Hazel - Scottsdale :: West Elevation Reflectivity Study

2022.02.18

LOISOS + UBBELOHDE

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Executive Summary and Table of Contents

This report by Loisos + Ubbelohde presents initial results characterizing potential solar reflections from a proposed 8 story mixed-use building at 4605 N. Scottsdale road in Scottsdale, Arizona. The project site sits to the East of an active portion of N. Scottsdale road. In response to questions from the City of Scottsdale, we have described the spatial and temporal conditions of solar reflectivity visual impacts on pedestrian and vehicular traffic on Scottsdale road from the West Elevation of the proposed building. Additionally, we have provided views of the experience from three pedestrian and vehicular locations to understand the extent of the visual impact.

Every building with glass areas in the exterior walls will generate sunlight reflections (see appendix for a range of typical reflection conditions). The building's design can address when, where, and for how long these reflections are visible. The proposed specified glass in this project has low exterior visual reflectances of 8% and 13%. These are not considered "highly reflective" and are relatively low reflectance in the range of glazing available for commercial application. The West elevation has a mix of punched openings at the upper residential areas and larger expanses of curtain wall at the lower retail areas. These larger glazed areas are partially shaded with building features and proposed trees lining the sidewalk. The building has a highly articulated west elevation and less than 100% glazing, both of which contribute to reduced solar reflection potential.

Where sunlight reflections from this building are visible to pedestrians and motorists, this project is equivalent to or better performing than typical buildings of this scale with either glazed curtain walls or punched openings.

Architect's Render

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Analysis Assumptions

This study characterizes and quantifies the extent of reflections from the proposed building's West Elevation that fall off site along North Scottsdale road. We selected ground level view locations in coordination with the Architect to represent typical pedestrian and vehicular impact from the building generated reflections. At these view locations, a representative reflection occurrence time during a clear sky is simulated and annual statistics are provided.

The glazed area of the project is flat and vertical, so there are no conditions of solar convergence (multiple simultaneous reflections landing in the same location) from curved facades that may has significant thermal impacts. This study is therefore limited to potential glare from reflections in the visual spectrum.

The accuracy of these simulations is limited by the resolution of the provided model and represents the glass as perfectly flat, clean planes. Actual IGUs have subtle curvature from differential pressures and the accumulated dirt on the glass surface can impact reflection angles and scattering.

All simulations use Radiance, a research grade lighting simulation tool based on the physics of light and material properties. These studies modeled the building geometry on site, and were calibrated with local sky and climate data and precise project location coordinates and orientation. See the following page for climate data description.

Materials: Where applicable, the glazing used in the simulations followed the specifications in the table below.

ID	Description : Product	Transmittance	Reflectance	
		Visible Light Tranmittance	Visible Exterior	Visible Interior
GL-01,02	Residential Vision Glass : Solarban 60	50%	8%	11%
GL-03,04,05	Retail + Amenity Vision Glass : Solarban 72	68%	13%	14%
Railing	Laminated Glass	80%	8%	8%

Geometry: Building Geometry and additional documents used to generate and calibrate our simulation model provided by CRTKL include:

- 2022-0202 ZSC Bldg A Model.rvt
- 2021-0216 Context.skp
- 2021-0827 ZSD Existing Design - Before and After Comparisons 1.skp

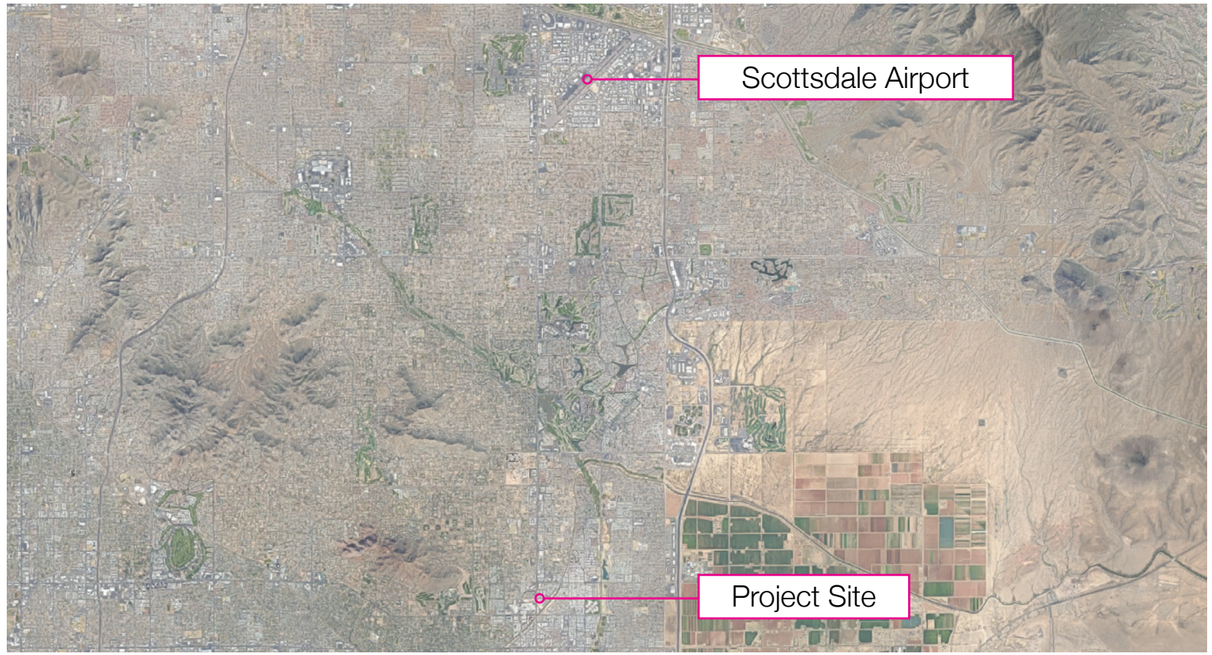
Reference Documents:

- Sheets for solar reflectivity study.pdf
- 2022-0203 Sun Reflectivity Floor Plans.pdf
- MATERIALS - EXTERIOR FINISH SCHEDULE.JPG
- SOLARBAN 60 OPTIGRAY + CLEAR.JPG
- SOLARBAN 72 STARPHIRE + STARPHIRE.JPG

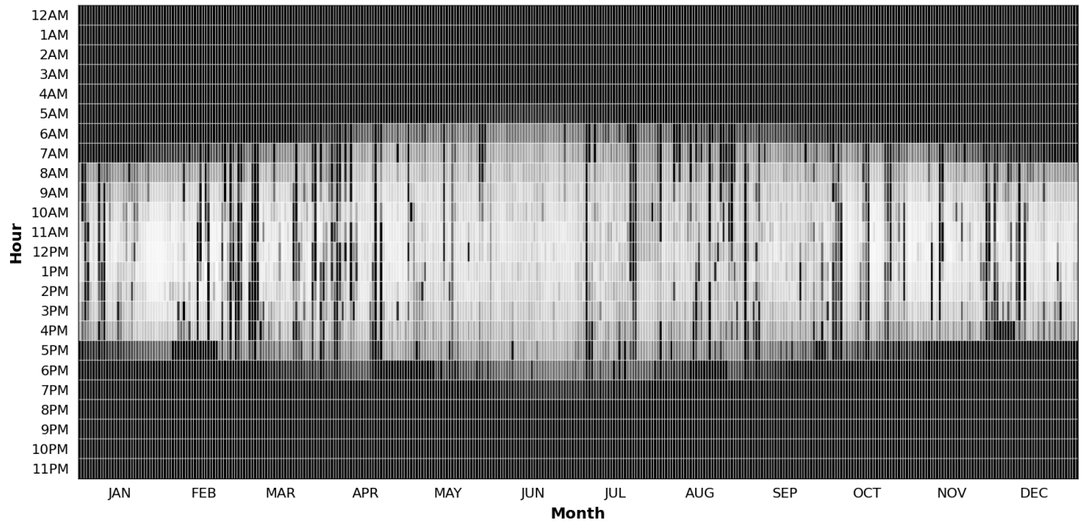
The project location is less than 8 miles South of Scottsdale Airport, the location of Typical Metrological Year (TMY) weather data used in our simulations. For our annual studies, we capture the impact of a full year of clear sky conditions to account for all potential reflections from all solar positions under clear sky conditions. For this we use an ASHRAE annual clear sky calculation. All solar positions are calculated for the project's exact coordinates, not the weather station's location. We then filter these results back through the TMY data to report both anticipated conditions (via the TMY data set) and MAXIMUM potential reflection occurrences (under ASHRAE annual clear skies).

The annual performance reported on page 6 includes the annual clear skies, the annual typical skies and the site under annual typical skies with trees included. The difference between full annual clear skies and the TMY typical clear skies is minimal, given the predominant clear sky conditions in Scottsdale. The inclusion of the shade trees has more impact than the use of the typical sky data in the annual simulations.

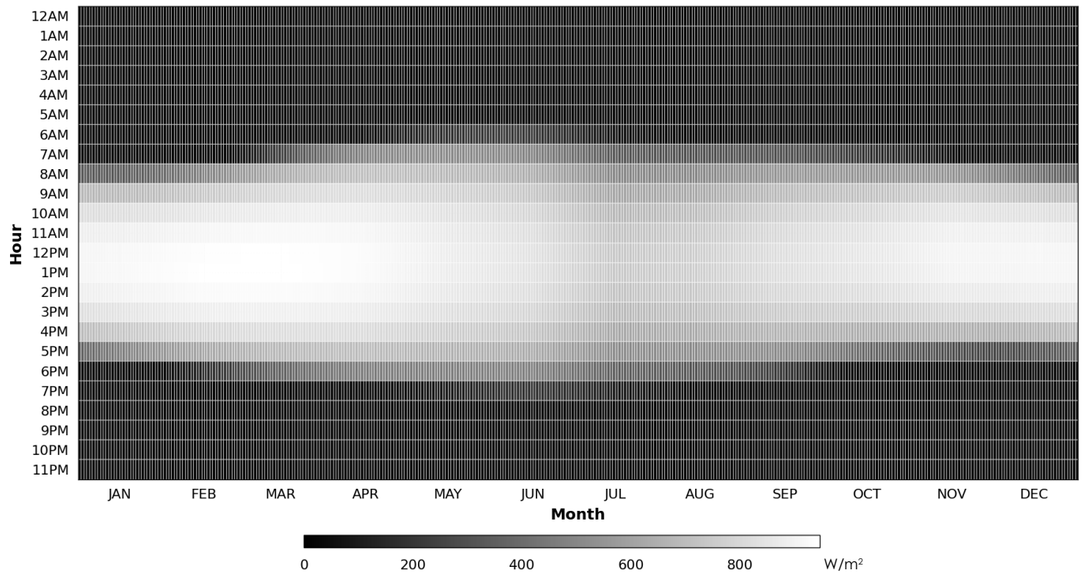
Project Site and Weather Station Location



Scottsdale :: TMY : Direct Normal Radiation - W/m²



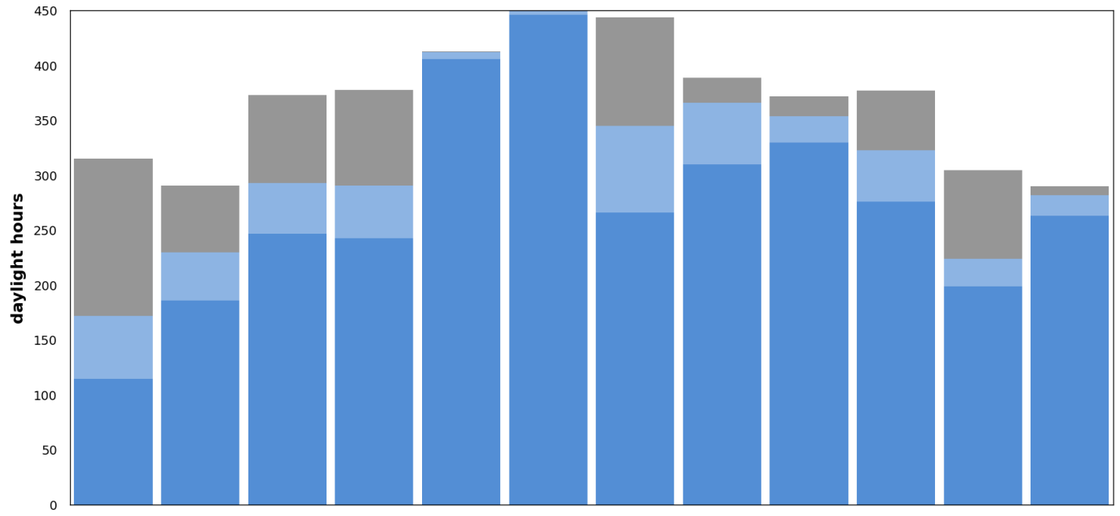
ASHRAE Annual Clear Sky : Direct Normal Radiation - W/m²



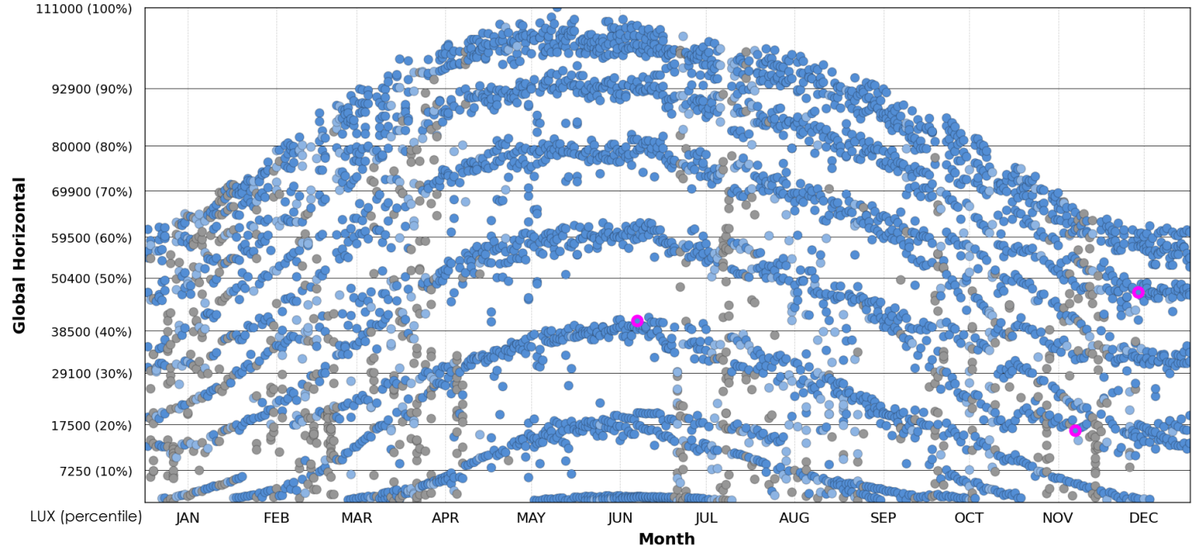
Regional Weather Data

All reflections visible from the selected view locations occur in the mid to late afternoon. For the simulations, we use the clear sky conditions that occur during those hours (see annual graphs that accompany each view). The brighter skies that occur during mid-day hours (as seen in the bottom chart to the right) do not create reflections that impact the pedestrian or vehicular traffic on N. Scottsdale Road, so we have not included any views simulated for those hours. Reflections off of the West elevation closer to noon are from higher sun angles and those reflections will land close to the façade. At those times, the sun's reflection in the glass will typically be outside (overhead) of both the pedestrian and vehicular field of view.

Scottsdale :: TMY : Daylight Hours by Sky Condition



Scottsdale :: TMY : Global Horizontal Illuminance - LUX (percentile)



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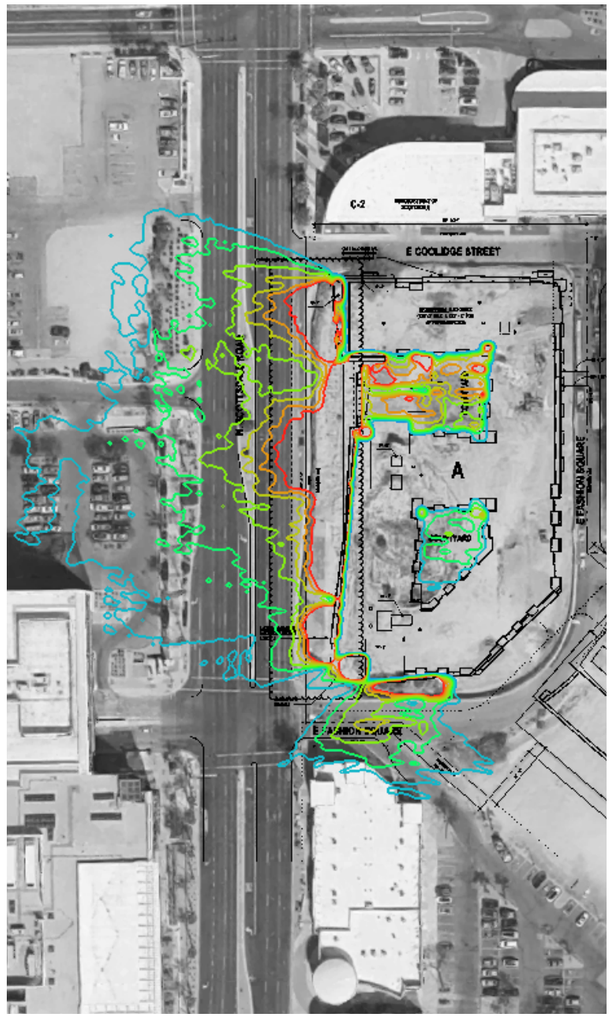
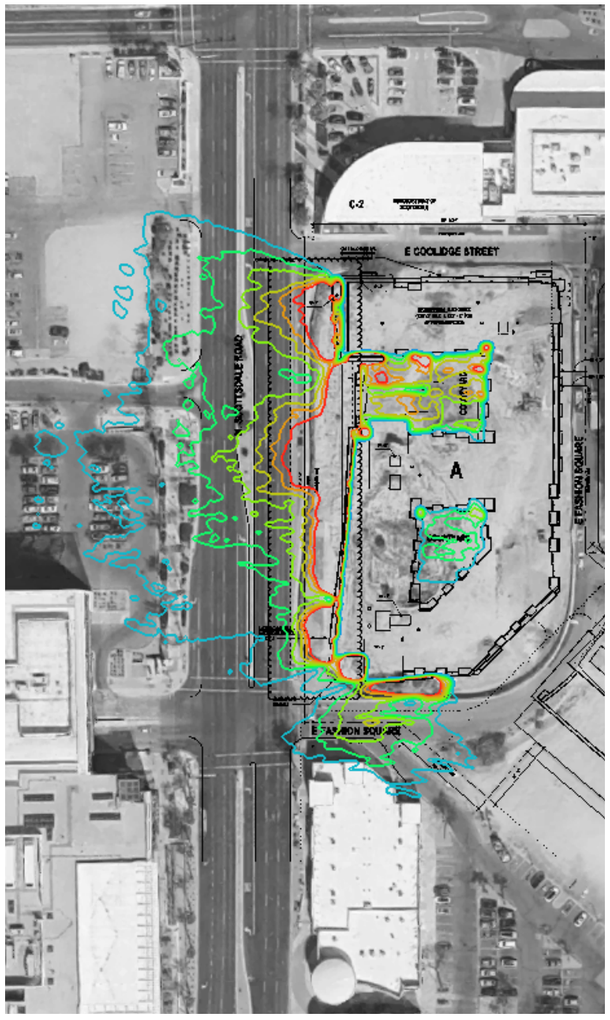
Annual Hours of Visible Reflections at Grade

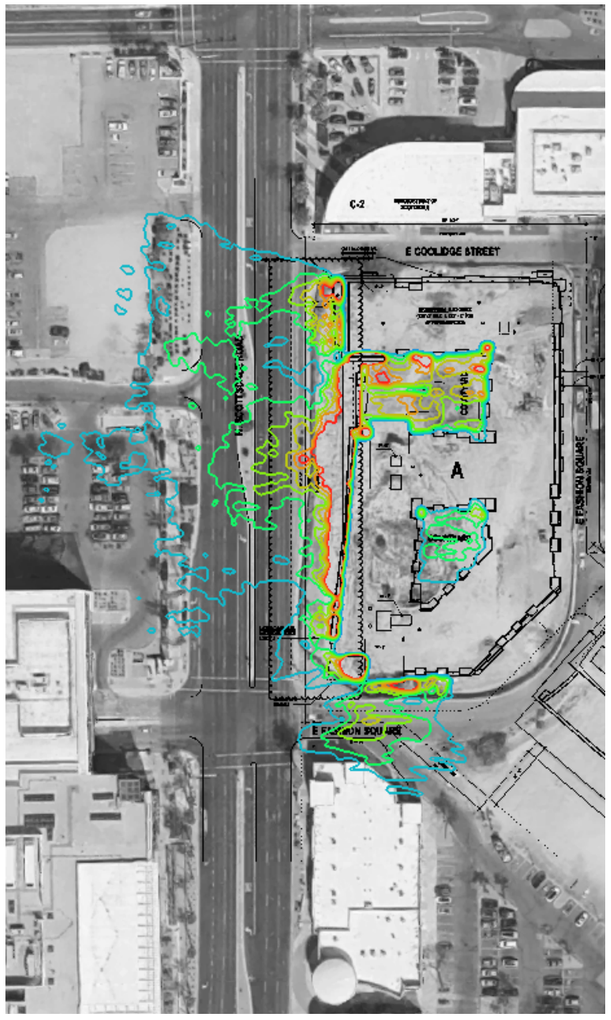
Annual Clear Skies : No Trees modeled

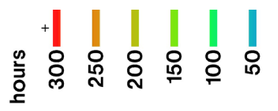


TMY : No Trees modeled



TMY : With Trees modeled





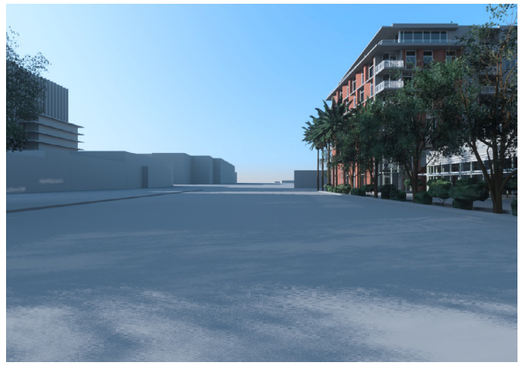
These color contours represent the cumulative hours that solar reflections from the proposed building's west elevation will land at grade level. The image to the left shows all possible reflections under the ASHRAE annual clear sky calculation, without any of the proposed trees included in the model. The center image filters out reflections that would occur during overcast hours in the TMY data set. This represents expected sky conditions across a typical year in Scottsdale and is the basis for the annual heatmaps and statistics provided along with each view location. The final image to the right is also TMY data filtered and includes the proposed trees in the modeling which provide some screening of incoming sun and reflections. This represents the anticipated annual performance of the proposed design.

View Selection Locations and Descriptions

1

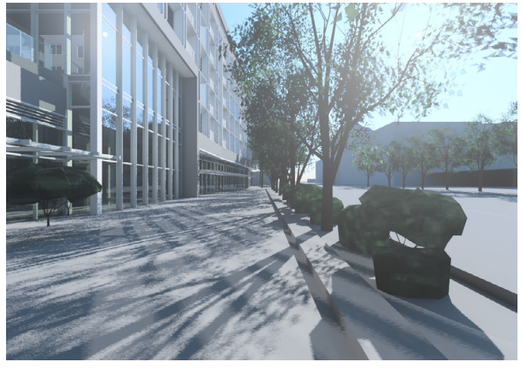
Pedestrian
- Looking East across N. Scottsdale to project's West Elevation
- Low angle reflections visible in late afternoon

2



Northbound Driver
- Northbound on N. Scottsdale
- Driver's view is perpendicular to reflection angles
- Reflection sources are typically out of view - a 180° fisheye view is also included to show this relationship

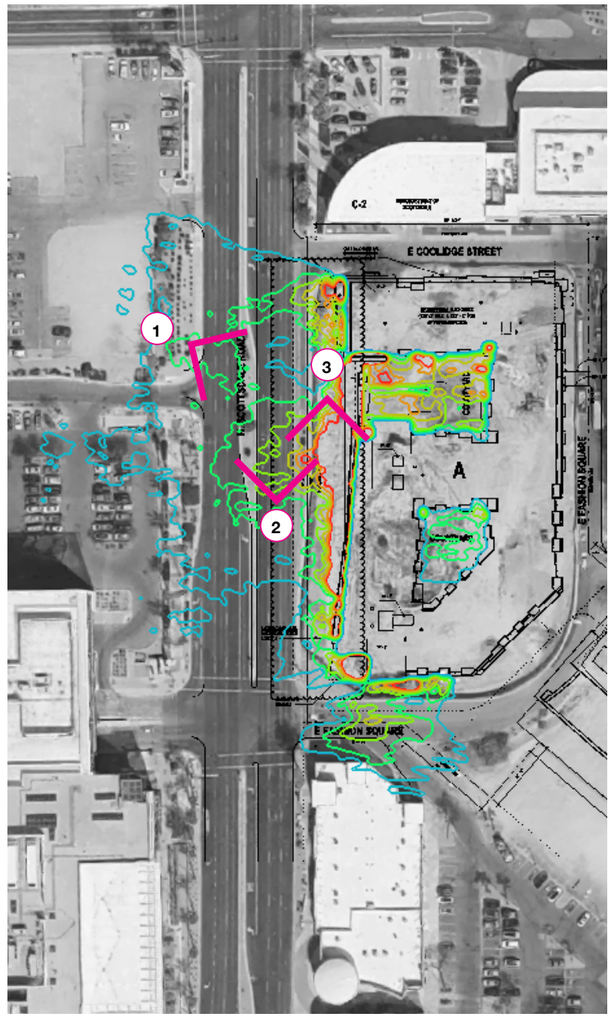
3



Pedestrian
- Looking South on East side of N. Scottsdale along project's West Elevation
- Visible reflections on ground
- Source is visible but at similar altitude as sun (also in view)

Note: All views (except fisheye) are 90° horizontal X 70° vertical, 5' above the ground plane as modeled.

TMY : With Trees modeled



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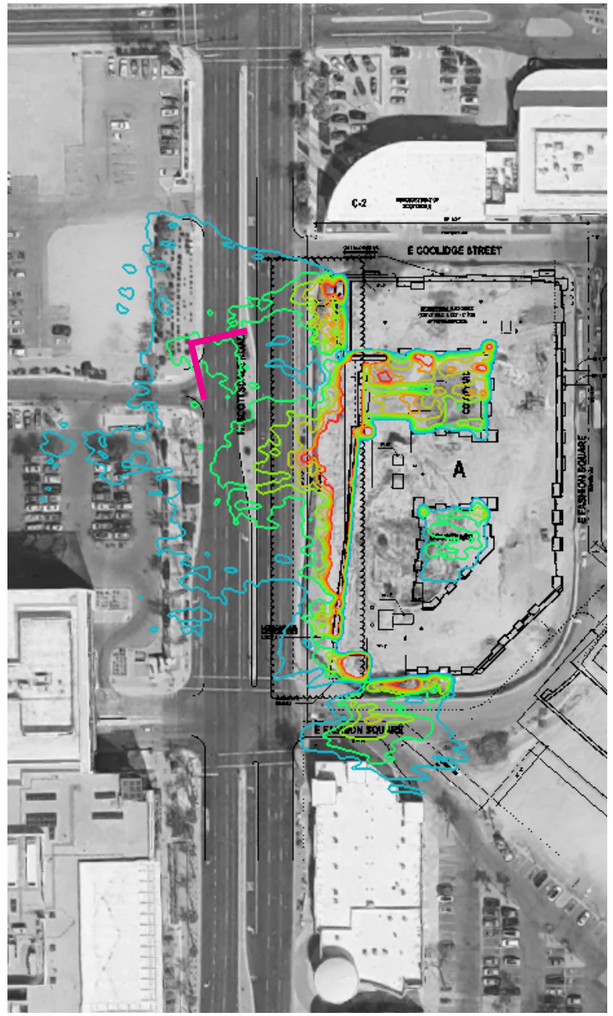
01 :: Pedestrian : West Side of N. Scottsdale looking East

Human Adaptation with Veiling Glare

Nov. 21st, 4:30 pm MST

TMY : With Trees modeled



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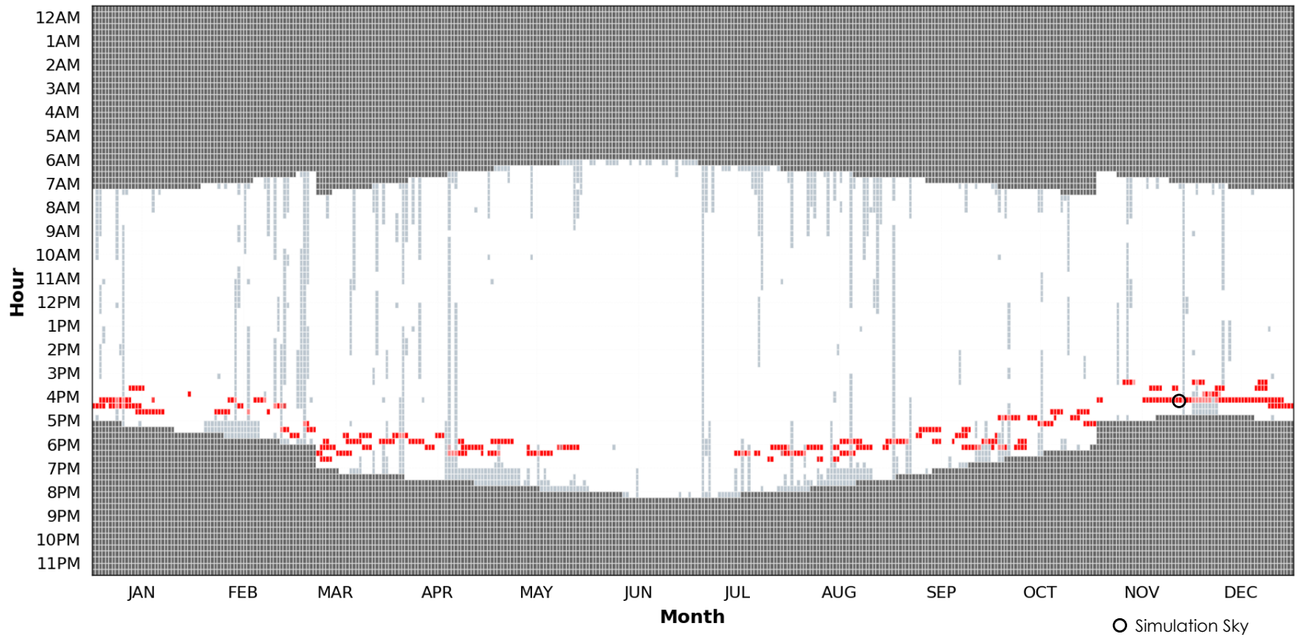
01 :: Pedestrian : West Side of N. Scottsdale looking East

Area of Glazing that will have visible reflections in Red - see annual graph

Annual Visual Reflection Potential :: TMY filtered - 15 min. increments



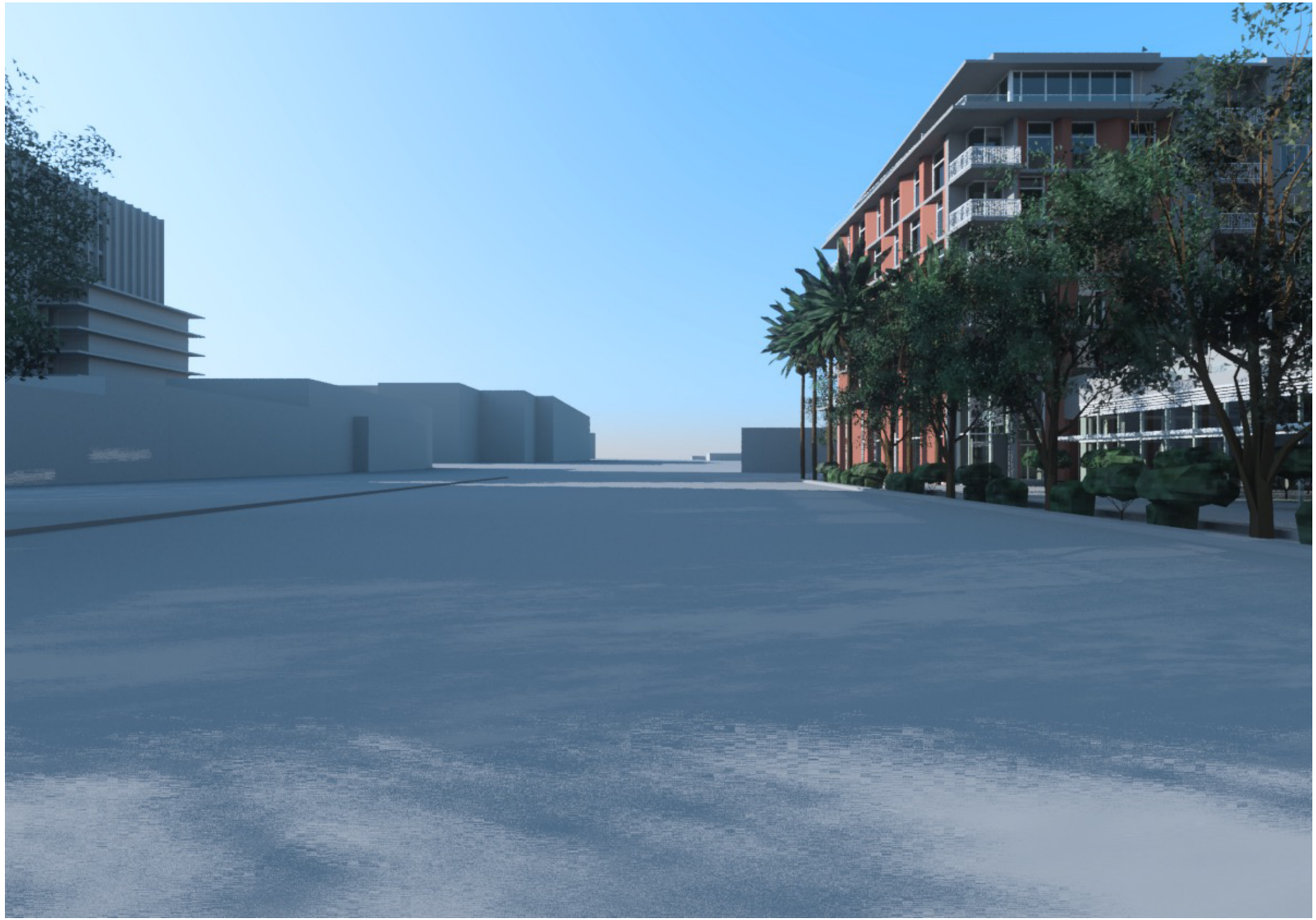
Annual Hours	TMY : Clear + Intermediate Skies	TMY: Overcast Skies
Visible Reflections	86	12
Total TMY	3910	446

At this view location, reflections of the Sun in the building's West elevation may be visible most days. However, reflections are partly screened by the tree canopies and typically last for ~15 minutes.

The Annual heatmap and statistics above are calculated without the screening provided by the proposed trees.

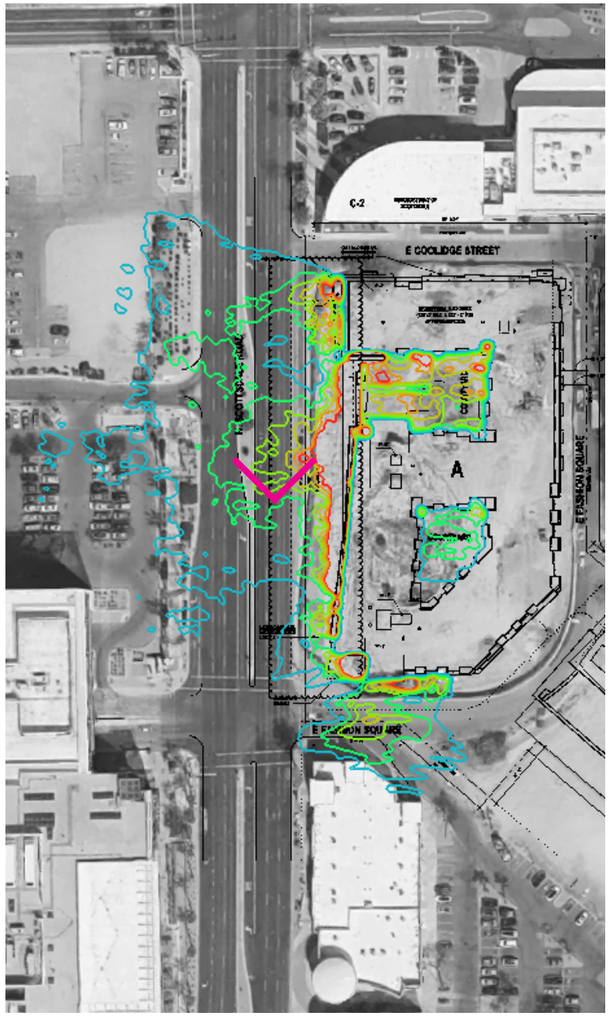
02 :: Driver : Northbound on N. Scottsdale

Human Adaptation with Veiling Glare



June 21st, 5:45 pm MST

TMY : With Trees modeled



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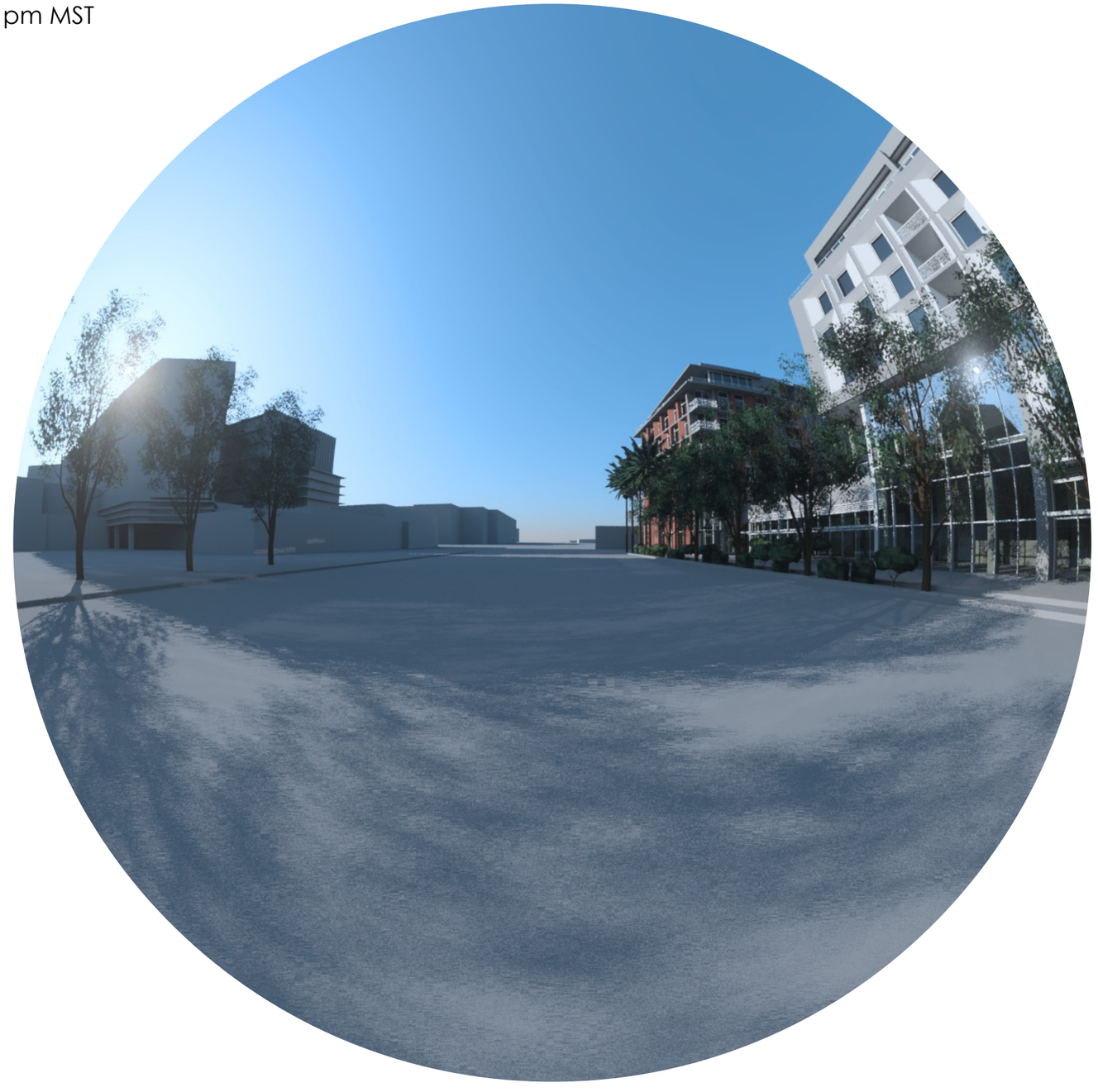
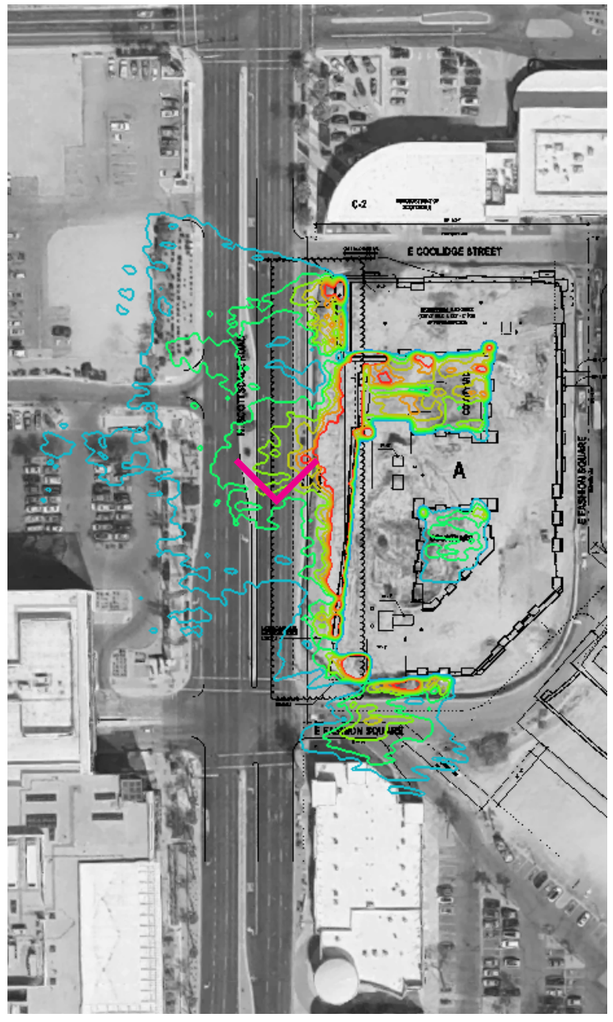
02 :: Driver : Northbound on N. Scottsdale

Human Adaptation with Veiling Glare

June 21st, 5:45 pm MST



TMY : With Trees modeled



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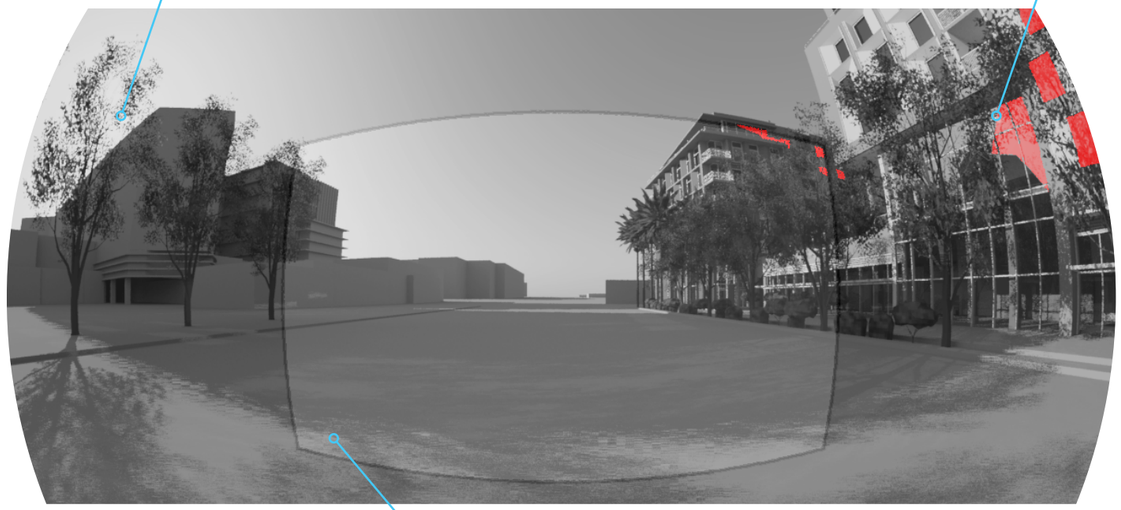
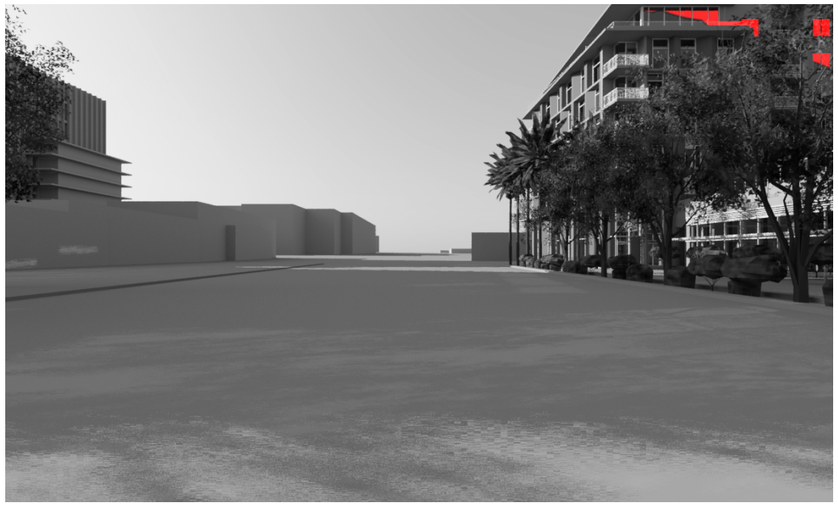
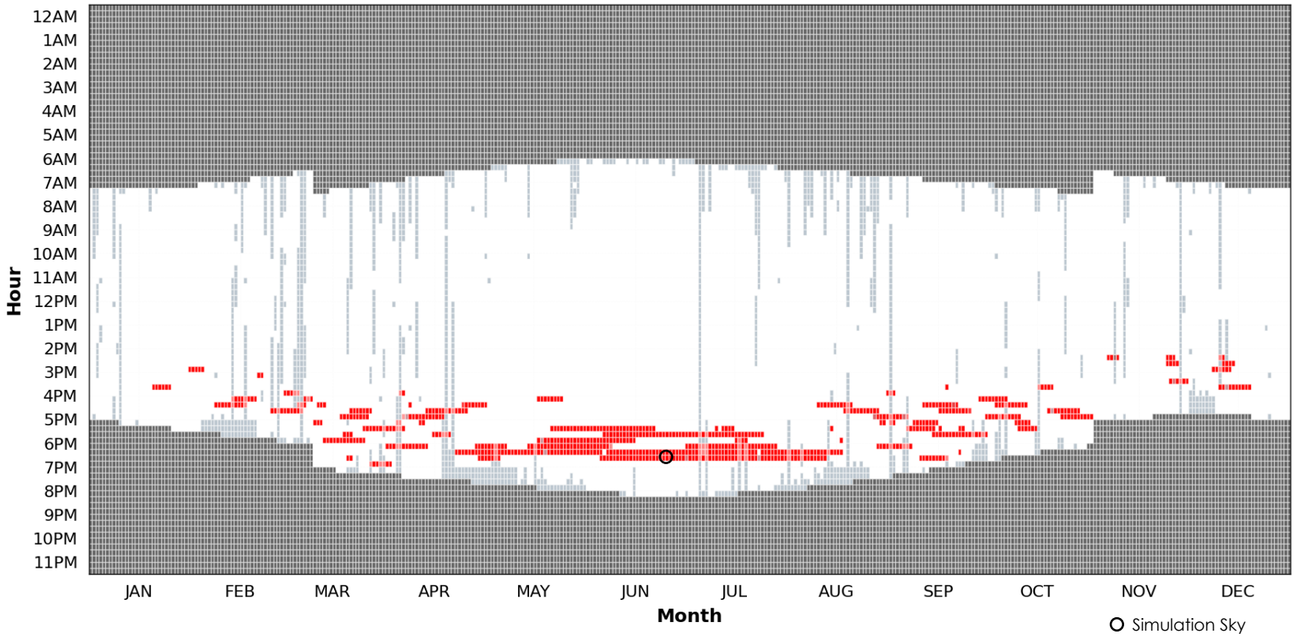
02 :: Driver : Northbound on N. Scottsdale

Area of Glazing that will have visible reflections in Red - see annual graph





Annual Visual Reflection Potential :: TMY filtered - 15 min. increments



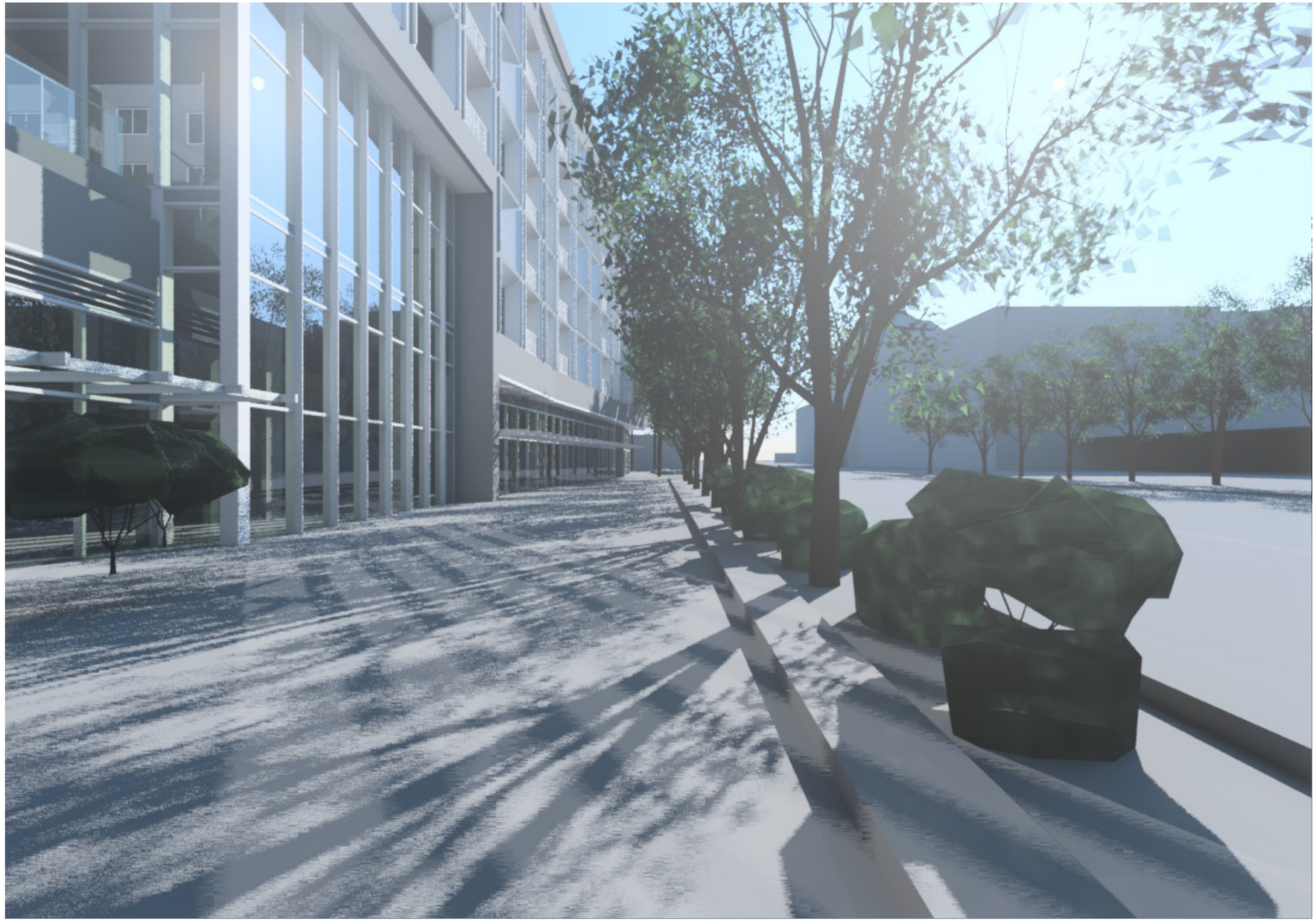
Annual Hours	TMY : Clear + Intermediate Skies	TMY: Overcast Skies
Visible Reflections	178	19
Total TMY	3910	446

At this view location, the source of reflections (on the building's elevation) that land on the road (heatmap above and annual overlay) will not typically be visible. These reflections will come from outside of a typical field of view for a driver.

The Annual heatmap and statistics above are calculated without the screening provided by the proposed trees.

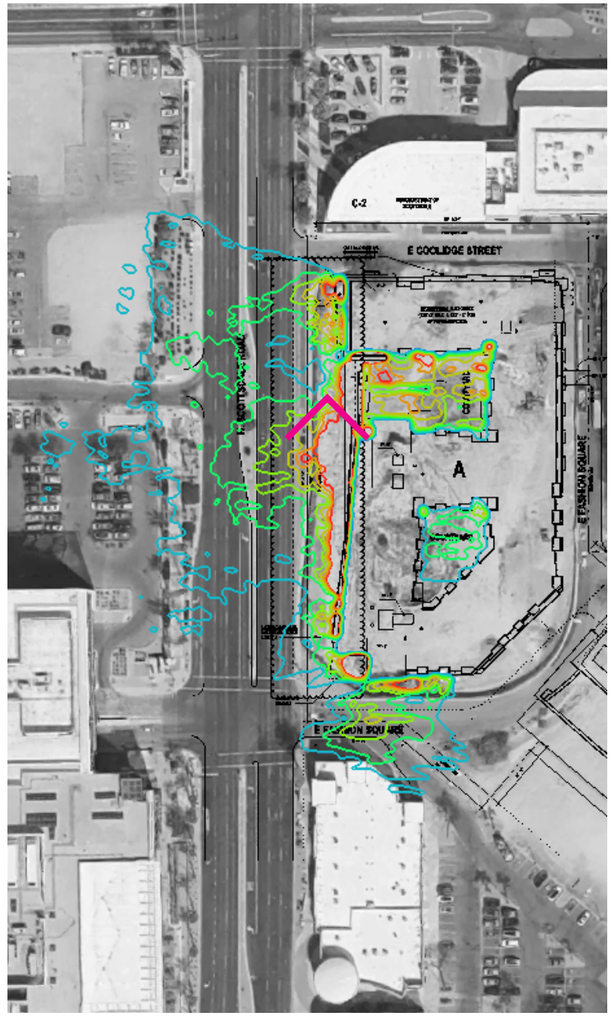
03 :: Pedestrian : Looking South adjacent project's West elevation

Human Adaptation with Veiling Glare



Dec. 13th, 2:30 pm MST

TMY : With Trees modeled



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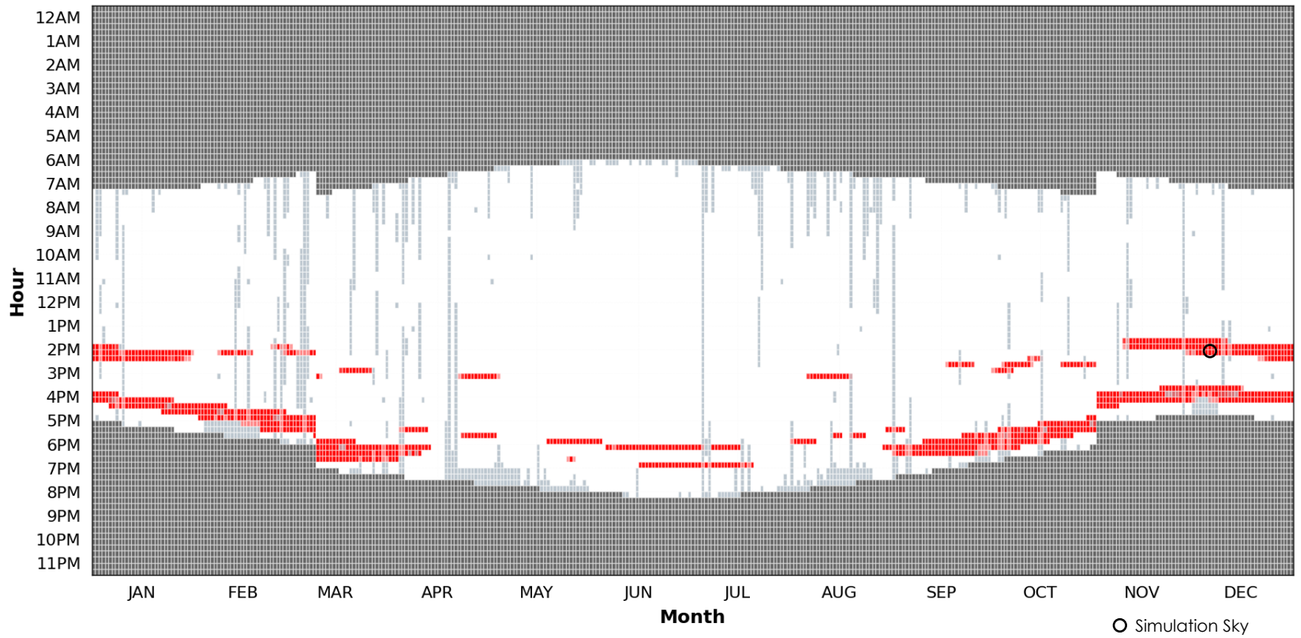
02 : Holly St. off-ramp, Southbound 101

Area of Glazing that will have visible reflections in Red - see annual graph

Annual Visual Reflection Potential :: TMY filtered - 15 min. increments



Annual Hours	TMY : Clear + Intermediate Skies	TMY: Overcast Skies
Visible Reflections	245	32
Total TMY	3910	446

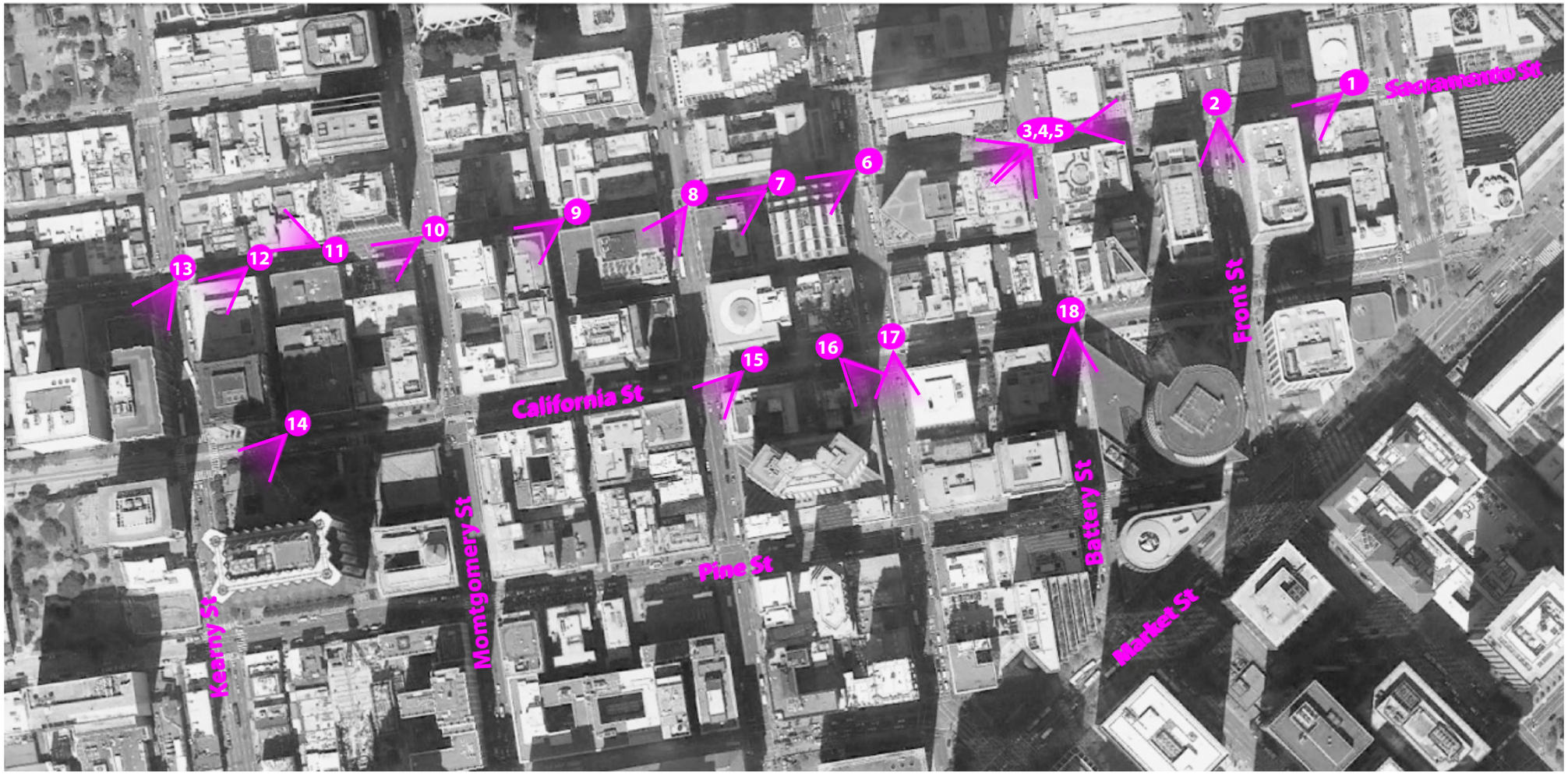
At this view location, reflections of the Sun in the building's West elevation will be visible most afternoons. The mid-afternoon reflections (as simulated here) will be at higher solar angles, visible in a typical field of view when walking south, and at times when the sun would also be in view at a similar altitude (to the right).

At this view location, the late reflections are low angle and closer to perpendicular relative to the direction of travel and the building's orientation.

The Annual heatmap and statistics above are calculated without the screening provided by the proposed trees.

Appendix

Typical Sunlight Reflections : San Francisco



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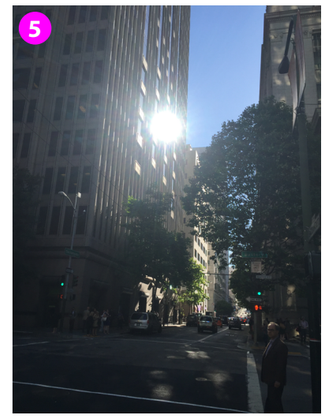
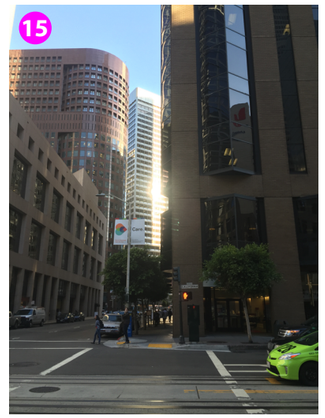
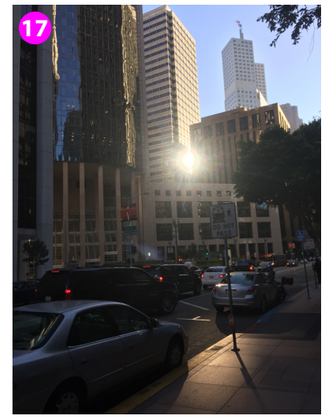
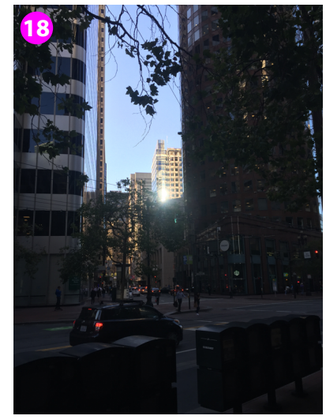
Typical Sunlight Reflections : San Francisco









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Typical Sunlight Reflections : Los Angeles