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Kansas City, MO 64105

Subject: Ryan Field Redevelopment at Northwestern University
Rebuttal to Arup responses dated September 27, 2023 and Steven Harper Presentation

Dear Mr. Nielson,

The following are responses to the Arup Memorandum (Ryan Field Redevelopment at Northwestern University – Review of WJHW Rebuttal to Arup) dated September 27, 2023. The intent is to provide a response to the comments presented by Arup regarding our rebuttal of the information presented in their Memoranda dated August 11 and August 15, 2023.

As indicated in Arup’s memo, Arup had no further comment for the following items within the Detailed Comments section: 2, 3, 4, 5, 19, 20 and 21. These items have been removed accordingly from WJHW’s responses contained within this letter.

General Statement on Public Safety Related to Sound Levels

It has been stated by the opposition to the Ryan Field Redevelopment – both in public testimony or comment as well as through rebuttals to the Northwestern documentation – that sound emanating from the proposed Ryan Field will be dangerous to the neighborhood and its occupants. The inference of these comments is that audible music from the stadium – requested up to six days a year – will cause irreparable harm to residents including catastrophic results. This is simply not accurate, nor supported by the evidence provided or other reputable medical information.

First, the sound levels experienced in the neighborhood will not rise to such levels as to cause physiological harm to a person. The predicted sound levels are expected to reach up to 70-75 dBA – see Figure 6 in our report dated August 2, 2023. This is the upper end of the sound emissions due to the fluctuating nature of the sound source, and the overall average (Leq) is likely to be less. Standards and guidelines from the regulatory entities of the Occupational Safety and Health Administration (“OSHA”) and World Health Organization (“WHO”), set the parameters for noise exposure, confirming the predicted levels will not be dangerous to the surrounding community.

- OSHA (Section 1910.95 – Occupational Noise Exposure): *Exposures to noise should be controlled below a level equivalent to 85 dBA for eight hours to minimize occupational noise induced hearing loss.*

Not only is the noise level predicted well below the 85 dBA limit set by OSHA, but exposure to the sound source is substantially less than the 8-hour maximum allowed. Neither of the conditions presented by OSHA as occupational hazards are present in the community surrounding the stadium.

- WHO (Guidelines for Community Noise): *“Hearing impairment is not expected to occur at LAeq,8h levels of 75 dB(A) or below, even for prolonged occupational noise exposure.”* Further, *“It is expected that environmental and leisure-time noise with a LAeq,24h of 70 dB(A) or below will not cause hearing impairment in the large majority of people, even after a lifetime of exposure.”*

The first statement indicates an 8-hour exposure to sound levels of 75 dBA or below will not result in hearing loss. The second statement states 24-hour exposure to levels of 70 dBA or below – even over a lifetime – will not cause hearing loss.

“After prolonged exposure, susceptible individuals in the general population may develop permanent effects, such as hypertension and ischaemic heart disease associated with exposure to high sound levels.” The WHO statements go on to state, *“Workers exposed to high levels of industrial noise for 5-30 years may show increased blood pressure and increased risk for hypertension. Cardiovascular effects have also been demonstrated after long-term exposure to air- and road-traffic with LAeq,24h values of 65-70 dB(A).”*

Both of the above WHO statements indicate the purported physiological and cardiological effects occur over substantial periods of time and at sound levels in excess of those that would be experienced due to concerts at the proposed stadium (note, the LAeq,24h is representative of the “average” sound level of a 24-hour period and not simply the time when a concert occurs).

Given the above statements, the sound levels expected are not considered dangerous in such a way as the parties have contended. We acknowledge the predicted sound levels will be audible in the neighborhoods surrounding the stadium, and that this may be perceived as an annoyance to some individuals, however, the predicted sound levels will not be dangerous.

General Comments

- **2.1 Arup’s Role and Responsibilities**

WJHW Response: No additional comment.

- **2.2 Sound Mitigation Strategies**

- Where the design has incorporated sound mitigation strategies through drawings/mark-ups that show the extents of the elements cited. These could be provided as architectural drawings in the appendix.

WJHW Response: *Architectural drawings remain in development, and are not available at this time.*

- The individual acoustical benefit of each strategy for community sound. This could be provided as a performance summary noting the amount of decibel

reduction, at what frequencies, and what surrounding communities benefit. This allows the receiver and other interested parties to clearly understand the performance outcomes and informs what elements should remain in the event of possible design revisions.

WJHW Response: *Comparing the individual contribution of each noise isolation element is unnecessary. It is the collective result of all noise mitigation elements which is relevant to the community. The noise mitigation outline in the report are included in the modelling and the results are representative of the community noise levels anticipated with these items included in the design. Enclosures and walls around the seating bowl have remained consistent throughout the modeling exercise.*

- Technical details of each strategy that help validate the performance summary. Information about the design of the strategy, material properties, and technical analysis (e.g. 3D sound modeling) further substantiate the individual strategies to technical reviewers.

WJHW Response: *There are currently 18 possible temporary mitigation options being analyzed, such as acoustical curtain panels and all weather sound panels, and Northwestern is committed to selecting one or more with a minimum 20 dbA reduction. The reason that the specific measure is not available at this time is because we would need full construction drawings in order to finalize the strategy, which is premature at this point in the process. Once the temporary strategies have been finalized, the venue operations plan will incorporate the appropriate content such as how and when the temporary options are utilized.*

- **2.3.1 Community Ambient Sound Levels – L_{90} and L_{eq}**

WJHW Response: *WJHW does not make statements regarding the use of L_{eq} as the ambient sound level. Our argument is the L_{eq} provides both a representation of the most common metric used for environmental sound in governmental, occupational, and health guidance regarding noise exposure as well a comparison to the average sound level in the measured locations. We think these are appropriate comparisons. L_{90} is certainly a metric the Commission can consider while deliberating.*

The intent of this comparison is to show that the neighborhoods are subject to increased sound levels due to football game activities and that concerts would achieve similar sound levels (acknowledging the difference in frequency content).

While L_{90} is often used to determine discomfort (annoyance) due to environmental noise, WJHW has explicitly stated we are not attempting to determine annoyance as it is highly subjective which is supported by the various community comments both for and against the stadium redevelopment and with community members specifically mentioning the potential noise levels at their residences (page 3,

WJHW Rebuttal to Arup Report, September 18, 2023).

- **2.3.2 Community Ambient Sound Levels – Weekday vs. Weekend Levels**

WJHW Response: *No additional comment.*

- **2.4.1 Community Concert Sound – Representation**

- Six of the eight short term measurement locations and one of the three long term measurement locations align with areas behind the proposed stage location. The predicted concert sound levels at these locations are reduced as a result of the directionality of the modeled sound system and stadium geometry.

WJHW Response: *No additional comment.*

- All long-term measurement locations are on NU property.

WJHW Response: *No additional comment.*

- No measurements were taken in locations identified in the computer modeling that correspond to the areas shown to have the highest predicted concert sound levels. Generally, this area is northwest of the proposed Ryan Field and does not benefit from the acoustic barrier effect by Trienens Performance Center and Welsh-Ryan Arena.

WJHW Response: *No additional comment.*

- **2.4.2 Community Concert Sound – Community Noise Impact**

WJHW Response: *WJHW specifically stated we were not attempting to determine annoyance as it is highly subjective which is supported by the various community comments both for and against the stadium redevelopment and with community members specifically mentioning the potential noise levels at their residences (page 3, WJHW Rebuttal to Arup Report, September 18, 2023). Regarding sleep disturbance, WJHW noted “sleep disturbance is limited – if not eliminated – by the agreed event end time of 10:00 pm or 10:15 pm” as referenced in the Arup memo (page 10).*

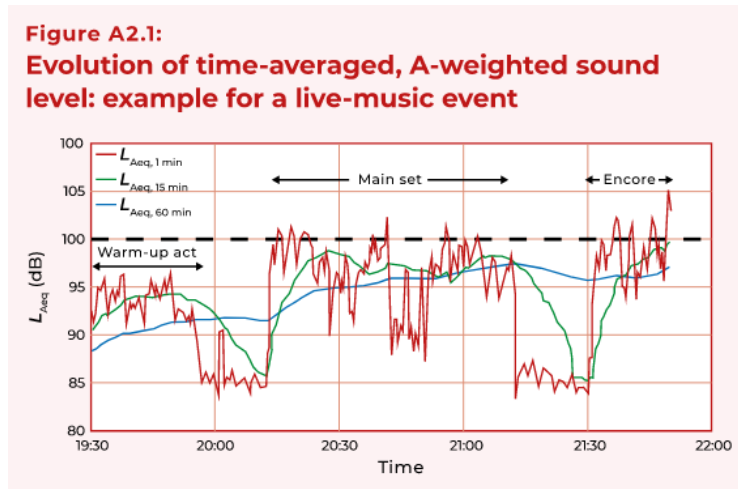
- **2.5 Community Concert Sound – Exceedance of Noise Regulations**

WJHW Response: *WJHW noted the average (L_{eq}) sound level in Wilmette exceeds the statutory requirement for individual noise sources. Arup agrees with this general statement (page 10). WJHW is not making any statement about individual noise sources exceeding the Wilmette noise ordinance; rather, we point out that the average sound level in the neighborhoods measured was in excess of the statutory limit of 45 dBA (evening/nighttime).*

- **2.6.1 Acoustic Metrics for Modeling of Concert Sound Levels – Concert Sound Modeling Source Sound Levels**

WJHW Response: *The reference to peak concert levels was to note that while the sound modelling is based on 101 dBA, the sound levels for the*

duration of a concert will not consistently be at 101 dBA. Figure A2.1: Evolution of time-averaged, A-weighted sound level: example for a live-music event from the WHO Global standard for safe listened venues and events, demonstrates how the sound levels can vary throughout the duration of a concert.



An example of the specific L_{eq} measurement could be a 15-minute L_{eq} maximum of 101 dBA (based on “Recommended Noise Control Procedure”, section 4.12 – Code of Practice on Environmental Noise Control at Concerts, The Noise Council). The specific L_{eq} measurement shall be agreed to and documented within the concert management plan.

Detailed Comments

Item 1	
Document	WJHW letter 1, Henderson Exhibit, pages 3 and 7
	Henderson Exhibit Tables 1 and 4 include weather conditions during the gameday and non-gameday measurements, based on an internet source. The tabulated "Max Wind Speed" for 5 out of 7 measurements periods is greater than typical 12 mph maximum speed recommended in measurement procedure standards ^{13,14} . The Henderson exhibit states "Overall, weather had negligible effects on the measurements."
Arup Comment	Provide explanation and additional observations to support the statement that weather conditions had negligible effect on measurements.
WJHW Response	The max wind speed included in the report was the maximum for the day and was not the continuous wind speed. Measured sound levels exceeded the wind induced noise levels reported utilizing the Larson Davis Model EPS2116 Outdoor Microphone Protection, therefore wind was assumed to have a negligible effect. Link to Larson Davis information follows. https://www.larsondavis.com/docs/librariesprovider2/datasheets/ld-eps2116-outdoor-noise-monitoring-microphone-protection-ds-0240.pdf?sfvrsn=c2e4e3c5_18 . Additional wind speed and gust information can be accessed from www.wunderground.com for additional context, however, these measurements are not at the specific meter locations.
Arup Response	Consensus standards call for measurement and documentation of wind speeds at measurement locations.
WJHW Response	No additional comment.
Item 6	
Document	WJHW letter 1, Henderson Exhibit, pages 4-5
	Only one gameday measurement (30-120 seconds in duration) was conducted in Wilmette. Results for gameday measurements are presented as an aggregate range with no results at individual receptors presented.
Arup Comment	Provide a supplementary gameday activity sound survey which includes additional neighborhoods to provide better representation of impacted areas. Include measurement results for each receiver location.
WJHW Response	Measurements were conducted in neighborhoods with close proximity to the stadium and are representative of those areas which may have the greatest impact from stadium activities.
Arup Response	Requested information not provided.
WJHW Response	Additional information was not provided as the completed measurements capture the highest sound levels due to their proximity to the stadium. As stated previously in our report, sound levels will continue to dissipate when moving away from the stadium, factoring in the impact of other structures, distance, directivity, and other factors.

Item 7	
Document	WJHW letters, pages 2-3
	The comparison of gameday vs. non-gameday activity sound in neighborhoods is based on a mix of different receivers and mix of long-term and short term (60-120 second acquisitions) and comparing broad ranges over multiple receivers.
Arup Comment	To quantify community sound levels due to gameday activities and compare to typical ambient (non- gameday) metrics, measurements of similar duration (longer than the 30-120s duration measurements measured by Henderson), time-of-day, and location could provide a more clear and meaningful comparison. Comparisons should be documented at each position rather than presenting overall aggregate range across all receivers.
WJHW Response	Figures 1 (page 3) and 2 (page 4) show long term measured sound levels during gameday and non-gameday weekends. Measurements are at the same location, have the same time period, and indicate sound levels across the entirety of the day (daytime and nighttime). Gameday and neighborhood noise studies utilized different locations. Studies occurred at different times during the year, but both occurred over the weekend.
Arup Response	Requested information not provided.
WJHW Response	No additional comment.

Item 8	
Document	WJHW letters, page 3
	WJHW compares surveyed gameday activity sound levels with ambient Leq dBA levels. Figures 1 and 2 also show logged LA90 levels, though these are not referenced or discussed in WJHW's analysis.
Arup Comment	For neighborhoods with intermittent traffic, measured L90 sound levels are a more appropriate representation of the ambient sound conditions. The L90 levels should also be compared against gameday activity sound levels when considering noise impact.
WJHW Response	L90 is the lower limit of the ambient sound level and sets an unrealistic expectation for the fluctuating nature of ambient sound. A full 90% of the sound experienced is above the limit set by L90. Leq is the standard statutory representation of measured sound level in community noise standards, including the State of Illinois.
Arup Response	See detailed response in §2.3.1.
WJHW Response	See response to §2.3.1 in General Comments.

Item 9	
Document	WJHW letters, pages 3-4
	A description of new stadium design elements is included and is argued that the new build design elements will "be helpful in reducing sound...". There is not sufficient analysis or modeling to demonstrate the gameday sound impact of the new stadium design and the outcomes of each individual and/or combination of elements. There is also no description of the proposed "canopy" with information about the design parameters (e.g. materiality, extent of coverage, etc.).
Arup Comment	Provide additional analysis each of these design elements can offer individually and collectively to clearly illustrate a more quantifiable estimate of outcomes related to sound levels in the surrounding communities. Clarify which of the listed elements (canopy, barriers, absorptive material, etc.) will be included in the stadium design.
Item 9 (revision A)	
Updated Document	WJHW letter 3, pages 5-6
	An additional description has been included (#3, page 6) that describes enclosures and walls around the seating bowl using vertical barriers. It is unclear if this is only a descriptor of elements that had already been included in analysis presented later in the document or a new/updated element of the design that has been incorporated in updated analysis.
Arup Comment	Provide additional analysis each of these design elements can offer individually and collectively to clearly illustrate a more quantifiable estimate of outcomes related to sound levels in the surrounding communities. Clarify which of the listed elements (canopy, barriers, absorptive material, etc.) will be included in the stadium design. Clarify if item #3 – enclosures and walls around the seating bowl – had previously been included in the presented 3D acoustic / electroacoustic modeled results.
WJHW Response	Comparing the individual contribution of each noise isolation element is unnecessary. It is the collective result of all noise mitigation elements which is relevant to the community. The noise mitigation outline in the report (pages 5, 10, and 14) are included in the modelling and the results are representative of the community noise levels anticipated with these items included in the design. Enclosures and walls around the seating bowl have remained consistent throughout the modeling exercise.
Arup Response	Requested information not provided. See comments in §2.2.
WJHW Response	See response to §2.2 in General Comments.

Item 10	
Document	WJHW letters, pages 2-3
	Surveyed gameday sound levels are compared with ambient Leq dBA levels. Figures 1 and 2 also show logged L90 dBA levels, though these are not referenced or discussed in the narrative.
Arup Comment	For neighborhoods with intermittent traffic, measured L90 percentile levels are a more appropriate representation of the ambient sound conditions perceived by residents. The L90 levels should also be compared against gameday sound levels when considering noise impact.
WJHW Response	L90 is the lower limit of the ambient sound level and sets an unrealistic expectation for the fluctuating nature of ambient sound. A full 90% of the sound experienced is above the limit set by L90. Leq is the standard statutory representation of measured sound level in community noise standards, including the State of Illinois.
Arup Response	See detailed response in §2.3.1.
WJHW Response	See response to §2.3.1 in General Comments.

Item 11	
Document	WJHW letters, page 3
	A distributed sound system is described as an element that will be included in the design. The benefits cited with regards to community noise are not unreasonable but are not quantified. No clear statement is made about the use of this system for other events (e.g. concerts).
Arup Comment	Provide analysis that illustrates the benefits of the distributed sound system for gameday community noise. Clarify if this distributed sound system will be used for other events. In our experience, a distributed sound system is likely not viable for large concert sound reinforcement.
WJHW Response	Regarding the concert experience using the distributed system, WJHW's experience shows this can be used - though, often they are not. Should a distributed system be used during a concert, it would be used as fill (as in, filling in the gaps that the stage/main system does not cover). The primary/directional sound would still come from the stage. WJHW has seen house sound systems used in conjunction with the touring rig, specifically in AT&T Stadium (Dallas) and US Bank (Minneapolis).
Arup Response	Requested information not provided. See general comments in §2.2.
WJHW Response	See response to §2.2 in General Comments.

Item 12	
Document	<p>WJHW letters page 4</p> <p>The letter states "We would expect that these design features, combined with lower capacity, will ultimately result in less sound exposure to the residential properties surrounding the stadium compared to the current experience."</p> <p>The argument that lower stadium capacity will not necessarily result in less sound exposure is not correlated with sound level measurements or modeled results. We note that the listed game attendance during the weekend surveyed by Henderson was recorded as 32,123. (https://nusports.com/sports/football/stats/2022/wisconsin/boxscore/19987) which is slightly below the maximum game capacity of the new stadium design of 35,000.</p>
Arup Comment	Statements of sound exposure based on lower stadium capacity design should be made in the context of actual crowd sizes of Ryan Field games in recent years.
WJHW Response	This is a general reference for stadium size (i.e. capacity). WJHW stands by the comment that the design features will result in less sound exposure to the community. The stadium design features provide improvement in noise reduction to the community – regardless of crowd size – as they provide additional barriers to sound transmission. The existing, on grade stadium is essentially wide open. The proposed new stadium includes numerous barriers around the perimeter of the seating bowl, is partially below grade and will have a canopy to limit sound transmission.
Arup Response	Our comment was specifically on the effect of lower stadium capacity contributing to reducing sound exposure, not other design features.
WJHW Response	No additional comment.

Item 13	
Document	<p>WJHW letters, pages 4-7</p> <p>Details on input data or methodology for the 3D acoustic / electroacoustic modeled concert sound predictions are not provided. Relevant details include:</p> <ul style="list-style-type: none"> • Stadium reference design (only 2D plan view shown) • Sound system design and configuration • Frequency spectrum of sound source levels (only overall dBA level at sound mix position is presented). Assumed frequency spectrum has a significant impact on audibility and disturbance in neighborhoods (e.g. whether a reasonable pop/rock, dance/EDM, r&b/hip hop, or other musical genre spectrums are considered) • Modeling standards used (user options within the modeling software). For example, is the 3D acoustic / electroacoustic model based on Cadna's implementation of ISO 9613? Is full 3D sound diffraction implemented? What ground effects are assumed? Does it account for meteorological (atmospheric) effects?
Arup Comment	Provide 3D acoustic / electroacoustic modeling input data and details listed above.

Item 13 (revision A)	
Updated Document	<p>WJHW letter 3, pages 6-7</p> <p>Additional details are provided on input data and methodology for the 3D acoustic / electroacoustic modeled concert sound predictions including:</p> <ul style="list-style-type: none"> • The 3D acoustic / electroacoustic model is based on Cadna's implementation of ISO 9613. It is noted that 'adverse wind conditions in all directions related to the sound source per ISO 9613' have been included. Other environmental factors (e.g. air temperature, humidity, temperature inversions, etc.) have not been included in the model. Have other standards been considered for implementation in the model? • The amplified sound source is noted to be a 'pop music' frequency spectrum. No details of the frequency spectrum are provided in relation to the sound levels set at the sound board location. • Use of a line array sound system is noted as the amplified sound source positioned at 56 ft above the field. Further details of the sound system design and configuration are not provided – just a photograph of an example of a line array loudspeaker – nor any details how Cadna incorporates a amplified sound system into its modeling input. <p>While these details clarify portions of our previous comments, further clarifications would help evaluate the results and conclusions and what limitations of the 3D acoustic / electroacoustic remain.</p>
Arup Comment	Provide additional 3D acoustic / electroacoustic modeling input data and details listed above.
WJHW Response	<p>Stadium is based on the architectural model. Sound system design is based on a generic touring concert sound system and specific inputs are indicated on page 7 of the report. Frequency spectrum is based on a typical pop music concert spectrum. Modeling standards include:</p> <ul style="list-style-type: none"> • Frequency spectrum utilized was from a previously measured rock concert. • Industry Standard: ISO 9613 • Meteorology was not accounted for in calculations. • Ground absorption was not accounted for in calculations. • Lateral Diffraction Setting: some Obj <p>This modelling approach was intentionally conservative as it does not include any event attendees (empty seats included in the model), trees and additional landscaping which will further assist in the attenuation of sound.</p>
Arup Response	<p>Requested detailed information not provided. Also see §2.6 regarding clarification of concert sound level input metric. Additionally, ISO 9613-2 states that "foliage of trees and shrubs provides a small amount of attenuation, but only if it is sufficiently dense to completely block the view along the propagation path, i.e. when it is impossible to see a short distance through the foliage." Provide further information to quantify the reduction from foliage including areas in the model that are "sufficiently dense" to use this mitigating factor in the analysis.</p>
WJHW Response	<p>As previously stated, the modelling does not account for landscaping. Due to the maturity of trees in the surrounding area, as well as the time of year which concerts would be held, trees will assist with the attenuation of sound.</p>

Item 14	
Document	WJHW letter 2, pages 5-7
	Concert sound prediction maps are included for two scenarios: A baseline design and a design "with Additional Sound Mitigation" (figures 3-6). While WJHW's narrative describes various noise mitigation options in general, details of noise mitigation design included in Henderson's "Additional Sound Mitigation" scenario are not presented.
Arup Comment	Provide design details for "mitigated scenario" to clarify what each of these design elements can offer individually and collectively. Clarify which of the listed elements will be included in the stadium design to clearly illustrate a more quantifiable estimate of outcomes related to noise.
WJHW Response	The mitigated scenario is the result of closing in locations of the north elevation openings. As the design of the structure continues to evolve, the University is committed to finalizing the investigation of mitigation options which will provide the most benefit to the surrounding community.
Arup Response	No additional information has been provided to address the comment.
WJHW Response	There are currently 18 possible mitigation options being analyzed and the University is committed to selecting one or more options with a minimum 20 dBA reduction. The reason that the specific measure is not available at this time is requiring full construction drawings in order to finalize the strategy, which is premature at this point in the process.

Item 15	
Document	WJHW letter 2, pages 5-7
	Concert sound predictions are presented as broadband dBA and dBC results only. No frequency band results, or indication of low-frequency results are provided.
Arup Comment	Consider frequency spectrum of predictions results, especially low-frequency (125Hz and below) impact.
WJHW Response	dBA is the standard to which most municipalities determine acceptability of community noise, including the Village of Wilmette and the State of Illinois. Low frequency sound impact is represented by dBC and was included in the report at the request of the City of Evanston.
Arup Response	No additional information has been provided to address the comment.
WJHW Response	Reference response above. Model images of the dBA and dBC contour maps have been provided to represent noise from concert events.

Item 16	
Document	WJHW letters, pages 8-10
	The specific nature of concert sound compared to typical or existing ambient sound sources in the environment are not addressed. Amplified concerts typically contain prevalent low-frequency (bass) energy that is often rhythmic. Characterizing concert sound in terms of single broadband dBA sound levels is not sufficient, and sound pressure levels at lower frequencies should be specifically considered. Considerations appropriate for an impact assessment are referenced in environmental noise survey standards, and there is precedent in other noise codes, agreements, and guidance documents.
Arup Comment	Provide a noise impact study that contains specific consideration of characteristics of concert music sounds compared to other existing ambient sound in the community.
WJHW Response	Model images of the dBA and dBC contour maps have been provided to represent noise from concert events.
Arup Response	Requested design details have not been provided.
WJHW Response	Reference response above.

Item 17	
Document	WJHW letters, pages 5-6
	An argument is made for the shielding effect of Northwestern University buildings to the North as partial justification of North-facing orientation of sound system. However, building shielding appears to benefit a small percentage of Wilmette residential land area as demonstrated in Henderson's 3D acoustic / electroacoustic modeling output.
Arup Comment	Provide further clarification on the level of benefit shielding is providing for community noise from concert events.
Item 17 (revision A)	
Updated Document	WJHW letter 3, page 9
	An argument is made that alternative stage locations do not realize the sound reduction benefits of the building barrier effect of structures to the North of Ryan Field in comparison to those to the South. However, 3D acoustic / electroacoustic modeling is not presented to qualify this conclusion and provide numerical and statistical comparison of the predicted sound levels and the population affected.
Arup Comment	Provide further clarification on the level of benefit shielding is providing for community noise from concert events.
WJHW Response	The benefit of shielding from the University buildings is noted in the report on page 9. In addition to the shielding effect of the buildings to the north, reference Appendix C North Stage Analysis for additional factors which warrant the final stage orientation.
Arup Response	No additional information has been provided to address the comment.
WJHW Response	Reference response above.

Item 18	
Document	WJHW letters, page 6
	<p>An argument is made that the effects of including structures beyond the Northwestern University property (not included in Henderson's 3D acoustic / electroacoustic model) would result in lower noise levels: "...would limit how far into the residential area sound travels before it reaches ambient levels. The sound levels in the residential community will be lower than at the property line, when factoring in the impact of other structures, distance, directivity, and other factors."</p> <p>There is no analysis or estimate of the difference or at what distance the sound is estimated to be attenuated to ambient (or code required) levels. Buildings also reflect sound and may cause local increases in sound level. Meteorological effects, depending on weather conditions, can result in less attenuation with distance.</p>
Arup Comment	Additional enhancements to the 3D acoustic / electroacoustic model to include residential structures and meteorological conditions should be included to analyze and accurately quantify the predicted sound attenuation with distance.
Item 18 (revision A)	
Updated Document	WJHW letter 3, page 9
	<p>The updated figures illustrate sound levels that differ from previous results, but no discussion is provided why there may be differences. Reviewing the mitigated option (figure 7), items of note include:</p> <ul style="list-style-type: none"> • Sound levels at various properties to the north have increased from 80 dBC in previous results to 85 dBC • Sound levels to the north within the residential areas are 75 dBC – 80 dBC along the south facing portion of the property. The north side of the property appears to benefit from some 'sound shadowing' with levels typically at 70 dBC or 5 dBC lower than the south portion of the property. <p>No discussion is provided on the effects of the meteorological conditions included, what effects additional meteorological conditions may have which have not been modeled, or a statistical analysis of sound levels from the updated model results with the residential structures included.</p>
Arup Comment	Additional enhancements to the 3D acoustic / electroacoustic model to include meteorological conditions should be included to analyze and accurately quantify the predicted sound attenuation with distance in varying conditions. Statistical analysis of the sound levels with/without the inclusion of the 3D modeled structures should be provided to evaluate the outcomes of their inclusion in the 3D acoustic / electroacoustic model.
WJHW Response	Additional residential and community buildings were included in the model per a previous response. Weather conditions can vary substantially - day to day, time of year, and even over an evening. While these conditions can impact sound transmission, the sheer number of combinations would be impossible to model. At this time, ISO 9613 has been used as the baseline as this is the industry standard to utilize when modelling anticipated sound levels.

Arup Response	No additional analysis of meteorological conditions has been provided. Inversions are common in evening hours, which may result in less sound attenuation at intermediate distances than would be predicted using ISO 9613 methodology.
WJHW Response	Reference response above.

Item 22

Document	WJHW letters, pages 9-10 Recommendations for concert sound mitigation include limiting sound levels by implementing sound level limits, noise level monitoring, and limiting hours of concerts. No specific limits are proposed or details of concert event management approaches for activities such as soundcheck, event start, curfew times, and teardown.
Arup Comment	The concert sound mitigation strategies should be developed in more detail and assessed in terms of both feasibility and effectiveness including event management approaches.
WJHW Response	<p>The report describes noise mitigation elements starting on page 5; notably there are multiple permanent items included in the stadium design that are intended to lower community sound levels for football games and other events, in comparison with the existing stadium, including:</p> <ul style="list-style-type: none"> • The event level/field being set 20+ ft below grade which reduces total building openings through which sound can escape to the community. • A distributed house sound system within the seating bowl which reduces sound output of the house system compared to the current end zone cluster. • A canopy above the seating areas provides adequate sound reduction characteristics and reduces the bowl opening through which sound can transmit to the community. • Enclosures and walls around the seating bowl that further reduces openings in the building and reduces sound emissions to the community. <p>Temporary sound mitigation strategies focusing on the northwest corner of the stadium are being analyzed, including sound curtains and moveable partitions which will have a minimum sound reduction performance of 20 dBA. In addition to the permanent architectural elements and temporary measures noted above, multiple operational parameters have been proposed such as:</p> <ul style="list-style-type: none"> • Ending concerts at 10:00 pm Sunday – Thursday and 10:15 pm Friday – Saturday notwithstanding local ordinances allowing sound until 11:00 on weekend evenings. • Installation of sound monitoring devices in and/or around the stadium. <p>Limiting maximum sound levels at the sound board.</p>
Arup Response	No additional information has been provided to address the comment. See general comments §2.2.
WJHW Response	See response to §2.2 in General Comments.

Item 23	
Document	<p>WJHW letter 2, pages 5-7</p> <p>Concert sound prediction maps are included for two scenarios: A baseline design and a design "with Additional Sound Mitigation" (figures 3-6).</p>
Updated Document	WJHW letter 3, pages 8-12
	<p>Concert sound prediction maps are included for two scenarios: A baseline design and a design "with Additional Sound Mitigation" (figures 4-7). 3D modelled structures beyond the property line of Northwestern University two to three blocks away have been included. However, no information on the source and currency of the 3D GIS data is noted. A different false color scale step is used in these figures which makes it difficult to compare to the previously published results.</p>
Arup Comment	<p>Provide details for 3D GIS information used. Provide figures with false color map scales equivalent to the previous presented figures (or update previous figures) to allow for direct comparison between modeled results.</p>
WJHW Response	<p>Structures beyond the University's property line were modelled to the following boundaries: Maple Avenue (North), Bryant Avenue (East), Lincoln Street (South) and Broadway Avenue (West). dBA and dBC scale was adjusted to focus on the levels encountered in the model in an effort to minimize confusion caused by the use of similar colors on the previous scale. dBA and dBC data shown in the modeling images can be directly compared as the only adjustment between the two reports was to include the structures outside of the University's property line to the extents noted above.</p>
Arup Response	Requested information has not been provided.
WJHW Response	Additional information is not warranted as the data shown in the current modeling images can be directly compared to the older modeling images.

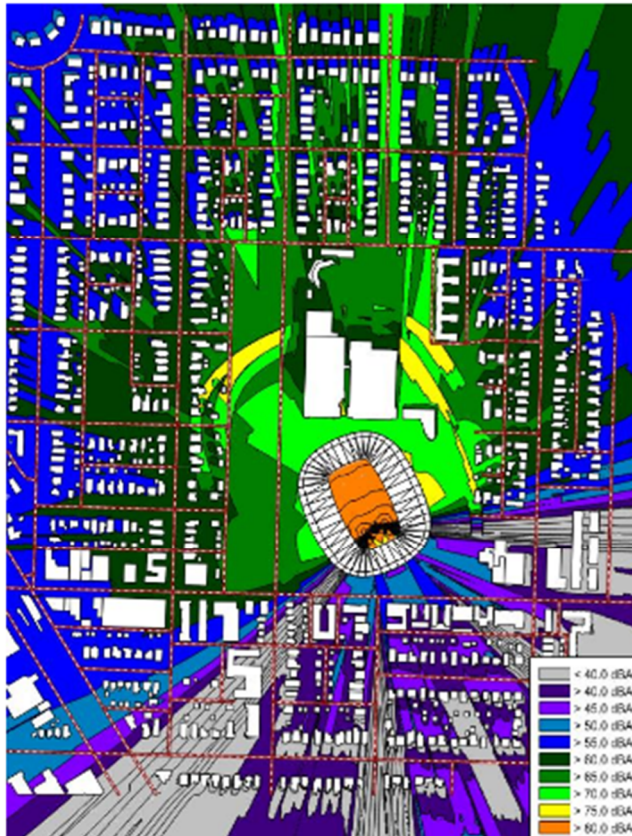
Response to Public Testimony of Mr. Steven Harper

The following are responses to public testimony presented at the Land Use Commission meeting on September 27, 2023, by Mr. Steven Harper.

- Mr. Harper's contention that the sound mitigation elements described for the acoustic model "may never make it into the stadium" is inaccurate. The acoustic model is based on the construction documents for the stadium and are representative of the architectural design. Regarding the temporary noise mitigation, Northwestern concedes this is still under review, but the noise mitigation requirements are set: 20 dB noise reduction. The issue is not that the temporary mitigation measures may or may not be included – to be clear, this mitigation is part of the stadium design – it is that the integration into the current design is complicated and requires thoughtful consideration to ensure it meets acoustical as well as architectural and structural requirements.

- The map Mr. Harper references is the “unmitigated” sound contour map (Figure 4, WJHW report dated August 2, 2023). The appropriate contour map is Figure 6 which shows the sound contours with the temporary (additional) sound mitigation. This map shows a clear improvement of sound transmission to the north and northwest of the stadium with lower sound impact on the residential properties.

Figure 6: Concert Environmental Assessment Results with Additional Sound Mitigation (dBA)



- It is not uncommon to enforce sound levels based on interior and exterior sound monitoring and is supported by the recommendations of The Noise Council (Code of Practice on Environmental Noise Control at Concerts). An excerpt includes:

Before the Event

4.8 Carry out a sound test prior to each event to ascertain the maximum level that can prevail at the monitoring position to enable the guidelines to be met. This effectively calibrates the system, taking into account as far as possible prevailing weather conditions, and, for indoor concerts, the sound insulation of the venue.

This document was referenced by Arup in their comments regarding the WJHW report of August 2, 2023. It is often necessary to conduct real world measurements of sound to ensure the

predicted results are relevant, especially when varying meteorological conditions may influence the subjective perception of sound.

- Mr. Harper also lists five errors in the Henderson concert analysis.
 1. Volume – Mr. Harper suggests the sound levels used in the model (i.e. 101 dBA) may be too low and that levels of 110 or 120 dBA could occur. Northwestern has stated 101 dBA is the agreed upon level not to exceed at the front of house mix position. His suggestion that the sound engineer would increase the sound levels inside the stadium to 110 to 120 dBA and would be excessively loud – likely painful for the attendees – and is well beyond the normal operations of concert sound systems.
 2. Type of Noise – Mr. Harper states that the Henderson analysis did not include the low frequency sound levels in our report. Figures 5 and 7 (WJHW report dated August 2, 2023) are exactly those dBC values he says are required for analysis. Further, Mr. Harper states that “citation after citation after citation of the health problems associated with noise and noise pollution.” As noted at the beginning of this report, the physiological effects of sound are related to high noise levels (greater than those predicted by the Henderson model) and for long durations (much longer than the 3-hour concerts proposed at Ryan Field). Mr. Harper states that the sound emanating from the concerts would limit the outdoor enjoyment of homes, forcing people to be inside. This is subjective as community members may enjoy this aspect.
 3. Other Concert Related Noise – Mr. Harper contends the noise from load in and load out activities will create significant noise impact. As previously stated by Northwestern’s expert, the noise from these activities are expected to be minimal as all unloading, loading, setup and takedown will occur below grade and within the stadium structure itself.
 4. Outdoor Events – Mr. Harper claims events held in Welsh Ryan Arena have been ignored and that additional festivals are not accounted for. As stated previously, festivals could include a concert event as part of the overall festival activities. Please reference the proposed terms of the text amendment.
 5. Impact on Neighborhood – Mr. Harper states WJHW has claimed concert sound levels shouldn’t be a problem for residents. WJHW’s has stated similar noise levels already exist in the neighborhoods due to football games. This is not an argument regarding duration, level of annoyance, or otherwise. It is a reminder that these noise levels currently exist in the neighborhoods.

We appreciate the opportunity to provide the above responses to the comments and concerns raised by Arup and the community.

Regards,



Greg Hughes
Principal