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ENERGY ENGINEERING AND CONSULTING

Chico Unified School District
Phase Two Solar Feasibility
Analysis and Report

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Chico
Unified School District

CONTENTS

1 BACKGROUND

Chico Unified School District is interested in pursuing the installation of additional solar capacity throughout their properties to offset electrical consumption while generating additional revenue for the District. The District has recently completed the installation of solar generation systems at four school sites and the District Corporate Yard that are currently generating electrical bill savings. The recently completed systems include total to roughly 1.6 megawatts of solar capacity and offset roughly 68% of the electrical load at those sites. The District chose to enter into power purchase agreement (PPA) with the solar installer, SolarCity, for the recently completed projects. In a PPA, rather than purchase the systems outright, the District pays a rate lower than their average Pacific Gas and Electric (PG&E) electricity rate for the solar energy generated from the systems. In total, these systems are projected to generate $3.1 million over the 20 year life of the PPA contracts. The District is now looking to further their solar power generation and increase revenue generation from solar energy generation.

The District has hired Newcomb Anderson McCormick (NAM) to perform a feasibility study and investigate the financial benefit of expanding the District's solar generation capacity in a Phase 2 effort. This report explains different options available to the District for successfully implementing additional solar systems at multiple District sites. The report estimates the net financial benefit over a 25 year period for the different implementation scenarios presented. The report concludes with a recommendation to the District as to the most cost-effective option for a Phase 2 effort.

This report first presents a synopsis of the current California Solar Regulatory Environment. Then a description of solar system construction and solar financial analysis is given. This is followed with the detailed District feasibility investigation for additional solar capacity.

The results of the feasibility analysis indicate that it is feasible for the District to install solar PV systems at fourteen separate school sites and one large additional property. The most cost effective method for the District's pursuit of additional solar is site-by-site load offset. The 25 year net benefit of a comprehensive District installation program yields $10.1 million if the systems are purchased up front at a cost of roughly $8.1 million. The 20 year net benefit of a comprehensive District installation program yields $4.1 million if PPA financing is utilized. Additionally, a large feed-in-tariff system would yield roughly $1.5 million in net benefit over 20 years at an up-front cost of roughly $6 million.

2 California Solar Regulatory Environment

There are several solar PV programs offered by the District's utility company, Pacific Gas and Electric (PG&E). These are programs that can be utilized to further increase the benefits of PV system installations. A few of these are detailed below.

2.1 Net Energy Metering and Time of Use Rate Structures

PG&E customers with onsite renewable energy generation are eligible to participate in PG&E's Net Energy Metering (NEM) program, which gives customers credit for excess electricity production. Under NEM, if a site's PV system produces more electricity than that site uses at any point in the day, the site will receive a credit on their bill for the excess electricity produced. This allows excess production on sunny afternoons to offset the electricity the District will still need to purchase from PG&E during times when the PV system is not producing power.

Time of Use (TOU) rate structures are utility rate structures that charge different amounts for electricity used at different parts of the day. The TOU rates are structured to reflect the Utility's cost of producing electricity at that time. TOU rate structures generally charge the most for electricity during the middle of the day of the summer months, called the peak period TOU. There are several different TOU rate structures offered by PG&E that vary in the peak period TOU price. PG&E customers with onsite solar generation have the opportunity to utilize the A-6 TOU rate structure, which has the highest peak period charge. Utilizing this rate structure at a school site with low energy use during the summer and coupling it with NEM, a site with solar can produce net energy export during the peak period TOU times. Net energy export during the peak period TOU times generates a credit for all exported energy at the peak period TOU price. By utilizing NEM and the available solar TOU rate structure, the financial benefits of a solar system can be maximized.

2.2 California Solar Initiative Incentive

California Senate Bill 1 (SB1) requires utilities to implement incentive programs to encourage customers to invest in high-quality solar energy systems. As an investor owned utility, PG&E uses the incentive program specified by the California Solar Initiative (CSI) to comply with California SB1. The CSI incentive rate declines over the 10 year period from 2007 to 2016 in steps based on the volume of confirmed incentive reservations. Under CSI, PG&E provides an incentive for five years based on the measured system electricity production. PG&E is currently in Step 10 of their program, which offers an incentive of $0.088/kWh produced by the system for the first five years of production. It is recommended that the District participate in this incentive program for all eligible planned PV systems. The financial benefit of the District's participation in the incentive program is discussed in the analysis results included in Section 4.1 of this report. As of the date of this report there are 66.4 megawatts still remaining in step 10 of the CSI program with 2.3 megawatts currently under review for incentive approval. This leaves 64.1 megawatts left for new installations. Although there is a large amount of remaining capacity, it is vital that the District act quickly to make incentive reservations if the decision is made to carry out further solar projects.

2.3 Feed In Tariffs

A "feed-in tariff" (FIT) provides a simple mechanism for small renewable generators to sell power to a utility at predefined terms and conditions, without engaging in time consuming contract negotiations. California has had a FIT program in effect since 2008. The program has generally not resulted in the implementation of many solar projects due to the low purchase price mandated by the enabling legislation (AB 1969). SB 32 and SB 2 (1x) amended California's FIT program, modifying the mechanism for determining the FIT price. On May 24, 2012 the California Public Utilities Commission (CPUC) adopted Decision 12-05-035 implementing this new pricing mechanism, updating program rules, and increasing the size of the program for each Investor Owned Utility in California (IOU). The Decision requires the IOUs to update their tariffs and standard contracts to reflect the new program rules. These documents should be finalized later this year.

2.4 Bill Credit Transfer (RES-BCT)

Renewable Energy Self-Generation - Bill Credit Transfer (RES-BCT) allows the District to install up to 5 MW of renewable generation within its geographic boundary. The excess generation from the RES-BCT system can be used to offset the generation component charges of up to 50 other locations (benefitting accounts) within the same geographic boundary. Unfortunately the other charges associated with rate tariffs (transmission charges, meter charges, demand charges, etc.) are not offsetable under RES-BCT. For this reason no RES-BCT projects have occurred. Until RES-BCT is changed to become financially more appealing, this program will likely not be used. However, a financial analysis was performed utilizing RES-BCT to determine if using this program would be cash flow positive.

2.5 Renewable Energy Credits (RECs)

California Senate Bill 107 (enacted January 1, 2007) defined and authorized a system of Renewable Energy Credits (RECs) that could be traded amongst parties to reach both state mandated and voluntary renewable energy goals. In this system, a party that owns a renewable energy system would be able to sell the "green" attributes of the energy produced to another party wishing to meet renewable energy goals without purchasing renewable energy directly. One REC is equivalent to 1 MWH of "green" energy generation.

The California Public Utilities Commission issued a decision on January 13, 2011, to authorize the use of tradable renewable energy credits (TRECS) for RPS compliance. From the 2010 compliance year through December 31, 2013, the use of TRECS was capped at 25% of a utility's RPS requirement, and the price of a TREC was capped at $50. SBX1-2 of 2011 appears to have put new restrictions on the use of TRECs which the CPUC will implement. According to the law, the use of TREC transactions signed after June 10, 2010 will be capped at 25% for the compliance period ending December 31, 2013, and will shrink to 10% of the requirement by 2017.[1] As the market for RECs is developing, they are excluded from the feasibility analysis as all of the costs and benefits are determined. However, if the District decides to pursue a route

[1] Retrieved January 11, 2012 from, http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA25R&re=0&ee=0

that results in the ownership of RECs, the sale of RECs should be considered as additional source of revenue increasing the total benefit of the systems installed.

It should be noted that if the District sells the RECs from the solar energy produced, the District may not make any claims about the "green" attributes of the energy because those green attributes will be sold along with the REC. As stated above, "green" attributes only refers to the stated environmental benefits of the system. The District will still be gaining the full financial benefit of the system's electricity production in offsetting their utility bill.

3 SOLAR FEASIBILITY METHODS

There are several options available for the District to pursue the continued addition of solar energy for generating revenue from solar. These options take advantage of the various solar regulatory mechanisms previously discussed to maximize the revenue generated from any additional solar capacity added. These options include the continued pursuit of Net Energy Metering (NEM) on a site-by-site basis at District properties. These systems can be funded either through up-front purchase of the systems or through Power Purchase Agreements (PPAs). The District may also pursue the development of larger pieces of land through PGE's Feed-In Tariff (FIT), and Renewable Energy Self-Generation Bill Credit Transfer Programs (RES-BCT). For each of the scenarios discussed, a detailed site assessment is completed to determine the feasible capacity of solar energy that can be installed at each site. The systems' solar energy generation is then modeled to project the annual energy generated by the system. Using this information a financial model is built to project the financial of a system and determine the potential revenue and associated payback periods for the District. The solar system types considered in the site assessments, solar production modeling and the financial modeling procedures are discussed below.

3.1 SOLAR SYSTEM CONSTRUCTION TYPES

There are several methods of installing solar systems. Three of the most common types of installations are; ground mounted, roof mounted, and shade structures. Table 1 includes a brief description of each type of installation and some of the associated benefits and concerns. These three system types are the basis of the site area assessments performed as part of this report. Each method will be considered for the scenarios analyzed.

TABLE 1: SOLAR SYSTEM INSTALLATION OPTIONS

Type	Description	Benefits	Concerns
Ground Mount	Installed low to the ground in a restricted area on a built up racking system	Potentially easiest construction process, variable tilt and orientation	Completely uses installation land area

Roof Mount	Installed directly on building rooftops	No land use obstructions, low cost installation	Potentially difficult DSA approval process, tilt and orientation dictated by roof structure
Shade Structure	High canopy structures generally installed over parking stall aisles or in park type settings	Offers shade for parking or picnic type areas, simple DSA process with DSA pre-check designs available	Installation layouts limited by existing parking/area layout, tilt is limited by structure design, higher construction cost

3.2 Solar System Production Modeling

The potential energy generation from each solar system type is modeled using computer program called PVSyst. The software is the industry standard for calculating solar production. Using the system size, a selected PV module and selected inverter, the production is calculating used TMY3 weather data from the nearest location available in Yuba county, which is the county directly South of Butte county. The weather discrepancy between these counties is negligible. Typical solar panels and inverters were selected: Yingli Solar 250W modules and appropriately sized Advanced Energy or Satcon inverters.

The generation created by PvSyst is hourly data and must be properly binned by the time of year and time of day defined by the PG&E A6 tariff. This binned data is used to offset site energy usage. Since there is no financial benefit to over producing energy over the course of a year, steps are taken to ensure solar systems are sized so that total energy generated is not in excess of total energy usage.

3.3 Financial Modeling

To accurately and appropriately project the potential financial benefit for the District a cash flow model for each scenario is developed to determine the cost effectiveness of each scenario. To estimate the financial benefit of procuring PV systems, the District's utility costs and estimated PV revenue is projected. The cash flow analysis is performed on a site by site basis in order to properly capture each site's utility costs and benefits. For each site, the baseline utility bill without solar is calculated and compared to the predicted utility bill with the proposed solar system.

The escalation of utility costs plays a critical role in determining the magnitude of bill savings, which adds to the revenue received by the District in the financial analysis. In recent studies related to the implementation of the California Renewable Energy Portfolio, the CPUC has used an annual energy escalation rate of 4.47%.[2]

[2] California Public Utility Commission. (2010, March). Introduction to the Net Metering Cost Effectiveness Evaluation. 37. Retrieved June 15, 2012 from, http://www.cpuc.ca.gov/NR/rdonlyres/0F42385A-FDBE-4B76-9AB3-E6AD522DB862/0/nem_combined.pdf

There are several factors that may lead to higher future energy rates, including variability in fuel source prices. With growing uncertainty of fuel source costs, additional costs associated with the increased market volatility may result in further increased utility costs. There is also likely to be further upward pressure on electricity prices from mandates and laws increasing IOU renewable energy procurement, carbon emissions constraints, and smart grid investments. For the purposes of this Feasibility Study and to maintain a conservative projection of utility bills, the financial analysis is performed using a utility escalation of 3.85%.

Assumptions used in the financial analysis are listed in

Table 2 along with notes regarding the source of each value. Further description of the utility rate escalation follows below.

TABLE 2: FINANCIAL ASSUMPTIONS

Financing Assumptions	Value	Source
Utility Rate Escalation	3.85%	CPUC
Utility Rebate ($/kWh)	$0.088	http://www.csi-trigger.com/
Utility Rebate 1 Term (Years)	5	CSI PV Program Handbook
NPV Discount Rate	3%	Typical value for solar projects
Overhead, Management & Contingency	10%	Typical value for solar projects

4 Detailed Feasibility Scenario Investigations

The following section includes the discussion of the different installation scenarios available to the District. First, the site-by-site net energy metering scenario is discussed followed by the discussion of the FIT and RES-BCT scenarios.

4.1 Scenario 1 – Net Energy Metering

Fourteen sites are investigated as potential sites that can benefit from NEM solar systems. Revenue is generated at these sites as a result of utility bill savings and CSI incentive payments. It is assumed that each site is switched to the PG&E A-6 TOU rate structure, and that each system participates in the CSI incentive program. Both lump sum system purchase and PPA financing are considered.

4.1.1 System Costs and System Sizing

As construction conditions vary at each site costs for solar systems vary from. The purchase price of a PV system can vary due to the following factors:

- PV module price
- System size and location
- Operations & Maintenance requirements

- Inclusion of a performance guarantee
- System installation type

All of these factors will vary amongst PV providers and over time. For the purpose of this study a total cost per watt or cost per kilowatt hour is used that includes the system construction cost and the up-front purchase of warranties and maintenance contracts that include all ongoing costs (e.g. operation and maintenance and inverter replacement). Based on recent systems installed and the potential extensive scope of the recommended projects, the cost for per unit capacity of solar power is estimated to be $4.50 per watt installed for lump sum capital costs. The only site that a different price per watt is used to determine the system cost is John A McManus because site considerations indicate more costly system construction. The cost for John A McManus is determined using $5.25 per watt. This metric rolls the capital costs, performance guarantee costs, and operation and maintenance costs into a single system cost. For PPA rates, $0.135 per kilowatt-hour generated is used and is escalated at 3.9% annually. The PPA rate includes performance guarantees and operation and maintenance, but not Overhead, Management, and Contingency.

These costs are considered conservative for the purposes of the feasibility analysis and through a competitive bidding process, prices could be lower. Lower prices will increase the cost effectiveness of the installed systems and the financial benefits realized by the District.

Table 3 outlines the sites investigated for NEM PV systems. The table shows the site meter, current rate, potential system size and type, and potential costs. Typically solar systems are sized to only offset 85% of the energy usage to ensure all generation is utilized throughout the life of the solar system. While 85% offset is desired, systems offsetting between 70% and 80% of the site load were chosen for in order to achieve a conservative financial analysis. The only site that was well off of the desired percent offset is the District Office, which has little viable room to site a well-performing solar system. Table 4 shows each site’s current energy usage, potential PV generation and percent offset for the considered layouts. Depending of the District’s preferences moving forward, larger offsets at each site can be pursued to improve the financial performance of each system.

These estimates are based on typical industry spacing for roof, shade structure, and ground systems. The density of these system types depend on panel tilt, site access, fire lanes, shading concerns, etc. The estimates utilized in this report are conservative in nature. Actual energy densities will vary due to each site’s specific constraints and panels used.

TABLE 3: SYSTEM SIZING FOR THE NEM SITES

Site	Meter	Load Rate	Potential System Size (kW DC)	System Type	Construction Cost
Bidwell Junior High	3876770250	A10SX	280.00	Ground Mount	$1,260,000
Chico Junior High	3876770060	A10S NonTOU	117.60	Shade Structure	$529,200
Citrus	3876770406	A10S	112.00	Shade Structure	$504,000
District Office	3876770105	A10S NonTOU	9.80	Roof Mount	$44,100
Emma Wilson	3876770070	A10S NonTOU	184.30	Shade Structure	$829,350
Fair View High	3876770526	A10S	111.70	Shade Structure	$502,650
Hooker Oak 053	3876770053	A10S	50.30	Shade Structure	$226,350

Hooker Oak 160	3876770160	A1P	50.30	Shade Structure	$226,350
Marigold	3876770270	A1P	104.80	Ground Mount	$471,600
John A McManus	3876770315	A10S NonTOU	158.20	Shade Structure	$830,550
Neal Dow	3876770235	A10S NonTOU	114.50	Shade Structure	$515,250
Parkview	3876770305	A10S NonTOU	133.00	Shade Structure	$598,500
Rosedale	3876770015	A1P	151.50	Shade Structure	$681,750
Shasta	3876770140	A10S NonTOU	109.30	Shade Structure	$491,850
Sierra View	3876770300	A1P	105.30	Shade Structure	$473,850

TABLE 4: ENERGY USAGE, GENERATION, AND OFFSET OF SITES INVESTIGATED

Site	Year One Estimated Energy Usage (kWh)	Year One Estimate Solar Generation (kWh)	Percent Offset
Bidwell Junior High	519,456	399,990	77%
Chico Junior High	223,420	158,894	71%
Citrus	209,256	145,438	70%
District Office	144,579	8,317	6%
Emma Wilson	314,923	256,092	81%
Fair View High	209,624	147,919	71%
Hooker Oak 053	90,593	65,958	73%
Hooker Oak 160	99,936	65,958	66%
Marigold	210,123	148,495	71%
John A McManus	295,260	241,359	82%
Neal Dow	213,084	155,515	73%
Parkview	238,813	177,881	74%
Rosedale	284,613	203,736	72%
Shasta	205,995	147,460	72%
Sierra View	188,510	137,371	73%

Sites considered for solar arrays are generally at least 700 square feet where PV modules can be mounted without being shaded by surrounding trees and buildings. This space needs to be within approximately 600 feet of the site's main electrical switchboard. The PV mounting direction must be mounted at an azimuth (face direction) angle between 90° (East) to 270° (West). The most preferable mounting direction is due south. District staff reviewed the initial layouts to eliminate any areas that were deemed off-limits for the construction of a solar array. For many of the sites, the addition of solar shade structures over playgrounds and the edges of play fields are recommended to offer shade for students during hot fall and spring days. Appendix A includes the detailed layouts for each site considered. An aerial photograph of the site, a table with basic site information and a brief description of site considerations, potential solar system locations and sizing are included for each site.

4.1.2 NEM Cash Flow

The first step to create a NEM cash flow is to establish and forecast a site's energy usage and electricity bill. To do this, each site's historical usage and bill data was collected. This data was averaged to provide typical site energy usage and bill amounts. The average usage data was binned consistent with the appropriate PG&E rate structures. The rates from each PG&E tariff are applied to the binned usage data to calculate an estimate of the first year bill. The calculated first year bill is compared to the historical average bill to ensure these amounts are within an acceptable margin of error. Table 5 shows the actual average yearly bill, calculated yearly bill, and percent differences.

TABLE 5: ACTUAL VERSUS CALCULATED BILL COMPARISON

Site	Actual Yearly Average Bill	Calculated Yearly Bill	Percent Difference
Bidwell Junior High	$82,384	$81,874	-1%
Chico Junior High	$37,237	$36,787	-1%
Citrus	$36,872	$36,427	-1%
District Office	$23,029	$24,028	4%
Emma Wilson	$54,712	$55,145	1%
Fair View High	$36,101	$35,818	-1%
Hooker Oak 053	$15,649	$16,241	4%
Hooker Oak 160	$17,054	$17,432	2%
Marigold	$35,827	$35,975	0%
John A McManus	$49,635	$49,537	0%
Neal Dow	$36,198	$36,196	0%
Parkview	$39,469	$39,413	0%
Rosedale	$48,104	$48,419	1%
Shasta	$35,562	$35,606	0%
Sierra View	$32,200	$33,079	3%

Using the first year modeled bill, future years' bills can be projected using the utility escalation rate as discussed above. Each site's usage is projected for 25 years, the minimum useful life for a solar system. For the PPA financing option, the financial analysis is limited to the typical 20 year term length of a PPA contract. The energy usage projection is used to calculate future bills, which establish a baseline to compare an estimated bill if solar is added. The difference between the baseline bill and the bill with solar is the revenue generated by the addition of the solar system.

To calculate the bill with solar, the modeled solar system production is used to determine the net energy purchased during any time of use period for each site. Solar generation is reduced by one percent per year due to solar panel generation degradation. The PG&E A6 tariff is then applied to the net energy purchased to calculate the energy bill with the addition of solar.

Table 6 shows the resulting bill savings, incentives, cost, and net benefit for each site for the up-front purchase based on 20 and 25 year life-cycles, respectively. Table 7 shows the projected bill savings, PPA costs and resulting net benefit for the PPA financing option. CSI incentives are not included for the PPA option because under standard PPA contracts, the solar contractor keeps the incentive payment and factors the total incentive value into the PPA rate. The site by site net present value (NPV) is also shown. Thirteen of the fourteen sites have net benefit from installing solar generation. The District Office is the only site that does not have the necessary space required to allow the construction of a financially sound solar system. Several sites are better suited for solar and have correspondingly higher net benefits.

TABLE 6: NEM-UP FRONT PURCHASE FINACIAL BENEFIT

Site	Total Costs	CSI Incentive	20 Yr Net Benefit	20 Yr NPV	25 Yr Net Benefit	25 Yr NPV
Bidwell Junior High	($1,260,000)	$172,511	$714,836	$207,530	$1,316,206	$512,084
Chico Junior High	($529,200)	$68,529	$406,253	$162,281	$702,556	$312,318
Citrus	($504,000)	$62,725	$249,095	$54,956	$480,043	$171,914
District Office	($44,100)	$3,587	($116,701)	($95,027)	($149,010)	($111,370)
Emma Wilson	($829,350)	$110,449	$706,733	$305,362	$1,196,136	$553,172
Fair View High	($502,650)	$63,796	$426,996	$183,140	$726,408	$334,742
Hooker Oak 053	($226,350)	$28,447	$210,765	$95,632	$353,143	$167,720
Hooker Oak 160	($226,350)	$28,447	$142,337	$46,578	$257,886	$105,090
Marigold	($471,600)	$64,044	$386,723	$163,121	$658,010	$300,492
John A McManus	($830,550)	$104,095	$567,907	$203,302	$1,011,007	$427,671
Neal Dow	($515,250)	$67,072	$395,049	$157,757	$682,975	$303,553
Parkview	($598,500)	$76,718	$421,201	$155,851	$742,236	$318,416
Rosedale	($681,750)	$87,869	$526,443	$211,156	$909,722	$405,234
Shasta	($491,850)	$63,598	$391,683	$160,871	$672,929	$303,281
Sierra View	($473,850)	$59,247	$366,742	$146,803	$635,374	$282,825
Total	**($8,185,350)**	**$1,061,133**	**$5,796,060**	**$2,159,313**	**$10,195,621**	**$4,387,144**

TABLE 7: NEM PPA FINANCING NET BENEFIT

Site	20 Yr. Utility Bill Savings	Total PPA Payment	20 Yr Net Benefit	20 Yr NPV
Bidwell Junior High	$1,802,325	($1,430,623)	$371,702	$274,242
Chico Junior High	$866,924	($568,309)	$298,615	$217,452
Citrus	$690,369	($520,179)	$170,190	$125,073
District Office	($76,188)	($29,746)	($105,934)	($75,739)
Emma Wilson	$1,425,634	($915,949)	$509,685	$370,716
Fair View High	$865,850	($529,055)	$336,794	$244,503
Hooker Oak 053	$408,668	($235,908)	$172,760	$125,211
Hooker Oak 160	$340,240	($235,908)	$104,332	$76,157
Marigold	$794,279	($531,114)	$263,165	$191,717
John A McManus	$1,294,361	($863,257)	$431,105	$313,807
Neal Dow	$843,227	($556,221)	$287,006	$209,061
Parkview	$942,983	($636,217)	$306,765	$223,680
Rosedale	$1,120,324	($728,692)	$391,633	$285,102
Shasta	$819,936	($527,413)	$292,523	$212,804

Sierra View	$781,345	($491,329)	$290,016	$210,834
Total	**$12,920,277**	**($8,799,920)**	**$4,120,356**	**$3,004,618**

4.2 Scenario 2 – Feed In Tariff

Under their Feed in Tariff (FIT) program, PG&E will purchase power directly from a customer or solar developer with power generating facilities sized up to 1.5 megawatts. The energy payments participants receive are parallel to wholesale energy prices that PG&E pays large energy generators. This means that the value of generated energy in a FIT is less valuable than energy generated by systems utilizing NEM programs. This makes economies of scale for construction prices paramount in the success of a FIT system.

The District has two large plots of land that would be possible locations for large solar systems. The first site is a large Canyon View field located adjacent to the intersection of Bruce Rd and Raley Blvd The second site is an additional plot of land adjacent to the Corporate Yard.

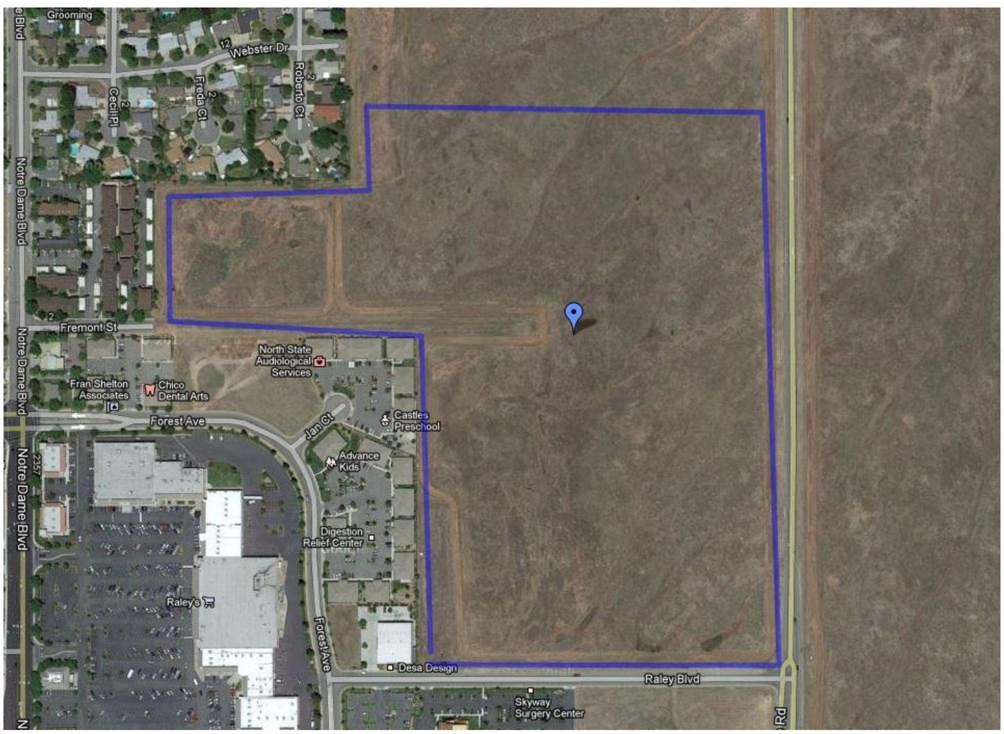


FIGURE 1: LARGE FIELD SITE LOCATED AT BRUCE RD AND RALEY RD

The large Canyon View field shown in Figure 1 appears to be better suited as it can fit a larger system to maximize the benefit of the FIT program. A 1.5 megawatt solar system is modeled using a tracking system with high efficiency solar panels at this site. The system is preliminarily designed to have a high power yield, which maximizes production. The resulting generation was binned using the FIT time of delivery schedule.

The FIT pricing depends on the contract length a customer chooses. For this analysis the longest and most beneficial contract was assumed. The proper pricing factors were applied to the generation and projected for 20 years to calculate the system's net benefit. The benefit is shown in Table 8 below. The cost of a solar system is incorporated into the FIT financial analysis by utilized a general cost per watt metric of $4.00 per watt. The price is lower than

NEM pricing due to the advantages of economies of scale. The term length of the current FIT contracts is limited to 20 year and thus the financial analysis is limited to 20 years.

TABLE 8: FIT FINACIAL BENEFIT

Site	20 Yr. Production Benefit	System Cost	20 Yr. Net Benefit	20 Yr NPV
1500 kW Tracker	$7,524,698	($6,000,000)	$1,524,698	($552,643)

4.3 Scenario 3 – RES-BCT

Similar to the FIT, RES-BCT creates an opportunity to develop a larger plot of land. Under this program a large remote solar system is used to generate electricity that offsets several sites owned by the same public entity. Financially, this program allows the generated bill credit to offset only a portion of the benefiting accounts electrical bill. Much like the FIT program, this makes the value of the generated electricity much less than the value of generated electricity utilizing NEM programs. To size the RES-BCT, the generation component of the utility bill for fourteen sites was calculated. These results are shown in Table 9. The term of current RES-BCT contracts is limited to 20 years and thus the financial analysis is limited to 20 years.

TABLE 9: GENERATION COSTS

Site	Year One Generation Cost
Bidwell Junior High	($35,873)
Chico Junior High	($15,114)
Citrus	($14,611)
District Office	($9,980)
Emma Wilson	($21,782)
Fair View High	($14,268)
Hooker Oak 053	($6,095)
Hooker Oak 160	($7,561)
Marigold	($15,623)
John A McManus	($20,187)
Neal Dow	($14,620)
Parkview	($16,335)
Rosedale	($21,023)
Shasta	($14,065)
Sierra View	($13,914)
TOTAL	**($241,050)**

The total generation credit to be applied at all sites must match the generation portion of the solar system's tariff. Using PvSyst, a 1.25 MW solar system was modeled using a tracking system with high efficiency solar panels. The same site as recommended for the FIT system is recommended for the RES BCT system. The system was preliminarily designed to have a high power yield, which maximizes production. The resulting generation was binned using PG&E's solar friendly A-6 rate and the generation portion of the tariff was used to calculate the system's net benefit. The cost of a solar system is incorporated into the financial analysis by using a cost per watt metric of $4.00 per watt.

Table 10 below shows the RES-BCT system benefit.

TABLE 10: RES-BCT SYSTEM NET BENEFIT

Site	Year 1 Generation Benefit	20 Yr. Generation Benefit	System Cost	20 Yr. Net Benefit	20 Yr NPV
1250 kW Tracker	$241,815	$6,374489	($5,000,000)	$1,374,489	($385,314)

5 RESULTS AND RECOMMENDATION

By comparing the net benefit from the three analyzed scenarios, despite higher costs, NEM solar systems have a larger financial benefit than the FIT or RES-BCT systems. The total net benefit for each scenario is shown in Table 11. Bill savings and CSI incentive clearly provide more benefit than the PG&E FIT and RES-BCT programs.

TABLE 11: NET BENEFIT COMPARISON

Scenario	Total Life Cycle Cost	20 Yr Net Benefit	20 Year NPV	25 Year Net Benefit	25 Year NPV
NEM-Purchase (25 Yr)	($8,185,350)	$5,796,060	$2,159,313	$10,195,621	$4,387,144
NEM-PPA (20 Yr)	($8,799,920)	$4,120,356	$3,004,618	NA	NA
FIT (20 Yr)	($6,000,000)	$1,524,698	($552,643)	NA	NA
RES-BCT (20 Yr)	($5,000,000)	$1,374,489	($385,314)	NA	NA

For the NEM-purchase scenario, both 20 and 25 year next benefit are included. For the NEM-PPA, FIT, RES-BCT scenarios, only the 20 year net benefit shown as this is the length of their contract agreements. If the analysis is limited to the 20 year period, the NEM-PPA net present value benefit is the highest of the options considered. The NEM-Ownership scenario has the largest cumulative benefit for the 20 year period. This discrepancy is due to the benefit distribution during the lifecycle of the projects. The FIT and RES-BCT project both result in negative net present values for the 20 year period.

Financial analysis for each of the three 20 year scenarios cannot be projected with much certainty past the 20 year time length and thus no attempt is made to do so. At the 20 year mark, the systems have not reached the end of their useful lives and can be used for continued solar generation; however the financial mechanism use to generate benefit is unknown at this time. A projection based on broad assumptions can be made, but it could not be considered reliable.

The financial benefit from a cash flow perspective is shown in Figure 2 below for the first 20 years of the system performance. The benefit distribution leading to the discrepancy between largest NPV benefit and largest cumulative benefit is depicted in the figure. Only the first 20 years are shown to give a year for year comparison of the NEM ownership scenario versus the term limited scenarios. It is apparent that the NEM scenario breaks even four years sooner than the other two scenarios.

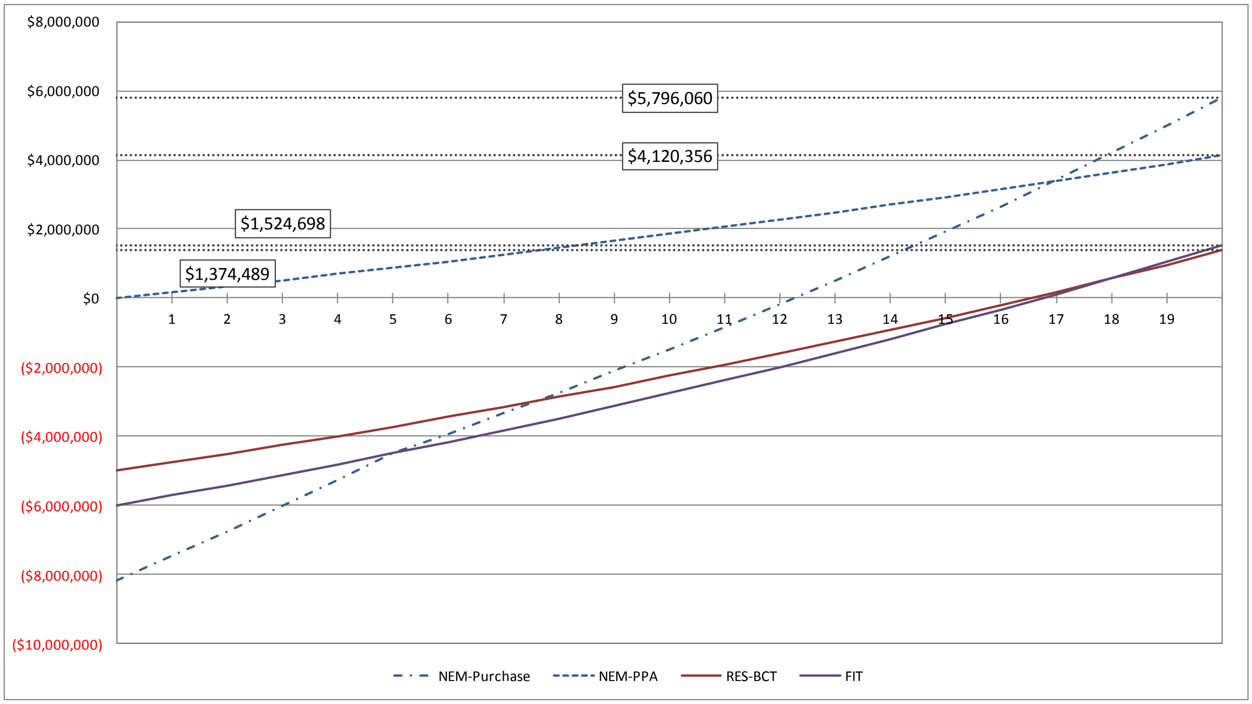


FIGURE 2: 25 YEAR CUMULATIVE CASHFLOW COMPARISON

As the analysis of the installation scenarios are performed independent of each other, a combination of the scenarios may present the best option for the District to best suit its needs and budget. The options available to the District can be combined to both offset utility use at District sites and generate energy for direct export to the Utility.

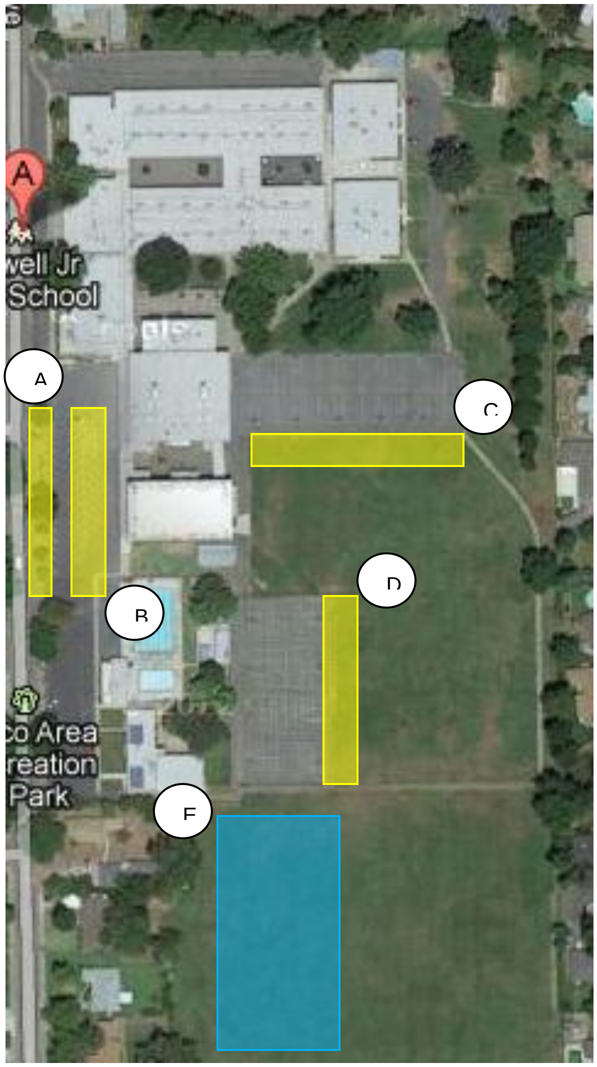
NAM recommends the two NEM options for immediate further consideration as they represent the most financial benefit for the District. If the District would like to pursue the RES-BCT or FIT options to utilize the Canyon View site, additional due diligence is recommended to maximize the return of the chosen system. A possible option to the District to utilize the Canyon View site is to pursue site-by-site installations at the highest financially beneficial and most constructible school sites as well as a RES-BCT system to offset the remaining sites plus any additional District electricity loads not covered in this study. It is important to note that as PG&E continues to develop their utility tariffs, the RES-BCT program may become more beneficial to consider in the future.

NAM recommends that the District pursue a competitive bid process to increase competition amongst solar vendors and drive installation prices down. In this process it is recommended to include each site deemed feasible for solar as lower prices may make installations at all sites possible. Lower installation prices would further extend the predicted financial benefits. It is also important to include all sites through the competitive bid process as the site studies completed as part of this project are preliminary in nature and the District will benefit from the additional due-diligence performed by solar vendors as part of developing their proposals. Additional information regarding detailed site conditions and cost per site differences stemming from the competitive bid will provide the information needed to determine the most optimal mix of PV systems and sites. NAM recommends that if both the site by site NEM and FIT scenarios are pursued, that they be pursued in separate processes as they are different projects and are likely to result in different parties competing for the work.

Appendix A Site Information

For each school site, all potential array locations that met preliminary District needs and appeared to represent a good location for maximizing solar production are indicated. The site diagrams are all oriented with North at the top of the image. Locations noted as “Primary” are used in the full financial analysis. For the complete financial analysis, full PVSyst models of the primary systems are constructed to gain an accurate representation of expected production. “Alternate” solar locations marked on the maps are still viable and should be considered for each site as they may represent better use of the site for the District.

BIDWELL JUNIOR HIGH SCHOOL, 2376 NORTH AVENUE, CHICO, CA 95926



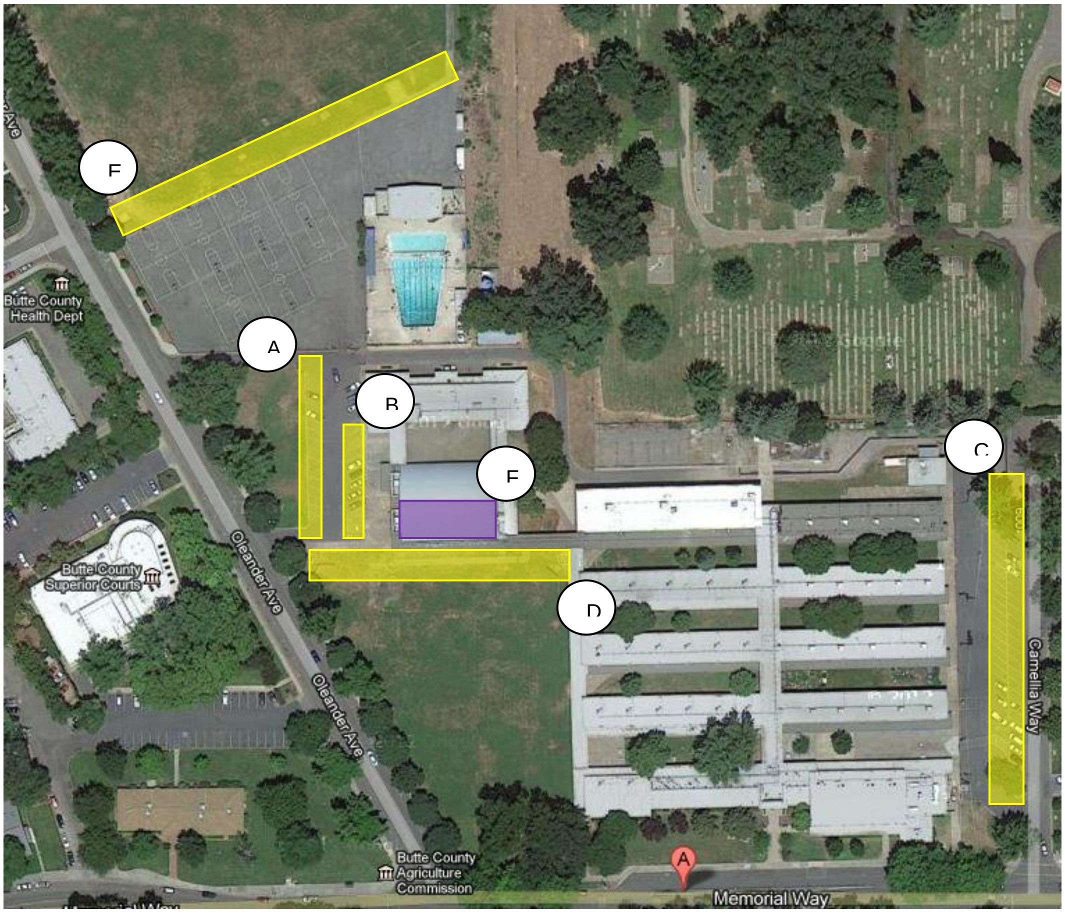
- Site Load – 519,456 kWh/yr
- Approximate 85% Load Offset System Size – 327 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	West Parking	Primary	Carport	60
B	West Parking	Primary	Carport	100
C	North Basketball Courts	Primary	Carport	100
D	Central Basketball Courts	Primary	Carport	100
E	North Athletic Field	Alternate	Ground Mt.	290

SITE CONSIDERATIONS

While the West Parking Lot could potentially accommodate a parking structure PV system, it was not selected because it is more expensive to build than a ground mount. Arrays A and B will have some tree and utility pole shading in the parking lot.

CHICO JUNIOR HIGH SCHOOL, 280 MEMORIAL WAY, CHICO, CA 95926



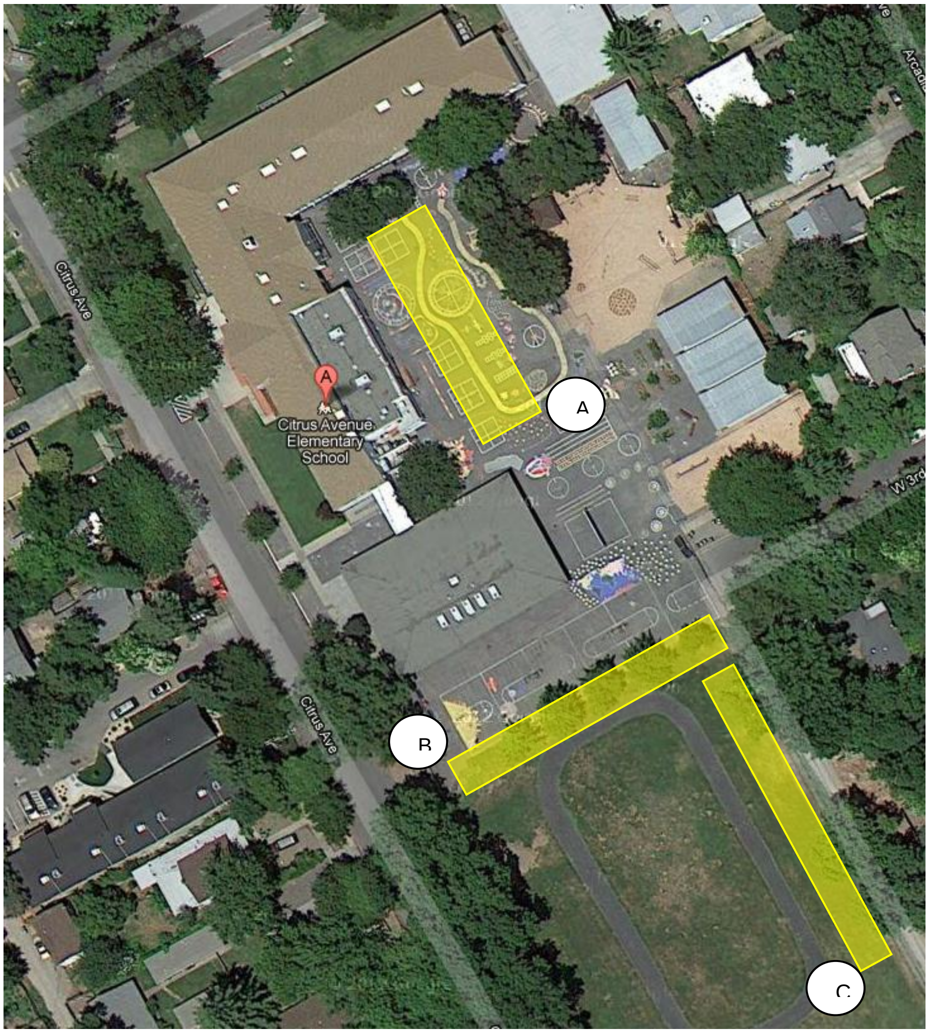
- Site Load – 223,420 kWh/yr
- Approximate 85% Load Offset System Size – 140 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	West parking	Primary	Carport	33
B	West parking	Alternate	Carport	26
C	East parking	Primary	Carport	118
D	Central Grass Edge	Alternate	Carport	110
E	North Blacktop Edge	Alternate	Carport	125
F	Gym Roof	Alternate	Roof Mount	68

SITE CONSIDERATIONS

Several options at this site appear to be viable limited shad impacts or tree removal requirements. Array E may have long trenching requirements associated with it. Array F will need further roof structure due diligence to determine if the roof is suitable for the addition of a solar system.

CITRUS ELEMENTARY SCHOOL, 1350 CITRUS AVE., CHICO, CA 95926



- Site Load – 209,256 kWh/yr
- Approximate 85% Load Offset System Size – 183 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	Center Playground	Primary	Carport	73
B	North Athletic Field	Primary	Carport	39
C	East Edge of Track	Alternate	Carport	39

SITE CONSIDERATIONS

Pitched roof mounting planes are relatively small and difficult to permit through DSA. There is very little shading for potential Playground solar shade structure (carport). Five trees need to be removed or relocated for Array B.

CHICO UNIFIED SCHOOL DISTRICT OFFICE, 1163 E 7TH ST. CHICO, CA 95928

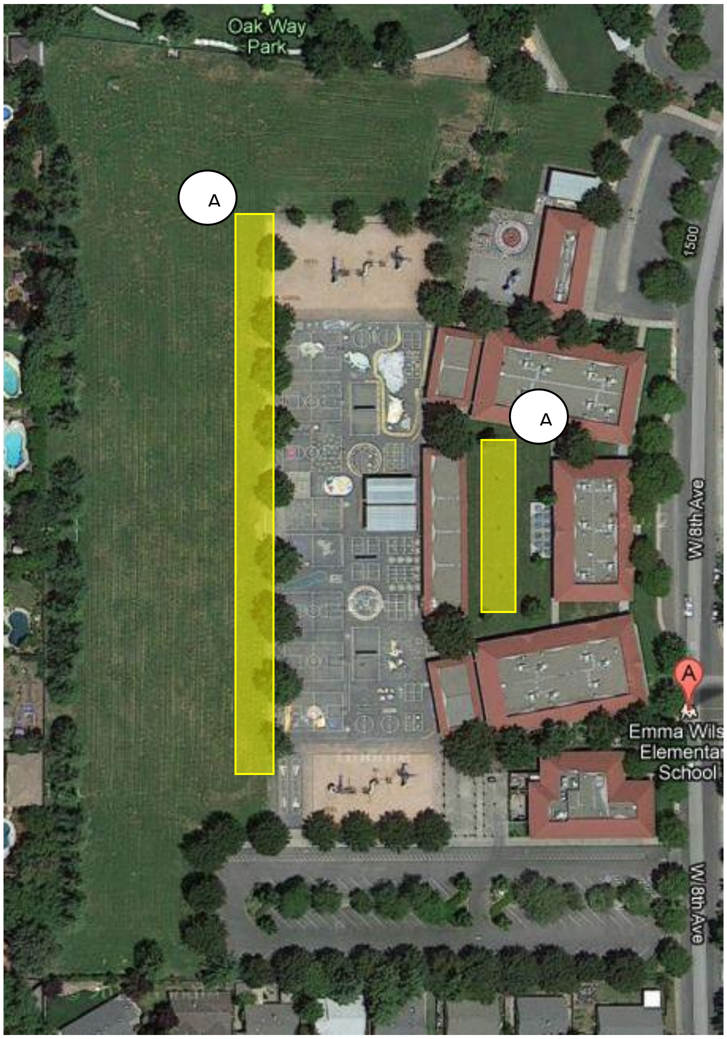
- Site Load – 144,579 kWh/yr
- Approximate 85% Load Offset System Size – 91 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	Southeast Roof	Primary	Roof Mount	10

SITE CONSIDERATIONS

The District Office site presents the largest challenge with the only viable option being a small roof system. The District may want to consider a small community education demonstration screen station for rather than a solar system at this site.

EMMA WILSON SCHOOL, 1530 W. 8TH AVE., CHICO, CA 95926



- Site Load – 314,923 kWh/yr
- Approximate 85% Load Offset System Size – 198 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	East Athletic Field	Primary	Carport	185
B	Grass Between Classrooms	Primary	Carport	58

SITE CONSIDERATIONS

Array A requires the removal of several trees that have been identified as removable. Array B will may require more DSA permitting due diligence due to proximity to school buildings. All parking has considerable tree shading and thus is not considered appropriate for array locations. Roof mounts are not considered due to condition and construction type of roof.

FAIR VIEW HIGH SCHOOL, 290 EAST AVE CHICO, CA 95926

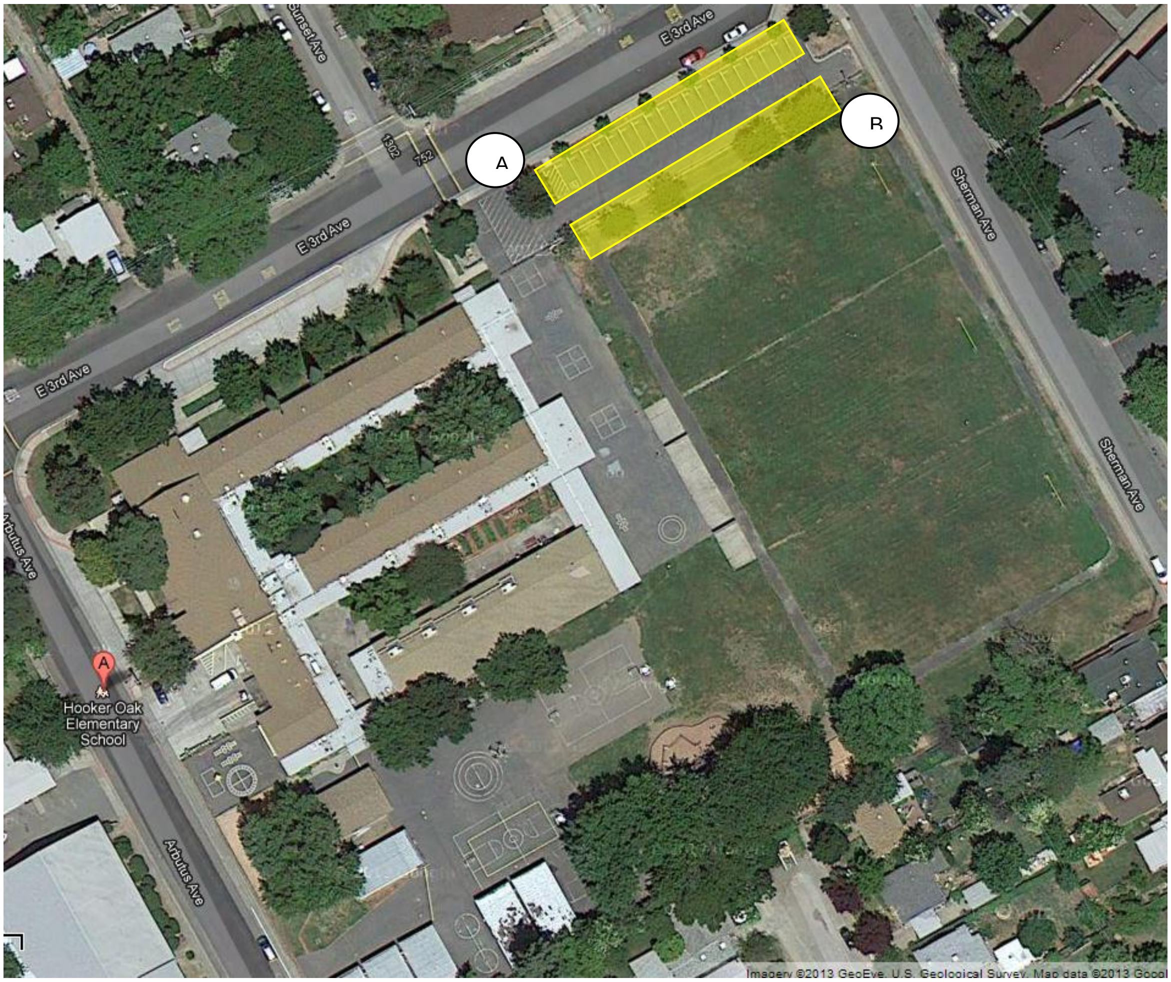
- Site Load – 209,624 kWh/yr
- Approximate 85% Load Offset System Size – 132 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	North Parking	Primary	Carport	40
B	Athletic Field Edge	Primary	Carport	72
C	East Parking	Alternate	Carport	45
D	East Parking	Alternate	Carport	28
E	New Building Roof	Alternate	Roof	20

SITE CONSIDERATIONS

Array A will require the removal of several trees. Arrays C and D have considerable shading from adjacent mature trees. Array E is proposed on top of new building that is not shown in this image.

HOOKER OAK OPEN STRUCTURE SCHOOL, METER -160, 1238 ARBUTUS AVE., CHICO, CA 95926



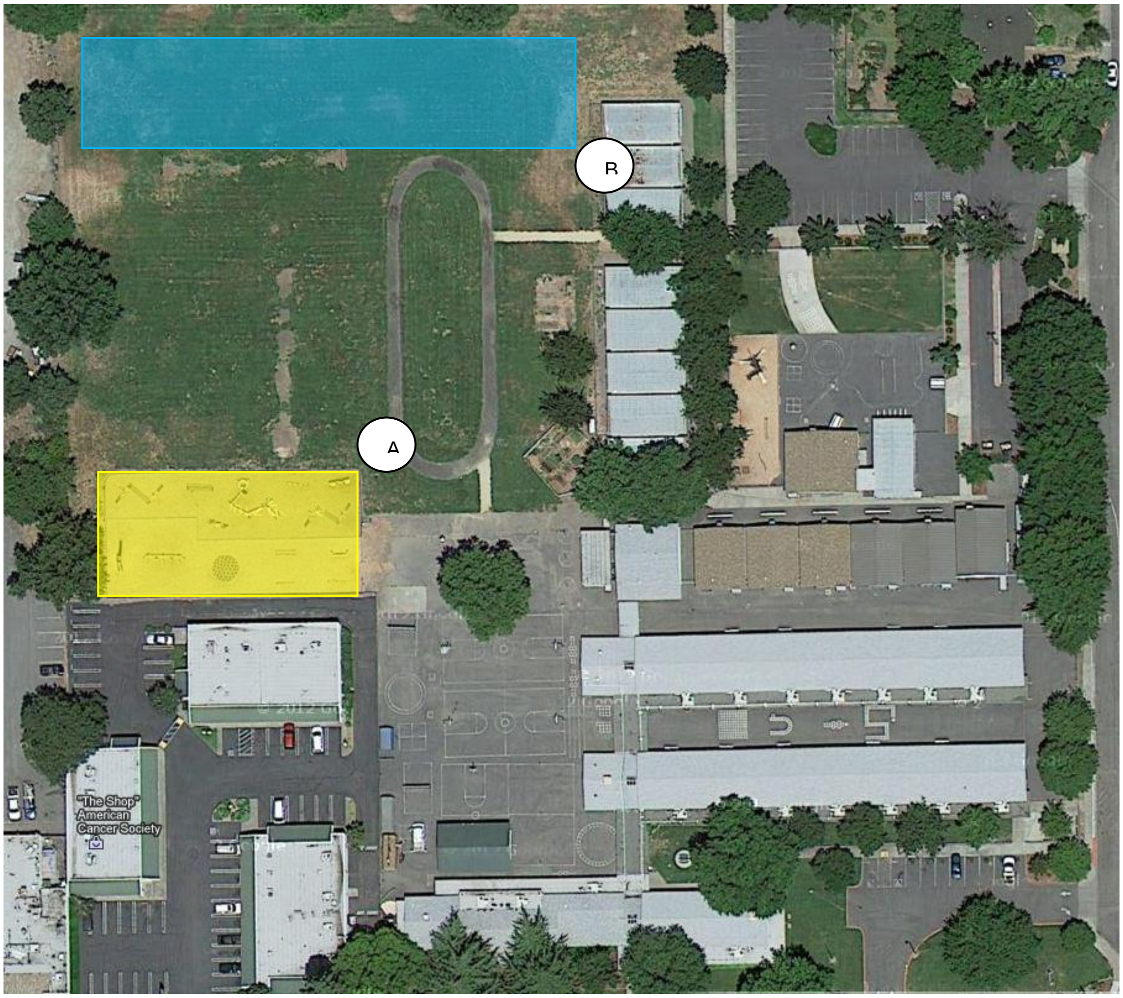
- Site Load –190,592 kWh/yr (two electric meters)
- Approximate 85% Load Offset System Size – 112 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	North Parking	Primary	Carport	52
B	North Athletic Field	151	Carport	48

SITE CONSIDERATIONS

Hooker Oak has two electric meters and this image represents the layout for the cumulative metering at the site. Both Arrays A and B require the removal of several trees. Roof mounts are not considered due to condition and construction type of roof.

JOHN MCMANUS ELEMENTARY SCHOOL, 988 E AVE CHICO, CA 95926



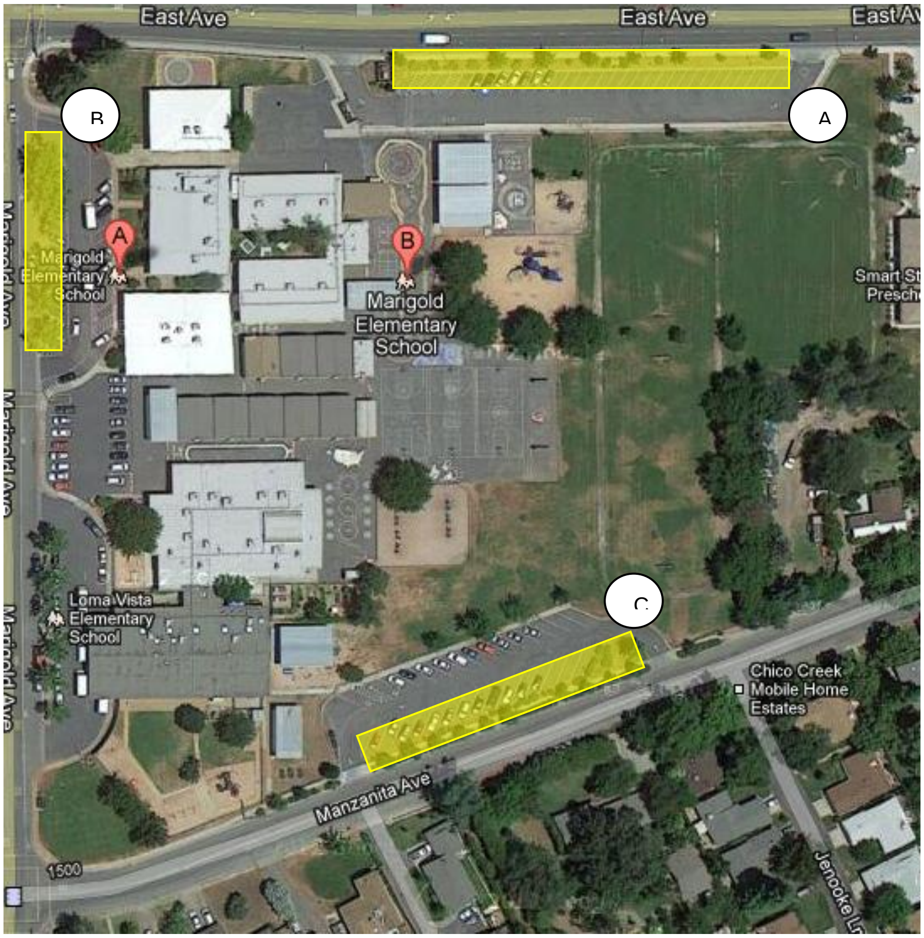
- Site Load – 295,260 kWh/yr
- Approximate 85% Load Offset System Size – 186 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	Sand Box Play Structures	Primary	Carport	158
B	North Athletic Field	Alternate	Ground Mt.	158

SITE CONSIDERATIONS

Array A is considered as a unique large shade structure covering the entire sand box areas and will require additional design effort compared to a standard structure. Array A has afternoon tree shading and will require tree trimming to mitigate the effect on production. Roof mounts are not considered due to condition and construction type of roof.

MARIGOLD ELEMENTARY SCHOOL, 2446 MARIGOLD CHICO, CA 95926



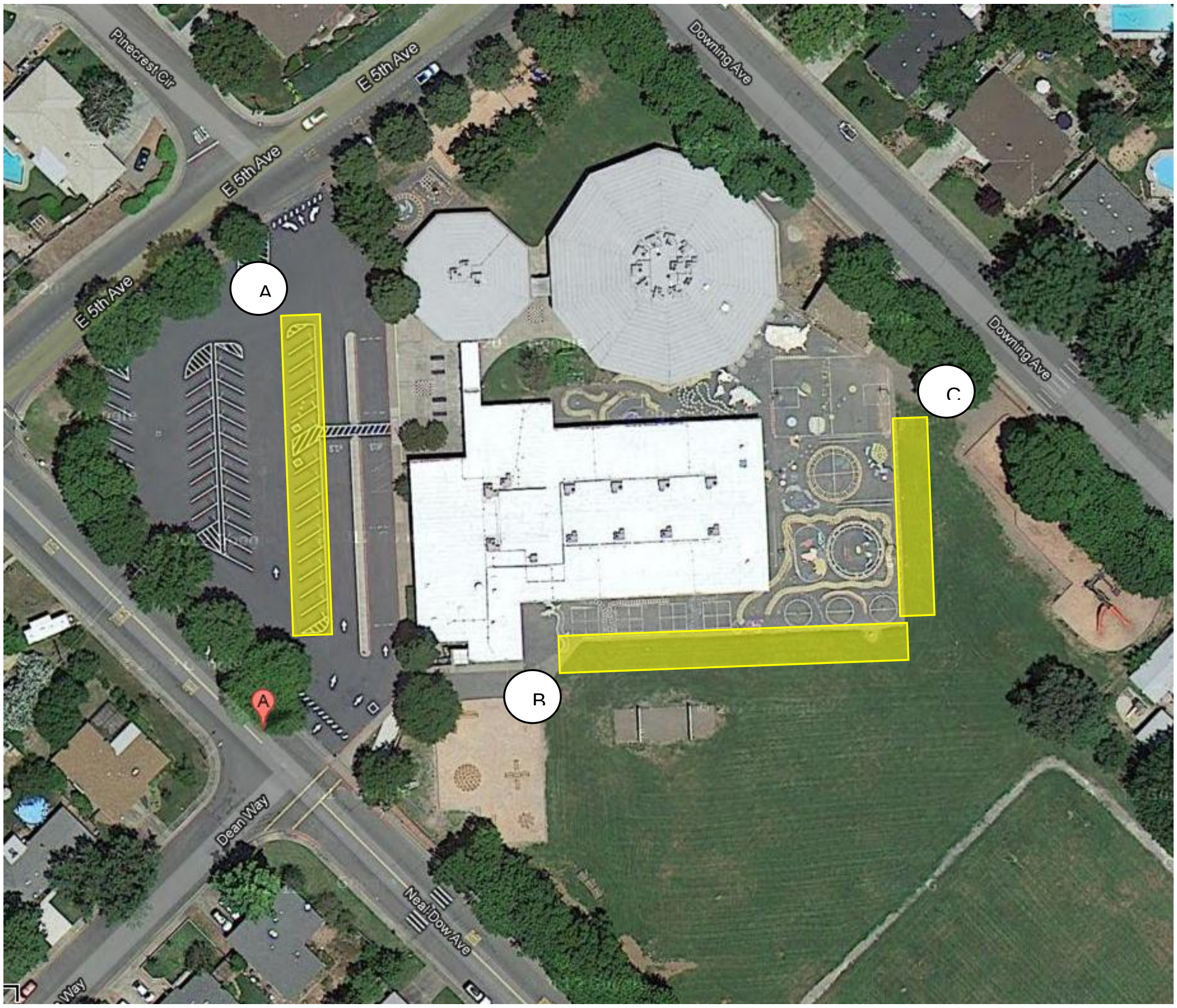
- Site Load – 210,123 kWh/yr
- Approximate 85% Load Offset System Size – 132 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	North Parking	Primary	Carport	104
B	West Parking	Alternate	Carport	50
C	South Parking (Loma Vista)	Alternate	Carport	60

SITE CONSIDERATIONS

This layout incorporates the Loma Vista campus which was not included in the detailed financial analysis due to its small size. However, Array C could be used for to feed into the Loma Vista Meter if this site is chosen for construction. All Arrays will require the removal of trees. Roof mounts are not considered due to condition and construction type of roof.

NEAL DOW ELEMENTARY SCHOOL, 988 E AVE CHICO, CA 95926



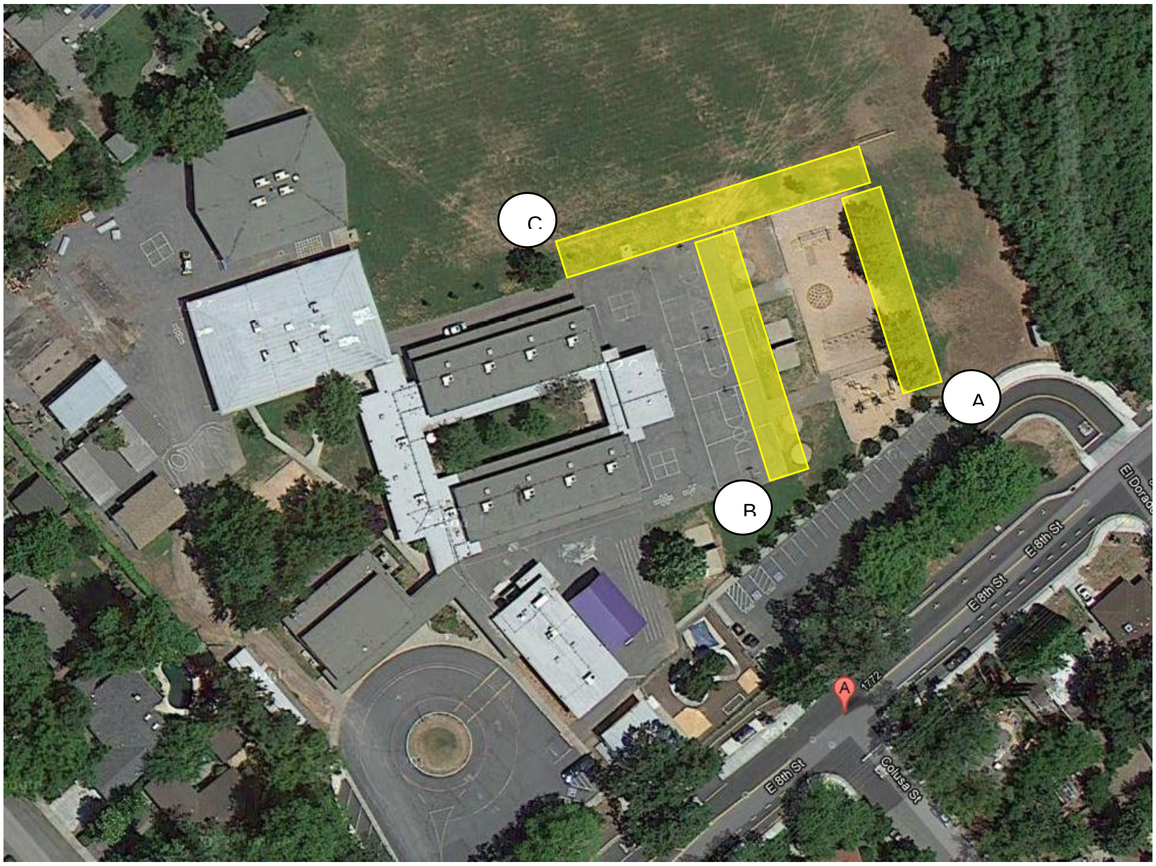
- Site Load – 213,084 kWh/yr
- Approximate 85% Load Offset System Size – 134 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	West Parking	Primary	Carport	52
B	S. Playground Edge	Primary	Carport	62
C	E. Playground Edge	Primary	Carport	32

SITE CONSIDERATIONS

Array A will have some shade during the winter and may require tree trimming to impacts on production. Roof mounts are not considered due to condition and construction type of roof.

PARKVIEW ELEMENTARY SCHOOL, 988 E AVE CHICO, CA 95926



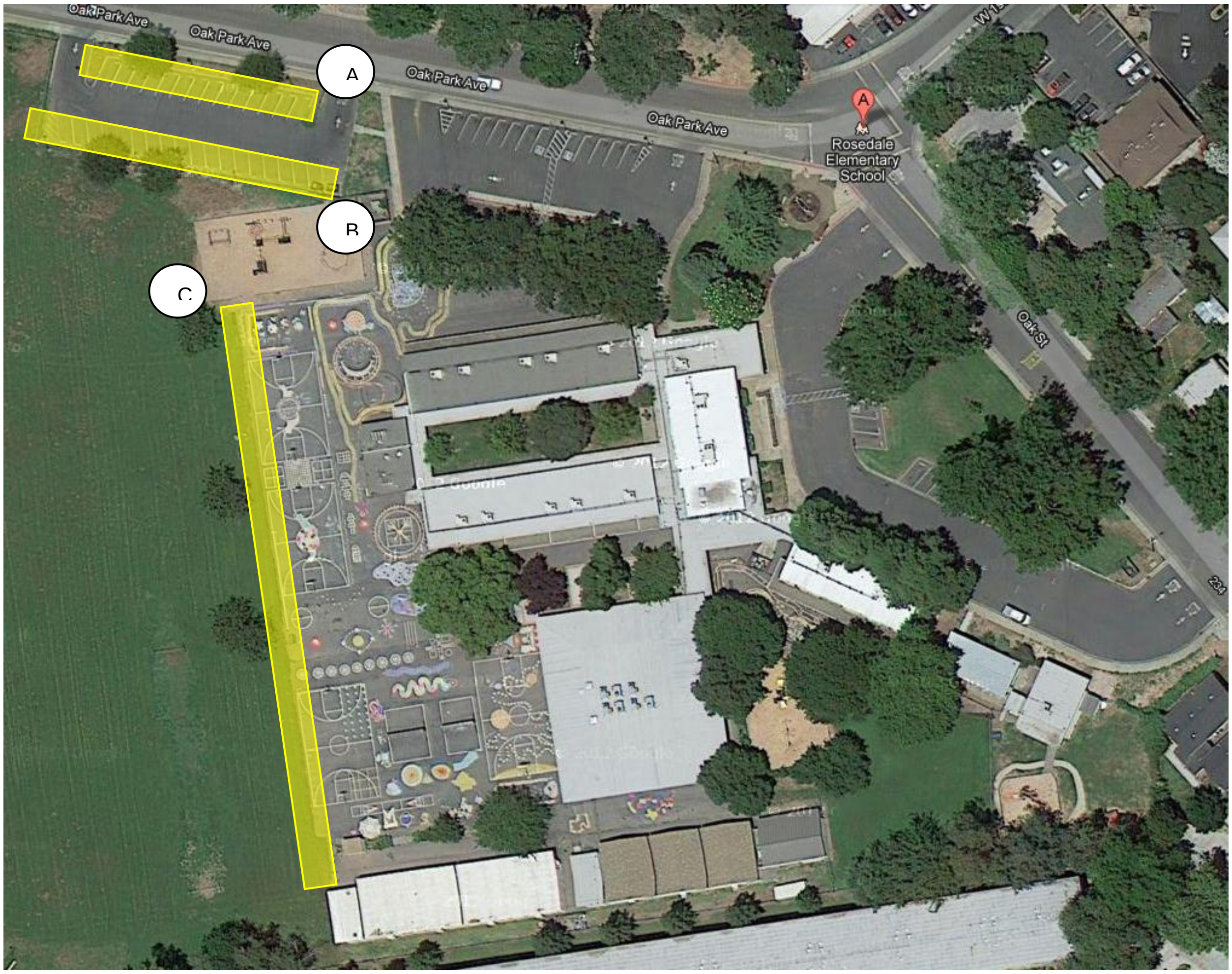
- Site Load – 238,813 kWh/yr
- Approximate 85% Load Offset System Size – 177 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	East Edge of Sandbox	Primary	Carport	40
B	East Edge of Blacktop	Primary	Carport	54
C	North Edge of Play Area	Primary	Carport	54

SITE CONSIDERATIONS

Roof mounts will be difficult to permit through the DSA, they are not included in production calculations. Shade structure A will require the removal of several trees. Array B will require relocation of tetherball and handball courts. Self shading due to the arrays proximity may be an issues requiring additional spacing between arrays.

ROSEDALE ELEMENTARY SCHOOL, 100 OAK ST CHICO, CA 95928



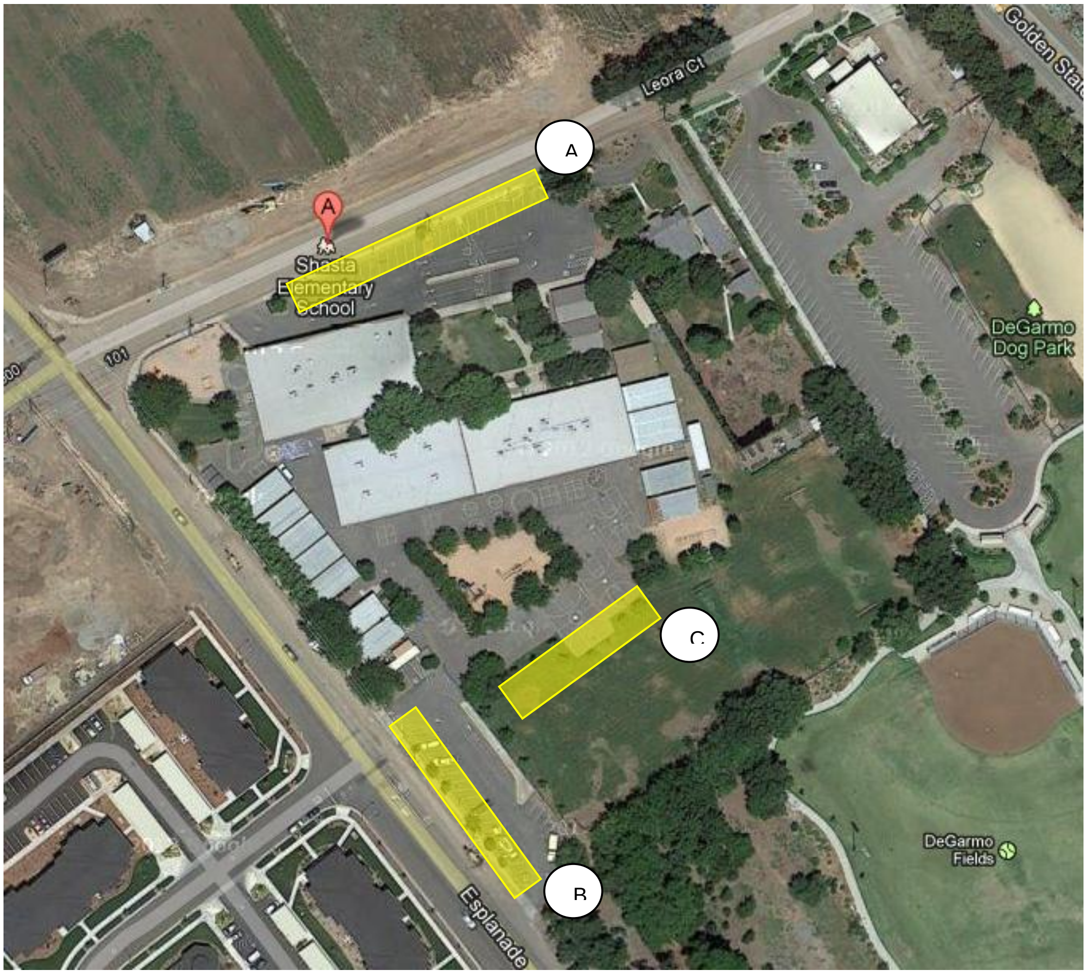
- Site Load – 284,613 kWh/yr
- Approximate 85% Load Offset System Size – 210 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	North Parking	Alternate	Carport	44
B	North Parking	Primary	Carport	55
C	East Athletic Field	Primary	Carport	160

SITE CONSIDERATIONS

Arrays A and B are far from the main electric service and will require long trenching runs. Array B will require relocation of three trees. Consideration to ADA parking lot shade will be necessary if no ADA spaces are covered by Array A or Array B. Roof mounts are not considered due to condition and construction type of roof.

SHASTA ELEMENTARY SCHOOL, 169 LEORA CT CHICO, CA 95973



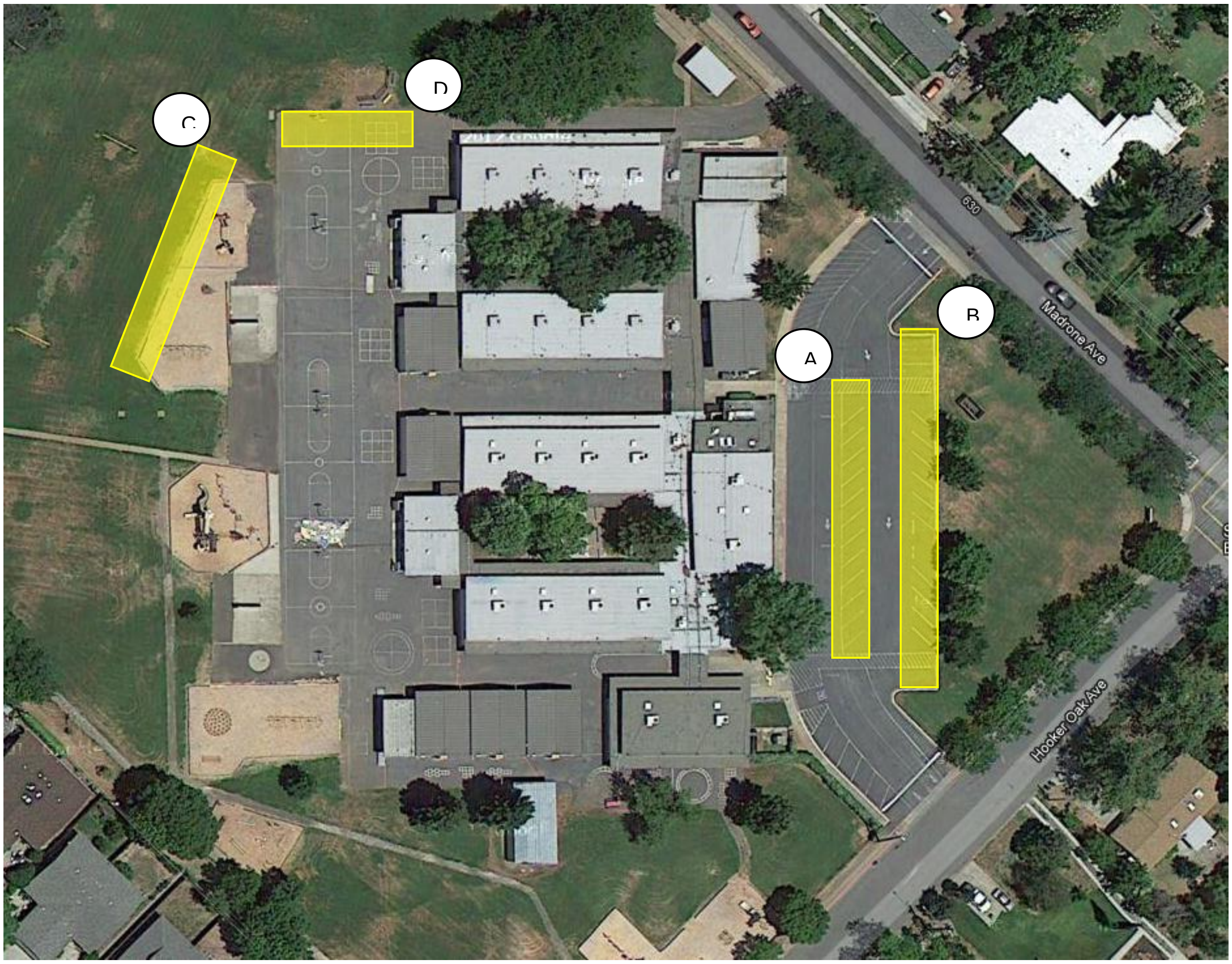
- Site Load – 205,995 kWh/yr
- Approximate 85% Load Offset System Size – 152 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	North Parking	Primary	Carport	62
B	Southwest Parking	Primary	Carport	47
C	Central Playground Edge	Primary	Carport	45

SITE CONSIDERATIONS

Arrays B and C will require difficult trenching through campus due to existing underground conditions, which may become a constructability issue for this site. Array C will require the removal of several trees. The adjacent recreation center parking lot has a capacity of 265 kW and may be suitable for use if the District enters a use agreement with the recreation department.

Sierra View Elementary School, 1598 Hooker Oak Ave Chico, CA 95926



- Site Load – 188,510
- Approximate 85% Load Offset System Size – 139 kW

No.	Location	Primary/ Alternate	Type	Approx. kW DC
A	East Parking	Primary	Carport	43
B	East Parking	Primary	Carport	59
C	West Play Area	Primary	Carport	40
D	North Playground	Alternate	Carport	30

Site Considerations

Array B will require the removal of 5 small trees adjacent to the lot. Array D is adjacent to a baseball backstop which may be an issue depending on the use type of the backstop. Roof mounts are not considered due to condition and construction type of roof.

Appendix B - NEM Cash Flow

NPV Discount Rate 3%

Cumulative Ownership Scenario

	20 Year Life Cycle		25 Yr Life Cycle															
	NPV	SUM	NPV	SUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Bill No Solar	($12,231,920.45)	($17,062,918)	($15,617,183.10)	($23,753,114)	$0	($581,977)	($604,384)	($627,652)	($651,817)	($676,912)	($702,973)	($730,038)	($758,144)	($787,333)	($817,645)	($849,124)	($881,815)	($915,765)
Bill with Solar	($2,859,770.64)	($4,142,642)	($4,017,202.07)	($6,433,276)	$0	($82,010)	($90,889)	($100,704)	($111,075)	($122,028)	($133,589)	($145,789)	($158,657)	($172,225)	($186,524)	($201,590)	($217,457)	($234,164)
Bill Savings	$9,372,149.80	$12,920,277	$11,599,981.03	$17,319,838	$0	$499,967	$513,494	$526,948	$540,742	$554,884	$569,384	$584,248	$599,487	$615,108	$631,120	$647,534	$664,358	$681,602
Utility Rebate	$972,513.17	$1,061,133	$972,513.17	$1,061,133	$0	$216,514	$214,349	$212,205	$210,083	$207,982	$0	$0	$0	$0	$0	$0	$0	$0
Total Revenue	$10,344,662.97	$13,981,410	$12,572,494.20	$18,380,971	$0	$716,481	$727,843	$739,153	$750,825	$762,867	$569,384	$584,248	$599,487	$615,108	$631,120	$647,534	$664,358	$681,602
Capital Costs	($8,185,350.00)	($8,185,350)	($8,185,350.00)	($8,185,350)	($8,185,350)													
O&M Costs	$0.00	$0	$0.00	$0	$0													
PeGu Costs	$0.00	$0	$0.00	$0	$0													
head, Management, Contingency Costs	$0.00	$0	$0.00	$0	$0													
	$0.00																	
Total Up Front Costs	($8,185,350.00)	($8,185,350)	($8,185,350.00)	($8,185,350)	($8,185,350)													
Net Benefit	$2,159,312.97	$5,796,060	$4,387,144.20	$10,195,621	($8,185,350)	$716,481	$727,843	$739,153	$750,825	$762,867	$569,384	$584,248	$599,487	$615,108	$631,120	$647,534	$664,358	$681,602

Purchas cash flow Continued	14	15	16	17	18	19	20	21	22	23	24	25
Bill No Solar	($951,022)	($987,637)	($1,025,661)	($1,065,149)	($1,106,157)	($1,148,744)	($1,192,970)	($1,238,900)	($1,286,597)	($1,336,131)	($1,387,573)	($1,440,994)
Bill with Solar	($251,747)	($270,249)	($289,710)	($310,176)	($331,691)	($354,303)	($378,063)	($403,022)	($429,235)	($456,757)	($485,649)	($515,970)
Bill Savings	$699,275	$717,388	$735,950	$754,973	$774,466	$794,441	$814,907	$835,877	$857,363	$879,374	$901,924	$925,024
Utility Rebate	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Revenue	$699,275	$717,388	$735,950	$754,973	$774,466	$794,441	$814,907	$835,877	$857,363	$879,374	$901,924	$925,024
Capital Costs												
O&M Costs												
PeGu Costs												
Overhead, Management, Contingency Costs												
Total Up Front Costs												
Net Benefit	$699,275	$717,388	$735,950	$754,973	$774,466	$794,441	$814,907	$835,877	$857,363	$879,374	$901,924	$925,024

Cumulative PPA Scenario

	20 Year Life Cycle		25 Yr Life Cycle (N/A)															
	NPV	SUM	NPV	SUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Bill No Solar	($12,231,920.45)	($17,062,918)			$0	($581,977)	($604,384)	($627,652)	($651,817)	($676,912)	($702,973)	($730,038)	($758,144)	($787,333)	($817,645)	($849,124)	($881,815)	($915,765)
Bill with Solar	($2,859,770.64)	($4,142,642)			$0	($82,010)	($90,889)	($100,704)	($111,075)	($122,028)	($133,589)	($145,789)	($158,657)	($172,225)	($186,524)	($201,590)	($217,457)	($234,164)
Bill Savings	$9,372,149.80	$12,920,277			$0	$499,967	$513,494	$526,948	$540,742	$554,884	$569,384	$584,248	$599,487	$615,108	$631,120	$647,534	$664,358	$681,602
PPA Costs	($6,367,531.39)	($8,799,920)			$0	($332,152)	($341,655)	($351,430)	($361,484)	($371,826)	($382,464)	($393,406)	($404,662)	($416,239)	($428,148)	($440,397)	($452,997)	($465,957)
Net Benefit	$3,004,618.41	$4,120,356			$0	$167,816	$171,840	$175,518	$179,258	$183,058	$186,920	$190,842	$194,825	$198,869	$202,973	$207,137	$211,361	$215,645

PPA cash flow Continued	14	15	16	17	18	19	20
Bill No Solar	($951,022)	($987,637)	($1,025,661)	($1,065,149)	($1,106,157)	($1,148,744)	($1,192,970)
Bill with Solar	($251,747)	($270,249)	($289,710)	($310,176)	($331,691)	($354,303)	($378,063)
Bill Savings	$699,275	$717,388	$735,950	$754,973	$774,466	$794,441	$814,907
PPA Costs	($479,288)	($493,000)	($507,105)	($521,613)	($536,537)	($551,887)	($567,676)
Net Benefit	$219,987	$224,388	$228,845	$233,360	$237,929	$242,554	$247,231