McLaughlin Lighting Retrofit

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Project background

We were requested to provide our client (McLaughlin Reserve management) with a report on current lighting fixture technologies and sufficient information on upgrading lights that are compatible with the current system.

To satisfy our clients' needs, a low range, mid range, and high range cost option for upgraded lighting systems will be explored. Emphasis will be set on researching various control systems which include integrated occupancy and light sensors. A cost analysis will be provided which includes the effect of potential PG&E rebates awarded to replacing energy inefficient fixtures. The goal is to provide our client with sufficient information to take actions to replace the lights (i.e. providing them with a quote for new lights from a lighting rep).

Some of the benefits through the realization of our efforts include providing on site energy savings, improving on site occupant comfort level, protecting on site environmental stewardship, and reaching UC commitment towards carbon neutrality initiative in 2025.

Methodology

Preliminary Research on Light Technology

Our approach to this project is first through extensive lighting technology research. We accomplished this task through communicating with field experts from the California Lighting Technology Center, energy data analysts from the Energy Conservation Office, and technology director from the Program for International Energy Technologies. Through meeting with them, we learned how to identify different types of ballasts (magnetic or electronic), PG&E rebate options (for cost analysis), case studies of similar lighting retrofit projects, and pros and cons of different lighting design and zoning options.

Their advice on our project scoping and their networks from the lighting industry paved our way to completing this project.

Site Visit & Data Collection

After gaining a sufficient understanding of various lighting technologies, we visited the site and met our client in person. We identified our clients' lighting usage needs (functional needs for different types of lighting) and operating patterns (use of lights in a typical day). Through walking the facility and examining existing lighting lamps and fixtures (make and model, distribution count, performance), we got a hold of the existing on site situation.

Further Research

We furthered our findings on existing lighting distribution through looking closely into facility lighting fixture drawings. Using specs from the manufacturer's website (General Electric), we then calculated the total energy usage with the lumen and wattage data and occupancy pattern

data.

Contact Reps

To provide our client with a realistic quote towards a lighting retrofit for the facility, we contacted multiple lighting representatives in the Sacramento region. Using proper lighting language (such as “2x4 recessed fluorescent troffer with 4 lamps”), we were able to quickly receive replacements of LED lighting suggestions from the reps. Their recommendations were extremely beneficial for our understandings.

Current System

The reserve currently has a total of 46 sodium lights and 228 fluorescent lights for the fiied station and warehouse. Below are the descriptions of each light and the locations. We also did a cost analysis of the current system which shows how much it cost to operate per year based on the occupation data we received (FS = Field Station, WH = Wearhouse*).

Item	Location	Count	Power per Appliance (W)	Annual Usage Hours	Annual Energy Use (kWh)
Field Station					
AV8 - 4 - 132	Bathrooms	6	32	446	85.632
PVSL60 Shower Light	Bathrooms	4	26	116.5	12.116
2 - T12 - 34	Entryway	5	72	466	167.76
2 - T12 - 34	Hallways	17	72	466	570.384
2 - T12 - 34	Offices/Misc	8	72	116.5	67.104
3 - T12 - 34	Offices/Misc	4	115	116.5	53.59
4 - T12 - 34	Offices/Misc	8	144	116.5	134.208
2 - T12 - 34	Kitchen	3	72	699	150.984
4 - T12 - 34	Living Room	7	144	466	469.728
2 - T12 - 34	Living Room	8	72	466	268.416
4 - T12 - 34	Bedrooms	11	144	185	293.04
2 - T12 - 34	Bedrooms	10	72	185	133.2
Warehouse					
4 - T12 - 34	Mining Gym	14	144	125	252
2 - T12 - 34	Mining Hallway	8	72	280	161.28
1 - T12 - 34	Mining Hallway	1	43	280	12.04
2 - T12 - 34	Mining Locker Room	27	72	96	186.624
1 - T12 - 34	Mining Locker Room	1	43	96	4.128
4 - T12 - 34	Mining Office 1st floor	6	4	500	12
2 - T12 - 34	Mining Office 2nd floor	29	72	1500	3132
Sodium Lights	Mining Storage Room	23	250	384	2208
2 - T12 - 34	Shared bathroom 2nd floor	2	72	375	54
2 - T12 - 34	UC Bathroom	1	72	125	9
4 - T12 - 34	UC Common Room	15	144	200	432
2 - T12 - 34	UC Hallway	1	72	250	18
4 - T12 - 34	UC Office 2nd floor	32	144	500	2304
Sodium Lights	UC Storage Room	23	250	140	805
				FS TOTAL	2406.162
				WH TOTAL	9590.072
				OVERALL	11996.234
Misc Data:					
WH Troffers Cost	1381.18512			Cost/yr	2519.20914
High Bays Cost	632.73				
FS Troffers Cost	484.76694				

Lighting Key

Item	Description	Actual Wattage
1 - T12 - 34	1 Lamp 34W T12 Fluorescent Lighting with Instant Strike Magnetic Ballast	43 W
2 - T12 - 34	2 Lamp 34W T12 Fluorescent Lighting with Instant Strike Magnetic Ballast	72W

3 - T12 - 34	3 Lamp 34W T12 Fluorescent Lighting with Instant Strike Magnetic Ballast	115W
4 - T12 - 34	4 Lamp 34W T12 Fluorescent Lighting with Instant Strike Magnetic Ballast	114W
Sodium Lights	14674 - GE Ecolux® Lucalox® High Pressure Sodium ED18 250W	250W
PVSL60 Shower Light	HE Williams PVSL60 Round Shower Light- Vertical Lamp 26W	26W
AV8 - 4 - 132	HE Williams 8” WIDE ARCHITECTURAL VANDAL WRAP. 1 Lamp. T8 4" Length. 32W	32W

*Floor plans for the field station and warehouse included at the end of this report

Results & Discussion

Available Lighting Technology

CJS Lighting, a local lighting technology representative in Roseville,CA, was contacted in order to provide modern LED light fixtures and controls that are comparable to those installed in the current system at the McLaughlin Reserve. A summary of the results of their quote are below.

LED Troffers

Lumens: 4,000
Watts: 32.4W
Cost per Fixture: $172
Controls: Manual Dimming Controls, Motion Sensor Compatible
Life Cycle: 90% LED lumen maintenance at 50,000 hours
Description: LBL LED wraparound provides a digital lighting platform to deliver general ambient lighting for surface-mount applications. The LED system delivers long life and excellent color to ensure a quality, low-maintenance lighting installation. Ideal for closets, storage rooms, hallways, stairwells and offices.

Lumens: 4,529
Watts: 32W
Cost per Fixture: $190
Controls: nLight compatible, Motion Sensor Compatible
Life Cycle: 80% LED lumen maintenance at 60,000 hours
Description: The BLTR Best-Value Low Profile LED Relight Assembly is a cost effective solution for renovating existing fluorescent troffer and parabolic fixtures while providing upgraded aesthetics and outstanding performance. The BLTR's popular center basket design offers a clean, versatile style, and volumetric distribution. The wide range of lumen packages and control and driver options make the BLTR a great choice for many applications including offices, schools, hospitals, retail spaces and other general lighting applications.

Lumens: 4,500
Watts: 33.2Wh
Cost per Fixture: $272
Controls: nLight compatible, Motion Sensor Compatible
Life Cycle: 80% LED lumen maintenance at 60,000 hours
Description: The VT Series Volumetric LED Troffer (VTL) combines the aesthetics and high performance with intelligent LED engines for applications such as offices, schools, retail locations and hospitals. High-efficacy light engines deliver long life and excellent color, ensuring a superior quality lighting installation that is highly efficient and sustainable. Multiple lumen packages and driver options provide solutions for all your lighting applications. Featured nLight control system provides design flexibility and ease of installation and optimum energy savings.

LED High Bays

Lumens: 22,000
Watts: 166W
Cost per Fixture: $212
Controls: Motion Sensor Compatible
Life Cycle: 70% lumen maintenance at >100,000 hours.
Description: Ideal one-for-one replacement of conventional lighting systems such as HID and fluorescent. For use in light Industrial applications such as, warehousing and other large indoor spaces with mounting heights ranging from 10' – permitted .

Lumens: 24,000
Watts: 172W
Cost per Fixture: $370
Controls: 0-100% Dimming, Zone Control, Bluetooth
Life Cycle: 88% Lumen Maintenance at 60,000 hours, 70% >100,000 hours.
Description: Ideal one-for-one replacement of conventional HID and fluorescent high bay systems. Applications include warehousing, manufacturing, gymnasiums, and other large indoor spaces with mounting heights up to 60'.

Lighting Control Technology

Cost: $54

Description: The nLight® AIR rPODB is a wireless, battery-powered wall switch including toggle and/or raise lower features with optional multi-pole control. It provides a user with local control of a lighting zone. A true wire-free switch, these single gang decorator style devices have soft-click buttons and a green LED indicator for each button. The rPODB wall switches communicate with other nLight AIR devices via radio frequency (RF). A battery-powered wall switch can work with any nLight AIR enabled fixture or power pack to provide toggle switch operation. Wall switches with the DX option have the added ability to adjust the level of any nLight AIR controlled dimmable light fixture.

Cost: $174
Description: The rCMS family of nLight AIR-enabled wireless ceiling/surface mount occupancy sensors provide a range of sensor solutions for applications with finished ceilings (e.g. ceiling tiles, sheetrock, plaster). The rCMS family sensors utilize digital Passive Infrared (PIR) detection and are available with several lens options, providing flexibility for multiple mounting height and coverage pattern requirements. Dual technology occupancy detection can also be added as an option for applications where occupants are stationary for long periods of time. All sensors have integrated on/off photocells, with automatic daylight harvesting/dimming control standard. Additionally, the rCMS family sensors are also available with an optional auxiliary low voltage relay for simple integration with a BMS system or other building system.

Energy Savings

The results of the quote from CJS Lighting were implemented into our energy audit model to predict potential energy savings. Potential savings from using the fixtures' dimming options were not considered. Savings from lowering the lights in the warehouse and using less lighting fixtures were also not considered. Fixtures were considered to be replaced 1:1 and an average wattage of 32W and 170W were used for the troffers and high bays respectively. A

more accurate audit would conduct a study in required lumens per square foot in the office and storage spaces, and adjust the number of fixtures in each room. Dimming options and their effect on total wattage would also be considered. Therefore, any reported savings are the minimum potential savings assuming the occupancy data provided by the McLaughlin Reserve is correct and consistent.

Projected Energy Audit with New Lighting Technology					
Item	**Location**	**Count**	**Power per Appliance (W)**	**Annual Usage Hours**	**Annual Energy Use (kWh)**
Field Station					
AV8 - 4 - 132	Bathrooms	6	32	446	85.632
PVSL60 Shower Light	Bathrooms	4	26	116.5	12.116
New LED's	Entryway	5	32	466	74.56
New LED's	Hallways	17	32	466	253.504
New LED's	Offices/Misc	8	32	116.5	29.824
New LED's	Offices/Misc	4	32	116.5	14.912
New LED's	Offices/Misc	8	32	116.5	29.824
New LED's	Kitchen	3	32	699	67.104
New LED's	Living Room	7	32	466	104.384
New LED's	Living Room	8	32	466	119.296
New LED's	Bedrooms	11	32	185	65.12
New LED's	Bedrooms	10	32	185	59.2
Item	**Location**	**Count**	**Power per Appliance (W)**	**Annual Usage Hours**	**Annual Energy Use (kWh)**
Warehouse					
New LED's	Mining Gym	14	32	125	56
New LED's	Mining Hallway	8	32	280	71.68
New LED's	Mining Hallway	1	32	280	8.96
New LED's	Mining Locker Room	27	32	96	82.944
New LED's	Mining Locker Room	1	32	96	3.072
New LED's	Mining Office 1st floor	6	32	500	96

New LED's	Mining Office 2nd floor	29	32	1500	1392
LED High Bays	Mining Storage Room	23	170	384	1501.44
New LED's	Shared bathroom 2nd floor	2	32	375	24
New LED's	UC Bathroom	1	32	125	4
New LED's	UC Common Room	15	32	200	96
New LED's	UC Hallway	1	32	250	8
New LED's	UC Office 2nd floor	32	32	500	512
LED High Bays	UC Storage Room	23	170	140	547.4

Power consumed by each type of fixture (current and projected) is tabulated below to view potential savings by replacing a specific type of fixture. A price per kWh of $0.21 was used.

Fixture Type	Current Est. kWh/year	Projected Est. kWh/year	Est. Minimum Potential Savings per year
Recessed Troffers	2310	800	$315
Surface Mount Troffer	6580	2355	$890
High Bays	3000	2050	$200
		TOTAL:	$1405

Assuming a 1:1 fixture replacement, the total upfront costs (not including installation fees) are tabulated below. PG&E rebates are included in total cost. It is assumed the surface mount troffers in the Warehouse offices will be replaced with the LBL4 Troffer. Recessed troffers have the option of being replaced with either the 2BLTR or 2VTL Troffer. Sodium Vapor lights have the option of being replaced with the IBE or IBG High Bays.

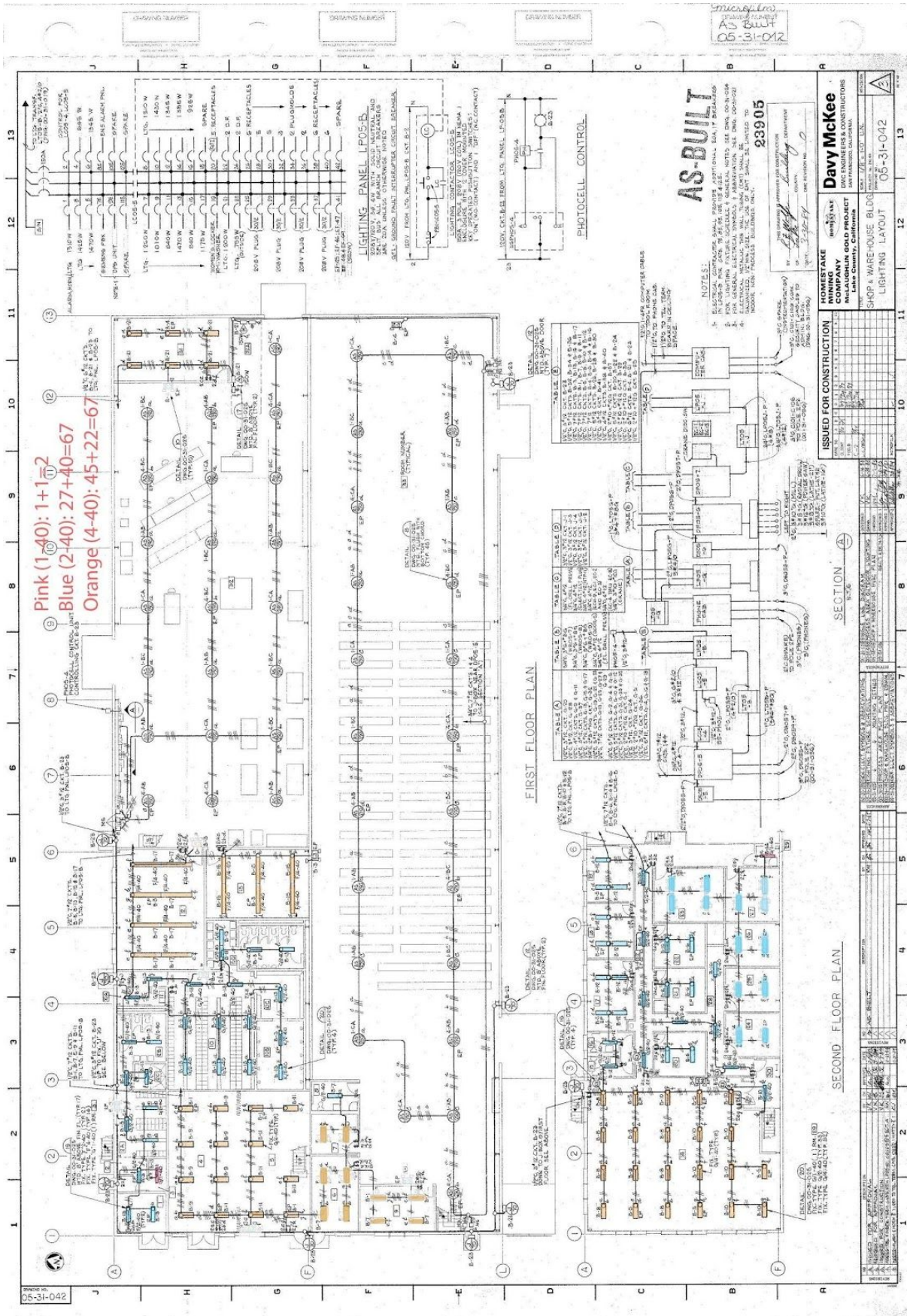
Lighting Option	Cost per Fixture	Count	Pge Rebate	Total Cost
IBE High Bay	$212	46	$55/fixture	$7220
IBG High Bay	$370	46	$55/fixture	$14,490
LBL4 Troffer	$172	137	$21.265/fixture	$20,650
2BLTR Troffer	$190	81	$21.295/fixture	$13,665

2VTL Troffer	$272	81	$22.50/fixture	$20,210

Recommendations & Conclusions

Based on our findings, this retrofit has the potential to produce positive annual energy savings. Although the payback period isn't ideal, it can be shortened by using lighting options that do not have occupancy sensing capabilities integrated into the fixture. In other words, getting cheaper fixtures would lower the payback period. Due to the limited timeframe that we were given, the lighting retrofit we conducted is limited in vendor options, so we suggest contacting more vendors and looking at what other vendors (besides CJS) have to offer. Looking into the PG&E application process should also be done as we assumed our client is eligible for them and no complications would arise. Additional cost, such as installation fees, were not taken into account for this retrofit and may also significantly impact the payback period, so we suggest taking these factors into account as well in the future.

Floor Plans


Pink (1-40): 1+1=2
Blue (2-40): 27+40=67
Orange (4-40): 45+22=67
AS-BUILT
23905
LIGHTING PANEL LP05-B
PHOTOCELL CONTROL
FIRST FLOOR PLAN
SECOND FLOOR PLAN
SECTION
ISSUED FOR CONSTRUCTION
HOMESTAKE MINING COMPANY
McLAUGHLIN GOLD PROJECT
Lake County, California
Davy McKee
SHOP & WAREHOUSE BLDG
LIGHTING LAYOUT
05-31-042

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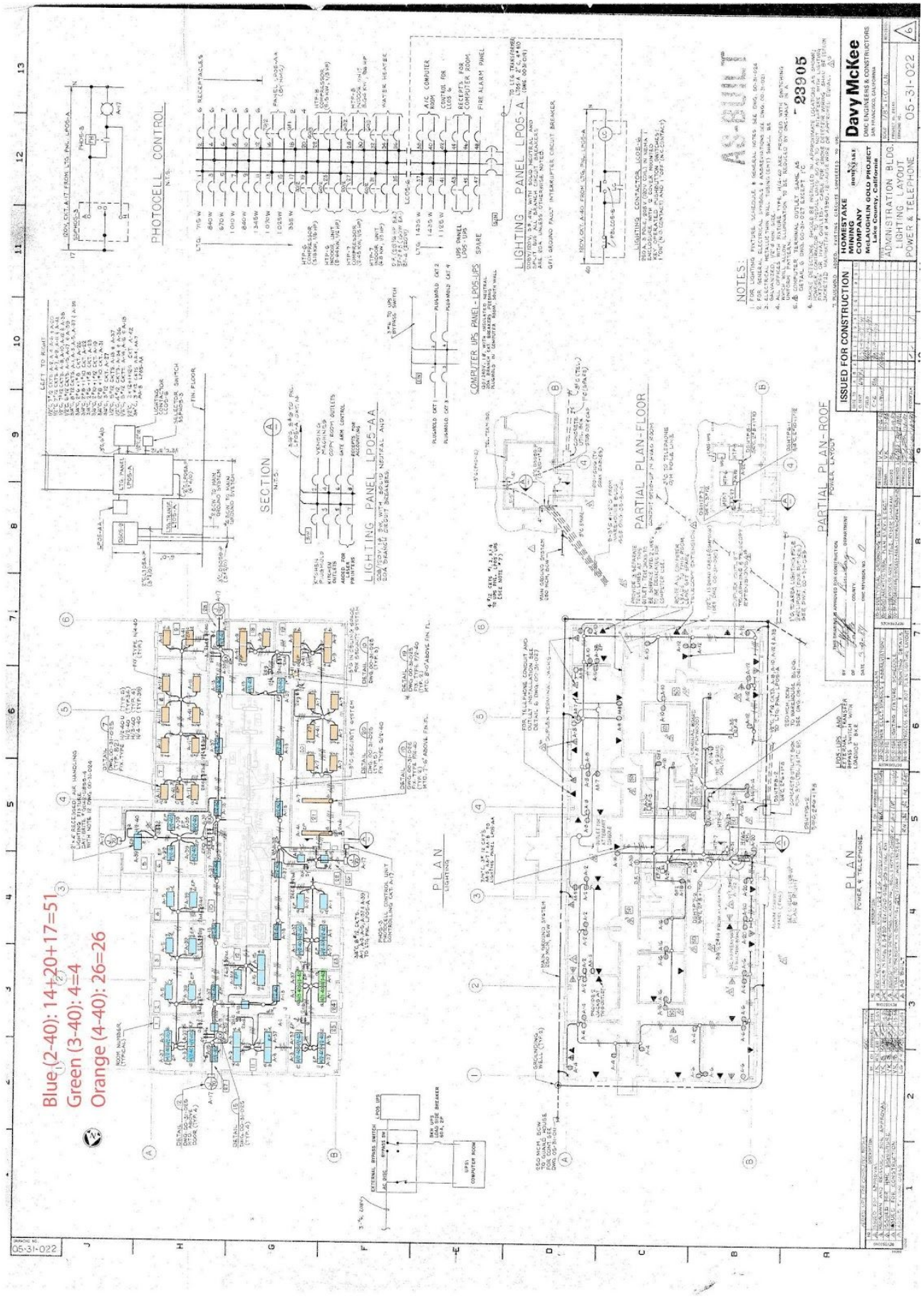
Blue (2-40): 14+20+17=51
Green (3-40): 4=4
Orange (4-40): 26=26
PHOTOCELL CONTROL
SECTION
LIGHTING PANEL LP05-AA
COMPUTER UPS PANEL - LP05-UPS
LIGHTING PANEL LP05-A
PARTIAL PLAN-FLOOR
PARTIAL PLAN-ROOF
NOTES:
ISSUED FOR CONSTRUCTION
HOMESTAKE MINING COMPANY
McLAUGHLIN GOLD PROJECT
Lake County, California
Davy McKee
ADMINISTRATION BLDG.
LIGHTING LAYOUT
POWER & TELEPHONE
05-31-022
23905

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