TECHNICAL MEMORANDUM

TO: Beth Bartz, Senior Associate

FROM: Thomas Hillstrom, Associate
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DATE: July 30, 2004

SUBJECT: St. Croix River Crossing Technical Memorandum – Noise on the River

Following is the noise on the river study that was conducted in 2000 for the St. Croix River Crossing SDEIS (January 2001) that was never published. The modeling was performed for the 2001 Consensus Alternative, the river crossing studied at that time; however, the methodology developed remains valid and was used in the noise on the river modeling for the 2004 SDEIS.

1.0 INTRODUCTION

This memorandum was prepared to document the methods and results of an assessment of future (2020) noise on the river surface that would be generated by vehicles traveling on the proposed St. Croix River Crossing and the existing Stillwater Lift Bridge. The results of this study were incorporated into the Supplemental Draft EIS prepared to identify all the impacts of the proposed alternatives for the river crossing.

1.1 REGULATORY AUTHORITY

The Lower St. Croix National Scenic Riverway is managed cooperatively by the National Park Service (NPS) and various state and local agencies. Section 7(a) of the Wild and Scenic Rivers Act establishes the NPS as the agency responsible for evaluating water resource projects proposed on the Lower St. Croix River. In evaluating the impacts of the proposed St. Croix River Crossing, the primary concern of the NPS is the potential impact of the proposed project on the outstanding values for which the Lower St. Croix was designated as a wild and scenic river, specifically, the river's scenic, recreational, and geological values.

For purposes of this assessment, the St. Croix River is considered a park, which falls under Noise Area Classification (NAC) 1. Both Minnesota standards and federal noise abatement criteria for parks are 70 dBA (L_{10}). Wisconsin noise abatement criteria for parks is 67 decibels (L_{eq}).

Currently, the noise-modeling computer program approved for use by Mn/DOT and Wis/DOT is the STAMINA 2.0 computer model developed by the Federal Highway Administration (FHWA) for use in estimating traffic-generated noise. This noise model includes a mechanism to model noise from bridges. The effect of sound energy transmitted through the bridge deck was represented in the model by the addition of imaginary traffic lanes at the bridge deck. The additional traffic volumes were based on a comparative study of existing sound levels measured under the I-94 bridge (Hudson Bridge) over the St. Croix River, approximately 11 kilometers (7 miles) downstream of Stillwater. The following sections of this document describe noise modeling methods and the background studies (The Hudson Bridge Study and the Stillwater Lift Bridge sound level measurements) performed to develop input data for the model, and the results of the sound level modeling study for the proposed bridge (noise impacts on the river).

1.2 HUDSON BRIDGE STUDY

The purpose of the Hudson Bridge Study was to determine whether an empirical relationship between the sound transmitted through the deck of a bridge and the airborne (traffic) noise could be found. The study resulted in an estimate of the energy ratio between the transmitted sound and the traffic noise emitted directly into the air on top of the bridge.

The study is based on simultaneous measurements of sound levels at six locations selected to approximate human activity locations on and near the St. Croix River. The reference location site was adjacent to the I–94 roadway and bridge deck on the Wisconsin approach, and was compared to five river level locations. The river level locations were: approximately 24 meters (80 feet) directly below the bridge centerline on the Minnesota riverbank; and four more river level locations on the Minnesota riverbank—one directly below the bridge edge railing, and three at increasing distances north of the rail location—30, 61 and 122 meters (100, 200 and 400 feet) north of the bridge.

The sound level measured at the I-94 roadway bridge deck was used as a reference level of airborne sound from traffic travelling on the bridge. Airborne sound from atop the bridge was assumed to be negligible compared to sound transmitted through the bridge deck. Sound levels measured directly below the bridge were used as a measure of sound transmitted through the bridge deck. The ratio of the sound energy of these two sound levels was considered to be equal to the percentage of sound transmitted through the bridge deck. Sound levels measured away from the bridge were not used in calculations, but were compared to modeled sound levels projected to result from traffic on the proposed bridge.

Traffic passing over several joints and spalled out portions of the Hudson Bridge deck caused short, audible sound peaks during measurement runs above and below the bridge. These short sound peaks would be likely to influence the L_{10} and L_{eq} sound levels more so than the L_{50} sound level. As the joint noise could be unique in many respects to this specific bridge alone, and therefore extraneous to this study, the L_{50} levels were used in determining energy ratios.

A table showing measured sound levels at the Hudson Bridge is presented below.

TABLE 1
HUDSON BRIDGE SOUND LEVEL MEASUREMENTS

Location	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Average
	L_{50}	L_{50}	L_{50}	L_{50}	L_{50}	L_{50}	
Reference (top of Bridge)	74.5	76.5	75	73.5	75.5	73.5	74.8
Below Center Line	66.5	68	67	67.5	67.5	67.5	67.3
Below Rail	66.5	68	67	67.5	67.5	67	67.3
30 meters (100 feet) north at river bank	62	63	61.5	62.5	62.5	62.5	62.3
61 meters (200 feet) north at river bank	60	61	59.5	60	60.5	60	60.2
122 meters (400 feet) north at river bank	58.5	59	57	58	59	58	58.3

The difference between the measured L_{50} levels, above and below the bridge, were used to calculate energy ratios of bridge deck-transmitted sound energy to airborne sound energy. These ratios were averaged. The range of ratio values, within which the true expected energy ratio would be found with a probability of approximately 96 percent, was from 12 percent to 33 percent. The most conservative (high) value was used in the analysis of noise impacts resulting from the Consensus Alternative.

1.3 STILLWATER LIFT BRIDGE MONITORING

To assess the affected environment (existing sound levels on the river) and to develop a set of data for comparison with the Hudson Bridge Study and the Consensus Alternative river noise analysis, sound levels were measured at the Lift Bridge. Sound monitoring at the Lift Bridge was conducted during the morning rush hour on November 5, 1999. Sound levels were simultaneously measured at various distances (15, 30, 61 and 122 meters or 50, 100, 200 and 400 feet) south of the bridge at the riverfront sidewalk. Sound levels were recorded for two half-hour periods.

Results of the sound level monitoring are presented below and were used to create the sound contours presented on Figure 1.

TABLE 2
STILLWATER LIFT BRIDGE NOISE MONITORING 11/5/99

	Distance from Bridge Centerline *			
Run 1 (7:00-7:30 a.m.)	**15 meters (50 feet)**	**30 meters (100 feet)**	**61 meters (200 feet)**	**122 meters (400 feet)**
L_{10} dBA	64	64	63.5	61
L_{50} dBA	60	60	59.5	56.5
Run 2 (7:30-8:00 a.m.)	**15 meters (50 feet)**	**30 meters (100 feet)**	**61 meters (200 feet)**	**122 meters (400 feet)**
L_{10} dBA	62.5	62	61.5	59.5
L_{50} dBA	59	59	58.5	55.5

* Monitoring locations are on the riverfront sidewalk southwest of the lift bridge.

1.4 PROPOSED STILLWATER BRIDGE MODELING

Sound levels on the river that would result from the Consensus Alternative Bridge of the St. Croix River were modeled using the STAMINA 2.0 computer software modified to account for sound energy transmitted through the bridge deck. To account for sound energy transmitted through the bridge deck, additional traffic lanes were coded into the model along the bridge deck. Based on the Hudson Bridge study, traffic volumes coded in these “imaginary” additional lanes were 33 percent of the volume of the traffic on the bridge. While the bridge deck was coded as a barrier into the model for the “normal” traffic on the bridge, no such barrier was coded for the “imaginary lanes.

The traffic mix data (percent of trucks) used in the noise modeling was two percent medium trucks and one percent heavy trucks. This truck percentage was assumed for the model based on regional average traffic mix data. Sound characteristics of the proposed bridge were assumed to be the same or similar to the Hudson Bridge, a concrete and steel highway bridge over the St. Croix River similar in size to the Consensus Alternative bridge. No effort was made to characterize sound characteristics of different types of bridges or materials used to construct the bridges.

Modeling results were used to create contours of sound levels at river level (contours are shown on Figure 2). The sound level contours show a zone below the bridge and extending approximately 35 to 50 meters (115 to 164 feet) from the bridge centerline, where sound levels would be 70 decibels (L_{10}) or greater. Predicted sound levels would be 65 decibels or greater within 120 to 145 meters (394 to 476 feet) of the bridge. The 60-decibel contour extends from 290 to 310 meters (951 to 1017 feet) up- and down-river from the bridge centerline. It should be noted that these sound levels were calculated using worst-case assumptions and, most of the time, actual sound levels would be lower.

2.0 CONCLUSIONS

Because of the lower speeds and fewer lanes of traffic, sound levels at the Lift Bridge are lower than those projected for the Consensus Alternative bridge. Peak sound levels near the Lift Bridge are currently below the 70-decibel criteria. They would probably not increase noticeably with the No-Build scenario because the bridge is already operating at capacity during peak traffic hours, and vehicle speeds would not be increased on the Lift Bridge. Sound levels from the existing bridge would decrease with the Consensus Alternative because it would be converted to a pedestrian bridge, which would eventually be eliminated when the existing Lift Bridge is removed.

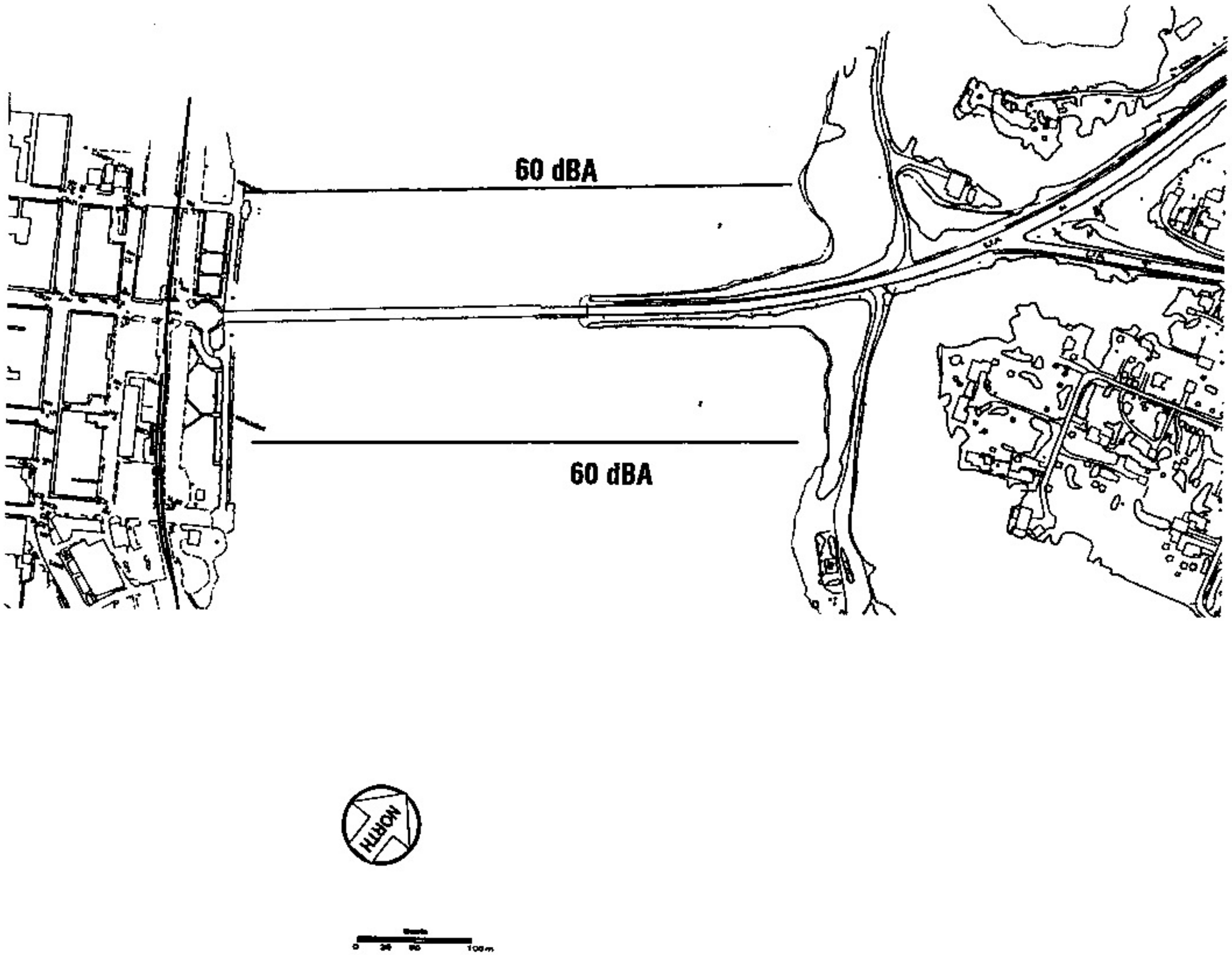
Peak traffic hour sound levels from the proposed Consensus Alternative bridge would exceed Federal noise standards (70 decibels) at river level directly below the bridge, and approximately 35 to 50 meters (115 to 164 feet) north and south of the bridge centerline. Sound levels would drop to less than 65 (L_{10}) decibels at a distance of approximately 150 meters (492 feet) from the bridge and below 60 decibels (L_{10}) at approximately 300 meters (984 feet) from the bridge.

3.0 MITIGATION OF NOISE IMPACTS

Mitigation of noise impacts through the installation of noise walls or other structures to block noise would negatively affect the visual appearance of the bridge as it relates to the St. Croix River Valley. Although no mitigation of noise impacts on water-based receptors is currently proposed, the removal of traffic from the Lift Bridge would reduce noise impacts on water-based receptors in the vicinity of the existing bridge.

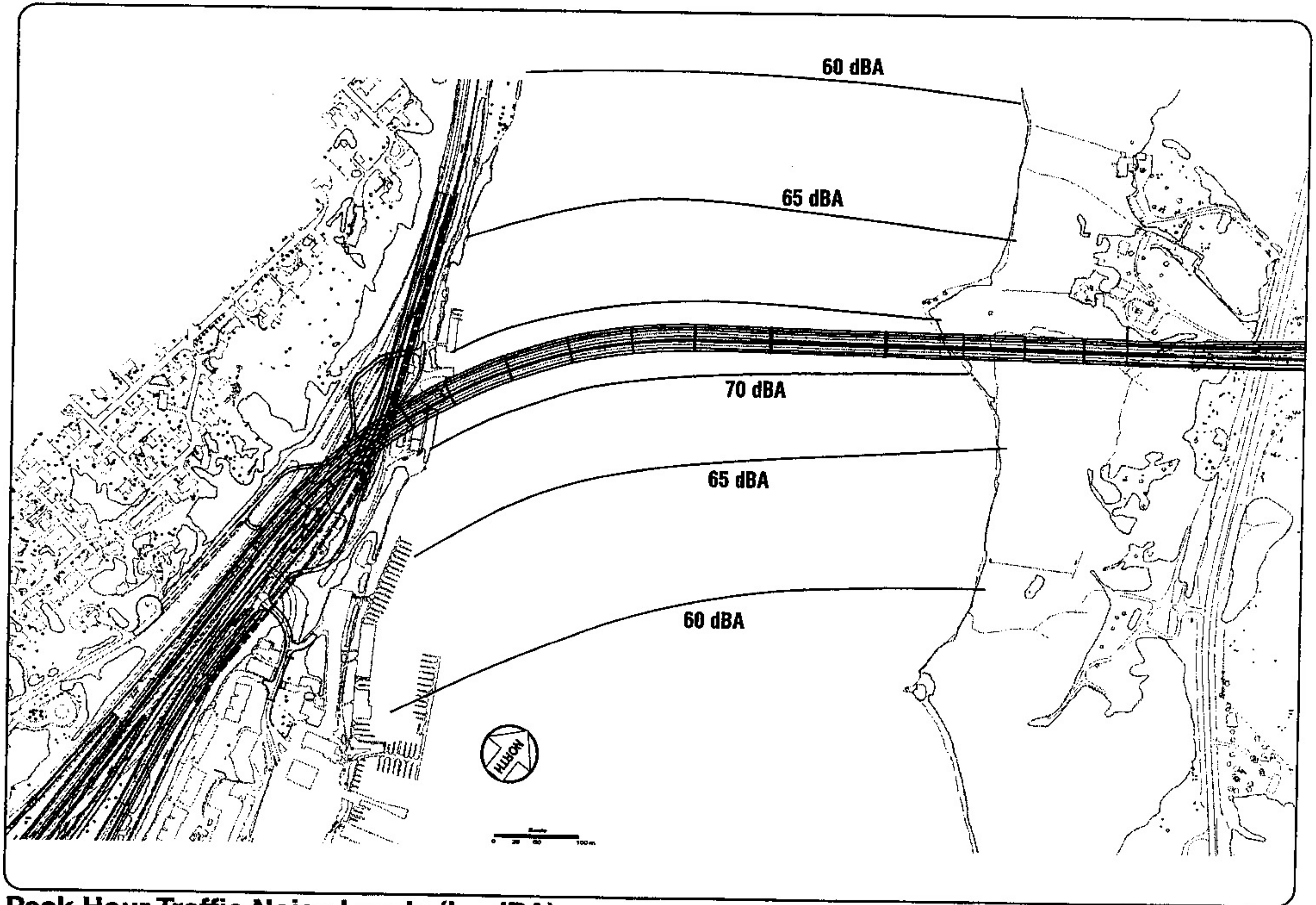
4.0 SUMMARY

Traffic-generated sound levels on the river would increase at the location of the proposed bridge. Peak-hour traffic sound levels would exceed federal noise standards directly below the proposed bridge and approximately 50 meters (164feet) to the north and south. The Preferred Alternative for recreation management on this section of river maintains existing opportunities for large numbers of people to engage in varieties of uses, including powerboats. The Consensus Alternative would include the removal of traffic from the Lift Bridge, which would reduce noise impacts on water-based receptors in the vicinity of the Lift Bridge.



Peak Hour Traffic Noise Levels (L_{10}-dBA)
Existing Noise Levels at River Surface

Figure 1



Peak Hour Traffic Noise Levels (L_{10}-dBA)

Year 2020 Noise Levels at River Surface - Consensus Alternative Bridge

Figure 2