CALIFORNIA SEA GRANT

This book is being sent to you compliments of the California Sea Grant College Program. We hope you find it useful and welcome any comments or suggestions.

James J. Sullivan
Program Manager

California Sea Grant College Program, A-032
University of California, La Jolla, CA 92093
(619) 452-4440

Institute of Transportation Studies

University of California

Research Report

COASTAL ACCESS ANALYSIS IN CALIFORNA:

AN ASSESSMENT OF RECREATION TRANSPORTATION

ANALYSIS IN COASTAL PLANNING

James E. Burke,
Environmental Planning;
Lecturer in College of
Environmental Design,
U.C. Berkeley

This work is a result of research sponsored in part by NOAA, National Sea Grant College Program, Department of Commerce, under grant number 04-8-M01-189, through the California Sea Grant College Program, and in part by the California State Resources Agency, project number R/NP-1-8H.

Berkeley, California

September 1981

ISSN 0192 4095

TABLE OF CONTENTS

		Page
I.	INTRODUCTION	1
	Transportation Planning in the Coastal Zone	4
II.	A GENERAL FRAMEWORK FOR COASTAL ACCESS PLANNING	9
	Land Use and Circulation Plans	11
	Population and Land Use Analysis	12
	Travel Behavior	13
	Trip Distribution and Assignment	15
	Access Analysis	18
	Mitigation Measures	22
III.	ANALYSIS OF COASTAL ACCESS IN CALIFORNIA	24
	Highway 1 Capacity Study	26
	Sea Ranch Traffic Analysis	36
	Big Sur Coast: A Subregional Analysis	42
	City of Santa Barbara Waterfront Area Analysis	50
	Aliso Viejo Summer Weekend Traffic Study for Coastal Access Roads	56
	A Subregional Analysis of Southern Orange County	63
	The San Diego Regional Coastal Access Study	69
IV.	CONCLUSIONS: LIMITATIONS AND CONCERNS	75
	FOOTNOTES	81
	REFERENCES	83

LIST OF FIGURES

		Page
Figure 1:	Coastal Access Framework	10
Figure 2:	California Study Area.	25
Figure 3:	Highway 1 Study Area	27
Figure 4:	Sea Ranch Study Area	37
Figure 5:	Big Sur Study Aea	43
Figure 6:	Santa Barbara Area	51
Figure 7:	Aliso Viejo Area	57
Figure 8:	Southern Orange County Area	64
Figure 9:	San Diego Study Area	70

I. INTRODUCTION

The purpose of this report is to determine how coastal access has been analyzed from a transportation planning perspective. The prospect of improving this type of analysis is begun here with a critical review of seven transportation studies undertaken with local coastal planning programs in California. Although coastal access is a goal of coastal management programs in California and elsewhere, the concept has been generally understood as physical access to the beach from a nearby public road. Thus, to date, coastal access programs have emphasized the legal aspects of access and have not investigated its transportation related implications. By contrast the public has repeatedly voiced transportation-related access issues as their primary concern in the coastal planning process. This report investigates the methodologies that can be used to address this concern and thereby broaden our understanding of the meaning of coastal access. The approach used is non-technical. The report is intended for a wide range of planners and decision makers both in California and throughout the coastal states who must yet address the issue of coastal access.

In the California Coastal Act of 1976 coastal access is not specifically addressed but is combined with other issues in a series of broad policy statements. These policy concerns along with the relevant sections of the Act are: cumulative impact (sections 30250, 30253), new development (30250-30255), public access (30252), public works (30254), recreation (30212.5, 30220-30224), shoreline access (30211, 30252) and visual impact (30240, 30251). The Act required that these policies be implemented through land use plans and zoning ordinances to be drawn up by local governments in a Local Coastal Program (LCP) under the guidance of the California Coastal Commission. Upon approval of these plans by Regional and State Coastal Commissions the regulation of development in the coastal zone would be transferred to local control. As of July 1, 1981, the target date for the completion of the LCPs, 15 of 68 local governments had completed the entire LCP process, while an additional 16 local governments had completed their land use plans and six others had completed plans for segments of their jurisdiction. The studies selected for review in this report were for jurisdictions that have, with the exception of Monterey County, completed at least the land use planning component of the LCP process. The studies and jurisdictions are listed in Table 1.

TABLE 1

SELECTED TRANSPORTATION STUDIES AND LCP JURISDICTIONS

Transportation Study	LCP Jurisdiction(s)
Highway 1	Sonoma County; Marin County (North Segment)
Sea Ranch	Sonoma County
Big Sur	Monterey County
Santa Barbara	City of Santa Barbara
Aliso Viejo	Orange County (Aliso Viejo, Dana Point, Irvine Coast, Laguna Niguel Segments)
Southern Orange County	Orange County (Aliso Viejo, Dana Point, Irvine Coast, Laguna Niguel Segments)
San Diego County	San Diego County; San Diego City

One difficulty in the analysis of coastal access is its range of meanings which result in a variety of approaches to the issue. But this is not a semantic problem; there are differences in the perception of access depending on very real local conditions such as physical characteristics (e.g. climate, slope, etc.) jurisdiction and level of need (e.g. urban versus rural need for access). The transportation related aspects of coastal access become important when its components (e.g. highway capacity, parking) are limiting factors in the use of a particular geographical area of the coast or in areas where there is very high demand (perhaps seasonally) for the use of coastal resources. Thus, the problem may be viewed as one of supply and demand or alternately as one with micro and macro properties both of which are related to geographical location. California, in particular, with over 1,100 miles of coastline presents a full variety of coastal access problems and opportunities. It is not realistic to expect one definition of the coastal access problem to fit each situation of to expect the derivation of one methodology which could be used on a state-wide basis. Thus, the seven studies selected for analysis present a variety in location, scale, setting (rural, suburban, urban), network description, analytical technique and access measure.

The Coastal Commission's emphasis in the area of coastal access has been the provision of a public right-of-way from the first inland public road to the ocean. The Coastal Access Program was created in 1979 (by AB.989) to foster the interagency implementation of public access. The program has reviewed proposed and existing accessways as well as those which exist "on paper" as conditions to almost 1,000 of the 50,000 coastal development permits issued in the last 10 years. The results are twofold: the publication of a Public Access Guide (University of California Press, October 1981) and an ongoing program by the California State Coastal Conservancy and local agencies to develop accessways in the coastal zone. The program addresses transportation concerns only in terms of site facilities such as the existence and size of parking lots and bicycle storage facilities, and the location of the nearest transit stop. The program itself may have transportation impacts that have never been investigated. For example, new accessways may be opened in areas of high recreation traffic congestion thus compounding an existing problem without recommending mitigation measures. However, the program has made enormous strides in only two years and can be expected to account for transportation (and other) concerns in the years ahead.

Transportation Planning in the Coastal Zone

Analysis of the case studies and other work in coastal transportation (referenced in the following sections) points to differences between travel patterns in the coastal zone and in inland areas. First, in coastal areas, recreational travel is a major component of total travel, at least for seasonal periods. Second, travel is done primarily by automobile for at least part of the trip. Third, recreation travel by auto (sightseeing) is a major form of recreation even in the face of an "energy crisis." Fourth, recreation travel in the coastal zone is not well understood; the recreation trip is more complex than the work trip, it has been studied far less than the work trip and consequently there is less reliable data available for its analysis. Fifth, coastal recreation travel appears to compete with other trip types for the use of the network during peak recreation periods. If a "fair share" is to be allocated to all user groups, outside interests must somehow be balanced against local interests. Sixth, coastal recreation travel is not analogous to recreation travel at a rural site such as a National Park or a National Forest. As stated above the non-recreation component is likely to be significant, especially near urban areas. Finally, travel behavior in the coastal zone may be very different than in the inland areas. For example, a fast-food stand at a beach or on a pier may be different in many respects from its inland counterpart but an analysis may use the trip generation factors derived at the inland location to describe travel behavior at the coastal location. Or a coastal resident may not use his car during peak recreation travel periods but, again, the analysis may have him making as many weekend trips as an inland resident.

Forecasting future levels of activities related to coastal access may be expected to emphasize recreational travel and participation models. Reviews of recreation travel models have been undertaken by Burke (1977), Cesario (1969), Deacon, et al (1972a), Lavery (1975), Midwest Research Inst./USDOT (1978), Moeller and Echelberger (1974), Thompson (1967), Wilkinson (1973) and Yotter (1974). The major types of models used to predict recreation travel volumes are gravity and attraction: probabilistic and the network or flow. As one might expect, these approaches are similar since they describe a single paradigm of recreation participation.[1] Burke (1977) discusses the weaknesses of recreation travel models. They fail to disaggregate for user, trip, and site characteristics. They may forecast an "average" number of recreationists, regardless of activity preference, trip duration, or site attractiveness characteristics. The gravity model, in particular, does not consider the capacity of each site, the type of recreation trip (such as vacation, weekend trip, or daily trip), or the effect of intervening opportunities (Kalter, 1971). But the network model improves on the gravity model by considering the interaction between sites.

Estimating future recreation activity in the coastal zone is one of the central problems facing coastal planners. Many of the people who use local facilities are from distant origins and have a choice of other activities and destinations (intervening opportunities) that is readily influenced by a variety of non-quantitative factors (values, styles, etc.). Nevertheless, it is useful to look at trends in participation of activities at coastal facilities, disaggregated by socio-economic attributes, and to project these into the future; accounting for future levels by participation of each group and its projected growth.

The methodology of recreation participation has been developed by the U.S. Bureau of Outdoor Recreation (BOR) and its forerunner, the Outdoor Recreation Resources Review Commission (ORRRC). Recreation "demand" is assumed to vary with the population size, real per capita income, education, leisure time, age, race, marital status, and other socio-economic characteristics. Recreation supply is assumed to be a function of recreation land and water acreage, natural environment acreage, historical and cultural acreage, levels of environmental degradation, and other factors. The level of future recreation participation in each activity (e.g. swimming) is assumed to be a function of demand and per capita supply as described above. It is also assumed to be related to other activities: thus, boating and fishing are complementary; other activities may be independent, while still others may substitute for one another. Thus, when one activity has a downward trend, its complementing activity will also, but its substitute activity will go up.[2]

Like most public planning programs the analysis of coastal access must rely on available data. This will consist of origin data, such as that provided in the U.S. Census, and site data, such as the records kept by Park and Recreation organizations. In addition, transportaion departments (state, regional or local) periodically collect count data and conduct origin-destination surveys. But even with a full complement of data from these sources, there are still pitfalls for the coastal planner.

Site data such as that collected at State beaches by the California Department of Parks and Recreation is available on a monthly or daily basis as an output of the Parks and Recreation Information System (PARIS). However, these "hard" figures become soft when one investigates their origin. Often busy rangers are called to "eyeball" the parking lot once an hour. In addition, parking may be extended beyond the design capacity through some innovative use of space, although this may not show up on the printout. Another example of the variability of participation data may be found in Southern California where lifeguards who watch bathers, make rescues, and administer first-aid are also expected to count the number of beach users—an impossible task on busy, peak-use days.

Traffic counts, and to a lesser degree, origin-destination surveys, suffer from occasional inaccuracies introduced by machine malfunction or misinterpretation on the part of those collecting the raw data, those manipulating it into "standard" form and those who analyze it. For example, traffic counts for coastal arterials received by the California Coastal Commission have, after intensive analysis, been found to occasionally have their direction reversed (counts labeled north should have been south, etc.).

The use of existing data may have other hidden pitfalls. There may be an incongruity between the data and the available theories. The data may be for the wrong time period (weekdays versus weekends), for a different locale, or in dissimilar units, or classes. Further, data are usually collected for specific purposes and may not be applicable for use in coastal zone analysis. According to Ditton and Stephens (1976), a full complement of coastal recreation activities is usually not included in the State Comprehensive Outdoor Recreation Plan (SCORP). For some activities such as fishing and swimming, no distinction is made between salt and fresh water locations. Further, data collected on a county basis is not disaggregated for the coastal zone, but is often aggregated into regions (Ditton and Stephen, 1976).

The SCORP data collection efforts have also been criticized by Burdge and Hendee (1972). They point out that while spot interviews and questionnaires of users are the usual form of data collection, the plan presents projections for recreation use for the entire state. Obviously, certain biases related to local recreational groups, such as middle and working class persons, will be present. In addition, the tourist is often ignored in these surveys.

Ultimately, the planner must carefully examine the available data, familiarize himself with its weaknesses, and then use it. But the effect of possible data inaccuracy on the results should be taken into account and appropriate caveats should be given.

II. A GENERAL FRAMEWORK OF TRANSPORTATION PLANNING FOR COASTAL ACCESS

There is no single method or "handbook" approach to coastal access planning. This is due to differences in:

- planning scale
- jurisdiction
- circulation network
- setting (urban, suburban or rural)
- climate
- coastal resources and impacts

and other factors that affect travel behavior of the public and the ability of a coastal area to meet a distant demand for recreational access. But there are components of the access problem that can be considered in any coastal planning programs. They are an expansion of the typical transportation study (trip generation, trip distribution, assignment and modal split), that is oriented toward weekday work trips, to include all types of trips that will occur in a coastal area throughout the week. However, weekend travel will be emphasized since this is to be the time when coastal access problems occur.

The coastal access framework is shown in Figure 1. It includes components of:

- Land Use and Circulation Plans (Alternatives)
- Population and Land Use Analysis
- Travel Behavior
- Trip Distribution Assignment
- Access Analysis
- Mitigation Measures

that comprise a Coastal Access Plan. It also indicates the influence of recreation travel models and recreation participation analysis discussed in

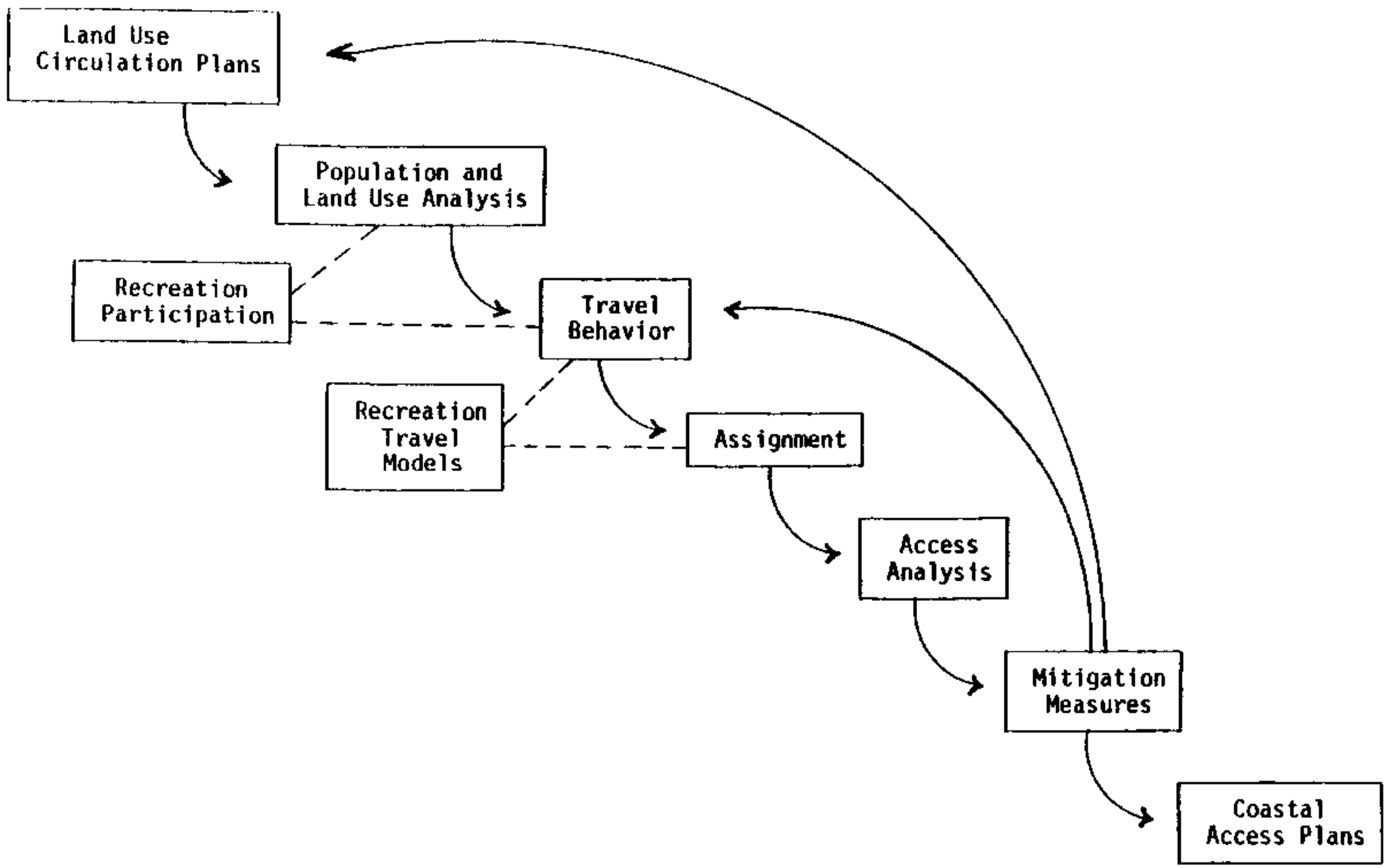

Figure 1: Coastal Access Framework

Chapter I. Various components of this framework are included in every coastal access program. In the following section the framework will be used to compare a variety of approaches used in California.

Land Use and Circulation Plans

Land Use and Circulation Plans provide a starting point for the analysis of coastal access. They are likely to be products of the same program investigating access and may be available as alternative plans, in which case coastal access would be one of the criteria used in their evaluation. Actually circulation and coastal access often cover identical concerns so they might be combined or appear in a variety of guises. In California, for example, coastal access is addressed in the public works and access components of the Local Coastal Programs. While the former is concerned with the development of highways and other facilities, the latter is primarily concerned with property rights and pedestrian access to the coast.

Land Use and Circulation Plans assist in the establishment of the study area boundary. Although many political, jurisdictional, administrative and natural factors may be used in establishing the boundary, since the problem is one of transportation, the circulation plan, or alternative plans, may form the most substantive basis for its delineation. There is a related problem of determining the circulation network to be used in the study. It will be a part of the regional network, but how much of it to include is a difficult question especially in urban areas such as the Los Angeles region. It should include coastal access routes and those arterials and intersections where congestion occurs as the result of coastal travel and where recreation trips compete with other trip types for the use of transportation facilities.

Setting the boundary and determining the circulation network assist in the assessment of problems associated with local growth and development versus those originating from beyond the study area. Ordinarily weekend trips of local residents can be distinguished from those of "day-trip" recreationists or "overnight" visitors from outside the area. Likewise, local ownership patterns can be investigated to distinguish permanent residents from second-home owners and seasonal renters.

Population and Land Use Analysis

Population projections and land use plans are usually taken as given in the development of a transportation plan. Both provide estimates of the future population through computations based on birth and migration rates, or on build-out and allowable residential densities (dwelling units per acre) and assumed levels of occupancy (persons per dwelling unit). The land use plan also provides a basis for estimating trip generation in terms of trip ends per land use type; it also indicates how trips will be dispersed on the circulation network.

But the California Coastal Commission has shown a willingness to contest and change land use plans which generate traffic that interferes with coastal access. This is a logical stance that is emerging in land use and transportation planning, a change from planning programs (i.e. General Plan) where land use and circulation elements were considered independently. It represents a new state of affairs for land use and transportation planners who have been trained to think differently about issues and procedures. As comprehensive coastal plans are drawn up in California, the intensity of the interaction between different types of planning is likely to increase and to affect the acceptance and use of planning techniques.

Population projections are usually disaggregated by socio-economic characteristics such as sex, age, race and income. The predicted growth rate for each of the resulting classes is important not only in its description of future social groups but because these attributes are used indirectly in the computation of future recreation participation, commerical revenues, housing demand and other planning indicators.

The constraints imposed by the land use plan may limit the population below its projected levels. Certainly this would be the case in communities that have recently passed growth control ordinances, perhaps due to alarm caused by projected population levels (e.g. Petaluma, California). But in other areas, predominantly rural communities and suburban areas apparently not bothered by growth problems, land use plans and zoning ordinances (often inconsistent with each other) would allow buildout to population levels far in excess of projected levels. Aware of these problems in California, the authors of the California Coastal Act of 1976 requires that Local Coastal Programs (LCP) provide land use plans and zoning ordinances. Further it requires that development planned by State, regional and local agencies and special districts be in the land use plan of the LCP, giving coastal jurisdictions a form of local control over higher level agencies. Thus the LCP was established to undertake a truly comprehensive approach to planning.[3]

Land use plans also provide capacity measures for recreation planning. The traditional approach is to apply area standards to determine the carrying capacity approach, it seems to be a justifiable first step, quickly taken, that can be refined as the analysis proceeds. In California, beaches rarely exceed the most limiting estimates of capacity, although some areas, notably the south Orange County, may do so within the next twenty years. Also, there is evidence (Burke, 1977) that beach recreationists may actually prefer crowding of certain types of groups and facilities.

Travel Behavior

All those aspects of coastal travel that involve individual user decisions are grouped under travel behavior. These include trip generation, arrival and departure pattern, vehicle occupancy, model split and trip distribution (route selection) on the circulation network.

Trip generation has been studied extensively for different types of residential, commercial and industrial facilities (Caltrans, 1965-1979, Institute of Transportation Engineers, 1976), but the emphasis has been on weekday work trips. Weekend trip generation coefficients have been developed by the California Department of Transportation (Caltrans), but only a small proportion of this work has been devoted to weekend trip making at coastal facilities.

There are differences in residential community types, important to coastal planners, that are not accounted for in trip and generation research. Older coastal communities may be comprised of a mixture of land uses (usually due to a lack of zoning in their beginning phases) and activities such as fishing, farming, commerce and the arts. Or the community may be one whose inhabitants commute to a nearby urban area and are heavily dependent on the automobile; it might be a second-home development ranging from plush large-lot retreats to trailer courts. It might be oriented toward commercial recreation with hotels, motels, restaurants and related businesses dominating the townscape. Most likely of all is that it would be some combination of these community types with varying mixes of trip purposes and generation levels.

The aspect of coastal trip making that has never been thoroughly investigated in California is the reputed tendency for coastal residents to reduce trip making during periods of peak coastal recreation travel. This point is of obvious importance in determining the potential interaction between local residents and visiting recreationists.

Measurements taken both in Northern and Southern California indicate that 50% of the visitors traveling by auto arrive at coastal beach and park facilities between 11:00 a.m. and 1:00 p.m. (Caltrans, CPO 1978). Arrivals and departures from marinas and golf courses are spread out over the day, as one would expect.

Numerous studies indicate that recreation trips carry 3.0 to 3.2 persons per vehicle. But recreation trips appear to be the most elastic type of trip in the face of gasoline shortages (Sterns, 1976). This would indicate that if shortages become a way of life, higher automobile occupancy levels can be expected, and increased numbers of recreationists will shift to public transit and bicyles, depending on their availability. For some groups there is still a high propensity to use automobiles for recreation travel, either due to the inconvenience and general dislike of public transit (Orange County EMA, 1979; CPO 1978; VTN/MRI, 1975) or for reasons of prestige, especially among younger people.

Trip Distribution and Assignment

Route selection by destination-oriented recreationists would appear to be similar to that of workers and others who would minimize distance, time and other perceptions of travel impedance (Leonhardt, 1971). It also appears that even coastal sightseers usually have a fixed destination in mind even though they might take a more circuitous route in their travels (DeLeuw Cather, June 1979). For example, sightseers in Big Sur travel south from the Monterey area and then turn around at about the forty to fifty mile mark and drive back to their origin (California Coastal Commission, January, 1977).

Origin-Destination (O-D) surveys are the basic means of determining route selection patterns of coastal travelers. They may be conducted with interviews, postcard surveys, or license plate surveys. Of course, each of these approaches is limited by survey design techniques and planning budgets, but they are the staple of coastal access planning and each LCP in California appears incomplete without its O-D survey. It is also important to realize that this information can be validated with other sources of information ("triangulation" to the social scientist) such as expert observation (the local traffic engineer), traffic counts and secondary data sources from other, related surveys. Most of the O-D surveys found in California LCPs are simple, one-shot, affairs that only approach a scientific sample at best and frequently omit major population groups or activities.

In traditional transportation planning analysis as trip ends are identified, trips are assigned to the network and link traffic volumes are increased until, for all practical purposes, the trip ends are accounted for. The obvious problem is that some links have more traffic than their capacity, or in the calibration phase, different levels than the existing traffic volumes. Reassignment of trips then takes place, sometimes under the control of a computer program such as a probabilistic assignment capacity-constrained algorithm. But when trips are disaggregated by purpose, the very crux of coastal access, packaged computerized solutions (e.g. UMTA programs) become very insensitive to who is traveling on a link and who gets rerouted if it overflows. Here is one place in the analysis that coastal access planners must be willing to challenge the thinking of more traditional transportation planners.

The study area boundary is the basis for a difference in the analysis of trips with both trip ends within the study area versus those with one or more trip ends outside of it. Internal trips are handled routinely, often taking into account items of interest in coastal access such as differences in trip types. Trips with both ends external to the study area, or through trips, are usually accounted for as a percentage of total traffic volume based on regional transportation estimates.

Trips with one trip end outside the study are of special interest to coastal planners; these are the trips of recreationists and others who travel long distances from population centers to spend the day, the weekend or longer vacation periods on the coast. This type of trip provides an opportunity to the planner to mesh or to complement the technique of recreation participation projections with the use of trip generation coefficients. The use of trip generation coefficients based on area or any other site attribute will simply not explain the crush of coastal visitors that may descend on a coastal area during a peak period of recreation. Many of the factors are simply origin related. Hot inland weather combined with a holiday will send literally millions of persons to the coast in the Los Angeles region. The city of Laguna Beach, for example, has eight million potential users within a two hour drive (non-congested conditions). There are no physical facilities (acres of beach, etc.) at Laguna Beach that would indicate how many persons will attempt to make use of the excellent coastal facilities. And on occasion the local highway system becomes an extended parking area, particularly during the Laguna Beach Art Festival, an event sponsored by the city and local merchants to attract visitors. Oddly, the beaches in this area are never utilized to capacity, although they may be if coastal access improves. The level of frustration with coastal access is implied by the fact that between 5% and 10% of the beach recreationists in the San Diego area are from the Los Angeles region approximately 100 miles to the north. Many travel even further, crossing into Mexico and traveling down the Baja California peninsula.

The point is that computing trip ends based on land area, parking lot spaces or other such measures is generally inappropriate for peak recreation conditions. Illegal parking, in particular, is a well-known indicator of beach use in many coastal areas. And many coastal jurisdictions cannot afford to control it during the peak use periods. Coastal transportation studies should attempt to analyze periods when coastal resources are intensively used.

To do this it must account for the demand, including the levels and types of participation, that exists in nearby population centers. The analysis must go beyond trip generation techniques based on site attributes.

Access Analysis

The answer to the question: "Is there sufficient coastal access?" depends not only on the definition of access and how it is measured within this definition but also on its relationship to other planning concerns. Increasing access may be possible only if other desirable features of a local coastal area are reduced. The components of access are also the components of other planning concerns, particularly circulation, but also housing, energy conservation and environmental quality in general. One reason why there is insufficient access in many coastal areas is that the mix of these components has been based on a whole host of planning criteria with the exception of access.

Access may be defined and measured in several ways. It may be just the physical access, such as a walkway, from a parking area or road to the beach. These paths, also known as accessways, are the subject of local ordinance and state law, such as the California Coastal Act of 1976, and are concerned with property rights, acquisitions, dedications, easements and related legal aspects. This type of access is often required as a permit condition for coastal development. The construction of a condominium complex, for example, might be permitted only if an accessway was made available to the public. The Coastal Access program has proceeded with the identification of existing and potential accessways, the identification of low access areas and the development of an implementation program to obtain access where it is needed most.

Coastal access may also be defined as a local traffic engineering problem where link and intersection capacity, pedestrian safety and parking are the major points of focus. This is particularly appropriate in small communities that have only a few major streets that become congested during the recreation season. In coastal access analysis at this level a survey of parking facilities and an analysis of traffic flows might result in an access program that would consider traffic controls to increase access (e.g. turn lanes) and safety (e.g. traffic signals) a somewhat difficult task in that the two criteria often work against each other. The program would also address the adequacy of parking and might even investigate ways of having a park and shuttle system set up as is currently done at several locations in California, notably Capitola in Santa Cruz County. This type of access program is based on the local or micro-circulation impacts and mitigation of coastal access.

Coastal access may also be measured in terms of its system-wide aspects, as in transportation planning. In this context costs, efficiency and effectiveness of transportation alternatives and system-wide measures such as vehicle miles traveled, travel time, air quality and energy consumption are used to evaluate coastal access. This level of analysis is appropriate in suburban and urban coastal areas where the trade-offs between recreation and other trip types become more apparent. The local population has travel requirements just as in any community, and while they may be impeded by an influx of recreation traffic, they in turn interfere with coastal access.

In addition to the competition between trip types on the circulation network, there is also competition for increasingly limited sources of development funds. Thus, a parking complex is likely to be located to the satisfaction of local merchants rather than recreationists. Or an alternative link alignment that improves coastal access may actually be the worse alternative according to a system performance measure for work trips such as vehicle miles traveled.

This level of access analysis is the most sophisticated and frequently the most controversial. This is because the analysis of weekday work and correlated trip types (e.g. commercial) has become a routine procedure whose results are familiar to commissions and boards concerned with development. The inclusion of coastal access in the planning program often upsets the long-standing procedure used to analyze travel in complex networks. The question of trade-offs becomes part of the analysis at a much earlier stage; they are subsumed in the analysis and there is the danger that decisions regarding coastal access taken by the transportation planner may be contrary to public desires. And since the internal workings of the procedure are often "mysterious" to the official decision-maker, it is possible that the issue may not be addressed in a meaningful way.

The analysis of coastal access requires more than a circulation plan. It incorporates many of the issues that planners at all levels have faced over the past decade: environmental and social impacts, neighborhood preservation, and inducement and dispersion of development. From this perspective coastal access becomes one of the factors that <u>should</u> be evaluated and traded off in the comprehensive planning process. Obviously paving the countryside is a ridiculous idea but with proper controls it would provide maximum coastal access by automobile, buses and other vehicles. At some point in the push for increased access there will be trade-offs with other worthwhile objectives, notably environmental quality. There are ecologically sensitive areas of the coast that should be protected from trampling and general overuse by the public. In this context, planning access means locating and limiting it. Paving over beaches and filling wetlands for parking and road widening are other examples of the conflict between access and the environment. Parking is space consuming; at three persons per automobile and a beach use standard of 100 square feet per person (California Department of Parks and Recreation), a car will require more room (350 $feet^2$), at the coastal destination than its occupants (300 $feet^2$)! If a parking structure is to be the solution, zoning and visual design policies such as those in the California Coastal Act come to the fore.

The obvious solution of using transit to reduce environmental degradation is simply not viable at the current time. As discussed under the Travel Behavior section, current life styles depend heavily on the car. The implementation of a transit program can be enormously expensive while fully loaded cars would appear to consume less energy per person. In addition, some persons are unable to ride transit to the coast for a variety of reasons, varying from personal equipment (e.g. surfboards, fishing rods) to the expense and inconvenience of family travel, especially with young children. As the difficulties of family travel indicate, any consideration of coastal access can quickly turn to socio-economic concerns and questions of equity, such as who will benefit from planned access and who will pay for it. The typical economic analysis and recommended solutions of resource demand based on consumer surplus and the "willingness to pay" fall short of the goals of most public planning programs because they do not reflect "ability to pay." Thus, public decision-making reflects a constant tension between responsible fiscal and economic policy and social concerns; the subsidy of public transit being a good example. It can be expected to carry over into decisions concerning coastal access in areas such as parking, park-and-ride schemes and the provision and location of beach facilities, marinas and natural areas.

The planner can provide all of the necessary ingredients for coastal access but he cannot insure its occurrence. There are a variety of reasons for this: site characteristics, activity preference and special characteristics and compatibility of user groups which indicate that there is a trade-off between a site's accessibility and its attractiveness. The planner may best attack this problem by a thorough on-site inspection of every coastal facility, including a cataloging of its natural and social features, and discussions with supervising personnel and different types of users.[5] The open-ended interviews conducted by the planner as participant observer always yield unexpected information about the perception of access and other aspects of coastal resource use, although it is not recommended that these social dynamics be extended to the public at large without an accompanying scientifically selected sample for comparison.

Mitigation Measures

Since development in the coastal zone may severely impact access, alternative mitigation measures should be considered in the coastal planning program. Typical mitigation measures include:

- developing new facilities
- encouraging the innovative use of existing facilities
- developing and encouraging the use of alternative modes of transportation
- restricting the type, amount and dispersion of land development

The usefulness of each of these measures depends on the conditions of each particular planning program, as mentioned in the beginning of this section; there are many reasons why one or more of these measure might be inapplicable. For example, until attitudes toward transit change, those who could make use of it in the coastal zone will continue to drive their automobiles, thus making the transit option too expensive to set up and run. In fact, any mitigation measure that requires funding will face increasing opposition in the midst of the movement to re-evaluate public financial priorities.

Care must be taken in mitigation of impacts in medium and large scale circulation networks. If, for example, a critical link such as that with the highest volume to capacity ratio (v/c) is to be widened, then the congestion may just be shifted to another point in the network. If a link is added to bypass a troublesome link or intersection, again the problem may be shifted to another point. The analysis of network flows is complicated and thus, a computer program is often relied upon for the correct mitigation scheme from a traffic flow perspective. As previously discussed, the computer analysis may also be used to obfuscate and impair the overall planning solution. The "correctness" of a mitigation scheme under these conditions with regard to trade-offs such as the environmental effects of a new link in a coastal area depend on an analysis of who would benefit from the change. In the past developers have sought changes in the circulation network that would make work and shopping trips more convenient for prospective home buyers. This kind of mitigation should not be done in the name of coastal access.

In California development patterns have been shifted in the permit process to lessen the impact on coastal access. This is a relatively new and controversial approach[6] to land use planning, although its effect is limited by the extent of the Coastal Commission's jurisdiction.

III. ANALYSIS OF COASTAL ACCESS IN CALIFORNIA

In this chapter we review studies of coastal access at seven locations in California (Figure 2) using the framework developed in the preceding section. These analyses are representative of the work recently completed or in progress as part of the LCP process. As seen in the studies, there is no concensus as to how the problem of coastal access might be resolved; indeed it is usually approached as a secondary issue within the context of a transportation studies that differ by scale and objective.

The format begins with the title, author and background information, including location, scale, setting and other relevant local characteristics. It also describes the planning program and its objectives under which the analysis took place. Relevant population, land use and circulation plans complete the preliminary information.

An outline of the study is followed by a summary of the travel model, which is different for each of these examples. Certain aspects of the model are emphasized in the discussion under recreation participation and travel behavior. Finally, sections on access analysis and mitigation measures describe how coastal access is defined and how its impacts are resolved.

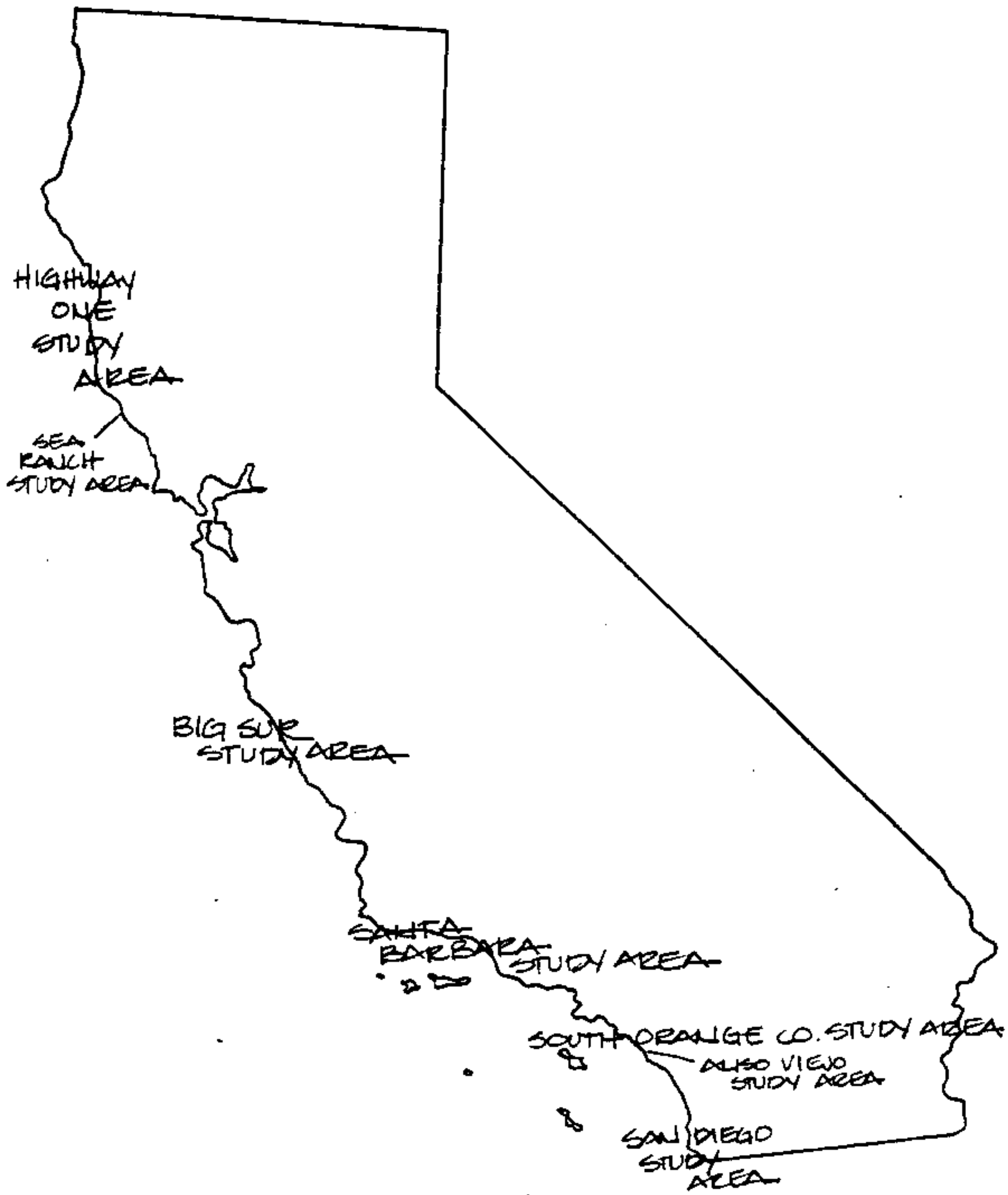

Figure 2: California Study Areas

TITLE: Highway 1 Capacity Study

AUTHOR: DeLeuw, Cather & Company, San Francisco, DKS Associates, Oakland and D.K. Goodrich, San Francisco, November 1979.

BACKGROUND

The study area covers a 200 mile stretch of the coastal route, State Highway 1, north of San Francisco in Marin, Sonoma and Mendocino counties that frequently becomes congested on peak summer weekends. The purpose of the study is to provide the California Coastal Commission with information regarding the effects of new development along the coast.

The planning area is a long coastal strip that includes many potential development sites (Figure 3). The analysis was performed on the macro-scale. Its travel model uses a "push" concept based on the population of inland areas and in impedance to recreation travel based on travel times from these areas to the coast.

The analysis utilized population projections of travel zones in order to estimate an External Influence Factor (EIF) component of travel on Highway 1. The effect of external travel along the coast for various horizon years then provided estimates for allowable new development. No major changes in the circulation system are planned in the area, although the study recommends bypasses around several coastal communities as potential mitigation measures.

STUDY OUTLINE

- Analysis of traffic data and travel survey results:
  - traffic counts (seasonal, daily, hourly; spatial variations)
  - travel survey (postcards and roadside interviews)
  - traffic counts (four residential areas)
  - telephone survey (Sea Ranch)

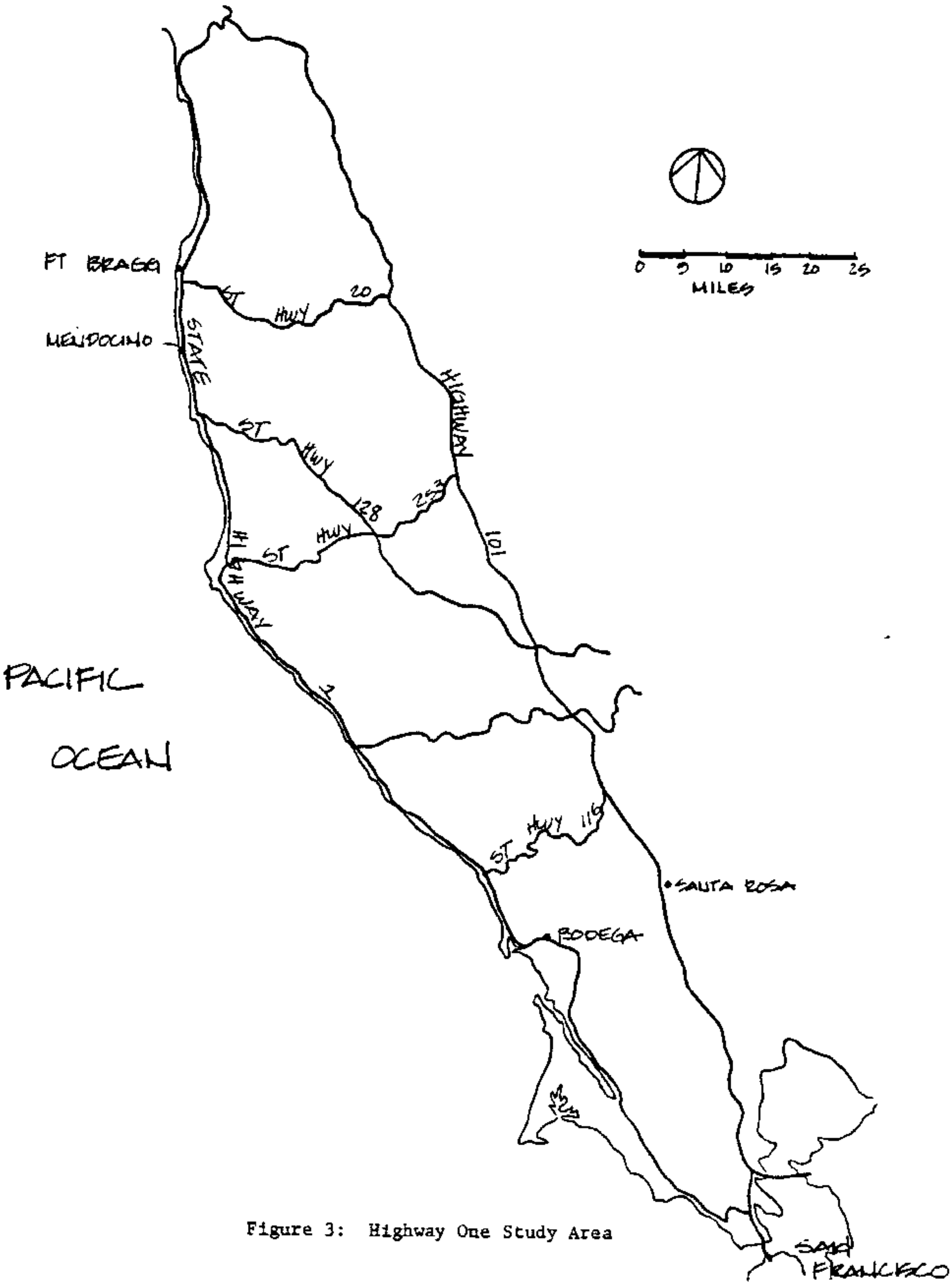

Figure 3: Highway One Study Area

- Calculation of capacity and service volumes on Highway 1
- Travel model development
- Analysis of existing and future land uses near Route 1
- Estimate of future external traffic and then the allowable local development based on local traffic patterns and highway capacity
- Mitigation measures

SUMMARY OF THE TRAVEL MODEL

- Delineation of the 200 mile linear highway network (study area) into "sections," "reaches" and "segments"
- Coastal travel divided into two categories:
  1) Recreation travel due to influences (trends) external to the coastal zone (the basis of the External Influence Factor, or EIF) that would occur regardless of new development along the coast;
  2) Recreation and non-recreation travel due to development in the Coastal Study Area (the basis for the Overnight Accommodation Influence Factor, or OAIF);
- Four "sections" of the network are used in the analysis of the EIF. The EIF component was estimated to be the level of existing traffic at the average minimum traffic volume point for each section. Survey data were used to disaggregate the daily Sunday trips on each section from each of fourteen external travel zones. Future traffic volumes due to external factors were then estimated to grow at 3%, a rate double that of the rate of population growth in each of the travel zones, approximately 3% per year.
- Each section is divided into one to three reaches which are used in the analysis of the OAIF component of coastal traffic. The OAIF contribution to the summer Sunday non-recreation and recreation traffic

volumes on each reach is determined by the trip generation characteristics of residential dwelling units and overnight accommodations (motel/hotel rooms, campsites), respectively. These were based on Highway 1 along each reach.

- Each reach is also divided into "segments." There are forty-five segments, averaging 4.4 miles in length.
- Each of the eight reaches in the network had an activity "hub" (e.g. a town) where local trip making intensified. Away from the hub on each reach, local trip making was assumed to fall off; a gradient effect that was used in the assignment of trips. That is, local trips had a higher probability to have one end at the hub than at a remote section of the reach. This probability gradient was estimated by the ratio of existing peak hour, local traffic on each segment to existing peak hour, local traffic at the hub. Existing peak hour OAIF traffic was estimated as the difference between existing peak hour traffic volume and the estimated existing peak hour EIF traffic volume. Peak hour two-way OAIF generation factors were calculated for each reach as ranging from 0.22 to 0.66 trip ends per unit depending on the total number of dwelling units along each reach and the recorded peak hour two-way traffic volume on the reach.
- Trip generation factors for different land uses were, based on consultant data collection to be ten trip ends per unit, for residential (per DU), hotel/motel (per room) and campsites (per site) during the peak hour Sunday traffic condition.
- OAIF peak hour two-way traffic on each Highway 1 "segment" is equal to:

  New Living Units in Reach x OAIF Trip Generation for Reach x gradient for that segment.

- The EIF and OAIF traffic components are added together to obtain total traffic volume on each segment, reach and section. As travel zone populations grew in the future, the EIF component grew on each section. This effect caused available capacity to decrease over time. The model indicated the level of development that can occur on a segment by a given horizon year before the service volume (at different levels of service) is reached. For example, if no development took place, and Highway 1 is not widened, then at some point in time the EIF component would account for all of the available increase in traffic volume for the limiting segment(s) within each reach. If some development took place, then the capacity limit would be reached at an earlier date.

RECREATION PARTICIPATION

A variation of the recreation participation projection technique is found in the computation of that portion of traffic in each "section" due to the External Influence Factor (EIF). But instead of projecting participation in terms of persons (beach attendance, etc.), it projected "section" traffic volumes as a linear function of population growth in traffic zones versus traffic levels on Highway 1.

The study did not use park visitation data. It concluded that the data did not render identifiable trends and was, therefore, not suitable for use in projecting future travel.

TRAVEL BEHAVIOR

Based on a trip generation study of four residential development sites, the study concluded that coastal summery Sunday residential trip generation was essentially the same as that reported by the Caltrans trip generation research program for a variety of Northern California communities: approximately 10 trip ends per dwelling unit. This finding is of interest since between 30% and 50% of the residents surveyed did not claim the property tax exemption, an indication of second home ownership. The Sunday peak hour trip generation ranged from 0.72 to 2.44 trip ends per dwelling unit. However, a Sea Ranch telephone survey led the authors to conclude that trip generation at that site was approximately half these levels. Also two way travel on Highway 1 is generated in the model with much lower levels of peak hour trip ends, from 0.20 to 0.66 trip ends per hour, as previously mentioned.

The authors also assumed that campsites generate a similar number of peak hour trip ends on a summer Sunday. It is difficult to say if this is correct or incorrect, two such sites monitored by Caltrans over six years ago generated 6.7 and 19.8 trip ends on a Sunday, an average of 9.2 trip ends. The Caltrans program has surveyed seven sites (five additional inland sites) with overnight camping, along with a variety of other uses, including a lake. The average Sunday trip ends per campsite is 12.5 with a range of 6.7 to 19.8 (the two coastal sites bracket the range). Unfortunately, under the scope of the study no direct trip generation data of recreation facilities was collected.

ACCESS ANALYSIS

Coastal access is implicitly determined by the level of traffic that can occur on Highway 1 during the summer Sunday peak periods. The study investigated the capacity of the highway, at levels of service "D" and "E," and the effect of increased recreational travel and local development on each segment. The analysis separated recreational from non-recreational traffic and thus provided a measure that may be useful to decision-makers regarding coastal access: the percentage of recreational traffic on each segment during peak recreation periods.

A projection of the competing uses of the highway indicates that its capacity would ultimately be used up by recreation travel alone, or in combination with development that might occur before this would happen. Therefore, a major impact predicted by the study was that the system would reach its capacity during peak recreation periods (provided that there are no major changes in the highway network) even if no development decisions are taken in the interim.

MITIGATION MEASURES

The study states that traffic capacity of Highway 1 can be improved through:

- lane and shoulder widening
- parking restrictions (on the highways)
- recreational vehicle restrictions
- improving traffic flow through major intersections
- left-turn lanes
- alternative roadway alignments
- by-pass routes
- major widening

also that traffic impacts may be mitigated by reducing travel demand through:

- transit service
- restraint of traffic
- dispersion of peak period travel
- promotion of ride sharing
- promotion of other travel modes

While the traffic engineering approaches to improving capacity may be controversial at the local level, they are generally straight forward from a planning perspective provided that their secondary impacts are taken into account. For example, the environmental and growth inducing impacts of alternative alignments, by-passes and widenings could be severe, depending on local conditions. It is the second set of mitigation measures that reduce travel demand that deserve comment.

The discussion in the study prefaces itself with the comments to the effect that in the absence of a fairly severe traffic restraint program, the extent to which mitigation measures can be effective is small--"too small to meaningfully affect traffic conditions and traffic's impact on the Highway 1 environment." For example, the most likely transit routes are shown to be three to four times more expensive (subsidy cost per passenger) than normally acceptable levels. And funds are clearly limited for this type of subsidy. The Golden Gate National Recreation Area, between the study area and the populous Bay Area, generally has a difficult time funding limited weekend transit service which is modest in scope compared to that required in this study area. Other than transit, no other mode of travel (bicycle, air, rail and ferry) appears to be able to mitigate auto travel.

Dispersion of peak period travel and ride sharing could be increased through educational programs and travel restraints as discussed below, but would appear to be a function of public values rather than a viable option open to planning decisions.

Travel restraints are obviously the most controversial mitigation measure presented. According to the study it may be accomplished through:

- restriction of local development
- congestion restraint
- fuel supply restraint
- pricing
- physical restraint

The first measure seems the most likely. The California Coastal Commission has done this in the past although its authority is restricted to the coastal zone and development beyond this boundary can also affect traffic volumes in the coastal zone.

The congestion restraint means to let the congestion build to the point where travel behavior would be altered. Local travelers would be able to navigate around traffic jams on back roads and distant travelers could decide to stay home if, for example, the weather indicated heavy coastal use. This hardly seems like a mitigation measure. Congestion is the problem that many coastal communities currently experience and are hoping to mitigate through coastal planning. This "measure" would be unacceptable at the local level.

The fuel supply and fuel cost constraints can hardly be done in the context of coastal planning. This type of planning is undertaken at the federal level and it is obviously interwoven into the fabric of our society (through production, inflation and recession, etc.). While it affects coastal travel, it cannot be controlled by coastal planners and decision-makers.

Pricing constraints such as increases of transit fares, tolls, parking and service costs have long been the favorite solution of economic planners that have almost always lost out in political arenas due to their regressive and inequitable effects. It is the "willingness-to-pay" concept that, in reality, masks the "ability-to-pay" criterion. It is difficult to imagine a public program that would embrace pricing constraints. There are many examples of decisions (i.e. natural gas deregulation) that have been unpopular for this very reason. However, de facto pricing constraints may be allowed by developing coastal attractions such as resort hotels with golf courses that cater to a high-income clientele. Here, again, the California Coastal Commission has been careful to restrict this type of development and to enforce mitigating features (access, public beaches, etc.) where it was allowed.

Physical restraints such as the use of barriers and flow metering devices will have a certain unpopular reception by the public unless they can be shown to increase access as have some ramp metering programs. In any case, the use of this measure is highly unlikely in view of current public attitudes.

TITLE: Sea Ranch Traffic Analysis

AUTHOR: California Coastal Commission Staff Reports,[7]

San Francisco, August 1977 (unpublished).

BACKGROUND

The Sea Ranch traffic analysis was part of an investigation by the California Coastal Commission study of the impact of an exclusive coastal community in a rural area, approximately 100 miles north of San Francisco, south of the Sonoma-Mendocino County border. The initial plan had twenty-two private access roads intersecting a ten-mile stretch of Highway 1, the major North-South arterial in the area to serve 5,200 homes (Figure 4). It was planned to be one of the largest "towns" on the Northern California coast.

The climate and rocky cliffs of the Northern California coast discourage swimming and sunbathing, but encourage sight-seeing, photography and landscape painting, fishing, snorkling (in a wetsuit) and beach-combing. As a result there is a significant, if unknown, level of sightseeing and recreational travel in the area.

The objective of the analysis was to determine how much development could occur at Sea Ranch before it began to interfere with coastal access in the area, specifically on Highway 1, a two-lane arterial.

Two land use scenarios were developed as a basis for trip generation. The first was based on a site plan for 2,340 dwelling units drawn up by the owners' association. The second was based on a build-out of the 1,897 privately owned, subdivided lots. Both of these plans were mapable and provided a basis for trip distribution.

No changes were planned for the circulation system for two reasons. First, the development, on a narrow strip of coastland, uses Highway 1 as the only access route between planning units of residential, commerical and recreation

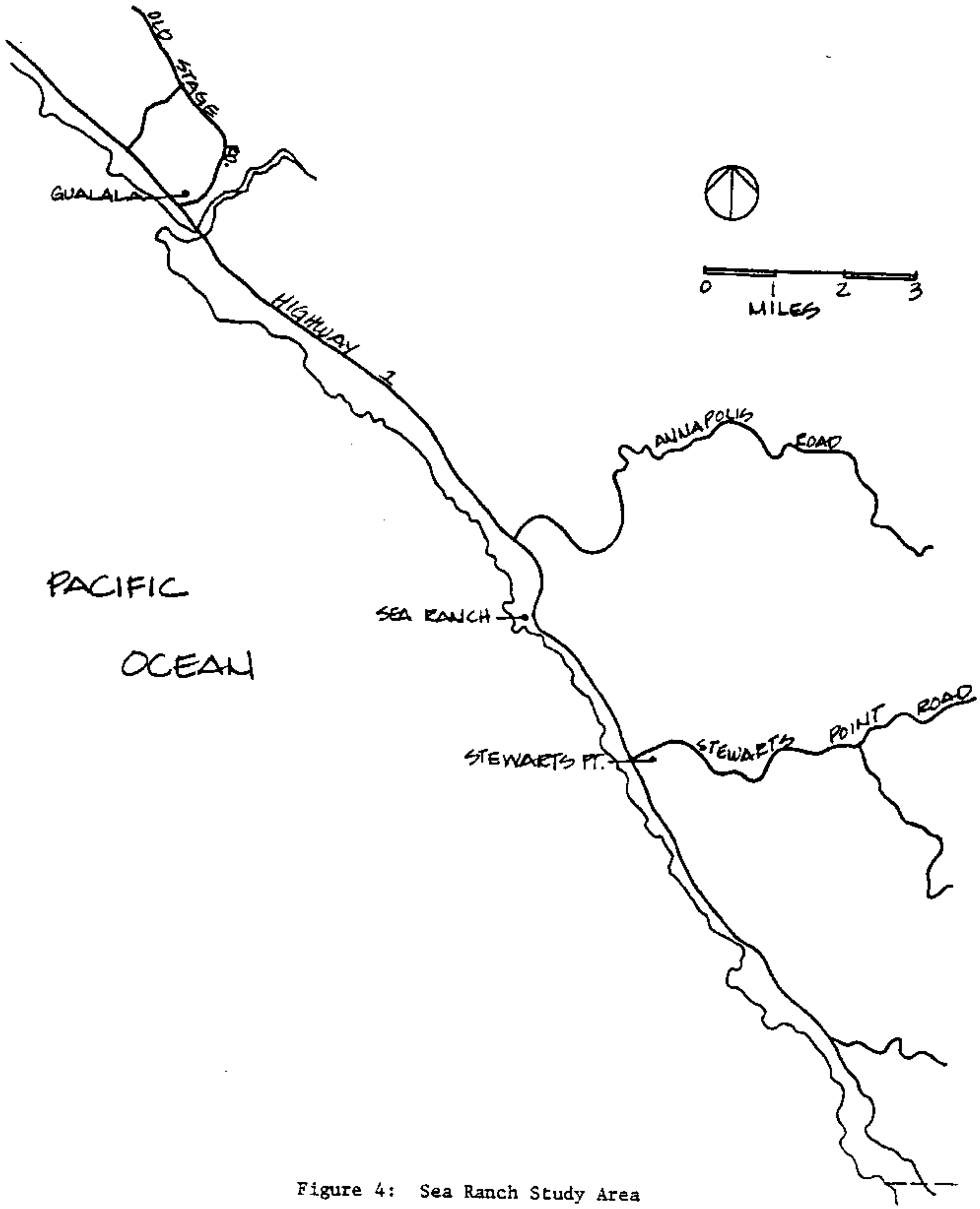

Figure 4: Sea Ranch Study Area

development. The property rights of existing owners preclude the provision of an alternative parallel path to Highway 1. Secondly, the California Coastal Act of 1976 prohibits the widening of coastal highways in rural areas.

STUDY OUTLINE

A series of papers rather than a single report were used to detail the Sea Ranch analysis:

- Issue Analysis
- Determining the Network
- Population Projections and Land Use Plans
- Recreation Use: Present and Future
- Trip Generation and Travel Patterns
- Travel Model
- Capacity Analysis
- Conclusions

SUMMARY OF TRAVEL MODEL

The analysis is a traditional small scale approach, similar to that used in the Santa Barbara study:

- The circulation network and site layout for two development scenarios were determined.
- Travel demand and trip generation factors were assumed.
- Trips generated by Sea Ranch were assigned to the network including four links (segments) of Highway 1.
- Future levels of trip making for other local developments were determined, using the same technique, based on California Coastal Commission land use development information.
- The critical link was defined as that link on Highway 1 where the difference between capacity (LOS E) and peak hour Sea Ranch and other

other local traffic was at a minimum. That is, a minimum amount of capacity remained for coastal recreationists.

- The analysis was undertaken for two peak hour residential trip generation rates: 0.8 and 0.4 trip ends per dwelling unit.
- The analysis was undertaken for two service volumes (Levels of Service D and E): with and without traffic controls.
- An analysis of the sensitivity of Sea Ranch traffic on the critical link to the distribution of Sea Ranch dwelling units was undertaken. A factor indicating the rate of change of traffic volume as dwelling units were shifted north or south of the critical link indicated the mitigation potential of redistributing development.

RECREATION PARTICIPATION

Very little was known about recreation participation in the area at the time of the analysis, so the study focused on those factors that could be predicted (highway capacity and traffic volumes caused by local development) and estimated the road capacity left for non-local coastal recreationists. Recreation activities in the area were reported to consists of small numbers of fishermen and scuba enthusiasts; traffic experts also estimated that there were significant numbers of coastal sightseers in the area on summer weekends, although no "hard" information was available.

One difficult point was the separation of recreationists from non-recreationists; of local from non-local population. The reason for the difficulty is the problem of second-home owners, seasonal or long-term renters and weekly or weekend renters. Sea Ranch, for example, is a mixture of primary and secondary residences and absent owners often rent their homes for varying periods.

TRAVEL BEHAVIOR

With a simple network and an absence of transit, the main travel behavior issue is not route or mode selection but that of trip generation. The analysis looked at peak hour trip generation at two levels, 0.8 and 0.4 trip ends per hour per residence. This level of trip making was significantly below that measured in twelve Bay Area residential areas which had a range of weekend peak hour trips ends of 1.51 and 0.68 with an average of 1.10 (Caltrans, Dist. 4). The lower trip generation rates used in the analysis reflected an assumption that coastal residents would prefer not to compete with visiting recreationists and would reschedule non-essential trips.

ACCESS ANALYSIS

Coastal access was measured in terms of traffic volume capacity available to non-local recreationists on the critical link during the peak recreation travel hour (corresponding to the peak travel hour). Thus factors that affect capacity in turn restrict coastal access. The major factor was safety. It was assumed that one or more traffic signals would be installed on Route 1, at some point as the community progressed toward buildout. The signals would reduce capacity of the highway through Sea Ranch by at least one-third, depending on their location and "greentime."

The results of the analysis are displayed in the table which follows. Based on an hourly trip generation of 0.8 or 0.4 Trip ends per DU, the Sea Ranch and other local traffic volumes are subtracted from the capacity of the critical link. The bottom two rows indicate the percentage of capacity remaining for the current capacity and the capacity reduced by the addition of traffic signals, respectively.

The Effect of Sea Ranch Development on Route 1

	Site Plan Buildout		Private Ownership Buildout	
Peak hr. Trip generation factor (trips per du)	0.8	0.4	0.8	0.4
Sea Ranch traffic on critical link (two-way, veh./hr.)	1194	663	847	484
Other local traffic	140	70	140	70
% current* link capacity for non-local recreationist, sightseeing	0.0 (capacity exceeded)	39.0%	18.0%	54.0%
% reduced** capacity left for non-local recreationist sightseeing	0.0 (capacity exceeded)	8.0	0.0 (capacity exceeded)	31%

* current capcity estimated to be 1200 veh./hr. (LOS "E")

** capacity reduced to approximately 800 veh./hr. by addition of traffic signals at major intersections of access roads and Route 1.

MITIGATION MEASURES

The study concludes that microscale highway engineering improvements could improve the capacity of Route 1, especially at intersections. Also, paths could be provided to allow for foot and bicycle travel by Sea Ranch residents, thus reducing the level of highway traffic. But the major means of mitigating coastal access impacts was to limit buildout to 2,029 DUs, the number of existing lots, approximately 2,100 DUs less than originally planned. In addition, California Coastal Commission requirements for the dedication of fine accessways and several view easements before the remaining 1,300 vacant lots can be built out were upheld in a recent federal district court ruling.

TITLE: Big Sur Coast: A Subregional Analysis

AUTHOR: California Castal Commission Staff Reports, San Francisco, January 1977.

BACKGROUND

This analysis was part of a subregional planning program conducted by the California Coastal Commission during 1976. The purpose of the program was to provide information to local governments for use in their Local Coastal programs and to assist the California Coastal Commission in the evaluation of permit requests for the subregion. The analysis of transportation in the Monterey County portion of Big Sur was the subject of the review.

The Big Sur coastline is well-known for its rugged beauty and its breath-taking views. Its only major road, Highway 1, provides access from Carmel in the north through seventy miles of mountainous and forested terrain to the Monterey-San Luis Obispo county line, and beyond to the Moro Bay area (figure 5). There are only a few hundred dwelling units dispersed throughout the area. It is essentially pristin in nature, being bound on its landward side by the Los Padres National Forest and the Ventana Wilderness area.

There were 1.4 million visitors to the area in 1975. This is expected to increase to 2.8 million visitors by the year 2,000, according to the U.S. Forest Service. In addition, current zoning would allow a buildout of over 9,000 dwelling units. The purpose of the transportation analysis was to estimate the impact of future development of recreational travel along Highway 1, a two-lane road throughout the study area.

SUMMARY OF THE TRAVEL MODE

The method used to analyze recreational travel in the study area was comprised of the following steps:

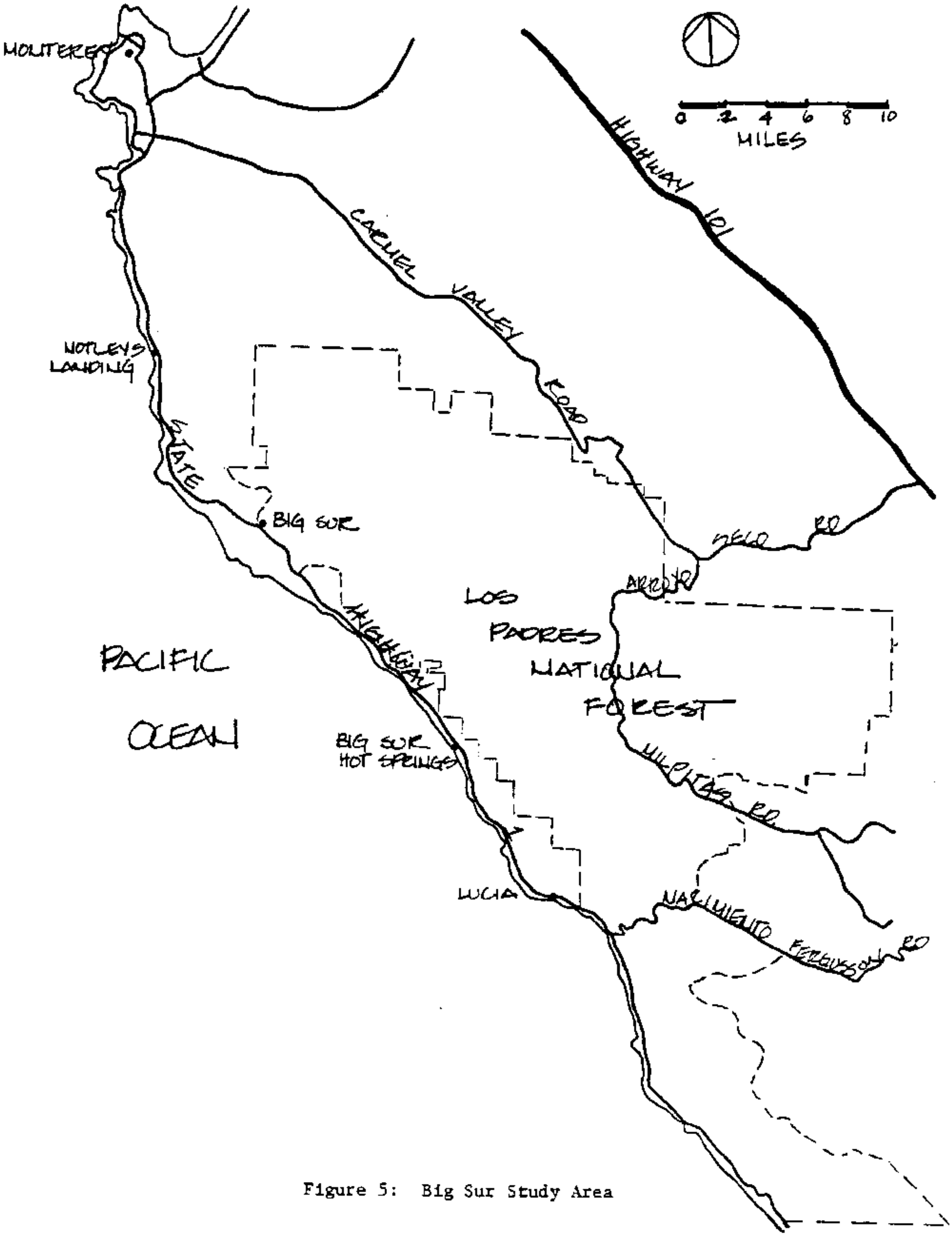

Figure 5: Big Sur Study Area

- Present and historical traffic count data were studied and a representative time frame was selected for analysis. In this study, summer Sunday was selected due to its high peaking characteristics.
- Current trip making was described at a level of detail necessary for the analysis of coastal access issues. The major trip purposes for the time frame were identified as recreational and residential. A simplified transportation network was developed and residential trip origins (centroids) and outstanding recreational trip destinations were located on it. Cordon points were established as ingress and egress points to the network for recreational traffic. Recreational travel was divided into five classes: pleasure driving, camping, day use and dispersed recreation, wilderness and lodge guests. These categories were designed to take advantage of existing U.S. Forest Service and California Department of Parks and Recreation data.
- Estimates of current trips to and from the area were computed based on residential and recreational activity levels within. The total of external trips at both external cordon points was compared to the total measured traffic at these points and found to differ by 14%.
- Estimates of current trip levels within the study area were obtained by dividing the area into four zones, and assuming trip generation rates and distribution patterns for residential and recreational trips.
- Potential future external trip volumes were derived from increases in recreation activity levels predicted by the U.S. Forest Service and the California Parks and Recreation Department. The potential for internal trips (within the study area) was derived from future buildout of residential areas.
- An analysis of the capacity of the highway and the distribution of the current level of internal trip making yielded the critical link,

a section of the network at its northern end. Based on the remaining capacity in this link a formula for trading-off new residential development versus recreational travel was constructed. Either 8,100 homes could be constructed with no additional recreational travel or recreational visitation could increase by 510,000 visitors, only half of the unconstrained increase in participation forecast for the year 2000.

RECREATION PARTICIPATION

The analysis was innovative in its development of trip generation information for trips to and from the study area, from the usual attendance figures published by recreation agencies. First, recreation travel was broken down by the major types of available participation data:

- pleasure driving: those who drive in the study area but do not patronize developed day use facilities or stay overnight.
- camping: those who camp overnight in designated areas.
- day use and dispersed recreation: those who use facilities intended for day use and do not stay overnight.
- wilderness: those who obtain permits to use wilderness areas.
- lodge guests: those who stay overnight in lodges, hotels or motels.

The next step was to translate "visitor-days" into daily person trips, and ultimately into vehicle trips with an appropriate vehicle occupancy factor. The visitor-day measure used by the U.S. Forest Service represents twelve visitor-hours, that is, any product of persons and duration of stay that equals twelve person-hours. The study then interprets a visitor-day for the following activities as:

- pleasure driving: six persons taking a two-hour pleasure drive through the area.
- camping: one person occupying a campsite for twelve hours.

- day use recreation: three persons spending four hours in day use recreation.

Two approaches may be used in the derivation of vehicle trips: the first works from the annual visitor-day attendance figures such as those provided by the U.S. Forest Service; the second works from the number of sites and estimates of turnover and occupancy. Examples of the assumptions and calculations for the major types of recreation are:

- Pleasure driving: Assume estimated annual attendance (1.4 million), annual to peak day conversion factor (.01), occupancy level (three persons per auto).

  Example:

  $$1.4 \text{ million visitors} \times \frac{\text{vehicle}}{3 \text{ visitors}} \times \frac{.01 \text{ peak day visitations}}{\text{annual visitations}}$$

  $$\times \frac{2 \text{ trip ends}}{\text{trip}} = 9{,}333 \text{ vehicle trips on a peak day.}$$

The use of two trip ends per trip is easy to visualize since many autos drive south from Carmel and then turn around inside the study area and return.

- Camping: The U.S. Forest Service estimated that there were 51,000 visitor-days per year spend in camping. Assume three percent of this demand occurs on a summer Sunday; average length of stay is three days; one-third of the sites turn over each day and one trip is generated into and one trip is generated out of the area when a turnover occurs.

  Example:

  $$51{,}000 \text{ visitor days} \times \frac{.03 \text{ peak day visitors}}{\text{annual visitation}} \times \frac{12 \text{ hour persons}}{\text{visitor-day}}$$

  $$\cdot \frac{\text{day}}{24 \text{ hours}} \times \frac{\text{turnover}}{3 \text{ days}} \times \frac{\text{auto}}{3 \text{ persons}} \times \frac{2 \text{ vehicle trips}}{\text{turnover}} = 170 \text{ trips}$$

For 508 State and private sites, assume 90% occupancy:

$$508 \text{ sites} \times \frac{.90 \text{ full sites}}{\text{total sites}} \times \frac{1 \text{ turnover}}{3 \text{ days}} \times \frac{2 \text{ vehicle trips}}{\text{turnover}} = 322 \text{ trips}$$

DAY USE AND DISPERSED RECREATION

Some usage of day use areas was due to campers and those counted in other categories. An estimate was made of those whose sole activity was related to day use facilities. Assumptions included 94,000 visitor days usage annually (1974-1975) peak day to annual conversion factor (.01), and the percentage engaging solely in day use activities (90%).

Example:

$$94{,}000 \text{ visitor-days} \times \frac{\begin{array}{c}3 \text{ persons, } 4\\ \text{hour stops each}\end{array}}{\text{visitor days}} \times \frac{\text{vehicle}}{3 \text{ persons}} \times .01 \times .9$$

$$\times \frac{2 \text{ trips}}{\text{vehicle}} = 1698 \text{ vehicle trips.}$$

The number of vehicles entering and leaving day use areas may also be counted directly by machine or person (attendant) or indirectly through sales or taxes.

TRAVEL BEHAVIOR

The vast majority of peak day traffic was attributed to recreation with over half being sightseeing and driving for pleasure. The local residents claimed that they made one round trip per summer Sunday although that three-fourths of the dwelling units generate one trip out of the study area during the peak day and one to two round trips internal to the study area.

Internal trip making by recreationists was estimated at 4.0 trip ends per campsite or room for campers and other overnight visitors. This is in excess of the external trip making described in the preceding section. Accounting for both types of trips gives a value of less than 5.0 TE per unit, a value at half that used in the Highway 1 study, but one that is given substantiation here.

The time of the study, there was no transit available for recreationists, although there is currently a pilot program, utilizing buses, which is attempting to get sightseers out of their cars.

ACCESS ANALYSIS

Coastal access was measured in terms of the percentage of total daily traffic, on the critical section of a highway, that can be attributed to recreationists, on a peak recreation day (summer Sunday). The threat to coastal access is the traffic from potential residential development that would usurp the remaining load capacity. In any case, even without further development, increasing demand for recreational travel in this area will cause the critical section of the network to reach capacity sometime within the next decade.

MITIGATION MEASURES

The main thrust of the study was its attempt to explain the trade-off between recreational attendance and the number of new dwelling units. A linear relationship was developed between the two factors. For example, if 10% of the remaining capacity was allocated to residential use, this would correspond to 810 additional dwelling units and would allow 1.85 million visitors to access the area; 50% (4,050 DU) would allow approximately 1.45 million visitors, and so forth. This is based on a service volume in the critical link corresponding to LOS D. This is essentially the extent of mitigation: the control of new development. Once again (in addition to the Highway 1 study) it is in a format welcomed by decision makers. It lays out the alternatives in a very clear fashion. But as stated in the conclusions, there are several problems with this type of approach.

With regard to mitigation, the major problem is not addressed, and that is the growth in recreation forecast for the area that is likely to inundate road capacity within the next decade, even if no new development occurs. The situation is very similar to the Highway 1 study and the discussion of that study's mitigation applies here to some degree. The difference is that this area is a national treasure, rather than a state-wide or local coastal resource, and the demand to experience it during the summer months might support a transit system. Also, it could conceivably become a National Park, in which case entrance fees might control access.

TITLE: City of Santa Barbara Waterfront Area Transportation Study

AUTHOR: De Leuw, Cather & Company, San Francisco, January 1979.

BACKGROUND

This is a study of the downtown, waterfront area of the city of Santa Barbara that examines future development alternatives and determines detailed traffic and parking impacts. The study area is small, about three miles in length, along the Pacific Ocean, stretching inland approximately one-half mile (Figure 6). It contains the major coastal recreation attractions in this city of 74,000: public beaches, a wharf, a marina and a bird refuge. It also contains a major north-south transportation artery, Route 101, which is a freeway except for five blocks (four signalized intersections) in the downtown area. There are 3,600 jobs in the area, half with the fifty-three restaurants and hotel/motels. There is a community college with approximately 7,000 students. Traffic volumes in the study area are highest during the months of July and August, with peak daily level on Sundays due to recreation traffic. Beach use is a major recreation attraction. Development scenarios were constructed by the City staff with assistance from local organizations and were based on redevelopment plans and a general knowledge of local aspirations. The development area within the study area was divided into ten sites, each of which was given between two and five alternative detailed development plans. These were then used to generate trip ends and future travel conditions. There are no major changes planned in the circulation system except for the upgrading of Route 101 to a freeway through the downtown area. The effects of this change are investigated in the study

STUDY OUTLINE

The analysis was a typical transportation study at the local level:

- Analysis of existing travel conditions: traffic volumes, parking,

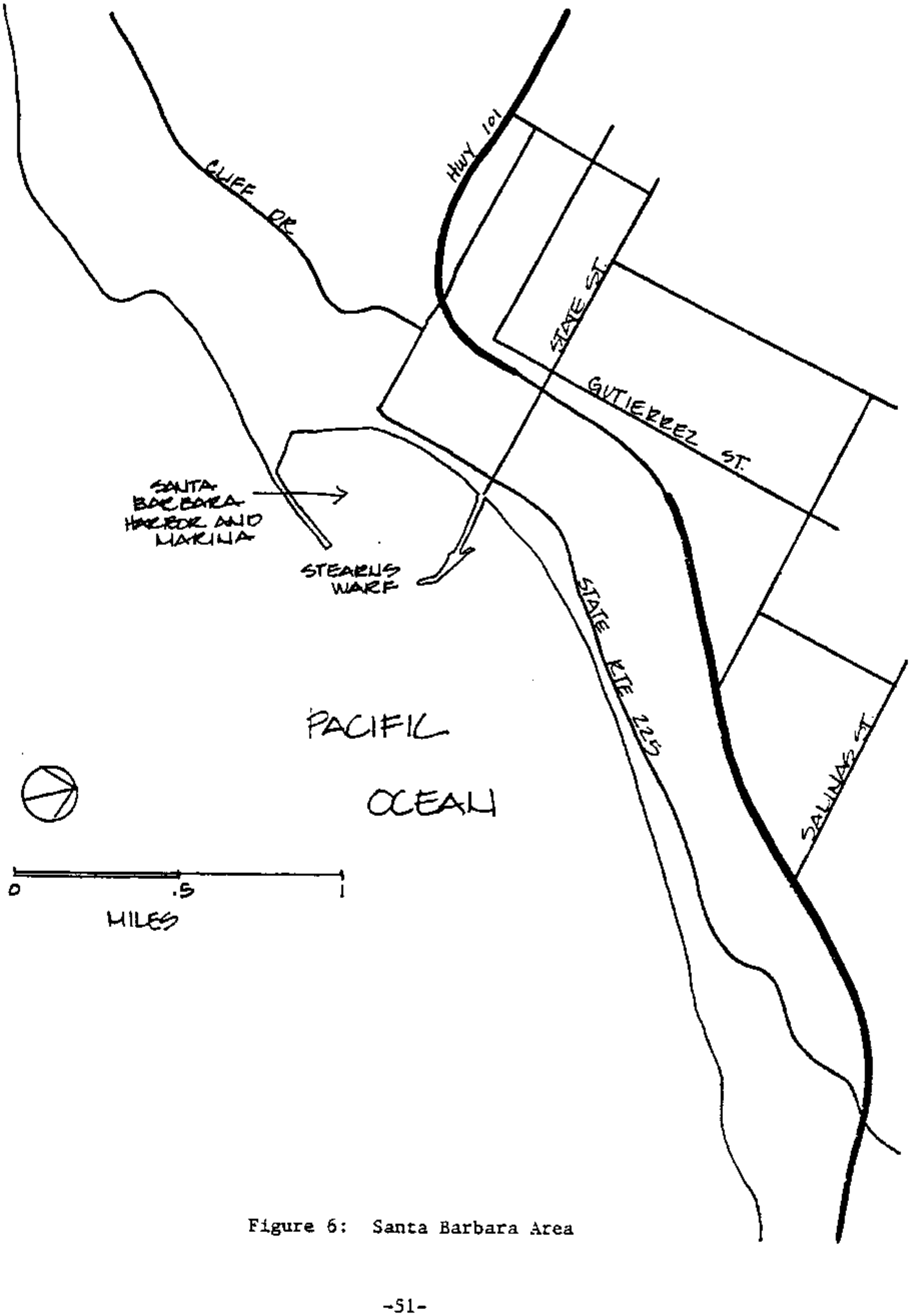

Figure 6: Santa Barbara Area

public transit service and bicycle routes.

- Survey of parkers and employees in the study area.
- Description of development scenarios.
- Estimate of future travel conditions; trip generation, trip distribution, trip assignment.
- Traffic and parking impacts of development scenarios.
- Mitigation measures.
- Implementation.

SUMMARY OF THE TRAVEL MODEL

The traditional approach to small area transportation analysis was used to estimate future traffic volumes:

- Trip generation: estimation of the number of vehicle-trips originating at or determined by multiplying a trip generation coefficient, an empirically derived constant for each land use by a measure of area for that land use (acres, ft^2, etc.) to obtain trip ends. This was done for each development alternative.
- Trip distribution: determination of the general destination (direction) of site generated vehicle trips.
- Trip assignment: assignment of trips from the site to a destination on particular roadways (a path).
- Service level analysis: determination of the effects of traffic volumes as a proportion of the roadway on intersection capacity.
- Impact analysis: determination of general impacts on neighborhood and local traffic circulation.

RECREATION PARTICIPATION

Recreation participation and its potential for growth in the study area was considered for boating, downtown parks, and commercial recreation. Beach use was not directly analyzed. Future traffic generated in the waterfront area is directly attributable to the development scenarios that include boat slips (1500 to 1800 boat slips) in the harbor expansion and acres (7 to 12.6 acres) of parks in the hotel/conference center. Commercial recreation was considered in a variety of shops in the study area at Stern's Wharf through trips generated by a restaurant, fish market, specialty shops and convenience food outlets. Beach related activities such as swimming, sunbathing and surf fishing did not contribute any additional trips to the future traffic volumes developed in the study. These were assumed to be accounted for by the new visitor serving facilities. In addition these direct uses of the beach were assumed to have a small traffic impact relative to the new development. It was not stated whether coastal recreation would increase. Since the trips attributed to the development scenarios are added to the existing traffic volumes, the implication is that any recreation participation not accounted for by the scenarios would remain constant.

TRAVEL BEHAVIOR

A parking survey was conducted by leaving postcards on parked cars on a Sunday, Monday and a Thursday during the last week of August, 1978. Eighty percent of the weekday parkers near City College reported school (City College) as their primary trip purpose, with restaurant, beach, boating and home each receiving about 5%. Sunday trip purposes surveyed throughout the study area were led by beach recreation (37%) and boating (25%). Information on employee trip behavior in the study area was obtained in a sample of interviews.

Nearly all travel was by automobile. Transit was estimated to carry less than 1% of the travelers to and from the study area during the week and an insignificant number of passengers on the weekend. Automobile occupancy levels were 1.26 persons during the week and 2.17 on Sundays. The latter reflects a higher proportion of recreation trips than the weekday rate.

The postcard survey also provided information on origin and destination that was used to assign future trips to the network on twelve primary access routes. This O-D routing was assumed to be the same for weekday and weekend. The majority of trips (60% to 70%, depending on origin) would use Route 101 to access the study area. The assignment procedure was done manually.

ACCESS ANALYSIS

Coastal access was not defined in the study but was indirectly treated in the analysis of the impacts created in the development scenarios. There was a concern for the capacity of key intersections to carry additional traffic at various levels of service (A through F). The availability of parking in the study area was also analyzed in detail. There was also a concern that new development did not restrict existing or future beach access.

MITIGATION MEASURES

The major recommended mitigation measure was to increase the capacity of the circulation network by upgrading Route 101 to a freeway with a variety of underpasses and overpasses replacing the existing intersections. This measure has local support and is actually an outgrowth of previous local recommendations and plans. It is likely that this proposal would increase access to the city beaches although major impacts are noted; namely, the effect of 60% to 70% of travelers to and from the study area attempting to enter and exit the freeway and the potential for shifting of congestion from one critical intersection to another. Finally, the potential parking problem in the area is underscored by a questionable accounting for increased recreational participation in beach related activities.

Rerouting and service improvements were recommended for the transit system and some detailed guidance was given as to how this might occur.

Bicycling was also encouraged with recommendations for additional bike paths, special lanes on streets and storage facilities at key locations. A bicycle parking ordinance was recommended; this would assist in the implementation of a 1974 Bikeway Master Plan.

TITLE: Aliso Viejo Summer Weekend Traffic Study for Coastal Access Roads

AUTHOR: Jack G. Raub Co., Costa Mesa, CA, January 1979.

BACKGROUND

This study investigated the impact of the new town of Aliso Viejo on coastal access in the Southern Orange County area. The study was undertaken in response to questions raised by the California Coastal Commission. It is a supplement to a series of reports that address the planning issues related to the new town of Aliso Viejo.[8] The study area is the planned site for the new town of Aliso Viejo, a 6,600 acre parcel of land between the Pacific Coast Highway (California Highway 1) and the San Diego Freeway (Figure 7). It will consist of industrial and commercial centers and 20,000 dwelling units. This study estimates the levels and mix of traffic on coastal access roads that would be used by coastal recreationists and Aliso Viejo residents during periods of peak recreation travel.

The circulation network consisted of the major arteries from the Pacific Coast Highway (PCH) between and including Laguna Canyon Road and Crown Valley Parkway to but excluding the San Diego Freeway. It included the arterials of the Master Plan of Arterial Highways for Orange County. These arterials provide access to some of the public's favorite beaches in Southern California, including Laguna Beach, but there are a variety of problems of which congestion and parking are the most pressing.

This part of the Orange County coast is the focal point for future large-scale development; there are plans for 60,000 dwelling units in the local area. The County evaluates the traffic impacts of development plans based on a regional study: the South East Orange County Circulation Study (SEOCCS). It also performs local analysis for amendments to General Plan elements. The sole concern of every analysis to date was the work trip along with commercial

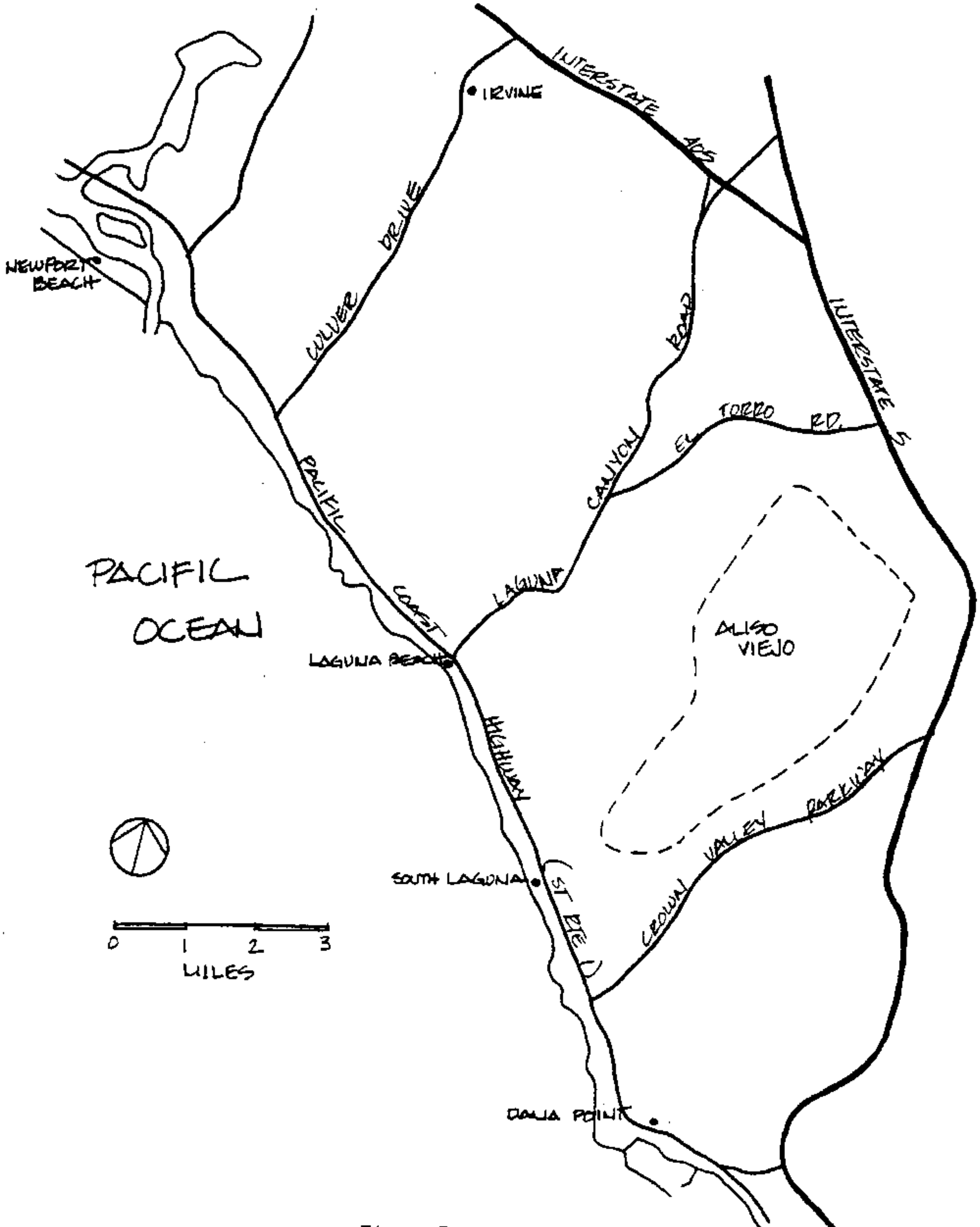

Figure 7: Aliso Viejo Area

and other types of weekday trip making. The analysis of weekend trip making has been avoided.

OUTLINE OF THE STUDY

This study was undertaken as an extension to the Aliso Viejo Traffic Study Technical Supplement. It is brief and to the point. Its major sections are:

- Analysis of Total Daily Traffic
- Analysis of Peak Hour Traffic

Each of these major sections included subsections of trip generation, trip distribution, recreational traffic analysis and traffic assignment.

OUTLINE OF THE TRAVEL MODE

The Aliso Viejo model computed the total daily traffic in the study area for a peak weekend period and, in a separate part of the analysis, computed the traffic attributed to new development (Aliso Viejo) during the same period. Finally, the percentage of total daily traffic as attributable to the new-development was computed.

Total daily traffic is computed in the following manner:

- An analysis of traffic count data on local coastal access routes was undertaken in order to determine the ratio of weekend to weekday traffic volumes.
- The weekday traffic volumes projected by a regional study (SEOCCS) are converted to weekend counts using the factor (ratio) computed above. A level of modal split is assumed.

The traffic volumes attributable to Aliso Viejo were computed in the following manner:

- The study area was divided into traffic zones and weekend traffic volumes were computed following the traditional method: land use, trip generation, distribution, assignment and modal split. The key to the analysis was travel distribution, as explained below.

- The proportion of trips having trip ends external to the study area was assumed from larger scale regional studies. They were divided between fifteen districts (cordon points) external to the study area. Three internal-external trip types were considered: non-residential (external trips to and from commercial, industrial and recreational attractions in Aliso Viejo), non-recreation residential (trips between Aliso Viejo residences and external commercial attractions) and recreational trips (trips between Aliso Viejo residences and external recreation attractions). The proportion of non-residential trips (or non-residential factor) to each external district is the fraction of expected weekday internal-external trips from the study area to the external district (from the regional transportation study) weighted by the population of the district. The non-recreation factor was computed in a like manner, except that it is weighted by a retail employment factor of the external district. The recreation factor was based on the assumed relative recreational attractiveness of each external district. The total attaction factor of each external district was computed as the weighted average of the three trip type factors multiplied by the total number of trips of each type generated in Aliso Viejo.
- The weekend traffic volumes due to Aliso Viejo on the coastal access routes were computed by assigning the internal-external trips to and from Aliso Viejo to the nearby coastal access routes. Also, trips internal to Aliso Viejo that use coastal access routes were accounted for as well.

The two parts of the analysis are combined:

- The traffic volumes on the coastal access routes due to Aliso Viejo were compared to the total traffic estimated for the future weekend day to determine the percentage due to the Aliso Viejo development.
- Total daily traffic for each coastal access route was disaggregated into peak hour flows in each direction based on state and county data. For three major routes (Laguna Canyon Road, Crown Valley Parkway and Pacific Coast Highway) the one-way peak hour flow ranges between .028 and .049 of the total daily traffic. Thus, two-way peak hour flows are between 5% and 10% of the total daily traffic.
- Finally, the volume to capacity ratios were computed for major sections of the three arterials mentioned above. Laguna Canyon Road is projected to operate at LOS "D" during the peak hour in the peak direction; Pacific Coast Highway at LOS "E" and "F."

RECREATION PROJECTION

The analysis did not use information concerning levels and projections of recreation participation. Future coastal recreation was assumed to be reflected in the conversion of future weekday volumes to weekend traffic using a factor computed from the current levels of each.

This approach implicitly assumed that there would be no per capita increase in coastal recreation with its straightforward conversion of current to future travel volumes. The study assumes that 33% of the weekend recreation trips from Aliso Viejo will use coastal facilities in the study area. Current trends indicate that there is an increase in the per capita use of coastal facilities. But it is difficult to say what the overall contribution of Aliso Viejo will be without a reference to current behavior in the study area.

TRAVEL BEHAVIOR

The use of future weekday traffic volumes as estimated in the Regional Transportation Model, to predict levels of future weekend travel in coastal areas implied several assumptions regarding travel behavior. First, future weekday travel volumes reflected the growth and distribution of employment and population centers and major changes in the circulation network. Work trips do not always provide a basis for designing a network for other types of trips. In Southern Orange County, for example, the future network is designed in general to provide access primarily in the northwest-southeast direction, not in the northeast-southwest direction required by visitors to the coast. These constraints imposed by the location of planned employment and population centers and by the topographics constraints imposed by coastal hills. In addition, coastal access travel may use routes that are not designed for a high level of work trip travel, thus creating heavy weekend congestion. So before predicted weekday traffic volumes can be factored up to weekend volumes on coastal access routes, an analysis of the direction and level of desired travel on coastal routes must be undertaken.

Another point is that weekend traffic volumes on some coastal routes are already at capacity, thus indicating that there is a frustrated demand for coastal access. To take a ratio of congested weekend to weekday level as a "recreation-work trip" factor underestimates the demand for coastal access that should, hopefully, be accommodated on the network by auto or by some other mode of travel.

Finally, the factoring method implicitly assumes that coastal recreation will remain constant, whereas most projections see a per capita increase in coastal activities of between 1% and 3% per year. This increase should be reflected in future estimates of coastal travel.

ACCESS ANALYSIS

Coastal access is measured as the peak hour one-way volume to service ratio (v/c), corresponding to a Level of Service, at critical points on three coastal access routes.

MITIGATION MEASURES

The study did not analyze mitigation measures in depth since it referred to the detailed analyses provided in other Aliso Viejo transportation studies. It mentioned only that the capacity of the affected arterials could be increased and that increased public transportation would be used to help reduce local and regional traffic to coastal facilities.[9] It also implied that some congestion may be tolerable: "It is important to note that summer weekends account for only thirty-two days (less than 9%) of the year. Spot overloads during summer peak hours may be tolerated on some of these days if roadway service levels are adequate throughout the remainder of the year."

TITLE: A Subregional Analysis of Southern Orange County

AUTHOR: California Coastal Commission Staff Report (Draft), San Francisco, CA, December 1977.

BACKGROUND

This analysis was undertaken as part of subregional planning process for the Southern Orange County coast, conducted by the California Commission staff. The program analyzed current and future population, land use, recreation and infrastructure of an area extending from Newport Beach to San Clemente along the coast and inland to the San Diego Freeway. The subregion included Laguna Beach, a popular resort, the Dana Point Marina and Doheny State Beach (Figure 8). Approximately 60,000 additional dwelling units are planned for this area (Irvine Ranch, Aliso Viejo and other developments) as well as major additions to the circulation network, including the San Joaquin Hills Freeway corridor.

One of the objectives of the Coastal Commission's subregional analysis was to investigate the effect of new development on coastal access. Briefly, it entailed the analysis of current recreation transportation patterns on the existing circulation network and the projection of future recreation travel demand along with residential and commercial trip-making on the future network. The purpose of the analysis was to develop information that could be used to address the issues raised by the influx of visitors to the subregion on a peak recreation day, a summer Sunday. The primary issues were the conflict between local residents and visiting recreationists on the subregion's highway facilities and the availability of parking at coastal recreation facilities.

STUDY OUTLINE

The transportation section of the study had the following major components:

- The Subregional Circulation Network

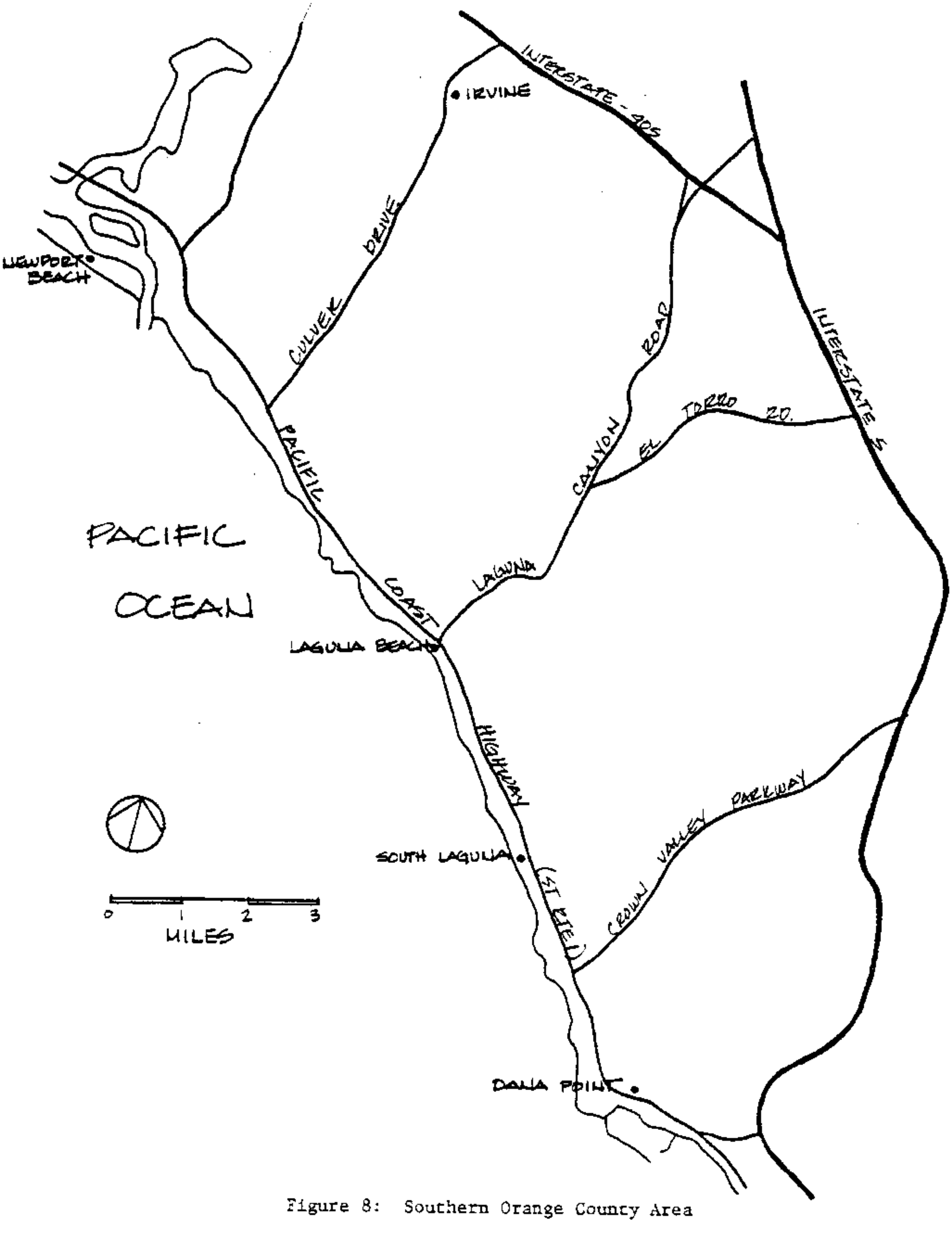

Figure 8: Southern Orange County Area

- Links Selected for Detailed Analysis
- Traffic Volume Characteristics
- Estimated Capacities of Selected Links
- The Estimation of Peak Recreation Day Traffic Volumes
- Analysis of Results

SUMMARY OF THE TRAVEL MODEL

The model had the following steps:

- Current and future circulation network links were selected for detailed analysis after a review of future land use and transportation plans, and the likely routes of residential, commercial and recreational travel.
- Traffic volumes of the selected links were analyzed for daily and hourly peaking characteristics during peak recreation periods. The peak recreation travel day was found to be a summer Sunday. The service volumes for the current and future link designs at levels of service "D" and "E" were also estimated.
- The study area was divided into zones based on type of trip attraction, and total daily trip ends were computed for residential, commerical and recreational nodes (zone centroids). Future residential and commercial trip ends were estimated from land use plans. Future coastal recreation trips were estimated from projections of future recreation in the following manner. The estimated number of recreationists who walked, bicycled or used other non-auto means of transportation were subtracted from the daily projection. The remainder was divided by the auto occupancy (i.e. three persons per auto) and multiplied by two (two trip ends per trip) to obtain the number of trip ends generated by each beach. This was a conservative estimate since it ignored day trips from and to the beach area during the day.

- The proportion of trips with one end external to study area (external trips), the distribution of internal and external trips and the number of trips through the study area were estimated through the use of previous studies and expert judgment. Three probability distributions representing the distribution of trip ends at residential, commercial and recreational nodes were developed based on a review of the literature, previous local studies and expert judgment. For each hour trip ends were distributed between each node and external stations, between residential and recreational nodes, between residential and commercial nodes and between residential and residential nodes (internal and "other" trip types represented by residential nodes). An accounting procedure tallied the number of cars parking at each recreation node each hour.
- An unconstrained multi-path assignment algorithm based on travel times was used to assign trips to the current and future networks. Estimated traffic volumes were compared with road capacities for each hour.
- The model was calibrated through the comparison of its results with current traffic patterns.
- The model was rerun for different levels and distributions of residential development.

RECREATION PARTICIPATION

The study area contains major beach attractions at Laguna Beach and Doheny Beach and the marina at Dana Point. In addition, there is widespread use of public and private beaches throughout the entire extent of this part of the Southern Orange County coastline. Beach use figures were obtained from state, county and local sources. This information was very "rough" except in a few cases where auto counters were used. More often, though, attendance is recorded by lifeguards who make an "educated guess." However, at Laguna Beach a quadrat sampling approach is used for a two to three week period in order to refine the estimation process. The attendance figures were converted to trip ends as previously mentioned in the Travel Model section.

Participation at the marina and commercial recreation facilities was not directly measured; trip end generation was based on the number of boat slips and square footage of the facilities used.

TRAVEL BEHAVIOR

Estimating future recreation travel behavior was one of the weak points of this study as it is likely to be in any analysis of recreational travel. The internal-external split and the travel distribution were based on existing O-D surveys, an analysis of current traffic volumes over alternate paths, current and future estimates of population levels and distribution in the study area and the surrounding region, and expert opinion.

Other factors were more certain. Occupancy was known to be approximately three persons per auto and the role of transit was limited. Between 10% and 20% of the beach recreationists used non-alternative modes (i.e. bicycle) to access study area recreation areas.

ACCESS ANALYSIS

Access was measured as the ratio of the estimated traffic volume and the service volume at LOS D and E for the peak hour on a summer Sunday. The computation also estimated the percentage of recreational traffic in the total traffic stream as an indication of the competition between it and other trip types. Due to the intense residential development planned for this area, recreation traffic comprised only 27% to 33% of future traffic volumes on the links selected for analysis from the future circulation network.

The analysis predicts a substantial impact to nearly every link under analysis in the future circulation network. The traffic volume predicted for Laguna Canyon Road exceeds its hourly and daily capacity (LOS E) by a factor of two. Other links are predicted to have a lesser yet substantial impact.

Parking was also another major impact forecast by the model. Laguna Beach would have to double its current parking capacity. The high levels of arterial and terminal congestion, in fact indicate that conditions for the implementation of a transit oriented solution to the access problem may be possible in the near future.

MITIGATION MEASURES

The study showed that different levels and distributions of development had varying degrees of impact but that there was no alternative where the impact was mitigated. There was an implication that transit might be a plausible mitigation measure. The study indicated that transit accounted for 5%, at most, of the recreation person trips made in the area, but that most of these were school-age children who opted for an automobile as soon as one became available. Future transit use was estimated to be 10% by the Southeast Orange County Circulation Study (SEOCCS) but this figure is for work trips within the local area. It is nearly impossible to take a coastal recreation trip from many distant inland areas via transit; it would appear that a shuttle or "park and ride" system is the solution required for this area.

TITLE: The San Diego Regional Coastal Access Study[10]

AUTHOR: Comprehensive Planning Organization of the San Diego Region, September 1978.

BACKGROUND

The study was prepared as a basis for a new element of the Regional Transportation Plan (RTP). It was undertaken in response to the California Caostal Act of 1976, which requires that coastal access and environmental quality be maintained in the coastal zone. It was also designed to assist local governments in the preparation of their local coastal programs. The study is significant in that it is the only analysis of coastal access conducted by a regional government in California. Its inclusion in the RTP is also precedent-setting.

There were three phases to the Coastal Access Study. First, there was a general data collection phase, including a household survey to develop information on the use of, and travel patterns to, coastal resources. Secondly, there was a detailed examination of four case study sites in order to identify coastal access problems common to many areas in the coastal zone. Finally, there was an assessment of the findings and the development of regional recommendations to enhance coastal access.

The study area is the coastal region of San Diego County, including local jurisdictions, although data on coastal visitations were collected from the entire county (Figure 9). The beaches and coastal recreation facilities within the study area attracted nearly 30 million visitors in 1976. Beaches provide the main attraction for the tourist industry, third largest in the region in terms of employment and income.

STUDY OUTLINE

The main points in the study were:

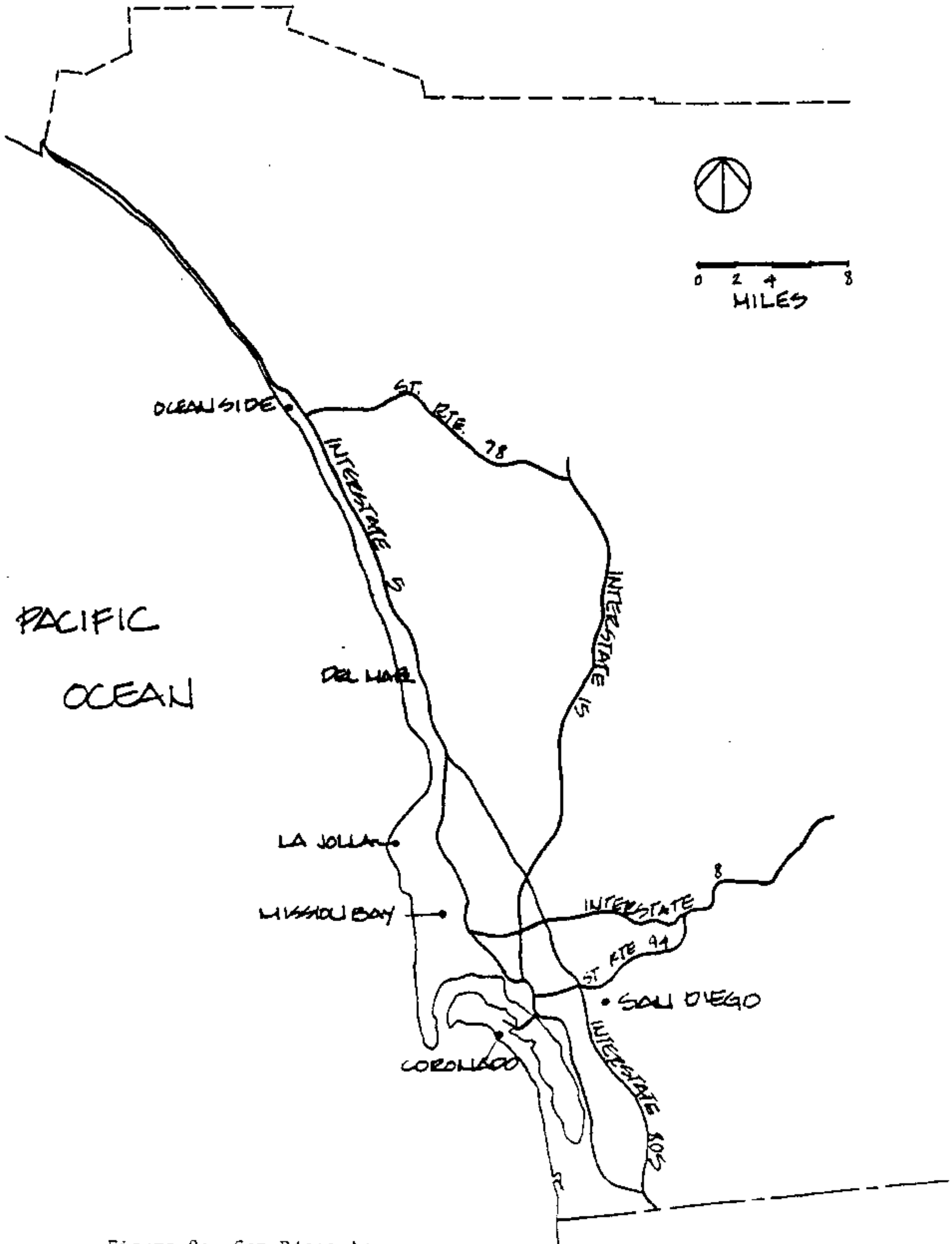

Figure 9: San Diego Area

- Data Base Development:
  - Coastal Resource Areas
  - Transportation Facilities and Services
  - Recreational Participation
  - Recreational Travel by San Diego Residents
  - Recreational Use of Public Transportation
  - Future Recreational Travel
  - Coastal Access Problems
- The Case Study Process:
  - Resources
  - Transportation
  - Usage Patterns
  - Observed Problems
  - Potential Improvements Measures
- Assessment of Regional Recommendations

SUMMARY OF THE TRAVEL MODEL

Because of the size and complexity of the study area, the analysis was more general in its approach. It provides estimates of trips from nine zones, which comprise the entire region, to and from coastal zones, in the year 1995. It provided information for use in the RTP and in the planning of regional recreation facilities. The process was essentially that of the recreation participation model (Chapter II), comprised of the following steps:

- Divide the region into nine zones; four smaller ones on the coast; five larger ones inland.
- Survey the zones and determine their recreational travel patterns and levels of trip generation and recreation participation per capita.

- From the estimates of growth in population and per capita participation projection the number of coastal recreation trips and assign these between zones to the indicated travel patterns.

RECREATION PARTICIPATION

The approach used to forecast recreation demand is the participation model discussed in Chapter II. The study began with the analysis of the data provided by the Parks and Recreation Information System (PARIS), the model used in the preparation of the 1975 California Outdoor Recreation Plan. From the various categories of PARIS information, Passive Outdoor Pursuits, Physically Active Recreation and Water Sports were used to estimate future activity in the region. However, since there was a suspicion that some of the PARIS data were inaccurate, and because it did not cover the tourist originating outside the State surveys were conducted at households throughout the region and at four coastal sites selected for case study. Subsequently this information was used in an update of PARIS.

An important issue in the study was the selection of a per capita rate of growth of recreation participation. Although the PARIS information suggested an annual growth rate of 1.1 percent per year, the visitation figures of the U.S. Park Service, Forest Service, Army Corps of Engineers and other states indicate that per capita vistation is increasing at a rate of 3.2% annually. A second recreation survey is being conducted in an effort to estimate the growth rate in the San Diego Region.

TRAVEL BEHAVIOR

The information collection phase of the study yielded the following findings concerning coastal travel behavior:

- The average vehicle occupancy was over three persons per car.

- Only 18% of those who drove to the beach parked more then 1,000 feet away from their destination. Correspondingly the most severe transportation problem was found to be parking.
- 50% of weekend beach recreationists arrived at their destination between 11:00 a.m. and 1:00 p.m.
- Over 20% of the trips to coastal areas by San Diego residents were made by transit, bicycle or walking.
- One out of every five people using transit for recreational purposes were tourists.
- 24% of those recreationists who did not use transit indicated that they did not do so because of the difficulty with recreational equipment.
- The conflict between bicyclists and vehicular traffic presented a severe safety problem in some areas.

ACCESS ANALYSIS

A household survey of over 1,000 persons ranked the following items in the order of their importance in the selection of a coastal recreation resource:

- Beach Quality
- Parking Availability
- Easy Access
- Levels of Traffic Congestion
- Availability of Public Facilities
- Availability of Lifeguard Facilities
- Water Quality
- People
- Familiarity with Beach
- Availability of Shops and Restaurants
- Allowance of Pets

Three of the top four factors are related to transportation, indicating that it is a major part of coastal access and, further, that the access question is of prime importance in meeting demand for coastal recreation.

The most frequently cited access-related problem was parking. Overflow parking from beaches caused conflicts in residential and commercial areas. There was also a substantial amount of illegal parking, often along the coastal access arterial which reduced its capacity and created a pedestrian safety problem. Major arterials that provided access to coastal facilities from inland population zones were found to be less congested than local roads within the recreation areas.

The definition of coastal access in this study appear to be related to the number of persons that can go to the beach of their choice, and the difficulty that an average person (measured in time, bus transfers, distance to walk, etc.) would experience in getting to the beach.

MITIGATION MEASURES

The mitigation measures recommended in the study are improved public transit to coastal areas on weekends, communications program that would provide advanced notice about traffic, parking and other coastal conditions, and a program that would encourage remote parking and the use of existing transit, bicycling and walking to recreation sites.

Potential mitigation measures that require further investigation are:

- Better traffic control techniques and traffic management strategies.
- Low cost traffic engineering projects.
- Increase bicycle access, including paths and storage facilities.
- Development controls, including requirements for physical access, parking and non-interference with recreational traffic.
- Saving vacant land to accommodate further parking.

IV. CONCLUSIONS: LIMITATIONS AND CONCERNS

The seven case studies differed in many respects: study area size, setting (primarily rural and suburban), network configuration and analytical technique. Their mitigation measures also varied, although many options were precluded by local conditions. But a striking feature of the studies was that many aspects were held in common. The first of these was the study objective, the assessment of transportation impacts during peak recreation periods resulting from increased residential and commercial development. This was common in each study and usually represented an extension of the analysis of weekday traffic. Another similarity between the studies, except for the San Diego example, was the use of summer Sunday peak hour or peak day traffic volumes as a measure of coastal access. Often the difference between estimated traffic volumes and service volumes was used to indicate the level of service and remaining roadway capacity.

Some other commonly-held aspects began to emerge during the analysis of the studies that provide keys to the understanding of coastal access. These are limitations and concerns that are issues in themselves, and are at the center of any public discussion of coastal access.

The first of these is the problem of designing a coastal highway network in order to accommodate all types of trips. In a rural area this is not much of a problem. In an urban area it is not a problem either, because there usually are not many, or any, design options available. But in a suburban coastal area not only do coastal recreation trips conflict with ordinary residential trip-making, but it may be very difficult to accommodate both types efficiently on a given network. Then the question becomes: "What is the basis for network design?." This is a question that will be raised repeatedly, perhaps in a different form, whenever large-scale coastal development decisions are considered. Its answer can be made only when local conditions are considered. The task of coming up with a solution that approaches both goals (access for recreation and work trips) is the essence of planning.

Another problem that several of the studies ran into was the attempt to mechanically trade off residential development for increased recreation travel capacity in the network. For example, the Highway 1 study recommends a mechanism for trading off new development with highway capacity for each segment of Highway 1. But the approach is likely to backfire, since in the final analysis, development is implicitly encouraged where there are low levels of traffic. This means that higher levels of development would be allowed in rural areas and development in coastal communities would be limited. This is directly opposed to the California Coastal Commission's policy to encourage development in existing communities.

The question of who is a resident appears whenever the analysis attempts to determine the level of local traffic during peak recreation periods. Are second-home owners and long-term vacationers local residents for the purpose of analyzing coastal access? Or are they somehow to be treated the same as day trip recreationists? From a coastal access viewpoint the question such as how much traffic will a first-home subdivision generate on a local arterial becomes very different when "motel complex" of "condominium development" is substituted for the subdivision. Thus, "cut-and-dried" policies about reserving a percentage of road capacity for recreationists lend to excessive definition that harbor legal difficulties. Once again, it is a planning problem strongly contingent on local politics that cannot be resolved by an analytical approach.

A few of the studies made no attempt to use attendance figures at beaches and other facilities within the study area. Either the analysis was approached the same as another inland traffic study, or there was an understandable mistrust of the visitation figures. But if the information is available, and it was collected in a reasonable fashion, it should somehow be incorporated into the analysis. Recreation attendance is growing at a rate of 3% to 5% per year (Midwest Research Inst., 1978), and some sort of trend should be present in the visitation data. If it is not, then an effort should be made to find out why; local supervisory personnel usually have a good idea of what is happening at "their" beach or on "their" section of the coast. The answer, if it can be found, would greatly improve the analysis.

Linking trip generation to recreation facility attendance is a murky business at best, but it is the direction to follow if coastal recreation traffic analysis is to improve. The Big Sur analysis is an attempt at this, although it leaves room for improvement. One obvious problem is the trips from and to the facility during the day, which result in over-stated attendance. Another problem is off-site parking, especially when a fee is charged on the site. Using parking figures, in this case, to estimate trips will always lead to low traffic volumes.

Safety is another problem that cannot be ignored in the analysis of coastal access. Pedestrian and bicycle traffic is likely to be higher in the vicinity of coastal recreation areas. There is also a high proportion of children in these areas and it may be reasonable to introduce speed zones, such as those near schools, in certain sections of the highway. Certainly there will be a demand for traffic controls to enhance pedestrian access to the beach. Unless solutions such as elevated walk-ways, land bridges or tunnels are introduced, there is likely to be a very real loss of highway capacity (a reduction in service volume) near coastal recreation areas in coastal towns. Safety is directly opposed to access unless there is a design solution. It is an aspect to be included in small scale analyses; otherwise, coastal access will be overestimated.

Bicycling is a promising mode of transportation in coastal areas, but its major barriers to implementation are safety and storage at the terminal point. There are also obvious range limitations involved in their use, but bicycles can be a major means of coastal access for young people in urban and suburban areas. Their use can be encouraged by the development of bikeways, separate from auto traffic, if possible, in order to improve safety. The inclusion of bicycling in any program of coastal access should recognize that a commitment to development is required if the program is to succeed beyond the fragmented level of usage seen in many coastal areas today.

Transit is often proposed as a mitigation measure for coastal access, but every serious analysis of its implementation indicates that it is not feasible at the current time. As the prices of gasoline and automobile increase, transit ridership in the coastal zone, as elsewhere, can be expected to increase as well. But the public has repeatedly stated reasons why transit will not be completely successful in capturing the recreational rider: equipment, small children and poor service on weekends (VTN/MRI, 1975; Orange County EMA, 1979; CPO 1977). Currently there are a few pilot programs in California with those at Capitola and Santa Cruz apparently being the most successful. These are "park and ride" programs that might be copied in other areas. However, more research is needed to determine the requirements for a successful transit program. At the current time, however, transit is making little, or no, impact on coastal recreation travel in California.

The final access problem, the one most often perceived by the public, is that of parking. Coastal recreationists want to park close to their destination for a variety of reasons similar to those given for not riding transit. Parking presents a dilemma to the coastal planner. Providing more of it may ultimately just make the problem of coastal access worse. Parking should not be treated separate from the question of transit. Obviously, increased parking encourages auto use and discourages transit, the very problem that many coastal access planners are trying to see their way through. Parking is a problem to be discussed on the local level. It has many dimensions, including public recognition, that tend to thrust it into the political arena.

TRANSPORTATION GUIDELINES FOR COASTAL ACCESS

This analysis is concluded with a set of questions whose answers are guidelines for the resolution of the problem of analyzing coastal access from the transportation planning perspective. These questions identify where traffic problems presently occur, and where they will occur in the future. Regardless of whether or not an analytical method is employed, these questions uncover the issues that should be resolved by traffic engineers and transportation planners. The "dimensions" they investigate are: present versus future, recreation versus non-recreation, and outside versus local. They also point out where the actual "bottlenecks," which inhibit access, occur in the present and in the future.

- What is the local coastal roadway network on which recreation travel occurs; what might it be in the future?
- What is the distribution of local residents in the coastal zone: present and future? What is the contribution of these residents to traffic loads on the coastal roadway network: present and future?
- On the coastal roadway network, what proportion of existing traffic loads is due to recreational travel at various times: hourly, day of the week, and season?
- How much higher might recreational trip demands be in the future? Where do today's recreational trips originate? Where might they be expected to originate in the future?

- How serious are instances of traffic congestion on "in season" recreational days? Where are the points of congestion? Are they caused by parking demands near popular recreational destinations where provisions for vehicle storage are inadequate?
- Does total travel demand currently exceed the roadway system's capacity? Will demand significantly exceed capacity in the future? How might actual or expected traffic congestion affect the access of non-residents into the area for recreation?
- Which is the more critical problem; road capacity or parking? How will the answers to these questions change under projected recreation demands and future coastal area growth assumptions?
- How compatible are the travel desires of local coastal residents (whether they be permanent, seasonal or transitory) with the travel desires of incoming coastal recreation users from other areas? How do or how might local coastal residents adjust their own tripmaking to avoid travel during recreational peak hours? Will resident and visitor travel conflict if potential development is unrestrained locally?
- What is the appropriate balance between local travel needs and recreational travel needs? What development controls will be effective in producing or preserving that balance?
- What trends or future developments in the provision of transportation service might lessen the conflict between coastal access and local travel desires? What appears to be the realistic potential for future means of coastal access that could satisfy recreational desires without inducing intolerable levels of traffic congestion?

These questions are also easily expanded or contracted to fit local needs. Coastal access is, after all, a public concern that requires a local solution.

FOOTNOTES

[1]The gravity and attraction models assume that the attraction of a recreation facility varies inversely as a function of its distance from a population center. Ellis and Van Doren (1966, Ullman and Volk (1962), Deacon, et al. (1972b), and McAllister and Klett (1976) have used the gravity formulation in recreation studies. Wolfe (1972) and Beamon (1974, 1976) have discussed possible forms of the distance component of the model. The attraction model is essentially the same as the gravity model except that it uses regression techniques for the evaluation of its parameters (Cesario, 1969).

Probabilistic models are a variation of gravity and attraction models. They derive the probability that a trip from a particular origin will terminate at a particular destination. Ellis and Van Doren (1966) describe two forms of the mode. The intervening opportunity model is a probabilistic model which allows for the analysis of the effect of alternative sites on recreation travel. Bellomo and Mehra (1974) also use a type of probabilistic model.

The network or flow model, also called the systems theory model, was developed by Ellis and Van Doren (1966). It describes recreation travel with the theory of electrical networks.

Linear programming approaches to recreation travel analysis have been undertaken by Tadros and Kalter (1971) and Penz (1975). A simulation model has been contribed by Gaummitz (1973). Finally, future recreation travel models will probably be derived from psychological models (Lambe, 1969) and entropy maximizing models (Cesario, 1975b).

[2]The participation model that forecasts activity levels is based on trends in recreation data disaggregated by activity type and socio-economic group. The model is calibrated with regression techniques to estimate participation coefficients (by activity and group), or parameters. This has been a major area of recreation research over the last decade (Cicchetti, 1972a,b; 1973; Cicchetti, et al., 1972, 1973).

Once the model is calibrated, forecasts of recreation participation may be obtained by using population projections for future years, disaggregated by socio-economic characteristics, in place of the population levels used to calibrate the model. Also, planned increases in recreation supply will be substituted for the current supply levels. Most of the State Comprehensive Outdoor Recreation Plans (SCORP) are based on this approach (Brown and Wilkins, 1975).

[3]Whether or not this has happened is not the main theme of this report, although the final chapter contains conclusions that reflect on this point.

[4]A related approach in traditional park planning has been to determine the number and size of parks that a planned urban area requires.

[5]On-site inspection of accessways is a routine practice of the Coastal Access Program of the California Coastal Commission and the State Coastal Conservancy.

[6]The Commission's authority to place such restrictive conditions on permits has been upheld in every court case tried thus far, from 1973 to the present date.

[7]This series of staff papers is also summarized in "Recreation Transportation on the California Coast," presented at ASCE's Coastal Zone '78, San Francisco, March 14-16, 1978.

[8]See the Aliso Viejo Traffic Study Technical Supplement and the Aliso Viejo Public Transportation Study as well as the Environmental Impact Report for Aliso Viejo (Jack Raub and Assts., Costa Mesa, CA 1977-1978).

[9]A personal communication from the authors of the study further states that the provision of on-site recreation facilities and the inclusion of over 52% of the Aliso Viejo property in permanent open space will mitigate Aliso Viejo's impacts on recreation travel.

[10]This study has since been supplemented with the Mission Bay Access Study, Jan. 1981.

REFERENCES

Beaman, Jay, 1976, "Corrections Regarding the Impedance of Distance Functions Functions for Several g(d) Functions." Journal of Leisure Research 8:49-52.

Beaman, Jay. 1974, "Distance and the 'Reaction' to Distance as a Function of Distance," Journal of Leisure Research 6:220-231.

Bellomo, S. and J. Mehra, "Statewide Travel Forecasting Procedures: Weekend Travel Model," Alan M. Vooehees and Associates, Inc., Final Report, August 1974.

Brown, T.L. and Wilkins, B.T., 1975, "Methods of Improving Recreation Projections." Journal of Leisure Research 7:225-234.

Burdge, Rabel James and Hendee, John, 1972, "The Demand Survey Dilemma," Guideline 2:65-68.

Burke, J.E., 1977, Recreation Planning in the Coastal Zone: Analytical Techniques, Information and Policies, Institute of Urban and Regional Development, WP #278, U.C. Berkeley.

Burke, J.E., 1979, "Coastal Access, Energy Conservation and Comprehensive Planning" presented at the Sea Grant Forum on Recreational Access in the Coastal Zone, March 26-27, USC Sea Grant Program, Los Angeles.

California Coastal Commission, January 1974, Big Sur Coast: A Sub-regional Analysis, San Francisco.

California Department of Transportation (Caltrans), District 4, 1965-1976. 1-11th Progress Report on Trip Ends Generation Research, San Francisco.

California Department of Transportation (Caltrans), District 11, 1973; 1979, Traffic Generation reports, San Diego.

Cesario, Frank J., 1975b, "A Primer on Entropy Modeling." JAIP: 40-48.

Cesario, Frank J., 1969. "Operations Research in Outdoor Recreation." Journal of Leisure Research 6:33-51.

Cicchetti, C.J., 1972a, "A Review of the Empirical Analyses That Have Been Based Upon the National Recreation Surveys." Journal of Leisure Research 4:90-107.

Cichetti, Charles J., 1973, Forecasting Recreation in the United States, Massachusetts: Lexington Books.

Cicchetti, Charles J., 1972b, "Outdoor Recreation and Congestion in the United States." In Population, Resources and the Environment, edited by R.G. Ridker. U.S. Commission on Population Growth and the American Future, Vol. III. Washington, D.C.

Cicchetti, Charles J., Fisher, A.C., and Smith, V.K., 1973, "Economic Models and Planning Outdoor Recreation." Operations Research 21.

Cicchetti, Charles J., Smith, V.K., Knetsch, J.L., and Patton, R.A., 1972, "Recreation Benefit Estimation and Forecasting: Implications of the Identification Problems." Water Resources Research 8:840-850.

Comprehensive Planning Organization, September 1978, The San Diego Regional Coastal Access Study, San Diego.

Deacon, J.A., Prigman, J.G., Kantenback, K.D., and Deen, R.D., 1972a, "Models of Outdoor Recreational Travel." HRR 472:45-62.

Deacon, J.A., Prigman, J.G., and Deen, R.C., 1972b, "Travel to Outdoor Recreation Areas in Kentucky." Journal of Leisure Research 4:312-332.

De Leuw, Cather and Company, January 1979, City of Santa Barbara Waterfront Area Transportation Study, San Francisco.

De Leuw, Cather and Company, June 1979, Highway 1 Capacity Study, San Francisco or DKS Assts., Oakland for the California Coastal Commission.

Ditton, R.B. and Stephens, M., 1976, Coastal Recreation: A Handbook for Planners and Managers, Washington, D.C.: Office of Coastal Zone Management, Department of Commerce.

Ellis, J.B. and Van Doren, C.S., 1966, "A Comparative Evaluation of Gravity and System Theory Models for Statewide Recreational Traffic Flows." Journal of Regional Science 6(2):57-70.

Gaumnitz, J.E., Swenth, R.L., and Tollefson, J.O., 1973, "Simulation of Water Recreation Users' Decisions." Land Economics 49(3): 269-277.

Institute of Transportation Engineers, 1976, Trip Generation, Arlington, Virginia.

Kalter, R.J., 1971, The Economics of Water-Based Recreation: A Survey and Critique of Recent Developments, Report 71-8. Springfield, Virginia: U.S. ACE, Inst. for Water Resources, NTIS.

Lambe, T.A., 1969, "The Opportunity, Gravity, and Thurstone Models of Individual Choice." Socio-Economic Planning Science 3-411-419.

Lavery, P., 1975, "The Demand for Recreation." Town Planning Review, 46(2): 185-201.

Leonhardt, K., 1971, "Weekend Recreation Travel: Development of a Concept," Paper #PB204-528, Puget Sound Government Conference, NTIS, Washington, D.C.

McAllister, D.M., and Klett, F.R., 1976, "A Modified Gravity Model of Regional Recreation Activity with an Application to Ski Trips," Journal of Leisure Research, 8(1):21-34.

Midwest Research Institute/U.S. Department of Transportation, August 1978, Recreational Travel Impacts, PB-295-583, RTIS, Springfield, Virginia.

Moeller, G.H., and Echelberger, H.E., 1974, "Approaches to Forecasting Recreation Consumption," in U.S. Forest Service Outdoor Recreation Research: Applying the Results, Technical Report NC-9, North Central Forest Experiment Station, St. Paul, Minnesota.

Orange County Environmental Management Agency, 1979, Orange County Recreation Needs and Regional Parks Study, Santa Ana, California.

Penz, A.J., 1975, "Outdoor Recreation Areas: Capacity and the Formulation of Use Policy," Management Science, 22(2):139-147.

Sterns, M., 1976, "Behavioral Impacts of the Energy Shortage: Shifts in Trip-making Characteristics," TRR #592, 38-40.

Tadros, M.E. and Kalter, R.J., 1971, "Spatial Allocation Model of Projected Water Based Recreation Demand," Water Resources Research, 7(4):798-811.

Thompson, B., 1967, "Recreational Travel: A Review and Pilot Study," Traffic Quarterly, pp. 527-542.

Ullman, E.L. and Volk, D.J., 1962, "An Operational Model for Predictory Reservoir Attendance and Benefits: Implications of Location Approach to Water Recreation," Papers of Michigan Academy of Science, Arts, and Letters, pp. 473-484.

U.S. Bureau of Outdoor Recreation, 1972, The 1970 Survey of Outdoor Recreation Activities, Preliminary Report, Government Printing Office, Washington, D.C.

VTN Consolidated/Midwest Research Institute, 1975, Recreation Access Study, Performed for U.S.D.O.T., NTIS, PB #241-994.

Wilkinson, P.F., 1973, "The Use of Models in Predicting the Consumption of Outdoor Recreation," Journal of Leisure Research, 5(3):34-48.

Wolfe, R.I., 1972, "The Inertia Model," Journal of Leisure Research, 4:73-76.

Yotter, E.E., 1974, "Weekend/Recreation Travel Modeling," California Department of Transportation, Transportation Systems Modeling Branch, Sacramento, California.