SUMMIT COUNTY

Solar Photovoltaic Feasibility Study

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SUMMARY

BacGen was asked to carry out a solar photovoltaic (PV) feasibility study for buildings owned by Summit County. The evaluation included practical considerations such as roof suitability, shading, size, etc, as well economic impact in terms of savings.

Park City fire stations, the Snyderville Basin Water Reclamation facilities and a number of Mountain Regional Water District projects were also evaluated as part of this study.

The Summit County **buildings** in **Table 1** and **Table 2** were considered for the feasibility study but a number of them were eliminated from further study, such as the Court House in Coalville, since it is a historic building. For buildings that looked promising, a sketch and further analysis is included in this report. **Table 3** and **Table 4** summarize the findings for the wastewater facilities and the Water District. **Table 5** and **Table 6** summarize the Fire Station findings.

With respect to the financial summary and cash flows throughout the report, please note the following:

- The cost per kWh produced, over 20 years, is calculated as the initial build cost, divided by 20 years of annual production (in kWh). No maintenance, insurance or *cost of money* was accounted for. A year-on-year loss of production of 0.5% was taken into account (caused by the gradual degradation of the modules).
- The Justice Center and Quinn's Health solar canopies are assumed to be **$3.00 per Watt** to fully implement. All others are assumed to be **$2.25 per Watt**.
- The Justice Center and Quinn canopies are not perfectly south facing, so there is a 5-7% loss in efficiency. The Richins building is east-west facing (resulting in 10-15% loss in efficiency). The Hoytsville system, transit center and library were assumed to be perfectly south facing.
- The **savings** are calculated as the equivalent payment to Rocky Mountain Power (fully blended rate with a 3% annual escalator) minus the initial construction cost.
- It may not be possible to offset the fully blended rate since not all demand charges will be offset, all the time, with a solar system. However, after solar implementation, for the Hoytsville project and Quinn, it should be considered to switch to a schedule 6A, with lower demand charges (but higher 'per kWh' consumption charge), since this will be more advantageous when a relatively high percentage of the solar production is net metered.

TABLE 1 Summary of Findings for Summit County Buildings

	Main Results	**Solar System Size Identified**
Justice Center Complex 6300 Silver Creek Dr Park City, UT 84098	The building already has a solar system on the roof (220 kW) but there is a potential for (long span) parking canopies.	454 kW solar canopies (@ $3.00 per Watt)
Richins Building 1885 W Ute Blvd Park City, UT 84098	Roof: east-west facing roof (96 kW) + parking canopies (210 kW). 200 kW would offset most (~90%) of the power consumption, but the roof project will be much cheaper to implement. Recommend considering switch to schedule 6A after solar implementation.	96 kW solar roof mount (@ $2.25 per Watt)
Quinn's Health Building 650 Round Valley Dr Park City, UT 84098	The roof already has a solar system. Long span canopy not feasible due to configuration issues. One regular canopy identified on south side of parking lot, which covers only limited number of parking stalls.	92 kW canopies (@ $3.00 per Watt)
Public Works 1755 S Hoytsville Rd Hoytsville, UT 84017	The PW building is the most suitable of all building in this location. Consider using this building and aggregate its meter with the Animal Control building on the same account. Only 86 kW is required to offset >90% consumption for the PW meter PLUS Animal Control meter.	86 kW roof mount (@ $2.25 per Watt)
Animal Control 1745 S Hoystville Rd Hoytsville, UT 84016	See above. No solar recommended on this building.	0
Weed Control 1735 S Hoytsville Rd Hoytsville, UT 84017	Very low power consumption. It would be expensive to aggregate this account with a schedule 6 (because of base charge). Building itself has east tilted roof which is partially shaded by a mountain ridge.	0
(Future) Transit Center west of Richins building approx. 1890 W Ute Blvd Park City, UT 84098	Prepped for solar. Small system included in building design.	5.6 kW roof (@ $2.25 per Watt)
(Future) Kamas Library 110 N Main St Kamas, UT 84036	Prepped for solar. Small system included in building design.	20 kW roof (@ $2.25 per Watt)

Courthouse 60 N Main St Coalville, UT 84017	Historical Building. Not suitable for roof solar and very limited parking spaces available.	0
USU Extension 45 E 100 North Coalville, UT 84017	Already has solar power.	0
Coalville Library 82 N 50 E Coalville, UT 84017	Steep tilted - east-west roof, historical building. Not recommended for solar at this time.	0
Search & Rescue - Coalville 126 Industrial Park Rd Coalville, UT 84017	Small building with very big tree shading (Standing seam). Not recommended for solar.	0
Search & Rescue - Kamas 45 E 100 N Kamas, UT 84036	Was unable to inspect roof (tall building). There is room for about 50 kW but 12 kW would offset all consumption. Structural assessment required before proceeding.	(12 kW) roof
Summit Park Shed 5053 Kilby Rd Park City, UT 84098	Low consumption. No further analysis	0
Ambulance - Kamas 220 E 400 S Kamas, UT 84036	East-west standing seam or corrugated roof? County owns. Was unable to inspect roof. If corrugated roof deck, solar would be more difficult to implement. 8 kW would offset all power. Structural assessment required before proceeding.	(8 kW) roof
Seniors - Park City 1361 Woodside Park City, UT 84060	Building not owned by County	0
Three Mile Landfill	This landfill is in full operation. Several cells will be closed in the near future, but the nature of the landfill build-up and the likely 'settling' that will take place in the next 10 -20 years make this landfill unsuitable for solar.	0
TOTAL potential solar for SC Buildings	(not including Kamas S&R and Kamas Ambulance)	**754 kW**
Total minimum funds required to install all 6# systems		**$2,105,100**

TABLE 2 Saving Summary for Summit County Buildings (See calculations for this Table on the next page)

	Justice	Richins	Quinn	Hoytsville	PC Transit	Kamas Library	TOTAL
System Size (kW)	454	96	92	86	5.6	20	602
Annual Consumption (kWh)	1,168,000	275,838	183,054	118,734	0	0	1,745,626
Year 1 Production (kWh)	645,526	121,719	130,811	112,965	8,366	28,438	823,744
% Offset	55%	44%	71%	95%			47%
20 Year Production (kWh) 0.5% annual degradation in production	12,315,283	2,322,143	2,495,600	2,155,135	159,606	542,537	15,715,309
Estimated System Build Cost $3.00/W for canopies and $2.25/W for roof systems	$1,362,000	$ 216,000	$276,000	$ 193,500	$ 12,600	$ 45,000	$1,649,100
Estimated Saving (compounded savings for 20 years (money NOT paid to RMP due to system generation, minus the 'estimated system build cost', not accounting for system O&M)	$143,544	$76,127	$ 47,639	$ 42,767	$ 8,738	$ 27,534	$346,349
$/kWh (20 y) Average cost per kWh generated, as the 'system cost' divided by the compounded production over 20 years	$ 0.111	$ 0.093	$ 0.111	$ 0.090	$0.079	$ 0.083	
Metric Ton CO_{2e} Avoided (20 y) [1]	**11,811**	**2,227**	**2,393**	**2,067**	**153**	**520**	**19,172**
Social Cost of Carbon (SC-CO_2) (20 y) (Avg **$46** per metric ton)[2]	**$ 543,316**	**$ 102,447**	**$ 110,099**	**$ 95,079**	**$ 7,041**	**$ 23,935**	**$ 881,917**
Saving from Solar, Accounting for Societal Carbon Emission Cost	**$ 686,860**	**$ 178,573**	**$ 157,738**	**$ 137,845**	**$ 15,780**	**$ 51,470**	**$ 1,228,266**

[1] Using actual emissions factor (2.11439 lbs/kWh) for RMP's electric generation mix; also see https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

[2] https://www.epa.gov/climatechange/evaluating-climate-policy-options-costs-and-benefits. The social cost estimate, per EPA modeling, varies between $11 per metric ton CO_2 in 2015 and increasing to $18 in 2035 (moderate scenario), and increasing from $105 in 2015 to $168 in 2035 (severe scenario). A 'middle of the road' approach was taken for this report, increasing from a cost of $36 in 2015 to $55 in 2035 ($46 average cost per metric ton CO_2).

Justice	SUM (20 y)	1	2	3	4	5	6	7	8	9	10
production (kWh/y)	12,315,283	645,526	642,298	639,087	635,891	632,712	629,548	626,401	623,269	620,152	617,052
RMP fully blended rate (3% annual increase)		0.091	0.094	0.097	0.100	0.103	0.106	0.109	0.112	0.116	0.119
Annual RMP cost (Utility Payments if NO solar)	$1,505,544	$ 59,027	$ 60,494	$ 61,997	$ 63,537	$ 65,116	$ 66,735	$68,393	$70,092	$ 71,834	$73,619
Equivalent Cost of Solar	$1,362,000	$ 71,391	$ 71,035	$ 70,679	$ 70,326	$ 69,974	$ 69,624	$69,276	$68,930	$ 68,585	$68,242
Saving from Solar	$ 143,544	$ (12,365)	$ (10,541)	$ (8,683)	$ (6,788)	$ (4,858)	$ (2,890)	$ (883)	$ 1,162	$ 3,249	$ 5,377
Social Cost of Carbon Emmision (per metric ton)		$ 36	$ 37	$ 38	$ 39	$ 40	$ 41	$ 42	$ 43	$ 44	$ 45
Annual Social Cost of Carbon (SC-CO2)	$ 529,931	$ 22,288	$ 22,762	$ 23,230	$ 23,693	$ 24,151	$ 24,604	$25,052	$25,494	$ 25,932	$26,365
Saving from Solar, Accounting for Societal Carbon Emmision Cost	$ 673,475	$ 9,923	$ 12,221	$ 14,548	$ 16,905	$ 19,293	$ 21,714	$24,168	$26,657	$ 29,181	$31,741

Richins	SUM (20 y)	1	2	3	4	5	6	7	8	9	10
production (kWh/y)	2,322,143	121,719	121,110	120,505	119,902	119,303	118,706	118,113	117,522	116,935	116,350
RMP fully blended rate (3% annual increase)		0.094	0.097	0.100	0.103	0.106	0.109	0.112	0.116	0.119	0.123
Annual RMP cost	$ 292,127	$ 11,453	$ 11,738	$ 12,029	$ 12,328	$ 12,635	$ 12,949	$13,271	$13,600	$ 13,938	$14,285
Equivalent Cost of Solar	$ 216,000	$ 11,322	$ 11,265	$ 11,209	$ 11,153	$ 11,097	$ 11,042	$10,987	$10,932	$ 10,877	$10,823
Saving from Solar	$ 76,127	$ 131	$ 472	$ 820	$ 1,175	$ 1,538	$ 1,907	$ 2,284	$ 2,669	$ 3,061	$ 3,462

Quinn	SUM (20 y)	1	2	3	4	5	6	7	8	9	10
production (kWh/y)	2,495,600	130,811	130,157	129,506	128,859	128,214	127,573	126,935	126,301	125,669	125,041
RMP fully blended rate (3% annual increase)		0.097	0.100	0.103	0.106	0.109	0.112	0.116	0.119	0.123	0.127
Annual RMP cost	$ 323,639	$ 12,689	$ 13,004	$ 13,327	$ 13,658	$ 13,998	$ 14,346	$14,702	$15,067	$ 15,442	$15,826
Equivalent Cost of Solar		$ 14,467	$ 14,395	$ 14,323	$ 14,251	$ 14,180	$ 14,109	$14,038	$13,968	$ 13,898	$13,829
Saving from Solar	$ 47,639	$ (1,778)	$ (1,391)	$ (996)	$ (593)	$ (182)	$ 237	$ 664	$ 1,099	$ 1,543	$ 1,997

Hoytsville	SUM (20 y)	1	2	3	4	5	6	7	8	9	10
production (kWh/y)	2,155,135	112,965	112,400	111,838	111,279	110,723	110,169	109,618	109,070	108,525	107,982
RMP fully blended rate (3% annual increase)		0.082	0.084	0.087	0.090	0.092	0.095	0.098	0.101	0.104	0.107
Annual RMP cost	$ 236,267	$ 9,263	$ 9,493	$ 9,729	$ 9,971	$ 10,219	$ 10,473	$10,733	$11,000	$ 11,273	$11,553

PC Transit	SUM (20 y)	1	2	3	4	5	6	7	8	9	10
production (kWh/y)	159,606	8,366	8,324	8,283	8,241	8,200	8,159	8,118	8,078	8,037	7,997
RMP fully blended rate (3% annual increase)		0.100	0.103	0.106	0.109	0.113	0.116	0.119	0.123	0.127	0.130
Annual RMP cost	$ 21,338	$ 837	$ 857	$ 879	$ 901	$ 923	$ 946	$ 969	$ 993	$ 1,018	$ 1,043

Kamas Library	SUM (20 y)	1	2	3	4	5	6	7	8	9	10
production (kWh/y)	542,537	28,438	28,296	28,154	28,014	27,873	27,734	27,595	27,457	27,320	27,184
RMP fully blended rate (3% annual increase)		0.100	0.103	0.106	0.109	0.113	0.116	0.119	0.123	0.127	0.130
Annual RMP cost	$ 72,534	$ 2,844	$ 2,914	$ 2,987	$ 3,061	$ 3,137	$ 3,215	$ 3,295	$ 3,377	$ 3,461	$ 3,547

TABLE 3 Snyderville Basin Water Reclamation Potential PV Projects

East Canyon Wastewater	This facility uses approximately 3,650,000 kWh/y. The maximum net metered capacity of 2 MW solar PV would still not offset all the power that is consumed at this facility. There is no land availability at this location. The total solar **roof** capacity identified is 174 kW, which would offset about 6% of power. This solar project comprises 6 separate roofs. The fully blended rate at this facility (per schedule 6B) is about $0.07 / kWh. The average cost for solar implementation per kWh (as an average over 20 years), would probably be higher than the current fully blended power rate, however as power rates go up, and softer (non-monetary) benefits become increasingly more important, a solar project may become viable at this facility.	174 kW ($392,000 investment at $2.25/$W_{DC}$)
Silver Creek Wastewater	This facility currently uses 1,100,000 kWh/y. The facility is being upgraded, with expected operational date of 2018-19, when is will have similar flows, load and design parameters as the East Canyon facility (and (ultimately) therefore similar expected electrical consumption). There is a ~ 9 acre piece of land to the south of the wastewater facility, owned by the District, which is potentially available for a solar PV ground mount. There would be enough room for 2.5 – 3 MW of solar. This capacity is more than is allowed under net metering law (2 MW maximum) and is more than is currently being consumed at the wastewater facility. About 800 kW would offset all *current* electrical consumption at the Silver Creek facility. A system size of 800 kW is recommended, since it will be hard to estimate true power consumption before the new wastewater facility is fully operational. This project would be ideally suited to develop as a **Power Purchase Agreement**, where a third party investor / developer takes ownership of the system for a fixed period of time (typically 20 years), takes advantage of federal and State tax incentives (not available for non-tax payers like the Snyderville Basin Water Reclamation District) and sells the power to the District for a fixed contract price per kWh of power produced. Note that the federal ITC percentage will gradually be reduced from 30% to lower percentages after December 31, 2019 so it would be most beneficial if this project was implemented before that	800 kW (in 2016-17) Or: 2.5 MW (later) (This project would most beneficially be done via a PPA contract, since a third party investor can take advantage of federal tax incentives)

	deadline. Note 1: The Mountain Regional Water District has an interest in offsetting power required for a future pump station in the area just to the west of the wastewater facility. Depending on the size of the pump station, the distance between the pump station and the ground mount location could be feasible if high voltage transmission is used. Note 2: It may be possible, some time in the future, to offset the consumption at the East Canyon facility with solar power produced at the Silver Creek facility, but today there is no legal pathway for that yet.	

TABLE 4 Mountain Regional Water District Potential PV Projects

Treatment Plant – Floating PV System on Reservoir	The 3 acre raw water storage reservoir would be suitable for a floating PV system. There is room for 1,608 modules, which would be about 500 kW. The annual consumption at the plant is 716,138 kWh. A 500 kW PV facility would offset almost all power. This project would be feasible under a PPA contract.	500 kW $1.0mm-$1.2mm investment; suitable for PPA
Treatment Plant – "Roof Mount" on covered storage tank	A low profile ballasted PV system could be installed on the (flush) concrete cover of the (treated water) storage tank. There is room for about 330 modules (95 kW)	95 kW
Treatment Plant – Roof Mount on Treatment Building	The treatment building has a corrugated roofing material. The Solar racking / mounting system would probably need to be penetrated through the roof deck onto structural members of the building. There is room for about 60 kW.	60 kW
Lost Canyon Booster Pumping Facility 7340 N State Wanship, UT	2-3 steep hillside acres available (~1 MW) or 9-10 acres available in farmer's field (3 MW). The pump station uses Schedule 9 power, with extremely low fully blended rate and carefully managed peak power demand charges through careful reservoir level control. The annual consumption is 6,086,610 kWh.	No solar recommended at this time
(Future) Silver Creek Concrete Tank 7867 Silver Gate Dr. Park City, UT	Tank is in planning stages. District would like to make pump station net zero, using solar and in-pipe turbine technology.	Solar and in-pipe technology recommended at future date.

TABLE 5 Fire Stations - Potential PV Projects

	Annual Consumption (kWh/y)	**Total Solar Capacity (kW_{DC})**	% Offset	**Total Investment**	**Remarks**
Station 31 2388 Holiday Ranch Loop Park City, UT	50,345	34	>90%	$76,500	This is a relatively 'straightforward' roof mount. A full shading study is recommended to assess the impact of tree shading. Micro-inverters are recommended.
Station 33 730 W Bitner Road Park City, UT	82,062 (admin)	47	75%	$ 98,000 **($2.08 / $Watt_{DC}$)**	There are already three solar arrays at this site. The fire station roof is suitable, but would have to offset power consumed at the Admin Building.
Station 35 2575 West Kilby Rd Park City, UT	31,025	20	>90%	$45,000	A ground mount solar array, either in front of the building or at the back, would have the potential to offset all power consumed at this building.
Station 36 1977 Canyons Resort Dr Park City, UT	61,421	38	~80%	$85,500	Steep shingle east-west facing roofs
Station 37 6534 Promontory Ranch Park City, UT	42,793	28	>90%	$63,000	A ground mount solar array at the back (on the south side), would have the potential to offset all power consumed at this building.
Station 38 1798 Deer Valley Drive Park City, UT	27,690	20	>90%	$45,000	Shingle roof (south-east and south-west facing).
TOTAL		**187**		**$ 413,000**	

- Stations #35 and #37 do not have a lot of solar roof capacity, but both have room for ground mounted solar arrays, which would be a good alternative solution at these locations.
- Station #33 has the highest electricity usage of all stations. The consumption is already partially offset by three solar arrays but the admin building still has substantial electricity consumption that can be offset with a low profile ballasted system on top of the fire station building.
- Stations #31, #36 and #38 are flush roof mounts, with tilted roofs. There may be some shading impact from trees at these three sites and some roofs are east-west facing. Micro-inverters may be a good solution for some or all of these sites.

TABLE 6 Economic Analysis, Fire Stations

	Station 31 (34 kW_{DC})	**Station 33 (47 kW_{DC})**	**Station 35 (20 kW_{DC})**	**Station 36 (38 kW_{DC})**	**Station 37 (28 kW_{DC})**	**Station 38 (20 kW_{DC})**	**TOTAL**
system size (kW)	34	47	20	38	28	20	**187**
Annual Consumption (kWh)	50,345	104,214 (total)	31,025	61,421	42,793	27,690	**317,487**
Year 1 Production (kWh)	49,178	66,828	29,875	48,181	41,825	28,928	**264,815**
20 Year Production (kWh)	938,213	1,274,938	569,952	919,192	797,933	551,886	**5,052,115**
System Cost	$ 76,500	$ 98,000	$ 45,000	$ 85,500	$ 63,000	$ 45,000	**$ 413,000**
Saving	$ 30,676	$ 41,700	$ 29,138	$ 15,219	$ 31,791	$29,715	**$ 178,239**
$/kWh (20 y)	$ 0.082	$ 0.077	$ 0.079	$ 0.093	$ 0.079	$ 0.082	

Building Solar Compared to RMP Solar Subscriber Program

As noted in **Table 2**, the average 'per kWh' power rate for owning these solar systems is around $0.09 for roof systems and $0.11 for canopies (not accounting for O&M). In comparison to RMP schedule 23 fully blended rate (see **Figure 1** below), that number is competitive today, and since RMP rates are likely to increase (assumed is a compounded 3% per year over the next 20 years, which was the average in the past 10 years), the *economical* case for solar is easily made (there are *additional* soft benefits).

Since the fully blended rate under schedule 6B is lower (see **Figure 2** below) than under schedule 23, it is harder to compete with implementing solar.

So, if subscribed under schedule 23, owning one's own solar systems is comparable to being enrolled in the RMP Solar Program (see **Figure 1**), since the flat rate in that program is $0.101/kWh. Note that the Program rate is $0.0701/kWh if in schedule 6B (or 6A) (see **Figures 2 and 3**) which is cheaper than owning one's own solar, but could be comparable to a Power Purchase Agreement (PPA) rate for larger systems like the one recommended for Silver Creek.

4,800 KWH USED - SUMMER

KWH BLOCKS	STANDARD CUSTOMER	SOLAR SUBSCRIBER CUSTOMER
Solar		1,000 $0.101
First 1,500	1,500 $0.117	1,500 $0.117
Remaining kWh	3,300 $0.066	2,300 $0.066
TOTAL KWH COST/MONTH	**$393.09**	**$428.61**

3,000 KWH USED - WINTER

KWH BLOCKS	STANDARD CUSTOMER	SOLAR SUBSCRIBER CUSTOMER
Solar		1,000 $0.101
First 1,500	1,500 $0.108	1,500 $0.108
Remaining kWh	1,500 $0.061	500 $0.061
TOTAL KWH COST/MONTH	**$252.85**	**$293.59**

Schedule 23

Figure 1 Comparison of RMP Solar Program to Schedule 23 (courtesy of RMP)

13,000 KWH USED - SUMMER

KWH BLOCKS	STANDARD CUSTOMER	SOLAR SUBSCRIBER CUSTOMER
Solar		800 $0.071
All kWh	13,000 $0.038	12,200 $0.038
TOTAL KWH COST/MONTH	**$495.65**	**$522.15**

11,000 KWH USED - WINTER

KWH BLOCKS	STANDARD CUSTOMER	SOLAR SUBSCRIBER CUSTOMER
Solar		800 $0.071
All kWh	11,000 $0.035	10,200 $0.035
TOTAL KWH COST/MONTH	**$386.54**	**$415.46**

Schedule 6

Figure 2 Comparison of RMP Solar Program to Schedule 6B (courtesy of RMP)

6,840 KWH USED - SUMMER

KWH BLOCKS		STANDARD CUSTOMER	SOLAR SUBSCRIBER CUSTOMER
Solar			1,800 $0.071
6A kWh	On-Peak	1,920 $0.118	642 $0.118
	Off-Peak	4,920 $0.036	4,398 $0.036
TOTAL KWH COST/MONTH		**$401.34**	**$360.25**

6,720 KWH USED - WINTER

KWH BLOCKS		STANDARD CUSTOMER	SOLAR SUBSCRIBER CUSTOMER
Solar			1,800 $0.071
6A kWh	On-Peak	2,560 $0.099	1,282 $0.099
	Off-Peak	4,160 $0.030	3,638 $0.030
TOTAL KWH COST/MONTH		**$376.34**	**$363.00**

Schedule 6A TOU

Figure 3 Comparison of RMP Solar Program to Schedule 6A (Time-Of-Day) (courtesy of RMP)

Societal and Soft Benefits:

The County has a vested interest in protecting and enhancing the environment, the economy, and quality of life through reducing energy consumption and helping the community become more sustainable in use of resources. The County has taken steps to reduce human-caused greenhouse gas emissions and increase energy efficiency to provide multiple local benefits by decreasing air pollution, reducing energy expenditures, and saving money for the local government, its businesses, and its residents. The County has adopted a leadership role in promoting renewable energy to power its facilities and to encourage the use of renewable energy countywide.

The visibility of Solar PV on county buildings demonstrates County's leadership in use of clean, renewable energy. Carports protect County fleet vehicles, reduce snow plowing and protect the public from the weather.

The overall 20 year emissions reduction associated with each system are set out in **Table 2**[3].

The Social Cost (SC) of Carbon

EPA and other federal agencies use the social cost of carbon (SC-CO_2) to estimate the climate benefits of rulemakings. The SC-CO_2 is an estimate of the economic damages associated with a small increase in carbon dioxide (CO_2) emissions, conventionally one metric ton, in a given year. This dollar figure also represents the value of damages avoided for a small emission reduction (i.e., the benefit of a CO_2 reduction). In this report, the average cost per metric ton (SC-CO_2) is assumed to be an average $46 over the 20 year life of the system[4].

O&M Frequency and Cost

It is hard to attach dollar amounts to anticipated maintenance frequency and costs for each option. If it is assumed that the maintenance of the solar systems is generally done by Summit County personnel, then it is recommended to set aside a maintenance budget from year 10 onwards, when inverter failures may start to occur (and warranty may have run out). Inverter warranty generally

[3] It was assumed that the emission of 2.11439 lbs. CO2e / kWh is prevented by using solar generation. This is based on a RMP average.

[4] https://www.epa.gov/climatechange/social-cost-carbon "3% average"; $36 in 2015 and $55 in 2035

runs 10 years, although some suppliers have started to issue full 20 year warranties. The solar modules generally have 20 year warranty too.

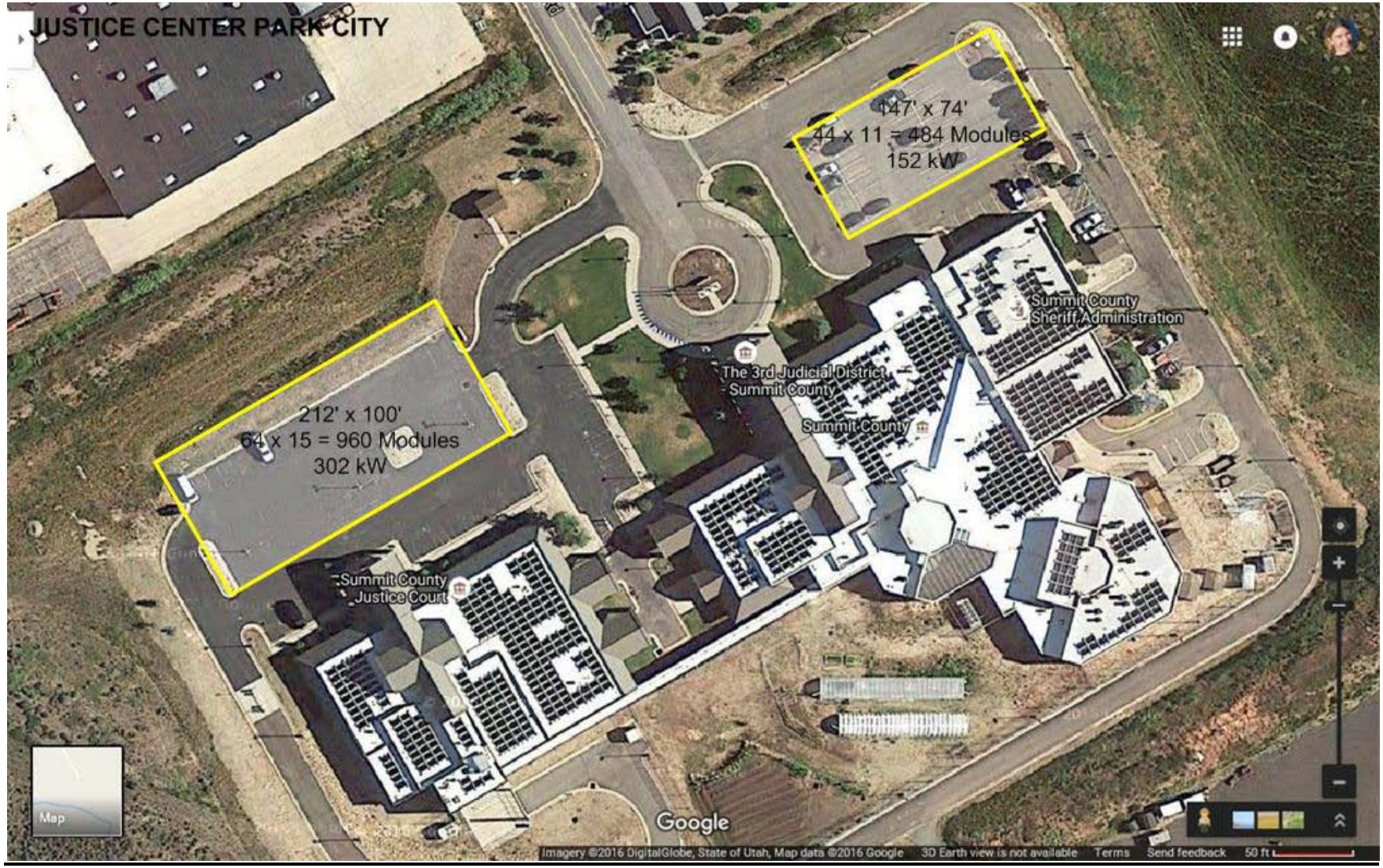
Annual maintenance should include inspection of the modules and wiring, inspection of electrical junction boxes, and if possible, measuring output of the modules on a given day (compared to a calibrated measuring device). Annual or semi-annual washing of the modules is also recommended.

If inverter failure is detected, the inverter should be under warranty, at the very least for the first ten years of the solar system life. Typically, there is a standard inverter failure procedure, such as calling the manufacturer's help desk, reporting the failure code, and troubleshooting the problem.

Regular *monitoring* should include monthly (or more frequent) checking of the solar monitoring system (associated with the inverters; generally web accessible), and comparison to modeled output (such as PV Watts; http://pvwatts.nrel.gov/pvwatts.php).

SUMMIT COUNTY BUILDINGS

Justice Center


JUSTICE CENTER PARK CITY
147' x 74'
44 x 11 = 484 Modules
152 kW
212' x 100'
64 x 15 = 960 Modules
302 kW
Summit County
Sheriff Administration
The 3rd Judicial District
- Summit County
Summit County
Summit County
Justice Court
Map
Google
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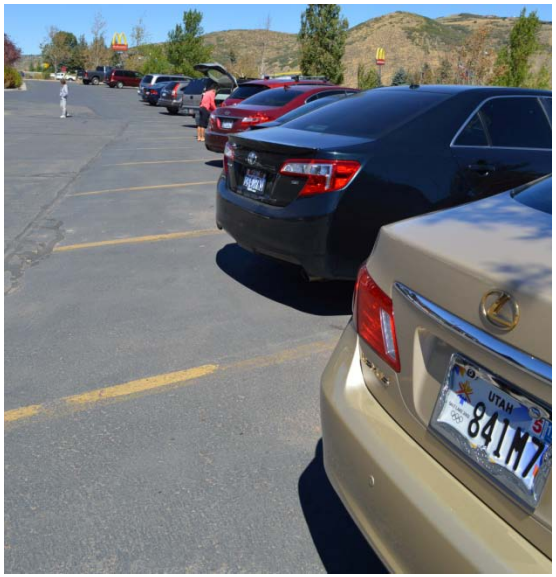
- The Justice Center building already has a solar system on the roof (220 kW) but there is a potential for (long span) parking canopies.
- Recommendation: 454 kW solar parking canopies.

Justice Center Complex 6300 Silver Creek Dr Park City, UT 84098

Acc #	Meter#	Schedule	average daily kWh	Annual Consumption kWh/y	Solar size for 100% offset (kW_{DC})[5]	Annual RMP Bills [6]	Fully Blended ($/kWh)
35266386 - 016	64142186	135/6b	3200	1,168,000	898	$96,130	0.0823

[5] Solar size required for 100% offset
[6] Current bill without solar

Richins Building



RICHINS BUIDLING
304 Modules
96 kW
216'
Tree
Topping?
Michaels
126' x 40'
20 x 12 = 240 Modules
75 kW
104' x 40'
16 x 12 = 192 Modules
60 kW
126' x 40'
20 x 12 = 240 Modules
75 kW
Google

- Recommended: 96 kW roof mount
- The Richins building has an east-west facing roof with room for 96 kW solar PV. Parking canopies (210 kW) are an option but because of the layout of the parking area, and the additional cost of parking structures, this is a less desirable option.
- About 200 kW of solar PV would offset most (>90%) of power, but the roof will be cheaper to implement. There appears to be stable power consumption throughout the year.

Richins Building, 1885 W Ute Blvd Park City, UT 84098

Acc #	Meter#	Schedule	average daily kWh	Annual Consumption kWh/y	Max solar size for 100% offset (kW_{DC})	Annual RMP Bills	Fully Blended ($/kWh)
35266386 - 016	3002663	6B	756	275,838	212	$ 20,924	$ 0.076

Quinn's Health

QUINNS HEALTH
650 Round Valley Drive
Park City Pkwy
184'
109'
161' x 40'
49 x 6 = 294 Modules
92 kW (66% offset)
Round Valley Dr
Map
Google
Imagery ©2016 State of Utah, Map data ©2016 Google
3D Earth view is not available
Terms
Send feedback
20 ft

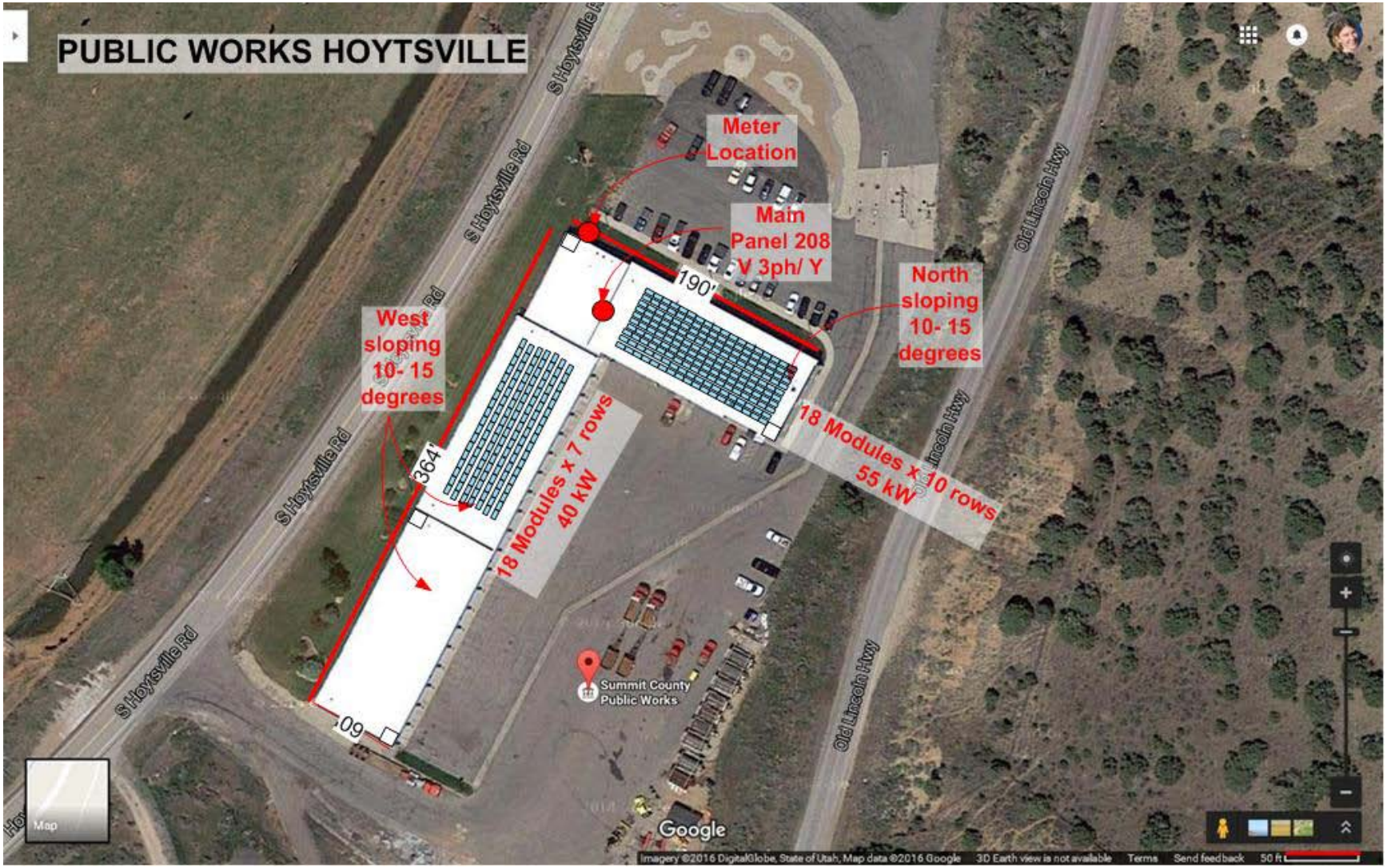
The roof already has a solar system. A long span canopy is not possible due to configuration issues. One regular canopy would be possible on the south side of parking lot (**92 kW canopy**) but will be relatively expensive to implement and will only cover 12# parking spaces.

Quinn's Health Building 650 Round Valley Dr Park City, UT 84098

Acc #	Meter#	Schedule	average daily kWh	Annual Consumption kWh/y	Max solar size for 100% offset (kW_{DC})	Annual RMP Bills	Fully Blended ($/kWh)
35266386 - 017	52857464	135 /6B Consider 6A	283	183,054	140	$ 17,809	$ 0.097

Public Works and Animal Welfare, Hoytsville

Public Works 1755 S Hoytsville Rd Hoytsville, UT 84017	The PW building is the most suitable of all building at this location. Consider using this building and aggregate its meter with Animal Control on the same account. Only 86 kW is required to offset all consumption for the PW and Animal Control meters.
Animal Control 1745 S Hoystville Rd Hoytsville, UT 84016	See above. No solar recommended on this building.
Weed Control 1735 S Hoytsville Rd Hoytsville, UT 84017	Very low power consumption. It would be expensive to aggregate this account with a schedule 6 (because of base charge). The building itself has east tilted roof which is partially shaded by the mountain ridge.


PUBLIC WORKS HOYTSVILLE
Meter Location
Main Panel 208 V 3ph/ Y
North sloping 10- 15 degrees
West sloping 10- 15 degrees
18 Modules x 7 rows 40 kW
18 Modules x 10 rows 55 kW
190'
364'
S Hoytsville Rd
Old Lincoln Hwy
Summit County Public Works
Google

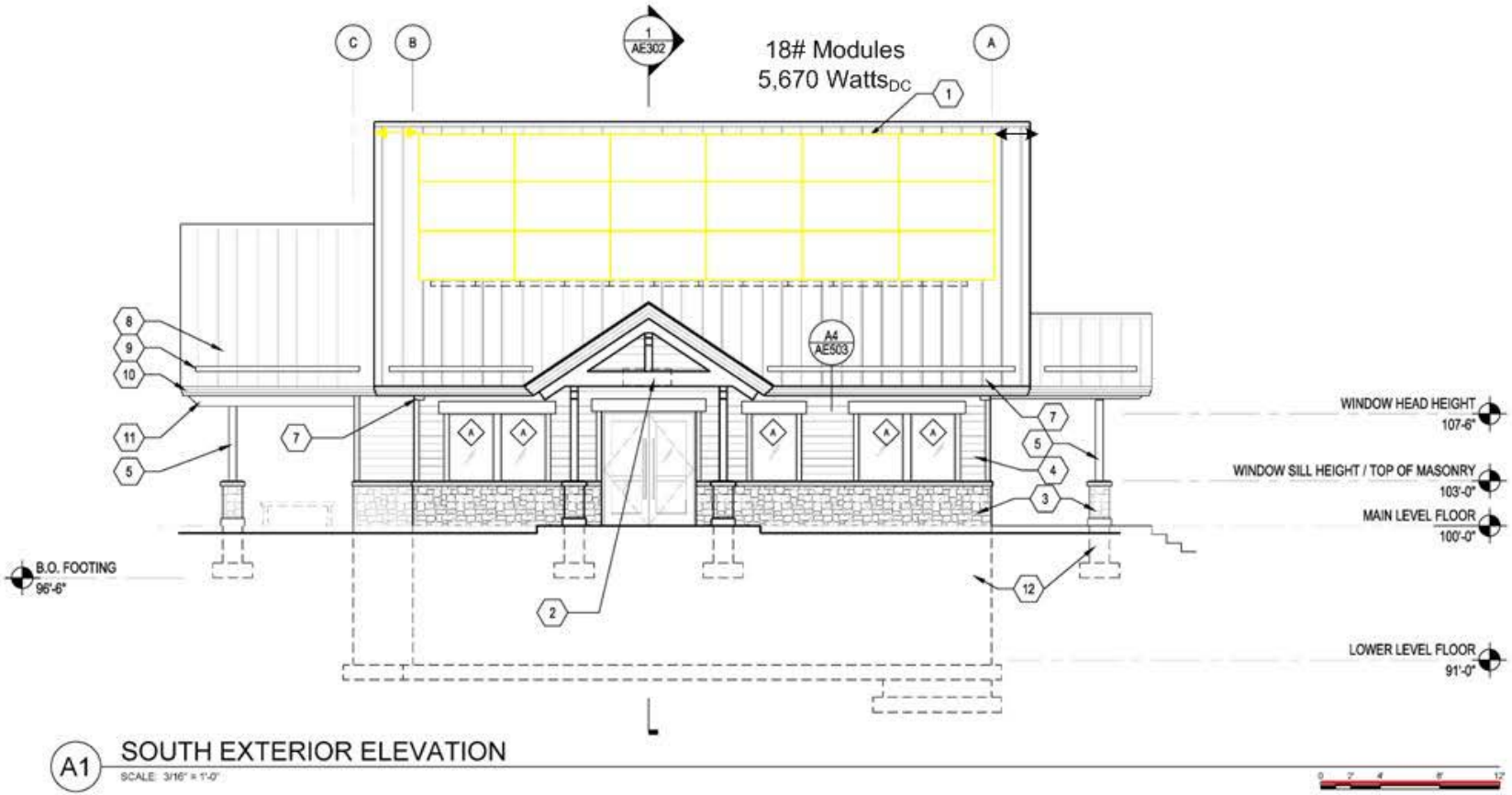
Hoytsville Buildings

	Acc #	Meter#	Schedule	average daily kWh	Annual Consumption kWh/y	Max solar size for 100% offset (kW_{DC})	Annual RMP Bills	Fully Blended ($/kWh)
Public Works 1755 S Hoytsville Rd Hoytsville, UT 84017	35266386 - 017	1249812	6 B	229	83,707	64	$10,655	$ 0.127
Animal Control 1745 S Hoystville Rd Hoytsville, UT 84016	35266386 - 017	66860142	23	96	35,027	27	$3,624	$0.103
Weed Control 1735 S Hoytsville Rd Hoytsville, UT 84017	35266386 - 017	50815374	23	20	7,340	5.6	$ 960	$ 0.131

- The meters for the PW building and Animal Control could be aggregated, and the consumption for those buildings offset with one solar system on the flat roof of the PW building.
- Less than 90 kW would offset >90% of the two meters. Note that the animal control meter would have to go on a schedule 6 (instead of schedule 23). Schedule 6A is recommended for both meters instead of 6B after solar implementation. Note that the basic charge for the Animal control center would go up from $10 per month to $54 per month.
- The north-east roof of the PW building is tilted north by about 5-10 degrees. It is still possible to implement low profile, ballasted, south facing racking but this will affect row spacing. The alternative would be to use the slightly tilted, west facing roofs on the south-west side of the building.
- **Recommended: 86 kW low profile ballasted roof mount on PW Building. On the interconnect application, request for 'Animal Control' to be aggregated with Public works meter, under Schedule 6a and convert the PW rate schedule to 6A.**

(Future) Transit Center

FUTURE TRANSIT CENTER



(Future) Transit Center (west of Richins building), 1890 W Ute Blvd Park City, UT 84098: Prepped for solar (Small system included in design – 5.6 kW)

(Future) Kamas Library

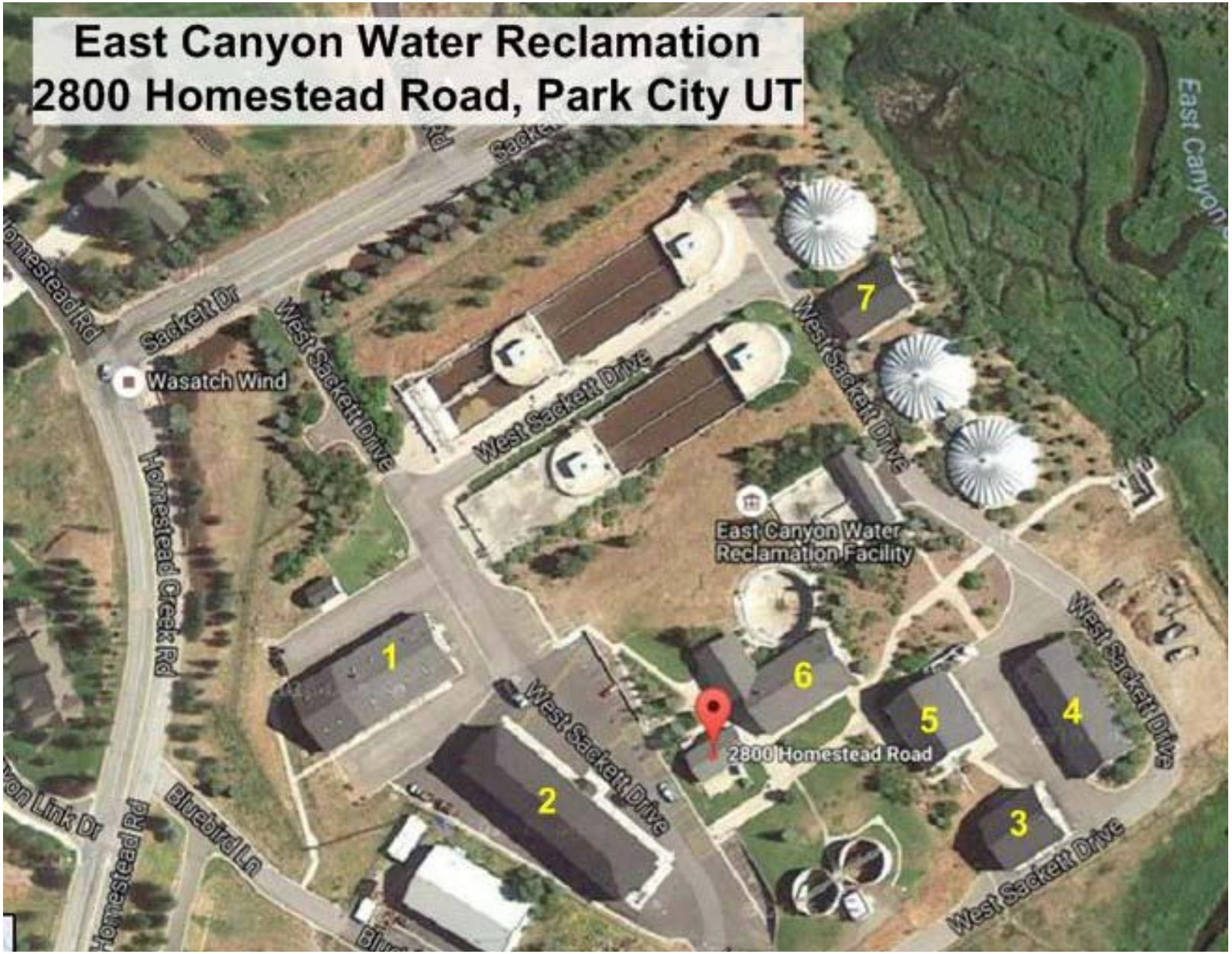
(Future) Kamas Library 110 N Main St Kamas, UT 84036: Prepped for solar. Small system included in design (20 kW)

Snyderville Basin Water Reclamation

Snyderville Basin Water Reclamation

	RMP schedule	Estimated annual consumption (kWh/y)	Max solar size for 100% offset (kW_{DC})	Blended rate ($/kWh)	Typical demand (kW)
East Canyon Facility Complex 2800 Homestead Road Park City, UT 84098 (2909 Sacket Dr, Park City)	6B	3,650,000	2,808	$ 0.076	503
Silver Creek Complex 7867 Silver Gate Drive Park City, UT 84098	6B	1,460,000	1,123	$ 0.077	234

East Canyon Facility Complex

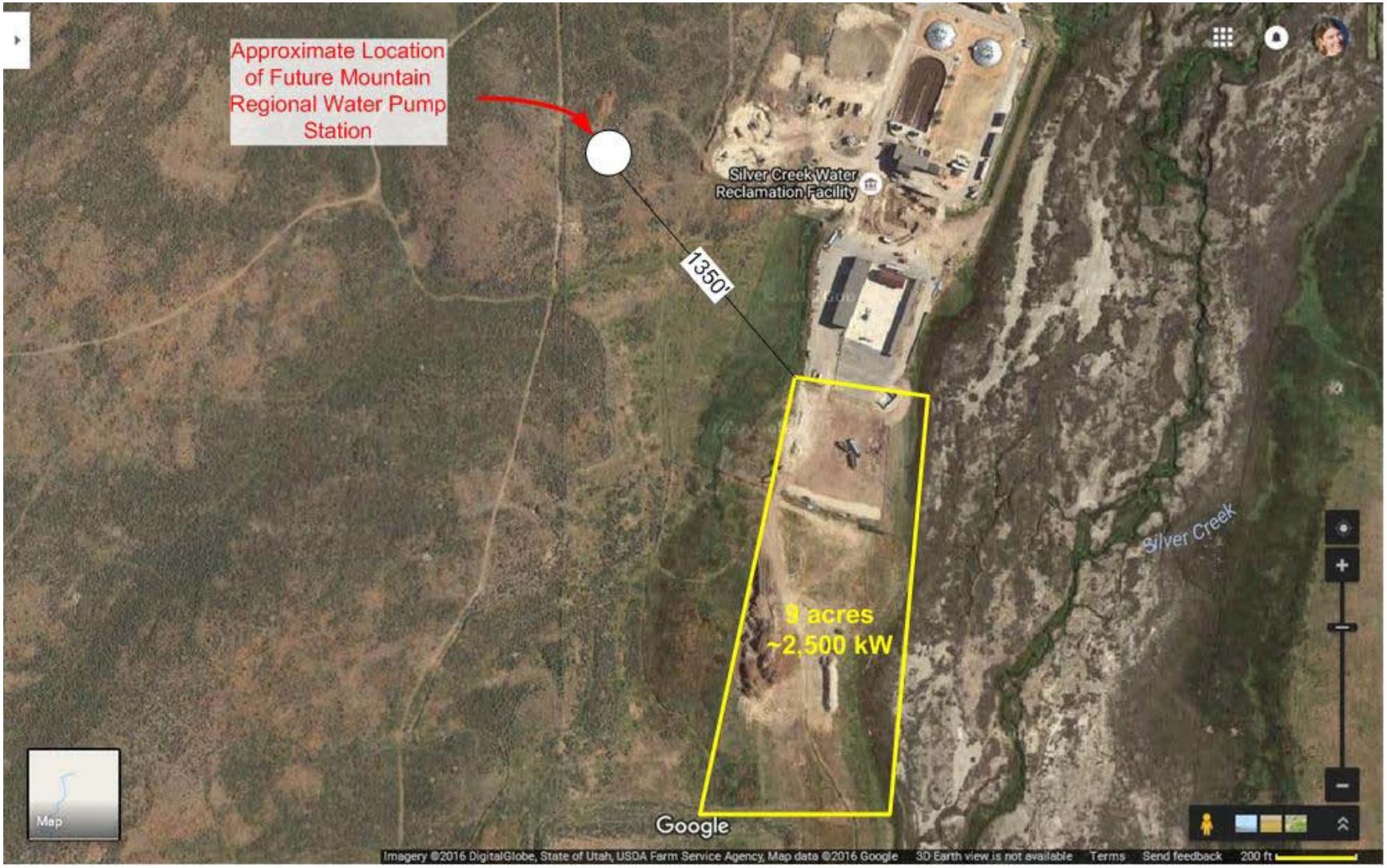

East Canyon Water Reclamation
2800 Homestead Road, Park City UT
Homestead Rd
Sackett Dr
Wasatch Wind
West Sackett Drive
Homestead Creek Rd
East Canyon Water Reclamation Facility
2800 Homestead Road
Bluebird Ln
East Canyon
1
2
3
4
5
6
7

East Canyon Buildings "1" and "2"
138'
126# Modules
40 kW
135'
113# Modules
35 kW
West Sackett Drive
West Sackett Drive
Bluebird Ln
Bluebird Ln
Map
Google
Imagery ©2016 State of Utah, Map data ©2016 Google
3D Earth view is not available
Terms
Send feedback

East Canyon Buildings "3", "4", "5" and "6"
95# Modules
30 kW
60# Modules
20 kW
102# Modules
32 kW
53# Modules
17 kW
2800 Homestead Road
West Sackett Drive
West Sackett Drive
West Sackett Drive
West Sackett Drive
Map
Google
Imagery ©2016 State of Utah, Map data ©2016 Google
3D Earth view is not available
Terms
Send feedback
20 ft

East Canyon Wastewater	This facility uses approximately 3,650,000 kWh/y. The maximum net metered capacity of 2 MW solar PV would still not offset all the power that is consumed at this facility. There is no land availability at this location. The total solar **roof** capacity identified is 174 kW, which would offset about 6% of power. This solar project comprises 6 separate roofs. The fully blended rate at this facility (per schedule 6B) is about $0.07 / kWh. The average cost for solar implementation per kWh (as an average over 20 years), would be higher than the current fully blended power rate, however as power rates go up, and softer (non-monetary) benefits become increasingly more important, a solar project may become viable at this facility.	**174 kW** **($392,000 investment at $2.25/$W_{DC}$)**

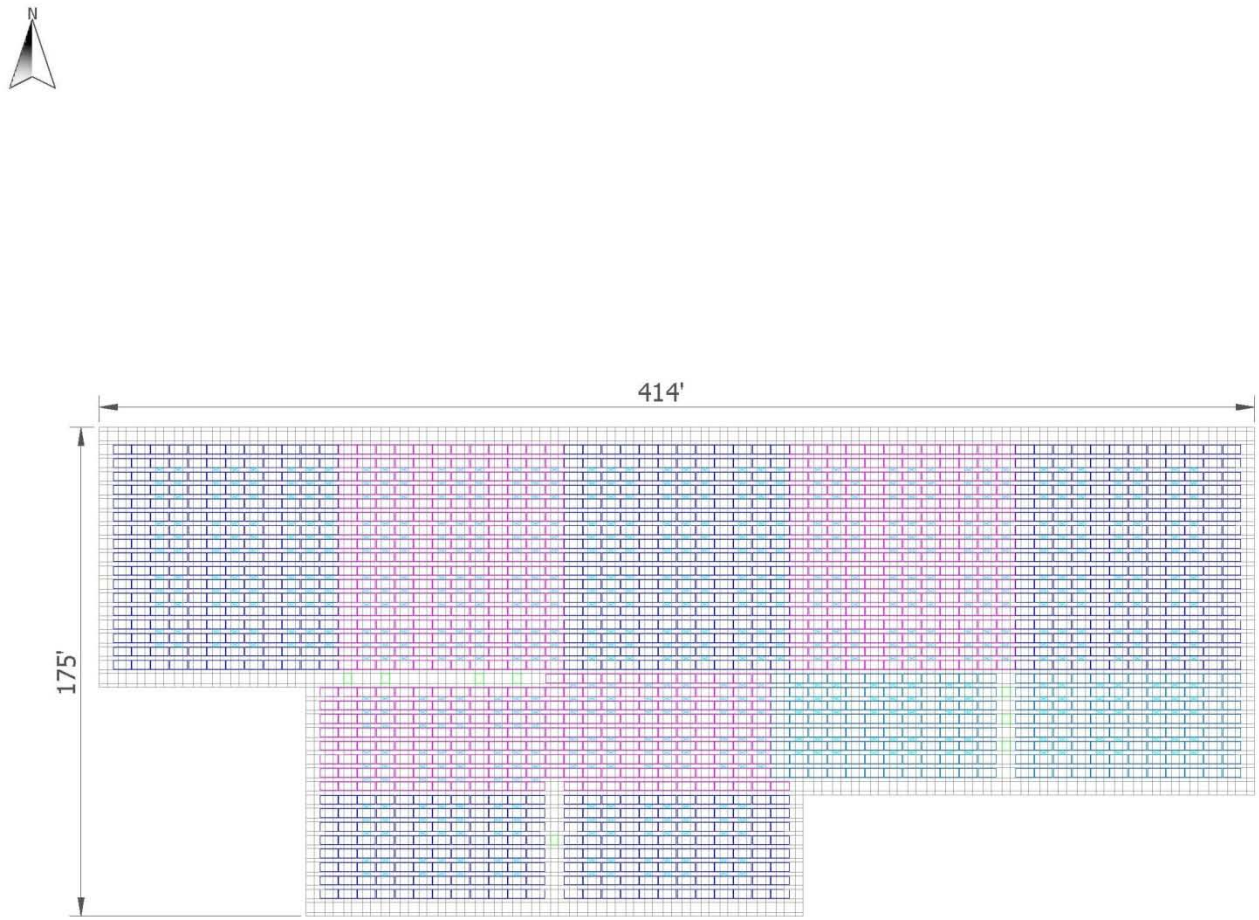
Silver Creek Complex


Approximate Location of Future Mountain Regional Water Pump Station
Silver Creek Water Reclamation Facility
1350'
9 acres
~2,500 kW
Silver Creek
Google
Map
Imagery ©2016 DigitalGlobe, State of Utah, USDA Farm Service Agency, Map data ©2016 Google
3D Earth view is not available
Terms
Send feedback
200 ft

Silver Creek Wastewater	This facility currently uses 1,100,000 kWh/y. The facility is being upgraded, with expected operational date of 2018-19, when is will have similar flows, load and design parameters as the East Canyon facility (and (ultimately) therefore similar expected electrical consumption). There is a ~ 9 acre piece of land to the south of the wastewater facility, owned by the District, which is potentially available for a solar PV ground mount. There would be enough room for 2.5 – 3 MW of solar. This capacity is more than is allowed under net metering law (2 MW maximum) and is more than is currently being consumed at the wastewater facility. About 800 kW would offset all *current* electrical consumption at the Silver Creek facility. A system size of 800 kW is recommended, since it will be hard to estimate true power consumption before the new wastewater facility is fully operational. This project would be ideally suited to develop as a **Power Purchase Agreement**, where a third party investor / developer takes ownership of the system for a fixed period of time (typically 20 years), takes advantage of federal and State tax incentives (not available for non-tax payers like the Snyderville Basin Water Reclamation District) and sells the power to the District for a fixed contract price per kWh of power produced. Note that the federal ITC percentage will gradually be reduced from 30% to lower percentages after December 31, 2019 so it would be most beneficial if this project was implemented before that deadline. Note 1: The Mountain Regional Water District has an interest in offsetting power required for a future pump station in the area just to the west of the wastewater facility. Depending on the size of the pump station, the distance between the pump station and the ground mount location could be feasible if high voltage transmission is used. Note 2: It may be possible, some time in the future, to offset the consumption at the East Canyon facility with solar power produced at the Silver Creek facility, but today there is no legal pathway for that yet.	800 kW (in 2016-17) Or: 2.5 MW (later) (This project would most beneficially be done via a PPA contract, since a third party investor can take advantage of federal tax incentives)

Mountain Regional Water District

Treatment Plant



WUS108_SUMMIT RESERVOIR

Strings configuration

Floating PV plant project

SUMMIT COUNTY, UT, USA

Legend :

- Combiner boxes
- PV panels (colored per inverter)
- Floats HYDRELIO
- Gaps without floats (Eco configuration)

CONFIDENTIAL

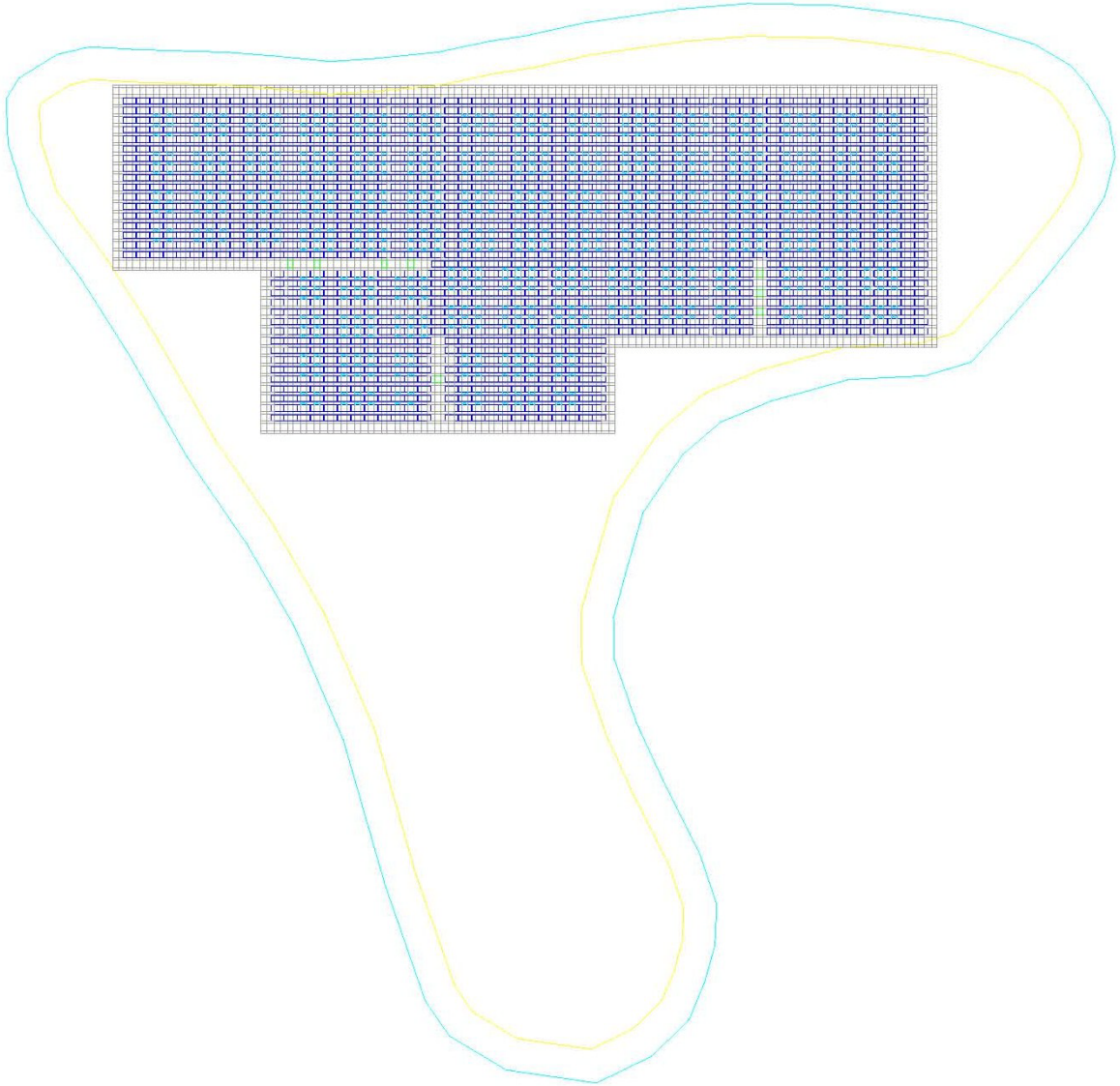
Ciel & Terre

Scale : 1:500

Layout : A3

Drawing N° : WUS108_TP06_Strings configuration_V1indA

DRAWN BY	DATE	CHECKED BY	DATE	COMMENTS
WL	09/26/16	XX	XX/XX/XX	



	RMP schedule	Estimated annual consumption (kWh/y)	Max solar size for 100% offset (kW_{DC})	Schedule 6A Time of Day Peak rate ($/kWh)	Typical demand (kW)
Mountain Region Treatment Plant 7565 N Promontory Ranch Rd, Park City	6A	716,138	500	$0.10	185

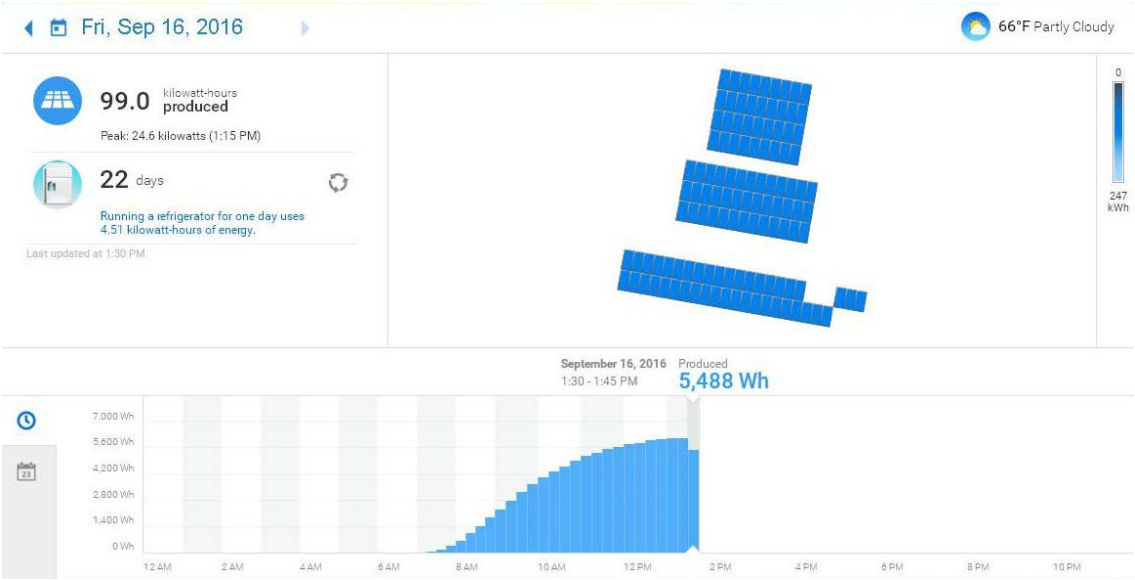
The 3 acre raw water storage reservoir would be suitable for a floating PV system. This is a clay lined, man-made raw water reservoir, filled each night, and drawn down for water treatment 24/7. This is not a wild life habitat. A floating system would have soft benefits like reduced algae growth (lower treatment cost) and lower evaporation.

There is room for 1,608 modules, which would be about 500 kW. The annual consumption at the plant is 716,138 kWh. A 500 kW PV facility would offset almost all power.

The company that provides the floatation units for the solar modules, quoted a total of $225,651 for a 500 kW system (about $0.45 per Watt installed) for materials only (i.e. no labor). This includes floaters and racking, but not modules, wiring, inverters, Balance of System, design, permitting, labor, insurance etc. The premium is about $0.25 per Watt over a ground mounted system.

A **500 kW** system, if implemented by an external contractor, would cost in the order of $1,215,000. However the District is considering doing some or most of the labor internally, which will make implementation cheaper. Alternatively, this project can be done under a **PPA contract**, with no out-of-pocket to the District.

Alternatively, there is room for a 95 kW 'roof mounted' system on the concrete tank just outside the treatment building. The roof of the building itself has capacity for about 60 kW, however roof inspection is required since it is a corrugated roofing material and wind speeds at that location are higher than in the valley.



PARK CITY FIRE DISTRICT

Station 31

STATION 31
2388 Holiday Ranch Loop Road

BASED ON JUNE-JULY 2016

Account #	Station	Address	Meter #	Bill item#	Schedule	Demand charge ($/kW)	Usage Charge ($/kWh)	kWh used (per month)	Demand (kW)	Charge (July 2016)
35328266-001 1	#31	2388 Holiday Ranch Loop Park City, UT	35695982	25	23	Not charged	0.117665	1500	13	176.50
							0.066112	2,500		165.28

- Recommended size 34 kW flush roof mount
- The south-east facing roof has suffers from tree shading on the north and the south side. A shading study should be conducted to ascertain whether micro-inverters would be a good solution.

Station 33

STATION 33
730 W Bitner Road

BASED ON JUNE-JULY 2016

Account #	Station	Address	Meter #	RMP bill item#	Schedule	Demand charge ($/kW)	Usage Charge ($/kWh)	kWh used (per month)	Demand (kW)	Charge (July 2016)
35328266-001 1	#33	(garage and training) 730 Bitner Road, Park City		28	14					$298.07
	#33		60614225	29	23	$8.65	0.117665	1500	16 (1)	$176.50
							0.066112	260		$17.19
21 kW solar					135			-1840		solar production
	#33	(Admin) 736 Bitner Road, Park City	60614224	30	6b	18.66	0.038404	6520	28	$250.39
11.7 kW solar					135			-80		solar production

- Recommended roof mounted solar array (ballasted, low profile) 47 kW.
- 736 W Bitner Road (Admin Building) already has 11.76 kW solar array Schedule 135 Meter #60614224. No further solar recommended on this building at this time, although it should be considered that the meter associated with this building be used for future solar on the garage building.
- 730 W Bitner Road has a 21 kW solar array associated with the meter. The array is physically on the building to the north (the warehouse) but appears to be connected to meter #60614225 which is on the side of the fire station (the one on the south).
- The larger roof mount 21 kW solar is offsetting the schedule 23 meter associated with the fire station. The solar system is performing as expected, generating a net metering credit of 1,840 kWh in June and offsetting 15 kW demand.
- The smaller 11.7 kW system appears to be attached to the schedule 6b meter on the admin building. It is generating electricity per design and in June/July there was a 80 kWh credit on the bill.
- The new solar system on the fire station roof, if installed, should offset the admin building meter (#60614224). Although a longer conduit run, it will offset more expensive demand charges (schedule 6b). Consider switching to schedule 6a after solar completion.
- Switching all meters to schedule 6 which would be more expensive. Changing admin building to schedule 23 which would be just about same charge.
- Recommend looking into item #28 / Schedule 14 (temporary service)? Is it still needed?
- There is 240 V supply to all buildings.

Station 35

STATION 35
2575 W Kilby Rd, Park City UT

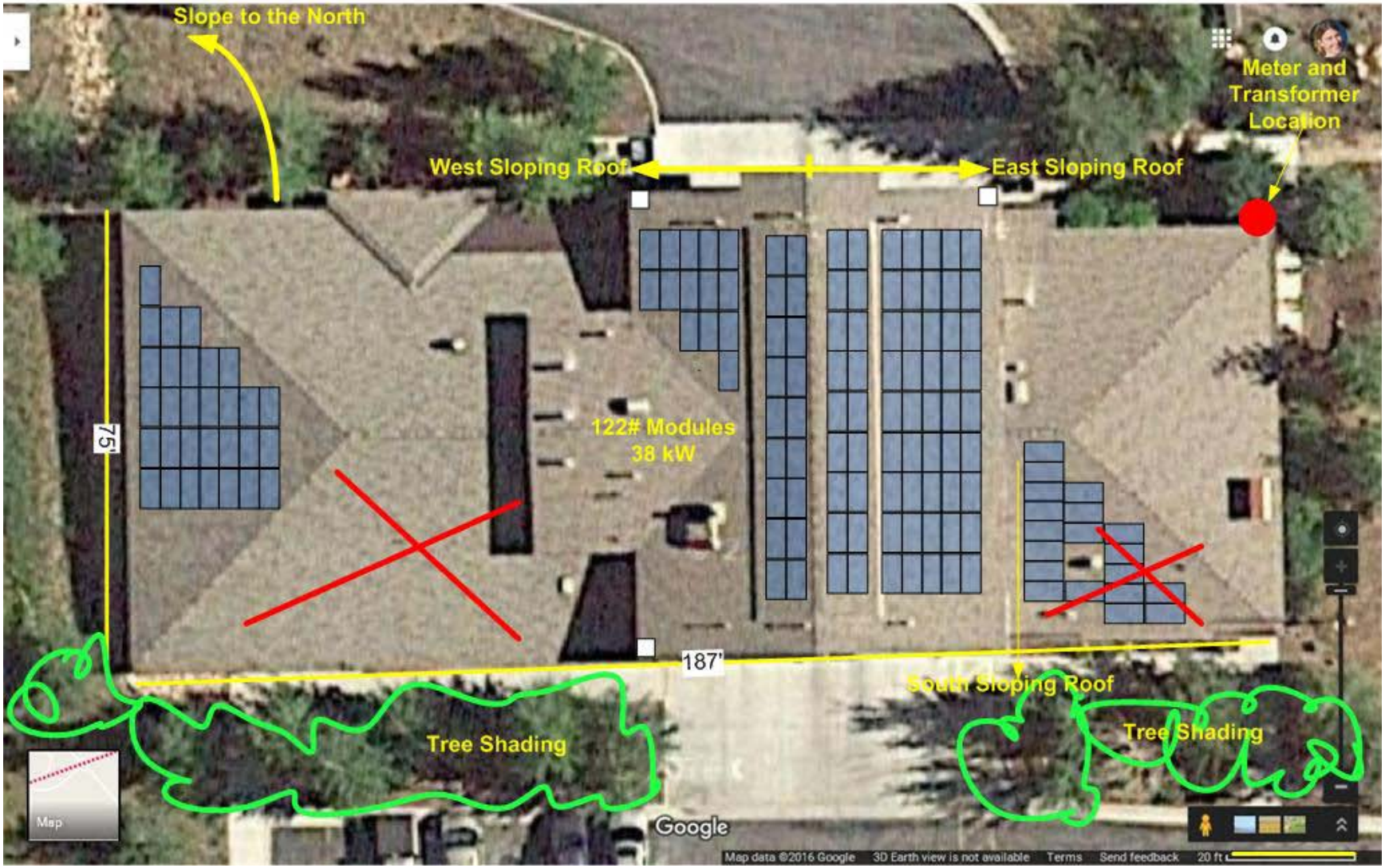
BASED ON JUNE-JULY 2016

Account #	Station	Address	Meter #	Bill item#	Schedule	Demand charge ($/kW)	Usage Charge ($/kWh)	kWh used (per month)	Demand (kW)	Charge (July 2016)
35328266-001 1	#35	2575 Kilby Rd, Park City UT	1723245	8	23		0.117665	1500	13	176.50
							0.066112	980		64.79

- Recommended solar array (ground mounted) 20 kW
- Landscaping features (large trees) are shading the southeast facing roof. This roof is therefore not very suitable for solar.
- The maximum system size (to offset all power) is about 20 kW, which is only about 64 modules.
- There is a flat grassy area in front of the building that would be suitable for a ground mount but was identified as not desirable for solar PV.
- There is also a containment area at the back of the building. This is a smaller area, with room for a 20 kW ground mounted array. The grade of this area is harder / more expensive for solar implementation (but probably not impossible).

Station 36

STATION 36
1977 Canyons Resort Drive Park City UT



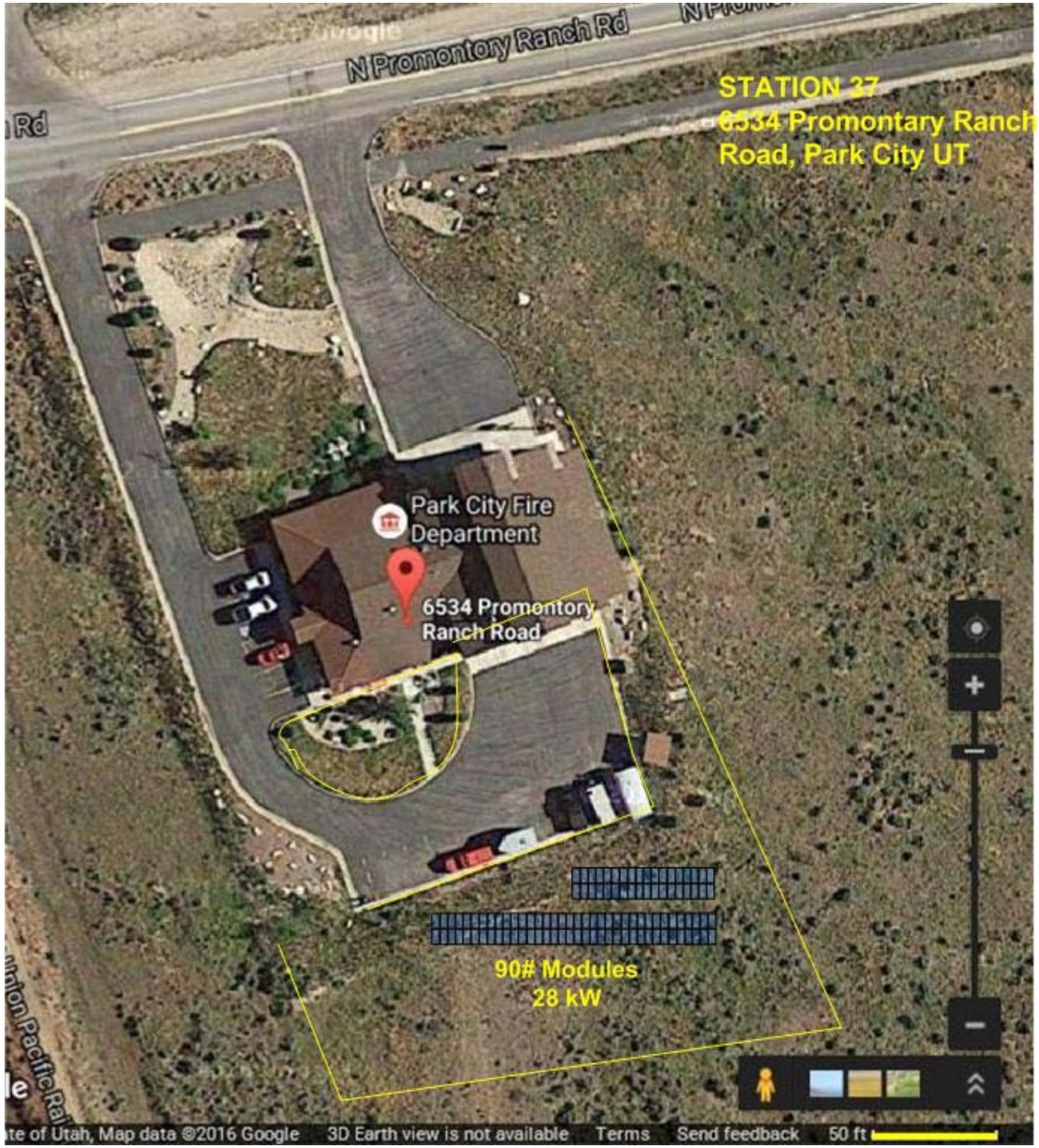
BASED ON JUNE-JULY 2016

Account #	Station	Address	Meter #	Bill item#	Schedule	Demand charge ($/kW)	Usage Charge ($/kWh)	kWh used (per month)	Demand (kW)	Charge (July 2016)
35328266-001 1	#36	1977 Canyons Resort Drive, Snyderville UT	58885297	17	23		0.117665	1500		176.50
						8.65			5	43.25
							0.066112	3380		223.46

- Recommended solar array (roof mounted) 38 kW
- The south facing roofs of Station #36 are shaded with trees.
- There are steep east and west sloping shingle roofs. There is room for about 122 modules, adding up to about 38 kW. This would offset about 80% of the station's power consumption.
- Micro-inverters are recommended for this application.
- It should be noted that with Schedule 23, the 'cheap' power is offset first (the first 1,500 kWh per month is more expensive $0.12 / kWh power).

Station 37

Park City Fire District
WILD LAND FIRE
DANGER
HIGH
www.pcfd.org
PCFD
PCFD


N Promontory Ranch Rd
STATION 37
6534 Promontary Ranch
Road, Park City UT
Park City Fire
Department
6534 Promontory
Ranch Road
90# Modules
28 kW
te of Utah, Map data ©2016 Google
3D Earth view is not available
Terms
Send feedback
50 ft

BASED ON JUNE-JULY 2016

Account #	Station	Address	Meter #	Bill item#	Schedule	Demand charge ($/kW)	Usage Charge ($/kWh)	kWh used (per month)	Demand (kW)	Charge (June /July 2016)
35328266-001 1	#37	6534 N Promontory Ranch Rd	28269105	19	23		0.117665	1500		$176.45
						8.65			13	No charge
							0.066112	1900		$125.61

- Recommended solar array (ground mounted) 28 kW
- The lower roof parts of this building have corrugated roof covering, which are harder for solar implementation.
- There is some land available to the south. This would easily fit an array that would offset all of the power consumption. A 28 kW facility would offset more than 90% of power consumption.
- The bill showed no charge for the demand in June/July.

Station 38

1798
PCFD
PARK CITY FIRE DISTRICT
Snow Park Fire
Station
Dedicated To
The Memory Of
Paul M. Kofford,
Park City Fire Chief.
1978 - 1981

STATION 38
1798 Deer Valley Road, Park City UT

BASED ON JUNE/JULY

Account #	Station #	Address	Meter #	Bill item#	Schedule	Demand charge ($/kW)	Usage Charge ($/kWh)	kWh used (per month)	Demand (kW)	Charge (June 2016)
35328266-001 1	#38	1798 Deer Valley Dr N Park City UT	28912989	22	23		0.117665	1500		176.4975
						8.65			8	No charge
							0.066112	700		46.2784

- Recommended solar array (roof mounted) 20 kW
- Several large trees are shading the south facing roof. However, higher on that roof, as well as on the west facing roof, there is room for about 64 modules, which would be about 20 kW. This would offset more than 90% of the building consumption.
- Micro inverters are recommended.