Alternatives Evaluation

In October 1999, the Fort Collins City Council directed the project team to analyze the three specific transit alternatives so that Council could then make an informed choice as to which alternative should be selected for preparing the conceptual design.

Three evaluation categories were selected; Performance, Cost Effectiveness and Impacts. These categories comprised detailed criteria as follows:

Performance

1. Person-Carrying Capacity
2. Transit Ridership
3. Mobility
4. Vehicle Miles Traveled
5. East-West Arterial Travel Time
6. Automobile/Transit Corridor Travel Time

Cost-Effectiveness

7. Capital Costs
8. Total Annualized Costs
9. Annualized Costs per Transit User

Impacts

10. Air Quality
11. Residential and Business Displacements
12. Noise
13. Visual
14. Lighting

In addition to developing measurements for each of the above criterion, it became evident that there are some criteria that are more important than others. In order to address the relative importance of criteria, the Mason Street Lead Team rated each criterion from one to ten, with one being the least important and ten being the most important. The result of this weighting is presented in the following table.

The following section presents the alternatives evaluation for each of the evaluation criterion. For each section, the criterion is defined. For each criterion, the measurement is specified as to whether it is measured by a qualitative

Mason Street Lead Team Criterion Weighting			
Categories	**Criterion Weight**		
Performance	**Minimum**	**Maximum**	**Average**
1. Person-Carrying Capacity	4	10	7.1
2. Transit Ridership	4	10	6.8
3. Mobility	4	9	7.4
4. Vehicle Miles Traveled	4	9	6.5
5. East/West Arterial Travel Time	3	10	6.4
6. Automobile/Transit Corridor Travel Time	5	10	7.9
Cost-Effectiveness	**Minimum**	**Maximum**	**Average**
7. Capital Costs	3	10	7.7
8. Total Annualized Costs	3	10	8.2
9. Annualized Cost per Transit User	4	10	7.8
Impacts	**Minimum**	**Maximum**	**Average**
10. Air Quality	3	10	7.6
11. Residential and Business Displacements	2	10	6.3
12. Noise	3	10	6.9
13. Visual	6	10	7.9
14. Lighting	3	9	5.8

or quantitative measurement. In addition, the source or method of measurement is specified along with the specified criterion from the Lead Team.

For each criterion, the support measurements and results are presented for each of the alternatives. In addition, a magnitude rating was determined for quantitatively normalizing each of the criteria to a conventional measurement, where the top alternative scored a 1.00, with the remaining alternatives being scored a relative portion. The overall criterion score is simply the criterion rating times the criterion weight.

The results of the evaluation are presented in the following table and graphics.

Evaluation Criteria 1			
Criterion	**Qualitative or Quantitative**	**Measures**	**Weight**
Person-Carrying Capacity Persons per hour that can be served with the proposed alternative mode, alignment, and operating plan, in peak hour peak direction.	Quantitative	Number of vehicles per hour times normal vehicle capacity	7.1

	Bus	Rail	Elevated
Vehicle Per Peak Hour	6	4	6
Persons Per Vehicle	40	160	40
Total Carrying Capacity	240	640	240
Rating	0.38	1.00	0.38
Score	**2.69**	**7.09**	**2.69**

Rail offers a distinct advantage for being able to carry the highest volume of transit ridership. However, with an increased number of buses, the total carrying capacity for the bus and elevated alternative could be increased.

Evaluation Criteria 2			
Criterion	**Qualitative or Quantitative**	**Measures**	**Weight**
Transit Ridership Number of people daily on the facility in both directions.	Quantitative	Forecast daily transit ridership from model	6.8

	Bus	Rail	Elevated
Annual Ridership	793,000	702,000	854,000
Rating	0.93	0.82	1.00
Score	**6.34**	**5.59**	**6.82**

Ridership is a function of overall speed and frequency. It is for this reason that the elevated bus alternative fairs the best, followed by the at-grade busway. With less frequency, the rail alternative rates the worst.

Evaluation Criteria 3			
Criterion	**Qualitative or Quantitative**	**Measures**	**Weight**
Mobility Total daily person miles of travel within the corridor.	Quantitative	From model determine total daily Person Miles of Travel within the corridor compared to baseline	7.4

Person Miles of Travel within Corridor Compared to 2020 Baseline	Bus	Rail	Elevated
Automobile	-500	-300	-500
Transit	+4,300	+3,500	+4,500
Total	3,800	3,200	4,000
Rating	0.95	0.80	1.00
Score	**7.00**	**5.89**	**7.36**

Based on the model results, person vehicle miles traveled will decrease within the Corridor. This is offset with increased transit ridership vehicle miles traveled, with the highest increase for the elevated bus, followed by the at-grade busway, and the rail alternative.

Evaluation Criteria 4			
Criterion	**Qualitative or Quantitative**	**Measures**	**Weight**
Vehicle Miles Traveled A calculation of the daily vehicle miles traveled (VMT) on the systems roadway network for each alternative vs. baseline.	Quantitative	From model, determine daily VMT for baseline vs. resulting VMT as a result of each alternative	6.5

	Bus	Rail	Elevated
Vehicle Miles Traveled Compared to 2020 Baseline	-3,000	-2,000	-3,200
Rating	0.94	0.63	1.00
Score	**7.00**	**5.89**	**7.36**

With the introduction of transit within the Mason Street Transportation Corridor, overall vehicle miles of travel will decrease. The reduction is commensurate with how much diversion occurs to transit. The results of the analysis determined that an elevated busway would yield the highest diversion, followed by the at-grade busway and rail.

Evaluation Criteria 5			
Criterion	**Qualitative or Quantitative**	**Measures**	**Weight**
East/West Arterial Travel Time From model and intersection level of service analysis, determine increased east-west arterial travel time as a result of improvement vs. baseline.	Quantitative	Sum of total east-west delay along east-west arterials of Harmony, Horsetooth, Drake, and Prospect	6.4

	Baseline 2020	Bus	Rail	Elevated
Total East/West Travel Time*	911	882	911	916
Rating	--	0.97	0.96	1.00
Score	--	**6.17**	**6.11**	**6.36**

*Prospect, Drake, Horsetooth, and Harmony

As presented, the elevated busway will have no impacts to the travel on east-west automobile travel along the arterials. With at-grade bus and rail signal interruption being minimized to every six to ten minutes and the signal cycle length being of short duration, the impacts to arterials will be very minimal.

Evaluation Criteria 6			
Criterion	**Qualitative or Quantitative**	**Measures**	**Weight**
Automobile/Transit Corridor Travel Time From model, total door-to-door travel time by mode for major origin/destination pairs.	Quantitative	Calculate for each alternative from model	7.9

	Bus	Rail	Elevated
Door to Door Travel Time* Automobile	19	19	19
Door to Door Travel Time* Transit	13	13	12
Travel Time Compared to Baseline	-6	-6	-7
Rating	0.86	0.86	1.00
Score	**6.80**	**6.80**	**7.91**

*Harmony to Laporte in Minutes

In order to attract automobile drivers and passengers, the transit travel time must be competitive with the automobile. All transit modes offer faster travel times when provided with separate corridors as compared to the congested College Avenue corridor. The elevated busway, without any cross street interference, provides the overall fastest travel times.

Evaluation Criteria 7			
Criterion	**Qualitattive or Quantitative**	**Measures**	**Weight**
Capital Costs A determination of the total capital costs of each alternative vs. baseline.	Quantitative	Total construction costs including capital cost for vehicles, stations, park-n-ride, and maintenance facilities	7.7

	Bus	Rail	Elevated
Networks	40-50	70-80	250-270
Rolling Stock	3-3.5	15-18	10-15
Station Stops	1-2	2-3	8-10
Park-N-Ride	3-4	3-4	3-4
Maintenance Facility	1-2	10-15	4-6
Total	48-60	100-120	275-305
Rating	1.00	0.49	0.18
Score	**7.73**	**3.79**	**1.39**

The capital costs include the transit network, vehicles, stations, park-n-ride facilities, and maintenance facilities. As presented in the above table, different alternatives have different cost impacts. The overall range of costs is quite extreme, with at-grade bus being in the range of $50M, rail at $100M, and elevated busway being the highest at $300M.

Evaluation Criteria 8			
Criterion	**Qualitattve or Quantitative**	**Measures**	**Weight**
Total Annualized Costs Determined by calculating annual operations and maintenance (O&M) costs for each alternative and adding annualized capital costs. Capital costs will be annualized according to standard FTA formulas, with economic lives of individual components as follows: - roadway construction elements: 30 years - rail construction elements: 50 years - buses: 12 years - rail vehicles: 25 years	Quantitative	Calculation of total annualized costs for each alternative	8.2

	Bus	Rail	Elevated
Annualized Capital Costs	2.0	2.9	6.4
Annual Operating and Maintenance	0.40	0.37	0.40
Total Annualized	2.4	3.3	6.8
Rating	1.00	0.73	0.35
Score	**8.18**	**5.97**	**2.86**

The annualized costs address both the capital amortization costs for the construction of the system plus the annual operating costs. Whereas the rail transit has a slightly lower annual operating and maintenance cost, the higher construction costs yield a less favorable alternative as compared to the at-grade busway. With the higher elevated cost, the elevated busway is a distant third.

Evaluation Criteria 9			
Criterion	**Qualitative or Quantitative**	**Measures**	**Weight**
Annualized Cost per Transit User A computation of the total annualized O&M and capital cost of each improvement per total number of transit users of the facility.	Quantitative	Divide annualized O&M and capital costs of alternative by annualized number of transit users	7.8

	Bus	Rail	Elevated
Total Annualized Ridership	793,000	702,000	854,000
Total Annualized Costs ($1 M)	2.4	3.3	6.8
Cost per Rider (Dollars)	3.03	4.70	7.96
Rating	1.00	0.64	0.35
Score	**7.82**	**5.00**	**2.74**

The at-grade busway is a clear winner when examining annualized costs per transit user. This results from the higher ridership resulting from higher frequency of service, coupled with lower annualized capital and operating costs.

Evaluation Criteria 10			
Criterion	**Qualitative or Quantitative**	**Measures**	**Weight**
Air Quality Alternative impacts to the Fort Collins Basin compared to baseline.	Qualitative	From model, based on changes in system wide VMT and other relevant criteria to calculate emissions resulting from each alternative.	7.6

	1 --	2 -	3 0	4 +	5 ++	Average	Rating	Score
Bus				⬭		4.00	0.89	6.80
Rail				⬭		4.00	0.89	6.80
Elevated					⬭	4.50	1.00	7.64

All three alternatives will provide an improvement in air quality compared to the no project alternative, as they will reduce vehicle miles traveled of automobiles. The elevated transit has a slight advantage, as transit would have no impact to arterial east-west travel.

Evaluation Criteria 11			
Criterion	**Qualitative or Quantitative**	**Measures**	**Weight**
Residential and Business Displacements	Quantitative	- Number of homes displaced - Number of businesses displaced	6.3

	Bus	Rail	Elevated
Homes Displaced	0	0	0
Business Displaced	0	0	0
Rating	1.0	1.0	1.0
Score	**6.27**	**6.27**	**6.27**

The overall Mason Street Transportation Corridor can be constructed without loss of any homes or businesses, regardless of alternative.

Evaluation Criteria 12								
Criterion					Qualitative or Quantitative	Measures		Weight
Noise					Qualitative	Federal Transit Administration (FTA) Impact Criterion		6.9
	1 --	2 -	3 0	4 +	5 ++	Average	Rating	Score
Bus						3.0	1.0	6.91
Rail						3.0	1.0	6.91
Elevated						2.0	0.67	4.63

Noise is not anticipated to be a major issue with any of the alternatives as the technology proposed for all are electric or hybrid propulsion systems. The elevated alternative might have a slightly greater impact.

Evaluation Criteria 13								
Criterion					Qualitative or Quantitative	Measures		Weight
Visual					Qualitative	Visual amenity or impact to neighborhood and community.		7.9
	1 --	2 -	3 0	4 +	5 ++	Average	Rating	Score
Bus						4.5	1.0	7.91
Rail						4.0	0.89	7.04
Elevated						2.0	0.44	3.48

A major objective of the Mason Street Transportation Corridor Plan is to improve the overall visual character of the Corridor, which would result in a positive experience. With the electric catenaries for the light rail alternative, the positive visual benefit might be slightly reduced. With the elevated structure traversing the entire Corridor length, a negative visual appearance would result.

Evaluation Criteria 14			
Criterion	Qualitative or Quantitative	Measures	Weight
Lighting	Qualitative	Benefits or impacts of alternative lighting on adjacent developments	5.8

	1 --	2 -	3 0	4 +	5 ++	Average	Rating	Score
Bus						3.0	1.0	5.82
Rail						3.0	1.0	5.82
Elevated						2.0	0.67	3.90

Lighting will not be an impact to the Corridor. Lighting will be limited to station lighting along the east side of the railroad, which has been identified by the adjacent businesses as a plus from a security perspective. The low lighting along the bicycle and pedestrian trails will be designed to minimize impacts to the adjacent residential areas. The elevated structure might cast a greater impact onto adjacent residences.

The results of the evaluation are presented in the following table. As can be seen, the at-grade busway was a clear winner when examining all aspects of performance, cost-effectiveness, and impacts.

On April 4, 2000, the three alternatives were presented to the Fort Collins City Council. They concurred unanimously to proceed with the development of the conceptual and action plans for the busway alternative.

The guidance of the City Council also included adding flexibility to the design so that possible future conversion to light rail could be permitted. Maintaining bicycle and pedestrian safety was also a high point, as well as connecting to the adjacent neighborhoods and businesses.

Alternatives Evaluation Summary			
Categories	Bus	Rail	Elevated
Performance			
1. Project Person-Carrying Capacity	2.69	7.09	2.69
2. Transit Ridership	6.34	5.59	6.82
3. Mobility	7.00	5.89	7.36
4. Vehicle Miles Traveled	6.15	4.12	6.55
5. East/West Arterial Travel Time	6.17	6.11	6.36
6. Automobile/Transit Corridor Travel Time	6.80	6.80	7.91
Cost-Effectiveness			
7. Capital Costs:	7.73	3.79	1.39
8. Total Annualized Costs	8.18	5.97	2.86
9. Annualized Cost per Transit User	7.82	5.00	2.74
Impacts			
10. Air Quality	6.80	6.80	7.64
11. Residential and Business Displacements	6.27	6.27	6.27
12. Noise	6.91	6.91	4.63
13. Visual	7.91	7.04	3.48
14. Lighting	5.82	5.82	3.90
Total	92.59	83.21	70.60