CROSS-COUNTY MetroLink Extension

Segment 1
Conceptual Design

Cross-County
MetroLink
Extension

Socio-Economic and Environmental Analysis 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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Acronyms

ACOE	Note: See USACE
ADA	Americans with Disabilities Act
ADT	average daily traffic
AIRS	Aerometric Information Retrieval System
AQ	Air Quality
ASM	Archaeological Survey of Missouri
BMP	Best Management Practice
BN&SF	Burlington Northern & Santa Fe Railroad
BSDA	Bi-State Development Agency (Bi-State)
CBD	central business district
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response Compensation and Liability Information System
CEI	Comprehensive Evaluation Inspection
CFR	Code of Federal Regulations
cfs	cubic feet per second
CMAQ	Congestion Mitigation and Air Quality
CMT	Citizens for Modern Transit
CO	carbon monoxide
dB	decibel
dBA	A-weighted decibels
EIS	Environmental Impact Statement
ELF	Extreme Low Frequency
EPA	Environmental Protection Agency
ESA	Environmental Site Assessment
EWGCC	East-West Gateway Coordinating Council (The Council)

FEMA	**Federal Emergency Management Agency**
FHWA	**Federal Highway Administration**
FIFRA	**Federal Insecticide, Fungicide, Rodenticide Act**
FTA	**Federal Transit Administration**
FGT	**fixed-guideway transit**
FY	**fiscal year**
HC	**Hydrocarbons**
HI	**Heavy Industrial**
HCM	***Highway Capacity Manual***
HOV	**high-occupancy vehicle**
HVAC	**heating, ventilation, air conditioning**
Hz	**Hertz**
ITE	**Institute of Transportation Engineers**
ITS	**Intelligent Transportation Systems**
kV	**kilovolt**
L_{eq}	**Noise level fluctuating over a given period of time**
L_{dn}	**Noise level averaged over a 24-hour period**
LID	**light industrial**
LM	**light manufacturing**
LOS	**level of service**
LRT	**light-rail transit**
LRTP	**Long-Range Transportation Plan**
LRV	**light-rail vehicle**
LUST	**leaking underground storage tank**
MDNR	**Missouri Department of Natural Resources**
mG	**milligauss**
MINUTP	**traffic analysis modeling program**
MoDOT	**Missouri Department of Transportation**
MPO	**Metropolitan Planning Organization**
mph	**miles per hour**
MSA	**metropolitan statistical area**
MSD	**Metropolitan Sanitary District**
MTIA	**Major Transportation Investment Analysis**
NAAQS	**National Ambient Air Quality Standards**
NAC	**noise abatement criteria**
NEPA	**National Environmental Policy Act**
NFRAP	**No Further Remedial Action Planned**
NO_X	**nitrogen oxides**
NPDES	**National Pollutant Discharge Elimination System**
NRHP	**National Register of Historic Places**

NWI	**National Wetland Inventory**
O_3	**ozone**
O&M	**operations and maintenance**
OSHA	**Occupational Safety and Health Administration**
Pb	**lead**
PDC	**Planned Development Commercial**
PM	**particulate matter**
PM10	**particulate matter under 10 microns in size**
PPM	**parts per million**
PUD	**Planned Unit Development**
RCRA	**Resource Conservation and Recovery Act**
ROW	**right-of-way**
SARA	**Superfund Authorization and Reauthorization Act**
SHPO	**State Historic Preservation Office**
SIP	**State Implementation Plan**
STIP	**Statewide Transportation Improvement Program**
SO_2	**sulfur dioxide**
SOV	**single-occupancy vehicle**
SQG	**Small Quantity Generators**
SR	**Single family Residential**
TAZ	**transportation analysis zone**
TDM	**transportation demand management**
TEA	**Transportation Equity Act**
TIF	**Tax Increment Financing**
TIP	**Transportation Improvement Program**
TOD	**transit-oriented development**
TRIS	**Toxic Chemical Release Inventory System**
TRRA	**Terminal Railroad Development Commercial**
TSCA	**Toxic Substances Control Act**
TSD	**Treatment, Storage, Disposal**
TSM	**transportation system management**
UMSL	**University of Missouri, St. Louis**
UP	**Union Pacific**
USACE	**United States Army Corps of Engineers**
USDA	**United States Department of Agriculture**
USDOT	**United States Department of Transportation**
USEPA	**United States Environmental Protection Agency**
USGS	**United States Geological Survey**
UST	**underground storage tanks**
USFWS	**United States Fish and Wildlife Service**

v/c	**volume to capacity ratio**
Vdb	**vibrational velocity decibel**
VMT	**vehicle miles traveled**
VOCs	**volatile organic compounds**

Executive Summary

Project Description

East-West Gateway Coordinating Council (the Council) and its partner agencies, Bi-State Development Agency (Bi-State) and Missouri Department of Transportation (MoDOT), are planning the construction of a light rail transit line extension in the Cross-County Corridor. The proposed Cross-County MetroLink Extension, known as Segment I, extends 7.8 miles from the existing Forest Park MetroLink station in the City of St. Louis west through downtown Clayton then south to Maplewood and Shrewsbury near I-44 (from DeBaliviere to Lansdowne). Conceptual designs for two major build alternatives have been developed. This conceptual design study builds on previous work done by the Council during the Cross-County Major Transportation Investment Analysis (MTIA) studies, including the selection of the MetroLink route in September 1997.

Light rail transit stations are currently being proposed at Forest Park Parkway/Skinker Boulevard, Millbrook Avenue/Big Bend, Carondelet Plaza, downtown Clayton, the Galleria, Citizens for Modern Transit right-of-way (CMT) and Eager Road, CMT and Manchester Road, Sunnen Business Park at Laclede Station Road, or CMT and Big Bend, and a terminal station at either Lansdowne Avenue (south of I-44) or at CMT and Deer Creek (north of I-44). A MetroLink maintenance facility and a park-n-ride facility are proposed in conjunction with the terminal station. Another park-n-ride facility would be constructed at the Eager Road station.

Project Setting

The Cross-County/Segment I corridor is 8.2 miles long (7.8 miles from DeBaliviere to Lansdowne). It is largely a built-up area traversing very heterogeneous land uses that range from residential to institutional to commercial to industrial. These land uses include areas that are significant in terms of their history, density or level of activity, and/or regional economic impact.

The corridor can be divided into three highly distinctive subareas:

- ***Forest Park/University City*. This area is dominated by the presence of existing high-quality residential neighborhoods, educational institutions, and Forest Park.**

- ***Clayton/Richmond Heights*. This is a mixed-use subarea that includes downtown Clayton; major commercial/retail areas, including the Galleria; and residential uses. Downtown Clayton is a place of work for more than 30,000 persons and has a compact, high-density core. It is second only to the St. Louis central business district (CBD) in its concentration of office activities.**

- ***South/I-44*. This subarea is the most diverse, with many types of development. It includes business/industrial uses, significant commercial centers, and residential neighborhoods. The potential right-of-way is very different from that in the other two subareas in that it primarily follows an old railroad right-of-way. This is in contrast to the Forest Park and Clayton subareas which largely use public street rights-of-way (although even these streets formerly served as trolly rights-of-way).**

From an urban design perspective, these locations present very different relationships between the transit facility and adjacent land-uses. Because of these different corridor characteristics, the recommended engineering and urban design concepts for the MetroLink extension incorporate strategies to enhance the urban characteristics that are unique to the residential neighborhoods. They also incorporate strategies that would take advantage of the new transit accessibility to promote desirable growth and development. The elements of these strategies are connected with three relationships to be captured in the design: (1) land-use change/development opportunities, (2) transit/land-use relationships, and (3) compatibility and unique urban characteristics.

Level of Analysis

This draft environmental analysis report presents the socioeconomic and environmental benefits and impacts of the conceptual design alternatives for the Cross-County MetroLink Extension Segment I project. The environmental analysis results will be integrated with the engineering, transportation, operations, cost, and financial analyses results for use in determining the preferred conceptual design. The environmental analysis for the previous planning studies in the Cross-County MetroLink corridor included a broad review of environmental factors to identify notable issues and constraints. Where appropriate, that information provided the starting point for this analysis. However, because this analysis required that the MetroLink extension alternatives be evaluated at a level of detail necessary to make informed design decisions, a more rigorous analysis was conducted.

Since the Cross-County MetroLink Extension Segment I project will be financed with local funds (i.e., no federal dollars), federal National Environmental Policy Act (NEPA) environmental regulations do not apply. However, the level of analysis for this report is consistent with Council on Environmental Quality guidance on environmental impact assessment as implemented through NEPA. This analysis report is similar to an environmental assessment completed under the auspices of NEPA. Input regarding the relevant resource areas was collected from a review of previous studies and reports, technical staff field investigation, agency coordination, and input received from community engagement activities. The most current data from local sources and recent aerial photography, supplemented by fieldwork, was used in the analysis. Methodologies used in the analysis of resource issues are documented in the *Socioeconomic and Environmental Methodology Draft Technical Report*, which was prepared for this MetroLink project. All references in this document to federal regulations other than NEPA (e.g., Section 106 of the National Historic Preservation Act and Section 4(f) of the U.S. Department of Transportation Act) are for guidance purposes only with regard to the environmental analysis being conducted for this conceptual design study.

Alternatives Evaluated

After considering a full range of conceptual design alternatives, two basic design configurations were retained for detailed analysis: a Fully Grade-Separated Alternative and an alternative light rail transit operating at-grade in public rights-of-way with grade-separated sections to avoid conflict with other major highway and railroad crossings, known as the At-Grade/Grade-Separated Combination Alternative. These alternatives describe concepts that would extend throughout the Segment I corridor. In addition, certain limited options were identified that would affect only certain sections of the corridor.

Corridor Alternatives

Fully Grade-Separated Alternative

- **This alternative is a below-ground alignment using a cut-and-cover design from the Forest Park Station (at DeBaliviere) to the east edge of downtown Clayton (near Forsyth Boulevard) at Forest Park Parkway; the MetroLink facility to be located within the existing right-of-way of Forest Park Parkway and Millbrook Boulevard.**
- **Within downtown Clayton, the alternative is a below-ground alignment, using cut-and-cover design, extending under Forsyth Boulevard and following an alignment to the west under Carondelet Plaza and Carondelet Avenue to Brentwood Boulevard, then south to Galleria Parkway, then east under Galleria Parkway to the CMT right-of-way; the MetroLink facility would be located within existing street right-of-way except in the east edge of downtown Clayton where the alignment would cross through existing private (vacant) property. For the section along Carondelet Avenue, an option was developed for using a bored tunnel construction technique rather than cut-and-cover. This would affect the profile of the line, which would become somewhat deeper.**

- **Along the CMT right-of-way, the MetroLink extension would be built at ground level from south of the Galleria Parkway to Flora Avenue. At Flora Avenue, the MetroLink alignment would ascend on an elevated structure through the Sunnen Business Park, over Big Bend Boulevard, Deer Creek, and I-44 to the Lansdowne Avenue Station and terminus.**

At-Grade/Grade-Separated Combination Alternative

- **This alternative is a below-grade alignment at the Forest Park Station extending west below Forest Park Parkway (cut-and-cover), and transitioning upward to existing ground level at a point approximately 1,000 feet west of DeBaliviere Avenue. The MetroLink extension then would continue in the median at-grade to a point 600 feet west of Big Bend Boulevard, where it would transition back down to below ground and extend below ground (cut-and-cover) to the east edge of downtown Clayton.**

- **Within downtown Clayton, the MetroLink extension would transition up to ground level at Forsyth Boulevard and continue west along the north edge of Carondelet Plaza to Hanley Road, and along Carondelet Avenue through the downtown core, turning south along the west side of Meramec Avenue. South of Bonhomme Avenue, the tracks would be elevated at Forest Park Parkway. The alignment could follow a path along the south edge of the highway or over the eastbound lanes to the CMT right-of-way. The MetroLink extension would cross existing private property in the section east of Hanley Road. It would follow the centerline of Carondelet Avenue, staying within the right-of-way; it would be located in public right-of-way (and a portion on private property at Carondelet and Meramec) for the remainder of this section.**

- **Along the CMT right-of-way, the MetroLink extension would be at ground level from Forest Park Parkway south to Flora Avenue. At Flora Avenue, it would descend to a below-ground (cut-and-cover) alignment through the Sunnen Business Park, passing under the Union Pacific (UP) railroad. South of the railroad, the MetroLink alignment would be at-grade, crossing Big Bend Boulevard and Oxford Avenue. From this point south, it would be on an elevated structure over Deer Creek and I-44 to the Lansdowne Avenue Station.**

Section Alternatives/Options

For certain limited sections along the two corridor alternatives described above, there are additional alternatives or design options.

Substitute sections for the At-Grade/Grade Separated Combination Alternative include:

- ***South Edge At-Grade.*** **Along Forest Park Parkway and Millbrook Boulevard, the track would be at-grade but along the south edge (not in the median) of the roadway. The at-grade alignment would transition to a below-grade location at a point east of Throop Avenue and continue underground to the east edge of downtown Clayton, where it would rise to the ground surface.**

- ***Skinker Boulevard and Big Bend Boulevard Underpasses.*** **For the at-grade alternative, in either a median or south edge location, special underpasses could be included as follows:**

  a. At Skinker Boulevard and Forest Park Parkway for the at-grade alternatives, median alternative (not south edge alternative), special underpasses could be included as follows:

    - ***Transit underpass.*** **The MetroLink tracks would transition from at grade to pass underneath Skinker Boulevard, with the station located under Skinker Boulevard. The transitions would occur west of Des Peres Avenue and east of Hoyt Drive.**

    - ***Roadway underpass.*** **Two lanes (one in each direction) on Skinker Boulevard would be placed in an underpass beneath Forest Park Parkway to enhance traffic capacity at this intersection.**

  b. At Big Bend Boulevard and Millbrook, also for the at-grade alternative, median alignment, a special transit underpass could be included. The MetroLink tracks would transition from at grade at Throop Drive to pass underneath Big Bend Boulevard, with the station located under Big Bend Boulevard. The tracks would stay underground, connecting with the underground section about 400 feet west of Big Bend Boulevard, which is included in the at-grade combination alternative.

- ***Downtown Clayton Elevated.*** **Within downtown Clayton from Forsyth Boulevard (east downtown edge) to the CMT right-of-way, this option entails an elevated transit structure following the north edge of Forest Park Parkway. The MetroLink extension would cross over Forest Park Parkway west of Meramec and run parallel to the south side of the parkway on an elevated structure until curving southward into the CMT right-of-way. There would be two options for vertical and horizontal alignment in the section between Hanley Road and Meramec. One option would be a high-profile alignment, which would be fully grade-separated and largely over Shaw Park Drive. The second option would have a lower profile and be constructed over the westbound lanes of Forest Park Parkway. This option would intersect Bemiston Avenue and the Central Avenue ramp at grade.**

- ***Forest Park Parkway At-Grade*. Within downtown Clayton, following a horizontal alignment similar to the Forest Park Parkway elevated, this option features a profile that would be lower, crossing Forsyth Boulevard at grade, then rising to an elevation equivalent to Forest Park Parkway near the Ritz Carlton Hotel. The alignment would pass over Hanley Road, under Bemiston Avenue, under Central Avenue Ramp, and over Forest Park Parkway from Meramec Avenue west to the CMT right-of-way.**

- ***Carondelet/Brentwood At-Grade.* This would be an optional at-grade alignment in downtown Clayton. Rather than turning from Carondelet Avenue at Meramec, the route would continue west to Brentwood, then turn south along the west side of the street. Near Shaw Park Drive, this option would transition to an elevated alignment, turning west over Shaw Park Drive and then over Forest Park Parkway to the CMT right-of-way.**

- ***Galleria Elevated.* In the Galleria area from approximately Clayton Road to Galleria Parkway, the MetroLink extension would ascend from the CMT right-of-way over I-170 to follow an alignment east of and parallel with Brentwood Boulevard; at Galleria Parkway, it would curve east back over I-170 to the CMT right-of-way.**

- ***Laclede Station Road At-Grade/Elevated.* In the section from Flora Avenue to Big Bend Boulevard, the MetroLink extension would leave the CMT, following Laclede Station Road at grade from Flora Avenue south past Sunnen Drive. At this point, the alignment would become elevated, curving eastward and parallel to the north edge of the railroad tracks, and back toward the CMT right-of-way. At the CMT, it would ascend over the railroad tracks and follow the CMT over Big Bend Boulevard.**

A substitute for either the Fully Grade-Separated or the At-Grade/Grade-Separated Combination Alternative is:

- ***Deer Creek Terminal Station.* As an option to extending the MetroLink alignment to Lansdowne Avenue, the MetroLink extension could end north of Deer Creek (north of I-44) in a location just east of Big Bend Boulevard.**

Summary of Benefits and Impacts

As noted this draft analysis report presents the analysis results for the transportation, urban design, economic, environmental impact, costs and finances, and MetroLink compatibility design objectives for the Cross-County Corridor. These analysis results are presented in Section 4 and Section 5. Tables 4-6 through 4-11 of the *Evaluation Results Final Technical Report* summarize the transportation, socioeconomic, and environmental benefits and impacts for all six design objectives. Refer to these tables for an overview summary of the Cross-County MetroLink Extension's benefits and impacts for each corridor alternative and section option.

Community and Agency Coordination

Community Participation

The community engagement process for the Cross-County MetroLink Extension Segment I Conceptual Design Study is being implemented by the Council, its partner agencies, and a consultant team. Phase I of the process—a public forum and three community issues workshops—was carried out in September and October 1998. Attendance at the four sessions was estimated at more than 800; 727 sign-in cards were collected.

Although the primary purpose of the forum was to provide information rather than to solicit comments, public comment forms were made available to individuals who wished to convey their comments to the Council and study team in writing. Comments were received concerning the engagement process and forum specifically, community impacts, and design recommendations and preferences. Community impact issues raised included concern about noise levels and vibration, vehicular and pedestrian safety, traffic, parking, urban design and aesthetics, costs, timing, and serving the young and elderly. Participants also expressed a variety of preferences regarding route location and profile, station design and location, integration with other forms of transit, and expansion.

The workshops were organized for specific areas of the corridor and included small group work sessions. Participants asked questions about the following: parking impacts on neighborhoods and Clayton businesses, methods for estimating costs and assessing impacts, design requirements for stations, strategies to control parking, signal phasing, noise mitigation, right-of-way requirements, pedestrian and bike safety, and traffic congestion. Regarding perceptions of positive influences, participants mentioned potential improvements in traffic congestion, air quality, and improved connections to the airport, downtown, and sports facilities. Community cohesiveness, economic development, improved accessibility for the elderly, and improved access to jobs also were mentioned.

Phase II of the community engagement process included many meetings with municipalities and groups. The round of public meetings was intended primarily as informational or educational. These sessions were designed to provide city officials, the public, and other stakeholders with greater access to the design consultants and more opportunities to have questions answered and concerns addressed. The team also sought to distribute information more widely, ensuring that property owners and stakeholders throughout the region had opportunities to learn more about the design alternatives and the ways these alternatives will be evaluated. Meetings were held with the City of St. Louis, St. Louis County, Clayton, Brentwood, Richmond Heights, Maplewood, Shrewsbury, University City, Washington University, Forest Park Advisory Board, St. Louis County Municipal League, League of Women Voters, Richmond Heights and Brentwood Chambers of Commerce, CMT Transit Coordinators, Hanley Industrial Court, Sunnen Business Park, and many other civic groups and public/private stakeholders. Also, as part of the

community outreach for the project, a telephone hot-line, e-mail address, and a web site were maintained. A Community Working Group comprised of municipal representatives, civic leaders and interested residents, held monthly meetings to discuss project issues and obtain information. During Phase III, the final phase of the community engagement process, additional public meetings will be held in early June 1999 to present the analysis results of the Cross-County MetroLink Extension Conceptual Design Study.

Agency Coordination

In early February 1999, the Council contacted the following resource and regulatory agencies to inform them of the Cross-County MetroLink Extension Segment I Conceptual Design Study: U.S. Environmental Protection Agency (Region VII); U.S. Department of the Interior, Fish and Wildlife Service and Water Resources Division—U.S. Geological Survey; U.S. Army Corps of Engineers (St. Louis District); Federal Highway Administration; Federal Transit Administration; Missouri Department of Conservation, State Historic Preservation Officer; and Missouri Department of Economic Development, Division of Motor Carrier & Railroad Safety.

Regulatory agency technical staff have also provided information to the study team for the Cross-County MetroLink Extension project during the data collection and environmental analysis phase of the project. The study team has coordinated with the Missouri Department of Natural Resources, U.S. Fish and Wildlife Service, U.S. Corps of Engineers, Missouri State Historic Preservation Office, St. Louis County, and other local, county, and state agencies.

1
Introduction

1.1 Project Description

East-West Gateway Coordinating Council (the Council) and its partner agencies, the Bi-State Development Agency (Bi-State) and the Missouri Department of Transportation (MoDOT), are planning the construction of a light rail transit line extension in the Cross-County Corridor. The proposed Cross-County MetroLink Extension, known as Segment I, extends 7.8 miles from the existing Forest Park MetroLink Station in the City of St. Louis west through downtown Clayton then south to Maplewood and Shrewsbury near I-44 (from DeBaliviere to Lansdowne) (see Figure 1-1). Conceptual designs for two major build alternatives have been developed. This conceptual design study builds on previous work done by the Council during the Cross-County Major Transportation Investment Analysis (MTIA) studies, including the selection of the MetroLink route in September 1997. Light rail transit stations are currently being proposed at Forest Park Parkway/Skinker Boulevard, Millbrook Avenue/Big Bend, Carondelet Plaza, downtown Clayton, the Galleria, Citizens for Modern Transit right-of-way (CMT) and Eager Road, CMT and Manchester Road, Sunnen Business Park at Laclede Station Road, or CMT and Big Bend, and a terminal station at either Lansdowne Avenue (south of I-44) or at CMT and Deer Creek (north of I-44). A MetroLink maintenance facility and a park-n-ride facility are proposed in conjunction with the terminal station. Another park-n-ride facility would be constructed at the Eager Road station.

1.2 Project Background

Since MetroLink went into operation in 1993, planning and investment studies have been carried out, focusing primarily on the most heavily traveled section of the region: the Cross-County corridor. These studies culminated in a decision to extend MetroLink from the vicinity of Forest Park west and south into St. Louis County.

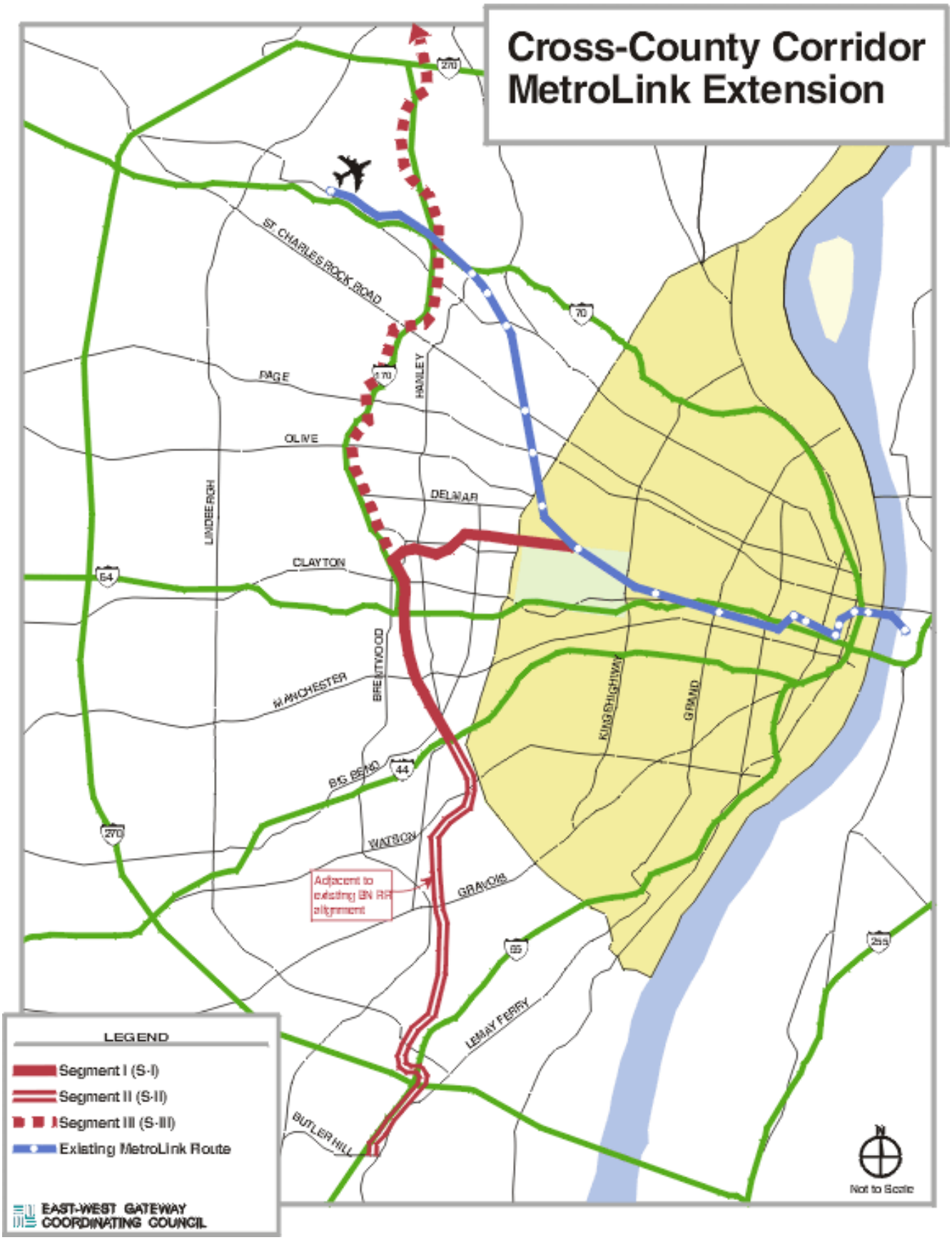
Because of the size of the Cross-County corridor, the expansion of MetroLink has been conceived to occur in three stages. The first stage, Segment I, would extend west through the University City/Clayton area and then south along the CMT right-of way through the communities of Richmond Heights, Brentwood, and Maplewood to a terminus in Shrewsbury. The second stage, Segment II, would be a southward extension from Shrewsbury to south St. Louis County in the vicinity of Butler Hill Road. The third stage, Segment III, would connect to Segment I in the Clayton area and extend north to Florissant (see Figure 1-1).

The subject of this Draft Socioeconomic and Environmental Analysis Technical Report is the first stage (Segment I) only.

The Cross-County MetroLink Extension Segment I Conceptual Design Study will make recommendations for the basic elements of the MetroLink extension; i.e., horizontal and vertical alignment, station location and layout, and location of major support facilities. The level of detail is sufficient to describe candidate MetroLink locations and determine what they would cost (capital, operating, and maintenance costs). The potential socioeconomic and environmental benefits and impacts of the construction and operation of MetroLink have also been analyzed.

The level of design detail is not to be considered final or even preliminary. Preliminary and final design activities will be undertaken after a decision is made about a preferred design at the conceptual level. In this conceptual phase of the work, previous planning results and additional ideas about the MetroLink extension were considered. These possibilities were examined relative to feasibility, from a physical and operational perspective. The results of the initial evaluation and screening of conceptual alternatives were a set of candidate alternatives that were evaluated in further detail.

The Cross-County MetroLink Extension alternatives and the environmental analysis results for these alternatives are described in this draft technical report. For the alternatives where impacts are identified, measures to mitigate impacts and/or make adjustments and modifications to the design may be required. Such modifications would be intended to improve the conceptual design relative to the project's design objectives and evaluation criteria. The results of the environmental analysis and alternatives evaluation activities will provide information for selecting a preferred alternative. In the summer of 1999, the preferred alternative will be selected by the East-West Gateway Coordinating Council Board of Directors, and the Bi-State Development Agency will then be authorized to proceed with the preliminary and final design.


Cross-County Corridor
MetroLink Extension
ST. CHARLES ROCK ROAD
PAGE
OLIVE
DELMAR
CLAYTON
HANLEY
LINDBERGH
BRENTWOOD
MANCHESTER
BIG BEND
WATSON
GRAVOIS
LEMAY FERRY
BUTLER HILL
KINGSHIGHWAY
GRAND
Adjacent to existing BN RR alignment
270
170
70
64
44
55
255
LEGEND
Segment I (S-I)
Segment II (S-II)
Segment III (S-III)
Existing MetroLink Route
EAST-WEST GATEWAY COORDINATING COUNCIL
N
Not to Scale

1.3 Framework for Impact Assessment

The development and environmental analysis of the conceptual design alternatives have been undertaken within a framework defined by transportation, engineering, and urban design considerations. Such a framework establishes important relationships that are manifested in the conceptual design in terms of location of MetroLink relative to adjacent land use, location of stations and connections to stations from the community, design characteristics and qualities in relation to the surrounding area, and performance of transit in relation to the distance traveled (travel time) and the increased trade area or access area that the new travel line creates.

Consistent with the analysis framework noted above, the MetroLink alternatives have been designed according to the design objectives listed in Table 1-1.

Table 1-1
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 environment 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.

Table 1-2 lists the six design objectives and associated evaluation criteria and measures which provide the framework for the analysis of the conceptual design alternatives. Table 1-2 is consistent with Table 1 of the Socioeconomic and Environmental Methodology Draft Technical Report and Table 2 of the Evaluation Methodology Draft Technical Report. The set of criteria and measures shown in Table 1-2 were used to evaluate the corridor-level alternatives and section alternatives/options.

Table 1-2
CRITERIA AND MEASURES BY CATEGORY

Objective	Criterion	Measure
(1) Transportation	A. Maximize transit ridership (Light Rail Transit (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 [1] centers in corridor b. Weighted travel times to major employment[1] 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 station 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
	F. Reductions in capacity for other modes	a. Intersection traffic capacity for locations affected by LRT b. Traffic impact on corridor streets due to access patterns to park-n-ride facilities or by buses to transfer facilities (impact analyzed in terms of added peak hour traffic and intersection capacity)

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

Table 1-2
CRITERIA AND MEASURES BY CATEGORY

Objective	Criterion	Measure
(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 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. 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.
	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

Table 1-2
CRITERIA AND MEASURES BY CATEGORY

Objective	Criterion	Measure
(4) Environmental Impact	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 (square feet and/or value)
	C. Minimize noise, vibration and electromagnetic-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 electromagnetic interferences (EMI), and potential effects of electromagnetic fields (EMF) on sensitive land uses
	D. Improve air quality	a. Changes in regional Air Quality (AQ) emissions b. Intersections 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
	F. Minimize impact on cultural resources (historic, archaeological) and parklands.	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

Table 1-2
CRITERIA AND MEASURES BY CATEGORY

Objective	Criterion	Measure
(5) Costs 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)
	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 Operations and Maintenance (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

Table 1-2
CRITERIA AND MEASURES BY CATEGORY

Objective	Criterion	Measure
(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

1.4 Conceptual Design Considerations

The Cross-County Segment I corridor is 7.8 miles long (7.8 miles from DeBaliviere to Lansdowne). It is largely a built-up area traversing very heterogeneous land uses that range from residential to institutional to commercial to industrial. These land uses include areas that are significant in terms of their history, density or level of activity, and/or regional economic impact.

The corridor can be divided into three highly distinctive subareas:

- ***Forest Park/University City.*** This area is dominated by the presence of existing upscale residential neighborhoods, educational institutions, and Forest Park.

- ***Clayton.*** This is a mixed-use subarea that includes downtown Clayton; major commercial/retail areas, including the Galleria; and residential uses. Downtown Clayton is a place of work for more than 30,000 persons and has a compact, high-density core. It is second only to the St. Louis CBD in its concentration of office activities.

- ***South/I-44.*** This subarea is the most diverse, with many types of development. It includes business/industrial uses, significant commercial centers, and residential neighborhoods. The potential right-of-way is very different from that in the other two subareas in that it primarily follows an old railroad right-of-way. This is in contrast to the Forest Park and Clayton subareas which largely use public street rights-of-way.

From an urban design perspective, these locations present very different relationships between the transit facility and adjacent land-uses. Because of these different corridor characteristics, the recommended engineering and urban design concepts for the MetroLink extension incorporate strategies to enhance the

urban characteristics that are unique to residential neighborhoods. They also incorporate strategies that would take advantage of the new transit accessibility to promote desirable growth and development. The elements of these strategies are connected with three relationships to be captured in the design: (1) land-use change/development opportunities, (2) transit/land-use relationships, and (3) compatibility and unique urban characteristics.

The conceptual design alternatives were based on a wide variety of information sources, standards, and guidance. This information provides important background for understanding the analysis results described in the following sections of this report.

- Design standards and policies, as used by the Bi-State Development Agency, were the basic design guide.
- Base mapping is the aerial mapping available through the Metropolitan St. Louis Sewer District (MSD). Accuracy of horizontal and vertical dimensioning, elevations, right-of-way locations, etc., are limited by this mapping resource. Supplemental ground surveys were undertaken to identify centerline pavement elevations in downtown Clayton and Union Electric transmission tower locations in the CMT right-of-way.
- Utility inventories were assembled based on published data. Some field inventories were completed by MSD relative to sewer location and depth.

Within the overall MetroLink design standards and perspectives, the candidate alternatives were developed. The basic corridor alternatives are organized as follows:

- Fully Grade-Separated Alternative.
- At-Grade/Grade-Separated Combination Alternative.
- Section Alternatives/Options
  - South Edge At-Grade
  - Skinker Boulevard and Big Bend Boulevard Underpasses
  - Downtown Clayton Elevated
  - Forest Park Parkway At-Grade
  - Carondelet/Brentwood At-Grade
  - Galleria Elevated
  - Laclede Station Road At-Grade/Elevated
  - Deer Creek Terminal Station

These candidate alternatives are described in detail in Section 2 of this report.

2
Alternatives Considered and Evaluated

This section describes the conceptual design alternatives that were considered early in the study and resulted from previous planning and feasibility studies. This section also describes in detail the candidate alternatives that were evaluated as part of the socioeconomic and environmental analysis.

2.1 Conceptual Alternatives Considered

As shown in Figure 2-1, the Cross-County MetroLink Extension Segment I Corridor extends from the existing Forest Park MetroLink Station west along Forest Park Parkway, Millbrook Boulevard, and Forest Park Parkway into and through downtown Clayton. From downtown Clayton, the corridor generally follows the previous Terminal Railroad right-of-way—now owned (or via easement) by Citizens for Modern Transit (CMT)—south to the vicinity of I-44 in Shrewsbury. South of I-44, right-of-way would be required.

For this corridor, a complete range of conceptual alternatives and options were examined, considering possible right-of-way locations and typical vertical alignments (elevated, at-grade, and below ground) (see Figures 2-1 and 2-2). Within the corridor, several combinations of streets could be used for the alternative alignment concepts. Land-use relationships, possible station locations in relation to development opportunities, and overall engineering and urban design principles were assessed to identify the set of possible design options.

Figure 2-2 shows the set of five basic vertical location concepts that were considered as part of this study.

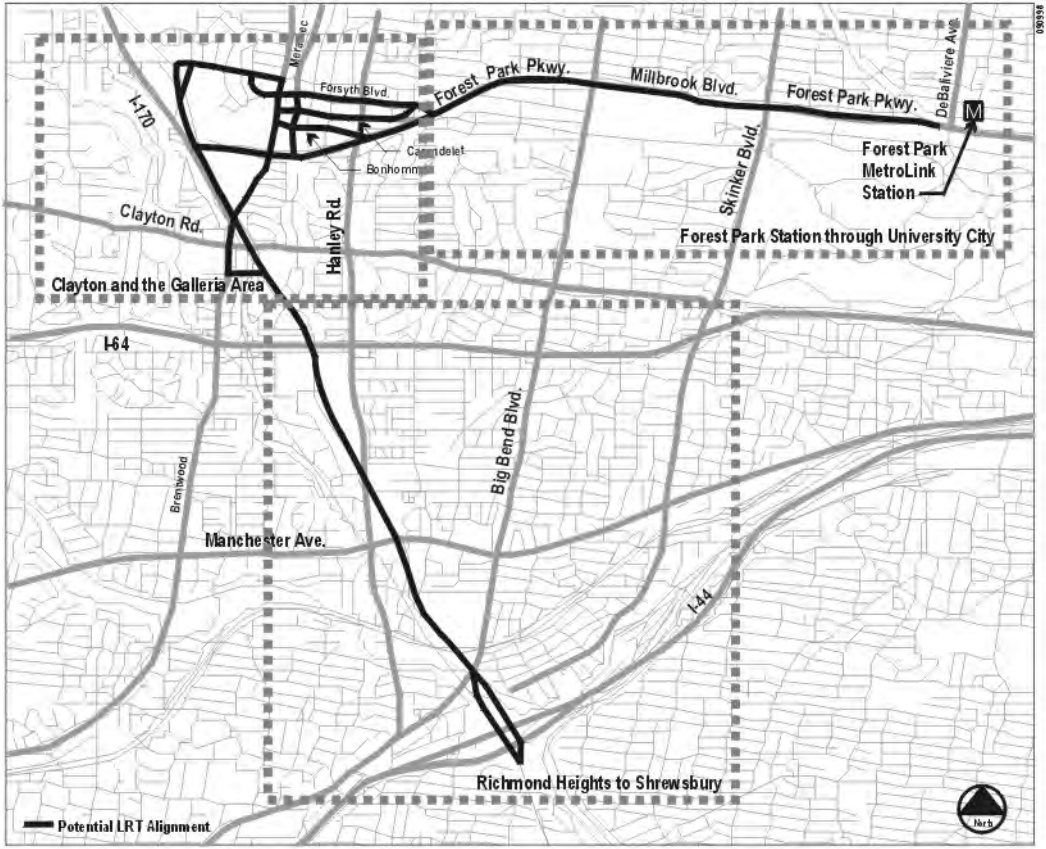
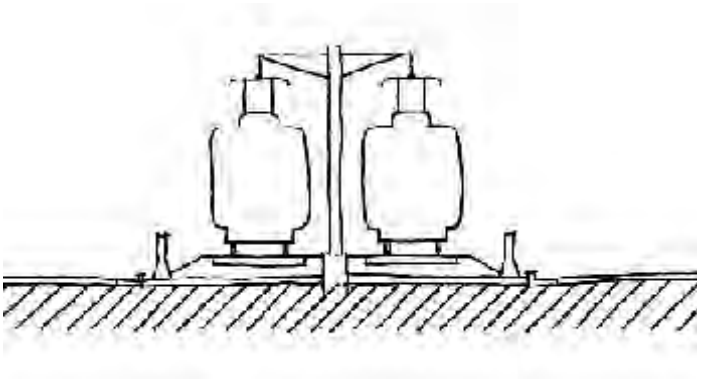
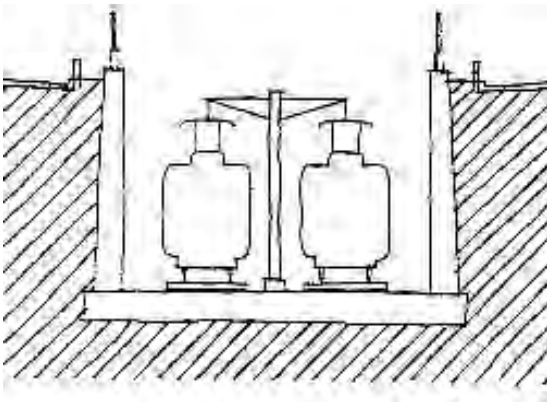

Forsyth Blvd.
Forest Park Pkwy.
Millbrook Blvd.
Forest Park Pkwy.
DeBaliviere Ave.
I-170
Carondelet
Bonhomme
Skinker Blvd.
Forest Park MetroLink Station
Clayton Rd.
Hanley Rd.
Forest Park Station through University City
Clayton and the Galleria Area
I-64
Big Bend Blvd.
Brentwood
Manchester Ave.
I-44
Richmond Heights to Shrewsbury
Potential LRT Alignment
North

Figure 2-2
Vertical Location Concepts

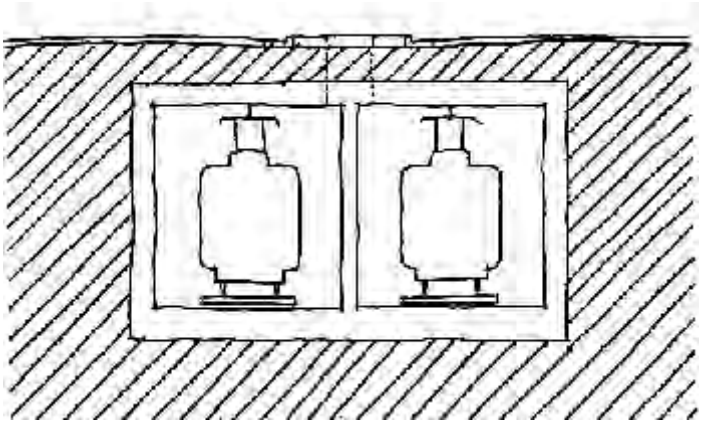
At Grade



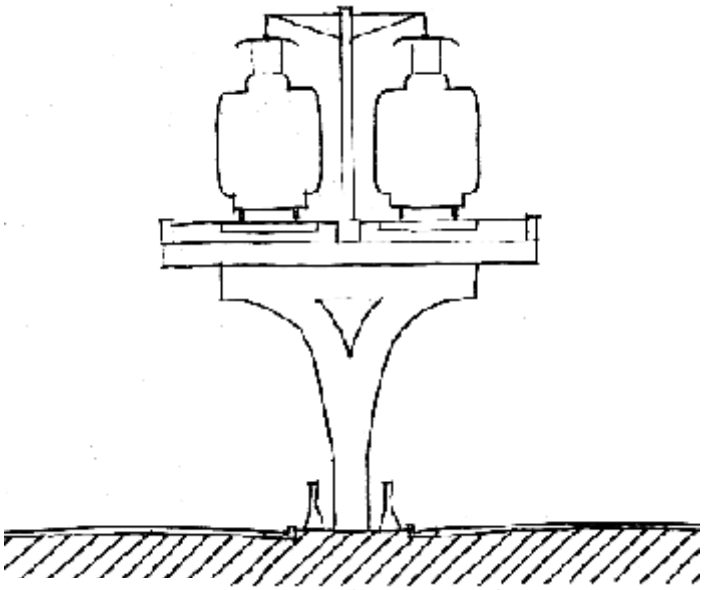
Open Cut



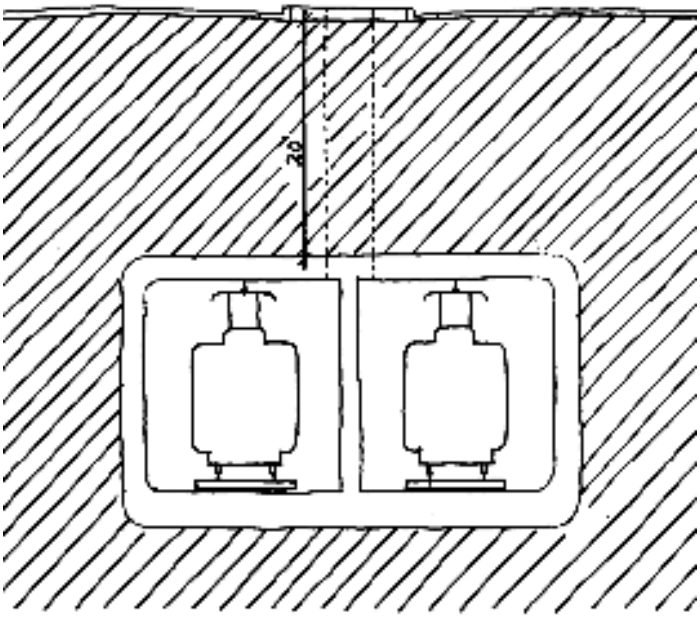
Cut and Cover



Elevated Structure



Bored Tunnel



1. ***Elevated*—Light Rail Transit (LRT) guideway structure and track would be above-ground grade or even be over other transportation facilities. The LRT structure needs to generally allow at least 14.5 feet clearance underneath for other traffic, where necessary.**

2. ***Surface*—LRT tracks located at ground surface. Tracks would be in streets sharing right-of-way with other traffic or in a separate right-of-way, such as the CMT.**

3. ***Below Grade (cut and cover)*—LRT tracks would be located in an underground structure (like a box). The track would be located at only moderate depth so that the top of the LRT "box" would be typically only 5 to 10 feet below the surface. Such depth allows construction to occur in a cut and cover fashion. The latter entails excavating an open trench for a limited distance, which varies with specific situations. This could be in the range of 300 to 1000 feet. The box structure is constructed and the ground surface is restored. Such construction can involve significant utility modifications.**

4. ***Below Grade (open cut)*—Similar to item (3) except that the LRT track structure would not be covered, but left open. This would require barriers/fencing along the top of the retaining walls (opening) for safety purposes.**

5. ***Below Grade (tunnel)*—LRT tracks would be below grade, but at significant depths (possibly 25 feet or more). In this case, the LRT "box" cannot be constructed by excavating an open trench, but must be bored through soil/rock.**

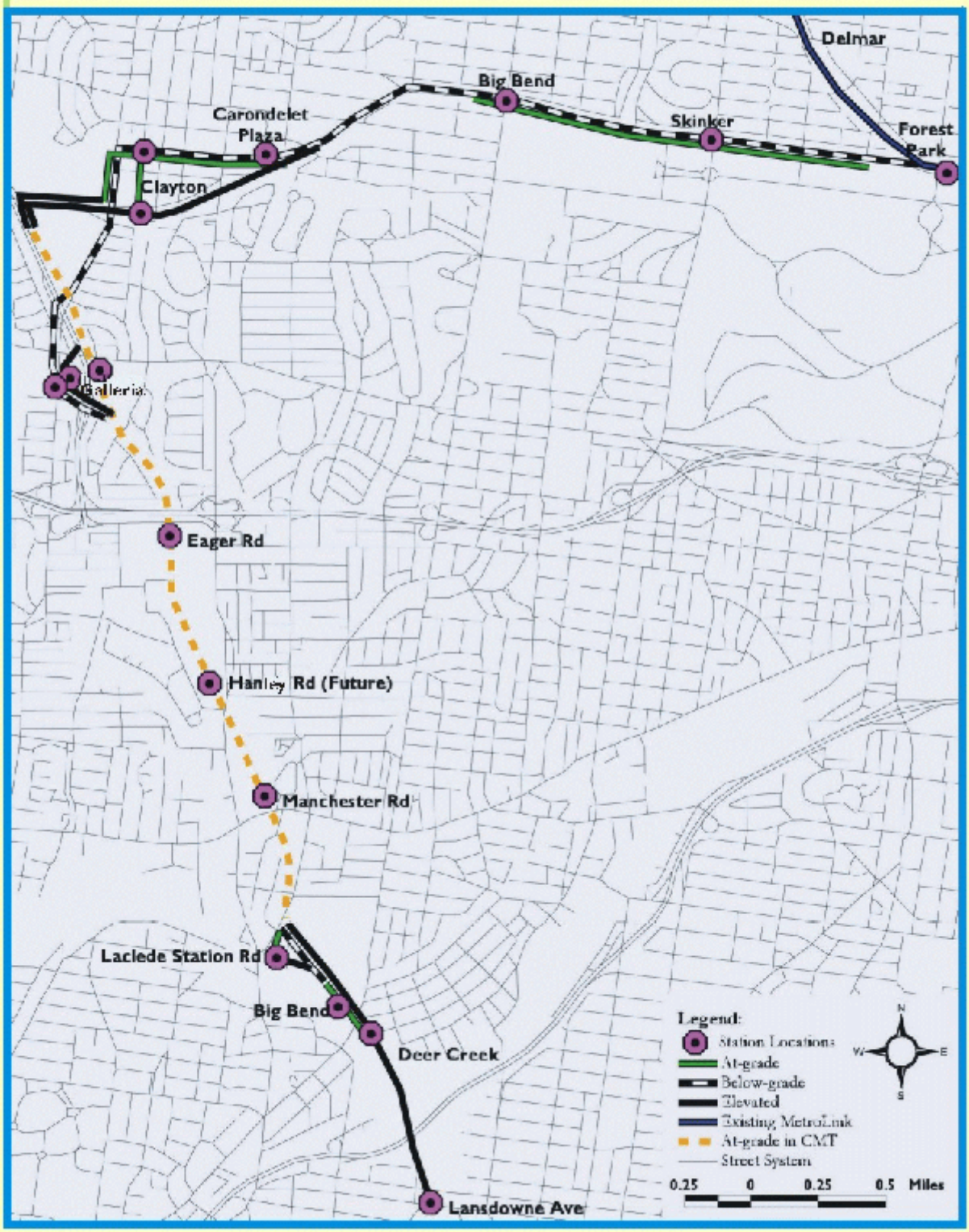
These basic vertical alignment concepts have uniquely different impacts on LRT construction, operation, and cost as well as varying impacts on the surrounding community. Using these concepts for overall planning purposes, it was possible to identify certain combinations of horizontal locations with vertical design types.

These conceptual alternatives were examined relative to operational and physical feasibility. The latter employed the appropriate MetroLink design standards to assess overall constructability. Information about potentially available rights-of-way was evaluated with regard to operational considerations; i.e., whether there was sufficient space to accommodate MetroLink and other existing traffic uses in such rights-of-way.

A comprehensive screening process identified candidate alternatives to be carried forward to more detailed conceptual designs.

In parallel with design activities, preliminary consideration was given to operational schemes. For example, feeder bus service was examined to identify needed facilities, and traffic operations were assessed for access to proposed stations in streets where MetroLink could be located.

CANDIDATE ALTERNATIVES



CROSS-COUNTY METROLINK EXTENSION - SEGMENT 1

2.2 Evaluation Alternatives

After considering a full range of conceptual design alternatives, two basic design configurations were retained for detailed analysis (see Figure 2-3): a Fully Grade-Separated Alternative and an alternative light rail transit operating at-grade in public rights-of-way with grade-separated sections to avoid conflict with other major highway and railroad crossings, known as the At-Grade/Grade-Separated Combination Alternative. These alternatives describe concepts that would extend throughout the Segment I corridor. In addition, certain limited options were identified that would affect only certain sections of the corridor.

2.2.1 Corridor Alternatives

Fully Grade-Separated Alternative

- **This alternative is a below-ground alignment using cut-and-cover construction from the Forest Park Station (at DeBaliviere) to the east edge of downtown Clayton (near Forsyth Boulevard) at Forest Park Parkway; the MetroLink facility to be located within the existing right-of-way of Forest Park Parkway and Millbrook Boulevard.**

- **Within downtown Clayton, the alternative is a below-ground alignment, using cut-and-cover construction, extending under Forsyth Boulevard and following an alignment to the west under Carondelet Plaza and Carondelet Avenue to Brentwood Boulevard, then south to Galleria Parkway, then east under Galleria Parkway to the CMT right-of-way; the MetroLink facility would be located within existing street right-of-way except in the east edge of downtown Clayton where the alignment would cross through existing private (vacant) property. For the section along Carondelet Avenue, an option was developed for using a bored tunnel construction technique rather than cut-and-cover. This would affect the profile of the line, which would become somewhat deeper.**

- **Along the CMT right-of-way, the MetroLink extension would be built at ground level from south of the Galleria Parkway to Flora Avenue. At Flora Avenue, the MetroLink alignment would ascend on an elevated structure through the Sunnen Business Park, over Big Bend Boulevard, Deer Creek, and I-44 to the Lansdowne Avenue Station and terminus.**

At-Grade/Grade-Separated Combination Alternative

- **This alternative is a below-grade alignment at the Forest Park Station extending west below Forest Park Parkway (cut-and-cover), and transitioning upward to existing ground level at a point approximately 1,000 feet west of DeBaliviere Avenue. The MetroLink extension then would continue in the median at-grade to a point 600 feet west of Big Bend Boulevard, where it would transition back down to below ground and extend below ground (cut-and-cover) to the east edge of downtown Clayton.**

- **Within downtown Clayton, the MetroLink extension would transition up to ground level**

at Forsyth Boulevard and continue west along the north edge of Carondelet Plaza to Hanley Road, and along Carondelet Avenue through the downtown core, turning south along the west side of Meramec Avenue. South of Bonhomme Avenue, the tracks would be elevated at Forest Park Parkway. The alignment could follow a path along the south edge of the highway or over the eastbound lanes to the CMT right-of-way. The MetroLink extension would cross existing private property in the section east of Hanley Road. It would follow the centerline of Carondelet Avenue, staying within the right-of-way; it would be located in public right-of-way (and a portion on private property at Carondelet and Meramec) for the remainder of this section.

- **Along the CMT right-of-way, the MetroLink extension would be at ground level from Forest Park Parkway south to Flora Avenue. At Flora Avenue, it would descend to a below-ground (cut-and-cover) alignment through the Sunnen Business Park, passing under the Union Pacific (UP) railroad. South of the railroad, the MetroLink alignment would be at-grade, crossing Big Bend Boulevard and Oxford Avenue. From this point south, it would be on an elevated structure over Deer Creek and I-44 to the Lansdowne Avenue Station.**

2.2.2 Section Alternatives/Options

For certain limited sections along the two corridor alternatives described above, there are additional alternatives or design options.

Substitute sections for the At-Grade/Grade Separated Combination Alternative include:

- ***South Edge At-Grade.* Along Forest Park Parkway and Millbrook Boulevard, the track would be at-grade but along the south edge (not in the median) of the roadway. The at-grade alignment would transition to a below-grade location at a point east of Throop Avenue and continue underground to the east edge of downtown Clayton, where it would rise to the ground surface.**

- ***Skinker Boulevard and Big Bend Boulevard Underpasses.***

  a. At Skinker Boulevard and Forest Park Parkway for the at-grade alternative, median alignment (not south edge alignment), special underpasses could be included as follows:

  - ***Transit underpass.* The MetroLink tracks would transition from at grade to pass underneath Skinker Boulevard, with the station located under Skinker Boulevard. The transitions would occur west of Des Peres Avenue and east of Hoyt Drive.**

  - ***Roadway underpass.* Two lanes (one in each direction) on Skinker Boulevard would be placed in an underpass beneath Forest Park Parkway to enhance traffic capacity at this intersection.**

b. **At Big Bend Boulevard and Millbrook, also for the at-grade alternative, median alignment, a special transit underpass could be included. The MetroLink tracks would transition from at grade at Throop Drive to pass underneath Big Bend Boulevard, with the station located under Big Bend Boulevard. The tracks would stay underground, connecting with the underground section about 400 feet west of Big Bend Boulevard, which is included in the at-grade combination alternative.**

- ***Downtown Clayton Elevated.*** **Within downtown Clayton from Forsyth Boulevard (east downtown edge) to the CMT right-of-way, this option entails an elevated transit structure following the north edge of Forest Park Parkway. The MetroLink extension would cross over Forest Park Parkway west of Meramec and run parallel to the south side of the parkway on an elevated structure until curving southward into the CMT right-of-way. There would be two options for vertical and horizontal alignment in the section between Hanley Road and Meramec. One option would be a high-profile alignment, which would be fully grade-separated and largely over Shaw Park Drive. The second option would have a lower profile and be constructed over the westbound lanes of Forest Park Parkway. This option would intersect Bemiston Avenue and the Central Avenue ramp at grade.**

- ***Forest Park Parkway At-Grade.*** **Within downtown Clayton, following a horizontal alignment similar to the Forest Park Parkway elevated, this option features a profile that would be lower, crossing Forsyth Boulevard at grade, then rising to an elevation equivalent to Forest Park Parkway near the Ritz Carlton Hotel. The alignment would pass over Hanley Road, under Bemiston Avenue, under Central Avenue Ramp, and over Forest Park Parkway from Meramec Avenue west to the CMT right-of-way.**

- ***Carondelet/Brentwood At-Grade.*** **This would be an optional at-grade alignment in downtown Clayton. Rather than turning from Carondelet Avenue at Meramec, the route would continue west to Brentwood, then turn south along the west side of the street. Near Shaw Park Drive, this option would transition to an elevated alignment, turning west over Shaw Park Drive and then over Forest Park Parkway to the CMT right-of-way.**

- ***Galleria Elevated.*** **In the Galleria area from approximately Clayton Road to Galleria Parkway, the MetroLink extension would ascend from the CMT right-of-way over I-170 to follow an alignment east of and parallel with Brentwood Boulevard; at Galleria Parkway, it would curve east back over I-170 to the CMT right-of-way.**

- ***Laclede Station Road At-Grade/Elevated.*** **In the section from Flora Avenue to Big Bend Boulevard, the MetroLink extension would leave the CMT, following Laclede Station Road at grade from Flora Avenue south past Sunnen Drive. At this point, the alignment would become elevated, curving eastward and parallel to the north edge of the railroad tracks, and back toward the CMT right-of-way. At the CMT, it would ascend over the railroad tracks and follow the CMT over Big Bend Boulevard.**

A substitute for either the Fully Grade-Separated or the At-Grade/Grade-Separated Combination Alternative is:

- ***Deer Creek Terminal Station.*** **As an option to extending the MetroLink alignment to Lansdowne Avenue, the MetroLink extension could end north of Deer Creek (north of I-44) in a location just east of Big Bend Boulevard.**

3
Existing Conditions

3.1 Transportation

Figure 3-1 summarizes essential information about the existing transportation network relative to the street system, current traffic volumes, and the configuration of Bi-State bus routes in the corridor. The key existing conditions are as follows:

1. **The streets that may be used for LRT locations are mostly under the jurisdiction of St. Louis County, the City of Clayton, Maplewood, or the City of St. Louis.**

2. **Excluding turn lanes, lane widths of key streets are:**

a.	Forest Park Parkway	4 lanes
b.	Millbrook Boulevard	4 lanes
c.	Brentwood Boulevard	6 lanes
d.	Forsyth Boulevard	6 lanes (including parking)
e.	Carondelet Avenue	4 lanes (including parking)
f.	Eager Road	2 lanes (at CMT bridge)
g.	Skinker Boulevard	4 lanes
h.	Big Bend Boulevard	4 lanes

3. **Traffic volumes on the arterials range from 20,000 to 30,000 vehicles per day. The highest volume is on Brentwood Boulevard (south of I-170) where volumes are in the 40,000 to 50,000 vehicles per day range.**

4. **Traffic signals are operated by the local jurisdictions with St. Louis County having control over the majority of signals. To a large extent, these signals do not operate within a system context, although some major arterials have closed loop signal systems that achieve progressive traffic flow through a series of signalized intersections.**

5. **Bi-State bus service exists along most arterial streets in the corridor. The Clayton CBD contains the largest concentration in that 12 routes enter the area (#17, 47, 51, 52, 55, 62, 63, 64, 66, 68, 93, 97, 252). Routes primarily travel on Brentwood and Forsyth Boulevards with primary bus stop zones on Forsyth between Meramec and Central and on Central between Forsyth and Carondelet.**

6. **Some Bi-State bus routes could be modified due to the presence of a new MetroLink extension. Routes 55 and 93 could be changed because they would duplicate the service providedby the MetroLink line. Other service changes would be likely. These details are part of the operations plan developed as part of this study.**

In addition to these existing conditions, previous planning studies included estimates of potential future conditions. The latter included ridership estimates for the Segment I MetroLink extension. Results were as follows for estimated year 2015 conditions:

1. **Overall line ridership = about 25,000 person trips per day**

2. **Work trips represented about 50 percent to 60 percent of the total daily trips.**

3. **Highest passenger boarding locations would be in the Clayton CBD, Eager Road, and I-44 stations.**

4. **Park-n-ride potentials would be the greatest at the Eager Road and I-44 stations.**

5. **Local/feeder bus transfers to LRT would be greatest at the Clayton CBD, I-44, and Manchester Road stations.**

Major activity centers inside the Cross-County corridor include:

- **Downtown Clayton (center core)**
- **Galleria Shopping Center**
- **Sunnen Business Park**
- **Washington University**
- **Forest Park**

Major activity centers outside the Cross-County corridor include:

- **Downtown St. Louis (center core)**
- **Suburban employment centers**
- **Lambert International Airport**
- **Washington university Medical Center complex**
- **University of Missouri - St. Louis**

TRANSPORTATION CONDITIONS

FIGURE 3

3.2 Urban Design and Land Use

3.2.1 Existing Land Use, Zoning and Plans

Existing land use, zoning and municipal land use plans were inventoried and analyzed for each of the jurisdictions directly affected by the Cross-County MetroLink Extension Segment I. A wide variety of land use and zoning exists along the alternative alignments. The use of land use and comprehensive planning tools also varies between the municipalities. Figure 3.2-1 presents a land use map for the Cross-County corridor.

City of St. Louis/University City

The northern section of the MetroLink alignment, located in University City and the City of St. Louis, is flanked on both sides primarily by single family development on lots ranging in size from 7,500 square feet to 10,000 square feet. There is some multifamily residential development along a portion of Millbrook Boulevard east of Big Bend Boulevard, and between Skinker Boulevard and DeBaliviere in the City of St. Louis. Overall residential development density within this area is approximately four to five dwelling units per acre. The Maryland Terrace and Park View National Register Historic Districts are located in the immediate vicinity of the proposed MetroLink alignment.

A major land use within this section is Washington University's 140-acre campus immediately adjacent to the south of the alignment between Big Bend Boulevard and Skinker Boulevard. The proposed MetroLink stations within this section would be immediately adjacent to both the east and west ends of the University. Washington University lies within an unincorporated section of St. Louis Country. Fontbonne College and Concordia Seminary are two other major educational institutions located immediately to the south of Washington University approximately 0.6 mile from the proposed Big Bend MetroLink station.

Zoning within this area is under the jurisdiction of University City and the City of St. Louis. The prevailing zoning adjacent to the proposed MetroLink alignment is ?Single Family Residential" in both jurisdictions, with limited ?Commercial" zoning at major street intersections (e.g., Big Bend Boulevard, Skinker Boulevard and Forsyth Boulevard). Current Land Use Plans for these two jurisdictions reflect a continuation of existing land use patterns.

Clayton/Richmond Heights

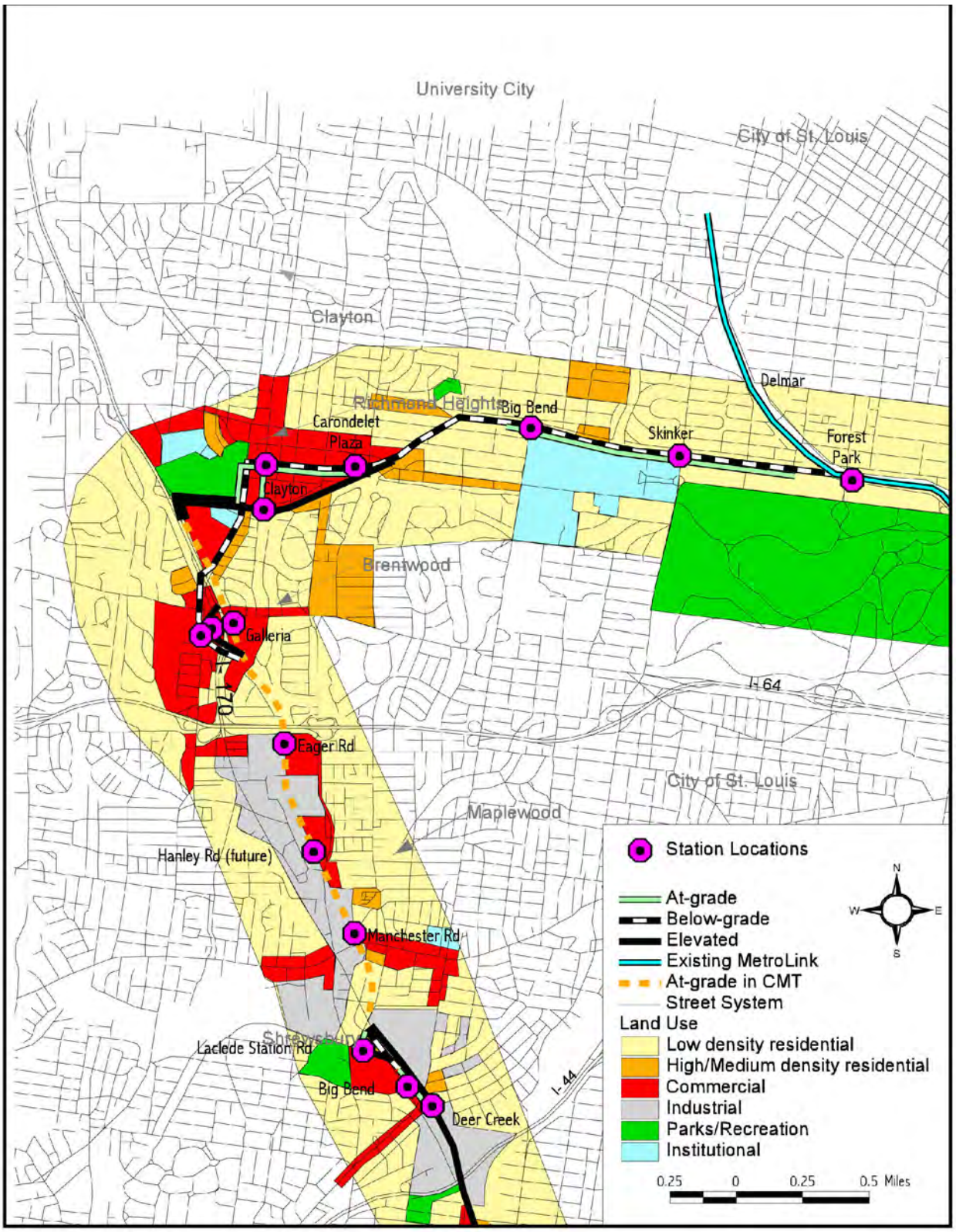
Land use patterns change from residential to primarily commercial beginning at the University City/Clayton eastern boundary. Intense commercial uses (e.g., high rise offices, hotels, retail, services) prevail in downtown Clayton which is bounded by Maryland Avenue on the north; Brentwood Boulevard on the west; and Forest Park Parkway on the east and south. St. Louis County government operations are also located in downtown Clayton, and include the County Administration Building, Courts Building and Justice Center. Both the Fully Grade-Separated and At-Grade/Grade-Separated Combination Alternatives transect the center of this commercial area, with the two proposed MetroLink stations located towards the eastern (Forsyth Boulevard/ Ritz-Carlton Hotel) and western (County Administration Building) ends of this activity center. The Forest Park Parkway Elevated alignment and associated MetroLink station would be located on the southern edge of downtown Clayton on the dividing line between downtown to the north and residential areas immediately to the south.

Commercial zoning predominates within downtown Clayton. The entire area adjacent to and surrounding the proposed basic alternative alignments is zoned ?C-3" or ?C-4" Commercial District, or has special commercial ?overlay" districts. A three-block area is designated as a ?CBD Core Overlay District" with the intention of maintaining and enhancing this area as the hub of pedestrian and night-time activity in downtown Clayton. Other special ?overlay" districts include the ?Clayton Plaza Overlay District" (Ritz-Carlton); the ?East of Hanley Overlay District" located along Forsyth Boulevard immediately to the north of the Ritz-Carlton; and the Brentwood Triangle Redevelopment-Planned Unit Development (PUD) Overlay District at the Clayton Road-Brentwood Boulevard- I-170 triangle. These overlay districts have been applied to redevelopment areas where there is an opportunity for mixed-use developments under a planned unit development procedure.

A *Business District Master Plan* was adopted by the Clayton Board of Aldermen in 1993. The Master Plan contains land use, urban design, infrastructure elements and implementation recommendations for development and redevelopment within the central business district. The Master Plan recognizes the need for MetroLink to access directly into downtown Clayton, and that this link to downtown St. Louis and Lambert Airport is essential for Clayton to remain a premier corporate center. In this regard, the Master Plan contains recommendations for MetroLink station sites and related future parking opportunities in addition to specific urban design features incorporating MetroLink into downtown.

Extensive commercial land uses continue to prevail south of downtown Clayton along Brentwood Boulevard to I-64 (U.S. 40) in Richmond Heights, with the Clayton Corporate Park and the Galleria Shopping Mall being major uses and destination points. Both alternative alignments would be immediately adjacent to the Clayton Corporate Office Park, while the Fully Grade-Separated Alternative and associated MetroLink station would also be immediately adjacent to the Galleria Shopping Mall on Brentwood Boulevard. The At-Grade/Grade-Separated Combination Alternative and associated MetroLink Station would be located approximately 1,000 feet east of the Galleria Shopping Mall, while the Galleria Elevated Option and associated MetroLink Station would be 250 to 300 feet east of the Galleria.

Zoning immediately adjacent to the proposed MetroLink alignment in this section of the corridor is primarily commercial, with residential zoning prevailing away from the major commercial corridors. The Clayton Corporate Park, located in the City of Clayton, is zoned as a ?Special Development District". The entire area along Brentwood Boulevard between Clayton Road and I-64 has various commercial zoning designations under the Richmond Heights Zoning Ordinance. For example, the Galleria Shopping Center and adjacent block facing the east side of Brentwood Boulevard is zoned ?PDC" (Planned Development Commercial), while the remaining area between Brentwood Boulevard and I-170 is zoned ?C2" General Business District. Single family residential zoning prevails adjacent to the CMT right-of-way from south of the Tropicana Bowling Alley to I-64.



Cross-County MetroLink Extension Segment I: Land Use Figure 3.2-1

The City of Richmond Heights has a Comprehensive Plan in effect that was updated in 1986 and is to be updated again this year. The plan identifies several redevelopment areas within the city, including the entire Brentwood Boulevard/I-170 corridor from Clayton Road to I-64. The plan identifies office, retail, and mixed-use development as appropriate along this entire corridor. Since the completion of this plan in 1986, the Galleria Shopping Center has been developed while the east side of Brentwood Boulevard across from the Galleria has been the subject of several redevelopment proposals. The plan also identifies a number of development tools as incentives for redevelopment, including Industrial Revenue Bonds and Tax Increment Financing (TIF).

Brentwood/Maplewood

The proposed MetroLink extension along the CMT right-of-way in Brentwood and Maplewood, between I-64 and I-44, is dominated by primarily commercial and industrial uses. The Promenade Shopping Center, located adjacent to the south of I-64 and approximately 800 feet west of the proposed Eager Road MetroLink station, is a major commercial use within this portion of the Cross-County corridor. Other major commercial uses include the Purina Mills Corporate Headquarters and the recently developed Home Depot at Hanley Road and Dale Avenue immediately to the east of the MetroLink and CMT right-of-way and proposed Eager Road station in Brentwood. The Deer Creek Shopping Center is located at Big Bend Boulevard/Oxford Avenue in Maplewood. The Hanley Industrial Park, located along Hanley Road between I-64 and Manchester Road, and the Sunnen Business Park, south of Manchester Road, are predominant industrial and office uses within this portion of Brentwood and Maplewood, respectively. The Big Bend Industrial Court, consisting of a number of industrial uses, is located along the southern portion of the MetroLink extension and would be the site for a possible Deer Creek Terminal station. Both MetroLink alternatives either bisect or closely parallel all of the above commercial and industrial areas, with the associated MetroLink stations in close proximity.

Industrial zoning prevails along the length of the CMT right-of-way within this portion of the alignment. The MetroLink alignment bisects the Hanley Industrial Court, which is zoned ?LID" (Light Industrial) under Brentwood's Zoning Ordinance. This area extends from I-64 on the north to Manchester Road on the south. Industrial zoning continues south into Maplewood with adjacent areas zoned predominantly ?LM" (Light Manufacturing) under Maplewood's Zoning Ordinance. Further south the Sunnen Business Park is designated as a PUD by the City of Maplewood, while the Big Bend Industrial Court area is zoned ?HM" (Heavy Industrial). A small area of ?SR" (Single-Family Residential) zoning prevails along the MetroLink alignment between the Sunnen industrial area on Manchester Road and the Sunnen Business Park to the south.

Neither the City of Brentwood nor the City of Maplewood has an existing comprehensive land-use plan. However, the City of Brentwood has had one plan and a study was recently completed for the Hanley Industrial Court area. A *Development Plan for Hanley Industrial Court,* completed in 1997, includes a land use plan, recommended physical improvements and strategies for redevelopment and plan implementation. The plan notes that the construction of the Cross-County MetroLink line along the existing CMT right-of-way would be a long-term benefit to the Hanley Industrial Park and should be encouraged. The plan also recommends an alternative MetroLink station site, and an improved roadway system supporting the MetroLink station and park-n-ride lot. The plan recommends the use of various development tools (e.g., TIF, Missouri

Chapter353 Redevelopment Law) to encourage reinvestment and redevelopment in the industrial park. A subsequent study entitled *Station Location Evaluation for Cross-County MetroLink Alignment* was completed in 1998 in response to the proposed location of the MetroLink station in the Hanley Industrial Court.

Shrewsbury/City of St. Louis

Land use south of I-44 adjacent to the proposed alignment consists of a mixture of residential and small scale commercial and industrial uses in the City of Shrewsbury and the City of St. Louis. The Laclede Gas Company storage tanks are located adjacent to I-44 at the northern end of this section of the alignment. The proposed Lansdowne Terminal Station is located within this short segment of the alignment south of I-44. Existing land uses within the proposed Lansdowne Station site include several residences and small businesses, and a number of vacant parcels. Adjacent land use within both the City of Shrewsbury and City of St. Louis is predominantly single-family residential. However, there are several multifamily developments immediately south of the end of the alignment in the City of St. Louis.

There is a mixture of zoning within this area with residential zoning prevailing in both the City of Shrewsbury and the City of St. Louis, but there is also a large industrial zoned area immediately north of I-44 between Shrewsbury Avenue and the proposed MetroLink alignment. The City of Shrewsbury does not have a comprehensive plan, and neither Shrewsbury nor the City of St. Louis has any specific development plans or proposals for this southernmost section of the proposed MetroLink alignment.

3.2.2 Existing Urban Design Characteristics/Visual Resources

Urban design issues deal with the relationships between many factors in the built environment, including architectural character; neighborhood scale; compatibility with surrounding area; aesthetic, visual, and acoustical concerns; streetscape development; enhancement of pedestrian linkages; determination of appropriate site amenities; and the creation of safe people-oriented public spaces. How well these pieces fit together within the overall framework of the neighborhood often determines whether new development is an asset or detriment to the area. Each development site exists not as an island, but within a particular context of a much larger whole. Designers must consider and balance a multitude of factors during the urban design process.

The northern portion of the Segment I corridor that runs along Forest Park Parkway and Millbrook Avenue will border some desirable and historic neighborhoods of the City of St. Louis and University City. These residential areas represent a unique cultural heritage that is reflected in their differences in architectural scale and character. Forest Park Parkway is a four-lane arterial roadway that defines the neighborhood boundaries between these distinct neighborhoods. These neighborhoods continue into the suburbs of Clayton, Richmond Heights, Maplewood, and Shrewsbury. Each of these suburban areas has its own architectural scale and neighborhood characteristics unique to its history.

***Catlin Tract.* The Catlin Tract Historic District neighborhood consists of large, three- and four-story homes on very large lots. All of these residences that border the south edge of Forest Park**

Parkway front on Lindell Boulevard. The rear yards are very deep, featuring at least a 150-foot separation from the rear of the houses and the parkway right-of-way. A private service alley runs between the parkway and the residential lot line. The rear yards of these estates are grass lawn areas that are sparsely planted with vegetation, allowing partially open views onto the property. East of Des Peres Avenue, a concrete fence forms a discontinuous barrier along the parkway right-of-way. This historic fence dates from the early 1900s and is currently in various states of disrepair. West of Des Peres Avenue, chain link fencing physically separates the neighborhood from the parkway.

DeBaliviere Boulevard/Skinker Avenue Neighborhood. **This neighborhood combines both single-family and multifamily residences along narrow tree-lined streets paralleling Forest Park Parkway and DeBaliviere. Most of the interior streets are one-way, and barricades prevent unrestricted access from commercial sites along DeBaliviere. Architecturally, the neighborhood consists of a mix of two- and three-story brick housing units dating from the 1920s and 30s. Some of the housing stock in the area is poorly maintained, and a number of buildings are in need of significant structural repairs. The lots are small and narrow in contrast to lots in the adjacent neighborhood to the south and west. The lots back onto the Forest Park Parkway northern right-of-way. A service alley and chain link fencing separate the rear lots from the right-of-way and define this neighborhood's southern boundary. The shallow rear lots are sparely landscaped, and most are fenced with chain link, allowing relatively open views along the parkway.**

Parkview. **The Parkview neighborhood lies to the west of the DeBaliviere/Skinker neighborhood. Parkview is primarily composed of large, single-family residences located on moderate size lots. Like its adjacent neighborhoods, this residential area expresses an interior orientation and backs onto the north edge of the Millbrook Avenue right-of way. Narrow tree-lined streets provide gated access to the neighborhood from Skinker Boulevard. Most of the houses are two- and three-story brick construction and date from 1900 to 1910. There are two well-used pedestrian walkways connecting the Parkview neighborhood with Washington University to the south and with the Delmar Loop to the north. The backyards abutting Millbrook are relatively shallow, not more than 70 feet deep. Although the rear yards have been landscaped, views along this neighborhood boundary remain largely unobstructed. The neighborhood's original southern boundary was a railroad right-of-way that later became Millbrook Avenue, along which ran a streetcar line.**

Washington University. **The northwest corner of the Washington University campus consists of grassy open space and surface parking lots. The Engineering School, the physical plant department, and a large multistory parking garage line the northern boundary along Millbrook Boulevard west of Skinker. The campus is a landmark destination point for thousands of employees and students. This campus environment represents a concentrated hub of pedestrian activity, with strong linkages to its surrounding neighborhoods. Of particular importance along the northwest and northeast corners of the university are pedestrian flows to and from the surrounding residential neighborhoods and to the Delmar Loop. University-related vehicular and pedestrian movements at Big Bend and Skinker Boulevards along Millbrook Avenue are frequent throughout the day and become heavy in the early evening hours.**

Maryland Terrace Neighborhoods. **The Maryland Terrace residential neighborhood lies south of Millbrook Avenue west of Big Bend and extends on the south and north of Millbrook all the way to the Bally building on Forsyth Avenue.**

Ames Place. **Ames Place includes multistory, multifamily apartment buildings which are found along the north edge of Millbrook. A row of apartment buildings faces Millbrook Avenue and extends from Big Bend east to the Parkview neighborhood. An interior-oriented, narrow private street paralleling Millbrook provides access to these apartments and also to a small block of commercial uses. A wide pedestrian walkway through the neighborhood connects the Washington University campus with the Delmar Loop. Washington University also owns and occupies several buildings near this commercial block.**

West Portland Place. West Portland Place **includes a commercial retail center that occupies the northwest quadrant of the intersection of Big Bend and Millbrook Avenue. A majority of these uses exhibit an interior orientation, with only two storefronts facing Big Bend. Pedestrian movements accessing this center from the university are regular throughout the day and are heavy at times, particularly in the early evening hours. Cars turn east and west from the center onto Millbrook.**

Downtown Clayton. **Considerable vehicular and pedestrian traffic is found in this area dominated by high- and mid-rise office buildings. Although adequate sidewalks border all the streets, there are relatively few other pedestrian amenities or streetscape improvements except along Forsyth and at the Government Center. Metered, on-street parking is available and heavily used, as parking is in short supply in downtown Clayton. Open space is a rarity, with the exception of Shaw Park. There is a significant lack of outdoor public space to serve the needs of the area's more than 30,000 office workers. There are few residential uses in this core area. Many of the high-rise office buildings feature retail uses at street level.**

The first proposed station site in the Clayton area is located immediately adjacent to the Ritz-Carlton Hotel and across Forsyth Avenue from the old Famous-Barr building, currently used as a Washington University library. Two relatively large adjacent tracts of land are currently vacant and available for commercial/retail development in the future. The hotel is a new large-scale, high-rise brick structure facing directly west. It is the center of considerable activity and a popular attraction for an upscale market. At this time, there are no commercial or residential developments adjacent to the hotel. Presently, there is very little pedestrian movement to or from this site. A fountain serves as a visual focal point as the hotel is approached by way of Carondelet Avenue. The area is attractively landscaped and has a well-developed, high-quality streetscape design. The nearby former Famous-Barr building is a mid-rise structure that is largely horizontal in character. Parking is available in a sizable surface parking lot and in a multilevel structure immediately to the west of the building.

The second transit station proposed for the downtown Clayton area is along Carondelet Avenue in the Government Center complex. This site has the potential to function as a large urban plaza and would serve a large number of office workers in adjacent buildings. Unfortunately, much of this site will be in shade during a large portion of the day. But great potential exists to develop this area as a successful public space through the use of appropriate site amenities. The existing streetscape along the Government Center is well developed, and the plaza should use a similar vocabulary of high-quality materials.

Forest Park Parkway becomes an elevated highway immediately south of the core station site and borders the eastern edge of downtown Clayton. Another alternative alignment and proposed

station site is along this boundary at Forest Park Parkway and Central Avenue. Residential neighborhoods extend south of the parkway. This southern boundary of downtown Clayton presents a strongly defined edge that features high walls and significant changes in grade. There is little pedestrian movement in or around the area; however, vehicular traffic flows on Forest Park Parkway, Hanley Road, and Forsyth Avenue are substantial.

Richmond Heights—The Galleria/Brentwood Boulevard. **Richmond Heights lies at the crossroads of Highway 40 and I-170. The city was the original end of the line for the electric streetcar line that ran along Forest Park in the 1890s. The area is bordered by St. Louis, Maplewood, Clayton, Brentwood, and Ladue. Most of the residences in the community date from the 1920s and vary from modest one-story brick homes to large estates on private drives. The recent addition of The Galleria, a large upscale commercial development that occupies several blocks along the west side of Brentwood Boulevard, has been an economic boon to the city. The complex is well landscaped, and the streetscape is well defined. Across this busy arterial roadway are smaller commercial buildings with a fragmented streetscape image and limited parking space. The 23-story University Tower Complex is the only high-rise development in this area. Farther to the east are residential neighborhoods of well-kept, one- and two-story brick homes. Vehicular traffic on this section of Brentwood Boulevard is extremely heavy and not conducive to safe pedestrian crossings.**

Maplewood. **The pleasant atmosphere of the Maplewood area, and its linkage to the early St. Louis Suburban Railway, made this community attractive to many upper middle class and professional families at the turn of the century. Although Maplewood's earlier buildings were predominantly residential, later development included commercial and industrial activity along Manchester Avenue and Big Bend Boulevard. Many of the industrial sites are not aesthetically compatible with the area's residences. Like its neighbor to the north, Maplewood was easily accessible by the early rail lines that ran along Manchester Road. Among the oldest of the suburb's industries is Sunnen Products. Sunnen Business Park is characterized by new three-story brick buildings and attractively designed parking lots. Unlike its neighbors to the north, brick is not the predominant building material used in residential homes. Narrow tree-lined streets such as Laclede Station Road and Flora Avenue are lined with one- and two-story homes on mid-size lots with generous rear yards.**

Shrewsbury. **The residential community of Shrewsbury will be the site for the southernmost station in the Segment I Cross-County MetroLink Extension. The transit line will run through an industrial area near I-44. Residential sections of the community have a somewhat suburban character, and, except along arterial roadways, the quiet streets are fronted by shallow well-landscaped front yards. The neighborhoods are predominantly single-family homes of brick and wood frame construction. There are some commercial and industrial sites along Lansdowne Avenue. The proposed transit station at Lansdowne Avenue represents the end of the line for Segment I of the MetroLink alignment. The Lansdowne station is expected to form the nucleus for redevelopment opportunities in this section of Shrewsbury.**

3.3 Economic Conditions

3.3.1 Community Demographics

A half-mile radius from the proposed MetroLink corridor was utilized as the basis for a demographic analysis of the adjacent area. Data based on Transportation Analysis Zones (TAZ) as provided by the East-West Gateway Coordinating Council is the primary source of information for the population estimates and projections.

The estimated 1996 residential population of the corridor is approximately 80,335 people. It is projected that by the year 2020 the population will decline to 75,979. This projected population decrease of 4,356 individuals will most likely be the result of further commercial and institutional development within the corridor.

Population within the City of St. Louis/University City portion of the corridor was estimated at 23,170 in 1996. In the year 2020 the projected population is 22,304, or a decrease of approximately 866 individuals. Single-family residences with some multi-family units characterize housing in this segment of the study area.

The Clayton portion of the corridor is characterized by intensive commercial and institutional activity. The 1996 population estimate is approximately 14,739 individuals, with a projected population by the year 2020 of 13,806 individuals. The residential area along this segment of the corridor is in a mixture of housing types ranging from single-family houses and condominiums to two-family and four-family residences and apartment buildings.

Industrial and commercial activity dominate the portion of the corridor in Richmond Heights, Brentwood, Maplewood and Shrewsbury. The 1996 population estimate for this south-central and southern portion of the corridor is 42,426 individuals. In the year 2020, population is projected to decrease to approximately 39,869 individuals. Single-family residences comprise most housing with very few multifamily units within this section of the corridor.

3.3.2 Employment

The MetroLink extension corridor traverses several key employment and destination centers in the St. Louis area. These employment centers provide a solid base for future MetroLink ridership.

Washington University, with over 2,300 employees and an annual student enrollment of approximately 11,600 students, is the only major employer within the northern portion of the corridor. Washington University employees and students would benefit from the existence of light rail in close proximity.

Clayton's Central Business District is the major employment center of the corridor area. It is the second largest employment center in the St. Louis metropolitan statistical area (MSA), employing over 30,000 people. Clayton is the home for one Fortune 500 headquarter office (Graybar Electric) and 34 Fortune 500 branch offices. Clayton is also the county seat of St. Louis County with the county government functions located in downtown Clayton. There are over eight million

square feet of office, retail/service, public, hotel and institutional floor space in downtown Clayton, with the majority (5.9 million square feet) being office space. Major employers located in Clayton include St. Louis County Government (1,800 employees); Enterprise Rent-A-Car (1,022 employees); Brown Group (491 employees); Commerce Bank (436 employees); and the Ritz-Carlton (400 employees). Other major employers within the central portion of the alignment include the Galleria shopping mall with over 1,800 employees, and the University Club Towers with over 600 employees.

Major employment centers also exist within the south-central and southern portions of the corridor in Brentwood, Richmond Heights and Maplewood. These include the Brentwood Promenade, the Hanley Industrial Park (800+ employees) and the Sunnen Business Park (900+ employees). The largest employers within the Hanley Industrial Park and adjacent area include Purina Mills (300 employees), KV Pharmaceutical (290 employees), Indeeco (260 employees), Caroline Company (170 employees), Schnucks Market, Inc. (157 employees), and Home Depot (150 employees).

3.3.3 Key Activity Centers

The above employment centers serve as key activity nodes in addition to other activity centers that serve as major destination points within the proposed MetroLink corridor. Most of the major activity centers (see Figure 3.3-1) are located in the north-central and central portions of the corridor. They range from recreation destinations such as Forest Park and Shaw Park in St. Louis City and Clayton, respectively, to the major institutional centers of Washington University and Fontbonne College, and to employment and entertainment destinations such as downtown Clayton, the University City Delmar Loop, the Galleria shopping mall and the Sunnen Business Park.

Clayton's downtown includes the St. Louis County Government Center, St. Louis County Justice Center, St. Louis County Courts Building, Clayton City Hall, World Trade Center, Shaw Park, Ritz-Carlton Hotel, St. Louis County Public Library, and major office buildings. In addition, downtown Clayton has a wide and diverse retail, service and entertainment activity base with a number of hotels also serving the business environment. Clayton has over 1,000 licensed businesses, which include over 50 restaurants. It is estimated that Clayton has an ?in and out" daytime population approximating 80,000.

The Galleria shopping center in Richmond Heights, occupying approximately 1.2 million square feet and employing over 1,800 people, is the St. Louis MSA's largest shopping mall, offering a wide variety of stores with many smaller retail and service activities located within close proximity of the Galleria. The University Club Towers, with over 272,443 square feet of floor space and over 600 employees, contains a variety of services such as medical, consulting, food, retail, and counseling. The Brentwood Promenade represents another major retail and commercial activity center with over 300,000 square feet of retail space. The Hanley Industrial Court is composed of many light industry and manufacturing companies with an employment base of over 800. The last major activity center along the southern section of the proposed route is the expanding Sunnen Business Park which currently employs over 900 individuals.

3.3.4 Potential Development and Redevelopment Areas

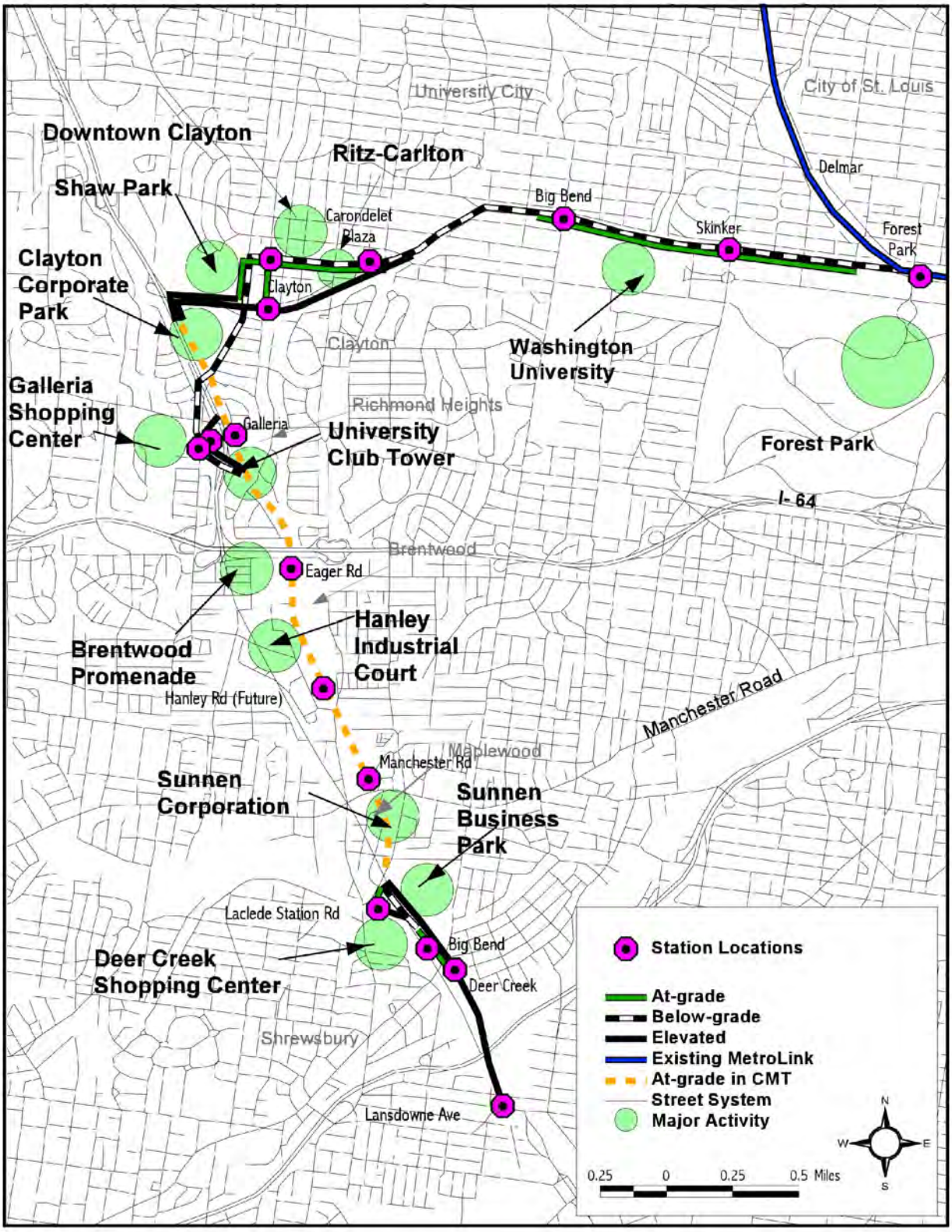
A number of significant redevelopment opportunities exist within the proposed MetroLink corridor. These opportunities would capitalize on existing activity and potential transit-oriented development. The existence of light rail transit and its accompanying stations and parking areas may also induce redevelopment of underutilized land within the MetroLink corridor.

There are numerous parcels within the MetroLink corridor which either are in the process of being developed or for which developments have been approved or proposed, and other parcels which have development potential but do not have specific development proposals (see Figure 3.3-2). Table 3.3-1 summarizes data for these parcels in respect to location, size, distance from nearest MetroLink station, existing/proposed/permitted uses, zoning, proposed development or development potential, construction cost and projected property tax revenue generated. A total of 22 development parcels have been identified comprising approximately 80 acres of land area. Potential square feet of development, construction cost and projected property tax revenues have not been estimated for those parcels which do not have development proposals and/or where the scale of future development is unknown.

The development parcels as identified are concentrated in the central portion of the MetroLink corridor; 14 of the 22 parcels are located in Clayton. Four of the parcels are in Richmond Heights and Brentwood, while two are associated with the Sunnen Business Park. Only two parcels were identified as potential development areas in the City of St. Louis and University City. Development associated with these parcels will impact each respective municipality in respect to increased revenue generated from property, sales and utility taxes, and fees such as business licenses.

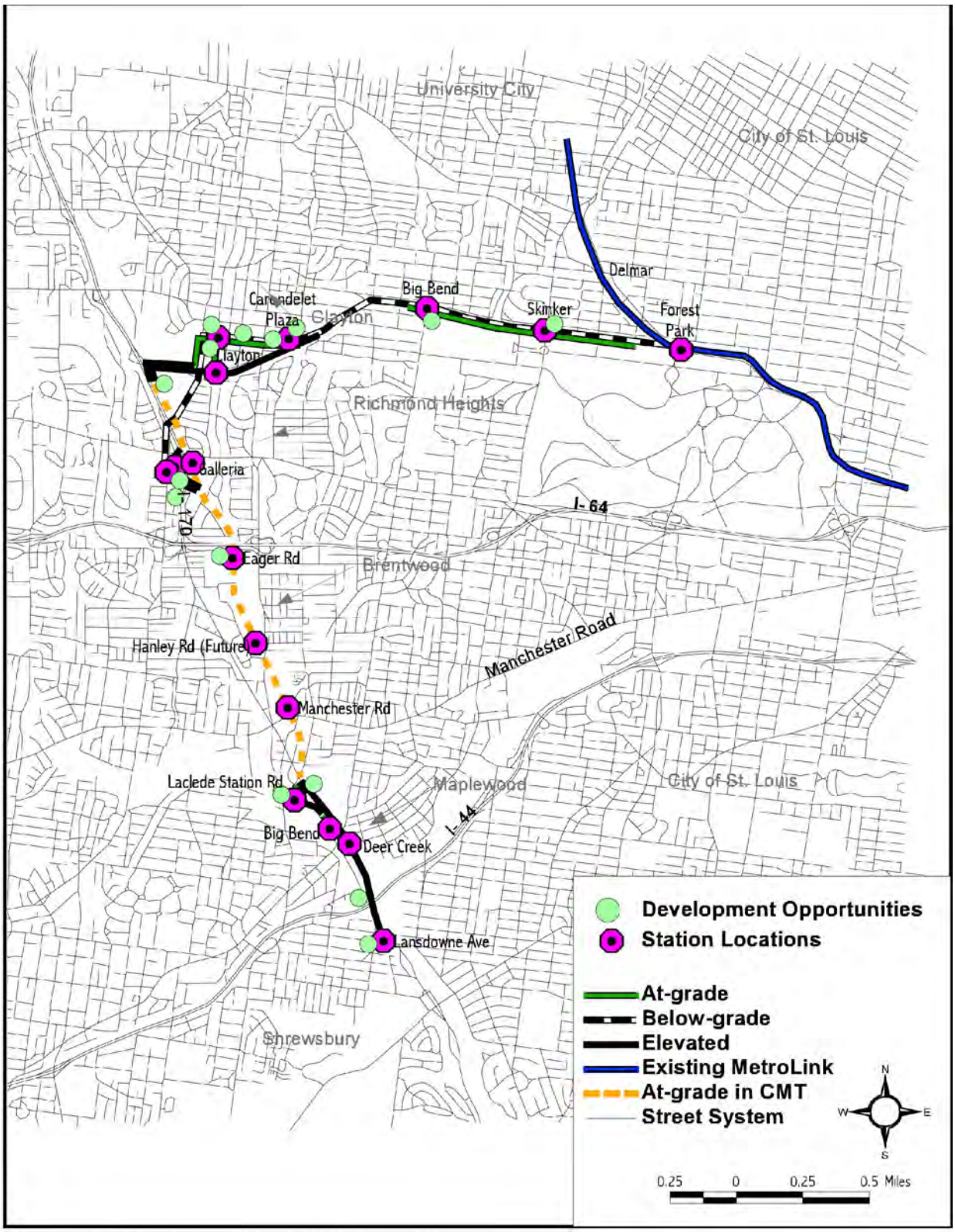
There are also two redevelopment opportunities within the University City and City of St. Louis portion of the proposed Cross-County MetroLink corridor. One exists at the southeast corner of Millbrook and Big Bend Boulevard, referred to as the?Old Channel 9" building property. This highly underutilized area encompasses just over 17 acres and is being redeveloped by Washington University. In addition, the parcel in the northeast corner of Skinker Boulevard and Forest Park Parkway currently containing a vacant 3-story building (formerly restaurant and apartments) is a potential redevelopment area. This parcel is also owned by Washington University.

The major center of ongoing, approved, and proposed developments is the City of Clayton. Within downtown Clayton several planned office and mixed-use developments will provide significant opportunities for MetroLink. In addition, the vacant parcels located adjacent to or near the Ritz-Carlton Hotel are highly underutilized and collectively provide over six acres for development. Also, the northeast and northwest corners of Forsyth and N. Jackson, comprising approximately four acres and containing the former Famous-Barr store and parking garage, are greatly underutilized and do not reflect the highest and best uses for this site. Following is a summary of major redevelopment projects and development opportunities in the City of Clayton.



Cross-County MetroLink Extension Segment I: Major Activity Centers

Figure 3.3-1



Cross-County MetroLink Extension Segment I: Development/Redevelopment Opportunities Figure 3.3-2

Table 3.3-1
CURRENT AND POTENTIAL DEVELOPMENT OPPORTUNITIES

Map No.	Location	Existing Land Use	Distance from Nearest Proposed MetroLink Station (feet)	Approx-imate Parcel Size (acres)	Zoning[1]	Permitted/ Proposed Use(s)	Square Feet of Proposed Develop-ment	Potential Square Feet of Develop-ment[2]	Construc-tion Cost ($millions)	Projected Property Tax Revenue[3]
1	NE corner of Skinker and Millbrook	Vacant com/res bldg	30	0.75	Com	Com/Residential	N/A	N/A	N/A	N/A
2	SE corner of Millbrook and Big Bend	Institutional	50	17.86	R-6	Institutional/ student housing	N/A	2,300,000	N/A	N/A
3	NE corner of Forsyth and MetroLink	Commercial	125	1.14	C-2	Commercial	N/A	340,000	40*	$872,576
4	NW corner of Forsyth and MetroLink	Commercial	175	2.83	C-2	Commercial	N/A	800,000	53*	1,156,163
5	Carondelet Plaza	Vacant	0	2.97	C-4	Commercial	N/A	850,000	47*	1,625,276
6	Carondelet Plaza	Vacant	50	0.86	C-4	Commercial	N/A	250,000	33*	719,875
7	Carondelet Plaza	Vacant	0	0.68	C-4	Commercial	N/A	210,000	28*	610,805
8	Carondelet Plaza	Vacant	125	1.60	C-4	Commercial	N/A	630,000	40*	872,576
9	South of Carondelet	Vacant	500	2.99	C-4	Residential	130,680	900,000	18*	233,141
10	NE corner of Carondelet and Central	Commercial	200	0.80	C-4	Mixed use	274,000	N/A	40	828,416
11	NE corner of Forsyth & Brentwood	Commercial	500	1.28	C-4	Mixed use	100,000—200,000	385,175	20*	436,288
12	NW corner of Forsyth & Brentwood	Commercial	500	0.70	SDD*	Office space	270,000	N/A	51	1,112,534

Key: N/A = not available; SDD = Special Development District; PDC = Planned Development Commercial; PUD = Planned Unit Development
[1] Zoning description pursuant to respective municipal jurisdictions.
[2] Potential square feet of development was generated using existing proposals or parcel sizes and applicable zoning and building regulations from respective municipal jurisdictions.
[3] Projected tax revenue includes total revenues from all taxing entities.
* Estimated construction based on area's average construction cost per square foot and reasonable potential construction.

Table 3.3-1
CURRENT AND POTENTIAL DEVELOPMENT OPPORTUNITIES

Map No.	Location	Existing Land Use	Distance from Nearest Proposed MetroLink Station (feet)	Approx-imate Parcel Size (acres)	Zoning[1]	Permitted/ Proposed Use(s)	Square Feet of Proposed Develop-ment	Potential Square Feet of Develop-ment[2]	Construc-tion Cost ($millions)	Projected Property Tax Revenue[3]
13	Forsyth between Brentwood & Maryland	Commercial	1,000	1.89	SDD*	Office space	240,000	N/A	40	828,416
14	Corner Brentwood and Bonhomme	Residential	425	0.57	R-7	Residential	280,000	N/A	35	453,330
15	Shaw Park Drive between Central and Meramec	Commercial	50	1.32	C-3	Parking structure	Parking	226,000	15.5*	0 (county)
16	Clayton Corporate Center	Commercial	2,200		SDD*	Office space	202,000	N/A	27*	588,988
17	University Club Tower	Commercial/parking	50	1.10	C-2	Retail/serv./offc.	N/A	N/A	N/A	N/A
18	East side of Brentwood Boulevard	Commercial	400	9.00	PDC*	Retail/serv./offc.	N/A	N/A	N/A	N/A
19	East side of Brentwood Promenade	Manufacturing	50	9.96	Indust.	Industrial	435,000	1,040,000	N/A	N/A
20	Hanley Industrial Court	Industrial	50	6.53	Indust.	Commercial	285,000	680,000	N/A	N/A
21	Residential area south of Flora between Laclede Station Road and Hanley Road	Residential	50	12.0	Resid.	Commercial	N/A	800,000	N/A	N/A
22	Sunnen Business Park	PUD	600	2.0	PUD	Mixed use	187,000	N/A	15	5,217

Key: N/A = not available; SDD = Special Development District; PDC = Planned Development Commercial; PUD = Planned Unit Development
[1] Zoning description pursuant to respective municipal jurisdictions.
[2] Potential square feet of development was generated using existing proposals or parcel sizes and applicable zoning and building regulations from respective municipal jurisdictions.
[3] Projected tax revenue includes total revenues from all taxing entities.
* Estimated construction based on area's average construction cost per square foot and reasonable potential construction.

- **A 200,000- to 300,000-square-foot high-rise residential development is under option for a three-acre site just south of Carondelet Plaza and the Carondelet Plaza circle north of Colorado Avenue. This development is approximately 500 feet from the nearest proposed MetroLink station at Carondelet Plaza.**

- **The new World Trade Center is proposed on Carondelet Avenue between S. Central and Bemiston Avenues. This 274,000-square-foot facility will primarily house office space with mixed use on the lower levels that will include food service and light retail use. This building is approximately 200 feet from the nearest proposed MetroLink station at Carondelet and Central Avenue.**

- **Mixed-use development is planned for the parcels located along Forsyth between Meramec and Brentwood Avenues. This development is approximately 500 feet from the nearest proposed MetroLink station at Carondelet and Central Avenue.**

- **St. Louis County is planning a new parking structure between Meramec and Central Avenues on Shaw Park Drive. This parking structure is within 50 feet of a proposed MetroLink station associated with the elevated option on Forest Park Parkway.**

- **Trammell Crow Company plans to develop Shaw Park Plaza, an office building at the corner of Brentwood Boulevard and Forsyth Avenue. Construction for this 270,000- square-foot building began in spring 1999. This office building is approximately 500 feet away from the nearest proposed MetroLink station.**

- **Conrad Properties is developing a 23-story, 280,000-square-foot, mixed-use, residential development at the corner of Bonhomme Avenue and Brentwood Boulevard. This project will include 128 apartments and condominiums, 98 extended-stay hotel suites and approximately 7,000 square feet of retail space. This project is scheduled for completion by spring 2000. This development is approximately 425 feet from the nearest proposed MetroLink station at Carondelet and Central Avenue.**

- **Enterprise, Inc., is planning to construct a fourth building within the Clayton Corporate Center for administration use. This development has not yet been approved by the Clayton Planning Commission. This building will be approximately 2,200 feet away from the nearest proposed MetroLink station.**

There are several parcels with major development potential in the north-central and central portions of the MetroLink corridor in Richmond Heights, Brentwood and Maplewood. There have been several discussions between developers and Richmond Heights officials concerning parcels across from the Galleria on the east side of Brentwood Boulevard between the Galleria Parkway and I-64. This area has been the subject of several large-scale development proposals in the recent past. In addition, there are several parcels associated with the University Club Tower on Brentwood that are underutilized and have greater development potential. For the aggregate, these have a potential for about 1,000,000 square feet of development.

The municipalities and organizations that are responsible for the Hanley Industrial Court and Sunnen Business Park area have both recognized the underutilization of these areas, and have initiatedplanning efforts to identify options for redevelopment. The City of Brentwood is working on redeveloping the Hanley Industrial Court and 9.9 acres just east of the Brentwood Promenade for commercial uses. The City of Maplewood is working with a consultant and the Sunnen Corporation to construct a 187,000 square foot, mixed-use development on the remaining undeveloped parcels of the Sunnen Business Park. This space, primarily for office use, may support up to an additional 885 employees. This proposed development would be approximately 650 feet from the nearest proposed Laclede Station Road MetroLink station.

Within the southern portion of the proposed MetroLink corridor, there are several large parcels surrounding I-44 in Shrewsbury which have not achieved their full economic/land use potential. The City of Shrewsbury has already acknowledged this potential, and is working to optimize these parcels. The city is also discussing the possibility of developing a downtown business district that will enhance the city's economic viability. The downtown business district under consideration would be located near the southern terminus of the study area, with parcels located east of Murdoch Cut-off /St. Vincent Avenue and north of Murdoch Avenue with Des Peres Park the eastern boundary. The Missouri Department of Transportation is initiating a planning study at the request of the City of Shrewsbury to look at access to and through I-44 in the area between Murdoch and Jamieson and Big Bend and Watson.

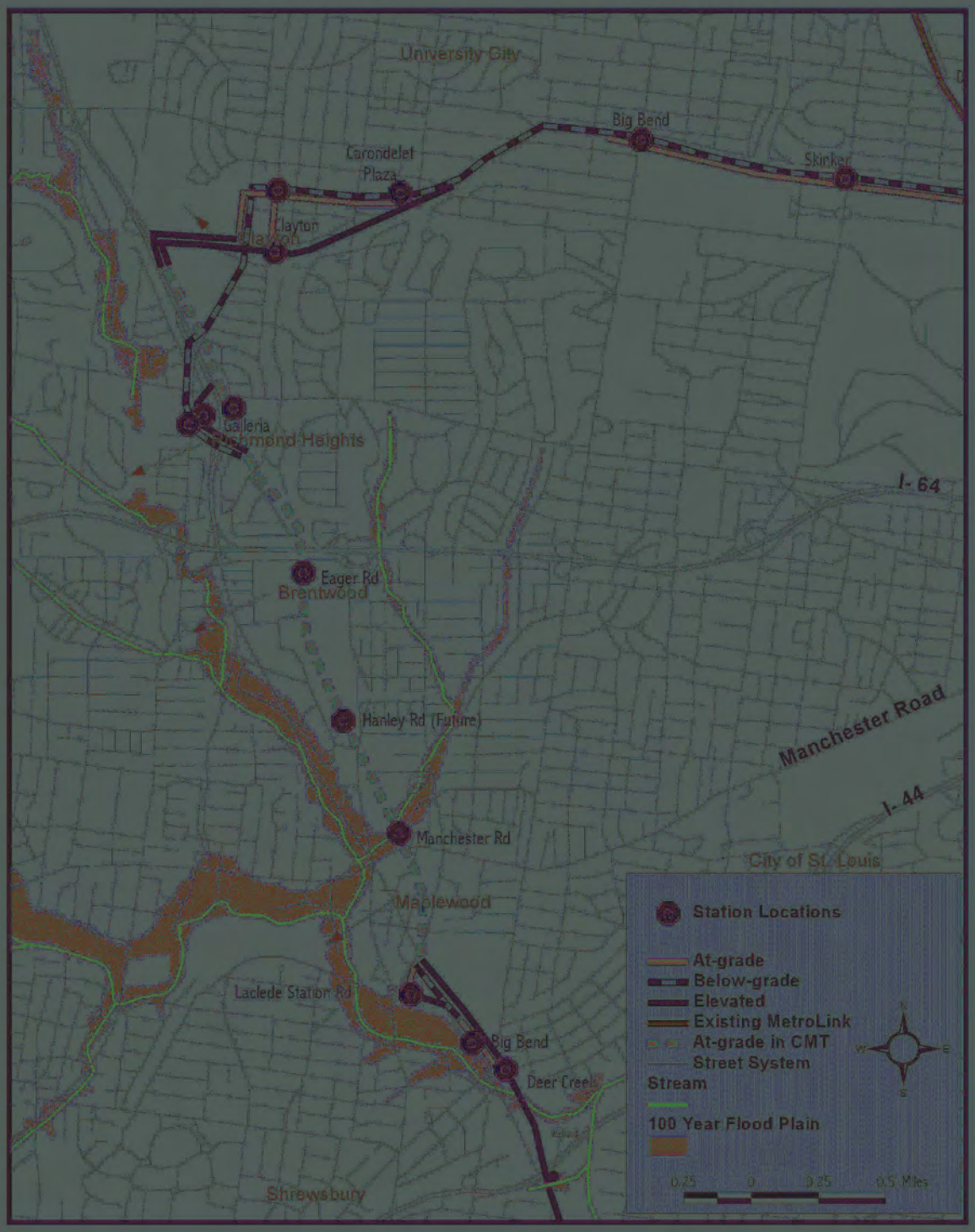
3.4 Environmental Setting

3.4.1 Natural Resources

Streams, Wetlands, and Floodplains

***Streams*. There were three streams identified within the Cross-County MetroLink Extension Segment I corridor (see Figure 3.4-1). The three streams are a tributary to Black Creek, Deer Creek, and the River Des Peres. The Black Creek tributary and Deer Creek are streams where crossings would probably require bridge construction. Stream channelization does not appear to be necessary at these stream crossings.**

The water quality for streams in the corridor is generally low. Water quality in the corridor is degraded by stormwater outfalls and point source discharges from commercial and residential areas. Stormwater runoff from developed areas transports contaminants, such as petroleum products, lawn chemicals, and other debris, into area streams.



Cross-County MetroLink Extension Segment I: Streams and Flood Plains Figure 3.4-1

***Wetlands*. Section 404 of the Clean Water Act extends authorization to the U.S. Army Corps of Engineers (USACE) to regulate activities which affect waters of the United States, including wetlands, and to issue permits for the discharge of dredged or fill material into wetlands and other waters of the U.S. Any activity that will impact wetlands or waters of the U.S. will require Section 404 permitting and mitigation may be required.**

Wetland resources were identified along the Cross-County MetroLink Extension Segment I corridor. Prior to the field investigation, potential wetland areas and stream crossings were identified using National Wetland Inventory (NWI) maps and United States Geological Survey (USGS) maps. The presence or absence of jurisdictional wetlands was verified in the field. During the field survey, other areas that exhibited wetland characteristics were also thoroughly surveyed and documented. These areas were usually identified based upon terrain position and the presence of wetland vegetation.

There were four sites surveyed in the field using the routine wetland delineation techniques as outlined in the 1987 USACE Wetland Delineation Manual (USACE, 1987) (see Table 3.4-1). Other sites that are typically correlated with wetlands, such as floodplains or riparian corridors, were also investigated during the survey.

Of the four sites investigated, only a single 0.17-acre site was considered a jurisdictional wetland. The I-44 Cattail Seep was the only site that had the requisite hydrology, hydrophytic vegetation, and hydric soils. The other three sites did not meet one or more of the criteria, therefore these sites would not be regulated.

The jurisdictional I-44 Cattail Seep is dominated by narrowleaf cattail and sedges. This wetland lies immediately south of I-44, just east of the Burlington Northern Santa Fe railroad line. The location of this wetland is shown on Figure 3.4-1. This wetland receives seep water from the base of a hill that lies to the north, and it has relatively low functional values related to water quality improvement, flood protection, and wildlife habitat. The overall value of the wetland is low due to the small size (0.17 acres), highly degraded nature of the wetland, and low functional values.

***Floodplains*. Crossings of the 100-year floodplain within the Cross-County MetroLink Extension Segment I corridor would occur at three locations including: an unnamed tributary of Black Creek, Deer Creek, and an off-channel portion of the River Des Peres. The Black Creek tributary and Deer Creek floodplains include regulatory floodways. These crossings are narrow and would be spanned by bridges. A small portion of the River Des Peres floodplain extends to the west along a narrow drainageway through the Cross-County corridor near the southern end of the project (south of I-44). Regulatory floodways are not affected at this area. This small portion of the floodplain may be spanned by bridges.**

Table 3.4-1
WETLAND RESOURCES IN THE CROSS-COUNTY METROLINK EXTENSION SEGMENT I PROJECT AREA

Location Name	Jurisdictional Determination	Size (acreage)	Description
Tropicana Lanes #1	No	0.02	Two small cattail depressions along the CMT line. This site lacks the requisite soils to be considered jurisdictional.
Tropicana Lanes #2	No	0.02	Three small cattail depressions along the CMT line and in ditches parallel to the CMT line. This site lacks the requisite soils to be considered jurisdictional.
I-44 Cattail Seep	Yes	0.17	Cattail seep that has the requisite soils, hydrology, and vegetation to be considered jurisdictional.
Landfill Pond	No	0.57	This is a highly disturbed yard-waste disposal site that lacks the requisite soils to be considered jurisdictional.

Source: Parsons Engineering Science, 1999

Vegetation and Wildlife Habitat

The natural habitat of the entire Cross-County corridor has been altered, disturbed, or degraded by development within the various municipalities. Residences, commercial and industrial improvements, and various infrastructure developments such as streets, roads, bridges, and railroad lines have greatly diminished the quality of vegetation and wildlife habitat.

The northern portion of the project area includes that portion of the alignment between the Forest Park Station and Clayton. The area along the CMT right-of-way from south of Forest Park Parkway southward to the Sunnen Business Park has primarily developed into an old field habitat since it was abandoned. The vegetation along the old railroad line ranges from non-vegetated, to sparsely vegetated, to completely overgrown in some areas. The vegetation along the CMT line is typically dominated by aggressive invader species such as the exotic bush honeysuckle, Johnson grass, cocklebur, bidens, and tall fescue. The gravel substrate along the CMT line restricts the quantity and quality of vegetation that it can produce. The old field habitat along the CMT line provides only marginal habitat for small mammals and birds.

Narrowbands of wooded riparian habitat occur along the Black Creek tributary, Deer Creek, and the River des Peres. Typical species found in the riparian areas include silver maple, sycamore,

cottonwood, and black willow. These riparian zones provide habitat and travel corridors for small mammals and resident and migratory birds. There are no unique or unusual habitats within the project area.

Both resident and migratory wildlife frequent the project area habitats, however most of the species present, especially the resident species, are tolerant of disturbance and the presence of human activities. Typical and abundant resident mammals include opossum, raccoon, striped skunk, house mouse, deer mouse, norway rats, black rats, moles, cottontail rabbits, and eastern gray squirrel. Other mammals, such as the white-tailed deer, red fox, coyote, beaver, and muskrats frequent the less disturbed portions of the project area, especially the riparian habitats along Black Creek, Deer Creek, and the River des Peres.

Typical migratory birds known to occur in the project area would include the American robin, northern cardinal, field sparrows, eastern meadowlark, mourning dove, and northern mockingbird. Introduced species such as the European starling, house sparrow, and rock dove (domestic pigeon) are abundant. Migratory waterfowl such as wood ducks, mallards, and giant Canada geese also frequent urban waterbodies, such as stormwater retention ponds, city lakes, golf course ponds, and streams, in the vicinity of the project area.

The urban setting restricts the diversity of reptiles and amphibians, however common reptiles and amphibians likely to occur in the project area would include the western ribbon snake, northern water snake, black rat snake, eastern garter snake, common snapping turtle, three-toed box turtle, American toad, southern leopard frog, and bullfrog.

Threatened and Endangered Species

The Columbia, Missouri Field Office of the U. S. Fish and Wildlife Service (USFWS) was contacted in order to obtain a list of federally-protected threatened and endangered species for St. Louis City and St. Louis County. According to the USFWS, there are five federally-listed species and two candidate species known to occur in St. Louis County, and these species are listed in Table 3.4-2.

The bald eagle is a common migrant and winter resident throughout the state of Missouri, and they are known to be rare breeders along some of the major rivers and large reservoirs in the state. In the vicinity of St. Louis County, bald eagles typically concentrate feeding and roosting activities along the Mississippi and Missouri Rivers during their annual fall and winter migrations. During the peak of their winter migration, hundreds of bald eagles can congregate along the banks of the Mississippi and Missouri Rivers. The eagles utilize the forested/riparian areas along the river banks for daytime perching sites and night roosts, and they utilize the riverine habitat for feeding and scavenging, primarily for fish. Bald eagles are susceptible to disturbance, and they prefer areas with limited human activity. There are no large to medium sized rivers in the project area that would provide suitable habitat for bald eagles, and the highly developed/disturbed nature of the project area would not be conducive to bald eagle use.

Table 3.4-2
FEDERALLY-LISTED SPECIES KNOWN TO OCCUR IN ST. LOUIS COUNTY

Common Name	Scientific Name	Status
Bald eagle	*Haliaeetus leucocephalus*	Threatened
Peregrine falcon	*Falco peregrinus*	Endangered
Pallid sturgeon	*Scaphirhynchus albus*	Endangered
Pink mucket pearly	*Lampsilis orbiculata*	Endangered
Running buffalo clover	*Trifolium stoloniferum*	Endangered
Sicklefin chub	*Macrhybopsis meeki*	Candidate for federal listing[1]
Sturgeon chub	*Macrhybopsis gelida*	Candidate for federal listing[1]

[1] The Endangered Species Act extends no legal protection to candidate species.

Source: U.S. Fish and Wildlife Service, 1999.

Peregrine falcons are rare migrants throughout Missouri that are known to nest on high cliffs, tall buildings, and bridges. In Missouri, peregrine falcons only nest in urban areas, including St. Louis, where they have been introduced. The last occurrence of peregrine falcons in St. Louis was documented in 1994 on the roof of the Park Plaza Hotel. In urban settings, peregrine falcons primarily feed on domestic pigeons, and they would be expected to hunt/forage for pigeons in the vicinity of Forest Park.

The range of the pallid sturgeon consists of the Missouri River and the Mississippi River downstream from its confluence with the Missouri River. Although limited data is available concerning preferred habitats of the pallid sturgeon, the species is typically found in tributary mouths, over sandbars, along main channel borders, and in deep holes elsewhere in the Missouri and Mississippi Rivers. There are no large to medium sized rivers in the project area that would provide suitable habitat for the pallid sturgeon. Water quality in the Mississippi River can be influenced by stormwater from the area, including Black Creek, Deer Creek, and the River des Peres watersheds.

The pink mucket pearly mussel is found in medium to large rivers in habitats that range from silt to boulder substrates in moderate to fast flowing water at depths from 0.5-8.0 meters. This mussel can be adversely impacted by increased turbidity and suspended sediments, which can cause nutritional stress and mortality. The pink mucket pearly mussel is only known to occur in the Meramec River in St. Louis County. No suitable habitat for this mussel exists in or immediately downstream from the project area.

Running buffalo clover is a white-flowered clover that prefers moist rich soils in partially shaded habitats. A single population of running buffalo clover exists in St. Louis County; however, this population is not in the vicinity of the project area. Other populations of this species are currently

being cultivated on Missouri Department of Conservation areas. Due to the highly developed/ disturbed nature of the project area, there would be no suitable habitat for this species.

The sicklefin and sturgeon chubs are small minnows native to the Missouri River. They occur along and over sandbars in main channel border areas and chutes between the mainland and sandbar islands. These chubs prefer sand and gravel substrates with current velocities of 0-1.3 feet-per-second. These chubs would not be expected to occur in project area streams or downstream from the project area.

3.4.2 Parklands

As shown in Figure 3.4-1, there are several parks located in the vicinity of the proposed alignments, including Forest Park in the City of St. Louis, Flynn Park in University City, Shaw Park in the City of Clayton, Lockwood Creek/Deer Creek County Park in Maplewood, and Webster Groves and Ackfeld Park in Shrewsbury.

There are proposed Cross-County MetroLink alignment options adjacent to Shaw Park, which is bordered by Brentwood Boulevard on the east and Shaw Park Drive on the south. Shaw Park functions as a multipurpose recreational activity center for the City of Clayton and includes facilities for baseball, tennis, picnics, shelters, swimming (summer), and ice-skating (winter). The park is used for several special events during the year, including Parties-in-the-Park, Taste of Clayton, and Shaw's Paws.

Ackfeld Park in Shrewsbury is also located adjacent to one of the MetroLink extension alignments. Activities in this park include swimming, volleyball, softball, and soccer.

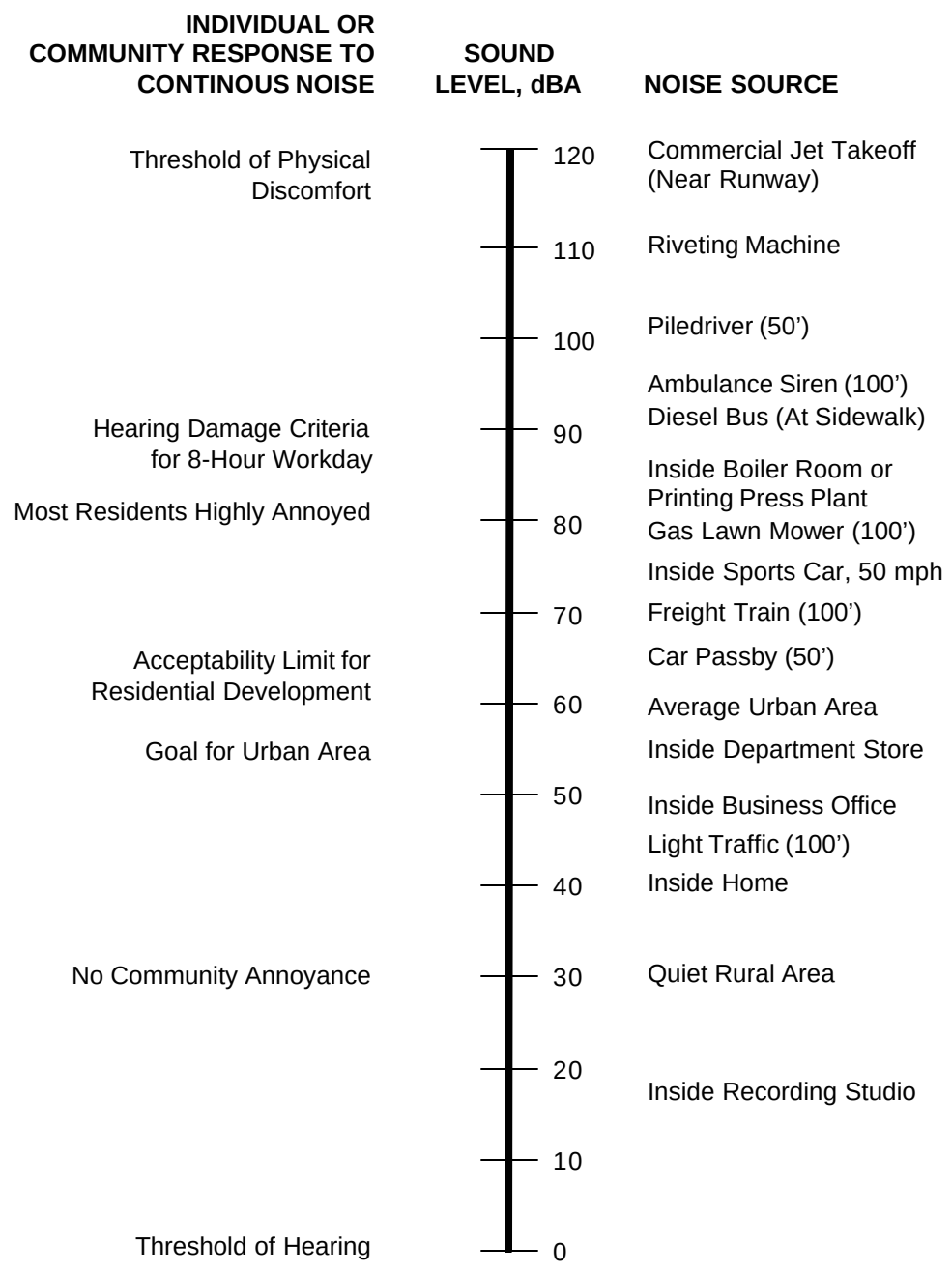
3.4.3 Noise and Vibration

A noise and vibration environmental assessment was conducted for the Cross-County MetroLink Extension. As a first step, existing conditions in the corridor were identified. Ambient noise and vibration measurements were conducted along the corridor to establish the existing conditions. Noise and vibration sensitive receptors, such as nearby residences, schools, or older buildings close to the MetroLink alignment (vibration), were also identified.

The most common way to measure sound is in terms of the "A-weighted" decibel, which is abbreviated dBA. The A-weighted scale is used so sound can be measured in a way similar to how the human ear hears sound. The human ear is not equally sensitive to all sound frequencies. Therefore, frequency adjustments are made in the A-weighted or dBA scale. For example a 3 dBA increase in sound is generally imperceptible to the human ear. An increase in sound of 10 dBA, which represents a 10-fold increase in acoustic energy, makes the sound appear to the human ear twice as loud. The dBA sound scale is a logarithmic scale. Figure 3.4-2 presents the typical sound levels from indoor and outdoor noise sources expressed in dBA and includes the responses of people to these levels.

Noise measurements were obtained by noise monitoring instruments to provide an in-depth view of the sound level over a measured period of time. The average sound level (L_{eq}) was monitored for both short-term and long-term durations. Short-term monitoring was for up to 15 minutes, while long-term measurements were for at least 24 hours. The long-term noise measurements included the day-night sound level (L_{dn}), which is obtained from the hourly L_{eq} plus a 10 dBA adjustment applied to nighttime noise between the hours of 10 p.m. and 7 a.m. Ten dBA is added to the actual monitored values because sounds at night appear to the human ear to be louder. Other noise measurements that were taken in the corridor include the minimum sound level (L_{min}) and the maximum sound level (L_{max}) monitored at the receptor site.

When assessing the impact of vibration on humans, the common measurement is the root mean square (rms) velocity level. The rms velocity level is expressed in terms of the energy average L_{eq} and the maximum instantaneous vibration L_{max}. For assessing vibration impacts on structures, especially for construction activities, the vibration peak particle velocity (ppv) is the common measurement. Where frequency criterion apply for special vibration-sensitive receptors, such as the electron microscopes at Washington University, the vibration is assessed for its maximum level vs. frequency. Figure 3.4-3 shows typical ground-borne vibration levels for various vibration sources and the respective responses of humans and structures.



Source: Parsons Engineering Science, Inc.

Figure 3.4-2 - Typical A-Weighted Sound Levels

Existing Cross-County Corridor Noise and Vibration

There are three distinctive sub-areas in the Cross-County MetroLink corridor, each of which experiences a wide range of sound levels, depending on the types of noise sources and their proximity to the sensitive receptor locations. These three sub-areas are Forest Park/University City, Clayton, and Galleria south to I-44. Existing noise sources and ambient noise measurement are presented for these three sub-areas. Both short-term and long-term noise and vibration measurements were conducted at representative locations along the corridor (See Figure 3.4-4).

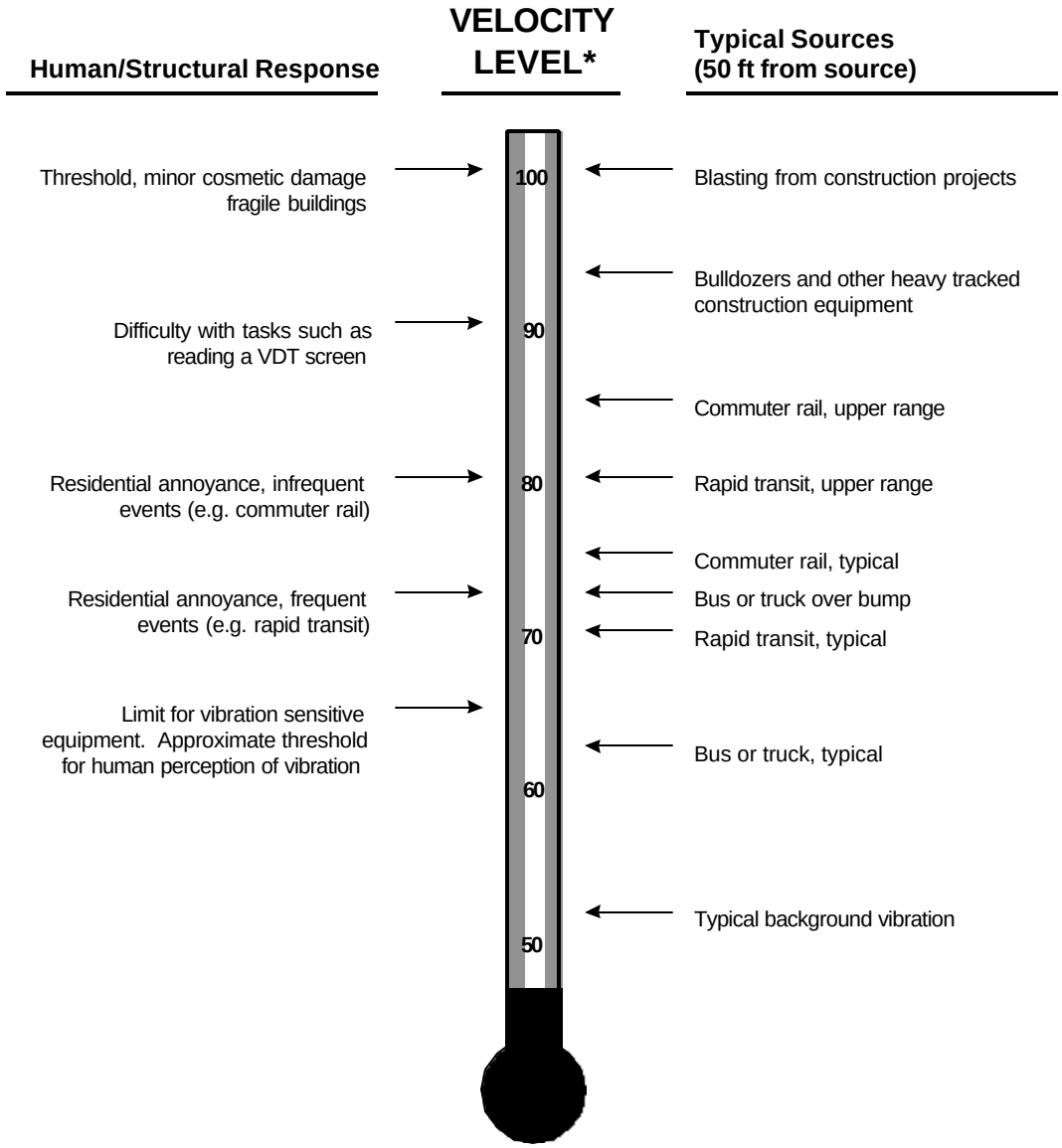
<u>Noise Measurements</u> - Noise measurements were conducted using Larson-Davis Model 870, Type 1, Precision Environmental Sound Level Meters. These meters were calibrated prior to and after the noise monitoring sessions using a Larson-Davis Model CA250 acoustic microphone calibrator. Short-term noise measurements consisted of 15-minute ambient noise measurements approximately 10 feet (3 meters) from sensitive receptor property lines nearest the proposed MetroLink alignment. Figure 3.4-3 shows the eight locations used for short-term ambient noise monitoring. Long-term noise measurements over a 24-hour period were also taken at eight locations along the corridor. All eight locations are residential land use, two of which are multi-family residential. Figure 3.4-4 shows the eight long-term noise measurement sites monitored over a 24-hour period.

<u>Vibration Measurements</u> - On April 26 and 27, 1999, vibration measurements were made using vibration monitoring systems consisting of Larson-Davis Model 2900 Dual Channel Analyzers, Bruel & Kjaer Type 4378 accelerometers, and Bruel & Kjaer Type 2635 Charge Amplifiers. The vibration monitoring system was calibrated according to manufacturers' instructions using a Bruel & Kjaer Type 4294 vibration calibrator.

Short-term vibration measurements were conducted at two locations: (1) at the exterior of a vibration-sensitive Washington University research building (the Mass Spectrometry building), and (2) the St. Louis County Administrative Building in the City of Clayton. Both structures are adjacent to the MetroLink alignment. Horizontal and vertical vibration measurements were conducted simultaneously.

Long-term vibration measurements were conducted in the Mass Spectrometry building on the campus of Washington University, which is on the south side of Millbrook Avenue. Horizontal and vertical vibration measurements were conducted simultaneously on the floor of the mass spectrometry lab and on the top of the spectrometry table (vertical measurement).

FIGURE 3.4-3
TYPICAL VIBRATION LEVELS



** RMS Vibration Velocity Level in dB relative to 10^{6} inches/second*

Source: *Transit Noise and Vibration Assessment,*
U.S. DOT Federal Transit Administration, April 1995.

Forest Park/University City Sub-Area

This sub-area currently contains existing residential neighborhoods, educational institutions, and Forest Park. These types of land-uses are potentially sensitive to noise and vibration. The proposed Forest Park/University City MetroLink alignment primarily uses public street rights-of-way.

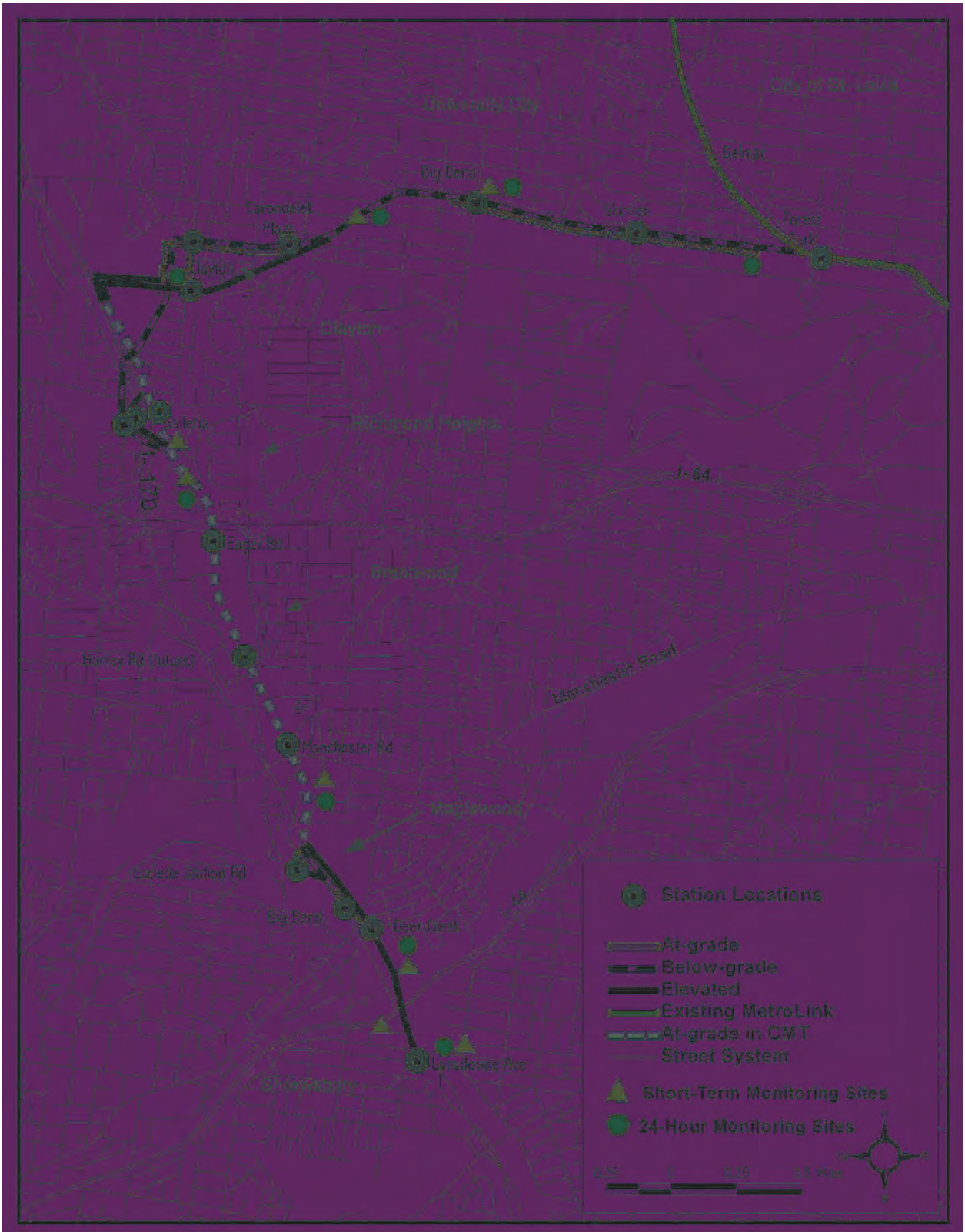
<u>Existing Noise</u> Ambient noise in this section of the Forest Park/University City sub-area of the corridor is primarily due to local street traffic and typical neighborhood sounds. On the west side of this section, as downtown Clayton is approached, some sounds related to commercial activity are apparent. Tables 3.4-1A and 3.4-2A show the results of the noise monitoring in this section which were taken on November 11, 1998, during the peak commuting hours and off-peak hours, respectively. Table 3.4-3 shows the results of the 24-hour noise monitoring in this section of the Forest Park/University City sub-area. The long-term ambient noise monitoring was conducted on Wednesday and Thursday, December 9 and 10 ,1998.

Table 3.4-1A
Peak-Hour Short-Term (15 Minutes) Property Line Ambient Noise Measurements

10' from Property Line	Start	Duration	Leq	Lmin	Lmax
Nearest LRT Alignment	Time	min:sec	dBA	dBA	dBA
6910 Pershing	06:58	15:00	65.7	52.6	73.0
7349 Lindell	07:18	15:00	64.5	53.0	73.8

Table 3.4-2A
Off-Peak-Hour Short-Term (15 Minutes) Property Line Ambient Noise Measurements

10' from Property Line	Start	Duration	Leq	Lmin	Lmax
Nearest LRT Alignment	Time	min:sec	dBA	dBA	dBA
6910 Pershing	12:53	15:00	64.3	53.5	75.8
7349 Lindell	12:03	15:00	61.3	50.7	69.5



Cross-County MetroLink Extension Segment I: Noise Monitoring Sites

Figure 3.4-4

Table 3.4-3
Long-Term (24-Hour) Property Line Ambient Noise Measurements

Location	Leq (24 hr)	Min Leq (h)	Max Leq (h)	Leq (pk hr)	Ldn
5835 Lindell	60.2	50.5	64.3	64.3	67.2
6910 Pershing	60.0	49.1	64.9	64.9	66.7
7349 Lindell	58.4	49.1	64.2	64.2	65.4

Existing Vibration - Ambient vibrations were monitored on April 26 and 27, 1999 at locations outside and inside the Washington University Mass Spectrometry building research facility. The short-term measurements were conducted on April 27. Table 3.4-4 gives the results of the ambient vibration measurements at the Washington University building. Existing vibration sources include traffic along Millbrook Avenue, the machine shop within the same building, the nearby University power plant, and normal personnel activities within the Mass Spectrometry building research facility. Table 3.4-5 presents the maximum measured values for the peak-to-peak vibrational displacement measured during the duration. The values in Table 3.4-5 are for the lab building structure and inside the lab room. Due to the type of research being conducted at the Mass Spectrometry building, Washington University has developed criteria regarding maximum vibration levels. The criteria is expressed in terms of vibrational displacement.

Table 3.4-4
University Mass Spectrometry Building Ambient Vibrations

Location	Time	Duration	Leq	Lmin	Lmax
Exterior - Vertical	09:24	15 minutes	58.1	n/a	70.6
Exterior - Horizontal	09:43	10 minutes	54.4	n/a	71.2

Table 3.4-5
Mass Spectrometry Building Ambient Vibration 1/3 Octave Frequency Spectra

Frequency	Mass Spectrometry Lab Building				Mass Spectrometry Lab			
	Floor (Long-term)		Exterior (Short-term)		Floor		Table	
Hz	Vert. MxS[1]	Horiz. MxS	Vert. MxS	Horiz. MxS	Vert. MxS	Horiz. MxS	Vert. MxS	Horiz. MxS
Overall	4.48	7.88	9.58	10.27	2.93	3.07	6.05	8.16
0.8	1.54	4.38	0.68	0.56	0.92	1.10	2.12	4.28
1	3.28	6.86	0.44	0.88	2.38	2.20	5.51	6.63
1.25	2.80	3.64	9.47	0.15	1.37	1.74	1.35	1.98
1.6	0.83	0.95	0.56	0.21	0.28	0.33	0.26	0.79
2	0.28	0.60	0.27	0.11	0.19	0.17	0.14	0.24
2	0.29	0.28	0.12	0.11	0.11	0.20	0.17	0.06
3.15	0.22	0.22	0.17	0.05	0.06	0.10	0.11	0.25
4	0.11	0.69	0.05	0.04	0.06	0.03	0.43	0.11
5	0.10	0.24	0.19	0.06	0.03	0.06	0.08	0.06
6	0.06	0.25	0.12	0.05	0.03	0.06	0.21	0.07
8	0.06	0.11	0.07	0.05	0.04	0.04	0.03	0.03
10	0.04	0.11	0.09	0.14	0.06	0.04	0.07	0.02
12.5	0.04	0.07	0.02	0.78	0.03	0.02	0.02	0.03
16	0.04	0.06	0.14	1.47	0.03	0.04	0.02	0.04
20	0.06	0.04	0.18	1.50	0.03	0.03	0.04	0.07
25	0.06	0.06	0.50	0.60	0.04	0.03	0.03	0.03
31.5	0.04	0.06	0.51	1.72	0.04	0.04	0.04	0.03
40	0.04	0.06	0.08	9.58	0.03	0.04	0.04	0.02
50	0.04	0.06	0.20	1.93	0.03	0.03	0.02	0.03
63	0.03	0.16	0.17	1.15	0.03	0.02	0.13	0.14
80	0.04	0.04	0.07	0.09	0.03	0.04	0.02	0.03
100	0.04	0.04	0.02	0.03	0.04	0.04	0.03	0.03
125	0.04	0.04	0.03	0.02	0.04	0.04	0.03	0.03
160	0.04	0.04	0.02	0.02	0.03	0.04	0.03	0.04

[1] **MxS = Mass spectra. This MxS value give the measured peak-to-peak vibrational displacement measured during the monitored duration.**

Clayton Sub-Area

Table 3.4-5
Mass Spectrometry Building Ambient Vibration 1/3 Octave Frequency Spectra

Frequency	Mass Spectrometry Lab Building				Mass Spectrometry Lab			
	Floor (Long-term)		Exterior (Short-term)		Floor		Table	
Hz	Vert. MxS[1]	Horiz. MxS	Vert. MxS	Horiz. MxS	Vert. MxS	Horiz. MxS	Vert. MxS	Horiz. MxS
Overall	4.48	7.88	9.58	10.27	2.93	3.07	6.05	8.16
0.8	1.54	4.38	0.68	0.56	0.92	1.10	2.12	4.28
1	3.28	6.86	0.44	0.88	2.38	2.20	5.51	6.63
1.25	2.80	3.64	9.47	0.15	1.37	1.74	1.35	1.98
1.6	0.83	0.95	0.56	0.21	0.28	0.33	0.26	0.79
2	0.28	0.60	0.27	0.11	0.19	0.17	0.14	0.24
2	0.29	0.28	0.12	0.11	0.11	0.20	0.17	0.06
3.15	0.22	0.22	0.17	0.05	0.06	0.10	0.11	0.25
4	0.11	0.69	0.05	0.04	0.06	0.03	0.43	0.11
5	0.10	0.24	0.19	0.06	0.03	0.06	0.08	0.06
6	0.06	0.25	0.12	0.05	0.03	0.06	0.21	0.07
8	0.06	0.11	0.07	0.05	0.04	0.04	0.03	0.03
10	0.04	0.11	0.09	0.14	0.06	0.04	0.07	0.02
12.5	0.04	0.07	0.02	0.78	0.03	0.02	0.02	0.03
16	0.04	0.06	0.14	1.47	0.03	0.04	0.02	0.04
20	0.06	0.04	0.18	1.50	0.03	0.03	0.04	0.07
25	0.06	0.06	0.50	0.60	0.04	0.03	0.03	0.03
31.5	0.04	0.06	0.51	1.72	0.04	0.04	0.04	0.03
40	0.04	0.06	0.08	9.58	0.03	0.04	0.04	0.02
50	0.04	0.06	0.20	1.93	0.03	0.03	0.02	0.03
63	0.03	0.16	0.17	1.15	0.03	0.02	0.13	0.14
80	0.04	0.04	0.07	0.09	0.03	0.04	0.02	0.03
100	0.04	0.04	0.02	0.03	0.04	0.04	0.03	0.03
125	0.04	0.04	0.03	0.02	0.04	0.04	0.03	0.03
160	0.04	0.04	0.02	0.02	0.03	0.04	0.03	0.04

[1] **MxS = Mass spectra. This MxS value give the measured peak-to-peak vibrational displacement measured during the monitored duration.**

Clayton Sub-Area

This is a mixed-use sub-area that includes downtown Clayton with major commercial/retail areas with some residential uses. Downtown Clayton is a place of employment for more than 30,000 persons and has a compact, high-density core area with a concentration of office activities. These types of land-uses are potentially sensitive to noise and vibration. The alignment primarily uses public street rights-of-way.

Existing Noise - Table 3.4-6 gives the results of the 24-hour noise monitoring in this section of the Downtown Clayton to the Galleria Area Section of the Clayton sub-area. The long-term ambient noise monitoring was conducted on Wednesday and Thursday, December 9 and 10, 1998, for the Brentwood Boulevard location.

Table 3.4-6
Long-Term (24-Hour) Property Line Ambient Noise Measurements

Location	Leq (24 hr)	Min Leq (h)	Max Leq (h)	Leq (pk hr)	Ldn
250 Brentwood #3E	69.4	57.0	72.8	72.8	75.7

Existing Vibration - Ambient vibrations were monitored on April 27, 1999, at an exterior location along the alignment in Clayton. The monitoring site was the southwest corner of the County of St. Louis Administrative Building. Table 3.4-7 gives the results of the ambient vibration measurements in the Clayton sub-area. Existing vibration sources include traffic along local streets and normal activities within the existing government office complex.

Table 3.4-7
Downtown Clayton Ambient Vibrations, VdB re 1 microinch/sec

Location	Time	Duration	Leq	Lmin	Lmax
SW Building Exterior - Vertical	18:03	15:00	66.1	50	76.5
SW Building Exterior - Horizontal	17:23	15:00	48.9	41	66.0

Galleria to I-44 Sub-Area

The Galleria south to I-44 sub-area is very diverse with many types of land uses and development. It includes business and industrial uses, commercial centers, and residential neighborhoods. These types of land-uses are potentially sensitive to noise and vibration. The MetroLink alignment follows a potential right-of-way that is very different from those in the other two sub-areas in that it will use mostly the CMT railroad right-of-way. Ambient noise in the Galleria Area to Shrewsbury Section of the South/I-44 sub-area of the corridor is primarily due to freeway and local street traffic, with major commercial activity and typical neighborhood sounds. Frequent railway operations in the southern portion of this section (I-44 area) also contribute to the ambient noise.

<u>Existing Noise</u> - Tables 3.4-8 and 3.4-9 show the results of the short-term noise monitoring in the Galleria South to I-44 sub-area which were taken on November 11,1 998, during the peak commuting hours and off-peak hours, respectively. Table 3.4-11 gives the results of the 24-hour noise monitoring in this section of the South/I-44 sub-area. The long-term ambient noise monitoring was conducted on Thursday and Friday, December 10 and 11, 1998.

Table 3.4-8
Peak-Hour Short-Term (15 Minutes) Property Line Ambient Noise Measurements

10' from Property Line Nearest LRT Alignment	Time	Duration min:sec	Leq dBA	Lmin dBA	Lmax dBA
1143 Terrace	08:03	15:00	59.1	52.9	77.0
School: 1107 E. Linden	08:04	15:00	57.7	53.7	70.8
2851 Laclede Station	08:45	15:00	54.5	49.3	64.3
Sussex/Manhattan	08:53	15:00	64.0	56.8	74.2

Table 3.4-9
Off-Peak-Hour Short-Term (15 Minutes) Property Line Ambient Noise Measurements

10' from Property Line Nearest LRT Alignment	Start Time	Duration min:sec	Leq dBA	Lmin dBA	Lmax dBA
7210 Lansdowne	10:15	15:00	67.0	50.1	80.4
4301 St. Vincent	10:16	15:00	54.4	48.1	64.3
Sussex/Manhattan	10:46	15:00	59.2	53.4	75.7
2851 Laclede Station	10:48	15:00	49.1	44.8	58.3
School: 1107 E. Linden	11:27	15:00	55.7	51.4	63.2
1143 Terrace	11:29	15:00	54.4	49.6	62.7

Table 3.4-10
Long-Term (24-Hour) Property Line Ambient Noise Measurements

Location	Max Leq (h)	Min Leq (h)	Leq (pk hr)	Leq (24 hr)	Ldn
1224 Buck	62.0	47.8	56.7	55.0	64.0
2851 Laclede Station	54.3	46.2	54.3	50.9	59.9
7204 Sussex	56.1	50.5	55.3	53.4	63.0
7210 Lansdowne	68.7	59.3	68.7	65.0	73.4

The ambient noise measurements shows decibel (dBA) values typical of the type of land-uses in the corridor. For example, in the Forest Park/University City sub-area where most of the land-uses are either residential or institutional with auto traffic along Forest Park Parkway/Millbrook Boulevard, ambient noise was 65 to 66 dBA for the peak hour. For downtown Clayton which contains mostly commercial land uses, ambient noise was over 69 dBA for the 24-hour duration, with values up to 73 dBA in the peak hour. The Laclede Station Road receptor site, in the Galleria South to I-44 sub-area, resulted in the lowest noise measurement with about 55 dBA for the peak hour.

Existing MetroLink Passby Noise Measurements

To quantify the existing noise of current MetroLink operations, a controlled area was sought which could provide a clear view of oncoming and outgoing trains. Bethany Cemetery provided an appropriate location since ambient noise was low. The cemetery ground sloped downward toward the south and the existing MetroLink line. The MetroLink alignment location is suitably shielded and far removed from roadway traffic. Distant aircraft and freeway sounds are barely audible from this location. The alignment consists of a double set of tracks. Two sound level monitors were set up, one at 50 feet (15 meters) north of the centerline of the two tracks and the other at 100 feet (30 meters) distance. Measurements were taken on November 11, 1998, and were conducted from the monitoring site and ended when the train was at a similar distance past the monitors. Table 3.4-11 presents the MetroLink passby noise measurement results for the 50-foot (15-meter) location. Table 3.4-12 presents the measured data for the 100-foot (30-meter) distance. On April 28, 1999, controlled speed MetroLink passby noise measurements were conducted at the same location. Table 3.4-13 presents the controlled speed MetroLink passby noise measurement results for the 50-foot (15-meter) location, while Table 3.4-14 presents the measured data for the 100-foot (30-meter) distance. For purposes of comparison, the published Federal Transit Authority (FTA) 50-foot (50 mph, welded track with ballast) source reference SEL for the passby of a light rail or rapid transit passby is an SEL of 82 dBA which is consistent with the SEL of MetroLink. Existing MetroLink Leq levels at various speed are also consistent with typical light rail transit systems around the country. In addition, the existing MetroLink system, generally without mitigation measures incorporated into the design, may not be representative of the Cross-County MetroLink Extension.

Table 3.4-11
Existing LRT Passby 50-Foot Noise Measurements - Nov 11 1998

Location - Event 50' LRT Passby	Start Time	Passby Seconds	Speed[1] MPH	Leq dBA	Lmin dBA	Lmax dBA	SEL[2] dBA
Far tracks EB	15:36	2.9	42.5	70.1	47.3	78.0	83.5
Near tracks WB	15:37	3.0	40.0	70.8	51.2	77.3	82.6
Far tracks EB	15:45	2.5	48.5	70.9	49.3	79.6	84.5
Near tracks WB	15:47	3.5	35.0	68.5	49.7	76.0	81.1
Site Ambient	15:48	n/a	n/a	46.5	43.5	50.5	n/a

1 Estimated speed based on 178-foot train length and measured passby time.

2 SEL = sound exposure level. SEL is FTA's noise metric for transit noise assessment and it is a means of expressing the cumulative noise exposure from a single event (passby)

Table 3.4-12
Existing LRT Passby 100-Foot Noise Measurements - Nov 11 1998

Location - Event	Start	Passby	Speed *	Leq	Lmin	Lmax	SEL
100' LRT Passby	Time	Seconds	MPH	dBA	dBA	dBA	dBA
Far tracks EB	15:36	2.9	42.5	66.9	48.9	73.8	80.3
Near tracks WB	15:37	3.0	40.0	67.7	50.0	73.3	79.5
Far tracks EB	15:45	2.5	48.5	66.8	50.0	74.7	80.4
Near tracks WB	15:47	3.5	35.0	65.0	50.1	71.2	77.6
Site Ambient	15:48	n/a	n/a	46.7	44.4	52.4	n/a

* Estimated speed based on 178-foot train length and measured passby time.

Table 3.4-13
Controlled Speed Existing LRT Passby 50-Foot Noise Measurements - April 28 1999

Location - Event	Start	Duration	Leq	Lmin	Lmax	SEL
50-Foot LRT Passby	Time	min:sec	dBA	dBA	dBA	dBA
55 MPH-Far tracks EB	10:28	00:11	73.3	59.6	78.7	83.5
55 MPH-Near tracks WB*	10:28	00:11	78.8	53.2	84.5	89.0
45 MPH-Near tracks WB	10:37	00:12	74.6	56.4	80.2	85.1
45 MPH-Far tracks EB	10:38	00:15	70.3	50.1	76.8	82.1
35 MPH-Far tracks EB	10:47	00:19	67.6	48.5	73.4	80.4
35 MPH-Near tracks WB	10:50	00:19	68.6	50.5	75.1	81.4
25 MPH-Far tracks EB	10:57	00:26	67.6	47.7	74.7	81.7
25 MPH-Near tracks WB	10:58	00:24	64.0	48.3	69.8	77.8
Site Ambient	10:59	05:02	49.1	45.0	59.9	n/a

* Includes train's bell.

Table 3.4-14
Controlled Speed Existing LRT Passby 100-Foot Noise Measurements - April 28 1999

Location - Event	Start	Duration	Leq	Lmin	Lmax	SEL
100-Foot LRT Passby	Time	min:sec	dBA	dBA	dBA	dBA
55 MPH-Far tracks EB	10:28	00:11	69.4	56.6	74.2	79.6
55 MPH-Near tracks WB*	10:28	00:11	74.3	53.5	79.0	84.5
45 MPH-Near tracks WB	10:37	00:11	70.2	57.2	74.2	80.7
45 MPH-Far tracks EB	10:38	00:15	67.4	50.6	73.4	79.3
35 MPH-Far tracks EB	10:47	00:19	64.7	49.6	69.8	77.5
35 MPH-Near tracks WB	10:50	00:19	65.0	49.4	70.9	77.8
25 MPH-Far tracks EB	10:57	00:26	61.9	49.1	67.4	75.9
25 MPH-Near tracks WB	10:58	00:24	61.1	49.1	65.8	74.9
Site Ambient	11:00	04:18	50.2	45.0	61.1	n/a

* Includes train's bell.

Existing MetroLink Station Noise Measurements

Existing MetroLink operations noise at the UMSL North Station were also monitored on November11 1998. 50-foot (15-meter) and 100-foot (30-meter) monitoring sites were established on the grassy parcel to the north of the station. Monitoring commenced when the arriving train became audible and ceased when the departing train became inaudible. Due to the proximity of the airport, monitoring was sometimes cut short when approaching aircraft noise became noticeable. Table 3.4-15 gives the results of the 50-foot (15-meter) LRT station monitoring, while Table 3.4-16 gives the results for the 100-foot (30-meter) monitoring site.

Table 3.4-15
Existing LRT Station 50-Foot Noise Measurements - Nov 11 1998

Location - Event		Duration	Leq	Lmin	Lmax
50-Foot LRT Arv/Dep	Time	min:sec	dBA	dBA	dBA
UMSL No.Sta.- 1 Train	16:51	00:48	56.2	49.0	60.4
UMSL No.Sta.- 1 Train	16:53	00:52	67.3	49.5	71.6
UMSL No.Sta.- 1 Train	16:59	00:47	57.6	53.7	61.5
UMSL No.Sta.- 1 Train	17:01	00:45	67.7	49.6	70.8
No. Station. - 2 Trains	17:07	00:42	66.0	55.0	69.9
North Station Ambient	17:12	00:30	52.2	50.2	56.2

Table 3.4-16
Existing LRT Station 100-Foot Noise Measurements - Nov 11 1998

Location - Event		Duration	Leq	Lmin	Lmax
100-Foot LRT Arv/Dep	Time	min:sec	dBA	dBA	dBA
UMSL No.Sta.- 1 Train	16:51	00:48	54.1	49.6	61.3
UMSL No.Sta.- 1 Train	16:53	00:52	61.0	51.1	64.8
UMSL No.Sta.- 1 Train	16:59	00:47	55.6	52.3	59.4
UMSL No.Sta.- 1 Train	17:01	00:45	62.2	52.0	65.1
No. Station. - 2 Trains	17:07	00:42	62.3	54.8	66.8
North Station Ambient	17:12	00:30	52.3	50.6	54.8

3.4.4 Electromagnetic Fields in the Environment

Static Magnetic and Electric Fields

The term, electromagnetic field, refers to a combination of electric and magnetic fields. Static electric and magnetic fields have frequencies at or close to zero hertz (Hz). These fields occur naturally in our everyday environment. The intensity of the atmospheric static electric field is about 130 V/m and is highly variable, changing with regional weather conditions, e.g., passing storm clouds. The flow of currents deep in the earth produces a static magnetic field that causes a compass needle to align in a north-south direction. At mid-latitudes in the northern hemisphere the flux density of the static magnetic field is ~500 milligauss (mG). The measured intensity is quite stable at any particular location with a daily variation of about 0.3 milligauss but varies considerably with latitude, e.g., 240-670 mG. Proximity to, or the movement of ferromagnetic objects also may perturb ambient magnetic fields.

Time-Varying Electric and Magnetic Fields

Riders and operators of MetroLink vehicles may also encounter time-varying electric and magnetic fields from sources unrelated to the MetroLink system. The major sources of exposure to time-varying electric and magnetic fields in the extreme-low-frequency (ELF) range between three and 3000 Hz in the existing environment are electric transmission lines and distribution lines. The levels commonly encountered around these and other sources in the environment are shown in Figure 3.4-5. With regard to time-varying electric and magnetic fields, it has been assumed that exposure to these fields in conjunction with MetroLink would be similar to those encountered walking or riding in a bus or car. The average and maximum magnetic fields measured during transportation by various means are shown in Table 3.4.4-1. Based on the levels measured in various transportation systems by Dietrich and Jacobs (1995) about 4% of the US population spends a half hour each day in ELF magnetic fields greater than 16 milligauss.

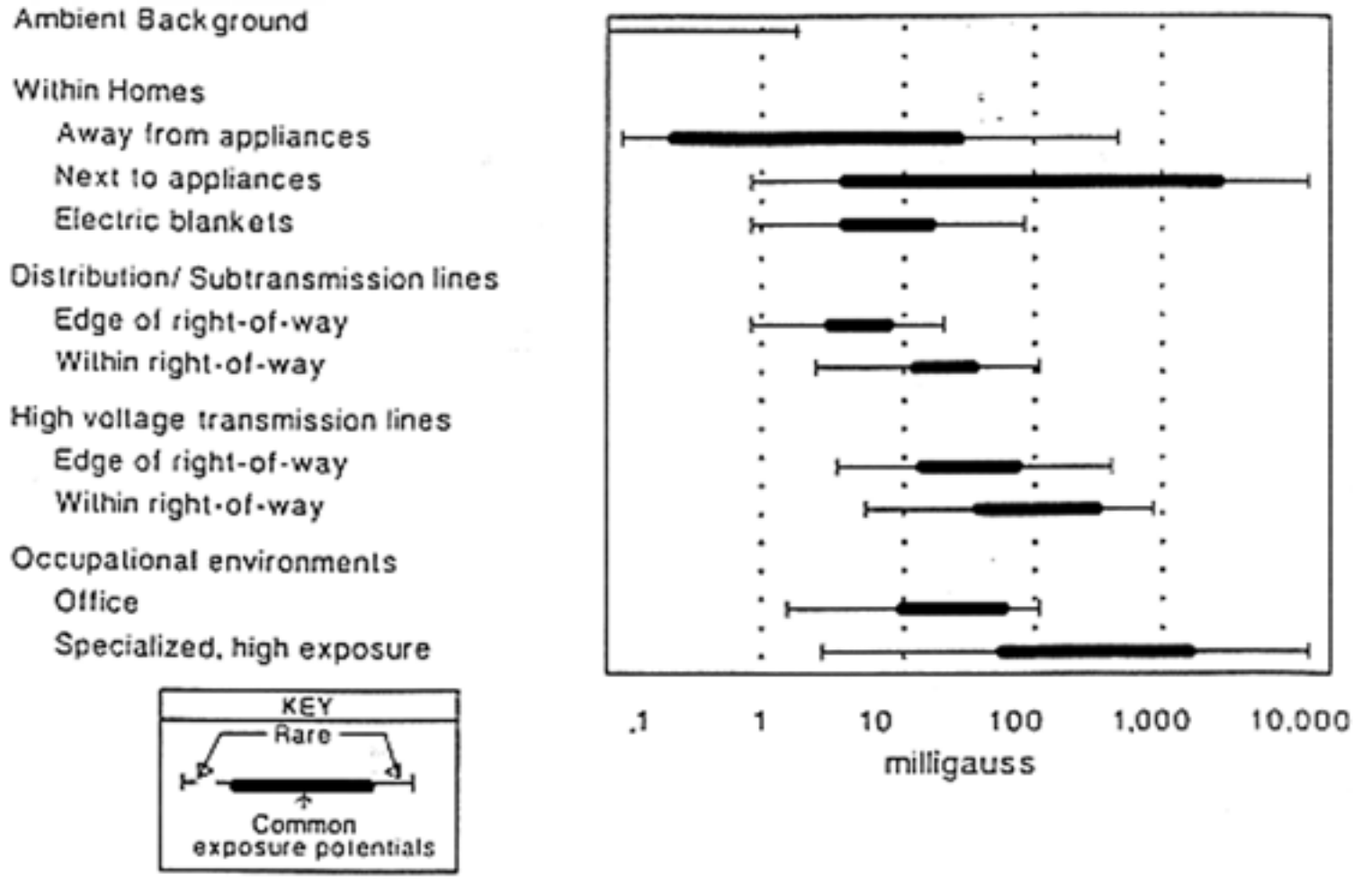
Table 3.4.4-1
AVERAGE AND MAXIMUM MAGNETIC FIELDS (5-3000 HZ) IN SELECTED TRANSPORTATION SYSTEMS

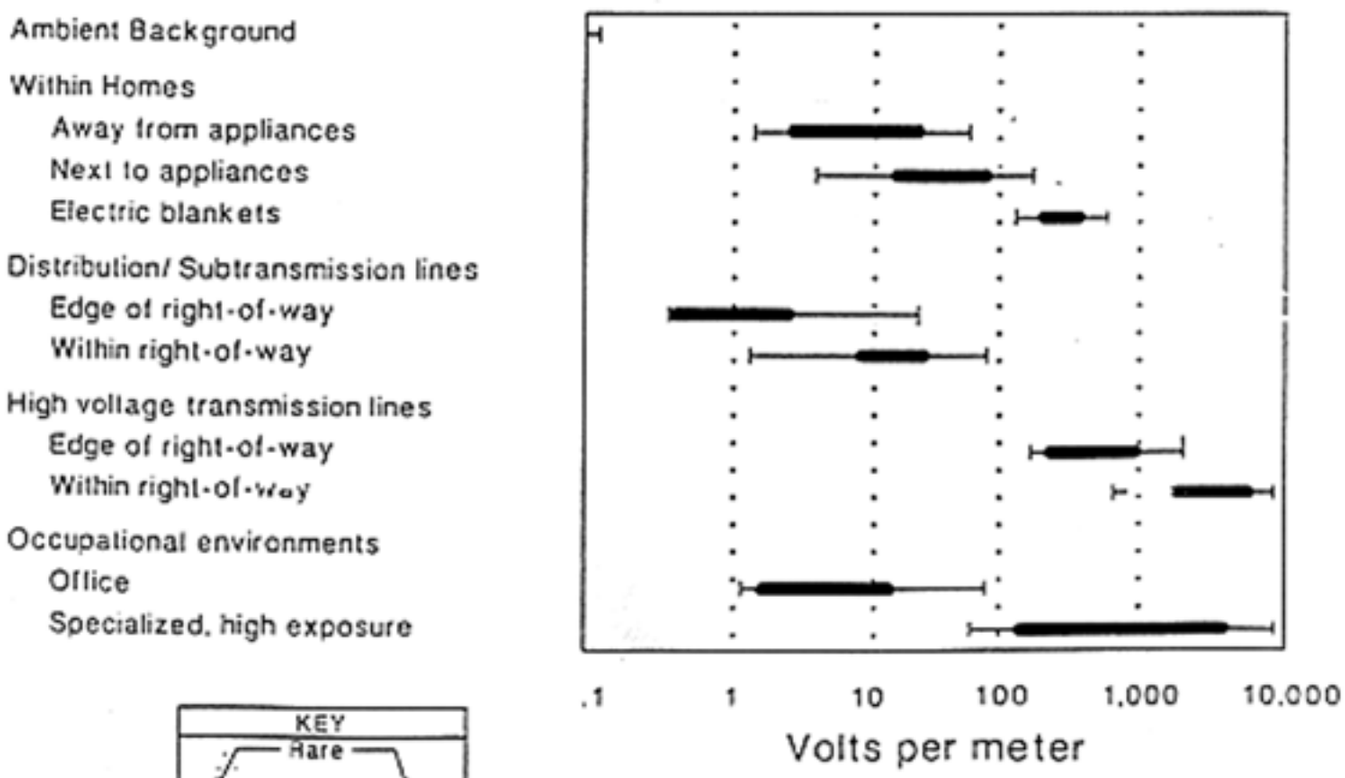
Transportation Mode	Average (Maximum)
Car and Light Trucks	5.7 (124.5)
Jetliner	13.6 (212.5)
Shuttle tram (electric)	13.7 90.4)
Conventional bus	16.8 (146)
Electric shuttle bus	20.4 (487.8)

Source: Dietrich and Jacobs, 1999

Figure 3.4-5

Range of Sixty-hertz Magnetic and Electrical Field Levels in the Environment





A specific source of ELF magnetic and electric fields to be considered in this project is a utility transmission line. Just east of I-70 and south of Forest Park Parkway, the MetroLink extension shifts onto the CMT, a former railroad right-of-way now shared with the Ameren Marshall-Hunter 138-kV transmission line and a variety of 4-kV and 34-kV distribution circuits. The MetroLink extension will leave this right-of-way at Deer Creek just north of I-44. The magnitude of the fields that would be encountered at platforms and in the vehicles was estimated by modeling.

Bailey Research Associates, Inc. modeled the expected electric and magnetic field levels for a representative section of the CMT right-of-way. The configuration of the right-of-way at this location is illustrated in Figure 3.4-6. The portion of the right-of-way to be occupied by the proposed MetroLink extension at this location is shown in this figure. The model used to calculate electric and magnetic fields was developed by the U.S. Department of Energy, Bonneville Power Administration, and has been validated and used by engineers and scientists for many years. The inputs to the model are line voltage, line current, and the physical dimensions of the line (conductor spacing and height). The field values are calculated at a reference height of 1 meter above ground. The configuration of the transmission lines and estimated currents were provided by Ameren. For modeling purposes normal circuit loading and equal currents in each phase (a balanced load) were assumed. The maximum voltage of each circuit was 5 percent above nominal values.

The profiles of 60-Hz electric and magnetic fields calculated across the right-of-way are shown in Figure 3.4-7. In the section of right-of-way allocated for the MetroLink extension the projected electric field varies between 100 and 400 V/m. Riders on trains would be totally shielded from the electric field by the metal body of the vehicle. The projected magnetic field varies between 26 mG and 40 mG and would be expected to be slightly attenuated by the vehicle.

Disturbances in the functions of electronic devices by electromagnetic fields are well known. Most cases of such interference can be traced to sources that produce electromagnetic fields and currents at the power frequency or radio-frequencies (500 MHZ - 1500 MHZ). The MetroLink system and its vehicles are designed and tested for compliance with transportation guidelines to prevent interference by power (60 Hz), audio (3000 - 5000 Hz) and higher frequency (800-900 MHZ) electromagnetic fields to MetroLink signal and communication circuitry or other sensitive devices in the vicinity of the rail line. Meeting these design criteria will preclude interference with other devices and so electromagnetic fields at these frequencies are not considered here.

Only rarely are electrical devices reported to be affected by changes in static magnetic fields at levels found in the ambient environment. One such device is the nuclear magnetic resonance (NMR) spectrometer. Such instruments are used for research by chemists at Washington University, whose laboratories are housed in buildings just south of the Cross-County MetroLink Extension along Millbrook Boulevard. Consequently, the potential of the proposed MetroLink Extension to affect the performance of NMR spectrometers and associated research requires evaluation.

Over the past 100 years there has been considerable interest in the potential beneficial and adverse effects of ELF electric and magnetic fields from facilities that generate and distribute electricity for use in the community, workplace and surrounding environment. Electric rail systems are one source of ELF fields. They are also a source of static fields.

Figure 3.4-6

Representative Cross-Section of the CMT Marshall-Hunter 138 kV Transmission Line

Right-of-way showing a typical structure and region allocated for the MetroLink Extension at this location

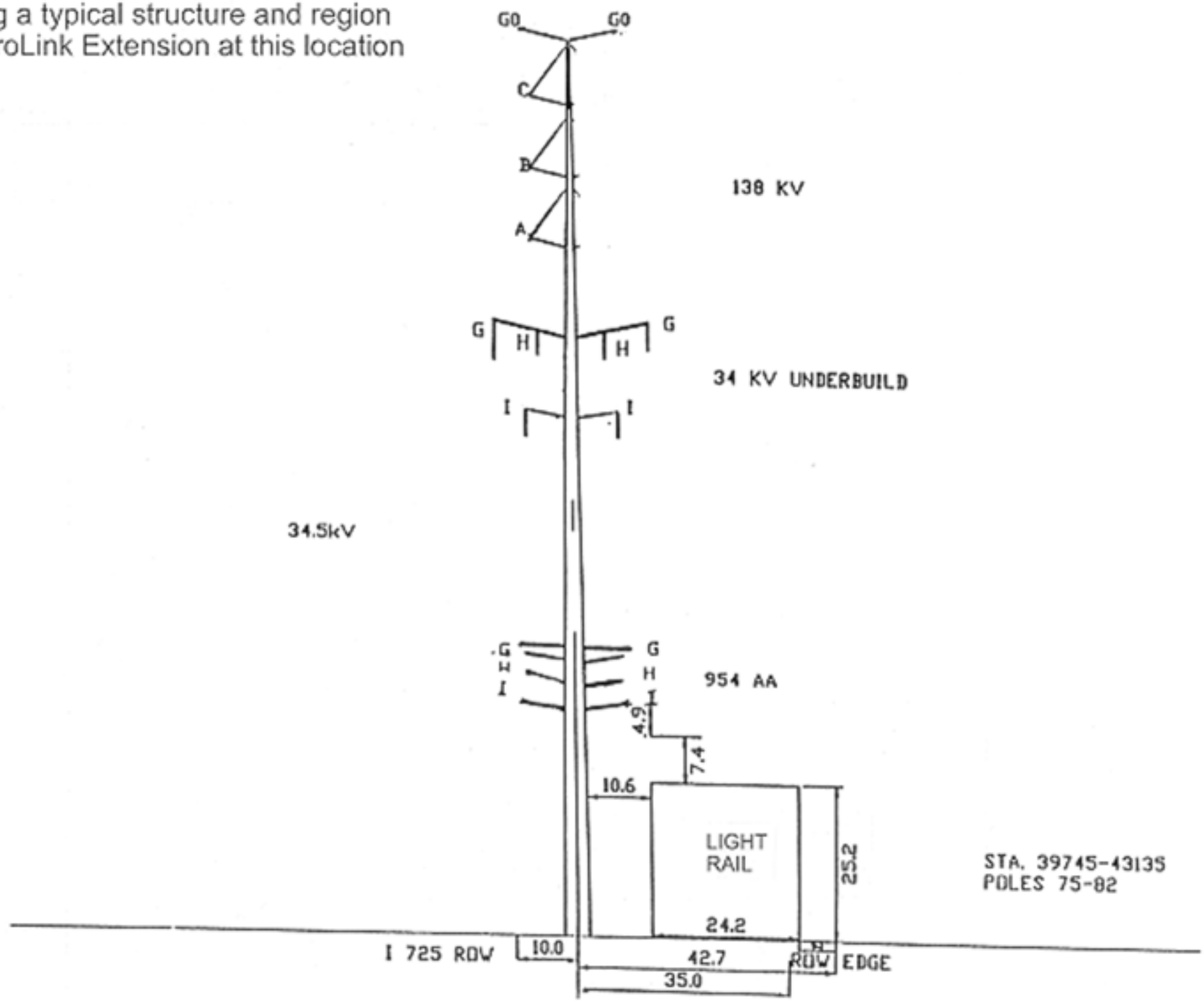
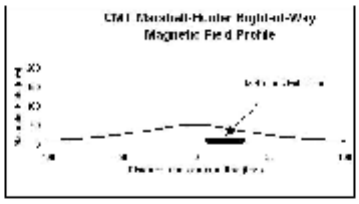
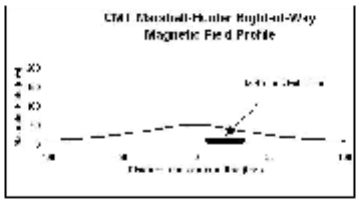


Figure 3.4-7
Downtown Clayton Ambient Vibrations





3.4.5 Air Quality

The EPA has established National Ambient Air Quality Standards (NAAQS) to protect the public from air pollution. The criteria pollutants included in the NAAQS are carbon monoxide (CO), ozone (O_3), nitrogen oxides (NO_X), sulfur dioxide (SO_2), particulate matter less than 10 microns (PM_{10}), and lead (Pb). Table 3.4-24 shows the NAAQS for the criteria pollutants. The table also includes volatile organic compounds (VOC), also called hydrocarbons (HC), and nitrogen oxides (NO_X), both of which are precursors to ozone.

TABLE 3.4-24
NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant		Standard			Allowed Excedances
		ppm	µg/m³	Period	
0_3*		0.08	—	3-year average of fourth-highest 8-hour readings from each year cannot exceed standard	
VOC (0_3 precursor)		—	—	—	—
NO_x (0_3 precursor)		—	—	—	—
CO		9 35	10,000 40,000	8-hour 1-hour	1/year 1/year
Particulates*	PM_{10}	—	50	Average of 3 yearly averages (each composed of averages of quarterly averages of 24-hour readings) must be below standard	
		—	150	Average of 3 yearly 99th percentile (24-hour) readings must meet standard	
	$PM_{2.5}$	—	15	Average of 3 yearly spatial averages must be below standard; each yearly spatial average is average yearly reading of all monitored locations, composed of averages of quarterly averages of 24-hour readings	
			65	Average of 3 yearly 98th percentile (24-hour) readings must meet standard	
NO_X		0.05	100	Annual average	Mean
SO_2		0.03 0.14 —	80 365 (1,300)	Annual average 24-hour 3-hour	Mean 1/year 1/year
Lead (Pb)		—	1.5	3-month	Mean

*** These standards were recent updates by the U.S. EPA in 1997. The EPA is still in the process of implementing this change nationwide.**

3.4.5.1 Attainment Status

The EPA has designated non-attainment areas for several pollutants in the region. These non-attainment areas are locations where the NAAQS are exceeded for a particular pollutant. The Missouri Department of Natural Resources has prepared a State Implementation Plan (SIP) for each of these areas to identify strategies for reducing pollutant levels to meet the standards.

The St. Louis area is designated as a "moderate" non-attainment area for ozone. "Moderate" means that the area has a design value of 0.138 up to 0.160 ppm. Since the standards were changed in 1997, EPA is reevaluating ozone attainment status for all areas in the United States, and the revised status is scheduled to be determined in the year 2000. The Sierra Club has filed a lawsuit with the EPA to downgrade the area's ozone attainment status from "moderate" to "serious," with attendant retroactive sanctions from November 1996. Action on this lawsuit is still pending.

The only non-attainment areas for particulates in the region are some townships in Illinois. St. Louis County is considered to be in attainment for PM_{10}. Since the standards were changed in 1997, EPA is reevaluating PM_{10} and $PM_{2.5}$ attainment status for all areas in the United States, and the revised status is scheduled to be determined in the year 2000.

In March 1999, a portion of the St. Louis area was redesignated as an attainment area for carbon monoxide, as CO standards have not been violated for the last 10 years. The former non-attainment area was defined as the area bounded by I-270 and the Mississippi River. The Missouri Department of Natural Resources applied for redesignation of this area to attainment status. The area is now classified as a "maintenance" area, and a maintenance plan will direct policies in the region to ensure that the attainment is maintained.

Regional air conformity analyses performed for the Long-Range Transportation Plan for the St. Louis area have included the Cross-County MetroLink Extension as part of the plan. This conforming Long-Range Transportation Plan is part of a conforming SIP.

3.4.5.2 Existing Air Monitoring

Monitoring data from the vicinity of the study area is available from a carbon monoxide monitor located at 55 Hunter Avenue in Clayton. This location is near the center of the Cross-County corridor. The monitor is operated by the St. Louis County Air Pollution Program, and data from this monitor is maintained by the Missouri Department of Natural Resources and the U.S. EPA Aerometric Information Retrieval System (AIRS) data system. Table 3.4-25 shows the data from the most recent year.

Table 3.4-25
1998 MONITORED CO LEVELS, CLAYTON AIR MONITOR
in parts per million (ppm)

One-Hour Period		Eight-Hour Period	
Highest	Second Highest	Highest	Second Highest
4.8	4.2	3.5	3.4

These data illustrate that all existing CO levels measured at this monitor in 1998 were well below the federal NAAQS standards of 35 ppm for a one-hour period and 9 ppm for an eight-hour period.

3.4.6 Cultural Resources

3.4.6.1 Historic Properties and Impact Area

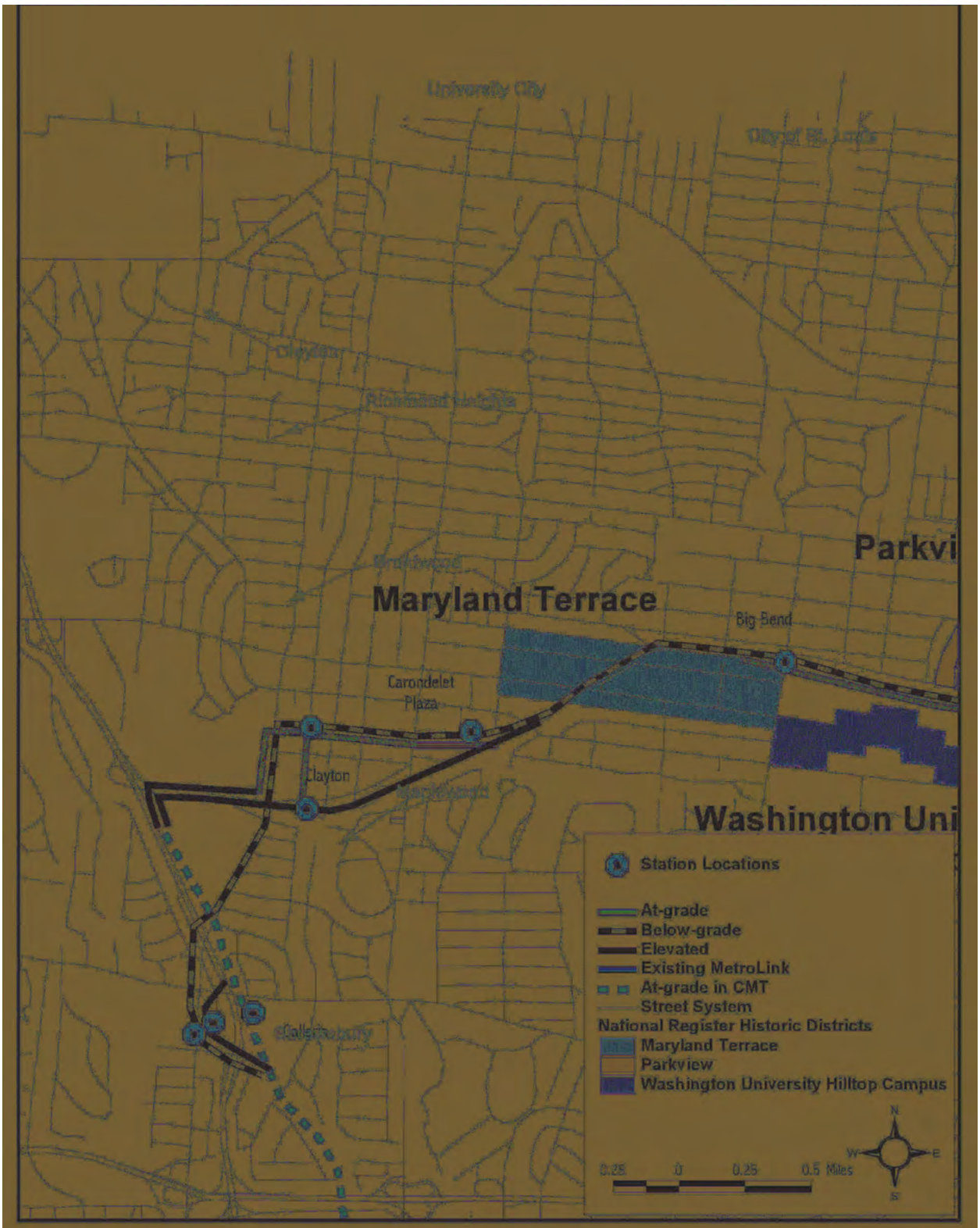
Historic structures, neighborhoods and districts that lie partially or wholly within 100 feet or one block of the various proposed horizontal alignments of the Cross-County MetroLink Extension Segment I are considered in the Impact Area. The historic properties listed below lie within or near the Impact Area, and are described in the following sections.

The following properties are listed in approximate order from east to west, along the general proposedMetroLink extension alignment (Figure 3.4-8). In the discussion for each area, the level of historic designation is noted.

- Skinker/DeBaliviere/Catlin Tract Historic District
- Parkview Neighborhood Historic District
- Washington University Hilltop Campus Historic District
- Maryland Terrace Neighborhood Historic District
- Shanley Building *(outside impact area, but in downtown Clayton)*

Skinker/DeBaliviere/Catlin Tract Historic District
St. Louis City Historic District, 1978

This large and diverse historic district, within the Kingsbury neighborhood of the City of St. Louis, includes several smaller subdistricts including part of the Parkview neighborhood, which lies in the City. (For a description of Parkview, see the next section.) Building upon the major infrastructure improvements made for the nearby Louisiana Purchase Exposition of 1904, Washington Heights was platted in 1907 and the Catlin Tract in 1909. Eventually 850 historic structures were built, most in the period 1907 to 1916.



Cross-County MetroLink Extension Segment I: National Register Historic Districts Figure 3.4-8

Unlike the Parkview and Maryland Terrace historic districts, this multi-faceted district is made up of apartments, middle class homes, large mansions, as in the Catlin Tract, and includes businesses, schools, and churches. The larger homes were built by renowned architectural firms, but for the most part, the structures were designed by contractors. Of particular note is builder Alexander A. Fischer, who is responsible for 75 of the buildings within this district. Because of the wide range of building types and builders, architectural styles vary greatly and include classic and Tudor revival, Arts and Crafts and Bungaloid. Uniformity was provided by strict deed restrictions, which defined the range of allowable materials, size, height and setback requirements.

The Catlin Tract is of particular note within this district, because it is adjacent to the southern edge of the proposed MetroLink alignment. This tract, a part of the larger property holdings, subdivided after the death of James Kingsbury, contains the largest single family lots in any of the historic districts along the MetroLink extension. Most of the western portion of this tract was leased for use by the World's Fair operators as the "Pike" amusement area. After the Fair, with the extension of Lindell Boulevard west to Skinker Boulevard, and with the improved Forest Park as their front yard, homes in this tract became some of the grandest residences in the City.

Parkview Neighborhood Historic District
National Register of Historic Places, 1986
University City Historic District, 1992
St. Louis City Historic District, 1978

Lying one-third in the City of St. Louis and two-thirds in University City, Parkview is at once architecturally both a city neighborhood and a suburban one. It has this dual nature both literally and figuratively. Parkview's entrance looks eastward to the City and continues the names of the city streets immediately to the east, but in its curved street pattern, which circles back on itself, it essentially ends the city and anticipates the suburbs.

Parkview is the largest and last planned private subdivision of noted surveyor Major Julius Pitzman. Pitzman (1837-1923) laid out several grand private residential places in St. Louis before Parkview. He is responsible, among others, for: Benton Place (1867), Compton Heights (1884), Westmoreland/Portland Place (1888), Lewis Place (1894) and is one of the group who laid out Forest Park (1876).

Parkview neighborhood planning started in 1903, grading began in 1904, and streets were platted in 1905. Of the eventual 255 homes, 85% were built between 1906 and 1914. For a while, this neighborhood, unlike any other private one, even had a central heating plant. The homes were designed by both St. Louis and national architectural firms in Tudor Revival, Colonial Revival and Craftsman styles. The Craftsman style is seen in Parkview more than in any of the other private neighborhoods. Because of this less-formal architectural style and also due to its narrower lot layout, the smaller setbacks, the overall picturesque street layout, with its concentric horseshoe, Parkview is a softer, less formal and more modern neighborhood than most other private places in the City.

Parkview's original southern boundary was the same railroad right-of-way that formed the northern boundary of adjacent Washington University. This right-of way became Millbrook Boulevard in 1941 and shared space with streetcars until the early 1960s. It is in this now all-automobile right-of way that the proposed MetroLink extension is to pass through.

Washington University Hilltop Campus Historic District
National Historic Landmark, 1987
National Register of Historic Places, 1979

One of only two properties in St. Louis County considered to be National Historic Landmarks, the highest landmark designation in the nation, the 146-year-old University moved to its current main campus location following the 1904 Louisiana Purchase Exposition and the Third Olympic Games of the modern period. Several buildings and facilities were built for the World's Fair and Games as permanent structures, to be given over to the University after these major events had ended.

The Hilltop Campus Historic District generally includes the central core of buildings extending west from Brookings Hall to Francis Field and Gym. Critical to National Register acceptance is their uniformity of design in the Collegiate Gothic Style in typical materials of limestone trim, pink granite walls and clay tile /copper roofs. Noteworthy, not only for their own individual rich gothic architectural detail, the campus buildings together form an ensemble, which adheres today, to the original Cope and Stewardson campus plan of 1899. Generally, the newer buildings, which are closer to the campus perimeter streets of Forsyth and Millbrook, are not part of this historic district. These newer buildings, for the most part, still share common building materials and create courtyard space in the same manner as do the older historic structures.

The following existing historic University buildings were built for World's Fair or Olympic Games use. They were all built in the period 1900-1902 and are listed in order of construction: Busch Hall, Brookings Hall, Cupples I, Cupples II, Liggett Hall (now Prince Hall), Ridgley Hall, the Power Plant, Lee Hall (now Umrath Hall), Francis Field and Gymnasium, Eads Hall.

The entire northern boundary of the Hilltop Campus District is Millbrook Boulevard, a former railroad right-of way for several railroad companies and the former streetcar company. The proposed MetroLink extension runs in this boulevard.

Maryland Terrace Neighborhood Historic District
National Register of Historic Places, 1997

Maryland Terrace was assembled from various properties and platted in 1911-12 by developer Everett Davis. The neighborhood was designed with extremely wide streets, deep setbacks and large lot sizes. Some lots were even doubled in size as homes were built, further adding to their grandeur. The first homes were built in 1913 and most construction was completed in the late 1920s. Maryland Terrace's plan is rectilinear, the site is generally flat and the layout is so expansive that long monumental views are possible, unlike the nearby Parkview with its more intimate concentric horseshoe plan.

As was typical of the other grand places, various prominent St. Louis architects designed the 205 houses. Enduring materials consisting of stone, brick, stucco, slate and clay tile were used to create mansions, predominately in the Tudor Revival, Colonial Revival and Italian Renaissance styles.

Maryland Terrace is bounded on the north by the proposed MetroLink extension alignment and then is diagonally bisected by this alignment at the neighborhood's middle, just as the railroad right-of way did when this neighborhood was originally laid out. The existence of the railroad pre-dates the neighborhood and was considered an asset. The developers marketed the Maryland Terrace homes based upon their proximity to trains traveling to downtown. To ease access to this rail transportation, which ran along the northern boundary of the neighborhood, walkways running north/south were originally provided.

Shanley Building
National Register of Historic Places, 1982

Although this building is outside of the Impact Area for the proposed MetroLink extension, as it runs through downtown Clayton, earlier possible alignments did pass close by this structure. Designed in 1935 by Harris Armstrong, this is the first example of the International Style in this part of the country. Moreover, this building exemplifies a typical total-design approach by its architect. Armstrong designed more than the building, which was to be used as an orthodontist office. He also designed the then-innovative double glazing system, the furniture, lighting, lamps and hardware.

3.4.6.2 Archaeological Resources

The Missouri Department of Natural Resources (MDNR) Historic Preservation Program in Jefferson City, Missouri and the Archaeological Survey of Missouri (ASM) in Columbia, Missouri were visited and records researched to determine if there were any known archaeological resources present within the Cross-County MetroLink Extension Segment I right-of-way for the proposed alternative alignment. No known archaeological resources were noted within the Cross-County MetroLink Extension Segment I proposed right-of-way.

Information from Cultural Resource Management reports and other sources indicated that archaeological resources may be present adjacent to the proposed right-of-way. Following are brief descriptions of potential archeological resources near the proposed Cross-County MetroLink Extension Segment I right-of-way.

- ***Forest Park:*** **Prior to the 1904 World's Fair, Forest Park contained a mound complex constructed by native Americans which was likely a satellite community of Cahokia Mounds. The mounds were bulldozed in preparation for the World's Fair. Forest Park also contains dumps from the World's Fair.**
- ***Historic Railroad Rights-of-Way:*** **The proposed Cross-County MetroLink Extension Segment 1 right-of-way south of Clayton to Interstate 44 runs mostly along the historic Terminal Railroad Association (TRRA) line. Just north of Interstate 44 the TRRA connected to the Saint Louis-San Francisco Railroad (now the Burlington Northern & Santa Fe). The Saint Louis-San Francisco Railroad was present in 1875 and is the second oldest line in Missouri. Artifacts could be present under the existing berms.**

3.4.7 Hazardous Materials

The proposed Cross-County MetroLink Extension Segment I right-of-way occurs in a developed urban setting, with commercial and industrial development prevalent throughout the western and southern portions of the proposed alignments. To assess the potential for hazardous materials and other regulated materials within or near the alignment corridor, environmental databases were searched and field work was conducted.

An initial environmental database search was conducted in October 1998 for an area one mile on each side of the Cross-County MetroLink alignment. Later a more detailed review was accomplished in an area 660 feet on each side. The data was from available federal and state records on environmental sites noted within the study area. The purpose of the database search was to identify locations that could present a problem during construction or operation of the MetroLink extension.

The databases searched indicated that within 660 feet of the MetroLink extension alignment the following occurred:

- **There were no National Priority List or Superfund sites;**
- **Eight locations were on the Comprehensive Environmental Response Compensation's Liability Information System (CERCLIS) database, of which six (6) of the sites were considered No Further Remedial Action Planned (NFRAP), one (1) was deferred to the Resource Conservation and Recovery Act (RCRA) subtitle C, and one (1) location was considered to have "low CERCLIS site status."**
- **Twenty locations had Leaking Underground Storage Tanks (LUSTs) excavated and four (4) LUST locations had clean-ups other than excavation.**
- **Eight locations had Underground Storage Tanks (USTs) closed in place, 25 locations had USTs removed, 13 locations had USTs currently in use.**
- **Thirty locations were considered to be small quantity generators, 8 locations were considered to be large quantity generators, one (1) location was listed as a Treatment Storage Disposal (TSD) facility, and 8 locations had non-specified amounts of hazardous waste regulated by RCRA.**
- **Three of the Small Quantity Generators (SQGs) and two of the Large Quantity Generators (LQGs) had Compliance Evaluation Inspection (CEI) violations.**
- **Seventeen locations had air permits and three locations had water discharge permits.**
- **Four locations had civil judicial enforcement cases.**

- **Nine locations had substances regulated by Federal Insecticide Fungicide Rodenticide Act/Toxic Substance Control Act (FIFRA/TSCA).**

- **Three locations had an emergency spill response and two locations have/had chemical releases regulated by Superfund Authorization and Reauthorization Act (SARA).**

- **Two locations use/possess radioactive materials.**

A further refinement of the corridor to a distance within approximately 100 feet on each side of the proposed alignments centerline noted only one property listed on the regulatory databases. Field surveys for displaced properties noted several other properties of concern not included on the regulatory databases. The majority of the activities on the properties in question included waste generation regulated by Resource Conservation and Recovery Act and petroleum storage. None of the sites were included on the National Priority List, or were considered to be a State Hazardous Waste Site.

3.5 Financial Resources/Existing MetroLink

The financial resources of the existing MetroLink system is detailed in the Financial Analysis Draft Technical Report. The financial capacity analysis for the Cross-County MetroLink Extension, Segment I, Conceptual Design Study, is summarized in Section 5.5 Costs and Financial Capacity of this report and described in detail in the Financial Analysis Draft Technical Report.

3.6 MetroLink

The existing MetroLink line is 17 miles long and runs from East St. Louis, Illinois, to downtown St. Louis to the main terminal building at Lambert-St. Louis International Airport. MetroLink has been serving the St. Louis region since 1993, with 31 bi-directional, articulated, light rail vehicles currently in service (26 light rail vehicles are operated during peak service hours). Nineteen light rail transit stations, including the terminal station at the Lambert-St. Louis International Airport, are part of the existing MetroLink line. The MetroLink stations include airport main terminal, Airport East, North Hanley, University of Missouri (UM)-St. Louis north and south, St. Charles Rock Road, Wellston, Delmar, Forest Park, Central West End, Grand Avenue, Union Station, Kiel Center, Busch Stadium, 8th and Pine, Convention Center, Laclede's Landing, East Riverfront (Illinois) and 5th and Missouri (Illinois). Park-n-ride facilities are located at the Illinois stations, Forest Park, Delmar, Wellston, Rock Road, the two University of Missouri stations, and North Hanley.

3.6.1 Cross-County Corridor and Future Extensions

Previous planning studies, which included a transportation system analysis and a Major Transportation Investment Analysis (MTIA), identified the MetroLink extensions in the Cross-County corridor. The Cross-County Segment I corridor is 7.8 miles long from DeBaliviere to

Lansdowne. It is largely developed and traverses heterogeneous land uses that range from residential to institutional to commercial to industrial. These activities include land uses significant in terms of their history, density or level of activity, and regional economic impact.

Segment I will extend from the existing MetroLink line at the Forest Park station to the vicinity of I-44. It will be designed in a way to provide for future extensions: Segments II and III in the Cross-County corridor and a possible West St. Louis County corridor (see Figure 1-1 in Section 1).

The implication of these connections is both physical and operational.

1. **The proposed Segment II extension will be a southward extension from I-44 into South County. Segment I needs to be aligned to allow a feasible linkage to the south-oriented right-of-way, probably along a railroad corridor.**

2. **The proposed Segment III extension will be a northward extension along CMT right-of-way toward Florissant. A future junction needs to be planned. This area could also be the connecting point for a West County corridor.**

3. **Planning for the junction at the Forest Park station, as well as a future Segment I/III junction near downtown Clayton, must recognize operational requirements in terms of LRT train headways and needed capacity. This could entail the need for a third track to minimize conflict between MetroLink trains operating on different routes and provide holding areas/turnaround capability for LRT trains.**

4
Transportation Impact Analysis Results and Possible Mitigation

4.1 Introduction/Analysis Approach

This section describes the results of the analysis of transportation benefits and impacts of the proposed Cross-County MetroLink Extension alternatives. The next section of this draft report, Section 5, describes the results of the analysis of socioeconomic and environmental benefits and impacts of the proposed Cross-County corridor alternatives. These results from both these sections will be integrated with the engineering, LRT operations, cost and financial analysis findings for use in comparing alternatives and in determining the preferred conceptual design.

As noted in Section 1 of this draft report, this MetroLink extension project will be financed with local funds (i.e., no federal dollars). Therefore, federal environmental requirements under the National Environmental Policy Act (NEPA) do not apply. However, the analysis results contained in this section are consistent with the Council on Environmental Quality guidance on environmental impact assessment and are similar in scope to a NEPA Environmental Assessment (EA).

The following subsections are focused on the study's first design objective, and associated evaluation criteria and measures. The next section of the report, Section 5, is focused on the next five design objectives (urban design, economic, environmental impact, costs and finances, and MetroLink compatibility) and associated evaluation criteria and measures. A discussion of whether and how each alternative would achieve the design objectives and criteria is provided as appropriate. Possible mitigation measures to either modify, reduce or eliminate specific impacts are given at the end of each subsection. A summary matrix of the transportation, socioeconomic and environmental benefits and impacts per alternative is presented at the end of Section 5. This

report information will aid in the comparative analysis of alternatives being considered as part of the draft Evaluation Results Technical Report.

4.2 Transportation Impacts

The transportation network within the Cross-County MetroLink Extension Segment I corridor includes three interstates, major and minor arterial roadways, city street systems, bus transit routes, and an existing MetroLink system. The criteria for assessing transportation impacts focus on overall utility as expressed by ridership, accessibility, and individual concerns such as mobility, personal safety and security. The criteria also focus on operational characteristics associated with traffic safety and congestion. The specific criteria and measures that are used are:

Criteria	Measure
A. Maximize 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 centers in corridor.** **b. Weighted travel times to major employment 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 station 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.**

Criteria	Measure
F. Minimize Traffic Impacts (Reduction in capacity for other modes)	**a. Intersection traffic capacity for locations affected by LRT.** **b. Traffic impacts on corridor streets due to access patterns to park-n-ride facilities or by buses to transfer facilities (impacts analyzed in terms of added peak hour traffic and intersection capacity).**

4.2.1 Maximize Transit Ridership

Ridership estimates were prepared with respect to the expected year that this MetroLink extension would be open for revenue service (year 2005) and for long range conditions (year 2020). It should be noted that there are some limitations or qualifications concerning the travel demand model and the forecasts of population and employment used to estimate future trips:

1. **The travel analysis zones are large in relation to potential development sites, hence, the model may not be sensitive to differences in station locations at the detail level.**

2. **Some activities, such as Washington University, are special trip generators. These may not be fully accounted for in trip making estimates.**

3. **There are several significant development potential areas in the corridor. The details of these opportunities are not known at this time and are not reflected in travel estimates.**

Given these qualifications, the ridership estimates in boardings per day are:

	Fully Grade Separated	At-Grade/Grade Separated Combination
Year 2005 Ridership	**20,618 boardings/day**	**18,402 boardings/day**
Year 2020 Ridership	**25,772 boardings/day**	**23,003 boardings/day**
Year 2005 Work Trips	**10,780 boardings/day**	**9,576 boardings/day**
Year 2020 Work Trips	**13,476 boardings/day**	**11,970 boardings/day**
Year 2020 Special Events	**250,000 trips/year**	**250,000 trips/year**

For the section options, the changes in estimated ridership would be as follows:

1. **Forest Park through University City**
   a. **Side-running at-grade**
      No difference compared to at-grade/median.

b. Skinker Boulevard and Big Bend Boulevard Underpasses
No difference compared to at-grade/median.

2. Downtown Clayton

a. Elevated option (high or low profile)
5,400 fewer boardings per day (year 2020) compared to fully grade separated alternative.
2,000 fewer riders per day (year 2020) compared to at-grade/grade separated combination for both downtown stations.

b. Forest Park Parkway at-grade
4,300 fewer boardings per day (year 2020) compared to the fully grade-separated alternative.

c. Carondelet/Brentwood at-grade option
No difference compared to Carondelet/Meramec at-grade alternative.

3. Galleria Elevated

- **300 more boardings per day compared to CMT alternative (at-grade combination),**

4. Laclede Station Road

- **150 more boardings per day (year 2020) compared to elevated alternatives through Sunnen Business Park.**

5. Deer Creek

- **200 fewer boardings per day (year 2020) for the Deer Creek station as the south terminal compared to a terminal at Lansdowne Avenue.**

Along with the estimates of overall ridership for the proposed MetroLink extension, there is information about boardings by individual station and the local mode of access for each station. For the basic alternatives, these estimates are as follows:

Year 2020 Local Mode of Access

	Fully Grade-Separated				At-Grade/Grade-Separated Combination			
	Boardings per	Local Access			Boardings per	Local Access		
Station	Day	Walk	Bus	Auto	Day	Walk	Bus	Auto
Forest Park	5,946[1]	1,285	555	610	5,330[2]	1,290	528	625
Skinker	184[3]	147	38	0	173[3]	143	30	0
Big Bend	928	904	25	0	883	874	11	0
Carondelet Plaza	1,160	1,060	100	0	1,050	960	90	0

	Fully Grade-Separated				At-Grade/Grade-Separated Combination			
	Boardings per	Local Access			Boardings per	Local Access		
Station	Day	Walk	Bus	Auto	Day	Walk	Bus	Auto
Downtown Clayton	3,739	3,298	441	0	3,554	3,088	466	0
Galleria	1,255	1,077	178	0	764	758	9	0
Eager Road	2,133	163	27	1,943	2,026	147	25	1,856
Manchester Road	554	258	298	0	477	236	241	0
Deer Creek	258	258	0	0	245	245	0	0
Lansdowne Avenue	5,774	256	600	4,198	5,353	724	522	4,609

[1] Includes two MetroLink lines; 2,927 boardings per day would be inter-rail transfers.
[2] Includes two MetroLink lines; 2,334 boardings per day would be inter-rail transfers.
[3] These estimates will be revised pending completion of special generator trip analysis of Washington University.

4.2.2 Improve Accessibility

Improved accessibility is one of the potential benefits of the new MetroLink line. This measure concerns land-use, especially non-residential land-use, with respect to improved linkage to customer, patrons, and/or labor force. This linkage is measured in terms of travel times between a representative set of origins and destinations, both residential and major activity centers, within and outside of the Cross-County Corridor.

Travel times are comprised of the time riding on a MetroLink train plus the access and egress time by some local mode. The local mode assumes that the link from residential origin to MetroLink will be via auto or local bus. The egress link from MetroLink to a major activity center will be via walking or local bus. Overall speeds for these local modes were assumed to be:

- Walk at 2 mph
- Local bus at 15 mph
- Auto at 30 mph

One of the potential benefits of the new MetroLink line is speed (or reduced travel time). Estimated travel times and corresponding speeds for the two basic corridor alternatives, the fully Grade Separated and At-Grade/Grade-Separated Combination alternatives, are summarized in Table 4.2-1.

Table 4.2-1
ESTIMATED METROLINK (SEGMENT I) TRAVEL TIMES AND SPEEDS
A = Fully Grade-Separated Alternative
B = At-Grade/Grade-Separated Combination Alternative

Link	Distance (miles)	Travel Times (minutes)		Overall Speed (mph)	
		A	B	A	B
Forest Park to Skinker	0.85	1.3	1.4	39	36
Skinker to Downtown Clayton (core station)	2.15	4.3	4.3	30	30
Downtown Clayton to Galleria	1.0[1] 1.3[2]	2.8	5.6	21	14
Galleria to Lansdowne	3.5	7.4	7.4	28	28
Overall	7.7[1] 7.8[2]	15.8	18.7	29	25

[1] Distance measured according to design plans from DeBaliviere (Forest Park Station) to Lansdowne Avenue Station for Alternative A.
[2] Same distance but for Alternative B.

These results indicate that the Fully Grade-Separated Alternative would achieve a somewhat faster travel time of about three minutes for the length of the Segment I corridor (Forest Park to Lansdowne Avenue). Overall speeds would be 25 to 29 mph for the At-Grade Combination versus the Fully Grade-Separated Alternative. Compared to existing travel times by transit (i.e., by bus), these speeds are about twice as fast. Thus, for the length of the corridor, the MetroLink extension could save 15 to 20 minutes of travel time compared to the existing system. This would be a major benefit for people traveling in the Cross-County corridor.

The improved travel time would increase accessibility to significant land uses within the corridor (see Table 4.2-2). Improved accessibility would support, enhance, or otherwise stimulate economic development in those areas directly served by the Cross-County MetroLink extension. These potential linkages are discussed in the following section.

4.2.2.1 Corridor Alternatives

The results of the travel time analysis for the two basic corridor alternatives (fully grade-separated and at-grade/grade-separated combination) are summarized in Table 4.2-2, which indicates the potential origin-destination travel time for 5 representative residential locations and 10 possible destinations. The latter includes 5 major activity centers in the Cross-County Corridor and 5 outside the corridor.

As indicated, the differences between the alternatives are in the range of up to 6 minutes. Some of this difference is simply the result of using walk, bus, or auto modes for local access. The MetroLink portion of these trips would represent differences of up to 3 minutes. In relation to overall travel time, a 3 to 4 minute difference would be a 10 percent difference in time. For an

individual traveler, this difference, except for very short trips, would probably be perceived as insignificant.

From an aggregate or system perspective, the travel time difference can be understood in terms of trade area or influence area. For an employer such as the Sunnen Corporation or Washington University or a financial institution in downtown Clayton, or for a retailer such as the Galleria shopping center, Promenade, or Deer Creek Center, the travel time difference could mean that a greater potential labor force or customer base is within a given travel time contour.

The travel time difference is apparent only in certain directions. For trips from residential areas to the south, southwest, and west (i.e., potentially accessing this MetroLink line at stations from Eager Road to Lansdowne Avenue), the two alternatives would provide the *same* travel time for destinations in the corridor from Maplewood to Clayton. This is because the design concepts are very similar in physical terms.

For trips from residential areas to the north, northeast, and east (i.e., potentially accessing this MetroLink line at stations from Forest Park Parkway to Big Bend Boulevard), the fully grade-separated alternative could have a shorter travel time by two to three minutes for destinations at the Galleria and south, southwest, or west. In other words, the Galleria and other destinations to the south, southwest, or west could be accessible to an area of 0.75 to 1.5 miles farther distant from the north section of the Cross-County MetroLink line using the fully grade-separated alternative as compared to the at-grade/grade-separated combination alternative. This is because the impact of at-grade MetroLink operations, which are somewhat slower than for fully grade-separated design, would occur in the Forest Park Parkway, Millbrook Boulevard, and downtown Clayton sections. This benefit, however, may be moot if the major activity centers that could be linked to population in the north or east do not consider such areas to be in their trade or influence zone (for competitive or other reasons).

The overall conclusion is that the difference in accessibility between the basic alternatives would be small. Each would significantly improve accessibility to important development areas.

Table 4.2-2
ESTIMATED TOTAL TRAVEL TIME (in minutes)
(MetroLink train plus local access time and any train-to-train transfer time)
A = Fully Grade Separated Alternative **B = At-Grade/Grade-Separated Combination Alternative**

		Travel Time to Destinations (Major Activity Centers)																			
Residential		Forest Park		Washington University (Hilltop)		Downtown Clayton (core)		Galleria Shopping Center		Sunnen Business Park		Downtown St. Louis (core)		Lambert Airport		Tesson Ferry Road (I-270)		Fenton (I-44)		W. County Shopping Ctr. (I-270 / Manchester)	
Origins	Time	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
St. Louis (north - Des Peres and Westminster)	Train[1]	0	0	2	2	6	6	9	12	13	16	14	14	19	19	16	19	16	19	13	15
	Local[2]	10-12	10-12	22-24	22-24	7-9	7-9	10-12	17-19	5-7	4-6	7-9	7-9	10-12	10-12	33-35	33-35	36-40	36-40	39-41	39-41
	Total	10-12	10-12	24-26	24-26	13-15	13-15	19-21	19-21	18-20	20-22	21-23	21-23	29-31	29-31	49-51	52-54	52-56	55-59	52-54	54-56
St. Louis (south - Rhodes and Hampton)	Train	16	19	14	17	10	11	7	7	2	2	30	33	39	42	-	-	-	-	4	4
	Local	12-16	12-16	24-28	24-28	9-13	9-13	12-16	19-23	7-11	6-10	9-13	9-13	12-16	12-16	35-39	35-39	40-44	40-44	41-45	41-45
	Total	28-32	31-35	38-42	41-45	19-23	20-24	19-23	26-30	9-13	8-12	39-43	42-46	51-55	54-58	35-39	35-39	40-44	40-44	45-49	45-49
Clayton (northwest - Brentwood and Kingsbury)	Train	7	8	5	6	-	-	3	6	8	11	21	22	30	31	10	13	10	13	7	10
	Local	9-10	9-10	21-22	21-22	6-7	6-7	9-10	16-17	4-5	3-4	6-7	6-7	9-10	9-10	32-33	32-33	37-38	37-38	38-39	38-39
	Total	16-17	17-18	26-27	27-28	6-7	6-7	12-13	22-23	12-13	14-15	27-28	28-29	39-40	40-41	42-43	45-46	47-48	50-51	45-46	48-49
Richmond Hts. (east - Big Bend and Bruno)	Train	11	14	7	12	4	6	2	2	4	4	25	28	34	37	6	6	6	6	3	3
	Local	10-12	10-12	22-24	22-24	7-9	7-9	10-12	17-19	5-7	4-6	7-9	7-9	10-12	10-12	33-35	33-35	38-40	38-40	39-41	39-41
	Total	21-23	24-26	29-31	34-36	11-13	13-15	12-14	19-21	9-11	8-10	32-34	35-37	44-46	47-49	39-41	39-41	44-46	44-46	42-44	42-44
Shrewsbury (south - Laclede and Keswick)	Train	16	19	14	17	10	11	7	7	2	2	30	33	39	42	-	-	-	-	3	3
	Local	12-16	12-16	24-28	24-28	9-13	9-13	12-16	19-23	7-11	6-10	9-13	9-13	12-16	12-16	35-39	35-39	40-44	40-44	41-45	41-45
	Total	28-32	31-35	19-23	20-24	19-23	26-30	33-37	36-40	9-13	8-12	18-22	18-22	39-43	42-46						

[1] Values rounded to the next highest whole minute
[2] Indicated auto vs. local bus or walk-time range

4.2.2.2 Section Alternatives/Options

These travel times would be affected by the various options being considered for certain sections in the corridor.

South Edge At-Grade

This option would be a substitute for the median at-grade in the section of the at-grade/grade-separated combination along Forest Park Parkway and Millbrook Boulevard.

The estimated difference in travel time for the link between the Forest Park and Big Bend stations would be 0.5 minutes faster than for the at-grade median. However, because of track curvature (slower speeds) for the underground alignment west of the Big Bend station, the overall travel time from the Big Bend station to the Pershing Avenue cut-off would be the same for these two alternatives.

Skinker Boulevard and Big Bend Boulevard Underpasses

Because of the station and speed associated with it, there would be no travel time differences for the underpass options.

Downtown Clayton Elevated

This option would be a substitute for the at-grade alternative since its west end would link to the CMT right-of-way. The travel time difference for the high vs. low profile versions would not occur since the two grade crossings for the latter would have gate crossing (pre-emption) operation with no delay to MetroLink. The travel time difference for travel through downtown Clayton would be as follows:

Compared to the underground alternative, the elevated alternative would be 0.5 minutes faster for westbound trains from the east edge of downtown Clayton to the station at Central Avenue. However, for northbound/eastbound trains from the Galleria station to the Central Avenue station, the elevated would be 0.25 minutes slower. For these fractions of minutes, the alternatives would not be significantly different from a rider's perspective.

Compared to the at-grade alternative, the elevated alternative would be 1.8 to 2.1 minutes faster. If this option were used for the overall corridor at-grade/grade separated alternative, the travel time for the Shrewsbury to Forest Park station would be reduced to 17 minutes. This would be only 1 minute slower than for the fully grade-separated corridor alternative.

Forest Park Parkway At-Grade

Comparedto the underground alternative, this option would have the same travel time. Compared to the at-grade alternative, this option would be 1.5 minutes faster.

Galleria Elevated

This option would be a substitute for the alignment along the CMT right-of-way for the section between Clayton Road and the Galleria Parkway. The estimated travel time difference would be 1 minute slower than the CMT alignment. This difference is because of the added turning movements and somewhat longer length of travel.

Laclede Station Road

This would be an option for either of the other two basic alternatives which follow an alignment through the Sunnen Business Park via elevated or underground alignments. The estimated travel time difference would be an additional 30 seconds of time relative to these other two alternatives. This would be considered insignificant relative to accessibility.

Deer Creek Terminal

This option would be a substitute for the Lansdowne Avenue station as the terminal station for the Cross-County MetroLink Extension Segment I line. This option would reduce train travel by 1.4 minutes, but it would increase local access travel time by ½ to 1 minute for riders using local bus or auto to access the station.

The net difference would be less than one minute. This option would not affect accessibility from a travel time perspective.

4.2.3 Increase Mobility

Mobility concerns the opportunity for individuals to travel to places, as required by their own needs. These destinations would include employment locations, shopping, education, health care, recreation, etc. The measure of mobility addresses whether a selection of destinations are within a quarter-mile walking distance of a MetroLink station, and can be reasonably accessed and whether the travel time is reasonable.

A context for considering mobility is defined by the distribution of population and employment in the corridor. Table 4.2-3 summarizes existing and year 2020 forecasts for population and employment by community.

Table 4.2-3
POPULATION AND EMPLOYMENT: 1990 AND 2020 (Traffic Analysis Zone Data)

	Population		Employment	
Community	1990	2020	1990	2020
St. Louis (City)	396,685	329,995	402,478	371,322
University City	40,087	37,300	8,900	8,800
Clayton	13,926	13,100	30,600	34,300
Richmond Heights	10,448	9,300	9,000	10,300
Brentwood	8,150	7,200	10,600	10,800
Maplewood	9,962	9,300	4,600	4,600
Shrewsbury	6,416	6,400	2,800	2,700
Webster Groves	22,992	21,000	8,400	7,900
Ladue	8,795	8,000	6,400	6,300
Crestwood	11,229	9,600	7,800	7,700

These data indicate increasing population in suburban areas and continuing employment growth in the Cross-County corridor. Areas in the north part of the corridor are stable in population, but have certain growth potential relative to the University City Loop area. However, the growth in more basic employment is occurring in the central and southern sections of the corridor. Mobility for people to get ready access to these areas would be a significant goal.

4.2.3.1 Corridor Alternatives

The basic corridor alternatives have been examined in terms of quarter-mile walking distance access. This includes determining how many people live within this distance of a proposed MetroLink station and how many places of employment are also within this access distance. Also, a count was made of institutional, recreational, and shopping land uses located within the same distance.

Table 4.2-4 summarizes the results of this assessment for two corridor alternatives. There would be some differences. For the Galleria area, the alignment along Brentwood (fully grade-separated alternative) would be closer to more employment than the CMT route (500 jobs). There is potential development that could increase employment in the Brentwood Boulevard by another 1,000 jobs. The Big Bend/Oxford station (at-grade combination alternative) would be closer to 800 more jobs and 800 more residents as compared to the grade-separated alternative with a station at Deer Creek.

Mobility also reflects reasonable travel time. Table 4.2-5 summarizes possible travel times for a range of possible origin-destination pairs. The origin-destination pairs reflect a selection of eight residential locations in and near the cross-county corridor and remote from the corridor:

1. **St. Louis: north, near Union and Westminster**
2. **St. Louis: south, near Hampton and Rhodes**
3. **Richmond Heights: east, near Big Bend and Hiawatha**
4. **Clayton: northwest, near Brentwood and Kingsbury**
5. **Shrewsbury: south, near Laclede Station and Keswick**
6. **Crestwood: southwest, near Sappington and Garber**
7. **Manchester: west, near Woods Mill and Manchester**
8. **Ferguson: north, near Florissant and Airport**

The destinations used for the analysis are as follows:

1. **Forest Park: cultural and recreational**
2. **Downtown Clayton: institutional (government and finance), employment**
3. **Galleria: shopping, employment**
4. **Washington University Medical Center: health care, employment**
5. **Sunnen Business Park: employment**
6. **Promenade and Hanley Industrial Court: shopping and employment**
7. **St. Louis downtown: all activities**

Table 4.2-4
POPULATION, EMPLOYMENT, AND ACTIVITIES WITHIN ONE-QUARTER-MILE WALKING DISTANCE OF STATIONS

	Fully Grade-Separated Alternative			At-Grade/Grade-Separated Combination Alternative		
Station	Year 2020 Population	Year 2020 Employment	No. of Activity Centers[1]	Year 2020 Population	Year 2020 Employment	No. Of Activity Centers[1]
Skinker Boulevard	1,780	1,368	2	1,780	1,368	2
Big Bend Boulevard	1,704	1,400	8	1,704	1,400	8
Carondelet Plaza	866	4,058	35	866	4,058	35
Carondelet/Central	477	22,050	150+	477	22,050	150+
Galleria/Brentwood[2]	615	3,000	125+[3]	-	-	-
Galleria/CMT[4]	-	-	-	860	2500	25
Eager Road	415	2,317	16	415	2,317	16[5]
Manchester Road	500	1,143	8	500	1,143	8
Big Bend/Oxford[4]	-	-	-	1,315	1,136	30[6]
Deer Creek[2]	476	311	6	-	-	-
Lansdowne Avenue	816	200	3	816	200	3

1 Institutional, recreational, and shopping land uses.
2 Station for fully grade separated only.
3 Includes more than 100 stores in the Galleria shopping mall.
4 Station for at-grade/grade separated combination only.
5 Includes 10 stores in the Brentwood Promenade.
6 Includes 20 stores in the Deer Creek shopping center.

The results of the walking distance analysis indicate that there is little difference between the basic corridor alternatives. Except in the Galleria and Deer Creek areas, stations are in approximately the same location. For the Galleria, the CMT/at-grade is accessible to more residential population; i.e., the residential neighborhood located east of the CMT right-of-way. However, there is little difference concerning access to employment (albeit that different

employment locations and buildings are accessible). For the Deer Creek area, the population within one-quarter mile for the Big Bend vs. the Deer Creek stations is different (1,315 vs. 476 people).

The results of the travel time analysis reflect the same travel difference between the two basic corridor alternatives. Most of the noted differences in Table 4.2-4 are associated with the local access modes. These reflect auto vs. bus vs. walking travel time differences. The MetroLink component would be a difference of up to 3 minutes; i.e., the fully grade-separated alternative being lower. The pattern of travel time differences is not different for residential origins in north, central, or south locations.

This analysis indicates that from the mobility aspect, the basic alternatives are not significantly different.

4.2.3.2 Section Options

The mobility measures outlined above could be affected by the various options being considered for certain sections. These impacts were discussed under the accessibility criterion (Section 4.2.2.2) in terms of travel time impacts and will be referenced only briefly in the following discussion.

South Edge At-Grade

In terms of quarter-mile walking distance access, this option would not result in any significant differences when compared to the median at-grade alternative. The travel time difference compared to the median at-grade alternative, would be insignificant.

Skinker Boulevard and Big Bend Boulevard Underpasses

No significant differences would result; station is basically same location.

Downtown Clayton Elevated

In terms of quarter-mile walking distance access, this option (either high or lower profile versions) would involve certain significant differences. First, this option does not have an east downtown Clayton station. As indicated in Table 4.2-4 for the underground or at-grade alternative, the population of 866 persons and employment locations for 4,058 persons in the vicinity of the Carondelet Plaza station would not be within walking distance for this option.

Second, the only station for this option is located at the south edge of the downtown, approximately one-quarter mile south of Carondelet Avenue. This station would be closer to

more residential population, but farther removed from employment locations and other activities. Also, the travel times for this alternative would be two minutes shorter than for the basic at-grade/grade separated combination, but the same travel time compared to the grade-separated (underground) alternative.

Forest Park Parkway At-Grade

This option has two stations, including one in east Clayton near Forsyth Boulevard. This station would be similarly accessible to population/employment/activity centers as shown for the Carondelet Plaza station for the fully grade-separated alternative, i.e., 866 population, 4,058 employees, and 35 activity locations.

Galleria Elevated

This option would have a location only slightly different (less than 150 feet to the east) from the underground alternative. It would have the same estimated population and employment within a quarter-mile walking distance. As discussed in other sections of this report, this option could stimulate joint development in the Brentwood Boulevard corridor, especially integral with the station.

This could increase population and/or employment within walking distance than may be possible with the underground alternative. In terms of travel time, this option would not result in any significant differences.

Laclede Station Road

This option has the potential for significantly more employment within a quarter-mile walking distance and would be associated with the continued growth of the Sunnen Business Park plus the expansion of commercial/industrial land uses along Hanley Road in this vicinity. The business park is nearly directly linked to the platform. In contrast, the Big Bend/Oxford or Deer Creek stations are several blocks away. Moreover, there is a significant vertical/topographic change between these station locations and the Sunnen Business Park or Hanley Road area.

This option would produce an increase in MetroLink travel time amounting to 30 seconds compared to the other alternatives. In terms of mobility, this is insignificant.

Deer Creek Terminal

The difference for this option concerns the Lansdowne Avenue station. If Deer Creek becomes the terminal station, then the population and employment within a walking distance of one-quarter mile of Lansdowne Avenue would need to use local bus or auto to reach the station. For

destinations near Lansdowne (in future), there would be a significant need for local bus service to connect Deer Creek to areas south of I-44. The local bus service in the preliminary operating plan would perform this function. As indicated previously, the travel time differences, involving added travel time on local buses vs. MetroLink travel time for the link between Lansdowne and Deer Creek, would be small.

4.2.4 Maximize Safety

Safety considerations address two basic aspects of the alternatives: (1) access to the proposed stations by vehicles and pedestrians, and (2) at-grade intersections between MetroLink trains and vehicular and pedestrian traffic. The measures used for this analysis include:

a. Potential conflicts between trains and other traffic
b. Pedestrian crossing of MetroLink tracks and access to stations
c. Sight distance for train operators to stop safely
d. Accident potentials

Traffic safety is an important consideration. Accident risk is a reality of transportation systems affecting all modes. The focus of this analysis is vehicle-related traffic accidents. To identify current experience, Table 4.2-5 identifies a general level of accidents occurring at arterial intersections in the general area of the corridor. Table 4.2-6 summarizes more specific information about key intersections along the proposed route.

In the Cross-County corridor, arterial intersections experience 20 to 30 accidents per year. In downtown Clayton, the five blocks that form the central section of the alignments also experience 20 to 25 accidents per year.

From the standpoint of accidents involving light rail transit operations, recent experience[1] is also helpful in understanding the potential situation in the Cross-County corridor. This would concern only those accidents involving pedestrians or collisions between transit trains and other traffic. Table 4.2-7 summarizes recent experience for a number of transit operations that have light rail in which at-grade crossings exist. The experience is quite variable; some operations such as the existing MetroLink have very few accidents. Others have more, but these are spread over more extensive systems with more numerous grade crossings.

4.2.4.1 Fully Grade-Separated Alternative

a. *Train-Vehicle Conflict*. Because of the grade separations, this alternative would have no intersections between MetroLink trains and other vehicular traffic.

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[1] TCRP Report #17, Integration of Light Rail Transit into City Streets, Transportation Research Board, 1996.

b. ***Pedestrian Access*. This measure concerns the possible presence of public crosswalks or pedestrianways over the MetroLink tracks and the proposed pattern of pedestrian access to stations.**

- ***Crosswalks*. The proposed alignment would not include any public (general use) pedestrian crosswalks over MetroLink tracks, although some informal crossings may be possible. Within the north and central sections of the corridor, the alignment is underground with no possible public crossing of the tracks. The south end of the corridor (i.e., south of Flora Avenue to I-44) the alignment would have an elevated position. No pedestrian crossing would be possible.**

- **However, in the section from I-64 to Flora Avenue and south of I-44 in the vicinity of Sutherland Avenue, the tracks are at-grade (mostly in the CMT right-of-way in the area north of I-44; south of I-55 the tracks are elevated over the freeway but drop down to ground grade or on earth fill near Sutherland.) The track zone would be fenced to prevent pedestrian crossings. At station platforms, there would be the potential for the general public to cross the tracks. This would be most probable at the Eager Road station. It could also occur in the vicinity of various industrial land uses along the alignment. There would be openings in the fence to permit access between properties. This would occur for at least two locations — north and south of Manchester Road at Sunnen Corporation property. Such access could also occur at Sutherland Avenue where an east-west crossing is possible for access to the MetroLink maintenance yard facility.**

Table 4.2-5
ACCIDENT DATA AND AVERAGE DAILY TRAFFIC (1998)
ILLUSTRATIVE INTERSECTIONS ALONG THE METROLINK ALIGNMENT

Intersection		Average Daily Traffic Volume	Number of Accidents Per Year
Delmar & Hanley			22
	Delmar	13,500	
	Hanley	17,200	
Delmar & Big Bend			23
	Delmar	22,300	
	Big Bend	20,000	
Big Bend & Millbrook			24
	Big Bend	20,600	
	Millbrook	26,600	
Big Bend & Forsyth			23
	Big Bend	19,300	
	Forsyth	12,200	
Forsyth & Hanley			21
	Forsyth	13,600	
	Hanley	22,500	

Table 4.2-6
ACCIDENT EXPERIENCE 1996-1998

Section - Location	1996	1997	1998
1) Forest Park Parkway/ Millbrook Boulevard			
a) Skinker Boulevard: Total	33	35	28
Type - angle	8	6	7
rear end	17	19	12
one vehicle	5	7	3
right angle	3	2	6
other	0	0	0
pedestrian	0	1	0
b) Big Bend Boulevard: Total	14	25	28
Type - angle	8	10	6
rear end	3	10	12
one vehicle	1	0	1
right angle	2	4	9
other	0	1	0
pedestrian	0	0	0
2) Downtown Clayton			
a) Carondelet Avenue (by block)			
- Hanley to Bemiston	9	6	4
- Bemiston to Central	0	0	9
- Central to Meramec	0	3	4
b) Meramec Avenue (by block)			
- Carondelet to Bonhomme	5	1	2
- Bonhomme to Shaw Park Drive	6	12	4
Total (two streets)	20	22	23

Table 4.2-7
1997 LIGHT RAIL COLLISION DATA

Transit Agency	Vehicles	Directional Route-Miles	Miles of Track	Number of Crossings	Total Collisions	Collisions at Grade Crossings
LA-LACMTA-Metro	48	82.4	85.8	77	21	12
Sacramento-RT	32	36.2	34.0	86	9	0
San Diego-The Trolley	64	48.3	48.3	61	22	14
San Francisco-Muni	100	49.7	54.2	191	35	0
San Jose-SCCTD	33	39.0	41.1	64	35	0
Denver-RTD	16	10.6	12.7	33	23	7
New Orleans-RTA	22	16.0	13.7	124	8	8
Boston-MBTA	141	55.9	77.5	56	20	0
Baltimore-Maryland-MTA	30	43.6	35.3	39	36	9
St. Louis-Bi-State	31	32.0	34.0	12	0	0
New Jersey Transit	16	8.3	8.3	1	1	0
Buffalo-NFTA	23	12.4	14.1	8	7	0
Cleveland-RTA	23	30.8	33.0	22	3	0
Portland-Tri-Met	25	30.2	33.4	55	12	11
Philadelphia-SEPTA	111	69.3	171.0	1702	92	19
Pittsburgh-PAT	38	38.1	46.5	42	35	0
Memphis-MATA	9	4.3	4.0	25	1	0
Dallas-DART	36	40.8	46.7	66	13	0
Galveston-Island Transit	4	4.9	4.9	57	N/A	N/A
Seattle-Metro	3	3.7	2.1	14	2	0
Total	803	658.5	802.8	2674	353	66
Source: 1997 National Transit Database						

- ***Station Access*. There would be two general situations: (1) access directly from public street right-of-way where stations are either below ground or elevated in the public right-of-way, or (2) access beyond street right-of-way where stations are in off-street positions.**

  Access from street right-of-way would occur at Forest Park, Skinker, Big Bend, Carondelet Plaza, downtown Clayton core, and the Galleria. Individual conditions would be as follows:

  — ***Forest Park*. Pedestrian access would be available from both sides of DeBaliviere Avenue; no crossing of this street would be necessary. Rebuilt DeBaliviere Avenue bridge is to have sidewalks with high-visibility crosswalk markings placed across Forest Park Parkway for pedestrian movement to and from the south.**

  — ***Skinker Boulevard*. Underground pedestrian access would be available to both sides of Forest Park Parkway. However, origins or destinations along the east side of Skinker Boulevard will require crossing this high volume street. There would be direct access to the Washington University campus without crossing streets.**

  — ***Big Bend Boulevard*. (Same situation as described for Skinker Boulevard.)**

  — ***Carondelet Plaza*. Access would be provided at several locations, two along Carondelet Plaza and one on the south side of Forsyth Boulevard. These locations would not require crossings of major streets with the exception of Forsyth Boulevard. Future development in this area would mostly result in pedestrian connections directly to the station.**

  — ***Downtown Clayton Core*. Streets in the vicinity of the station have relatively low volumes. Station access would occur in a new plaza, without vehicle traffic.**

  — ***Galleria/Brentwood Boulevard*. Underground station access would be provided to both sides of Brentwood Boulevard for the option locating the station in the center of the street right-of-way; or to the west side of Brentwood for the option to locate the platform to the west edge of the right-of-way. For the west edge option, about half of the passengers would need to cross Brentwood Boulevard at-grade; this would occur at a signalized intersection but the pavement is very wide and the walk clearance time minimal.**

For stations with off-street locations, pedestrian access is removed from high volume arterial streets. Specific observations about these stations include:

- ***Eager Road*. This station is a substantial distance from arterial streets; however, for the small number of riders walking to the station, there might not be a clearly marked pedestrianway through adjacent development sites.**

- ***Manchester Road*. Improved sidewalks along Manchester Road would be a significant improvement to make access reasonably safe.**

- ***Deer Creek*. Pedestrian access is far removed from arterial streets. Most local access would be via bus and auto; a clear sight pedestrianway would be marked and signaled.**

- ***Lansdowne Avenue*. Pedestrian access would be available from both sides of Lansdowne Avenue; no crossing of this arterial street would be necessary. Intra-site paths could provide safe connections to station access facilities.**

c. ***Sight Distance*. Sight distance issues could be a concern only where pedestrians could cross the tracks — either to move between platforms, for access to station site facilities (bus stop, drop-off/pick-up, or parking), or because of a general public crosswalk. For this alternative all underground and elevated stations would have center platforms. There would be no crossing of tracks in these cases. The only exception would be at the Forest Park Station where passengers could cross tracks in order to transfer between MetroLink routes. Along the CMT right-of-way, passengers would cross the tracks at the Eager Road and Manchester Road stations.**

The operator sight distance at the Eager Road and Manchester Road locations is excellent. Tracks have a straight alignment. There are no vision barriers.

At the Forest Park Station, trains would converge on the station from the west (Cross-County) or northwest (Airport Main) with limited sight distance. Pedestrian track-to-track crosswalks would be placed just west of the DeBaliviere Avenue bridge. People could be crossing two sets of tracks and might not see trains because of the curve in the tracks from Airport Main or because trains would be in a tunnel from Cross-County. Trains will be slowing down, however, to stop at the station. This should be satisfactory with appropriate signing, lighting, and warning signals.

d. ***Accident Potential*. Given the above conditions associated with this alternative, it is difficult to estimate (quantify) the accident potential. As summarized earlier, motor vehicle accidents now occur throughout the Cross-County corridor. Accident potential could increase at locations where access would occur in the presence of high volume streets.**

The latter would have greatest risk where drop-off/pick-up and bus stop activities are likely to occur along arterial streets rather than in off-street facilities. For this alternative, this higher risk situation would occur at the DeBaliviere, Skinker, Big Bend, and Brentwood Boulevard Galleria stations.

Accident potential could also exist where pedestrians cross tracks. As noted in previous discussions, this could happen at the Eager Road and Manchester Road Stations, and at some private crossings associated with Sunnen Corporation property south of Hanley Road.

4.2.4.2 At-Grade/Grade Separated Combination Alternative

a. ***Train-Vehicle Conflicts.*** **For this alternative, there would be a series of locations where MetroLink tracks will be crossed at-grade by other traffic. Specifically, the alignment would have the following features:**

- **Tracks would be at-grade along Forest Park Parkway and Millbrook Boulevard from approximately 1700 feet west of DeBaliviere Avenue to 400 feet west of Big Bend Boulevard. Except for the five intersections in this section, the tracks will be located in an exclusive right-of-way protected by barriers (no vehicle or pedestrian crossings possible). There would be two stations with at-grade platforms. Passenger access would be via crosswalks in the two street intersections (at Skinker and Big Bend Boulevards).**

- **Tracks would be at-grade through downtown Clayton; they would be in a semi-exclusive right-of-way. Vehicle traffic would cross the tracks at eight intersections or roadways. Pedestrians would likely cross tracks along nearly all sections of the track from Forsyth Boulevard to south of Bonhomme Avenue (along either Meramec Avenue or Brentwood Boulevard).**

- **The Galleria station in the CMT right-of-way would have pedestrian access across the tracks.**

- **Tracks would be at-grade across Big Bend Boulevard (north of Oxford Boulevard) and across Oxford Avenue (east of Big Bend); at-grade pedestrian access (across the tracks) would occur for the Big Bend station.**

At each major street intersection, the cross-street (thru and left turn) movements and the left turns from the street parallel to the tracks would potentially conflict with train traffic. For each at-grade intersection, the following conflicting movements could occur:

		# of Movement Conflicts
—	Des Peres Avenue	4
—	Skinker Boulevard (4 lane street)	8
—	Hoyt Drive (2 lane street)	2
—	Throop Drive (2 lane street)	2
—	Big Bend (4 lane street)	8
—	Forsyth Boulevard (4 lane street)	4
—	Carondelet Plaza (4 lane street)	4
—	Hanley Road (4 lane street)	8
—	Bemiston Avenue (2 lane street)	6
—	Central Avenue (4 lane street)	6
—	Meramec Avenue (4 lane street)	5
—	Bonhomme/Meramec Avenue (4 lane street)	6
—	Big Bend (near Oxford)	4
—	Oxford Avenue	2

(Each traffic lane is counted as a potential conflict.)

Each driveway with allowed access across the tracks involves two conflicting movements (in and out of driveway).

The above intersections would be controlled with traffic signals. Signal phasing would separate conflicting traffic movements from train movement. Special signs would be used to augment standard signing and marking. Driveways would have other signs and warning devices.

b. ***Pedestrian Access.*** **Pedestrian access has been discussed relative to the fully grade-separated alternative [Section 4.2.4.1(b)]. These comments also apply to this alternative with the following differences:**

— ***Skinker Boulevard*****. Pedestrian access would still be at the intersection, but for this alternative, access is to the median via crosswalks and along the median to the station platforms. All passengers must cross either the eastbound or westbound Forest Park Parkway traffic lanes. The platform would be designed to include raised barriers to separate pedestrians from traffic.**

— ***Big Bend Boulevard.*** **Same comment as for Skinker, except Millbrook Boulevard is the street passengers must cross, in part, to access the station.**

— ***Carondelet Plaza.*** **The station would be located further west on Carondelet Plaza than for the fully grade-separated alternative. Pedestrian access would be separated from the vehicle roadway. Traffic volumes are low, as well.**

— ***Galleria/CMT*****. Rather than having station access on busy Brentwood Boulevard, this station would be accessed from Galleria Parkway, east of I-70, to off-street facilities. This would be a low accident environment. The only possible conflict would be the sidewalk connection along Galleria Parkway to the east, which crosses the I-70 entrance ramp. This is a specialized intersection giving pedestrians clearance to cross the street.**

— ***Big Bend Boulevard at Oxford Avenue*****. The station would be in an off-street position. Sidewalk connections would extend east to Big Bend Boulevard and west into the shopping center. These conditions would not represent serious conflicts for pedestrians.**

c. ***Sight Distance*****. In the vicinity of at-grade crossings or intersections, there is excellent sight distance for MetroLink operations. At the high-volume cross-streets (Skinker, Big Bend, and Hanley), trains are approaching/leaving stations and would be operating at very slow speeds. There would be good stopping opportunities to avoid collisions with other traffic.**

At two locations, there could be some sight distance limitations. These would occur at the end of the underground-to-ground surface transition just north of Forsyth Boulevard (east edge of downtown Clayton) and for the 90º curve at Meramec/Carondelet. For the former, westbound trains emerging from the transition would have limited sight distance to the cross traffic in this vicinity (traffic in the Washington University or Bally's parking lot, pedestrian traffic). For the latter, the existing high-rise building at the southeast corner of Meramec/Carondelet would limit sight distance to the south or east. In this case, trains would be operating at a very slow speed because of both the location of the station and the curved alignment.

d. ***Accident Potentials*****. Because of the intersecting movements with MetroLink trains, there would be an accident risk. In addition to the data presented earlier about general accident experience, a recent research study of light rail transit accident experience in ten cities across the United States provide a reference[2] for examining accident potential. This documented experience indicates that while there is a risk, the accident potential is low concerning at-grade situations.**

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[2] Transit Cooperative Research Program Report #17, Integration of Light Rail Transit into City Streets, Transportation Research Board, 1996.

The data indicate that the primary reason for accidents is motorist or pedestrian behavior, sometimes influenced by a less favorable design. The vast majority of accidents have involved violations of traffic controls, ignoring warning signals, or reckless behavior. In some cases, the design and operation of light rail transit created a new or different situation for motorists and pedestrians, causing some level of confusion or uncertainty about how to respond to train movements (drive vehicle or walk).

The risk of train-vehicle or pedestrian accident is associated with the extent of exposure for conflict or collision. TCRP Report #17 reports that the exposure would be associated with those sections where MetroLink tracks would be in semi-exclusive right-of-way or in mixed traffic. With semi-exclusive right-of-way, tracks can be crossed by vehicles or pedestrians. In contrast, with exclusive right-of-way barriers prevent vehicles or pedestrians from crossing the tracks.

For this alternative, there would be no mixed traffic operation, but there would be some length of semi-exclusive right-of-way. These would occur at five intersections along Forest Park Parkway and Millbrook Boulevard, at intersections and grade crossings throughout downtown Clayton from Forsyth on the east to just south of Bonhomme Avenue along Meramec Avenue, and at Big Bend and Oxford Avenue near the Deer Creek station. For these locations, the amount of track-miles in a semi-exclusive situation would be:

—	***Forest Park Parkway/Millbrook***	**= 0.14 miles**
—	***Downtown Clayton***	**= 1.55 miles**
—	***Big Bend/Oxford***	**= 0.05 miles**
	Total	**= 1.74 track miles**

The semi-exclusive track miles for Forest Park Parkway/Millbrook and Big Bend/Oxford reflect the width of seven at-grade crossings or intersections. The 1.55 track miles in downtown Clayton represent both at-grade crossings, intersections and mid-block conditions. There are eight[1] at-grade crossings and intersections. At-grade crossing would be locations where MetroLink crosses a single street (e.g. Forsyth near Bally's); at-grade intersections would be locations where MetroLink crosses through an intersection of two streets. These amount to 0.22 track miles. The other sections in downtown Clayton would entail tracks in separated locations (from traffic lanes). However, the design character would involve various streetscape features with curbs and other barriers (low height). These, however, might not guarantee that pedestrians would be prevented from crossing racks at any point in downtown. It is also possible that vehicles could cross the tracks at some mid-point locations. For this reason, the full

[1] Crossings: Forsyth, Carondelet Plaza (south of Forsyth), Carondelet Plaza (east of Hanley) Intersections: along Carondelet at Hanley, Bemiston, Central, and Meramec and at Bonhomme and Meramec.

extent of track miles has been used. Final design could result in means to curtail mid-block crossings with a resultant reduction in risk.

Using the previously cited research results, the average accident rate is 3.7 accidents per track-mile per year. This would mean that the potential would be 6 to 7 accidents per year for the alternative. The reported range of accident rates was 0.5 to 6.2 accidents per track-mile per year. Using these values, the range would be 1 to 11 accidents per year.

This accident rate can be applied to the existing MetroLink operation for comparison purposes. The existing line (excluding the St. Clair extension) has twelve at-grade crossings. They represent only 0.27 travel miles in non-exclusive use. Using the 3.7 accidents per track mile per year rate, this would indicate an annual risk of 1 accident per year. This was the accident experience in 1998, i.e., a very low number. As the MetroLink system continues to expand, it could be expected that such low risk would continue. On this basis, the risk of accident could result in 6 to 7 train-vehicle or pedestrian accidents per year. Of these, 1 to 2 could be pedestrian accidents.

4.2.4.3 Section Options

In addition to the two basic corridor alternatives, there are options for specific sections along the corridor. Safety aspects of these are as follows:

South Edge At-Grade

This alternative is an option to the median at-grade alternative along Forest Park Parkway and Millbrook Boulevard. Its alignment would transition from underground at the Forest Park Station to at-grade at a point 1700 feet west of DeBaliviere Avenue and continue at-grade to a point east of Throop Drive where it would transition to an underground alignment. The Skinker Boulevard Station would be at-grade and the Big Bend Boulevard Station would be underground.

a. ***Train-Vehicle Conflicts.*** **There would be three at-grade intersections. The movement conflicts would be:**

—	**Des Peres Avenue**	**4 movement conflicts**
—	**Skinker Boulevard**	**8 movement conflicts**
—	**Hoyt Drive**	**3 movement conflicts**

These intersections would be operated with the joint use of traffic signals and railroad crossing gates/warning signals. The conflicts compared to the median alternative are slightly greater because of right turns from the street parallel to the tracks.

There would be no conflict at the Throop Drive or Big Bend Boulevard intersections. Hence, the overall extent of conflicts would be less than the median at-grade alternative.

b. ***Pedestrian Access*. Pedestrian access at Skinker Boulevard would be different. With the platform in a single location at the south edge of Millbrook Boulevard, direct pedestrian access would be in a somewhat safer environment. Passengers with campus origins or destinations would not need to cross any streets to access the station.**

For the Big Bend Station, all access would be at the south edge of the Millbrook Boulevard right-of-way. These would be reasonably offset from traffic lanes. However, passengers with origins and destinations to the north would all have to cross Millbrook Boulevard at-grade.

c. ***Sight Distance*. There would be no sight distance conditions different than those previously discussed. The underground-to-surface transitions would occur inside raised barriers so that no sight distance concerns would be present.**

d. ***Accident Potentials.* Because this option has lower track miles in semi-exclusive right-of-way, the risk of accident would be somewhat lower. Track miles would be 0.05 miles less. One less high-traffic intersection would have at-grade operations. This could translate into a risk of one less accident per year.**

Skinker Boulevard and Big Bend Boulevard Underpasses

All underpasses would reduce accident potential regarding collisions with MetroLink trains.

1. For the Skinker Boulevard Underpass, the following would be expected:

a. ***Train-Vehicle Conflicts.* The eight movement conflicts at Skinker Boulevard would be eliminated by the train underpass. For the roadway underpass only four conflicts would be removed.**

The roadway underpass would increase accident potentials at the ends of the transition structures. In these locations, there would likely be significant merging activities that could lead to side-swipe accidents. Also, at the south end of the underpass, there could be left-turn conflicts by vehicles turning to or from Lindell Boulevard.

b. ***Pedestrian Access*. For the train underpass, pedestrian access would be as described for the underground alternative. Underground passageways would lead to stairs/elevators at four locations: northeast, southeast, and southwest corners and south side of Forest Park Parkway about 200 feet east of Skinker Boulevard.**

For the roadway underpass, the accident pattern would be the same as for the median-at-grade.

c. ***Sight Distance*. The west end of the train underpass would be just east of Hoyt Drive. There is a pedestrian crosswalk on Millbrook Boulevard at Hoyt Drive. The transition structure could create a sight distance limitation; i.e., pedestrian couldn't see westbound trains approaching the crosswalk.**

For the roadway underpass, there would be sight distance limitations at each end of the underpass. This would affect both vehicle and pedestrian traffic. Barriers of some kind would be needed at the end of the transition structures to prevent vehicles and pedestrians from crossing Skinker Boulevard at these points.

d. ***Accident Potentials*. The train underpass would increase the amount of track miles in exclusive right-of-way. This would eliminate one high volume intersection from at-grade operations. This could reduce accident risk by one per year.**

For the roadway underpass, no change in train accident risk would seem likely, although less traffic would cross MetroLink tracks.

2. **For the Big Bend Boulevard Underpass, the following would be expected:**

a. ***Train-Vehicle Conflicts.* The eight movement conflicts at Big Bend Boulevard would be eliminated by the train underpass.**

b. ***Pedestrian Access*. For the train underpass, pedestrian access would be somewhat different than as described for the underground alternative. In this case, underground passageways would lead to stairs/elevators at all four corners of Millbrook Boulevard and Big Bend Boulevard.**

c. ***Sight Distance*. The east end of the train underpass would be just west of Throop Drive. The transition structure could create a sight distance limitation; i.e., motorists may not see eastbound trains approaching the intersection until they emerge from the tunnel.**

d. ***Accident Potentials*. The train underpass would increase the amount of track miles in exclusive right-of-way. This would eliminate one high volume intersection from at-grade operations. This could reduce accident risk by one per year.**

Downtown Clayton Elevated

This option could be a substitute for either the underground or at-grade alternatives through downtown Clayton.

a. ***Train-Vehicle Conflicts.*** **The high profile alignment would be completely grade-separated with no train-vehicle conflicts. The lower profile, however would have two at-grade crossing at Bemiston and at Central.**

b. ***Pedestrian Access*****. This option (either profile) has only one elevated station (i.e., over Shaw Park Drive west of Central Avenue). Access would be grade-separated via a pedestrian bridge over Shaw Park Drive and along the west side of Central Avenue. There is the potential for another pedestrian connection to the platform from the residential area south of Forest Park Parkway. In either case, pedestrian access does not require street crossings.**

c. ***Sight Distance*****. The station would have a center platform. There would be no crossing of the tracks. Sight distance for the operator would not be a safety issue.**

d. ***Accident Potentials.*** **Since the high profile version would have no at-grade section in downtown Clayton, accident potential would be zero concerning other vehicles and pedestrians. For the lower profile version, there would be two at-grade crossings. They could represent an accident risk of 1 to 2 per year. Compared to the at-grade alternative for the downtown section, the elevated option would represent a reduction in the risk of accidents of 3 to 5 accidents per year for the lower profile version and up to 5 to 6 accidents per year for the high profile.**

Forest Park Parkway At-Grade

This option would be a substitute for either the underground or at-grade alternative through downtown Clayton.

a. ***Train-Vehicle Conflicts.*** **The alignment would be grade-separated except for an at-grade crossing of Forsyth Boulevard in east Clayton. This crossing would be protected by crossing gates and warning signals. There would be two traffic movements in conflict with MetroLink operations.**

b. ***Pedestrian Access*****. This option has two downtown stations, and both would be at grade. The east station would be directly linked by sidewalk to Forsyth Boulevard. The station at Central Avenue would include pedestrian bridges over Shaw Park Drive: one would link to the St. Louis County garage site at the northwest corner of Central/Shaw Park Drive, and one would link to the northeast corner. The latter could also include a pedestrian bridge over Forest Park Parkway to the residential neighborhood south of downtown.**

c. ***Sight Distance*. The stations would have center platforms. Sight distances for the operator would not be a safety issue.**

d. ***Accident Potentials.* There would be a small risk of accident at the Forsyth Boulevard at-grade crossing. In terms of an accident rate, the risk would be less than one per year.**

Brentwood Boulevard At-Grade

This would be an option to the At-Grade/Grade-Separated Combination alternative in downtown Clayton. Instead of turning south onto Meramec Avenue, the MetroLink alignment would continue west on Carondelet Avenue to Brentwood Boulevard.

a. ***Train-Vehicle Conflicts.* This would increase the number of conflicts by one. The intersection of Brentwood/Carondelet would be substituted for the intersection of Bonhomme/Meramec. Each has 6 conflicting movements. With tracks running straight through the Meramec/Carondelet intersection, conflicts increase from 5 to 6; hence, there would be only a net increase in one conflict for the route.**

However, the situation could be somewhat worse in that Brentwood Boulevard is a high-volume street. The risk of accident exposure would be higher than at Meramec and Bonhomme based upon daily traffic volumes entering the intersection.

b. ***Pedestrian Access*. Since no stations are included in this option, conditions would be the same as those previously described for the at-grade alternative. A more significant aspect is that tracks would be located along Shaw Park. The west sidewalk along Brentwood would serve the park. It would also be adjacent to the track zone. The sidewalk could be expected to be used by people attracted to the park (including all age groups). This condition might entail some added risk in that pedestrians could be crossing tracks along this section at Brentwood Boulevard.**

c. ***Sight Distance*. This option also involves a 90º curve for the tracks. The situation would not be any different than previously described. Because of the turn, train speeds would slow in the approaches.**

d. ***Accident Potentials.* Conditions previously described would apply here. The length of semi-exclusive right-of-way would increase by one block or 0.15 track miles. MetroLink tracks would cross one additional high-traffic-volume intersection. This could increase risk by 1 to 2 accidents per year.**

Galleria/Elevated

This would be an option for the alignment along the CMT right-of-way in the Galleria area.

a. ***Train-Vehicle Conflicts.*** **No train-vehicle conflicts would be added or reduced.**

b. ***Pedestrian Access*****. The proposed station would be integrated with new development. Street access would occur on University Club Tower Drive with sidewalk connections to Brentwood Boulevard. Pedestrians would not cross any streets directly, except that connections to the Galleria Shopping Center would require crossing Brentwood, a very high-volume street. The design concept includes the potential for a pedestrian bridge over Brentwood to overcome this concern.**

c. ***Sight Distance*****. The station would have a center platform. There would be no at-grade crossing of the tracks. Stopping distance would not be a problem for this option.**

d. ***Accident Potentials.*** **This option would not change the risk of accidents. The addition of a pedestrian bridge over Brentwood Boulevard would lower the risk.**

Laclede Station Road

This option would be a substitute for either of the two basic alternatives. The alignment would pass along the west and south edges of the Sunnen Business Park.

a. ***Train-Vehicle Conflicts.*** **This option would add two at-grade crossings of the MetroLink tracks (i.e., at Flora Avenue and Sunnen Drive). This would increase movement conflicts by 6 (4 at Sunnen and 2 at Flora) compared to the elevated alternative. The increase would be zero compared to the combination alternative. Each of these locations would have low to moderate traffic volumes. They would be controlled by railroad crossing gates and warning signals. Because of the station location, the Sunnen Drive crossing would have trains operating at a very slow speed. At Flora Avenue, trains would be operating at 25 mph.**

b. ***Pedestrian Access*****. Pedestrian access would be at-grade toward the north end of the station, but would require steps/ramp toward the south end (i.e., from Hanley Road). The at-grade access would entail the crossing of Sunnen Drive. As a low-volume road, this would not be a significant safety consideration. Access at Hanley is set back in an off-street facility. This would not require crossing Hanley Road at the location. However, some crossing could be needed further north and/or south to access the west side at Hanley and beyond.**

c. *Sight Distance*. The option includes a 90º curve. There would not be sight distance limitations at this curve. The station immediately north of the curve would require slow speed operation.

There are some sight distance limitations at the Flora Avenue at-grade crossing. The tracks would be on an upgrade from the north approaching the crossing. High vegetation exists along the right-of-way at this point.

d. *Accident Potentials*. The option would increase the length of track miles in semi-exclusive right-of-way by 0.04 track miles. This could increase the risk of accidents; it would be very small, i.e., the application of the risk factor would indicate a risk of 0.1 accidents per year.

Deer Creek Terminal

This option would substitute Deer Creek for Lansdowne Avenue as the south terminal of the line for either basic alternative. This could possibly reduce accident potential slightly by virtue of removing station site access movements from the high-traffic intersection of Lansdowne/River Des Peres Boulevard. There would, however, be an increase in traffic at Big Bend/Oxford Avenue. The two conditions could balance.

4.2.5 Enhance Personal Security

Considerations of personal safety focus on users of the system. Measures reflect concerns that riders could have about personal security, as distinguished from traffic safety.

4.2.5.1 Fully Grade-Separated Alternative

a. *Pedestrian access* for this alternative entails a variety of circumstances. There would be six below-ground stations, two surface level on the CMT right-of-way, and two in elevated locations. From a personal security perspective, these stations would be accessed in the following manner:

- Underground Stations

  — *Forest Park*. This station is below ground grade, but the platform is open to the sky, except for the western 50 to 75 feet, which is under the DeBaliviere Avenue bridge. Access is from both sides of DeBaliviere. Ramps and stairways are in open sight. The elevator has openly visible access.

  — *Skinker Boulevard*. This station would be in a tunnel. Access is via underground passageways that link the mezzanine level of the station to

the northwest and southwest corners of Skinker/Forest Park Parkway. There is also an access to the south side of Millbrook Boulevard about 300 feet west of Skinker. The platform and passageways are not visible from the street. Each has corners that limit sight distance.

— ***Big Bend.*** **This station has the same characteristics as the Skinker Boulevard station described above.**

— ***Carondelet Plaza.*** **This station would be in a tunnel. However, because of the positioning of the platform, access to the ground surface is directly vertical from the platform; that is, no mezzanine passageways are required. The platform is not visible from the ground. There is the potential that joint development could occur at this location that would incorporate other activities with the station.**

— ***Downtown Clayton Core.*** **This station would be in a tunnel. Its position allows for vertical access directly to the ground surface; i.e., no underground passageways required. The station's proximity to the St. Louis County complex would make it possible for county personnel to observe the platform from contiguous buildings. It is possible that secured linkage to the basement levels of the courthouse and administrative center could be developed.**

— ***Galleria.*** **The station would be in a tunnel. If the west side of the Brentwood Boulevard platform location is used, access to the ground level could be achieved directly over the platform. If the center-of-right-of-way position is used, then mezzanine passageways would be required. These station locations would not be observable.**

- **Ground Surface Stations**

— ***Eager Road.*** **This platform, in the CMT right-of-way at ground level, would be visible. There would be no hiding places in the access facilities. Parking facilities could include a garage. It would be a self-parking facility with no attendants. Internal areas of the garage would have hiding places.**

— ***Manchester Road.*** **This platform would be in the CMT right-of-way at ground level. The right-of-way is on an embankment, requiring stairs and ramps, which would be visible, to access the platform. The platform would be visible from Manchester Road.**

- **Elevated Stations**

  — ***Deer Creek.*** **This platform would be elevated along the CMT right-of-way and would be visible from adjoining land uses. An existing industrial building near the platform site (just to the west) would block some visibility from Big Bend Boulevard.**

  — ***Lansdowne Avenue.*** **This platform would be on an embankment. Pedestrian access would be available to both sides of Lansdowne Avenue. The platform would be visible from Lansdowne Avenue. Most of the vertical access could be from the parking and bus transfer facilities on the north side of Lansdowne. The facilities would include a customer service building (attended). The site would also include a parking garage, which would be a self-parking facility without attendants. Internal areas of the structure would have hiding places.**

b. ***Usage Level.*** **A personal security consideration closely allied with the quality of pedestrian access is the level of patron activity at the station. Based on the ridership estimates, the following stations would have low ridership (less than 1,000 boardings per day):**

— **Skinker Boulevard**
— **Big Bend**
— **Carondelet Plaza (short term)**
— **Deer Creek (when not terminal station)**

Conversely, the stations with significantly high ridership activity would be:

— **Forest Park**
— **Galleria**
— **Manchester Road**
— **Downtown Clayton Core**
— **Eager Road**
— **Lansdowne Avenue**

In addition to ridership, the activity levels in the areas surrounding the stations would mean people on the street, enhancing patrons' sense of security. These stations would include:

— **Forest Park**
— **Downtown Clayton Core**
— **Eager Road**
— **Carondelet Plaza**
— **Galleria**

c. ***Eyes on the Street.*** **Along with activity in and around the station, another aspect of personal security concerns the concept of "eyes on the street." This occurs when nearby land uses are in position for people to see the station and immediate area. It is a type of "ownership" in which people pay attention to occurrences in their immediate area.**

— ***Forest Park Station.*** **There are nearby areas that offer eyes on the street. There are vantage points from nearby buildings to see the station area. Possible joint development at the station site could enhance this potential.**

— ***Skinker Boulevard.*** **The opportunity for eyes on the street would be limited. Campus buildings are somewhat distant from the station, although there is the possibility that university security forces would be in the station vicinity. Nearby residential land uses do not front on Forest Park Parkway or Millbrook. Fencing and vegetation would limit observation.**

— ***Big Bend.*** **This location would afford good opportunities for eyes on the street. Campus facilities are closer, and there would be new development adjacent. There is an active local commercial center at the northwest corner of the intersection. Also, the station could be observed from some nearby residences.**

— ***Carondelet Plaza.*** **Located near a major hotel and possibly adjacent to a future residential development, this station would offer a good level of observation. Nearby commercial activity creates daytime activity, and the residential land uses create a nighttime presence.**

— ***Downtown Clayton Core.*** **The downtown is an active place. The public uses create the potential for 24-hour observation. Adjacent buildings have unrestricted views of the station.**

— ***Galleria.*** **This station is in the middle of a great deal of activity during both daytime and evening hours. There are no immediate residential land uses, so nighttime observation would be limited.**

— ***Eager Road.*** **Although in a somewhat secluded location, this station is near substantial activity. Since there are no residential land uses nearby, any possible observation would generally be during daytime hours. Future development of adjacent sites, however, could change this situation.**

— ***Manchester Road.*** **Activities near the station are limited. The Sunnen Corporation main plant creates a significant visual presence. There are some residences northeast of the site that front away from the station.**

— ***Deer Creek.*** **Activities near the station include adjacent industrial land uses, a gas station, and some commercial centers. Residential land use is somewhat far from this location.**

— ***Lansdowne Avenue.*** **There are some residential and industrial land uses near the site to create the potential for eyes on the station, but in a limited fashion.**

d. ***Proximity to Moving Traffic.*** **Another aspect of rider perception of safety is associated with the proximity of station access to moving traffic.**

- ***Forest Park.*** **Access would be from midblock locations. Ramps, stairs, and elevators are not adjacent to traffic lanes.**

- ***Skinker Boulevard.*** **Access would be from the corners of the intersection, which are 5 to 10 feet from moving traffic.**

- ***Big Bend.*** **Access would be from the corners of the intersection, which are 5 to 10 feet from moving traffic.**

- ***Carondelet Plaza.*** **Station access facilities are close to the pavement, but there is reasonable clearance so that moving traffic should not be a concern.**

- ***Downtown Clayton Core.*** **Station access is in a vehicle-free environment.**

- ***Galleria.*** **Station access is close to a very high-traffic street. Clearance for moving traffic is limited. For the station location option on the west side of Brentwood, somewhat more clearance is possible.**

- ***Eager Road.*** **This station would have little impact from moving traffic. The station is significantly distant, and the linkage between parking and the station is short, crossing only one 2-lane drive.**

- ***Manchester Road.*** **There is little conflict with moving traffic at this station. Sidewalks would be developed along Manchester Road to create enhanced clearance between pedestrians and moving traffic.**

- ***Deer Creek.*** **There is little conflict with moving traffic.**

- ***Lansdowne Avenue.*** **There is little conflict with moving traffic. The station has pedestrian access from both sides of Lansdowne Avenue.**

4.2.5.2 At-Grade/Grade-Separated Alternative

a. **As with the previous alternative, pedestrian access entails a variety of circumstances. There could be five stations with at-grade street access, three on ground surface in the CMT, and one elevated structure and one below ground.**

- **Underground Stations**

  - ***Forest Park.*** **This is the same station design that would be used for the fully grade-separated alternative. See Section 4.2.5.1a. for discussion.**

- **Ground Surface Stations**

  - ***Eager Road and Manchester Road.*** **These stations would have the same design as that for the fully grade-separated alternative. See Section 4.2.5.1a. for discussion.**

  - ***Galleria/CMT.*** **The platform would be located on the CMT right-of-way between Clayton Road and Galleria Parkway. The platform would be highly visible. Station access would not involve any hiding places or entrapment locations.**

- **At-Grade Stations**

  - ***Skinker Boulevard.*** **The platform would be at-grade near the Forest Park Parkway/Skinker Boulevard intersection. These facilities would be highly visible. There would be no hiding places along pedestrian access connections.**

  - ***Big Bend.*** **The platforms would be at-grade near the Big Bend/Millbrook Boulevard intersection and would be highly visible, without any hiding places.**

  - ***Carondelet Plaza.*** **The platforms would be at-grade along the north edge of Carondelet Plaza, just south of Forsyth Boulevard. The platforms would be highly visible, with no hiding places along pedestrian access routes.**

  - ***Downtown Clayton Core.*** **The platforms would be in a pedestrian plaza on Carondelet Avenue between Central and Meramec. With the removal of the second-level structure over the street, the station would be highly visible, without hiding places.**

  - ***Big Bend/Oxford Boulevard.*** **The platforms would be at-grade just west of Big Bend Boulevard and adjacent to the Deer Creek Center. These platforms would be visible. Although the station site would be open to view from three sides, the existing rail embankment and vegetation would create some potential hiding places.**

- **Elevated Stations**

  - ***Lansdowne Avenue.*** **This is the same station design as that for the fully grade-separated alternative. See Section 4.2.5.1a. for discussion.**

b. ***Usage Level.*** **The discussion of usage level provided in connection with the fully grade-separated alternative would apply to this alternative. The general pattern of ridership by station and land-use activity around station sites would be the same for the at-grade/grade-separated combination alternative as for the fully grade-separated alternative.**

The difference is that the low level of activity for stations with platforms out of public view, such as the underground stations at Skinker and Big Bend, is a more serious problem than for similar locations with an at-grade alignment in which the platforms are in public view.

c. ***Eyes on the Street.*** **The comments listed in Section 4.2.5.1c. for the fully grade-separated alternative apply to this alternative.**

The one difference is for the Big Bend/Oxford Boulevard station site, which is tucked into a corner of the shopping center with the existing railroad to the immediate north. There is some commercial land use to the east from which the station would be visible. The Deer Creek Center building has a blank wall without windows facing the site.

d. ***Proximity to Moving Traffic.*** **The conditions cited in the discussion of the fully grade-separated alternative for the downtown Clayton core, Eager Road, Manchester Road, and Lansdowne Avenue stations also apply to this alternative. There are differences for the following stations:**

- ***Skinker Boulevard.*** **Station access would be via the standard crosswalks to the median and then along the median to the platform. The platforms would have a low wall on the edge adjacent to the traffic lane to prevent vehicle encroachment into the platform. The intersecting streets carry high volumes of traffic. Pedestrians would be in proximity to moving traffic, which could create some sense of discomfort.**

- ***Big Bend.*** **The comments above for Skinker Boulevard apply to Big Bend Boulevard.**

- ***Carondelet Plaza.*** **The platform is north of the existing Carondelet Plaza roadway. Passengers would be separated from moving traffic. No negative perceptions would be expected.**

- ***Galleria/CMT.*** **The platform is on the CMT right-of-way. Passengers would be substantially separated from moving traffic. The only possible concern could be the sidewalk link along Galleria Parkway to Brentwood Boulevard, which would require an at-grade crossing of the I-170 entrance ramp, although this would be at**

a signalized intersection. Eastbound to northbound left-turning vehicles would need to respect the crosswalk, which might make pedestrians wary of this crossing.

4.2.5.3 Section Options

The following discussion applies to the various section options using the four measures applied to the two basic corridor alternatives.

South Edge At-Grade

This option concerns placing an at-grade alignment along the south edge of Forest Park Parkway and Millbrook Boulevard. Because of various alignment conditions, the at-grade portion would transition to a below-ground alignment at a point east of Throop Drive. An at-grade station would be located west of Skinker Boulevard, and an underground station would be located east of Big Bend Boulevard.

a. ***Pedestrian Access.*** **The conditions for the Skinker station would be the same as those described for the basic at-grade options. The platform would be in public view, without hiding places. The Big Bend station would have conditions similar to those described for the underground alternative. The platforms would be in a tunnel. Underground passageways would connect the street surface to the platforms, and these spaces would be out of public view.**

b. ***Usage Level.*** **The comments noted previously for the Skinker and Big Bend stations apply to this option.**

c. ***Eyes on the Street.*** **The comments noted previously apply to this option.**

d. ***Proximity to Moving Traffic.*** **The edge location for station platforms remove access from the median location. For the Skinker station, a more comfortable location would result if passengers did not feel the presence of moving traffic so close to them. For Big Bend Boulevard, the below-grade location and south edge access would not involve concerns about moving traffic.**

Skinker Boulevard and Big Bend Boulevard Underpasses

a. ***Pedestrian Access*****. Conditions for the train underpass would be the same as described for the underground alternative. The station is out of view and includes three underground passageways that could be entrapment zones. The roadway underpass would not be any different than described for the median at-grade.**

b. ***Usage Level*. Same comment as made previously. Usage level at this station would be low.**

c. ***Eyes on Street*. Previous comments apply here, no difference.**

d. ***Proximity to Moving Traffic.* The conditions for the train underpass would have access from the sides of the street, similar to that described for the underground. The roadway underpass would be same as for the median at-grade or south edge at-grade.**

Downtown Clayton Elevated

This option (high or low profile) involves the use of an elevated alignment along Forest Park Parkway through downtown Clayton. One elevated station at Central/Shaw Park Drive would be included.

a. ***Pedestrian Access.* The platform would be clearly visible from various directions. Pedestrian access, however, includes a mezzanine level and a pedestrian bridge north along Central Avenue. These facilities could have an open design, but they could be perceived by passengers as entrapment locations.**

b. ***Usage Level*. The station would have a moderate use level. Movements in and out of downtown Clayton could maintain activity throughout much of the day, excluding late evening.**

c. ***Eyes on the Street.* The proximity of high-rise office and residential land uses creates the potential for the platform to be seen by other people.**

d. ***Proximity to Moving Traffic.* This station is well removed from other moving traffic.**

Forest Park Parkway At-Grade

This option involves the use of a generally at-grade alignment along Forest Park Parkway through downtown Clayton. Two at-grade stations would be included: at Forsyth Boulevard and at Central Avenue.

a. ***Pedestrian Access.* Both platforms would be clearly visible from various directions. Pedestrian access, however, for the Central Avenue station includes pedestrian bridges over Shaw Park Drive. These facilities could have an open design, but they could be perceived by passengers as entrapment locations. The Forsyth Boulevard station has sidewalk access.**

b. ***Usage Level.*** **The stations would have a moderate use level. Movements in and out of downtown Clayton could maintain activity throughout much of the day, excluding late evening.**

c. ***Eyes on the Street.*** **The proximity of high-rise office, hotel, and residential land uses creates the potential for the platforms to be seen by other people.**

d. ***Proximity to Moving Traffic.*** **These stations are well removed from other moving traffic.**

Galleria Elevated

This option would locate an elevated alignment through a prime redevelopment area. The station could be physically integrated with such development.

a. ***Pedestrian Access.*** **Access would be integrated with development and be fully visible to site security personnel. In the short term, the platforms and access would be in public view.**

b. ***Usage Level.*** **The station site would be busy. Ridership potentials would be high. Major office, retail, and other commercial uses would create an active site.**

c. ***Eyes on the Street.*** **The integrated development would permit substantial observation by others in the station area.**

d. ***Proximity to Moving Traffic.*** **Passengers would feel safely removed from moving traffic. The only possible negative aspect would be the need to cross Brentwood Boulevard at-grade to reach the Galleria shopping center. The design concept includes a possible pedestrian bridge, which would overcome this issue.**

Laclede Station Road

This would be an optional alignment around the west and south edges of the Sunnen Business Park.

a. ***Pedestrian Access.*** **In the short term, the platforms and access would be in public view. Station access from Hanley Road would be visible from Hanley Road. There would be no entrapment areas.**

b. ***Usage Level.*** **The potential ridership generated by residential and major commercial/ industrial land uses will crate a moderate usage level. Activity would be mostly industrial work trips, and evening activity levels would be low.**

c. *Eyes on the Street.* **In the short term, existing residential property would create 24-hour observation of the platform. As the area redevelops, there would be new industrial/ commercial development in proximity to the station to ensure observation.**

d. *Proximity to Moving Traffic.* **There would be no traffic concern at this location.**

4.2.6 Minimize Traffic Impacts (Reduction in Capacity of Other Modes)

Traffic impact considerations would address two basic situations: (1) traffic conditions for the at-grade alternative at intersections and (2) traffic conditions associated with access to proposed MetroLink stations.

4.2.6.1 Fully Grade-Separated Alternative

a. *At-Grade Intersection Capacity.* **Since this alternative has no at-grade sections, there would be no impact on intersection capacity because of train operations at grade. The only possible impact would be delays associated with passenger drop-off/pick-up activities at stations from high volume streets. There is a risk of this problem along Skinker Boulevard, Big Bend and Brentwood (at Galleria). The specific extent can't be estimated.**

b. *Site Access Conditions.* **This measure addresses the access situation associated with traffic attracted to proposed stations. One involves access to stations with specific facilities to attract traffic; e.g., park-n-ride and major bus transfers. The second concerns the possible attraction of park-n-riders but in locations where no parking is being provided. This would result in neighborhood or commercial area encroachments.**

- *Site Traffic.* **Station sites that will generate significant traffic will be the Eager Road and Lansdowne Avenue stations, which will have major park-n-ride facilities. The Lansdowne Avenue station will also have a major bus transfer facility.**

  — *Eager Road.* **Based upon the estimated year 2020 ridership and mode of arrival (See section 4.2.1), this site would require a major 1,000-space park-n-ride facility. Principal site access would be via a connection to the intersection of Dale Avenue and Hanley Road. A second connection could be made to Eager Road at a point just east of the CMT right-of-way (i.e., west of Hanley Road). However, assuming improvements to I-64 (being planned by Missouri DOT) and the Hanley Rd interchange, access will primarily focus on Hanley Rd. An Eager Rd access would not be readily accessible for the freeway direction of approach to the site.**

  The traffic associated with this site has been examined to assess traffic conditions on the surrounding streets.

Figure 4.2-1 illustrates the existing peak-hour traffic in the area. Hanley Road is a major six-lane arterial with peak-hour volumes in the range of 2,000 to 2,600 vehicles per hour. The ramps to and from I-64 produce a substantial flow of traffic. The close juxtaposition of intersections along Hanley Road causes existing weaving problems and delay.

Based on other experience,[2] the estimated site traffic generation for the 1,000-space facility would be as follows:

	A.M. Hour	P.M. Hour
Inbound	595 vehicles	110 vehicles
Outbound	20	440
	615 vehicles	550 vehicles

This distribution of this site traffic was examined in relation to the location of residential population in this section of the corridor. Consideration also was given to the likely attraction of medium- to longer-distance trips from West County and southwest suburban areas via I-64. The overall directions of approach for site traffic would be as follows:

From the west		61%
From the north	9	
From the east		12
From the south	18	
	100%	

Figure 4.2-2 illustrates the assignment of these site-generated traffic volumes to the adjacent street system for a one-access site concept. Figure 4.2-3 illustrates estimated year 2020 traffic for the area, excluding site traffic generation. As shown, the assumption is that the configuration would change to a "simple point" diamond type. This would enhance capacity and operations.

Figure 4.2-4 illustrates the combined effect of site-generated traffic and other traffic for year 2020 conditions. As shown, two intersections would experience maximum traffic loads: Hanley at Dale and Hanley at Eager. For the one-access scheme, approach volumes at the former would be 955 vehicles in the P.M. peak hour, and for the latter, 4,885 vehicles.

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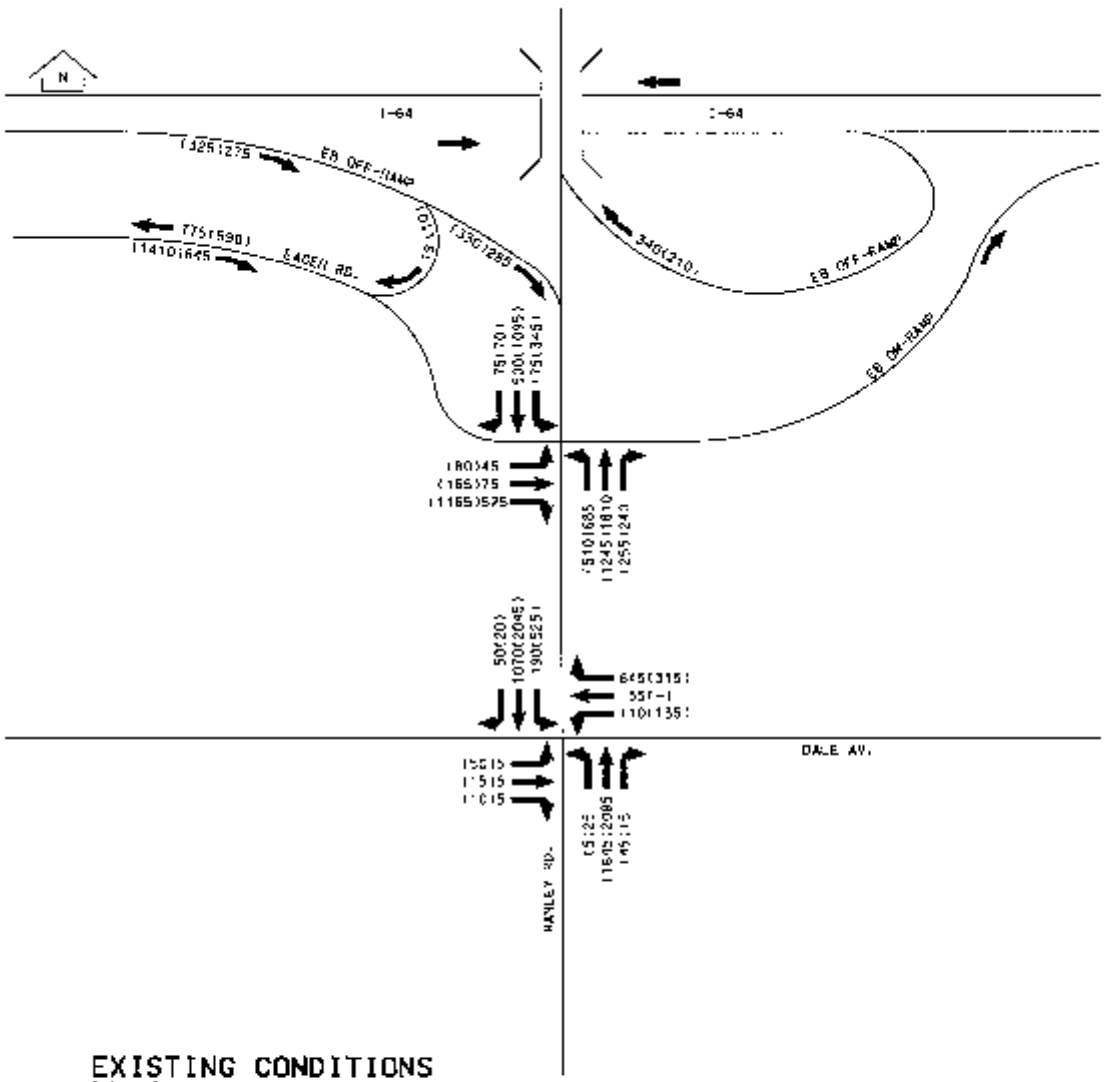
2 *Trip Generation*, published by the Institute of Transportation Engineers, and other consultant experience.

As an indication of traffic conditions, traffic capacity analysis was applied to the interchange ramp/Hanley Road and Hanley Road/Eager Road intersections. Under year 2020 the overall intersection level of service (LOS) will be:

	AM Peak Hr.	PM Peak Hr.
I-64/Hanley	**E+**	**D**
Dale/Hanley	**C**	**D**

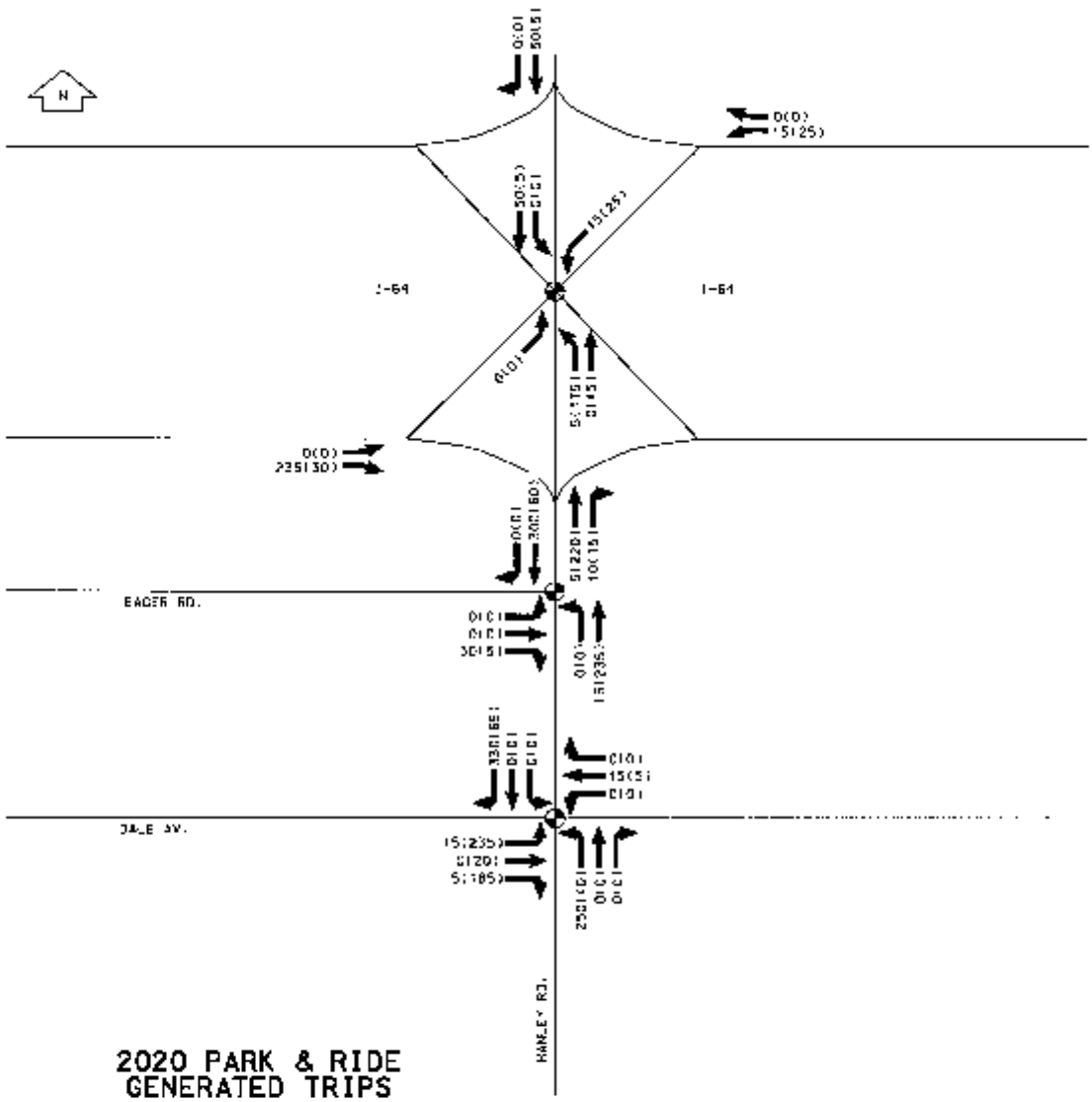
From the standpoint of the MetroLink station, the analysis indicates that access would be acceptable from an operational perspective. There is also the possibility that the placement or redistribution of site parking could be reconsidered. Possibly, some parking could be positioned west of the CMT right-of-way, with access routes coordinated through the Promenade and Hanley Industrial Court.



EXISTING CONDITIONS
FALL 1998 – SPRING 1999

XX AM PEAK HOUR (7:30-8:30AM)
(XX) PM PEAK HOUR (5:00-6:00PM)

FIGURE 4.2-1

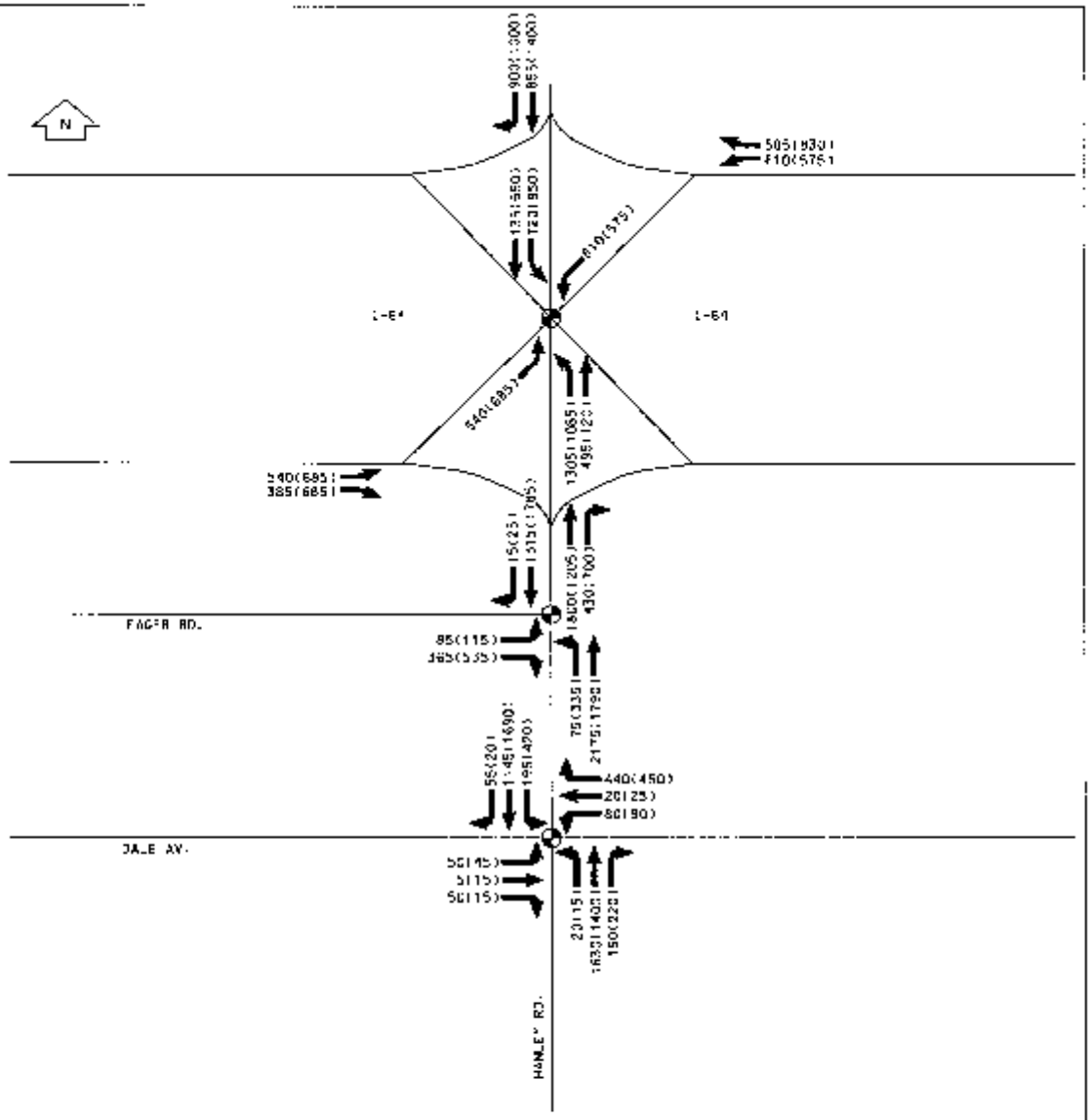


2020 PARK & RIDE GENERATED TRIPS ONE ACCESS – HANLEY ONLY

XX AM PEAK HOUR (7:30-8:30AM)
(XX) PM PEAK HOUR (5:00-6:00PM)

SIGNALIZED INTERSECTION

FIGURE 4.2-2

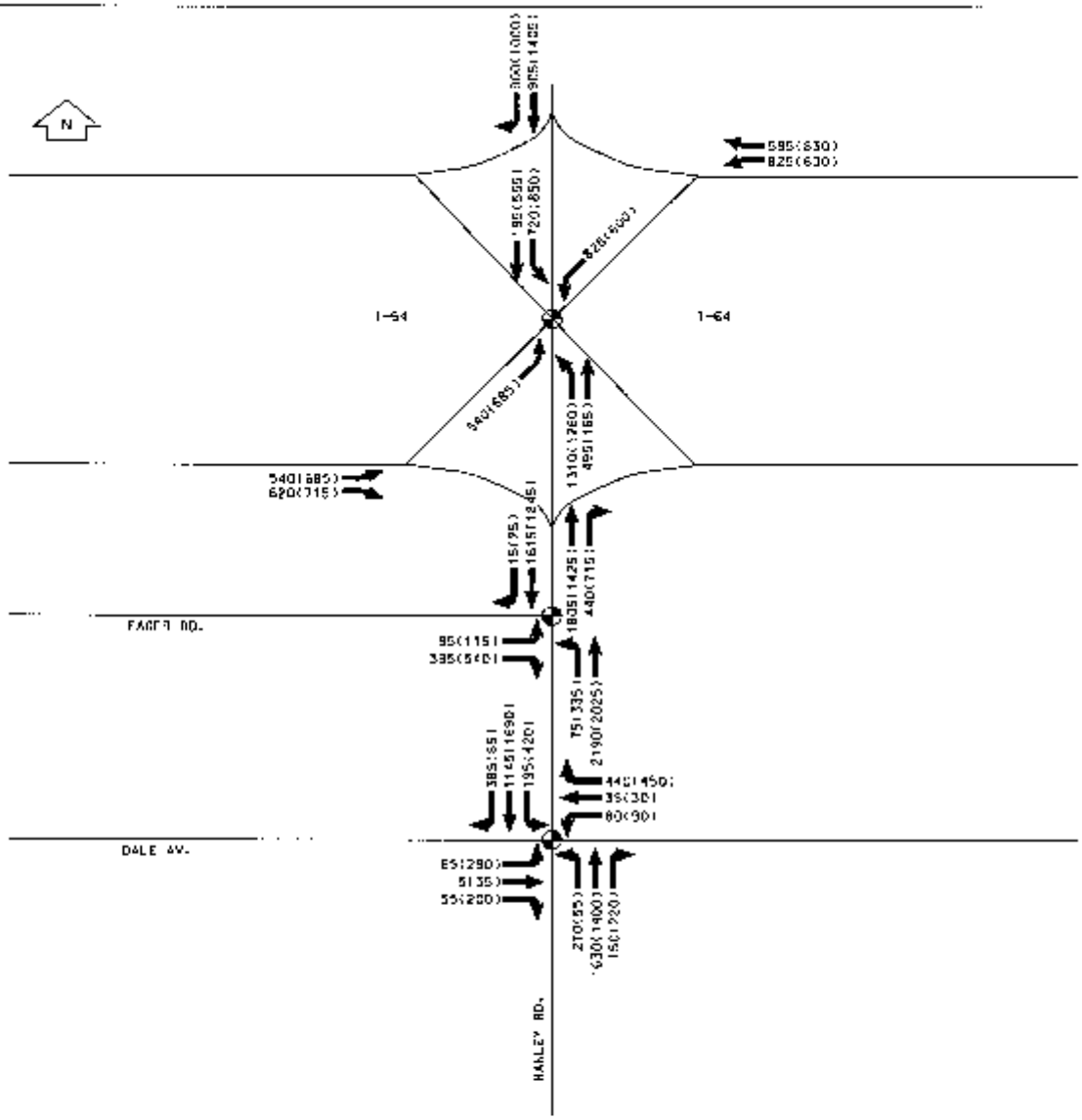


2020 TRAFFIC, WITHOUT PARK & RIDE
ONE ACCESS

XX AM PEAK HOUR (7:30-8:30AM)
(XX) PM PEAK HOUR (5:00-6:00PM)

SIGNALIZED INTERSECTION

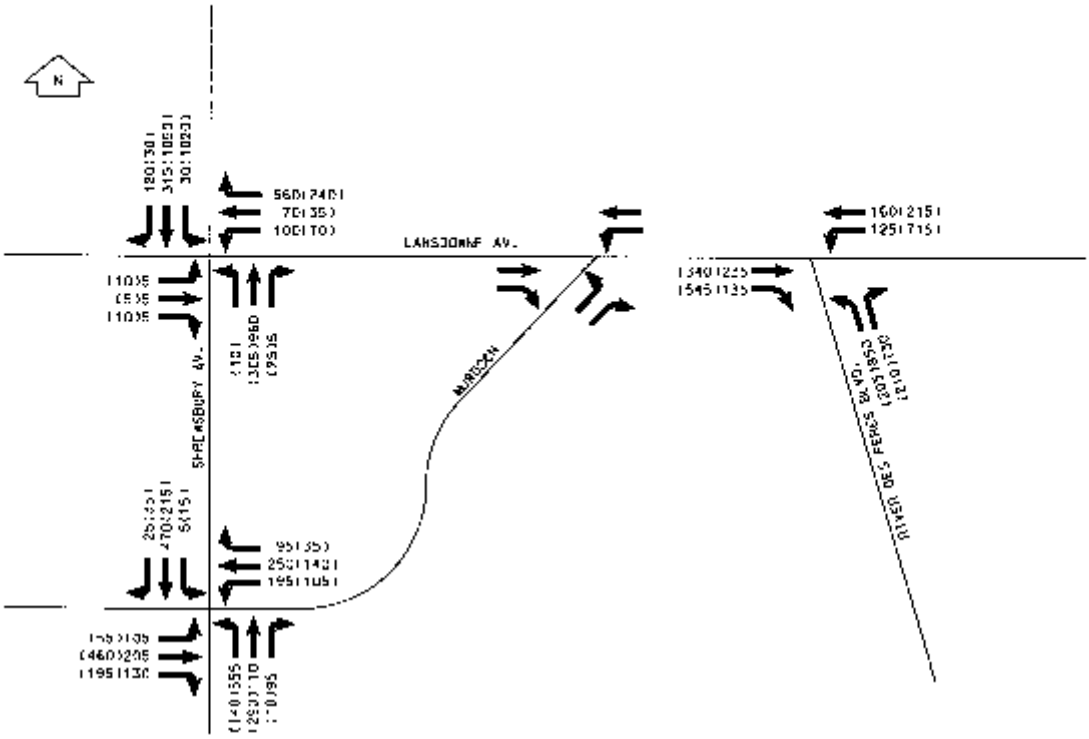
FIGURE 4.2 3



2020 TOTAL TRAFFIC
ONE ACCESS

XX AM PEAK HOUR (7:30-8:30AM)
(XX) PM PEAK HOUR (5:00-6:00PM)
SIGNALIZED INTERSECTION

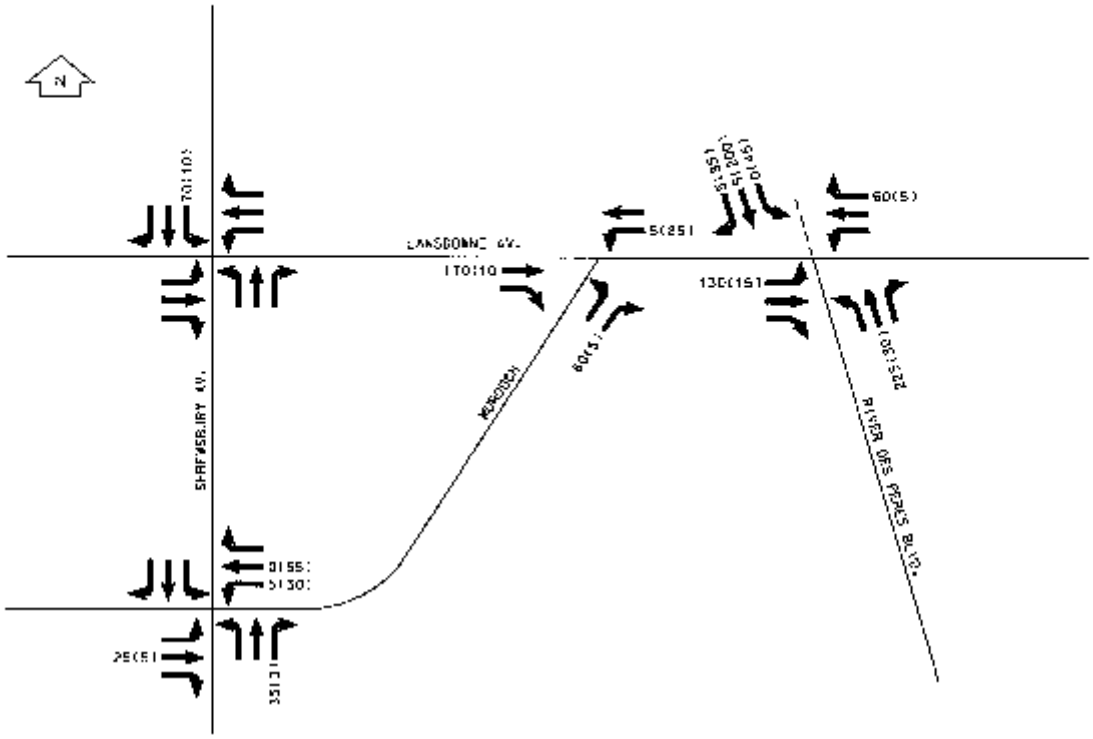
FIGURE 4.2-4



EXISTING 1998–1999

XX AM PEAK HOUR (7:15–8:15AM)
(XX) PM PEAK HOUR (4:15–5:15PM)

FIGURE 4.2-5



LANSDOWNE PARK & RIDE
2020 SITE GENERATED TRAFFIC

XX AM PEAK HOUR (7:15-8:15AM)
(XX) PM PEAK HOUR (4:15-5:15PM)

FIGURE 4.2-6

— *Lansdowne Avenue.* **Similar to the Eager Road station, Lansdowne Avenue would have a major park-n-ride facility (800 spaces) and a major bus transfer facility. The station site has a single access point at the existing Lansdowne Avenue/River Des Peres Boulevard intersection.**

Existing peak-hour traffic volumes are illustrated in Figure 4.2-5. Peak Lansdowne Avenue volumes are approximately 900 to 1,000 vehicles per hour in each direction in the P.M.; for River Des Peres Boulevard, the northbound traffic volume is 1500 vehicles per hour in the A.M.,and more than 400 vehicles per hour in the P.M. The estimated site traffic generation associated with the park-n-ride facilities are as follows:

	A.M. Hour	P.M. Hour
Inbound	415 vehicles	105 vehicles
Outbound	10	330
	425 vehicles	435 vehicles

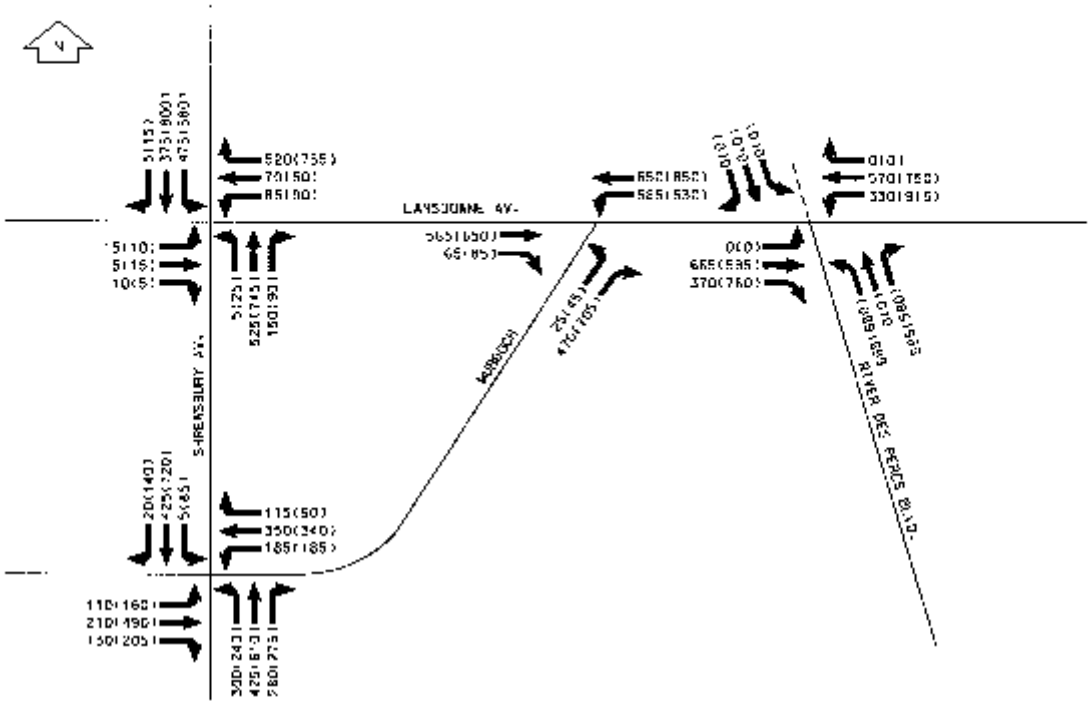
The estimated directional distribution would be as follows:

East	26%
South	26
North	15
West	33
	100%

The assignment of site traffic is illustrated in Figure 4.2-6. Because of access to the City of St. Louis, Shrewsbury, and other suburbs, and somewhat balanced flow of traffic by direction is anticipated. This reflects the existing arterial and freeway system.

Figure 4.2-7 indicates the expected year 2020 non-site traffic. Non-site traffic will increase substantially during the next 20 years. Lansdowne Ave. traffic will increase by 60 to 70%. River Des Peres Blvd. volumes, however, will remain at levels similar to existing levels.

The combination of site and other traffic is illustrated in Figure 4.2-8. Peak-hour volumes on Lansdowne Avenue would increase to 1,100 to 1,600 vehicles per hour per direction. Northbound River Des Peres Blvd. traffic volumes will be 1200 to 1500 vehicles per hour.



LANSDOWNE PARK & RIDE
2020 TRAFFIC, WITHOUT PARK & RIDE TRAFFIC

XX AM PEAK HOUR (7:15-8:15AM)
(XX) PM PEAK HOUR (4:15-5:15PM)

FIGURE 4.2.7

Traffic capacity analysis indicates that the overall intersection level of service at Lansdowne and River Des Peres in the A.M. peak will be D, but in the P.M. it will be F. This assumes that the site access drive would have three exit lanes. To mitigate this situation, the signal phasing could be optimized to be more efficient plus additional turn lanes would be required: dual right turn in the west approach, dual left turns in the east approach, and dual left turns in the south approach.

Besides the traffic impact at the site, site-generated traffic would also affect other intersections. Volumes would increase in the intersection of Murdoch and Shrewsbury Avenue. At the former, traffic on Murdoch would increase by 200 to 400 vehicles (westbound) in A.M. and P.M. peak hour, respectively. For eastbound, the increase would be 35 to 150 vehicles in the A.M. and P.M. peak hours. For southbound, the increase would be 50 to 660 vehicles. The bulk of these increases would not be due to MetroLink station traffic generation. Site traffic would only entail increases of 60 to 85 vehicles during the A.M. and P.M. peak hours in this intersection in total.

The impact of these volumes from a capacity perspective is that Murdoch would need two through lanes plus a left turn lane in the north, east, and west approaches. The south approach would need an additional lane for right turns.

At Shrewsbury and Lansdowne, the traffic on Lansdowne (westbound) would increase by 55 to 555 vehicles in the A.M. and P.M. peak hours, respectively. Eastbound volumes (i.e. east approach) would have no change. Traffic on Shrewsbury (southbound) would increase by 460 vehicles in A.M. peak but would not have any increase in P.M. peak. Again, only a very small amount of traffic south would be due to site traffic, i.e. 10 to 70 vehicles in peak hours for A.M. and P.M. respectively. The intersection would need dual left turn lanes in the north approach and a right turn lane in the east approach.

- ***Other Site Impacts.*** **It is possible that potential MetroLink riders will try to park their cars in the vicinity of the proposed stations. This would encroach on residential neighborhoods or existing private parking facilities. An inventory has been made of these locations, as described below:**

  — ***Forest Park.*** **Parking encroachment at this station has already been a problem at DeGiverville Avenue and Pershing Avenue (and possibly other streets). Parking prohibitions and residential parking permit regulations**

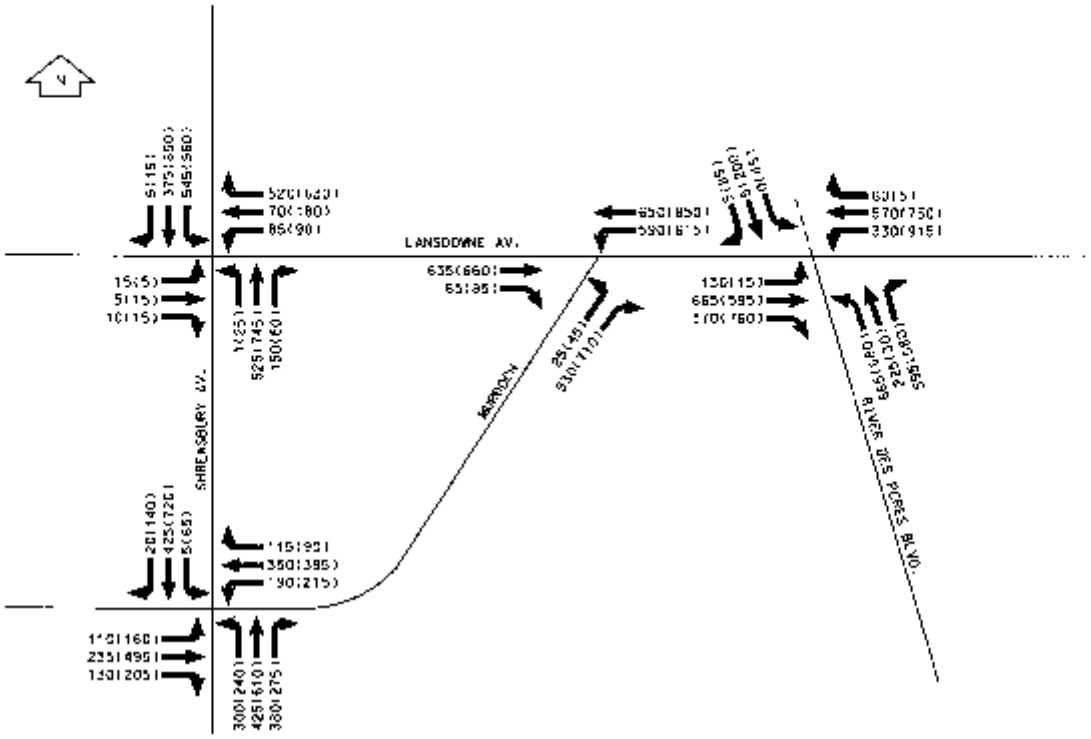
are in place, and these would need to be continued and enforced. A possible redevelopment project at the site of the existing MetroLink station parking lot could significantly expand off-street parking capacity.

— ***Skinker Boulevard.*** **There is considerable risk of parking encroachment near this station, including parking in nearby residential areas and on the Washington University campus. In the residential areas, the streets at risk include Pershing, Waterman, and Eastgate. There are some parking controls in the area, but they may need to be augmented with more specific management measures. On the Washington University campus, there is some on-street metered parking that could attract MetroLink riders. Campus parking regulations are well enforced so that encroachment in campus lots would not be expected.**

— ***Big Bend Boulevard.*** **Similar to Skinker Boulevard, there are nearby residential streets, campus parking, and commercial parking that could be affected by MetroLink parkers. The streets at risk include University Drive, Pershing, Waterman, Westmoreland, Trinity, and possibly others. There are some parking controls on these streets, such as time limits, parking restrictions during midday periods, and residential permits. There is a small, off-street commercial (customer) parking lot at the northwest corner of Big Bend and Millbrook and parking lots in adjacent sections of the Washington University campus that could be impacted by MetroLink parkers. Parking management actions may be necessary to minimize these impacts.**

— ***Carondelet Plaza Station.*** **There are various existing parking lots and commercial garages in this vicinity that could be used by MetroLink parkers. The Bally's and Washington University parking lots on the north side of Forsyth would be a likely target for such parkers. There is on-street metered parking in the immediate area. The occupancy levels for these facilities may increase, although the short time limits would discourage all-day parkers. There will be a need for effective enforcement to maintain appropriate use of the existing parking facilities.**

— ***Downtown Clayton Core.*** **There is substantial on- and off-street parking near this station. MetroLink parkers would compete for space with the downtown population. This could increase parking occupancy levels, although the City of Clayton and St. Louis County are adding (or will) major new parking facilities to the supply. There would be little opportunity for encroachment in the downtown.**



LANSDOWNE PARK & RIDE
2020 TOTAL TRAFFIC WITH SITE

XX AM PEAK HOUR (7:15-8:15AM)
(XX) PM PEAK HOUR (4:15-5:15PM)

FIGURE 4.2-6

— ***Galleria Station.*** **This station would be under Brentwood Boulevard directly adjacent to the Galleria shopping center. There would be a significant risk for encroachment in this facility. A portion of the shopping center is cordoned off until 10:00 A.M. each day, which would effectively eliminate encroachment by typical employees using MetroLink. However, midday and evening travelers could readily attempt to use shopping center parking. There are other nearby parking facilities, generally parts of land uses along the east side of Brentwood Boulevard, that could also be used by MetroLink riders. Most of these facilities have signed restrictions, such as "for use by customers and employees only." The situation will require effective enforcement, mostly directed at private parking. There would be little likelihood of any on-street parking encroachment.**

— ***Eager Road Station.*** **This station will include a major public park-n-ride facility that could involve a user fee. The latter is a policy decision to be yet made. The possibility of user fees could potentially cause MetroLink riders to look for free parking in other nearby private parking lots. The risk would be most likely at the Purina office building, Home Depot, Hanley Industrial Court, and Promenade lots. Collectively, these facilities offer abundant opportunity for parking. The situation will require consideration of a coordinated parking management strategy. There would be little encroachment on public on-street parking.**

— ***Manchester Road.*** **This station could include parking encroachment in industrial parking lots and on residential streets. There are several nearby industrial parking facilities north and south of Manchester Road that could attract MetroLink parkers. The residential area most at risk would include Bartold Avenue, West Point Drive, Circle Drive, and Laclede Station Road. These streets are very close to the station (to the northeast). Parking management would be essential in controlling the likely encroachment.**

— ***Deer Creek.*** **This station should have enough on-site parking to adequately serve MetroLink parkers. There are some adjoining private parking lots that could be impacted. Also, the nearby residential streets of Oxford, Commonwealth, Sussex, and Manhattan avenues could be used for parking. This would be cause for observation to assess whether encroachment is occurring.**

— ***Lansdowne Avenue.*** **This station will have a substantial park-n-ride facility, which also could involve a user fee. This could cause some parkers to search for free parking. There are some private employee lots along St.**

Vincent Avenue that could be at risk. More than likely, nearby residential streets would be used, including St. Vincent, Sutherland, Devonshire, and Wabash avenues, and possibly Plainview. This would be a matter for surveillance to determine whether such encroachment is occurring. If so, then parking management measures may have to be considered.

4.2.6.2 At-Grade/Grade-Separated Combination

a. ***At-Grade Intersection Capacity.*** **This alternative would involve at-grade MetroLink train operations through various intersections. For these locations, existing peak-hour traffic volumes were collected. Traffic signal phasing was examined to find ways to accommodate train movements. These results were included in the Draft Operations Plan prepared for this project.**

Traffic capacity and level of service analysis were completed for the affected intersections. Tables 4.2-8 and 4.2-9 summarize these findings in terms of overall averages for the intersection.

Generally, these intersections operate at Level of Service D or better, and volume-to-capacity ratios (V/C) are well under 1.00. It should be noted that certain specific traffic movements at some intersections operate at worse than Level of Service D, especially some left-turn movements.

Table 4.2-8
CAPACITY ANALYSIS RESULTS: EXISTING VOLUMES
A.M. PEAK HOUR

Corridor Intersection	Cycle Length	Existing Conditions		Proposed Intersection Operations						
				Train w/ Traffic Green		Train w/ Exclusive Phase				
		Intersection Average		Intersection Average		No Train		Full Train Clearance		Weighted Average
		LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
Forest Park/Millbrook										
DeBaliviere	100	D	1.03	NA	NA	NA	NA	NA	NA	NA
Des Peres (1)	100	B	0.52	B+	0.46	NA	NA	NA	NA	NA
Skinker (1)	100	D+	0.76	D	0.79	NA	NA	NA	NA	NA
Skinker (2)	100	D+	0.76	C+	0.53	NA	NA	NA	NA	NA
Hoyt (1)	100	B+	0.55	B+	0.61	NA	NA	NA	NA	NA
Throop (1)	100	A	0.48	A	0.53	NA	NA	NA	NA	NA
Big Bend (1)	100	D+	0.75	D+	0.79	NA	NA	NA	NA	NA
Carondelet										
Hanley (1)	120	C	0.68	NA	NA	C	0.68	C+	0.68	C
Bemiston (1) *	72	B	0.43	NA	NA	B	0.46	C+	0.58	B
Central (3) *	72	A	0.35	NA	NA	B	0.25	B	0.30	B
Meramec (4) *	72	A	0.19	NA	NA	B+	0.13	B	0.20	B+
Meramec (5) *	72	A	0.19	NA	NA	B+	0.13	B	0.18	B+
Brentwood (6) *	110	A	0.13	NA	NA	B+	0.39	B	0.47	B+
Meramec										
Bonhomme (1)	72	B	0.34	NA	NA	B	0.34	C	0.51	B
Shaw Park	72	B+	0.16	NA	NA	NA	NA	NA	NA	NA

(1) Taking median-running through trains into consideration.
(2) Taking median-running through trains into consideration and northbound/southbound thru movement grade-separated.
(3) Taking through trains into consideration and west approach closed to vehicular traffic.
(4) Taking turning trains into consideration and east approach closed to vehicular traffic.
(5) Taking through trains into consideration and east approach closed to vehicular traffic.
(6) Taking turning trains into consideration.

***Existing intersection is unsignalized**

****Weighted Average Delay = [(Delay with full clearance time * Number of cycles with "LRT only" phase) + (Delay with no clearance time * Number of cycles without "LRT only" phase)] / [Total number of cycles]; based on 8 minute train headways.**

Note: LOS = level of service; delay is measured in seconds per vehicle; V/C = volume to capacity ratio.

Table 4.2-9
CAPACITY ANALYSIS RESULTS: EXISTING VOLUMES
P.M. PEAK HOUR

Corridor Intersection	Cycle Length	Existing Conditions		Proposed Intersection Operations						
				Train w/ Traffic Green		Train w/ Exclusive Phase				
		Intersection Average		Intersection Average		No Train		Full Train Clearance		Weighted Average**
		LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
Forest Park/Millbrook										
DeBaliviere	100	D	0.79	NA	NA	NA	NA	NA	NA	NA
Des Peres (1)	100	B+	0.54	B+	0.48	NA	NA	NA	NA	NA
Skinker (1)	100	D+	0.79	D	0.85	NA	NA	NA	NA	NA
Skinker (2)	100	D+	0.79	C+	0.64	NA	NA	NA	NA	NA
Hoyt (1)	100	B	0.68	B	0.75	NA	NA	NA	NA	NA
Throop (1)	100	B+	0.58	B+	0.63	NA	NA	NA	NA	NA
Big Bend (1)	100	D+	0.87	D	0.90	NA	NA	NA	NA	NA
Carondelet										
Hanley (1)	120	C+	0.56	NA	NA	C+	0.56	C+	0.64	C+
Bemiston (1) *	72	B	0.46	NA	NA	B	0.46	C+	0.60	B
Central (3) *	72	A	0.35	NA	NA	B+	0.22	B	0.27	B+
Meramec (4) *	72	A	0.30	NA	NA	B+	0.21	B	0.30	B
Meramec (5) *	72	A	0.30	NA	NA	B+	0.21	B	0.22	B+
Brentwood (6) *	110	C	0.14	NA	NA	B	0.46	C+	0.56	B
Meramec										
Bonhomme (1)	72	B	0.30	NA	NA	B	0.30	B	0.45	B
Shaw Park	72	B+	0.47	NA	NA	NA	NA	NA	NA	NA

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(4) Taking turning trains into consideration and east approach closed to vehicular traffic.
(5) Taking through trains into consideration and east approach closed to vehicular traffic.
(6) Taking turning trains into consideration.

***Existing intersection is unsignalized**
****Weighted Average Delay = [(Delay with full clearance time * Number of cycles with "LRT only" phase) + (Delay with no clearance time * Number of cycles without "LRT only" phase)] / [Total number of cycles]; based on 8 minute train headways.**
Note: LOS = level of service; delay is measured in seconds per vehicle; V/C = volume to capacity ratio.

As a result of changing traffic conditions, future traffic volumes will be different than those existing. Estimates of such traffic growth have been prepared for year 2020.

Also, changed access patterns associated with the at-grade alternative in downtown Clayton will affect traffic flow. Existing traffic movements have been adjusted to reflect revised circulation. Specifically, along Carondelet Avenue between Hanley Road and Bemiston Avenue, left turns in or out of driveways to existing parking facilities would not be permitted. Movements would become right turns in and out. This pattern change affects volumes in both the Hanley/Carondelet and Bemiston/Carondelet intersections. The estimated results are as follows:

Intersection / Approach	A.M. Peak Hour (vehicles)			P.M. Peak Hour (vehicles)		
	Right	Thru	Left	Right	Thru	Left
Hanley/Carondelet						
North	+22			+6		
East		- 12			- 4	
South			+77			+18
West	- 24	- 5	- 13	- 160	- 33	- 88
Bemiston/Carondelet						
North			- 10			- 2
East	+18	- 4	+28	+121	- 24	+184
South	+13			+6		
West		- 90			- 24	

The impact is to reduce traffic volumes in the Hanley Road intersection and add them to Bemiston. Since there is more available traffic capacity at Bemiston, this shift in traffic would be workable.

Applying these traffic-volume changes to the analysis of the at-grade intersections provides a basis for assessing future traffic conditions. Tables 4.2-10 and 4.2-11 summarize the results in terms of level of service (LOS) and volume-to-capacity ratios (V/C).

The estimated conditions indicate that the impact of traffic growth will change level of service. Peak hour volume levels would be closer to capacity. Most intersections would operate at Level of Service D or better.

Table 4.2-10
CAPACITY ANALYSIS RESULTS: FUTURE VOLUMES
A.M. PEAK HOUR

Corridor Intersection	Cycle Length	Year 2020		Proposed Intersection Operations						
				Train w/ Traffic Green		Train w/ Exclusive Phase				
		Intersection Average		Intersection Average		No Train		Full Train Clearance		Weighted Average**
		LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
Forest Park/Millbrook										
DeBaliviere	100	E	1.24	NA	NA	NA	NA	NA	NA	NA
Des Peres (1)	100	B	0.62	B	0.55	NA	NA	NA	NA	NA
Skinker (1)	100	D	0.91	D	0.98	NA	NA	NA	NA	NA
Skinker (2)	100	D	0.91	C	0.64	NA	NA	NA	NA	NA
Hoyt (1)	100	B	0.66	B	0.73	NA	NA	NA	NA	NA
Throop (1)	100	A	0.58	A	0.64	NA	NA	NA	NA	NA
Big Bend (1)	100	D	0.80	D	0.84	NA	NA	NA	NA	NA
Carondelet										
Hanley (1)	120	C	0.82	NA	NA	C	0.83	C	0.83	C
Bemiston (1) *	72	B	0.52	NA	NA	B	0.53	C	0.70	C
Central (3) *	72	A	0.42	NA	NA	B	0.30	C	0.36	C
Meramec (4) *	72	A	0.23	NA	NA	B	0.16	C	0.24	C
Meramec (5) *	72	A	0.23	NA	NA	B	0.16	C	0.22	C
Brentwood (6) *	110	A	0.16	NA	NA	B	0.47	B	0.56	B+
Meramec										
Bonhomme (1)	72	B	0.40	NA	NA	B	0.40	C	0.61	B
Shaw Park	72	B+	0.19	NA	NA	NA	NA	NA	NA	NA

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(2) Taking median-running through trains into consideration and northbound/southbound thru movement grade-separated.
(3) Taking through trains into consideration and west approach closed to vehicular traffic.
(4) Taking turning trains into consideration and east approach closed to vehicular traffic.
(5) Taking through trains into consideration and east approach closed to vehicular traffic.
(6) Taking turning trains into consideration.

***Existing intersection is unsignalized**
****Weighted Average Delay = [(Delay with full clearance time * Number of cycles with "LRT only" phase) + (Delay with no clearance time * Number of cycles without "LRT only" phase)] / [Total number of cycles]; based on 8 minute train headways.**
Note: LOS = level of service; delay is measured in seconds per vehicle; V/C = volume to capacity ratio.

Table 4.2-11
CAPACITY ANALYSIS RESULTS: FUTURE VOLUMES
P.M. PEAK HOUR

Corridor Intersection	Cycle Length	Year 2020		Proposed Intersection Operations						
				Train w/ Traffic Green		Train w/ Exclusive Phase				
		Intersection Average		Intersection Average		No Train		Full Train Clearance		Weighted Average**
		LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
Forest Park/Millbrook										
DeBaliviere	100	D	0.95	NA	NA	NA	NA	NA	NA	NA
Des Peres (1)	100	B	0.65	B	0.58	NA	NA	NA	NA	NA
Skinker (1)	100	D	0.95	D	1.06	NA	NA	NA	NA	NA
Skinker (2)	100	D	0.95	C	0.77	NA	NA	NA	NA	NA
Hoyt (1)	100	B	0.82	C	0.90	NA	NA	NA	NA	NA
Throop (1)	100	B	0.70	B	0.76	NA	NA	NA	NA	NA
Big Bend (1)	100	D	0.93	D	0.96	NA	NA	NA	NA	NA
Carondelet										
Hanley (1)	120	C	0.67	NA	NA	C	0.60	C	0.60	C
Bemiston (1) *	72	B	0.55	NA	NA	C	0.58	C	0.87	C
Central (3) *	72	A	0.42	NA	NA	B	0.26	B	0.34	B+
Meramec (4) *	72	A	0.36	NA	NA	B	0.25	C+	0.36	B
Meramec (5) *	72	A	0.36	NA	NA	B	0.25	C+	0.26	B
Brentwood (6) *	110	C	0.17	NA	NA	B	0.55	C	0.67	C
Meramec										
Bonhomme (1)	72	C+	0.36	NA	NA	B	0.36	C	0.54	C
Shaw Park	72	B+	0.56	NA	NA	NA	NA	NA	NA	NA

(1) Taking median-running through trains into consideration.
(2) Taking median-running through trains into consideration and northbound/southbound thru movement grade-separated.
(3) Taking through trains into consideration and west approach closed to vehicular traffic.
(4) Taking turning trains into consideration and east approach closed to vehicular traffic.
(5) Taking through trains into consideration and east approach closed to vehicular traffic.
(6) Taking turning trains into consideration.

*Existing intersection is unsignalized

**Weighted Average Delay = [(Delay with full clearance time * Number of cycles with "LRT only" phase) + (Delay with no clearance time * Number of cycles without "LRT only" phase)] / [Total number of cycles]; based on 8 minute train headways.

Note: LOS = level of service; delay is measured in seconds per vehicle; V/C = volume to capacity ratio.

As discussed above, the at-grade alignment in downtown Clayton causes some modification in access and circulation. All access is maintained, but the pattern of vehicle traffic movements would change.

The impact would be associated with a series of driveways along Carondelet Avenue between Hanley Road and Bemiston Avenue. Most of these driveways access parking facilities and loading docks. One drive serves the front door of the Radisson Hotel. Because of using right-turn-in and -out movements, motorists would need to circulate around the block. Those intending to use driveways on the north side of the street would need to adjust their patterns to travel westbound through the Hanley Road intersection. Those destined for the south side of the street (including the hotel) would need to travel eastbound through the Bemiston intersections. Such adjustments are reasonably possible using combinations of Forsyth, Bonhomme, Hanley, Bemiston, and Central Avenue.

In the other sections of the corridor, the similar situation would occur. All existing intersections and access points would be kept open. There would be some changes in access patterns. At the northwest corner of Big Bend Boulevard and Millbrook Boulevard, an existing commercial driveway would be limited to right-turn in and out movement. Driveway geometrics along Washington University would be modified by virtue of changes in the alignment of Millbrook Boulevard to accommodate station platforms and turn lanes.

At the intersection of Forest Park Parkway and Des Peres Avenue, left turns from Forest Park Parkway would be prohibited. This means that the access pattern to the area served by Des Peres Avenue would be modified. Other streets, such as DeBaliviere, Lindell, Pershing, Waterman, Kingsbury, and Westminster, would need to be used as substitutes for access. Current volumes making the left turn at Des Peres Avenue are 60 vehicles per hour westbound (A.M. and P.M.) and 5 vehicles per hour eastbound (A.M. and P.M.). This traffic would redistribute over multiple streets in the area.

b. ***Site Traffic.*** **The analysis discussed for Eager Road and Lansdowne Avenue for the fully grade-separated alternative would be the same for the at-grade alternative**

Similarly, the impact of parking encroachment discussed previously would apply here. There could be some difference associated with the Galleria/CMT station. The latter station is closer to existing development on the east side of the CMT right-of-way and to the neighborhoods in the vicinity of Linden and Winzenburg.

There is substantial existing parking for the offices and Tropicana Bowling Alley immediately adjacent to the station site. While the ground-side access would be provided west of the station, there is an alternate route to the east side of the station using Crescent Drive at Clayton Road for access, these existing parking areas and internal circulation drives would be attractive for MetroLink riders to use. This would result in both parking encroachment and added traffic via drop-off/pick-up activities.

The station could be fenced off along its east side, but this would defeat part of the purpose for the station. There are many potential MetroLink users in this area who need convenient access.

As discussed previously for the other Galleria station (underground), some type of parking management would be needed to minimize the encroachment. Similarly, for the residential area, the station would be a short walking distance from Linden Avenue. Existing institutional land-uses, fronting on Linden Avenue, have existing parking lots extending along the CMT right-of-way. These locations, plus other streets in this vicinity (McMorrow, Winzenburg, Terrace, Buck), could be impacted by MetroLink parkers. Should this impact occur, parking management actions would be needed, including enforcement.

4.2.6.3 Section Alternative/Options

The following options are possible for certain sections along the corridor. Differences in traffic impact, as compared to the basic alternative, are discussed.

South Edge At-Grade Option

This option entails an alignment wherein the at-grade tracks would be located along the south edge of Forest Park Parkway and Millbrook Boulevard, from just west of DeBaliviere to a point midway between Hoyt and Throop Drives. At this location, the track would transition to a below-ground alignment. Throop Drive would be kept open.

This option would not affect site traffic; station site traffic and potential residential and commercial area parking encroachment would be the same as previously discussed. There would be a significant impact on three intersections due to at-grade traffic operations.

This option (also referred to as "side-running" alignment parallel to Forest Park Parkway and Millbrook Boulevard) would affect traffic conditions differently (compared to the at-grade median alternative) at all intersections in this section. For the intersections at Throop Drive and Big Bend Boulevard, MetroLink tracks would be underground. There would be no impact on traffic operations due to train movements. For the intersections at Des Peres Avenue, Skinker Boulevard, and Hoyt Drive, at-grade operations would still occur.

For these at-grade intersections, traffic signal phases would need to use pre-emption; i.e., whenever MetroLink trains approached, signals would automatically initiate a crossing clearance sequence using crossing gates and warning signals. Traffic on the north-south cross-streets would be stopped during this period. Eastbound right turns and westbound left turns would also be stopped for train movements. The advance clearance time and the time for train passage would amount to 25 to 30 seconds. Such time needs to be allocated from other phases in the traffic-signal cycle.

For Des Peres Avenue and Hoyt Drive, the north-south traffic volumes are low; i.e., under 250 vehicles per hour for each street for either A.M. or P.M. peak hours. The adjustment in signal times to accommodate pre-emption would not significantly impact these intersections. Level of Service would remain C or better. Also, for the Des Peres Avenue intersection, the side-running alignment would change street geometry in such a way as to allow space for left turn lanes on Forest Park Parkway. For this alternative, left turns would continue to be allowable where they would be prohibited for the at-grade median alternative.

For the Skinker Boulevard intersection, pre-emption signal phasing would have a significant impact. The time requirement would significantly increase delay for Skinker Boulevard traffic. Preliminary signal phasing analysis indicates that the green-light time could be reduced by as much as 50% compared to the condition when no trains are present. The estimated level of service would be in the E-F range; i.e., substantial congestion.

Skinker Boulevard and Big Bend Boulevard Underpasses

The train underpasses at both Skinker Boulevard and Big Bend Boulevard would eliminate any impact on traffic operations. Levels of service would be associated with that caused by existing and future traffic alone.

The roadway underpass at Skinker Boulevard would improve traffic conditions significantly. It is estimated that the level of service would improve from LOS D to LOS C. This benefit would be associated more with increasing traffic capacity via the through lanes than the impacts of train operations. It would, of course, be available all the time, not just when trains are in operation.

Downtown Clayton Elevated

As an option for either the underground or at-grade alternative though downtown Clayton, the high profile elevated alternative would not have traffic impacts on downtown intersections. It would be similar to the conditions described for the underground alternative. However, the lower profile would have some effect.

This option would introduce at-grade crossings at Bemiston and Central on the structures over Forest Park Parkway. Bemiston has an average daily traffic (ADT) volume of 1,610 vehicles, and Central has an ADT of 7,010 vehicles. The peak-hour volumes are estimated to be 210 vehicles per hour at Bemiston (P.M.) and 700 vehicles per hour at Central (A.M.). Operation of the crossing would be via pre-emption and the use of crossing gates and flashing signals. There would be some delay, especially at Central Avenue, but such delay would not cause levels of service to fall into an unacceptable range (worse than Level of Service D).

Because of sight distance and queuing on the Central Avenue exit ramp, additional signals would be needed to warn advancing vehicles that a gate closure was occurring.

Because this option has only one station (at Shaw Park Drive and Central Avenue), site station-generated traffic would focus only at one place. Downtown Clayton MetroLink stations would not have park-n-ride facilities, but there could still be some drop-off/pick-up activity at the stations. For this option, such activity would be at the edge of downtown.

Forest Park Parkway At-Grade

This option would affect traffic in three ways: (a) at-grade crossing at Forsyth Boulevard, (b) removal of westbound exit/entrance ramps at Ritz Drive for Forest Park Parkway, and (c) relocation of existing westbound Bemiston exit ramp to the east of Hanley Road.

The Forsyth Boulevard crossing would entail some delay associated with MetroLink operations. This street has peak-hour traffic (both directions) of 1,000 vehicles per hour. Existing level of service is B. The train-related delay will not significantly change this condition.

The existing ramps at Ritz Drive have low peak-hour volumes; the exit ramp volume is 70 vehicles per hour, and the entrance ramp volume is 200 vehicles per hour. These movements would be relocated to the new exit ramp at Hanley Road and to the existing entrance ramp at Meramec Avenue. The relocation of this traffic to other downtown streets is not expected to raise or significantly reduce levels of service.

The relocation of the Bemiston ramp will not cause significant traffic impact. The existing Bemiston ramp has peak-hour volumes of 200 vehicles. These vehicles would essentially follow the same route, but entering Shaw Park Drive at Hanley Road rather than one-half block west of Hanley Road.

Galleria Elevated

This would be an option for the alignment in the CMT right-of-way. From the standpoint of at-grade traffic impacts, there would be none. This option could have certain site impacts.

The station is positioned east of Brentwood Boulevard. Drop-off/pick-up and bus transfer would occur on University Club Tower Drive or on Brentwood Boulevard. This would be similar to that described for the underground alternative. This site-generated traffic could have facilities in an off-street location as part of a joint development concept envisioned for this option. It is possible that this could even include some parking space for MetroLink riders, although this station is anticipated to be a destination station.

Without available parking, there is the potential for encroachment on other parking resources in this vicinity. There are other employee and customer-only parking facilities in the block and across Brentwood Boulevard in the Galleria Shopping Center. The potential encroachment would require parking management actions and effective enforcement.

Laclede Station Road Option

This would be an option to either of the basic corridor alternatives. There are no expected traffic capacity impacts associated with this scheme. The two at-grade crossings at Flora Avenue and Sunnen Drive would be controlled by railroad crossing gates and warning signals. Peak hour traffic volumes would be at low to moderate levels. No level of service issues would be expected.

The site would attract a small volume of bus and drop-off/pick-up traffic at the off-street facility on Hanley Road near the existing Laclede Station Road intersection. Volumes would be small and no significant impact is expected.

From a parking enforcement perspective, there is the potential for MetroLink riders to use parking space in the Sunnen Business Park. There are various existing parking lots in the Business Park, and these would be expanded. These lots would be very attractive to MetroLink riders and parking management actions should be anticipated. However, such use would be an encroachment on these facilities (unless some specific arrangements were made with the property owner to allow such use).

Deer Creek Terminal

For this option, the Deer Creek station would become the south terminal. As such, it would have site facilities, including park-n-ride, similar to those described for Lansdowne Avenue.

The site would generate traffic at the same level as Lansdowne Avenue, as listed below:

	A.M. Hour	P.M. Hour
Inbound	415 vehicles	105 vehicles
Outbound	10	330
	425 vehicles	435 vehicles

The site would be accessed via the intersection of Big Bend Boulevard and Oxford Avenue. If the site would be a permanent location, it is possible additional access could be created through a connection to Shrewsbury Avenue west of Big Bend Boulevard. This would require a bridge over Deer Creek.

For the single-access situation, it would be expected that the directional distribution would be 20 percent from the north and 80 percent from the south via Big Bend Boulevard. Those coming from the south on Big Bend would divide into two groups: 40 percent continuing along Big Bend Boulevard to the southwest and 40 percent on Shrewsbury Avenue, 20 percent to the east (St. Louis), and 20 percent to the south and southwest into Shrewsbury and other suburbs. The peak-hour traffic volumes at the intersection of Big Bend Boulevard and Oxford Avenue would be as follows:

	A.M. Hour			P.M. Hour		
Approach	**Right**	**Through**	**Left**	**Right**	**Through**	**Left**
North	**—**	**—**	**83**	**—**	**—**	**21**
East	**2**	**—**	**8**	**66**	**26**	**238**
South	**290**	**—**	**—**	**76**	**—**	**—**
West	**—**	**42**	**—**	**—**	**8**	**—**

It is expected that these volumes can be accommodated. Separate right-turn (northbound) and left-turn (westbound) lanes would need to be added to the existing street cross sections.

4.2.7 Possible Mitigation

This section discusses possible mitigation, which would be associated with any concerns or impacts revealed by the assessment of the alternatives and section options.

Table 4.2-12 summarizes analysis results in terms of apparent significant impacts. For the ridership, accessibility, and mobility criteria, there are no apparent significant impacts. The differences between alternatives and options is small. The only item of note is that the downtown Clayton elevated option would have significantly lower accessibility. It has only one station and is positioned away from the downtown core. Inasmuch as downtown Clayton is a significant activity center, with continued prospects for growth, reducing regional transit accessibility in this fashion would be considered a serious impact.

Table 4.2-12
POSSIBLE IMPACTS REQUIRING MITIGATION

	Alternatives			Section Options						
Transportation Criteria	**Fully Grade-Separated**	**At-Grade/ Grade-Separated Combination**		**South Edge At-Grade**	**Downtown Clayton Elevated**	**Galleria Elevated**	**Laclede Station Road**	**Deer Creek Terminal**	**Skinker & Big Bend Underpasses**	**Forest Park Parkway At-Grade**
Transit Ridership	**NSI**	**NSI**		**NSI**	**NSI**	**NSI**	**NSI**	**Reduce coverage area**	**NSI**	**Has two stations to enhance ridership**
Accessibility	**NSI**	**NSI**		**NSI**	**Limited access to downtown Clayton**	**NSI**	**NSI**	**NSI**	**NSI**	**NSI**
Mobility	**NSI**	**NSI**		**NSI**	**NSI**	**NSI**	**NSI**	**NSI**	**NSI**	**NSI**
Traffic Safety	**Pedestrian crossing of Brentwood Boulevard**	**Added measures to separate MetroLink and other traffic in downtown Clayton; sight distance at Forsyth transition and Meramec at Carondelet**		**NSI**	**NSI**	**NSI**	**NSI**	**NSI**	**Reduces risks of accidents**	**NSI**
Personal Safety/ Security	**Risks in pedestrian tunnels and low volumes at two stations; proximity to Brentwood Boulevard**	**Proximity to moving traffic at two stations**		**NSI**	**NSI**	**NSI**	**NSI**	**NSI**	**Similar to grade separated for Skinker and Big Bend stations**	**NSI**
Traffic Capacity	**Parking encroachment; LOS F at Lansdowne**	**Parking encroachment; traffic LOS F at Lansdowne**		**Reduction in traffic LOS for Skinker**	**NSI**	**NSI**	**NSI**	**NSI**	**Reduces risks of traffic conflicts at two arterial intersections**	**NSI**

NSI = no significant impact identified

The other criteria deal with issues pertaining to safety (traffic and personal) and traffic capacity/ congestion. The items to be mitigated include the following:

Fully Grade-Separated Alternative

1. **The tunnel elements would constitute a personal safety risk. The design and operational strategy would need to employ more security measures that would need to be clearly evident to passengers. Open design concepts, video surveillance, safety patrols, warning alarms, high-quality maintenance, and anti-graffiti concepts, etc., would be part of these efforts.**

2. **Pedestrian access for the Galleria station would need extra facilities to ensure pedestrian safety. Creating proper clearances along the sidewalks, sidewalk marking, proper pedestrian clearance times for signal phasing, refuge islands, clear signing to direct passengers to proper paths, barriers to prevent midblock pedestrian movements, etc., would be needed.**

3. **Many proposed stations create the risk of parking encroachment by MetroLink patrons in residential, commercial, and industrial areas. Conditions need to be under surveillance. Potential strategies for achieving parking management include on-street time limits, parking prohibitions for early morning hours or evenings, residential parking permits, traffic management to limit non-local traffic access into neighborhoods, and enforcement. In private parking facilities, gates and other restraints, coupled with smart card/token access means, may be required.**

4. **Traffic generation at the Eager Road and Lansdowne Avenue station will require significant roadway and related improvements. Growth in non-site traffic would engender the need for improvements. MetroLink station site traffic will add to this need. At Eager Road, freeway upgrading/redesign by the Missouri Department of Transportation would be a significant benefit.**

At-Grade/Grade-Separated Combination Alternative

1. **At-grade operations would entail some risk of accidents. Other experience indicates that designs need to be simple; light rail transit should be introduced into street rights-of-way without requiring complicated traffic operations. Motorists and pedestrians need to understand how they are to behave in the presence of train movements. Clear and very visible signing and marking is needed, supported by public education and information programs.**

Accident risks can be reduced by placing tracks in exclusive rights-of-way, i.e., no crossing vehicle or pedestrian traffic. There would be an opportunity to increase the extent of such conditions in the downtown Clayton section of the corridor.

2. **At two locations, limited sight distance would result: Forsyth Boulevard (east downtown Clayton) and Carondelet/Meramec. While trains would be operating at slow speeds, efforts need to be made to increase sight distances at the corners and create reaction/clearance zones for pedestrian and vehicular traffic.**

3. **Two at-grade stations (Skinker and Big Bend) require passengers to access station platforms in the median of high-traffic-volume streets. The median islands need proper barriers. Consideration could also be given to "zebra" crossing concepts with barriers to cause passengers to properly look before crossing.**

4. **Potential reduction in traffic levels of service could occur at Skinker and Big Bend Boulevard. This would be due in part to possible growth in general traffic. The coordination of train and traffic control systems would be essential for maximizing intersection efficiency. Advanced (programmable) traffic controllers need to be considered.**

5. **Parking encroachment will be a risk. The same comment applies to this alternative as to the fully grade-separated alternative.**

6. **There will be traffic capacity issues at Eager Road and Lansdowne Avenue. The same comments apply to this alternative as to the fully grade-separated alternative.**

Section Options

1. **For the downtown Clayton elevated option, consideration could be given to adding a second station to the alignment. This could be considered at a point just west of the Ritz-Carlton Hotel. The Forest Park Parkway at-grade option accomplishes this objective via a station at Forsyth Boulevard.**

2. **For the south edge at-grade option, pre-emption signal operations will cause a significant decrease in traffic level of service for Skinker Boulevard. This may require consideration of a different station location strategy with split platforms placed at the nearside (approach) of the crossing. All trains would stop before crossing Skinker Boulevard. Rather than signal pre-emption, signal prioritization concepts could be used in which the train signal phase would be optimally fit into the traffic signal cycle. The risk would be that the dwell time at the station may need to be longer than necessary for unloading/loading passengers.**

5
Socioeconomic and Environmental Impact Analysis Results and Possible Mitigation

5.1 Introduction/Analysis Approach

This section describes the analysis results of the socioeconomic and environmental benefits and impact of the proposed Cross-County MetroLink Extension alternatives. The following subsections are focused on the study's design objectives of urban design, economic, environmental impact, costs and finances, and MetroLink compatibility. The results from this section and Section 4, Transportation, will be integrated with the engineering, LRT operations, cost and financial analysis findings for use in comparing alternatives.

As noted in Section 1 of this draft report, this MetroLink extension project will be financed with local funds (i.e., no federal dollars). Therefore, federal environmental requirements under the National Environmental Policy Act (NEPA) do not apply. However, the analysis results contained in this section are consistent with the Council on Environmental Quality guidance on environmental impact assessment and are similar in scope to a NEPA Environmental Assessment (EA).

A summary matrix of the transportation, socioeconomic and environmental benefits and impact per alternatives is presented at the end of this section. This report information will aid in the comparative analysis of alternatives being considered as part of the draft Evaluation Results Technical Report.

5.2 Urban Design/Land Use Impacts

5.2.1 Support Existing or Planned Land Use

Sections 3.2 and 3.3 (Existing Conditions) described the existing land use, zoning, planning activity and economic conditions in the various sections of the proposed MetroLink corridor. As previously indicated, the majority of the MetroLink corridor traverses primarily commercial and industrial developed or developing areas, with the exception of the northern portion in University City and the City of St. Louis which is developed residential and institutional and smaller sections of residential in Richmond Heights and Maplewood. All of the areas traversed by the MetroLink extension alternatives have well established land use patterns, which in most instances (e.g. Clayton, Brentwood, Richmond Heights, Maplewood) are being further reinforced internally or externally through newly approved and proposed developments. The current land use and development patterns will be further reinforced and enhanced as the MetroLink extension will increase each area's transportation capacity and accessibility, with increased linkages between user groups and activity centers.

Current zoning patterns within the corridor and adjacent to the alignment(s) are generally compatible with MetroLink and its anticipated impacts. As described in Sections 3.2 and 3.3, current on-going developments and approved/proposed developments within the study corridor are consistent with currently established land use patterns, and compatible with both MetroLink alternatives. Several of the communities, most notably Clayton, Brentwood, and Maplewood, have addressed and/or identified development opportunities, land use and design issues anticipated with the Cross-County extension of MetroLink through their community.

Table 5.2-1 provides a summary of the characteristics of each proposed MetroLink station site in relation to surrounding land use and type(s) of destinations served. The two stations at Skinker Boulevard and Big Bend Boulevard are located on the edge of three prevailing land use districts— medium density residential to the north, institutional (Washington University) to the south, and recreational (Forest Park) to the east. Washington University is a major employment center and has heavy pedestrian traffic considering the level of student enrollment. Forest Park is a major local and regional recreational destination with its various venues attracting 6.4 million visitors annually. Each of these user groups of MetroLink will have direct linkages to these stations. Station impacts would be the same under both the Fully Grade-Separated Alternative and At-Grade/Grade-Separated Combination Alternative.

Within downtown Clayton, station linkages and impacts would also be the same under both alternative alignments for the Carondelet Plaza and Carondelet/Central stations. However, under the Downtown Clayton Elevated option, the station would be located on the edge of downtown on Shaw Park Drive. The Forest Park Parkway at-grade option, however, includes a second station in east Clayton at Forsyth Boulevard. The Carondelet Plaza station is located in a transitional land use area between established residential areas to the north, east and south, and the downtown Clayton to the west, while the Carondelet/Central station is centrally located in downtown Clayton. Within the MetroLink Cross-County corridor, the major concentration and

movement of people occurs in downtown Clayton which has an estimated daytime population of 80,000, and is an entertainment and shopping destination in addition to an employment destination.

The Galleria station would be centrally located in the Brentwood Boulevard commercial core under the Fully Grade-Separated Alternative, while under the At-Grade/Grade-Separated Alternative this station would be located more on the edge of this activity center. The Galleria Elevated Option provides a compromise location for this station midway between the other two proposed station sites at this location.

The MetroLink station sites would be the same for the Eager Road and Manchester stations under both the Fully Grade-Separated Alternative and At-Grade/Separated Alternative. The Eager Road station is located within a major developing area, but not necessarily centrally located with respect to the Hanley Industrial Park.

Table 5.2-1
METROLINK STATION LOCATION CHARACTERISTICS

MetroLink Station	Prevailing Adjacent Land Use	Station Location Relative to Adjacent Land Use	Type of Major Destination Area
Skinker Boulevard	Residential/Institutional/ Recreational	Edge	Institutional/ Recreational
Big Bend Boulevard	Residential/Institutional	Edge	Institutional
Carondelet Plaza	Commercial/Residential	Edge	Employment
Carondelet/Central Avenue	Commercial	Central	Employment/ Entertainment/ Recreational
Downtown Clayton Elevated	Commercial/Residential	Edge	Employment/ Entertainment/ Recreational
Galleria	Commercial	Central (Edge)	Employment/ Entertainment
Eager Road	Commercial/Industrial	Central/Edge	Employment
Manchester Road	Industrial	Central	Employment
Laclede Station Road	Commercial/Residential	Edge	Employment
Big Bend Boulevard	Commercial/Industrial	Central	Employment
Lansdowne	Mix of Uses	Edge	NA[1]

[1] NA - Information not available. City of Shrewsbury is currently developing plan for area

Although not centrally located in relation to the nearest major employment center (Sunnen Business Park), the Laclede Station Road station, under the Laclede Station Road At-Grade/Elevated Option, would provide the most accessible station for the employees at Sunnen Business Park. The proposed station site at Big Bend Boulevard under both the Fully Grade-Separated Alternative and At-Grade/Grade-Separated Alternative would be less accessible and would require additional pedestrian (i.e., walkway) or vehicular access to the Sunnen Business Park.

5.2.2 Enhance Planned/Developing Major Activity Centers

Table 5.2-2 provides a summary of the transit markets by major activity center served by MetroLink and its associated stations. The overall development intensity of each activity center and walking distance to the nearest MetroLink station is also noted. Table 3.3-1 in Section 3.3. (Economic Conditions) should also be consulted regarding the relationship of redevelopment parcels to distance to the nearest MetroLink station.

As noted in Table 5.2-2, several of the major activity centers within the MetroLink corridor serve more than one transit market. For example, multiple transit markets exist in the Washington University/Forest Park area, and for the Carondelet Plaza area, downtown Clayton, Galleria and Brentwood Promenade activity centers. Downtown Clayton is the most intensely developed activity center, and serves more potential transit markets than any other activity center along the proposed MetroLink corridor.

Table 5.2-2
TRANSIT MARKETS SERVED BY MAJOR ACTIVITY CENTERS

	Transit Markets						
Activity Center	Residential	Recreational/ Entertainment	Institutional	Employment	Shopping	Development Intensity	Walking Distance/Nearest Station[1]
Forest Park		X				Low/Moderate	600[2]
Washington University	X		X	X		Low/Moderate	1,000[3]
Carondelet Plaza		X		X		High	100;600[4]
Clayton	X	X	X	X	X	High	0-400[5]
Galleria		X		X	X	High	300;1100[6]
Hanley Indust. Park				X		Moderate	0-1,200[7]
Brentwood Promenade				X	X	Moderate	800[8]
Sunnen Bus. Park				X		Moderate	700;1600;2400[9]

[1] Distance measured in feet. Walking distance varies based on distance of station from edge versus the center of activity area.
[2] Forest Park station - all alternatives.
[3] Skinker Boulevard station-measured to east front of the Galleria, for both basic corridor alternatives-grade-separated and at-grade combination.
[4] Carondelet Plaza station - 100' for at-grade alternative station and 600' for grade-separated station to front door of hotel.
[5] Carondelet/Central station - for at-grade and belowground alternative, range of distance to downtown core in general.
[6] Galleria station 300' for Brentwood underground and 110 for CMT at-grade to east side of shopping center.
[7,8] Eager Road station - all alternatives.
[9] Deer Creek area station - measured to center of Sunnen Business Park; 700' to Laclede Station Road station, 1600' to the Big Bend Boulevard station (at-grade combination alternative), 2400' to the Deer Creek station (grade separated alternative).

Walking distances to the nearest MetroLink station would be similar under both the Fully Grade-Separated Alternative and At-Grade/Grade-Separated Alternative for the Forest Park, Washington University, Carondelet Plaza and downtown Clayton activity centers. The closest walking distance for the Galleria would be associated with the Fully Grade-Separated Alternative, with the greatest walking distance associated with the At-Grade/Fully Grade-Separated Alternative. The Eager Road MetroLink station, representing both the Fully Grade-Separated Alternative and At-Grade/Grade-Separated Alternative, is located towards the northern end of the Hanley Industrial Park rather than being centrally located within this activity center. However, the Eager Road station is closer to the Brentwood Promenade and major potential redevelopment parcels within this area. The Laclede Station Road At-Grade/Elevated Option provides the most accessible proposed station to the Sunnen Business Park.

Section 5.2.3 Maintain Viable Access

This criterion addresses the potential changes or modifications to urban land use access that would occur for the MetroLink extension alternatives.

Fully Grade-Separated Alternative

There would be no adverse driveway or access impacts under this alternative.

Grade Separated/At-Grade Alternative

Under this alternative, almost all of the impacts on driveways and other access points would be within downtown Clayton, specifically on Carondelet Avenue, Meramec Avenue and Brentwood Boulevard. These impacts would primarily affect left turns for vehicular traffic.

Forest Park Parkway

There are four access drives off Forest Park Parkway/Millbrook Boulevard between DeBaliviere and Pershing Avenue. These include one alley access on the south side between DeBaliviere and Skinker Boulevard; two right-turn-in/out driveways to Washington University campus parking on the north side; and one commercial driveway on the north side. Under either the median at-grade or south edge option, access will be maintained to all driveways. However, geometric changes will be required for the two right-turn-in/out driveways and the commercial driveway which could become right-turn-in/out for the at-grade median option.

Carondelet Plaza

Between Forsyth and Hanley Road, there is alley access on both the north and south sides of Carondelet Plaza and an access drive for the Ritz-Carlton Hotel garage. Since the MetroLink will be on the north edge of Carondelet Plaza, left-turn access to the alley on the south side will be retained and not affected. However, there will be some geometric change in access to the north

side alley, which also could be made one-way southbound only, or access could be eliminated from Carondelet Plaza.

It is assumed that the majority of guests at the Ritz-Carlton would arrive from the west (via I-64 or via I-170 from the airport), with direct access to the hotel from Brentwood Boulevard or Hanley Road east on Carondelet/Carondelet Plaza and a right turn into the hotel lobby/entrance area and parking garage. Direct access from the east without crossing the MetroLink tracks would be provided by the Forest Park Parkway exit ramp immediately adjacent to the hotel, which leads into Carondelet Plaza, resulting in a right turn into the hotel entrance and parking garage. The only exit available from the lobby entrance and parking garage is to Carondelet Plaza, necessitating a left turn toward downtown Clayton on Carondelet Plaza or a right turn to Forsyth. Hotel-destined traffic would be adversely impacted only on Forsyth Boulevard, which would necessitate crossing the MetroLink tracks on Forsyth and Carondelet Plaza.

Carondelet Avenue

Between Hanley Road and Bemiston Avenue, there are five driveways providing access to three garages, as well as an alley on the north side of Carondelet Avenue, with four driveways on the south side providing access to the Radisson Hotel, a parking garage, a surface parking lot, and an alley. The MetroLink At-Grade/Grade-Separated Combination Alternative will be located in the median with barrier access to be retained, but left turns in and out would be prohibited on the north side except for alley access. Thus, left turns will be eliminated to and from the north side, which will impact the three garages as there will be only right-turn-in/out access to and from their five driveways. This will result in an alternate route for garage-oriented traffic originating from the west: either Forsyth Boulevard or Bonhomme to Hanley Road, and then entering Carondelet from Hanley for a right turn into these garages. This results in an extra two blocks of vehicular movement to reach the garages.

The Radisson Hotel is located at the southeast corner of Carondelet Avenue and Bemiston Avenue. The main entrance into the hotel is from Carondelet. This entrance provides direct access to the lobby and to the associated parking garage on the other side of the alley behind (south side) the hotel. The alley runs east-west from Bemiston Avenue to about two-thirds the distance to Hanley Road and then exits to both Carondelet and Bonhomme Avenue. Direct access to the parking garage is provided by this alley. Hotel guests checking out (who do not drive their car to the lobby entrance) could exit the hotel garage without entering Carondelet Avenue. In addition, it is assumed that the majority of hotel guests would arrive from the west (via I-64 or via I-170 from the airport) and would come directly eastbound on Carondelet Avenue from Central or Brentwood, which would require a right turn into the hotel entrance/lobby area. The conceptual design of the tracks and median in front of the hotel allows the possibility that westbound left turn ingress could be provided. This would make it possible to approach the hotel from Hanley Road.

Guests exiting the front/lobby of the hotel could, instead of making a left turn to Carondelet, make a right turn to Carondelet to Hanley, and come around the other side of the block on Bonhomme toward Brentwood. This adjustment would result in an extra two-and-one-half-block vehicular movement. The same vehicular movement adjustment would also be necessary for the two parking access driveways, as left turns in/out would be eliminated. Customers entering these two garages would have to circulate another block in order to enter from the west with a right turn.

There are no access drives on Carondelet Avenue between Bemiston Avenue and Central Avenue. The Central/Meramec portion of Carondelet will be closed to vehicular traffic except for emergency vehicle access. From Meramec Avenue to Brentwood Boulevard, there are two driveways providing access to parking and an alley on both the north and south sides of Carondelet Avenue. With the MetroLink tracks in the median, left turn lanes will be prohibited in this block, i.e., access will be via right turns in and out only.

Meramec Avenue

From Carondelet Avenue to Bonhomme, there are five access drives to the county parking structure on the east side of Meramec, with only one access drive on the west side (alley). The MetroLink tracks will be on the west side of Meramec; thus, there will be no impacts on access to the county garage. However, access to the alley will have to be modified either through its closure at Meramec or by converting it to one-way westbound. This alley leads to substantial surface parking in the interior of the block. The alley also extends to Brentwood Boulevard and to Carondelet Avenue. Access would still be available to this parking from the west and north. There would be extra travel distance (one block) for some traffic coming from the east (depending on what street is being used for travel from the east) to reach this parking area.

In the Bonhomme to Shaw Park Drive block there are six access drives to parking lots/garages and one alley access drive on the east side of Meramec, with one alley access drive to extensive surface parking in the interior of the lot. Since MetroLink will be on the west side of Meramec, there will be no change or impact on the six access drives on the east side of Meramec. However, on the west side the alley could possibly be made one-way westbound or closed completely. Access to this parking would still be available from Bonhomme Avenue via the alley and Shaw Park Drive. There would be only minor inconvenience and extra driving distance involved under either option.

Brentwood Boulevard

Access driveways on Brentwood Boulevard from Carondelet Avenue to Shaw Park Drive include a loop drive on the west to serve Shaw Park and three driveways to parking on the east side. Since MetroLink is on the west side of Brentwood, there would be no impact on the access drives on the east side of Brentwood Boulevard. Access to the loop drive on the west side, controlled with stop sign and flashing warning signals with "No Right Turn," would cause inconvenience for

vehicular traffic using this loop drive in front of the park. Some geometric modifications may be required to minimize this impact and conflicts.

5.2.4 Create Compatibility in Design Quality/Visual Resources

This section presents the range of urban design and visual quality benefits and impacts that are associated with developing the Cross County MetroLink Extension. In terms of urban design and visual resources, the MetroLink Extension could generate a wide variety of factors that may benefit both residential neighborhoods and commercial areas. Generally, the compatible urban design features generated by developing MetroLink could include the following elements.

- **Improve local accessibility by reinforcing neighborhood scale**
- **Enhance multi-functional, mixed-use neighborhoods**
- **Integrate neighborhoods into the larger metropolitan area**
- **Provide open space around stations as a link to the surrounding fabric**
- **Strengthen local identity (Lansdowne Avenue, Laclede Station Road, Big Bend (South), Deer Creek Station)**
- **Provide for diversity of uses within and around certain station locations**
- **Create variety, character and historical harmony in station design**
- **Create pedestrian-related pockets of appropriately scaled transit-oriented development around some stations**
- **Identify the pedestrian as the focal point around which MetroLink works**
- **Reinforce the importance of walkable neighborhoods**
- **Use landscaping to soften visual impacts and define site/corridor boundaries**
- **Use perimeter landscaping around park and ride lots and parking structures to screen views of vehicles and visually soften building exteriors**

5.2.4.1 Fully Grade Separated Alternative

Urban design impacts generated by this alternative will be relatively minor for the below-grade portions of the alignment. The elevated portions of the alignment would cause visual impact. The urban design benefits and impacts are listed below.

Forest Park Parkway from DeBaliviere to Clayton

- **Urban design benefits would include possible development of small scale transit-oriented land uses around station locations, for example at Big Bend and Millbrook Boulevard.**
- **Visual impacts are not anticipated in the section.**

Downtown Clayton

- **Benefits would include the development of new transit-oriented land uses especially commercial, retail and office uses around the stations.**

- **Visual impacts are not anticipated in this section.**

Downtown Clayton to the Galleria

- **Benefits would include development of new transit-oriented retail, commercial and office land uses in areas immediately adjacent to the Galleria.**
- **No visual impacts are anticipated; minor visual impacts would occur at the station access points at the Galleria Mall.**

Galleria to I-64

- **Visual impacts may occur in this area of the Cross-County corridor along the CMT right-of-way where the MetroLink extension transitions to the ground surface.**

I-64 to Lansdowne

- **Benefits would include establishing a gateway character for the Lansdowne Avenue Station expressing its importance as the southern terminus of the MetroLink line.**
- **Benefits to the surrounding Shrewsbury and City of St. Louis area could also include transit-oriented development around the station.**
- **Visual impacts would occur in elevated sections of MetroLink over I-44, from Deer Creek to Lansdowne.**

5.2.4.2 At-Grade/Grade Separated Combination Alternative

Forest Park Parkway from DeBaliviere to Pershing

- **Benefits could include development of new small scale transit-oriented land uses, especially commercial, retail, office and residential uses, around the stations, for example at Big Bend and Millbrook Boulevard.**
- **Visual impacts would occur for the at-grade alignment in this section.**

Downtown Clayton

- **Benefits could include the development of new transit-oriented land uses, especially commercial, retail and office uses, around the stations, for example Carondelet Plaza**
- **Increased urban design and visual integration of downtown Clayton.**
- **Potential impacts may include altered visual quality found on the existing streetscapes associated with Carondelet and Meramec Avenues.**

Galleria to Lansdowne

- **Benefits may include establishing a gateway character for the Lansdowne Avenue terminus station expressing its importance as the southern terminus of the MetroLink line.**
- **Visual impacts would occur for residences and businesses along the CMT right-of-way from Galleria Parkway to Flora Avenue.**

- ***5.2.4.3 Other Options***

South Edge At-Grade

- **Benefits could include the development of new small scale transit-oriented land uses, especially commercial, retail and office uses, around the stations, for example at Big Bend and Millbrook Boulevard.**
- **Visual impacts would occur for the at-grade alignment in this section.**

Skinker Boulevard and Big Bend Boulevard Underpasses

- **The underground sections would eliminate any visual impacts.**

Downtown Clayton Elevated

- **Benefits could include the development of new transit-oriented land uses, especially commercial, retail and office uses near the planned parking garage and in the currently underutilized properties around the proposed station**
- **Some residents in areas south of Forest Park Parkway could experience major visual impacts, as a result of the elevated sections of this alignment.**

Forest Park Parkway At-Grade

- **Benefits would include development of transit-oriented land uses in two locations: east Clayton and near Central Avenue. The latter could include a significant multipurpose development, including MetroLink, Bi-State bus transfer facility, parking facility, and other developments.**
- **This option has a significantly lower profile in this section east of Meramec compared to the elevated (higher or lower profile version) option. This lower profile would avoid the visual impacts associated with higher-profile options.**

Carondelet and Brentwood At-Grade

- **Benefits could include the development of new transit-oriented land uses, especially commercial, retail and office uses, around the stations and the MetroLink line.**

- **Visual impacts generated by the at-grade alignment could be experienced by existing commercial, residential, and institution receptors.**
- **Visual impacts would occur along the east side of Shaw Park and on the elevated portion of the MetroLink extension south of the park.**

Galleria Elevated

- **Benefits could include development of new transit-oriented land uses, especially commercial, retail and office uses, in the currently underutilized properties around the proposed station on the east side of Brentwood Boulevard**
- **Business owners, employees, and pedestrians may experience some visual impacts as a result of the elevated MetroLink structure.**

Laclede Station Road

- **Benefits could include the development of new transit-oriented land uses, especially commercial, retail, office and possibly residential uses, around the station.**
- **Business owners, residents, and employees in the area may experience some visual impacts as a result of the elevated MetroLink structure over the Union Pacific railroad tracks.**

Deer Creek Terminal Station

- **Benefits could include the development of new transit-oriented land uses, especially commercial, retail, office and possibly residential uses, around the station.**
- **Benefits to the surrounding community could also include development of the station area as the southern terminus.**
- **Business owners, residents, and employees on and around Oxford Street and Deer Creek Road may experience some visual impacts as a result of the terminus station.**

5.2.5 Possible Urban Design Mitigation

The following section presents urban design techniques and resources that could be applied to mitigate any impacts associated with development of the Cross-County MetroLink Extension and promote urban design benefits through developing attractively designed public spaces and transit-oriented land uses. The urban design elements for the MetroLink extension will be developed further during the preliminary design phase of the project.

5.2.5.1 Fully-Grade Separated Option

Forest Park Parkway from DeBaliviere to Pershing

- **Each station design could emphasize the architectural history of its adjacent neighborhood.**
- **Streetscapes and pedestrian connections between neighborhoods and other land uses could be visually enhanced especially along Forest Park Parkway, Millbrook, and principal cross streets**

Downtown Clayton

- **Visible public open space could be created at the station to serve as a gathering place for office workers in this urban center**
- **High-quality, well developed streetscape elements could be used link the transit site to the rest of downtown Clayton**
- **Strong site linkages could be provided to the existing downtown sidewalk system**
- **Various transit-oriented land uses could be encouraged near the MetroLink station, especially commercial, retail, and office development.**

Downtown Clayton to the Galleria

- **No urban design mitigation required. Compatible site materials and visual elements could be used to visually link the Galleria station to the Galleria Mall.**

Galleria to I-64

- **The MetroLink Extension could be insulated from adjoining residences by developing buffer zones which incorporate landscape plantings and fences as visual screens.**

I-64 to Lansdowne

- **Buffer zones could be developed which allow for landscape plantings along residential property fronting the CMT line.**

- **Development opportunities could be created at and around station locations. In particular, the Lansdowne station as the terminus station could serve as the nucleus for new commercial-retail uses along Lansdowne Avenue and the Murdoch Cut-Off, with moderate to high-density, multi-story multi-family residential uses nearby.**

5.2.5.2 At Grade/Grade Separated Combination

Forest Park Parkway-Millbrook Boulevard from DeBaliviere to Pershing

- **Each station design could emphasize the architectural history of its adjacent neighborhood.**
- **Streetscapes and pedestrian connections between neighborhoods and other land uses could be visually enhanced especially along Forest Park Parkway, Millbrook, and principal cross streets.**
- **Architecturally compatible fencing could be used along with landscaping along the right-of-way to screen views of MetroLink.**
- **Good pedestrian connections could be provided linking Washington University and adjacent residential neighborhoods.**
- **Enhancement of existing small scale commercial-retail-office uses could be encouraged at certain quadrants of the intersections of Skinker/Forest Park Parkway and Millbrook/Big Bend.**

Downtown Clayton

- **Visible public open space could be created at the station to serve as a gathering place for office workers in this urban center.**
- **High-quality, well developed streetscape elements could be used to link the transit site to the rest of downtown Clayton**
- **Strong site linkages could be provided to the existing downtown sidewalk system**
- **Pedestrian walkways could be clarified at Carondelet Plaza and along Carondelet and Meramec Avenues through use of well developed streetscape design amenities, including vegetative plantings, signage, lighting, fences, and railings as required.**
- **Street character of Carondelet and Meramec Avenues could be enhanced in a manner consistent with the high quality streetscape development present at Carondelet Plaza and the Government Center.**
- **Commercial-retail-office development opportunities could be encouraged adjacent to stations as to integrate them into the urban environment.**
- **Any visual impacts on buildings along west edge of Meramec Avenue could be buffered through use of landscape plantings and pedestrian walkway amenities.**

Downtown Clayton to the Galleria

- **No urban design mitigation required. Compatible site materials and visual elements could be used to visually link the Galleria station to the Galleria Mall.**

I-64 to Lansdowne

- **Buffer zones could be developed which allow for landscape plantings along residential property fronting the CMT line.**

Galleria to Lansdowne

- **The MetroLink Extension could be insulated from adjoining residences by developing buffer zones which incorporate landscape plantings and fences as visual screens.**
- **Architecturally appropriate station design elements could be used to complement adjacent land uses.**
- **Well developed pedestrian connections could be provided from surrounding neighborhoods and commercial areas to station locations.**
- **Fencing, vegetative buffers, and landscaping can be used as visual screens where appropriate.**

5.2.5.3 Other Options

South Edge At Grade

- **Visual impacts on adjacent neighborhoods could be minimized through use of landscaping.**
- **A pedestrian oriented park-like space at northeast corner of Washington University could be developed. Site amenities could incorporate a fountain, street furnishings, historical lighting, and landscaping.**
- **Pedestrian connections to north-south pedestrian ways could be enhanced.**

Skinker Boulevard and Big Bend Boulevard Underpasses

- **The same comments made for the Fully Grade-Separated option would apply to the station areas.**
- **For the at-grade segments, sensitive streetscape treatments would be included.**

Downtown Clayton Elevated

- **Architecturally appropriate screening and landscaping could be used to minimize any visual impacts on adjacent residential neighborhoods south of Forest Park Parkway.**
- **Pedestrian linkages could be provided to downtown Clayton's sidewalk system.**
- **Various transit-oriented land uses could be encouraged in the immediate vicinity of the station and the new County parking garage.**

Forest Park Parkway At-Grade

- **Architecturally appropriate screening and landscaping could be used to minimize any visual impacts on adjacent residential neighborhoods south of Forest Park Parkway.**
- **Pedestrian linkages could be provided to downtown Clayton's sidewalk system.**
- **Various transit-oriented land uses could be encouraged in the immediate vicinity of the stations at the new county parking garage (Central Avenue) and the development area east of the Ritz Carlton Hotel.**

Carondelet & Brentwood at Grade

- **Urban character of Carondelet Avenue could be enhanced in a manner consistent with the new Government Center plaza/streetscape.**
- **A combination of vegetative plantings and screens could be used to minimize any visual impacts on buildings along Brentwood Boulevard.**
- **Landscaped buffers could be provided to protect Shaw Park from any visual impacts resulting from the at-grade and elevated sections.**

Galleria Elevated

- **A highly visible, convenient, above street pedestrian overpass or a street level pedestrian link across Brentwood Boulevard could be developed from the station.**
- **Various transit-oriented commercial, retail and office land uses could be encouraged in the immediate vicinity of the Galleria Station.**

Laclede Station Road

- **Pedestrian connections at the station could be clarified; landscaping could be used to define links between the nearby developed sites and the station access points.**
- **Landscaping could be provided to soften any visual impacts at Sunnen Business Park/Laclede Station Road.**
- **The station design could be compatible with the "small town" image typical of the surrounding community.**
- **Transit-oriented development (selected combinations of small-scale convenience center, as defined in Section 5.3.1, type uses) could be used in conjunction with current redevelopment plans to connect the station with Sunnen Business Park and the surrounding land uses.**

Deer Creek Terminal Station

- **A combination of vegetative plantings, screens, and various site improvements could be used to enhance the area's visual character and to announce the southern terminus for the Cross-County MetroLink line if this option is selected.**

- **Landscape buffer zones could mitigate any visual impacts for adjacent land uses.**
- **Visual pedestrian connections could be improved through use of streetscape design elements.**
- **Transit-oriented development (selected combinations of commercial, retail, office and residential uses) could be used to connect/integrate the station with the surrounding area.**

5.3 Economic Effects

5.3.1 Foster Development and Redevelopment

Economic development and re-development activities in large urban areas require numerous positive inputs in order to be sustained over a period of years. The viability of economic development rises dramatically when the public and private sectors cooperate together. Similarly, successful transit oriented development (TOD) seldom if ever occurs in a public-private planning vacuum. Typically, successful TODs are the result of multi-jurisdictional, coordinated planning efforts involving: public transit; compact spatial forms; mixed uses (moderate and high-density housing, public uses, jobs, retail, services, etc.); pedestrian-orientation; and a focus on the human dimension rather than on the vehicular scale. To maximize positive economic development impacts, these elements must be concentrated in places with multi-modal access (MetroLink stations) to regional transit systems.

"Walkable" neighborhoods perhaps constitute the single most important key to the successful establishment of TODs in the St. Louis Metro area. In order for TODs to be most effective, the areas around the proposed MetroLink stations must be designed to accommodate attractive, interesting and comfortable pedestrian environments. Concentration of transit access, retail shops, personal and professional services, parks, pedestrian walkways and child care squarely in the center of a TOD permits and encourages the combination of multiple trips without resorting to a car for each separate trip.

Modern retail businesses exhibit a pronounced preference toward grouping in specific locations. The development of central business districts and even malls are demonstrations of this strong locational bias. The relatively recent development of Clayton as a business-retail-government center illustrates this tendency. Since the most important aspect of TODs is their intrinsic nodality, the conscious "packaging" of individual proposed MetroLink stations as the "hub" or "anchor" of a surrounding commercial core becomes a critical decision.

At least four types of TODs could be developed around MetroLink stations: convenience centers; neighborhood centers, specialty retail centers, and community centers. The primary defining differences in these centers involve the scale, size and intensity of development and the relationships of the centers with their surrounding areas.

Convenience Centers **would have between 10,000 and 25,000 total sq. ft. and provide a variety of convenience shopping and service activities, including movable shopping kiosks as well as more typical permanent storefronts. The following proposed stations have the potential to generate Convenience Center TODs:**

- **Skinker Boulevard**
- **Millbrook Avenue/Big Bend Boulevard**
- **Maplewood at Big Bend Blvd.**
- **Laclede Station Road**
- **Hanley Road**

Neighborhood Centers **would contain between 25,000 and 100,000 sq. ft. and provide convenience shopping and services as well as a supermarket, drug store, bagel/coffee house, restaurants, bars, etc. The following proposed stations have the potential to generate Neighborhood Center TODs:**

- **Lansdowne Avenue**
- **Eager Road**
- **Deer Creek**

Specialty Retail Centers **would contain between 50,000 and 125,000 sq. ft. and provide street-level and mid-rise shopping opportunities that combine convenience goods and services with such specialty offerings as women's shoes and apparel, restaurants and bars, jewelry, greeting cards/gifts, office supplies, etc. The following proposed station has the potential to generate Specialty Retail Center TODs:**

- **Carondelet Plaza**

Community Centers **would contain between 100,000 to 500,000 sq. ft. and possibly more of widely mixed commercial-retail-service uses including multi-level shopping centers as well as all the uses listed in the other TOD centers. The following proposed stations have the potential to generate Community Center TODs:**

- **Downtown Clayton (all options)**
- **Galleria Elevated**

If the low range estimate of commercial-retail business growth develops in each of the above centers, approximately 440,000 sq. ft. could be added in St. Louis County as a result of the new MetroLink Extension. If commercial development would occur in the high end of the estimate, approximately 1,750,000 sq. ft. or more of commercial-retail development could be added to the existing business districts due to the MetroLink Extension. These estimates are for commercial-retail property only, no estimate is provided for residential development, which would most likely

occur in the moderate to high-density range. Of course, these TODs could take a certain period of time to reach their fullest potential and may not be totally built out for twenty years or more.

A critical step in the economic development planning process for TODs around MetroLink stations is to *not* consider only the various empty or underutilized parcels around the proposed stations as *the prime* development areas. TOD planning requires a much more detailed and comprehensive approach that analyzes the entire area around each station in terms of the following elements:

- **Location of the MetroLink station, preferably central to the TOD**
- **Placement and orientation any of at-grade lots and parking structures**
- **Location and type of transit station facilities**
- **Pedestrian and vehicular access (on-site and off-site)**
- **Location of core commercial-retail uses**
- **Location of secondary commercial-retail uses**
- **Combination of primary and accessory residential use with other uses, especially retail**
- **Location of public spaces, including buildings and open space amenities**
- **Spatial relationships of TOD to secondary areas**

Table 3.3-1, Current and Potential Development Opportunities, in Section 3.3 summarizes the relationship of the MetroLink alignment and associated stations to land parcels currently undergoing redevelopment, proposed for redevelopment, or having redevelopment potential. This table should be consulted regarding the nature of development proposals and/or development potential for individual parcels and distance relationship with the nearest MetroLink station.

As noted previously, 14 of the 22 parcels identified for development/redevelopment are located in Clayton, with all but one parcel within 400 to 500 feet of the nearest proposed MetroLink station. The only exception would be for the Downtown Elevated option where the Station is located south of downtown on Forest Park Parkway. All of the potential development parcels along Brentwood Boulevard across from the Galleria and those parcels identified for redevelopment in the Hanley Industrial Court and Sunnen Business Park are in close proximity to the nearest proposed MetroLink station, as indicated previously in Section 3.3.

The northern portion of the alignment in University City and the City of St. Louis consists of both pedestrian- and vehicle-oriented environments. Pedestrian-oriented traffic is associated primarily with the Washington University campus and, to a certain degree, with visitors to Forest Park. MetroLink will provide an important additional external connection to adjacent areas and will enhance potential pedestrian-oriented traffic associated with the adjacent residential neighborhoods and commercial-retail uses, such as the Delmar Loop area.

Downtown Clayton is an intense, mixed-use development activity center in a pedestrian-oriented environment. In addition, extended-hour activities are associated with various public and private uses in the downtown restaurants and entertainment facilities, shopping, Shaw Park, County

Library, etc. Downtown Clayton and adjacent residential areas offer multiple transit markets for residential, recreation/entertainment, employment, government service, and shopping user groups. The location of a MetroLink station in this part of the metropolitan area will enhance Clayton's transportation capacity, improve its internal circulation and external access, strengthen its already prominent mixed-use developments, and reinforce linkages to adjacent areas.

As noted previously, the MetroLink alignments and proposed stations are within a corridor of high-activity centers, with ongoing development and potentially significant redevelopment parcels. The increased external access and transportation capacity afforded by MetroLink will not only sustain current development, but will also provide leverage for enhancing future development activities within the immediate area.

Opportunities for public/private joint development are often associated with modern transit station sites. A number of such potential development opportunities within the proposed MetroLink corridor include the following:

- **The Missouri Department of Transportation is initiating a planning study at the request of the City of Shrewsbury to look at access to and through I-44 in the area between Murdoch and Jamieson and Big Bend and Watson. TOD coordination by the City of Shrewsbury could permit higher densities and a greater variety of mixed uses than allowable under existing regulations.**

- **Cooperation between the City of Brentwood and the Hanley Industrial Court Association should continue to identify appropriate use of matching public funds for infrastructure improvements as the association pursues financing and land use alternatives in the redevelopment of Hanley Industrial Court.**

- **The Galleria Elevated Option would provide potential public/private joint development opportunity between the City of Richmond Heights and private developers for the east side of Brentwood Blvd on both sides of the Galleria Parkway. Commercial retail, offices, or mixed-use development would be appropriate in this area.**

- **Any of the three options for the MetroLink alignment through Maplewood would create potential joint development opportunities. For example, a Laclede Station Road station could be incorporated in a joint development involving of City of Maplewood and Sunnen Industries for new development associated with the business park.**

- **The planned St. Louis County parking garage at Central Avenue and Shaw Park Drive in Clayton, and the proposed MetroLink parking garage at the Eager Road station site in Brentwood, would enhance development potential at these two sites. The former site with both garage and bus transfer facilities would be associated with both the Downtown Clayton Elevated and Forest Park Parkway At-Grade options.**

5.3.2 Enhance Economic Viability of Key Activity Centers

Programs to enhance the economic vitality of key activity centers located around new MetroLink stations specifically include sharply focused transit-oriented development planning. These planning activities must include a highly coordinated team approach uniting traditional urban planning/urban design with market-driven real estate development and financing techniques. For the new MetroLink stations to succeed as centers of social interaction and economic vitality, these TOD planning activities must include public/private partnering, involving multiple layers of governmental jurisdiction, such as St. Louis County, various municipalities, Bi-State Development Agency, Missouri Department of Transportation as well as a wide range of private real estate developers and financing specialists.

The key to this planning process is to make certain that the goal is *not* to produce a document. In order for TODs to be successful, the goal of the planning process must be real-world implementation. And that goal requires a focus that is primarily—however, not exclusively—market-driven. Although innovative planning techniques and urban designs are necessities because they facilitate and encourage appropriate transit-supportive development, market demand is the engine that drives TODs.

The economic development planning process for key activity centers along the MetroLink extension should include the following steps:

- **Establish design guidelines**
- **Apply appropriate urban policy and development controls**
- **Define primary TOD sites, secondary neighborhoods, and pedestrian-vehicular circulation system**
- **Assess local market demands/opportunities**
- **Identify the appropriate mix of uses, including public**
- **Tie residential densities to transit ridership thresholds**
- **Develop specific area plans**
- **Establish relationships between infill/redevelopment and new growth**
- **Provide development incentives/improvements as required**

5.3.3 Enhance Corridor Tax Base

The minimization of displacements and impacts on other private property is a primary consideration in the proposed MetroLink alignments. The ability to use the CMT right-of-way for a significant portion of the proposed Cross-County MetroLink alignments has contributed substantially to minimizing private property impacts and displacements.

Table 5.3-1 illustrates the economic impacts associated with displacements under each alternative and associated option. As noted previously, the majority of displacements and other property impacts are associated with the Lansdowne and Deer Creek stations.

As noted in Table 5.3-1, the greatest negative economic impacts would occur in the Deer Creek Terminal Station Option under either alternative, with the second greatest negative impacts under the At-Grade/Grade-Separated Alternative, Carondelet/Meramec At-Grade Option. The greatest potential displacement/loss of employment and loss of real property tax revenues would result under these two options. The cities of Maplewood (Deer Creek Terminal) and Clayton (Carondelet/Meramec Option) would incur real property, sales, utility, and business tax losses under these two options. The greatest real annual property tax loss would be $85.06 thousand under the Deer Creek Terminal Station Option.

Also as indicated in Table 5.3-1, the initial negative economic impacts associated with the Lansdowne Terminal Station Option would be significantly less than those incurred with the Deer Creek Terminal Station Option. This situation is due primarily to the significant underutilization of the properties within the proposed Lansdowne terminal station site.

Table 3.3-1 in Section 3.3 provides a summary of estimated construction costs and projected real property tax revenues generated by the potential redevelopment parcels identified by municipal officials. The 22 parcels identified for redevelopment comprise almost 80 acres of land area. For those development projects currently under construction and those approved and proposed for construction, it is estimated that annual total real property tax revenues generated would approximate $7.0 million. This projection is based on construction cost estimates for the individual projects. These projects include six developments in Clayton and one in Maplewood, encompassing a total of over 1.7 million square feet of office, retail, and mixed-use space.

Development of the other St. Louis County parcels identified for redevelopment to their full potential could result in an additional $7 million to $12 million in annual real property tax revenues (depending on type and intensity of development) in addition to increases in sales and utility taxes and business licenses. Increased employment will be associated with this new construction, some of which will be new to the area, while jobs will result from internal shifts from within the metropolitan St. Louis area. Regardless of their origin, new employment generated by TOD and related redevelopment will be many times greater than the employment loss associated with the displacement necessary for project implementation. Thus, although there will be certain short-term adverse economic impacts, the mid- and long-term economic benefits from redevelopment associated with MetroLink will far outweigh negative economic impacts.

Table 5.3-1
REAL PROPERTY TAX REVENUE IMPACT FROM POSSIBLE DISPLACEMENTS[1]

Alternative/Option	Total Displacements	Acres	Employment	Property Assessed Valuation ($000)	Lost Real Property Tax Revenues [2] ($000)
Fully Grade-Separated Alternative[3]	19	7.0	50-60	$294.1	$24.3
Deer Creek Terminal Station Option	15	13.3	115-125	945.7	85.0
At-Grade/Grade-Separated Alternative[3,4]	42	7.33	150-185	758.8	63.9
South Edge Option	0	0	0	0	0
Skinker Blvd. and Big Bend Blvd. Underpasses Option	0	0	0	0	0
Downtown Clayton Elevated Option	0	0	0	0	0
a) Bally's Transition	1	0.5	25	389.9	38.2
b) Maryland Ave Transition	1	—	0	32.8	2.6
Forest Park Parkway At-Grade Option	0	0.6	0	1,111.7	26.0
Carondelet/Brentwood At-Grade Option	0	0	0	0	0
Galleria Elevated Option	0	0	0	0	0
Laclede Station Road At-Grade/Elevated Option	0	0	0	0	0
Deer Creek Terminal Station Option	15	13.3	115-125	945.7	85.0

Source: St. Louis County Department of Revenue, Assessment Division.

1 Includes only property potentially impacted by displacements; does not include other impacted properties.

2 Includes total real property tax revenues for all taxing entities.

3 Both basic alternatives include the proposed Lansdowne terminal station park-n-ride lot and bus transfer and maintenance yard facilities.

4 The Forest Park Parkway and Millbrook Boulevard median alignment location is included in the basic alternative. The Carondelet/Meramec at-grade alignment is also part of basic alternative.

5.4 Environmental Impacts

5.4.1 Minimize Impact on Natural Resources

Streams, Wetlands, and Floodplains

***Streams*. There are three streams identified within the Cross-County MetroLink Extension Segment I alignments for the Fully Grade-Separated and At-Grade/Grade-Separated Combination alignments. The three streams are as follows: a tributary to Black Creek; Deer Creek; and the River des Peres.**

There would be short-term direct and indirect adverse impacts to streams and water quality during the construction of the Fully Grade-Separated and At-Grade/Grade-Separated Combination alignments. The Black Creek tributary and Deer Creek are stream crossings that would require bridge construction. However, stream channelization would not be necessary at these stream crossings. Short-term adverse impacts to stream water quality would occur as a result of clearing and grading and other construction activities in the stream watersheds. No instream construction of bridge piers would be required.

Under the Fully Grade-Separated and At-Grade/Grade-Separated Combination alignments, the Lansdowne Avenue Station would be constructed immediately adjacent to the River des Peres. The footprint of the Lansdowne Station does not encroach upon the River des Peres, and instream construction is not necessary. The construction of the Lansdowne Station would create short-term indirect adverse water quality impacts to the River des Peres from potential soil erosion and increased sediment loading, especially during storm events.

Under the Deer Creek Terminal Station alternative, only the Black Creek tributary would be crossed. The footprint of the Deer Creek Terminal Station lies immediately adjacent to Deer Creek. However, no instream construction would be necessary during the construction of the Deer Creek Terminal Station. There would be short-term adverse water quality impacts to Deer Creek during the construction of the Deer Creek Terminal Station from potential soil erosion and increased sediment loading, especially during storm events.

The water quality for streams in the project area is generally low due to the adverse effects associated with stormwater outfalls and point source discharges from commercial and residential areas. Also, stormwater runoff from developed areas transports contaminants, such as petroleum products, lawn chemicals, and household garbage/debris, into the project area streams.

***Wetlands*. Section 404 of the Clean Water Act extends authorization to the U.S. Army Corps of Engineers (ACOE) to regulate activities which affect waters of the United States, including wetlands, and to issue permits for the discharge of dredged or fill material into wetlands and other waters of the U.S. Any activity that will impact wetlands or waters of the U.S. will require Section 404 permitting and mitigation may be required.**

A single 0.17-acre jurisdictional wetland was identified in the Cross-County MetroLink Extension Segment I alignments or the Fully Grade-Separated and At-Grade/Grade-Separated Combination alternative. I-44 Cattail Seep was the only site that had the requisite hydrology, hydrophytic vegetation, and hydric soils.

Under the Deer Creek Terminal Station alternative, the I-44 cattail seep wetland would not be affected. There would be no impacts to jurisdictional wetlands from the Downtown Clayton Elevated, Galleria Elevated, or Laclede Station Road At-Grade/Elevated options.

***Floodplains*. There would be minor long-term direct impacts to floodplains and regulatory floodways as a result of constructing the Cross-County MetroLink Extension Segment I alignments for the Fully Grade-Separated and At-Grade/Grade-Separated Combination alternatives. Crossings of the 100-year floodplain would occur at three locations including: an unnamed tributary of Black Creek; Deer Creek; and an off-channel portion of the River des Peres. The Black Creek tributary and Deer Creek floodplains also include regulatory floodways. The crossings of the Black Creek tributary and Deer Creek are narrow and would be spanned by bridges designed to minimize the impacts to floodplains and avoid impacts to floodways.**

A small portion of the River des Peres floodplain extends to the west along a narrow drainageway through the Fully Grade-Separated and At-Grade/Grade-Separated Combination alternatives near the Lansdowne Avenue Station. Regulatory floodways are not affected at this area. However, the 100-year floodplain would be crossed. Since this is a very small crossing, impacts to floodplains would be minimal.

Under the Deer Creek Terminal Station alternative, the only potential floodplain and regulatory floodway impact would be at the Black Creek tributary. Therefore, potential adverse impacts to floodplains and floodways would be reduced under this alternative when compared to the Fully Grade-Separated and At-Grade/Grade-Separated Combination alternatives.

The Downtown Clayton Elevated, Galleria Elevated, or Laclede Station Road At-Grade/Elevated alternatives would not impact regulatory floodways or floodplains.

Vegetation and Wildlife Habitat

There would be direct and indirect impacts to vegetation and wildlife habitat as a result of constructing the Cross-County MetroLink Extension Segment I for the Fully Grade- Separated and At-Grade/Grade-Separated Combination alternatives. Construction of the Downtown Clayton Elevated, Galleria Elevated, Laclede Station Road At-Grade/Elevated, and/or Deer Creek Terminal Station alternatives would also cause short-term and long-term impacts to vegetation and wildlife habitat.

Due to the degraded nature of the habitats present in the project area, impacts to vegetation and wildlife habitat would not be severe. Long-term impacts would primarily occur as a result of the permanent conversion of wildlife habitat to developed areas. Short-term adverse impacts to wildlife and wildlife habitat would occur during MetroLink construction. There would be minor

short-term impacts to wildlife from construction related disturbances, such as noise. The increase in human activity could alter animal behavior which could disrupt breeding, nesting, and feeding/ foraging activities. Impacts from construction would be more acute for less mobile species such as ground nesting birds, reptiles, and amphibians.

Threatened and Endangered Species

According to the USFWS, there are five federally-listed species and two candidate species known to occur in St. Louis County. The federally-protected species known to occur in St. Louis City and St. Louis County include the following: bald eagle, peregrine falcon, pallid sturgeon, pink mucket pearly mussel, and running buffalo clover. The sicklefin chub and sturgeon chub are the two candidate species listed for the county.

No direct or indirect adverse impacts to threatened and endangered species are anticipated as a result of developing the Cross-County MetroLink Extension Segment I alignments for the Fully Grade-Separated and At-Grade/Grade-Separated Combination alternatives (Table 5.4-1). The use of best management practices and other soil erosion/water quality controls would insure that no indirect water quality impacts would occur in the Mississippi River downstream from the project site.

Table 5.4-1
SUMMARY OF POTENTIAL IMPACTS TO FEDERALLY-LISTED SPECIES KNOWN TO OCCUR IN ST. LOUIS COUNTY

Species and Status	Environmental Impacts
Bald eagle (Haliaeetus leucocephalus) Listed Threatened	Due to the lack of suitable habitat for the bald eagle in the project area, no impacts are anticipated.
Peregrine falcon (Falco peregrinus) Listed Endangered	The peregrine falcon may be present in the project area. Since this species has adapted to an urban setting and since there are no known nesting sites in the project area, no impacts are anticipated.
Pallid sturgeon (Scaphirhynchus albus) Listed Endangered	There is no suitable pallid sturgeon habitat present in the project area. The use of best management practices and other soil erosion/water quality controls would insure that no indirect water quality impacts would occur in the Mississippi River downstream from the project site.
Pink mucket pearly mussel (Lampsilis orbiculata) Listed Endangered	There is no suitable habitat present in the project area for the pink mucket pearly mussel. The use of best management practices and other soil erosion/water quality controls would insure that no indirect water quality impacts would occur downstream from the project site.

Species and Status	Environmental Impacts
Running buffalo clover (Trifolium stoloniferum) Listed Endangered	There are no known populations of running buffalo clover in the vicinity of the project area, and no suitable habitat for this species exists in the project area.
Sicklefin chub (Macrhybopsis meeki) and sturgeon chub (Macrhybopsis gelida) *Candidate for federal listing	There is no suitable habitat present in the project area or downstream from the project area for the sicklefin and sturgeon chubs. The use of best management practices and other soil erosion/water quality controls would insure that no indirect water quality impacts would occur in the downstream from the project site.

*** Note: The Endangered Species Act extends no legal protection to candidate species.**
Source: Parsons Engineering Science, 1999.

Possible Natural Resources Mitigation

Streams, Wetlands, and Floodplains

Streams. **There were three streams identified within the Cross-County MetroLink Extension Segment I alignments for the Fully Grade-Separated and At-Grade/Grade-Separated Combination alternatives, as follows: a tributary to Black Creek, Deer Creek, and the River des Peres.**

Section 404 of the Clean Water Act extends authorization to the U.S. Army Corps of Engineers (ACOE) to regulate activities that affect waters of the United States. The Missouri Department of Natural Resources (MDNR) administers the Section 401 water quality program. Each of the stream crossings would be considered a separate and complete project for Section 404 and Section 401 purposes. The results of an official coordination/project review with the ACOE and the MDNR will determine which nationwide permits are applicable to the project. It is believed that mitigation would not be necessary as long as impact minimization measures, such as the use of best management practices (BMPs) and other water quality controls, are implemented.

Wetlands. **Section 404 of the Clean Water Act extends authorization to the ACOE to regulate activities that affect waters of the United States, including wetlands, and to issue permits for the discharge of dredged or fill material into wetlands and other waters of the U.S. The MDNR administers the Section 401 water quality program. Any activity that will impact wetlands or waters of the U.S. will require Section 404 and Section 401 permitting, and mitigation may be required.**

A single 0.17-acre jurisdictional wetland was identified in the Cross-County MetroLink Extension Segment I alignments for the Fully Grade-Separated and At-Grade/Grade-Separated Combination alternatives. The 0.17-acre I-44 cattail seep was the only jurisdictional wetland

identified in the entire project area. The results of an official coordination/project review with the ACOE and the MDNR will determine which nationwide permits are applicable to the project. The MDNR may require in-kind wetland mitigation if the I-44 cattail seep is filled.

***Floodplains*. Crossings of the 100-year floodplain would occur at three locations: an unnamed tributary of Black Creek, Deer Creek, and an off-channel portion of the River des Peres. The Black Creek tributary and Deer Creek floodplains also include regulatory floodways. The crossings of the Black Creek tributary and Deer Creek are narrow and would be spanned by bridges. Therefore, the impact to floodplains and floodways would not be severe, and mitigation would not be required.**

Threatened and Endangered Species

According to the U.S. FWS, there are five federally listed species and two candidate species known to occur in St. Louis County. The federally protected species known to occur in St. Louis City and St. Louis County include the following: bald eagle, peregrine falcon, pallid sturgeon, pink mucket pearlymussel, and running buffalo clover. The sicklefin chub and sturgeon chub are the two candidate species listed for the county.

It is highly unlikely that the federally listed species for St. Louis City and County would be impacted by the proposed Cross-County MetroLink Extension Segment I alignments for the Fully Grade-Separated and At-Grade/Grade-Separated Combination alternatives. A formal coordination request will be sent to the U.S. FWS, which will be requested to issue a "no effect" letter that supports this determination. No mitigation will be required for threatened and endangered species.

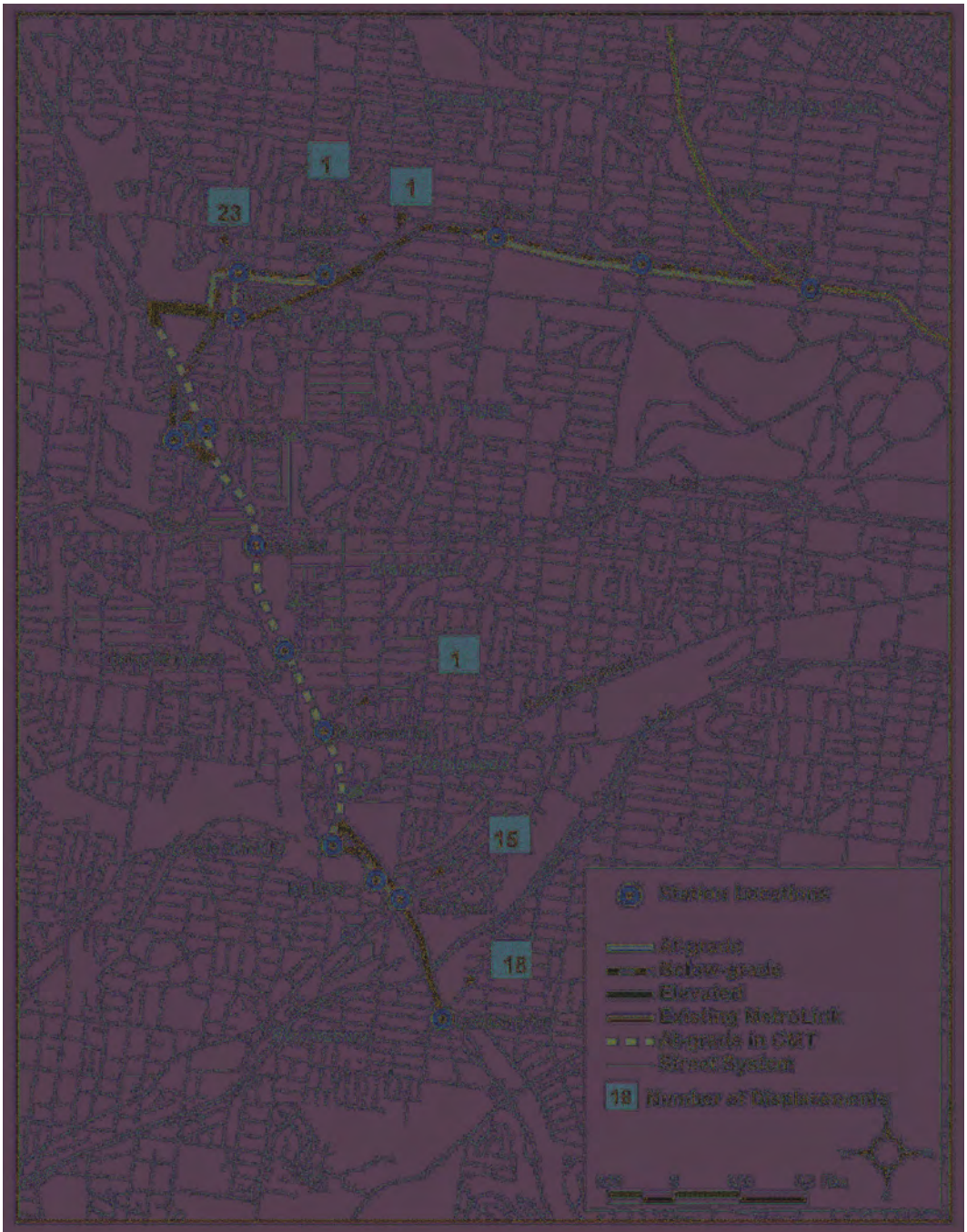
5.4.2 Minimize Displacement

Minimizing displacements and other property impacts was among the considerations in the selection of alignment alternatives and options for the Cross-County MetroLink Extension Segment I. Table 5.4-2 depicts the number of displacements and other properties impacted by the two alternatives and the various options under each alternative. A displacement is considered where an occupied building and associated lot is required for implementation of an alternative or option. Other properties impacted include those required for rights-of-way, air rights and easements for alignments, parking lots, bus transfer points, vehicular and pedestrian access, etc., but which do not necessitate a displacement.

Under the basic Fully Grade-Separated Alternative there would be 19 total displacements, with 48 additional properties impacted as a result of required rights-of-way, air rights and easements necessary for project implementation (Figure 5.4-1). All of these displacements, with one exception, are associated with the parking garage, bus transfer and maintenance yard at the proposed MetroLink Lansdowne Terminal Station at the southern end of the alignment. The displacements consist of ten businesses and nine residences. Six of the business displacements and three of the residential displacements are located in the City of Shrewsbury, with the remainder located in the City of St. Louis. It is estimated that there are between 50-60 employees

associated with these potential business displacements. All of the other properties impacted, again with only a couple of exceptions, are associated with the proposed Lansdowne Terminal Station. The majority of these properties are located within the City of St. Louis between Lansdowne Avenue and Bancroft Avenue.

The same displacements and other impacted properties would also be associated with the At-Grade/Fully Grade-Separated Alternative with the Lansdowne station considered as the southern terminus of the alignment segment. Approximately six additional properties, however, would be impacted under this alternative because of rights-of-way and other needs. In addition, other displacements would occur within the City of Clayton depending upon which optional alignment would be selected under this alternative. The Carondelet/Meramec At-Grade Option would involve 23 business displacements with an associated 100-125 employees in the 3-story office building at the corner of Carondelet Avenue and Meramec Avenue. These businesses include the St. Louis Bread Company and small professional offices. Under the Forest Park Parkway Elevated Option, there would be one displacement associated with each of the two transitional options in the vicinity of Forsyth Boulevard. Bally's Total Fitness or a residence in the Maryland Avenue Historic District would necessitate displacement under these two respective options. None of the other alignment options under this alternative would involve any displacements, although some property impacts would occur – most notably under the Galleria Elevated Option which would require air rights from approximately a dozen adjacent property owners



Orange County MetroLink Extension Segment I: Potential Displacements

Figure 6.4-1

The Deer Creek Terminal Station is considered an option under each of the two basic alternatives rather than extending the alignment to Lansdowne Avenue. Fifteen business displacements and an additional six properties would be impacted under this option. All of the business displacements are associated with the proposed park-n-ride lot, bus transfer and maintenance yard located between Deer Creek and Big Bend Boulevard. The business displacements include eleven industrial-related businesses and four commercial businesses with an estimated 115-125 employees. All of the industrial businesses are located in the Big Bend Industrial Court area.

5.4.2.1 Mitigation for Displacements and Relocations

Once the preferred alternative is selected and the MetroLink Extension project proceeds with preliminary and final design studies, property owners for businesses and residences that will be displaced will be contacted. Relocations will be accomplished in accordance with the procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and the Uniform Relocation Act Amendments of 1987, known jointly as the Uniform Relocation Assistance Act.

Table 5.4-2
DISPLACEMENTS/PROPERTIES IMPACTED BY ALTERNATIVE/OPTION

Alternative/Option	Displacements		Total Displacements	Number of Empls.	Number of Buildings	Other Properties Impacted
	Bus.	Res.				
Fully Grade-Separated Alternative [1]	10	9	19	50-60	17	48
Deer Creek Terminal Station	15	0	15	115-125	10	6
At-Grade/Grade-Separated Alternative [1,2]	33	9	42	150-185	19	57[3]
South Edge Option	0	0	0	0	0	0
Skinker Boulevard and Big Bend Boulevard Underpasses Option	0	0	0	0	0	0
Downtown Clayton Elevated Option	(see Transition Option)		0	0	0	0
Bally's Transition	1	0	1	25	1	0
Maryland Ave Transition	0	1	1	N/A	1	0
Forest Park Parkway At-Grade Option	0	0	0	0	0	2[4]
Carondelet/Brentwood At-Grade Option	0	0	0	0	0	3
Galleria Elevated Option	0	0	0	0	0	12
Laclede Station Road At-Grade/ Elevated Option	0	0	0	0	0	0
Deer Creek Terminal Station	15	0	15	115-125	10	6

Note: Displacements and other properties impacted under each option are in addition to those listed for each basic alternative unless specifically noted otherwise.

[1] Both basic alternatives include the proposed Lansdowne terminal station park-n-ride lot and bus transfer and maintenance yard facilities.

[2] The Forest Park Parkway and Millbrook Boulevard median alignment location is included in the basic alternative. The Carondelet/Meramec At-Grade alignment in downtown Clayton is also a part of the basic alternative.

[3] Includes nine properties associated with the Forest Park Parkway and Millbrook Boulevard median alignment location.

[4] Possible loss of 50 parking spaces.

5.4.3 Minimize Noise, Vibration, and Electromagnetic-Related Impacts

5.4.3.1 Noise and Vibration

This section presents the results of the noise and vibration assessment for the Cross-County MetroLink Extension. This assessment was conducted to quantify the extent of potential impacts and to identify feasible mitigation options where appropriate. The analysis was conducted according to the procedures outlined in the Federal Transit Administration publication, *Transit Noise and Vibration Impact Assessment* (U.S. DOT, April 1995). The impact criteria are described in Table 5.4.3.1-1.

The potential main sources of noise for the Cross-County MetroLink extension project will be from the operation of MetroLink vehicles along the corridor. All receptors next to the light rail alignment will experience some noise from wheel-rail interaction, the vehicle's cooling fans, HVAC equipment, and MetroLink warning devices. At some locations, certain receptors will experience additional noise from localized noise sources, such as warning bells at roadway crossings, wheel squeal on tight curves and on crossover tracks and switches. The major sources of temporary construction noise and vibration will come from the use of diesel-powered construction equipment along the MetroLink alignment and from heavy excavation equipment at station locations. Construction noise and vibration would be a temporary impact and it is discussed in Section 5.4.5.

Description of Impact Assessment

The degree of noise or vibration impact resulting from this MetroLink project depends on the noise and vibration levels produced, the location of sensitive receptors, and existing or ambient noise and vibration levels. The following sections briefly describe these factors, as well as applicable noise and vibration criteria. Ambient noise and vibration levels are discussed in Section 3.4.3 of this report.

Noise from MetroLink vehicles has been predicted in terms of the hourly L_{eq} noise levels and L_{dn} noise levels. FTA noise source reference levels were adjusted using project-specific operational information to predict noise levels at receptor locations. Vibration levels were predicted for MetroLink vehicles also. FTA generalized vibration levels were adjusted using project-specific operating parameters and local geological conditions.

For the Cross-County MetroLink project, there will be two MetroLink cars per train, where each car is about 89 ft long. Thus the trains will be about 178 ft long. Each car has three trucks underneath and each truck has two axles (4 wheels). The end trucks both are powered, the center truck is an idler. All motors run together, sharing the load equally. Existing cars have one motor per truck, geared to both axles. But the new cars will have two motors per truck, one geared to each axle. The headways on the existing line are 8 minutes during peak hour, 12 minutes off-peak and 15 minutes on Sunday or late at night.

Representative Receptors

Sixteen noise locations and two vibration locations were chosen as representative noise and vibration receptors along the Cross-County MetroLink Extension alignment. Nearby residences, businesses, research facilities and public buildings have been included in the assessment. (Figure 3.4-4 shows the ambient noise and vibration monitoring locations.)

Applicable Noise Standards

Federal regulations contain no absolute noise levels that must be met by a transit project of this type. However, the FTA has adopted noise guidelines for LRT systems that, when met, are designed to result in an acceptable community noise environment. Table 5.4.3.1-1 presents the FTA's three land use categories for transit noise impact criteria. The FTA noise guidance criteria are presented in Table 5.4.3.1-2. Background noise levels and predicted MetroLink project noise levels together determine the degree of impact at a given receptor location.

Table 5.4.3.1-1
LAND USE CATEGORIES AND METRICS FOR TRANSIT NOISE IMPACT CRITERIA

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor L_{eq} (h)*	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor L_{eq} (h)*	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios and concert halls fall into this category. Places for meditation or study associated with cemeteries, monuments, museums. Certain historical sites, parks and recreational facilities are also included.

* L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.
Source: U.S. DOT, FTA, April 1995.

Table 5.4.3.1-2
FTA GUIDELINES FOR THE SIGNIFICANCE OF NOISE IMPACTS
L_{eq} and L_{dn}, dBA

Existing Noise Exposure	Allowable Project Noise Exposure	Allowable Combined Total Noise Exposure	Allowable Noise Exposure Increase
45	51	52	7
50	53	55	5
55	55	58	3
60	57	62	2
65	60	66	1
70	64	71	1
75	65	75	0
Source: U.S. DOT, FTA, April 1995.			

Applicable Vibration Limits

FTA has developed acceptable limits for vibration. These limits are designed to: (1) minimize effects caused when buildings are set into motion, (2) minimize the disruption of vibration sensitive manufacturing and research processes, and (3) prevent damage to structures. These criteria, shown in Table5.4.3.1-3, were used to assess vibration impacts.

Research Equipment Vibrational Displacement Limits

Operational vibration specifications were provided by Washington University. These limits are designed to allow for proper research processes in the Mass Spectrometry Building, adjacent to the MetroLink alignment along Millbrook Boulevard. Examples of these vibrational displacement limits are shown in Table 5.4.3.1-4. They were used to assess vibration impacts on the research equipment at the University. The research instruments are in the basement of the building on laboratory benches fitted with air mounts.

Table 5.4.3.1-3
GROUND-BORNE VIBRATION AND GROUND-BORNE NOISE IMPACT CRITERIA

	Ground-Borne Vibrational Velocity Impact Levels		Ground-Borne Noise Impact Levels	
Vibration Land Use Category	Frequent[a] Events	Infrequent[b] Events	Frequent[a] Events	Infrequent[b] Events
Category 1: Buildings where low ambient noise and/or vibration is essential for interior operations	65 VdB[c]	65 VdB	—[d]	—[d]
Category 2: Residences and buildings where people normally sleep.	72 VdB	80 VdB	35 dBA	43 dBA
Category 3: Institutional land uses with primary daytime use.	75 VdB	83 VdB	40 dBA	48 dBA
Vibration Damage Criteria	Buildings = 100 VdB		Historic Building=95 VdB	

Source: U.S. DOT, FTA, April 1995.

Notes: a More than 70 vibration events per day.
b Fewer than 70 vibration events per day.
c Vibration level is in VdB, based on velocity, relative to 1 microinch/second.
d Vibration sensitive equipment is not sensitive to ground-borne noise.

Table 5.4.3.1-4
WASHINGTON UNIVERSITY MASS SPECTROMETERS VIBRATIONAL DISPLACEMENT LIMITS

Frequency of Floor Vibration Hz	Peak-to-Peak Amplitude Limit µm (micro meter)	Peak-to-Peak Amplitude Limit µin (micro inch)
1	0.5	19.7
3	1.3	50.7
10	9.5	372.2

Source: Washington University, 1999.

5.4.3.1.3 Noise and Vibration Impact Assessment Results

The potential for noise and vibration impacts in the three corridor sub-areas (Forest Park/University City, downtown Clayton, and Galleria South to I-44) is discussed in this section of the report.

Forest Park/University City Sub-area

Operational Noise

Table 5.4.3.1-5 shows the projected MetroLink unmitigated L_{dn} noise levels for three representative noise locations in this sub-area, as well as the projected change in noise levels resulting from the operation of the Cross-County MetroLink project. As can be seen in Table 5.4.3.1-5, the projected noise levels for certain MetroLink Alternatives do not exceed the FTA "impact" or "severe impact" thresholds for the receptor locations. This sub-area of the corridor has roadway traffic along Forest Park Parkway/Millbrook Boulevard. As a result, ambient noise levels in this portion of the alignment are relatively high and in some locations already exceed FTA impact levels. This will reduce the perceived impact of noise from the MetroLink vehicles. With mitigation in some areas, no noise impacts would occur in this section from the operation of the MetroLink Extension.

Table 5.4.3.1-5
LRT NOISE IMPACT ASSESSMENT SUMMARY WITHOUT MITIGATION

Receptor and Proposed Vertical Alignment (Land Use Category 2, unless noted)	Side of Tracks	Projected Noise Levels (Ldn, dBA)		Change in Noise Levels under the LRT Alternative (Ldn, dBA)				
		Existing & No Build	Future Project	FutureSum w/Project	FTA Thresholds		Exceeds FTA Criteria?	
					Imp[a]	Sev[b]	Imp[a]	Sev[b]
5835 Lindell - GS Below Grade	S	67.2	0.0	65.2	62	68	N	N
5835 Lindell - AG/GS FPP Median	S	67.2	66.4	68.9	62	68	Y	Y
5835 Lindell - AG/GS FPP South Edge	S	67.2	63.8	67.6	62	68	Y	N
6910 Pershing - GS Below Grade	N	66.7	0.0	66.7	62	68	N	N
6910 Pershing - AG/GS FPP Median	N	66.7	70.8	71.6	62	68	Y	Y
7349 Lindell - GS Below Grade	S	65.4	0.0	65.4	66	74	N	N
7349 Lindell - AG/GS FPP Median	S	65.4	0.0	65.4	66	74	N	N
7349 Lindell - AG/GS North FPP	S	65.4	0.0	65.4	66	74	N	N
7349 Lindell - North FFP Elevated	S	65.4	68.4	69.6	66	74	Y	N
6910 Pershing - AG/GS FPP South Edge	N	66.7	0.0	66.7	62	68	N	N

[a] FTA "Impact" threshold based on existing noise exposure per Table 5.4.3.1-2.
[b] FTA "Severe Impact" threshold based on existing noise exposure per Table 5.4.3.1-2.
GS = Grade separated, AG = At-Grade, FPP = Forest Park Parkway.
Source: Parsons Engineering Science, Inc., May 1999.

The Fully Grade Separated Alternative would create no noise impacts. Mitigation measure for the At-Grade/Grade Separated alignment would reduce noise impacts to acceptable levels. Either "knee walls", low trackside barriers, which are already incorporated into the MetroLink design, or vehicle skirts, which serve as noise barriers over the LRT wheels, would provide sufficient noise mitigation for the At-Grade/Grade Separated alignments.

Operational Vibration

Table 3.4-4 and 3.4-5 give the ambient vibration conditions for the mass spectrometers in the basement lab of the Mass Spectrometry building on the Washington University campus on the south side of Millbrook Boulevard. The results of the vibration analysis show that, in the very low frequency range, maximum vibrations already exceed the vibration criteria by a substantial amount. Since the operation of the mass spectrometer has continued under these conditions, it would be inappropriate for the Cross-County MetroLink project to be responsible for lowering existing vibrations. Thus, the vibration criteria should be that of achieving existing conditions under which the research facility currently operates.

As can be seen in Tables 5.4.3.1-10 and 5.4.3.1-11, the projected vibration for the Forest Park Parkway median alignment complies with both the FTA impact thresholds for vibration-sensitive locations. Mitigation of only 0.8 VdB would bring the Forest Park Parkway below-grade alignment into compliance. Mitigation of 6.8 VdB for the Forest Park Parkway south edge alignment would be required for compliance. Mitigation options for the below-grade and south edge options would include either operating changes (slower speed, equipment selection), special trackwork to reduce wheel impacts, or resilient track support (multiple types are available). This would provide sufficient mitigation for the Forest Park Parkway below-grade and south edge alignments to be in compliance.

Table 5.4.3.1-10
LRT VIBRATION IMPACT ASSESSMENT SUMMARY WITHOUT MITIGATION

		Ground-Borne Vibration				LRT Project Exceeds FTA Criteria?	
Sensitive Vibration Receptor Location (Vibration Land Use Category 1)	Side of Tracks	Vibration Impact Criteria VdB	Future Vibration with Project VdB	GBN[1] Impact Criteria dBA	Future GBN[1] with Project dBA	Vibration	GBN[1]
WU Mass Spectrometry Floor (GS below grade)	S	65	65.80	40	30.8	Y	N
WU Mass Spectrometry (AG/GS FPP median)	S	65	64.05	40	14.1	N	N
WU Mass Spectrometry (AG/GS FPP south)	S	65	71.80	40	36.8	Y	N

Source: Parsons Engineering Science, Inc., May 1999.
[1] GBN = ground-borne noise. This criterion is for people, not equipment.

Table 5.4.3.1-11
WASHINGTON UNIVERSITY MASS SPECTROMETERS VIBRATIONAL DISPLACEMENT LIMITS

Frequency of Floor Vibration	Peak-to-Peak Amplitude Limit	LRT Peak-to-Peak Displacement, Fm			
		Existing WUMS Ambient	LRT Operations		
Hz	Fm (micrometer)		GS Below-Grade	AG/GS FPP Median	AG/GS FPP South
1	0.5	2.20 to 6.86	5.51	4.51	11.00
3	1.3	0.06 to 0.22	N/A	N/A	N/A
10	9.5	0.40 to 0.11	N/A	N/A	N/A
Source: Parsons Engineering Science, Inc., May 1999.					

Clayton Section

Operational Noise

Table 5.4.3.1-6 shows the projected MetroLink unmitigated L_{dn} noise levels for representative locations in this sub-area for the operation of the Cross-County MetroLink project. As noted, the projected noise levels with the LRT Alternative do exceed the FTA "impact" and "severe impact" thresholds for some receptor locations. Therefore, noise impacts will occur as a result of the At-Grade/Grade Separated Combination Alternative especially at the sharp turn at the Carondelet/Meramec intersection and the 90 degree turn at Brentwood Boulevard (for the Carondelet/Brentwood option). The Downtown Elevated option along Forest Park Parkway would also result in noise impacts and require mitigation. Vehicle skirts, undercar absorption, ballast on the elevated trackbed, or low trackside sound barriers which are already incorporated into the design would mitigate noise impacts in this section option. Noise impacts for the Forest Park Parkway at-grade options would be potentially less than for the elevated options in the section from Forsyth west to Meramec. There could still, however, be a need to consider some mitigation, such as noise walls along the south right-of-way line.

This sub-area of the Cross-County corridor is a highly urbanized area. As a result, ambient noise levels are relatively high and in some locations exceed FTA impact levels. This reduces the perceived impact of noise from the MetroLink vehicles. With mitigation in some areas of downtown Clayton, no noise impacts would occur in this section from the operation of the MetroLink Extension.

Operational Vibration

Predicted LRT vibration levels range from 65 VdB at 100 feet to 85 VdB at 25 feet. Thus, no vibration impacts are anticipated.

Table 5.4.3.1-6
LRT NOISE IMPACT ASSESSMENT SUMMARY WITHOUT MITIGATION, CLAYTON CBD

Receptor and Proposed Vertical Alignment (Land Use Category 2, unless noted)	Side of Tracks	Projected Noise Levels (Ldn, dBA)		Change in Noise Levels under the LRT Alternative (Ldn, dBA)				
		Existing & No Build	Future Project	Future Sum w/Project	FTA Thresholds		Exceeds FTA Criteria?	
					Imp[a]	Sev[b]	Imp[a]	Sev[b]
250 Brentwood #3E—GS Below Grade	N	75.7	0.0	75.7	66	75	N	N
250 Brentwood #3E—AG/GS Elevated	N	75.7	67.8	74.4	66	75	Y	N
250 Brentwood #3E—AG/GS At-Grade	N	75.7	71.6	71.6	66	75	Y	N
250 Brentwood #3E—FPP Elevated	N	75.7	67.5	74.3	66	75	Y	N

[a] FTA "Impact" threshold based on existing noise exposure per Table 5.4.3.1-2.
[b] FTA "Severe Impact" threshold based on existing noise exposure per Table 5.4.3.1-2.
[c] Peak Hour Leq is metric for locations without overnight sleeping quarters

Table 5.4.3.1-7
LRT NOISE IMPACT ASSESSMENT SUMMARY WITHOUT MITIGATION, GALLERIA/RICHMOND HEIGHTS

Receptor and Proposed Vertical Alignment (Land Use Category 2, unless noted)	Side of Tracks	Projected Noise Levels (Ldn, dBA)		Change in Noise Levels under the LRT Alternative (Ldn, dBA)				
		Existing & No Build	Future Project	Future Sum w/Project	FTA Thresholds		Exceeds FTA Criteria?	
					Imp[a]	Sev[b]	Imp[a]	Sev[b]
School: 1107 E. Linden[c]-GS Below	W	57.7 L_{eq}	0.0	57.7 L_{eq}	57	63	N	N
School: 1107 E. Linden[c]-AG/GS Grade	W	57.7 L_{eq}	67.4	67.7	57	63	Y	Y
Church: 1107 E. Linden[c]-GS Below	W	57.7 L_{eq}	0.0	57.7 L_{eq}	57	63	N	N
Church: 1107 E. Linden[c]-AG/GS Grade	W	57.7 L_{eq}	68.6	66.6	57	63	Y	Y
1143 Terrace-GS Below Grade	E	64.0	0.0	64.0	61	66	N	N
1143 Terrace-GS At Grade	E	64.0	73.7	73.9	61	66	Y	Y
1143 Terrace-AG/GS Trench	E	64.0	64.7	66.6	61	66	Y	Y
1224 Buck-GS Below Grade	W	64.0	0.0	64.0	61	66	N	N
1224 Buck-GS At Grade	W	64.0	70.2	70.8	61	66	Y	Y
1224 Buck-AG/GS Trench	W	64.0	62.2	64.2	61	66	Y	N

[a] FTA "Impact" threshold based on existing noise exposure per Table 5.4.3.1-2.
[b] FTA "Severe Impact" threshold based on existing noise exposure per Table 5.4.3.1-2.
[c] Peak Hour Leq is metric for locations without overnight sleeping quarters

Galleria South to I-44 Sub-area

Operational Noise

Tables 5.4.3.1-8 and 5.4.3.1-9 show the projected MetroLink unmitigated Ldn noise levels for representative locations along the Cross-County MetroLink project in this subarea. As can be seen in both tables, the projected noise levels with the LRT Alternative do exceed the FTA "impact" and "severe impact" thresholds for most receptor locations. Therefore, noise impacts will occur as a result of the MetroLink Alternative in this section for the At-Grade/Grade Separated Alternative and section options (for both corridor alternatives) that require elevated structures. The southern portion of this sub-area has heavy freeway traffic and is lined by industrial and commercial land uses. As a result, ambient noise levels are relatively high and in

some locations already exceed FTA impact levels. This will reduce the perceived impact of noise from the MetroLink vehicles.

Mitigation measures can reduce the noise impact in this sub-area. Noise mitigation measures will necessary for the elevated alignments. A combination of vehicle skirts and low trackside noise, barriers which are already incorporated in the design, would mitigate the elevated portions of the alternatives. With mitigation in some areas of Galleria South to I-44 sub-area, no noise impacts would occur in this section from the operation of the MetroLink Extension.

Table 5.4.3.1-8
LRT Noise Impact Assessment Summary without Mitigation

		Projected Noise Levels (Ldn, dBA)		Change in Noise Levels under the LRT Alternative (Ldn, dBA)				
Receptor and Proposed Vertical Alignment (Land Use Category 2, unless noted)	Side of Tracks	Existing & No Build	Future Project	FutureSum w/ Project	FTA Project Thresholds		Exceeds FTA Criteria?	
					Imp[a]	Sev[b]	Imp[a]	Sev[b]
2851 Laclede Station - GS Elevated	E	59.9	70.0	70.0	58	64	Y	Y
2851 Laclede Station - GS Grade	E	59.9	67.0	67.5	58	64	Y	Y
2851 Laclede Station - AG/GS Trench	E	59.9	59.0	62.5	58	64	Y	N
7204 Sussex - GS Elevated	E	63.0	72.4	72.6	60	66	Y	Y
7204 Sussex AG/GS Elevated	E	63.0	72.4	72.6	60	66	Y	Y
7204 Sussex - Laclede Elevated	E	63.0	70.4	72.6	60	66	Y	Y
4301 St. Vincent - GS Elevated	W	64.0	70.4	71.0	61	66	Y	Y
4301 St. Vincent - AG/GS Elevated	W	64.0	70.4	71.0	61	66	Y	Y
4301 St. Vincent - Laclede Elevated	W	64.0	70.4	71.0	61	66	Y	Y
7210 Lansdowne - GS Elevated	S	73.4	68.8	71.7	66	72	Y	N
7210 Lansdowne - AG/GS Elevated	S	73.4	68.8	71.7	66	72	Y	N
7210 Lansdowne - Laclede Elevated	S	73.4	68.8	71.7	66	72	Y	N
7210 Lansdowne - Terminus Station	S	73.4	69.5	71.9	66	72	Y	N

[a] FTA "Impact" threshold based on existing noise exposure per Table 5.4.3.1-2.
[b] FTA "Severe Impact" threshold based on existing noise exposure per Table 5.4.3.1-2.
[c] Peak Hour Leq is metric for locations without overnight sleeping quarters
Source: Parsons Engineering Science, Inc., May 1999.

Operational Vibrations

No vibration sensitive receptors were identified in this sub-area. No vibration impacts are anticipated.

5.4.3.1.4 Possible Noise and Vibration Mitigation

Introduction

Where potential noise impacts were identified, FTA guidelines have been considered to mitigate the potential impacts. FTA has documented possible noise and vibration mitigation measures which have been found effective in reducing impacts. Many LRT systems are operational throughout the United States. The experience gained by other transit authorities is a potential resource for the Cross-County MetroLink project. Noise studies have been obtained and reviewed from several cities where light rail now operates. Transit agency staff from San Diego, San Francisco, Los Angeles, San Jose, and Portland have been contacted to provide information. Coordination with these agencies regarding their experience in mitigating light rail transit noise impacts has proven valuable. Information gathered will be used during the Preliminary Engineering phase of the Cross-County MetroLink project.

Additional noise analysis was conducted for each corridor alternative and section option incorporating knee-wall mitigation, which is part of the Cross-County MetroLink Extension design. The analysis results show that this design feature would reduce levels an average of 3 to 4 dBA throughout the corridor. Moreover, in some sensitive receptor locations, noise levels were reduced 5 to 6 dBA, an amount definitely perceptible to the human ear. Resilient wheels, as already in use by MetroLink on other lines of the system, could reduce noise levels an additional 10 dBA, as noted in Table 5.3.1.4-13. Adding rail lubrication on sharp curves would also help to mitigate noise impacts. This additional noise analysis further substantiates the finding that with mitigation throughout the Cross-County corridor, no noise impacts would occur from the operation of the MetroLink Extension.

Typical Light Rail Transit Noise Mitigation Measures

Table 5.4.3.1.4-9 shows typical noise mitigation measures commonly used around the country. The table shows measures for the noise sources, noise paths and receivers and includes estimates of the effectiveness of the mitigation measures. Rail noise impacts sometimes require the use of several measures together to mitigate potential impacts.

Table 5.4.3.1.4-9
RAIL TRANSIT NOISE MITIGATION MEASURES

Application	Mitigation Measure	Effectiveness
SOURCE	Stringent Vehicle & Equipment Noise Specifications	Varied
	Operating Restrictions	Varied
	Resilient or Damped Wheels to Reduce Wheels Squeal on Curves	10-20 dB
	Vehicle skirts	6-10 dB
	Undercar Absorption	5 dB
	Wheel Maintenance	*
	Rail Maintenance	*
	Curve Radii designed greater than 1,000 feet	Avoids Wheel Squeal
	Rail Lubrication on Tighter Curves	Reduces Wheel Squeal
	Moving-Point Frogs for Reducing Crossover Gaps	Reduces Wheel Impact
PATH	Sound Barriers close to Tracks	6-10 dB
	Sound Barriers at Receptor Property Lines	3-5 dB
	Alteration of Vertical and/or Horizontal Alignments	Varied
	Acquisition of Buffer Zones	Varied
	Ballast on Elevated Trackway	5 dB
	Ballast on At-Grade Trackways	3 dB
	Resilient Track Support	Varied
RECEIVER	Acquiring Rights for Construction of Sound Barriers	5-10 dB
	Apply Noise Insulation in Buildings	5-20 dB

* Measures to maintain rail systems in as-new condition. Otherwise, noise levels could increase by up to 10 dB (a doubling of loudness).

Source: U.S. DOT, FTA April 1995.

Typical Light Rail Transit Vibration Mitigation Measures

Table 5.4.3.1.4-10 presents typical vibration mitigation measures. Rail transit vibration control sometimes require the use of several measures combined to mitigate potential impacts.

Since no vibration impacts were identified, no mitigation measures are recommended at this time. As already noted temporary noise and vibration impacts due to construction activity will occur. These temporary impacts are address in Section 5.4.5

Table 5.4.3.1.4-10
RAIL TRANSIT VIBRATION MITIGATION MEASURES

Mitigation Measure	Effectiveness
Operating Changes (slower speed, equipment selection)	Varied
Stringent Vehicle & Equipment Vibration Specifications	Varied
Wheel Maintenance	*
Rail Maintenance	*
Careful planning and design of Special Trackwork	Reduces Wheel Impacts
Moving-Point Frogs for Reducing Crossover Gaps	Reduces Wheel Impacts
Deep Trenches near Tracks	Similar to sound walls
Acquisition of Buffer Zones	Increases distance to receiver
Acquisition of Vibration Easements	Transferable with property
Resilient Track Support (multiple types)	Varied
Building Modifications	Vibration isolation

* Measures to maintain rail systems in as-new condition. Otherwise, vibration levels could increase by up to 20 VdB.
Source: U.S. DOT, FTA April 1995.

5.4.3.2 Electromagnetic Fields/Interference (EMF/EMI)

This assessment evaluates existing information regarding potential impacts of electromagnetic fields produced by power supplies, catenary circuitry, and light-rail vehicle motors. These facilities are sources of static fields with frequencies between 0 and 3 hertz (Hz) and fields in the ELF range. Two types of potential impacts are being evaluated in this conceptual design study: (1) disturbances to sensitive electronic devices (electromagnetic interference, or EMI); and (2) potential human biological or health effects.

5.4.3.2.1 Electromagnetic Fields Produced by MetroLink

Static Magnetic and Electric Fields

Direct current (dc) electric power is one man-made source of static electric and magnetic fields. The MetroLink light-rail vehicles are supplied with dc electricity via overhead catenary wires at a nominal voltage (750 volts). In the Siemens SD 400 Series I vehicles currently deployed, the amount of power delivered to the motors is controlled by varying the amount of time that a solid-state thyristor with a repetition rate of 250 Hz is turned on. The thyristor is located on the vehicle. In the Siemens SD 400 Series II vehicles, which are anticipated to be deployed later this year, the dc power is converted by multiple thyristors to provide three-phase alternating current (ac) power to the vehicle motors. The current returns via the steel rails [some current may return via other paths] to the nearest substation to complete the circuit.

The catenary-vehicle-rail circuit is the source of a static magnetic field that varies in intensity with the power required by the motors and ancillary services, e.g., lighting, heating, air conditioning . Based on information provided by engineers at the Bi-State Development Agency and Siemens Transportation Systems Inc., it is estimated that the peak current flow in the catenary and rails for two, coupled Series I vehicles would be about 2500 amperes. The more powerful motors on the Series II vehicles are expected to draw approximately 20% more current. However, these maximum currents would be present only briefly while speeding up or during regenerative braking. Once the vehicle is moving at constant speed, the power demands will drop significantly. At a constant speed of 50 miles per hour, the Series II vehicle might only draw 275 amperes (about one tenth the maximum current).

If the current flow on the catenary is the same as that returning in the track below it[1], then the current flow is said to be balanced. Assuming, as a rough approximation, that the catenary-vehicle-track circuit is represented as two long parallel lines with equal currents in opposite directions, then the intensity of the magnetic field drops off with the inverse of the square of the distance from the track. The profile of the maximum expected static magnetic field as a function of distance from the track is shown in Figure 5.4-2 for a single Series II vehicle drawing 3,000 amperes (A). Although traction power on one to three mile sections of track is largely isolated from adjoining sections, currents on each catenary-track circuit will reflect the power drawn by multiple vehicles (going in either direction) on that section. For normal operations, the total maximum current drawn was assumed to be 6600 A, based upon two trains accelerating (6000 A) plus a third train drawing 600 A.

However, if the current flowing on the catenary is not equal to that returning on the rails beneath it, then the current flows on the catenary and track are unbalanced. In such a case, the net current acts as a line source of magnetic field, which the current declines as the inverse of the

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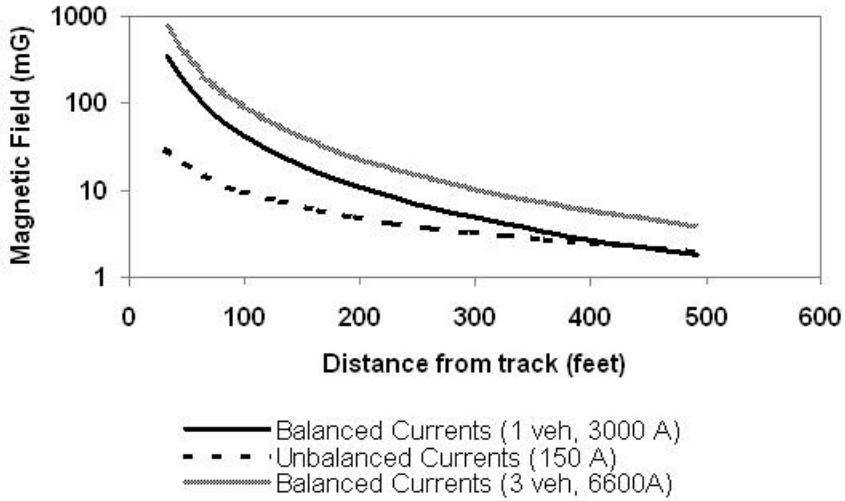
[1] Note: The return current is always the same as that flowing on the catenary. However, it may not return on the track under the catenary. It will divide according to the impedances of various ground paths.

distance from the source. At present, the potential magnitude of imbalances of current flow on the MetroLink system is not known. However, to illustrate the importance of current imbalances consider Figure 5.4-2 again. Here, the field from an unbalanced current of 150 A (5 percent of the maximum current drawn by a Series II vehicle) declines more slowly with distance than the balanced current. At a distance of about 450 feet from the track the field from the unbalanced current exceeds that of the balanced current. Thus, as one moves away from the track, unbalanced current assumes a relatively more important source of impact to the ambient static magnetic field.

Because the dc electric fields produced by the overhead catenary are quite small in magnitude, there is no need to consider them (Dietrich et al, 1993a).

Comparison of Balanced and Unbalanced Power Flows



To characterize the time-varying fields from the MetroLink Extension, a search of the literature was undertaken to identify urban transit vehicles with characteristics similar to the MetroLink Series I vehicles. The most similar system that was located is the Green Line operated by the Massachusetts Bay Transportation Authority (MBTA) in Boston. The vehicles on the Green Line have a 218-Hz thyristor chopper-controlled propulsion system that is supplied by overhead 700-V catenaries. Table 5.4.3.2-1 summarizes measurements of dc magnetic fields that were taken inside vehicles and at station platforms as part of research conducted on behalf of the Federal Railroad Administration (FRA).

Table 5.4.3.2-1
MEASUREMENTS OF STATIC MAGNETIC FIELDS (0-3 HZ) ASSOCIATED WITH THE OPERATION OF MBTA GREEN LINE RAIL VEHICLES

Location	Average (mG)	Range (mG)
Inside vehicle	459	75 - 1091
Station platform	494	147 - 765
Wayside	-	435 - 600
Note: The ambient static magnetic field for Boston is 550 mG Source: Dietrich et al, 1993b		

These data indicate the approximate magnitude of the static magnetic fields that will be produced by the operation of the MetroLink Extension. However, it is not possible from these measurements to determine the potential contribution of unbalanced current flow on the magnetic field at distances further from the track.

Time-Varying Electric and Magnetic Fields

The major sources of project-related ELF electric and magnetic fields are the MetroLink power-delivery and on-board traction systems. Particular sources of ELF fields that have been characterized in studies of similar urban transit systems include the:

- **Power supply from the utility**
- **Traction substations that convert 60-Hz power to dc power**
- **On-board chopper motor control**

Power to the MetroLink system is drawn from Ameren 60-Hz distribution lines at voltages of 12.5 or 34.5 kV. MetroLink has traction substations to step down the voltage and rectify ac to dc power. Therefore, the 60-Hz fields from the power supply system to MetroLink are similar to those that are omnipresent from the distribution and use of power in the community. Some ripple voltages resulting from the rectification process may not be completely filtered out at the substation and therefore may also be carried by catenary wires. On-board the vehicles, the

traction control system underneath the floor is also a source of ac magnetic fields. The dc current drawn from the catenary and provided to the motors is 'chopped' to deliver power in pulses. The choppers on MetroLink Series I cars operate at a fixed frequency of 250 Hz. As the operator of the vehicle adjusts the acceleration and speed of the vehicle, the width of the pulses per second delivered to the motors changes and, magnetic fields centered at a frequency of 250 Hz are produced.

Table 5.4.3.2-2 summarizes measurements of the ac magnetic fields that were taken inside vehicles and at station platforms of the MBTA Green Line.

Table 5.4.3.2-2
MEASUREMENTS OF EXTREME LOW FREQUENCY MAGNETIC FIELDS (3 - 3000 HZ) ASSOCIATED WITH THE OPERATION OF THE MBTA GREEN LINE RAIL VEHICLES

Location	Frequency Range (Hz)	Average (mG)	Range (mG)
Inside vehicle (110 cm above floor)	5 - 45	2.4	0.8 - 6.7
	50 - 60	0.7	0.3 - 1.5
	65 - 300	1.0	0.1 - 2.6
	305 - 2560	0.8	0.2 - 2.3
	5 - 2560	2.9	1.0 - 7.0
Platform*	5 - 45	2.0	0.5 - 8.0
	50 - 60	0.9	0.4 - 3.7
	65 - 300	2.6	0.7 - 14.2
	305 - 2560	1.1	0.4 - 6.2
	5 - 2560	3.9	1.4 - 15.2

* measurements include data on vehicles supplied with power by a third rail.
Source: Dietrich et al, 1993.

A comparison of Table 5.4.3.2-2 with Table 5.4.3.2-1 shows that contribution of the static magnetic field to the total field is much greater than for the ac magnetic field. Measurements of the frequency spectrum of the MBTA Green Line during a one-minute period of acceleration confirm this difference with respect to variability over time. Only small fluctuations (<2 mG) of the magnetic field at 60 Hz, and much smaller magnetic fields (<0.2 mG) at 218 Hz (the chopper frequency) and odd harmonics were observed. In contrast, the dc magnetic field increased over

the same time period from 440 mG to almost 600 mG in a jerky, monotonic fashion (Dietrich et al, 1993b).

5.4.3.2.2 Evaluation of Electric and Magnetic Field Impacts on Electronic Devices

The levels of ELF electric and magnetic fields that are associated with the operation of the proposed MetroLink extension are expected to be similar to or below levels of those fields encountered in everyday environments and other transportation systems. The levels are much too low to expect any influence on electronic devices carried or worn on MetroLink vehicles or present in buildings adjacent to the MetroLink right-of-way. However, under certain conditions small perturbations to the earth's static magnetic field may occur several hundreds of feet from the track as the result of balanced and unbalanced dc currents flowing on the catenary-track circuit. While most electronic devices would not be affected by such small changes in the static magnetic field, scientific instruments that require a stable field, such as NMR spectrometers, could be impacted.

As noted in a letter from Dr. J. Schaefer of the Department of Chemistry at Washington University (Schaefer, 1998), and in a subsequent meeting in which the department chairman, Dr. Ackerman, and other faculty met with representatives of the Parsons Transportation Group and the Bi-State Development Agency, there are good theoretical and experimental arguments to suggest that the proposed MetroLink extension would reduce the resolution of NMR spectrometer measurements and possibly introduce artifacts. It has been estimated that a change in the ambient magnetic field of several milligauss, if not constant, could affect NMR spectrometer performance and the impact would be greater for larger changes in field level. The closest NMR spectrometer is on the third floor of George McMillen Laboratory about 125-150 feet south of Millbrook Boulevard. Other NMR instruments are located in buildings between 225 and 300 feet south of Millbrook Boulevard. Potential effects on other instruments, including the mass spectrograph facility located about 50 feet south of the proposed route, have not been assessed. Thus, the available data suggest the strong likelihood that fluctuations in the ambient static field arising from current flow on the catenary-track circuit of the proposed MetroLink extension will adversely affect the performance of NMR spectrometers and, perhaps, other classes of instruments as well.

This condition would prevail whether it is the Fully Grade-Separated Alternative (below the ground surface at this location) or the At-Grade/Grade-Separated Combination Alternative (above-ground at this location). The option that would potentially have the greatest effect would be the South Edge Option, in which the MetroLink vehicles would run closer to the Washington University buildings along Millbrook Boulevard.

5.4.3.2.3 Applicable Regulatory Guidance

The Federal Government has not promulgated health-based standards for long term low level exposure to electric and magnetic fields as found in ordinary residential and urban environments.

Exposure limits for power frequency fields have been defined by various other organizations including the International Commission on Non-ionizing Radiation Protection (ICNRP) and the American Conference of Governmental Industrial Hygienists (ACGIH). These guidelines limit exposures in order to prevent known short-term adverse effects. The ACGIH-recommended limit for occupational exposures is one millitesla [mT](10 G or 10,000 mG) (ACGIH, 1998). The field levels likely to be associated with this project in residential and other public environments are well below these recommended exposure limits.

Seven states have established guidelines for the levels of electric fields on, or at the edge of, rights-of-way for newly constructed high voltage transmission lines. New York and Florida have set guidelines for magnetic field levels as well. In these states, the limits for electric and magnetic fields at the edge-of-right-of way are 1.6 - 2.0 kV/m and 150-200 milligauss, respectively. These guidelines were instituted to limit fields of new projects to those of existing transmission lines, not because of a need to limit EMF based on health considerations.
The ac fields produced by the Ameren distribution circuits for the MetroLink extension and the Marshall-Hunter transmission line would not exceed these guidance values.

The ACGIH recommends that routine occupational exposures to static magnetic fields be restricted to 60 mT(600,000 mG) for eight-hour exposure periods. For those who wear a medical device such as a pacemaker or who have implanted devices, exposure is limited to 0.5 mT. Thus, the static magnetic field levels associated with this project are well below the lowest restriction — 0.5 mT (5,000 mG).

5.4.3.2.4 Summary and Conclusion

A review and assessment of the scientific studies does not suggest the likelihood of any health hazard from electromagnetic exposures related to this project. The anticipated exposures of individuals in proximity to the dc and ac field sources are likely to be typically much lower than most exposures that have been investigated in laboratory studies. These studies report either no effects, or effects that do not extrapolate to health concerns. Small alterations in the naturally occurring levels in the dc magnetic field of the earth that are associated with the operation of the MetroLink Extension are not of health significance to humans or animals.

This review considered the scientific research published after the studies considered by the National Institute of Environmental Health Sciences (NIEHS) in 1998, and the National Research Council/National Academy of Sciences in 1997. The additional information reviewed does not support a change in current policies for addressing EMF issues.

5.4.3.2.5 Mitigation of EMI Effects

Furtherinvestigations will be conducted during the preliminary design phase of the Cross-County MetroLink extension to determine the magnitude of the potential impact of the MetroLink extension on the performance of scientific instruments at Washington University. Investigation

will include comprehensive measurements to characterize the magnetic fields associated with the operation of MetroLink, and to determine other magnetic field sources, if any, near or around the buildings on the Washington University campus that contain NMR instruments. Further research and continued cooperation and discussion among the interested parties should lead to appropriate, cost-effective mitigation measures based on possible modifications to the design and operation of the proposed MetroLink extension where the alignment adjoins the Washington University campus and/or modifications to facilities on campus.

5.4.4 Improve Air Quality

The construction and operation of the Cross-County MetroLink extension is expected to increase transit ridership and incrementally help the region reduce automobile emissions and achieve its air quality conformity objectives. While the project will help improve air quality on a regional level, localized impacts are possible at certain congested intersections.

Motor vehicles generate air pollutants, including carbon monoxide (CO), nitrogen oxides/ hydrocarbons (ozone [O_3] precursors), lead, and suspended particulates less than 10 microns in diameter(PM_{10}). Because of historic exceedances of the National Ambient Air Quality Standards (NAAQS) for CO and O_3, the St. Louis area is currently designated a non-attainment area for these criteria pollutants, and the area is in danger of losing federal funding for transportation projects. (Section 3.4.5 discusses the NAAQS and pending changes in attainment status in greater detail). The 1990 Clean Air Act Amendments require transportation agencies in non-attainment areas to assume greater responsibility in improving air quality. Therefore, microscale air modeling has been performed to determine the impact of the proposed LRT extension on CO concentrations in the study area as part of the Transportation Conformity Analysis for the project, as required under federal conformity regulations (40 CFR Part 93 and 40 CFR Part 51 *et. seq.*).

The Cross-County MetroLink extension project is included as part of the conforming Long-Range Transportation Plan (LRTP) of the conforming State Implementation Plan (SIP). The Transportation Improvement Plan (TIP) also includes the project.

For this project, the pollutant of most concern is CO. An odorless, invisible gas, CO is dangerous to humans in high concentrations because it binds to red blood cells more effectively than oxygen, limiting the oxygen available for respiration. No air quality analysis was performed for other pollutants for the reasons described below.

Near the earth's surface, ozone is an irritant and a major contributor to photochemical smog. Motor vehicles emit nitrogen oxides and hydrocarbons, which are ozone precursors, but the contribution of a single transportation project to total area wide ozone is negligible and difficult to model accurately. Area wide ozone modeling would be of very limited usefulness to this study and was therefore not conducted. Airborne lead levels have declined steadily as leaded gasoline use declines; no modeling of lead has been performed for this study.

Motor vehicles emit small amounts of particulates, but most are deposited within the roadway right-of-way. In urban areas, roadway traffic on paved streets contributes an insignificant percentage of total ambient particulate concentrations compared to stationary sources. The study area is in attainment for particulates. There is no accepted way to measure particulate hot-spot emissions, and modeling of particulates cannot be performed at this time. The following is a summary of the CO "hot spot" dispersion modeling that was performed.

5.4.4.1 Methodology

The project team determined that two intersection areas would be appropriate to use as representative worst-case locations for microscale CO modeling: Forest Park Parkway/Skinker Boulevard and Hanley Road/Dale Avenue/Eager Road/I-64. The first intersection was selected because of historic traffic congestion and the potential for increased traffic in the area. The latter location was selected for study because it would be affected by an adjacent park-n-ride facility.

In all cases, modeling covered an area within 1,000 feet of the intersection under investigation. For the Hanley/Dale area, that included Eager Road, the southern half of the I-64 interchange, and the I-64 mainline itself. The I-64 interchange with Hanley Road was assumed to be in its future planned configuration of a single-point urban interchange by the year 2020.

The year chosen for analysis of CO impacts was 2020. The model MOBILE5b was used to determine the emission rates of motor vehicles in 2020. Emission rates for vehicles were determined based on local conditions, such as inspection/maintenance programs, vehicle anti-tampering programs, local fuels, etc. Intersection traffic operations were determined using the SIGNAL97 model, as described in greater detail in Section 4.

The model CAL3QHC was utilized to determine the dispersion of CO from vehicles to receptor sites (locations that could be affected by CO). CAL3QHC takes into account the number of vehicles, the physical layout of the intersection modeled, the traffic signal phasing, vehicle delay, and meteorological factors to determine a concentration of CO at receptors. In this study, worst-case meteorological conditions were assumed. CO concentrations were modeled to ensure that there are no exceedances of one-hour and eight-hour standards.

For year 2020, the design year, P.M. peak conditions for each intersection were analyzed for the proposed project. An eight-hour average concentration was determined from the one-hour analysis using a "persistence factor," which assumes that worst-case meteorological and traffic conditions would not be expected to be sustained for an eight-hour period. The persistence factor that was used is 70 percent, a standard default value commonly used for mobile-source air modeling.

Year 1998 CO monitoring data was available from the U.S. EPA and Missouri Department of Natural Resources, as described in Section 3.4.5.2. The first and second-highest monitored value of the year is reported. This was done because one exceedance of NAAQS CO standards is

permitted in each calendar year before a violation is recognized. Table 3.4.5-2 shows the highest and second-highest monitored concentrations for a one-hour and eight-hour period.

The monitoring data was adjusted to provide a background air concentration for modeling of a future year. This adjustment took into consideration the growth of traffic between the year 1998 and 2020. It also was adjusted based on MOBILE5a emission rate changes in future years, meaning that improvements in vehicle emission control technology were considered. The adjusted year 2020 background levels differ between the two study locations because traffic is anticipated to grow at a faster rate in the Hanley/Dale area than at Forest Park Parkway/Skinker Boulevard. Table 5.4.4-1 shows the adjusted background levels for year 2020.

Table 5.4.4-1
ADJUSTED 2020 BACKGROUND CO LEVELS USED FOR MODELING
(parts per million, ppm)

One-Hour Period		Eight-Hour Period	
Skinker/Forest Park	Hanley/Dale/Eager	Skinker/Forest Park	Hanley/Dale/Eager
2.6	2.9	2.1	2.3

At the intersections analyzed, receptors with an elevation of five feet (breathing height) were sited at the edges of buildings where persons would be expected to spend an eight-hour period and would represent direct impact to people if a window was open. Table 5.4.4-2 lists the studied receptors.

Table 5.4.4-2
RECEPTOR LOCATIONS STUDIED
(in addition to sidewalk receptors)

Intersection	Receptor Locations
Skinker/Forest Park Parkway	• Building in northeast quadrant of intersection • House in northwest quadrant of intersection • House in southeast quadrant of intersection
Hanley/Dale/Eager	• Building in northwest quadrant of Hanley/Dale intersection (two corners of building) • Building in northeast quadrant of Hanley/Dale intersection (two corners of building) • A building north of Dale Avenue

The results of the peak-hour modeling were determined by adding the adjusted one-hour background (ambient) CO level to the modeled concentrations created by the intersection traffic itself. In the case of eight-hour values, the modeled concentrations from traffic were factored

down with the 70 percent persistence factor, and that value was added to the adjusted eight-hour background level.

5.4.4.2 Modeling Results

Tables 5.4.4-3 through 5.4.4-6 provide the results of the one-hour and eight-hour CO concentration modeling. Values in these tables include background emissions, and in the case of eight-hour averages, take into account the persistence factor. As Tables 5.4.4-3 and 5.4.4-4 show, there are no future exceedances of the one-hour CO NAAQS standard of 35.0 ppm under the LRT Alternative. Tables 5.4.4-5 and 5.4.4-6 show that modeled eight-hour CO concentrations at these locations would be below the NAAQS standard of 9.0 ppm.

Table 5.4.4-3
CO ANALYSIS, SKINKER BOULEVARD AND FOREST PARK PARKWAY
MODELED ONE-HOUR CO CONCENTRATIONS
(in parts per million, ppm)

Receptors	2020 LRT Alternative
1. Building in northeast quadrant of intersection	3.8
2. House in northwest quadrant of intersection	3.9
3. House in southeast quadrant of intersection	2.9
Background component of above totals	2.6
NAAQS Standard	35.0

Table 5.4.4-4
CO ANALYSIS, HANLEY/DALE/EAGER/I-64 AREA
MODELED ONE-HOUR CO CONCENTRATIONS
(in parts per million, ppm)

Receptors	2020 LRT Alternative
1. Building in northwest quadrant of intersection of Dale/Hanley, northeast corner of the building	3.2
2. Building in northwest quadrant of intersection of Dale/Hanley, southeast corner of the building	3.5
3. Building in northeast quadrant of intersection of Dale/Hanley, southwest corner of the building	4.0
4. Building in northeast quadrant of intersection of Dale/Hanley, northwest corner of the building	3.7
5. Building in southeast quadrant of intersection of Dale/Hanley, northwest corner of the building	3.7
6. Building in southeast quadrant of intersection of Dale/Hanley, southwest corner of the building	3.6
7. Building north of Dale	4.1
Background component of above totals	2.9
NAAQS Standard	35.0

Table 5.4.4-5
CO ANALYSIS, SKINKER BOULEVARD AND FOREST PARK PARKWAY
MODELED EIGHT-HOUR CO CONCENTRATIONS
(in parts per million, ppm)

Receptors	2020 LRT Alternative
1. Building in northeast quadrant of intersection	2.9
2. House in northwest quadrant of intersection	3.0
3. House in southeast quadrant of intersection	2.3
Background component of above totals	2.1
NAAQS Standard	9.0

Table 5.4.4-6
CO ANALYSIS, HANLEY/DALE/EAGER/I-64 AREA
MODELED EIGHT-HOUR CO CONCENTRATIONS
(in parts per million, ppm)

Receptors	2020 LRT Alternative
1. Building in northwest quadrant of intersection of Dale/Hanley, northeast corner of the building	2.5
2. Building in northwest quadrant of intersection of Dale/Hanley, southeast corner of the building	2.7
3. Building in northeast quadrant of intersection of Dale/Hanley, southwest corner of the building	3.1
4. Building in northeast quadrant of intersection of Dale/Hanley, northwest corner of the building	2.9
5. Building in southeast quadrant of intersection of Dale/Hanley, northwest corner of the building	2.9
6. Building in southeast quadrant of intersection of Dale/Hanley, southwest corner of the building	2.8
7. Building north of Dale	3.1
Background component of above totals	2.3
NAAQS Standard	9.0

5.4.4.3 Conclusions and Mitigation

The modeling results indicate that no intersections are predicted to experience significant, project-relatedCO levels that exceed the NAAQS standard. No specific mitigation measures are required since the project will not create any impact.

5.4.4.4 Regionwide Effects

The Cross-County MetroLink extension is expected to improve air quality in the region by reducing the number of vehicle miles traveled and therefore reducing the commensurate automobile emissions. A related reduction in congestion will also lower the amount of pollution created.

A network model covering the area bounded by Olive Boulevard/Dielman Road on the northwest and Gravois Road/River des Peres Boulevard on the southeast was evaluated to estimate the

regional effects of the project on air quality. This model does not consider every street in the area, but focuses only on main roads.

By determining the vehicle miles traveled (VMT) and vehicle hours traveled (VHT), an average speed throughout the network was calculated. The MOBILE5b model was used to determine emission rates, and a total amount of emissions (in metric tons per day) was calculated for three pollutants during wintertime conditions. In addition to CO, nitrogen oxides (NO_X) and hydrocarbons (HC) were studied. Table 5.4.4-7 summarizes the reduction in air emissions under different alternative scenarios. All scenarios would have an incremental effect in lowering regional mobile-source air emissions over the No-Build scenario.

Table 5.4.4-7
DAILY NETWORKWIDE EMISSIONS, WINTERTIME, 2020 REGIONAL NETWORK BOUNDED BY OLIVE/DIELMAN AND GRAVOIS/RIVER DES PERES

Alternative	Daily Vehicle Miles Traveled	Daily Vehicle Hours Traveled	Metric Tons per Day		
			HC	CO	NO_X
No-Build	4,430,868	131,354	1.595	19.230	3.943
Base—Grade-Separated	4,393,343	129,894	1.582	19.023	3.910
At-Grade	4,398,599	130,073	1.583	19.046	3.915
Laclede Station	4,401,955	130,553	1.585	19.104	3.918
Elevated Clayton[1]	4,405,238	130,709	1.586	19.119	3.921
Elevated Galleria	4,398,197	129,909	1.583	18.956	3.914
Deer Creek Terminus	4,391,935	129,581	1.581	18.929	3.909

[1] Because distances and operations would be nearly identical, these results would also apply to the Forest Park Parkway At-Grade option.

5.4.5 Minimize Construction Impacts

This section examines the anticipated construction impacts of the Fully Grade-Separated and the At-Grade/Grade Separated Combination Alternatives. The following potential impacts associated with these alternatives were analyzed under the assumption that the construction impacts would be temporary:

- **Visual and Aesthetic Quality**
- **Parks**
- **Socioeconomic Impacts**
- **Erosion, Sedimentation, and Water Quality**
- **Vegetation**
- **Floodplains**

- **Air Quality**
- **Noise and Vibration**
- **Utilities and Emergency Services Disruption**
- **Disposal of Excess Material**
- **Traffic Delays and Detours**
- **Hazardous Materials**

The following paragraphs describe the anticipated approach to construction and evaluate temporary impacts and possible mitigation strategies.

General Approach to Construction

The construction of the LRT project is anticipated to begin in the summer 2002 and be completed in fall 2005 (estimated), including operational testing. Throughout this time there will be activity within the corridor as the Cross-County MetroLink Extension is constructed. The project contractors are required to conform to the provisions of standard engineering and construction practices to control various adverse impacts associated with construction activities. A brief description of the construction methods for each major project component is given below. Construction activities for the Cross-County MetroLink Extension (at-grade portions) will be done in the following order: site preparation and clearing, excavation, utility relocation and grading, ballast, tie, track and catenary system installation.

Trackwork

Rail sections for most parts of the Cross-County MetroLink corridor will be delivered by truck. For the southern part of the Cross-County MetroLink corridor, rail can be delivered to the Deer Creek area by the Burlington Northern & Santa Fe railroad. Ballast, ties and turnouts will be delivered by truck. It is anticipated that concrete and precast members for bridge and retaining wall construction and construction equipment will be delivered by truck. Both the Fully-Grade Separated and the At-Grade/Grade Separated Combination alternatives will require the delivery of construction materials and equipment.

The contractors will select several points of access to the corridor. Haul routes for construction materials will also be at the discretion of the contractor. Most of the major arterial roadways crossing the MetroLink alignment could become temporary haul routes for construction materials.

Power Systems

The installation of power systems will occur, for the most part, after the track and station construction is complete. For the overhead catenary, power poles will be installed in concrete foundations and wire will then be strung between the poles. Cable channel (including

communication wire and electrical conduit) construction will occur as part of the trackbed preparation.

Stations

The proposed construction for MetroLink stations will use high platforms. Two station configurations will be used: center-of-the-track platforms and side platforms. Some side platforms will be split at intersections. Center platforms will be generally 200 feet in length, and 16.5 feet in width. Construction materials will be brought to the site by truck.

Tunneling

Cut-and-cover tunnel structures would provide a double-track concrete box with a covering. Construction is done in a temporary, 40 foot-wide trench with the side walls consisting of sheet steel piling driven into place and braced with steel beam struts and whalers. Retaining walls at transitions from surface to underground locations are similarly constructed. The temporary steel sheet piling and bracing is removed and reused as the construction is staged. Staging would generally be intersection to intersection with at least one block between stages. The considerable volume of excavation would be handled with typical bulldozer and/or backhoe equipment that fits in the trench with truck haulers to disposal sites. The At-Grade/Grade Separated Combination Alternative would require the most cut and cover tunnel construction. Cast-in-place concrete structures would be constructed with concrete supplies from a temporary concrete mixing plant. Bored tunnel construction may be used, for example through downtown Clayton along Carondelet Avenue to avoid street surface disruption. The construction access pit would be located east of the Carondelet Plaza Drive and Forsyth Boulevard intersection. The access pit allows installation of the tunnel boring machine, removal of excavated material, and delivery of construction materials. Twin tunnel bores, one for each track, would be lined with reinforced concrete. The boring machine would cut an estimated 40 feet of tunnel per day (two 10-hour shifts). The Fully Grade Separated Alternative would potentially require more bored tunnel construction.

Temporary Impact Analysis and Possible Mitigation Strategies

The following paragraphs discuss anticipated construction-related impacts, as well as possible mitigation strategies for each potential impact.

Visual and Aesthetic Quality

For residences and businesses located near the project area, there will be temporary negative visual impacts associated with construction work, particularly from earthwork operations, storage of materials/equipment, etc. The cut and cover construction for either the Fully Grade Separated or the At-Grade/Grade Separated Combination alternatives would create the most visual impacts. The bored tunnel construction for the grade-separated corridor alternative in downtown Clayton would create the least visual impacts since construction activity would be visible only at the

construction access pits. Temporary visual impacts also include removal of street trees and landscaped areas; the relocation of light standards and street furnishings; and the reconstruction of pedestrian systems and sidewalks along the alignment. The contractor will be required to maintain and restore all work areas and storage yards to minimize these impacts. Street trees, landscaping, street lighting and furnishings will be replaced when appropriate.

Parks

Along the north side of Forest Park, short-term impacts related to construction may occur due to temporary changes in pedestrian and motorist access to park activities or events. These short-term impacts can be minimized by maintaining directional signage to let pedestrians, bicyclists and motorists know how to access the park. Therefore, available parking for park activities and events inside the park will be not affected.

For the Carondelet/Brentwood Boulevard At-Grade option, construction related impacts mentioned above are anticipated along the southeast portion of Shaw Park. In addition, there would be 0.7 acres of direct impact for right-of-way acquisition.

Socioeconomic Impacts

Merchants and property owners along Forest Park Parkway, Millbrook Boulevard, Carondelet Plaza, and Carondelet and Meramec or Brentwood in downtown Clayton, and in the Galleria area, would be affected due to MetroLink construction. Temporary impacts would include potential loss of visibility and accessibility to their businesses. This is true for businesses directly adjacent to the MetroLink construction and for those retail and wholesale businesses that rely in walk-in or drive-up customers.

The primary goal during MetroLink construction will be to work to preserve at least one access at all times for all businesses, or to provide alternative access and parking. Simultaneously, directional signage, both inside and outside the construction site, will be important so clients know in ample time which businesses are open and how to get there.

Possible mitigation measures taken during MetroLink construction could include maintenance of street lights in front of businesses to prevent an unsafe environment and subsequent vandalism. Fugitive dust and noise pollution resulting from the use of heavy equipment would need to be controlled. Close and frequent contact with affected business owners would be important to minimize any negative impacts and to provide responses in an appropriate and timely manner.

Erosion, Sedimentation and Water Quality

The stream crossings at the south end of the Cross-County corridor would require special consideration during the construction process. Cut and fill operations in the vicinity of these

waters may contribute to minor siltation during construction of bridges. Best Construction Management Practices and standard erosion protection measures will be used to minimize erosion during this time. Permanent adverse impacts related to construction are not expected, since all waterways will be spanned by the LRT bridge structures.

An erosion control plan will be required as part of the project construction. Temporary erosion control measures may include siltation fence, bale ditch checks, bale diversions, dikes, floating siltation devices, slope drains, and temporary sediment basins. Permanent retention basins may be sized for use as sediment basins during the construction process. Stockpiled or excess material scheduled for removal may require special erosion protection. No storage will be allowed near watercourses.

Permanent erosion protection measures, including revegetation, landscaping, and riprap, will be installedprior to removing temporary measures. Sediment due to construction should be removed from permanent retention basins, both existing and proposed, during final cleanup. A major component of permanent sediment control is obtained by directing runoff through retention basins or grassed swales prior to discharging to receiving waters.

Vegetation

During construction, additional vegetation resources may be disturbed in staging areas, access roads, and other auxiliary areas associated with construction. These vegetation impacts will occur in upland areas and will be temporary. Revegetation and landscaping after completion of construction will replace the vegetation in the corridor.

Floodplains

Construction of either the Lansdowne or the Deer Creek terminal station, parking and MetroLink maintenance facilities would require minimal (if any) construction within the 100-year floodplains at either River Des Peres or Deer Creek, respectively. Regulations for construction within a floodplain will be followed. These regulations outline building methods, materials, floodproofing, and structural requirements for floodplain construction, as well as specify that the flood capacity of the watercourse and its floodplain cannot be diminished by construction.

Upon completion of construction, all disturbed soils will either be paved, consist of compacted gravel shoulders, or be revegetated and landscaped, thereby reducing the potential for soil erosion and subsequent sedimentation into the streams. The flood capacities of the water courses and associated floodplains will not be affected by the completed project. No long term construction impacts to water resources or floodplains are anticipated.

Air Quality

Adverse air quality impacts associated with the construction activities include emissions from vehicles and equipment, and fugitive dust from clearing, excavation, and grading. Vehicular emissions impacts would be temporary and minimized by maintaining traffic flow during construction periods. Contractors will be required to control fugitive dust and airborne particulates as per Missouri air quality standards. Some ways to control fugitive dust include applying water to exposed soils, revegetating exposed areas as soon as possible and limiting the extent and duration of exposed areas and material piles.

Noise and Vibration

Trucks and machinery used for construction produce noise, which may affect some of the susceptible land use areas during construction. Construction workers can reduce disturbance to neighbors by ensuring that all machinery is equipped with the proper mufflers, that machinery is well maintained, and that noise levels conform to local, state, and federal regulations. Consideration will be given to restricting use of construction equipment during certain hours, depending upon location, as per FTA and FHWA noise abatement standards.

Noise at construction sites is non-steady and intermittent. When construction activity occurs along a right-of-way, as in the case of roadway and MetroLink track and station construction, long-term noise exposure descriptors are difficult to quantify. Roadway and MetroLink track and station construction is accomplished in several different phases. These phases and their estimated noise levels at the right-of-way can be characterized by Table 5.4-7 (FHWA, 1977).

Table 5.4.5-1
CONSTRUCTION NOISE AT RIGHT-OF-WAY

Phase	Leq (h), dBA
Clearing and grubbing	83
Earthwork	85
Foundation	83
Superstructure	83
Base Preparation	85
Paving	86

Short-term construction noise impacts are expected. Several possible construction mitigation measures are listed in this section which can be applied when construction activities are near sensitive receptors. Contractors could use newer equipment that is quieter and ensure that all equipment items have the manufacturers' recommended noise abatement measures, such as mufflers, engine covers, and engine vibration insulators. In addition, contractors could consider alternatives to driven piles.

The duration and time of day that construction activities take place can be adjusted to minimize the noise impact on exposed businesses and residences. Activities could be scheduled so that quiet periods are provided. Haul routes could be chosen carefully for material and dump trucks to minimize noise impacts in neighborhoods.

Good public relations with the community are necessary to minimize the reactions to unavoidable noise. The communities should be notified in advance of the scheduled construction and informed of the importance of the Cross-County MetroLink Extension project.

Vibrations may occur as a result of construction practices. These vibrations could result from various activities that include, but are not limited to, pile driving and use of construction equipment. Factors that can affect the degree of vibration are soil type, depth of water table, and proximity to structures. Heavy construction activity near historic buildings and other sensitive receptors, such as the Washington University buildings near Forest Park Parkway, will be minimized as much as possible.

Utilities and Emergency Services Disruption

Coordination of utilities and emergency services should occur as far in advance of construction as possible to minimize conflicts and disruption of service to the area. Business and residential customers would receive ample notification to plan around utility disruptions. Emergency services may be affected during construction because access will change and some streets will be closed off. In addition, higher volumes on local streets and congested conditions along the alignment during construction may also present impediments to emergency vehicles. Coordination between Bi-State Development Agency, City of St. Louis, St. Louis County, other municipalities contractors, and the emergency services is important to keep emergency personnel informed so they can perform their duties properly.

Disposal of Excess Material

The Cross-County MetroLink Extension project will involve excavation of soils and removal of pavement. If it becomes necessary to dispose of unsuitable material or removed pavement, this should be done in an environmentally-responsible manner. Materials should be salvaged for reuse whenever reasonable. Also, the source of borrow material is unknown at this time. Borrow material will be handled in a manner consistent with Missouri erosion control practices.

Traffic Delays and Detours

Efforts will be made to keep such disruptions to a minimum. This might require limiting some construction to off-peak hours. Staging of construction, if possible, would help minimize overall impacts on a specific area. A public information outreach program could be instituted to help make motorists aware of alternative travel options.

Contractors should be required to conduct their operations in a manner that results in a minimum amount of inconvenience and delay to local and through traffic. Access to adjacent properties shall be maintained to the extent practical. Detours and alternate routes should be adequately signed, and barricades, lighting, and traffic control devices should be used to protect the construction work and public safety.

Hazardous Materials

During construction the potential exists that uncontrolled releases of hazardous materials or petroleum products will be encountered. The potential for adverse impacts is greatest when soil is being excavated for tunneling, trenching, and/or other types of construction activity. The potential for adverse impacts is lowest when the tracks are elevated or following the existing grade and soil disturbances are minimized. Adverse impacts could include exposure of construction workers to hazardous materials or petroleum products, construction delays, and/or increased construction costs.

- **The Fully-Grade Separated and the At-Grade/Grade Separated Combination with the Deer Creek terminus option have the highest potential for impacts. These alternatives would have the greatest amount of industrial sites, buildings to be removed and soil disturbance. For the Deer Creek terminus option there are 12 properties of concern.**

- **The At-Grade/Grade-Separated Combination alternative with the Downtown Clayton Elevated, Galleria Elevated, and Laclede Station Road At Grade/Elevated Alternatives with the Lansdowne Terminus has the least potential for impacts. This combination alternative and section options would have the least amount of industrial sites, buildings to be removed and soil disturbance. For the Lansdowne terminus there are three properties of concern.**

5.4.6 Minimize Impact on Cultural Resources

Historic Structures and Districts

Although minimizing negative effects of the Cross-County MetroLink Extension is a design goal for all communities and neighborhoods through which the system passes, particular attention must be paid to the potential impact on historic structures and districts. Historic structures and districts, by their very designation, have been given a special status, which requires extra consideration to protect and preserve these resources.

The following historic properties, which lie adjacent to the proposed MetroLink extension, are described in Section 3.4 of this draft report:

- **Skinker/DeBaliviere/Catlin Tract Historic District**
- **Parkview Neighborhood Historic District**

- **Washington University Hilltop Campus Historic District**
- **Maryland Terrace Neighborhood Historic District**
- **Shanley Building *(outside impact area, but in downtown Clayton)***

All neighborhoods, historic or otherwise, along the proposed alignment, will generally experience more short-term effects, during construction, than during operation of the extended MetroLink system. Short-term effects will be associated with the construction activities and the effects must be managed in the short-term, but inevitably they will end. This discussion of effects on historic structures will focus on long-term effects, such effects are experienced during the normal operation of the completed transit extension.

Section 106 and Section 4(f) Review

The impact of the proposed light-rail extension will be evaluated against the criteria established by Section 106 of the National Historic Preservation Act of 1966 and Section 4(f) of the Department of Transportation Act of 1966. Since no federal funds are to be used on this transit extension project, references to these federal requirements are for guidance purposes only in the analysis.

Section 106 Review

Section 106 review procedure is codified in the regulations of the Advisory Council on Historic Preservation, Protection of Historic Properties" (36 Code of Federal Regulations, Part 800). On page 107 of this code, it states in regard to effects of projects on historic properties . . . .

> **An effect occurs when a project changes the integrity of location, design, setting, materials, workmanship, feeling or association of the property that contributes to its significance in accordance with the National Register.**

Specifically, the wording of this code continues on page 108 . . . .

> **Adverse effects on National Register properties, or properties which meet the Criteria may occur under conditions which include, but are not limited to:**
>
> **A. Destruction or alteration of all or part of a property;**
> **B. Isolation from or alteration of the property's surrounding environment;**
> **C. Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting**

The terminology of Section 106 Review defines three levels of Effect" of a project on an historic property: No Effect", No Adverse Effect", Adverse Effect". A No Effect" determination by the State Historic Preservation Officer, means that no further consideration or action needs to be taken by the project scope as regards the questioned historic property. No Adverse Effect"

means that there may be an effect, but that it is not negative. This determination still requires management of the project implementation in terms of its relationship with the affected historic property. An Adverse Effect" determination may lead to several actions depending upon the scale of the adversity and the significance of both the historic property and the proposed project. Actions which might occur include: project cancellation, major project alteration or modification, or minor project design mitigation.

Section 4(f) Review

Section 4(f) of the Department of Transportation Act, unlike Section 106, is more focused on the preservation of natural sites. Reference in Section 4(f) is made to protecting the beauty of the countryside, parkland, natural refuges and historic sites. Review power under Section 4(f) is given to the Secretary of Transportation as opposed to the State Historic Preservation Officer (SHPO), although there is a joint determination with the SHPO under Section 4(f), if the subject property is an historic site, as opposed to a natural park or refuge. Detailed analysis and determination of effect, under Section 4(f), is only required only if there is direct use , in this case of the historic properties, and if such use would preclude the continued use of such historic asset.

In a manner similar to section 106 language, terminology under 4(f) regarding the potential effect of a project on an historic site is categorized under three headings: Generally Not Significant," "Possibly Significant" and Generally Significant". The three Section 4(f) headings approximately correspond to the three section 106 determinations.

Shanley Building

The effect of this transit extension, as currently proposed, on the Shanley Building, can be categorized, per Section 106 terminology as No Effect" and under Section 4(f) as Generally Not Significant." This building is far removed from the transit alignment. The MetroLink extension would not impact this property.

The Historic Neighborhoods and Washington University Hilltop Campus

The discussion of the proposed MetroLink extension in terms of the defined historic neighborhoods might well be done simultaneously. The above-referenced historic properties are situated directly along, but not inside of, the proposed alignment right-of-way. Generally, each historic district has the same type of relationship with this alignment both in a physical sense and in an historic sense. Ironically, the effect of returning a railroad right-of way, albeit a light-rail system, along the edges of these properties is, in some sense, a restoration of their original setting and context.

The Forest Park Parkway/Millbrook Boulevard right-of-way started as a railroad right-of-way. The first railroad which passed through this corridor had its origins in 1872 and was finally completed in 1887, operating as the St. Louis, Kansas City and Colorado Railway. The railroad

served between downtown St. Louis and Creve Coeur; the segment through Clayton ran along the current Forest Park Parkway.

The railroad ownership along this right-of-way changed hands several times and eventually in 1901 it became the Rock Island Railroad. Archival photographs from the late 1910s reveal at least four tracks along the Forest Park Parkway/Millbrook right-of-way and only a mud service road running alongside.

It is in this setting, along this iron road, that the four historic districts were built. In fact, the railroad proximity allowed for easy access to building materials and to a means of transportation in a time before the automobile. The railroad provided a means to bring construction materials and supplies to the World's Fair of 1904 and to the nascent Washington University Campus. As was mentioned in earlier discussion, Maryland Terrace was overtly marketed to prospective homebuyers, as a neighborhood with good access to downtown bound commuter trains. This same historic transit system served Washington University and Parkview with a stop near the present-day Washington University Power Plant along Millbrook.

The advent of private automobiles required a paved road to be built in the 1930s along Millbrook, then known as the Rock Island Road. It was not until 1941, that this stretch was formally dedicated as Millbrook, a 4-lane boulevard. The railroad had by then been reduced to two tracks running along the north side of the right-of-way. In the early 1960s, with the loss of the street car system, this railroad right-of-way finally became all-vehicular and, except for some widening and loss of plantings, appears much today as in the early 1960s.

MetroLink Design Alternatives and Historic Districts

Under the At-Grade/Grade-Separated Combination Alternative (Downtown Clayton Elevated) there is the potential that one residence may be displaced within the Maryland Terrace Neighborhood. This potential loss of one residence occurs directly adjacent to the alignment right-of-way on the western part of Maryland Terrace and north of the Bally's Health Club. This potential displacement is due to the transition of the track from below-grade to an above-grade, elevated position in order to cross over Forsyth Boulevard and run along Forest Park Parkway (Downtown Clayton Elevated). The train and track position is still underground as it passes by the residence next to the one which might be displaced, so this residence is unaffected by the potential displacement nearby.

With respect to historic structures, the designation of an historic district recognizes the collective value of the defined properties as being equal to the value of each particular property. Though this residence is not a registered property in itself, it has been determined to be a contributing" property. A "contributing " designation means that it is historic and it is to be treated as if it were on the National Register. The decision to displace this residence would be considered an "Adverse Effect" on this historic property. If this residence is displaced, then coordination with the Missouri State Historic Preservation Office would be appropriate.

For the At-Grade/Grade-Separated Combination Alternative, additional right-of-way could be requiredfor the MetroLink extension from the residential properties in Maryland Terrace in the southwest corner of the Big Bend/Forest Park Parkway intersection. No displacements will occur. This right-of-way acquisition at the MetroLink station location for both the At-Grade Median and the South Edge options would be an impact on these historic properties.

Outside of the Downtown Clayton Elevated section option discussed above, which may take one residence within Maryland Terrace, the effect of the Cross-County MetroLink Extension on these historic properties is one of No Adverse Effect." The return of rail service, from the historic preservation perspective, is a restoration of the historical setting for all of these neighborhoods.

In referring back to the Section 106 and Section 4(f) review criteria, for adverse affects of a project on historic structures and districts, the following should be considered:

1. **Except as noted above, the MetroLink extension alternatives do not alter or destroy any of the historic properties. In all other locations than those mentioned above, the alternatives are outside of the historic district property lines.**
2. **The properties are not isolated from their environment by this MetroLink extension. They are better connected to it. The proposed MetroLink extension does not cross in front of the main access points to these neighborhoods, rather it runs alongside the districts.**

3. **The MetroLink extension adjacent to the historic neighborhoods is not out of character with these neighborhoods. The MetroLink may serve to restore some of the former urban character, when rail service was an integral factor in the origins of these districts, which were founded as rail commuter neighborhoods.**

MetroLink Design Compatibility with Historic Districts

The return of rail traffic to this right-of-way will add urban design elements, some of which have not been seen in years along this corridor and some of which are entirely new. These new elements have both visual and audible characteristics. (Audible changes to this corridor are discussed in Section 5.4.3 of this draft environmental report.) New or returning visual features will be present whether the MetroLink extension is placed underground or above ground.

Underthe Fully Grade-Separated Alternative, underground track, station stops and other below-grade railroad infrastructure will of course have no visual effect on the historic properties. The above-grade components of an underground alignment, which include: stairs, elevator enclosures, railings, canopies, roofs, walkways, landscaping, signage, lighting and other above-grade items, will be seen and must be designed to be compatible with the architectural features, which are unique to these historic districts.

The At-Grade/Grade-Separated Combination Alternative alignment options bring additional MetroLink system features into view. The greater number of components of the at-grade alignments must be designed for an appropriate fit with the adjacent historic buildings. Additional transit elements with an at-grade alignment include: the track and its adjacent bed, separation elements to keep the railroad right-of-way from other adjacent uses, station stop platforms and ramps, additional lighting, and the catenary poles which support the trains' power lines.

Design compatibility is enhanced by incorporating the following measures:

1. **New transit elements should be designed with consideration given to *existing* predominant building materials, existing building scale and existing form and detail.**

2. **New transit elements should be designed with consideration given to *historical* materials, scale, form and detail which might have existed or did exist when the original railroad ran through this right-of-way.**

3. **All design for station stops and access, track profile, catenaries, lighting, signage and plantings should be reviewed with the interested public to allow residents of these neighborhoods to have input into the design process and final form of these transit elements.**

MetroLink Enhancement of the Historic Districts

This current transportation right-of-way, including the defined adjacent historic districts, is generally well-maintained, well-used and fully-developed. The extension of MetroLink in this right-of-way brings obvious transportation and economic advantages and infrastructure improvements. The return of rail service to this historic architectural corridor, if handled sensitively, will not inhibit, degrade or otherwise compromise the historically-important current land uses. The return of rail service offers the possibility of returning to a more correct historical setting for these neighborhoods and thereby may lead to their actual enhancement as historical resources.

Archaeological

During construction the potential exists that previously unknown archeological resources will be encountered. The potential for adverse impacts is greatest when soil is being excavated for tunneling, trenching, and/or other types of construction activity. The potential for adverse impacts is lowest when the tracks are elevated or following the existing grade and soil disturbances are minimized. Adverse impacts could include construction delays, increased construction costs and/or loss of significant archaeological resources.

- ***Fully Grade-Separated Alternative.*** **The Fully Grade-Separated Alternative with the Deer Creek Terminal Station has the highest potential for impacts. This combination and alternative would have the greatest amount of soil disturbance.**

- ***At-Grade/Grade-Separated Combination Alternative.*** **The At-Grade/Grade-Separated Combination Alternative ending at Lansdowne with the Downtown Clayton Elevated, Galleria Elevated and Laclede Station Road At-Grade/Elevated Alternatives has the least potential for impacts. This combination alternative would have the least amount of soil disturbance.**

Parklands

Carondelet/Brentwood At-Grade

The proposed option in the At-Grade/Grade-Separated Alternative that travels at the surface along Brentwood Boulevard from Carondelet south to Shaw Park Drive and then turns west along Shaw Park Drive to reach the CMT right-of-way will require an easement or taking from Shaw Park at the southeast corner of the park. There have not been any Section 6f Land and Water Conservation Funds expended in this park, according to information provided by the Missouri Department of Natural Resources.

The turn from Brentwood Boulevard to Shaw Park Drive will take a corner of the southernmost tennis court. The overall right-of-way requirement from Shaw Park would be 0.7 acres. With this particular option, the physical impact is not intrusive to the main functions of the park; however, this would result in the loss of one of the tennis courts. There would be visual impacts associated with the light rail alignment running along the southern portion of the park along Shaw Park Drive and the view into the park. For views from the park, views to the south and east are already part of an urban transportation environment and include Brentwood Boulevard, Shaw Park Drive, and Forest Park Parkway. With these active urban transportation elements adjoining the edges of the park and the light rail alignment running along the edge of these roadways, the noise impacts should be minimal.

5.4.7 Achieve Equity in Terms of Project Benefits and Cost

This section presents equity comparisons in terms of MetroLink investment for each section of the Cross-County corridor, number of riders generated per investment, and percentage of riders generated in each section per MetroLink investment. Tables 5.4-8 through 5.4-12 compare the ridership per capital cost by corridor section for the Fully Grade Separated and At-Grade/Grade Separated alternatives plus the section options that are included as part of that section. The corridor sections and the costs listed these tables incorporate costs listed in the Capital Cost Estimates Draft Technical Report. A description of the corridor sections is as follows:

- **Section 1** **Forest Park through University City (2.55 miles long; City of St. Louis and University City)**
  LRT Stations: Skinker, Big Bend

- **Section 2** **Downtown Clayton (1.5 miles long; City of Clayton)**
  LRT Stations: East Clayton (Carondelet Plaza), Downtown Clayton

- **Section 3.1** **I-170 (CMT or Brentwood Blvd.) Through Galleria to Manchester Road (2.36 miles long; Richmond Heights and Brentwood)**
  LRT Stations: Galleria, Eager Road, Hanley Road (future), Manchester Road

- **Section 3.2** **Manchester (Along CMT) through Sunnen to Deer Creek (1.04 miles long; City of Maplewood)**
  LRT Stations: Laclede Station Road, Big Bend, Deer Creek

- **Section 4** **Deer Creek (over I-44) to Lansdowne Ave. (.73 miles long; City of Shrewsbury)**
  LRT Stations: Lansdowne

Table 5.4-8
RIDERSHIP VS. CAPITAL COST INVESTMENT
CROSS-COUNTY METROLINK EXTENSION
SECTION 1: FOREST PARK THROUGH UNIVERSITY CITY

Ridership at MetroLink Stations (Daily Boardings)	Corridor Alternatives			Alternative Options	
	Fully Grade Separated		At Grade/ Grade Separated Combination	South Edge At Grade[1]	Skinker and Big Bend Transit Underpasses[1]
	Lansdowne	Deer Creek			
Skinker Boulevard	184	182	173	173	173
Big Bend Boulevard	928	924	883	883	883
Total Boardings (Section 1)	1,112	1,106	1,056	1,056	1,056
Total Boardings for Corridor	25,772	25,532	23,003	23,003	23,003
Capital Cost by Alternative (Section 1) ($1,000,000s)	141.4	141.4	79.3	96.6	104.8
Total Capital Cost for Corridor ($1,000,000s)	517.9	474.4	377.4	394.7	403.9

[1] No change in MetroLink ridership for transit or roadway options.

Table 5.4-9
RIDERSHIP VS. CAPITAL COST INVESTMENT
CROSS-COUNTY METROLINK EXTENSION
SECTION 2: DOWNTOWN CLAYTON

	Corridor Alternatives			Alternative Options			
	Fully Grade Separated						
Ridership at MetroLink Stations (daily boardings)	Lans-downe	Deer Creek	At-Grade/ Grade-Separated Combination	Downtown Clayton Elevated Option 1	Downtown Clayton Elevated Option 2	Forest Park Parkway At-Grade	Carondelet/ Brentwood At-Grade
East Clayton	1,160	1,160	1,050	0	0	1,160	1,050
Downtown Clayton	3,739	3,636	3,290	2,342	2,342	2,342	3,290
Total Ridership (Sec. 2)	4,899	4,796	4,348	2,342	2,342	3,502	4,348
Total Ridership for Corridor	25,772	25,532	23,003	20,310	20,310	21,470	23,003
Capital Cost by Alternative (Sec. 2) ($1,000,000s)	92.0	92.0	55.7	56.2	58.8	54.1	44.0
Total Cost for Corridor ($1,000,000s)	517.9	474.4	377.4	380.5	383.1	378.4	365.4

Table 5.4-10
RIDERSHIP VS. CAPITAL COST INVESTMENT
CROSS-COUNTY METROLINK EXTENSION
SECTION 3.1: CMT (GALLERIA TO MANCHESTER)

	Corridor Alternatives			Alternative Options	
	Fully Grade-Separated		At-Grade/ Grade-Separated Combination		
Ridership at MetroLink Stations (daily boardings)	Lansdowne	Deer Creek		Galleria Elevated	Deer Creek Terminus
Galleria	1,255	1,215	764	1,083	1,215
Eager Road	2,133	1,920	2,026	2,234	1,920
Hanley Road (future)	N/A	N/A	N/A	N/A	N/A
Manchester	554	287	477	1,561	287
Total Boardings Section 3.1	3,942	3,422	3,267	4,818	3,422
Total Boardings for Corridor	25,772	25,532	23,007	23,166	25,532
Capital Cost by Alternative (Section 3.1) ($1,000,000s)	85.5	85.5	55.5	76.2	55.5
Total Capital Cost for Corridor ($1,000,000s)	517.9	474.4	377.4	398.1	333.1

Table 5.4-11
RIDERSHIP VS. CAPITAL COST INVESTMENT
CROSS-COUNTY METROLINK EXTENSION
SECTION 3.2: CMT (MANCHESTER TO DEER CREEK)

Ridership at MetroLink Stations (daily boardings)	Corridor Alternatives			Alternative Options	
	Fully Grade-Separated		At-Grade/ Grade-Separated Combination	Laclede Station Road	Deer Creek Terminus
	Lansdowne	Deer Creek			
Laclede Station Road	N/A	122	N/A	406	401
Big Bend	N/A	N/A	245	N/A	N/A
Deer Creek	258	4,287	N/A	N/A	5,473
Total Boardings Section 3.2	258	4,409	245	406	5,824
Total Boardings for Corridor	25,772	25,532	23,003	25,288	25,532
Capital Cost by Alternative (Section 3.2) ($1,000,000s)	45.2	45.2	33.1	35.7	44.0
Total Capital Cost for Corridor ($1,000,000s)	517.9	474.4	377.4	380	333.1

Table 5.4-12
RIDERSHIP VS. CAPITAL COST INVESTMENT
CROSS-COUNTY METROLINK EXTENSION
SECTION 4: DEER CREEK TO LANSDOWNE

Ridership at MetroLink Stations (daily boardings)	Corridor Alternatives			Alternative Option
	Fully Grade-Separated		At-Grade/Grade-Separated Combination	Deer Creek Terminus
	Lansdowne	Deer Creek		
Lansdowne	5,774	0	5,353	0
Total Boardings Section 4	5,774	0	5,353	0
Total Boardings for Corridor	25,772	25,532	23,003	25,532
Capital Cost by Alternative (Section 4) ($1,000,000s)	55.2	—	55.2	0
Total Capital Cost for Corridor ($1,000,000s)	517.9	—	377.4	333.1

Table 5.4-13
OVERALL CAPITAL COST PER MILE
CROSS-COUNTY METROLINK EXTENSION

Sect.	Item	Cost per Mile by Section by Alternative ($1,000,000s)						
1	Alternative	1A	1B	Skinker/Big Bend Transit Underpasses	1C			
	Cost	79.3	96.6	104.8	141.4			
	Cost/Mile	31	38	42	55			
2	Alternative	2A	2A-1BRD	2B	2B-1	2C	2D	2J
	Cost	55.7	43.7	92.0	93.9	56.2	58.8	54.1
	Cost/Mile	37	29	61	63	37	40	37
3.1	Alternative	3.1A	3.1B	3.2C				
	Cost	55.5	85.5	76.2				
	Cost/Mile	24	36	32				
3.2	Alternative	3.2A	3.2D	3.2E	3.2A1	3.2D1	3.2E1	
	Cost	33.1	35.7	45.2	44.0	54.6	56.9	
	Cost/Mile	32	34	43	42	53	55	
4	Alternative	4A						
	Cost	55.2						
	Cost/Mile	76						
Over-all	Alternative	AG/DC	AG/L	AG/L/LC	AG/L/Elev/LC	AG/UP/FPP/LC/L	FL	
	Cost	333	377	380	401	404	518	
	Cost/Mile	44	46	46	49	50	63	

Definitions for Table 5.4-13

Section 1: **Forest Park through University City**

1A at-grade
1B south edge
1C underground
Skinker and Big Bend underpasses with 1A

Section 2: **Downtown Clayton**

2A at-grade via Meramec
2A(1) at-grade via Brentwood
2B underground cut/cover
2B(1) underground bored tunnel
2C elevated—Bally's
2D elevated—Maryland
2J Forest Park Parkway at grade

Section 3.1: **CMT Galleria to Manchester**

3.1A CMT
3.1B underground
3.1C Galleria elevated

Section 3.2: **CMT Manchester to Deer Creek**

3.2A **belowground at Business Park**
3.2A(1) **Deer Creek terminal with 3.2A**
3.2D **Laclede Station Road**
3.2D(1) **Deer Creek terminal with 3.2D**
3.2E **Elevated at Business Park**
3.2E(1) **Deer Creek terminal with 3.2E**

Section 4: **Deer Creek to Lansdowne**

4A **elevated**

Corridor Alternatives

AG/DC	**at-grade/grade-separated combination ending at Deer Creek**
AG/L	**at-grade/grade-separated combination ending at Lansdowne**
AG/L/LC	**at-grade/grade-separated combination following the Laclede Station Road alignment ending at Lansdowne**
AG/L/Elev/LC	**at-grade/grade-separated combination, including Galleria elevated and Laclede Station Road, ending at Lansdowne**
AG/UP/FPP/LC/L	**at-grade/grade-separated combination, including Skinker and Big Bend transit underpasses, Forest Park Parkway at-grade, Laclede Station Road alignment, ending at Lansdowne**
F/L	**fully grade-separated ending at Lansdowne**

Table 5.4-14
RIDERS PER CAPITAL COST INVESTMENT
CROSS-COUNTY METROLINK EXTENSION

Section	No. of Stations	Estimated Year 2020 Daily Boardings for Stations		Daily Boardings per $million of Capital Cost	
		Fully Grade-Separated Alternative	At-Grade/Grade-Separated Combination	Fully Grade-Separated	At-Grade/Grade-Separated Combination
1[a]	3	4,039	3,389	29	43
	2[b]	1,112	1,056	9	17
2	2	4,899	4,348	53	81
3.1	3	3,942	3,267	46	59
3.2	1	258	245	4	5
	2[c]	5,874		108	
4	1	5,774	5,353	105	97
Overall				50	61

[a] Includes Forest Park station and associated capital costs.
[b] Excludes Forest Park station, with reduction in capital cost of $16 million for this section of each alternative.
[c] Assumes Deer Creek terminal station with a Laclede Station Road alignment.

5.4.7.1 Comparing Positive and Negative Impacts per Municipality

5.4.7.1.1 Introduction

The purpose of this equity measure is to ensure that low-income households, minority households, and minority business enterprises do not suffer a disproportionate share of adverse environmental impacts resulting from the Cross-County MetroLink Extension project. Executive Order 12898, which addresses the issue of environmental justice, was used as guidance for this review. Through evaluating potential environmental impacts of the Fully Grade-Separated and At-Grade/Grade-Separated Combination Alternatives with regard to minority and/or low-income communities, this equity analysis ensures that persons or populations:

- **Are not discriminated against in major project decisions; or**
- **Denied the benefits of the project; or**
- **Burdened with a disproportionate share of the impacts**

Sections 5.4.7.1.2 through 5.4.7.1.5 discuss the results of the equity analysis, as applied to criterion 4G, measure d, as outlined in Table 1-2 in Section 1 of this report.

This equity review also addresses issues related to Title VI Fixed Facility Impacts. Title VI of the Civil Rights Act of 1964 requires that federal programs and expenditures are not discriminatory and that the benefits of federal investments and program are shared across the population. Guidance is provided in FTA Circular C 4702.1 regarding the Title VI fixed facility impact analysis. Subsections 5.4.7.1.6 through 5.4.7.1.10 discuss the results of this analysis review.

5.4.7.1.2 Community Engagement Opportunities for Decision-Making Involvement

Community engagement outreach efforts to date have included newsletters, media announcements, public meetings and forums, working group meetings, an information hotline and web site, and other methods of contacting the concerned residents, business owners, and other stakeholders in the Cross-County MetroLink corridor. These opportunities for involvement by all populations are documented in the October 1998 memorandum titled *Phase I Summary of Community Engagement Activities and Other Community Involvement*, as well as other summary memorandums.

5.4.7.1.3 Disproportionate Distribution of Impacts and Benefits

In this environmental analysis of the corridor, alternatives and options were analyzed for disproportionate impacts to minority and low-income populations as well as minority business owners. Table 5.4.7-1 shows the minority and low-income populations by census tract in all parts of the study corridor. For example, census tracts 1051, 1052, and 1121 are immediately adjacent to and north of Millbrook Boulevard and Forest Park Parkway, east to west, respectively. This

area of the corridor represents a transition from higher income/lower minority percent areas south of Forest Park Parkway and Millbrook to lower income/higher minority percent north. In addition to the higher minority populations in the northeastern part of the Cross-County corridor, minority populations are distributed throughout the municipalities. The City of Shrewsbury has the lowest minority population, at 4.0 percent. All persons in the Cross-County corridor will have equal access to the MetroLink extension, which is one of the benefits of the project.

Once the MetroLink extension is in operation, all residents of the corridor will experience the same benefits of increased accessibility and mobility, as described in Section 5.2. The MetroLink Segment I extension will expand the existing MetroLink system between the downtown Clayton/ Forest Park area and Shrewsbury and offer improved access to commercial, retail, industrial, and other major activity centers in the Cross-County corridor. This improved access will in turn expand the opportunities for work, recreation, and shopping in areas previously unaccessible by those who either do not own vehicles or currently commute by bus. Therefore, the benefit to minority and low-income populations would be equal to, if not greater than, the benefit to other populations in the Cross-County corridor.

5.4.7.1.4 Anticipated Environmental Impacts

There are no anticipated negative impacts to the natural or urban environment that would have disproportionate adverse effects on minority or low-income populations or minority-owned businesses within the corridor.

5.4.7.1.5 Environmental Justice Mitigation

No adverse impacts are anticipated for either the Fully Grade-Separated Alternative or the At-Grade/Grade-Separated Combination Alternative or the alternative options; therefore, no mitigation measures are recommended.

5.4.7.1.6 Potential Impact on Minority Communities near LRT Stations

Given the limited impacts throughout the Cross-County corridor near LRT stations, as described throughout Section 4, low-income and minority communities will not bear a disproportionate share of any negative impacts associated with this project. These populations, which are generally more transit-dependent, will benefit from better access to MetroLink stations and improved bus-to-MetroLink linkages in their neighborhoods. In addition, all persons in the corridor will have equal access to the Cross-County MetroLink extension.

Table 5.4.7-1
MINORITY AND LOW-INCOME POPULATIONS
METROLINK EXTENSION SEGMENT I CORRIDOR

Geographic Area[1]	Total Population	Percent Minority	Median Household Income	Percent Below Poverty Level[2]	Percent Below 50% of Poverty Level
St. Louis County	993,529	15.8%	$38,127	5.6%	2.6%
City of St. Louis	396,685	49.0	19,458	24.6	12.8
Census Tract 1051	3,810	34.6	29,609	22.5	12.2
Census Tract 1052	3,073	70.5	23,165	30.4	15.0
Census Tract 1121	4,998	38.6	23,776	21.7	7.3
University City	40,087	51.1	32,150	12.8	7.0
Census Tract 2161	6,716	43.8	19,178	31.0	18.7
Census Tract 2162	8,367	20.3	41,747	6.4	3.1
Clayton	13,874	9.3	44,218	4.6	2.8
Census Tract 2163	5,812	11.3	34,420	11.1	7.1
Census Tract 2164	5,256	4.8	47,576	4.3	2.9
Census Tract 2165	3,276	12.6	46,051	3.8	2.2
Brentwood	8,150	6.7	38,854	2.9	1.3
Census Tract 2172	2,578	16.6	24,623	8.2	1.7
Census Tract 2173	2,821	11.6	32,846	4.4	2.2
Richmond Heights	10,448	17.5	32,237	7.3	1.7
Census Tract 2166	2,545	8.3	40,611	3.4	1.1
Maplewood	9,962	17.3	21,492	11.4	3.7
Census Tract 2170	3,378	11.3	22,628	9.4	1.7
Census Tract 2171	1,307	20.2	22,392	7.6	3.7
Shrewsbury	6,416	4.1	35,246	5.2	0.6
Census Tract 2196	6,789	4.0	35,252	4.8	0.5
Total/Avg. Municipal[3]	88,937	29.4	33,058	9.2	4.3
Total/Avg. Cens. Tract	60,726	21.8	29,525	13.6	6.1

Source: U.S. Census Bureau, 1990.

[1] A census tract may overlap into an adjacent municipality.

[2] The poverty threshold for a family of four was $12,674 in 1989, which was used in the 1990 U.S. Census.

[3] Does not include the City of St. Louis or St. Louis County.

5.4.7.1.7 Potential Environmental Impacts

The environmental impacts have been addressed throughout Section 4 of this Draft Socioeconomic and Environmental Analysis Technical Report. The following environmental impacts are generally not significant to minority and low-income populations for the reasons outlined:

a. Noise/Vibration

- **Projected LRT noise levels will not cause any adverse effects.**
- **Mitigation for short-term construction-related noise is addressed in Section 5.4.3 of this report.**
- **No vibration impacts will occur to minority or low-income residences.**

b. Air Quality

- **The results of the project-specific air quality analysis show no exceedances of NAAQS standards in the Cross-County MetroLink corridor.**
- **The Cross-County MetroLink extension would provide improved, high-occupancy public transit, and it is part of a conforming Long-Range Transportation Plan.**

c. Water

- **No streams or other Waters of the U.S. will experience long-term effects from the Cross-County MetroLink extension.**
- **Best Management Practices (BMP) will be implemented to minimize soil erosion and sedimentation to maintain water quality in the streams that are crossed during MetroLink construction.**
- **A nationwide Corps 404 permit may be required for the minor wetland impact south of I-44 at the Lansdowne station. No minority populations or businesses are located in this area.**

5.4.7.1.8 Description of Significant Changes or Impacts on Minority-Owned Businesses and Communities

Minority-owned businesses will not be adversely affected by the construction and operation of the Cross-County MetroLink extension and may benefit from increased business as economic development and redevelopment occur along the Cross-County corridor. Short-term construction-related impacts to businesses and communities along the MetroLink alignment will occur; however, minority-owned businesses and communities will not experience a disproportionate shared of construction-related impacts. Mitigation measures for construction-related impacts are discussed in Section 5.4.5. There will be no reduction in Bi-State bus service to adjacent neighborhoods or minority businesses and households. Increased transit service is anticipated, as bus routes will be coordinated with MetroLink service and station locations.

5.4.7.1.9 Minority-Owned Businesses and Disposition of Relocation Program

As described in Section 5.4.2, the construction of the Lansdowne terminus station and MetroLink maintenance and storage facility will require the displacement of 18 businesses. Business relocations will be accomplished in accordance with the procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and the Uniform Relocation Act Amendments of 1987, known jointly as the Uniform Relocation Assistance Act. Research and field investigations indicate that none of these businesses is minority-owned. A review of the *Missouri Minority Business Directory* confirmed that none of the businesses to be displaced by any of the Cross-County MetroLink alternatives is minority-owned. Therefore, no adverse social or economic effects to minority-owned businesses will occur because of the necessary relocations.

5.4.7.1.10 Title VI Mitigation

As a result of the Title VI fixed facility impact analysis conducted for this project, it has been determined that the impacts relating to Title VI are generally not significant. Therefore, no mitigation measures beyond those stated in Section 4 of this technical report are recommended.

5.5 Costs and Financial Capacity

5.5.1 Maximize Cost-Effectiveness

This criterion deals with the effectiveness of the investment. It examines costs in relation to measures of effectiveness.

5.5.2 Capital Costs

A separate document contains the estimate of capital costs, which will not be repeated here except in summary terms.

The capital costs[1] for alternatives and section options are as follows:

Corridor Alternatives

	(in $M)
• Fully Grade-Separated	$518
• At-Grade/Grade-Separated Combination	377

Section Alternative/Options:

• South Edge At-Grade	$394[2]

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1 Rounded to the nearest $1,000,000.

2 When in conjunction with the At-Grade/Grade-Separated Combination Alternative.

3 When in conjunction with the Fully Grade-Separated Alternative.

• Skinker Boulevard and Big Bend Boulevard Underpasses (Transit)	403[2]
• Skinker Boulevard Underpass (Roadway)	387[2]
• Downtown Clayton Elevated	378[2]
• Forest Park Parkway At-Grade	376[2]
• Downtown Clayton At-Grade via Carondelet/Brentwood	365[2]
• Galleria Elevated	399[2]
• Laclede Station Road	380[2]
• Deer Creek Terminal	333[2]/474[3]

Includedwith these costs, $98,600,000 (common to all alternatives) is estimated to cover the cost of vehicles (train sets, vehicles for expanded local bus service, and vehicles for the Forest Park Circulator), plus some capital cost for facilities for the Forest Park Circulator.

Considering the cost differences[1] compared to the least costly alternative, the following results:

	(in $M)
• Deer Creek Terminal with At-Grade Combination Alternative (least cost)	$333
• Downtown Clayton At-Grade via Carondelet/Brentwood	+$32
• Forest Park Parkway At-Grade	+$43
• At-Grade/Grade-Separated Combination Alternative	+$44
• Downtown Clayton Elevated	+$45
• Laclede Station Road/Lansdowne	+$47
• Skinker Blvd Underpass (Roadway)	+$54
• South Edge At-Grade	+$61
• Galleria Elevated	+$65
• Skinker Boulevard and Big Bend Boulevard Underpasses (Transit)	+$70
• Deer Creek Terminal with Fully Grade-Separated Alternative	+$141
• Fully Grade-Separated Alternative	+$185

Another comparison of the capital cost is to estimate the overall cost per mile of transit line. These results are summarized by section of the corridor and for the corridor overall.

<u>Cost by Section</u>

Section 1: Forest Park through University City

(1) At-Grade Alternatives	**$31 to $42 million per mile**
(2) Underground Alternative	**$55 million per mile**

Section 2: Downtown Clayton

(1) At-Grade Alternatives	**$29 to $37 million per mile**
(2) Elevated Alternatives	**$37 to $40 million per mile**

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[1] Rounded to the nearest $1,000,000.

(3) Underground Alternatives **$61 to $63 million per mile**

Section 3.1: CMT - Galleria to Manchester Road

(1) At-Grade on CMT	**$24 million per mile**
(2) At-Grade with Elevated at Galleria	**$32 million per mile**
(3) Underground on Brentwood/Galleria Parkway with At-Grade on CMT	**$36 million per mile**

Section 3.2: CMT - Manchester Road to Deer Creek

(1) At-Grade with Underground through Sunnen Business Park	**$32 million per mile**
(2) At-Grade with Laclede Station Road Alignment	**$34 million per mile**
(3) At-Grade with Elevated through Sunnen Business Park	**$43 million per mile**
(4) Deer Creek Terminal Options:	
(a) With Underground through Sunnen Business Park	**$42 million per mile[1]**
(b) With Laclede Station Road	**$53 million per mile[1]**
(c) With Elevated through Sunnen Business Park	**$55 million per mile[1]**

Section 4: Lansdowne Avenue

(1) Elevated **$76 million per mile[1]**

Relative to the overall corridor alternatives identified above, the cost per mile would be:

• **Fully Grade-Separated**	**$63 million per mile**
• **At-Grade/Grade-Separated Combination**	**$46 million per mile**
• **South Edge At-Grade**	**$48 million per mile**
• **Skinker and Big Bend Underpasses**	**$49 million per mile**
• **Downtown Clayton At-Grade with Brentwood**	**$45 million per mile**
• **Downtown Clayton Elevated**	**$47 million per mile**
• **Forest Park Parkway At-Grade**	**$46 million per mile**
• **Galleria Elevated**	**$49 million per mile**
• **Laclede Station Road**	**$46 million per mile**
• **Deer Creek Terminal**	**$44 to $64 million per mile**

5.5.3 Operating and Maintenance Costs

Operating and maintenance (O/M) costs are discussed in a separate document. Estimates of O/M costs are based upon the following unit costs for variable items:

MetroLink:	**$1.45 per revenue mile**
	$33.91 per revenue hour
Local Bus:	**$1.34 per vehicle revenue mile**
	$34.78 per vehicle revenue hour

[1] These costs include the terminal station maintenance and yard facility.

The overall estimated basic operating cost for the Fully-Grade Separated Alternative is $15,300,000 per year ($9.65 million for MetroLink, and $5.65 million for local bus and the Forest Park Circulator). Compared to the other basic alternative(At-Grade Combination), these O/M costs would be the same. The local bus and Forest Park Circulator costs are identical for each alternative. For MetroLink operations, the difference in estimated travel time is not large enough to change fleet requirements, hence, the estimated annual MetroLink car miles and hours should be the same.

Based upon the estimated ridership and the assumed fares, it is estimated that farebox revenue will be $3 to $4 million per year. This amounts to a farebox recovery rate of approximately 50%. Farebox revenue for every 1,000 daily riders (boarding) amounts to about $175,000 per year. Since the estimated ridership for the basic At-Grade Combination Alternative is 2,800 boardings per day lower, this alternative would have a slightly lower fare revenue potential of $490,000 per year.

Relative to the various section options, the overall O/M costs would not be significantly different. Fare revenue could be somewhat different as follows:

1. **Downtown Clayton Elevated**
   - **5,400 fewer boardings compared to the basic Fully Grade-Separated alternative, or about $900,000 less revenue per year.**
   - **2,700 fewer boardings compared to the basic At-Grade Combination alternative, or about $475,000 less revenue per year.**

2. **Forest Park Parkway At-Grade**
   - **4,300 fewer boardings compared to basic Fully Grade-Separated alternative, or about $700,000 less revenue per year.**
   - **1,500 fewer boardings compared to the basic At-Grade Combination Alternative, or about $260,000 less revenue per year.**

3. **Galleria Elevated**
   - **300 more boardings per day compared to the basic At-Grade Combination, or about $50,000 more revenue per year.**

4. **Laclede Station Road**
   - **150 more boardings per year compared to the basic At-Grade Combination, or about $30,000 more revenue per year.**

5. **Deer Creek Terminal**
   - **200 fewer riders per day relative to the basic Grade-Separated Alternative, or about $35,000 less revenue per year.**

5.5.4 Capital Cost Benefits

From a cost-effectiveness perspective, the consideration focuses on the benefits that the added investment would produce. Based on the analysis results identified in this report, benefits can be associated with each increment of added cost. Benefits may be real or perceived, measurable or qualitative.

5.5.4.1 Deer Creek Terminal with basic corridor alternative - At-Grade/Grade-Separated Combination

1. **Would extend high-quality transit service seven miles into St. Louis County, expanding accessibility and enhancing mobility.**

2. **Accessibility enhancements would benefit several major activity centers, including downtown Clayton, Galleria area, Eager Road/Promenade/Hanley Industrial Court area, and Sunnen Business Park/Deer Creek Center area.**

3. **Accessibility could stimulate redevelopment opportunities in Maplewood and the northern edge of Shrewsbury and reinforce the region's core communities.**

4. **Would provide a strategic transportation link connecting employment centers and low-income job seekers.**

5. **Would reduce existing transit travel time using bus by 50 percent for trips along the 7 to 8 mile long Segment I portion of the Cross-County corridor.**

6. **MetroLink would expand transportation capacity in terms of capability to accommodate at least 3,000 people per hour in each direction, with the potential to serve 4,000 people per hour in each direction. In comparison to the traffic capacity of freeway lanes, the two-track MetroLink line is equivalent to 2.5 to 3.5 freeway lanes. With high traffic growth in the Cross-County corridor, added transportation capacity will be essential to serve expected travel demand.**

7. **Along with MetroLink, there would be expansion in local modes of access. This would include more local bus service, expansion of park-n-ride facilities, and improvement to the Forest Park area circulator system. Local bus service enhancement would occur throughout the corridor, with added concentration of service in the south and southwest suburban area. Major park-n-ride facilities would be located to be accessible from two major freeways: I-64 and I-44.**

8. **As an electric-powered transit mode, MetroLink would aid in reducing air pollution through its own operation and by attracting auto users to transit.**

9. **Stations would be located to be convenient within the Cross-County corridor; i.e., at nine locations. Stations would be within reasonable (one-quarter mile) walking distance of significant land uses, but not too closely spaced to slow down overall train speed in the corridor.**

10. **Stations would be designed to be safe for riders and be aesthetically appropriate to fit in with surrounding areas.**

11. **Operations would be designed to promote safety, especially in locations where at-grade operations would occur. The majority of the alignment (85 percent) would be in exclusive right-of-way for MetroLink; e.g., no at-grade conditions where tracks would be crossed by other vehicle or pedestrian traffic. For the 15 percent of the alignment that would be in a semi-exclusive situation (as defined by at-grade crossings, intersections, and approximately seven blocks in downtown Clayton where pedestrians could cross tracks at grade in mid-block locations), new traffic signal facilities and operations would be employed, along with highly improved traffic signs and markings to minimize the risk of accidents.**

12. **As a result of MetroLink construction, various other infrastructure benefits would be realized, including:**

    a. **Reconstruction/rehabilitation of significant sections of Forest Park Parkway (DeBaliviere to Skinker) and Millbrook Boulevard (Skinker to Pershing).**

    b. **Rebuilding and widening of the DeBaliviere Avenue bridge (at the Forest Park MetroLink station).**

    c. **Replacement of CMT bridge over Manchester Avenue, with widening of Manchester Avenue.**

    d. **Streetscape improvements along Forest Park Parkway, Millbrook Boulevard, Carondelet Plaza, Carondelet Avenue, and Meramec Avenue.**

    e. **Pedestrianway and sidewalk improvements throughout the corridor.**

12. **The location of the tracks on the CMT near Forest Park Parkway would provide a convenient opportunity to expand MetroLink (Cross-County Segment III) to the north. At the Deer Creek station, tracks would be located so that they could be extended south as part of MetroLink expansion, i.e., Cross-County Segment II.**

5.5.4.2 At-Grade/Grade-Separated Combination to Lansdowne Avenue (Basic corridor At-Grade/Grade-Separated Combination alternative)

1. **All benefits identified for the Deer Creek terminal (above) would apply here, plus the benefit of extending MetroLink service to areas south of I-44 into Shrewsbury and St. Louis (southwest area).**

2. **There would be increased ridership of approximately 200 boardings per day.**

3. **The extension to Lansdowne would expand the accessibility benefits of MetroLink by including more redevelopment area within the more direct influence zone.**

4. **Lansdowne Avenue connects to various major arterials offering more convenient access to MetroLink. The site would be more visible than the Deer Creek terminal station site.**

5. **The extension to Lansdowne Avenue would be a significant link in allowing the southward expansion of MetroLink into South County.**

5.5.4.3 Forest Park Parkway At-Grade (with Basic At-Grade/Grade-Separated Combination)

1. **Introduces a different alignment through downtown Clayton that would nearly eliminate all possible traffic impacts.**

2. **Maintains two stations for access to major development potentials on east edge of downtown and near Central Avenue.**

3. **Would have a low profile, similar to the highway, to eliminate visual impacts of new structures for neighborhoods to the south of downtown.**

4. **Would have a relatively straight alignment through downtown, which will promote somewhat better MetroLink speed; the absence of sharp horizontal curves will eliminate a potential source of noise.**

5.5.4.4 Laclede Station Road (with basic At-Grade/ Grade Separated Combination alternative as substitute for underground alignment through the Sunnen Business Park)

1. **Would achieve significantly increased accessibility to employment in the Sunnen Business Park and Hanley Road area.**

2. **Would stimulate and support achievement of local redevelopment goals.**

3. **Would minimize disruption to existing and significant economic development.**

5.5.4.5 Downtown Clayton Elevated (with basic At-Grade/ Grade Separated Alternative Combination as substitute for at-ground alignment through downtown Clayton)

1. **For the higher profile version, would create a grade-separated operating environment for MetroLink, allowing lower travel times by 2 minutes in this section with no risk of delay; for the lower profile version, similar benefits would be provided although there would be two at-grade crossings in the alignment.**

2. **The higher profile version would create a safer operating environment because it would be an exclusive transit right-of-way. The lower profile version would have two at-grade crossings which would introduce a risk of accident.**

3. **Would minimize disruption during construction compared to alignments through the middle of downtown.**

4. **Would entail low risk for construction cost escalation by minimizing the potential impact of unknown utility system costs.**

5.5.4.6 At-Grade Downtown Clayton via Carondelet/Brentwood (With basic At-Grade/ Grade Separated Combination alternatives as substitute for at-grade alignment in downtown Clayton via Carondelet/Meramec)

1. **Would avoid potentially significant right-of-way acquisition and displacement along Meramec Avenue south of Carondelet Avenue. However, the trade-off to this benefit is that:**
   a. **Shaw Park land would need to be used for the transit line; this would require relocating existing tennis courts in the southwest corner of the park.**
   b. **At-grade traffic operations would include one more high-volume intersection at Brentwood Boulevard. This represents more traffic coordination requirements than would be needed for the Meramec Avenue alignment option.**

5.5.4.7 South Edge At-Grade (With basic At-Grade/ Grade-Separated Combination Alternative)

1. **Would create more accessible safer station locations along Millbrook Boulevard with fewer potential pedestrian/vehicle conflicts.**

2. **Would increase the potential for more direct linkage to campus development.**

3. **Would remove risk of potential impacts on traffic operations and reduced level of service at the Big Bend/Millbrook intersection due to MetroLink operations. However, traffic conditions at Skinker Boulevard would be worse when compared to the median at-grade**

alignment because of the necessity of using signal pre-emption operations and crossing gates and flashing warning lights.

5.5.4.8 Skinker Boulevard and Big Bend Boulevard Underpasses (With basic At-Grade/ Grade-Separated Combination Alternative)

1. The transit underpass version would:

a. Remove any potential risk of impacts on traffic operations and level of service at both the Skinker/Forest Park Parkway and Big Bend/Millbrook intersections due to MetroLink operations.

b. Eliminate the risk of accidents due to MetroLink operations at both intersections.

2. The roadway underpass version (Skinker Blvd thru lanes) would:

a. Reduce the small potential risk of impacts on traffic operations and level of service at the Skinker/ Forest Park Parkway intersection by bypassing north-south traffic.

b. Reduce the risk of accidents at the intersection but increase the risk of accidents at the ends of the underpass due to sight-distance limitations.

c. Along length of the underpass structure constrain access to local east-west streets and driveways along Skinker Blvd to right turn in/out only (no left turns).

5.5.4.9 Galleria Elevated

1. Would promote significant development in the Brentwood Boulevard corridor.

2. Would create potential for more ridership, i.e., would allow access for increased density of development with higher overall transportation capacity (due to MetroLink) allowing for reduced auto trip generation and lower on-site parking requirements.

5.5.4.10 Fully Grade-Separated Alternative with Deer Creek Terminal

1. Added transit ridership compared to the basic At-Grade/Grade-Separated Combination alternative of 2,500 boardings per day.

2. Would eliminate risk of 6 to 7 train/vehicle-pedestrian accidents per year as compared to the basic At-Grade/Grade-Separated Combination alternative.

3. Would eliminate risk of reduced traffic level of service at high traffic volume intersections (Skinker, Big Bend, Hanley).

4. Would increase speed of travel by 3 minutes less travel time; that would represent 5 to 10% reduction in total trip time for typical door-to-door trips in the Cross-County corridor.

5. **For travel in the westbound/southbound directions, there is a potential for expanding the area of accessibility to the north and northeast of the Cross-County Corridor.**

6. **Would eliminate the risk of traffic delays in at-grade locations with the potential for more reliable service.**

7. **Since service capacity would not be constrained by street traffic conditions, there would be the potential to enhance service capacity and schedule reliability.**

8. **More of the line would be in a weather-protected environment.**

5.5.4.11 Fully-Grade Separated Alternative to Lansdowne Avenue

1. **Would increase ridership potential by 200 boardings per day compared to a Deer Creek Terminal.**

2. **All the benefits identified above for the fully grade-separated alternative, together with an increase in accessibility to and development potential of areas in St. Louis (southwest area) and Shrewsbury.**

3. **All benefits identified for the Deer Creek terminal (above) would apply here, plus the benefit of extending MetroLink service to areas south of I-44 into Shrewsbury and St. Louis (southwest area).**

4. **The extension to Lansdowne would expand the accessibility benefits of MetroLink by including more redevelopment area within the more direct influence zone.**

5. **Lansdowne Avenue connects to various major arterials offering more convenient access to MetroLink. The site would be more visible than the Deer Creek terminal station site.**

6. **The extension to Lansdowne Avenue would be a significant link in allowing the southward expansion of MetroLink into South County.**

5.5.5 Trade-Offs

Benefits are often perceived as non-quantifiable and subjective. Therefore, trade-offs will naturally be subjective. Generally, there could be three types of trade-offs; i.e., results that are opposed but balance each other in an acceptable fashion:

1. **Benefits versus added costs**
2. **Benefits versus increased impacts**
3. **Reduced impacts versus added costs**

The discussion in the preceding section identified the potential benefits associated with increments of cost. The trade-offs are summarized below:

- ***Benefits***

  1. **Economic development support.**
  2. **Accessibility to more people—workers and/or customers.**
  3. **Expanded mobility—larger area can be reached with more convenient and higher-quality service.**
  4. **Improved personal productivity via reduced travel times.**
  5. **Operational advantages for MetroLink—capacity, reliability, and safety.**
  6. **Improved air quality associated with greater use of mass transit.**

- ***Potential Impacts***

  1. **Environmental conditions—noise, vibration, electromagnetic effects**
  2. **Risk of traffic accidents along at-grade alignments.**
  3. **Risk of personal security because of limited visibility and entrapment areas associated with underground facilities.**
  4. **Displacement of existing land use activities.**
  5. **Acquisition of open space for right-of-way and removal of existing mature vegetation for transit facilities.**
  6. **Range of construction impacts for sections of alignment to be built in existing street rights-of-way associated with elevated, at-grade, cut-and-cover, and bored tunnel alignments.**

With any combination of benefit and impact is an associated cost. Based on the accumulated benefits only, the fully grade-separated alternative may be perceived as the "best." Subjectively, many urban designers consider at-grade design as better, supporting an active, more appealing urban environment. However, many people consider MetroLink solely in functional and utilitarian terms (much like water and sewer systems). This attitude would suggest that the tracks, primary facilities, and trains be out of sight.

However, it is likely that cost will be an issue. This means that several very overriding trade-offs will need to be addressed:

1. **The extent of MetroLink expansion; i.e., how large an area will have direct MetroLink access for the resources available. This affects development at the aggregate scale and mobility at the personal level.**

2. **The quality of the operating environment for MetroLink in terms of speed (travel time), reliability, safety, and capacity.**

3. The need to achieve a balanced use of resources between capital and operating costs.

4. The level of increased benefit for each increment of cost.

Trade-off No. 1 suggests that the overall unit construction cost be minimized (within proper design standards) to extend the system as far as possible and maximize economic return.

Trade-off No. 2 suggests that increased investment via higher overall unit costs is necessary to achieve quality service. If investment is too low, service quality could be compromised.

Trade-off No. 3 recognizes that in addition to initial construction, the available resources needed to support net operating and maintenance costs (O/M). Selecting alternatives with lower capital cost provides more resources for O/M.

Trade-off No. 4 considers that some incremental costs may not yield substantial benefits, while other investments may produce larger benefits. This trade-off is aimed at optimizing the cost-effectiveness of the overall investment.

In between these four trade-offs are various impacts that need to be managed to acceptable levels. These entail environmental concerns, displacement, and construction impact. Thus, the trade-offs are in tension with each other. The impacts represent a third factor that affects the balance between the others. Thus, the evaluation challenge is to find when and how the balance can be achieved; i.e., gain necessary expansion in mobility and economic development while achieving appropriate MetroLink operating conditions and keeping certain impacts at acceptable levels.

5.6 MetroLink Compatibility

5.6.1 Compatibility of Design Features

For the conceptual design of the Fully Grade-Separated and the At-Grade/Grade-Separated Combination Alternatives, all existing MetroLink design standards have been followed. This is also true for the MetroLink stations and station layouts. Therefore, the Cross-County MetroLink Extension Segment I will be similar to the existing MetroLink line that runs from downtown St. Louis to the Airport main terminal. With regard to maintenance facilities, the maintenance facility planned for the Cross-County MetroLink Extension will be of a smaller scale than the existing Bi-State operated Ewing maintenance shop. No major maintenance activities will take place at either the Lansdowne or Deer Creek terminal station. Only minor maintenance, cleaning, phasing and LRT vehicle storage will occur. The design of the maintenance facility and the activities that occur there will be consistent with existing MetroLink maintenance and operations.

5.6.2 Opportunity for Developing Segments II and III

For the Fully-Grade-Separated and the At-Grade/Grade Separated Combination alternatives, the Lansdowne terminal station south of I-44 provides a better and more cost-effective opportunity (in the long-term) for developing the future Segment II MetroLink extension. The elevated MetroLink track over I-44 would already be in place and the planned maintenance facility at Lansdowne would also serve the Segment II extension into South County. At the Lansdowne terminus the Cross-County MetroLink Extension Segment I would be along the Burlington Northern & Santa Fe (BNSF) railroad right-of-way since the CMT right-of-way ends north of I-44. To date, no discussions have taken place with BNSF railroad officials about the possibility of shared right-of-way for Segment II. If BNSF railroad right-of-way could be used, Segment II would simply continue south into South County from the Lansdowne MetroLink station.

For the Segment III extension, which would begin just west of downtown Clayton and travel north on the CMT right-of-way toward Florissant. The At Grade/Grade-Separated Combination Alternative would provide a better opportunity to facilitate a junction between Segment I and Segment III extensions. This is because all of the design options for the combination alternative proceed west of downtown Clayton along Shaw Park Drive and/or Forest Park Parkway to the CMT right-of-way. At this location, constructing a Y junction to run MetroLink north along the CMT to Florissant is very feasible. Enough right-of-way exists in the CMT right-of-way to accommodate this straight-forward design. For the Fully Grade-Separated Alternative, the MetroLink alignment would be below grade running south under Brentwood Boulevard to the Galleria Parkway. The alignment would then go east under Galleria Parkway to the CMT right-of-way. The transition from Segment I (running south) and Segment III (running north) would need to be at this location. A more complex track junction would need to be constructed in the CMT right-of-way. For Segment III, a separate Galleria station on the CMT right-of-way would be necessary if Segment III was to serve LRT passengers in the Galleria area. Also, this design may require that four LRT tracks be constructed in the area of the junction to accommodate all MetroLink movements for both extensions. This may require more than the 100 feet of CMT right-of-way at this location. Also, Segment III will run north of this location along the CMT right-of-way (just east of I-170) and would not serve the downtown Clayton passengers. A separate MetroLink line into downtown Clayton may be needed, or passenger transfers may be required (from Segment III to Segment I) at a new Galleria station to accommodate passengers wanting to access downtown Clayton.

For the Segment II extension, the MetroLink junctions and/or transitions between segments would not add significantly to the capital costs of the overall MetroLink projects. The Segment III junction and possible new Galleria station would be a capital cost consideration. The same MetroLink design standards would be used for the future Segment II and Segment III extensions as for Segment I.

6
Community Involvement and Agency Coordination

6.1 Community Engagement Process

Community involvement has been an important part of the Cross-County MetroLink Extension Segment I Conceptual Design Study. The community engagement process has been led by the Council and a team of community involvement consultants. The community engagement process is being implemented in three phases: Phase I—public forum and community issues workshops; Phase II—meetings with municipalities, city leaders, civic interest groups, and other stakeholders; and Phase III—Public Meetings.

6.1.1 Phase I: Public Forum and Community Issues Workshops

The Cross-County MetroLink Extension public forum was held at the Clayton Community Center on September 28, 1998, from 4:00 to 6:00 P.M. and 7:00 to 9:00 P.M. The public forum was designed as an open house. The public was invited to learn more about the first phase of the Conceptual Design Study for the proposed Cross-County MetroLink Extension. The forum provided an opportunity for the public to ask questions of and explore ideas with members of the design team and the Council's staff. It was sponsored by the East-West Gateway Coordinating Council (the Council) in cooperation with the Bi-State Development Agency (Bi-State) and the Missouri Department of Transportation (MoDOT). Two hundred fifty-two sign-in cards were collected from attendees; however, actual attendance is estimated at 275. Based on the evaluations received, the majority of attendees were residents of Clayton and its vicinity. Staff from the Council, Bi-State, MoDOT, and members of the community engagement and conceptual design teams attended the meeting to answer questions and receive residents' input.

Participants were able to review displays showing the conceptual design options and to learn more about the ways the conceptual design options would be refined and evaluated. The forum displays were organized into a series of ten stations:

- **Station 1: Welcome & Sign-in**
- **Station 2: Planning History & Context**
- **Station 3: Basic Design Options**
- **Station 4: Design Options for Forest Park Station through University City**
- **Station 5: Design Options for Clayton and the Galleria Area**
- **Station 6: Design Options for Richmond Heights to Shrewsbury**
- **Station 7: Evaluation Criteria**
- **Station 8: Forest Park Transportation System**
- **Station 9: Community Design**
- **Station 10: Community Involvement**

Each station was marked by a large sign and included hand-outs or information displays. Information posted on the displays included: large maps, photos of existing conditions at possible alignment locations, sketches of the various vertical alignment options (at-grade, above grade, belowgrade), and accompanying text. Representatives from the Council and the study team were at each station in order to speak directly with the public regarding their questions or concerns. Upon entering the forum, participants were provided with a handout that described the purpose of the evening, a map of the stations with key questions for each station, and a schedule of upcoming public events.

In addition to the information displays, other materials were made available to the forum attendees including the following: Forum Orientation Handouts, Evaluation Sheets, Comment Sheets, Study Brochures, and Study Newsletter (Cross-County MetroLink Update, Volume 1, Fall 1998). Fact sheets were available, titled: Upcoming Events, How to Get Involved, Frequently Asked Questions, Design Definitions, the Route, the Cross-County Team, and the Community Working Group. Forum evaluation sheets were also distributed to attendees asking them to evaluate the forum regarding logistics (location, time, set-up) and the quality of their experience.

Although the primary purpose of the forum was to provide information rather than to solicit comments, public comment forms were made available to individuals who wished to convey their comments to the Council and study team in writing. Comments were received concerning the engagement process and forum specifically, community impacts, and design recommendations and preferences. Community impact issues raised included concern about noise levels and vibration, vehicular and pedestrian safety, traffic, parking, urban design and aesthetics, costs, timing, and serving the young and elderly. Participants also expressed a variety of preferences

regarding route location and profile, station design and location, integration with other forms of transit, and expansion.

6.1.2 Community Issues Workshops

Three community issues workshops were held in October 1998 as part of the Phase I community engagement activities.

Workshop 1 (Forest Park Station through University City)

The first Community Issues Workshop was held at Compton Drew Investigative Learning Center on October 1, 1998, from 7:00 to 9:00 P.M. This Community Issues Workshop was designed to provide an opportunity for the study team to elicit comments, concerns and questions from interested parties concerning the Cross-County study and the design options for the section of the MetroLink extension from Forest Park Station through University City. A total of 225 sign-in cards were collected from attendees; however, actual attendance is estimated at 250 persons. Council, MoDOT, and technical design staff were available to answer questions and help facilitate the meeting. A team of facilitators and recorders also participated.

The workshop was organized around an introductory presentation and small group work sessions. Upon arriving, participants were asked to sign-in and pick-up several pieces of information about the study. The workshop began with a welcome by the Council's Executive Director, followed by a presentation of design options. In small group work sessions, participants were asked by a facilitator to respond to the questions regarding the MetroLink extension and to express their concerns. Participant comments in the large and small groups were recorded on flip charts.

A large group question and answer session also took place during the meeting and revealed community concerns about several potential impacts of the extension. Participants asked questions about the following: parking impacts on neighborhoods and Clayton businesses, methods for estimating costs and assessing impacts, design requirements for stations, strategies to control parking, signal phasing, noise mitigation, right-of-way requirements, pedestrian and bike safety, and traffic congestion.

Regarding perceptions of positive influences, participants mentioned potential improvements in traffic congestion, air quality, and improved connections to the airport, downtown and sports facilities. Community cohesiveness, economic development, improved accessibility for the elderly, and improved access to jobs also were mentioned. When asked about their concerns, participants said they believed the quality of life of adjacent neighborhoods would decline due to increased noise, traffic congestion, parking on residential street, and vibration. Participants also expressed concern about aesthetics, pedestrian safety, the possible need for additional right-of-way to accommodate the tracks, potential affects on bus service, the availability of sufficient funds to "do it right," and the integrity of the planning process.

Workshop 2 (Richmond Heights to Shrewsbury)

The second Community Issues Workshop was held at the Richmond Heights Library on October 7, 1998, from 7:00 to 9:00 P.M. This Community Issues Workshop was designed to provide an opportunity for the study team to elicit comments, concerns and questions from interested parties concerning the Cross-County study and the design options for the section of the MetroLink extension from Richmond Heights to Shrewsbury. A total of 139 sign-in cards were collected from the attendees; however, 150 information packets were distributed and the actual attendance is estimated at 165.A team of agency staff, transportation consultants, meeting facilitators and recorders also participated.

This workshop was also organized around an introductory presentation, a question-and-answer period, small group work sessions, and a final question-and-answer session. Upon entering the room, participants were asked to fill out a registration card and were handed a packet of information about the study. Prior to beginning the workshop, participants were encouraged to view displays prepared by the design team. The workshop began with a welcome and an agenda review. A brief introduction to the study was provided and the study schedule reviewed. Next, the design options for this section of the extension were presented. A question and answer session followed. After the panel discussion, participants broke into small groups for discussion.

Participants asked questions regarding the scope of the environmental analysis that will be conducted as part of the study, the study timeline, methods of financing the extension, traffic impacts on local streets, width of the existing right-of-way and possible distance from tracks to houses. Five small group work sessions were held. Participants mentioned potential benefits in increased property values, economic development, and improved accessibility to job centers, downtown, and the airport. Participants shared thoughts about very specific benefits, such as the ability to get into Clayton without worrying about parking, the possibility of alleviating traffic on Brentwood Boulevard and Hanley Road, and the possibility of connecting Webster University to the system via shuttle buses.

When asked about their concerns, participants said they were worried about the possible affects of the extension-vibration, noise, divisiveness, visual clutter, increased traffic-on adjacent neighborhoods, the size of park-and-ride facilities, the design quality of stations and other facilities, and potential negative affects on property values. A few expressed concern about the safety of children crossing the tracks or increased crime from strangers entering their neighborhood. Others mentioned they were concerned about the project's cost. Comment sheets were distributed to the participants in their handouts. Comments were received about design recommendations and preferences related to specific design suggestions regarding access road, pedestrian and bicycle access, ADA accessibility and adequate parking.

Workshop 3 (Clayton and the Galleria Area)

The third Community Issues workshop was held at the Wydown Middle School on October 8, 1998, from 7:00 to 9:00 P.M. This Community Issues Workshop was designed to provide an opportunity for the study team to elicit comments, concerns and questions from interested parties concerning the Cross-County study and the design options for the section of the MetroLink extension in Clayton and the Galleria area. A total of 111 sign-in cards were collected from attendees; however, actual attendance is estimated at 125. Based upon the evaluations received, the majority of attendees were residents of Clayton. A team of agency staff, meeting facilitators and recorders also participated. The format of the workshop was similar to that of the first two workshops.

The panel addressed several questions, including questions regarding the difference between MetroLink and the old street car system, project costs and financing, the authority of state agencies to regulate surface-running trains, the condition of Forest Park Parkway south of the Clayton CBD, and methods for assessing traffic impacts on local streets. Regarding perceptions of positive influences, participants mentioned possible reductions in traffic congestion, increased accessibility to Clayton and downtown St. Louis, increased property values, benefits for merchants, improvements in air quality, and better accessibility for the young, elderly and persons with disabilities. Participants also mentioned that the system could help make the St. Louis region a more unified, modern, cosmopolitan community. When asked about their concerns, participants said they were worried about impacts on neighborhoods (vibration, noise, divisiveness, visual clutter, increased traffic) if the line were not below-grade, possible decreases in property value, the visual affects of an elevated option, and impacts on MetroLink and bus fares.

Participants also expressed concerns that a surface train may be too slow or may result in increased congestion on Clayton's commercial and residential streets. Some raised concerns about the extensions costs and proposed methods of financing. A few also expressed concern about the possibility of increased crime from strangers entering Clayton. The potential short term impacts on merchants during construction also was mentioned. Fifteen comment forms were handed-in at the workshop. Respondents had questions and concerns about impacts of construction, costs, and funding. Specific design recommendations were made pertaining to horizontal and vertical alignments, stations, and bike facilities.

6.1.3 Phase II: Stakeholder Meetings

Phase II of the community engagement process included many meetings with municipalities and groups. The round of public meetings were intended primarily as informational or educational sessions. These sessions were designed to provide city officials, the public, and other stakeholders with greater access to the design consultants and more opportunities to have questions answered and concerns addressed. More emphasis was placed on clearly defining the candidate alternatives that are being evaluated. The team also sought to distribute information

more widely, ensuring that property owners and stakeholders throughout the region had opportunities to learn more about the design alternatives and the ways these alternatives will be evaluated. As part of the second phase of community engagement meetings, meetings with the following stakeholders have taken place to discuss the Cross-County MetroLink Extension project, answer questions, and receive input.

Meetings were held with the City of St. Louis, Clayton, Brentwood, Richmond Heights, Maplewood, Shrewsbury, University City, Washington University, Forest Park Advisory Board, St. Louis County Municipal League, League of Women Voters, Richmond Heights and Brentwood Chambers of Commerce, CMT Transit Coordinators, Hanley Industrial Court, Sunnen Business Park, and many other civic groups and public/private stakeholders. Also, as part of the community outreach for the project, a telephone hot-line, e-mail address, and a web site was maintained. A community working group, comprised of municipal representatives, civic leaders and interested residents, held regular meetings to discuss project issues and obtain information.

During Phase III, the final phase of the community engagement process, additional public meetings will be held in early June 1999 to present the results of the Cross-County MetroLink Extension Conceptual Design Study.

6.2 Agency Coordination

Coordination with the resource and regulatory agencies occurred during the environmental analysis and preparation of the Socioeconomic and Environmental Analysis Draft Technical Report. In early February 1999, the Council contacted the following agencies to inform them of the Cross-County MetroLink Extension Segment I Conceptual Design Study.

U.S. Environmental Protection Agency (Region VII)

U.S. Department of the Interior
Fish and Wildlife Service

Water Resources Division—U.S. Geological Survey

U.S. Army Corps of Engineers (St. Louis District)

Federal Highway Administration

Federal Transit Administration

Missouri Department of Conservation

State Historic Preservation Officer

Missouri Department of Economic Development

Missouri Department of Economic Development
Division of Motor Carrier & Railroad Safety

The agency contact letter provided the above agencies with a project description, project background, and purpose of the study. A MetroLink Extension Segment I general alignment map was included with the correspondence as well as a project newsletter. Regulatory agency technical staff have also provided information to the study team for the Cross-County MetroLink Extension project during the data collection and environmental analysis phase of the project. The study team has coordinated with the Missouri Department of Natural Resources, U.S. Fish and Wildlife Service, U.S. Corps of Engineers, Missouri State Historic Preservation Office, St. Louis County, and other local, county, and state agencies.