NEW YORK STATE OF OPPORTUNITY. NYSERDA

Optimizing Solid State Lighting and Controls in New Low-Rise Affordable Housing

Final Report

July 2017

Report Number 17-15

NYSERDA’s Promise to New Yorkers:

NYSERDA provides resources, expertise, and objective information so New Yorkers can make confident, informed energy decisions.

Mission Statement:

Advance innovative energy solutions in ways that improve New York’s economy and environment.

Vision Statement:

Serve as a catalyst – advancing energy innovation, technology, and investment; transforming New York’s economy; and empowering people to choose clean and efficient energy as part of their everyday lives.

Optimizing Solid State Lighting and Controls in New Low-Rise Affordable Housing

Prepared for:

New York State Energy Research and Development Authority

Albany, New York

Kerry P. Hogan
Project Manager

Prepared by:

Taitem Engineering, PC

Beth Mielbrecht

Lighting Research Center, Rensselaer Polytechnic Institute

Jennifer Brons

NYSERDA Report 17-15 NYSERDA Contract 39668 July 2017

Notice

This report was prepared by Taitem Engineering, PC in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority (hereafter "NYSERDA"). The opinions expressed in this report do not necessarily reflect those of NYSERDA or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, NYSERDA, the State of New York, and the contractor make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. NYSERDA, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

NYSERDA makes every effort to provide accurate information about copyright owners and related matters in the reports we publish. Contractors are responsible for determining and satisfying copyright or other use restrictions regarding the content of reports that they write, in compliance with NYSERDA's policies and federal law. If you are the copyright owner and believe a NYSERDA report has not properly attributed your work to you or has used it without permission, please email print@nyserda.ny.gov

Information contained in this document, such as web page addresses, are current at the time of publication.

Table of Contents

List of Figures

List of Tables

Executive Summary

This research focuses on the use of sensor-controlled lighting in multifamily residential common spaces. At three apartment complexes in New York State, sensor-controlled lighting was evaluated. All three sites featured sensor-controlled outdoor lighting; at one of the three sites, sensor-controlled indoor lighting was also evaluated in hallways and staircases. The luminaires all used light emitting diodes (LEDs). The luminaires dim to a low set point (understood as the "sleep" set point) when the sensor does not register activity for a preset period of time. When the sensor registers occupancy, light output increases to a set level (usually 100%). The outdoor luminaires operate only at night, while the indoor luminaires operate in this fashion 24 hours a day. Furthermore, lighting measurements at the sites showed suitable light levels when luminaires operated at full output, and questionnaires given to occupants demonstrated that they like having sensor-controlled lighting.

Monitoring data of parking lot lights showed considerable energy savings (41-86%) compared to energy use when lights are operating at full output without the dimming feature. There were three major contributors to these energy savings. Some circuits had lights programmed with particularly aggressive (i.e., short) time delays until they dimmed. As expected, a part of these savings was due to sensors dimming down the lights when the parking lots were vacant late at night. Unexpectedly, a part of these savings was due to energy use that was apparently less than the maximum rated output when occupied. Because of inconsistent dimmer and timer settings between lights within monitored circuits, it is difficult to draw conclusions about the relative impact of these settings on energy savings for the monitored parking lot lighting.

Hours of use for outdoor lighting were longer in winter than in summer. While subsequent energy savings were higher in the winter season in absolute terms (kWh), seasonal changes had little impact in relative (%) terms.

Energy use of sensor-controlled wall packs at one site was evaluated. Because the wall packs are mounted above infrequently used spaces, energy savings were considerable (82-83%); if the lights had been mounted above frequently used entrances, the percentages for energy savings would likely have been lower. At one site, wall packs were mounted adjacent to a busy avenue, which may have impacted sensor behavior.

At another site, interior staircase lighting was used to systematically study the impact of sensor timer settings on energy savings. Staircase lights with longer delay times (15 minutes) resulted in less energy savings (23-36%) compared to staircase lights with shorter delay times (5 minutes [43-47% savings] and 10 minutes [38-41% savings]).

A lesson learned from this research was the difficulty of characterizing energy use patterns of circuits with very low power demand (<100 W), especially with short monitoring intervals (e.g., 1 minute). If future research is intending to measure the impact of short delay times (<5 minutes), greater precision of short measurement intervals would be needed. Circuit monitoring equipment is available that measures current (amps) rather than energy (watt-hour) pulses; such monitoring equipment may have the precision necessary to capture small changes with the necessary precision. Alternatively, newer lighting technology is now available that allows facility managers (and lighting researchers) to evaluate energy use patterns for individual luminaires, rather than aggregating across an entire circuit.

1 Methodology

This research focuses on the use of sensor-controlled lighting in low-rise affordable multifamily residential common spaces. At three apartment complexes in New York State, sensor-controlled LED lighting was evaluated. All three sites featured sensor-controlled outdoor lighting; at one of the three sites, sensor-controlled indoor lighting was evaluated in hallways and staircases.

In 2015-2016, Taitem Engineering contracted the Lighting Research Center (LRC) at Rensselaer Polytechnic Institute to complete the tasks described in the Monitoring and Evaluation plans shown in Appendix A of this report. LRC site tasks consisted of measuring photometric conditions and administering a questionnaire to the residents. LRC also provided the photography shown, and used monitoring data from Taitem Engineering to perform energy calculations shown in Section 2.3.

1.1 Sites

In 2014, Taitem Engineering kicked off the project with an introduction to the three sites. The developer of all three properties was Affordable Housing Concepts of Gardiner, NY.

1.1.1 Mason’s Ridge II, New Windsor, NY

The first site to be completed was Mason’s Ridge II in New Windsor, NY. The low-rise, three-story apartment building was newly constructed. The lighting that was evaluated consisted of exterior wall-mounted and pole-mounted lighting (Figure 1). Lighting plans/specifications are located in Appendix B.

Figure 1. Mason's Ridge II in New Windsor, NY

1.1.2 197 Lander Street, Newburgh, NY

A small remodeled historic apartment building is located 197 Lander Street in Newburgh, NY (Figure 2). This site featured wall-mounted LED exterior luminaires as shown in Figure 2. The lighting plan and specification for the Lander Street site are in Appendix C.

Figure 2. 197 Lander Street, Newburgh, NY

1.1.3 Lion Heart Residences, Cohoes, NY (3 buildings)

Lion Heart Residences is a complex with three apartment buildings surrounding a central parking lot (Figure 3). In addition to exterior lighting, this site featured interior lighting in staircase landings and hallways. It should be noted that the architect’s building numbering conventions were changed by the local fire department; Taitem Engineering’s specifications (shown in Appendix D) follow the architect’s convention. Occupant questionnaires and the remainder of this report follow the final labeling convention established by the fire department. The architect’s label for “Building 1” is now referred to as Building 4. The architect’s label for “Building 2” remained Building 2. The architect’s label for “Building 3” is now referred to as Building 1.

Figure 3. Lion Heart Residences, Cohoes, NY (with updated building labeling)

1.2 Sensor-Controlled LED Lighting

As shown in Appendices B, C, and D, Taitem Engineering created the lighting plans and specifications for the three sites. Table 1 indicates that all three sites featured wall-mounted lighting (“wall packs”). Other types of sensor-controlled LED lighting, pole-mounted as well as staircase and hallway lighting, were installed at two of the sites.

Table 1. Types of sensor-controlled lighting equipment demonstrated at the three sites

		Sites		
		Mason’s Ridge II New Windsor	**Lander Street Newburgh**	**Lion Heart Cohoes**
Exterior	Wall Packs	✓	✓	✓
Exterior	Pole-mounted/parking	✓		✓
Interior	Staircase Lighting			✓
Interior	Hallway Lighting			✓

1.2.1 Wall Pack Lighting

Taitem Engineering specified the same wall pack (CREE “XSPW”) at all three sites. This luminaire uses an infrared sensor to switch between high- and low-output. Program settings can be found in the lighting specifications for each site, Appendix B, C, and D.

Figure 4. Wall pack luminaire type

1.2.2 Pole-Mounted Parking Lot Lighting

Two sites had pole-mounted parking lot lighting: Mason’s Ridge II and Lion Heart Residences. The product that was specified for Mason’s Ridge (CREE “XSP1”) was not available at the lighting output and distribution necessary to achieve industry recommended lighting practice at Lion Heart Residences. LRC identified a product from another manufacturer that had the necessary output and distribution (Acuity “DSX1”).[1,2] Both luminaire types use an infrared occupancy sensor to switch between high- and low-output at night. Program settings for parking lot lights can be found in Appendix B, C, and D.

Figure 5. Pole-Mounted Sensor-Controlled Lighting

[2] IESNA RP-20 “Lighting for Parking Facilities” (see References)

1.2.3 Staircase Lighting

As shown in Table 1, the Lion Heart Cohoes also demonstrated sensor-controlled interior lighting. All three buildings at this site featured the same luminaire in the staircase common areas. The luminaire was built by a New York State manufacturer (Lamar Lighting "VOL"). This product uses an ultrasonic sensor to dim down the lights when no one is present. To test the impact of delay times on energy savings, each building demonstrated a different delay time. Building 4 on the north side of the complex was programmed with 5-minute delay, and Buildings 2 and 1 were set for 10-minute and 15-minute delays, respectively. In all three buildings, the Lamar "VOL" luminaires were programmed to dim to 20% of full output when vacant for the assigned delay time.

Figure 6. Staircase Lighting at Lion Heart Cohoes

1.2.4 Hallway Lighting

Only Building 4 at the Cohoes site had an elevator, and therefore common hallways. In Buildings 1 and 2, apartments had direct access from the stairwell landings. An additional goal of this research was to study the impact of fixture-mounted sensors versus remotely-mounted sensors in multifamily hallways. It was also intended that the research incorporate the impact of grouped versus independent operation of luminaires with integral sensors. LRC identified products that would meet these goals of the project, which Taitem Engineering included in their specifications (Appendix D).

1.2.4.1 Hallway Lighting with Integral Sensors, Grouped and Individual operation

A product from CREE ("CS14,” Figure 7) was identified that has a sensor integrated in each luminaire, but that could be wirelessly grouped by floor (“Smartcast”). The ground floor of Building 4 was set for independent operation, while the third floor was set for grouped operation.

Figure 7. Hallway Lighting with Integral Sensors

1.2.4.2 Hallway Lighting with Remote Sensors, Grouped operation

A product from Lutron Lighting (“FXSW R14S”) was identified that produced bi-level lighting with remote sensors (“LRF2-OHLB-P”). (See Figure 8.)

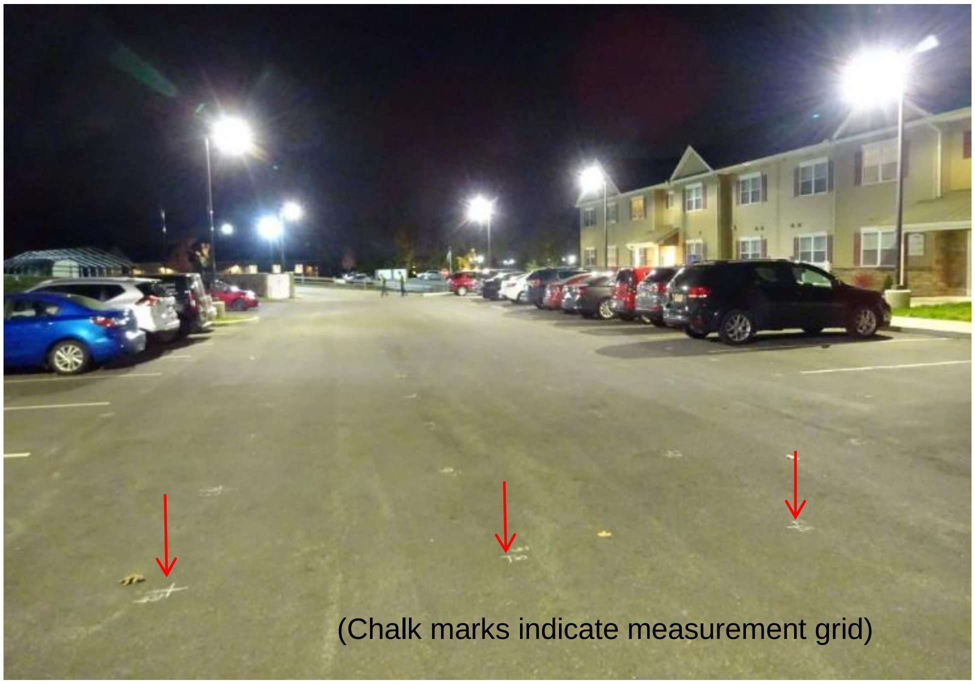
Figure 8. Hallway Lighting with Remote Sensors

1.3 Photometric Measurements

The Illuminating Engineering Society of North America (IESNA) establishes recommended field measurement procedure for parking lots.[3] This document recommends that a grid of measurement points (Figure 9) should be laid out at no more than half the height of the mounting pole. At each measurement point, LRC recorded illuminance falling on the ground (“horizontal illuminance”), as well as at the eye (“vertical illuminance”) in up to 4 directions. The illuminance meter (Gigahertz Optik X91 Photometer) was held in position for vertical illuminance measurements using a tripod adjusted to 5 feet in height.

Due to buildings being occupied during the evaluation, LRC omitted measurement points with vehicles obstructing or casting shadows.

Figure 9. Measurement Grid in Mason's Ridge Parking Lot



(Chalk marks indicate measurement grid)

For other outdoor spaces such as sidewalks or lawn areas, IESNA has not established a recommended measurement point for spacing. Therefore, LRC measured lights landing on relevant surfaces (on the ground, on garbage can lids, door handles, etc.) at a regular interval as shown above.

---

[3] LM-64-01, see references.

1.4 Questionnaire

LRC developed simple questionnaires for both the exterior and interior components demonstrated in this research. These were approved by both the project team (Taitem Engineering and NYSERDA) as well as Rensselaer Polytechnic Institute's Institutional Review Board[4] for research with human subjects.

The same questions were asked of both wall pack and parking lot luminaires. The exterior lighting questions are shown in Table 2. For the interior lighting demonstrated at the Cohoes site, a separate questionnaire was developed (Table 3). All participants answered for staircase lighting; for those in Building 4 who also had hallway lighting, the same questions were repeated.

Table 2. Exterior Lighting Questionnaire

The (wall-mounted lights/parking lot lights) DIM UP/DOWN automatically. I like this feature. ("Agree/Disagree")
Based on my experience in this outdoor space, I think the (wall-mounted lights/parking lot lights) are too DIM. ("Always, Often, Sometimes, Never")
Based on my experience in this outdoor space, I think the (wall-mounted lights/parking lot lights) are too BRIGHT. ("Always, Often, Sometimes, Never")
When I walk through this outdoor space, the output adjusts appropriately. ("Agree/Disagree")
These fixtures give enough light to find coins or keys I dropped on the ground. ("Agree/Disagree")
Overall, compared to other outdoor areas/parking lots, the light in this space is... ("Better/Worse")

Table 3. Interior Lighting Questionnaire Questions (Only applicable to Cohoes site)

This ("stair/landing area" or "hallway") is… ("Too bright" / "Too dark")
When I enter the ("stair/landing" or "hallway") areas, the light levels increase. In my opinion, I… ("Like that the light levels increase" / "Dislike this")
Have the lights in the ("stair/landing" or "hallway") areas ever dimmed down when you were still using the space? ("Yes" / "No")
Overall, compared to other multifamily ("stair/landings" or "hallways"), the lighting in this area is… ("Better"/ "Worse")

---

[4] IRB ruled this protocol (#1449) exempt due to anonymous participant status.

1.5 Energy Monitoring Equipment

Taitem used the following data monitoring equipment at each of the sites:

- Data Loggers: Onset HOBO Model #UX120-017
- Transducer: Continental Control Systems Wattnode Model #T-WNB-3Y-208 OptP3
- Current Transformers: Continental Control Systems Model #T-ACT-0750-20

A current transformer (C/T) was installed on each monitored lighting circuit. The C/T was located on the 120V circuit wire at the circuit breaker connection. The C/Ts were connected to the input side of the Wattnode Transducer; each transducer is capable of monitoring three circuits simultaneously. The Wattnode outputs were each connected to one of the Onset HOBO inputs.

The C/Ts output a small current that is in direct proportion to the current in the monitored lighting circuit. The Wattnode transducer reads the C/T current and calculates the power used over time (watt-hours). For the specific Wattnode model used, each channel outputs a pulse for every 0.1667 watt-hour recorded on that channel. The Onset HOBO data logger was programmed to record the number of pulses for a specific time period, that is, every 60 seconds.

Energy savings were calculated by comparing expected maximum energy (if no sensors/dimming) to actual monitored energy. For most circuits, expected maximum energy was calculated by multiplying luminaire quantity by maximum rated power for each luminaire, multiplied by the relevant time interval. However, for two circuits, luminaire quantities on the circuits were uncertain;[5] therefore, maximum energy was assumed to be the highest value on the monitoring data. This energy calculation technique assumes that all lights were operated at maximum output at least once during the monitoring period. Details about energy calculation methodology are shown in section 2.3 of this report.

---

[5] It is unclear how many staircase lights were on the two circuits that were monitored in Building 4. See section 2.3.8.2 for details.

2 Results

LRC measured photometric conditions at the three sites and administered questionnaires to the residents. LRC also used energy monitoring data provided by Taitem Engineering to analyze savings due to sensors at these sites.

2.1 Photometric Measurements

2.1.1 Mason’s Ridge II Photometric Measurements

LRC measured the parking lot at Mason’s Ridge II in November of 2015. Measurement points were densely spaced at 6 feet x 6 feet apart. Researchers measured when luminaires were operating at full output (as opposed to dimmed or “sleep” mode, which is not able to be measured without triggering sensors). Average illuminance on the ground was 15.7 lux (excluding shaded/blocked parking spaces and malfunctioning luminaire), as shown in Figure 10. Minimum illuminance measured was 3.9 lux, and max:min uniformity ratio was: 8:1. This is similar to industry recommendations for a minimum 5 lux,[6] and better than max:min uniformity ratio of 15:1. Average illuminance on the sidewalk, as shown in Figure 11, was 18.2 lux, due to additional contribution from wall pack luminaires. This was slightly higher than the parking lot, but questionnaires do not rate this area as too bright (see 2.2.4.1). Vertical illuminances were measured in the directions of the sidewalk (east and west). Vertical illuminances on the sidewalk are shown in Appendix E and summarized in Figure 12.

---

[6] Per IESNA RP-20-14. (See References.)

Figure 10. Mason's Ridge Parking Lot Horizontal Illuminances (lux)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	8.3		13.7	11.3	8.3	Obstructed/excluded									5.0	3.9	4.3	4.5	Excluded because one luminaire was malfunctioning during visit										
2	17.4		14.9	13.1	10.7										9.1	8.7	9.0	7.6											
3	29.2		18.2	16.1	11.5										23.6	19.3	16.5	12.5											
4	26.8	18.8	16.9	12.4	10.0	9.1	10.0	11.1	12.2	14.5	16.3	20.4	26.0	25.5	23.3	18.9	18.4	14.1											
5	20.8	16.5	13.9	10.7	9.8	9.9	10.7	11.2	11.9	15.1	21.3	26.2	22.3	21.8	23.1	26.8	21.8	15.1											
6	18.0	15.1	12.2	9.5	10.3	11.0	10.8	11.0	12.3	16.3	19.3	18.9	19.2	20.5	19.3	18.2	19.1	16.9	13.9	11.6	10.6	10.1	9.8	11.5	14.4	17.0	20.3	22.7	21.6
7	17.4	13.1	10.8	10.1	11.8	11.9	16.6	12.5	14.0	15.1	15.1	15.9	17.8	19.5	19.4	18.1	17.2	17.0	16.3	15.0	13.5	13.3	12.9	14.4	14.1	16.0	16.6	18.6	19.4
8	13.9	11.3	10.6	10.9	13.5	13.8	14.5	14.9	16.5	16.7	17.7	19.0	20.1	20.6	20.2	19.2	18.0	17.7	17.9	17.7	17.4	17.8	15.7	15.7	14.2	16.0	17.5	19.1	21.1
9	10.7	9.4	9.9	11.3	12.5	13.0		15.9		15.3					16.5	12.4		14.7	15.2	16.3	16.8	16.3	14.9	14.1	14.3	16.3	18.5		
10	Obstructed/ excluded			11.7	13.2			14.7	Obstructed/excluded										12.7	Obstructed/excluded				16.0	17.2	Obstructed/excluded			
11				12.0	14.8			15.8											16.7					20.9	20.1				25.4
12				10.3	12.4		21.9	20.6		19.5	20.4						14.3		19.2				22.5	21.2	17.6			22.5	31.9

Figure 11. Mason's Ridge Sidewalk Horizontal Illuminances (lux)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
			10.2	13.1	16.6	11.9	23.2	26.7	22.5	17.4	16.0	14.0	12.3	11.3	12.6	14.2	15.3	18.3	24.3	25.8	22.9	19.2	19.5	18.0	18.1	20.7	23.3	26.6

Figure 12. Mason’s Ridge Average Vertical Illuminances (lux) at Five Feet Above Grade

	Parking Lot	Sidewalk
North-facing	9.1	
East-facing	12.2	16.2
South-facing	9.0	
West-facing	10.1	13.4

2.1.2 Lander Street Photometric Measurements

Compared to the two other sites, the Lander site was small, with diverse surface types: rear entrance sidewalk, garbage cans, and lawn. Figure 13 shows tabular measurement results; Figure 14 and Figure 15 are annotated photos to illustrate the three areas where measurements were taken. The wall packs provide plenty of light on the rear entrance sidewalk, garbage cans, and lawn. However, the door handle may be difficult for residents to see at night, due to the overhang above the door that has created a shaded area; no residents were available to comment on this concern (see 2.2.4).

Figure 13. Landers Illuminance Measurements

Illuminance (lux)	Notes
0.57	Horizontal measurements taken on the rear entrance sidewalk
19.03	
18.62	
20.20	
30.89	
28.06	
20.14	
18.06	
19.03	
20.94	Horizontal measurements taken on lids of trash cans
20.34	
23.95	
28.10	
26.67	
25.92	
35.06	Horizontal measurements at lawn area
40.88	
41.51	
32.65	
28.95	
37.11	
39.08	
29.94	
29.65	
1.93	Vertical: Door Handle
2.48	Vertical: Buzzer

Figure 14. Landers Sidewalk Measurement Locations

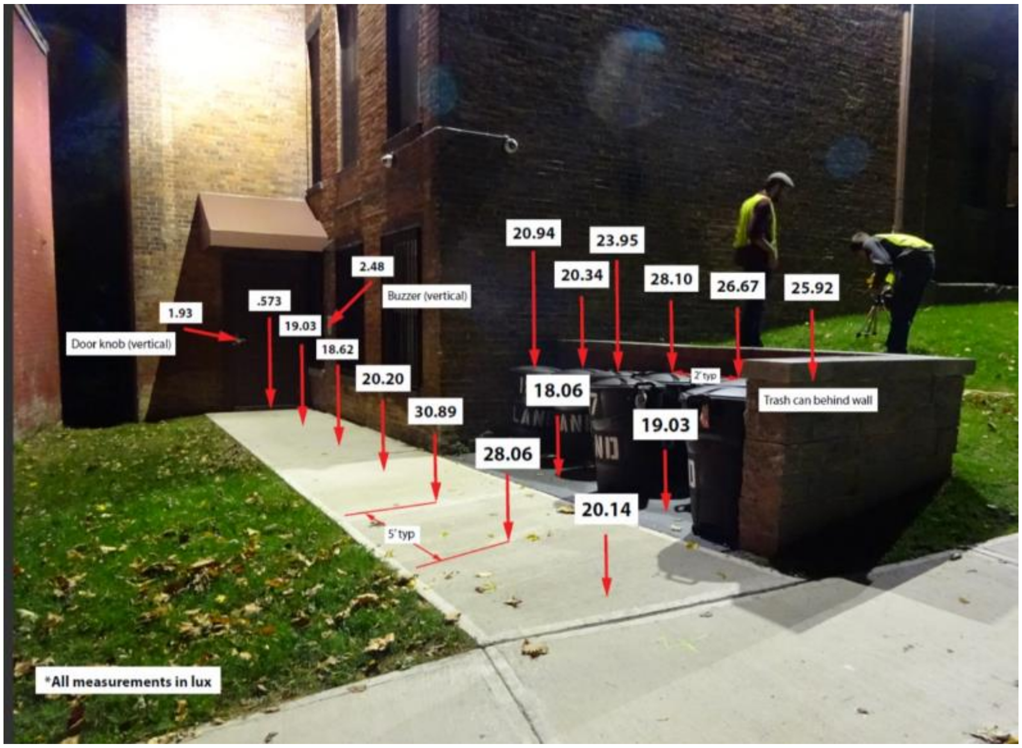


Figure 15. Landers Lawn Measurements Locations

2.1.3 Lion Heart Cohoes

2.1.3.1 Exterior

LRC measured exterior lighting in parking lots at Lion Heart Cohoes over several nights in 2016. Researchers measured when luminaires were operating at full output (as opposed to dimmed "sleep" mode). Measurement points were spaced at 8 feet x 8 feet apart.[7] Excluding obstructed/shaded parking spaces, average illuminance on the ground in the three lots was 32.4 lux (max: 49.0 lux, min: 12.0). This is higher than the parking lot at Mason's Ridge II, but residents did not consider this to be too bright (see questionnaire results, Figure 24). Horizontal illuminance measurements in the parking lots are shown in Figure 16, Figure 17, and Figure 18. A summary of parking lot vertical illuminance measurements is shown in Figure 20, and detailed measurements are shown in Appendix E.

LRC measured horizontal illuminance on the sidewalk on 5-feet spacing, in front of the three buildings. Average illuminance on the sidewalks was 48.6 lux; this was higher than the parking area due to additional contribution from wall pack luminaires (Figure 19). For comparison with vertical illuminances in the parking lots, vertical measurements were collected at several of horizontal measurement locations along the sidewalk (Figure 20).

---

[7] Luminaires were mounted at a height of 25 feet, and industry's recommended practice is for measurement-point spacing of no greater than half a pole height (12.5 feet). Since it is generally expected that the recommended practice will become stricter in the future, requiring a third of pole height (8.3 feet), LRC measured at an 8-foot spacing.

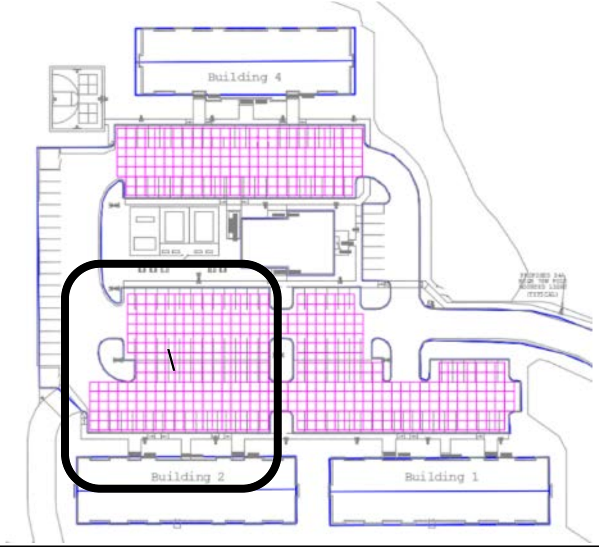
Figure 16. Building 4 Parking Lot - Horizontal Illuminance (Lux) Measurement Results

Building 4

(see "Sidewalk" Measurements)

(Obtructed / Excluded)													39.0	38.8	42.0	42.0	38.3		39.1	39.2		39.8	35.3		
													36.1	35.0	43.1	36.4	39.3		43.4				39.5		
27.3	30.4	33.3						35.8	35.1			34.0	39.0	36.3	39.0	36.2	38.0		43.1		43.2		38.8		
26.6	31.0	29.4	29.6	32.5	24.4	35.4	32.8	31.9	32.5	33.5	33.1	34.0	43.6	41.6	42.0	42.9	41.5	42.5	42.4	47.6	45.1	42.7	38.3	34.2	32.5
27.9	29.9	28.4	29.0	32.3	32.2	32.7	31.8	30.9	29.7	30.6	30.9	36.9	41.6	40.4	42.6	41.1	41.3	41.7	41.3	45.0	43.6	40.9	35.3	32.1	30.3
28.0	28.0	25.6	26.7	28.7	28.6			25.9			28.1	30.5	30.6	38.0	37.6	37.9	38.7	39.0	37.4	39.5	40.0		33.9		31.4
		26.9	26.1	26.1	(Obtructed / Excluded)						20.8	21.8	22.4					33.6	36.6	34.7					
		31.8	28.1	25.7							18.0	19.5	19.6					37.7	35.7	26.9					

Figure 17. Building 2 Parking Lot - Horizontal Illuminance (Lux) Measurement Results

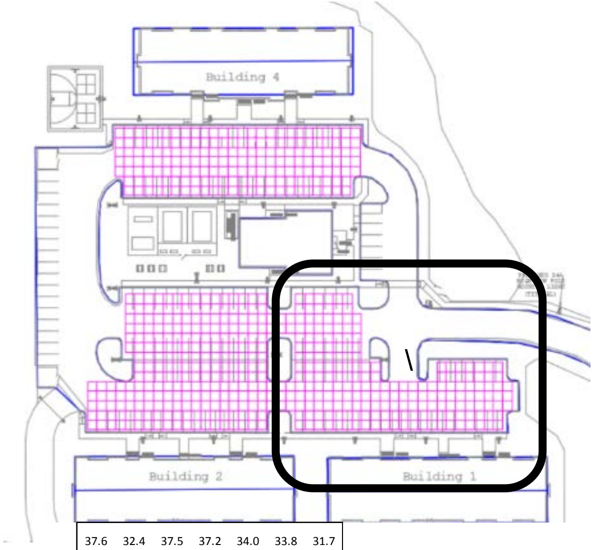


				43.0	39.9	39.0	38.2	37.4	39.4	37.5	39.1	39.7	37.3	37.3	32.7	32.7	30.0	31.1	35.5
				42.6	44.4	44.2	43.0	41.6	39.7	35.6	34.9	35.1	30.0	39.0	33.3	35.3	29.7	31.8	28.6
				40.9	48.1	44.6	41.7	43.9	42.4	37.3	32.6	33.4	31.0	40.7	33.6	35.4	29.1	30.5	23.7
				40.0	45.0	44.5	48.4	43.0	42.3	34.3	28.1	32.8	27.0	37.8	29.2	34.1	23.3	28.7	22.0
				42.7	43.7	43.0	49.0	42.0	42.2	29.6	23.1	28.2	20.2	32.1	25.2	30.5		25.7	20.7
										21.5	19.2	17.2	16.1	24.0	21.5	25.4		21.9	18.9
						(Obstructed/excluded)					14.5	14.6	14.1	19.9		19.5			18.5
										14.6					(Obstructed/excluded)				
											16.0								
25.9	28.0	34.2	46.3		38.5	39.6	40.0	32.8	18.5	21.7	21.0	19.0			28.8		30.7	14.6	26.6
24.9	24.6	27.5	35.0	33.2	37.8	41.7	40.0	35.0	37.2	27.3	23.4	23.3	27.2	28.0	29.2	30.5	30.3	29.0	28.1
25.6	24.0	23.0	33.6	30.0	36.3	44.1	41.4	38.7	36.0	29.8	26.6	29.0	26.3	27.7	30.6	26.0	27.4	25.4	28.9
17.1	17.7			29.3	30.5	33.9		31.7	25.3	27.0	29.1	28.1	20.9	17.0	25.3	17.8	17.9		
									(Obstructed/excluded)										

(see "Sidewalk" Measurements)

Building 2

Figure 18. Building 1 Parking Lot - Horizontal Illuminance (Lux) Measurement Results

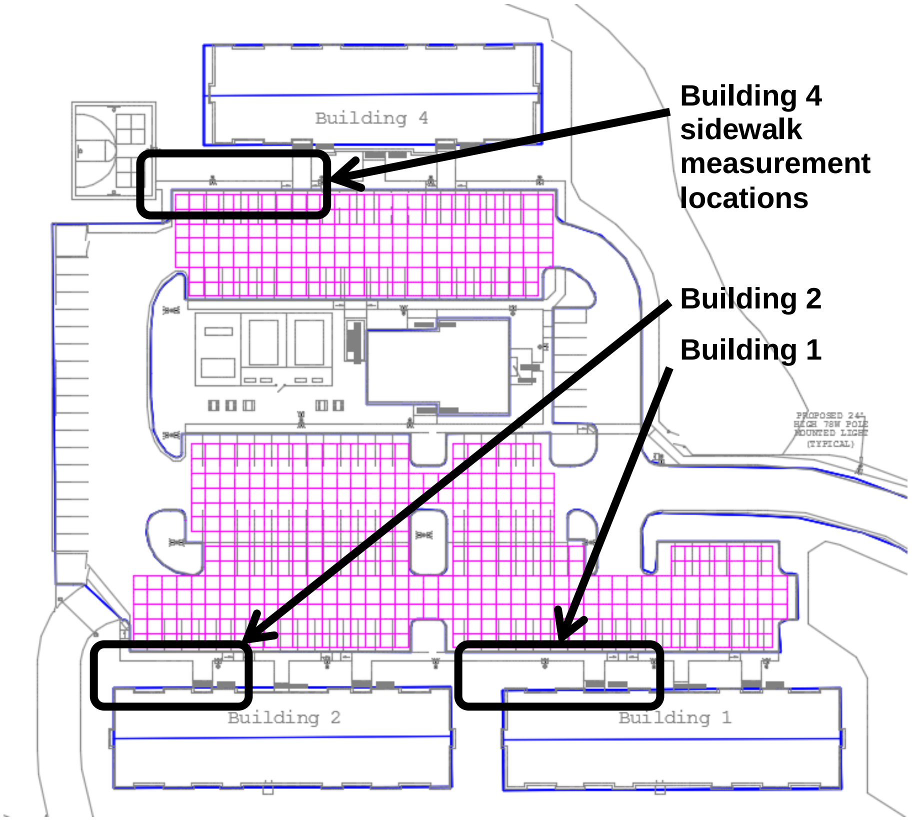


	37.6	32.4	37.5	37.2	34.0	33.8	31.7																	
	32.5	33.0	35.8	37.5	36.8	36.3	36.1																	
30.4	30.6	32.0	34.2	35.0	35.0	34.6	35.1	32.5																
29.3	31.4	32.2	32.6	33.5	35.0	35.0	35.0	38.4																
28.3	29.0	30.0	31.3	36.4	33.8	34.6	35.3	38.6																
	26.4	26.4	28.2	28.7	29.7	31.3	34.2																	
	25.6	24.0	25.3	24.3	29.9	27.5	26.0																	
	23.7	23.4	24.2	24.6															(Obstructed/excluded)					
			28.8	35.1				(Obstructed/excluded)																
31.5		30.5	32.8	37.4					38.0		42.2	36.6	35.8	34.0	29.0	26.6			19.9			13.3	13.5	12.0
30.7	32.8	33.5	34.1	39.1	40.0	42.0	43.0	43.3	42.0	41.0	38.0	38.0	36.6	35.0	31.8	31.2	27.7	25.3	22.2	21.6	21.5	20.1	17.9	16.9
31.5	33.5	33.6	36.1	39.1	40.7	43.0	43.5	43.0	43.8	41.8	39.1	38.0	37.6	37.0	39.8	32.0	29.7	28.0	25.5	25.5	26.2	23.2	21.7	22.0
28.8	30.2	32.3	35.8				36.2	37.2		38.8						30.5						22.5	23.8	21.0
			31.6									(Obstructed/excluded)												
		32.2	42.2	37.5																				
												(see "Sidewalk" Measurements)												
												Building 1												

Figure 19. Cohoes Average Vertical Illuminances (lux) at 5’ Above Grade

	Building 1		Building 2		Building 4	
	Parking Lot	Sidewalk	Parking Lot	Sidewalk	Parking Lot	Sidewalk
North-facing	21.0		29.0		25.2	
East-facing	17.4	26.4	19.9	34.3	22.3	33.6
South-facing	29.2		24.2		21.7	
West-facing	26.5	28.3	24.8	6.9	22.6	29.2

Figure 20. Sidewalk Illuminance (Lux) Measurement Results



Sidewalk Measurements - Building 4

	0'	5'	10'	15'	20'	25'	30'	35'	40'	45'	50'	55'
Horizontal (lux)	40.5	36.6	32.2	31.3	30.4	33.1	32.4	37.1	39.9	44.2	48.2	38.7
Vertical, Facing East >	15.9		26.3		32.9		42.1		37.4		29.2	
Vertical, Facing West <	15.5		31.2		33.3		32.8		25.7		23.0	

Sidewalk Measurements - Building 2

	0'	5'	10'	15'	20'	25'	30'	35'	40'	45'	50'	55'	60'
Horizontal (lux)	20.7	18.6	21.3	20	22.9	20.5	26	32.3	47.6	69.2	75.6	70.2	82.5
Vertical, Facing East >	4.5		6.7		17.9		30.7		48		110.5		21.9
Vertical, Facing West <	3.5		5.4		9.3		4.7		3.8		13.3		8.5

Sidewalk Measurements - Building 1

	0'	5'	10'	15'	20'	25'	30'	35'	40'	45'	50'	55'	60'
Horizontal (lux)	62.8	71.8	78.6	79.3	82.4	74.4	64.1	55.9	44.3	48.8	49	45.2	41.2
Vertical, Facing East >		12.4		24.5		35.2		33		30.6		14.9	
Vertical, Facing West <		24		42.9		43.9		38.4		30.6		17.5	

	65'	70'	75'	80'	85'	90'	95'	100'	105'	110'	115'
Horizontal (lux)	30.6	38.5	39.9	50.6	68.3	80.2	77.7	65.5	49.3	57.8	53
Vertical, Facing East >	14.6		28.3		45.3		38.2		25.4		14.6
Vertical, Facing West <	24		24.9		22.4		27.9		23.4		20

2.1.3.2 Cohoes Interior Measurements

LRC also measured illuminance in a typical staircase at Cohoes, with luminaires at full output (as opposed to dimmed or "sleep" mode). As shown in Figure 21, light levels from the Lamar luminaires comfortably met requirements for minimum safe egress (10.76 lux).[8] Comments from installers are shown in 2.2.5.3, and from residents in Appendix F 2.4.1.

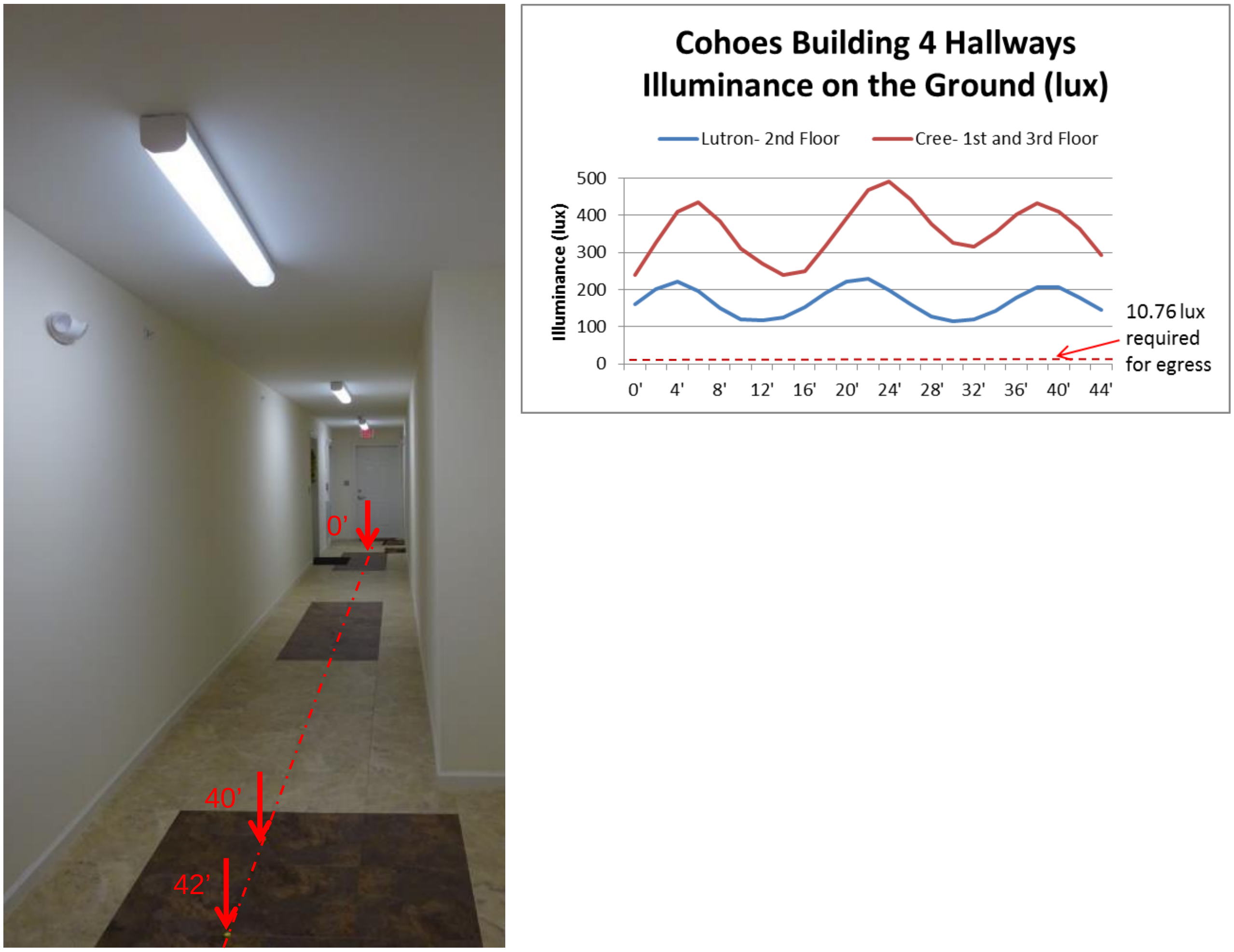
Figure 21. Measurements on Stair Treads

---

[8] National Fire Protection Association (NFPA) 101 Life Safety Code. See References.

In Building 4 hallways, one luminaire type (CREE) provided more light than the other (Lutron). However, both lighting systems did a good job of providing smooth, diffuse illumination; the ratio of light falling directly below luminaires versus between luminaires was 2:1. (See Figure 22.) Because of this level of uniformity, occupants did not express concerns about dark spots (see 2.2 Questionnaire Results); one occupant commented that it seemed too bright directly under the CREE luminaires (Appendix F, 2.4.1). Both systems comfortably met minimum illumination levels (10.76 lux).

Figure 22. Hallway Measurements (Building 4 only)



2.2 Questionnaire Results

2.2.1 Exterior

LRC collected extensive questionnaire data for wall packs and parking lot lighting at Mason’s Ridge II and Lion Heart Cohoes sites. These are large sites with a dozen or more residents.

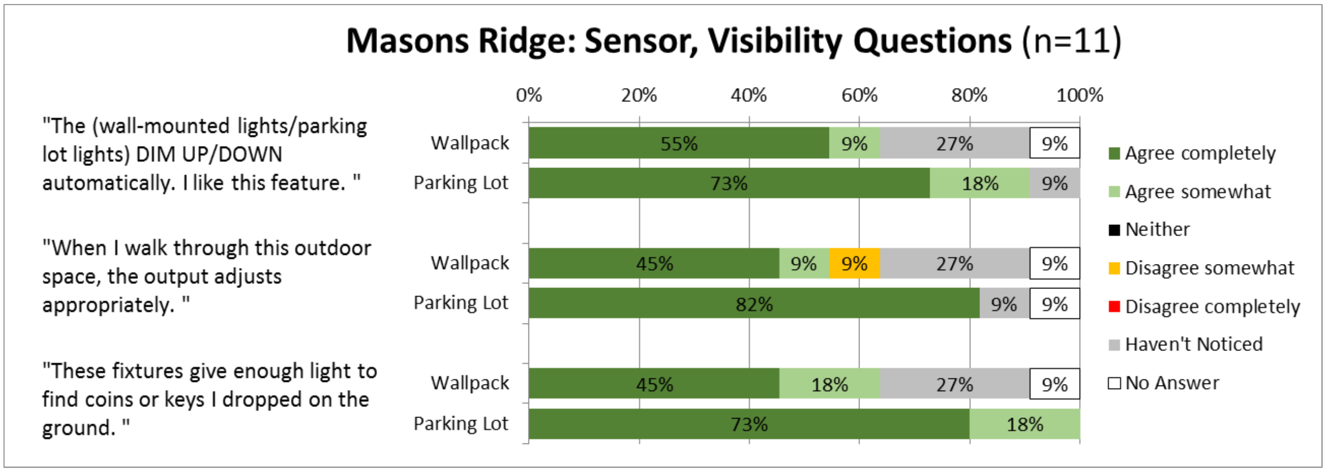
The Lander Street site, however, only has a few residents. When LRC evaluated the site, there were no English-speaking residents available to answer the questionnaire. One resident spoke English and although she did not have time to answer the questionnaire, she mentioned (while rushing to work) that she had not noticed the wall packs dimming. Following up on her comment, LRC approached passing neighbors, who also had not observed the lights dimming. LRC researchers sat in a car to observe the lights from far away for an extended period of time (20+ minutes) at night, but did not observe any of the lights lessen in intensity. After leaving the site, LRC attempted to follow up with security personnel to access camera recordings, but those personnel were not able to determine the logistics of providing LRC access. LRC reviewed Taitem’s monitoring data for the Lander site (section 2.3), but those were inconclusive as to the condition of the lighting as well. Because it appears that the sensors do not dim the wall packs at Lander Street, no questionnaires were collected at that site. Taitem contacted the building representative, and the fixture settings were examined and reset for the specified dimming operation. It was confirmed that the fixtures and lighting are operating properly.

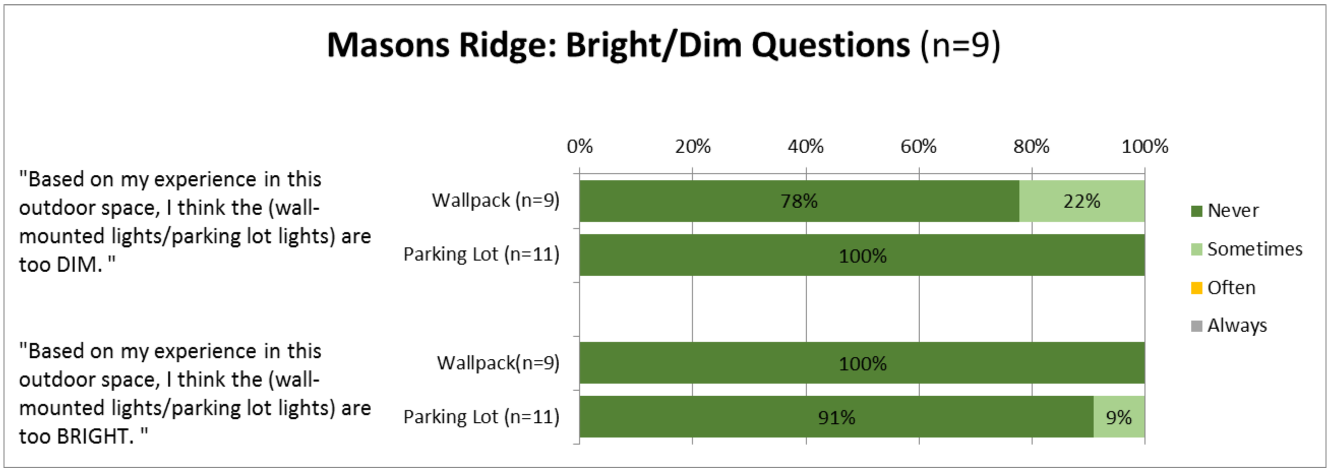
2.2.1.1 Mason’s Ridge Exterior Questionnaires

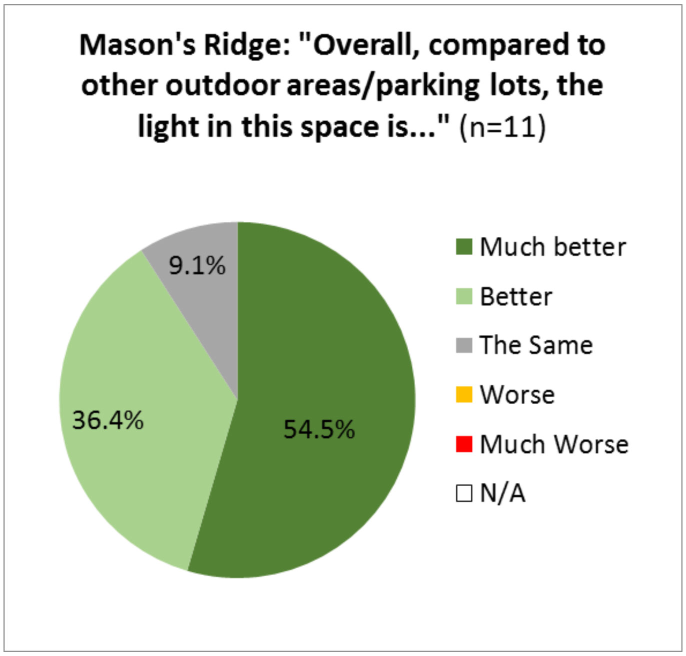
LRC administered the questionnaire to 11 residents at Mason’s Ridge. As shown in Figure 23 and the comments in Appendix F, residents clearly like their outdoor lighting. More residents agreed with positive statements about the parking lot lighting than the wall packs lighting the sidewalk. There were no complaints about lights shining into bedrooms (Appendix F). Even the person who indicated that the parking lot lights are “sometimes” too bright elaborated, “but it’s a good thing!” Most of the residents reported that their outdoor lighting was “better” or “much better” than other outdoor areas.

Resident comments (Appendix F) indicate they perceive they are getting more of something desirable when present, as opposed to feeling as if they are having something taken away when they leave.
("I love that they get brighter when I get closer. I get scared at night; these make me feel better. I think they should do these everywhere.")

Figure 23. Mason's Ridge Questionnaire Results





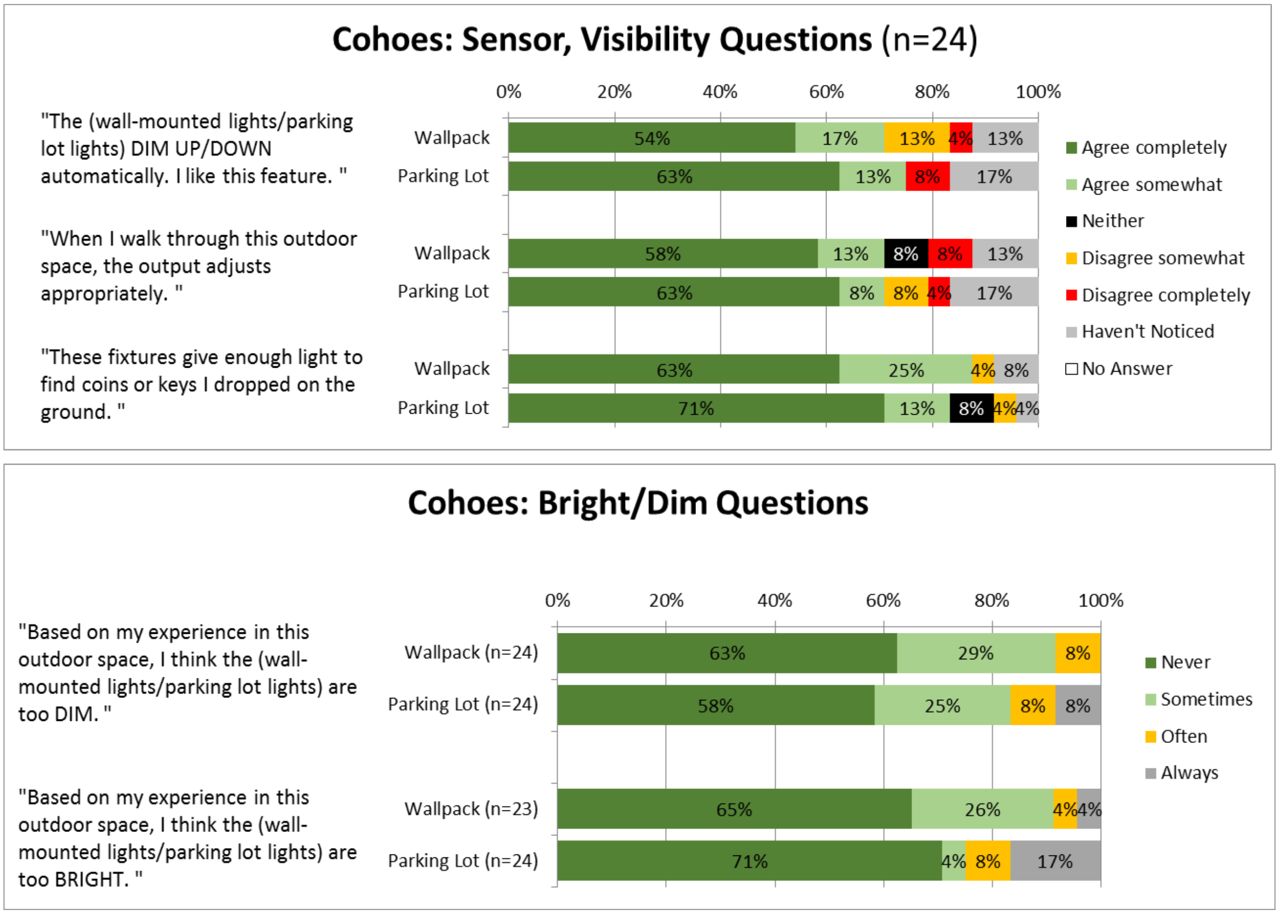


2.2.1.2 Lion Heart Cohoes Exterior Questionnaires

LRC administered the questionnaire to 24 occupants at Lion Heart Cohoes. Overall residents had positive feedback about the sensor function, the amount of light provided (Figure 24). One resident said, “I love how the sensors turn the light up” (Appendix F). Overall occupant feedback was similar to Mason’s Ridge II.

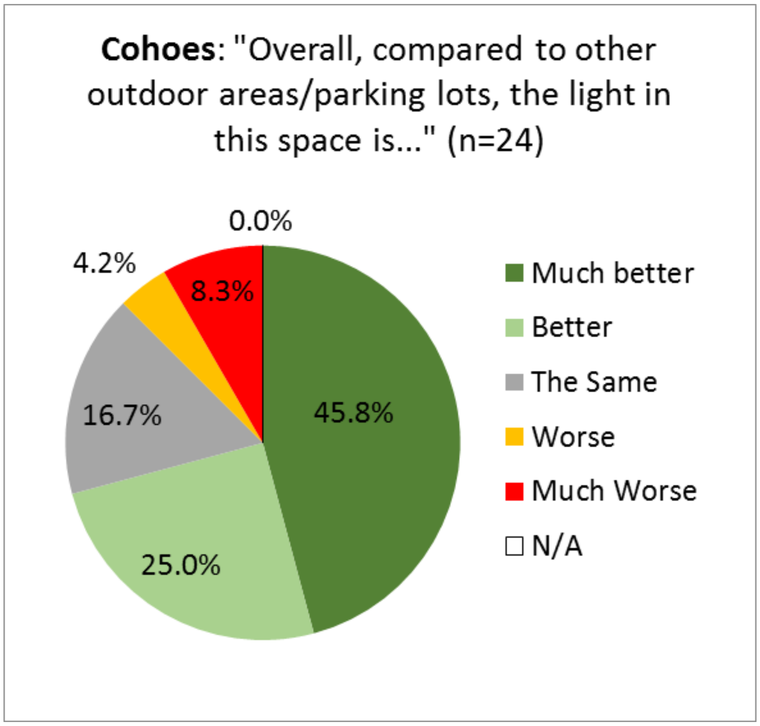
Some occupants at the Cohoes site pointed out that the sensors controlling the wall packs do not sense them when they walk by; LRC confirmed that one must stand close to the wall packs to get them to turn up to full output. As shown in Appendix F, some residents were concerned about light from wall packs entering their windows at night. (“I don't like light [shining] in my room. They shine in my window. I don't like that.” "If I was living in the front apartment [just the pole lights] would be perfect: not shining through blinds, not glaring in the house all the time.")

Figure 24. Cohoes Exterior Lighting Questionnaire Results



Almost three-quarters of the residents at the Cohoes site reported their outdoor lighting was “better” or “much better” than other outdoor areas (Figure 25).

Figure 25. Cohoes Exterior Lighting Overall Comparison

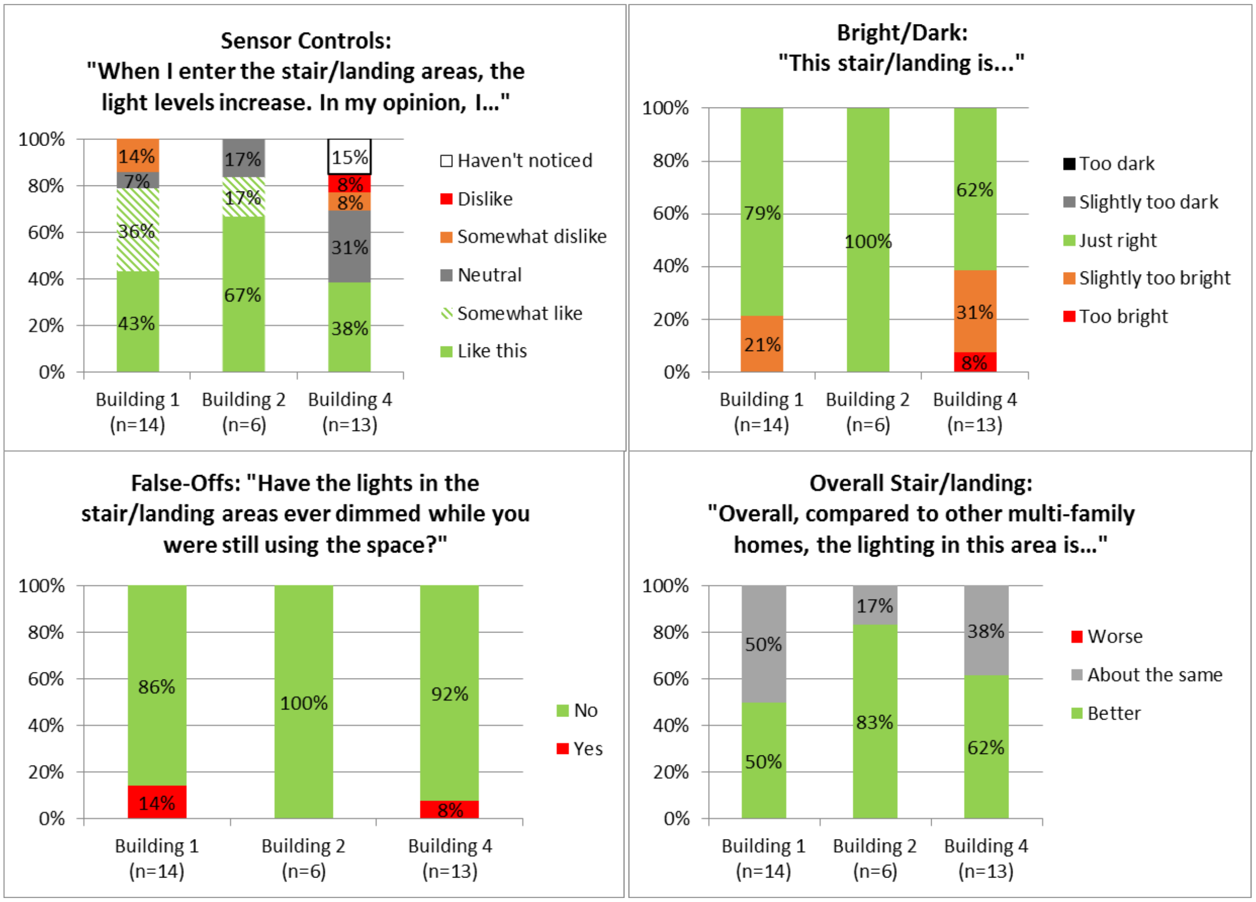


2.2.2 Lion Heart Cohoes Interior Questionnaires

2.2.2.1 Stair/Landing Area (All Three Buildings)

The results (Figure 26) indicate that occupants were satisfied with the amount of light provided by the staircase luminaires. In Buildings 1 and 2 most residents indicated that they “like” or “somewhat like” the sensor control; in Building 4 residents were more neutral, negative or hadn’t noticed the sensors in the stairs; this could be due to the fact that Building 4 has an elevator, so residents can avoid the staircases. Overall, most residents in all three buildings thought the lighting in the staircase/landing area was “better” than other multifamily residences.

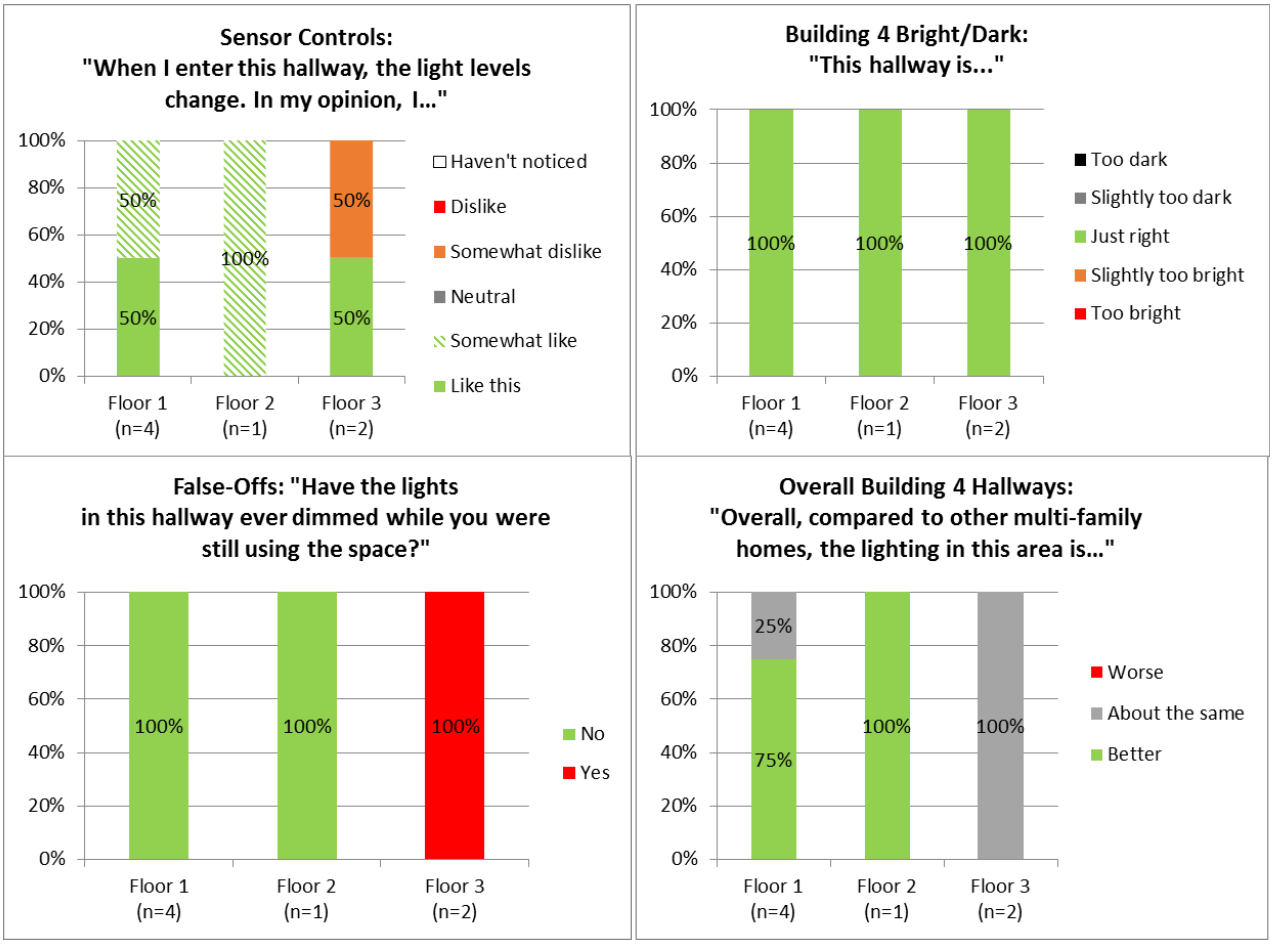
Figure 26. Stair/landing Questionnaire Results



2.2.2.2 Hallways (Only Building 4, Floor 1, 2, and 3)

A few (seven) residents were available to answer questionnaires in Building 4 hallways after some adjustment to the controls. The results shown (Figure 27) indicate that occupants were satisfied with the amount of light provided by the hallway luminaires. On all three floors, residents indicated they “like” or “somewhat like” the sensor control. On the third floor (with grouped operation) both the respondents indicated the lights dimmed down while in the space. One of the two respondents from the third floor indicated they “somewhat dislike” the sensors. Results were mixed on the “overall” hallway lighting question.

Figure 27. Building 4 Hallway Questionnaire Results



2.2.2.3 Lion Heart Cohoes – Installer Comments

Installers at the Cohoes site shared comments about ease of installation and programming of the sensor-controlled lighting.

Exterior Lighting Installer Comments

Installers found that the Acuity parking lot lights were particularly difficult to program, since they require a lift truck and multiple button presses to adjust.

They pointed out that at the driveway, the lights don’t come up to full brightness quick enough when driving at a higher rate of speed compared to the typical parking lot driving speed. A respondent stated, “I was under the impression that they should come up in advance.” LRC confirmed that these lights sometimes don’t turn up until after the vehicle has passed a pole. Using a motorized lift, the developer confirmed that the settings on the driveway lights are in fact programmed to come up to full brightness without delay when they sense occupancy. Therefore, this problem is partly due to narrower sensor coverage than light coverage and partly due to higher vehicle speeds.

Interior Lighting Installer Comments

Installers preferred programming of one luminaire type (Lamar) over the others (CREE “CS14” and Lutron “FXSW”) because it uses dip switches, which provides physical, visual proof that the intended settings have been achieved. “There’s nothing on the fixture (CREE or Lutron) that confirms that you’ve done the right thing,” reported an installer.

The project manager liked how the Lamar staircase light (with ultrasonic sensor) senses a person in advance of arrival. “It’s really magical,” was his comment in the interview. The developer also liked how quickly the Lamar product shipped.

The installers had to devise their own mounting in a few cases. For the Lutron fixture in the hallways, the remote sensor did not come with a corner mount, so the contractor had to cut a block of wood to hold the sensor at an angle (see Figure 8). For the CREE fixture, the product did not come with a way to mount to a junction box behind a gypsum board ceiling; the contractor had to devise his own mounting system.

2.3 Energy Monitoring Results

Taitem Engineering provided LRC with raw monitoring data sets for Mason’s Ridge, New Windsor; Lander Street, Newburgh; and Lion Heart, Cohoes sites. These included a three-week sample of summer, winter, and the intervening shoulder season. The monitoring data consisted of time-stamped counts of “pulses.” Taitem advised LRC to translate the pulses to watt-hours by multiplying pulse counts by 0.1667 watt-hours. For 208V circuits, pulse counts were multiplied by both 0.1667 and by two.

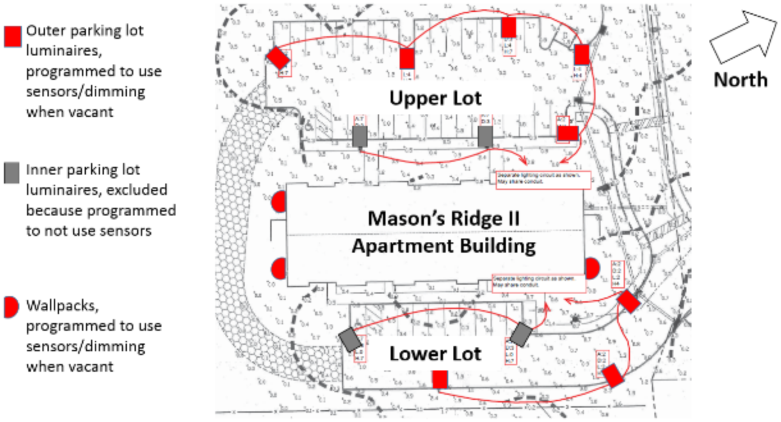
For outdoor luminaires that turn off during the day, LRC evaluated the data to determine dusk/dawn times. These nightly hours of use were multiplied by the manufacturer’s rated power for each luminaire, multiplied by the number of luminaires on the circuit. The resulting maximum rated energy use for each circuit was compared to actual monitored energy use for each circuit, resulting in percent energy savings by season.

Indoor luminaires operated 24-hours a day and had a slightly different energy savings calculation technique. Because of uncertainty about quantity of luminaires on some of the circuits, LRC compared actual energy use to the maximum demand measured by the monitoring equipment, multiplied by the monitoring duration.

2.3.1 Mason’s Ridge II Energy Monitoring Results

The circuits that Taitem monitored are shown in Figure 28.

Figure 28. Mason's Ridge Lighting Circuits



The luminaires shown in red are ones that were programmed to be controlled by sensors, thus they were included in the energy calculations. (The grey-colored lights on Figure 28 were programmed to remain at full output from dusk to dawn, so were excluded from the energy analysis.) Three circuits of sensor-controlled lighting were evaluated at this site: the upper parking lot lights, the lower parking lot lights, and the wall packs mounted on the north and south sides of the building.

2.3.1.1 Mason's Ridge Parking Lot Energy Monitoring Results

Figure 29 shows an example of monitoring data for one circuit (lower parking lot) for one seasonal sample (winter). The green line indicates energy use for every five-minute monitoring period. The orange line indicates expected maximum energy.[9] The area under the orange line indicates energy saved due to sensor controls.

Figure 29. Typical Energy Use Graph for One Parking Lot Circuit

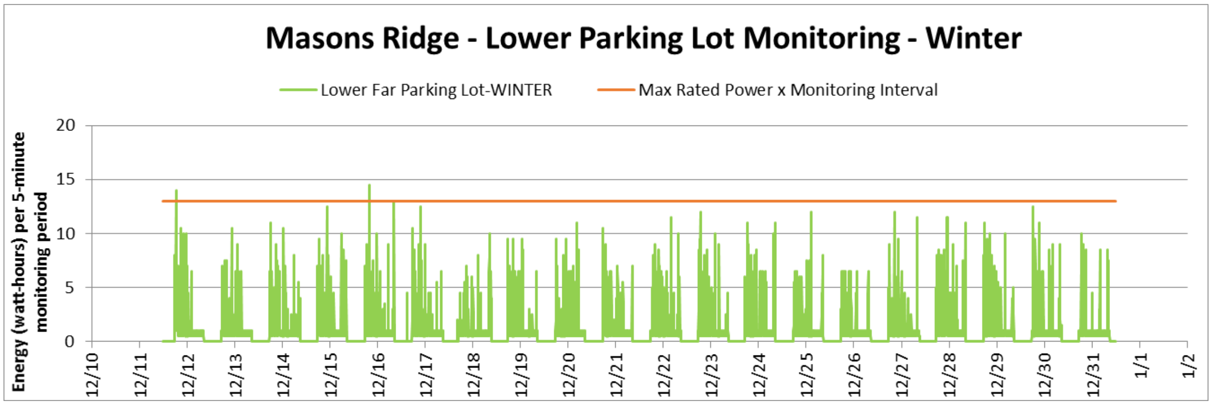


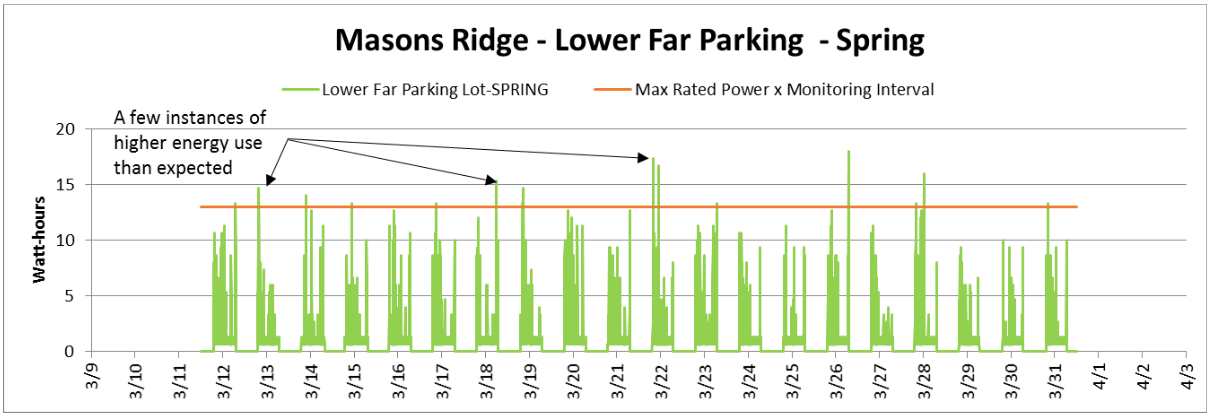
Figure 29 and the other energy use graphs (Appendix F) show that the sensors saved considerable energy every night. As expected, the parking lot lights were more frequently at full output in the early part of the evening, then settle down to lower output late at night. This graph also implies that when residents use the lot late at night, some of the lights are not triggered to full output.

There were a few odd results with the Mason's Ridge parking lot monitoring data. For example, Figure 30 shows occasional higher energy use than expected in the lower lot. There are a few possible explanations. It is possible that the luminaires have higher power demand than rated. Alternatively, it is possible that voltage fluctuations on the circuit resulted in temporarily higher current, thus higher pulse counts. Another explanation could be that other electrical loads could be incorrectly installed on this circuit. The most likely explanation seems to be that the monitoring equipment only counts integer pulse quantities, so may round up or down slightly. Therefore, the parking lot energy calculations assume the orange line as a comparison point for the nightly energy use.

---

[9] Three parking luminaires in the lower lot and five in the upper lot x 52 watts at full output per luminaire x five-minutes monitoring interval = 13 watt-hours expected maximum in the lower lot, or 21.667 watt-hours in the upper lot.

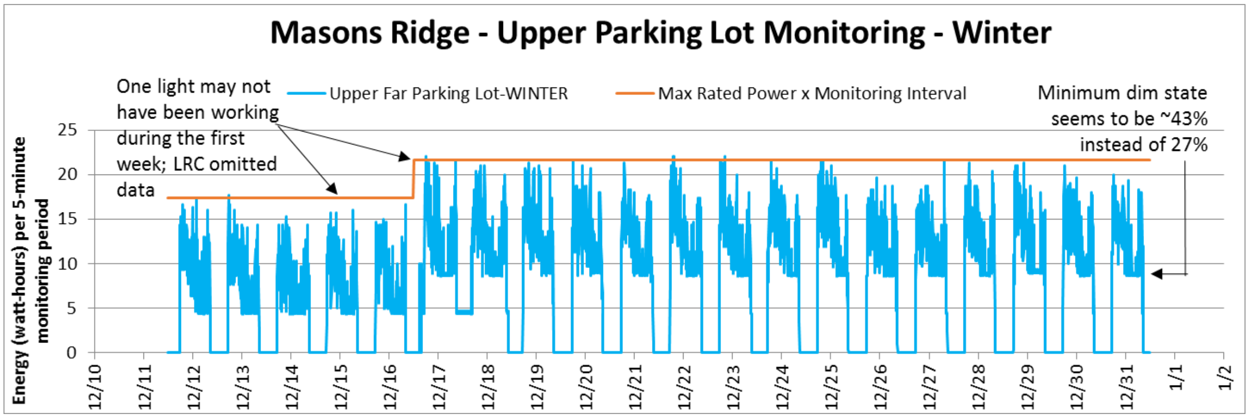
Figure 30. Occasional Higher Energy Use than Expected



There were other examples of unusual energy monitoring results. In the Mason's Ridge upper parking lot, energy use appears to increase towards the end of the first week of collection, then stays higher for the remaining nights. This monitoring took place shortly after LRC performed the site evaluation, during which one light on this circuit did not turn on. LRC assumes the malfunctioning light was repaired during the day on December 17, 2015. Because the light also appears to have stayed on the next day, December 18, during the day, LRC excluded the first week of data at this location. Energy savings estimates for the Mason's Ridge upper parking lot are therefore based on two weeks of data rather than three.

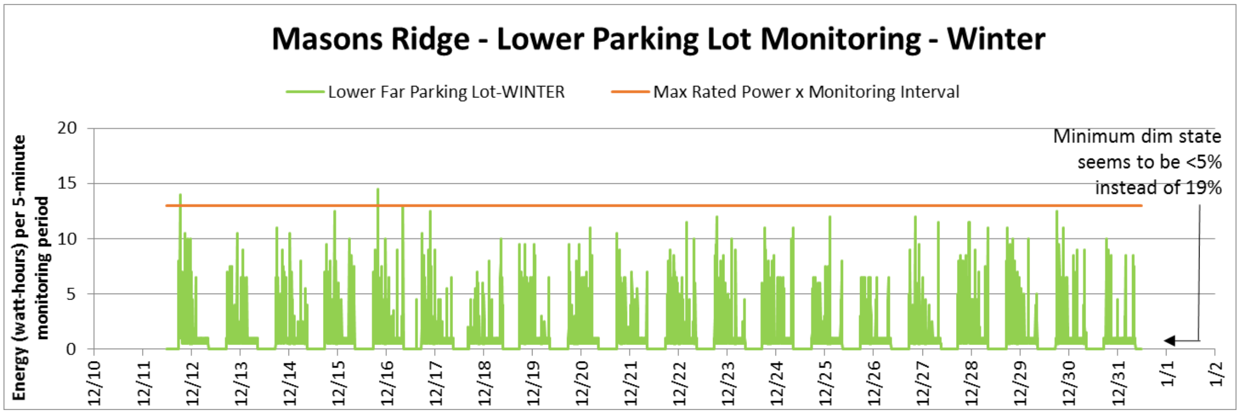
Another unexpected result was that the upper parking lot lights appear to dim down to a higher energy use level than intended; programming instructions indicated that upper circuits should dim to 27% output when vacant, but Figure 31 shows minimum dim state of around 43% in the upper lot. The control on each light is capable of being set to dim to the following steps: OFF, 15%, 19%, 23%, 27%, 31%, and 41%. Therefore, it seems likely that the upper parking lot lights are actually programmed for the 41% setting. During times of prolonged inactivity, dim settings have an impact on energy savings.

Figure 31. Malfunctioning Light Repaired, Higher Minimum Dim State than Expected



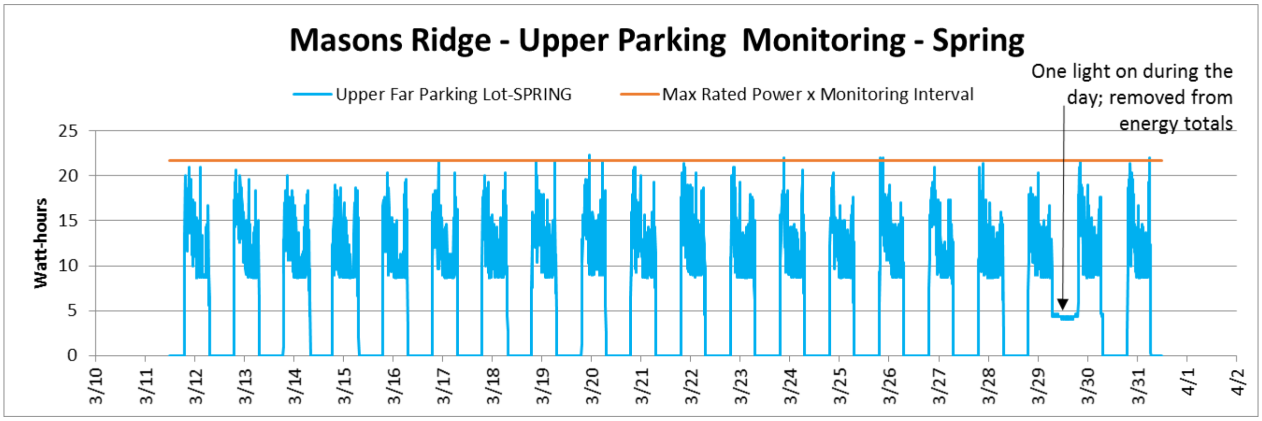
Conversely, the lower parking lot at Mason's Ridge seems to dim to a much lower level than the directed instructions (19%). Figure 32 shows that the lower parking lot lights dim below 5% output when vacant. This is especially unexpected because the minimum that the system is capable of should be 15%. It is possible that two of the three lights on this circuit were inadvertently programmed to turn off entirely when vacant, with the remaining one programmed to turn down to 15%. Low-level dim state has a large impact on energy savings results.

Figure 32. Lower Parking Lot Lights, Low Minimum Dim State Than Expected



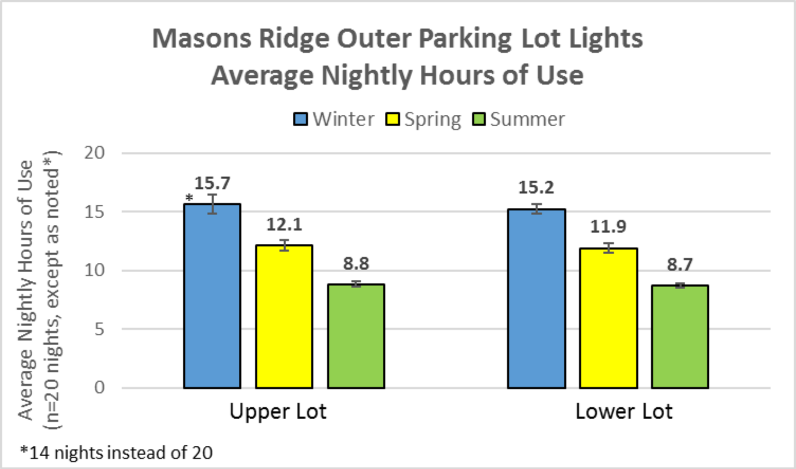
There was one other unexpected result from the monitoring data in the Mason's Ridge parking lots. Figure 33 shows one instance where a light seems to have stayed on during the day; because this was not typical of the rest of the monitoring, LRC removed these daytime data from the energy calculations.

Figure 33. Daytime Use on 3/29/16 Removed from Energy Calculations



As expected, nightly hours of use were longer in winter than in summer for both upper and lower parking lots (Figure 34).

Figure 34. Average Nightly Hours Use by Season, Mason's Ridge Parking Lot Lights



Overall, use of sensors/dimming saved substantial energy in the Mason's Ridge parking lots. Energy savings in the upper lot ranged 41-44% depending on season, whereas savings ranged 86-88% in the lower lot. There are several possible contributors to the differential energy savings between these two lots. More residences are accessed from the upper lot than the lower one, so there may be more people visiting the upper lot at night, resulting in more time at full output. In addition, the directed instructions were for longer delay times (four minutes) in the upper lot than the lower lot (two minutes), which would also result in more time at full output. Lastly, and perhaps most importantly, the upper lot circuit appears to be operating at a higher dim state (around 40%) than the lower lot (around 5%).

Figure 35. Seasonal Energy Savings Estimates, Masons Ridge Parking Lot Lights

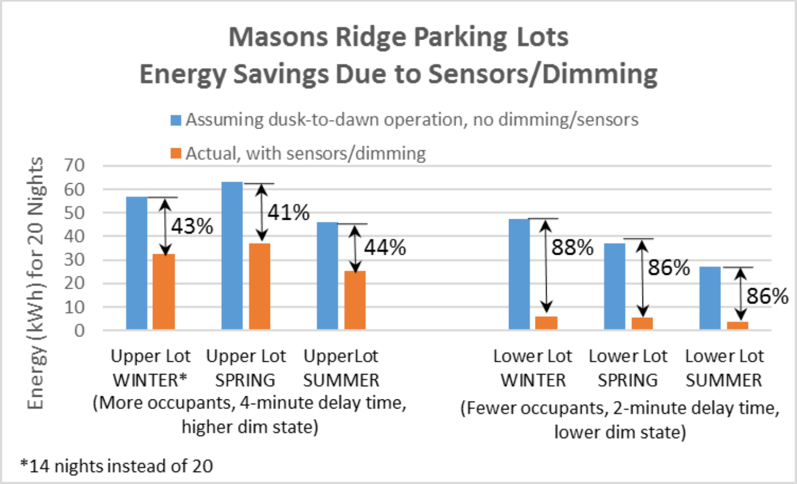


Figure 35 also shows that although seasonal changes do result in changes to energy use (shown in orange bars), percent of energy savings relative to maximum rated output (blue bars) did not change to a great extent.

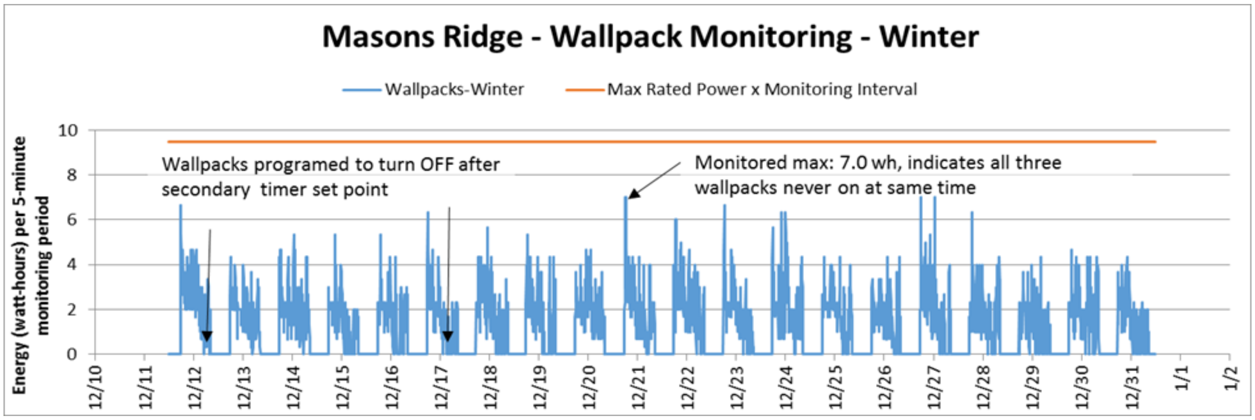
2.3.1.2 Mason's Ridge Wall Pack Energy Monitoring Results

Figure 36 shows an example of monitoring data for the wall pack circuit for one seasonal sample (winter). The blue line indicates energy use for every five-minute monitoring period. The orange line indicates expected maximum energy.[10]

---

[10] [(Two wall packs on the circuit x 42 watts at full output per luminaire) + (one wall pack at 30 watts)] x five-minutes monitoring interval = 9.5 watt-hours.

Figure 36. Typical Energy Use Graph for Wall Pack Circuit



This figure shows two noteworthy results. These wall packs have a two-step dimming program, by which they dim to a low level after being vacant for a few minutes;[11] then after 30 minutes, the wall packs turn off entirely. LRC observed this function at the site visit in November 2015.

The other noteworthy result shown in Figure 36 is the fact that maximum energy is less than expected. There are two wall packs on the south side, and one wall pack on the north side. These data indicate that at no time during the three monitoring periods did an occupant walk around the entire building, to cause all three wall packs to come to full output.

---

[11] North wall pack, 23%, South wall packs 27%.

As expected, nightly hours of use were longer for wall packs in winter than in summer (Figure 37).

Figure 37. Average Nightly Hours Use by Season, Mason's Ridge Wall Packs

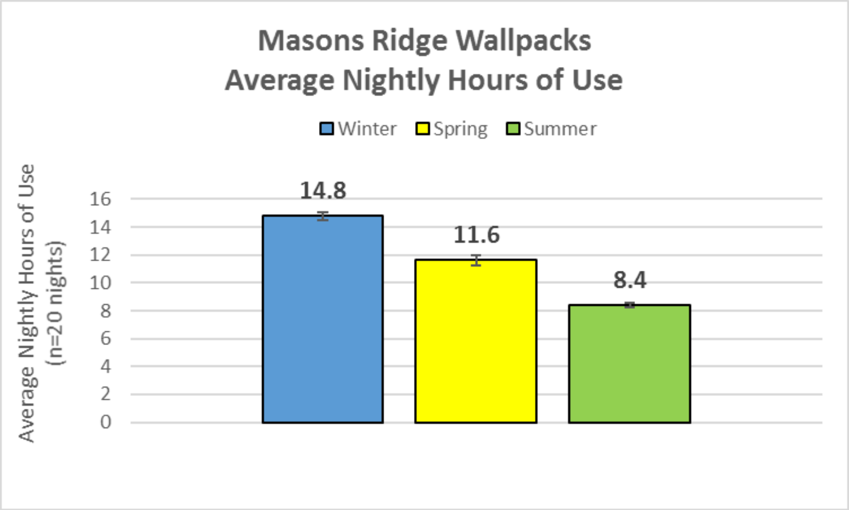
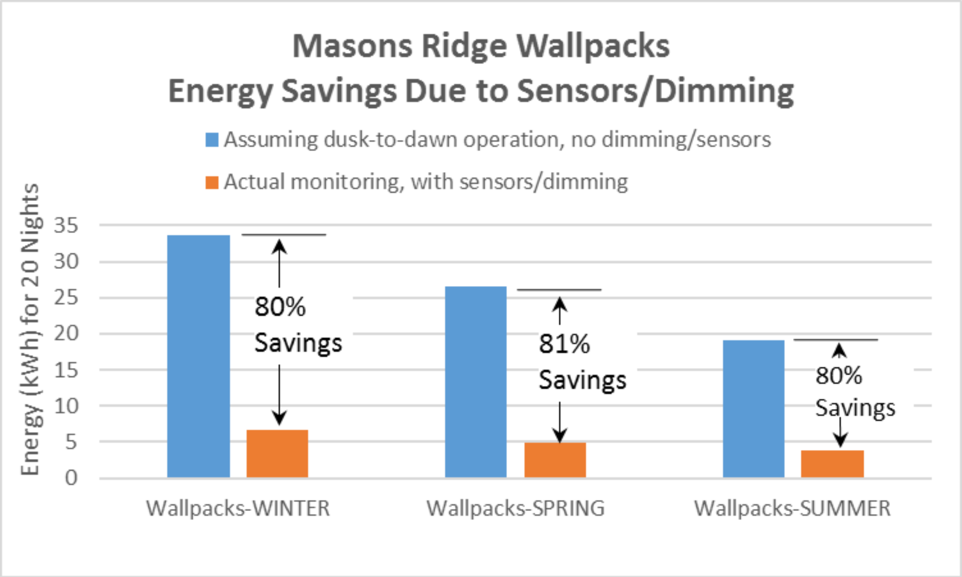


Figure 38 shows that the sensors and dimming saved considerable energy on the Mason's Ridge wall pack circuit. Even though the nightly hours of use were longer in the winter than in the summer, the percent energy savings in relative terms (percentage) did not change significantly over each season (80-81%).

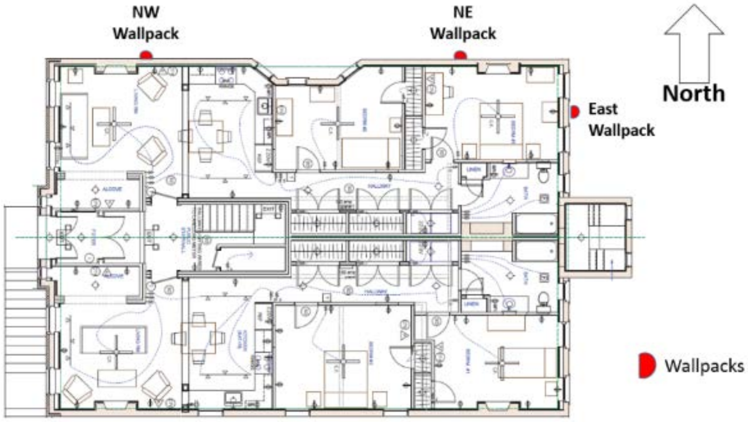
Figure 38. Seasonal Energy Savings Estimates, Masons Ridge Wall Packs



2.3.2 Landers Energy Monitoring Results

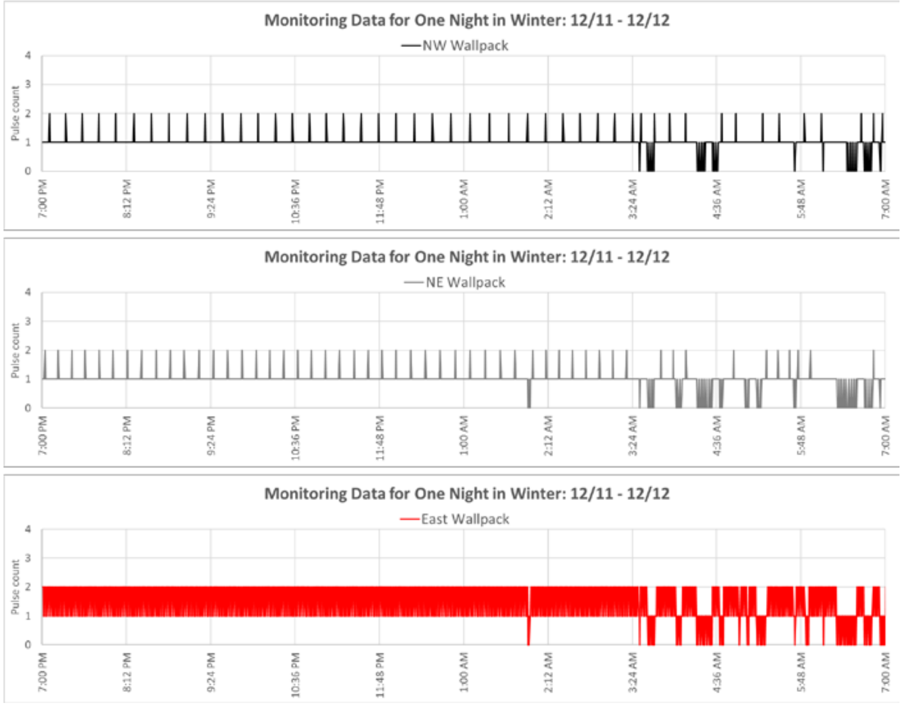
At the Landers site, Taitem Engineering installed separate monitoring equipment for each of the three wall packs; the three luminaires are shown in Figure 39.

Figure 39. Landers Monitoring Plan



While LRC site observations did not reveal dimming activity, the monitoring data do suggest these lights may have dimmed late at night. The challenge with the data set is that the loads are very small (<50W) and the monitoring interval was especially short (30 seconds). As shown in Figure 40, monitoring data appear to be alternating between integer pulses.

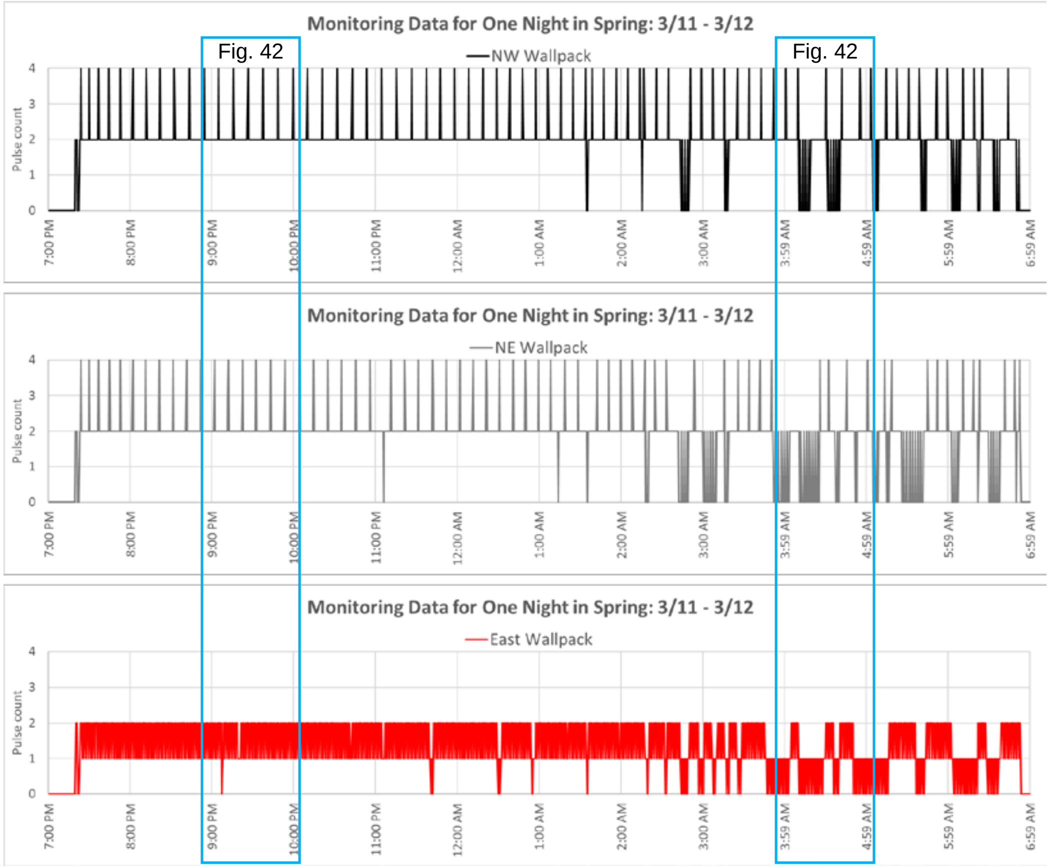
Figure 40. Landers Monitoring Data for One Night in Winter



Looking at the spring data, the northeast and northwest wall packs alternate for some reason between 2 and 4 pulses, while the east wall pack oscillates between 1 and 2 pulses. It is not clear why the monitoring equipment would record pulse counts in greater increments than one pulse, and why winter (and summer) data sets for both north-facing wall packs have a different pattern from spring.

Figure 41. Landers Monitoring Data for One Night in Spring

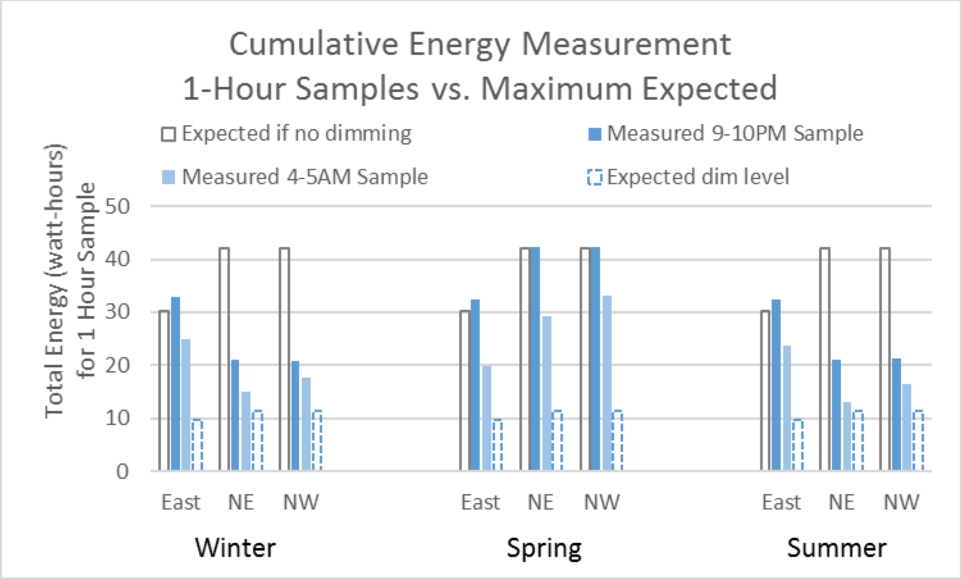
(Sampled time ranges from Figure 42 shown in blue windows)



Despite this curious inconsistency about how differently the monitoring equipment records the loads of the three circuits between seasons, Figures 40 and 41 do imply that the lights are operating at a lower output late at night.

To investigate whether the lights are in fact dimming in response to vacancy, LRC sampled a one-hour period early in the evening (9:00 p.m. to 10:00 p.m.) and just before morning (4:00 a.m. to 5:00 a.m.) for all three seasons (see blue windows in Figure 41 above). As shown in Figure 42, the spring data seem to support the conclusion that the lights are operating at the programmed high output early in the evening and occasionally dim down or off late at night. The winter and summer data however are less conclusive.

Figure 42. Indirect Evidence that Landers Wall Packs May Be Dimming

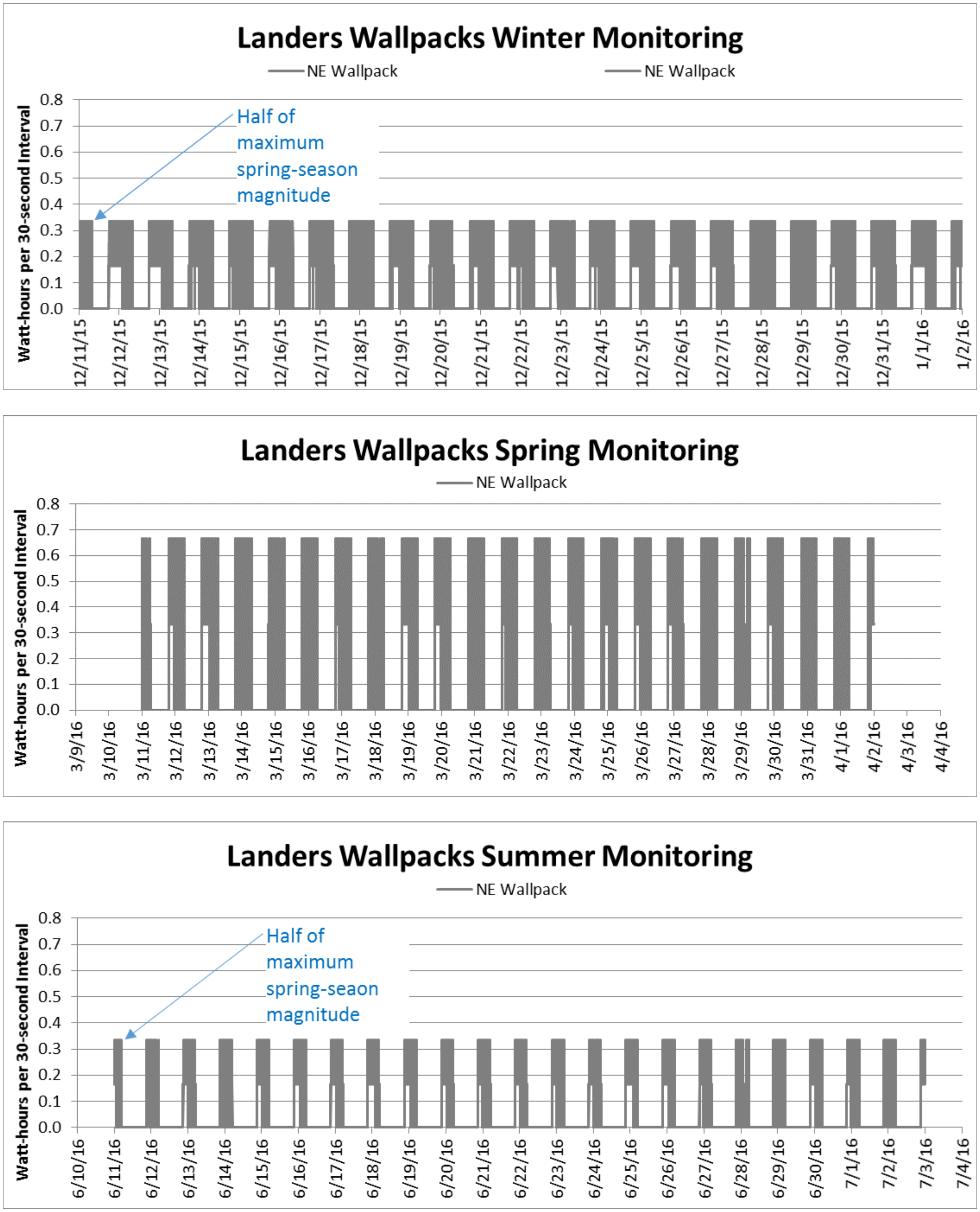


For the east-facing wall pack for all three seasons, the cumulative energy (32.5 watt-hours) early in the evening appears slightly higher than expected (30.2 watt-hours); it was intended that this luminaire should operate at 72% of full output when occupied.

For the northeast and northwest wall packs, the sample of spring data indicates the lights are operating at the full, expected output early in the evening. Late in the evening, cumulative energy use indicates all three lights spent some time dimmed in response to vacancy. The dashed bar indicates what the energy use would have been if the light operated for the full hour at the intended “low” output. While the spring data appear to match expectations for lights at full output and for intermittent dimming in response to vacancy, the winter and summer data on the north side of the building are less certain.

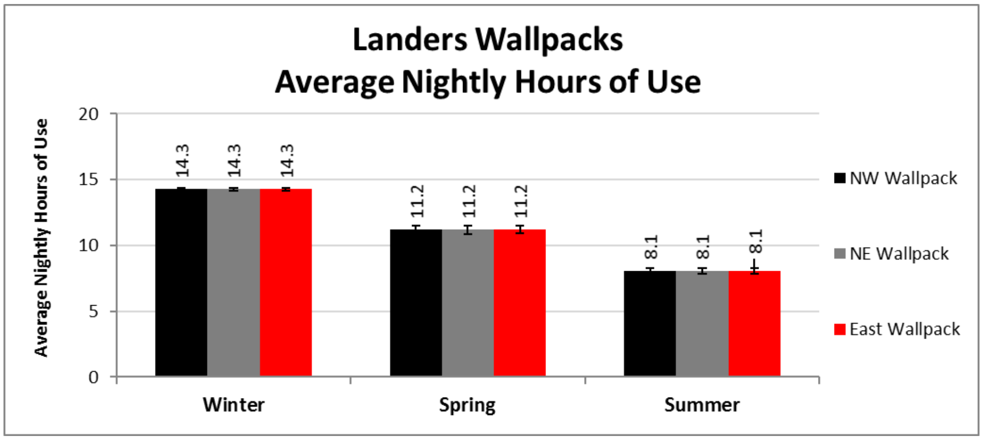
For northeast and northwest wall packs—because the winter and summer pulse counts are half that of spring—the maximum cumulative energy use in winter and summer are also about half compared to spring. Figure 43 shows the data from the northeast wall pack as an example. Assuming the lights were not reprogrammed multiple times during the monitoring period, it appears there may be a problem with the monitoring data for the northeast and northwest wall packs in winter and summer.

Figure 43. Lower Maximum Energy Use in Summer and Winter Does Not Seem Likely



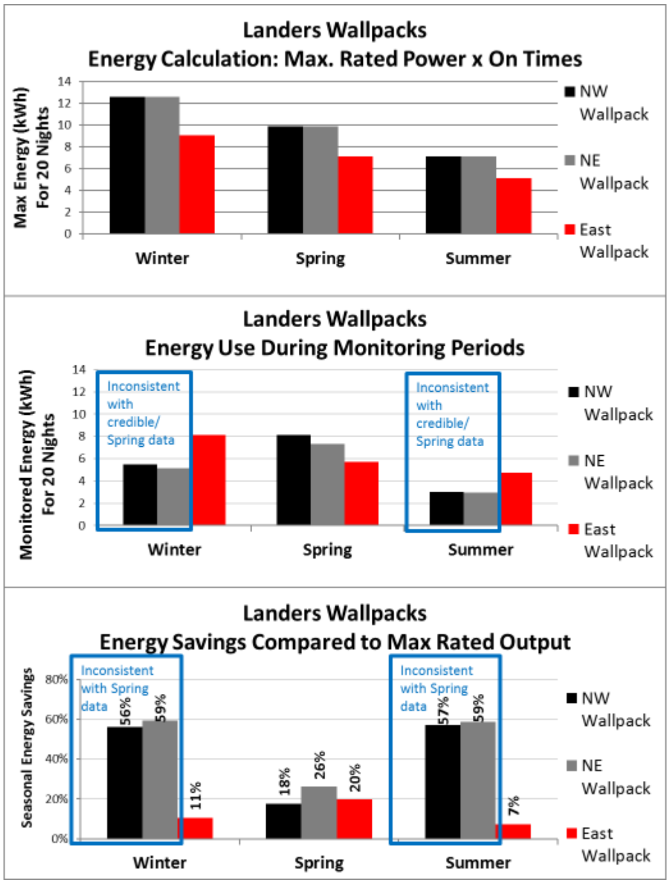
While the pulse magnitudes seem inconsistent between seasons, the three wall packs do show virtually the same on/off times and subsequent nightly hours of use (Figure 44).

Figure 44. Average Nightly Hours of Use by Season, Landers Wall Packs



As discussed above, cumulative data for winter and summer seem problematic in winter and summer. Figure 45 shows that the "Energy Use During Monitoring Periods" for winter and summer seasons seem artificially low for the north-facing wall packs, even though the maximum pulse counts in Figure 43 are lower than in spring. As a result of unexpectedly low cumulative totals, energy savings estimates are artificially high for the northwest and northeast wall packs in both winter and summer.

Figure 45. Seasonal Energy Use and Savings Estimates, Landers Wall Packs



While the data seem to indicate that the Landers wall packs are dimming in response to vacancy late at night, LRC hesitates to confirm the Landers wall pack energy results without further confirmation that the monitoring equipment is working properly, since re-monitoring with a longer measurement interval would enable researchers to differentiate actual off times from fractional pulses at low output.

Note, too, that the Landers site is located adjacent to a fast-moving road, which may prevent the lights from dimming more frequently as vehicles on Gidney Avenue activate the lighting (Figure 46).

Figure 46. Traffic from Gidney Avenue May Impact Sensors (Shown in Red)

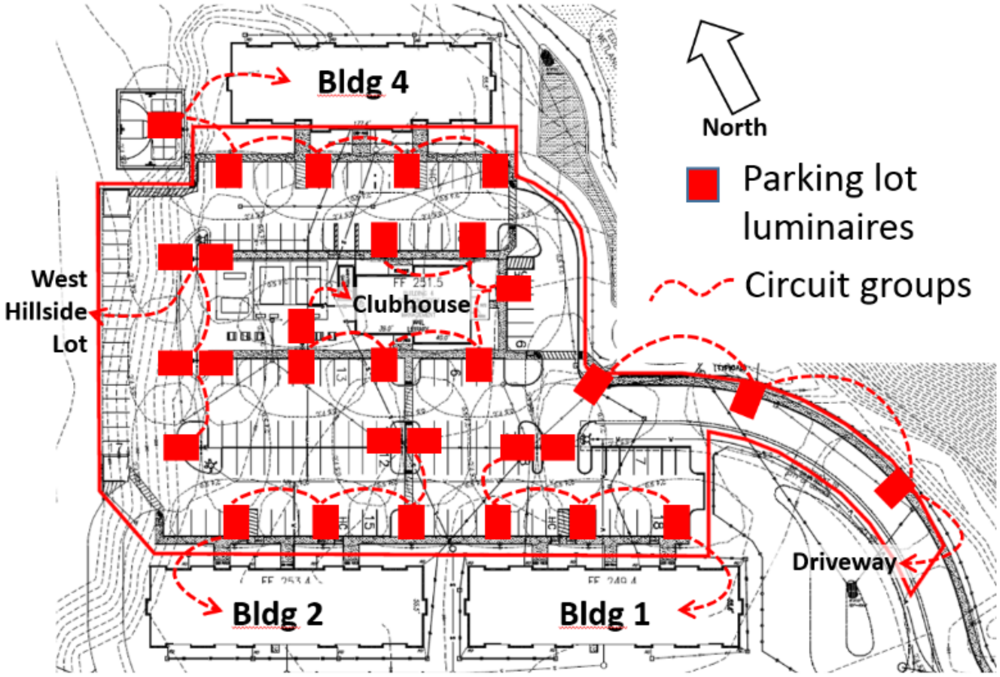
2.3.3 Lionheart Cohoes Energy Monitoring Results

2.3.3.1 Outdoor Lighting Results

Parking Lot Lighting

The parking lot circuits that Taitem Engineering monitored at the Cohoes site are shown in Figure 47.

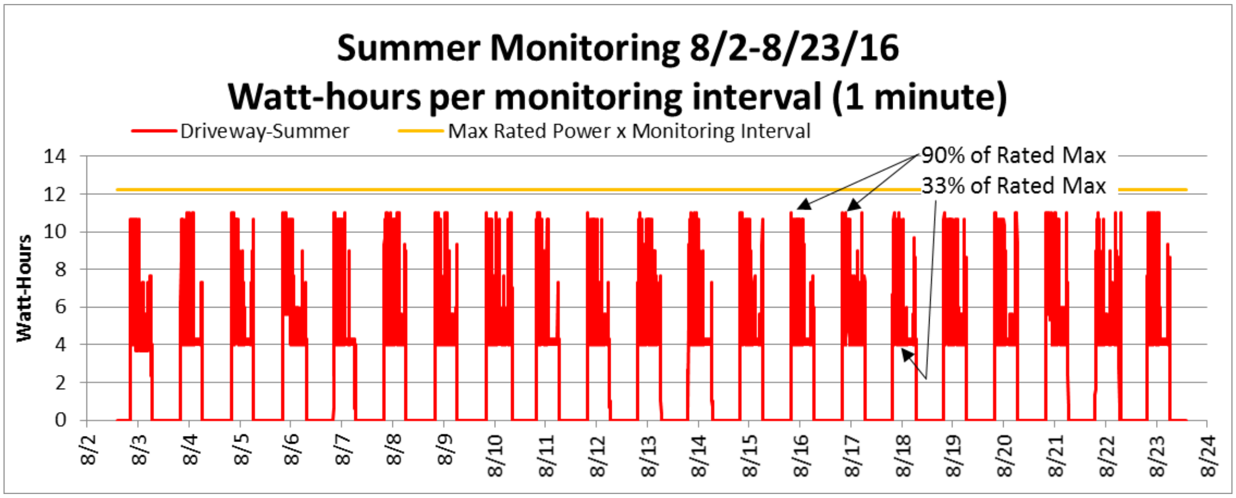
Figure 47. Parking Lot Luminaires, Circuit Groups



Taitem Engineering successfully monitored five of the six parking lot circuits at the Cohoes site. Their monitoring data showed the sensors/dimming saved considerable energy used by the parking lot lights at this site. Not all of the savings came from dimming the lights when vacant; part of the energy savings came from lower than maximum rated output when occupied.

For example, in Figure 48, the lights at the driveway operated at 90% of expected output when occupied.[12] However, the instructions were that the lights should step up to 100% output when occupied. As shown in Figure 48, this circuit dimmed to 33% of expected when vacant. This seems reasonable when considering that control voltage results in unknown light output and energy use.[13] The instructions were to program one of the lights on the driveway circuit to dim down to 4V and six lights to 2V. Assuming this corresponds to approximately 40% output and assuming 2V/10V corresponds to approximately 20% output, that would mean the minimum on the circuit should be approximately 23%; this is reasonably close to the 33% shown in the monitoring data (Figure 48). It appears therefore that the driveway lights are programmed reasonably close to what the researchers had intended. If the lights operated at 100% of maximum rated output when occupied, less energy savings would have been realized.

Figure 48. Driveway Monitoring, Summer Monitoring



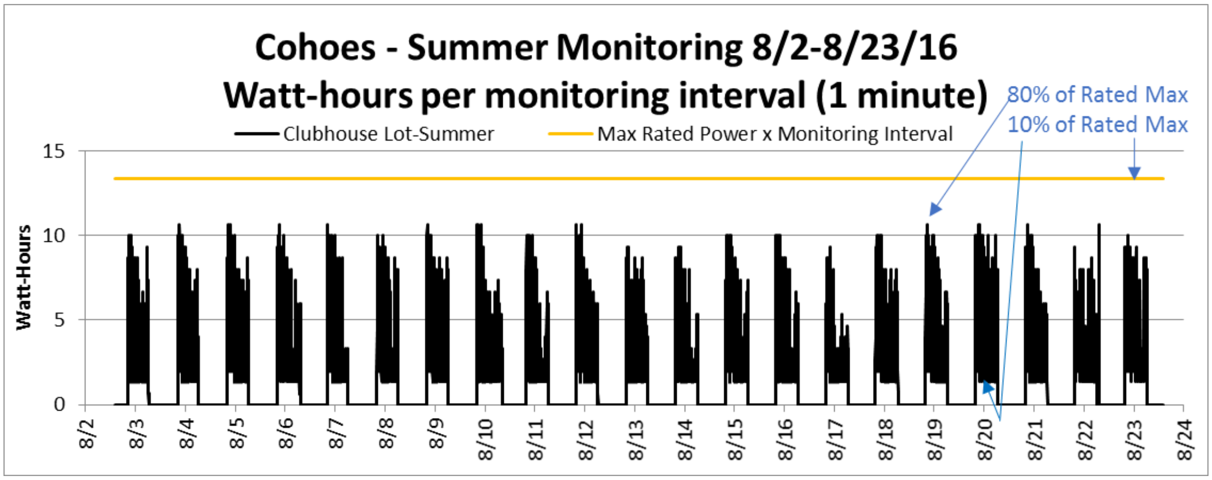
---

[12] (Seven luminaires) x (105 W each) x (one-minute monitoring interval) = 12.25 watt-hours.

[13] Maximum control voltage is 10 V, which can be stepped down in 1 V increments to achieve dimming and energy savings. For simplicity, LRC has assumed that a reduction in control voltage resulted in an equivalent reduction of both light output and power demand. Laboratory testing with the luminaires and internal drivers would be necessary to confirm the exact relationship between control voltage and both light output and power.

The parking lights surrounding the central clubhouse operated at only 80% of the expected output when fully occupied, and dimmed down to approximately 10% when fully vacant (Figure 49).[14] It was intended that five of the lights on this circuit would dim to 1 V (presumably 10%), one at 3 V (presumably 30%), and another to 2 V (presumably 20%). Since that would result in a weighted average of 13%, the 10% shown here is reasonably close to expectations. It appears therefore that the lights on the clubhouse circuit are programmed to dim as intended, but the maximum light output may be lower than intended; therefore, part of the energy savings is due not to dimming lights when vacant but rather to program settings at maximum output.

Figure 49. Clubhouse Lot, Summer Monitoring

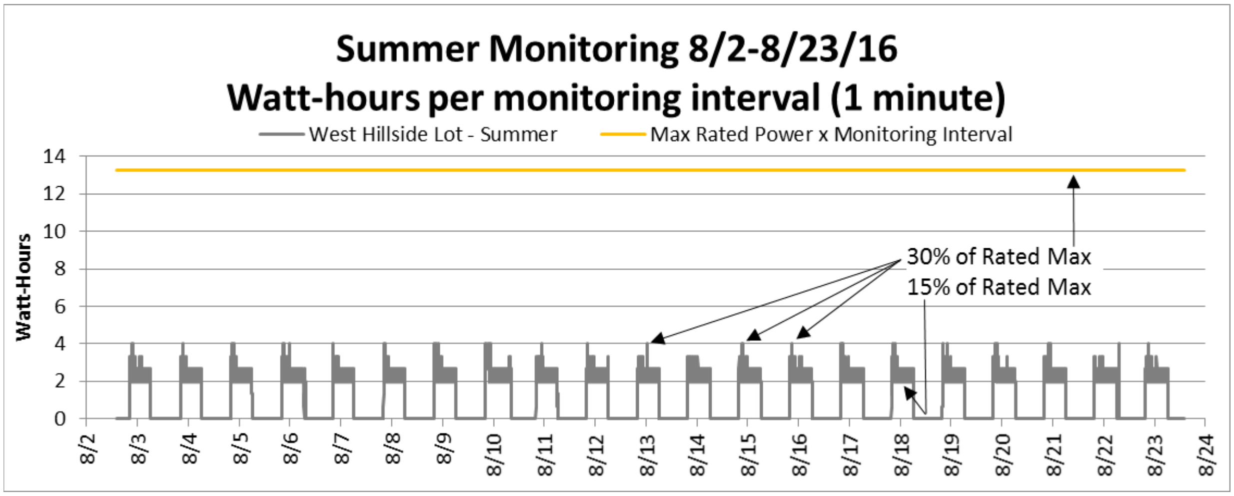


---

[14] [(Five luminaires) x (105W each) + (two luminaires) x (138W)] x one-minute interval = 13.35 watt-hours.

The west hillside parking lot circuit appears to be operating at much lower light output than intended (Figure 50). While the dimmed output appears to be exactly as expected, the maximum output appears to be only about 30% of expected.[15] Because the residents do not often use this side lot, there are no questionnaire results nor photometric measurements to confirm or refute this conclusion. The combination of low-occupancy patterns and low-maximum light output resulted in greater energy savings in this lot than the other Cohoes parking lot circuits.

Figure 50. West Hillside Lot, Summer Monitoring

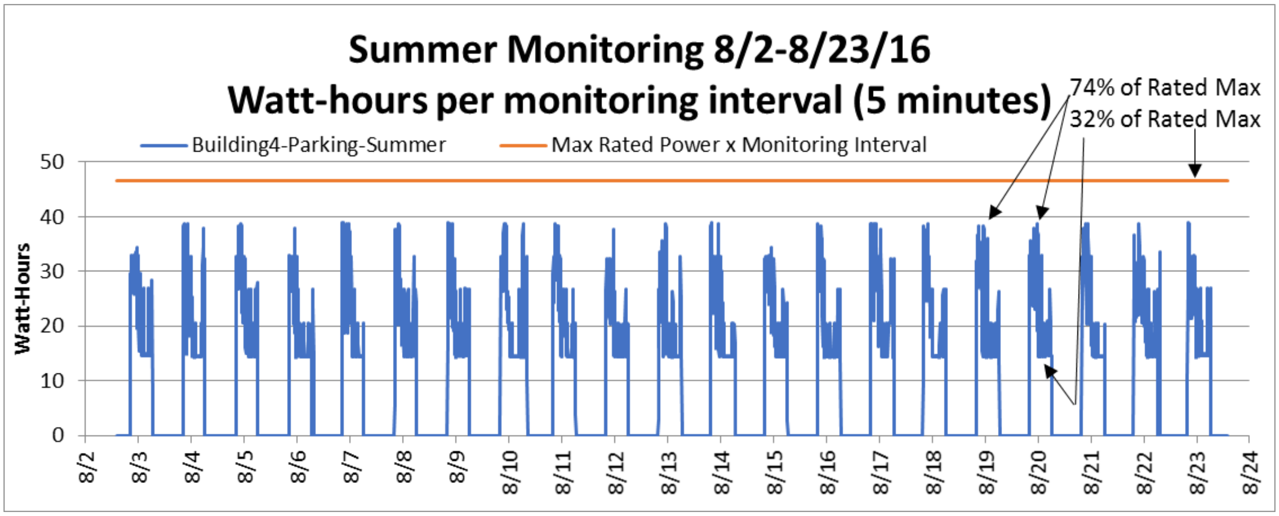


---

[15] One luminaire at 105 W and 5 luminaires at 138 W x 1-minute monitoring interval = 13.25 watt-hours.

The parking lots in front of the Cohoes apartment buildings show frequent usage patterns early in the evening, but still considerable energy savings due to sensors/dimming late at night. In the Building 4 parking lot (Figure 51), the minimum output (32%) is reasonably similar to what was intended (3 V for four lights, 1 V for the sport court light). However, the maximum light output was only 74% of the rated maximum;[16] it is possible that the maximum light setting on one or more of the lights is set lower than full output. The lower-than-expected maximum output contributed to energy savings.

Figure 51. Building 4 Parking Lot, Summer Monitoring



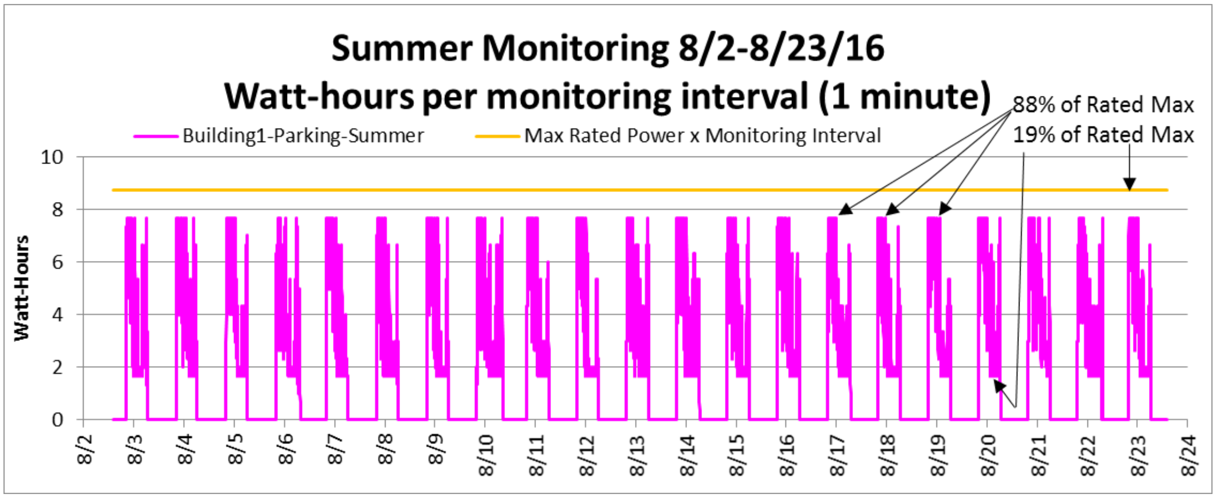
Taitem Engineering attempted to monitor the parking lights at Building 2; however, there was apparently a problem with the equipment monitoring that circuit; although LRC confirmed those lights were on at night, the monitoring data indicated “0” output at all times. Therefore, no data for Building 2 parking lot are available for analysis.

---

[16] (Four luminaires) x (105W) + (one luminaire) x (138W) x five-minute interval = 46.5 watt-hours.

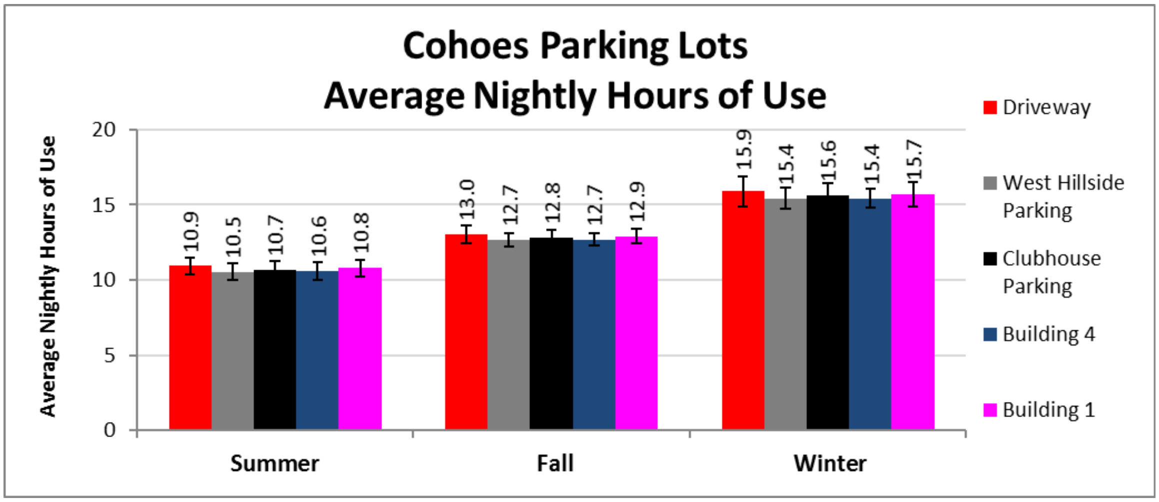
The Building 1 parking lot showed the same pattern as the other buildings: high output early in the evening, then low use overnight, returning to higher output in the morning. As shown in Figure 52, the parking lights dimmed to about 19% of expected—reasonably similar to what would be expected from following instructed directions (one luminaire at 1 V, one at 2 V, and three at 3 V, expected average of ~24%).[17] Lower than expected maximum output contributed to energy savings.

Figure 52. Building 1 Lot, Summer Monitoring



Overall, Figure 53 shows that nightly hours of use in the Cohoes parking lots were longer for winter (~16 hours) than in summer (~11 hours).

Figure 53. Average Nightly Hours Use by Season, Cohoes Parking Lots

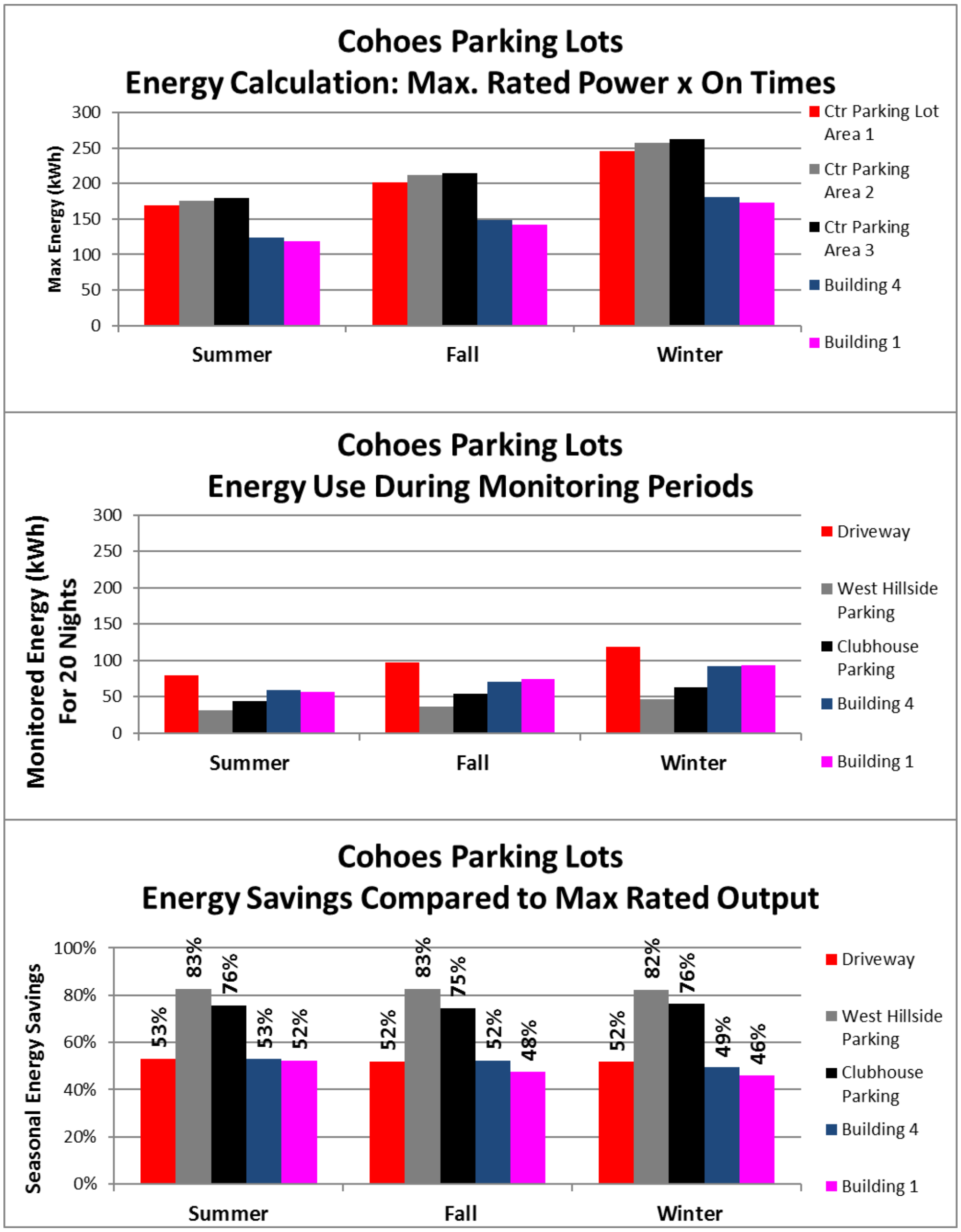


---

[17] Five luminaires at 105W x 5-minute interval = 8.75 watt-hours.

Figure 54 shows that the sensors and dimming saved considerable energy on the Cohoes parking lot circuits. Even though the nightly hours of use were longer in the winter than in the summer, the relative (%) energy savings overall did not change significantly over each season. The circuit with the greatest savings (West Hillside Lot: 82-83%) was partly due to low occupancy patterns, and partly due to apparent reduced maximum output settings. For parking lots in front of the apartment buildings, sensors/dimming saved 46-53% compared to maximum rated output. The clubhouse circuit showed good savings (75-76%). The driveway circuit had similar energy savings (52-53%) as the apartment buildings.

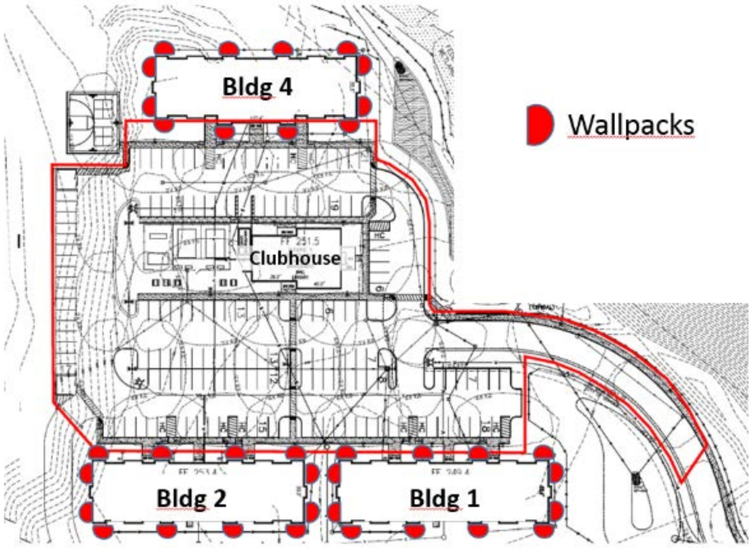
Figure 54. Seasonal Energy Use and Savings Estimates, Cohoes Parking Lots



Wall Packs

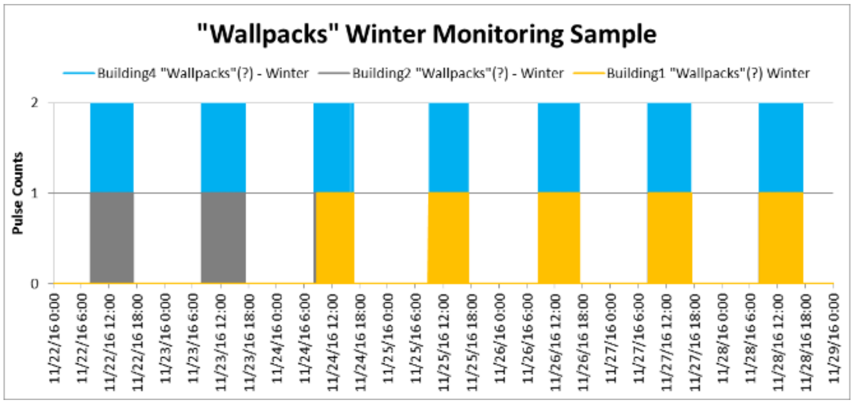
Taitem Engineering attempted to monitor the Cohoes wall packs shown in Figure 55.

Figure 55. Wall Pack Locations



However, the results of the monitoring showed circuits that were on during the day and off at night (Figure 56). Data from all three buildings and all three seasons showed only daytime use. Taitem Engineering confirmed that the time stamps on the data are correct. During site visits, LRC confirmed that the wall packs are in fact on at night and off during the day. Therefore, LRC and Taitem Engineering conclude that the circuits are erroneously labeled in the electrical panels as “wall packs” and are probably other electrical loads that are only operated during the day. Apparently, no monitoring of actual wall packs was completed for this site.

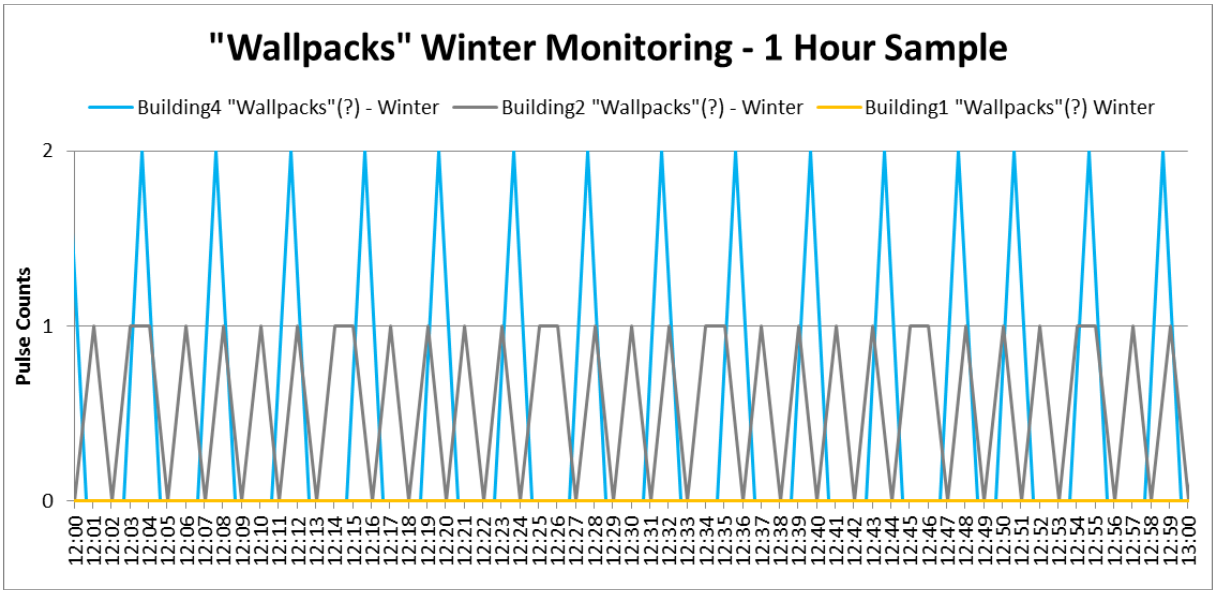
Figure 56. Circuits Labeled as "Wall Packs," Seven-day Sample, Daytime-only Use



Also, difficult to explain is the fact that the “wall pack” circuits were not continuously on, but rather, alternated between on and off at a regular interval (Figure 57). It is possible that whatever loads were measured were too small and/or time interval too short (one minute) for the monitoring equipment to collect an entire “pulse” per monitoring interval. Especially strange is that the circuit for Building 4 “wall packs” oscillates by two-pulse increments, rather than one-pulse increments.

Figure 57. Circuits Labeled as "Wall Packs," Monitoring Sample from Noon to 1:00 p.m.

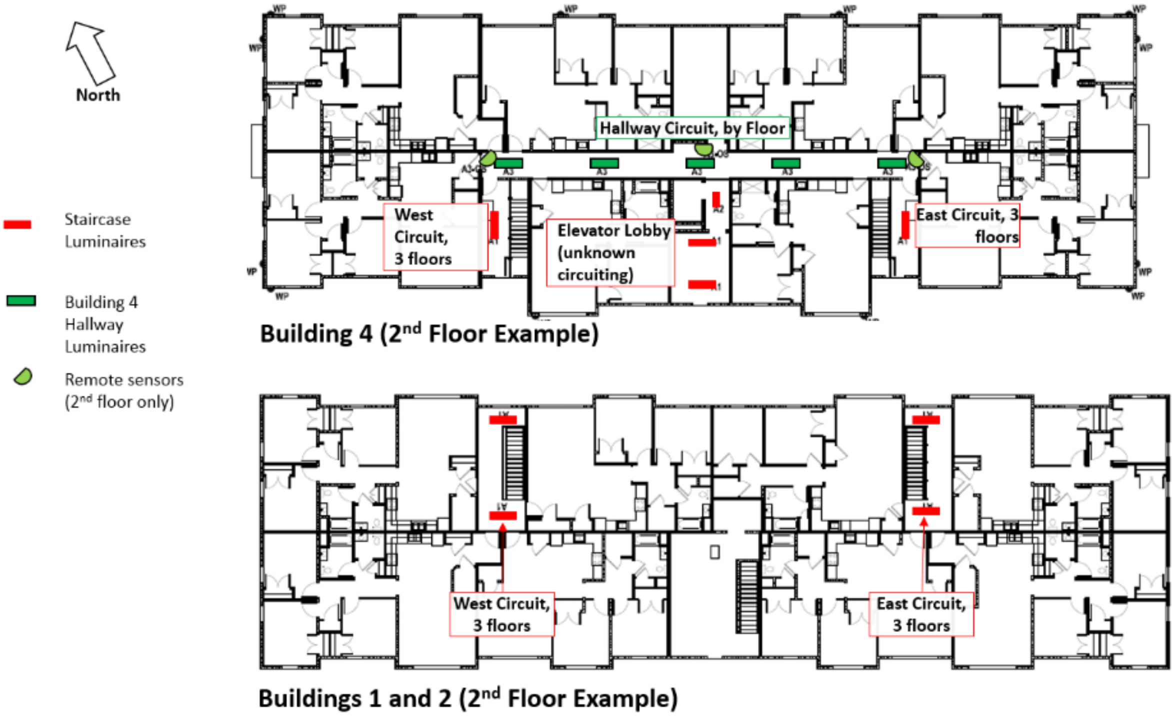
For this report, Cohoes “wall packs” have been eliminated from analysis.



2.3.3.2 Indoor Lighting Results

Examples of the indoor, sensor-controlled lighting types and locations are shown in Figure 58.

Figure 58. Typical Indoor Lighting Plans



Staircase Lighting

Taitem Engineering performed energy monitoring for the two staircase circuits in Building 4. The circuit referred to as the “east” staircase has higher (50%) maximum energy use than the circuit referred to as “west” staircase circuit. This would make sense if the east circuit included some, but not all of the lights in the elevator lobbies; the elevator lobbies have more lights than either the east or the west staircases, thus two and a half times the expected energy use. It is unclear how many staircase lights are on the two staircase circuits that were monitored in Building 4. Therefore, for the following interior energy calculations, LRC used maximum pulse count on the monitoring circuit, rather than multiplying maximum rated power of each luminaire by the (uncertain) quantity of luminaires.

Despite the fact that it is unclear which and how many staircase luminaires were monitored, the data show that the sensors succeeded in dimming down the staircase lights, thus contributing to energy savings.

Figure 59 shows an example for both staircase lighting circuits in Building 4. Figure 60 shows that the staircase lights dim to low levels when vacant, especially at night.

Figure 59. Monitoring Example of Two Staircase Circuits in Building 4

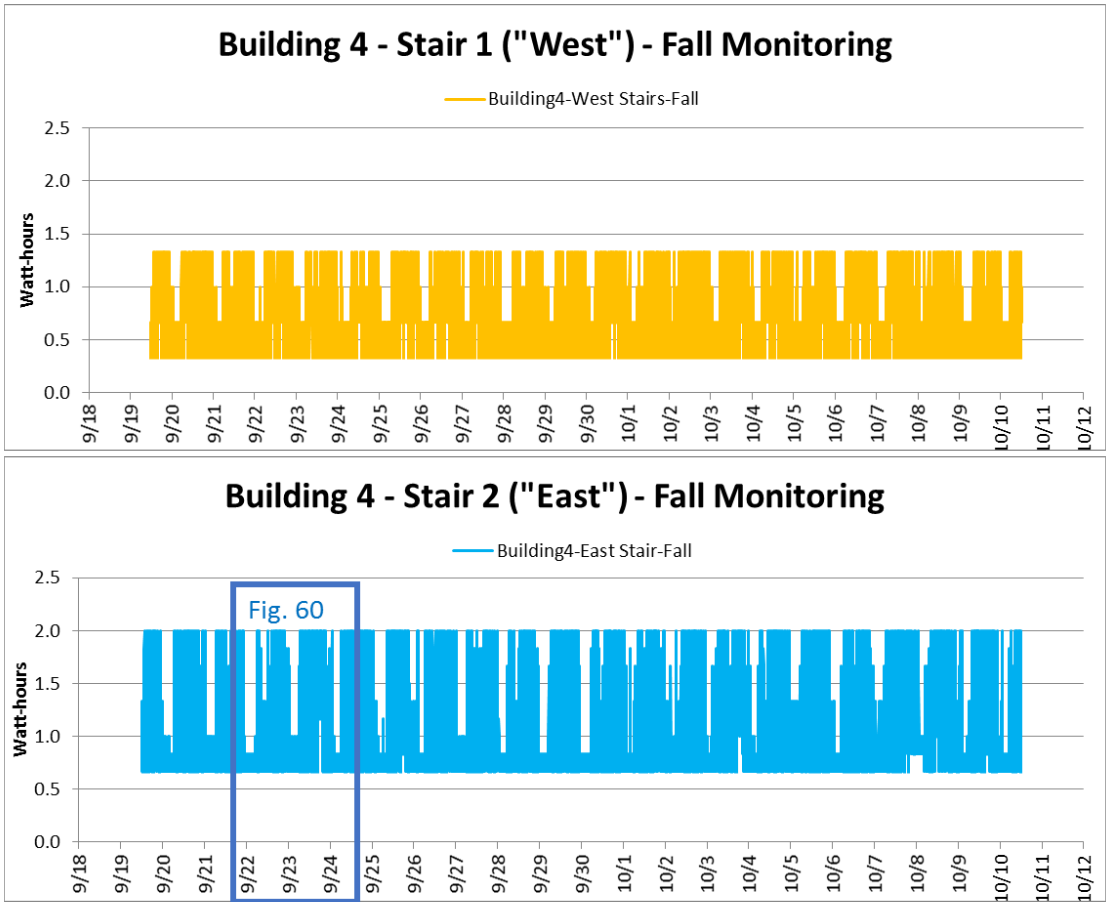
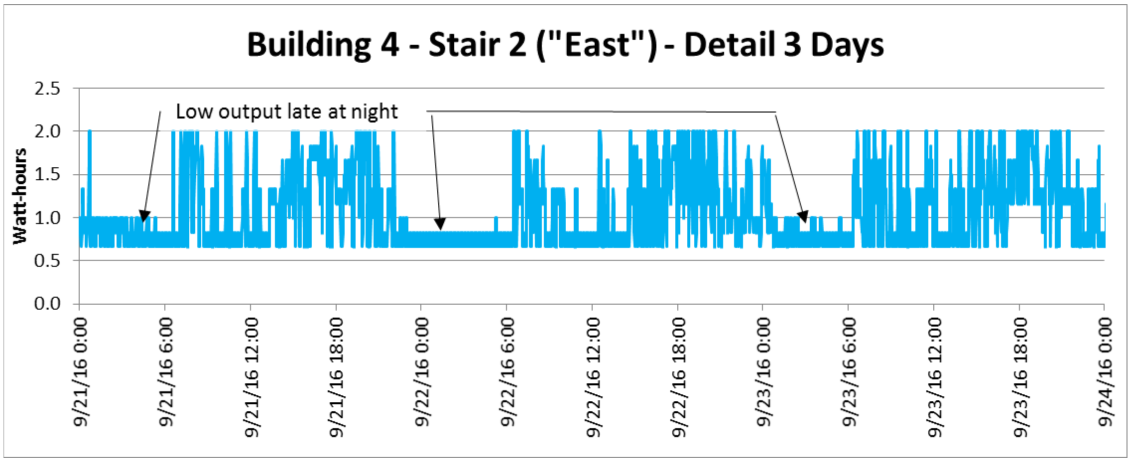


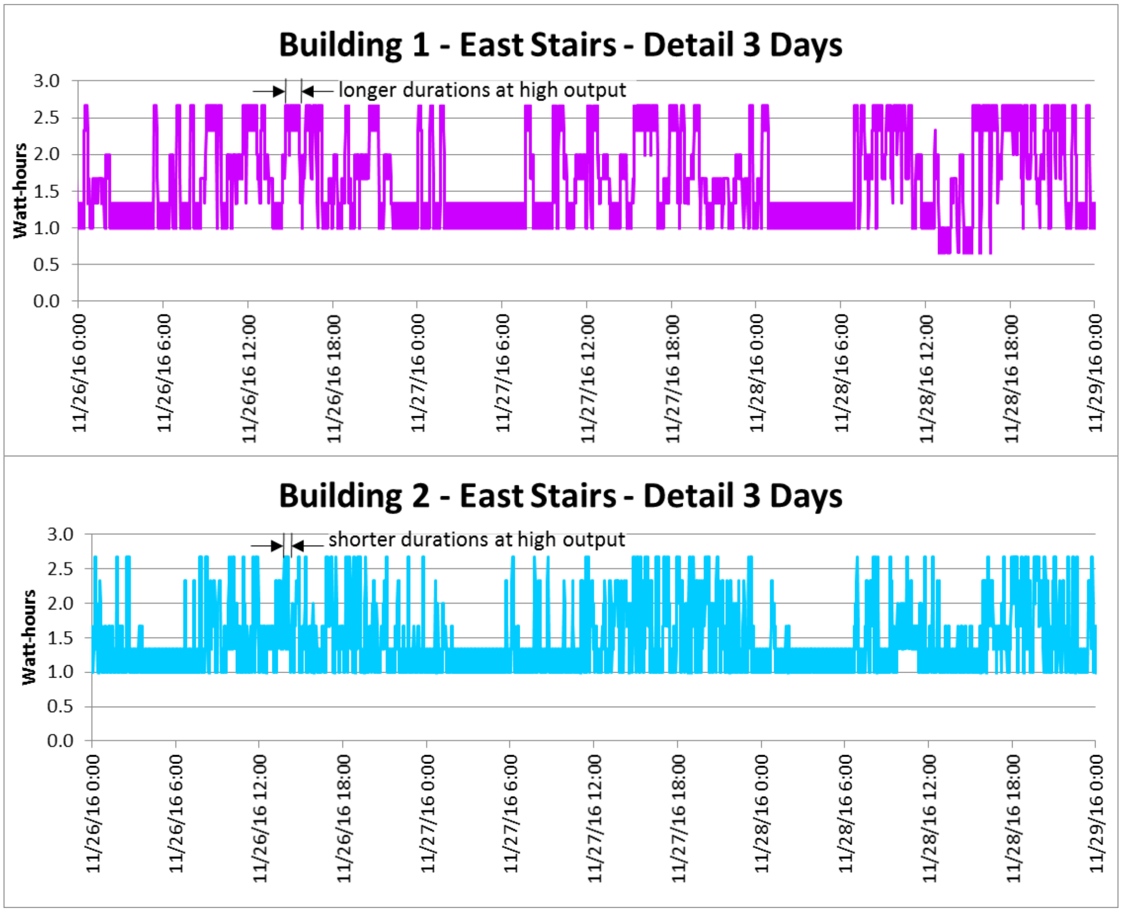
Figure 60. Detail Showing Typical Nightly Usage Patterns in Building 4



As shown in Figure 58, Buildings 1 and 2 have staircases on the east and west sides of the buildings; the east and west circuits were monitored separately. In the case of Buildings 1 and 2, the measured maximum energy closely matches what would be expected. For both buildings, the maximum output in the east staircases was 99% of expected, and the west staircases was 93%. However, to enable comparison with Building 4 staircase monitoring, the energy savings calculations for Buildings 1 and 2 use the same calculation methodology as Building 4: maximum measured pulse, rather than maximum rated output and luminaire quantity.

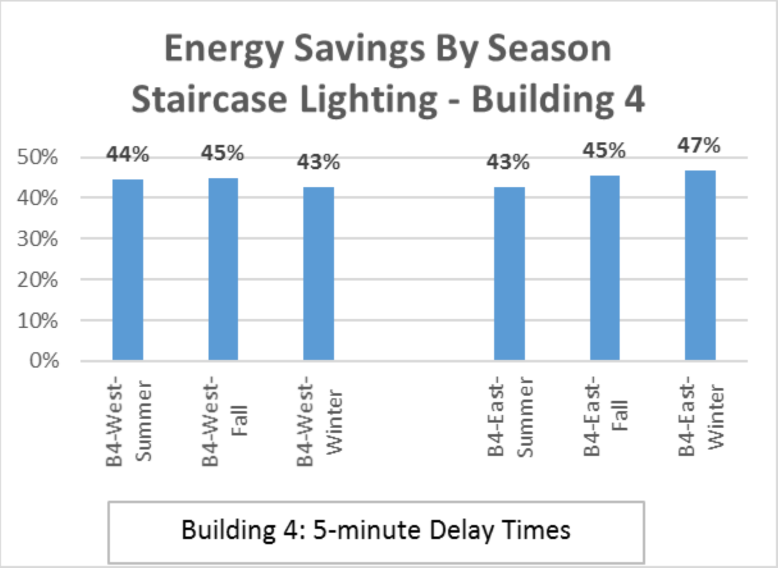
As shown in Figure 61 and Appendix F, staircase lighting in Buildings 1 and 2 also operated at reduced output at night. However, Building 1 stair lights seem to spend longer time durations at full output compared to those in Building 2. This is exactly as expected because Building 1 lights were deliberately set to a longer delay time (15 minutes) than Building 2 (10 minutes) or Building 4 (5 minutes).

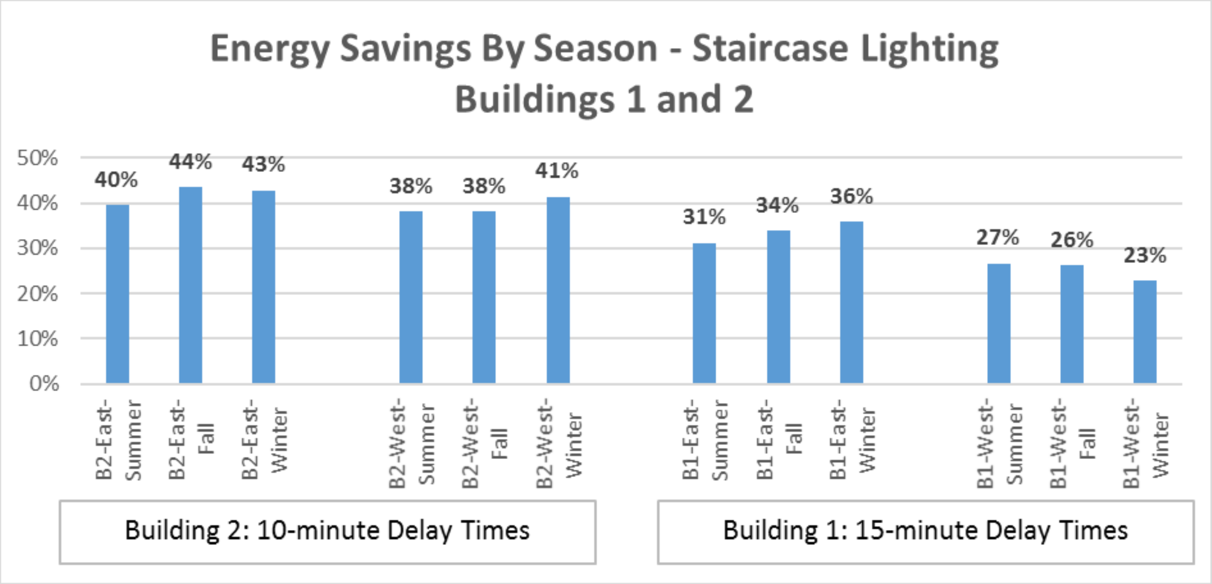
Figure 61. Detail Showing Typical Nightly Usage Patterns in Buildings 1 and 2



Overall, Building 1 staircase lights had less energy savings than the two other buildings at the Cohoes site (Figure 62). This supports the research hypothesis that longer delay times lead to lower energy savings.

Figure 62. Energy Savings in Staircases

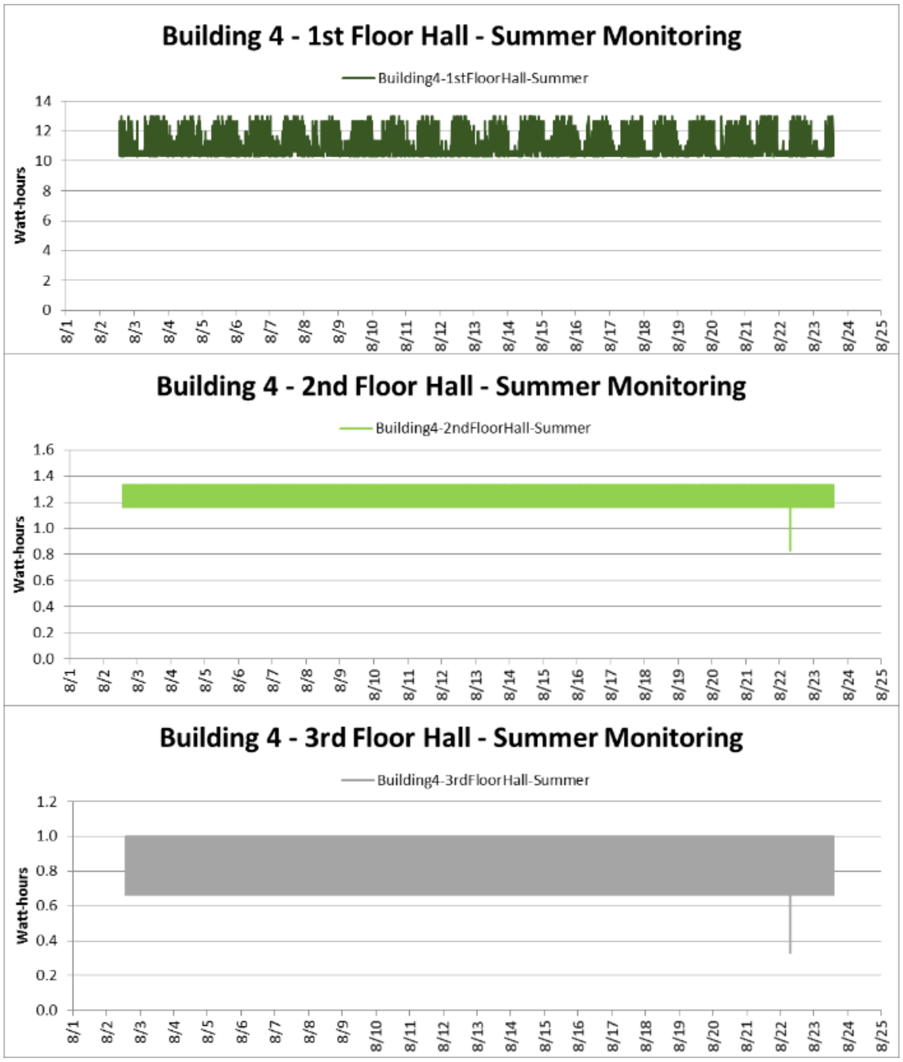




Building 4 Hallway Lighting

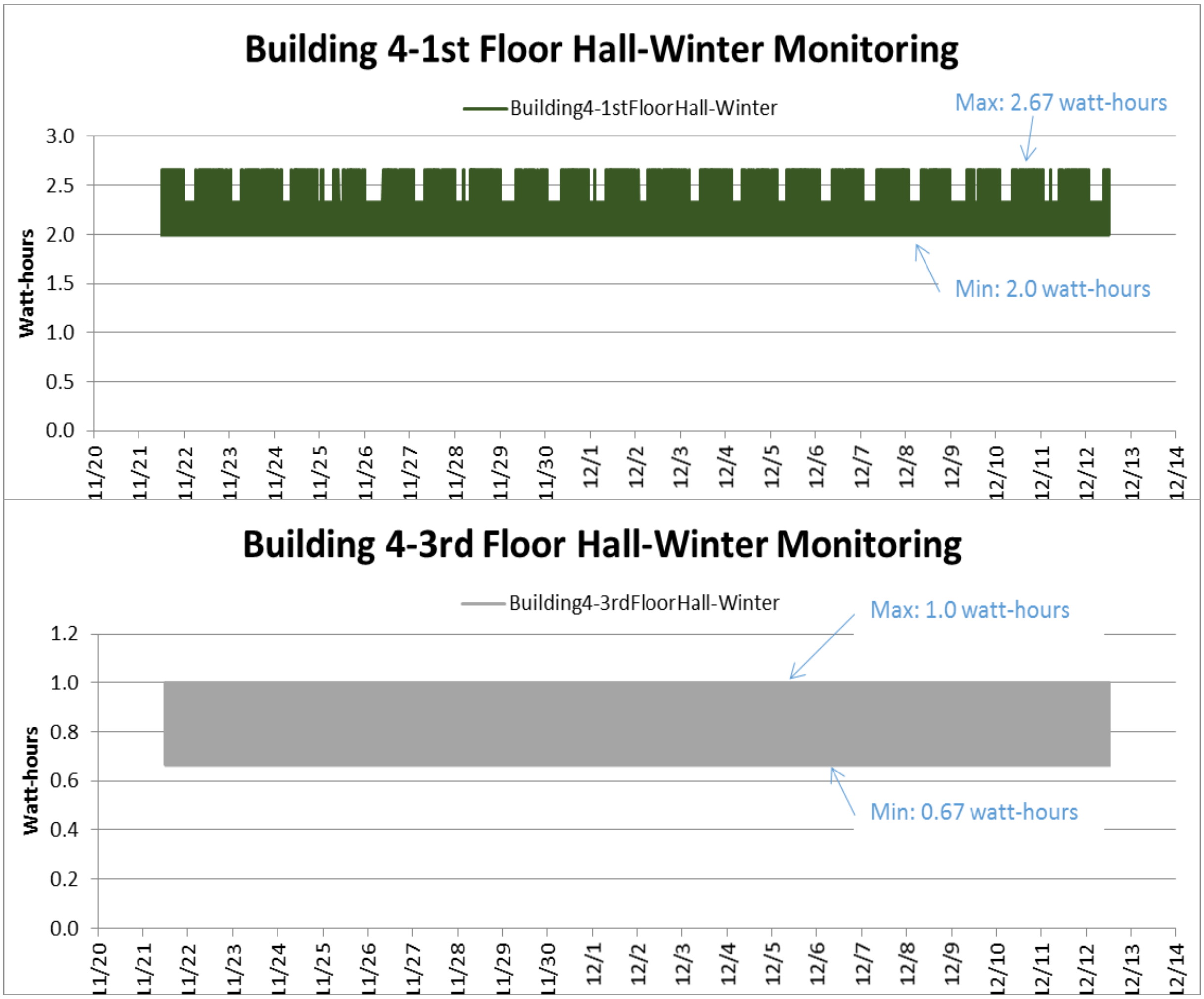
Monitoring of the first floor hallway lights showed a clear day/night occupancy cycle. However, the hallways on the second and third floors do not show a clear pattern of dimming when vacant. It is possible that the hallway lights on the second and third floors do not in fact dim in response to vacancy. Before this monitoring started, LRC noted that the second and third floor lights were not dimming as expected. The property management team sent personnel to recommission those lights. However, these data still do not support the assumption that these second and third floor hallway lights are dimming. Alternatively, there may have been a problem with the monitoring data.

Figure 63. Building 4 Hallway Lights Monitoring Comparison



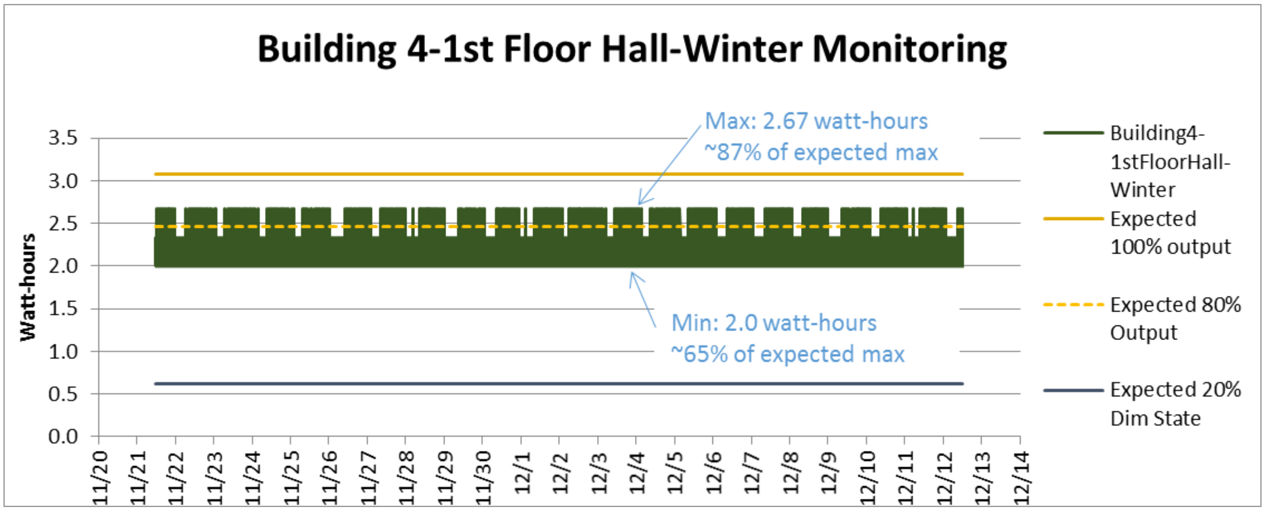
It is also strange that the first and third floor hallways do not have the same maximum energy use, despite having the same luminaire types and quantities, and the same monitoring frequency (one minute). Figure 64 shows that both the maximum and minimum energy use are different for the first and third floor hallways.

Figure 64. Comparing Maximum and Minimum Energy Use by Floor for Same Luminaire Type



It is also strange that programming for these lights was intended to operate at 80% output when occupied, and 20% when vacant. Figure 65 shows that the lights in the first floor hallway appear to be operating at about 87% of expected output when occupied, and about 65% output when vacant. However, these do not correspond to the available settings from this manufacturer, making the cause for the data is unclear

Figure 65. Maximum and Minimum Levels Inconsistent with Expectations



As a result of these curious inconsistencies, LRC did not attempt to draw conclusions about energy savings between types of hallway lights or attempt to compare the lights to the other sensor-controlled lighting on the site.

2.3.4 Energy Discussion

The results of the energy monitoring at the three sites show that program settings for bi-level, sensor-controlled lighting has a significant impact on energy savings. The systems demonstrated on this project have the ability to adjust both the maximum output (when occupied) and minimum dim level (when vacant), as well as time delay. Many of the parking lot lights at the Cohoes site appear to be operating at less than 100% output when occupied; energy savings percentages would have been lower if the circuits had operated at 100% of expected output when occupied.

As expected, the parking lot lights dimmed late at night when fewer residents use the space; late-night dimming was another contributor to energy savings. Wall packs at the Mason's Ridge site saved considerable energy (80-81%) due to the fact that they illuminate spaces that are infrequently visited by pedestrians (on the far side of the building); if the wall packs had been positioned on the front of the building where the entrances are located, savings percentages would likely have been lower. It is unfortunate that wall pack data from the Cohoes site were not available to quantify this comparison. Spring wall pack data at the Landers site could be used for comparison, but this site is adjacent to a busy boulevard. Since the traffic triggered the sensors to illuminate the area, there was little sensor-controlled dimming. Wall Packs at the Landers site seem to have lower energy savings percentages, perhaps due to the adjacent busy roadway. Nearby, extraneous activity is a consideration when locating occupancy-sensor controlled lights.

Although hours of use for outdoor lighting were longer in winter than summer, the percent of maximum energy used or saved did not change significantly between seasons. Interior lighting also showed energy benefits from sensors and dimming. Staircase lights programmed with longer delay times (15 minutes) resulted in less energy savings (23-36%) compared to staircase lights with shorter delay times. A delay time of 5 minutes resulted in 43-47% savings, and a delay time of 10 minutes resulted in 38-41% savings.

It would be interesting in future studies to systematically evaluate the impact of dim settings and timer delays on energy savings. There were several different dim settings specified for the parking lot luminaires at both Cohoes and Masons Ridge sites. Parking lot lights at the Mason's Ridge site had two different timer-delay settings, and some lights were not programmed to dim at all when vacant. Parking lights at the Cohoes site had four different timer-delay settings. Because of all of these different settings mixed within circuits, it is difficult to draw conclusions about the relative impact of these settings on energy savings. Theoretically, the lights at these sites could be used for a follow-up study; they could be reprogrammed for consistent dim settings and delay times, as was done with the staircase lights.

However, feedback from installation personnel about difficulty of programming may preclude such inquiries. Also, more robust monitoring strategies should be employed to study these smaller differences.

Another lesson learned from this research was the difficulty of characterizing energy use patterns of circuits with very low power demand (<100 W), especially with short monitoring intervals (e.g., ≤1 minute). The monitoring equipment used at these sites was able to record circuit energy use with a precision of 0.1667 watt-hours per measurement “pulse.” At a 30-second monitoring interval[18], a circuit would have to vary by 20W in order to register a change of one measurement “pulse.” At a one-minute measurement interval[19], a circuit would have to vary by 10W. At a five-minute measurement interval[20], circuit use would only have to vary by 2W to record a change. If future research intends to measure the impact of delay times <five minutes for low power sources, greater precision of short measurement intervals would be needed. Other circuit monitoring equipment is available that measures current (amps) rather than energy (watt-hour) pulses; such monitoring equipment may have the precision necessary to capture small changes in power demand with short measurement intervals. Alternatively, newer lighting technology is now available that allows facility managers (and lighting researchers) to evaluate energy use patterns for individual luminaires, rather than aggregating across an entire circuit.

---

[18] Thirty-second monitoring interval was attempted at the Landers site.

[19] One-minute interval was used at Mason’s Ridge and most of the Cohoes monitoring.

[20] Five-minute interval was used for some circuits at Building 4 in Cohoes, for winter and half of shoulder season.

3 References

Illuminating Engineering Society of North America (IESNA). 2001. LM-64-01 IESNA Guide for the Photometric measurement of Parking Areas.

Illuminating Engineering Society of North America (IESNA). 2014. RP-20-14 Lighting for Parking Facilities.

National Fire Protection Association (NFPA). 2015. 101: Life Safety Code.

4 Credits

Taitem Engineering: Florence Baveye, Anna Legard, Beth Mielbrecht, Jan Schwartzberg, Ian Shapiro, Myron Walter.

Lighting Research Center, Rensselaer Polytechnic Institute: Jennifer Brons, Matt Caraway, John Fowler, Daniel Frering, Kassandra Gonzales, Charlie Jarboe, Russ Leslie.

Affordable Housing Concepts: Paul Krempl, Keith Libolt, Kathy Parisi, Mark Snelling, George Tukel.

Appendix A. Monitoring and Verification Plan

Energy Monitoring: Taitem Engineering will measure lighting energy use (measured in kWh) by use of dataloggers connected to the lighting circuits at the circuit breaker panel. Current transformers will be installed inside the breaker panel, and sensor wiring will be pulled outside the breaker panel, to an adjacent locked instrumentation panel, mounted on the wall. The dataloggers will be installed in the instrumentation panel, for purpose of secure but easy access to download data. Circuits will be dedicated to one type of lighting only, for example, wall packs will be on one circuit, lighting poles will be on a separate circuit, and no other loads will be on either circuit. Data will be downloaded once a month to a laptop computer, and transported to the Taitem Engineering home office. Data will then be copied to our server, which is located in a locked and temperature-controlled server room. The data is automatically backed up offsite daily along with our regular data backups. Raw data will be available for review by NYSERDA.

Photometric Measurements: The LRC will take photometric measurements of the lighted exterior areas of each site. Calibrated illuminance and luminance meters shall be used. Measurements shall be collected after dark. Exterior photometric measurements shall be taken in accordance with recommendations of the Illuminating Engineering Society of North America (IESNA), as follows:

The LRC will confirm the luminaire placement and design to confirm that lighting was installed as designed and inspect and record the condition of the luminaires at each location.

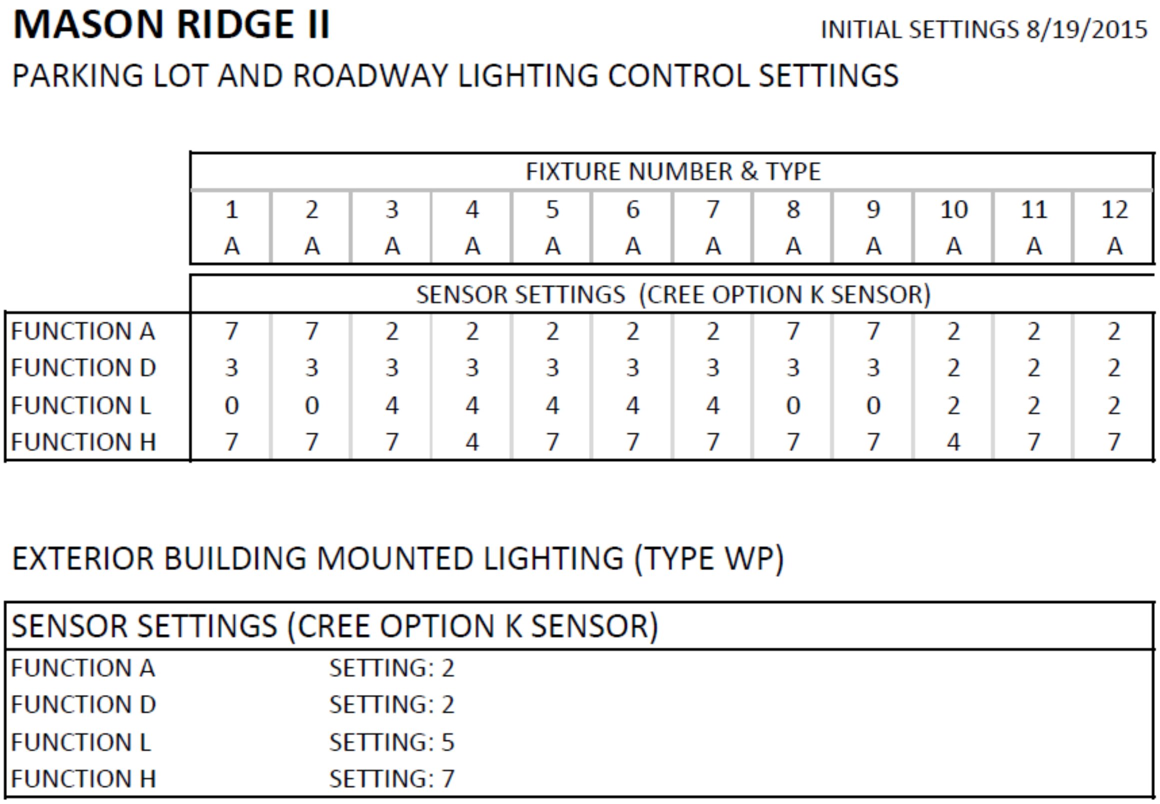
The LRC will take horizontal illuminance/luminance measurements on the ground; and vertical illuminance/luminance measurements at five feet above ground level on a regular grid around each wall-mounted luminaire and between each pole-mounted luminaire. The measurements will be collected shortly after installation, and repeated at the end of the monitoring period.

At each measurement location, geometric relationships shall be noted using a tape measure. Photos shall be taken using a high-resolution digital camera (minimum 10 megapixels), without flash. Observation of Lighting Controls: The LRC will observe the lighting to assess the actual operation of lighting controls (i.e., whether exterior lights are mistakenly on at conditions of moderate light, such as late dawn, early dusk, or passing clouds; and to assess how the lighting controls respond to occupancy/vacancy at each location). These observations will occur at the beginning and end of monitoring period. Review an

Analysis of Energy and Light Logger Data: The LRC will review and analyze the light logger and energy data collected at each location, which will be supplied by Taitem Engineering.

Human Factors Assessment: The LRC will administer a questionnaire at each site to assess the exterior lighting. The questionnaire will be administered to visitors and residents of the sites. Respondents will also be given the opportunity to add comments about the lighting. The questionnaire will be provided for comment by NYSERDA before administration at the sites. The LRC will submit the proposed questionnaires for approval to the Rensselaer Polytechnic Institute's Institutional Review Board (IRB) for research with human subjects. The IRB shall confirm that questionnaire data collection is performed in an acceptable and equitable manner. Questionnaires will be administered at least once at each of the sites, since the new lighting has already been installed. If any equipment settings are changed to optimize for energy efficiency or in response to feedback from the questionnaire, the questionnaire will be re-administered a second time at that location(s). The questionnaires will be administered in person. A nominal nonmonetary incentive may be offered for each survey completed in order to encourage participation.

Appendix B. Lighting Plans and Specifications, Mason's Ridge, New Windsor, NY



MASON RIDGE II INITIAL SETTINGS 8/19/2015

PARKING LOT AND ROADWAY LIGHTING CONTROL SETTINGS

	FIXTURE NUMBER & TYPE											
	1 A	2 A	3 A	4 A	5 A	6 A	7 A	8 A	9 A	10 A	11 A	12 A
	SENSOR SETTINGS (CREE OPTION K SENSOR)											
FUNCTION A	7	7	2	2	2	2	2	7	7	2	2	2
FUNCTION D	3	3	3	3	3	3	3	3	3	2	2	2
FUNCTION L	0	0	4	4	4	4	4	0	0	2	2	2
FUNCTION H	7	7	7	4	7	7	7	7	7	4	7	7

EXTERIOR BUILDING MOUNTED LIGHTING (TYPE WP)

SENSOR SETTINGS (CREE OPTION K SENSOR)	
FUNCTION A	SETTING: 2
FUNCTION D	SETTING: 2
FUNCTION L	SETTING: 5
FUNCTION H	SETTING: 7

K Option Occupancy Control

For use with XSP1™ and XSP2™

Description:

The Cree occupancy control option allows multiple operating input power options for high and low modes. These input power mutliplers are conveniently selected to balance LED life, lumen output and energy savings. Occupancy control options are designed to have integrated and remotely located sensors. Occupancy control function is designed with all LEDs operating at the same input power for maximum and uniform LED life.

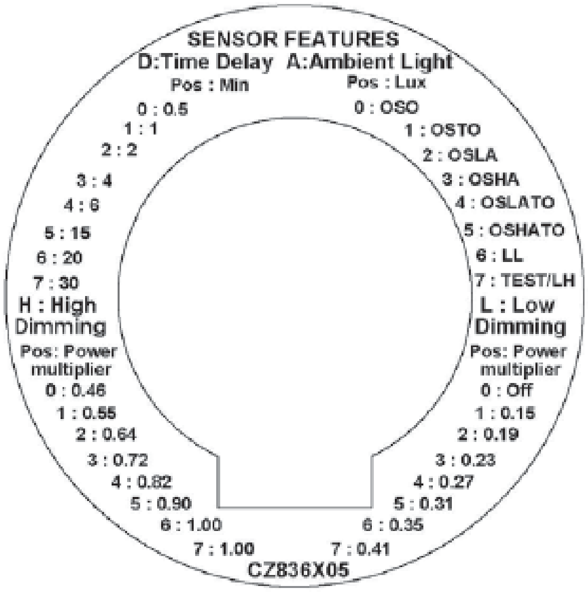
The occupancy sensor used in the Cree K option uses passive infrared technology that reacts to changes in infrared energy (moving heat) within the coverage area. During operation if motion is detected within the sensor's coverage area, the relay in the sensor closes and the lighting load is automatically turned on. When motion is no longer detected for the duration of the time settings, the relay opens and the lighting load is turned off, or set to low level depending on the settings of the sensor. The occupancy sensor includes independent field adjustable settings for Ambient Light, Time Delay, High and Low Dimming.

The Ambient Light feature (A) is factory set at "disabled" which eliminates any daylight harvesting management and allows the fixture to operate only on occupancy. The Ambient Light feature has eight possible settings and can be adjusted from 20-1900 Lux (2-175FC). When activated, the Ambient Light feature will only prevent the lights from turning on or going into high mode (depending on the setting of the sensor) when ambient light exceeds the selected level. In the event occupancy switches a luminaire to high mode and shortly thereafter ambient light levels increase above the selected ambient level, the unit will not immediately return to low mode, rather it must complete the set time cycle (Time Delay Feature) prior to returning to low mode. Settings will vary based on application. Please be aware that light from different sources may disrupt the ambient light feature. Testing and adjusting the Ambient Light feature is recommended before adjusting settings for all other installed luminaires for the specific application.

The Time Delay feature (D) can be adjusted from 0.5 minutes to 30 minutes and is factory set at 4 minutes. Once motion is detected, the lighting load will remain unchanged until the set time cycle is completed.

The Low Dimming feature (L) can be adjusted from an off position to a maximum input power of 41%. This feature is factory set at 23%.

The High Dimming feature (H) can be adjusted from a 46% input power to a maximum input power of 100% and is factory set at 100%.



BetaLED TECHNOLOGY

Rev. Date: 6/14/2012

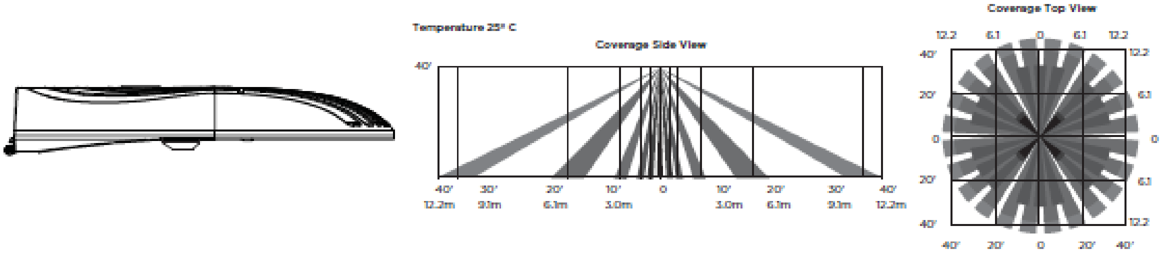
Sensor Settings							
Time Delay Feature (D)		Ambient Level Feature (A)		Low Dimming Feature (L)		High Dimming Feature (H)	
Position	Time (Min)	Postion	Light Level (LUX)	Postion	Input Power Multipler	Postion	Input Power Multipler
0	0.5	0	Test Mode	0	OFF	0	0.46
1	1	1	20	1	0.15	1	0.55
2	2	2	110	2	0.19	2	0.64
3	**4**	3	215	**3**	**0.23**	3	0.72
4	6	4	550	4	0.27	4	0.82
5	15	5	1100	5	0.31	5	0.90
6	20	6	1900	6	0.35	6	1.00
7	30	**7**	**Disable**	7	0.41	**7**	**1.00**

Notes:
Sensor feature settings can be independently selected for desired performance.
Factory Settings: Time (D): 4min.; Ambient Light (A): Disable; Low Dimming (L): 75mA; High Dimming (H): 525mA

XSP Series Occupancy Control Option Output Multipliers		
Input Power Multiplier	Lumen Multiplier	50K Hours Calculated Lumen Maintenance Factor @ 15°C (59°F)
0.15	0.15	
0.19	0.19	
0.23	0.23	
0.27		
0.31		
0.35		
0.41		
0.46	0.52	94%
0.55	0.61	93%
0.64	0.70	93%
0.72	0.77	93%
0.82	0.86	92%
0.90	0.91	91%
1.00	1.00	91%

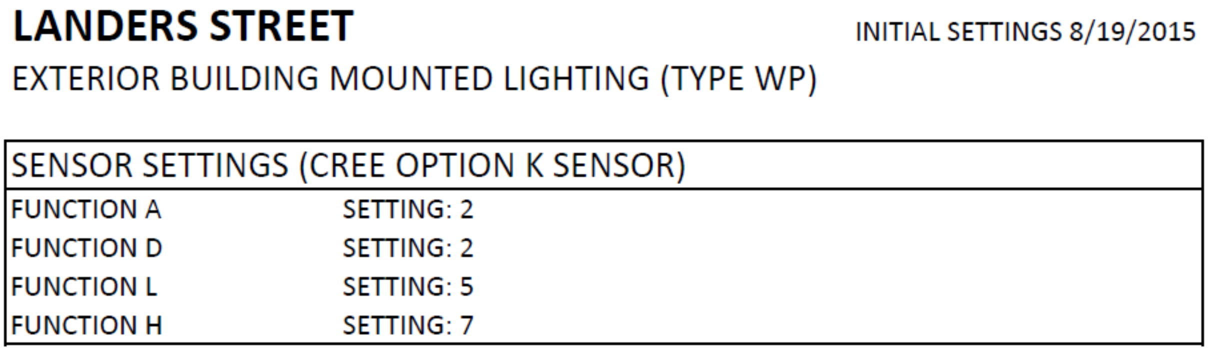
Note: Multipliers are for estimating purposes only. Check actual spec sheet data where available.

Figure 1 – XSP Series Street Lights



Sensor Details	
Application	Lens
XSP Series Street Light	Lens coverage: 30' (9.1m) optimal mounting height and 60' (18.3m) diameter coverage with a 360° circular pattern. The minimum and maximum mounting heights are 20' (6.1m) and 40' (12.2m) respectively. Lens mounting height to coverage radius is 1:1. See Figure 1. Note: When mounting heights are above 30' (9.1m), the sensor only detects large objects such as fork lift trucks or cars.

Appendix C. Lighting Plans and Specifications, Lander Street, Newburgh, NY



LANDERS STREET

INITIAL SETTINGS 8/19/2015

EXTERIOR BUILDING MOUNTED LIGHTING (TYPE WP)

SENSOR SETTINGS (CREE OPTION K SENSOR)

FUNCTION A	SETTING: 2
FUNCTION D	SETTING: 2
FUNCTION L	SETTING: 5
FUNCTION H	SETTING: 7

K Option Occupancy Control

For use with XSP1™ and XSP2™

Description:

The Cree occupancy control option allows multiple operating input power options for high and low modes. These input power mutliplers are conveniently selected to balance LED life, lumen output and energy savings. Occupancy control options are designed to have integrated and remotely located sensors. Occupancy control function is designed with all LEDs operating at the same input power for maximum and uniform LED life.

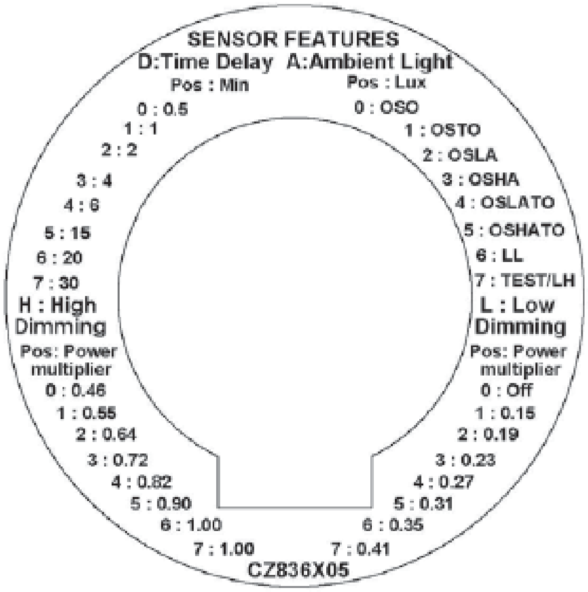
The occupancy sensor used in the Cree K option uses passive infrared technology that reacts to changes in infrared energy (moving heat) within the coverage area. During operation if motion is detected within the sensor's coverage area, the relay in the sensor closes and the lighting load is automatically turned on. When motion is no longer detected for the duration of the time settings, the relay opens and the lighting load is turned off, or set to low level depending on the settings of the sensor. The occupancy sensor includes independent field adjustable settings for Ambient Light, Time Delay, High and Low Dimming.

The Ambient Light feature (A) is factory set at "disabled" which eliminates any daylight harvesting management and allows the fixture to operate only on occupancy. The Ambient Light feature has eight possible settings and can be adjusted from 20-1900 Lux (2-175FC). When activated, the Ambient Light feature will only prevent the lights from turning on or going into high mode (depending on the setting of the sensor) when ambient light exceeds the selected level. In the event occupancy switches a luminaire to high mode and shortly thereafter ambient light levels increase above the selected ambient level, the unit will not immediately return to low mode, rather it must complete the set time cycle (Time Delay Feature) prior to returning to low mode. Settings will vary based on application. Please be aware that light from different sources may disrupt the ambient light feature. Testing and adjusting the Ambient Light feature is recommended before adjusting settings for all other installed luminaires for the specific application.

The Time Delay feature (D) can be adjusted from 0.5 minutes to 30 minutes and is factory set at 4 minutes. Once motion is detected, the lighting load will remain unchanged until the set time cycle is completed.

The Low Dimming feature (L) can be adjusted from an off position to a maximum input power of 41%. This feature is factory set at 23%.

The High Dimming feature (H) can be adjusted from a 46% input power to a maximum input power of 100% and is factory set at 100%.



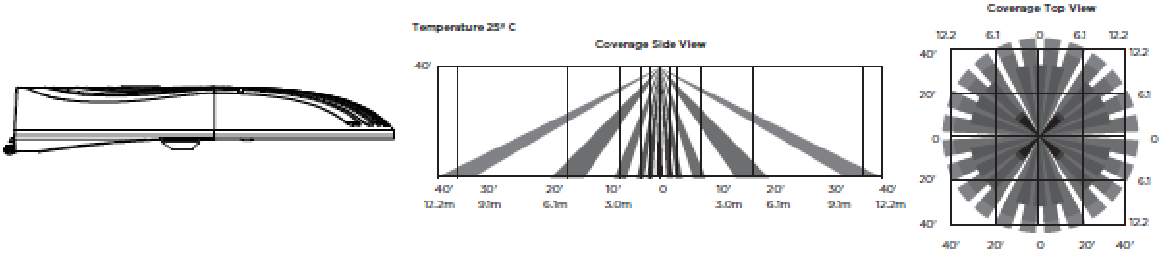
Sensor Settings							
Time Delay Feature (D)		Ambient Level Feature (A)		Low Dimming Feature (L)		High Dimming Feature (H)	
Position	Time (Min)	Postion	Light Level (LUX)	Postion	Input Power Multipler	Postion	Input Power Multipler
0	0.5	0	Test Mode	0	OFF	0	0.46
1	1	1	20	1	0.15	1	0.55
2	2	2	110	2	0.19	2	0.64
3	**4**	3	215	**3**	**0.23**	3	0.72
4	6	4	550	4	0.27	4	0.82
5	15	5	1100	5	0.31	5	0.90
6	20	6	1900	6	0.35	6	1.00
7	30	**7**	**Disable**	7	0.41	**7**	**1.00**

Notes:
Sensor feature settings can be independently selected for desired performance.
Factory Settings: Time (D): 4min.; Ambient Light (A): Disable; Low Dimming (L): 75mA; High Dimming (H): 525mA

XSP Series Occupancy Control Option Output Multipliers		
Input Power Multiplier	Lumen Multiplier	50K Hours Calculated Lumen Maintenance Factor @ 15°C (59°F)
0.15	0.15	
0.19	0.19	
0.23	0.23	
0.27		
0.31		
0.35		
0.41		
0.46	0.52	94%
0.55	0.61	93%
0.64	0.70	93%
0.72	0.77	93%
0.82	0.86	92%
0.90	0.91	91%
1.00	1.00	91%

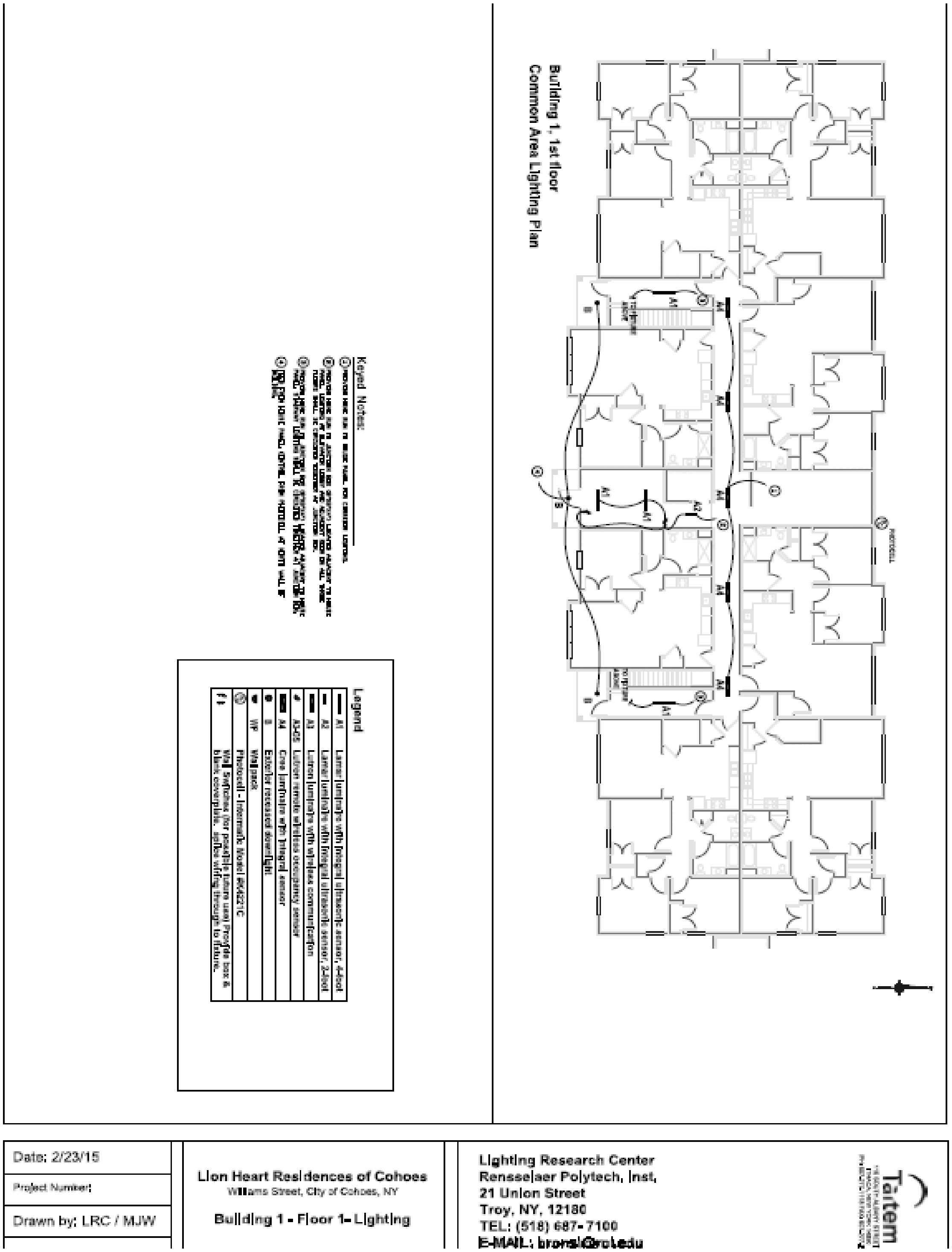
Note: Multipliers are for estimating purposes only. Check actual spec sheet data where available.

Figure 1 – XSP Series Street Lights



Sensor Details	
Application	Lens
XSP Series Street Light	Lens coverage: 30' (9.1m) optimal mounting height and 60' (18.3m) diameter coverage with a 360° circular pattern. The minimum and maximum mounting heights are 20' (6.1m) and 40' (12.2m) respectively. Lens mounting height to coverage radius is 1:1. See Figure 1. Note: When mounting heights are above 30' (9.1m), the sensor only detects large objects such as fork lift trucks or cars.

Appendix D. Lighting Plans and Specifications, Lion Heart Residences, Cohoes, NY



Date: 2/23/15

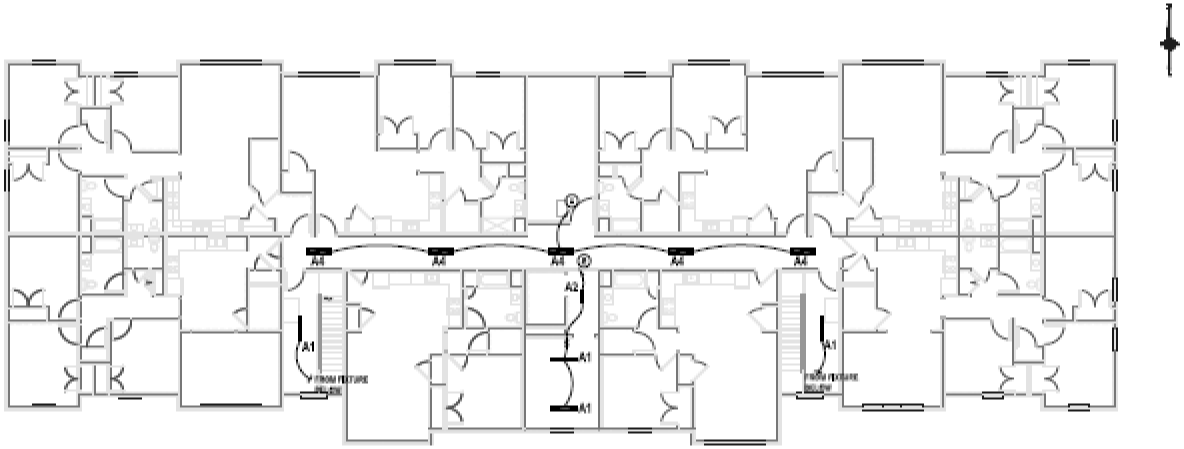
Project Number:

Drawn by: LRC / MJW

Lion Heart Residences of Cohoes
Williams Street, City of Cohoes, NY

Building 1 - Floor 1- Lighting

Lighting Research Center
Rensselaer Polytech, Inst,
21 Union Street
Troy, NY, 12180
TEL: (518) 687- 7100
E-MAIL: brons@rpi.edu



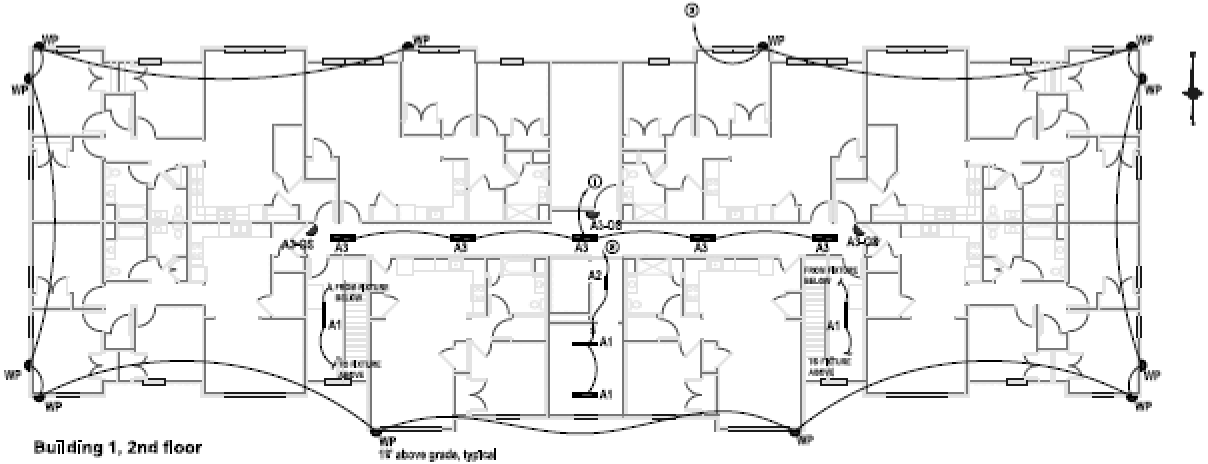
Building 1, 3rd floor
Common Area Lighting Plan

Keyed Notes:

① PROVIDE HOME RUN TO HOUSE PANEL FOR CORRIDOR LIGHTING.

② PROVIDE HOME RUN TO JUNCTION BOX [illegible] LOCATED ADJACENT TO HOUSE PANEL [illegible] AT ELEVATOR LOBBY AND ADJACENT ROOMS ON ALL THREE FLOORS SHALL BE GROUPED TOGETHER AT JUNCTION BOX.

③ PROVIDE HOME RUN TO HOUSE PANEL FOR EXTERIOR WALL PACKS.



Building 1, 2nd floor
Common Area Lighting Plan

Date: 2/23/15

Project Number:

Drawn by: LRC / MJW

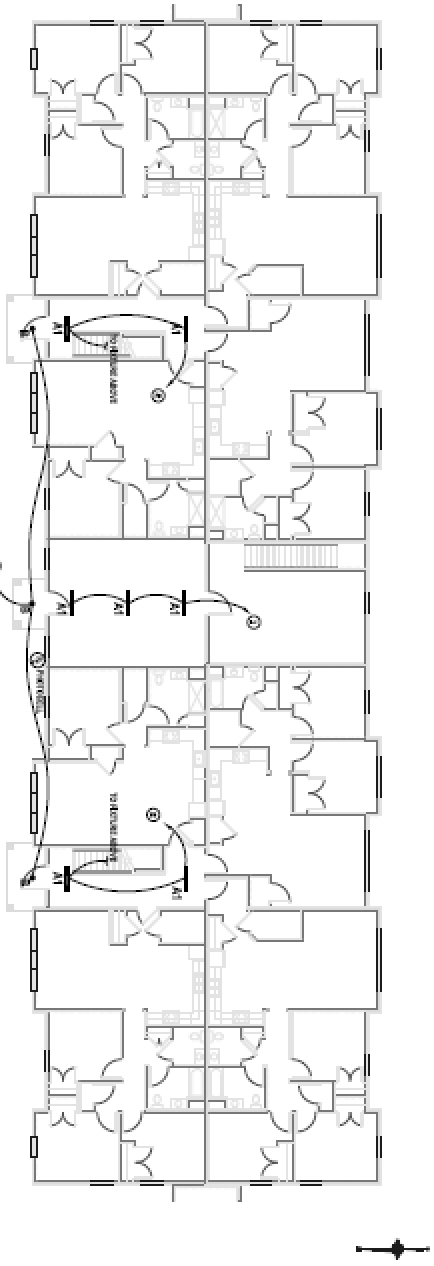
Lion Heart Residences of Cohoes
Williams Street, City of Cohoes, NY

Building 1 - Floors 2-3 - Lighting

Lighting Research Center
Rensselaer Polytech. Inst.
21 Union Street
Troy, NY, 12180
TEL: (518) 687-7100
E-MAIL: brons

Taitem
115 SOUTH ALBANY STREET
ITHACA, NEW YORK 14850

Building 2, 1st floor
Common Area Lighting Plan



Keyed Notes:

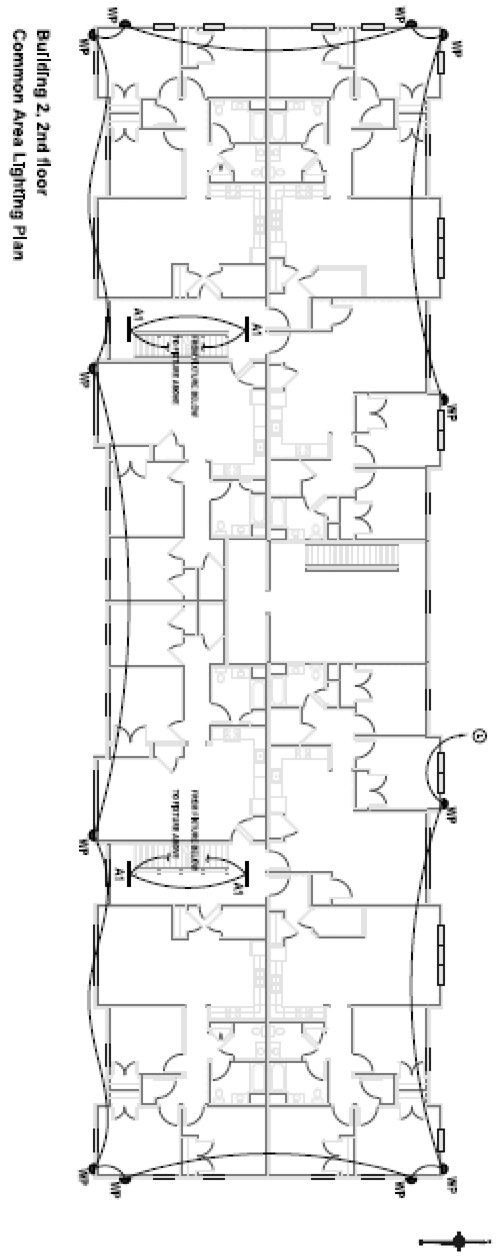
① [illegible]

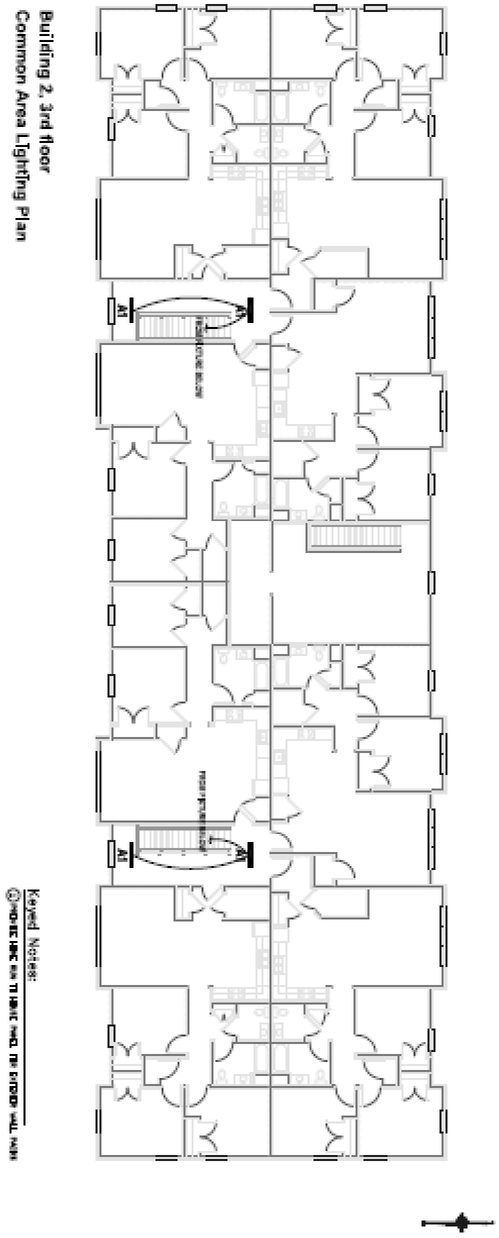
② [illegible]

③ [illegible]

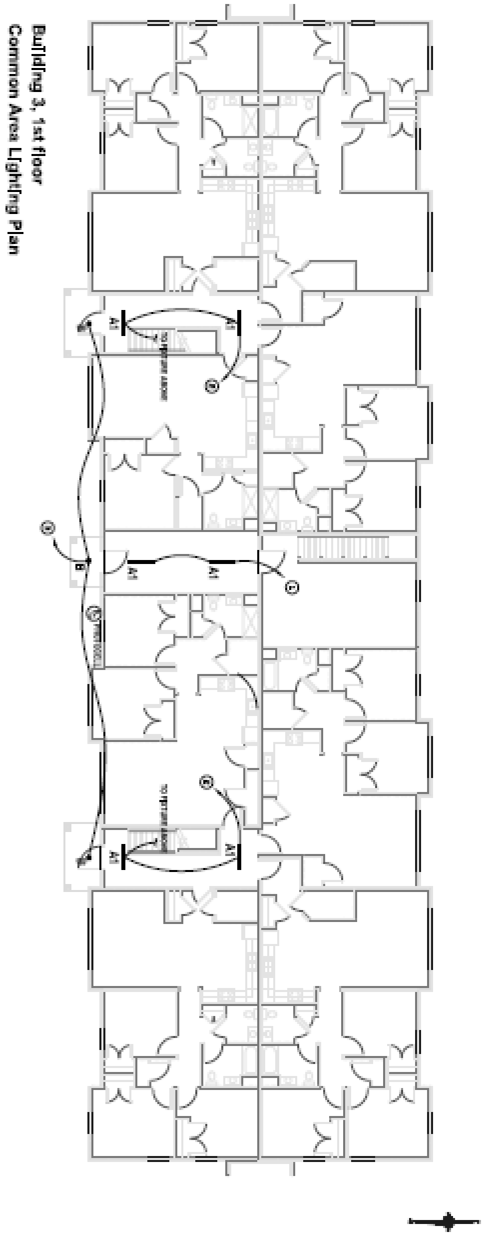
Date: 2/23/15	**Lion Heart Residences of Cohoes** Williams Street, City of Cohoes, NY **Building 2 - Floor 1 - Lighting**	**Lighting Research Center** **Rensselaer Polytech, Inst,** **21 Union Street** **Troy, NY, 12180** **TEL: (518) 687-7100** **E-MAIL : [illegible]**
Project Number:		
Drawn by: LRC / MJW		

Taitem





Date: 2/23/15	**Lion Heart Residences of Cohoes** Williams Street, City of Cohoes, NY **Building 2 - Floors 2-3 - Lighting**	**Lighting Research Center** **Rensselaer Polytech. Inst.** **21 Union Street** **Troy, NY, 12180** **TEL: (518) 687-7100**
Project Number:		
Drawn by: LRC / MJW		



Keyed Notes:

① [illegible]
② [illegible]
③ [illegible]

Date: 2/23/15

Project Number:

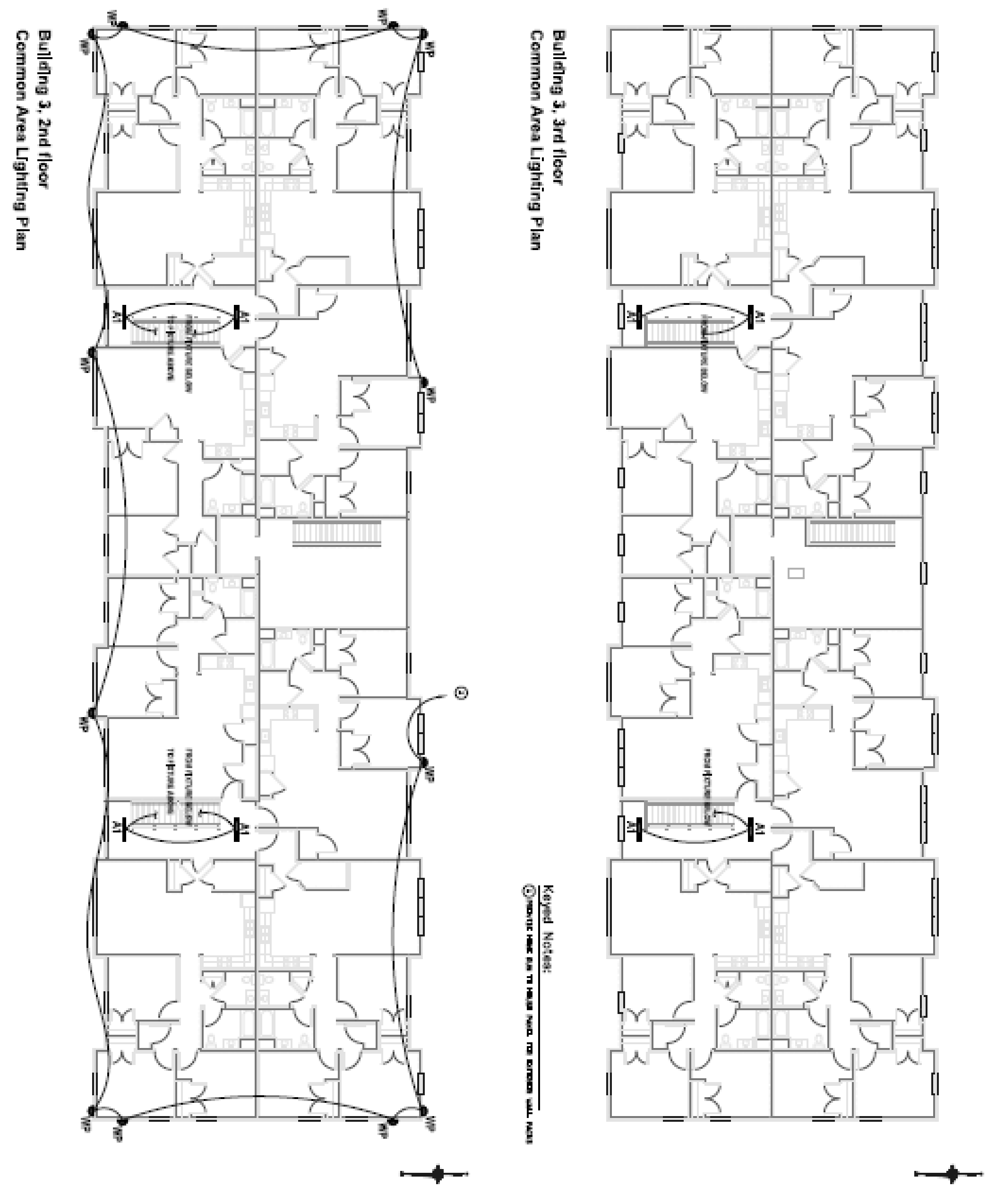
Drawn by: LRC / MJW

Lion Heart Residences of Cohoes
Williams Street, City of Cohoes, NY

Building 3 - Floor 1- Lighting

Lighting Research Center
Rensselaer Polytech. Inst.
21 Union Street
Troy, NY, 12180
TEL: (518) 687- 7100
E-MAIL: bronsk@rpi.edu

Taitem



Building 3, 2nd floor
Common Area Lighting Plan

Building 3, 3rd floor
Common Area Lighting Plan

Date: 2/23/15

Project Number:

Drawn by: LRC / MJW

Lion Heart Residences of Cohoes
Williams Street, City of Cohoes, NY

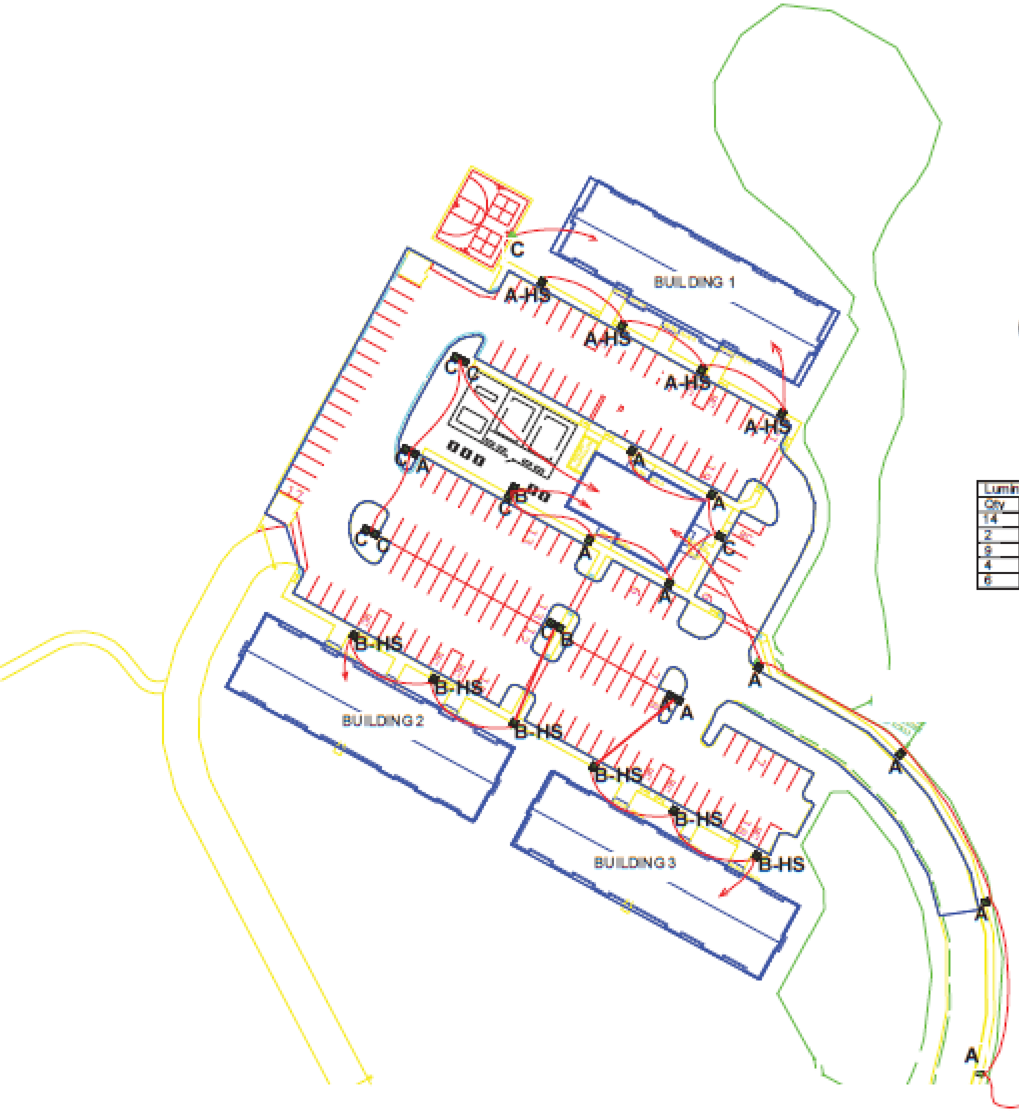
Building 3 - Floors 2 & 3 Lighting

Lighting Research Center
Rensselaer Polytech. Inst.
21 Union Street
Troy, NY, 12180
TEL: (518) 687- 7100
E-MAIL: bronsj@rpi.edu

Taitem

COHOES SITE LIGHTING

Luminaire Schedule					
Qty	Label	LLF	Lum. Watts	Lum. Lumens	Tag
14	DSX1_LED_30C_1000_40K_T3M_MVO	0.700	105	9449	A
2	DSX1_LED_30C_1000_40K_TFTM_MV	0.700	105	9322	B
9	DSX1_LED_40C_1000_40K_TFTM_MV	0.700	138	12190	C
4	DSX1_LED_30C_1000_40K_T3M_MVO_HS	0.700	105	6845	A-HS
6	DSX1_LED_30C_1000_40K_TFTM_MV_HS	0.700	105	6340	B-HS



CONTINUE U.G. WIRING TO THREE
ADDITIONAL TYPE A ROADWAY
LIGHTS. ALL BASES TYPE II.
REFER TO PROJECT SITE
DRAWINGS FOR LOCATIONS.

INITIAL SETTINGS 8/19/2015

COHOES LION HEART II

PARKING LOT AND ROADWAY LIGHTING CONTROL SETTINGS

* Denotes Factory Setting "-" Denotes No Setting

		FIXTURE NUMBER & TYPE																																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
		B-HS	B-HS	B-HS	B-HS	B-HS	B-HS	C	C	C	B	A	A	C	A	C	B	A	A	C	A	A	C	C	C	A-HS	A-HS	A-HS	A-HS	A	A	A	A	A	A	A
		SENSOR SETTINGS (SENSOR SWITCH SBGR-6-ODP)																																		
PROGRAMMING FUNCTION NUMBER	2	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	4	4	4	4	1	1	1	1	1	1	1
	4	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	7	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	11	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	12	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	1	1	1
	13	6	6	6	6	6	6	3	*	*	*	*	*	3	*	*	*	*	*	3	*	*	*	3	*	6	6	6	6	*	2	2	2	2	2	2
	15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	16	4	4	4	4	4	4	3	2	2	2	2	3	3	2	2	4	2	2	3	2	2	2	3	2	4	4	4	4	5	3	3	3	3	3	3
	21	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	22	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	2	2	2	2	2	2

EXTERIOR BUILDING MOUNTED LIGHTING (TYPE WP)

SENSOR SETTINGS (CREE OPTION K SENSOR)	
FUNCTION A	SETTING: 2
FUNCTION D	SETTING: 2
FUNCTION L	SETTING: 5
FUNCTION H	SETTING: 7

INTERIOR LIGHTING - BUILDING 1 - FLOORS 1 & 3

	SENSOR SETTINGS (LAMAR OCCU-SMART SENSOR)		
FIXTURE	TIME DELAY	OCCUPIED MODE	UNOCCUPIED MODE
TYPE A1	5 MINUTES	HIGH OUTPUT	20% OUTPUT
TYPE A2	5 MINUTES	HIGH OUTPUT	20% OUTPUT

INTERIOR LIGHTING - BUILDING 1 - FLOOR 1

	SENSOR SETTINGS (CREE SMARTCAST SENSOR)			
FIXTURE	TIME DELAY	OCCUPIED MODE	UNOCCUPIED MODE	MODE
TYPE A4	5 MINUTES	HIGH OUTPUT	20% OUTPUT	GROUP MODE

INTERIOR LIGHTING - BUILDING 1 - FLOOR 3

	SENSOR SETTINGS (CREE SMARTCAST SENSOR)			
FIXTURE	TIME DELAY	OCCUPIED MODE	UNOCCUPIED MODE	MODE
TYPE A4	5 MINUTES	HIGH OUTPUT	20% OUTPUT	INDEPENDENT MODE

INTERIOR LIGHTING - BUILDING 1 - FLOOR 2

	SENSOR SETTINGS (LAMAR OCCU-SMART SENSOR)		
FIXTURE	TIME DELAY	OCCUPIED MODE	UNOCCUPIED MODE
TYPE A1	5 MINUTES	HIGH OUTPUT	20% OUTPUT
TYPE A2	5 MINUTES	HIGH OUTPUT	20% OUTPUT

INTERIOR LIGHTING - BUILDING 1 - FLOOR 2

	SENSOR SETTINGS (LUTRON SENSOR)		
FIXTURE	TIME DELAY	OCCUPIED MODE	UNOCCUPIED MODE
TYPE A3	5 MINUTES	80% OUTPUT	20% OUTPUT

INTERIOR LIGHTING - BUILDING 2

	SENSOR SETTINGS (LAMAR OCCU-SMART SENSOR)		
FIXTURE	TIME DELAY	OCCUPIED MODE	UNOCCUPIED MODE
TYPE A1	10 MINUTES	HIGH OUTPUT	20% OUTPUT

INTERIOR LIGHTING - BUILDING 3

	SENSOR SETTINGS (LAMAR OCCU-SMART SENSOR)		
FIXTURE	TIME DELAY	OCCUPIED MODE	UNOCCUPIED MODE
TYPE A1	15 MINUTES	HIGH OUTPUT	20% OUTPUT

D-Series Size 1

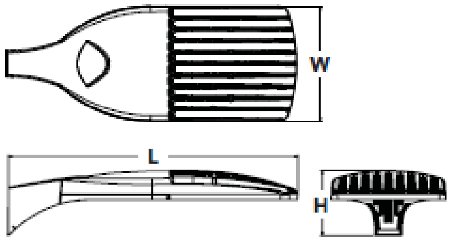
LED Area Luminaire

Catalog Number	
Notes	COHOES SITE LIGHTING
Type	A

Hit the Tab key or mouse over the page to see all interactive elements.

Specifications

EPA:	1.2 ft² (0.11 m²)
Length:	33" (83.8 cm)
Width:	13" (33.0 cm)
Height:	7-1/2" (19.0 cm)
Weight (max):	27 lbs (12.2 kg)



Introduction

The modern styling of the D-Series is striking yet unobtrusive - making a bold, progressive statement even as it blends seamlessly with its environment.

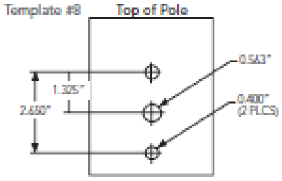
The D-Series distills the benefits of the latest in LED technology into a high performance, high efficacy, long-life luminaire. The outstanding photometric performance results in sites with excellent uniformity, greater pole spacing and lower power density. It is ideal for replacing 100 – 400W metal halide in pedestrian and area lighting applications with typical energy savings of 65% and expected service life of over 100,000 hours.

Ordering Information

EXAMPLE: DSX1 LED 60C 1000 40K T3M MVOLT SPA DDBXD

DSX1 LED	30C	1000	40K	T3M	MV	SPA	PIRH		DDBXD
Series	**LEDs**	**Drive current**	**Color temperature**	**Distribution**	**Voltage**	**Mounting**	**Control options**	**Other options**	**Finish** *(required)*
DSX1 LED	**Forward optics** 30C 30 LEDs (one engine) 40C 40 LEDs (two engines) 60C 60 LEDs (two engines) **Rotated optics** [1] 60C 60 LEDs (two engines)	530 530 mA 700 700 mA 1000 1000 mA (1 A)	30K 3000 K (80 CRI min.) 40K 4000 K (70 CRI min.) 50K 5000 K (70 CRI) AMBPC Amber phosphor converted [2]	T1S Type I short T2S Type II short T2M Type II medium T3S Type III short T3M Type III medium T4M Type IV medium TFTM Forward throw medium T5VS Type V very short T5S Type V short T5M Type V medium T5W Type V wide	MVOLT [3] 120 [3] 208 [3] 240 [3] 277 [3] 347 [4] 480 [4]	**Shipped included** SPA Square pole mounting RPA Round pole mounting WBA Wall bracket SPUMBA Square pole universal mounting adaptor [5] RPUMBA Round pole universal mounting adaptor [5] **Shipped separately** [6] KMA8 DDBXD U Mast arm mounting bracket adaptor (specify finish)	**Shipped installed** PER NEMA twist-lock receptacle only (no controls) [7] DMG 0-10V dimming driver (no controls) [8] DCR Dimmable and controllable via ROAM® (no controls) [9] DS Dual switching [10,11] PIR Motion sensor, 8-15' mounting height [12] PIRH Motion sensor, 15-30' mounting height [12] BL30 Bi-level switched dimming, 30% [11,13] BL50 Bi-level switched dimming, 50% [11,13]	**Shipped installed** HS House-side shield [14] WTB Utility terminal block [15] SF Single fuse (120, 277, 347V) [16] DF Double fuse (208, 240, 480V) [16] L90 Left rotated optics [17] R90 Right rotated optics [17]	DDBXD Dark bronze DBLXD Black DNAXD Natural aluminum DWHXD White DDBTXD Textured dark bronze DBLBXD Textured black DNATXD Textured natural aluminum DWHGXD Textured white

Drilling



DSX1 shares a unique drilling pattern with the AERIS™ family. Specify this drilling pattern when specifying poles, per the table below.

DM19AS	Single unit	DM29AS	2 at 90° *
DM28AS	2 at 180°	DM39AS	3 at 90° *
DM49AS	4 at 90° *	DM32AS	3 at 120° **

Example: SSA 20 4C DM19AS DDBXD

Visit Lithonia Lighting's POLES CENTRAL to see our wide selection of poles, accessories and educational tools.

*Round pole top must be 3.25" O.D. minimum.

**For round pole mounting (RPA) only.

Accessories

Ordered and shipped separately.

DLL127F 1.5 JU	Photocell - SSL twist-lock (120-277V) [18]
DLL347F 1.5 CUL JU	Photocell - SSL twist-lock (347V) [18]
DLL480F 1.5 CUL JU	Photocell - SSL twist-lock (480V) [18]
SC U	Shorting cap [18]
DSX1HS 30C U	House-side shield for 30 LED unit
DSX1HS 40C U	House-side shield for 40 LED unit
DSX1HS 60C U	House-side shield for 60 LED unit
PUMBA DDBXD U*	Square and round pole universal mounting bracket adaptor (specify finish)
KMA8 DDBXD U	Mast arm mounting bracket adaptor (specify finish) [6]

For more control options, visit DTL and ROAM online.

Tenon Mounting Slipfitter**

Tenon O.D.	Single Unit	2 at 180°	2 at 90°	3 at 120°	3 at 90°	4 at 90°
2-3/8"	AST20-190	AST20-280	AST20-290	AST20-320	AST20-390	AST20-490
2-7/8"	AST25-190	AST25-280	AST25-290	AST25-320	AST25-390	AST25-490
4"	AST35-190	AST35-280	AST35-290	AST35-320	AST35-390	AST35-490

NOTES

1 Rotated optics only available with 60C.
2 AMBPC only available with 530mA or 700mA.
3 MVOLT driver operates on any line voltage from 120-277V (50/60 Hz). Specify 120, 208, 240 or 277 options only when ordering with fusing (SF, DF options).
4 Not available with single board, 530mA product (30C 530, or 60C 530 DS). Not available with DCR, BL30 or BL50.
5 Available as a separate combination accessory: PUMBA (finish) U.
6 Must be ordered as a separate accessory; see Accessories information. For use with 2-3/8" mast arm (not included).
7 Photocell ordered and shipped as a separate line item from Acuity Brands Controls. See accessories. Not available with DS option.
8 DMG option for 347v or 480v requires 1000mA.
9 Specifies a ROAM® enabled luminaire with 0-10V dimming capability; PER option required. Not available with 347 or 480V. Additional hardware and services required for ROAM® deployment; must be purchased separately. Call 1-800-442-6745 or email: sales@roamservices.net. N/A with BL30, BL50, DS, PIR or PIRH.
10 Requires 40C or 60C. Provides 50/50 luminaire operation via two independent drivers on two separate circuits. N/A with PER, DCR, WTB, PIR, or PIRH.
11 Requires an additional switched circuit.
12 PIR specifies the SensorSwitch SBGR-10-ODP control; PIRH specifies the SensorSwitch SBGR-6-ODP control; see Motion Sensor Guide for details. Dimming driver standard. Not available with DS or DCR.
13 Dimming driver standard. MVOLT only. Not available with DCR.
14 Also available as a separate accessory; see Accessories information.
15 WTB not available with DS.
16 Single fuse (SF) requires 120, 277 or 347 voltage option. Double fuse (DF) requires 208, 240 or 480 voltage option.
17 Available with 60 LEDs (60C option) only.
18 Requires luminaire to be specified with PER option. Ordered and shipped as a separate line item from Acuity Brands Control.

LITHONIA LIGHTING.
One Lithonia Way • Conyers, Georgia 30012 • Phone: 800.279.8041 • Fax: 770.918.1209 • www.lithonia.com

Cree Configuration Tool With SmartCast™ Technology

Wireless Configuration Tool

Includes: CCT-CWC-1

IMPORTANT SAFEGUARDS

When using electrical equipment, basic safety precautions should always be followed including the following:

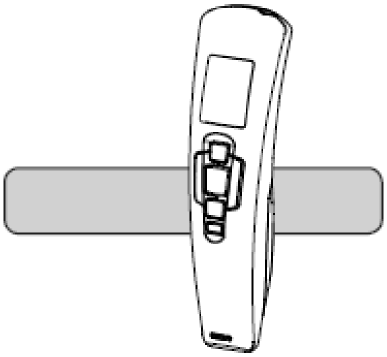
READ AND FOLLOW ALL SAFETY INSTRUCTIONS

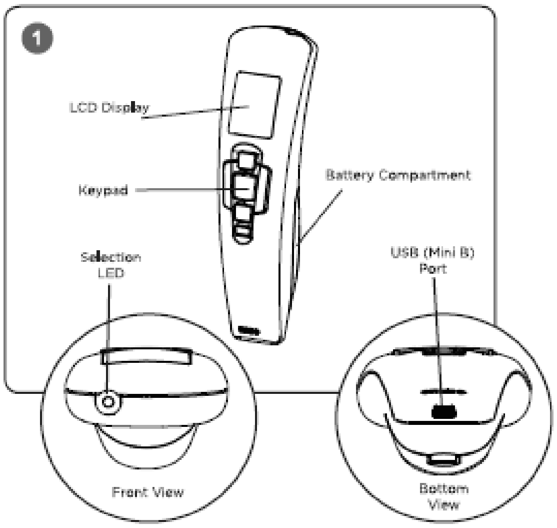
1. **Caution:** The batteries used in this device may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100°C (212°F) or dispose of in fire. Replace batteries with CR123A type only. Use of another battery may present a risk of fire or explosion.
2. Dispose of used batteries properly. Keep away from children. Do not disassemble and do not dispose of in fire.
3. Replace batteries at the same time using fresh cells only.
4. Avoid direct eye exposure to forward facing LED.
5. Indoor use only and suitable for damp locations.
6. Any changes or modifications to these devices not explicitly approved by manufacturer could void your authority to operate this equipment.

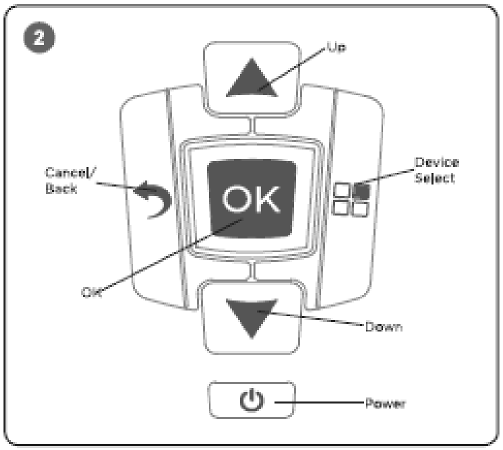
SAVE THESE INSTRUCTIONS FOR FUTURE REFERENCE

- USB cable (part number; LAH00206X0001A0) can be used to power the device in the absence of working batteries.

INSTALLATION INSTRUCTIONS







UNIT DESCRIPTION- FIGURE 1

The Cree Configuration Tool is used to set up and configure Cree SmartCast™ Technology enabled devices. Revolutionary OneButton™ Setup enables automated setup of luminaires and dimmers with little to no installer intervention. With the press of a single button, SmartCast™ Technology enabled luminaires and dimmers create their own secure network, learn about the spaces they're installed in and form logical groups.

BATTERY INSTALLATION

STEP 1:
Remove battery cover and install the two included CR123A batteries in the orientation indicated by label on the device.

STEP 2:
Replace battery cover.

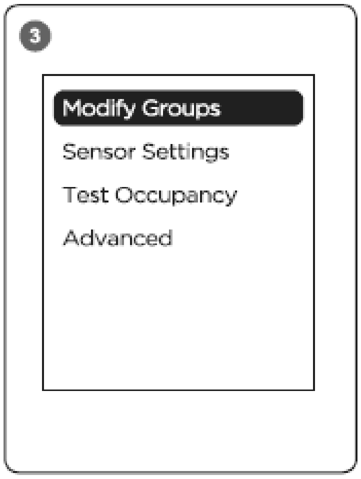
SET UP NEW INSTALLATION

STEP 1:
Turn Configuration Tool on using power button. Cree logo is displayed when tool starts up. See **Figure 2.**

STEP 2:
Once ready, the Configuration Tool will prompt to begin OneButton™ Setup. Be sure to have all devices powered on before beginning OneButton™ Setup. If other lighting networks are found, select **Set Up New** to setup a new installation.

STEP 3:
OneButton™ Setup will create a secure lighting network, calibrate daylighting, and form luminaires and dimmers into groups. The Configuration Tool will display progress throughout this process.

Step 4:
OneButton™ Setup is complete and your installation is ready to use. Changes to groups and other settings can be made from the Main Menu.



MAIN MENU

After starting the Configuration Tool and setting up a new installation or joining an existing installation, you will be brought to the Main Menu. See **Figure 3.**

Modify Groups

- Create new groups by selecting devices
- Merge existing groups together
- Add devices to an existing group
- Ungroup an existing group

Sensor Settings

- Make changes to motion sensor settings, including timeout and occupied/unoccupied levels
- Repeat calibration of ambient light sensor.

Test Occupancy

- Place motion sensors into a test mode where they will have a short timeout and operate individually to verify operation and placement.

Advanced

- Setting/Changing a PIN for the Configuration Tool
- Device replacement
- Add new devices to the existing lighting network
- Joining a lighting network
- Resetting devices or the lighting network

CLEANING

Clean using a cloth dampened only with water and a little mild detergent. Use of solvents or hydrocarbon-based cleaners may cause permanent damage.

FCC NOTICE

This device complies with Part 15 of the FCC Rules. 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 modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the device.

This device has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the device is operated in a commercial environment. This device generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this device in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

In addition, this device complies with ICES-003 of the Industry Canada (IC) Regulations.

The LED in the front of this device operates within Risk Group 1 levels per IEC 62471.

K Option Occupancy Control

For use with XSP1™ and XSP2™

Description:
The Cree occupancy control option allows multiple operating input power options for high and low modes. These input power mutliplers are conveniently selected to balance LED life, lumen output and energy savings. Occupancy control options are designed to have integrated and remotely located sensors. Occupancy control function is designed with all LEDs operating at the same input power for maximum and uniform LED life.

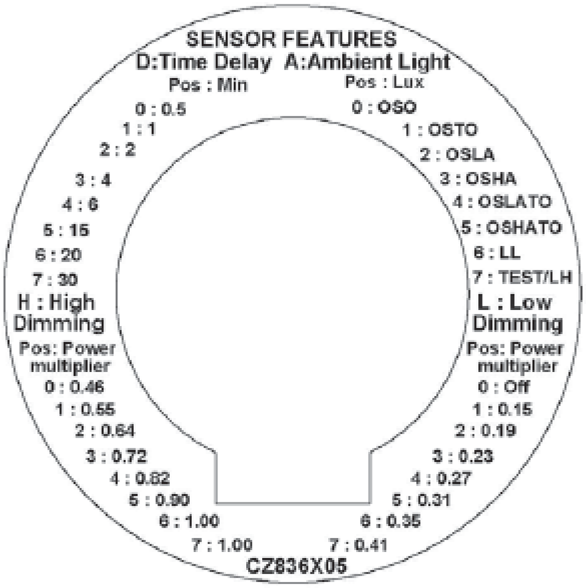
The occupancy sensor used in the Cree K option uses passive infrared technology that reacts to changes in infrared energy (moving heat) within the coverage area. During operation if motion is detected within the sensor's coverage area, the relay in the sensor closes and the lighting load is automatically turned on. When motion is no longer detected for the duration of the time settings, the relay opens and the lighting load is turned off, or set to low level depending on the settings of the sensor. The occupancy sensor includes independent field adjustable settings for Ambient Light, Time Delay, High and Low Dimming.

The Ambient Light feature (A) is factory set at "disabled" which eliminates any daylight harvesting management and allows the fixture to operate only on occupancy. The Ambient Light feature has eight possible settings and can be adjusted from 20-1900 Lux (2-175FC). When activated, the Ambient Light feature will only prevent the lights from turning on or going into high mode (depending on the setting of the sensor) when ambient light exceeds the selected level. In the event occupancy switches a luminaire to high mode and shortly thereafter ambient light levels increase above the selected ambient level, the unit will not immediately return to low mode, rather it must complete the set time cycle (Time Delay Feature) prior to returning to low mode. Settings will vary based on application. Please be aware that light from different sources may disrupt the ambient light feature. Testing and adjusting the Ambient Light feature is recommended before adjusting settings for all other installed luminaires for the specific application.

The Time Delay feature (D) can be adjusted from 0.5 minutes to 30 minutes and is factory set at 4 minutes. Once motion is detected, the lighting load will remain unchanged until the set time cycle is completed.

The Low Dimming feature (L) can be adjusted from an off position to a maximum input power of 41%. This feature is factory set at 23%.

The High Dimming feature (H) can be adjusted from a 46% input power to a maximum input power of 100% and is factory set at 100%.



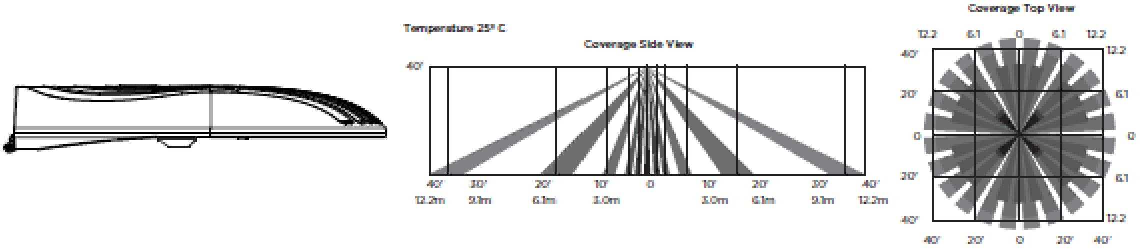
Sensor Settings							
Time Delay Feature (D)		Ambient Level Feature (A)		Low Dimming Feature (L)		High Dimming Feature (H)	
Position	Time (Min)	Postion	Light Level (LUX)	Postion	Input Power Multipler	Postion	Input Power Multipler
0	0.5	0	Test Mode	0	OFF	0	0.46
1	1	1	20	1	0.15	1	0.55
2	2	2	110	2	0.19	2	0.64
3	**4**	3	215	**3**	**0.23**	3	0.72
4	6	4	550	4	0.27	4	0.82
5	15	5	1100	5	0.31	5	0.90
6	20	6	1900	6	0.35	6	1.00
7	30	**7**	**Disable**	7	0.41	**7**	**1.00**

Notes:
Sensor feature settings can be independently selected for desired performance.
Factory Settings: Time (D): 4min.; Ambient Light (A): Disable; Low Dimming (L): 75mA; High Dimming (H): 525mA

XSP Series Occupancy Control Option Output Multipliers		
Input Power Multiplier	Lumen Multiplier	50K Hours Calculated Lumen Maintenance Factor @ 15˚C (59˚F)
0.15	0.15	
0.19	0.19	
0.23	0.23	
0.27		
0.31		
0.35		
0.41		
0.46	0.52	94%
0.55	0.61	93%
0.64	0.70	93%
0.72	0.77	93%
0.82	0.86	92%
0.90	0.91	91%
1.00	1.00	91%

Note: Multipliers are for estimating purposes only. Check actual spec sheet data where available.

Figure 1 – XSP Series Street Lights



Sensor Details	
Application	Lens
XSP Series Street Light	Lens coverage: 30' (9.1m) optimal mounting height and 60' (18.3m) diameter coverage with a 360˚ circular pattern. The minimum and maximum mounting heights are 20' (6.1m) and 40' (12.2m) respectively. Lens mounting height to coverage radius is 1:1. See Figure 1. Note: When mounting heights are above 30' (9.1m), the sensor only detects large objects such as fork lift trucks or cars.

Wireless Wall-Mount Sensor

Lutron® wall-mounted occupancy and vacancy sensors are wireless, battery-powered, passive infrared (PIR) sensors that automatically control lights via RF communication to compatible dimming or switching devices. These sensors detect the heat 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 or switching devices to turn the lights on or off automatically. They combine both convenience and exceptional energy savings along with ease of installation.

Features

- Wireless occupancy/vacancy sensor has 2 settings available: Auto-On/Auto-Off, and Manual-On/Auto-Off
- Vacancy model meets CA Title 24 requirements
- Passive infrared motion detection with exclusive Lutron® XCT™ Technology for fine motion detection
- 180° field of view model:
  - Minor motion = 1500 ft² (139.4 m²)
  - Major motion = 3000 ft² (278.7 m²)
- 90° field of view model:
  - Minor motion = 1225 ft² (113.8 m²)
  - Major motion = 2500 ft² (232.3 m²)
- Hallway model with long, narrow field of view:
  - Major motion = coverage of up to 150 ft (45.7 m)
- Simple and intuitive adjustments available for Timeout, Activity, and Auto-On settings
- Accessible test buttons make setup easy
- Lens illuminates during test mode to verify ideal locations
- Multiple sensors can be added for extended coverage; refer to product specification submittal of receiving device to determine system limits
- 10-year battery life design
- RoHS compliant

Compatible RF Devices

- For use with Lutron® products only
- Communicates to various wireless Lutron® Clear Connect® systems*

Models Available

- LRF__-__ __LB-P-WH

Coverage Type
Sensor Type
Frequency/Channel Code

Example:
LRF**2**-**VH**LB-P-WH
(434 MHz White Hallway Vacancy Sensor)

Frequency/Channel Code

2 = 431.0 – 437.0 MHz (US, Canada, Mexico, Brazil)*
3 = 868.125 – 869.850 MHz (Europe and UAE)
4 = 868.125 – 868.475 MHz (China and Singapore)
5 = 865.5 – 866.5 MHz (India)
7 = 433.0 – 433.7 MHz (Hong Kong)

Sensor Type

O = Occupancy/Vacancy (Auto-On/Auto-Off)
V = Vacancy (Manual-On/Auto-Off)**

Coverage Type

H = Hallway
K = 90° Corner-Mount
W = 180° Wall-Mount

---

* Contact Lutron Customer Service at www.lutron.com for frequency/channel code compatibility with your particular geographic region, and for integrating with other Lutron® lighting and shading products.

* BAA compliant models available for LRF2 configurations. Add a "U" prefix to your chosen model number. Example: **U**LRF2-OWLB-P

** Vacancy sensor type for LRF2 models only

LUTRON® SPECIFICATION SUBMITTAL Page 1

Job Name: Lions Heart Cohoes
Job Number:
Model Numbers: LRF2-OHLB-P

Specifications

Regulatory

- Lutron Quality Systems Registered to ISO 9001:2008

Regulatory Approvals

LRF2-

- cULus listed
- FCC certified
- IC certified
- COFETEL certified
- ANATEL certified
- SUTEL certified
- Meets CA (U.S.A.) Energy Commission Title 24 requirements

LRF3-

- CE marked (European Union)
- TRA type approved (United Arab Emirates)
- CITC type approved (Saudi Arabia)

LRF4-

- SRRC type approved (Mainland China)
- iDA registered (Singapore)

LRF5-

- WPC type approved (India) [expected Q1 2014]

Power/Performance

- Operating voltage: 3 V⎓
- Operating current: 14 µA nominal
- Requires one CR 123 lithium battery
- 10-year battery-life design
- 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

RF Range

- Distance between local load controls and sensor should not exceed 60 ft (18 m) line-of-sight or 30 ft (9 m) through walls.

Sensor Coverage Test

- Dedicated test button
- Lens illuminates orange in response to motion during test mode

Wireless Communication Test

- Dedicated 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)
- *Disabled***: Lights must be turned ON manually from dimming or switching device. Sensor turns lights OFF automatically

Sensitivity Options

- *Low Activity*: 🚶 (default setting)
- *Medium Activity*: 🚶
- *High Activity*: 🚶

---

* Intended for use in high-activity, briefly-occupied areas only

** 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 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.

LUTRON SPECIFICATION SUBMITTAL

Job Name: Lions Heart Cohoes

Job Number:

Model Numbers: LRF2-OHLB-P

Installation Overview

Sensor Placement

- The mounting height of the sensor should be between 6 ft and 8 ft (1.6 m and 2.4 m).
- For smaller rooms less than 12 ft × 12 ft (3.7 m × 3.7 m), detection may be improved by mounting the sensor at 6 ft (1.8 m) from the floor.
- The ability to detect motion requires that the sensor have line-of-sight of all room occupants. The sensor must have an unobstructed view of the room. **DO NOT** mount behind or near tall cabinets, shelves, hanging fixtures, etc. The sensor cannot detect occupants 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 light bulbs and HVAC vents.
- 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 sensor's ability to detect occupants.
- Distance between local load controls and sensor should not exceed 60 ft (18 m) line-of-sight or 30 ft (9 m) through walls.

LUTRON SPECIFICATION SUBMITTAL Page 3

Job Name: Lions Heart Cohoes

Job Number:

Model Numbers: LRF2-OHLB-P

Mounting

- 180° and hallway sensors mount directly to wall with mounting bracket (included). See Figure A.
- 90° sensors mount directly in corner or on wall offset away from corner with mounting bracket (included). See Figure B.
  - Temporary mounting is recommended to test sensor coverage and wireless communication before permanently installing the sensor.
    - Temporary mounting: A 3M™ Command™ adhesive strip is provided for temporarily mounting and testing the sensor. This strip is designed for easy, damage-free removal and is not reusable.
    - Permanent mounting: Mounting bracket, screws, and anchors are provided to mount sensor.
- The Flexible Mounting Armature, LRF-ARM-WH (purchased separately), allows sensors to be mounted at greater heights on a ceiling, wall, or other flat surface.
  - The ball-and-clamp design expands the coverage area for Lutron® standard wall-, corner-, or hall-mount sensors. See Figure C.
  - Common mounting areas: warehouse aisles, loading docks, long hallways.

Figure C. Flexible Mounting Armature
Measurements are: in (mm)

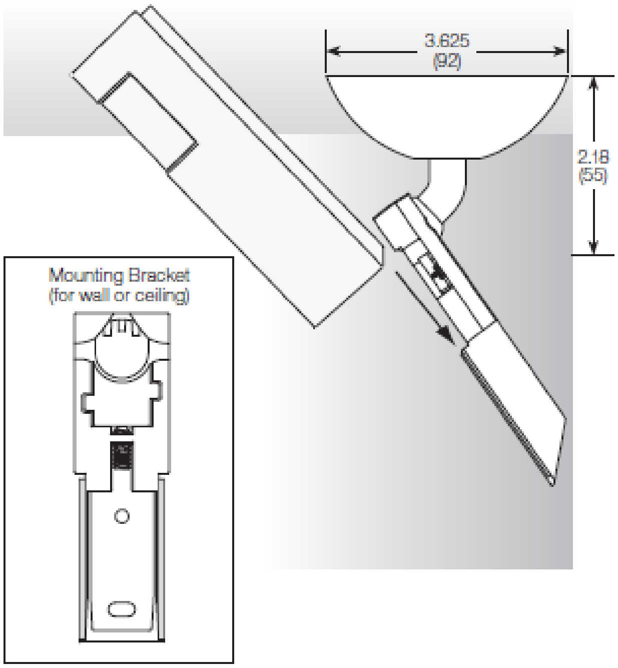


Figure A. 180° Wall-Mount Sensor and Hallway Sensor

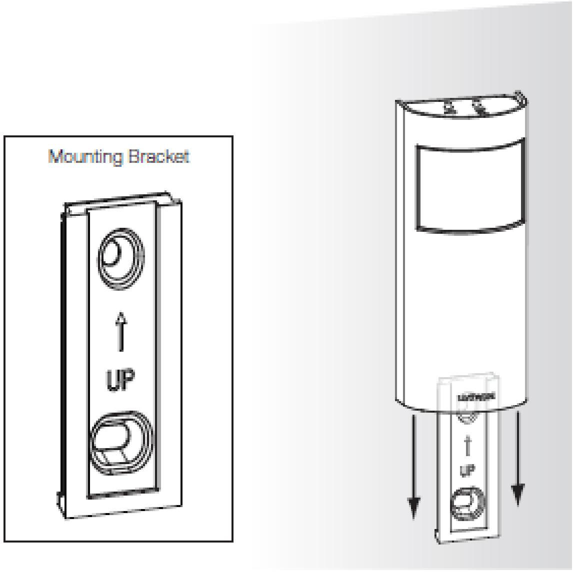
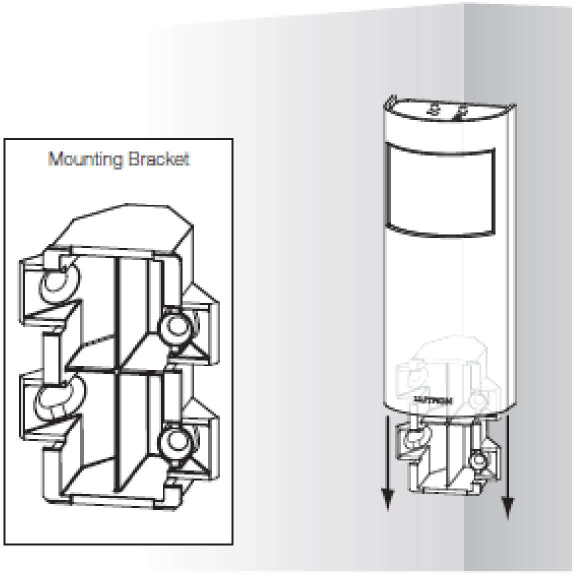


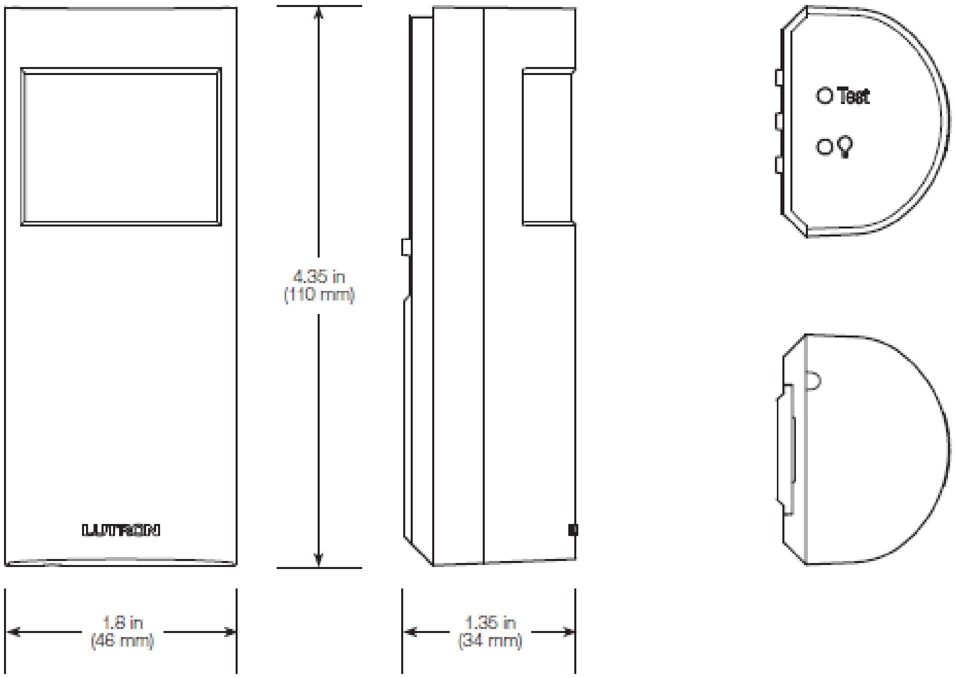
Figure B. 90° Corner-Mount Sensor



3M and Command are trademarks of 3M Company.

Job Name: Lions Heart Cohoes	**Model Numbers:** LRF2-OHLB-P
Job Number:	

Dimensions



LUTRON. SPECIFICATION SUBMITTAL Page 5

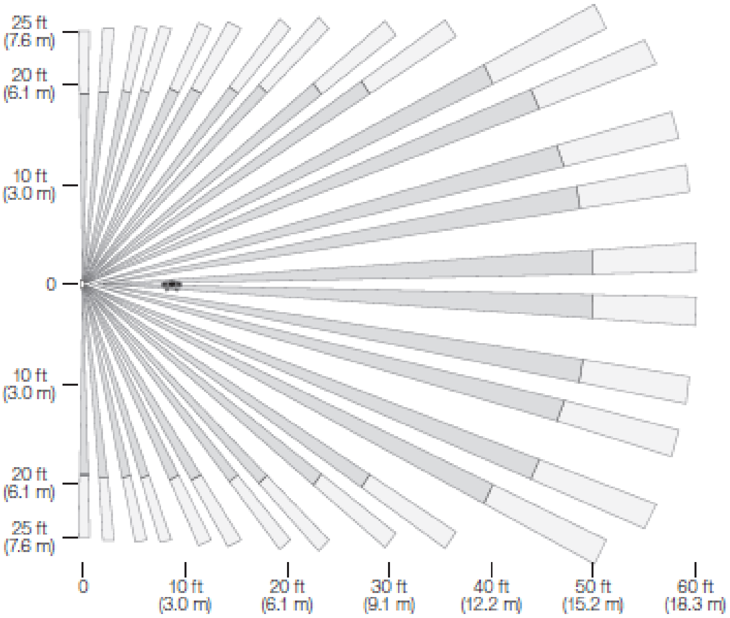
Job Name: Lions Heart Cohoes	**Model Numbers:** LRF2-OHLB-P
Job Number:	

Coverage Diagrams

180° Wall-Mount Sensors

Models: LRFX-OWLB-P-WH and LRFX-VWLB-P-WH

Horizontal Beam Diagram

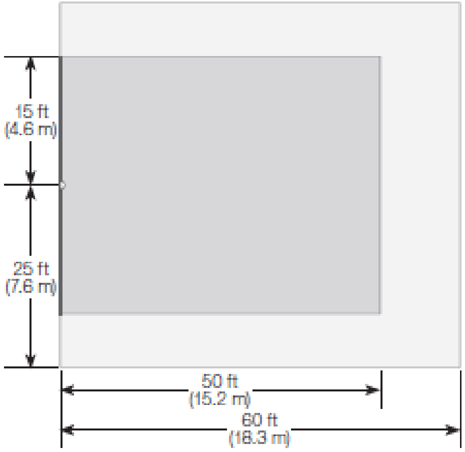


Tested Coverage Area

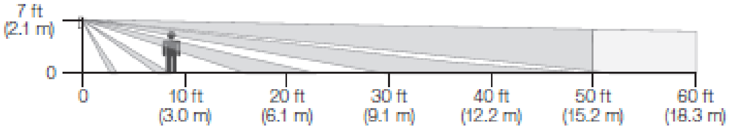
□ Major motion coverage: 3000 ft² (278.7 m²)

▨ Minor motion coverage: 1500 ft² (139.4 m²)

Compliant to NEMA WD7 test grid (shown below)



Vertical Beam Diagram*



---

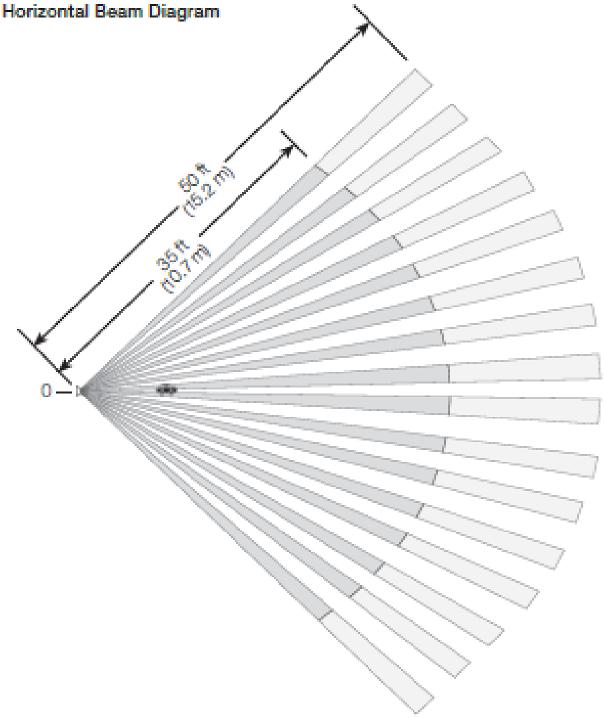
* Sensor mounting shown at 7 ft (2.1 m). Mounting height should be between 6 ft and 8 ft (1.6 m and 2.4 m).

Coverage Diagrams

90° Corner-Mount Sensors

Models: LRFX-OKLB-P-WH and LRFX-VKLB-P-WH

Horizontal Beam Diagram

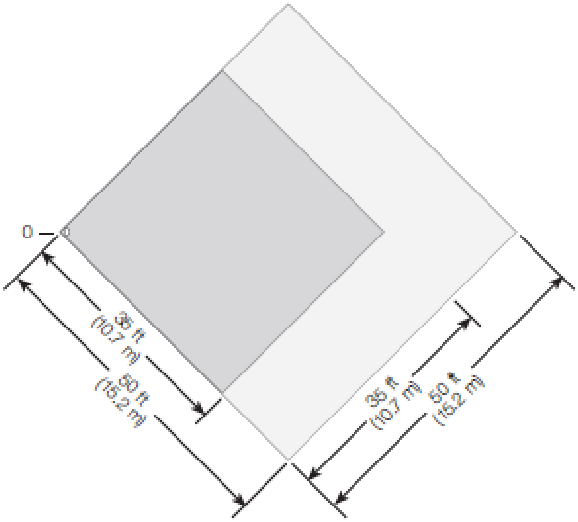


Tested Coverage Area

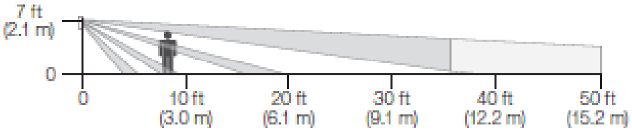
□ Major motion coverage: 2500 ft² (232.3 m²)

▨ Minor motion coverage: 1225 ft² (113.8 m²)

Compliant to NEMA WD7 test grid (shown below)



Vertical Beam Diagram*



---

* Sensor mounting shown at 7 ft (2.1 m). Mounting height should be between 6 ft and 8 ft (1.6 m and 2.4 m).

LUTRON® SPECIFICATION SUBMITTAL Page 7

Job Name: Lions Heart Cohoes	**Model Numbers:** LRF2-OHLB-P
Job Number:	

Coverage Diagrams

Hallway Sensors

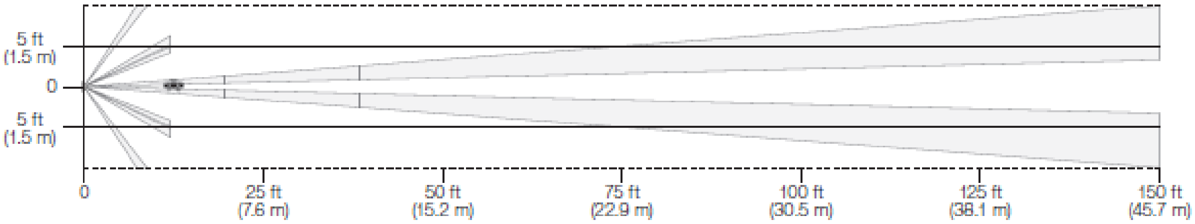
Models: LRFX-OHLB-P-WH and LRFX-VHLB-P-WH

- Designed to mount at the end of a hallway with a clear view down the length of a hall.
- Detection at longer distances is best when motion occurs at right angles to the sensor.
- Multiple sensors can be used to extend coverage.

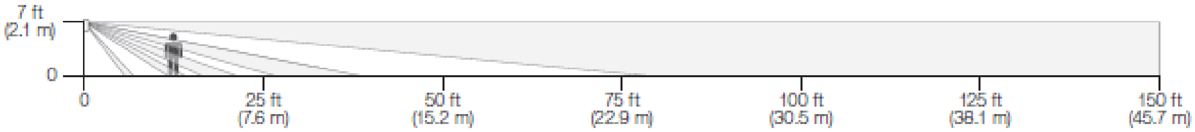
Maximum Recommended Hallway Length

Hall Width	Hall Length
6 ft (1.8 m) or less	50 ft (15.2 m)
8 ft (2.4 m) or less	100 ft (30.5 m)
10 ft (3.0 m) or more	150 ft (45.7 m)

Top View



Side View*



Sensor mounting shown at 7 ft (2.1 m). Mounting height should be between 6 ft and 8 ft (1.6 m and 2.4 m) and centered within hallway.

LUTRON®

Stairwell Fixture Solution

Installation Instructions

Important Notes

1. Install and wire in accordance with national and local electrical codes, by a qualified professional familiar with the construction and operation of luminaire electrical systems and the hazards involved.
2. Fixtures are shipped with preset occupied and unoccupied light levels. Light levels may need to be field adjusted to meet local code (see **Programming**).
3. Compatible with Lutron® Radio Powr Savr™ wireless occupancy sensors (not included). At a minimum, one sensor per entryway is required.

   Note: Not compatible with Radio Powr Savr™ daylight sensors or Pico® wireless controls.
4. Emergency Ballast/Driver Options:

   The emergency ballast/driver fixture provides a test button with an LED for identification and to verify power. Pressing the button will mimic an emergency power loss situation (illuminate one lamp for fluorescent only), verifying that the emergency ballast/driver is properly wired and charged.

Fluorescent Only

5. Pre-wired Lutron® 1% dimming ballast. Reduced-wattage T8 lamps are able to dim to a minimum of 10% with an EcoSystem® reduced-wattage dimming ballast. 32 W T8 ballasts will not operate with reduced-wattage lamps.
6. Lamps are not included with this fixture. For optimal performance, install new lamps with installation. Use only with lamps conforming to the IEC 60081/60901 specification. Lutron recommends GE, Sylvania, or Philips lamps that are certified for dimming.

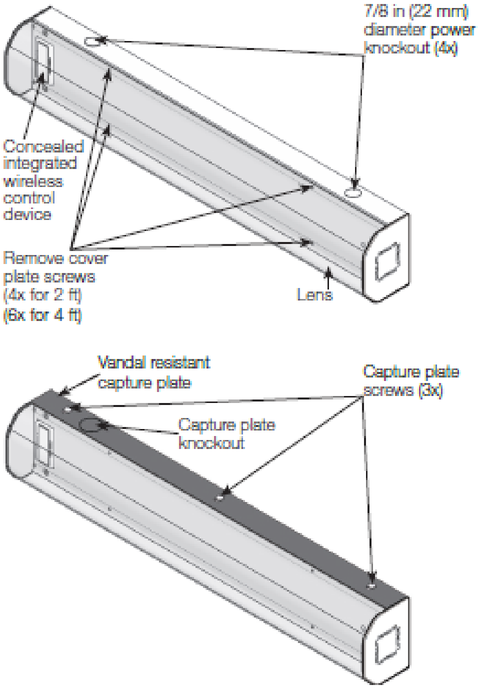
   Note: Consult lamp manufacturer for lamp burn-in requirements. To burn-in, see **Figure D**.
7. 0 to 90% humidity. Non-condensing, indoor/dry location use only. Ambient operating temperature 50 to 104 °F (10 to 40 °C)

LED Only

8. LEDs are integrated into the fixture. To ensure proper performance, avoid making contact with the LEDs.
9. 0 to 90% humidity. Non-condensing, indoor/dry location use only. Ambient operating temperature 32 to 104 °F (0 to 40 °C)

IMPORTANT INFORMATION
Please Read Before Installing

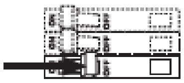
Figure A: Installation Components



Installation

WARNING! Shock Hazard. May result in serious injury or death. Switch off power to all power feeds via circuit breaker or isolator before wiring or servicing.

1. Turn off power to the fixture location.



2. Remove the existing fixture (if applicable), preserving the power wiring.
3. Carefully remove the lens:
   A. For vandal resistant option, loosen capture plate screws with security bit and slide capture plate to rear of fixture.
   B. Apply pressure to the center of the lens, removing one lens edge off the lip of the fixture.
   C. Lift edge of lens and rotate away from the fixture to remove.
4. Remove cover plate screws, and remove cover plate from fixture (see **Figure A**).

   Note: To bypass the end caps, the cover plate can flex slightly to ease its removal from the fixture.

Continued on next page...

P/N 041402d
09/2014

Installation *(continued)*

5. Determine the appropriate mounting method for the new fixture. Use appropriate mounting hardware to support a 20 lb (4.54 kg) fixture; M4 (#8) screw recommended. Secure the fixture to the wall or ceiling.

   Note: If using top or bottom knockouts with vandal resistant option, the capture plate can be removed and flipped to utilize all knockouts.

6. Connect the Load Wires to the Ballast/Driver Connector (see **Figure B**). Connect Power Source to the Mains Disconnect.

   Note: Ensure all components are properly grounded and check that all wires are securely connected.

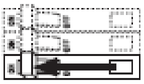
   Fluorescent Lamps Only: Emergency Ballast

   - For input power wiring, connect either the Black wire for 120 V~, or the Orange wire for 277 V~ on the emergency ballast to the line/hot input connector of the power source. Cap off the power wire you do not use.
   - Connect Emergency Ballast Battery Disconnect prior to restoring power to enable the emergency output.

8. Replace the cover plate using the four screws (see **Figure A**).

   Note: To bypass the end caps, the cover plate can flex slightly to ease installation into the fixture body.

9. Restore power.



   Note: Fixture will default to occupied light level (high-end).

10. Determine the locations of the wireless occupancy sensors that will be associated with the wireless control device (see **Figure C**). Be sure to mount the sensors where they will detect occupancy, not just movement of the door opening.

    Note:

    - At a minimum, one sensor per entryway is required.
    - Compatible with all Lutron® Radio Powr Savr™ wireless occupancy sensors (not included). Not compatible with Radio Powr Savr™ daylight sensors or Pico® wireless controls. See the instruction sheet included with your sensor for more information, or at www.lutron.com/rps.

11. Associate sensors to fixtures (see **Association**).

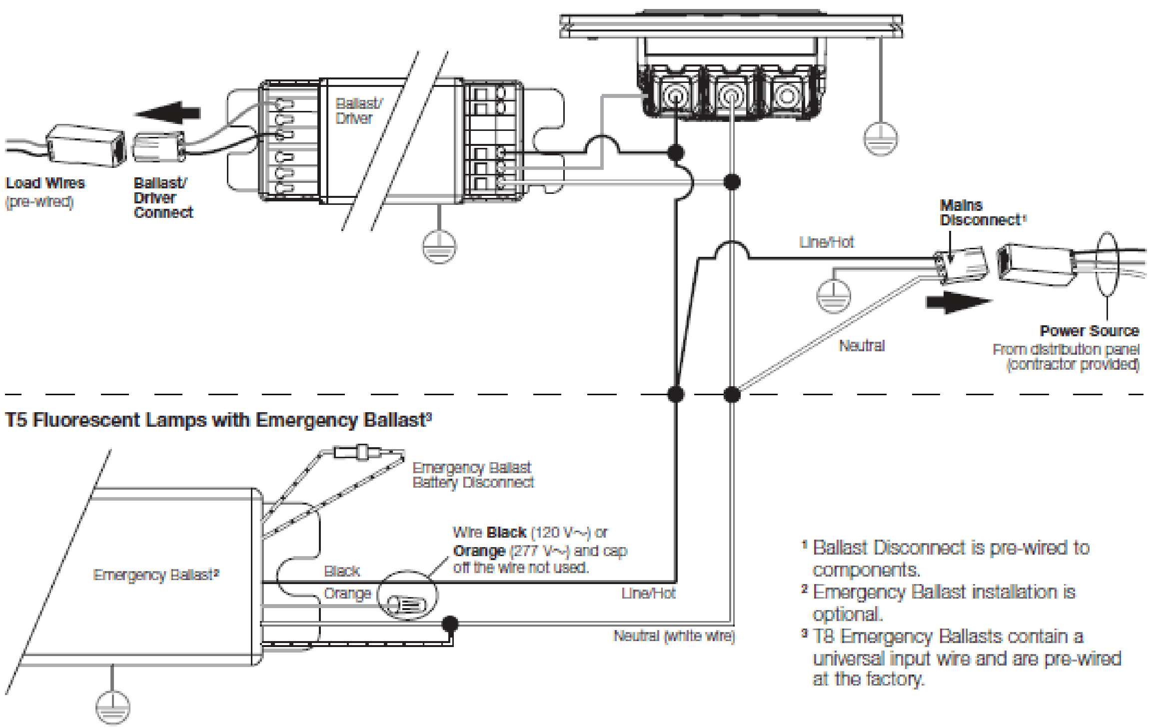
12. If desired, change the default factory settings (sensor timeout, occupied light level, unoccupied light level). See **Programming**.

13. Replace the lens onto the fixture.

14. For vandal resistant option, slide capture plate to front of fixture and secure capture plate screws using the security bit.

Figure B: Input Power Wiring

For lamp wiring, consult the wiring diagram on the ballast/driver.



[1] Ballast Disconnect is pre-wired to components.

[2] Emergency Ballast installation is optional.

[3] T8 Emergency Ballasts contain a universal input wire and are pre-wired at the factory.

Association

Lutron® Radio Powr Savr™ Wireless Occupancy Sensors Only

1. Identify which fixtures will have the same sensor associated to them. Typically, this will include all fixtures within the floor above and the floor below the entryway (see **Figure C**).

   Note: Up to nine fixtures can have the same sensor associated to them, and up to nine sensors can be associated to a fixture within RF range.

2. Press and hold Ⓣ on the wireless control device for approximately 6 seconds until the ILs (Indicator Lights) flash (see **Figure D**). Repeat this step for all fixtures identified in step 1.
   - Associate only one sensor at a time.
   - Wireless control devices will automatically return to normal operation after 10 minutes of inactivity.

3. Press and hold the "💡" or "Lights Off" button on the sensor for approximately 6 seconds until the lens on the sensor flashes orange (see **Figure E**) to complete Association.

Programming (Optional)

1. To adjust the desired occupied (high-end) and unoccupied (low-end) light levels of the fixture, enter programming mode on the wireless control device by pressing and holding the Ⓣ and ▲ buttons for approximately 3 seconds until an IL starts flashing (see **Figure D**).

2. Use ▲ / ▼ to adjust the desired occupied (high-end) light level. Press Ⓣ once to continue. Use ▲ / ▼ to adjust to the desired unoccupied (low-end) light level. **Figure F** shows the approximate light level increments, as displayed by the ILs.

3. Press Ⓣ to save the light level settings and return the wireless control device to normal operation.
   - The wireless control device will automatically exit programming mode after 30 seconds if no buttons are pressed. The new settings will be saved only if all steps are completed.
   - During normal operation, the ILs on the wireless control device will not match **Figure F**.

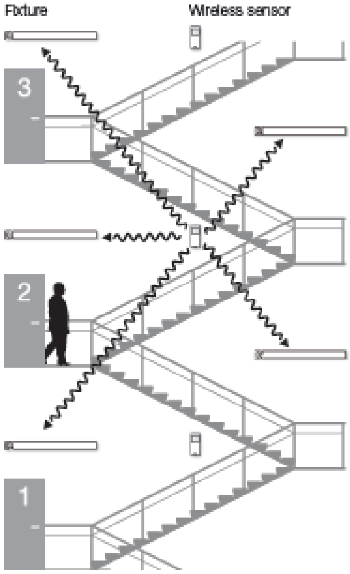
Notes:

– Default settings for occupied/unoccupied light levels are dependent upon model purchased (50/10 or 80/20).

– Timeout is the time delay until lights go to low-end after no occupancy is detected. To change the timeout of the Radio Powr Savr™ occupancy sensor, see instruction sheet provided with sensor.

Figure C: Typical Layout

Example below shows associated occupancy sensors turning fixtures on to occupied light level (high end).



Note:
RF range (sensor to fixture):
- 60 ft (18 m) line of sight
- 30 ft (9 m) through normal construction materials

Figure D: Wireless Control Device

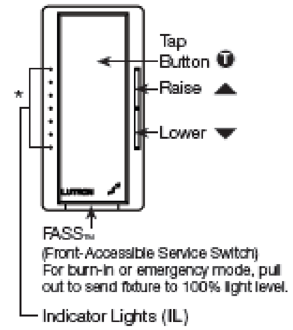


Figure E: Lights Off Button

Press and hold "💡" or "Lights Off" button.

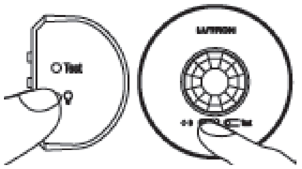


Figure F: Wireless Control Device Display Chart

*IL Display ○ = on ● = off	● ● ● ● ● ● ○	● ● ● ● ● ○ ●	● ● ● ● ○ ● ●	● ● ● ○ ● ● ●	● ● ○ ● ● ● ●	● ○ ● ● ● ● ●	○ ● ● ● ● ● ●
Occupied (High-end)	40%	50%	60%	70%	80%	90%	100%
Unoccupied (Low-end)	1%**	5%	10%	20%	30%	40%	50%

**To achieve 10% unoccupied light level on a reduced wattage T8, the wireless control device requires field adjustment to 1% unoccupied light level. LED dims to 5% reliably.

Return to Factory Settings

Performing these steps will disassociate all sensors that were previously associated to the fixture and return the occupied and unoccupied light levels to their factory settings.

1. On the wireless control device, quickly press Ⓣ 3 times. Hold Ⓣ on the 3rd press for approximately 3 seconds until the lights cycle up and down.
2. Release Ⓣ, then immediately tap Ⓣ 3 times quickly.
3. The lights will cycle up and down 3 times to verify that the device has been returned to factory settings.

Troubleshooting

Symptoms	Solution(s)
The light is flickering, flashing, dropping out, or does not turn on.	• Check all wires, lamp connections, and sockets to ensure that they are properly connected • Ensure that 120-277 V~ power is present and properly connected to the fixtures • Ensure ambient temperature is within the specified range
Lights remain at one level and do not change.	• Verify that all sensors are present and within RF range* • Press the "💡" or "Lights Off" button on the sensor to verify that association is still active and that fixture is functioning properly • Ensure that the FASS™ is pushed in • Pull the FASS™ out to verify that the fixture proceeds to occupied (high-end) light level within 10 seconds
Sensor cannot be associated.	• Ensure that 120-277 V~ power is present and properly connected to the fixtures • Ensure the wireless control device is in programming mode and all ILs are flashing • Consult troubleshooting section of sensor instruction sheet for more solutions, or visit www.lutron.com/rps
Wireless control device does not respond to button presses.	• The wireless control device does not respond to manual control once a sensor is associated to it (except for re-association and programming) • Ensure that 120-277 V~ power is present and properly connected to the fixtures • Verify that ILs are illuminated on the wireless control device • Press the "💡" or "Lights Off" button on the sensor to verify that association is still active and that fixture is functioning properly
Wireless control device has top and bottom ILs flashing.	• Verify that all sensors are present and within RF range* • Pull out and push in FASS™ then press the "💡" or "Lights Off" button on each associated sensor to verify sensor battery life and association
Sensor lens is flashing orange.	• Sensor battery requires replacement • Sensor may be in test mode for coverage detection, press "Test" button on sensor to exit test mode

* If a sensor is missing or out of RF range for two hours, the fixtures will turn on to the occupied light level and the top and bottom ILs on the wireless control devices will flash. If a sensor requires replacement, all fixtures that it was associated to will need to be returned to factory settings. The new sensor and any overlapping sensors will need to be associated/re-associated to the appropriate fixtures.

Worldwide Headquarters
USA
Lutron Electronics Co., Inc.
7200 Suter Road
Coopersburg, PA 18036-1299
USA
TEL: +1.610.282.3800
FAX: +1.610.282.1243
Technical support: 1.800.523.9466
or +1.610.282.6701
Toll-free: 1.888.LUTRON1

European Headquarters
United Kingdom
Lutron EA Ltd
6 Sovereign Close
London, E1W 3JF, UK
TEL: +44.(0)20.7702.0657
FAX: +44.(0)20.7480.6899
Technical support: +44.(0)20.7680.4481
FREEPHONE: 0800.282.107

Asian Headquarters
Singapore
Lutron GL Ltd
15 Hoe Chiang Road
Tower Fifteen
Singapore, 089316
TEL: +65.6220.4666
FAX: +65.6220.4333
Technical support: 800.120.4491

Warranty:
www.lutron.com/TechnicalDocumentLibrary/Warranty_CommercialSystems.pdf

LED LAMP

SPECIFICATIONS

Type B

Soft White
2700K

Ideal For

5-6 Inch Retrofit Trim

Features

- High Output Bright LEDs
- Instant On to Full Brightness
- 50,000 Hour Life
- RoHS Compliant
- 5 Year Warranty
- Indoor / Suitable for Wet Locations
- UL Listed
- Energy Star®

Housing Compatability

- Suitable for type IC, type Non-IC and Air Tight Housings


Standard base adapter included.

Specifications

Item Number	**Input Power** (Watts)	**Incandescent Equiv.** (Watts)	**Input Line Voltage**
LEDR56/827	20.5	100	120
Base Type	**Lumens**	**Lumen Efficiency** (LPW)	**CCT**
E26 Adapter	1245	60	2700K
CRI	**Housing**	**Life Hours**	
>80	Fits 5" & 6" housings	50,000	

TYPE WP

XSPWA02FC-1ZK

XSP Series

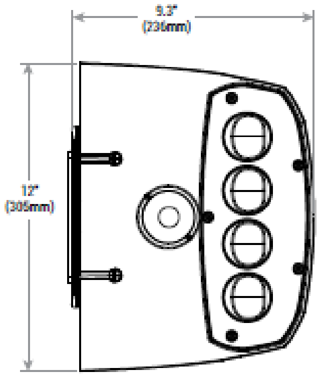
XSPW™ Wall Mount Luminaire

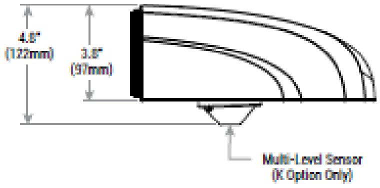
Product Description

The XSPW™ wall mount luminaire has a slim, low profile design intended for outdoor wall mounted applications. The rugged lightweight aluminum housing and mounting box are designed for installation over standard and mud ring single gang J-Boxes. The luminaire allows for through-wired or conduit entry from the top, bottom, sides and rear. The housing design is intended specifically for LED technology including a weathertight LED driver compartment and thermal management. Optic design features industry-leading NanoOptic® Precision Delivery Grid™ system in multiple distributions.
Applications: General area and security lighting

Performance Summary

- Utilizes BetaLED® Technology
- NanoOptic® Precision Delivery Grid™ optic
- Made in the U.S.A. of U.S. and imported parts
- **CRI:** Minimum 70 CRI
- **CCT:** 4000K (+/- 300K), 5700K (+/- 500K)
- **Limited Warranty**[†]: 10 years on luminaire/10 years on Colorfast DeltaGuard® finish





Ordering Information

Example: XSPWA02FC-UZ

XSPW	A	0	2	F	C	-	1	Z	K
Product	**Version**	**Mounting**	**Optic**	**Modules**	**Input Power Designator**	**-**	**Voltage**	**Color Options**	**Options**
XSPW	**A**	**0** Wall	**2** Type II Medium **3** Type III Medium	**F** 4000K **M** 5700K	**C** 42W **G** 25W	**-** US ***** Canada	**U** Universal 120-277V **1** 120V **2** 208-277V **6*** 347V	**Z** Bronze **S** Silver **T** Black **B** Platinum Bronze **W** White	**Y** 0-10V Dimming - Control by others - Available with Input Power Designator C only - Refer to dimming spec sheet for details **P** **Photocell** - Not available with K option - Must specify 1, 2, or 6 voltage **K** Multi-Level - Refer to ML spec sheet for details - Available with Input Power Designator C only

---

[†] See www.cree.com/lighting/products/warranty for warranty terms

* Available in Canada only

Rev. Date: V3 12/09/2014

Product Specifications

CONSTRUCTION & MATERIALS

- Slim, low profile design
- Luminaire housing specifically designed for LED applications with advanced LED thermal management and driver
- Luminaire mounting box designed for installation over standard and mud ring single gang J-Boxes
- Luminaire can also be direct mounted to a wall and surface wired
- Secures to wall with four 3/16" (5mm) screws (by others)
- Conduit entry from top, bottom, sides, and rear
- Designed and UL approved for easy through-wiring
- Designed for downlight applications only
- Exclusive Colorfast DeltaGuard® finish features an E-coat epoxy primer with an ultra-durable powder topcoat, providing excellent resistance to corrosion, ultraviolet degradation and abrasion. Bronze, silver, black, white, and platinum bronze are available
- **Weight:** 9.5lbs. (4.3kg)

ELECTRICAL SYSTEM

- **Input Voltage:** 120-277V or 347V, 50/60Hz, Class 2 driver
- **Power Factor:** > 0.9 at full load
- **Total Harmonic Distortion:** < 20% at full load
- Integral 10kV surge suppression protection standard
- To address inrush current, slow blow fuse or type C/D breaker should be used
- **Source Current:** 0.15 mA

REGULATORY & VOLUNTARY QUALIFICATIONS

- cULus Listed
- Suitable for wet locations
- Enclosure rated IP66 per IEC 60529
- DLC qualified. Please refer to http://www.designlights.org/QPL for most current information
- 10kV surge suppression protection tested in accordance with IEEE/ANSI C62.41.2
- Meets FCC Part 15 standards for conducted and radiated emissions
- Luminaire and finish endurance tested to withstand 5,000 hours of elevated ambient salt fog conditions as defined in ASTM Standard B 117
- Meets Buy American requirements within ARRA
- RoHS compliant. Consult factory for additional details

Electrical Data*

Input Power Designator	System Watts 120-277V	System Watts 347V	Total Current				
			120V	208V	240V	277V	347V
C	42	46	0.36	0.21	0.19	0.16	0.14
G	25	27	0.22	0.13	0.11	0.10	0.08

* Electrical data at 25°C (77°F). Actual wattage may differ by +/- 7% when operating between 120-347V +/- 10%

Recommended Cree® XSPW Series Lumen Maintenance Factors (LMF)[1]

Ambient	Input Power Designator	Initial LMF	25K hr Projected[2] LMF	50K hr Projected[2] LMF	75K hr Projected[2] LMF	100K hr Calculated[3] LMF
5°C (41°F)	C G	1.04	1.02	1.01	1.00	1.00
10°C (50°F)	C G	1.03	1.01	1.00	0.99	0.99
15°C (59°F)	C G	1.02	1.00	0.99	0.98	0.98
20°C (68°F)	C G	1.01	0.99	0.98	0.97	0.97
25°C (77°F)	C G	1.00	0.98	0.97	0.96	0.96

[1] Lumen maintenance values at 25°C (77°F) are calculated per TM-21 based on LM-80 data and in-situ luminaire testing

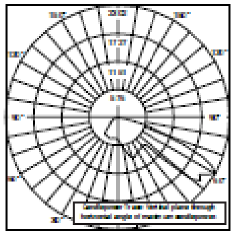
[2] In accordance with IESNA TM-21-11, Projected Values represent interpolated value based on time durations that are within six times (6X) the IESNA LM-80-08 total test duration (in hours) for the device under testing ((DUT) i.e. the packaged LED chip)

[3] In accordance with IESNA TM-21-11, Calculated Values represent time durations that exceed six times (6X) the IESNA LM-80-08 total test duration (in hours) for the device under testing ((DUT) i.e. the packaged LED chip)

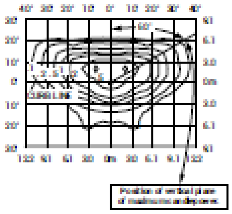
Photometry

All published luminaire photometric testing performed to IESNA LM-79-08 standards by a NVLAP certified laboratory. To obtain an IES file specific to your project consult: http://www.cree.com/lighting.

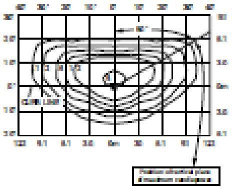
2



CESTL Test Report #: 2014-0017
DXSPWA-2TG US
Initial Delivered Lumens: 2,739



DXSPWA-2TC US
Mounting Height: 10' (3.0m) A.F.G.
Initial Delivered Lumens: 3,819
Initial FC at grade



DXSPWA-2TG US
Mounting Height: 10' (3.0m) A.F.G.
Initial Delivered Lumens: 2,529
Initial FC at grade

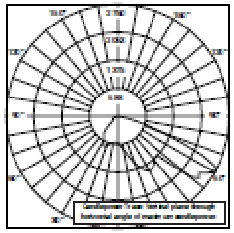
Type II Medium Distribution

Input Power Designator	4000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
C	3,819	B1 U0 G1	4,109	B1 U0 G1
G	2,529	B1 U0 G1	2,722	B1 U0 G1

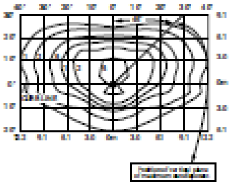
* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -4 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: www.iesna.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf.

3



CESTL Test Report #: 2014-0018
DXSPWA-3TC US
Initial Delivered Lumens: 4,187



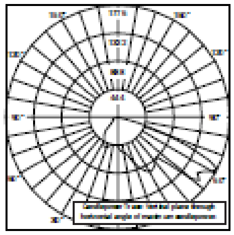
DXSPWA-3TC US
Mounting Height: 10' (3.0m) A.F.G.
Initial Delivered Lumens: 3,819
Initial FC at grade

Type III Medium Distribution

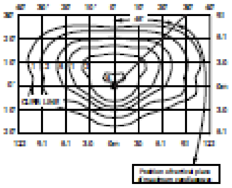
Input Power Designator	4000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
C	3,819	B1 U0 G1	4,109	B1 U0 G1
G	2,529	B1 U0 G1	2,722	B1 U0 G1

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -4 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: www.iesna.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf.



CESTL Test Report #: 2014-0019
DXSPWA-3TG US
Initial Delivered Lumens: 2,692



DXSPWA-3TG US
Mounting Height: 10' (3.0m) A.F.G.
Initial Delivered Lumens: 2,529
Initial FC at grade

Appendix E. Photometric Measurements

E.1 Mason's Ridge II, New Windsor, NY

LRC used a tripod to hold the illuminance meter at five feet above the ground. The meter probe was rotated to face the four nominal directions, as shown. Per recommended practice, measurements were excluded in locations "facing" away from lighting, especially at the edge of the property. Also excluded were points that were blocked or shaded by cars, and an area that would have been lighted by a malfunctioning luminaire. These vertical illuminance measurements show that light is contributed on the face from many angles.

Masons Ridge - Vertical Illuminance Measurements, facing NORTH ⬆

Data excluded because facing off-site														0.9	1.0	1.0	Data excluded due to malfunctioning luminaire
Cars		0.9	1.0	1.0	0.8	0.8		Cars			1.0			1.2	1.1	1.1	
		5.5	3.9	2.0	3.5	1.7	2.3				1.3	2.7	10.4	6.8	6.1	4.6	
17.1	13.0	9.6	7.1	6.9	5.5	2.8	4.9	5.6	7.8	11.8	18.7	18.7	18.0	18.0	18.4	12.4	
25.3	16.3	11.9	11.4	10.6	6.8	5.9	6.6	8.2	11.9	15.3	18.2	18.8	27.8	19.1	17.7	16.1	
23.5	15.0	12.8	14.1	10.4	7.4	6.9	7.6	11.0	15.2	15.9	20.1	24.2	26.6	25.4	20.3	16.9	
18.4	12.8	13.6	13.0	3.0	7.8	2.9	9.6	12.0	11.2	13.3	14.8	16.2	15.9	14.5	13.0	10.8	
14.9	11.9	13.2	11.3	8.5	7.7	7.4	7.5	7.6	7.6	7.7	8.4	8.9	8.4	7.6	7.6	6.8	
			9.2	7.3	6.0	Car	5.0	Car	4.4	4.7	Cars		4.6	4.1	4.6	5.0	
			7.4	6.0	4.8		3.7		3.5	3.3			3.1	2.8	3.6	4.0	
			6.3	4.9	4.1		3.3		3.2	2.6			2.5	2.1	1.9	3.6	

Masons Ridge - Vertical Illuminance Measurements, facing EAST ⬅

		2.1	2.1	2.2	2.2	3.8					4.1	3.4		2.7	2.6	2.9							5.9	6.9				
		2.4	2.4	2.5	2.6	4.4					6.8	5.0		3.1	3.1	3.3							8.5	10.7				
		2.8	2.8	4.7	3.2	7.9					16.8	16.5		3.6	4.5	3.9							12.7	18.5				
3.6	3.9	3.0	3.3	6.0	4.0	9.9	13.9	17.7	22.0	24.6	22.0	20.1	4.7	3.8	4.1	4.4	3.2	3.4	5.8	6.9	8.6	10.5	14.1	16.9	18.3	23.7	22.4	21.2
3.0	4.6	3.4	3.5	6.2	7.3	10.2	13.6	17.6	21.3	27.0	30.9	17.8	7.3	3.9	4.7	4.8	3.4	3.7	6.2	7.3	9.1	11.9	14.7	16.7	21.7	26.0	27.2	16.7
4.0	5.0	4.1	4.2	6.5	8.2	10.3	13.8	11.1	21.6	24.2	17.9	12.6	9.1	5.0	6.7	6.0	4.6	3.6	7.1	8.1	10.1	12.4	15.9	19.2	22.1	22.6	18.8	13.3
5.8	6.8	5.7	7.1	7.6	9.3	11.1	13.6	17.6	20.2	20.2	19.2	16.9	12.3	7.7	8.2	7.2	6.3	4.5	8.5	9.2	11.8	14.6	17.9	20.1	20.9	20.1	18.2	11.4
7.6	8.4	9.1	10.6	8.3	11.6	13.5	14.9	15.0	14.8	14.7	14.2	14.4	11.4	11.4	12.5	11.7	9.7	6.8	11.2	11.3	14.0	16.0	19.1	20.8	21.7	20.9	16.7	10.6
7.5	10.5	12.9	16.1	12.6	17.2	16.2	14.2	9.5	9.7	9.9	10.9	11.5	13.0	13.0	16.9	16.5	15.3	10.7	14.4	12.8	14.9	16.5	17.4	17.6	17.2	16.7	14.8	8.8
			19.1	16.5	16.8				7.3	7.9			12.8	13.3	18.2	19.0								16.8	18.1	17.3	17.1	11.9
			18.5	21.7	23.0				5.5	7.2			12.5	13.6	19.4	24.2								19.9	23.1	27.0	21.5	16.0
			19.0	21.2	26.2		18.7		6.1	7.1			12.7	14.9	19.6	23.1						15.1		18.2	20.8	24.5	19.7	19.2

Masons Ridge - Vertical Illuminance Measurements, facing South ⬇

		16.3	13.1	9.0	7.5	7.1					4.1	4.8		4.8	4.7	4.8	4.3	3.5		2.8	3.1		3.6	4.5				
		16.7	12.5	9.3	6.2	6.2					6.6	7.0		7.9	8.1	8.0	5.7	4.6		3.4	3.8		4.6	5.9				
		9.8	7.6	3.6	2.2	3.6					7.9	3.5		12.2	10.2	8.4	6.1	4.5		3.3	4.0		4.1	5.5				
2.1	2.0	1.8	1.8	2.0	2.0	2.2	2.3	2.4	2.6	24.6	2.9	3.2	3.7	3.4	3.4	3.4	3.3	3.2	3.1	3.3	3.3	3.5	4.0	4.3	4.8	5.7	6.3	7.5
2.2	2.0	2.1	2.2	2.4	2.7	2.5	2.9	3.1	3.8	27.0	4.0	4.4	4.5	4.5	4.5	4.6	4.6	4.6	4.4	4.3	4.7	4.7	5.2	5.5	6.3	7.5	8.6	10.8
3.0	2.8	3.0	3.0	3.1	3.5	3.8	4.1	4.4	5.1	24.2	5.9	6.5	6.7	6.2	6.4	6.7	6.5	6.0	6.2	6.1	6.1	6.2	6.7	7.3	8.5	10.3	12.4	14.0
4.4	4.3	4.6	4.3	5.2	4.7	5.8	6.8	6.7	7.3	20.7	8.5	9.2	10.1	10.0	4.9	9.7	9.2	8.4	8.9	8.8	8.7	8.6	9.0	10.1	12.0	14.8	17.9	17.5
5.4	5.5	7.3	7.5	7.1	8.7	9.7	10.5	11.6	11.2	11.6	11.2	12.6	13.9	14.7	14.5	13.8	13.2	12.8	13.9	13.6	13.0	13.1	12.9	14.0	16.1	17.5	18.0	11.3
4.2	6.3	10.8	10.6	12.8	13.7		18.8	19.5	19.4	18.5	17.2	14.9	16.3	15.8	16.2	16.7	17.5	20.1	21.3	21.4	20.2	19.1	16.8	16.0	15.8	16.4	17.5	18.6
			10.6	11.7	12.5		21.0		19.8	16.1			13.7	13.0	13.8	14.4								13.4	13.6	15.0	16.1	18.4
			7.8	13.2	14.5		17.9		18.2	14.9			9.9	9.7	10.6	12.7								12.4	10.8	11.7	13.0	13.0
			5.9	7.6	17.6		18.2		19.0	18.2			7.6	7.1	7.3	8.4						13.8		6.6	5.8	4.8	4.2	3.8

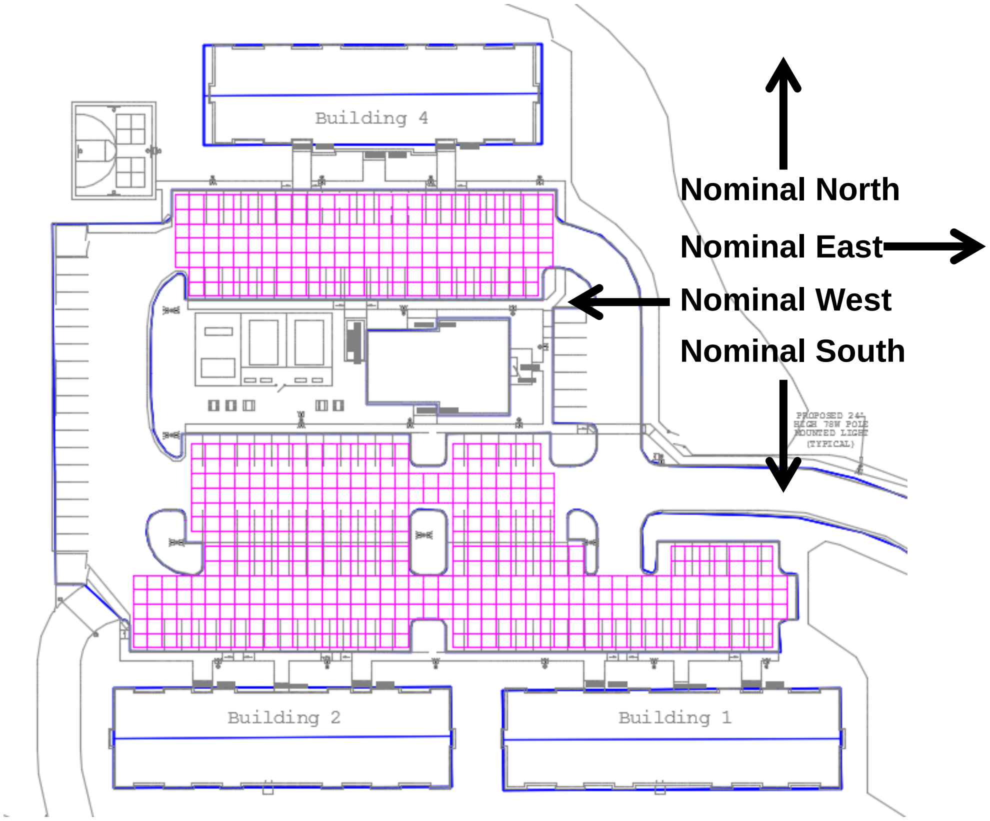
Masons Ridge - Vertical Illuminance Measurements, facing West ➡

		13.0	14.2	13.3	12.2	12.2					1.6	1.1		3.2	3.7	5.0	5.5	4.3		2.7	2.3		1.9	1.8				
		17.9	18.6	11.2	15.1	13.7					1.8	2.7		5.3	8.6	11.2	10.2	8.1		4.9	3.8		2.8	2.5				
		24.3	22.0	16.2	14.3	13.4					1.1	2.5		15.0	21.0	23.2	19.7	15.0		8.7	5.7		3.7	3.1				
	15.6	18.8	15.5	14.3	15.1	11.7	7.6	5.1	4.0	3.3	1.4	2.7	1.8	15.1	26.3	225.9	22.5	17.5	11.9	8.7	6.6	5.0	4.1	3.7	3.3	3.1	3.2	3.2
	12.7	14.3	14.2	16.2	13.9	9.1	5.9	4.1	3.2	2.6	1.6	2.8	2.1	16.4	29.2	27.9	22.1	18.0	13.0	9.8	7.4	6.0	4.6	4.1	3.8	3.5	3.6	3.3
	5.6	10.4	14.0	13.7	10.7	6.8	4.6	3.3	3.0	2.2	2.1	3.3	5.7	12.0	17.2	23.0	24.3	19.6	14.2	10.4	8.2	6.7	5.8	3.2	4.5	4.4	4.2	4.4
	5.4	7.6	12.1	9.9	7.7	4.9	3.9	3.1	4.0	1.9	3.9	3.7	9.8	12.5	17.3	19.5	21.0	18.5	15.2	11.3	9.3	7.3	7.7	4.4	6.0	5.8	6.1	6.1
	5.5	6.2	8.6	7.1	5.8	3.7	2.8	3.0	4.0	5.3	5.3	7.1	8.2	11.3	13.3	13.3	13.0	12.3	11.7	10.4	10.1	9.4	9.5	6.4	9.0	9.3	9.0	7.8
	3.0	5.4	6.2	5.1	4.0	3.1	2.3	1.8	6.7	10.1	10.6	11.3	15.6	12.7	11.5	9.8	8.4	7.7	7.5	7.3	10.5	12.3	13.5	12.1	13.0	12.1	10.6	8.3
			3.9	3.3	2.4				10.4	9.8			13.9	12.3	10.1	7.6								14.4	14.5	12.0	10.6	8.2
			2.9	2.2	2.6				10.9	13.9			14.7	12.0	9.9	7.0								18.8	15.0	12.9	10.1	8.1
			2.3	1.5	2.3		2.1		13.5	25.7			15.2	12.4	9.2	7.0						26.3		15.5	15.7	13.5	10.4	8.5

E.2 Lion Heart Residences, Cohoes, NY

E.2.1 Cohoes Exterior Parking Lots – Vertical Measurements

Measurement points in the three Cohoes parking lots are shown. These vertical illuminance measurements show that light is contributed on the face from many angles.



Cohoes - Vertical Illuminance Measurements, facing NORTH

Parking Lot at Building 1

	29.9	20.7	24.7	23.7	25.3	23.1	26.0																	
	37.8	28.0	32.6	33.4	32.0	30.7	30.7																	
44.9	42.7	37.4	32.6	35.2	33.9	32.4	31.3	28.3																
33.8	38.8	38.4	37.5	29.4	30.3	29.6	29.0	25.8																
19.5	22.2	24.6	35.1	21.3	22.0	22.2	24.5	23.9																
	13.5	13.6	21.9	13.6	14.1	15.6	15.6																	
	6.3	6.1	12.3	6.7	8.5	9.3	11.5																	
		3.8	7.0	4.7			7.6																	
		10.6	7.9	11.3																				
24.7		20.5	13.6	18.2					37.5	24.7	28.2	31.5	29.1	23.1	18.0	11.0		4.8	3.9	3.7	3.5	3.5	3.0	2.7
24.4	25.3	24.6	22.2	22.5	24.3	32.0	35.6	40.0	39.0	37.5	31.8	31.3	31.8	27.9	20.7	15.4	10.0	5.1	3.5	3.2	2.8	2.7	2.3	2.0
23.0	23.9	25.3	23.2	20.7	28.0	33.6	36.5	39.9	42.0	37.7	32.8	34.1	30.6	24.5	20.2	16.7	11.4	6.3	3.2	2.7	2.6	2.5	2.1	2.1
20.7	20.1	24.1	24.2	21.9	26.4	31.8	37.0	29.3	39.0	34.5	30.8	32.2	29.3		20.0	17.0	11.1	6.2	3.2	2.4	2.4	2.1	1.9	1.6
		18.4	20.4				32.4																	
		11.1	13.8				19.4																	

Parking Lot at Building 2

				28.9	18.6	21.1	17.6	24.8	28.2	34.2	43.2	41.5	36.4	32.1	29.0	24.5	27.6	25.6	28.6
				28.8	33.0	33.6	30.7	29.0	38.7	48.1	54.5	46.1	49.7	50.0	45.2	34.8	36.8	17.9	35.4
				34.1	42.5	45.9	43.2	40.9	43.5	53.7	59.3	54.5	51.3	61.1	53.2	49.1	46.4	19.5	36.5
				39.9	41.6	48.1	46.4	33.2	46.1	50.5	51.4	48.1	49.4	56.4	50.9	50.5	47.3	38.8	33.1
				39.9	40.9	43.7	48.3	46.5	45.7	45.5	41.2	37.8	42.8	48.8	44.3	39.8	22.4	26.4	20.1
										35.8	32.1	30.0	33.5	36.7	33.6	28.2	9.4	18.0	12.4
										26.3	23.2	22.2	25.2	27.1	26.2	22.0	14.4	12.3	4.4
										17.9	15.2								
										12.1	12.0								
39.5	38.8	37.4	49.1		45.0	51.0	43.6		22.6	13.8	11.4	9.5	8.3			7.3	15.0	13.9	1.1
40.9	40.9	37.4	44.3	39.4	42.7	40.6	41.8	30.0	23.8	17.7	14.2	10.1	9.6	8.0	8.1	8.1	13.6	12.8	10.0
35.9	34.4	32.4	36.0	34.4	37.9	41.2	37.6	29.8	23.6	12.6	13.7	10.7	8.7	7.9	7.5	8.2	11.2	10.7	10.0
30.0	25.1	26.4	27.0	28.4	28.5	34.0	33.2	28.1	20.2	17.5	11.4	9.9	8.9	7.8	7.3	7.7	8.9	5.7	6.2
					20.3	23.0					6.5				6.4	6.2	6.3		
											4.1				4.9	4.2	4.3		

Parking Lot at Building 4

		19.1	20.2						22.8	28.1				24.7		27.5	32.6		32.0	30.8		23.5	23.8	23.8	
		32.7	33.3						36.2	36.2				32.9		38.9	44.9		49.7	44.1		35.3	35.4	35.4	
28.0	31.1	30.3	36.6	43.5	41.5	39.1	41.3	42.3	43.2	41.7				44.1		44.4	48.1		49.9	51.3		44.0	41.1	37.1	35.1
25.6	31.3	30.2	33.3	38.7	40.0	40.8	41.9	44.8	41.2	40.5	36.2	34.0	44.9	47.6	48.3	47.7	46.9	47.5	49.7	53.2	51.3	43.9	36.7	32.2	31.4
12.7	15.1	16.4	18.2	22.3	24.6	28.1	29.8	29.0	25.6	26.1	23.5	22.9	30.0	33.5	31.4	30.8	29.3	30.6	31.5	35.3	38.0	32.4	26.8	24.5	23.0
5.1	6.6	6.0	7.5	7.9	9.3	10.3	10.3	10.5	10.2	9.4	8.8	8.5	10.6	10.7	10.6	11.4	10.8	12.5	14.4	15.9	15.5	14.6	13.3	13.3	12.8
		3.4		4.4		4.1			5.8	4.1	4.3	6.0	6.0		6.5	6.7		7.3	7.6	7.4					
		2.7		3.1		3.5			3.9	3.3	3.4	4.4	4.7		4.7	5.0		4.9	5.0	4.9					

Cohoes - Vertical Illuminance Measurements, facing EAST ➡

Parking Lot at Building 1

	30.9	16.4	28.0	22.9	17.3	11.4	12.8																	
	26.7	19.0	23.8	23.1	19.8	16.4	22.2																	
23.5	22.8	21.6	26.2	20.5	23.1	26.6	29.3	26.0																
18.5	21.0	21.1	23.8	17.3	22.9	29.9	35.0	31.2																
14.3	15.7	13.5	18.3	14.1	19.9	34.1	36.3	42.0																
	19.9	9.2	12.6	13.6	22.3	32.3	37.7																	
	5.3	4.9	8.9	10.0	22.9	33.2	40.7																	
		4.5	7.4	9.4			37.7																	
		5.2	6.3	11.0																				
5.3		7.3	7.0	13.6					24.8	10.3	8.8	8.0	7.1	4.5	3.2	3.4	4.2	6.2	6.5	6.1	3.6	2.3	1.2	1.3
5.3	8.6	12.1	10.0	23.3	31.5	37.4	32.0	31.1	25.0	19.1	15.4	17.1	13.8	7.7	4.2	6.1	8.9	11.3	15.0	13.9	9.4	4.1	0.9	1.2
5.6	10.8	17.6	16.2	28.3	36.6	37.1	26.2	25.9	27.0	22.6	20.2	21.2	17.0	12.5	4.8	7.4	12.9	17.9	19.0	19.3	18.1	3.6	1.0	1.5
6.4	9.2	19.4	27.4	33.7	35.9	32.9	22.0	22.9	23.7	21.8	26.0	28.4	22.6		5.9	7.0	13.8	21.9	26.4	29.5	18.6	9.2	1.2	1.3
		17.0	25.3				17.8																	
		17.9	24.7				17.7																	

Parking Lot at Building 2

				6.8	13.4	22.3	28.3	35.8	32.3	37.2	31.4	6.6	7.2	23.7	25.6	27.6	33.1	24.3	15.4
				8.5	17.9	26.3	38.9	39.0	42.1	28.8	31.9	6.6	7.6	22.9	24.3	36.7	26.2	36.7	16.2
				8.7	18.6	30.2	33.9	34.1	36.4	33.7	28.1	6.7	7.1	21.4	22.6	26.1	26.1	39.0	10.1
				10.3	5.9	26.9	27.3	19.6	32.4	29.9	21.3	6.8	7.4	20.8	22.1	23.5	22.6	16.8	9.9
				11.6	15.1	21.4	22.8	22.3	25.9	21.3	18.2	6.5	8.7	16.4	17.8	19.0	18.4	14.0	9.2
										14.2	16.3	5.7	7.5	10.9	12.6	14.0	15.4	13.9	10.5
										10.1	7.5	5.3	6.7	8.5	11.1	13.4	21.6	19.0	12.7
										5.4	5.8								
										3.6									
49.9	35.1	22.3	13.1		9.9	10.9	9.8	9.0	10.4	4.3	11.0	10.7	8.1	11.2	13.6	21.9	16.4	11.7	
38.1	32.7	23.8	18.8	20.1	19.9	16.6	12.0	14.2	16.9	20.4	20.3	15.8	12.5	13.2	17.3	24.0	23.0	14.9	
27.2	25.9	26.2	25.4	28.7	24.4	20.6	14.2	18.9	22.1	26.0	26.7	21.8	14.8	12.9	19.9	27.0	27.2	22.2	
21.1	18.9	26.7	29.8	34.0	30.2	21.7	13.6	21.1	27.3	30.8	30.4	25.2	16.3	11.4	17.8	29.3	31.5	25.3	
					29.7										14.9				
											29.0				15.6	22.5			

Parking Lot at Building 4

		25.8	16.7						30.3	25.4				35.5		57.6	35.3		27.1	30.7		29.4	27.9	18.0	
		21.7	18.0						28.5	22.1				34.5		35.5			29.7			28.5	24.9	17.1	
25.4	21.8	20.8	18.2	22.4	25.2	28.9	28.8	23.8	25.9	18.7	9.8	11.3		36.6	37.6	32.8	35.2	28.7	31.2	31.2	26.9	25.2	20.8	10.7	1.6
19.1	19.1	14.5	12.8	18.6	20.2	23.6	25.1	27.5	23.6	20.7	14.4	10.9	36.8	40.0	39.5	37.6	34.8	30.4	31.8	32.6	28.4	23.7	16.3	8.5	1.4
9.7	6.7	7.4	7.8	11.0	12.5	14.5	15.3	19.2	20.8	21.2	18.8	23.0	33.3	37.0	33.3	33.2	31.9	29.3	31.2	31.9	29.7	21.0	9.4	5.0	1.5
4.8	3.8	4.3	4.7	6.3	6.3	8.3	8.2	14.8	19.0	21.7	22.5	24.2	31.6	32.9	29.4	26.0	27.8	28.9	30.4	31.1	27.0	17.1	7.9	3.7	2.2
		3.6		6.4		6.2			20.2	23.9	25.8	27.9	32.0		30.1			30.0	30.6						
		5.4		6.9		4.8	8.7		17.5	23.0	26.8	29.5	33.7		29.3	26.8		30.2	32.1	30.9					

Cohoes - Vertical Illuminance Measurements, facing SOUTH

Parking Lot at Building 1

	9.2	10.7	10.5	14.7	19.6	24.3	27.5																	
	14.8	16.7	9.3	21.1	24.5	27.9	32.8																	
21.2	19.6	24.6	19.4	25.1	27.5	30.8	34	37.3																
24.5	25.4	27.3	22.9	24.1	24.5	31.4	33.9	39.4																
26.2	25.9	26.5	22	19.8	18.9	27.7	26.9	37.8																
	21.4	21.9	17.4	16.9	17.1	19.1	24.3																	
	13.9	15.4	18.7	11.2	12	11.4	13.6																	
		7.4	14.3	7.8			6.15																	
		10.7	7.8	12.1																				
16.3		20.3	12.1	22.1					20.6	23.2	24	23.4	21.9	18.6	17.8	18.9	21.7	21.9	21.1	20	17.6	14.5	12.2	11.6
31	34	37.8	22.6	43.9	41.8	40.4	35.5	25.5	39	40.9	40.7	40.4	40.6	35.6	32.6	34	37.3	35.9	37.7	39.4	39	31.5	27.1	25.5
41.6	44.3	45.3	39.2	44.5	47.9		44.7	40.6	47.6	44.9	43	43.9	47.3	43.8	39.5	41.5	42.9	41.4	42.4	37	51	45.1	41.2	41.8
43.2	42.1	40.5	41.3				43.3	39.4	40.7	41.9	40.3		45.8			39.2	39.2		42.8		50.2	48.5	44.9	44
		29	31.4				31.8																	
		27.5	26.8				27.4																	

Parking Lot at Building 2

				11.0	12.7	13.8	14.6	12.8	14.1	12.5	5.8	8.3	7.0	6.1	6.2	6.2	5.5	5.0	4.6
				22.6	21.0	22.3	24.9	15.0	18.5	15.5	7.5	9.4	7.9	6.4	7.3	8.0	7.2	24.0	6.5
				29.0	27.2	30.9	31.4	15.1	20.6	17.3	9.7	11.3	8.5	6.7	7.9	9.1	9.3	20.2	8.3
				33.1	32.6	35.6	35.4	26.0	21.0	18.2	10.2	10.8	8.8	8.3	8.1	9.6	11.1	11.1	10.9
				35.4	37.5	42.2	36.9	25.7	19.2	15.1	11.2	10.3	8.2	7.8	8.0	9.4	12.3	12.8	12.4
										12.3	10.3	18.0	5.5	7.1	7.1	8.6	19.3	13.8	13.7
										10.7	8.7	5.9	6.3	6.9	7.3	7.7	10.7	11.2	12.9
										9.2	8.9								
										13.3	13.4								
3.3	4.9	6.9	10.2		17.9	19.2	19.7	21.4	26.0	28.3	27.7	24.6	21.2	21.2	22.7	23.6	23.6	20.8	21.2
4.3	6.9	11.2	17.0	26.0	33.7	37.9	37.5	40.5	46.4	50.6	43.3	45.1	40.1	40.7	42.8	42.7	40.0	38.8	38.4
3.8	8.3	14.0	21.2	29.3	338.6	45.6	47.3	50.5	53.2	53.0	55.6	54.2	49.7	48.8	51.6	47.8	45.6	45.8	43.7
7.0	5.5		21.9		38.6	43.4		47.5	49.9	50.2	50.2	51.1	50.2		44.8	44.1	42.5		42.1
					38.1	32.9					35.6				35.3	33.4	31.8		
					30.4						26.8				31.3	28.2	21.0		

Parking Lot at Building 4

		4.5	5.8						5.0	4.3				6.7		5.9	6.8		7.6	6.6		5.4	5.1	5.2	
		7.0	8.1						6.4	5.0						9.0	11.5		14.1	12.8		10.8	10.9	11.0	
19.5	16.0	15.4	15.6	18.1	18.4	17.7	13.1	10.4	10.2	8.3	6.6	8.9	10.9	12.0	13.3	14.7	17.3	20.2	22.0	23.1	19.7	18.3	18.0	17.4	16.6
24.6	23.7	23.0	23.5	27.6	25.3	21.8	13.9	14.4	14.4	13.2	11.2	17.1	24.1	23.8	26.9	29.6	31.6	33.8	37.1	39.1	33.6	29.2	27.6	25.6	23.8
27.4	28.4	27.1	29.8	29.4	24.2	21.2	17.0	16.0	16.4	15.7	15.2	21.4	31.1	33.7	34.2	37.0	41.9	42.7	44.1	43.3	38.5	33.3	33.0	28.9	18.6
50.6	31.6	31.1		30.6	25.0	22.1	17.5		16.2	15.3	16.0	22.1	30.6	31.0	37.3	37.8		42.5	39.5	37.6				30.2	30.8
		26.8		30.1		28.7	17.9		20.2	13.3	15.2	21.5	21.3		36.2	34.9		39.1	33.8	32.0					
		23.6		25.2		26.5	16.8		16.0	10.7	12.5	21.9	13.4		25.7	30.2		36.9	25.2	19.8					

Cohoes - Vertical Illuminance Measurements, facing WEST ⬅

Parking Lot at Building 1

	37.4	37.4	32.4	29.8	26.2	23.5	27.5																	
	31.4	33.1	28.2	32.1	29.3	23.7	30.0																	
22.1	29.7	35.2	34.3	35.2	30.9	27.5	29.4	28.9																
16.3	26.0	34.7	35.6	34.1	30.6	26.7	26.8	24.8																
13.2	22.3	30.8	32.5	30.9	28.8	26.7	24.5	21.8																
	24.0	32.6	27.8	34.1	29.9	24.6	21.0																	
	26.3	36.0	37.1	33.8	27.9	22.2	18.2																	
		33.4	40.3	33.0			17.0																	
		34.0	39.2	34.3																				
11.2		35.0	40.1	38.3					16.2	14.6	14.8	24.3	32.4	34.5	30.6	24.6	12.7	16.0	12.6	11.2	9.2	7.9	6.0	6.6
10.9	24.9	36.8	41.3	39.6	36.9	32.6	25.5	22.7	32.3	23.2	22.6	27.3	34.4	34.2	30.6	30.7	29.4	21.9	20.0	16.6	14.2	9.1	6.2	12.5
9.9	24.0	37.0	41.5	36.9	35.4	32.4	24.4	24.2	28.5	27.0	25.4	26.1	32.3	31.4	26.7	31.4	31.1	27.1	22.3	19.9	15.6	8.4	8.9	17.4
12.4	24.8	34.8	39.5	35.4	32.8	27.8	21.8	25.0	28.0	30.9	27.6	27.7	29.2		26.5	29.9	34.2	31.3	25.7	21.5	14.7	8.1	13.5	24.5
			35.3																					
			30.8																					

Parking Lot at Building 2

	32.4	40.7	40.9	37.9	32.6	28.2	21.6	15.4	16.7	31.5	38.6	39.2	34.5	25.7	12.3	8.1
	20.3	40.3	48.9	37.7	33.5	22.5	24.0	10.7	14.8	28.9	4.4	43.6	36.2	28.3	6.7	9.5
	18.7	35.2	49.9	48.9	32.6	28.0	26.6	13.2	16.4	25.8	32.8	37.9	37.5	30.5	8.6	10.3
	16.7	28.5	47.4	55.3	49.7	33.6	30.9	16.6	18.5	23.6	29.4	29.1	24.6	27.2	20.1	10.8
	16.7	35.3	50.5	59.3	53.7	40.7	39.0	20.3	19.3	21.6	23.7	23.4	23.2	9.3	16.8	11.6
							36.5	21.9	8.5	16.4	17.8	17.3	18.4	12.9	13.1	9.8
							35.5	22.1	16.2	13.5	12.9	14.6	14.2	10.3	9.5	8.3
							32.6	22.5								
							31.8	23.2								
3.5		25.5	45.6	48.8	48.8	42.9	37.3	31.2	21.2	14.1	12.3	10.6	11.2	11.9	9.5	8.4
1.2	4.1	22.5	32.9	38.5	42.0	45.6	43.4	37.0	27.7	21.2	13.8	14.9	17.9	18.5	15.2	11.0
1.2	7.1	14.7	21.8	29.8	37.0	41.9	42.7	34.1	30.6	24.8	15.6	13.9	23.5	21.3	20.5	11.7
2.4	5.0	11.0	18.7	24.1	31.7	34.9	42.0	33.9	29.6	24.7	21.0	19.5	27.5	27.3	20.8	9.3
			12.5									26.5	25.4	27.2		
								25.1				25.0	26.3	27.5		

Parking Lot at Building 4

		3.6	4.1						23.9	19.6				34.0		29.1	24.9		32.1	45.0		44.8	36.8	29.1	
		3.7	4.3						25.4	20.8							24.0			39.0			35.5	28.1	
2.7	4.5	6.2	7.7	20.8	34.0	34.4	33.2	31.5	26.7	22.2	22.8	27.6	28.6	27.2	24.1	23.7	22.5	18.7	26.9	35.1	40.8	37.2	31.5	28.1	21.3
2.2	2.3	7.8	12.1	27.3	35.5	37.1	33.9	30.6	27.1	22.6	19.3	23.6	26.8	28.1	21.9	19.8	22.4	20.5	29.8	40.0	46.2	32.9	28.4	26.0	22.3
1.2	3.0	11.8	19.4	30.5	33.9	33.5	32.2	29.8	25.7	20.2	15.4	12.5	17.8	18.9	16.7	14.3	18.7	22.7	29.1	33.1	31.9	29.4	26.0	24.7	23.9
0.9	5.8	13.9	28.8	34.7	34.4	32.2	29.4	24.4	21.8	14.3	11.5	10.4	9.8	6.8	8.0	7.4	15.7	22.7	26.1	26.5	24.9	24.0	21.6	20.8	25.8
		21.0		42.9		36.1	30.2		18.5	12.0	8.3	8.3	4.9		6.8	3.8		21.8	28.5	28.8					
		33.9		47.8		38.0	28.8		16.8	10.2	6.0	9.5	3.6		8.3	4.0		26.2	31.7	31.1					

Appendix F. Questionnaire Comments

F.1 Mason’s Ridge II, New Windsor, NY

F.1.1 Wall Packs

- “The sensor goes on. It gets brighter. It's very bright here now. And you don't notice it, even on the top floor.”

F.1.2 Parking Lots

- "Sometimes" too bright, elaborating "But, it's a good thing!"

F.1.3 Overall

- "I love the way they get brighter when I get closer. I get scared at night; these make me feel better. I think they should do these everywhere."
- "Very safe!"
- "I do like the lights a lot"
- "I think the lights are really nice!"

F.2 Lion Heart Residences, Cohoes, NY

F.2.1 Wall Packs

- “I don't like light (shining) in my room. They shine in my window. I don't like that.”
- “I just notice when they go on and off.”
- Regarding sensor-controlled dimming: "It's pretty neat!" Walkways are "pretty well lit"
- Slightly disagreed about liking sensors: "Sometimes it's nice if you're by yourself. Sometimes it's an aggravation."
- "When I take out the garbage, it does work perfectly." (However, concern about light trespass from wall packs, prefers just parking lot lights.) "If I was living in the front apartment (just the pole lights) would be perfect: not shining through blinds, not glaring in the house all the time."
- Lots of negative comments from this subject, who expressed other negative emotions about other topics. "A leaf will set it off" "I don't like the LED factor." (Person declined to elaborate what aspect of LEDs were objectionable). "You have to be right under the sensor in order for it to trip" (LRC experimenter also noticed this point)
- In terms of brightness: "They're perfect!"
- Sensor/dimmers "Love it!"
- Too dim: "as soon as you come out, they brighten right up."
- “Not bad at all.”
- “I love it just the way they (are).”
- “Lights are on good timer.”

F.2.2 Parking Lots

- “Parking lot lights need more, or brighter.”
- (Unlike the wall packs) “I don't see the ones on the pole.”
- “If I dropped coin/keys close to Building 4 (=apartment building with elevators) I would see them, but not if it was close to Building 3 (=central laundry/office).”
- “Timing could use some help.”
- Repeating "If I was living in the front apartment (just the pole lights) would be perfect: not shining through blinds, not glaring in the house all the time."
- Light output: "They got them adjusted well"
- Regarding visibility of dropped items, agrees: "…because I (have) done it!"
- "They should be brighter"
- "(It seems like) they only brighten for like 3 seconds."
- “It's perfect!”
- Brightness: "Just right"
- Safety: "I was one of the first to move in. I used to come out with my (late) dog. I love how the sensors turn the light up."
- “The lights are very relaxing and nice”
- “Nice”
- Regarding driveway lights "They are perfect timers. The driveway lights are perfect. You can see stray animals, skunks. At a walking pace it works good."

F.2.3 Exterior Overall

- Overall "much better" because "I do a lot of walking at night."
- Overall: "It's good. I live on the third floor; they don't shine in my house."

F.2.4 Cohoes Interior

F.2.4.1 Stairway/Landing

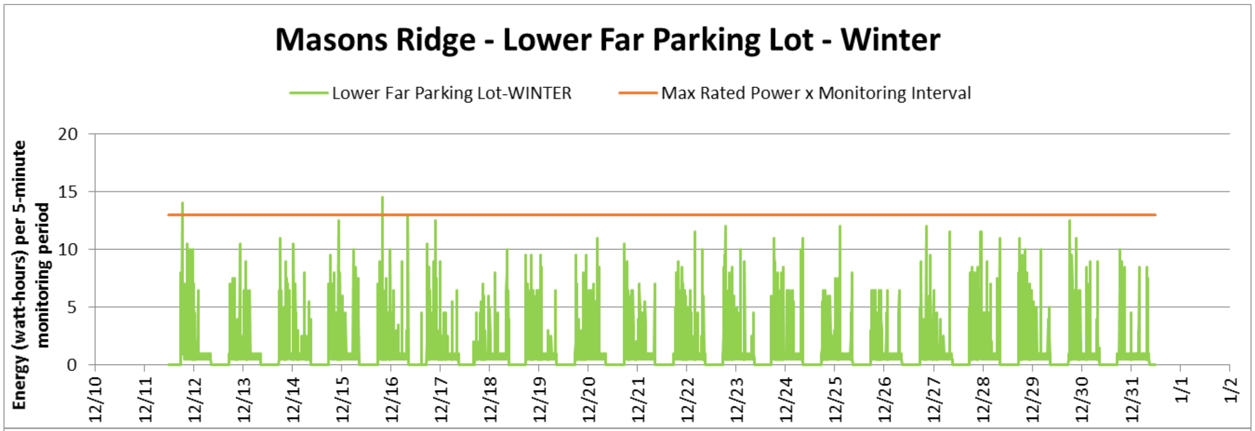
- “Shines under my door, a weather strip might help”
- “Good”
- "Like it to be just bright white 5000K"
- "It’s hard for my eyes to adjust."
- "I love them"
- "Stay bright enough to unlock the door"
- Doesn't think these need dimmers: "I think they should stay on in main hallway and stairs when you come in." (Unlike hallway here in building 4)
- “Very lit [sic] enough”
- Overall “same” because sensors "Need adjustments"

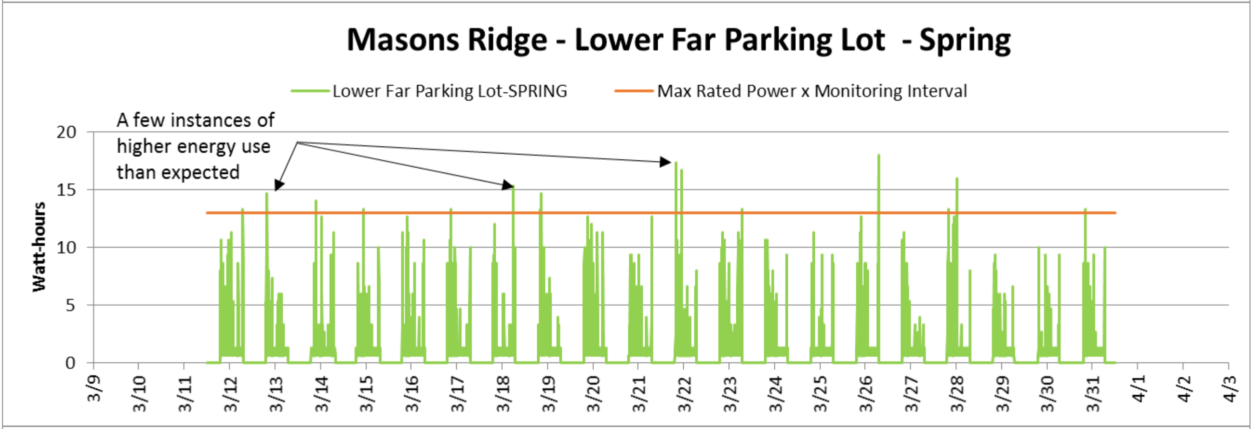
F.2.4.2 Building 4 Hallway

- "Keep it up."
- Overall "About the same."
- "They are a little bright when you are under them." (referring to the CREE lights)

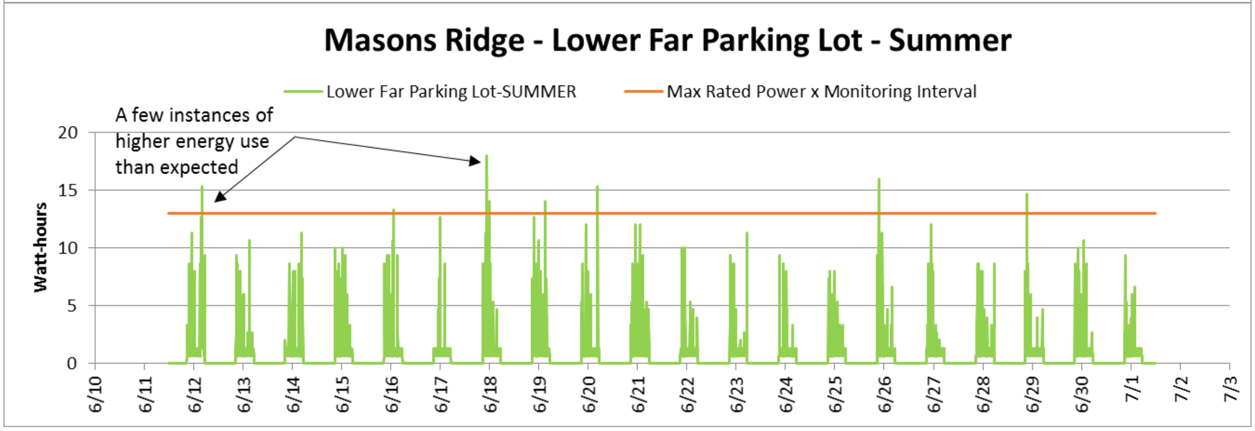
Appendix G. Energy Data

G.1 Mason's Ridge II, New Windsor, NY

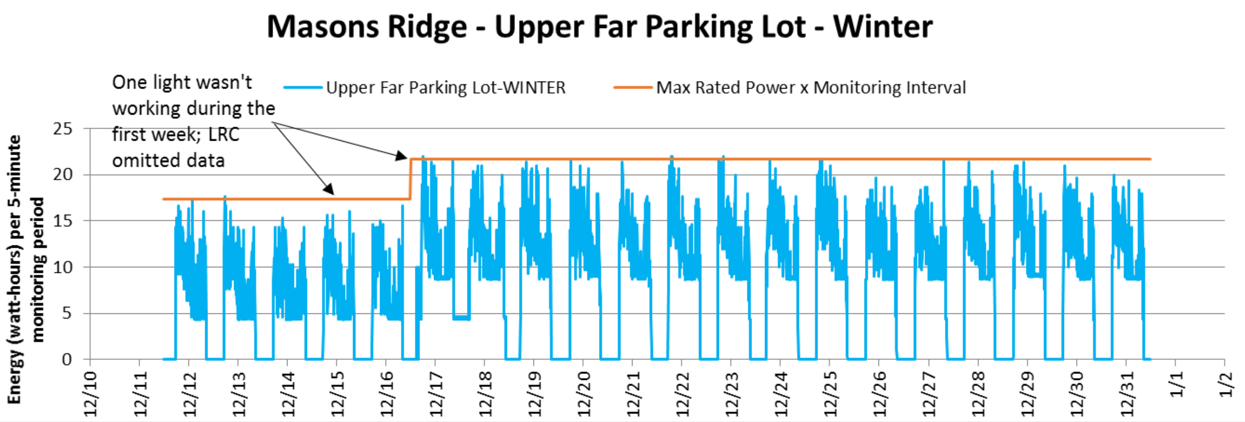




A few instances of higher energy use than expected

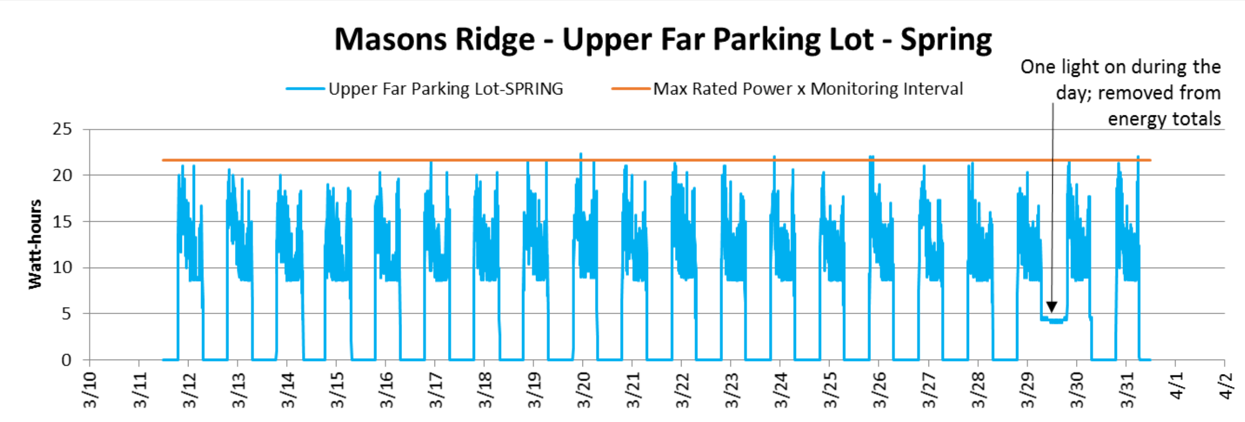


A few instances of higher energy use than expected



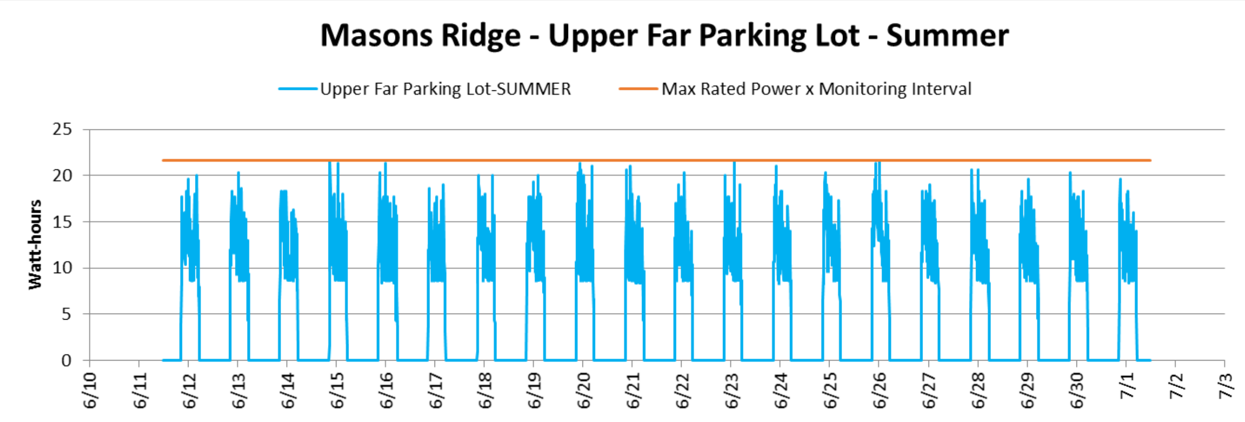
Masons Ridge - Upper Far Parking Lot - Winter

One light wasn't working during the first week; LRC omitted data

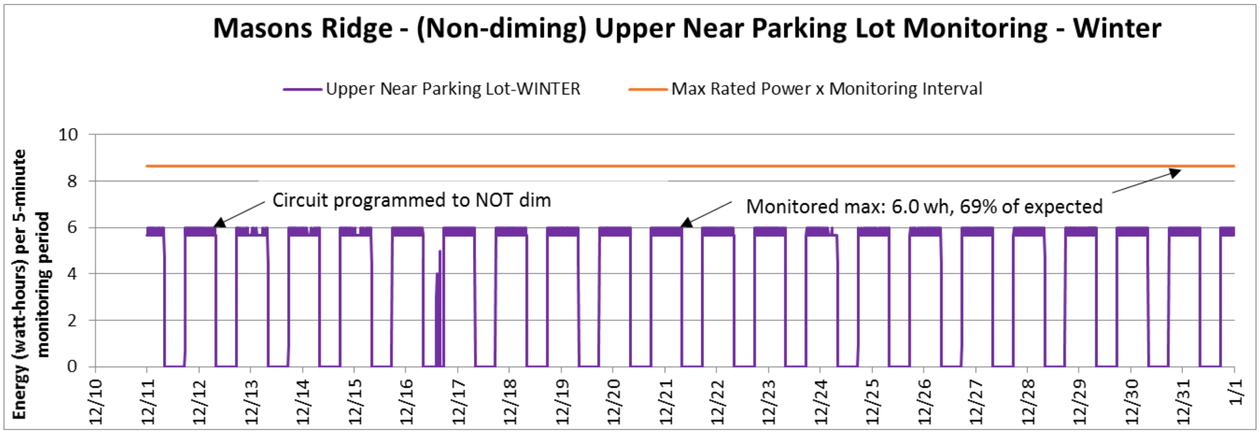


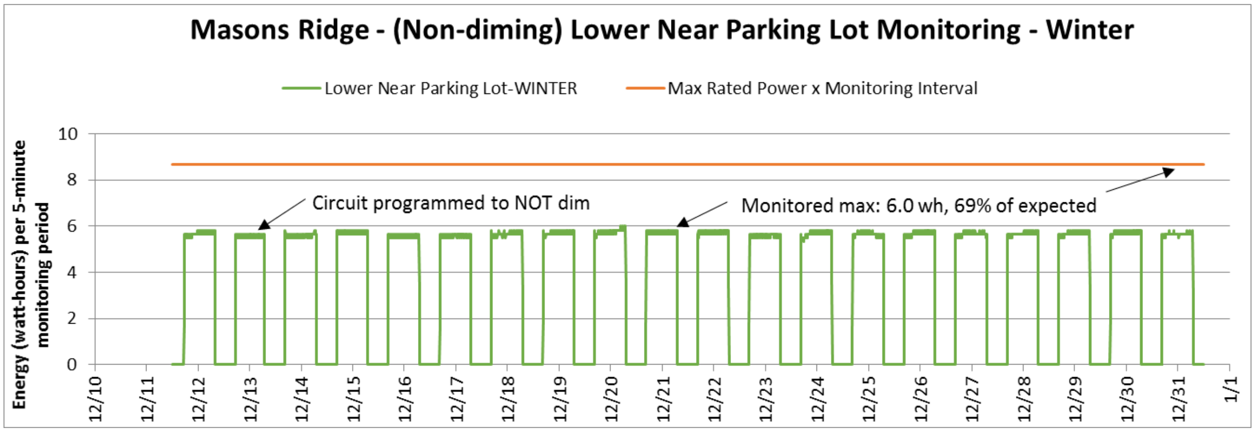
Masons Ridge - Upper Far Parking Lot - Spring

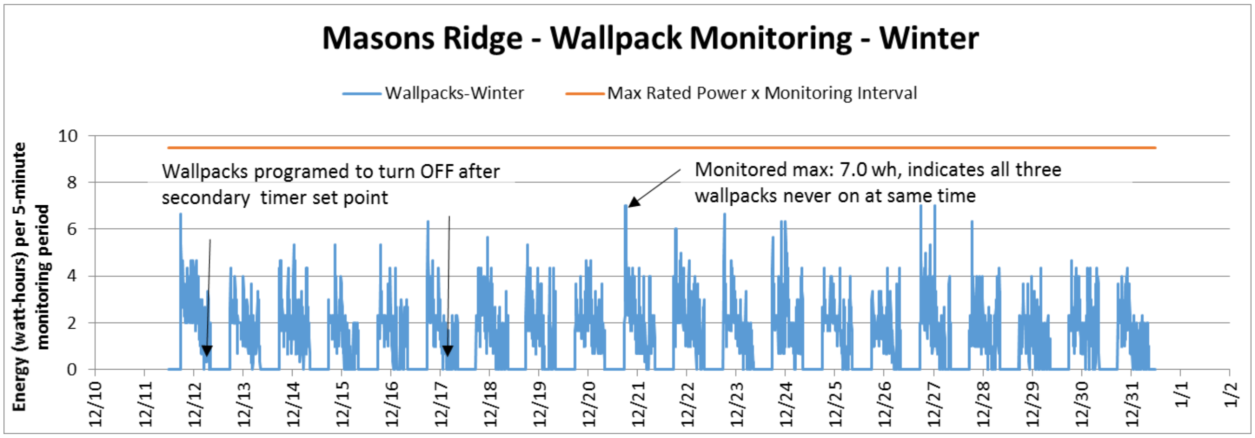
One light on during the day; removed from energy totals



Masons Ridge - Upper Far Parking Lot - Summer


Masons Ridge - (Non-diming) Upper Near Parking Lot Monitoring - Winter
Upper Near Parking Lot-WINTER
Max Rated Power x Monitoring Interval
Energy (watt-hours) per 5-minute monitoring period
10
8
6
4
2
0
Circuit programmed to NOT dim
Monitored max: 6.0 wh, 69% of expected
12/10
12/11
12/12
12/13
12/14
12/15
12/16
12/17
12/18
12/19
12/20
12/21
12/22
12/23
12/24
12/25
12/26
12/27
12/28
12/29
12/30
12/31
1/1

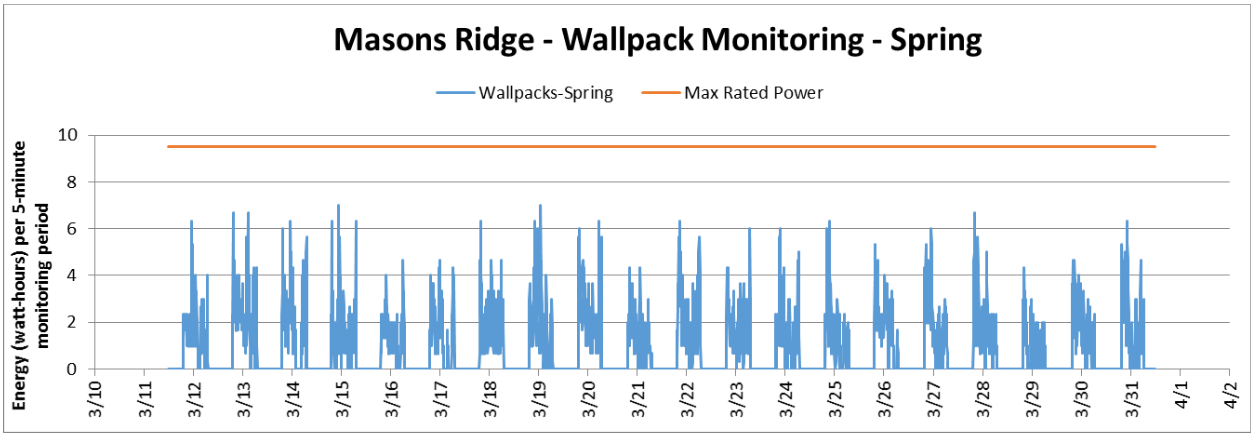

Masons Ridge - (Non-diming) Lower Near Parking Lot Monitoring - Winter
Lower Near Parking Lot-WINTER
Max Rated Power x Monitoring Interval
Energy (watt-hours) per 5-minute monitoring period
10
8
6
4
2
0
Circuit programmed to NOT dim
Monitored max: 6.0 wh, 69% of expected
12/10
12/11
12/12
12/13
12/14
12/15
12/16
12/17
12/18
12/19
12/20
12/21
12/22
12/23
12/24
12/25
12/26
12/27
12/28
12/29
12/30
12/31
1/1



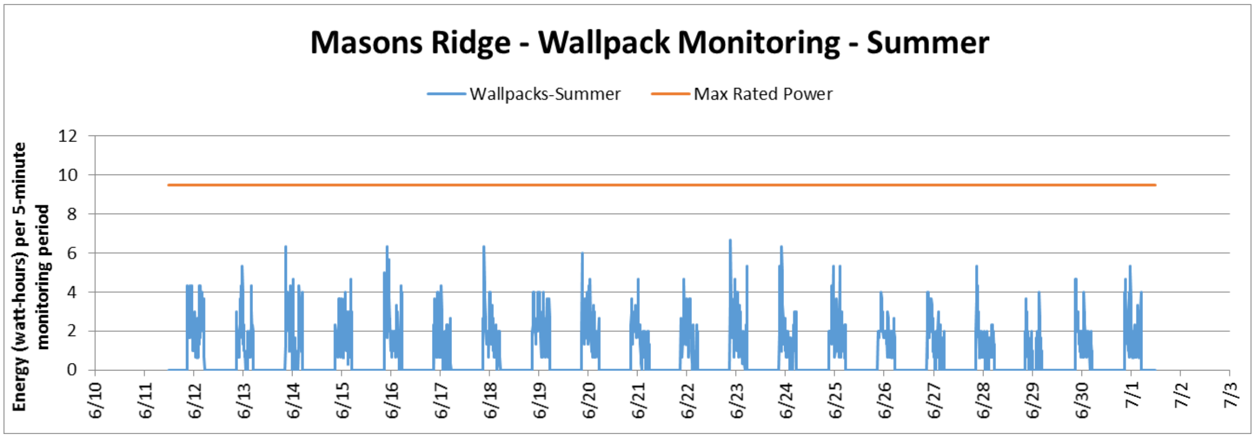
Masons Ridge - Wallpack Monitoring - Winter

Wallpacks programed to turn OFF after secondary timer set point

Monitored max: 7.0 wh, indicates all three wallpacks never on at same time

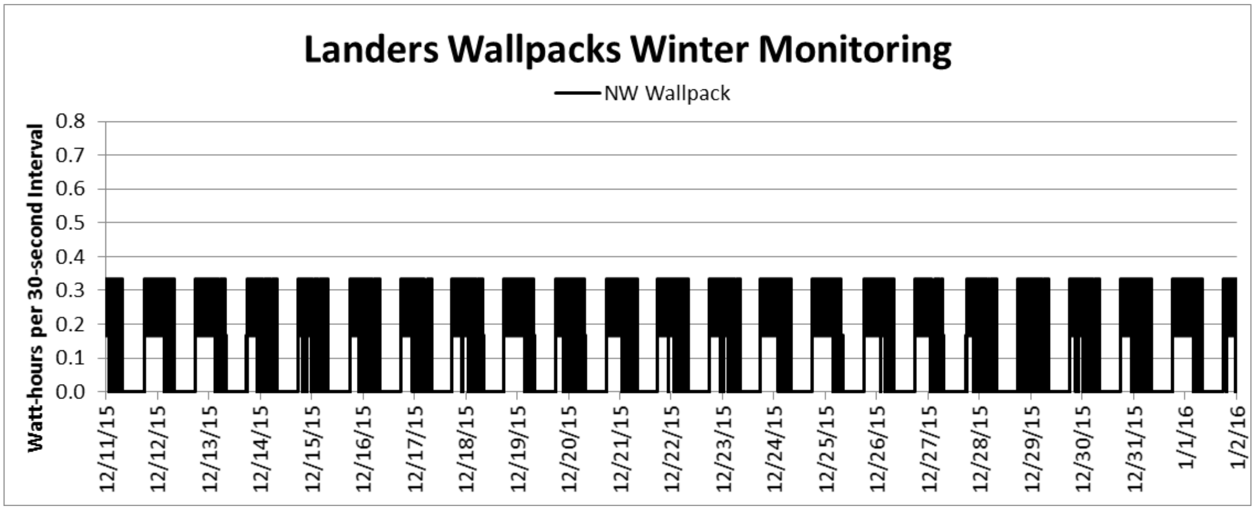


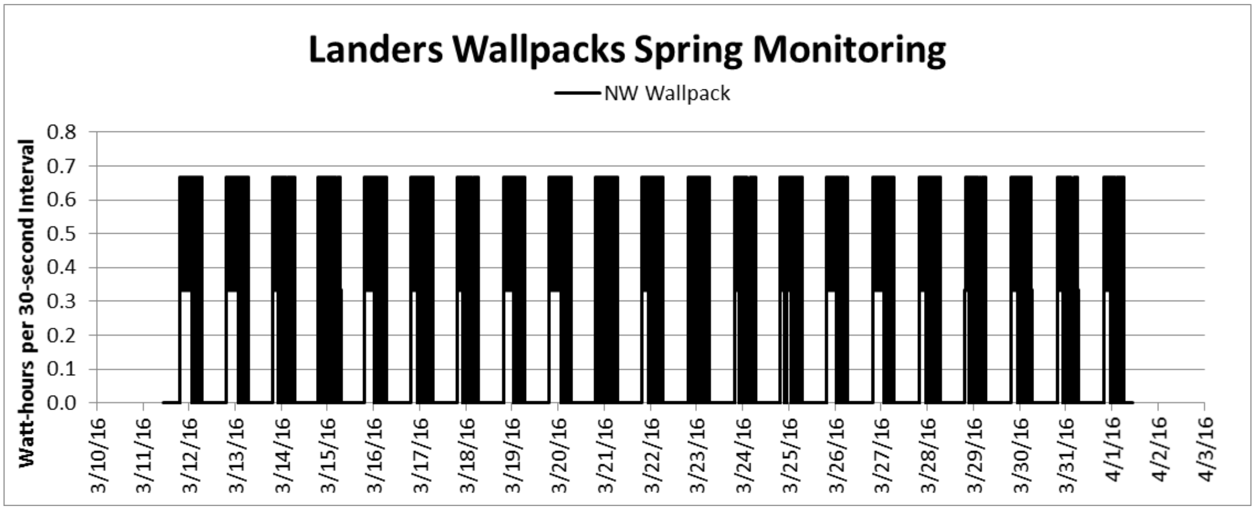
Masons Ridge - Wallpack Monitoring - Spring

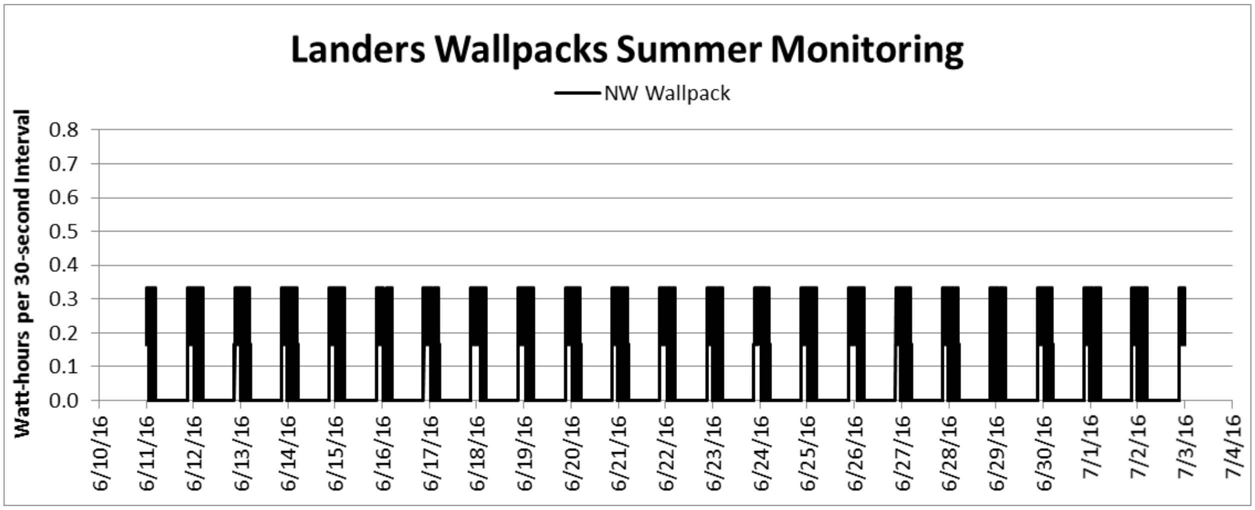


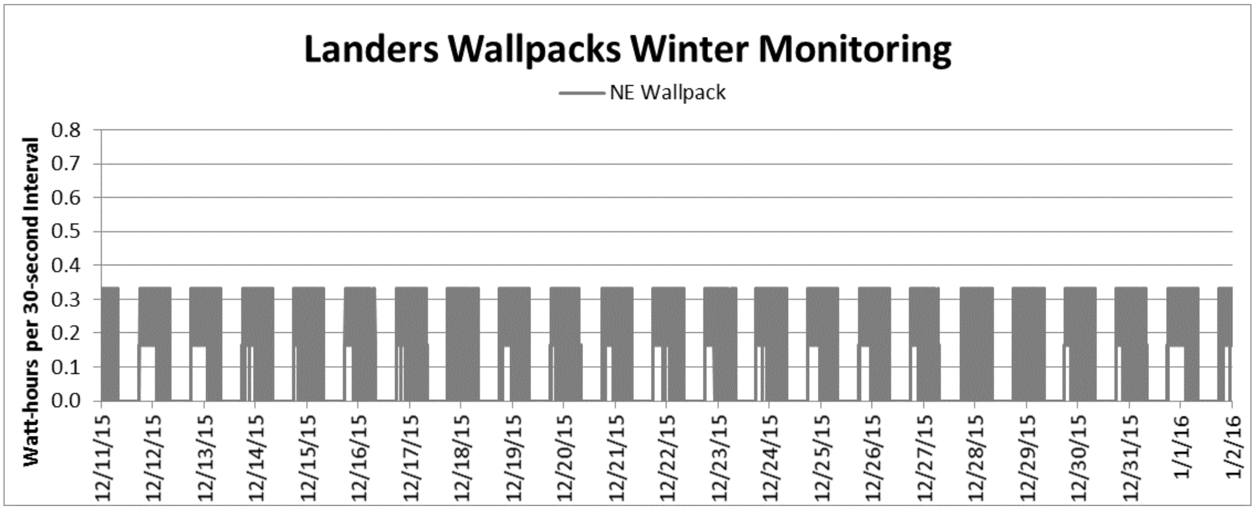
Masons Ridge - Wallpack Monitoring - Summer

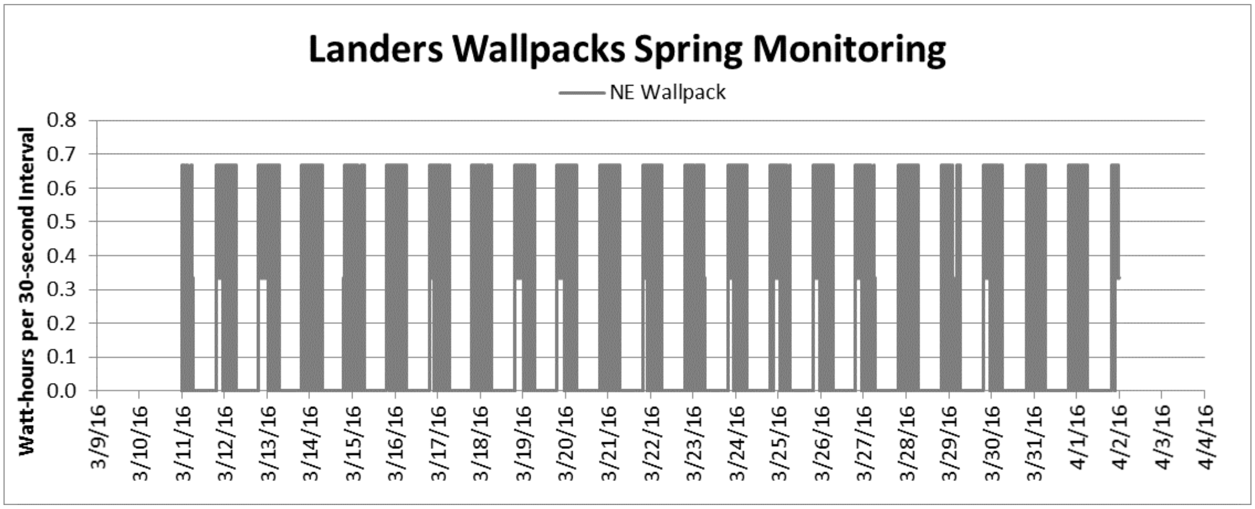
G.2 Lander Street, Newburgh, NY

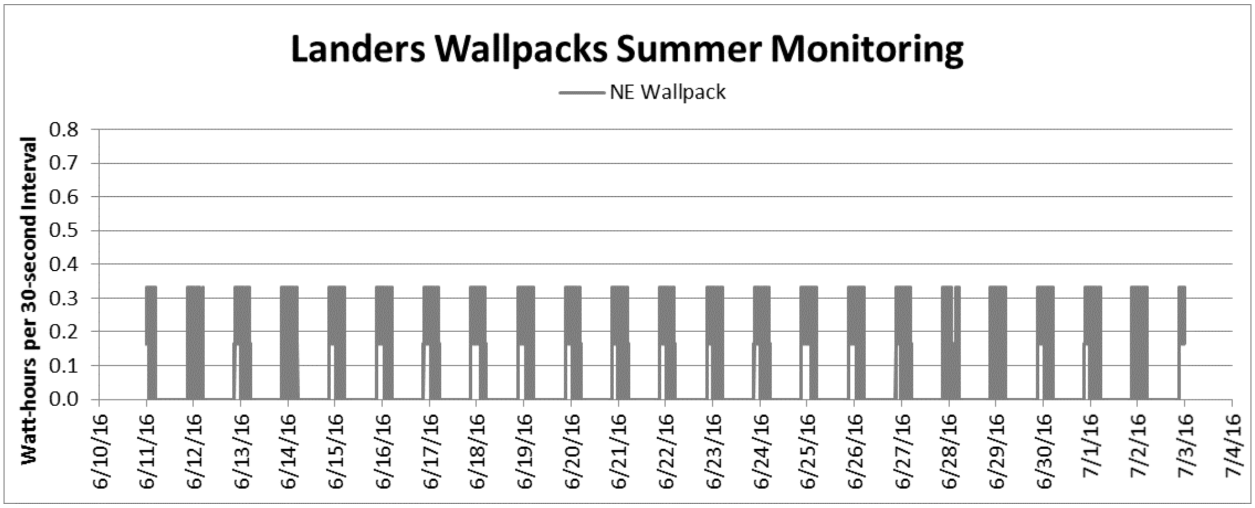


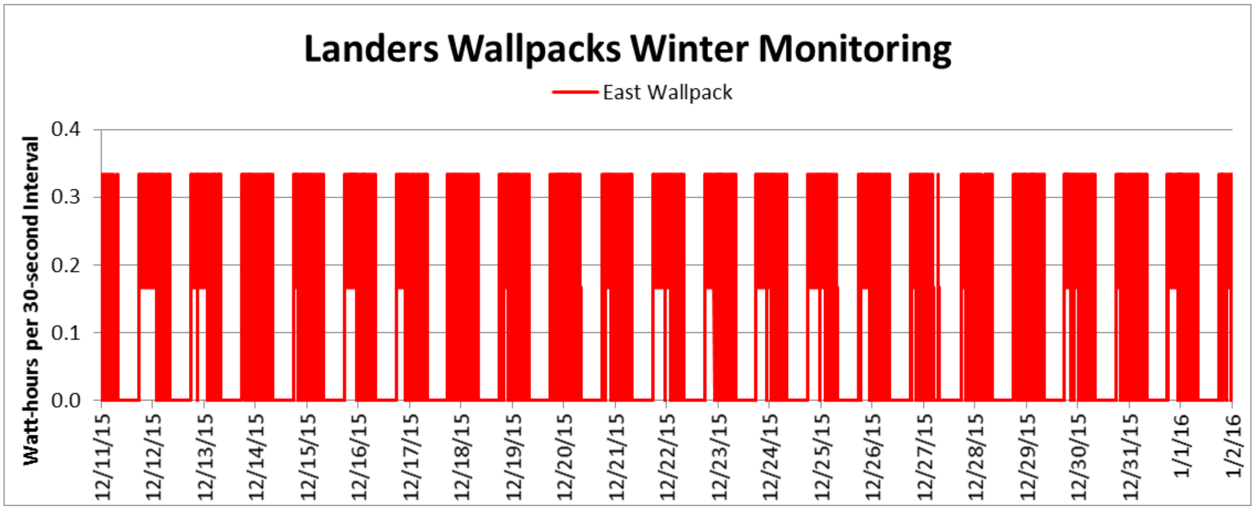


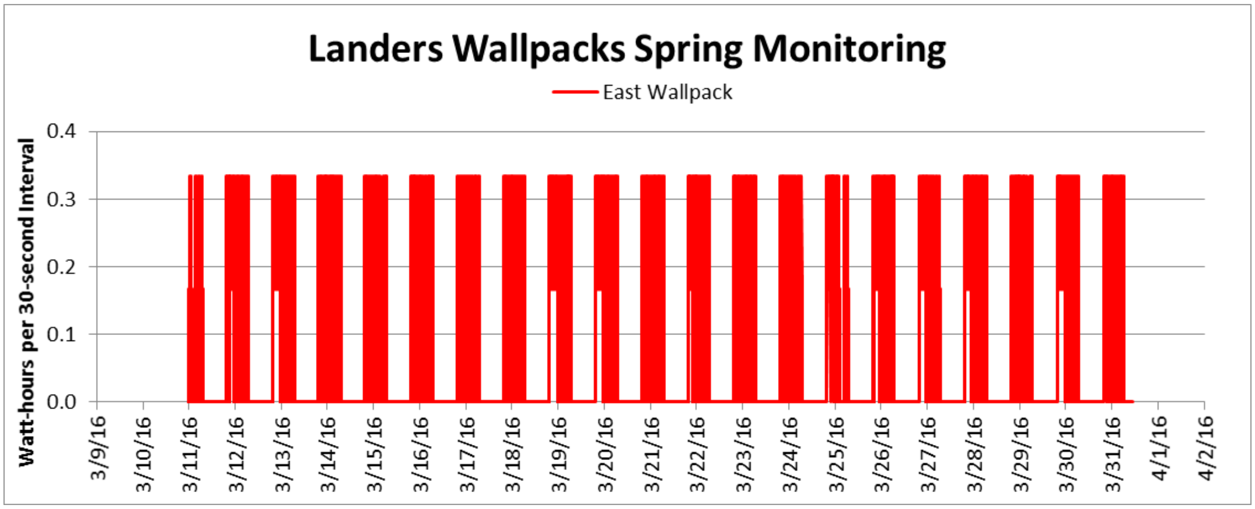


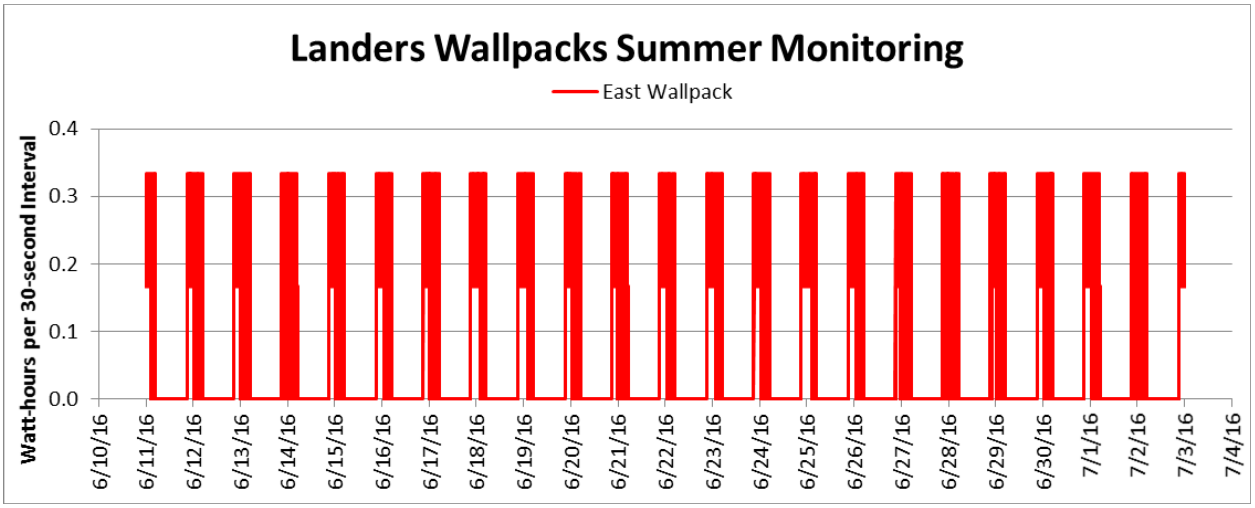

Landers Wallpacks Winter Monitoring


Landers Wallpacks Spring Monitoring

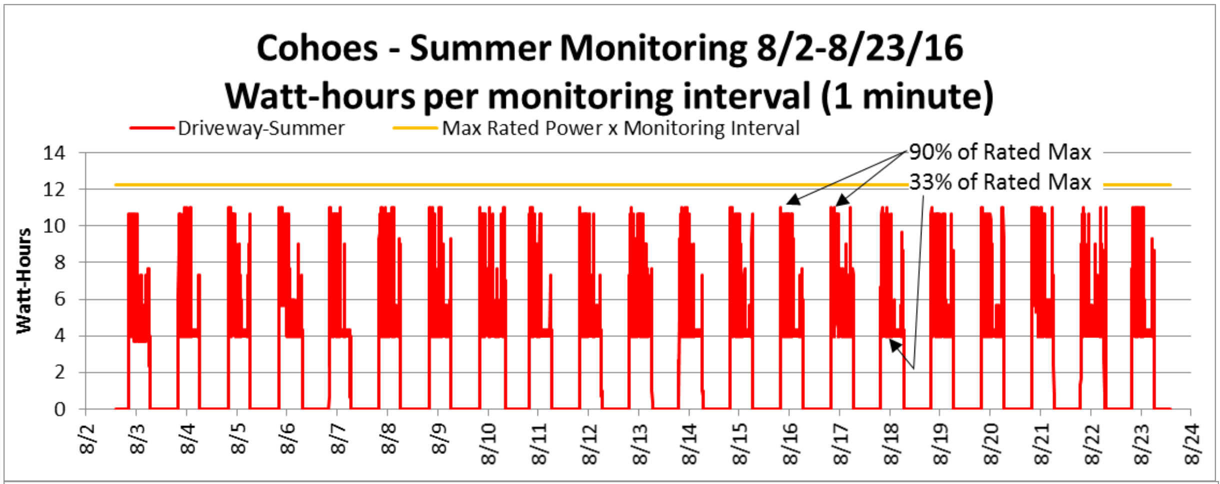

Landers Wallpacks Summer Monitoring

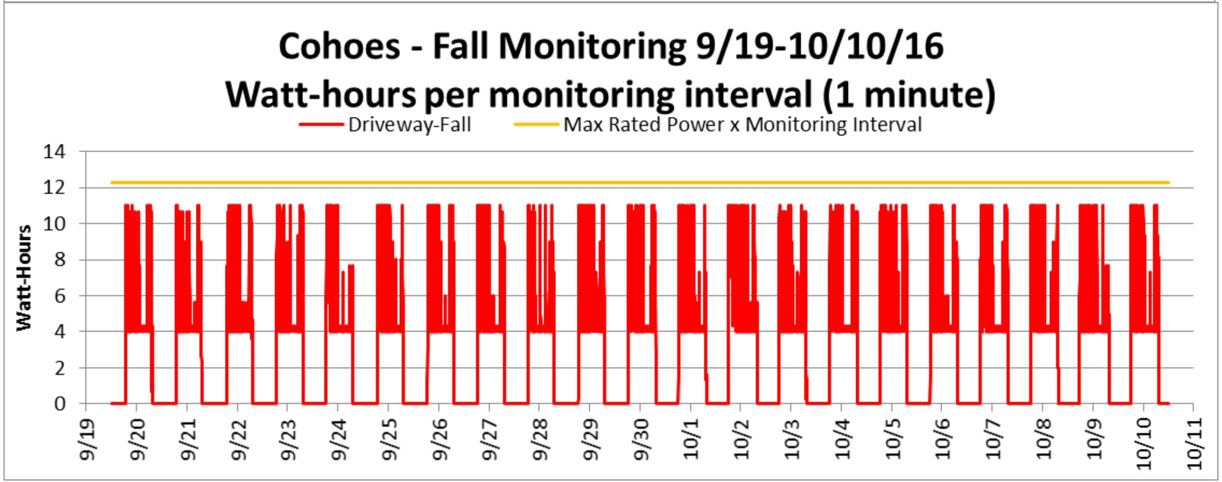

Landers Wallpacks Winter Monitoring
East Wallpack
Watt-hours per 30-second Interval
0.4
0.3
0.2
0.1
0.0
12/11/15
12/12/15
12/13/15
12/14/15
12/15/15
12/16/15
12/17/15
12/18/15
12/19/15
12/20/15
12/21/15
12/22/15
12/23/15
12/24/15
12/25/15
12/26/15
12/27/15
12/28/15
12/29/15
12/30/15
12/31/15
1/1/16
1/2/16

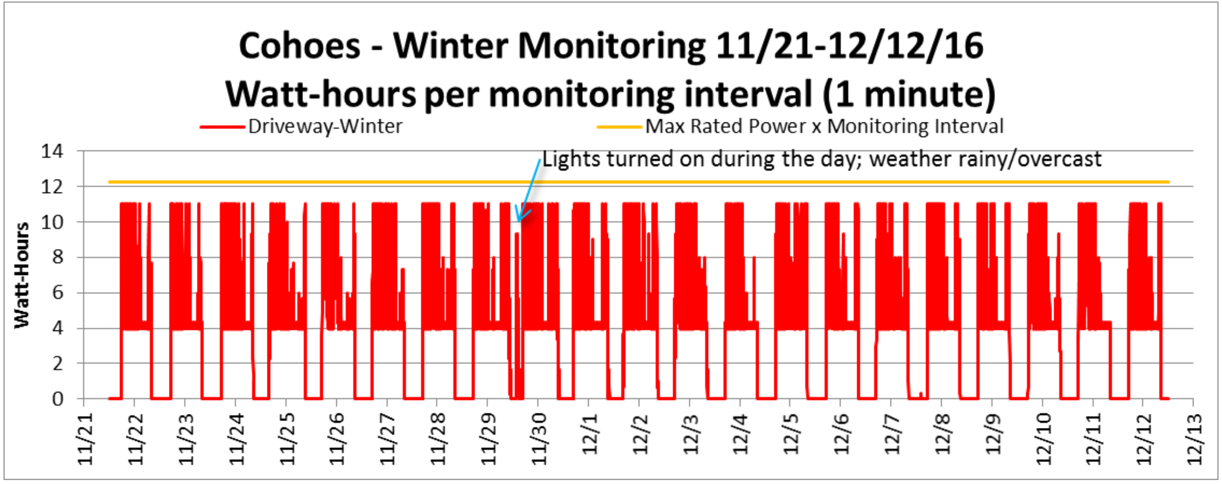

Landers Wallpacks Spring Monitoring
East Wallpack
Watt-hours per 30-second Interval
0.4
0.3
0.2
0.1
0.0
3/9/16
3/10/16
3/11/16
3/12/16
3/13/16
3/14/16
3/15/16
3/16/16
3/17/16
3/18/16
3/19/16
3/20/16
3/21/16
3/22/16
3/23/16
3/24/16
3/25/16
3/26/16
3/27/16
3/28/16
3/29/16
3/30/16
3/31/16
4/1/16
4/2/16

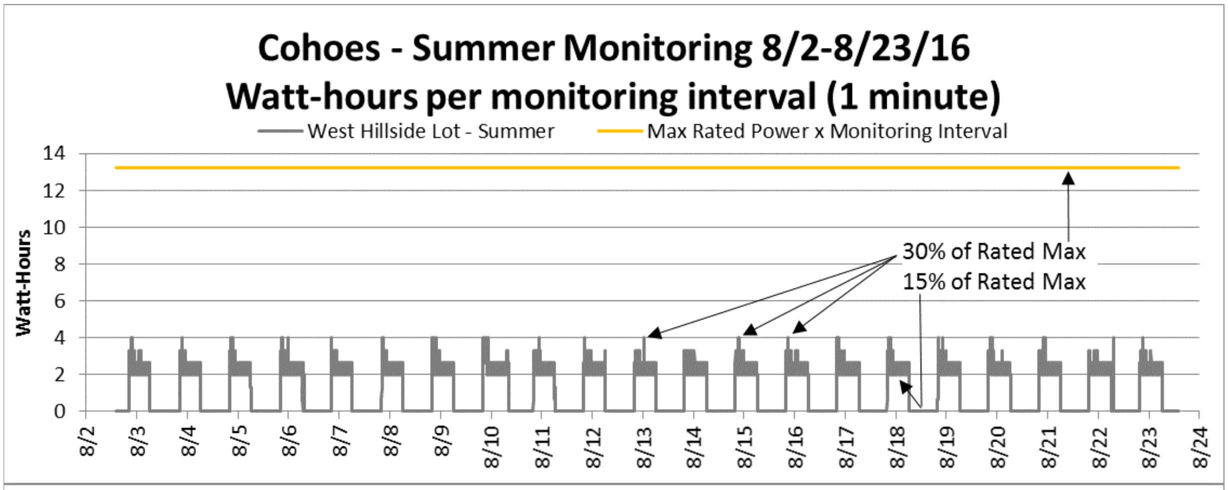

Landers Wallpacks Summer Monitoring
East Wallpack
Watt-hours per 30-second Interval
0.4
0.3
0.2
0.1
0.0
6/10/16
6/11/16
6/12/16
6/13/16
6/14/16
6/15/16
6/16/16
6/17/16
6/18/16
6/19/16
6/20/16
6/21/16
6/22/16
6/23/16
6/24/16
6/25/16
6/26/16
6/27/16
6/28/16
6/29/16
6/30/16
7/1/16
7/2/16
7/3/16
7/4/16

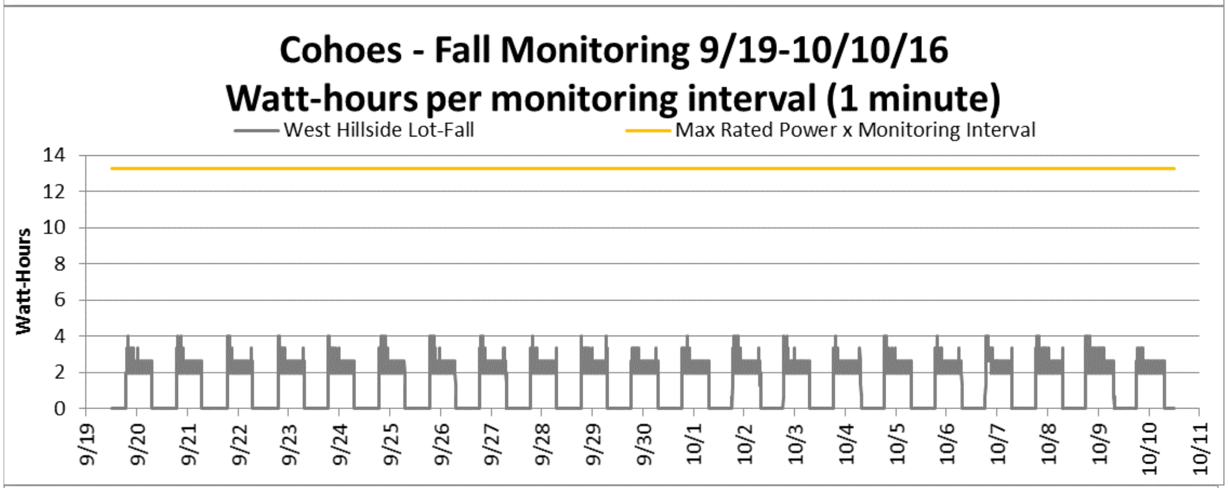
G.3 Lion Heart Residences, Cohoes, NY

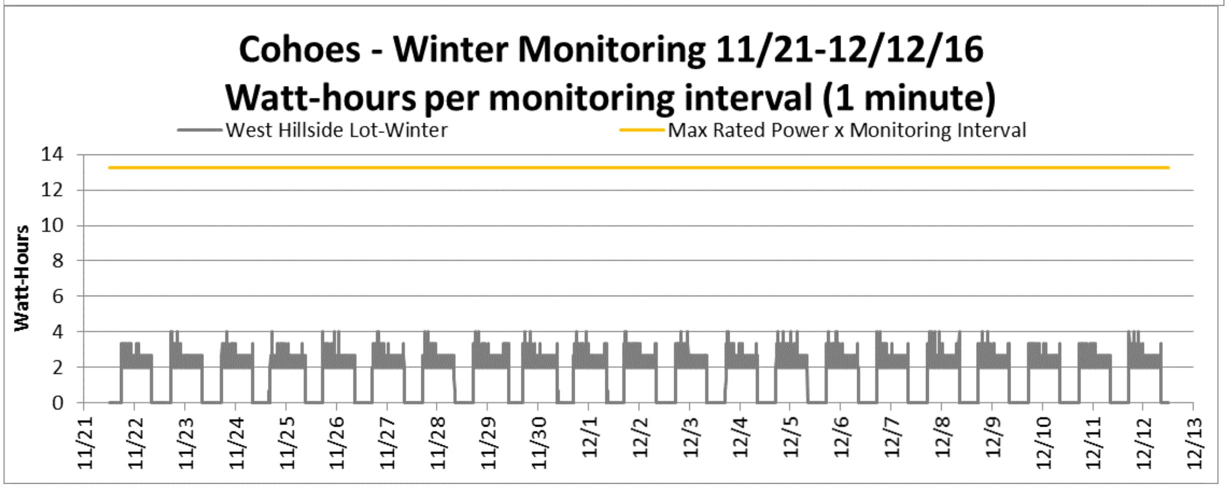


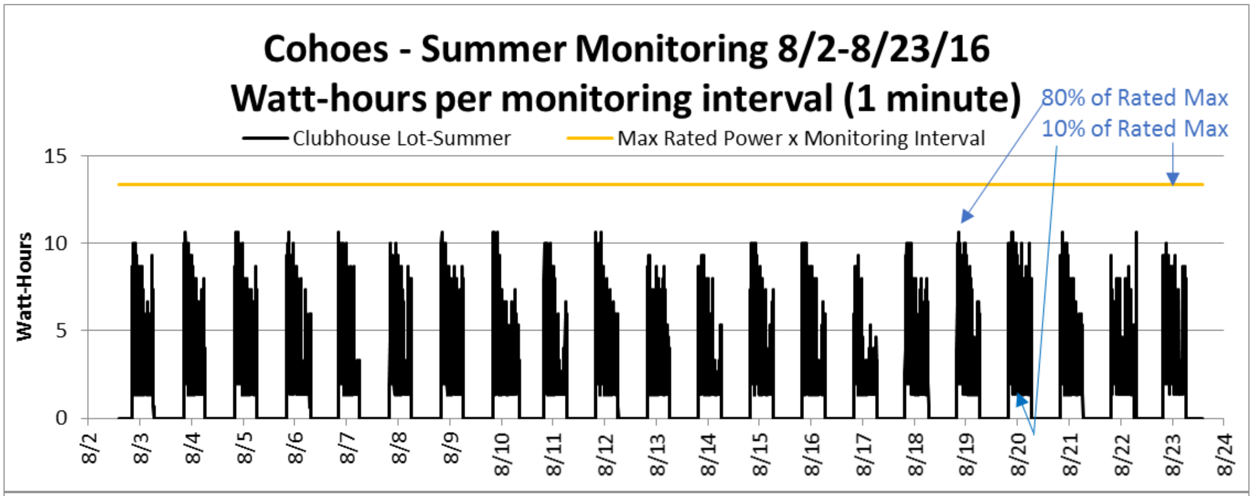


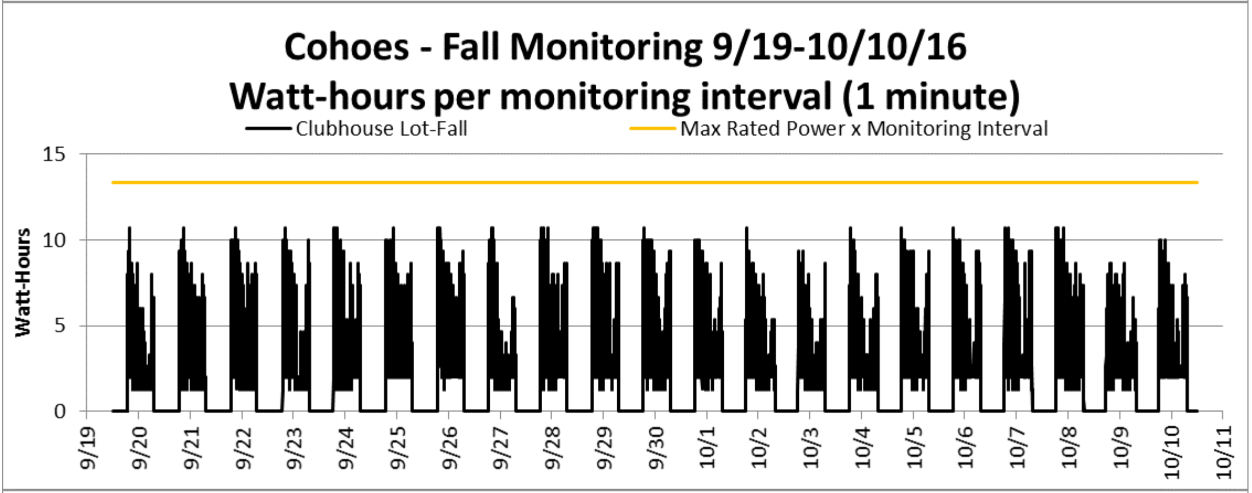


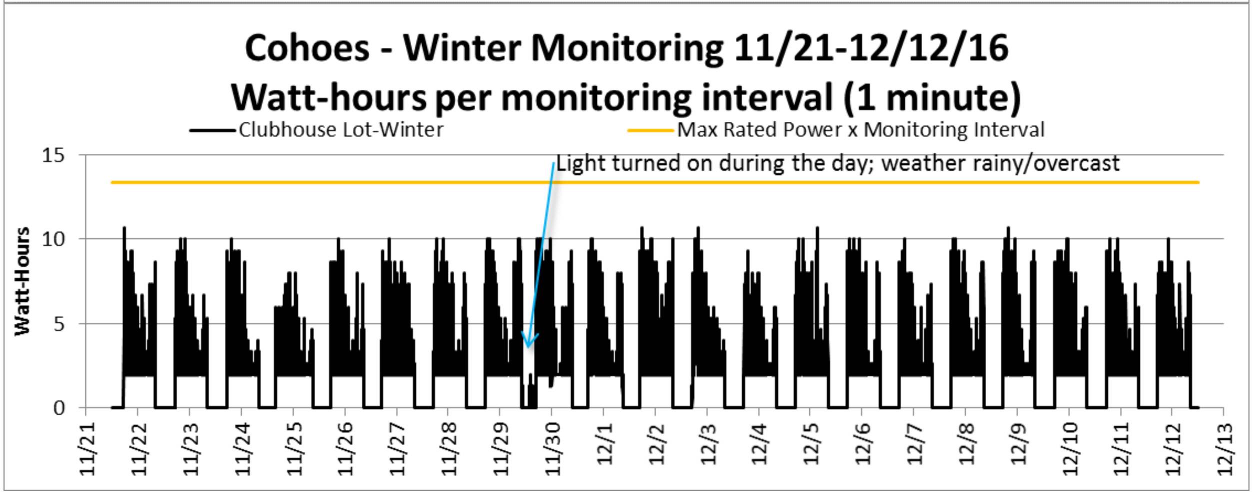

Cohoes - Summer Monitoring 8/2-8/23/16
Watt-hours per monitoring interval (1 minute)
West Hillside Lot - Summer
Max Rated Power x Monitoring Interval
Watt-Hours
14
12
10
8
6
4
2
0
30% of Rated Max
15% of Rated Max
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24

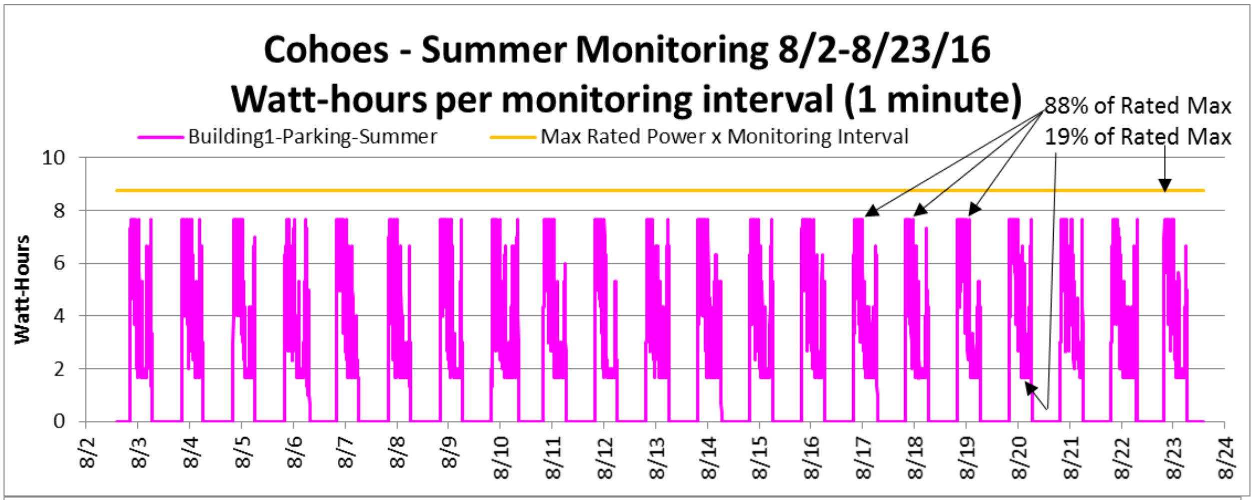

Cohoes - Fall Monitoring 9/19-10/10/16
Watt-hours per monitoring interval (1 minute)
West Hillside Lot-Fall
Max Rated Power x Monitoring Interval
Watt-Hours
14
12
10
8
6
4
2
0
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11

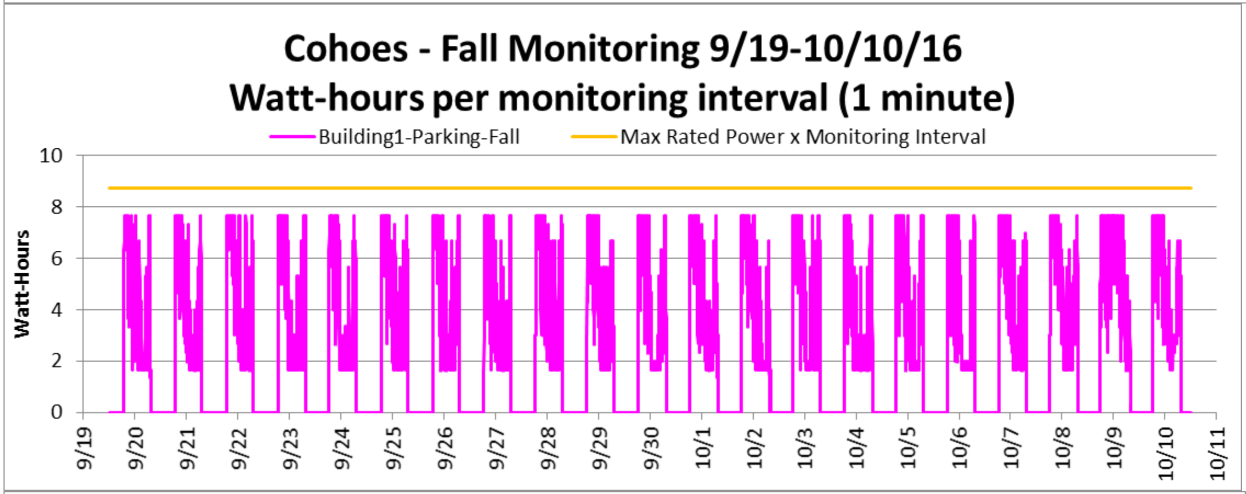

Cohoes - Winter Monitoring 11/21-12/12/16
Watt-hours per monitoring interval (1 minute)
West Hillside Lot-Winter
Max Rated Power x Monitoring Interval
Watt-Hours
14
12
10
8
6
4
2
0
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13

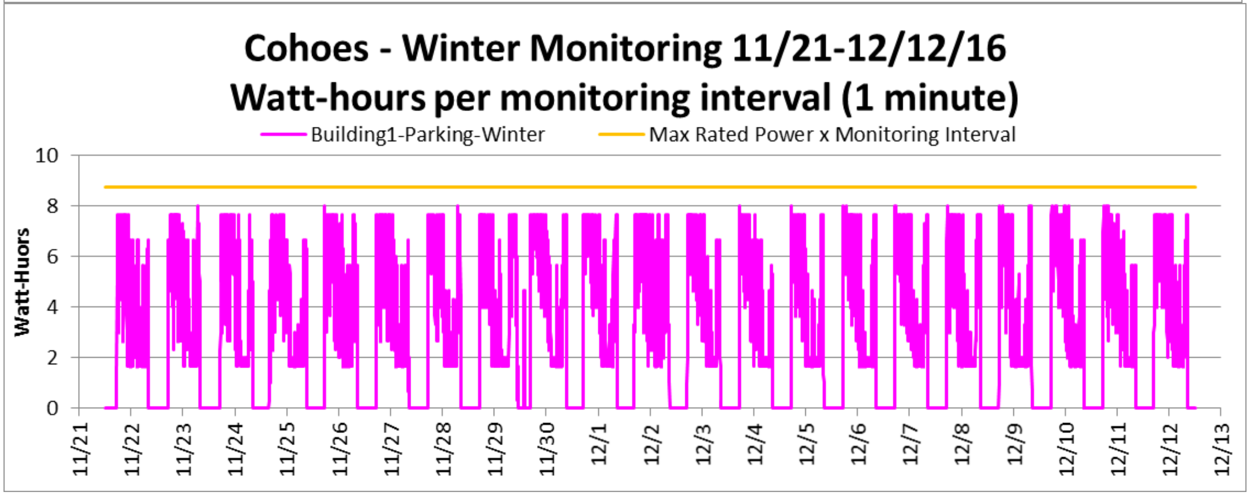

Cohoes - Summer Monitoring 8/2-8/23/16
Watt-hours per monitoring interval (1 minute)
Clubhouse Lot-Summer
Max Rated Power x Monitoring Interval
80% of Rated Max
10% of Rated Max
Watt-Hours
15
10
5
0
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24

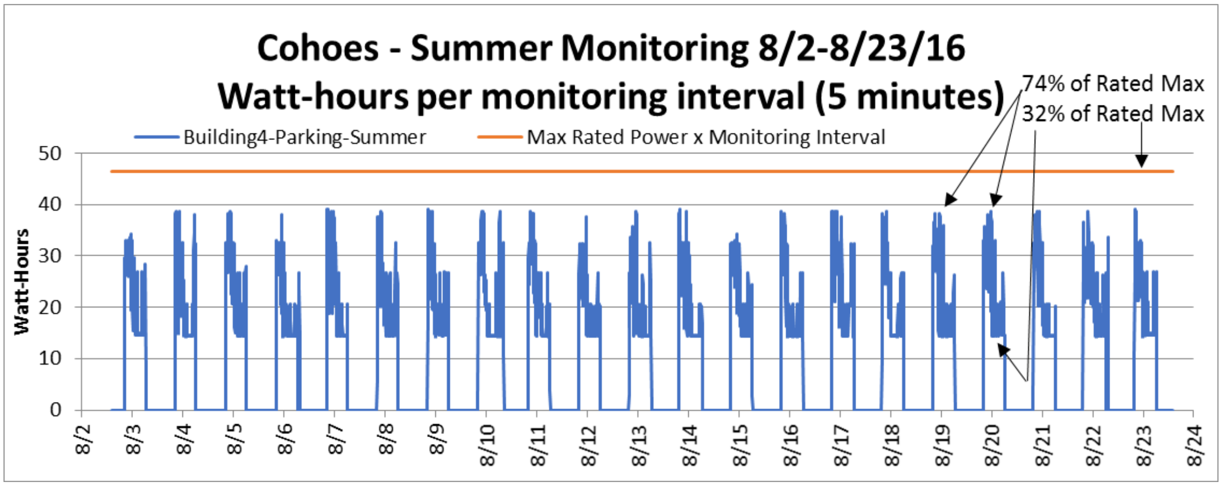

Cohoes - Fall Monitoring 9/19-10/10/16
Watt-hours per monitoring interval (1 minute)
Clubhouse Lot-Fall
Max Rated Power x Monitoring Interval
Watt-Hours
15
10
5
0
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11


Cohoes - Winter Monitoring 11/21-12/12/16
Watt-hours per monitoring interval (1 minute)
Clubhouse Lot-Winter
Max Rated Power x Monitoring Interval
Light turned on during the day; weather rainy/overcast
Watt-Hours
15
10
5
0
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13


Cohoes - Summer Monitoring 8/2-8/23/16
Watt-hours per monitoring interval (1 minute)
Building1-Parking-Summer
Max Rated Power x Monitoring Interval
88% of Rated Max
19% of Rated Max
Watt-Hours
0
2
4
6
8
10
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24

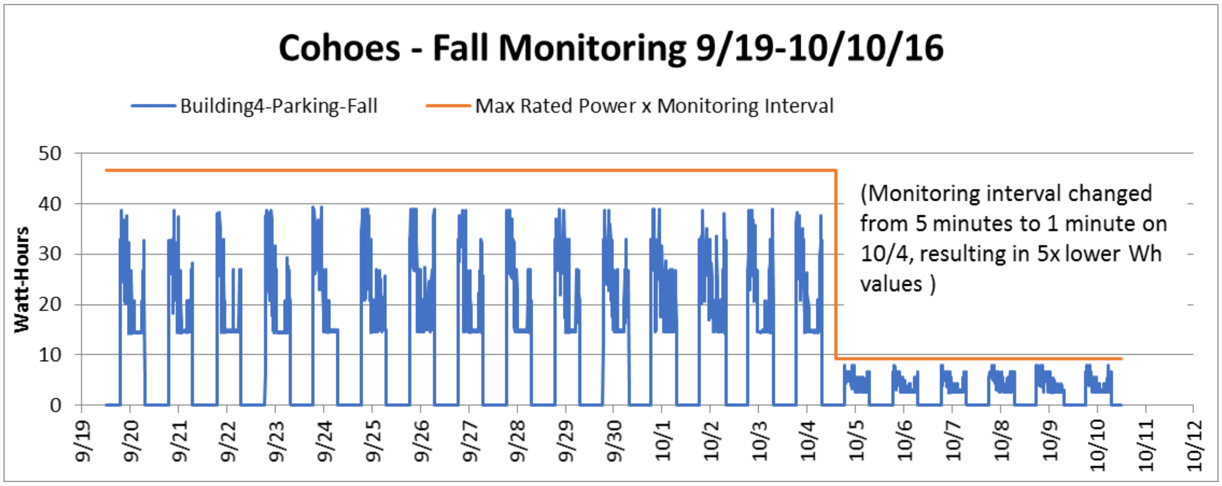

Cohoes - Fall Monitoring 9/19-10/10/16
Watt-hours per monitoring interval (1 minute)
Building1-Parking-Fall
Max Rated Power x Monitoring Interval
Watt-Hours
0
2
4
6
8
10
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11


Cohoes - Winter Monitoring 11/21-12/12/16
Watt-hours per monitoring interval (1 minute)
Building1-Parking-Winter
Max Rated Power x Monitoring Interval
Watt-Huors
0
2
4
6
8
10
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13



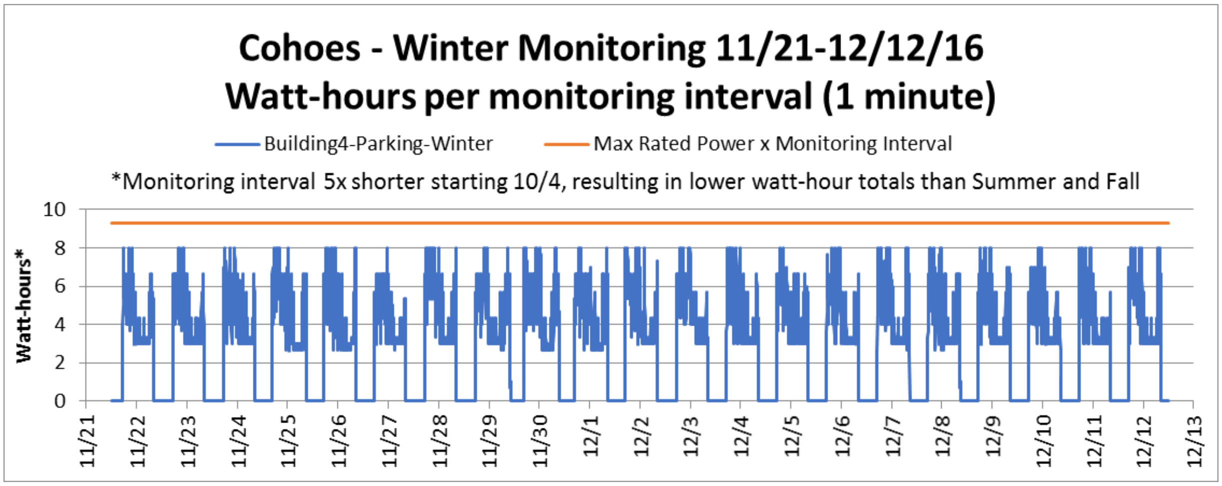
Cohoes - Summer Monitoring 8/2-8/23/16
Watt-hours per monitoring interval (5 minutes)

74% of Rated Max
32% of Rated Max



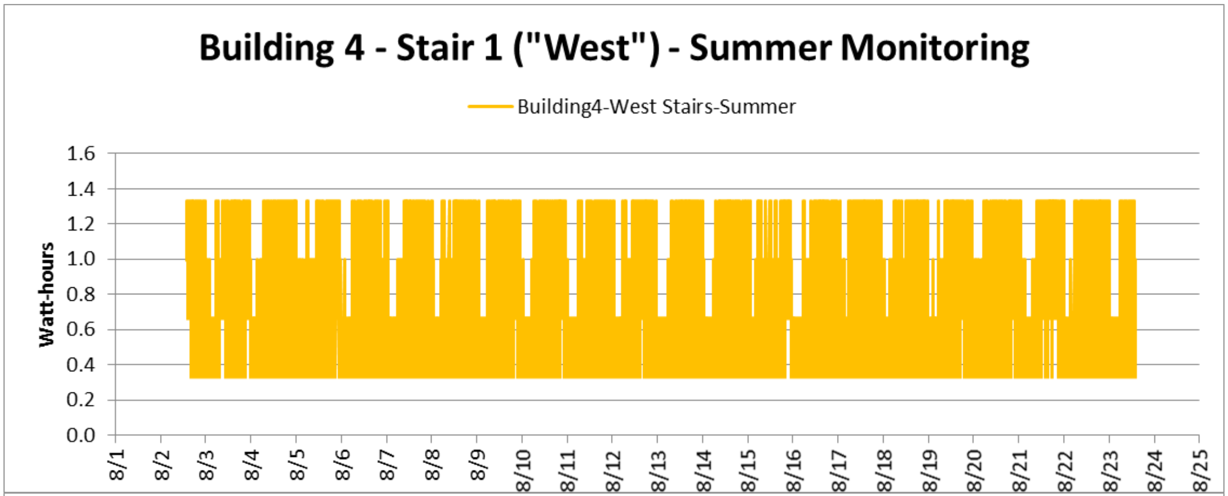
Cohoes - Fall Monitoring 9/19-10/10/16

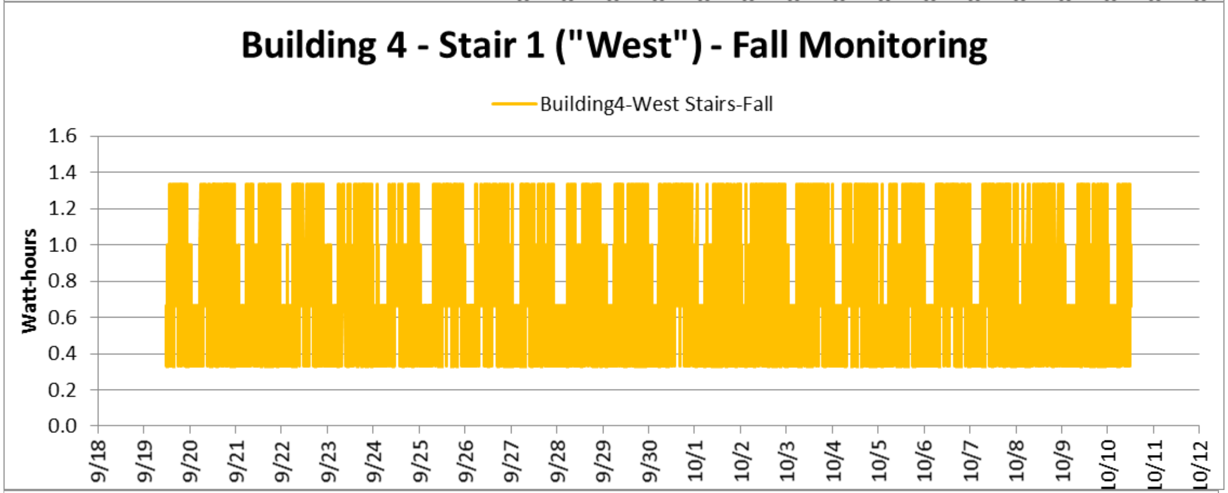
(Monitoring interval changed from 5 minutes to 1 minute on 10/4, resulting in 5x lower Wh values)

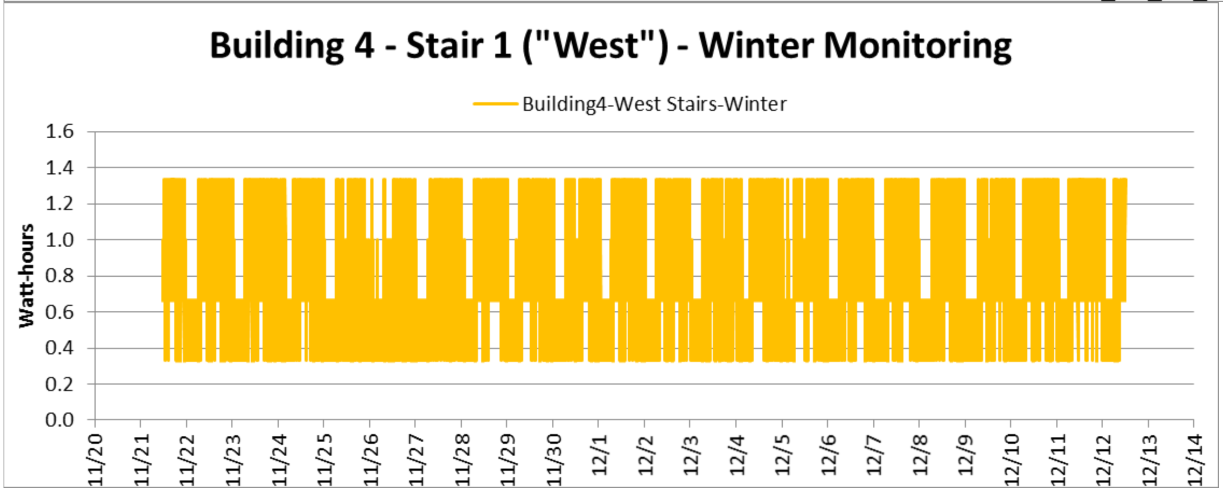


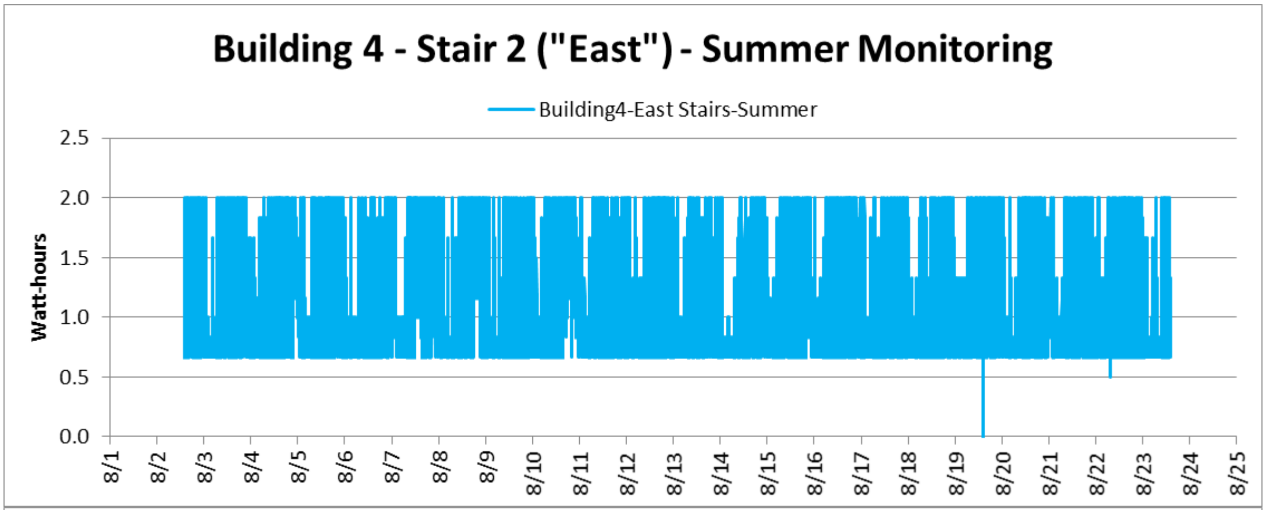
Cohoes - Winter Monitoring 11/21-12/12/16
Watt-hours per monitoring interval (1 minute)

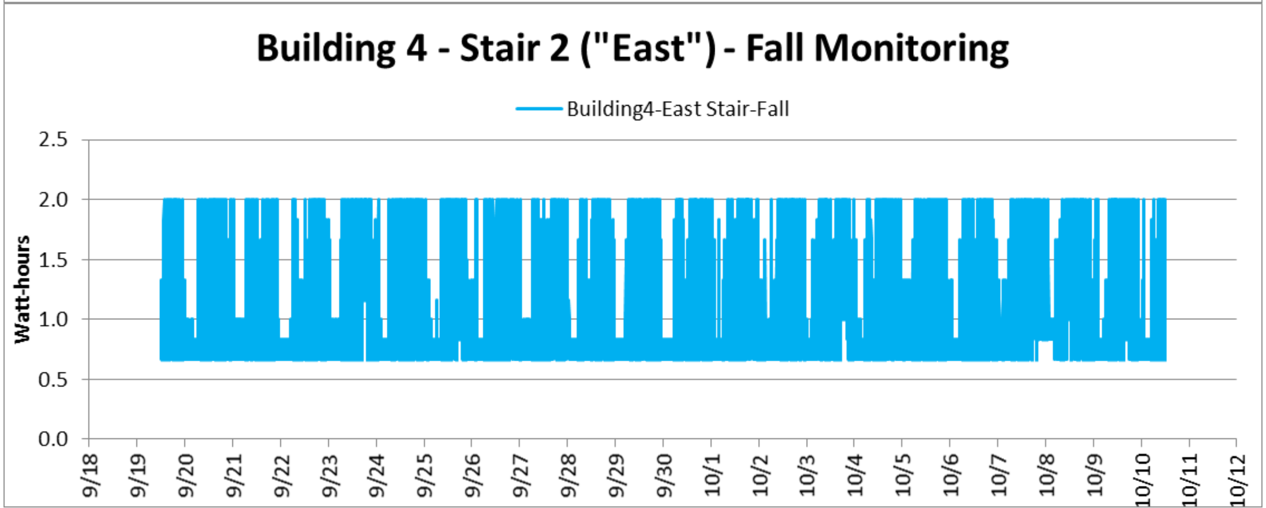
*Monitoring interval 5x shorter starting 10/4, resulting in lower watt-hour totals than Summer and Fall

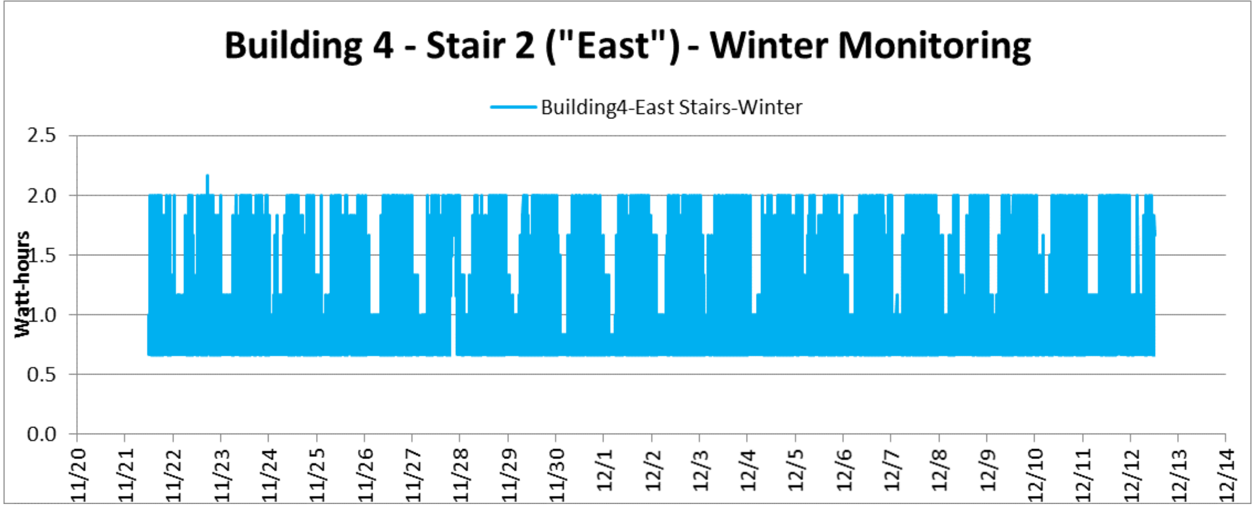

Building 4 - Stair 1 ("West") - Summer Monitoring
Building4-West Stairs-Summer
Watt-hours
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
8/1
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25

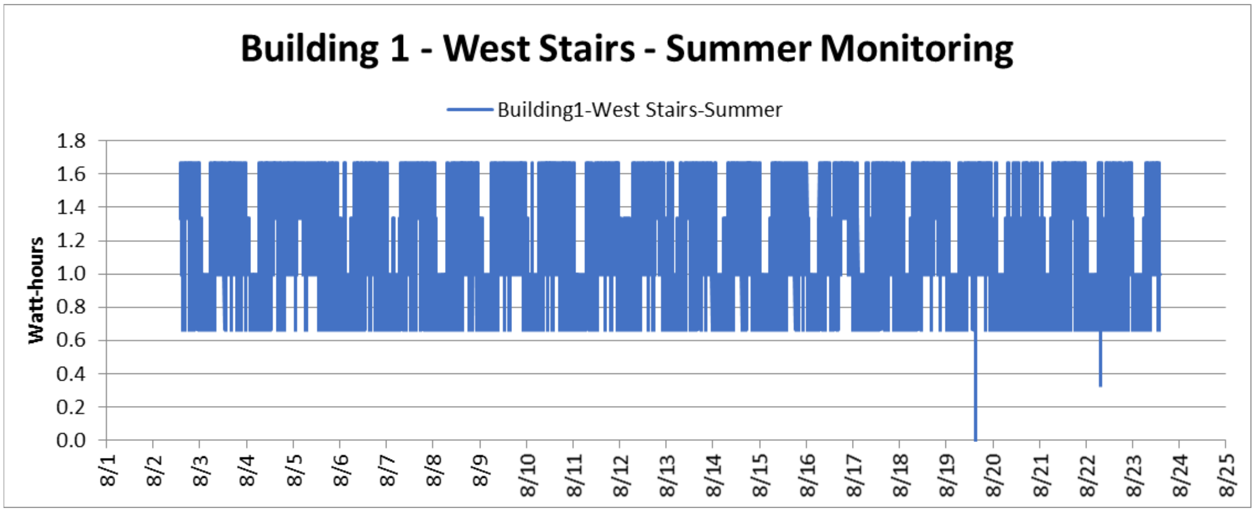

Building 4 - Stair 1 ("West") - Fall Monitoring
Building4-West Stairs-Fall
Watt-hours
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
9/18
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11
10/12

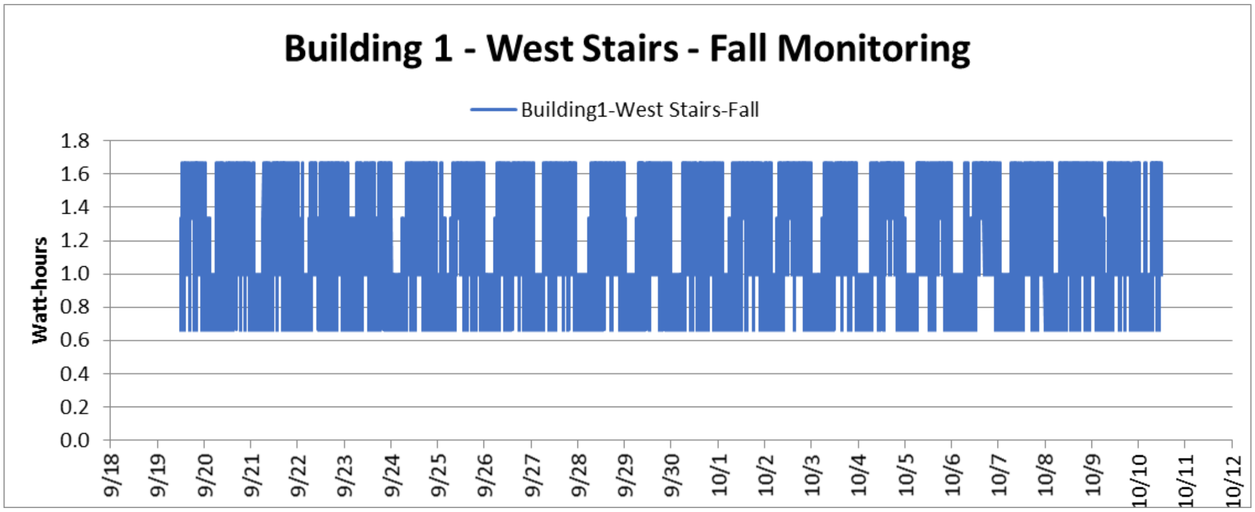

Building 4 - Stair 1 ("West") - Winter Monitoring
Building4-West Stairs-Winter
Watt-hours
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
11/20
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13
12/14

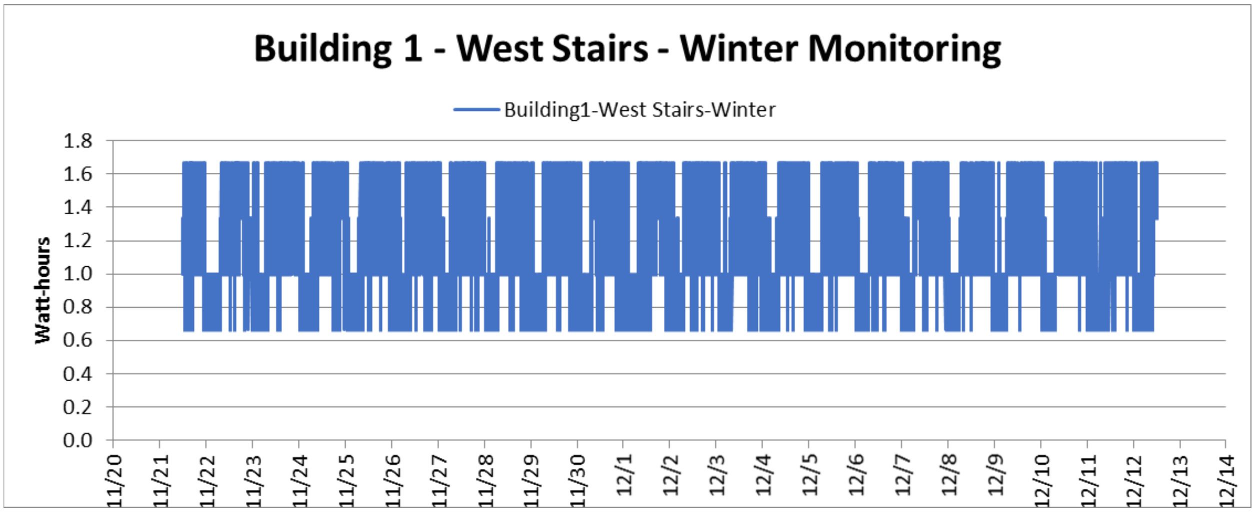

Building 4 - Stair 2 ("East") - Summer Monitoring
Building4-East Stairs-Summer
Watt-hours
2.5
2.0
1.5
1.0
0.5
0.0
8/1
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25

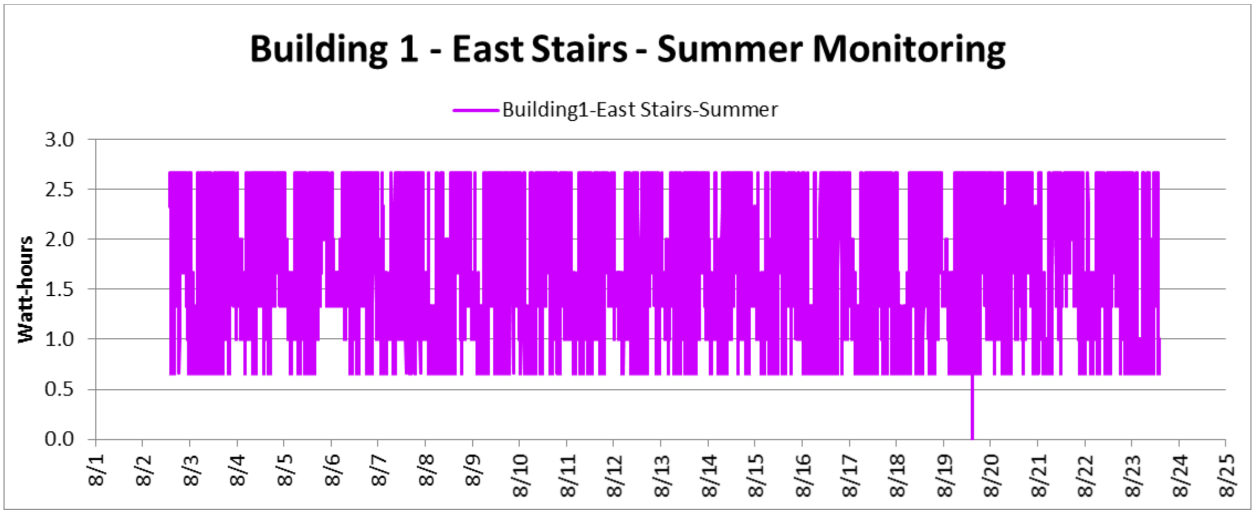

Building 4 - Stair 2 ("East") - Fall Monitoring
Building4-East Stair-Fall
Watt-hours
2.5
2.0
1.5
1.0
0.5
0.0
9/18
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11
10/12

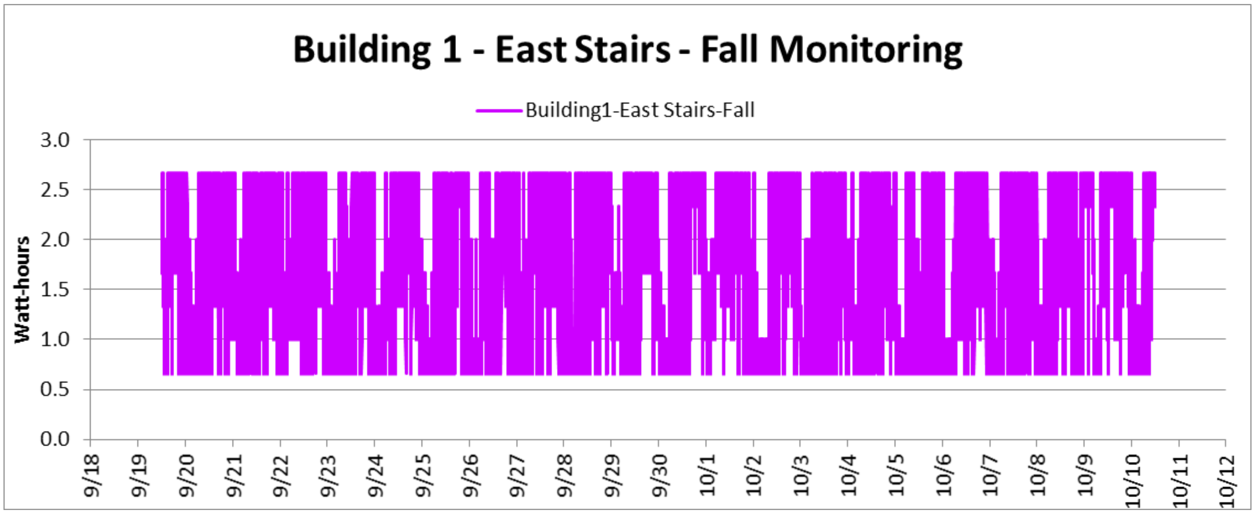

Building 4 - Stair 2 ("East") - Winter Monitoring
Building4-East Stairs-Winter
Watt-hours
2.5
2.0
1.5
1.0
0.5
0.0
11/20
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13
12/14

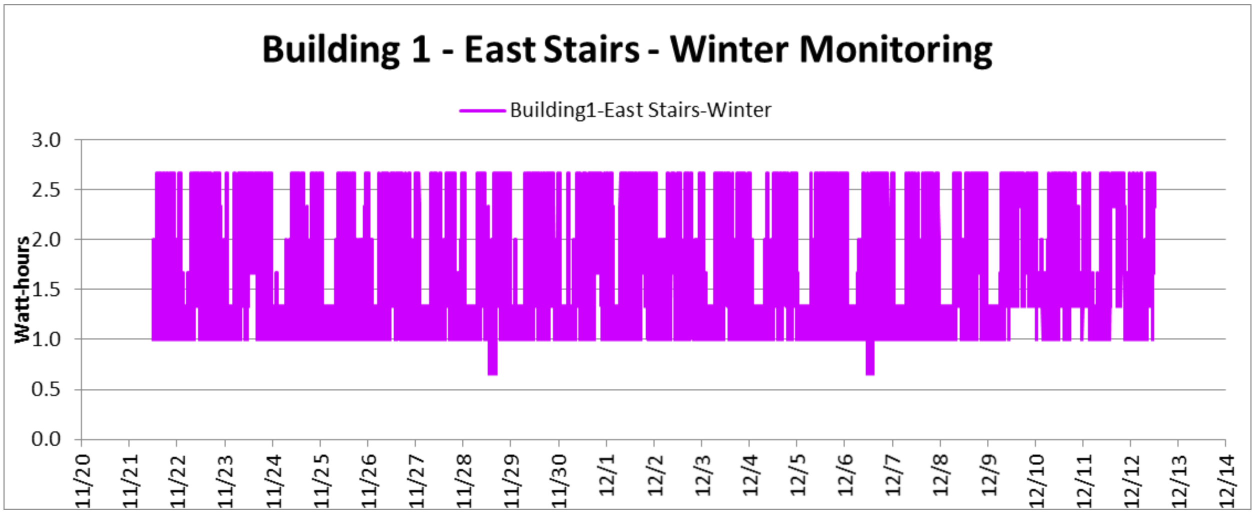

Building 1 - West Stairs - Summer Monitoring
Building1-West Stairs-Summer
Watt-hours
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
8/1
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25

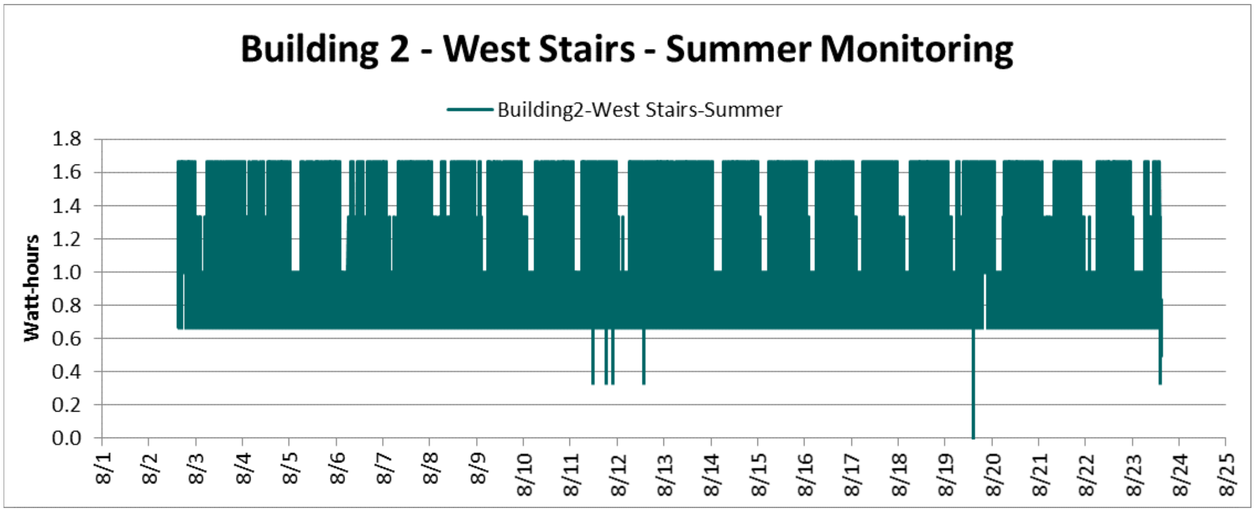

Building 1 - West Stairs - Fall Monitoring
Building1-West Stairs-Fall
Watt-hours
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
9/18
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11
10/12

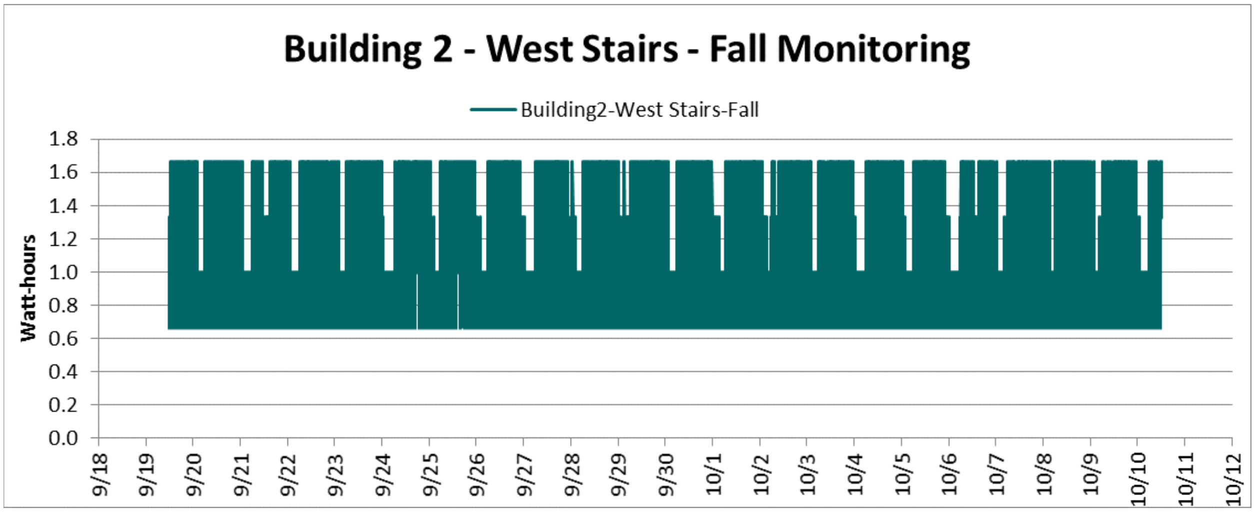

Building 1 - West Stairs - Winter Monitoring
Building1-West Stairs-Winter
Watt-hours
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
11/20
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13
12/14

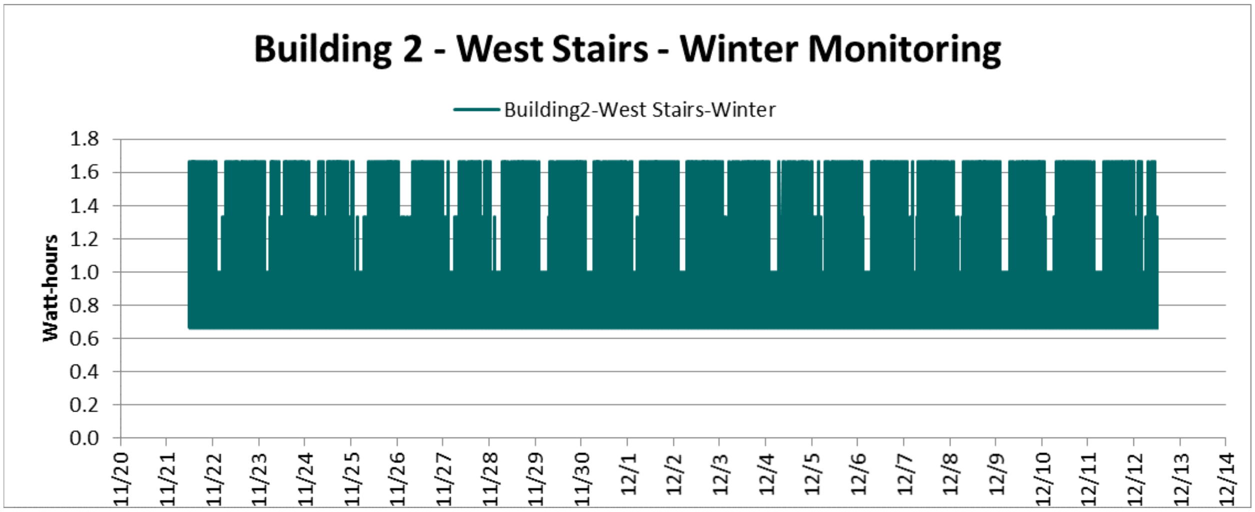

Building 1 - East Stairs - Summer Monitoring
Building1-East Stairs-Summer
Watt-hours
3.0
2.5
2.0
1.5
1.0
0.5
0.0
8/1
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25

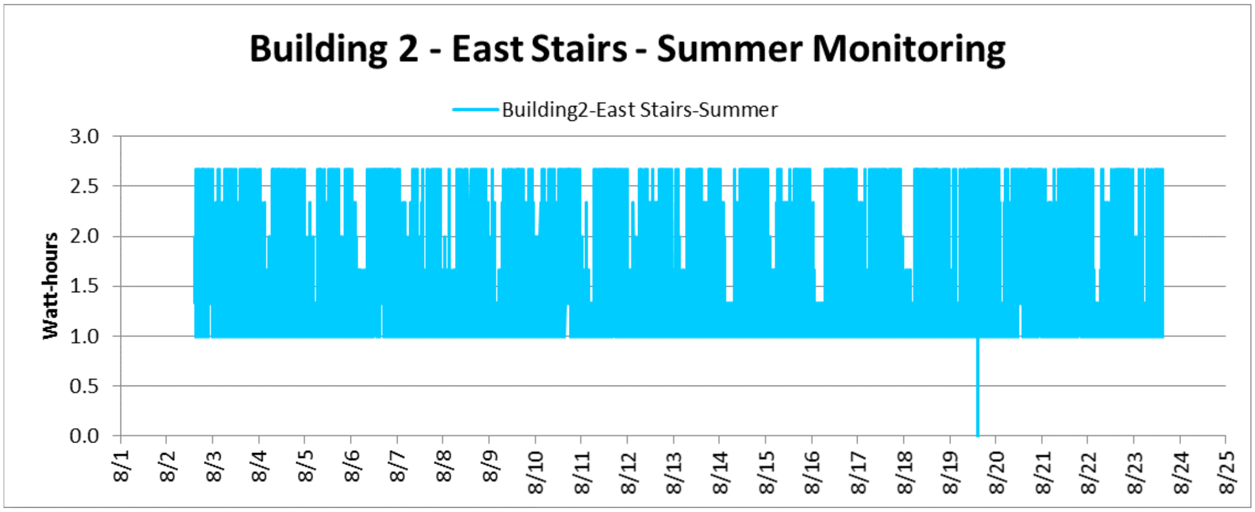

Building 1 - East Stairs - Fall Monitoring
Building1-East Stairs-Fall
Watt-hours
3.0
2.5
2.0
1.5
1.0
0.5
0.0
9/18
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11
10/12

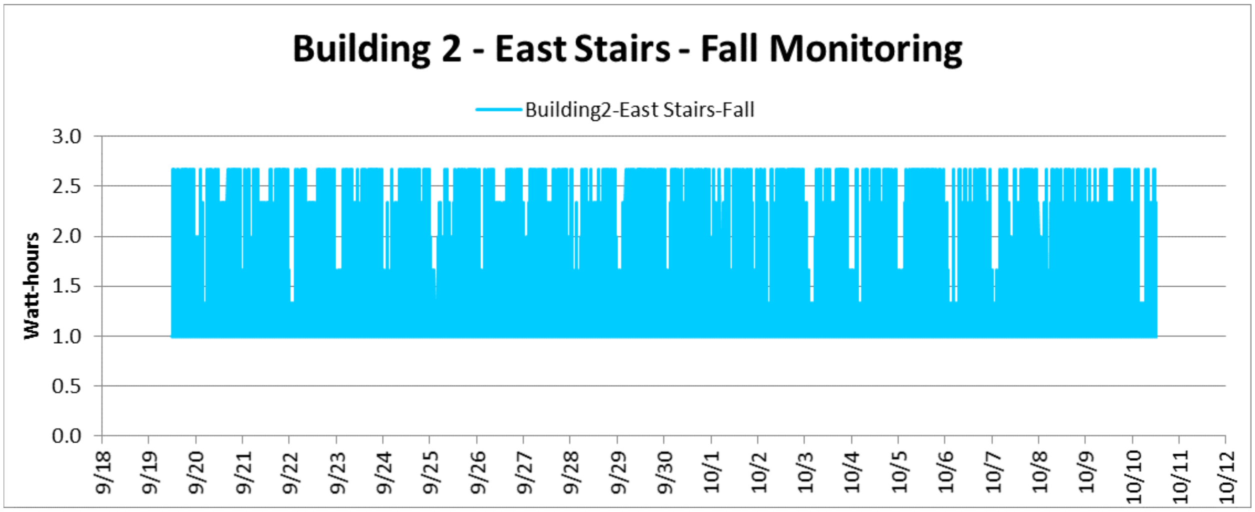

Building 1 - East Stairs - Winter Monitoring
Building1-East Stairs-Winter
Watt-hours
3.0
2.5
2.0
1.5
1.0
0.5
0.0
11/20
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13
12/14

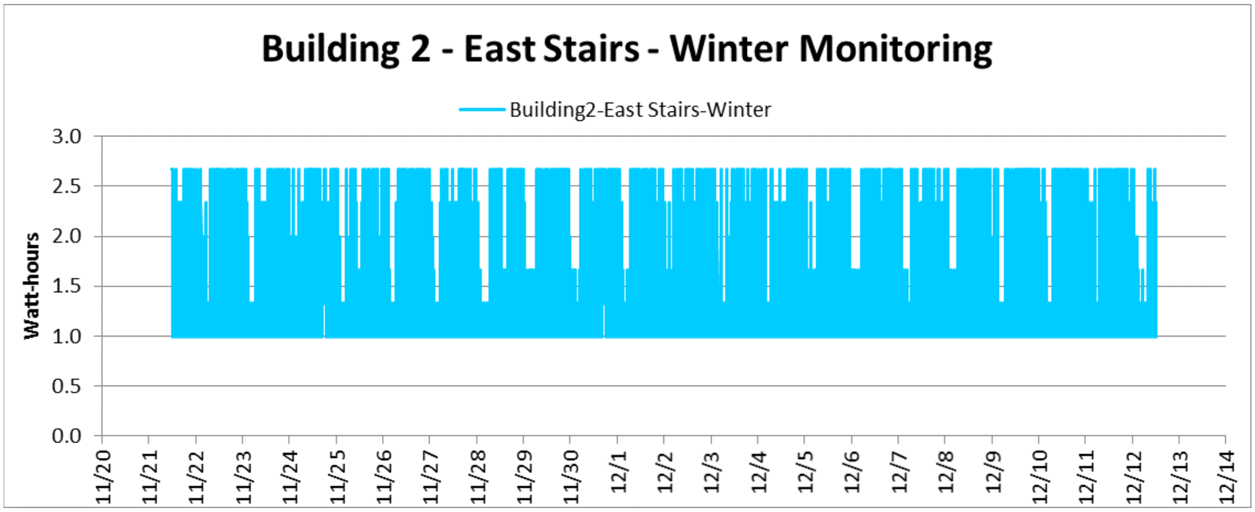

Building 2 - West Stairs - Summer Monitoring
Building2-West Stairs-Summer
Watt-hours
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
8/1
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25

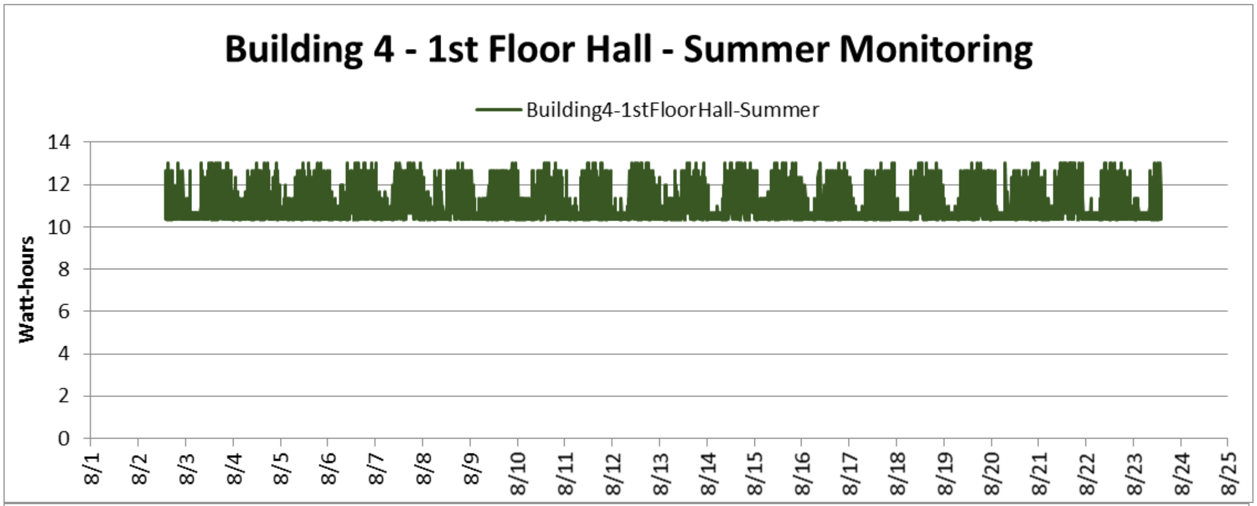

Building 2 - West Stairs - Fall Monitoring
Building2-West Stairs-Fall
Watt-hours
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
9/18
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11
10/12

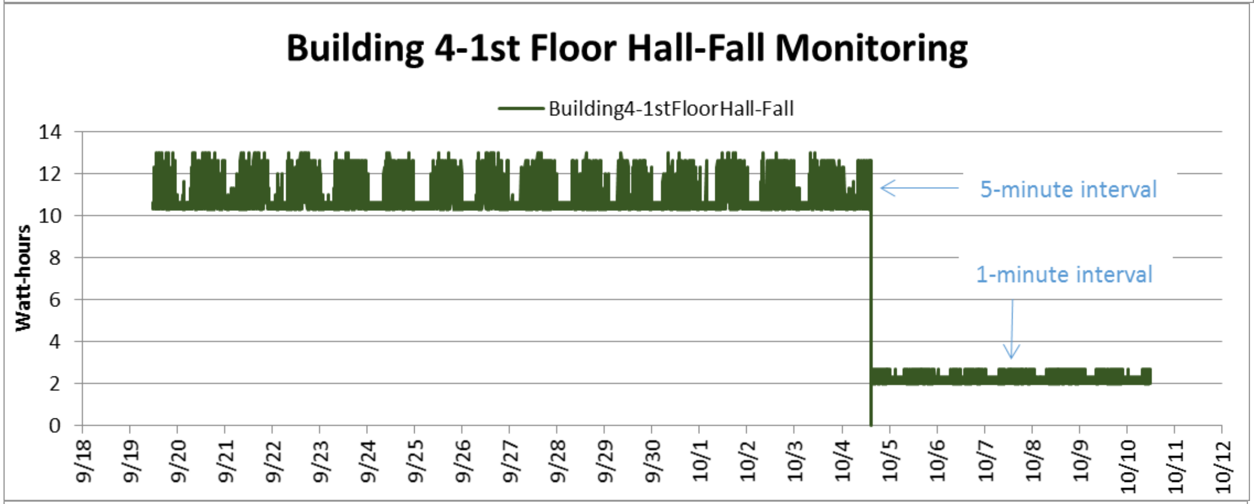

Building 2 - West Stairs - Winter Monitoring
Building2-West Stairs-Winter
Watt-hours
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
11/20
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13
12/14

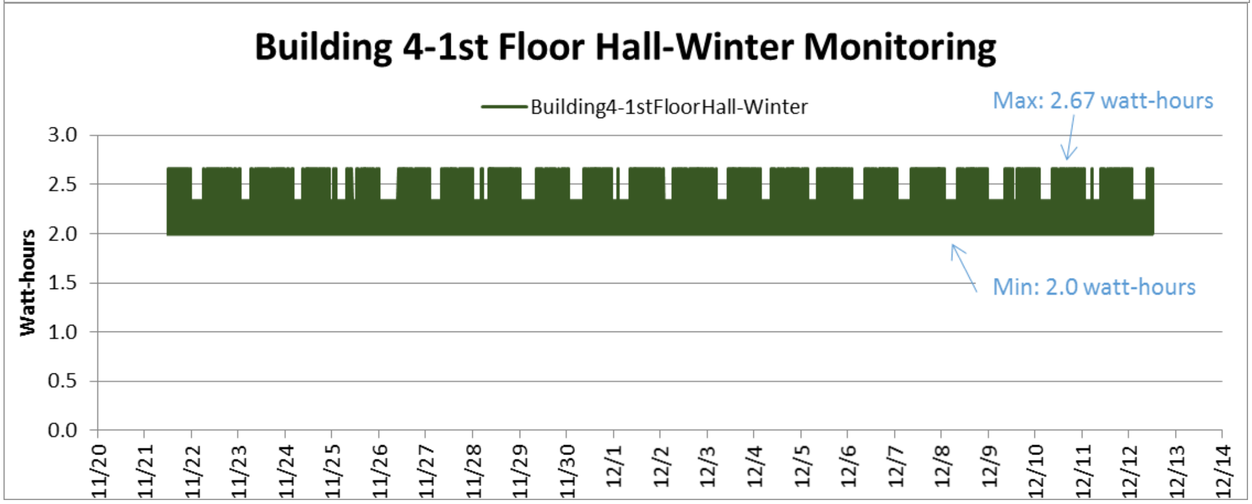

Building 2 - East Stairs - Summer Monitoring
Building2-East Stairs-Summer
Watt-hours
3.0
2.5
2.0
1.5
1.0
0.5
0.0
8/1
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25

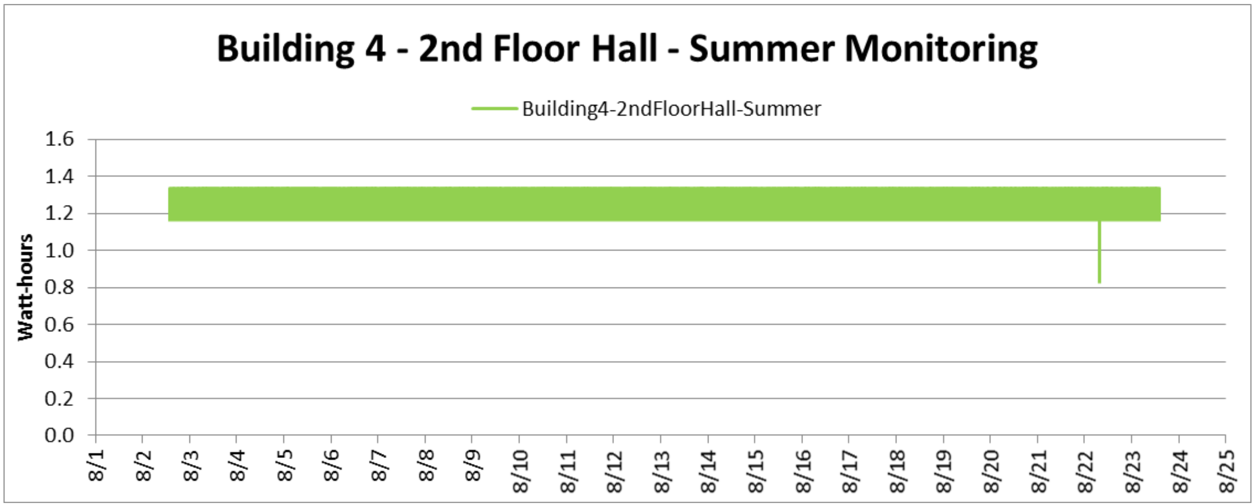

Building 2 - East Stairs - Fall Monitoring
Building2-East Stairs-Fall
Watt-hours
3.0
2.5
2.0
1.5
1.0
0.5
0.0
9/18
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11
10/12

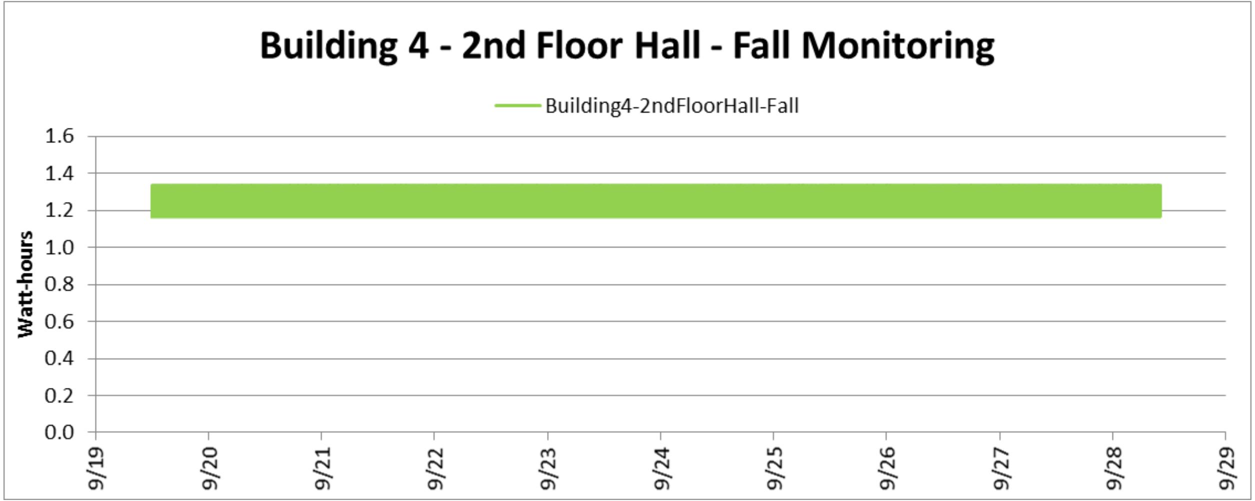

Building 2 - East Stairs - Winter Monitoring
Building2-East Stairs-Winter
Watt-hours
3.0
2.5
2.0
1.5
1.0
0.5
0.0
11/20
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13
12/14

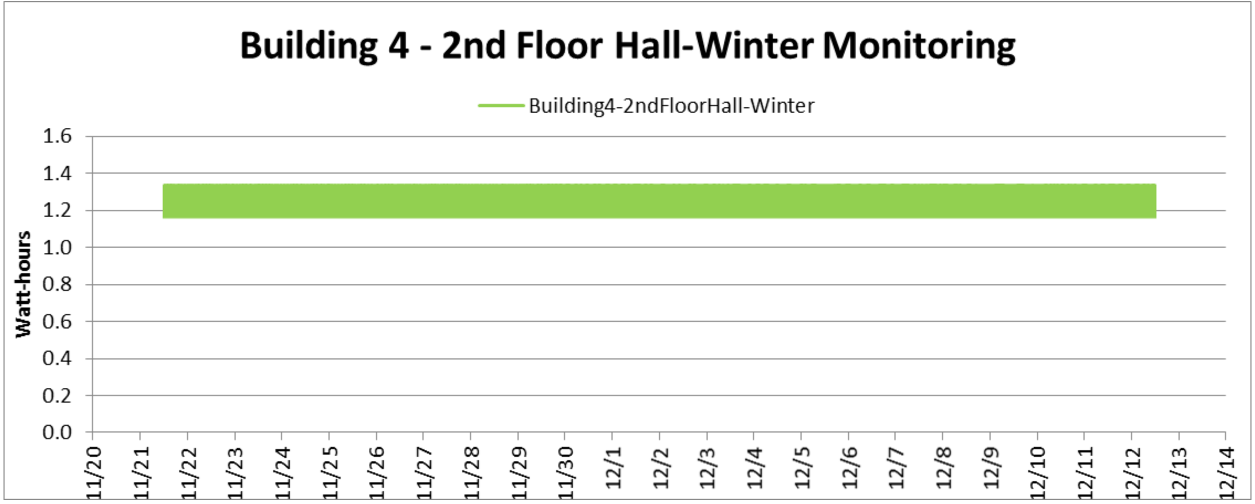

Building 4 - 1st Floor Hall - Summer Monitoring
Building4-1stFloorHall-Summer
Watt-hours
0
2
4
6
8
10
12
14
8/1
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25

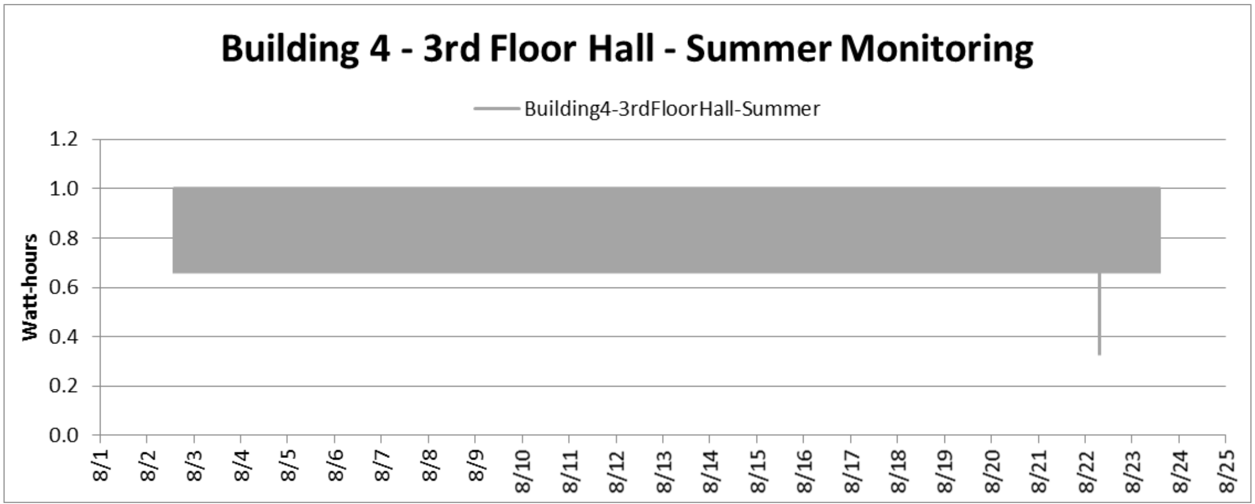

Building 4-1st Floor Hall-Fall Monitoring
Building4-1stFloorHall-Fall
Watt-hours
5-minute interval
1-minute interval
0
2
4
6
8
10
12
14
9/18
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11
10/12

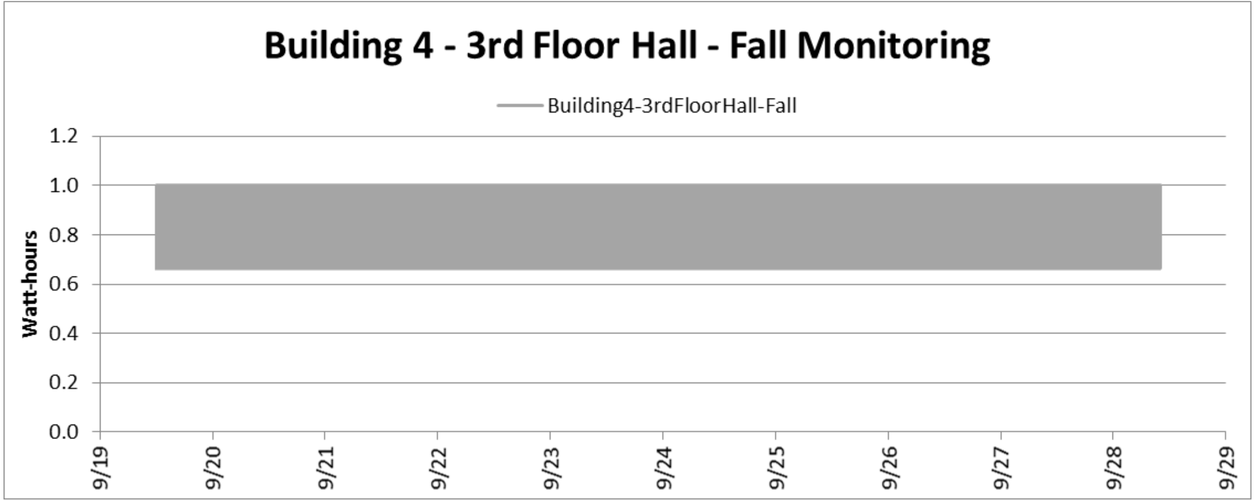

Building 4-1st Floor Hall-Winter Monitoring
Building4-1stFloorHall-Winter
Max: 2.67 watt-hours
Min: 2.0 watt-hours
Watt-hours
0.0
0.5
1.0
1.5
2.0
2.5
3.0
11/20
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13
12/14

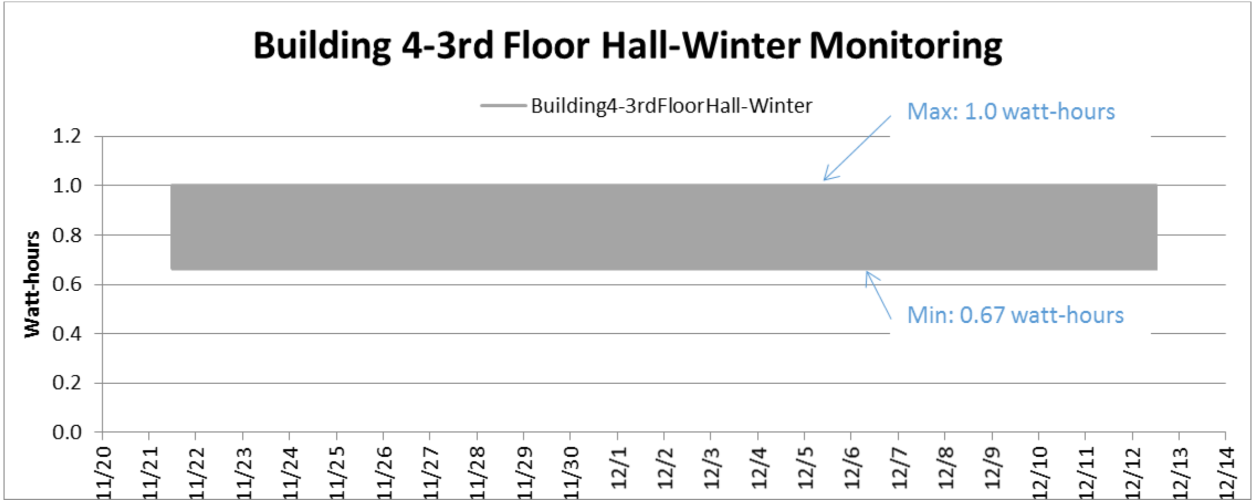

Building 4 - 2nd Floor Hall - Summer Monitoring
Building4-2ndFloorHall-Summer
Watt-hours
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
8/1
8/2
8/3
8/4
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25


Building 4 - 2nd Floor Hall - Fall Monitoring
Building4-2ndFloorHall-Fall
Watt-hours
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29


Building 4 - 2nd Floor Hall-Winter Monitoring
Building4-2ndFloorHall-Winter
Watt-hours
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
11/20
11/21
11/22
11/23
11/24
11/25
11/26
11/27
11/28
11/29
11/30
12/1
12/2
12/3
12/4
12/5
12/6
12/7
12/8
12/9
12/10
12/11
12/12
12/13
12/14


Building 4 - 3rd Floor Hall - Summer Monitoring


Building 4 - 3rd Floor Hall - Fall Monitoring


Building 4-3rd Floor Hall-Winter Monitoring

NYSERDA, a public benefit corporation, offers objective information and analysis, innovative programs, technical expertise, and support to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels. NYSERDA professionals work to protect the environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York State since 1975.

To learn more about NYSERDA's programs and funding opportunities, visit nyserda.ny.gov or follow us on Twitter, Facebook, YouTube, or Instagram.

New York State
Energy Research and
Development Authority

17 Columbia Circle
Albany, NY 12203-6399

toll free: 866-NYSERDA
local: 518-862-1090
fax: 518-862-1091

info@nyserda.ny.gov
nyserda.ny.gov

State of New York
Andrew M. Cuomo, Governor

New York State Energy Research and Development Authority
Richard L. Kauffman, Chair | Alicia Barton, President and CEO