

Appendix FEIR-5

Urban Heat Island Effect Memorandum



Memorandum

To Yanet Martinez (LACMA) Date October 3rd, 2018
From Julian Parsley Job no 031731
Copied to Ron Elad, file
Subject LACMA Roof and Urban Heat Island Effect

1.0 Executive Summary

This memo outlines the sensitivity studies undertaken in order to determine the impact of the roofing type and finish on the urban heat island (UHI) effect of the proposed Museum Building. It reviews the impacts from the new design, where the change in roof color from black to a lighter color (anticipated to be a gray or sand stone finish) provides an improvement in local heat island impacts. Under all scenarios the project has a positive impact on heat island impacts South of Wilshire due to the poor performance of the existing Asphalt car park.

The proposed roof design, when paired with a landscape design that is at least 60% vegetated, would have an aged SRI value of 35 which is nearly equal to the SRI of the current site. Depending on the final landscaping design, any negative impacts can be minimized. Any worsening of heat island within the park is not anticipated to impact adjacent residential neighbors.

2.0 Urban Heat Island Effect

The purpose of this study is to examine the urban heat island effect that the proposed Museum Building project will have on the local environment. This study will compare the effect of existing museum buildings and landscaping with the proposed Museum Building.

This study has two parts: the first portion considers the site as a whole, while the second focuses on the area directly south of Wilshire Boulevard. Please see Figure 2 below for this area delineation.

2.1 Assumptions

One method of comparing the heat island effect of surfaces is by their solar reflective index (SRI). SRI depends on solar reflectance and emittance and relates to their effect on surface temperatures. For example, a completely black surface has an SRI of 0 and a pure white surface has an SRI of 100. Materials with higher SRI values are more effective at reflecting sunlight, and therefore can help reduce the urban heat island effect.

It is important to note that most building materials and surfaces degrade over time due to exposure to sun and external environment. Asphalt, concrete, and other building materials fade or darken with age, increasing or decreasing SRI.

The table below (Table 1) displays the study's assumptions about the SRI of site surfaces.

Surface Type	Solar Reflectance	Emittance	SRI
Aged Concrete	0.25	0.9	25.5
New Concrete (ordinary)	0.4	0.9	45
Aged Asphalt	0.1	0.9	6
New Asphalt	0.05	0.9	0
Existing Roof (placeholder)	0.32	0.91	35
Metal Roof	0.3	0.83	28.5
Proposed Museum Building Black Roof Aged	0.1	0.9	6
Proposed Museum Building Black Roof New	0.05	0.9	0
Proposed Museum Building Light gray Colored Roof Aged	0.25	0.9	25.5
Proposed Museum Building Light gray Colored Roof New	0.4	0.9	45

Table 1: Reflectance, Emittance, and SRI of roof and pavement surfaces, from coolroofs.org database and "The Effect of Pavements' Temperatures on Air Temperatures in Large Cities," by Pomerantz, Pon, and Akbari.

2.2 Area measurements

In order to compare the existing site with the proposed construction, the area of each type of surface in the study has been measured. These areas can be found in Table 2.

Note: vegetated area does not contribute to the heat island effect, so the level of vegetative cover has a large and positive effect on the heat island contributions of the site. The existing site North of Wilshire has approximately a 50% vegetative cover in landscaped areas (excluding roof areas). Landscaping plans are not yet finalized, so this is an important variable in our analysis.

Surface Type	Area Existing (sf)	First Proposed Area 40% Vegetation (sf)	Second Proposed Area 40% Vegetation (sf)
Aged Asphalt	107,219	8,404	10,812
Roof	123,712	182,285	171,791
Concrete	92,866	65,410	65,410
Vegetation	76,839	87,213	87,213
Decomposed granite		65,410	65,410
Total	400,636	400,636	400,636

Table 2: Area by surface type of existing and proposed site plans.

These areas were measured using aerial photos of the existing site, and a drawing of the proposed site, both appropriately scaled to match each other. The precise area boundaries used in the calculation can be seen below in Figure 1 of the existing site, and Figure 2 of the proposed sites.

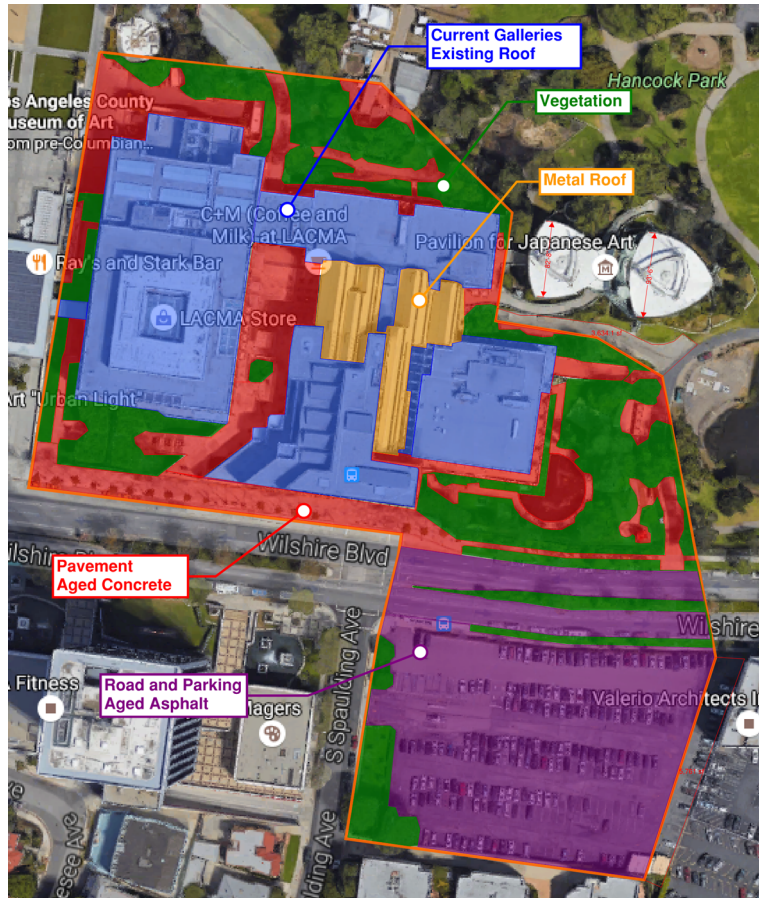
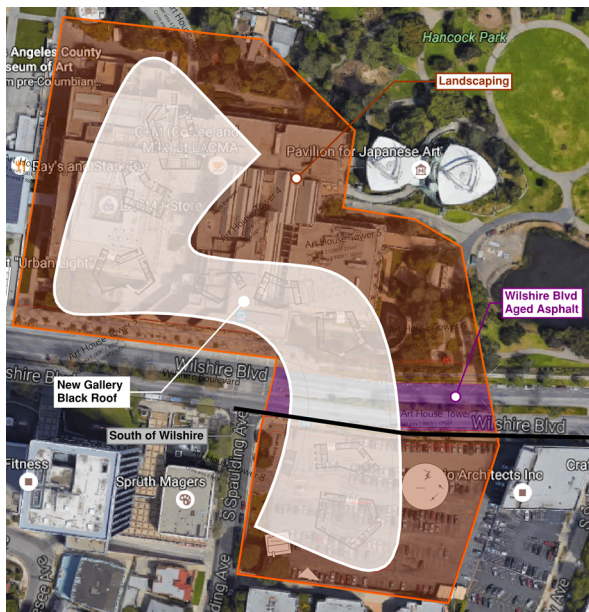


Figure 1: Existing Site plan. Different colors represent surfaces with different radiative heat transfer properties.



a) First proposed site plan.



b) Second proposed site plan.

Figure 2: Two proposed site plans.

2.3 Results

The above data was used to determine a site-wide SRI for the entire site, as well as the portion of the site south of Wilshire which impacts the closest residents. It is clear that landscaping decisions regarding ground covering plants will have a significant impact on the heat island effect of the site. Site-wide SRI was calculated with landscaping options according to various levels of coverage from 20% to 80%.

For each option two site-wide SRIs were found to account for the effects of aging on surface materials. One represents new construction, and the other represents the site at an age of 5 years.

The site-wide SRI values are displayed in Table 3. Each column represents the SRI of the entire site, under a given condition (comparing the original design and the new proposed plan): the existing site plan, and post construction with landscaping options containing 80-20% plant coverage. To take material degradation into account, SRI is calculated for each option both as new construction, and as it will perform 5 years after construction.

	First Proposed Plan		Second Proposed Plan	
	New	Aged	New	Aged
80% Plants	29	30	44	35
60% Plants	27	27	42	32
40% Plants	25	24	41	30
20% Plants	24	21	39	27
Existing	35.4			

Table 3: Results of weighted SRI calculations for the first proposed plan with a black roof. Higher values of SRI indicate improved performance.

Table 3 above shows the site wide SRI for the existing conditions and the impact of construction of the two proposed plans, with various levels of landscaping. The second proposed plan has a much higher SRI than the first one due to the change in color of the roof from black to light gray colored. In addition, the second proposed design has the potential to increase the site-wide SRI depending on the amount of vegetation. Heat island can be mitigated by maximizing planted landscaped areas, but this should be carefully balanced against water consumption.

The area south of Wilshire Boulevard (Figures 3 and 4) is an area of potential improvement on heat island effects by increasing the SRI from existing conditions. The site has a relatively large area of land available for landscaping, and the existing area is almost entirely covered by asphalt. When we examine only the area south of Wilshire, we can see a large effect from vegetative coverage. The impact is shown in Table 4 for the original plan, and the revised design. The heat island effect will be reduced south of Wilshire closest to residential development, even after the building and site materials have aged and with minimal landscape planting. In all cases, the assumptions for the landscape coverage assume 50% of the landscape area is planted, and 50% covered by crushed stone, providing design flexibility for drought tolerant landscaping schemes. The addition of Solar PV to the roof would result in a heat island performance more in line with the original design, while still offering improvement over the existing conditions.



Figure 3: Area of the first proposed plan south of Wilshire. Landscaping zone has unknown plant coverage.

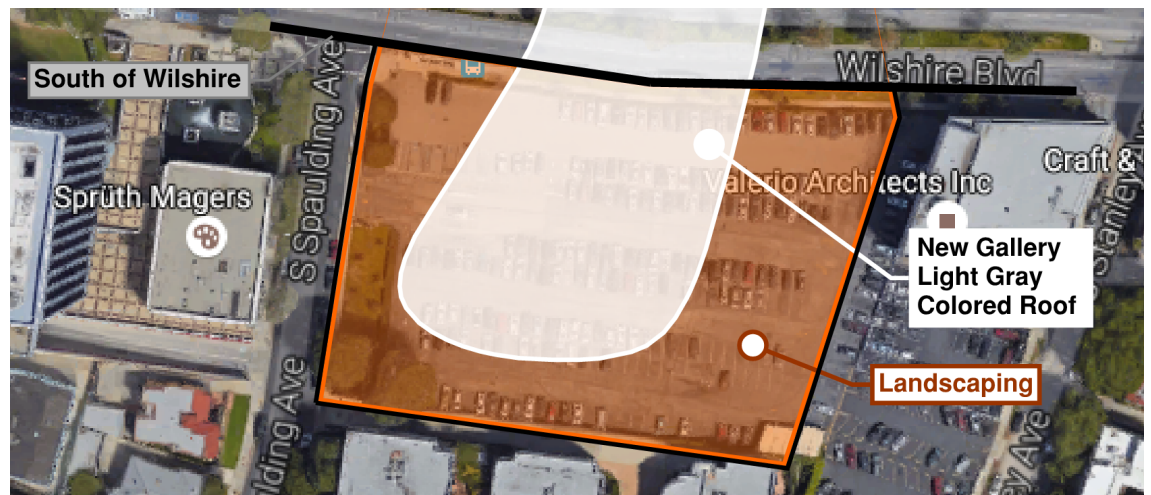


Figure 4: Area of the second proposed plan south of Wilshire. Landscaping zone has unknown plant coverage.

	First Proposed Plan		Second Proposed Plan	
	New	Aged	New	Aged
80% Plants	32	31	52	38
60% Plants	29	27	49	34
40% Plants	28	23	46	30
20% Plants	26	20	43	26
Existing	10.8			

Table 4: SRI calculations specific to the area south of Wilshire Blvd for the first proposed plan and second proposed plan. Higher values of SRI indicate improved performance. All tested scenarios offer an improvement of the existing conditions.

2.4 Photovoltaic panels

The addition of PV panels would have two effects on the proposed project.

First, PV panels provide shading of the roof surface. This decreases heat gains through the roof and subsequent building cooling energy use and energy costs.

Second, per exception to section 140.3(a)1A in the California Energy Code, roof areas covered by building integrated photovoltaic panels are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

This SRI code exception gives the project credit for the reduction in total site electricity use and subsequent reduction of source energy greenhouse gas emissions. However, due to the dark color of most PV panels, they will actually have a negative effect on the urban heat island potential of a project, approximating the performance of a black roof. If PV panels are installed, the project would still deliver an improvement in heat island impacts South of Wilshire, and any impacts North of Wilshire would unlikely have any measureable impact on surrounding buildings.

3.0 Conclusions

When the portion of the site south of Wilshire Boulevard is interrogated separately from the rest of the site, the SRI in that region is shown to improve dramatically with the new lighter roof material. It is anticipated that the urban heat island effect within this southern portion of the site will be improved compared to the existing site, even if PV panels are installed on the new roof.

Depending on the amount of vegetation integrated into the rest of the site, the current building design may increase heat island impacts in the park North of Wilshire Boulevard, however, it is not anticipated that this will have any measureable impact on the surrounding buildings.