

DETAILED NOISE IMPACT TABLE

The following table presents the results from the Detailed Noise Assessment for the Central Corridor Light Rail Project.

Segment	Receptor Location	Land Use Category	Distance to Track (ft)	Existing Noise Level (dBA)	Impact Criteria		Project Related Noise Level (dBA)	Total Noise Level (dBA)	Noise Level Increase Over Existing	Impact Level	Number of Impacted Units	
					Moderate	Severe					Moderate	Severe
Downtown St. Paul	300 E 4Th St, St. Paul	2	27	68	63	68	67	70	2	Moderate	28	0
	270 E 4Th St, St. Paul	2	29	68	63	68	67	71	3	Moderate	10	0
	275 E 4Th St, St. Paul	2	38	68	63	68	67	70	2	Moderate	35	0
	262 E 4Th St, St. Paul	2	30	68	63	68	65	70	2	Moderate	23	0
	172 E 4Th St, St. Paul	1	30	68	63	68	65	70	2	Moderate	1	0
	Total Number of Impacted Units in Downtown St. Paul											97
Midway East	259 W University Ave, St. Paul	2	64	66	61	67	64	68	2	Moderate	1	0
	302 W University Ave, St. Paul	2	59	66	61	67	65	68	2	Moderate	2	0
	315 W University Ave, St. Paul	2	66	66	61	67	64	68	2	Moderate	1	0
	312 W University Ave, St. Paul	2	60	66	61	67	65	68	2	Moderate	4	0
	341 W University Ave, St. Paul	2	61	66	61	67	64	68	2	Moderate	1	0
	344 W University Ave, St. Paul	2	69	66	61	67	64	68	2	Moderate	1	0
	347 W University Ave, St. Paul	2	62	66	61	67	64	66	0	Moderate	12	0
	365 W University Ave, St. Paul	2	69	66	61	67	66	69	3	Moderate	1	0
	377 W University Ave, St. Paul	2	64	66	61	67	64	68	2	Moderate	1	0
	377 W University Ave, St. Paul	2	63	66	61	67	64	68	2	Moderate	1	0
	389 W University Ave, St. Paul	2	73	66	61	67	64	68	2	Moderate	4	0
	393 W University Ave, St. Paul	2	75	66	61	67	66	69	3	Moderate	2	0
	397 W University Ave, St. Paul	2	75	66	61	67	66	69	3	Moderate	1	0
	421 W University Ave, St. Paul	2	64	66	61	67	64	68	2	Moderate	2	0
	425 W University Ave, St. Paul	2	63	66	61	67	64	68	2	Moderate	2	0

432 W University Ave, St. Paul	2	75	66	61	67	66	69	3	Moderate	1	0
438 W University Ave, St. Paul	2	75	66	61	67	66	69	3	Moderate	4	0
437 W University Ave, St. Paul	2	62	66	61	67	64	68	2	Moderate	2	0
446 W University Ave, St. Paul	2	62	66	61	67	64	68	2	Moderate	1	0
455 W University Ave, St. Paul	2	77	66	61	67	63	68	2	Moderate	1	0
474 W University Ave, St. Paul	2	60	66	61	67	64	68	2	Moderate	2	0
561 W University Ave, St. Paul	2	61	66	61	67	64	68	2	Moderate	2	0
591 W University Ave, St. Paul	2	63	66	61	67	64	68	2	Moderate	1	0
609 W University Ave, St. Paul	2	63	66	61	67	64	68	2	Moderate	4	0
625 W University Ave, St. Paul	2	63	66	61	67	64	68	2	Moderate	2	0
631 W University Ave, St. Paul	2	61	66	61	67	64	68	2	Moderate	1	0
633 W University Ave, St. Paul	2	60	66	61	67	64	68	2	Moderate	4	0
626 University Ave, St. Paul	2	63	66	61	67	64	68	2	Moderate	21	0
651 W University Ave, St. Paul	2	58	66	61	67	65	68	2	Moderate	3	0
681 W University Ave, St. Paul	2	82	66	61	67	66	69	3	Moderate	1	0
705 Aurora Ave, St. Paul	2	246	66	61	67	65	68	2	Moderate	0	0
711 Aurora Ave, St. Paul	2	253	66	61	67	58	67	1	Moderate	1	0
713 Aurora Ave, St. Paul	2	256	66	61	67	66	69	3	Moderate	1	0
709 W University Ave, St. Paul	3	98	66	66	72	70	71	5	Moderate	1	0
719 Aurora Ave, St. Paul	2	254	66	61	67	66	69	3	Moderate	1	0
721 Aurora Ave, St. Paul	2	251	66	61	67	66	69	3	Moderate	1	0
729 Aurora Ave, St. Paul	2	251	66	61	67	66	69	3	Moderate	2	0
731 Aurora Ave, St. Paul	2	252	66	61	67	66	69	3	Moderate	1	0
733 Aurora Ave, St. Paul	2	251	66	61	67	66	69	3	Moderate	1	0
458 N Grotto St, St. Paul	2	252	66	61	67	66	69	3	Moderate	2	0
738 W University Ave, St. Paul	2	64	66	61	67	74	75	9	Severe	0	1

741 Aurora Ave, St. Paul	2	253	66	61	67	65	69	3	Moderate	2	0
499 N Grotto St, St. Paul	2	205	66	61	67	66	69	3	Moderate	2	0
741 W University Ave, St. Paul	2	117	66	61	67	66	69	3	Moderate	1	0
749 W University Ave, St. Paul	2	94	66	61	67	66	69	3	Moderate	2	0
750 W University Ave, St. Paul	2	99	66	61	67	66	69	3	Moderate	4	0
754 W University Ave, St. Paul	2	96	66	61	67	66	69	3	Moderate	1	0
755 W University Ave, St. Paul	2	90	66	61	67	66	69	3	Moderate	2	0
759 W University Ave, St. Paul	2	80	66	61	67	69	70	4	Severe	0	2
756 W University Ave, St. Paul	2	95	66	61	67	66	69	3	Moderate	2	0
762 W University Ave, St. Paul	2	96	66	61	67	69	71	5	Severe	0	2
766 W University Ave, St. Paul	2	95	66	61	67	70	72	6	Severe	0	1
771 W University Ave, St. Paul	2	88	66	61	67	71	72	6	Severe	0	1
770 W University Ave, St. Paul	2	94	66	61	67	72	73	7	Severe	0	1
773 W University Ave, St. Paul	2	60	66	61	67	77	77	11	Severe	0	2
774 W University Ave, St. Paul	2	91	66	61	67	74	75	9	Severe	0	2
777 W University Ave, St. Paul	2	63	66	61	67	78	78	12	Severe	0	1
785 W University Ave, St. Paul	2	63	66	61	67	78	78	12	Severe	0	2
799 W University Ave, St. Paul	2	74	66	61	67	73	74	8	Severe	0	3
818 W University Ave, St. Paul	2	117	66	61	67	62	67	1	Moderate	1	0
822 W University Ave, St. Paul	2	116	66	61	67	62	67	1	Moderate	1	0
826 W University Ave, St. Paul	2	118	66	61	67	62	67	1	Moderate	3	0
825 W University Ave, St. Paul	2	64	66	61	67	64	68	2	Moderate	1	0
830 W University Ave, St. Paul	2	114	66	61	67	62	67	1	Moderate	2	0

834 W University Ave, St. Paul	2	111	66	61	67	62	67	1	Moderate	1	0
838 W University Ave, St. Paul	2	102	66	61	67	65	69	3	Moderate	1	0
839 W University Ave, St. Paul	2	67	66	61	67	66	69	3	Moderate	3	0
842 W University Ave, St. Paul	2	118	66	61	67	65	68	2	Moderate	2	0
846 W University Ave, St. Paul	2	104	66	61	67	65	69	3	Moderate	1	0
850 W University Ave, St. Paul	2	108	66	61	67	66	69	3	Moderate	1	0
854 W University Ave, St. Paul	2	75	66	61	67	66	69	3	Moderate	1	0
860 W University Ave, St. Paul	2	104	66	61	67	62	67	1	Moderate	5	0
908 W University Ave, St. Paul	2	75	66	61	67	66	69	3	Moderate	1	0
931 W University Ave, St. Paul	2	75	66	61	67	66	69	3	Moderate	1	0
935 W University Ave, St. Paul	2	65	66	61	67	64	68	2	Moderate	5	0
979 W University Ave, St. Paul	2	59	66	61	67	68	70	4	Moderate	3	0
990 W University Ave, St. Paul	2	75	66	61	67	66	69	3	Moderate	1	0
1058 W University Ave, St. Paul	2	75	66	61	67	66	69	3	Moderate	4	0
1137 W University Ave, St. Paul	2	97	66	61	67	65	69	3	Moderate	6	0
1138 Sherburne Ave, St. Paul	2	244	66	61	67	63	68	2	Moderate	1	0
1194 Sherburne Ave, St. Paul	2	264	63	60	65	63	66	3	Moderate	1	0
1302 Sherburne Ave, St. Paul	2	240	63	60	65	63	66	3	Moderate	6	0
1306 Sherburne Ave, St. Paul	2	251	63	60	65	62	66	3	Moderate	1	0
1374 Sherburne Ave, St. Paul	2	242	63	60	65	63	66	3	Moderate	1	0
1402 Sherburne Ave, St. Paul	2	247	63	60	65	63	66	3	Moderate	1	0
1406 Sherburne Ave, St. Paul	2	254	63	60	65	63	66	3	Moderate	1	0
1410 Sherburne Ave, St. Paul	2	249	63	60	65	63	66	3	Moderate	1	0

1414 Sherburne Ave, St. Paul	2	252	63	60	65	64	66	3	Moderate	1	0
1418 Sherburne Ave, St. Paul	2	257	63	60	65	64	66	3	Moderate	1	0
1422 Sherburne Ave, St. Paul	2	259	63	60	65	64	67	4	Moderate	1	0
1424 Sherburne Ave, St. Paul	2	252	63	60	65	64	67	4	Moderate	1	0
1428 Sherburne Ave, St. Paul	2	255	63	60	65	64	67	4	Moderate	1	0
1434 Sherburne Ave, St. Paul	2	249	63	60	65	64	67	4	Moderate	1	0
1438 Sherburne Ave, St. Paul	2	253	63	60	65	64	67	4	Moderate	1	0
1442 Sherburne Ave, St. Paul	2	245	63	60	65	64	67	4	Moderate	1	0
1444 Sherburne Ave, St. Paul	2	249	63	60	65	64	67	4	Moderate	1	0
1460 Sherburne Ave, St. Paul	2	255	63	60	65	64	67	4	Moderate	1	0
1464 Sherburne Ave, St. Paul	2	261	63	60	65	64	67	4	Moderate	1	0
1466 Sherburne Ave, St. Paul	2	244	63	60	65	64	67	4	Moderate	1	0
1470 Sherburne Ave, St. Paul	2	253	63	60	65	64	66	3	Moderate	2	0
1472 Sherburne Ave, St. Paul	2	249	63	60	65	64	66	3	Moderate	1	0
1478 Sherburne Ave, St. Paul	2	252	63	60	65	63	66	3	Moderate	1	0
1480 Sherburne Ave, St. Paul	2	250	63	60	65	63	66	3	Moderate	2	0
1484 Sherburne Ave, St. Paul	2	254	63	60	65	63	66	3	Moderate	1	0
1486 Sherburne Ave, St. Paul	2	253	63	60	65	64	66	3	Moderate	1	0
1488 Sherburne Ave, St. Paul	2	246	63	60	65	64	67	4	Moderate	2	0
1492 Sherburne Ave, St. Paul	2	260	63	60	65	64	67	4	Moderate	1	0
1498 Sherburne Ave, St. Paul	2	255	63	60	65	64	67	4	Moderate	2	0
1504 Sherburne Ave, St. Paul	2	252	63	60	65	64	67	4	Moderate	2	0
1508 Sherburne Ave, St. Paul	2	249	63	60	65	64	67	4	Moderate	1	0

1514 Sherburne Ave, St. Paul	2	251	63	60	65	64	67	4	Moderate	2	0
1518 Sherburne Ave, St. Paul	2	249	63	60	65	64	67	4	Moderate	2	0
1524 Sherburne Ave, St. Paul	2	255	63	60	65	64	67	4	Moderate	1	0
1530 Sherburne Ave, St. Paul	2	271	63	60	65	64	67	4	Moderate	2	0
1553 W University Ave, St. Paul	2	75	67	62	67	66	70	3	Moderate	1	0
1563 W University Ave, St. Paul	2	66	67	62	67	66	70	3	Moderate	1	0
1569 W University Ave, St. Paul	2	75	67	62	67	66	70	3	Moderate	12	0
1573 W University Ave, St. Paul	2	75	67	62	67	66	70	3	Moderate	1	0
1577 W University Ave, St. Paul	2	75	67	62	67	66	70	3	Moderate	1	0
1708 W University Ave, St. Paul	2	100	67	62	67	66	69	2	Moderate	1	0

Total Number of Impacted Units in Midway East

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Midway West	468 Herschel St, St. Paul	2	61	67	62	67	64	69	2	Moderate	6	0
	1744 W University Ave, St. Paul	2	111	67	62	67	65	69	2	Moderate	1	0
	1756 W University Ave, St. Paul	2	87	67	62	67	63	68	1	Moderate	1	0
	463 N Fairview Ave, St. Paul	2	96	67	62	67	62	68	1	Moderate	22	0
	1900 W University Ave, St. Paul	2	97	67	62	67	62	68	1	Moderate	6	0
	1951 W University Ave, St. Paul	1	44	68	63	68	63	69	1	Moderate	1	0
	2144 W University Ave, St. Paul	2	61	68	63	68	64	70	2	Moderate	5	0
	2179 W University Ave, St. Paul	2	84	68	63	68	63	69	1	Moderate	4	0
	2289 W University Ave, St. Paul	2	145	68	63	68	68	71	3	Severe	0	1
	2285 W University Ave, St. Paul	2	138	68	63	68	66	70	2	Moderate	10	0
	781 Raymond Ave, St. Paul	2	319	68	63	68	64	69	1	Moderate	0	0
2388 W University Ave, St. Paul	2	91	68	63	68	67	71	3	Moderate	10	0	

	2389 W University Ave, St. Paul	2	73	68	63	68	70	72	4	Severe	0	4
	Total Number of Impacted Units in Midway West										66	5
University/Prospect Park	900 Se Washington Ave, Minneapolis	2	70	62	59	64	71	71	9	Severe	0	16
	315 Se Ontario St, Minneapolis	2	185	62	59	64	63	66	4	Moderate	1	0
	818 Se Washington Ave, Minneapolis	2	36	62	59	64	68	69	7	Severe	0	11
	229 S 19Th Ave, Minneapolis	3	130	64	65	71	64	67	3	Moderate	1	0
	225 S 19Th Ave, Minneapolis	3	130	64	65	71	64	67	3	Moderate	1	0
	1849 S Washington Ave, Minneapolis	2	184	64	60	66	61	66	2	Moderate	26	0
	1501 S 4Th St, Minneapolis	1	110	64	60	66	60	65	1	Moderate	1	0
	Total Number of Impacted Units in University/Prospect Park										30	27
	Total Number of Impacted Units in Project Area										415	50

HDR ASSESSMENT OF CENTRAL PRESBYTERIAN CHURCH

CCPO staff asked HDR to reply to a request by Central Presbyterian Church to be considered an FTA Land Use Category 1 site for CCLRT noise assessment purposes. Following is HDR's response.

FTA presents land use categories in Table 3-2, Land Use Categories for Transit Noise Impact Criteria (Transit Noise and Vibration Impact Assessment/FTA May 2006). FTA Category Land Use 1 is reserved for those buildings, such as concert halls and recording studios which are quiet spaces that facilitate communication. This is achieved through careful design and construction to heighten speech intelligibility, reduce the intrusion of noise and vibration from sources that are outside the building, as well as minimize magnetic (EMF) and electrical interference. Additionally, most spaces placed within Category 1 have carefully controlled and tailored reverberation characteristics.

Higher reverberation times, such as those that may be found within Central Presbyterian Church and other churches of this size, contribute to a higher ALCONS (% of All Consonants Lost) greater than 10%, thus contributing to a lack of speech intelligibility. High reverberation times within older religious structures are common and can be as high as 3-8 seconds (mid-frequency bands 500Hz-1 kHz and lower). These high RT times are beneficial to the resonance of a church organ and chant, but not for speech intelligibility. It is commonly known that chant essentially evolved due to the high reverberation times within gothic churches and the low speech intelligibility. For spaces where high speech intelligibility is key (like recording and broadcast studios, and certain performance spaces), reverberation times less than 1 second (mid-band) are recommended. The following table represents common reverberation time targets for particular spaces

**Table 1
Room Suitability Based on Reverberation Times**

Room is Used for:	Suitability Based on Reverberation Time (Mid Band 500 Hz-1 kHz)				
	0-0.8 seconds	0.8 - 1.3 seconds	1.4 - 2.0 seconds	2.1 - 3.0 seconds	>3.0 seconds
Recording Studio	Excellent	Good	Fair - Poor	Poor	Unacceptable
Speech	Excellent	Good	Fair - Poor	Poor	Unacceptable
Contemporary music	Good	Excellent	Good-Fair	Fair-Poor	Unacceptable
Theater	Good	Excellent	Good-Fair	Fair-Poor	Unacceptable
Choral music	Poor	Fair - Good	Excellent	Good - Fair	Fair - Poor
Orchestral	Poor	Poor - Fair	Good	Excellent	Good - Fair
Organ/Chant	Unacceptable	Poor	Poor - Fair	Fair-Good	Excellent

Source: HDR Engineering, 2008

Data in the table above shows the relationship between reverberation time and the suitability of a space for certain uses. Table 1 suggests that the reverberation time in buildings like Central Presbyterian Church is not representative of a recording studio or similar Category 1 land use.

Category 1 land uses also incorporate specifically engineered central air-conditioning to lower any mechanical noise for the enjoyment and intelligibility of the program/recorded material. Central Presbyterian Church does not incorporate central air conditioning and must leave the doors open during hot summer days to cool the congregation. This alone allows for a great deal of external noise to enter the sanctuary during services, which diminishes quite and degrades speech intelligibility.

Also, the design of the church does not provide enough STC (Sound Transmission Coefficient) at windows and openings to provide for a low enough noise floor (background noise level) to be considered on par with the Category 1 definition of “recording studios and concert halls”. Although Central Presbyterian Church may have originally been built as an “Auditorium for St. Paul”, this in no way ensures that it was built with the same rigid specification required for the low noise floors of concert halls and recording studios.

Additionally, due to its age, Central Presbyterian Church would need considerable upgrades to its structure and acoustical “treatments” to be considered within Category 1 of the FTA guidelines. When specifying uses of spaces, architects use the commonly accepted Noise Criteria curves (NC) as adopted by the Acoustical Society of America to differentiate between churches, recording studios, and performance halls. The Noise Criteria numbers determine the noise floor level in dB. The following table provides targeted NC levels for some specific environments.

Table 2
Recommended Noise Criteria for Specific Areas

Recommended Acceptable Noise Levels in Unoccupied Rooms			
Type of Area	Unoccupied Room	Noise Rating N	dB-A
Studios	Radio	15	30
	Disk recording	15	30
	Sound stages	20	34
	TV (no audience)	20	34
	TV (with audience)	25	38
Auditoriums	Concert Halls	20	34
	Legitimate play	20	34
	Motion picture	25	38
Schools	Classrooms	25	38
	Lecture Halls	25	38
	Laboratories	30	42
	Corridors	30	42
	Libraries	30	42
Churches	Sanctuaries	25	38
	Choir lofts	25	38
	Narthex	30	42
Hospitals	Private Rooms	25	38
	Operating rooms	25	38
	Wards	25	38
	Corridors	30	42
Residences	Homes, rural	20	34
	Homes, suburban	25	38
	Homes, urban	30	42
	Apartment houses, suburban	25	38
	Apartment houses, urban	30	42
Restaurants	Dining room	40	50
	Cocktail lounge	40	50
	Cafeterias	40	50
Stores	Department	45	54
	Retail	40	50
	Supermarket	45	54
Offices	Private	35	46
	Banks	40	50
	Accounting	40	50
Workshops	Machine shop	65	70
	Carpenter shop	65	70
	Electric shop	65	70
Hotels	Lobbies	35	46
	Ballrooms	35	46
	Suites	30	42
Sports	Coliscums	35	46
	Gymnasiums	35	46
	Swimming pools	40	50

Table source; Acoustic and Noise Control, Reittinger, 1972, Chemical Publishing

Table 2 shows that the accepted noise threshold for sanctuaries, choir lofts and similar spaces is between 25 and 30dB, while recording studios and concert halls are 5-10dB lower - a clearly noticeable and audible difference when discussing the decibel and its logarithmic nature.

Further information in Table 2 identifies a fundamental difference between large cavernous religious buildings and acoustically designed recording and broadcast studios. This demonstrates that there is a fundamental difference between Central Presbyterian Church and land uses commonly recognized as belonging in FTA land use Category 1.

And finally, HDR notes that the FTA guidance manual specifically places Churches a within Category 3.

Upon careful review of the acoustical characteristics of Central Presbyterian Church and land uses commonly recognized as belonging in FTA land use Category 1, HDR considers Central Presbyterian Church a Category 3 land use. Therefore HDR can not justify inclusion of Central Presbyterian Church as a Category 1 land use for the purposes of the CCLRT noise analysis.