Bear Creek Elementary School
Lighting and Personal Appliance Audit
Findings and Recommendations

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greenBVSD

Contents

Summary of Recommendations

The following table outlines the major recommendations for Bear Creek Elementary School. For more information about these recommendations, as well as estimated cost savings, see later sections of the Audit Report.

Recommendation	Responsible Party
Educate staff and students about the importance of energy use, conservation and efficiency.	District, School Administration, Staff, Student Groups
Encourage staff to turn off lights at the end of the day instead of relying on motion sensors.	School Administration and Staff
Improve signage about energy conservation, including "Turn me off when not in use" stickers for light switches.	Student Groups
Replace all incandescent bulbs with compact fluorescent bulbs.	Staff
Unplug personal appliances when not in use. Plug appliances into power strips for easy on/off.	Staff
Retire personal appliances, such as mini-fridges and microwaves.	Staff
Encourage the use of natural lighting, when possible, to reduce electrical lighting demand	School Administration and Staff
De-lamp fixtures in over-lit areas.	Custodial Staff
Decrease the lag time between when a room becomes unoccupied and the motion sensors switch off the lights.	District, Custodial Staff
Ensure exterior lights are only one when necessitated by ambient light levels.	Custodial Staff
Switch to LED exterior lights.	District, School Administration
Install light switches so that areas can be controlled independently and on location.	District
Replace conventional appliances with Energy Star rated counterparts.	District, School Administration

Summary of Cost Savings

The following table summarizes the cost saving associated with various recommendations. These values serve to illustrate the magnitude of savings associated with implementation, but will vary based upon degree of implementation and accuracy of assumptions. See Estimated Cost Saving sections later in the Audit Report for more information.

		Recommendation	kWh Saved in 10 Years	$ Saved in 10 Years
Low or No Cost	Savings Immediate	Increase Natural Lighting Use	3,500	$455
		Bathroom Lighting	1,800	$235
		Power Strip, Unplug Appliances	10,000	$1,300
		Computer Monitors Off	32,000	$4,150
		Retire Mini-Fridges	18,000	$2,300
		Retire Microwave	1,000	$130
Moderate to High Costs	Payback in 1-5 years	De-lamping in Over-Lit Areas[$]	13,000	$1,700
		Motion Sensors[$]	17,500	$2,300
		Incandescent to CFL[$]	2,000	$260
		Conversion to 28W T8s[$]	61,000	$7,900
		Exterior Lighting[$$]	58,000	$7,500

$ = moderate costs associated with labor; $$ = high upfront capital investment

Goals of the Audit

The audit is designed to identify low- and no-cost improvements that can be undertaken by individual schools by encouraging behavior changes and awareness. Lighting in commercial buildings, such as schools, can often account for over 20% of electrical use, while personal appliances can account for another 10% (EIA, 2003). These contributions can often be reduced through conservation and efficiency measures. Conservation refers to reducing overall use, while efficiency is related to using technology that provides the same output with a reduced energy input.

The Bear Creek Elementary School Audit was conducted on October 7 and 8, 2010 during after-school hours. Information was gathered by walking through all rooms within the school building. The number and types of lights were recorded for each room, as well as notes about how lights are controlled. A light meter was also used to record the illumination levels provided by electric lights. The number and types of personal appliances in each room were also recorded.

Data collected during the audit was then processed to provide estimates for yearly contributions of lighting and personal appliances to overall electrical use. These calculations relied on several assumptions, which will be detailed later in the Audit Report. These calculations, along with observations made during the audit, provide the basis for recommendations.

Background Information

Bear Creek Elementary School was identified for the audit because of its high electrical use. In 2009, Bear Creek had the fourth highest electrical demand of all elementary schools in the District (see Figures 1-3). Bear Creek does not have a particularly large building, nor does it have many more students than other schools in the district. These factors usually contribute to higher energy use. Other potential contributors are lighting and personal appliances, as stated above.

Between July 2007 and June 2010, Bear Creek Elementary had an annual average electrical use of 361,500 kWh. Bear Creek Elementary spent an average of $27,700 per year on electricity during the same time period. The average cost of electricity is $0.13/kWh.

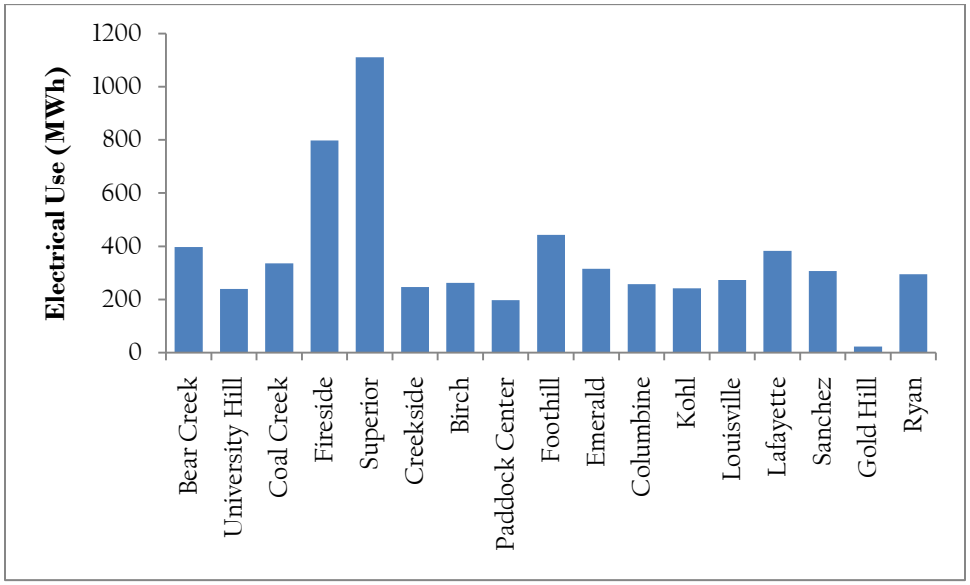

Figure 1. Overall Electrical Use (MWh) in 2009 at Boulder Valley School District Elementary Schools. Bear Creek had the fourth highest overall electrical usage in 2009.

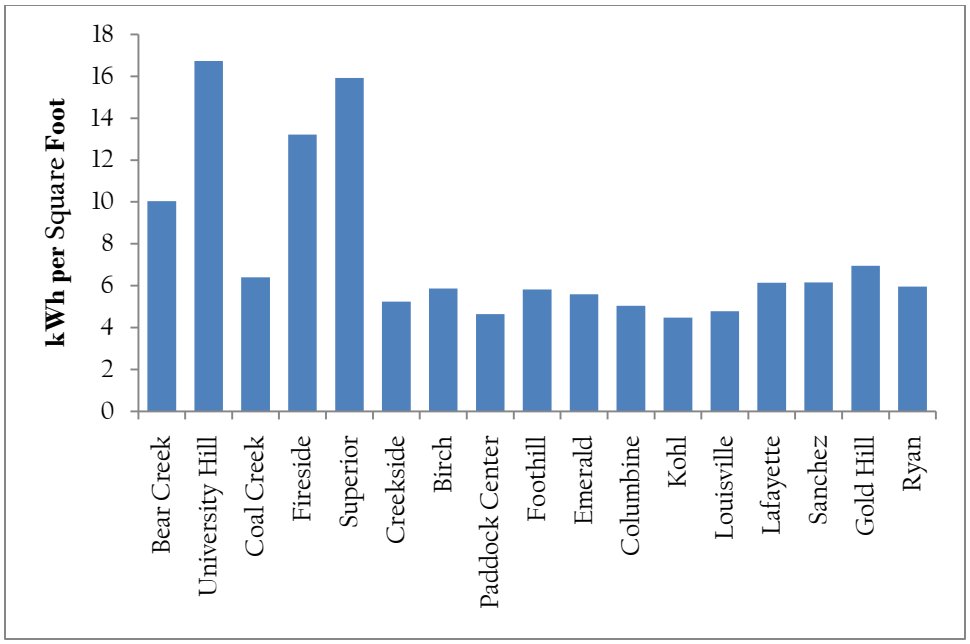

Figure 2. Electrical use is often correlated with building size. Bear Creek Elementary was the 4th largest user of electricity per square foot in 2009.

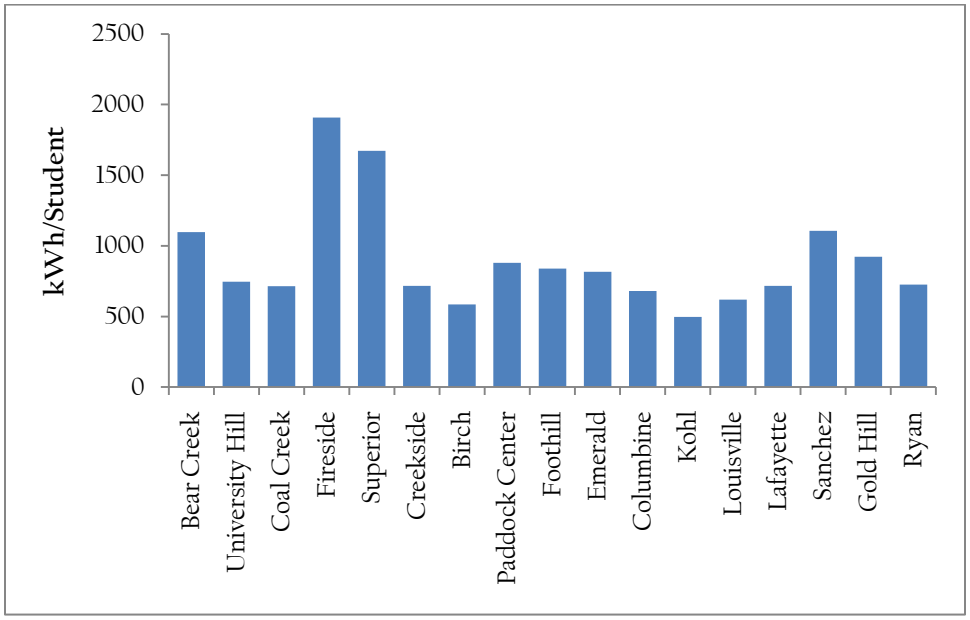

Figure 3. Electrical use is often correlated with number of building users. Bear Creek Elementary was the 4th largest user of electricity per student in 2009.

Overall Findings

The average electrical use at Bear Creek Elementary is assumed to be 361,500 kWh. This value represents a three year average, spanning from July 2007 to June 2010. Lighting accounts for approximately 17% of total electrical demand, while personal appliances contribute approximately 8% (see Figure 4). The remaining 75% were not identified in this audit, but include other uses such as heating, cooling and larger appliances. In terms of cost, lighting the building costs approximately $4,700 per year, and personal appliances another $2,200.

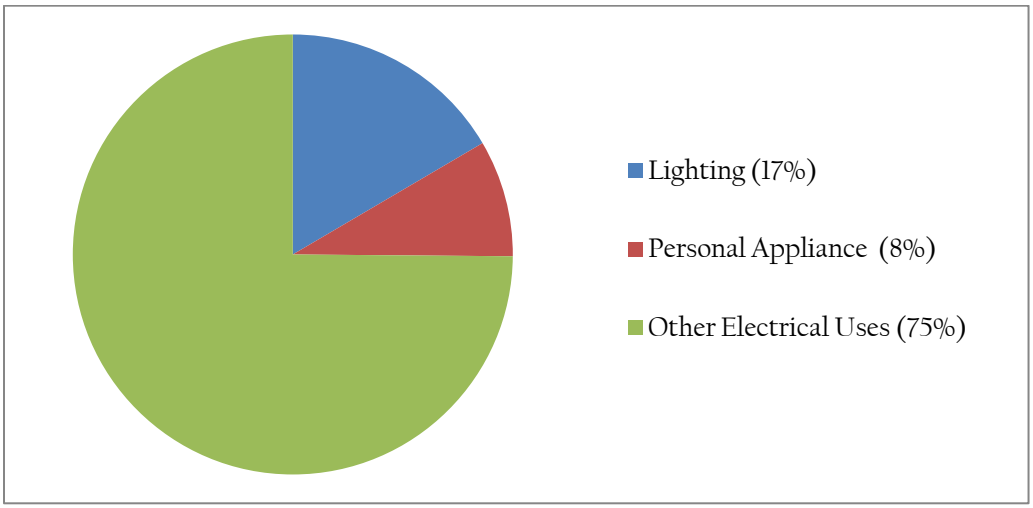

Figure 4. Contribution of lighting and personal appliances to overall electrical use at Bear Creek Elementary School. The total annual electrical use is assumed to be 361,500 kWh, which represents a 3-year average.

Lighting Data

Total Number of Lights: 1,134

- 4' T8 Fluorescent Tubes (32 W): 903
- 2' T8 Fluorescent Tubes (17 W): 14
- Incandescent Bulbs (45-100 W): 22
- Compact Fluorescent Bulbs (14 W): 3

Assumptions about Usage:

- Lights in Corridors on for 13 hours per day
- Lights in Classrooms on for 9 hours per day
- Lights in Bathrooms on for 10.5 hours per day
- Individual Bulbs on for 5 hours per week

The above usage values correspond to the 180 day school year. However, school buildings are still in use, in one form or another, throughout the year. To capture this additional usage, it assumed that lights are on as listed above for an additional 45 days (1/4 of total use for remaining 185 days of the year). Also note that exterior lights are not included in the total lighting use as large portions of the building were inaccessible for surveying due to current construction.

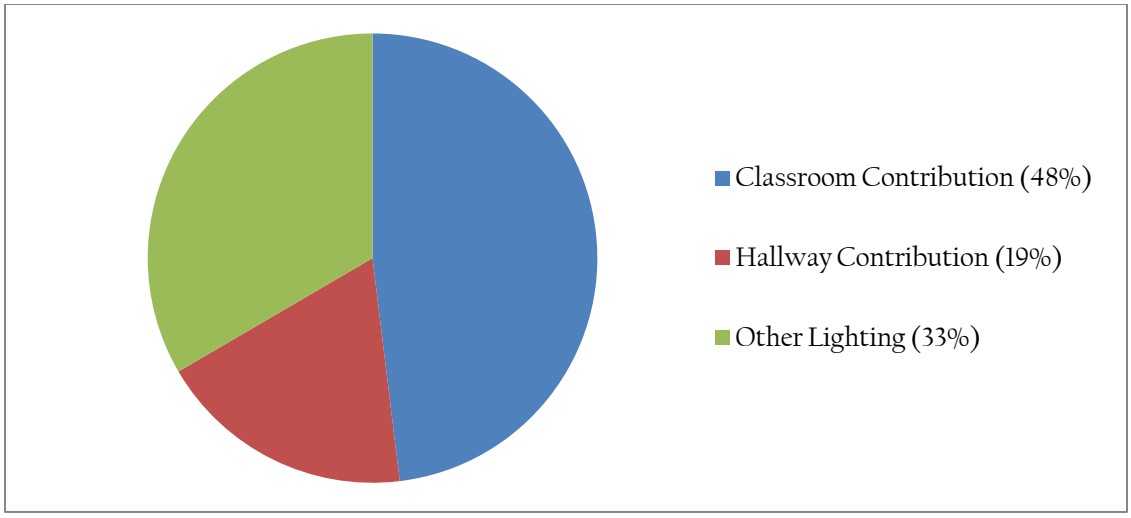

Figure 5. Contribution of hallways and classrooms to overall lighting demand (59,840 kWh/yr).

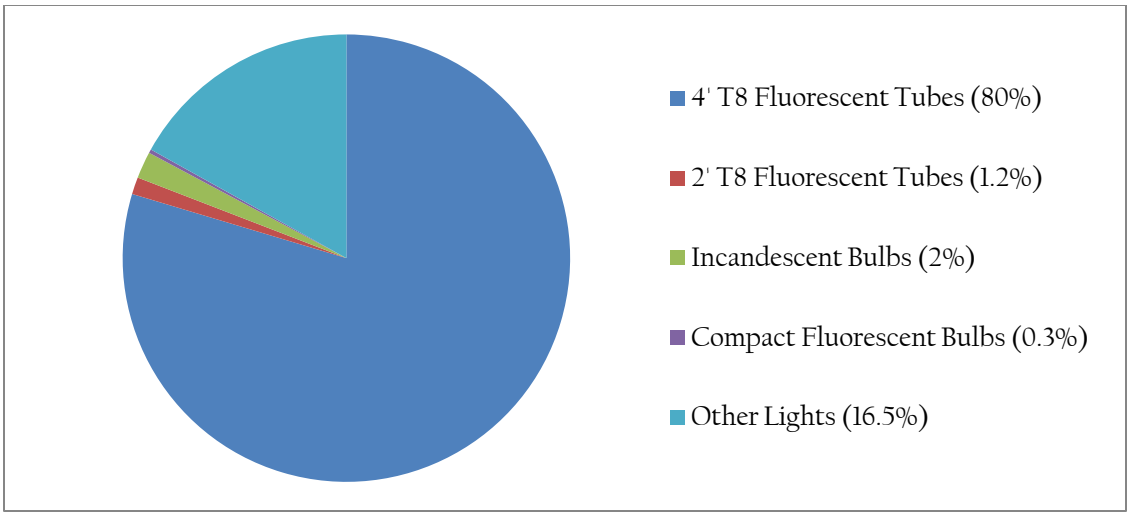

Figure 6. Contribution of different lighting fixtures to overall lighting demand (59,840 kWh/yr).

Lighting Observations

(1) One of the unique features of Bear Creek Elementary School is the overwhelming lack of windows. Natural lighting is not an option in the majority of classrooms throughout the school building. One notable exception was Classroom #162, which has several high windows which provide adequate levels of light throughout the room in the afternoon hours. The Teachers Lounge also has two large, northwest facing windows which provide adequate natural light during the afternoon. At the time of the audit, both of these areas were fully illuminated with electric lighting, even though they were unoccupied.

(2) Another unique feature of Bear Creek Elementary School is the open classroom areas, which are currently partitioned to provide six individual rooms. During the transition from open to divided classrooms, new wiring was put in place so that teachers could control lighting in their individual spaces. However, there were several situations in which switches inside classrooms controlled lights in the corridor area. For example, the switch to control the lights in Corridor 136 is located inside Classroom 136F.

(3) Based on light meter readings, there weren't many over-lit areas within the school building. However, the coat rooms (133, 174 and 177) are a potential area for de-lamping. These spaces, from my understanding, are used for storing coats and bags during the school day. The illumination requirements for these spaces are lower than for classroom settings, yet the light levels in these coat rooms (45-50 foot-candles) were at the upper end of what was observed in classrooms (30-50 foot-candles).

(4) Motion sensors were installed in schools throughout the district, in part, to reduce energy waste. Several teachers mentioned that their motion sensors are often tripped by moving objects in the room, such as the American Flag or art projects hanging from the ceiling. These movements, created by air flow from the HVAC system, can results in lights being on all night long. The motion sensors also have a 12-15 minute delay. That is 12-15 minutes of extra electricity use for unnecessary lighting.

(5) Lights were on in every student bathroom. The comfort of entering alit bathroom may be important for elementary school children. Many of the light switches were too high for small children to reach, even if they wished to switch them off.

(6) Exterior lights were also partially surveyed during the audit. The southern side of the school was inaccessible due to construction. However, of the 16 exterior lights observed, 5 were on at the time of the audit (approximately 4PM). Information was not gathered about whether these lights are controlled by ambient light levels or a timer. Lighting contributions due to exterior lights were not included in calculations due to the lack of complete data.

(7) At the time of the audit, there were at least 11 unoccupied rooms with all the lights on. One of these spaces (Room 104) was a storage supply closet with the door closed and the lights controlled by switch only.

(8) There were 22 incandescent bulbs in classrooms throughout the building. Some were used for illuminating individual reading areas, some for providing light to classroom pets, and some for aesthetics.

Lighting Recommendations

(1) Teachers, staff and students need to have a conversation about the importance of energy conservation and efficiency at the school, and discuss ways in which they can have an impact.

(a) Teachers and staff should be encouraged to use manual light switches at the end of the school day, to ensure lights are off for the evening. This will not only save 12-15 minutes per room of extra lighting, but will prevent non-human moving objects from tripping the sensors during the course of the night.

(b) Teachers and staff should be encouraged to swap out their incandescent bulbs for compact fluorescent bulbs (or even retire their individual lamps). Incentives can be provided for making this switch, or bulbs can be made available for teachers to use.

(c) Learning about energy conservation and efficiency can be easily incorporated into classroom discussion. Students should be encouraged to think about ways in which they can help improve energy use in their classroom, as well as at home. Student groups can get involved with promoting energy conservation at their school by making stickers and posters about energy-related topics, such as "Turn Me Off When Not in Use" stickers for light switches.

(d) The custodial staff should also be involved in these conversations, as they are major users of the building after-hours. Custodians should only turn on the lights in whatever area of the building they are currently servicing. Light switches should be used to ensure lights are out, instead of relying on motion sensors. Custodians should also report rooms where motion sensors appear to be mal-functioning or rooms in which lights were left on by the teacher or staff member.

(2) Natural lighting has limited ability to replace electric lighting at Bear Creek Elementary School, but it should be embraced where possible.

(a) In the Teachers Lounge, in addition to turning off lights when unoccupied, teachers should rely on natural lighting during the afternoon hours.

(b) Teachers with windows should be encouraged to use natural lighting when possible. In some classrooms, this will require removing posters and art work from windows. These items can be relocated to wall spaces. In addition to providing natural lighting, windows provide a connection for students to the natural world. Some researchers suggest that access to nature, even just visually, can improve students' performance in the classroom and mitigate behavioral issues, such as attention deficit hyperactivity disorder (Louv, 2008).

(c) In some naturally lit spaces, it may be necessary to put in another switch so that nearby, non-naturally lit spaces can be controlled separately. For instance, Classroom 162 receives great afternoon light. However, the switch for the lights in this room also controls the lights in Room 162A, which does not have windows. Adding a separate switch for Room 162A will allow the teacher in Classroom 162 to switch off the overhead lights in the afternoon without negatively impacting the adjacent space.

(3) Motion sensors provide an important energy saving service, when used correctly. However, there are ways to improve their use.

(a) Teachers should be encouraged to use their manual switches when leaving rooms at the end of the day, or for longer periods during the day. Each time a light is switched off, instead of relying on the motion sensor, 12-15 minutes of extra lighting is conserved.

(b) A survey should be conducted to determine which rooms have motion sensors that are being tripped by non-human moving objects (flags, artwork, etc.). Teachers can be encouraged to affix student work to walls instead of hanging from the ceiling. Flags can be relocated so as to be out of the motion sensor's view path.

(c) It will be worth investigating whether the lag time between un-occupancy and lights off can be reduced. The Sustainability Intern will look into the feasibility of this technique.

(4) De-lamping is the process by which fixtures are dismantled so as to prevent the operation of a bulb. It is a useful conservation technique that can be employed in over-lit places. Xcel Energy has a rebate program for de-lamping.

(a) Coat rooms are the most notable areas for de-lamping. Removing a tube from the existing fixtures would cut the electrical demand of these spaces significantly, while still providing adequate levels of light.

(b) De-lamping is also an option for fixtures directly in front of windows. Removing 1-2 lamps from such fixtures will not significantly reduce light levels during cloudy days, but will prevent over-lighting spaces when natural light is abundant. A single classroom (such as 136A) can be chosen for a trial-run this de-lamping process.

(5) Determine whether lights remain on in bathrooms for comfort and safety, or whether it is because switches are merely too high for students to reach.

(a) If there is not a safety/comfort factor, the BVSD electrician can be contacted to install switches at a lower level. In addition, stickers promoting conservation ("Turn me off when not in use") will be affixed below each new switch. The conversion will

offer an opportunity to speak with students about the importance of turning off the lights, whether at school or at home, as a way of conserving energy.

(b) Lights in bathrooms should be switched off at the end of the school day, especially in areas unoccupied by students involved in after-school programs.

(c) Installation of motion sensors in all bathrooms may be another way to ensure student comfort and safety while still conserving energy. According to notes taken during the audit, some, but not all, bathrooms were equipped with sensors.

(6) Ensure exterior lights are only on when ambient light levels have reached a certain level.

(a) Light sensors can be installed on exterior lights to prevent unnecessary lighting during daylight hours.

(b) Exterior lights can be placed on a timer. However, the turn on and shut off times should change throughout the school year, depending on the season.

(c) The District currently requires school buildings to be lit at night. It might be time to have another conversation about the efficiency of this policy. Recent research suggests that lighting campuses at night is not effective at reducing instances of vandalism; it is more suspicious and noticeable if an individual is on school groups with a flashlight. Exterior lights are some of the larger energy users, and revising this "lights on" policy has the potential to significantly reduce costs.

(d) LED light technology for exterior lighting has advanced significantly over the past years. While these lights have much higher up-front costs, the lifetime savings will outweigh this cost differential. The school should consider LED exterior lights in future budget conversations.

(7) The Boulder Valley School District electrician should be contacted to install new switches in several areas of the school.

(a) The switches for all corridor lights should be located in the corridor, not adjacent classrooms. It was noted that Classroom 136F houses the switch for Corridor 136. There may be other locations in the school where this is the case.

(b) See 2(c) above.

Estimated Cost Savings Associated with Lighting Recommendations

Deciding which recommendations to pursue first can be a difficult task. Some recommendations require increased communication and education of electricity users, while others will require time and monetary investments. The table below outlines estimated savings associated with each recommendation category. These estimates are meant to show the magnitude of savings associated with each response, but will vary depending on actual implementation.

Recommendation	kWh Saved in 10 Years	$ Saved in 10 Years
(1) Increase Natural Lighting Use	3,500	$455
(2) De-Lamping in Overlit Areas[$]	13,000	$1,700
(3) Motion Sensors[$]	17,500	$2,300
(4) Bathroom Lighting	1,800	$235
(5) Exterior Lighting[$$]	58,000	$7,500
(6) Incandescent to CFL[$]	2,000	$260
(7) Conversion to 28W T8s[$]	61,000	$7,900

$ = moderate costs associated with labor inputs, $$ = high upfront capital investment

Assumptions:

(1) Rely on natural lighting, instead of electric lighting, in Teachers Lounge and Classroom #162 for just 2 hours a day, 150 days per year.

(2) Remove 3 bulbs from each of the following Classrooms: 138C, 138F, 136A, 168. Remove 2 bulbs for each of the following Rooms: 177, 174, 105, 103 and 133.

(3) Reduce motion sensor lag time from 15 minutes to 8 minutes. Assume sensors switch off lights twice during the school day; reducing lag time will save 14 minutes of excess lighting. Turning lights off completely at the end of the day saves 15 minutes of extra lighting from all motion sensor controlled lights.

(4) Lighting in bathrooms is reduced by 2 hours per day.

(5) Exterior lighting hours are reduced by 1 hour per day, every day of the year. Significantly more cost savings could be realized by converting to LED lamps, as indicated by the high upfront initial cost symbol in table above.

(6) All incandescent bulbs are converted to compact fluorescent bulbs (14 W), but run the same number of hours per day.

(7) The District plans to begin stocking 28W, 4' T8 bulbs instead of the current 32W model. These will be swapped in as existing bulbs reach the end of their life.

Personal Appliance Data

Major Appliances:

Desktop Computers (130W/5W): 77
Electric Pencil Sharpeners (20W): 17
Full-Size Fridges (600W): 2
Laptop Computers (65W/5W): 10
Microwaves (1200W/3W): 4
Mini-Fridges (100W): 3
Personal Fans (660W): 20
Stereos (400W/4W): 9
Other Appliances (wattages vary): 44

Wattage values (on/standby) based on data collected by Monarch K-8 and the Lawrence Berkeley National Lab.

Assumptions about Usage:

Computers: On 5 hrs/day, Standby 2 hrs/day
Pencil Sharpeners: 1 min/day
Full-Size Fridges: Always On
Microwaves: On 30 min/day, Standby remainder of year
Mini-Fridges: Always On
Personal Fans: On 4 hrs/day, 60 days/yr
Stereos: On 50 hrs/yr, Standby remainder of year
Other Appliances: Usage varies (see attached calculations)

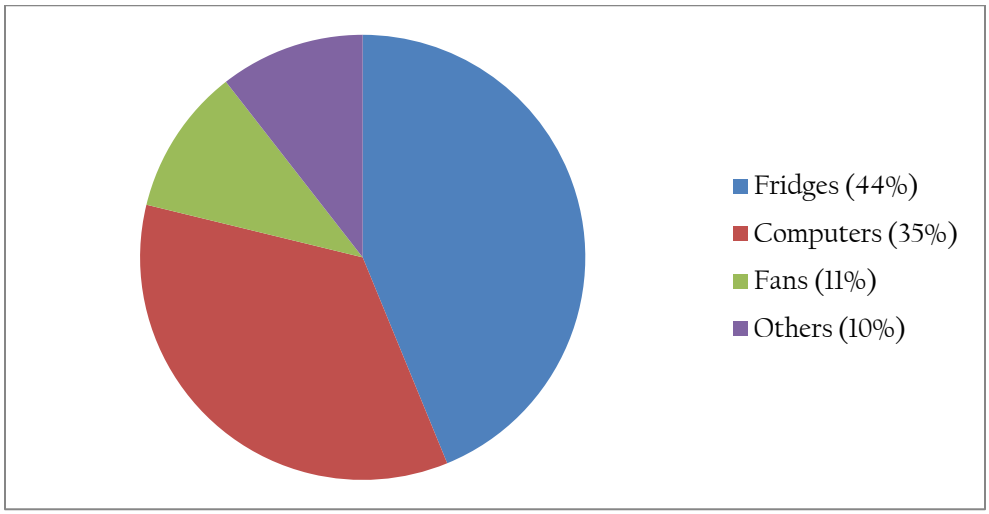

Figure 7. Contribution of different appliances to overall appliance electricity demand. Annual appliance electrical use is estimated to be 30,700 kWh.

Personal Appliance Observations

(1) Refrigerators are the largest users of electricity in the personal appliance category because they are always running. The mini-fridge in Classroom 136C contained only a container of lemon juice at the time of the audit. There was also a mini-fridge in Classroom 162 (containing a small lunch) and in the nurse's office. A full-size fridge was located in the Teachers Lounge, and a second in the lunchroom for use by the YMCA afterschool program.

(2) The majority of computers in the school were Energy Star rated.

(3) There were two microwaves in the Teachers Lounge.

(4) The majority of smaller appliances (stereos, fans, pencil sharpeners) were plugged in. Some were plugged into power strips, but many were not.

Personal Appliance Recommendations

(1) Teachers and staff should be encouraged to unplug all appliances when not in use.

(a) Educate staff and students about why unplugging is an important component of energy conservation. Many appliances, especially those with clocks or lit components, are always drawing energy when plugged in. These energy losses are referred to as "phantom or "vampire" energy losses. Exploring these energy vampires can be incorporated into the classroom curriculum.

(b) Appliances, especially those utilized by students, should be plugged into power strips. Power strips not only allow the user to quickly turn off several units at once, but they mitigate dangers associated with electrical outlets. Power strips do still draw small amounts of energy and, therefore, they are most effective when several appliances are plugged in (replacing many vampire energy sources with just one).

(c) Replace electric appliances with manual ones, where possible. In the future, the school should chose to purchase manual appliances (pencil sharpeners, staplers, hole-punchers) instead of ones that use energy.

(d) At the end of the school year, all teachers and staff should be required to unplugged appliances that will not be in use over the summer. The custodial staff can do a final sweep to ensure there are no unnecessary energy draws during the summer months.

(2) Reduce energy use by computers.

(a) The District has recently begun to use a computer management software tool which remotely powers computers down to a very low level (~1.2W). This software will help reduce energy losses while computers are not in use. This step has already been taken by the District and will require no additional effort on behalf of individual schools.

(b) While the District requires computers to remain on at all times so that ITS can provide remote support, individual can still switch off their computer monitors. Turning off the monitors can save small amounts of energy that will add up over time. Individual teachers, as well as computer room staff, should be encouraged to turn off their monitors when not in use.

(3) Mini-fridges should be retired.

(a) Teachers in Classrooms 136C and 162 should be encouraged to retire their mini-fridges and rely on the fridge provided in the Teachers Lounge for storing their food items.

(b) The mini-fridge in the Nurse's Office should only be retired if the nurse uses it for storage of personal food items.

(c) Fridges should be defrosted and unplugged during the summer months when school is not in session.

(4) One of the two microwaves in the Teachers' Lounge should be retired.

(a) The older microwave with higher energy requirements should be retired.

(b) Microwaves continuously draw a small amount of standby energy. Microwaves should be fully unplugged during the summer and other longer holidays. Better yet, they should be unplugged in between uses.

(c) Microwave ovens are currently non Energy Star rated, but when such a product becomes available, the existing microwave should be replaced, budget allowing.

(5) Energy-Star everywhere!

(a) The majority of desktop and laptop computers are Energy-Star rated. Any remaining computers should be replaced, budget allowing.

(b) Other appliances should be swapped for Energy Star equivalents when possible.

Estimated Cost Savings Associated with Appliance Recommendations

Deciding which recommendations to pursue first can be a difficult task. Some recommendations require increased communication and education of electricity users, while others will require time and monetary investments. The table below outlines estimated savings associated with each recommendation category. These estimates are meant to show the magnitude of savings associated with each response, but will vary depending on actual implementation.

Recommendation	**kWh Saved in 10 years**	**$ Saved in 10 years**
(1) Power Strip, Unplug	10,000	$1,300
(2) Monitors Off	32,000	$4,150
(3) Retire Mini-Fridges	18,000	$2,300
(4) Retire Microwave	1,000	$130

Assumptions:

(1) Assume no stand-by power is needed for appliances.
(2) Assume turning monitors off (instead of sleep mode) reduces energy demand by 11W during non-use times.
(3) 2 mini-fridges are retired.
(4) 1 microwave is retired

Conclusions

Bear Creek Elementary School was chosen for the lighting and personal appliance audit because it is a higher energy user among Boulder Valley School District Elementary Schools. This audit has identified areas for improvement in regards to both lighting and personal appliance use. These recommendations fall under the general categories of energy conservation of energy efficiency. Many of these recommendations can be implemented merely through education of students, teachers and staff members (turning off lights, unplugging appliances). Other recommendations will require the school to work with BVSD personnel (installation of new light switching, upgrading exterior lights). Some of these recommendations are low or no-cost, while others will require the school to invest a portion of their budget. Each upgrade will reduce overall electricity use, saving the District money. Most importantly, each upgrade or behavioral change can be used as a learning opportunity for students, helping to creating sustainable, conscientious global citizens.

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Lighting Appendix

Room Description	Fixture Type	#	Wattage (W)	Hours per Day	Days per Year	kWh per Year
Art Supply Room	4' T8 Fluorescent	4	32	2	225	57.6
Bathroom	2' T8 Fluorescent	1	17	10.5	225	40.1625
Bathroom	2' T8 Fluorescent	1	17	10.5	225	40.1625
Bathroom	2' T8 Fluorescent	1	17	10.5	225	40.1625
Bathroom	2' T8 Fluorescent	2	17	1	225	7.65
Bathroom	2' T8 Fluorescent	1	17	2	225	7.65
Bathroom	2' T8 Fluorescent	2	17	1	225	7.65
Bathroom	2' T8 Fluorescent	1	17	10	225	38.25
Bathroom	2' T8 Fluorescent	2	17	2	225	15.3
Bathroom	4' T8 Fluorescent	1	32	10.5	225	75.6
Bathroom	4' T8 Fluorescent	2	32	10.5	225	151.2
Bathroom	4' T8 Fluorescent	1	32	10.5	225	75.6
Bathroom	4' T8 Fluorescent	1	32	10.5	225	75.6
Bathroom	4' T8 Fluorescent	2	32	10.5	225	151.2
Bathroom	4' T8 Fluorescent	1	32	10.5	225	75.6
Cafeteria	4' T8 Fluorescent	14	32	6	225	604.8
Cafeteria	4' T8 Fluorescent	48	32	6	225	2073.6
Classroom	4' T8 Fluorescent	32	32	9	225	2073.6
Classroom	4' T8 Fluorescent	32	32	9	225	2073.6
Classroom	4' T8 Fluorescent	40	32	9	225	2592
Classroom	4' T8 Fluorescent	34	32	9	225	2203.2
Classroom	4' T8 Fluorescent	24	32	9	225	1555.2
Classroom	4' T8 Fluorescent	24	32	9	225	1555.2
Classroom	4' T8 Fluorescent	28	32	9	225	1814.4
Classroom	4' T8 Fluorescent	30	32	9	225	1944
Classroom	4' T8 Fluorescent	36	32	9	225	2332.8
Classroom	4' T8 Fluorescent	36	32	9	225	2332.8
Classroom	4' T8 Fluorescent	28	32	9	225	1814.4
Classroom	4' T8 Fluorescent	30	32	9	225	1944
Classroom	4' T8 Fluorescent	13	32	9	225	842.4
Classroom	4' T8 Fluorescent	31	32	9	225	2008.8
Classroom	4' T8 Fluorescent	9	32	9	225	583.2
Classroom	4' T8 Fluorescent	12	32	9	225	777.6
Classroom	CFL	1	13	1	225	2.925
Classroom	CFL	2	14	1	225	6.3
Classroom	Incandescent	1	60	12	200	144
Classroom	Incandescent	3	60	1	200	36
Classroom	Incandescent	1	75	1	200	15

Classroom	Incandescent	3	40	1	200	24
Classroom	Incandescent	1	40	1	200	8
Classroom	Incandescent	1	60	1	200	12
Classroom	plant grow light	2	50	1	200	20
Classroom	small bulbs	2	50	1	200	20
Coat Room	4' T8 Fluorescent	6	32	6	225	259.2
Coat Room	4' T8 Fluorescent	6	32	6	225	259.2
Coat Room	4' T8 Fluorescent	6	32	6	225	259.2
Computer Room	4' T8 Fluorescent	20	32	8	225	1152
Conference Room	4' T8 Fluorescent	8	32	1	225	57.6
Copy Room	4' T8 Fluorescent	3	32	10	225	216
Copy Room	4' T8 Fluorescent	4	32	10	225	288
Copy Room	Incandescent	1	60	1	200	12
Corridor	4' T8 Fluorescent	12	32	13	225	1123.2
Corridor	4' T8 Fluorescent	22	32	13	225	2059.2
Corridor	4' T8 Fluorescent	6	32	13	225	561.6
Corridor	4' T8 Fluorescent	12	32	13	225	1123.2
Corridor	4' T8 Fluorescent	12	32	13	225	1123.2
Corridor	4' T8 Fluorescent	14	32	13	225	1310.4
Corridor	4' T8 Fluorescent	14	32	13	225	1310.4
Corridor	4' T8 Fluorescent	2	32	13	225	187.2
Corridor	4' T8 Fluorescent	7	32	13	225	655.2
Corridor	4' T8 Fluorescent	3	32	13	225	280.8
Corridor	Spotlights	6	75	0	200	0
Entranceway	4' T8 Fluorescent	1	32	13	225	93.6
Entranceway	4' T8 Fluorescent	1	32	13	225	93.6
Entranceway	4' T8 Fluorescent	1	32	13	225	93.6
Entranceway	4' T8 Fluorescent	1	32	13	225	93.6
Entranceway	4' T8 Fluorescent	1	32	13	225	93.6
Gym	Bay Lights	10	200	10	225	4500
Kitchen	4' T8 Fluorescent	18	32	10	225	1296
Kitchen	Incandescent	4	60	1	200	48
Library	4' T8 Fluorescent	52	32	10.5	225	3931.2
Library	X-mas Lights	150	0.25	0	200	0
Main Office	4' T8 Fluorescent	10	32	10.5	225	756
Modified Classroom	4' T8 Fluorescent	6	32	10.5	225	453.6
Modified Classroom	Incandescent	1	60	1	200	12
Modified Classroom	Incandescent	2	100	1	200	40
Music Room	4' T8 Fluorescent	24	32	10	225	1728
Nurses Room	4' T8 Fluorescent	8	32	10	225	576
Principals Office	4' T8 Fluorescent	10	32	6	225	432

Resource Room	4' T8 Fluorescent	8	32	6	225	345.6
Resource Room	Incandescent	4	60	1	200	48
Stage Area	4' T8 Fluorescent	13	32	2	225	187.2
Stage Area	Spotlights	12	75	0.01	200	1.8
Storage Closet	4' T8 Fluorescent	1	32	0.01	225	0.072
Storage Room	4' T8 Fluorescent	1	32	0.01	225	0.072
Storage Supply Closet	4' T8 Fluorescent	2	32	0.01	225	0.144
Supply Room	4' T8 Fluorescent	4	32	1	225	28.8
Supply Room	4' T8 Fluorescent	3	32	1	225	21.6
Teachers Lounge	4' T8 Fluorescent	4	32	10	225	288
Unaccessed	2' T8 Fluorescent	1	17		225	0
Unaccessed	2' T8 Fluorescent	1	17		225	0
Unaccessed	2' T8 Fluorescent	1	17		225	0
Unaccessed	4' T8 Fluorescent	4	32		225	0
Unaccessed	4' T8 Fluorescent	2	32		225	0
Unaccessed	4' T8 Fluorescent	2	32		225	0
Unaccessed	4' T8 Fluorescent	18	32		225	0
Unaccessed	4' T8 Fluorescent	1	32		225	0
Unaccessed	4' T8 Fluorescent	1	32		225	0
Unaccessed	4' T8 Fluorescent	2	32		225	0
Unaccessed	4' T8 Fluorescent	6	32		225	0
Unaccessed	4' T8 Fluorescent	1	32		225	0
Unaccessed	4' T8 Fluorescent	2	32		225	0
Unaccessed	4' T8 Fluorescent	18	32		225	0
Unaccessed	4' T8 Fluorescent	1	32		225	0
Unaccessed	4' T8 Fluorescent	1	32		225	0
Unaccessed	4' T8 Fluorescent	1	32		225	0
Unaccessed	Spotlights	10	75	0.01	200	1.5
Unaccessed	4' T8 Fluorescent	4	32	10	225	288

Assumptions:

-The School Year is 180 student days; however the building is in use throughout the year. It is assumed the building is fully occupied for 225 days per year in an attempt to capture these other uses.

-Information about inaccessible (due to construction) areas was gathered from architectural lighting plan diagrams. These areas were not included in calculations because their usage is uncertain at this time.

-Lighting usage per day varies based on room type. The typical school day is 8:30AM-3:00PM (6.5hrs) but the building is in use, in one form or another, earlier in the mornings and into the evenings. The estimated usage times attempt to capture all these lighting demand times.

Personal Appliance Appendix

Appliance	Number	Wattage (on/standby)	Hours (on/standby)	Days/Yr (on/standby)	kWh/yr
Air Purifier	4	400	1	200	320.0
Coffee Maker	1	825/3	0.5/23.5	200/365	108.2
Copy Machine	2	1300/10	1/23	200/365	687.9
Desktop Computers	77	130/5	5/2	200/200	10737.3
Dishwasher	1	1800	1	60	108.0
DVD Player	2	25/7.5	0.25/23.75	100/365	131.3
Fan	20	660	4	60	3168.0
Hand Vacuum	1	660	1	15	9.9
Laptop Computer	10	65/5	4/2	120/120	324.0
Large Fridge	1	600	24	365	5256.0
Large TV/DVD	1	150/3	2/22	15/365	28.6
Microwave	4	1200/3	0.5/23.5	120/365	390.9
Mini Fridge	3	100	24	365	2628.0
Overhead Projector	9	340/5	1/23	100/180	492.3
Paper Shredder	2	175/.25	0.25/23.75	20/365	6.1
Pencil Sharpner	17	20	0.02	100	0.6
Printer	10	50/5	0.5/23.5	60/365	443.9
Radio	4	10	1	50	2.0
Radio Clock	2	10/2	1/23	50/365	34.6
Stapler	1	100	0.25	50	1.3
Stereo	9	400/4	1/23	50/365	482.2
Tape Player	2	100/0.25	1/23	15/15	3.2
TV/VCR	1	95/3	2/22	15/365	26.9
VCR	1	27/5	2/22	15/365	41.0
YMCA tall fridge	1	600	24	365	5256.0

Assumptions:

-Each appliance has electrical uses associated with direct use, as well as smaller electrical demands while on stand-by. Information is unavailable about the standby power on some appliances.

-Wattage (on/standby) values come from Monarch K-8 and the Lawrence Berkeley National Lab.

-Hours and days (on/standby) are estimates and actual usage amounts will vary. The calculated kWh/yr values represent the magnitude of electricity used by each appliance type.