WJHW

WRIGHTSON | JOHNSON | HADDON | WILLIAMS
Designers and Planners for Sound, Video, Multi-Media
Telecommunications, Broadcast, Theatre & Acoustics
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Mr. Kelly Kerns
POPULOUS
4800 Main Street, Suite 300
Kansas City, MO 64112

VIA Email: Kelly.Kerns@populous.com

Subject: Buffalo Bills New Stadium
Environmental Sound Study

Dear Mr. Kerns,

Wrightson, Johnson, Haddon, and Williams ("WJHW") has performed environmental noise modeling for concert and gameday events at the proposed new Buffalo Bills Football Stadium "New Stadium" or "Project") in Orchard Park, New York for use in Erie County's review of the New Stadium pursuant to New York's State Environmental Quality Review Act ("SEQR"). The noise modeling is based on the concept design drawings, and envelope models prepared by Populous for the Schematic Design Presentation on July 28, 2022 and updated site plan and canopy geometry prepared by Populous and transmitted on September 21, 2022.

The intent of this report is to assess the predicted noise propagation from concert and gameday events at the New Stadium to the surrounding community as compared to the Existing Stadium as a baseline condition. The results of the noise modeling indicate that predicted noise propagation from the New Stadium will remain comparable to, or may be less than, noise levels produced at the Existing Highmark Stadium ("Existing Stadium"). This is primarily due to the architectural design of the New Stadium, where the roof canopy, higher seating structures, and video board at the north end of the stadium all help to contain the sound from both concert and football events within the stadium. Further, the sound system within the New Stadium is being designed as a distributed system with more speakers which can operate at lower power levels while maintaining the same sound level at the seating areas because they are having to throw the sound a shorter distance to the fans. Additionally, the patron capacity of the stadium will be reduced by about 10% in the New Stadium.

Project Description

The New Stadium is located on the west side of Abbott Road, across from the Existing Stadium. The project site is in the Town of Orchard Park, New York but is adjacent to the Town of Hamburg, New York to the west. The building will be depressed into the site approximately 35 feet below grade such that the main concourse is located at or near grade, with a capacity of approximately 60,000 - 63,000 patrons in a 360-degree configuration. The building façade at the main concourse level is primarily brick, and the upper concourse is enclosed with a perforated metal screening. A 360-degree metal roof canopy is provided over the seating areas, approximately 190-210 ft. above grade.

Nearby sensitive receivers to the stadium include the State University of New York ("SUNY") Erie Community College South ("ECC South") campus directly to the west of the project site (approximately 1,075 ft from the New Stadium), the residential area along Sheldon Road north of the project site

(approximately 1,140 ft from the New Stadium), the neighborhood on the east side of Abbott Road between One Bills Drive and US 20A (approximately 540 ft from the New Stadium), and the neighborhood south of US 20A between Abbott Road and Parker Road (approximately 1,340 ft from the New Stadium). Excerpts from the Orchard Park, New York zoning map and Hamburg, New York zoning map are included below in Figure 1 and Figure 2, respectively.

Figure 1: Town of Orchard Park, New York Zoning Map

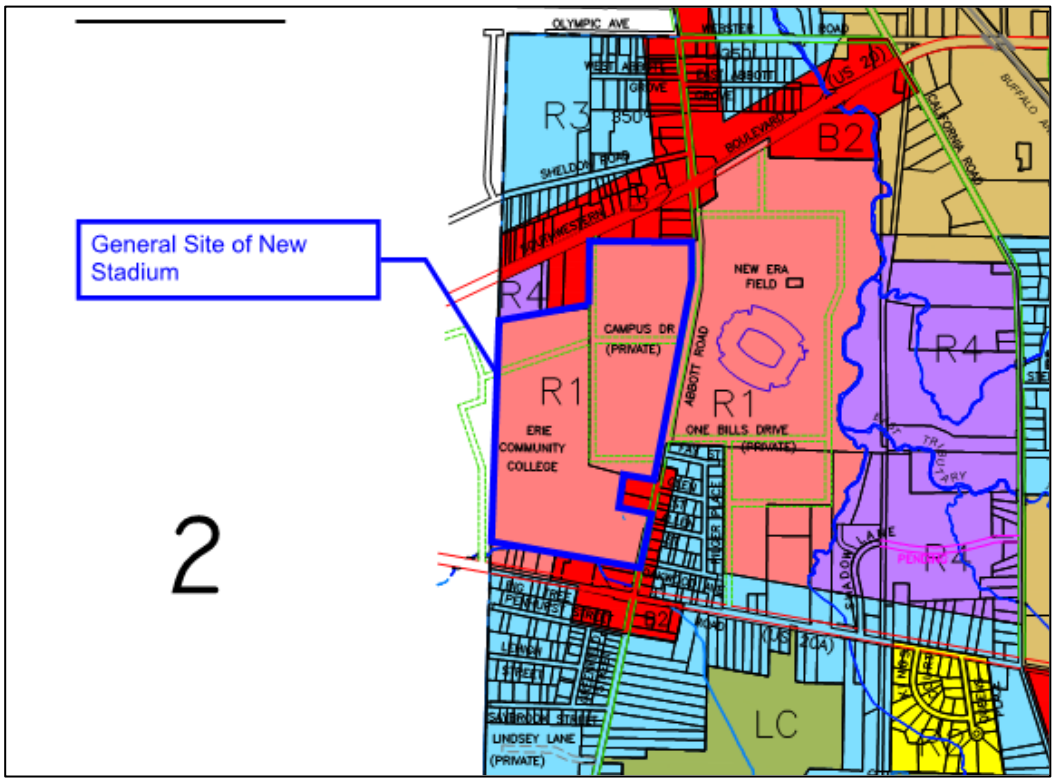
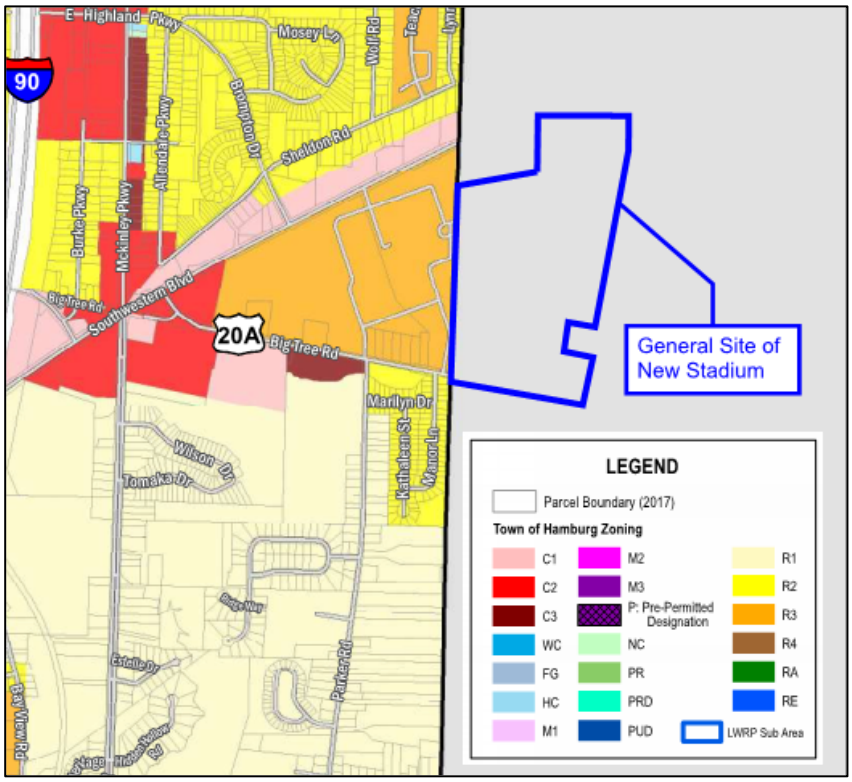


Figure 2: Town of Hamburg, New York Zoning Map



Relevant Noise Ordinances

The Code of the Town of Orchard Park, Part II, General Legislation, Chapter 87 Noise, Section 87-3 states:

> *Subject to the provisions of this chapter, the creation of any unreasonably loud, disturbing and unnecessary noise is prohibited. Noise of such character, intensity and duration as to be detrimental to the life or health of any individual is prohibited.*

The Code of the Town of Hamburg, Part II, General Legislation, Chapter 175 Noise, Article II states:

> *A. The creation of any unnecessary and unreasonably loud or disturbing noise is prohibited as a public nuisance.*
>
> *B. Noise of such character, intensity and duration as to be detrimental to the life, health or welfare of the inhabitants of the Town of Hamburg is prohibited as a public nuisance.*
>
> *C. In particular, without excluding other types of prohibited sounds by failure to enumerate them, all sleep-disturbing noises are prohibited. Sleep-disturbing noises shall mean any unnecessary and unreasonably loud or disturbing sounds occurring during the hours between 11:00 p.m. and 7:00 a.m. and unreasonably interfering with the sleep, comfort, health and repose of any individual within hearing thereof or in the vicinity.*

These two municipal ordinances are "nuisance ordinances" and do not set a prescribed limit to the maximum sound levels. For this reason, the project has proposed a comparison to the Existing Stadium conditions as a baseline for community noise impact, with the intent to limit the receptors where there is a significant increase in noise level during events. This is consistent with the guidelines published in the New York State Environmental Permits Guidance Document "Assessing and Mitigating Noise Impacts" which states:

> *The goal for any permitted operation should be to minimize increases in sound pressure level above ambient levels at the chosen point of sound reception. Increases ranging from 0-3 dB should have no appreciable effect on receptors. Increases from 3-6 dB may have potential for adverse noise impact only in cases where the most sensitive of receptors are presents. Sound pressure increases of more than 6 dB may require a closer analysis of impact potential depending on existing SPLs and the character of surrounding land use and receptors … An increase of 10 dB(A) deserves consideration of avoidance and mitigation measures in most cases.*

Noise Modeling Methodology

Sound levels were predicted using SoundPlan, an industry-standard software for modeling environmental sound propagation. Included in the model were preliminary New Stadium geometry from Populous, sound system designs from WJHW, recent touring concert configurations, and topographical information from United States Geological Survey data and Google Maps. Aerial images of the site were taken from Google Maps. Parking lots around the New Stadium, both existing and proposed, were included in the noise model. Buildings around the New Stadium, including the training center, SUNY ECC South campus, and the nearby residences that might otherwise provide noise buffering were excluded from the model to assess for worst-case noise propagation. Foliage and specific meteorological conditions that sometimes serve to attenuate noise were also not included as these may vary substantially depending on time of year and specific weather patterns during a specific event.

Assumptions

The stadium design is currently in the conceptual stage, and as such we have made the following assumptions:

- The lower New Stadium façade is shown to be brick and glass; we have assumed this material is completely solid and any sound transmission through the glass would be negligible compared to the sound travelling around and over these walls.
- The upper New Stadium façade is shown to be perforated metal panels; we have assumed this material will allow all sound to pass through as a conservative estimate.
- The Existing Stadium geometry was estimated from available aerial images of the site and public information on the Existing Stadium construction; the playing field was modeled at 40 ft. below grade, and the top of the seating was modeled at 60 ft. above grade.
- The temporary concert sound system design (applicable for both the New Stadium and the Existing Stadium) is assumed to consist of a stage in the south end zone with two large line arrays suspended from a temporary stage truss 50 ft. above the field, with music played at 112 dBA at the mix position 100 ft. from the front of the stage. The frequency spectrum for the music was taken from the noise limit riders of other large US concert venues.
- The New Stadium sound system design is assumed to consist of 12-box JBL VLA line arrays suspended around the perimeter of the stadium canopy spaced every 75 ft., based on WJHW's

preliminary design of the sound system. Noise levels are assumed to be 100 dBA, a maximum 10-minute Leq, throughout the seating area and the content of the sound system was assumed to be pop music.

- The crowd capacity in the New Stadium will be reduced by about 10% from the Existing Stadium; sound levels from crowd noise in the New Stadium were assumed to reach a maximum Leq of 100 dBA at the sidelines over a 10-minute period.

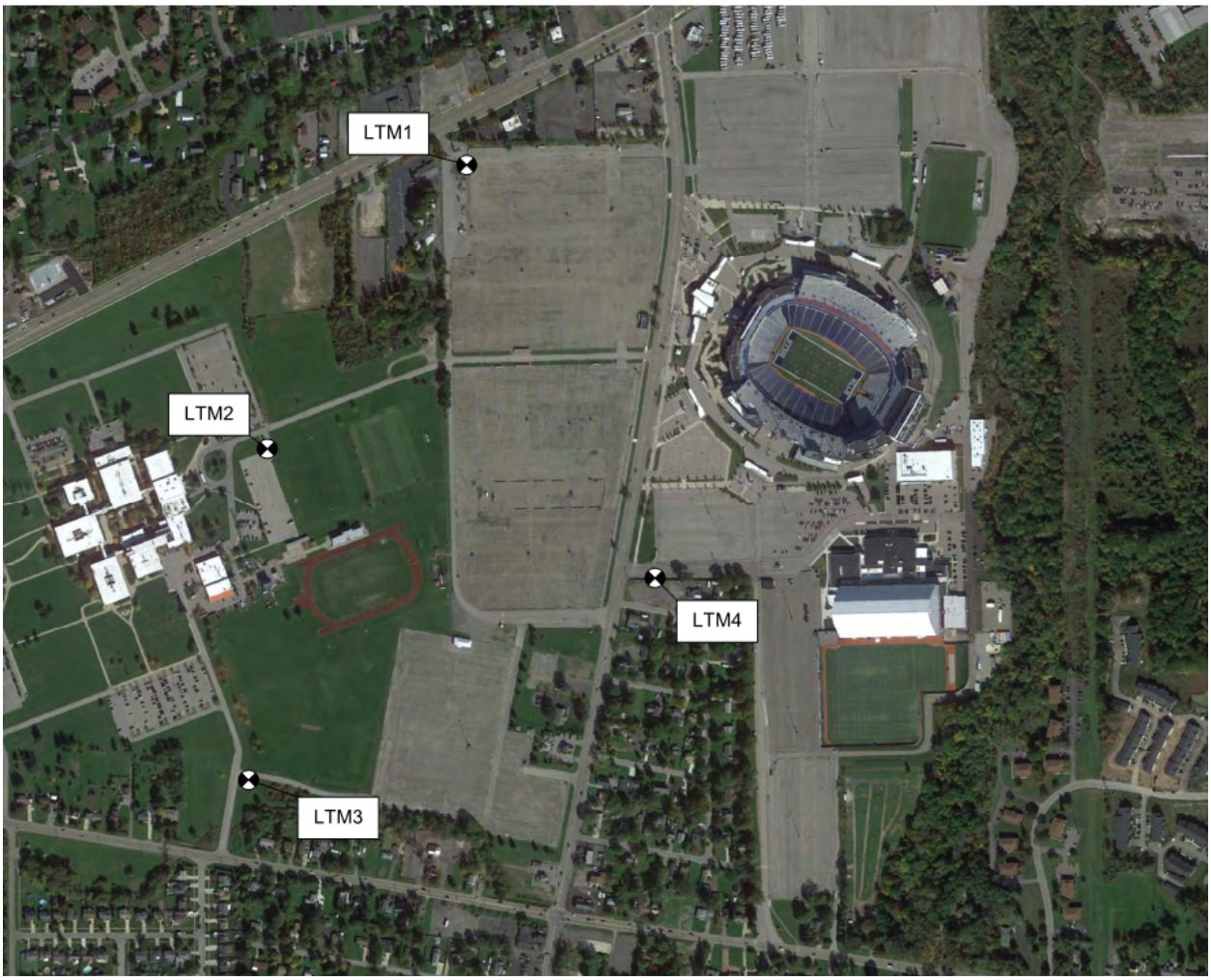
Changes to the building structure (i.e. location and dimensions of the main video board, locations of the speakers, exact height of the brick/glass façade) are expected as design progresses and all will have an impact on the sound transmission to the community. However, the results presented in this report are a reasonable estimate of the New Stadium's noise impact to the surrounding receptors based on the current conceptual design and WJHW's experience with sound modeling of other stadiums, outdoor amphitheater and concert venues.

Other factors which may impact the community sound levels are new building mechanical systems, emergency generators, and exterior loudspeakers at the plazas and entrances to the building. As design progresses, mechanical equipment noise levels will be analyzed following the calculation procedures and best design practices outlined in the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) HVAC Applications Handbook (2019) Chapter 49 - Noise to limit the impact of those systems on the nearby residential area. In WJHW's experience, mechanical systems noise is less objectionable than the amplified speech/music from a sound system and including the elements necessary to meet design noise levels within the stadium will result in negligible community impact compared to the New Stadium's sound system. Likewise, the small sound systems in any outdoor plazas or at the entrances to the building have less of an impact on the community as the main stadium sound system or temporary concert system because the entrance systems operate at quieter sound levels and are intended to provide coverage to a smaller area. The mechanical equipment and smaller exterior sound systems have not been included in the noise model since they are not the governing sound sources, but community impact will be considered as design progresses.

Sensitive Acoustical Receptors

On September 13, 2022 to September 20, 2022, acousticians from GHD monitored the sound levels around the Existing Stadium for the ambient, dark-day sound level as well as the maximum sound levels during a regular season NFL game. Their measurement locations, which are referenced in the following results, are presented below in Figure 3. LTM 1 is located at the property line of the commercial properties north of the New Stadium, LTM 2 is located at the property line of the SUNY ECC South campus, and LTM 3 & LTM 4 are located at the residential property line south of the New Stadium.

Figure 3: Longterm Monitoring Location Plan from GHD



Results

The contour graphics on the following pages show the 5-minute maximum Leq sound levels predicted for temporary concert sound systems in the New Stadium and Existing Stadium and for the permanent house sound system in the New Stadium.

When a concert is set up at the south end zone of the New Stadium as described above, sound levels at the residences 1,140 ft. to the north of the New Stadium are predicted to be 75-80 dBA. Southwest of the stadium, maximum sound levels at the residences 540 ft. from the New Stadium are predicted to be 65 dBA. At the SUNY ECC South buildings 1,075 ft. from the New Stadium, sound levels are predicted to be 65 dBA. These are shown in the sound contours in Figure 4 below.

In the Existing Stadium with the same temporary concert setup, sound levels at the residences 1,570 ft. north of the Existing Stadium are predicted to be 85-90 dBA and sound levels at the residences 560 ft. to the south of the Existing Stadium are predicted to be 70 dBA. The sound levels at the SUNY ECC South buildings 2,430 ft. west of the Existing Stadium are predicted to be 75 dBA. These noise contours are shown in Figure 5 on the following page.

Figure 4: Anticipated Sound Levels in New Stadium during Concert Event

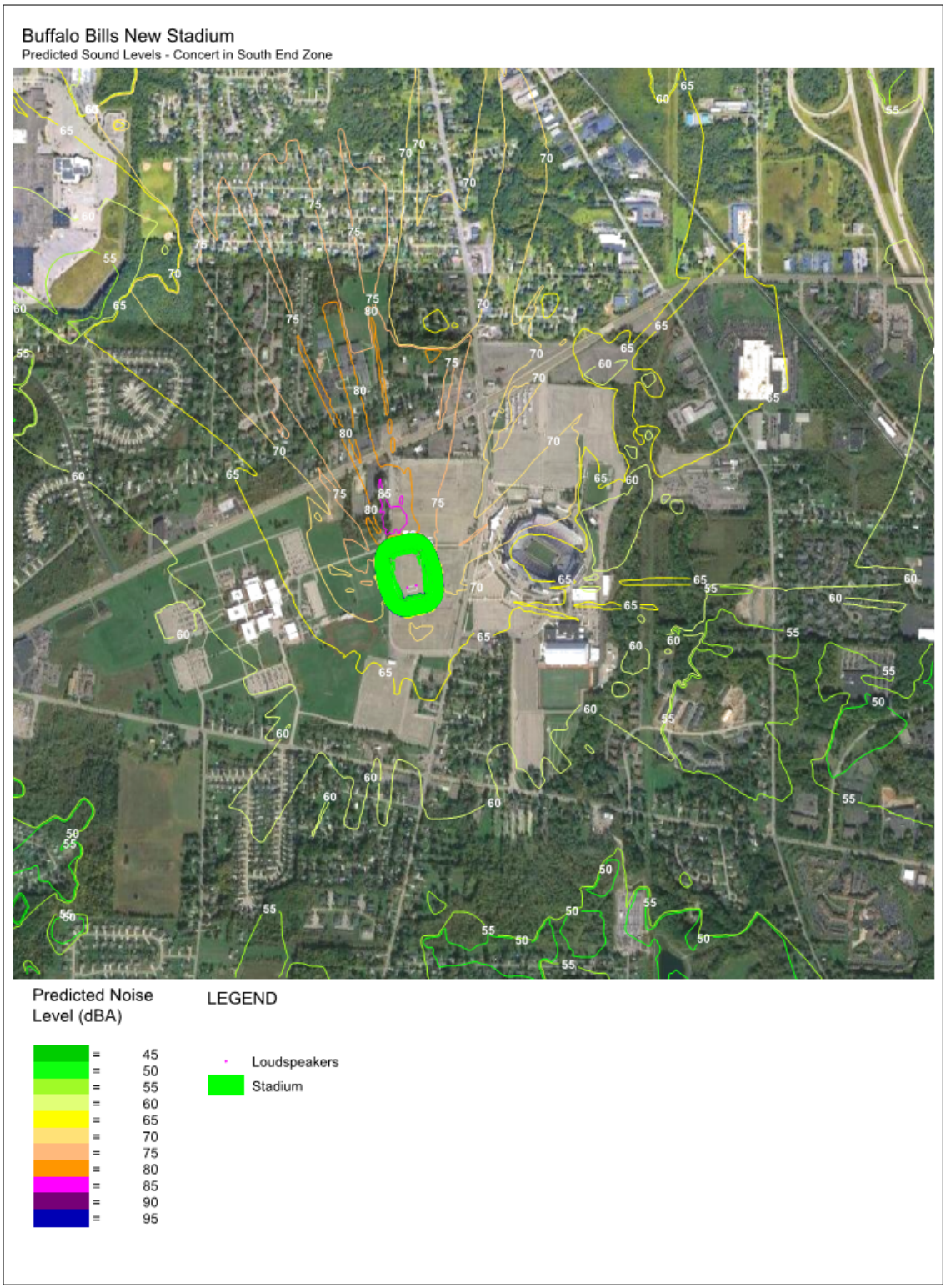


Figure 5: Estimated Sound Levels in Existing Stadium during Concert Event

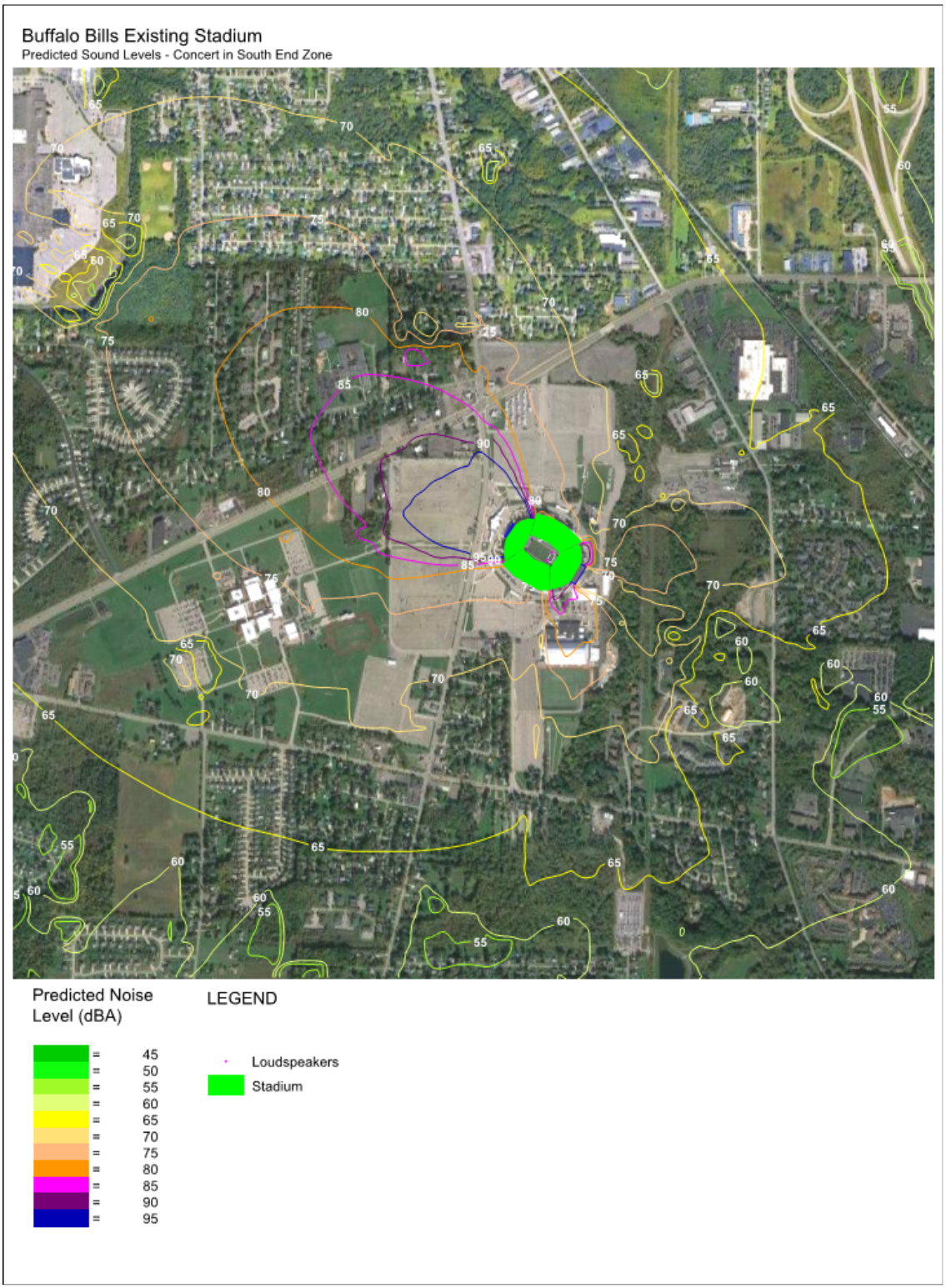
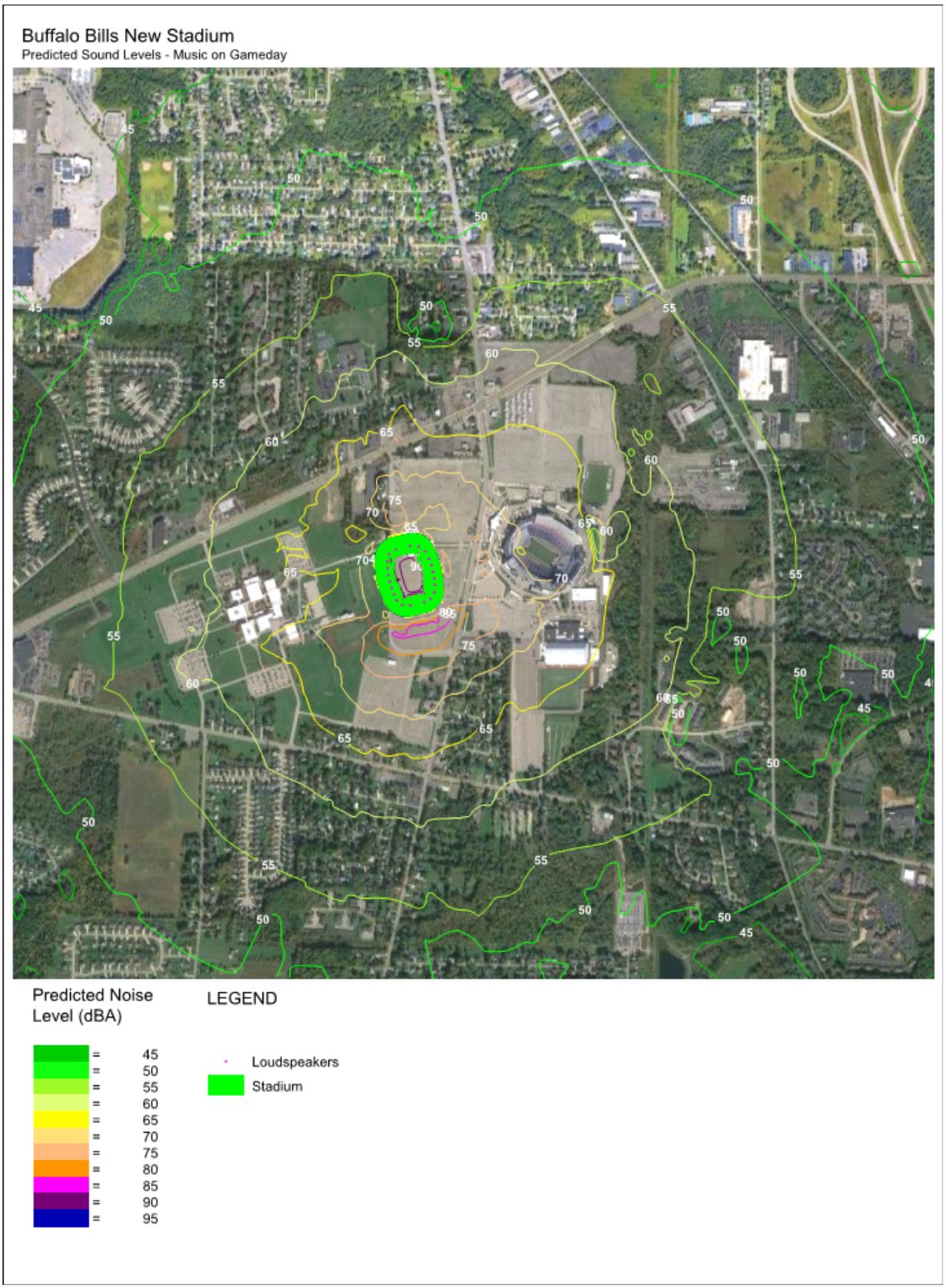


Figure 6: Anticipated Sound Levels from New Stadium on Gameday



The New Stadium's preliminary design for a stadium sound system to be used for gameday activities (i.e. house sound system) has predicted sound levels at the residences 1,140 ft. north of the stadium of approximately 70 dBA (or 5-10 dBA less than the temporary concert system sound levels). At the residences 540 ft. to the south of the stadium, sound levels are predicted to be 80-85 dBA. The sound levels at the SUNY ECC South buildings 1,1075 ft. west of the New Stadium are predicted to be 70-75 dBA. The sound contours for this situation are shown in Figure 6 on the previous page.

The table below presents the maximum 10-minute Leq sound level predictions from the scenarios listed above, as well as the predicted sound levels of the maximum1-minute Leq sound levels produced by spectators in the stadium, at the noise monitoring locations identified by GHD. Also included in the table are the L5 sound levels measured by GHD during an NFL game at the Existing Stadium.

	Predicted Sound Level, dBA, at Sensitive Receptors			
Modeled Scenario	**LTM 1 Commercial**	**LTM 2 School**	**LTM 3 Residential**	**LTM 4 Residential**
Existing Stadium – Concert	92 dBA	76 dBA	69 dBA	73 dBA
New Stadium – Concert	79 dBA	68 dBA	60 dBA	65 dBA
New Stadium – Music on Gameday	69 dBA	64 dBA	64 dBA	76 dBA
New Stadium – Crowd on Gameday	72 dBA	67 dBA	66 dBA	78 dBA
Existing Stadium – Gameday (Measured)	72 dBA	65 dBA	62 dBA	76 dBA

Summary Discussion

In comparing the New Stadium to the Existing Stadium with the same temporary concert setup and sound levels at each sound mix position, there is appreciably less community sound impact predicted with the New Stadium construction for sensitive receptors near to the stadium. At the locations closest to the stadium (identified in the results section above) and at the long-term measurement positions identified by GHD, the sound levels from a concert in the New Stadium are anticipated to be from 5 to 10 dBA less than the same concert in the Existing Stadium. Within a 1-mile radius of the New Stadium, we anticipate that a small area approximately 4,110 ft. from the New Stadium (at Lynwood Ave. and Brookview Terrace) could see an increase in sound level of approximately 3 dBA due to the new location of the stadium.

The overall lack of a significant increase in sound level is because while the New Stadium is still open air and is closer to US-20 and the residences located to the north, the higher seating structures and video board on the north side of the New Stadium help to contain the sound within the venue.

On game day in the New Stadium, sound levels to the south are predicted to be 5-10 dBA louder than the sound levels during concerts in the New Stadium (as the concert rig would be facing away from the seats in the south end zone). However, it should be noted that music on game day is played more sporadically and for shorter durations (pre-game, half time, and between plays) as compared to 60+ minutes of continuous music during some concerts. Additionally, sound levels at the residences further to the north of the New Stadium will be quieter on gameday than during concerts.

Comparing the predicted sound levels from the crowd and the permanent house sound system on gameday at the New Stadium to the Existing Stadium, the location where the most noticeable increase in sound level is predicted from the crowd noise at the SUNY ECC South buildings (LTM 2) and the nearest residential long-term measurement position (LTM 4). However, at all locations the individual loudspeaker and crowd noise measured over a 10-minute period are predicted to be less than 3 dBA over the measured L5 sound levels in the existing stadium.

Several features of the New Stadium's design help to mitigate noise impacts as compared to the Existing Stadium. First, the New Stadium's physical design is a more effective barrier between sounds in the New Stadium and the surrounding community. Specifically, the roof above the seating areas and the solid façade elements on the concourse level of the New Stadium provide a better sound "enclosure" than is available at the Existing Stadium. Additionally, the New Stadium would feature a completely distributed sound system with more speaker clusters (spaced approximately 75 ft. apart along the perimeter of the roof canopy), located closer to the seating and aimed more directly at the seating sections. This design will allow less sound propagation to the surrounding community than the Existing Stadium's sound design, which consists of only four main clusters of speakers, situated prominently on the roof of the Existing Stadium and aimed less directly at the seating areas. In WJHW's experience, a distributed system, like the one proposed for the New Stadium, allows each individual speaker to operate at a lower power level while still maintaining the same average sound level throughout the seating areas.

Recommendations & Conclusions

Based on conceptual design of the New Stadium, the brick and glass façade at the main concourse level will provide an adequate barrier for concert noise, and the canopy roof will provide a structure for supporting the stadium loudspeakers containing the PA and music sound levels on gamedays. Further development of the New Stadium's dedicated sound system design will focus on directing the output of the speakers only to the seating areas for the best intelligibility of the sound system which also limits noise escaping to the community.

Likewise, best design practices will be followed for mechanical equipment and the smaller sound systems at the outdoor areas to minimize community sound impact. Given the likely distance of mechanical equipment from the adjacent property lines, we recommend specifying that large mechanical equipment and emergency generators are no louder than 65 dBA at 7 m (23 ft) to ensure that sound levels at the property line do not cause an increase in the nighttime ambient (non-gameday) noise levels by more than 3 dBA.

Based on the preliminary modeling of a temporary concert sound system, at most locations closest to the stadium, concert sound levels from the New Stadium are predicted to be quieter than the Existing Stadium. At a small area on Lynwood Avenue and Brookview Terrace, sound levels will increase by approximately 3 dBA; this increase would be only just noticeable and will not have an appreciable impact on the residences. With the design factors of the New Stadium described previously in addition to the reduced capacity, a similar reduction in the sound level for gameday events is also expected for locations to the north of the New Stadium. The most notable increase in gameday sound level, compared to measurements performed by GHD, will be at the SUNY ECC South campus, primarily because it is located much closer to the New Stadium than the Existing Stadium. The increase is still less than the 6 dBA difference considered to be an adverse imact.

Sincerely,

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