Evaluating Efficiency of Transit Alternatives in Griffin Line Corridor, Hartford, Connecticut

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The Greater Hartford Transit District, in cooperation with the Capitol Region Council of Governments, has completed the Griffin Line Corridor Major Investment Study (MIS), which is an extensive evaluation of the Griffin Line Transit and Economic Development Project. The project considers five different transit alternatives to improve transportation and economic development conditions in the corridor. In conformance with Federal Transit Administration (FTA) guidance, the evaluation of alternatives considers the effectiveness, efficiency, and equity of an investment in each of the five alternatives. The efficiency evaluation of each of the alternatives considers the alternative's cost-effectiveness in terms of cost per trip and its operating efficiency in terms of operating costs per hour, mile, and passenger and its FTA cost-effectiveness index. To ensure that the efficiency evaluation measures fully reflect the projected and potential benefits of each alternative, the Griffin Line Corridor MIS includes the concepts of *new service trip* and *bus-equivalent* hours and miles. Furthermore, a critical element of the evaluation of alternatives in the Griffin Line Corridor is the analysis of the cumulative impacts of alternative transit supportive policies and alternative transit operating assumptions on the relative cost efficiency of the alternatives. The cumulative impact analysis includes an Operating and Maintenance Cost Sensitivity Study, which is an examination of the impact of different levels of ridership (represented as percentage increases or decreases compared with the baseline ridership forecast) on the projected annual operating and maintenance costs for each alternative.

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The efficiency evaluation of each of the alternatives considers the alternative's cost-effectiveness in terms of cost per trip and its operating efficiency in terms of operating costs per hour, mile, and passenger and its FTA cost-effectiveness index. To ensure that the efficiency evaluation measures fully reflect the projected and potential benefits of each alternative, the Griffin Line Corridor MIS includes the concepts of *new service trip* and *bus-equivalent* hours and miles. Furthermore, a critical element of the evaluation of alternatives in the Griffin Line Corridor is the analysis of the cumulative impacts of alternative transit supportive policies and alternative transit operating assumptions on the relative cost efficiency of the alternatives. The cumulative impact analysis includes an Operating and Maintenance Cost Sensitivity Study, which is an examination of the impact of

different levels of ridership (represented as percentage increases or decreases compared with the baseline ridership forecast) on the projected annual operating and maintenance costs for each alternative.

Griffin Line Corridor

The Griffin Line Corridor is a 15-mi (24-km) corridor connecting two major economic and transportation generators in the region—downtown Hartford and Bradley International Airport. The corridor, illustrated in Figure 1, includes the city of Hartford; the towns of Bloomfield, Windsor, and East Granby; and the state-owned Bradley International Airport in Windsor Locks. The initial Griffin Line transitway under consideration in the MIS connects the Union Station Transportation Center on the west side of downtown Hartford, several Hartford neighborhoods (Clay Arsenal, Asylum Hill, Upper Albany, Blue Hills), St. Francis Hospital and Medical Center, the Albany Avenue retail district, the University of Hartford, Weaver High School, the COPACO Shopping Center, Bloomfield Town Center and High School, and the Griffin Center Office Park. This initial 9-mi (14-km) segment of the Griffin Line Corridor between Hartford and Bloomfield includes the existing 8.5-mi (13-km) abandoned rail right-of-way known as the Griffin Line. The right-of-way was purchased by the Connecticut Department of Transportation in 1981 and 1989 under the State's Rail Banking Program to reserve the right-of-way for potential use as a mass transit facility.

Transportation Alternatives Considered

Five alternatives are under consideration to meet the future public transportation and economic development needs of the Griffin Line Corridor. The alternatives con-

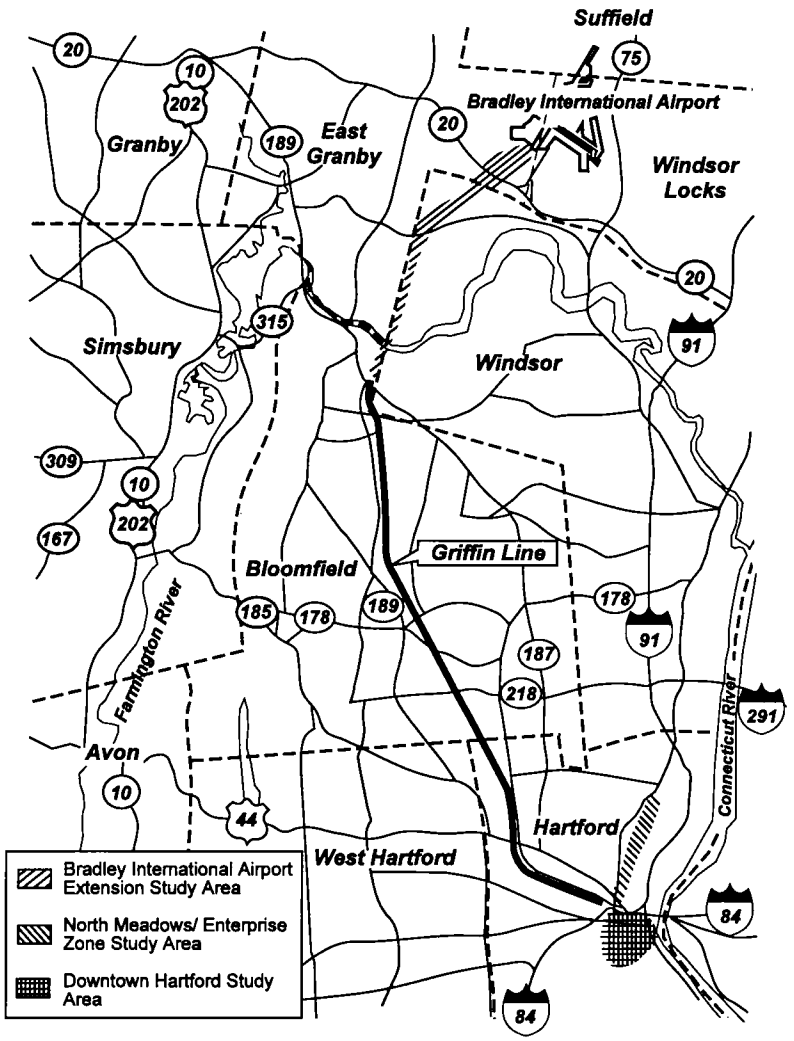

FIGURE 1 Griffin Line corridor including area studied for possible expansions.

sist of "no-build," which essentially maintains current conditions; a transportation system management (TSM) alternative consisting of low-cost, operationally oriented transportation improvements; and three build alternatives, the bus bypass, the busway, and the light-rail transit (LRT) alternative. The "no-build" alternative is shown in Figure 2, and the other four alternatives are shown in Figure 3. Brief summaries of each alternative follow.

No-Build Alternative

The no-build alternative includes the existing 1994 bus service in the Hartford area, with additional bus service on routes that are projected to exceed capacity by 2010. This alternative maintains the existing radial route structure centered on downtown Hartford. It also maintains the current mixture of local and express routes, with the express routes serving the outlying areas from a number of park-and-ride lots.

TSM Alternative

All service improvements identified in the no-build alternative will be provided; the primary components of the TSM alternative are new routes linking downtown Hartford to the growing suburban employment centers in the Griffin Line Corridor, particularly in the area between Bloomfield and Bradley International Airport.

Bus Bypass Alternative

The bus bypass alternative consists of an exclusive (bus only) roadway of 4.7 mi (7.5 km) in the Griffin Line right-of-way beginning at Church Street in the vicinity of Union Station in downtown Hartford to Park Avenue in Bloomfield. No stations or stops would exist along the bypass. The major purpose of the bypass roadway would be to provide shorter travel times between Hartford, Bloomfield Center, and the Griffin Center Office Park. One new route, linking Hartford to Bradley In-

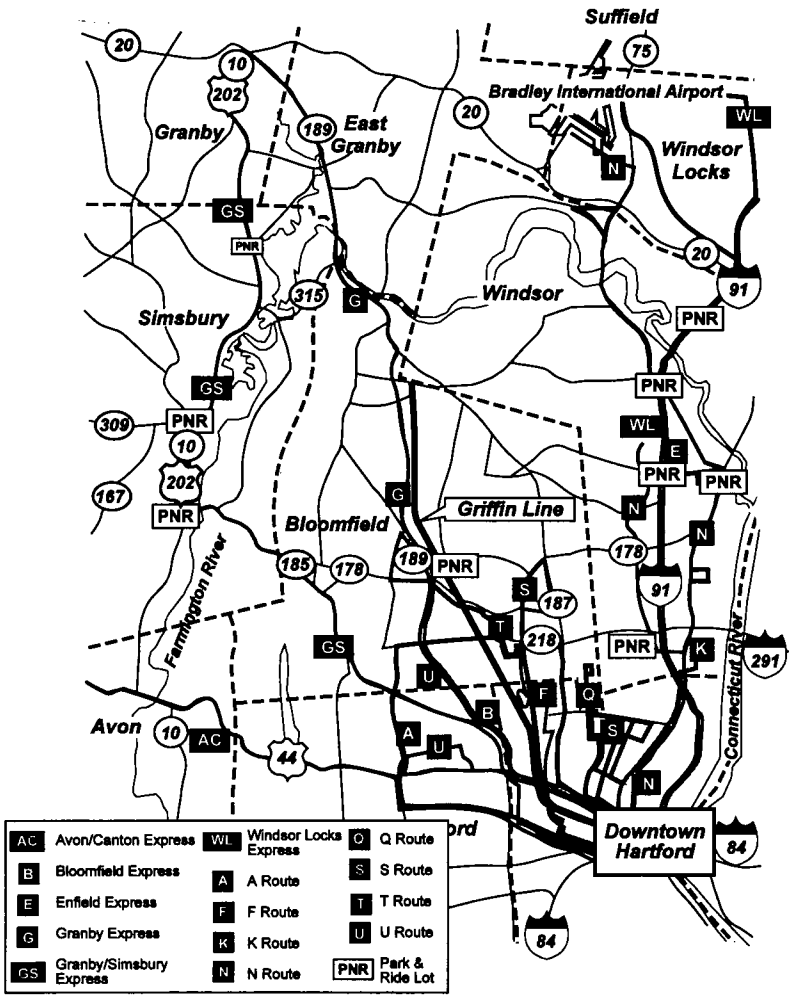

FIGURE 2 No-build alternative: existing bus routes.

ternational Airport via the Griffin Line Corridor, is included. Selected existing transit routes would also be diverted to the bypass to reduce travel times. The alternative also includes route and headway changes to selected corridor routes and the same service improvements identified in the no-build alternative, specifically those required to provide adequate capacity on routes with projected ridership increases to the year 2010.

Busway Alternative

The busway alternative consists of an exclusive (bus only) roadway of 8.4 mi (13.5 km) in the Griffin Line right-of-way between Church Street in the vicinity of Union Station in downtown Hartford to Prospect Hill Road in Bloomfield. A total of eight stations would be built along the busway, and bus access to the guideway would be provided at four sites. The northernmost station, Griffin Center Office Park, would be accessible by existing streets from the fixed-guideway terminus. One new local bus route, with stops at all busway stations, would be added. Six existing local routes (or branches) would be modified to provide feeder service to the busway, and two existing express routes in the Griffin Line Corridor would be diverted to the busway to provide a faster trip in and out of Hartford. Finally, shuttle bus routes would operate between the busway and major employment areas. This alternative also includes the same service improvements identified in the no-build alternative, namely, those required to provide adequate capacity on routes with projected ridership increases to the year 2010.

LRT Alternative

The LRT alternative consists of the construction of an LRT line in the Griffin Line right-of-way from Union Station in downtown Hartford to the Griffin Center Of-

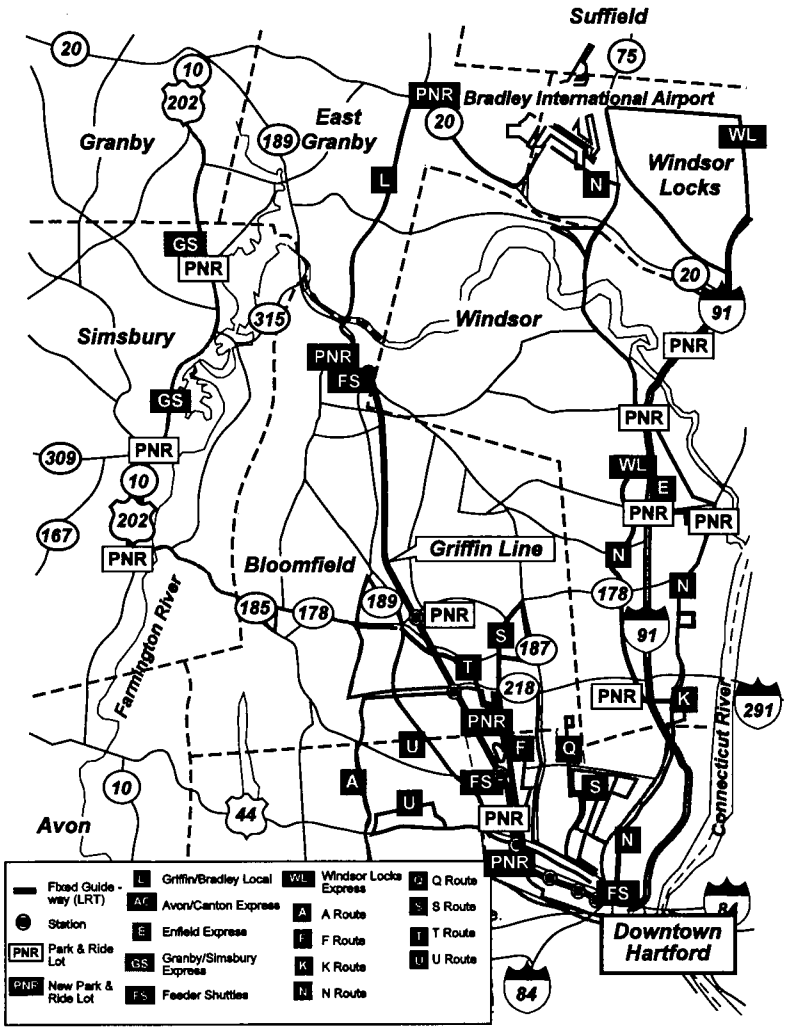

FIGURE 3 LRT alternative: supporting bus routes.

fice Park, a distance of about 9 mi (14 km). The LRT vehicle is a modern trolley electrically powered with overhead catenary, similar to those in recent systems in Sacramento, Portland, and San Diego. Eight LRT stations would be built at the same locations as those proposed for the busway stations. The alternative also includes a number of changes and improvements to the bus service operated in the corridor, including new feeder services, the conversion of one current express route into an LRT feeder, and modifications to the routing of six existing local routes (branches) to allow them to function as LRT feeders. Shuttle bus routes would operate between the LRT and major employment areas. This alternative also includes the same service improvements identified in the no-build alternative, namely, those required to provide adequate capacity on routes with projected ridership increases to the year 2010.

Capital, Operating, and Maintenance Cost Estimates

The capital and operating and maintenance cost estimates for the alternatives are summarized as follows:

Alternative	*Total Capital Cost ($ millions)*	*Annual Operating and Maintenance Costs (beyond No-Build) ($ millions)*
No-build	2.2	—
TSM	8.1	2.0
Bus bypass	44.7	1.6
Busway	95.0	4.8
LRT	176.5	6.7

Operating and Maintenance Costs

The annual operating and maintenance costs range from $33.0 million for the no-build alternative to $39.7 million for the light-rail alternative. By comparison, the total annual budget (1994) for operations and maintenance for the CT Transit, Hartford Division, was $30.5 million. The no-build alternative, then, represents an approximate 8 percent increase from the 1994 budgeted amount.

TSM Alternative

The total annual operating and maintenance cost for the TSM alternative is $35.0 million, approximately $2.0 million higher than the no-build alternative. The increase in operating costs can be directly attributed to service improvements and expansion planned as part of the TSM alternative. These improvements and expansion include reduced headways on one express route and the addition of one new route.

Bus Bypass Alternative

The annual cost for operating the baseline definition of the bus bypass alternative would be $34.7 million (FY 1994 dollars). This total is $1.7 million higher than the cost of the no-build alternative but $0.4 million less than the cost of the TSM alternative. The operating costs for the bus bypass alternative would be lower than the costs for the TSM alternative because the higher operating speeds afforded by the use of the exclusive right-of-way would require fewer buses to operate the same general service levels.

Busway Alternative

The annual cost for operating the baseline definition of the busway alternative would be $37.8 million (FY 1994 dollars). This total is $4.8 million higher than the cost of the no-build alternative and $2.7 million higher than the cost of the TSM alternative. The operating costs for the busway alternative are higher than the costs for the TSM alternative because of the increased express bus service and related stops at eight new busway stations along the Griffin Line. Facilities maintenance costs for the eight proposed stations would be incurred if the busway alternative were implemented. In addition, several existing bus routes would be improved and the new local bus route would be implemented with a higher frequency of service.

LRT Alternative

The annual cost for operating the baseline definition of the LRT alternative would be $39.7 million (FY 1994 dollars). The cost for bus service would be $33.7 million and the cost for the light-rail service would be $6.0 million. The total costs (bus and light rail) are $6.7 million higher than the costs of the no-build alternative and $4.7 million higher than the cost of the TSM alternative. The increased costs can be attributed to the introduction of light-rail service and the additional personnel and facilities related to it. The operating cost for the bus service would be lower for this alternative compared with all other alternatives, with the exception of the no-build alternative. Some express routes would be converted to light-rail feeders, whereas other routes would be modified slightly to improve service to the proposed light-rail stations. Project policy implemented by the working group (including CT Transit, Connecticut Department

of Transportation (CTDOT), Capitol Region Council of Governments, and Greater Hartford Transit District), which minimized any significant bus service modifications or reductions in the level of service, limited any further savings in bus costs associated with the LRT alternative at this time. More detailed treatment and scheduling analyses can be completed in the future phases of the project to introduce cost savings and efficiency measures while maintaining transit service quality.

Operating and Maintenance Cost Methodology

Separate operating and maintenance cost models have been developed for each of the two transit modes (bus and light rail) proposed for implementation in the Griffin Line Corridor. The transit cost models were constructed to conform with the FTA's most recent technical guidelines for transit alternatives analysis (*1*). The operating and maintenance cost models were developed to be disaggregate, resource build-up models, consistent with the above FTA guidelines. Staffing requirements, labor costs, and nonlabor expenses were calculated on the basis of the projected quantity of service supplied (e.g., peak vehicles, revenue vehicle-miles) and the physical size of the system (e.g., route-miles, number of stations).

Bus Operating and Maintenance Cost Model

The bus operating and maintenance cost model was based on CT Transit's current organization, which consists of three service units (maintenance, transit, and administrative) in three operating divisions. Operating and maintenance costs were estimated for each service unit within the Hartford division only since this is the division that would be affected by the implementation of the transit alternatives. Furthermore, operating and maintenance costs were estimated for Finance and Marketing and Planning and Scheduling within the Administrative Services unit in the Hartford division. Since some administrative costs are shared by all three operating divisions, shared costs were allocated to the Hartford division based on its share of vehicle miles proposed in CT Transit's FY 1994 budget.

Actual salary and wage data for each position (e.g., money counter) were not available for use in the bus operating and maintenance cost model. Salary ranges for specific salary groups were used instead (e.g., seven positions make up the Clerical and Support salary group). There are eight salary groups within CT Transit. For purposes of estimating labor costs, 65 percent of the top salary in each salary group was used as a reasonable estimate of annual labor costs for all positions within each group.

The ability of the cost model to estimate bus operating and maintenance costs accurately for the study alternatives was tested and calibrated by applying the model to FY 1992 and FY 1993 actual data and to CT Transit's FY 1994 budgeted data. Input variables and actual operating and maintenance costs for FY 1992 and FY 1993 were obtained from CT Transit's Section 15 reports. Input variables and budgeted operating and maintenance costs for FY 1994 were obtained from CT Transit's 1994 operating budget.

Light-Rail Operating and Maintenance Cost Model

Hartford does not currently have light rail; therefore, comparable Section 15 cost data for other similar at-grade independently operating light-rail systems were used to develop the light-rail operating cost model. The model was adjusted for local sensitivities, including the use of CT Transit wage and fringe benefit rates and Northeast Utilities energy costs and local material costs, to develop light-rail operating cost estimates.

The structure of the light-rail model is similar to the bus cost model, with line-item costs tabulated for specific light-rail service units (e.g., light-rail administration, operations, and maintenance). Specific line items were provided for unique labor positions, such as electromechanic or train operator, and also for unique nonlabor expenses, such as traction power or vehicle spare parts. Each labor and nonlabor expense item was modeled as a separate line item to ensure that the equations that estimate expenses were mutually exclusive and covered all operating costs. Operating and maintenance costs were calculated from the quantity of service supplied and other system characteristics.

The light-rail cost model reflects CT Transit wage and fringe benefit rates. Overhead expenses were allocated to light-rail operations based on CT Transit's FY 1994 operating budget. CT Transit's overhead costs include functions not directly associated with transit operations, such as marketing and customer services. The ratio of budgeted administrative overhead costs to budgeted bus operating costs was applied to light-rail direct operating costs. It should be noted that most of the administrative costs for the light-rail system are variable (i.e., they adjust with the size of the system), whereas other costs are based on a fixed percentage (overhead). Since most of the variability in administrative costs was accommodated by the light-rail cost model, it was reasonable to assume that the light-rail overhead rate was similar to the bus overhead rate.

The operating and maintenance cost model developed for the Griffin Line Corridor light-rail operations was similarly calibrated with actual operating budgets for six U.S. LRT systems.

Projected Demand for Transit Alternatives

Ridership forecasts are presented in terms of projected daily boardings in 2010. The ridership analysis considers demand forecasts for each alternative under various policies and operating assumptions in addition to under baseline conditions. Figure 4 illustrates the ranges of projected demand for each of the transit alternatives.

The range of forecasts for each alternative from baseline to implementation of the downtown Hartford employers' market price parking policy is as follows:

- TSM: 2,000 to 2,200 boardings per day,
- Bus bypass: 2,500 to 4,800 boardings per day,
- Busway: 10,900 to 15,200 boardings per day,
- Light rail: 8,700 to 14,800 boardings per day.

Analysis demonstrates that ridership forecasts for the busway and light-rail alternatives are similar when operating plans include comparable service frequencies along the corridor. In addition, the range of ridership forecast for the complete light-rail service from downtown Hartford to Bradley International Airport is 11,600 to 18,000 boardings per day. This range encompasses Union Station as a major transfer node (lower bound) and the implementation of the downtown Hartford employers' market price parking policy (upper bound).

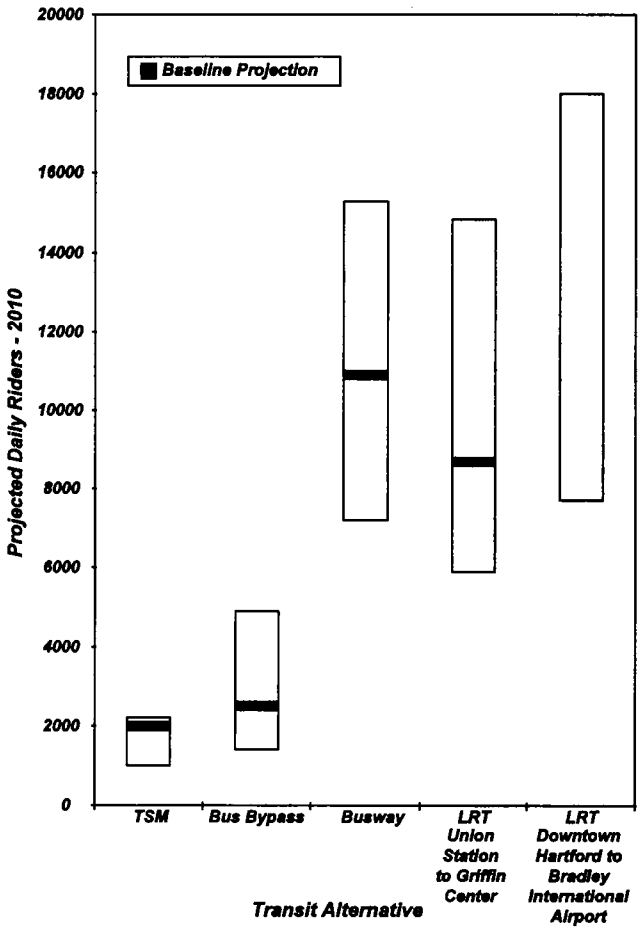

FIGURE 4 Projected daily ridership in 2010 for Griffin Line alternatives.

Evaluation of Alternatives

The Griffin Line evaluation framework adheres to FTA and CTDOT technical procedures. Federal transportation legislation, the 1991 Intermodal Surface Transportation Efficiency Act, dictates that all major transportation investments under consideration be analyzed, evaluated, and selected following guidelines and procedures outlined in the Metropolitan Planning Regulations.

Evaluation Framework

Each alternative is evaluated on the basis of five major elements:

1. **Effectiveness (goals achievement):** How effective is each alternative at achieving the stated goals and objectives of the Griffin Line Transit and Economic Development Project ?
2. **Efficiency (cost-effectiveness):** How efficient and effective is each alternative in providing transportation and mobility, economic and community development, and long-term environmental benefits in relation to the projected capital and operating costs ?
3. **Equity considerations:** How are the benefits and costs of each alternative distributed? (Affected groups include transit users, socioeconomic categories, neighborhoods, businesses, political jurisdictions.)
4. **Trade-off analyses:** What are the key differences between the alternatives?
5. **Financial analyses:** What are the anticipated federal and other capital and operating expenditures, annual cash flow requirements, and potential public- and private-sector funding sources for each alternative?

The evaluation addresses several key long-term issues for the corridor and the Capitol Region including the following:

- **Mobility and accessibility:** Does the alternative improve mobility in both the city and suburban communi-

TABLE 1 Evaluation of Baseline Transit Alternatives

EVALUATION MEASURES	BASELINE TRANSIT ALTERNATIVES				
	No-Build	TSM	Bus Bypass	Busway	LRT
Cost Effectiveness (1994 dollars) in 2010					
Total Cost Per Trip* (Total System)	$1.66	$1.74	$1.86	$2.11	$2.51
Total State Subsidy Per Trip* (Total System)	$0.82	$0.89	$0.90	$1.00	$1.17
Total O&M Cost Per Trip (Total System)	$1.65	$1.71	$1.70	$1.77	$1.88
Total O&M State Subsidy Per Trip (Total System)	$0.82	$0.88	$0.87	$0.93	$1.04
Net O&M State Subsidy Per New Service Trip	—	$3.75	$2.32	$1.30	$2.40
** includes annualized capital (7%) and annual O&M*					
Operating Efficiency					
Operating Cost (1994$) Per Train/Bus Hour	$68.02/hr	$67.64/hr	$68.26/hr	$70.64/hr	$369.97/hr
Operating Cost (1994$) Per "Bus Equivalent" Hour	$71.00/hr	$70.98/hr	$71.48/hr	$74.59/hr	$75.21/hr
Operating Cost (1994$) Per Vehicle/Bus Hour	$5.30/mi	$5.25/mi	$5.14/hr	$5.09/mi	$11.48/mi
Operating Cost (1994$) Per "Bus Equivalent" Mile	$5.64	$5.61	$5.50	$5.52	$5.40
Operating Cost (1994) Per Passenger (Total System)	$1.32/pass	$1.39/pass	$1.36/pass	$1.41/pass	$1.46/pass
Operating Cost Per Guideway Passenger Place -Mile	NA	NA	$0.22	$0.28	$0.12
Efficiency-Ridership/O&M Cost Sensitivity Study					
Operating Cost Per Passenger (Total System) at:					
80% of Baseline Ridership	NA	$1.44	$1.40	$1.45	$1.50
120% of Baseline Ridership	NA	$1.35	$1.33	$1.39	$1.41
160% of Baseline Ridership	NA	$1.34	$1.33	$1.37	$1.36
FTA Cost Effectiveness Index					
FTA New Riders	—	1,600	1,600	4,800	4,000
Total FTA "Cost Per New Rider" @ 4.9%	—	—	<0	$7.27	$19.30

ties? Does the alternative improve job accessibility, particularly for the transit dependent?

- **System build-out and transit network development:** Can the alternative lead toward development of a more extensive transit network and be integrated with potential transit investments in the corridor? What are the long-term cost-effectiveness and efficiency of the alternative in relation to a potential system build-out and transit network?
- **Regional development and transportation:** Can the alternative lead toward efficient and attractive development within the corridor, the Capitol Region, and its transportation network? Is the alternative consistent with regional development and transportation policies?
- **Economic and community development:** How will the corridor communities be developed? Will the alternative attract quality investment to station areas, the corridor, and the region? What is the economic impact? Will "permanent" jobs and sustained economic growth be created?
- **Local land use policies and transit-oriented development:** Is the alternative consistent with local land use and development policies? Will the alternative complement urban redevelopment initiatives and suburban growth management strategies? Will transit-oriented investments be realized? Will urban sprawl and reliance on the automobile continue or be reduced?

Evaluation Measures

The evaluation of the five Griffin Line alternatives considers how efficiently each alternative would support mobility and accessibility, economic and community development, and long-term economic benefits in relation to each alternative's capital and operating costs. The efficiency or cost-effectiveness of each alternative assumes the baseline operating plans and policies. Four key efficiency parameters are summarized in Table 1.

Cost-Effectiveness

Several measures of cost-effectiveness are presented for each alternative under baseline conditions and forecasts. Measures include

- Total cost per passenger trip for total transit system, including annualized capital and annual total operating and maintenance (O&M) costs;
- Total state subsidy per passenger trip for total transit system (including state share of annualized capital and annual net system O&M costs);
- Total O&M cost per passenger trip for total transit system (total O&M costs);
- Total O&M state subsidy per passenger trip for total transit system (net system O&M costs); and

• Net O&M state subsidy per new service trip (net new service O&M costs).

The baseline data illustrate that, generally speaking, the general cost-effectiveness parameters—total cost per trip, total state subsidy per trip, total O&M cost per trip, and total O&M state subsidy per trip—are higher with increased levels of service. The no-build and TSM alternatives have the lowest costs per passenger, whereas the busway and particularly the LRT alternative exhibit the highest costs per passenger. However, the range between the highest and lowest values for O&M cost parameters is only about 14 percent. Values of total cost and total state subsidy per trip are higher for the busway and LRT alternatives because of the inclusion of annualized capital costs for the new fixed-guideway infrastructure and related equipment and facilities.

The relative effectiveness of the alternatives changes when the alternatives are evaluated with respect to net O&M costs per new service trip, which is simply the number of daily trips (not boardings) made on the new transit services. With this concept, the cost-effectiveness of the busway and LRT alternatives compares favorably with the TSM and bus bypass alternatives in terms of net O&M state subsidy per new service trip. These "build" alternatives represent more efficient operations, particularly the baseline busway alternative.

Operating Efficiency

Several measures of operating efficiency are presented for each alternative under baseline conditions and forecasts. Measures include

- Operating cost per train/bus hour,
- Operating cost per train/bus mile,
- Operating cost per passenger (total transit system), and
- Operating cost per system capacity (passenger place mile).

Analysis of the baseline data illustrates that, generally speaking, operating efficiency parameters are reasonably similar across alternatives with the exception that light-rail hourly and per mile costs are higher. This difference is due to the disparity in mode and carrying capacity.

When alternatives are compared on a "bus-equivalent" hourly and mileage basis, where a "bus equivalent" reflects a single standard CT Transit bus (capacity = 55), the analysis normalizes express buses and LRT vehicles to an equivalent bus in terms of capacity. The resulting hourly and mileage data are very consistent between LRT and other alternatives. Indeed, the LRT cost per bus-equivalent mile is lower than that of all other alternatives.

Sensitivity Analysis of Ridership Versus O&M Cost

The cumulative impacts of alternative transit supportive policies and alternative transit operating assumptions on the operating efficiency of each of the five transit alternatives are examined with a sensitivity analysis of operating efficiency of each alternative at various ridership levels. The sensitivity analysis examines the impact of different ridership levels (represented as percentage increases or decreases compared with the baseline ridership forecast) on annual O&M costs for each alternative. The O&M cost model, calibrated to the CT Transit-Hartford Division operations, was used to project the O&M costs of the five alternatives under various ridership scenarios.

Assumptions The sensitivity analysis, or parametric study, was undertaken with the following assumptions and study parameters:

- Baseline ridership forecasts (100 percent) for each alternative were varied at set increments from a low of 50 percent of baseline to a high of 200 percent of baseline.
- Ridership changes were assumed to be evenly spread across all routes and services.
- The O&M cost model applied in the estimation of the baseline cost estimates was applied with adjusted operating inputs (vehicles, hours, miles) required to serve the alternative ridership demand levels studied in the analysis.
- Capital improvements (vehicle purchases, station expansion, etc.) were not included.

Results The results of the sensitivity analysis are shown in Figure 5. The analysis illustrates that the O&M costs of the bus-oriented alternatives (TSM, bus bypass, busway) increase at a fairly linear rate above the baseline ridership. This rate of increase reflects additional O&M staff required with increasing ridership, given limited capacity per bus and per bus operator. Below the baseline ridership, the O&M cost curve flattens for these alternatives. As ridership decreases, costs can only be decreased by reduction in service levels. Policy decisions that were outside the scope of the study determined that service reductions would not be implemented and hence are not reflected in the O&M cost model.

The LRT alternative shows significant economies of scale as the baseline ridership increases, primarily because of the efficiency benefits associated with the larger-capacity vehicles and the capability to operate multivehicle consists with one operator. It is also interesting to

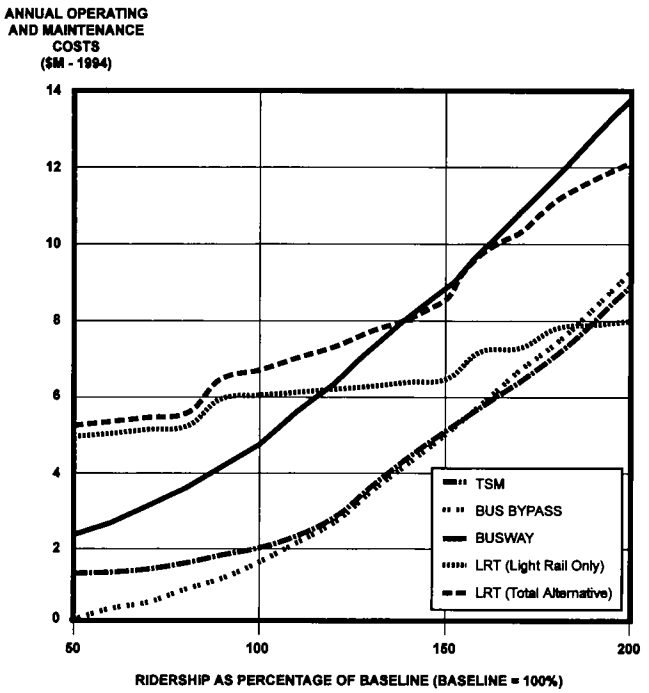

FIGURE 5 Sensitivity analysis of O&M cost versus ridership.

note the difference between the two LRT measures reflected on the sensitivity analysis graph (Figure 5): one reflects O&M costs for LRT operations only, whereas the other reflects LRT operations and supportive bus feeder operations.

O&M costs for the light-rail-only case exhibit a low rate of increase with additional ridership, whereas light rail and bus services exhibits a relatively high rate of increase (though not as high as the bus-only alternatives). This again illustrates the longer-term efficiencies of the higher-capacity light-rail operation, since the increase in the case of light-rail and bus services reflects increased bus costs more than increased light-rail costs. In practice, the actual rate of increase for the light-rail alternative (including supportive bus services) would likely be in the mid-range of the two light-rail cases illustrated. As ridership levels increased, routing and scheduling efficiencies would likely be introduced for the supportive bus services to take advantage of the higher capacity of the light-rail alternative.

FTA Cost-Effectiveness Index

The FTA cost-effectiveness index is intended to provide one measure of the relative attractiveness of various transit alternatives. The method of calculation for this index, the cost per new rider, is documented elsewhere (*1*).

Conclusion

The evaluation of the relative efficiency of the five transit alternatives analyzed in the Griffin Line Corridor Major Investment Study strives to ensure that the costs of each alternative are considered in the context of each alternative's benefits. Through the concepts of new-service-trip and bus-equivalent measures, the costs of each alternative are compared in the context of the benefits of the alternative.

The sensitivity study results reinforce the need to evaluate operating efficiencies over a range of anticipated operating scenarios. Relative efficiencies will change with varying operating scenarios. As the operating conditions will likely vary considerably over the useful life of the transportation investment, the investment should be evaluated for the changing conditions it will likely undergo.

Postscript

On July 12, 1995, CRCOG, the designated metropolitan planning organization, formally selected the LRT alternative as studied in the Griffin Line Corridor Major Investment Study and directed the Greater Hartford Transit District to complete a detailed plan to finance and implement the service. The link between transit investment and sound land use and economic and community development played a significant role in the region's decision to select light rail. Although the evaluation of alternatives indicates that, at initial ridership levels, the busway alternative would be a more cost-effective alternative to achieve the mobility goal, the CRCOG resolution states that "the Griffin Line [LRT alternative] would contribute to important State and regional goals including mobility improvements for urban and suburban residents, economic and community development and sound land use, air quality and energy policies."

The region's decision to select LRT followed formal recommendations by the city of Hartford, Town of Bloomfield, and numerous community and business organizations emphasizing the economic and community development benefits of transit investment. The Hartford City Council resolution selecting light rail as the locally preferred alternative agrees: "The economic and community development impacts of the Griffin Line are as important as the improvements in transit." The Bloomfield Town Planning and Zoning Commission "sees the light-rail alternative as the best way to promote the Town's long-range community and economic development goals" and continued its commitment to implement proactive growth management policies and zoning regulations to direct new development to light-rail sta-

tion areas while preserving open space in other parts of town.

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REFERENCE

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