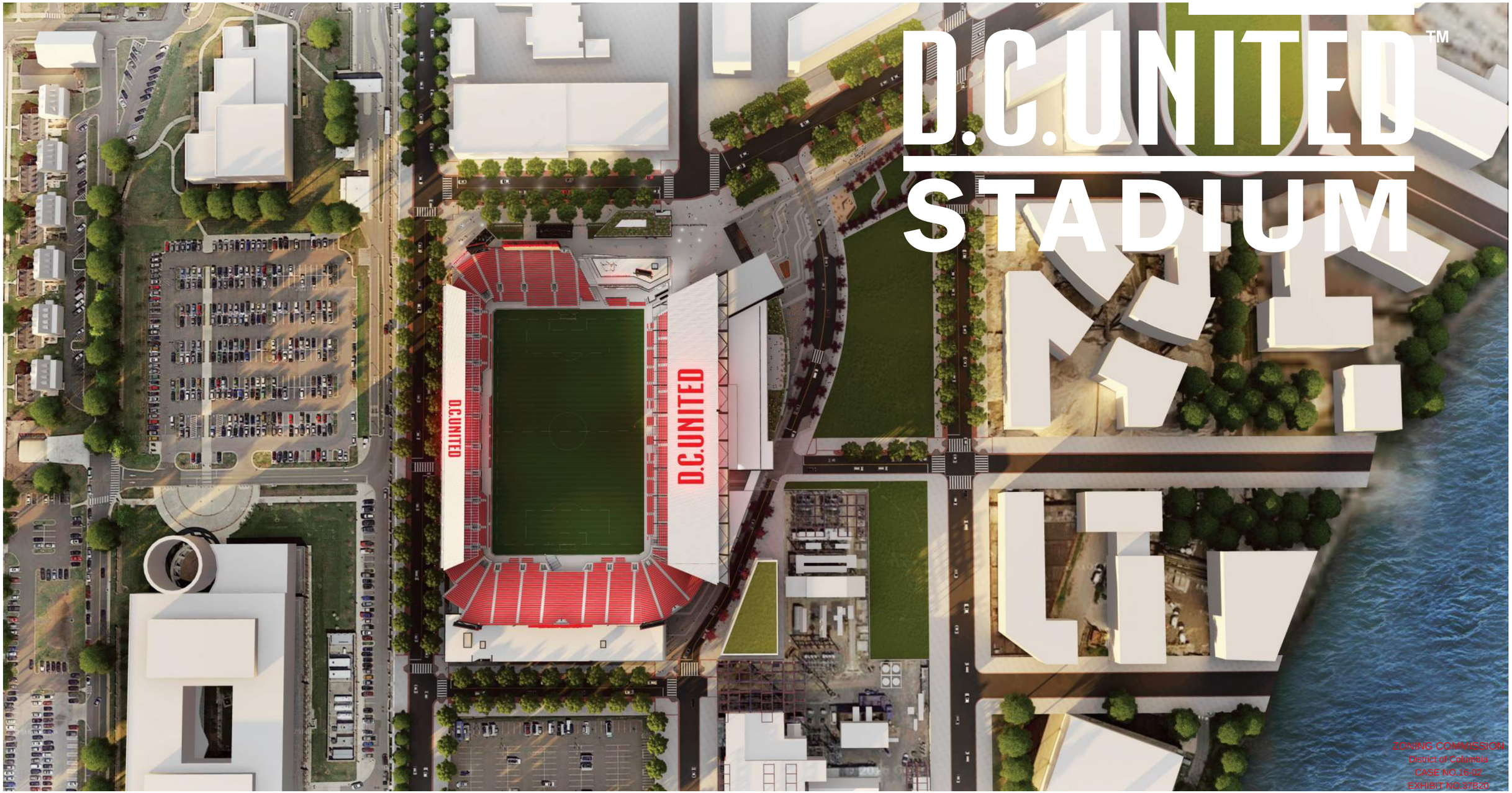
D.C.UNITED™
STADIUM
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ZONING COMMISSION
District of Columbia
CASE NO.16-02
EXHIBIT NO.37B20

SECTION

09

TECHNICAL STUDIES:
STADIUM LIGHT STUDY

STADIUM SOUND STUDY

STADIUM SUN STUDY

STADIUM LIGHT STUDY

The proposed lighting system for both the sports lighting and the building façade shall be evaluated and designed to ensure any spill light and glare impact to the surrounding area is minimized while fulfilling the functional needs of the project. The lighting guidelines being used for the proposed development require that in no event shall any light element associated with the stadium adversely impact the operation of motor vehicles on area roadways. Additionally, spill light levels shall not adversely impact residential community.

The design goal is to limit spill illumination to the surrounding neighborhoods to 2 foot-candles at the stadium's boundary. The design goals are to limit glare to all motorists around the stadium to a threshold value rating of 40 GR at motor intersections around the stadium. Calculations for both spill and glare will utilize two internationally recognized guidelines and computer programs.

A fully controllable lighting control system shall be implemented for complete automated on/off or dimming functions. The use of an integrated astronomical time clock will further help to ensure lighting is programmed to operate efficiently during evening hours.

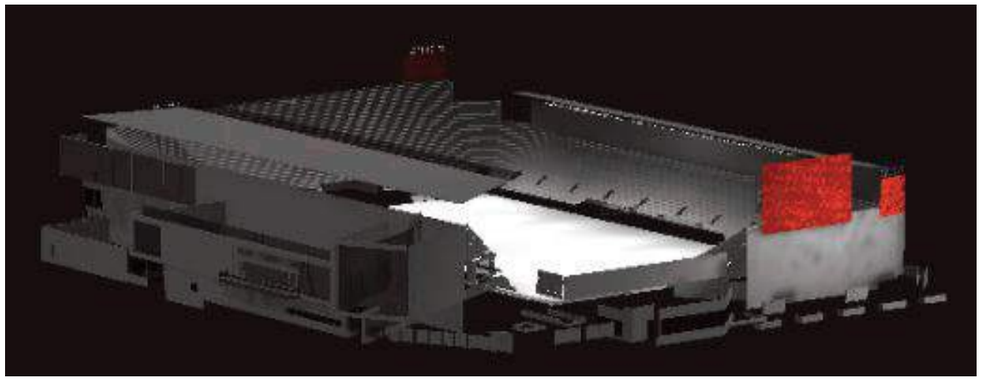
- Foot-candle (FC) – Unit used to define illumination. 1 foot-candle is equal to 1-lumen falling on an area of 1-square foot.

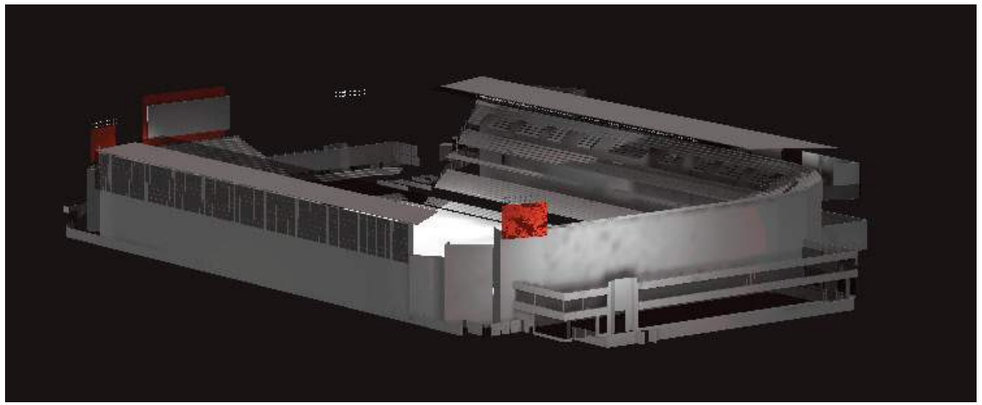
Light Source	Horizontal Illuminance Range (FC)	
Full Moon to Twilight	0.01	0.10
Typical City Parking Lot	1.0	2.0
Street Lighting	.25	1.0
Office/Classroom	40	70
Soccer Stadium	200	250
Sunny Day	3,000	5,000

Lighting Design Approach & Light Mitigation Strategies

- The sports lighting design for the new stadium will have LED luminaires and consume 50% less energy than similar MLS stadiums
- Illumination on the playing field shall be approximately 250FC horizontal with state-of-the-art fixtures
- Luminaire with beam efficiency of 50% or greater; compared to existing stadiums with beam efficiency of less than 30%. This will minimize light pollution and direct glare to the residential community and roadways.
- Limited façade uplighting

Array Lighting





FIELD LIGHTING ANALYSIS

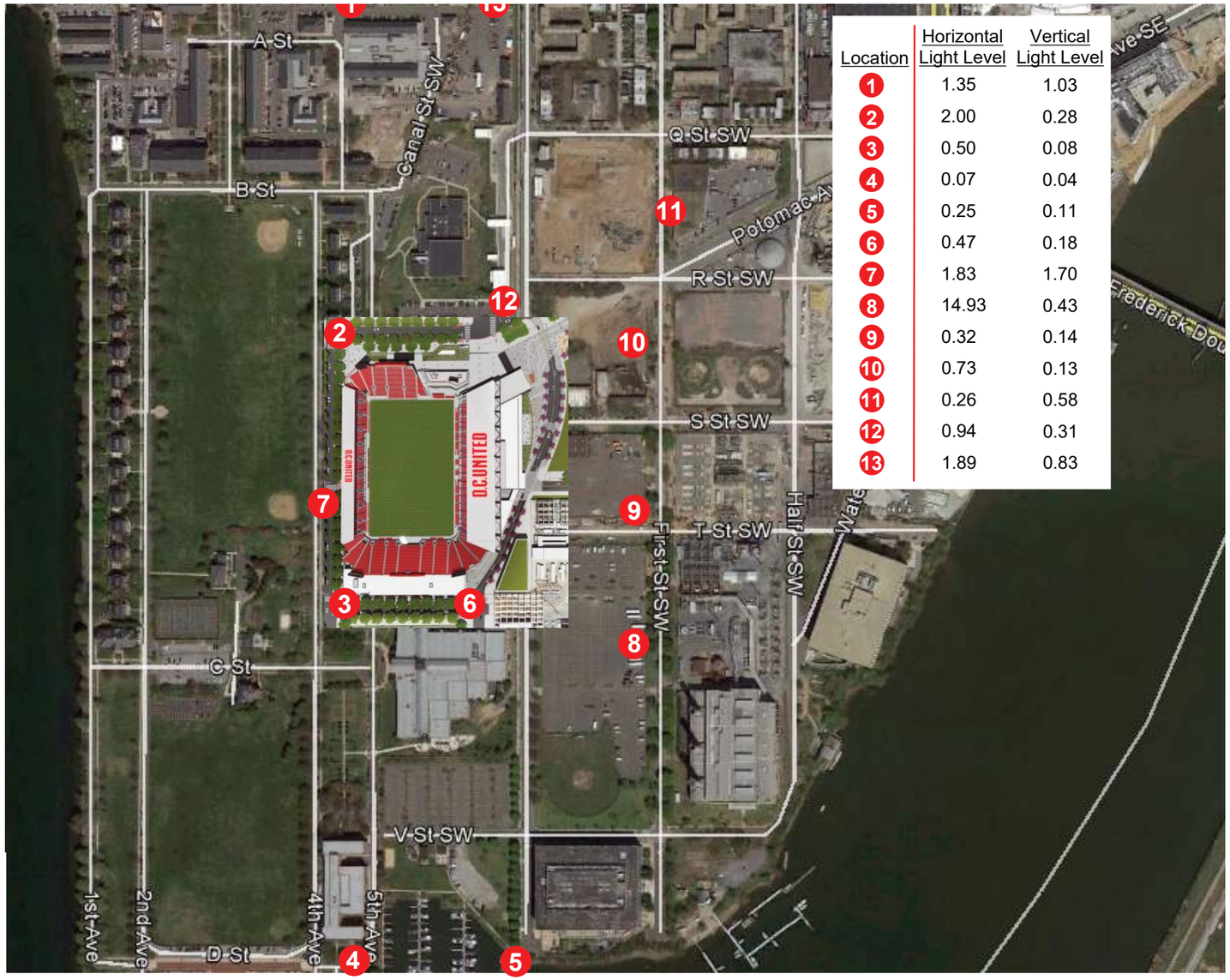
STADIUM LIGHT STUDY

Light Spillage Mitigation Strategies

- Aiming arrays for light racks versus pole lights
- Architecture that obstructs views of luminaires
- Final field aiming commissioning to address light spillage

Light Beams

Survey



Location	Horizontal Light Level	Vertical Light Level
1	1.35	1.03
2	2.00	0.28
3	0.50	0.08
4	0.07	0.04
5	0.25	0.11
6	0.47	0.18
7	1.83	1.70
8	14.93	0.43
9	0.32	0.14
10	0.73	0.13
11	0.26	0.58
12	0.94	0.31
13	1.89	0.83

Existing Light Levels

STADIUM SOUND STUDY

General

The proposed in-house sound system for the building is being designed as a distributed system to ensure minimal impact to the surrounding areas while meeting the performance expectations of a modern MLS stadium.

Predictive computer modeling and calculations of the impact are done with internationally recognized sound modeling software utilizing the current sound system and building model in concert with available existing sound level data. Evaluation and analysis criteria will be based on D.C. Municipal Regulations, ISO 9613-2 and HUD Noise Guidebook.

Goal of the analysis is to gain insight to impacts that sound may have on the surrounding community and to allow feedback to inform the progress of the design.

The analysis below includes the review of the typical day of game stadium configuration. Concert configurations and custom 3rd party sound installations were not analyzed.

Stadium and Background

D.C. United's proposed stadium includes 2-canopy structures to the east and west. The bowl opens in the four corners and only grandstands are on the North and South of the building. The sound system will utilize distributed speaker clusters throughout the building, hanging from the underside of canopies and on the backside of the bowl. The distributed system brings the sound closer to patrons and keeps the peak volume of the speakers and sound system to a minimum.

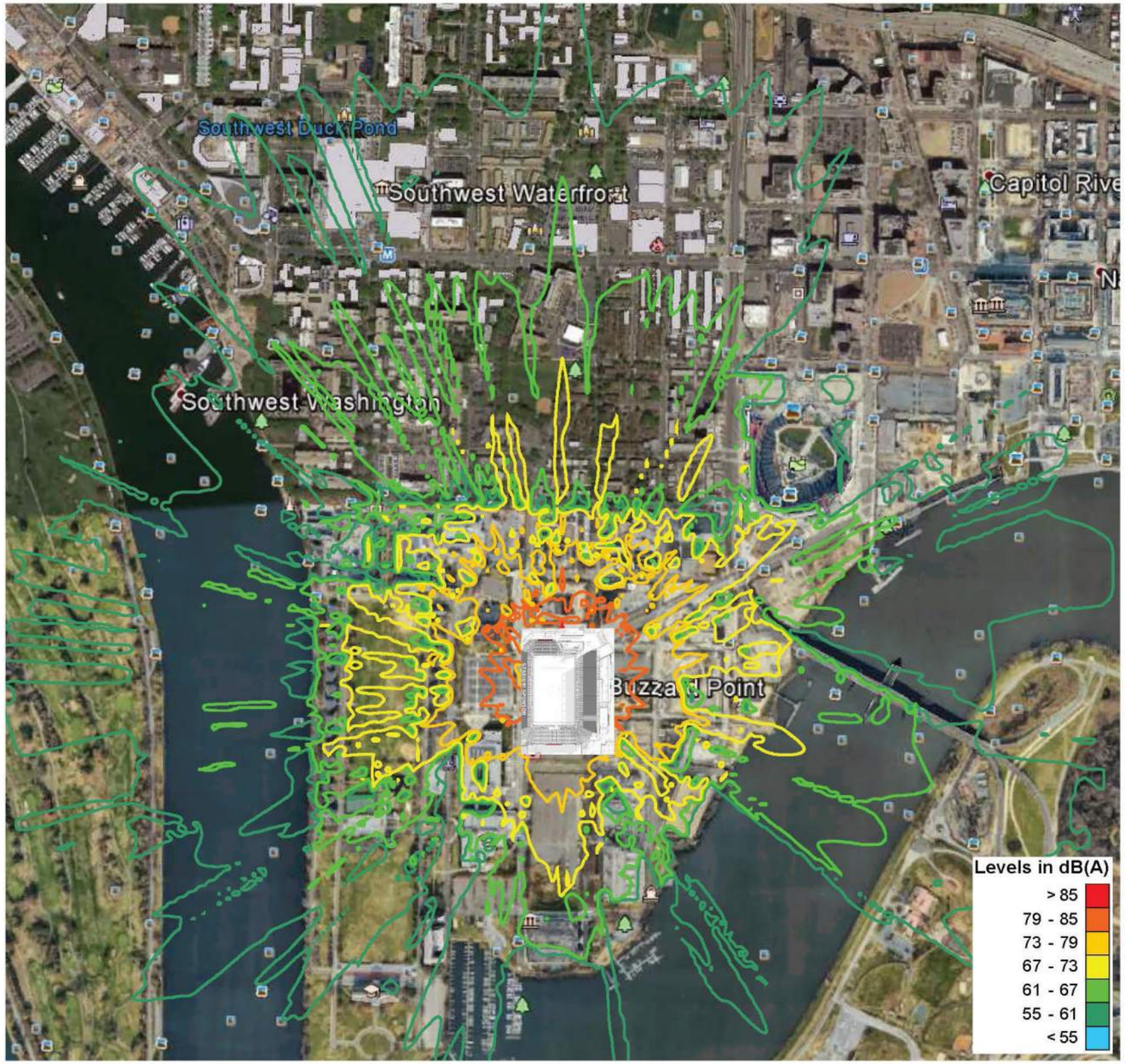
Based on the previous sound study done in the "Buzzard Point Soccer Stadium Environmental Mitigation Study", dated December 2014 the noise due to traffic on local streets was observed to be the major current contributor to ambient noise. The measured levels in the report around the current stadium site are around 60 dBA while low 70s occur along South Capitol Street.

Analysis

The analysis of Noise is the analysis of sound in the environment that is undesired. Noise is perceived by the human ear and includes many factors impacting not only the measurable sound, but also the perception of sound. Some of these factors include the frequency of the noise source, the period or number of times the sound occurs in a particular amount of time, and the amplitude or volume of the sound that is being perceived.

Humans cannot perceive all frequencies of sound equally and computer analysis is skewed towards the frequencies that are more easily perceived to align predictions with human perception. It should be noted that human response to sound and noise depends on a great number of factors outside predictive analysis. Such factors include the quality of sound, the change in volume over various intervals, as well as the pitch of the noise being perceived.

Perception of sound varies from person to person, but there are generally established guidelines for perceptibility. A change of 3dbA in sound levels is considered barely perceptible to the average person. Changes of 10dBA or more in sound level would be perceived as a doubling or halving of the current sound level.



Results

Based on the current predicted sound levels pedestrians will perceive an increase in background noise as far north as P Street with perceptibility dropping off north of M. Starting at P Street noise levels inside residences and buildings with windows and doors closed will drop below perceptible levels. In buildings and residences south of P street the noise levels should be within 3-6dB of the existing background noise levels.

Additional Mitigations

Even though the sound system prediction notes a minimal impact, there are design methodologies to maintain the current predicted impacts:

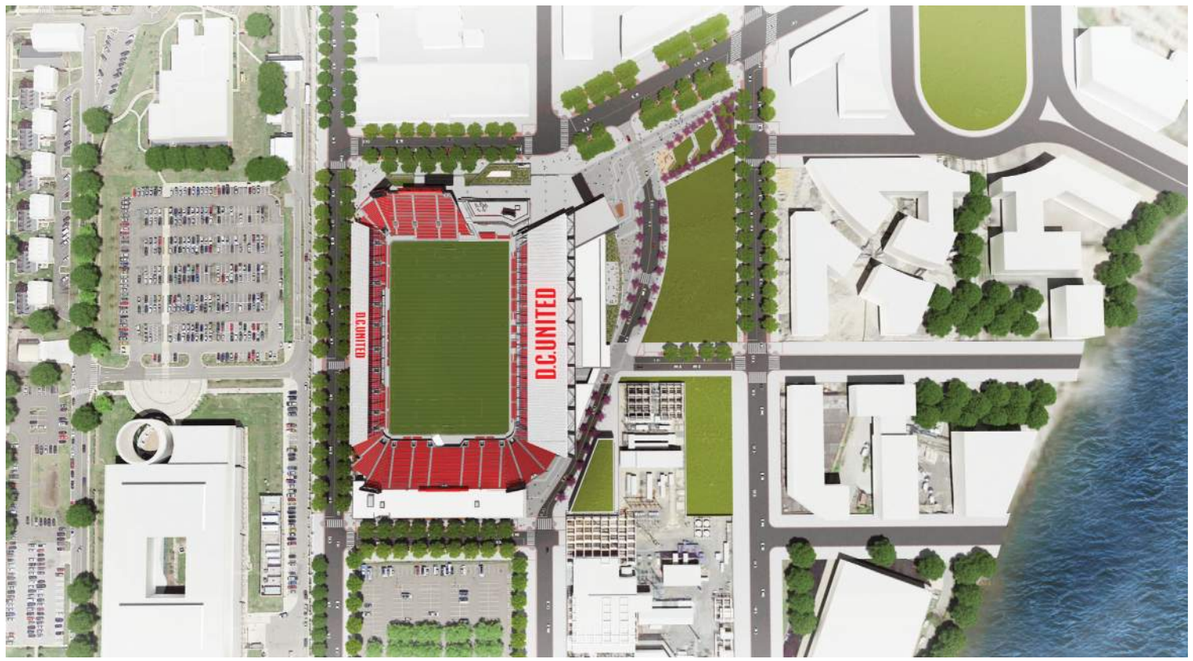
- Ensure that the system remains a distributed type. Distributed sound systems provide the best experience for stadium patrons without projecting sound into the surrounding communities.

- Aiming and tuning of specific speaker groups to minimize sound bleed from corners of the building.

STADIUM SUN STUDY

SUMMER SOLSTICE - 8:00 AM

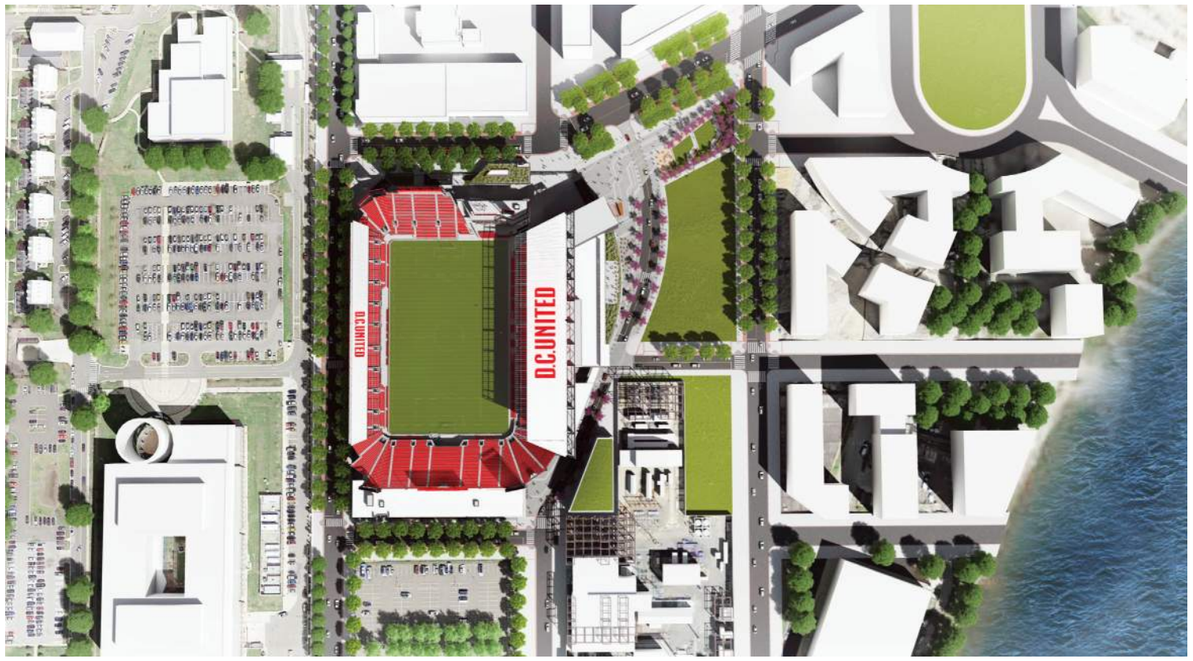
SUMMER SOLSTICE - 10:00 AM



SUMMER SOLSTICE - 1:00 PM

SUMMER SOLSTICE - 4:00 PM

EQUINOX - 8:00 AM

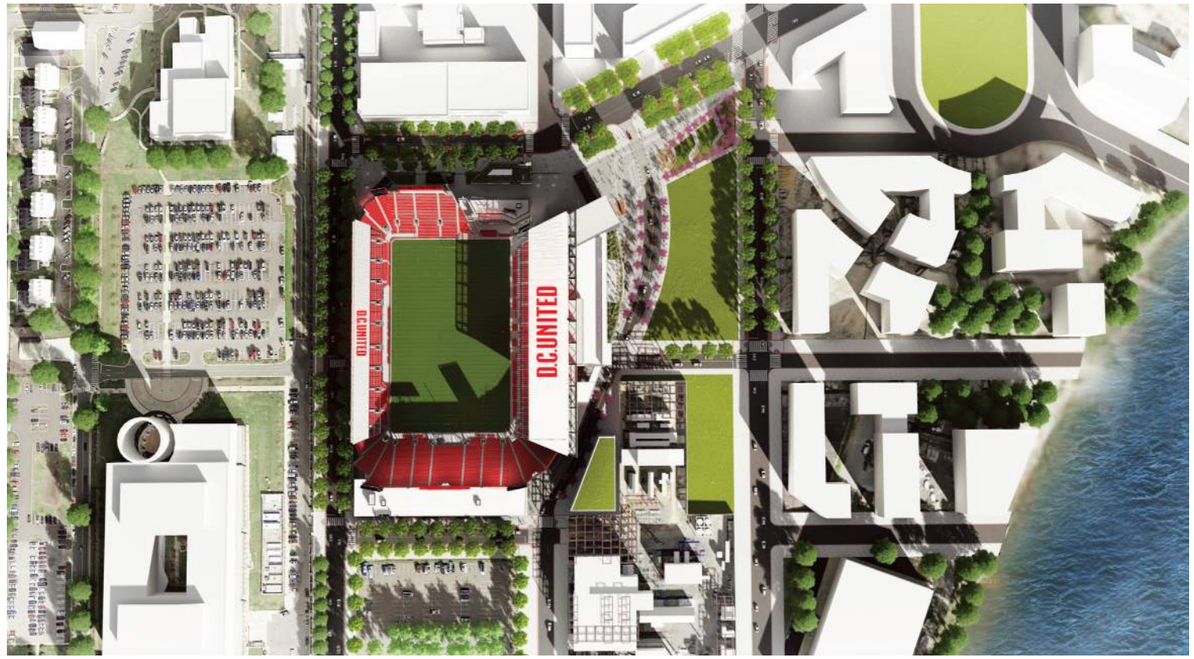


EQUINOX - 10:00 AM

EQUINOX - 1:00 PM

EQUINOX - 4:00 PM

WINTER SOLSTICE - 8:00 AM



WINTER SOLSTICE - 10:00 AM

WINTER SOLSTICE - 1:00 PM

WINTER SOLSTICE - 4:00 PM