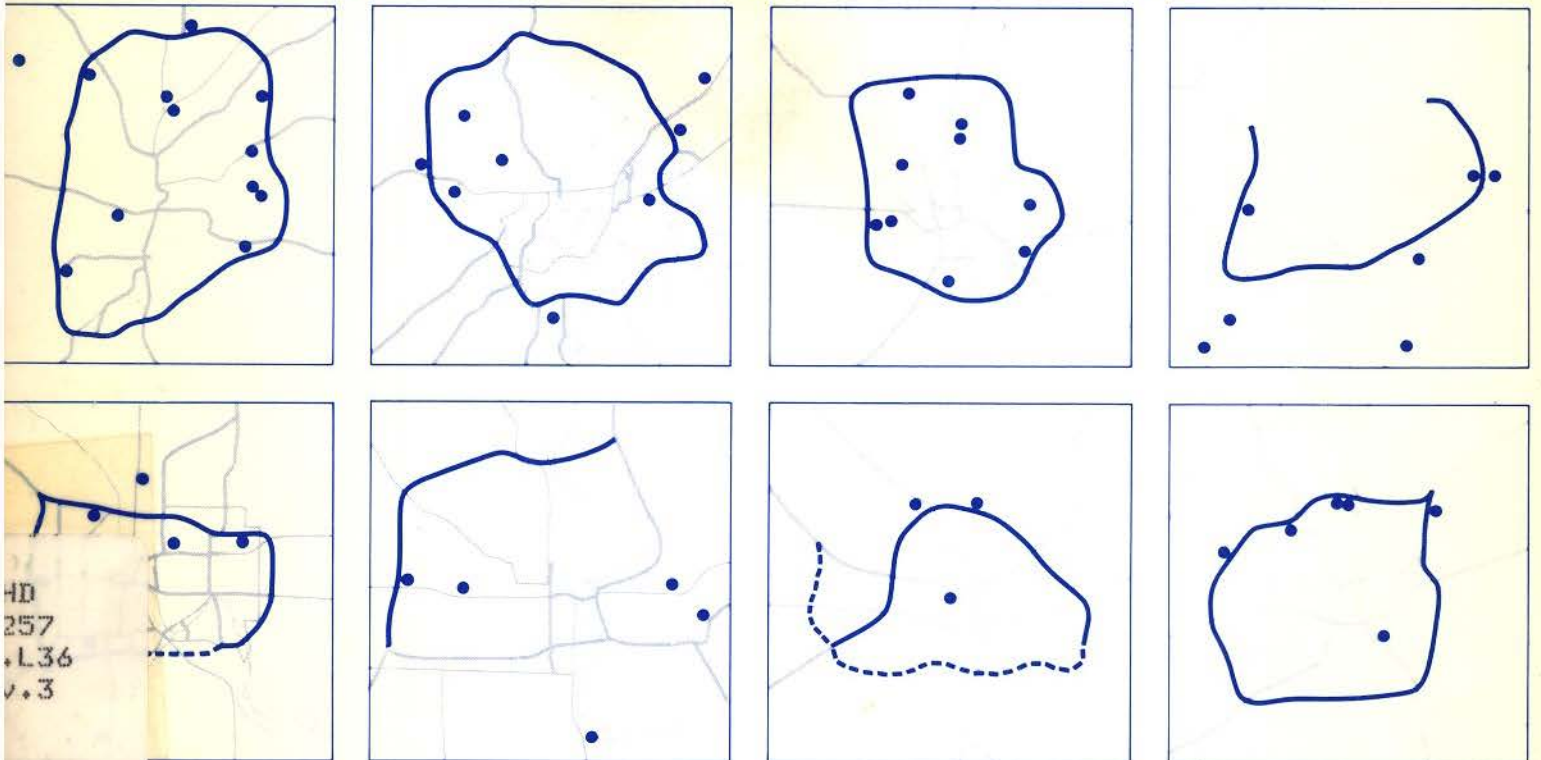


Guidebook

October 1980

THE LAND USE AND URBAN DEVELOPMENT IMPACTS OF BELTWAYS



NOTICE

This document is disseminated under the sponsorship of the U.S. Department of Transportation and the U.S. Department of Housing and Urban Development in the interest of information exchange. Opinions expressed are those of the consultant; none of the statements herein should be taken as a policy position of either of the sponsoring agencies. The United States Government assumes no liability for the contents or use of this document. Findings, opinions and conclusions presented in this report represent those of the contractor or, where noted, of individuals interviewed during the course of the study. This document does not reflect the views of officials in the U.S. Department of Transportation or the U.S. Department of Housing and Urban Development.

**THE LAND USE AND URBAN
DEVELOPMENT IMPACTS OF BELTWAYS
GUIDEBOOK**

Prepared By

Payne-Maxie Consultants
Blayney-Dyett, Urban and Regional Planners

for

U.S. Department of Transportation
Office of the Assistant Secretary for
Policy and International Affairs
Federal Highway Administration

U.S. Department of Housing and Urban Development
Office of Community Planning and Development
and National Urban Policy

October 1980

01824

HD
257
.L36
v.3

USER'S GUIDE

This guidebook is intended to provide local officials, particularly transportation and land use planners and members of affected business and community groups, with a conceptual framework for evaluating a proposal to build a beltway — a limited-access highway partially or completely circling a city — in their region. It pin-points for critical analysis the possible consequences of beltway construction and measures to enhance or reduce these consequences in localities with different characteristics, planning policies, and development review procedures. Hidden policy questions are made explicit for consideration, and criteria are provided for evaluation of the benefits and disbenefits of implementing beltway plans. Impacts that are addressed include:

- Effects on travel and location decisions
- Effects on development decisions
- Effects on land use and public facilities programming
- Economic and social consequences
- Environmental consequences

Examples of beltways' impacts in selected metropolitan areas are presented drawing on a survey of related literature, a comparative statistical analysis of 27 beltway cities, and eight case studies. Methods for analyzing mitigation measures and making tradeoffs also are presented. Finally, the guidebook directs the reader to some of the most pertinent, valuable and current reference material for assessment techniques for beltway impacts, descriptions of planning steps to modify foreseeable impacts of beltway construction, and case studies on existing beltways.

For each potential beltway effect, specific measures are proposed and analytical procedures described. Many of these potential effects may not occur, or may be included in only a very mild form, as a result of implementation of a particular beltway proposal. In several cases existing beltways appear to have exercised very little influence on regional development patterns. However, each potential effect should be at least briefly considered for any beltway proposal. The best way to use the guidebook is to begin with the chapter on the Assessment Process in which broad policy questions are posed. These should then be refined by the reader to focus on effects that are most critical to a decision on the specific proposal under evaluation. Assessment of specific potential impacts, both direct and indirect, is found in separate chapters. The reader need consult only those sections most relevant to the proposal under scrutiny.

The guidebook mainly will be useful to transportation and land use planners charged with evaluating proposals to build new beltways or to expand the capacity of existing beltways. Members of business and community groups may also find this guidebook helpful for identifying ways in which a prospective beltway may affect them before the decision-making process is over and construction has begun. Where beltways already have been built, local planners and elected officials may find the chapter on mitigation and enhancement measures helpful for its descriptions of ways to maximize benefits and reduce potential harmful effects. Assessment techniques presented in the guidebook also could be used in conducting urban impact analyses of beltway proposals under the President's Community Conservation Guidance of November 1979, which seeks to minimize unintended adverse impacts of federally assisted projects on existing commercial centers and land use patterns.

TABLE OF CONTENTS

	<u>Page</u>
USER'S GUIDE	i
1. INTRODUCTION	1
2. THE ASSESSMENT PROCESS	3
3. EFFECTS ON TRAVEL AND LOCATION DECISIONS	15
4. EFFECTS ON DEVELOPMENT DECISIONS	22
Developable Land	24
Residential	26
Retail	28
Wholesale	29
Office	31
Industrial	33
Institutional	34
5. EFFECTS ON LAND USE AND PUBLIC FACILITIES PROGRAMMING	
Development Patterns	36
Land Use Policy	37
Infrastructure	39
6. INDIRECT EFFECTS: ECONOMIC AND SOCIAL CONSEQUENCES	
Employment Opportunities	41
Housing Opportunities	42
Retail Trade and Shopping Opportunities	45
Fiscal Resources	45
Public Services	46
7. INDIRECT EFFECTS: ENVIRONMENTAL CONSEQUENCES	48
8. MITIGATION AND ENHANCEMENT MEASURES	53
9. TRADE OFF ANALYSIS: DETERMINING NET BENEFIT	
Procedure for Tradeoff Analysis	59
Possible Tradeoffs	61
Determining Net Benefits	62
APPENDIX A: Selected References	A-1
APPENDIX B: Beltway Impact Studies	B-1
APPENDIX C: Methodology	C-2
PARTICIPATING STAFF	

LIST OF TABLES

	<u>Page</u>	
2.1.	Beltway Evaluation Criteria	9
2.2.	Attributes of a Beltway: Comparison with Alternatives	12
2.3.	Compensating Measures for Potential Adverse Impacts of Beltway, Given Planning Objective: Encourage Nodal Development	13
4.1.	Location of Offices Built in Louisville Area, 1960 - 1980	32
8.1.	Potential Adverse Effects Directly or Indirectly Attributable to Beltways	54
8.2.	Mitigation Measures for Potential Adverse Effects	58

LIST OF FIGURES

	<u>Page</u>	
2.1.	Urbanized Land in Minneapolis/St. Paul: 1973 and Alternatives for 1990	11
3.1.	Residence Locations in San Antonio	16
3.2.	Patterns of Change in Vehicle-Miles-Of-Travel Between 1970 and 1976 in Baltimore	18
3.3.	Destination of Work Trips in Baltimore, 1975	19
4.1.	Residential Development Trends in San Antonio and Omaha	24
4.2.	Ratio of Vacant Sewer-Served Land to Total Vacant Land in Baltimore, 1973 (1973 Existing Plus 5-Year Plan Sewer Service Area)	25
4.3.	Development of Industrial Parks vs. Interstate Highway Construction in Columbus	33
5.1.	Metropolitan Growth Areas in Columbus 1978-1985	38
6.1.	Employment Concentrations in San Antonio	43
6.2.	Assisted Housing Concentrations in Columbus, 1976	44
7.1.	Flow Bands (Traffic Volumes) on Freeways and Selected Arterials in Atlanta, 1970 and 2000	49

1. INTRODUCTION

Today, proposals for the construction of a beltway—a limited-access highway partially or completely circling a city—are under consideration in approximately 30 metropolitan areas. However, little practical guidance is available to local planners evaluating beltway projects, though beltways are integral components of urban transportation systems in some 35-40 American cities, and numerous empirical studies and theoretical treatises on the impact of highways in general are readily available. Most existing beltways were planned in the 1940s and 1950s when transportation facilities were thought to respond to metropolitan growth rather than to influence the character of urban development. The small body of research on beltways concentrates narrowly on retail and industrial location in relation to the highways. No consistent evidence has been compiled on beltways' effects on urban dynamics and their economic, social, fiscal and environmental implications.

This guidebook is intended to fill a void in the planning literature by providing a practical framework for evaluation of beltway proposals at the local level, for only within the region can the impacts of such a project be accurately assessed and effectively countered or enhanced. This guidebook presents the unique issues confronted by the beltway planner as well as those questions related to any prospective regional-scale investment in the transportation network. These include:

- Clarifying the objectives of beltway proponents;
- Determining the alternatives to construction of the belt;
- Analyzing the technical and political soundness of the belt project, what its positive and negative impacts will be and how to maximize or minimize them;
- Evaluating whether or not the belt project or a modified version is indeed in the best interests of the region.

Analytical techniques illustrated are simple, using easily available data. The official or planner requiring greater precision is referred to specific reference sources outlining more sophisticated assessment tools.

This guidebook, then, provides beltway planners with a structure for organizing their thinking about the possible consequences of construction of a beltway in their region. Guidebook procedures do not substitute for environmental assessment procedures mandated by the National Environmental Policy Act or urban impact analysis requirements under the President's Community Conservation Guidance of November 1979. They do not interpret federal regulations, nor lead the reader through federally required planning procedures. The guidebook is not a compendium of analytical techniques, nor is it an academic model for forecasting the impacts of belt construction. What this guidebook does is to build a framework for analysis of a specific beltway proposal by focusing mainly on land use and urban development effects and impacts on the economies of central cities. Selective references to some of the most pertinent and useful of the vast array of transportation and land use planning literature also are provided in the appendices.

The analytical framework presented here is grounded in the experience of American beltway cities, thoroughly examined in The Land Use and Urban Development Impacts of Beltways study commissioned by the U.S. Department of Transportation and the U.S. Department of Housing and Urban Development. This guidebook is a companion volume to two other volumes: the Final Report, which synthesizes a review of pertinent literature, a comparative statistical analysis of 54 American cities, half with beltways and half without, and eight in-depth case studies; and the Case Studies report, which includes the detailed finding for each of the case study areas. Examples and statistics used in this guidebook are taken from the larger study; the reader desiring elaboration of any such reference is directed to the other volumes.

The guidebook has been designed to complement but not duplicate the handbooks and manuals prepared for the U.S. Department of Transportation on environmental assessment of highway projects and those prepared for the U.S. Department of Housing and Urban Development and the U.S. Department of Commerce on community development, housing, and urban revitalization. Where these will prove useful to the beltway analyst, specific references are offered; several of the best are listed below:

American Society of Planning Officials, Local Capital Improvements and Development Management Literature Synthesis, U.S. Department of Housing and Urban Development, Office of Policy Development and Research, 1977.

Robert W. Burchell and David Listokin, The Fiscal Impact Guidebook - Estimating Local Costs and Revenue of Land Development, U.S. Department of Housing and Urban Development, 1979.

J.S. Lane, L.R. Grezenback, T.J. Martin and S.C. Lockwood, David A. Crane and Partners/CACP, Incorporated, The No Action Alternative: Impact Assessment Guidelines, Transportation Research Board, National Cooperative Highway Research Program Report 217, 1979.

U.S. Conference of Mayors, The Private Development Process: A Guidebook for Local Government, U.S. Department of Housing and Urban Development, 1979.

U.S. Department of Housing and Urban Development and U.S. Department of Commerce, Economic Development: New Roles for City Government: A Guidebook for Local Government, 1979.

U.S. Department of Housing and Urban Development and U.S. Department of Commerce, Local Economic Development Tools and Techniques: A Guidebook for Local Government, 1979.

U.S. Department of Housing and Urban Development and U.S. Department of Commerce, The Private Economic Development Process: A Guidebook for Local Government, 1979.

U.S. Department of Transportation, Environmental Assessment Notebook Series: Highways, 1975.

2. THE ASSESSMENT PROCESS

Assessing the potential impacts of a proposed beltway is a complicated process, requiring an evaluation of both tangible and intangible conditions and consequences, the nature of which are locally determined rather than predicted by a particular type of transportation investment. Both systems-level and corridor-level planning and analysis are required to determine the likely direct and indirect effects of beltway construction. Much of the substance of this initial assessment will be required in an environmental impact statement and an alternatives analysis if the beltway proposal is to be implemented.

The unique feature of a beltway, in contrast to radial highways, is that it serves cross-town and through traffic, not downtown-oriented trips. Consequently, it mainly affects accessibility to suburban locations, conferring no direct benefits to downtown areas. This beltway attribute may affect the distribution of development and economic activity within the metropolitan areas with socioeconomic, fiscal, and environmental consequences. Policy issues related to beltway impacts include:

- How will the beltway serve urban transportation needs? Will it support or hinder efforts to promote transit and reduce overall transportation energy consumption?
- How will the beltway affect travel patterns and the location decisions of workers, households, and employers?
- How will the beltway affect decisions on proposed residential, commercial, and industrial development? What impact will this have on efforts to revitalize older urban areas?
- Will urbanization patterns be affected? If so, how will this alter demand for other infrastructure investments?
- Will the beltway contribute to scattered suburban development, or will it promote compact, high density development in already suburbanizing areas?
- Will beltway-related industrial and commercial development reduce accessibility to employment opportunities for central city residents, particularly low income and minority workers?
- Will beltway-related residential development meet the housing needs of those expected to work in the corridor?
- Will the beltway affect the fiscal capacity of any local jurisdiction to provide needed public services?
- Will the beltway contribute to environmental degradation through increased air pollution, conversion of agricultural land for urban use, or disruption of sensitive environments?
- How will alternatives to the beltway differ in their effects, and what compensating measures might be implemented to maximize the benefits and minimize the harm that the beltway might cause?

- Are there benefits to the metropolitan area at large that might justify accepting detrimental effects on particular jurisdictions or groups of people?

To gauge the likely impacts of construction of a beltway, which are defined as the differences between the consequences of constructing the beltway and those of not building the beltway, a five-step analysis is proposed:

1. **Define Local Conditions and Establish a Framework for Impact Assessment**, including the region's economic structure and outlook, local land use and development, local political issues, environmental conditions, key actors in the public and private sectors, the planning context, and the transportation network.
2. **Identify Transportation and Land Use Policy Options**, including the proposed beltway, any alternatives and a no-project option.
3. **Evaluate Likely Consequences** of construction of the beltway and alternatives and implementation of different transportation and land use policy options.
4. **Determine the Potential Scope of Complementary Measures** to reduce or enhance the foreseeable effects of the beltway and other options and gauge the costs and benefits of each.
5. **Prepare Recommendations** after weighing benefits and disbenefits of belt construction and those accruing to other options and evaluating who gains and who loses after implementation of all feasible compensative measures.

Each step in the analysis involves significantly different techniques and builds upon the outcome of the preceding work. The uninformed analyst may be tempted to focus on Step 3, to the detriment of other considerations; however, omission of any one of the five components of assessment will substantially reduce the usefulness of the analysis of the proposed beltway's potential impacts.

✓ **Step 1. Define Local Conditions and Establish Impact Assessment Framework**

The purpose of this step is to gather information on local conditions that will influence the way in which the proposed beltway affects the corridor it would serve, the central city and other communities, and the metropolitan area at large. Successful completion of this step will yield a profile of the central city, the corridor and the metropolitan area's economic structure and outlook, land use and development trends, local political issues, environmental conditions, key actors in the public and private sectors, the context for planning and the current transportation network. This profile will serve as the foundation for all further analysis.

✓ Using readily available data (see Appendix A, ref. 18 and 19) on regional population, employment and housing, a simple but functional economic analysis can be constructed showing:

- Population trends and moving patterns, in different jurisdictions within the area and in different demographic groups defined by age, sex, ethnicity, household size, occupation, income and education; ✓ *
- Employment trends, including the expansion or shrinkage of different sectors of the local economy and characteristics of the labor force by age, sex, ethnicity, residence, occupation, sector of employment, income, education and unemployment rate; ✓ *
- Retail market trends, including the historical and projected sales, the location of retail establishments over time, the share of regional sales captured by different jurisdictions and retail centers over time, and the current and projected health of downtown retailing; ✓ *
- Office space market trends, including the historical and projected needs by type, the location and price of new office construction over time, the share of regional office space located within different jurisdictions and within office parks, and the current and projected health of the downtown office space market; ✓ *
- Industrial space market trends, including the historical and projected needs by type of industrial space, the location and cost of new industrial space over time, the share of the region's industry located in different jurisdictions and within industrial parks, the extent of regional dependence upon particular industries, and the projected changes in employment requirements of the region's industrial base over the next five to ten years; ✓
- Housing market trends, including the location and type of unmet demand and oversupply of housing, the location and cost of new housing units for rent and for sale, the share of the region's housing in different jurisdictions, and the existing and projected location and proportion of particular types of housing within the region which are of policy interest, including high-density housing, rental units, moderate- and low-cost housing, housing subsidized by federal and state programs, and substandard housing. ✓

Regional planning organizations normally compile much of this information. From this data base, the most important economic indicators should be projected over the next 5, 10 and 20 years, using regional forecasts as a starting point, assuming local and regional land use policies are unchanged and that the proposed beltway is not constructed.

*
NO
RAIL
ALT.

Environmental issues of concern to the beltway planner include:

- Air quality, including location of polluted or deteriorated areas, cause of deterioration, number of people affected by poor air quality, and extent of planning, management and regulatory efforts responsive to deteriorated air quality;
- Water quality, including location of polluted or deteriorated areas, cause of deterioration, number of people affected by poor water quality, and the extent of planning, management and regulatory efforts responsive to deteriorated water quality, aquifer recharge areas, and coastal zones;

- Flood areas, including their location, the number of people affected by risk of flood, and the extent of planning, management and regulatory efforts responsive to flood hazards;
- Wetlands, including their size and location and the extent of planning and management efforts undertaken to protect them;
- Open space and scenic resources, including regional location and current uses, the number and location of residents without access to open space, and the extent of planning, management and regulatory efforts to maintain open space, parkland, and historic cultural, and scenic resources;
- Conversion of agricultural land to urban uses, including the location of prime agricultural land in the region, the location of agricultural land recently converted to other uses, and management, planning and regulatory efforts to control the rate of conversion of agricultural land to other uses;
- Noise, including current and projected conditions, the location of major sources and areas where community standards are exceeded, and planning, management, and regulatory efforts responsive to excessive noise levels;
- Energy use, by sector and source, changes in energy use over time, and the extent of planning, management and regulatory efforts to conserve energy in the region.

Local Air Quality Maintenance Plans, Water Quality Management Plans and general land use plans usually will provide sufficient information for this analysis, but inventories of existing conditions may have to be compiled if information in these documents is not up-to-date or sufficiently detailed for impact analysis.

Political and equity issues ^{RELEVANT} ~~germane~~ to beltway planning also need to be examined, and the basis for any objections to the beltway understood so the analysis responds to all concerns. Interviews with members of community groups with which the beltway planner does not have day-to-day contact are recommended so that concerns alive in circles other than local government are included in the analysis.

Local controversies should be researched from several perspectives. Groups requiring particular attention are:

- Suburban residents, to determine attitudes toward central city problems;
- The downtown business community, to determine attitudes toward central city problems and revitalization efforts;
- Central city residents, to determine their accessibility to employment, services, community facilities, etc.;
- Ethnic minorities, to determine their location of residence and accessibility to employment, community facilities and services;
- Elderly residents to determine their location of residence and accessibility to community facilities and services;

- Low-income households and the unemployed, to determine their location of residence and accessibility to employment, community facilities and services;
- Environmental organizations.

This initial reconnaissance also should inventory land use and the regional transportation network, including their historical evolution over the last 20 years. The analyst should review the current loads on utilities and other infrastructure, existing traffic volumes and any planned improvements to the transportation system, and committed development and planned improvements which will change land use.

Next, the regulatory and institutional framework affecting land use and transportation should be investigated. Factors that may affect the ability of local governments to plan for a beltway include:

- The legal authority and effectiveness of each organization responsible for land use and transportation planning at the local, regional and state level over the last 20 years;
- The policies and effectiveness of historical and contemporary land use and transportation plans and zoning ordinances;
- The scope of enabling legislation for planning and urban renewal activities, and the history of its utilization;
- The performance of both public and private downtown revitalization groups;
- Historical and current relationships between local planning officials and the local business community, financiers and developers, and organized community groups;
- The constraints of regulations upon potential planning and urban renewal activities;
- Historical and current policies on annexation and extension of utilities and infrastructure to developing communities;
- The history of development controversies, such as community objections to a planned freeway or shopping center;
- The fiscal situation of the central city and surrounding municipalities and the distribution of locally generated tax revenues, including sales tax, property tax, occupancy tax, and municipal income tax, and the distribution of public expenditures by type and by jurisdiction;
- Potential planning resources outside local planning departments, including the faculty, students and facilities of nearby universities, downtown groups, other agencies with related goals, federal programs and local corporations seeking a civic role.

Finally, a set of evaluation criteria should be identified reflecting the issues most critical to a decision on the proposed beltway. Essentially, this step is quite similar to the "scoping" effort required by environmental review regulations, but the focus is more on potential impacts on development patterns and socioeconomic and fiscal consequences, including effects on distressed communities and the viability of other federal programs, rather than on environmental impacts as such. Table 2.1 presents a comprehensive list of evaluation criteria from which the beltway analyst might choose those most germane to the specific beltway proposal being considered.

RELEVANT

Step 2. Identify Transportation and Land Use Policy Options

Next, future land use and transportation options need to be defined precisely. Research and projections done in Step 1 may have indicated that the central business district is declining, that residential suburbanization is spreading at a rate that will overload utilities infrastructure, or that commuters lack good crosstown access. Several realistic transportation and land use policy options can be envisioned to address these needs in different ways, at different costs, and with different short- and long-term consequences.

Two or three realistic options for both land use and transportation policy should be defined at this stage of analysis. Assessment of these options will form the foundation of the environmental evaluation and alternatives analysis required by the U.S. Department of Transportation before construction of a highway project. Available from the U.S. Federal Highway Administration (FHWA) are several helpful Urban Transportation Planning System (UTPS) programs designed to assist in the evaluation of a region's transportation options.

Among the various consequences of the policy options to be considered is their degree of conformance with community priorities, current local planning objectives and National Urban Policy. Regions dependent upon federal financing must pay particular attention to the objectives of the federal urban policy including strengthening urban economies, expanding employment opportunities and job mobility, promoting fiscal stability, expanding opportunities for people disadvantaged by discrimination and low-income status, and encouraging energy-efficient and environmentally sound urban development.¹ Currently, federal transportation policies reflect the same emphases, manifested by encouragement of energy conservation, public transportation, bolstering of urban centers and efforts to make more efficient use of existing transportation systems through low-capital improvements.

Step 2, then, for the beltway analyst involves:

- Determining foreseeable community needs to be addressed by land use and transportation planning in the beltway corridor and elsewhere in the metropolitan area.

¹ See 1980 National Urban Policy Report for details, available from the U.S. Department of Housing and Urban Development, Office of Community Planning and Development.

TABLE 2.1. BELTWAY EVALUATION CRITERIA ✓

Impact Area	Measure	Impact Area	Measure
Effects on Travel and Location Decisions		Effects on Land Use and Public Facilities Programming	
1. Accessibility	Travel time differences	1. Density of development	Change in intensity of land use by type and acreage affected ✓
2. Increased travel	VMT per capita	2. Sequence of development	Change in expected timing of development by sub area ✓
3. Travel mode	Proportion trips by auto, public transit, bicycle, etc.	3. Consistency with goals, policies, standards, and land use designations of regional and local plans	Evaluation of degree of conformance
4. Household location decisions	Change in moving patterns and location preferences	4. Ability of existing utilities and committed improvements to serve	Ratio of service needs to existing and projected supply and capacity
5. Employers' location decisions	Change in annual moving patterns:	5. Capacity of local streets	Change in level of service; projected congestion attributable to traffic increases
6. Transit Service	Effects on corridor and system-wide ridership	6. Schools	Unused capacity or overload in corridor and districtwide
Effects on Development Decisions		7. Recreation and parks	Change in use or quality of experience
1. Developable land	Change in acreage of developable land with and without readily available services ✓	Economic and Social Effects	
2. Housing	Housing units by type and price in corridor; number which might have been built in central city (older urban areas); number displaced.	1. Employment opportunities	Change in accessibility to jobs by corridor residents and residents of central cities (older urban areas); number of jobs displaced ✓
3. Retail	Acreage (square feet of space) developed; proportion that could have been accommodated in older urban areas ✓	2. Housing opportunities	Change in housing opportunities by type and price within corridor and central city (older urban areas); number of new units priced at or below 80 percent of median sales or rent levels in corridor
4. Wholesale distribution, and other commercial (hotel-motel, specialized activities)	Acreage (square feet of space) developed; proportion that could have been accommodated in older urban areas ✓	3. Shopping opportunities	Change in accessibility to retail goods and services in corridor and central city (older urban areas) ✓
5. Office	Acreage (square feet of space) developed; proportion that could have been accommodated in older urban areas ✓	4. Fiscal resources	Change in the costs and revenues of the central city and other local governments; annual differences; discounted present value of 15-year total ✓
6. Industrial	Acreage (square feet of space) developed; proportion that could have been accommodated in older urban areas	5. Social services	Change in level of social services offered in corridor and central city (older urban area)
7. Institutional	Acreage (square feet of space) developed; proportion that could have been accommodated in older urban areas	6. Public safety	Change in policy and fire service levels in corridor and central city (older urban area); potential increase in crime
Impact Area	Measure	Impact Area	Measure
Environmental Effects		6. Open space	Acrees converted to urban use by type of open space (agricultural lands, forest lands, etc.)
1. Air quality	Change in air polluting emissions and ambient air quality; relation to standards and conformance with AQMP	7. Ecological habitats	Increase in degree of threat; acreage lost by type and value
2. Water quality	Evaluation of direct and indirect water quality impacts; conformance with water quality management plan	8. Archaeological and historic sites	Degree of threat with anticipated development
3. Flood hazard	Potential increase in exposure to flooding with anticipated development	9. Noise	Change in ambient noise levels and number of people affected by noise exceeding standards
4. Geologic and seismic	Potential increase in exposure with anticipated development	10. Energy consumption	Increase in energy consumption by sector
5. Fire hazard	Potential increase in risk based on analysis of response times		

- Identifying the two or three realistic land use policy options most responsive to community needs, local priorities, current planning objectives, and National Urban Policy. Possibilities include allowing the unrestrained operation of market forces, continuing implementation of existing policies, establishing a boundary for urban growth, and encouraging nodal development in the region.
- Development of the two or three realistic transportation policy options most responsive to community needs, local priorities, current planning objectives, and National Transportation Policy. Possibilities include different emphases on public transit, radial highway corridors, arterial improvement, traffic management techniques, alternative beltway proposals, and maintenance of the existing system.
- Clarification of the objectives of the proponents and opponents of the beltway project and other options, for the purposes of comparison with other possible transportation options. The attributes of the proposed beltway and alternatives should be defined precisely.

Obviously, no one land use or transportation planning policy will be followed to the exclusion of all others, and land use and transportation policies must be coordinated for maximum effectiveness.

Adoption of one or more of the possible options as local and/or regional policy will hinge upon evaluation of the comparative effectiveness, costs, and consequences of the options anticipated, accomplished in Step 3.

Step 3. Evaluate the Likely Consequences of Implementation of Potential Policy Options and Beltway Proposals

The impact of a particular planning policy is the difference between its consequences and those resulting from implementation of other planning policies, including a policy of doing nothing. The foreseeable results of different land use policy options should be calculated and compared in terms of population and employment distribution and residential, commercial and industrial land use over 5, 10, and 20 year planning periods in the beltway corridor, suburban communities, and the central city. Differences should be mapped and tabulated by planning area or traffic analysis zone as well. An example of a rough mapping of the likely consequences of two different policy options in the Twin Cities region is provided in Figure 2.1.

Each policy will entail different regional transportation needs stemming from different patterns of urban development. Transportation policies developed in Step 2 must be synchronized with land use policy options and compared to determine impacts potentially attributable to the proposed beltway.

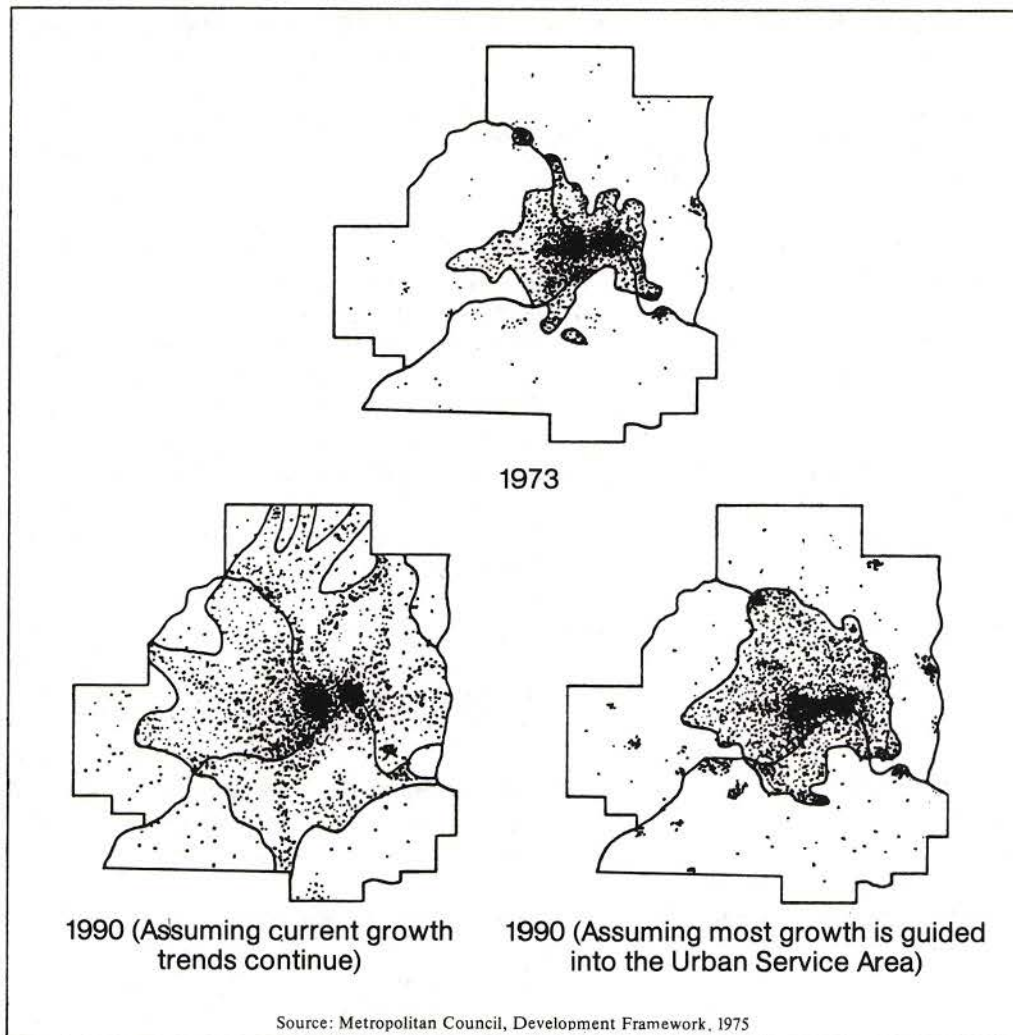


Figure 2.1.
 URBANIZED LAND IN MINNEAPOLIS/ST. PAUL:
 1973 AND ALTERNATIVES FOR 1990

A new beltway may affect land use and economic development in the corridor it serves, in the central city, and in the metropolitan area, depending upon local conditions. Further, the impacts of beltway construction will vary, depending, among other things, upon whether the region is growing, stable or declining, and whether prevailing land use policies are liberal or restrictive. Several aspects of beltway design interact with local conditions to influence land use and economic development in different ways. Belt characteristics affecting urban development patterns are shown in Table 2.2.

Investigation of the experience of cities with a beltway reveals the beltway in many cases to have had little impact on land use and development patterns. Though every

TABLE 2.2. ATTRIBUTES OF A BELTWAY: COMPARISON WITH ALTERNATIVES

<u>Attribute</u>	<u>Measures</u>
Capacity	Number of lanes; peak hour traffic volumes; volume/capacity ratios
Transportation service	Travel time by mode Travel cost by mode Differences in metropolitan area and corridor vehicle miles of travel Reduced congestion; effects on level of service on major arterials and local streets Accident rates
Route location	Distance from central city and central business district
Land consumption	Acres required by type of use displaced
Displacement and relocation	Households and businesses displaced; relocation opportunities
Physical facilities	Alignment, right of way landscaping, high occupancy vehicle (HOV) lanes, noise barriers
Interchanges/frontage roads	Design and spacing
Coordination with transit	Use of HOV lanes, ramp metering, exclusive busway ramps

potential effect of beltway construction should be considered by the analyst evaluating a belt proposal, potential effects unlikely to occur or to occur in only a very mild form should be identified at this stage of the analysis. Assessment of these effects need not be as rigorous as the analytical procedures described in later chapters of the guidebook.

Local conditions such as the extent of growth pressure, the vitality of retail, office, industrial, and residential markets, and land use planning policies will determine how these modifiable elements of belt design affect adjacent development. For example, a beltway with frequent interchanges and frontage roads will almost certainly induce strip commercial development along its route in an area with a growing retail market and liberal land use controls. A comparative analysis of corridor impacts of beltways with different attributes under different land use policy options should be prepared to highlight differences. This "sensitivity analysis" should be conducted at every stage of beltway impact assessment to determine the differential impacts of beltways of different designs.

TABLE 2.3. COMPENSATING MEASURES FOR POTENTIAL ADVERSE IMPACTS OF BELTWAY, GIVEN PLANNING OBJECTIVE: ENCOURAGE NODAL DEVELOPMENT

<u>Compensating Measures</u>	<i>Potential Adverse Effects</i>	<i>Congestion Near Nodes</i>	<i>Nodes Compete with Downtown</i>	<i>Unbalanced Uses in Nodes</i>	<i>Excessive Noise Levels Near Nodes</i>	<i>Fiscal Harm to Local Municipalities</i>	<i>Overlarge Share of Regional Employment in Nodes</i>
High Volume Intersection Design	●				●		
Staged Development at Nodes		●				●	●
Require Balanced Uses at Nodes		●	●				●
Transit Connection Between Nodes, and to Downtown	●	●		●	●		
Annex Nodes to City						●	
Regional Tax Sharing						●	
Coordinate Financing of Complementary Uses at Nodes			●				●
Encourage Flex-Time, Car Pooling and Transit Use at Employment Centers Located at Nodes	●				●		
Active Downtown Development Efforts		●					●
Impact Zoning	●	●	●				●
Limited Infrastructure Improvements	●	●				●	●

Many of the consequences of belt construction can be countered or reinforced with planning measures. The effectiveness of such measures again depends upon local conditions. Table 2.3 shows how certain compensative measures might reduce or eliminate adverse effects and enhance a beltway's benefits, given a local land use policy to encourage nodal development interchange areas.

Step 4. Determine the Potential Scope and Feasibility of Complementary Measures

Measures to enhance or reduce the beltway's likely impacts upon the region take several forms and can be initiated and supported by a variety of actors. Possibilities include:

- Modification of the beltway design;
- Changes in land use policies;
- Capital improvements and urban service area programming;
- Special interchange area and corridor zoning;
- Other development regulations to provide incentives for planned development;
- Transportation planning and programs designed to complement and enhance the beltway;
- Downtown development and revitalization efforts;
- Direct financial participation of local governments, financiers and developers in corridor or central city joint development projects or infrastructure improvement projects.

Each of these categories contain numerous specific actions which will vary in effectiveness according to local conditions.

Step 5. Prepare Recommendations Based on Summary Assessment of Net Benefit

At this point the analyst must balance the benefits and disbenefits of the likely consequences of a beltway, as modified by various mitigating measures and enhancement techniques. No universal rules can be established by outside observers to guide this process. What this guidebook does provide is a balance sheet to structure the analyst's thinking about the tradeoffs to be made among the several local and regional goals which may be affected by the beltway proposal and to ensure that compromises are informed by an analysis of probable costs, scope and effectiveness of mitigation and enhancement measures.

3. EFFECTS ON TRAVEL AND LOCATION DECISIONS

By improving accessibility between points, any new transportation facility will influence travel behavior and decisions on where to locate households, retail establishments and industrial plants. Households desiring a larger house, more land, or a rural environment may find that a new or improved highway allows them to move further from work yet still commute in a reasonable time. Workers and shoppers may find commuting easier and choice enlarged within the highway corridor. Manufacturing and distribution firms seeking sites for expansion or new facilities find cheaper land at outlying locations which are newly accessible to suppliers and markets within the metropolitan area and nationwide.

The issues the beltway analyst must address include:

- Will the beltway serve the travel markets for which it is designed better than will other options?
- Will the beltway support or hinder efforts to increase transit ridership and reduce total travel?
- How will the beltway affect congestion on radial highways and local streets?
- Will the beltway and the accessibility it offers affect the location decisions of workers, households and businesses?
- How would transportation investment options other than the beltway differ in their effects?

Understanding a beltway's ability to affect travel patterns and location decisions is critical to an understanding of its effects on development decisions and the real estate market. These "second order" effects represent a response to the perceived or actual improvement in transportation that the beltway provides. Where beltways clearly serve a need, they provide a valuable transportation service considered by individuals when deciding where to live or work.

Planners of existing beltways by and large assumed that the highways were essential to meet the transportation needs of projected development. Options rarely were examined in detail, nor were comparisons made between the beltway and other options in terms of accessibility provided to those living or working in the transportation corridor. Further, little analysis was undertaken of the effects of improving accessibility on overall travel or location decisions. Since then, the only empirical research in which these subjects were addressed focused on Route 128 around Boston and the Capital Beltway (see Appendix B).

Case study research has not shown existing beltways to have substantially altered regional travel and location decisions. In San Antonio, for example, analysis of differences in residence locations and commuting patterns of those working in a beltway corridor and working downtown showed that the beltway had had little impact on location decisions. Those working in the beltway corridor were not consistently favoring one residential area over another; however, they were spending more time traveling to work than those working downtown. This is illustrated in Figure 3.1. Nonetheless, a beltway, or any major addition to a regional highway system carries the potential for dramatic impact on travel and location patterns in particular environments.

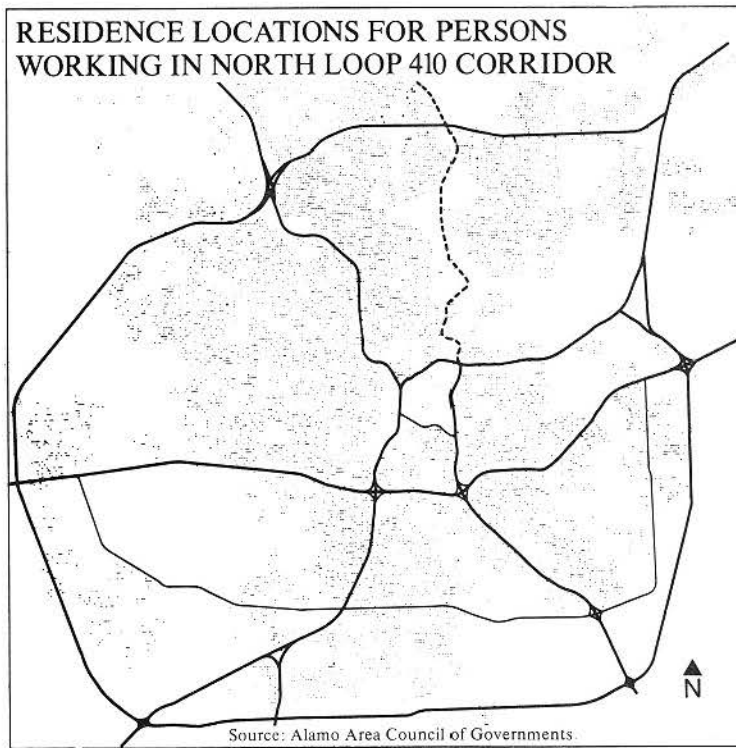
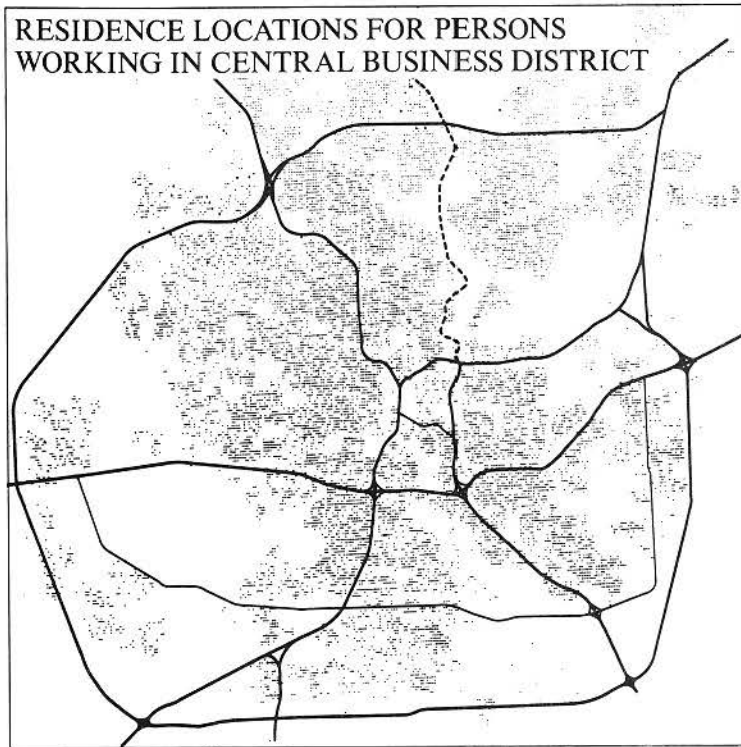


Figure 3.1.
RESIDENCE LOCATIONS IN SAN ANTONIO

A partial list of factors affecting a beltway's impact on travel and location decisions include:

- Changes in congestion and level of service on major arterials and local streets;
- Travel time and cost savings on the beltway versus alternative routes;
- Peak hour congestion at interchanges;
- Through traffic and truck traffic on the beltway;
- Beltway-induced development and pre-existing development patterns; and
- Local and express transit service.

When evaluating effects on location decisions, the beltway analyst should recognize changing attitudes in the face of uncertainty about gasoline availability; the availability of transit may become a more decisive criterion for individuals comparing residence and workplace alternatives. Though people may not use transit, the opportunity to do so in the future is important. Beltways linking low density suburban areas poorly served by transit may have less impact on location decisions than those in areas where the local district is committed to expanding bus service and building park-and-ride lots on express bus routes linking downtown and major employment centers with suburban communities. In Baltimore, for example, park-and-ride lots are located at beltway interchange, while in San Antonio a loop express service links shopping centers built along the beltway. Corridors with rail transit service also are more attractive for residential development than those without.¹

In the following sections, ways of measuring impacts on travel and location decisions which are attributable to the beltway are outlined.

Effect: Change in accessibility.

Measure: Potential travel time differences and trip time differences based on actual and projected travel patterns under alternative development scenarios and beltway alternatives, including a no-beltway option. ✓

Analytical Procedures: The difference between accessibility and mobility is important. The first effect reflects an opportunity to travel between two locations; the second actual travel between the two spots. Accessibility improvement is theoretical, based solely on a calculation of travel times derived from a computer-coded transportation network. These travel differences can be "weighted" to reflect the number of people living or working in a traffic analysis zone. A further refinement is to compute the differences between the beltway and other options ✓

1 See Metropolitan Transportation Commission, BART in the San Francisco Bay Area (Springfield; National Technical Information Service, DOT-BIP-FR-9-201-78, June 1979) and Robert Knight and Lisa Trygg Land Use Impacts on Rail Rapid Transit (Washington: U.S. Government Printing Office, DOT-OS-60181, 1977).

from an origin-destination survey. This becomes an analysis of mobility, reflecting actual travel. Where a beltway links developing areas, surveys of past travel patterns may be of limited use without extensive updating. Nonetheless, an understanding of recent changes in regional travel patterns, such as is depicted in Figure 3.2 for the Baltimore area, is essential for projecting future traffic levels. Differences in accessibility can be calculated quite readily with transportation planning and travel demand forecasting models maintained by regional planning agencies or state highway departments. Alternatively, the computer programs available through the Federal Highway Administration's Urban Transportation Planning System can be used. For different types of trips, time periods of travel and trip combinations, travel time and cost differences should be computed for each beltway alternative and each land use option. Effects of the no-beltway option also should be calculated. These differences should then be disaggregated and mapped to show where the greatest gains would occur using planning areas or traffic analysis zones as the spatial mapping units. This will provide a starting point for studies of the beltway's potential effects on location and development decisions. The subareas showing the greatest improvement in accessibility should be those where the beltway may have the greatest effect on development, in the absence of other constraints.

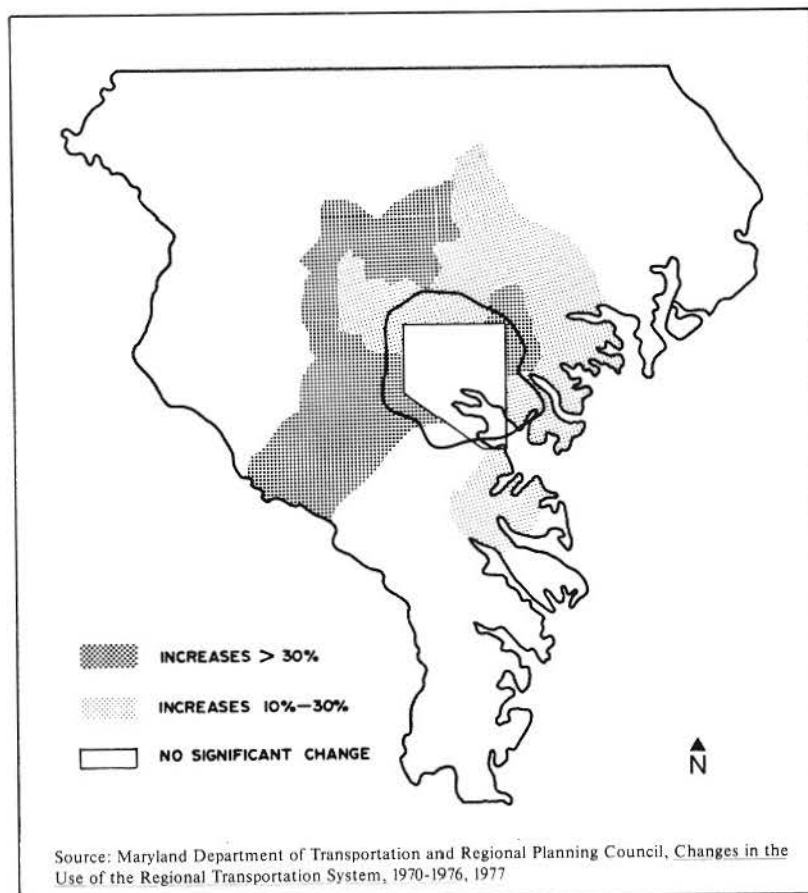


Figure 3.2.
 PATTERNS OF CHANGE IN VEHICLE-MILES-OF-TRAVEL BETWEEN 1970 AND 1976 IN BALTIMORE

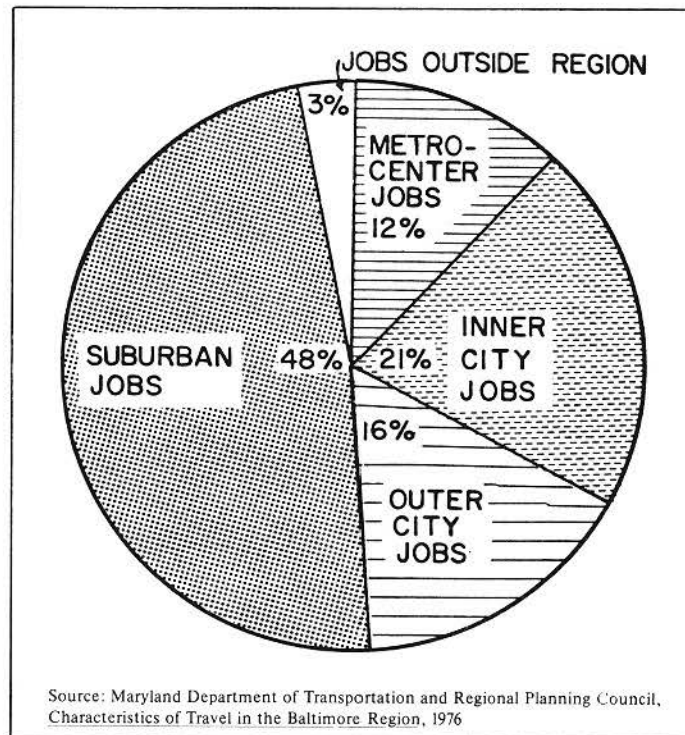


Figure 3.3.
DESTINATION OF WORK TRIPS
IN BALTIMORE, 1975

Effect: Change in distances routinely driven by individuals.

Measure: Change in vehicle miles traveled (VMT) per capita.

Analytical Procedures: Using techniques for projection of future traffic levels, VMT per capita can be compared for each of the region's transportation investment options, including the beltway. Depending upon local conditions the beltway may induce little or no difference in VMT per capita than the other options, may increase travel by encouraging round-about trips in an automobile rather than direct or other modes, or may actually decrease projected VMT per capita by providing relatively direct route for intra-suburban trips. Figure 3.3 shows the huge proportion of work trips made to the suburbs in the Baltimore area; in a locale with substantial intra-suburban travel, the beltway may actually reduce trip lengths.

Effect: Change in mode of travel chosen by individuals.

Measure: Proportion of trips made on public transit, by private automobile, bicycle and other modes.

Analytical Procedures: Clearly, construction of a highway encourages automobile travel while development of a light rail or bus system promotes use of mass transit. However, different highway projects are more supportive than others of efforts to increase transit ridership by virtue of their location connecting a large employer

with a neighborhood where many employees live, by encouraging nodal development at highway interchanges, or perhaps by including a system of frontage roads attractive to bicycle riders. Use of several modes of transportation given different transportation investment and land use options can be estimated and compared by using the computer analysis programs in FHWA's Urban Transportation Planning System or other techniques of travel demand forecasting which include mode split calculations.

Effect: Change in household location decisions.

Measure: Change in moving patterns:

- number seeking housing in beltway corridor;
- number leaving central city or other older urban areas;
- number who might have located in central city or older urban area without transportation improvement.

Analytical Procedures: Using information in the Annual Housing Survey, if available for the metropolitan area, the 1980 census, and any local surveys of those moving into suburban communities, a profile of current and projected moving patterns under alternative development scenarios, transportation and land use options, can be prepared. The next step is to determine the relative importance of accessibility improvements in location decisions. The Annual Housing Survey provides some evidence on this subject; several questions address reasons for moving, and the responses are classified by residence location and ethnicity. In most metropolitan areas, a beltway is not going to affect the initial decision to move unless it substantially increases the accessibility to developable land and the overall rate of residential development, bringing affordable housing within commute range of people working in the city. It is more likely to influence the choice of a neighborhood or community after more important criteria—housing cost, distance from work, quality of public service and schools, neighborhood character, and environmental amenities—are met. A beltway will expand the radius of potential residence locations, but it is unlikely to increase significantly the number of moves made each year.

The analyst can identify how a relative improvement in accessibility will affect an individual householder's selection of a new residence by (1) determining the proportional distribution of commute times among new residents in the beltway corridor, or similar suburban areas if the corridor is largely undeveloped, and (2) gauging the potential increase in the number that could consider a corridor residence location with an improvement in accessibility to major employment centers. For example, without the beltway, 10,000 jobs might lie within a 15-20 minute drive of a section of the beltway corridor. Once the beltway is built, the number of jobs which could be reached in the same commuting time could increase by 50 percent. The number of people spending 15-20 minutes driving to work who are looking for housing in the corridor then might increase 50 percent, if there are a sizeable number of people in the region who would locate in a neighborhood with the characteristics of beltway communities.

Surveys have demonstrated, however, that ease of commuting rarely is an important reason for moving, and therefore the estimated proportional increase should be reduced by some factor. Evidence for this can be found in a San Francisco Bay Area survey conducted in 1977 for the BART Impact Program in which only one out of two

respondents moving to a suburban community indicated that ease of access to work was a major consideration, and less than 10 percent stated that easy commuting was the most important reason for selecting a residence location.¹

Effect: Change in employers' location decisions.

Measure: Change in annual moving patterns:

- number of firms relocating to corridor;
- number leaving central city;
- number who might have located in central city or older urban area.

Analytical Procedures: By interviewing local realtors, chamber of commerce officials, and representatives of trade organizations, the beltway analyst can establish a profile of the firms relocating to the beltway corridor and similar suburban locations. The regional planning organization may have analyzed trends in the employment location using information available from Dun & Bradstreet which lists employers by zip code and SIC category. To determine the relative importance of highway accessibility in site selection, a sample of employers who recently moved out to the beltway corridor or similar suburban communities should be interviewed. The analyst should ask whether they considered renting or purchasing space in an older urban area, and, if not, what made such an option unacceptable. From these interviews and information on moving patterns, the analyst should be able to judge how many firms considering a beltway corridor location in the future might have stayed in an older urban area.

By looking at employers' and/or households' location decisions before development decisions, the analyst is probing the beltway's impacts on the demand for space with the objective of isolating the specific effects of improvements in accessibility. In reality, the effects are not separate; developers build in response to their perceptions of a market, while employers seeking new space often are limited to choosing from what is currently available. A beltway may increase opportunities, and, for firms valuing highway access, be a major element on their location decisions.

1 Michael V. Dyett, et al., Study of Households' Location Decisions (Berkeley: Metropolitan Transportation Commission, 1978), pp. 21-25.

4. EFFECTS ON DEVELOPMENT DECISIONS

That the construction of major transportation facilities alters the way in which a developer views potential sites is widely recognized. Local officials' vital interest in the shape of future development is now echoed in Washington, manifested in the concern expressed in the President's National Urban Policy and Community Conservation Guidance, and the Department of Transportation's policy objectives that major federal investments neither harm the economic viability of central cities nor promote development patterns inconsistent with local land use plans. Before settling upon a belt project, the analyst must assess:

- ★ — To what extent will the proposed beltway affect the timing, location, design and concentration of new housing, retail space, office buildings and industrial plants?
- Will beltway construction promote a development pattern which will undermine the economic vitality of the central city?
- How would alternative transportation investments differ in their effects?

Regional development decisions may be affected at several levels and in different ways during beltway planning, construction and operation. For example, the beltway may affect development on a regional scale by pulling office buildings from downtown where they might otherwise have located, as appears to have been the case in Omaha where 45 percent of office space constructed between 1970 and 1976 is found within one mile of the young beltway. Or, on a smaller scale, the belt may serve as the decisive factor in a choice between suburban sites, attracting a regional shopping center to a belt interchange rather than a radial location. At the smallest scale, belt design may determine the pattern of development within the beltway corridor itself.

Case study research and comparative statistical analysis have shown that development effects of beltway construction are far more likely to be distributive within the region than development-inducing. The two potential sources of growth stemming from the beltway—beltway construction expenditures and the enhanced competitive position of the region due to the beltway—have not proved significant. Even after multiplier effects, the former is relatively small, and the latter was not evident in a statistical analysis of 27 beltway cities compared with 27 cities without beltways.

Distributional effects have important social and political consequences that warrant analysis. Clearly, employment and housing opportunities for different demographic groups will be altered if beltway draws employers and residential developers to sites within the beltway corridor. The second-order social and economic effects of beltway construction entailed by the highway's influence on development decisions are addressed in Chapter 6.

Other indirect results of beltway construction on land use and public facilities programming and on the environment are discussed in Chapters 5 and 7 respectively.

The planners of existing beltways frequently made erroneous assumptions about the likely development effects of beltway construction, positing little land use impact or a uniform effect around the entire circumference of the freeway. Investigation of the experience of case study cities revealed that beltways did not influence intra-regional development decisions to a significantly greater degree than did radial highways, despite the high accessibility of interchange sites. The attraction of belt sites appears to be jointly determined by the specific attributes of the beltway, such as the degree and type of access provided, and local conditions determining the market. Local influences contributing to development pressure along the belt route include:

- A strong regional market;
- Accommodating zoning;
- Existing infrastructure;
- A population base already resident within the corridor;
- Lower taxes in the corridor than in other areas;
- Available financing;
- Promotion of beltway sites;
- The example of others moving into the general area of the beltway; and
- Provision of industrial, commercial and household requirements other than accessibility, such as open land or nearby public schools.

Case study research showed that beltways could stimulate existing development forces by improving access to developable land, but were incapable of creating a market. Clear examples of this distinction are found in San Antonio, where urbanization has spread past the northern arc of Loop 410 but has not occurred near the southern section, which still runs through open land; and in Omaha, a poor image, difficult topography and inadequate infrastructure have maintained the rural character of the northern belt in decided contrast to the most southern segment near metropolitan growth areas (see Figure 4.1).

Given supportive local conditions, then, the proposed beltway is likely to affect development patterns in the belt corridor, in surrounding communities and throughout the region. Sectors affected include residential, retail, office and industrial markets. Development dynamics are different in each of these four areas and should be analyzed separately. Common to the analysis of each, however, must be an isolation of belt effects from other, multiple local influences. To determine the development impacts attributable to the beltway, and other transportation improvements, their projected consequences should be compared with those from maintaining the system as is.

Potential changes in the availability of developable land in the region and in the four sectors likely to be affected may be measured as follows:

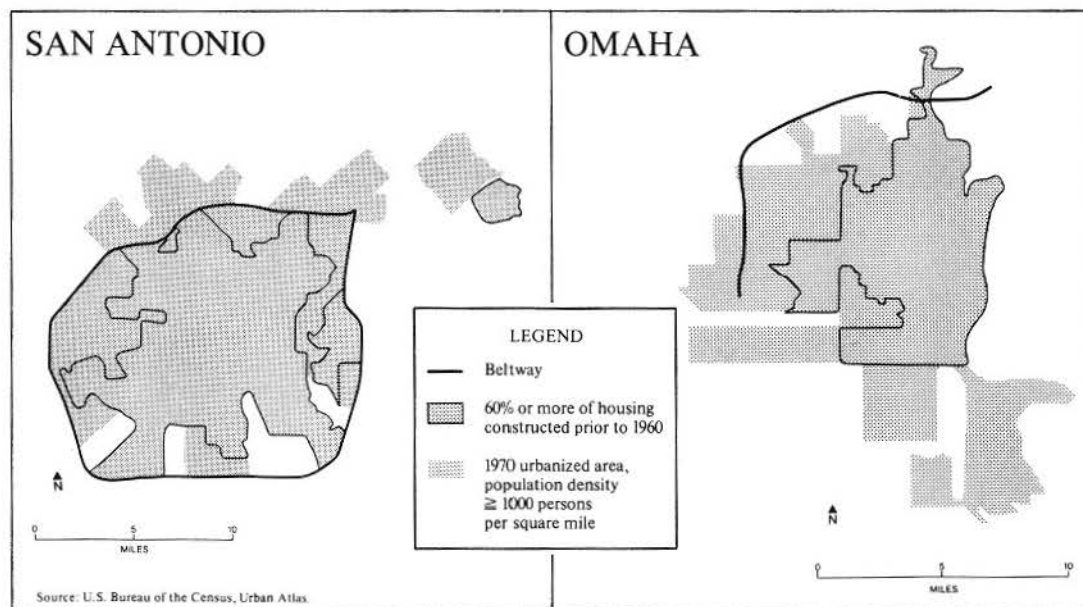


Figure 4.1.
RESIDENTIAL DEVELOPMENT TRENDS IN
SAN ANTONIO AND OMAHA

Developable Land

For the construction of the beltway to alter development decisions in the region, the new belt must substantially increase the accessibility of developable land in the proposed corridor. Although this appears overly obvious, the analyst should inventory the amount of land which will be affected by beltway construction to set the parameters for consideration of the beltway's potential impact on residential, retail, office, and industrial development patterns.

Effect: Increase the amount of developable land in the region.

Measure: Number of developable acres with substantially increased accessibility.

Analytical Procedures: Consulting local and regional land use and transportation planners and planning documents, and the maps showing differences in accessibility to employment centers with the beltway and alternatives, the analyst should determine how much of the land in the beltway corridor would be substantially more accessible after the beltway was built, subtracting acreage environmentally unsuitable for development, with very restrictive zoning, or with a low priority for the extension of public infrastructure. Figure 4.2 is a partial example of such an effort, relating the availability of vacant, sewer-served land to the beltway route.

The significance of the increase in developable land in the region depends upon the scarcity of such land. Land prices and conversations with realtors, developers, financiers, and planners should establish the importance of belt-accessible land in the

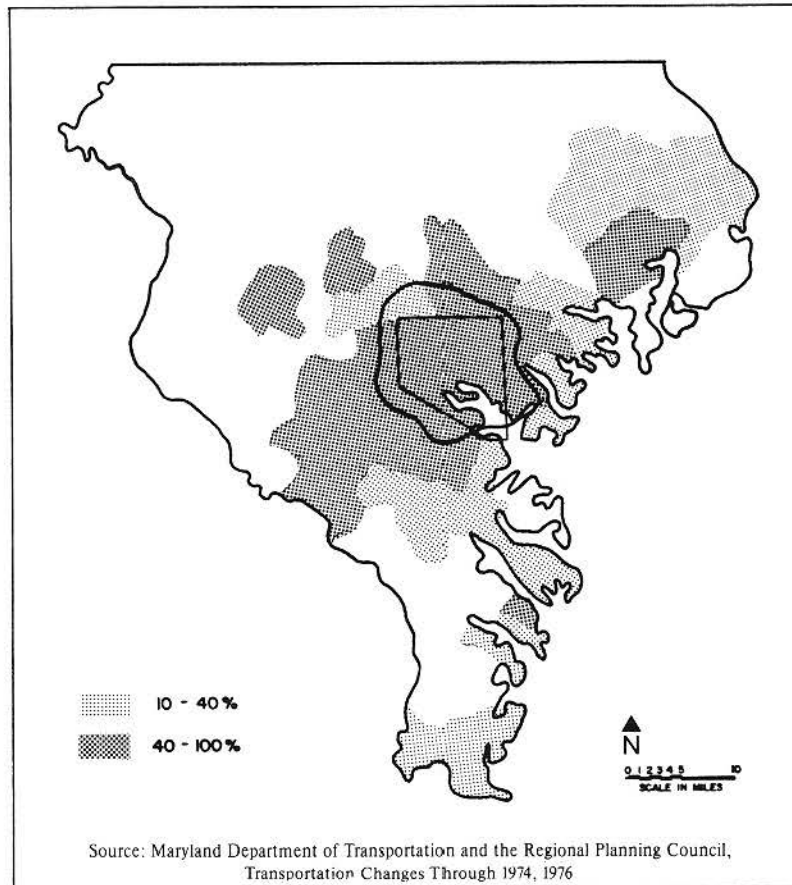


Figure 4.2.
RATIO OF VACANT SEWER-SERVED LAND TO
TOTAL VACANT LAND IN BALTIMORE, 1973
(1973 EXISTING PLUS 5-YEAR PLAN SEWER
SERVICE AREA)

local land market. When using estimates of developable land prepared by local or regional planning agencies, the assumptions upon which they are based should be critically reviewed and updated to reflect (a) recent or projected development-projects with approved permits, (b) changes in local plans and zoning, and (c) changes in infrastructure improvement programming, particularly plans for new streets and highways. Development opportunities in the beltway corridor should be compared with opportunities in other corridors where new or improved highways are proposed and with opportunities in areas where no transportation improvements are needed to accommodate development. This will place the increase in developable land attributable to the beltway in a regional context and provide background information that can be used when gauging the relative value of belt-accessible land in the real estate market.

Residential

Construction of the beltway may affect the housing market directly by displacing residents in its proposed alignment or indirectly by inducing additional residential construction in the corridor. Case studies of beltway impacts show that displacement and relocation have not occurred frequently. However, most existing beltways were built in the 1950s and 1960s, well outside the urbanized boundary of the cities. Current policy objectives, such as energy conservation, may call for the routing of beltways through already developed areas, entailing greater dislocation than has been true historically.

Effect: Displacement.

Measure: Number of housing units demolished or suffering loss of value by density, tenure, adequacy, cost, and demographic characteristics of residents.

Analytical Procedures: If the exact belt route is known, the alignment including medians, berms, interchanges and alterations of local streets as well as lanes, shoulders and land set aside for future expansion can be superimposed upon a base map or aerial photograph of the area to determine exactly which housing units will be affected. If the route has been only generally established, potential displacement can be estimated by calculating the land area to be absorbed by belt construction and assuming that these acres will contain housing with the characteristics average for census tracts through which the beltway might run.

The significance of displacement occasioned by belt construction depends not only upon the number of households displaced, but also upon the availability of comparable housing nearby. A statistical description of the entire census tract the belt will run through may be used as a proxy for a description of the households affected. However, conversations with local officials and real estate agents are recommended to uncover any discrepancy between the tract as a whole, to reveal households of elderly people or low-income families, likely to pose special relocation problems, and to assess the factors affecting neighborhood desirability, such as the quality of local schools and proximity to shopping facilities and transit routes.

Effect: Induce residential development in beltway corridor.

Measure: Number of housing units constructed by density, tenure, cost, and amenities and percent of this number which might have been built in older urban areas.

Analytical Procedures: As with other potential development effects, the only important source of residential development in the beltway corridor is redistribution from other locations where it might have occurred had the beltway not been constructed. Estimation of the number of housing units attracted to beltway locations requires a working knowledge of the local housing market and constraints upon development extant in the corridor. Important aspects of the housing market include:

- The rate of regional population growth;
- Local housing construction trends;
- The past strength of the market in the proposed corridor;

- The demographic characteristics of people moving into the corridor and the area around it;
- The location of employment opportunities for these demographic groups; and
- The demand in the region for housing of different types.

Development constraints in the corridor which will also affect the pace of residential development include:

- The proportion of undevelopable land in the corridor and elsewhere in the region;
- Restrictive zoning in the corridor;
- Existing or planned infrastructure in the corridor; and
- Proximity to uses perceived to be incompatible with residential development.

Once all available information on local conditions is assembled, through interviews with local real estate agents and developers, planners, and relocation and redevelopment staffs, the analyst must make a judgement as to what share of new residential development will locate in the beltway corridor and where it would have located in the absence of the beltway. Projections should be made assuming the construction of a belt of different capacities and incorporating different assumptions about land use policies and transportation improvements. Several helpful models include variations of the constant share and shift-share technique, Klein's Index of Development Pressure, and procedures outlined in HUD's FHA Techniques of Housing Market Analysis.¹

Projections of residential development likely to be induced by construction of the beltway may reveal potentially adverse effects when viewed in the context of local and regional planning objectives. Most of these stem from "too much" residential development encouraged by the new belt. The beltway effects listed below will be discussed with potential mitigating measures in later sections:

- Promote sprawling development pattern;
- Displace development more suitable to beltway sites;
- Skew distribution of tax revenues;
- Encourage development of housing at inappropriate density;
- Encourage imbalance of housing market;

1 Descriptions of these are found in the Federal Highway Administration, Workbook and Resource Guide: Social and Economic Considerations in Highway Planning and Design Training Course (Washington: National Highway Institute, 1977).

- Encourage segmentation of the housing market;
- Encourage premature residential development;
- Increase the rate of suburbanization;
- Undermine efforts to increase housing stock in other, strategic areas.

Retail

It is often said almost axiomatically that retail establishments follow residential development. However, construction of a beltway may induce retail development far greater than that required to serve nearby residents by providing sites almost regionally accessible. Development of two types of retailing other than neighborhood-oriented outlets may be stimulated: traveller services, including motels, restaurants and service stations; and major retail centers oriented to a regional market. By potentially enlarging trade areas, the beltway may create favorable conditions for development on a scale which could prove harmful to downtown retailing and to other major retail centers in the region. Minimally, retail development within the beltway corridor will consist of establishments which in other circumstances would have located elsewhere in the region.

Effect: Induce retail development in corridor, perhaps at the expense of older urban areas.

✓ **Measure:** Acreage of retail use or square feet of retail space by merchandise sold, location (in centers or freestanding), and percent of these which might have developed in older urban areas.

Analytical Procedures: Much the same approach as was used to estimate likely residential development in the beltway corridor can be used to calculate probable corridor retail development. The analyst should familiarize him or herself with the local retail market, paying particular attention to:

- the rate of regional population growth
- trends in the location of major and minor retail centers throughout the region
- the past strength of retailing in the beltway corridor
- the clientele served by existing retailing in the proposed beltway corridor
- the likely location of new residential office and industrial development in the beltway corridor
- the location of major retail centers in the trade area of proposed beltway interchanges
- the potential market for additional retail space in the suburbs and in the beltway corridor
- the likely results of downtown retail revitalization efforts

In addition, development constraints in the corridor should be researched, including:

- the proportion of undevelopable land in the corridor
- restrictive zoning in the corridor
- little existing or planned infrastructure in the corridor
- proximity to uses perceived to be incompatible with retailing

Again, once all available information on local conditions is assembled through interviews with local retailers, developers, planners, and downtown development group staffs, the analyst must make a judgment as to what share of retail development will locate in the beltway corridor. Projections should be made incorporating several different sets of assumptions including construction of the beltway at different capacities and implementation of substantially different planning policies. Research on retail development has provided the analyst with several helpful techniques for estimating the future shape of the retail market, including constant and shift-share analysis, central place theory, the crosstown retail impact model developed to evaluate a Chicago highway project, Reilly's Law of Retail Gravitation, travel expenditure models oriented to retailing serving highway travellers, and Klein's Index of Development Pressure. Descriptions of these are readily available: these models are particularly well outlined in the Federal Highway Administration's Workbook and Resource Guide: Social and Economic Considerations in Highway Planning and Design Training Course.

Also parallel with the analysis of residential development, potential adverse effects of beltway construction on retail development take the form of "too much" retail development in the beltway corridor. They include:

- glutting the regional retail market
- harming the central business district, small municipal downtowns, and other retail centers
- undermining the efforts of downtown revitalization groups to rebuild retailing downtown
- shifting shopping and retail employment opportunities out of reach of transit-dependent regional residents
- stimulating strip commercial development along the belt route
- encouraging the proliferation of unaesthetic roadway advertising

These possible results of beltway construction are discussed in greater depth along with potential steps to reduce their adverse impact in Chapters 8 and 9.

Wholesale, Distribution and Other Commercial Activities

Beltway corridors attract wholesale and warehouse activities because of the accessibility they provide to the Interstate Highway System and within metropolitan areas. Interchanges offer logical sites for goods distribution and transfer facilities, as is obvious upon driving the beltways in Atlanta, Baltimore, Louisville, and San Antonio. Because such activities are not labor intensive, they do not represent a

major shift in employment opportunities. In fact, warehouse space in older urban areas vacated by firms moving to a beltway corridor may be suitable, after renovation, for other retail or office uses which provide relatively more employment.

Hotels and motels are attracted to the beltway corridors for similar reasons. Where the beltways serve airports, as in Minneapolis-St. Paul or San Antonio, strip commercial development is likely to occur around nearby interchanges. Such development probably would not have occurred downtown or in older urban areas had the beltway not been built, since they cater mainly to airport-related markets.

Effect: Induce other commercial development in corridor.

Measure: Acreage or commercial development, or square feet of space built, number of hotel rooms constructed, location, and percent of these amounts which might have been built in older urban areas.

Analytical Procedures: The procedure for analyzing the attraction of other commercial development to the beltway corridor involves an analysis of market trends and the desirability and appropriateness of corridor sites for such development, using much of the information needed to evaluate retail development potential. Assessment of the market for other commercial uses includes:

- the rate of regional employment growth
- trends in the location of warehouse, goods distribution, and wholesale facilities and in hotel and motel space
- attractiveness of the beltway corridor and competing locations
- opportunities for access to rail, airports, and seaports

Constraints on other commercial development that should be examined are comparable to the constraints on retail development, namely the availability of developable land, restrictive zoning, lack of adequate infrastructure, and proximity of uses perceived as incompatible with such development.

Truck traffic trends on radial highways should be evaluated and opportunities for reducing such traffic by constructing goods distribution facilities in the beltway corridor should be assessed. If through truck traffic is a local concern, planners might examine how a policy allowing only trucks with business in the urban core to use radial highways would affect the market for warehouse and goods distribution facilities in the beltway corridor. Such a policy has been successfully implemented in Atlanta.

Realtors and others active in the commercial development market, shippers, regional transportation planners, and local planners should be interviewed to determine whether projections of the corridor's share of such development are reasonable. When sites attractive for other commercial development also are suitable for retail development or office development, local zoning ordinances and general plans should be consulted to determine whether all such uses are permitted without restrictions or conditions. The final allocations should reflect the analyst's judgment about the viability of potential commercial uses. Projections should incorporate different assumptions about the beltway options and local land use policies so that the benefits and disadvantages of development scenarios can be compared.

The most likely adverse effects following a shift in wholesale and goods distribution activities would be a potential loss of employment opportunities for inner city residents. Ways to minimize this effect are discussed in Chapter 8.

Office

As with retail development, office space represents an important component of the downtown economy which has been drawn over the past several years into the suburbs, retail establishments following the middle- and upper-income market and office space locating within easy commuting distance of managerial employees. The beltway analyst should determine whether or not construction of the beltway is likely to accelerate this process.

Effect: Induce office space development in the beltway corridor.

Measure: Acreage of office use or square feet of office space by quality, cost of space, location within office parks or free standing, and percent of beltway corridor office space which might have located within older urban areas. ✓

Analytical Procedures: Analysis of the magnitude of potential office development within the beltway corridor is very similar to that for projecting residential and retail development. Assessment of the local office space market includes:

- the rate of regional population growth
- trends in the location of new office space
- the past strength of the office space market in the beltway corridor ✓
- the type of office space existing in the beltway corridor
- the benefits of a downtown location for prospective office users
- the potential market for additional office space in suburban locations
- the likely impact of downtown revitalization efforts

Office space development in the beltway corridor will be shaped by constraints including:

- undevelopable land
- restrictive zoning ✓
- lack of existing or planned infrastructure
- proximity to uses perceived incompatible with office development

In addition to these determinants of office space location is accessibility to neighborhoods housing office workers, both managerial and clerical. The analysis of labor force accessibility and the effects of a beltway on household location decisions should prove useful in gauging how the beltway will affect the relative desirability of sites for new office space. One source of such techniques is Armin Ludwig's Radial Freeways and the Growth of Office Space in Central Cities.

The experience of several case study cities indicates that beltways may exert a one-time pull on office development. For example, office space construction in Louisville may be interpreted as showing this pattern. As Table 4.1 shows, a very large proportion of regional office space was constructed within the corridor immediately after the beltway was built in the late 1950s and early 1960s. Although the corridor continued to account for a substantial fraction of new construction, it never again captured such a large share of the office space market.

The primary foreseeable adverse impact beltway construction could have on office space development would be to draw so large a share of regional office space investment as to undermine the economic vitality of the downtown. Measures to alleviate or eliminate this prospect are reviewed in Chapter 8.

TABLE 4.1: LOCATION OF OFFICES BUILT IN LOUISVILLE ✓
AREA, 1960 - 1980
 (Space Added in Square Feet)

<u>Year</u>	<u>CBD</u>	<u>Beltway Corridor^a</u>	<u>Inside Belt^b</u>	<u>Suburban Areas^c</u>	<u>Total</u>
1960-64	67,000	159,000	42,000	31,000	299,000
Percent of Total	22	53	14	10	100%
1965-69	542,000	287,000	32,000	110,000	971,000
Percent of Total	56	30	3	11	100%
1970-74	2,012,000 ^d	968,000	114,000	742,000	3,836,000
Percent of Total	52	25	3	19	100%
1975-80	364,000	94,000	73,000	853,000	1,384,000
Percent of Total	<u>26</u>	<u>7</u>	<u>5</u>	<u>62</u>	<u>100%</u>
Totals	2,985,000	1,508,000	261,000	1,736,000	6,490,000
Percent Distribution	46	23	4	27	100

^a Within one mile of I-264.

^b Incorporated, unincorporated and non-CBD Louisville.

^c Locations more than a mile outside I-264 including Louisville, unincorporated areas, and incorporated suburbs in Jefferson County.

^d Two large privately developed structures built downtown, 1972.

Source: Louisville Area Chamber of Commerce, 1979-80 Office Space Guide.

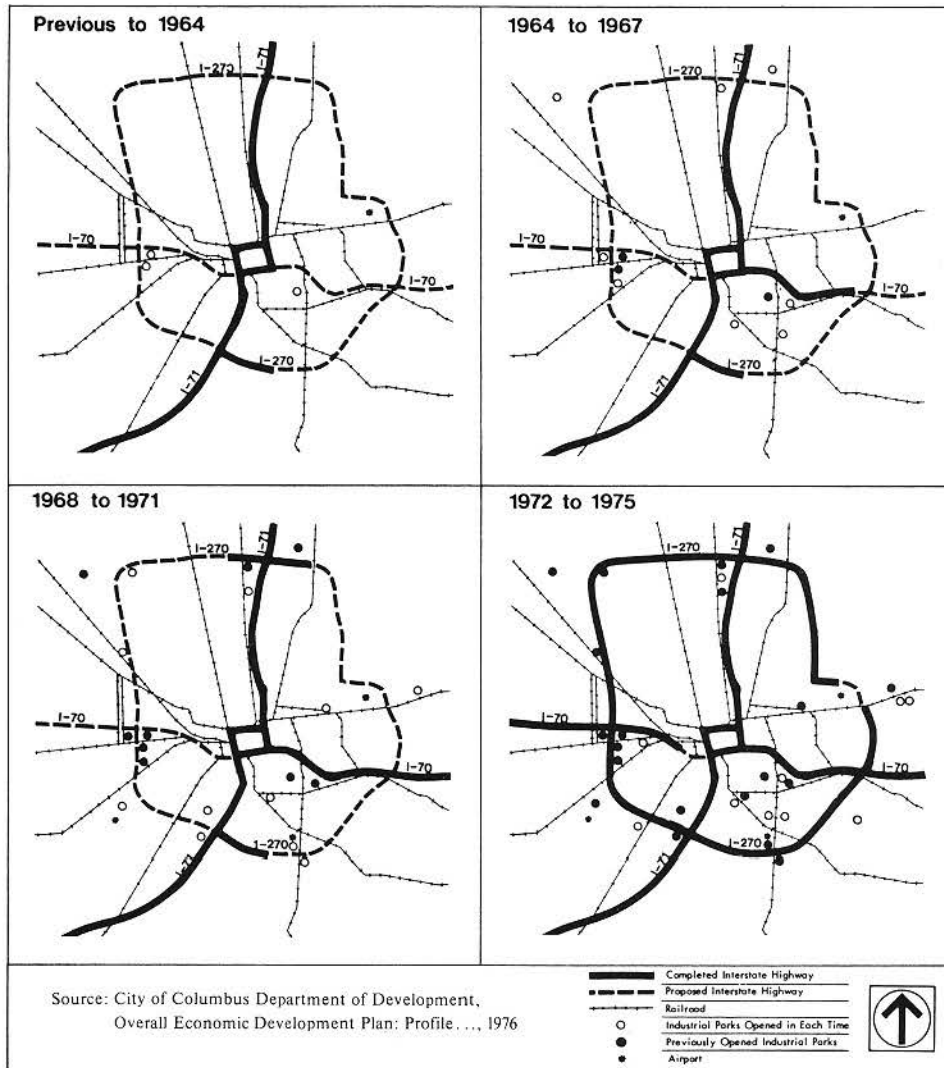


Figure 4.3.
DEVELOPMENT OF INDUSTRIAL PARKS VS. INTERSTATE
HIGHWAY CONSTRUCTION IN COLUMBUS

Industrial

The changing requirements of American industry have provoked a nationwide shift in industrial location from the central city to the suburban periphery. Thus, unless the analyst resides in an unusual region where industry remains concentrated near downtown, the issue is the extent of redistribution of industrial plants from other suburban locations the beltway might cause. An example of the potential impact of a beltway upon industrial location, in this case industrial parks, can be found in Figure 4.3 which shows the evolution of the Columbus, Ohio beltway and regional industrial park development. Interestingly, the belt appears to have provoked substantial development in anticipation of construction rather than after the beltway was completed.

Effect: Induce industrial development in the beltway corridor.

Measure: Acreage in industrial use or square feet of industrial space, by type of industry and employment requirements.

Analytical Procedures: The analysis of the corridor's likely share of future industrial space is very similar to that followed in determining the expected share of residential, retail, and office space, except that potential effects upon the downtown are not of concern. The local industrial space market should be characterized by reviewing:

- the rate of regional population growth
- trends in the location of individual plants and industrial parks
- the size of industrial firms in industrial parks
- the past strength of the industrial space market in the beltway corridor
- the location of regional markets, and sources of industrial inputs, including raw materials, processed inputs, and the residences of potential managerial, operative, and clerical employees
- the potential market for additional industrial space in suburban locations

Similar development constraints may obstruct industrial development as they might other forms of development, including:

- undevelopable land
- restrictive zoning
- little existing or planned infrastructure
- proximity to uses perceived to be incompatible with industry

Conversations with developers, planners, financiers, and economic development agency staff can be supplemented with surveys of industrial decisionmakers and the results of constant and shift-share analysis and utilization of Klein's Index of Development Pressure. As before, projections should integrate several different sets of assumptions about belt design, alternatives to the beltway, and future regional planning and local land use and transportation planning policies.

If industrial sites adjacent to the beltway are attractive to industries in the area, a potential adverse impact of beltway construction is location of a large share of the region's employment opportunities in an area not accessible by public transit. This possibility and methods to reduce its impact on the community are discussed in Chapters 8 and 9.

Institutional

Beltway sites may also appear attractive to decisionmakers locating institutional facilities such as government offices, schools, hospitals and parks, though National Urban Policy calls for the siting of federal offices within older urban areas. The accessibility of a belt interchange particularly might prove an asset to a regional

paramedic system or to a public facility serving residents of the surrounding suburbs. An example of this phenomenon occurring indirectly is found in the Minneapolis area where Hennepin County officials have decided to locate county agencies in regional shopping centers near the beltway to increase patronage of county services.

Effect: Encourage institutional location in the beltway corridor.

Measure: Acreage in institutional use by type of institution and proportion which might have located in older urban areas.

Analytical Procedures: Analysis of institutional development is somewhat different than that for other forms of development, since it is not so directly affected by market forces. Projections for location of residential development may be used to map out areas which will probably be requiring additional public facilities, but the most reliable source of information is interviews with public officials in decision-making positions to determine their thinking on appropriate sites for future construction of local institutions.

Potential adverse effects of beltway construction on institutional development include shifting employment out of the central city and decreasing the accessibility of public services and educational opportunities to inner-city residents. These possible impacts and steps to reduce their negative consequences are reviewed in Chapters 8 and 9.

5. EFFECTS ON LAND USE AND PUBLIC FACILITIES PROGRAMMING

The potential for a beltway to influence land use and therefore indirectly impact programming of public facilities is evident. Several particular elements of beltway design influence the highway's impact on land use and public facility programming. Transportation service, accessibility, and interchange/ frontage road design are most important, followed by location. The beltway's effects can be split into several categories: sequence and density of development, planning policy, and infrastructure needs and programs.

The analyst must determine whether the beltway:

- Would promote scattered suburban development or compact, higher density development nodes concentrating uses already in suburbanizing areas;
- Would be compatible with regional and local planning objectives, national urban policy, and whether the beltway's potential effects are manageable with available planning tools;
- Would affect the demand for other federally financed infrastructure requirements; or
- Would affect land use and public facilities programming differently than would other transportation investment options.

Techniques and procedures for examining each of these effects are outlined in the following sections.

Development Patterns

A beltway may affect the density, location and sequence of development. Most often, beltway construction appears to have had mixed consequences, where consequences are evident, both contributing to scattered residential development and centralizing some suburban activities. Planners need to know how to implement a beltway proposal so as to achieve compact development patterns and to reduce demand for new infrastructure.

Effect: Change density of development.

Measure: Change in intensity of land use by type and acreage affected.

Analytical Procedures: This analysis relies on the forecasts of development generated by the belt and options being considered. Beltway accessibility often results in pressures for higher intensity land uses thereby increasing land values. Interchange quadrants are most likely to be affected, so opportunities to increase densities under current zoning restrictions and with zoning should be evaluated. The ability of local infrastructure to accommodate high-intensity development should be evaluated to determine if any constraints on density exist. Development density is a function of land and construction costs and market demand. The effects of beltway accessibility on these demand should be calculated, using information compiled in the

analysis of retail, commercial, and industrial development opportunities. Here the focus is on the feasibility of an intensification of use, not the specific uses proposed. In Raleigh, for example, land designated for single family housing became multi-family, areas designated for multi-family housing became office or retail/commercial, and areas intended for commercial facilities became high-intensity commercial or industrial. These policy decisions reflected analysis of acceptable development densities. Carefully planned beltways with limited interchange space available for high intensity development may generate strong nodes with supportive land use policies.

Effect: Alter sequence of development.

Measure: Change in expected timing of development by sub-area.

Analytical Procedure: Research has shown that a beltway alone is not sufficient to induce development; other forces must also be at work. A good foundation for an assessment of the potential of beltway construction to alter the sequence of development in the region is the mapping of rapid, slow, and restricted growth areas in relation to the belt route, such as is illustrated in Figure 5.1. These should be determined on the basis of the share of construction occurring in each area, perhaps using building permit values. An overlay should be prepared showing planned improvements in infrastructure which may affect the sequence of development. This will enable the analyst to identify where the beltway will complement and reinforce the effects of infrastructure improvements. The beltway may be expected to draw development to slow or restricted growth areas along the beltway only if limited access has functioned to stall growth on these sites. Where environmental constraints or an area's poor image have limited development opportunities, a beltway will not create a market for land or significantly affect the timing of development.

It is safe to assume that belt-related development pressure will occur where land is closest to the beltways. However, in cases such as in Atlanta, owners of land near the beltway set such high prices on their land that developers prefer less accessible, lower cost sites, if other factors are equal.

Whether a change in the density or sequence of development is acceptable should be evaluated in terms of local and regional land use policy, the subject of the next section.

Land Use Policy

Evaluation of development likely to be induced by construction of a beltway, by implementation of another transportation option or likely to occur if no investment in the regional transportation system is made must include determination of its conformance with local and regional land use policy. Do local plans include the beltway? Are interchanges limited to areas shown as major nodes, or are tools available to deal with pressures for changed use in interchange quadrants? Are any sections of the beltway in environmentally sensitive zones? Are plans and capacity to provide public service and infrastructure in the corridor coordinated with land use plans? Do adopted land use plans account for the development likely to be induced by the beltway? Historically, few examples exist where eventual land use patterns in the beltway corridor matched those projected before the beltway was built.

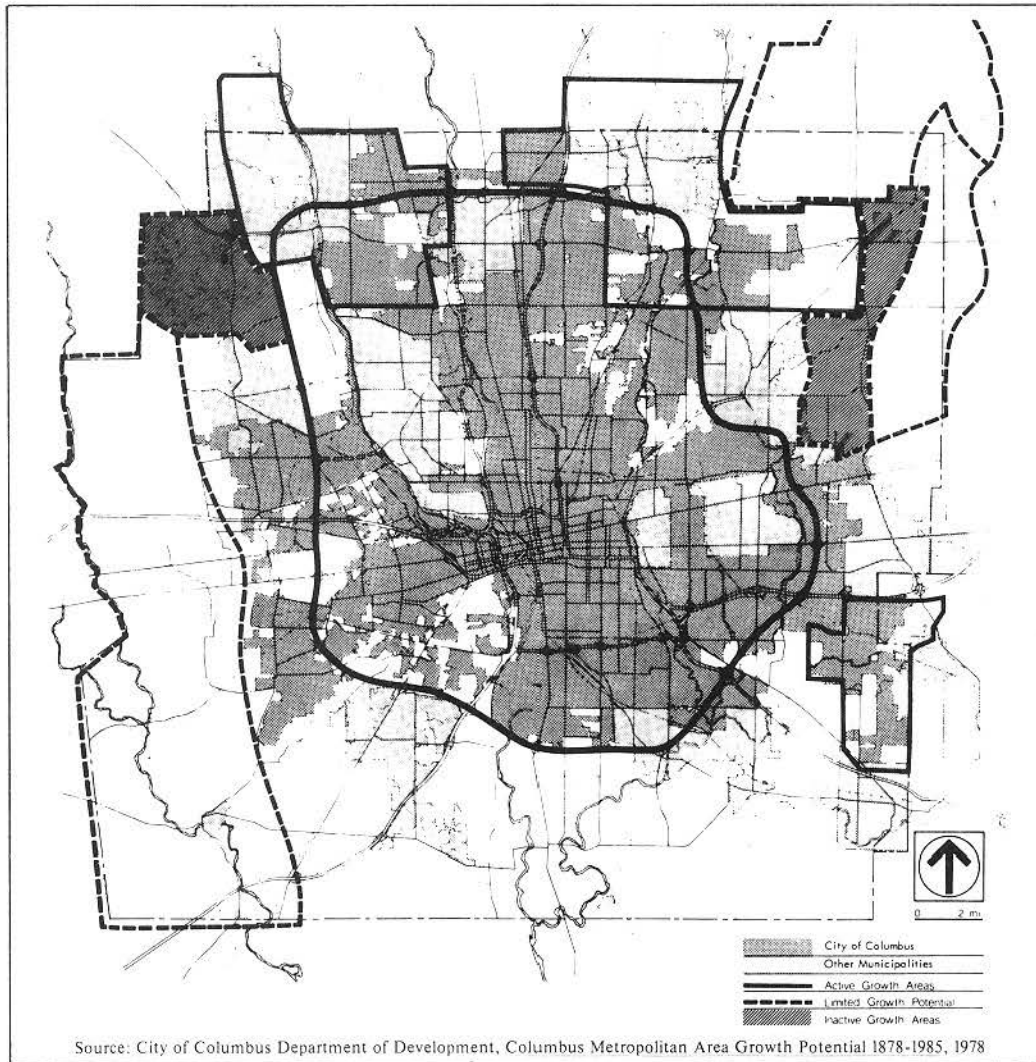


Figure 5.1.
METROPOLITAN GROWTH AREAS IN COLUMBUS 1978-1985

Effect: Induce development inconsistent with local and regional policy.

Measure: Evaluation of degree of conformance.

Analytical Procedures: Plans of all affected cities, counties, and special districts should be checked as well as regional plans. Land use plans, infrastructure plans, and traffic circulation plans should all be included in this review. If the beltway corridor is presently unincorporated, are there plans for its annexation? Are potentially developable areas designated for the type and intensity of development improvement judged most desirable and most likely to occur? How willing are local communities to change the zoning and planning at the request of developers?

Plan maps should be checked to determine the types of uses, locations, and densities within the beltway corridor and any policies that may affect the timing of development such as designated urban service areas. Where local or regional plans have not been officially adopted by the governing bodies of the local jurisdictions, zoning maps and ordinances should be consulted. In some cases, zoning districts may limit the allowable uses to one type, such as low density residential development, while in others a broad range of uses may be permitted or even encouraged—a planned unit development (PUD) district being a typical example. The issue of consistency usually will arise when the beltway corridor is planned for relatively low density uses, including agriculture and open space, and a relatively intense use, such as a major retail center, clearly would conflict with these land use policies. When this occurs, plans should be examined to determine when a limited access highway or major thoroughfare was first envisioned and what uses historically had been anticipated in the corridor. Local officials and planners should be interviewed to learn whether land use plans reflect current policy or need to be updated to meet anticipated needs or to address the role of the beltway in the development process.

Infrastructure

By encouraging development in formerly undeveloped areas, beltways may increase the demand for public facilities, including interchange improvements, water trunks, sewer trunks and treatment facilities, and other forms of municipal investment. Many of these are largely funded through matching federal and state grant programs. Provision of suburban water and sewer extensions may lead to further scattered suburban residential development drawing vitality from older urban areas.

Particular areas of concern are utility capacity, local street capacity, schools, and recreation and park facilities. An example of areas where utility planning has been well coordinated with beltway planning is Columbus, where extension of sewer and water services to areas through which the beltway runs required annexation.

Effect: Overload capacity of existing and committed utility systems to serve projected development.

Measure: Ratio of service needs to existing and projected supply or capacity.

Analytical Procedures: First, maps showing the location and capacity of current utility systems and any planned expansions should be acquired, and service areas mapped. Then, using standard per capita or unit requirements or load factors, the adequacy of the sewage and water systems to handle additional demands resulting from beltway-related development can be assessed. Where development is inconsistent with local plans or zoning, a potential problem may exist. On the other hand, where projected development lies within an urban service area, then the local utility system should be adequate. If an apparent shortfall exists, the engineering staff of the utility company should be able to provide an estimate of the site and cost of facilities required to serve beltway-induced development.

If the beltway is routed outside existing water and sewer service districts, the analyst should determine whether there is a plan for annexation of the land around the beltway or for creation of a new district.

Effect: Overload local and arterial street capacity.

Measure: Change in level of service.

Analytical Procedures: Traffic levels on streets may be affected by the beltway, particularly on connecting arterials. While congestion on some highways may be relieved, tremendous loads will be placed on arterial connections to the beltway, especially at major nodes. Traffic generation of beltway corridor development under different scenarios should be calculated, and the capacity of existing or programmed roads compared to anticipated traffic levels. Usually, maps of current and projected volumes are available. Where the current road network appears unable to carry projected traffic, costs of necessary improvements should be determined. Alternatively, the alignment or interchange plan of the beltway may be modified.

Effect: Overload capacity of local schools.

Measure: Unused capacity or overload in corridor or district-wide.

Analytical Procedures: Changes in the student population resulting from beltway corridor development should be calculated for different scenarios and land use policies. Ratios of students by housing type obtained from local school districts may be used. School district boundaries should be mapped, and the number of potential students compared to available capacity in local schools to evaluate the degree of shortfall or excess capacity with full development in the beltway corridor.

Unless the amount of single family housing developed in the beltway corridor is much greater than anticipated by land use planners—a fairly unlikely occurrence—it is not probable that schools will be overcrowded, since enrollments are declining in all but the most rapidly growing areas.

Effect: Alter accessibility or attractiveness of parks and other recreation facilities.

Measure: Change in use or quality of experience.

Analytical Procedures: Existing and planned parks and recreation areas in the beltway corridor or accessible by the beltway should be mapped, and differences in their accessibility by different modes with and without the beltway calculated. Recreation planners should be consulted to determine how these differences will affect use.

Noise or visual intrusion may affect the serenity of a natural area. Because of the federal Section 4(f) park preservation policies, park lands hardly ever are proposed for acquisition for freeway right of way, and such areas should be avoided if possible.

6. INDIRECT EFFECTS: ECONOMIC AND SOCIAL CONSEQUENCES

An emerging focus of national urban policy is the impact of transportation investments on metropolitan development patterns and socioeconomic conditions both in the transportation corridor and in the central city. In addition, the Department of Transportation requires the possible adverse economic and social effects of any major transportation investment be considered in the context of the potential effects of other investment options. The analyst evaluating a beltway must weigh the social implications of travel and location decisions, development decisions and facilities programming decisions, including:

- The extent to which the proposed beltway will alter housing and employment opportunities throughout the metropolitan area;
- Whether the proposed beltway will influence retail trade patterns significantly and, if so, whether this will disrupt access to shopping facilities for households not in the beltway corridor;
- Whether shifts in development patterns and the location of employment and retail centers will drain the fiscal resources of the central city, reducing the capacity to fund necessary public services; and
- How alternative alignments, interchange spacing, or transportation investment strategies would differ in their effects.

Assessing the socioeconomic impacts of beltways requires an examination of the likely consequences of development pattern shifts for sub-groups of the population, particularly low income, elderly, and minority households.

Employment Opportunities

A beltway may affect employment opportunities in three ways. The first is loss or relocation of jobs caused by routing the beltway so that property used for business purposes is taken. Beltways built to date have rarely had such effects, since most alignments have been primarily through open land. The Uniform Relocation Act calls for the mitigation of any such adverse effect of beltway construction. The second effect is the employment benefit from construction of the beltway. This is a short-term effect, probably comparable to that of an alternative transportation investment, and too small even after multiplier effects to warrant the analyst's attention unless the beltway is to be constructed through an area with severe unemployment. The potentially significant beltway effect is altered accessibility to different job opportunities for residents of different geographic areas and users of different modes of transportation subsequent to changes in employers' locations, discussed in Chapters 3 and 4.

Effect: Create job displacement.

Measure: Number of jobs dislocated or eliminated, by demographic characteristics of employees.

Analytical Procedures: The extent of potential job displacement can be determined by the same methods used to assess probable residential displacement described in Chapter 4.

The significance of employment displacement depends upon the nature and financial capability of affected firms. Clearly a site specific resource extraction business can not relocate easily, in contrast to a chain store or franchise operation which would probably quickly re-establish itself in a new location. Relocation studies have shown that small businesses which are marginal or operated by older persons are often not re-established elsewhere.

Effect: Change employment opportunities for different groups in the region.

Measure: Change in accessibility to jobs by corridor residents and residents of inner city or older urban areas.

Analytical Procedures: Likely effects of each transportation investment option on employment opportunities can be gauged by comparing the employment implications of potential development scenarios constructed in Chapter 4. Figure 6.1 illustrates a mapping of employment centers in San Antonio such as might be done for different transportation investment possibilities. Using standard employment-per-acre ratios for different land uses, the likely employment distribution effects of the beltway alternatives can be estimated. If developable sites are available and planning policy allows development for commercial and industrial uses, it is likely that the rate and magnitude of growth in employment opportunities will increase in the beltway corridor. With survey or census data, the residential location and demographic characteristics of the corridor labor force can be approximated, allowing projection of the mode and distance of potential corridor employees' commute to work.

Workers residing in or beyond the beltway corridor gain accessibility to the regional employment market as a result of both the transportation service and employment attraction attributes of the beltway. Transit-dependent, inner city workers may be adversely affected by construction of the beltway if their employers move near the beltway from closer or more transit accessible locations. Analysis should be related to the investigation of growing sectors of the local economy, the locational preferences and movement of firms in growth sectors, and an estimate of the labor force and locational characteristics of their workers.

Beltway studies indicate that the relocation of firms can improve work place accessibility for suburban, white collar workers; however, the movement of industrial establishments can have an adverse effect on blue collar workers for whom there are fewer housing opportunities in suburban areas.

Housing Opportunities

Through its effects on residential development decisions, a beltway may affect housing opportunities of different groups within the region. A beltway may attract relatively high-density rental housing, and possibly some single family housing, contributing either to in-fill development between existing radial corridors, or, to the spread of low density housing.

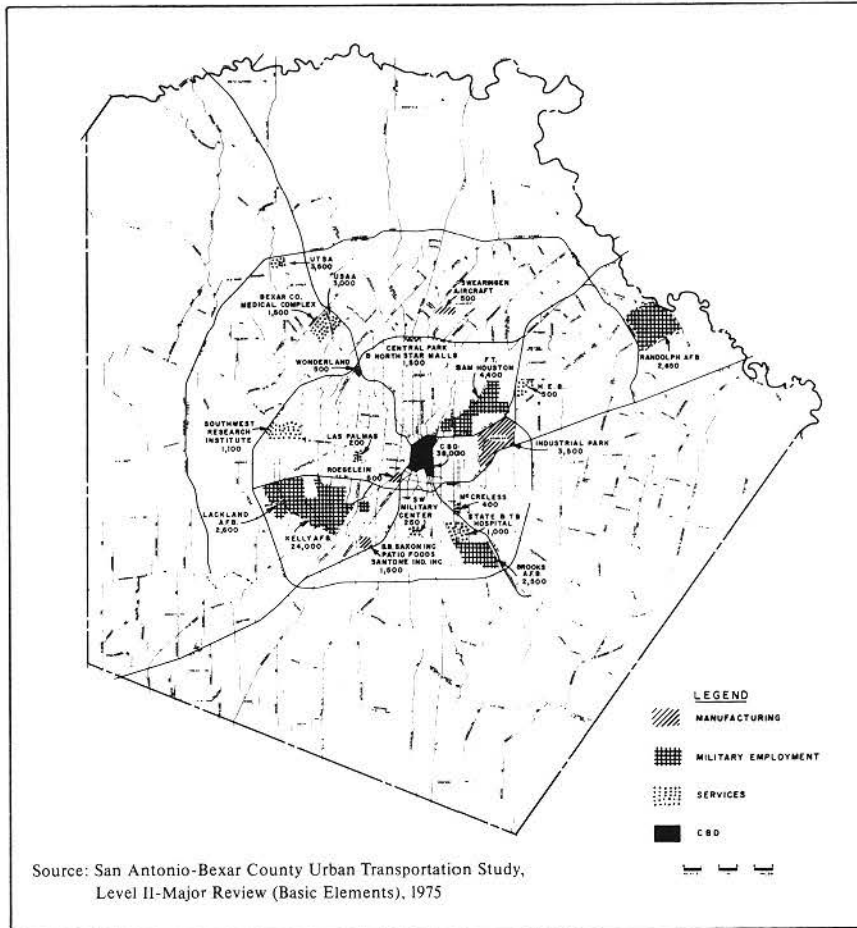


Figure 6.1.
EMPLOYMENT CONCENTRATIONS IN SAN ANTONIO

To determine the potential impact of the proposed beltway on regional housing opportunities, the analyst must ask the following:

- What are the demographic characteristics of the likely inhabitants of beltway-induced residential development?
- Where would housing attracted to the beltway corridor be built in the absence of the beltway?

Effect: Change housing opportunities for different groups in the region.

Measure: Change in housing opportunities by type and price within corridor and older inner city areas; number of new or rehabilitated units prices for low- and moderate-income households.

Analytical Procedures: As with employment opportunities, the first step involves a review of the likely beltway impact on residential development decisions compared to the potential effects of other transportation investment options, considered in Chapter 4.

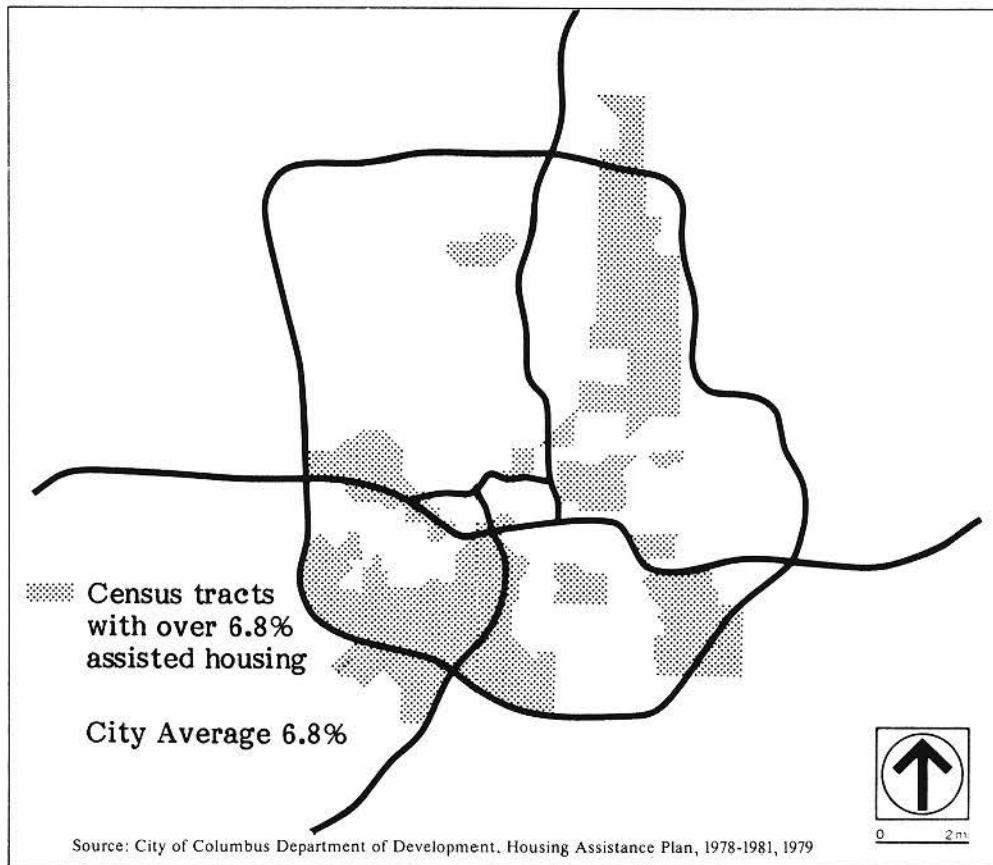


Figure 6.2.
 ASSISTED HOUSING CONCENTRATIONS IN COLUMBUS, 1976

The task at this point in the analysis is to determine how the "first order" beltway effects on residential development decisions affect overall housing opportunities. Experience has shown that relatively high-density garden apartment complexes often cluster along beltways in the vicinity of interchanges. Developers find that the beltway is an excellent marketing tool, advertising on the beltway where local ordinances allow it. In the absence of strong planning control, substantial pressure to convert single family zoning to multi-family zoning in interchange areas should be expected. If the beltway can be anticipated to encourage development of a particular type of housing, such as high-density garden apartment complexes, existing housing of other types of concern to planning officials such as low-income or assisted housing may be displaced or isolated. Mapping of the stock of housing, such as in Figure 6.2 showing the location of assisted housing in relation to the Columbus beltway, will indicate the potential for displacement by belt-induced development.

Retail Trade and Shopping Opportunities

The development decisions of retail establishments will affect both the pattern of regional retail sales and employment and, indirectly, access to shopping for households throughout the metropolitan area.

Effect: Alter shopping opportunities for different groups in the region.

Measure: Change in accessibility to retail goods and services in corridor and older inner city areas.

Analytical Procedures: Regional residents in or near the beltway corridor will benefit from improved access to shopping opportunities if the beltway encourages retail development nearby. Effects on residents in other areas will depend on the importance of the beltway relative to other forces determining the location of retail establishments.

Analysis of a beltway's effect on shopping opportunities should begin with the assessment of retail development potential and secondary effects on retail businesses in older urban areas, as described in Chapter 4. The benefits of improved access should be calculated by first comparing off-peak travel times from residence zones to major retail centers with each beltway option and the no-beltway alternative and then determining what the aggregate travel time savings might be. Maps of accessibility differences prepared for the analyses recommended in Chapter 3 should prove useful.

If a major retail center built in the beltway corridor will draw shoppers away from older commercial districts, forcing stores to relocate or close, nearby residents and workers may enjoy fewer conveniently located places to shop for goods and services. If this could occur, particular attention should be given to the implications of shifts in retail activity in terms of shopping opportunities for the transit-dependent, the poor, the elderly and the handicapped.

Fiscal Resources

Effects on development patterns and thus on location of businesses, households, and required public infrastructure may affect the fiscal capacity of both cities and special districts in the corridor and the central city, particularly if there is a point-of-sale based sales tax or a local income tax or payroll tax. Public expenditures will be affected by infrastructure needs and public service requirements associated with development directly or indirectly attributable to the beltway.

Effect: Alter distribution of fiscal resources among regional jurisdictions.

Measure Change in the costs and revenues of the central city, other jurisdictions, and special districts.

Analytical Procedures: With the development scenarios constructed in Chapter 4 for implementation of different transportation investment options, differences in the distribution of potential tax revenues and public expenditures can be estimated.

Infrastructure needs and costs for arterial road improvements, sewer and water extensions, and school construction for alternative development scenarios are of particular concern. To relate capital and operating costs to projected revenues consistently for each forecast, the analyst should discount annualized costs or revenues projected over the next 15 to 25 years to obtain the present value. Details on useful analytical techniques and data sources are contained in HUD's Fiscal Impact Guidebook.

Modern commercial and industrial development usually "pays its own way" or generates a fiscal surplus for local government, while most new housing costs more to service than it will produce in property tax revenues. In addition, unplanned, scattered development can increase public service and infrastructure costs.

In general, central cities which do not annex or have jurisdiction over growing suburban areas with new commercial and industrial development will be under extreme fiscal pressure, since their public service costs are increasing faster than are revenues from existing, aging property. Where retail sales do not keep pace with inflation, as is occurring in nearly all older cities without new retail centers, sales and property taxes from retail establishments are lagging as well. This has occurred in beltway cities, including Atlanta and Louisville, where most new development is outside the central city, a significant portion in the beltway corridor. By contrast, in San Antonio and Raleigh the beltway and related corridor development are within the central cities; thus, any shifts in location of development do not affect overall revenues.

Public Services

A fiscal transfer effected by beltway-related development may reduce the capacity of the central city to meet increasing costs of providing social services and maintaining police and fire departments. At the same time, a beltway may improve access to public services for residents in the beltway corridor. Response times for emergency paramedic care or fire protection may be reduced dramatically with a beltway and a larger area covered from existing facilities without diminishing the quality of service.

Effect: Alter level of social services available to different groups in the region.

Measure: Change in level of social services offered in corridor and older urban areas.

Analytical Procedures: The needs for services in the beltway corridor depends upon the number and demographic characteristics of people living there, estimated in Chapter 4. If local general plans contain "social service" elements, these will provide good information on needs and service level standards. Regional health maintenance organizations (HMOs) also should have information on needs and be able to assist in evaluating the beltway's impacts. The ability of the central city to maintain service levels is a function of the beltway's effects on fiscal capacity and on household and employer location decisions.

Effect: Affect provision of services for public safety.

Measure: Changes in police, fire, and emergency medical service levels in the corridor and older urban areas.

Analytical Procedures: Existing and projected fire station, police station, and hospital locations should be mapped and the beltway's effects on response time calculated. These may be positive, by offering faster travel speeds, or negative, by cutting off through streets. If available, a good source is the public facilities element of local general plans, which usually include maps of response time and standards for judging the adequacy of service levels.

Indirect effects also should be analyzed, including increased demand for services resulting from changes in location or density of development and decreased ability to maintain service levels in older urban areas. Police and fire department personnel and health and service planners should be interviewed to obtain their reactions to estimates of future requirements potentially attributable to the beltway.

7. INDIRECT EFFECTS: ENVIRONMENTAL CONSEQUENCES

In areas where a beltway alters travel patterns, development decisions, and urbanization, it can contribute to environmental degradation by increasing air pollution and conversion of agricultural land to urban use, and disrupting sensitive environmental habitats or cultural resources. Pressure for development of lands exposed to environmental hazards—flooding or geologic and seismic hazards—or lands needed to protect natural resources such as groundwater aquifer also might increase. Residents in the beltway corridor may have to live with increased highway noise. Finally, to the extent that a beltway indirectly contributes to scattered suburban development, it can foster energy-inefficient settlement patterns, making conservation of energy more difficult and increasing polluting auto emissions.

Current environmental review procedures established by the National Environmental Policy Act and, in many states, by local laws on environmental protection, require that potentially significant effects should be examined. Beltways have infrequently been shown to have affected land use and urban development patterns to the extent that the environment has been degraded by beltway construction. However, each of the impacts mentioned in the opening paragraph of this chapter have occurred in one form or another where beltways have been built, and each bears some preliminary consideration.

Rather than duplicate information readily available in technical manuals and guidebooks on environmental impact assessment techniques for highway projects, this chapter offers a number of suggested measures for potential impacts and briefly describes analytical procedures for each. Appendix A includes many references to source materials containing more detailed descriptions of these methods. Of note are the Notebook Series on Environmental Assessment published by the U.S. Department of Transportation, the report on Evaluating Urban Transportation System Alternatives prepared for DOT, and the report on Highways and Ecology: Impact Assessment and Mitigation prepared for FHWA. Analysis at this level will identify potential environmental issues and lay the basis for more rigorous site-specific assessment required by federal law during project review.

Effect: Change in air quality.

Measure: Change in air polluting emissions and ambient air quality; relation to standards and conformance with Air Quality Maintenance Plan (AQMP).

Analytical Procedures: Potential differences in vehicular travel and in air polluting emissions, calculated using procedures prescribed in Chapter 3, for each transportation investment option and development scenario should be examined. Traffic and congestion projections, such as those mapped for metropolitan Atlanta in Figure 7.1, can be compared to estimate the beltway's probable effect on air quality. Analysis of land use and transportation scenarios using techniques by the Regional Planning Council in Baltimore has demonstrated that emissions rates can be lowered by combining centralized development patterns with transportation control measures. Since extensive air quality modelling usually has been undertaken in preparing an AQMP for the metropolitan area, as mandated by the federal Clean Air Act, the beltway analyst should confer with the air quality planners to determine whether the beltway proposal would not violate efforts to demonstrate "reasonable further progress" toward attainment of federal standards.

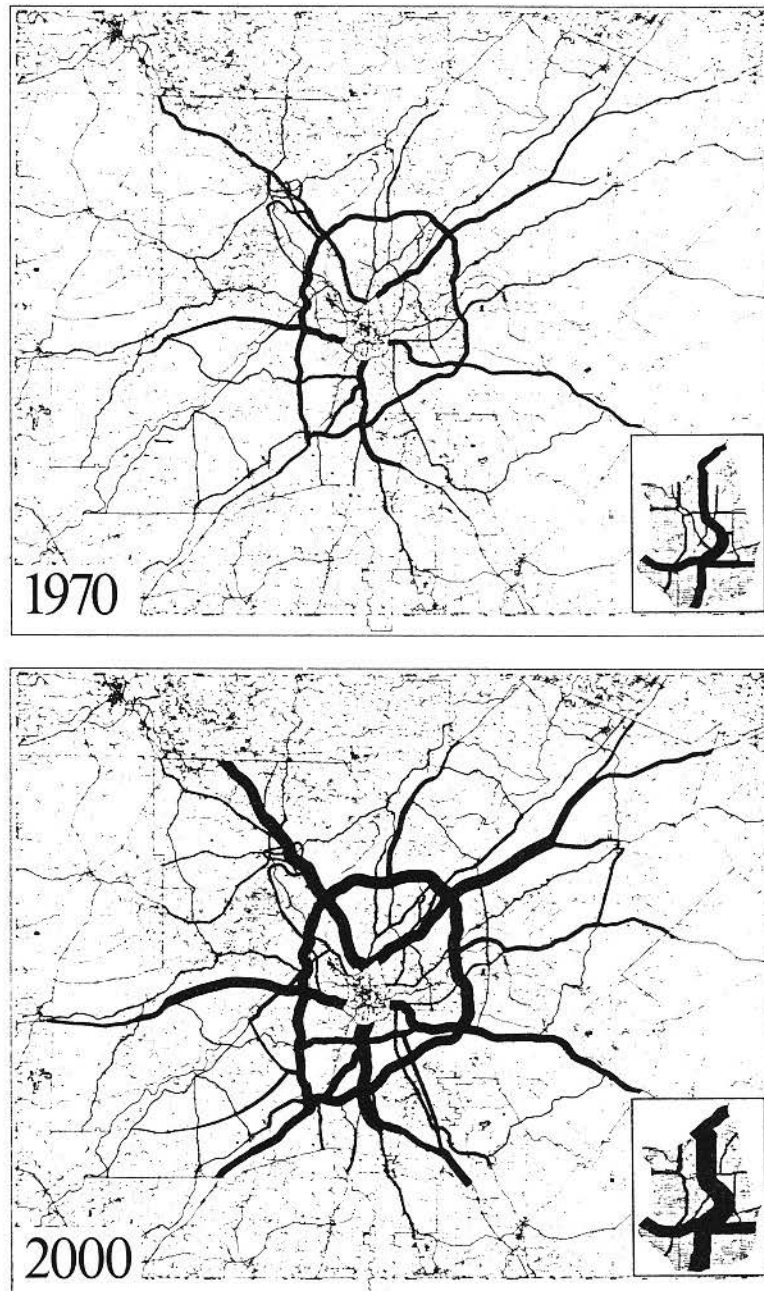


Figure 7.1.
 FLOW BANDS (TRAFFIC VOLUMES) ON
 FREEWAYS AND SELECTED ARTERIALS
 IN ATLANTA, 1970 AND 2000

When the effects of a specific beltway project are being reviewed, it also will be necessary to analyze air quality concentrations in the corridor and the air basin with future development with and without the beltway and compare these with national ambient air quality standards. Secondary effects should be gauged to determine whether the beltway or other options under evaluation will so reduce traffic on local streets that overall emissions will be lower due to higher average travel speeds.

Effect: Change in water quality.

Measure: Evaluation of direct and indirect water quality impacts; conformance with water quality management plan.

Analytical Procedures: Water quality impact assessment should be conducted with waste load factors and analysis techniques comparable to those used in preparing the metropolitan area's water quality management plan, also referred to as the Section 208 plan. As with air quality impact assessment, the beltway analyst should begin by determining whether anticipated corridor development under several scenarios conform with the projections in the water quality management plan. If it does not, further studies are warranted.

Later, at the project planning stage, water quality sampling may be required and forecasts of water quality under each development scenario should be prepared, particularly if construction of the beltway will alter runoff patterns or induce development in a way that was not anticipated by the regional water quality planners.

Effect: Change in flood hazard.

Measure: Potential increase in exposure to flooding with anticipated development.

Analytical Procedures: The beltway analyst should evaluate whether any of the development scenarios or alignment options would change flooding patterns by constraining flows or increasing development in a watershed that might exceed the capacity of local flood control improvements. Federal flood insurance program maps show only flooding based on existing development; local flood control districts should be consulted to determine the effects of projected development. The degree of risk with each beltway option and development scenario also should be estimated. It is important to determine whether induced development will be subject to flooding and if so, to ascertain that practicable evacuation routes have been established. Public safety elements in local general plans usually contain such information.

Effect: Geologic and seismic hazards.

Measure: Potential increase in exposure with anticipated development.

Analytical Procedures: Whether anticipated development in the beltway corridor will be exposed to such risks can be readily determined using maps of geologic and seismic hazards. Any potential problem areas should be checked by a qualified professional geologist to gauge the nature and extent of risk if local development regulations do not provide sufficient protection against construction in such areas.

Effect: Fire hazard.

Measure: Potential increase in risk based on analysis of response times.

Analytical Procedures: Response time from existing and planned fire stations should be determined and mapped to identify areas proposed for development within the corridor that lie outside what the local fire department terms an unacceptable range.

Effect: Loss of open space.

Measure: Acres converted to urban use by type of open space, such as agricultural lands or forest lands.

Analytical Procedures: Using maps of existing open space lands, the loss of open space can be calculated. Particular attention should be given to parks and recreation areas, visually prominent areas, wetlands, agricultural lands, lands in the coastal zone, and other open space judged important by local communities. Section 4(f) requirements must be met wherever parklands, wildlife and waterfowl refuges, and historic sites may be affected by proposed federal transportation facilities. In these cases, analysis must include detailed study of feasible options to the proposed project and careful evaluation of all possible measures to reduce or eliminate potential adverse effects.

Effect: Loss of ecological habitats.

Measure: Increase in degree of threat; acreage lost by type and value.

Analytical Procedures: Maps showing prime ecological habitats should be compared with maps of projected development to determine the extent of prospective loss and the degree of threat. A regional approach to ecosystems analysis should be adopted. Direct impacts due to construction, operation or maintenance activities can be magnified by consequences of beltway-induced development. In evaluating the extent of loss and degree of threat, attributes of each prime habitat that could be affected by the beltway include:

- overall productivity
- food chains and food webs
- population density
- species diversity
- habitat quality and diversity

Whenever a rare or endangered habitat potentially may be affected, directly or indirectly, by a proposed beltway, detailed studies should be commissioned and feasible mitigation and enhancement measures should be explored. In corridor planning, vigorous analysis may not be required; however, specific issues requiring further study should be highlighted so that they are evaluated in project planning.

Effect: Loss of archaeological and historic sites.

Measure: Degree of threat with anticipated development.

Analytical Procedures: Using maps of historic sites and available surveys of known cultural resources, the beltway analyst can identify where projected development might harm these sites. At the project stage, specific information on cultural resources which may be eligible for National Register and which may be affected either directly or indirectly by the beltway should be obtained through a combination of background research and field investigation. Depending on the resources affected and the nature of the impact, Section 106 and Section 4(f) review requirements may be applicable.

Effect: Increase in highway noise.

Measure: Change in ambient noise levels and number of people affected by noise exceeding standards.

Analytical Procedures: Highway noise contours with projected traffic volumes should be mapped and areas identified where ambient noise levels will exceed community noise level standards established by local jurisdiction or recommended by FHWA. Beltway planners should work with local officials to minimize opportunities for noise-sensitive development in areas with high noise levels.

Effect: Increase in energy consumption.

Measure: Increase in energy consumption by sector and by source.

Analytical Procedures: First, energy required for beltway construction and maintenance should be estimated. Then, energy use by sector and service should be projected under alternative development scenarios, conservation strategies, gasoline and heating oil prices, and differences among them calculated. Transportation models can be used to derive vehicular energy use; land use projections can be translated into energy use by building type. Simplified procedures for calculating energy consumption effects are contained in DOT's report on Evaluating Urban Transportation System Alternatives and the National Cooperative Highway/Research Program Report on Energy and Transportation Systems.

8. MITIGATION AND ENHANCEMENT MEASURES

Study of the experience of American beltway cities has shown that construction of most beltways entailed some minor adverse impacts at the corridor level; only rarely were larger negative effects evident. However, where potential adverse impacts attributable to beltways may be predicted, they often can be reduced or eliminated by changes of design, interchange location, local land use policy, or timing of development; early construction or expansion of needed public facilities and services, or downtown revitalization efforts. Similar techniques can also be used to amplify potential benefits of beltway construction such as the encouragement of nodal development, improved provision of emergency services, shortened intra-suburban worktrips, and consolidation of urban goods transfer facilities. In environmental review, the federal government and state highway departments have gained considerable experience with mitigation measures for the adverse fiscal, economic, social and environmental effects which can be associated with beltway construction. Analysis of mitigation and enhancement measures is closely tied to tradeoff analysis: a beltway with adverse impacts may be in the overall public interest if the potential benefits are large enough to counterbalance projected negative effects.

As a starting point, potential adverse effects attributable to beltways were identified, drawing on theory and experience to date gleaned from the case studies of eight beltways. Table 8.1 summarizes these impacts. Fifteen types of potential mitigation and enhancement measures should be evaluated:

1. Change in beltway capacity.
2. Change in beltway location or interchange location/spacing.
3. Change in proposed use, mix of uses, or density of development in interchange areas.
4. Allocate some proportion of new housing in the beltway corridor for low-moderate income families.
5. Delay construction of beltway or establish development staging policies.
6. Establish urban service area boundary.
7. Finance partially or completely construction of necessary public facilities, flood control project, utilities, or trafficways.
8. Implement joint development projects in interchange areas.
9. Implement aggressive revitalization program in older urban areas.
10. Promote joint use of beltway right of way with high occupancy vehicle (HOV) lanes, park-and-ride lots, and transit service.
11. Establish a regional tax revenue sharing program.
12. Improve access to downtown and older urban areas.
13. Annex beltway corridor or segments to central city.
14. Preserve, protect for later excavation, or salvage threatened archaeological or paleontological sites; preserve historic sites and buildings.
15. Control air and water pollution and noise generation by technical means; provide necessary insulation or noise attenuation barriers.

TABLE 8.1. POTENTIAL ADVERSE EFFECTS DIRECTLY OR INDIRECTLY ATTRIBUTABLE TO BELTWAYS

<p>Transportation</p> <p>Increase trip lengths and total travel (VMT) Increase reliance on auto-travel Hinder efforts to promote transit and enhance mobility of the disadvantaged Increase congestion on local streets because of unanticipated nodal development</p> <p>Land Use</p> <p>Increase scattered outlying residential development Decrease infill development in older less accessible urban areas Delay redevelopment of older, less accessible urban areas Increase decentralization of retail, office and industrial activity</p> <p>Public Facilities Programming</p> <p>Increase demand for new infrastructure Undermine efforts to foster development where capacity exists Increase pressure for extension of urban services</p> <p>Revitalization Activity</p> <p>Undermine efforts to encourage retail, office, or residential development downtown or in older urban areas</p> <p>Industrial</p> <p>Undermine efforts to revitalize and/or redevelop older industrial areas</p> <p>Fiscal</p> <p>Reduce central city's fiscal base Increase local communities public service costs</p> <p>Employment and Housing Opportunities</p> <p>Increase segregation by income and race within central cities and older urban areas Decrease employment opportunities for minorities and the disadvantaged in central city.</p> <p>Energy Consumption</p> <p>Increase transportation-related energy use Increase building energy use in suburban areas</p> <p>Environment</p> <p>Increase exposure to highway noise Encourage development in environmentally sensitive areas Increase air pollution</p>
--

For each potential adverse or beneficial impact, several means of mitigation or enhancement should be examined. Selection of the most appropriate measure or group of measures should be based on consideration of the following factors:

Cost

Timing

Effectiveness and scope of mitigation or enhancement

Legal or institutional obstacles

Optional measures considered and reasons for their rejection

Potential direct or indirect benefits and disbenefits

Change in Beltway Capacity. The number of lanes could be increased or decreased, or additional capacity could be provided in increments to avoid spurring premature or inappropriate development. Reducing capacity should avoid overburdening local infrastructure and draining economic activity out of older urban areas. Benefits of adding capacity might include diverting the maximum amount of traffic from an environmentally sensitive area or from radial highways serving the urban core.

Change in Beltway Location or Interchange Location/Spacing. Moving the beltway closer in or farther out from the central city might change the amount of development likely to occur in the beltway corridor, thus possibly avoiding overloading public facilities and streets or increasing opportunities for nodal development. Interchange spacing could be changed to support land use development objectives such as mixed use, nodal development or urban service areas. Adverse environmental effects—highway noise, flooding, or geologic hazards—also may be avoided or reduced by a change in location. Interchange location and spacing should be evaluated according to the following criteria:

- Consistency with and potential for implementing regional and local land use plans;
- Impact on older urban areas or downtown revitalization programs;
- Impact on the rate of development in urban fringe areas;
- Impact on minorities housing and employment opportunities;
- Impact on the operational integrity of the highway;
- Impact on level of service and traffic flow;
- Increase on energy consumption;
- Demonstrated need;
- Connection to a freeway, expressway, or major arterial; and
- Compatibility with existing or proposed express transit service.

Change in Proposed Use or Density in Interchange Areas. In many cases, the degree of benefit of adverse impact is directly proportional to the proposed density or intensity of use of development in the beltway corridor, particularly in interchange areas. Reducing the number of allowable housing units or square feet of commercial/ industrial space would lower the expected level of impact if coordinated with land use controls for other areas. If the public service needs of one proposed use are significantly higher than another, a change in the mix of uses in a planned unit development (PUD) or major regional center project might eliminate an anticipated overload of existing facilities or congestion on local streets. Adverse effects on business districts in older urban areas also might be reduced.

Density controls might be used to promote land use patterns consistent with regional and local planning goals such as clustered development. For instance, increasing residential densities might be desirable to foster nodal development and reduce energy consumption.

Provide Lower Income Housing. To meet the nation's housing goals and to implement the local housing assistance plans, developers of residential projects over some

prescribed size in the beltway corridor might be required to set aside 10 to 25 percent of the housing units for low and moderate income families, using federal or state financing programs. Requirements for relocation assistance also could be imposed if lower income tenants were displaced by development induced by the beltway, and adequate affordable housing were unavailable. Enactment of appropriate legislation might be necessary to overcome prospective legal challenges to this measure. Developers could be asked to sell or rent some proportion of the new housing at or below 80 percent of median sale price or rent levels in the metropolitan area—a technique known as inclusionary zoning. In preparing housing assistance plans, projection of the numbers "expected to reside" in the community should guide assistance requests.

Modify Construction or Corridor Development Schedule. Delaying construction of the beltway or phasing development and completion of public facilities, schools, utilities, or flood control improvements could eliminate some short-run adverse beltway impacts or encourage a desirable development pattern.

Establish Urban Service Area Boundary. To promote compact development, staged to match local infrastructure capacity, local governments could establish an urban service area boundary delineating the "edge" of development over a given planning period. In the 8 case studies of communities with beltways, examples of urban service area programs were found in Baltimore, Minneapolis, and San Antonio.

Development outside established limits might be permitted if consistent with the long range development plan and applicable environmental standards, and acceptably financed. Such a plan might require the developer to pay the capital costs, operating and maintenance costs becoming a public responsibility.

Finance Needed Off-Site Improvements. Rather than delay beltway construction and related projects, local governments may prefer to ask developers to finance off-site improvements, such as flood control channels or interceptor sewers, necessary to meet minimum service requirements. The expected gains for a developer from early completion with lower construction and land holding costs might be greater than the financing costs with repayment from a public agency at a later date. This option is best when specific funds such as gas tax revenues are earmarked for capital improvements. Then local agencies can count on having sufficient revenues to defray infrastructure costs. Finally, benefit assessment districts could be formed to finance needed infrastructure improvements. However, care should be taken to avoid misuse of this mechanism. The Omaha case study illustrates how improvement districts in unincorporated areas can foster scattered development and increase debt dramatically.

Implement Joint Development Projects. Projects physically and/or functionally related to the beltway, termed joint development projects, could include a mixed-use regional center, a park-and-ride lot for transit patrons, and preferential access for express buses. Rail or bus transit stops could be designed to provide easy access to drivers and built within the highway right of way, reducing land acquisition costs.

Implement Revitalization Program. In older urban areas, downtown revitalization programs using tax-increment financing, tax abatement, community development corporations, available federal and state financing, and private sector participation can counter the attractiveness of a beltway corridor for many types of uses and may

appeal to firms considering a move from downtown. Several Federal programs are designed to assist revitalization efforts; descriptions of these are found in the 1979 Catalog of Federal Domestic Assistance. HUD's Guidebook for Local Government series is a valuable reference on such programs.

Establish a Regional Tax Revenue Sharing Program. Local governments could be compensated for intrametropolitan shifts in retail sales and commercial, residential, and industrial development with a metropolitan tax revenue sharing program, modeled possibly on that established by the Minnesota Legislature for the Twin Cities area.

Improve Access to Older Urban Areas. Delays in completion of radial highways often have made central business districts far less accessible than outlying employment and shopping centers to many metropolitan area residents. A clear example is Baltimore. To remove this obstruction, state highway departments could give radial highway projects high priority. Alternatively, or to complement such highway improvement programs, transit districts could improve service to downtown and within older urban areas.

Annexation. Where local governments have the authority and the willingness to annex suburban areas, including developable lands within the beltway corridor, they may compensate for a potential drain in fiscal resources attributable to a shift in development or economic activity. Columbus, Ohio, by tying extension of services to annexation, has managed to contain a substantial fraction of developing land within city boundaries.

Preservation or Salvage Operations. Archaeological, paleontological, or historic resources threatened by a proposed beltway could be preserved in place by a change in design or location. Alternatively, the beltway could be delayed a sufficient length of time to permit relocation of historic structures or excavation of archeological or paleontological resources.

Pollution Control Measures. Air and water pollution or noise generation, directly or indirectly attributable to the beltway, usually can be controlled by technical means. For example, hydrocarbon emissions from gas stations can be reduced drastically by vapor control devices. Settling ponds can be constructed to contain industrial wastewater for on-site treatment, and noise attenuation barriers can be built to meet ambient noise level standards.

The chart on the next page summarizes the mitigation measures that might reduce or eliminate potential adverse effects.

TABLE 8.2.

MITIGATION MEASURES FOR POTENTIAL ADVERSE EFFECTS OF BELTWAYS

Adverse Effects	Mitigation Measures														
	Change in Capacity	Change in Location	Change in Interchange Spacing	Change in Proposed User/Density in Interchange Areas	Provide Lower Income Housing	Modify Construction or Corridor Development or Establish Urban Service Area Boundary	Finance Needed Improvements	Implement Joint Development Projects	Promote Joint Use R/I/W Program	Implement Revitalization Sharing Program	Establish a Tax Base Improve Program	Annex Access to Older Urban Areas	Annex Developing Areas	Preserve or Salvage Cultural Resources	Pollution Control Measures
Transportation															
Increase trip lengths and total travel (VMT)	•	•	•	•					•		•				
Increase reliance on auto-travel	•	•		•					•	•	•				
Hinder efforts to promote transit and enhance mobility	•	•		•					•	•	•				
Increase congestion on local streets	•	•	•	•			•		•	•					
Land Use															
Increase scattered outlying development	•	•	•			•	•	•	•		•				
Decrease infill development	•	•	•	•		•				•	•	•			
Delay redevelopment of older urban areas	•	•		•		•				•	•	•			
Increase conversion of agricultural land to urban use	•	•	•	•		•	•			•					
Increase decentralization of retail, office, and industrial activity	•	•	•	•		•	•	•	•		•	•	•		
Public Facilities Programming															
Increase demand for new infrastructure	•	•	•	•		•	•	•	•	•	•				
Undermine efforts to foster development where capacity exists	•	•	•	•		•	•			•	•	•			
Increase pressure for extension of urban services	•	•	•	•		•	•	•	•		•				
Revitalization Activity															
Undermine revitalization efforts	•			•		•	•				•	•	•		
Industrial															
Undermine revitalization efforts to revitalize and/or redevelop older industrial areas		•	•	•		•	•				•		•		
Fiscal															
Reduce central city's fiscal base	•	•		•		•	•			•	•	•	•		
Increase local communities public service costs	•	•	•	•		•	•	•	•	•		•			
Employment and Housing Opportunities															
Increase segregation by income and race	•	•			•	•				•		•			
Decrease employment opportunities for minorities and the disadvantaged	•	•	•	•	•	•			•		•				
Energy Consumption															
Increase transportation-related energy use	•	•	•	•		•	•	•	•	•		•			•
Increase building energy use in suburban areas	•			•		•	•			•					
Environment															
Increase exposure to highway noise	•	•		•											•
Encourage development in environmentally sensitive areas	•	•	•	•		•	•			•		•		•	•
Increase air pollution	•	•		•		•		•	•	•		•			•

9. TRADE OFF ANALYSIS: DETERMINING NET BENEFIT

Rigid standards and precise checklists cannot be established for evaluating all possible impacts directly or indirectly attributable to beltways; consequently, decisionmakers will have to balance a project's strengths and weaknesses to determine whether it will be of net benefit to the metropolitan area, to the central cities and to older urban areas. That is, will the benefits outweigh the disbenefits? The opportunity to trade transportation, land use, economic and environmental benefits for potential adverse impacts allows for more flexibility in reviewing beltway proposals and encourages creative planning. One key component of tradeoff analysis is the search for potential means to mitigate adverse impacts and to enhance a beltway's benefits. Consequently, tradeoff analysis builds on and is closely tied to analysis of mitigation and enhancement measures.

The purpose of this section is to outline a procedure for making specific types of tradeoffs as a means of determining net benefit and to describe what compensating factors might justify accepting a beltway's adverse impacts. This chapter does not address issues of economic efficiency or cost-effectiveness analysis or detail how to assess tradeoffs with the no-project alternative, subjects which are treated in detail in other publications.¹

Procedure for Tradeoff Analysis

The first step in tradeoff analysis is to prepare a balance sheet, summarizing the benefits and potential adverse effects of the beltway and viable options which are probable given local conditions. Both effects which will occur with current land use policies and those which would require feasible changes in policy and/or development incentives should be noted, though distinguished from one another. The most important benefit of the beltway is transportation service and related user benefits such as reduced travel time and cost and greater mobility; most other effects will be compared with these benefits. The balance sheet also should include a summary of capital costs and operating and maintenance costs over the planning period, expressed in constant dollars, for each option. Cost-effectiveness measures should be calculated for each option showing the present value of:

- Capital, operating and maintenance costs per daily person-miles of travel on the beltway; and
- Capital cost per hours of travel time saved, compared with the "no-beltway" option.

1 See, for example, U.S. Department of Transportation, Evaluating Urban Transportation System Alternatives (Washington: Office of Transportation Economic Analysis, November 1978) and Transportation Research Board, The No-Action Alternatives - Impact Assessment Guidelines (Washington, National Cooperative Highway Research Program Report No. 217, December 1979).

For each adverse impact directly or indirectly attributable to the proposed beltway, the analyst should go through the following steps:

1. **Is the impact substantial?** If it is not, it probably will be acceptable as long as (a) no feasible mitigation measure can be implemented and (b) it will not violate any federal, state, or local policy, standard, or regulation or community objective.
2. **Can the adverse impact be mitigated?** If so, list the mitigation measures and evaluate them according to the following criteria:
 - a. **Cost:** Public and/or private capital and annual operating and maintenance costs, in constant dollars, over 5, 10, and 20 year periods.
 - b. **Timing:** The number of months required to implement the proposed mitigation measure; expected earliest time of relief for an overloaded public service or facility or an impacted business district.
 - c. **Effectiveness and Extent of Mitigation:** The spatial and temporal dimensions of mitigation. Would commitments be made, for example, to ensure adequate funding for a housing assistance or revitalization program for the time required for those affected to adapt to economic conditions and development patterns with the beltway?
 - d. **Legal or Institutional Obstacles:** Can the local agency or state highway agency implement the measure under existing laws, ordinances, and regulations, or is new legislation needed? If action by another public agency is required, is that agency's present legal authority sufficient, or must additional legislation be enacted? Are trained personnel available, if needed, to monitor the effectiveness of the proposed mitigation measure?
 - e. **Potential Benefits/Disbenefits:** Benefits or adverse impacts directly or indirectly attributable to the proposed mitigation measure should be described and the distributional effects—who gains and who loses—indicated. If benefits can be quantified and a dollar value assigned to them, a benefit-cost ratio calculated.
3. **Can any potential mitigation measures apply to more than one adverse impact?** If so, list the mitigation measures and determine the overall cost-effectiveness, using the criteria listed for Step 1. Advantages and disadvantages of selecting these measures should be analyzed in detail.
4. **For certain adverse impacts there may be no feasible means of minimizing or eliminating the effect of the proposed beltway, or state and/or local agencies may have refused to accept the proposed mitigation measure.** In these cases potential benefits should be related to and compared with the adverse effects to assess which transportation alternative is in the public interest. List the tradeoffs and state why they are justified. Enhancement techniques also could be implemented and benefits attributable to these could compensate for potential adverse effects. These should be evaluated according to the criteria listed in Step 2.

In analyzing projects under Step 4, tradeoffs might be justified by reference to adopted goals and policies of the local communities, policies and programs of other public agencies, or specific interest groups. Whatever the rationale for any given tradeoff, it should be clearly documented, and, wherever possible, specific levels of expected benefit should be described, citing the evaluation criteria impact measures.

To avoid having tradeoff analysis simply be an academic exercise, private sector representatives must commit to work together on an implementation program. Those concerned about beltways' adverse impacts on land use and development patterns and on the economies of central cities and older commercial areas can do much more than has been done in the past to formulate and implement plans and action programs designed to minimize or eliminate such effects. Experience in the case study areas has demonstrated that the most successful planning comes with local initiatives and public and private sector cooperation.

Possible Tradeoffs

To illustrate the proposed procedure for tradeoff analysis and determining net benefit, the potential adverse effects listed in Table 9.1 were examined to determine first, whether tradeoffs would be possible and second, what the compensating factors or benefits might be. Compensating factors range from transportation benefits to fiscal, economic, or social benefits, the potential for reduced natural hazards, high quality design, environmental amenities or additional public facilities. A change in the local land use plan such as a reallocation of proposed land uses or change in densities elsewhere in the community, might provide indirect, long-range benefits rendering acceptable one or more adverse impacts attributable to a beltway.

Transportation Benefits: A beltway that allows through traffic to by-pass the urban core can reduce congestion and improve access to downtown. These gains in mobility may more than offset minor shifts in employment. Gains in corridor accessibility may be judged of sufficiently high priority given commitments to development of major employment centers, possibly with local and even federal government assistance, that the potential shift in medium-high density housing and retail activity that might result in considered acceptable.

Fiscal Benefits: A surplus of revenues over costs might justify no increase in housing opportunities for the disadvantaged in the corridor if these funds could provide housing elsewhere. Increased public revenues might justify loss of open space, if property tax rates were reduced or public services improved.

Additional Public Facilities: Parks, streets, drainage and flood control improvements, or other public facilities constructed or funded by developers, might provide sufficient benefits to the community at large to justify a fiscal "deficit". Additional public facilities also might justify accepting a short term decrease in property values on adjacent sites, loss of open space, potential destruction of archaeological and historic sites, or no increase in housing or employment opportunities for lower income and minority households. The tradeoff here is between long term, communitywide benefits attributable to an improved transportation system and isolated adverse impacts affecting specific interest groups or older urban areas.

Economic Benefits: For every potential adverse impact except flood, fire and geologic/seismic hazards, potential economic benefits such as increased employment or retail sales in one jurisdiction may outweigh anticipated disbenefits, even though sales elsewhere decline in the short-run as long as older urban areas are not severely affected. In this type of tradeoff, it is important to identify who reaps the gains and who must bear the social costs. Are local or metropolitan area gains at the expense of a few disadvantaged households, or are the disbenefits rather equally distributed throughout the community? This tradeoff should be examined in relation to policies established by the President's Community Conservation Guidance.

Social Benefits: New housing, whatever its type or price, may be judged of sufficient benefit to the community to override near term overloading of public services and facilities or adverse economic and environmental impacts. Even though the housing may not specifically meet the needs of lower income families, the elderly, handicapped, or minorities, these groups may indirectly benefit as the impact of new housing filters down through the market, making existing housing more readily available to lower income households.

Reduced Natural Hazards: A beltway which stabilized natural conditions or reduced flooding potential, for example, might have adverse fiscal effects or might not be consistent with federal urban policies because of effects on older urban areas. In the final analysis, however, benefits attributable to reduced natural hazards might counterbalance such expected disbenefits or adverse impacts. Here, the reduced risk of loss of property and life would have to be compared with the value the metropolitan area residents place on these environmental resources.

Determining Net Benefit

The analytical framework presented in this guidebook presents a workable approach to impact assessment as the basis for determining net benefit. By starting with an understanding of how beltways have affected other urban areas, planners, policy analysts, local officials and members of community groups should be able to focus quickly on issues most relevant to their situation, identify critical differences between several options including the no-project alternative, and establish whether a specific beltway proposal meets the net benefit test.

When evaluating the land use and urban development impacts of a specific beltway proposal and measures that may compensate for adverse effects, two key points should be kept in mind:

First, beltways work together with other forces, most of which are more important in determining travel, location, and investment decisions, urban development patterns, and the economic health of central cities and metropolitan areas. Beltways rarely are the causal factor of a particular growth form. Where local land use planning and economic development policies are technically sound, sensitive to economic and environmental constraints, and enjoy strong political support, a beltway may be a benign influence on development trends and the vitality of older urban areas. On the other hand, where market forces are relatively unchecked, gains in accessibility due to beltway construction may significantly alter development trends.

- Second, where theory, intuition, and local experience in specific instances indicate the ability of beltways to effect the full range of potential consequences discussed above, the comparative statistical analysis presented in the Final Report reveals that beltway construction rarely has significant regional consequences. Case studies have shown that where a beltway may be predicted to alter the character of urban growth, local initiative is required to and is capable of reducing or eliminating potential adverse impacts of beltway construction on development patterns, on public facilities programming, on central city economic health, on particularly vulnerable segments of the population, and on the metropolitan environment.

A summary evaluation that places the impacts of a beltway in context and clearly shows how to take advantage of the urban form-giving opportunities without jeopardizing other urban revitalization efforts or compromising local and regional land use policies will improve the urban transportation decision-making process. Further, by involving local, state and federal agencies and affected interest groups in the planning process, rational tradeoffs can be made and necessary commitments to implementation can be secured and the benefits beltways offer realized. Without coordination among land use planners, transportation planners, and local officials, these potential benefits will be lost, and expected adverse affects may very well occur.

APPENDIX A: SELECTED REFERENCES

1. American Society of Planning Officials, Local Capital Improvements and Development Management Literature Synthesis, U.S. Department of Housing and Urban Development, Office of Policy Development and Research, Washington, D.C., 1977.

A critical analysis of the role of capital facilities in implementing development policies and affecting urbanization patterns. The legal issues of growth management also are addressed. Specific attention is given to both radial and belt highway land use impacts (pp. 43-44). Annotated bibliography.

- ** 2. Robert W. Burchell and David Listokin, The Fiscal Impact Guidebook—Estimating Local Costs and Revenue of Land Development, U.S. Department of Housing and Urban Development, Washington, D.C., 1979.

Shows several methods to compute from easily available information about a proposed project, what local costs and benefits will be entailed.

3. David A. Curry and Dudley G. Anderson, Procedures for Estimating Highway User Costs, Air Pollution, and Noise Effects, National Cooperative Highway Research Program, Report 133, Highway Research Board, Washington, D.C., 1972.

This study develops procedures that can be used to select level of traffic service on the basis of user costs and related consequences of air and noise pollution. It is oriented to highway engineers, planners, and policy-makers responsible for the planning and evaluation of highway programs.

4. Jarir S. Dajani and Leonard Ortolano, eds., Methods of Forecasting the Reciprocal Impacts of Infrastructure Development and Land-Use, Stanford: Program in Infrastructure Planning and Management, Department of Engineering, Stanford University, June 1979.

Technical description and criticism of 25 techniques for forecasting the impacts of infrastructure investments on land use.

5. Gladstone Associates, Innovative Financing Techniques: A Catalog and Annotated Bibliography, Institute of Public Administration, Washington, D.C., 1978.

* Available through National Technical Information Service (NTIS), Springfield, VA 22151.

** Available through U.S. Government Printing Office (USGPO), Washington, D.C. 20402.

6. J.S. Lane, L.R. Grezenback, T.J. Martin, and S.C. Lockwood, David A. Crane and Partners/DACP, Incorporated, The No Action Alternative, Impact Assessment Guidelines, Transportation Research Board, National Cooperative Highway Research Program Report 217, Washington, D.C., 1979.
7. Armin K. Ludwig et al., Radial Freeways and the Growth of Office Space in Central Cities, for the U.S. Department of Transportation, May 1977.
8. Syyed T. Mahmood and Amit K. Ghosh ed. Handbook for Community Economic Development, for Economic Development Administration, U.S. Department of Commerce, Washington, D.C., 1979.

Good handbook, well written for easy use, describes data sources for local groups and revitalization techniques.

9. Elaine N. Pierroz, Economic Practices Manual, A Handbook for Preparing an Economic Impact Assessment, State of California, Office of Planning and Research, Sacramento, 1978.
- ** 10. Rahenkamp Sachs Wells and Associates, Inc. and The American Society of Planning Officials, Innovative Zoning: A Digest of the Literature, U.S. Department of Housing and Urban Development, Washington, D.C., 1977.

Excellent annotated bibliography.

- ** 11. Rahenkamp Sachs Wells and Associates, Inc., The American Society of Planning Officials, and David Stoloff, Innovative Zoning: A Local Official's Guidebook, U.S. Department of Housing and Urban Development, 1977.

Description of innovative zoning and its implementation.

- * 12. Systems Design Concepts, Incorporated, Evaluating Urban Transportation System Alternatives, U.S. Department of Transportation, Washington, D.C., 1978.

A comprehensive and practical synthesis of methodologies for evaluation of multi-nodal systems, major highway and tourist corridor improvements and low cost TSM options. Reviewed are procedures for predicting costs and impacts, legal and administrative requirements and tradeoff procedures. Extensive bibliography.

* Available through National Technical Information Service (NTIS).

** Available through U.S. Government Printing Office (USGPO).

- ** 13. U.S. Conference of Mayors, Developing a Local Housing Strategy, A Guidebook for Local Government, U.S. Department of Housing and Urban Development, Washington, D.C., 1979.
- ** 14. U.S. Conference of Mayors, Local Housing Assistance Tools and Techniques, A Guidebook for Local Government, U.S. Department of Housing and Urban Development, Washington, D.C., 1979.
- ** 15. U.S. Conference of Mayors, The Private Development Process, A Guidebook for Local Government, Washington, D.C., 1979.
- ** 16. U.S. Department of Commerce, Bureau of the Census, Construction Statistics Data Finder, Washington, D.C., 1978.
- ** 17. U.S. Department of Commerce, Bureau of the Census, Directory of Federal Statistics for Local Areas: A Guide to Sources, 1976, Washington, D.C., 1978.

Table-by-table description of statistical reports issued by federal departments or agencies prior to January 1, 1977 on areas smaller than States.

- ** 18. U.S. Department of Commerce, Bureau of the Census, Directory of Federal Statistics for Local Areas: A Guide to Sources, Urban Update 1977-1978, Washington, D.C., 1979. ✓
- 19. U.S. Department of Housing and Urban Development, A Guide to the Annual Housing Survey, Office of Policy Development and Research, Washington, D.C., 1979. ✓

An introduction to the purposes, scope, and uses of U.S. Department of Housing and Urban Development's Annual Housing Survey, prepared by the Census Bureau.

- ** 20. U.S. Department of Housing and Urban Development and U.S. Department of Commerce, Economic Development: New Roles for City Government, A Guidebook for Local Government, Washington, D.C., 1979.
- 21. U.S. Department of Housing and Urban Development, Emerging Partnership Opportunities for Cities, Washington, D.C., undated.
- ** 22. U.S. Department of Housing and Urban Development and U.S. Department of Commerce, Local Economic Development Tools and Techniques, A Guidebook for Local Government, Washington, D.C. 1979.

* Available through National Technical Information Service (NTIS).
 ** Available through U.S. Government Printing Office (USGPO).

** 23. U.S. Department of Housing and Urban Development and U.S. Department of Commerce, The Private Economic Development Process, A Guidebook for Local Government, Washington, D.C., 1979.

** 24. U.S. Department of Transportation, Environmental Assessment Notebook Series: Highways, Washington, D.C., 1975.

The Notebook Series seeks to better integrate the transportation planning process and describes techniques for conducting social, economic and physical impact analyses, and organizes them in a readily usable form. This set contains the following notebooks: Identification of Transportation Alternatives, Social Impacts, Economic Impacts, Physical Impacts, Organization and Content of Environmental Assessment Materials, Environmental Assessment Reference Book.

25. U.S. Department of Transportation, Special Area Analysis - Final Manual, Washington, D.C., August 1973.

Provides modelling assistance for evaluation of accessibility, air pollution, noise and dislocation.

26. U.S. Federal Highway Administration, by Planning Environment International, Workbook and Resource Guide: Social and Economic Considerations in Highway Planning and Design Training Course, Washington, D.C., 1977.

Useful workbook for highway planners. Of special interest is "Resources Guide" chapter, describing analytical techniques.

27. U.S. Federal Housing Administration, UTPS Community Aggregate Planning Model, Washington, D.C., July 1977.

Sketch planning tool designed for the preliminary evaluation of large numbers of broadly defined transportation options.

** 28. U.S. Office of Management and Budget, 1979 Catalog of Federal Domestic Assistance, Washington, D.C., 1979.

Contains description of all federal programs indexed by type, administering agency, and eligible participants.

** 29. U.S. Office of Management and Budget, Second Update to the 1979 Catalog of Federal Domestic Assistance, Washington, D.C., 1979.

Details modifications of programs since May 1979 when catalog was published.

** Available through U.S. Government Printing Office (USGPO),
Washington, D.C. 20402

APPENDIX B. BELTWAY IMPACT STUDIES

1. Bone, A.J., and Martin Wohl, Economic Impact Study of Massachusetts Route 128, Massachusetts Institute of Technology Transportation Engineering Division, Cambridge, Mass., 1958.

A study of land use changes, the basic factors causing such changes, and the traffic generating characteristics of industrial development adjacent to the highway.

2. Connally, Julia, The Socio-Economic Impact of the Capital Beltway, University of Virginia, Bureau of Population and Economic Research, Charlottesville, Virginia, 1968.

An analysis of changes in population, land use, real estate activity and traffic volumes attributable to the Capitol Beltway, its effects on industrial location, commuting and shopping patterns, and decisions made by local officials, realtors and businessmen.

3. deLeon, Peter, and John Enns, The Impact of Highways Upon Metropolitan Dispersion: St. Louis, Rand Institute Paper Number P-5061 (Santa Monica, California), 1973.

Analysis of the effects of highway improvements on urban form and the suburbanization of industries.

4. Khasnabis, Snehamay, and Willard Babcock, Impact of a Beltline Type of Freeway Upon a Medium-Sized Urban Area in North Carolina: A Case Study (Raleigh, N.C.: University of North Carolina), 1975.

Analysis of the effects of a beltway on land use, traffic and the environment.

5. The Urban Institute (Muller, Thomas et al.), The Impact of Beltways on Central Business Districts: A Case Study of Richmond, Washington, D.C., April 1978.

Analysis of the effects of beltways on central business districts and a critique of studies undertaken of the proposed beltway around Richmond, Virginia.

6. Smith, Wilbur and Associates, Maryland Capital Beltway Impact Study: Washington SMSA and Maryland Counties, Columbia, S.C., 1968.

Analysis of the effects of the Capital Beltway on urbanization patterns, including economic base, industrial development, recreation activities, institutional activities, work trips, business centers, residential property values, land use, environmental factors, and traffic.

7. Thompson, Russell, William Atkins and Dan Davis, Preliminary Study of the Economic Impact of a Section of San Antonio's Loop 13 Expressway, Texas Transportation Institute, June 1960.

Analysis of land values and use in the Loop 13 corridor.
8. U.S. Department of Transportation, Economic and Demographic Forecasting Team, Suburbanization and Beltways: (Interim report on Beltway Impact Study), May 1972.

Analysis of the relationship between beltways and metropolitan growth patterns.
9. Bochert, John R., Beltline Commercial and Industrial Development Study in the Minneapolis-St. Paul Metropolitan Area, University of Minnesota in cooperation with the Minnesota Highway Department, U.S. Bureau of Public Roads, Minneapolis, 1960.

A comparative study of the present and proposed beltline routes on the west side of the Twin Cities metropolitan area.
10. Langley, C. John, Jr., "Adverse Impacts of the Washington Beltway on Residential Property Values," Land Economics, pp. 54-65, 1976.
11. Levitan, Don, Massachusetts Route 128: A Nonemulative Enigma, Transportation Research Board, Washington, D.C., 1976.

A description of the 40 year period from 1925 to 1965 during which plans were originally developed for 128, the highway was built, and then later widened to handle increasing traffic loads.
12. Maryland State Roads Commission, Economic Impact Studies 1960.

An examination of the effect of the Baltimore Belt on freeway construction sales, subdivision activity, and individual conceptions. Included are maps showing 1952 and 1960 land use and data on a sample of property sales in a Beltway area and a control area.
13. Massachusetts Department of Commerce and Development, Future Development of Eastern Massachusetts Route 495 and Fringe Area, 1963 and 1975-1990, Boston, 1967.

An examination of a circumferential highway passing through urban and rural areas and connecting with several radial highways is examined using the EMPIRIC land use forecasting model. Impacts of two alternative highway plans are examined based on two growth patterns - nodal and low density.

14. National Capital Parks and Planning Commission, Moving People and Goods, Washington, D.C., 1950.

This study advocates ring routes as the basis for the regional plan.

15. Ojala, Carl F. and Paul F. Rizza, "Route 128: A Study of Industry Location Factors," Atlanta Economic Review, pp. 36-39, 1970.
16. Theil, Floyd, "Beltway and Tax Base Impact," Journal of the Urban Planning and Development Division, American Society of Civil Engineers, pp. 105-117.

APPENDIX C. METHODOLOGY

1. Berry, Brian J. L., (ed.), City Classification Handbook: Methods and Applications, Wiley-Interscience, New York, 1972.

Contains 12 essays grouped into five sections as follows: methodological background, dimensions of variation and derivation of classes; uses of city classification in social and political research; alternative modes of classification and types of cities; strengths and weaknesses of classification procedures; and a final overview.

2. Bishop, A. Bruce, C.H. Oglesby, and Gene E. Willike, Socio-Economic and Community Factors in Planning Urban Freeways, Project on Engineering-Economic Planning of Stanford University, Stanford, California, 1969.
3. Canty, Eugene T. and Thomas F. Golab, Procedure for Estimating National Market and Total Socio-Economic Impacts of New Systems of Urban Transportation, Highway Research Record, No. 399, 1972, pp. 87-98.
4. Charles River Associates, Measurement of the Effects of Transportation Changes, Prepared for the Urban Mass Transportation Administration, Cambridge, Mass., 1972.

Presents a review of transit and highway impact studies and a conceptual framework for evaluating the impacts of transportation changes. Specific literature is reviewed, research designs for impact analysis are proposed, data collection methods are described, and recommendations for further research are presented.

Highway impact studies were most severely criticized because they lacked a theoretical foundation, focused mainly on corridor effects ignoring issues of transferability, assumed the validity of a "before-after" methodology, and did not adequately distinguish user benefits from indirect land use and development effects. The authors concluded that a before-after research design is inappropriate unless more than two time periods are included.

5. Charles River Associates, Policy Evaluation with Travel Behavior Models: Methodological Issues and Case Studies, U.S. Department of Transportation, Cambridge, Mass., 1979.

This report presents applications of recent advances in travel demand model estimation to current policy issues and, based on these findings, makes recommendations for further improvements in travel behavior forecasting.

6. Christensen, Kathleen, Social Impacts of Land Development, The Urban Institute, Washington, D.C., 1976.

This report explores changes in the physical environment of a neighborhood, and how these changes may affect the neighborhood as a social environment. Discusses recreation patterns at public facilities, shopping opportunities, pedestrian mobility, etc. Tables and diagrams. Bibliography has references on case studies, data collection methodology, legal background, and general related reading.

7. Erickson, Paul A., George Camougis, and Edward J. Robbins., Highways and Ecology: Impact Assessment and Mitigation, New England Research, Inc., for Federal Highway Administration, 1978.

This book uses an ecosystem approach to impact assessments. The components and dynamics of terrestrial, aquatic and wetland ecosystems are described. Potential biological and ecological impacts of a highway project are also described. Extensive bibliography.

8. Faucett (Jack) Associates, Methodology for Relating Highway Investment to Regional Economic Activity: Interim Report, Silver Spring, Maryland, 1970.

9. Keefer, Louis, Urban Travel Patterns for Airports, Shopping Centers, and Industrial Plants, National Cooperative Highway Research Program Report 24, Transportation Research Board, Washington, D.C., 1966

This research was initiated to determine the criteria or values which establish the travel patterns created by various major traffic generators. The initial project specified the study of airports, shopping centers and industrial areas in cities of more than 50,000 population. The nature of relationships between travel patterns and the various characteristics of traffic generators, the transportation network, and the contributory area are evaluated for these three types of land use. Contains annotated bibliography.

10. Mehta, Rajendra K. and Frank L. Ventura, A Method of Predicting the Effect of Long Range Transportation Plans on Residential Land Use Activities, Warren, Mich., 1973.

11. U.S. Department of Housing and Urban Development, Office of Community Planning and Development, Pockets of Poverty: An Examination of Needs and Options, Washington, D.C, 1979

This report examines the effectiveness of present UDAG (Urban Development Action Grant) eligibility criteria, the distribution of Federal aid to UDAG eligible and non-eligible areas, and the extent of local commitments to pockets of poverty. It contains a strong discussion of methodological issues underlying the selection of specific factors or variables as measurements of urban distress.

12. U.S. Department of Housing and Urban Development, Office of Community Planning and Development, Urban Policy Staff, Urban and Community Impact Analysis: Handbook and Prototypes, Washington, D.C., 1978.

The purpose of this handbook is to provide guidance to Federal agencies in preparing urban and community impact analyses.

13. Voorhees, Alan M. and Associates, Inc., Guidelines to Reduce Energy Consumption Through Transportation Actions, U.S. Department of Transportation, Washington, D.C., May 1974.

PARTICIPATING STAFF

BLAYNEY-DYETT, URBAN AND REGIONAL PLANNERS

Michael V. Dyett, Partner in Charge
John A. Blayney
Michael Fajans
Mary C. King
Marlene Friedman
Nicklaus von Rotz
Jane W. Parker
Kate O'Leary

PAYNE-MAXIE CONSULTANTS

James Payne, Partner in Charge

RESOURCE PANEL

H. James Brown, Harvard University
Robert Knight, Sage Mangement Consultants

S.C.R.T.D. LIBRARY