CROSS-COUNTY MetroLink Extension

Segment 1
Conceptual Design

Cross-County
MetroLink
Extension

Evaluation Methodology
Final Technical Report

Prepared for the
East-West Gateway Coordinating Council
in association with the
Bi-State Development Agency
Missouri Department of Transportation

By Parsons Transportation Group
and Associated Consultants

August 1999

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Chicago, Illinois
Draft December 1998
Final August 1999

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1
Purpose

This document, describing the methodology for evaluating alternative corridor design concepts, is one of several reports that outline proposed technical methods to be used in this conceptual design study.

The approach described in this report is fact-driven. It uses measured and estimated data to evaluate and define differences between design concepts for corridor alternatives. Those differences will provide a basis for making decisions about a preferred alternative for the Cross-County MetroLink Extension - Segment I.

2
Evaluation Framework

The evaluation method described herein corresponds to the nature of the decision being made. The decision, in this case, is the selection of a conceptual design for the extension of MetroLink in the Cross-County corridor, as described by horizontal and vertical alignments, cost estimates, financing and other elements necessary to reach decisions on the implementation of the project. Design details associated with these alignments will be developed to an approximate 10% level, that is, 10% of the design detail needed for construction.

A conceptual design project differs from a planning study. The latter involves defining the need for transportation improvements in a corridor and then comparing how well different transportation modes or types of improvements meet the identified need. Such planning work has already been completed in the Cross-County corridor. The focus of the current work is the design of the extension of the MetroLink system from the vicinity of the Forest Park station along Forest Park Parkway and Millbrook Boulevard, through downtown Clayton, and south to the vicinity of I-44 following the Citizens of Modern Transit (CMT) right-of-way.

Definitions

Evaluation is defined as a process that measures the relative desirability of alternatives. The requirements for such a process are that it:

1. **Discriminate among the alternatives based on differences in costs, benefits, and impacts.**

2. **Weight the tradeoffs among alternatives.**

3. **Operate on quantitative as well as qualitative information.**

4. **Recognize uncertain and incomplete information, risks, and rewards.**

5. Recognize that different interest place relative values on different objectives, criteria, and measures.

As part of the method discussion, the following terms are used:

Objective	**overall purpose, function, or impact to be achieved via the investment in the Cross County MetroLink Extension - Segment I.**
Criteria	**standards used to measure the achievement of an objective.**
Measure	**the units of analysis, associated with the criteria, used to estimate the performance, impact, or cost of an alternative.**
LRT	**light rail transit using the same technology as used by MetroLink.**
Trade-off	**A relationship between two or more different objectives or criteria in which increased positive impacts for one result in increased negative impacts for another.**
Cost-Effectiveness	**a measure of productivity in which units of cost are compared to benefits, e.g., how much benefit will be obtained per $1,000,000 of investment or how much cost to achieve a particular benefit.**

Evaluation Purpose

The evaluation method is organized to translate design and analysis results into information that will support decisions about the selection of a concept design. Specifically, the matters to be decided are:

1. Location of the LRT Line.[1]

a. Horizontal - where will it be located? In what street, right-of-way (existing or new), or easement will the facility be located, and where within such streets or rights-of-way will it be located?

b. Vertical - what will be the height or depth of the facility? Specific reference is made to the basic design alternatives:

- **LRT in an elevated (above ground) structure.**
- **LRT located on ground surface in a public streets, either sharing the right-of-way with other traffic or in a separate transit-only space.**
- **LRT located on ground surface but in its own right-of-way/easement, such as the CMT right-of-way.**

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[1] At conceptual design level of detail, the intent is to locate the LRT line with an accuracy of ±1% for horizontal and within ±10% for vertical alignment.

- **LRT in a below ground structure with a shallow depth permitting cut/cover or open cut construction methods or with a deeper depth requiring bored tunnels.**

2. Station locations (the number, location, and size of stations).

3. Station layout.

a. Location of platforms

b. Facilities to be included within the station

c. Local means of access:

- **kiss-n-ride facilities (drop-off access and street access).**
- **park-n-ride facilities (location, number of parking spaces, design concept, and street access location).**
- **bus transfer facilities (location, number of bus berths, design concept, and street access location).**
- **pedestrian access and bikeway connections.**

4. The location and design characteristics of major special facilities such as an LRT maintenance and/or storage facility.

The conceptual design alternatives represent a combination of the above described elements. It is recognized that there are other items (beyond the above features of the alternatives) that represent design details that would be decided in later stages of design (i.e., at the 30% and 100% levels). These are design elements that are not fundamental to critical decision about the conceptual design or location of MetroLink and would have little or no bearing on the comparisons between alternative design concepts. An example would be specifications for building and construction. For cost estimating purposes, ranges of such possible details will be identified. Such details represent options that can be added to alternatives after the basic choices (as outlined above) are made. Because such items would be designed later, they would not be part of the evaluation method of concept design.

Evaluation Process

The overall evaluation process is composed of seven basic steps, as shown in Figure 1. The evaluation itself is an iterative process used to analyze, discriminate between, and refine alternative with reference to the design objectives. Results of the process become the basis for the technical recommendation on a preferred alternative. The seven steps are:

Step 1: Define Design Objectives

Establish the basic purposes to be achieved by making a transportation investment.

Step 2: **Develop Candidate Design Alternatives**

Identify design options for geographic segments of the overall corridor (horizontal and vertical alignments, station locations, etc.).

Step 3: **Identify Logical Corridor Alternatives**

Using variations of the conceptual design options, develop consistent, complete corridor alternatives for testing and evaluation; that is, define alternative that extend from Forest Park to Shrewsbury. Develop alternatives that reflect a range of cost and performance characteristics.

Step 4: **Select Performance Criteria and Measures**

Define the criteria needed to measure how well the alternative achieve the design objectives, and develop performance measures for each criterion to evaluate the impacts of the alternatives.

Step 5: **Analyze Costs, Benefits and Impacts of Corridor Alternatives**

Analyze the performance of the corridor alternatives using the selected set of criteria and measures, placing greater emphasis in the evaluation on the major criteria identified for each design objective. Identify the strength and weaknesses of each alternative with respect to the design objectives.

Step 6: **Compare Corridor Alternatives and Identify Trade-offs**

Compare the relative strengths and weaknesses of the corridor alternatives and evaluate the explicit trade-offs between design objectives. Assess which alternative(s) best meet the design objectives. Through a comparable set analysis, evaluate project elements (vertical and horizontal alignments, station locations, etc.) by geographic segment to determine how varying those elements might improve the performance of corridor alternatives. Refine and reevaluate the corridor alternatives, as appropriate, with the goal of maximizing the performance of each.

Step 7: **Prepare Evaluation Report**

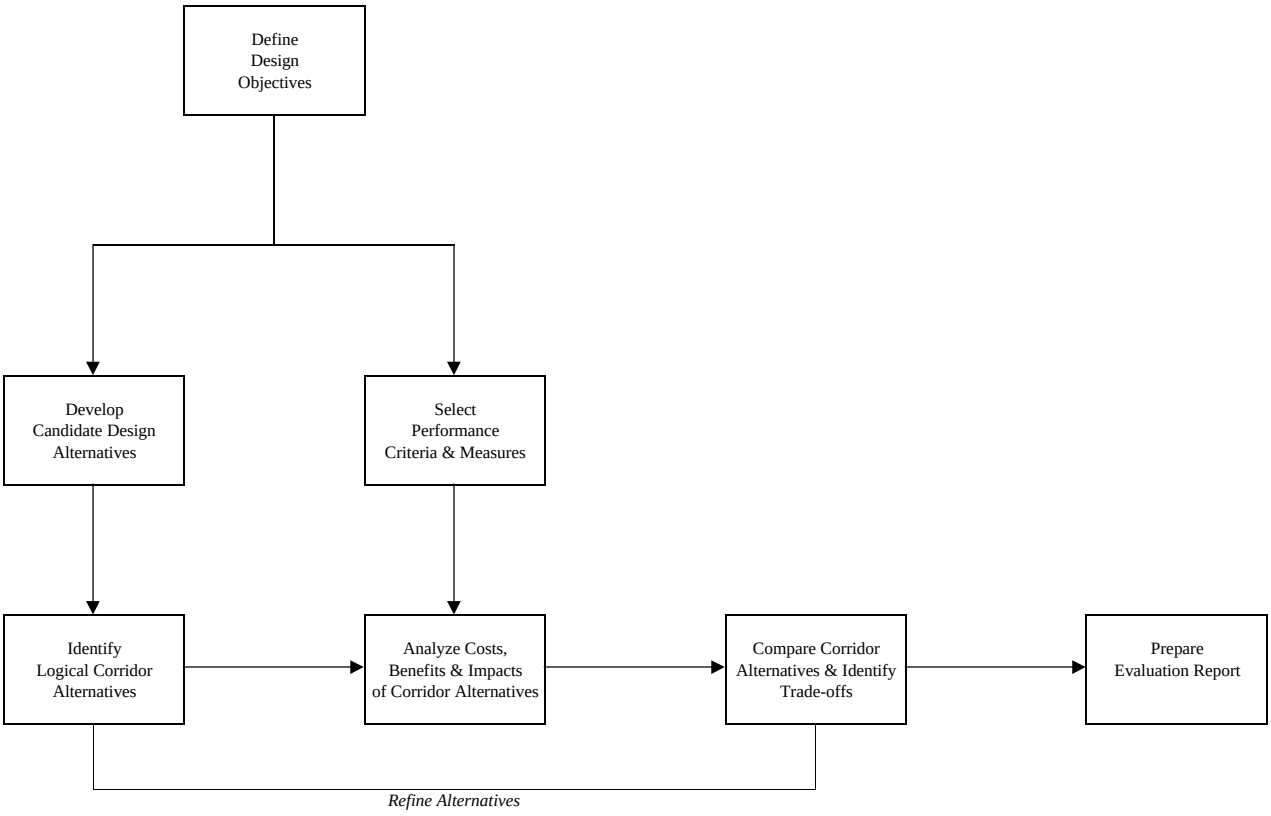
Translate the findings of steps 5 and 6 into a report using tabular and visual formats to summarize and clarify the technical information for input into public discussion and the decision-making process leading to the selection of a preferred conceptual design for the Cross-County MetroLink Extension-Segment I.

Corridor-Level Alternatives

Because certain critical impacts such as ridership, operating costs, cost-effectiveness, mobility

and accessibility can only be estimated using corridor-level analysis, alternative will be evaluated and compared at the corridor-level. Initial steps in the process to identify candidate design alternatives involved consideration of a variety of possible concepts (horizontal and vertical alignments, station locations, and supporting facilities). These concepts were developed for three discrete route segments rather than for the entire corridor: 1) Forest Park Station through University City, 2) Clayton and the Galleria Area, and 3) Richmond Heights to Shrewsbury Area. To accomplish the corridor-level analysis (meaning the evaluation of routes extending from the Forest Park Station to Shrewsbury), candidate design alternatives for the route segment will be logically combined to define corridor scale alternatives. The intent will be to develop corridor alternatives that differ in design characteristics and that reflect a range of performance and costs.

Figure 1
General Evaluation Process



3
Design Objectives, Criteria and Performance Measures

As discussed in Chapter 2, the corridor alternatives for the Cross-County MetroLink Extension-Segment I will be evaluated against a series of design objectives. These design objectives represent the transportation function and service to be provided, the urban design relationships to be developed, the economic benefits to be achieved, and the beneficial impacts to be created or negative impacts to be avoided through the design of the LRT route and its elements.

To determine how the alternative will achieve the design objectives, a comprehensive set of criteria and measures have been identified. The criteria interpret the objectives in explicit terms. The measures are the quantitative and qualitative characteristics, performances, and impacts of each alternative design concept. The selection of measures is guided by the potential to reliably estimate the performance, benefit, or impacts of alternatives (i.e., usable analytical tools), by the availability of data, and the ability to discriminate between alternatives.

Design Objectives

The proposed objectives for the Segment I alternatives are listed in Table 1.

Table 1 - Design Objectives

(1) Transportation	**Provide high quality public transportation service to improve mobility and accessibility and to enhance the attractiveness of MetroLink as a mode of choice without diminishing the performance of the regional transportation system.**
(2) Urban Design	**Design facilities that are compatible with the character of the corridor and that are coordinated with and contribute to existing and planned land-use in areas generally contiguous with MetroLink and the region as a whole.**
(3) Economic	**Contribute to desirable economic and community development in the corridor and the region.**
(4) Environmental Impact	**Have maximum positive and minimum negative impacts on the environmental in the neighborhoods and institutions in the corridor, and do not have disproportionately high and adverse human health or environmental effects on children or on minority and low-income populations.**
(5) Cost and Finances	**Make cost effective investments that are affordable relative to anticipated financial resources and that do not compromise the potential for future extensions.**
(6) MetroLink Compatibility	**Design facilities that are consistent and compatible with the existing and future MetroLink system.**

Source: Parsons Transportation Group

Criteria and Measures

Table 2 list a set of criteria and measures based on the above objectives to be used to evaluate alternatives. These criteria and measure address the design objectives in the following ways:

Transportation

The criteria address both aggregate and individual concerns. Overall utility of the alternative is expressed by ridership and accessibility. The former indicate the relative effectiveness of the alternative to capture riders and serve a significant transportation purpose. Accessibility addresses critical linkages between customers and their destinations. The latter would be defined in terms of linkage to employment (or linkage labor force to development for the sake of supporting commercial, retail, and industrial land-use). It also addressed linkages to activity centers as a means to measure development access to its trade area (for customers, patrons and visitors).

Criteria addressing individual concerns focus on mobility, personal safety and security. Mobility is defined by both the quantity and quality of transit service. The latter is a combination of the MetroLink extension into the Cross-County corridor itself plus the local mode of access improvements included in the design concepts (e.g., improved Bi-State bus service, park-n-ride, bicycle and pedestrian access to LRT stations). Safety and security issues associated with new transit facilities relate to both users of the transit system and the impact of the system on the surrounding transportation system and community. While measuring these impacts is largely a qualitative exercise, comparative data can be derived from other operating systems to suggest the degree of potential impacts.

System operation issues associated with traffic safety and congestion and particularly important in this study because of the consideration of at-grade design concepts, some of which would include LRT trains operating in the same street right-of-way with other traffic. While it is unlikely that LRT trains and other traffic would share the same through lane, there would be crossings and intersections of LRT with other traffic. This sharing of space could create the potential of accidents and affect the road capacity available for other traffic movements.

Urban Design

The criteria address matters of LRT/land-use relationships and compatibility. The former would consider relationships across the corridor and at specific sites. Beyond transportation functionality, the LRT system is to be an asset to surrounding communities. It must fit in and contribute to its surroundings, either by aiding in achieving desirable change or helping to maintain the quality of existing communities.

The design of the LRT facility should consider the various dimensions of high quality urban design. These include visual, aesthetic, and scale characteristics. Since the Cross-County corridor has variation in its character, the design concepts need to be evaluated based on their ability to be in balance with each distinct area. These measures involve matters of culture, history and architectural quality. Their interpretation will reflect the values of the communities in the corridor.

Economic

The corridor contains locally and regionally important development and redevelopment areas. The economic vitality of several communities is associated with the success of those development areas, and the new transit service can contribute to the long range sustainability of both the local communities and the region. The criteria consider ways in which an alternative might aid in achieving these purposes via linkage, increased areas of access, increased size of the regional trade area, and enhanced use of land. The criteria also reflect the principles of transit-oriented development, which indicate that certain land-use concepts can contribute significantly to the success of transit and vice versa.

Environmental Impact

The criteria represents a comprehensive range of benefits and impacts associated with natural and cultural resources. Most criteria focus on minimizing adverse impacts on people, land-use,

and nature. Two special criteria are included to address the direct effects of construction and the consideration of equity. The former criterion recognizes that the LRT improvement will be fit into a substantially developed corridor. As a large scale public project, the potential for construction impacts need to be assessed. Because the LRT design concepts will include at-grade alternative, the criteria focus on site details concerning specific access to existing properties and the impacts of modifying that access.

Equity will be considered in terms of the geographic and social distribution of benefits and impacts. The purpose is to gauge both the benefits and cost accruing to each community in the corridor, with the goal of each community sharing both benefits and costs in a fair and balanced way.

Cost and Finances

The criteria address both absolute and relative costs. The former deals with the estimated costs for each alternative (capital, operating and maintenance, and life-cycle costs) in a direct way (how much each alternative costs). It also compares these estimates to potential resources to address the questions of financial feasibility and implementability.

On a relative basis, the alternatives will be evaluated in terms of cost-effectiveness, or measures that directly compare the cost and relative performance of the investment alternatives. Cost information, as well as data on benefits, will also be used to identify how well the investment achieves equity among the communities in the corridor.

MetroLink Compatibility

As the MetroLink system grows incrementally, the compatibility of new routes with those built previously becomes an important issue. The criteria address design and operational consistency with the existing system. Because Segment I is designed to anticipate other extensions, the criteria also consider the relative ease and cost for each alternative to allow for further extensions.

Table 2 - Criteria and Measures by Category

Objective	Criterion	Measure
(1) Transportation	(A) Maximum transit ridership (LRT in combination with bus users)	a. estimated daily ridership b. estimated work trip ridership per day c. estimated ridership for special events
	(B) Improve accessibility	a. weighted travel times to major employment[2] centers in corridor b. weighted travel times to major employment[2] centers outside of corridor
	(C) Increase mobility	a. residential population within 1/4 mile walking distance of LRT stations b. employment locations within 1/4 mile walking distance of LRT stations c. number of health care, educational, recreational, commercial and social service locations within 1/4 mile of LRT stations d. change in total travel time for a representative sample of trips within the corridor and trips with one end outside of the corridor
	(D) Maximize safety	a. number of LRT train/traffic movement conflict points weighted by volume potential b. qualitative - pedestrians crossing LRT tracks and passengers walk access to LRT stations crossing other traffic c. sight distance available to LRT train operators d. projected changes in accident rates based on comparative data
	(E) Enhance traveler's sense of personal security	a. qualitative - application of safety and security principles, e.g., sight distance, visibility, proximity to moving traffic, other security features

Table 2 - Continued

[2] Along with identifying employment concentrations, consideration would also be given to major activity centers in which accessibility is associated with customers/visitors rather than employees.

Objective	Criterion	Measure
	(F) Minimize reductions in transportation capacity for other traffic	a. intersection traffic capacity for locations affected by LRT b. traffic impact on corridor streets due to access patters to park-n-ride facilities or by buses to transfer facilities (impact analyzed in terms of added peak hour traffic and intersection capacity)
(2) Urban Design	(A) Support existing or planned land-use	a. qualitative - location of stations and influence on land-use b. qualitative - specific comparison with recommended transportation elements c. compatibility with local plans and zoning
	(B) Specific enhancement to planned/developing major activity centers	a. walking distance to major activity centers-Clayton CBD core, Washington University (Hilltop Campus), Galleria, Sunnen Business Park, and Hanley Business Park
	(C) Maintain viable access to adjacent sites	a. access or driveway impacts in terms of: driveways affected driveways relocated driveways eliminated b. qualitative - changes in access patterns (to and from) in terms of added travel distances, complexity, difficulty
	(D) Create compatibility in design quality with surrounding area	a. qualitative - assessment of urban design, characteristics (visual, aesthetic, scale, level of activity, etc)
(3) Economic	(A) Foster development and redevelopment in strategic locations	a. distance proximity to areas with redevelopment goals - Forest Park MetroLink Station, Brentwood, Richmond Heights, Maplewood, and Shrewsbury b. qualitative - opportunities to leverage LRT and other investments, opportunities to create enhanced redevelopment sites c. qualitative - achievement of transit-oriented development principles

Table 2 - Continued

Objective	Criterion	Measure
	(B) Enhances economic viability of key activity centers	a. changes in trade area due to enhanced travel specifications for the Clayton CBD, Galleria area, and Promenade
	(C) Enhances corridor tax base	a. qualitative - acres of under utilized land that could have value added b. acres of taxable land removed from tax rolls for transportation facilities
(D) Environmental Impact[3]	(A) Minimize impact on natural resources	a. impact on waterways and wetlands via reduction in wetland acreage or quality, change in water quality or waterway capacity b. impact on wildlife and vegetation in terms of changes to habitat and removal or damage to unique vegetation
	(B) Minimize displacement	a. number of dwelling units or related structures of property taken or displaced b. number of non-residential properties displaced (sq. ft. and/or value)
	(C) Minimize noise, vibration and electro-magnetic related impacts on sensitive areas	a. changes in noise levels at residential, institutional, and other sensitive land-uses b. changes in vibration levels at sensitive land-uses c. qualitative - assessment of potential electro-magnetic interference (EMI), and potential effects of electro-magnetic fields (EMF) on sensitive land-uses
	(D) Improve air quality	a. changes in regional AQ emissions b. intersection and parking facility hot spots - emissions associated with traffic operations affected by LRT
	(E) Minimize construction impacts	a. qualitative-assessment of land-use impacts due to construction (disruption of access, impact of construction activities) b. length of construction process

[3]See Environmental Analysis Method Report for details about analyzing impacts.

Table 2 - Continued

Objective	Criterion	Measure
	(F) Minimize impact on cultural resources (historic, archeological) and park lands	a. displacement, damage, impact on function or accessibility, or impact on surrounding environment
	(G) Achieve equity in terms of project benefits and cost	a. comparison of unit LRT investment levels ($ per mile) for locations in each municipality in the corridor b. number of riders generated in each municipality per capita c. percent of riders generated in each municipality compared to the percent of capital cost for facilities located in each d. comparison of positive and negative impacts per municipality e. comparison of rides generated per traffic analysis zone with zones categorized by income level and transit dependency
(5) Cost and Finances	(A) Maximize cost-effectiveness	a. portion of project capital cost devoted to local modes of access per additional rider (compare all alternatives to the least cost alternatives) b. portion of project capital cost devoted to LRT per additional rider (compare to least cost alternative) c. define all trade-offs and compute cost per unit of benefit increased accessibility increased mobility eliminate loss in traffic capacity eliminate loss in site access aesthetic and visual benefits improved LRT travel time reduction in accident potential change in noise impacts increased economic benefits acres of more developable land acres of/units of displacement amount of increased accessible land by major category other to be determined d. qualitative - assess achievement of basic goals (compare to anticipated targets.

Table 2 - Continued

Objective	Criterion	Measure
	(B) Minimize project costs while achieving basic design objectives	**a. capital costs** **b. annual operating and maintenance costs** **c. life cycle costs** **d. qualitative - assess achievement of basic goals (compare to anticipated targets)**
	(C) Maximize feasibility of implementation	**a. percent of annualized capital cost covered by available resources for capital costs** **b. percent of annual O/M costs covered by available resources** **c. qualitative - risk assessment as to the sustainability of financial resources** **d. risk assessment of constructability**
	(D) Enhance opportunity of private sector participation in financing	**a. estimated range of possible private sector funds**
(6) MetroLink Compatibility	**(A) Compatibility of design features**	**a. comparison of station layouts noting similarities and differences from a customer perspective** **b. comparison of all facilities in terms of maintenance requirements**
	(B) Opportunity for developing Segments II and III MetroLink Extension	**a. operating efficiency of future system/effective level of service** **b. potential capital cost to develop junctions** **c. implications for design requirements or policies affecting future extensions** **d. effects on overall financial plan**

4
Evaluation Method

Once the corridor-level alternatives are defined, the evaluation can proceed according to the process outlined in Figure 2. The goal of the evaluation is ultimately to support a technical recommendation on a preferred design concept for the Cross-County MetroLink Extension - Segment I. To attain that goal, the evaluation must discriminate between corridor-level alternatives according to design objectives, criteria, and measures, with the results organized in way that describes how well each alternative achieves the design objectives and that highlights key differences between the alternatives. The proposed evaluation method has six basic features:

1) **an analysis of each corridor-level alternative using the selected performance measures and summarized by criteria category;**

2) **an evaluation of each alternative from the perspective of the design objectives;**

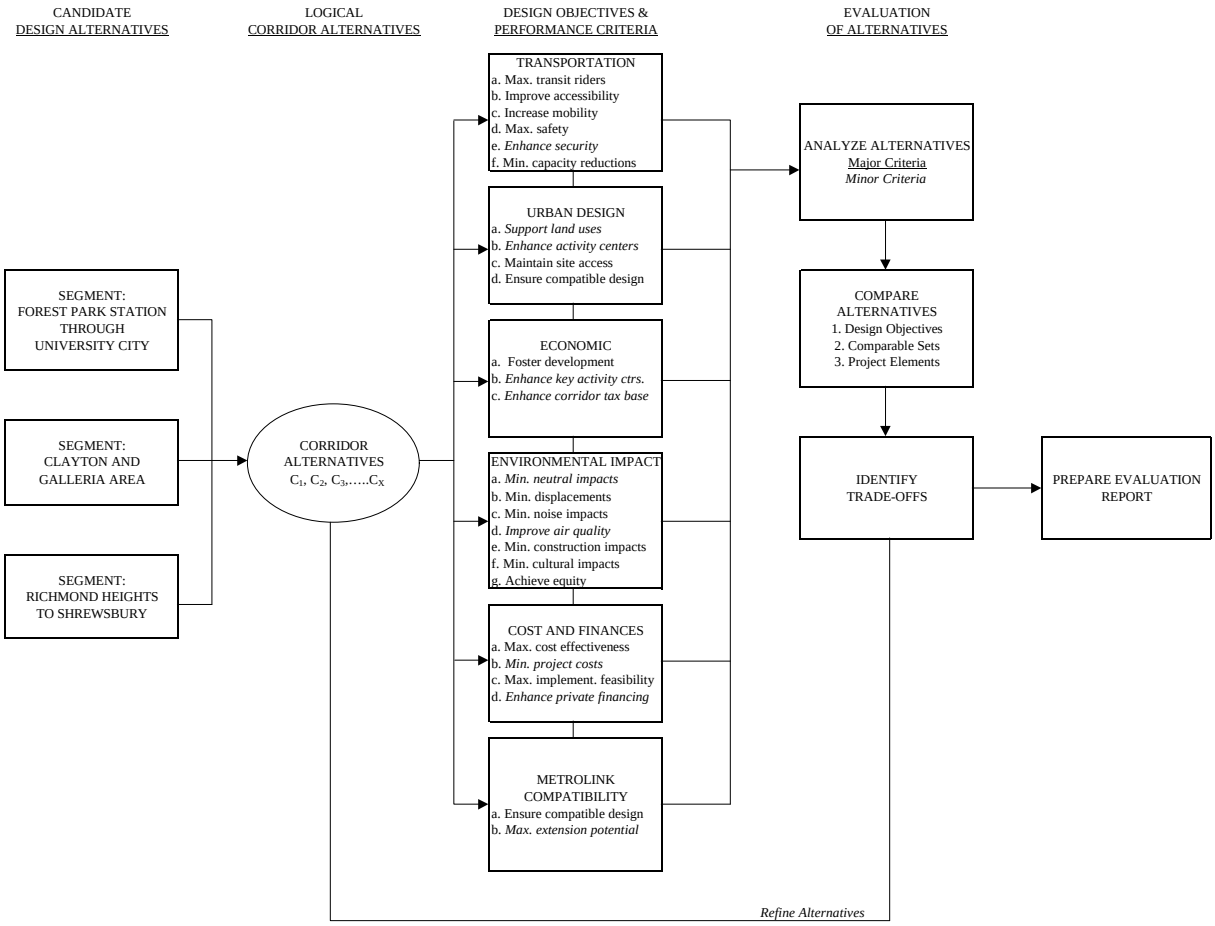
3) **a trade-off analysis that compares key differences between the alternatives with reference to how well they attain of the design objectives;**

4) **a comparative review (using comparable sets) of the effect that specific project elements have on the overall performance of the corridor-level alternatives;**

5) **a refinement and reevaluation of the corridor-level alternatives based on the review of project elements;**

6) **a summary report that discusses the advantages and disadvantages of each alternative and the key differences and trade-offs between them.**

Figure 2
Detailed Evaluation Process



The first two features of the method are relatively direct straightforward. Information derived from travel demand forecasts, conceptual engineering, design and engineering principles, field surveys and on-site data collection activities, and local and national experience will be used to evaluate the alternatives relative to the 63 performance measures identified in Chapter 3. Results from those individual measures will hen be aggregated to the criteria level and a general assessment will be made concerning how well the evaluated alternative meets the performance criteria and, in turn, achieves the design objectives.

As Table 2 indicates, the measures used to estimate the performance and impacts of each alternative will include both quantitative and qualitative units of analyses. Where appropriate, certain benchmarks or levels of expected achievement will be identified. Data for these could be extracted from exiting agency standards and policies or widely accepted practice (e.g., the standard for traffic level of service will be "D", according to the Highway Capacity Manual). These targets would then be incorporated in the comparisons to identify how well the alternative perform.

Comparison of Alternatives

The heart of the evaluation process is the comparison of alternatives. The relative desirability of an alternative can only be evaluated by comparing its performance against other alternatives in achieving the design objectives and then using the results of the comparison to identify significant differences and the resulting trade-offs between alternatives. In evaluating the comparative data it is critical to keep the concept of a *significance* in mind. A significant difference between alternatives related to the relative importance of the specific criteria being evaluated and the magnitude of the difference. The comparative analysis should focus on the key criteria in which there are notable differences between the alternatives.

The comparison of alternatives will involve arranging the evaluation results for each alternative in tabular form and reading across the columns to highlight those measures in which significant differences occur. Highlighted differences in measures would be further refined by categorizing them as being within a major or other criteria category. While this evaluation process does not employ weights to define the relative value of criteria, it does recognize that certain criteria and associated measures have greater importance to decision-makers. The major (or more significant) criteria, derived from previous planning activities and decisions made relative to this proposed MetroLink extension, are listed below. These major criteria would form the primary basis for evaluating trade-off relationships between the alternatives.

Evaluation Measure	Evaluation Value			
	Corridor Alternative 1	Corridor Alternative 2	Corridor Alternative 3	Corridor Alternative X
1 (A) (a) (b) (c) 1 (B) (a) (b)				

Major Criteria[4]

1. **Transportation:**
   - a. ridership potential
   - b. improve accessibility
   - c. increase mobility
   - d. safety
   - f. minimize reductions in transportation capacity

2. **Urban Design:**
   - c. maintain or improve viable access to sites
   - d. create compatibility in design quality with surrounding area

3. **Economic:**
   - a. foster development and redevelopment in strategic location

4. **Environmental Impact:**
   - b. minimize displacement
   - c. minimize noise impacts
   - e. minimize construction impacts
   - f. minimize impact on cultural resources
   - g. achieve equity in benefits and cost

5. **Costs and Finances:**
   - a. maximize cost-effectiveness
   - c. maximize feasibility of implementation

[4]Criteria not listed are considered other

6. MetroLink Compatibility:

b. opportunity to develop future segments and phases

Results will be organized according to two grouping of criteria, major and other, with a summary developed for he fourteen major criteria. These results would be further compared in terms of an overall tradeoff comparison between the environmental impact category and the cost and finances category.

Refinement of Alternatives

Once the comparative analysis is completed on the corridor-level alternatives, more detailed analysis of project elements will occur. The purpose of this analysis will be to identify how specific project design elements (horizontal and vertical alignments, station locations and size, etc.) affect the performance of the larger alternatives, and how the corridor alternatives might be refined to improve their performance while preserving their distinct character.

Project elements will be evaluated using comparable sets. Comparable sets refer to the well-known metaphor of comparing apples to apples and oranges to oranges. Using this technique, evaluation results relating to design elements will be organized so that like items are being compared, i.e., track locations are compared to other track locations; station locations to other station locations, etc.

The sequence of comparing results would begin with a sorting task to create comparable sets. In order to compare the alternatives, the criteria/measures will be sorted by design feature (see Chapter 2), that is, which measures are relevant to the performance, impact, or costs of the specific features of the alternatives (horizontal or vertical alignment, station location or layout, local mode of access facilities and service, major support facility location and operation) being compared. For example, consider the transportation objective, Criteria F - traffic capacity reductions. The analysis would consider if the criteria and measure applies to the specific feature's and if yes, are the alternatives different enough to show differences in values of the measure. If yes, these criteria and measures would be used for evaluation of the specific feature.

For this purpose, the following matrix would be prepared:

Evaluation Measure	Features of Alternative Concepts			
	Apply		Differences in Alternatives	
	Yes	No	Yes	No
1 (A) (a) (b) (c)				

The following tables would also be developed to compare alternatives by criteria category.

Evaluation Measure	Analysis Results by Features by Alternative								
	Horizontal/Vertical Location			Station Location		Station Layout		Mode of Access	
	A	B	C	A	B	A	B	A	B
1A) (a) (b) (c)									

For each category, the results summarized by the previous matrices for type of feature will be extracted on a paired alternative basis (two at a time) to identify the relative merit between them. This will be repeated until there is a result which distinguishes or defines differences for alternatives. The analysis could result in recommendations for improving the performance of the corridor-level alternatives. Refinement of those alternatives would lead, in turn, to a reevaluation as outlined in the previous section.

Summary of Results

Evaluation activities inevitably produce a substantial and complex volume of numbers which are potentially confusing. There is, therefore, a need to distill and clarify these data. This would be the last phase in the overall evaluation process.

Various tables will be part of the result summaries. However, these will be supported by several visual summaries that will simplify the analysis for discussion and decision-making purposes.

The visual techniques recommended for this purpose will include (but will not be limited to):

1. **Objective achievement profile using bar chart techniques.**

2. **Network maps with color line codes to illustrate certain performance measures.**

3. **Pie charts to illustrate financial analysis results.**

4. **Corridor base maps with sections color coded to indicate impact analysis results.**

5. **Photos of other projects to depict similar situations and other pictures to visualize the design concepts.**