Rooftop Analysis Conducted by: **June 1st, 2014**
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Abstract: As a team we set out to assess the available locations for future solar panel installations. We had to keep in mind the criterion for visibility, along with other factors to be considered when installing solar panels. Such as shading from surrounding objects, and the direction in which the buildings and their roofs are facing. The Lab Buildings, Lecture Halls, Sem I and Sem 2 Buildings, Com, CAB, CRC, HCC and the Soccer Pavilion were all seen as possible options for solar panel installation. The library already has a solar array with plenty of space for additional units.

The CAB, CRC, SEM2 A and B present good opportunities for their own photovoltaic (PV) systems.

Rooftop Analysis

The layout of The Evergreen State College campus is East to West. The main entrance of the college is from the south. The entrance provides a unique opportunity to have most incoming foot traffic entering from the south, facing toward solar arrays while entering the campus. Many roof tops are too tall to be visible from the ground level or to create visual impact for displaying solar arrays.

Without lifting PV arrays higher above the roof on stilts, they will probably not be seen from the ground. Many of the building locations are good candidates for solar installation and power generation, but pose difficulty for being seen.

Evergreen's campus landscape which is comprised of tall trees, rolling surface grade, and multi-height buildings which were built at different times. While some receive adequate light earlier in the day, others have better light conditions later in the day. Using a trade-off method with roof tops that receive unshaded light throughout the day, we may better meet campus electrical needs.

Climate: The Pacific Northwest's typical climate average from 1961 through 1990 is approximately 229 cloudy days and 85 partly cloudy days. A clear day denotes zero to 30% average sky cover. Partly cloudy is 40-70%. Cloudy is 80-100%.[1] Climate Data for Olympia

With partial to significant cloud cover throughout much of the year, micro inverters would provide the best advantage for harvesting solar power efficiently through the year. When clouds, trees, or nearby buildings partly shade a roof at different times of day, microinverters allow the rest of the PV panels on an array to continue producing power. Most rooftops receive adequate sun from 11am till 2pm.

Shading: Evergreen has a unique landscape. Direct lighting is limited due to the trees surrounding the campus, and the multiple layered heights of all of the buildings. We also have to be aware of the location because we want the panels to be visible for the grant needed to help support the solar project. Most building roofs are flat.

Potential Buildings: The rooftop analysis group met with Rich Davis on April 29th to view the blueprints, and accessed the roof of two candidates for solar installation. We visited the rooftops of the Seminar 1 building and the Communications Building.

Seminar I: roof area 996 square meters.
We got to go up on the top of Seminar I. We thought this would be one of the better roofs to have solar installed on. However, to get Bonneville grants, the panels would have to be visible. On the top of this building they wouldn't be seen very well.

Lab 2: roof area 1766 square meters
Lab 2 is one of the taller buildings, it has some potential for an array. However it is surrounded by dense trees on its South face. Without cutting down these trees a very limited amount of light is able to reach the roof area. The roof is also not very visible.

Library: Approximately 6,000 sq ft.

The library currently has a small solar array of 4x11 panels, designed to generate a maximum of 9 kW. They are installed at a tilt of only 10° to minimize wind lift, because the College chose to ballast them on the flat roof with concrete block instead of drilling support structures into the roof, risking leaks. An installation tilt at latitude (47°) to 32° would generate more solar power.

The library roof has the most potential for harnessing direct sunlight. Its location is best suited in comparison to other buildings for receiving direct light all day and throughout

all seasons. This is due to locating, height, and surrounding trees which have reached maturity, mostly on the north side.

We recommend using the entire 4th floor LIB rooftop area for solar installation. This would be in addition to the current solar array and would have the most impact for gaining our energy needs.

The Library building also offers quite a bit of area on its third floor roof. Some of the roof space is on the building's South side, but its full extent also covers the North side. During our midday roof visit, the third floor roof on the north side was heavily shadowed. The third floor, on its south face, offers prospective area for harvesting sun, but should be considered secondary and intermittent.

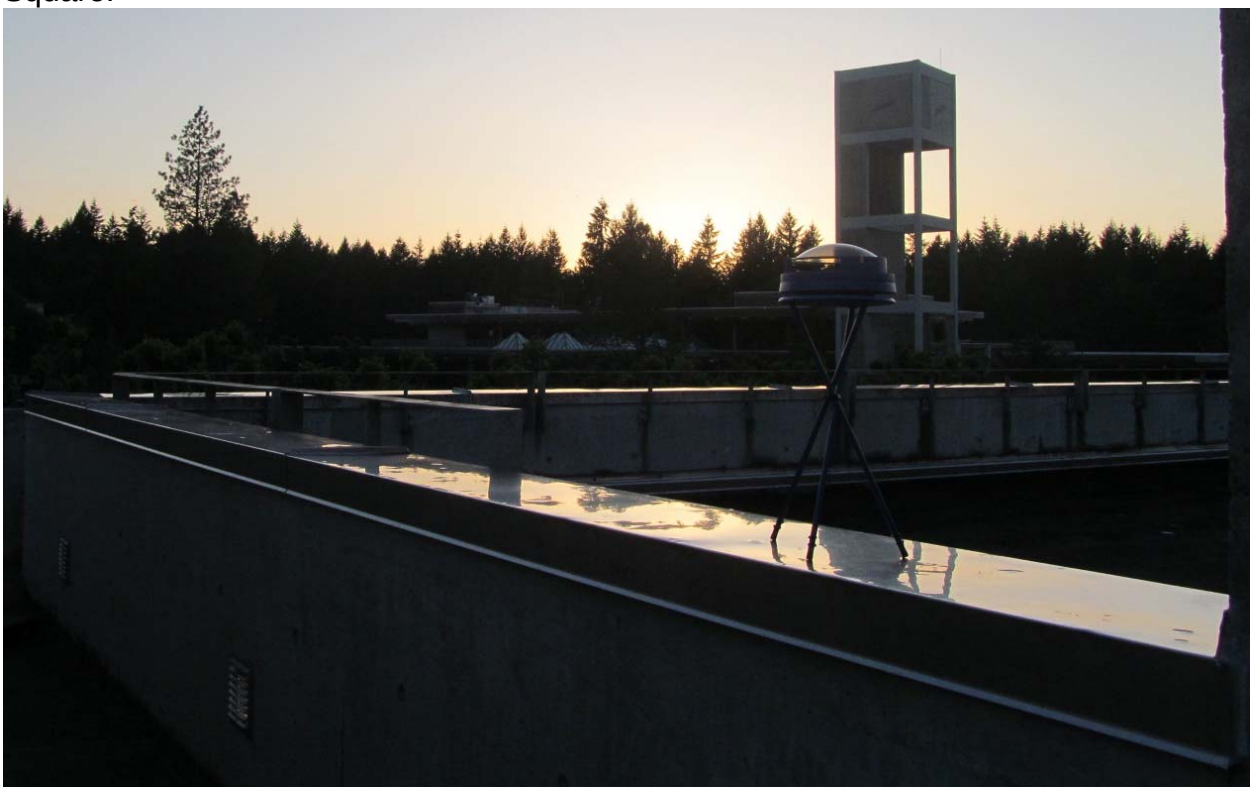
CAB: roof area 2639 Square meters (total)

The long roof strip down the center could have the same potential as the Library building, although we were unable to physically check this space. The CAB building offers unique opportunities for PV visual aesthetics on its sides. This building has several outdoor lounging areas which currently have no cover; we propose using solar arrays as awnings to provide shade in the summer or rain cover in the winter months. Users report that the patio is too hot in sunny months, and that a sun shade would be welcome. The drawback is limited sun due to time of day and time of year.

SEM 2, Building B: 604 square meters. SEM2 B is near the center-east of the college. This building is not shaded by any other structures or trees, so it is a very good candidate for power generation. Unless the solar panels were raised, the public might not be able to see them.

SEM2 Building A: 513 square meters.
Building A is an excellent candidate for PV installation. It has good sun exposure and potentially high visibility. There are no buildings or trees that are able to cast shade directly onto Sem2 A. Solar panels could be installed near the walkway along the roofs of the buildings and then protected from vandalism by a simple fence. This would allow

the panels to be visible to foot traffic moving through Seminar buildings and all of Red Square.



SEM2 C: 605 square meters
SEM2 D: 617 square meters
SEM2 E: 569 Square meters
Building C, D and, E all have trees that cast shadows on them. Directly on the south facing walls and roofs of the buildings. This makes Sem2 C, D, and E three unacceptable choices for solar panels.

CRC (College Recreational Center)**:** roof area 3582 Square meters.

The CRC is also a very ideal place for solar panels. You can see the roof from the top on SEM 2. Also, when you walk down the path towards the Rec Center. There is also many good uses for solar on the CRC. They use a lot of power there. The pool is the biggest burden for heating.

COM (Communications and performance center)**:** roof area 2871 square meters

The COM building is one of the taller buildings that is also surrounded by trees. But when examined, the roof had great sun exposure. Several trees to the East of the COM building are unhealthy and fated to be removed. This building would be considered secondary in choice with intermittent sun.

Lecture Hall: rotunda roof area 1567 square meters

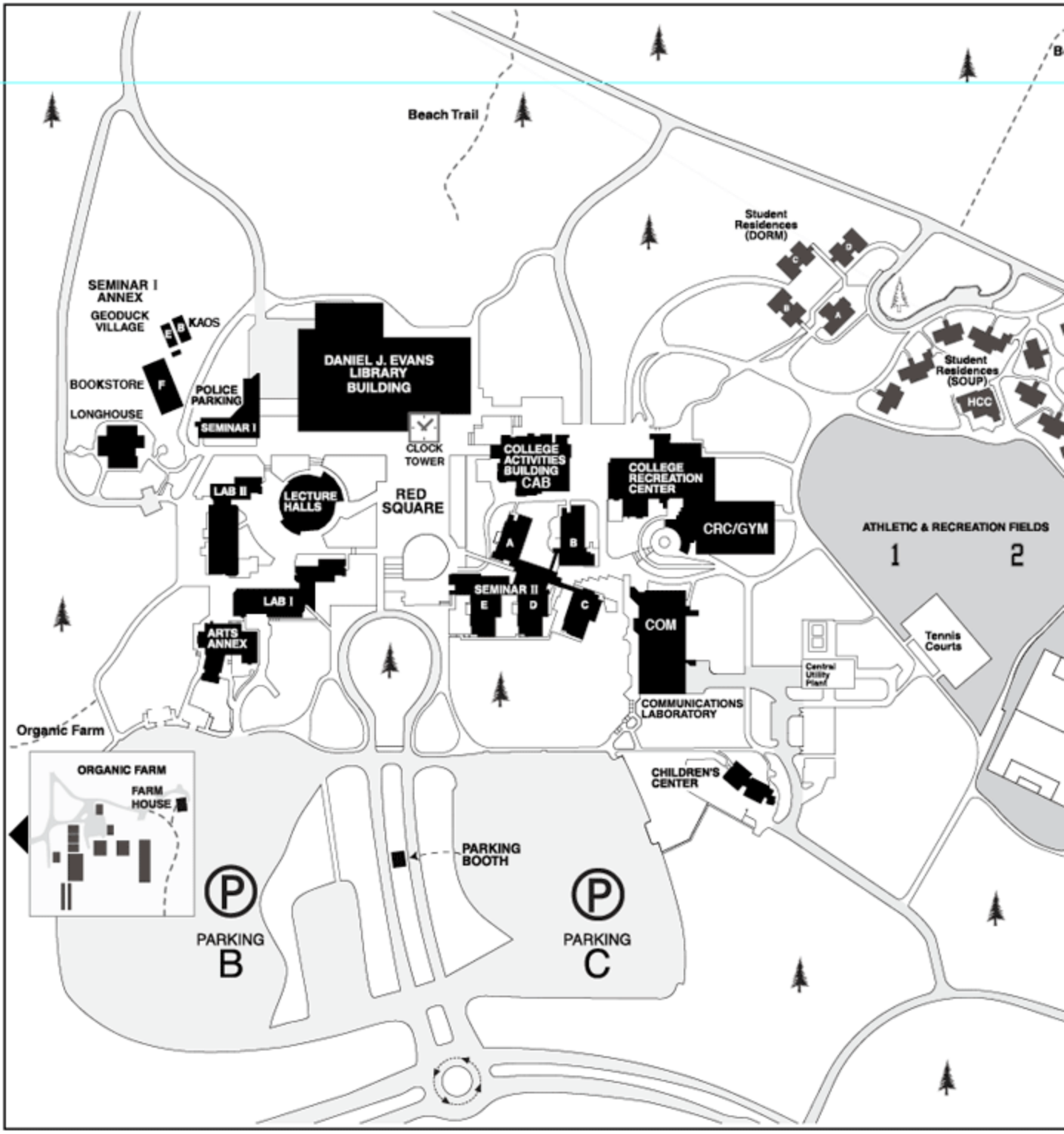
The Lecture Hall building is due to be torn down in the near future. Its height in comparison to surrounding buildings is shadowed throughout the day. It might be in our best interest if the future design was a taller building with the same coned roof. The roof angles makes it ideal for viewing installed PV from the ground. Currently this building is the least likely to contribute value to a solar installation.

Soccer Field Bleachers (pictured below right): A number of renovations are planned for the Rec Center and surrounding areas. The soccer fields do not have covered stands, and many events occur in inclement weather or uncomfortable heat. If PV panels could provide sun shade and some raincover for fans, they could also generate power in fine weather, and create an educational aspect. The area is also ideal, because the field is in the sun almost all day. (This picture was taken June 1st, 7pm)

CRP: Covered Recreational Pavilion: 702 sq meters (south facing roof - pictured above left)

The Pavilion is ideal. The roof is scheduled for renovation. Its south facing roof is an excellent place to put a solar array, with good sun and very high visibility. We propose that the college install a metal roof, to maximize future PV possibilities.

Create a covered Walkway Between CRC and CAB: We also examined the walkway in between the CRC and CAB on the top level. It would create a covered area, and also good area for an array.


Beach Trail
Student Residences (DORM)
SEMINAR I ANNEX
GEODUCK VILLAGE
KAOS
BOOKSTORE
POLICE PARKING
LONGHOUSE
SEMINAR I
DANIEL J. EVANS LIBRARY BUILDING
CLOCK TOWER
Student Residences (SOUP)
HCC
COLLEGE ACTIVITIES BUILDING CAB
COLLEGE RECREATION CENTER
CRC/GYM
LAB II
LECTURE HALLS
RED SQUARE
ATHLETIC & RECREATION FIELDS
1
2
LAB I
SEMINAR II
COM
ARTS ANNEX
Tennis Courts
Central Utility Plant
COMMUNICATIONS LABORATORY
Organic Farm
ORGANIC FARM
FARM HOUSE
CHILDREN'S CENTER
PARKING BOOTH
PARKING B
PARKING C

What needs to be arranged if solar panels are installed?

Maintenance: Cleaning once or twice a year preferably after spring and before winter, with the most emphases on after spring due to pollen buildup.

Educational kiosk: The CAB is one of the most visited buildings on campus. It would be an ideal location to have an educational booth with information on the Solar Arrays. An educational booth was originally part of the plan for the current 9 kW solar installation on the LIB roof, but it did not get built. We propose to offer this task to an Independent Learning Contract (ILC) student who could ask for grant money through the Clean Energy Committee to fund putting together such an informational "kiosk". It could possibly show the current power usage of the campus versus the power output of the solar arrays along with room for any other potential solar array.

Long Term: Further work on building efficiency for lowering power need to reach the school's goal of being carbon neutral by 2020.

References:

1. Western Regional Climate Center, Local Climate Data Summaries
www.wrcc.dri.edu/cgi-bin/clilcd.pl?wa24227

http://pvwatts.nrel.gov/pvwatts.php- Used to get area of the roofs.

Climate Action Plan – from Scott Morgan