CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	Capital Costs[1] (Design/Const)	O&M Costs[2]	Farm Crops Production Loss Costs[3]	Ecological Acreage Loss (Project)	Ecological Value Per Acre	Ecological Land Loss Costs[4]	Ecological Acreage Loss Induced Development	Ecological Value Per Acre	Ecological Land Loss Induced Development Costs[4]	Chicago UZA Estimated Population	Chicago UZA Estimated AVMT-No Build	Per Capita VMT	AVMT Change[5]	Proportion Auto Traffic	Auto AVMT Change	VMT Value	Auto VMT Benefits[5]
0	2022	($453,001,250)		$0	0	($4,373)	$0	0	($2,916)	$0	8,982,430	68,833,929,745	7,663					
0	2023	($453,001,250)		$0	0	($4,373)	$0	0	($2,916)	$0	9,014,767	69,081,731,892	7,663					
0	2024	($453,001,250)		$0	0	($4,373)	$0	0	($2,916)	$0	9,047,220	69,330,426,127	7,663					
0	2025	($453,001,250)		$0	0	($4,373)	$0	0	($2,916)	$0	9,079,790	69,580,015,661	7,663					
1	2026		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,112,477	69,830,503,717	7,663	-11,400,000	1.00	-11,400,000	($0.28)	$3,139,560
2	2027		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,145,282	70,081,893,531	7,663	-11,682,758	1.00	-11,682,758	($0.28)	$3,217,432
3	2028		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,178,205	70,334,188,347	7,663	-11,965,516	1.00	-11,965,516	($0.28)	$3,295,303
4	2029		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,211,247	70,587,391,425	7,663	-12,248,274	1.00	-12,248,274	($0.28)	$3,373,175
5	2030		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,244,407	70,841,506,035	7,663	-12,531,032	1.00	-12,531,032	($0.28)	$3,451,046
6	2031		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,277,687	71,096,535,456	7,663	-12,813,790	1.00	-12,813,790	($0.28)	$3,528,918
7	2032		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,311,087	71,352,482,984	7,663	-13,096,548	1.00	-13,096,548	($0.28)	$3,606,789
8	2033		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,344,607	71,609,351,923	7,663	-13,379,306	1.00	-13,379,306	($0.28)	$3,684,661
9	2034		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,378,247	71,867,145,590	7,663	-13,662,064	1.00	-13,662,064	($0.28)	$3,762,532
10	2035		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,412,009	72,125,867,314	7,663	-13,944,822	1.00	-13,944,822	($0.28)	$3,840,404
11	2036		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,445,892	72,385,520,436	7,663	-14,227,580	1.00	-14,227,580	($0.28)	$3,918,276
12	2037		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,479,897	72,646,108,310	7,663	-14,510,338	1.00	-14,510,338	($0.28)	$3,996,147
13	2038		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,514,025	72,907,634,300	7,663	-14,793,096	1.00	-14,793,096	($0.28)	$4,074,019
14	2039		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,548,275	73,170,101,783	7,663	-15,075,854	1.00	-15,075,854	($0.28)	$4,151,890
15	2040		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,582,649	73,433,514,149	7,663	-15,358,612	1.00	-15,358,612	($0.28)	$4,229,762
16	2041		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,617,147	73,697,874,800	7,663	-15,641,370	1.00	-15,641,370	($0.28)	$4,307,633
17	2042		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,651,768	73,963,187,150	7,663	-15,924,128	1.00	-15,924,128	($0.28)	$4,385,505
18	2043		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,686,515	74,229,454,623	7,663	-16,206,886	1.00	-16,206,886	($0.28)	$4,463,376
19	2044		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,721,386	74,496,680,660	7,663	-16,489,644	1.00	-16,489,644	($0.28)	$4,541,248
20	2045		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,756,383	74,764,868,710	7,663	-16,772,402	1.00	-16,772,402	($0.28)	$4,619,120
21	2046		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,791,506	75,034,022,238	7,663	-17,055,160	1.00	-17,055,160	($0.28)	$4,696,991
22	2047		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,826,756	75,304,144,718	7,663	-17,337,918	1.00	-17,337,918	($0.28)	$4,774,863
23	2048		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,862,132	75,575,239,639	7,663	-17,620,676	1.00	-17,620,676	($0.28)	$4,852,734
24	2049		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,897,636	75,847,310,502	7,663	-17,903,434	1.00	-17,903,434	($0.28)	$4,930,606
25	2050		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,933,267	76,120,360,819	7,663	-18,186,192	1.00	-18,186,192	($0.28)	$5,008,477
26	2051		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	9,969,027	76,394,394,118	7,663	-18,468,950	1.00	-18,468,950	($0.28)	$5,086,349
27	2052		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	10,004,915	76,669,413,937	7,663	-18,751,708	1.00	-18,751,708	($0.28)	$5,164,220
28	2053		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	10,040,933	76,945,423,827	7,663	-19,034,466	1.00	-19,034,466	($0.28)	$5,242,092
29	2054		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	10,077,080	77,222,427,353	7,663	-19,317,224	1.00	-19,317,224	($0.28)	$5,319,963
30	2055		($18,373,480)	$0	0	($4,373)	$0	0	($2,916)	$0	10,113,358	77,500,428,092	7,663	-19,599,982	1.00	-19,599,982	($0.28)	$5,397,835
TOTALS		($1,812,005,000)	($514,457,440)	$0			$0			$0		2,330,138,224,467		-426,082,524		-426,082,524		$117,343,127
3% Discount		($1,683,850,946)	($319,968,642)	$0			$0			$0								$71,373,575
5% Discount		($1,606,297,132)	($232,365,727)	$0			$0			$0								$50,508,228
7% Discount		($1,534,405,834)	($173,930,711)	$0			$0			$0								$36,906,621

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CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	Proportion Heavy Tk	Diesel Bus VMT Decrease	VMT Value	Diesel Bus VMT Benefits[5]	Train Miles Traveled	Annual Ridership	Auto Drivers Convert to Riding Train	Assumed 20% Drivers Working 1/2 hr on train	Productivity Rate Per Hour	Increased Worker Productivity Benefits[5a]	Auto Noise Value (per VMT)	Auto Noise Benefits[6]	Bus Noise Value (per VMT)	Bus Noise Benefits[6]	Train Noise Value (per VMT)	Train Noise Costs[6]	CO_2 Change (MT)	CO_2 Value (per MT)	Undiscounted CO2 Value @ 3% Avg SCC
0	2022																			
0	2023																			
0	2024																			
0	2025																			
1	2026	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,140,000	228,000	$27.22	**$3,103,080**	($0.0153)	**$174,420**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$63.47	$699,693
2	2027	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,168,276	233,655	$27.22	**$3,180,047**	($0.0153)	**$178,746**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$65.66	$723,836
3	2028	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,196,552	239,310	$27.22	**$3,257,013**	($0.0153)	**$183,072**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$66.76	$735,962
4	2029	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,224,827	244,965	$27.22	**$3,333,980**	($0.0153)	**$187,399**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$67.85	$747,978
5	2030	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,253,103	250,621	$27.22	**$3,410,947**	($0.0153)	**$191,725**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$68.94	$759,995
6	2031	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,281,379	256,276	$27.22	**$3,487,914**	($0.0153)	**$196,051**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$68.94	$759,995
7	2032	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,309,655	261,931	$27.22	**$3,564,880**	($0.0153)	**$200,377**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$71.13	$784,137
8	2033	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,337,931	267,586	$27.22	**$3,641,847**	($0.0153)	**$204,703**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$72.23	$796,264
9	2034	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,366,206	273,241	$27.22	**$3,718,814**	($0.0153)	**$209,030**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$73.32	$808,280
10	2035	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,394,482	278,896	$27.22	**$3,795,781**	($0.0153)	**$213,356**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$74.42	$820,406
11	2036	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,422,758	284,552	$27.22	**$3,872,747**	($0.0153)	**$217,682**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$75.51	$832,422
12	2037	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,451,034	290,207	$27.22	**$3,949,714**	($0.0153)	**$222,008**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$77.70	$856,565
13	2038	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,479,310	295,862	$27.22	**$4,026,681**	($0.0153)	**$226,334**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$78.79	$868,581
14	2039	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,507,585	301,517	$27.22	**$4,103,647**	($0.0153)	**$230,661**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$79.89	$880,707
15	2040	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,535,861	307,172	$27.22	**$4,180,614**	($0.0153)	**$234,987**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$80.98	$892,724
16	2041	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,564,137	312,827	$27.22	**$4,257,581**	($0.0153)	**$239,313**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$83.17	$916,866
17	2042	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,592,413	318,483	$27.22	**$4,334,548**	($0.0153)	**$243,639**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$84.26	$928,882
18	2043	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,620,689	324,138	$27.22	**$4,411,514**	($0.0153)	**$247,965**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$85.36	$941,009
19	2044	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,648,964	329,793	$27.22	**$4,488,481**	($0.0153)	**$252,292**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$86.45	$953,025
20	2045	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,677,240	335,448	$27.22	**$4,565,448**	($0.0153)	**$256,618**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$87.55	$965,151
21	2046	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,705,516	341,103	$27.22	**$4,642,415**	($0.0153)	**$260,944**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$89.74	$989,294
22	2047	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,733,792	346,758	$27.22	**$4,719,381**	($0.0153)	**$265,270**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$90.83	$1,001,310
23	2048	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,762,068	352,414	$27.22	**$4,796,348**	($0.0153)	**$269,596**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$91.93	$1,013,436
24	2049	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,790,343	358,069	$27.22	**$4,873,315**	($0.0153)	**$273,923**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$93.02	$1,025,452
25	2050	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,818,619	363,724	$27.22	**$4,950,281**	($0.0153)	**$278,249**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$94.11	$1,037,469
26	2051	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,846,895	369,379	$27.22	**$5,027,248**	($0.0153)	**$282,575**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$95.21	$1,049,595
27	2052	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,875,171	375,034	$27.22	**$5,104,215**	($0.0153)	**$286,901**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$96.30	$1,061,611
28	2053	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,903,447	380,689	$27.22	**$5,181,182**	($0.0153)	**$291,227**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$97.40	$1,073,738
29	2054	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,931,722	386,344	$27.22	**$5,258,148**	($0.0153)	**$295,554**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$97.40	$1,073,738
30	2055	1.00	-276,451	($11.23)	**$3,104,545**	686,188	13,156,627	1,959,998	392,000	$27.22	**$5,335,115**	($0.0153)	**$299,880**	($0.1558)	**$43,071**	$0.9945	**($682,414)**	-11,024	$97.40	$1,073,738
TOTALS			-7,740,628		**$86,927,252**	19,213,264	368,385,556				**$115,979,663**		**$6,519,063**		**$1,205,990**		**($19,107,591)**	-275,600		
3% Discount					**$54,064,715**						**$70,544,253**		**$3,965,199**		**$750,070**		**($11,884,034)**			
5% Discount					**$39,262,556**						**$49,921,349**		**$2,806,013**		**$544,711**		**($8,630,353)**			
7% Discount					**$29,388,862**						**$36,477,786**		**$2,050,368**		**$407,728**		**($6,460,004)**			

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CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	NPV CO2 Benefits @ 3% Avg SCC[7] [Undisc/(1.03^A)]	NO_x Change Auto (MT)	NO_x Value (per MT)	NO_x Benefits[8]	PM_{10} Change Auto (per MT)	$PM_{2.5}$ Change Auto (per MT)	PM Value (per MT)	PM Benefit[9]	VOC Change Auto (MT)	VOC Value (per MT)	VOC Benefits[10]	Resource Externalities Value	Resource Consumption Benefits[11]	Parking Internal + External Benefits Value	Total Parking Benefits[12]	Walking Health Costs Value - External	Bicycling Health Costs Value - External	Health Benefits - Increased Cardivascular Activity[13]
0	2022																		
0	2023																		
0	2024																		
0	2025																		
1	2026	$679,314	-7.90	($8,498)	$67,136	-0.05	-0.05	($388,785)	$37,673	-11.79	($2,157)	$25,426	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,264,268
2	2027	$682,285	-8.10	($8,498)	$68,801	-0.05	-0.05	($388,785)	$38,608	-12.08	($2,157)	$26,056	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,320,429
3	2028	$673,510	-8.29	($8,498)	$70,466	-0.05	-0.05	($388,785)	$39,542	-12.37	($2,157)	$26,687	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,376,591
4	2029	$664,569	-8.49	($8,498)	$72,131	-0.05	-0.05	($388,785)	$40,477	-12.66	($2,157)	$27,318	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,432,752
5	2030	$655,578	-8.68	($8,498)	$73,797	-0.06	-0.05	($388,785)	$41,411	-12.96	($2,157)	$27,948	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,488,914
6	2031	$636,483	-8.88	($8,498)	$75,462	-0.06	-0.05	($388,785)	$42,345	-13.25	($2,157)	$28,579	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,545,075
7	2032	$637,575	-9.08	($8,498)	$77,127	-0.06	-0.05	($388,785)	$43,280	-13.54	($2,157)	$29,210	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,601,236
8	2033	$628,578	-9.27	($8,498)	$78,792	-0.06	-0.05	($388,785)	$44,214	-13.83	($2,157)	$29,840	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,657,398
9	2034	$619,479	-9.47	($8,498)	$80,457	-0.06	-0.06	($388,785)	$45,149	-14.13	($2,157)	$30,471	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,713,559
10	2035	$610,459	-9.66	($8,498)	$82,123	-0.06	-0.06	($388,785)	$46,083	-14.42	($2,157)	$31,102	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,769,721
11	2036	$601,360	-9.86	($8,498)	$83,788	-0.06	-0.06	($388,785)	$47,017	-14.71	($2,157)	$31,732	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,825,882
12	2037	$600,777	-10.06	($8,498)	$85,453	-0.06	-0.06	($388,785)	$47,952	-15.00	($2,157)	$32,363	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,882,043
13	2038	$591,461	-10.25	($8,498)	$87,118	-0.07	-0.06	($388,785)	$48,886	-15.30	($2,157)	$32,994	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,938,205
14	2039	$582,251	-10.45	($8,498)	$88,783	-0.07	-0.06	($388,785)	$49,821	-15.59	($2,157)	$33,624	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$2,994,366
15	2040	$573,005	-10.64	($8,498)	$90,449	-0.07	-0.06	($388,785)	$50,755	-15.88	($2,157)	$34,255	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,050,528
16	2041	$571,361	-10.84	($8,498)	$92,114	-0.07	-0.06	($388,785)	$51,690	-16.17	($2,157)	$34,886	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,106,689
17	2042	$561,989	-11.04	($8,498)	$93,779	-0.07	-0.07	($388,785)	$52,624	-16.47	($2,157)	$35,516	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,162,850
18	2043	$552,743	-11.23	($8,498)	$95,444	-0.07	-0.07	($388,785)	$53,558	-16.76	($2,157)	$36,147	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,219,012
19	2044	$543,497	-11.43	($8,498)	$97,109	-0.07	-0.07	($388,785)	$54,493	-17.05	($2,157)	$36,777	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,275,173
20	2045	$534,381	-11.62	($8,498)	$98,775	-0.07	-0.07	($388,785)	$55,427	-17.34	($2,157)	$37,408	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,331,334
21	2046	$531,794	-11.82	($8,498)	$100,440	-0.08	-0.07	($388,785)	$56,362	-17.64	($2,157)	$38,039	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,387,496
22	2047	$522,576	-12.02	($8,498)	$102,105	-0.08	-0.07	($388,785)	$57,296	-17.93	($2,157)	$38,669	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,443,657
23	2048	$513,500	-12.21	($8,498)	$103,770	-0.08	-0.07	($388,785)	$58,231	-18.22	($2,157)	$39,300	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,499,819
24	2049	$504,455	-12.41	($8,498)	$105,435	-0.08	-0.07	($388,785)	$59,165	-18.51	($2,157)	$39,931	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,555,980
25	2050	$495,501	-12.60	($8,498)	$107,101	-0.08	-0.07	($388,785)	$60,099	-18.80	($2,157)	$40,561	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,612,141
26	2051	$486,692	-12.80	($8,498)	$108,766	-0.08	-0.08	($388,785)	$61,034	-19.10	($2,157)	$41,192	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,668,303
27	2052	$477,926	-12.99	($8,498)	$110,431	-0.08	-0.08	($388,785)	$61,968	-19.39	($2,157)	$41,823	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,724,464
28	2053	$469,306	-13.19	($8,498)	$112,096	-0.08	-0.08	($388,785)	$62,903	-19.68	($2,157)	$42,453	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,780,626
29	2054	$455,637	-13.39	($8,498)	$113,761	-0.08	-0.08	($388,785)	$63,837	-19.97	($2,157)	$43,084	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,836,787
30	2055	$442,366	-13.58	($8,498)	$115,427	-0.09	-0.08	($388,785)	$64,772	-20.27	($2,157)	$43,715	(0.05)		($0.148)	$0	($0.28109)	($0.11615)	$3,892,948
TOTALS		$16,202,404	-295		$2,509,249	-1.87	-1.75		$1,408,063	-441		$950,308		$0		$0			$84,628,511
3% Discount		$17,100,407			$1,526,242				$856,450			$578,022		$0		$0			$51,475,016
5% Discount		$17,100,407			$1,080,061				$606,075			$409,043		$0		$0			$36,426,813
7% Discount		$17,100,407			$789,206				$442,862			$298,890		$0		$0			$26,617,259

CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	Walking Mortality Costs Value - Internal	Bicycling Mortality Costs Value - Internal	Mortality Benefits - Increased Cardivascular Activity[13]	Barrier Effect Value-Car	Barrier Effect Value-Heavy Bus	Barrier Effect Benefits[14]	Transport Diversity Value	Transport Diversity Benefits-Auto[15]	Uncompensated Moving Costs Value per HH	Number of HHs	Uncompensated HH Displacement Moving Costs[16]	Average Travel Time Savings Per Train Rider (hrs)	Time Value (per hr)	Travel Time Savings[17]	Property Value Increase Less Travel Time Savings Benefit	Road Accidents Reduced	CTA Bus Accidents Decreased	CTA Train Accidents Increased	Total Change in Accidents
0	2022																			
0	2023																			
0	2024																			
0	2025																			
1	2026	($0.28109)	($0.11615)	$2,264,268	($0.01690)	($0.02745)	$185,071	($0.00845)	$96,330				0.35	$14.03	$64,605,617		-31.18	-1.53	0.41	-32.31
2	2027	($0.28109)	($0.11615)	$2,320,429	($0.01690)	($0.02745)	$189,850	($0.00845)	$98,719				0.35	$14.03	$64,605,617		-31.96	-1.53	0.41	-33.08
3	2028	($0.28109)	($0.11615)	$2,376,591	($0.01690)	($0.02745)	$194,629	($0.00845)	$101,109				0.35	$14.03	$64,605,617		-32.73	-1.53	0.41	-33.85
4	2029	($0.28109)	($0.11615)	$2,432,752	($0.01690)	($0.02745)	$199,407	($0.00845)	$103,498				0.35	$14.03	$64,605,617		-33.51	-1.53	0.41	-34.63
5	2030	($0.28109)	($0.11615)	$2,488,914	($0.01690)	($0.02745)	$204,186	($0.00845)	$105,887				0.35	$14.03	$64,605,617		-34.28	-1.53	0.41	-35.40
6	2031	($0.28109)	($0.11615)	$2,545,075	($0.01690)	($0.02745)	$208,964	($0.00845)	$108,277				0.35	$14.03	$64,605,617		-35.05	-1.53	0.41	-36.17
7	2032	($0.28109)	($0.11615)	$2,601,236	($0.01690)	($0.02745)	$213,743	($0.00845)	$110,666				0.35	$14.03	$64,605,617		-35.83	-1.53	0.41	-36.95
8	2033	($0.28109)	($0.11615)	$2,657,398	($0.01690)	($0.02745)	$218,522	($0.00845)	$113,055				0.35	$14.03	$64,605,617		-36.60	-1.53	0.41	-37.72
9	2034	($0.28109)	($0.11615)	$2,713,559	($0.01690)	($0.02745)	$223,300	($0.00845)	$115,444				0.35	$14.03	$64,605,617		-37.37	-1.53	0.41	-38.50
10	2035	($0.28109)	($0.11615)	$2,769,721	($0.01690)	($0.02745)	$228,079	($0.00845)	$117,834				0.35	$14.03	$64,605,617		-38.15	-1.53	0.41	-39.27
11	2036	($0.28109)	($0.11615)	$2,825,882	($0.01690)	($0.02745)	$232,858	($0.00845)	$120,223				0.35	$14.03	$64,605,617		-38.92	-1.53	0.41	-40.04
12	2037	($0.28109)	($0.11615)	$2,882,043	($0.01690)	($0.02745)	$237,636	($0.00845)	$122,612				0.35	$14.03	$64,605,617		-39.69	-1.53	0.41	-40.82
13	2038	($0.28109)	($0.11615)	$2,938,205	($0.01690)	($0.02745)	$242,415	($0.00845)	$125,002				0.35	$14.03	$64,605,617		-40.47	-1.53	0.41	-41.59
14	2039	($0.28109)	($0.11615)	$2,994,366	($0.01690)	($0.02745)	$247,193	($0.00845)	$127,391				0.35	$14.03	$64,605,617		-41.24	-1.53	0.41	-42.36
15	2040	($0.28109)	($0.11615)	$3,050,528	($0.01690)	($0.02745)	$251,972	($0.00845)	$129,780				0.35	$14.03	$64,605,617		-42.01	-1.53	0.41	-43.14
16	2041	($0.28109)	($0.11615)	$3,106,689	($0.01690)	($0.02745)	$256,751	($0.00845)	$132,170				0.35	$14.03	$64,605,617		-42.79	-1.53	0.41	-43.91
17	2042	($0.28109)	($0.11615)	$3,162,850	($0.01690)	($0.02745)	$261,529	($0.00845)	$134,559				0.35	$14.03	$64,605,617		-43.56	-1.53	0.41	-44.68
18	2043	($0.28109)	($0.11615)	$3,219,012	($0.01690)	($0.02745)	$266,308	($0.00845)	$136,948				0.35	$14.03	$64,605,617		-44.33	-1.53	0.41	-45.46
19	2044	($0.28109)	($0.11615)	$3,275,173	($0.01690)	($0.02745)	$271,086	($0.00845)	$139,337				0.35	$14.03	$64,605,617		-45.11	-1.53	0.41	-46.23
20	2045	($0.28109)	($0.11615)	$3,331,334	($0.01690)	($0.02745)	$275,865	($0.00845)	$141,727				0.35	$14.03	$64,605,617		-45.88	-1.53	0.41	-47.00
21	2046	($0.28109)	($0.11615)	$3,387,496	($0.01690)	($0.02745)	$280,644	($0.00845)	$144,116				0.35	$14.03	$64,605,617		-46.65	-1.53	0.41	-47.78
22	2047	($0.28109)	($0.11615)	$3,443,657	($0.01690)	($0.02745)	$285,422	($0.00845)	$146,505				0.35	$14.03	$64,605,617		-47.43	-1.53	0.41	-48.55
23	2048	($0.28109)	($0.11615)	$3,499,819	($0.01690)	($0.02745)	$290,201	($0.00845)	$148,895				0.35	$14.03	$64,605,617		-48.20	-1.53	0.41	-49.32
24	2049	($0.28109)	($0.11615)	$3,555,980	($0.01690)	($0.02745)	$294,979	($0.00845)	$151,284				0.35	$14.03	$64,605,617		-48.98	-1.53	0.41	-50.10
25	2050	($0.28109)	($0.11615)	$3,612,141	($0.01690)	($0.02745)	$299,758	($0.00845)	$153,673				0.35	$14.03	$64,605,617		-49.75	-1.53	0.41	-50.87
26	2051	($0.28109)	($0.11615)	$3,668,303	($0.01690)	($0.02745)	$304,537	($0.00845)	$156,063				0.35	$14.03	$64,605,617		-50.52	-1.53	0.41	-51.64
27	2052	($0.28109)	($0.11615)	$3,724,464	($0.01690)	($0.02745)	$309,315	($0.00845)	$158,452				0.35	$14.03	$64,605,617		-51.30	-1.53	0.41	-52.42
28	2053	($0.28109)	($0.11615)	$3,780,626	($0.01690)	($0.02745)	$314,094	($0.00845)	$160,841				0.35	$14.03	$64,605,617		-52.07	-1.53	0.41	-53.19
29	2054	($0.28109)	($0.11615)	$3,836,787	($0.01690)	($0.02745)	$318,873	($0.00845)	$163,231				0.35	$14.03	$64,605,617		-52.84	-1.53	0.41	-53.97
30	2055	($0.28109)	($0.11615)	$3,892,948	($0.01690)	($0.02745)	$323,651	($0.00845)	$165,620				0.35	$14.03	$64,605,617		-53.62	-1.53	0.41	-54.74
TOTALS				$84,628,511			$6,988,314		$3,600,397		0	$0			$1,808,957,273		-1,166	-43	12	-1,306
3% Discount				$51,475,016			$4,247,707		$2,189,930			$0			$1,125,087,436					
5% Discount				$36,426,813			$3,003,481		$1,549,726			$0			$817,054,316					
7% Discount				$26,617,259			$2,192,949		$1,132,393			$0			$611,582,612					

R. Arkell, AICP
8/28/2018

CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	Value of Statistical Life	Road Death/ Crash Ratio	Deaths Reduced	Deaths Prevented Benefits	No Injury AIS 0 0.43676 * $0	Minor AIS 1 0.41739 * $27,700	Moderate AIS 2 0.08872 * $433,965	Serious AIS 3 0.04817 * $969,496	Severe AIS 4 0.00617 * $2,456,056	Critical AIS 5 0.00279 * $5,475,343	Injuries Prevented Benefits Accidents*$\sum$[Pr(AIS_x)*Value (AIS_x)]	Property Damage Only $3,425 per Accident[18]	Total Accident Death/ Injury/PDO Benefits[18]	Residual Value[19]
0	2022														
0	2023														
0	2024														
0	2025														
1	2026	$9,750,000	0.003205	-0.1035	**$1,009,468**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$4,304,440**	**$110,652**	**$5,424,560**	
2	2027	$9,865,050	0.003205	-0.1060	**$1,045,833**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$4,402,823**	**$113,302**	**$5,561,958**	
3	2028	$9,981,458	0.003205	-0.1085	**$1,082,916**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$4,501,206**	**$115,951**	**$5,700,073**	
4	2029	$10,099,239	0.003205	-0.1110	**$1,120,728**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$4,599,590**	**$118,600**	**$5,838,918**	
5	2030	$10,218,410	0.003205	-0.1135	**$1,159,282**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$4,697,973**	**$121,249**	**$5,978,505**	
6	2031	$10,338,987	0.003205	-0.1159	**$1,198,590**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$4,796,356**	**$123,898**	**$6,118,845**	
7	2032	$10,460,987	0.003205	-0.1184	**$1,238,664**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$4,894,739**	**$126,548**	**$6,259,951**	
8	2033	$10,584,427	0.003205	-0.1209	**$1,279,517**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$4,993,122**	**$129,197**	**$6,401,837**	
9	2034	$10,709,323	0.003205	-0.1234	**$1,321,162**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$5,091,506**	**$131,846**	**$6,544,514**	
10	2035	$10,835,693	0.003205	-0.1258	**$1,363,611**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$5,189,889**	**$134,495**	**$6,687,995**	
11	2036	$10,963,554	0.003205	-0.1283	**$1,406,878**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$5,288,272**	**$137,145**	**$6,832,295**	
12	2037	$11,092,924	0.003205	-0.1308	**$1,450,977**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$5,386,655**	**$139,794**	**$6,977,426**	
13	2038	$11,223,821	0.003205	-0.1333	**$1,495,920**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$5,485,038**	**$142,443**	**$7,123,401**	
14	2039	$11,356,262	0.003205	-0.1358	**$1,541,722**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$5,583,422**	**$145,092**	**$7,270,236**	
15	2040	$11,490,266	0.003205	-0.1382	**$1,588,396**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$5,681,805**	**$147,741**	**$7,417,942**	
16	2041	$11,625,851	0.003205	-0.1407	**$1,635,958**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$5,780,188**	**$150,391**	**$7,566,536**	
17	2042	$11,763,036	0.003205	-0.1432	**$1,684,420**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$5,878,571**	**$153,040**	**$7,716,031**	
18	2043	$11,901,840	0.003205	-0.1457	**$1,733,799**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$5,976,954**	**$155,689**	**$7,866,442**	
19	2044	$12,042,281	0.003205	-0.1482	**$1,784,108**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$6,075,337**	**$158,338**	**$8,017,784**	
20	2045	$12,184,380	0.003205	-0.1506	**$1,835,363**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$6,173,721**	**$160,987**	**$8,170,071**	
21	2046	$12,328,156	0.003205	-0.1531	**$1,887,580**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$6,272,104**	**$163,637**	**$8,323,320**	
22	2047	$12,473,628	0.003205	-0.1556	**$1,940,773**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$6,370,487**	**$166,286**	**$8,477,546**	
23	2048	$12,620,817	0.003205	-0.1581	**$1,994,958**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$6,468,870**	**$168,935**	**$8,632,764**	
24	2049	$12,769,743	0.003205	-0.1605	**$2,050,153**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$6,567,253**	**$171,584**	**$8,788,990**	
25	2050	$12,920,426	0.003205	-0.1630	**$2,106,372**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$6,665,637**	**$174,233**	**$8,946,242**	
26	2051	$13,072,887	0.003205	-0.1655	**$2,163,632**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$6,764,020**	**$176,883**	**$9,104,534**	
27	2052	$13,227,147	0.003205	-0.1680	**$2,221,950**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$6,862,403**	**$179,532**	**$9,263,885**	
28	2053	$13,383,227	0.003205	-0.1705	**$2,281,344**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$6,960,786**	**$182,181**	**$9,424,311**	
29	2054	$13,541,149	0.003205	-0.1729	**$2,341,829**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$7,059,169**	**$184,830**	**$9,585,829**	
30	2055	$13,700,935	0.003205	-0.1754	**$2,403,425**	$0	$11,562	$38,501	$46,701	$15,154	$15,276	**$7,157,553**	**$187,479**	**$9,748,457**	**$600,487,120**
TOTALS				-3.8360	**$44,624,076**							**$157,713,168**	**$4,099,668**	**$206,436,912**	**$600,487,120**
3% Discount					**$26,850,398**							**$96,058,208**	**$2,495,085**		**$219,778,286**
5% Discount					**$18,702,588**							**$68,085,739**	**$1,766,914**		**$114,332,748**
7% Discount					**$13,463,873**							**$49,826,736**	**$1,291,959**		**$60,168,809**

CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	Discount Factor (3%)	Discount Factor (5%)	Discount Factor (7%)	NPV Costs (3% Discount)	NPV Benefits (3% Discount)	NPV Costs (5% Discount)	NPV Benefits (5% Discount)	NPV Costs (7% Discount)	NPV Benefits (7% Discount)
0	2022	0.9709	0.9524	0.9346	($439,818,914)	$0	($431,438,391)	$0	($423,374,968)	$0
0	2023	0.9426	0.9070	0.8734	($426,998,978)	$0	($410,872,134)	$0	($395,651,292)	$0
0	2024	0.9151	0.8638	0.8163	($414,541,444)	$0	($391,302,480)	$0	($369,784,920)	$0
0	2025	0.8885	0.8227	0.7629	($402,491,611)	$0	($372,684,128)	$0	($345,594,654)	$0
1	2026	0.8626	0.7835	0.7130	($16,437,614)	$73,599,227	($14,930,293)	$66,912,506	($13,586,852)	$60,952,787
2	2027	0.8375	0.7462	0.6663	($15,959,311)	$71,831,518	($14,219,508)	$64,075,190	($12,696,942)	$57,287,341
3	2028	0.8131	0.7107	0.6227	($15,494,347)	$70,091,361	($13,543,024)	$61,349,031	($11,866,105)	$53,836,092
4	2029	0.7894	0.6768	0.5820	($15,042,723)	$68,391,173	($12,897,029)	$58,730,652	($11,090,530)	$50,597,282
5	2030	0.7664	0.6446	0.5439	($14,604,437)	$66,731,912	($12,283,429)	$56,230,741	($10,364,501)	$47,548,739
6	2031	0.7441	0.6139	0.5083	($14,179,491)	$65,104,368	($11,698,413)	$53,824,004	($9,686,111)	$44,674,954
7	2032	0.7224	0.5847	0.4751	($13,765,978)	$63,530,968	($11,141,981)	$51,542,568	($9,053,455)	$42,000,603
8	2033	0.7014	0.5568	0.4440	($13,365,804)	$61,990,907	($10,610,322)	$49,340,504	($8,460,817)	$39,472,140
9	2034	0.6810	0.5303	0.4150	($12,977,064)	$60,486,232	($10,105,341)	$47,238,185	($7,908,196)	$37,102,155
10	2035	0.6611	0.5051	0.3878	($12,597,852)	$59,009,012	($9,625,132)	$45,228,685	($7,389,876)	$34,866,939
11	2036	0.6419	0.4810	0.3624	($12,231,978)	$57,577,440	($9,165,885)	$43,295,696	($6,905,856)	$32,768,569
12	2037	0.6232	0.4581	0.3387	($11,875,633)	$56,183,132	($8,729,505)	$41,458,089	($6,454,231)	$30,808,967
13	2038	0.6050	0.4363	0.3166	($11,528,816)	$54,809,439	($8,314,087)	$39,691,137	($6,033,096)	$28,964,043
14	2039	0.5874	0.4155	0.2959	($11,193,432)	$53,474,809	($7,917,724)	$37,996,037	($5,638,639)	$27,226,629
15	2040	0.5703	0.3957	0.2765	($10,867,576)	$52,170,786	($7,540,417)	$36,373,885	($5,268,955)	$25,589,288
16	2041	0.5537	0.3769	0.2584	($10,551,248)	$50,905,616	($7,182,166)	$34,833,562	($4,924,043)	$24,061,286
17	2042	0.5375	0.3589	0.2415	($10,242,543)	$49,655,446	($6,839,160)	$33,342,717	($4,601,998)	$22,619,793
18	2043	0.5219	0.3418	0.2257	($9,945,271)	$48,446,963	($6,513,305)	$31,919,374	($4,300,915)	$21,264,998
19	2044	0.5067	0.3256	0.2109	($9,655,621)	$47,262,345	($6,204,599)	$30,564,529	($4,018,888)	$19,988,938
20	2045	0.4919	0.3101	0.1971	($9,373,594)	$46,102,206	($5,909,233)	$29,260,916	($3,755,917)	$18,793,007
21	2046	0.4776	0.2953	0.1842	($9,101,095)	$44,982,740	($5,627,205)	$28,015,806	($3,510,096)	$17,675,563
22	2047	0.4637	0.2812	0.1722	($8,836,218)	$43,882,053	($5,358,517)	$26,816,915	($3,281,425)	$16,624,586
23	2048	0.4502	0.2678	0.1609	($8,578,963)	$42,807,408	($5,103,168)	$25,671,893	($3,066,093)	$15,629,203
24	2049	0.4371	0.2551	0.1504	($8,329,331)	$41,759,186	($4,861,159)	$24,581,512	($2,866,006)	$14,699,631
25	2050	0.4243	0.2429	0.1406	($8,085,416)	$40,728,457	($4,628,677)	$23,527,754	($2,679,259)	$13,827,468
26	2051	0.4120	0.2314	0.1314	($7,851,028)	$39,734,692	($4,409,534)	$22,530,350	($2,503,944)	$13,004,136
27	2052	0.4000	0.2204	0.1228	($7,622,358)	$38,759,274	($4,199,919)	$21,570,949	($2,340,064)	$12,230,300
28	2053	0.3883	0.2099	0.1147	($7,399,404)	$37,802,674	($3,999,832)	$20,650,285	($2,185,711)	$11,497,216
29	2054	0.3770	0.1999	0.1072	($7,184,072)	$36,869,722	($3,809,273)	$19,763,795	($2,042,792)	$10,809,987
30	2055	0.3660	0.1904	0.1002	($6,974,457)	$255,734,949	($3,628,242)	$133,250,311	($1,909,401)	$70,333,942
TOTALS					($2,015,703,623)	$1,800,416,014	($1,847,293,212)	$1,259,587,578	($1,714,796,549)	$916,756,579
3% Discount		($215,287,609)			**B/C Ratio:**	0.89	**B/C Ratio:**	0.68	**B/C Ratio:**	0.53
5% Discount		($587,705,634)			**NPV:**	($215,287,609)	**NPV:**	($587,705,634)	**NPV:**	($798,039,969)
7% Discount		($798,039,969)								

CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	Capital Costs[1] (Design/Const)	O&M Costs[2]	Farm Crops Production Loss Costs[3]	Ecological Acreage Loss (Project)	Ecological Value Per Acre	Ecological Land Loss Costs[4]	Ecological Acreage Loss Induced Development	Ecological Value Per Acre	Ecological Land Loss Induced Development Costs[4]	Chicago UZA Estimated Population	Chicago UZA Estimated AVMT-No Build	Per Capita VMT	AVMT Change[5]	Proportion Auto Traffic	Auto AVMT Change	VMT Value	Auto VMT Benefits[5]

Benefit-cost analysis (BCA) of the proposed Chicago Transit Authority (CTA) Red Line Extension from 95th Street to 130th Street in Chicago. The analysis assumes construction from 2022-2025, passenger operations beginning in 2026 and covers operations of 30 years through 2055. Sources of information are primarily the following public documents: CTA Draft Environmental Assessment (DEIS), dated October 2016 (http://www.rmapil.org/assets/documents/nicti_draft_ea.pdf); U.S. Department of Transportation, TIGER Benefit-Cost Analysis Resource Guide (TIGER Guide), dated March 2015 (https://www.transportation.gov/policy-initiatives/tiger/tiger-benefit-cost-analysis-bca-resource-guide). Other sources are identified in these notations. All figures are in 2018 dollars.

1. Capital Costs: According to the DEIS (page 9-1), the total estimated capital construction cost is at least $1,716,000,000 (2015) or $1,812,005,000 (2018$). It is assumed that the funds will be spent over four years from 2022-2025 at an average of $453,001,250 per year. Capital costs could be substantially higher as construction costs tend to outpace inflation as documented in the DEIS (pages 9-1 to 9-4).

2. Operating and Maintenance (O&M) Costs: The DEIS (pages 9-8 to 9-9) estimates annual O&M costs at $17.4M (2015$) or $18,373,480M (2018$). Park and ride O&M costs are not included as the CTA presumes a private contractor will manage them.

3. Farm Crops Production Costs: Not applicable.

4. Ecological Acreage Loss Costs: A calculation is not made as much of the right of way for the Project is predominantly within or adjacent to existing expressways and a rail line. Further, it is assuumed that projected wetland losses will be fully mitigated. Ecological losses due to induced development are not calculated due to a lack of credible information.

5. Vehicle Miles Traveled: Chicago UZA population is estimated for 2020 based upon the 2010 Census population of 8,608,208 and the 3.6% increase from 2000-2010. A 0.36% annual increase is assumed. Annual vehicle miles traveled data (AVMT) is derived from the IDOT Eisenhower Expressway Reconstruction Expansion DEIS 2040 estimates. This is included for informational purposes only as the data has no practical application for the CTA RLE BCA. According to Appendix W of the DEIS (page 1-1), the estimated reduction in regional vehicle miles traveled (VMT) for the build alternatives ranges from 11.4 to 19.6 million. Incremental increases over time are assumed accordingly in the BCA. The per mile operating costs of average sedans, SUVs, and minivans assumed is $0.68 based on AAA's Your Driving Costs (2017). The variable rate (non-fixed) of this cost assumed is $0.2754 (2018$). Per the DEIS (page 9-8), annual reductions of CTA bus miles due to the Project are expected in the amount of 276,451. According to the National Transit Database, 2013 National Transit Profile Summary, average operating expenses for buses per vehicle revenue mile were $10.60 ($11.23 in 2018$).

5a. Productivity Increase: Increased train estimated annual miles is 686,188 based on the DEIS (page 9-8)(5,489,502/8). Train passengers that otherwise would have driven a car have the potential to increase productivity. An assumption is made that reduced VMT is based on an average of 10 miles per trip, one person per car, these drivers opt to ride the train, and 20% of them opt to work 1/2 hour on each train trip. According to the TIGER Guide the value of time for business purposes is $25.23 (2013 $) or $27.22 (FY2018 $).

6. Noise: The TRB Transportation Benefit-Cost Analysis web site provides noise impact values per VMT for vehicles from several studies [bca.transportationeconomics.org, referencing: Todd Litman (2010), "Noise," Transportation Cost and Benefit Analysis, Victoria Transport Policy Institute (www.vtpi.org), available at www.vtpi.org/tca/tca0511.pdf]. Dollar values for noise impacts in these cited studies show the following ranges per VMT (converted to 2018 $): heavy trucks ($0.035-$0.26); and auto ($0.001 and $0.028). Mid-levels of $0.1558 for trucks (and buses) and $0.0153 for autos are used. Additionally, in the VTPI document, the following study is cited which includes values for passenger train noise: M. Maibach, et al. (2008), Handbook on Estimation of External Cost in the Transport Sector, CE Delft (www.ce.nl) Table 22 p 69. The average proportion noise values for cars (day, night, urban, suburban, rural) in this study are compared to the same for passenger trains. The latter monetized value is about 65 times that of automobiles. Consequently, $0.0153 (value used for autos) X 65 is used to determine an estimated value of $0.9945 for passenger train noise per mile.

The following reference is used for NOx, PM10, PM2.5, and VOC emission rates per VMT: Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks, U.S. EPA, Office of Transportation and Air Quality, April 2008 (AAE) (http://www.epa.gov/otaq/consumer/420f08024.pdf);

7. CO2: According to the DEIS, Appendix U, Table 5-3, the UPRR Alternative will reduce CO2 emissions from the no-build alternative by 12,152 tons per year which equates to 11,024 metric tons (MT). Social cost of carbon (SCC) values are obtained from the TIGER BCA Guide. The data is then multiplied for each year by the social cost of carbon (SCC) values converted from 2013 $ to 2018$. Per the guidance, the CO2 values are only discounted at the 3 percent rate but are also used in the 5 and 7 percent benefit columns as disbenefits.

8. NOx: The AAE value of 0.693 grams per VMT is used and multiplied by auto/light truck AVMT reduced and then divided by 1,000,000 (grams to MT factor) to calculate the reduction for automobiles/light trucks annually.

9. PM10 and PM2.5: The AAE respective values of 0.0044 and 0.0041 grams per VMT are used and multiplied by auto/light truck AVMT reduced and then divided by 1,000,000 (grams to MT factor) to calculate the reduction for automobiles/light trucks annually.

10. VOC: The AAE value of 1.034 grams per VMT is used and multiplied by auto/light truck AVMT reduced and then divided by 1,000,000 (grams to MT factor) to calculate the reduction for automobiles/light trucks annually.

11. Resource Consumption Costs: These are external costs of transport resource production (primarily petroleum) or the social benefits of resource conservation. These include military security costs for foreign oil, trade deficits from its import, environmental damages from oil extraction, oil company tax subsidies, and human health risks from injuries and pollution during extraction. Depletion of non-renewable resources for future generations is an externality as well although it is not costed. See the VTPI Transportation Cost and Benefit Analysis II - Resource Consumption External Costs (http://www.vtpi.org/tca/tca0512.pdf). The VTPI, Transportation Cost Analysis Spreadsheet has default cost values per VMT as follows in 2007 $ for average travel: average car $0.039 ($0.047 in 2018 $); light truck/van $0.050 ($0.059 in 2018 $). Based on the DEIS, Appendix W, a calculation is not made as changes in energy energy useage due to the Project are less than the margin of error.

12. Parking Costs: The VTPI, Transportation Cost Analysis Spreadsheet has default parking cost values per VMT as follows in 2007 $ for average travel: car/pickup/van $0.064 ($0.072 2015 $) (internal); $0.060 ($0.068 2015 $)(external) for a total of $0.124 ($0.1478 in 2018 $). Internal costs are paid directly by users for residential parking while external costs are off-street parking paid by non-users through increased bundled goods costs and services that includes free/reduced cost parking. The Project does not affect residential parking. There could be some potential benefit in external parking due to passengers arriving at their destination and not needing parking. However, this could be completely offset by station parking lots where passengers board trains. Therefore, no benefit or cost is assigned.

R. Arkell, AICP
8/28/2018

CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	Proportion Heavy Tk	Diesel Bus VMT Decrease	VMT Value	Diesel Bus VMT Benefits[5]	Train Miles Traveled	Annual Ridership	Auto Drivers Convert to Riding Train	Assumed 20% Drivers Working 1/2 hr on train	Productivity Rate Per Hour	Increased Worker Productivity Benefits[5a]	Auto Noise Value (per VMT)	Auto Noise Benefits[6]	Bus Noise Value (per VMT)	Bus Noise Benefits[6]	Train Noise Value (per VMT)	Train Noise Costs[6]	CO_2 Change (MT)	CO_2 Value (per MT)	Undiscounted CO2 Value @ 3% Avg SCC

13. Health Costs: The VTPI Spreadsheet has default health cost values per VMT as follows in 2007 $ for average reductions as follows: walking: $0.24 (internal)($0.28109 2018 $); $0.24 (external)($0.28109 2018 $); bicycling $0.095 (internal)($0.11615 2018 $); $0.095 (external)($0.11615 2018 $). Internal cost reduction is reflected through extended lives and reduced mortality rates. External cost reduction is shown through reduced hospital and health care costs. For this BCA, one-half of the benefits are assigned to walking and one-half to bicycling for both internal and external. Benefits only relate to changes in VMT due to the project which assumes drivers converting to walking or bicycling to the RLE.

14. Barrier Effects: These are delay costs to non-motorized travel caused by motorized travel. See the VTPI Transportation Cost and Benefit Analysis II - Barrier Effect publication (http://www.vtpi.org/tca/tca0513.pdf). The VTPI, Transportation Cost Analysis Spreadsheet has default barrier effect cost values per VMT as follows in 2007 $ for average travel: car/pickup/van $0.014 ($0.0169 in 2018 $) and diesel bus $0.023 ($0.02745 in 2018 $). It is assumed that diesel buses and heavy trucks have the same values. The VMT reduction is multiplied by these values accordingly.

15. Transport Diversity: According to the VTPI Transportation Cost Analysis Spreadsheet, the value per VMT for transportation diversity is $0.007 in 2007 $ ($0.00845 in 2018 $). This represents the benefits of improving transportation options brought about by the Project that reduces overall transportation costs for the public. Additionally, the value measures the extent disadvantaged populations (elderly, low income, minority) are unable to travel due to increased accessibility brought about by improved mode choice.

16. Uncompensated Moving Costs: Not applicable.

17. Travel Time Savings: The TIGER Guide hourly value of time for all purposes is $14.02 (2018$)(personal and business). The DEIS states that the Project is expected to generate 42,000 daily weekday transit trips (page 9-12). The DEIS states (page 2-6) that transit times will be improved from between 14 to 28 minutes from the Project area to points north of 95th Street (page 2-6). For the BCA, it is assumed that average transit travel time savings per trip is 21 minutes (although it is acknowledged that the savings for trips solely in the project area are likely less). Estimated annual ridership is as follows: 42,000 x 260 weekdays = 10,920,000. Based upon 2016 CTA rail ridership data (transitchicago.com/facts/), this amount represents about 83% of rides. To capture weekend trips 10,920,000/0.83 = 13,156,627 total annual rides. 13,156,627 x 21 minutes = 276,289,157 annual minutes saved.
Increased Land Value: The TIGER Guide states the following: "1) The benefit of any property value increase can only be considered as a one-time stock benefit and cannot be treated as a stream of benefits accruing annually; 2) It cannot include any investment by developers; 3) Other benefits to land value already counted, such as travel time savings, must also be netted out." According to Capturing the Value of Transit by Reconnecting America's Center for TOD (2008), studies have shown ranges of residential property increases as follows: residential land, 2-45%; and office/retail, 1-167% within a 1/4-mile radius of TOD. Property value data and estimates of changes were not made to determine if any potential total land value increases exceed the value of travel time savings.

18. Accident Reduction Benefits: According to the 2010 Illinois Crash Statistics publication (http://www.idot.illinois.gov/Assets/uploads/files/Transportation-System/Resources/Safety/Crash-Reports/crash-facts/2010%20Crash%20Facts.pdf), page 10, totals for the state are as follows: 105.74B VMT; 289,260 crashes; and 927 fatalities. The crash rate is 1 accident per 365,561 VMT. This rate is multiplied by the annual VMT savings due to the Project to estimate annual accident reduction. The fatality/crash ratio is 0.0032047 based on the 2010 data.

According to the DEIS (PAGE 9-8), the Project will result in a reduction of 276,452 CTA bus miles per year. According to CTA 2016 Performance Measures (https://www.transitchicago.com/assets/1/6/Performance_Metrics_-_December_2016.pdf), the 2016 annual bus incident rate per 100,000 miles is 0.555. Thus, 276,452 X (0.555/100000) = 1.53 bus incidents decreased annually.

The Project adds 5.3 miles to the CTA rail system (10.6 due to doubletrack) which is an increase in track mileage of about 4.7% from the existing 224.1 miles. An assumption is made that train miles traveled will increase accordingly. According to CTA 2016 Performance Measures (https://www.transitchicago.com/assets/1/6/Performance_Metrics_-_December_2016.pdf), the 2016 annual rail incident rate per 100,000 miles is 0.074. CTA trains make about 2,318 trips a day over 224.1 miles of track on 8 routes. It is assumed that 1 train trip covers 112 miles/8 = 14 miles per trip. Thus 2,318 X 14 = 32,452 train miles daily or 11,844,980 train miles annually. 11,844,980 X 4.7% = 556,714 additional train miles due to the Project. Thus, 556,714 X (0.074/100000) = 0.412 rail incidents increased annually.
The TIGER BCA Guide identifies the value of a statistical life as about $9.2M in 2013 $ or $9.75M in 2018 $. The guide also states that the growth rate in this metric is about 1.18 percent above inflation. This amount is increased annually by 1.18 percent.

The estimates of injury severity is based in part on the TIGER Guide, Section 3. Accordingly, the data on number of road accidents reduced is converted to the Abbreviated Injury Scale (AIS) to determine estimated level of injury by severity rates (none, minor, moderate, serious, severe, critical). The AIS format is also used for bus and train accidents.

19. The expected life of the Project elements were obtained from *Transport infrastructure evaluation using cost-benefit analysis: improvements at evaluating the asset through residual value a case study.* Massachusetts Institute of Technology, Engineering Systems Division, ESC-WP-2013-21, updated August 2014 (http://esd.mit.edu/WPS/2013/esd-wp-2013-21.pdf). Project element costs are based upon the August 2009 CTA Locally Prefferred Alternatives Report, Table 6.14, LPA Capital Costs for percentage breakdowns based upon the total cost of $1,812,005,000 in 2018$.
a. 4 Stations, 50% after 30 years (60 years life): $317,100,875 (17.5% of capital costs) X 50% useful life = **$158,550,438**.
b. Permanent Way (tracks, ballast), 20% after 30 years (38 years life): $371,461,025 (20.5% of capital costs) X 20% = $74,292,205. Given that the Project ROW is elevated, the criteria for bridges is used instead, 50% after 30 years (60 years life): $371,461,025 (20.5% of capital costs) X 50% = **$185,730,513**.
c. Systems/Signaling/Safety, 50% after 30 years (60 years useful life): $264,552,730 (14.6% of capital costs) X 50% = **$132,276,365**.
d. Land (150 years useful life): $65,232,180 (3.6% of capital costs) X 80% useful life = **$52,185,744**.
e. Sitework/Easthwork (60 years life): $43,488,120 (2.4% of capital costs) X 50% = **$21,744,060**.
f. Yards, Shops, Admin. Bldgs., (50 years life): CTA does not consider replacement of the 98th Street facility as part of the Project.
g. Vehicles, 0% after 30 years (30 years useful life): $362,401,000 (20.0% of capital costs) X 0% useful life = **$0** [FTA circular 5010.1D p. IV-18 states that rail cars have a useful life of at least 25 years (30 years useful life is assumed)].
h. The above totals 78.6% of capital costs. Professional services is 15.8% with the remaining 5.6 % as unallocated contingency **($50,000,000** is arbitrarily added to to the total residual value to account for this.).**Thus, the total residual value after 30 years is $600,487,120.**

CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	NPV CO2 Benefits @ 3% Avg SCC[7] [Undisc/(1.03^A)]	NO_x Change Auto (MT)	NO_x Value (per MT)	NO_x Benefits[8]	PM_{10} Change Auto (per MT)	$PM_{2.5}$ Change Auto (per MT)	PM Value (per MT)	PM Benefit[9]	VOC Change Auto (MT)	VOC Value (per MT)	VOC Benefits[10]	Resource Externalities Value	Resource Consumption Benefits[11]	Parking Internal + External Benefits Value	Total Parking Benefits[12]	Walking Health Costs Value - External	Bicycling Health Costs Value - External	Health Benefits - Increased Cardivascular Activity[13]

CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	Walking Mortality Costs Value - Internal	Bicycling Mortality Costs Value - Internal	Mortality Benefits - Increased Cardivascular Activity[13]	Barrier Effect Value-Car	Barrier Effect Value-Heavy Bus	Barrier Effect Benefits[14]	Transport Diversity Value	Transport Diversity Benefits-Auto[15]	Uncompensated Moving Costs Value per HH	Number of HHs	Uncompensated HH Displacement Moving Costs[16]	Average Travel Time Savings Per Train Rider (hrs)	Time Value (per hr)	Travel Time Savings[17]	Property Value Increase Less Travel Time Savings Benefit	Road Accidents Reduced	CTA Bus Accidents Decreased	CTA Train Accidents Increased	Total Change in Accidents

CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	Value of Statistical Life	Road Death/ Crash Ratio	Deaths Reduced	Deaths Prevented Benefits	No Injury AIS 0 0.43676 * $0	Minor AIS 1 0.41739 * $27,700	Moderate AIS 2 0.08872 * $433,965	Serious AIS 3 0.04817 * $969,496	Severe AIS 4 0.00617 * $2,456,056	Critical AIS 5 0.00279 * $5,475,343	Injuries Prevented Benefits Accidents*$\sum$[Pr(AIS_x)*Value (AIS_x)]	Property Damage Only $3,425 per Accident[18]	Total Accident Death/ Injury/PDO Benefits[18]	Residual Value[19]

R. Arkell, AICP
8/28/2018

CHICAGO TRANSIT AUTHORITY
RED LINE EXTENSION
BENEFIT-COST ANALYSIS (2018 $)

Year	Calendar Year	Discount Factor (3%)	Discount Factor (5%)	Discount Factor (7%)	NPV Costs (3% Discount)	NPV Benefits (3% Discount)	NPV Costs (5% Discount)	NPV Benefits (5% Discount)	NPV Costs (7% Discount)	NPV Benefits (7% Discount)