F Unit Price Regional & Escalation Analysis

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Rocky Mountain Rail Authority
High Speed Rail Feasibility Study
Capital Cost Estimate
Unit Price Development
March 13, 2008

The principals of Quandel Consultants, LLC developed unit costs for the design and construction of high speed passenger rail infrastructure on a series of previous planning projects. Initially the unit costs were applied to planned construction of the Midwest Regional Rail Initiative. Later the costs were applied to capital cost estimates for high speed rail in Florida, Ohio, Minnesota and California.

The base set of unit costs addresses typical passenger rail infrastructure construction elements including: roadbed and trackwork, systems, facilities, structures, and grade crossings.

The unit costs have been evaluated by peer panels, freight railroads and contractors. The values have been found to be reasonable for developing the capital costs under normal contractor bidding procedures and under railroad force account agreements for construction. It should be noted that in two cases the costs have not been sufficient, specifically:

- DBOM procurement, where the contractor takes on large future operating risks and seeks to front load the risk in the initial construction
- Rail alignments constructed in narrow highway medians under congested urban traffic

The unit costs were developed and evaluated in the period between January 2000 and June 2002. Two questions must be considered in applying these costs to high speed rail planning in Colorado:

1. Relative Costs: Are the costs reasonable for rail construction in Colorado considering local costs of materials and labor?
2. Cost Escalation: How should the costs be escalated from the nominal June 2002 values to current values considering the historical changes in construction costs?

A variety of indices are employed to monitor construction costs throughout the United States. However, no publicly available index exists for rail construction. In addition, relatively few recent examples of completed intercity passenger rail construction are found. This is especially true for high speed applications.

Relative Costs:

Engineering News Record tracks a Building Cost index and a more general Construction Cost Index in major cities and averages the values to produce national indices. It is reasonable to assume that the Construction Cost Index is a better indicator of regional cost differences for a transportation project than the Building Cost Index. The Construction Cost Index (CCI) is calculated as the sum of 200 hours of local (union) common labor including fringes plus the local cost of 1.128 tons of Portland cement plus the national average price of 25cwt of fabricated structural steel. The Construction Cost indices from 1990 to 2008 indicate that construction costs in Denver have been typically 20-30% lower than national construction costs and 25-40% lower than an arbitrary average of costs in the Midwest. However, Kansas City has had a consistently lower CCI than Denver over the period.

To some extent, the construction cost of relatively specialized products and systems is independent of local regional costs. In the case of railroad construction, the costs of key materials such as rail, concrete

ties and signal equipment are relatively uniform throughout the country. Similarly, the cost of skilled labor and mechanized track laying systems will be similar in all locations. These factors tend to diminish the regional construction cost differences.

Cost Escalation:

Multiple State DOTs prepare periodic highway construction cost indices based on the tabulated bid prices of earthwork, asphalt pavement, concrete pavement, structural concrete, reinforcing steel and structural steel to assemble a composite index tied to base year costs in 1987. The State of Washington publishes the indices for the states of Washington, California, Colorado, Oregon, South Dakota, Utah and an FHWA composite. (The FHWA discontinued preparing the composite index in 2006). This data cannot be used to compare the absolute costs of highway construction among states, but may be used to compare the price trends. Comparing the indices over the 6 year period from 2002 to 2008, the Colorado index has outpaced the others, increasing by a factor of 2.21 compared to an average of 1.91 for the six states.

The Bureau of Labor Statistics prepares a variety of monthly, national Producer Price Indices, which are often used for escalation cost adjustments in construction projects. Two such indices may be suitable for our application, the Highway and Street Construction Index (PCUBHWY) and the Other Heavy Construction Index (PCUBHVY). A computation of escalation from June 2002 to January 2009 using either index yields similar results (HWY=51%, HVY=44%), but as the highway index is heavily influenced by the costs of petroleum products such as asphalt, it is reasonable to assume that the Other Heavy Construction Index is more suitable for our purpose.

Unit Price Adjustment:

Based on the available data, it is reasonable to believe that the June 2002 unit costs developed for the Midwest can be adjusted downward for use in Colorado during the same time period. Considering the regional CCI difference and the relative uniformity of railroad material prices, an adjustment factor of 0.85 is reasonable.

While the BLS PPI suggests a national escalation factor of 1.44 for the period, the coincident Colorado DOT highway cost escalation factor of 2.21 is significant and suggests that construction cost escalation in Colorado exceeds that represented in the BLS value. The State of Colorado DOT has attributed much of the highway cost escalation to a regional shortage of Portland cement and high worldwide demand for asphalt, petroleum products and steel.

While the cost of rail construction is energy intensive due to the requirement for extensive grading to achieve desirable grades and curves, it is less so than highway construction which uses petroleum products such as asphalt as a construction material. While a precise methodology for discounting the observed Colorado highway cost inflation does not exist, it is reasonable to believe that the regional escalation factor for rail construction over the period lies somewhere between the BLS PPI value of 1.44 and the CDOT value of 2.21. An average of the two values yields 1.825.

Therefore the unit cost adjustment value considering regional cost differences and inflation from June 2002 to January 2009 is computed as follows:

New Unit Cost = Original Unit Cost x 0.85 x 1.825 or Original Unit Cost x 1.55

ENR Construction Cost Index

The construction cost index for ENR's individual cities use the same components and weighting as those for the 20-city national indexes. The city indexes use local prices for portland cement and 2 X 4 lumber and the national average price for structural steel. The city's CCI uses local union wages, plus fringes, for laborers. Year 1913=100.

		Denver		National		Chicago	Kansas City	Cincinatti	St Louis	Midwest Coarse Avg	Ratio Denver National	Ratio Denver Midwest
1990	**Dec.**	3668		4777		4999	4764	4934	5091	4947	77%	74%
1991	**Dec.**	3715		4889		5384	4762	5011	5172	5082	76%	73%
1992	**Dec.**	3834		5059		5644	4956	5209	5316	5281	76%	73%
1993	**Dec.**	4012		5310		5963	5224	5345	5765	5574	76%	72%
1994	**Dec.**	4009		5439		6178	5305	5504	5947	5733	74%	70%
1995	**Dec.**	4088		5524		6334	5370	5451	6054	5802	74%	70%
1996	**Dec.**	4334		5744		6743	5653	5489	6302	6047	75%	72%
1997	**Dec.**	4329		5858		6626	5909	5585	6475	6149	74%	70%
1998	**Dec.**	4470		5991		7087	5981	5641	6599	6327	75%	71%
1999	**Dec.**	4498		6127		7465	6000	5889	6806	6540	73%	69%
2000	**Dec.**	4767		6283		7748	6221	6045	6851	6716	76%	71%
2001	**Dec.**	4663		6390		7680	6477	5858	7048	6766	73%	69%
2002	**Dec.**	4744		6563		7965	6782	6156	7197	7025	72%	68%
2003	**Dec.**	5015		6782		8348	6972	6287	7414	7255	74%	69%
2004	**Dec.**	5450		7308		9351	8020	6997	7882	8063	75%	68%
2005	**Dec.**	5552		7647		10126	8125	7108	8449	8452	73%	66%
2006	**Dec.**	5714		7888		10523	8705	7416	8537	8795	72%	65%
2007	**Dec.**	5747		8089		11138	8975	7588	8749	9112	71%	63%
2008	**Dec.**	5936		8551		11858	9392	7924	9044	9554	69%	62%

CONSTRUCTION COST INDICES

YEAR	WASHINGTON 1990 = 110	FHWA 1987 = 100	CALIFORNIA 1987 = 100	COLORADO 1987 = 100	OREGON 1987 = 100	SOUTH DAKOTA 1987 = 100	UTAH 1987 = 100
1990	110	109	114	103	107	112	128
1991	121	108	108	111	119	114	126
1992	108	105	107	111	109	112	126
1993	106	108	113	115	115	117	151
1994	105	115	119	119	112	120	135
1995	124	122	115	122	138	133	166
1996	124	120	119	142	135	133	176
1997	139	131	125	140	150	147	163
1998	116	127	129	158	142	149	146
1999	120	137	139	159	155	169	143
2000	128	146	146	171	148	180	132
2001	129	145	154	157	130	153	153
2002	139	148	142	150	164	154	153
2003	145	150	149	154	172	161	127
2004	170	154	216	168	162	202	153
2005	176	184	268	255	206	196	260
2006	228	221	281	256	248	246	294
2007	230	___	261	271	241	268	253
2008	241	___	287	331	283	256	323

WSDOT 2008 index is for the 2008 calendar year

California, Colorado, Oregon, and Utah 2008 CCI is for quarters 1, 2, & 3. South Dakota CCI is for quarters 1 & 2.

WSDOT 2003 and 2004 CCI data points adjusted to correct for spiking bid prices on structural steel

Note: FHWA CCI discontinued in 2007

Washington State Department of Transportation

For more information, please call the WSDOT Construction Office at (360) 705-7822
or visit http://www.wsdot.wa.gov/biz/construction

1/5/2009

Escalation Factor Calculation 2002-2008

	2008	2002	Ratio
Washington	241	139	1.73
California	287	142	2.02
Colorado	331	150	2.21
Oregon	283	164	1.73
South Dakota	256	154	1.66
Utah	323	153	2.11
Average Ratio	1721	902	1.91

ENR Construction Cost Index

The construction cost index for ENR's individual cities use the same components and weighting as those for the 20-city national indexes. The city indexes use local prices for portland cement and 2 X 4 lumber and the national average price for structural steel. The city's CCI uses local union wages, plus fringes, for laborers. Year 1913=100.

		Denver		National		Chicago	Kansas City	Cincinatti	St Louis	Midwest		
1978	Dec.	2564.8								Coarse		
1979	Dec.	2739.1								Avg		
1980	Dec.	2947.1										
1981	Dec.	3200.6										
1982	Dec.	3445.7										
1983	Dec.	3690.2										
1984	Dec.	3106.4										
1985	Dec.	3316.2										
1986	Dec.	3503.4										
1987	Dec.	3507.0										
1988	Dec.	3538.3										
1989	Dec.	3641.8										
1990	Dec.	3668.2		4777		4999	4764	4934	5091	4947		
1991	Dec.	3715.3		4889		5384	4762	5011	5172	5082		
1992	Dec.	3833.6		5059		5644	4956	5209	5316	5281		
1993	Dec.	4012.0		5310		5963	5224	5345	5765	5574		
1994	Dec.	4008.7		5439		6178	5305	5504	5947	5733		
1995	Dec.	4087.8		5524		6334	5370	5451	6054	5802		
1996	Dec.	4334.1		5744		6743	5653	5489	6302	6047		
1997	Dec.	4329.2		5858		6626	5909	5585	6475	6149		
1998	Dec.	4470.4		5991		7087	5981	5641	6599	6327		
1999	Dec.	4498.5		6127		7465	6000	5889	6806	6540		
2000	Dec.	4766.7		6283		7748	6221	6045	6851	6716		
2001	Dec.	4663.1		6390		7680	6477	5858	7048	6766		
2002	Dec.	4744.3		6563		7965	6782	6156	7197	7025		
2003	Dec.	5015.4		6782		8348	6972	6287	7414	7255		
2004	Dec.	5450.3		7308		9351	8020	6997	7882	8063		
2005	Dec.	5551.6		7647		10126	8125	7108	8449	8452		
2006	Dec.	5714.3		7888		10523	8705	7416	8537	8795		
2007	Dec.	5747.0		8089		11138	8975	7588	8749	9112		
2008	Dec.	5935.7		8551		11858	9392	7924	9044	9554		
2009	Jan.	5921.7										
	Feb.	5907.5										
	Mar.	5910.0										

Bureau of Labor Statistics: Producer Price Indices

Series Id: PCUBHVY--BHVY--
Industry: Other heavy construction
Product: Other heavy construction
Base Date: 198606

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1999	132.4	132.2	132.6	133.7	134.2	134.5	135.7	136.2	136.4	136.1	136.3	136.9	134.8
2000	137.8	139	140	139.5	139.3	140.5	140.3	139.8	140.8	140.6	140.4	139.7	139.8
2001	140.1	140.3	139.9	140.5	141.9	141.7	139.7	139.7	140.4	137.9	137.1	136.1	139.6
2002	136.3	136.2	136.7	137.4	137.3	137.5	137.6	137.8	138.1	138.1	137.6	137.4	137.3
2003	138	138.8	139.2	138.8	138.6	138.9	139.2	139.5	140.3	140.3	140.6	141	139.4
2004	143.3	145.3	148.4	151.3	153.8	153.9	155.5	157.9	159	161.5	161.2	159.9	154.2
2005	162.3	163.9	166.4	167.4	166.8	167.8	169.8	171.2	174.1	177.1	173.2	174	169.5
2006	176.3	175.8	177.8	181.5	184	186.4	187.7	188.6	184.4	182.9	182.7	183.5	182.6
2007	182.6	183.9	187.1	190.3	192.6	192.6	194.6	192.3	193.1	193.3	197.4	196.1	191.3
2008	197.9	199.7	205.3	210.1	216.9	222.5	227.3	224.7	225.3	216.5(p)	206.0(p)	198.8(p)	212.6(p)
2009	198.0(p)												

p : Preliminary. All indexes are subject to revision four months after original publication.

PCUBHVY Computation	Jan 09	198	Ratio	1.44	
	Jun 02	137.5			

Series Id: PCUBHWY--BHWY--
Industry: Highway and street construction
Product: Highway and street construction
Base Date: 198606

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1999	122.8	122.6	123.3	125.4	125.9	126	126.9	128.1	129	128.8	129.6	130.7	126.6
2000	132	134	136	135.6	135.8	137.6	137.1	136.6	138.9	138.5	138.4	137.3	136.5
2001	137.8	138.2	137.4	138.5	139.9	138.8	136.6	137	138.4	135.4	134.1	132.4	137
2002	132.9	132.4	132.7	133.3	133.8	133.9	134.1	134.2	134.4	134.4	133.9	133.7	133.7
2003	134.7	135.7	136.8	137.1	137	136.9	136.7	136.9	136.8	136.7	137.1	137.2	136.6
2004	140.5	141.2	142.5	145.2	147.9	147	149.2	150.5	151.8	155.5	155.4	152	148.2
2005	154.3	156.5	160.4	162.9	162.4	163.7	167.6	170	176.1	180.8	173.1	173.4	166.8
2006	177.5	175.9	179.4	185.4	187.9	190.4	191.8	192.9	185.9	183.2	182.9	184.1	184.8
2007	183.1	185.2	190	194.6	197.6	196.8	200	195.9	197.5	197.5	204.9	202.7	195.5
2008	204.7	205.9	213.8	218.5	227.3	234.4	243.5	239.3	241.1	227.4(p)	212.4(p)	201.0(p)	222.5(p)
2009	201.8(p)												

ENR Cost Indices		BCI		CCI	
City Cost Index - Chicago					
1990	Dec.	2893.6	1.3	4999	0.8
1991	Dec.	3034.72	4.9	5384	7.7
1992	Dec.	3162.99	4.2	5644	4.8
1993	Dec.	3347.46	5.8	5963	5.7
1994	Dec.	3415.62	2	6178	3.6
1995	Dec.	3446.51	0.9	6334	2.5
1996	Dec.	3738.78	8.5	6743	6.5
1997	Dec.	3621.15	-3.2	6626	-1.7
1998	Dec.	3809.94	5.2	7087	7
1999	Dec.	4029.25	5.8	7465	5.3
2000	Dec.	4167.18	3.4	7748	3.8
2001	Dec.	4135.3	-0.8	7680	-0.9
2002	Dec.	4221.9	2.1	7965	3.7
2003	Dec.	4421.79	4.7	8348	4.8
2004	Dec.	4821.71	9	9351	12
2005	Dec.	5113.15	6	10126	8.3
2006	Dec.	5367.5	5	10523	3.9
2007	Dec.	5582.09	4	11138	5.9
2008	Dec.	5905.54	5.8	11858	6.5
City Cost Index - Cincinnati					
1990	Dec.	2638.73	1.9	4934	1.2
1991	Dec.	2674.15	1.3	5011	1.6
1992	Dec.	2817.16	5.4	5209	4
1993	Dec.	2892.78	2.7	5345	2.6
1994	Dec.	3001.15	3.8	5504	3
1995	Dec.	2942.02	—2.0	5451	—1.0
1996	Dec.	2977.85	1.2	5489	0.7
1997	Dec.	3103.51	4.2	5585	1.8
1998	Dec.	3130.94	0.9	5641	1
1999	Dec.	3245.02	3.6	5889	4.4
2000	Dec.	3377.42	4.1	6045	2.7
2001	Dec.	3190.66	-5.5	5858	-3.1
2002	Dec.	3333.19	4.5	6156	5.1
2003	Dec.	3429.28	2.9	6287	2.1
2004	Dec.	3845.89	12.2	6997	11.3
2005	Dec.	4003.69	4.1	7108	1.6
2006	Dec.	3898.44	–2.6	7416	4.3
2007	Dec.	3988.78	2.3	7588	2.3
2008	Dec.	4201.04	5.3	7924	4.4
2009	Jan.	4188.79	5	7911	4.2
	Feb.	4174.54	4.6	7897	4.1
	Mar.	4177.04	4.3	7900	3.9

City Cost Index Kansas City					
1990	Dec.	2645.28	1.6	4764	0.9
1991	Dec.	2637.2	-0.3	4762	0
1992	Dec.	2677.21	1.5	4956	4.1
1993	Dec.	2874.34	7.4	5224	5.4
1994	Dec.	2916.25	1.5	5305	1.5
1995	Dec.	2889.17	-0.9	5370	1.2
1996	Dec.	3202.29	10.8	5653	5.3
1997	Dec.	3343.32	4.4	5909	4.5
1998	Dec.	3304.51	-1.2	5981	1.2
1999	Dec.	3415.89	3.4	6000	0.3
2000	Dec.	3436.62	0.6	6221	3.7
2001	Dec.	3516.74	2.3	6477	4.1
2002	Dec.	3607.87	2.6	6782	4.7
2003	Dec.	3711.13	2.9	6972	2.8
2004	Dec.	4300.41	15.9	8020	15
2005	Dec.	4428.85	3	8125	1.3
2006	Dec.	4715.49	6.5	8705	7.1
2007	Dec.	4780.99	1.4	8975	3.1
2008	Dec.	5135.71	7.4	9392	4.7
2009	Jan.	5164.03	8	9680	7.8
	Feb.	5149.78	7.7	9665	7.7
	Mar.	5152.28	7.4	9668	7.5
City Cost Index St Louis					
1990	Dec.	2602.16	-0.9	5091	-0.8
1991	Dec.	2686.93	3.3	5172	1.6
1992	Dec.	2743.01	2.1	5316	2.8
1993	Dec.	3034.48	10.6	5765	8.5
1994	Dec.	3091.81	1.9	5947	3.2
1995	Dec.	3089.59	-0.1	6054	1.8
1996	Dec.	3253.4	5.3	6302	4.1
1997	Dec.	3325.68	2.2	6475	2.7
1998	Dec.	3394.54	2.1	6599	1.9
1999	Dec.	3505.65	3.3	6806	3.1
2000	Dec.	3463.92	-1.2	6851	0.7
2001	Dec.	3540.7	2.2	7048	2.9
2002	Dec.	3556.96	0.5	7197	2.1
2003	Dec.	3772.85	6.1	7414	3
2004	Dec.	4071.93	7.9	7882	6.3
2005	Dec.	4306.73	5.8	8449	7.2
2006	Dec.	4437.08	3	8537	1
2007	Dec.	4509.06	1.6	8749	2.5
2008	Dec.	4705.5	4.4	9044	3.4
2009	Jan.	4687.81	3.9	9027	3.2
	Feb.	4673.56	4.1	9012	3.3
	Mar.	4676.06	3.8	9015	3.1

Bureau of Labor Statistics: Producer Price Indices

Series Id: PCUBHVY--BHVY--
Industry: Other heavy construction
Product: Other heavy construction
Base Date: 198606

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1999	132.4	132.2	132.6	133.7	134.2	134.5	135.7	136.2	136.4	136.1	136.3	136.9	134.8
2000	137.8	139	140	139.5	139.3	140.5	140.3	139.8	140.8	140.6	140.4	139.7	139.8
2001	140.1	140.3	139.9	140.5	141.9	141.7	139.7	139.7	140.4	137.9	137.1	136.1	139.6
2002	136.3	136.2	136.7	137.4	137.3	137.5	137.6	137.8	138.1	138.1	137.6	137.4	137.3
2003	138	138.8	139.2	138.8	138.6	138.9	139.2	139.5	140.3	140.3	140.6	141	139.4
2004	143.3	145.3	148.4	151.3	153.8	153.9	155.5	157.9	159	161.5	161.2	159.9	154.2
2005	162.3	163.9	166.4	167.4	166.8	167.8	169.8	171.2	174.1	177.1	173.2	174	169.5
2006	176.3	175.8	177.8	181.5	184	186.4	187.7	188.6	184.4	182.9	182.7	183.5	182.6
2007	182.6	183.9	187.1	190.3	192.6	192.6	194.6	192.3	193.1	193.3	197.4	196.1	191.3
2008	197.9	199.7	205.3	210.1	216.9	222.5	227.3	224.7	225.3	216.5(p)	206.0(p)	198.8(p)	212.6(p)
2009	198.0(p)												

p : Preliminary. All indexes are subject to revision four months after original publication.

Series Id: PCUBHWY--BHWY--
Industry: Highway and street construction
Product: Highway and street construction
Base Date: 198606

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1999	122.8	122.6	123.3	125.4	125.9	126	126.9	128.1	129	128.8	129.6	130.7	126.6
2000	132	134	136	135.6	135.8	137.6	137.1	136.6	138.9	138.5	138.4	137.3	136.5
2001	137.8	138.2	137.4	138.5	139.9	138.8	136.6	137	138.4	135.4	134.1	132.4	137
2002	132.9	132.4	132.7	133.3	133.8	133.9	134.1	134.2	134.4	134.4	133.9	133.7	133.7
2003	134.7	135.7	136.8	137.1	137	136.9	136.7	136.9	136.8	136.7	137.1	137.2	136.6
2004	140.5	141.2	142.5	145.2	147.9	147	149.2	150.5	151.8	155.5	155.4	152	148.2
2005	154.3	156.5	160.4	162.9	162.4	163.7	167.6	170	176.1	180.8	173.1	173.4	166.8
2006	177.5	175.9	179.4	185.4	187.9	190.4	191.8	192.9	185.9	183.2	182.9	184.1	184.8
2007	183.1	185.2	190	194.6	197.6	196.8	200	195.9	197.5	197.5	204.9	202.7	195.5
2008	204.7	205.9	213.8	218.5	227.3	234.4	243.5	239.3	241.1	227.4(p)	212.4(p)	201.0(p)	222.5(p)
2009	201.8(p)												

Construction Cost Index History

HOW ENR BUILDS THE INDEX: 200 hours of common labor at the 20-city average of common labor rates, plus 25 cwt of standard structural steel shapes at the mill price prior to 1996 and the fabricated 20-city price from 1996, plus 1.128 tons of portland cement at the 20-city price, plus 1,088 board ft of 2 x 4 lumber at the 20-city price.

ENR's Construction Cost Index History (1908-2009)

1913=100 * Revised	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVERAGE
1990	4680	4685	4691	4693	4707	4732	4734	4752	4774	4771	4787	4777	4732
1991	4777	4773	4772	4766	4801	4818	4854	4892	4891	4892	4896	4889	4835
1992	4888	4884	4927	4946	4965	4973	4992	5032	5042	5052	5058	5059	4985
1993	5071	5070	5106	5167	5262	5260	5252	5230	5255	5264	5278	5310	5210
1994	5336	5371	5381	5405	5405	5408	5409	5424	5437	5437	5439	5439	5408
1995	5443	5444	5435	5432	5433	5432	5484	5506	5491	5511	5519	5524	5471
1996	5523	5532	5537	5550	5572	5597	5617	5652	5683	5719	5740	5744	5620
1997	5765	5769	5759	5799	5837	5860	5863	5854	5851	5848	5838	5858	5826
1998	5852	5874	5875	5883	5881	5895	5921	5929	5963	5986	5995	5991	5920
1999	6000	5992	5986	6008	6006	6039	6076	6091	6128	6134	6127	6127	6059
2000	6130	6160	6202	6201	6233	6238	6225	6233	6224	6259	6266	6283	6221
2001	6281	6272	6279	6286	6288	6318	6404	6389	6391	6397	6410	6390	6343
2002	6462	6462	6502	6480	6512	6532	6605	6592	6589	6579	6578	6563	6538
2003	6581	6640	6627	6635	6642	6694	6695	6733	6741	6771	6794	6782	6694
2004	6825	6862	6957	7017	7065	7109	7126	7188	7298	7314	7312	7308	7115
2005	7297	7298	7309	7355	7398	7415	7422	7479	7540r	7563	7630	7647	7446
2006	7660	7689	7692	7695	7691	7700	7721	7722	7763	7883	7911	7888	7751
2007	7880	7880	7856	7865	7942	7939	7959	8007	8050	8045	8092	8089	7966
2008	8090	8094	8109	8112*	8141	8185	8293	8362	8557	8623	8602	8551	8310
2009	8549	8533	8534										

Annual Average

1908	97	1931	181	1954	628	1977	2576
1909	91	1932	157	1955	660	1978	2776
1910	96	1933	170	1956	692	1979	3003
1911	93	1934	198	1957	724	1980	3237
1912	91	1935	196	1958	759	1981	3535
1913	100	1936	206	1959	797	1982	3825
1914	89	1937	235	1960	824	1983	4066
1915	93	1938	236	1961	847	1984	4146
1916	130	1939	236	1962	872	1985	4195
1917	181	1940	242	1963	901	1986	4295
1918	189	1941	258	1964	936	1987	4406
1919	198	1942	276	1965	971	1988	4519
1920	251	1943	290	1966	1019	1989	4615
1921	202	1944	299	1967	1074		
1922	174	1945	308	1968	1155		
1923	214	1946	346	1969	1269		
1924	215	1947	413	1970	1381		
1925	207	1948	461	1971	1581		
1926	208	1949	477	1972	1753		
1927	206	1950	510	1973	1895		
1928	207	1951	543	1974	2020		
1929	207	1952	569	1975	2212		
1930	203	1953	600	1976	2401		

		Sandag 2005	2008
Cost Elements	**Unit**	**Unit Cost**	
Right of Way			
Land Acquisition Rural	Mile		$129.0
Land Acquisition Urban	Mile		$387.0
Sub Right of Way			
Guideway & Track			
At Grade Guideway	LF	$3.0	$3.4
Aerial Guideway Type A	LF	$5.9	$6.6
Aerial Guideway Type B	LF	$7.8	$8.8
Bridge	LF	$23.0	$25.8
Tunnel Type A	LF	$30.0	$33.6
Tunnel Type B	LF	$40.0	$44.8
Sub Guideway & Track			
Systems			
Propulsion, C& C Systems	Mile	$16,400	$18,368
Power Distribution	Mile	$1,240	$1,389
Sub Systems			
Maintenance Facilities			
Maintenance Facilities	Sections	$2,750	$3,080
Stations & Parking			
Full Service - New - Low Volume - 500 Surface Park			$ 5,000
Full Service - Renovated - Low Volume- 500 Surface Park			$ 4,000
Terminal - New - Low Volume - 500 Surface Park			$ 7,500
Terminal - Renovated - Low Volume - 500 Surface Park			$ 6,000
Full Service - New- High Volume - Dual Platform - 1000 Surface Park			$ 10,000
Terminal - New- High Volume - Dual Platform - 1000 Surface Park			$ 15,000
Stations & Parking			
Sub Construction Costs			
Contingency	30%		
Other Costs			
Design Engineering	10%		
Insurance and Bonding	2%		
Program Management	4%		
Construction Management & Inspection	6%		
Engineering Services During Construction	2%		
Integrated Testing and Commissioning	2%		
Erosion Control and Water Quality Management	2%		
Sub Other Costs			
Total Infrastructure Costs			
URBAN MAGLEV			
Construction Cost			
Maintenance Facilities			
Station & Parking			
Contingency			
Other Costs			

National ENR Index Denver

2005	7647
2008	8551
Esc	1.118216

COST PER MILE ANALYSIS, AGS COSTS FROM JF SATO			Stations/MF	TOTAL	
Pure	28,994,242	28,994,242	1,391,102	30,385,344	
escalation factor	1.55	2.21		1.66	national inflation
	44,941,075	64,077,275		50,439,671	
30%	13,482,323	19,223,182		15,131,901	
sub	58,423,398	83,300,457		65,571,572	
28%	16,358,551	23,324,128		18,360,040	
	74,781,949	106,624,585		83,931,612	

	RMRA: High Speed Rail Unit Costs		Midwest Unit Cost including contingency & soft	Eliminate 31% on Unit Cost for contingency & soft costs "Pure" construction cost	Escalation Factor	Comments
					1.55	
			2002	2002	2009	
		Unit	Unit Cost		Unit Cost	
Trackwork						
1.1	HSR on Existing Roadbed	per mile	$ 993	$ 758	$ 1,175	
1.2	HSR on Existing Roadbed	per mile	$ 1,059	$ 808	$ 1,253	
1.3	HSR on New Roadbed & New Embankment	per mile	$ 1,492	$ 1,139	$ 1,765	
1.4	HSR on New Roadbed & New Embankment (Double Track)	per mile	$ 2,674	$ 2,041	$ 3,164	
1.5	HSR Double Track on 15' Retained Earth Fill	per mile	$ 16,280	$ 10,781	$ 16,711	51% on unit cost
1.6	Timber & Surface w/ 33% Tie replacement	per mile	$ 222	$ 169	$ 263	
1.7	Timber & Surface w/ 66% Tie Replacement	per mile	$ 331	$ 253	$ 392	
1.8	Relay Track w/ 136# CWR	per mile	$ 354	$ 270	$ 419	
1.9	Freight Siding	per mile	$ 912	$ 696	$ 1,079	
2.0	Passenger Siding	per mile	$ 1,376	$ 1,050	$ 1,628	
2.10	NCHRP Class 6 Barrier (on tangent)	lineal ft	$ 1.3	$ 0.86	$ 1.33	51% on unit cost
2.11	NCHRP Class 5 Barrier (on curves)	lineal ft	$ 0.2	$ 0.13	$ 0.21	51% on unit cost
2.12	Fencing, 4 ft Woven Wire (both sides)	per mile	$ 51	$ 39	$ 60	
2.13	Fencing, 6 ft Chain Link (both sides)	per mile	$ 153	$ 117	$ 181	
2.14	Fencing, 10 ft Chain Link (both sides)	per mile	$ 175	$ 134	$ 207	
2.15	Decorative Fencing (both sides)	per mile	$ 394	$ 301	$ 466	
2.16	Drainage Improvements (cross country)	per mile	$ 66	$ 50	$ 78	need to combine with 1.36 and 1.40 below -
2.17	Drainage Improvements in Median or along highway	per mile	$ 528	$ 403	$ 625	
2.18	Land Acquisition Urban	per mile	$ 327	$ 250	$ 387	have a call into Jim Rogers at CDOT - have R2C2 for rural
2.19	Land Acquisition Rural	per mile	$ 129	$ 98	$ 153	have a call into Jim Rogers at CDOT
2.20	#33 High Speed Turnout	each			$ 672	made half of crossover
2.21	#24 High Speed Turnout	each	$ 450	$ 344	$ 532	
2.22	#20 Turnout Timber	each	$ 124	$ 95	$ 147	
2.23	#10 Turnout Timber	each	$ 69	$ 53	$ 82	
2.24	#20 Turnout Concrete	each	$ 249	$ 190	$ 295	
2.25	#10 Turnout Concrete	each	$ 118	$ 90	$ 140	
2.26	#33 Crossover	each	$ 1,136	$ 867	$ 1,344	
2.27	#20 Crossover	each	$ 710	$ 542	$ 590	revised to double concrete turnout
2.28	Elevate & Surface Curves	per mile	$ 58	$ 44	$ 69	
2.29	Curvature Reduction	per mile	$ 393	$ 300	$ 465	
2.30	Elastic Fasteners	per mile	$ 82	$ 63	$ 97	
2.31	Realign Track for Curves (See Table G6 for Costs)	lump sum			$ -	we may need for chip's work
	Sub-total Trackwork					
Structures						
	Bridges-under					
2.1	Four Lane Urban Expressway	each	$ 4,835	$ 3,691	$ 5,721	
2.2	Four Lane Rural Expressway	each	$ 4,025	$ 3,073	$ 4,762	
2.3	Two Lane Highway	each	$ 3,054	$ 2,331	$ 3,614	
2.4	Rail	each	$ 3,054	$ 2,331	$ 3,614	
2.5	Minor river	each	$ 810	$ 618	$ 958	
2.6	Major River	each	$ 8,098	$ 6,182	$ 9,582	
2.7	Double Track High (50') Level Bridge	per LF	$ 14	$ 9	$ 14	From Tampa 51%
2.8	Rehab for 110	per LF	$ 14	$ 10.7	$ 16.6	This looks too high. We need to check
2.9	Convert open deck bridge to ballast deck (single track)	per LF	$ 4.7	$ 3.6	$ 5.5	This looks too high. We need to check
2.10	Convert open deck bridge to ballast deck (double track)	per LF	$ 9.4	$ 7.1	$ 11.1	This looks too high. We need to check
2.11	Single Track on Flyover/Elevated Structure	per LF	$ 4.0	$ 3.1	$ 4.7	
2.12	Single Track on Approach Embankment w/ Retaining Wall	per LF	$ 3.0	$ 2.3	$ 3.5	
2.13	Double Track on Flyover/Elevated Structure	per LF	$ 7.0	$ 5.3	$ 8.3	
2.14	Double Track on Approach Embankment w/ Retaining Wall	per LF	$ 5.5	$ 4.2	$ 6.5	
2.15	Ballasted Concrete Deck Replacement Bridge	per LF	$ 2.1	$ 1.6	$ 2.5	
2.16	Land Bridges	per LF	$ 2.6	$ 2.0	$ 3.1	construction cost at $2000 per lf as per Dane County
	Bridges-over					
2.17	Four Lane Urban Expressway	each	$ 2,087	$ 1,593	$ 2,469	
2.18	Four Lane Rural Expressway	each	$ 2,929	$ 2,236	$ 3,466	
2.19	Two Lane Highway	each	$ 1,903	$ 1,453	$ 2,252	
2.20	Rail	each	$ 6,110	$ 4,664	$ 7,229	
	Tunnels					
	Two Bore Long Tunnel	route ft			$ 44,000	
	Single Bore Short Tunnel	lineal ft			$ 25,000	
	Sub-total Structures					
Systems						
3.1	Signals for Siding w/ High Speed Turnout	each	$ 1,268	$ 968	$ 1,500	
3.2	Install CTC System (Single Track)	per mile	$ 183	$ 140	$ 217	
3.3	Install CTC System (Double Track)	per mile	$ 300	$ 229	$ 355	
3.4	Install PTC System	per mile	$ 197	$ 150	$ 171	Revised based on Milw-Water PTC Report
3.5	Electric Lock for Industry Turnout	each	$ 103	$ 79	$ 122	
3.6	Signals for Crossover	each	$ 700	$ 534	$ 828	
3.7	Signals for Turnout	each	$ 400	$ 305	$ 473	
3.8	Signals, Communications & Dispatch	per mile	$ 1,500	$ 993	$ 1,540	51% on Unit cost
3.9	Electrification (Double Track)	per mile	$ 3,000	$ 1,987	$ 3,079	51% on Unit cost
3.10	Electrification (Single Track)	per mile	$ 1,500	$ 993	$ 1,540	51% on Unit cost
	Sub-total Systems					
Crossings						
4.1	Private Closure	each	$ 83	$ 63.4	$ 98.2	31%
4.2	Four Quadrant Gates w/ Trapped Vehicle Detector	each	$ 492	$ 376	$ 582	31%
4.3	Four Quadrant Gates	each	$ 288	$ 220	$ 341	31%
4.4	Convert Dual Gates to Quad Gates	each	$ 150	$ 115	$ 177	31%
4.5	Conventional Gates single mainline track	each	$ 166	$ 127	$ 196	31%
4.6	Conventional Gates double mainline track	each	$ 205	$ 156	$ 243	31%

4.7	Convert Flashers Only to Dual Gate	each	$ 50	$ 38.2	$ 59.2	31%
4.8	Single Gate with Median Barrier	each	$ 180	$ 137	$ 213	31%
4.9	Convert Single Gate to Extended Arm	each	$ 15	$ 11.5	$ 17.7	31%
4.10	Precast Panels without Rdway Improvements	each	$ 80	$ 61.1	$ 94.7	31%
4.11	Precast Panels with Rdway Improvements	each	$ 150	$ 115	$ 177	31%
	Sub-total Crossings					
Station/Maintenance Facilities						
5.1	Full Service - New - Low Volume - 500 Surface Park	each	$ 1,000		$ 5,000	Revised to reflect reasonable value
5.2	Full Service - Renovated - Low Volume- 500 Surface Park	each	$ 500		$ 4,000	Revised to reflect reasonable value
5.3	Terminal - New - Low Volume - 500 Surface Park	each	$ 2,000		$ 7,500	Revised to reflect reasonable value
5.4	Terminal - Renovated - Low Volume - 500 Surface Park	each	$ 1,000		$ 6,000	Revised to reflect reasonable value
5.5	Full Service - New- High Volume - Dual Platform - 1000 Surface Park	each			$ 10,000	Revised to reflect reasonable value
5.6	Terminal - New- High Volume - Dual Platform - 1000 Surface Park	each			$ 15,000	Revised to reflect reasonable value
5.5	Maintenance Facility (non-electrified track)	each	$ 10,000		$ 80,000	Revised to reflect reasonable value
5.6	Maintenance Facility (electrified track)	each	$ 86,000		$ 100,000	Revised to reflect reasonable value
5.7	Layover Facility	lump sum	$ 6,536		$ 10,000	Revised to reflect reasonable value
	Sub-total Station/Maintenance Facilities					
	This sp					