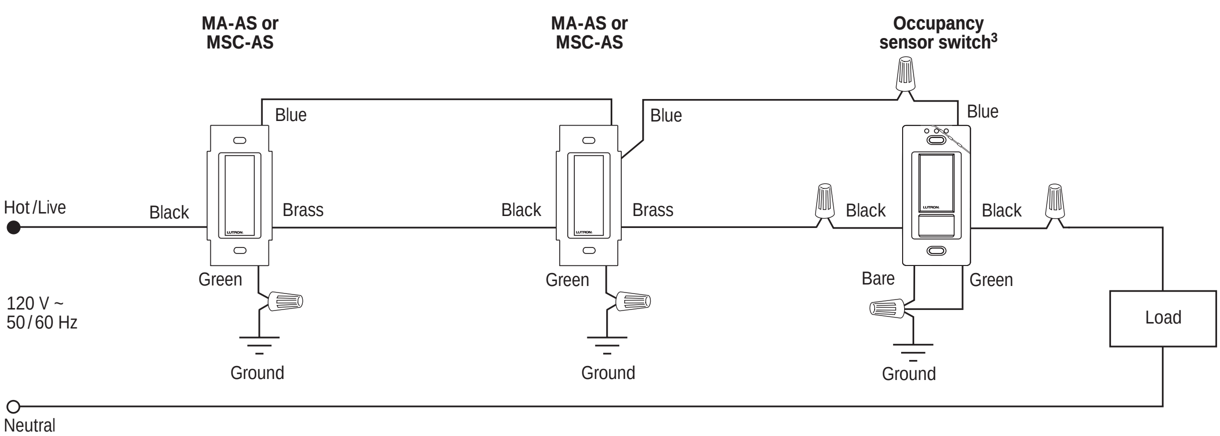
Multi-Location Installation (120 V ~)[1, 2, 3]
-OPS6M2U-DV, -VPS6M2U-DV with MA-AS or MSC-AS



Note: When a neutral connection is available, connect the white-sleeved wire to neutral.

Wiring Diagram 10 - without Neutral

Multi-Location Installation (120 V ~)[1, 2, 3]
-OPS6M2U-DV, -VPS6M2U-DV with MA-AS or MSC-AS



Note: Remove white sleeve and connect green wire to ground only in retrofit and replacement applications.

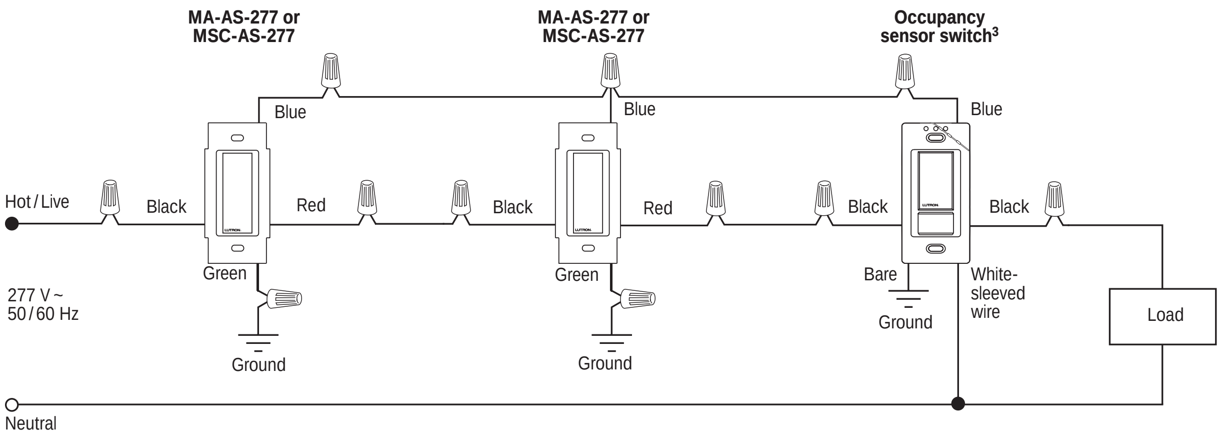
1 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).
2 Only one occupancy sensor switch can be used per multi-location circuit.
3 Occupancy sensor switch can be installed in any location.
4 Fan load applies to 120 V ~ only (not for 277 V ~).

Continued on next page...

Wiring Diagrams *(continued)*

Wiring Diagram 11 - with Neutral

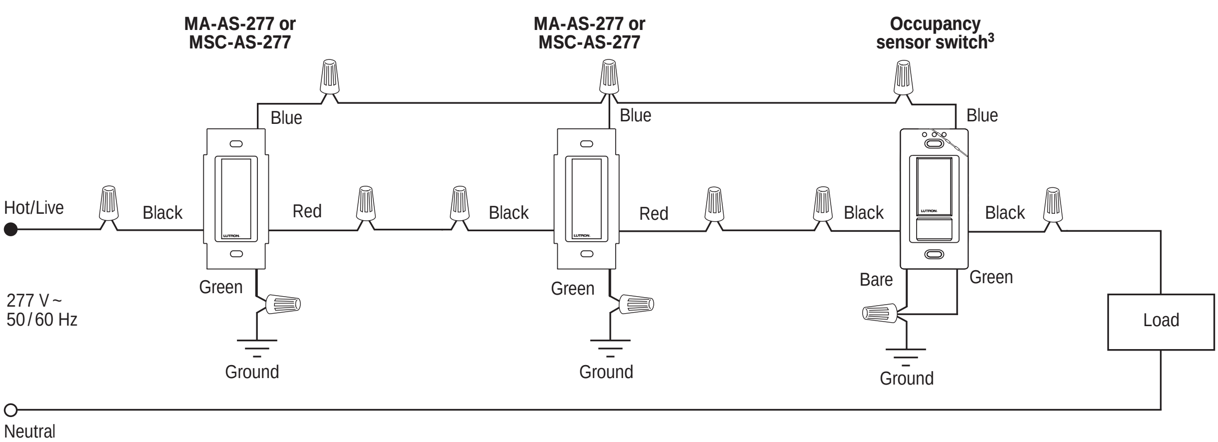
Multi-Location Installation (277 V ~)[1, 2, 3, 4]
-OPS6M2U-DV, -VPS6M2U-DV with MA-AS-277 or MSC-AS-277



Note: When a neutral connection is available, connect the white-sleeved wire to neutral.

Wiring Diagram 11 - without Neutral

Multi-Location Installation (277 V ~)[1, 2, 3, 4]
-OPS6M2U-DV, -VPS6M2U-DV with MA-AS-277 or MSC-AS-277



Note: Remove white sleeve and connect green wire to ground only in retrofit and replacement applications.

1 A single standard mechanical 3-way switch or up to 9 companion switches may be connected to most occupancy sensor switches. Standard mechanical 3-way switch cannot be combined with companion switch. Total blue terminal wire length may be up to 150 ft (46 m).
2 Only one occupancy sensor switch can be used per multi-location circuit.
3 Occupancy sensor switch can be installed in any location.
4 Fan load applies to 120 V ~ only (not for 277 V ~).

Continued on next page...

Colors and Finishes

Gloss Finishes

White
WH

Ivory
IV

Almond
AL

Light Almond
LA

Gray
GR

Brown
BR

Black
BL

Satin Finishes

Snow
SW

Midnight
MN

Taupe
TP

Biscuit
BI

Eggshell
ES

Palladium
PD

Hot
HT

Merlot
MR

Plum
PL

Sienna
SI

Terracotta
TC

Bluestone
BG

Greenbriar
GB

Goldstone
GS

Mocha Stone
MS

Stone
ST

Desert Stone
DS

Limestone
LS

For the latest color offerings please see our website: http://www.lutron.com/satincolors

- Due to printing limitations, colors and finishes shown cannot be guaranteed to match actual product colors perfectly.
- Color chip keychains are available for more precise color matching:
  Gloss Finishes: DG-CK-1
  Satin Finishes: SC-CK-1

Job Name:	Model Numbers:
Job Number:	

Technical Appendix 2

Lab Airflow Optimization ECM

Calculations (Savings Summary & Calculation)

- Kornberg
- Del Monte
- BMEO

Scope of Work (Cost Estimate & Scope of Work)

- Kornberg
- Del Monte
- BMEO

Technical Appendix 2

Lab Airflow Optimization ECM

Calculations (Savings Summary & Calculation)

- Kornberg
- Del Monte
- BMEO

UNIVERSITY OF ROCHESTER

Laboratory Air Flow Optimization

BMEO

Option A

Building Utility Impact		
Building Level Energy Savings		
Electrical Energy Savings	200	mmBtu/Year
Chilled Water Savings	398	mmBtu/Year
Steam Savings	509	mmBtu/Year
Total Energy Savings	**1,107**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	58,553	kWh/Year
Chilled Water Savings	33,136	Ton-Hour/Year
Steam Savings	509	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	$0	Per Year

UNIVERSITY OF ROCHESTER

Laboratory Air Flow Optimization

BMEO

Option B

Building Utility Impact		
Building Level Energy Savings		
Electrical Energy Savings	302	mmBtu/Year
Chilled Water Savings	626	mmBtu/Year
Steam Savings	884	mmBtu/Year
Total Energy Savings	**1,811**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	88,370	kWh/Year
Chilled Water Savings	52,157	Ton-Hour/Year
Steam Savings	884	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	$0	Per Year

wendel

Project Name: University of Rochester Energy Conservation MP Support
Building: Biomedical Engineering - Optics Building
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Existing Conditions							Fume Hood			Downdraft			Snorkel			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Opening Area (sf)	Measured Face Velocity	OCC. MIN CFM	Opening Area (sf)	Measured Face Velocity	OCC. MIN CFM	Opening Area (sf)	Measured Face Velocity	OCC. MIN CFM	Total Hood Exhaust CFM	Min. General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH		Pressurization SP	CFM/Sqft
B103	Lab	105	9.5	998	1&2	170			-			-			50	50	120	170		10	-	-	1.6
Suite B109	Lab	1,209	9.5	11,486	1&2	1,550			575			-			200	775	1,150	1,925		10	375	(375)	1.3
Suite 110	Lab	1,408	9.5	13,376	1&2	2,010			575			-			300	875	1,360	2,235		10	225	(225)	1.4
103	Lab	310	9.5	2,945	1&2	345			575			-			-	575	(80)	495		10	150	(150)	1.1
104	Lab	1,654	9.5	15,713	1&2	2,395			-			-			-	-	2,620	2,620		10	225	(225)	1.4
222	Lab	789	9.5	7,496	1&2	950			575			-			-	575	675	1,250		10	300	(300)	1.2
Suite 224	Lab	559	9.5	5,311	1&2	665			-			-			-	-	890	890		10	225	(225)	1.2
226	Lab	425	9.5	4,038	1&2	525			575			-			150	725	(50)	675		10	150	(150)	1.2
227	Lab	278	9.5	2,641	1&2	220			575			-			-	575	(130)	445		10	225	(225)	0.8
228	Lab	422	9.5	4,009	1&2	520			-			-			100	100	570	670		10	150	(150)	1.2
230	Lab	425	9.5	4,038	1&2	525			-			-			100	100	575	675		10	150	(150)	1.2
Suite 232	Lab	1,101	9.5	10,460	1&2	1,530			575			-			-	575	1,180	1,755		10	225	(225)	1.4
Suite 237	Lab	1,100	9.5	10,450	1&2	1,530			575			-			-	575	1,180	1,755		10	225	(225)	1.4
239	Lab	402	9.5	3,819	1&2	640			-			-			-	-	640	640		10	-	-	1.6
Suite 321	Lab	1,119	9.5	10,631	1&2	1,330			-			-			200	200	1,580	1,780		10	450	(450)	1.2
324	Lab	565	9.5	5,368	1&2	745			575			-			-	575	320	895		10	150	(150)	1.3
326	Lab	425	9.5	4,038	1&2	525			-			-			100	100	575	675		10	150	(150)	1.2
Suite 329	Lab	1,102	9.5	10,469	1&2	1,530			1,350			750			-	2,100	(345)	1,755		10	225	(225)	1.4
Suite 333	Lab	1,105	9.5	10,498	1&2	1,535			575			-			-	575	1,185	1,760		10	225	(225)	1.4
Suite 336	Lab	1,094	9.5	10,393	1&2	1,520			575			-			100	675	1,070	1,745		10	225	(225)	1.4
339	Lab	415	9.5	3,943	1&2	510			575			-			-	575	85	660		10	150	(150)	1.2
420	Lab	555	9.5	5,273	1&2	730			575			-			100	675	205	880		10	150	(150)	1.3
422	Lab	568	9.5	5,396	1&2	750			-			-			100	100	800	900		10	150	(150)	1.3
Suite 425	Lab	1,125	9.5	10,688	1&2	1,265			575			-			200	775	1,015	1,790		10	525	(525)	1.1
428	Lab	425	9.5	4,038	1&2	525			-			-			100	100	575	675		10	150	(150)	1.2
429	Lab	425	9.5	4,038	1&2	525			575			-			-	575	100	675		10	150	(150)	1.2
431	Lab	568	9.5	5,396	1&2	900			-			-			-	-	900	900		10	-	-	1.6
Suite 434	Lab	1,126	9.5	10,697	1&2	1,265			575			-			200	775	1,015	1,790		10	525	(525)	1.1
Suite 438	Lab	1,116	9.5	10,602	1&2	1,250			575			-			200	775	1,000	1,775		10	525	(525)	1.1
Suite 521	Lab	1,120	9.5	10,640	1&2	1,330			575			-			200	775	1,005	1,780		10	450	(450)	1.2
Suite 525	Lab	1,272	9.5	12,084	1&2	1,570			575			-			200	775	1,245	2,020		10	450	(450)	1.2
528	Lab	422	9.5	4,009	1&2	520			-			-			100	100	570	670		10	150	(150)	1.2
530	Lab	425	9.5	4,038	1&2	525			575			-			100	675	-	675		10	150	(150)	1.2
531	Lab	425	9.5	4,038	1&2	525			-			-			100	100	575	675		10	150	(150)	1.2
Suite 534	Lab	1,129	9.5	10,726	1&2	1,345			575			-			200	775	1,020	1,795		10	450	(450)	1.2
Suite 538	Lab	1,116	9.5	10,602	1&2	1,325			-			-			200	200	1,575	1,775		10	450	(450)	1.2
												-											
												-											
		27,829	342	264,376	-	35,620	-	-	13,425	-	-	750	-	-	3,300	17,475	26,770	44,245	-	362	8,625	(8,625)	46

Project Name: University of Rochester Energy Conservation MP Support
Building: Biomedical Engineering - Optics Building
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Desired Face Velocity 85 FPM   Desired CFM/Sqft 1.00 CFM/SQFT   Desired Lab ACH 8

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood			Downdraft			Snorkel			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	CFM / SF	Pressurization SP	CFM/Sqft
B103	Lab	105	9.5	998	1&2	133	-	-	-	-	-	-	-	-	50	50	83	133	133	8	1.3	-	1.3
Suite B109	Lab	1,209	9.5	11,486	1&2	1,209	-	-	575	-	-	-	-	-	200	775	809	1,584	1,584	8	1.0	(375)	1.0
Suite 110	Lab	1,408	9.5	13,376	1&2	1,558	-	-	575	-	-	-	-	-	300	875	908	1,783	1,783	8	1.1	(225)	1.1
103	Lab	310	9.5	2,945	1&2	425	-	-	575	-	-	-	-	-	-	575	-	460	575	12	1.4	(150)	1.4
104	Lab	1,654	9.5	15,713	1&2	1,870	-	-	-	-	-	-	-	-	-	-	2,095	2,095	2,095	8	1.1	(225)	1.1
222	Lab	789	9.5	7,496	1&2	789	-	-	575	-	-	-	-	-	-	575	514	1,089	1,089	9	1.0	(300)	1.0
Suite 224	Lab	559	9.5	5,311	1&2	559	-	-	-	-	-	-	-	-	-	-	784	784	784	9	1.0	(225)	1.0
226	Lab	425	9.5	4,038	1&2	575	-	-	575	-	-	-	-	-	150	725	-	575	725	11	1.4	(150)	1.4
227	Lab	278	9.5	2,641	1&2	220	-	-	575	-	-	-	-	-	-	575	(130)	445	445	10	0.8	(225)	0.8
228	Lab	422	9.5	4,009	1&2	422	-	-	-	-	-	-	-	-	100	100	472	572	572	9	1.0	(150)	1.0
230	Lab	425	9.5	4,038	1&2	425	-	-	-	-	-	-	-	-	100	100	475	575	575	9	1.0	(150)	1.0
Suite 232	Lab	1,101	9.5	10,460	1&2	1,170	-	-	575	-	-	-	-	-	-	575	820	1,395	1,395	8	1.1	(225)	1.1
Suite 237	Lab	1,100	9.5	10,450	1&2	1,168	-	-	575	-	-	-	-	-	-	575	818	1,393	1,393	8	1.1	(225)	1.1
239	Lab	402	9.5	3,819	1&2	509	-	-	-	-	-	-	-	-	-	-	509	509	509	8	1.3	-	1.3
Suite 321	Lab	1,119	9.5	10,631	1&2	1,119	-	-	-	-	-	-	-	-	200	200	1,369	1,569	1,569	9	1.0	(450)	1.0
324	Lab	565	9.5	5,368	1&2	566	-	-	575	-	-	-	-	-	-	575	141	716	716	8	1.0	(150)	1.0
326	Lab	425	9.5	4,038	1&2	425	-	-	-	-	-	-	-	-	100	100	475	575	575	9	1.0	(150)	1.0
Suite 329	Lab	1,102	9.5	10,469	1&2	1,875	-	-	1,350	-	-	750	-	-	-	2,100	-	1,396	2,100	12	1.7	(225)	1.7
Suite 333	Lab	1,105	9.5	10,498	1&2	1,175	-	-	575	-	-	-	-	-	-	575	825	1,400	1,400	8	1.1	(225)	1.1
Suite 336	Lab	1,094	9.5	10,393	1&2	1,161	-	-	575	-	-	-	-	-	100	675	711	1,386	1,386	8	1.1	(225)	1.1
339	Lab	415	9.5	3,943	1&2	425	-	-	575	-	-	-	-	-	-	575	-	565	575	9	1.0	(150)	1.0
420	Lab	555	9.5	5,273	1&2	555	-	-	575	-	-	-	-	-	100	675	30	705	705	8	1.0	(150)	1.0
422	Lab	568	9.5	5,396	1&2	569	-	-	-	-	-	-	-	-	100	100	619	719	719	8	1.0	(150)	1.0
Suite 425	Lab	1,125	9.5	10,688	1&2	1,125	-	-	575	-	-	-	-	-	200	775	875	1,650	1,650	9	1.0	(525)	1.0
428	Lab	425	9.5	4,038	1&2	425	-	-	-	-	-	-	-	-	100	100	475	575	575	9	1.0	(150)	1.0
429	Lab	425	9.5	4,038	1&2	425	-	-	575	-	-	-	-	-	-	575	-	575	575	9	1.0	(150)	1.0
431	Lab	568	9.5	5,396	1&2	719	-	-	-	-	-	-	-	-	-	-	719	719	719	8	1.3	-	1.3
Suite 434	Lab	1,126	9.5	10,697	1&2	1,126	-	-	575	-	-	-	-	-	200	775	876	1,651	1,651	9	1.0	(525)	1.0
Suite 438	Lab	1,116	9.5	10,602	1&2	1,116	-	-	575	-	-	-	-	-	200	775	866	1,641	1,641	9	1.0	(525)	1.0
Suite 521	Lab	1,120	9.5	10,640	1&2	1,120	-	-	575	-	-	-	-	-	200	775	795	1,570	1,570	9	1.0	(450)	1.0
Suite 525	Lab	1,272	9.5	12,084	1&2	1,272	-	-	575	-	-	-	-	-	200	775	947	1,722	1,722	9	1.0	(450)	1.0
528	Lab	422	9.5	4,009	1&2	422	-	-	-	-	-	-	-	-	100	100	472	572	572	9	1.0	(150)	1.0
530	Lab	425	9.5	4,038	1&2	525	-	-	575	-	-	-	-	-	100	675	-	575	675	10	1.2	(150)	1.2
531	Lab	425	9.5	4,038	1&2	425	-	-	-	-	-	-	-	-	100	100	475	575	575	9	1.0	(150)	1.0
Suite 534	Lab	1,129	9.5	10,726	1&2	1,129	-	-	575	-	-	-	-	-	200	775	804	1,579	1,579	9	1.0	(450)	1.0
Suite 538	Lab	1,116	9.5	10,602	1&2	1,116	-	-	-	-	-	-	-	-	200	200	1,366	1,566	1,566	9	1.0	(450)	1.0
		27,829		264,376		29,848	-	-	13,425	-	-	750	-	-	3,300	17,475	20,998	37,394	38,473	317	38.8	(8,625)	39

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Project Name: University of Rochester Energy Conservation MP Support
Building: Biomedical Engineering - Optics Building
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Existing Conditions								Fume Hood			Downdraft			Snorkel					Summary				
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Opening Area (sf)	Measured Face Velocity	OCC. MIN CFM	Opening Area (sf)	Measured Face Velocity	OCC. MIN CFM	Opening Area (sf)	Measured Face Velocity	OCC. MIN CFM	Total Hood Exhaust CFM	Min. General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH		Pressurization SP	CFM/Sqft
B103	Lab	105	9.5	998	1&2	170			-			-			50	50	120	170		10	-	-	1.6
Suite B109	Lab	1,209	9.5	11,486	1&2	1,550			575			-			200	775	1,150	1,925		10	375	(375)	1.3
Suite 110	Lab	1,408	9.5	13,376	1&2	2,010			575			-			300	875	1,360	2,235		10	225	(225)	1.4
103	Lab	310	9.5	2,945	1&2	345			575			-			-	575	(80)	495		10	150	(150)	1.1
104	Lab	1,654	9.5	15,713	1&2	2,395			-			-			-	-	2,620	2,620		10	225	(225)	1.4
222	Lab	789	9.5	7,496	1&2	950			575			-			-	575	675	1,250		10	300	(300)	1.2
Suite 224	Lab	559	9.5	5,311	1&2	665			-			-			-	-	890	890		10	225	(225)	1.2
226	Lab	425	9.5	4,038	1&2	525			575			-			150	725	(50)	675		10	150	(150)	1.2
227	Lab	278	9.5	2,641	1&2	220			575			-			-	575	(130)	445		10	225	(225)	0.8
228	Lab	422	9.5	4,009	1&2	520			-			-			100	100	570	670		10	150	(150)	1.2
230	Lab	425	9.5	4,038	1&2	525			-			-			100	100	575	675		10	150	(150)	1.2
Suite 232	Lab	1,101	9.5	10,460	1&2	1,530			575			-			-	575	1,180	1,755		10	225	(225)	1.4
Suite 237	Lab	1,100	9.5	10,450	1&2	1,530			575			-			-	575	1,180	1,755		10	225	(225)	1.4
239	Lab	402	9.5	3,819	1&2	640			-			-			-	-	640	640		10	-	-	1.6
Suite 321	Lab	1,119	9.5	10,631	1&2	1,330			-			-			200	200	1,580	1,780		10	450	(450)	1.2
324	Lab	565	9.5	5,368	1&2	745			575			-			-	575	320	895		10	150	(150)	1.3
326	Lab	425	9.5	4,038	1&2	525			-			-			100	100	575	675		10	150	(150)	1.2
Suite 329	Lab	1,102	9.5	10,469	1&2	1,530			1,350			750			-	2,100	(345)	1,755		10	225	(225)	1.4
Suite 333	Lab	1,105	9.5	10,498	1&2	1,535			575			-			-	575	1,185	1,760		10	225	(225)	1.4
Suite 336	Lab	1,094	9.5	10,393	1&2	1,520			575			-			100	675	1,070	1,745		10	225	(225)	1.4
339	Lab	415	9.5	3,943	1&2	510			575			-			-	575	85	660		10	150	(150)	1.2
420	Lab	555	9.5	5,273	1&2	730			575			-			100	675	205	880		10	150	(150)	1.3
422	Lab	568	9.5	5,396	1&2	750			-			-			100	100	800	900		10	150	(150)	1.3
Suite 425	Lab	1,125	9.5	10,688	1&2	1,265			575			-			200	775	1,015	1,790		10	525	(525)	1.1
428	Lab	425	9.5	4,038	1&2	525			-			-			100	100	575	675		10	150	(150)	1.2
429	Lab	425	9.5	4,038	1&2	525			575			-			-	575	100	675		10	150	(150)	1.2
431	Lab	568	9.5	5,396	1&2	900			-			-			-	-	900	900		10	-	-	1.6
Suite 434	Lab	1,126	9.5	10,697	1&2	1,265			575			-			200	775	1,015	1,790		10	525	(525)	1.1
Suite 438	Lab	1,116	9.5	10,602	1&2	1,250			575			-			200	775	1,000	1,775		10	525	(525)	1.1
Suite 521	Lab	1,120	9.5	10,640	1&2	1,330			575			-			200	775	1,005	1,780		10	450	(450)	1.2
Suite 525	Lab	1,272	9.5	12,084	1&2	1,570			575			-			200	775	1,245	2,020		10	450	(450)	1.2
528	Lab	422	9.5	4,009	1&2	520			-			-			100	100	570	670		10	150	(150)	1.2
530	Lab	425	9.5	4,038	1&2	525			575			-			100	675	-	675		10	150	(150)	1.2
531	Lab	425	9.5	4,038	1&2	525			-			-			100	100	575	675		10	150	(150)	1.2
Suite 534	Lab	1,129	9.5	10,726	1&2	1,345			575			-			200	775	1,020	1,795		10	450	(450)	1.2
Suite 538	Lab	1,116	9.5	10,602	1&2	1,325			-			-			200	200	1,575	1,775		10	450	(450)	1.2
												-											
												-											
		27,829	342	264,376	-	35,620	-	-	13,425	-	-	750	-	-	3,300	17,475	26,770	44,245	-	362	8,625	(8,625)	46

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Project Name: University of Rochester Energy Conservation MP Support
Building: Biomedical Engineering - Optics Building
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Desired Face Velocity: 85 FPM | Desired CFM/Sqft: 1.00 CFM/SQFT | Desired Lab ACH: 6

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood			Downdraft			Snorkel			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	CFM / SF	Pressurization SP	CFM/Sqft
B103	Lab	105	9.5	998	1&2	105	-	-	-	-	-	-	-	-	50	50	55	105	105	6	1.0	-	1.0
Suite B109	Lab	1,209	9.5	11,486	1&2	1,209	-	-	575	-	-	-	-	-	200	775	809	1,584	1,584	8	1.0	(375)	1.0
Suite 110	Lab	1,408	9.5	13,376	1&2	1,408	-	-	575	-	-	-	-	-	300	875	758	1,633	1,633	7	1.0	(225)	1.0
103	Lab	310	9.5	2,945	1&2	425	-	-	575	-	-	-	-	-	-	575	-	460	575	12	1.4	(150)	1.4
104	Lab	1,654	9.5	15,713	1&2	1,654	-	-	-	-	-	-	-	-	-	-	1,879	1,879	1,879	7	1.0	(225)	1.0
222	Lab	789	9.5	7,496	1&2	789	-	-	575	-	-	-	-	-	-	575	514	1,089	1,089	9	1.0	(300)	1.0
Suite 224	Lab	559	9.5	5,311	1&2	559	-	-	-	-	-	-	-	-	-	-	784	784	784	9	1.0	(225)	1.0
226	Lab	425	9.5	4,038	1&2	575	-	-	575	-	-	-	-	-	150	725	-	575	725	11	1.4	(150)	1.4
227	Lab	278	9.5	2,641	1&2	220	-	-	575	-	-	-	-	-	-	575	(130)	445	445	10	0.8	(225)	0.8
228	Lab	422	9.5	4,009	1&2	422	-	-	-	-	-	-	-	-	100	100	472	572	572	9	1.0	(150)	1.0
230	Lab	425	9.5	4,038	1&2	425	-	-	-	-	-	-	-	-	100	100	475	575	575	9	1.0	(150)	1.0
Suite 232	Lab	1,101	9.5	10,460	1&2	1,101	-	-	575	-	-	-	-	-	-	575	751	1,326	1,326	8	1.0	(225)	1.0
Suite 237	Lab	1,100	9.5	10,450	1&2	1,100	-	-	575	-	-	-	-	-	-	575	750	1,325	1,325	8	1.0	(225)	1.0
239	Lab	402	9.5	3,819	1&2	402	-	-	-	-	-	-	-	-	-	-	402	402	402	6	1.0	-	1.0
Suite 321	Lab	1,119	9.5	10,631	1&2	1,119	-	-	-	-	-	-	-	-	200	200	1,369	1,569	1,569	9	1.0	(450)	1.0
324	Lab	565	9.5	5,368	1&2	565	-	-	575	-	-	-	-	-	-	575	140	715	715	8	1.0	(150)	1.0
326	Lab	425	9.5	4,038	1&2	425	-	-	-	-	-	-	-	-	100	100	475	575	575	9	1.0	(150)	1.0
Suite 329	Lab	1,102	9.5	10,469	1&2	1,875	-	-	1,350	-	-	750	-	-	-	2,100	-	1,327	2,100	12	1.7	(225)	1.7
Suite 333	Lab	1,105	9.5	10,498	1&2	1,105	-	-	575	-	-	-	-	-	-	575	755	1,330	1,330	8	1.0	(225)	1.0
Suite 336	Lab	1,094	9.5	10,393	1&2	1,094	-	-	575	-	-	-	-	-	100	675	644	1,319	1,319	8	1.0	(225)	1.0
339	Lab	415	9.5	3,943	1&2	425	-	-	575	-	-	-	-	-	-	575	-	565	575	9	1.0	(150)	1.0
420	Lab	555	9.5	5,273	1&2	555	-	-	575	-	-	-	-	-	100	675	30	705	705	8	1.0	(150)	1.0
422	Lab	568	9.5	5,396	1&2	568	-	-	-	-	-	-	-	-	100	100	618	718	718	8	1.0	(150)	1.0
Suite 425	Lab	1,125	9.5	10,688	1&2	1,125	-	-	575	-	-	-	-	-	200	775	875	1,650	1,650	9	1.0	(525)	1.0
428	Lab	425	9.5	4,038	1&2	425	-	-	-	-	-	-	-	-	100	100	475	575	575	9	1.0	(150)	1.0
429	Lab	425	9.5	4,038	1&2	425	-	-	575	-	-	-	-	-	-	575	-	575	575	9	1.0	(150)	1.0
431	Lab	568	9.5	5,396	1&2	568	-	-	-	-	-	-	-	-	-	-	568	568	568	6	1.0	-	1.0
Suite 434	Lab	1,126	9.5	10,697	1&2	1,126	-	-	575	-	-	-	-	-	200	775	876	1,651	1,651	9	1.0	(525)	1.0
Suite 438	Lab	1,116	9.5	10,602	1&2	1,116	-	-	575	-	-	-	-	-	200	775	866	1,641	1,641	9	1.0	(525)	1.0
Suite 521	Lab	1,120	9.5	10,640	1&2	1,120	-	-	575	-	-	-	-	-	200	775	795	1,570	1,570	9	1.0	(450)	1.0
Suite 525	Lab	1,272	9.5	12,084	1&2	1,272	-	-	575	-	-	-	-	-	200	775	947	1,722	1,722	9	1.0	(450)	1.0
528	Lab	422	9.5	4,009	1&2	422	-	-	-	-	-	-	-	-	100	100	472	572	572	9	1.0	(150)	1.0
530	Lab	425	9.5	4,038	1&2	525	-	-	575	-	-	-	-	-	100	675	-	575	675	10	1.2	(150)	1.2
531	Lab	425	9.5	4,038	1&2	425	-	-	-	-	-	-	-	-	100	100	475	575	575	9	1.0	(150)	1.0
Suite 534	Lab	1,129	9.5	10,726	1&2	1,129	-	-	575	-	-	-	-	-	200	775	804	1,579	1,579	9	1.0	(450)	1.0
Suite 538	Lab	1,116	9.5	10,602	1&2	1,116	-	-	-	-	-	-	-	-	200	200	1,366	1,566	1,566	9	1.0	(450)	1.0
		27,829		264,376		28,919	-	-	13,425	-	-	750	-	-	3,300	17,475	20,069	36,396	37,544	309	37.5	(8,625)	37

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Building: Biomedical Engineering - Optics Building
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Existing Conditions							Fume Hood			Downdraft			Snorkel			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Opening Area (sf)	Measured Face Velocity	UNOCC. MIN CFM	Opening Area (sf)	Measured Face Velocity	UNOCC. MIN CFM	Opening Area (sf)	Measured Face Velocity	UNOCC. MIN CFM	Total Hood Exhaust CFM	Min. General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH		Pressurization SP	CFM/Sqft
B103	Lab	105	9.5	998	1&2	100			-			-			50	50	50	100		6	-	-	1.0
Suite B109	Lab	1,209	9.5	11,486	1&2	780			350			-			200	550	605	1,155		6	375	(375)	0.6
Suite 110	Lab	1,408	9.5	13,376	1&2	1,125			350			-			300	650	700	1,350		6	225	(225)	0.8
103	Lab	310	9.5	2,945	1&2	145			350			-			-	350	(55)	295		6	150	(150)	0.5
104	Lab	1,654	9.5	15,713	1&2	1,350			-			-			-	-	1,575	1,575		6	225	(225)	0.8
222	Lab	789	9.5	7,496	1&2	450			350			-			-	350	400	750		6	300	(300)	0.6
Suite 224	Lab	559	9.5	5,311	1&2	310			-			-			-	-	535	535		6	225	(225)	0.6
226	Lab	425	9.5	4,038	1&2	255			350			-			150	500	(95)	405		6	150	(150)	0.6
227	Lab	278	9.5	2,641	1&2	40			350			-			-	350	(85)	265		6	225	(225)	0.1
228	Lab	422	9.5	4,009	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
230	Lab	425	9.5	4,038	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
Suite 232	Lab	1,101	9.5	10,460	1&2	830			350			-			-	350	705	1,055		6	225	(225)	0.8
Suite 237	Lab	1,100	9.5	10,450	1&2	830			350			-			-	350	705	1,055		6	225	(225)	0.8
239	Lab	402	9.5	3,819	1&2	385			-			-			-	-	385	385		6	-	-	1.0
Suite 321	Lab	1,119	9.5	10,631	1&2	620			-			-			200	200	870	1,070		6	450	(450)	0.6
324	Lab	565	9.5	5,368	1&2	390			350			-			-	350	190	540		6	150	(150)	0.7
326	Lab	425	9.5	4,038	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
Suite 329	Lab	1,102	9.5	10,469	1&2	835			400			750			-	1,150	(90)	1,060		6	225	(225)	0.8
Suite 333	Lab	1,105	9.5	10,498	1&2	835			350			-			-	350	710	1,060		6	225	(225)	0.8
Suite 336	Lab	1,094	9.5	10,393	1&2	825			350			-			100	450	600	1,050		6	225	(225)	0.8
339	Lab	415	9.5	3,943	1&2	245			350			-			-	350	45	395		6	150	(150)	0.6
420	Lab	555	9.5	5,273	1&2	380			350			-			100	450	80	530		6	150	(150)	0.7
422	Lab	568	9.5	5,396	1&2	390			-			-			100	100	440	540		6	150	(150)	0.7
Suite 425	Lab	1,125	9.5	10,688	1&2	550			350			-			200	550	525	1,075		6	525	(525)	0.5
428	Lab	425	9.5	4,038	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
429	Lab	425	9.5	4,038	1&2	255			350			-			-	350	55	405		6	150	(150)	0.6
431	Lab	568	9.5	5,396	1&2	540			-			-			-	-	540	540		6	-	-	1.0
Suite 434	Lab	1,126	9.5	10,697	1&2	555			350			-			200	550	530	1,080		6	525	(525)	0.5
Suite 438	Lab	1,116	9.5	10,602	1&2	545			350			-			200	550	520	1,070		6	525	(525)	0.5
Suite 521	Lab	1,120	9.5	10,640	1&2	625			350			-			200	550	525	1,075		6	450	(450)	0.6
Suite 525	Lab	1,272	9.5	12,084	1&2	765			350			-			200	550	665	1,215		6	450	(450)	0.6
528	Lab	422	9.5	4,009	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
530	Lab	425	9.5	4,038	1&2	255			350			-			100	450	(45)	405		6	150	(150)	0.6
531	Lab	425	9.5	4,038	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
Suite 534	Lab	1,129	9.5	10,726	1&2	630			350			-			200	550	530	1,080		6	450	(450)	0.6
Suite 538	Lab	1,116	9.5	10,602	1&2	620			-			-			200	200	870	1,070		6	450	(450)	0.6
		27,829	342	264,376	-	17,990	-	-	7,750	-	-	750	-	-	3,300	11,800	14,815	26,615	-	217	8,625	(8,625)	23

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Project Name: University of Rochester Energy Conservation MP Support
Building: Biomedical Engineering - Optics Building
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Desired Face Velocity 100 FPM | Desired CFM/Sqft 1 CFM/SQFT | Desired Lab ACH 4

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood			Downdraft			Snorkel			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	New Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	CFM / SF	Pressurization SP	CFM/Sqft
B103	Lab	105	9.5	998	1&2	100	-	-	-	-	-	-	-	-	50	50	50	100	100	6	1.0	-	1.0
Suite B109	Lab	1,209	9.5	11,486	1&2	780	-	-	350	-	-	-	-	-	200	550	605	1,155	1,155	6	0.6	(375)	0.6
Suite 110	Lab	1,408	9.5	13,376	1&2	1,125	-	-	350	-	-	-	-	-	300	650	700	1,350	1,350	6	0.8	(225)	0.8
103	Lab	310	9.5	2,945	1&2	145	-	-	350	-	-	-	-	-	-	350	(55)	295	295	6	0.5	(150)	0.5
104	Lab	1,654	9.5	15,713	1&2	1,350	-	-	-	-	-	-	-	-	-	-	1,575	1,575	1,575	6	0.8	(225)	0.8
222	Lab	789	9.5	7,496	1&2	450	-	-	350	-	-	-	-	-	-	350	400	750	750	6	0.6	(300)	0.6
Suite 224	Lab	559	9.5	5,311	1&2	310	-	-	-	-	-	-	-	-	-	-	535	535	535	6	0.6	(225)	0.6
226	Lab	425	9.5	4,038	1&2	255	-	-	350	-	-	-	-	-	150	500	(95)	405	405	6	0.6	(150)	0.6
227	Lab	278	9.5	2,641	1&2	40	-	-	350	-	-	-	-	-	-	350	(85)	265	265	6	0.1	(225)	0.1
228	Lab	422	9.5	4,009	1&2	255	-	-	-	-	-	-	-	-	100	100	305	405	405	6	0.6	(150)	0.6
230	Lab	425	9.5	4,038	1&2	255	-	-	-	-	-	-	-	-	100	100	305	405	405	6	0.6	(150)	0.6
Suite 232	Lab	1,101	9.5	10,460	1&2	830	-	-	350	-	-	-	-	-	-	350	705	1,055	1,055	6	0.8	(225)	0.8
Suite 237	Lab	1,100	9.5	10,450	1&2	830	-	-	350	-	-	-	-	-	-	350	705	1,055	1,055	6	0.8	(225)	0.8
239	Lab	402	9.5	3,819	1&2	385	-	-	-	-	-	-	-	-	-	-	385	385	385	6	1.0	-	1.0
Suite 321	Lab	1,119	9.5	10,631	1&2	620	-	-	-	-	-	-	-	-	200	200	870	1,070	1,070	6	0.6	(450)	0.6
324	Lab	565	9.5	5,368	1&2	390	-	-	350	-	-	-	-	-	-	350	190	540	540	6	0.7	(150)	0.7
326	Lab	425	9.5	4,038	1&2	255	-	-	-	-	-	-	-	-	100	100	305	405	405	6	0.6	(150)	0.6
Suite 329	Lab	1,102	9.5	10,469	1&2	835	-	-	400	-	-	750	-	-	-	1,150	(90)	1,060	1,060	6	0.8	(225)	0.8
Suite 333	Lab	1,105	9.5	10,498	1&2	835	-	-	350	-	-	-	-	-	-	350	710	1,060	1,060	6	0.8	(225)	0.8
Suite 336	Lab	1,094	9.5	10,393	1&2	825	-	-	350	-	-	-	-	-	100	450	600	1,050	1,050	6	0.8	(225)	0.8
339	Lab	415	9.5	3,943	1&2	245	-	-	350	-	-	-	-	-	-	350	45	395	395	6	0.6	(150)	0.6
420	Lab	555	9.5	5,273	1&2	380	-	-	350	-	-	-	-	-	100	450	80	530	530	6	0.7	(150)	0.7
422	Lab	568	9.5	5,396	1&2	390	-	-	-	-	-	-	-	-	100	100	440	540	540	6	0.7	(150)	0.7
Suite 425	Lab	1,125	9.5	10,688	1&2	550	-	-	350	-	-	-	-	-	200	550	525	1,075	1,075	6	0.5	(525)	0.5
428	Lab	425	9.5	4,038	1&2	255	-	-	-	-	-	-	-	-	100	100	305	405	405	6	0.6	(150)	0.6
429	Lab	425	9.5	4,038	1&2	255	-	-	350	-	-	-	-	-	-	350	55	405	405	6	0.6	(150)	0.6
431	Lab	568	9.5	5,396	1&2	540	-	-	-	-	-	-	-	-	-	-	540	540	540	6	1.0	-	1.0
Suite 434	Lab	1,126	9.5	10,697	1&2	555	-	-	350	-	-	-	-	-	200	550	530	1,080	1,080	6	0.5	(525)	0.5
Suite 438	Lab	1,116	9.5	10,602	1&2	545	-	-	350	-	-	-	-	-	200	550	520	1,070	1,070	6	0.5	(525)	0.5
Suite 521	Lab	1,120	9.5	10,640	1&2	625	-	-	350	-	-	-	-	-	200	550	525	1,075	1,075	6	0.6	(450)	0.6
Suite 525	Lab	1,272	9.5	12,084	1&2	765	-	-	350	-	-	-	-	-	200	550	665	1,215	1,215	6	0.6	(450)	0.6
528	Lab	422	9.5	4,009	1&2	255	-	-	-	-	-	-	-	-	100	100	305	405	405	6	0.6	(150)	0.6
530	Lab	425	9.5	4,038	1&2	255	-	-	350	-	-	-	-	-	100	450	(45)	405	405	6	0.6	(150)	0.6
531	Lab	425	9.5	4,038	1&2	255	-	-	-	-	-	-	-	-	100	100	305	405	405	6	0.6	(150)	0.6
Suite 534	Lab	1,129	9.5	10,726	1&2	630	-	-	350	-	-	-	-	-	200	550	530	1,080	1,080	6	0.6	(450)	0.6
Suite 538	Lab	1,116	9.5	10,602	1&2	620	-	-	-	-	-	-	-	-	200	200	870	1,070	1,070	6	0.6	(450)	0.6
		27,829		264,376		17,990	-	-	7,750	-	-	750	-	-	3,300	11,800	14,815	26,615	26,615	217	23	(8,625)	23

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Project Name: University of Rochester Energy Conservation MP Support
Building: Biomedical Engineering - Optics Building
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Existing Conditions							Fume Hood			Downdraft			Snorkel			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Opening Area (sf)	Measured Face Velocity	UNOCC. MIN CFM	Opening Area (sf)	Measured Face Velocity	UNOCC. MIN CFM	Opening Area (sf)	Measured Face Velocity	UNOCC. MIN CFM	Total Hood Exhaust CFM	Min. General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH		Pressurization SP	CFM/Sqft
B103	Lab	105	9.5	998	1&2	100			-			-			50	50	50	100		6	-	-	1.0
Suite B109	Lab	1,209	9.5	11,486	1&2	780			350			-			200	550	605	1,155		6	375	(375)	0.6
Suite 110	Lab	1,408	9.5	13,376	1&2	1,125			350			-			300	650	700	1,350		6	225	(225)	0.8
103	Lab	310	9.5	2,945	1&2	145			350			-			-	350	(55)	295		6	150	(150)	0.5
104	Lab	1,654	9.5	15,713	1&2	1,350			-			-			-	-	1,575	1,575		6	225	(225)	0.8
222	Lab	789	9.5	7,496	1&2	450			350			-			-	350	400	750		6	300	(300)	0.6
Suite 224	Lab	559	9.5	5,311	1&2	310			-			-			-	-	535	535		6	225	(225)	0.6
226	Lab	425	9.5	4,038	1&2	255			350			-			150	500	(95)	405		6	150	(150)	0.6
227	Lab	278	9.5	2,641	1&2	40			350			-			-	350	(85)	265		6	225	(225)	0.1
228	Lab	422	9.5	4,009	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
230	Lab	425	9.5	4,038	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
Suite 232	Lab	1,101	9.5	10,460	1&2	830			350			-			-	350	705	1,055		6	225	(225)	0.8
Suite 237	Lab	1,100	9.5	10,450	1&2	830			350			-			-	350	705	1,055		6	225	(225)	0.8
239	Lab	402	9.5	3,819	1&2	385			-			-			-	-	385	385		6	-	-	1.0
Suite 321	Lab	1,119	9.5	10,631	1&2	620			-			-			200	200	870	1,070		6	450	(450)	0.6
324	Lab	565	9.5	5,368	1&2	390			350			-			-	350	190	540		6	150	(150)	0.7
326	Lab	425	9.5	4,038	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
Suite 329	Lab	1,102	9.5	10,469	1&2	835			400			750			-	1,150	(90)	1,060		6	225	(225)	0.8
Suite 333	Lab	1,105	9.5	10,498	1&2	835			350			-			-	350	710	1,060		6	225	(225)	0.8
Suite 336	Lab	1,094	9.5	10,393	1&2	825			350			-			100	450	600	1,050		6	225	(225)	0.8
339	Lab	415	9.5	3,943	1&2	245			350			-			-	350	45	395		6	150	(150)	0.6
420	Lab	555	9.5	5,273	1&2	380			350			-			100	450	80	530		6	150	(150)	0.7
422	Lab	568	9.5	5,396	1&2	390			-			-			100	100	440	540		6	150	(150)	0.7
Suite 425	Lab	1,125	9.5	10,688	1&2	550			350			-			200	550	525	1,075		6	525	(525)	0.5
428	Lab	425	9.5	4,038	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
429	Lab	425	9.5	4,038	1&2	255			350			-			-	350	55	405		6	150	(150)	0.6
431	Lab	568	9.5	5,396	1&2	540			-			-			-	-	540	540		6	-	-	1.0
Suite 434	Lab	1,126	9.5	10,697	1&2	555			350			-			200	550	530	1,080		6	525	(525)	0.5
Suite 438	Lab	1,116	9.5	10,602	1&2	545			350			-			200	550	520	1,070		6	525	(525)	0.5
Suite 521	Lab	1,120	9.5	10,640	1&2	625			350			-			200	550	525	1,075		6	450	(450)	0.6
Suite 525	Lab	1,272	9.5	12,084	1&2	765			350			-			200	550	665	1,215		6	450	(450)	0.6
528	Lab	422	9.5	4,009	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
530	Lab	425	9.5	4,038	1&2	255			350			-			100	450	(45)	405		6	150	(150)	0.6
531	Lab	425	9.5	4,038	1&2	255			-			-			100	100	305	405		6	150	(150)	0.6
Suite 534	Lab	1,129	9.5	10,726	1&2	630			350			-			200	550	530	1,080		6	450	(450)	0.6
Suite 538	Lab	1,116	9.5	10,602	1&2	620			-			-			200	200	870	1,070		6	450	(450)	0.6
		27,829	342	264,376	-	17,990	-	-	7,750	-	-	750	-	-	3,300	11,800	14,815	26,615	-	217	8,625	(8,625)	23

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Project Name: University of Rochester Energy Conservation MP Support
Building: Biomedical Engineering - Optics Building
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Desired Face Velocity	100	FPM	Desired CFM/Sqft	0.5	CFM/SQFT	Desired Lab ACH	4

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood			Downdraft			Snorkel			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	New Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	CFM / SF	Pressurization SP	CFM/Sqft
B103	Lab	105	9.5	998	1&2	67	-	-	-	-	-	-	-	-	50	50	17	67	67	4	0.6	-	0.6
Suite B109	Lab	1,209	9.5	11,486	1&2	605	-	-	350	-	-	-	-	-	200	550	430	980	980	5	0.5	(375)	0.5
Suite 110	Lab	1,408	9.5	13,376	1&2	704	-	-	350	-	-	-	-	-	300	650	279	929	929	4	0.5	(225)	0.5
103	Lab	310	9.5	2,945	1&2	145	-	-	350	-	-	-	-	-	-	350	(55)	295	295	6	0.5	(150)	0.5
104	Lab	1,654	9.5	15,713	1&2	827	-	-	-	-	-	-	-	-	-	-	1,052	1,052	1,052	4	0.5	(225)	0.5
222	Lab	789	9.5	7,496	1&2	395	-	-	350	-	-	-	-	-	-	350	345	695	695	6	0.5	(300)	0.5
Suite 224	Lab	559	9.5	5,311	1&2	280	-	-	-	-	-	-	-	-	-	-	505	505	505	6	0.5	(225)	0.5
226	Lab	425	9.5	4,038	1&2	350	-	-	350	-	-	-	-	-	150	500	-	363	500	7	0.8	(150)	0.8
227	Lab	278	9.5	2,641	1&2	40	-	-	350	-	-	-	-	-	-	350	(85)	265	265	6	0.1	(225)	0.1
228	Lab	422	9.5	4,009	1&2	211	-	-	-	-	-	-	-	-	100	100	261	361	361	5	0.5	(150)	0.5
230	Lab	425	9.5	4,038	1&2	213	-	-	-	-	-	-	-	-	100	100	263	363	363	5	0.5	(150)	0.5
Suite 232	Lab	1,101	9.5	10,460	1&2	551	-	-	350	-	-	-	-	-	-	350	426	776	776	4	0.5	(225)	0.5
Suite 237	Lab	1,100	9.5	10,450	1&2	550	-	-	350	-	-	-	-	-	-	350	425	775	775	4	0.5	(225)	0.5
239	Lab	402	9.5	3,819	1&2	255	-	-	-	-	-	-	-	-	-	-	255	255	255	4	0.6	-	0.6
Suite 321	Lab	1,119	9.5	10,631	1&2	560	-	-	-	-	-	-	-	-	200	200	810	1,010	1,010	6	0.5	(450)	0.5
324	Lab	565	9.5	5,368	1&2	283	-	-	350	-	-	-	-	-	-	350	83	433	433	5	0.5	(150)	0.5
326	Lab	425	9.5	4,038	1&2	213	-	-	-	-	-	-	-	-	100	100	263	363	363	5	0.5	(150)	0.5
Suite 329	Lab	1,102	9.5	10,469	1&2	925	-	-	400	-	-	750	-	-	-	1,150	-	776	1,150	7	0.8	(225)	0.8
Suite 333	Lab	1,105	9.5	10,498	1&2	553	-	-	350	-	-	-	-	-	-	350	428	778	778	4	0.5	(225)	0.5
Suite 336	Lab	1,094	9.5	10,393	1&2	547	-	-	350	-	-	-	-	-	100	450	322	772	772	4	0.5	(225)	0.5
339	Lab	415	9.5	3,943	1&2	208	-	-	350	-	-	-	-	-	-	350	8	358	358	5	0.5	(150)	0.5
420	Lab	555	9.5	5,273	1&2	300	-	-	350	-	-	-	-	-	100	450	-	428	450	5	0.5	(150)	0.5
422	Lab	568	9.5	5,396	1&2	284	-	-	-	-	-	-	-	-	100	100	334	434	434	5	0.5	(150)	0.5
Suite 425	Lab	1,125	9.5	10,688	1&2	550	-	-	350	-	-	-	-	-	200	550	525	1,075	1,075	6	0.5	(525)	0.5
428	Lab	425	9.5	4,038	1&2	213	-	-	-	-	-	-	-	-	100	100	263	363	363	5	0.5	(150)	0.5
429	Lab	425	9.5	4,038	1&2	213	-	-	350	-	-	-	-	-	-	350	13	363	363	5	0.5	(150)	0.5
431	Lab	568	9.5	5,396	1&2	360	-	-	-	-	-	-	-	-	-	-	360	360	360	4	0.6	-	0.6
Suite 434	Lab	1,126	9.5	10,697	1&2	555	-	-	350	-	-	-	-	-	200	550	530	1,080	1,080	6	0.5	(525)	0.5
Suite 438	Lab	1,116	9.5	10,602	1&2	545	-	-	350	-	-	-	-	-	200	550	520	1,070	1,070	6	0.5	(525)	0.5
Suite 521	Lab	1,120	9.5	10,640	1&2	560	-	-	350	-	-	-	-	-	200	550	460	1,010	1,010	6	0.5	(450)	0.5
Suite 525	Lab	1,272	9.5	12,084	1&2	636	-	-	350	-	-	-	-	-	200	550	536	1,086	1,086	5	0.5	(450)	0.5
528	Lab	422	9.5	4,009	1&2	211	-	-	-	-	-	-	-	-	100	100	261	361	361	5	0.5	(150)	0.5
530	Lab	425	9.5	4,038	1&2	300	-	-	350	-	-	-	-	-	100	450	-	363	450	7	0.7	(150)	0.7
531	Lab	425	9.5	4,038	1&2	213	-	-	-	-	-	-	-	-	100	100	263	363	363	5	0.5	(150)	0.5
Suite 534	Lab	1,129	9.5	10,726	1&2	565	-	-	350	-	-	-	-	-	200	550	465	1,015	1,015	6	0.5	(450)	0.5
Suite 538	Lab	1,116	9.5	10,602	1&2	558	-	-	-	-	-	-	-	-	200	200	808	1,008	1,008	6	0.5	(450)	0.5
		27,829		264,376		14,537	-	-	7,750	-	-	750	-	-	3,300	11,800	11,362	22,540	23,162	191	19	(8,625)	19

ECM - 3 - Lab Airflow Optimization - AHU-1 & 2

Project Name:	University of Rochester Energy Conservation MP Support
Building:	Biomedical Engineering - Optics Building
Date:	4/1/2021
ECM	Lab Airflow Optimization
Calculated By:	CLF
Reviewed By:	GHB

Summary of Existing System

Measured Data and Data Limitations

ECMs Implemented

	DAT Reset Schedule
x	Lab CFM Adjustment
	Night Setbacks

Summary of Systems Used for Calculation

Existing Usage (10 / 6 ACM)		
Preheat Usage	1,798	mmBtu
Cooling Usage	3,310	mmBtu
Reheat Usage	2,870	mmBtu
Supply Fan Usage	327,696	kWh

Proposed Usage - Option A (8 / 4 ACH)		
Preheat Usage	1,604	mmBtu
Cooling Usage	2,912	mmBtu
Reheat Usage	2,555	mmBtu
Supply Fan Usage	269,142	kWh

Proposed Usage - Option B (6 / 4 ACH)		
Preheat Usage	1,457	mmBtu
Cooling Usage	2,684	mmBtu
Reheat Usage	2,327	mmBtu
Supply Fan Usage	239,326	kWh

Summary of EEM Savings - Option A (8 / 4 ACH)

Proposed Savings		
Preheat Usage	194	mmBtu
Cooling Usage	398	mmBtu
Reheat Usage	316	mmBtu
Supply Fan Usage	58,553	kWh

Summary of EEM Savings - Option A (6 / 4 ACH)

Proposed Savings		
Preheat Usage	340	mmBtu
Cooling Usage	626	mmBtu
Reheat Usage	543	mmBtu
Supply Fan Usage	88,370	kWh

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Project Name:	University of Rochester Energy Conservation MP Support
Building:	Biomedical Engineering - Optics Building
Date:	4/1/2021
Calculated By:	CLF
Reviewed By:	GHB
System:	AHU-1 & 2
Scenario:	Existing

Summary of Use

Preheat Usage	1,798	mmBtu
Cooling Usage	3310	mmBtu
Reheat Usage	2870	mmBtu
Supply Fan Usage	327696	kWh

Scheduling / Population load (1=Occ 0=UnOcc)

	Schedule Days1-5	Population Days1-5	Schedule Days6,7,8	Population Days6,7,8
1	0	100%	0	100%
2	0	100%	0	100%
3	0	100%	0	100%
4	0	100%	0	100%
5	0	100%	0	100%
6	0	100%	0	100%
7	1	100%	1	100%
8	1	100%	1	100%
9	1	100%	1	100%
10	1	100%	1	100%
11	1	100%	1	100%
12	1	100%	1	100%
13	1	100%	1	100%
14	1	100%	1	100%
15	1	100%	1	100%
16	1	100%	1	100%
17	1	100%	1	100%
18	1	100%	1	100%
19	1	100%	1	100%
20	0	100%	0	100%
21	0	100%	0	100%
22	0	100%	0	100%
23	0	100%	0	100%
24	0	100%	0	100%

Fan Info

Fan Label	SF	
Fan HP:	125.0	
Fan QTY:	2.0	
Calculated Load Factor:	75%	
Fan Motor Eff:	90%	
Fan kW:	155.4	
Max Fan Flow:	73,000	
Fan Affinity Law Adjsut:	1.5	

Lab Airflow CFM Reduction

Occupied Design Ariflow	35,620	CFM
Unoccupied Design Airflow	17,990	CFM
Occupied Airflow Reduction	0	CFM
Unoccupied Airflow Reduction	0	CFM

Misc System Info

Cooling Shutoff	55	degF
Cooling Shutoff	5	May
Cooling Shutoff	10	October

Active Space Setpoints (Average)

OAT	Occ	Unocc	Load %
0	68.0	68.0	0.00%
10	68.0	68.0	0.00%
20	68.0	68.0	0.00%
30	68.0	68.0	0.00%
40	68.0	68.0	0.00%
50	68.0	68.0	0.00%
55	68.0	68.0	0.00%
60	69.2	69.2	0.00%
70	71.6	71.6	0.00%
80	74.0	74.0	0.00%
100	74.0	74.0	0.00%

System Setpoint Simulations

OAT	PHT STP	DAT STP	DAH STP	
0	55.0	65.0	25.6	
10	55.0	63.6	25.3	
20	55.0	62.1	24.9	
30	55.0	60.7	24.6	
40	55.0	59.3	24.2	
50	55.0	57.9	23.9	
55	55.0	57.1	23.7	
60	55.0	56.4	23.5	
70	55.0	55.0	23.2	
80	55.0	55.0	23.2	
100	55.0	55.0	23.2	
	1.585E-05	-0.001483	-0.109225	64.903594
	X=	28.00	Y=	61.03
	0	0	0	55
	X=	28.00	Y=	55.00
	3.861E-06	-0.000361	-0.026601	25.589599
	X=	90.00	Y=	23.08

Reheat Loading

OAT	DAT	Occ	Unocc	
0	85.0	85.0%	85.0%	
10	85.0	76.8%	76.8%	
20	85.0	68.5%	68.5%	
30	85.0	60.3%	60.3%	
40	85.0	52.0%	52.0%	
50	85.0	43.8%	43.8%	
55	85.0	39.6%	39.6%	
60	85.0	35.5%	35.5%	
70	85.0	27.3%	27.3%	
80	85.0	19.0%	19.0%	
100	85.0	2.5%	2.5%	
	0	0	0	85
	X=	0.00	Y=	85.00
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	0.00	Y=	0.85
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	55.00	Y=	0.40
	% of CFM to Reheat	100.0%		

Project Name: University of Rochester Energy Conservation MP Support
Building: Biomedical Engineering - Optics Building
Date: 44287.465
Calculated By: CLF
Reviewed By: GHB
System: AHU-1 & 2
Scenario: Existing

Formulas

D : Based on Simulation
E : Design CFM x Fan Simulation
F : ((E / Fan CFM Output)   Fan Affinity) x Fan Kw
G : 1.08 x (D - B) x E / 1,000,000
H : 4.5 x (C - Coil Enthalpy) x E / 1,000,000
J : Based on Simulation
K : Based on Simulation
L : 1.08 x (K - I) x E x % CFM to Reheat / 1,000,000

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
MAX	8.0	93.9	40.8	55.0	64.5	25.5	35620.0	53.0	1.9	2.7	75.9	85.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN	1.0	3.9	1.8	55.0	54.6	23.1	17990.0	19.0	0.0	0.0	54.6	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	36600	496470	194424	481800	501243	207772	241246750	327696	1798	3310	489054	744600	2870	0	0	0	0	0	0	0	0	0	0

Time Stamp	Type	Outside dry-bulb temp (F)	Specific Enthalpy (Btu/lb)	Preheat Setpoint	SAT STP (degF)	Enthalpy Setpoint	Supply Air CFM	Supply Fan Usage (kWh)	Preheat Usage (mmBtu)	Cooling Usage (mmBtu)	DAT (degF)	Reheat DAT (degF)	Reheat Usage (mmBtu)
1/1/17 0:00	7.0	41.0	14.4	55.0	59.0	24.2	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 1:00	7.0	37.9	12.6	55.0	59.5	24.3	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 2:00	7.0	37.0	11.9	55.0	59.6	24.3	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 3:00	7.0	34.0	11.2	55.0	60.1	24.4	17990	19	0.4	0.0	55.0	85.0	0.3
1/1/17 4:00	7.0	33.1	11.0	55.0	60.2	24.5	17990	19	0.4	0.0	55.0	85.0	0.3
1/1/17 5:00	7.0	28.9	9.8	55.0	60.9	24.6	17990	19	0.5	0.0	55.0	85.0	0.4
1/1/17 6:00	7.0	30.9	10.5	55.0	60.6	24.5	35620	53	0.9	0.0	55.0	85.0	0.7
1/1/17 7:00	7.0	32.0	10.7	55.0	60.4	24.5	35620	53	0.9	0.0	55.0	85.0	0.7
1/1/17 8:00	7.0	32.0	11.0	55.0	60.4	24.5	35620	53	0.9	0.0	55.0	85.0	0.7
1/1/17 9:00	7.0	35.1	11.7	55.0	59.9	24.4	35620	53	0.8	0.0	55.0	85.0	0.6
1/1/17 10:00	7.0	37.0	12.3	55.0	59.6	24.3	35620	53	0.7	0.0	55.0	85.0	0.6
1/1/17 11:00	7.0	41.0	13.3	55.0	59.0	24.2	35620	53	0.5	0.0	55.0	85.0	0.6
1/1/17 12:00	7.0	43.0	13.9	55.0	58.7	24.1	35620	53	0.5	0.0	55.0	85.0	0.6
1/1/17 13:00	7.0	45.0	14.6	55.0	58.4	24.0	35620	53	0.4	0.0	55.0	85.0	0.6
1/1/17 14:00	7.0	46.0	14.6	55.0	58.3	24.0	35620	53	0.3	0.0	55.0	85.0	0.5
1/1/17 15:00	7.0	46.9	15.0	55.0	58.2	23.9	35620	53	0.3	0.0	55.0	85.0	0.5
1/1/17 16:00	7.0	46.9	15.0	55.0	58.2	23.9	35620	53	0.3	0.0	55.0	85.0	0.5
1/1/17 17:00	7.0	44.1	14.5	55.0	58.6	24.0	35620	53	0.4	0.0	55.0	85.0	0.6
1/1/17 18:00	7.0	43.0	14.2	55.0	58.7	24.1	35620	53	0.5	0.0	55.0	85.0	0.6
1/1/17 19:00	7.0	42.1	14.0	55.0	58.9	24.1	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 20:00	7.0	39.9	13.6	55.0	59.2	24.2	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 21:00	7.0	39.9	13.4	55.0	59.2	24.2	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 22:00	7.0	41.0	14.1	55.0	59.0	24.2	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 23:00	7.0	44.1	14.8	55.0	58.6	24.0	17990	19	0.2	0.0	55.0	85.0	0.3
1/2/17 0:00	8.0	45.0	15.2	55.0	58.4	24.0	17990	19	0.2	0.0	55.0	85.0	0.3
1/2/17 1:00	8.0	44.1	15.0	55.0	58.6	24.0	17990	19	0.2	0.0	55.0	85.0	0.3
1/2/17 2:00	8.0	43.0	15.1	55.0	58.7	24.1	17990	19	0.2	0.0	55.0	85.0	0.3
1/2/17 3:00	8.0	42.1	15.2	55.0	58.9	24.1	17990	19	0.3	0.0	55.0	85.0	0.3
1/2/17 4:00	8.0	42.1	15.5	55.0	58.9	24.1	17990	19	0.3	0.0	55.0	85.0	0.3
1/2/17 5:00	8.0	42.1	15.5	55.0	58.9	24.1	17990	19	0.3	0.0	55.0	85.0	0.3
1/2/17 6:00	8.0	42.1	15.5	55.0	58.9	24.1	35620	53	0.5	0.0	55.0	85.0	0.6
1/2/17 7:00	8.0	42.1	15.5	55.0	58.9	24.1	35620	53	0.5	0.0	55.0	85.0	0.6
1/2/17 8:00	8.0	42.1	15.7	55.0	58.9	24.1	35620	53	0.5	0.0	55.0	85.0	0.6
1/2/17 9:00	8.0	43.0	15.9	55.0	58.7	24.1	35620	53	0.5	0.0	55.0	85.0	0.6
1/2/17 10:00	8.0	44.1	16.4	55.0	58.6	24.0	35620	53	0.4	0.0	55.0	85.0	0.6
1/2/17 11:00	8.0	46.0	17.3	55.0	58.3	24.0	35620	53	0.3	0.0	55.0	85.0	0.5
1/2/17 12:00	8.0	46.9	17.5	55.0	58.2	23.9	35620	53	0.3	0.0	55.0	85.0	0.5
1/2/17 13:00	8.0	48.9	18.5	55.0	57.9	23.9	35620	53	0.2	0.0	55.0	85.0	0.5
1/2/17 14:00	8.0	50.0	19.1	55.0	57.7	23.8	35620	53	0.2	0.0	55.0	85.0	0.5
1/2/17 15:00	8.0	51.1	19.4	55.0	57.6	23.8	35620	53	0.2	0.0	55.0	85.0	0.5
1/2/17 16:00	8.0	51.1	19.4	55.0	57.6	23.8	35620	53	0.2	0.0	55.0	85.0	0.5
1/2/17 17:00	8.0	50.0	19.1	55.0	57.7	23.8	35620	53	0.2	0.0	55.0	85.0	0.5
1/2/17 18:00	8.0	50.0	19.1	55.0	57.7	23.8	35620	53	0.2	0.0	55.0	85.0	0.5
1/2/17 19:00	8.0	50.0	19.3	55.0	57.7	23.8	17990	19	0.1	0.0	55.0	85.0	0.3

Project Name:	University of Rochester Energy Conservation MP Support
Building:	Biomedical Engineering - Optics Building
Date:	4/1/2021
Calculated By:	CLF
Reviewed By:	GHB
System:	AHU-1 & 2
Scenario:	Proposed System

Summary of Use

Preheat Usage	1,604	mmBtu
Cooling Usage	2912	mmBtu
Reheat Usage	2555	mmBtu
Supply Fan Usage	269142	kWh

Scheduling / Population load (1=Occ 0=UnOcc)

	Schedule Days1-5	Population Days1-5	Schedule Days6,7,8	Population Days6,7,8
1	0	100%	0	100%
2	0	100%	0	100%
3	0	100%	0	100%
4	0	100%	0	100%
5	0	100%	0	100%
6	0	100%	0	100%
7	1	100%	1	100%
8	1	100%	1	100%
9	1	100%	1	100%
10	1	100%	1	100%
11	1	100%	1	100%
12	1	100%	1	100%
13	1	100%	1	100%
14	1	100%	1	100%
15	1	100%	1	100%
16	1	100%	1	100%
17	1	100%	1	100%
18	1	100%	1	100%
19	1	100%	1	100%
20	0	100%	0	100%
21	0	100%	0	100%
22	0	100%	0	100%
23	0	100%	0	100%
24	0	100%	0	100%

Fan Info

Fan Label	SF
Fan HP:	125.0
Fan QTY:	2.0
Calculated Load Factor:	75%
Fan Motor Eff:	90%
Fan kW:	155.4
Max Fan Flow:	73,000
Fan Affinity Law Adjsut:	1.5

Misc System Info

Cooling Shutoff	55	degF
Cooling Shutoff	5	May
Cooling Shutoff	10	October

Active Space Setpoints (Average)

OAT	Occ	Unocc	Load %
0	68.0	68.0	0.00%
10	68.0	68.0	0.00%
20	68.0	68.0	0.00%
30	68.0	68.0	0.00%
40	68.0	68.0	0.00%
50	68.0	68.0	0.00%
55	68.0	68.0	0.00%
60	69.2	69.2	0.00%
70	71.6	71.6	0.00%
80	74.0	74.0	0.00%
90	74.0	74.0	0.00%

Lab Airflow CFM Reduction

Occupied Design Ariflow	35,620	CFM
Unoccupied Design Airflow	17,990	CFM
Occupied Airflow Reduction	5,772	CFM
Unoccupied Airflow Reduction	0	CFM

System Setpoint Simulations

OAT	PHT STP	DAT STP	DAH STP	
0	55.0	65.0	25.6	
10	55.0	63.6	25.3	
20	55.0	62.1	24.9	
30	55.0	60.7	24.6	
40	55.0	59.3	24.2	
50	55.0	57.9	23.9	
55	55.0	57.1	23.7	
60	55.0	56.4	23.5	
70	55.0	55.0	23.2	
80	55.0	55.0	23.2	
100	55.0	55.0	23.2	
	1.585E-05	-0.001483	-0.109225	64.903594
	X=	28.00	Y=	61.03
	0	0	0	55
	X=	28.00	Y=	55.00
	3.861E-06	-0.000361	-0.026601	25.589599
	X=	90.00	Y=	23.08

Reheat Loading

OAT	DAT	Occ	Unocc	
0	85.0	85.0%	85.0%	
10	85.0	76.8%	76.8%	
20	85.0	68.5%	68.5%	
30	85.0	60.3%	60.3%	
40	85.0	52.0%	52.0%	
50	85.0	43.8%	43.8%	
55	85.0	39.6%	39.6%	
60	85.0	35.5%	35.5%	
70	85.0	27.3%	27.3%	
80	85.0	19.0%	19.0%	
100	85.0	2.5%	2.5%	
	0	0	0	85
	X=	0.00	Y=	85.00
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	0.00	Y=	0.85
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	55.00	Y=	0.40
	% of CFM to Reheat	100.0%		

wendel

Project Name: University of Rochester Energy Conservation MP Support
Building: Biomedical Engineering - Optics Building
Date: 44287.465
Calculated By: CLF
Reviewed By: GHB
System: AHU-1 & 2
Scenario: Proposed System

Formulas

D : Based on Simulation
E : Design CFM x Fan Simulation
F : ((E / Fan CFM Output) Fan Affinity) x Fan Kw
G : 1.08 x (D - B) x E / 1,000,000
H : 4.5 x (C - Coil Enthalpy) x E / 1,000,000
J : Based on Simulation
K : Based on Simulation
L : 1.08 x (K - I) x E x % CFM to Reheat / 1,000,000

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
MAX	8.0	93.9	40.8	55.0	64.5	25.5	29847.7	40.6	1.6	2.2	75.9	85.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN	1.0	3.9	1.8	55.0	54.6	23.1	17990.0	19.0	0.0	0.0	54.6	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	36600	496470	194424	481800	501243	207772	213857028	269142	1604	2912	489054	744600	2555	0	0	0	0	0	0	0	0	0	0

Time Stamp	Type	Outside dry-bulb temp (F)	Specific Enthalpy (Btu/lb)	Preheat Setpoint	SAT STP (degF)	Enthalpy Setpoint	Supply Air CFM	Supply Fan Usage (kWh)	Preheat Usage (mmBtu)	Cooling Usage (mmBtu)	DAT (degF)	Reheat DAT (degF)	Reheat Usage (mmBtu)
1/1/17 0:00	7.0	41.0	14.4	55.0	59.0	24.2	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 1:00	7.0	37.9	12.6	55.0	59.5	24.3	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 2:00	7.0	37.0	11.9	55.0	59.6	24.3	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 3:00	7.0	34.0	11.2	55.0	60.1	24.4	17990	19	0.4	0.0	55.0	85.0	0.3
1/1/17 4:00	7.0	33.1	11.0	55.0	60.2	24.5	17990	19	0.4	0.0	55.0	85.0	0.3
1/1/17 5:00	7.0	28.9	9.8	55.0	60.9	24.6	17990	19	0.5	0.0	55.0	85.0	0.4
1/1/17 6:00	7.0	30.9	10.5	55.0	60.6	24.5	29848	41	0.8	0.0	55.0	85.0	0.6
1/1/17 7:00	7.0	32.0	10.7	55.0	60.4	24.5	29848	41	0.7	0.0	55.0	85.0	0.6
1/1/17 8:00	7.0	32.0	11.0	55.0	60.4	24.5	29848	41	0.7	0.0	55.0	85.0	0.6
1/1/17 9:00	7.0	35.1	11.7	55.0	59.9	24.4	29848	41	0.6	0.0	55.0	85.0	0.5
1/1/17 10:00	7.0	37.0	12.3	55.0	59.6	24.3	29848	41	0.6	0.0	55.0	85.0	0.5
1/1/17 11:00	7.0	41.0	13.3	55.0	59.0	24.2	29848	41	0.5	0.0	55.0	85.0	0.5
1/1/17 12:00	7.0	43.0	13.9	55.0	58.7	24.1	29848	41	0.4	0.0	55.0	85.0	0.5
1/1/17 13:00	7.0	45.0	14.6	55.0	58.4	24.0	29848	41	0.3	0.0	55.0	85.0	0.5
1/1/17 14:00	7.0	46.0	14.6	55.0	58.3	24.0	29848	41	0.3	0.0	55.0	85.0	0.5
1/1/17 15:00	7.0	46.9	15.0	55.0	58.2	23.9	29848	41	0.3	0.0	55.0	85.0	0.4
1/1/17 16:00	7.0	46.9	15.0	55.0	58.2	23.9	29848	41	0.3	0.0	55.0	85.0	0.4
1/1/17 17:00	7.0	44.1	14.5	55.0	58.6	24.0	29848	41	0.4	0.0	55.0	85.0	0.5
1/1/17 18:00	7.0	43.0	14.2	55.0	58.7	24.1	29848	41	0.4	0.0	55.0	85.0	0.5
1/1/17 19:00	7.0	42.1	14.0	55.0	58.9	24.1	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 20:00	7.0	39.9	13.6	55.0	59.2	24.2	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 21:00	7.0	39.9	13.4	55.0	59.2	24.2	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 22:00	7.0	41.0	14.1	55.0	59.0	24.2	17990	19	0.3	0.0	55.0	85.0	0.3
1/1/17 23:00	7.0	44.1	14.8	55.0	58.6	24.0	17990	19	0.2	0.0	55.0	85.0	0.3
1/2/17 0:00	8.0	45.0	15.2	55.0	58.4	24.0	17990	19	0.2	0.0	55.0	85.0	0.3
1/2/17 1:00	8.0	44.1	15.0	55.0	58.6	24.0	17990	19	0.2	0.0	55.0	85.0	0.3
1/2/17 2:00	8.0	43.0	15.1	55.0	58.7	24.1	17990	19	0.2	0.0	55.0	85.0	0.3
1/2/17 3:00	8.0	42.1	15.2	55.0	58.9	24.1	17990	19	0.3	0.0	55.0	85.0	0.3
1/2/17 4:00	8.0	42.1	15.5	55.0	58.9	24.1	17990	19	0.3	0.0	55.0	85.0	0.3
1/2/17 5:00	8.0	42.1	15.5	55.0	58.9	24.1	17990	19	0.3	0.0	55.0	85.0	0.3
1/2/17 6:00	8.0	42.1	15.5	55.0	58.9	24.1	29848	41	0.4	0.0	55.0	85.0	0.5
1/2/17 7:00	8.0	42.1	15.5	55.0	58.9	24.1	29848	41	0.4	0.0	55.0	85.0	0.5
1/2/17 8:00	8.0	42.1	15.7	55.0	58.9	24.1	29848	41	0.4	0.0	55.0	85.0	0.5
1/2/17 9:00	8.0	43.0	15.9	55.0	58.7	24.1	29848	41	0.4	0.0	55.0	85.0	0.5
1/2/17 10:00	8.0	44.1	16.4	55.0	58.6	24.0	29848	41	0.4	0.0	55.0	85.0	0.5
1/2/17 11:00	8.0	46.0	17.3	55.0	58.3	24.0	29848	41	0.3	0.0	55.0	85.0	0.5
1/2/17 12:00	8.0	46.9	17.5	55.0	58.2	23.9	29848	41	0.3	0.0	55.0	85.0	0.4
1/2/17 13:00	8.0	48.9	18.5	55.0	57.9	23.9	29848	41	0.2	0.0	55.0	85.0	0.4
1/2/17 14:00	8.0	50.0	19.1	55.0	57.7	23.8	29848	41	0.2	0.0	55.0	85.0	0.4
1/2/17 15:00	8.0	51.1	19.4	55.0	57.6	23.8	29848	41	0.1	0.0	55.0	85.0	0.4
1/2/17 16:00	8.0	51.1	19.4	55.0	57.6	23.8	29848	41	0.1	0.0	55.0	85.0	0.4
1/2/17 17:00	8.0	50.0	19.1	55.0	57.7	23.8	29848	41	0.2	0.0	55.0	85.0	0.4
1/2/17 18:00	8.0	50.0	19.1	55.0	57.7	23.8	29848	41	0.2	0.0	55.0	85.0	0.4
1/2/17 19:00	8.0	50.0	19.3	55.0	57.7	23.8	17990	19	0.1	0.0	55.0	85.0	0.3

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Project Name:	University of Rochester Energy Conservation MP Support
Building:	Biomedical Engineering - Optics Building
Date:	4/1/2021
Calculated By:	CLF
Reviewed By:	GHB
System:	
Scenario:	Proposed System

Summary of Use

Preheat Usage	1,457	mmBtu
Cooling Usage	2684	mmBtu
Reheat Usage	2327	mmBtu
Supply Fan Usage	239326	kWh

Scheduling / Population load (1=Occ 0=UnOcc)

	Schedule Days1-5	Population Days1-5	Schedule Days6,7,8	Population Days6,7,8
1	0	100%	0	100%
2	0	100%	0	100%
3	0	100%	0	100%
4	0	100%	0	100%
5	0	100%	0	100%
6	0	100%	0	100%
7	1	100%	1	100%
8	1	100%	1	100%
9	1	100%	1	100%
10	1	100%	1	100%
11	1	100%	1	100%
12	1	100%	1	100%
13	1	100%	1	100%
14	1	100%	1	100%
15	1	100%	1	100%
16	1	100%	1	100%
17	1	100%	1	100%
18	1	100%	1	100%
19	1	100%	1	100%
20	0	100%	0	100%
21	0	100%	0	100%
22	0	100%	0	100%
23	0	100%	0	100%
24	0	100%	0	100%

Fan Info

Fan Label	SF
Fan HP:	125.0
Fan QTY:	2.0
Calculated Load Factor:	75%
Fan Motor Eff:	90%
Fan kW:	155.4
Max Fan Flow:	73,000
Fan Affinity Law Adjsut:	1.5

Misc System Info

Cooling Shutoff	55	degF
Cooling Shutoff	5	May
Cooling Shutoff	10	October

Active Space Setpoints (Average)

OAT	Occ	Unocc	Load %
0	68.0	68.0	0.00%
10	68.0	68.0	0.00%
20	68.0	68.0	0.00%
30	68.0	68.0	0.00%
40	68.0	68.0	0.00%
50	68.0	68.0	0.00%
55	68.0	68.0	0.00%
60	69.2	69.2	0.00%
70	71.6	71.6	0.00%
80	74.0	74.0	0.00%
90	74.0	74.0	0.00%

Lab Airflow CFM Reduction

Occupied Design Ariflow	35,620	CFM
Unoccupied Design Airflow	17,990	CFM
Occupied Airflow Reduction	6,701	CFM
Unoccupied Airflow Reduction	3,453	CFM

System Setpoint Simulations

OAT	PHT STP	DAT STP	DAH STP	
0	55.0	65.0	25.6	
10	55.0	63.6	25.3	
20	55.0	62.1	24.9	
30	55.0	60.7	24.6	
40	55.0	59.3	24.2	
50	55.0	57.9	23.9	
55	55.0	57.1	23.7	
60	55.0	56.4	23.5	
70	55.0	55.0	23.2	
80	55.0	55.0	23.2	
100	55.0	55.0	23.2	
	1.585E-05	-0.001483	-0.109225	64.903594
	X=	28.00	Y=	61.03
	0	0	0	55
	X=	28.00	Y=	55.00
	3.861E-06	-0.000361	-0.026601	25.589599
	X=	90.00	Y=	23.08

Reheat Loading

OAT	DAT	Occ	Unocc	
0	85.0	85.0%	85.0%	
10	85.0	76.8%	76.8%	
20	85.0	68.5%	68.5%	
30	85.0	60.3%	60.3%	
40	85.0	52.0%	52.0%	
50	85.0	43.8%	43.8%	
55	85.0	39.6%	39.6%	
60	85.0	35.5%	35.5%	
70	85.0	27.3%	27.3%	
80	85.0	19.0%	19.0%	
100	85.0	2.5%	2.5%	
	0	0	0	85
	X=	0.00	Y=	85.00
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	0.00	Y=	0.85
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	55.00	Y=	0.40
	% of CFM to Reheat	100.0%		

wendel

Project Name:	University of Rochester Energy Conservation MP Support
Building:	Biomedical Engineering - Optics Building
Date:	44287.465
Calculated By:	CLF
Reviewed By:	GHB
System:	0
Scenario:	Proposed System

Formulas

D : Based on Simulation
E : Design CFM x Fan Simulation
F : ((E / Fan CFM Output) Fan Affinity) x Fan Kw
G : 1.08 x (D - B) x E / 1,000,000
H : 4.5 x (C - Coil Enthalpy) x E / 1,000,000
J : Based on Simulation
K : Based on Simulation
L : 1.08 x (K - I) x E x % CFM to Reheat / 1,000,000

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
MAX	8.0	93.9	40.8	55.0	64.5	25.5	28919.0	38.8	1.6	2.2	75.9	85.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN	1.0	3.9	1.8	55.0	54.6	23.1	14536.8	13.8	0.0	0.0	54.6	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	36600	496470	194424	481800	501243	207772	195586041	239326	1457	2684	489054	744600	2327	0	0	0	0	0	0	0	0	0	0

Time Stamp	Type	Outside dry-bulb temp (F)	Specific Enthalpy (Btu/lb)	Preheat Setpoint	SAT STP (degF)	Enthalpy Setpoint	Supply Air CFM	Supply Fan Usage (kWh)	Preheat Usage (mmBtu)	Cooling Usage (mmBtu)	DAT (degF)	Reheat DAT (degF)	Reheat Usage (mmBtu)
1/1/17 0:00	7.0	41.0	14.4	55.0	59.0	24.2	14537	14	0.2	0.0	55.0	85.0	0.2
1/1/17 1:00	7.0	37.9	12.6	55.0	59.5	24.3	14537	14	0.3	0.0	55.0	85.0	0.3
1/1/17 2:00	7.0	37.0	11.9	55.0	59.6	24.3	14537	14	0.3	0.0	55.0	85.0	0.3
1/1/17 3:00	7.0	34.0	11.2	55.0	60.1	24.4	14537	14	0.3	0.0	55.0	85.0	0.3
1/1/17 4:00	7.0	33.1	11.0	55.0	60.2	24.5	14537	14	0.3	0.0	55.0	85.0	0.3
1/1/17 5:00	7.0	28.9	9.8	55.0	60.9	24.6	14537	14	0.4	0.0	55.0	85.0	0.3
1/1/17 6:00	7.0	30.9	10.5	55.0	60.6	24.5	28919	39	0.8	0.0	55.0	85.0	0.6
1/1/17 7:00	7.0	32.0	10.7	55.0	60.4	24.5	28919	39	0.7	0.0	55.0	85.0	0.5
1/1/17 8:00	7.0	32.0	11.0	55.0	60.4	24.5	28919	39	0.7	0.0	55.0	85.0	0.5
1/1/17 9:00	7.0	35.1	11.7	55.0	59.9	24.4	28919	39	0.6	0.0	55.0	85.0	0.5
1/1/17 10:00	7.0	37.0	12.3	55.0	59.6	24.3	28919	39	0.6	0.0	55.0	85.0	0.5
1/1/17 11:00	7.0	41.0	13.3	55.0	59.0	24.2	28919	39	0.4	0.0	55.0	85.0	0.5
1/1/17 12:00	7.0	43.0	13.9	55.0	58.7	24.1	28919	39	0.4	0.0	55.0	85.0	0.5
1/1/17 13:00	7.0	45.0	14.6	55.0	58.4	24.0	28919	39	0.3	0.0	55.0	85.0	0.4
1/1/17 14:00	7.0	46.0	14.6	55.0	58.3	24.0	28919	39	0.3	0.0	55.0	85.0	0.4
1/1/17 15:00	7.0	46.9	15.0	55.0	58.2	23.9	28919	39	0.3	0.0	55.0	85.0	0.4
1/1/17 16:00	7.0	46.9	15.0	55.0	58.2	23.9	28919	39	0.3	0.0	55.0	85.0	0.4
1/1/17 17:00	7.0	44.1	14.5	55.0	58.6	24.0	28919	39	0.3	0.0	55.0	85.0	0.5
1/1/17 18:00	7.0	43.0	14.2	55.0	58.7	24.1	28919	39	0.4	0.0	55.0	85.0	0.5
1/1/17 19:00	7.0	42.1	14.0	55.0	58.9	24.1	14537	14	0.2	0.0	55.0	85.0	0.2
1/1/17 20:00	7.0	39.9	13.6	55.0	59.2	24.2	14537	14	0.2	0.0	55.0	85.0	0.2
1/1/17 21:00	7.0	39.9	13.4	55.0	59.2	24.2	14537	14	0.2	0.0	55.0	85.0	0.2
1/1/17 22:00	7.0	41.0	14.1	55.0	59.0	24.2	14537	14	0.2	0.0	55.0	85.0	0.2
1/1/17 23:00	7.0	44.1	14.8	55.0	58.6	24.0	14537	14	0.2	0.0	55.0	85.0	0.2
1/2/17 0:00	8.0	45.0	15.2	55.0	58.4	24.0	14537	14	0.2	0.0	55.0	85.0	0.2
1/2/17 1:00	8.0	44.1	15.0	55.0	58.6	24.0	14537	14	0.2	0.0	55.0	85.0	0.2
1/2/17 2:00	8.0	43.0	15.1	55.0	58.7	24.1	14537	14	0.2	0.0	55.0	85.0	0.2
1/2/17 3:00	8.0	42.1	15.2	55.0	58.9	24.1	14537	14	0.2	0.0	55.0	85.0	0.2
1/2/17 4:00	8.0	42.1	15.5	55.0	58.9	24.1	14537	14	0.2	0.0	55.0	85.0	0.2
1/2/17 5:00	8.0	42.1	15.5	55.0	58.9	24.1	14537	14	0.2	0.0	55.0	85.0	0.2
1/2/17 6:00	8.0	42.1	15.5	55.0	58.9	24.1	28919	39	0.4	0.0	55.0	85.0	0.5
1/2/17 7:00	8.0	42.1	15.5	55.0	58.9	24.1	28919	39	0.4	0.0	55.0	85.0	0.5
1/2/17 8:00	8.0	42.1	15.7	55.0	58.9	24.1	28919	39	0.4	0.0	55.0	85.0	0.5
1/2/17 9:00	8.0	43.0	15.9	55.0	58.7	24.1	28919	39	0.4	0.0	55.0	85.0	0.5
1/2/17 10:00	8.0	44.1	16.4	55.0	58.6	24.0	28919	39	0.3	0.0	55.0	85.0	0.5
1/2/17 11:00	8.0	46.0	17.3	55.0	58.3	24.0	28919	39	0.3	0.0	55.0	85.0	0.4
1/2/17 12:00	8.0	46.9	17.5	55.0	58.2	23.9	28919	39	0.3	0.0	55.0	85.0	0.4
1/2/17 13:00	8.0	48.9	18.5	55.0	57.9	23.9	28919	39	0.2	0.0	55.0	85.0	0.4
1/2/17 14:00	8.0	50.0	19.1	55.0	57.7	23.8	28919	39	0.2	0.0	55.0	85.0	0.4
1/2/17 15:00	8.0	51.1	19.4	55.0	57.6	23.8	28919	39	0.1	0.0	55.0	85.0	0.4
1/2/17 16:00	8.0	51.1	19.4	55.0	57.6	23.8	28919	39	0.1	0.0	55.0	85.0	0.4
1/2/17 17:00	8.0	50.0	19.1	55.0	57.7	23.8	28919	39	0.2	0.0	55.0	85.0	0.4
1/2/17 18:00	8.0	50.0	19.1	55.0	57.7	23.8	28919	39	0.2	0.0	55.0	85.0	0.4
1/2/17 19:00	8.0	50.0	19.3	55.0	57.7	23.8	14537	14	0.1	0.0	55.0	85.0	0.2

UNIVERSITY OF ROCHESTER

Laboratory Air Flow Optimization

Del Monte

Option A

Building Utility Impact		
Building Level Energy Savings		
Electrical Energy Savings	419	mmBtu/Year
Chilled Water Savings	2,762	mmBtu/Year
Steam Savings	3,537	mmBtu/Year
Total Energy Savings	**6,717**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	122,805	kWh/Year
Chilled Water Savings	230,144	Ton-Hour/Year
Steam Savings	3,537	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	$0	Per Year

UNIVERSITY OF ROCHESTER

Laboratory Air Flow Optimization

Del Monte

Option B

Building Utility Impact		
Building Level Energy Savings		
Electrical Energy Savings	425	mmBtu/Year
Chilled Water Savings	2,813	mmBtu/Year
Steam Savings	3,619	mmBtu/Year
Total Energy Savings	**6,856**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	124,439	kWh/Year
Chilled Water Savings	234,395	Ton-Hour/Year
Steam Savings	3,619	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	$0	Per Year

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Project Name: University of Rochester Energy Conservation MP Support
Building: Del Monte
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Existing Conditions							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Total Hood Exhaust CFM	General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH	Pressurization		CFM/Sqft
1-11006	Lab	116	9	1,041	AHS-L-5	121			-			-			-			-			-			-	-	178	178		10.3	(57)		1.0
1-11001	Lab	3146	9	28,313	AHS-L-5	6,561	6.7	106.0	709	6.7	108.0	722	6.7	103.0	688	6.7	92.0	615			-			-	2,734	7,265	9,999		21.2	(3,438)		2.1
1-11002	Lab	210	9	1,888	AHS-L-5	334			-			-			-			-			-			-	-	482	482		15.3	(148)		1.6
1-11301 (S)	Lab	1615	9	14,536	AHS-L-5	3,728	6.7	109.0	729	6.7	110.0	735			-			-			-			-	1,464	3,825	5,289		21.8	(1,561)		2.3
1-11301 (N)	Lab	1597	9	14,373	AHS-L-4	3,540	6.7	102.0	682	6.7	91.0	608			-			-			-			-	1,290	3,650	4,940		20.6	(1,400)		2.2
1-11311	Lab	3144	9	28,292	AHS-L-4	7,078	6.7	96.0	642	6.7	100.0	668			-			-			-			-	1,310	7,396	8,706		18.5	(1,628)		2.3
1-11310	Lab	102	9	914	AHE-L-4	-			-			-			-			-			-			-	-	215	215		14.1	(215)		-
1-11306	Lab	195	9	1,751	AHS-L-5	303			-			-			-			-			-			-	-	448	448		15.3	(145)		1.6
1-11304	Lab	410	9	3,688	AHS-L-5	743			-			-			-			-			-			-	-	1,112	1,112		18.1	(369)		1.8
1-11353	Lab	101	9	911	AHS-L-4	140			-			-			-			-			-			-	-	202	202		13.3	(62)		1.4
1-11308	Lab	206	9	1,850	AHS-L-4	310			-			-			-			-			-			-	-	436	436		14.1	(126)		1.5
1-11320	Lab	211	9	1,903	AHS-L-4	383			-			-			-			-			-			-	-	530	530		16.7	(147)		1.8
1-11316	Lab	195	9	1,751	AHS-L-4	290			-			-			-			-			-			-	-	446	446		15.3	(156)		1.5
1-11314	Lab	299	9	2,691	AHS-L-4	502			-			-			-			-			-			-	-	718	718		16.0	(216)		1.7
1-11312	Lab	101	9	911	AHS-L-4	588	6.7	103.0	688			-			-			-			-			-	688	-	688		45.4	(100)		5.8
1-11318	Lab	211	9	1,902	AHS-L-4	464			-			-			-			-			-			-	-	496	496		15.6	(32)		2.2
1-11322	Lab	202	9	1,822	AHS-L-4	314			-			-			-			-			-			-	-	458	458		15.1	(144)		1.6
2-11001	Lab	3156	9	28,408	AHS-L-5	7,849	6.7	101.0	675			-			-			-			-			-	675	8,024	8,699		18.4	(850)		2.5
2-11002	Lab	209	9	1,884	AHS-L-5	381			-			-			-			-			-			-	-	547	547		17.4	(166)		1.8
2-11301 (S)	Lab	1624	9	14,620	AHS-L-5	3,701	6.7	110.0	735			-			-			-			-			-	735	4,066	4,801		19.7	(1,100)		2.3
2-11301 (N)	Lab	1601	9	14,409	AHS-L-4	3,771			-			-			-			-			-			-	-	3,918	3,918		16.3	(147)		2.4
2-11311	Lab	3160	9	28,437	AHS-L-4	7,169	6.7	94.0	628			-			-			-			-			-	628	7,837	8,465		17.9	(1,296)		2.3
2-11310	Lab	101	9	911	AHS-L-4	150			-			-			-			-			-			-	-	205	205		13.5	(55)		1.5
2-11306 (S)	Lab	203	9	1,825	AHS-L-5	897			-			-			-			-			-			-	-	506	506		16.6	391		4.4
2-11306 (N)	Lab	206	9	1,850	AHE-L-4	-			-			-			-			-			-			-	-	512	512		16.6	(512)		-
2-11304	Lab	300	9	2,700	AHS-L-5	463			-			-			-			-			-			-	-	675	675		15.0	(212)		1.5
2-11302	Lab	101	9	911	AHS-L-5	602	6.7	116.0	775			-			-			-			-			-	775	-	775		51.1	(173)		5.9
2-11350	Lab	212	9	1,911	AHE-L-4	-			-			-			-			-			-			-	-	654	654		20.5	(654)		-
2-11322	Lab	422	9	3,799	AHS-L-4	856			-			-			-			-			-			-	-	950	950		15.0	(94)		2.0
2-11318	Lab	202	9	1,821	AHS-L-4	335			-			-			-			-			-			-	-	454	454		15.0	(119)		1.7
2-11314	Lab	299	9	2,690	AHS-L-4	480			-			-			-			-			-			-	-	660	660		14.7	(180)		1.6
2-11312	Lab	101	9	911	AHS-L-4	609	6.3	90.0	563			-			-			-			-			-	563	-	563		37.0	47		6.0
2-11320	Lab	204	9	1,833	AHS-L-4	357			-			-			-			-			-			-	-	505	505		16.5	(148)		1.8
3-11006	Lab	116	9	1,041	AHS-L-5	165			-			-			-			-			-			-	-	247	247		14.2	(82)		1.4
3-11001	Lab	3147	9	28,325	AHS-L-5	6,770	6.7	95.0	635	6.7	105.0	702	6.7	94.0	628	6.7	102.0	682			-			-	2,647	7,820	10,467		22.2	(3,697)		2.2
3-11002	Lab	209	9	1,883	AHS-L-5	486			-			-			-			-			-			-	-	1,775	1,775		56.6	(1,289)		2.3
3-11301	Lab	1607	9	14,464	AHS-L-5	3,725	6.7	95.0	635			-			-			-			-			-	635	4,358	4,993		20.7	(1,268)		2.3
3-11311	Lab	4752	9	42,769	AHS-L-4	10,323	6.7	107.0	715	6.7	99.0	662	6.7	95.0	635	6.7	101.0	675	6.7	103.0	688	6.7	102.0	682	4,057	11,927	15,984		22.4	(5,661)		2.2
3-11310	Lab	101	9	909	AHS-L-4	146			-			-			-			-			-			-	-	192	192		12.7	(46)		1.4
3-11353	Lab	101	9	911	AHS-L-4	195			-			-			-			-			-			-	-	286	286		18.8	(91)		1.9
3-11308	Lab	205	9	1,848	AHS-L-4	564	6.7	107.0	715			-			-			-			-			-	715	-	715		23.2	(151)		2.7
3-11306	Lab	194	9	1,750	AHS-L-5	305			-			-			-			-			-			-	-	434	434		14.9	(129)		1.6
3-11304	Lab	194	9	1,750	AHS-L-5	570	6.7	98.0	655			-			-			-			-			-	655	-	655		22.5	(85)		2.9
3-11302	Lab	204	9	1,834	AHS-L-5	378			-			-			-			-			-			-	-	427	427		14.0	(49)		1.9
3-11320	Lab	204	9	1,834	AHS-L-4	553			-			-			-			-			-			-	-	603	603		19.7	(50)		2.7
3-11318	Lab	208	9	1,875	AHS-L-4	325			-			-			-			-			-			-	-	443	443		14.2	(118)		1.6
3-11316	Lab	195	9	1,751	AHS-L-4	306			-			-			-			-			-			-	-	425	425		14.6	(119)		1.6
3-11314	Lab	195	9	1,751	AHS-L-4	304			-			-			-			-			-			-	-	423	423		14.5	(119)		1.6
3-11312	Lab	206	9	1,858	AHS-L-4	765	6.7	103.0	688			-			-			-			-			-	688	130	818		26.4	(53)		3.7
3-11322	Lab	101	9	911	AHS-L-4	587	6.7	94.0	628			-			-			-			-			-	628	-	628		41.4	(41)		5.8
		35,794	432	322,150	-	79,486	113	1,726	11,498	40	613	4,097	20	292	1,952	20	295	1,972	7	103	688	7	102	682	20,889	86,860	107,749	-	1,001	(28,263)	-	110

Project Name: University of Rochester Energy Conservation MP Support
Building: Del Monte
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Desired Face Velocity 80 FPM | 1 CFM/SQFT | Desired Lab ACH 8

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	Pressurization		CFM/Sqft
1-11006	Lab	116	9	1,041	AHS-L-5	116	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	173	173	173	10	(57)		1.0
1-11001	Lab	3,146	9	28,313	AHS-L-5	3,146	6.7	106	708.51	7	108	721.88	7	103	688	7	92	615	-	-	-	-	-	-	2,734	3,850	6,584	6,584	14	(3,438)		1.0
1-11002	Lab	210	9	1,888	AHS-L-5	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	358	358	358	11	(148)		1.0
1-11301 (S)	Lab	1,615	9	14,536	AHS-L-5	1,615	6.7	109	728.56	7	110	735.24	-	-	-	-	-	-	-	-	-	-	-	-	1,464	1,712	3,176	3,176	13	(1,561)		1.0
1-11301 (N)	Lab	1,597	9	14,373	AHS-L-4	1,597	6.7	102	682	7	91	608	-	-	-	-	-	-	-	-	-	-	-	-	1,290	1,707	2,997	2,997	13	(1,400)		1.0
1-11311	Lab	3,144	9	28,292	AHS-L-4	3,144	6.7	96	642	7	100	668	-	-	-	-	-	-	-	-	-	-	-	-	1,310	3,462	4,772	4,772	10	(1,628)		1.0
1-11310	Lab	102	9	914	AHE-L-4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	220	220	220	14	(215)		0.0
1-11306	Lab	195	9	1,751	AHS-L-5	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	340	340	340	12	(145)		1.0
1-11304	Lab	410	9	3,688	AHS-L-5	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	779	779	779	13	(369)		1.0
1-11353	Lab	101	9	911	AHS-L-4	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	163	163	163	11	(62)		1.0
1-11308	Lab	206	9	1,850	AHS-L-4	206	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	332	332	332	11	(126)		1.0
1-11320	Lab	211	9	1,903	AHS-L-4	211	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	358	358	358	11	(147)		1.0
1-11316	Lab	195	9	1,751	AHS-L-4	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	351	351	351	12	(156)		1.0
1-11314	Lab	299	9	2,691	AHS-L-4	299	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	515	515	515	11	(216)		1.0
1-11312	Lab	101	9	911	AHS-L-4	588	6.7	103	688	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	688	-	202	688	45	(100)		5.8
1-11318	Lab	211	9	1,902	AHS-L-4	222	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	254	254	254	8	(32)		1.0
1-11322	Lab	202	9	1,822	AHS-L-4	202	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	346	346	346	11	(144)		1.0
2-11001	Lab	3,156	9	28,408	AHS-L-5	3,156	6.7	101	675	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	675	3,331	4,007	4,007	8	(850)		1.0
2-11002	Lab	209	9	1,884	AHS-L-5	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	375	375	375	12	(166)		1.0
2-11301 (S)	Lab	1,624	9	14,620	AHS-L-5	1,624	6.7	110	735	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735	1,989	2,725	2,725	11	(1,100)		1.0
2-11301 (N)	Lab	1,601	9	14,409	AHS-L-4	1,774	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,921	1,921	1,921	8	(147)		1.1
2-11311	Lab	3,160	9	28,437	AHS-L-4	3,160	6.7	94	628	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	628	3,828	4,456	4,456	9	(1,296)		1.0
2-11310	Lab	101	9	911	AHS-L-4	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	156	156	156	10	(55)		1.0
2-11306 (S)	Lab	203	9	1,825	AHS-L-5	634	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	243	243	243	8	391		3.1
2-11306 (N)	Lab	206	9	1,850	AHE-L-4	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	520	520	520	17	(512)		0.0
2-11304	Lab	300	9	2,700	AHS-L-5	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	512	512	512	11	(212)		1.0
2-11302	Lab	101	9	911	AHS-L-5	602	6.7	116	775	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	775	-	275	775	51	(173)		5.9
2-11350	Lab	212	9	1,911	AHE-L-4	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	700	700	700	22	(654)		0.2
2-11322	Lab	422	9	3,799	AHS-L-4	422	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	516	516	516	8	(94)		1.0
2-11318	Lab	202	9	1,821	AHS-L-4	202	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	321	321	321	11	(119)		1.0
2-11314	Lab	299	9	2,690	AHS-L-4	299	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	479	479	479	11	(180)		1.0
2-11312	Lab	101	9	911	AHS-L-4	609	6.3	90	563	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	563	-	121	563	37	47		6.0
2-11320	Lab	204	9	1,833	AHS-L-4	204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	352	352	352	12	(148)		1.0
3-11006	Lab	116	9	1,041	AHS-L-5	116	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	198	198	11	(82)		1.0
3-11001	Lab	3,147	9	28,325	AHS-L-5	3,147	6.7	95	635	7	105	702	7	94	628	7	102	682	-	-	-	-	-	-	2,647	4,197	6,844	6,844	14	(3,697)		1.0
3-11002	Lab	209	9	1,883	AHS-L-5	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,498	1,498	1,498	48	(1,289)		1.0
3-11301	Lab	1,607	9	14,464	AHS-L-5	1,607	6.7	95	635	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	635	2,240	2,875	2,875	12	(1,268)		1.0
3-11311	Lab	4,752	9	42,769	AHS-L-4	4,752	6.7	107	715	7	99	662	7	95	635	7	101	675	7	103	688	7	102	682	4,057	6,356	10,413	10,413	15	(5,661)		1.0
3-11310	Lab	101	9	909	AHS-L-4	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	147	147	147	10	(46)		1.0
3-11353	Lab	101	9	911	AHS-L-4	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	192	192	192	13	(91)		1.0
3-11308	Lab	205	9	1,848	AHS-L-4	564	6.7	107	715	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	715	-	357	715	23	(151)		2.7
3-11306	Lab	194	9	1,750	AHS-L-5	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	323	323	323	11	(129)		1.0
3-11304	Lab	194	9	1,750	AHS-L-5	570	6.7	98	655	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	655	-	279	655	22	(85)		2.9
3-11302	Lab	204	9	1,834	AHS-L-5	204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	253	253	253	8	(49)		1.0
3-11320	Lab	204	9	1,834	AHS-L-4	204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	254	254	254	8	(50)		1.0
3-11318	Lab	208	9	1,875	AHS-L-4	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	326	326	326	10	(118)		1.0
3-11316	Lab	195	9	1,751	AHS-L-4	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	314	314	314	11	(119)		1.0
3-11314	Lab	195	9	1,751	AHS-L-4	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	314	314	314	11	(119)		1.0
3-11312	Lab	206	9	1,858	AHS-L-4	635	6.7	103	688	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	688	-	260	688	22	(53)		3.1
3-11322	Lab	101	9	911	AHS-L-4	587	6.7	94	628	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	628	-	143	628	41	(41)		5.8
		36,102	450	324,918	-	39,401	113.2	1,726	11,498	40	613	4,097	20	292	1,952	20	295	1,972	7	103	688	7	102	682	20,889	46,775	64,586	67,663	769	(28,263)	-	74.9

wendel

Project Name: University of Rochester Energy Conservation MP Support
Building: Del Monte
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Existing Conditions							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Total Hood Exhaust CFM	General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH	Pressurization		CFM/Sqft
1-11006	Lab	116	9	1,041	AHS-L-5	33			-			-			-			-			-			-	-	49	49		2.8	(16)		0.3
1-11001	Lab	3146	9	28,313	AHS-L-5	1,650			208			208			208			208			-			-	832	1,069	1,901		4.0	(251)		0.5
1-11002	Lab	210	9	1,888	AHS-L-5	64			-			-			-			-			-			-	-	108	108		3.4	(44)		0.3
1-11301 (S)	Lab	1615	9	14,536	AHS-L-5	851			208			208			-			-			-			-	416	559	975		4.0	(124)		0.5
1-11301 (N)	Lab	1597	9	14,373	AHS-L-4	839			208			208			-			-			-			-	416	482	898		3.7	(59)		0.5
1-11311	Lab	3144	9	28,292	AHS-L-4	1,615			208			208			-			-			-			-	416	1,662	2,078		4.4	(463)		0.5
1-11310	Lab	102	9	914	AHE-L-4	-			-			-			-			-			-			-	-	48	48		3.2	(48)		-
1-11306	Lab	195	9	1,751	AHS-L-5	73			-			-			-			-			-			-	-	130	130		4.5	(57)		0.4
1-11304	Lab	410	9	3,688	AHS-L-5	182			-			-			-			-			-			-	-	328	328		5.3	(146)		0.4
1-11353	Lab	101	9	911	AHS-L-4	35			-			-			-			-			-			-	-	45	45		3.0	(10)		0.3
1-11308	Lab	206	9	1,850	AHS-L-4	81			-			-			-			-			-			-	-	134	134		4.3	(53)		0.4
1-11320	Lab	211	9	1,903	AHS-L-4	84			-			-			-			-			-			-	-	174	174		5.5	(90)		0.4
1-11316	Lab	195	9	1,751	AHS-L-4	75			-			-			-			-			-			-	-	122	122		4.2	(47)		0.4
1-11314	Lab	299	9	2,691	AHS-L-4	116			-			-			-			-			-			-	-	234	234		5.2	(118)		0.4
1-11312	Lab	101	9	911	AHS-L-4	52			208			-			-			-			-			-	208	-	208		13.7	(156)		0.5
1-11318	Lab	211	9	1,902	AHS-L-4	131			-			-			-			-			-			-	-	153	153		4.8	(22)		0.6
1-11322	Lab	202	9	1,822	AHS-L-4	71			-			-			-			-			-			-	-	115	115		3.8	(44)		0.4
2-11001	Lab	3156	9	28,408	AHS-L-5	1,790			208			-			-			-			-			-	208	3,392	3,600		7.6	(1,810)		0.6
2-11002	Lab	209	9	1,884	AHS-L-5	95			-			-			-			-			-			-	-	172	172		5.5	(77)		0.5
2-11301 (S)	Lab	1624	9	14,620	AHS-L-5	880			208			-			-			-			-			-	208	918	1,126		4.6	(246)		0.5
2-11301 (N)	Lab	1601	9	14,409	AHS-L-4	916			-			-			-			-			-			-	-	1,340	1,340		5.6	(424)		0.6
2-11311	Lab	3160	9	28,437	AHS-L-4	1,688			208			-			-			-			-			-	208	2,173	2,381		5.0	(693)		0.5
2-11310	Lab	101	9	911	AHS-L-4	36			-			-			-			-			-			-	-	49	49		3.2	(13)		0.4
2-11306 (S)	Lab	203	9	1,825	AHS-L-5	212			-			-			-			-			-			-	-	162	162		5.3	50		1.0
2-11306 (N)	Lab	206	9	1,850	AHE-L-4	-			-			-			-			-			-			-	-	165	165		5.4	(165)		-
2-11304	Lab	300	9	2,700	AHS-L-5	103			-			-			-			-			-			-	-	162	162		3.6	(59)		0.3
2-11302	Lab	101	9	911	AHS-L-5	59			208			-			-			-			-			-	208	-	208		13.7	(149)		0.6
2-11350	Lab	212	9	1,911	AHE-L-4	-			-			-			-			-			-			-	-	114	114		3.6	(114)		-
2-11322	Lab	422	9	3,799	AHS-L-4	147			-			-			-			-			-			-	-	226	226		3.6	(79)		0.3
2-11318	Lab	202	9	1,821	AHS-L-4	65			-			-			-			-			-			-	-	110	110		3.6	(45)		0.3
2-11314	Lab	299	9	2,690	AHS-L-4	120			-			-			-			-			-			-	-	159	159		3.5	(39)		0.4
2-11312	Lab	101	9	911	AHS-L-4	54			208			-			-			-			-			-	208	-	208		13.7	(154)		0.5
2-11320	Lab	204	9	1,833	AHS-L-4	82			-			-			-			-			-			-	-	172	172		5.6	(90)		0.4
3-11006	Lab	116	9	1,041	AHS-L-5	47			-			-			-			-			-			-	-	76	76		4.4	(29)		0.4
3-11001	Lab	3147	9	28,325	AHS-L-5	1,586			208			208			208			208			-			-	832	2,137	2,969		6.3	(1,383)		0.5
3-11002	Lab	209	9	1,883	AHS-L-5	105			-			-			-			-			-			-	-	277	277		8.8	(172)		0.5
3-11301	Lab	1607	9	14,464	AHS-L-5	941			208			-			-			-			-			-	208	1,028	1,236		5.1	(295)		0.6
3-11311	Lab	4752	9	42,769	AHS-L-4	2,332			208			208			208			208			208			208	1,248	1,614	2,862		4.0	(530)		0.5
3-11310	Lab	101	9	909	AHS-L-4	41			-			-			-			-			-			-	-	53	53		3.5	(12)		0.4
3-11353	Lab	101	9	911	AHS-L-4	42			-			-			-			-			-			-	-	57	57		3.8	(15)		0.4
3-11308	Lab	205	9	1,848	AHS-L-4	68			208			-			-			-			-			-	208	-	208		6.8	(140)		0.3
3-11306	Lab	194	9	1,750	AHS-L-5	79			-			-			-			-			-			-	-	131	131		4.5	(52)		0.4
3-11304	Lab	194	9	1,750	AHS-L-5	115			208			-			-			-			-			-	208	-	208		7.1	(93)		0.6
3-11302	Lab	204	9	1,834	AHS-L-5	80			-			-			-			-			-			-	-	124	124		4.1	(44)		0.4
3-11320	Lab	204	9	1,834	AHS-L-4	108			-			-			-			-			-			-	-	134	134		4.4	(26)		0.5
3-11318	Lab	208	9	1,875	AHS-L-4	72			-			-			-			-			-			-	-	120	120		3.8	(48)		0.3
3-11316	Lab	195	9	1,751	AHS-L-4	76			-			-			-			-			-			-	-	129	129		4.4	(53)		0.4
3-11314	Lab	195	9	1,751	AHS-L-4	72			-			-			-			-			-			-	-	120	120		4.1	(48)		0.4
3-11312	Lab	206	9	1,858	AHS-L-4	87			208			-			-			-			-			-	208	130	338		10.9	(251)		0.4
3-11322	Lab	101	9	911	AHS-L-4	69			208			-			-			-			-			-	208	-	208		13.7	(139)		0.7
		35,794	432	322,150	-	18,119	-	-	3,536	-	-	1,248	-	-	624	-	-	624	-	-	208	-	-	208	6,448	20,856	27,304	-	273	(9,185)	-	22

wendel

Project Name: University of Rochester Energy Conservation MP Support
Building: Del Monte
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Desired Face Velocity 80 FPM | 1 CFM/SQFT | Desired Lab ACH 4

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	New Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	Pressurization		CFM/Sqft
1-11006	Lab	116	9	1,041	AHS-L-5	33			-			-			-			-			-			-	-	49	49	49	2.8	(16)		0.3
1-11001	Lab	3,146	9	28,313	AHS-L-5	1,650			208			208			208			208			-			-	832	1,069	1,901	1,901	4.0	(251)		0.5
1-11002	Lab	210	9	1,888	AHS-L-5	64			-			-			-			-			-			-	-	108	108	108	3.4	(44)		0.3
1-11301 (S)	Lab	1,615	9	14,536	AHS-L-5	851			208			208			-			-			-			-	416	559	975	975	4.0	(124)		0.5
1-11301 (N)	Lab	1,597	9	14,373	AHS-L-4	839			208			208			-			-			-			-	416	482	898	898	3.7	(59)		0.5
1-11311	Lab	3,144	9	28,292	AHS-L-4	1,615			208			208			-			-			-			-	416	1,662	2,078	2,078	4.4	(463)		0.5
1-11310	Lab	102	9	914	AHE-L-4	-			-			-			-			-			-			-	-	48	48	48	3.2	(48)		-
1-11306	Lab	195	9	1,751	AHS-L-5	73			-			-			-			-			-			-	-	130	130	130	4.5	(57)		0.4
1-11304	Lab	410	9	3,688	AHS-L-5	182			-			-			-			-			-			-	-	328	328	328	5.3	(146)		0.4
1-11353	Lab	101	9	911	AHS-L-4	35			-			-			-			-			-			-	-	45	45	45	3.0	(10)		0.3
1-11308	Lab	206	9	1,850	AHS-L-4	81			-			-			-			-			-			-	-	134	134	134	4.3	(53)		0.4
1-11320	Lab	211	9	1,903	AHS-L-4	84			-			-			-			-			-			-	-	174	174	174	5.5	(90)		0.4
1-11316	Lab	195	9	1,751	AHS-L-4	75			-			-			-			-			-			-	-	122	122	122	4.2	(47)		0.4
1-11314	Lab	299	9	2,691	AHS-L-4	116			-			-			-			-			-			-	-	234	234	234	5.2	(118)		0.4
1-11312	Lab	101	9	911	AHS-L-4	52			208			-			-			-			-			-	208	-	208	208	13.7	(156)		0.5
1-11318	Lab	211	9	1,902	AHS-L-4	131			-			-			-			-			-			-	-	153	153	153	4.8	(22)		0.6
1-11322	Lab	202	9	1,822	AHS-L-4	71			-			-			-			-			-			-	-	115	115	115	3.8	(44)		0.4
2-11001	Lab	3,156	9	28,408	AHS-L-5	1,790			208			-			-			-			-			-	208	3,392	3,600	3,600	7.6	(1,810)		0.6
2-11002	Lab	209	9	1,884	AHS-L-5	95			-			-			-			-			-			-	-	172	172	172	5.5	(77)		0.5
2-11301 (S)	Lab	1,624	9	14,620	AHS-L-5	880			208			-			-			-			-			-	208	918	1,126	1,126	4.6	(246)		0.5
2-11301 (N)	Lab	1,601	9	14,409	AHS-L-4	916			-			-			-			-			-			-	-	1,340	1,340	1,340	5.6	(424)		0.6
2-11311	Lab	3,160	9	28,437	AHS-L-4	1,688			208			-			-			-			-			-	208	2,173	2,381	2,381	5.0	(693)		0.5
2-11310	Lab	101	9	911	AHS-L-4	36			-			-			-			-			-			-	-	49	49	49	3.2	(13)		0.4
2-11306 (S)	Lab	203	9	1,825	AHS-L-5	203			-			-			-			-			-			-	-	153	153	153	5.0	50		1.0
2-11306 (N)	Lab	206	9	1,850	AHE-L-4	-			-			-			-			-			-			-	-	165	165	165	5.4	(165)		-
2-11304	Lab	300	9	2,700	AHS-L-5	103			-			-			-			-			-			-	-	162	162	162	3.6	(59)		0.3
2-11302	Lab	101	9	911	AHS-L-5	59			208			-			-			-			-			-	208	-	208	208	13.7	(149)		0.6
2-11350	Lab	212	9	1,911	AHE-L-4	-			-			-			-			-			-			-	-	114	114	114	3.6	(114)		-
2-11322	Lab	422	9	3,799	AHS-L-4	147			-			-			-			-			-			-	-	226	226	226	3.6	(79)		0.3
2-11318	Lab	202	9	1,821	AHS-L-4	65			-			-			-			-			-			-	-	110	110	110	3.6	(45)		0.3
2-11314	Lab	299	9	2,690	AHS-L-4	120			-			-			-			-			-			-	-	159	159	159	3.5	(39)		0.4
2-11312	Lab	101	9	911	AHS-L-4	54			208			-			-			-			-			-	208	-	208	208	13.7	(154)		0.5
2-11320	Lab	204	9	1,833	AHS-L-4	82			-			-			-			-			-			-	-	172	172	172	5.6	(90)		0.4
3-11006	Lab	116	9	1,041	AHS-L-5	47			-			-			-			-			-			-	-	76	76	76	4.4	(29)		0.4
3-11001	Lab	3,147	9	28,325	AHS-L-5	1,586			208			208			208			208			-			-	832	2,137	2,969	2,969	6.3	(1,383)		0.5
3-11002	Lab	209	9	1,883	AHS-L-5	105			-			-			-			-			-			-	-	277	277	277	8.8	(172)		0.5
3-11301	Lab	1,607	9	14,464	AHS-L-5	941			208			-			-			-			-			-	208	1,028	1,236	1,236	5.1	(295)		0.6
3-11311	Lab	4,752	9	42,769	AHS-L-4	2,332			208			208			208			208			208			208	1,248	1,614	2,862	2,862	4.0	(530)		0.5
3-11310	Lab	101	9	909	AHS-L-4	41			-			-			-			-			-			-	-	53	53	53	3.5	(12)		0.4
3-11353	Lab	101	9	911	AHS-L-4	42			-			-			-			-			-			-	-	57	57	57	3.8	(15)		0.4
3-11308	Lab	205	9	1,848	AHS-L-4	68			208			-			-			-			-			-	208	-	208	208	6.8	(140)		0.3
3-11306	Lab	194	9	1,750	AHS-L-5	79			-			-			-			-			-			-	-	131	131	131	4.5	(52)		0.4
3-11304	Lab	194	9	1,750	AHS-L-5	115			208			-			-			-			-			-	208	-	208	208	7.1	(93)		0.6
3-11302	Lab	204	9	1,834	AHS-L-5	80			-			-			-			-			-			-	-	124	124	124	4.1	(44)		0.4
3-11320	Lab	204	9	1,834	AHS-L-4	108			-			-			-			-			-			-	-	134	134	134	4.4	(26)		0.5
3-11318	Lab	208	9	1,875	AHS-L-4	72			-			-			-			-			-			-	-	120	120	120	3.8	(48)		0.3
3-11316	Lab	195	9	1,751	AHS-L-4	76			-			-			-			-			-			-	-	129	129	129	4.4	(53)		0.4
3-11314	Lab	195	9	1,751	AHS-L-4	72			-			-			-			-			-			-	-	120	120	120	4.1	(48)		0.4
3-11312	Lab	206	9	1,858	AHS-L-4	87			208			-			-			-			-			-	208	130	338	338	10.9	(251)		0.4
3-11322	Lab	101	9	911	AHS-L-4	69			208			-			-			-			-			-	208	-	208	208	13.7	(139)		0.7
		36,102	450	324,918	-	18,110			3,536	-	-	1,248	-	-	624	-	-	624	-	-	208	-	-	208	6,448	20,847	27,295	27,295	272	(9,185)	-	22

Project Name: University of Rochester Energy Conservation MP Support
Building: Del Monte
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Existing Conditions							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Total Hood Exhaust CFM	General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH	Pressurization		CFM/Sqft
1-11006	Lab	116	9	1,041	AHS-L-5	121			-			-			-			-			-			-	-	178	178		10.3	(57)		1.0
1-11001	Lab	3146	9	28,313	AHS-L-5	6,561	6.7	106.0	709	6.7	108.0	722	6.7	103.0	688	6.7	92.0	615			-			-	2,734	7,265	9,999		21.2	(3,438)		2.1
1-11002	Lab	210	9	1,888	AHS-L-5	334			-			-			-			-			-			-	-	482	482		15.3	(148)		1.6
1-11301 (S)	Lab	1615	9	14,536	AHS-L-5	3,728	6.7	109.0	729	6.7	110.0	735			-			-			-			-	1,464	3,825	5,289		21.8	(1,561)		2.3
1-11301 (N)	Lab	1597	9	14,373	AHS-L-4	3,540	6.7	102.0	682	6.7	91.0	608			-			-			-			-	1,290	3,650	4,940		20.6	(1,400)		2.2
1-11311	Lab	3144	9	28,292	AHS-L-4	7,078	6.7	96.0	642	6.7	100.0	668			-			-			-			-	1,310	7,396	8,706		18.5	(1,628)		2.3
1-11310	Lab	102	9	914	AHE-L-4	-			-			-			-			-			-			-	-	215	215		14.1	(215)		-
1-11306	Lab	195	9	1,751	AHS-L-5	303			-			-			-			-			-			-	-	448	448		15.3	(145)		1.6
1-11304	Lab	410	9	3,688	AHS-L-5	743			-			-			-			-			-			-	-	1,112	1,112		18.1	(369)		1.8
1-11353	Lab	101	9	911	AHS-L-4	140			-			-			-			-			-			-	-	202	202		13.3	(62)		1.4
1-11308	Lab	206	9	1,850	AHS-L-4	310			-			-			-			-			-			-	-	436	436		14.1	(126)		1.5
1-11320	Lab	211	9	1,903	AHS-L-4	383			-			-			-			-			-			-	-	530	530		16.7	(147)		1.8
1-11316	Lab	195	9	1,751	AHS-L-4	290			-			-			-			-			-			-	-	446	446		15.3	(156)		1.5
1-11314	Lab	299	9	2,691	AHS-L-4	502			-			-			-			-			-			-	-	718	718		16.0	(216)		1.7
1-11312	Lab	101	9	911	AHS-L-4	588	6.7	103.0	688			-			-			-			-			-	688	-	688		45.4	(100)		5.8
1-11318	Lab	211	9	1,902	AHS-L-4	464			-			-			-			-			-			-	-	496	496		15.6	(32)		2.2
1-11322	Lab	202	9	1,822	AHS-L-4	314			-			-			-			-			-			-	-	458	458		15.1	(144)		1.6
2-11001	Lab	3156	9	28,408	AHS-L-5	7,849	6.7	101.0	675			-			-			-			-			-	675	8,024	8,699		18.4	(850)		2.5
2-11002	Lab	209	9	1,884	AHS-L-5	381			-			-			-			-			-			-	-	547	547		17.4	(166)		1.8
2-11301 (S)	Lab	1624	9	14,620	AHS-L-5	3,701	6.7	110.0	735			-			-			-			-			-	735	4,066	4,801		19.7	(1,100)		2.3
2-11301 (N)	Lab	1601	9	14,409	AHS-L-4	3,771			-			-			-			-			-			-	-	3,918	3,918		16.3	(147)		2.4
2-11311	Lab	3160	9	28,437	AHS-L-4	7,169	6.7	94.0	628			-			-			-			-			-	628	7,837	8,465		17.9	(1,296)		2.3
2-11310	Lab	101	9	911	AHS-L-4	150			-			-			-			-			-			-	-	205	205		13.5	(55)		1.5
2-11306 (S)	Lab	203	9	1,825	AHS-L-5	897			-			-			-			-			-			-	-	506	506		16.6	391		4.4
2-11306 (N)	Lab	206	9	1,850	AHE-L-4	-			-			-			-			-			-			-	-	512	512		16.6	(512)		-
2-11304	Lab	300	9	2,700	AHS-L-5	463			-			-			-			-			-			-	-	675	675		15.0	(212)		1.5
2-11302	Lab	101	9	911	AHS-L-5	602	6.7	116.0	775			-			-			-			-			-	775	-	775		51.1	(173)		5.9
2-11350	Lab	212	9	1,911	AHE-L-4	-			-			-			-			-			-			-	-	654	654		20.5	(654)		-
2-11322	Lab	422	9	3,799	AHS-L-4	856			-			-			-			-			-			-	-	950	950		15.0	(94)		2.0
2-11318	Lab	202	9	1,821	AHS-L-4	335			-			-			-			-			-			-	-	454	454		15.0	(119)		1.7
2-11314	Lab	299	9	2,690	AHS-L-4	480			-			-			-			-			-			-	-	660	660		14.7	(180)		1.6
2-11312	Lab	101	9	911	AHS-L-4	609	6.3	90.0	563			-			-			-			-			-	563	-	563		37.0	47		6.0
2-11320	Lab	204	9	1,833	AHS-L-4	357			-			-			-			-			-			-	-	505	505		16.5	(148)		1.8
3-11006	Lab	116	9	1,041	AHS-L-5	165			-			-			-			-			-			-	-	247	247		14.2	(82)		1.4
3-11001	Lab	3147	9	28,325	AHS-L-5	6,770	6.7	95.0	635	6.7	105.0	702	6.7	94.0	628	6.7	102.0	682			-			-	2,647	7,820	10,467		22.2	(3,697)		2.2
3-11002	Lab	209	9	1,883	AHS-L-5	486			-			-			-			-			-			-	-	1,775	1,775		56.6	(1,289)		2.3
3-11301	Lab	1607	9	14,464	AHS-L-5	3,725	6.7	95.0	635			-			-			-			-			-	635	4,358	4,993		20.7	(1,268)		2.3
3-11311	Lab	4752	9	42,769	AHS-L-4	10,323	6.7	107.0	715	6.7	99.0	662	6.7	95.0	635	6.7	101.0	675	6.7	103.0	688	6.7	102.0	682	4,057	11,927	15,984		22.4	(5,661)		2.2
3-11310	Lab	101	9	909	AHS-L-4	146			-			-			-			-			-			-	-	192	192		12.7	(46)		1.4
3-11353	Lab	101	9	911	AHS-L-4	195			-			-			-			-			-			-	-	286	286		18.8	(91)		1.9
3-11308	Lab	205	9	1,848	AHS-L-4	564	6.7	107.0	715			-			-			-			-			-	715	-	715		23.2	(151)		2.7
3-11306	Lab	194	9	1,750	AHS-L-5	305			-			-			-			-			-			-	-	434	434		14.9	(129)		1.6
3-11304	Lab	194	9	1,750	AHS-L-5	570	6.7	98.0	655			-			-			-			-			-	655	-	655		22.5	(85)		2.9
3-11302	Lab	204	9	1,834	AHS-L-5	378			-			-			-			-			-			-	-	427	427		14.0	(49)		1.9
3-11320	Lab	204	9	1,834	AHS-L-4	553			-			-			-			-			-			-	-	603	603		19.7	(50)		2.7
3-11318	Lab	208	9	1,875	AHS-L-4	325			-			-			-			-			-			-	-	443	443		14.2	(118)		1.6
3-11316	Lab	195	9	1,751	AHS-L-4	306			-			-			-			-			-			-	-	425	425		14.6	(119)		1.6
3-11314	Lab	195	9	1,751	AHS-L-4	304			-			-			-			-			-			-	-	423	423		14.5	(119)		1.6
3-11312	Lab	206	9	1,858	AHS-L-4	765	6.7	103.0	688			-			-			-			-			-	688	130	818		26.4	(53)		3.7
3-11322	Lab	101	9	911	AHS-L-4	587	6.7	94.0	628			-			-			-			-			-	628	-	628		41.4	(41)		5.8
		35,794	432	322,150	-	79,486	113	1,726	11,498	40	613	4,097	20	292	1,952	20	295	1,972	7	103	688	7	102	682	20,889	86,860	107,749	-	1,001	(28,263)	-	110

Project Name: University of Rochester Energy Conservation MP Support
Building: Del Monte
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Desired Face Velocity 80 FPM | 1 CFM/SQFT | Desired Lab ACH 6

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	Pressurization		CFM/Sqft
1-11006	Lab	116	9	1,041	AHS-L-5	116	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	173	173	173	10	(57)		1.0
1-11001	Lab	3,146	9	28,313	AHS-L-5	3,146	6.7	106	708.51	7	108	721.88	7	103	688	7	92	615	-	-	-	-	-	-	2,734	3,850	6,584	6,584	14	(3,438)		1.0
1-11002	Lab	210	9	1,888	AHS-L-5	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	358	358	358	11	(148)		1.0
1-11301 (S)	Lab	1,615	9	14,536	AHS-L-5	1,615	6.7	109	728.56	7	110	735.24	-	-	-	-	-	-	-	-	-	-	-	-	1,464	1,712	3,176	3,176	13	(1,561)		1.0
1-11301 (N)	Lab	1,597	9	14,373	AHS-L-4	1,597	6.7	102	682	7	91	608	-	-	-	-	-	-	-	-	-	-	-	-	1,290	1,707	2,997	2,997	13	(1,400)		1.0
1-11311	Lab	3,144	9	28,292	AHS-L-4	3,144	6.7	96	642	7	100	668	-	-	-	-	-	-	-	-	-	-	-	-	1,310	3,462	4,772	4,772	10	(1,628)		1.0
1-11310	Lab	102	9	914	AHE-L-4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	220	220	220	14	(215)		0.0
1-11306	Lab	195	9	1,751	AHS-L-5	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	340	340	340	12	(145)		1.0
1-11304	Lab	410	9	3,688	AHS-L-5	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	779	779	779	13	(369)		1.0
1-11353	Lab	101	9	911	AHS-L-4	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	163	163	163	11	(62)		1.0
1-11308	Lab	206	9	1,850	AHS-L-4	206	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	332	332	332	11	(126)		1.0
1-11320	Lab	211	9	1,903	AHS-L-4	211	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	358	358	358	11	(147)		1.0
1-11316	Lab	195	9	1,751	AHS-L-4	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	351	351	351	12	(156)		1.0
1-11314	Lab	299	9	2,691	AHS-L-4	299	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	515	515	515	11	(216)		1.0
1-11312	Lab	101	9	911	AHS-L-4	588	6.7	103	688	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	688	-	202	688	45	(100)		5.8
1-11318	Lab	211	9	1,902	AHS-L-4	211	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	243	243	243	8	(32)		1.0
1-11322	Lab	202	9	1,822	AHS-L-4	202	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	346	346	346	11	(144)		1.0
2-11001	Lab	3,156	9	28,408	AHS-L-5	3,156	6.7	101	675	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	675	3,331	4,007	4,007	8	(850)		1.0
2-11002	Lab	209	9	1,884	AHS-L-5	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	375	375	375	12	(166)		1.0
2-11301 (S)	Lab	1,624	9	14,620	AHS-L-5	1,624	6.7	110	735	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735	1,989	2,725	2,725	11	(1,100)		1.0
2-11301 (N)	Lab	1,601	9	14,409	AHS-L-4	1,601	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,748	1,748	1,748	7	(147)		1.0
2-11311	Lab	3,160	9	28,437	AHS-L-4	3,160	6.7	94	628	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	628	3,828	4,456	4,456	9	(1,296)		1.0
2-11310	Lab	101	9	911	AHS-L-4	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	156	156	156	10	(55)		1.0
2-11306 (S)	Lab	203	9	1,825	AHS-L-5	574	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	183	183	183	6	391		2.8
2-11306 (N)	Lab	206	9	1,850	AHE-L-4	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	520	520	520	17	(512)		0.0
2-11304	Lab	300	9	2,700	AHS-L-5	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	512	512	512	11	(212)		1.0
2-11302	Lab	101	9	911	AHS-L-5	602	6.7	116	775	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	775	-	275	775	51	(173)		5.9
2-11350	Lab	212	9	1,911	AHE-L-4	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	700	700	700	22	(654)		0.2
2-11322	Lab	422	9	3,799	AHS-L-4	422	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	516	516	516	8	(94)		1.0
2-11318	Lab	202	9	1,821	AHS-L-4	202	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	321	321	321	11	(119)		1.0
2-11314	Lab	299	9	2,690	AHS-L-4	299	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	479	479	479	11	(180)		1.0
2-11312	Lab	101	9	911	AHS-L-4	609	6.3	90	563	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	563	-	91	563	37	47		6.0
2-11320	Lab	204	9	1,833	AHS-L-4	204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	352	352	352	12	(148)		1.0
3-11006	Lab	116	9	1,041	AHS-L-5	116	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	198	198	11	(82)		1.0
3-11001	Lab	3,147	9	28,325	AHS-L-5	3,147	6.7	95	635	7	105	702	7	94	628	7	102	682	-	-	-	-	-	-	2,647	4,197	6,844	6,844	14	(3,697)		1.0
3-11002	Lab	209	9	1,883	AHS-L-5	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,498	1,498	1,498	48	(1,289)		1.0
3-11301	Lab	1,607	9	14,464	AHS-L-5	1,607	6.7	95	635	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	635	2,240	2,875	2,875	12	(1,268)		1.0
3-11311	Lab	4,752	9	42,769	AHS-L-4	4,752	6.7	107	715	7	99	662	7	95	635	7	101	675	7	103	688	7	102	682	4,057	6,356	10,413	10,413	15	(5,661)		1.0
3-11310	Lab	101	9	909	AHS-L-4	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	147	147	147	10	(46)		1.0
3-11353	Lab	101	9	911	AHS-L-4	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	192	192	192	13	(91)		1.0
3-11308	Lab	205	9	1,848	AHS-L-4	564	6.7	107	715	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	715	-	357	715	23	(151)		2.7
3-11306	Lab	194	9	1,750	AHS-L-5	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	323	323	323	11	(129)		1.0
3-11304	Lab	194	9	1,750	AHS-L-5	570	6.7	98	655	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	655	-	279	655	22	(85)		2.9
3-11302	Lab	204	9	1,834	AHS-L-5	204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	253	253	253	8	(49)		1.0
3-11320	Lab	204	9	1,834	AHS-L-4	204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	254	254	254	8	(50)		1.0
3-11318	Lab	208	9	1,875	AHS-L-4	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	326	326	326	10	(118)		1.0
3-11316	Lab	195	9	1,751	AHS-L-4	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	314	314	314	11	(119)		1.0
3-11314	Lab	195	9	1,751	AHS-L-4	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	314	314	314	11	(119)		1.0
3-11312	Lab	206	9	1,858	AHS-L-4	635	6.7	103	688	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	688	-	260	688	22	(53)		3.1
3-11322	Lab	101	9	911	AHS-L-4	587	6.7	94	628	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	628	-	143	628	41	(41)		5.8
		36,102	450	324,918	-	39,156	113.2	1,726	11,498	40	613	4,097	20	292	1,952	20	295	1,972	7	103	688	7	102	682	20,889	46,530	64,311	67,419	766	(28,263)	-	74.5

Project Name: University of Rochester Energy Conservation MP Support
Building: Del Monte
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Existing Conditions							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Total Hood Exhaust CFM	General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH	Pressurization		CFM/Sqft
1-11006	Lab	116	9	1,041	AHS-L-5	33			-			-			-			-			-			-	-	49	49		2.8	(16)		0.3
1-11001	Lab	3146	9	28,313	AHS-L-5	1,650			208			208			208			208			-			-	832	1,069	1,901		4.0	(251)		0.5
1-11002	Lab	210	9	1,888	AHS-L-5	64			-			-			-			-			-			-	-	108	108		3.4	(44)		0.3
1-11301 (S)	Lab	1615	9	14,536	AHS-L-5	851			208			208			-			-			-			-	416	559	975		4.0	(124)		0.5
1-11301 (N)	Lab	1597	9	14,373	AHS-L-4	839			208			208			-			-			-			-	416	482	898		3.7	(59)		0.5
1-11311	Lab	3144	9	28,292	AHS-L-4	1,615			208			208			-			-			-			-	416	1,662	2,078		4.4	(463)		0.5
1-11310	Lab	102	9	914	AHE-L-4	-			-			-			-			-			-			-	-	48	48		3.2	(48)		-
1-11306	Lab	195	9	1,751	AHS-L-5	73			-			-			-			-			-			-	-	130	130		4.5	(57)		0.4
1-11304	Lab	410	9	3,688	AHS-L-5	182			-			-			-			-			-			-	-	328	328		5.3	(146)		0.4
1-11353	Lab	101	9	911	AHS-L-4	35			-			-			-			-			-			-	-	45	45		3.0	(10)		0.3
1-11308	Lab	206	9	1,850	AHS-L-4	81			-			-			-			-			-			-	-	134	134		4.3	(53)		0.4
1-11320	Lab	211	9	1,903	AHS-L-4	84			-			-			-			-			-			-	-	174	174		5.5	(90)		0.4
1-11316	Lab	195	9	1,751	AHS-L-4	75			-			-			-			-			-			-	-	122	122		4.2	(47)		0.4
1-11314	Lab	299	9	2,691	AHS-L-4	116			-			-			-			-			-			-	-	234	234		5.2	(118)		0.4
1-11312	Lab	101	9	911	AHS-L-4	52			208			-			-			-			-			-	208	-	208		13.7	(156)		0.5
1-11318	Lab	211	9	1,902	AHS-L-4	131			-			-			-			-			-			-	-	153	153		4.8	(22)		0.6
1-11322	Lab	202	9	1,822	AHS-L-4	71			-			-			-			-			-			-	-	115	115		3.8	(44)		0.4
2-11001	Lab	3156	9	28,408	AHS-L-5	1,790			208			-			-			-			-			-	208	3,392	3,600		7.6	(1,810)		0.6
2-11002	Lab	209	9	1,884	AHS-L-5	95			-			-			-			-			-			-	-	172	172		5.5	(77)		0.5
2-11301 (S)	Lab	1624	9	14,620	AHS-L-5	880			208			-			-			-			-			-	208	918	1,126		4.6	(246)		0.5
2-11301 (N)	Lab	1601	9	14,409	AHS-L-4	916			-			-			-			-			-			-	-	1,340	1,340		5.6	(424)		0.6
2-11311	Lab	3160	9	28,437	AHS-L-4	1,688			208			-			-			-			-			-	208	2,173	2,381		5.0	(693)		0.5
2-11310	Lab	101	9	911	AHS-L-4	36			-			-			-			-			-			-	-	49	49		3.2	(13)		0.4
2-11306 (S)	Lab	203	9	1,825	AHS-L-5	212			-			-			-			-			-			-	-	162	162		5.3	50		1.0
2-11306 (N)	Lab	206	9	1,850	AHE-L-4	-			-			-			-			-			-			-	-	165	165		5.4	(165)		-
2-11304	Lab	300	9	2,700	AHS-L-5	103			-			-			-			-			-			-	-	162	162		3.6	(59)		0.3
2-11302	Lab	101	9	911	AHS-L-5	59			208			-			-			-			-			-	208	-	208		13.7	(149)		0.6
2-11350	Lab	212	9	1,911	AHE-L-4	-			-			-			-			-			-			-	-	114	114		3.6	(114)		-
2-11322	Lab	422	9	3,799	AHS-L-4	147			-			-			-			-			-			-	-	226	226		3.6	(79)		0.3
2-11318	Lab	202	9	1,821	AHS-L-4	65			-			-			-			-			-			-	-	110	110		3.6	(45)		0.3
2-11314	Lab	299	9	2,690	AHS-L-4	120			-			-			-			-			-			-	-	159	159		3.5	(39)		0.4
2-11312	Lab	101	9	911	AHS-L-4	54			208			-			-			-			-			-	208	-	208		13.7	(154)		0.5
2-11320	Lab	204	9	1,833	AHS-L-4	82			-			-			-			-			-			-	-	172	172		5.6	(90)		0.4
3-11006	Lab	116	9	1,041	AHS-L-5	47			-			-			-			-			-			-	-	76	76		4.4	(29)		0.4
3-11001	Lab	3147	9	28,325	AHS-L-5	1,586			208			208			208			208			-			-	832	2,137	2,969		6.3	(1,383)		0.5
3-11002	Lab	209	9	1,883	AHS-L-5	105			-			-			-			-			-			-	-	277	277		8.8	(172)		0.5
3-11301	Lab	1607	9	14,464	AHS-L-5	941			208			-			-			-			-			-	208	1,028	1,236		5.1	(295)		0.6
3-11311	Lab	4752	9	42,769	AHS-L-4	2,332			208			208			208			208			208			208	1,248	1,614	2,862		4.0	(530)		0.5
3-11310	Lab	101	9	909	AHS-L-4	41			-			-			-			-			-			-	-	53	53		3.5	(12)		0.4
3-11353	Lab	101	9	911	AHS-L-4	42			-			-			-			-			-			-	-	57	57		3.8	(15)		0.4
3-11308	Lab	205	9	1,848	AHS-L-4	68			208			-			-			-			-			-	208	-	208		6.8	(140)		0.3
3-11306	Lab	194	9	1,750	AHS-L-5	79			-			-			-			-			-			-	-	131	131		4.5	(52)		0.4
3-11304	Lab	194	9	1,750	AHS-L-5	115			208			-			-			-			-			-	208	-	208		7.1	(93)		0.6
3-11302	Lab	204	9	1,834	AHS-L-5	80			-			-			-			-			-			-	-	124	124		4.1	(44)		0.4
3-11320	Lab	204	9	1,834	AHS-L-4	108			-			-			-			-			-			-	-	134	134		4.4	(26)		0.5
3-11318	Lab	208	9	1,875	AHS-L-4	72			-			-			-			-			-			-	-	120	120		3.8	(48)		0.3
3-11316	Lab	195	9	1,751	AHS-L-4	76			-			-			-			-			-			-	-	129	129		4.4	(53)		0.4
3-11314	Lab	195	9	1,751	AHS-L-4	72			-			-			-			-			-			-	-	120	120		4.1	(48)		0.4
3-11312	Lab	206	9	1,858	AHS-L-4	87			208			-			-			-			-			-	208	130	338		10.9	(251)		0.4
3-11322	Lab	101	9	911	AHS-L-4	69			208			-			-			-			-			-	208	-	208		13.7	(139)		0.7
		35,794	432	322,150	-	18,119	-	-	3,536	-	-	1,248	-	-	624	-	-	624	-	-	208	-	-	208	6,448	20,856	27,304	-	273	(9,185)	-	22

Project Name: University of Rochester Energy Conservation MP Support
Building: Del Monte
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: GHB

Desired Face Velocity 80 FPM | 0.5 CFM/SQFT | Desired Lab ACH 4

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	New Face Velocity	Calculated Exhaust CFM	New Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	Pressurization		CFM/Sqft
1-11006	Lab	116	9	1,041	AHS-L-5	33			-			-			-			-			-			-	-	49	49	49	2.8	(16)		0.3
1-11001	Lab	3,146	9	28,313	AHS-L-5	1,637			208			208			208			208			-			-	832	1,056	1,888	1,888	4.0	(251)		0.5
1-11002	Lab	210	9	1,888	AHS-L-5	64			-			-			-			-			-			-	-	108	108	108	3.4	(44)		0.3
1-11301 (S)	Lab	1,615	9	14,536	AHS-L-5	845			208			208			-			-			-			-	416	553	969	969	4.0	(124)		0.5
1-11301 (N)	Lab	1,597	9	14,373	AHS-L-4	899			208			208			-			-			-			-	416	542	958	958	4.0	(59)		0.6
1-11311	Lab	3,144	9	28,292	AHS-L-4	1,572			208			208			-			-			-			-	416	1,619	2,035	2,035	4.3	(463)		0.5
1-11310	Lab	102	9	914	AHE-L-4	-			-			-			-			-			-			-	-	48	48	48	3.2	(48)		-
1-11306	Lab	195	9	1,751	AHS-L-5	73			-			-			-			-			-			-	-	130	130	130	4.5	(57)		0.4
1-11304	Lab	410	9	3,688	AHS-L-5	182			-			-			-			-			-			-	-	328	328	328	5.3	(146)		0.4
1-11353	Lab	101	9	911	AHS-L-4	35			-			-			-			-			-			-	-	45	45	45	3.0	(10)		0.3
1-11308	Lab	206	9	1,850	AHS-L-4	81			-			-			-			-			-			-	-	134	134	134	4.3	(53)		0.4
1-11320	Lab	211	9	1,903	AHS-L-4	84			-			-			-			-			-			-	-	174	174	174	5.5	(90)		0.4
1-11316	Lab	195	9	1,751	AHS-L-4	75			-			-			-			-			-			-	-	122	122	122	4.2	(47)		0.4
1-11314	Lab	299	9	2,691	AHS-L-4	116			-			-			-			-			-			-	-	234	234	234	5.2	(118)		0.4
1-11312	Lab	101	9	911	AHS-L-4	52			208			-			-			-			-			-	208	-	207	208	13.7	(156)		0.5
1-11318	Lab	211	9	1,902	AHS-L-4	106			-			-			-			-			-			-	-	128	128	128	4.0	(22)		0.5
1-11322	Lab	202	9	1,822	AHS-L-4	71			-			-			-			-			-			-	-	115	115	115	3.8	(44)		0.4
2-11001	Lab	3,156	9	28,408	AHS-L-5	1,578			208			-			-			-			-			-	208	3,180	3,388	3,388	7.2	(1,810)		0.5
2-11002	Lab	209	9	1,884	AHS-L-5	95			-			-			-			-			-			-	-	172	172	172	5.5	(77)		0.5
2-11301 (S)	Lab	1,624	9	14,620	AHS-L-5	812			208			-			-			-			-			-	208	850	1,058	1,058	4.3	(246)		0.5
2-11301 (N)	Lab	1,601	9	14,409	AHS-L-4	800			-			-			-			-			-			-	-	1,224	1,224	1,224	5.1	(424)		0.5
2-11311	Lab	3,160	9	28,437	AHS-L-4	1,580			208			-			-			-			-			-	208	2,065	2,273	2,273	4.8	(693)		0.5
2-11310	Lab	101	9	911	AHS-L-4	36			-			-			-			-			-			-	-	49	49	49	3.2	(13)		0.4
2-11306 (S)	Lab	203	9	1,825	AHS-L-5	172			-			-			-			-			-			-	-	122	122	122	4.0	50		0.8
2-11306 (N)	Lab	206	9	1,850	AHE-L-4	-			-			-			-			-			-			-	-	165	165	165	5.4	(165)		-
2-11304	Lab	300	9	2,700	AHS-L-5	103			-			-			-			-			-			-	-	162	162	162	3.6	(59)		0.3
2-11302	Lab	101	9	911	AHS-L-5	59			208			-			-			-			-			-	208	-	200	208	13.7	(149)		0.6
2-11350	Lab	212	9	1,911	AHE-L-4	-			-			-			-			-			-			-	-	114	114	114	3.6	(114)		-
2-11322	Lab	422	9	3,799	AHS-L-4	147			-			-			-			-			-			-	-	226	226	226	3.6	(79)		0.3
2-11318	Lab	202	9	1,821	AHS-L-4	65			-			-			-			-			-			-	-	110	110	110	3.6	(45)		0.3
2-11314	Lab	299	9	2,690	AHS-L-4	120			-			-			-			-			-			-	-	159	159	159	3.5	(39)		0.4
2-11312	Lab	101	9	911	AHS-L-4	54			208			-			-			-			-			-	208	-	205	208	13.7	(154)		0.5
2-11320	Lab	204	9	1,833	AHS-L-4	82			-			-			-			-			-			-	-	172	172	172	5.6	(90)		0.4
3-11006	Lab	116	9	1,041	AHS-L-5	47			-			-			-			-			-			-	-	76	76	76	4.4	(29)		0.4
3-11001	Lab	3,147	9	28,325	AHS-L-5	1,574			208			208			208			208			-			-	832	2,125	2,957	2,957	6.3	(1,383)		0.5
3-11002	Lab	209	9	1,883	AHS-L-5	105			-			-			-			-			-			-	-	277	277	277	8.8	(172)		0.5
3-11301	Lab	1,607	9	14,464	AHS-L-5	804			208			-			-			-			-			-	208	891	1,099	1,099	4.6	(295)		0.5
3-11311	Lab	4,752	9	42,769	AHS-L-4	2,332			208			208			208			208			208			208	1,248	1,614	2,862	2,862	4.0	(530)		0.5
3-11310	Lab	101	9	909	AHS-L-4	41			-			-			-			-			-			-	-	53	53	53	3.5	(12)		0.4
3-11353	Lab	101	9	911	AHS-L-4	42			-			-			-			-			-			-	-	57	57	57	3.8	(15)		0.4
3-11308	Lab	205	9	1,848	AHS-L-4	68			208			-			-			-			-			-	208	-	208	208	6.8	(140)		0.3
3-11306	Lab	194	9	1,750	AHS-L-5	79			-			-			-			-			-			-	-	131	131	131	4.5	(52)		0.4
3-11304	Lab	194	9	1,750	AHS-L-5	115			208			-			-			-			-			-	208	-	190	208	7.1	(93)		0.6
3-11302	Lab	204	9	1,834	AHS-L-5	80			-			-			-			-			-			-	-	124	124	124	4.1	(44)		0.4
3-11320	Lab	204	9	1,834	AHS-L-4	102			-			-			-			-			-			-	-	128	128	128	4.2	(26)		0.5
3-11318	Lab	208	9	1,875	AHS-L-4	72			-			-			-			-			-			-	-	120	120	120	3.8	(48)		0.3
3-11316	Lab	195	9	1,751	AHS-L-4	76			-			-			-			-			-			-	-	129	129	129	4.4	(53)		0.4
3-11314	Lab	195	9	1,751	AHS-L-4	72			-			-			-			-			-			-	-	120	120	120	4.1	(48)		0.4
3-11312	Lab	206	9	1,858	AHS-L-4	87			208			-			-			-			-			-	208	130	338	338	10.9	(251)		0.4
3-11322	Lab	101	9	911	AHS-L-4	69			208			-			-			-			-			-	208	-	190	208	13.7	(139)		0.7
		36,102	450	324,918	-	17,391			3,536	-	-	1,248	-	-	624	-	-	624	-	-	208	-	-	208	6,448	20,128	26,527	26,576	269	(9,185)	-	21

ECM - 03 - Lab HVAC Systems - AHS-L-04 & AHS-L-05

Project Name:	University of Rochester
Building:	Medical Research Building
Date:	4/1/2021
ECM	Lab HVAC Systems
Calculated By:	CLF
Reviewed By:	GHB

Summary of Existing System

Measured Data and Data Limitations

ECMs Implemented

	DAT Reset Schedule
x	Lab CFM Adjustment
	Night Setbacks

Summary of Systems Used for Calculation

Existing Usage (10 / 6 ACM)

Preheat Usage	3,273	mmBtu
Cooling Usage	6,337	mmBtu
Reheat Usage	5,275	mmBtu
Supply Fan Usage	205,989	kWh

Proposed Usage - Option A (8 / 4 ACH)

Preheat Usage	1,928	mmBtu
Cooling Usage	3,576	mmBtu
Reheat Usage	3,083	mmBtu
Supply Fan Usage	83,184	kWh

Proposed Usage - Option B (6 / 4 ACH)

Preheat Usage	1,896	mmBtu
Cooling Usage	3,525	mmBtu
Reheat Usage	3,033	mmBtu
Supply Fan Usage	81,550	kWh

Summary of EEM Savings - Option A (8 / 4 ACH)

Proposed Savings

Preheat Usage	1,344	mmBtu
Cooling Usage	2,762	mmBtu
Reheat Usage	2,192	mmBtu
Supply Fan Usage	122,805	kWh

Summary of EEM Savings - Option A (6 / 4 ACH)

Proposed Savings

Preheat Usage	1,377	mmBtu
Cooling Usage	2,813	mmBtu
Reheat Usage	2,242	mmBtu
Supply Fan Usage	124,439	kWh

wendel

Project Name:	University of Rochester
Building:	Medical Research Building
Date:	4/1/2021
Calculated By:	CLF
Reviewed By:	GHB
System:	AHS-L-04 & AHS-L-05
Scenario:	Existing

Summary of Use

Preheat Usage	3,273	mmBtu
Cooling Usage	6,337	mmBtu
Reheat Usage	5,275	mmBtu
Supply Fan Usage	205,989	kWh

Scheduling / Population load (1=Occ 0=UnOcc)

	Schedule Days1-5	Population Days1-5	Schedule Days6,7,8	Population Days6,7,8
1	0	100%	0	100%
2	0	100%	0	100%
3	0	100%	0	100%
4	0	100%	0	100%
5	0	100%	0	100%
6	0	100%	0	100%
7	1	100%	1	100%
8	1	100%	1	100%
9	1	100%	1	100%
10	1	100%	1	100%
11	1	100%	1	100%
12	1	100%	1	100%
13	1	100%	1	100%
14	1	100%	1	100%
15	1	100%	1	100%
16	1	100%	1	100%
17	1	100%	1	100%
18	1	100%	1	100%
19	1	100%	1	100%
20	0	100%	0	100%
21	0	100%	0	100%
22	0	100%	0	100%
23	0	100%	0	100%
24	0	100%	0	100%

Fan Info

Fan Label	SF
Fan HP:	100.0
Fan QTY:	2.0
Calculated Load Factor:	75%
Fan Motor Eff:	90%
Fan kW:	124.3
Max Fan Flow:	170,000
Fan Affinity Law Adjsut:	1.5

Lab Airflow CFM Reduction

Occupied Design Ariflow	79,486	CFM
Unoccupied Design Airflow	18,119	CFM
Occupied Airflow Reduction	0	CFM
Unoccupied Airflow Reduction	0	CFM

Misc System Info

Cooling Shutoff	55	degF
Cooling Shutoff	5	May
Cooling Shutoff	10	October

Active Space Setpoints (Average)

OAT	Occ	Unocc	Load %
0	68.0	68.0	0.00%
10	68.0	68.0	0.00%
20	68.0	68.0	0.00%
30	68.0	68.0	0.00%
40	68.0	68.0	0.00%
50	68.0	68.0	0.00%
55	68.0	68.0	0.00%
60	69.2	69.2	0.00%
70	71.6	71.6	0.00%
80	74.0	74.0	0.00%
100	74.0	74.0	0.00%

System Setpoint Simulations

OAT	PHT STP	DAT STP	DAH STP	
0	55.0	65.0	25.6	
10	55.0	63.6	25.3	
20	55.0	62.1	24.9	
30	55.0	60.7	24.6	
40	55.0	59.3	24.2	
50	55.0	57.9	23.9	
55	55.0	57.1	23.7	
60	55.0	56.4	23.5	
70	55.0	55.0	23.2	
80	55.0	55.0	23.2	
100	55.0	55.0	23.2	
	1.585E-05	-0.001483	-0.109225	64.903594
	X=	28.00	Y=	61.03
	0	0	0	55
	X=	28.00	Y=	55.00
	3.861E-06	-0.000361	-0.026601	25.589599
	X=	90.00	Y=	23.08

Reheat Loading

OAT	DAT	Occ	Unocc	
0	85.0	85.0%	85.0%	
10	85.0	76.8%	76.8%	
20	85.0	68.5%	68.5%	
30	85.0	60.3%	60.3%	
40	85.0	52.0%	52.0%	
50	85.0	43.8%	43.8%	
55	85.0	39.6%	39.6%	
60	85.0	35.5%	35.5%	
70	85.0	27.3%	27.3%	
80	85.0	19.0%	19.0%	
100	85.0	2.5%	2.5%	
	0	0	0	85
	X=	0.00	Y=	85.00
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	0.00	Y=	0.85
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	55.00	Y=	0.40
	% of CFM to Reheat	100.0%		

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Project Name:	University of Rochester
Building:	Medical Research Building
Date:	44287.47
Calculated By:	CLF
Reviewed By:	GHB
System:	AHS-L-04 & AHS-L-05
Scenario:	Existing

Formulas

D : Based on Simulation
E : Design CFM x Fan Simulation
F : ((E / Fan CFM Output)   Fan Affinity) x Fan Kw
G : 1.08 x (D - B) x E / 1,000,000
H : 4.5 x (C - Coil Enthalpy) x E / 1,000,000
J : Based on Simulation
K : Based on Simulation
L : 1.08 x (K - I) x E x % CFM to Reheat / 1,000,000

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
MAX	8.0	93.9	40.8	55.0	64.5	25.5	79486.0	39.8	4.3	6.0	75.9	85.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN	1.0	3.9	1.8	55.0	54.6	23.1	18119.0	4.3	0.0	0.0	54.6	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	36600	496470	194424	481800	501243	207772	449908855	205989	3273	6337	489054	744600	5275	0	0	0	0	0	0	0	0	0	0

Time Stamp	Type	Outside dry-bulb temp (F)	Specific Enthalpy (Btu/lb)	Preheat Setpoint	SAT STP (degF)	Enthalpy Setpoint	Supply Air CFM	Supply Fan Usage (kWh)	Preheat Usage (mmBtu)	Cooling Usage (mmBtu)	DAT (degF)	Reheat DAT (degF)	Reheat Usage (mmBtu)
1/1/17 0:00	7.0	41.0	14.4	55.0	59.0	24.2	18119	4	0.3	0.0	55.0	85.0	0.3
1/1/17 1:00	7.0	37.9	12.6	55.0	59.5	24.3	18119	4	0.3	0.0	55.0	85.0	0.3
1/1/17 2:00	7.0	37.0	11.9	55.0	59.6	24.3	18119	4	0.4	0.0	55.0	85.0	0.3
1/1/17 3:00	7.0	34.0	11.2	55.0	60.1	24.4	18119	4	0.4	0.0	55.0	85.0	0.3
1/1/17 4:00	7.0	33.1	11.0	55.0	60.2	24.5	18119	4	0.4	0.0	55.0	85.0	0.3
1/1/17 5:00	7.0	28.9	9.8	55.0	60.9	24.6	18119	4	0.5	0.0	55.0	85.0	0.4
1/1/17 6:00	7.0	30.9	10.5	55.0	60.6	24.5	79486	40	2.1	0.0	55.0	85.0	1.5
1/1/17 7:00	7.0	32.0	10.7	55.0	60.4	24.5	79486	40	2.0	0.0	55.0	85.0	1.5
1/1/17 8:00	7.0	32.0	11.0	55.0	60.4	24.5	79486	40	2.0	0.0	55.0	85.0	1.5
1/1/17 9:00	7.0	35.1	11.7	55.0	59.9	24.4	79486	40	1.7	0.0	55.0	85.0	1.4
1/1/17 10:00	7.0	37.0	12.3	55.0	59.6	24.3	79486	40	1.5	0.0	55.0	85.0	1.4
1/1/17 11:00	7.0	41.0	13.3	55.0	59.0	24.2	79486	40	1.2	0.0	55.0	85.0	1.3
1/1/17 12:00	7.0	43.0	13.9	55.0	58.7	24.1	79486	40	1.0	0.0	55.0	85.0	1.3
1/1/17 13:00	7.0	45.0	14.6	55.0	58.4	24.0	79486	40	0.9	0.0	55.0	85.0	1.2
1/1/17 14:00	7.0	46.0	14.6	55.0	58.3	24.0	79486	40	0.8	0.0	55.0	85.0	1.2
1/1/17 15:00	7.0	46.9	15.0	55.0	58.2	23.9	79486	40	0.7	0.0	55.0	85.0	1.2
1/1/17 16:00	7.0	46.9	15.0	55.0	58.2	23.9	79486	40	0.7	0.0	55.0	85.0	1.2
1/1/17 17:00	7.0	44.1	14.5	55.0	58.6	24.0	79486	40	0.9	0.0	55.0	85.0	1.3
1/1/17 18:00	7.0	43.0	14.2	55.0	58.7	24.1	79486	40	1.0	0.0	55.0	85.0	1.3
1/1/17 19:00	7.0	42.1	14.0	55.0	58.9	24.1	18119	4	0.3	0.0	55.0	85.0	0.3
1/1/17 20:00	7.0	39.9	13.6	55.0	59.2	24.2	18119	4	0.3	0.0	55.0	85.0	0.3
1/1/17 21:00	7.0	39.9	13.4	55.0	59.2	24.2	18119	4	0.3	0.0	55.0	85.0	0.3
1/1/17 22:00	7.0	41.0	14.1	55.0	59.0	24.2	18119	4	0.3	0.0	55.0	85.0	0.3
1/1/17 23:00	7.0	44.1	14.8	55.0	58.6	24.0	18119	4	0.2	0.0	55.0	85.0	0.3
1/2/17 0:00	8.0	45.0	15.2	55.0	58.4	24.0	18119	4	0.2	0.0	55.0	85.0	0.3
1/2/17 1:00	8.0	44.1	15.0	55.0	58.6	24.0	18119	4	0.2	0.0	55.0	85.0	0.3
1/2/17 2:00	8.0	43.0	15.1	55.0	58.7	24.1	18119	4	0.2	0.0	55.0	85.0	0.3
1/2/17 3:00	8.0	42.1	15.2	55.0	58.9	24.1	18119	4	0.3	0.0	55.0	85.0	0.3
1/2/17 4:00	8.0	42.1	15.5	55.0	58.9	24.1	18119	4	0.3	0.0	55.0	85.0	0.3
1/2/17 5:00	8.0	42.1	15.5	55.0	58.9	24.1	18119	4	0.3	0.0	55.0	85.0	0.3
1/2/17 6:00	8.0	42.1	15.5	55.0	58.9	24.1	79486	40	1.1	0.0	55.0	85.0	1.3
1/2/17 7:00	8.0	42.1	15.5	55.0	58.9	24.1	79486	40	1.1	0.0	55.0	85.0	1.3
1/2/17 8:00	8.0	42.1	15.7	55.0	58.9	24.1	79486	40	1.1	0.0	55.0	85.0	1.3
1/2/17 9:00	8.0	43.0	15.9	55.0	58.7	24.1	79486	40	1.0	0.0	55.0	85.0	1.3
1/2/17 10:00	8.0	44.1	16.4	55.0	58.6	24.0	79486	40	0.9	0.0	55.0	85.0	1.3
1/2/17 11:00	8.0	46.0	17.3	55.0	58.3	24.0	79486	40	0.8	0.0	55.0	85.0	1.2
1/2/17 12:00	8.0	46.9	17.5	55.0	58.2	23.9	79486	40	0.7	0.0	55.0	85.0	1.2
1/2/17 13:00	8.0	48.9	18.5	55.0	57.9	23.9	79486	40	0.5	0.0	55.0	85.0	1.2
1/2/17 14:00	8.0	50.0	19.1	55.0	57.7	23.8	79486	40	0.4	0.0	55.0	85.0	1.1
1/2/17 15:00	8.0	51.1	19.4	55.0	57.6	23.8	79486	40	0.3	0.0	55.0	85.0	1.1
1/2/17 16:00	8.0	51.1	19.4	55.0	57.6	23.8	79486	40	0.3	0.0	55.0	85.0	1.1
1/2/17 17:00	8.0	50.0	19.1	55.0	57.7	23.8	79486	40	0.4	0.0	55.0	85.0	1.1
1/2/17 18:00	8.0	50.0	19.1	55.0	57.7	23.8	79486	40	0.4	0.0	55.0	85.0	1.1
1/2/17 19:00	8.0	50.0	19.3	55.0	57.7	23.8	18119	4	0.1	0.0	55.0	85.0	0.3

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Project Name:	University of Rochester
Building:	Medical Research Building
Date:	4/1/2021
Calculated By:	CLF
Reviewed By:	GHB
System:	
Scenario:	Proposed System A

Summary of Use

Preheat Usage	1,928	mmBtu
Cooling Usage	3,576	mmBtu
Reheat Usage	3,083	mmBtu
Supply Fan Usage	83,184	kWh

Scheduling / Population load (1=Occ 0=UnOcc)

	Schedule Days1-5	Population Days1-5	Schedule Days6,7,8	Population Days6,7,8
1	0	100%	0	100%
2	0	100%	0	100%
3	0	100%	0	100%
4	0	100%	0	100%
5	0	100%	0	100%
6	0	100%	0	100%
7	1	100%	1	100%
8	1	100%	1	100%
9	1	100%	1	100%
10	1	100%	1	100%
11	1	100%	1	100%
12	1	100%	1	100%
13	1	100%	1	100%
14	1	100%	1	100%
15	1	100%	1	100%
16	1	100%	1	100%
17	1	100%	1	100%
18	1	100%	1	100%
19	1	100%	1	100%
20	0	100%	0	100%
21	0	100%	0	100%
22	0	100%	0	100%
23	0	100%	0	100%
24	0	100%	0	100%

Fan Info

Fan Label	SF
Fan HP:	100.0
Fan QTY:	2.0
Calculated Load Factor:	75%
Fan Motor Eff:	90%
Fan kW:	124.3
Max Fan Flow:	170,000
Fan Affinity Law Adjsut:	1.5

Lab Airflow CFM Reduction

Occupied Design Ariflow	79,486	CFM
Unoccupied Design Airflow	18,119	CFM
Occupied Airflow Reduction	40,085	CFM
Unoccupied Airflow Reduction	9	CFM

Misc System Info

Cooling Shutoff	55	degF
Cooling Shutoff	5	May
Cooling Shutoff	10	October

Active Space Setpoints (Average)

OAT	Occ	Unocc	Load %
0	68.0	68.0	0.00%
10	68.0	68.0	0.00%
20	68.0	68.0	0.00%
30	68.0	68.0	0.00%
40	68.0	68.0	0.00%
50	68.0	68.0	0.00%
55	68.0	68.0	0.00%
60	69.2	69.2	0.00%
70	71.6	71.6	0.00%
80	74.0	74.0	0.00%
90	74.0	74.0	0.00%

System Setpoint Simulations

OAT	PHT STP	DAT STP	DAH STP	
0	55.0	65.0	25.6	
10	55.0	63.6	25.3	
20	55.0	62.1	24.9	
30	55.0	60.7	24.6	
40	55.0	59.3	24.2	
50	55.0	57.9	23.9	
55	55.0	57.1	23.7	
60	55.0	56.4	23.5	
70	55.0	55.0	23.2	
80	55.0	55.0	23.2	
100	55.0	55.0	23.2	
	1.585E-05	-0.001483	-0.109225	64.903594
	X=	28.00	Y=	61.03
	0	0	0	55
	X=	28.00	Y=	55.00
	3.861E-06	-0.000361	-0.026601	25.589599
	X=	90.00	Y=	23.08

Reheat Loading

OAT	DAT	Occ	Unocc	
0	85.0	85.0%	85.0%	
10	85.0	76.8%	76.8%	
20	85.0	68.5%	68.5%	
30	85.0	60.3%	60.3%	
40	85.0	52.0%	52.0%	
50	85.0	43.8%	43.8%	
55	85.0	39.6%	39.6%	
60	85.0	35.5%	35.5%	
70	85.0	27.3%	27.3%	
80	85.0	19.0%	19.0%	
100	85.0	2.5%	2.5%	
	0	0	0	85
	X=	0.00	Y=	85.00
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	0.00	Y=	0.85
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	55.00	Y=	0.40
		% of CFM to Reheat	100.0%	

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Project Name:	University of Rochester
Building:	Medical Research Building
Date:	44287.47
Calculated By:	CLF
Reviewed By:	GHB
System:	0
Scenario:	Proposed System A

Formulas

D : Based on Simulation
E : Design CFM x Fan Simulation
F : ((E / Fan CFM Output)   Fan Affinity) x Fan Kw
G : 1.08 x (D - B) x E / 1,000,000
H : 4.5 x (C - Coil Enthalpy) x E / 1,000,000
J : Based on Simulation
K : Based on Simulation
L : 1.08 x (K - I) x E x % CFM to Reheat / 1,000,000

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
MAX	8.0	93.9	40.8	55.0	64.5	25.5	39400.6	13.9	2.1	3.0	75.9	85.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN	1.0	3.9	1.8	55.0	54.6	23.1	18109.8	4.3	0.0	0.0	54.6	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	36600	496470	194424	481800	501243	207772	259666911	83184	1928	3576	489054	744600	3083	0	0	0	0	0	0	0	0	0	0

Time Stamp	Type	Outside dry-bulb temp (F)	Specific Enthalpy (Btu/lb)	Preheat Setpoint	SAT STP (degF)	Enthalpy Setpoint	Supply Air CFM	Supply Fan Usage (kWh)	Preheat Usage (mmBtu)	Cooling Usage (mmBtu)	DAT (degF)	Reheat DAT (degF)	Reheat Usage (mmBtu)
1/1/17 0:00	7.0	41.0	14.4	55.0	59.0	24.2	18110	4	0.3	0.0	55.0	85.0	0.3
1/1/17 1:00	7.0	37.9	12.6	55.0	59.5	24.3	18110	4	0.3	0.0	55.0	85.0	0.3
1/1/17 2:00	7.0	37.0	11.9	55.0	59.6	24.3	18110	4	0.4	0.0	55.0	85.0	0.3
1/1/17 3:00	7.0	34.0	11.2	55.0	60.1	24.4	18110	4	0.4	0.0	55.0	85.0	0.3
1/1/17 4:00	7.0	33.1	11.0	55.0	60.2	24.5	18110	4	0.4	0.0	55.0	85.0	0.3
1/1/17 5:00	7.0	28.9	9.8	55.0	60.9	24.6	18110	4	0.5	0.0	55.0	85.0	0.4
1/1/17 6:00	7.0	30.9	10.5	55.0	60.6	24.5	39401	14	1.0	0.0	55.0	85.0	0.8
1/1/17 7:00	7.0	32.0	10.7	55.0	60.4	24.5	39401	14	1.0	0.0	55.0	85.0	0.7
1/1/17 8:00	7.0	32.0	11.0	55.0	60.4	24.5	39401	14	1.0	0.0	55.0	85.0	0.7
1/1/17 9:00	7.0	35.1	11.7	55.0	59.9	24.4	39401	14	0.8	0.0	55.0	85.0	0.7
1/1/17 10:00	7.0	37.0	12.3	55.0	59.6	24.3	39401	14	0.8	0.0	55.0	85.0	0.7
1/1/17 11:00	7.0	41.0	13.3	55.0	59.0	24.2	39401	14	0.6	0.0	55.0	85.0	0.7
1/1/17 12:00	7.0	43.0	13.9	55.0	58.7	24.1	39401	14	0.5	0.0	55.0	85.0	0.6
1/1/17 13:00	7.0	45.0	14.6	55.0	58.4	24.0	39401	14	0.4	0.0	55.0	85.0	0.6
1/1/17 14:00	7.0	46.0	14.6	55.0	58.3	24.0	39401	14	0.4	0.0	55.0	85.0	0.6
1/1/17 15:00	7.0	46.9	15.0	55.0	58.2	23.9	39401	14	0.3	0.0	55.0	85.0	0.6
1/1/17 16:00	7.0	46.9	15.0	55.0	58.2	23.9	39401	14	0.3	0.0	55.0	85.0	0.6
1/1/17 17:00	7.0	44.1	14.5	55.0	58.6	24.0	39401	14	0.5	0.0	55.0	85.0	0.6
1/1/17 18:00	7.0	43.0	14.2	55.0	58.7	24.1	39401	14	0.5	0.0	55.0	85.0	0.6
1/1/17 19:00	7.0	42.1	14.0	55.0	58.9	24.1	18110	4	0.3	0.0	55.0	85.0	0.3
1/1/17 20:00	7.0	39.9	13.6	55.0	59.2	24.2	18110	4	0.3	0.0	55.0	85.0	0.3
1/1/17 21:00	7.0	39.9	13.4	55.0	59.2	24.2	18110	4	0.3	0.0	55.0	85.0	0.3
1/1/17 22:00	7.0	41.0	14.1	55.0	59.0	24.2	18110	4	0.3	0.0	55.0	85.0	0.3
1/1/17 23:00	7.0	44.1	14.8	55.0	58.6	24.0	18110	4	0.2	0.0	55.0	85.0	0.3
1/2/17 0:00	8.0	45.0	15.2	55.0	58.4	24.0	18110	4	0.2	0.0	55.0	85.0	0.3
1/2/17 1:00	8.0	44.1	15.0	55.0	58.6	24.0	18110	4	0.2	0.0	55.0	85.0	0.3
1/2/17 2:00	8.0	43.0	15.1	55.0	58.7	24.1	18110	4	0.2	0.0	55.0	85.0	0.3
1/2/17 3:00	8.0	42.1	15.2	55.0	58.9	24.1	18110	4	0.3	0.0	55.0	85.0	0.3
1/2/17 4:00	8.0	42.1	15.5	55.0	58.9	24.1	18110	4	0.3	0.0	55.0	85.0	0.3
1/2/17 5:00	8.0	42.1	15.5	55.0	58.9	24.1	18110	4	0.3	0.0	55.0	85.0	0.3
1/2/17 6:00	8.0	42.1	15.5	55.0	58.9	24.1	39401	14	0.5	0.0	55.0	85.0	0.6
1/2/17 7:00	8.0	42.1	15.5	55.0	58.9	24.1	39401	14	0.5	0.0	55.0	85.0	0.6
1/2/17 8:00	8.0	42.1	15.7	55.0	58.9	24.1	39401	14	0.5	0.0	55.0	85.0	0.6
1/2/17 9:00	8.0	43.0	15.9	55.0	58.7	24.1	39401	14	0.5	0.0	55.0	85.0	0.6
1/2/17 10:00	8.0	44.1	16.4	55.0	58.6	24.0	39401	14	0.5	0.0	55.0	85.0	0.6
1/2/17 11:00	8.0	46.0	17.3	55.0	58.3	24.0	39401	14	0.4	0.0	55.0	85.0	0.6
1/2/17 12:00	8.0	46.9	17.5	55.0	58.2	23.9	39401	14	0.3	0.0	55.0	85.0	0.6
1/2/17 13:00	8.0	48.9	18.5	55.0	57.9	23.9	39401	14	0.3	0.0	55.0	85.0	0.6
1/2/17 14:00	8.0	50.0	19.1	55.0	57.7	23.8	39401	14	0.2	0.0	55.0	85.0	0.6
1/2/17 15:00	8.0	51.1	19.4	55.0	57.6	23.8	39401	14	0.2	0.0	55.0	85.0	0.5
1/2/17 16:00	8.0	51.1	19.4	55.0	57.6	23.8	39401	14	0.2	0.0	55.0	85.0	0.5
1/2/17 17:00	8.0	50.0	19.1	55.0	57.7	23.8	39401	14	0.2	0.0	55.0	85.0	0.6
1/2/17 18:00	8.0	50.0	19.1	55.0	57.7	23.8	39401	14	0.2	0.0	55.0	85.0	0.6
1/2/17 19:00	8.0	50.0	19.3	55.0	57.7	23.8	18110	4	0.1	0.0	55.0	85.0	0.3

Project Name:	University of Rochester
Building:	Medical Research Building
Date:	4/1/2021
Calculated By:	CLF
Reviewed By:	GHB
System:	
Scenario:	Proposed System B

Summary of Use

Preheat Usage	1,896	mmBtu
Cooling Usage	3,525	mmBtu
Reheat Usage	3,033	mmBtu
Supply Fan Usage	81,550	kWh

Scheduling / Population load (1=Occ 0=UnOcc)

	Schedule Days1-5	Population Days1-5	Schedule Days6,7,8	Population Days6,7,8
1	0	100%	0	100%
2	0	100%	0	100%
3	0	100%	0	100%
4	0	100%	0	100%
5	0	100%	0	100%
6	0	100%	0	100%
7	1	100%	1	100%
8	1	100%	1	100%
9	1	100%	1	100%
10	1	100%	1	100%
11	1	100%	1	100%
12	1	100%	1	100%
13	1	100%	1	100%
14	1	100%	1	100%
15	1	100%	1	100%
16	1	100%	1	100%
17	1	100%	1	100%
18	1	100%	1	100%
19	1	100%	1	100%
20	0	100%	0	100%
21	0	100%	0	100%
22	0	100%	0	100%
23	0	100%	0	100%
24	0	100%	0	100%

Fan Info

Fan Label	SF
Fan HP:	100.0
Fan QTY:	2.0
Calculated Load Factor:	75%
Fan Motor Eff:	90%
Fan kW:	124.3
Max Fan Flow:	170,000
Fan Affinity Law Adjsut:	1.5

Lab Airflow CFM Reduction

Occupied Design Ariflow	79,486	CFM
Unoccupied Design Airflow	18,119	CFM
Occupied Airflow Reduction	40,330	CFM
Unoccupied Airflow Reduction	728	CFM

Misc System Info

Cooling Shutoff	55	degF
Cooling Shutoff	5	May
Cooling Shutoff	10	October

Active Space Setpoints (Average)

OAT	Occ	Unocc	Load %
0	68.0	68.0	0.00%
10	68.0	68.0	0.00%
20	68.0	68.0	0.00%
30	68.0	68.0	0.00%
40	68.0	68.0	0.00%
50	68.0	68.0	0.00%
55	68.0	68.0	0.00%
60	69.2	69.2	0.00%
70	71.6	71.6	0.00%
80	74.0	74.0	0.00%
90	74.0	74.0	0.00%

System Setpoint Simulations

OAT	PHT STP	DAT STP	DAH STP	
0	**55.0**	**65.0**	**25.6**	
10	**55.0**	**63.6**	**25.3**	
20	**55.0**	**62.1**	**24.9**	
30	**55.0**	**60.7**	**24.6**	
40	**55.0**	**59.3**	**24.2**	
50	**55.0**	**57.9**	**23.9**	
55	**55.0**	**57.1**	**23.7**	
60	**55.0**	**56.4**	**23.5**	
70	**55.0**	**55.0**	**23.2**	
80	**55.0**	**55.0**	**23.2**	
100	**55.0**	**55.0**	**23.2**	
	1.585E-05	-0.001483	-0.109225	64.903594
	X=	28.00	**Y=**	61.03
	0	0	0	55
	X=	28.00	**Y=**	55.00
	3.861E-06	-0.000361	-0.026601	25.589599
	X=	90.00	**Y=**	23.08

Reheat Loading

OAT	DAT	Occ	Unocc	
0	**85.0**	**85.0%**	**85.0%**	
10	**85.0**	**76.8%**	**76.8%**	
20	**85.0**	**68.5%**	**68.5%**	
30	**85.0**	**60.3%**	**60.3%**	
40	**85.0**	**52.0%**	**52.0%**	
50	**85.0**	**43.8%**	**43.8%**	
55	**85.0**	**39.6%**	**39.6%**	
60	**85.0**	**35.5%**	**35.5%**	
70	**85.0**	**27.3%**	**27.3%**	
80	**85.0**	**19.0%**	**19.0%**	
100	**85.0**	**2.5%**	**2.5%**	
	0	0	0	85
	X=	0.00	**Y=**	85.00
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	0.00	**Y=**	0.85
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	55.00	**Y=**	0.40
	% of CFM to Reheat	100.0%		

wendel

Project Name:	University of Rochester
Building:	Medical Research Building
Date:	44287.47
Calculated By:	CLF
Reviewed By:	GHB
System:	0
Scenario:	Proposed System B

Formulas

D : Based on Simulation
E : Design CFM x Fan Simulation
F : ((E / Fan CFM Output) Fan Affinity) x Fan Kw
G : 1.08 x (D - B) x E / 1,000,000
H : 4.5 x (C - Coil Enthalpy) x E / 1,000,000
J : Based on Simulation
K : Based on Simulation
L : 1.08 x (K - I) x E x % CFM to Reheat / 1,000,000

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
MAX	8.0	93.9	40.8	55.0	64.5	25.5	39156.3	13.7	2.1	2.9	75.9	85.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN	1.0	3.9	1.8	55.0	54.6	23.1	17391.3	4.1	0.0	0.0	54.6	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	36600	496470	194424	481800	501243	207772	255623028	81550	1896	3525	489054	744600	3033	0	0	0	0	0	0	0	0	0	0

Time Stamp	Type	Outside dry-bulb temp (F)	Specific Enthalpy (Btu/lb)	Preheat Setpoint	SAT STP (degF)	Enthalpy Setpoint	Supply Air CFM	Supply Fan Usage (kWh)	Preheat Usage (mmBtu)	Cooling Usage (mmBtu)	DAT (degF)	Reheat DAT (degF)	Reheat Usage (mmBtu)
1/1/17 0:00	7.0	41.0	14.4	55.0	59.0	24.2	17391	4	0.3	0.0	55.0	85.0	0.3
1/1/17 1:00	7.0	37.9	12.6	55.0	59.5	24.3	17391	4	0.3	0.0	55.0	85.0	0.3
1/1/17 2:00	7.0	37.0	11.9	55.0	59.6	24.3	17391	4	0.3	0.0	55.0	85.0	0.3
1/1/17 3:00	7.0	34.0	11.2	55.0	60.1	24.4	17391	4	0.4	0.0	55.0	85.0	0.3
1/1/17 4:00	7.0	33.1	11.0	55.0	60.2	24.5	17391	4	0.4	0.0	55.0	85.0	0.3
1/1/17 5:00	7.0	28.9	9.8	55.0	60.9	24.6	17391	4	0.5	0.0	55.0	85.0	0.3
1/1/17 6:00	7.0	30.9	10.5	55.0	60.6	24.5	39156	14	1.0	0.0	55.0	85.0	0.8
1/1/17 7:00	7.0	32.0	10.7	55.0	60.4	24.5	39156	14	1.0	0.0	55.0	85.0	0.7
1/1/17 8:00	7.0	32.0	11.0	55.0	60.4	24.5	39156	14	1.0	0.0	55.0	85.0	0.7
1/1/17 9:00	7.0	35.1	11.7	55.0	59.9	24.4	39156	14	0.8	0.0	55.0	85.0	0.7
1/1/17 10:00	7.0	37.0	12.3	55.0	59.6	24.3	39156	14	0.8	0.0	55.0	85.0	0.7
1/1/17 11:00	7.0	41.0	13.3	55.0	59.0	24.2	39156	14	0.6	0.0	55.0	85.0	0.6
1/1/17 12:00	7.0	43.0	13.9	55.0	58.7	24.1	39156	14	0.5	0.0	55.0	85.0	0.6
1/1/17 13:00	7.0	45.0	14.6	55.0	58.4	24.0	39156	14	0.4	0.0	55.0	85.0	0.6
1/1/17 14:00	7.0	46.0	14.6	55.0	58.3	24.0	39156	14	0.4	0.0	55.0	85.0	0.6
1/1/17 15:00	7.0	46.9	15.0	55.0	58.2	23.9	39156	14	0.3	0.0	55.0	85.0	0.6
1/1/17 16:00	7.0	46.9	15.0	55.0	58.2	23.9	39156	14	0.3	0.0	55.0	85.0	0.6
1/1/17 17:00	7.0	44.1	14.5	55.0	58.6	24.0	39156	14	0.5	0.0	55.0	85.0	0.6
1/1/17 18:00	7.0	43.0	14.2	55.0	58.7	24.1	39156	14	0.5	0.0	55.0	85.0	0.6
1/1/17 19:00	7.0	42.1	14.0	55.0	58.9	24.1	17391	4	0.2	0.0	55.0	85.0	0.3
1/1/17 20:00	7.0	39.9	13.6	55.0	59.2	24.2	17391	4	0.3	0.0	55.0	85.0	0.3
1/1/17 21:00	7.0	39.9	13.4	55.0	59.2	24.2	17391	4	0.3	0.0	55.0	85.0	0.3
1/1/17 22:00	7.0	41.0	14.1	55.0	59.0	24.2	17391	4	0.3	0.0	55.0	85.0	0.3
1/1/17 23:00	7.0	44.1	14.8	55.0	58.6	24.0	17391	4	0.2	0.0	55.0	85.0	0.3
1/2/17 0:00	8.0	45.0	15.2	55.0	58.4	24.0	17391	4	0.2	0.0	55.0	85.0	0.3
1/2/17 1:00	8.0	44.1	15.0	55.0	58.6	24.0	17391	4	0.2	0.0	55.0	85.0	0.3
1/2/17 2:00	8.0	43.0	15.1	55.0	58.7	24.1	17391	4	0.2	0.0	55.0	85.0	0.3
1/2/17 3:00	8.0	42.1	15.2	55.0	58.9	24.1	17391	4	0.2	0.0	55.0	85.0	0.3
1/2/17 4:00	8.0	42.1	15.5	55.0	58.9	24.1	17391	4	0.2	0.0	55.0	85.0	0.3
1/2/17 5:00	8.0	42.1	15.5	55.0	58.9	24.1	17391	4	0.2	0.0	55.0	85.0	0.3
1/2/17 6:00	8.0	42.1	15.5	55.0	58.9	24.1	39156	14	0.5	0.0	55.0	85.0	0.6
1/2/17 7:00	8.0	42.1	15.5	55.0	58.9	24.1	39156	14	0.5	0.0	55.0	85.0	0.6
1/2/17 8:00	8.0	42.1	15.7	55.0	58.9	24.1	39156	14	0.5	0.0	55.0	85.0	0.6
1/2/17 9:00	8.0	43.0	15.9	55.0	58.7	24.1	39156	14	0.5	0.0	55.0	85.0	0.6
1/2/17 10:00	8.0	44.1	16.4	55.0	58.6	24.0	39156	14	0.5	0.0	55.0	85.0	0.6
1/2/17 11:00	8.0	46.0	17.3	55.0	58.3	24.0	39156	14	0.4	0.0	55.0	85.0	0.6
1/2/17 12:00	8.0	46.9	17.5	55.0	58.2	23.9	39156	14	0.3	0.0	55.0	85.0	0.6
1/2/17 13:00	8.0	48.9	18.5	55.0	57.9	23.9	39156	14	0.3	0.0	55.0	85.0	0.6
1/2/17 14:00	8.0	50.0	19.1	55.0	57.7	23.8	39156	14	0.2	0.0	55.0	85.0	0.6
1/2/17 15:00	8.0	51.1	19.4	55.0	57.6	23.8	39156	14	0.2	0.0	55.0	85.0	0.5
1/2/17 16:00	8.0	51.1	19.4	55.0	57.6	23.8	39156	14	0.2	0.0	55.0	85.0	0.5
1/2/17 17:00	8.0	50.0	19.1	55.0	57.7	23.8	39156	14	0.2	0.0	55.0	85.0	0.6
1/2/17 18:00	8.0	50.0	19.1	55.0	57.7	23.8	39156	14	0.2	0.0	55.0	85.0	0.6
1/2/17 19:00	8.0	50.0	19.3	55.0	57.7	23.8	17391	4	0.1	0.0	55.0	85.0	0.2

UNIVERSITY OF ROCHESTER

Laboratory Air Flow Optimization

KMRB

Option A

Building Utility Impact		
Building Level Energy Savings		
Electrical Energy Savings	152	mmBtu/Year
Chilled Water Savings	1,108	mmBtu/Year
Steam Savings	1,443	mmBtu/Year
Total Energy Savings	**2,703**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	44,444	kWh/Year
Chilled Water Savings	92,346	Ton-Hour/Year
Steam Savings	1,443	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	$0	Per Year

UNIVERSITY OF ROCHESTER

Laboratory Air Flow Optimization

KMRB

Option B

Building Utility Impact		
Building Level Energy Savings		
Electrical Energy Savings	166	mmBtu/Year
Chilled Water Savings	1,233	mmBtu/Year
Steam Savings	1,703	mmBtu/Year
Total Energy Savings	**3,102**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	48,514	kWh/Year
Chilled Water Savings	102,749	Ton-Hour/Year
Steam Savings	1,703	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	$0	Per Year

wendel

Project Name: University of Rochester Energy Conservation MP Support
Building: KMRB
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By:

Assumed
Avg. CFM/Sqft

Existing Conditions							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Total Hood Exhaust CFM	General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH	Pressurization	Supply CFM/Sqft	General Exhaust CFM/Sqft
1-9905 / 1-9911 / 1-9915	Lab	2397	9	21,573	AHS-L-1	2,723	6.3	98.0	613			-			-			-			-			-	613	2,345	2,958		8.23	(235)	1.1	1.0
1-9872 / 1-9878 / 1-9892	Lab	3583	9	32,247	AHS-L-1	4,836	6.3	97.0	606	6.3	97	606			-			-			-			-	1,213	4,330	5,543		10	(707)	1.3	1.2
1-9858 / 1-9852 / 1-9538	Lab	3618	9	32,562	AHS-L-2	2,881	6.3	96.0	600			-			-			-			-			-	600	3,069	3,669		7	(788)	0.8	0.8
1-9855	Lab	407	9	3,663	AHS-L-1	623	6.3	98.0	613			-			-			-			-			-	613	118	731		12	(108)	1.5	0.3
1-9804 / 1-9812	Lab	2415	9	21,735	AHS-L-3	4,277	6.3	107.0	669	6.3	99	619	6	104	650			-			-			-	1,938	3,242	5,180		14.30	(903)	1.8	1.3
1-9807 / 1-9809	Lab	448	9	4,032	AHS-L-3	916	6.3	103.0	644			-			-			-			-			-	644	487	1,131		17	(215)	2.0	1.1
1-9816 / 1-9828	Lab	2409	9	21,681	AHS-L-3	4,331			-			-			-			-			-			-	-	4,677	4,677		13	(346)	1.8	1.9
1-9823	Lab	596	9	5,364	AHS-L-2	672			-			-			-			-			-			-	-	735	735		8	(63)	1.1	1.2
1-9839	Lab	584	9	5,256	AHS-L-2	820			-			-			-			-			-			-	-	1,112	1,112		13	(292)	1.4	1.9
1-9811 / 1-9813	Lab	311	9	2,799	AHS-L-3	369			-			-			-			-			-			-	-	-	-		-	369	1.2	-
1-9825	Lab	562	9	5,058	AHS-L-3	320			-			-			-			-			-			-	-	137	137		2	183	0.6	0.2
1-9826	Lab	14	9	126	AHS-L-2	102			-			-			-			-			-			-	-	140	140		67	(38)	7.3	10.0
1-9827 / 1-9829	Lab	98	9	882	AHS-L-2	413			-			-			-			-			-			-	-	382	382		26	31	4.2	3.9
1-9837	Lab	156	9	1,404	AHS-L-2	132			-			-			-			-			-			-	-	192	192		8	(60)	0.8	1.2
1-9847	Lab	198	9	1,782	AHS-L-2	168			-			-			-			-			-			-	-	240	240		8	(72)	0.8	1.2
1-9845	Lab	194	9	1,746	AHS-L-2	238			-			-			-			-			-			-	-	315	315		11	(77)	1.2	1.6
1-9803 / 1-9805	Lab	199	9	1,791	AHS-L-3	238			-			-			-			-			-			-	-	309	309		10	(71)	1.2	1.6
1-9857	Lab	198	9	1,782	AHS-L-1	182			-			-			-			-			-			-	-	244	244		8	(62)	0.9	1.2
1-9859	Lab	197	9	1,773	AHS-L-1	183			-			-			-			-			-			-	-	238	238		8	(55)	0.9	1.2
1-9861 / 1-9863	Lab	193	9	1,737	AHS-L-1	157			-			-			-			-			-			-	-	223	223		8	(66)	0.8	1.2
2-9905 / 2-9915	Lab	2416	9	21,744	AHS-L-1	3,051	6.3	98.0	613			-			-			-			-			-	613	2,846	3,459		10	(408)	1.3	1.2
2-9872 / 2-9878 / 2-9892	Lab	3451	9	31,059	AHS-L-1	4,638	6.3	102.0	638	6	104	650			-			-			-			-	1,288	4,074	5,362		10	(724)	1.3	1.2
2-9861 / 2-9863	Lab	193	9	1,737	AHS-L-1	170			-			-			-			-			-			-	-	318	318		11	(148)	0.9	1.6
2-9859	Lab	187	9	1,683	AHS-L-1	159			-			-			-			-			-			-	-	224	224		8	(65)	0.9	1.2
2-9857	Lab	187	9	1,683	AHS-L-1	139			-			-			-			-			-			-	-	207	207		7	(68)	0.7	1.1
2-9855 A & B	Lab	134	9	1,206	AHS-L-1	513			-			-			-			-			-			-	-	655	655		33	(142)	3.8	4.9
2-9841 & 2-9843	Lab	395	9	3,555	AHS-L-2	316			-			-			-			-			-			-	-	441	441		7	(125)	0.8	1.1
2-9845	Lab	194	9	1,746	AHS-L-2	147			-			-			-			-			-			-	-	211	211		7	(64)	0.8	1.1
2-9847	Lab	198	9	1,782	AHS-L-2	144			-			-			-			-			-			-	-	204	204		7	(60)	0.7	1.0
2-9837	Lab	77	9	693	AHS-L-2	72			-			-			-			-			-			-	-	104	104		9	(32)	0.9	1.4
2-9839	Lab	195	9	1,755	AHS-L-2	190			-			-			-			-			-			-	-	271	271		9	(81)	1.0	1.4
2-9827 / 2-9829	Lab	162	9	1,458	AHS-L-2	410			-			-			-			-			-			-	-	415	415		17	(5)	2.5	2.6
2-9825	Lab	562	9	5,058	AHS-L-2	270			-			-			-			-			-			-	-	382	382		5	(112)	0.5	0.7
2-9626	Lab	115	9	1,035	AHS-L-2	78			-			-			-			-			-			-	-	103	103		6	(25)	0.7	0.9
2-9803	Lab	90	9	810	AHS-L-3	-			-			-			-			-			-			-	-	92	92		7	(92)	-	1.0
2-9805	Lab	100	9	900	AHS-L-3	52			-			-			-			-			-			-	-	-	-		-	52	0.5	-
2-9807	Lab	184	9	1,656	AHS-L-3	153			-			-			-			-			-			-	-	224	224		8	(71)	0.8	1.2
2-9809	Lab	189	9	1,701	AHS-L-3	149			-			-			-			-			-			-	-	224	224		8	(75)	0.8	1.2
2-9813	Lab	418	9	3,762	AHS-L-3	419			-			-			-			-			-			-	-	608	608		10	(189)	1.0	1.5
2-9819	Lab	198	9	1,782	AHS-L-2	173			-			-			-			-			-			-	-	235	235		8	(62)	0.9	1.2
2-9838 / 2-9852 / 2-9858	Lab	3638	9	32,742	AHS-L-2	3,169	6.3	103.0	644	6	105	656			-			-			-			-	1,300	2,960	4,260		8	(1,091)	0.9	0.8
2-9804 / 2-9812 / 2-9616 / 2-9828	Lab	4770	9	42,930	AHS-L-3	3,095	6.3	100.0	625	6	94	588			-			-			-			-	1,213	3,397	4,610		6	(1,515)	0.6	0.7
2-9823	Lab	413	9	3,717	AHS-L-2	461			-			-			-			-			-			-	-	318	318		5	143	1.1	0.8
3-9905 / 3-9915	Lab	2323	9	20,907	AHS-L-3	2,335	6.3	94.0	588			-			-			-			-			-	588	3,905	4,493		13	(2,158)	1.0	1.7
3-9872 / 3-9878 / 3-9892	Lab	3618	9	32,562	AHS-L-1	4,555	6.3	101.0	631	6	101	631			-			-			-			-	1,263	4,920	6,183		11	(1,628)	1.3	1.4
3-9861 & 3-9863	Lab	193	9	1,737	AHS-L-1	160			-			-			-			-			-			-	-	230	230		8	(70)	0.8	1.2
3-9859	Lab	187	9	1,683	AHS-L-1	155			-			-			-			-			-			-	-	220	220		8	(65)	0.8	1.2
3-9626	Lab	114	9	1,026	AHS-L-2	105			-			-			-			-			-			-	-	105	105		6	-	0.9	0.9
3-9803 & 3-9805	Lab	199	9	1,791	AHS-L-3	155			-			-			-			-			-			-	-	225	225		8	(70)	0.8	1.1
3-9807	Lab	197	9	1,773	AHS-L-3	195			-			-			-			-			-			-	-	280	280		9	(85)	1.0	1.4
3-9809	Lab	189	9	1,701	AHS-L-3	195			-			-			-			-			-			-	-	280	280		10	(85)	1.0	1.5
3-9813	Lab	412	9	3,708	AHS-L-3	325			-			-			-			-			-			-	-	470	470		8	(145)	0.8	1.1
3-9825	Lab	560	9	5,040	AHS-L-2	260			-			-			-			-			-			-	-	375	375		4	(115)	0.5	0.7
3-9827 & 3-9829	Lab	98	9	882	AHS-L-2	440			-			-			-			-			-			-	-	440	440		30	-	4.5	4.5
3-9837	Lab	172	9	1,548	AHS-L-2	440			-			-			-			-			-			-	-	235	235		9	205	2.6	1.4
3-9839	Lab	186	9	1,674	AHS-L-2	175			-			-			-			-			-			-	-	250	250		9	(75)	0.9	1.3
3-9843	Lab	401	9	3,609	AHS-L-2	250			-			-			-			-			-			-	-	355	355		6	(105)	0.6	0.9
3-9845	Lab	194	9	1,746	AHS-L-2	155			-			-			-			-			-			-	-	225	225		8	(70)	0.8	1.2
3-9847	Lab	198	9	1,782	AHS-L-2	160			-			-			-			-			-			-	-	230	230		8	(70)	0.8	1.2
3-9848	Lab	81	9	729	AHS-L-2	65			-			-			-			-			-			-	-	85	85		7	(20)	0.8	1.0
3-9855	Lab	407	9	3,663	AHS-L-1	495			-			-			-			-			-			-	-	605	605		10	(110)	1.2	1.5
3-9857	Lab	187	9	1,683	AHS-L-1	155			-			-			-			-			-			-	-	225	225		8	(70)	0.8	1.2
3-9838 / 3-9852 / 3-9858	Lab	3534	9	31,806	AHS-L-2	2,890	6.3	102.0	638			-			-			-			-			-	638	3,130	3,768		7	(878)	0.8	0.9
3-9816 / 3-9828	Lab	2415	9	21,735	AHS-L-3	3,115	6.3	98.0	613	6	100	625			-			-			-			-	1,238	3,380	4,618		13	(1,503)	1.3	1.4
3-9804 / 3-9812	Lab	2406	9	21,654	AHS-L-3	3,160			-			-			-			-			-			-	-	3,520	3,520		10	(360)	1.3	1.5
G9852 / G9858 / G9838	Lab	3610	9	32,490	AHS-L-2	2,515	6.3	92.0	575	6	101	631	6	105	656	6	101	631	6	101	631	6	101	631	3,756	1,860	5,616		10	(3,101)	0.7	0.5
G9816 / G9828	Lab	2410	9	21,690	AHS-L-3	3,325	6.3	101.0	631	6	89	556	6	104	650			-			-			-	1,838	2,190	4,028		11	(703)	1.4	0.9
G9804 / G9812	Lab	2406	9	21,654	AHS-L-3	3,050	6.3	107.0	669			-			-			-			-			-	669	3,050	3,719		10	(669)	1.3	1.3
G9805	Lab	100	9	900	AHS-L-3	100			-			-			-			-			-			-	-	145	145		10	(45)	1.0	1.5
G9820	Lab	95	9	855	AHS-L-2	200			-			-			-			-			-			-	-	300	300		21	(100)	2.1	3.2
G9823	Lab	312	9	2,808	AHS-L-2	180			-			-			-			-			-			-	-	720	720		15	(540)	0.6	2.3
G9825A	Lab	117	9	1,053	AHS-L-2	150			-			-			-			-			-			-	-	200	200		11	(50)	1.3	1.7
G9821	Lab	787	9	7,083	AHS-L-2	445			-			-			-			-			-			-	-	550	550		5	(105)	0.6	0.7
G9826A	Lab	98	9	882	AHS-L-2	135			-			-			-			-			-			-	-	135	135		9	-	1.4	1.4
G9837	Lab	197	9	1,773	AHS-L-2	210			-			-			-			-			-			-	-	155	155		5	55	1.1	0.8
G9839	Lab	72	9	648	AHS-L-2	105			-			-			-			-			-			-	-	115	115		11	(10)	1.5	1.6
G9807 / G9809	Lab	376	9	3,384	AHS-L-2	360			-			-			-			-			-			-	-	500	500		9	(140)	1.0	1.3
G9813	Lab	408	9	3,672	AHS-L-3	1,600	7.8	88.0	682			-			-			-			-			-	682	1,950	2,632		43	(1,032)	3.9	4.8
G9843	Lab	501	9	4,509	AHS-L-2	665	6.3	93.0	581			-			-			-			-			-	581	100	681		9	(16)	1.3	0.2
G9909 / G9915	Lab	1520	9	13,680	AHS-L-3	1,940	6.3	93.0	581	6.3	93.0	581	6.3	93.0	581			-			-			-	1,744	2,232	3,976		17	(2,036)	1.3	1.5
G9872 / G9878 / G9892	Lab	3596	9	32,364	AHS-L-3	4,589	6.3	86.0	538	6.3	101	631	6	97	606	6	97	606	6	103	644	6	100	625	3,650	5,281	8,931		17	(4,342)	1.3	1.5
G9855	Lab	407	9	3,663	AHS-L-3	519			-			-			-			-			-			-	-	598	598		10	(78)	1.3	1.5
G9857	Lab	196	9	1,764	AHS-L-3	250			-			-			-			-			-			-	-	288	288		10	(38)	1.3	1.5
G9859	Lab	196	9	1,764	AHS-L-3	250			-			-			-			-			-			-	-	288	288		10	(38)	1.3	1.5
G9861 & G9863	Lab	193	9	1,737	AHS-L-3	246			-			-			-			-			-			-	-	283	283		10	(37)	1.3	1.5
		73,111	774	657,999	-	83,323	133	2,057	12,988	69	1,084	6,775	31	503	3,144										26,676	85,678	112,354	-	926	(29,031)	#DIV/0	125

wendel

Project Name: University of Rochester Energy Conservation MP Support
Building: KMRB
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By:

Assumed
Avg. CFM/Sqft

Desired Face Velocity 80 FPM Desired CFM/Sqft 1 CFM/SQFT Desired Lab ACH 8 10 12

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	New Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	Pressurization	SQFT ACH	CFM/Sqft
1-9905 / 1-9911 / 1-9915	Lab	2,397	9	21,573	AHS-L-1	2,642	6.3	98	613	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	613	2,264	2,876	2,876	8	(235)	1.1	1.1
1-9872 / 1-9878 / 1-9892	Lab	3,583	9	32,247	AHS-L-1	3,593	6.3	97	606	6	97	606	-	-	-	-	-	-	-	-	-	-	-	-	1,213	3,087	4,300	4,300	8	(707)	1.0	1.0
1-9858 / 1-9852 / 1-9538	Lab	3,618	9	32,562	AHS-L-2	2,881	6.3	96	600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600	3,069	3,669	3,669	7	(788)	0.8	0.8
1-9855	Lab	407	9	3,663	AHS-L-1	505	6.3	98	613	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	613	-	515	613	8	(108)	1.2	1.2
1-9804 / 1-9812	Lab	2,415	9	21,735	AHS-L-3	2,415	6.3	107	669	6	99	619	6	104	650	-	-	-	-	-	-	-	-	-	1,938	1,380	3,318	3,318	9	(903)	1.0	1.0
1-9807 / 1-9809	Lab	448	9	4,032	AHS-L-3	448	6.3	103	644	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	644	19	663	663	10	(215)	1.0	1.0
1-9816 / 1-9828	Lab	2,409	9	21,681	AHS-L-3	2,545	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,891	2,891	2,891	8	(346)	1.1	1.1
1-9823	Lab	596	9	5,364	AHS-L-2	652	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	715	715	715	8	(63)	1.1	1.1
1-9839	Lab	584	9	5,256	AHS-L-2	584	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	876	876	876	10	(292)	1.0	1.0
1-9811 / 1-9813	Lab	311	9	2,799	AHS-L-3	742	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	373	373	373	8	369	2.4	2.4
1-9825	Lab	562	9	5,058	AHS-L-3	320	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	137	137	137	2	183	0.6	0.6
1-9826	Lab	14	9	126	AHS-L-2	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	52	52	25	(38)	1.0	1.0
1-9827 / 1-9829	Lab	98	9	882	AHS-L-2	149	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118	118	118	8	31	1.5	1.5
1-9837	Lab	156	9	1,404	AHS-L-2	132	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	192	192	192	8	(60)	0.8	0.8
1-9847	Lab	198	9	1,782	AHS-L-2	168	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	240	240	240	8	(72)	0.8	0.8
1-9845	Lab	194	9	1,746	AHS-L-2	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	271	271	271	9	(77)	1.0	1.0
1-9803 / 1-9805	Lab	199	9	1,791	AHS-L-3	199	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	270	270	270	9	(71)	1.0	1.0
1-9857	Lab	198	9	1,782	AHS-L-1	182	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	244	244	244	8	(62)	0.9	0.9
1-9859	Lab	197	9	1,773	AHS-L-1	183	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	238	238	238	8	(55)	0.9	0.9
1-9861 / 1-9863	Lab	193	9	1,737	AHS-L-1	157	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	223	223	223	8	(66)	0.8	0.8
2-9905 / 2-9915	Lab	2,416	9	21,744	AHS-L-1	2,492	6.3	98	613	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	613	2,287	2,899	2,899	8	(408)	1.0	1.0
2-9872 / 2-9878 / 2-9892	Lab	3,451	9	31,059	AHS-L-1	3,451	6.3	102	638	6	104	650	-	-	-	-	-	-	-	-	-	-	-	-	1,288	2,887	4,175	4,175	8	(724)	1.0	1.0
2-9861 / 2-9863	Lab	193	9	1,737	AHS-L-1	170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	318	318	318	11	(148)	0.9	0.9
2-9859	Lab	187	9	1,683	AHS-L-1	159	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	224	224	224	8	(65)	0.9	0.9
2-9857	Lab	187	9	1,683	AHS-L-1	139	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	207	207	207	7	(68)	0.7	0.7
2-9855 A & B	Lab	134	9	1,206	AHS-L-1	134	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	276	276	276	14	(142)	1.0	1.0
2-9841 & 2-9843	Lab	395	9	3,555	AHS-L-2	316	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	441	441	441	7	(125)	0.8	0.8
2-9845	Lab	194	9	1,746	AHS-L-2	147	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	211	211	211	7	(64)	0.8	0.8
2-9847	Lab	198	9	1,782	AHS-L-2	144	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204	204	204	7	(60)	0.7	0.7
2-9837	Lab	77	9	693	AHS-L-2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	104	104	104	9	(32)	0.9	0.9
2-9839	Lab	195	9	1,755	AHS-L-2	190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	271	271	271	9	(81)	1.0	1.0
2-9827 / 2-9829	Lab	162	9	1,458	AHS-L-2	189	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	194	194	194	8	(5)	1.2	1.2
2-9825	Lab	562	9	5,058	AHS-L-2	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	382	382	382	5	(112)	0.5	0.5
2-9626	Lab	115	9	1,035	AHS-L-2	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	103	103	103	6	(25)	0.7	0.7
2-9803	Lab	90	9	810	AHS-L-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92	92	92	7	(92)	-	-
2-9805	Lab	100	9	900	AHS-L-3	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	0.5	0.5
2-9807	Lab	184	9	1,656	AHS-L-3	153	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	224	224	224	8	(71)	0.8	0.8
2-9809	Lab	189	9	1,701	AHS-L-3	149	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	224	224	224	8	(75)	0.8	0.8
2-9813	Lab	418	9	3,762	AHS-L-3	418	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	607	607	607	10	(189)	1.0	1.0
2-9819	Lab	198	9	1,782	AHS-L-2	173	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	235	235	235	8	(62)	0.9	0.9
2-9838 / 2-9852 / 2-9858	Lab	3,638	9	32,742	AHS-L-2	3,169	6.3	103	644	6	105	656	-	-	-	-	-	-	-	-	-	-	-	-	1,300	2,960	4,260	4,260	8	(1,091)	0.9	0.9
2-9804 / 2-9812 / 2-9616 / 2-9828	Lab	4,770	9	42,930	AHS-L-3	3,095	6.3	100	625	6	94	588	-	-	-	-	-	-	-	-	-	-	-	-	1,213	3,397	4,610	4,610	6	(1,515)	0.6	0.6
2-9823	Lab	413	9	3,717	AHS-L-2	639	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	496	496	496	8	143	1.5	1.5
3-9905 / 3-9915	Lab	2,323	9	20,907	AHS-L-3	2,323	6.3	94	588	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	588	3,893	4,481	4,481	13	(2,158)	1.0	1.0
3-9872 / 3-9878 / 3-9892	Lab	3,618	9	32,562	AHS-L-1	3,618	6.3	101	631	6	101	631	-	-	-	-	-	-	-	-	-	-	-	-	1,263	3,983	5,246	5,246	10	(1,628)	1.0	1.0
3-9861 & 3-9863	Lab	193	9	1,737	AHS-L-1	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	230	230	230	8	(70)	0.8	0.8
3-9859	Lab	187	9	1,683	AHS-L-1	155	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	220	220	220	8	(65)	0.8	0.8
3-9626	Lab	114	9	1,026	AHS-L-2	105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	105	105	105	6	-	0.9	0.9
3-9803 & 3-9805	Lab	199	9	1,791	AHS-L-3	155	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	225	225	8	(70)	0.8	0.8
3-9807	Lab	197	9	1,773	AHS-L-3	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	280	280	280	9	(85)	1.0	1.0
3-9809	Lab	189	9	1,701	AHS-L-3	189	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	274	274	274	10	(85)	1.0	1.0
3-9813	Lab	412	9	3,708	AHS-L-3	325	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	470	470	470	8	(145)	0.8	0.8
3-9825	Lab	560	9	5,040	AHS-L-2	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	375	375	375	4	(115)	0.5	0.5
3-9827 & 3-9829	Lab	98	9	882	AHS-L-2	118	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118	118	118	8	-	1.2	1.2
3-9837	Lab	172	9	1,548	AHS-L-2	411	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	206	206	206	8	205	2.4	2.4
3-9839	Lab	186	9	1,674	AHS-L-2	175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	250	250	250	9	(75)	0.9	0.9
3-9843	Lab	401	9	3,609	AHS-L-2	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	355	355	355	6	(105)	0.6	0.6
3-9845	Lab	194	9	1,746	AHS-L-2	155	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	225	225	8	(70)	0.8	0.8
3-9847	Lab	198	9	1,782	AHS-L-2	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	230	230	230	8	(70)	0.8	0.8
3-9848	Lab	81	9	729	AHS-L-2	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	85	85	85	7	(20)	0.8	0.8
3-9855	Lab	407	9	3,663	AHS-L-1	407	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	517	517	517	8	(110)	1.0	1.0
3-9857	Lab	187	9	1,683	AHS-L-1	155	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	225	225	8	(70)	0.8	0.8
3-9838 / 3-9852 / 3-9858	Lab	3,534	9	31,806	AHS-L-2	2,890	6.3	102	638	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	638	3,130	3,768	3,768	7	(878)	0.8	0.8
3-9816 / 3-9828	Lab	2,415	9	21,735	AHS-L-3	2,415	6.3	98	613	6	100	625	-	-	-	-	-	-	-	-	-	-	-	-	1,238	2,680	3,918	3,918	11	(1,503)	1.0	1.0
3-9804 / 3-9812	Lab	2,406	9	21,654	AHS-L-3	2,527	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,887	2,887	2,887	8	(360)	1.1	1.1
G9852 / G9858 / G9838	Lab	3,610	9	32,490	AHS-L-2	2,515	6.3	92	575	6	101	631	6.3	105	656	6.3	101	631	6.3	101	631	6.3	101	631	3,756	1,860	5,616	5,616	10	(3,101)	0.7	0.7
G9816 / G9828	Lab	2,410	9	21,690	AHS-L-3	2,410	6.3	101	631	6	89	556	6	104	650	-	-	-	-	-	-	-	-	-	1,838	1,275	3,113	3,113	9	(703)	1.0	1.0
G9804 / G9812	Lab	2,406	9	21,654	AHS-L-3	2,406	6.3	107	669	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	669	2,406	3,075	3,075	9	(669)	1.0	1.0
G9805	Lab	100	9	900	AHS-L-3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	145	145	145	10	(45)	1.0	1.0
G9820	Lab	95	9	855	AHS-L-2	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	195	195	195	14	(100)	1.0	1.0
G9823	Lab	312	9	2,808	AHS-L-2	180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	720	720	720	15	(540)	0.6	0.6
G9825A	Lab	117	9	1,053	AHS-L-2	117	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	167	167	167	10	(50)	1.0	1.0
G9821	Lab	787	9	7,083	AHS-L-2	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	550	550	550	5	(105)	0.6	0.6
G9826A	Lab	98	9	882	AHS-L-2	118	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118	118	118	8	-	1.2	1.2
G9837	Lab	197	9	1,773	AHS-L-2	291	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	236	236	236	8	55	1.5	1.5
G9839	Lab	72	9	648	AHS-L-2	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86	86	86	8	(10)	1.1	1.1
G9807 / G9809	Lab	376	9	3,384	AHS-L-2	360	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	500	500	500	9	(140)	1.0	1.0
G9813	Lab	408	9	3,672	AHS-L-3	408	7.8	88	682	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	682	758	1,440	1,440	24	(1,032)	1.0	1.0
G9843	Lab	501	9	4,509	AHS-L-2	585	6.3	93	581	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	581	20	601	601	8	(16)	1.2	1.2
G9909 / G9915	Lab	1,520	9	13,680	AHS-L-3	1,520	6.3	93	581	6	93	581	6	93	581	-	-	-	-	-	-	-	-	-	1,744	1,813	3,556	3,556	16	(2,036)	1.0	1.0
G9872 / G9878 / G9892	Lab	3,596	9	32,364	AHS-L-3	3,596	6.3	86	538	6	101	631	6	97	606	6	97	606	6	103	644	6	100	625	3,650	4,288	7,938	7,938	15	(4,342)	1.0	1.0
G9855	Lab	407	9	3,663	AHS-L-3	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	488	488	488	8	(78)	1.0	1.0
G9857	Lab	196	9	1,764	AHS-L-3	197	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	235	235	235	8	(38)	1.0	1.0
G9859	Lab	196	9	1,764	AHS-L-3	197	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	235	235	235	8	(38)	1.0	1.0
G9861 & G9863	Lab	193	9	1,737	AHS-L-3	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	232	232	232	8	(37)	1.0	1.0
		73,111	765	657,999	-	67,938	133	2,057	12,988	69	1,084	6,775	31	503	3,144	13	198	1,238	13	204	1,275	13	201	1,256	26,676	70,294	96,871	96,969	740	(29,031)	80.8	81

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Project Name: University of Rochester Energy Conservation MP Support
Building: KMRB
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: 0

Assumed
Avg. CFM/Sqft

Existing Conditions							Fume Hood 1	Fume Hood 2	Fume Hood 3	Fume Hood 4	Fume Hood 5	Fume Hood 6	Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Design Exhaust CFM	Design Exhaust CFM	Design Exhaust CFM	Design Exhaust CFM	Design Exhaust CFM	Design Exhaust CFM	Total Hood Exhaust CFM	General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH	Pressurization	Supply CFM/Sqft	General Exhaust CFM/Sqft
1-9905 / 1-9911 / 1-9915	Lab	2397	9	21,573	AHS-L-1	1,328	337.00	-	-	-			337	1,297	1,634		5	(306)	0.6	0.5
1-9872 / 1-9878 / 1-9892	Lab	3583	9	32,247	AHS-L-1	2,431	253.00	232	-	-	-	-	485	2,509	2,994		6	(563)	0.7	0.7
1-9858 / 1-9852 / 1-9538	Lab	3618	9	32,562	AHS-L-2	1,571	278.00	-	-	-	-	-	278	1,951	2,229		4	(658)	0.4	0.5
1-9855	Lab	407	9	3,663	AHS-L-1	297	281.00	-	-	-	-	-	281	100	381		6	(84)	0.7	0.2
1-9804 / 1-9812	Lab	2415	9	21,735	AHS-L-3	1,912	215.00	226	215	-	-	-	656	1,643	2,299		6	(387.00)	0.8	0.7
1-9807 / 1-9809	Lab	448	9	4,032	AHS-L-3	314	337.00	-	-	-	-	-	337	168	505		8	(191)	0.7	0.4
1-9816 / 1-9828	Lab	2409	9	21,681	AHS-L-3	2,140	-	-	-	-	-	-	-	2,720	2,720		8	(580)	0.9	1.1
1-9823	Lab	596	9	5,364	AHS-L-2	406	-	-	-	-	-	-	-	467	467		5	(61)	0.7	0.8
1-9839	Lab	584	9	5,256	AHS-L-2	399	-	-	-	-	-	-	-	263	263		3	136	0.7	0.5
1-9811 / 1-9813	Lab	311	9	2,799	AHS-L-3	146	-	-	-	-	-	-	-	-	-		-	146	0.5	-
1-9825	Lab	562	9	5,058	AHS-L-3	295	-	-	-	-	-	-	-	98	98		1	197	0.5	0.2
1-9826	Lab	14	9	126	AHS-L-2	51	-	-	-	-	-	-	-	71	71		34	(20)	3.6	5.1
1-9827 / 1-9829	Lab	98	9	882	AHS-L-2	413	-	-	-	-	-	-	-	281	281		19	132	4.2	2.9
1-9837	Lab	156	9	1,404	AHS-L-2	73	-	-	-	-	-	-	-	107	107		5	(34)	0.5	0.7
1-9847	Lab	198	9	1,782	AHS-L-2	65	-	-	-	-	-	-	-	129	129		4	(64)	0.3	0.7
1-9845	Lab	194	9	1,746	AHS-L-2	90	-	-	-	-	-	-	-	198	198		7	(108)	0.5	1.0
1-9803 / 1-9805	Lab	199	9	1,791	AHS-L-3	93	-	-	-	-	-	-	-	172	172		6	(79)	0.5	0.9
1-9857	Lab	198	9	1,782	AHS-L-1	65	-	-	-	-	-	-	-	110	110		4	(45)	0.3	0.6
1-9859	Lab	197	9	1,773	AHS-L-1	86	-	-	-	-	-	-	-	140	140		5	(54)	0.4	0.7
1-9861 / 1-9863	Lab	193	9	1,737	AHS-L-1	68	-	-	-	-	-	-	-	128	128		4	(60)	0.4	0.7
2-9905 / 2-9915	Lab	2416	9	21,744	AHS-L-1	1,469	236.00	-	-	-	-	-	236	1,680	1,916		5	(447)	0.6	0.7
2-9872 / 2-9878 / 2-9892	Lab	3451	9	31,059	AHS-L-1	2,090	257.00	253	-	-	-	-	510	2,279	2,789		5	(699)	0.6	0.7
2-9861 / 2-9863	Lab	193	9	1,737	AHS-L-1	60	-	-	-	-	-	-	-	98	98		3	(38)	0.3	0.5
2-9859	Lab	187	9	1,683	AHS-L-1	81	-	-	-	-	-	-	-	120	120		4	(39)	0.4	0.6
2-9857	Lab	187	9	1,683	AHS-L-1	82	-	-	-	-	-	-	-	101	101		4	(19)	0.4	0.5
2-9855 A & B	Lab	134	9	1,206	AHS-L-1	169	-	-	-	-	-	-	-	243	243		12	(74)	1.3	1.8
2-9841 & 2-9843	Lab	395	9	3,555	AHS-L-2	176	-	-	-	-	-	-	-	285	285		5	(109)	0.4	0.7
2-9845	Lab	194	9	1,746	AHS-L-2	79	-	-	-	-	-	-	-	135	135		5	(56)	0.4	0.7
2-9847	Lab	198	9	1,782	AHS-L-2	81	-	-	-	-	-	-	-	128	128		4	(47)	0.4	0.6
2-9837	Lab	77	9	693	AHS-L-2	59	-	-	-	-	-	-	-	74	74		6	(15)	0.8	1.0
2-9839	Lab	195	9	1,755	AHS-L-2	80	-	-	-	-	-	-	-	165	165		6	(85)	0.4	0.8
2-9827 / 2-9829	Lab	162	9	1,458	AHS-L-2	410	-	-	-	-	-	-	-	410	410		17	-	2.5	2.5
2-9825	Lab	562	9	5,058	AHS-L-2	207	-	-	-	-	-	-	-	254	254		3	(47)	0.4	0.5
2-9626	Lab	115	9	1,035	AHS-L-2	54	-	-	-	-	-	-	-	69	69		4	(15)	0.5	0.6
2-9803	Lab	90	9	810	AHS-L-3	-	-	-	-	-	-	-	-	92	92		7	(92)	-	1.0
2-9805	Lab	100	9	900	AHS-L-3	52	-	-	-	-	-	-	-	-	-		-	52	0.5	-
2-9807	Lab	184	9	1,656	AHS-L-3	61	-	-	-	-	-	-	-	116	116		4	(55)	0.3	0.6
2-9809	Lab	189	9	1,701	AHS-L-3	66	-	-	-	-	-	-	-	117	117		4	(51)	0.3	0.6
2-9813	Lab	418	9	3,762	AHS-L-3	178	-	-	-	-	-	-	-	357	357		6	(179)	0.4	0.9
2-9819	Lab	198	9	1,782	AHS-L-2	105	-	-	-	-	-	-	-	137	137		5	(32)	0.5	0.7
2-9838 / 2-9852 / 2-9858	Lab	3638	9	32,742	AHS-L-2	1,427	309.0	246	-	-	-	-	555	1,640	2,195		4	(768)	0.4	0.5
2-9804 / 2-9812 / 2-9616	Lab	4770	9	42,930	AHS-L-3	1,488	229.0	246	-	-	-	-	475	1,696	2,171		3	(683)	0.3	0.4
2-9823	Lab	413	9	3,717	AHS-L-2	211	-	-	-	-	-	-	-	180	180		3	31	0.5	0.4
3-9905 / 3-9915	Lab	2323	9	20,907	AHS-L-3	1,088	260.0	-	-	-	-	-	260	1,834	2,094		6	(1,006)	0.5	0.8
3-9872 / 3-9878 / 3-9892	Lab	3618	9	32,562	AHS-L-1	2,098	215.0	271	-	-	-	-	486	2,227	2,713		5	(615)	0.6	0.6
3-9861 & 3-9863	Lab	193	9	1,737	AHS-L-1	73	-	-	-	-	-	-	-	110	110		4	(37)	0.4	0.6
3-9859	Lab	187	9	1,683	AHS-L-1	82	-	-	-	-	-	-	-	131	131		5	(49)	0.4	0.7
3-9626	Lab	114	9	1,026	AHS-L-2	58	-	-	-	-	-	-	-	63	63		4	(5)	0.5	0.6
3-9803 & 3-9805	Lab	199	9	1,791	AHS-L-3	62	-	-	-	-	-	-	-	122	122		4	(60)	0.3	0.6
3-9807	Lab	197	9	1,773	AHS-L-3	84	-	-	-	-	-	-	-	166	166		6	(82)	0.4	0.8
3-9809	Lab	189	9	1,701	AHS-L-3	86	-	-	-	-	-	-	-	157	157		6	(71)	0.5	0.8
3-9813	Lab	412	9	3,708	AHS-L-3	151	-	-	-	-	-	-	-	244	244		4	(93)	0.4	0.6
3-9825	Lab	560	9	5,040	AHS-L-2	218	-	-	-	-	-	-	-	265	265		3	(47)	0.4	0.5
3-9827 & 3-9829	Lab	98	9	882	AHS-L-2	439	-	-	-	-	-	-	-	440	440		30	(1)	4.5	4.5
3-9837	Lab	172	9	1,548	AHS-L-2	82	-	-	-	-	-	-	-	85	85		3	(3)	0.5	0.5
3-9839	Lab	186	9	1,674	AHS-L-2	65	-	-	-	-	-	-	-	114	114		4	(49)	0.3	0.6
3-9843	Lab	401	9	3,609	AHS-L-2	137	-	-	-	-	-	-	-	157	157		3	(20)	0.3	0.4

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Assumed
Avg. CFM/Sqft

3-9845	Lab	194	9	1,746	AHS-L-2	70	-	-	-	-	-	-	-	122	122		4	(52)	0.4	0.6
3-9847	Lab	198	9	1,782	AHS-L-2	66	-	-	-	-	-	-	-	121	121		4	(55)	0.3	0.6
3-9848	Lab	81	9	729	AHS-L-2	67	-	-	-	-	-	-	-	81	81		7	(14)	0.8	1.0
3-9855	Lab	407	9	3,663	AHS-L-1	120	-	-	-	-	-	-	-	221	221		4	(101)	0.3	0.5
3-9857	Lab	187	9	1,683	AHS-L-1	71	-	-	-	-	-	-	-	108	108		4	(37)	0.4	0.6
3-9838 / 3-9852 / 3-9858	Lab	3534	9	31,806	AHS-L-2	1,072	257.0	-	-	-	-	-	257	1,266	1,523		3	(451)	0.3	0.4
3-9816 / 3-9828	Lab	2415	9	21,735	AHS-L-3	1,460	243.0	264	-	-	-	-	507	1,279	1,786		5	(326)	0.6	0.5
3-9804 / 3-9812	Lab	2406	9	21,654	AHS-L-3	1,409	-	-	-	-	-	-	-	2,175	2,175		6	(766)	0.6	0.9
G9852 / G9858 / G9838	Lab	3610	9	32,490	AHS-L-2	1,611	243.0	312	243	236	167	167	1,368	902	2,270		4	(659)	0.4	0.2
G9816 / G9828	Lab	2410	9	21,690	AHS-L-3	1,418	257.0	258	205	-	-	-	720	841	1,561		4	(143)	0.6	0.3
G9804 / G9812	Lab	2406	9	21,654	AHS-L-3	1,322	267.0	-	-	-	-	-	267	1,499	1,766		5	(444)	0.5	0.6
G9805	Lab	100	9	900	AHS-L-3	103	-	-	-	-	-	-	-	90	90		6	13	1.0	0.9
G9820	Lab	95	9	855	AHS-L-2	95	-	-	-	-	-	-	-	197	197		14	(102)	1.0	2.1
G9823	Lab	312	9	2,808	AHS-L-2	162	-	-	-	-	-	-	-	369	369		8	(207)	0.5	1.2
G9825A	Lab	117	9	1,053	AHS-L-2	76	-	-	-	-	-	-	-	98	98		6	(22)	0.6	0.8
G9821	Lab	787	9	7,083	AHS-L-2	318	-	-	-	-	-	-	-	430	430		4	(112)	0.4	0.5
G9826A	Lab	98	9	882	AHS-L-2	70	-	-	-	-	-	-	-	64	64		4	6	0.7	0.7
G9837	Lab	197	9	1,773	AHS-L-2	113	-	-	-	-	-	-	-	88	88		3	25	0.6	0.4
G9839	Lab	72	9	648	AHS-L-2	54	-	-	-	-	-	-	-	98	98		9	(44)	0.8	1.4
G9807 / G9809	Lab	376	9	3,384	AHS-L-2	159	-	-	-	-	-	-	-	298	298		5	(139)	0.4	0.8
G9813	Lab	408	9	3,672	AHS-L-3	598	289.0	-	-	-	-	-	289	131	420		7	178	1.5	0.3
G9843	Lab	501	9	4,509	AHS-L-2	303	201.0	-	-	-	-	-	201	113	314		4	(11)	0.6	0.2
G9909 / G9915	Lab	1520	9	13,680	AHS-L-3	1,040	700.0	700	-	-	-	-	1,400	1,238	2,638		12	(1,598)	0.7	0.8
G9872 / G9878 / G9892	Lab	3596	9	32,364	AHS-L-3	2,460	700.0	700	700	700	700	700	4,200	2,930	7,130		13	(4,669)	0.7	0.8
G9855	Lab	407	9	3,663	AHS-L-3	278	-	-	-	-	-	-	-	332	332		5	(53)	0.7	0.8
G9857	Lab	196	9	1,764	AHS-L-3	134	-	-	-	-	-	-	-	160	160		5	(26)	0.7	0.8
G9859	Lab	196	9	1,764	AHS-L-3	134	-	-	-	-	-	-	-	160	160		5	(26)	0.7	0.8
G9861 & G9863	Lab	193	9	1,737	AHS-L-3	132	-	-	-	-	-	-	-	157	157		5	(25)	0.7	0.8
		73,111	774	657,999	-	40,567	6,364	3,708	1,363				14,105	44,610	58,715	-	509	(18,148)	58	69

wendel

Project Name: University of Rochester Energy Conservation MP Support
Building: KMRB
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: 0

Assumed
Avg. CFM/Sqft

80 Desired CFM/Sqft | 1 CFM/SQFT | Desired Lab ACH 4

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood 1	Fume Hood 2	Fume Hood 3	Fume Hood 4	Fume Hood 5	Fume Hood 6	Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Calculated Exhaust CFM	Calculated Exhaust CFM	Calculated Exhaust CFM	Calculated Exhaust CFM	Calculated Exhaust CFM	Calculated Exhaust CFM	Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	Pressurization		CFM/Sqft
1-9905 / 1-9911 / 1-9915	Lab	2,397	9	21,573	AHS-L-1	1,328	337	-	-	-	-	-	337	1,297	1,634	1,634	5	(306)		0.6
1-9872 / 1-9878 / 1-9892	Lab	3,583	9	32,247	AHS-L-1	2,431	253	232	-	-	-	-	485	2,509	2,994	2,994	6	(563)		0.7
1-9858 / 1-9852 / 1-9538	Lab	3,618	9	32,562	AHS-L-2	1,571	278	-	-	-	-	-	278	1,951	2,229	2,229	4	(658)		0.4
1-9855	Lab	407	9	3,663	AHS-L-1	297	281	-	-	-	-	-	281	100	381	381	6	(84)		0.7
1-9804 / 1-9812	Lab	2,415	9	21,735	AHS-L-3	1,912	215	226	215	-	-	-	656	1,643	2,299	2,299	6	(387)		0.8
1-9807 / 1-9809	Lab	448	9	4,032	AHS-L-3	314	337	-	-	-	-	-	337	168	505	505	8	(191)		0.7
1-9816 / 1-9828	Lab	2,409	9	21,681	AHS-L-3	2,140	-	-	-	-	-	-	-	2,720	2,720	2,720	8	(580)		0.9
1-9823	Lab	596	9	5,364	AHS-L-2	406	-	-	-	-	-	-	-	467	467	467	5	(61)		0.7
1-9839	Lab	584	9	5,256	AHS-L-2	399	-	-	-	-	-	-	-	263	263	263	3	136		0.7
1-9811 / 1-9813	Lab	311	9	2,799	AHS-L-3	146	-	-	-	-	-	-	-	-	-	-	-	146		0.5
1-9825	Lab	562	9	5,058	AHS-L-3	295	-	-	-	-	-	-	-	98	98	98	1	197		0.5
1-9826	Lab	14	9	126	AHS-L-2	14	-	-	-	-	-	-	-	34	34	34	16	(20)		1.0
1-9827 / 1-9829	Lab	98	9	882	AHS-L-2	191	-	-	-	-	-	-	-	59	59	59	4	132		1.9
1-9837	Lab	156	9	1,404	AHS-L-2	73	-	-	-	-	-	-	-	107	107	107	5	(34)		0.5
1-9847	Lab	198	9	1,782	AHS-L-2	65	-	-	-	-	-	-	-	129	129	129	4	(64)		0.3
1-9845	Lab	194	9	1,746	AHS-L-2	90	-	-	-	-	-	-	-	198	198	198	7	(108)		0.5
1-9803 / 1-9805	Lab	199	9	1,791	AHS-L-3	93	-	-	-	-	-	-	-	172	172	172	6	(79)		0.5
1-9857	Lab	198	9	1,782	AHS-L-1	65	-	-	-	-	-	-	-	110	110	110	4	(45)		0.3
1-9859	Lab	197	9	1,773	AHS-L-1	86	-	-	-	-	-	-	-	140	140	140	5	(54)		0.4
1-9861 / 1-9863	Lab	193	9	1,737	AHS-L-1	68	-	-	-	-	-	-	-	128	128	128	4	(60)		0.4
2-9905 / 2-9915	Lab	2,416	9	21,744	AHS-L-1	1,469	236	-	-	-	-	-	236	1,680	1,916	1,916	5	(447)		0.6
2-9872 / 2-9878 / 2-9892	Lab	3,451	9	31,059	AHS-L-1	2,090	257	253	-	-	-	-	510	2,279	2,789	2,789	5	(699)		0.6
2-9861 / 2-9863	Lab	193	9	1,737	AHS-L-1	60	-	-	-	-	-	-	-	98	98	98	3	(38)		0.3
2-9859	Lab	187	9	1,683	AHS-L-1	81	-	-	-	-	-	-	-	120	120	120	4	(39)		0.4
2-9857	Lab	187	9	1,683	AHS-L-1	82	-	-	-	-	-	-	-	101	101	101	4	(19)		0.4
2-9855 A & B	Lab	134	9	1,206	AHS-L-1	134	-	-	-	-	-	-	-	208	208	208	10	(74)		1.0
2-9841 & 2-9843	Lab	395	9	3,555	AHS-L-2	176	-	-	-	-	-	-	-	285	285	285	5	(109)		0.4
2-9845	Lab	194	9	1,746	AHS-L-2	79	-	-	-	-	-	-	-	135	135	135	5	(56)		0.4
2-9847	Lab	198	9	1,782	AHS-L-2	81	-	-	-	-	-	-	-	128	128	128	4	(47)		0.4
2-9837	Lab	77	9	693	AHS-L-2	59	-	-	-	-	-	-	-	74	74	74	6	(15)		0.8
2-9839	Lab	195	9	1,755	AHS-L-2	80	-	-	-	-	-	-	-	165	165	165	6	(85)		0.4
2-9827 / 2-9829	Lab	162	9	1,458	AHS-L-2	162	-	-	-	-	-	-	-	162	162	162	7	-		1.0
2-9825	Lab	562	9	5,058	AHS-L-2	207	-	-	-	-	-	-	-	254	254	254	3	(47)		0.4
2-9626	Lab	115	9	1,035	AHS-L-2	54	-	-	-	-	-	-	-	69	69	69	4	(15)		0.5
2-9803	Lab	90	9	810	AHS-L-3	-	-	-	-	-	-	-	-	92	92	92	7	(92)		-
2-9805	Lab	100	9	900	AHS-L-3	52	-	-	-	-	-	-	-	-	-	-	-	52		0.5
2-9807	Lab	184	9	1,656	AHS-L-3	61	-	-	-	-	-	-	-	116	116	116	4	(55)		0.3
2-9809	Lab	189	9	1,701	AHS-L-3	66	-	-	-	-	-	-	-	117	117	117	4	(51)		0.3
2-9813	Lab	418	9	3,762	AHS-L-3	178	-	-	-	-	-	-	-	357	357	357	6	(179)		0.4
2-9819	Lab	198	9	1,782	AHS-L-2	105	-	-	-	-	-	-	-	137	137	137	5	(32)		0.5
2-9838 / 2-9852 / 2-9858	Lab	3,638	9	32,742	AHS-L-2	1,427	309	246	-	-	-	-	555	1,640	2,195	2,195	4	(768)		0.4
2-9804 / 2-9812 / 2-9616	Lab	4,770	9	42,930	AHS-L-3	1,488	229	246	-	-	-	-	475	1,696	2,171	2,171	3	(683)		0.3
2-9823	Lab	413	9	3,717	AHS-L-2	211	-	-	-	-	-	-	-	180	180	180	3	31		0.5
3-9905 / 3-9915	Lab	2,323	9	20,907	AHS-L-3	1,088	260	-	-	-	-	-	260	1,834	2,094	2,094	6	(1,006)		0.5
3-9872 / 3-9878 / 3-9892	Lab	3,618	9	32,562	AHS-L-1	2,098	215	271	-	-	-	-	486	2,227	2,713	2,713	5	(615)		0.6
3-9861 & 3-9863	Lab	193	9	1,737	AHS-L-1	73	-	-	-	-	-	-	-	110	110	110	4	(37)		0.4
3-9859	Lab	187	9	1,683	AHS-L-1	82	-	-	-	-	-	-	-	131	131	131	5	(49)		0.4
3-9626	Lab	114	9	1,026	AHS-L-2	58	-	-	-	-	-	-	-	63	63	63	4	(5)		0.5
3-9803 & 3-9805	Lab	199	9	1,791	AHS-L-3	62	-	-	-	-	-	-	-	122	122	122	4	(60)		0.3
3-9807	Lab	197	9	1,773	AHS-L-3	84	-	-	-	-	-	-	-	166	166	166	6	(82)		0.4
3-9809	Lab	189	9	1,701	AHS-L-3	86	-	-	-	-	-	-	-	157	157	157	6	(71)		0.5
3-9813	Lab	412	9	3,708	AHS-L-3	151	-	-	-	-	-	-	-	244	244	244	4	(93)		0.4
3-9825	Lab	560	9	5,040	AHS-L-2	218	-	-	-	-	-	-	-	265	265	265	3	(47)		0.4

Project Name: University of Rochester Energy Conservation MP Support
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Assumed
Avg. CFM/Sqft

3-9827 & 3-9829	Lab	98	9	882	AHS-L-2	98	-	-	-	-	-	-	-	99	99	99	7	(1)		1.0
3-9837	Lab	172	9	1,548	AHS-L-2	82	-	-	-	-	-	-	-	85	85	85	3	(3)		0.5
3-9839	Lab	186	9	1,674	AHS-L-2	65	-	-	-	-	-	-	-	114	114	114	4	(49)		0.3
3-9843	Lab	401	9	3,609	AHS-L-2	137	-	-	-	-	-	-	-	157	157	157	3	(20)		0.3
3-9845	Lab	194	9	1,746	AHS-L-2	70	-	-	-	-	-	-	-	122	122	122	4	(52)		0.4
3-9847	Lab	198	9	1,782	AHS-L-2	66	-	-	-	-	-	-	-	121	121	121	4	(55)		0.3
3-9848	Lab	81	9	729	AHS-L-2	67	-	-	-	-	-	-	-	81	81	81	7	(14)		0.8
3-9855	Lab	407	9	3,663	AHS-L-1	120	-	-	-	-	-	-	-	221	221	221	4	(101)		0.3
3-9857	Lab	187	9	1,683	AHS-L-1	71	-	-	-	-	-	-	-	108	108	108	4	(37)		0.4
3-9838 / 3-9852 / 3-9858	Lab	3,534	9	31,806	AHS-L-2	1,072	257	-	-	-	-	-	257	1,266	1,523	1,523	3	(451)		0.3
3-9816 / 3-9828	Lab	2,415	9	21,735	AHS-L-3	1,460	243	264	-	-	-	-	507	1,279	1,786	1,786	5	(326)		0.6
3-9804 / 3-9812	Lab	2,406	9	21,654	AHS-L-3	1,409	-	-	-	-	-	-	-	2,175	2,175	2,175	6	(766)		0.6
G9852 / G9858 / G9838	Lab	3,610	9	32,490	AHS-L-2	1,611	243	312	243	236	167	167	1,368	902	2,270	2,270	4	(659)		0.4
G9816 / G9828	Lab	2,410	9	21,690	AHS-L-3	1,418	257	258	205	-	-	-	720	841	1,561	1,561	4	(143)		0.6
G9804 / G9812	Lab	2,406	9	21,654	AHS-L-3	1,322	267	-	-	-	-	-	267	1,499	1,766	1,766	5	(444)		0.5
G9805	Lab	100	9	900	AHS-L-3	100	-	-	-	-	-	-	-	87	87	87	6	13		1.0
G9820	Lab	95	9	855	AHS-L-2	95	-	-	-	-	-	-	-	197	197	197	14	(102)		1.0
G9823	Lab	312	9	2,808	AHS-L-2	162	-	-	-	-	-	-	-	369	369	369	8	(207)		0.5
G9825A	Lab	117	9	1,053	AHS-L-2	76	-	-	-	-	-	-	-	98	98	98	6	(22)		0.6
G9821	Lab	787	9	7,083	AHS-L-2	318	-	-	-	-	-	-	-	430	430	430	4	(112)		0.4
G9826A	Lab	98	9	882	AHS-L-2	70	-	-	-	-	-	-	-	64	64	64	4	6		0.7
G9837	Lab	197	9	1,773	AHS-L-2	113	-	-	-	-	-	-	-	88	88	88	3	25		0.6
G9839	Lab	72	9	648	AHS-L-2	54	-	-	-	-	-	-	-	98	98	98	9	(44)		0.8
G9807 / G9809	Lab	376	9	3,384	AHS-L-2	159	-	-	-	-	-	-	-	298	298	298	5	(139)		0.4
G9813	Lab	408	9	3,672	AHS-L-3	467	289	-	-	-	-	-	289	-	245	289	4	178		1.1
G9843	Lab	501	9	4,509	AHS-L-2	303	201	-	-	-	-	-	201	113	314	314	4	(11)		0.6
G9909 / G9915	Lab	1,520	9	13,680	AHS-L-3	1,040	700	700	-	-	-	-	1,400	1,238	2,638	2,638	12	(1,598)		0.7
G9872 / G9878 / G9892	Lab	3,596	9	32,364	AHS-L-3	2,460	700	700	700	700	700	700	4,200	2,930	7,130	7,130	13	(4,669)		0.7
G9855	Lab	407	9	3,663	AHS-L-3	278	-	-	-	-	-	-	-	332	332	332	5	(53)		0.7
G9857	Lab	196	9	1,764	AHS-L-3	134	-	-	-	-	-	-	-	160	160	160	5	(26)		0.7
G9859	Lab	196	9	1,764	AHS-L-3	134	-	-	-	-	-	-	-	160	160	160	5	(26)		0.7
G9861 & G9863	Lab	193	9	1,737	AHS-L-3	132	-	-	-	-	-	-	-	157	157	157	5	(25)		0.7
		73,111	765	657,999	-	39,550	6,364	3,708	1,363	936	867	867	14,105	43,593	57,654	57,698	438	(18,148)	-	48

wendel

Project Name: University of Rochester Energy Conservation MP Support
Building: KMRB
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By:

Assumed
Avg. CFM/Sqft

Existing Conditions							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary								
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Total Hood Exhaust CFM	General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH	Pressurization	Supply CFM/Sqft	General Exhaust CFM/Sqft
1-9905 / 1-9911 / 1-9915	Lab	2397	9	21,573	AHS-L-1	2,723	6.3	98.0	613			-			-			-			-			-	613	2,345	2,958		8.23	(235)	1.1	1.0
1-9872 / 1-9878 / 1-9892	Lab	3583	9	32,247	AHS-L-1	4,836	6.3	97.0	606	6.3	97	606			-			-			-			-	1,213	4,330	5,543		10	(707)	1.3	1.2
1-9858 / 1-9852 / 1-9538	Lab	3618	9	32,562	AHS-L-2	2,881	6.3	96.0	600			-			-			-			-			-	600	3,069	3,669		7	(788)	0.8	0.8
1-9855	Lab	407	9	3,663	AHS-L-1	623	6.3	98.0	613			-			-			-			-			-	613	118	731		12	(108)	1.5	0.3
1-9804 / 1-9812	Lab	2415	9	21,735	AHS-L-3	4,277	6.3	107.0	669	6.3	99	619	6	104	650			-			-			-	1,938	3,242	5,180		14.30	(903)	1.8	1.3
1-9807 / 1-9809	Lab	448	9	4,032	AHS-L-3	916	6.3	103.0	644			-			-			-			-			-	644	487	1,131		17	(215)	2.0	1.1
1-9816 / 1-9828	Lab	2409	9	21,681	AHS-L-3	4,331			-			-			-			-			-			-	-	4,677	4,677		13	(346)	1.8	1.9
1-9823	Lab	596	9	5,364	AHS-L-2	672			-			-			-			-			-			-	-	735	735		8	(63)	1.1	1.2
1-9839	Lab	584	9	5,256	AHS-L-2	820			-			-			-			-			-			-	-	1,112	1,112		13	(292)	1.4	1.9
1-9811 / 1-9813	Lab	311	9	2,799	AHS-L-3	369			-			-			-			-			-			-	-	-	-		-	369	1.2	-
1-9825	Lab	562	9	5,058	AHS-L-3	320			-			-			-			-			-			-	-	137	137		2	183	0.6	0.2
1-9826	Lab	14	9	126	AHS-L-2	102			-			-			-			-			-			-	-	140	140		67	(38)	7.3	10.0
1-9827 / 1-9829	Lab	98	9	882	AHS-L-2	413			-			-			-			-			-			-	-	382	382		26	31	4.2	3.9
1-9837	Lab	156	9	1,404	AHS-L-2	132			-			-			-			-			-			-	-	192	192		8	(60)	0.8	1.2
1-9847	Lab	198	9	1,782	AHS-L-2	168			-			-			-			-			-			-	-	240	240		8	(72)	0.8	1.2
1-9845	Lab	194	9	1,746	AHS-L-2	238			-			-			-			-			-			-	-	315	315		11	(77)	1.2	1.6
1-9803 / 1-9805	Lab	199	9	1,791	AHS-L-3	238			-			-			-			-			-			-	-	309	309		10	(71)	1.2	1.6
1-9857	Lab	198	9	1,782	AHS-L-1	182			-			-			-			-			-			-	-	244	244		8	(62)	0.9	1.2
1-9859	Lab	197	9	1,773	AHS-L-1	183			-			-			-			-			-			-	-	238	238		8	(55)	0.9	1.2
1-9861 / 1-9863	Lab	193	9	1,737	AHS-L-1	157			-			-			-			-			-			-	-	223	223		8	(66)	0.8	1.2
2-9905 / 2-9915	Lab	2416	9	21,744	AHS-L-1	3,051	6.3	98.0	613			-			-			-			-			-	613	2,846	3,459		10	(408)	1.3	1.2
2-9872 / 2-9878 / 2-9892	Lab	3451	9	31,059	AHS-L-1	4,638	6.3	102.0	638	6	104	650			-			-			-			-	1,288	4,074	5,362		10	(724)	1.3	1.2
2-9861 / 2-9863	Lab	193	9	1,737	AHS-L-1	170			-			-			-			-			-			-	-	318	318		11	(148)	0.9	1.6
2-9859	Lab	187	9	1,683	AHS-L-1	159			-			-			-			-			-			-	-	224	224		8	(65)	0.9	1.2
2-9857	Lab	187	9	1,683	AHS-L-1	139			-			-			-			-			-			-	-	207	207		7	(68)	0.7	1.1
2-9855 A & B	Lab	134	9	1,206	AHS-L-1	513			-			-			-			-			-			-	-	655	655		33	(142)	3.8	4.9
2-9841 & 2-9843	Lab	395	9	3,555	AHS-L-2	316			-			-			-			-			-			-	-	441	441		7	(125)	0.8	1.1
2-9845	Lab	194	9	1,746	AHS-L-2	147			-			-			-			-			-			-	-	211	211		7	(64)	0.8	1.1
2-9847	Lab	198	9	1,782	AHS-L-2	144			-			-			-			-			-			-	-	204	204		7	(60)	0.7	1.0
2-9837	Lab	77	9	693	AHS-L-2	72			-			-			-			-			-			-	-	104	104		9	(32)	0.9	1.4
2-9839	Lab	195	9	1,755	AHS-L-2	190			-			-			-			-			-			-	-	271	271		9	(81)	1.0	1.4
2-9827 / 2-9829	Lab	162	9	1,458	AHS-L-2	410			-			-			-			-			-			-	-	415	415		17	(5)	2.5	2.6
2-9825	Lab	562	9	5,058	AHS-L-2	270			-			-			-			-			-			-	-	382	382		5	(112)	0.5	0.7
2-9626	Lab	115	9	1,035	AHS-L-2	78			-			-			-			-			-			-	-	103	103		6	(25)	0.7	0.9
2-9803	Lab	90	9	810	AHS-L-3	-			-			-			-			-			-			-	-	92	92		7	(92)	-	1.0
2-9805	Lab	100	9	900	AHS-L-3	52			-			-			-			-			-			-	-	-	-		-	52	0.5	-
2-9807	Lab	184	9	1,656	AHS-L-3	153			-			-			-			-			-			-	-	224	224		8	(71)	0.8	1.2
2-9809	Lab	189	9	1,701	AHS-L-3	149			-			-			-			-			-			-	-	224	224		8	(75)	0.8	1.2
2-9813	Lab	418	9	3,762	AHS-L-3	419			-			-			-			-			-			-	-	608	608		10	(189)	1.0	1.5
2-9819	Lab	198	9	1,782	AHS-L-2	173			-			-			-			-			-			-	-	235	235		8	(62)	0.9	1.2
2-9838 / 2-9852 / 2-9858	Lab	3638	9	32,742	AHS-L-2	3,169	6.3	103.0	644	6	105	656			-			-			-			-	1,300	2,960	4,260		8	(1,091)	0.9	0.8
2-9804 / 2-9812 / 2-9616 / 2-9828	Lab	4770	9	42,930	AHS-L-3	3,095	6.3	100.0	625	6	94	588			-			-			-			-	1,213	3,397	4,610		6	(1,515)	0.6	0.7
2-9823	Lab	413	9	3,717	AHS-L-2	461			-			-			-			-			-			-	-	318	318		5	143	1.1	0.8
3-9905 / 3-9915	Lab	2323	9	20,907	AHS-L-3	2,335	6.3	94.0	588			-			-			-			-			-	588	3,905	4,493		13	(2,158)	1.0	1.7
3-9872 / 3-9878 / 3-9892	Lab	3618	9	32,562	AHS-L-1	4,555	6.3	101.0	631	6	101	631			-			-			-			-	1,263	4,920	6,183		11	(1,628)	1.3	1.4
3-9861 & 3-9863	Lab	193	9	1,737	AHS-L-1	160			-			-			-			-			-			-	-	230	230		8	(70)	0.8	1.2
3-9859	Lab	187	9	1,683	AHS-L-1	155			-			-			-			-			-			-	-	220	220		8	(65)	0.8	1.2
3-9626	Lab	114	9	1,026	AHS-L-2	105			-			-			-			-			-			-	-	105	105		6	-	0.9	0.9
3-9803 & 3-9805	Lab	199	9	1,791	AHS-L-3	155			-			-			-			-			-			-	-	225	225		8	(70)	0.8	1.1
3-9807	Lab	197	9	1,773	AHS-L-3	195			-			-			-			-			-			-	-	280	280		9	(85)	1.0	1.4
3-9809	Lab	189	9	1,701	AHS-L-3	195			-			-			-			-			-			-	-	280	280		10	(85)	1.0	1.5
3-9813	Lab	412	9	3,708	AHS-L-3	325			-			-			-			-			-			-	-	470	470		8	(145)	0.8	1.1
3-9825	Lab	560	9	5,040	AHS-L-2	260			-			-			-			-			-			-	-	375	375		4	(115)	0.5	0.7
3-9827 & 3-9829	Lab	98	9	882	AHS-L-2	440			-			-			-			-			-			-	-	440	440		30	-	4.5	4.5
3-9837	Lab	172	9	1,548	AHS-L-2	440			-			-			-			-			-			-	-	235	235		9	205	2.6	1.4
3-9839	Lab	186	9	1,674	AHS-L-2	175			-			-			-			-			-			-	-	250	250		9	(75)	0.9	1.3
3-9843	Lab	401	9	3,609	AHS-L-2	250			-			-			-			-			-			-	-	355	355		6	(105)	0.6	0.9
3-9845	Lab	194	9	1,746	AHS-L-2	155			-			-			-			-			-			-	-	225	225		8	(70)	0.8	1.2
3-9847	Lab	198	9	1,782	AHS-L-2	160			-			-			-			-			-			-	-	230	230		8	(70)	0.8	1.2
3-9848	Lab	81	9	729	AHS-L-2	65			-			-			-			-			-			-	-	85	85		7	(20)	0.8	1.0
3-9855	Lab	407	9	3,663	AHS-L-1	495			-			-			-			-			-			-	-	605	605		10	(110)	1.2	1.5
3-9857	Lab	187	9	1,683	AHS-L-1	155			-			-			-			-			-			-	-	225	225		8	(70)	0.8	1.2
3-9838 / 3-9852 / 3-9858	Lab	3534	9	31,806	AHS-L-2	2,890	6.3	102.0	638			-			-			-			-			-	638	3,130	3,768		7	(878)	0.8	0.9
3-9816 / 3-9828	Lab	2415	9	21,735	AHS-L-3	3,115	6.3	98.0	613	6	100	625			-			-			-			-	1,238	3,380	4,618		13	(1,503)	1.3	1.4
3-9804 / 3-9812	Lab	2406	9	21,654	AHS-L-3	3,160			-			-			-			-			-			-	-	3,520	3,520		10	(360)	1.3	1.5
G9852 / G9858 / G9838	Lab	3610	9	32,490	AHS-L-2	2,515	6.3	92.0	575	6	101	631	6	105	656	6	101	631	6	101	631	6	101	631	3,756	1,860	5,616		10	(3,101)	0.7	0.5
G9816 / G9828	Lab	2410	9	21,690	AHS-L-3	3,325	6.3	101.0	631	6	89	556	6	104	650			-			-			-	1,838	2,190	4,028		11	(703)	1.4	0.9
G9804 / G9812	Lab	2406	9	21,654	AHS-L-3	3,050	6.3	107.0	669			-			-			-			-			-	669	3,050	3,719		10	(669)	1.3	1.3
G9805	Lab	100	9	900	AHS-L-3	100			-			-			-			-			-			-	-	145	145		10	(45)	1.0	1.5
G9820	Lab	95	9	855	AHS-L-2	200			-			-			-			-			-			-	-	300	300		21	(100)	2.1	3.2
G9823	Lab	312	9	2,808	AHS-L-2	180			-			-			-			-			-			-	-	720	720		15	(540)	0.6	2.3
G9825A	Lab	117	9	1,053	AHS-L-2	150			-			-			-			-			-			-	-	200	200		11	(50)	1.3	1.7
G9821	Lab	787	9	7,083	AHS-L-2	445			-			-			-			-			-			-	-	550	550		5	(105)	0.6	0.7
G9826A	Lab	98	9	882	AHS-L-2	135			-			-			-			-			-			-	-	135	135		9	-	1.4	1.4
G9837	Lab	197	9	1,773	AHS-L-2	210			-			-			-			-			-			-	-	155	155		5	55	1.1	0.8
G9839	Lab	72	9	648	AHS-L-2	105			-			-			-			-			-			-	-	115	115		11	(10)	1.5	1.6
G9807 / G9809	Lab	376	9	3,384	AHS-L-2	360			-			-			-			-			-			-	-	500	500		9	(140)	1.0	1.3
G9813	Lab	408	9	3,672	AHS-L-3	1,600	7.8	88.0	682			-			-			-			-			-	682	1,950	2,632		43	(1,032)	3.9	4.8
G9843	Lab	501	9	4,509	AHS-L-2	665	6.3	93.0	581.25			-			-			-			-			-	581	100	681		9	(16)	1.3	0.2
G9909 / G9915	Lab	1520	9	13,680	AHS-L-3	1,940	6.3	93.0	581	6.3	93.0	581	6.3	93.0	581			-			-			-	1,744	2,232	3,976		17	(2,036)	1.3	1.5
G9872 / G9878 / G9892	Lab	3596	9	32,364	AHS-L-3	4,589	6.3	86.0	538	6.3	101	631	6	97	606	6	97	606	6	103	644	6	100	625	3,650	5,281	8,931		17	(4,342)	1.3	1.5
G9855	Lab	407	9	3,663	AHS-L-3	519			-			-			-			-			-			-	-	598	598		10	(78)	1.3	1.5
G9857	Lab	196	9	1,764	AHS-L-3	250			-			-			-			-			-			-	-	288	288		10	(38)	1.3	1.5
G9859	Lab	196	9	1,764	AHS-L-3	250			-			-			-			-			-			-	-	288	288		10	(38)	1.3	1.5
G9861 & G9863	Lab	193	9	1,737	AHS-L-3	246			-			-			-			-			-			-	-	283	283		10	(37)	1.3	1.5
		73,111	774	657,999	-	83,323	133	2,057	12,988	69	1,084	6,775	31	503	3,144										26,676	85,678	112,354	-	926	(29,031)	108	125

Project Name: University of Rochester Energy Conservation MP Support
Building: KMRB
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By:

Assumed
Avg. CFM/Sqft

Desired Face Velocity 80 FPM | Desired CFM/Sqft 1 CFM/SQFT | Desired Lab ACH 6 | 10 12

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood 1			Fume Hood 2			Fume Hood 3			Fume Hood 4			Fume Hood 5			Fume Hood 6			Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	Opening Area (sf)	Measured Face Velocity	Calculated Exhaust CFM	New Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	Pressurization	SQFT ACH	CFM/Sqft
1-9905 / 1-9911 / 1-9915	Lab	2,397	9	21,573	AHS-L-1	2,723	6.3	98	613	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	613	2,345	2,632	2,958	7	(235)	1.1	1.1
1-9872 / 1-9878 / 1-9892	Lab	3,583	9	32,247	AHS-L-1	3,583	6.3	97	606	6	97	606	-	-	-	-	-	-	-	-	-	-	-	-	1,213	3,077	4,290	4,290	8	(707)	1.0	1.0
1-9858 / 1-9852 / 1-9538	Lab	3,618	9	32,562	AHS-L-2	2,881	6.3	96	600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600	3,069	3,669	3,669	7	(788)	0.8	0.8
1-9855	Lab	407	9	3,663	AHS-L-1	623	6.3	98	613	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	613	118	515	731	8	(108)	1.5	1.5
1-9804 / 1-9812	Lab	2,415	9	21,735	AHS-L-3	2,415	6.3	107	669	6	99	619	6	104	650	-	-	-	-	-	-	-	-	-	1,938	1,380	3,318	3,318	9	(903)	1.0	1.0
1-9807 / 1-9809	Lab	448	9	4,032	AHS-L-3	448	6.3	103	644	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	644	19	663	663	10	(215)	1.0	1.0
1-9816 / 1-9828	Lab	2,409	9	21,681	AHS-L-3	2,409	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,755	2,755	2,755	8	(346)	1.0	1.0
1-9823	Lab	596	9	5,364	AHS-L-2	596	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	659	659	659	7	(63)	1.0	1.0
1-9839	Lab	584	9	5,256	AHS-L-2	584	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	876	876	876	10	(292)	1.0	1.0
1-9811 / 1-9813	Lab	311	9	2,799	AHS-L-3	369	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	280	-	6	369	1.2	1.2
1-9825	Lab	562	9	5,058	AHS-L-3	320	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	137	137	137	2	183	0.6	0.6
1-9826	Lab	14	9	126	AHS-L-2	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	52	52	25	(38)	1.0	1.0
1-9827 / 1-9829	Lab	98	9	882	AHS-L-2	119	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	88	88	6	31	1.2	1.2
1-9837	Lab	156	9	1,404	AHS-L-2	156	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	216	192	216	8	(60)	1.0	1.0
1-9847	Lab	198	9	1,782	AHS-L-2	198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	270	240	270	8	(72)	1.0	1.0
1-9845	Lab	194	9	1,746	AHS-L-2	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	271	271	271	9	(77)	1.0	1.0
1-9803 / 1-9805	Lab	199	9	1,791	AHS-L-3	199	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	270	270	270	9	(71)	1.0	1.0
1-9857	Lab	198	9	1,782	AHS-L-1	198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	260	244	260	8	(62)	1.0	1.0
1-9859	Lab	197	9	1,773	AHS-L-1	197	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	252	238	252	8	(55)	1.0	1.0
1-9861 / 1-9863	Lab	193	9	1,737	AHS-L-1	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	259	223	259	8	(66)	1.0	1.0
2-9905 / 2-9915	Lab	2,416	9	21,744	AHS-L-1	2,416	6.3	98	613	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	613	2,211	2,824	2,824	8	(408)	1.0	1.0
2-9872 / 2-9878 / 2-9892	Lab	3,451	9	31,059	AHS-L-1	3,451	6.3	102	638	6	104	650	-	-	-	-	-	-	-	-	-	-	-	-	1,288	2,887	4,175	4,175	8	(724)	1.0	1.0
2-9861 / 2-9863	Lab	193	9	1,737	AHS-L-1	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	341	318	341	11	(148)	1.0	1.0
2-9859	Lab	187	9	1,683	AHS-L-1	187	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	252	224	252	8	(65)	1.0	1.0
2-9857	Lab	187	9	1,683	AHS-L-1	187	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	255	207	255	7	(68)	1.0	1.0
2-9855 A & B	Lab	134	9	1,206	AHS-L-1	134	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	276	276	276	14	(142)	1.0	1.0
2-9841 & 2-9843	Lab	395	9	3,555	AHS-L-2	395	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	520	441	520	7	(125)	1.0	1.0
2-9845	Lab	194	9	1,746	AHS-L-2	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	258	211	258	7	(64)	1.0	1.0
2-9847	Lab	198	9	1,782	AHS-L-2	198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	258	204	258	7	(60)	1.0	1.0
2-9837	Lab	77	9	693	AHS-L-2	77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	109	104	109	9	(32)	1.0	1.0
2-9839	Lab	195	9	1,755	AHS-L-2	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	276	271	276	9	(81)	1.0	1.0
2-9827 / 2-9829	Lab	162	9	1,458	AHS-L-2	162	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	167	167	167	7	(5)	1.0	1.0
2-9825	Lab	562	9	5,058	AHS-L-2	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	382	382	382	5	(112)	0.5	0.5
2-9626	Lab	115	9	1,035	AHS-L-2	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	103	103	103	6	(25)	0.7	0.7
2-9803	Lab	90	9	810	AHS-L-3	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	182	92	182	7	(92)	1.0	1.0
2-9805	Lab	100	9	900	AHS-L-3	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	0.5	0.5
2-9807	Lab	184	9	1,656	AHS-L-3	184	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	255	224	255	8	(71)	1.0	1.0
2-9809	Lab	189	9	1,701	AHS-L-3	189	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	264	224	264	8	(75)	1.0	1.0
2-9813	Lab	418	9	3,762	AHS-L-3	418	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	607	607	607	10	(189)	1.0	1.0
2-9819	Lab	198	9	1,782	AHS-L-2	198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	260	235	260	8	(62)	1.0	1.0
2-9838 / 2-9852 / 2-9858	Lab	3,638	9	32,742	AHS-L-2	3,169	6.3	103	644	6	105	656	-	-	-	-	-	-	-	-	-	-	-	-	1,300	2,960	4,260	4,260	8	(1,091)	0.9	0.9
2-9804 / 2-9812 / 2-9616 / 2-9828	Lab	4,770	9	42,930	AHS-L-3	3,095	6.3	100	625	6	94	588	-	-	-	-	-	-	-	-	-	-	-	-	1,213	3,397	4,610	4,610	6	(1,515)	0.6	0.6
2-9823	Lab	413	9	3,717	AHS-L-2	461	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	318	372	318	6	143	1.1	1.1
3-9905 / 3-9915	Lab	2,323	9	20,907	AHS-L-3	2,323	6.3	94	588	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	588	3,893	4,481	4,481	13	(2,158)	1.0	1.0
3-9872 / 3-9878 / 3-9892	Lab	3,618	9	32,562	AHS-L-1	3,618	6.3	101	631	6	101	631	-	-	-	-	-	-	-	-	-	-	-	-	1,263	3,983	5,246	5,246	10	(1,628)	1.0	1.0
3-9861 & 3-9863	Lab	193	9	1,737	AHS-L-1	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	263	230	263	8	(70)	1.0	1.0
3-9859	Lab	187	9	1,683	AHS-L-1	187	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	252	220	252	8	(65)	1.0	1.0
3-9626	Lab	114	9	1,026	AHS-L-2	105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	105	105	105	6	-	0.9	0.9
3-9803 & 3-9805	Lab	199	9	1,791	AHS-L-3	199	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	269	225	269	8	(70)	1.0	1.0
3-9807	Lab	197	9	1,773	AHS-L-3	197	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	282	280	282	9	(85)	1.0	1.0
3-9809	Lab	189	9	1,701	AHS-L-3	189	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	274	274	274	10	(85)	1.0	1.0
3-9813	Lab	412	9	3,708	AHS-L-3	412	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	557	470	557	8	(145)	1.0	1.0
3-9825	Lab	560	9	5,040	AHS-L-2	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	375	375	375	4	(115)	0.5	0.5
3-9827 & 3-9829	Lab	98	9	882	AHS-L-2	98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98	98	98	7	-	1.0	1.0
3-9837	Lab	172	9	1,548	AHS-L-2	360	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	155	155	155	6	205	2.1	2.1
3-9839	Lab	186	9	1,674	AHS-L-2	186	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	261	250	261	9	(75)	1.0	1.0
3-9843	Lab	401	9	3,609	AHS-L-2	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	355	355	355	6	(105)	0.6	0.6
3-9845	Lab	194	9	1,746	AHS-L-2	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	264	225	264	8	(70)	1.0	1.0
3-9847	Lab	198	9	1,782	AHS-L-2	198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	268	230	268	8	(70)	1.0	1.0
3-9848	Lab	81	9	729	AHS-L-2	81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	101	85	101	7	(20)	1.0	1.0
3-9855	Lab	407	9	3,663	AHS-L-1	407	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	517	517	517	8	(110)	1.0	1.0
3-9857	Lab	187	9	1,683	AHS-L-1	187	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	257	225	257	8	(70)	1.0	1.0
3-9838 / 3-9852 / 3-9858	Lab	3,534	9	31,806	AHS-L-2	2,890	6.3	102	638	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	638	3,130	3,768	3,768	7	(878)	0.8	0.8
3-9816 / 3-9828	Lab	2,415	9	21,735	AHS-L-3	2,415	6.3	98	613	6	100	625	-	-	-	-	-	-	-	-	-	-	-	-	1,238	2,680	3,918	3,918	11	(1,503)	1.0	1.0
3-9804 / 3-9812	Lab	2,406	9	21,654	AHS-L-3	2,406	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,766	2,766	2,766	8	(360)	1.0	1.0
G9852 / G9858 / G9838	Lab	3,610	9	32,490	AHS-L-2	2,515	6.3	92	575	6	101	631	6.3	105	656	6.3	101	631	6.3	101	631	6.3	101	631	3,756	1,860	5,616	5,616	10	(3,101)	0.7	0.7
G9816 / G9828	Lab	2,410	9	21,690	AHS-L-3	3,325	6.3	101	631	6	89	556	6	104	650	-	-	-	-	-	-	-	-	-	1,838	2,190	3,113	4,028	9	(703)	1.4	1.4
G9804 / G9812	Lab	2,406	9	21,654	AHS-L-3	2,406	6.3	107	669	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	669	2,406	3,075	3,075	9	(669)	1.0	1.0
G9805	Lab	100	9	900	AHS-L-3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	145	145	145	10	(45)	1.0	1.0
G9820	Lab	95	9	855	AHS-L-3	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	195	195	195	14	(100)	1.0	1.0
G9823	Lab	312	9	2,808	AHS-L-2	312	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	852	720	852	15	(540)	1.0	1.0
G9825A	Lab	117	9	1,053	AHS-L-2	117	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	167	167	167	10	(50)	1.0	1.0
G9821	Lab	787	9	7,083	AHS-L-2	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	550	550	550	5	(105)	0.6	0.6
G9826A	Lab	98	9	882	AHS-L-2	98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98	98	98	7	-	1.0	1.0
G9837	Lab	197	9	1,773	AHS-L-2	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	155	177	155	6	55	1.1	1.1
G9839	Lab	72	9	648	AHS-L-2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82	82	82	8	(10)	1.0	1.0
G9807 / G9809	Lab	376	9	3,384	AHS-L-2	376	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	516	500	516	9	(140)	1.0	1.0
G9813	Lab	408	9	3,672	AHS-L-3	408	7.8	88	682	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	682	758	1,440	1,440	24	(1,032)	1.0	1.0
G9843	Lab	501	9	4,509	AHS-L-2	665	6.3	93	581	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	581	100	517	681	7	(16)	1.3	1.3
G9909 / G9915	Lab	1,520	9	13,680	AHS-L-3	1,520	6.3	93.0	581	6.3	93.0	581	6.3	93.0	581	-	-	-	-	-	-	-	-	-	1,744	1,813	3,556	3,556	16	(2,036)	1.0	1.0
G9872 / G9878 / G9892	Lab	3,596	9	32,364	AHS-L-3	3,596	6.3	86.0	538	6.3	101	631	6	97	606	6	97	606	6	103	644	6	100	625	3,650	4,288	7,938	7,938	15	(4,342)	1.0	1.0
G9855	Lab	407	9	3,663	AHS-L-3	407	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	485	485	485	8	(78)	1.0	1.0
G9857	Lab	196	9	1,764	AHS-L-3	196	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	234	234	234	8	(38)	1.0	1.0
G9859	Lab	196	9	1,764	AHS-L-3	196	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	234	234	234	8	(38)	1.0	1.0
G9861 & G9863	Lab	193	9	1,737	AHS-L-3	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	230	230	230	8	(37)	1.0	1.0
		73,111	765	657,999	-	69,019	133	2,057	12,988	69	1,084	6,775	31	503	3,144	13	198	1,238	13	204	1,275	13	201	1,256	26,676	71,374	95,708	98,050	723	(29,031)	83.7	84

Project Name: University of Rochester Energy Conservation MP Support
Building: KMRB
Date: 4/1/2021
EEM: Lab Airflow Optimization
Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: 0

Assumed
Avg. CFM/Sqft

Existing Conditions							Fume Hood 1	Fume Hood 2	Fume Hood 3	Fume Hood 4	Fume Hood 5	Fume Hood 6	Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	Supply CFM	Design Exhaust CFM	Design Exhaust CFM	Design Exhaust CFM	Design Exhaust CFM	Design Exhaust CFM	Design Exhaust CFM	Total Hood Exhaust CFM	General Exhaust CFM	Total Lab Exhaust CFM		Calculated ACH	Pressurization	Supply CFM/Sqft	General Exhaust CFM/Sqft
1-9905 / 1-9911 / 1-9915	Lab	2397	9	21,573	AHS-L-1	1,328	337.00	-	-	-			337	1,297	1,634		5	(306)	0.6	0.5
1-9872 / 1-9878 / 1-9892	Lab	3583	9	32,247	AHS-L-1	2,431	253.00	232	-	-	-	-	485	2,509	2,994		6	(563)	0.7	0.7
1-9858 / 1-9852 / 1-9538	Lab	3618	9	32,562	AHS-L-2	1,571	278.00	-	-	-	-	-	278	1,951	2,229		4	(658)	0.4	0.5
1-9855	Lab	407	9	3,663	AHS-L-1	297	281.00	-	-	-	-	-	281	100	381		6	(84)	0.7	0.2
1-9804 / 1-9812	Lab	2415	9	21,735	AHS-L-3	1,912	215.00	226	215	-	-	-	656	1,643	2,299		6	(387.00)	0.8	0.7
1-9807 / 1-9809	Lab	448	9	4,032	AHS-L-3	314	337.00	-	-	-	-	-	337	168	505		8	(191)	0.7	0.4
1-9816 / 1-9828	Lab	2409	9	21,681	AHS-L-3	2,140	-	-	-	-	-	-	-	2,720	2,720		8	(580)	0.9	1.1
1-9823	Lab	596	9	5,364	AHS-L-2	406	-	-	-	-	-	-	-	467	467		5	(61)	0.7	0.8
1-9839	Lab	584	9	5,256	AHS-L-2	399	-	-	-	-	-	-	-	263	263		3	136	0.7	0.5
1-9811 / 1-9813	Lab	311	9	2,799	AHS-L-3	146	-	-	-	-	-	-	-	-	-		-	146	0.5	-
1-9825	Lab	562	9	5,058	AHS-L-3	295	-	-	-	-	-	-	-	98	98		1	197	0.5	0.2
1-9826	Lab	14	9	126	AHS-L-2	51	-	-	-	-	-	-	-	71	71		34	(20)	3.6	5.1
1-9827 / 1-9829	Lab	98	9	882	AHS-L-2	413	-	-	-	-	-	-	-	281	281		19	132	4.2	2.9
1-9837	Lab	156	9	1,404	AHS-L-2	73	-	-	-	-	-	-	-	107	107		5	(34)	0.5	0.7
1-9847	Lab	198	9	1,782	AHS-L-2	65	-	-	-	-	-	-	-	129	129		4	(64)	0.3	0.7
1-9845	Lab	194	9	1,746	AHS-L-2	90	-	-	-	-	-	-	-	198	198		7	(108)	0.5	1.0
1-9803 / 1-9805	Lab	199	9	1,791	AHS-L-3	93	-	-	-	-	-	-	-	172	172		6	(79)	0.5	0.9
1-9857	Lab	198	9	1,782	AHS-L-1	65	-	-	-	-	-	-	-	110	110		4	(45)	0.3	0.6
1-9859	Lab	197	9	1,773	AHS-L-1	86	-	-	-	-	-	-	-	140	140		5	(54)	0.4	0.7
1-9861 / 1-9863	Lab	193	9	1,737	AHS-L-1	68	-	-	-	-	-	-	-	128	128		4	(60)	0.4	0.7
2-9905 / 2-9915	Lab	2416	9	21,744	AHS-L-1	1,469	236.00	-	-	-	-	-	236	1,680	1,916		5	(447)	0.6	0.7
2-9872 / 2-9878 / 2-9892	Lab	3451	9	31,059	AHS-L-1	2,090	257.00	253	-	-	-	-	510	2,279	2,789		5	(699)	0.6	0.7
2-9861 / 2-9863	Lab	193	9	1,737	AHS-L-1	60	-	-	-	-	-	-	-	98	98		3	(38)	0.3	0.5
2-9859	Lab	187	9	1,683	AHS-L-1	81	-	-	-	-	-	-	-	120	120		4	(39)	0.4	0.6
2-9857	Lab	187	9	1,683	AHS-L-1	82	-	-	-	-	-	-	-	101	101		4	(19)	0.4	0.5
2-9855 A & B	Lab	134	9	1,206	AHS-L-1	169	-	-	-	-	-	-	-	243	243		12	(74)	1.3	1.8
2-9841 & 2-9843	Lab	395	9	3,555	AHS-L-2	176	-	-	-	-	-	-	-	285	285		5	(109)	0.4	0.7
2-9845	Lab	194	9	1,746	AHS-L-2	79	-	-	-	-	-	-	-	135	135		5	(56)	0.4	0.7
2-9847	Lab	198	9	1,782	AHS-L-2	81	-	-	-	-	-	-	-	128	128		4	(47)	0.4	0.6
2-9837	Lab	77	9	693	AHS-L-2	59	-	-	-	-	-	-	-	74	74		6	(15)	0.8	1.0
2-9839	Lab	195	9	1,755	AHS-L-2	80	-	-	-	-	-	-	-	165	165		6	(85)	0.4	0.8
2-9827 / 2-9829	Lab	162	9	1,458	AHS-L-2	410	-	-	-	-	-	-	-	410	410		17	-	2.5	2.5
2-9825	Lab	562	9	5,058	AHS-L-2	207	-	-	-	-	-	-	-	254	254		3	(47)	0.4	0.5
2-9626	Lab	115	9	1,035	AHS-L-2	54	-	-	-	-	-	-	-	69	69		4	(15)	0.5	0.6
2-9803	Lab	90	9	810	AHS-L-3	-	-	-	-	-	-	-	-	92	92		7	(92)	-	1.0
2-9805	Lab	100	9	900	AHS-L-3	52	-	-	-	-	-	-	-	-	-		-	52	0.5	-
2-9807	Lab	184	9	1,656	AHS-L-3	61	-	-	-	-	-	-	-	116	116		4	(55)	0.3	0.6
2-9809	Lab	189	9	1,701	AHS-L-3	66	-	-	-	-	-	-	-	117	117		4	(51)	0.3	0.6
2-9813	Lab	418	9	3,762	AHS-L-3	178	-	-	-	-	-	-	-	357	357		6	(179)	0.4	0.9
2-9819	Lab	198	9	1,782	AHS-L-2	105	-	-	-	-	-	-	-	137	137		5	(32)	0.5	0.7
2-9838 / 2-9852 / 2-9858	Lab	3638	9	32,742	AHS-L-2	1,427	309.0	246	-	-	-	-	555	1,640	2,195		4	(768)	0.4	0.5
2-9804 / 2-9812 / 2-9616	Lab	4770	9	42,930	AHS-L-3	1,488	229.0	246	-	-	-	-	475	1,696	2,171		3	(683)	0.3	0.4
2-9823	Lab	413	9	3,717	AHS-L-2	211	-	-	-	-	-	-	-	180	180		3	31	0.5	0.4
3-9905 / 3-9915	Lab	2323	9	20,907	AHS-L-3	1,088	260.0	-	-	-	-	-	260	1,834	2,094		6	(1,006)	0.5	0.8
3-9872 / 3-9878 / 3-9892	Lab	3618	9	32,562	AHS-L-1	2,098	215.0	271	-	-	-	-	486	2,227	2,713		5	(615)	0.6	0.6
3-9861 & 3-9863	Lab	193	9	1,737	AHS-L-1	73	-	-	-	-	-	-	-	110	110		4	(37)	0.4	0.6
3-9859	Lab	187	9	1,683	AHS-L-1	82	-	-	-	-	-	-	-	131	131		5	(49)	0.4	0.7
3-9626	Lab	114	9	1,026	AHS-L-2	58	-	-	-	-	-	-	-	63	63		4	(5)	0.5	0.6
3-9803 & 3-9805	Lab	199	9	1,791	AHS-L-3	62	-	-	-	-	-	-	-	122	122		4	(60)	0.3	0.6
3-9807	Lab	197	9	1,773	AHS-L-3	84	-	-	-	-	-	-	-	166	166		6	(82)	0.4	0.8
3-9809	Lab	189	9	1,701	AHS-L-3	86	-	-	-	-	-	-	-	157	157		6	(71)	0.5	0.8
3-9813	Lab	412	9	3,708	AHS-L-3	151	-	-	-	-	-	-	-	244	244		4	(93)	0.4	0.6
3-9825	Lab	560	9	5,040	AHS-L-2	218	-	-	-	-	-	-	-	265	265		3	(47)	0.4	0.5
3-9827 & 3-9829	Lab	98	9	882	AHS-L-2	439	-	-	-	-	-	-	-	440	440		30	(1)	4.5	4.5
3-9837	Lab	172	9	1,548	AHS-L-2	82	-	-	-	-	-	-	-	85	85		3	(3)	0.5	0.5
3-9839	Lab	186	9	1,674	AHS-L-2	65	-	-	-	-	-	-	-	114	114		4	(49)	0.3	0.6
3-9843	Lab	401	9	3,609	AHS-L-2	137	-	-	-	-	-	-	-	157	157		3	(20)	0.3	0.4

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Project Name: University of Rochester Energy Conservation MP Support
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Date: 4/1/2021
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Scenario: Exisitng and Proposed
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Reviewed By: 0

Assumed
Avg. CFM/Sqft

3-9845	Lab	194	9	1,746	AHS-L-2	70	-	-	-	-	-	-	-	122	122		4	(52)	0.4	0.6
3-9847	Lab	198	9	1,782	AHS-L-2	66	-	-	-	-	-	-	-	121	121		4	(55)	0.3	0.6
3-9848	Lab	81	9	729	AHS-L-2	67	-	-	-	-	-	-	-	81	81		7	(14)	0.8	1.0
3-9855	Lab	407	9	3,663	AHS-L-1	120	-	-	-	-	-	-	-	221	221		4	(101)	0.3	0.5
3-9857	Lab	187	9	1,683	AHS-L-1	71	-	-	-	-	-	-	-	108	108		4	(37)	0.4	0.6
3-9838 / 3-9852 / 3-9858	Lab	3534	9	31,806	AHS-L-2	1,072	257.0	-	-	-	-	-	257	1,266	1,523		3	(451)	0.3	0.4
3-9816 / 3-9828	Lab	2415	9	21,735	AHS-L-3	1,460	243.0	264	-	-	-	-	507	1,279	1,786		5	(326)	0.6	0.5
3-9804 / 3-9812	Lab	2406	9	21,654	AHS-L-3	1,409	-	-	-	-	-	-	-	2,175	2,175		6	(766)	0.6	0.9
G9852 / G9858 / G9838	Lab	3610	9	32,490	AHS-L-2	1,611	243.0	312	243	236	167	167	1,368	902	2,270		4	(659)	0.4	0.2
G9816 / G9828	Lab	2410	9	21,690	AHS-L-3	1,418	257.0	258	205	-	-	-	720	841	1,561		4	(143)	0.6	0.3
G9804 / G9812	Lab	2406	9	21,654	AHS-L-3	1,322	267.0	-	-	-	-	-	267	1,499	1,766		5	(444)	0.5	0.6
G9805	Lab	100	9	900	AHS-L-3	103	-	-	-	-	-	-	-	90	90		6	13	1.0	0.9
G9820	Lab	95	9	855	AHS-L-2	95	-	-	-	-	-	-	-	197	197		14	(102)	1.0	2.1
G9823	Lab	312	9	2,808	AHS-L-2	162	-	-	-	-	-	-	-	369	369		8	(207)	0.5	1.2
G9825A	Lab	117	9	1,053	AHS-L-2	76	-	-	-	-	-	-	-	98	98		6	(22)	0.6	0.8
G9821	Lab	787	9	7,083	AHS-L-2	318	-	-	-	-	-	-	-	430	430		4	(112)	0.4	0.5
G9826A	Lab	98	9	882	AHS-L-2	70	-	-	-	-	-	-	-	64	64		4	6	0.7	0.7
G9837	Lab	197	9	1,773	AHS-L-2	113	-	-	-	-	-	-	-	88	88		3	25	0.6	0.4
G9839	Lab	72	9	648	AHS-L-2	54	-	-	-	-	-	-	-	98	98		9	(44)	0.8	1.4
G9807 / G9809	Lab	376	9	3,384	AHS-L-2	159	-	-	-	-	-	-	-	298	298		5	(139)	0.4	0.8
G9813	Lab	408	9	3,672	AHS-L-3	598	289.0	-	-	-	-	-	289	131	420		7	178	1.5	0.3
G9843	Lab	501	9	4,509	AHS-L-2	303	201.0	-	-	-	-	-	201	113	314		4	(11)	0.6	0.2
G9909 / G9915	Lab	1520	9	13,680	AHS-L-3	1,040	700.0	700	-	-	-	-	1,400	1,238	2,638		12	(1,598)	0.7	0.8
G9872 / G9878 / G9892	Lab	3596	9	32,364	AHS-L-3	2,460	700.0	700	700	700	700	700	4,200	2,930	7,130		13	(4,669)	0.7	0.8
G9855	Lab	407	9	3,663	AHS-L-3	278	-	-	-	-	-	-	-	332	332		5	(53)	0.7	0.8
G9857	Lab	196	9	1,764	AHS-L-3	134	-	-	-	-	-	-	-	160	160		5	(26)	0.7	0.8
G9859	Lab	196	9	1,764	AHS-L-3	134	-	-	-	-	-	-	-	160	160		5	(26)	0.7	0.8
G9861 & G9863	Lab	193	9	1,737	AHS-L-3	132	-	-	-	-	-	-	-	157	157		5	(25)	0.7	0.8
		73,111	774	657,999	-	40,567	6,364	3,708	1,363				14,105	44,610	58,715	-	509	(18,148)	58	69

wendel

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Date: 4/1/2021
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Scenario: Exisitng and Proposed
Calculated By: CLF
Reviewed By: 0

Assumed
Avg. CFM/Sqft

80 Desired CFM/Sqft | 0.5 CFM/SQFT | Desired Lab ACH 4

New Fume Hood Face Velocity or Lab ACH Scenario							Fume Hood 1	Fume Hood 2	Fume Hood 3	Fume Hood 4	Fume Hood 5	Fume Hood 6	Summary							
Room Number	Room Type	Sq. Ft	Assumed Ceiling Height	Volume (cubic feet)	Associated AHU	New Calculated Supply CFM	Calculated Exhaust CFM	Calculated Exhaust CFM	Calculated Exhaust CFM	Calculated Exhaust CFM	Calculated Exhaust CFM	Calculated Exhaust CFM	Total Hood Exhaust CFM	New General Exhaust CFM	Desired New Total Lab Exhaust CFM	Actual New Total Lab Exhaust CFM	New ACH	Pressurization		CFM/Sqft
1-9905 / 1-9911 / 1-9915	Lab	2,397	9	21,573	AHS-L-1	1,199	337	-	-	-	-	-	337	1,168	1,505	1,505	4	(306)		0.5
1-9872 / 1-9878 / 1-9892	Lab	3,583	9	32,247	AHS-L-1	1,792	253	232	-	-	-	-	485	1,870	2,355	2,355	4	(563)		0.5
1-9858 / 1-9852 / 1-9538	Lab	3,618	9	32,562	AHS-L-2	1,809	278	-	-	-	-	-	278	2,189	2,467	2,467	5	(658)		0.5
1-9855	Lab	407	9	3,663	AHS-L-1	297	281	-	-	-	-	-	281	100	381	381	6	(84)		0.7
1-9804 / 1-9812	Lab	2,415	9	21,735	AHS-L-3	1,208	215	226	215	-	-	-	656	939	1,595	1,595	4	(387)		0.5
1-9807 / 1-9809	Lab	448	9	4,032	AHS-L-3	314	337	-	-	-	-	-	337	168	505	505	8	(191)		0.7
1-9816 / 1-9828	Lab	2,409	9	21,681	AHS-L-3	1,205	-	-	-	-	-	-	-	1,785	1,785	1,785	5	(580)		0.5
1-9823	Lab	596	9	5,364	AHS-L-2	298	-	-	-	-	-	-	-	359	359	359	4	(61)		0.5
1-9839	Lab	584	9	5,256	AHS-L-2	399	-	-	-	-	-	-	-	263	263	263	3	136		0.7
1-9811 / 1-9813	Lab	311	9	2,799	AHS-L-3	146	-	-	-	-	-	-	-	-	-	-	-	146		0.5
1-9825	Lab	562	9	5,058	AHS-L-3	295	-	-	-	-	-	-	-	98	98	98	1	197		0.5
1-9826	Lab	14	9	126	AHS-L-2	7	-	-	-	-	-	-	-	27	27	27	13	(20)		0.5
1-9827 / 1-9829	Lab	98	9	882	AHS-L-2	191	-	-	-	-	-	-	-	59	59	59	4	132		1.9
1-9837	Lab	156	9	1,404	AHS-L-2	78	-	-	-	-	-	-	-	112	112	112	5	(34)		0.5
1-9847	Lab	198	9	1,782	AHS-L-2	99	-	-	-	-	-	-	-	163	163	163	5	(64)		0.5
1-9845	Lab	194	9	1,746	AHS-L-2	97	-	-	-	-	-	-	-	205	205	205	7	(108)		0.5
1-9803 / 1-9805	Lab	199	9	1,791	AHS-L-3	100	-	-	-	-	-	-	-	179	179	179	6	(79)		0.5
1-9857	Lab	198	9	1,782	AHS-L-1	99	-	-	-	-	-	-	-	144	144	144	5	(45)		0.5
1-9859	Lab	197	9	1,773	AHS-L-1	99	-	-	-	-	-	-	-	153	153	153	5	(54)		0.5
1-9861 / 1-9863	Lab	193	9	1,737	AHS-L-1	97	-	-	-	-	-	-	-	157	157	157	5	(60)		0.5
2-9905 / 2-9915	Lab	2,416	9	21,744	AHS-L-1	1,208	236	-	-	-	-	-	236	1,419	1,655	1,655	5	(447)		0.5
2-9872 / 2-9878 / 2-9892	Lab	3,451	9	31,059	AHS-L-1	1,726	257	253	-	-	-	-	510	1,915	2,425	2,425	5	(699)		0.5
2-9861 / 2-9863	Lab	193	9	1,737	AHS-L-1	97	-	-	-	-	-	-	-	135	135	135	5	(38)		0.5
2-9859	Lab	187	9	1,683	AHS-L-1	94	-	-	-	-	-	-	-	133	133	133	5	(39)		0.5
2-9857	Lab	187	9	1,683	AHS-L-1	94	-	-	-	-	-	-	-	113	113	113	4	(19)		0.5
2-9855 A & B	Lab	134	9	1,206	AHS-L-1	67	-	-	-	-	-	-	-	141	141	141	7	(74)		0.5
2-9841 & 2-9843	Lab	395	9	3,555	AHS-L-2	198	-	-	-	-	-	-	-	307	307	307	5	(109)		0.5
2-9845	Lab	194	9	1,746	AHS-L-2	97	-	-	-	-	-	-	-	153	153	153	5	(56)		0.5
2-9847	Lab	198	9	1,782	AHS-L-2	99	-	-	-	-	-	-	-	146	146	146	5	(47)		0.5
2-9837	Lab	77	9	693	AHS-L-2	39	-	-	-	-	-	-	-	54	54	54	5	(15)		0.5
2-9839	Lab	195	9	1,755	AHS-L-2	98	-	-	-	-	-	-	-	183	183	183	6	(85)		0.5
2-9827 / 2-9829	Lab	162	9	1,458	AHS-L-2	97	-	-	-	-	-	-	-	97	97	97	4	-		0.6
2-9825	Lab	562	9	5,058	AHS-L-2	207	-	-	-	-	-	-	-	254	254	254	3	(47)		0.4
2-9626	Lab	115	9	1,035	AHS-L-2	58	-	-	-	-	-	-	-	73	73	73	4	(15)		0.5
2-9803	Lab	90	9	810	AHS-L-3	45	-	-	-	-	-	-	-	137	137	137	10	(92)		0.5
2-9805	Lab	100	9	900	AHS-L-3	52	-	-	-	-	-	-	-	-	-	-	-	52		0.5
2-9807	Lab	184	9	1,656	AHS-L-3	92	-	-	-	-	-	-	-	147	147	147	5	(55)		0.5
2-9809	Lab	189	9	1,701	AHS-L-3	95	-	-	-	-	-	-	-	146	146	146	5	(51)		0.5
2-9813	Lab	418	9	3,762	AHS-L-3	209	-	-	-	-	-	-	-	388	388	388	6	(179)		0.5
2-9819	Lab	198	9	1,782	AHS-L-2	99	-	-	-	-	-	-	-	131	131	131	4	(32)		0.5
2-9838 / 2-9852 / 2-9858	Lab	3,638	9	32,742	AHS-L-2	1,427	309	246	-	-	-	-	555	1,640	2,195	2,195	4	(768)		0.4
2-9804 / 2-9812 / 2-9616	Lab	4,770	9	42,930	AHS-L-3	1,488	229	246	-	-	-	-	475	1,696	2,171	2,171	3	(683)		0.3
2-9823	Lab	413	9	3,717	AHS-L-2	211	-	-	-	-	-	-	-	180	180	180	3	31		0.5
3-9905 / 3-9915	Lab	2,323	9	20,907	AHS-L-3	1,162	260	-	-	-	-	-	260	1,908	2,168	2,168	6	(1,006)		0.5
3-9872 / 3-9878 / 3-9892	Lab	3,618	9	32,562	AHS-L-1	1,809	215	271	-	-	-	-	486	1,938	2,424	2,424	4	(615)		0.5
3-9861 & 3-9863	Lab	193	9	1,737	AHS-L-1	97	-	-	-	-	-	-	-	134	134	134	5	(37)		0.5
3-9859	Lab	187	9	1,683	AHS-L-1	94	-	-	-	-	-	-	-	143	143	143	5	(49)		0.5
3-9626	Lab	114	9	1,026	AHS-L-2	63	-	-	-	-	-	-	-	68	68	68	4	(5)		0.6
3-9803 & 3-9805	Lab	199	9	1,791	AHS-L-3	100	-	-	-	-	-	-	-	160	160	160	5	(60)		0.5
3-9807	Lab	197	9	1,773	AHS-L-3	99	-	-	-	-	-	-	-	181	181	181	6	(82)		0.5
3-9809	Lab	189	9	1,701	AHS-L-3	95	-	-	-	-	-	-	-	166	166	166	6	(71)		0.5
3-9813	Lab	412	9	3,708	AHS-L-3	206	-	-	-	-	-	-	-	299	299	299	5	(93)		0.5
3-9825	Lab	560	9	5,040	AHS-L-2	218	-	-	-	-	-	-	-	265	265	265	3	(47)		0.4

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Assumed
Avg. CFM/Sqft

3-9827 & 3-9829	Lab	98	9	882	AHS-L-2	58	-	-	-	-	-	-	-	59	59	59	4	(1)		0.6
3-9837	Lab	172	9	1,548	AHS-L-2	82	-	-	-	-	-	-	-	85	85	85	3	(3)		0.5
3-9839	Lab	186	9	1,674	AHS-L-2	93	-	-	-	-	-	-	-	142	142	142	5	(49)		0.5
3-9843	Lab	401	9	3,609	AHS-L-2	137	-	-	-	-	-	-	-	157	157	157	3	(20)		0.3
3-9845	Lab	194	9	1,746	AHS-L-2	97	-	-	-	-	-	-	-	149	149	149	5	(52)		0.5
3-9847	Lab	198	9	1,782	AHS-L-2	99	-	-	-	-	-	-	-	154	154	154	5	(55)		0.5
3-9848	Lab	81	9	729	AHS-L-2	41	-	-	-	-	-	-	-	55	55	55	4	(14)		0.5
3-9855	Lab	407	9	3,663	AHS-L-1	204	-	-	-	-	-	-	-	305	305	305	5	(101)		0.5
3-9857	Lab	187	9	1,683	AHS-L-1	94	-	-	-	-	-	-	-	131	131	131	5	(37)		0.5
3-9838 / 3-9852 / 3-9858	Lab	3,534	9	31,806	AHS-L-2	1,072	257	-	-	-	-	-	257	1,266	1,523	1,523	3	(451)		0.3
3-9816 / 3-9828	Lab	2,415	9	21,735	AHS-L-3	1,208	243	264	-	-	-	-	507	1,027	1,534	1,534	4	(326)		0.5
3-9804 / 3-9812	Lab	2,406	9	21,654	AHS-L-3	1,203	-	-	-	-	-	-	-	1,969	1,969	1,969	5	(766)		0.5
G9852 / G9858 / G9838	Lab	3,610	9	32,490	AHS-L-2	1,611	243	312	243	236	167	167	1,368	902	2,270	2,270	4	(659)		0.4
G9816 / G9828	Lab	2,410	9	21,690	AHS-L-3	1,418	257	258	205	-	-	-	720	841	1,561	1,561	4	(143)		0.6
G9804 / G9812	Lab	2,406	9	21,654	AHS-L-3	1,203	267	-	-	-	-	-	267	1,380	1,647	1,647	5	(444)		0.5
G9805	Lab	100	9	900	AHS-L-3	73	-	-	-	-	-	-	-	60	60	60	4	13		0.7
G9820	Lab	95	9	855	AHS-L-2	48	-	-	-	-	-	-	-	150	150	150	10	(102)		0.5
G9823	Lab	312	9	2,808	AHS-L-2	156	-	-	-	-	-	-	-	363	363	363	8	(207)		0.5
G9825A	Lab	117	9	1,053	AHS-L-2	59	-	-	-	-	-	-	-	81	81	81	5	(22)		0.5
G9821	Lab	787	9	7,083	AHS-L-2	394	-	-	-	-	-	-	-	506	506	506	4	(112)		0.5
G9826A	Lab	98	9	882	AHS-L-2	65	-	-	-	-	-	-	-	59	59	59	4	6		0.7
G9837	Lab	197	9	1,773	AHS-L-2	113	-	-	-	-	-	-	-	88	88	88	3	25		0.6
G9839	Lab	72	9	648	AHS-L-2	36	-	-	-	-	-	-	-	80	80	80	7	(44)		0.5
G9807 / G9809	Lab	376	9	3,384	AHS-L-2	188	-	-	-	-	-	-	-	327	327	327	6	(139)		0.5
G9813	Lab	408	9	3,672	AHS-L-3	598	289	-	-	-	-	-	289	131	420	420	7	178		1.5
G9843	Lab	501	9	4,509	AHS-L-2	303	201	-	-	-	-	-	201	113	314	314	4	(11)		0.6
G9909 / G9915	Lab	1,520	9	13,680	AHS-L-3	760	700.0	700	-	-	-	-	1,400	958	2,358	2,358	10	(1,598)		0.5
G9872 / G9878 / G9892	Lab	3,596	9	32,364	AHS-L-3	1,798	700.0	700	700	700	700	700	4,200	2,267	6,467	6,467	12	(4,669)		0.5
G9855	Lab	407	9	3,663	AHS-L-3	204	-	-	-	-	-	-	-	257	257	257	4	(53)		0.5
G9857	Lab	196	9	1,764	AHS-L-3	98	-	-	-	-	-	-	-	124	124	124	4	(26)		0.5
G9859	Lab	196	9	1,764	AHS-L-3	98	-	-	-	-	-	-	-	124	124	124	4	(26)		0.5
G9861 & G9863	Lab	193	9	1,737	AHS-L-3	97	-	-	-	-	-	-	-	122	122	122	4	(25)		0.5
		73,111	765	657,999	-	35,362	6,364	3,708	1,363	936	867	867	14,105	39,405	53,510	53,510	424	(18,148)	-	45

ECM - 03 - Lab HVAC Systems - AHS-L- 1, 2 & 3

Project Name:	University of Rochester
Building:	Medical Research Building - Kronberg
Date:	4/1/2021
ECM	Lab HVAC Systems
Calculated By:	CLF
Reviewed By:	GHB

Summary of Existing System

Measured Data and Data Limitations

ECMs Implemented

	DAT Reset Schedule
x	Lab CFM Adjustment
	Night Setbacks

Summary of Systems Used for Calculation

Existing Usage (10 / 6 ACM)

Preheat Usage	4,154	mmBtu
Cooling Usage	7,670	mmBtu
Reheat Usage	6,636	mmBtu
Supply Fan Usage	208,459	kWh

Proposed Usage - Option A (8 / 4 ACH)

Preheat Usage	3,604	mmBtu
Cooling Usage	6,562	mmBtu
Reheat Usage	5,743	mmBtu
Supply Fan Usage	164,014	kWh

Proposed Usage - Option B (6 / 4 ACH)

Preheat Usage	3,500	mmBtu
Cooling Usage	6,437	mmBtu
Reheat Usage	5,587	mmBtu
Supply Fan Usage	159,945	kWh

Summary of EEM Savings - Option A (8 / 4 ACH)

Proposed Savings

Preheat Usage	550	mmBtu
Cooling Usage	1,108	mmBtu
Reheat Usage	893	mmBtu
Supply Fan Usage	44,444	kWh

Summary of EEM Savings - Option A (6 / 4 ACH)

Proposed Savings

Preheat Usage	654	mmBtu
Cooling Usage	1,233	mmBtu
Reheat Usage	1,049	mmBtu
Supply Fan Usage	48,514	kWh

wendel

Project Name:	University of Rochester
Building:	Medical Research Building - Kronberg
Date:	4/1/2021
Calculated By:	CLF
Reviewed By:	GHB
System:	AHS-L- 1, 2 & 3
Scenario:	Existing

Summary of Use

Preheat Usage	4,154	mmBtu
Cooling Usage	7670	mmBtu
Reheat Usage	6636	mmBtu
Supply Fan Usage	208459	kWh

Scheduling / Population load (1=Occ 0=UnOcc)

	Schedule Days1-5	Population Days1-5	Schedule Days6,7,8	Population Days6,7,8
1	0	100%	0	100%
2	0	100%	0	100%
3	0	100%	0	100%
4	0	100%	0	100%
5	0	100%	0	100%
6	0	100%	0	100%
7	1	100%	1	100%
8	1	100%	1	100%
9	1	100%	1	100%
10	1	100%	1	100%
11	1	100%	1	100%
12	1	100%	1	100%
13	1	100%	1	100%
14	1	100%	1	100%
15	1	100%	1	100%
16	1	100%	1	100%
17	1	100%	1	100%
18	1	100%	1	100%
19	1	100%	1	100%
20	0	100%	0	100%
21	0	100%	0	100%
22	0	100%	0	100%
23	0	100%	0	100%
24	0	100%	0	100%

Fan Info

Fan Label	SF
Fan HP:	125.0
Fan QTY:	3.0
Calculated Load Factor:	75%
Fan Motor Eff:	90%
Fan kW:	233.1
Max Fan Flow:	300,000
Fan Affinity Law Adjsut:	1.5

Lab Airflow CFM Reduction

Occupied Design Ariflow	83,323	CFM
Unoccupied Design Airflow	40,567	CFM
Occupied Airflow Reduction	0	CFM
Unoccupied Airflow Reduction	0	CFM

Misc System Info

Cooling Shutoff	55	degF
Cooling Shutoff	5	May
Cooling Shutoff	10	October

Active Space Setpoints (Average)

OAT	Occ	Unocc	Load %
0	68.0	68.0	0.00%
10	68.0	68.0	0.00%
20	68.0	68.0	0.00%
30	68.0	68.0	0.00%
40	68.0	68.0	0.00%
50	68.0	68.0	0.00%
55	68.0	68.0	0.00%
60	69.2	69.2	0.00%
70	71.6	71.6	0.00%
80	74.0	74.0	0.00%
100	74.0	74.0	0.00%

System Setpoint Simulations

OAT	PHT STP	DAT STP	DAH STP	
0	55.0	65.0	25.6	
10	55.0	63.6	25.3	
20	55.0	62.1	24.9	
30	55.0	60.7	24.6	
40	55.0	59.3	24.2	
50	55.0	57.9	23.9	
55	55.0	57.1	23.7	
60	55.0	56.4	23.5	
70	55.0	55.0	23.2	
80	55.0	55.0	23.2	
100	55.0	55.0	23.2	
	1.585E-05	-0.001483	-0.109225	64.903594
	X=	28.00	Y=	61.03
	0	0	0	55
	X=	28.00	Y=	55.00
	3.861E-06	-0.000361	-0.026601	25.589599
	X=	90.00	Y=	23.08

Reheat Loading

OAT	DAT	Occ	Unocc	
0	85.0	85.0%	85.0%	
10	85.0	76.8%	76.8%	
20	85.0	68.5%	68.5%	
30	85.0	60.3%	60.3%	
40	85.0	52.0%	52.0%	
50	85.0	43.8%	43.8%	
55	85.0	39.6%	39.6%	
60	85.0	35.5%	35.5%	
70	85.0	27.3%	27.3%	
80	85.0	19.0%	19.0%	
100	85.0	2.5%	2.5%	
	0	0	0	85
	X=	0.00	Y=	85.00
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	0.00	Y=	0.85
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	55.00	Y=	0.40
	% of CFM to Reheat	100.0%		

Project Name:	University of Rochester
Building:	Medical Research Building - Kronberg
Date:	44287.474
Calculated By:	CLF
Reviewed By:	GHB
System:	AHS-L- 1, 2 & 3
Scenario:	Existing

Formulas

D : Based on Simulation
E : Design CFM x Fan Simulation
F : ((E / Fan CFM Output) Fan Affinity) x Fan Kw
G : 1.08 x (D - B) x E / 1,000,000
H : 4.5 x (C - Coil Enthalpy) x E / 1,000,000
J : Based on Simulation
K : Based on Simulation
L : 1.08 x (K - I) x E x % CFM to Reheat / 1,000,000

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
MAX	8.0	93.9	40.8	55.0	64.5	25.5	83322.9	34.1	4.5	6.2	75.9	85.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN	1.0	3.9	1.8	55.0	54.6	23.1	40567.1	11.6	0.0	0.0	54.6	85.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	36600	496470	194424	481800	501243	207772	558244006	208459	4154	7670	489054	744600	6636	0	0	0	0	0	0	0	0	0	0

Time Stamp	Type	Outside dry-bulb temp (F)	Specific Enthalpy (Btu/lb)	Preheat Setpoint	SAT STP (degF)	Enthalpy Setpoint	Supply Air CFM	Supply Fan Usage (kWh)	Preheat Usage (mmBtu)	Cooling Usage (mmBtu)	DAT (degF)	Reheat DAT (degF)	Reheat Usage (mmBtu)
1/1/17 0:00	7.0	41.0	14.4	55.0	59.0	24.2	40567	12	0.6	0.0	55.0	85.0	0.7
1/1/17 1:00	7.0	37.9	12.6	55.0	59.5	24.3	40567	12	0.7	0.0	55.0	85.0	0.7
1/1/17 2:00	7.0	37.0	11.9	55.0	59.6	24.3	40567	12	0.8	0.0	55.0	85.0	0.7
1/1/17 3:00	7.0	34.0	11.2	55.0	60.1	24.4	40567	12	0.9	0.0	55.0	85.0	0.7
1/1/17 4:00	7.0	33.1	11.0	55.0	60.2	24.5	40567	12	1.0	0.0	55.0	85.0	0.8
1/1/17 5:00	7.0	28.9	9.8	55.0	60.9	24.6	40567	12	1.1	0.0	55.0	85.0	0.8
1/1/17 6:00	7.0	30.9	10.5	55.0	60.6	24.5	83323	34	2.2	0.0	55.0	85.0	1.6
1/1/17 7:00	7.0	32.0	10.7	55.0	60.4	24.5	83323	34	2.1	0.0	55.0	85.0	1.6
1/1/17 8:00	7.0	32.0	11.0	55.0	60.4	24.5	83323	34	2.1	0.0	55.0	85.0	1.6
1/1/17 9:00	7.0	35.1	11.7	55.0	59.9	24.4	83323	34	1.8	0.0	55.0	85.0	1.5
1/1/17 10:00	7.0	37.0	12.3	55.0	59.6	24.3	83323	34	1.6	0.0	55.0	85.0	1.5
1/1/17 11:00	7.0	41.0	13.3	55.0	59.0	24.2	83323	34	1.3	0.0	55.0	85.0	1.4
1/1/17 12:00	7.0	43.0	13.9	55.0	58.7	24.1	83323	34	1.1	0.0	55.0	85.0	1.3
1/1/17 13:00	7.0	45.0	14.6	55.0	58.4	24.0	83323	34	0.9	0.0	55.0	85.0	1.3
1/1/17 14:00	7.0	46.0	14.6	55.0	58.3	24.0	83323	34	0.8	0.0	55.0	85.0	1.3
1/1/17 15:00	7.0	46.9	15.0	55.0	58.2	23.9	83323	34	0.7	0.0	55.0	85.0	1.3
1/1/17 16:00	7.0	46.9	15.0	55.0	58.2	23.9	83323	34	0.7	0.0	55.0	85.0	1.3
1/1/17 17:00	7.0	44.1	14.5	55.0	58.6	24.0	83323	34	1.0	0.0	55.0	85.0	1.3
1/1/17 18:00	7.0	43.0	14.2	55.0	58.7	24.1	83323	34	1.1	0.0	55.0	85.0	1.3
1/1/17 19:00	7.0	42.1	14.0	55.0	58.9	24.1	40567	12	0.6	0.0	55.0	85.0	0.7
1/1/17 20:00	7.0	39.9	13.6	55.0	59.2	24.2	40567	12	0.7	0.0	55.0	85.0	0.7
1/1/17 21:00	7.0	39.9	13.4	55.0	59.2	24.2	40567	12	0.7	0.0	55.0	85.0	0.7
1/1/17 22:00	7.0	41.0	14.1	55.0	59.0	24.2	40567	12	0.6	0.0	55.0	85.0	0.7
1/1/17 23:00	7.0	44.1	14.8	55.0	58.6	24.0	40567	12	0.5	0.0	55.0	85.0	0.6
1/2/17 0:00	8.0	45.0	15.2	55.0	58.4	24.0	40567	12	0.4	0.0	55.0	85.0	0.6
1/2/17 1:00	8.0	44.1	15.0	55.0	58.6	24.0	40567	12	0.5	0.0	55.0	85.0	0.6
1/2/17 2:00	8.0	43.0	15.1	55.0	58.7	24.1	40567	12	0.5	0.0	55.0	85.0	0.7
1/2/17 3:00	8.0	42.1	15.2	55.0	58.9	24.1	40567	12	0.6	0.0	55.0	85.0	0.7
1/2/17 4:00	8.0	42.1	15.5	55.0	58.9	24.1	40567	12	0.6	0.0	55.0	85.0	0.7
1/2/17 5:00	8.0	42.1	15.5	55.0	58.9	24.1	40567	12	0.6	0.0	55.0	85.0	0.7
1/2/17 6:00	8.0	42.1	15.5	55.0	58.9	24.1	83323	34	1.2	0.0	55.0	85.0	1.4
1/2/17 7:00	8.0	42.1	15.5	55.0	58.9	24.1	83323	34	1.2	0.0	55.0	85.0	1.4
1/2/17 8:00	8.0	42.1	15.7	55.0	58.9	24.1	83323	34	1.2	0.0	55.0	85.0	1.4
1/2/17 9:00	8.0	43.0	15.9	55.0	58.7	24.1	83323	34	1.1	0.0	55.0	85.0	1.3
1/2/17 10:00	8.0	44.1	16.4	55.0	58.6	24.0	83323	34	1.0	0.0	55.0	85.0	1.3
1/2/17 11:00	8.0	46.0	17.3	55.0	58.3	24.0	83323	34	0.8	0.0	55.0	85.0	1.3
1/2/17 12:00	8.0	46.9	17.5	55.0	58.2	23.9	83323	34	0.7	0.0	55.0	85.0	1.3
1/2/17 13:00	8.0	48.9	18.5	55.0	57.9	23.9	83323	34	0.5	0.0	55.0	85.0	1.2
1/2/17 14:00	8.0	50.0	19.1	55.0	57.7	23.8	83323	34	0.4	0.0	55.0	85.0	1.2
1/2/17 15:00	8.0	51.1	19.4	55.0	57.6	23.8	83323	34	0.4	0.0	55.0	85.0	1.2
1/2/17 16:00	8.0	51.1	19.4	55.0	57.6	23.8	83323	34	0.4	0.0	55.0	85.0	1.2
1/2/17 17:00	8.0	50.0	19.1	55.0	57.7	23.8	83323	34	0.4	0.0	55.0	85.0	1.2
1/2/17 18:00	8.0	50.0	19.1	55.0	57.7	23.8	83323	34	0.4	0.0	55.0	85.0	1.2
1/2/17 19:00	8.0	50.0	19.3	55.0	57.7	23.8	40567	12	0.2	0.0	55.0	85.0	0.6

Project Name:	University of Rochester
Building:	Medical Research Building - Kronberg
Date:	4/1/2021
Calculated By:	CLF
Reviewed By:	GHB
System:	
Scenario:	Proposed System

Summary of Use

Preheat Usage	3,604	mmBtu
Cooling Usage	6562	mmBtu
Reheat Usage	5743	mmBtu
Supply Fan Usage	164014	kWh

Scheduling / Population load (1=Occ 0=UnOcc)

	Schedule Days1-5	Population Days1-5	Schedule Days6,7,8	Population Days6,7,8
1	0	100%	0	100%
2	0	100%	0	100%
3	0	100%	0	100%
4	0	100%	0	100%
5	0	100%	0	100%
6	0	100%	0	100%
7	1	100%	1	100%
8	1	100%	1	100%
9	1	100%	1	100%
10	1	100%	1	100%
11	1	100%	1	100%
12	1	100%	1	100%
13	1	100%	1	100%
14	1	100%	1	100%
15	1	100%	1	100%
16	1	100%	1	100%
17	1	100%	1	100%
18	1	100%	1	100%
19	1	100%	1	100%
20	0	100%	0	100%
21	0	100%	0	100%
22	0	100%	0	100%
23	0	100%	0	100%
24	0	100%	0	100%

Fan Info

Fan Label	SF
Fan HP:	125.0
Fan QTY:	3.0
Calculated Load Factor:	75%
Fan Motor Eff:	90%
Fan kW:	233.1
Max Fan Flow:	300,000
Fan Affinity Law Adjsut:	1.5

Lab Airflow CFM Reduction

Occupied Design Ariflow	83,323	CFM
Unoccupied Design Airflow	40,567	CFM
Occupied Airflow Reduction	15,384	CFM
Unoccupied Airflow Reduction	1,017	CFM

Misc System Info

Cooling Shutoff	55	degF
Cooling Shutoff	5	May
Cooling Shutoff	10	October

Active Space Setpoints (Average)

OAT	Occ	Unocc	Load %
0	68.0	68.0	0.00%
10	68.0	68.0	0.00%
20	68.0	68.0	0.00%
30	68.0	68.0	0.00%
40	68.0	68.0	0.00%
50	68.0	68.0	0.00%
55	68.0	68.0	0.00%
60	69.2	69.2	0.00%
70	71.6	71.6	0.00%
80	74.0	74.0	0.00%
90	74.0	74.0	0.00%

System Setpoint Simulations

OAT	PHT STP	DAT STP	DAH STP	
0	55.0	65.0	25.6	
10	55.0	63.6	25.3	
20	55.0	62.1	24.9	
30	55.0	60.7	24.6	
40	55.0	59.3	24.2	
50	55.0	57.9	23.9	
55	55.0	57.1	23.7	
60	55.0	56.4	23.5	
70	55.0	55.0	23.2	
80	55.0	55.0	23.2	
100	55.0	55.0	23.2	
	1.585E-05	-0.001483	-0.109225	64.903594
	X=	28.00	Y=	61.03
	0	0	0	55
	X=	28.00	Y=	55.00
	3.861E-06	-0.000361	-0.026601	25.589599
	X=	90.00	Y=	23.08

Reheat Loading

OAT	DAT	Occ	Unocc	
0	85.0	85.0%	85.0%	
10	85.0	76.8%	76.8%	
20	85.0	68.5%	68.5%	
30	85.0	60.3%	60.3%	
40	85.0	52.0%	52.0%	
50	85.0	43.8%	43.8%	
55	85.0	39.6%	39.6%	
60	85.0	35.5%	35.5%	
70	85.0	27.3%	27.3%	
80	85.0	19.0%	19.0%	
100	85.0	2.5%	2.5%	
	0	0	0	85
	X=	0.00	Y=	85.00
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	0.00	Y=	0.85
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	55.00	Y=	0.40
	% of CFM to Reheat	100.0%		

wendel

Project Name:	University of Rochester
Building:	Medical Research Building - Kronberg
Date:	44287.474
Calculated By:	CLF
Reviewed By:	GHB
System:	0
Scenario:	Proposed System

Formulas

D : Based on Simulation
E : Design CFM x Fan Simulation
F : ((E / Fan CFM Output) Fan Affinity) x Fan Kw
G : 1.08 x (D - B) x E / 1,000,000
H : 4.5 x (C - Coil Enthalpy) x E / 1,000,000
J : Based on Simulation
K : Based on Simulation
L : 1.08 x (K - I) x E x % CFM to Reheat / 1,000,000

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
MAX	8.0	93.9	40.8	55.0	64.5	25.5	67938.4	25.1	3.7	5.1	75.9	85.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN	1.0	3.9	1.8	55.0	54.6	23.1	39549.9	11.2	0.0	0.0	54.6	85.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	36600	496470	194424	481800	501243	207772	481160731	164014	3604	6562	489054	744600	5743	0	0	0	0	0	0	0	0	0	0

Time Stamp	Type	Outside dry-bulb temp (F)	Specific Enthalpy (Btu/lb)	Preheat Setpoint	SAT STP (degF)	Enthalpy Setpoint	Supply Air CFM	Supply Fan Usage (kWh)	Preheat Usage (mmBtu)	Cooling Usage (mmBtu)	DAT (degF)	Reheat DAT (degF)	Reheat Usage (mmBtu)
1/1/17 0:00	7.0	41.0	14.4	55.0	59.0	24.2	39550	11	0.6	0.0	55.0	85.0	0.7
1/1/17 1:00	7.0	37.9	12.6	55.0	59.5	24.3	39550	11	0.7	0.0	55.0	85.0	0.7
1/1/17 2:00	7.0	37.0	11.9	55.0	59.6	24.3	39550	11	0.8	0.0	55.0	85.0	0.7
1/1/17 3:00	7.0	34.0	11.2	55.0	60.1	24.4	39550	11	0.9	0.0	55.0	85.0	0.7
1/1/17 4:00	7.0	33.1	11.0	55.0	60.2	24.5	39550	11	0.9	0.0	55.0	85.0	0.7
1/1/17 5:00	7.0	28.9	9.8	55.0	60.9	24.6	39550	11	1.1	0.0	55.0	85.0	0.8
1/1/17 6:00	7.0	30.9	10.5	55.0	60.6	24.5	67938	25	1.8	0.0	55.0	85.0	1.3
1/1/17 7:00	7.0	32.0	10.7	55.0	60.4	24.5	67938	25	1.7	0.0	55.0	85.0	1.3
1/1/17 8:00	7.0	32.0	11.0	55.0	60.4	24.5	67938	25	1.7	0.0	55.0	85.0	1.3
1/1/17 9:00	7.0	35.1	11.7	55.0	59.9	24.4	67938	25	1.5	0.0	55.0	85.0	1.2
1/1/17 10:00	7.0	37.0	12.3	55.0	59.6	24.3	67938	25	1.3	0.0	55.0	85.0	1.2
1/1/17 11:00	7.0	41.0	13.3	55.0	59.0	24.2	67938	25	1.0	0.0	55.0	85.0	1.1
1/1/17 12:00	7.0	43.0	13.9	55.0	58.7	24.1	67938	25	0.9	0.0	55.0	85.0	1.1
1/1/17 13:00	7.0	45.0	14.6	55.0	58.4	24.0	67938	25	0.7	0.0	55.0	85.0	1.1
1/1/17 14:00	7.0	46.0	14.6	55.0	58.3	24.0	67938	25	0.7	0.0	55.0	85.0	1.0
1/1/17 15:00	7.0	46.9	15.0	55.0	58.2	23.9	67938	25	0.6	0.0	55.0	85.0	1.0
1/1/17 16:00	7.0	46.9	15.0	55.0	58.2	23.9	67938	25	0.6	0.0	55.0	85.0	1.0
1/1/17 17:00	7.0	44.1	14.5	55.0	58.6	24.0	67938	25	0.8	0.0	55.0	85.0	1.1
1/1/17 18:00	7.0	43.0	14.2	55.0	58.7	24.1	67938	25	0.9	0.0	55.0	85.0	1.1
1/1/17 19:00	7.0	42.1	14.0	55.0	58.9	24.1	39550	11	0.6	0.0	55.0	85.0	0.6
1/1/17 20:00	7.0	39.9	13.6	55.0	59.2	24.2	39550	11	0.6	0.0	55.0	85.0	0.7
1/1/17 21:00	7.0	39.9	13.4	55.0	59.2	24.2	39550	11	0.6	0.0	55.0	85.0	0.7
1/1/17 22:00	7.0	41.0	14.1	55.0	59.0	24.2	39550	11	0.6	0.0	55.0	85.0	0.7
1/1/17 23:00	7.0	44.1	14.8	55.0	58.6	24.0	39550	11	0.5	0.0	55.0	85.0	0.6
1/2/17 0:00	8.0	45.0	15.2	55.0	58.4	24.0	39550	11	0.4	0.0	55.0	85.0	0.6
1/2/17 1:00	8.0	44.1	15.0	55.0	58.6	24.0	39550	11	0.5	0.0	55.0	85.0	0.6
1/2/17 2:00	8.0	43.0	15.1	55.0	58.7	24.1	39550	11	0.5	0.0	55.0	85.0	0.6
1/2/17 3:00	8.0	42.1	15.2	55.0	58.9	24.1	39550	11	0.6	0.0	55.0	85.0	0.6
1/2/17 4:00	8.0	42.1	15.5	55.0	58.9	24.1	39550	11	0.6	0.0	55.0	85.0	0.6
1/2/17 5:00	8.0	42.1	15.5	55.0	58.9	24.1	39550	11	0.6	0.0	55.0	85.0	0.6
1/2/17 6:00	8.0	42.1	15.5	55.0	58.9	24.1	67938	25	0.9	0.0	55.0	85.0	1.1
1/2/17 7:00	8.0	42.1	15.5	55.0	58.9	24.1	67938	25	0.9	0.0	55.0	85.0	1.1
1/2/17 8:00	8.0	42.1	15.7	55.0	58.9	24.1	67938	25	0.9	0.0	55.0	85.0	1.1
1/2/17 9:00	8.0	43.0	15.9	55.0	58.7	24.1	67938	25	0.9	0.0	55.0	85.0	1.1
1/2/17 10:00	8.0	44.1	16.4	55.0	58.6	24.0	67938	25	0.8	0.0	55.0	85.0	1.1
1/2/17 11:00	8.0	46.0	17.3	55.0	58.3	24.0	67938	25	0.7	0.0	55.0	85.0	1.0
1/2/17 12:00	8.0	46.9	17.5	55.0	58.2	23.9	67938	25	0.6	0.0	55.0	85.0	1.0
1/2/17 13:00	8.0	48.9	18.5	55.0	57.9	23.9	67938	25	0.4	0.0	55.0	85.0	1.0
1/2/17 14:00	8.0	50.0	19.1	55.0	57.7	23.8	67938	25	0.4	0.0	55.0	85.0	1.0
1/2/17 15:00	8.0	51.1	19.4	55.0	57.6	23.8	67938	25	0.3	0.0	55.0	85.0	0.9
1/2/17 16:00	8.0	51.1	19.4	55.0	57.6	23.8	67938	25	0.3	0.0	55.0	85.0	0.9
1/2/17 17:00	8.0	50.0	19.1	55.0	57.7	23.8	67938	25	0.4	0.0	55.0	85.0	1.0
1/2/17 18:00	8.0	50.0	19.1	55.0	57.7	23.8	67938	25	0.4	0.0	55.0	85.0	1.0
1/2/17 19:00	8.0	50.0	19.3	55.0	57.7	23.8	39550	11	0.2	0.0	55.0	85.0	0.6

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Project Name:	University of Rochester
Building:	Medical Research Building - Kronberg
Date:	4/1/2021
Calculated By:	CLF
Reviewed By:	GHB
System:	
Scenario:	Proposed System

Summary of Use

Preheat Usage	3,500	mmBtu
Cooling Usage	6437	mmBtu
Reheat Usage	5587	mmBtu
Supply Fan Usage	159945	kWh

Scheduling / Population load (1=Occ 0=UnOcc)

	Schedule Days1-5	Population Days1-5	Schedule Days6,7,8	Population Days6,7,8
1	0	100%	0	100%
2	0	100%	0	100%
3	0	100%	0	100%
4	0	100%	0	100%
5	0	100%	0	100%
6	0	100%	0	100%
7	1	100%	1	100%
8	1	100%	1	100%
9	1	100%	1	100%
10	1	100%	1	100%
11	1	100%	1	100%
12	1	100%	1	100%
13	1	100%	1	100%
14	1	100%	1	100%
15	1	100%	1	100%
16	1	100%	1	100%
17	1	100%	1	100%
18	1	100%	1	100%
19	1	100%	1	100%
20	0	100%	0	100%
21	0	100%	0	100%
22	0	100%	0	100%
23	0	100%	0	100%
24	0	100%	0	100%

Fan Info

Fan Label	SF
Fan HP:	125.0
Fan QTY:	3.0
Calculated Load Factor:	75%
Fan Motor Eff:	90%
Fan kW:	233.1
Max Fan Flow:	300,000
Fan Affinity Law Adjsut:	1.5

Lab Airflow CFM Reduction

Occupied Design Ariflow	83,323	CFM
Unoccupied Design Airflow	40,567	CFM
Occupied Airflow Reduction	14,304	CFM
Unoccupied Airflow Reduction	5,206	CFM

Misc System Info

Cooling Shutoff	55	degF
Cooling Shutoff	5	May
Cooling Shutoff	10	October

Active Space Setpoints (Average)

OAT	Occ	Unocc	Load %
0	68.0	68.0	0.00%
10	68.0	68.0	0.00%
20	68.0	68.0	0.00%
30	68.0	68.0	0.00%
40	68.0	68.0	0.00%
50	68.0	68.0	0.00%
55	68.0	68.0	0.00%
60	69.2	69.2	0.00%
70	71.6	71.6	0.00%
80	74.0	74.0	0.00%
90	74.0	74.0	0.00%

System Setpoint Simulations

OAT	PHT STP	DAT STP	DAH STP	
0	55.0	65.0	25.6	
10	55.0	63.6	25.3	
20	55.0	62.1	24.9	
30	55.0	60.7	24.6	
40	55.0	59.3	24.2	
50	55.0	57.9	23.9	
55	55.0	57.1	23.7	
60	55.0	56.4	23.5	
70	55.0	55.0	23.2	
80	55.0	55.0	23.2	
100	55.0	55.0	23.2	
	1.585E-05	-0.001483	-0.109225	64.903594
	X=	28.00	Y=	61.03
	0	0	0	55
	X=	28.00	Y=	55.00
	3.861E-06	-0.000361	-0.026601	25.589599
	X=	90.00	Y=	23.08

Reheat Loading

OAT	DAT	Occ	Unocc	
0	85.0	85.0%	85.0%	
10	85.0	76.8%	76.8%	
20	85.0	68.5%	68.5%	
30	85.0	60.3%	60.3%	
40	85.0	52.0%	52.0%	
50	85.0	43.8%	43.8%	
55	85.0	39.6%	39.6%	
60	85.0	35.5%	35.5%	
70	85.0	27.3%	27.3%	
80	85.0	19.0%	19.0%	
100	85.0	2.5%	2.5%	
	0	0	0	85
	X=	0.00	Y=	85.00
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	0.00	Y=	0.85
	2.195E-21	-2.61E-19	-0.00825	0.85
	X=	55.00	Y=	0.40
	% of CFM to Reheat	100.0%		

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Project Name: University of Rochester
Building: Medical Research Building - Kronberg
Date: 44287.474
Calculated By: CLF
Reviewed By: GHB
System: 0
Scenario: Proposed System

Formulas

D : Based on Simulation
E : Design CFM x Fan Simulation
F : ((E / Fan CFM Output) Fan Affinity) x Fan Kw
G : 1.08 x (D - B) x E / 1,000,000
H : 4.5 x (C - Coil Enthalpy) x E / 1,000,000
J : Based on Simulation
K : Based on Simulation
L : 1.08 x (K - I) x E x % CFM to Reheat / 1,000,000

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
MAX	8.0	93.9	40.8	55.0	64.5	25.5	69019.0	25.7	3.7	5.2	75.9	85.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN	1.0	3.9	1.8	55.0	54.6	23.1	35361.5	9.4	0.0	0.0	54.6	85.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	36600	496470	194424	481800	501243	207772	469471578	159945	3500	6437	489054	744600	5587	0	0	0	0	0	0	0	0	0	0

Time Stamp	Type	Outside dry-bulb temp (F)	Specific Enthalpy (Btu/lb)	Preheat Setpoint	SAT STP (degF)	Enthalpy Setpoint	Supply Air CFM	Supply Fan Usage (kWh)	Preheat Usage (mmBtu)	Cooling Usage (mmBtu)	DAT (degF)	Reheat DAT (degF)	Reheat Usage (mmBtu)
1/1/17 0:00	7.0	41.0	14.4	55.0	59.0	24.2	35362	9	0.5	0.0	55.0	85.0	0.6
1/1/17 1:00	7.0	37.9	12.6	55.0	59.5	24.3	35362	9	0.7	0.0	55.0	85.0	0.6
1/1/17 2:00	7.0	37.0	11.9	55.0	59.6	24.3	35362	9	0.7	0.0	55.0	85.0	0.6
1/1/17 3:00	7.0	34.0	11.2	55.0	60.1	24.4	35362	9	0.8	0.0	55.0	85.0	0.7
1/1/17 4:00	7.0	33.1	11.0	55.0	60.2	24.5	35362	9	0.8	0.0	55.0	85.0	0.7
1/1/17 5:00	7.0	28.9	9.8	55.0	60.9	24.6	35362	9	1.0	0.0	55.0	85.0	0.7
1/1/17 6:00	7.0	30.9	10.5	55.0	60.6	24.5	69019	26	1.8	0.0	55.0	85.0	1.3
1/1/17 7:00	7.0	32.0	10.7	55.0	60.4	24.5	69019	26	1.7	0.0	55.0	85.0	1.3
1/1/17 8:00	7.0	32.0	11.0	55.0	60.4	24.5	69019	26	1.7	0.0	55.0	85.0	1.3
1/1/17 9:00	7.0	35.1	11.7	55.0	59.9	24.4	69019	26	1.5	0.0	55.0	85.0	1.3
1/1/17 10:00	7.0	37.0	12.3	55.0	59.6	24.3	69019	26	1.3	0.0	55.0	85.0	1.2
1/1/17 11:00	7.0	41.0	13.3	55.0	59.0	24.2	69019	26	1.0	0.0	55.0	85.0	1.1
1/1/17 12:00	7.0	43.0	13.9	55.0	58.7	24.1	69019	26	0.9	0.0	55.0	85.0	1.1
1/1/17 13:00	7.0	45.0	14.6	55.0	58.4	24.0	69019	26	0.7	0.0	55.0	85.0	1.1
1/1/17 14:00	7.0	46.0	14.6	55.0	58.3	24.0	69019	26	0.7	0.0	55.0	85.0	1.1
1/1/17 15:00	7.0	46.9	15.0	55.0	58.2	23.9	69019	26	0.6	0.0	55.0	85.0	1.0
1/1/17 16:00	7.0	46.9	15.0	55.0	58.2	23.9	69019	26	0.6	0.0	55.0	85.0	1.0
1/1/17 17:00	7.0	44.1	14.5	55.0	58.6	24.0	69019	26	0.8	0.0	55.0	85.0	1.1
1/1/17 18:00	7.0	43.0	14.2	55.0	58.7	24.1	69019	26	0.9	0.0	55.0	85.0	1.1
1/1/17 19:00	7.0	42.1	14.0	55.0	58.9	24.1	35362	9	0.5	0.0	55.0	85.0	0.6
1/1/17 20:00	7.0	39.9	13.6	55.0	59.2	24.2	35362	9	0.6	0.0	55.0	85.0	0.6
1/1/17 21:00	7.0	39.9	13.4	55.0	59.2	24.2	35362	9	0.6	0.0	55.0	85.0	0.6
1/1/17 22:00	7.0	41.0	14.1	55.0	59.0	24.2	35362	9	0.5	0.0	55.0	85.0	0.6
1/1/17 23:00	7.0	44.1	14.8	55.0	58.6	24.0	35362	9	0.4	0.0	55.0	85.0	0.6
1/2/17 0:00	8.0	45.0	15.2	55.0	58.4	24.0	35362	9	0.4	0.0	55.0	85.0	0.5
1/2/17 1:00	8.0	44.1	15.0	55.0	58.6	24.0	35362	9	0.4	0.0	55.0	85.0	0.6
1/2/17 2:00	8.0	43.0	15.1	55.0	58.7	24.1	35362	9	0.5	0.0	55.0	85.0	0.6
1/2/17 3:00	8.0	42.1	15.2	55.0	58.9	24.1	35362	9	0.5	0.0	55.0	85.0	0.6
1/2/17 4:00	8.0	42.1	15.5	55.0	58.9	24.1	35362	9	0.5	0.0	55.0	85.0	0.6
1/2/17 5:00	8.0	42.1	15.5	55.0	58.9	24.1	35362	9	0.5	0.0	55.0	85.0	0.6
1/2/17 6:00	8.0	42.1	15.5	55.0	58.9	24.1	69019	26	1.0	0.0	55.0	85.0	1.1
1/2/17 7:00	8.0	42.1	15.5	55.0	58.9	24.1	69019	26	1.0	0.0	55.0	85.0	1.1
1/2/17 8:00	8.0	42.1	15.7	55.0	58.9	24.1	69019	26	1.0	0.0	55.0	85.0	1.1
1/2/17 9:00	8.0	43.0	15.9	55.0	58.7	24.1	69019	26	0.9	0.0	55.0	85.0	1.1
1/2/17 10:00	8.0	44.1	16.4	55.0	58.6	24.0	69019	26	0.8	0.0	55.0	85.0	1.1
1/2/17 11:00	8.0	46.0	17.3	55.0	58.3	24.0	69019	26	0.7	0.0	55.0	85.0	1.1
1/2/17 12:00	8.0	46.9	17.5	55.0	58.2	23.9	69019	26	0.6	0.0	55.0	85.0	1.0
1/2/17 13:00	8.0	48.9	18.5	55.0	57.9	23.9	69019	26	0.5	0.0	55.0	85.0	1.0
1/2/17 14:00	8.0	50.0	19.1	55.0	57.7	23.8	69019	26	0.4	0.0	55.0	85.0	1.0
1/2/17 15:00	8.0	51.1	19.4	55.0	57.6	23.8	69019	26	0.3	0.0	55.0	85.0	1.0
1/2/17 16:00	8.0	51.1	19.4	55.0	57.6	23.8	69019	26	0.3	0.0	55.0	85.0	1.0
1/2/17 17:00	8.0	50.0	19.1	55.0	57.7	23.8	69019	26	0.4	0.0	55.0	85.0	1.0
1/2/17 18:00	8.0	50.0	19.1	55.0	57.7	23.8	69019	26	0.4	0.0	55.0	85.0	1.0
1/2/17 19:00	8.0	50.0	19.3	55.0	57.7	23.8	35362	9	0.2	0.0	55.0	85.0	0.5

Technical Appendix 2

Lab Airflow Optimization ECM

Scope of Work (Cost Estimate & Scope of Work)

- Kornberg
- Del Monte
- BMEO

DIRECT MATERIAL & LABOR | COST ESTIMATE

Project : University of Rochester | BMEO
Project # : 402805
Measure : ECM 3 | Lab HVAC Systems
Date : 04/02/21

Estimated by: GHB
Checked by: JGD
Approved by: JGD
Vendor Quotes: No
Subcontractor Pricing: No

Item No.	Description	Material	Labor	Other[1]	Subtotal Cost
1	1.1 Lab HVAC Systems				**$0.00**
2	A. Occupied Airflow ACH Reduction	$0.00	$87,750.00	$0.00	**$87,750.00**
3	B. Unoccupied Airflow ACH Reduction	$0.00	$43,875.00	$0.00	**$43,875.00**
3.0	General Costs: Bonds	$0.00	$0.00	$1,611.00	**$1,611.00**
3.1	General Costs: Other	$0.00	$0.00	$0.00	**$0.00**
				Subtotal:	$133,236

Contingency:	5.0%	$6,662
Escalation Reserve:	5.0%	$6,662
Engineering Procurement & Construction MGMT:	25.0%	$33,309
Total:		$179,869

Notes

[1] Other inclues misc. material and equipment necessary for installation, communication, insurances, permits, bonding. Prior to final pricing and subcontract execution these values will be required to be itemized by the bidder.

ECM 3: Lab HVAC Systems

The following is a General Scope of Work for the University of Rochester Energy Conservation Master Plan. The intent of this document is to provide a general outline of the project scope of work for developing firm project costs. Project Design Documents, including construction and permit sets, will be developed following approval of the proposed project by University of Rochester.

Project Job Site(s)

No.	Building Name
1	BMEO

***** NOT FOR CONSTRUCTION *****

The scope of this project consists of providing all labor and material, along with providing all equipment necessary to complete and make fully operational the systems defined in this specification. The project is intended to follow University of Rochester design guidelines. All products, procedures, and completed systems are intended to comply with ASHRAE standards. While this document does not include specification details, the final project manual will be produced that includes specifications that are aligned with University of Rochester design standards.

It is our expectation that the subcontractor submitting a quotation is familiar with the University of Rochester design standards and has accounted for the impact these standards have on pricing, including but not limited, material, labor and general conditions.

1.0 General

A. **Documents |** At the start of construction, submit manufacturer's product data for materials (including but not limited to: sensors, actuators, controllers, cabinets, wire & conduit), P&ID drawings, coordination & layout drawings, and other commonly required submittals per University of Rochester standards.

B. **Documents |** Maintaining of all Project Record Documents as detailed in this Contract Document.

C. **Documents |** Document and Submit a summary of existing conditions including digital photos of the job site prior to the start of work.
    a. Examine sizes and conditions of existing equipment.

D. **Material Handling |** Label all control wiring.

E. **Material Handling |** Delivery of the material and equipment to job site.

F. **Material Handling |** A location within the facility will be identified for the subcontractor to store all material and equipment. The subcontract is required to keep this area organized and accessible as well as free of any loose material or garbage.

G. **Material Handling |** Provide moving, storage and protection for all University of Rochester's existing equipment, furniture and cabinetry on job site to perform contract work. Protect floor in areas used to store furniture.

H. **Installation Requirements |** Provide all associated equipment, and all particulars/specialties needed to make the provided equipment fully functional and perform its intended use.

I. **Installation Requirements |** Install all equipment per manufacturer's instructions

J. **Installation Requirements |** Paint and finish as needed to match preconstruction conditions.

K. **Installation Requirements |** Subcontractor is responsible for all cutting and patching associated with the work.

L. **Permits |** Subcontractor with Contractor approval will submit application for electric service permits if necessary. The Subcontractor will pay the cost of the permits.

M. **Permits |** Building permit fees will be paid by Wendel.

N. **Inspections & Codes |** All electrical work must be performed by a licensed electrical contractor and include a valid underwriters certification at the completion of the project as part of the close out O&M package.

O. **Inspections & Codes |** Provide all electrical connections required in accordance with all Federal, State, and Local Codes.

P. **Inspections & Codes |** Field verify all voltages prior to ordering any equipment.

Q. **Installation Requirements |** Removal of all waste generated by Work per EPA requirements, University of Rochester standards, and local authority regulations.

R. **Inspections & Codes |** Test, adjust, and balance all equipment and materials provided, or modified under this Subcontract.

S. **Inspections & Codes |** Provide all mechanical connections required in accordance with all Federal, State, and Local Codes.

T. **Coordination |** Coordination of equipment and utility service shutdowns with 2-weeks notice to the facility and Wendel. All work requiring a shutdown will be completed during normal business hours.

U. **Closeout |** Provide operator training and operation manuals

V. **Closeout |** Starting Systems

1. Coordinate schedule for start-up of various equipment and systems.
2. Notify Wendel and facility seven days prior to start-up of each item.
3. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
4. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
5. Verify wiring and support components for equipment are complete and tested. Execute start-up under supervision of responsible Contractor's personnel in accordance with manufacturers' instructions.
6. Provide manufacturer authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

W. **Commissioning |** Subcontractor shall assign representatives with expertise and authority to act on its behalf to participate in and perform commissioning process activities under the direction of Wendel. Wendel will develop commissioning procedures the subcontractor will be responsible to execute the procedure under Wendel’s supervision.

X. **Trending |** All points connected to the building management system shall be trended and have data stored for three years at a minimum of one (1) hour intervals. All trends shall be remotely accessible by Wendel or another authorized and University of Rochester approved third party.

Y. **Trending |** Trended data will be viewable in tabular and graphic form in conjunction with current BMS formatting standards at University of Rochester. Subcontractor to integrate into existing BMS. This data will also have the ability to be exported into a csv. Formatted file.

Z. **OVERALL SYSTEM |** The new control points added shall fully integrate into the existing building management system. The required integration shall include the creation of custom graphics and the compilation and display of all devices and objects on the existing Siemens interface. All graphic displays will reside on the existing Siemens interface and be modified accordingly. In addition, the system shall perform the said integration through the use of BACnet/IP communications).

AA. **Key Definition |** Provide - furnish and install

BB. **Key Definition |** Wendel - maybe referred to as, Wendel, Contractor, or Design/Builder

1.1 Lab Airflow Optimization - OCCUPIED

A. For Laboratory spaces as outlined in the table below:

Room	Fume Hood Qty	GEX Qty	Supply Qty
B102A	0	1	1
B102B	0	1	1
B104	0	1	1
B103	0	1	1
Suite B109	1	4	4
Suite 110	1	4	4
103	1	1	1
104	0	1	1
222	1	1	1
Suite 224	0	2	2
226	1	1	1
227	1	1	1
228	0	1	1
230	0	1	1
Suite 232	1	4	4
Suite 237	1	3	4
239	0	1	1
Suite 321	0	3	3
324	1	1	1
326	0	1	1
Suite 329	1	4	4
Suite 333	1	4	4
Suite 336	1	5	5
339	1	1	1
420	1	1	1
422	0	1	1
Suite 425	1	3	3
428	0	1	1
429	1	1	1
431	0	1	1
Suite 434	1	3	3
Suite 438	1	3	3
Suite 521	1	3	3
Suite 525	1	3	3
528	0	1	1

Room	Fume Hood Qty	GEX Qty	Supply Qty
530	1	1	1
531	0	1	1
Suite 534	1	3	3
Suite 538	0	3	3

1. **General Exhaust Air Flow Control |** Rebalance each lab general exhaust damper to maintain a lab total exhaust equal to 8 air changes per hour in each lab. In labs where the total fume hood exhaust is greater than or equal to 8 air changes per hour, the lab general exhaust airflow will be set to zero cfm.
2. **Supply Air Flow Control |** Recalibrate supply air volume damper so the lab maintains a negative airflow differential relative to total lab exhaust. (Airflow differential to be determined in Airflow Testing & Balancing, intent to match existing differential)
3. **Air Flow Testing & Balancing |** Provide Pre & Post Retrofit air flow testing and balancing, by a certified TAB specialist, for each control box. Provide TAB report to Wendel prior to substantial completion. Include final TAB report in close out document package.

1.2 Lab Airflow Optimization – UNOCCUPIED

A. **For Laboratory spaces as outlined in the table in 1.1:**

1. **General Exhaust Air Flow Control |** Rebalance each lab general exhaust damper to maintain a lab total exhaust equal to 4 air changes per hour during UNOCCUPIED periods in each lab. In labs where the total fume hood exhaust is greater than or equal to 4 air changes per hour, the lab general exhaust airflow will be set to zero cfm.
2. **Supply Air Flow Control |** Recalibrate supply air volume damper so the lab maintains a negative airflow differential relative to total lab exhaust. (Airflow differential to be determined in Airflow Testing & Balancing, intent to match existing differential)
3. **Air Flow Testing & Balancing |** Provide Pre & Post Retrofit air flow testing and balancing, by a certified TAB specialist, for each control box. Provide TAB report to Wendel prior to substantial completion. Include final TAB report in close out document package.

DIRECT MATERIAL & LABOR | COST ESTIMATE

Project :	University of Rochester | KMRB	Estimated by:	GHB
Project # :	402805	Checked by:	JGD
Measure :	ECM 3 | Lab HVAC Systems	Approved by:	JGD
Date :	04/02/21	Vendor Quotes:	No
		Subcontractor Pricing:	No

Item No.	Description	Material	Labor	Other[1]	Subtotal Cost
1	1.1 Lab HVAC Systems				**$0.00**
2	A. Occupied Airflow ACH Reduction	$0.00	$191,250.00	$0.00	**$191,250.00**
3	B. Unoccupied Airflow ACH Reduction	$0.00	$95,625.00	$0.00	**$95,625.00**
3.0	General Costs: Bonds	$0.00	$0.00	$1,611.00	**$1,611.00**
3.1	General Costs: Other	$0.00	$0.00	$0.00	**$0.00**
				Subtotal:	$288,486
			Contingency:	5.0%	$14,424
			Escalation Reserve:	5.0%	$14,424
			Engineering Procurement & Construction MGMT:	25.0%	$72,122
				Total:	$389,456

Notes

[1] Other inclues misc. material and equipment necessary for installation, communication, insurances, permits, bonding. Prior to final pricing and subcontract execution these values will be required to be itemized by the bidder.

ECM 3: Lab HVAC Systems

The following is a General Scope of Work for the University of Rochester Energy Conservation Master Plan. The intent of this document is to provide a general outline of the project scope of work for developing firm project costs. Project Design Documents, including construction and permit sets, will be developed following approval of the proposed project by University of Rochester.

Project Job Site(s)

No.	Building Name
1	KMRB

***** NOT FOR CONSTRUCTION *****

The scope of this project consists of providing all labor and material, along with providing all equipment necessary to complete and make fully operational the systems defined in this specification. The project is intended to follow University of Rochester design guidelines. All products, procedures, and completed systems are intended to comply with ASHRAE standards. While this document does not include specification details, the final project manual will be produced that includes specifications that are aligned with University of Rochester design standards.

It is our expectation that the subcontractor submitting a quotation is familiar with the University of Rochester design standards and has accounted for the impact these standards have on pricing, including but not limited, material, labor and general conditions.

1.0 General

A. **Documents |** At the start of construction, submit manufacturer's product data for materials (including but not limited to: sensors, actuators, controllers, cabinets, wire & conduit), P&ID drawings, coordination & layout drawings, and other commonly required submittals per University of Rochester standards.

B. **Documents |** Maintaining of all Project Record Documents as detailed in this Contract Document.

C. **Documents |** Document and Submit a summary of existing conditions including digital photos of the job site prior to the start of work.
   a. Examine sizes and conditions of existing equipment.

D. **Material Handling |** Label all control wiring.

E. **Material Handling |** Delivery of the material and equipment to job site.

F. **Material Handling |** A location within the facility will be identified for the subcontractor to store all material and equipment. The subcontract is required to keep this area organized and accessible as well as free of any loose material or garbage.

G. **Material Handling |** Provide moving, storage and protection for all University of Rochester's existing equipment, furniture and cabinetry on job site to perform contract work. Protect floor in areas used to store furniture.

H. **Installation Requirements |** Provide all associated equipment, and all particulars/specialties needed to make the provided equipment fully functional and perform its intended use.

I. **Installation Requirements |** Install all equipment per manufacturer's instructions

J. **Installation Requirements |** Paint and finish as needed to match preconstruction conditions.

K. **Installation Requirements |** Subcontractor is responsible for all cutting and patching associated with the work.

L. **Permits |** Subcontractor with Contractor approval will submit application for electric service permits if necessary. The Subcontractor will pay the cost of the permits.

M. **Permits |** Building permit fees will be paid by Wendel.

N. **Inspections & Codes |** All electrical work must be performed by a licensed electrical contractor and include a valid underwriters certification at the completion of the project as part of the close out O&M package.

O. **Inspections & Codes |** Provide all electrical connections required in accordance with all Federal, State, and Local Codes.

P. **Inspections & Codes |** Field verify all voltages prior to ordering any equipment.

Q. **Installation Requirements |** Removal of all waste generated by Work per EPA requirements, University of Rochester standards, and local authority regulations.

R. **Inspections & Codes |** Test, adjust, and balance all equipment and materials provided, or modified under this Subcontract.

S. **Inspections & Codes |** Provide all mechanical connections required in accordance with all Federal, State, and Local Codes.

T. **Coordination |** Coordination of equipment and utility service shutdowns with 2-weeks notice to the facility and Wendel. All work requiring a shutdown will be completed during normal business hours.

U. **Closeout |** Provide operator training and operation manuals

V. **Closeout |** Starting Systems
1. Coordinate schedule for start-up of various equipment and systems.
2. Notify Wendel and facility seven days prior to start-up of each item.
3. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
4. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
5. Verify wiring and support components for equipment are complete and tested. Execute start-up under supervision of responsible Contractors' personnel in accordance with manufacturers' instructions.
6. Provide manufacturer authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

W. **Commissioning |** Subcontractor shall assign representatives with expertise and authority to act on its behalf to participate in and perform commissioning process activities under the direction of Wendel. Wendel will develop commissioning procedures the subcontractor will be responsible to execute the procedure under Wendel's supervision.

X. **Trending |** All points connected to the building management system shall be trended and have data stored for three years at a minimum of one (1) hour intervals. All trends shall be remotely accessible by Wendel or another authorized and University of Rochester approved third party.

Y. **Trending |** Trended data will be viewable in tabular and graphic form in conjunction with current BMS formatting standards at University of Rochester. Subcontractor to integrate into existing BMS. This data will also have the ability to be exported into a csv. Formatted file.

Z. **OVERALL SYSTEM |** The new control points added shall fully integrate into the existing building management system. The required integration shall include the creation of custom graphics and the compilation and display of all devices and objects on the existing Schneider Electric EcoStruxure interface. All graphic displays will reside on the existing Schneider Electric EcoStruxure interface and be modified accordingly. In addition, the system shall perform the said integration through the use of BACnet/IP communications).

AA. **Key Definition |** Provide - furnish and install

BB. **Key Definition |** Wendel - maybe referred to as, Wendel, Contractor, or Design/Builder

1.1 Lab Airflow Optimization - OCCUPIED

A. For Laboratory spaces as outlined in the table below:

Room	Fume Hood Qty	GEX Qty	Supply Qty
1-9905 / 1-9911 / 1-9915	1	7	7
1-9872 / 1-9878 / 1-9892	2	10	10
1-9858 / 1-9852 / 1-9538	1	11	11
1-9855	1	1	1
1-9804 / 1-9812	3	6	7
1-9807 / 1-9809	1	1	2
1-9816 / 1-9828	0	8	8
1-9823	0	4	4
1-9839	0	4	4
1-9811 / 1-9813	0	1	1
1-9825	0	0	1
1-9825A	0	1	1
1-9826	0	1	1
1-9827 / 1-9829	0	1	1
1-9837	0	1	1
1-9847	0	1	1
1-9845	0	1	1
1-9803 / 1-9805	0	1	1
1-9857	0	1	1
1-9859	0	1	1
1-9861 / 1-9863	0	1	1
2-9905 / 2-9915	1	7	7
2-9872 / 2-9878 / 2-9892	2	10	10
2-9861 / 2-9863	0	1	1
2-9859	0	1	1
2-9857	0	1	1
2-9855 A & B	0	1	1
2-9841 & 2-9843	0	1	1
2-9845	0	1	1
2-9847	0	1	1
2-9837	0	1	1
2-9839	0	1	1
2-9827 / 2-9829	0	1	1
2-9825	0	1	1

Room	Fume Hood Qty	GEX Qty	Supply Qty
2-9626	0	1	1
2-9803	0	1	0
2-9805	0	0	1
2-9807	0	1	1
2-9809	0	1	1
2-9813	0	1	1
2-9819	0	1	1
2-9838 / 2-9852 / 2-9858	2	10	11
2-9804 / 2-9812 / 2-9616 / 2-9828	2	14	14
2-9823	1	2	2
3-9905 / 3-9915	1	8	6
3-9872 / 3-9878 / 3-9892	2	11	10
3-9861 & 3-9863	0	1	1
3-9859	0	1	1
3-9626	0	1	1
3-9803 & 3-9805	0	1	1
3-9807	0	1	1
3-9809	0	1	1
3-9813	0	1	1
3-9825	0	1	1
3-9827 & 3-9829	0	1	1
3-9837	0	1	1
3-9839	0	1	1
3-9843	0	1	1
3-9845	0	1	1
3-9847	0	1	1
3-9848	0	0	1
3-9855	0	1	1
3-9857	0	1	1
3-9838 / 3-9852 / 3-9858	1	11	11
3-9816 / 3-9828	2	7	7
3-9804 / 3-9812	0	8	7
G9383C	0	0	1
G9852 / G9858 / G9838	5	10	11

Room	Fume Hood Qty	GEX Qty	Supply Qty
G9816 / G9828	3	6	6
G9804 / G9812	1	7	7
G9805	0	1	1
G9820	0	1	1
G9823	0	1	1
G9825A	0	1	1
G9821	0	1	1
G9821A	0	1	1
G9821B	0	1	1
G9821C	0	1	1
G9826A	0	1	1
G9827 & G9829	0	1	1
G9837	0	1	1
G9839	0	1	1
G9807 / G9809	0	2	2
G9813	1	1	1
G9843	1	1	1

1. **General Exhaust Air Flow Control |** Rebalance each lab general exhaust damper to maintain a lab total exhaust equal to 8 air changes per hour in each lab. In labs where the total fume hood exhaust is greater than or equal to 8 air changes per hour, the lab general exhaust airflow will be set to zero cfm.
2. **Supply Air Flow Control |** Recalibrate supply air volume damper so the lab maintains a negative airflow differential relative to total lab exhaust. (Airflow differential to be determined in Airflow Testing & Balancing, intent to match existing differential)
3. **Air Flow Testing & Balancing |** Provide Pre & Post Retrofit air flow testing and balancing, by a certified TAB specialist, for each control box. Provide TAB report to Wendel prior to substantial completion. Include final TAB report in close out document package.

1.2 Lab Airflow Optimization – UNOCCUPIED

A. For Laboratory spaces as outlined in the table in 1.1:

1. **General Exhaust Air Flow Control |** Rebalance each lab general exhaust damper to maintain a lab total exhaust equal to 4 air changes per hour during UNOCCUPIED periods in each lab. In labs where the total fume hood exhaust is greater than or equal to 4 air changes per hour, the lab general exhaust airflow will be set to zero cfm.
2. **Supply Air Flow Control |** Recalibrate supply air volume damper so the lab maintains a negative airflow differential relative to total lab exhaust. (Airflow differential to be determined in Airflow Testing & Balancing, intent to match existing differential)
3. **Air Flow Testing & Balancing |** Provide Pre & Post Retrofit air flow testing and balancing, by a certified TAB specialist, for each control box. Provide TAB report to Wendel prior to substantial completion. Include final TAB report in close out document package.

DIRECT MATERIAL & LABOR | COST ESTIMATE

Project :	University of Rochester | Del Monte	Estimated by:	GHB
Project # :	402805	Checked by:	JGD
Measure :	ECM 3 | Lab HVAC Systems	Approved by:	JGD
Date :	04/02/21	Vendor Quotes:	No
		Subcontractor Pricing:	No

Item No.	Description	Material	Labor	Other[1]	Subtotal Cost
1	1.1 Lab HVAC Systems				**$0.00**
2	A. Occupied Airflow ACH Reduction	$0.00	$112,500.00	$0.00	**$112,500.00**
3	B. Unoccupied Airflow ACH Reduction	$0.00	$56,250.00	$0.00	**$56,250.00**
3.0	General Costs: Bonds	$0.00	$0.00	$1,611.00	**$1,611.00**
3.1	General Costs: Other	$0.00	$0.00	$0.00	**$0.00**
				Subtotal:	$170,361
			Contingency:	5.0%	$8,518
			Escalation Reserve:	5.0%	$8,518
			Engineering Procurement & Construction MGMT:	25.0%	$42,590
				Total:	$229,987

Notes

[1] Other inclues misc. material and equipment necessary for installation, communication, insurances, permits, bonding. Prior to final pricing and subcontract execution these values will be required to be itemized by the bidder.

ECM 3: Lab HVAC Systems

The following is a General Scope of Work for the University of Rochester Energy Conservation Master Plan. The intent of this document is to provide a general outline of the project scope of work for developing firm project costs. Project Design Documents, including construction and permit sets, will be developed following approval of the proposed project by University of Rochester.

Project Job Site(s)

No.	Building Name
1	Del Monte

***** NOT FOR CONSTRUCTION *****

The scope of this project consists of providing all labor and material, along with providing all equipment necessary to complete and make fully operational the systems defined in this specification. The project is intended to follow University of Rochester design guidelines. All products, procedures, and completed systems are intended to comply with ASHRAE standards. While this document does not include specification details, the final project manual will be produced that includes specifications that are aligned with University of Rochester design standards.

It is our expectation that the subcontractor submitting a quotation is familiar with the University of Rochester design standards and has accounted for the impact these standards have on pricing, including but not limited, material, labor and general conditions.

1.0 General

A. **Documents |** At the start of construction, submit manufacturer's product data for materials (including but not limited to: sensors, actuators, controllers, cabinets, wire & conduit), P&ID drawings, coordination & layout drawings, and other commonly required submittals per University of Rochester standards.

B. **Documents |** Maintaining of all Project Record Documents as detailed in this Contract Document.

C. **Documents |** Document and Submit a summary of existing conditions including digital photos of the job site prior to the start of work.

   a. Examine sizes and conditions of existing equipment.

D. **Material Handling |** Label all control wiring.

E. **Material Handling |** Delivery of the material and equipment to job site.

F. **Material Handling |** A location within the facility will be identified for the subcontractor to store all material and equipment. The subcontract is required to keep this area organized and accessible as well as free of any loose material or garbage.

G. **Material Handling |** Provide moving, storage and protection for all University of Rochester's existing equipment, furniture and cabinetry on job site to perform contract work. Protect floor in areas used to store furniture.

H. **Installation Requirements |** Provide all associated equipment, and all particulars/specialties needed to make the provided equipment fully functional and perform its intended use.

I. **Installation Requirements |** Install all equipment per manufacturer's instructions

J. **Installation Requirements |** Paint and finish as needed to match preconstruction conditions.

K. **Installation Requirements |** Subcontractor is responsible for all cutting and patching associated with the work.

L. **Permits |** Subcontractor with Contractor approval will submit application for electric service permits if necessary. The Subcontractor will pay the cost of the permits.

M. **Permits |** Building permit fees will be paid by Wendel.

N. **Inspections & Codes |** All electrical work must be performed by a licensed electrical contractor and include a valid underwriters certification at the completion of the project as part of the close out O&M package.

O. **Inspections & Codes |** Provide all electrical connections required in accordance with all Federal, State, and Local Codes.

P. **Inspections & Codes |** Field verify all voltages prior to ordering any equipment.

Q. **Installation Requirements |** Removal of all waste generated by Work per EPA requirements, University of Rochester standards, and local authority regulations.

R. **Inspections & Codes |** Test, adjust, and balance all equipment and materials provided, or modified under this Subcontract.

S. **Inspections & Codes |** Provide all mechanical connections required in accordance with all Federal, State, and Local Codes.

T. **Coordination |** Coordination of equipment and utility service shutdowns with 2-weeks notice to the facility and Wendel. All work requiring a shutdown will be completed during normal business hours.

U. **Closeout |** Provide operator training and operation manuals

V. **Closeout |** Starting Systems

1. Coordinate schedule for start-up of various equipment and systems.
2. Notify Wendel and facility seven days prior to start-up of each item.
3. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
4. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
5. Verify wiring and support components for equipment are complete and tested. Execute start-up under supervision of responsible Contractors' personnel in accordance with manufacturers' instructions.
6. Provide manufacturer authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

W. **Commissioning |** Subcontractor shall assign representatives with expertise and authority to act on its behalf to participate in and perform commissioning process activities under the direction of Wendel. Wendel will develop commissioning procedures the subcontractor will be responsible to execute the procedure under Wendel's supervision.

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Y. **Trending |** Trended data will be viewable in tabular and graphic form in conjunction with current BMS formatting standards at University of Rochester. Subcontractor to integrate into existing BMS. This data will also have the ability to be exported into a csv. Formatted file.

Z. **OVERALL SYSTEM |** The new control points added shall fully integrate into the existing building management system. The required integration shall include the creation of custom graphics and the compilation and display of all devices and objects on the existing Schneider Electric EcoStruxure interface. All graphic displays will reside on the existing Schneider Electric EcoStruxure interface and be modified accordingly. In addition, the system shall perform the said integration through the use of BACnet/IP communications).

AA. **Key Definition |** Provide - furnish and install

BB. **Key Definition |** Wendel - maybe referred to as, Wendel, Contractor, or Design/Builder

1.1 Lab Airflow Optimization - OCCUPIED

A. For Laboratory spaces as outlined in the table below:

Room	Fume Hood Qty	GEX Qty	Supply Qty
1-11006	0	1	1
1-11001	4	5	5
1-11002	0	1	1
1-11301 (S)	2	3	3
1-11301 (N)	2	3	3
1-11311	2	6	7
1-11310	0	1	1
1-11306	0	1	1
1-11304	0	1	1
1-11353	0	1	1
1-11308	0	1	1
1-11320	0	1	1
1-11316	0	1	1
1-11314	0	1	1
1-11312	1	0	1
1-11318	0	2	2
1-11322	0	1	1
2-11001	1	6	6
2-11002	0	1	1
2-11301 (S)	1	3	3
2-11301 (N)	0	3	3
2-11311	1	5	5
2-11310	0	1	1
2-11306 (S)	0	1	1
2-11306 (N)	0	1	1
2-11304	0	1	1
2-11302	1	0	1
2-11350	0	1	0
2-11322	0	2	2
2-11318	0	1	1
2-11314	0	1	1
2-11312	1	0	1
2-11320	0	1	1

Room	Fume Hood Qty	GEX Qty	Supply Qty
3-11006	0	1	1
3-11001	4	4	4
3-11002	0	2	1
3-11301	1	4	3
3-11311	6	7	6
3-11310	0	1	1
3-11353	0	1	1
3-11308	1	0	1
3-11306	0	1	1
3-11304	1	0	1
3-11302	0	2	1
3-11320	0	2	2
3-11318	0	1	1
3-11316	0	1	1
3-11314	0	1	1
3-11312	1	1	1
3-11322	1	0	1

1. **General Exhaust Air Flow Control |** Rebalance each lab general exhaust damper to maintain a lab total exhaust equal to 8 air changes per hour in each lab. In labs where the total fume hood exhaust is greater than or equal to 8 air changes per hour, the lab general exhaust airflow will be set to zero cfm.
2. **Supply Air Flow Control |** Recalibrate supply air volume damper so the lab maintains a negative airflow differential relative to total lab exhaust. (Airflow differential to be determined in Airflow Testing & Balancing, intent to match existing differential)
3. **Air Flow Testing & Balancing |** Provide Pre & Post Retrofit air flow testing and balancing, by a certified TAB specialist, for each control box. Provide TAB report to Wendel prior to substantial completion. Include final TAB report in close out document package.

1.2 Lab Airflow Optimization – UNOCCUPIED

A. For Laboratory spaces as outlined in the table in 1.1:

1. **General Exhaust Air Flow Control |** Rebalance each lab general exhaust damper to maintain a lab total exhaust equal to 4 air changes per hour during UNOCCUPIED periods in each lab. In labs where the total fume hood exhaust is greater than or equal to 4 air changes per hour, the lab general exhaust airflow will be set to zero cfm.
2. **Supply Air Flow Control |** Recalibrate supply air volume damper so the lab maintains a negative airflow differential relative to total lab exhaust. (Airflow differential to be determined in Airflow Testing & Balancing, intent to match existing differential)
3. **Air Flow Testing & Balancing |** Provide Pre & Post Retrofit air flow testing and balancing, by a certified TAB specialist, for each control box. Provide TAB report to Wendel prior to substantial completion. Include final TAB report in close out document package.

Technical Appendix 3

Heat Recovery Heat Pump ECM

Calculations (Savings Summary & Calculation)

- Kornberg
- Del Monte
- BMEO

Scope of Work (Cost Estimate & Scope of Work)

- Kornberg
- Del Monte
- BMEO

Technical Appendix 3

Heat Recovery Heat Pump ECM

Calculations (Savings Summary & Calculation)

- Kornberg
- Del Monte
- BMEO

UNIVERSITY OF ROCHESTER

Heat Recovery Heat Pump

KMRB

Building Utility Impact		
Building Level Energy Savings		
Electrical Energy Savings	(2,627)	mmBtu/Year
Chilled Water Savings	5,662	mmBtu/Year
Steam Savings	8,173	mmBtu/Year
Total Energy Savings	**11,207**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	(770,069)	kWh/Year
Chilled Water Savings	471,812	Ton-Hour/Year
Steam Savings	8,173	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	-$3,150	Per Year

ECM - 1 - HEAT RECOVERY CHILLER

Project Name:	University of Rochester
Building:	Kornberg Medical Research Building
Date:	4/1/2021
EEM	Heat Recovery Chiller
Calculated By:	RGK
Reviewed By:	SDM

Summary of Existing Systems Used for Calculation

Existing System Summary		
Adjusted Baseline CHW Use	28,270	mmBTU
Adjusted Baseline HW Use	51,283	mmBTU

Proposed System Summary		
HRC Cooling	5,665	mmBTU
Supplemental Cooling	22,609	mmBTU
HRC Heating	8,173	mmBTU
Supplemental Heating	43,111	mmBTU
HRC Pump Usage	-35,428	kWh
HRC Electrical Usage	-734,641	kWh

Summary of EEM Savings

Heat Recovery Chiller Savings Summary		
District CHW Savings	5,662	mmBTU
Electrical Savings	-770,069	kWh
Heating Savings	8,173	mmBTU

Total Savings:	11,207	mmBTU
Total Current Usage:	106,771	
% Savings:	10%	

Project Name:	University of Rochester
Building:	Kornberg Medical Research Building
Date:	4/1/2021
EEM:	Heat Recovery Chiller
Scenerio:	HRC
Calculated By:	RGK
Reviewed By:	SDM

System Enable Setpoints

CHW Enable Temp	0	deg F	
HW Enable Temp	0	deg F	
Month Start	January	**1**	
Month End	December	**12**	
Interactive Savings	10%	%	

LOADING CHECK	100.00%
Load Safety Factor	100.00%

Baseline Load Simulation

OAT	HWST (°F)			
-10	180			
0	180			
10	172			
20	164			
30	156			
40	148			
50	140			
60	140			
70	140			
80	140			
90	140			
	0.0001632	-0.012587	-0.490909	177.8555
	X=	80.00	Y=	141.57
	#VALUE	#VALUE	#VALUE	#VALUE
	X=	10.00	Y=	#VALUE

Existing Energy Summary

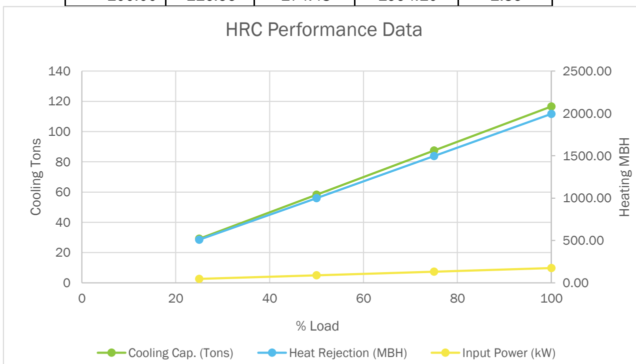
Adjusted Baseline CHW Use	28,270	mmBTU
Adjusted Baseline HW Use	51,283	mmBTU

Proposed Energy Summary

HRC Cooling	5,665	mmBTU
Supplemental Cooling	22,609	mmBTU
HRC Heating	8,173	mmBTU
Supplemental Heating	43,111	mmBTU
HRC Pump Usage	-35,428	kWh
HRC Electrical Usage	-734,641	kWh

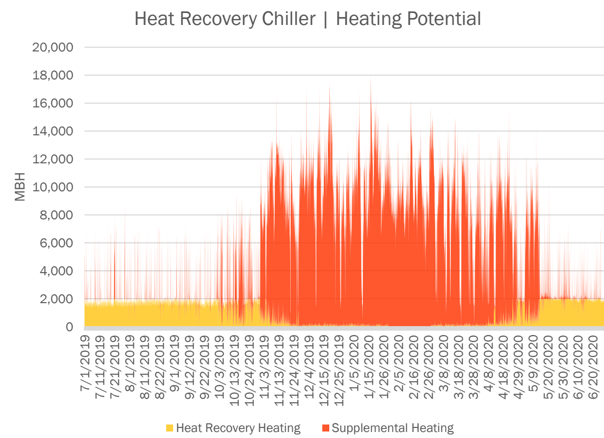
Heat Recovery Chiller Performance Data

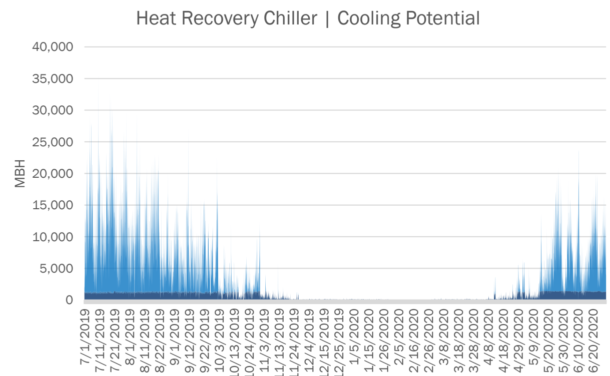
% Load	Cooling Cap. (Tons)	Input Power (kW)	Heat Rejection (MBH)	Base COP
25.00	29.14	46.77	509.40	2.19
50.00	58.26	87.87	999.00	2.33
75.00	87.42	130.86	1495.50	2.35
100.00	116.55	174.48	1994.10	2.35

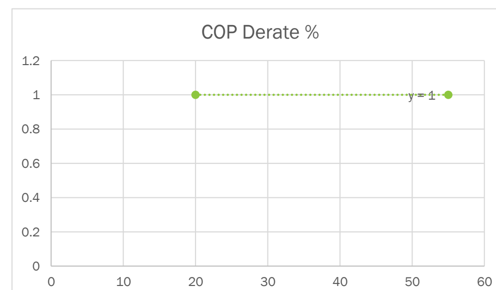


Heat Recovery Chiller Pump Information

Pump Label	CHW Pumps	HW Pumps
Motor HP	60	20
Motor Eff	0.91	0.91
Pump GPM	280	199
Pump Eff	85.0%	85.0%
BHP	6.23	4.44
Ft. Hd.	75	75
QTY	1	1
kW	5.1	3.6
Control Type	CV	CV
Affintiy Law Adj.	1	1







wendel

Project Name: University of Rochester
Building: Kornberg Medical Research Building
Date: 4/1/2021
EEM: Heat Recovery Chiller
Scenerio: HRC
Calculated By: RGK
Reviewed By: SDM

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
MAX	93.0	43.7	20032.1	2003.2	18028.9	100.0	1994.1	18028.9	40.1	4.0	36117.2	116.6	1398.6	34922.0	174.5	5.1	3.6	0.0
MIN	2.0	1.3	87.6	8.8	78.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	437,579	164,551	56,981,472	5,698,147	51,283,324	404,802	8,172,712	43,110,720	31,412	3,141	28,270,446	472,119	5,665,426	22,608,697	734,641	20,683	14,745	0
Time Stamp	**Outside dry-bulb temp (F)**	**Specific Enthalpy (btu/lbm)**	**Baseline Steam Usage (MBH)**	**ECM Steam Savings (MBH)**	**Adjusted Baseline HW Load (MBH)**	**% HRC Heating Load above OAT Enable Temp**	**HRC Heating (MBH)**	**Supp Heating from Hxers (MBH)**	**Baseline CHW (mmBTU)**	**ECM CHW Savings (mmBtu)**	**Adjusted Baseline CHW Load (MBH)**	**HRC Cooling Load (tons)**	**HRC Cooling (MBH)**	**Supp Cooling from CHW plant (MBH)**	**HRC Electrical Load (kW)**	**HRC Chilled Water Pumps (kW)**	**HRC Hot Water Pumps (kW)**	
7/1/19 0:00	59.0	23.9	1,750.482	175.048	1575.43	79.00	1,575.4	0.1	1.76	0.18	1,587.28	92.1	1,105.1	482.2	137.8	4.0	2.9	
7/1/19 1:00	59.0	23.9	2,125.211	212.521	1912.69	95.92	1,912.7	0.0	2.41	0.24	2,166.69	111.8	1,341.6	825.1	167.4	4.9	3.5	
7/1/19 2:00	58.0	23.8	1,894.265	189.426	1704.84	85.49	1,704.8	0.0	2.13	0.21	1,912.73	99.7	1,195.9	716.9	149.2	4.4	3.1	
7/1/19 3:00	57.0	23.2	1,684.174	168.417	1515.76	76.01	1,515.7	0.1	4.17	0.42	3,754.90	88.6	1,063.2	2,691.7	132.6	3.9	2.8	
7/1/19 4:00	57.0	23.2	1,593.105	159.311	1433.79	71.90	1,433.8	0.0	12.13	1.21	10,914.06	83.8	1,005.7	9,908.4	125.5	3.7	2.6	
7/1/19 5:00	55.0	22.3	6,782.167	678.217	6103.95	100.00	1,994.1	4,109.9	3.54	0.35	3,190.23	116.6	1,398.6	1,791.6	174.5	5.1	3.6	
7/1/19 6:00	58.0	24.1	1,986.316	198.632	1787.68	89.65	1,787.7	0.0	1.90	0.19	1,714.47	104.5	1,254.0	460.5	156.4	4.6	3.3	
7/1/19 7:00	62.0	25.4	5,700.677	570.068	5130.61	100.00	1,994.1	3,136.5	4.53	0.45	4,074.89	116.6	1,398.6	2,676.3	174.5	5.1	3.6	
7/1/19 8:00	68.0	27.3	5,547.855	554.786	4993.07	100.00	1,994.1	2,999.0	3.69	0.37	3,324.66	116.6	1,398.6	1,926.1	174.5	5.1	3.6	
7/1/19 9:00	71.0	28.0	2,036.663	203.666	1833.00	91.92	1,833.0	0.0	15.88	1.59	14,292.77	107.1	1,285.7	13,007.0	160.4	4.7	3.3	
7/1/19 10:00	76.0	28.2	1,991.974	199.197	1792.78	89.90	1,792.8	0.0	8.73	0.87	7,860.00	104.8	1,257.5	6,602.5	156.9	4.6	3.3	
7/1/19 11:00	76.0	28.5	2,964.491	296.449	2668.04	100.00	1,994.1	673.9	10.30	1.03	9,266.25	116.6	1,398.6	7,867.6	174.5	5.1	3.6	
7/1/19 12:00	77.0	28.8	1,772.569	177.257	1595.31	80.00	1,595.2	0.1	10.00	1.00	8,999.17	93.3	1,119.0	7,880.1	139.6	4.1	2.9	
7/1/19 13:00	79.0	29.6	1,870.979	187.098	1683.88	84.44	1,683.8	0.0	12.76	1.28	11,481.69	98.4	1,181.2	10,300.5	147.3	4.3	3.1	
7/1/19 14:00	79.0	29.3	1,856.459	185.646	1670.81	83.79	1,670.8	0.0	6.15	0.62	5,535.76	97.7	1,172.0	4,363.8	146.2	4.3	3.1	
7/1/19 15:00	79.0	30.5	1,783.501	178.350	1605.15	80.50	1,605.1	0.1	14.66	1.47	13,193.49	93.8	1,125.9	12,067.6	140.4	4.1	2.9	
7/1/19 16:00	79.0	30.1	1,855.031	185.503	1669.53	83.72	1,669.5	0.0	13.40	1.34	12,057.27	97.6	1,171.1	10,886.2	146.1	4.3	3.0	
7/1/19 17:00	79.0	30.1	1,772.899	177.290	1595.61	80.02	1,595.5	0.1	14.30	1.43	12,868.84	93.3	1,119.2	11,749.6	139.6	4.1	2.9	
7/1/19 18:00	79.0	30.5	1,992.380	199.238	1793.14	89.92	1,793.2	0.0	12.32	1.23	11,089.50	104.8	1,257.8	9,831.7	156.9	4.6	3.3	
7/1/19 19:00	78.0	27.1	1,866.298	186.630	1679.67	84.23	1,679.6	0.0	16.83	1.68	15,148.56	98.2	1,178.2	13,970.4	147.0	4.3	3.1	
7/1/19 20:00	75.0	26.2	1,794.113	179.411	1614.70	80.97	1,614.6	0.1	6.59	0.66	5,932.77	94.4	1,132.6	4,800.1	141.3	4.1	2.9	
7/1/19 21:00	71.0	25.5	1,910.979	191.098	1719.88	86.25	1,719.9	0.0	11.79	1.18	10,606.81	100.5	1,206.4	9,400.4	150.5	4.4	3.1	
7/1/19 22:00	67.0	25.9	1,660.738	166.074	1494.66	74.95	1,494.6	0.1	8.91	0.89	8,016.44	87.4	1,048.4	6,968.0	130.8	3.8	2.7	
7/1/19 23:00	67.0	25.6	1,597.569	159.757	1437.81	72.10	1,437.8	0.0	1.99	0.20	1,789.16	84.0	1,008.5	780.7	125.8	3.7	2.6	
7/2/19 0:00	66.0	25.7	3,190.687	319.069	2871.62	100.00	1,994.1	877.5	6.65	0.66	5,984.18	116.6	1,398.6	4,585.6	174.5	5.1	3.6	
7/2/19 1:00	67.0	26.4	1,648.951	164.895	1484.06	74.42	1,484.0	0.1	3.93	0.39	3,538.27	86.7	1,041.0	2,497.3	129.9	3.8	2.7	
7/2/19 2:00	67.0	27.2	1,693.318	169.332	1523.99	76.42	1,523.9	0.1	9.25	0.92	8,323.12	89.1	1,069.0	7,254.1	133.3	3.9	2.8	
7/2/19 3:00	68.0	27.7	1,622.109	162.211	1459.90	73.21	1,459.8	0.1	6.45	0.65	5,806.48	85.3	1,024.0	4,782.5	127.7	3.7	2.7	
7/2/19 4:00	68.0	28.2	1,547.573	154.757	1392.82	69.85	1,392.8	0.0	6.51	0.65	5,861.21	81.4	976.9	4,884.3	121.9	3.6	2.5	
7/2/19 5:00	68.0	28.2	1,805.784	180.578	1625.21	81.50	1,625.1	0.1	4.96	0.50	4,460.03	95.0	1,140.0	3,320.0	142.2	4.2	3.0	
7/2/19 6:00	69.0	28.9	1,762.671	176.267	1586.40	79.55	1,586.3	0.1	4.11	0.41	3,702.45	92.7	1,112.8	2,589.7	138.8	4.1	2.9	
7/2/19 7:00	68.0	30.1	3,598.443	359.844	3238.60	100.00	1,994.1	1,244.5	4.62	0.46	4,156.16	116.6	1,398.6	2,757.6	174.5	5.1	3.6	
7/2/19 8:00	72.0	31.6	7,609.598	760.960	6848.64	100.00	1,994.1	4,854.5	13.80	1.38	12,417.51	116.6	1,398.6	11,018.9	174.5	5.1	3.6	
7/2/19 9:00	74.0	32.0	3,761.762	376.176	3385.59	100.00	1,994.1	1,391.5	9.69	0.97	8,717.65	116.6	1,398.6	7,319.1	174.5	5.1	3.6	

UNIVERSITY OF ROCHESTER

Heat Recovery Heat Pump

Del Monte

Building Utility Impact		
Building Level Energy Savings		
Electrical Energy Savings	(1,904)	mmBtu/Year
Chilled Water Savings	4,062	mmBtu/Year
Steam Savings	5,876	mmBtu/Year
Total Energy Savings	**8,034**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	(557,929)	kWh/Year
Chilled Water Savings	338,507	Ton-Hour/Year
Steam Savings	5,876	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	-$2,520	Per Year

ECM - 1 - HEAT RECOVERY CHILLER

Project Name:	University of Rochester
Building:	Del Monte
Date:	10/12/2020
EEM	Heat Recovery Chiller
Calculated By:	RGK
Reviewed By:	SDM

Summary of Existing Systems Used for Calculation

Existing System Summary		
Adjusted Baseline CHW Use	15,075	mmBTU
Adjusted Baseline HW Use	27,980	mmBTU

Proposed System Summary		
HRC Cooling	4,063	mmBTU
Supplemental Cooling	11,013	mmBTU
HRC Heating	5,877	mmBTU
Supplemental Heating	22,104	mmBTU
HRC Pump Usage	-25,400	kWh
HRC Electrical Usage	-532,529	kWh

Summary of EEM Savings

Heat Recovery Chiller Savings Summary		
District CHW Savings	4,062	mmBTU
Electrical Savings	-557,929	kWh
Heating Savings	5,876	mmBTU
Total Savings:	8,034	mmBTU
Total Current Usage:	59,280	
% Savings:	14%	

wendel

Project Name: University of Rochester
Building: Del Monte
Date: 10/12/2020
EEM: Heat Recovery Chiller
Scenerio: HRC
Calculated By: RGK
Reviewed By: SDM

Existing Energy Summary

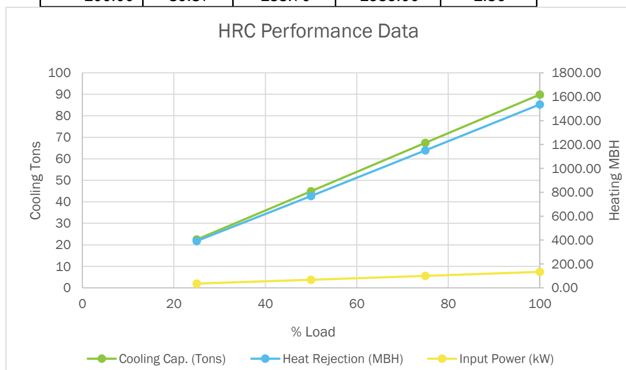
Adjusted Baseline CHW Use	15,075	mmBTU
Adjusted Baseline HW Use	27,980	mmBTU

Proposed Energy Summary

HRC Cooling	4,063	mmBTU
Supplemental Cooling	11,013	mmBTU
HRC Heating	5,877	mmBTU
Supplemental Heating	22,104	mmBTU
HRC Pump Usage	-25,400	kWh
HRC Electrical Usage	-532,529	kWh

Heat Recovery Chiller Performance Data

% Load	Cooling Cap. (Tons)	Input Power (kW)	Heat Rejection (MBH)	Base COP
25.00	22.47	35.85	392.00	2.20
50.00	44.94	67.32	769.00	2.35
75.00	67.41	100.30	1151.00	2.36
100.00	89.87	133.70	1535.00	2.36



Heat Recovery Chiller Pump Information

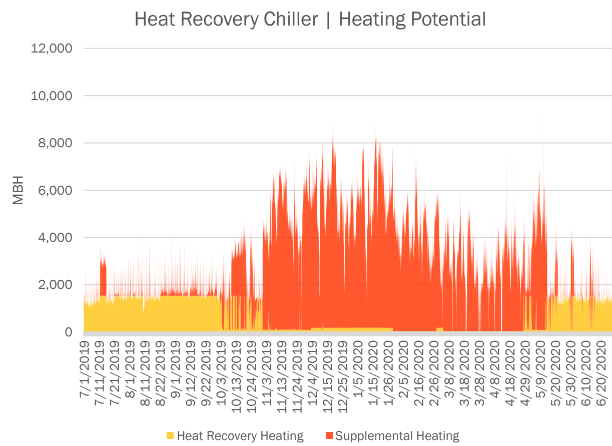
Pump Label	CHW Pumps	HW Pumps
Motor HP	60	15
Motor Eff	0.91	0.91
Pump GPM	216	154
Pump Eff	85.0%	85.0%
BHP	4.81	3.42
Ft. Hd.	75	75
QTY	1	1
kW	3.9	2.8
Control Type	CV	CV
Affintiy Law Adj.	1	1

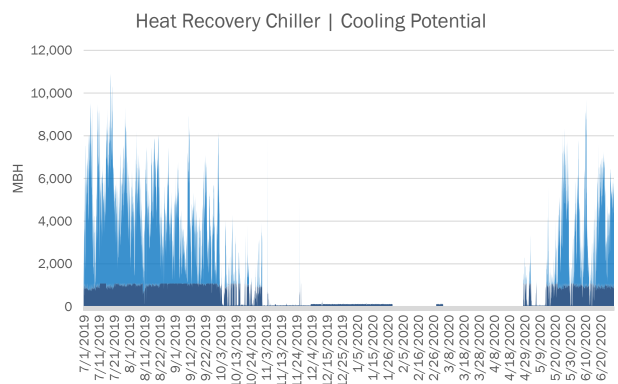
System Enable Setpoints

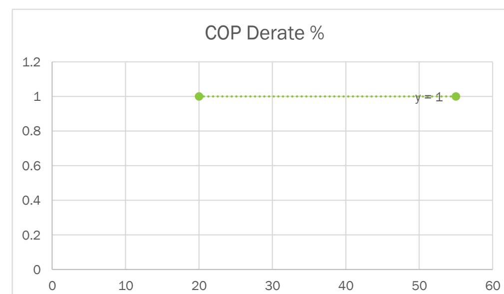
CHW Enable Temp	0	deg F
HW Enable Temp	0	deg F
Month Start	January	**1**
Month End	December	**12**
Interactive Savings	10%	%
LOADING CHECK	100.00%	
Load Safety Factor	100.00%	

Baseline Load Simulation

OAT	HWST (°F)			
-10	140			
0	140			
10	140			
20	140			
30	140			
40	140			
50	140			
60	140			
70	140			
80	140			
90	140			
	0	0	0	140
	X=	80.00	Y=	140.00
	#VALUE	#VALUE	#VALUE	#VALUE
	X=	10.00	Y=	#VALUE







wendel

Project Name: University of Rochester
Building: Del Monte
Date: 10/12/2020
EEM: Heat Recovery Chiller
Scenerio: HRC
Calculated By: RGK
Reviewed By: SDM

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
MAX	93.0	43.7	11030.7	1103.1	9927.6	100.0	1535.0	9850.1	12.2	1.2	10953.2	89.9	1078.4	10072.4	133.7	3.9	2.8	0.0
MIN	2.0	1.3	6.8	0.7	6.1	0.3	27.6	0.0	0.0	0.0	3.4	0.3	3.5	0.0	7.3	0.0	0.0	0.0
SUM	437,579	164,551	31,088,454	3,108,845	27,979,609	376,652	5,877,015	22,103,701	16,750	1,675	15,075,387	338,546	4,062,546	11,013,306	532,529	14,839	10,561	0
Time Stamp	**Outside dry-bulb temp (F)**	**Specific Enthalpy (btu/lbm)**	**Baseline Steam Usage (MBH)**	**ECM Steam Savings (MBH)**	**Adjusted Baseline HW Load (MBH)**	**% HRC Heating Load above OAT Enable Temp**	**HRC Heating (MBH)**	**Supp Heating from Hxers (MBH)**	**Baseline CHW (mmBTU)**	**ECM CHW Savings (mmBtu)**	**Adjusted Baseline CHW Load (MBH)**	**HRC Cooling Load (tons)**	**HRC Cooling (MBH)**	**Supp Cooling from CHW plant (MBH)**	**HRC Electrical Load (kW)**	**HRC Chilled Water Pumps (kW)**	**HRC Hot Water Pumps (kW)**	
7/1/19 0:00	59.0	23.9	2,316.7	231.665	2,085.0	100.0	1,535.0	550.0	3.6	0.4	3,284.7	89.9	1,078.4	2,206.3	133.7	3.9	2.8	
7/1/19 1:00	59.0	23.9	1,396.3	139.625	1256.63	81.86	1,256.4	0.3	1.50	0.15	1,348.28	73.6	882.9	465.3	109.5	3.2	2.3	
7/1/19 2:00	58.0	23.8	1,347.8	134.775	1212.98	70.11	1,076.0	137.0	0.84	0.08	756.07	63.0	756.2	0.0	93.8	2.8	2.0	
7/1/19 3:00	57.0	23.2	1,367.4	136.737	1230.63	80.17	1,230.4	0.3	3.80	0.38	3,423.22	72.1	864.7	2,558.5	107.2	3.2	2.2	
7/1/19 4:00	57.0	23.2	1,399.2	139.922	1259.30	82.04	1,259.0	0.3	1.50	0.15	1,345.64	73.7	884.8	460.8	109.7	3.2	2.3	
7/1/19 5:00	55.0	22.3	1,487.3	148.728	1338.55	87.20	1,338.4	0.2	2.42	0.24	2,178.42	78.4	940.5	1,237.9	116.6	3.4	2.4	
7/1/19 6:00	58.0	24.1	1,631.9	163.193	1468.74	49.22	757.2	711.5	0.59	0.06	530.84	44.2	530.9	0.0	66.3	1.9	1.4	
7/1/19 7:00	62.0	25.4	1,641.1	164.113	1477.01	48.99	753.7	723.3	0.59	0.06	528.37	44.0	528.4	0.0	66.0	1.9	1.4	
7/1/19 8:00	68.0	27.3	1,911.6	191.162	1720.46	100.00	1,535.0	185.5	2.62	0.26	2,360.93	89.9	1,078.4	1,282.5	133.7	3.9	2.8	
7/1/19 9:00	71.0	28.0	1,620.0	161.998	1457.98	94.98	1,457.9	0.1	3.92	0.39	3,532.22	85.4	1,024.4	2,507.9	127.0	3.7	2.7	
7/1/19 10:00	76.0	28.2	1,731.4	173.141	1558.27	100.00	1,535.0	23.3	4.07	0.41	3,663.60	89.9	1,078.4	2,585.2	133.7	3.9	2.8	
7/1/19 11:00	76.0	28.5	1,545.5	154.550	1390.95	90.62	1,390.8	0.1	3.67	0.37	3,299.09	81.4	977.3	2,321.8	121.2	3.6	2.5	
7/1/19 12:00	77.0	28.8	1,513.2	151.325	1361.92	88.72	1,361.8	0.2	5.07	0.51	4,559.55	79.7	956.9	3,602.6	118.7	3.5	2.5	
7/1/19 13:00	79.0	29.6	1,516.9	151.689	1365.20	88.94	1,365.0	0.2	4.91	0.49	4,420.80	79.9	959.2	3,461.6	118.9	3.5	2.5	
7/1/19 14:00	79.0	29.3	1,444.7	144.475	1300.27	84.71	1,300.0	0.2	2.07	0.21	1,861.32	76.1	913.6	947.7	113.3	3.3	2.4	
7/1/19 15:00	79.0	30.5	1,806.3	180.627	1625.64	100.00	1,535.0	90.6	3.99	0.40	3,588.39	89.9	1,078.4	2,509.9	133.7	3.9	2.8	
7/1/19 16:00	79.0	30.1	1,394.2	139.423	1254.80	81.75	1,254.5	0.3	6.89	0.69	6,203.78	73.5	881.7	5,322.1	109.3	3.2	2.3	
7/1/19 17:00	79.0	30.1	1,335.1	133.513	1201.62	78.28	1,201.4	0.3	6.16	0.62	5,543.65	70.4	844.3	4,699.3	104.7	3.1	2.2	
7/1/19 18:00	79.0	30.5	1,308.2	130.818	1177.37	76.70	1,177.1	0.3	5.02	0.50	4,518.68	68.9	827.3	3,691.4	102.6	3.0	2.2	
7/1/19 19:00	78.0	27.1	1,311.6	131.158	1180.42	76.90	1,180.2	0.3	4.07	0.41	3,663.62	69.1	829.4	2,834.2	102.8	3.0	2.2	
7/1/19 20:00	75.0	26.2	1,317.8	131.783	1186.05	77.27	1,185.8	0.3	3.52	0.35	3,164.53	69.4	833.4	2,331.2	103.3	3.0	2.2	
7/1/19 21:00	71.0	25.5	1,339.2	133.916	1205.24	78.52	1,205.0	0.3	5.36	0.54	4,820.19	70.6	846.9	3,973.3	105.0	3.1	2.2	
7/1/19 22:00	67.0	25.9	3,037.4	303.737	2733.63	100.00	1,535.0	1,198.6	3.57	0.36	3,216.26	89.9	1,078.4	2,137.8	133.7	3.9	2.8	
7/1/19 23:00	67.0	25.6	1,411.8	141.183	1270.64	82.78	1,270.4	0.2	2.09	0.21	1,881.70	74.4	892.8	988.9	110.7	3.3	2.3	
7/2/19 0:00	66.0	25.7	1,411.3	141.125	1270.13	82.74	1,269.9	0.2	1.92	0.19	1,732.40	74.4	892.4	840.0	110.7	3.3	2.3	
7/2/19 1:00	67.0	26.4	1,375.6	137.559	1238.03	80.65	1,237.8	0.3	2.86	0.29	2,577.64	72.5	869.9	1,707.8	107.9	3.2	2.3	
7/2/19 2:00	67.0	27.2	1,408.0	140.800	1267.20	82.55	1,267.0	0.2	2.12	0.21	1,905.85	74.2	890.4	1,015.5	110.4	3.3	2.3	
7/2/19 3:00	68.0	27.7	1,326.2	132.620	1193.58	77.76	1,193.3	0.3	3.90	0.39	3,506.28	69.9	838.7	2,667.6	104.0	3.1	2.2	
7/2/19 4:00	68.0	28.2	1,286.1	128.608	1157.47	75.41	1,157.2	0.3	5.63	0.56	5,064.36	67.8	813.3	4,251.1	100.8	3.0	2.1	
7/2/19 5:00	68.0	28.2	1,288.7	128.867	1159.80	75.56	1,159.5	0.3	3.84	0.38	3,452.13	67.9	814.9	2,637.2	101.0	3.0	2.1	
7/2/19 6:00	69.0	28.9	1,438.1	143.808	1294.27	84.32	1,294.0	0.2	4.18	0.42	3,758.44	75.8	909.4	2,849.0	112.8	3.3	2.4	
7/2/19 7:00	68.0	30.1	3,050.4	305.040	2745.36	100.00	1,535.0	1,210.4	5.01	0.50	4,508.04	89.9	1,078.4	3,429.6	133.7	3.9	2.8	
7/2/19 8:00	72.0	31.6	1,543.7	154.374	1389.37	90.51	1,389.2	0.1	5.93	0.59	5,335.44	81.3	976.2	4,359.3	121.0	3.6	2.5	
7/2/19 9:00	74.0	32.0	1,531.1	153.106	1377.96	89.77	1,377.8	0.2	6.59	0.66	5,932.97	80.7	968.2	4,964.8	120.1	3.5	2.5	

UNIVERSITY OF ROCHESTER

Heat Recovery Heat Pump

BMEO

Building Utility Impact		
Building Level Energy Savings		
Electrical Energy Savings	(1,530)	mmBtu/Year
Chilled Water Savings	3,273	mmBtu/Year
Steam Savings	4,733	mmBtu/Year
Total Energy Savings	**6,476**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	(448,516)	kWh/Year
Chilled Water Savings	272,723	Ton-Hour/Year
Steam Savings	4,733	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	-$1,890	Per Year

ECM - 1 - HEAT RECOVERY CHILLER

Project Name:	University of Rochester
Building:	Goergen Hall - Biomedical Engineering and Optics
Date:	4/1/2021
EEM	Heat Recovery Chiller
Calculated By:	RGK
Reviewed By:	SDM

Summary of Existing Systems Used for Calculation		
Existing System Summary		
Adjusted Baseline CHW Use	7,291	mmBTU
Adjusted Baseline HW Use	15,242	mmBTU

Proposed System Summary		
HRC Cooling	3,274	mmBTU
Supplemental Cooling	4,018	mmBTU
HRC Heating	4,734	mmBTU
Supplemental Heating	10,509	mmBTU
HRC Pump Usage	-20,474	kWh
HRC Electrical Usage	-428,042	kWh

Summary of EEM Savings		
Heat Recovery Chiller Savings Summary		
District CHW Savings	3,273	mmBTU
Electrical Savings	-448,516	kWh
Heating Savings	4,733	mmBTU
Total Savings:	6,476	mmBTU
Total Current Usage:	73,684	
% Savings:	9%	

wendel

Project Name:	University of Rochester
Building:	Goergen Hall - Biomedical Engineering and Optics
Date:	4/1/2021
EEM:	Heat Recovery Chiller
Scenerio:	HRC
Calculated By:	RGK
Reviewed By:	SDM

Existing Energy Summary

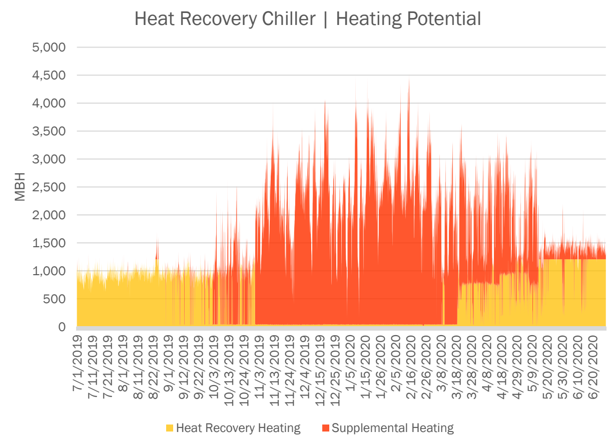
Adjusted Baseline CHW Use	7,291	mmBTU
Adjusted Baseline HW Use	15,242	mmBTU

Proposed Energy Summary

HRC Cooling	3,274	mmBTU
Supplemental Cooling	4,018	mmBTU
HRC Heating	4,734	mmBTU
Supplemental Heating	10,509	mmBTU
HRC Pump Usage	-20,474	kWh
HRC Electrical Usage	-428,042	kWh

Heat Recovery Chiller Performance Data

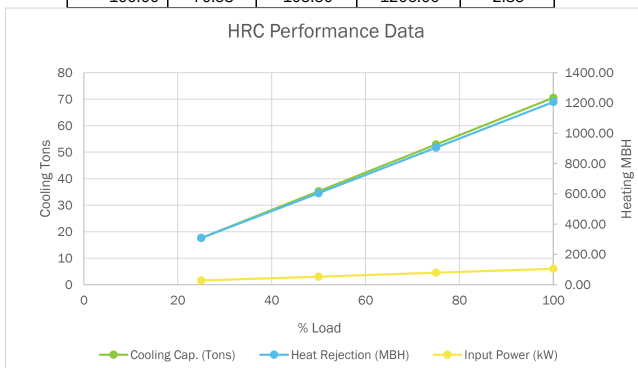
% Load	Cooling Cap. (Tons)	Input Power (kW)	Heat Rejection (MBH)	Base COP
25.00	17.63	28.28	308.10	2.19
50.00	35.26	53.11	604.40	2.33
75.00	52.90	79.11	904.70	2.35
100.00	70.53	105.50	1206.00	2.35

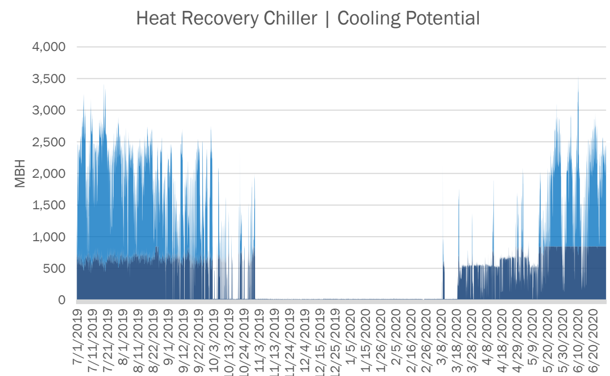


System Enable Setpoints

CHW Enable Temp	0	deg F	
HW Enable Temp	0	deg F	
Month Start	January	**1**	
Month End	December	**12**	
Interactive Savings	10%	%	

LOADING CHECK	100.00%
Load Safety Factor	100.00%



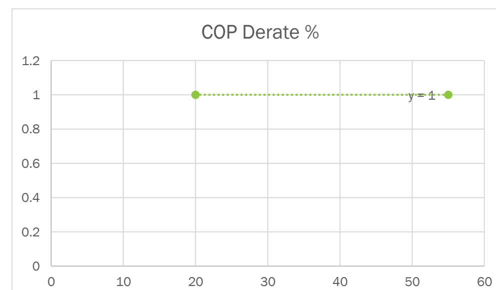


Baseline Load Simulation

OAT	**HWST (°F)**			
-10	140			
0	140			
10	140			
20	140			
30	140			
40	140			
50	140			
60	140			
70	140			
80	140			
90	140			
	0	0	0	140
	X=	80.00	Y=	140.00
	#VALUE	#VALUE	#VALUE	#VALUE
	X=	10.00	Y=	#VALUE

Heat Recovery Chiller Pump Information

Pump Label	CHW Pumps	HW Pumps
Motor HP	60	20
Motor Eff	0.91	0.91
Pump GPM	169	121
Pump Eff	85.0%	85.0%
BHP	3.77	2.69
Ft. Hd.	75	75
QTY	1	1
kW	3.1	2.2
Control Type	CV	CV
Affintiy Law Adj.	1	1



wendel

Project Name: University of Rochester
Building: Goergen Hall - Biomedical Engineering and Optics
Date: 4/1/2021
EEM: Heat Recovery Chiller
Scenerio: HRC
Calculated By: RGK
Reviewed By: SDM

FORMULA INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
MAX	93.0	43.7	5038.2	503.8	4534.4	100.0	1206.0	4507.3	3.9	0.4	3549.8	70.5	846.4	2954.0	105.5	3.1	2.2	0.0
MIN	2.0	1.3	56.8	5.7	51.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM	437,579	164,551	16,936,096	1,693,610	15,242,486	386,672	4,733,998	10,509,011	8,101	810	7,290,881	272,826	3,273,911	4,018,209	428,042	11,956	8,518	0
Time Stamp	**Outside dry-bulb temp (F)**	**Specific Enthalpy (btu/lbm)**	**Baseline Steam Usage (MBH)**	**ECM Steam Savings (MBH)**	**Adjusted Baseline HW Load (MBH)**	**% HRC Heating Load above OAT Enable Temp**	**HRC Heating (MBH)**	**Supp Heating from Hxers (MBH)**	**Baseline CHW (mmBTU)**	**ECM CHW Savings (mmBtu)**	**Adjusted Baseline CHW Load (MBH)**	**HRC Cooling Load (tons)**	**HRC Cooling (MBH)**	**Supp Cooling from CHW plant (MBH)**	**HRC Electrical Load (kW)**	**HRC Chilled Water Pumps (kW)**	**HRC Hot Water Pumps (kW)**	
7/1/19 0:00	59.0	23.9	1,078.805	107.880	970.92	80.51	971.1	0.0	1.54	0.15	1,387.99	56.8	681.4	706.6	84.9	2.5	1.8	
7/1/19 1:00	59.0	23.9	1,164.369	116.437	1047.93	86.89	1,048.1	0.0	1.32	0.13	1,191.46	61.3	735.5	456.0	91.7	2.7	1.9	
7/1/19 2:00	58.0	23.8	1,064.148	106.415	957.73	79.41	957.9	0.0	1.23	0.12	1,105.48	56.0	672.2	433.3	83.8	2.5	1.7	
7/1/19 3:00	57.0	23.2	1,072.802	107.280	965.52	80.06	965.7	0.0	1.15	0.11	1,030.54	56.5	677.6	352.9	84.4	2.5	1.8	
7/1/19 4:00	57.0	23.2	1,192.062	119.206	1072.86	88.96	1,073.0	0.0	1.01	0.10	905.88	62.7	753.0	152.9	93.8	2.8	2.0	
7/1/19 5:00	55.0	22.3	1,146.823	114.682	1032.14	85.58	1,032.3	0.0	0.88	0.09	792.26	60.4	724.4	67.9	90.3	2.6	1.9	
7/1/19 6:00	58.0	24.1	1,341.102	134.110	1206.99	82.36	993.4	213.6	0.77	0.08	697.06	58.1	697.1	0.0	86.9	2.5	1.8	
7/1/19 7:00	62.0	25.4	1,197.583	119.758	1077.82	89.37	1,078.0	0.0	1.06	0.11	958.08	63.0	756.5	201.6	94.3	2.8	2.0	
7/1/19 8:00	68.0	27.3	1,246.279	124.628	1121.65	93.01	1,121.8	0.0	1.30	0.13	1,173.03	65.6	787.2	385.8	98.1	2.9	2.0	
7/1/19 9:00	71.0	28.0	1,096.422	109.642	986.78	81.82	987.0	0.0	1.69	0.17	1,520.03	57.7	692.6	827.5	86.3	2.5	1.8	
7/1/19 10:00	76.0	28.2	1,013.658	101.366	912.29	75.65	912.5	0.0	1.98	0.20	1,784.60	53.4	640.3	1,144.3	79.8	2.3	1.7	
7/1/19 11:00	76.0	28.5	1,004.614	100.461	904.15	74.97	904.4	0.0	2.07	0.21	1,863.98	52.9	634.6	1,229.4	79.1	2.3	1.7	
7/1/19 12:00	77.0	28.8	1,018.898	101.890	917.01	76.04	917.2	0.0	2.18	0.22	1,965.29	53.6	643.6	1,321.7	80.2	2.4	1.7	
7/1/19 13:00	79.0	29.6	948.487	94.849	853.64	70.78	853.9	0.0	2.29	0.23	2,060.48	49.9	599.1	1,461.4	74.7	2.2	1.6	
7/1/19 14:00	79.0	29.3	970.685	97.068	873.62	72.44	873.8	0.0	2.48	0.25	2,235.52	51.1	613.1	1,622.4	76.4	2.2	1.6	
7/1/19 15:00	79.0	30.5	863.423	86.342	777.08	64.43	777.5	0.0	2.66	0.27	2,392.13	45.4	545.3	1,846.8	68.0	2.0	1.4	
7/1/19 16:00	79.0	30.1	906.250	90.625	815.62	67.63	815.9	0.0	2.73	0.27	2,453.54	47.7	572.4	1,881.1	71.4	2.1	1.5	
7/1/19 17:00	79.0	30.1	936.157	93.616	842.54	69.86	842.8	0.0	2.73	0.27	2,456.61	49.3	591.3	1,865.3	73.7	2.2	1.5	
7/1/19 18:00	79.0	30.5	997.779	99.778	898.00	74.46	898.2	0.0	2.71	0.27	2,438.19	52.5	630.2	1,807.9	78.5	2.3	1.6	
7/1/19 19:00	78.0	27.1	943.341	94.334	849.01	70.40	849.3	0.0	2.77	0.28	2,493.46	49.7	595.8	1,897.6	74.3	2.2	1.6	
7/1/19 20:00	75.0	26.2	900.227	90.023	810.20	67.18	810.5	0.0	2.16	0.22	1,940.72	47.4	568.6	1,372.1	70.9	2.1	1.5	
7/1/19 21:00	71.0	25.5	983.197	98.320	884.88	73.37	885.1	0.0	2.18	0.22	1,965.29	51.8	621.0	1,344.3	77.4	2.3	1.6	
7/1/19 22:00	67.0	25.9	1,001.806	100.181	901.63	74.76	901.8	0.0	1.99	0.20	1,793.33	52.7	632.8	1,160.5	78.9	2.3	1.6	
7/1/19 23:00	67.0	25.6	1,027.093	102.709	924.38	76.65	924.6	0.0	1.82	0.18	1,633.65	54.1	648.8	984.9	80.8	2.4	1.7	
7/2/19 0:00	66.0	25.7	1,062.807	106.281	956.53	79.31	956.7	0.0	1.75	0.17	1,572.23	55.9	671.3	900.9	83.7	2.5	1.7	
7/2/19 1:00	67.0	26.4	1,067.975	106.798	961.18	79.70	961.4	0.0	1.75	0.17	1,572.23	56.2	674.6	897.6	84.1	2.5	1.8	
7/2/19 2:00	67.0	27.2	1,082.865	108.286	974.58	80.81	974.8	0.0	1.67	0.17	1,498.53	57.0	684.0	814.5	85.2	2.5	1.8	
7/2/19 3:00	68.0	27.7	1,091.423	109.142	982.28	81.45	982.5	0.0	1.68	0.17	1,510.82	57.4	689.4	821.4	85.9	2.5	1.8	
7/2/19 4:00	68.0	28.2	1,118.096	111.810	1006.29	83.44	1,006.5	0.0	1.97	0.20	1,768.76	58.9	706.2	1,062.5	88.0	2.6	1.8	
7/2/19 5:00	68.0	28.2	1,067.575	106.757	960.82	79.67	961.0	0.0	2.12	0.21	1,910.02	56.2	674.3	1,235.7	84.0	2.5	1.8	
7/2/19 6:00	69.0	28.9	1,106.469	110.647	995.82	82.57	996.0	0.0	2.19	0.22	1,971.43	58.2	698.9	1,272.5	87.1	2.6	1.8	
7/2/19 7:00	68.0	30.1	1,385.272	138.527	1246.74	100.00	1,206.0	40.7	2.30	0.23	2,069.70	70.5	846.4	1,223.3	105.5	3.1	2.2	
7/2/19 8:00	72.0	31.6	1,136.651	113.665	1022.99	84.82	1,023.2	0.0	2.55	0.25	2,290.79	59.8	718.0	1,572.8	89.5	2.6	1.9	
7/2/19 9:00	74.0	32.0	1,149.656	114.966	1034.69	85.80	1,034.9	0.0	2.64	0.26	2,373.70	60.5	726.2	1,647.5	90.5	2.7	1.9	

Technical Appendix 3

Heat Recovery Heat Pump ECM

Scope of Work (Cost Estimate & Scope of Work)

- Kornberg
- Del Monte
- BMEO

DIRECT MATERIAL & LABOR | COST ESTIMATE

Project : University of Rochester | KMRB
Project # : 402805
Measure : ECM 5 | Heat Recovery Systems
Date : 04/01/21

Estimated by: GHB
Checked by: JGD
Approved by: JGD
Vendor Quotes: No
Subcontractor Pricing: No

Item No.	Description	Material	Labor	Other[1]	Subtotal Cost
	1.1 Equipment				**$0.00**
	A. Heat Recovery Chiller (RL Kistler Budget)	$176,400.00	$0.00	$0.00	**$176,400.00**
	B. Chilled Water Pumps	$6,300.00	$0.00	$0.00	**$6,300.00**
	C. Hot Water Pumps	$6,300.00	$0.00	$0.00	**$6,300.00**
	D. Variable Frequency Drives	$9,324.00	$0.00	$0.00	**$9,324.00**
	E. In-line Relief Fan	$2,205.00	$0.00	$0.00	**$2,205.00**
	F. Specialties	$63,000.00	$0.00	$0.00	**$63,000.00**
	1.2 Rigging & Equipment Setting				**$0.00**
	A. Receiving & Storage	$0.00	$1,071.00	$0.00	**$1,071.00**
	B. Delivery	$0.00	$1,512.00	$0.00	**$1,512.00**
	C. Concrete Equipment Pads	$1,134.00	$2,394.00	$0.00	**$3,528.00**
	D. Crane & Rigging	$0.00	$1,008.00	$2,520.00	**$3,528.00**
	1.3 Piping				**$0.00**
	A. Chilled Water Piping	$0.00	$0.00	$113,400.00	**$113,400.00**
	B. Hot Water Piping	$0.00	$0.00	$113,400.00	**$113,400.00**
	C. Core Drilling	$0.00	$5,040.00	$0.00	**$5,040.00**
	D. Insulation (Piping & Pumps)	$5,670.00	$9,450.00	$0.00	**$15,120.00**
	1.4 Electrical				**$0.00**
	A. Electrical Chase / Conduit Installation	$12,768.00	$14,112.00	$0.00	**$26,880.00**
	B. Heat Recovery Chiller Breaker & Feeders	$10,710.00	$9,450.00	$0.00	**$20,160.00**
	C. CHW / HW Pumps Breakers & Feeders	$11,592.00	$12,600.00	$0.00	**$24,192.00**
	D. BAS Controls Electrical Connections	$567.00	$1,512.00	$0.00	**$2,079.00**
	E. Refrigerant Relief Fan Service	$2,646.00	$2,268.00	$0.00	**$4,914.00**
	1.5 Controls				**$0.00**
	A. Heat Recovery Chiller Points	$7,560.00	$7,560.00	$0.00	**$15,120.00**
	B. CHW / HW Pumps VFD Points	$12,096.00	$12,096.00	$0.00	**$24,192.00**
	C. ASHRAE 15 System	$10,080.00	$15,120.00	$0.00	**$25,200.00**
	D. Misc. Control / Monitoring Points	$9,072.00	$9,072.00	$0.00	**$18,144.00**
	E. Modulating Control Valves	$6,300.00	$0.00	$0.00	**$6,300.00**
	1.6 Refrigerant Relief System				**$0.00**
	A. Sidewall Louvers	$2,772.00	$4,410.00	$0.00	**$7,182.00**
	B. Ductwork	$4,410.00	$6,930.00	$0.00	**$11,340.00**
	C. Wall Penetrations	$0.00	$4,410.00	$0.00	**$4,410.00**
	1.7 Start-up / Commissioning				**$0.00**
	A. CHW / HW Pump & Motor Alignments	$0.00	$3,780.00	$0.00	**$3,780.00**
	B. Testing & Balancing Services	$0.00	$1,890.00	$0.00	**$1,890.00**
	C. Factory Start-Up	$0.00	$4,410.00	$0.00	**$4,410.00**
	1.8 Warranty				**$0.00**
	A. 2-Year Parts & Labor Warranty	$0.00	$0.00	$25,200.00	**$25,200.00**
3.0	General Costs: Bonds	$0.00	$0.00	$15,655.94	**$15,655.94**
3.1	General Costs: Other	$0.00	$0.00	$7,827.97	**$7,827.97**
				Subtotal:	$769,005

Contingency:	5.0%	$38,450
Escalation Reserve:	5.0%	$38,450
Engineering Procurement & Construction MGMT:	25.0%	$192,251
Total:		$1,038,157

Notes

[1] Other inclues misc. material and equipment necessary for installation, communication, insurances, permits, bonding. Prior to final pricing and subcontract execution these values will be required to be itemized by the bidder.

ECM 5: Heat Recovery Systems

The following is a General Scope of Work for the University of Rochester Energy Conservation Master Plan. The intent of this document is to provide a general outline of the project scope of work for developing firm project costs. Project Design Documents, including construction and permit sets, will be developed following approval of the proposed project by University of Rochester.

Project Job Site(s)

No.	Building Name
1	KMRB

***** NOT FOR CONSTRUCTION *****

The scope of this project consists of providing all labor and material, along with providing all equipment necessary to complete and make fully operational the systems defined in this specification. The project is intended to follow University of Rochester design guidelines. All products, procedures, and completed systems are intended to comply with ASHRAE standards. While this document does not include specification details, the final project manual will be produced that includes specifications that are aligned with University of Rochester design standards.

It is our expectation that the subcontractor submitting a quotation is familiar with the University of Rochester design standards and has accounted for the impact these standards have on pricing, including but not limited, material, labor and general conditions.

1.0 General

A. **Documents |** At the start of construction, submit manufacturer's product data for materials (including but not limited to: sensors, actuators, controllers, cabinets, wire & conduit), P&ID drawings, coordination & layout drawings, and other commonly required submittals per University of Rochester standards.

B. **Documents |** Maintaining of all Project Record Documents as detailed in this Contract Document.

C. **Documents |** Document and Submit a summary of existing conditions including digital photos of the job site prior to the start of work.
   a. Examine sizes and conditions of existing equipment.

D. **Material Handling |** Label all control wiring.

E. **Material Handling |** Delivery of the material and equipment to job site.

F. **Material Handling |** A location within the facility will be identified for the subcontractor to store all material and equipment. The subcontract is required to keep this area organized and accessible as well as free of any loose material or garbage.

G. **Material Handling |** Provide moving, storage and protection for all University of Rochester's existing equipment, furniture and cabinetry on job site to perform contract work. Protect floor in areas used to store furniture.

H. **Installation Requirements |** Provide all associated equipment, and all particulars/specialties needed to make the provided equipment fully functional and perform its intended use.

I. **Installation Requirements |** Install all equipment per manufacturer's instructions

J. **Installation Requirements |** Paint and finish as needed to match preconstruction conditions.

K. **Installation Requirements |** Subcontractor is responsible for all cutting and patching associated with the work.

L. **Permits |** Subcontractor with Contractor approval will submit application for electric service permits if necessary. The Subcontractor will pay the cost of the permits.

M. **Permits |** Building permit fees will be paid by Wendel.

N. **Inspections & Codes |** All electrical work must be performed by a licensed electrical contractor and include a valid underwriters certification at the completion of the project as part of the close out O&M package.

O. **Inspections & Codes |** Provide all electrical connections required in accordance with all Federal, State, and Local Codes.

P. **Inspections & Codes |** Field verify all voltages prior to ordering any equipment.

Q. **Installation Requirements |** Removal of all waste generated by Work per EPA requirements, University of Rochester standards, and local authority regulations.

R. **Inspections & Codes |** Test, adjust, and balance all equipment and materials provided, or modified under this Subcontract.

S. **Inspections & Codes |** Provide all mechanical connections required in accordance with all Federal, State, and Local Codes.

T. **Coordination |** Coordination of equipment and utility service shutdowns with 2-weeks notice to the facility and Wendel. All work requiring a shutdown will be completed during normal business hours.

U. **Closeout |** Provide operator training and operation manuals

V. **Closeout |** Starting Systems

1. Coordinate schedule for start-up of various equipment and systems.
2. Notify Wendel and facility seven days prior to start-up of each item.
3. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
4. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
5. Verify wiring and support components for equipment are complete and tested. Execute start-up under supervision of responsible Contractors' personnel in accordance with manufacturers' instructions.
6. Provide manufacturer authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

W. **Commissioning |** Subcontractor shall assign representatives with expertise and authority to act on its behalf to participate in and perform commissioning process activities under the direction of Wendel. Wendel will develop commissioning procedures the subcontractor will be responsible to execute the procedure under Wendel's supervision.

X. **Trending |** All points connected to the building management system shall be trended and have data stored for three years at a minimum of one (1) hour intervals. All trends shall be remotely accessible by Wendel or another authorized and University of Rochester approved third party.

Y. **Trending |** Trended data will be viewable in tabular and graphic form in conjunction with current BMS formatting standards at University of Rochester. Subcontractor to integrate into existing BMS. This data will also have the ability to be exported into a csv. Formatted file.

Z. **OVERALL SYSTEM |** The new control points added shall fully integrate into the existing building management system. The required integration shall include the creation of custom graphics and the compilation and display of all devices and objects on the existing Schneider Electric EcoStruxure interface. All graphic displays will reside on the existing Schneider Electric EcoStruxure interface and be modified accordingly. In addition, the system shall perform the said integration through the use of BACnet/IP communications).

AA. **Key Definition |** Provide - furnish and install

BB. **Key Definition |** Wendel - maybe referred to as, Wendel, Contractor, or Design/Builder

1.1 ECM 5 | Heat Recovery System

A. Heat Recovery Chiller

1. Install Heat Recovery Chiller 150 nominal tons with a condenser water leaving temperature of 140˚F and a chilled water supply temperature of 44°F. New heat recovery chiller shall utilized R410a refrigerant.
   [CUT SHEET PROVIDED

B. Chilled Water Loop Modifications

1. **Primary HR Cooling Loop Pump & Motor |** Provide two (2) base mounted pump and motor sets with a capacity of 280 gpm at 55ft of head and premium efficiency motor with 7.5 Hp and class G insulation. Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation.
   [CUT SHEET PROVIDED
2. **4" Chilled Water Pipe|** Provide 200 linear feet of schedule 40 steel 4 chilled water pipe. Refer to Exhibit D for layout and schematic. Include valves, mounting and through penetrations. Note pipe length is for the total length of both supply and return piping, it also does not include fitting factors. Provide pipe insulation on all new piping per the State of New York Energy Conservation Code.
3. **Strainer & Filter |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
4. **Expansion Tank |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
5. **Air Separator |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
6. **Refill / Purge / Water Treatment|** All existing loops should be isolated either through the use of shutoff valve or frozen with new valves installed. The intent is to NOT drain any existing system beyond what is necessary to perform the work. All new work will be filled, the water will be treated and the system will be vented of air.
7. **Balance |** Provide hydronic balancing of the new equipment and interconnections to each loop.

C. Hot Water Loop Modifications

1. **Primary HR Cooling Loop Pump & Motor |** Provide two (2) base mounted pump and motor sets with a capacity of 399 gpm at 65 ft of head and premium efficiency motor with 10 Hp and class G insulation. Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation.
   [CUT SHEET PROVIDED
2. **6" Hot Water Water Pipe|** Provide 200 linear feet of schedule 40 steel 6 hot water pipe. Refer to Exhibit D for layout and schematic. Include valves, mounting and through penetrations. Note pipe length is for the total length of both supply and return piping, it also does not include fitting factors. Provide pipe insulation on all new piping per the State of New York Energy Conservation Code.
3. **Strainer & Filter |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
4. **Expansion Tank |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.

5. **Air Separator |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
6. **Refill / Purge / Water Treatment|** All existing loops should be isolated either through the use of shutoff valve or frozen with new valves installed. The intent is to NOT drain any existing system beyond what is necessary to perform the work. All new work will be filled, the water will be treated and the system will be vented of air.
7. **Balance |** Provide hydronic balancing of the new equipment and interconnections to each loop.

D. **Refrigerant Alarm & Exhaust**

1. **Refrigerant Alarm |** Provide new refrigerant alarm with appropriate sensors, annunciators, strobes, signage, etc. as required per the local & state code.
2. **Refrigerant Ventilation |** Provide new inline exhaust fan, ductwork, specialties, controls, and wall penetration in existing chase for new refrigerant exhaust system.

DI. **Electrical | Pumps & Fans**

1. **New VSD |** Install ABB VFD with integrated bypass for Hp as noted for **Primary HR Cooling Loop and Heat Rejection Primary Loop Pumps.** Provide mounting, power wire as noted in table below, EMT conduit, through penetrations, electrical connections and specialties.
2. **Controls VSD |** Provide connection of VSD to building management system. Provide control points including, % speed, Hz, kW, with up to three years or trending in 1 hour intervals. Provide mounting, control wire, power wire, EMT conduit, through penetrations, electrical connections and specialties.
3. **Refrigerant Fan |** Install new combination motor starter / disconnect to serve new refrigerant exhaust fan.

DII. **Electrical | Power Distribution**

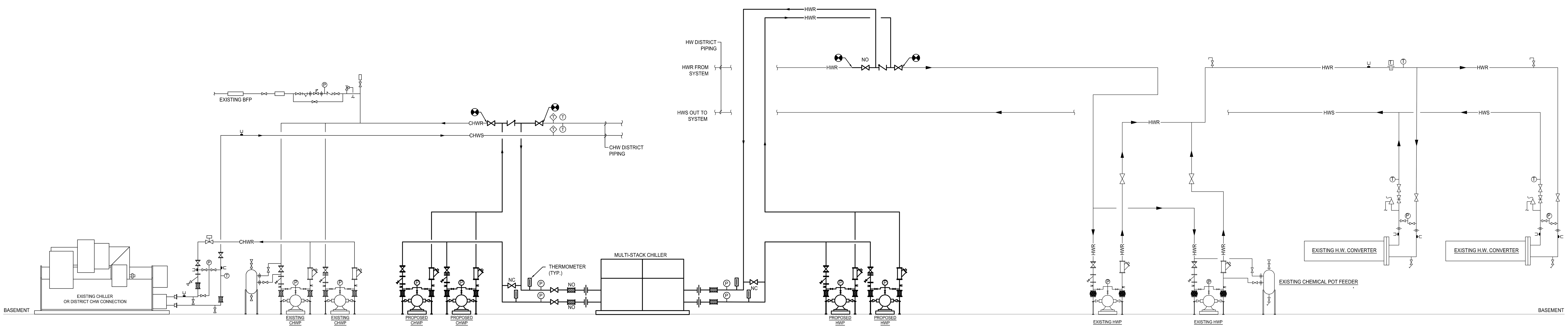
1. **Chiller Connection |** Provide new 450A breaker in the power switchgear. Provide 480V 450A disconnect, including mounting and verification of clearances. Provide two (2) sets of 250 Kcmil wire plus ground in 4 conduit including hangers, supports, through penetrations, terminations and other specialties.
2. **Panel Board for Pumps |** Provide new 20A 480V breaker in existing distribution gear for Primary HR Cooling Loop Pump. For each pump, provide three (3) #12 conductors plus ground in 3/4 conduit. Provide mounting, connections, verification of clearances. Connect to new VSD.
3. **Panel Board for Pumps |** Provide new 25A 480V breaker in existing distribution gear for Heat Rejection Primary Loop Pumps. For each pump, provide three (3) #12 conductors plus ground in 3/4 conduit. Provide mounting, connections, verification of clearances. Connect to new VSD.

DIII. **Controls**

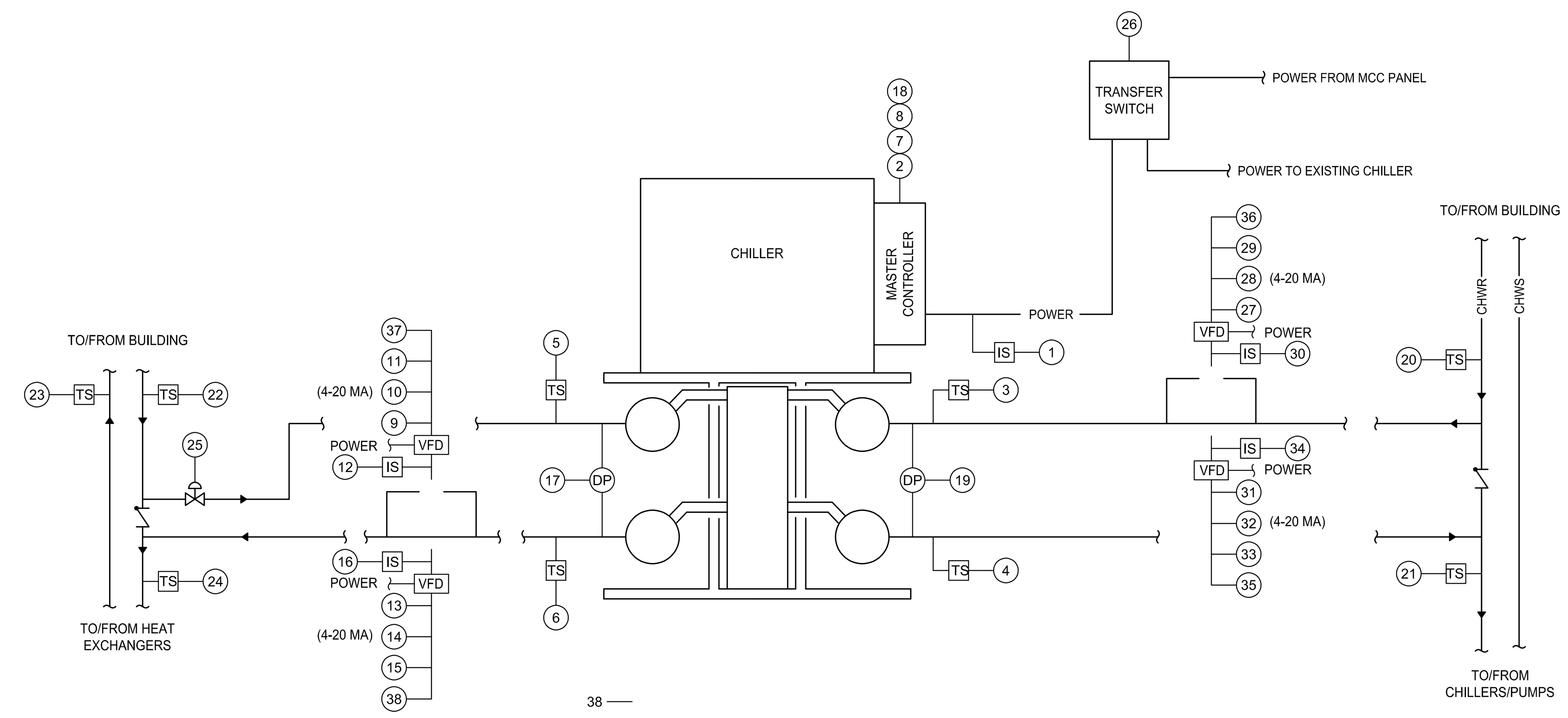
1. Heat Recovery System Controls:
   a. Provide a component panel enclosure with new pneumatic devices and a main controller enclosure.
   b. Provide 10K thermistor immersion temperature sensors to monitor the hot water supply and return temperature at the chiller, pump loop and each heat exchanger.
   c. Provide relays for start/stop and current sensors for status at each pump VFD (or starters for the inline pumps) and wire to the new controller.
   d. Provide controller inputs to monitor each VFD alarm and controller outputs control each VFD speed.
   e. Provide a new differential pressure sensor for the new lead/lag set of pumps for VFD speed control and wire to the new controller.

f. Provide and install 10K thermistor immersion temperature sensors to monitor the chilled water supply and return temperature at the chiller, pump loops, water to water heat pump and dry cooler.

g. Provide relays for start/stop and current sensors for status at each pump VFD and wire to the new controller. This includes the pump VFDs for the water to water heat exchanger.
h. Provide controller inputs to monitor each VFD alarm and controller outputs control each VFD speed.
i. Provide a new differential pressure sensor for the CHW side and HW side of the WWHP and wire to the new controller.
j. Provide point capacity for start/stop, alarm and status at the WWHP master control panel and wire to the new controller.
k. Provide point capacity for a cooling reset, heating reset and heater alarm at the chiller and wire to the new controller.
l. Provide a new pneumatic 3-way condenser water bypass valve and run poly tubing in EMT back to the component panel.
m. Furnish and install a new refrigerant monitor and wire to the new controller.
n. Provide Programming and Points to achieve the following:
   (1) HR Chiller Input power in kW
   (2) Heat Rejection Loop Supply Temp, Return Temp and Pump Speed
   (3) HR Cooling Loop Supply Temp, Return Temp and Pump Speed
   (4) Building Chilled Water Loop Supply Temp, Return Temp and Pump Speed
   (5) Building Hot Water Loop Supply Temp, Return Temp and Pump Speed

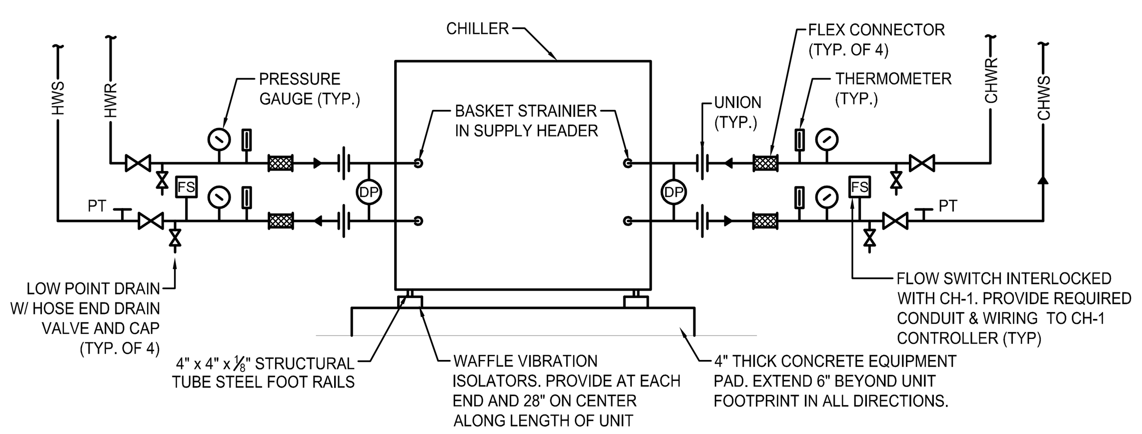


1 HEAT RECOVERY LOOP SCHEMATIC
SCALE: NOT TO SCALE



HVAC ABBREVIATIONS

BFP	BACKFLOW PREVENTER
CHW	CHILLED WATER
CHWR	CHILLED WATER RETURN
CHWS	CHILLED WATER SUPPLY
CHWP	CHILLED WATER CIRCULATING PUMP
HW	HOT WATER
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
HWP	HOT WATER CIRCULATING PUMP
NC	NORMALLY CLOSED
NO	NORMALLY OPEN



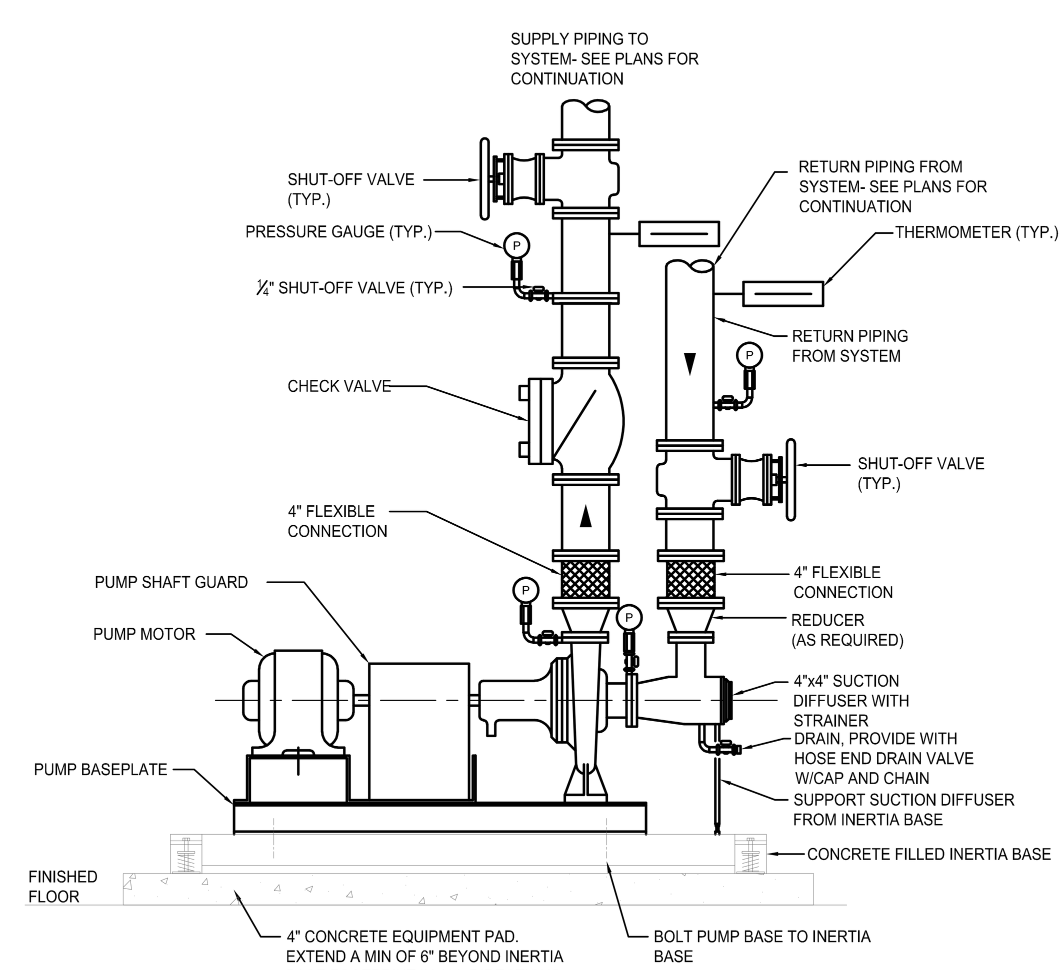
2 HEAT RECOVERY CHILLER PIPING DETAIL
SCALE: NOT TO SCALE

HVAC SYMBOLS - PIPING DESIGNATIONS

	EXISTING PIPING (REFER TO DESIGNATIONS BELOW FOR TYPE)
	PIPING TO BE REMOVED (REFER TO DESIGNATIONS BELOW FOR TYPE)
HWS	HOT WATER SUPPLY
HWR	HOT WATER RETURN
CHWS	CHILLED WATER SUPPLY
CHWR	CHILLED WATER RETURN
CWS	CONDENSER WATER SUPPLY
CWR	CONDENSER WATER RETURN
	POINT OF CONNECTION

HVAC SYMBOLS - VALVES AND SPECIALTIES

	SHUT-OFF VALVE (GATE, BALL, ETC.)
	CHECK VALVE
	STRAINER
	FLEXIBLE CONNECTOR
	DIRECTION OF FLOW
X	SENSOR/SWITCH (X INDICATES P - PRESSURE, T - TEMPERATURE, F - FLOW)
X	GAUGE (X INDICATES T - TEMPERATURE, P - PRESSURE, F - FLOW)
PT	PRESSURE/TEMPERATURE TAP
	CIRCULATING PUMP
	UNION



3 BASE MOUNTED CIRCULATING PUMP
SCALE: NOT TO SCALE

CONTROL POINTS LIST

SYSTEM: HEAT RECOVERY CHILLER

	POINT DESCRIPTION	HARDWARE POINTS: ANALOG INPUT	ANALOG OUTPUT	DIGITAL INPUT	DIGITAL OUTPUT	SOFTWARE POINTS: ANALOG VALUE	DIGITAL VALUE	SCHEDULE	TREND	ALARM	SHOW ON GRAPHIC
1	STATUS			X						X	X
2	ENABLE /DISABLE				X						X
3	CHILLER EVAPORATOR ENTERING WATER TEMP	X				X			X	X	X
4	CHILLER EVAPORATOR LEAVING WATER TEMP	X				X			X		X
5	CHILLER CONDENSER ENTERING WATER TEMP	X				X			X	X	X
6	CHILLER CONDENSER LEAVING WATER TEMP	X				X			X		X
7	CHILLER ALARM			X						X	X
8	CHILLED WATER SUPPLY TEMP SETPOINT		X					X		X	X
9	PUMP START/STOP				X			X			X
10	SPEED		X				X				X
11	ALARM			X						X	X
12	STATUS			X						X	X
13	PUMP START/STOP				X			X			X
14	SPEED		X				X				X
15	ALARM			X						X	X
16	STATUS			X						X	X
17	DIFFERENTIAL PRESSURE SENSOR EVAPORATOR	X				X		X			X
18	HOT WATER SUUPLY TEMP SETPOINT		X					X		X	X
19	DIFFERENTILA PRESSURE SENSOR CONDENSER	X				X		X			X
20	UPSTREAM CHILLED WATER RETURN TEMP	X				X			X	X	X
21	DOWNSTREAM CHILLED WATER RETURN TEMP	X				X			X	X	X
22	UPSTREAM HOT WATER RETURN TEMP	X				X			X	X	X
23	HOT WATER SUPPLY TEMP	X				X			X	X	X
24	DOWNSTREAM HOT WATER RETURN TEMP	X				X			X	X	X
25	HOT WATER RETURN CONTROL VALVE				X		X				X
26	CHILLER POWER TRANSFER SWITCH				X		X		X		X
27	PUMP START/STOP				X			X			X
28	SPEED		X				X				X
29	ALARM			X						X	X
30	STATUS			X						X	X
31	PUMP START/STOP				X			X			X
32	SPEED		X				X				X
33	ALARM			X						X	X
34	STATUS			X						X	X
35	SPEED FEEDBACK	X				X			X		X
36	SPEED FEEDBACK	X				X			X		X
37	SPEED FEEDBACK	X				X			X		X
38	SPEED FEEDBACK	X				X			X		X

4 HEAT RECOVERY CHILLER CONTROL POINT LIST
SCALE: NOT TO SCALE

NO.	DATE	DESCRIPTION
0	12/29/20	BID DOCUMENTS

REVISIONS

PREPARED FOR
UNIVERSITY OF ROCHESTER
UTILITIES AND ENERGY MANAGEMENT DEPT.
ROCHESTER, NEW YORK

PREPARED BY

wendel
Centerpointe Corporate Park
375 Essjay Road, Suite 200
Williamsville, NY 14221
www.wendelcompanies.com
p:716.688.0766 f:716.625.6825

KMRB - Heat Recovery Systems

SHEET NUMBER M-001

Archive Drawing Number	DRAWN BY	DATE	OF
402805	RGK	05/11/2020	1 OF 1

DIRECT MATERIAL & LABOR | COST ESTIMATE

wendel

Project : University of Rochester | Del Monte
Project # : 402805
Measure : ECM 5 | Heat Recovery Systems
Date : 04/01/21

Estimated by: GHB
Checked by: JGD
Approved by: JGD
Vendor Quotes: No
Subcontractor Pricing: No

Item No.	Description	Material	Labor	Other[1]	Subtotal Cost
	1.1 Equipment				**$0.00**
	A. Heat Recovery Chiller (RL Kistler Budget)	$141,120.00	$0.00	$0.00	**$141,120.00**
	B. Chilled Water Pumps	$5,040.00	$0.00	$0.00	**$5,040.00**
	C. Hot Water Pumps	$5,040.00	$0.00	$0.00	**$5,040.00**
	D. Variable Frequency Drives	$7,459.20	$0.00	$0.00	**$7,459.20**
	E. In-line Relief Fan	$1,764.00	$0.00	$0.00	**$1,764.00**
	F. Specialties	$50,400.00	$0.00	$0.00	**$50,400.00**
	1.2 Rigging & Equipment Setting				**$0.00**
	A. Receiving & Storage	$0.00	$856.80	$0.00	**$856.80**
	B. Delivery	$0.00	$1,209.60	$0.00	**$1,209.60**
	C. Concrete Equipment Pads	$907.20	$1,915.20	$0.00	**$2,822.40**
	D. Crane & Rigging	$0.00	$806.40	$2,016.00	**$2,822.40**
	1.3 Piping				**$0.00**
	A. Chilled Water Piping	$0.00	$0.00	$90,720.00	**$90,720.00**
	B. Hot Water Piping	$0.00	$0.00	$90,720.00	**$90,720.00**
	C. Core Drilling	$0.00	$4,032.00	$0.00	**$4,032.00**
	D. Insulation (Piping & Pumps)	$4,536.00	$7,560.00	$0.00	**$12,096.00**
	1.4 Electrical				**$0.00**
	A. Electrical Chase / Conduit Installation	$12,768.00	$14,112.00	$0.00	**$26,880.00**
	B. Heat Recovery Chiller Breaker & Feeders	$8,568.00	$7,560.00	$0.00	**$16,128.00**
	C. CHW / HW Pumps Breakers & Feeders	$9,273.60	$10,080.00	$0.00	**$19,353.60**
	D. BAS Controls Electrical Connections	$453.60	$1,209.60	$0.00	**$1,663.20**
	E. Refrigerant Relief Fan Service	$2,116.80	$1,814.40	$0.00	**$3,931.20**
	1.5 Controls				**$0.00**
	A. Heat Recovery Chiller Points	$6,048.00	$6,048.00	$0.00	**$12,096.00**
	B. CHW / HW Pumps VFD Points	$9,676.80	$9,676.80	$0.00	**$19,353.60**
	C. ASHRAE 15 System	$8,064.00	$12,096.00	$0.00	**$20,160.00**
	D. Misc. Control / Monitoring Points	$7,257.60	$7,257.60	$0.00	**$14,515.20**
	E. Modulating Control Valves	$5,040.00	$0.00	$0.00	**$5,040.00**
	1.6 Refrigerant Relief System				**$0.00**
	A. Sidewall Louvers	$2,217.60	$3,528.00	$0.00	**$5,745.60**
	B. Ductwork	$3,528.00	$5,544.00	$0.00	**$9,072.00**
	C. Wall Penetrations	$0.00	$3,528.00	$0.00	**$3,528.00**
	1.7 Start-up / Commissioning				**$0.00**
	A. CHW / HW Pump & Motor Alignments	$0.00	$3,024.00	$0.00	**$3,024.00**
	B. Testing & Balancing Services	$0.00	$1,512.00	$0.00	**$1,512.00**
	C. Factory Start-Up	$0.00	$3,528.00	$0.00	**$3,528.00**
	1.8 Warranty				**$0.00**
	A. 2-Year Parts & Labor Warranty	$0.00	$0.00	$20,160.00	**$20,160.00**
3.0	General Costs: Bonds	$0.00	$0.00	$12,637.65	**$12,637.65**
3.1	General Costs: Other	$0.00	$0.00	$12,637.65	**$12,637.65**
				Subtotal:	$627,068

Contingency:	5.0%	$31,353
Escalation Reserve:	5.0%	$31,353
Engineering Procurement & Construction MGMT:	25.0%	$156,767
Total:		$846,542

Notes

[1] Other inclues misc. material and equipment necessary for installation, communication, insurances, permits, bonding. Prior to final pricing and subcontract execution these values will be required to be itemized by the bidder.

ECM 5: Heat Recovery Systems

The following is a General Scope of Work for the University of Rochester Energy Conservation Master Plan. The intent of this document is to provide a general outline of the project scope of work for developing firm project costs. Project Design Documents, including construction and permit sets, will be developed following approval of the proposed project by University of Rochester.

Project Job Site(s)

No.	Building Name
1	Del Monte

***** NOT FOR CONSTRUCTION *****

The scope of this project consists of providing all labor and material, along with providing all equipment necessary to complete and make fully operational the systems defined in this specification. The project is intended to follow University of Rochester design guidelines. All products, procedures, and completed systems are intended to comply with ASHRAE standards. While this document does not include specification details, the final project manual will be produced that includes specifications that are aligned with University of Rochester design standards.

It is our expectation that the subcontractor submitting a quotation is familiar with the University of Rochester design standards and has accounted for the impact these standards have on pricing, including but not limited, material, labor and general conditions.

1.0 General

A. **Documents |** At the start of construction, submit manufacturer's product data for materials (including but not limited to: sensors, actuators, controllers, cabinets, wire & conduit), P&ID drawings, coordination & layout drawings, and other commonly required submittals per University of Rochester standards.

B. **Documents |** Maintaining of all Project Record Documents as detailed in this Contract Document.

C. **Documents |** Document and Submit a summary of existing conditions including digital photos of the job site prior to the start of work.
   a. Examine sizes and conditions of existing equipment.

D. **Material Handling |** Label all control wiring.

E. **Material Handling |** Delivery of the material and equipment to job site.

F. **Material Handling |** A location within the facility will be identified for the subcontractor to store all material and equipment. The subcontract is required to keep this area organized and accessible as well as free of any loose material or garbage.

G. **Material Handling |** Provide moving, storage and protection for all University of Rochester's existing equipment, furniture and cabinetry on job site to perform contract work. Protect floor in areas used to store furniture.

H. **Installation Requirements |** Provide all associated equipment, and all particulars/specialties needed to make the provided equipment fully functional and perform its intended use.

I. **Installation Requirements |** Install all equipment per manufacturer's instructions

J. **Installation Requirements |** Paint and finish as needed to match preconstruction conditions.

K. **Installation Requirements |** Subcontractor is responsible for all cutting and patching associated with the work.

L. **Permits |** Subcontractor with Contractor approval will submit application for electric service permits if necessary. The Subcontractor will pay the cost of the permits.

M. **Permits |** Building permit fees will be paid by Wendel.

N. **Inspections & Codes |** All electrical work must be performed by a licensed electrical contractor and include a valid underwriters certification at the completion of the project as part of the close out O&M package.

O. **Inspections & Codes |** Provide all electrical connections required in accordance with all Federal, State, and Local Codes.

P. **Inspections & Codes |** Field verify all voltages prior to ordering any equipment.

Q. **Installation Requirements |** Removal of all waste generated by Work per EPA requirements, University of Rochester standards, and local authority regulations.

R. **Inspections & Codes |** Test, adjust, and balance all equipment and materials provided, or modified under this Subcontract.

S. **Inspections & Codes |** Provide all mechanical connections required in accordance with all Federal, State, and Local Codes.

T. **Coordination |** Coordination of equipment and utility service shutdowns with 2-weeks notice to the facility and Wendel. All work requiring a shutdown will be completed during normal business hours.

U. **Closeout |** Provide operator training and operation manuals

V. **Closeout |** Starting Systems

1. Coordinate schedule for start-up of various equipment and systems.
2. Notify Wendel and facility seven days prior to start-up of each item.
3. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
4. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
5. Verify wiring and support components for equipment are complete and tested. Execute start-up under supervision of responsible Contractors' personnel in accordance with manufacturers' instructions.
6. Provide manufacturer authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

W. **Commissioning |** Subcontractor shall assign representatives with expertise and authority to act on its behalf to participate in and perform commissioning process activities under the direction of Wendel. Wendel will develop commissioning procedures the subcontractor will be responsible to execute the procedure under Wendel's supervision.

X. **Trending |** All points connected to the building management system shall be trended and have data stored for three years at a minimum of one (1) hour intervals. All trends shall be remotely accessible by Wendel or another authorized and University of Rochester approved third party.

Y. **Trending |** Trended data will be viewable in tabular and graphic form in conjunction with current BMS formatting standards at University of Rochester. Subcontractor to integrate into existing BMS. This data will also have the ability to be exported into a csv. Formatted file.

Z. **OVERALL SYSTEM |** The new control points added shall fully integrate into the existing building management system. The required integration shall include the creation of custom graphics and the compilation and display of all devices and objects on the existing Schneider Electric EcoStruxure interface. All graphic displays will reside on the existing Schneider Electric EcoStruxure interface and be modified accordingly. In addition, the system shall perform the said integration through the use of BACnet/IP communications).

AA. **Key Definition |** Provide - furnish and install

BB. **Key Definition |** Wendel - maybe referred to as, Wendel, Contractor, or Design/Builder

1.1 ECM 5 | Heat Recovery System

A. Heat Recovery Chiller

1. Install Heat Recovery Chiller 120 nominal tons with a condenser water leaving temperature of 140°F and a chilled water supply temperature of 44°F. New heat recovery chiller shall utilized R410a refrigerant.
[CUT SHEET PROVIDED

B. Chilled Water Loop Modifications

1. **Primary HR Cooling Loop Pump & Motor |** Provide two (2) base mounted pump and motor sets with a capacity of 216 gpm at 55ft of head and premium efficiency motor with 7.5 Hp and class G insulation. Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation.
[CUT SHEET PROVIDED
2. **4" Chilled Water Pipe|** Provide 200 linear feet of schedule 40 steel 4 chilled water pipe. Refer to Exhibit D for layout and schematic. Include valves, mounting and through penetrations. Note pipe length is for the total length of both supply and return piping, it also does not include fitting factors. Provide pipe insulation on all new piping per the State of New York Energy Conservation Code.
3. **Strainer & Filter |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
4. **Expansion Tank |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
5. **Air Separator |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
6. **Refill / Purge / Water Treatment|** All existing loops should be isolated either through the use of shutoff valve or frozen with new valves installed. The intent is to NOT drain any existing system beyond what is necessary to perform the work. All new work will be filled, the water will be treated and the system will be vented of air.
7. **Balance |** Provide hydronic balancing of the new equipment and interconnections to each loop.

C. Hot Water Loop Modifications

1. **Primary HR Cooling Loop Pump & Motor |** Provide two (2) base mounted pump and motor sets with a capacity of 307 gpm at 75 ft of head and premium efficiency motor with 10 Hp and class G insulation. Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation.
[CUT SHEET PROVIDED
2. **6" Hot Water Water Pipe|** Provide 200 linear feet of schedule 40 steel 6 hot water pipe. Refer to Exhibit D for layout and schematic. Include valves, mounting and through penetrations. Note pipe length is for the total length of both supply and return piping, it also does not include fitting factors. Provide pipe insulation on all new piping per the State of New York Energy Conservation Code.
3. **Strainer & Filter |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
4. **Expansion Tank |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.

5. **Air Separator |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
6. **Refill / Purge / Water Treatment|** All existing loops should be isolated either through the use of shutoff valve or frozen with new valves installed. The intent is to NOT drain any existing system beyond what is necessary to perform the work. All new work will be filled, the water will be treated and the system will be vented of air.
7. **Balance |** Provide hydronic balancing of the new equipment and interconnections to each loop.

D. **Refrigerant Alarm & Exhaust**

1. **Refrigerant Alarm |** Provide new refrigerant alarm with appropriate sensors, annunciators, strobes, signage, etc. as required per the local & state code.
2. **Refrigerant Ventilation |** Provide new inline exhaust fan, ductwork, specialties, controls, and wall penetration in existing chase for new refrigerant exhaust system.

DI. **Electrical | Pumps & Fans**

1. **New VSD |** Install ABB VFD with integrated bypass for Hp as noted for **Primary HR Cooling Loop and Heat Rejection Primary Loop Pumps**. Provide mounting, power wire as noted in table below, EMT conduit, through penetrations, electrical connections and specialties.
2. **Controls VSD |** Provide connection of VSD to building management system. Provide control points including, % speed, Hz, kW, with up to three years or trending in 1 hour intervals. Provide mounting, control wire, power wire, EMT conduit, through penetrations, electrical connections and specialties.
3. **Refrigerant Fan |** Install new combination motor starter / disconnect to serve new refrigerant exhaust fan.

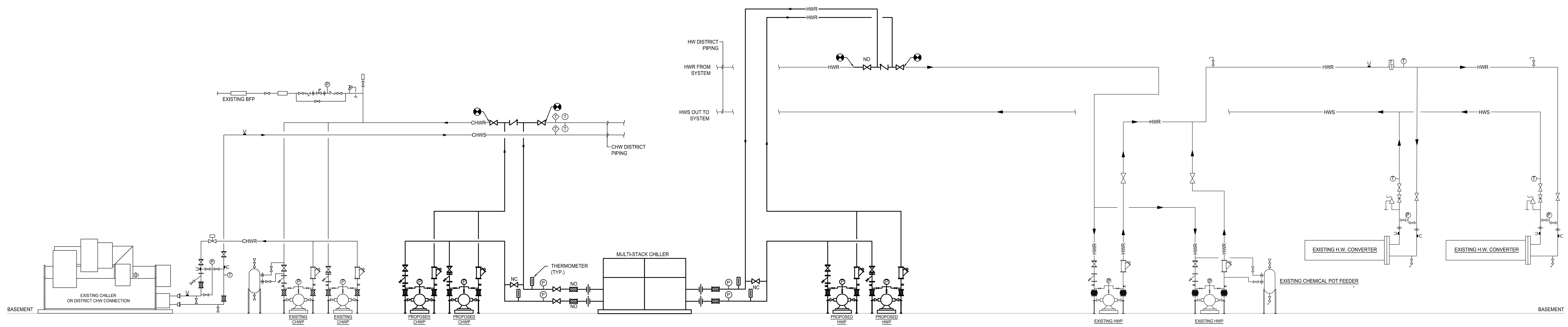
DII. **Electrical | Power Distribution**

1. **Chiller Connection |** Provide new 300A breaker in the power switchgear. Provide 480V 300A disconnect, including mounting and verification of clearances. Provide 350 Kcmil wire and 4 conduit including hangers, supports, through penetrations, terminations and other specialties.
2. **Panel Board for Pumps |** Provide new 20A 480V breaker in existing distribution gear for Primary HR Cooling Loop Pump. For each pump, provide three (3) #12 conductors plus ground in 3/4 conduit. Provide mounting, connections, verification of clearances. Connect to new VSD.
3. **Panel Board for Pumps |** Provide new 25A 480V breaker in existing distribution gear for Heat Rejection Primary Loop Pumps. For each pump, provide three (3) #12 conductors plus ground in 3/4 conduit. Provide mounting, connections, verification of clearances. Connect to new VSD.

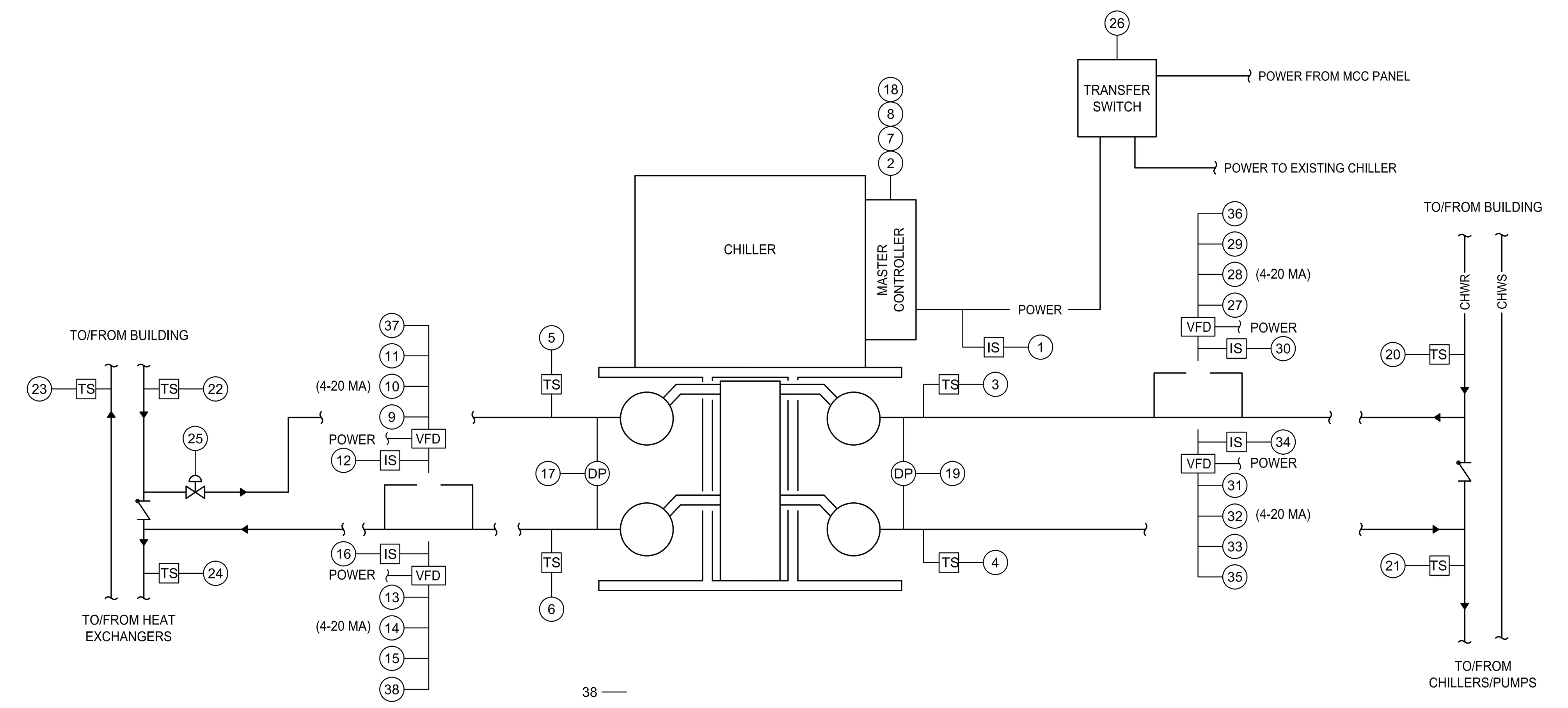
DIII. **Controls**

1. Heat Recovery System Controls:
   a. Provide a component panel enclosure with new pneumatic devices and a main controller enclosure.
   b. Provide 10K thermistor immersion temperature sensors to monitor the hot water supply and return temperature at the chiller, pump loop and each heat exchanger.
   c. Provide relays for start/stop and current sensors for status at each pump VFD (or starters for the inline pumps) and wire to the new controller.
   d. Provide controller inputs to monitor each VFD alarm and controller outputs control each VFD speed.
   e. Provide a new differential pressure sensor for the new lead/lag set of pumps for VFD speed control and wire to the new controller.
   f. Provide and install 10K thermistor immersion temperature sensors to monitor the chilled water supply and return temperature at the chiller, pump loops, water to water heat pump and dry cooler.

g. Provide relays for start/stop and current sensors for status at each pump VFD and wire to the new controller. This includes the pump VFDs for the water to water heat exchanger.
h. Provide controller inputs to monitor each VFD alarm and controller outputs control each VFD speed.
i. Provide a new differential pressure sensor for the CHW side and HW side of the WWHP and wire to the new controller.
j. Provide point capacity for start/stop, alarm and status at the WWHP master control panel and wire to the new controller.
k. Provide point capacity for a cooling reset, heating reset and heater alarm at the chiller and wire to the new controller.
l. Provide a new pneumatic 3-way condenser water bypass valve and run poly tubing in EMT back to the component panel.
m. Furnish and install a new refrigerant monitor and wire to the new controller.
n. Provide Programming and Points to achieve the following:
    (1) HR Chiller Input power in kW
    (2) Heat Rejection Loop Supply Temp, Return Temp and Pump Speed
    (3) HR Cooling Loop Supply Temp, Return Temp and Pump Speed
    (4) Building Chilled Water Loop Supply Temp, Return Temp and Pump Speed
    (5) Building Hot Water Loop Supply Temp, Return Temp and Pump Speed

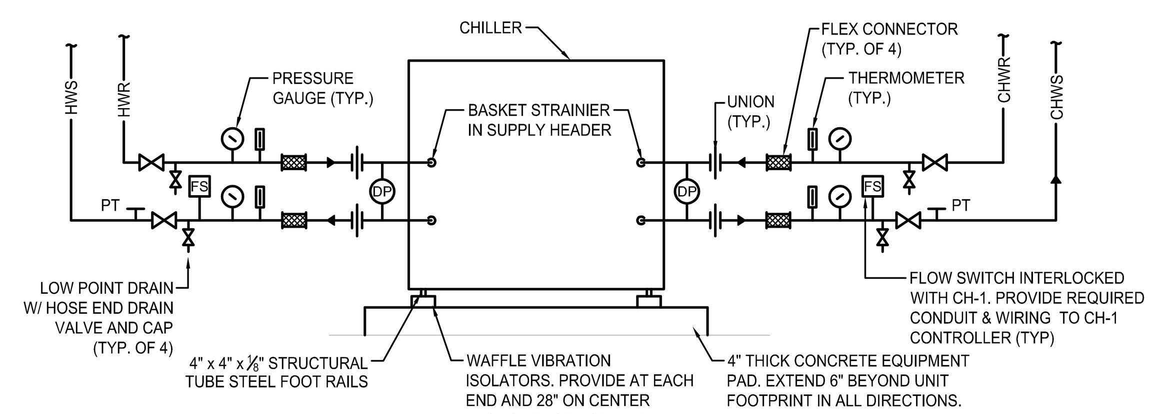


1 HEAT RECOVERY LOOP SCHEMATIC
SCALE: NOT TO SCALE



HVAC ABBREVIATIONS

BFP	BACKFLOW PREVENTER
CHW	CHILLED WATER
CHWR	CHILLED WATER RETURN
CHWS	CHILLED WATER SUPPLY
CHWP	CHILLED WATER CIRCULATING PUMP
HW	HOT WATER
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
HWP	HOT WATER CIRCULATING PUMP
NC	NORMALLY CLOSED
NO	NORMALLY OPEN



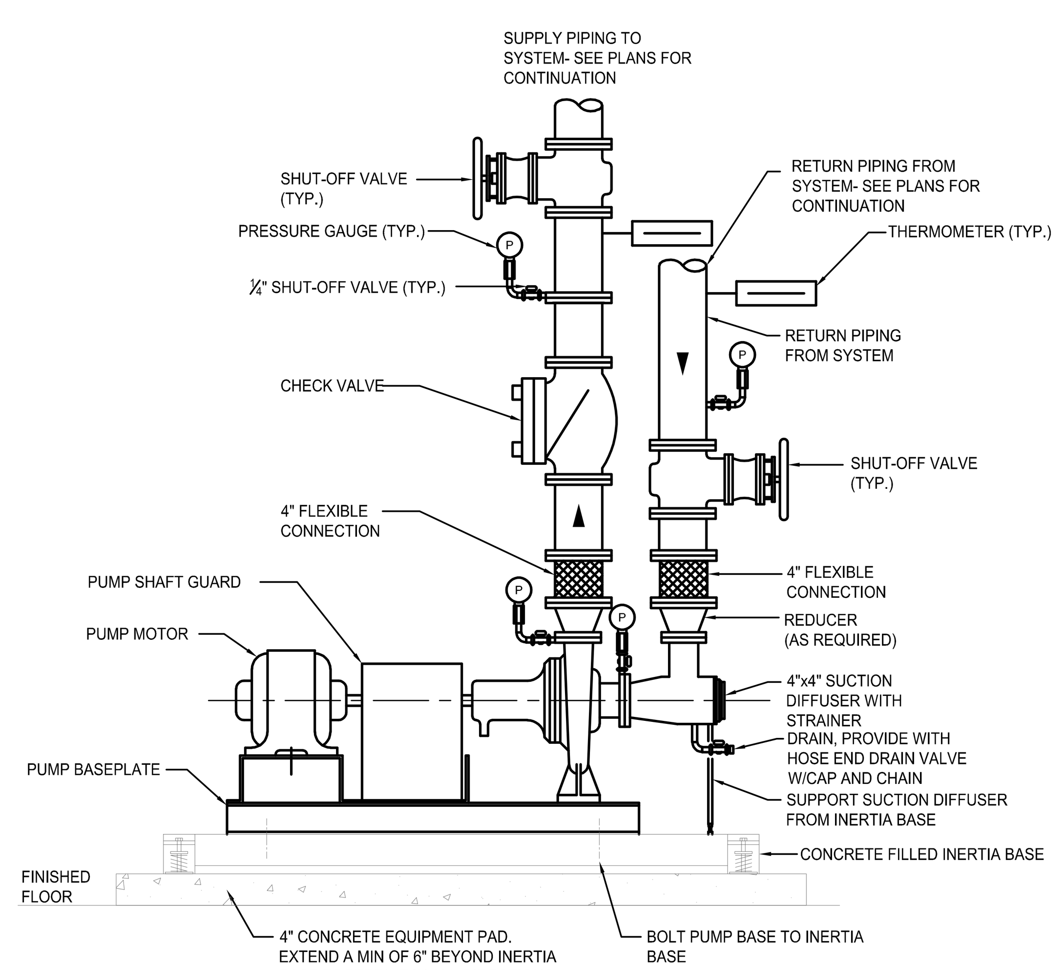
2 HEAT RECOVERY CHILLER PIPING DETAIL
SCALE: NOT TO SCALE

HVAC SYMBOLS - PIPING DESIGNATIONS

- EXISTING PIPING (REFER TO DESIGNATIONS BELOW FOR TYPE)
- PIPING TO BE REMOVED (REFER TO DESIGNATIONS BELOW FOR TYPE)
- HWS — HOT WATER SUPPLY
- HWR — HOT WATER RETURN
- CHWS — CHILLED WATER SUPPLY
- CHWR — CHILLED WATER RETURN
- CWS — CONDENSER WATER SUPPLY
- CWR — CONDENSER WATER RETURN
- POINT OF CONNECTION

HVAC SYMBOLS - VALVES AND SPECIALTIES

- SHUT-OFF VALVE (GATE, BALL, ETC.)
- CHECK VALVE
- STRAINER
- FLEXIBLE CONNECTOR
- DIRECTION OF FLOW
- SENSOR/SWITCH (X INDICATES P - PRESSURE, T - TEMPERATURE, F - FLOW)
- GAUGE (X INDICATES T - TEMPERATURE, P - PRESSURE, F - FLOW)
- PT — PRESSURE/TEMPERATURE TAP
- CIRCULATING PUMP
- UNION



3 BASE MOUNTED CIRCULATING PUMP
SCALE: NOT TO SCALE

CONTROL POINTS LIST

SYSTEM: HEAT RECOVERY CHILLER

		HARDWARE POINTS				SOFTWARE POINTS					
	POINT DESCRIPTION	ANALOG INPUT	ANALOG OUTPUT	DIGITAL INPUT	DIGITAL OUTPUT	ANALOG VALUE	DIGITAL VALUE	SCHEDULE	TREND	ALARM	SHOW ON GRAPHIC
1	STATUS			X						X	X
2	ENABLE /DISABLE				X						X
3	CHILLER EVAPORATOR ENTERING WATER TEMP	X				X			X	X	X
4	CHILLER EVAPORATOR LEAVING WATER TEMP	X				X			X		X
5	CHILLER CONDENSER ENTERING WATER TEMP	X				X			X	X	X
6	CHILLER CONDENSER LEAVING WATER TEMP	X				X			X		X
7	CHILLER ALARM			X						X	X
8	CHILLED WATER SUPPLY TEMP SETPOINT		X					X		X	X
9	PUMP START/STOP				X			X			X
10	SPEED		X				X				X
11	ALARM			X						X	X
12	STATUS			X						X	X
13	PUMP START/STOP				X			X			X
14	SPEED		X				X				X
15	ALARM			X						X	X
16	STATUS			X						X	X
17	DIFFERENTIAL PRESSURE SENSOR EVAPORATOR	X				X		X			X
18	HOT WATER SUUPLY TEMP SETPOINT		X					X		X	X
19	DIFFERENTILA PRESSURE SENSOR CONDENSER	X				X		X			X
20	UPSTREAM CHILLED WATER RETURN TEMP	X				X			X	X	X
21	DOWNSTREAM CHILLED WATER RETURN TEMP	X				X			X	X	X
22	UPSTREAM HOT WATER RETURN TEMP	X				X			X	X	X
23	HOT WATER SUPPLY TEMP	X				X			X	X	X
24	DOWNSTREAM HOT WATER RETURN TEMP	X				X			X	X	X
25	HOT WATER RETURN CONTROL VALVE				X		X				X
26	CHILLER POWER TRANSFER SWITCH				X		X		X		X
27	PUMP START/STOP				X			X			X
28	SPEED		X				X				X
29	ALARM			X						X	X
30	STATUS			X						X	X
31	PUMP START/STOP				X			X			X
32	SPEED		X				X				X
33	ALARM			X						X	X
34	STATUS			X						X	X
35	SPEED FEEDBACK	X				X			X		X
36	SPEED FEEDBACK	X				X			X		X
37	SPEED FEEDBACK	X				X			X		X
38	SPEED FEEDBACK	X				X			X		X

4 HEAT RECOVERY CHILLER CONTROL POINT LIST
SCALE: NOT TO SCALE

NO.	DATE	DESCRIPTION
0	12/29/20	BID DOCUMENTS

REVISIONS

PREPARED FOR
UNIVERSITY OF ROCHESTER
UTILITIES AND ENERGY MANAGEMENT DEPT.
ROCHESTER, NEW YORK

PREPARED BY

wendel
Centerpointe Corporate Park
375 Essjay Road, Suite 200
Williamsville, NY 14221
www.wendelcompanies.com
p:716.688.0766 f:716.625.6825

MRBx - Heat Recovery Systems

SHEET NUMBER M-001

Archive Drawing Number	DRAWN BY	DATE	OF
402805	RGK	05/11/2020	1 OF 1

wendel DIRECT MATERIAL & LABOR | COST ESTIMATE

Project : University of Rochester | BMEO
Project # : 402805
Measure : ECM 5 | Heat Recovery Systems
Date : 04/01/21

Estimated by: GHB
Checked by: JGD
Approved by: JGD
Vendor Quotes: No
Subcontractor Pricing: No

Item No.	Description	Material	Labor	Other[1]	Subtotal Cost
	1.1 Equipment				**$0.00**
	A. Heat Recovery Chiller (RL Kistler Budget)	$105,840.00	$0.00	$0.00	**$105,840.00**
	B. Chilled Water Pumps	$3,780.00	$0.00	$0.00	**$3,780.00**
	C. Hot Water Pumps	$3,780.00	$0.00	$0.00	**$3,780.00**
	D. Variable Frequency Drives	$5,594.40	$0.00	$0.00	**$5,594.40**
	E. In-line Relief Fan	$1,323.00	$0.00	$0.00	**$1,323.00**
	F. Specialties	$37,800.00	$0.00	$0.00	**$37,800.00**
	1.2 Rigging & Equipment Setting				**$0.00**
	A. Receiving & Storage	$0.00	$642.60	$0.00	**$642.60**
	B. Delivery	$0.00	$907.20	$0.00	**$907.20**
	C. Concrete Equipment Pads	$680.40	$1,436.40	$0.00	**$2,116.80**
	D. Crane & Rigging	$0.00	$604.80	$1,512.00	**$2,116.80**
	1.3 Piping				**$0.00**
	A. Chilled Water Piping	$0.00	$0.00	$68,040.00	**$68,040.00**
	B. Hot Water Piping	$0.00	$0.00	$68,040.00	**$68,040.00**
	C. Core Drilling	$0.00	$3,024.00	$0.00	**$3,024.00**
	D. Insulation (Piping & Pumps)	$3,402.00	$5,670.00	$0.00	**$9,072.00**
	1.4 Electrical				**$0.00**
	A. Electrical Chase / Conduit Installation	$12,768.00	$14,112.00	$0.00	**$26,880.00**
	B. Heat Recovery Chiller Breaker & Feeders	$6,426.00	$5,670.00	$0.00	**$12,096.00**
	C. CHW / HW Pumps Breakers & Feeders	$6,955.20	$7,560.00	$0.00	**$14,515.20**
	D. BAS Controls Electrical Connections	$340.20	$907.20	$0.00	**$1,247.40**
	E. Refrigerant Relief Fan Service	$1,587.60	$1,360.80	$0.00	**$2,948.40**
	1.5 Controls				**$0.00**
	A. Heat Recovery Chiller Points	$4,536.00	$4,536.00	$0.00	**$9,072.00**
	B. CHW / HW Pumps VFD Points	$7,257.60	$7,257.60	$0.00	**$14,515.20**
	C. ASHRAE 15 System	$6,048.00	$9,072.00	$0.00	**$15,120.00**
	D. Misc. Control / Monitoring Points	$5,443.20	$5,443.20	$0.00	**$10,886.40**
	E. Modulating Control Valves	$3,780.00	$0.00	$0.00	**$3,780.00**
	1.6 Refrigerant Relief System				**$0.00**
	A. Sidewall Louvers	$1,663.20	$2,646.00	$0.00	**$4,309.20**
	B. Ductwork	$2,646.00	$4,158.00	$0.00	**$6,804.00**
	C. Wall Penetrations	$0.00	$2,646.00	$0.00	**$2,646.00**
	1.7 Start-up / Commissioning				**$0.00**
	A. CHW / HW Pump & Motor Alignments	$0.00	$2,268.00	$0.00	**$2,268.00**
	B. Testing & Balancing Services	$0.00	$1,134.00	$0.00	**$1,134.00**
	C. Factory Start-Up	$0.00	$2,646.00	$0.00	**$2,646.00**
	1.8 Warranty				**$0.00**
	A. 2-Year Parts & Labor Warranty	$0.00	$0.00	$15,120.00	**$15,120.00**
3.0	General Costs: Bonds	$0.00	$0.00	$9,619.36	**$9,619.36**
3.1	General Costs: Other	$0.00	$0.00	$9,619.36	**$9,619.36**
				Subtotal:	$477,303

Contingency:	5.0%	$23,865
Escalation Reserve:	5.0%	$23,865
Engineering Procurement & Construction MGMT:	25.0%	$119,326
Total:		$644,359

Notes

[1] Other inclues misc. material and equipment necessary for installation, communication, insurances, permits, bonding. Prior to final pricing and subcontract execution these values will be required to be itemized by the bidder.

ECM 5: Heat Recovery Systems

The following is a General Scope of Work for the University of Rochester Energy Conservation Master Plan. The intent of this document is to provide a general outline of the project scope of work for developing firm project costs. Project Design Documents, including construction and permit sets, will be developed following approval of the proposed project by University of Rochester.

Project Job Site(s)

No.	Building Name
1	BMEO

***** NOT FOR CONSTRUCTION *****

The scope of this project consists of providing all labor and material, along with providing all equipment necessary to complete and make fully operational the systems defined in this specification. The project is intended to follow University of Rochester design guidelines. All products, procedures, and completed systems are intended to comply with ASHRAE standards. While this document does not include specification details, the final project manual will be produced that includes specifications that are aligned with University of Rochester design standards.

It is our expectation that the subcontractor submitting a quotation is familiar with the University of Rochester design standards and has accounted for the impact these standards have on pricing, including but not limited, material, labor and general conditions.

1.0 General

A. **Documents |** At the start of construction, submit manufacturer's product data for materials (including but not limited to: sensors, actuators, controllers, cabinets, wire & conduit), P&ID drawings, coordination & layout drawings, and other commonly required submittals per University of Rochester standards.

B. **Documents |** Maintaining of all Project Record Documents as detailed in this Contract Document.

C. **Documents |** Document and Submit a summary of existing conditions including digital photos of the job site prior to the start of work.
   a. Examine sizes and conditions of existing equipment.

D. **Material Handling |** Label all control wiring.

E. **Material Handling |** Delivery of the material and equipment to job site.

F. **Material Handling |** A location within the facility will be identified for the subcontractor to store all material and equipment. The subcontract is required to keep this area organized and accessible as well as free of any loose material or garbage.

G. **Material Handling |** Provide moving, storage and protection for all University of Rochester's existing equipment, furniture and cabinetry on job site to perform contract work. Protect floor in areas used to store furniture.

H. **Installation Requirements |** Provide all associated equipment, and all particulars/specialties needed to make the provided equipment fully functional and perform its intended use.

I. **Installation Requirements |** Install all equipment per manufacturer's instructions

J. **Installation Requirements |** Paint and finish as needed to match preconstruction conditions.

K. **Installation Requirements |** Subcontractor is responsible for all cutting and patching associated with the work.

L. **Permits |** Subcontractor with Contractor approval will submit application for electric service permits if necessary. The Subcontractor will pay the cost of the permits.

M. **Permits |** Building permit fees will be paid by Wendel.

N. **Inspections & Codes |** All electrical work must be performed by a licensed electrical contractor and include a valid underwriters certification at the completion of the project as part of the close out O&M package.

O. **Inspections & Codes |** Provide all electrical connections required in accordance with all Federal, State, and Local Codes.

P. **Inspections & Codes |** Field verify all voltages prior to ordering any equipment.

Q. **Installation Requirements |** Removal of all waste generated by Work per EPA requirements, University of Rochester standards, and local authority regulations.

R. **Inspections & Codes |** Test, adjust, and balance all equipment and materials provided, or modified under this Subcontract.

S. **Inspections & Codes |** Provide all mechanical connections required in accordance with all Federal, State, and Local Codes.

T. **Coordination |** Coordination of equipment and utility service shutdowns with 2-weeks notice to the facility and Wendel. All work requiring a shutdown will be completed during normal business hours.

U. **Closeout |** Provide operator training and operation manuals

V. **Closeout |** Starting Systems

1. Coordinate schedule for start-up of various equipment and systems.
2. Notify Wendel and facility seven days prior to start-up of each item.
3. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
4. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
5. Verify wiring and support components for equipment are complete and tested. Execute start-up under supervision of responsible Contractors' personnel in accordance with manufacturers' instructions.
6. Provide manufacturer authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

W. **Commissioning |** Subcontractor shall assign representatives with expertise and authority to act on its behalf to participate in and perform commissioning process activities under the direction of Wendel. Wendel will develop commissioning procedures the subcontractor will be responsible to execute the procedure under Wendel’s supervision.

X. **Trending |** All points connected to the building management system shall be trended and have data stored for three years at a minimum of one (1) hour intervals. All trends shall be remotely accessible by Wendel or another authorized and University of Rochester approved third party.

Y. **Trending |** Trended data will be viewable in tabular and graphic form in conjunction with current BMS formatting standards at University of Rochester. Subcontractor to integrate into existing BMS. This data will also have the ability to be exported into a csv. Formatted file.

Z. **OVERALL SYSTEM |** The new control points added shall fully integrate into the existing building management system. The required integration shall include the creation of custom graphics and the compilation and display of all devices and objects on the existing Siemens Apogee BMS interface. All graphic displays will reside on the existing Siemens Apogee BMS interface and be modified accordingly. In addition, the system shall perform the said integration through the use of BACnet/IP communications).

AA. **Key Definition |** Provide - furnish and install

BB. **Key Definition |** Wendel - maybe referred to as, Wendel, Contractor, or Design/Builder

1.1 ECM 5 | Heat Recovery System

A. Heat Recovery Chiller

1. Install Heat Recovery Chiller 90 nominal tons with a condenser water leaving temperature of 140˚F and a chilled water supply temperature of 44°F. New heat recovery chiller shall utilized R410a refrigerant.
   [CUT SHEET PROVIDED

B. Chilled Water Loop Modifications

1. **Primary HR Cooling Loop Pump & Motor |** Provide two (2) base mounted pump and motor sets with a capacity of 170 gpm at 55ft of head and premium efficiency motor with 5 Hp and class G insulation. Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation.
   [CUT SHEET PROVIDED
2. **4" Chilled Water Pipe |** Provide 200 linear feet of schedule 40 steel 4 chilled water pipe. Refer to Exhibit D for layout and schematic. Include valves, mounting and through penetrations. Note pipe length is for the total length of both supply and return piping, it also does not include fitting factors. Provide pipe insulation on all new piping per the State of New York Energy Conservation Code.
3. **Strainer & Filter |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
4. **Expansion Tank |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
5. **Air Separator |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
6. **Refill / Purge / Water Treatment |** All existing loops should be isolated either through the use of shutoff valve or frozen with new valves installed. The intent is to NOT drain any existing system beyond what is necessary to perform the work. All new work will be filled, the water will be treated and the system will be vented of air.
7. **Balance |** Provide hydronic balancing of the new equipment and interconnections to each loop.

C. Hot Water Loop Modifications

1. **Primary HR Cooling Loop Pump & Motor |** Provide two (2) base mounted pump and motor sets with a capacity of 242 gpm at 65 ft of head and premium efficiency motor with 7.5 Hp and class G insulation. Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation.
   [CUT SHEET PROVIDED
2. **4" Hot Water Water Pipe |** Provide 200 linear feet of schedule 40 steel 4 hot water pipe. Refer to Exhibit D for layout and schematic. Include valves, mounting and through penetrations. Note pipe length is for the total length of both supply and return piping, it also does not include fitting factors. Provide pipe insulation on all new piping per the State of New York Energy Conservation Code.
3. **Strainer & Filter |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
4. **Expansion Tank |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.

5. **Air Separator |** Provide as part of the installation, housekeeping pad, connections, mounting, hangers valves, and other specialties as necessary to provide a complete installation as outlined in the typical detail provided in Exhibit D.
6. **Refill / Purge / Water Treatment|** All existing loops should be isolated either through the use of shutoff valve or frozen with new valves installed. The intent is to NOT drain any existing system beyond what is necessary to perform the work. All new work will be filled, the water will be treated and the system will be vented of air.
7. **Balance |** Provide hydronic balancing of the new equipment and interconnections to each loop.

D. **Refrigerant Alarm & Exhaust**

1. **Refrigerant Alarm |** Provide new refrigerant alarm with appropriate sensors, annunciators, strobes, signage, etc. as required per the local & state code.
2. **Refrigerant Ventilation |** Provide new inline exhaust fan, ductwork, specialties, controls, and wall penetration in existing chase for new refrigerant exhaust system.

DI. **Electrical | Pumps & Fans**

1. **New VSD |** Install ABB VFD with integrated bypass for Hp as noted for **Primary HR Cooling Loop and Heat Rejection Primary Loop Pumps.** Provide mounting, power wire as noted in table below, EMT conduit, through penetrations, electrical connections and specialties.
2. **Controls VSD |** Provide connection of VSD to building management system. Provide control points including, % speed, Hz, kW, with up to three years or trending in 1 hour intervals. Provide mounting, control wire, power wire, EMT conduit, through penetrations, electrical connections and specialties.
3. **Refrigerant Fan |** Install new combination motor starter / disconnect to serve new refrigerant exhaust fan.

DII. **Electrical | Power Distribution**

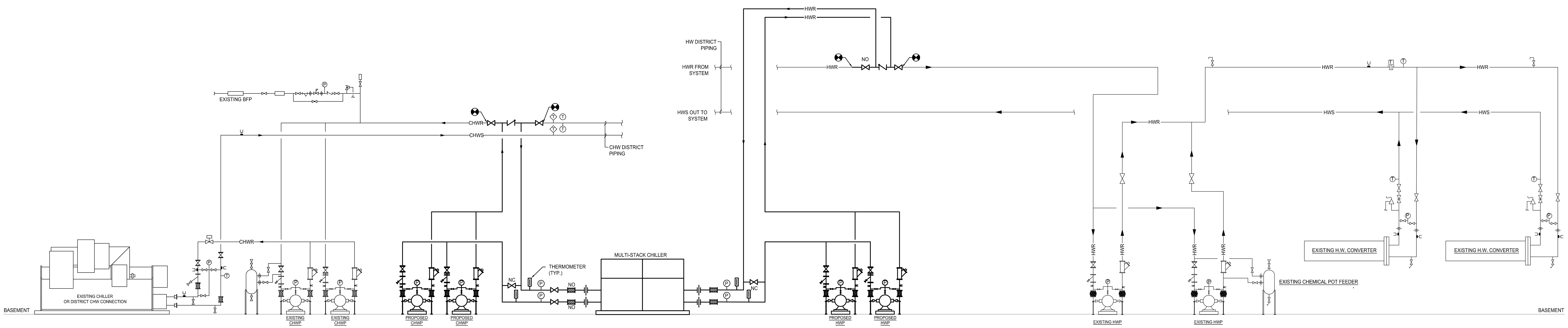
1. **Chiller Connection |** Provide new 225A breaker in the power switchgear. Provide 480V 225A disconnect, including mounting and verification of clearances. Provide 250 Kcmil wire plus ground in 4 conduit including hangers, supports, through penetrations, terminations and other specialties.
2. **Panel Board for Pumps |** Provide new 15A 480V breaker in existing distribution gear for Primary HR Cooling Loop Pump. For each pump, provide three (3) #14 conductors plus ground in 3/4 conduit. Provide mounting, connections, verification of clearances. Connect to new VSD.
3. **Panel Board for Pumps |** Provide new 15A 480V breaker in existing distribution gear for Heat Rejection Primary Loop Pumps. For each pump, provide three (3) #14 conductors plus ground in 3/4 conduit. Provide mounting, connections, verification of clearances. Connect to new VSD.

DIII. **Controls**

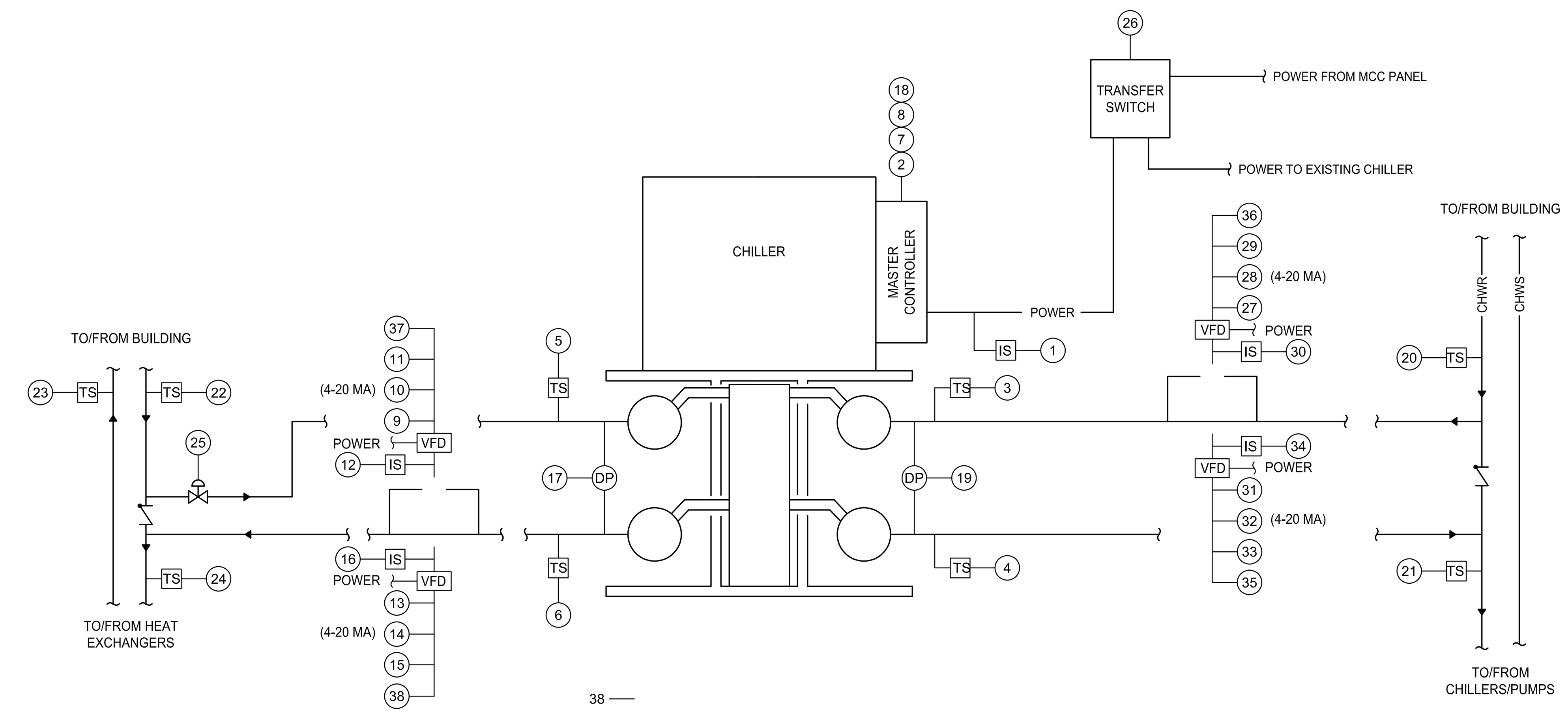
1. Heat Recovery System Controls:
   a. Provide a component panel enclosure with new pneumatic devices and a main controller enclosure.
   b. Provide 10K thermistor immersion temperature sensors to monitor the hot water supply and return temperature at the chiller, pump loop and each heat exchanger.
   c. Provide relays for start/stop and current sensors for status at each pump VFD (or starters for the inline pumps) and wire to the new controller.
   d. Provide controller inputs to monitor each VFD alarm and controller outputs control each VFD speed.
   e. Provide a new differential pressure sensor for the new lead/lag set of pumps for VFD speed control and wire to the new controller.

f. Provide and install 10K thermistor immersion temperature sensors to monitor the chilled water supply and return temperature at the chiller, pump loops, water to water heat pump and dry cooler.

g. Provide relays for start/stop and current sensors for status at each pump VFD and wire to the new controller. This includes the pump VFDs for the water to water heat exchanger.
h. Provide controller inputs to monitor each VFD alarm and controller outputs control each VFD speed.
i. Provide a new differential pressure sensor for the CHW side and HW side of the WWHP and wire to the new controller.
j. Provide point capacity for start/stop, alarm and status at the WWHP master control panel and wire to the new controller.
k. Provide point capacity for a cooling reset, heating reset and heater alarm at the chiller and wire to the new controller.
l. Provide a new pneumatic 3-way condenser water bypass valve and run poly tubing in EMT back to the component panel.
m. Furnish and install a new refrigerant monitor and wire to the new controller.
n. Provide Programming and Points to achieve the following:
    (1) HR Chiller Input power in kW
    (2) Heat Rejection Loop Supply Temp, Return Temp and Pump Speed
    (3) HR Cooling Loop Supply Temp, Return Temp and Pump Speed
    (4) Building Chilled Water Loop Supply Temp, Return Temp and Pump Speed
    (5) Building Hot Water Loop Supply Temp, Return Temp and Pump Speed

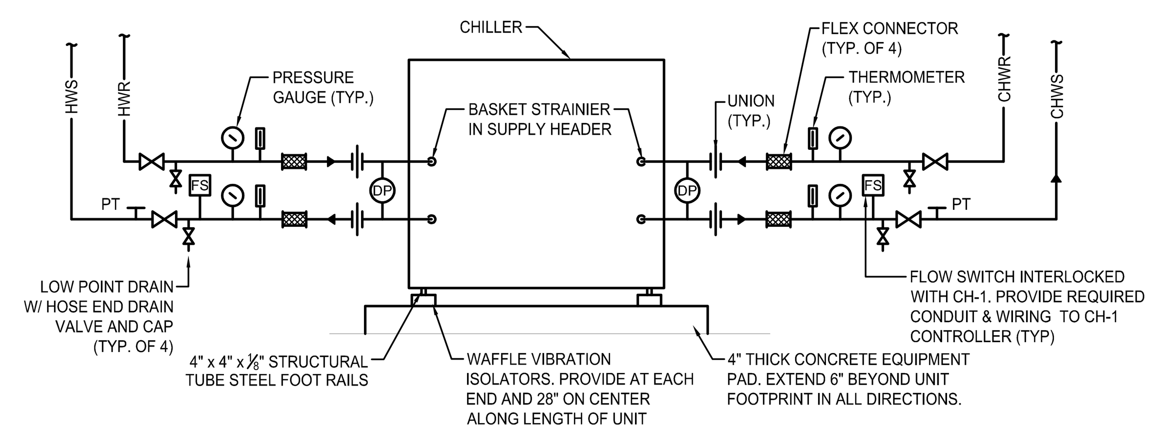


1 HEAT RECOVERY LOOP SCHEMATIC
SCALE: NOT TO SCALE



HVAC ABBREVIATIONS

BFP	BACKFLOW PREVENTER
CHW	CHILLED WATER
CHWR	CHILLED WATER RETURN
CHWS	CHILLED WATER SUPPLY
CHWP	CHILLED WATER CIRCULATING PUMP
HW	HOT WATER
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
HWP	HOT WATER CIRCULATING PUMP
NC	NORMALLY CLOSED
NO	NORMALLY OPEN



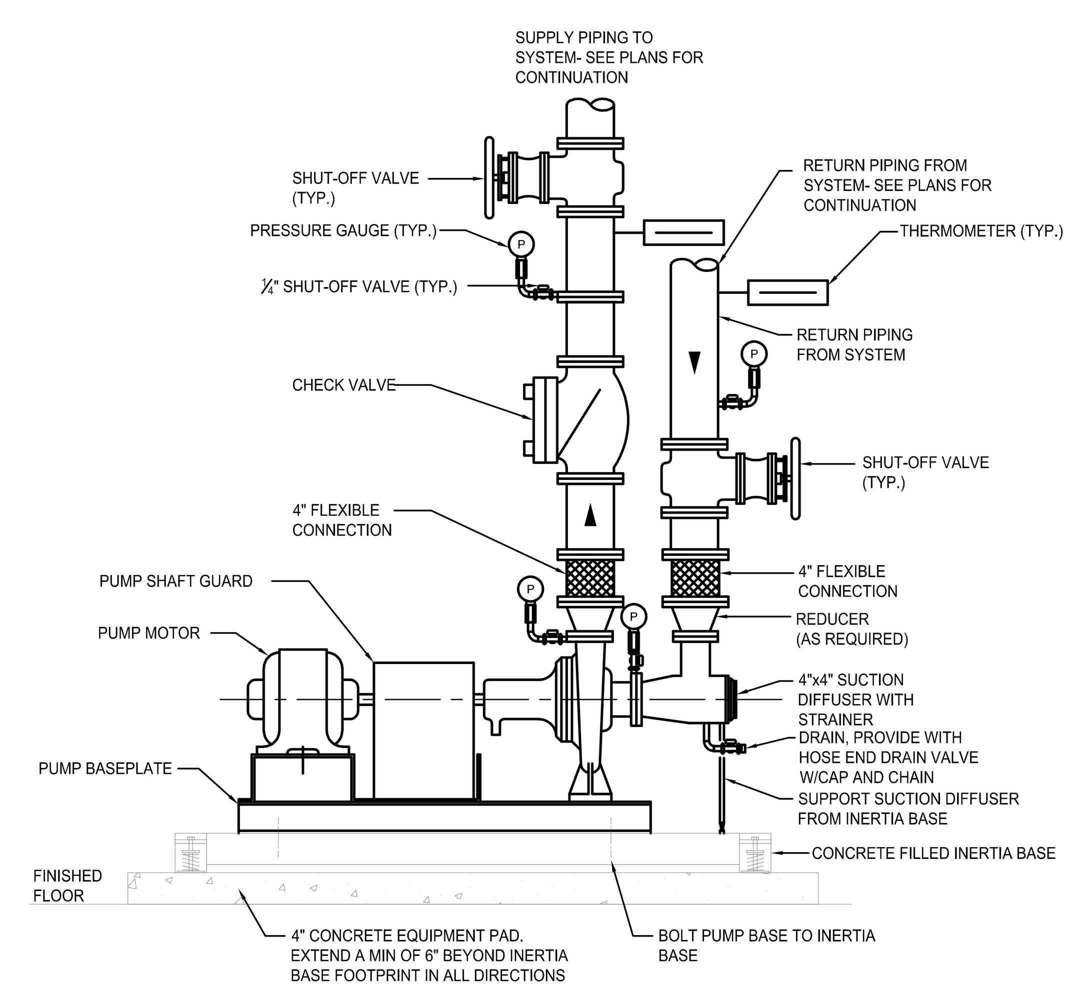
2 HEAT RECOVERY CHILLER PIPING DETAIL
SCALE: NOT TO SCALE

HVAC SYMBOLS - PIPING DESIGNATIONS

- EXISTING PIPING (REFER TO DESIGNATIONS BELOW FOR TYPE)
- PIPING TO BE REMOVED (REFER TO DESIGNATIONS BELOW FOR TYPE)
- HWS — HOT WATER SUPPLY
- HWR — HOT WATER RETURN
- CHWS — CHILLED WATER SUPPLY
- CHWR — CHILLED WATER RETURN
- CWS — CONDENSER WATER SUPPLY
- CWR — CONDENSER WATER RETURN
- POINT OF CONNECTION

HVAC SYMBOLS - VALVES AND SPECIALTIES

- SHUT-OFF VALVE (GATE, BALL, ETC.)
- CHECK VALVE
- STRAINER
- FLEXIBLE CONNECTOR
- DIRECTION OF FLOW
- SENSOR/SWITCH (X INDICATES P - PRESSURE, T - TEMPERATURE, F - FLOW)
- GAUGE (X INDICATES T - TEMPERATURE, P - PRESSURE, F - FLOW)
- PT — PRESSURE/TEMPERATURE TAP
- CIRCULATING PUMP
- UNION



3 BASE MOUNTED CIRCULATING PUMP
SCALE: NOT TO SCALE

CONTROL POINTS LIST

SYSTEM: HEAT RECOVERY CHILLER

	POINT DESCRIPTION	HARDWARE POINTS: ANALOG INPUT	ANALOG OUTPUT	DIGITAL INPUT	DIGITAL OUTPUT	SOFTWARE POINTS: ANALOG VALUE	DIGITAL VALUE	SCHEDULE	TREND	ALARM	SHOW ON GRAPHIC
1	STATUS			X						X	X
2	ENABLE /DISABLE				X						X
3	CHILLER EVAPORATOR ENTERING WATER TEMP	X				X			X	X	X
4	CHILLER EVAPORATOR LEAVING WATER TEMP	X				X			X		X
5	CHILLER CONDENSER ENTERING WATER TEMP	X				X			X	X	X
6	CHILLER CONDENSER LEAVING WATER TEMP	X				X			X		X
7	CHILLER ALARM			X						X	X
8	CHILLED WATER SUPPLY TEMP SETPOINT		X					X		X	X
9	PUMP START/STOP				X			X			X
10	SPEED		X				X				X
11	ALARM			X						X	X
12	STATUS			X						X	X
13	PUMP START/STOP				X			X			X
14	SPEED		X				X				X
15	ALARM			X						X	X
16	STATUS			X						X	X
17	DIFFERENTIAL PRESSURE SENSOR EVAPORATOR	X				X		X			X
18	HOT WATER SUUPLY TEMP SETPOINT		X					X		X	X
19	DIFFERENTILA PRESSURE SENSOR CONDENSER	X				X		X			X
20	UPSTREAM CHILLED WATER RETURN TEMP	X				X			X	X	X
21	DOWNSTREAM CHILLED WATER RETURN TEMP	X				X			X	X	X
22	UPSTREAM HOT WATER RETURN TEMP	X				X			X	X	X
23	HOT WATER SUPPLY TEMP	X				X			X	X	X
24	DOWNSTREAM HOT WATER RETURN TEMP	X				X			X	X	X
25	HOT WATER RETURN CONTROL VALVE				X		X				X
26	CHILLER POWER TRANSFER SWITCH				X		X		X		X
27	PUMP START/STOP				X			X			X
28	SPEED		X				X				X
29	ALARM			X						X	X
30	STATUS			X						X	X
31	PUMP START/STOP				X			X			X
32	SPEED		X				X				X
33	ALARM			X						X	X
34	STATUS			X						X	X
35	SPEED FEEDBACK	X				X			X		X
36	SPEED FEEDBACK	X				X			X		X
37	SPEED FEEDBACK	X				X			X		X
38	SPEED FEEDBACK	X				X			X		X

4 HEAT RECOVERY CHILLER CONTROL POINT LIST
SCALE: NOT TO SCALE

NO.	DATE	DESCRIPTION
0	12/29/20	BID DOCUMENTS

REVISIONS

PREPARED FOR
UNIVERSITY OF ROCHESTER
UTILITIES AND ENERGY MANAGEMENT DEPT.
ROCHESTER, NEW YORK

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BMEO - Heat Recovery Systems

SHEET NUMBER M-001

Archive Drawing Number	DRAWN BY	DATE	OF
402805	RGK	05/11/2020	1 OF 1

Technical Appendix 4

Retro-Commissioning Scoping Survey ECM

RCX Scoping Survey

University of Rochester

PROJECT

Retro-Commissioning Scoping Survey

Report Date

October 4th, 2021

Prepared By:

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Wendel Companies
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Rochester, NY 14608

Reviewed By:

Jason G. Denue, PE, REP
Principal
Wendel Companies

contents

Section 1

Executive Summary

Executive Summary

1.1 Purpose (Why)

Determine if retro-commissioning (RCx) is an appropriate energy conservation measure where we should be spending some of our limited capital funds and to provide a basis for authorizing the next step of the RCx investigation. (..part of a larger study, but may be viewed independently..)

1.2 Study Goals

Estimate the projected energy savings and expenses associated with performing future retro-commissioning projects across campus.

1.3 Building Selection

We determined that the project was funded sufficiently for a scoping of three buildings which were selected as follows:

1. We decided to focus on River Campus and avoid selecting Medical Center buildings for this study because MC buildings are more complex, require additional study resources and we did not want to add the complexity of working around or take the chance of impacting patient care, particularly during the COVID-19 Pandemic.
2. We started with a list of 74 buildings. See Appendix C.
3. The list was narrowed down to selected 10 candidate buildings which have:
    a. Coincidental heating and cooling use
    b. Average or higher energy use intensity (EUI) Kbtu/sqft
    c. Average or higher high total annual energy use
        i. Based on industry guidelines for building type and also compared to other RC buildings.
4. The list was finally narrowed down from ten to three buildings based on:
    a. non-residential (limited opportunity)
    b. non-laboratory, non-medical (too difficult for this limited study)
    c. Ease of physical access
    d. Access to the building automation system (BAS) and documentation.

The selected buildings were Rush Rhees Library, Danforth Dining Center, and Frederick Douglass Center.

1.3 Methodology

This Report presents an assessment of the major energy-consuming equipment and identifies potential RCx opportunities and includes the following elements:

1. Energy usage analysis for the last 24 months (Page 14)
2. Building documentation review (Page 31)
3. Building staff interview notes (Appendix A) (Page 37)
4. Facility walk-through notes (Appendix B) (Page 78)
5. Building Management System (BMS) assessment (Page 78)

1.4 Scope

The scope of this study consisted of the first step of three in RetroCommissioning. In the Scoping study a cursory review of energy usage, building prints, building controls and walkthrough is performed. The objective of this scoping study was to identify controls alterations that would achieve a reduction is energy usage and have a moderate to low simple payback. These Energy conservation measures would then be tabulated and conveyed to University of Rochester for review and consideration of Implementation. A secondary objective of this scoping study was to extrapolate the finding of the three buildings selected to the rest of the river and medical campus to give a perspective of what performing how type of work could help reduce energy cost, usage and overall payback of the conservation effort.

1.5 Results

The following is a summary of the three building that were selected. The scoping study, after being review with University of Rochester staff, produced energy conservation measures that range from moderate to easy to implement with

Building	Estimated Energy Savings					ECM Cost ($)*	Simple Payback (Years)	Page
	Cooling (%)*	Electric (%)*	Heating (%)*	Total (%)*	Dollars ($)*,**			
Danforth	6.0%	4.1%	4.2%	2.5%	$9,273	$24,000	2.6	
RRL	13.7%	13.6%	13.3%	8.6%	$106,149	$165,130	1.6	
FDC	16.1%	0.1%	14.3%	7.7%	$35,818	$64,900	1.8	
Total	13.3%	7.2%	12.3%	7.5%	$151,240	$254,030	1.7	
Campus***	13.3%	7.2%	12.3%	7.5%	$2,658,173	$4,901,922	1.7	

*Reflects the middle of the road savings/costs estimate in the savings/cost Charts.

** Reflects utility rate charted to the building by UEM including overhead. See table shown on indicated page for financial information related to utility/commodity savings only.

*** Results extrapolated to UEM connected buildings on River Campus and the Medical Center.

1.6 Extrapolation

Extrapolation of the savings from the pilot scoping study (3 buildings) to project what the savings would be if the same work was done across the rest of the building stock at the university of Rochester. The initial numbers show that will a moderate investment a large amount of savings can be achieved. The extrapolation reflects that further RetroCommissioning should be undertaken to help achieve the University's energy conservation goals.

Methodology: From the summary table the total savings were calculated from the energy saved was divided into the energy usage for all three building. This gave us a total savings percentage for each energy category. This savings percentage is what is being applied across the campus. The savings for the units of energy was then calculated by multiplying the savings percentage by the total energy used for that category for the medical and river campuses. Then the Campus Building Rates were applied to the to the units of energy to calculate the annual savings.

For the Extrapolation of Costs for the ECM's, the total cost of the three buildings was divided by the total square footage of the pilot buildings. This calculated a cost per square foot that was multiplied by the square footage of the selected campuses for a total cost of the energy conservation measures.

1.7 Conclusions

The economics projected and the moderate difficulty of the implementation would help the University achieve a savings project that could help overcome programmatic apprehensions of energy conservation projects. It would also help fund more difficult and longer payback projects that would be necessary to accomplish the university's overall energy and cost reduction goals.

1.8 Next Steps:

Complete RetroComissioning Study and Implementation with Functional Performance testing.

- Request proposal for RetroComissioning Study – 1 Month
- Receive proposal and execute contract – 1-2 months
- RetroCommisioning Study Completion – 1-2 Months
- Request Pricing for controls programming and alterations. – 1 month
- Execution of controls labor – 2 months
- Functional Performance testing and report – 1 month

Select Buildings for future RetroComissioning implementation.

- Review building stock and energy usage.
- Review any future major capital work or building renovations
- Review budget for study and implementation
- Select multiyear phasing approach
- Secure Funding or financing
- Execute plan

Section 2

Building Description

Building Description

2.1 Physical Characteristics

The building consists of the following:

RUSH RHEES LIBRARY

- Age and Building Use
  - Built in 1930.
  - Partial addition in 1964 to add 2 floors on part of north side.
  - Major Addition in 1970 to double the square footage
  - Higher education institution/Library.
- Space types information:
  - Stacks, Rare Books, offices, conference rooms,
  - Official building hours are 10AM to 8PM Monday through Friday and 10AM to 6PM Saturday and 10AM to 5PM Sunday.
  - The building is operated 24/7 and specific equipment runs 24/7**
- Gross Square Footage
  - 349,284 sqft
- Conditioned Square Footage
  - 349,284 sqft
- Number of Stories
  - 4 stories
- Building Occupancy:
  - 75% occupied (observation of less than normal occupancy from Covid)*
- Special Features worth noting.
  - Rare Books area

DANFORTH DINING HALL

- Age and Building Use
  - Original building constructed 1955
  - Renovated 2011.
  - Cafeteria
- Space types information:
  - Labs, classrooms, conference rooms, kitchens, dining areas, retail.
  - Official building hours are 11AM to 1:30 – 5 to 7pm PM Monday through Friday and Closed Saturday and Sunday.
  - The building is operated 24/7 and specific equipment runs 24/7**
- Gross Square Footage
  - 35,128 sqft
- Conditioned Square Footage
  - 35,128 sqft
- Number of Stories
  - 1 stories
- Building Occupancy:
  - 75% occupied (observation of less than normal occupancy from Covid)*
- Special Features worth noting.
  - Open kitchen area, Dishwasher, Kitchen Exhaust fans drive the space OA requirement.

FREDRICK DOUGLASS COMMONS

- Age and Building Use

        - Built in 1950.
        - Major Renovation in 2016
        - Higher education institution/Cafeteria.
- Space types information:
    - Classrooms, conference rooms, kitchens, dining areas, retail.
    - Official building hours are 7AM to 12AM Monday through Friday and 8AM to 12AM Saturday and Sunday.
    - The building is operated 24/7 and specific equipment runs 24/7**
- Gross Square Footage
    - 89,151,sqft
- Conditioned Square Footage
    - 89,151 sqft
- Number of Stories
    - 4 stories
- Building Occupancy:
    - 75% occupied (observation of less than normal occupancy from Covid)*
- Special Features worth noting.
    - Open kitchen area, Dishwasher, Kitchen Exhaust fans drive the space OA requirement, Retail Space

*The occupancy is an observation based on the walkthrough. While it could also represent that there are unused spaces, this is an assumption based on my walkthrough that the buildings were not back at full occupancy pre-Covid

**Operating (or Occupied) hours for the buildings were taken from the University of Rochester's website. Looking at the trends for the HVAC equipment it was noted that the equipment was running 24/7. This would track with the initial guidance given for outdoor air flushing for Covid-19. Looking further back in the trends it was noted that the building was running 24/7 pre-Covid-19. The space temperatures also did not set back during unoccupied times both pre and post Covid-19. There is an opportunity to set back the space temperatures while the building is still running Covid-19 outdoor air flushing protocols. Programing can also be done but not implemented to shut off equipment/outdoor air so when the university decides to suspend Covid protocols the energy savings will be as easy as a click off a button.

2.2 Building Systems Summary

The following is summary of facility

RUSH RHEES LIBRARY

- Heating Plant
    - District Steam
- Hot Water System
    - 3 primary hot water pumps on 3 different steam to hot water systems.
    - 1 snow melt pumps.
    - Hot water to glycol heat exchanger for specific preheat coils.
- Cooling Plant
    - District chilled water
- Chilled Water System
    - 2 chilled water pumps.
- Air Handling System
    - 7 Air handling units.
- Exhaust Systems
- Air Terminal Units
    - DDU boxes for most spaces.
    - Unitary Air Handlers
    - 17 Heat pump units.
    - 17 Fan Coil Units.
    - Hot water radiation systems

DANFORTH DINING HALL

- Heating Plant
    - District Hot Water
- Hot Water System
    - 2 primary hot water pumps.
    - 2 domestic hot water pumps.
    - Hot water to glycol heat exchanger for specific preheat coils.
- Cooling Plant
    - District Chilled Water
    - Chilled Water System
    - 1 chilled water pump.
- Air Handling System
    - 1 Air handling unit.
- Exhaust Systems
- 4 Kitchen exhaust fans.
    - 1 Dishwasher Exhaust Fans
- Air Terminal Units
    - VAV boxes for most spaces.
    - Unitary Air Handlers
    - Finned tube hot water radiation system

FREDRICK DOUGLASS COMMONS

- Heating Plant
    - District Hot Water
- Hot Water System
    - 4 primary hot water pumps.
    - 4 Domestic Hot water pumps
    - 1 snow melt pumps.

- Hot water to glycol heat exchanger for specific preheat coils.
- Cooling Plant
    - District Chilled Water
    - Chilled Water System
    - 1 chilled water pump.
- Air Handling System
    - 5 Air handling units.
    - 4 Roof Top Units.
- Exhaust Systems
    - 10 Exhaust Fans
- Air Terminal Units
    - VAV boxes for most spaces.
    - Unitary Air Handlers
    - 2 self-contained air conditioning units.
    - 7 Door air curtains heaters.
    - 4 hot water cabinet unit heaters.
    - 1 finned tube hot water radiation systems.

2.3 Building Management System

RUSH RHEES LIBRARY

- Manufacturer: ALC/Webctrl
- Access: Wendel received read only access
- Remote Access: Enabled
- Level of control: All major pieces and terminal equipment of the HVAC system are controlled by the BMS. Operator can override most control points. All temperature, humidity, pressure, and occupancy set points are adjustable by the operator.
- Trending Capabilities: Ability to trend all control.

Rush Rhees Library also has the following system

- Manufacturer: Siemens Apogee
- Access: Wendel received read only access
- Remote Access: Enabled
- Level of control: All major pieces and terminal equipment of the HVAC system are controlled by the BMS. Operator can override most control points. All temperature, humidity, pressure, and occupancy set points are adjustable by the operator.
- Trending Capabilities: Ability to trend all control points if trending is set up by control's contractor. Wendel was not given access to the trends.

DANFORTH DINING HALL

- Manufacturer: Siemens Apogee
- Access: Wendel received read only access
- Remote Access: Enabled
- Level of control: All major pieces and terminal equipment of the HVAC system are controlled by the BMS. Operator can override most control points. All temperature, humidity, pressure, and occupancy set points are adjustable by the operator.
- Trending Capabilities: Ability to trend all control points if trending is set up by control's contractor. Wendel was not given access to the trends.

Danforth Dining Hall also has the following system

- Manufacturer: Schneider Electric EcoStuxure
- Access: Wendel received read only access
- Remote Access: Enabled
- Level of control: Snow melt system
- Trending Capabilities: Ability to trend all control points if trending is set up by control's contractor. Wendel was not given access to the trends.

FREDRICK DOUGLASS COMMONS

- Manufacturer: ALC/Webctrl
- Access: Wendel received read only access
- Remote Access: Enabled
- Level of control: All major pieces and terminal equipment of the HVAC system are controlled by the BMS. Operator can override most control points. All temperature, humidity, pressure, and occupancy set points are adjustable by the operator.
- Trending Capabilities: Ability to trend all control points.

Section 3

Energy Usage Analysis

Energy Use Analysis

Energy Use Index

Since building type and the services provided in that building impact the energy intensity, we utilize Energy benchmarking[1, 2,] , which is the practice of comparing energy usage data for a select building against data from a national database of buildings in the same usage type. This allows us to assess what the potential for savings is for in each building.

The chart below compares 24 months of energy data for the facility form the period of December 2018 through November 2020. Note that Danforth Dining Center and Rush Reese Library have EUIs greater than the mean.

NATIONAL COMPARISON (Site Energy Usage)								
Building	Building Use	Total Building EUI (kBtu/yr/sqft)	Calculated, Weighted Energy Use Index (EUI) Values Site Energy, kBtu/yr per gross sq ft					
			Percentiles					
			10th	25th	50th	75th	90th	Mean
Danforth Dining Center	Restaurant/ cafeteria	311.51	66.0	126.0	269.4	416.8	648.2	310.9
Fredric Douglass Dinning Center	Restaurant/ cafeteria	222.21	66.0	126.0	269.4	416.8	648.2	310.9
Rush Rhees Library	Library	123.16	45.7	57.0	73.4	123.2	152.7	90.8

1 – Utility end-use data & benchmarking data is based on the Commercial Building Energy Consumption Survey (CBECS) conducted by the U.S. Department of Energy for buildings across the country. The CBECS commercial sector survey encompasses data available through the U.S. Energy Information Administration based on a specific U.S. region and division.

2 - A normalized EUI is calculated by converting all energy consumed in a building to a common unit, 1,000 Btu's or kBtu's, and then dividing it by the gross square footage of the building. EUI is typically measured in kbtu/sqft/year. Utilizing conversion rates of 1 kilowatt hour is equal to 3.413 kbtu and 1 mmBtu is equal to 1,000 kbtu

3 - CBECS include the steam/hot water used at the building. Currently it does not account for chilled water. As for the efficiency of the equipment at the central plant, it does not account for this. In example if the equipment is onsite, i.e. boiler in the building, the natural gas bills reflect this efficiency. The data collected with any district plants only accounts for energy used at the building and does not account for the efficiency of the boiler or CHP systems.

Building Historical Annual Energy Use			
Building	Cooling (Ton-hr)	Heating (mmBTU)	Electric (kWh)
Danforth Dining Center	171,875	5,881	882,634
Fredric Douglass Dinning Center	860,162	26,056	2,174,743
Rush Rhees Library	346,778	10,174	1,604,481

Section 4

Proposed Measures for Investigation

Proposed Measures for Investigation

4.1 Conversion Factors

The following are conversion factors, efficiencies, billing rates and emissions rates used to assess changes to energy usages on campus. Data sources are as follows:

- Conversion Rates | Industry standards
- Building to Plant Ratios | 2018 plant and building utility data
- Building Utility Rates | Provided by UR.
- Purchased Utility Rates | Include Commodity Cost and Fixed Costs.
- Purchased Utility Rates | Provided by UR.
- Emissions Rates | eGRID 2018 for electric and industry standard conversions for Natural Gas.

Conversion Rates		
Electric	0.003412	mmBtu per kWh
Chilled Water	12,000	Btu per tonhr
Steam	1,194	Btu/lb
Boiler Eff	72%	-
Plant Efficiency Ratios		
Chilled Water	49%	CHW from electric
Chiller Elec.	0.65	kW/ton
Chiller Steam.	0.0037	mmBtu/Tonhr
Chiller NG.	0.0052	mmBtu/Tonhr
Total Heating System Eff.	67%	
Building Rates*		
Electric	$0.089	$/kWh
Chilled Water	$6.28	$/ton-day
Chilled Water	$21.81	$/mmbtu
Steam/Hot water	$14.50	$/mmBtu
Utility Rates		
Electric	$0.0650	$/kWh
Natural Gas	$3.210	$/dTh
Natural Gas	$3.210	$/mmBtu
Emissions Rates		
Electric	295.94	lb/MWh
Nat. Gas	116.38	lbs/mmBtu

Table B2 - Summary of utility rates

*Building Rates are the costs of producing the energy, utility rates plus efficiency losses, as well and maintaining the infrastructure needed to deliver the services on the campuses internal systems. Utility Costs are for reference.

4.2 Overview of Results

The following is a high-level overview of observations which informed our recommendations for RCx ECMs. A summary is presented in Section 4 which shows the estimated energy savings and costs ranges.

- Air Handling Unit operation appears to present opportunities for energy savings based on the following:
  - Adjust sequences and setpoints for discharge air temperature and static pressure reset.
- Building zone and spaces appear to be missing control points to allow for more efficient control such as:
  - Incorporate CO2 sensors to allow for demand-controlled ventilation.
  - Incorporate occupancy sensor for HVAC system control in conference rooms and other variable occupancy spaces.
  - Set back temperatures of spaces during unoccupied times
  - Adjust operation of kitchen hood ventilation rates.
  - Program Dual Duct Boxes for independent Air Valve operation to reduce air flow based on cooling/heating need.
- Additional observations of building systems
  - Interlock Fin Tube Radiation with space terminal air boxes to prevent simultaneous heating and cooling.
  - Heat Pumps and Walk in Coolers condensers sink with the chilled water system.

4.3 Proposed Measures for Investigation

The following is a description of the preliminary RCx ECMs identified as part of the scoping survey. For each RCx ECM we have identified the scope and the reasoning for their recommendation. A Table is provided At the end of this section which demonstrates initial estimates for savings and costs.

Rush Rhees Library		
ECM #	ECM Name	Reasoning
1	Dual Duct Box Temperature Set Back	The terminal units (VAV's and DDUs) have no night temperature setback. All space is 24/7. Trending shows all spaces have constant set points that are manually changed.
2	Dual Duct Box Independent Air Valve Operation - Min/Max airflow	Dual Duct Boxes are set up for independent damper operation but are not operating that way. Set Damper positions according for need for cooling/heating demand along with max/min instead of discharge air temp with full air flow.
3	AHU | Static Pressure Reset	Reset Discharge air Static Pressure set point based on feedback from airflow to terminal units.
4	AHU | Discharge Air Reset	Reset Discharge air temperature based on OA and calls for cooling/heating.
5	Interlock Fin tube with Cooling Coil Valve/Radiation loop set point adjustment	Reset HW Radiation loop downward when calls for cooling are required. This was observed happening in shoulder seasons. May be harder to do with some of the terminal air units being on the siemens system and the radiation loop being hand valves.
6	Hot Water Pump VFD	Hot Water Pump running at constant speed. Install VFD
7	AHU | DCV	Current OA operations are based on ability to economize OAT VS Cooling Deck DAT (10-30% Damper 24/7). Recommend reviewing space requirements and implementing DCV sequences where applicable.

Danforth Dining Hall		
ECM #	ECM Name	Reasoning
1	Interlock Fin tube with Cooling Coil Valve/Radiation loop set point adjustment	Reset HW Radiation loop downward when calls for cooling are required. This was observed happening in shoulder seasons.
2	Night Set Back For temperature	The terminal units (VAV's) have no night temperature setback. All spaces are 24/7. Trending shows all spaces have constant set points that are manually changed.
3	AHU | Discharge Air Reset	Reset Discharge air Static Pressure set point based on feedback from airflow to terminal units.
4	AHU | DCV	Air Handling Unit could benefit from demand control ventilation sequences and or adjustments to the sequences to optimize reductions. Current OA operations are based time of day but is in covid protocol.

Fredrick Douglass Commons		
ECM #	ECM Name	Reasoning
1	Interlock Fin tube with Cooling Coil Valve/Radiation loop set point adjustment	Reset HW Radiation loop downward when calls for cooling are required. This was observed happening in shoulder seasons.
2	Night Set Back For temperature	The terminal units (VAV's) have no night temperature setback. All spaces are 24/7. Trending shows all spaces have constant set points that are manually changed.
3	DCV set point adjustment for RTU 1-4	Revise CO2 setpoint up from 750 PPM
4	Retune Hood captive air systems	Captive air systems reduce Exhaust based on temperature. The hoods have had issues with smoke capture since installation. Proper capture will reduce exhaust and OA needed to make up.
5	AHU | DCV	Air Handling Units could benefit from demand control ventilation sequences and or adjustments to the sequences to optimize reductions. Current OA operations are based time of day but is in covid protocol.

Energy Conservation Measure Summary Table | DDH													
ECM #	ECM Name	Reasoning	University of Rochester Building Controls (Level, Type)	Cooling Savings (Ton/hr)			Electrical Savings (kWh)			Hot water/Steam (MMBTU)		
				Low	Mid	High	Low	Mid	High	Low	Mid	High
1	Interlock Fintube with Cooling Coil Valve/Radition loop set point adjustment	Reset HW Radiation loop downward when calls for cooling are required. This was observed happening in shoulder seasons.	1A	945	1,103	1,260	0	0	0	45	53	60
				0.5%	0.6%	0.7%	0.0%	0.0%	0.0%	0.8%	0.9%	1.0%
2	Night Set Back For temperature	The terminal units (VAV's) have no night temperature setback. All space are 24/7. Trending shows all spaces have constant set point manually changed.	2A	3,780	4,410	5,040	0	0	0	68	79	91
				2.2%	2.6%	2.9%	0.0%	0.0%	0.0%	1.2%	1.3%	1.5%
3	AHU | Discharge Air Reset	Reset Discharge air Static Pressure set point based on feedback from airflow to terminal units.	1A	0	0	0	30,788	35,919	41,050	0	0	0
				0.0%	0.0%	0.0%	3.5%	4.1%	4.7%	0.0%	0.0%	0.0%
4	Retune Hood captive air systems	Captive air systems reduce Exhuast based on temperature. The hoods have had issues with smoke capture since instalation. Proper capture will reduce exhuast and OA needed to make up.	1C	4,050	4,725	5,400	0	0	0	97	113	130
				2.4%	2.7%	3.1%	0.0%	0.0%	0.0%	1.7%	1.9%	2.2%
Totals				8,775	10,238	11,700	30,788	35,919	41,050	211	246	281
				5.1%	6.0%	6.8%	3.5%	4.1%	4.7%	3.6%	4.2%	4.8%

Notes:

1. The M&L costs inlcude material and labor only. Cost for the Retro-Commissioning, engeering (if required), design (if required), and contingency are not included.
2. Items such as controls sysmte upgrades, controller replacement, or the addition of new controller is not included in the estiamte ranges provided.
3. The University Building Controls Levels and Types are defined as follows:

Level 1 – Primary Equipment – AHUs, Pump Sets, HXs, etc
Level 2 – Terminal Equipment – VAVs, HPs, FCUs, etc
Level 3 – Standalone Equipment – Not connected to DDC, commonly CUHs, Steam Radiators, but may include almost anything.
Type A: Programming changes only
Type B: Repair of Malfunctioning Hardware
Type C: New or Upgraded Hardware

Energy Conservation Measure Summary Table | RRL

ECM #			University of Rochester Building Controls (Level, Type)	Cooling Savings (Ton/hr)			Electrical Savings (kWh)			Hot water/Steam (MMBTU)		
				Low	Mid	High	Low	Mid	High	Low	Mid	High
1	Dual Duct Box Temperature Set Back	The terminal units (VAV's and DDUs) have no night temperature setback. All space are 24/7. Trending shows all spaces have constant set point manually changed.	2A	21,168	37,044	52,920	0	0	0	893	1,042	1,191
				2.5%	4.3%	6.2%	0.0%	0.0%	0.0%	3.4%	4.0%	4.6%
2	Dual Duct Box Independent Air Valve Operation - Min/Max airflow	Dual Duct Boxes are set up for independent damper operation but are not operating that way. Set Damper positions according for need for cooling/heating damand along with max/min instead of discharge air temp with full air flow.	2A	13,608	23,814	34,020	40,874	61,311	81,747	112	1,036	1,960
				1.6%	2.8%	4.0%	1.9%	2.8%	3.8%	0.4%	4.0%	7.5%
3	AHU | Static Pressure Reset	Reset Discharge air Static Pressure set point based on feedback from airflow to terminal units.	1A	0	0	0	153,938	230,907	307,876	0	0	0
				0.0%	0.0%	0.0%	7.1%	10.6%	14.2%	0.0%	0.0%	0.0%
4	AHU | Discharge Air Reset	Reset Discharge air temperature based on OA and calls for cooling/heating.	1A	12,701	22,226	31,752	0	0	0	298	447	595
				1.5%	2.6%	3.7%	0.0%	0.0%	0.0%	1.1%	1.7%	2.3%
5	Interlock Fintube with Cooling Coil Valve/Radition loop set point adjustment	Reset HW Radiation loop downward when calls for cooling are required. This was observed happening in shoulder seasons. May be harder to do with some of the teminal air units being on the siemens system and the radition loop being hand valves.	1A	3,175	8,203	13,230	0	0	0	38	98	159
				0.4%	1.0%	1.5%	0.0%	0.0%	0.0%	0.1%	0.4%	0.6%
6	Hot Water Pump VFD	Hot Water Pump running at constant speed. Install VFD	1C	0	0	0	2,984	3,730	4,476	0	0	0
				0.0%	0.0%	0.0%	0.1%	0.2%	0.2%	0.0%	0.0%	0.0%
7	AHU | DCV	While units are scheduled off at night, many do not have demand controlled ventilation sequences or or are utilizing unoccupied operation. Current OA operations are based on ability to economize OAT VS Cooling Deck DAT (10-30% Damper 24/7).Recommend reviewing space requirements, and implementing DCV sequences where applicable.	1C	15,120	26,460	37,800	0	0	0	567	851	1,134
				1.8%	3.1%	4.4%	0.0%	0.0%	0.0%	2.2%	3.3%	4.4%
Totals				65,772	117,747	169,722	197,796	295,947	394,099	1,908	3,473	5,039
				7.6%	13.7%	19.7%	9.1%	13.6%	18.1%	7.3%	13.3%	19.3%

Notes:

1. The M&L costs inlcude material and labor only. Cost for the Retro-Commissioning, engeering (if required), design (if required), and contingency are not included.
2. Items such as controls sysmte upgrades, controller replacement, or the addition of new controller is not included in the estiamte ranges provided.
3. The University Building Controls Levels and Types are defined as follows:

Level 1 – Primary Equipment – AHUs, Pump Sets, HXs, etc
Level 2 – Terminal Equipment – VAVs, HPs, FCUs, etc
Level 3 – Standalone Equipment – Not connected to DDC, commonly CUHs, Steam Radiators, but may include almost anything.
Type A: Programming changes only
Type B: Repair of Malfunctioning Hardware
Type C: New or Upgraded Hardware

Energy Conservation Measure Summary Table | FDC												
ECM #	ECM Name	Reasoning	University of Rochester Building Controls (Level, Type)	Cooling Savings (Ton/hr)			Electrical Savings (kWh)			Hot water/Steam (MMBTU)		
				Low	Mid	High	Low	Mid	High	Low	Mid	High
1	Interlock Fintube with Cooling Coil Valve/Radition loop set point adjustment	Reset HW Radiation loop downward when calls for cooling are required. This was observed happening in shoulder seasons.	1A	5,842	6,815	7,789	0	0	0	280	327	374
				1.7%	2.0%	2.2%	0.0%	0.0%	0.0%	2.8%	3.2%	3.7%
2	Night Set Back For temperature	The terminal units (VAV's) have no night temperature setback. All space are 24/7. Trending shows all spaces have constant set point manually changed.	2A	23,367	27,262	31,156	1,434	1,912	2,390	421	491	561
				6.7%	7.9%	9.0%	0.1%	0.1%	0.1%	4.1%	4.8%	5.5%
3	DCV set point adjustment for RTU 1-4	Revise CO2 setpoint up from 750 PPM	1A	3,949	4,607	5,265	0	0	0	161	207	253
				1.1%	1.3%	1.5%	0.0%	0.0%	0.0%	1.6%	2.0%	2.5%
4	Retune Hood captive air systems	Captive air systems reduce Exhuast based on temperature. The hoods have had issues with smoke capture since instalation. Proper capture will reduce exhuast and OA needed to make up.	2A	4,138	4,828	5,517	0	0	0	118	138	158
				1.2%	1.4%	1.6%	0.0%	0.0%	0.0%	1.2%	1.4%	1.6%
5	AHU | DCV	While units are scheduled off at night, many do not have demand controlled ventilation sequences or or are utilizing unoccupied operation. Current OA operations are based time of day but is in covid protocol.	1C	10,422	12,159	13,896	0	0	0	250	292	334
				3.0%	3.5%	4.0%	0.0%	0.0%	0.0%	2.5%	2.9%	3.3%
Totals				47,718	55,671	63,624	1,434	1,912	2,390	1,230	1,455	1,679
				13.8%	16.1%	18.3%	0.1%	0.1%	0.1%	12.1%	14.3%	16.5%

Notes:

1. The M&L costs inlcude material and labor only. Cost for the Retro-Commissioning, engeering (if required), design (if required), and contingency are not included.
2. Items such as controls sysmte upgrades, controller replacement, or the addition of new controller is not included in the estiamte ranges provided.
3. The University Building Controls Levels and Types are defined as follows:

Level 1 – Primary Equipment – AHUs, Pump Sets, HXs, etc
Level 2 – Terminal Equipment – VAVs, HPs, FCUs, etc
Level 3 – Standalone Equipment – Not connected to DDC, commonly CUHs, Steam Radiators, but may include almost anything.
Type A: Programming changes only
Type B: Repair of Malfunctioning Hardware
Type C: New or Upgraded Hardware

Energy Conservation Measure Summary Table | DDH															
ECM #	Utility Rates*						Building Rates**						M&L Cost[1,2]		
	Energy Savings (Utility Rates)			Payback (M&L Cost)			Energy Savings (Building Rates)			Payback (M&L Cost)					
	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High
1	$244	$284	$325	7.4	9.5	11.1	$905	$1,056	$1,207	2.0	2.6	3.0	$1,800	$2,700	$3,600
2	$432	$504	$576	6.9	8.9	10.4	$1,976	$2,305	$2,634	1.5	2.0	2.3	$3,000	$4,500	$6,000
3	$2,001	$2,335	$2,668	1.5	1.9	2.2	$2,598	$3,032	$3,465	1.2	1.5	1.7	$3,000	$4,500	$6,000
4	$579	$676	$772	18.0	18.8	19.4	$2,469	$2,881	$3,292	4.2	4.4	4.6	$10,400	$12,700	$15,000
	$3,256	$3,798	$4,341	5.6	6.4	7.0	$7,948	$9,273	$10,598	2.3	2.6	2.9	$18,200	$24,400	$30,600

Notes:

* The Energy Cost Savings and simple payback based only on utility commodity charges. This does not include UEM overhead and represents a true savings to the university. This rate is appropriate to use when UEM or the University in general is paying for the ECM.

** The Energy Cost Savings and simple payback based total energy rate charged to customer. This includes both the variable commodity rate plus the fixed yearly overhead budget fee converted to a fixed rate. T

Energy Conservation Measure Summary Table | RRL															
ECM #	Utility Rates*						Building Rates**						M&L Cost[1,2]		
	Energy Savings (Utility Rates)			Payback (M&L Cost)			Energy Savings (Building Rates)			Payback (M&L Cost)					
	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High
1	$4,871	$6,028	$7,186	2.5	4.5	5.8	$18,488	$24,800	$31,113	0.6	1.1	1.3	$12,000	$27,000	$42,000
2	$3,575	$9,615	$15,654	3.4	2.5	2.3	$8,637	$26,426	$44,215	1.4	0.9	0.8	$12,000	$24,000	$36,000
3	$10,006	$15,009	$20,012	1.2	1.6	1.8	$12,992	$19,489	$25,985	0.9	1.2	1.4	$12,000	$24,000	$36,000
4	$1,782	$2,761	$3,741	6.7	8.7	9.6	$7,640	$12,290	$16,941	1.6	2.0	2.1	$12,000	$24,000	$36,000
5	$271	$701	$1,131	44.2	38.5	37.1	$1,383	$3,574	$5,764	8.7	7.6	7.3	$12,000	$27,000	$42,000
6	$194	$242	$291	17.4	19.1	20.2	$252	$315	$378	13.4	14.7	15.6	$3,380	$4,630	$5,880
7	$3,140	$4,815	$6,491	4.8	7.2	8.3	$12,178	$19,256	$26,334	1.2	1.8	2.1	$15,000	$34,500	$54,000
	$23,839	$39,172	$54,506	3.3	4.2	4.6	$61,570	$106,149	$150,729	1.3	1.6	1.7	$78,380	$165,130	$251,880

Notes:

* The Energy Cost Savings and simple payback based only on utility commodity charges. This does not include UEM overhead and represents a true savings to the university. This rate is appropriate to use when UEM or the University in general is paying for the ECM.

** The Energy Cost Savings and simple payback based total energy rate charged to customer. This includes both the variable commodity rate plus the fixed yearly overhead budget fee converted to a fixed rate. This rate is appropri

Energy Conservation Measure Summary Table | FDC															
ECM #	Utility Rates*						Building Rates**						M&L Cost[1,2]		
	Energy Savings (Utility Rates)			Payback (M&L Cost)			Energy Savings (Building Rates)			Payback (M&L Cost)					
	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High
1	$1,507	$1,758	$2,009	4.0	9.4	13.4	$5,594	$6,527	$7,459	1.1	2.5	3.6	$6,000	$16,500	$27,000
2	$2,762	$3,238	$3,714	2.2	2.8	3.2	$12,334	$14,410	$16,486	0.5	0.6	0.7	$6,000	$9,000	$12,000
3	$880	$1,119	$1,358	1.4	1.6	1.8	$3,363	$4,203	$5,042	0.4	0.4	0.5	$1,200	$1,800	$2,400
4	$683	$797	$910	15.2	16.4	17.4	$2,799	$3,265	$3,732	3.7	4.0	4.2	$10,400	$13,100	$15,800
5	$1,490	$1,738	$1,987	8.7	14.1	18.1	$6,354	$7,413	$8,472	2.0	3.3	4.2	$13,000	$24,500	$36,000
	$7,323	$8,651	$9,979	5.0	7.5	9.3	$30,445	$35,818	$41,191	1.2	1.8	2.3	$36,600	$64,900	$93,200

Notes:

* The Energy Cost Savings and simple payback based only on utility commodity charges. This does not include UEM overhead and represents a true savings to the university. This rate is appropriate to use when UEM or the University in general is paying for the ECM.

** The Energy Cost Savings and simple payback based total energy rate charged to customer. This includes both the variable commodity rate plus the fixed yearly overhead budget fee converted to a fixed rate. This rate is appropr

4.4 Supporting Data & Savings Assumptions

Please find the savings assumptions below and the raw utility data on the following pages.

Energy Savings Assumptions			
ECM #	**ECM Name**	**Key Assumption**	**Key Equation**
1	AHU | Kitchen Exhaust Optimization	Reduce kitchen hood ventilation from heavy duty cooking requirements to light duty cooking requirements.	CFM x 1.08 x Delta T /1000000 HP x .746 x % Speed^2.3 x PF / eff. x hours
2	AHU | Static Pressure Reset	Reduce air handling units average fan speed by 15% for 8760 hrs.	HP x .746 x % Speed^2.3 x PF / eff. x hours
3	AHU | Discharge Air Reset	Reduce mechanical heating load required in 25% of spaces by 3F for between 1500 hrs. Increase mechanical cooling load required in 25% of spaces by 3F for between 500 hrs.	CFM x 1.08 x Delta T /1000000
4	AHU | DCV	Reduce minimum outside air CFM of the air handling system by 50%.	CFM x 1.08 x Delta T /1000000
5	AHU | Installation of fan VFDs	Reduce fan speeds for AHU 3A, 6, 17, and 19 from 100% to 70% for 8760 hrs.	HP x .746 x % Speed^2.3 x PF / eff. x hours
6	Zones | Occupancy Sensors	Reduce mechanical heating load required in 25% of spaces by 4F for between 1500 hrs. Increase mechanical cooling load required in 25% of spaces by 4F for between 500 hrs.	CFM x 1.08 x Delta T /1000000
7	Interlock Fintube with Cooling Coil Valve/Radition loop set point adjustment	Reduce mechanical heating load required in 25% of spaces by 4F for between 1500 hrs. Increase mechanical cooling load required in 25% of spaces by 1F for between 500 hrs (smaller cooling savings because this anamoly happens during the shoulder season).	CFM x 1.08 x Delta T /1000000
8	DCV set point adjustment for RTU 1-4	Revise CO2 setpoint up from 750 PPM to 1000 PPM. Airflow at assumed 50% as the fan are locked at 50%. 75% outdoor airflow as coil designs are at 4500 CFM. Reduce OA flow by 15%.	CFM x 1.08 x Delta T /1000000
9	Dual Duct Box Independent Air Valve Operation - Min/Max airflow	Reduce Airflow by 5% of total DDU unit.	CFM x 1.08 x Delta T /1000000

Section 5

RCX Process & Next Steps

RCX Process & Next Steps

Step 1 | Identify Need (completed)

The first step in the process is to identify the need for a retro-commissioning. This includes a scoping investigation into the facility's usage and energy consumption. The intent of this phase is to identify likely opportunities which may result in energy savings.

Step 2 | Develop a scope for the Retro-Commissioning

Following the scoping survey, Wendel and University will meet to decide on the scope and scale of the Retro-Commissioning effort. Questions such as:

- What systems should be included? Examples of systems which are often not included are: lighting, building envelope, plumbing systems, electrical distribution systems.
- What level of point-to-point testing will be performed? An example of a point-to-point test is where a damper or actuator is commanded open / closed and another person in the field observes its operation. Should each devise be checked? Should a representative % of devices be check?
- What level of function testing should be performed? So we test every sequence of operation (included smoke purge, alarms, start-up sequences) or just sequences that will impact energy usage?
- Are the sequences well documented?
- Will airflow need to be tested?
- Will a controls contractor need to be present to perform the testing?

Step 3 | Point-to-point check

In this step devices will be checked to see how they react to inputs from the control system. This would include calibration of sensors as well. The scope and scale of the point-to-point check will be determined in step 2.

Step 4 | Functional Testing

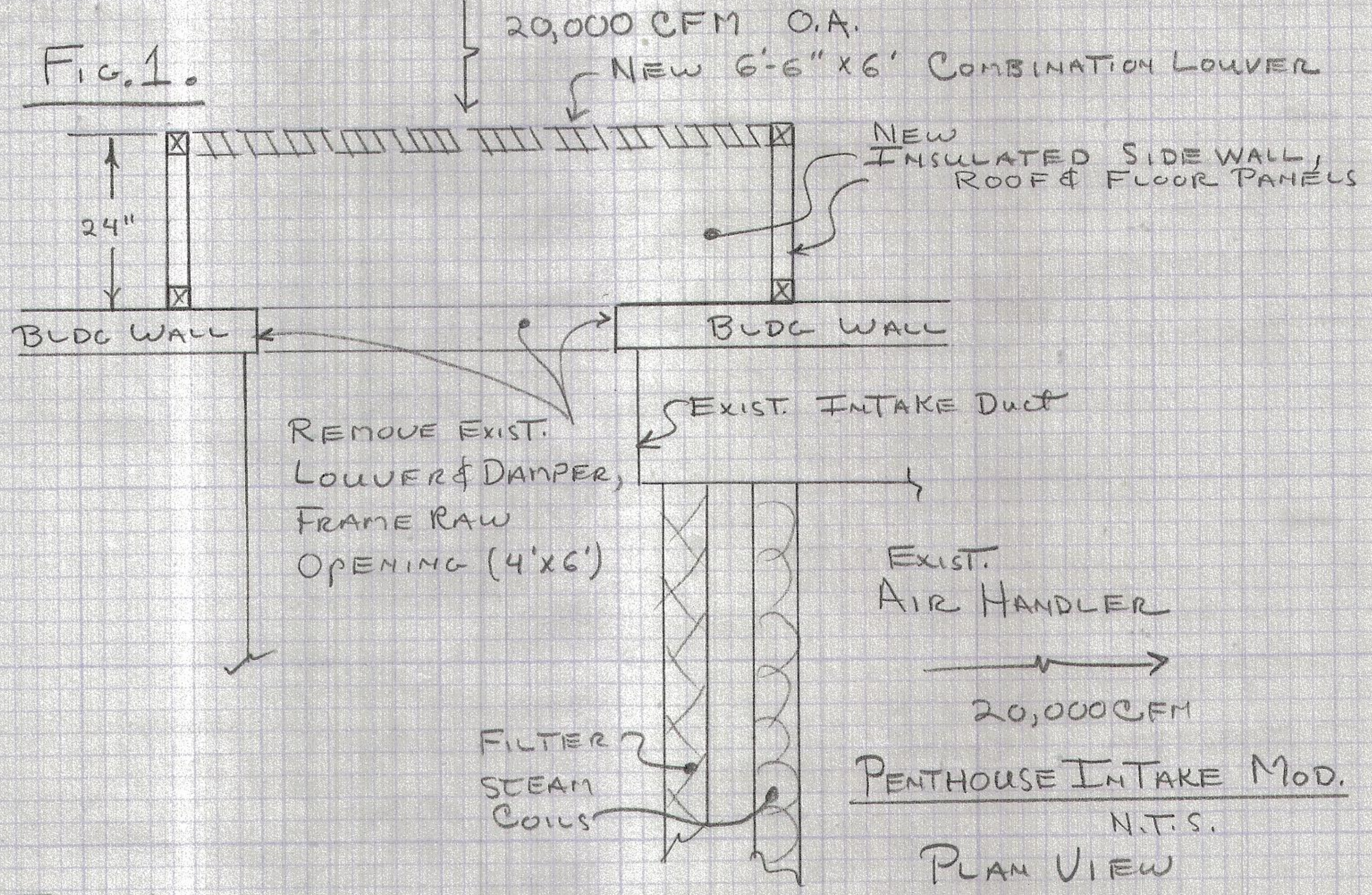
In this step devices will be manipulated to see how they respond to different inputs. This will also provide the basis for understanding current operation and recommendations for changes to improve energy efficiency and address deficiencies.

Step 5 | Reporting

Analysis is summarized in a report which will include summaries, testing logs, savings calculations, and cost estimates for changes.

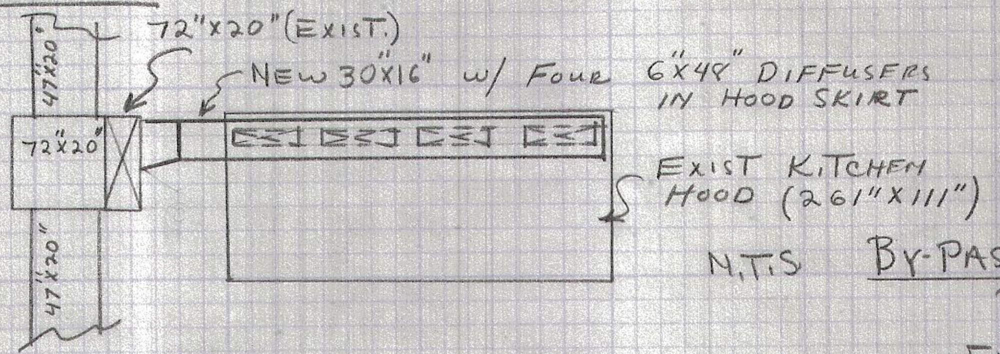
A Supporting Survey Notes

Fig. 1.



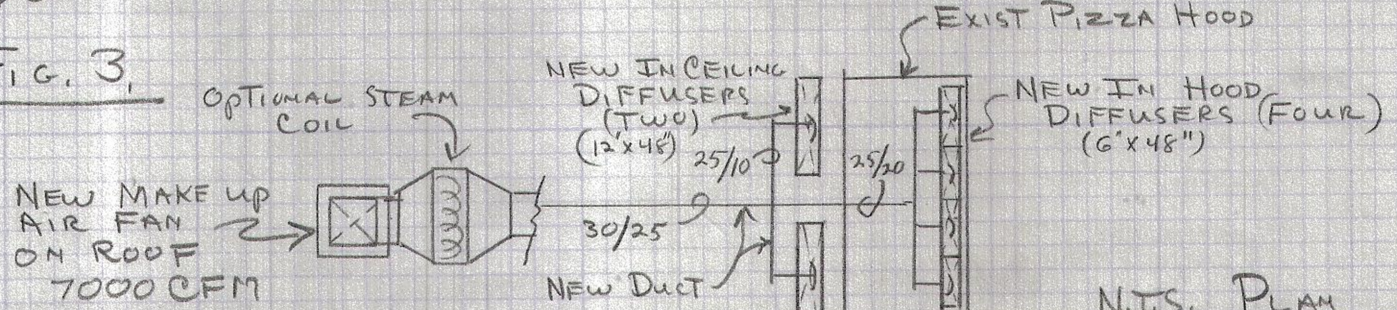
Penthouse Intake Mod.
N.T.S.
Plan View

Fig. 2.



N.T.S. By-Pass Air Main Kitch. Hood
Plan View

Fig. 3.



N.T.S. Plan
By Pass Air Pizza Hood

REV.	NO.	DATE

UNIVERSITY OF ROCHESTER
DESIGN / CONSTRUCTION DIVISION
FAUVER STADIUM ROOM 212
UNIVERSITY OF ROCHESTER
ROCHESTER, N.Y. 14627

PROJECT: Danforth Kitchen Exhaust & Supply Air, Plan Details

DATE:
SCALE: None
DRAWN BY: FRW
DWG. NO.:
PROJ. NO.: 88016

H.H. SULLIVAN, INC 514399

ROOFTOP UNIT SCHEDULE

UNIT TAG	SERVICE	SUPPLY FAN PERFORMANCE DATA								HOT GLYCOL COIL HEATING PERFORMANCE DATA											CHILLED WATER COOLING COIL PERFORMANCE DATA														BASIS OF DESIGN	NOTES
		AIRFLOW (CFM)	ESP (IN WG)	HP/ BHP	FAN RPM	DRIVE	VOLTAGE	PHASE	Hz	EDB (°F)	LDB (°F)	FACE VEL (FPM)	COIL ROWS	FINS / IN	APD (IN WC)	EGT (°F)	LGT (°F)	GPM	WPD (FT WG)	TOTAL (MBH)	EDB (°F)	EWB (°F)	LDB (°F)	LWB (°F)	FACE VEL (FPM)	COIL ROWS	FINS / IN	APD (IN WC)	EWT (°F)	LWT (°F)	GPM	WPD (FT WG)	TOTAL CAP (MBH)	SENSIBLE CAP (MBH)		
RTU-1	EVENTS SPACE	6,500	0.75	7.5/ 6.44	2,433	BELT	208	3	60	20.4	90.6	471	2	11	0.24	180	130.1	22.1	5.3	510.5	85.9	71.0	55.4	55	471	6	12	0.84	40	61.0	40	6.7	320	200.5	YORK/JOHNSON CONTROL MODEL 51x60	A, B, C, D
RTU-2	EVENTS SPACE	6,500	0.75	7.5/ 6.44	2,433	BELT	208	3	60	20.4	90.6	471	2	11	0.24	180	130.1	22.1	5.3	510.5	85.9	71.0	55.4	55	471	6	12	0.84	40	61.0	40	6.7	320	200.5	YORK/JOHNSON CONTROL MODEL 51x60	A, B, C, D
RTU-3	EVENTS SPACE	6,500	0.75	7.5/ 6.44	2,433	BELT	208	3	60	20.4	90.6	471	2	11	0.24	180	130.1	22.1	5.3	510.5	85.9	71.0	55.4	55	471	6	12	0.84	40	61.0	40	6.7	320	200.5	YORK/JOHNSON CONTROL MODEL 51x60	A, B, C, D
RTU-4	EVENTS SPACE	6,500	0.75	7.5/ 6.44	2,433	BELT	208	3	60	20.4	90.6	471	2	11	0.24	180	130.1	22.1	5.3	510.5	85.9	71.0	55.4	55	471	6	12	0.84	40	61.0	40	6.7	320	200.5	YORK/JOHNSON CONTROL MODEL 51x60	A, B, C, D

NOTES:

A. REFER TO SPECIFICATION SECTION 237413.

B. PROVIDE UNIT WITH 12" INSULATED ACOUSTIC ROOF CURB, GFCI SERVICE OUTLET, ECONOMIZER, DOUBLE-WAL CONSTRUCTION, MERV 11 FILTRATION, AND VARIABLE FREQUENCY DRIVES IN NEMA 3R BOX.

C. HOT GLYCOL SOLUTION IS 40% PROPYLENE GLYCOL.

D. COIL DESIGN CONDITIONS ARE BASED UPON AN OUTSIDE AIR FLOW RATE OF 4,500 CFM.

BRAZED PLATE HEAT EXCHANGER SCHEDULE

UNIT TAG	LOCATION	SERVICE	HOT SIDE PERFORMANCE DATA					COLD SIDE PERFORMANCE DATA					PLATES	HEAT TRANSFER AREA (SQ. FT.)	HEAT TRANSFER (MBH)	BASIS OF DESIGN	NOTES
			FLUID	GPM	EWT (°F)	LWT (°F)	WPD (FT WG)	FLUID	GPM	EWT (°F)	LWT (°F)	WPD (FT WG)					
HX-1	CRAWLSPACE MER	HW HEATING LOOP	WATER	165.8	225	140	1.87	WATER	280	130	180	4.74	90	328.21	898.32	SONDEX MODEL # SL333-BR27-90-TM-LIQUID	A
HX-2	CRAWLSPACE MER	GLYCOL HEATING LOOP	WATER	143.41	225	140	1.52	40% PROPYLENE GLYCOL 60% WATER	255	130	180	4.75	200	313.29	814.02	SONDEX MODEL # SL140-BR25-200-TL-LIQUID	A, B, C
HX-3	CRAWLSPACE MER	GLYCOL HEATING LOOP	WATER	143.41	225	140	1.52	40% PROPYLENE GLYCOL 60% WATER	255	130	180	4.75	200	424.5	9,991.4	SONDEX MODEL # SL140-BR25-200-TL-LIQUID	A, B, C
HX-4	CRAWLSPACE MER	GLYCOL HEATING LOOP SNOWMELT	WATER	35.97	225	140	.22	40% PROPYLENE GLYCOL 60% WATER	160	110	130	4.21	40	60.13	439.02	SONDEX MODEL # SL140-BR25-40-TK-LIQUID	A, B, C

NOTES:

A. REFER TO SPECIFICATION SECTION 235700.

B. PROVIDE HEAT EXCHANGER WITH THERMOMETERS, ISOLATION VALVES, AND UNIONS AT EACH INLET AND OUTLET. PROVIDE MANUFACTURER'S STAINLESS STEEL DRIP PAN AND INSULATED SHIELD.

C. UNIT SHALL BE DOUBLE-WALLED CONSTRUCTION.

PUMP SCHEDULE

UNIT TAG	LOCATION	SERVICE	GPM	PD (FT WG)	PUMP TYPE	IMPELLER DIAMETER (IN)	TRIPLE-DUTY VALVE SIZE (IN)	MINIMUM EFFICIENCY (%)	MOTOR DATA					BASIS OF DESIGN	NOTES
									HP	VOLTS	PHASE	FREQ	RPM		
P-1	CRAWLSPACE MER	CHILLED WATER LOOP	715	100	BASE-MOUNTED END-SUCTION	11	6	82.5	25	208	3	60	1750	BELL & GOSSETT SERIES 1510 - 4EB	A, B
P-2	CRAWLSPACE MER	HOT WATER LOOP	280	100	BASE-MOUNTED END-SUCTION	10-7/8	5	73.8	15	208	3	60	1750	BELL & GOSSETT SERIES 1510 - 3EB	A, B
P-3	CRAWLSPACE MER	HOT WATER LOOP	280	100	BASE-MOUNTED END-SUCTION	10-7/8	5	73.8	15	208	3	60	1750	BELL & GOSSETT SERIES 1510 - 3EB	A, B
P-4	CRAWLSPACE MER	HOT GLYCOL LOOP	510	100	BASE-MOUNTED END-SUCTION	11	6	80.6	20	208	3	60	1750	BELL & GOSSETT SERIES 1510 - 3EB	A, B
P-5	CRAWLSPACE MER	HOT GLYCOL LOOP	510	100	BASE-MOUNTED END-SUCTION	11	6	80.6	20	208	3	60	1750	BELL & GOSSETT SERIES 1510 - 3EB	A, B
P-6	CRAWLSPACE MER	HOT GLYCOL LOOP SNOWMELT	160	100	BASE-MOUNTED END-SUCTION	10.125	3	68.8	10	208	3	60	1750	BELL & GOSSETT SERIES 1510 - 2EB	A, B

NOTES:

A. REFER TO SPECIFICATION SECTION 232123.

B. PROVIDE PUMP WITH BRAIDED 304 STAINLESS STEEL FLEXIBLE CONNECTORS, TRIPLE-DUTY VALVE, SUCTION DIFFUSER, AND 250# FLANGES.

AIR SEPARATOR SCHEDULE

UNIT TAG	LOCATION	SERVICE	AIR SEPARATOR				BASIS OF DESIGN	NOTES
			INLET (IN)	FLOW (GPM)	OUTLET (IN)	MAX. PD (FT WG)		
AS-1	CRAWLSAPCE MER	CHILLED WATER LOOP	6	710	6	3	SPIROTHERM SPIROVENT VHT600FA	A, B
AS-2	CRAWLSAPCE MER	HOT WATER LOOP	5	280	5	3	SPIROTHERM SPIROVENT VHT500FA	A, B
AS-3	CRAWLSAPCE MER	HOT GLYCOL LOOP	6	510	6	3	SPIROTHERM SPIROVENT VHT600FA	A, B
AS-4	CRAWLSAPCE MER	SNOWMELT LOOP	4	160	4	3	SPIROTHERM SPIROVENT VHT400FA	A, B

NOTES:

A. REFER TO SPECIFICATION SECTION 232116.

B. PROVIDE MANUFACTURER'S HIGH CAPACITY AIR VENT.

EXPANSION TANK SCHEDULE

UNIT TAG	LOCATION	SERVICE	TYPE	ACCEPTANCE VOLUME (GAL)	CHARGE PRESSURE (PSIG)	VOLUME (GAL)	DIAMETER (IN)	BASIS OF DESIGN	NOTES
ET-1	CRAWLSPACE MER	CHILLED WATER LOOP	DIAPHRAGM	84	55	211	30	BELL & GOSSETT D-280V	A, B
ET-2	CRAWLSPACE MER	HOT WATER LOOP	DIAPHRAGM	84	55	211	30	BELL & GOSSETT D-280V	A, B
ET-3	CRAWLSPACE MER	HOT WATER LOOP	DIAPHRAGM	84	55	211	30	BELL & GOSSETT D-280V	A, B
ET-4	CRAWLSPACE MER	SNOWMELT LOOP	DIAPHRAGM	34	55	110	24	BELL & GOSSETT D-200V	A, B

NOTES:

A. REFER TO SPECIFICATION SECTION 232116.

B. MOUNT TANK ON 4" THICK CONCRETE PAD.

CHAINTREUIL | JENSEN | STARK ARCHITECTS, LLP
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Buffalo, NY 14210
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54 South Union Street
Rochester, NY 14607
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www.cjsarchitects.com

ARGUS
Argus Engineering, PLLC
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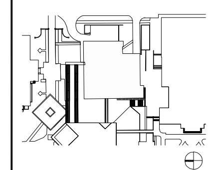
Syracuse NY 13211
315-475-6061



THE UNIVERSITY OF ROCHESTER
Frederick Douglass Building
Renovations & Alterations
UR Project No. 142003

735 LIBRARY ROAD
ROCHESTER NEW YORK, 14623

DRAWING TITLE

SCHEDULES

JOB NO.	1317
SCALE	AS NOTED
DATE	November 20, 2015
DRAWN BY	AJK
CHECKED BY	GLL
REVISIONS	10/30/15 ADDENDUM #1
	11/4/15 ADDENDUM #2
	11/9/15 ADDENDUM #3
	5/11/16 3rd and 4th Floor Revisions

THIS IS A SINGLE SHEET OF A COHESIVE SET OF CONSTRUCTION DOCUMENTS (INCLUDING DRAWINGS AND SPECIFICATIONS). INTERPRETATION OF THE INFORMATION AS PRESENTED SHOULD BE BASED ON THE ENTIRE SET OF DOCUMENTS.

DRAWING NO.

H-701

RECORD DRAWING SET - CONFORMED

CABINET / UNIT HEATER SCHEDULE

UNIT TAG	LOCATION	SA (CFM)	HEATING PERFORMANCE DATA: EWT (°F)	LWT (°F)	GPM	PD (FT WG)	TOTAL (MBH)	ELECTRICAL DATA: HP (W)	VOLTS	PHASE	FREQ	BASIS OF DESIGN	NOTES
UH-1	PULP/GREASE COLLECTION ROOM 120	1100	180	130	2.0	0.23	44.8	1/20	120	1	60	STERLING HS-72	A, G
CUH-1	SERVICE CORR. 119 ADJ. TO ELEV. 3	335	180	130	1.7	.56	39.5	1/10	120	1	60	STERLING W-1080-03	A, B, C, D, E, G, H, I
CUH-2	CORRIDOR 105	335	180	130	1.0	.56	22.8	1/10	120	1	60	STERLING RW-1120-03	A, B, C, D, E, F, G, H, I
CUH-3	VESTIBULE 200	335	180	130	1.0	.56	22.8	1/10	120	1	60	STERLING RW-1120-03	A, B, C, D, E, F, G, H, I
CUH-4	STAIRWAY 200 S4	630	180	130	1.7	.56	39.5	1/10	120	1	60	STERLING RW-1120-06	A, B, C, D, E, F, G, H, I

NOTES:

A. RATINGS BASED ON HIGH SPEED FAN OPERATION, 60° ENTERING AIR TEMPERATURE.
B. ALUMINUM GRILLE INLET/OUTLET.
C. PROVIDE W/ AQUASTAT.
D. PROVIDE HIGH STATIC MOTOR.
E. PROVIDE UNIT WITH INTEGRAL DISCONNECT.
F. FULLY RECESSED UNIT, COORDINATE OPENING SIZE.
G. REFER TO SPECIFICATION SECTION 238239.
H. COLOR SELECTED BY ARCHITECT.
I. 40% POLYPROPYLENE GLYCOL.

AIR-COOLED CONDENSING UNIT SCHEDULE

UNIT TAG	LOCATION	SERVICE	NOMINAL CAPACITY (BTUH)	REFRIGERANT	AMBIENT TEMPERATURE (°F)	FAN PERFORMANCE DATA: RPM	HP	QUANTITY	DRIVE	UNIT POWER: VOLTS	PHASE	FREQ	AMPS (MCA)	BASIS OF DESIGN	NOTES
ACCU-2	ROOF	ELEVATOR MACHINE ROOM	24,000	R-410A	95	-	-	1	DIRECT	208	1	60	18	MITSUBISHI MUY-GE24NA	A, B
ACCU-3	ROOF	ELEVATOR MACHINE ROOM	24,000	R-410A	95	-	-	1	DIRECT	208	1	60	18	MITSUBISHI MUY-GE24NA	A, B

NOTES:

A. INCLUDE OPTIONAL WIND BAFFLE FOR LOW AMBIENT OPERATION DOWN TO 0° F.
B. REFER TO SPECIFICATION SECTION 238126.

AIR CONDITIONING UNIT SCHEDULE

UNIT TAG	LOCATION	SERVICE	EVAPORATOR FAN PERFORMANCE DATA: CFM	MOTOR DATA: HP (MCA)	VOLTS	PHASE	FREQ	DX COOLING PERFORMANCE DATA: ROOM SET POINTS: DB (F°)	RH (%)	TOTAL CAPACITY (MBH)	SENSIBLE CAPACITY (MBH)	BASIS OF DESIGN	NOTES
AC-2	ELEVATOR MR	ELEVATOR MR	775	(1)	208	1	60	72	50	24,000	-	MITSUBISHI MSY-GE24NA	A, B, C, D
AC-3	ELEVATOR MR	ELEVATOR MR	775	(1)	208	1	60	72	50	24,000	-	MITSUBISHI MSY-GE24NA	A, B, C, D

NOTES:

A. INDICATED AIRFLOW RATE IS FOR UNIT ON HIGH SPEED.
B. WALL-MOUNTED UNIT.
C. PROVIDE 5/8" RL AND 7/8" RS PIPING BETWEEN AC UNIT AND OUTDOOR CONDENSING UNIT.
D. REFER TO SPECIFICATION SECTION 238126.

CONVECTOR SCHEDULE

UNIT TAG	LOCATION	TYPE	CAPACITY (BTUH)	EAT (°F)	EWT (°F)	LWT (°F)	GPM	ENCLOSURE SIZE (IN.): HEIGHT	LENGTH	DEPTH	RECESS	BASIS OF DESIGN	NOTES
CV-1	VESTIBULE 100	RECESSED	6,700	65	180	130	1.34	26	64	4	FULL	STERLING FWG-A	A, B, C
CV-2	VESTIBULE 100	RECESSED	6,700	65	180	130	1.34	26	64	4	FULL	STERLING FWG-A	A, B, C

NOTES:

A. REFER TO SPECIFICATION SECTION 238233.
B. GRATE PROVIDED BY OTHERS.
C. 40% POLYPROPYLENE GLYCOL.

GRILLE / REGISTER / DIFFUSER SCHEDULE

UNIT TAG	SERVICE	DESCRIPTION	MATERIAL	FACE SIZE	NECK SIZE	MOUNTING	FINISH	ACCESSORIES	BASIS OF DESIGN	NOTES
SA-1	SUPPLY AIR	SQUARE PLAQUE DIFFUSER	STEEL	NOMINAL 24" X 24"	SEE PLANS	LAY-IN	WHITE (STANDARD)	RADIAL DAMPER	TITUS OMNI	A, B
SA-2	SUPPLY AIR	PLENUM SLOT DIFF. (2-3/4" SLOT)	HEAVY-GAUGE EXTRUDED AL.	SEE PLANS	SEE PLANS	LAY-IN	WHITE (STANDARD)	11" HIGH PLENUM	TITUS ML-38	A, B
SA-3	SUPPLY AIR	ROUND DIFFUSER	STEEL	PER NECK SIZE	SEE PLANS	EXPOSED	WHITE (STANDARD)	RADIAL DAMPER	TITUS TMRA	A, B
SA-4	ARCH. GRILLE AT WINDOW SEAT	LINEAR BAR	STEEL	4"x2'-6"	SEE PLANS	SURFACE	WHITE (STANDARD)	-	TITUS CT-481	A, B, C
RA-1	RETURN AIR	PERFORATED GRILLE	STEEL	NOMINAL 24" X 24"	SEE PLANS	LAY-IN	WHITE (STANDARD)	-	TITUS PAR	A, B
RA-2	RETURN AIR	PERFORATED GRILLE	ALUMINUM	NOMINAL 24" X 24"	SEE PLANS	LAY-IN	WHITE (STANDARD)	-	TITUS PAR-AA	A, B
XA-1	EXHAUST AIR	LOUVERED REGISTER	STEEL	NECK SIZE + 1-1/4"	SEE PLANS	SURFACE	WHITE (STANDARD)	OPPOSED BLADE DAMPER	TITUS 350RL	A, B
XA-2	EXHAUST AIR	LOUVERED REGISTER	ALUMINUM	NECK SIZE + 1-1/4"	SEE PLANS	SURFACE	WHITE (STANDARD)	OPPOSED BLADE DAMPER	TITUS 350FL	A, B
TA-1	RETURN AIR	PERFORATED GRILLE	STEEL	NOMINAL 24" X 24"	SEE PLANS	LAY-IN	WHITE (STANDARD)	-	TITUS PAR	A, B

NOTES:

A. PROVIDE MANUFACTURER'S MOUNTING FRAME COMPATIBLE WITH SURFACE IN WHICH OUTLET IS INSTALLED.
B. REFER TO SPECIFICATION SECTION 233713.
C. PROVIDE 3/4" BORDER.

AIR HANDLING UNIT SCHEDULE

UNIT TAG	LOCATION	SERVICE	SUPPLY FAN PERFORMANCE DATA: ESP (IN WC)	TSP (IN WC)	SA (CFM)	RPM	TYPE	DIA (IN)	MOTOR DATA: HP	VOLTS	PHASE	FREQ	RPM
EXISTING (AHU-01)	CRAWLSPACE MECHANICAL RM.	FIRST FLOOR			26,000	(EXISTING TO REMAIN)							
AHU-02	CRAWLSPACE MECHANICAL RM.	FIRST FLOOR	2.1	-	20,435	1,405	DIRECT	100	25	208	3	60	1,200
AHU-03	FOURTH FLOOR	SECOND FLOOR	2.0	-	19,000	1,328	DIRECT	100	20	208	3	60	1,200
AHU-04	PENTHOUSE	THIRD FLOOR	2.10	-	16,100	1,839	DIRECT	100	20	208	3	60	1,800
AHU-05	PENTHOUSE	FOURTH FLOOR	1.85	-	16,100	1,813	DIRECT	100	20	208	3	60	1,800

UNIT TAG	HOT GLYCOL HEATING PERFORMANCE DATA: MIN OA (CFM)	EDB (°F)	LDB (°F)	FACE VEL. (FPM)	COIL ROWS	FINS / IN	APD (IN WC)	EGT (°F)	LGT (°F)	GPM	WPD (FT WG)	TOTAL (MBH)
EXISTING (AHU-01)	-	7.52	69.72	556	3	9	0.33	180	130	90	5.30	1,804.3
AHU-02	18,465	7.5	96.4	456	2	13	0.27	180	130	90	6.6	2,088.8
AHU-03	15,325	9.3	93.4	424	2	12	0.22	180	130	79	5.2	1,831.2
AHU-04	5,575	5.3	94.1	404	2	12	0.21	180	129.9	71.1	6.5	1,649.9
AHU-05	3,880	13.6	91.7	404	2	11	0.19	180	130	61.6	5.0	1,425.8

UNIT TAG	CHILLED WATER COOLING COIL PERFORMANCE DATA: MIN OA (CFM)	OAT (°F)	EDB (°F)	EWB (°F)	LDB (°F)	LWB (°F)	FACE VEL. (FPM)	COIL ROWS	APD (IN WC)	FINS / IN	EWT (°F)	LWT (°F)	GPM	WPD (FT WG)	SENSIBLE (MBH)	TOTAL (MBH)	BASIS OF DESIGN	NOTES
EXISTING (AHU-01)	(EXISTING TO REMAIN)																TEMTROL 5WC-8-33x51x3-9 AL	B, C
AHU-02	18,465	-	87	71.7	54.4	53.4	456	6	0.84	12	45	61	139.1	12.9	674.1	1113.1	YORK/JOHNSON CONTROL MODEL 84x102	A, B
AHU-03	15,325	-	87	71.7	54.8	54.3	424	6	0.66	11	45	61	127	10.9	618.7	1,018	YORK/JOHNSON CONTROL MODEL 84x102	A, B
AHU-04	5,575	-	82.4	68.5	54.4	53.9	404	6	0.58	11	45	60.9	87.4	8.9	457.6	698.3	YORK/JOHNSON CONTROL MODEL 72x108	A,B
AHU-05	3,880	-	81.4	67.8	54.4	54.0	404	6	0.57	11	45	61.0	82.3	8.0	441.7	659.9	YORK/JOHNSON CONTROL MODEL 72x108	A, B

NOTES:

A. UNIT SHALL HAVE DOUBLE-WALLED CONSTRUCTION.
B. REFER TO SPECIFICATION SECTION 238216.
C. UNIT IS A 4-PIECE COIL TO BE INSTALLED IN EXISTING AIR HANDLING UNIT AHU-01. CONTRACTOR SHALL PROVIDE ALL REQUIRED MATERIALS AND LABOR TO DISCONNECT AND REMOVE EXISTING STEAM HEATING COIL AND INSTALL HOT GLYCOL COIL IN AHU-01.
D. AHU-02 TO BE FIELD ERECTED WITH AHU MANUFACTURE SUPERVISION.

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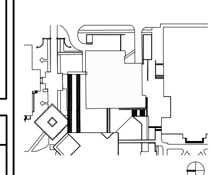

THE UNIVERSITY OF ROCHESTER
Frederick Douglass Building
Renovations & Alterations
UR Project No. 142003

735 LIBRARY ROAD
ROCHESTER NEW YORK, 14623

DRAWING TITLE

SCHEDULES

JOB N0.	1317
SCALE	AS NOTED
DATE	November 20, 2015
DRAWN BY	AJK
CHECKED BY	GLL
REVISIONS 1	10/30/15 ADDENDUM #1
2	11/4/15 ADDENDUM #2
3	11/9/15 ADDENDUM #3
4	5-/11/16 3rd and 4th Floor Revisions

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DRAWING NO.

H-702

RECORD DRAWING SET - CONFORMED

VARIABLE AIR VOLUME TERMINAL SCHEDULE

UNIT TAG	LOCATION	SERVICE	CFM MIN	CFM MAX	INLET DUCT SIZE (IN)	HOT WATER HEATING COIL PERFORMANCE DATA EAT (°F)	LAT (°F)	APD (IN WC)	EWT (°F)	LWT (°F)	GPM	ROWS	WPD (FT WG)	TOTAL (MBH)	MIN INLET SP (IN WC)	BASIS OF DESIGN	AHU UNIT	NOTES
VAV-1	SEE PLANS	SEE PLANS	900	900	12	55	96.89	0.16	180	136.62	1.94	2	0.17	40.9	0.17	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-2	SEE PLANS	SEE PLANS	780	780	10	55	97.95	0.21	180	135.52	1.68	2	0.55	36.34	0.22	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-3	SEE PLANS	SEE PLANS	1,200	1,200	14	55	107.89	0.14	180	139.43	3.49	2	3.61	68.86	0.15	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-4	SEE PLANS	SEE PLANS	3,580	3,580	16	55	90.63	0.6	180	143.11	7.71	2	2.55	138.4	0.65	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-5	SEE PLANS	SEE PLANS	1,115	1,115	12	55	98.88	0.22	180	134.56	2.4	2	1.36	53.08	0.23	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-6	SEE PLANS	SEE PLANS	600	600	08	55	94.56	0.25	180	139.03	1.29	2	0.25	25.75	0.26	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-7	SEE PLANS	SEE PLANS	1,800	1,800	16	55	99.15	0.20	180	134.28	3.88	2	0.7	86.21	0.21	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-8	SEE PLANS	SEE PLANS	1,340	1,340	14	55	103.79	0.16	180	143.18	3.96	2	0.65	70.93	0.18	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-9	SEE PLANS	SEE PLANS	600	300	08	55	98.96	0.25	180	134.47	0.65	2	0.11	14.31	0.20	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-10	SEE PLANS	SEE PLANS	1,000	1,000	12	55	96.44	0.10	180	137.47	2.15	2	0.19	44.96	0.2	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-11	SEE PLANS	SEE PLANS	135	200	05	55	99.01	0.06	180	137.42	0.29	2	0.04	6.45	0.07	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-12	SEE PLANS	SEE PLANS	420	750	10	55	93.99	0.2	180	139.63	0.9	2	0.04	17.77	0.21	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-13	SEE PLANS	SEE PLANS	390	500	06	55	94.58	0.25	180	139	0.84	2	0.15	16.75	0.37	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-14	SEE PLANS	SEE PLANS	650	1,200	14	55	93.39	0.07	180	140.25	1.4	1	2.39	27.07	0.08	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-15	SEE PLANS	SEE PLANS	1,000	1,000	12	55	96.44	0.19	180	137.09	2.15	2	0.19	44.96	0.2	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-16	SEE PLANS	SEE PLANS	1,830	1,830	14	55	96.00	0.27	180	137.54	3.94	2	0.65	81.40	0.3	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-17	SEE PLANS	SEE PLANS	2,575	2,575	14	55	91.88	0.47	180	141.81	5.55	2	1.22	103.03	0.53	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-18	SEE PLANS	SEE PLANS	2,000	2,000	14	55	94.95	0.31	180	138.63	4.31	2	0.76	86.68	0.35	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-19	SEE PLANS	SEE PLANS	2,000	2,000	16	55	97.90	0.23	180	135.57	4.31	2	0.86	93.08	0.25	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-20	SEE PLANS	SEE PLANS	3,240	3,240	16	55	91.91	0.51	180	141.78	6.98	2	2.11	129.75	0.55	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-21	SEE PLANS	SEE PLANS	2,000	2,000	16	55	97.90	0.23	180	135.57	4.31	2	0.86	93.08	0.25	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-22	SEE PLANS	SEE PLANS	2,000	2,000	16	55	97.90	0.23	180	135.57	4.31	2	0.86	93.08	0.25	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-23	SEE PLANS	SEE PLANS	700	700	10	55	92.86	0.18	180	140.79	1.51	2	0.1	28.76	0.19	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-24	SEE PLANS	SEE PLANS	3,340	3,340	16	55	91.52	0.53	180	142.18	7.19	2	2.24	132.34	0.57	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-25	SEE PLANS	SEE PLANS	300	500	06	55	95.71	0.25	180	137.84	0.65	2	0.11	13.25	0.37	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-26	SEE PLANS	SEE PLANS	325	1,250	10	55	93.90	0.45	180	139.71	0.7	2	0.03	13.72	0.47	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-27	SEE PLANS	SEE PLANS	625	625	08	55	94.12	0.27	180	139.49	1.35	2	0.27	26.53	0.28	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-28	SEE PLANS	SEE PLANS	450	450	08	55	96.93	0.16	180	136.58	0.97	2	0.19	20.47	0.17	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-29	SEE PLANS	SEE PLANS	350	750	10	55	90.62	0.11	180	143.11	0.75	1	0.45	13.53	0.12	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-30	SEE PLANS	SEE PLANS	430	1,030	12	55	92.85	0.11	180	140.8	0.93	1	0.84	17.66	0.12	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-31	SEE PLANS	SEE PLANS	4.065	4.065	19	55	92.52	0.51	180	141.15	8.76	2	3.77	165.48	0.69	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-32	SEE PLANS	SEE PLANS	1,070	1,070	10	55	90.47	0.35	180	143.27	2.3	2	0.16	41.18	0.37	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-33	SEE PLANS	SEE PLANS	1,740	1,740	12	55	90.45	0.46	180	143.29	3.75	2	0.48	66.93	0.48	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-34	SEE PLANS	SEE PLANS	4.065	4,065	19	55	95.52	0.51	180	141.15	8.76	2	8.73	165.48	0.69	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-35	SEE PLANS	SEE PLANS	4.065	4,065	19	55	95.52	0.51	180	141.15	8.76	2	8.73	165.48	0.69	YORK/JOHNSON CONTROLS MODEL TSS	-	A

VARIABLE AIR VOLUME TERMINAL SCHEDULE

UNIT TAG	LOCATION	SERVICE	CFM MIN	CFM MAX	INLET DUCT SIZE (IN)	HOT WATER HEATING COIL PERFORMANCE DATA EAT (°F)	LAT (°F)	APD (IN WC)	EWT (°F)	LWT (°F)	GPM	ROWS	WPD (FT WG)	TOTAL (MBH)	MIN INLET SP (IN WC)	BASIS OF DESIGN	AHU UNIT	NOTES
VAV-36	SEE PLANS	SEE PLANS	490	490	06	55	93.57	0.24	180	140.05	1.06	2	0.19	15.7	0.36	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-37	SEE PLANS	SEE PLANS	300	625	10	55	92.28	0.08	180	141.4	0.65	1	0.34	12.13	0.09	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-38	SEE PLANS	SEE PLANS	390	1,080	10	55	93.93	0.35	180	139.68	0.84	2	0.04	16.47	0.37	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-39	SEE PLANS	SEE PLANS	650	2,345	14	55	91.36	0.22	180	142.35	1.4	1	0.34	25.64	0.27	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-40	SEE PLANS	SEE PLANS	160	645	08	55	91.68	0.15	180	142.02	0.34	1	0.12	6.37	0.16	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-41	SEE PLANS	SEE PLANS	300	1,115	10	55	92.28	0.2	180	141.4	0.65	1	0.34	12.13	0.22	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-42	SEE PLANS	SEE PLANS	160	535	08	55	91.68	0.11	180	142.02	0.34	1	0.12	6.37	0.12	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-43	SEE PLANS	SEE PLANS	60	255	05	55	95.42	0.04	180	138.13	0.13	1	0.06	2.63	0.05	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-44	SEE PLANS	SEE PLANS	600	3,700	16	55	94.83	0.35	180	138.75	1.29	1	0.33	25.93	0.4	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-45	SEE PLANS	SEE PLANS	160	260	06	55	96.44	0.09	180	137.06	0.34	2	0.01	7.19	0.12	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-46	SEE PLANS	SEE PLANS	160	265	06	55	98.28	0.09	180	135.17	0.34	2	0.04	7.51	0.12	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-47	SEE PLANS	SEE PLANS	220	580	08	55	94.42	0.24	180	139.17	0.47	2	0.01	9.41	0.25	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-48	SEE PLANS	SEE PLANS	160	715	08	55	91.68	0.18	180	142.02	0.34	1	0.12	6.37	0.2	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-49	SEE PLANS	SEE PLANS	250	555	08	55	92.09	0.22	180	141.59	0.54	2	0.01	10.06	0.23	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-50	SEE PLANS	SEE PLANS	180	970	08	55	90.94	0.3	180	142.78	0.39	1	0.14	7.02	0.34	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-51	SEE PLANS	SEE PLANS	540	540	08	55	95.68	0.21	180	137.87	1.16	2	0.22	23.83	0.22	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-52	SEE PLANS	SEE PLANS	600	2,540	14	55	92.91	0.25	180	141.47	1.29	1	0.3	24.22	0.31	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-53	SEE PLANS	SEE PLANS	210	875	08	55	95.12	0.46	180	138.45	0.45	2	0.01	9.14	0.49	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-54	SEE PLANS	SEE PLANS	165	940	10	55	97.39	0.15	180	136.09	0.36	1	0.17	7.59	0.17	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-55	SEE PLANS	SEE PLANS	240	1,985	12	55	93.16	0.32	180	140.49	0.52	1	0.06	9.94	0.35	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-56	SEE PLANS	SEE PLANS	580	950	12	55	99.06	0.17	180	134.36	0.86	2	0.09	27.73	0.18	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-57	SEE PLANS	SEE PLANS	400	1,500	12	55	93.67	0.2	180	139.95	0.86	1	0.73	16.78	0.22	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-58	SEE PLANS	SEE PLANS	370	1,670	12	55	94.54	0.24	180	139.05	0.8	1	0.63	15.88	0.26	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-59	SEE PLANS	SEE PLANS	1,100	2,000	12	55	95.46	0.57	180	139.05	2.37	2	0.21	48.29	0.6	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-60	SEE PLANS	SEE PLANS	2,000	2,000	102	55	91.37	0.57	180	142.34	4.31	2	4.09	78.92	0.6	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-61	SEE PLANS	SEE PLANS	220	375	06	55	96.31	0.16	180	137.21	0.47	2	0.07	9.86	0.23	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-62	SEE PLANS	SEE PLANS	220	375	06	55	96.31	0.16	180	137.21	0.47	2	0.07	9.86	0.23	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-63	SEE PLANS	SEE PLANS	3,330	3,330	16	55	91.56	0.53	180	142.14	7.17	2	2.22	132.09	0.57	YORK/JOHNSON CONTROLS MODEL TSS	-	A
VAV-64	SEE PLANS	SEE PLANS	315	815	08	55	94.23	0.23	180	75.57	6.5	1	2.96	14.05	0.26	YORK/JOHNSON CONTROLS MODEL TSS	-	A

NOTES:

A. REFER TO SPECIFICATION SECTIONS 230900 AND 233600.

LOUVER SCHEDULE

TAG #	LOCATION	APPLICATION	SIZE W x H	SILL DIM. (IN.)	FREE AREA SQ. FT.	CFM	MAX PRESSURE DROP IN W.G.	FREE AREA VEL. (FT./MIN.)	SECTION HIGH	SECTION WIDTH	BASIS OF DESIGN	NOTES
L-1	PENTHOUSE SOUTH SIDE AHU-05	RELIEF	9'-0" x 7'-6"	8"	35.29	16,100	0.03	456	2	1	GREENHECK MODEL # EHMG01	A, B, C, D, E
L-2	PENTHOUSE NORTH SIDE AHU-04	RELIEF	8'-0" x 8'-0"	8"	34.27	16,100	0.04	470	2	1	GREENHECK MODEL # EHMG01	A, B, C, D, E
L-3	FOURTH LEVEL WEST SIDE AHU-03	RELIEF	10'-0" x 8'-0"	8"	42.68	18,975	0.03	445	2	1	GREENHECK MODEL # EHMG01	A, B, C, D, E
L-4	BASEMENT LEVEL WEST SIDE AHU-02	INTAKE	5'-0" x 8'-0"	8"	20.82	10,217	0.04	491	1	1	GREENHECK MODEL # EHMG01	A, B, C, D, E
L-5	BASEMENT LEVEL WEST SIDE AHU-02	INTAKE	8'-0" x 8'-0"	8"	34.27	10,217	0.01	298	2	1	GREENHECK MODEL # EHMG01	A, B, C, D, E

NOTES:

A. SIDEWALL MOUNTING. (HIDDEN MULLION).
B. REFER TO SPECIFICATION SECTION 238900.
C. FINAL COLOR SELECTED BY ARCHITECT. (LOUVER FINISH KYNAR 70% (2 COAT))
D. LOUVER TO INCLUDE MOTORIZED DAMPER.
E. ALUMINUM BIRD SCREEN (1/2" x 0.063 MESH). MATCH LOUVER FINISH.

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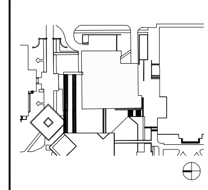

THE UNIVERSITY OF ROCHESTER
Frederick Douglass Building
Renovations & Alterations
UR Project No. 142003

735 LIBRARY ROAD
ROCHESTER NEW YORK, 14623

DRAWING TITLE

SCHEDULES

JOB N0.	1317
SCALE	AS NOTED
DATE	November 20, 2015
DRAWN BY	AJK
CHECKED BY	GLL
REVISIONS 1	10/30/15 ADDENDUM #1
2	11/4/15 ADDENDUM #2
3	11/9/15 ADDENDUM #3
4	5-/11/16 3rd and 4th Floor Revisions

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DRAWING NO.

H-703

RECORD DRAWING SET - CONFORMED

FAN SCHEDULE

UNIT TAG	LOCATION	SERVICE	TYPE	CFM	ESP (IN WG)	MIN. FAN DIA (IN)	FAN RPM	OUTLET VELOCITY (FPM)	DRIVE	INLET SOUND BY OCTAVE BAND 63	125	250	500	1,000	2,000	4,000	8,000	RADIATED AVG. SOUND POWER LwA	dBA	SONES	MOTOR DATA HP	VOLT	PHASE	FREQ	RPM	BASIS OF DESIGN	NOTES
F-2	CRAWLSPACE	AH-02 RETURN/EXHAUST FAN	INLINE/MIXED FLOW	25,975	2.0	40	1,013	1,549	BELT	88	92	85	81	79	75	69	63	84	73	23	15	208	3	60	1,750	GREENHECK QEI-40-I-150	A, D
F-3	SECOND FLOOR ROOF	ALLERGEN KITCHEN	UPBLAST CENTRIFUGAL	5,236	1.5	-	792	-	BELT	81	82	83	76	72	70	68	63	79	68	17.1	3	208	3	60	1,725	GREENHECK CUE-300HP-30	B, D
F-4	SECOND FLOOR ROOF	STREET KITCHEN	UPBLAST CENTRIFUGAL	6,150	1.7	-	871	-	BELT	82	83	86	80	75	74	71	67	83	71	20	3	208	3	60	1,725	GREENHECK CUBE-300HP-30	B, D
F-5	SECOND FLOOR ROOF	STREET KITCHEN	UPBLAST CENTRIFUGAL	6,163	1.7	-	872	-	BELT	82	83	86	80	75	74	71	67	83	71	20	3	208	3	60	1,725	GREENHECK CUBE-300HP-30	B, D
F-6	SECOND FLOOR ROOF	DISHWASHING	UPBLAST CENTRIFUGAL	1,000	0.75	-	1,618	-	BELT	73	72	75	67	61	62	56	57	71	59	9.8	1/3	208	1	60	1,725	GREENHECK CUBE-101-3G	C, D
F-7	SECOND FLOOR ROOF	EURO KITCHEN	UPBLAST CENTRIFUGAL	6,450	2.8	-	1,255	-	BELT	80	83	81	79	79	75	68	64	83	72	19.5	5	208	3	60	1,725	GREENHECK CUBE-360XP-50	B, D
F-8	SECOND FLOOR ROOF	KOSHER KITCHEN	UPBLAST CENTRIFUGAL	3,408	1.7	-	1,013	-	BELT	78	80	82	77	71	70	67	64	79	68	16.5	2	208	3	60	1,725	GREENHECK CUBE-220HP-20	B, D
F-9	SECOND FLOOR ROOF	KOSHER KITCHEN	UPBLAST CENTRIFUGAL	4,475	1.7	-	1,106	-	BELT	79	81	87	80	73	73	69	66	83	71	20	3	208	3	60	1,725	GREENHECK CUE-220HP-30	B, D
F-10	SECOND FLOOR ROOF	GREASE/MSB/CART WASH	UPBLAST CENTRIFUGAL	500	1.0	-	1,287	-	BELT	89	80	78	72	67	66	64	54	75	64	14.2	1/4	208	1	60	1,725	GREENHECK CUBE-141HP-4	C, D
F-11	SECOND FLOOR ROOF	TOILET EXHAUST - WEST	UPBLAST CENTRIFUGAL	900	1.5	-	1,807	-	BELT	78	78	74	71	66	65	58	54	73	62	11.1	3/4	208	3	60	1,725	GREENHECK CUE-161XP-7	D
F-12	FOURTH FLOOR MECH ROOM	AHU-03 RETURN/EXHAUST FAN	INLINE/MIXED FLOW	20,000	2.0	30	1,187	2,169	BELT	78	87	87	86	82	79	75	68	88	76	25	15	208	3	60	1,750	GREENHECK QEI-30-I-150	A, D
F-13	PENTHOUSE	AHU-04 RETURN/EXHAUST FAN	INLINE/MIXED FLOW	17,000	2.0	27	1,187	2,169	BELT	80	83	92	88	86	82	81	72	92	80	31	15	208	3	60	1,750	GREENHECK QEI-27-II-150	A, D
F-14	PENTHOUSE	AHU-05 RETURN/EXHAUST FAN	INLINE/MIXED FLOW	17,000	2.0	27	1,187	2,169	BELT	80	83	92	88	86	82	81	72	92	80	31	15	208	3	60	1,750	GREENHECK QEI-27-II-150	A, D
F-15	PENTHOUSE ROOF	TOILET EXHAUST 3RD AND 4TH FLOOR	UPBLAST CENTRIFUGAL	1,050	1.5	-	1,725	-	DIRECT	81	51	66	73	65	50	52	50	72	60	10.0	1	208	3	60	1,725	GREENHECK CUE-141A	B, D
F-16	FOURTH FLOOR ROOF	KITCHEN 219	UPBLAST CENTRIFUGAL	6,774	1.5	-	772	2,169	BELT	81	82	82	78	70	69	67	63	79	67	16.4	3	208	3	60	1,725	GREENHECK CUBE-300-30	A, D
F-17	FOURTH FLOOR ROOF	KITCHEN 219	UPBLAST CENTRIFUGAL	8,550	2.17	-	763	2,169	BELT	86	92	84	78	76	73	69	66	83	72	23	5	208	3	60	1,725	GREENHECK CUBE-360HP-36	A, D
F-18	CRAWLSPACE	AH-01 RETURN/EXHAUST FAN	INLINE/MIXED FLOW	22,375	2.0	30	1,282	2,427	BELT	80	89	89	89	85	82	79	71	91	79	30	15	208	3	60	1,750	GREENHECK QEI-30-I-150	A, D
F-19	PENTHOUSE ROOF	FOURTH FLOOR STOVE HOOD	UPBLAST CENTRIFUGAL	1350	1.7	-	1,650	-	BELT	82	57	72	75	66	54	55	53	74	62	10.5	3/4	208	3	60	1,725	GREENHECK CUBE-141-7	A, D
F-20	MECHANICAL ROOM 125	MECHANICAL ROOM 125	IN-LINE	500	0.5	-	1,725	-	DIRECT	75	75	72	65	61	58	55	48	68	57	8.8	1/6	120	1	60	1,725	GREENHECK SQ-90-VG	A, D

NOTES:

A. PROVIDE FAN WITH NEMA PREMIUM EFFICIENCY MOTOR, BASE-MOUNTING KIT WITH RESTRAINED SPRING ISOLATORS, INLET/OUTLET FLANGES, AND DISCONNECT SWITCH.

B. PROVIDE FAN WITH NEMA PREMIUM EFFICIENCY MOTOR, 24" HIGH INSULATED ROOF CURB, CURB SEAL, HINGED CURB CAP, NON-STICK COATED FAN WHEEL, HOOD HASPS, STAINLESS STEEL FASTENERS, GREASE TRAP, HEAT BAFFLE, CLEANOUT PORT, BELT GUARD, EXTENDED LUBRICATION LINES, AND DISCONNECT SWITCH.

C. PROVIDE FAN WITH NEMA PREMIUM EFFICIENCY MOTOR, 12" HIGH INSULATED ROOF CURB, CURB SEAL, HINGED CURB CAP, HOOD HASPS, STAINLESS STEEL FASTENERS, BELT GUARD, EXTENDED LUBRICATION LINES, AND DISCONNECT SWITCH.

D. REFER TO SPECIFICATION SECTION 233423.

FIN TUBE RADIATION SCHEDULE

UNIT TAG	CAPACITY (BTUH / HR / LINEAR FT.)	ENCLOSURE H (IN)	D (IN)	MOUNTING HEIGHT TO TOP	ELEMENT HGT. (IN)	WIDTH (IN)	TUBE SIZE (IN)	ROWS	FINS PER FOOT	ACTIVE FIN LENGTH (FT)	AVG. WATER TEMP. °F	BASIS OF DESIGN	NOTES
FT-1	980	-	-	8-7/8	3-5/8	4-1/4	3/4	1	50	AS SHOWN	170	STERLING BARE ELEMENT STYLE 'B'	A, B
FT-2	880	11-3/4	4-3/8	15-11/16	3-1/4	3-1/4	3/4	2	50	AS SHOWN	170	STERLING MODEL # JVA-E5-11	A, C, D

NOTES:

A. REFER TO SPECIFICATION SECTION 238236.

B. COORDINATE WITH ARCHITECTURAL WINDOW SEAT.

C. COLOR SELECTED BY ARCHITECT.

D. PROVIDE END CAPS.

DOOR AIR CURTAIN SCHEDULE

UNIT TAG	LOCATION	SERVICE	FAN PERFORMANCE DATA: MOTOR DATA: MOTOR QUANTITY	HP	VOLTS	PHASE	FREQ.	FAN DATA: FAN QUANTITY	AMPS	TOTAL AIR VOLUME (CFM)	HOT WATER HEATING COIL PERFORMANCE DATA: △T (°F)	TOTAL (MBH)	GPM	BASIS OF DESIGN	NOTES
DAC-1	DOCK 226	OVERHEAD GARAGE DOOR	3	1/2	208	1	60	3	10.5	4,760	29	213.1	15	BERNER IDC12-3132W	A, B, C, D
DAC-2	119A	VESTIBULE 119A	1	1/5	208	1	60	1	1.7	2,010	25	56.1	6	BERNER CLC08-1072W	A, B, C, D
DAC-3	VESTIBULE 200	VESTIBULE 200	1	1/5	208	1	60	1	1.7	2,010	25	56.1	6	BERNER CLC08-1072W	A, B, C, D
DAC-4	VESTIBULE 206	VESTIBULE 206	1	1/5	208	1	60	1	1.7	2,010	25	56.1	6	BERNER CLC08-1072W	A, B, C, D
DAC-5	ANTEROOM 214	ANTEROOM 214	1	1/5	208	1	60	1	1.7	2,010	25	56.1	6	BERNER CLC08-1072W	A, B, C, D
DAC-6	GRAB & GO 220	GRAB & GO 220	1	1/5	208	1	60	1	1.7	-	25	27.7	5	BERNER CLC08-1036W	A, B, C, D
DAC-7	GRAB & GO 220	GRAB & GO 220	1	1/5	208	1	60	1	1.7	-	25	27.7	5	BERNER CLC08-1036W	A, B, C, D, E

NOTES:

A. REFER TO SPECIFICATION SECTION 233433.

B. PROVIDE WITH MANUFACTURER'S STAND ALONE CONTROL PACKAGE INCLUDING: DOOR SWITCH, LED DISPLAY, LOW VOLTAGE CONTROL CIRCUIT, THERMOSTAT, ON/OFF AUTO OPERATION, TIME DELAY AND FAN SPEED SELECTION.

C. FINISH: STAINLESS STEEL CABINET.

D. FURNISH UNIT COMPLETE WITH CONTROLS, HOT WATER HEATING COIL, MOUNTING BRACKETS AND DISCHARGE NOZZLE.

E. FINISH COLOR SELECTED BY ARCHITECT.

GRAVITY VENTILATOR SCHEDULE

UNIT TAG	LOCATION	SERVICE	SP (IN. WG.)	CFM	BASE HEIGHT (IN.)	THROAT VELOCITY (FT/MIN)	THROAT AREA (FT2)	BASIS OF DESIGN	NOTES
GRV-1	LEVEL 5 ROOF	AHU-3	.5	21,629	5	1,901	11.38	GREENHECK FGR 21 X 78	A, B, C, E
GRV-2	LEVEL 2 ROOF	RTU-1	.12	3,250	5	1,003	3.24	GREENHECK GRSR -24	A, B, D, E, F
GRV-3	LEVEL 2 ROOF	RTU-2	.12	3,250	5	1,003	3.24	GREENHECK GRSR -24	A, B, D, E, F
GRV-4	LEVEL 2 ROOF	RTU-3	.12	3,250	5	1,003	3.24	GREENHECK GRSR -24	A, B, D, E, F
GRV-5	LEVEL 2 ROOF	RTU-4	.12	3,250	5	1,003	3.24	GREENHECK GRSR -24	A, B, D, E, F
GRV-6	PENTHOUSE ROOF	AHU-4 AND 5	.443	16,100	5	1,789	9	GREENHECK FGR 24 X 54	A, B, E, F, G

NOTES:

A. REFER TO SPECIFICATION SECTION 233723.

B. PROVIDE 12" HIGH CURB.

C. DAMPER 21" X 78".

D. DAMPER 24" x 24".

E. PROVIDE STAINLESS STEEL BIRD SCREEN.

F. QUANTITY (2).

G. DAMPER 24" x 54".

SNOWMELT MANIFOLD SCHEDULE

UNIT TAG	LOCATION	SERVICE	CONFIGURATION	ZONE CIRCUITS	FLUID	FLOW RATE (GPM)	BASIS OF DESIGN	NOTES
MF-1	STORAGE 207A	EXTERIOR TERRACE	CONTROL PANEL	10	40% PROPYLENE GLYCOL	56	UPONOR	A, B, C
MF-2	DRY STORAGE 217	LOADING DOCK	CONTROL PANEL	2	40% PROPYLENE GLYCOL	9	UPONOR	A, B, C
MF-3	MECHANICAL ROOM B06A	AREA WAY	CONTROL PANEL	1	40% PROPYLENE GLYCOL	4	UPONOR	A, B, C
MF-4	ELECTRICAL B09	AREA WAY	CONTROL PANEL	1	40% PROPYLENE GLYCOL	4	UPONOR	A, B, C

NOTES:

A. REFER TO SPECIFICATION SECTION 238316.

B. PANEL EWT = 110° F / LWT = 130°F

B. SNOWMELT SYSTEM AVERAGE WATER TEMPERATURE = 120° F AT DESIGN CONDITIONS.

C. TUBE SPACING SHALL BE 9" ON CENTERS.

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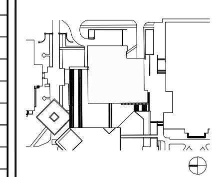


THE UNIVERSITY OF ROCHESTER
Frederick Douglass Building
Renovations & Alterations
UR Project No. 142003

735 LIBRARY ROAD
ROCHESTER NEW YORK, 14623

DRAWING TITLE
SCHEDULES

JOB NO.	1317
SCALE	AS NOTED
DATE	November 20, 2015
DRAWN BY	AJK
CHECKED BY	GLL
REVISIONS	1 10/30/15 ADDENDUM #1
	2 11/4/15 ADDENDUM #2
	3 11/9/15 ADDENDUM #3
	4 5/11/16 3rd and 4th Floor Revisions

THIS IS A SINGLE SHEET OF A COHESIVE SET OF CONSTRUCTION DOCUMENTS (INCLUDING DRAWINGS AND SPECIFICATIONS). INTERPRETATION OF THE INFORMATION AS PRESENTED SHOULD BE BASED ON THE ENTIRE SET OF DOCUMENTS.

DRAWING NO.
H-704

RECORD DRAWING SET - CONFORMED

Appendix RCx-A

Supporting Survey Notes

Preliminary Assessment Interview
HVAC ONLY

Building Name: RRL

Contact Name: Richard Stein

Wendel Auditor: Jason Denue Date:3/23/2021

BUILDING OVERVIEW

Building Schedule:

- Monday - Friday: 24/7
- Saturday - Sunday: 24/7

HVAC Schedule:

- Monday - Friday: 24/7
- Saturday - Sunday: 24/7

Space Types / uses

- **Type 1**: Library
- **Type 2**: Study Areas
- **Type 3**: Conference Space

EMS Yes / No

- **Type**: Pneumatic / DDC, some standalone PN
- **Manufacturer** Legacy / Updated, (Siemens Apogee, Day Webcontrol)
- **Has Trending**: Y / N WebControl Yes, Siemens Pi
- **Has Remote Access**: Y / N
- **Has Temperature setback**: Y / N
- **Has Time of Day Schedule**: Y / N

Heating Plant Yes / No

- **Heating System** : Steam / HW / Electric
- **Fuel Source** : NG / Fuel Oil / Propane

- **Steam Boilers** or N/A
  1. Number of Boilers:
  2. Boiler Output: field
  3. Boiler Input: field
  4. Blow down procedure: Automatic / Manual
     How frequent:______________________
  5. Condensate return system:
  6. Steam Pressure at Boiler: field
  7. Steam pressure at PRV 1: field psig or N/A
  8. Steam pressure at PRV 2: field psig or N/A
  9. Feed water system:
     a. Treated: Y / N
     b. Preheated: Y / N
  10. Burner Controls: Linkage / Electronic -
      Replace Boilers: Y / N Replace Burners: Y / N

- **Steam traps** or N/A
  1. Maintenance program: Y / N
  2. Trap condition (general): poor /average /new

  Replace Traps: Y / N
- **Combustion Air** : Y / N
- **Plant Enabled at**:
- **Hot Water Boilers** or N/A
  1. Number of Boilers: ________________
  2. Boiler Output: field mmBtu
  3. Boiler Input: field mmBtu
  4. Hot water system control: HW Reset / OA Reset / Constant Temperature
  5. Hot water temperature set point:
     Max:___________ Min:___________
  6. Burner Controls: Linkage / Electronic

  Replace Boilers: Y / N Replace Burners: Y / N

- **Hot Water Pumps**
  1. Primary Pumps:
     a. Power: field HP
     b. Number of Pumps: 2
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD
  2. Primary Glycol Pumps Pumps:
     a. Power: field HP
     b. Number of Pumps: 2
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: Y / N Add VFD: Y / N / Has

  3. Secondary Pumps:
     a. Power: field HP
     b. Number of Pumps: ______________
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: Y / N Add VFD: Y / N / Has

Domestic Hot Water System Yes / No

- **Hot Water Supply Temperature**: __________
- **Storage Tank**: Y / N
  1. Storage Temperature:__________________
  2. Storage Tank Volume:_________________
- **Heat exchanger**: Steam / Hot Water / N/A
  1. Usage: Year Round / School year
- **Heating Source**: Main Boilers / DHW Heater

- **DHW Heater**: Electric / NG / N/A
  1. Burner: Atmospheric / Force Draft
  2. Usage: Year Round / School year

  Replace with Condensing: **Y / N**
- **Dish washer Booster Heater** or N/A need to investigate
  1. Fuel Source: Steam / NG / Electric

[field

Cooling Plant Yes / No

- **Chilled water system** District Connection
- **Chiller**
  1. Chiller Type: Centrifugal / Screw / absorption / gas driven / ___________
  2. Chiller Capacity: field Tons
  3. VSD: **Y / N**
  4. OA reset: **Y / N**
- **Cooling Tower**
  1. Tower Type: Open / Closed / _____force draft_______
  2. Tower Capacity: Tons
  3. Add VSD: **Y / N / Has**
  4. Uses Glycol: **Y / N**
- **Controls**
  1. CHW Set Point: __________
  2. CW Set Point: ______

- **Chilled Water Pumps**
  1. Primary Pumps:
     a. Power: field HP
     b. Number of Pumps: 1
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

Replace Motors: **Y / N** Add VFD: **Y / N / Has**

  2. Secondary Pumps:
     a. Power: field HP
     b. Number of Pumps: _______________
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

Replace Motors: **Y / N** Add VFD: **Y / N / Has**

Terminal Units Yes / No

- **Space Type 1** : Stacks Heat Pumps (loop?)
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / _______________
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump /
  4. Ventilation: Y / N
  5. Controls: Thermostat DDC / DCV / Other
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other _____________
  8. Equipment Condition: Poor / Average / Good
- **Space Type 2**: Vairous
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / _______________
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump / _____________
  4. Ventilation: Y / N
  5. Controls: Thermostat / DCV / Other____________
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other _____________
  8. Equipment Condition: Poor / Average / Good
- **Space Type 3**:
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / VAV RH
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump / _____________
  4. Ventilation: Y / N
  5. Controls: Thermostat / DCV / Other____________
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other _____________
  8. Equipment Condition: Poor / Average / Good
- **Space Type 4** : radiators
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / _______________
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump / _____________
  4. Ventilation: Y / N
  5. Controls: Thermostat / DCV / Other____________
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other _____________
  8. Equipment Condition: Poor / Average / Good

Ventilation System 1 Yes / No

- **AHU Number(s):** AHU 1&2
- **Number of Units:** 2
- **Schedule:**
- **Location:** Indoors / RTU
- **Type of AHUs:** CV / VAV / DualDuct / Induction / Other ___________ (need look into further - may vary based on season HTG /CLG)
- **Heating** : HW / HW-Glycol / Steam / Furnace / Heat Pump / N/A
- **Cooling** : CHW / DX / Heat Pump / N/A
- **Humidification** : Y / N
- **Heat Recovery** : Y / N / Has
- **Outdoor Air**
  - Control: TOD / DCV / N/A (OA over ridden for COVID)
- **Exiting Economizer** : Y / N
- **System Fans**

1. Supply Fan:
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position (Static Pressure setpoint)
2. Return Fan 4qty
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position (Static Pressure setpoint)
3. Exhuast Fan or N/A
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position

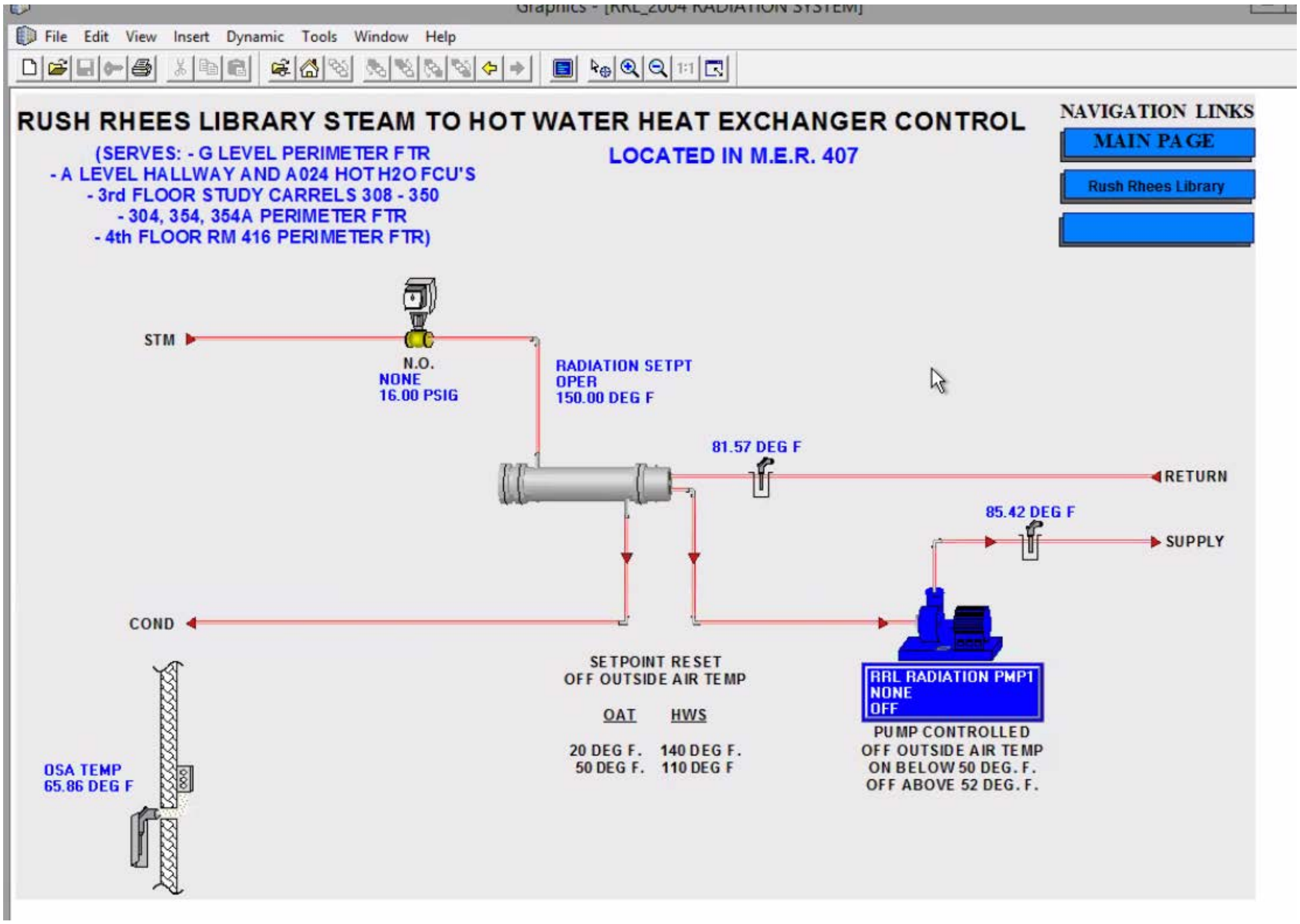
Ventilation System 2 Yes / No

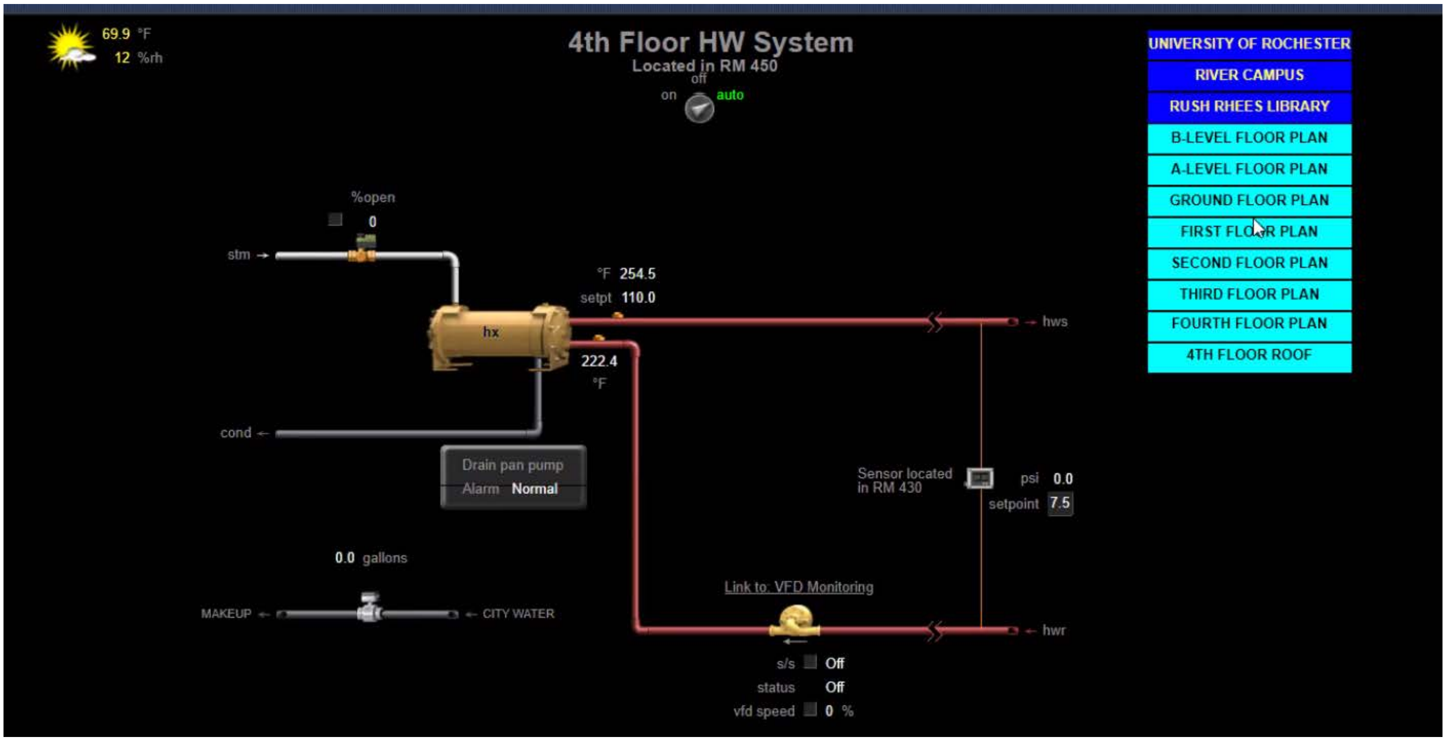
- **AHU Number(s):** *VAV*
- **Number of Units:** ____Mult_____________
- **Schedule:**
  - Monday - Friday: On_______ - Off ________
  - Saturday - Sunday: On_______ - Off ________
- **Location:** Indoors / RTU
- **Type of AHUs:** CV / VAV / Dual Duct / Induction / Other ___________
- **Heating:** HW / HW-Glycol / Steam / Furnace / Heat Pump / N/A
- **Cooling:** CHW / DX / Heat Pump / N/A
- **Humidification:** Y / N
- **Heat Recovery:** Y / N / Has
- **Outdoor Air**
  - Control: TOD / DCV / N/A
- **Add Economizer:** Y / N / Has
- **System Fans**

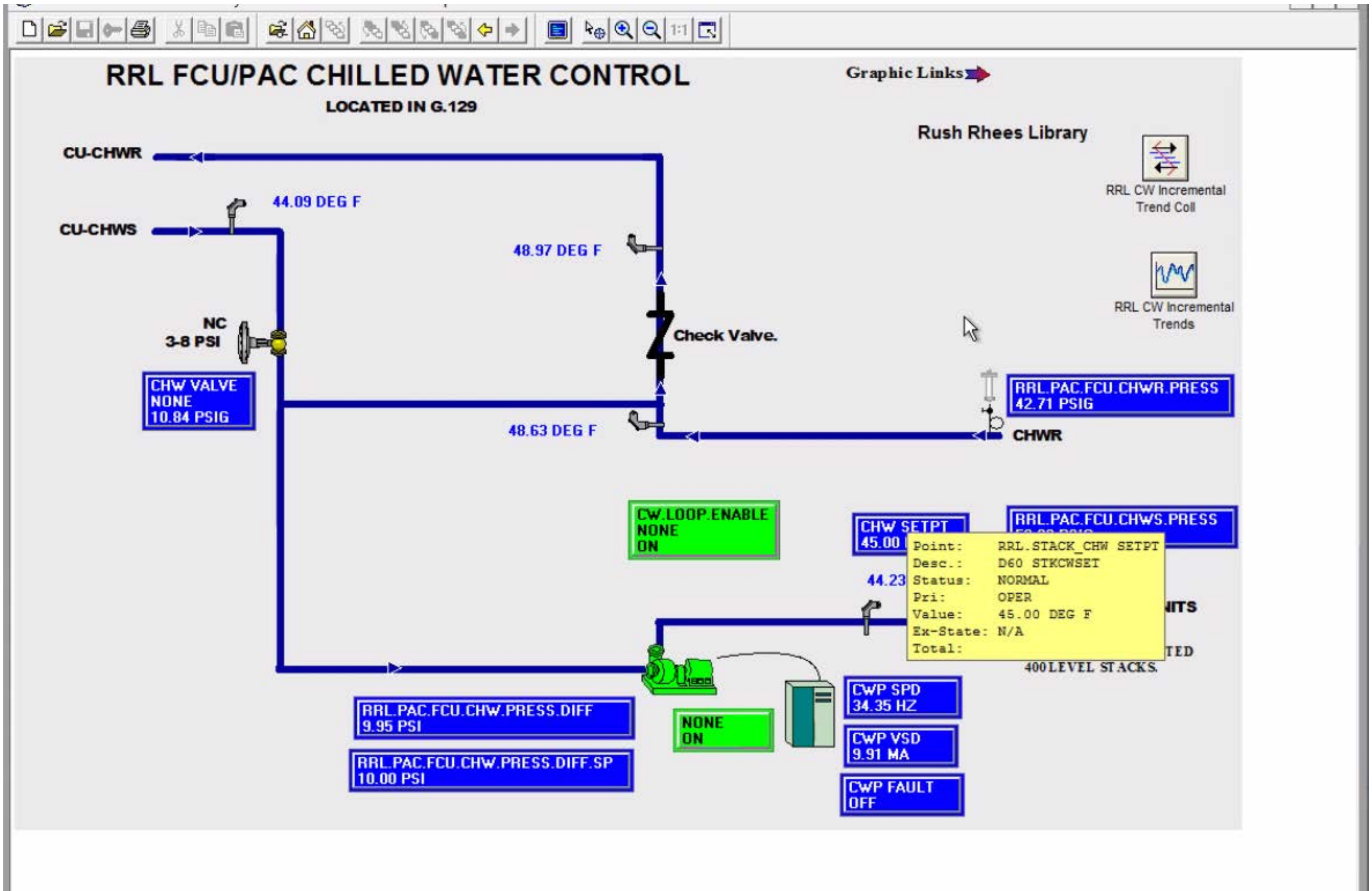
1. Supply Fan:
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
2. Return Fan or N/A
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
3. Exhaust Fan or N/A
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position

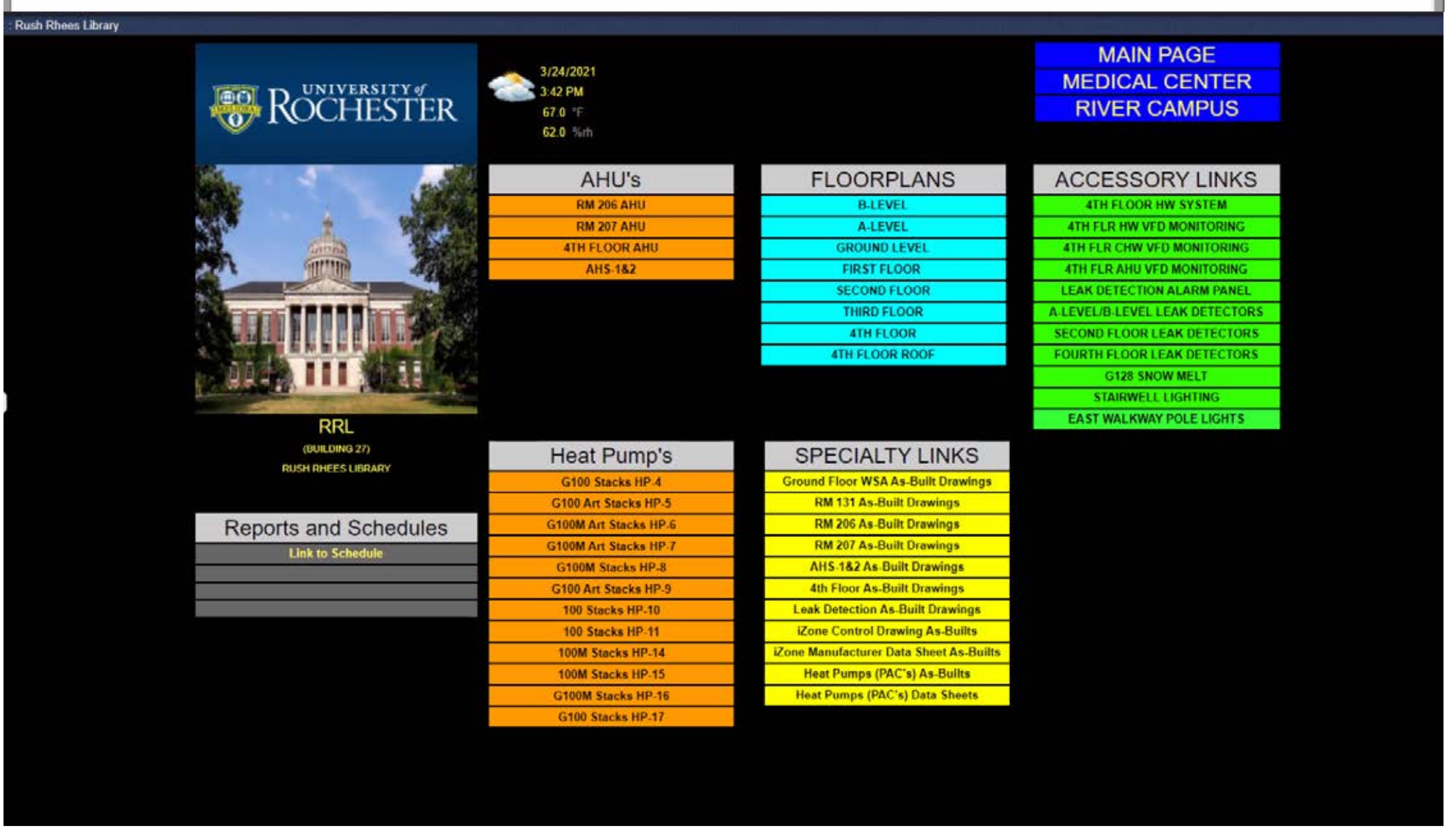
Ventilation System 3 Yes / No

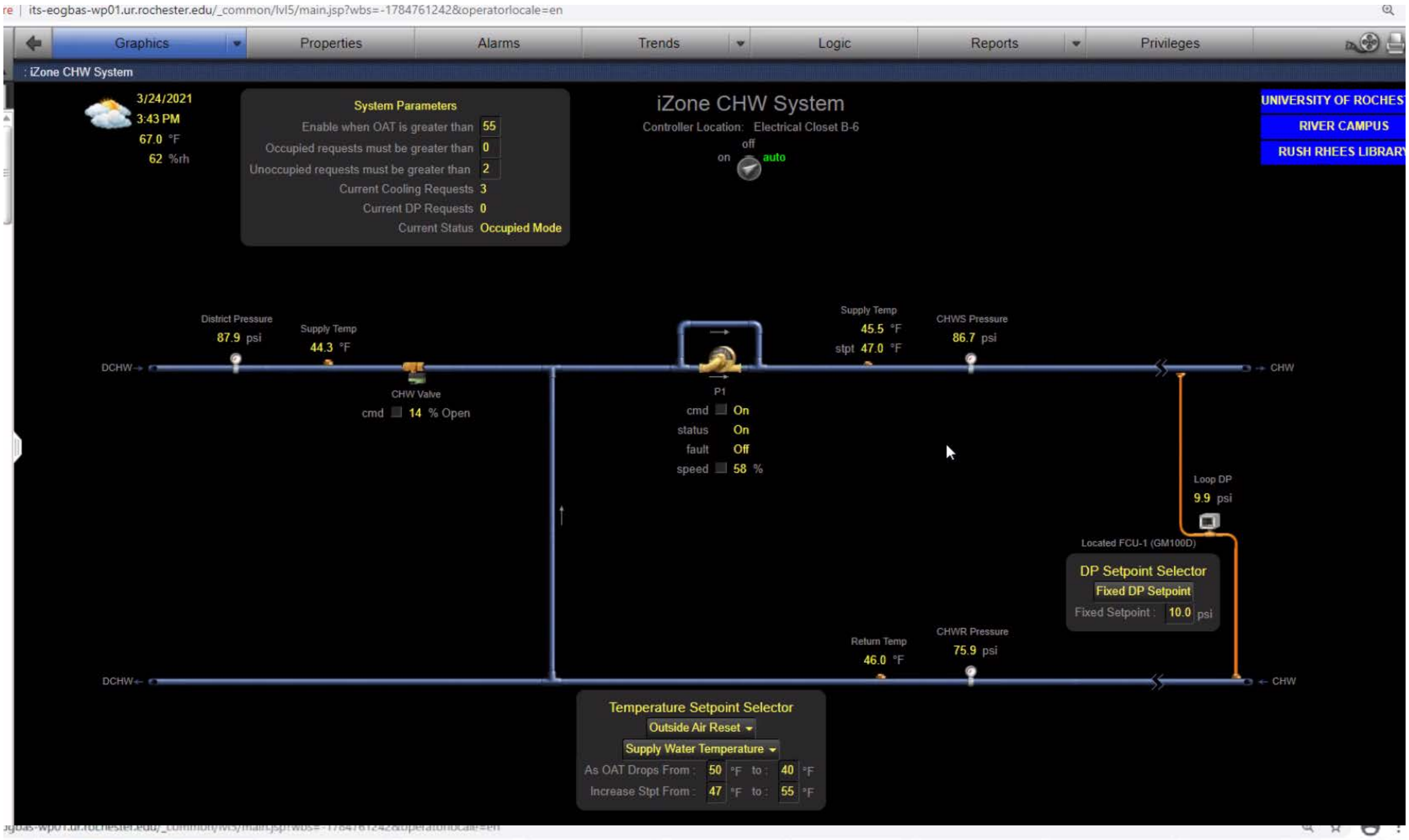
- **AHU Number(s):** *ERV 100% OA*
- **Number of Units:** _______________
- **Schedule:**
  - ➢ Monday - Friday: On_______ - Off ________
  - ➢ Saturday - Sunday: On_______ - Off ________
- **Location:** Indoors / RTU
- **Type of AHUs:** CV / VAV / Dual Duct / Induction / Other __________
- **Heating:** HW / HW-Glycol / Steam / Furnace / Heat Pump / N/A
- **Cooling:** CHW / DX / Heat Pump / N/A
- **Humidification:** Y / N
- **Heat Recovery:** Y / N / Has
- **Outdoor Air**
  - ➢ Control: TOD / DCV / N/A
- **Add Economizer:** Y / N / Has
- **System Fans**
  1. Supply Fan:
     a. Power: field Hp
     b. Efficiency: Premium / High / Standard
     c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
  2. Return Fan or N/A
     a. Power: field Hp
     b. Efficiency: Premium / High / Standard
     c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
  3. Exhaust Fan or N/A
     a. Power: field Hp
     b. Efficiency: Premium / High / Standard
     c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position

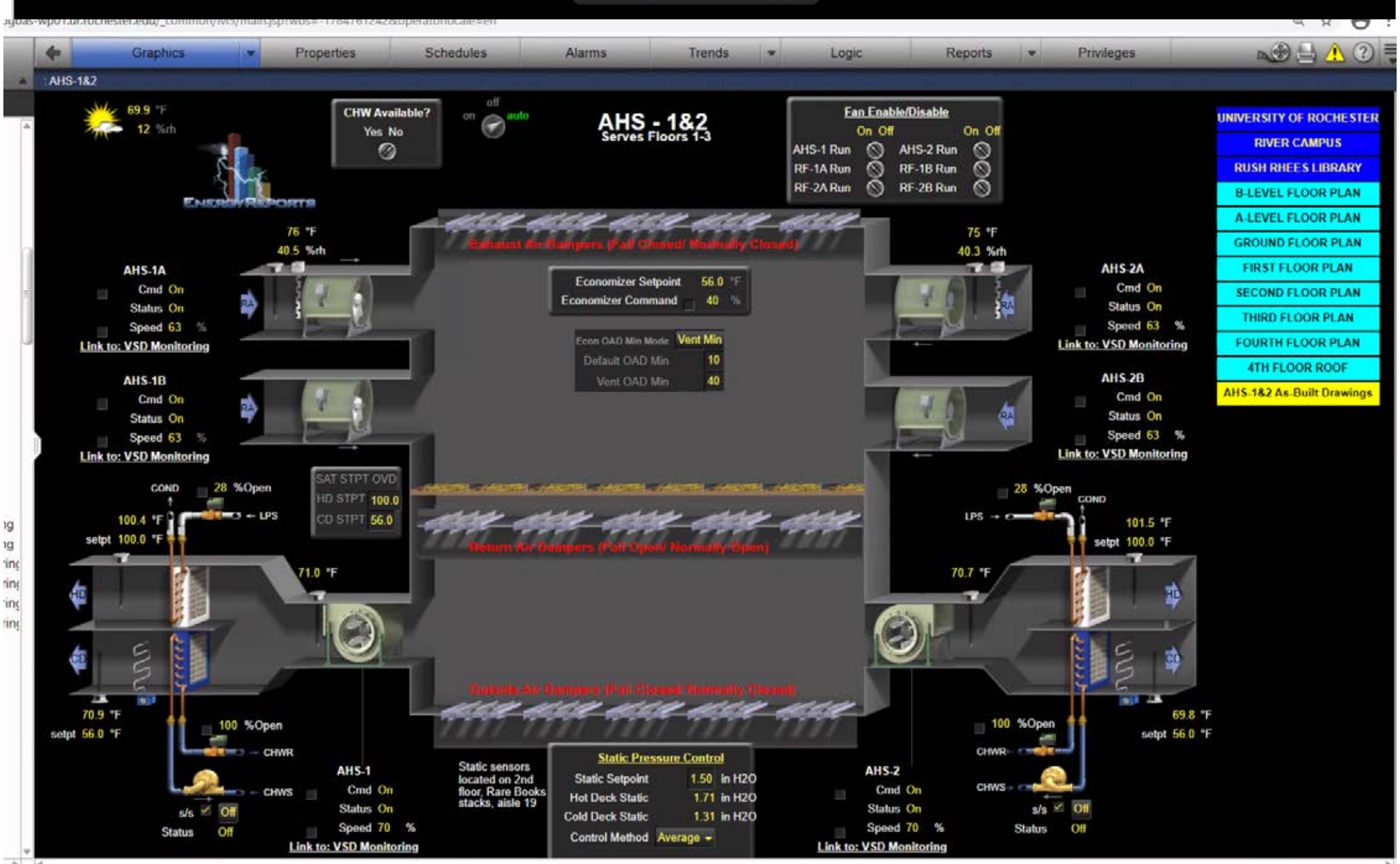

Graphics - [RRL_2004 RADIATION SYSTEM]
File Edit View Insert Dynamic Tools Window Help
RUSH RHEES LIBRARY STEAM TO HOT WATER HEAT EXCHANGER CONTROL
(SERVES: - G LEVEL PERIMETER FTR
- A LEVEL HALLWAY AND A024 HOT H2O FCU'S
- 3rd FLOOR STUDY CARRELS 308 - 350
- 304, 354, 354A PERIMETER FTR
- 4th FLOOR RM 416 PERIMETER FTR)
LOCATED IN M.E.R. 407
NAVIGATION LINKS
MAIN PAGE
Rush Rhees Library
STM
N.O.
NONE
16.00 PSIG
RADIATION SETPT
OPER
150.00 DEG F
81.57 DEG F
RETURN
85.42 DEG F
SUPPLY
COND
SETPOINT RESET
OFF OUTSIDE AIR TEMP
OAT HWS
20 DEG F. 140 DEG F.
50 DEG F. 110 DEG F
RRL RADIATION PMP1
NONE
OFF
PUMP CONTROLLED
OFF OUTSIDE AIR TEMP
ON BELOW 50 DEG. F.
OFF ABOVE 52 DEG. F.
OSA TEMP
65.86 DEG F

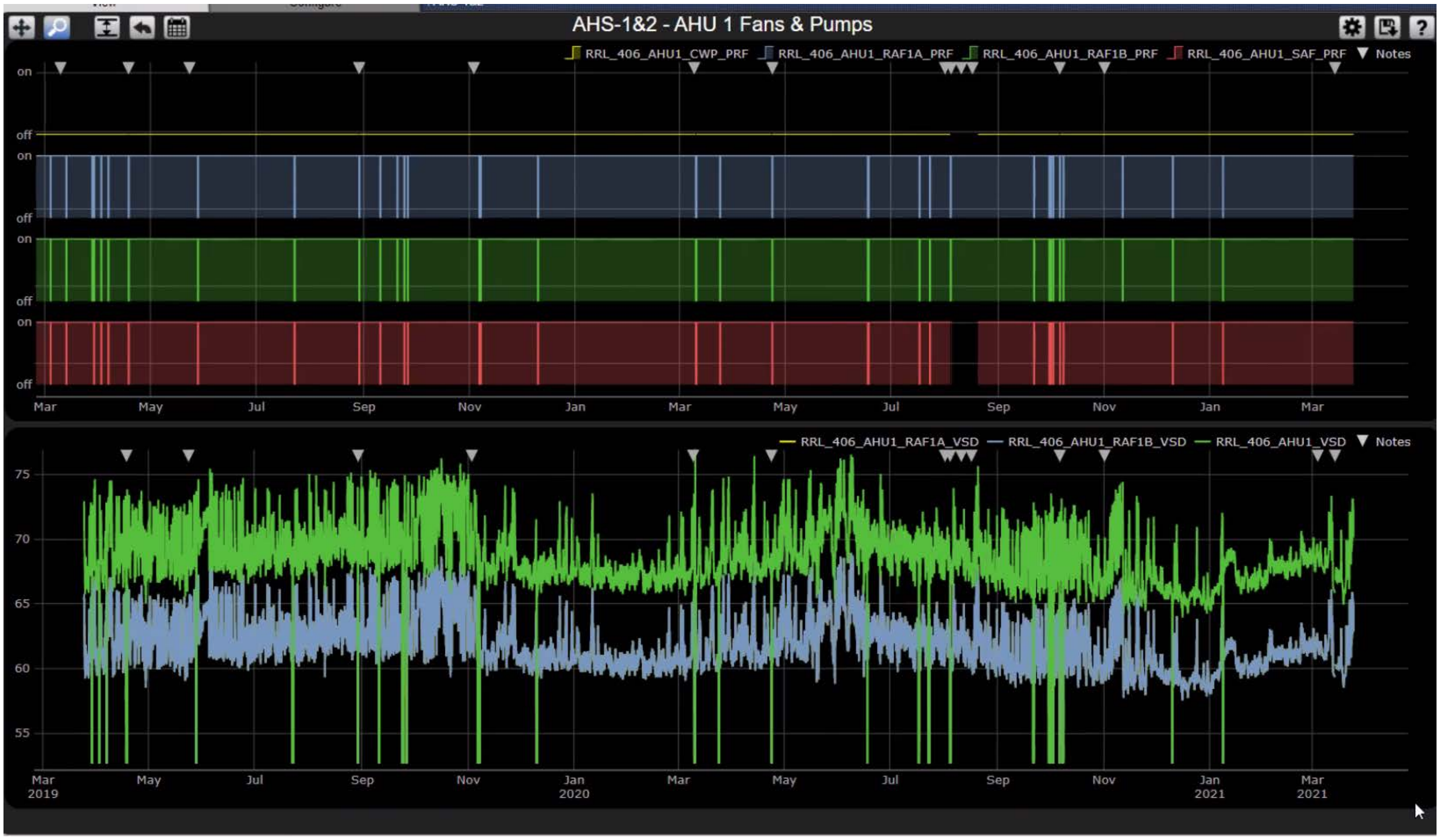

69.9 °F
12 %rh
4th Floor HW System
Located in RM 450
off
on
auto
UNIVERSITY OF ROCHESTER
RIVER CAMPUS
RUSH RHEES LIBRARY
B-LEVEL FLOOR PLAN
A-LEVEL FLOOR PLAN
GROUND FLOOR PLAN
FIRST FLOOR PLAN
SECOND FLOOR PLAN
THIRD FLOOR PLAN
FOURTH FLOOR PLAN
4TH FLOOR ROOF
%open
0
stm
°F 254.5
setpt 110.0
hx
hws
222.4
°F
cond
Drain pan pump
Alarm Normal
Sensor located in RM 430
psi 0.0
setpoint 7.5
0.0 gallons
Link to: VFD Monitoring
MAKEUP
CITY WATER
hwr
s/s Off
status Off
vfd speed 0 %


RRL FCU/PAC CHILLED WATER CONTROL
LOCATED IN G.129
Graphic Links
Rush Rhees Library
RRL CW Incremental Trend Coll
RRL CW Incremental Trends
CU-CHWR
CU-CHWS
44.09 DEG F
48.97 DEG F
NC
3-8 PSI
Check Valve.
CHW VALVE
NONE
10.84 PSIG
48.63 DEG F
RRL.PAC.FCU.CHWR.PRESS
42.71 PSIG
CHWR
CW.LOOP.ENABLE
NONE
ON
CHW SETPT
45.00
RRL.PAC.FCU.CHWS.PRESS
Point: RRL.STACK_CHW SETPT
Desc.: D60 STKCWSET
Status: NORMAL
Pri: OPER
Value: 45.00 DEG F
Ex-State: N/A
Total:
44.23
400 LEVEL STACKS.
RRL.PAC.FCU.CHW.PRESS.DIFF
9.95 PSI
NONE
ON
CWP SPD
34.35 HZ
CWP VSD
9.91 MA
RRL.PAC.FCU.CHW.PRESS.DIFF.SP
10.00 PSI
CWP FAULT
OFF


Rush Rhees Library
UNIVERSITY of ROCHESTER
3/24/2021
3:42 PM
67.0 °F
62.0 %rh
MAIN PAGE
MEDICAL CENTER
RIVER CAMPUS
AHU's
RM 206 AHU
RM 207 AHU
4TH FLOOR AHU
AHS-1&2
FLOORPLANS
B-LEVEL
A-LEVEL
GROUND LEVEL
FIRST FLOOR
SECOND FLOOR
THIRD FLOOR
4TH FLOOR
4TH FLOOR ROOF
ACCESSORY LINKS
4TH FLOOR HW SYSTEM
4TH FLR HW VFD MONITORING
4TH FLR CHW VFD MONITORING
4TH FLR AHU VFD MONITORING
LEAK DETECTION ALARM PANEL
A-LEVEL/B-LEVEL LEAK DETECTORS
SECOND FLOOR LEAK DETECTORS
FOURTH FLOOR LEAK DETECTORS
G128 SNOW MELT
STAIRWELL LIGHTING
EAST WALKWAY POLE LIGHTS
RRL
(BUILDING 27)
RUSH RHEES LIBRARY
Heat Pump's
G100 Stacks HP-4
G100 Art Stacks HP-5
G100M Art Stacks HP-6
G100M Art Stacks HP-7
G100M Stacks HP-8
G100 Art Stacks HP-9
100 Stacks HP-10
100 Stacks HP-11
100M Stacks HP-14
100M Stacks HP-15
G100M Stacks HP-16
G100 Stacks HP-17
SPECIALTY LINKS
Ground Floor WSA As-Built Drawings
RM 131 As-Built Drawings
RM 206 As-Built Drawings
RM 207 As-Built Drawings
AHS-1&2 As-Built Drawings
4th Floor As-Built Drawings
Leak Detection As-Built Drawings
iZone Control Drawing As-Builts
iZone Manufacturer Data Sheet As-Builts
Heat Pumps (PAC's) As-Builts
Heat Pumps (PAC's) Data Sheets
Reports and Schedules
Link to Schedule


its-eogbas-wp01.ur.rochester.edu/_common/lvl5/main.jsp?wbs=-1784761242&operatorlocale=en
Graphics
Properties
Alarms
Trends
Logic
Reports
Privileges
iZone CHW System
3/24/2021
3:43 PM
67.0 °F
62 %rh
System Parameters
Enable when OAT is greater than 55
Occupied requests must be greater than 0
Unoccupied requests must be greater than 2
Current Cooling Requests 3
Current DP Requests 0
Current Status Occupied Mode
iZone CHW System
Controller Location: Electrical Closet B-6
off
on auto
UNIVERSITY OF ROCHESTER
RIVER CAMPUS
RUSH RHEES LIBRARY
District Pressure
87.9 psi
Supply Temp
44.3 °F
DCHW
CHW Valve
cmd 14 % Open
P1
cmd On
status On
fault Off
speed 58 %
Supply Temp
45.5 °F
stpt 47.0 °F
CHWS Pressure
86.7 psi
CHW
Loop DP
9.9 psi
Located FCU-1 (GM100D)
DP Setpoint Selector
Fixed DP Setpoint
Fixed Setpoint : 10.0 psi
Return Temp
46.0 °F
CHWR Pressure
75.9 psi
Temperature Setpoint Selector
Outside Air Reset
Supply Water Temperature
As OAT Drops From : 50 °F to : 40 °F
Increase Stpt From : 47 °F to : 55 °F


Graphics
Properties
Schedules
Alarms
Trends
Logic
Reports
Privileges
AHS-1&2
69.9 °F
12 %rh
CHW Available?
Yes No
off
on auto
AHS - 1&2
Serves Floors 1-3
Fan Enable/Disable
On Off
AHS-1 Run
RF-1A Run
RF-2A Run
AHS-2 Run
RF-1B Run
RF-2B Run
UNIVERSITY OF ROCHESTER
RIVER CAMPUS
RUSH RHEES LIBRARY
B-LEVEL FLOOR PLAN
A-LEVEL FLOOR PLAN
GROUND FLOOR PLAN
FIRST FLOOR PLAN
SECOND FLOOR PLAN
THIRD FLOOR PLAN
FOURTH FLOOR PLAN
4TH FLOOR ROOF
AHS-1&2 As-Built Drawings
Exhaust Air Dampers (Fail Closed/ Normally Closed)
76 °F
40.5 %rh
75 °F
40.3 %rh
AHS-1A
Cmd On
Status On
Speed 63 %
Link to: VSD Monitoring
Economizer Setpoint 56.0 °F
Economizer Command 40 %
Econ OAD Min Mode Vent Min
Default OAD Min 10
Vent OAD Min 40
AHS-2A
Cmd On
Status On
Speed 63 %
Link to: VSD Monitoring
AHS-1B
Cmd On
Status On
Speed 63 %
Link to: VSD Monitoring
AHS-2B
Cmd On
Status On
Speed 63 %
Link to: VSD Monitoring
SAT STPT OVD
HD STPT 100.0
CD STPT 56.0
COND
28 %Open
LPS
100.4 °F
setpt 100.0 °F
Return Air Dampers (Fail Open/ Normally Open)
71.0 °F
70.7 °F
101.5 °F
setpt 100.0 °F
Outside Air Dampers (Fail Closed/ Normally Closed)
70.9 °F
setpt 56.0 °F
100 %Open
CHWR
CHWS
s/s Off
Status Off
AHS-1
Cmd On
Status On
Speed 70 %
Link to: VSD Monitoring
Static sensors located on 2nd floor, Rare Books stacks, aisle 19
Static Pressure Control
Static Setpoint 1.50 in H2O
Hot Deck Static 1.71 in H2O
Cold Deck Static 1.31 in H2O
Control Method Average
AHS-2
Cmd On
Status On
Speed 70 %
Link to: VSD Monitoring
69.8 °F
setpt 56.0 °F


AHS-1&2 - AHU 1 Fans & Pumps
RRL_406_AHU1_CWP_PRF
RRL_406_AHU1_RAF1A_PRF
RRL_406_AHU1_RAF1B_PRF
RRL_406_AHU1_SAF_PRF
Notes
on
off
Mar
May
Jul
Sep
Nov
Jan
Mar
May
Jul
Sep
Nov
Jan
Mar
RRL_406_AHU1_RAF1A_VSD
RRL_406_AHU1_RAF1B_VSD
RRL_406_AHU1_VSD
75
70
65
60
55
Mar 2019
Jan 2020
Jan 2021
Mar 2021

Preliminary Assessment Interview
HVAC ONLY

Building Name: UR Danforth Dining

Contact Name: Richard Stein

Wendel Auditor: Jason Denue   Date:3/24/2021

BUILDING OVERVIEW

Building Schedule:

- Monday - Friday: 24/7 COVID - original schedules BIC RICH
- Saturday - Sunday: 24/7 COVID - original schedules BIC RICH

HVAC Schedule:

- Monday - Friday: 24/7 COVID - original schedules BIC RICH
- Saturday - Sunday 24/7 COVID - original schedules BIC RICH

Space Types / uses

- **Type 1**: Kitchen Area
- **Type 2**: Dinning Area
- **Type 3**: office
- **Type 4**: dishwashing

Special Equipment

- **Dishwasher**
- **Kitchen hood**
- **Walk-in cooler**

EMS Yes / No

- **Type**: Pneumatic / DDC, some non DDC control
- **Manufacturer** Legacy / Updated, Siemens Appogee, glycol system on ecostructure
- **Has Trending** : Y / N- trend points requested trending in PI
- **Has Remote Access** : Y / N
- **Has Temperature setback** : Y / N - not currently due to COVID - normally needs to check
- **Has Time of Day Schedule** : Y / N

Heating Plant Yes / No

- **Heating System:** District HW
- **Fuel Source** : NG / Fuel Oil / Propane

- **Steam Boilers** or N/A
  1. Number of Boilers:
  2. Boiler Output: field
  3. Boiler Input: field
  4. Blow down procedure: Automatic / Manual
     How frequent:______________________
  5. Condensate return system:
  6. Steam Pressure at Boiler: field
  7. Steam pressure at PRV 1: field psig or N/A
  8. Steam pressure at PRV 2: field psig or N/A
  9. Feed water system:
     a. Treated: Y / N
     b. Preheated: Y / N
  10. Burner Controls: Linkage / Electronic -
      Replace Boilers: Y / N Replace Burners: Y / N

- **Steam traps** or N/A
  1. Maintenance program: Y / N
  2. Trap condition (general): poor /average /new

  Replace Traps: Y / N
- **Combustion Air** : Y / N
- **Plant Enabled at:**

- **Hot Water Boilers** or N/A
  1. Number of Boilers: ________________
  2. Boiler Output: field mmBtu
  3. Boiler Input: field mmBtu
  4. Hot water system control: HW Reset / OA Reset / Constant Temperature
  5. Hot water temperature set point:
     Max:__________ Min:__________
  6. Burner Controls: Linkage / Electronic

  Replace Boilers: Y / N Replace Burners: Y / N

- **Hot Water Pumps**
  1. Primary Pumps:
     a. Power: field HP
     b. Number of Pumps: 2
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: Y / N Add VFD: Y / N / **Has**

  2. Glycool Pumps:
     a. Power: field HP
     b. Number of Pumps: 2
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: Y / N Add VFD: Y / N / **Has**

Domestic Hot Water System Yes / No

- **Hot Water Supply Temperature** : 145F
- **Storage Tank** : Y / N
  1. Storage Temperature: 145F
- Storage Tank Volume: 3qty 500gal
- **Heat exchanger**: Steam / Hot Water / N/A
  1. Usage: Year Round / School year
- **Heating Source**: Main Boilers / DHW Heater

- **DHW Heater**: Electric / NG / N/A
  1. Burner: Atmospheric / Force Draft
  2. Usage: Year Round / School year

  Replace with Condensing: **Y / N**
- **Dish washer Booster Heater** or N/A need to investigate
  1. Fuel Source: Steam / NG / Electric

Cooling Plant Yes / No

- **Chilled water system** District loop
- **Chiller**
  1. Chiller Type: Centrifugal / Screw / absorption / gas driven / ___________
  2. Chiller Capacity: field Tons
  3. VSD: **Y / N**
  4. OA reset: **Y / N**
- **Cooling Tower**
  1. Tower Type: Open / Closed / _____force draft_______
  2. Tower Capacity: ________600 each_____Tons
  3. Add VSD: **Y / N / Has**
  4. Uses Glycol: **Y / N**
- **Controls**
  1. CHW Set Point: 44F (no reset)
  2. CW Set Point: ______83-85_____ no condenser relief

- **Chilled Water Pumps**
  1. Primary Pumps:
     a. Power: field HP
     b. Number of Pumps: field
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: **Y / N** Add VFD: **Y / N / Has**

  2. Water Cooled Cond. Pumps:
     a. Power: field HP
     b. Number of Pumps: field
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: **Y / N** Add VFD: **Y / N / Has**

Terminal Units Yes / No

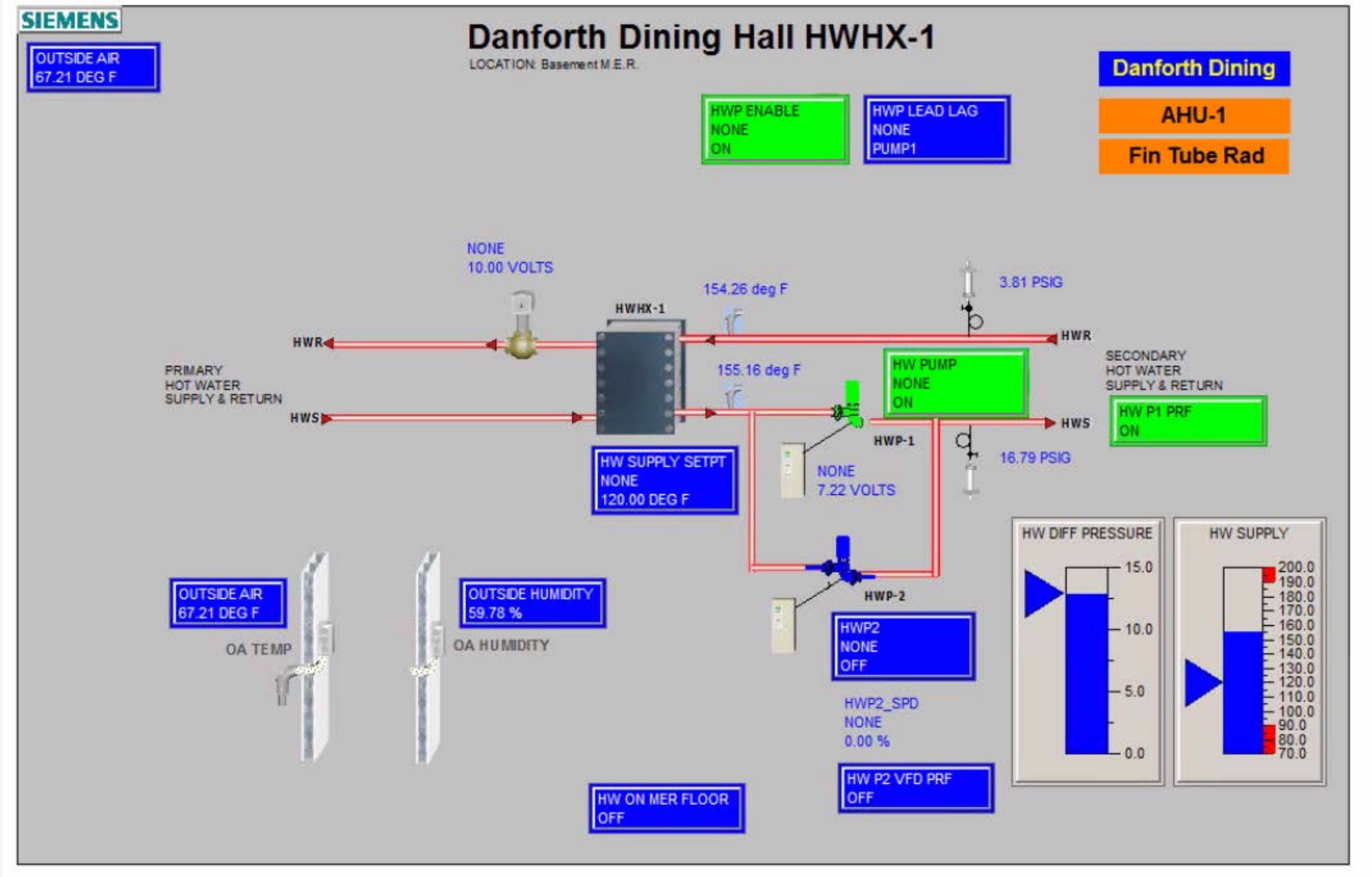
- **Space Type 1** : walk-in coolers (qty unknown)
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / Evap
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump / ________
  4. Ventilation: Y / N (Room now)
  5. Controls: Thermostat / DCV / Other_____________
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other ______________
  8. Equipment Condition: Poor / Average / Good
- **Space Type 2** : Perimeter most of building
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / ________________
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump / ______________
  4. Ventilation: Y / N
  5. Controls: Thermostat / DCV / Loop temp Outdoor air reset
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other ______________
  8. Equipment Condition: Poor / Average / Good
- **Space Type 3**: Entrance
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / ________________
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump / ______________
  4. Ventilation: Y / N
  5. Controls: Thermostat / DCV / Other_____________
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other ______________
  8. Equipment Condition: Poor / Average / Good
- **Space Type 4** :
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / ________________
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump / ______________
  4. Ventilation: Y / N
  5. Controls: Thermostat / DCV / Other_____________
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other ______________
  8. Equipment Condition: Poor / Average / Good

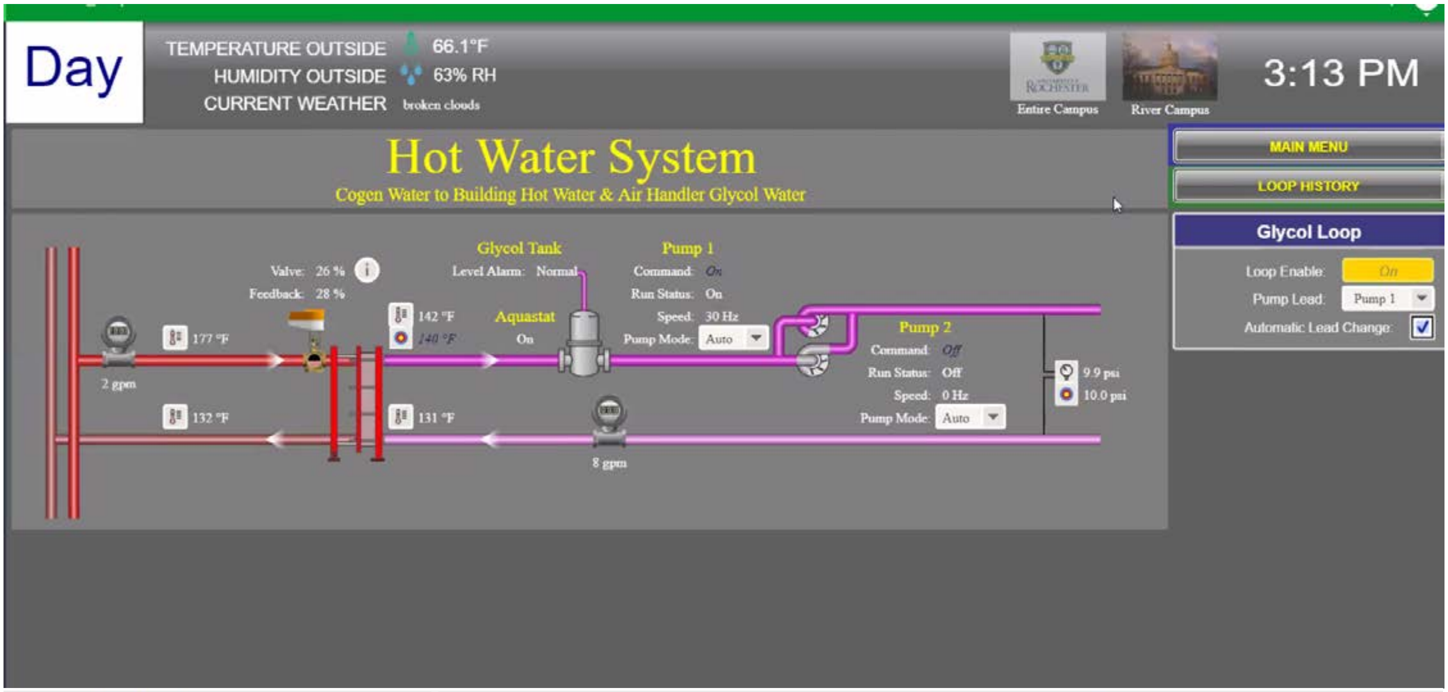
Preliminary Assessment Interview
HVAC ONLY

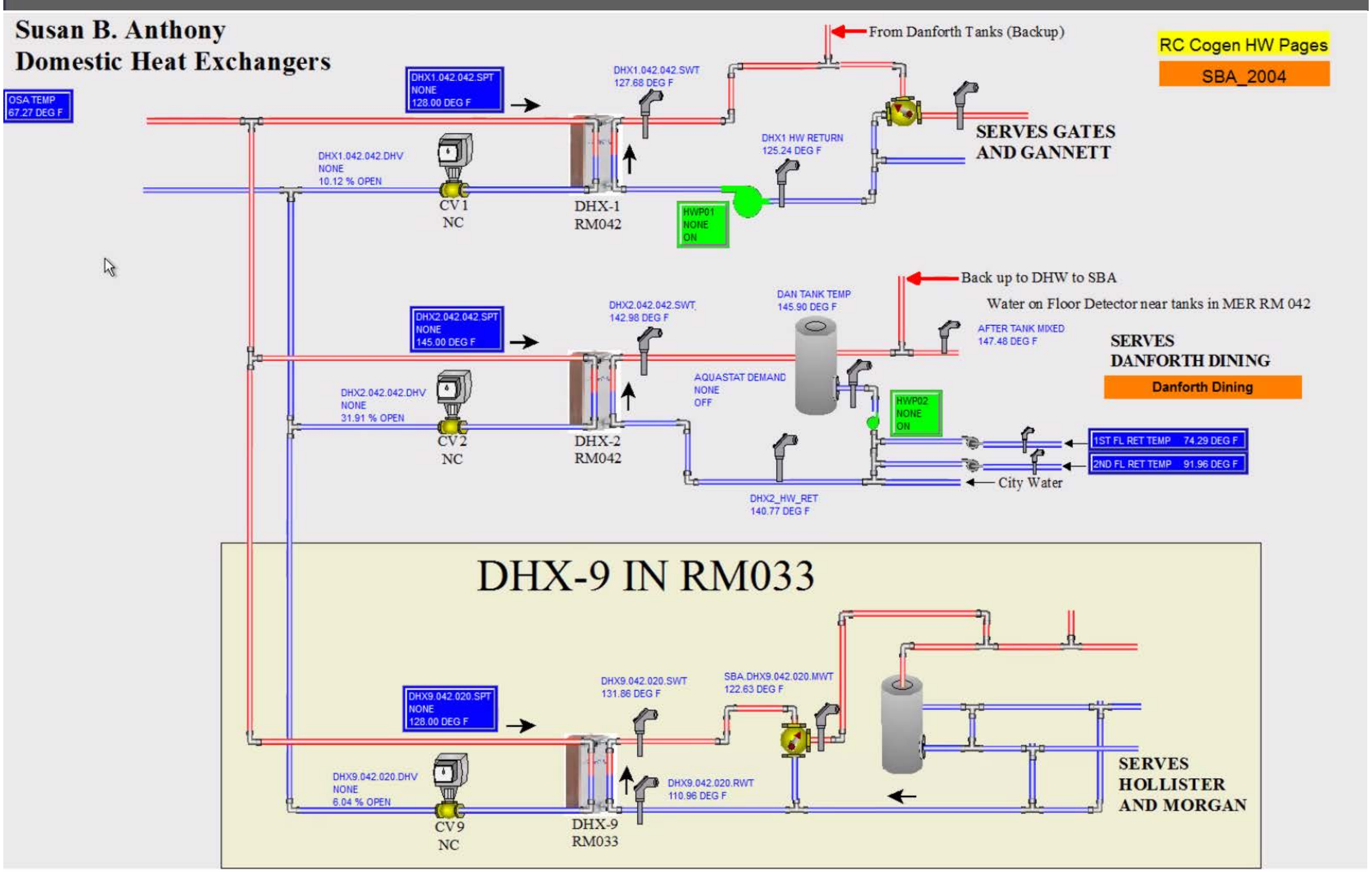
Ventilation System 1   Yes / No

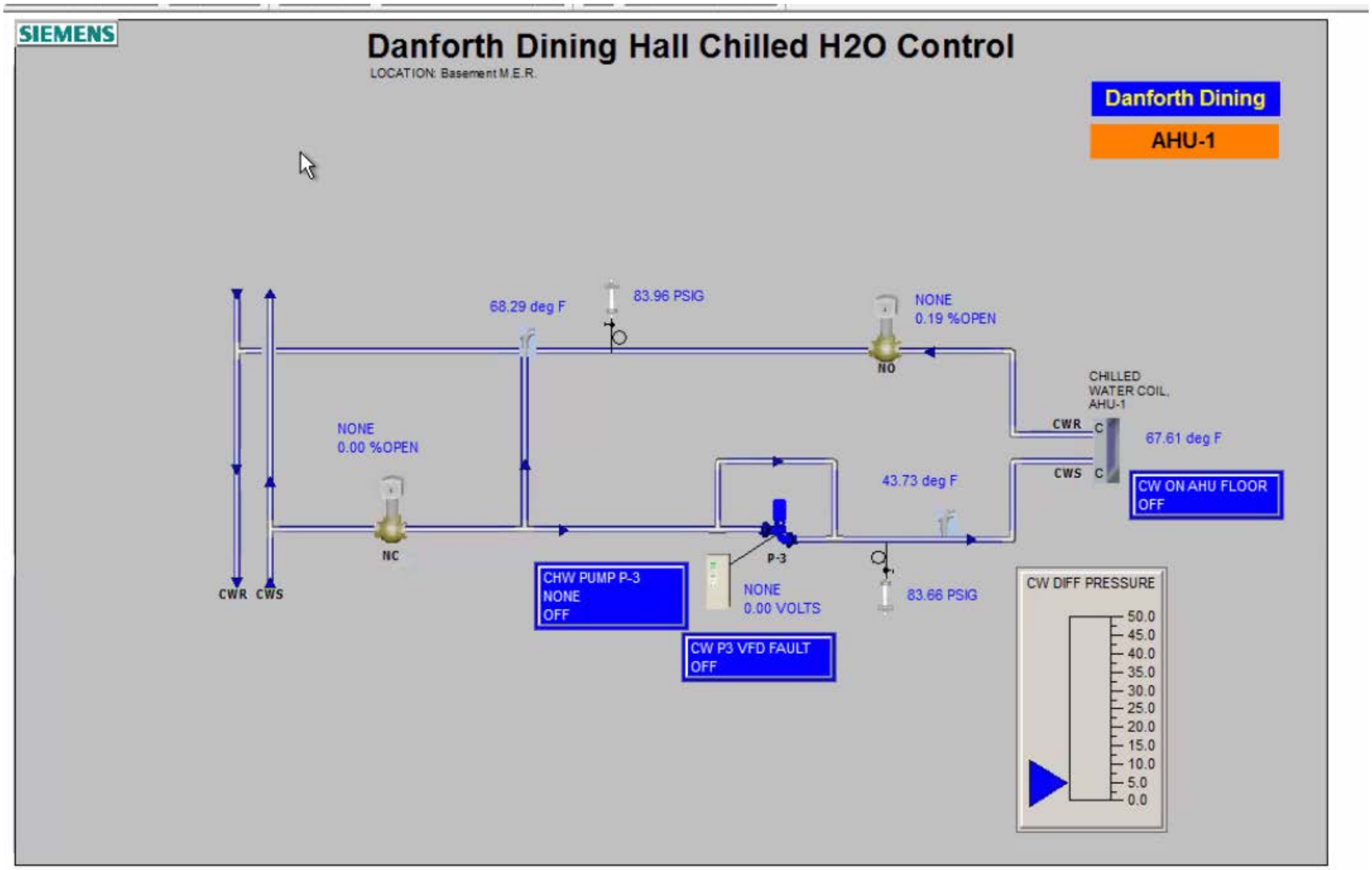
- **AHU Number(s):** 1*(Fill in one sheet for all common units)*
- **Number of Units:** 1
- **Schedule:** Operating 24/7 for COVID
  - ➢ Monday - Friday: On_______ - Off ________
  - ➢ Saturday - Sunday: On_______ - Off ________
- **Location:** Indoors / RTU
- **Type of AHUs:** CV / VAV / Dual Duct / Induction / Other
- **Heating:** HW / HW-Glycol / Steam / Furnace / Heat Pump / N/A
- **Cooling:** CHW / DX / Heat Pump / N/A
- **Humidification:** Y / N
- **Heat Recovery:** Y / N / Has
- **Outdoor Air**
  - ➢ Control: TOD / DCV / N/A (specific to GYM only)
- **Exiting Economizer:** Y / N
- **System Fans**

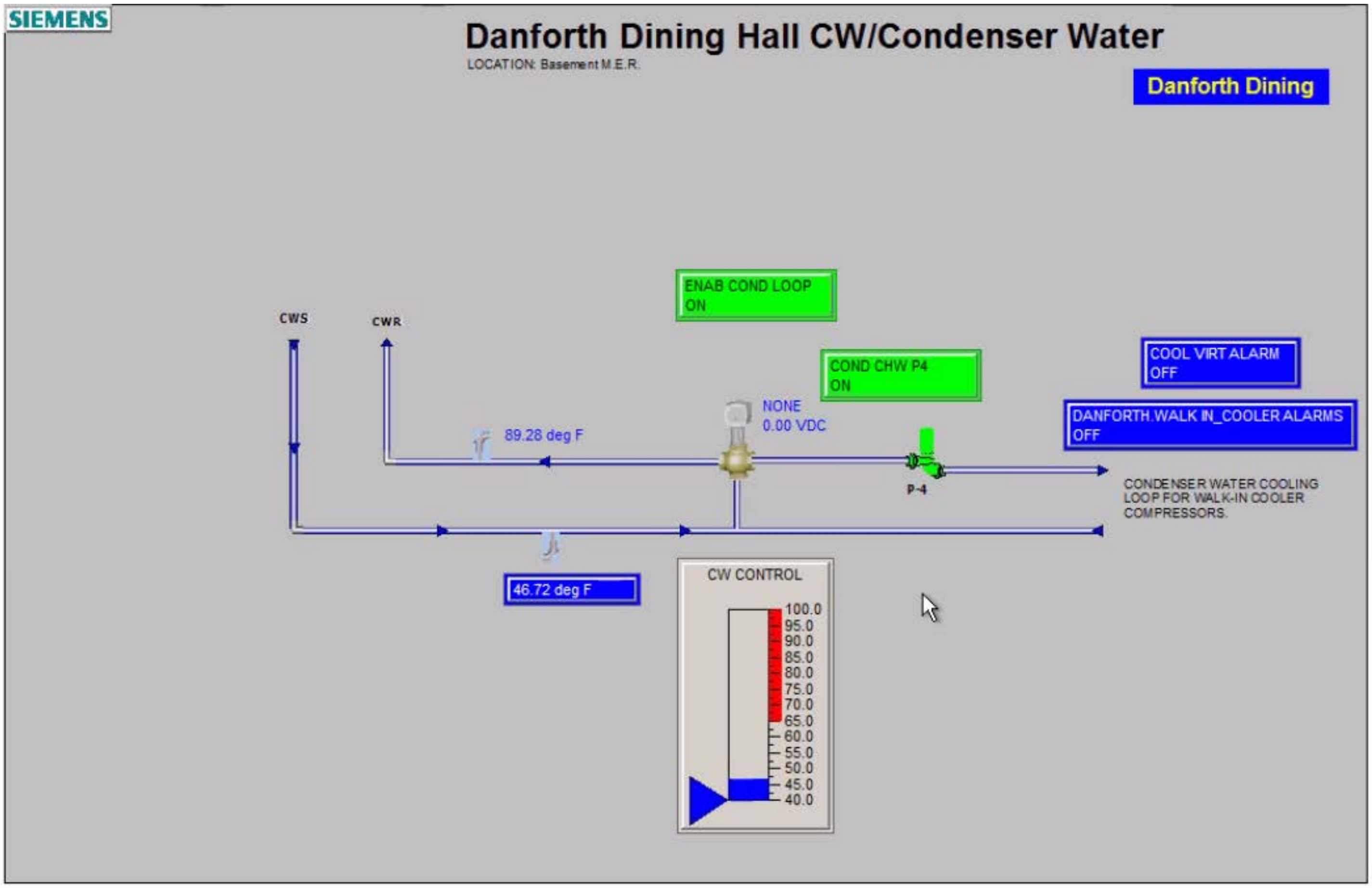
1. Supply Fan:
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
2. Return Fan or N/A
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
3. Exhuast Fan or N/A
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position

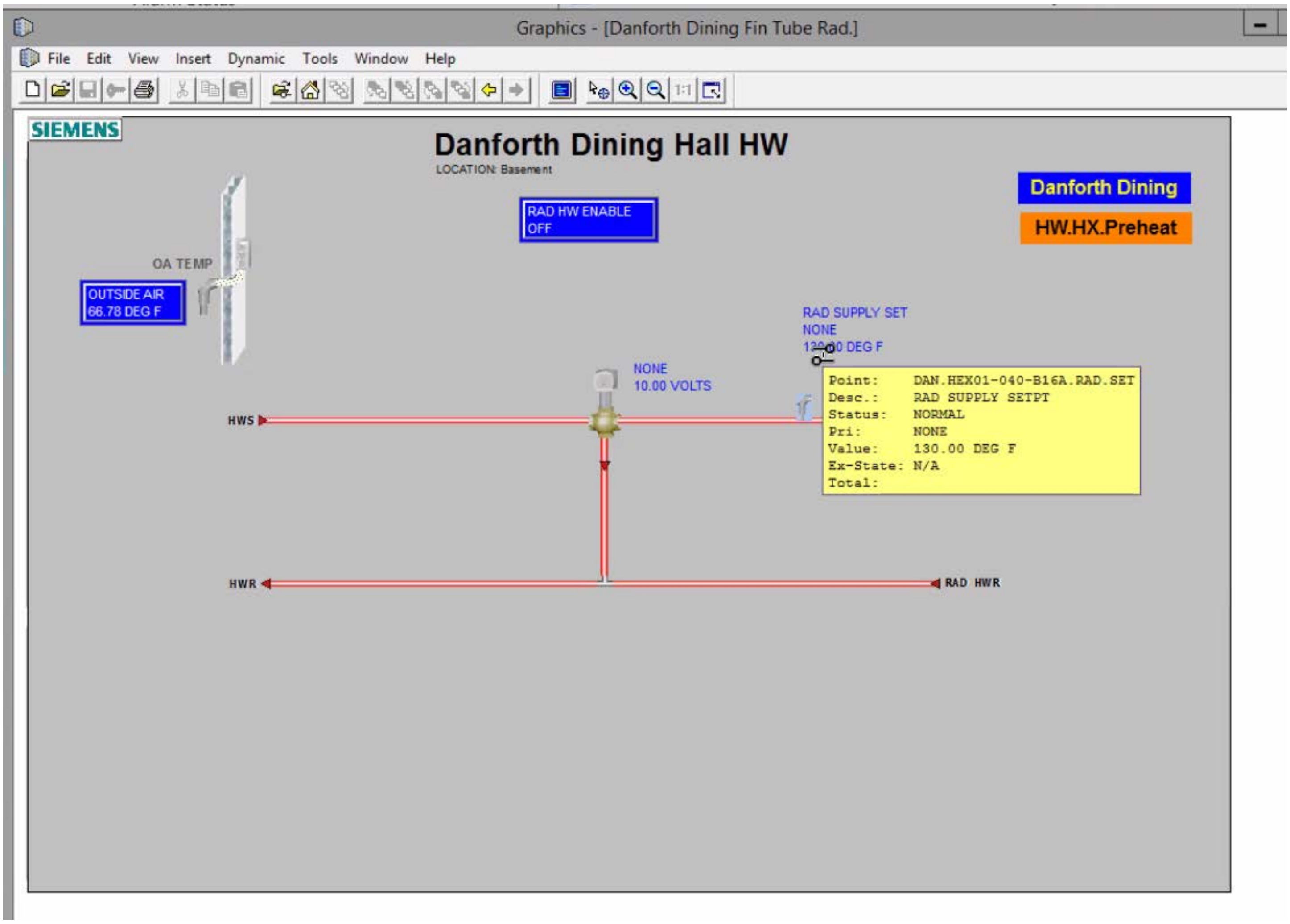

SIEMENS
Danforth Dining Hall HWHX-1
LOCATION: Basement M.E.R.
OUTSIDE AIR
67.21 DEG F
HWP ENABLE
NONE
ON
HWP LEAD LAG
NONE
PUMP1
Danforth Dining
AHU-1
Fin Tube Rad
NONE
10.00 VOLTS
154.26 deg F
3.81 PSIG
HWHX-1
HWR
HWR
PRIMARY
HOT WATER
SUPPLY & RETURN
155.16 deg F
HW PUMP
NONE
ON
SECONDARY
HOT WATER
SUPPLY & RETURN
HWS
HWS
HW P1 PRF
ON
HWP-1
16.79 PSIG
HW SUPPLY SETPT
NONE
120.00 DEG F
NONE
7.22 VOLTS
HW DIFF PRESSURE
HW SUPPLY
OUTSIDE AIR
67.21 DEG F
OUTSIDE HUMIDITY
59.78 %
OA TEMP
OA HUMIDITY
HWP-2
HWP2
NONE
OFF
HWP2_SPD
NONE
0.00 %
HW P2 VFD PRF
OFF
HW ON MER FLOOR
OFF
15.0
10.0
5.0
0.0
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0

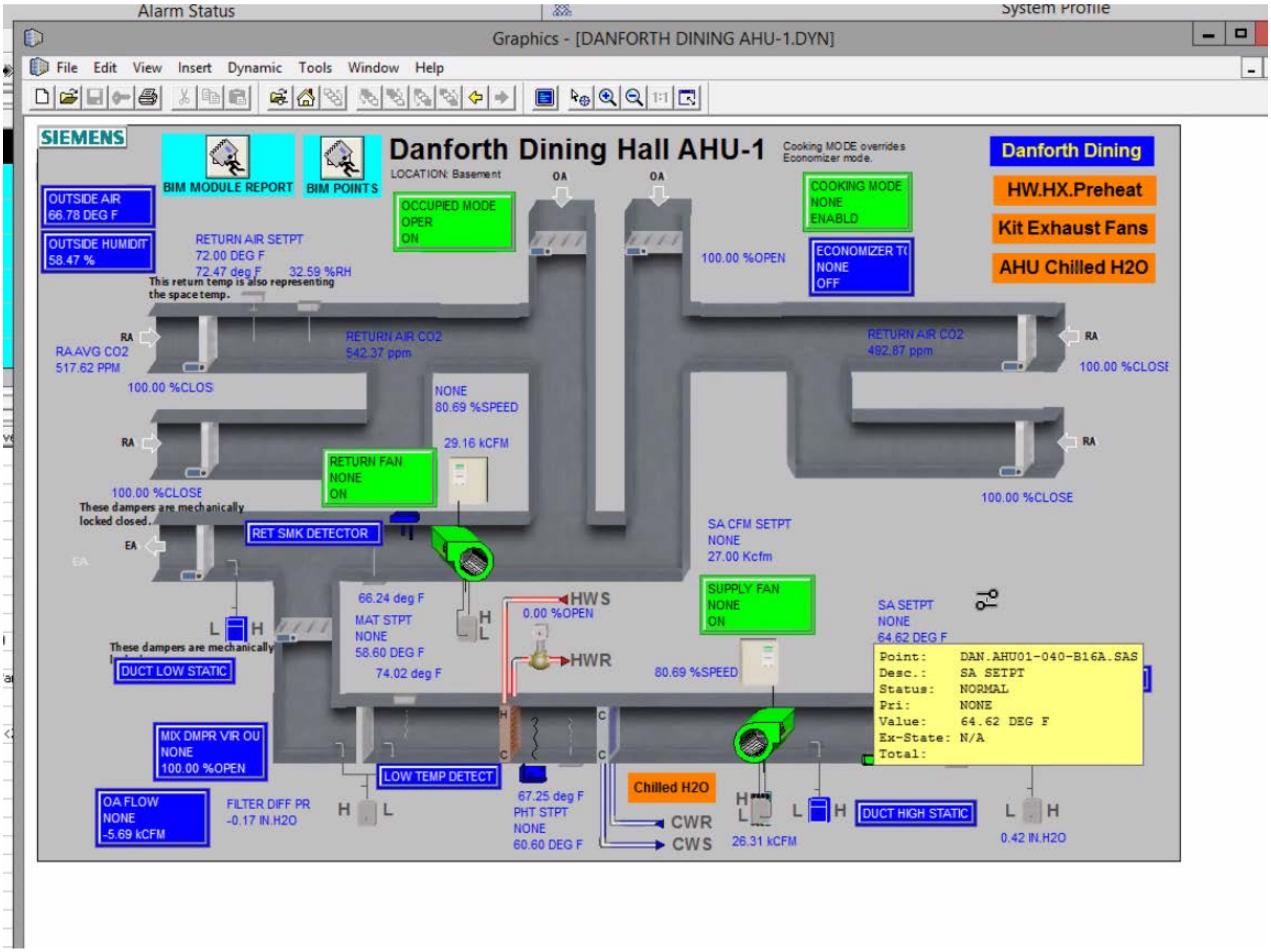

Day
TEMPERATURE OUTSIDE 66.1°F
HUMIDITY OUTSIDE 63% RH
CURRENT WEATHER broken clouds
Entire Campus
River Campus
3:13 PM
Hot Water System
Cogen Water to Building Hot Water & Air Handler Glycol Water
MAIN MENU
LOOP HISTORY
Glycol Loop
Loop Enable: On
Pump Lead: Pump 1
Automatic Lead Change
Valve: 26 %
Feedback: 28 %
Glycol Tank
Level Alarm: Normal
Pump 1
Command: On
Run Status: On
Speed: 30 Hz
Pump Mode: Auto
142 °F
140 °F
Aquastat
On
177 °F
2 gpm
Pump 2
Command: Off
Run Status: Off
Speed: 0 Hz
Pump Mode: Auto
9.9 psi
10.0 psi
132 °F
131 °F
8 gpm

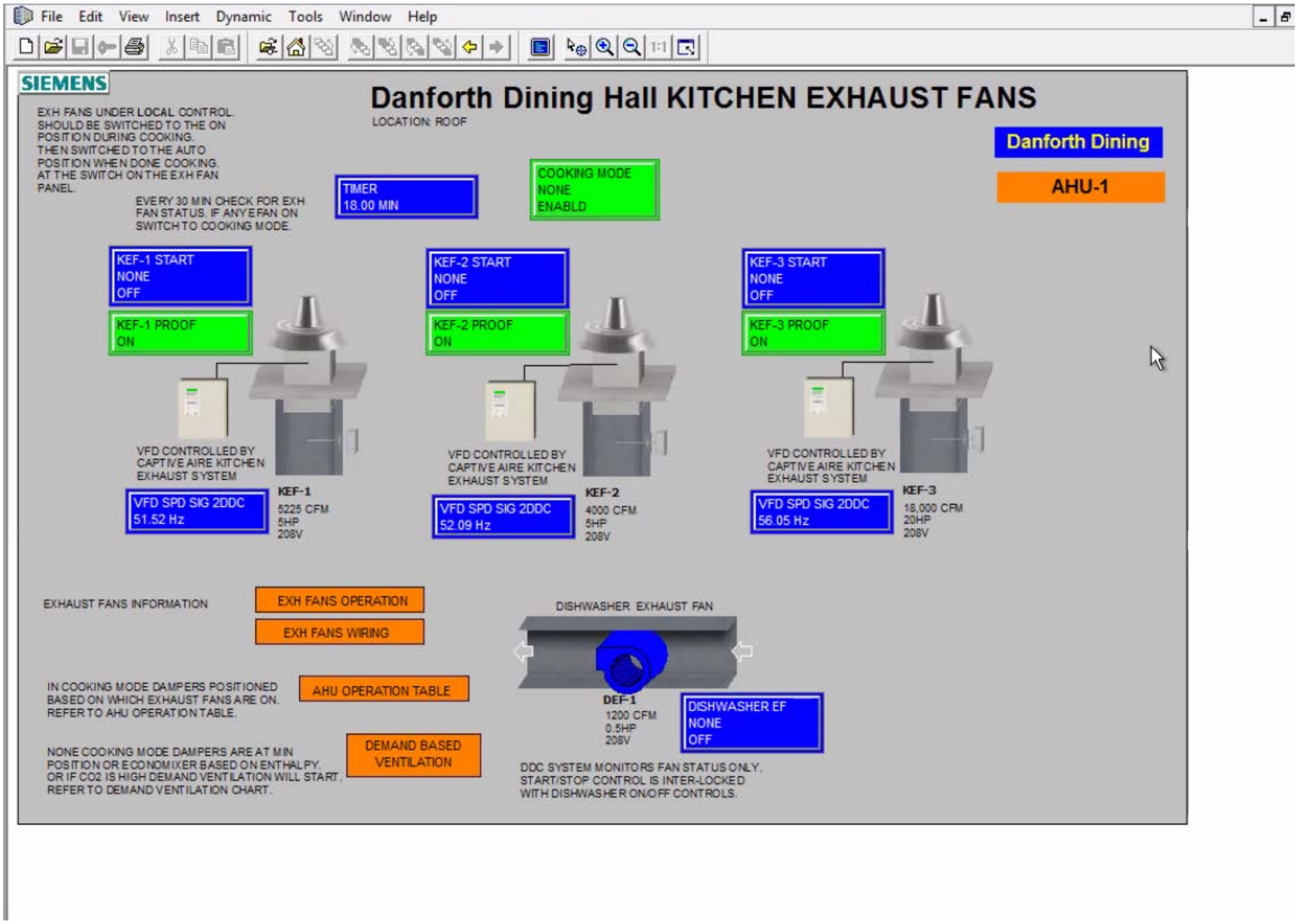

Susan B. Anthony
Domestic Heat Exchangers
From Danforth Tanks (Backup)
RC Cogen HW Pages
SBA_2004
OSA TEMP 67.27 DEG F
DHX1.042.042.SPT NONE 128.00 DEG F
DHX1.042.042.SWT 127.68 DEG F
DHX1.042.042.DHV NONE 10.12 % OPEN
DHX1 HW RETURN 125.24 DEG F
SERVES GATES AND GANNETT
CV1 NC
DHX-1 RM042
HWP01 NONE ON
Back up to DHW to SBA
Water on Floor Detector near tanks in MER RM 042
DHX2.042.042.SPT NONE 145.00 DEG F
DHX2.042.042.SWT 142.98 DEG F
DAN TANK TEMP 145.90 DEG F
AFTER TANK MIXED 147.48 DEG F
SERVES DANFORTH DINING
Danforth Dining
AQUASTAT DEMAND NONE OFF
DHX2.042.042.DHV NONE 31.91 % OPEN
HWP02 NONE ON
1ST FL RET TEMP 74.29 DEG F
2ND FL RET TEMP 91.96 DEG F
CV2 NC
DHX-2 RM042
City Water
DHX2_HW_RET 140.77 DEG F
DHX-9 IN RM033
DHX9.042.020.SWT 131.86 DEG F
SBA.DHX9.042.020.MWT 122.63 DEG F
DHX9.042.020.SPT NONE 128.00 DEG F
DHX9.042.020.DHV NONE 6.04 % OPEN
DHX9.042.020.RWT 110.96 DEG F
SERVES HOLLISTER AND MORGAN
CV9 NC
DHX-9 RM033


SIEMENS
Danforth Dining Hall Chilled H2O Control
LOCATION: Basement M.E.R.
Danforth Dining
AHU-1
68.29 deg F
83.96 PSIG
NONE
0.19 %OPEN
NO
CHILLED WATER COIL, AHU-1
CWR
CWS
67.61 deg F
NONE
0.00 %OPEN
43.73 deg F
CW ON AHU FLOOR
OFF
NC
P-3
CWR CWS
CHW PUMP P-3
NONE
OFF
NONE
0.00 VOLTS
83.66 PSIG
CW P3 VFD FAULT
OFF
CW DIFF PRESSURE
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0


SIEMENS
Danforth Dining Hall CW/Condenser Water
LOCATION: Basement M.E.R.
Danforth Dining
ENAB COND LOOP
ON
CWS
CWR
COND CHW P4
ON
COOL VIRT ALARM
OFF
DANFORTH.WALK IN_COOLER ALARMS
OFF
NONE
0.00 VDC
89.28 deg F
P-4
CONDENSER WATER COOLING
LOOP FOR WALK-IN COOLER
COMPRESSORS.
46.72 deg F
CW CONTROL
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0


Graphics - [Danforth Dining Fin Tube Rad.]
File Edit View Insert Dynamic Tools Window Help
SIEMENS
Danforth Dining Hall HW
LOCATION: Basement
RAD HW ENABLE
OFF
Danforth Dining
HW.HX.Preheat
OA TEMP
OUTSIDE AIR
66.78 DEG F
RAD SUPPLY SET
NONE
130.00 DEG F
NONE
10.00 VOLTS
Point: DAN.HEX01-040-B16A.RAD.SET
Desc.: RAD SUPPLY SETPT
Status: NORMAL
Pri: NONE
Value: 130.00 DEG F
Ex-State: N/A
Total:
HWS
HWR
RAD HWR


Alarm Status
System Profile
Graphics - [DANFORTH DINING AHU-1.DYN]
File Edit View Insert Dynamic Tools Window Help
SIEMENS
BIM MODULE REPORT
BIM POINTS
Danforth Dining Hall AHU-1
LOCATION: Basement
Cooking MODE overrides Economizer mode.
Danforth Dining
HW.HX.Preheat
Kit Exhaust Fans
AHU Chilled H2O
OUTSIDE AIR 66.78 DEG F
OUTSIDE HUMIDIT 58.47 %
RETURN AIR SETPT 72.00 DEG F
72.47 deg F
32.59 %RH
This return temp is also representing the space temp.
OCCUPIED MODE OPER ON
OA
OA
COOKING MODE NONE ENABLD
ECONOMIZER T NONE OFF
100.00 %OPEN
RA
RA AVG CO2 517.62 PPM
RETURN AIR CO2 542.37 ppm
RETURN AIR CO2 492.87 ppm
100.00 %CLOSE
100.00 %CLOS
NONE 80.69 %SPEED
29.16 kCFM
RETURN FAN NONE ON
100.00 %CLOSE
These dampers are mechanically locked closed.
EA
RET SMK DETECTOR
SA CFM SETPT NONE 27.00 Kcfm
66.24 deg F
MAT STPT NONE 58.60 DEG F
74.02 deg F
HWS
0.00 %OPEN
HWR
SUPPLY FAN NONE ON
80.69 %SPEED
SA SETPT NONE 64.62 DEG F
Point: DAN.AHU01-040-B16A.SAS
Desc.: SA SETPT
Status: NORMAL
Pri: NONE
Value: 64.62 DEG F
Ex-State: N/A
Total:
These dampers are mechanically
DUCT LOW STATIC
MIX DMPR VIR OU NONE 100.00 %OPEN
LOW TEMP DETECT
Chilled H2O
OA FLOW NONE -5.69 kCFM
FILTER DIFF PR -0.17 IN.H2O
67.25 deg F
PHT STPT NONE 60.60 DEG F
CWR
CWS
26.31 kCFM
DUCT HIGH STATIC
0.42 IN.H2O


File Edit View Insert Dynamic Tools Window Help
SIEMENS
Danforth Dining Hall KITCHEN EXHAUST FANS
LOCATION: ROOF
EXH FANS UNDER LOCAL CONTROL. SHOULD BE SWITCHED TO THE ON POSITION DURING COOKING. THEN SWITCHED TO THE AUTO POSITION WHEN DONE COOKING. AT THE SWITCH ON THE EXH FAN PANEL.
EVERY 30 MIN CHECK FOR EXH FAN STATUS. IF ANY E FAN ON SWITCH TO COOKING MODE.
TIMER 18.00 MIN
COOKING MODE NONE ENABLD
Danforth Dining
AHU-1
KEF-1 START NONE OFF
KEF-1 PROOF ON
KEF-2 START NONE OFF
KEF-2 PROOF ON
KEF-3 START NONE OFF
KEF-3 PROOF ON
VFD CONTROLLED BY CAPTIVE AIRE KITCHEN EXHAUST SYSTEM
KEF-1 5225 CFM 5HP 208V
VFD SPD SIG 2DDC 51.52 Hz
VFD CONTROLLED BY CAPTIVE AIRE KITCHEN EXHAUST SYSTEM
KEF-2 4000 CFM 5HP 208V
VFD SPD SIG 2DDC 52.09 Hz
VFD CONTROLLED BY CAPTIVE AIRE KITCHEN EXHAUST SYSTEM
KEF-3 18,000 CFM 20HP 208V
VFD SPD SIG 2DDC 56.05 Hz
EXHAUST FANS INFORMATION
EXH FANS OPERATION
EXH FANS WIRING
DISHWASHER EXHAUST FAN
IN COOKING MODE DAMPERS POSITIONED BASED ON WHICH EXHAUST FANS ARE ON. REFER TO AHU OPERATION TABLE.
AHU OPERATION TABLE
DEF-1 1200 CFM 0.5HP 208V
DISHWASHER EF NONE OFF
NONE COOKING MODE DAMPERS ARE AT MIN POSITION OR ECONOMIXER BASED ON ENTHALPY. OR IF CO2 IS HIGH DEMAND VENTILATION WILL START. REFER TO DEMAND VENTILATION CHART.
DEMAND BASED VENTILATION
DDC SYSTEM MONITORS FAN STATUS ONLY. START/STOP CONTROL IS INTER-LOCKED WITH DISHWASHER ON/OFF CONTROLS.

Preliminary Assessment Interview
HVAC ONLY

Building Name: FDB

Contact Name: Richard Stein

Wendel Auditor: Jason Denue   Date:4/08/2021

BUILDING OVERVIEW

Building Schedule:

- Monday - Friday: 24/7 due to pandemic
- Saturday - Sunday: 24/7 due to pandemic

HVAC Schedule:

- Monday - Friday: 24/7 due to pandemic typically Scheduled (will provide schedule)
- Saturday - Sunday 24/7 due to pandemic typically Scheduled (will provide schedule)

Space Types / uses

- **Type 1**: Kitchens
- **Type 2**: Dinning
- **Type 3**: Even Space
- **Type 4**: Offices

EMS Yes / No

- **Type**: Pneumatic / DDC, Webcontrol
- **Manufacturer** Legacy / Updated,
- **Has Trending**: Y / N
- **Has Remote Access**: Y / N
- **Has Temperature setback**: Y / N
- **Has Time of Day Schedule**: Y / N

Heating Plant Yes / No

- **Heating System** : Steam / HW / Electric
- **Fuel Source** : NG / Fuel Oil / Propane

- **Steam Boilers** or N/A
  1. Number of Boilers:
  2. Boiler Output: field
  3. Boiler Input: field
  4. Blow down procedure: Automatic / Manual How frequent:______________________
  5. Condensate return system:
  6. Steam Pressure at Boiler: field
  7. Steam pressure at PRV 1: field psig or N/A
  8. Steam pressure at PRV 2: field psig or N/A
  9. Feed water system:
     a. Treated: Y / N
     b. Preheated: Y / N
  10. Burner Controls: Linkage / Electronic -Replace Boilers: Y / N Replace Burners: Y / N

- **Steam traps** or N/A
  1. Maintenance program: Y / N
  2. Trap condition (general): poor /average /new

  Replace Traps: Y / N
- **Combustion Air** : Y / N
- **Plant Enabled at**:
- **Hot Water Boilers** or N/A
  1. Number of Boilers: ________________
  2. Boiler Output: field mmBtu
  3. Boiler Input: field mmBtu
  4. Hot water system control: HW Reset / OA Reset / Constant Temperature
  5. Hot water temperature set point: Max:____________ Min:____________
  6. Burner Controls: Linkage / Electronic

  Replace Boilers: Y / N Replace Burners: Y / N

- **Hot Water Pumps**
  1. Primary Pumps: Perimeter Reheats
     a. Power: field HP
     b. Number of Pumps: 2
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: Y / N Add VFD: Y / N / Has
  1. Primary Pumps: Snow Melt System
     a. Power: field HP
     b. Number of Pumps: 2
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: Y / N Add VFD: Y / N / Has
  2. Primary Pumps: Glycool Preheats
     a. Power: field HP
     b. Number of Pumps: 2
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: Y / N Add VFD: Y / N / Has

Domestic Hot Water System Yes / No

- **Hot Water Supply Temperature:** __________
- **Storage Tank:** Y / N
  1. Storage Temperature:__________________
  2. Storage Tank Volume:_________________
- **Heat exchanger:** Steam / Hot Water / N/A
  1. Usage: Year Round / School year
- **Heating Source:** Main Boilers / DHW Heater
- **DHW Heater:** Electric / NG / N/A
  1. Burner: Atmospheric / Force Draft
  2. Usage: Year Round / School year

  Replace with Condensing: **Y / N**
- **Dish washer Booster Heater** or HX
  1. Fuel Source: Steam / NG / Electric

Cooling Plant Yes / No

- **Chilled water system** enabled at: _______ OAT
- **Chiller**
  1. Chiller Type: Centrifugal / Screw / absorption / gas driven / ___________
  2. Chiller Capacity: field Tons
  3. VSD: **Y / N**
  4. OA reset: **Y / N**
- **Cooling Tower**
  1. Tower Type: Open / Closed / _____force draft_______
  2. Tower Capacity: ________600 each_____Tons
  3. Add VSD: **Y / N / Has**
  4. Uses Glycol: **Y / N**
- **Controls**
  1. CHW Set Point: __________
  2. CW Set Point: ______83-85_____ no condenser relief

- **Chilled Water Pumps**
  1. Primary Pumps:
     a. Power: field HP
     b. Number of Pumps: 2
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: **Y / N** Add VFD: **Y / N / Has**

  2. Secondary Pumps:
     a. Power: field HP
     b. Number of Pumps: _______________
     c. Efficiency: Premium / High / Standard
     d. Control: Start & Stop / 2 speed / VFD

  Replace Motors: **Y / N** Add VFD: **Y / N / Has**

Terminal Units Yes / No

- **Space Type 1** : Fin Tube areas- outside wall (example third floor)
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / _______________
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump /
  4. Ventilation: Y / N (Room now)
  5. Controls: Thermostat / DCV / DDC
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other _____________
  8. Equipment Condition: Poor / Average / Good
- **Space Type 2** : Most spaces
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / VAV Reheat
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump / _____________
  4. Ventilation: Y / N
  5. Controls: Thermostat / DCV / DDC
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other _____________
  8. Equipment Condition: Poor / Average / Good
- **Space Type 3** :
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / _______________
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump / _____________
  4. Ventilation: Y / N
  5. Controls: Thermostat / DCV / Other____________
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other _____________
  8. Equipment Condition: Poor / Average / Good
- **Space Type 4** : bathrooms| halls
  1. Unit Type: Unit heaters / Fan Coils / Radiation / Heat Pumps / _______________
  2. Heat Source: Steam / HW / Electric / Furnace
  3. Cooling Source: CHW / DX / Heat Pump / _____________
  4. Ventilation: Y / N
  5. Controls: Thermostat / DCV / Other____________
  6. Scheduled: Y / N
  7. Control valves: 2-Way / 3-Way / Thermostatic / Hand / N/A / Other _____________
  8. Equipment Condition: Poor / Average / Good

Ventilation System 1 Yes / No

- **AHU Number(s):** *Event Space*
- **Number of Units:** 4
- **Schedule:**
  - Pandemic 24/7
- **Location:** Indoors / RTU
- **Type of AHUs:** CV / VAV / Dual Duct / Induction / Other
- **Heating:** HW / HW-Glycol / Steam / Furnace / Heat Pump / N/A
- **Cooling:** CHW / DX / Heat Pump / N/A
- **Humidification:** Y / N
- **Heat Recovery:** Y / N / Has
- **Outdoor Air**
  - Control: TOD / DCV / N/A - overridden to 100% OA
- **Exiting Economizer :** Y / N
- **System Fans**

1. Supply Fan:
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
2. Return Fan or N/A
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
3. Exhaust dampers - controlled
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position

Ventilation System 2 Yes / No

- **AHU Number(s):** *AHU | one per floor (kitchen connect to AHU-1,2,3,5)*
- **Number of Units:** 5
- **Schedule:**
  1. Pandemic 24/7
- **Location:** Indoors / RTU
- **Type of AHUs:** CV / VAV / Dual Duct / Induction / Other ____________
- **Heating:** HW / HW-Glycol / Steam / Furnace / Heat Pump / N/A
- **Cooling:** CHW / DX / Heat Pump / N/A
- **Humidification:** Y / N
- **Heat Recovery:** Y / N / Has
- **Outdoor Air**
  - Control: TOD / DCV /N/A - overridden to elevated minimum OA | flow station in AHU
- **Add Economizer:** Y / N / Has
- **System Fans**
  1. Supply Fan:
     a. Power: field Hp
     b. Efficiency: Premium / High / Standard
     c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
  2. Return Fan or N/A
     a. Power: field Hp
     b. Efficiency: Premium / High / Standard
     c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
  3. Exhaust Fan or N/A
     a. Power: field Hp
     b. Efficiency: Premium / High / Standard
     c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position

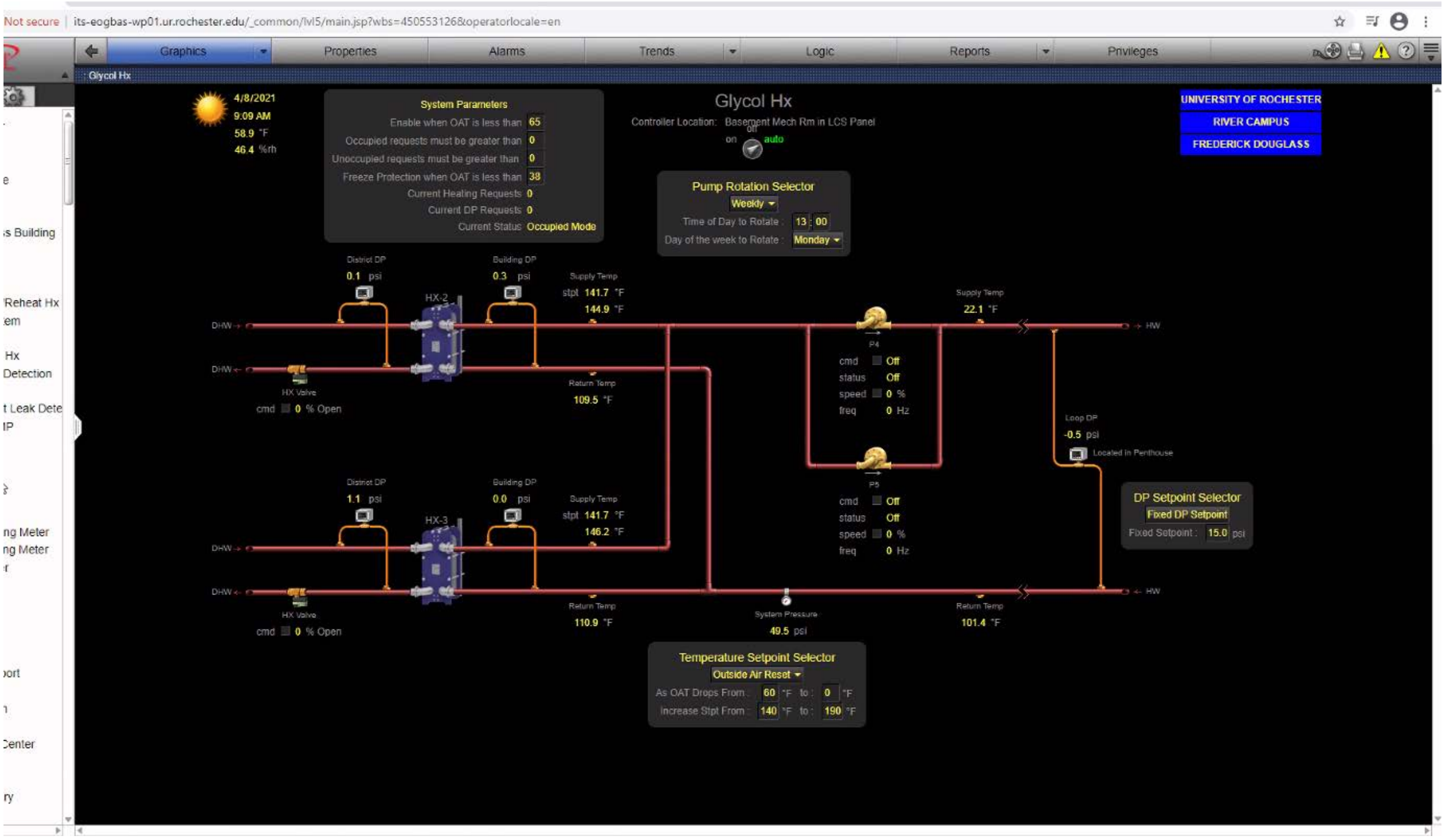
Are the exhaust fans turning on and off. AHU may not be interlocked with exhaust fans RCX list of recommendations

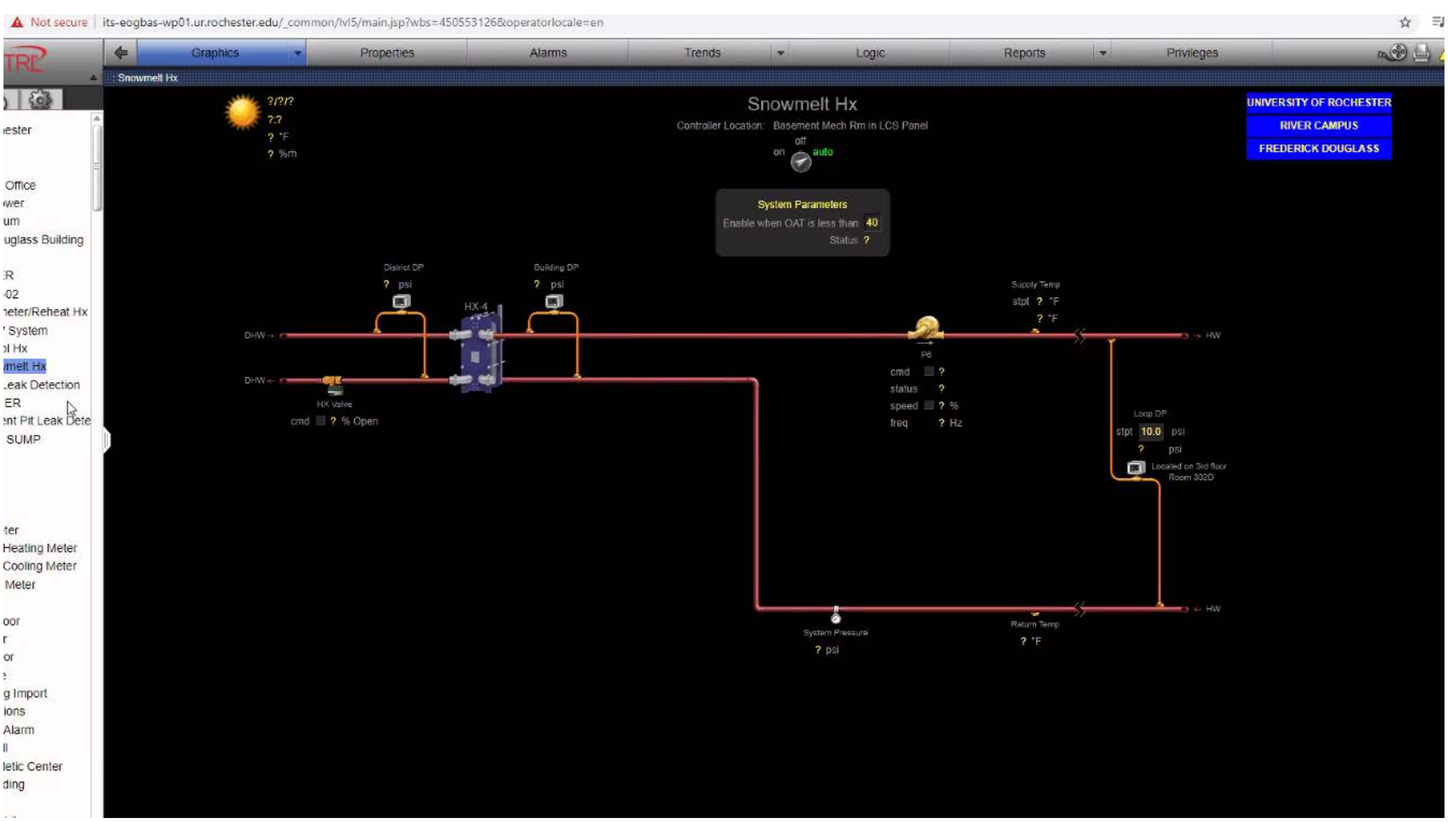
Ventilation System 3 Yes / No

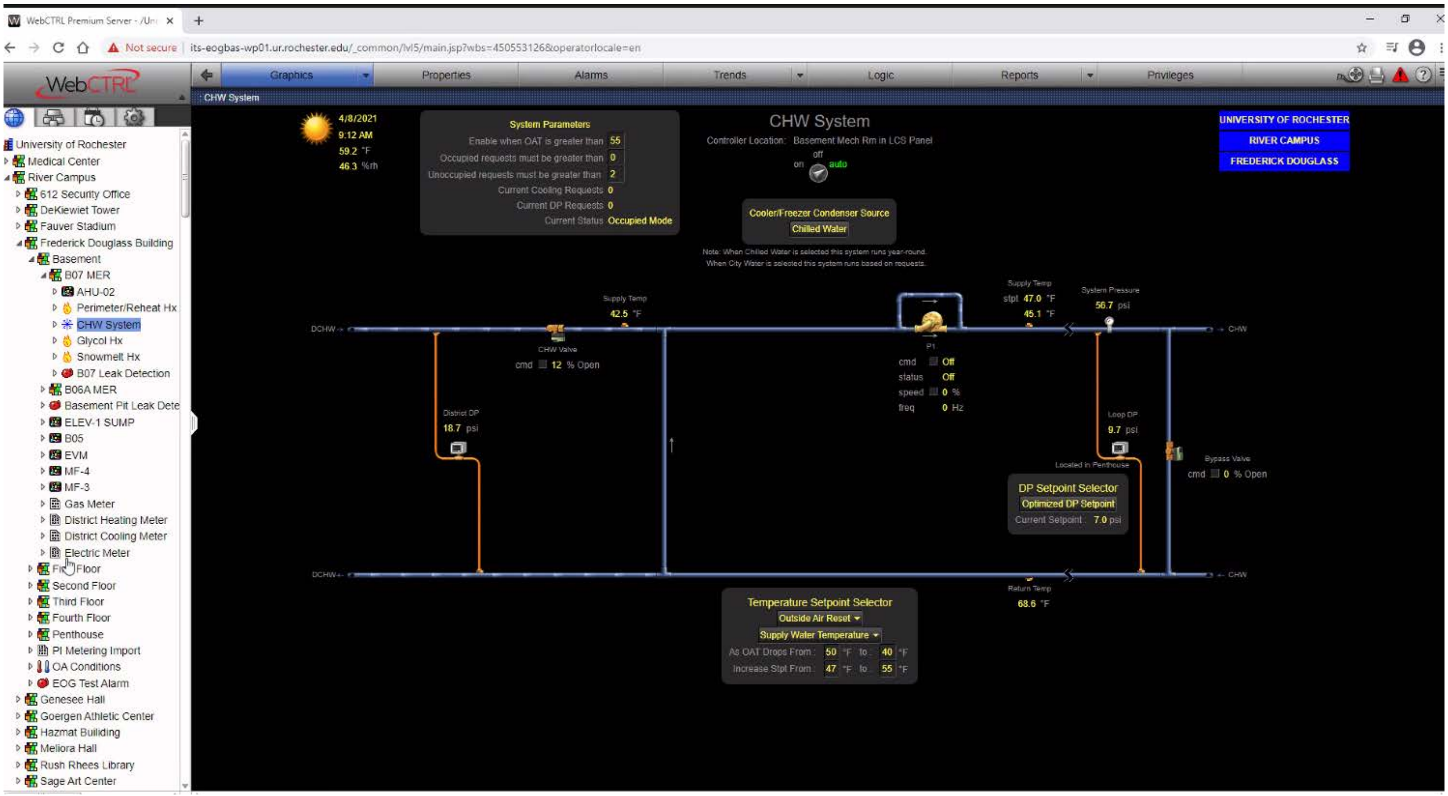
- **AHU Number(s):** *(Fill in one sheet for all common units)*
- **Number of Units:** ________________
- **Schedule:**
  - Monday - Friday: On_______ - Off ________
  - Saturday - Sunday: On_______ - Off ________
- **Location**: Indoors / RTU
- **Type of AHUs**: CV / VAV / Dual Duct / Induction / Other ___________
- **Heating**: HW / HW-Glycol / Steam / Furnace / Heat Pump / N/A
- **Cooling**: CHW / DX / Heat Pump / N/A
- **Humidification**: Y / N
- **Heat Recovery**: Y / N / Has
- **Outdoor Air**
  - Control: TOD / DCV / N/A
- **Add Economizer**: Y / N / Has
- **System Fans**

1. Supply Fan:
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
2. Return Fan or N/A
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position
3. Exhaust Fan or N/A
   a. Power: field Hp
   b. Efficiency: Premium / High / Standard
   c. Control: Start & Stop / 2 speed / VFD / Inlet Vanes / Damper Position

Coolers can run on chilled water or domestic water


Graphics
Properties
Alarms
Trends
Logic
Reports
Privileges
Glycol Hx
4/8/2021
9:09 AM
58.9 °F
46.4 %rh
System Parameters
Enable when OAT is less than 65
Occupied requests must be greater than 0
Unoccupied requests must be greater than 0
Freeze Protection when OAT is less than 38
Current Heating Requests 0
Current DP Requests 0
Current Status Occupied Mode
Glycol Hx
Controller Location: Basement Mech Rm in LCS Panel
Pump Rotation Selector
Weekly
Time of Day to Rotate: 13 : 00
Day of the week to Rotate: Monday
UNIVERSITY OF ROCHESTER
RIVER CAMPUS
FREDERICK DOUGLASS
DP Setpoint Selector
Fixed DP Setpoint
Fixed Setpoint: 15.0 psi
Temperature Setpoint Selector
Outside Air Reset
As OAT Drops From: 60 °F to: 0 °F
Increase Stpt From: 140 °F to: 190 °F
System Pressure
49.5 psi


Graphics
Properties
Alarms
Trends
Logic
Reports
Privileges
Snowmelt Hx
Snowmelt Hx
Controller Location: Basement Mech Rm in LCS Panel
UNIVERSITY OF ROCHESTER
RIVER CAMPUS
FREDERICK DOUGLASS
System Parameters
Enable when OAT is less than 40
Status ?
HX-4
Loop DP
stpt 10.0 psi
System Pressure
? psi
Return Temp
? °F

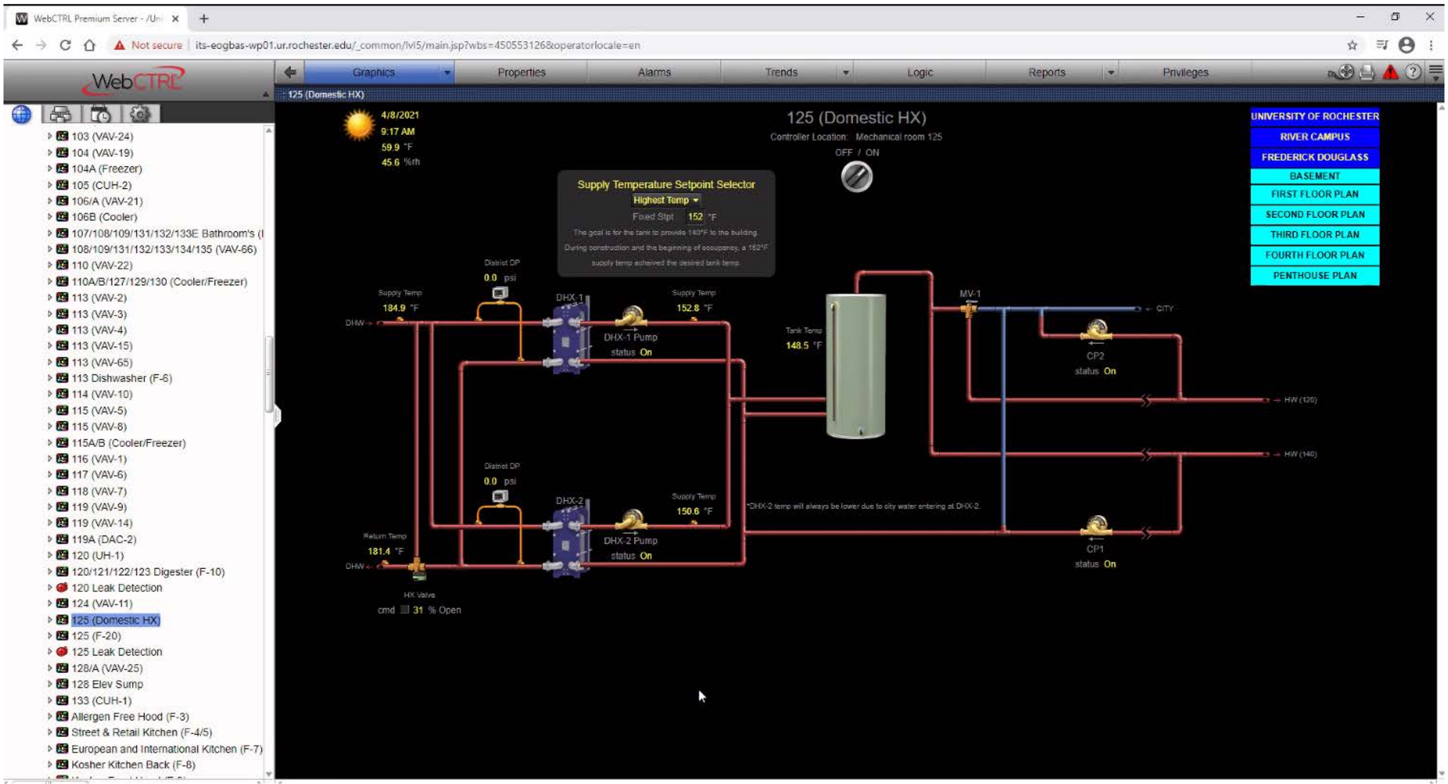

WebCTRL Premium Server
its-eogbas-wp01.ur.rochester.edu/_common/lvl5/main.jsp?wbs=4505531268&operatorlocale=en
Graphics
Properties
Alarms
Trends
Logic
Reports
Privileges
CHW System
University of Rochester
Medical Center
River Campus
612 Security Office
DeKiewiet Tower
Fauver Stadium
Frederick Douglass Building
Basement
B07 MER
AHU-02
Perimeter/Reheat Hx
CHW System
Glycol Hx
Snowmelt Hx
B07 Leak Detection
B06A MER
ELEV-1 SUMP
B05
EVM
MF-4
MF-3
Gas Meter
District Heating Meter
District Cooling Meter
Electric Meter
Second Floor
Third Floor
Fourth Floor
Penthouse
PI Metering Import
OA Conditions
EOG Test Alarm
Genesee Hall
Goergen Athletic Center
Hazmat Building
Meliora Hall
Rush Rhees Library
Sage Art Center
4/8/2021
9:12 AM
59.2 °F
46.3 %rh
System Parameters
Enable when OAT is greater than 55
Occupied requests must be greater than 0
Unoccupied requests must be greater than 2
Current Cooling Requests 0
Current DP Requests 0
Current Status Occupied Mode
CHW System
Controller Location: Basement Mech Rm in LCS Panel
UNIVERSITY OF ROCHESTER
RIVER CAMPUS
FREDERICK DOUGLASS
Cooler/Freezer Condenser Source
Chilled Water
Supply Temp
42.5 °F
CHW Valve
cmd 12 % Open
District DP
18.7 psi
Supply Temp
stpt 47.0 °F
45.1 °F
System Pressure
56.7 psi
cmd Off
status Off
speed 0 %
freq 0 Hz
Loop DP
9.7 psi
Bypass Valve
cmd 0 % Open
DP Setpoint Selector
Optimized DP Setpoint
Current Setpoint 7.0 psi
Return Temp
68.6 °F
Temperature Setpoint Selector
Outside Air Reset
Supply Water Temperature
As OAT Drops From 50 °F to 40 °F
Increase Stpt From 47 °F to 55 °F

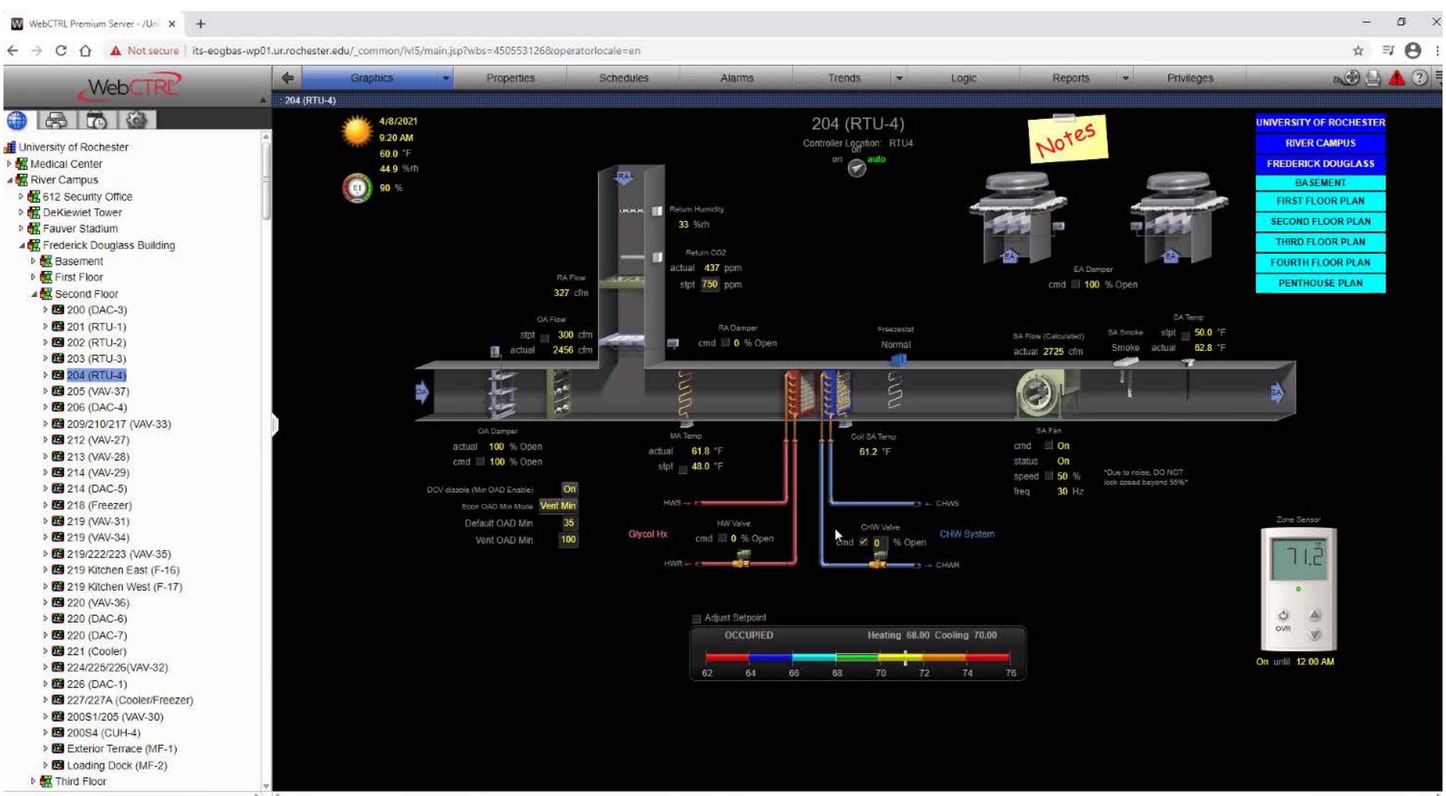
Redo

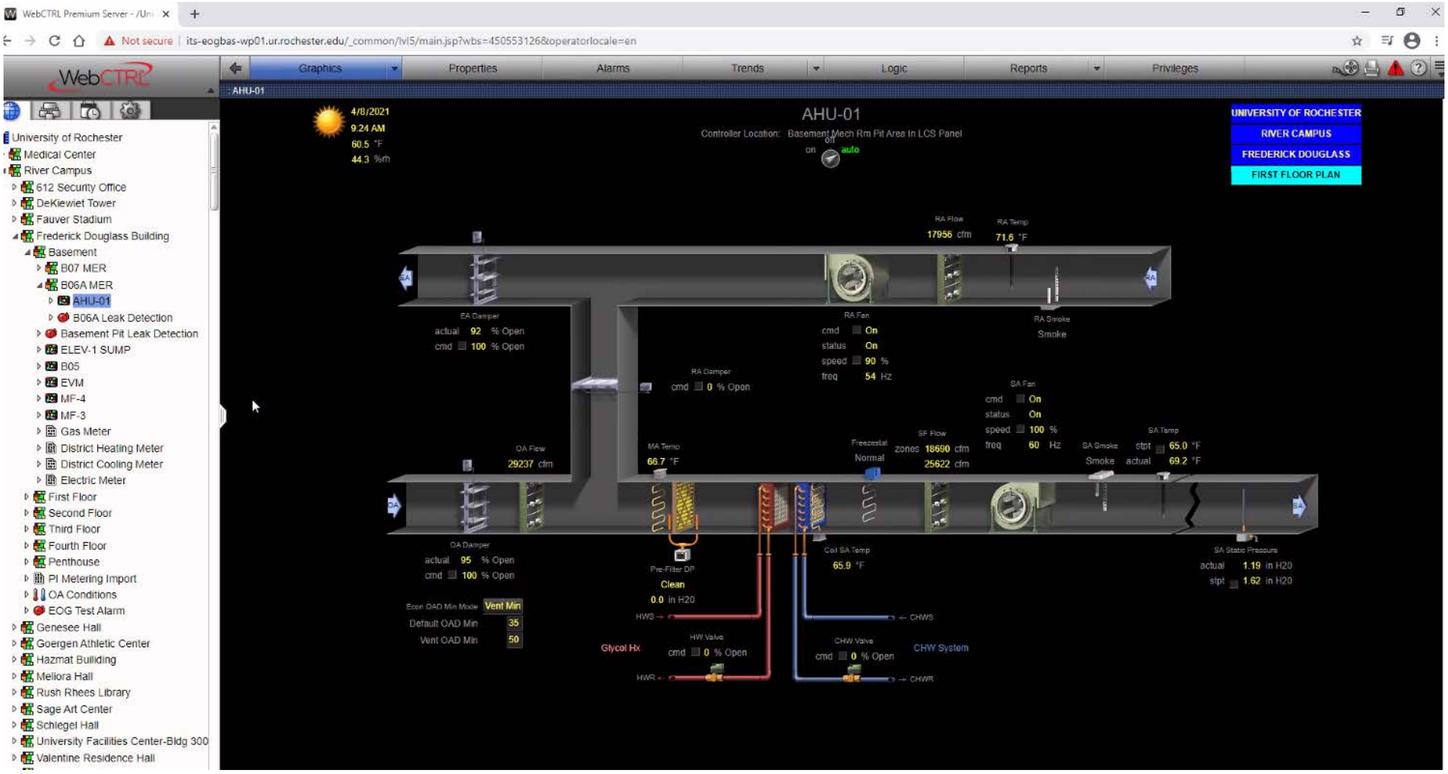
Enable	Equipment	Current Value	New Value
☐	River Campus / Frederick Douglass Building / Third Floor / 305 (VAV-39)	100.0	100.0
☐	River Campus / Frederick Douglass Building / Third Floor / 305A (VAV-41)	100.0	100.0
☐	River Campus / Frederick Douglass Building / Third Floor / 305B/C/D (VAV-40)	0.0	0.0
☐	River Campus / Frederick Douglass Building / Third Floor / 305E (VAV-43)	0.0	0.0
☐	River Campus / Frederick Douglass Building / Third Floor / 304 (VAV-38)	0.0	0.0
☐	River Campus / Frederick Douglass Building / Third Floor / 312 (VAV-49)	0.0	0.0
☐	River Campus / Frederick Douglass Building / Fourth Floor / 401 (VAV-59)	13.0	13.0
☐	River Campus / Frederick Douglass Building / Fourth Floor / 403 (VAV-58)	0.0	0.0
☐	River Campus / Frederick Douglass Building / Fourth Floor / 407 (VAV-57)	0.0	0.0
☐	River Campus / Frederick Douglass Building / Fourth Floor / 410 (VAV-54)	0.0	0.0
☐	River Campus / Frederick Douglass Building / Fourth Floor / 410C/D/E (VAV-53)	0.0	0.0
☐	River Campus / Frederick Douglass Building / Fourth Floor / 410A/B/411 (VAV-55)	0.0	0.0
☐	River Campus / Frederick Douglass Building / Fourth Floor / 413 (VAV-56)	50.6	50.6
☐	River Campus / Frederick Douglass Building / Fourth Floor / 420 (VAV-64)	100.0	100.0
☑	Enable All		100.0 Set All To
			? Change All By

Apply Changes

Preliminary Assessment Interview
HVAC ONLY






AHU-01
UNIVERSITY OF ROCHESTER
RIVER CAMPUS
FREDERICK DOUGLASS
FIRST FLOOR PLAN

Appendix RCx-B

Site Walkthrough & BSA Survey Sheets

Energy RCX Scoping Checklist
Site Information

Project Name	Rochester RCX Scoping
Building Name	Rush Rhees Library
Building Type	Library
Year Built	1930
Gross Area	349,284
No. Stories	4 + basement
Initial Walk-Through Date:	4/13/2021

Space Types

Cirical Rare Books
Stacks
Reading area
Office

Key Contacts

Name	Richard D. Stein	
Title/Role	Assistant Director Building Controls	
Phone	585.275.2432	
Email	rstein8@facilities.rochester.edu	

Notes

Prints for building were only arch. Facilities Mechanic said blueprints are in the rare books area and require security access. Building is controlled by Siemens Apogee and Automatic Logic Systems. The dual duct system is divided between the two systems and it is unknown if the dual duct siemen controllers communicate back to the AL Controller for the AHU which does look at calls for H/C. While onsite it was observed that the radiant systems and the air handling systems were in conflict.Large common areas with varing high occupancy were also served by multple different systems (ahu, dcu, rad) that would also be a source of conflict of HC and OA. Siemens system access does not allow viewing or creation of trending or schedules

Energy RCX Scoping Checklist

Rush Rhees Library

Pre Audit	Assigned to
☑ Introduciton to Client	JGD
☑ Initial Visit Scheduled 2 weeks in advance	JGD
☑ Pull-in Checklists & Templates	JGD
☑ Floor Plans Downloaded	SDM
☑ Utility Data Downloaded	JGD
☑ Utility Analysis Completed	JGD
☐ Mechanical Plans and Schedules Downloaded	N/A
Offsite Work (Prep)	
☐ Mechanical Equipment Schedules Reviewed	N/A
☑ Site Facility Interview	JGD
☐ Request Trend Data	SDM
☑ Review Trend Data	SDM
☐ Benchmark Buildings	XYZ

Control System Summary

Type: Pneumatic | Siemens Apogee/Automated Logic

Manufacturer:

Trending: Y for Automated Logic/Siemens Apogee

Trending: Y on Automated Logic System

Qualitative Sensor Review: Verify temperature sensors are reading accurately (this is done by looking at BMS readings and seeing if they are reasonable based upon the unit's operation)

AHU Qualitative Review Completed

Chilled Water Qualitative Review Completed

Hot Water Qualitative Review Completed

AHU Qualitative Review Completed

Energy RCX Scoping Checklist
Rush Rhees Library
AHU-1 4th Floor

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

4th Floor VAVs reheats at coil

Control System Type

Type: DDC
Manufacturer: utomated Logic
Trending: Y

Unit Configuration

AHU Type: VAV
Return Air Type: Return Air Unit
Fans: Supply
Heat Recovery Coil: None
Preheat Coil: N/A
Reheat Coil: Hot Water
Cooling Coil: Chilled Water
Is Heating Coil Before or After Cooling Coil? RH at VAV

Schedule

Schedule Type: 24/7

HVAC Schedule M - F:	24/7	Covid	24/7	Normal
HVAC Schedule S - S: Space	24/7	Covid	24/7	Normal
Schedule M - F: Space	24/7	Covid	24/7	Normal
Schedule S - S: Existing	24/7	Covid	24/7	Normal

Optimal Start: No Tend of unit status: Yes

Screen Shot of Trend: No

Fan Speed control

Constant Speed: No (If Yes, End of section)
Speed Control: VFD
What is static pressure setpoint versus unit external capacity:
Review trend of fan speed avalible: Yes
Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH:	38	hz		time
Observed Fan speed LOW:	38	hz		time

Energy RCX Scoping Checklist

Rush Rhees Library

AHU-1 4th Floor

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: Based on temp

If DCV, CO2 sensor location: Space | RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : *if not avalible mark "N/A"*

Record Observed Points:

Date & Time	4/7/2021	
OA Damper Position:	100%	*if not avalible mark "N/A"*
OA Air Flow:		*if not avalible mark "N/A"*
SA Fan Speed:	68%	SA Fan CFM: (blank) *No drawings*
OA Temp:	43.9	
RA Temp:	75.6	
MA Temp:	62.6	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies

SA Temp Setpoint: 70

SA Temp Base on: Based on calls for cooling?, Definely could be based on outdoor air

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? Yes

SA Temp Actual: 67.1

Resest Temp HIGH:	70	F	Calls for heat	Other
Resest Temp Low:	58	F	Calls for cool	Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer (40%)

Economizer Control Type: OA Drybulb

Other

Dehumidificaiton Contorl:	NO	Setpoint:		Sensor :	Space | RA
Humidification Contorl:	NO	Setpoint:		Sensor :	Space | RA
Face & Bypass	NO				

Energy RCX Scoping Checklist

Rush Rhees Library

AHU-1 4th Floor

FIELD SURVEY

Assigned to

SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper: Observed w/ Photo | No Access | Not Applicable

Observed approx damper position: 100 %open

Is the Damper Stuck Open or Close?: No Open | Closed

Do some blades appeard to be not working?: No

Are any actuators broke / disconnected?: No

Return Air (RA) Damper: Observed w/ Photo | No Access | Not Applicable

Observed approx damper position: 0 %open

Is the Damper Stuck Open or Close?: No Open | Closed

Do some blades appeard to be not working?: No

Are any actuators broke / disconnected?: No

Fan VFD or starter: Observed w/ Photo | No Access | Not Applicable

Observed Fan Speed: 38 Hz

Observed Fan power: Amp or kW

Is the drive in hand or bypass No

Is the starter in hand or bypass No

Valves: No Access

Chilled Water Valve: 2-way

Chilled Water Valve Actuator: connected

Hot Water Valve: N/A

Hot Water Valve Actuator: N/A

Steam Valve: N/A

Steam Valve Actuator: N/A

Glycol Hot Water Valve: N/A

Glycol Hot Water Valve Actuator: N/A

Air Tightness: No Access

Observed holes in duct connections: No

Door close tight: No

Other Notes:

VFD Graphic not linked, CHW pump overided to off position

wendel

Energy RCX Scoping Checklist

Rush Rhees Library

AHU-1-2 Dual Duct

REMOTE CONTROL

Assigned to

SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

All floors

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV | Dual Duct

Return Air Type: Return Air Unit | 100% Outside Air Unit during covid

Fans: 2 Supply |4 Return

Heat Recovery Coil: None

Preheat Coil:

Reheat Coil: Steam

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? Dual Duct

Schedule

Schedule Type: 24/7

HVAC Schedule M - F:	24/7	Covid	24/7	Pre Covid
HVAC Schedule S - S:	24/7	Covid	24/7	Pre Covid
Space Schedule M - F:	24/7	Covid	8am-10pm	Pre Covid
Space Schedule S - S:	24/7	Covid	10am-10pm	Pre Covid

Existing Optimal Start: No

Tend of unit status: Yes

Screen Shot of Trend: No

Fan Speed control

Constant Speed: No (If Yes, End of section)

Speed Control: VFD (6) to meet Static Setpoint

What is static pressure setpoint versus unit external capacity: 1.5

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: No

Observed Fan speed HIGH: 45 hz

Observed Fan speed LOW: 40 hz

Energy RCX Scoping Checklist

Rush Rhees Library

AHU-1-2 Dual Duct

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No but currently running this way

Ventilation Control: Modulate to control Ma to Cool deck SP

If DCV, CO2 sensor location: Space | RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : N/A *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : N/A *if not avalible mark "N/A"*

Record Observed Points:

Date & Time	5/7/2021	
OA Damper Position:	100	*if not avalible mark "N/A"*
OA Air Flow:	100%	*if not avalible mark "N/A"*
SA Fan Speed:	68	SA Fan CFM: *no drawings*
OA Temp:	45.3	
RA Temp:	73	
MA Temp:	57	

Confirm Trends: Yes

Discharge Air Temperature Control

Discharge Air Temp: Constant with operator changes

SA Temp Setpoint: Varies

SA Temp Base on: operator overide

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? Yes

SA Temp Actual: Based on which deck is being served

Reset Temp HIGH:	95	F	operator over OA Temp | RA Temp | Other
Reset Temp Low:	55	F	operator over OA Temp | RA Temp | Other

Confirm Trends: Yes | No

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: 10-40%

Economizer Control Type: OA Temp Setpoint to match cool deck set point

Other

Dehumidificaiton Contorl:	No	Setpoint:		Sensor :	Space | RA
Humidification Contorl:	No	Setpoint:		Sensor :	Space | RA
Face & Bypass	No				

Energy RCX Scoping Checklist

Rush Rhees Library

AHU-1-2 Dual Duct

FIELD SURVEY

Assigned to: SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper: Observed

Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Return Air (RA) Damper: Observed

Observed approx damper position:	0	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Fan VFD or starter:

Observed Fan Speed:	45	Hz
Observed Fan power:	N/A	Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	

Valves: Observed

Chilled Water Valve:	2-way
Chilled Water Valve Actuator:	connected
Hot Water Valve:	N/A
Hot Water Valve Actuator:	N/A
Steam Valve:	full
Steam Valve Actuator:	connected
Glycol Hot Water Valve:	N/A
Glycol Hot Water Valve Actuator:	N/A

Air Tightness: | No Access |

Observed holes in duct connections:	N/A
Door close tight:	N/A

Other Notes:

Largest energy user of the building Dual Duct System. Chilled water of and OA locked open for Covid. Space Set points and flow for Dual Ducts do not set back. From Graphics and trends they look to have independent operation for heat cool valves. DDB are on both siemens Apogge and AL systems.

Energy RCX Scoping Checklist

Rush Rhees Library

AHU Rm 206

REMOTE CONTROL

Assigned to

SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

Room 207

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV Single Zone

Return Air Type: Return Air Unit

Fans: Supply

Heat Recovery Coil: None

Preheat Coil: N/A

Reheat Coil: N/A

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? Heating provided by radiant, heat at cool at the same time

Schedule

Schedule Type: 24/7

HVAC Schedule M - F:	24/7	Covid	24/7	Normal
HVAC Schedule S - S:	24/7	Covid	24/7	Normal
Space Schedule M - F:	24/7	Covid	24/7	Normal
Space Schedule S - S:	24/7	Covid	24/7	Normal

Existing Optimal Start: No

Tend of unit status: Yes

Screen Shot of Trend: No

Fan Speed control

Constant Speed: No (If Yes, End of section)

Speed Control: VFD based on space temp PID

What is static pressure setpoint versus unit external capacity: 1.5

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH: 30 hz

Observed Fan speed LOW: 30 hz

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Energy RCX Scoping Checklist

Rush Rhees Library

AHU Rm 206

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: Based on OA temp

If DCV, CO2 sensor location: Space | RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : N/A *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : N/A *if not avalible mark "N/A"*

Record Observed Points:

Date & Time	4/7/2021	
OA Damper Position:	0%	*if not avalible mark "N/A"*
OA Air Flow:	100%	*if not avalible mark "N/A"*
SA Fan Speed:	50%	SA Fan CFM: *No drawings*
OA Temp:	42	
RA Temp:	75.3	
MA Temp:	75.3	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies on temp space

SA Temp Setpoint:

SA Temp Base on: Based on calls for cooling?, Definely could be based on outdoor air

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? Yes

SA Temp Actual: 50.9

Resest Temp HIGH: F — Calls for heat: Other

Resest Temp Low: F — Calls for cool: Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer (40%)

Economizer Control Type: OA Drybulb

Other

Dehumidificaiton Contorl: NO

Humidification Contorl: NO

Face & Bypass NO

FIELD SURVEY

Energy RCX Scoping Checklist

Rush Rhees Library

AHU Rm 206

Assigned to

SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper: Observed w/ Photo | No Access | Not Applicable

Observed approx damper position: 0 %open

Is the Damper Stuck Open or Close?: No Open | Closed

Do some blades appear to be not working?: No

Are any actuators broke / disconnected?: No

Return Air (RA) Damper: Observed w/ Photo | No Access | Not Applicable

Observed approx damper position: 100 %open

Is the Damper Stuck Open or Close?: No Open | Closed

Do some blades appear to be not working?: No

Are any actuators broke / disconnected?: No

Fan VFD or starter: Observed w/ Photo | No Access | Not Applicable

Observed Fan Speed: 50 Hz

Observed Fan power: Amp or kW

Is the drive in hand or bypass No

Is the starter in hand or bypass No

Valves: No Access

Chilled Water Valve: 2-way

Chilled Water Valve Actuator: connected

Hot Water Valve: N/A

Hot Water Valve Actuator: N/A

Steam Valve: N/A

Steam Valve Actuator: N/A

Glycol Hot Water Valve: N/A

Glycol Hot Water Valve Actuator: N/A

Air Tightness: No Access

Observed holes in duct connections: No

Door close tight: No

Other Notes:

Economizer needs to be reprogrammed. Call for cool during heating with radiant and using CHW

Energy RCX Scoping Checklist

Rush Rhees Library

AHU Rm 207

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

Room 207

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV Single Zone

Return Air Type: Return Air Unit

Fans: Supply

Heat Recovery Coil: None

Preheat Coil: N/A

Reheat Coil: N/A

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? Heating provided by radiant, heat at cool at the same time

Schedule

Schedule Type: 24/7

HVAC Schedule M - F:	24/7	Covid	24/7	Normal
HVAC Schedule S - S:	24/7	Covid	24/7	Normal
Space Schedule M - F:	24/7	Covid	24/7	Normal
Space Schedule S - S:	24/7	Covid	24/7	Normal

Existing Optimal Start: No

Tend of unit status: Yes

Screen Shot of Trend: No

Fan Speed control

Constant Speed: No (If Yes, End of section)

Speed Control: VFD based on space temp PID

What is static pressure setpoint versus unit external capacity: N/A

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH: 50 hz

Observed Fan speed LOW: 50 hz

Energy RCX Scoping Checklist

Rush Rhees Library

AHU Rm 207

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: Based on OA temp

If DCV, CO2 sensor location: Space | RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : N/A *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : N/A *if not avalible mark "N/A"*

Record Observed Points:

Date & Time	4/7/2021	
OA Damper Position:	0%	*if not avalible mark "N/A"*
OA Air Flow:		*if not avalible mark "N/A"*
SA Fan Speed:	30%	SA Fan CFM: *No drawings*
OA Temp:	42	
RA Temp:	74	
MA Temp:	74	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies on temp space

SA Temp Setpoint:

SA Temp Base on: Based on calls for cooling?, Definely could be based on outdoor air

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? Yes

SA Temp Actual: 74.7

Resest Temp HIGH:	F	Calls for heat	Other
Resest Temp Low:	F	Calls for cool	Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer (40%)

Economizer Control Type: OA Drybulb

Other

Dehumidificaiton Contorl: NO

Humidification Contorl: NO

Face & Bypass NO

wendel

Energy RCX Scoping Checklist

Rush Rhees Library

AHU Rm 207

FIELD SURVEY

AIR HANDLING SYSTEM FIELD REVIEW

Assigned to: SDM

Field Audit

Outdoor Air (OA) Damper: Observed w/ Photo | No Access | Not Applicable

Observed approx damper position:	0	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appeard to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Return Air (RA) Damper: Observed w/ Photo | No Access | Not Applicable

Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appeard to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Fan VFD or starter: Observed w/ Photo | No Access | Not Applicable

Observed Fan Speed:	30	Hz
Observed Fan power:		Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	

Valves: No Access

Chilled Water Valve:	2-way
Chilled Water Valve Actuator:	connected
Hot Water Valve:	N/A
Hot Water Valve Actuator:	N/A
Steam Valve:	N/A
Steam Valve Actuator:	N/A
Glycol Hot Water Valve:	N/A
Glycol Hot Water Valve Actuator:	N/A

Air Tightness: No Access

Observed holes in duct connections:	No
Door close tight:	No

Other Notes:

Energy RCX Scoping Checklist
Rush Rhees Library
Central Systems

REMOTE CONTROL

Assigned to
SDM

CENTRAL BUILDING SYSTEM CONTROLS REVIEW

Chilled Water System Control

System Seasonally Enabled: Yes | No

Chilled Water System OA enabled setpoint:	Constant/55	*if not avalible mark "N/A"*
Chilled Water System enabled date:	N/A	*if not avalible mark "N/A"*
Chilled Water System disable date:	N/A	*if not avalible mark "N/A"*

Chilled Water Pumping

Pump Setup: Building Chilled Water (Building Chilled water from district (main CHW), FCU,PAC C

What is static pressure setpoint: Con, 10

Is there a bypass valve?: No

Confirm Trends: No

Chiller Plant Logs: N/A *if not avalible mark "N/A"*

Heating System Control

System Seasonally Enabled: Yes | No

Heating System OA enabled setpoint:	Constant	*if not avalible mark "N/A"*
Heating System enabled date:	N/A	*if not avalible mark "N/A"*
Heating System disable date:	N/A	*if not avalible mark "N/A"*

Hot Water System: Yes

Pump Setup: Building Hot Water (HW Radiant 1, Radiant 2 Appogee)

What is static pressure setpoint: Constant

Is there a bypass valve?: Yes | No

Steam System: Yes

Steam System Pressure Setpoint: 1.5 *PSIG* 6.39 Actual

Confirm Trends: No

Boiler Plant Logs: No *if not avalible mark "N/A"*

Building occupancy Schedule	8am-10pm
BAS occupancy Schedule	24/7

Energy RCX Scoping Checklist

Rush Rhees Library

Central Systems

FIELD SURVEY

Assigned to: SDM

CENTRAL BUILDING SYSTEM CONTROLS REVIEW

Field Audit

Chilled Water Primary Pumps: Observed/ Main CHW no pumps from district loop

Observed Speed: Hz

Observed power: Amp or kW

Is the drive in hand or bypass: N/A

Is the starter in hand or bypass: N/A

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Chilled Water FCU/PAC Pumps: Observed w/ Photo | No Access | Not Applicable

Observed Speed: 33.9 Hz

Observed power: Amp or kW

Is the drive in hand or bypass: No

Is the starter in hand or bypass: No

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Hot Water Primary Pumps: Observed Constant Speed

Observed Speed: 60 Hz

Observed power: Amp or kW

Is the drive in hand or bypass: No

Is the starter in hand or bypass: No

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Hot Water Seconday Pumps: Not Applicable

Observed Speed: Hz

Observed power: Amp or kW

Is the drive in hand or bypass: No

Is the starter in hand or bypass: No

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Cond. Water Pumps: Not Applicable

Observed Speed: Hz

Observed power: Amp or kW

Is the drive in hand or bypass: Yes | No

Is the starter in hand or bypass: Yes | No

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Energy RCX Scoping Checklist
Site Information

Project Name	Building Name
Rochester RCX Scoping	Danforth Dining

Building Type	Year Built
Dinning Hall	Renovated 2011

Gross Area	No. Stories
35,128	1

Space Types	Initial Walk-Through Date:
Kitchen	4/13/2021
Offices	
Cafateria	

Key Contacts

Name	Richard D. Stein	
Title/Role	Assistant Director Building Controls	
Phone	585.275.2432	
Email	rstein8@facilities.rochester.edu	

Notes

Building has Chilled water for WIC/WIF.

Energy RCX Scoping Checklist
Danforth Dining

Pre Audit	Assigned to
☑ Introduciton to Client	JGD
☑ Initial Visit Scheduled 2 weeks in advance	JGD
☑ Pull-in Checklists & Templates	JGD
☑ Floor Plans Downloaded	SDM
☐ Utility Data Downloaded	JGD
☐ Utility Analysis Completed	JGD
☐ Mechanical Plans and Schedules Downloaded	N/A
Offsite Work (Prep)	
☐ Mechanical Equipment Schedules Reviewed	N/A
☐ Site Facility Interview	JGD
☐ Request Trend Data	SDM
☐ Review Trend Data	SDM
☐ Benchmark Buildings	XYZ

Control System Summary

Type: DDC

Manufacturer: Siemens

Trending: N

Trending: N

Qualitative Sensor Review: Verify temperature sensors are reading accurately (this is done by looking at BMS readings and seeing if they are reasonable based upon the unit's operation)

AHU Qualitative Review Completed

Chilled Water Qualitative Review Completed

Hot Water Qualitative Review Completed

AHU Qualitative Review Completed

Energy RCX Scoping Checklist

Danforth Dining

AHU-1

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

Kitchen/Cafeteria/Offices

Control System Type

Type: DDC

Manufacturer: Siemens

Trending: N

Unit Configuration

AHU Type: VAV

Return Air Type: Return Air Unit Currently running as 100% OA for Covid

Fans: Supply | Return

Heat Recovery Coil: None

Preheat Coil: Hot Water

Reheat Coil:

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? Yes

Schedule

Schedule Type: Unknown

HVAC Schedule M - F:	Unknown	on	Unknown	off
HVAC Schedule S - S:	Unknown	on	Unknown	off
Space Schedule M - F:	Unknown	on	Unknown	off
Space Schedule S - S:	Unknown	on	Unknown	off

Existing Optimal Start: Unknown

Tend of unit status: No   Screen Shot of Trend: No

Fan Speed control

Constant Speed: Yes   (If Yes, End of section)

Speed Control: VFD

What is static pressure setpoint versus unit external capacity: 0.43

Review trend of fan speed avalible: No

Does the Fan speed modulate more than 10%?: Unknown

Observed Fan speed HIGH:		hz		time
Observed Fan speed LOW:		hz		time

Energy RCX Scoping Checklist

Danforth Dining

AHU-1

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: DCV - Integrated with KEF

If DCV, CO2 sensor location: RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : N/A *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : N/A *if not avalible mark "N/A"*

Record Observed Points:

Date & Time	5/3/2021 12:40	
OA Damper Position:	100	*if not avalible mark "N/A"*
OA Air Flow:	29000	*if not avalible mark "N/A"*
SA Fan Speed:	83.10%	SA Fan CFM: ___ *from drawings*
OA Temp:	70	
RA Temp:	72.6	
MA Temp:	65.59	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies

SA Temp Setpoint: 55

SA Temp Base on: Unknown

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? No

		SA Temp Actual:		
Resest Temp HIGH:		F		OA Temp | RA Temp | Other
Resest Temp Low:		F		OA Temp | RA Temp | Other

Confirm Trends: No

Economizer Cycle Control

Economizer: Unknown *may need to check drawings*

Economizer Limits: Full Economizer (100% airflow)

Economizer Control Type: Unknown

Other

Dehumidificaiton Contorl: No

Humidification Contorl: No

Face & Bypass No

Energy RCX Scoping Checklist

Danforth Dining

AHU-1

FIELD SURVEY

Assigned to

SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper: Observed

Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appeard to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Return Air (RA) Damper: Observed

Observed approx damper position:	0	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appeard to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Fan VFD or starter: Observed

Observed Fan Speed:	83.31	Speed
Observed Fan power:		Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	

Valves: Observed w/ Photo | No Access | Not Applicable

Chilled Water Valve:	2-way
Chilled Water Valve Actuator:	connected
Hot Water Valve:	2-way
Hot Water Valve Actuator:	connected
Steam Valve:	N/A
Steam Valve Actuator:	N/A
Glycol Hot Water Valve:	N/A
Glycol Hot Water Valve Actuator:	N/A

Air Tightness: Observed

Observed holes in duct connections:	No
Door close tight:	No

Other Notes:

Based on Days observed Discharge air setpoint needs adjustement an to be interlocked with fin radiation

wendel

Energy RCX Scoping Checklist
Danforth Dining
Central Systems

REMOTE CONTROL

Assigned to
SDM

CENTRAL BUILDING SYSTEM CONTROLS REVIEW

Chilled Water System Control

System Seasonally Enabled: No

Chilled Water System OA enabled setpoint:	Unknown	*if not avalible mark "N/A"*
Chilled Water System enabled date:	Unknown	*if not avalible mark "N/A"*
Chilled Water System disable date:	Unknown	*if not avalible mark "N/A"*

Chilled Water Pumping

Pump Setup: Primary/Secondary Secondary is variable

What is static pressure setpoint: Unknown

Is there a bypass valve?: No

Confirm Trends: No

Chiller Plant Logs: No *if not avalible mark "N/A"*

Heating System Control

System Seasonally Enabled: Yes

Heating System OA enabled setpoint:	Unknown	*if not avalible mark "N/A"*
Heating System enabled date:	Unknown	*if not avalible mark "N/A"*
Heating System disable date:	Unknown	*if not avalible mark "N/A"*

Hot Water System: Yes

Pump Setup: Building Hot Water Variable

What is static pressure setpoint: Unknown

Is there a bypass valve?: Yes | No

Steam System: No

Steam System Pressure Setpoint: *PSIG*

Confirm Trends: No

Boiler Plant Logs: No *if not avalible mark "N/A"*

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Energy RCX Scoping Checklist

Danforth Dining

Central Systems

FIELD SURVEY

CENTRAL BUILDING SYSTEM CONTROLS REVIEW

Assigned to: SDM

Field Audit

Chilled Water Primary Pumps: Observed

Observed Speed:	0	Hz
Observed power:	0	Amp or kW
Is the drive in hand or bypass:	No	
Is the starter in hand or bypass:	No	

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Chilled Water Seconday Pumps: Observed w/ Photo | No Access | Not Applicable

Observed Speed:	0	Hz
Observed power:	0	Amp or kW
Is the drive in hand or bypass:	No	
Is the starter in hand or bypass:	No	

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Hot Water Primary Pumps: Observed w/ Photo | No Access | Not Applicable

Observed Speed:	69.74	Hz
Observed power:		Amp or kW
Is the drive in hand or bypass:	No	
Is the starter in hand or bypass:	No	

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Hot Water Seconday Pumps: ot Applicable

Observed Speed:		Hz
Observed power:		Amp or kW
Is the drive in hand or bypass:	Yes | No	
Is the starter in hand or bypass:	Yes | No	

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Cond. Water Pumps: Not Applicable

Observed Speed:		Hz
Observed power:		Amp or kW
Is the drive in hand or bypass:	Yes | No	
Is the starter in hand or bypass:	Yes | No	

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

wendel

Energy RCX Scoping Checklist

Site Information

Project Name	**Building Name**
Rochester RCX Scoping	Fredrick Douglass Commons
Building Type	**Year Built**
Classrom/ Kitchen and Common are	1950
Gross Area	**No. Stories**
89,151	4
Space Types	**Initial Walk-Through Date:**
Kitchen	4/13/2021
Dining	
Office	

Key Contacts

Name	Richard D. Stein	
Title/Role	Assistant Director Building Controls	
Phone	585.275.2432	
Email	rstein8@facilities.rochester.edu	

Notes

Energy RCX Scoping Checklist

Fredrick Douglass Commons

Pre Audit	Assigned to
☑ Introduciton to Client	JGD
☑ Initial Visit Scheduled 2 weeks in advance	JGD
☑ Pull-in Checklists & Templates	JGD
☑ Floor Plans Downloaded	SDM
☐ Utility Data Downloaded	JGD
☐ Utility Analysis Completed	JGD
☐ Mechanical Plans and Schedules Downloaded	N/A
Offsite Work (Prep)	
☐ Mechanical Equipment Schedules Reviewed	N/A
☐ Site Facility Interview	JGD
☐ Request Trend Data	SDM
☐ Review Trend Data	SDM
☐ Benchmark Buildings	XYZ

Control System Summary

Type: DDC

Manufacturer: Automated Logic

Trending: Y

Trending: Y

Qualitative Sensor Review: Verify temperature sensors are reading accurately (this is done by looking at BMS readings and seeing if they are reasonable based upon the unit's operation)

AHU Qualitative Review Completed

Chilled Water Qualitative Review Completed

Hot Water Qualitative Review Completed

AHU Qualitative Review Completed

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-1

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

201

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV single zone

Return Air Type: Return Air Unit

Fans: Supply

Heat Recovery Coil: None

Preheat Coil: HW Glycol

Reheat Coil:

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? before

Schedule

Schedule Type: 24/7 Covid; Occ/Unocc with fan run on call for conditioning

HVAC Schedule M - F:	24/7	Covid	5am-11pm	Normal
HVAC Schedule S - S:	24/7	Covid	5am-11pm	Normal
Space Schedule M - F:	7am-12am	Covid	5am-11pm	Normal
Space Schedule S - S:	7am-12am	Covid	5am-11pm	Normal

Existing Optimal Start: Yes

Tend of unit status: Yes   Screen Shot of Trend: No

Fan Speed control

Constant Speed: No   (If Yes, End of section)

Speed Control: VFD based on need for conditioning

What is static pressure setpoint versus unit external capacity: 0.75

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH: 60 hz

Observed Fan speed LOW: 60 hz

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-1

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: DCV

If DCV, CO2 sensor location: RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : 35% *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : 300 *if not avalible mark "N/A"*

750 ppm *setpoint*

Record Observed Points:

Date & Time	341 pm 5/6/21			
OA Damper Position:	100%	*if not avalible mark "N/A"*		
OA Air Flow:	1991	*if not avalible mark "N/A"*		
SA Fan Speed:	50%	SA Fan CFM:	6500	*from drawings*
OA Temp:	65.2			
RA Temp:				
MA Temp:	64			

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies - Currently overiden to heating setpoint

SA Temp Setpoint: 69.2

SA Temp Base on: space temp

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? no

SA Temp Actual: 70.9

Resest Temp HIGH:	98	F		Other
Resest Temp Low:	50	F		Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer (note air flow)

Economizer Control Type: OA DB vs zone temp

Other

Dehumidificaiton Contorl: No

Humidification Contorl: No

Face & Bypass No

Energy RCX Scoping Checklist

FIELD SURVEY

Fredrick Douglass Commons

RTU-1

AIR HANDLING SYSTEM FIELD REVIEW

Assigned to: SDM

Field Audit

Outdoor Air (OA) Damper: Observed

Observed approx damper position:	100	%open	
Is the Damper Stuck Open or Close?:	No	Open | Closed	
Do some blades appear to be not working?:	No		
Are any actuators broke / disconnected?:	No		

Return Air (RA) Damper: Observed

Observed approx damper position:	0	%open	
Is the Damper Stuck Open or Close?:	No	Open | Closed	
Do some blades appear to be not working?:	No		
Are any actuators broke / disconnected?:	No		

Fan VFD or starter: Observed

Observed Fan Speed:	30	Hz
Observed Fan power:		Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	

Valves: Observed

Chilled Water Valve:	2-way
Chilled Water Valve Actuator:	connected
Hot Water Valve:	N/A
Hot Water Valve Actuator:	N/A
Steam Valve:	N/A
Steam Valve Actuator:	N/A
Glycol Hot Water Valve:	2-way
Glycol Hot Water Valve Actuator:	connected

Air Tightness: Observed

Observed holes in duct connections:	No
Door close tight:	No

Other Notes:

SF locked below 55% because of noise

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-2

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

202

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV single zone

Return Air Type: Return Air Unit

Fans: Supply

Heat Recovery Coil: None

Preheat Coil: HW Glycol

Reheat Coil:

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? before

Schedule

Schedule Type: 24/7 Covid; Occ/Unocc with fan run on call for conditioning

HVAC Schedule M - F:	24/7	Covid	5am-11pm	Normal
HVAC Schedule S - S:	24/7	Covid	5am-11pm	Normal
Space Schedule M - F:	7am-12am	Covid	5am-11pm	Normal
Space Schedule S - S:	7am-12am	Covid	5am-11pm	Normal

Existing Optimal Start: Yes

Tend of unit status: Yes

Screen Shot of Trend: No

Fan Speed control

Constant Speed: No (If Yes, End of section)

Speed Control: VFD based on need for conditioning

What is static pressure setpoint versus unit external capacity: 0.75

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH: 60 hz

Observed Fan speed LOW: 60 hz

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-2

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: DCV

If DCV, CO2 sensor location: RA — *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : 35% — *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : 300 — *if not avalible mark "N/A"*

750 ppm *setpoint*

Record Observed Points:

Date & Time	612 pm 5/6/21	
OA Damper Position:	100%	*if not avalible mark "N/A"*
OA Air Flow:	2756	*Set point 300 cfm*
SA Fan Speed:	50%	SA Fan CFM: 6500 *from drawings*
OA Temp:	67.3	
RA Temp:		
MA Temp:	63.3	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies - Currently overiden to heating setpoint

SA Temp Setpoint: 60.7

SA Temp Base on: space temp

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? no

SA Temp Actual: 59.6

Resest Temp HIGH:	98	F		Other
Resest Temp Low:	50	F		Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer (note air flow)

Economizer Control Type: OA DB vs zone temp

Other

Dehumidificaiton Contorl: No

Humidification Contorl: No

Face & Bypass No

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-2

FIELD SURVEY

Assigned to

SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper: Observed

Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Return Air (RA) Damper: Observed

Observed approx damper position:	0	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Fan VFD or starter: Observed

Observed Fan Speed:	30	Hz
Observed Fan power:		Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	

Valves: Observed

Chilled Water Valve:	2-way
Chilled Water Valve Actuator:	connected
Hot Water Valve:	N/A
Hot Water Valve Actuator:	N/A
Steam Valve:	N/A
Steam Valve Actuator:	N/A
Glycol Hot Water Valve:	2-way
Glycol Hot Water Valve Actuator:	connected

Air Tightness: Observed

Observed holes in duct connections:	No
Door close tight:	No

Other Notes:

SF locked below 55% because of noise

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-3

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

203

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV single zone

Return Air Type: Return Air Unit

Fans: Supply

Heat Recovery Coil: None

Preheat Coil: HW Glycol

Reheat Coil:

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? before

Schedule

Schedule Type: 24/7 Covid; Occ/Unocc with fan run on call for conditioning

HVAC Schedule M - F:	24/7	Covid	5am-11pm	Normal
HVAC Schedule S - S:	24/7	Covid	5am-11pm	Normal
Space Schedule M - F:	7am-12am	Covid	5am-11pm	Normal
Space Schedule S - S:	7am-12am	Covid	5am-11pm	Normal

Existing Optimal Start: Yes

Tend of unit status: Yes   Screen Shot of Trend: No

Fan Speed control

Constant Speed: No   (If Yes, End of section)

Speed Control: VFD based on need for conditioning

What is static pressure setpoint versus unit external capacity: 0.75

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH: 60 hz

Observed Fan speed LOW: 60 hz

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-3

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: DCV

If DCV, CO2 sensor location: RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : 35% *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : 300 *if not avalible mark "N/A"*

750 ppm *setpoint*

Record Observed Points:

Date & Time	612 pm 5/6/21	
OA Damper Position:	100%	*if not avalible mark "N/A"*
OA Air Flow:	2756	*Set point 300 cfm*
SA Fan Speed:	50%	SA Fan CFM: 6500 *from drawings*
OA Temp:	60.5	
RA Temp:		
MA Temp:	53.3	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies - Currently overiden to heating setpoint

SA Temp Setpoint: 57.2

SA Temp Base on: space temp

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? no

SA Temp Actual: 58.5

Resest Temp HIGH:	98	F		Other
Resest Temp Low:	50	F		Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer (note air flow)

Economizer Control Type: OA DB vs zone temp

Other

Dehumidificaiton Contorl: No

Humidification Contorl: No

Face & Bypass No

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-3

FIELD SURVEY

Assigned to

SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper: Observed			
Observed approx damper position:	100	%open	
Is the Damper Stuck Open or Close?:	No	Open | Closed	
Do some blades appear to be not working?:	No		
Are any actuators broke / disconnected?:	No		
Return Air (RA) Damper: Observed			
Observed approx damper position:	0	%open	
Is the Damper Stuck Open or Close?:	No	Open | Closed	
Do some blades appear to be not working?:	No		
Are any actuators broke / disconnected?:	No		
Fan VFD or starter: Observed			
Observed Fan Speed:	30	Hz	
Observed Fan power:		Amp or kW	
Is the drive in hand or bypass	No		
Is the starter in hand or bypass	No		
Valves: Observed			
Chilled Water Valve:	2-way		
Chilled Water Valve Actuator:	connected		
Hot Water Valve:	N/A		
Hot Water Valve Actuator:	N/A		
Steam Valve:	N/A		
Steam Valve Actuator:	N/A		
Glycol Hot Water Valve:	2-way		
Glycol Hot Water Valve Actuator:	connected		
Air Tightness: Observed			
Observed holes in duct connections:	No		
Door close tight:	No		

Other Notes:

SF locked below 55% because of noise

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-4

REMOTE CONTROL

Assigned to

SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

204

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV single zone

Return Air Type: Return Air Unit

Fans: Supply

Heat Recovery Coil: None

Preheat Coil: HW Glycol

Reheat Coil:

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? before

Schedule

Schedule Type: 24/7 Covid; Occ/Unocc with fan run on call for conditioning

HVAC Schedule M - F:	24/7	Covid	5am-11pm	Normal
HVAC Schedule S - S:	24/7	Covid	5am-11pm	Normal
Space Schedule M - F:	7am-12am	Covid	5am-11pm	Normal
Space Schedule S - S:	7am-12am	Covid	5am-11pm	Normal

Existing Optimal Start: Yes

Tend of unit status: Yes   Screen Shot of Trend: No

Fan Speed control

Constant Speed: No   (If Yes, End of section)

Speed Control: VFD based on need for conditioning

What is static pressure setpoint versus unit external capacity: 0.75

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH: 60 hz

Observed Fan speed LOW: 60 hz

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-4

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: DCV

If DCV, CO2 sensor location: RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : 35% *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : 300 *if not avalible mark "N/A"*

Record Observed Points: 750 ppm *setpoint*

Date & Time	612 pm 5/6/21	
OA Damper Position:	65%	*if not avalible mark "N/A"*
OA Air Flow:	2726	*Set point 300 cfm*
SA Fan Speed:	50%	SA Fan CFM: 6500 *from drawings*
OA Temp:	59.4	
RA Temp:		
MA Temp:	54.5	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies - Currently overiden to heating setpoint

SA Temp Setpoint: 68.5

SA Temp Base on: space temp

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? no

SA Temp Actual: 70.5

Resest Temp HIGH:	98	F		Other
Resest Temp Low:	50	F		Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer (note air flow)

Economizer Control Type: OA DB vs zone temp

Other

Dehumidificaiton Contorl: No

Humidification Contorl: No

Face & Bypass No

Energy RCX Scoping Checklist

Fredrick Douglass Commons

RTU-4

FIELD SURVEY

Assigned to

SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper: Observed

Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Return Air (RA) Damper: Observed

Observed approx damper position:	0	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Fan VFD or starter: Observed

Observed Fan Speed:	30	Hz
Observed Fan power:		Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	

Valves: Observed

Chilled Water Valve:	2-way
Chilled Water Valve Actuator:	connected
Hot Water Valve:	N/A
Hot Water Valve Actuator:	N/A
Steam Valve:	N/A
Steam Valve Actuator:	N/A
Glycol Hot Water Valve:	2-way
Glycol Hot Water Valve Actuator:	connected

Air Tightness: Observed

Observed holes in duct connections:	No
Door close tight:	No

Other Notes:

SF locked below 55% because of noise

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-1

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

First Floor

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV hw reheat

Return Air Type: Return Air Unit

Fans: Supply | Return

Heat Recovery Coil: None

Preheat Coil: HW Glycol

Reheat Coil:

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? before

Schedule

Schedule Type: 24/7

HVAC Schedule M - F:	24/7	Covid	24/7	Normal
HVAC Schedule S - S:	24/7	Covid	24/7	Normal
Space Schedule M - F:	7am-12am	Covid	7am-12am	Normal
Space Schedule S - S:	7am-12am	Covid	7am-12am	Normal

Existing Optimal Start: Yes

Tend of unit status: Yes

Screen Shot of Trend: No

Fan Speed control

Constant Speed: No (If Yes, End of section)

Speed Control: VFD

What is static pressure setpoint versus unit external capacity: 1.6

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH: 60 hz

Observed Fan speed LOW: 60 hz

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-1

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: Time of Day

If DCV, CO2 sensor location: Space | RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : N/A *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : N/A *if not avalible mark "N/A"*

Record Observed Points:

Date & Time	341 pm 5/6/21	
OA Damper Position:	65%	*if not avalible mark "N/A"*
OA Air Flow:	26073	*if not avalible mark "N/A"*
SA Fan Speed:	100%	SA Fan CFM: 26000 *from drawings*
OA Temp:	59.7	
RA Temp:	71.1	
MA Temp:	64	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies - Currently overiden to heating setpoint

SA Temp Setpoint: 65

SA Temp Base on: space temp

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? no

SA Temp Actual: 65

Resest Temp HIGH:	65	F		Other
Resest Temp Low:	55	F		Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer (note air flow)

Economizer Control Type: OA DB vs RA DB

Other

Dehumidificaiton Contorl: No

Humidification Contorl: No

Face & Bypass No

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-1

FIELD SURVEY

Assigned to: SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper: Observed

Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Return Air (RA) Damper: Observed

Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Fan VFD or starter: Observed

Observed Fan Speed:	60	Hz
Observed Fan power:	N/A	Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	

Valves: Observed

Chilled Water Valve:	2-way
Chilled Water Valve Actuator:	connected
Hot Water Valve:	N/A
Hot Water Valve Actuator:	N/A
Steam Valve:	N/A
Steam Valve Actuator:	N/A
Glycol Hot Water Valve:	2-way
Glycol Hot Water Valve Actuator:	connected

Air Tightness: Observed

Observed holes in duct connections:	No
Door close tight:	No

Other Notes:

Vav under control have RH randomly overiden

Energy RCX Scoping Checklist
Fredrick Douglass Commons
AHU-2

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

First Floor

Control System Type

Type: DDC
Manufacturer: utomated Logic
Trending: Y

Unit Configuration

AHU Type: VAV hw reheat
Return Air Type: Return Air Unit
Fans: Supply | Return
Heat Recovery Coil: None
Preheat Coil: HW Glycol
Reheat Coil:
Cooling Coil: Chilled Water
Is Heating Coil Before or After Cooling Coil? before

Schedule

Schedule Type: 24/7

HVAC Schedule M - F:	24/7	Covid	24/7	Normal
HVAC Schedule S - S:	24/7	Covid	24/7	Normal
Space Schedule M - F:	7am-12am	Covid	7am-12am	Normal
Space Schedule S - S:	7am-12am	Covid	7am-12am	Normal

Existing Optimal Start: Yes
Tend of unit status: Yes   Screen Shot of Trend: No

Fan Speed control

Constant Speed: No   (If Yes, End of section)
Speed Control: VFD
What is static pressure setpoint versus unit external capacity: 1.3
Review trend of fan speed avalible: Yes
Does the Fan speed modulate more than 10%?: Yes
Observed Fan speed HIGH: 60 hz
Observed Fan speed LOW: 60 hz

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-2

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: Time of Day

If DCV, CO2 sensor location: Space | RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : N/A *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : N/A *if not avalible mark "N/A"*

Record Observed Points:

Date & Time	355 pm 5/6/21	
OA Damper Position:	100%	*if not avalible mark "N/A"*
OA Air Flow:	15308	*if not avalible mark "N/A"*
SA Fan Speed:	100%	SA Fan CFM: 20435 *from drawings*
OA Temp:	60	
RA Temp:	70.2	
MA Temp:	57.2	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies -

SA Temp Setpoint: 55

SA Temp Base on: space temp

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? no

SA Temp Actual: 55

Resest Temp HIGH:	68	F		Other
Resest Temp Low:	55	F		Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer

Economizer Control Type: OA DB vs RA DB

Other

Dehumidificaiton Contorl: No

Humidification Contorl: No

Face & Bypass No

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-2

FIELD SURVEY

Assigned to

SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper:	Observed	
Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appeard to be not working?:	No	
Are any actuators broke / disconnected?:	No	
Return Air (RA) Damper:	Observed	
Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appeard to be not working?:	No	
Are any actuators broke / disconnected?:	No	
Fan VFD or starter:	Observed	
Observed Fan Speed:	60	Hz
Observed Fan power:	N/A	Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	
Valves:	Observed	
Chilled Water Valve:	2-way	
Chilled Water Valve Actuator:	connected	
Hot Water Valve:	N/A	
Hot Water Valve Actuator:	N/A	
Steam Valve:	N/A	
Steam Valve Actuator:	N/A	
Glycol Hot Water Valve:	2-way	
Glycol Hot Water Valve Actuator:	connected	
Air Tightness:	Observed	
Observed holes in duct connections:	No	
Door close tight:	No	

Other Notes:

Vav under control have RH randomly overiden

REMOTE CONTROL

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-3

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

Second Floor

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV hw reheat

Return Air Type: Return Air Unit

Fans: Supply | Return

Heat Recovery Coil: None

Preheat Coil: HW Glycol

Reheat Coil:

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? before

Schedule

Schedule Type: 24/7

HVAC Schedule M - F:	24/7	Covid	24/7	Normal
HVAC Schedule S - S:	24/7	Covid	24/7	Normal
Space Schedule M - F:	7am-12am	Covid	7am-12am	Normal
Space Schedule S - S:	7am-12am	Covid	7am-12am	Normal

Existing Optimal Start: Yes

Tend of unit status: Yes   Screen Shot of Trend: No

Fan Speed control

Constant Speed: No   (If Yes, End of section)

Speed Control: VFD

What is static pressure setpoint versus unit external capacity: 1.3

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH: 58 hz

Observed Fan speed LOW: 58 hz

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-3

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: Time of Day

If DCV, CO2 sensor location: Space | RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : N/A *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : N/A *if not avalible mark "N/A"*

Record Observed Points:

Date & Time	355 pm 5/6/21	
OA Damper Position:	60%	*if not avalible mark "N/A"*
OA Air Flow:	20699	*From BAS*
SA Fan Speed:	98%	SA Fan CFM: 19000 *from drawings*
OA Temp:	60	
RA Temp:	70.6	
MA Temp:	63.5	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies -

SA Temp Setpoint: 58

SA Temp Base on: space temp

Is setpoint being maintained? no

Is heating and cooling valve enabled at the same time? no

SA Temp Actual: 66.8

Resest Temp HIGH:	65 F		Other
Resest Temp Low:	58 F		Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer

Economizer Control Type: OA DB vs RA DB

Other

Dehumidificaiton Contorl: No

Humidification Contorl: No

Face & Bypass No

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-3

FIELD SURVEY

AIR HANDLING SYSTEM FIELD REVIEW

Assigned to: SDM

Field Audit

Outdoor Air (OA) Damper: Observed

Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Return Air (RA) Damper: Observed

Observed approx damper position:	100	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Fan VFD or starter: Observed

Observed Fan Speed:	58	Hz
Observed Fan power:	N/A	Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	

Valves: Observed

Chilled Water Valve:	2-way
Chilled Water Valve Actuator:	connected
Hot Water Valve:	N/A
Hot Water Valve Actuator:	N/A
Steam Valve:	N/A
Steam Valve Actuator:	N/A
Glycol Hot Water Valve:	2-way
Glycol Hot Water Valve Actuator:	connected

Air Tightness: Observed

Observed holes in duct connections:	No
Door close tight:	No

Other Notes:

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-4

REMOTE CONTROL

Assigned to

SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

Third Floor

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV hw reheat

Return Air Type: Return Air Unit

Fans: Supply | Return

Heat Recovery Coil: None

Preheat Coil: HW Glycol

Reheat Coil:

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? before

Schedule

Schedule Type: 24/7

HVAC Schedule M - F:	24/7	Covid	24/7	Normal
HVAC Schedule S - S:	24/7	Covid	24/7	Normal
Space Schedule M - F:	7am-12am	Covid	7am-12am	Normal
Space Schedule S - S:	7am-12am	Covid	7am-12am	Normal

Existing Optimal Start: Yes

Tend of unit status: Yes

Screen Shot of Trend: No

Fan Speed control

Constant Speed: No (If Yes, End of section)

Speed Control: VFD

What is static pressure setpoint versus unit external capacity: 1.3

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH: 58 hz

Observed Fan speed LOW: 58 hz

Energy RCX Scoping Checklist
Fredrick Douglass Commons
AHU-4

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: Time of Day

If DCV, CO2 sensor location: Space | RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : N/A *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : N/A *if not avalible mark "N/A"*

Record Observed Points:

Date & Time	451 pm 5/6/21	
OA Damper Position:	60%	*if not avalible mark "N/A"*
OA Air Flow:	3866	*From BAS*
SA Fan Speed:	47%	SA Fan CFM: 16100 *from drawings*
OA Temp:	61	
RA Temp:	70	
MA Temp:	58.9	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies -

SA Temp Setpoint: 62

SA Temp Base on: space temp

Is setpoint being maintained? Yes

Is heating and cooling valve enabled at the same time? no

SA Temp Actual: 61.1

Resest Temp HIGH:	62	F		Other
Resest Temp Low:	55	F		Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer

Economizer Control Type: OA DB vs RA DB

Other

Dehumidificaiton Contorl: No

Humidification Contorl: No

Face & Bypass No

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-4

FIELD SURVEY

Assigned to

SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper: Observed

Observed approx damper position:	89	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Return Air (RA) Damper: Observed

Observed approx damper position:	13	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Fan VFD or starter: Observed

Observed Fan Speed:	28	Hz
Observed Fan power:	N/A	Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	

Valves: Observed

Chilled Water Valve:	2-way
Chilled Water Valve Actuator:	connected
Hot Water Valve:	N/A
Hot Water Valve Actuator:	N/A
Steam Valve:	N/A
Steam Valve Actuator:	N/A
Glycol Hot Water Valve:	2-way
Glycol Hot Water Valve Actuator:	connected

Air Tightness: Observed

Observed holes in duct connections:	No
Door close tight:	No

Other Notes:

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-5

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

System Servces

Third Floor

Control System Type

Type: DDC

Manufacturer: utomated Logic

Trending: Y

Unit Configuration

AHU Type: VAV hw reheat

Return Air Type: Return Air Unit

Fans: Supply | Return

Heat Recovery Coil: None

Preheat Coil: HW Glycol

Reheat Coil:

Cooling Coil: Chilled Water

Is Heating Coil Before or After Cooling Coil? before

Schedule

Schedule Type: 24/7

HVAC Schedule M - F:	24/7	Covid	24/7	Normal
HVAC Schedule S - S:	24/7	Covid	24/7	Normal
Space Schedule M - F:	7am-12am	Covid	7am-12am	Normal
Space Schedule S - S:	7am-12am	Covid	7am-12am	Normal

Existing Optimal Start: Yes

Tend of unit status: Yes   Screen Shot of Trend: No

Fan Speed control

Constant Speed: No   (If Yes, End of section)

Speed Control: VFD

What is static pressure setpoint versus unit external capacity: 1.3

Review trend of fan speed avalible: Yes

Does the Fan speed modulate more than 10%?: Yes

Observed Fan speed HIGH: 58 hz

Observed Fan speed LOW: 58 hz

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-5

REMOTE CONTROL

Assigned to: SDM

AIR HANDLING SYSTEM CONTROLS REVIEW

Ventilation Control

Is the Unit 100% OA: No (If Yes, End of section)

Ventilation Control: Time of Day

If DCV, CO2 sensor location: Space | RA *if not avalible mark "N/A"*

Record minimum OA Damper position setpoint : N/A *if not avalible mark "N/A"*

Record minimum OA airflow setpoint : N/A *if not avalible mark "N/A"*

Record Observed Points:

Date & Time	451 pm 5/6/21	
OA Damper Position:	60%	*if not avalible mark "N/A"*
OA Air Flow:	4673	*From BAS*
SA Fan Speed:	78%	SA Fan CFM: 16100 *from drawings*
OA Temp:	62	
RA Temp:	70	
MA Temp:	65.6	

Confirm Trends: Yes | No

Discharge Air Temperature Control

Discharge Air Temp: Varies -

SA Temp Setpoint: 65

SA Temp Base on: space temp

Is setpoint being maintained? no

Is heating and cooling valve enabled at the same time? no

SA Temp Actual: 67.4

Resest Temp HIGH: 65 F | Other

Resest Temp Low: 55 F | Other

Confirm Trends: Yes

Economizer Cycle Control

Economizer: Yes *may need to check drawings*

Economizer Limits: Partial Economizer

Economizer Control Type: OA DB vs RA DB

Other

Dehumidificaiton Contorl: No

Humidification Contorl: No

Face & Bypass No

Energy RCX Scoping Checklist

Fredrick Douglass Commons

AHU-5

FIELD SURVEY

Assigned to

SDM

AIR HANDLING SYSTEM FIELD REVIEW

Field Audit

Outdoor Air (OA) Damper: Observed

Observed approx damper position:	32	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Return Air (RA) Damper: Observed

Observed approx damper position:	68	%open
Is the Damper Stuck Open or Close?:	No	Open | Closed
Do some blades appear to be not working?:	No	
Are any actuators broke / disconnected?:	No	

Fan VFD or starter: Observed

Observed Fan Speed:	47	Hz
Observed Fan power:	N/A	Amp or kW
Is the drive in hand or bypass	No	
Is the starter in hand or bypass	No	

Valves: Observed

Chilled Water Valve:	2-way
Chilled Water Valve Actuator:	connected
Hot Water Valve:	N/A
Hot Water Valve Actuator:	N/A
Steam Valve:	N/A
Steam Valve Actuator:	N/A
Glycol Hot Water Valve:	2-way
Glycol Hot Water Valve Actuator:	connected

Air Tightness: Observed

Observed holes in duct connections:	No
Door close tight:	No

Other Notes:

wendel

Energy RCX Scoping Checklist

Fredrick Douglass Commons

Central Systems

REMOTE CONTROL

Assigned to: SDM

CENTRAL BUILDING SYSTEM CONTROLS REVIEW

Chilled Water System Control

System Seasonally Enabled: Yes | No

Chilled Water System OA enabled setpoint:	55	*if not avalible mark "N/A"*
Chilled Water System enabled date:	N/A	*if not avalible mark "N/A"*
Chilled Water System disable date:	N/A	*if not avalible mark "N/A"*

Chilled Water Pumping

Pump Setup: Building Chilled Water Variable

What is static pressure setpoint: 7

Is there a bypass valve?: Yes

Confirm Trends: Yes | No

Chiller Plant Logs: Yes | No *if not avalible mark "N/A"*

Heating System Control

Three separate systems Perimeter/RH,Glycol,Snow Melt

System Seasonally Enabled: System Enabled by OAT

Heating System OA enabled setpoint:	85/65/40	*Perimeter/RH,Glycol,Snow Melt*
Heating System enabled date:	N/A	*if not avalible mark "N/A"*
Heating System disable date:	N/A	*if not avalible mark "N/A"*

Hot Water System: Yes

Pump Setup: Building Hot Water Variable, Variable, Fixed

What is static pressure setpoint: 15,15,10

Is there a bypass valve?: No

Steam System: No

Steam System Pressure Setpoint: N/A *PSIG*

Confirm Trends: Yes

Boiler Plant Logs: N/A *if not avalible mark "N/A"*

wendel

Energy RCX Scoping Checklist

Fredrick Douglass Commons

Central Systems

FIELD SURVEY

Assigned to

SDM

CENTRAL BUILDING SYSTEM CONTROLS REVIEW

Field Audit

Chilled Water Primary Pumps: Observed

Observed Speed:	off	Hz
Observed power:		Amp or kW
Is the drive in hand or bypass:	No	
Is the starter in hand or bypass:	No	

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Snow Melt Pumps: Observed

Observed Speed:	0	Hz
Observed power:		Amp or kW
Is the drive in hand or bypass:	Yes | No	
Is the starter in hand or bypass:	Yes | No	

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

RH/Rad Hot Water Primary Pumps: Observed

Observed Speed:	34	Hz
Observed power:		Amp or kW
Is the drive in hand or bypass:	No	
Is the starter in hand or bypass:	No	

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

HW/Glycol Water Primary Pumps: Observed

Observed Speed:	40	Hz
Observed power:		Amp or kW
Is the drive in hand or bypass:	Yes | No	
Is the starter in hand or bypass:	Yes | No	

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

Cond. Water Pumps: Not Applicable

Observed Speed:		Hz
Observed power:		Amp or kW
Is the drive in hand or bypass:	Yes | No	
Is the starter in hand or bypass:	Yes | No	

Photos: pumps / motor nameplate / pump nameplate / triple duty valve / pressure guage / starter / VFD

C RCX Initial Building List

Please find the Initial Building List on the following page.

Building Name	Building Abbreviation	Building Use
Autoclave	Autoclave	Autoclave
Kornberg Medical Research Building		Lab/Research
Del Monte Institute		Lab/Research
Hutchinson Hall	Hutchison	Lab/Classroom/Office
Morey Hall	Morey	Classroom/Office
Danforth Dining Center	Danforth Dining	Dining/Kitchen
New York State Optics	NYS Optics	Office/Lab
School of Medicine and Dentistry		Hospital
Emergency Department	Emergency Dept/PICU	Hospital
Goergen Hall for Biomedical Engineering and Optics		Classroom/Lab/Office
Taylor Hall	Taylor	Office/Machine Shop
Galisano Childrens Hospital at Strong	GCHaS	Hospital
James P. Wilmot Cancer Center, JWCC		Hospital
Ambulatory Care Facility	Ambulatory Care	Hospital
Meliora Hall	Meliora	Classroom/Office/Vivarium
Strong Memorial Hospital	SMH	Hospital
Gavett Hall	Gavett	Engineering/Offices/Lab/Classroom/Offices
Fredric Douglass Dinning Center, FDC, FDB	FDB	Kitchen/Dining/Conf. Rooms
Rettner Hall	Rettner Hall	Classroom/Office
Wilmot Building	Wilmot	Office/Classroom/Lab/Special Refrigeration Needs
Hoyt Hall	Hoyt	Auditorium/Office
Lattimore Hall	Lattimore	Classroom/Office
Wallis Hall	Wallis	Office
Medical Center Annex	Med Ctr Annex	Office/Lab
Sage Art Gallery	Sage Arts Center	Gallery/Office
Wilson Commons	Wilson Commons	Dining/Commons/Office
Levine Pavilion		Assembly/Conference
Eastman Dental Center	Eastman Dental	Medical
R-Wing	R Wing	Hospital
Interfaith Chapel	Interfaith Chapel	Assembly/Office
Hylan Building	Hylan	Classroom/Office
Computer Studies Building, Carlson Library	Comp Studies/Lib	Library/Classroom/Office/Lab
Genesee Hall	Genesee Hall	Dorm
Rush Rheese Library	Rush Rhees Libr	Library/Office/Classroom
612 Willson Blvd		Office/Maintenance
Theta Chi		Dorm
Sigma Chi		Dorm
Hoeing Hall	Hoeing	Dorm
Hopeman Engineering Building	Hopeman	Engineering/Classroom/Lab/Office
Hill Court	Hill Court	Dorm
Goergen Athletics Center (GAC), Zornow	Goergen Gym	Athletics/Gymnasium/Pool/Fieldhouse
Tiernan Hall		Dorm
East River Road Medical Building	ERR_MB	Medical
Saunders Research Building	Saunders	Lab/Research
Lovejoy Hall	Lovejoy	Dorm
Burton Hall	Burton	Dorm
Susan B. Anthony Hall	SBA	Dorm
Alpha Delta Phi	ADP Fraternity	Dorm
University Health Services	UHS	Office/Medical
Community Living Center, Quad Annex, Sigma Phi Epsilon	Sig Ep	Dorm
Schlegel Hall (Includes Gleason Wing)		Classroom/Office
Crosby Hall	Crosby	Dorm
Hellenwood Hall	Helen Wood Hall	Office/Dorm
Harkness Hall	Harkness	Engineering/Classroom/Lab/Office
Wegmans Hall	Wegmans Hall	Classroom/Office
Dewey Hall	Dewey	Classroom/Office
Gilbert Hall	Gilbert	Dorm
O'Brien Hall	O'Brien	Dorm
Goler House		Apartments
Delta Kappa Epsilon	DKE Fraternity	Dorm
Wilder Hall		Dorm
Access Center		Medical/Administration
Drama House	Drama House	Dorm
Douglass Leadership House, Delta Upsilon, Medieval House	Douglass Leadership House	Dorm
Anderson Hall	Anderson	Dorm
Strong Auditorium	Strong Auditorium	Assembly
Spurrier Gymnasium	Spurrier	Gymnasium/Classroom/Office
Bausch and Lomb Hall	Bausch & Lomb	Classroom/Lab/Office
Sigma Alpha MU		Dorm
LeChase Hall	LeChase	Classroom/Office
Psi Upsilon	Psi U Fraternity	Dorm
Todd Union	Todd Union	Office/Post Office
Fauver Stadium	Fauver	Office/Sports
University Facilities Center		Offices/Utility

Technical Appendix 5

Photovoltaic System ECM

River Campus Rooftop Solar
- Savings Summary
- Cost Estimate
- Roof Area Maps

Medical Campus Rooftop Solar
- Savings Summary
- Cost Estimate
- Roof Area Maps

South Campus Rooftop Solar
- Savings Summary
- Cost Estimate
- Roof Area Maps

Eastman Campus Rooftop Solar
- Savings Summary
- Cost Estimate
- Roof Area Maps

Technical Appendix 5 - RC

Photovoltaic System ECM

River Campus Rooftop Solar

- Savings Summary
- Cost Estimate
- Roof Area Maps

UNIVERSITY OF ROCHESTER

River Campus Rooftop Solar

Energy Conservation Measure Summary

Table 1-1

Measure Summary		
Building Level Energy Savings		
Electrical Energy Savings	16,441	mmBtu/Year
Chilled Water Savings	-	mmBtu/Year
Steam Savings	-	mmBtu/Year
Total Energy Savings	**16,441**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	4,818,644	kWh/Year
Chilled Water Savings	-	Ton-Hour/Year
Steam Savings	-	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	-$26,406	Per Year

Value Stack Calculator v 2.3, for Projects Impacted by the 2019 Value Stack Order (Qualified after 7/26/2018)

TOTAL PROJECT VALUE ($2019), BY YEAR:

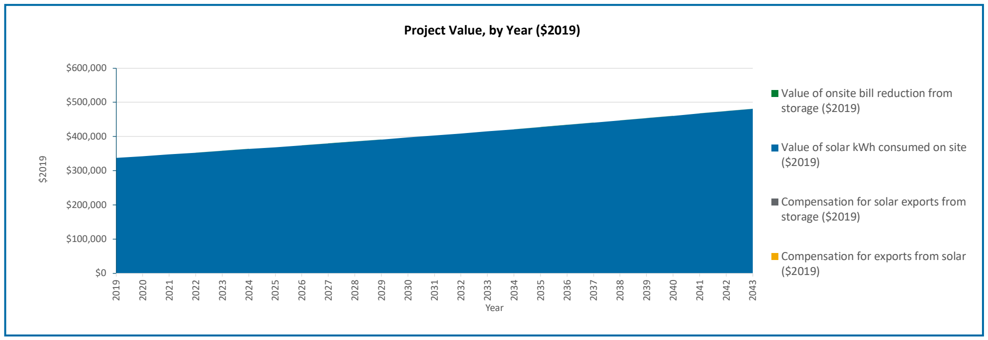
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Compensation for exports from solar ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of solar kWh consumed on site ($2019)	$ 337,305	$ 342,331	$ 347,432	$ 352,608	$ 357,862	$ 363,194	$ 368,606	$ 374,098	$ 379,672	$ 385,329	$ 391,071	$ 396,898	$ 402,812
Retail rate is taken from User Inputs Row 95													
Compensation for solar exports from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of onsite bill reduction from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bill changes from solar parasitic loads on site, at retail rate ($2019)	$ (70)	$ (71)	$ (73)	$ (74)	$ (76)	$ (77)	$ (79)	$ (80)	$ (82)	$ (84)	$ (85)	$ (87)	$ (89)
Total value of energy produced	**$ 337,235**	**$ 342,260**	**$ 347,359**	**$ 352,534**	**$ 357,787**	**$ 363,117**	**$ 368,527**	**$ 374,018**	**$ 379,590**	**$ 385,246**	**$ 390,986**	**$ 396,811**	**$ 402,723**

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Compensation for exports from solar ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of solar kWh consumed on site ($2019)	$ 408,813	$ 414,905	$ 421,087	$ 427,361	$ 433,729	$ 440,191	$ 446,750	$ 453,407	$ 460,163	$ 467,019	$ 473,978	$ 481,040
Retail rate is taken from User Inputs Row 95												
Compensation for solar exports from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of onsite bill reduction from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bill changes from solar parasitic loads on site, at retail rate ($2019)	$ (91)	$ (92)	$ (94)	$ (96)	$ (98)	$ (100)	$ (102)	$ (104)	$ (106)	$ (108)	$ (110)	$ (113)
Total value of energy produced	**$ 408,723**	**$ 414,812**	**$ 420,993**	**$ 427,265**	**$ 433,631**	**$ 440,091**	**$ 446,648**	**$ 453,303**	**$ 460,056**	**$ 466,911**	**$ 473,867**	**$ 480,927**

TOTAL PROJECT VALUE ($2019 / kWh), BY YEAR:

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Solar generation immediately exported by solar system (kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-
On-site consumption served by solar (kWh)	4,818,644	4,794,551	4,770,579	4,746,726	4,722,992	4,699,377	4,675,880	4,652,501	4,629,238	4,606,092	4,583,062	4,560,146	4,537,346
On-site parasitic load during hours with no solar generation (kWh)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Discharge from storage exported to the grid (kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-
Discharge from storage consumed by building load (kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg Compensation for exports from solar ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of solar kWh consumed on site ($2019/kWh)	$ 0.0700	$ 0.0714	$ 0.0728	$ 0.0743	$ 0.0758	$ 0.0773	$ 0.0788	$ 0.0804	$ 0.0820	$ 0.0837	$ 0.0853	$ 0.0870	$ 0.0888
Retail rate is taken from User Inputs Row 95													
Avg Compensation for solar exports from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of onsite bill reduction from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Bill changes from solar parasitic loads on site, at retail rate ($2019/kWh)	$ (0.0700)	$ (0.0714)	$ (0.0728)	$ (0.0743)	$ (0.0758)	$ (0.0773)	$ (0.0788)	$ (0.0804)	$ (0.0820)	$ (0.0837)	$ (0.0853)	$ (0.0870)	$ (0.0888)
Average Project Value, $2019 per kWh	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Solar generation immediately exported by solar system (kWh)	-	-	-	-	-	-	-	-	-	-	-	-
On-site consumption served by solar (kWh)	4,514,659	4,492,086	4,469,625	4,447,277	4,425,041	4,402,915	4,380,901	4,358,996	4,337,201	4,315,515	4,293,938	4,272,468
On-site parasitic load during hours with no solar generation (kWh)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Discharge from storage exported to the grid (kWh)	-	-	-	-	-	-	-	-	-	-	-	-
Discharge from storage consumed by building load (kWh)	-	-	-	-	-	-	-	-	-	-	-	-
Avg Compensation for exports from solar ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of solar kWh consumed on site ($2019/kWh)	$ 0.0906	$ 0.0924	$ 0.0942	$ 0.0961	$ 0.0980	$ 0.1000	$ 0.1020	$ 0.1040	$ 0.1061	$ 0.1082	$ 0.1104	$ 0.1126
Retail rate is taken from User Inputs Row 95												
Avg Compensation for solar exports from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of onsite bill reduction from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Bill changes from solar parasitic loads on site, at retail rate ($2019/kWh)	$ (0.0906)	$ (0.0924)	$ (0.0942)	$ (0.0961)	$ (0.0980)	$ (0.1000)	$ (0.1020)	$ (0.1040)	$ (0.1061)	$ (0.1082)	$ (0.1104)	$ (0.1126)
Average Project Value, $2019 per kWh	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**



MATERIAL & LABOR COST ESTIMATE

Project : University of Rochester
Project # : 402805
Measure : Rooftop Solar River Campus
Date : 04/01/21

Estimated by: SDM
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	Solar Array	1	3,904	$1,140.00	$4,450,884	$760.00	$2,967,256	$7,418,139.85
	NY Megawatt Block Rebate	1	3,904	($130.00)	($507,557)			($507,556.94)
			SUBTOTALS:	Materials:	$3,943,327	Labor:	$2,967,256	$6,910,582.91
							Asbestos Abatement Cost:	$0.00
							TOTAL:	$6,910,582.91

TOTAL DIRECT CONSTRUCTION COST:		$6,910,582.91
Engineering, Commissioning, Project & Construction Management:	15%	$1,036,587.44
SUBTOTAL:		$7,947,170.35
TOTAL:		$7,947,170.35

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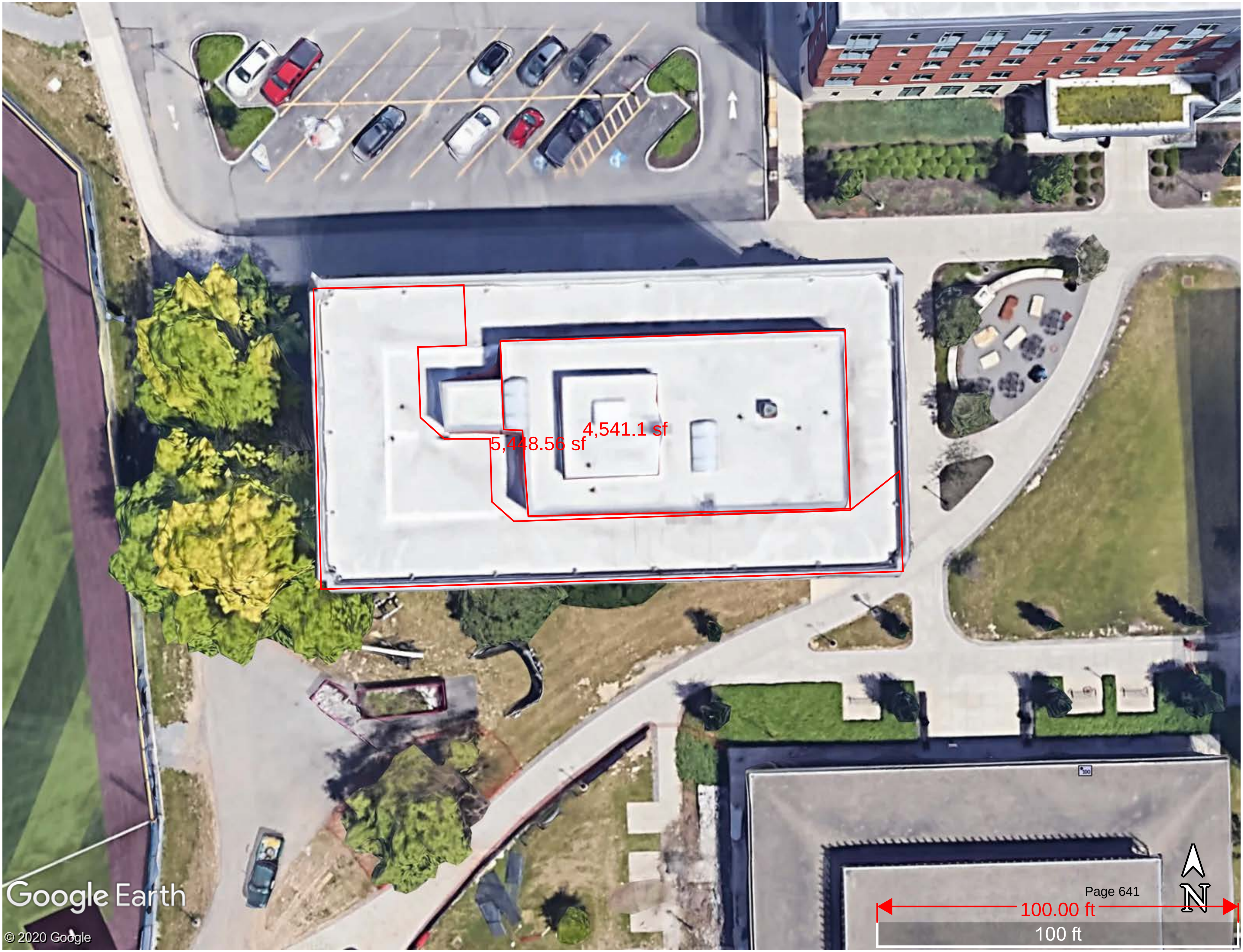

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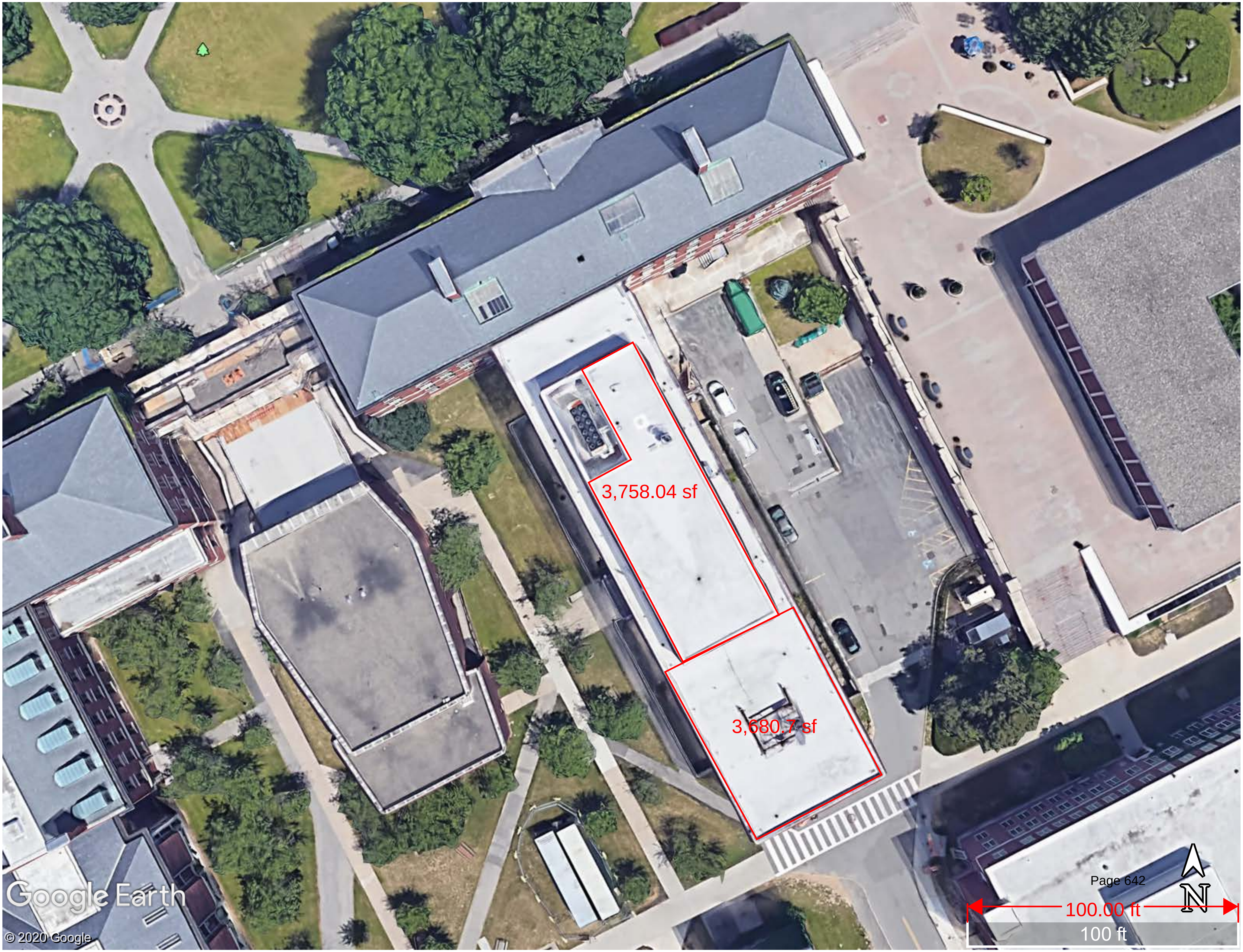

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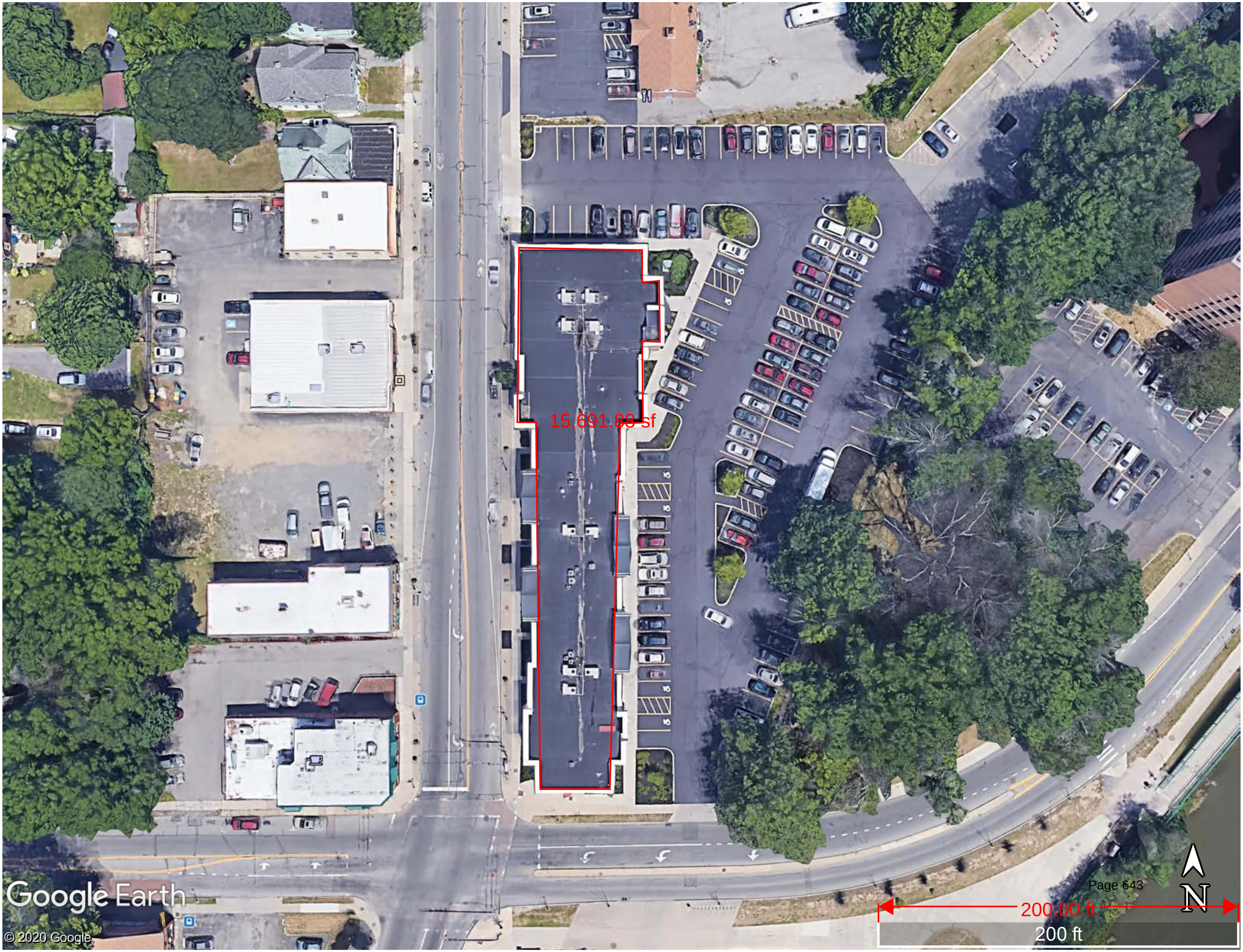

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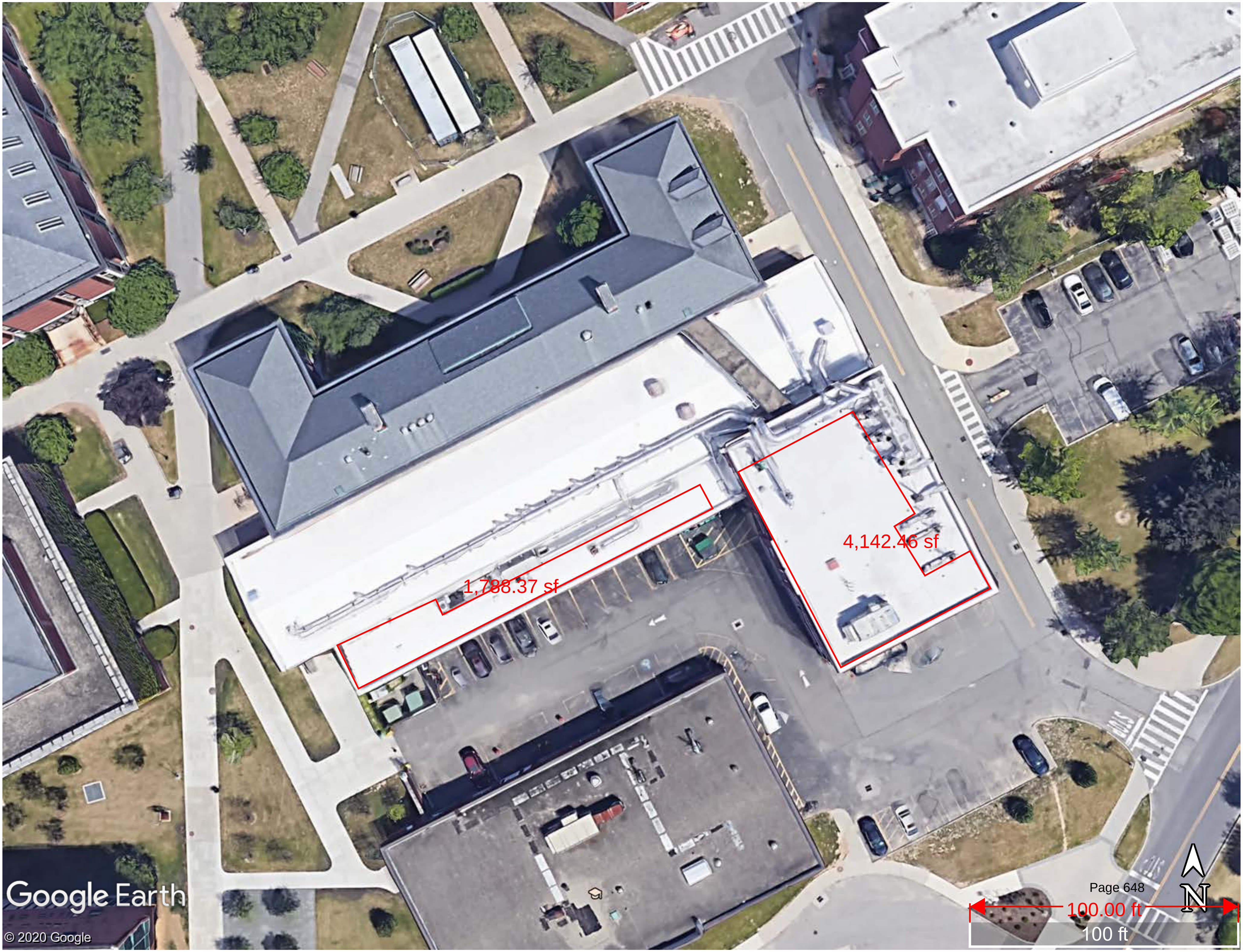
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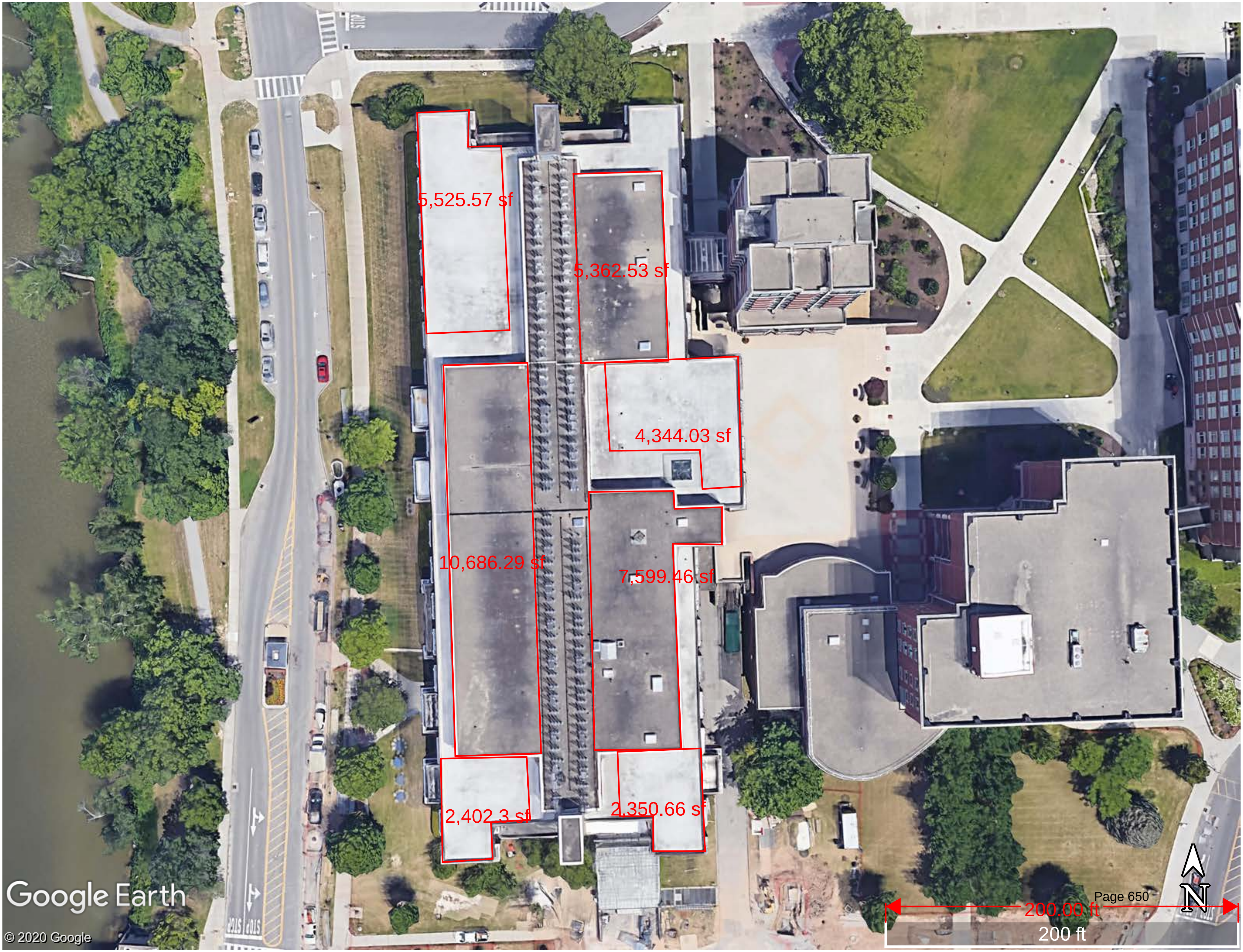

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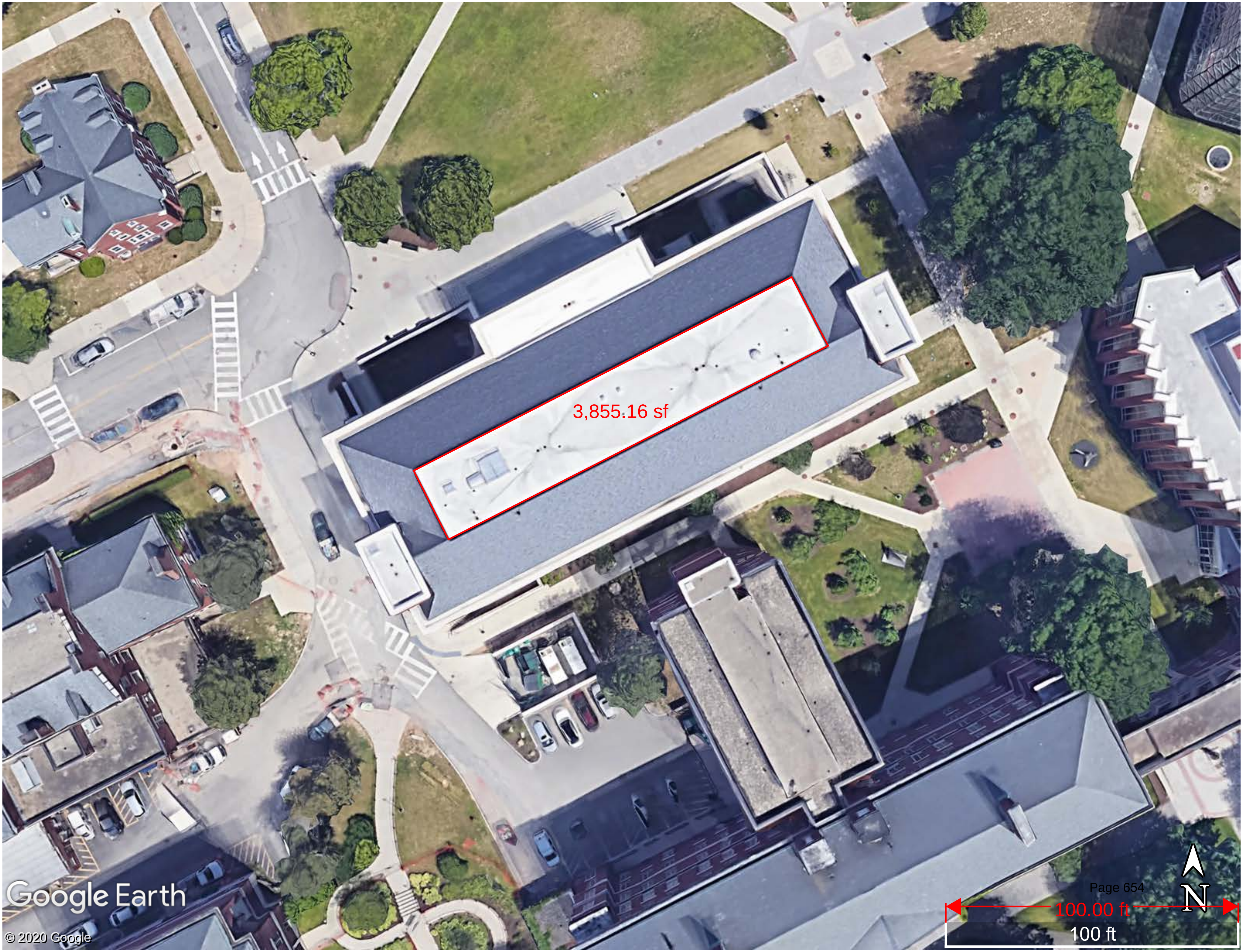
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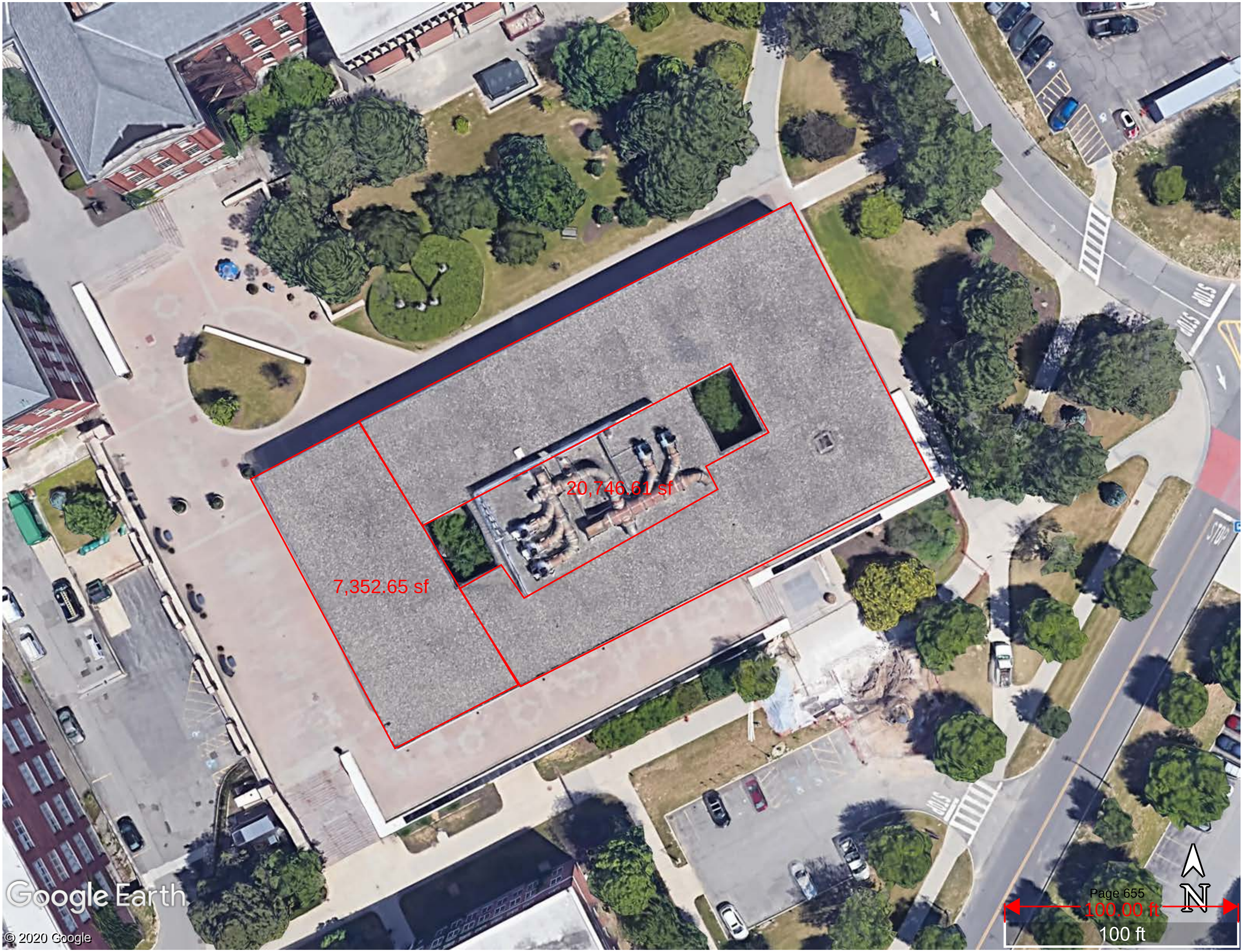

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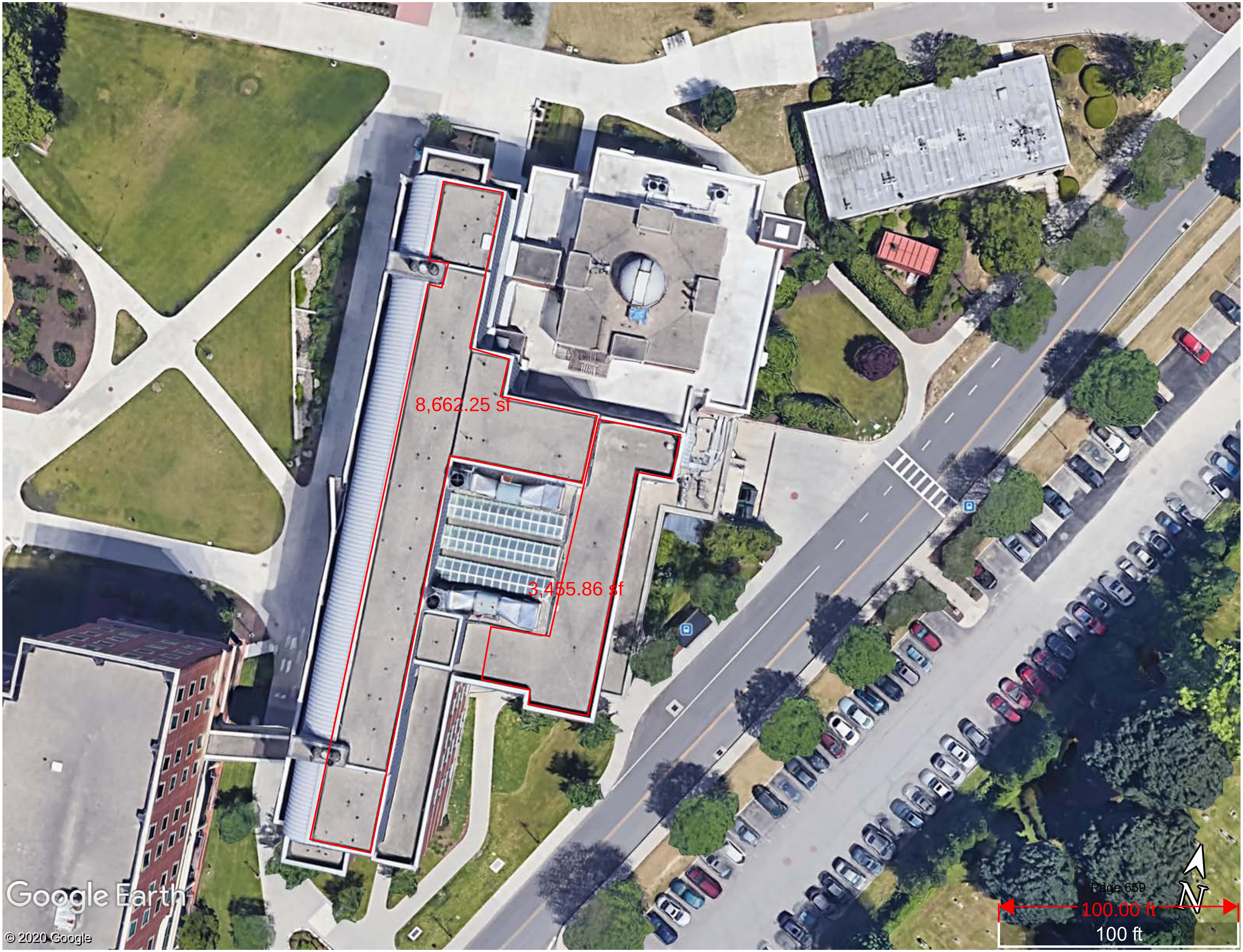
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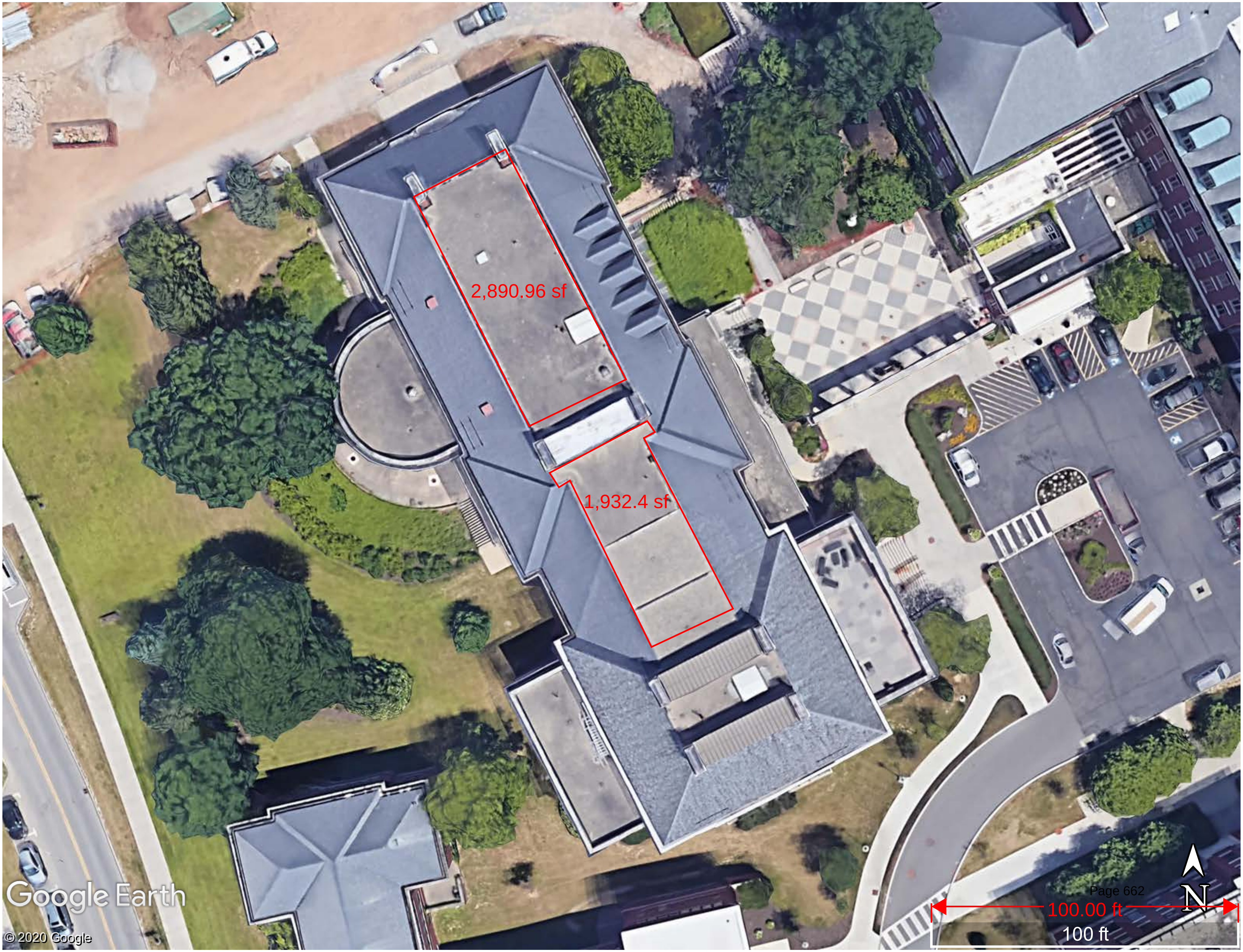

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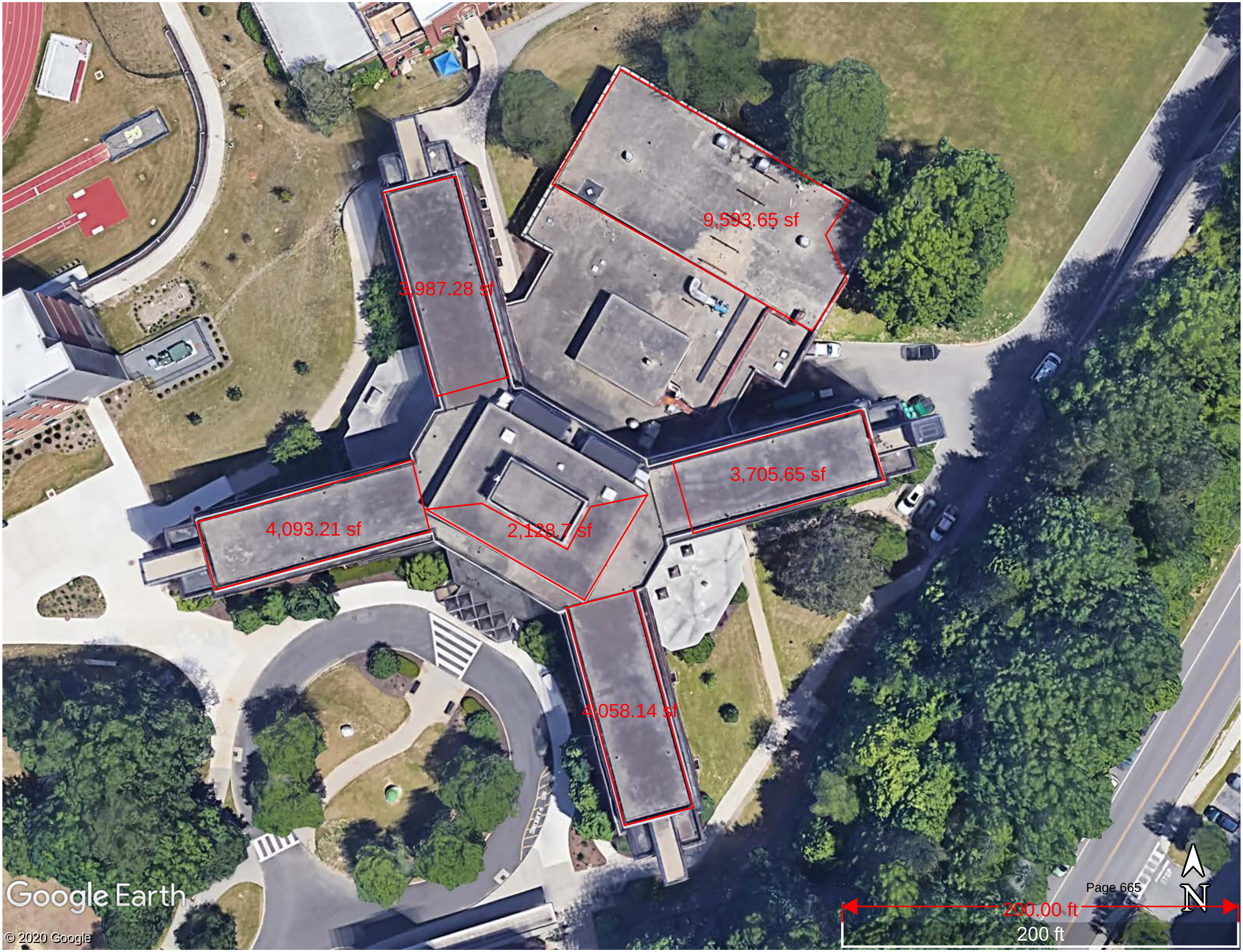

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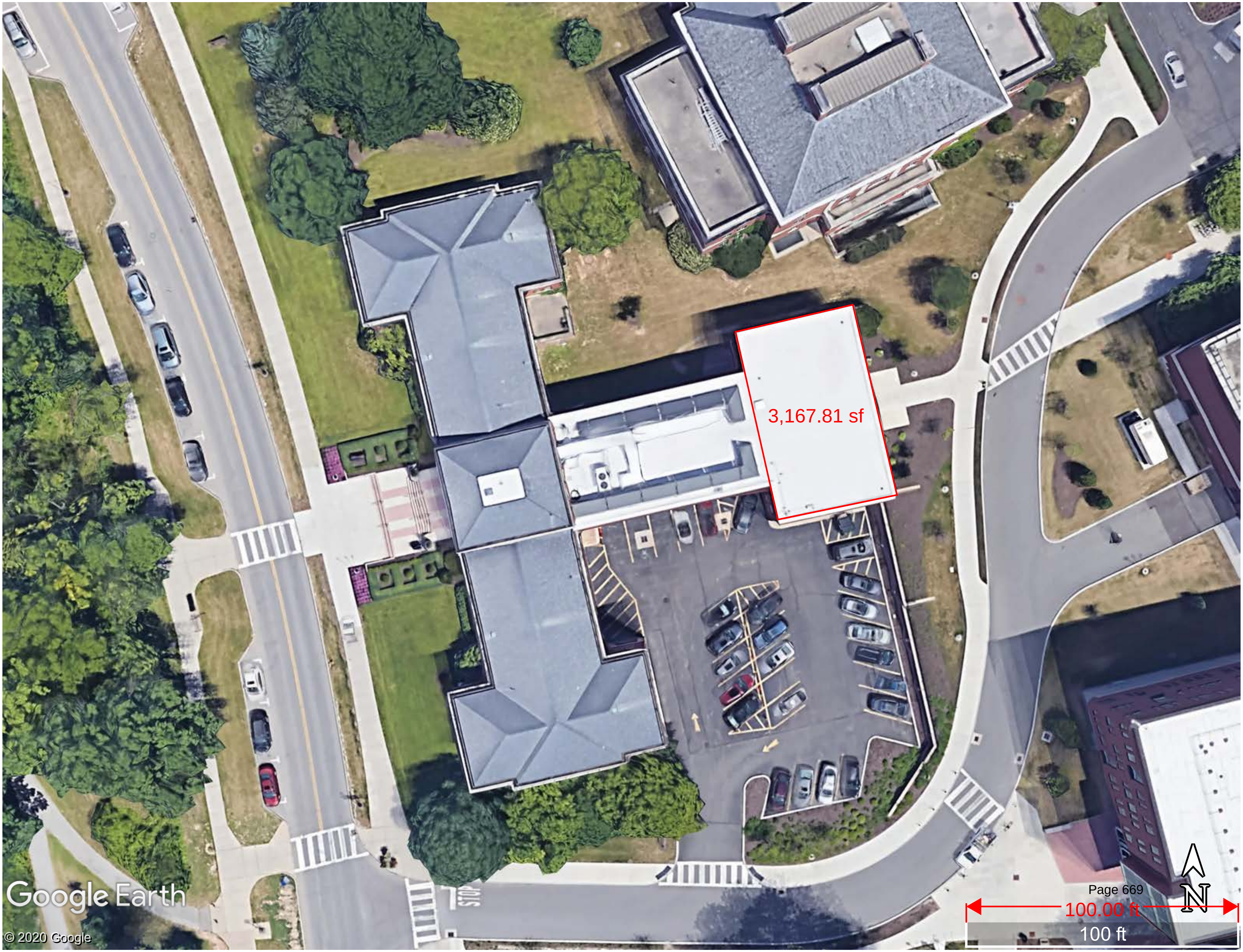

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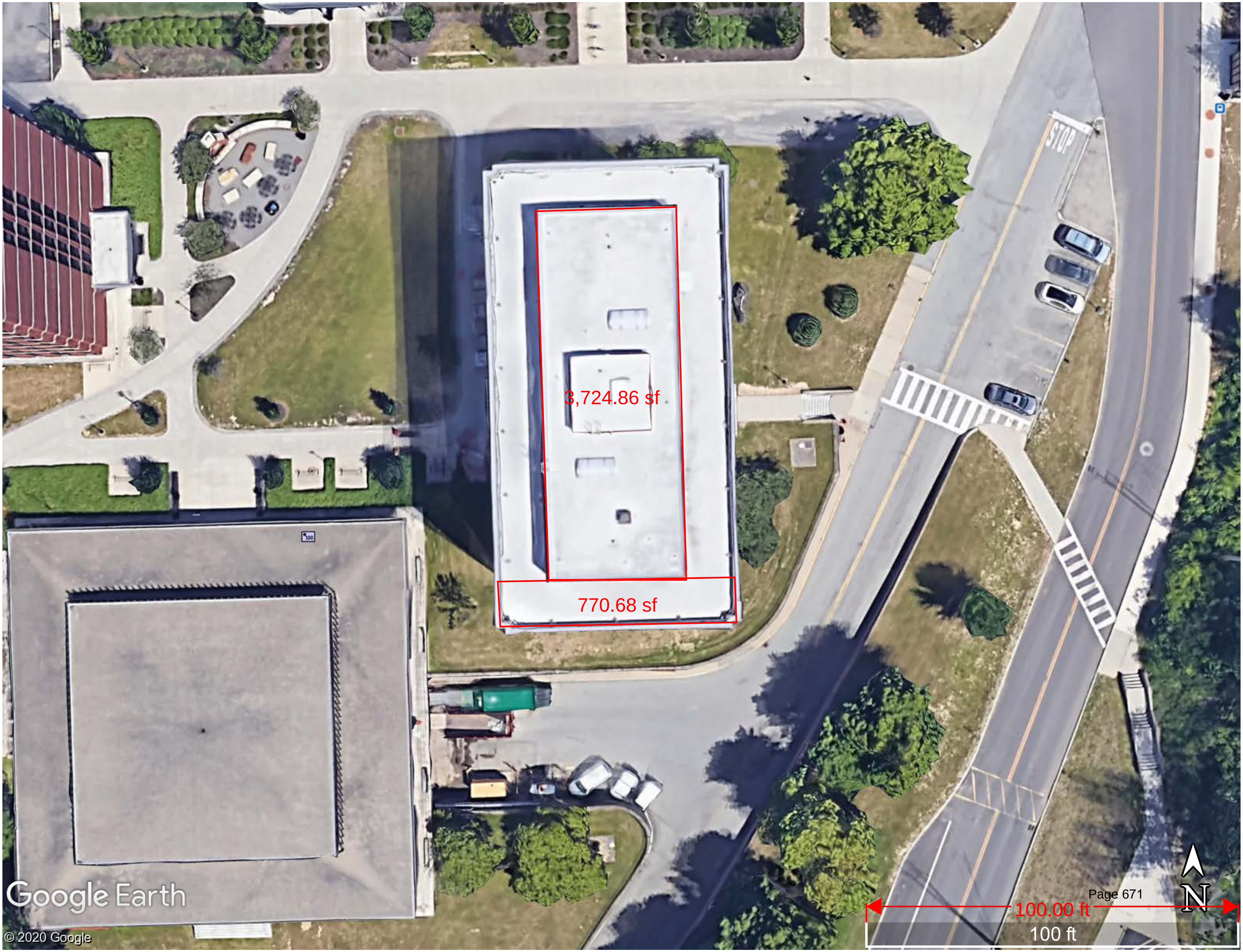
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Google Earth
© 2020 Google

Technical Appendix 5 - MC

Photovoltaic System ECM

Medical Campus Rooftop Solar

- Savings Summary
- Cost Estimate
- Roof Area Maps

UNIVERSITY OF ROCHESTER
Medical Campus Rooftop Solar

Energy Conservation Measure Summary

Table 1-1

Measure Summary		
Building Level Energy Savings		
Electrical Energy Savings	20,150	mmBtu/Year
Chilled Water Savings	-	mmBtu/Year
Steam Savings	-	mmBtu/Year
Total Energy Savings	**20,150**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	5,905,583	kWh/Year
Chilled Water Savings	-	Ton-Hour/Year
Steam Savings	-	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	-$32,362	Per Year

Value Stack Calculator v 2.3, for Projects Impacted by the 2019 Value Stack Order (Qualified after 7/26/2018)

TOTAL PROJECT VALUE ($2019), BY YEAR:

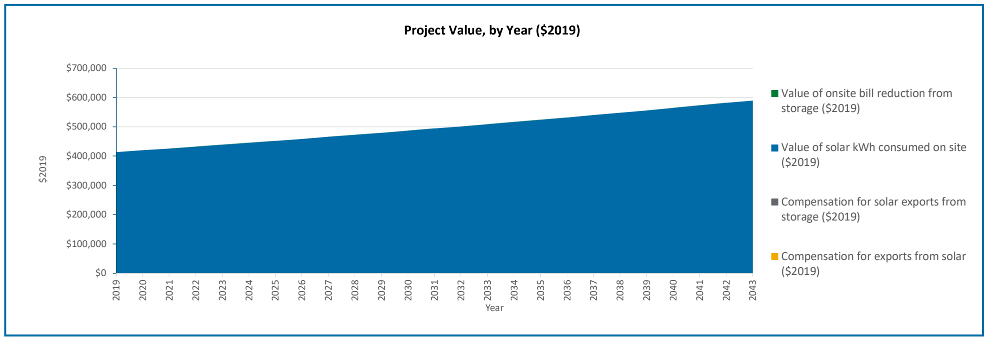
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Compensation for exports from solar ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of solar kWh consumed on site ($2019)	$ 413,391	$ 419,550	$ 425,802	$ 432,146	$ 438,585	$ 445,120	$ 451,752	$ 458,483	$ 465,315	$ 472,248	$ 479,284	$ 486,426	$ 493,674
Retail rate is taken from User Inputs Row 95													
Compensation for solar exports from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of onsite bill reduction from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bill changes from solar parasitic loads on site, at retail rate ($2019)	$ (70)	$ (71)	$ (73)	$ (74)	$ (76)	$ (77)	$ (79)	$ (80)	$ (82)	$ (84)	$ (85)	$ (87)	$ (89)
Total value of energy produced	**$ 413,321**	**$ 419,479**	**$ 425,729**	**$ 432,072**	**$ 438,509**	**$ 445,043**	**$ 451,673**	**$ 458,403**	**$ 465,233**	**$ 472,164**	**$ 479,199**	**$ 486,339**	**$ 493,585**

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Compensation for exports from solar ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of solar kWh consumed on site ($2019)	$ 501,029	$ 508,495	$ 516,071	$ 523,761	$ 531,565	$ 539,485	$ 547,523	$ 555,681	$ 563,961	$ 572,364	$ 580,892	$ 589,548
Retail rate is taken from User Inputs Row 95												
Compensation for solar exports from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of onsite bill reduction from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bill changes from solar parasitic loads on site, at retail rate ($2019)	$ (91)	$ (92)	$ (94)	$ (96)	$ (98)	$ (100)	$ (102)	$ (104)	$ (106)	$ (108)	$ (110)	$ (113)
Total value of energy produced	**$ 500,939**	**$ 508,402**	**$ 515,977**	**$ 523,665**	**$ 531,467**	**$ 539,385**	**$ 547,421**	**$ 555,577**	**$ 563,855**	**$ 572,256**	**$ 580,782**	**$ 589,435**

TOTAL PROJECT VALUE ($2019 / kWh), BY YEAR:

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Solar generation immediately exported by solar system (kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-
On-site consumption served by solar (kWh)	5,905,583	5,876,056	5,846,675	5,817,442	5,788,355	5,759,413	5,730,616	5,701,963	5,673,453	5,645,086	5,616,860	5,588,776	5,560,832
On-site parasitic load during hours with no solar generation (kWh)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Discharge from storage exported to the grid (kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-
Discharge from storage consumed by building load (kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg Compensation for exports from solar ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of solar kWh consumed on site ($2019/kWh)	$ 0.0700	$ 0.0714	$ 0.0728	$ 0.0743	$ 0.0758	$ 0.0773	$ 0.0788	$ 0.0804	$ 0.0820	$ 0.0837	$ 0.0853	$ 0.0870	$ 0.0888
Retail rate is taken from User Inputs Row 95													
Avg Compensation for solar exports from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of onsite bill reduction from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Bill changes from solar parasitic loads on site, at retail rate ($2019/kWh)	$ (0.0700)	$ (0.0714)	$ (0.0728)	$ (0.0743)	$ (0.0758)	$ (0.0773)	$ (0.0788)	$ (0.0804)	$ (0.0820)	$ (0.0837)	$ (0.0853)	$ (0.0870)	$ (0.0888)
Average Project Value, $2019 per kWh	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Solar generation immediately exported by solar system (kWh)	-	-	-	-	-	-	-	-	-	-	-	-
On-site consumption served by solar (kWh)	5,533,028	5,505,363	5,477,836	5,450,447	5,423,195	5,396,079	5,369,098	5,342,253	5,315,541	5,288,964	5,262,519	5,236,206
On-site parasitic load during hours with no solar generation (kWh)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Discharge from storage exported to the grid (kWh)	-	-	-	-	-	-	-	-	-	-	-	-
Discharge from storage consumed by building load (kWh)	-	-	-	-	-	-	-	-	-	-	-	-
Avg Compensation for exports from solar ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of solar kWh consumed on site ($2019/kWh)	$ 0.0906	$ 0.0924	$ 0.0942	$ 0.0961	$ 0.0980	$ 0.1000	$ 0.1020	$ 0.1040	$ 0.1061	$ 0.1082	$ 0.1104	$ 0.1126
Retail rate is taken from User Inputs Row 95												
Avg Compensation for solar exports from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of onsite bill reduction from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Bill changes from solar parasitic loads on site, at retail rate ($2019/kWh)	$ (0.0906)	$ (0.0924)	$ (0.0942)	$ (0.0961)	$ (0.0980)	$ (0.1000)	$ (0.1020)	$ (0.1040)	$ (0.1061)	$ (0.1082)	$ (0.1104)	$ (0.1126)
Average Project Value, $2019 per kWh	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**



MATERIAL & LABOR COST ESTIMATE

Project : University of Rochester
Project # : 402805
Measure : Rooftop Solar Medical Campus
Date : 04/01/21

Estimated by: SDM
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	Solar Array	1	4,785	$1,140.00	$5,454,867	$760.00	$3,636,578	$9,091,445.55
	NY Megawatt Block Rebate	1	4,785	($130.00)	($622,046)			($622,046.27)
			SUBTOTALS:	Materials:	$4,832,821	Labor:	$3,636,578	$8,469,399.28
							Asbestos Abatement Cost:	$0.00
							TOTAL:	$8,469,399.28

TOTAL DIRECT CONSTRUCTION COST:		$8,469,399.28
Engineering, Commissioning, Project & Construction Management:	15%	$1,270,409.89
SUBTOTAL:		**$9,739,809.17**
TOTAL:		**$9,739,809.17**

wendel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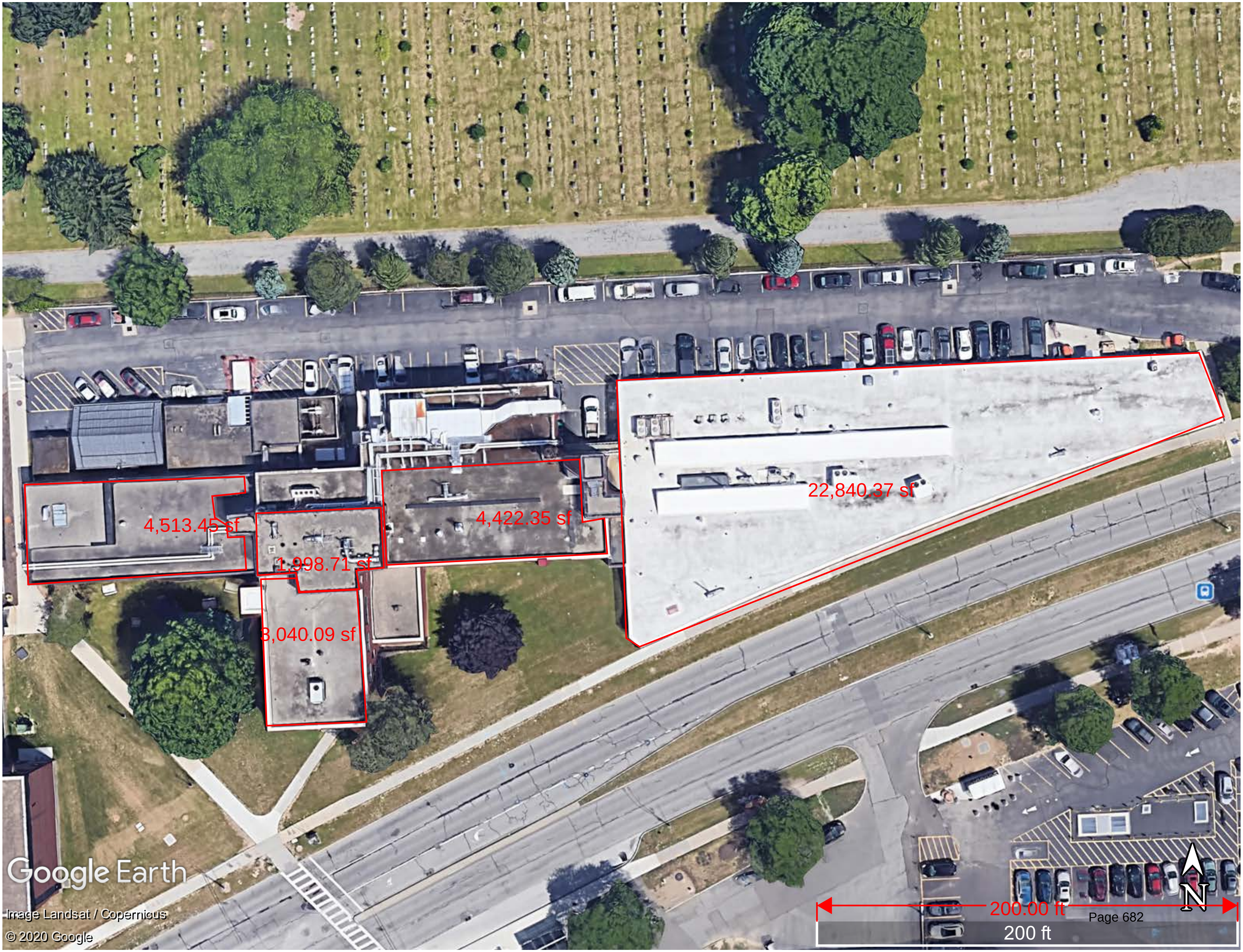
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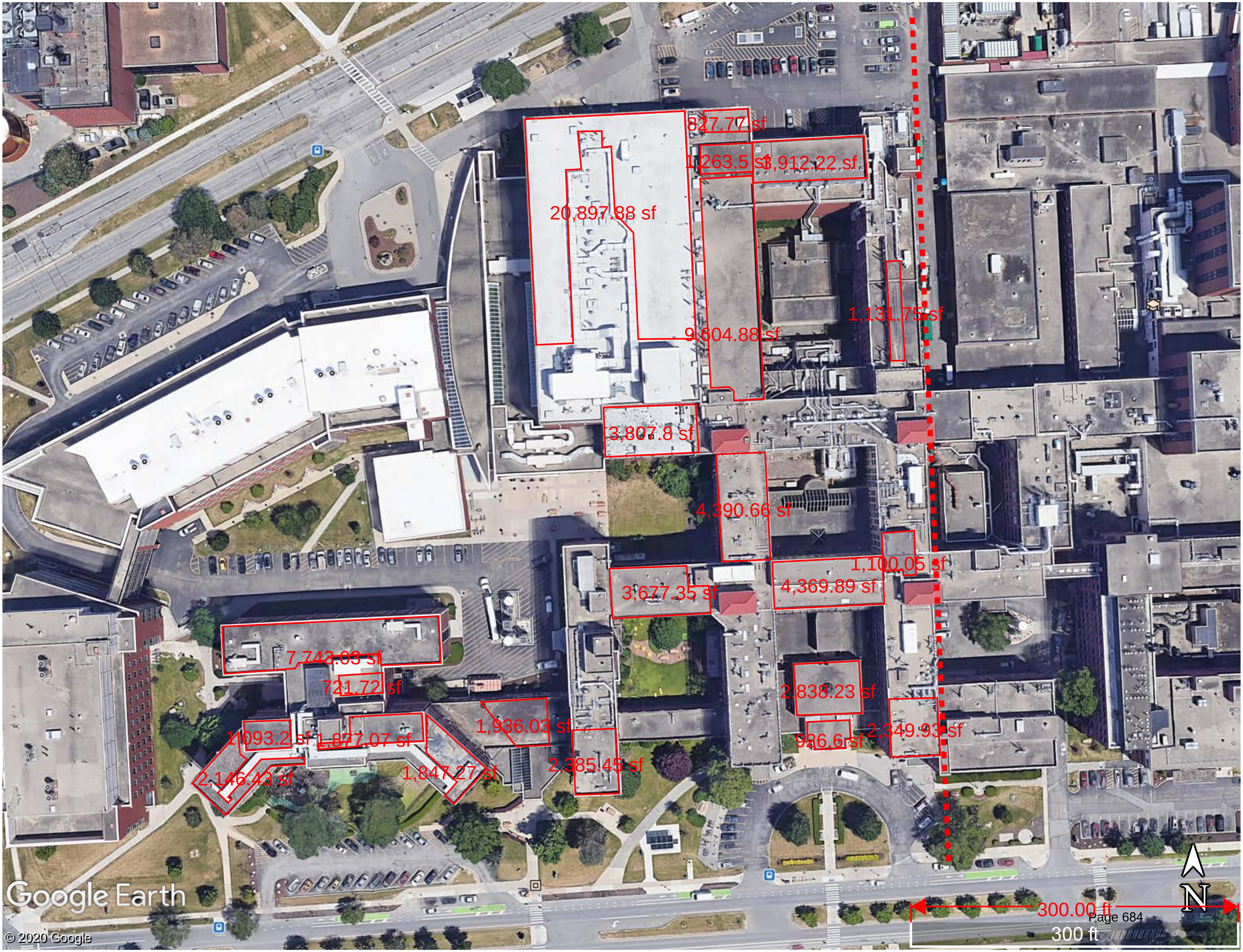

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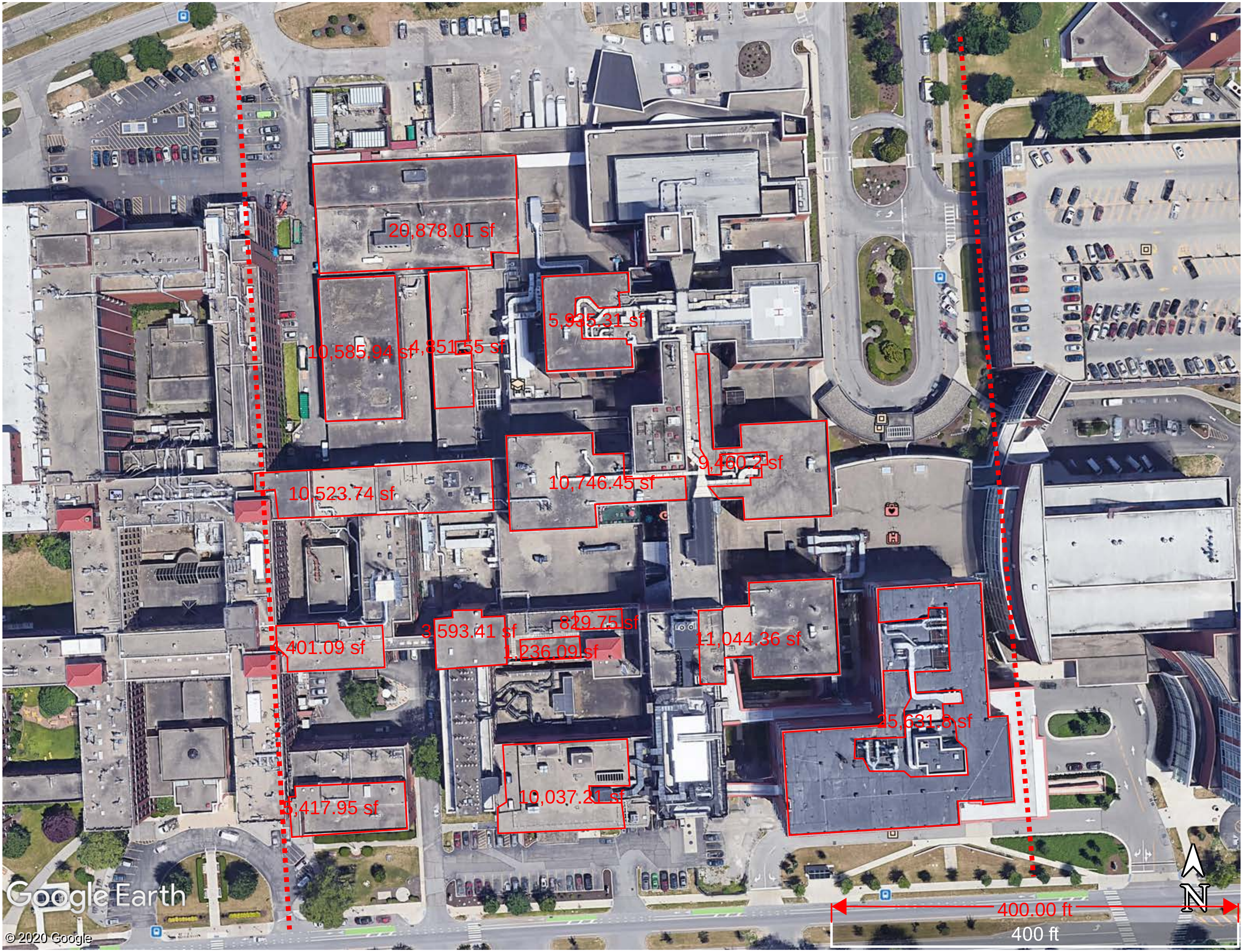
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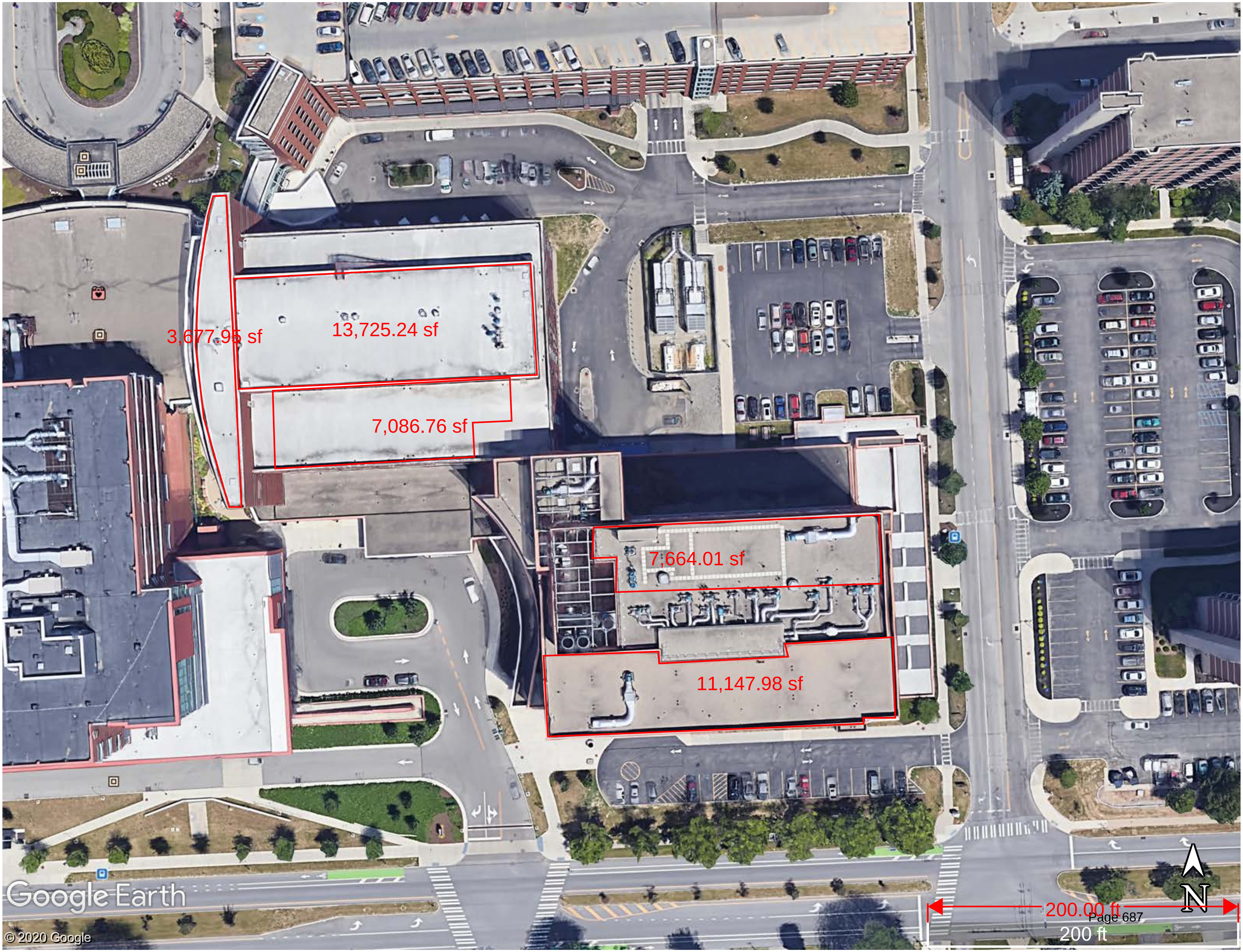

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11,147.98 sf
Google Earth
© 2020 Google
200.00 ft
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Technical Appendix 5 - SC

Photovoltaic System ECM

South Campus Rooftop Solar

- Savings Summary
- Cost Estimate
- Roof Area Maps

UNIVERSITY OF ROCHESTER

South Campus Rooftop Solar

Energy Conservation Measure Summary

Table 1-1

Measure Summary		
Building Level Energy Savings		
Electrical Energy Savings	7,332	mmBtu/Year
Chilled Water Savings	-	mmBtu/Year
Steam Savings	-	mmBtu/Year
Total Energy Savings	**7,332**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	2,148,787	kWh/Year
Chilled Water Savings	-	Ton-Hour/Year
Steam Savings	-	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	-$11,775	Per Year

Value Stack Calculator v 2.3, for Projects Impacted by the 2019 Value Stack Order (Qualified after 7/26/2018

TOTAL PROJECT VALUE ($2019), BY YEAR:

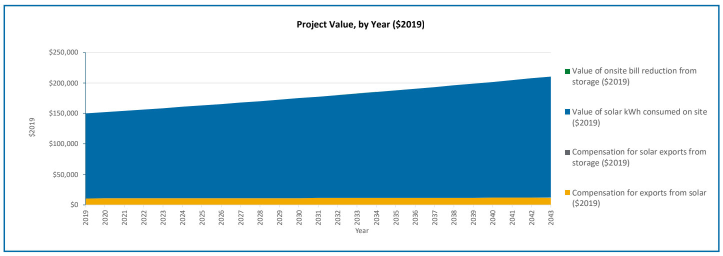
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Compensation for exports from solar ($2019)	$ 10,710	$ 10,756	$ 10,795	$ 10,827	$ 10,869	$ 10,911	$ 10,955	$ 11,008	$ 11,054	$ 11,095	$ 11,144	$ 11,194	$ 11,246
Value of solar kWh consumed on site ($2019)	$ 139,125	$ 141,198	$ 143,302	$ 145,437	$ 147,604	$ 149,803	$ 152,035	$ 154,300	$ 156,600	$ 158,933	$ 161,301	$ 163,704	$ 166,144
Retail rate is taken from User Inputs Row 95													
Compensation for solar exports from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of onsite bill reduction from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bill changes from solar parasitic loads on site, at retail rate ($2019)	$ (70)	$ (71)	$ (73)	$ (74)	$ (76)	$ (77)	$ (79)	$ (80)	$ (82)	$ (84)	$ (85)	$ (87)	$ (89)
Total value of energy produced	**$ 149,765**	**$ 151,882**	**$ 154,023**	**$ 156,190**	**$ 158,397**	**$ 160,637**	**$ 162,912**	**$ 165,228**	**$ 167,572**	**$ 169,944**	**$ 172,359**	**$ 174,811**	**$ 177,300**

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Compensation for exports from solar ($2019)	$ 11,306	$ 11,353	$ 11,409	$ 11,466	$ 11,524	$ 11,592	$ 11,653	$ 11,709	$ 11,773	$ 11,839	$ 11,906	$ 11,982
Value of solar kWh consumed on site ($2019)	$ 168,619	$ 171,131	$ 173,681	$ 176,269	$ 178,896	$ 181,561	$ 184,266	$ 187,012	$ 189,798	$ 192,626	$ 195,497	$ 198,409
Retail rate is taken from User Inputs Row 95												
Compensation for solar exports from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of onsite bill reduction from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bill changes from solar parasitic loads on site, at retail rate ($2019)	$ (91)	$ (92)	$ (94)	$ (96)	$ (98)	$ (100)	$ (102)	$ (104)	$ (106)	$ (108)	$ (110)	$ (113)
Total value of energy produced	**$ 179,834**	**$ 182,392**	**$ 184,996**	**$ 187,639**	**$ 190,322**	**$ 193,053**	**$ 195,817**	**$ 198,617**	**$ 201,466**	**$ 204,357**	**$ 207,293**	**$ 210,279**

TOTAL PROJECT VALUE ($2019 / kWh), BY YEAR:

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Solar generation immediately exported by solar system (kWh)	161,291	160,484	159,682	158,883	158,089	157,299	156,512	155,730	154,951	154,176	153,405	152,638	151,875
On-site consumption served by solar (kWh)	1,987,496	1,977,559	1,967,671	1,957,833	1,948,044	1,938,303	1,928,612	1,918,969	1,909,374	1,899,827	1,890,328	1,880,876	1,871,472
On-site parasitic load during hours with no solar generation (kWh)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Discharge from storage exported to the grid (kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-
Discharge from storage consumed by building load (kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg Compensation for exports from solar ($2019/kWh)	$ 0.0664	$ 0.0670	$ 0.0676	$ 0.0681	$ 0.0688	$ 0.0694	$ 0.0700	$ 0.0707	$ 0.0713	$ 0.0720	$ 0.0726	$ 0.0733	$ 0.0740
Avg Value of solar kWh consumed on site ($2019/kWh)	$ 0.0700	$ 0.0714	$ 0.0728	$ 0.0743	$ 0.0758	$ 0.0773	$ 0.0788	$ 0.0804	$ 0.0820	$ 0.0837	$ 0.0853	$ 0.0870	$ 0.0888
Retail rate is taken from User Inputs Row 95													
Avg Compensation for solar exports from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of onsite bill reduction from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Bill changes from solar parasitic loads on site, at retail rate ($2019/kWh)	$ (0.0700)	$ (0.0714)	$ (0.0728)	$ (0.0743)	$ (0.0758)	$ (0.0773)	$ (0.0788)	$ (0.0804)	$ (0.0820)	$ (0.0837)	$ (0.0853)	$ (0.0870)	$ (0.0888)
Average Project Value, $2019 per kWh	**$ 0.0697**	**$ 0.0710**	**$ 0.0724**	**$ 0.0738**	**$ 0.0752**	**$ 0.0767**	**$ 0.0781**	**$ 0.0796**	**$ 0.0812**	**$ 0.0827**	**$ 0.0843**	**$ 0.0860**	**$ 0.0876**

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Solar generation immediately exported by solar system (kWh)	151,116	150,360	149,608	148,860	148,116	147,375	146,639	145,905	145,176	144,450	143,728	143,009
On-site consumption served by solar (kWh)	1,862,115	1,852,804	1,843,540	1,834,322	1,825,151	1,816,025	1,806,945	1,797,910	1,788,921	1,779,976	1,771,076	1,762,221
On-site parasitic load during hours with no solar generation (kWh)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Discharge from storage exported to the grid (kWh)	-	-	-	-	-	-	-	-	-	-	-	-
Discharge from storage consumed by building load (kWh)	-	-	-	-	-	-	-	-	-	-	-	-
Avg Compensation for exports from solar ($2019/kWh)	$ 0.0748	$ 0.0755	$ 0.0763	$ 0.0770	$ 0.0778	$ 0.0787	$ 0.0795	$ 0.0802	$ 0.0811	$ 0.0820	$ 0.0828	$ 0.0838
Avg Value of solar kWh consumed on site ($2019/kWh)	$ 0.0906	$ 0.0924	$ 0.0942	$ 0.0961	$ 0.0980	$ 0.1000	$ 0.1020	$ 0.1040	$ 0.1061	$ 0.1082	$ 0.1104	$ 0.1126
Retail rate is taken from User Inputs Row 95												
Avg Compensation for solar exports from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of onsite bill reduction from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Bill changes from solar parasitic loads on site, at retail rate ($2019/kWh)	$ (0.0906)	$ (0.0924)	$ (0.0942)	$ (0.0961)	$ (0.0980)	$ (0.1000)	$ (0.1020)	$ (0.1040)	$ (0.1061)	$ (0.1082)	$ (0.1104)	$ (0.1126)
Average Project Value, $2019 per kWh	**$ 0.0893**	**$ 0.0911**	**$ 0.0928**	**$ 0.0946**	**$ 0.0965**	**$ 0.0983**	**$ 0.1002**	**$ 0.1022**	**$ 0.1042**	**$ 0.1062**	**$ 0.1083**	**$ 0.1104**



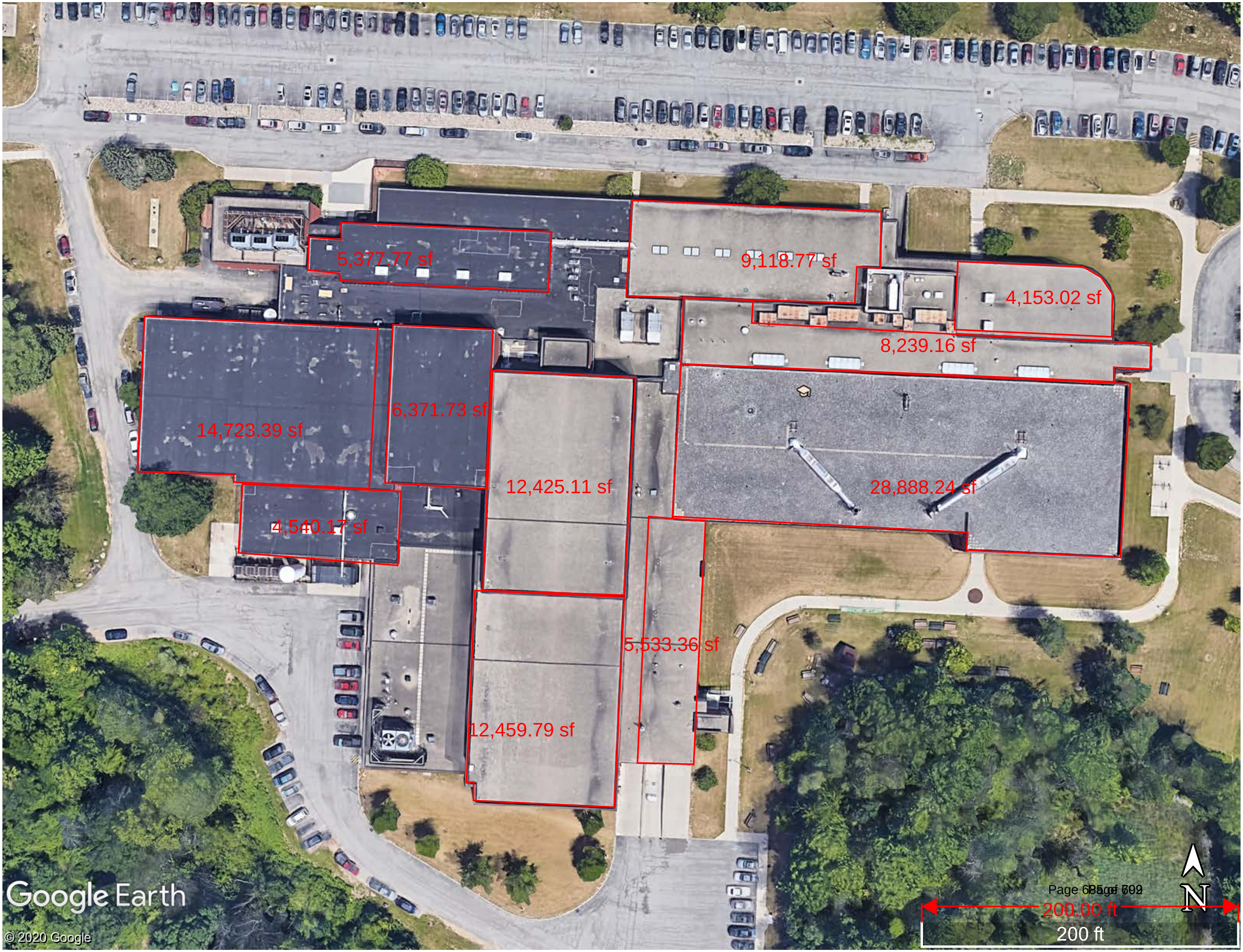
MATERIAL & LABOR COST ESTIMATE

Project : University of Rochester
Project # : 402805
Measure : Rooftop Solar South Campus
Date : 04/01/21

Estimated by: SDM
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	Solar Array	1	1,741	$1,140.00	$1,984,791	$760.00	$1,323,194	$3,307,985.10
	NY Megawatt Block Rebate	1	1,741	($350.00)	($609,366)			($609,365.68)
			SUBTOTALS:	Materials:	$1,375,425	Labor:	$1,323,194	$2,698,619.42
							Asbestos Abatement Cost:	$0.00
							TOTAL:	$2,698,619.42

TOTAL DIRECT CONSTRUCTION COST:		$2,698,619.42
Engineering, Commissioning, Project & Construction Management:	15%	$404,792.91
SUBTOTAL:		**$3,103,412.33**
TOTAL:		**$3,103,412.33**



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5,533.36 sf
12,459.79 sf
Google Earth
© 2020 Google
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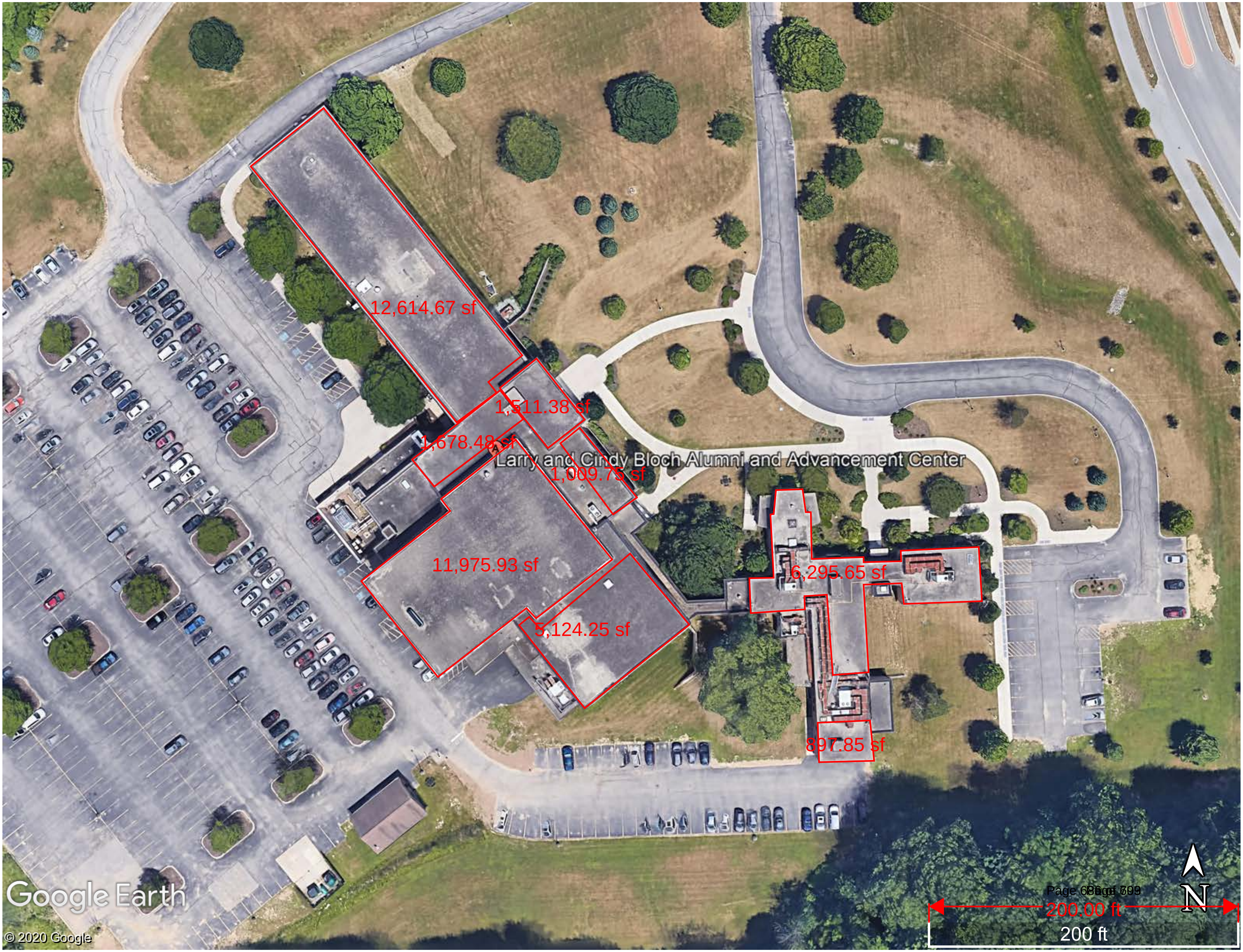
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Larry and Cindy Bloch Alumni and Advancement Center
1,009.75 sf
11,975.93 sf
6,295.65 sf
5,124.25 sf
897.85 sf
Google Earth
© 2020 Google
200.00 ft
200 ft
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8,103.1 sf
8,306.62 sf
12,116.26 sf
271 E River Rd
Google Earth
© 2020 Google
100.00 ft
100 ft
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Technical Appendix 5 - ESM

Photovoltaic System ECM

Eastman Campus Rooftop Solar

- Savings Summary
- Cost Estimate
- Roof Area Maps

UNIVERSITY OF ROCHESTER

Eastman Campus Rooftop Solar

Energy Conservation Measure Summary

Building Utility Impact		
Building Level Energy Savings		
Electrical Energy Savings	2,521	mmBtu/Year
Chilled Water Savings	-	mmBtu/Year
Steam Savings	-	mmBtu/Year
Total Energy Savings	**2,521**	**mmBtu/Year**
Building Level Utility Savings		
Electrical Energy Savings	738,717	kWh/Year
Chilled Water Savings	-	Ton-Hour/Year
Steam Savings	-	klbs/Year
Water Savings	-	kGal/Year
Annual O&M Savings ($)		
Operational & Maintenance Savings	-$4,048	Per Year

Value Stack Calculator v 2.3, for Projects Impacted by the 2019 Value Stack Order (Qualified after 7/26/2018

TOTAL PROJECT VALUE ($2019), BY YEAR:

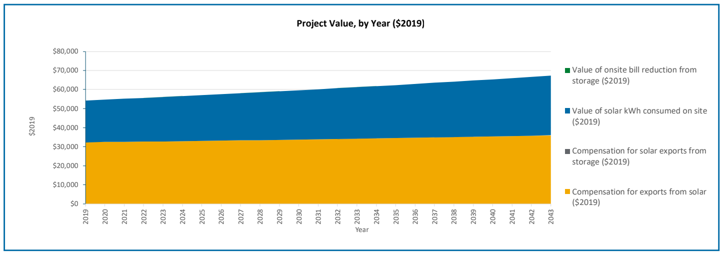
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Compensation for exports from solar ($2019)	$ 32,314	$ 32,483	$ 32,594	$ 32,647	$ 32,765	$ 32,886	$ 33,012	$ 33,200	$ 33,333	$ 33,410	$ 33,550	$ 33,694	$ 33,842
Value of solar kWh consumed on site ($2019)	$ 21,956	$ 22,283	$ 22,615	$ 22,952	$ 23,294	$ 23,641	$ 23,993	$ 24,351	$ 24,714	$ 25,082	$ 25,456	$ 25,835	$ 26,220
Retail rate is taken from User Inputs Row 95													
Compensation for solar exports from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of onsite bill reduction from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bill changes from solar parasitic loads on site, at retail rate ($2019)	$ (70)	$ (71)	$ (73)	$ (74)	$ (76)	$ (77)	$ (79)	$ (80)	$ (82)	$ (84)	$ (85)	$ (87)	$ (89)
Total value of energy produced	**$ 54,200**	**$ 54,695**	**$ 55,136**	**$ 55,524**	**$ 55,983**	**$ 56,450**	**$ 56,926**	**$ 57,471**	**$ 57,965**	**$ 58,408**	**$ 58,920**	**$ 59,442**	**$ 59,973**

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Compensation for exports from solar ($2019)	$ 34,053	$ 34,151	$ 34,311	$ 34,475	$ 34,644	$ 34,873	$ 35,050	$ 35,175	$ 35,361	$ 35,551	$ 35,746	$ 36,000
Value of solar kWh consumed on site ($2019)	$ 26,611	$ 27,007	$ 27,409	$ 27,818	$ 28,232	$ 28,653	$ 29,080	$ 29,513	$ 29,953	$ 30,399	$ 30,852	$ 31,312
Retail rate is taken from User Inputs Row 95												
Compensation for solar exports from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value of onsite bill reduction from storage ($2019)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bill changes from solar parasitic loads on site, at retail rate ($2019)	$ (91)	$ (92)	$ (94)	$ (96)	$ (98)	$ (100)	$ (102)	$ (104)	$ (106)	$ (108)	$ (110)	$ (113)
Total value of energy produced	**$ 60,573**	**$ 61,065**	**$ 61,626**	**$ 62,197**	**$ 62,778**	**$ 63,426**	**$ 64,028**	**$ 64,584**	**$ 65,208**	**$ 65,842**	**$ 66,488**	**$ 67,199**

TOTAL PROJECT VALUE ($2019 / kWh), BY YEAR:

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Solar generation immediately exported by solar system (kWh)	425,061	422,936	420,821	418,717	416,623	414,540	412,468	410,405	408,353	406,311	404,280	402,258	400,247
On-site consumption served by solar (kWh)	313,656	312,088	310,528	308,975	307,430	305,893	304,364	302,842	301,327	299,821	298,322	296,830	295,346
On-site parasitic load during hours with no solar generation (kWh)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Discharge from storage exported to the grid (kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-
Discharge from storage consumed by building load (kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg Compensation for exports from solar ($2019/kWh)	$ 0.0760	$ 0.0768	$ 0.0775	$ 0.0780	$ 0.0786	$ 0.0793	$ 0.0800	$ 0.0809	$ 0.0816	$ 0.0822	$ 0.0830	$ 0.0838	$ 0.0846
Avg Value of solar kWh consumed on site ($2019/kWh)	$ 0.0700	$ 0.0714	$ 0.0728	$ 0.0743	$ 0.0758	$ 0.0773	$ 0.0788	$ 0.0804	$ 0.0820	$ 0.0837	$ 0.0853	$ 0.0870	$ 0.0888
Retail rate is taken from User Inputs Row 95													
Avg Compensation for solar exports from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of onsite bill reduction from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Bill changes from solar parasitic loads on site, at retail rate ($2019/kWh)	$ (0.0700)	$ (0.0714)	$ (0.0728)	$ (0.0743)	$ (0.0758)	$ (0.0773)	$ (0.0788)	$ (0.0804)	$ (0.0820)	$ (0.0837)	$ (0.0853)	$ (0.0870)	$ (0.0888)
Average Project Value, $2019 per kWh	**$ 0.0734**	**$ 0.0744**	**$ 0.0754**	**$ 0.0763**	**$ 0.0773**	**$ 0.0784**	**$ 0.0794**	**$ 0.0806**	**$ 0.0817**	**$ 0.0827**	**$ 0.0839**	**$ 0.0850**	**$ 0.0862**

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Solar generation immediately exported by solar system (kWh)	398,246	396,255	394,273	392,302	390,341	388,389	386,447	384,515	382,592	380,679	378,776	376,882
On-site consumption served by solar (kWh)	293,869	292,400	290,938	289,483	288,036	286,596	285,163	283,737	282,318	280,907	279,502	278,105
On-site parasitic load during hours with no solar generation (kWh)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Discharge from storage exported to the grid (kWh)	-	-	-	-	-	-	-	-	-	-	-	-
Discharge from storage consumed by building load (kWh)	-	-	-	-	-	-	-	-	-	-	-	-
Avg Compensation for exports from solar ($2019/kWh)	$ 0.0855	$ 0.0862	$ 0.0870	$ 0.0879	$ 0.0888	$ 0.0898	$ 0.0907	$ 0.0915	$ 0.0924	$ 0.0934	$ 0.0944	$ 0.0955
Avg Value of solar kWh consumed on site ($2019/kWh)	$ 0.0906	$ 0.0924	$ 0.0942	$ 0.0961	$ 0.0980	$ 0.1000	$ 0.1020	$ 0.1040	$ 0.1061	$ 0.1082	$ 0.1104	$ 0.1126
Retail rate is taken from User Inputs Row 95												
Avg Compensation for solar exports from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Value of onsite bill reduction from storage ($2019/kWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avg Bill changes from solar parasitic loads on site, at retail rate ($2019/kWh)	$ (0.0906)	$ (0.0924)	$ (0.0942)	$ (0.0961)	$ (0.0980)	$ (0.1000)	$ (0.1020)	$ (0.1040)	$ (0.1061)	$ (0.1082)	$ (0.1104)	$ (0.1126)
Average Project Value, $2019 per kWh	**$ 0.0875**	**$ 0.0887**	**$ 0.0899**	**$ 0.0912**	**$ 0.0925**	**$ 0.0940**	**$ 0.0953**	**$ 0.0966**	**$ 0.0981**	**$ 0.0995**	**$ 0.1010**	**$ 0.1026**



MATERIAL & LABOR COST ESTIMATE

Project : University of Rochester
Project # : 402805
Measure : Rooftop Solar Eastman Campus
Date : 04/01/21

Estimated by: SDM
Checked by:
Approved by:
File: Cost Estimate

Item No.	Description	Qty.	Unit	Material Unit Price	Material Total	Labor Unit Price	Labor Total	Total Cost Labor & Material
1	Solar Array	1	599	$1,140.00	$682,338	$760.00	$454,892	$1,137,230.44
	NY Megawatt Block Rebate	1	599	($350.00)	($209,650)			($209,650.00)
			SUBTOTALS:	Materials:	$472,688	Labor:	$454,892	$927,580.44
							Asbestos Abatement Cost:	$0.00
							TOTAL:	$927,580.44

TOTAL DIRECT CONSTRUCTION COST:		$927,580.44
Engineering, Commissioning, Project & Construction Management:	15%	$139,137.07
SUBTOTAL:		**$1,066,717.51**
TOTAL:		**$1,066,717.51**

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7,270.24 sf
Google Earth
© 2020 Google
Page 699
100.00 ft
100 ft
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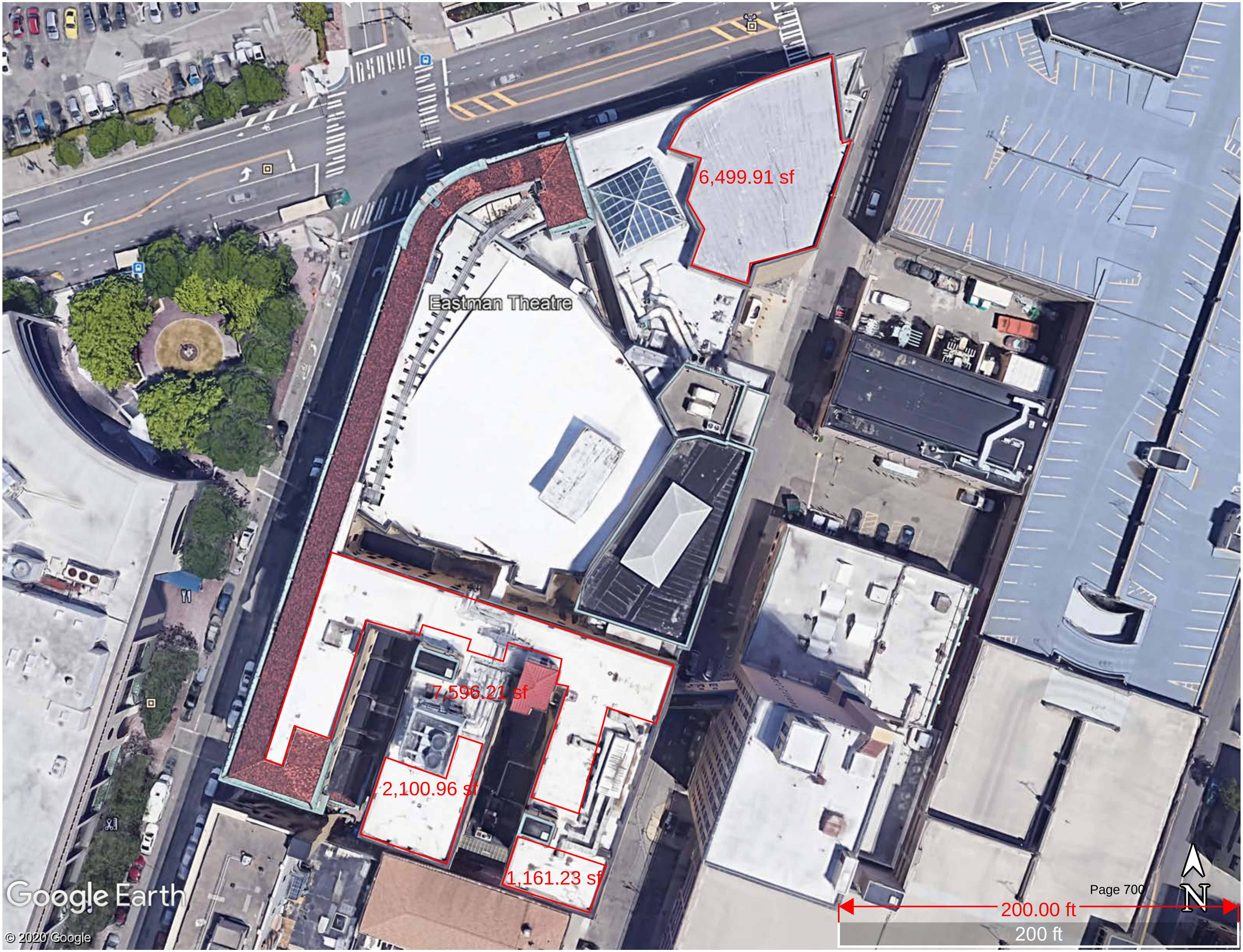
Eastman Theatre
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7,596.21 sf
2,100.96 sf
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200.00 ft
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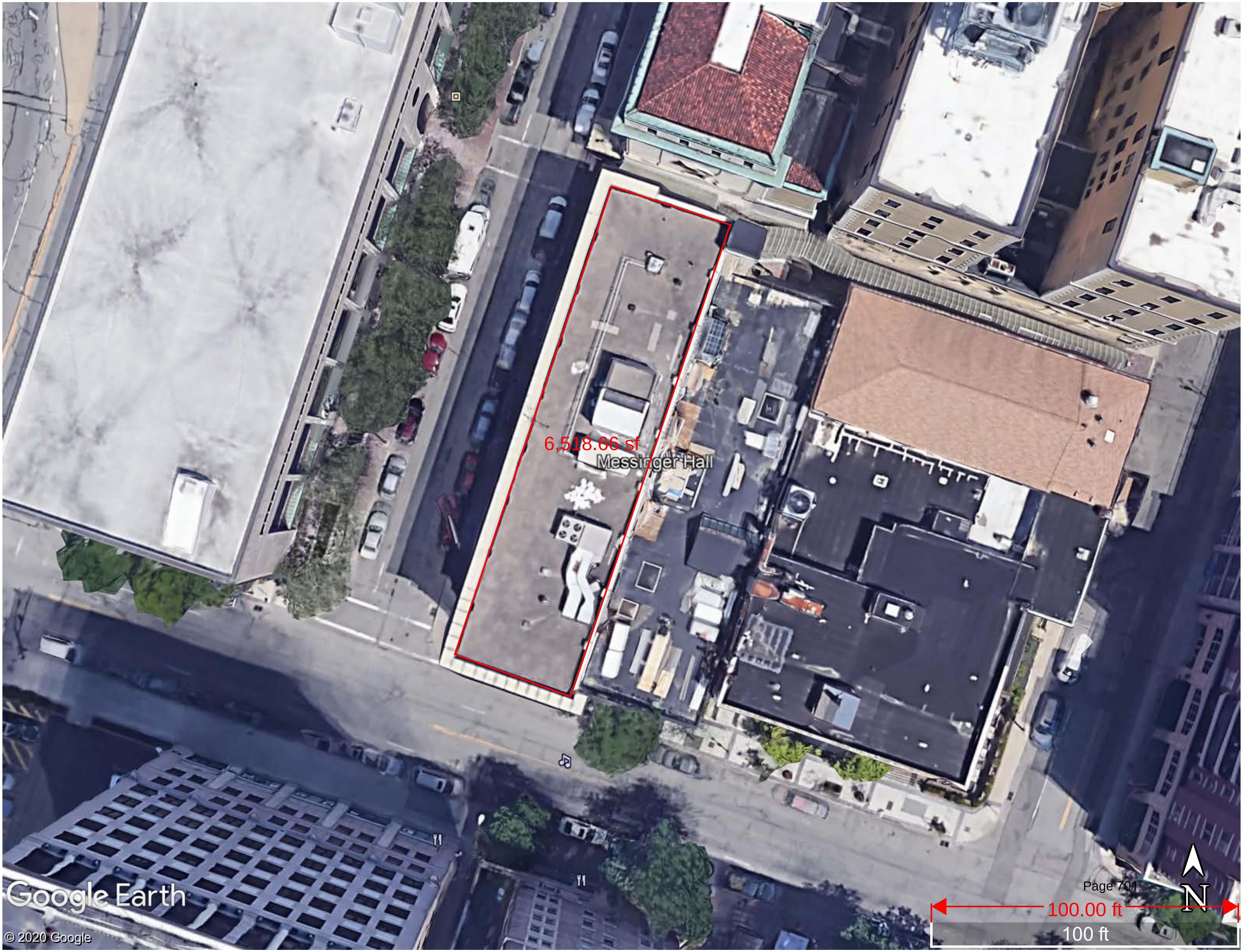
Google Earth
© 2020 Google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Google Earth
© 2020 Google


23,997.09 sf
Miller Center
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100.00 ft
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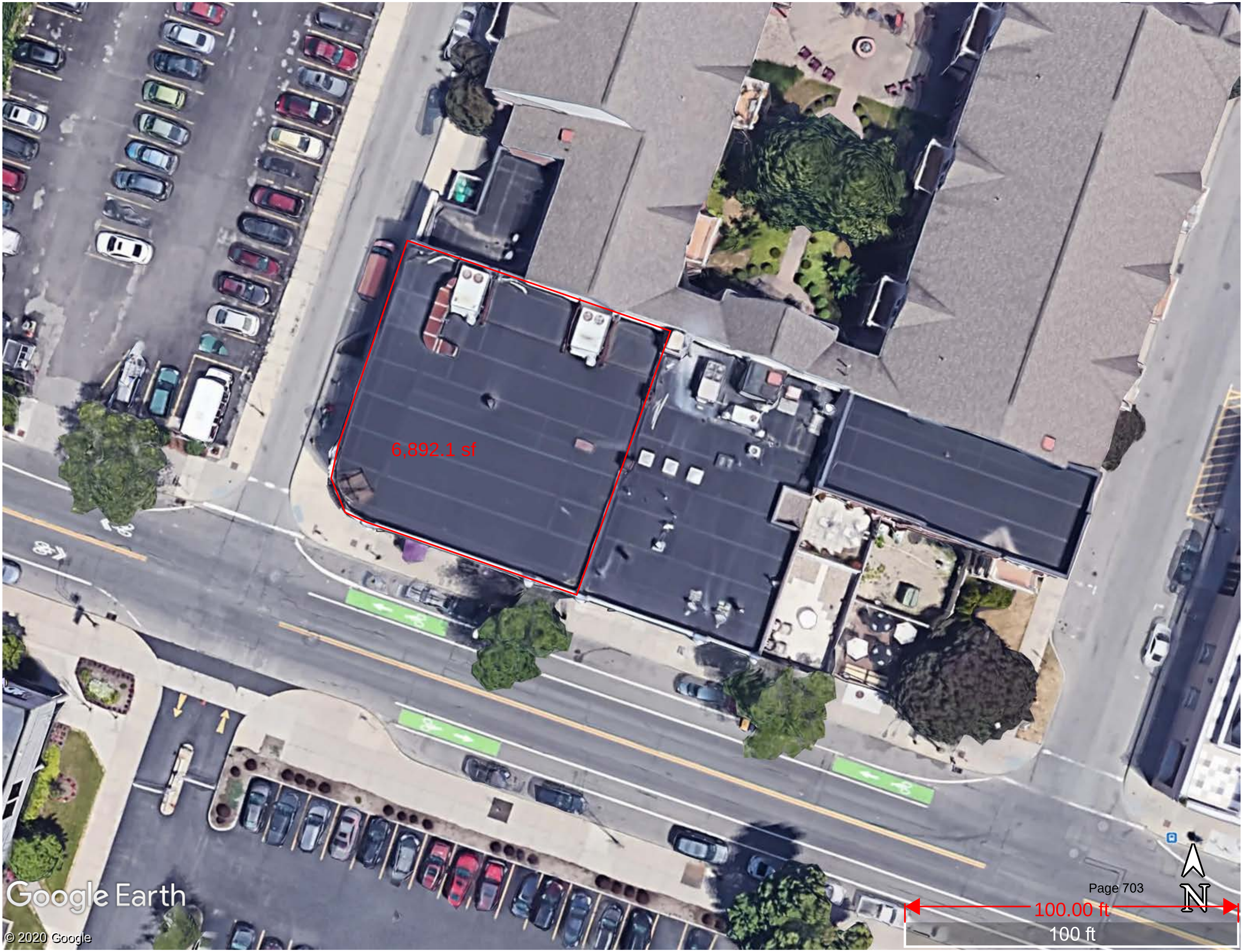
6,892.1 sf
Google Earth
© 2020 Google
100.00 ft
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Technical Appendix 6

EMIS Savings and M&V Plan

Savings from using sub-meter data with EMIS

Project Name:	Energy Management Information System (EMIS)		
Measure:	Reduce energy consumption with submetering and awareness	**Project No.:**	RC-048
Calc By:	TV	**ECM No.:**	2
Reviewed By:		**Date:**	8/2/2019

Notes:

The University of Rochester intends to utilize EMIS software to collect, organize, analyze and increase stakeholder awareness of energy data obtained from sub-meter devices.

Savings:

A	FY19 Electric Use		161,929,445	kWh
B	FY18 Natural Gas Use		2,568,059	mmBTU
C	Projected Energy Savings		1.0%	
D	Projected Electric Energy Savings		1,619,294	kWh
E	Projected Natural Gas Energy Savings		25,681	mmBTU

Potential Incentive:

F	Maximum Incentive Rate allowed by NYSERDA Self Direct	$	267.02	$/MWh
G	Estimated Cost of Software	$	180,527	
H	Estimated Total Incentive from RG&E	$	180,527	
I	Requested Incentive Rate by NYSERDA Self Direct	$	111.49	$/MWh

A Total electrical energy used in Fiscal year 19 from Substation 33 and Substation 710.

B FY19 data is not yet fully available, so FY18 data was obtained for the total gas use of the CU Plant.

C GSA Document Submetering Business Case: How to calculate cost-effective solutions in the building context

Table 2 - Bill allocation only 2-5%

US Department of Energy EMIS in 2019: Is Building Analytics Ready to go Mainstream - Page 5, 1 year (4%)

The 4% value of DOE study was used as it is within the range of the GSA study

D = A x C

E = B x C

F For reference only

G Obtained from quote from eSight Enterprise plus contingency

J = G

K = H / D

Measurement & Verification Approach

OVERVIEW

This document outlines a standardized Measurement & Verification (M&V) plan using options from the International Performance Measurement and Verification Protocol (IPMVP) guidelines 2010. This M&V Approach calculates savings in common units of energy, kWh purchased by the utility. Improvements to system performance from better data visibility, tracking and analytics will result in savings achieved within campus buildings. However, due to the complexity of the campus distribution system, changing loads (new buildings) and other interactive effects, tracking of savings at the campus utility meter will not provide an accurate representation of the benefits of these improvements. As such, an M&V Approach based on IPMVP Option C (building submeter) & Option A[1] (Retrofit Isolation) will be followed to track the energy savings of the Project. The follow summarizes this approach.

Determining savings with measurements in accordance with the IPMVP guideline involves comparing post-retrofit energy consumption against the normalized and adjusted baseline[2], in order to act as a proxy for the conditions that would have prevailed had the retrofit not been performed.

GENERAL APPROACH

It is anticipated that the EMIS system will direct building managers and system operators to operational improvements which will result in a reduction in energy usage. The University will track these efforts and provide a summary of before and after conditions. While the modifications are unknown, it is anticipated that they will fall into two categories:

1. Operational Adjustments
2. Energy Conservation Measures

It is anticipated that operational adjustments such as building scheduling, behavioral modifications, etc. will be measured and verified following the IPMVP Option C Whole Building procedure and will leverage building submeter data.

It is anticipated that ECMs will be identified (such as economizer modifications) and will be measured and verified following a IPMVP Option A Retrofit Isolation procedure and will leverage mutually agreed trend data and calculations.

The follow outlined both approaches.

[1] Option A as described in the IPMVP dated September 2010 Chapter 4.7.
[1] Option C as described in the IPMVP dated September 2010 Chapter 4.9.
[2] Normalized and adjusted baseline as described in the IPMVP dated September 2010 Chapter 4.1 and Chapter 9.

Operational Adjustments M&V Approach

Part 1 | Pre Retrofit Baseline

The PRE RETROFIT BASELINE period will be established by the University for dates yet to be defined. Date will be defined by the University once the improvement opportunity is identified by the EMIS system and University staff. Energy usage will be summarized from building sub meters. Corresponding weather data will be utilized for the same period for comparison.

To account for impacts that weather will have on the building's energy usage, the loads which comprise the **PRE RETROFIT BASELINE** is broken into two categories, **WEATHER DEPENDENT LOAD and BASE LOAD**.

1.1 Weather Dependent Load

Weather Dependent Loads are loads which vary based on weather conditions, typically outdoor air-dry bulb temperature and relative humidity. The primary utilities in this building serve **WEATHER DEPENDENT LOAD**, **and BASE LOAD**. To isolate the weather dependent load the following procedure will be applied to the **DIRECT UTILITY SUBMETERs** values associated with the **PRE RETROFIT BASELINE PERIOD**.

1.1.1 Weather Dependent Load | Normalization

The weather dependent load is normalized utilizing the EMIS software. All inputs, formulas and outputs from the software relative to normalization calculations will be available for review by third parties. The following loads will be *Normalized Electric Cooling Load, Normalized Electric Heating Load, Normalized Hot Water Load, and Normalized Chilled Water Load.*

1.1.2 Chilled Water Conversion

Building Chilled Water usage, which is directly measured by building level chilled water meters and are supplied by chillers located at the Mid Campus Chiller Plant, will utilize a conversion rate of .85kW / Ton.

Part 2 | Post Retrofit Usage

The POST RETROFIT USAGE period will be established by the University for dates yet to be defined. Date will be defined by the University once the improvement opportunity has been implemented by the University staff. Energy usage will be summarized from building sub meters. Corresponding weather data will be utilized for the same period for comparison.

To account for impacts that weather will have on the building's energy usage, the loads which comprise the **POST RETROFIT USAGE** is broken into two categories, **WEATHER DEPENDENT LOAD and BASE LOAD**.

2.1 Weather Dependent Load

Weather Dependent Loads are loads which vary based on weather conditions, typically outdoor air-dry bulb temperature and relative humidity. The primary utilities in this building serve **WEATHER DEPENDENT LOAD**, **and BASE LOAD**. To isolate the weather dependent load the following procedure will be applied to the **DIRECT UTILITY SUBMETERs** values associated with the **POST RETROFIT USAGE PERIOD**.

2.1.1 Weather Dependent Load | Normalization

The weather dependent load is normalized utilizing the EMIS software. All inputs, formulas and outputs from the software relative to normalization calculations will be available for review by third parties. The following loads will be *Normalized Electric Cooling Load, Normalized Electric Heating Load, Normalized Hot Water Load, and Normalized Chilled Water Load.*

2.1.2 Chilled Water Conversion

Building Chilled Water usage, which is directly measured by building level chilled water meters, and are supplied by chillers located at the Mid Campus Chiller Plant, will utilize a conversion rate of .85kW / Ton.

Part 3 | M&V Savings

The **SAVINGS** will be determined by comparing the **PRE RETROFIT BASELINE as outlined in PART 1 t**o the **POST RETROFIT USAGE** as **outlined in PART 2**.

Energy Conservation Measures M&V Approach

Part 1 | Pre Retrofit Baseline

The PRE RETROFIT BASELINE period will be established by the University for dates yet to be defined. Date will be defined by the University once the improvement opportunity is identified by the EMIS system and University staff. Energy usage will be summarized from building sub meters as well as key trending points which are relevant to system performance. Corresponding weather data will be utilized for the same period for comparison.

To account for impacts that weather will have on the building's energy usage, the loads which comprise the **PRE RETROFIT BASELINE** is broken into two categories, **WEATHER DEPENDENT LOAD and BASE LOAD**.

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Weather Dependent Loads are loads which vary based on weather conditions, typically outdoor air-dry bulb temperature and relative humidity. The primary utilities in this building serve **WEATHER DEPENDENT LOAD, and BASE LOAD**. To isolate the weather dependent load the following procedure will be applied to the **DIRECT UTILITY SUBMETERs** values associated with the **PRE RETROFIT BASELINE PERIOD**.

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The weather dependent load is normalized utilizing the EMIS software. All inputs, formulas and outputs from the software relative to normalization calculations will be available for review by third parties. The following loads will be *Normalized Electric Cooling Load, Normalized Electric Heating Load, Normalized Hot Water Load, and Normalized Chilled Water Load.*

1.1.2 Chilled Water Conversion

Building Chilled Water usage, which is directly measured by building level chilled water meters and are supplied by chillers located at the Mid Campus Chiller Plant, will utilize a conversion rate of .85kW / Ton.

1.2 Baseline | Directly Metered Loads & Measured Variables

The following are the key variables that will be impacted by this project which were critical to the development of the baseline energy usage.

[THE FOLLOWING ARE EXAMPLE VARIABLES WHICH MAY CHANGE DEPENDING ON THE ECM - THIS PLAN WILL BE PROVIDED BY RG&E and REVIEWED BY UR FOR EACH ECM

- *AIRFLOW OPTIMIZATION, HVAC CONTROLS OPTIMIZATION | The amount of energy usage to condition the outdoor air is a direct function of the following key measured variables. These were trended or measured as outlined in the technical appendix to establish the baseline. With the abbreviation [DVR] meaning demand ventilation rate.*
  - *Outdoor Air CFM [DVR]**
  - *Outdoor Air Temperature [OAT]*
  - *Supply Air Temperature [SAT]*
  - *Outdoor Air Enthalpy [OAH]*
  - *Supply Air Enthalpy [SAH]*

**If not directly measured with a calibrated flow station, the DVR can be calculated based on fan speed, OA Temperature, RA Temperature and MA Temperature. If the scope of work selected does not include upgrades to* *trending capabilities, the ability for Wendel to perform this M&V procedure will be limited to the capabilities of the existing infrastructure. As such periodic trends may need to be utilized.*

This calculation breakdown the operation of the primary air handling system into four basic parts. The following are the basic formulas used, each formula will result in energy usage in MMBtus.

BASELINE HEATING: VENTILATION OCCUPIED | BLHVOcc (mmBtu)

= [∑{DVR * 1.08 * (DAT_i - OAT_i) / 1,000,000 * OH_{prei}}
Where:
DVR: Existing Ventilation Rate (CFM)
OAT_i: Temperature of Outdoor air at each heating temperature bin
DAT_i: Discharge Air Temperature Set point in Heating
OH_{prei}: Occupied hours by time of day bin
Note:
1.08 = Psychometric conversion factor for calculating the sensible energy in air based on dry bulb temperatures
1,000,000 = Conversion Factor (Btu/h per mmBtu)

BASELINE HEATING: VENTILATION UNOCCUPIED | BLHVUNOcc (mmBtu)

= [∑{DVR * 1.08 * (DAT_i - OAT_i) / 1,000,000 * UOH_i}
Where:
DVR: Existing Ventilation Rate (CFM)
OAT_i: Temperature of Outdoor air at each heating temperature bin
DAT_i: Discharge Air Temperature Set point in Heating
UOH_i: Unoccupied hours by time of day bin
Note:
1.08 = Psychometric conversion factor for calculating the sensible energy in air based on dry bulb temperatures
1,000,000 = Conversion Factor (Btu/h per mmBtu)

BASELINE COOLING: VENTILATION OCCUPIED | BLCLVOcc (mmBtu)

= [∑{DVR * 4.5 * absolute value of (OAH_i – DAH_i) / 1,000,000 * OH_{prei}}
Where:
DVR: Existing Ventilation Rate (CFM)
OAH_i: Enthalpy of Outdoor air at each cooling temperature bin
DAH_i: Discharge Air Enthalpy Set point in Cooling
OH_{prei}: Occupied hours by time of day bin
Note:
4.5 = Psychometric conversion factor for calculating the total energy in air based on enthalpy
1,000,000 = Conversion Factor (Btu/h per mmBtu)

BASELINE COOLING: VENTILATION UNOCCUPIED | BLCLVUNOcc (mmBtu)

*= [∑{DVR * 4.5 * absolute value of (OAH_i – DAH_i) / 1,000,000 * UOH_{prei}}*
Where:
DVR: Existing Ventilation Rate (CFM)
OAH_i: Enthalpy of Outdoor air at each cooling temperature bin
DAH_i: Discharge Air Enthalpy Set point in Cooling
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Part 2 | Post Retrofit Usage

The POST RETROFIT USAGE period will be established by the University for dates yet to be defined. Date will be defined by the University once the improvement opportunity is identified by the EMIS system and University staff. Energy usage will be summarized from building sub meters as well as key trending points which are relevant to system performance. Corresponding weather data will be utilized for the same period for comparison.

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2.1.1 Weather Dependent Load | Normalization

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[THE FOLLOWING ARE EXAMPLE VARIABLES WHICH MAY CHANGE DEPENDING ON THE ECM - THIS PLAN WILL BE PROVIDED BY RG&E and REVIEWED BY UR FOR EACH ECM

- *AIRFLOW OPTIMIZATION, HVAC CONTROLS OPTIMIZATION* | *The amount of energy usage to condition the outdoor air is a direct function of the following key measured variables. These were trended or measured as outlined in the technical appendix to establish the baseline. With the abbreviation [DVR] meaning demand ventilation rate.*
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  – *Supply Air Temperature [SAT]*
  – *Outdoor Air Enthalpy [OAH]*

– *Supply Air Enthalpy [SAH]*

**If not directly measured with a calibrated flow station, the DVR can be calculated based on fan speed, OA Temperature, RA Temperature and MA Temperature. If the scope of work selected does not include upgrades to trending capabilities, the ability for Wendel to perform this M&V procedure will be limited to the capabilities of the existing infrastructure. As such periodic trends may need to be utilized.*

This calculation breakdown the operation of the primary air handling system into four basic parts. The following are the basic formulas used, each formula will result in energy usage in MMBtus.

BASELINE HEATING: VENTILATION OCCUPIED | BLHVOcc (mmBtu)

$= [\sum\{DVR * 1.08 * (DAT_i - OAT_i) / 1,000,000 * OH_{prei}\}$

Where:

DVR: *Existing Ventilation Rate (CFM)*

OAT_i: *Temperature of Outdoor air at each heating temperature bin*

DAT_i: *Discharge Air Temperature Set point in Heating*

OH_{prei}: *Occupied hours by time of day bin*

Note:

1.08 = Psychometric conversion factor for calculating the sensible energy in air based on dry bulb temperatures

1,000,000 = Conversion Factor (Btu/h per mmBtu)

BASELINE HEATING: VENTILATION UNOCCUPIED | BLHVUNOcc (mmBtu)

$= [\sum\{DVR * 1.08 * (DAT_i - OAT_i) / 1,000,000 * UOH_i\}$

Where:

DVR: *Existing Ventilation Rate (CFM)*

OAT_i: *Temperature of Outdoor air at each heating temperature bin*

DAT_i: *Discharge Air Temperature Set point in Heating*

UOH_i: *Unoccupied hours by time of day bin*

Note:

1.08 = Psychometric conversion factor for calculating the sensible energy in air based on dry bulb temperatures

1,000,000 = Conversion Factor (Btu/h per mmBtu)

BASELINE COOLING: VENTILATION OCCUPIED | BLCLVOcc (mmBtu)

$= [\sum\{DVR * 4.5 * \text{absolute value of } (OAH_i - DAH_i) / 1,000,000 * OH_{prei}\}$

Where:

DVR: *Existing Ventilation Rate (CFM)*

OAH_i: *Enthalpy of Outdoor air at each cooling temperature bin*

DAH_i: *Discharge Air Enthalpy Set point in Cooling*

OH_{prei}: *Occupied hours by time of day bin*

Note:

4.5 = Psychometric conversion factor for calculating the total energy in air based on enthalpy

1,000,000 = Conversion Factor (Btu/h per mmBtu)

BASELINE COOLING: VENTILATION UNOCCUPIED | BLCLVUNOcc (mmBtu)

*= [$\sum${DVR * 4.5 * absolute value of (OAH_i – DAH_i) / 1,000,000 * UOH_{prei}}*
Where:
DVR: Existing Ventilation Rate (CFM)
OAH_i: Enthalpy of Outdoor air at each cooling temperature bin
DAH_i: Discharge Air Enthalpy Set point in Cooling
UOH_{prei}: Unoccupied hours by time of day bin
Note:
4.5 = Psychometric conversion factor for calculating the total energy in air based on enthalpy
1,000,000 = Conversion Factor (Btu/h per mmBtu)

Part 3 | M&V Savings

The **SAVINGS** will be determined by comparing the **PRE RETROFIT BASELINE as outlined in PART 1 t**o the **POST RETROFIT USAGE** as **outlined in PART 2.**

Technical Appendix 7

Extrapolated Results Summary by ECM

SURVEYED BUILDINGS | LIGHTING

Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Measure Cost	Cost/sqft	Kw Savings	kWh Savings	mmBtu Savings	O&M Savings	Projected Savings (mmBtu)	Projected Savings ($)
1	Ambulatory Care Facility	Ambulatory Care Facility	Hospital	224,609	4,740,048	51,190	19,472	2,587	3	$412,981	$656,793	$2.92		790,176	-533	$5,628	2,163	
2	Delmonte Institute	Del Monte	Lab/Research	152,227	5,667,756	60,981	19,852	2,526	12	$479,602		$0.00						
3	Fauver Stadium	Fauver	Office/Sports	63,097	256,300	557	922	0	20	$21,245	$31,694	$0.50		17,791	-10	$71	51	
4	Goergen Hall for Biomedical Engineering and Optics	GCHaS	Classroom/Lab/Office	271,861	5,232,009	69,473	4	35,819	27	$497,305		$0.00						
5	Kornberg Medical Research Building	Kornberg/ KMRB	Lab/Research	235,914	9,501,958	107,634	40,778	2,526	39	$824,895	$850,838	$3.61		612,702	-331	$8,391	1,760	
6	Schlegel Hall (Includes Gleason Wing)	Schlegel Hall	Classroom/Office	115,832	887,929	4,489	0	1,885	0	$69,098	$214,466	$1.85		134,945	-73	-$176	388	
7	Wallis Hall	Wallis	Office	49,598	444,629	3,828	5,557	1,553	94	$56,580	$150,553	$3.04		98,975	-53	$1,251	284	
8	Wilder Hall	Wilder	Dorm	78,822	339,414	0	0	3,749	95	$37,066	$75,937	$0.96		16,598	-10	-$180	46	

EXTRAPOLATION | LIGHTING

Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Measure Cost	Cost/sqft	Kw Savings	kWh Savings	mmBtu Savings	O&M Savings	Projected Savings (mmBtu)	Projected Savings ($)
8	Alpha Delta Phi	ADP Fraternity	Dorm	10,546	68,996	0	0	559	0	$6,814	$10,160	$0.96	0.0	2,221	-1	-$24	6.18	155.41
1	Ambulatory Care Facility	Ambulatory Care Facility	Hospital	224,609	4,740,048	51,190	19,472	2,587	1	$412,981	$656,793	$2.92	0.0	790,176	-533	$5,628	2162.71	68956.37
8	Anderson Hall	Anderson	Dorm	74,853	344,265	0	0	3,069	2	$34,992	$72,113	$0.96	0.0	15,762	-10	-$171	43.85	1103.07
5	Autoclave	Autoclave	Autoclave	5,618	332,848	0	4,263	0	3	$38,435	$20,262	$3.61	0.0	14,591	-8	$200	41.90	1397.95
4	Bausch and Lomb Hall	Bausch & Lomb	Classroom/Lab/Office	114,228	1,584,872	35,079	7,752	0	4	$140,425	$0	$0.00	0.0	0	0	$0	0.00	0.00
8	Burton Hall	Burton	Dorm	33,449	160,602	0	0	1,996	5	$18,328	$32,225	$0.96	0.0	7,043	-4	-$76	19.59	492.92
8	Community Living Center, Quad Annex, Sigma Phi Epsilon	Grad Living Ctr	Dorm	12,650	0	0	0	0	6	$0	$12,187	$0.96	0.0	2,664	-2	-$29	7.41	186.42
4	Computer Studies Building, Carlson Library	Comp Studies/Lib	Library/Classroom/Office/Lab	108,965	1,506,571	12,810	0	5,350	7	$125,170	$0	$0.00	0.0	0	0	$0	0.00	0.00
8	Crosby Hall	Crosby	Dorm	32,247	132,184	0	0	1,862	8	$15,863	$31,067	$0.96	0.0	6,790	-4	-$73	18.89	475.21
8	Danforth Dining Center	Danforth Dining	Dining/Kitchen	35,128	882,673	7,162	411	5,470	9	$83,068	$33,842	$0.96	0.0	7,397	-5	-$80	20.58	517.66
8	DeKiewiet	DeKiewiet	Office/Dorm	57,428	387,848	0	0	0	10	$27,149	$55,326	$0.96	0.0	12,093	-8	-$131	33.64	846.29
5	Del Monte Institute	Del Monte	Lab/Research	152,227	5,667,756	60,981	19,852	2,526	11	$479,602	$549,016	$3.61	0.0	395,355	-213	$5,414	1135.46	37879.35
8	Delta Kappa Epsilon	DKE Fraternity	Dorm	9,066	29,645	0	0	465	12	$3,726	$8,734	$0.96	0.0	1,909	-1	-$21	5.31	133.60
7	Dewey Hall	Dewey	Classroom/Office	122,890	953,165	9,457	4,901	0	13	$84,648	$373,027	$3.04	0.0	245,232	-132	$3,100	704.31	23237.17
8	Douglass Leadership House, Delta Upsilon, Medieval Hous	Douglass Leadership House	Dorm	8,389	35,476	0	0	359	14	$3,758	$8,082	$0.96	0.0	1,766	-1	-$19	4.91	123.62
8	Drama House	Drama House	Dorm	10,221	30,607	0	0	483	15	$3,856	$9,847	$0.96	0.0	2,152	-1	-$23	5.99	150.62
1	East River Road Medical Building	ERR_MB	Medical	92,078	2,104,586	0	0	0	16	$147,321	$269,251	$2.92	0.0	323,931	-219	$2,307	886.60	28268.52
1	Eastman Dental Center	Eastman Dental	Medical	92,029	1,414,307	20,056	6,559	0	17	$123,410	$269,108	$2.92	0.0	323,759	-219	$2,306	886.13	28253.48
1	Emergency Department	Emergency Dept/PICU	Hospital	175,848	4,991,867	19,340	10,157	13,079	18	$433,002	$514,208	$2.92	0.0	618,635	-418	$4,406	1693.20	53986.43
1	Fauver Stadium	Fauver	Office/Sports	63,097	256,300	557	922	0	19	$21,245	$184,506	$2.92	0.0	221,976	-150	$1,581	607.55	19371.17
8	Fredric Douglass Dinning Center, FDC, FDB	FDB	Kitchen/Dining	89,151	1,604,478	14,450	0	10,174	20	$149,240	$85,888	$0.96	0.0	18,773	-12	-$203	52.23	1313.78
1	G&J Wing	G&J Wing	Hospital	245,211	4,058,737	0	0	0	21	$284,112	$717,037	$2.92	0.0	862,655	-582	$6,144	2361.09	75281.36
1	Galisano Childrens Hospital at Strong	GCHaS	Hospital	271,861	5,232,009	69,473	4	35,819	22	$497,305	$794,965	$2.92	0.0	956,409	-646	$6,812	2617.69	83463.02
4	Gavett Hall	Gavett	Engineering/Offices/Lab/Classroom/Office	79,685	1,266,970	20,812	9,574	0	23	$123,841	$0	$0.00	0.0	0	0	$0	0.00	0.00
8	Genesee Hall	Genesee Hall	Dorm	71,403	531,510	7,781	0	5,066	24	$55,626	$68,789	$0.96	0.0	15,035	-9	-$163	41.83	1052.23
1	GG Wing	GG Wing	Hospital	106,212	2,210,213	79,476	17,321	19,047	25	$288,269	$310,582	$2.92	0.0	373,656	-252	$2,661	1022.70	32607.85
1	GG Wing (MCSP)	GG Wing (MCSP)	Hospital	11,801	245,579	8,831	1,925	2,116	26	$32,030	$34,509	$2.92	0.0	41,517	-28	$296	113.63	3623.09
8	Gilbert Hall	Gilbert	Dorm	72,775	411,496	0	0	3,359	27	$40,729	$70,111	$0.96	0.0	15,324	-10	-$166	42.63	1072.45
3	Goergen Athletics Center (GAC), Zornow	Goergen Gym	Athletics/Gymnasium/Pool/Fieldhouse	244,044	3,213,807	9,513	2,148	6,373	28	$255,747	$122,586	$0.50	0.0	68,810	-37	$276	197.62	5926.23
4	Goergen Hall for Biomedical Engineering and Optics	BME	Classroom/Lab/Office	113,427	2,584,883	25,056	5	16,064	29	$239,389	$0	$0.00	0.0	0	0	$0	0.00	0.00
8	Goler House	Goler House	Apartments	359,144	0	0	0	11,739	30	$41,675	$345,997	$0.96	0.0	75,625	-48	-$818	210.39	5292.54
4	Harkness Hall	Harkness	Engineering/Classroom/Lab/Office	61,990	386,027	2,913	1,547	1,343	31	$37,444	$0	$0.00	0.0	0	0	$0	0.00	0.00
8	Helen Wood Hall	Helen Wood Hall	Office/Dorm	119,064	874,192	16,880	0	4,996	32	$79,873	$114,706	$0.96	0.0	25,071	-16	-$271	69.75	1754.59
8	Hill Court	Hill Court	Dorm	151,494	640,033	0	0	10,092	33	$80,629	$145,948	$0.96	0.0	31,900	-20	-$345	88.75	2232.50
8	Hoeing Hall	Hoeing	Dorm	43,377	163,912	0	0	3,035	34	$22,248	$41,789	$0.96	0.0	9,134	-6	-$99	25.41	639.23
4	Hopeman Engineering Building	Hopeman	Engineering/Classroom/Lab/Office	72,252	750,957	7,858	0	3,321	35	$64,797	$0	$0.00	0.0	0	0	$0	0.00	0.00
7	Hoyt Hall	Hoyt	Auditorium/Office	19,940	234,585	3,969	2,239	0	36	$24,590	$60,527	$3.04	0.0	39,791	-21	$503	114.28	3770.44
4	Hutchison Hall	Hutchison	Lab/Classroom/Office	313,148	9,232,963	131,724	581	58,466	37	$863,299	$0	$0.00	0.0	0	0	$0	0.00	0.00
7	Hylan Building	Hylan	Classroom/Office	59,914	572,798	15,912	191	4,399	38	$57,281	$181,866	$3.04	0.0	119,561	-65	$1,511	343.38	11329.09
3	Interfaith Chapel	Interfaith Chapel	Assembly/Office	29,283	239,236	2,243	0	2,376	39	$25,307	$14,709	$0.50	0.0	8,257	-4	$33	23.71	711.09
1	James P. Wilmot Cancer Center, JWCC	Wilmot Cancer SMH	Hospital	275,536	4,568,850	64,781	10,657	14,825	40	$413,908	$805,712	$2.92	0.0	969,338	-654	$6,904	2653.08	84591.27
5	Kornberg Medical Research Building	KMRB or Kornberg	Lab/Research	235,914	9,501,958	107,634	40,778	2,526	41	$824,895	$850,838	$3.61	0.0	612,702	-331	$8,391	1759.68	58703.58
3	L Wing	L Wing	Hospital	777,371	1,280,639	0	0	0	42	$89,645	$390,483	$0.50	0.0	219,186	-118	$879	629.50	18877.26
7	Lattimore Hall	Lattimore	Classroom/Office	81,124	985,930	18,239	66	8,206	43	$99,402	$246,249	$3.04	0.0	161,886	-87	$2,046	464.94	15339.67
7	LeChase Hall	LeChase	Classroom/Office	79,567	578,810	2,786	0	2,526	44	$49,641	$241,522	$3.04	0.0	158,779	-86	$2,007	456.01	15045.26
3	Levine Pavilion	Levine	Assembly/Conference	66,517	1,117,178	16,444	569	2,526	45	$90,113	$33,412	$0.50	0.0	18,755	-10	$75	53.86	1615.26
8	Lovejoy Hall	Lovejoy	Dorm	42,622	291,236	0	0	2,526	46	$29,355	$41,062	$0.96	0.0	8,975	-6	-$97	24.97	628.10
6	Medical Center Annex	Med Ctr Annex	Office/Lab	79,099	1,619,642	7,864	4,924	2,526	47	$140,262	$146,454	$1.85	0.0	92,151	-50	-$120	264.66	7446.60
7	Meliora Hall	Meliora	Classroom/Office	130,970	1,932,773	17,626	6,475	2,526	48	$168,236	$397,554	$3.04	0.0	261,356	-141	$3,304	750.61	24765.01
7	Morey Hall	Morey	Classroom/Office	59,681	237,434	11,621	14,026	2,526	49	$76,033	$181,159	$3.04	0.0	119,096	-64	$1,505	342.04	11285.03
6	New York State Optics	NYS Optics	Office/Lab	4,383	108,481	1,890	0	2,526	50	$16,668	$8,115	$1.85	0.0	5,106	-3	-$7	14.67	412.63
1	O Wing	O Wing	Hospital	183,231	3,032,834	0	0	0	51	$212,298	$535,796	$2.92	0.0	644,607	-435	$4,591	1764.29	56252.94
8	O'Brien Hall	O'Brien	Dorm	54,381	373,480	2,398	0	2,526	52	$35,246	$52,390	$0.96	0.0	11,451	-7	-$124	31.86	801.39
1	Old Cancer Center	Old Cancer Center	Hospital	162,842	2,695,367	44,297	6,840	4,639	53	$231,906	$476,177	$2.92	0.0	572,881	-387	$4,080	1567.97	49993.61
1	OO Wing	OO Wing	Hospital	148,368	2,455,792	19,466	3,255	4,081	54	$199,038	$433,853	$2.92	0.0	521,961	-352	$3,717	1428.61	45549.97
8	Psi Upsilon	Psi U Fraternity	Dorm	13,670	41,417	0	0	502	55	$4,681	$13,170	$0.96	0.0	2,878	-2	-$31	8.01	201.45
1	Q Wing	Q Wing	Hospital	76,040	1,258,611	0	0	0	56	$88,103	$222,353	$2.92	0.0	267,509	-181	$1,905	732.17	23344.69
1	Q Wing	Q Wing	Hospital	76,040	1,258,611	0	0	0	89	$88,103	$222,353	$2.92	0.0	267,509	-181	$1,905	732.17	23344.69
1	R North	R North	Hospital	67,853	850,016	0	0	0	57	$59,501	$198,414	$2.92	0.0	238,708	-161	$1,700	653.34	20831.36
1	R North	R North	Hospital	67,853	850,016	0	0	0	90	$59,501	$198,414	$2.92	0.0	238,708	-161	$1,700	653.34	20831.36
3	RC Grounds	RC Grounds	Athletics/Fieldhouse	0	47,353	0	0	0	91	$3,315	$0	$0.50	0.0	0	0	$0	0.00	0.00
3	RC Sports	RC Sports	Athletics/Fieldhouse	0	3,683	0	0	0	92	$258	$0	$0.50	0.0	0	0	$0	0.00	0.00
7	Rettner Hall	Rettner Hall	Classroom/Office	20,605	353,312	4,386	0	2,319	58	$33,210	$62,546	$3.04	0.0	41,118	-22	$520	118.09	3896.18
4	Rush Rheese Library	Rush Rhees Libr	Library/Office/Classroom	349,284	2,174,743	29,867	26,057	0	59	$246,407	$0	$0.00	0.0	0	0	$0	0.00	0.00
	Rvr Cmp Parking	Rvr Cmp Parking	Parking	0	283,826	0	0	0	93	$19,868								0.00
1	R-Wing	R Wing	Hospital	175,565	1,349,335	40,940	1,552	11,863	60	$144,369	$513,380	$2.92	0.0	617,639	-417	$4,399	1690.48	53899.55
1	S Wing	S Wing	Hospital	318,662	6,631,166	88,790	23,373	22,852	61	$633,255	$931,820	$2.92	0.0	1,121,057	-757	$7,984	3068.33	97831.33
1	S Wing	S Wing	Hospital	318,662	6,631,166	88,790	23,373	22,852	94	$633,255	$931,820	$2.92	0.0	1,121,057	-757	$7,984	3068.33	97831.33
1	S Wing (MCSP)	S Wing (MCSP)	Hospital	35,407	736,796	9,866	2,597	2,539	62	$70,362	$103,536	$2.92	0.0	124,562	-84	$887	340.93	10870.15

SURVEYED BUILDINGS | LIGHTING																	
Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Measure Cost	Cost/sqft	kWh Savings	mmBtu Savings	O&M Savings	Projected Savings (mmBtu)	Projected Savings ($)
1	S Wing (MCSP)	S Wing (MCSP)	Hospital	35,407	736,796	9,866	2,597	2,539	95	$70,362	$103,536	$2.92	124,562	-84	$887	340.93	10870.15
3	Sage Art Gallery	Sage Arts Center	Gallery/Office	29,821	307,198	0	0	2,868	63	$31,685	$14,979	$0.50	8,408	-5	$34	24.15	724.16
5	Saunders Research Builidng	Saunders	Lab/Research	194,523	1,356,944	15,867	0	10,106	64	$131,752	$701,559	$3.61	505,203	-273	$6,919	1450.94	48404.06
7	Schlegel Hall (Includes Gleason Wing)	Schlegel Hall	Classroom/Office	115,832	887,929	4,489	0	1,885	65	$69,098	$351,603	$3.04	231,147	-125	$2,922	663.85	21902.58
8	Sig Ep	Sig Ep	Dorm	12,650	107,679	0	0	570	66	$9,561	$12,187	$0.96	2,664	-2	-$29	7.41	186.42
8	Sig Ep	Sig Ep	Dorm	12,650	107,679	0	0	570	96	$9,561	$12,187	$0.96	2,664	-2	-$29	7.41	186.42
8	Sigma Alpha MU	SAM Fraternity	Dorm	11,532	51,417	0	0	405	67	$5,037	$11,110	$0.96	2,428	-2	-$26	6.76	169.94
8	Sigma Chi	SC Fraternity	Dorm	8,909	61,171	0	0	541	68	$6,203	$8,583	$0.96	1,876	-1	-$20	5.22	131.29
6	Spurrier Gymnasium	Spurrier	Gymnasium/Classroom/Office	56,012	144,252	0	0	1,785	69	$16,433	$103,708	$1.85	65,254	-35	-$85	187.41	5273.13
	SRB parking lot	SRB parking lot	Parking	0	10,367	0	0	0	97	$726							0.00
3	Strong Auditorium	Strong Auditorium	Assembly	43,131	31,867	0	14,594	0	70	$54,039	$21,665	$0.50	12,161	-7	$49	34.93	1047.37
1	Strong Memorial Hospital	SMH	Hospital	1,030,971	23,723,418	297,981	63,177	37,327	71	$2,034,116	$3,014,725	$2.92	3,626,965	-2,448	$25,831	9927.00	316514.54
8	Susan B. Anthony Hall	SBA	Dorm	179,432	1,321,447	5,307	0	9,055	72	$124,945	$172,864	$0.96	37,783	-24	-$409	105.11	2644.21
7	Taylor Hall	Taylor	Office/Machine Shop	11,739	235,690	714	1,743	0	73	$22,727	$35,633	$3.04	23,426	-13	$296	67.28	2219.72
1	Telecom - Anx	Telecom - Anx	Hospital	0	764,918	0	0	0	98	$53,544	$0	$2.92	0	0	$0	0.00	0.00
1	Telecom - G/T	Telecom - G/T	Hospital	0	185,324	0	0	0	99	$12,973	$0	$2.92	0	0	$0	0.00	0.00
1	Telecom - HCrt	Telecom - HCrt	Hospital	0	138,450	0	0	0	100	$9,692	$0	$2.92	0	0	$0	0.00	0.00
1	Telecom - SMH	Telecom - SMH	Hospital	0	169,490	0	0	0	101	$11,864	$0	$2.92	0	0	$0	0.00	0.00
8	Theta Chi	TC Fraternity	Dorm	7,611	44,549	0	0	492	74	$4,867	$7,332	$0.96	1,603	-1	-$17	4.46	112.16
8	Tiernan Hall	Tiernan	Dorm	40,950	213,665	0	0	2,483	75	$23,771	$39,451	$0.96	8,623	-5	-$93	23.99	603.46
7	Todd Union	Todd Union	Office/Post Office	54,307	201,727	1,472	1,845	0	76	$20,753	$164,847	$3.04	108,372	-59	$1,370	311.24	10268.87
1	U Wing	U Wing	Hospital	214,258	3,546,406	0	0	0	77	$248,248	$626,526	$2.92	753,763	-509	$5,368	2063.05	65778.66
1	U Wing	U Wing	Hospital	214,258	3,546,406	0	0	0	102	$248,248	$626,526	$2.92	753,763	-509	$5,368	2063.05	65778.66
8	University Facilities Center	UFC	Offices/Utility	214,258	324,454	0	0	0	78	$22,712	$206,415	$0.96	45,116	-28	-$488	125.51	3157.42
7	University Health Services	UHS	Office/Medical	27,790	261,097	1,483	0	3,178	79	$29,641	$84,355	$3.04	55,456	-30	$701	159.27	5254.79
8	Valentine	Valentine	Dorm	57,428	467,753	0	0	0	80	$32,743	$55,326	$0.96	12,093	-8	-$131	33.64	846.29
8	Valentine	Valentine	Dorm	57,428	467,753	0	0	0	103	$32,743	$55,326	$0.96	12,093	-8	-$131	33.64	846.29
8	Valentine Verizon Cell tower	Valentine Verizon Cell tower	Dorm	0	3,106	0	0	0	104	$217	$0	$0.96	0	0	$0	0.00	0.00
7	Wallis Hall	Wallis	Office	49,598	444,629	3,828	5,557	1,553	81	$56,580	$150,553	$3.04	98,975	-53	$1,251	284.26	9378.45
7	Wegmans Hall	Wegmans Hall	Classroom/Office	60,976	833,752	7,518	0	1,198	82	$63,037	$185,090	$3.04	121,680	-66	$1,538	349.46	11529.90
8	Wilder Hall	Wilder	Dorm	78,822	339,414	0	0	3,749	83	$37,066	$75,937	$0.96	16,598	-10	-$180	46.17	1161.56
1	Wilmot Cancer SMD	Wilmot Cancer SMD	Hospital	0	1,411,320	20,011	3,225	4,579	105	$127,619	$0	$2.92	0	0	$0	0.00	0.00
4	Wilmot Cancer SMD	Wilmot	Office/Classroom/Lab	275,536	1,001,642	11,676	0	4,608	84	$87,127	$0	$0.00	0	0	$0	0.00	0.00
8	Wilson Commons	Wilson Commons	Dining/Commons/Office	104,338	2,240,639	12,699	6,117	0	85	$179,271	$100,519	$0.96	21,970	-14	-$238	61.12	1537.58
1	X Wing	X Wing	Hospital	62,002	1,026,256	0	0	0	86	$71,838	$181,304	$2.92	218,123	-147	$1,553	597.00	19034.97
			EXTRAPOLATION TOTAL	10,351,862	143,429,796	1,485,451	344,026	411,955	3,661	$12,774,262	$20,221,963	$1.95	25,232,121	-8,000	158,781	45,142	$1,391,084

See Pages 115 and 116 for Aggregated Results from all selected extrapolated measures.

SURVEYED BUILDINGS | Lab Airflow Optimization

Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Measure Cost	Cost/sqft	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	Projected Savings (mmBtu)	Projected Savings ($)
1	Ambulatory Care Facility	Ambulatory Care Facility	Hospital	224,609	4,740,048	51,190	19,472	2,587	3	$412,981		$0.00				0	
2	Delmonte Institute	Del Monte	Lab/Research	152,227	5,667,756	60,981	19,852	2,526	12	$479,602	$234,246	$1.54	124,439	2,813	3,619	6,856	
3	Fauver Stadium	Fauver	Office/Sports	63,097	256,300	557	922	0	20	$21,245		$0.00				0	
4	Goergen Hall for Biomedical Engineering and Optics	GCHaS	Classroom/Lab/Office	271,861	5,232,009	69,473	4	35,819	27	$497,305	$183,200	$0.67	88,370	626	884	1,811	
5	Kornberg Medical Research Building	KMRB or Kornberg	Lab/Research	235,914	9,501,958	107,634	40,778	2,526	39	$824,895	$396,668	$1.68	48,514	1,233	1,703	3,102	
6	Schlegel Hall (Includes Gleason Wing)	Schlegel Hall	Classroom/Office	115,832	887,929	4,489	0	1,885	87	$69,098		$0.00				0	
7	Wallis Hall	Wallis	Office	49,598	444,629	3,828	5,557	1,553	94	$56,580		$0.00				0	
8	Wilder Hall	Wilder	Dorm	78,822	339,414	0	0	3,749	95	$37,066		$0.00				0	

EXTRAPOLATION | Lab Airflow Optimization

Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Measure Cost	Cost/sqft	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	Projected Savings (mmBtu)	Projected Savings ($)
	Alpha Delta Phi	ADP Fraternity	Dorm	10,546	68,996	0	0	559	0	$6,814	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Ambulatory Care Facility	Ambulatory Care Facility	Hospital	224,609	4,740,048	51,190	19,472	2,587	1	$412,981	$151,358	$0.67	73,010.1	517.1	730.3	1,496.5	28,509.4
	Anderson Hall	Anderson	Dorm	74,853	344,265	0	0	3,069	2	$34,992	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Autoclave	Autoclave	Autoclave	5,618	332,848	0	4,263	0	3	$38,435	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Bausch and Lomb Hall	Bausch & Lomb	Classroom/Lab/Office	114,228	1,584,872	35,079	7,752	0	4	$140,425	$76,975	$0.67	37,130.3	263.0	371.4	761.1	14,498.9
	Burton Hall	Burton	Dorm	33,449	160,602	0	0	1,996	5	$18,328	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Community Living Center, Quad Annex, Sigma Phi Epsilon	Grad Living Ctr	Dorm	12,650	0	0	0	0	6	$0	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Computer Studies Building, Carlson Library	Comp Studies/Lib	Library/Classroom/Office/Lab	108,965	1,506,571	12,810	0	5,350	7	$125,170	$73,428	$0.67	35,419.5	250.9	354.3	726.0	13,830.8
	Crosby Hall	Crosby	Dorm	32,247	132,184	0	0	1,862	8	$15,863	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Danforth Dining Center	Danforth Dining	Dining/Kitchen	35,128	882,673	7,162	411	5,470	9	$83,068	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	DeKiewiet	DeKiewiet	Office/Dorm	57,428	387,848	0	0	0	10	$27,149	$0	$0.00	0.0	0.0	0.0	0.0	0.0
2	Delmonte Institute	Del Monte	Lab/Research	152,227	5,667,756	60,981	19,852	2,526	11	$479,602	$234,246	$1.54	124,439.3	2,812.7	3,619.0	6,856.4	125,370.9
	Delta Kappa Epsilon	DKE Fraternity	Dorm	9,066	29,645	0	0	465	12	$3,726	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Dewey Hall	Dewey	Classroom/Office	122,890	953,165	9,457	4,901	0	13	$84,648	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Douglass Leadership House, Delta Upsilon, Medieval Hous	Douglass Leadership House	Dorm	8,389	35,476	0	0	359	14	$3,758	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Drama House	Drama House	Dorm	10,221	30,607	0	0	483	15	$3,856	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	East River Road Medical Building	ERR_MB	Medical	92,078	2,104,586	0	0	0	16	$147,321	$62,049	$0.67	29,930.3	212.0	299.4	613.5	11,687.4
4	Eastman Dental Center	Eastman Dental	Medical	92,029	1,414,307	20,056	6,559	0	17	$123,410	$62,016	$0.67	29,914.4	211.9	299.2	613.2	11,681.2
4	Emergency Department	Emergency Dept/PICU	Hospital	175,848	4,991,867	19,340	10,157	13,079	18	$433,002	$118,499	$0.67	57,160.1	404.8	571.8	1,171.7	22,320.2
	Fauver Stadium	Fauver	Office/Sports	63,097	256,300	557	922	0	19	$21,245	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Fredric Douglass Dinning Center, FDC, FDB	FDB	Kitchen/Dining	89,151	1,604,478	14,450	0	10,174	20	$149,240	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	G&J Wing	G&J Wing	Hospital	245,211	4,058,737	0	0	0	21	$284,112	$165,241	$0.67	79,706.9	564.5	797.3	1,633.8	31,124.4
4	Galisano Childrens Hospital at Strong	GCHaS	Hospital	271,861	5,232,009	69,473	4	35,819	22	$497,305	$183,200	$0.67	88,369.5	625.9	884.0	1,811.4	34,507.1
4	Gavett Hall	Gavett	Engineering/Offices/Lab/Classroom/Office	79,685	1,266,970	20,812	9,574	0	23	$123,841	$53,697	$0.67	25,901.9	183.5	259.1	530.9	10,114.3
	Genesee Hall	Genesee Hall	Dorm	71,403	531,510	7,781	0	5,066	24	$55,626	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	GG Wing	GG Wing	Hospital	106,212	2,210,213	79,476	17,321	19,047	25	$288,269	$71,574	$0.67	34,524.7	244.5	345.4	707.7	13,481.4
4	GG Wing (MCSP)	GG Wing (MCSP)	Hospital	11,801	245,579	8,831	1,925	2,116	26	$32,030	$7,953	$0.67	3,836.1	27.2	38.4	78.6	1,497.9
	Gilbert Hall	Gilbert	Dorm	72,775	411,496	0	0	3,359	27	$40,729	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Goergen Athletics Center (GAC), Zornow	Goergen Gym	Athletics/Gymnasium/Pool/Fieldhouse	244,044	3,213,807	9,513	2,148	6,373	28	$255,747	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Goergen Hall for Biomedical Engineering and Optics	BME	Classroom/Lab/Office	113,427	2,584,883	25,056	5	16,064	29	$239,389	$76,435	$0.67	36,869.9	261.1	368.8	755.7	14,397.2
	Goler House	Goler House	Apartments	359,144	0	0	0	11,739	30	$41,675	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Harkness Hall	Harkness	Engineering/Classroom/Lab/Office	61,990	386,027	2,913	1,547	1,343	31	$37,444	$41,773	$0.67	20,150.1	142.7	201.6	413.0	7,868.3
	Helen Wood Hall	Helen Wood Hall	Office/Dorm	119,064	874,192	16,880	0	4,996	32	$79,873	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Hill Court	Hill Court	Dorm	151,494	640,033	0	0	10,092	33	$80,629	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Hoeing Hall	Hoeing	Dorm	43,377	163,912	0	0	3,035	34	$22,248	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Hopeman Engineering Building	Hopeman	Engineering/Classroom/Lab/Office	72,252	750,957	7,858	0	3,321	35	$64,797	$48,689	$0.67	23,485.8	166.3	234.9	481.4	9,170.9
	Hoyt Hall	Hoyt	Auditorium/Office	19,940	234,585	3,969	2,239	0	36	$24,590	$0	$0.00	0.0	0.0	0.0	0.0	0.0
5	Hutchison Hall	Hutchison	Lab/Classroom/Office	313,148	9,232,963	131,724	581	58,466	37	$863,299	$526,530	$1.68	64,397.0	1,636.7	2,260.8	4,117.2	74,492.0
	Hylan Building	Hylan	Classroom/Office	59,914	572,798	15,912	191	4,399	38	$57,281	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Interfaith Chapel	Interfaith Chapel	Assembly/Office	29,283	239,236	2,243	0	2,376	39	$25,307	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	James P. Wilmot Cancer Center, JWCC	Wilmot Cancer SMH	Hospital	275,536	4,568,850	64,781	10,657	14,825	40	$413,908	$185,676	$0.67	89,564.1	634.4	895.9	1,835.9	34,973.5
5	Kornberg Medical Research Building	KMRB or Kornberg	Lab/Research	235,914	9,501,958	107,634	40,778	2,526	41	$824,895	$396,668	$1.68	48,514.3	1,233.0	1,703.2	3,101.8	56,119.5
	L Wing	L Wing	Hospital	777,371	1,280,639	0	0	0	42	$89,645	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Lattimore Hall	Lattimore	Classroom/Office	81,124	985,930	18,239	66	8,206	43	$99,402	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	LeChase Hall	LeChase	Classroom/Office	79,567	578,810	2,786	0	2,526	44	$49,641	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Levine Pavilion	Levine	Assembly/Conference	66,517	1,117,178	16,444	569	2,526	45	$90,113	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Lovejoy Hall	Lovejoy	Dorm	42,622	291,236	0	0	2,526	46	$29,355	$0	$0.00	0.0	0.0	0.0	0.0	0.0
5	Medical Center Annex	Med Ctr Annex	Office/Lab	79,099	1,619,642	7,864	4,924	2,526	47	$140,262	$132,998	$1.68	16,266.2	413.4	571.1	1,040.0	18,816.2
	Meliora Hall	Meliora	Classroom/Office	130,970	1,932,773	17,626	6,475	2,526	48	$168,236	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Morey Hall	Morey	Classroom/Office	59,681	237,434	11,621	14,026	2,526	49	$76,033	$0	$0.00	0.0	0.0	0.0	0.0	0.0
2	New York State Optics	NYS Optics	Office/Lab	4,383	108,481	1,890	0	2,526	50	$16,668	$6,745	$1.54	3,582.9	81.0	104.2	197.4	3,609.7
4	O Wing	O Wing	Hospital	183,231	3,032,834	0	0	0	51	$212,298	$123,474	$0.67	59,559.8	421.8	595.8	1,220.8	23,257.3
	O'Brien Hall	O'Brien	Dorm	54,381	373,480	2,398	0	2,526	52	$35,246	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Old Cancer Center	Old Cancer Center	Hospital	162,842	2,695,367	44,297	6,840	4,639	53	$231,906	$109,735	$0.67	52,932.5	374.9	529.5	1,085.0	20,669.4
2	OO Wing	OO Wing	Hospital	148,368	2,455,792	19,466	3,255	4,081	54	$199,038	$228,309	$1.54	121,284.9	2,741.4	3,527.3	6,682.6	122,192.9
	Psi Upsilon	Psi U Fraternity	Dorm	13,670	41,417	0	0	502	87	$4,681	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Q Wing	Q Wing	Hospital	76,040	1,258,611	0	0	0	88	$88,103	$51,241	$0.67	24,717.0	175.1	247.2	506.6	9,651.7
4	R North	R North	Hospital	67,853	850,016	0	0	0	55	$59,501	$45,724	$0.67	22,056.0	156.2	220.6	452.1	8,612.5
	Rettner Hall	Rettner Hall	Classroom/Office	20,605	353,312	4,386	0	2,319	56	$33,210	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Rush Rheese Library	Rush Rhees Libr	Library/Office/Classroom	349,284	2,174,743	29,867	26,057	0	89	$246,407	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	R-Wing	R Wing	Hospital	175,565	1,349,335	40,940	1,552	11,863	57	$144,369	$118,308	$0.67	57,068.1	404.2	570.9	1,169.8	22,284.3
4	S Wing	S Wing	Hospital	318,662	6,631,166	88,790	23,373	22,852	90	$633,255	$214,738	$0.67	103,582.5	733.6	1,036.1	2,123.2	40,447.5
4	S Wing (MCSP)	S Wing (MCSP)	Hospital	35,407	736,796	9,866	2,597	2,539	91	$70,362	$23,860	$0.67	11,509.2	81.5	115.1	235.9	4,494.2
	Sage Art Gallery	Sage Arts Center	Gallery/Office	29,821	307,198	0	0	2,868	92	$31,685	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Saunders Research Builidng	Saunders	Lab/Research	194,523	1,356,944	15,867	0	10,106	58	$131,752	$131,084	$0.67	63,230.5	447.8	632.5	1,296.1	24,690.6
	Schlegel Hall (Includes Gleason Wing)	Schlegel Hall	Classroom/Office	115,832	887,929	4,489	0	1,885	59	$69,098	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Sig Ep	Sig Ep	Dorm	12,650	107,679	0	0	570	93	$9,561	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Sigma Alpha MU	SAM Fraternity	Dorm	11,532	51,417	0	0	405	60	$5,037	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Sigma Chi	SC Fraternity	Dorm	8,909	61,171	0	0	541	61	$6,203	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Spurrier Gymnasium	Spurrier	Gymnasium/Classroom/Office	56,012	144,252	0	0	1,785	94	$16,433	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Strong Auditorium	Strong Auditorium	Assembly	43,131	31,867	0	14,594	0	62	$54,039	$0	$0.00	0.0	0.0	0.0	0.0	0.0
5	Strong Memorial Hospital	SMH	Hospital	1,030,971	23,723,418	297,981	63,177	37,327	95	$2,034,116	$1,733,485	$1.68	212,013.1	5,388.3	7,443.3	13,555.0	245,248.6
4	Susan B. Anthony Hall	SBA	Dorm	179,432	1,321,447	5,307	0	9,055	63	$124,945	$120,914	$0.67	58,325.1	413.1	583.4	1,195.5	22,775.1

SURVEYED BUILDINGS | Lab Airflow Optimization																	
Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Measure Cost	Cost/sqft	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	Projected Savings (mmBtu)	Projected Savings ($)
	Taylor Hall	Taylor	Office/Machine Shop	11,739	235,690	714	1,743	0	64	$22,727	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Theta Chi	TC Fraternity	Dorm	7,611	44,549	0	0	492	65	$4,867	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Tiernan Hall	Tiernan	Dorm	40,950	213,665	0	0	2,483	66	$23,771	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Todd Union	Todd Union	Office/Post Office	54,307	201,727	1,472	1,845	0	96	$20,753	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	U Wing	U Wing	Hospital	214,258	3,546,406	0	0	0	67	$248,248	$144,383	$0.67	69,645.5	493.3	696.7	1,427.6	27,195.6
	University Facilities Center	UFC	Offices/Utility	214,258	324,454	0	0	0	68	$22,712	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	University Health Services	UHS	Office/Medical	27,790	261,097	1,483	0	3,178	69	$29,641	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Valentine	Valentine	Dorm	57,428	467,753	0	0	0	97	$32,743	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Wallis Hall	Wallis	Office	49,598	444,629	3,828	5,557	1,553	70	$56,580	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Wegmans Hall	Wegmans Hall	Classroom/Office	60,976	833,752	7,518	0	1,198	71	$63,037	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Wilder Hall	Wilder	Dorm	78,822	339,414	0	0	3,749	72	$37,066	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Wilmot Cancer SMD	Wilmot	Office/Classroom/Lab	275,536	1,001,642	11,676	0	4,608	73	$87,127	$185,676	$0.67	89,564.1	634.4	895.9	1,835.9	34,973.5
	Wilson Commons	Wilson Commons	Dining/Commons/Office	104,338	2,240,639	12,699	6,117	0	98	$179,271	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	X Wing	X Wing	Hospital	62,002	1,026,256	0	0	0	99	$71,838	$41,781	$0.67	20,154.0	142.7	201.6	413.1	7,869.8
4	OO Wing	OO Wing	Hospital	148,368	2,455,792	19,466	3,255	4,081	100	$199,038	$99,981	$0.67	48,227.7	341.6	482.4	988.6	18,832.2
	Parking Garage	Parking Garage	Parking	0	749,346	0	0	0	101	$52,454	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	Q Wing	Q Wing	Hospital	76,040	1,258,611	0	0	0	74	$88,103	$51,241	$0.67	24,717.0	175.1	247.2	506.6	9,651.7
4	R North	R North	Hospital	67,853	850,016	0	0	0	75	$59,501	$45,724	$0.67	22,056.0	156.2	220.6	452.1	8,612.5
	RC Grounds	RC Grounds	Athletics/Fieldhouse	0	47,353	0	0	0	76	$3,315	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	RC Sports	RC Sports	Athletics/Fieldhouse	0	3,683	0	0	0	77	$258	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Rvr Cmp Parking	Rvr Cmp Parking	Parking	0	283,826	0	0	0	102	$19,868	$0	$0.00	0.0	0.0	0.0	0.0	0.0
4	S Wing	S Wing	Hospital	318,662	6,631,166	88,790	23,373	22,852	78	$633,255	$214,738	$0.67	103,582.5	733.6	1,036.1	2,123.2	40,447.5
4	S Wing (MCSP)	S Wing (MCSP)	Hospital	35,407	736,796	9,866	2,597	2,539	79	$70,362	$23,860	$0.67	11,509.2	81.5	115.1	235.9	4,494.2
	Sig Ep	Sig Ep	Dorm	12,650	107,679	0	0	570	80	$9,561	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	SRB parking lot	SRB parking lot	Parking	0	10,367	0	0	0	103	$726	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Telecom - Anx	Telecom - Anx	Hospital	0	764,918	0	0	0	104	$53,544	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Telecom - G/T	Telecom - G/T	Hospital	0	185,324	0	0	0	81	$12,973	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Telecom - HCrt	Telecom - HCrt	Hospital	0	138,450	0	0	0	82	$9,692	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Telecom - SMH	Telecom - SMH	Hospital	0	169,490	0	0	0	83	$11,864	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	U Wing	U Wing	Hospital	214,258	3,546,406	0	0	0	105	$248,248	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Valentine	Valentine	Dorm	57,428	467,753	0	0	0	84	$32,743	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Valentine Verizon Cell tower	Valentine Verizon Cell tower	Dorm	0	3,106	0	0	0	85	$217	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	Wilmot Cancer SMD	Wilmot Cancer SMD	Hospital	0	1,411,320	20,011	3,225	4,579	86	$127,619	$0	$0.00	0.0	0.0	0.0	0.0	0.0
	X Wing	X Wing	Hospital	62,002	1,026,256	0	0	0	106	$71,838	$0	$0.00	0.0	0.0	0.0	0.0	0.0
			EXTRAPOLATION TOTAL	10,351,862	143,429,796	1,485,451	344,026	411,955	3,661	$12,774,262	$5,981,652	$0.58	2,439,423	13,659	19,747	51,838	$930,581

See Pages 115 and 116 for Aggregated Results from all selected extrapolated measures.

SURVEYED BUILDINGS | Heat Recovery Heat Pump

Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water	Current Steam (MLBS)	Current Hot Water	Current Natural Gas	Current Domestic Water	Current Utility Cost	Measure Cost	Cost/sqft	Kw Savings	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	O&M Savings	Projected Savings	Projected Savings ($)
1	Ambulatory Care Facility	Ambulatory Care Facility	Hospital	224,609	4,740,048	51,190	19,472	2,587	3		$412,981		$0.00						0	
2	Del Monte Institute	Del Monte	Lab/Research	152,227	5,667,756	60,981	19,852	2,526	12		$479,602	$752,029	$4.94		-557,929	4,062	5,876		8,034	
3	Fauver Stadium	Fauver	Office/Sports	63,097	256,300	557	922	0	20		$21,245		$0.00						0	
4	Goergen Hall for Biomedical Engineering and Optics	GCHaS	Classroom/Lab/Office	271,861	5,232,009	69,473	4	35,819	27		$497,305	$572,213	$2.10		-448,516	3,273	4,733		6,476	
5	Kornberg Medical Research Building	KMRB or Kornberg	Lab/Research	235,914	9,501,958	107,634	40,778	2,526	39		$824,895	$922,885	$3.91		-770,069	5,662	8,173		11,207	
6	Schlegel Hall (Includes Gleason Wing)	Schlegel Hall	Classroom/Office	115,832	887,929	4,489	0	1,885	87		$69,098		$0.00						0	
7	Wallis Hall	Wallis	Office	49,598	444,629	3,828	5,557	1,553	94		$56,580		$0.00						0	
8	Wilder Hall	Wilder	Dorm	78,822	339,414	0	0	3,749	95		$37,066		$0.00						0	

EXTRAPOLATION | Heat Recovery Heat Pump

Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water	Current Steam (MLBS)	Current Hot Water	Current Natural Gas	Current Domestic Water	Current Utility Cost	Measure Cost	Cost/sqft	Kw Savings	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	O&M Savings	Projected Savings	Projected Savings ($)
	Alpha Delta Phi	ADP Fraternity	Dorm	10,546	68,996	0	0	559	0		$6,814	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
5	Ambulatory Care Facility	Ambulatory Care Facility	Hospital	224,609	4,740,048	51,190	19,472	2,587	1		$412,981	$878,660	$3.91	0.0	-733,167.0	5,390.4	7,781.0	0.0	10,670	165,158.7
	Anderson Hall	Anderson	Dorm	74,853	344,265	0	0	3,069	2		$34,992	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Autoclave	Autoclave	Autoclave	5,618	332,848	0	4,263	0	3		$38,435	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
4	Bausch and Lomb Hall	Bausch & Lomb	Classroom/Lab/Office	114,228	1,584,872	35,079	7,752	0	4		$140,425	$350,000	$2.10	0.0	-188,453.1	1,375.1	1,988.9	0.0	2,721	42,061.1
	Burton Hall	Burton	Dorm	33,449	160,602	0	0	1,996	5		$18,328	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Community Living Center, Quad Annex, Sigma Phi Epsilon	Grad Living Ctr	Dorm	12,650	0	0	0	0	6		$0	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
4	Computer Studies Building, Carlson Library	Comp Studies/Lib	Library/Classroom/Office/Lab	108,965	1,506,571	12,810	0	5,350	7		$125,170	$350,000	$2.10	0.0	-179,770.2	1,311.7	1,897.2	0.0	2,596	40,123.1
	Crosby Hall	Crosby	Dorm	32,247	132,184	0	0	1,862	8		$15,863	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
5	Danforth Dining Center	Danforth Dining	Dining/Kitchen	35,128	882,673	7,162	411	5,470	9		$83,068	$350,000	$3.91	0.0	-114,664.5	843.0	1,216.9	0.0	1,669	25,830.2
	DeKiewiet	DeKiewiet	Office/Dorm	57,428	387,848	0	0	0	10		$27,149	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
2	Delmonte Institute	Del Monte	Lab/Research	152,227	5,667,756	60,981	19,852	2,526	11		$479,602	$752,029	$4.94	0.0	-557,929.4	4,062.1	5,875.9	0.0	8,034	124,150.6
	Delta Kappa Epsilon	DKE Fraternity	Dorm	9,066	29,645	0	0	465	12		$3,726	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Dewey Hall	Dewey	Classroom/Office	122,890	953,165	9,457	4,901	0	13		$84,648	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Douglass Leadership House, Delta Upsilon, Medieval Hous	Douglass Leadership House	Dorm	8,389	35,476	0	0	359	14		$3,758	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Drama House	Drama House	Dorm	10,221	30,607	0	0	483	15		$3,856	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	East River Road Medical Building	ERR_MB	Medical	92,078	2,104,586	0	0	0	16		$147,321	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Eastman Dental Center	Eastman Dental	Medical	92,029	1,414,307	20,056	6,559	0	17		$123,410	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Emergency Department	Emergency Dept/PICU	Hospital	175,848	4,991,867	19,340	10,157	13,079	18		$433,002	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Fauver Stadium	Fauver	Office/Sports	63,097	256,300	557	922	0	19		$21,245	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Fredric Douglass Dinning Center, FDC, FDB	FDB	Kitchen/Dining	89,151	1,604,478	14,450	0	10,174	20		$149,240	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	G&J Wing	G&J Wing	Hospital	245,211	4,058,737	0	0	0	21		$284,112	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Galisano Childrens Hospital at Strong	GCHaS	Hospital	271,861	5,232,009	69,473	4	35,819	22		$497,305	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
4	Gavett Hall	Gavett	Engineering/Offices/Lab/Classroom/Office	79,685	1,266,970	20,812	9,574	0	23		$123,841	$350,000	$2.10	0.0	-131,464.1	959.3	1,387.4	0.0	1,898	29,341.6
	Genesee Hall	Genesee Hall	Dorm	71,403	531,510	7,781	0	5,066	24		$55,626	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
5	GG Wing	GG Wing	Hospital	106,212	2,210,213	79,476	17,321	19,047	25		$288,269	$415,498	$3.91	0.0	-346,697.5	2,549.0	3,679.4	0.0	5,046	78,099.7
5	GG Wing (MCSP)	GG Wing (MCSP)	Hospital	11,801	245,579	8,831	1,925	2,116	26		$32,030	$350,000	$3.91	0.0	-38,521.9	283.2	408.8	0.0	561	8,677.7
	Gilbert Hall	Gilbert	Dorm	72,775	411,496	0	0	3,359	27		$40,729	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Goergen Athletics Center (GAC), Zornow	Goergen Gym	Athletics/Gymnasium/Pool/Fieldhouse	244,044	3,213,807	9,513	2,148	6,373	28		$255,747	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
4	Goergen Hall for Biomedical Engineering and Optics	BME	Classroom/Lab/Office	113,427	2,584,883	25,056	5	16,064	29		$239,389	$350,000	$2.10	0.0	-187,131.6	1,365.4	1,974.9	0.0	2,702	41,766.1
	Goler House	Goler House	Apartments	359,144	0	0	0	11,739	30		$41,675	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
4	Harkness Hall	Harkness	Engineering/Classroom/Lab/Office	61,990	386,027	2,913	1,547	1,343	31		$37,444	$350,000	$2.10	0.0	-102,271.0	746.2	1,079.3	0.0	1,477	22,826.0
	Helen Wood Hall	Helen Wood Hall	Office/Dorm	119,064	874,192	16,880	0	4,996	32		$79,873	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Hill Court	Hill Court	Dorm	151,494	640,033	0	0	10,092	33		$80,629	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Hoeing Hall	Hoeing	Dorm	43,377	163,912	0	0	3,035	34		$22,248	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
4	Hopeman Engineering Building	Hopeman	Engineering/Classroom/Lab/Office	72,252	750,957	7,858	0	3,321	35		$64,797	$350,000	$2.10	0.0	-119,201.2	869.8	1,258.0	0.0	1,721	26,604.7
4	Hoyt Hall	Hoyt	Auditorium/Office	19,940	234,585	3,969	2,239	0	36		$24,590	$350,000	$2.10	0.0	-32,897.0	240.0	347.2	0.0	475	7,342.3
5	Hutchison Hall	Hutchison	Lab/Classroom/Office	313,148	9,232,963	131,724	581	58,466	37		$863,299	$1,225,021	$3.91	0.0	-1,022,175.3	7,515.3	10,848.2	0.0	14,876	230,262.8
	Hylan Building	Hylan	Classroom/Office	59,914	572,798	15,912	191	4,399	38		$57,281	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Interfaith Chapel	Interfaith Chapel	Assembly/Office	29,283	239,236	2,243	0	2,376	39		$25,307	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
5	James P. Wilmot Cancer Center, JWCC	Wilmot Cancer SMH	Hospital	275,536	4,568,850	64,781	10,657	14,825	40		$413,908	$1,077,885	$3.91	0.0	-899,402.5	6,612.6	9,545.2	0.0	13,089	202,606.1
5	Kornberg Medical Research Building	KMRB or Kornberg	Lab/Research	235,914	9,501,958	107,634	40,778	2,526	41		$824,895	$922,885	$3.91	0.0	-770,068.6	5,661.7	8,172.6	0.0	11,207	173,471.4
	L Wing	L Wing	Hospital	777,371	1,280,639	0	0	0	42		$89,645	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
4	Lattimore Hall	Lattimore	Classroom/Office	81,124	985,930	18,239	66	8,206	43		$99,402	$350,000	$2.10	0.0	-133,838.2	976.6	1,412.5	0.0	1,932	29,871.5
	LeChase Hall	LeChase	Classroom/Office	79,567	578,810	2,786	0	2,526	44		$49,641	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Levine Pavilion	Levine	Assembly/Conference	66,517	1,117,178	16,444	569	2,526	45		$90,113	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Lovejoy Hall	Lovejoy	Dorm	42,622	291,236	0	0	2,526	46		$29,355	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
5	Medical Center Annex	Med Ctr Annex	Office/Lab	79,099	1,619,642	7,864	4,924	2,526	47		$140,262	$350,000	$3.91	0.0	-258,194.3	1,898.3	2,740.2	0.0	3,758	58,162.8
	Meliora Hall	Meliora	Classroom/Office	130,970	1,932,773	17,626	6,475	2,526	48		$168,236	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
4	Morey Hall	Morey	Classroom/Office	59,681	237,434	11,621	14,026	2,526	49		$76,033	$350,000	$2.10	0.0	-98,461.6	718.4	1,039.1	0.0	1,422	21,975.8
2	New York State Optics	NYS Optics	Office/Lab	4,383	108,481	1,890	0	2,526	50		$16,668	$350,000	$4.94	0.0	-16,064.2	117.0	169.2	0.0	231	3,574.6
	O Wing	O Wing	Hospital	183,231	3,032,834	0	0	0	51		$212,298	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	O'Brien Hall	O'Brien	Dorm	54,381	373,480	2,398	0	2,526	52		$35,246	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
5	Old Cancer Center	Old Cancer Center	Hospital	162,842	2,695,367	44,297	6,840	4,639	53		$231,906	$637,032	$3.91	0.0	-531,548.6	3,908.1	5,641.2	0.0	7,736	119,740.6
4	OO Wing	OO Wing	Hospital	148,368	2,455,792	19,466	3,255	4,081	54		$199,038	$350,000	$2.10	0.0	-244,777.6	1,786.1	2,583.3	0.0	3,534	54,632.2
	Psi Upsilon	Psi U Fraternity	Dorm	13,670	41,417	0	0	502	87		$4,681	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Q Wing	Q Wing	Hospital	76,040	1,258,611	0	0	0	88		$88,103	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	R North	R North	Hospital	67,853	850,016	0	0	0	55		$59,501	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Rettner Hall	Rettner Hall	Classroom/Office	20,605	353,312	4,386	0	2,319	56		$33,210	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Rush Rheese Library	Rush Rhees Libr	Library/Office/Classroom	349,284	2,174,743	29,867	26,057	0	89		$246,407	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	R-Wing	R Wing	Hospital	175,565	1,349,335	40,940	1,552	11,863	57		$144,369	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	S Wing	S Wing	Hospital	318,662	6,631,166	88,790	23,373	22,852	90		$633,255	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	S Wing (MCSP)	S Wing (MCSP)	Hospital	35,407	736,796	9,866	2,597	2,539	91		$70,362	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Sage Art Gallery	Sage Arts Center	Gallery/Office	29,821	307,198	0	0	2,868	92		$31,685	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
4	Saunders Research Builidng	Saunders	Lab/Research	194,523	1,356,944	15,867	0	10,106	58		$131,752	$409,432	$2.10	0.0	-320,923.6	2,341.7	3,386.9	0.0	4,634	71,627.3
	Schlegel Hall (Includes Gleason Wing)	Schlegel Hall	Classroom/Office	115,832	887,929	4,489	0	1,885	59		$69,098	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Sig Ep	Sig Ep	Dorm	12,650	107,679	0	0	570	93		$9,561	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Sigma Alpha MU	SAM Fraternity	Dorm	11,532	51,417	0	0	405	60		$5,037	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Sigma Chi	SC Fraternity	Dorm	8,909	61,171	0	0	541	61		$6,203	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
	Spurrier Gymnasium	Spurrier	Gymnasium/Classroom/Office	56,012	144,252	0	0	1,785	94		$16,433	$0	$0.00	0.0	0.0	0.0	0.0	0.0	0	0.0
4	Strong Auditorium	Strong Auditorium	Assembly	43,131	31,867	0	14,594	0	62		$54,039	$350,000	$2.10	0.0	-71,157.4	519.2	751.0	0.0	1,027	15,881.7
4	Strong Memorial Hospital	SMH	Hospital	#######	########	297,981	63,177	37,327	95		$2,034,116	$2,169,987	$2.10	0.0	-1,700,893.8	12,410.9	17,950.6	0.0	24,558	379,624.5
4	Susan B. Anthony Hall	SBA	Dorm	179,432	1,321,447	5,307	0	9,055	63		$124,945	$377,668	$2.10	0.0	-296,026.5	2,160.0	3,124.2	0.0	4,274	66,070.5

SURVEYED BUILDINGS | Heat Recovery Heat Pump																	
Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas (mmBtu)	Current Utility Cost	Measure Cost	Cost/sqft	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	Projected Savings	Projected Savings ($)
4	Taylor Hall	Taylor	Office/Machine Shop	11,739	235,690	714	1,743	0	64	$22,727	$350,000	$2.10	-19,367.0	141.3	204.4	280	4,322.5
	Theta Chi	TC Fraternity	Dorm	7,611	44,549	0	0	492	65	$4,867	$0	$0.00	0.0	0.0	0.0	0	0.0
	Tiernan Hall	Tiernan	Dorm	40,950	213,665	0	0	2,483	66	$23,771	$0	$0.00	0.0	0.0	0.0	0	0.0
	Todd Union	Todd Union	Office/Post Office	54,307	201,727	1,472	1,845	0	96	$20,753	$0	$0.00	0.0	0.0	0.0	0	0.0
	U Wing	U Wing	Hospital	214,258	3,546,406	0	0	0	67	$248,248	$0	$0.00	0.0	0.0	0.0	0	0.0
	University Facilities Center	UFC	Offices/Utility	214,258	324,454	0	0	0	68	$22,712	$0	$0.00	0.0	0.0	0.0	0	0.0
4	University Health Services	UHS	Office/Medical	27,790	261,097	1,483	0	3,178	69	$29,641	$350,000	$2.10	-45,847.9	334.5	483.9	662	10,232.8
	Valentine	Valentine	Dorm	57,428	467,753	0	0	0	97	$32,743	$0	$0.00	0.0	0.0	0.0	0	0.0
4	Wallis Hall	Wallis	Office	49,598	444,629	3,828	5,557	1,553	70	$56,580	$350,000	$2.10	-81,826.7	597.1	863.6	1,181	18,263.0
	Wegmans Hall	Wegmans Hall	Classroom/Office	60,976	833,752	7,518	0	1,198	71	$63,037	$0	$0.00	0.0	0.0	0.0	0	0.0
	Wilder Hall	Wilder	Dorm	78,822	339,414	0	0	3,749	72	$37,066	$0	$0.00	0.0	0.0	0.0	0	0.0
	Wilmot Cancer SMD	Wilmot	Office/Classroom/Lab	275,536	1,001,642	11,676	0	4,608	73	$87,127	$0	$0.00	0.0	0.0	0.0	0	0.0
4	Wilson Commons	Wilson Commons	Dining/Commons/Office	104,338	2,240,639	12,699	6,117	0	98	$179,271	$350,000	$2.10	-172,136.6	1,256.0	1,816.7	2,485	38,419.4
	X Wing	X Wing	Hospital	62,002	1,026,256	0	0	0	99	$71,838	$0	$0.00	0.0	0.0	0.0	0	0.0
	OO Wing	OO Wing	Hospital	148,368	2,455,792	19,466	3,255	4,081	100	$199,038	$0	$0.00	0.0	0.0	0.0	0	0.0
	Parking Garage	Parking Garage	Parking	0	749,346	0	0	0	101	$52,454	$0	$0.00	0.0	0.0	0.0	0	0.0
	Q Wing	Q Wing	Hospital	76,040	1,258,611	0	0	0	74	$88,103	$0	$0.00	0.0	0.0	0.0	0	0.0
	R North	R North	Hospital	67,853	850,016	0	0	0	75	$59,501	$0	$0.00	0.0	0.0	0.0	0	0.0
	RC Grounds	RC Grounds	Athletics/Fieldhouse	0	47,353	0	0	0	76	$3,315	$0	$0.00	0.0	0.0	0.0	0	0.0
	RC Sports	RC Sports	Athletics/Fieldhouse	0	3,683	0	0	0	77	$258	$0	$0.00	0.0	0.0	0.0	0	0.0
	Rvr Cmp Parking	Rvr Cmp Parking	Parking	0	283,826	0	0	0	102	$19,868	$0	$0.00	0.0	0.0	0.0	0	0.0
	S Wing	S Wing	Hospital	318,662	6,631,166	88,790	23,373	22,852	78	$633,255	$0	$0.00	0.0	0.0	0.0	0	0.0
	S Wing (MCSP)	S Wing (MCSP)	Hospital	35,407	736,796	9,866	2,597	2,539	79	$70,362	$0	$0.00	0.0	0.0	0.0	0	0.0
	Sig Ep	Sig Ep	Dorm	12,650	107,679	0	0	570	80	$9,561	$0	$0.00	0.0	0.0	0.0	0	0.0
	SRB parking lot	SRB parking lot	Parking	0	10,367	0	0	0	103	$726	$0	$0.00	0.0	0.0	0.0	0	0.0
	Telecom - Anx	Telecom - Anx	Hospital	0	764,918	0	0	0	104	$53,544	$0	$0.00	0.0	0.0	0.0	0	0.0
	Telecom - G/T	Telecom - G/T	Hospital	0	185,324	0	0	0	81	$12,973	$0	$0.00	0.0	0.0	0.0	0	0.0
	Telecom - HCrt	Telecom - HCrt	Hospital	0	138,450	0	0	0	82	$9,692	$0	$0.00	0.0	0.0	0.0	0	0.0
	Telecom - SMH	Telecom - SMH	Hospital	0	169,490	0	0	0	83	$11,864	$0	$0.00	0.0	0.0	0.0	0	0.0
	U Wing	U Wing	Hospital	214,258	3,546,406	0	0	0	105	$248,248	$0	$0.00	0.0	0.0	0.0	0	0.0
	Valentine	Valentine	Dorm	57,428	467,753	0	0	0	84	$32,743	$0	$0.00	0.0	0.0	0.0	0	0.0
	Valentine Verizon Cell tower	Valentine Verizon Cell tower	Dorm	0	3,106	0	0	0	85	$217	$0	$0.00	0.0	0.0	0.0	0	0.0
	Wilmot Cancer SMD	Wilmot Cancer SMD	Hospital	0	1,411,320	20,011	3,225	4,579	86	$127,619	$0	$0.00	0.0	0.0	0.0	0	0.0
	X Wing	X Wing	Hospital	62,002	1,026,256	0	0	0	106	$71,838	$0	$0.00	0.0	0.0	0.0	0	0.0
			EXTRAPOLATION TOTAL	10,351,862	143,429,796	1,485,451	344,026	411,955	3,661	$12,774,262	$14,538,192	$1.40	-21,801,216	73,980	112,609	106,450	$1,591,123

See Pages 115 and 116 for Aggregated Results from all selected extrapolated measures.

SURVEYED BUILDINGS | Retro-Commissioning																	
Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas	Current Utility Cost	Measure Cost	Cost/sqft	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	Projected Savings	Projected Savings ($)
1	Rush Rheese Library	Rush Rhees Libr	Library/Office/Classroom	349,284	2,174,743	29,867	26,057	0	3	$246,407	$165,130	$0.47	295,947	3,473	3,473	7,956	
2	Fredric Douglass Dinning Center, FDC, FDB	FDB	Kitchen/Dining	89,151	1,604,478	14,450	0	10,174	12	$149,240	$64,900	$0.73	1,912	668	1,454	2,129	
3	Danforth Dining Center	Danforth Dining	Dining/Kitchen	35,128	882,673	7,162	411	5,470	20	$83,068	$24,400	$0.69	35,919	123	246	491	

EXTRAPOLATION | Retro-Commissioning																	
Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas	Current Utility Cost	Measure Cost	Cost/sqft	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	Projected Savings	Projected Savings ($)
	Alpha Delta Phi	ADP Fraternity	Dorm	10,546	68,996	0	0	559	0	$6,814	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Ambulatory Care Facility	Ambulatory Care Facility	Hospital	224,609	4,740,048	51,190	19,472	2,587	1	$412,981	$106,188	$0.47	190,310.5	2,233.4	2,233.4	5,116	98,437.5
	Anderson Hall	Anderson	Dorm	74,853	344,265	0	0	3,069	2	$34,992	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Autoclave	Autoclave	Autoclave	5,618	332,848	0	4,263	0	3	$38,435	$2,656	$0.47	4,760.1	55.9	55.9	128	2,462.2
1	Bausch and Lomb Hall	Bausch & Lomb	Classroom/Lab/Office	114,228	1,584,872	35,079	7,752	0	4	$140,425	$54,003	$0.47	96,785.0	1,135.8	1,135.8	2,602	50,061.7
	Burton Hall	Burton	Dorm	33,449	160,602	0	0	1,996	5	$18,328	$0	$0.00	0.0	0.0	0.0	0	0.0
	Community Living Center, Quad Annex, Sigma Phi Epsilon	Grad Living Ctr	Dorm	12,650	0	0	0	0	6	$0	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Computer Studies Building, Carlson Library	Comp Studies/Lib	Library/Classroom/Office/Lab	108,965	1,506,571	12,810	0	5,350	7	$125,170	$51,515	$0.47	92,325.7	1,083.5	1,083.5	2,482	47,755.2
	Crosby Hall	Crosby	Dorm	32,247	132,184	0	0	1,862	8	$15,863	$0	$0.00	0.0	0.0	0.0	0	0.0
3	Danforth Dining Center	Danforth Dining	Dining/Kitchen	35,128	882,673	7,162	411	5,470	9	$83,068	$24,400	$0.69	35,918.8	122.9	245.7	491	9,498.7
1	DeKiewiet	DeKiewiet	Office/Dorm	57,428	387,848	0	0	0	10	$27,149	$27,150	$0.47	48,658.6	571.0	571.0	1,308	25,168.5
1	Del Monte Institute	Del Monte	Lab/Research	152,227	5,667,756	60,981	19,852	2,526	11	$479,602	$71,968	$0.47	128,981.5	1,513.7	1,513.7	3,467	66,715.2
	Delta Kappa Epsilon	DKE Fraternity	Dorm	9,066	29,645	0	0	465	12	$3,726	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Dewey Hall	Dewey	Classroom/Office	122,890	953,165	9,457	4,901	0	13	$84,648	$58,098	$0.47	104,124.3	1,222.0	1,222.0	2,799	53,857.9
	Douglass Leadership House, Delta Upsilon, Medieval Hous	Douglass Leadership House	Dorm	8,389	35,476	0	0	359	14	$3,758	$0	$0.00	0.0	0.0	0.0	0	0.0
	Drama House	Drama House	Dorm	10,221	30,607	0	0	483	15	$3,856	$0	$0.00	0.0	0.0	0.0	0	0.0
1	East River Road Medical Building	ERR_MB	Medical	92,078	2,104,586	0	0	0	16	$147,321	$43,531	$0.47	78,017.4	915.6	915.6	2,097	40,354.2
1	Eastman Dental Center	Eastman Dental	Medical	92,029	1,414,307	20,056	6,559	0	17	$123,410	$43,508	$0.47	77,975.9	915.1	915.1	2,096	40,332.8
1	Emergency Department	Emergency Dept/PICU	Hospital	175,848	4,991,867	19,340	10,157	13,079	18	$433,002	$83,135	$0.47	148,995.5	1,748.6	1,748.6	4,006	77,067.4
	Fauver Stadium	Fauver	Office/Sports	63,097	256,300	557	922	0	19	$21,245	$0	$0.00	0.0	0.0	0.0	0	0.0
2	Fredric Douglass Dinning Center, FDC, FDB	FDB	Kitchen/Dining	89,151	1,604,478	14,450	0	10,174	20	$149,240	$64,900	$0.73	1,911.9	668.0	1,454.4	2,129	35,974.0
1	G&J Wing	G&J Wing	Hospital	245,211	4,058,737	0	0	0	21	$284,112	$115,928	$0.47	207,766.7	2,438.3	2,438.3	5,585	107,466.6
1	Galisano Childrens Hospital at Strong	GCHaS	Hospital	271,861	5,232,009	69,473	4	35,819	22	$497,305	$128,527	$0.47	230,347.0	2,703.3	2,703.3	6,193	119,146.2
1	Gavett Hall	Gavett	ngineering/Offices/Lab/Classroom/Office	79,685	1,266,970	20,812	9,574	0	23	$123,841	$37,672	$0.47	67,516.9	792.4	792.4	1,815	34,922.9
	Genesee Hall	Genesee Hall	Dorm	71,403	531,510	7,781	0	5,066	24	$55,626	$0	$0.00	0.0	0.0	0.0	0	0.0
1	GG Wing	GG Wing	Hospital	106,212	2,210,213	79,476	17,321	19,047	25	$288,269	$50,214	$0.47	89,993.4	1,056.1	1,056.1	2,419	46,548.8
1	GG Wing (MCSP)	GG Wing (MCSP)	Hospital	11,801	245,579	8,831	1,925	2,116	26	$32,030	$5,579	$0.47	9,999.3	117.3	117.3	269	5,172.1
	Gilbert Hall	Gilbert	Dorm	72,775	411,496	0	0	3,359	27	$40,729	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Goergen Athletics Center (GAC), Zornow	Goergen Gym	Athletics/Gymnasium/Pool/Fieldhouse	244,044	3,213,807	9,513	2,148	6,373	28	$255,747	$115,376	$0.47	206,777.7	2,426.7	2,426.7	5,559	106,955.1
1	Goergen Hall for Biomedical Engineering and Optics	BME	Classroom/Lab/Office	113,427	2,584,883	25,056	5	16,064	29	$239,389	$53,625	$0.47	96,106.3	1,127.9	1,127.9	2,584	49,710.7
	Goler House	Goler House	Apartments	359,144	0	0	0	11,739	30	$41,675	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Harkness Hall	Harkness	Engineering/Classroom/Lab/Office	61,990	386,027	2,913	1,547	1,343	31	$37,444	$29,307	$0.47	52,523.9	616.4	616.4	1,412	27,167.8
3	Helen Wood Hall	Helen Wood Hall	Office/Dorm	119,064	874,192	16,880	0	4,996	32	$79,873	$82,702	$0.69	121,744.4	416.4	832.8	1,665	32,195.3
	Hill Court	Hill Court	Dorm	151,494	640,033	0	0	10,092	33	$80,629	$0	$0.00	0.0	0.0	0.0	0	0.0
	Hoeing Hall	Hoeing	Dorm	43,377	163,912	0	0	3,035	34	$22,248	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Hopeman Engineering Building	Hopeman	Engineering/Classroom/Lab/Office	72,252	750,957	7,858	0	3,321	35	$64,797	$34,158	$0.47	61,218.9	718.4	718.4	1,646	31,665.3
3	Hoyt Hall	Hoyt	Auditorium/Office	19,940	234,585	3,969	2,239	0	36	$24,590	$13,850	$0.69	20,388.9	69.7	139.5	279	5,391.8
1	Hutchison Hall	Hutchison	Lab/Classroom/Office	313,148	9,232,963	131,724	581	58,466	37	$863,299	$148,046	$0.47	265,329.3	3,113.8	3,113.8	7,133	137,240.7
3	Hylan Building	Hylan	Classroom/Office	59,914	572,798	15,912	191	4,399	38	$57,281	$41,616	$0.69	61,262.8	209.5	419.1	838	16,200.9
3	Interfaith Chapel	Interfaith Chapel	Assembly/Office	29,283	239,236	2,243	0	2,376	39	$25,307	$20,340	$0.69	29,942.2	102.4	204.8	409	7,918.2
1	James P. Wilmot Cancer Center, JWCC	Wilmot Cancer SMH	Hospital	275,536	4,568,850	64,781	10,657	14,825	40	$413,908	$130,264	$0.47	233,460.8	2,739.8	2,739.8	6,276	120,756.8
1	Kornberg Medical Research Building	KMRB or Kornberg	Lab/Research	235,914	9,501,958	107,634	40,778	2,526	41	$824,895	$111,532	$0.47	199,889.2	2,345.8	2,345.8	5,374	103,392.0
0	L Wing	L Wing	Hospital	777,371	1,280,639	0	0	0	42	$89,645	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Lattimore Hall	Lattimore	Classroom/Office	81,124	985,930	18,239	66	8,206	43	$99,402	$38,353	$0.47	68,736.1	806.7	806.7	1,848	35,553.5
1	LeChase Hall	LeChase	Classroom/Office	79,567	578,810	2,786	0	2,526	44	$49,641	$37,617	$0.47	67,416.9	791.2	791.2	1,812	34,871.1
1	Levine Pavilion	Levine	Assembly/Conference	66,517	1,117,178	16,444	569	2,526	45	$90,113	$31,447	$0.47	56,359.6	661.4	661.4	1,515	29,151.8
	Lovejoy Hall	Lovejoy	Dorm	42,622	291,236	0	0	2,526	46	$29,355	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Medical Center Annex	Med Ctr Annex	Office/Lab	79,099	1,619,642	7,864	4,924	2,526	47	$140,262	$37,395	$0.47	67,020.3	786.5	786.5	1,802	34,666.0
3	Meliora Hall	Meliora	Classroom/Office	130,970	1,932,773	17,626	6,475	2,526	48	$168,236	$90,972	$0.69	133,918.4	458.0	916.1	1,831	35,414.7
3	Morey Hall	Morey	Classroom/Office	59,681	237,434	11,621	14,026	2,526	49	$76,033	$41,455	$0.69	61,024.6	208.7	417.4	834	16,137.9
1	New York State Optics	NYS Optics	Office/Lab	4,383	108,481	1,890	0	2,526	50	$16,668	$2,072	$0.47	3,713.7	43.6	43.6	100	1,920.9
1	O Wing	O Wing	Hospital	183,231	3,032,834	0	0	0	51	$212,298	$86,625	$0.47	155,250.7	1,822.0	1,822.0	4,174	80,302.9
	O'Brien Hall	O'Brien	Dorm	54,381	373,480	2,398	0	2,526	52	$35,246	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Old Cancer Center	Old Cancer Center	Hospital	162,842	2,695,367	44,297	6,840	4,639	53	$231,906	$76,986	$0.47	137,975.8	1,619.2	1,619.2	3,709	71,367.5
1	OO Wing	OO Wing	Hospital	148,368	2,455,792	19,466	3,255	4,081	54	$199,038	$70,144	$0.47	125,711.9	1,475.3	1,475.3	3,380	65,024.1
	Psi Upsilon	Psi U Fraternity	Dorm	13,670	41,417	0	0	502	87	$4,681	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Q Wing	Q Wing	Hospital	76,040	1,258,611	0	0	0	88	$88,103	$35,949	$0.47	64,428.3	756.1	756.1	1,732	33,325.3
1	R North	R North	Hospital	67,853	850,016	0	0	0	55	$59,501	$32,079	$0.47	57,491.8	674.7	674.7	1,546	29,737.4
1	Rettner Hall	Rettner Hall	Classroom/Office	20,605	353,312	4,386	0	2,319	56	$33,210	$9,741	$0.47	17,458.6	204.9	204.9	469	9,030.4
1	Rush Rheese Library	Rush Rhees Libr	Library/Office/Classroom	349,284	2,174,743	29,867	26,057	0	89	$246,407	$165,130	$0.47	295,947.2	3,473.2	3,473.2	7,956	153,077.7
1	R-Wing	R Wing	Hospital	175,565	1,349,335	40,940	1,552	11,863	57	$144,369	$83,001	$0.47	148,755.7	1,745.8	1,745.8	3,999	76,943.4
1	S Wing	S Wing	Hospital	318,662	6,631,166	88,790	23,373	22,852	90	$633,255	$150,653	$0.47	270,001.6	3,168.7	3,168.7	7,259	139,657.4
1	S Wing (MCSP)	S Wing (MCSP)	Hospital	35,407	736,796	9,866	2,597	2,539	91	$70,362	$16,739	$0.47	30,000.2	352.1	352.1	807	15,517.5
1	Sage Art Gallery	Sage Arts Center	Gallery/Office	29,821	307,198	0	0	2,868	92	$31,685	$14,098	$0.47	25,267.2	296.5	296.5	679	13,069.4
1	Saunders Research Builidng	Saunders	Lab/Research	194,523	1,356,944	15,867	0	10,106	58	$131,752	$91,964	$0.47	164,818.7	1,934.3	1,934.3	4,431	85,251.9
3	Schlegel Hall (Includes Gleason Wing)	Schlegel Hall	Classroom/Office	115,832	887,929	4,489	0	1,885	59	$69,098	$80,457	$0.69	118,439.6	405.1	810.2	1,619	31,321.3
	Sig Ep	Sig Ep	Dorm	12,650	107,679	0	0	570	93	$9,561	$0	$0.00	0.0	0.0	0.0	0	0.0
	Sigma Alpha MU	SAM Fraternity	Dorm	11,532	51,417	0	0	405	60	$5,037	$0	$0.00	0.0	0.0	0.0	0	0.0
	Sigma Chi	SC Fraternity	Dorm	8,909	61,171	0	0	541	61	$6,203	$0	$0.00	0.0	0.0	0.0	0	0.0
2	Spurrier Gymnasium	Spurrier	Gymnasium/Classroom/Office	56,012	144,252	0	0	1,785	94	$16,433	$40,776	$0.73	1,201.2	419.7	913.8	1,338	22,601.8
1	Strong Auditorium	Strong Auditorium	Assembly	43,131	31,867	0	14,594	0	62	$54,039	$20,391	$0.47	36,544.8	428.9	428.9	982	18,902.7
1	Strong Memorial Hospital	SMH	Hospital	1,030,971	23,723,418	297,981	63,177	37,327	95	$2,034,116	$487,409	$0.47	873,538.5	10,251.6	10,251.6	23,484	451,834.8
	Susan B. Anthony Hall	SBA	Dorm	179,432	1,321,447	5,307	0	9,055	63	$124,945	$0	$0.00	0.0	0.0	0.0	0	0.0
3	Taylor Hall	Taylor	Office/Machine Shop	11,739	235,690	714	1,743	0	64	$22,727	$8,154	$0.69	12,003.3	41.1	82.1	164	3,174.3
	Theta Chi	TC Fraternity	Dorm	7,611	44,549	0	0	492	65	$4,867	$0	$0.00	0.0	0.0	0.0	0	0.0
	Tiernan Hall	Tiernan	Dorm	40,950	213,665	0	0	2,483	66	$23,771	$0	$0.00	0.0	0.0	0.0	0	0.0

SURVEYED BUILDINGS | Retro-Commissioning																			
Tag #	Building Name	Building Abbreviation	Type	Area	Current Electric (kWh)	Current Chilled Water (Tons)	Current Steam (MLBS)	Current Hot Water (mmBtu)	Current Natural Gas	Current Utility Cost	Measure Cost	Cost/sqft	kWh Savings	CHW mmBtu Savings	HW mmBtu Savings	Projected Savings	Projected Savings ($)
1	Todd Union	Todd Union	Office/Post Office	54,307	201,727	1,472	1,845	0	96	$20,753	$25,675	$0.47	46,014.2	540.0	540.0	1,237	23,800.7
1	U Wing	U Wing	Hospital	214,258	3,546,406	0	0	0	67	$248,248	$101,294	$0.47	181,540.4	2,130.5	2,130.5	4,880	93,901.2
1	University Facilities Center	UFC	Offices/Utility	214,258	324,454	0	0	0	68	$22,712	$101,294	$0.47	181,540.4	2,130.5	2,130.5	4,880	93,901.2
1	University Health Services	UHS	Office/Medical	27,790	261,097	1,483	0	3,178	69	$29,641	$13,138	$0.47	23,546.4	276.3	276.3	633	12,179.3
	Valentine	Valentine	Dorm	57,428	467,753	0	0	0	97	$32,743	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Wallis Hall	Wallis	Office	49,598	444,629	3,828	5,557	1,553	70	$56,580	$23,448	$0.47	42,024.2	493.2	493.2	1,130	21,736.9
1	Wegmans Hall	Wegmans Hall	Classroom/Office	60,976	833,752	7,518	0	1,198	71	$63,037	$28,827	$0.47	51,664.8	606.3	606.3	1,389	26,723.4
	Wilder Hall	Wilder	Dorm	78,822	339,414	0	0	3,749	72	$37,066	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Wilmot Cancer SMD	Wilmot	Office/Classroom/Lab	275,536	1,001,642	11,676	0	4,608	73	$87,127	$130,264	$0.47	233,460.8	2,739.8	2,739.8	6,276	120,756.8
2	Wilson Commons	Wilson Commons	Dining/Commons/Office	104,338	2,240,639	12,699	6,117	0	98	$179,271	$75,956	$0.73	2,237.6	781.8	1,702.2	2,492	42,102.2
1	X Wing	X Wing	Hospital	62,002	1,026,256	0	0	0	99	$71,838	$29,312	$0.47	52,534.0	616.5	616.5	1,412	27,173.0
1	OO Wing	OO Wing	Hospital	148,368	2,455,792	19,466	3,255	4,081	100	$199,038	$70,144	$0.47	125,711.9	1,475.3	1,475.3	3,380	65,024.1
	Parking Garage	Parking Garage	Parking	0	749,346	0	0	0	101	$52,454	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Q Wing	Q Wing	Hospital	76,040	1,258,611	0	0	0	74	$88,103	$35,949	$0.47	64,428.3	756.1	756.1	1,732	33,325.3
1	R North	R North	Hospital	67,853	850,016	0	0	0	75	$59,501	$32,079	$0.47	57,491.8	674.7	674.7	1,546	29,737.4
1	RC Grounds	RC Grounds	Athletics/Fieldhouse	0	47,353	0	0	0	76	$3,315	$0	$0.47	0.0	0.0	0.0	0	0.0
1	RC Sports	RC Sports	Athletics/Fieldhouse	0	3,683	0	0	0	77	$258	$0	$0.47	0.0	0.0	0.0	0	0.0
	Rvr Cmp Parking	Rvr Cmp Parking	Parking	0	283,826	0	0	0	102	$19,868	$0	$0.00	0.0	0.0	0.0	0	0.0
1	S Wing	S Wing	Hospital	318,662	6,631,166	88,790	23,373	22,852	78	$633,255	$150,653	$0.47	270,001.6	3,168.7	3,168.7	7,259	139,657.4
1	S Wing (MCSP)	S Wing (MCSP)	Hospital	35,407	736,796	9,866	2,597	2,539	79	$70,362	$16,739	$0.47	30,000.2	352.1	352.1	807	15,517.5
	Sig Ep	Sig Ep	Dorm	12,650	107,679	0	0	570	80	$9,561	$0	$0.00	0.0	0.0	0.0	0	0.0
	SRB parking lot	SRB parking lot	Parking	0	10,367	0	0	0	103	$726	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Telecom - Anx	Telecom - Anx	Hospital	0	764,918	0	0	0	104	$53,544	$0	$0.47	0.0	0.0	0.0	0	0.0
1	Telecom - G/T	Telecom - G/T	Hospital	0	185,324	0	0	0	81	$12,973	$0	$0.47	0.0	0.0	0.0	0	0.0
1	Telecom - HCrt	Telecom - HCrt	Hospital	0	138,450	0	0	0	82	$9,692	$0	$0.47	0.0	0.0	0.0	0	0.0
1	Telecom - SMH	Telecom - SMH	Hospital	0	169,490	0	0	0	83	$11,864	$0	$0.47	0.0	0.0	0.0	0	0.0
1	U Wing	U Wing	Hospital	214,258	3,546,406	0	0	0	105	$248,248	$101,294	$0.47	181,540.4	2,130.5	2,130.5	4,880	93,901.2
	Valentine	Valentine	Dorm	57,428	467,753	0	0	0	84	$32,743	$0	$0.00	0.0	0.0	0.0	0	0.0
	Valentine Verizon Cell tower	Valentine Verizon Cell tower	Dorm	0	3,106	0	0	0	85	$217	$0	$0.00	0.0	0.0	0.0	0	0.0
1	Wilmot Cancer SMD	Wilmot Cancer SMD	Hospital	0	1,411,320	20,011	3,225	4,579	86	$127,619	$0	$0.47	0.0	0.0	0.0	0	0.0
1	X Wing	X Wing	Hospital	62,002	1,026,256	0	0	0	106	$71,838	$29,312	$0.47	52,534.0	616.5	616.5	1,412	27,173.0
			EXTRAPOLATION TOTAL	10,351,862	143,429,796	1,485,451	344,026	411,955	3,661	$12,774,262	$4,183,386	$0.40	8,869,127	46,484	51,457	156,797	$2,905,259

See Pages 115 and 116 for Aggregated Results from all selected extrapolated measures.

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