



guide for
park-and-ride facilities

park ride

november 2004



American Association of State
Highway and Transportation Officials

AVA Documents
Document Sharing Hub

GUIDE FOR PARK-AND-RIDE FACILITIES

OCTOBER 2004



Prepared by the
Task Force on Public Transportation Facilities Design
AASHTO Subcommittee on Design

Published by the
American Association of State Highway and Transportation Officials
444 North Capitol Street, N.W., Suite 249
Washington, D.C. 20001
(202) 624-5800
www.transportation.org

© 2004 by the American Association of State Highway and Transportation Officials.
All rights reserved. This book, or parts thereof, may not be reproduced in any form without
written permission of the publisher. Printed in the United States of America.

Publ. Code: GPRF-2

ISBN # 1-56051-294-6



AASHTO 2004–2005 Executive Committee

Voting Members

Officers:

President: J. Bryan Nicol, Indiana

Vice President: Jack Lettiere, New Jersey

Secretary-Treasurer: Larry M. King, Pennsylvania

Regional Representatives:

REGION I: Allen Biehler, Pennsylvania, One-Year Term
Dan Tangherlini, District of Columbia, Two-Year Term

REGION II: Fernando Fagundo, Puerto Rico, One-Year Term
Harold Linnenkohl, Georgia, Two-Year Term

REGION III: Gloria Jeff, Michigan, One-Year Term
Frank Busalacchi, Wisconsin, Two-Year Term

REGION IV: Tom Norton, Colorado, One-Year Term
David Sprynczynatyk, North Dakota, Two-Year Term

Nonvoting Members

Immediate Past President: John R. Njord, Utah

Executive Director: John Horsley, Washington, DC

Technical Committee on Public Transportation Facilities Design

Members

Region I Luisa Paiewonsky, Massachusetts

Region II Joseph P. Palladi, Georgia
Michelle D. Hoffman, Maryland
Stephen Bates, Virginia

Region III Michael Christensen, Minnesota

Region IV Antonette C. Clark, California
Myron Swisher, Colorado
Carlos A. Lopez (Chair), Texas
Dave McCormick, Washington

Ad Hoc Members

Jim McDonnell, AASHTO
Dennis Christiansen, Texas Transportation Institute
Chuck Fuhs, Parsons Brinckerhoff Quade and Douglas, Inc.
Robert Schlicht, FHWA
Jon Obenberger, FHWA

Representing the TRB HOV Systems Committee

Dave Schumacher, Metropolitan Transit Development Board, San Diego
Katherine Turnbull, Texas Transportation Institute
Agnes Govern, Sound Transit, Seattle
Thomas W. Mulligan, City of Mississauga, Ontario

AASHTO Highway Subcommittee on Design

Chair: Allen D. Biehler, Pennsylvania

Vice Chair: Susan Martinovich, Nevada

Secretary: Dwight A. Horne, FHWA

Liaison: Jim McDonnell, AASHTO

State Member

Alabama	Don T. Arkle Steven E. Walker, P.E.
Alaska	Gary Hogins, P.E.
Arizona	John L. Louis
Arkansas	Phillip L. McConnell Charles D. Clements
California	Mark Leja
Colorado	Dean Van DeWege
Connecticut	Carl F. Bard Arthur W. Gruhn James H. Norman
Delaware	Michael A. Angelo Kevin Canning Michael H. Simmons
District of Columbia	Kathleen Penney Zahra Dorriz Allen Miller
Florida	Brian A. Blanchard, P.E. Robert Greer Jim Mills, P.E.
Georgia	Thomas L. Turner, P.E. James “Ben” Buchan, P.E.
Hawaii	Gary C.P. Choy Julius Fronda
Idaho	Loren D. Thomas Steven C. Hutchinson
Illinois	Michael Hine
Indiana	Gerald Mroczka
Iowa	Michael J. Kennerly David L. Little William J. Stein
Kansas	James O. Brewer Richard G. Adams LaMonte C. Armstrong

Kentucky	Kenneth Sperry, P.E. David Jones Gary W. Sharpe, P.E.
Louisiana	N. Kent Israel Nicholas Kalivoda, III Lloyd E. Porta
Maine	Jerome A. Casey, P.E.
Maryland	Kirk G. McClelland Robert D. Douglass
Massachusetts	John Blundo, P.E. Stanley Wood, Jr.
Michigan	Mark Van Port Fleet
Minnesota	Richard A. Elasky Mukhtar Thakur
Mississippi	David Foster John B. Pickering, P.E. Keith Purvis
Missouri	David B. Nichols Diane Heckemeyer
Montana	Carl S. Peil Paul R. Ferry Ronald E. Williams
Nebraska	Don Turek Dawn Allyn Eldon D. Poppe
Nevada	Wayne Kinder
New Hampshire	Craig A. Green
New Jersey	Richard W. Dunne Arthur J. Eisdorfer Robert A. Signora
New Mexico	Roy Maestas Dennis Peralta Max Valerio
New York	Phillip J. Clark Daniel D'Angelo, P.E. Richard W. Lee
North Carolina	Jay A. Bennett, P.E. Deborah M. Barbour Art McMillan
North Dakota	Mark Gaydos
Ohio	Cash Misel Larry F. Sutherland, P.E.

Oklahoma	Christine M. Senkowski, P.E. Bruce E. Taylor
Oregon	Thomas Lauer
Pennsylvania	Dean A. Schreiber, P.E.
Puerto Rico	Ariel Pérez José E. Santana-Pimentel
Rhode Island	J. Michael Bennett, P.E.
South Carolina	Robert I. Pratt Rocque L. Kneece, P.E. John V. Walsh, P.E.
South Dakota	Joel Gengler Joe J. Feller
Tennessee	Jeff C. Jones James Zeigler
Texas	Mark A. Marek
Utah	Jason E. Davis
Vermont	Robert F. Shattuck
Virginia	Mohammad Mirshahi, P.E.
Washington	Harold Peterfeso Richard Albin
West Virginia	Norman H. Roush, P.E. David E. Clevenger Randolph T. Epperly, Jr.
Wisconsin	Beth Cannestra Robert F. Pfeiffer
Wyoming	Paul P. Bercich

U.S. DOT Member

FAA	Rick Marinelli, P.E
------------	---------------------

Associate Member—Bridge, Port, and Toll

N.J. Turnpike Authority	J. Lawrence Williams
Penn. Turnpike Commission	Barry L. Troup, P.E.
Port Authority of NY and NJ	Yue Sun Chen

Associate Member—Federal

USDA Forest Service	Deborah Beighley
----------------------------	------------------

Associate Member—International

Alberta	Allan Kwan
British Columbia	Richard Voyer
Ontario	Joe Bucik
Saskatchewan	Sukhy Kent





Table of Contents

LIST OF FIGURES	xii
LIST OF TABLES	xiv
ACKNOWLEDGMENTS	xv
CHAPTER 1 ORGANIZATION OF GUIDE	1
CHAPTER 2 DEFINING THE PARK-AND-RIDE FACILITY	3
2.1 Classifying the Park-and-Ride Lot	3
2.1.1 The Park-and-Ride System as a Mode of Transportation	3
2.1.2 The Park-and-Ride Lot as a Facility	4
2.2 Park-and-Ride Facilities Defined by Function	4
2.2.1 Informal Park-and-Ride Lots	4
2.2.2 Opportunistic or Joint-Use Lots	4
2.2.3 Park-and-Pool Lots	5
2.2.4 Suburban Park-and-Ride Lots (As Defined by Use)	5
2.2.5 Transit Centers (Intermodal Transit Center)	6
2.2.6 Satellite Parking Facilities	6
2.3 Park-and-Ride Facilities Defined by Distance to Destination Market	7
2.3.1 Suburban Park-and-Ride Lots (As Defined by Location)	7
2.3.2 Remote Long-Distance Lots	8
2.3.3 Local Urban Park-and-Ride Lots	8
2.3.4 Peripheral Park-and-Ride Lots	9
2.4 The Changing Role of the Park-and-Ride Facility	9
CHAPTER 3 PARK-AND-RIDE PLANNING PROCESS	11
3.1 System Planning Process	11
3.1.1 The System Study	12
3.1.2 System Inventory	13
3.1.3 Purpose and Need	14
3.1.4 Goals/Objectives/Measures of Effectiveness	14
3.1.5 Service Network	16
3.1.6 Policy-Level Environmental/Investment Analysis	16
3.1.7 Public Involvement	16
3.1.8 Intergovernmental Agreements	17
3.2 Site-Level Location and Design Studies	17
3.3 Final (Detail) Design and Construction	19
3.4 Making the Suburban Park-and-Ride Facility Location Decision	20
3.4.1 Locating Park-and-Ride Facilities to Assure Strong Patronage Demand	21
3.4.2 Locating Park-and-Ride Facilities to Provide for Community Integration	26

3.4.3	Locating Park-and-Ride Facilities to Reduce Implementation Costs and Financial Risk	27
3.4.4	Summary	29
3.5	Suburban Park-and-Ride Demand Estimation Techniques	30
3.5.1	Overview and Background	30
3.5.2	Regional Modeling Approach for Site-Specific Suburban Park-and-Ride Facilities	30
3.5.3	Site-Level Forecasting for Suburban Park-and-Ride Lots Based on Site and Service Characteristics	34
3.5.4	Summary	44
CHAPTER 4	OPERATIONS AND MAINTENANCE OF PARK-AND-RIDE FACILITIES	45
4.1	Access Management	45
4.1.1	Unsignalized Access Spacing (Driveway-to-Driveway Spacing)	46
4.1.2	Corner Clearance Criteria (Driveway-to-Intersection Spacing)	49
4.2	Priority Treatments	49
4.2.1	Ramp Metering with HOV Bypass Lane	49
4.2.2	Signal Priority on Surface Streets for Transit Vehicles	50
4.2.3	Queue Bypass Lanes on Surface Streets for Transit Vehicles	52
4.3	Signing	54
4.3.1	Guide Signs to the Facility	56
4.3.2	Facility Signs	57
4.3.3	Sign Board Location and Placement	58
4.4	Intelligent Transportation Systems	59
4.4.1	Electronic Fare Payment	60
4.4.2	Traveler Information	60
4.5	Maintenance	61
4.6	Performance Monitoring	62
CHAPTER 5	DESIGN CONSIDERATIONS FOR PARK-AND-RIDE FACILITIES	63
5.1	Functional Zones of a Transit Facility	64
5.2	Community Integration	64
5.2.1	Land-Use Coordination and Integrated Park-and-Ride Facilities	66
5.2.2	Organization of Surrounding Land Use	68
5.2.3	Locate Supporting Land Uses in Proximity to the Park-and-Ride Facility	70
5.2.4	Identify Joint-Use Development Opportunities Related to Existing and Future Park-and-Ride Facilities	72
5.3	Pedestrian and Passenger Facility Requirements	77
5.3.1	Facility Layout Based on Pedestrian Access Needs	77
5.3.2	Pedestrian Design Summary	77
5.3.3	Separation of Competing Modes	78
5.3.4	Pedestrian Pathways	79
5.3.5	Pedestrian Waiting Areas	80
5.3.6	A Safe Environment	81
5.3.7	Bicycle Access	86

5.4	Accessibility for Persons with Disabilities	88
5.5	Providing for the Transit Vehicle	88
5.5.1	The Transit Design Vehicle	90
5.5.2	Transit Vehicle Maneuverability and Access Requirements	91
5.5.3	Turning Radii and Design of Curb Returns	91
5.5.4	Acceleration and Maximum Negotiable Grades	93
5.5.5	Adequate Clear Sight Distance	93
5.5.6	Traversing Driveways, Raised Pedestrian Pathways, Traffic-Calming Devices, and Railroad Crossings	95
5.5.7	Bus Access and Parking Requirements	96
5.5.8	Pavement and Cross-Section Requirements	98
5.5.9	Other Design Considerations	101
5.6	Providing for the Private Automobile	104
5.6.1	Facility Type (Surface or Structured)	105
5.6.2	Parking Layout	105
5.6.3	Parking Stall Alignment and Dimensions	106
5.6.4	On-Site Circulation	108
5.6.5	Parking Demand Management	109
5.6.6	Paving Requirements	109
5.6.7	Drop-and-Ride Activities	110
5.7	Drainage Requirements	110
5.8	Illumination Requirements	111
 CHAPTER 6 ARCHITECTURE, LANDSCAPE, AND ART: INTEGRAL PARTS OF THE PARK-AND-RIDE FACILITY		 113
6.1	Art and Architecture	113
6.1.1	Justification for Art	113
6.1.2	An Argument for Permanence	114
6.1.3	When to Incorporate Art and Architecture	114
 GLOSSARY OF TERMS		 125
 ABBREVIATIONS		 132
 REFERENCES		 135

List of Figures

Figure	Title	
2-1	Park-and-Ride Lots by Distance	7
3-1	Park-and-Ride System Planning Process	12
3-2	Park-and-Ride Site-Level Study Process	19
3-3	Siting a Park-and-Ride Lot	22
3-4	Combined Radial/Circumferential Commute Pattern	24
3-5	River Stone Embedded in Concrete	25
3-6	Open Shelter Design	26
3-7	Common Barriers to Pedestrians and Nonmotorized Access to Be Avoided or Mitigated	28
3-8	Overview of Park-and-Ride Demand Estimation Methodology	31
3-9	Estimated Market Catchment Area	36
3-10	Park-and-Ride Service Area	36
3-11	Alternative Service Area Concept	36
3-12	Peripheral Park-and-Ride Market Demand Shed (Approximated)	37
3-13	Park-and-Ride Demand Estimation Equations	43
4-1	Example of a Queue Jumper Bus Bay	53
4-2	Queue-Jumper Bus Bay Layout	54
4-3	Bus Queue Jump Concept with Exclusive Signal	55
4-4	Facility Sign Examples	57–58
4-5	Park-and-Ride Guide Signing Examples	59
5-1	Example Park-and-Ride Layout for a Small-Sized Lot	65
5-2	Small-Sized Lot with Parking Structure	66
5-3	Example Park-and-Ride Layout for a Medium-Sized Lot	67
5-4	Example Park-and-Ride Layout for a Large-Sized Lot	68
5-5	Functional Zones of a Transit Facility	69
5-6	Multimodal Approach to Park-and-Ride Lots (Bicycle Storage Rack)	70
5-7	Auto-Transit Park-and-Ride Interface	71
5-8	Pedestrian Underpass at a Park-and-Ride Lot	72
5-9	Park-and-Ride as Community Focal Point	73
5-10	On-Site Focal Point/Icon	74
5-11	Joint-Use Park-and-Ride Facility—Historic Firestation	75
5-12	Joint-Use Park-and-Ride Facility—Espresso Shop	76
5-13	Walking Distances Under Normal Conditions	78

5-14	Prototype Park-and-Ride Facilities	79
5-15	Raised Pedestrian Pathway/Traffic Hump/Speed Table	80
5-16	Passenger Facility Location	82
5-17	High Canopy Shelter Design	83
5-18	Designing a Defensible Space—Mixed-Use Park-and-Ride Facility	84
5-19	Designing a Defensible Space—Business Facing Park-and-Ride Facility	85
5-20	Designing a Defensible Space—On-Site Bakery and Shops	86
5-21	Designing a Defensible Space—Community “Crime Stoppers” Program	87
5-22	Designing a Defensible Space—Security Camera in Park-and-Ride Facility	88
5-23	On-Site Security Office	89
5-24	Bicycle Racks and Storage Facilities	89
5-25	Bicycle Storage Units	90
5-26	Minimum Turning Path for Intercity Bus (Bus-12 [Bus-40]) Design Vehicle	94
5-27	Minimum Turning Path for Intercity Bus (Bus-14 [Bus-45]) Design Vehicle	95
5-28	Minimum Turning Path for City Transit Bus (CITY-BUS) Design Vehicle	96
5-29	Minimum Turning Path for Articulated Bus (A-BUS) Design Vehicle	97
5-30	Bus Underside Clearance Angles	98
5-31	Bus Bay Configurations	99
5-32	Linear Bus Bay Design—On-Street	100
5-33	Linear Bus Bay Application—On-Street	101
5-34	Linear Bus Bay Design—Off-Street Inside Park-and-Ride Lot	101
5-35	Sawtooth Bus Bay Design	102
5-36	Sawtooth Bus Bay Application	102
5-37	Bus Loop Application	103
5-38	Pavement Cross Section	104
5-39	Preferred Parking Stall Layout	106
5-40	Angled Versus 90-Degree Parking	107
6-1	Mural on Shelter	116
6-2	Braeswood Park-and-Ride	117
6-3	Bus Sculpture	117
6-4	Stained-Glass Tiger	118
6-5	Overlake Park-and-Ride Shelter	118
6-6	Escondido Transit Center	119
6-7	Shelter at Pavilion Park-and-Ride	120
6-8	Art at Aurora Village Transit Center	120
6-9	Transit Sculpture	121
6-10	Mixed-Use Park-and-Ride	122
6-11	Ocean Theme on Shelter	123
6-12	Aurora Village Shelter Art	124

List of Tables

Table	Title	
2-1	Park-and-Ride Facility Classification by Function	5
2-2	Park-and-Ride Facilities by Distance to Destination Market	8
3-1	Contributing Factors to Park-and-Ride Demand	38–40
3-2	Cross-Correlation Matrix of Independent Park-and-Ride Demand Regression Variables	44
4-1	Unsignalized Access Spacing Comparisons Based Upon Spillback—Metric	47
4-2	Unsignalized Access Spacing Comparisons Based Upon Spillback—U.S. Customary	48
4-3	Summary of Bus Signal Priority (BSP) Strategies	51
5-1	Average Walking Distances in Meters (Feet) by Purpose and Population Size	78
5-2	Rail and Bus Station—Pedestrian Level-of-Service on Walkways	81
5-3	Bus Vehicle Dimensions—Metric	92
5-4	Bus Vehicle Dimensions—U.S. Customary	92
5-5	Minimum Travel Way Designs for City Transit Buses—Metric	93
5-6	Minimum Travel Way Designs for City Transit Buses—U.S. Customary	93
5-7	Parking Stall Dimensions	108
5-8	Recommended Maintained Lighting Levels	111

Acknowledgments

AASHTO's Technical Committee on Public Transportation Facilities Design is indebted to the many contributors to this guide. The foundational basis of the guide was the *Park-and-Ride Planning and Design Guidelines, Monograph 11* (October, 1997), developed by Robert J. Spillar, Parsons Brinckerhoff Quade and Douglas, Inc. Under the guidance of Technical Committee members, Mr. Spillar's monograph was supplemented by recent developments in park-and-ride facility planning and design. In addition, excerpts from *NCHRP Report 414, HOV Systems Manual* were used. Supplemental background research and editing was accomplished by Ginger Daniels Goodin, Michael Martello, and William Eisele, of the Texas Transportation Institute, with Ivan Lorenz developing and editing graphics and Heather Ford performing the word processing. Special thanks go to Elizabeth Morgan and Dale Cummings of King County Metro Transit in Seattle for assistance with photographs. The Technical Committee also wishes to thank the many individuals who provided comments and feedback during the peer review process.



Chapter 1

Organization of Guide

The guide is divided into six primary chapters. Each chapter is organized as a stand-alone treatise and deals with a unique element of the planning and design process. A description of each follows:

CHAPTER 2—DEFINING THE PARK-AND-RIDE SYSTEM

A park-and-ride nomenclature is developed to assist in the classification of facilities for planning purposes. Understanding the extended market of the park-and-ride (P&R) facility, as well as the type of lot to be developed, can greatly assist the planning agency in developing policies towards implementing a successful park-and-ride program.

CHAPTER 3—PARK-AND-RIDE PLANNING PROCESS

A sound planning process is fundamental to the development of a successful park-and-ride program. A process for planning both a park-and-ride system as well as individual facility development is outlined in this chapter. A robust public involvement process is a major feature of these planning approaches and is used to integrate the concerns and needs of the community with the planning and design of a successful program.

Selecting the right location for the park-and-ride facility is perhaps one of the most important elements in assuring a successful lot. Based on industry experience, there are a number of rules of thumb that can be employed in choosing candidate locations for in-depth analysis and preliminary design. Many agencies have developed their own anecdotal indicators for selecting successful park-and-ride locations. This chapter may assist the designers and planners when seeking to implement park-and-ride facilities in areas with little or no previous experience with the park-and-ride concept.

Suburban park-and-ride lots represent one of the largest and most important types of park-and-ride facilities. They are of interest to transit planners because they can provide opportunities to aggregate transit demand and support high frequency transit services in suburban environments. Likewise, they are of interest to urban planners because they can provide a mechanism for enhancing a sense of identity within the suburban community and encourage transit-friendly developments in the surrounding properties. Fundamental to the development of successful suburban park-and-ride facilities is the need to estimate accurately and reliably future parking demand for the facility. In this chapter, several methods are explored for estimating suburban park-and-ride demand.

CHAPTER 4—OPERATIONS AND MAINTENANCE OF PARK-AND-RIDE FACILITIES

The park-and-ride facility should operate or function in a manner that promotes safety, mobility, and efficiency. It should strive to operate in a manner that promotes fuel efficiency, reduces pollution, and improves “quality of life” issues of the community. These goals are not always complimentary and trade-offs or pros and cons of various alternatives must be evaluated.

The design of a park-and-ride facility is inextricably linked to how it operates, and the distinction between what are labeled as “design” considerations versus “operational” considerations is often blurred. For purposes of this guide, concepts such as access management, priority treatments for high-occupancy vehicles

(HOVs) and transit vehicles, on-site and off-site signing, and intelligent transportation system (ITS) technology will be classified as operational considerations. All can play a role in the park-and-ride facility's operation.

CHAPTER 5—DESIGN CONSIDERATIONS FOR PARK-AND-RIDE FACILITIES

A range of design options exists for individual park-and-ride facilities. The park-and-ride facility can be designed as a bare-bones parking lot with the intent of providing maximum efficiency only. Also, the park-and-ride facility can be designed as an integral part of the surrounding community, providing an integrated gathering place for a range of activities. A synthesis of design concepts and elements is provided in this chapter.

CHAPTER 6—ARCHITECTURE, LANDSCAPE, AND ART: INTEGRAL PARTS OF THE PARK-AND-RIDE FACILITY

It must be remembered that above all else, transit facilities and specifically park-and-ride lots are people places. By integrating art into the park-and-ride facility and by utilizing sound concepts of landscape and architectural design, the park-and-ride lot can become much more than just another parking facility. It can become a focal point for the surrounding suburban community or neighborhood in which it is located.

Examples of integrating such aesthetic concerns with successful transit facilities are provided in this chapter, ranging from inexpensive community art programs to elaborate architecturally elegant transit centers. The purpose of this chapter is to provide decision makers and planning/design professionals with a concept library of unique architectural and artistic designs.

Information presented in this guide is intended to provide a general knowledge of the park-and-ride planning and design process. Applicable local ordinances, design requirements, and building codes must be consulted for their effect on the planning and design process. Local data resources, development patterns, and transit networks may present unique opportunities for park-and-ride implementation and should be explored.

Chapter 2

Defining the Park-and-Ride Facility

Park-and-ride facilities have existed in one form or another since the mid-1920s. Early public investment in park-and-ride lots in most American urban areas began in response to increasing global oil prices and a renewed interest in mass transit. Thus the park-and-ride concept is not new to many areas of North America, and much has been learned within the industry over the past 30 years. The need and desire for HOV applications will increase as many of our traditional roadways become more congested. As with other transit facilities and modes, the industry's current planning and design knowledge base has evolved from a combination of positive and negative experiences with the technology.

The purpose of this chapter is to provide a framework for a discussion of park-and-ride facilities. A number of labels has been developed to describe specific types of park-and-ride lots, and it is helpful to understand the terminology when evaluating options for providing such services. In general, these terms can be applied regardless of the transit mode being served.

2.1 CLASSIFYING THE PARK-AND-RIDE LOT

Park-and-ride lots can be classified as intermodal transfer facilities. They provide a collection point for travelers to transfer between the auto mode and transit (bus or rail), or between the single occupant vehicle (SOV) and other higher occupancy vehicle (vanpool or carpool) modes. With planning and forethought, park-and-ride lots can serve a wide array of intermodal transfers, thereby increasing the activity at the park-and-ride facility and better integrating it with the surrounding community. Other modes potentially supported by a park-and-ride facility include pedestrian, bicycle, paratransit, intercity bus transit, airport service, and intercity and commuter rail.

The United States federal government, through the Intermodal Surface Transportation Efficiency Act (ISTEA) over fiscal years 1992–1997 and subsequent actions by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), prioritized multimodal and intermodal projects over those that encourage the continued reliance on the single occupant vehicle in urban areas. Over fiscal years 1998–2003, the Transportation Equity Act for the 21st Century (TEA-21) has built upon ISTEA's emphasis on intermodal connections. Such a prioritization is also encouraged by the realities of limited infrastructure budgets at the local, state, and federal levels, which necessitate wise public investment.

The park-and-ride facility clearly fits the definition of a multimodal and intermodal facility. The park-and-ride lot, if carefully planned and integrated into a comprehensive transportation system, can encourage a shift from the single occupant vehicle to higher occupancy modes, meeting the efficiency needs of future urban travel markets while addressing related issues such as congestion mitigation and air quality.

2.1.1 The Park-and-Ride System as a Mode of Transportation

As an intermodal staging location for transfers between numerous transport modes, park-and-ride facilities have traditionally been viewed as only a component of the larger transit or highway auto-oriented modes. If examined from a systems perspective, however, a park-and-ride network can be recognized as having unique modal characteristics, not shared by either the traditional transit or highway modes. These unique characteristics include demand patterns, service area concepts, patron attributes, transit operating concepts, and modes of access.

With these unique characteristics, the park-and-ride system provides increased opportunities over other modes of transit for private investment and private-public partnering. A healthy park-and-ride system can be used strategically to encourage urban development in lower density suburban environments. It can, however, also lead to continued dispersed low-density development, depending upon the location and design of the individual facilities within the system.

2.1.2 The Park-and-Ride Lot as a Facility

A number of previous researchers, implementing agencies, and transit operators have sought to categorize park-and-ride lots by the function they provide or by their distance from the destination market that they serve. As the principal function of the park-and-ride facility continues to evolve, and as urban areas continue to grow, it is likely that what is meant by “park-and-ride facility” will also continue to evolve. The definitions provided in this chapter represent those currently used within the industry and are provided to develop a vocabulary for the transportation planner and engineer.

2.2 PARK-AND-RIDE FACILITIES DEFINED BY FUNCTION

A hierarchy of park-and-ride facilities can be developed based on the functional characteristics of the individual park-and-ride lot. Such a classification system can be beneficial when determining the intended use of a lot and the appropriateness of public investment in the planned facility. Six facility types—can be identified based on functional characteristics—ranging from the informal park-and-ride lot to the design-intensive suburban park-and-ride lot. A summary table of facility functions and characteristics can be found in Table 2.1.

2.2.1 Informal Park-and-Ride Lots

The informal park-and-ride lot is often simply a transit stop to which motorists regularly drive their cars and leave them parked on-street or in an adjacent property. Such impromptu park-and-ride operations may indicate the need for a higher order facility providing a safer environment for patrons and a more identifiable presence for transit. Informal park-and-ride lots can also be locations where carpool or vanpool formation takes place. These non-transit operations are often more difficult to discern within the urban fabric than are those connected with a transit stop. Informal park-and-ride lots can be close to the primary service destination or at great distance from it. The key to their formation is convenient access. They are often found at the intersection of major arterials or upstream of recurring congestion points or other natural geographic barriers to travel. Public investment in informal park-and-ride facilities is typically non-existent. Private investment is possible, but unlikely.

2.2.2 Opportunistic or Joint-Use Lots

Opportunistic or joint-use lots are characterized as sharing the facility with another activity such as a church, theater, shopping mall, or special events center. The park-and-ride activity can be either the secondary or primary use of the facility, depending upon the desired orientation and opportunity provided. Joint-use lots can be constructed or procured at relatively low cost and developed fairly quickly if opportunities exist within the existing land use environment to encourage such facilities (e.g., available parking facilities which are unused during peak commuting hours). A primary concern when establishing a joint-use lot is the arrangement of a long-term relationship between the implementing agency and the parking lot owner, usually requiring a two- to five-year commitment on both parts. Benefits may accrue to private parking lot operators.

Opportunistic lots can also describe smaller lots built near a local bus stop or major roadway intersection, taking advantage of surplus highway right-of-way or vacant lands. In most cases, opportunistic or joint-use lots tend to be smaller than other lots, ranging between 5 and 30 spaces, but are occasionally quite

TABLE 2-1. Park-and-Ride Facility Classification by Function.

Facility Type	Function	Characteristics	Public Investment
Informal Park-and-Ride Lots	Access to transit stop	Motorists park on-street or in an adjacent property	None
Opportunistic or Joint-Use Lots	Access to transit, carpooling, vanpooling	Shared use with church, theater, shopping mall, special events center, or use of surplus right-of-way	High or low depending on agreement with property owner
Park-and-Pool Lots	Carpool and vanpool formation	Typically small; may be opportunistic lot	High or low depending on agreement with property owner
Suburban Park-and-Ride Lots	Collect potential transit patrons in suburban areas for line-haul express transit service	Located at outer edges of urban landscape; private auto as collect/distribute mode, transit (bus, rail) as line-haul mode	Usually public investment, but opportunities for joint development and multi-use facility are high
Transit Centers (Intermodal)	Park-and-ride function integrated with center where interchange of local and express transit takes place	In high demand locations; offers patrons a much higher degree of travel services, route choices, and destination alternatives	High public investment but image of permanence can generate opportunities for private investment
Satellite Parking Facilities	Provides inexpensive alternative to on-site parking within an activity center	Placed at the edge of an activity center (e.g., central business district, sports complex, airport); may not offer benefits of lower VMT and emissions compared to facilities located at trip origin	Potentially low if operated privately under free market system

large. If directly served by transit, they may be linked to local or express transit. Alternatively, they may be intended to serve only as a place for carpool and vanpool staging and formation.

Public investment may be high or low, depending upon the enabling agreement and size of the lot. There is a great deal of potential for public-private joint venture in providing these facilities.

2.2.3 Park-and-Pool Lots

Park-and-pool lots are typically smaller lots, intended exclusively for the use of carpool and vanpool formation. This type of lot is often developed as an opportunistic or joint-use facility, and may be a part of a development mitigation plan whereby a developer dedicates a (small) number of spaces within a larger development for park-and-pool purposes. Similarly, some transportation agencies, such as the Texas Department of Transportation (TxDOT), have made use of vacant right-of-way within highway interchanges or under overpasses to provide park-and-pool facilities.

2.2.4 Suburban Park-and-Ride Lots (As Defined by Use)

Suburban park-and-ride lots, as the name suggests, are typically located at the outer edges of the urban landscape. The chief function of these lots is to collect potential transit patrons as close to their place of origin (their homes) as possible, and provide a transfer point to long-haul (often express) transit service.

These facilities primarily rely on the private automobile as the collection and distribution mode but can be accessed through bicycle use and walking. They rely on trunk-line transit routes (bus or rail) to provide the line-haul aspect of the home-to-work trip.

Suburban park-and-ride lots are typically funded by public investment, but can in some cases sustain private ownership. Opportunities for joint development and multi-use facilities are high, depending upon the specific location of the facility and transit services supported.

2.2.5 Transit Centers (Intermodal Transit Center)

A transit center is often thought of only as a place where interchange between local and express transit services occurs. The fact that such centers often serve as park-and-ride facilities as well is often overlooked. As such, the transit center can play a vital role in both the transit and park-and-ride networks. Transit center park-and-ride lots have typically been built in higher demand locations than the typical suburban park-and-ride facility. They often offer the patron a much higher degree of travel services, route choices, and destination alternatives than is to be found at the latter. Although they typically require a greater investment on the part of the transit agency, they can portray a greater image of permanence on the part of the transit agency which, in turn, can generate opportunities for private investment in the center.

2.2.6 Satellite Parking Facilities

Satellite parking lots (also known as remote parking lots) are placed at the edge of an activity center (i.e., sports complex, airport, or central business district) to provide relatively inexpensive alternatives to on-site parking and reduce congestion within the activity center itself. Thus, the satellite parking facility is characterized by its proximity to the destination end rather than the origin end of the travel market being served. The ability of these facilities to provide the same benefits as other types of park-and-ride facilities is questionable.

Optimally placed park-and-ride facilities, located closer to the origin than the destination end of their intended travel market, provide several distinct benefits that the satellite parking facility cannot provide. First, park-and-ride facilities that are located near the origin end of the travel market provide the opportunity to improve air quality within the urban air shed. Air quality is typically affected by the number of vehicle trips made, the distance of vehicle trips made, the speed of travel, and the characteristics of the vehicle making the trip. Park-and-ride facilities placed near the origin of the trip greatly reduce the length of the auto portion of the trip. Also, the emitting characteristics of the transit vehicle can be better controlled as compared to the private auto.

Thus, minimizing the auto access distance and maximizing the transit travel distance provide a better chance of improving air quality. The satellite parking facility potentially maximizes the auto access distance and minimizes the transit vehicle travel distance. Park-and-ride facilities located close to residential trip generators can be designed to encourage walk or bike access, reducing the total number of motor vehicle trips within the air shed, further improving air quality. The satellite parking facility does not provide this opportunity.

It can be argued that satellite parking facilities reduce congestion within an activity center and reduce demand for scarce parking resources. It can allow for the redevelopment of existing parking into higher and better uses. On the other hand, when using satellite-parking facilities, congestion and parking demand is shifted from the activity center to the edges of the activity center. Congestion on routes leading to the activity center will still exist, as private autos attempt to access the satellite parking facilities on the center's edge. The decision to build satellite-parking facilities involves tradeoffs that must be considered in the context of each individual situation.

2.3 PARK-AND-RIDE FACILITIES DEFINED BY DISTANCE TO DESTINATION MARKET

In addition to their functional classification, park-and-ride facilities can be defined in terms of their distance from the primary destination market (typically the central business district [CBD] or sub-area activity center) of the metropolitan area in which they are located. Lots can be defined as suburban lots, local urban lots, peripheral lots, or long-distance remote lots. Each provides a unique type of service, depending upon its location within the urban landscape. These four categories of park-and-ride lots, and the types of routes connecting them to major activity centers, are illustrated in Figure 2-1. A summary table of facilities can be found in Table 2.2.

2.3.1 Suburban Park-and-Ride Lots (as Defined by Location)

Suburban lots are the traditional facilities that are thought of when planning and designing park-and-ride facilities. Suburban park-and-ride lots are defined as lots that are typically 6 to 50 km (4 to 30 mi) from the CBD, a major employment site, or major activity center and that provide an intermodal or change-of-mode service. The predominant modal interchange is typically between the private automobile and transit mode, but may include modal changes between transit and bicycle, pedestrian, carpool, vanpool, or drop-and-ride modes as well. Transit modes that may be offered at the facility include: express and local bus transit, rail (heavy, light, commuter, and intercity), ferries, and paratransit.

As indicated earlier, suburban park-and-ride lots tend to be publicly funded but can present significant opportunities for public-private joint ventures or outright privatization.

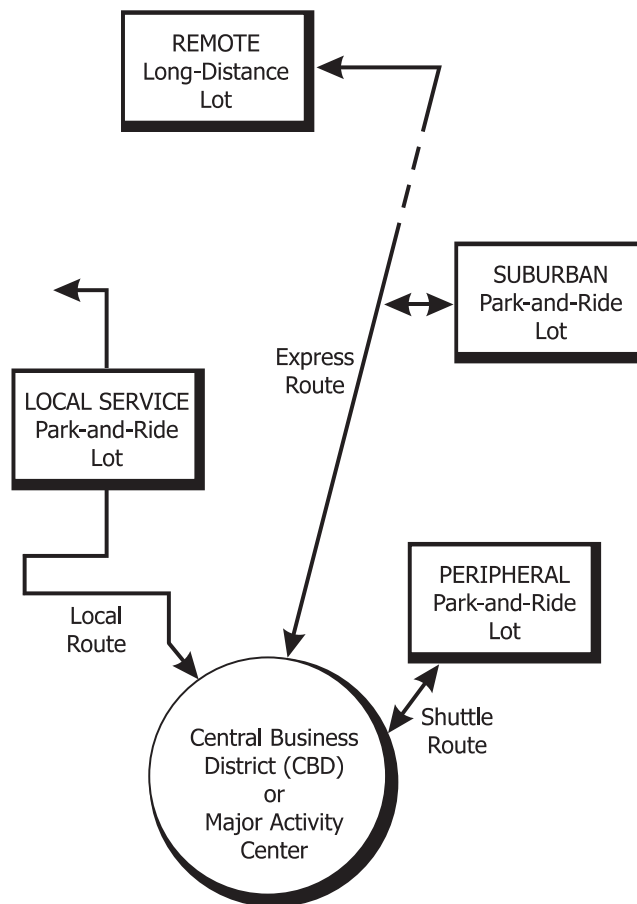


FIGURE 2-1. Park-and-Ride Lots by Distance. Adapted from Reference (31).

TABLE 2-2. Park-and-Ride Facilities by Distance to Destination Market.

Facility Type	Distance From Primary Destination	Characteristics	Public Investment
Suburban Park-and-Ride Lots	6 to 50 km (4 to 30 mi)	Intermodal or change-of-mode service provided	Tend to be publicly funded but offer opportunities for joint ventures or privatization
Remote Long-Distance Lots	65 to 130 km (40 to 80 mi)	Intercity commuters served	Typically publicly funded
Local Urban Park-and-Ride Lots	2 to 7 km (1 to 4 mi)	Fills gap between suburban market and central business district; informal, shared use, or opportunistic	Often publicly funded, but provide opportunities for private operation
Peripheral Park-and-Ride Lots	Located at edge or periphery of primary destination	Intercept travelers prior to activity center; satellite park-and-ride lot	Opportunities for private investment; public investment should be carefully evaluated

2.3.2 Remote Long-Distance Lots

Remote long-distance lots, similar to suburban facilities, provide an intermodal platform for change-of-mode activities. However, these lots typically lie farther from their primary service destination and may exist within a secondary or bedroom urban area to the primary center being served. These lots are relatively new within the urban environment and are a result of the rising costs of living in central metropolitan regions. They are typically seen where city pairs exist such as Dallas-Ft. Worth, Albuquerque-Santa Fe, Seattle-Tacoma, Denver-Boulder, and the communities of Northern New Jersey paired with New York City.

Distances between the remote long-distance lot and the primary destination are typically 65–130 km (40–80 mi) or more. Transit service between such distant locations and the central city has traditionally been the realm of the private intercity transit carrier (e.g., Trailways, Greyhound). However, as interurban travel demand increased between city pairs, and as suburban in-fill narrowed the distance gap between the city pairs, local and regional transit agencies have taken over the responsibility for these travel markets—providing basic services between the interrelated cities.

From the user's perspective, avoidance of the drive commute becomes an important element in choosing to use such facilities due to the increase in personal costs of using a private automobile, resulting from increased congestion, slower average roadway speeds, and overall deteriorating quality of the private auto commute.

Remote long-distance park-and-ride facilities will require varying degrees of public investment, depending upon the demand for travel existing between the paired urban areas. If demand for travel is high, opportunities for privatization may exist.

2.3.3 Local Urban Park-and-Ride Lots

Local urban lots are those lots that fill the gap between the suburban market and CBD within the metropolitan area. They are typically 2 to 7 km (1 to 4 mi) from the CBD or activity center and are often informal, shared use, or opportunistic lots. They are often served by only local or local-express transit routes. Interchanges between non-motorized modes of access and the transit system are likely to play a more important role at these facilities than at the more remote suburban lots.

Local urban park-and-ride lots are often publicly funded, but also provide opportunities for private operation. Opportunities for small joint-use facilities may exist and should be explored.

2.3.4 Peripheral Park-and-Ride Lots

Peripheral park-and-ride lots include those facilities built at the edge or periphery of a business district to provide additional parking just beyond the business district core. One type of peripheral facility—the satellite park-and-ride lot—has already been described.

The chief purpose of the peripheral lot is to intercept travelers prior to downtown, storing their vehicles in locations where parking costs are relatively cheap and excess land is available. Parking patrons are then transported to downtown using local transit or a shuttle-type system. Urban areas typically resort to this type of facility when parking is limited in their downtown or when streets are extremely constrained or congested. A number of cities in Great Britain, including Bath, Cambridge, Oxford, and York, have successfully used peripheral and suburban park-and-ride lots to preserve the character of their town centers while providing additional parking within their municipalities (13).

Peripheral lots must be analyzed critically for their intended purpose. These lots are not well suited to the task of reducing commute-oriented vehicle-miles of travel and congestion on downtown-bound streets (see description of satellite parking facilities). It can also be argued that such peripheral lots, depending on their proximity to the primary activity center, do not provide for improved air quality or lessen the dependence on the private automobile. It is important for the implementing agency of such proposed facilities to consider the ability of the private sector to construct and operate such facilities on a for-profit basis. Peripheral parking lots will often naturally appear without public investment, if parking is constrained within the central business district or primary activity center. Thus, public investment in such lots should be carefully evaluated.

2.4 THE CHANGING ROLE OF THE PARK-AND-RIDE FACILITY

In the United States and Canada, park-and-ride lots have traditionally been designed for the purpose of primarily serving the work-oriented commute trip. Communities in Great Britain have turned to park-and-ride facilities as a means for reducing traffic within their historical town centers and providing convenient services to shoppers and tourists gaining access to their CBDs. The facility definitions provided in this chapter have been largely based on these traditional approaches to the park-and-ride mode.

However, the role of the park-and-ride facility is rapidly changing. In congested urban areas, new interest in park-and-ride facilities is coming from both the private and public sectors. For example, in the Puget Sound region, one developer proposed to build parking structures at approximately 20 existing regional park-and-ride facilities, with the intent of charging for premium park-and-ride services. Another example of the new interest in park-and-ride facilities is an innovative study in San Jose, California, to link the development of new park-and-ride facilities with emerging intelligent transport technologies, creating a “smart lot.” This new public and private interest is generating a host of innovative concepts and opportunities in park-and-ride planning and design.

One notable change on the horizon is the increasing move to package new park-and-ride facilities with urban developments and gain spin-off value from the investment. Some agencies are now even turning to the private sector to provide the needed parking capacity. Transit agencies with mature operating park-and-ride systems are looking towards their capital assets to find additional sources of revenue. Park-and-ride facilities, by their nature, represent capital-intensive assets that can be leveraged in the market place.

In some locations, the role of the park-and-ride facility has historically been focused on carpool or vanpool formation and therefore, the park-and-ride facilities were not designed with transit access in mind. An increasing number of express bus and bus rapid transit systems being established are resulting in local

or state agencies planning for a significant amount of transit enhancements at many park-and-ride facilities in order to increase bus access and promote further utilization of an HOV system by express buses.

The changing role of the park-and-ride facility and the variety of environments in which they are built reaffirms the need to approach every planning or design project with an eye for innovation and optimization. In short, the park-and-ride facility can be whatever the community is willing to make of it—an integrated part of the urban fabric or a single-use facility.

Chapter 3

Park-and-Ride Planning Process

In an economy characterized by shrinking funds for capital projects, improved planning processes must be used in the development of park-and-ride and other multimodal facilities. Because park-and-ride facilities are often located in suburban areas with high visibility, individual lots that do not demonstrate successful demand characteristics engender a negative stereotype of transit; they suggest that transit is not efficient and therefore a waste of public funds. On the other hand, park-and-ride facilities that demonstrate strong demand characteristics raise the positive visibility of transit service, provide an efficient mechanism for collecting ridership, and set the stage for developing a stable transit market in surrounding neighborhoods. With the incorporation of effective architectural design and planning, suburban park-and-ride facilities can serve as major transit centers, becoming focal points for the communities they serve. Such facilities establish a transit presence that demonstrates a continuing commitment to the suburban market. As such, these public investments can encourage transit-friendly developments and land use densification within walking or biking distance of the lot when accompanied by supporting land use policies.

It is typically more effective to plan park-and-ride facilities as part of a coordinated and multi-modal transportation and land use system, than to plan individual facilities and try to tie these facilities together after the fact. Park-and-ride facilities cannot function on their own without direct linkages to the surrounding transit and highway infrastructure. It is important to develop a comprehensive system plan inclusive of park-and-ride facilities before developing the individual elements or facilities within that overall system plan. Success of the individual park-and-ride facility lies in its ability to connect with the regional transportation network and the selection of a site location within that network.

This chapter provides a framework for the planning of park-and-ride facilities from a systems-level perspective as well as providing guidance in planning, conducting alternatives analysis, and design/construction options from a site-level perspective. Preliminary site selection criteria and demand estimation techniques, both particular to suburban park-and-ride facilities, are discussed as well.

3.1 SYSTEM PLANNING PROCESS

The system planning process is a critical step to ensuring successful park-and-ride operations throughout the metropolitan environment. Often, agencies within a single metropolitan area (e.g., local, state, and regional) may be interested in constructing such facilities. However, only the regional or local transit agencies may be responsible for providing service to a given facility. This situation requires the transit agencies to be a primary participant in the planning process. The transit agency must be able to provide service to each individual park-and-ride lot if the lot is to serve as a transfer point between auto, bike, and pedestrian modes and transit modes. Also, transit agencies will have important insights into the transit market that will contribute to successful facilities. Park-and-ride facilities planned without the participation and commitment of the local transit agency would be better defined as park-and-pool lots, because transit service may not be guaranteed to such sites.

The system planning process chosen by the transportation planner will often be unique to the urban area in which it is being implemented. Planners and engineers must be sensitive to the community they are serving, and every effort should be made to use both customary and unique planning processes tailored to fit the local planning environment. The role of the planner and engineer during the system planning process is in large part one of facilitator and information gatherer. The participating agencies, communities, and concerned citizens must be the primary decision makers to assure broad acceptance of the plan.

A work flow diagram of a generalized park-and-ride system planning process is depicted in Figure 3-1. This approach highlights many of the important elements necessary for a successful planning process. Depending on how advanced a region is within its system planning process, as illustrated through either a coherent planning effort or through a history of ad hoc planning and implementation, the order of individual system planning activities may differ. Individual elements of the process should be adapted to meet the needs of the local community, transit system operator, regional or metropolitan planning organization (MPO), and expectations of the affected jurisdictions. The remainder of this chapter provides a brief discussion of each of the major elements of the system planning and implementation process.

3.1.1 The System Study

The purpose of the system study and resulting system plan is to identify a common regional need for and approach to the provision of park-and-ride facilities. Broad policy issues, including the goals and objectives of the system plan, system level measures of effectiveness, operational goals and responsibilities, and generalized location decisions, should be evaluated at the system plan level. It is important to remember that the system plan need not be a static guideline. On the contrary, it must reflect inevitable, evolving conditions as well as new opportunities for park-and-ride developments over its lifetime. It must provide the participating agencies with a common platform from which to program further site-specific studies, investments, and construction projects.

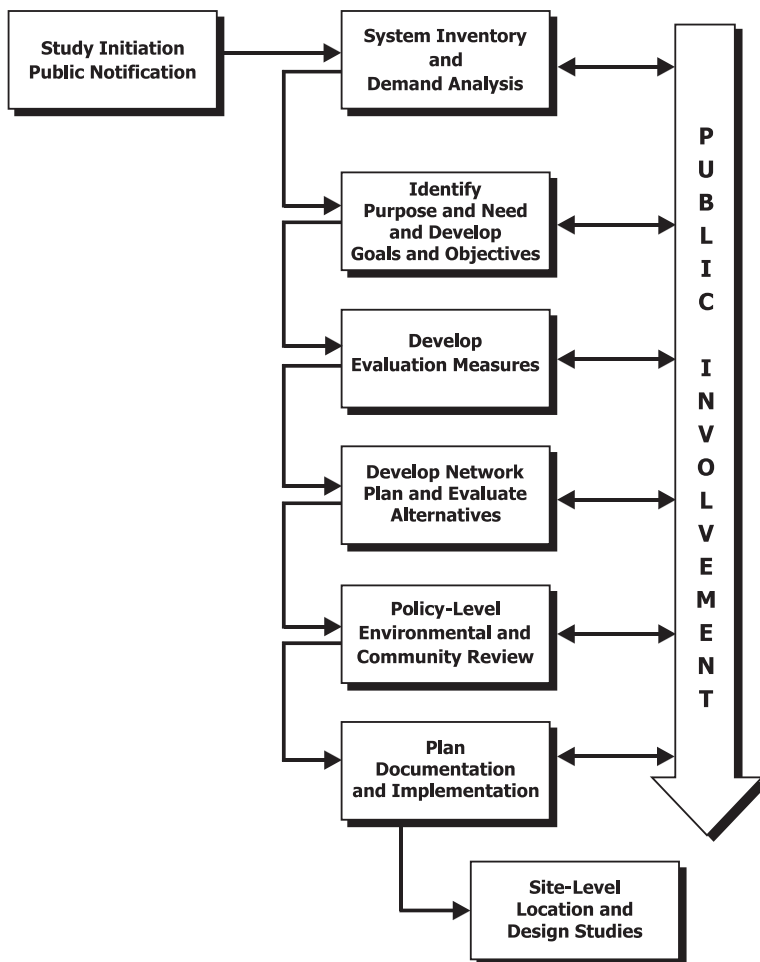


FIGURE 3-1. Park-and-Ride System Planning Process.

Primary activities that should be completed as part of the system study and documented in a system plan include:

- Inventory of existing facilities and existing transit service network by service level
- Documentation of recognized purpose and need for a park-and-ride system, travel needs to be served, and the size and general character of such a system
- Determination of goals and objectives
- Establishment of an evaluation process framework (definition of a successful park-and-ride facility)
- Development of a system-wide service network, serving the existing and proposed park-and-ride system by connecting it to major employment destinations
- Development of intergovernmental agreements outlining general policies for facility acquisition, maintenance, and service
- Policy-level environmental review screening for critical flaws and investment analysis, if necessary
- Public involvement and review process
- Inventory of environmental features

3.1.2 System Inventory

An important factor in the system planning process is realizing that considerable work may already have been completed within a region towards developing a regional park-and-ride system, either as part of an ongoing regional transportation plan or through the natural growth process of the local transit agency. In either case, this completed work should be inventoried and a definition of the existing state of the system should be developed. At a minimum, the inventory should include:

- Identification of existing facilities
- Identification of facility maintenance policies
- Identification of site ownership by facility
- Listing of transit and non-transit services provided, along with responsible agency
- Listing of capital amenities provided (e.g., shelters, schedule kiosks, benches, on-site retail vendors, security devices)
- Identification of access attributes of each facility with respect to high occupancy vehicle and/or freeway networks
- Identification of bicycle and pedestrian access facilities and networks
- Identification of access attributes of each facility with respect to Americans with Disabilities Act (ADA) requirements
- Inventory of spaces provided and utilization and turnover rate, including on-street parking related to on-site transit operations, types of spaces provided (long-term, short-term, drop-and-ride), costs, etc.

Ideally, the system inventory will be updated on a regular basis and should be keyed to a geographic information system or referenced to a map so that it can be used to develop a picture of the existing park-and-ride network. Existing and planned transit routes and services should be overlaid onto this graphical

representation of the system plan to better understand rider demand zones and service type needs and develop a context for placing new facilities or expanding those already in existence.

3.1.3 Purpose and Need

Through definition of the existing system, the planning team will develop a working knowledge both of the region and of the strengths and weaknesses within the existing park-and-ride system (given that such a system exists). Local transit operators, transportation organizations, affected public agencies, and interested citizen groups should then forge a statement of purpose and need, of deficiencies within the existing park-and-ride system, and of the major regional goals and objectives for the system plan. Attention should be paid to developing a vision of the future system that is attainable and developing realistic goals and objectives. When developing these goals and objectives and in identifying the needs of the community, a planning team consisting of the implementing agency, the local transit provider, the agency responsible for highway and arterial streets, the local MPO, and major jurisdictions should be forged.

A statement of purpose and need should be included with supporting information on the existing park-and-ride system, regional deficiencies, and recognized opportunities. Goals and objectives developed at the regional level should be broad enough to apply to a number of specific locations. Goals and objectives that are overly focused on a single criterion or measure of success should be discouraged in favor of a more inclusive set of regional objectives.

3.1.4 Goals/Objectives/Measures of Effectiveness

3.1.4.1 Goals

Goals are broad in nature and should be standard regardless of the type of transportation infrastructure being considered (P&R, HOV, ITS, general-purpose [GP] lanes, transit, etc.). For example, improvements in the following categories are considered goals:

- Mobility
- Efficiency
- Safety
- Energy Savings
- Emissions
- Economic Development
- Quality of Life

3.1.4.2 Objectives

Objectives are more specific in nature and should be realistic, correlated to particular goals, and be quantifiable via measures of effectiveness (MOEs). Objectives must be specifically relevant to the region in which the system planning effort is being conducted. Example objectives that might be incorporated within a statement of purpose include the following:

- Maximize the demand potential and thus the projected transit ridership at individual park-and-ride facilities
- Provide a system of facilities that is well integrated into the surrounding suburban or urban development and that supports surrounding land uses and community development plans

- Develop a system of park-and-ride facilities that promotes a conversion to a traditional pedestrian/bicycle access transit system and a reduced reliance on the private automobile as a transit access mode
- Develop a system that encourages transit-friendly development immediately adjacent to the individual elements of the system, and that develops a future transit market within the suburban environment
- Coordinate park-and-ride development with the provision of convenient and accessible transit system(s), providing for ease in route-to-route transfers and overall transit system optimization
- Develop a system that minimizes the cost to public agencies and promotes the use of joint-use facilities, joint development, and privatization opportunities
- Develop a system that links individual communities to a regional transportation network, providing identity to the community and/or neighborhood in which individual elements and facilities are placed
- Incorporate a community art program and significant architectural elements into the design of individual facilities

It is important to note that a statement of goals and objectives will often contain a number of competing items. During the site-level alternatives evaluation process, which follows the system plan, the implementing agencies and communities will evaluate individual elements of the park-and-ride system and specific park-and-ride location opportunities for their ability to meet the various predefined goals and objectives. By incorporating a number of goals and objectives, trade-offs among alternatives can be evaluated and a system that reflects the character and needs of the community can be better developed.

3.1.4.3 Measures of Effectiveness

After the definition of regional goals and objectives, measures of effectiveness (i.e., evaluation criteria) must be developed that allow the implementing agencies and citizens to judge the usefulness of individual elements. The degree of detail incorporated into the measures of effectiveness should be in proportion to the issue that they are being used to evaluate. For example, at the system plan level, only rough estimates of potential park-and-ride demand based on general trip making characteristics of the underlying service populations will be adequate, whereas during the site selection process, more detailed and reliable forecasting procedures should be utilized to define the scope of the needed design. Measures of effectiveness can include qualitative assessments (e.g., public surveys) as well as quantitative measures.

Measures of effectiveness appropriate at the systems analysis level include:

- Regional or corridor demand for park-and-ride service based on socioeconomic, urban development, and trip interchange data
- Multi-modal connectivity and mobility characteristics provided by the proposed park-and-ride system
- Community acceptance and support for the elements of the system
- Availability of public funding, joint venture opportunities, and public-private investment alternatives
- Cost-effectiveness, based on competing and/or supportive community objectives
- Estimates of changes in vehicle miles of travel and auto vehicle trips as a result of system implementation
- Emission reductions and pollutant reapportionment and/or reduction within the affected area resulting from system implementation

These measures of effectiveness are by no means comprehensive. Individual and unique measures should be developed that reflect the goals and objectives of the region for which the system plan is being developed.

3.1.5 Service Network

Numerous studies have shown that one of the most important elements that affect park-and-ride demand is the frequency and character of the transit service provided at individual park-and-ride facilities (11, 34, 35). At the regional level, a network of transit services must be developed and implemented for individual park-and-ride facilities within the system to work effectively.

At a minimum, it is recommended that service corridors be identified throughout the region and that park-and-ride facility development be focused into these corridors. The development will typically follow major corridors with high levels of travel demand and/or congestion, organized around the freeway or highway network or along existing transit systems. Minimum transit service standards should be identified, detailing what levels of peak and off-peak service are or will be provided by the participating transit agency to each park-and-ride facility within the regional corridors. Demand forecasting experience has shown that the most successful park-and-ride facilities, measured in terms of parking demand, are those provided with transit service characterized by a maximum of 10- to 15-minute headways during the peak periods, and with the availability of regularly scheduled midday service between the primary activity center and suburban facility (35).

The importance of identifying various transit service parameters, such as headways and total travel time, which provide service levels necessary to support park-and-ride facilities within the system plan cannot be overemphasized. Changing the transit service characteristics within any given corridor or for an individual park-and-ride facility can have significant cost-effectiveness impacts on the system.

3.1.6 Policy-Level Environmental/Investment Analysis

Depending on the magnitude of the park-and-ride system plan and local requirements, a policy-level environmental analysis may be required. A primary concern at the system level will be the effects on air quality standards as a result of the park-and-ride plan. Any vehicle trip generates a large proportion of its total emissions at and within a few miles of starting. Therefore, trip reduction may be more critical than vehicle miles traveled (VMT) reduction in some areas. To the extent that park-and-ride facilities reduce VMT but not trip reduction, their assumed regional emission benefits may need to account for the relatively short, high-emission trips associated with local distribution driving.

The National Environmental Policy Act (NEPA) requires that any time significant changes to local or regional traffic patterns occur that environmental considerations (i.e., air quality) be evaluated either at the planning level or through a hot-spot analysis, depending on the type of planning effort being undertaken. For example, if the implementation of a specific facility is being considered, then a hot-spot analysis may be required. If a new system of park-and-ride lots is being considered, impacts on the regional air shed may require analysis. In a federal non-attainment area, the metropolitan transportation plan (MTP) or regional transportation plan (RTP) will likely require amending and conformity with established air quality goals. In such areas, the impacts of mobile emissions within the regional air shed must be considered. Likewise, local state environmental impact policy should be reviewed (if applicable) for the need to conduct a policy-level environmental impact analysis. If federal monies are to be used, Federal environmental analysis requirements should be reviewed (e.g., NEPA). Consult with the FHWA, FTA, Environmental Protection Agency (EPA) and the local planning agency to ensure that the level of analysis is appropriate.

3.1.7 Public Involvement

Public participation is also an important factor in the system planning process. Public participation can be used to determine minimum service standards for the proposed park-and-ride system, characteristics of

the lot design, and corridor prioritization. Public participation at the system planning level can reduce opposition to future facilities by incorporating public concerns at the outset, rather than attempting to mitigate those concerns at the time of construction.

A public involvement program, consisting of a series of open houses or information gathering sessions, is strongly advisable at the system planning level. A citizen and technical advisory committee—consisting of transit patrons, community leaders, representatives of affected agencies, and community business—can be organized to provide input throughout the study and to build community support for the program. This same citizen and technical advisory committee can also serve as the advocacy group for the resulting system plan, interceding on behalf of the agency to the MPO and other elected jurisdictions. In addition, input and findings from any other citizen committee that would impact a park-and-ride system plan should be made available, and vice versa.

3.1.8 Intergovernmental Agreements

The system plan provides an opportunity to develop intergovernmental agreements or at least an intergovernmental understanding among the affected jurisdictions and participating agencies. An intergovernmental agreement might be used as a mechanism to formally adopt the system plan. Such agreements are most important when more than one transit operator (public or private) provides service within the metropolitan region or when several agencies are in the position to build and operate park-and-ride facilities. Such is the situation when a highway agency builds the facilities within excess roadway right-of-way space and allows the local transit agency or a private operator to provide service to them.

Some of the more important issues to document in an intergovernmental agreement include:

- Development of a framework for intergovernmental participation and cooperation
- Coordination of transit service and identification of minimum design requirements
- Identification of transfer locations between neighboring transit operators and coordination of transfer policies
- Identification of funding sources
- Development of consistent policies on assignment of liability and definition of responsibilities
- Methods or approval processes that can be used to update detailed elements of the system plan without requiring a new agreement or the adoption of an amendment

The above issues are geared to developing a general approach to the interworkings and cooperation between government agencies with overlapping jurisdictions. At the project-specific level, additional refinements to specific intergovernmental agreements may be required to identify property ownership and usage, maintenance and service responsibilities, and the assignment of specific liabilities resulting from park-and-ride operations. Local legal counsel should be used to assure compliance with all laws and regulations.

3.2 SITE-LEVEL LOCATION AND DESIGN STUDIES

Once the regional system plan has been developed, planning and alternatives analysis for individual park-and-ride facilities can be conducted within the framework outlined during the broader system planning effort. Within the system plan, general locations for individual facilities will have been identified. During the alternatives analysis and site selection process, site-specific issues will be evaluated, often focusing on several specific locations/sites within the general location identified by the system planning process.

Choosing the optimum site within a generalized service area for a park-and-ride facility will depend on a number of competing interests and community goals. These factors are evaluated on a site-by-site basis. Individual site-specific locations are compared and evaluated to select a preferred park-and-ride location.

In brief, a site-specific alternatives analysis process would include:

- Determination of site availability
- Site evaluation, ranking, and selection of a preferred site from a range of local alternatives
- Site-level demand forecasts (i.e., demand estimates for a specific location)
- Conceptual site design, including allowances for public art and unique architectural elements to be incorporated into final design
- Analysis of location-specific (site-specific) environmental impacts, including:
 - Traffic study/access analysis including pedestrian and vehicular circulation patterns
 - Air, noise, and vibration quality
 - Drainage analysis
 - Geotechnical/civil analysis
 - Hazardous waste mitigation plans (if necessary)
 - Historical/cultural resource impacts
 - Lighting
- Assessing storm water management requirements early in the site evaluation process is essential. Sensitive watershed areas and associated storm water runoff detention and treatment requirements can limit the number of potential park-and-ride lot locations that are feasible.
- Developing and conducting an early and continuous public involvement program centering around a specific site to identify and gather community issues for consideration in the site design
- Pursuing and securing adequate funding resources, including private participation
- Preliminary design and engineering

A successful site-level alternatives analysis process should eventually lead to a design report (supported by the necessary environmental documentation) and facility concept that is embraced by the community and by all the participating agencies. The time required to complete a site-level study will vary, depending on the complexity of the issues involved in the analysis, community support, and agency participation. Regardless of the time required, the resulting facility plan will be more inclusive if based on a community-oriented process. Community support built at the system-level and site-level planning stages will carry over into the construction, operation, and use of the facility.

A simplified site-level study process is identified in Figure 3-2, which illustrates the relationship of the site-level analysis with system planning efforts. The remainder of this guide addresses the details of the site-level analysis, including facility location, demand estimation, and design features.

As with the system planning process, a continuous public involvement process is identified throughout the duration of the project. The public involvement process incorporated at the site-specific level will be more focused than at the systems level, and will require greater interaction among the planning and design teams and the affected community.

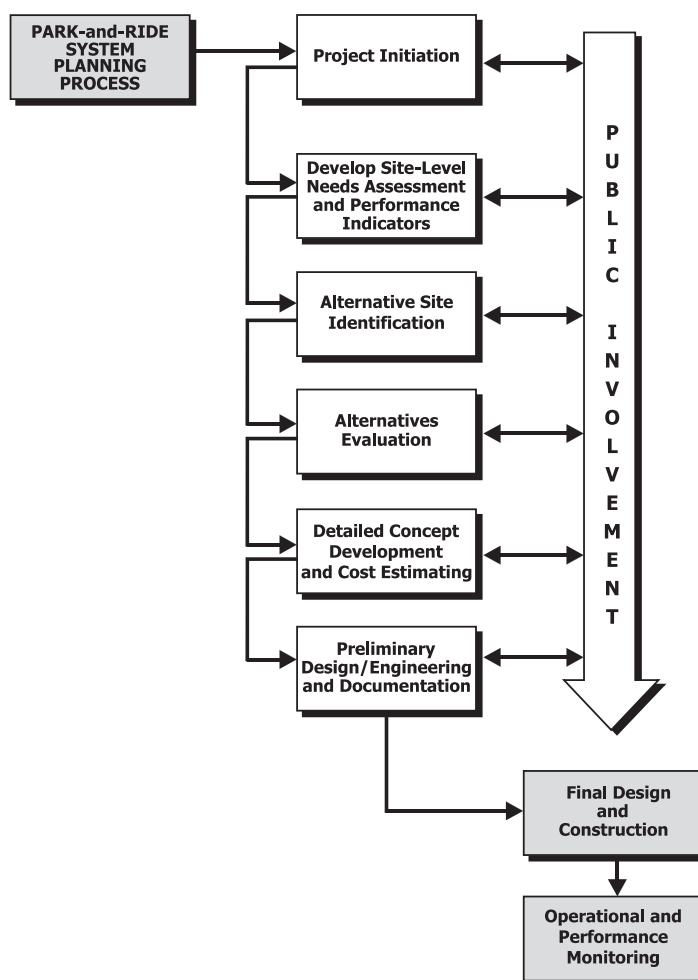


FIGURE 3-2. Park-and-Ride Site-Level Study Process.

3.3 FINAL (DETAIL) DESIGN AND CONSTRUCTION

Final or detail design and construction may immediately follow the site-level alternatives evaluation and preliminary/conceptual engineering design phase of the facility implementation process or be postponed until funding can be secured. Design options to traditional construction such as joint-use parking facilities, facility leasing, and staged construction should be evaluated for potential advantages in expediting the implementation process. Leased and joint-use lots, although not always in the best locations from the perspective of the park-and-ride system plan, can be used as test markets for expanded public investment in the form of a permanent park-and-ride facility.¹ Likewise, the staged construction of public lots can be used to minimize the financial exposure of the implementing agency, since construction of subsequent facility phases can be delayed if required.

Construction techniques should minimize the required public expenditure while at the same time provide for a long life cycle in terms of structures and materials used in the site development. This approach will reduce the operation and maintenance costs of the facility and prolong its usefulness.

Unsuccessful facilities should be examined to determine if they can be rendered more successful by such techniques as adjusting transit operations at the facility, providing additional patron amenities, increased

¹ Some agencies prefer to organize the preliminary design/engineering and final design into a single phase called detail design. This single, detailed design phase typically includes all phases of the design once a single site and concept have been selected. Adoption of this type of approach to detailed design may qualify more of the design phase for federal funding, thus shifting some of the financial burden off the local transit authority.

advertising, or improving security measures. Alternatively, facilities that truly do not present satisfactory conditions for attracting future demand should be evaluated for trade or sale so that more effective facilities can be developed. Empty or scarcely used transit facilities can have long-term negative impacts on an agency's ability to justify and fund future facilities, because of public criticism. An effective asset management program that reinforces successful facilities and that gracefully removes under-performing ones will greatly improve the overall objective of creating and maintaining public support for a successful park-and-ride system.

3.4 MAKING THE SUBURBAN PARK-AND-RIDE FACILITY LOCATION DECISION

Park-and-ride facility location is an important factor in determining the demand characteristics for a proposed facility. Choosing the right location for a proposed park-and-ride facility, or even selecting the right set of location alternatives to evaluate, is often one of the more difficult elements in the park-and-ride planning process. Optimizing the location is often complicated because site options available to the implementing agency are typically limited because of existing land use developments, land costs, environmental constraints, lack of adequate available alternative sites, and location of transit lines in the case of fixed guideway transit systems.

Additionally, evaluation of site alternatives and the selection of the optimum site is based on competing criteria developed for the park-and-ride system as a whole. When various sites are evaluated using multiple measures of effectiveness, tradeoffs among competing effectiveness measures must be accommodated. For instance, for specific locations it may not be possible to maximize demand while at the same time maximizing facility integration with surrounding land uses. Likewise, it may not be possible to eliminate or minimize adverse environmental impacts while at the same time minimizing the cost of construction. Thus, the optimum park-and-ride location will be that site which best meets the greatest number of needs of the surrounding community (without any fatal flaws) while attaining ridership demand characteristics that provide acceptable cost-benefit performance ratios.

The purpose of this section is to provide a checklist consisting of site selection criteria that have been developed for and used in a number of park-and-ride facility studies. This checklist can be used to attain many different specific community goals. It must be remembered that it will be next to impossible for any one site to provide all the optimum characteristics included in the checklist. However, potential locations should be evaluated in terms of their ability to most effectively meet the greatest number of community needs. Tradeoffs among specific criteria must be weighed by the site selection team to determine the best-suited location for the intended park-and-ride facility. Joint-use or leased lots should not be overlooked in this process.

This site location checklist has been organized into three common community goal categories:

- Assuring strong patronage demand
- Providing for integration with the community
- Reducing the financial impact and risk to the implementing agency

It is the intent to provide a practical approach for sketch planning through an examination of criteria that have been successfully applied in the development of operating systems. Criteria in all three community goal categories should be considered in the site selection process. The transportation planner must work with the affected agencies and community to develop a set of location criteria that best suits the specific study area. The checklist can assist in this endeavor, but will most likely not provide the comprehensive evaluation approach that is to be gained through detailed evaluation of the options available.

3.4.1 Locating Park-and-Ride Facilities to Assure Strong Patronage Demand

One of the primary concerns of an implementing agency—and indeed the community as a whole—is that a new park-and-ride facility demonstrates adequate demand to justify the public expenditure. Transit agencies in turn rely on demand estimates to schedule appropriate service levels, provide amenities, and program future growth. Although demand will not be the only factor in defining the optimum facility location, it must be considered an important criterion.

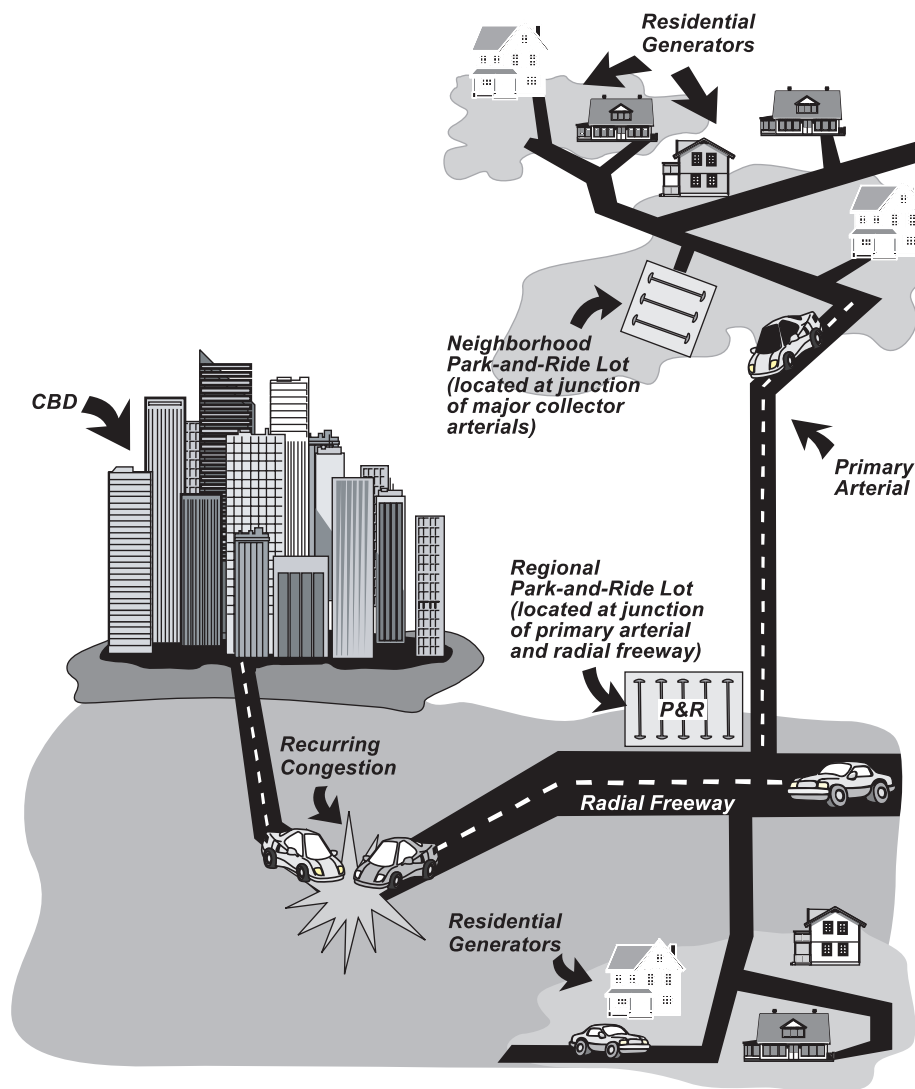
The following factors can be used to locate applicable site alternatives for evaluation. Although they do not guarantee high parking demand, they can significantly assist in the preliminary identification of promising opportunities:

- **Locate with Geographic Affinity to Activity Center Served.** Proposed facilities should be located in geographic areas that display strong origin-destination trip interchange characteristics with the primary activity center served (typically the metropolitan CBD). The geographic area immediately upstream of the lot should demonstrate sufficient suburban and urban residential densities to supply acceptable demand for the facility.
- **Minimize Auto Access Time.** Auto access to the park-and-ride facility should be made as convenient and as least time consuming to the user as possible. The transit portion of the trip should (in most cases) represent more than 50 percent of the total journey time from the patron's home to the final destination (9). Locate the facility so that commuters do not have to backtrack to reach the lot. Park-and-ride lots are often located on the inbound side of a freeway interchange to enhance accessibility and visibility (31).
- **Maximize Regional Location.** Park-and-ride lots should generally be located no closer than approximately 6 to 8 km (4 to 5 mi) and preferably 16 km (10 mi) or more from the primary activity center being served. This location will generate acceptable levels of reduction in vehicle mi traveled (VMT). Park-and-pool lot demand is conducive at even further distances (in the range of 16 to 40 km [10 to 25 mi]) from the primary activity center. Park-and-ride facilities at distances greater than 50 km [30 mi] have typically not been found to be successful (9, 34, 35). However, special circumstances may exist, such as city pairs demonstrating strong historical intercity demand (e.g., Seattle-Tacoma, Dallas-Fort Worth, Denver-Boulder city pairs). The existence of city pairs can make park-and-ride facilities at greater distances from the primary activity center quite successful, where the underlying travel demand is high. Likewise, in some major metropolitan areas such as New York, New Jersey, and Los Angeles, park-and-ride lots at distances greater than 50 km [30 mi] may be viable due to high residential costs in inner urban areas, which encourage longer commutes. Large urban areas tend to have transit connections that make park-and-ride lots more viable at greater distances.

Park-and-ride facilities placed within the primary destination center they are intended to serve should be evaluated as to their purpose—for example, they might actually be used more as peripheral parking than as true park-and-ride lots. Such facilities will not generate reductions in vehicle emissions, VMT, or congestion, and may actually increase regional emission totals. Such facilities tend to operate more as peripheral parking lots to the central activity center rather than as true park-and-ride facilities. This type of peripheral lot provides an ideal opportunity for privatization on a for-pay and for-profit basis (see “Peripheral Park-and-Ride Lots,” Chapter 2).

- **Locate Upstream of Congestion.** Facilities immediately upstream of recurring congestion within the regional transportation system have been found to demonstrate higher demand characteristics than other facilities, resulting from commuters seeking to avoid traffic jams (see Figure 3-3). Demand is further enhanced if transit is supplied with a significant advantage over the private automobile (e.g., a transit HOV lane, queue bypass lane(s), or other transit priority features).

Likewise, the park-and-ride facility should be placed so as to intercept primary commuter paths prior to reaching the main radial travel corridor. The park-and-ride lot should therefore be placed



Note: CBD to Park-and-Ride (P&R) Lot five miles or greater.

FIGURE 3-3. Siting a Park-and-Ride Lot.

between the primary commuter market area being served and the radial freeway connecting that area with the primary destination being served (see Figure 3-3).

- Maximize Service Area Population.** Park-and-ride facilities should be placed so as to serve the greatest possible population base and population densities within 4 km (2.5 mi) of the proposed facility. Research has shown that 50 percent of a park-and-ride facility's demand is typically generated within a 4-km (2.5-mi) radius of the facility, and that an additional 35 percent (i.e., a total of 85 percent of total demand) will come from an area defined by a parabola extending 16 km (10 mi) upstream of the lot and having a long cord of 16 to 19 km (10 to 12 mi) (35).
- Locate Adjacent to Transit Corridors.** New park-and-ride facilities should be located adjacent to existing major transit corridors, where peak transit service can be provided with headways on the order of 15 min or less (10 min or less is optimal) (35). Mid-day service can also be critical to generating high demand characteristics. Transit service should be oriented to the park-and-ride facility so as to minimize downstream transfers (i.e., the transit mode serving the park-and-ride facility should serve the primary activity center directly, without necessitating a transit-to-transit transfer). To achieve this goal, park-and-ride lots should be placed in proximity to the existing transit route structure within the given corridor (35).

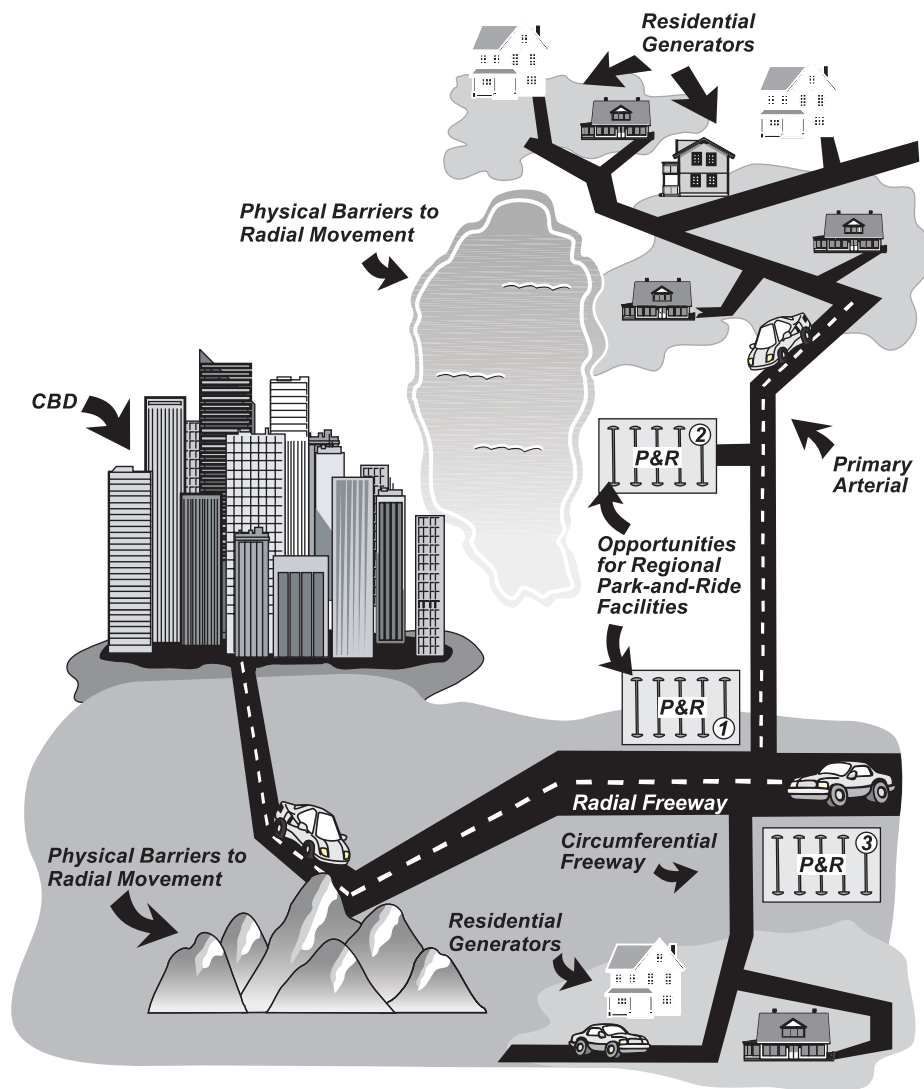
- **Provide Frequent Express Service.** Experience has shown that frequent express service (between the park-and-ride facility and primary activity center being served) is one of the demand generating characteristics of successful park-and-ride facilities. Express service refers to limited stops, such as one stop every five minutes. Minimum service frequencies of 15 minutes are acceptable for major park-and-ride facilities. Experience in several regions has shown that once usage grows sufficiently to support 5- to 10-minute service headways, further demand will be drawn to the high frequency service provided at the lot, and demand growth accelerates rapidly (14).
- **Locate Adjacent Regional Freeway or Arterial with Radial Orientation.** Locate park-and-ride facilities adjacent to, or within visible range of, major regional freeways or high-speed arterials that provide radial access to the activity center being served. Such facilities can be defined as those with average daily traffic volumes per lane approaching and exceeding 20,000 vehicles (7). By locating a park-and-ride facility within visible range of a radial freeway, the lot will be essentially self-advertising, and is more likely to develop demand quickly, drawing patrons from the adjacent (presumably congested) freeway. Access to the park-and-ride facility need not be directly from the freeway, and in fact the preferred access route is via a feeder arterial or secondary street. The main issue is that visibility from the primary travel corridor is critical (35, 37).

Within the freeway or arterial corridor, the park-and-ride facility should ideally be located at or near freeway interchanges to provide direct or semi-direct access to the freeway from the facility. This location will maximize the ability of transit to compete with the private automobile, intercept the maximum number of potential users, and often coincide with existing transit route structures (27).

Location of park-and-ride facilities on circumferential beltways or other non-radial roadways may result in less productive facilities as compared to those located on the radial freeway network. Location of facilities at the intersection of a circumferential and radial freeway should be chosen so that the lot falls downstream of the interchange on the radial freeway, for maximum demand generating capabilities.

Geographic barriers to direct travel between the park-and-ride facility and the central activity center will affect the demand attributes of the park-and-ride facility. Barriers such as lakes, rivers, hills, and mountains that block direct radial access between the origin and destination locations may induce park-and-ride demand on circumferential freeways, similar to that seen on radial networks (see Figure 3-4). The impact of geographical barriers should be analyzed for their effects on travel flow patterns. If radial movement requires a circumferential movement because of geographic barriers, these corridors may be good candidates for park-and-ride lots as well (see Figure 3-4).

- **Auto to Transit Cost Ratio.** To maximize the usage of the park-and-ride system, the ratio of regional auto operating costs to transit fare costs should be maximized from the user's perspective. The more expensive auto operating costs are relative to the transit fare, the higher the demand for remote parking or park-and-ride facilities. Parking costs are an important element in determining the cost of auto access. Increased parking costs in the central activity center being served, or increased difficulty in securing parking, will increase park-and-ride demand.
- **Lot Competition/Reinforcement.** When implementing a new park-and-ride facility, the influence of nearby park-and-ride lots should be evaluated. If transit demand is high and capacity at proximate lots is insufficient to handle the system demand, then additional supply can have synergistic effects on demand. On the other hand, if capacity exceeds demand, placement of adjacent lots may create competition for the same patron population. Park-and-ride lots placed closer than about 6 to 8 km (4 to 5 mi) within the same corridor have strong potential for creating a (mutually negative) competitive situation and should be evaluated carefully for their interrelated demand characteristics (35).
- **Transit Speed and HOV Facilities.** Provision of HOV facilities and transit priority treatments is highly beneficial to the development of a successful park-and-ride system. Increasing transit speeds has been found to increase the competitiveness of the park-and-ride facility with respect to the private automobile, thus increasing demand for park-and-ride usage.



Note: When a physical barrier does not exist (e.g. in the case of a beltway on a flat plane) the preferred Park-and-Ride (P&R) lot location is on the radial roadway link (location 1 above).

FIGURE 3-4. Combined Radial/Circumferential Commute Pattern.

- A Safe and Secure Environment.** A safe and secure environment for patrons, parked vehicles, and transit operators is critical to the success of a park-and-ride facility. Safety and security is as much a perception as it is real. Frequent and consistent removal of graffiti, broken glass and trash, and overgrown landscaping is important when providing an environment that feels safe and secure to the user. An aggressive approach to security breaches and other concerns can support an operator's efforts to secure the park-and-ride facility. Security techniques should not be intrusive or create a feeling of imprisonment for the patrons. For example, security cameras, emergency telephones, increased lighting levels and lighting hours of operation, use of white light source for all site lighting, and activity-generating joint uses are preferable to fences and on-site security. Techniques that facilitate integration with the surrounding community should be encouraged as a method for increasing the safety and security of the park-and-ride facility. Security measures should match the perceived need of the site, and should not inconvenience legitimate access to the park-and-ride facility. Architectural and design solutions should be considered for discouraging vagrancy and for eliminating potentially unsafe conditions (see Figures 3-5 and 3-6).
- Design for Multimodal Connections.** The park-and-ride design should be developed as both a multimodal facility (providing access to a number of travel options) and an intermodal facility



FIGURE 3-5. River stone embedded in concrete beneath low overhang discourages vagrancy. BC Transit, Vancouver, British Columbia, Canada.

Photo courtesy of Parsons Brinckerhoff Quade & Douglas, Inc.

(providing convenient transfers between modes). In addition to facilitating the traditional intermodal connection between the auto and transit modes, much attention should be given to planning and designing for bicycle, pedestrian, and handicapped access.

Similarly, carpool and vanpool formation should also be accommodated within the facility and consideration should be given to defining specific locations for these other intermodal connections (i.e., between the single-occupancy vehicle (SOV) and HOV). Transit-to-transit connections should be optimized through the park-and-ride facility, giving the facility a dual purpose as both a transit center and park-and-ride facility. The increased activity will improve the connectivity of the lot with the surrounding community and increase midday activity at the lot, thus improving the security attributes of the system.

- **Maximize the Facility's Visibility.** The optimum park-and-ride facility will be highly visible from the primary travel corridor. Every effort should be made so that the facility is not intrusive and fits appropriately within the surrounding environment, while still remaining visible. Increased visibility will reduce (although not eliminate) the need for extensive signage and advertising.



FIGURE 3-6. Open shelter design permits clear visibility of surrounding lot. LakeTran System, Lake County, Ohio.

- **Bicycle and Pedestrian Feeder Facility Networks.** Create solid neighborhood bicycle and pedestrian facility connections. Homeowners within 0.8 km (0.5 mi) should be able to easily walk to the park-and-ride lot. Homeowners within 3 to 5 km (2 to 3 mi) should be able to safely bike to the park-and-ride lot (and safely park their bike or take it on the bus).

3.4.2 Locating Park-and-Ride Facilities to Provide for Community Integration

Choosing park-and-ride site alternatives that provide for improved integration of the facility with the surrounding community is desirable for numerous reasons. These reasons include the enhanced perceived security of such locations, the economic benefit that the lot can bring to area businesses, and the ability of such facilities to develop a transit-oriented suburban market. A good community integration plan can also reduce impacts to the natural and built environment surrounding the proposed facility and therefore engender a greater sense of community ownership and popularity.

The following discussion provides insight into the placement of park-and-ride facilities so that they are better integrated into the surrounding community:

- **Locate in Areas with Compatible Land Uses.** Locating a new park-and-ride facility within an area of compatible land uses will increase the potential for joint usage and improve community integration opportunities. Compatible land uses will be defined by the community in which the facility is being located; possibilities range from a suburban business center to an industrial area to excess freeway right-of-way to transit-oriented development (TOD). The impacts on the built environment will likely be reduced by attention to compatible land use issues.
- **Locate in Accordance with Local Ordinances and Plans.** Locating new park-and-ride facilities within areas of compatible land uses, and in areas that do not require a zoning change or change in local land use plan, will minimize the cost of implementation and reduce delay in initiating

operation. Long-range transportation plans should also be considered when selecting facility location or designing a park-and-ride system.

- **Minimize Environmental Impact.** By their nature, park-and-ride lots involve the introduction of significant amounts of new impervious surfaces into the natural and built environment. Operation of such facilities will also increase vehicle emissions in the vicinity of the facility, potentially increase local area traffic congestion, and introduce new visual and noise impacts into the environment. Sites should be selected and designs developed that seek to minimize these impacts.

Specifically, level sites should be chosen to minimize the need for grading. The sites should generally be free of hazardous wastes, drainage and soil problems, and otherwise fragile ecosystems. A preliminary investigation of all candidate sites (including, as appropriate, sample soil borings, wetlands delineation, and hazardous waste investigation) should be conducted early in the site selection process to avoid subsequent surprise costs or forced abandonment of a prospective site. Other specific investigations required by NEPA and local policies should be considered when selecting a range of alternate sites.

- **Minimize Impacts on Surrounding Local Traffic Circulation Patterns and Safety Characteristics.** Every effort should be made to minimize the negative impacts of the park-and-ride facility on local area traffic circulation patterns and congestion levels. Both the transit operations and the embarking and departing patron traffic should be analyzed for potential effects. P.M. peak traffic will typically define the critical time period for analysis, but a.m. peak operations should be evaluated at a fatal flaw level to determine if further evaluation is warranted. Joint development park-and-ride lots will typically have more pronounced p.m. peak traffic impacts, resulting from the combined effects of traffic generated by transit activities and surrounding land uses.

Access and egress to the park-and-ride facility should be relatively easy and cause minimum delay. Whenever possible, the facility should be located on the in-bound direction to the primary activity center. This location should allow the arriving patron to make a right turn into the parking facility with minimum delay. Access to the facility from feeder arterials, rather than the primary one, is preferable.

- **Provide Adequate Space.** The size of the park-and-ride facility should be designed to minimize on-site pedestrian walking distance to about 120 to 150 m (400 to 500 ft), 305 m maximum (1,000 ft), while at the same time providing adequate space for expected demand. A lot will reach its effective capacity when about 85 percent of the total parking capacity is regularly filled. Beyond the 85-percent level, individual parking spaces often become more difficult to locate, and casual park-and-ride users will be dissuaded from using the facility.

- **Provide a Continuous Pedestrian/Bicycle Pathway.** To maximize the usability of the park-and-ride facility, a continuous sidewalk network and pedestrian circulation pathway throughout the park-and-ride facility must be provided. Direct unobstructed access between all parts of the lot, including the outer corners, and the transit intermodal facility must also be provided (37).

Barriers to pedestrian flow between the park-and-ride facility and adjacent residential or employment locations should be eliminated (see Figure 3-7). Bicycle storage should be provided at the park-and-ride facility and allowances for taking a patron's bicycle onto the bus or train should be considered.

3.4.3 Locating Park-and-Ride Facilities to Reduce Implementation Costs and Financial Risk

The third major category of community goals and objectives can be defined under the broad category of reducing cost impacts and financial risks of operation to the implementing agency. Maintaining high user demand, along with an active attempt to improve community integration of the proposed facility, will contribute significantly to a site's ability to provide minimal cost impacts and reduce the financial risk to

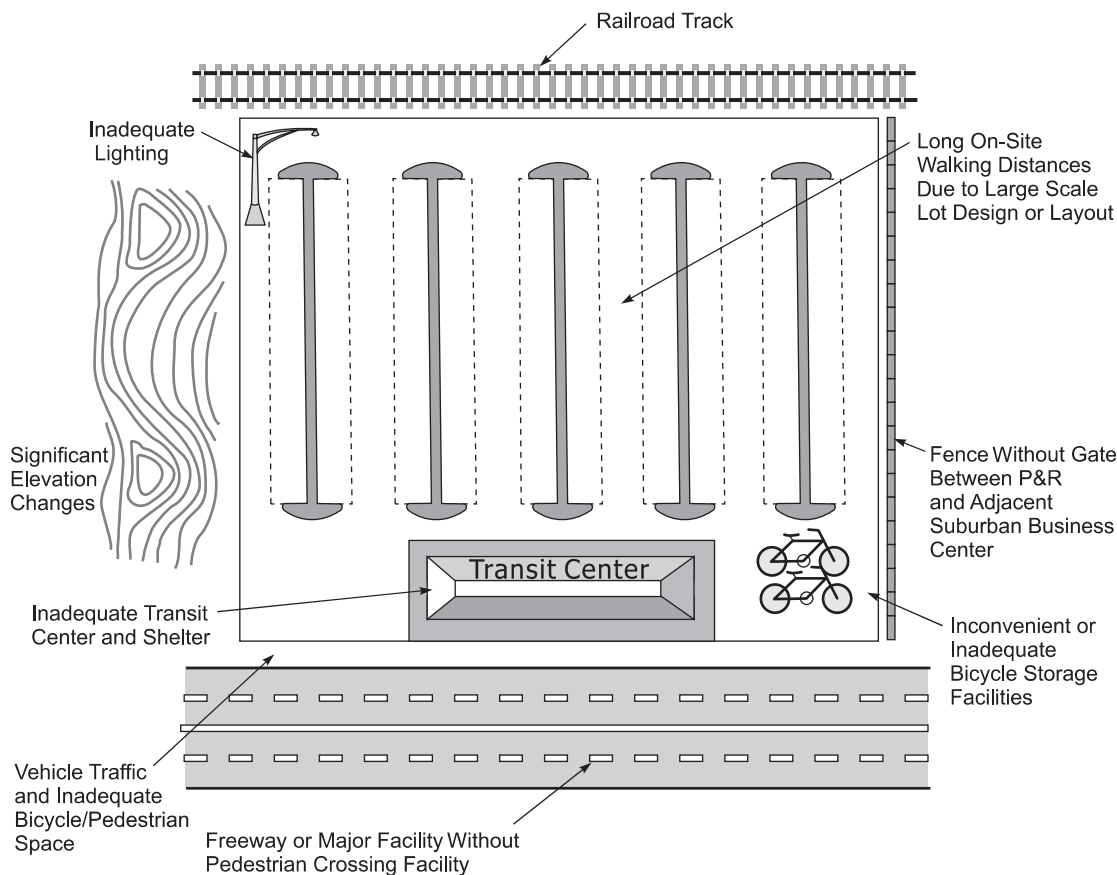


FIGURE 3-7. Common Barriers to Pedestrians and Nonmotorized Access to Be Avoided or Mitigated.

the agency. Although no site can provide a fail-safe investment for the implementing agency, the transportation planner can reduce the threat of financial risk by planning a facility that is well served by transit, accepted and supported by the community, and one which relates well to the surrounding environment.

A number of guidelines are useful to consider in evaluating various site alternatives for park-and-ride opportunities. These concepts are based on various resources and are not intended to represent a comprehensive guide to successful risk management. Close coordination with the implementing agency, the local jurisdiction in charge of land use regulations, and concerned citizenry is always advised.

- **Consider Joint-Use or Temporary Lots.** Jurisdictions seeking to implement park-and-ride facilities within untried markets should first consider developing temporary test lots. This can be accomplished via a (temporary) joint-use arrangement with a church, theater, or other private business that has parking demand characteristics that do not compete with park-and-ride operations. If these test lots demonstrate satisfactory demand, a permanent presence can be negotiated with the property owner or permanent facility developed nearby.
- **Consider Enlarging Successful Lots.** Where possible, consider enlarging lots that demonstrate successful demand characteristics, rather than developing new facilities that could potentially compete with the existing lots to the detriment of both. Structured parking, re-striping, and remodeling of existing lots can often be effectively accomplished at or below the cost and risk of developing new facilities.
- **Encourage Positive or Negligible Economic Impacts.** Sites that require minimal relocation of productive viable business or residential properties should be chosen in preference to sites that would cause more extensive impacts. Relocation of productive businesses and residential properties

is not only expensive, but can create ill will in the community towards the transit operator and remove possible service locations for patrons.

- **Select Sites That Minimize Capital and Operating Financial Commitments.** Sites that minimize financial costs to the implementing and operating agencies should be chosen. Tradeoffs between the expected lifetime operating costs and capital costs of site acquisition and construction should be evaluated using a net present value analysis. This will allow the implementing agency to determine the true costs associated with competing alternatives.

Donated or free sites should be evaluated carefully to determine their relative advantages with respect to the existing park-and-ride system and other competing site alternatives. It should be remembered that donated sites will still result in operating costs and may be less desirable than other site alternatives in the long run.

Sites that maximize the use of existing services or that can be accessed by only minor deviations of existing services should be evaluated in preference to those needing wholly new service routings. Geographic constraints en route to the facility should be evaluated for their impacts on existing or proposed transit and patron access.

- **Allow for Potential Expansion/Joint Development.** Sites that can accommodate reasonable expansion and/or provide opportunities for joint development should be evaluated on the basis of this expanded potential. Expanding successful sites is often easier and more quickly implemented than construction of entirely new facilities. When developing new facilities, allowances for such potentials should be planned into the site location and design.
- **Design Park-and-Ride Service to Complement Local Service.** Park-and-ride facilities can, in some cases, compete with local service within the same area, especially when a cost differential exists between the two services (11). This situation should generally be avoided, either by local route modification or elimination.
- **Pursue Joint Development Opportunities.** Joint development of park-and-ride facilities with private businesses can lead to greater community integration and reduced operating costs. Several specific steps can be taken at the micro-scale level to promote joint development opportunities:
 - Develop a market-oriented approach to developing park-and-ride facilities. Evaluate what the transit organization can bring to the private development community in terms of access, allowances for higher building densities, parking requirement reductions, property exchange, etc.
 - Explore opportunities for shared parking with businesses and community service organizations that demonstrate parking generation demands that are non-competitive to transit service (27).
 - Provide direct connections between the park-and-ride facility and neighboring land uses for auto, transit, pedestrian, and other nonmotorized modes (27).
 - Develop facility designs that encourage the clustering of private buildings near the park-and-ride facility.
 - Consider leasing space for transit administration offices and transit retail stores in joint developments, thereby providing an anchor or seed tenant for the joint development partner.
 - Provide development coordination services when working with surrounding developments and businesses.

3.4.4 Summary

Choosing the right location to place individual park-and-ride facilities is often a difficult decision for implementing agencies. A thorough alternatives analysis process should be conducted to identify the community's goals with respect to the specific proposed facility as well as the universe of potential sites

available. Donated properties should be evaluated for their long-term operational attributes and impacts on the transit system rather than being automatically accepted as an inexpensive alternative to property acquisition.

A number of guidelines have been presented that can assist in the identification of site alternatives and can be used in a sketch planning process to refine the alternatives. Detailed site evaluation and engineering studies should be conducted before proceeding with site acquisition, final design, and construction efforts.

3.5 SUBURBAN PARK-AND-RIDE DEMAND ESTIMATION TECHNIQUES

3.5.1 Overview and Background

Alternative approaches to demand estimation range from the traditional four-step process typically used in regions with robust regional modeling capabilities to site-specific demand estimation and sketch planning techniques such as demand observation and ridership surveys. A number of planning studies have developed site characteristic checklists to assist in the evaluation of potential park-and-ride demand without actually estimating facility demand.

Two primary approaches for developing improved demand forecasts have evolved within the industry:

- Estimating individual park-and-ride demand based on regional modeling approaches
- Developing site-specific forecasting tools, tailored to the metropolitan region

Many smaller agencies, as well as larger ones interested in a more cursory analysis of potential site-specific demand, are utilizing basic rules of thumb to design individual facilities at a conceptual level. These rules of thumb can be used in sketch planning studies and for purposes of final design when better data is not available (see Section 3.4).

Each demand forecasting technique has strengths and weaknesses that the planner should be aware of when choosing one method over the other. It is critical to remember that forecasting, especially at the site-specific level, requires a great deal of common sense and local experience on the part of the planner. All of the approaches discussed in this document can generate erroneous forecast estimates if not applied with an extensive knowledge of the study area.

3.5.2 Regional Modeling Approach for Site-Specific Suburban Park-and-Ride Facilities

Use of regional modeling techniques to estimate park-and-ride demand at specific facilities has become more popular with recent advances in practical computing capabilities. Recent studies in Houston, Seattle, and California have focused on this methodology as a preferred means for estimating demand for park-and-ride facilities.

Use of a regional travel demand modeling approach for estimating park-and-ride demand must be viewed within the context of the overall transportation modeling technique. Determination of park-and-ride demand is heavily dependent on the modal choice model selected for use within the overall transportation modeling structure. As a consequence, techniques for estimating park-and-ride demand can only be as accurate as the theoretical modal split assumptions built into the model.

Experience has shown that the potential for overestimation of park-and-ride demand is high when the travel characteristics incorporated within the system-wide model do not closely correspond to the site-specific conditions observed at the design and construction level when the lot is realized (14). This is especially true when the transportation model is not capacity constrained, and when the park-and-ride system being modeled is capacity limited. The regional modeling approach should be used to develop