4.

CITY OF CAMBRIDGE
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EXECUTIVE DEPARTMENT
ROBERT W. HEALY
City Manager

RICHARD C. ROSSI
Deputy City Manager

March 20, 1992

To the Honorable, the City Council:

Shortly after preparing the package of materials for Consent Agenda Item #3, I received the attached letter from Daniel S. Greenbaum, Commissioner of the Department of Environmental Protection (DEP).

I think Commissioner Greenbaum's very positive response to a draft of my proposed Trip Reduction Ordinance is a critical step in the process toward developing a SIP revision. Commissioner Greenbaum indicates that the proposed ordinance would clearly enhance the City's commitment to improving air quality. He also commends the extensive and creative work that has gone into the development of this proposal.

Commissioner Greenbaum also encourages us to formally submit this proposal to DEP so that it might be considered simultaneously with other parking control and trip reduction measures affecting other core communities in the region. I think this reference by the Commissioner emphasizes the need to move toward final action by the City Council as soon as possible.

Very truly yours,

Robert W. Healy
City Manager

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

William F. Weld
Governor
Daniel S. Greenbaum
Commissioner

March 20, 1992

Robert W. Healy
City Manager
Cambridge City Hall
Cambridge, Massachusetts 02139

Dear Mr. Healy:

My staff and I have reviewed a draft Cambridge Trip Reduction Ordinance which you are proposing in accordance with the August, 1990 Memorandum of Agreement between the Department and the City of Cambridge. I appreciate the extensive and creative work effort that has gone into the development of this proposal. The proposed ordinance which includes programs to control vehicle miles of travel to and in Cambridge would clearly enhance the city's commitment to improving air quality.

It is my understanding that the city will be moving quickly to submit the proposal to the Cambridge City Council for enactment as a city ordinance and then will make a formal submittal to the Department for subsequent processing as an amendment to the Massachusetts State Implementation Plan (SIP). I would encourage you to make this submittal at the earliest possible date; we then intend to process this submittal simultaneously with other parking control and trip reduction measures currently before us for other core communities in the region.

The proposal, which would be submitted as a revision to the existing Cambridge Parking Freeze once it is favorably acted on by the city council, must meet certain federal criteria to make it substitutable and enforceable. Any SIP revision must demonstrate that the air quality benefits of the revision are equal to or better than the existing parking freeze. In addition, any such proposal should contain monitoring and tracking provisions which will allow both the state and the U.S. Environmental Protection Agency to determine that the air quality goals of the proposal are continuously being met.

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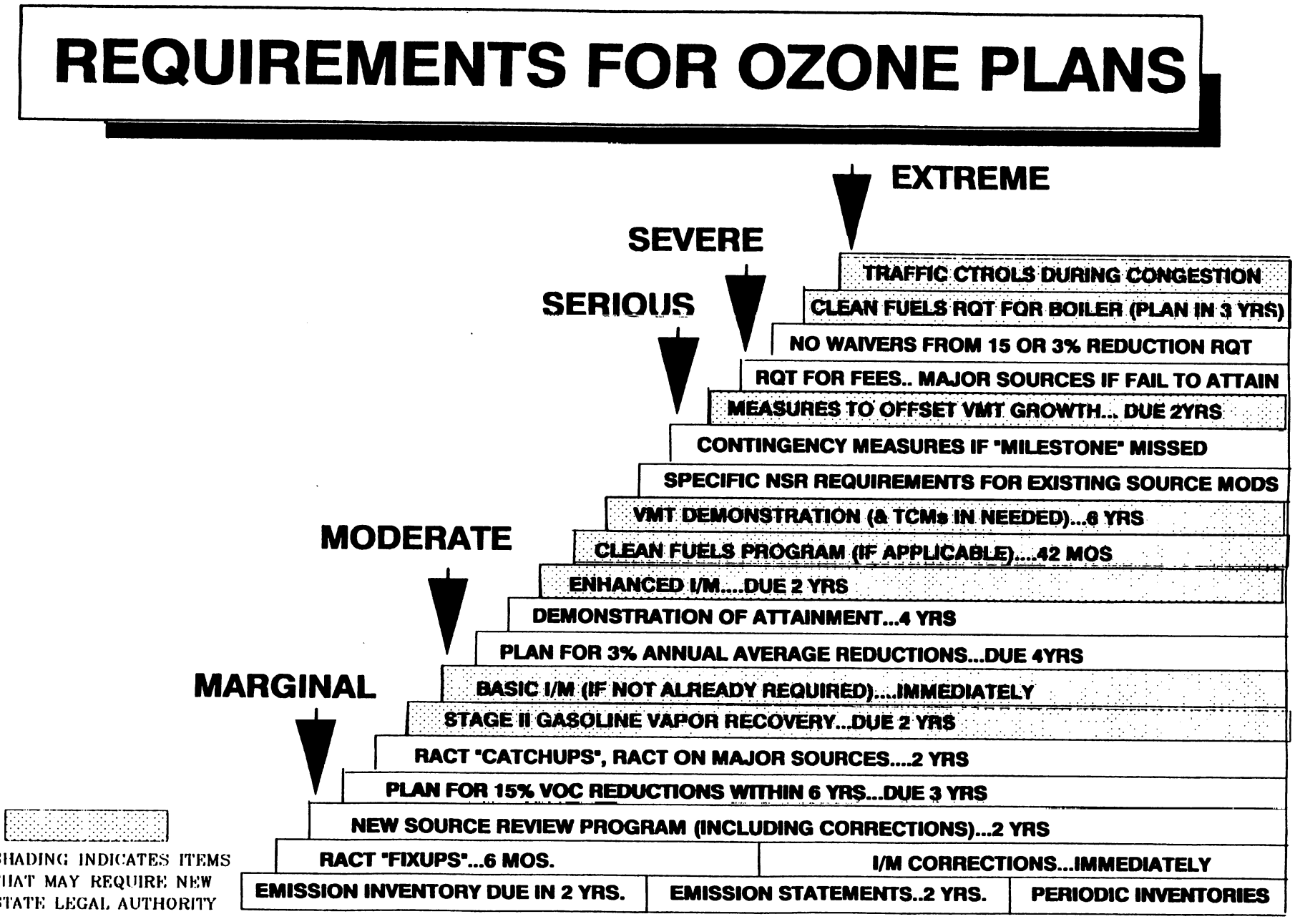
In closing, let me reemphasize that I am very encouraged with the progress the City of Cambridge has made in this difficult task. I look forward to receiving your formal submittal in the near future.

Sincerely,

Daniel S. Greenbaum
Commissioner

Figure B - 3


REQUIREMENTS FOR OZONE PLANS
EXTREME
SEVERE
SERIOUS
MODERATE
MARGINAL
TRAFFIC CTROLS DURING CONGESTION
CLEAN FUELS RQT FOR BOILER (PLAN IN 3 YRS)
NO WAIVERS FROM 15 OR 3% REDUCTION RQT
RQT FOR FEES.. MAJOR SOURCES IF FAIL TO ATTAIN
MEASURES TO OFFSET VMT GROWTH... DUE 2YRS
CONTINGENCY MEASURES IF "MILESTONE" MISSED
SPECIFIC NSR REQUIREMENTS FOR EXISTING SOURCE MODS
VMT DEMONSTRATION (& TCMs IN NEEDED)...6 YRS
CLEAN FUELS PROGRAM (IF APPLICABLE)...42 MOS
ENHANCED I/M....DUE 2 YRS
DEMONSTRATION OF ATTAINMENT...4 YRS
PLAN FOR 3% ANNUAL AVERAGE REDUCTIONS...DUE 4YRS
BASIC I/M (IF NOT ALREADY REQUIRED)....IMMEDIATELY
STAGE II GASOLINE VAPOR RECOVERY...DUE 2 YRS
RACT "CATCHUPS", RACT ON MAJOR SOURCES....2 YRS
PLAN FOR 15% VOC REDUCTIONS WITHIN 6 YRS...DUE 3 YRS
NEW SOURCE REVIEW PROGRAM (INCLUDING CORRECTIONS)...2 YRS
RACT "FIXUPS"...6 MOS.
I/M CORRECTIONS...IMMEDIATELY
EMISSION INVENTORY DUE IN 2 YRS.
EMISSION STATEMENTS..2 YRS.
PERIODIC INVENTORIES
SHADING INDICATES ITEMS THAT MAY REQUIRE NEW STATE LEGAL AUTHORITY
GTH/DEC 7,1990

total increase emissions of such air pollutant shall be at least 1.15 to 1.

(c) Serious areas

Except as otherwise specified in paragraph (4), each State in which all or part of a Serious Area is located shall, with respect to the Serious Area (or portion thereof, to the extent specified in this subsection), make the submissions described under subsection (b) of this section (relating to Moderate Areas), and shall also submit the revisions to the applicable implementation plan (including the plan items) described under this subsection. For any Serious Area, the terms "major source" and "major stationary source" include (in addition to the sources described in section 7602 of this title) any stationary source or group of sources located within a contiguous area and under common control that emits, or has the potential to emit, at least 50 tons per year of volatile organic compounds.

(1) Enhanced monitoring

In order to obtain more comprehensive and representative data on ozone air pollution, not later than 18 months after November 15, 1990 the Administrator shall promulgate rules, after notice and public comment, for enhanced monitoring of ozone, oxides of nitrogen, and volatile organic compounds. The rules shall, among other things, cover the location and maintenance of monitors. Immediately following the promulgation of rules by the Administrator relating to enhanced monitoring, the State shall commence such actions as may be necessary to adopt and implement a program based on such rules, to improve monitoring for ambient concentrations of ozone, oxides of nitrogen and volatile organic compounds and to improve monitoring of emissions of oxides of nitrogen and volatile organic compounds. Each State implementation plan for the area shall contain measures to improve the ambient monitoring of such air pollutants.

(2) Attainment and reasonable further progress demonstrations

Within 4 years after November 15, 1990 the State shall submit a revision to the applicable implementation plan that includes each of the following:

(A) Attainment demonstration

A demonstration that the plan, as revised, will provide for attainment of the ozone national ambient air quality standard by the applicable attainment date. This attainment demonstration must be based on photochemical grid modeling or any other analytical method determined by the Administrator, in the Administrator's discretion, to be at least as effective.

(B) Reasonable further progress demonstration

A demonstration that the plan, as revised, will result in VOC emissions reductions from the baseline emissions described in subsection (b)(1)(B) of this section equal to the following amount averaged over each consecutive 3-year period beginning 6 years after November 15, 1990, until the attainment date:

(i) at least 3 percent of baseline emissions each year; or

(ii) an amount less than 3 percent of such baseline emissions each year, if the State demonstrates to the satisfaction of the Administrator that the plan reflecting such lesser amount includes all measures that can feasibly be implemented in the area, in light of technological achievability.

To lessen the 3 percent requirement under clause (ii), a State must demonstrate to the satisfaction of the Administrator that the plan for the area includes the measures that are achieved in practice by sources in the same source category in nonattainment areas of the next higher classification. Any determination to lessen the 3 percent requirement shall be reviewed at each milestone under subsection (g) of this section and revised to reflect such new measures (if any) achieved in practice by sources in the same category in any State, allowing a reasonable time to implement such measures. The emission reductions described in this subparagraph shall be calculated in accordance with subsection (b)(1)(C) and (D) of this section (concerning creditability of reductions). The reductions creditable for the period beginning 6 years after November 15, 1990, shall include reductions that occurred before such period, computed in accordance with subsection (b)(1) of this section, that exceed the 15-percent amount of reductions required under subsection (b)(1)(A) of this section.

(C) NO_x control

The revision may contain, in lieu of the demonstration required under subparagraph (B), a demonstration to the satisfaction of the Administrator that the applicable implementation

plan, as revised, provides for reductions of emissions of VOC's and oxides of nitrogen (calculated according to the creditability provisions of subsection (b)(1)(C) and (D) of this section), that would result in a reduction in ozone concentrations at least equivalent to that which would result from the amount of VOC emission reductions required under subparagraph (B). Within 1 year after November 15, 1990, the Administrator shall issue guidance concerning the conditions under which NO_x control may be substituted for VOC control or may be combined with VOC control in order to maximize the reduction in ozone air pollution. In accord with such guidance, a lesser percentage of VOCs may be accepted as an adequate demonstration for purposes of this subsection.

(3) Enhanced vehicle inspection and maintenance program

(A) Requirement for submission

Within 2 years after November 15, 1990, the State shall submit a revision to the applicable implementation plan to provide for an enhanced program to reduce hydrocarbon emissions and NO_x emissions from in-use motor vehicles registered in each urbanized area (in the nonattainment area), as defined by the Bureau of the Census, with a 1980 population of 200,000 or more.

(B) Effective date of State programs; guidance

The State program required under subparagraph (A) shall take effect no later than 2 years from November 15, 1990, and shall comply in all respects with guidance published in the Federal Register (and from time to time revised) by the Administrator for enhanced vehicle inspection and maintenance programs. Such guidance shall include—

(i) a performance standard achievable by a program combining emission testing, including on-road emission testing, with inspection to detect tampering with emission control devices and misfueling for all light-duty vehicles and all light-duty trucks subject to standards under section 7521 of this title; and

(ii) program administration features necessary to reasonably assure that adequate management resources, tools, and practices are in place to attain and maintain the performance standard.

Compliance with the performance standard under clause (i) shall be determined using a method to be established by the Administrator.

(C) State program

The State program required under subparagraph (A) shall include, at a minimum, each of the following elements—

(i) Computerized emission analyzers, including on-road testing devices.

(ii) No waivers for vehicles and parts covered by the emission control performance warranty as provided for in section 7541(b) of this title unless a warranty remedy has been denied in writing, or for tampering-related repairs.

(iii) In view of the air quality purpose of the program, if, for any vehicle, waivers are permitted for emissions-related repairs not covered by warranty, an expenditure to qualify for the waiver of an amount of $450 or more for such repairs (adjusted annually as determined by the Administrator on the basis of the Consumer Price Index in the same manner as provided in subchapter V of this chapter.

(iv) Enforcement through denial of vehicle registration (except for any program in operation before November 15, 1990 whose enforcement mechanism is demonstrated to the Administrator to be more effective than the applicable vehicle registration program in assuring that noncomplying vehicles are not operated on public roads).

(v) Annual emission testing and necessary adjustment, repair, and maintenance, unless the State demonstrates to the satisfaction of the Administrator that a biennial inspection, in combination with other features of the program which exceed the requirements of this chapter, will result in emission reductions which equal or exceed the reductions which can be obtained through such annual inspections.

(vi) Operation of the program on a centralized basis, unless the State demonstrates to the satisfaction of the Administrator that a decentralized program will be equally effective. An electronically connected testing system, a licensing system, or other measures (or any combination thereof) may be considered, in accordance with criteria established by the Administrator, as equally effective for such purposes.

(vii) Inspection of emission control diagnostic systems and the maintenance or repair of malfunctions or system deterioration identified by or affecting such diagnostics systems.

Each State shall biennially prepare a report to the Administrator which assesses the emission reductions achieved by the program required under this paragraph based on data collected during inspection and repair of vehicles. The methods used to assess the emission reductions shall be those established by the Administrator.

(4) Clean-fuel vehicle programs

(A) Except to the extent that substitute provisions have been approved by the Administrator under subparagraph (B), the State shall submit to the Administrator, within 42 months of November 15, 1990, a revision to the applicable implementation plan for each area described under part C of subchapter II of this chapter to include such measures as may be necessary to ensure the effectiveness of the applicable provisions of the clean-fuel vehicle program prescribed under part C of subchapter II of this chapter, including all measures necessary to make the use of clean alternative fuels in clean-fuel vehicles (as defined in part C of subchapter II of this chapter) economic from the standpoint of vehicle owners. Such a revision shall also be submitted for each area that opts into the clean fuel-vehicle program as provided in part C of subchapter II of this chapter.

(B) The Administrator shall approve, as a substitute for all or a portion of the clean-fuel vehicle program prescribed under part C of subchapter II of this chapter, any revision to the relevant applicable implementation plan that in the Administrator's judgment will achieve long-term reductions in ozone-producing and toxic air emissions equal to those achieved under part C of subchapter II of this chapter, or the percentage thereof attributable to the portion of the clean-fuel vehicle program for which the revision is to substitute. The Administrator may approve such revision only if it consists exclusively of provisions other than those required under this chapter for the area. Any State seeking approval of such revision must submit the revision to the Administrator within 24 months of November 15, 1990. The Administrator shall approve or disapprove any such revision within 30 months of November 15, 1990. The Administrator shall publish the revision submitted by a State in the Federal Register upon receipt. Such notice shall constitute a notice of proposed rulemaking on whether or not to approve such revision and shall be deemed to comply with the requirements concerning notices of proposed rulemaking contained in sections 553 through 557 of Title 5 (related to notice and comment). Where the Administrator approves such revision for any area, the State need not submit the revision required by subparagraph (A) for the area with respect to the portions of the Federal clean-fuel vehicle program for which the Administrator has approved the revision as a substitute.

(C) If the Administrator determines, under section 7509 of this title, that the State has failed to submit any portion of the program required under subparagraph (A), then, in addition to any sanctions available under section 7509 of this title, the State may not receive credit, in any demonstration of attainment or reasonable further progress for the area, for any emission reductions from implementation of the corresponding aspects of the Federal clean-fuel vehicle requirements established in part C of subchapter II of this chapter.

(5) Transportation control

(A) Beginning 6 years after November 15, 1990 and each third year thereafter, the State shall submit a demonstration as to whether current aggregate vehicle mileage, aggregate vehicle emissions, congestion levels, and other relevant parameters are consistent with those used for the area's demonstration of attainment. Where such parameters and emissions levels exceed the levels projected for purposes of the area's attainment demonstration, the State shall within 18 months develop and submit a revision of the applicable implementation plan that includes a transportation control measures program consisting of measures from, but not limited to, section 7408(f) of this title that will reduce emissions to levels that are consistent with emission levels projected in such demonstration. In considering such measures, the State should ensure adequate access to downtown, other commercial, and residential areas and should avoid measures that increase or relocate emissions and congestion rather than reduce them. Such revision shall be developed in accordance with guidance issued by the Administrator pursuant to section 7408(e) of this title and with the requirements of section 7504(b) of this title and shall include implementation and funding schedules that achieve expeditious emissions reductions in accordance with implementation plan projections.

(6) De minimis rule

The new source review provisions under this part shall ensure that increased emissions of volatile organic compounds resulting from any physical change in, or change in the method of operation of, a stationary source located in the area shall not be considered de minimis for purposes of determining the applicability of the permit requirements established by this chapter unless the increase in net emissions of such air pollutant from such source does not exceed 25 tons when aggregated with all other net increases in emissions from the source over any period of 5 consecutive calendar years which includes the calendar year in which such increase occurred.

(7) Special rule for modifications of sources emitting less than 100 tons

In the case of any major stationary source of volatile organic compounds located in the area (other than a source which emits or has the potential to emit 100 tons or more of volatile organic compounds per year), whenever any change (as described in section 7411(a)(4) of this title) at that source results in any increase (other than a de minimis increase) in emissions of volatile organic compounds from any discrete operation, unit, or other pollutant emitting activity at the source, such increase shall be considered a modification for purposes of section 7502(c)(5) of this title and section 7503(a) of this title, except that such increase shall not be considered a modification for such purposes if the owner or operator of the source elects to offset the increase by a greater reduction in emissions of volatile organic compounds concerned from other operations, units, or activities within the source at an internal offset ratio of at least 1.3 to 1. If the owner or operator does not make such election, such change shall be considered a modification for such purposes, but in applying section 7503(a)(2) of this title in the case of any such modification, the best available control technology (BACT), as defined in section 7479 of this title, shall be substituted for the lowest achievable emission rate (LAER). The Administrator shall establish and publish policies and procedures for implementing the provisions of this paragraph.

(8) Special rule for modifications of sources emitting 100 tons or more

In the case of any major stationary source of volatile organic compounds located in the area which emits or has the potential to emit 100 tons or more of volatile organic compounds per year, whenever any change (as described in section 7411(a)(4) of this title) at that source results in any increase (other than a de minimis increase) in emissions of volatile organic compounds from any discrete operation, unit, or other pollutant emitting activity at the source, such increase shall be considered a modification for purposes of section 7502(c)(5) of this title and section 7503(a) of this title, except that if the owner or operator of the source elects to offset the increase by a greater reduction in emissions of volatile organic compounds from other operations, units, or activities within the source at an internal offset ratio of at least 1.3 to 1, the requirements of section 7503(a)(2) of this title (concerning the lowest achievable emission rate (LAER)) shall not apply.

(9) Contingency provisions

In addition to the contingency provisions required under section 7502(c)(9) of this title, the plan revision shall provide for the implementation of specific measures to be undertaken if the area fails to meet any applicable milestone. Such measures shall be included in the plan revision as contingency measures to take effect without further action by the State or the Administrator upon a failure by the State to meet the applicable milestone.

(10) General offset requirement

For purposes of satisfying the emission offset requirements of this part, the ratio of total emission reductions of volatile organic compounds to total increase emissions of such air pollutant shall be at least 1.2 to 1.

Any reference to "attainment date" in subsection (b) of this section, which is incorporated by reference into this subsection, shall refer to the attainment date for serious areas.

(d) Severe areas

Each State in which all or part of a Severe Area is located shall, with respect to the Severe Area, make the submissions described under subsection (c) of this section (relating to Serious Areas), and shall also submit the revisions to the applicable implementation plan (including the plan items) described under this subsection. For any Severe Area, the terms "major source" and "major stationary source" include (in addition to the sources described in section 7602 of this title) any stationary source or group of sources located within a contiguous area and under common control that emits, or has the potential to emit, at least 25 tons per year of volatile organic compounds.

(B) the presence of which in the ambient air results from numerous or diverse mobile or stationary sources; and

(C) for which air quality criteria had not been issued before December 31, 1970 but for which he plans to issue air quality criteria under this section.

(2) The Administrator shall issue air quality criteria for an air pollutant within 12 months after he has included such pollutant in a list under paragraph (1). Air quality criteria for an air pollutant shall accurately reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health or welfare which may be expected from the presence of such pollutant in the ambient air, in varying quantities. The criteria for an air pollutant, to the extent practicable, shall include information on—

(A) those variable factors (including atmospheric conditions) which of themselves or in combination with other factors may alter the effects on public health or welfare of such air pollutant;

(B) the types of air pollutants which, when present in the atmosphere, may interact with such pollutant to produce an adverse effect on public health or welfare; and

(C) any known or anticipated adverse effects on welfare.

(b) Issuance by Administrator of information on air pollution control techniques; standing consulting committees for air pollutants; establishment; membership

(1) Simultaneously with the issuance of criteria under subsection (a) of this section, the Administrator shall, after consultation with appropriate advisory committees and Federal departments and agencies, issue to the States and appropriate air pollution control agencies information on air pollution control techniques, which information shall include data relating to the cost of installation and operation, energy requirements, emission reduction benefits, and environmental impact of the emission control technology. Such information shall include such data as are available on available technology and alternative methods of prevention and control of air pollution. Such information shall also include data on alternative fuels, processes, and operating methods which will result in elimination or significant reduction of emissions.

(2) In order to assist in the development of information on pollution control techniques, the Administrator may establish a standing consulting committee for each air pollutant included in a list published pursuant to subsection (a)(1) of this section, which shall be comprised of technically qualified individuals representative of State and local governments, industry, and the academic community. Each such committee shall submit, as appropriate, to the Administrator information related to that required by paragraph (1).

(c) Review, modification, and reissuance of criteria or information

The Administrator shall from time to time review, and, as appropriate, modify, and reissue any criteria or information on control techniques issued pursuant to this section. Not later than six months after August 7, 1977, the Administrator shall revise and reissue criteria relating to concentrations of NO_2 over such period (not more than three hours) as he deems appropriate. Such criteria shall include a discussion of nitric and nitrous acids, nitrites, nitrates, nitrosamines, and other carcinogenic and potentially carcinogenic derivatives of oxides of nitrogen.

(d) Publication in Federal Register; availability of copies for general public

The issuance of air quality criteria and information on air pollution control techniques shall be announced in the Federal Register and copies shall be made available to the general public.

(e) Transportation planning and guidelines

The Administrator shall, after consultation with the Secretary of Transportation, and after providing public notice and opportunity for comment, and with State and local officials, within nine months after enactment of the Clean Air Act Amendments of 1989 and periodically thereafter as necessary to maintain a continuous transportation-air quality planning process, update the June 1978 Transportation-Air Quality Planning Guidelines and publish guidance on the development and implementation of transportation and other measures necessary to demonstrate and maintain attainment of national ambient air quality standards. Such guidelines shall include information on—

(1) methods to identify and evaluate alternative planning and control activities;

(2) methods of reviewing plans on a regular basis as conditions change or new information is presented;

(3) identification of funds and other resources necessary to implement the plan, including interagency agreements on providing such funds and resources;

(4) methods to assure participation by the public in all phases of the planning process; and

(5) such other methods as the Administrator determines necessary to carry out a continuous planning process.

(f) Information regarding processes, procedures, and methods to reduce or control pollutants in transportation; reduction of mobile source related pollutants; reduction of impact on public health

(1) The Administrator shall publish and make available to appropriate Federal, State, and local environmental and transportation agencies not later than one year after enactment of the Clean Air Act Amendments of 1990, and from time to time thereafter—

(A) information prepared, as appropriate, in consultation with the Secretary of Transportation, and after providing public notice and opportunity for comment, regarding the formulation and emission reduction potential of transportation control measures related to criteria pollutants and their precursors, including, but not limited to—

(i) programs for improved public transit;

(ii) restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or high occupancy vehicles;

(iii) employer-based transportation management plans, including incentives;

(iv) trip-reduction ordinances;

(v) traffic flow improvement programs that achieve emission reductions;

(vi) fringe and transportation corridor parking facilities serving multiple occupancy vehicle programs or transit service;

(vii) programs to limit or restrict vehicle use in downtown areas or other areas of emission concentration particularly during periods of peak use;

(viii) programs for the provision of all forms of high-occupancy, shared-ride services;

(ix) programs to limit portions of road surfaces or certain sections of the metropolitan area to the use of non-motorized vehicles or pedestrian use, both as to time and place;

(x) programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas;

(xi) programs to control extended idling of vehicles;

(xii) programs to reduce motor vehicle emissions, consistent with subchapter II of this chapter, which are caused by extreme cold start conditions;

(xiii) employer-sponsored programs to permit flexible work schedules;

(xiv) programs and ordinances to facilitate non-automobile travel, provision and utilization of mass transit, and to generally reduce the need for single-occupant vehicle travel, as part of transportation planning and development efforts of a locality, including programs and ordinances applicable to new shopping centers, special events, and other centers of vehicle activity;

(xv) programs for new construction and major reconstructions of paths, tracks or areas solely for the use by pedestrian or other non-motorized means of transportation when economically feasible and in the public interest. For purposes of this clause, the Administrator shall also consult with the Secretary of the Interior; and

(xvi) program to encourage the voluntary removal from use and the marketplace of pre-1980 model year light duty vehicles and pre-1980 model light duty trucks.

(B) information on additional methods or strategies that will contribute to the reduction of mobile source related pollutants during periods in which any primary ambient air quality standard will be exceeded and during episodes for which an air pollution alert, warning, or emergency has been declared;

(C) information on other measures which may be employed to reduce the impact on public health or protect the health of sensitive or susceptible individuals or groups; and

(D) information on the extent to which any process, procedure, or method to reduce or control such air pollutant may cause an increase in the emissions or formation of any other pollutant.

(2) In publishing such information the Administrator shall also include an assessment of—

(A) the relative effectiveness of such processes, procedures, and methods;

(B) the potential effect of such processes, procedures, and methods on transportation systems and the provision of transportation services; and

(C) the environmental, energy, and economic impact of such processes, procedures, and methods.

(3) The Secretary of Transportation and the Administrator shall submit to Congress by January 1, 1993, and every 3 years thereafter a report that—

(A) reviews and analyzes existing State and local air quality-related transportation programs,

including specifically any analyses of whether adequate funding is available to complete transportation projects identified in State implementation plans in the time required by applicable State implementation plans and any Federal efforts to promote those programs;

(B) evaluates the extent to which the Department of Transportation's existing air quality-related transportation programs and such Department's proposed budget will achieve the goals of and compliance with this chapter; and

(C) recommends what, if any, changes to such existing programs and proposed budget as well as any statutory authority relating to air quality-related transportation programs that would improve the achievement of the goals of and compliance with this chapter.

(4) In each report to Congress after the first report required under paragraph (3), the Secretary of Transportation shall include a description of the actions taken to implement the changes recommended in the preceding report.

(g) Assessment of risks to ecosystems

The Administrator may assess the risks to ecosystems from exposure to criteria air pollutants (as identified by the Administrator in the Administrator's sole discretion).

(h) RACT/BACT/LAER clearinghouse

The Administrator shall make information regarding emission control technology available to the States and to the general public through a central database. Such information shall include all control technology information received pursuant to State plan provisions requiring permits for sources, including operating permits for existing sources.

(July 14, 1955, ch. 360, title I, § 108, as added Dec. 31, 1970, Pub.L. 91–604, § 4(a), 84 Stat. 1678, and amended Aug. 7, 1977, Pub.L. 95–95, title I, §§ 104, 105, title IV, § 401(a), 91 Stat. 689, 790; Nov. 15, 1990, Pub.L. 101–549, title I, §§ 108(a)–(c), (o), 111, 104 Stat. 2465, 2466, 2469, 2470.)

References in Text

The enactment of the Clean Air Act Amendments of 1989, referred to in subsecs. (e), (f)(1)(A), probably means the date of the enactment of Pub.L. 101–549, which was approved Nov. 15, 1990.

Effective Date of 1990 Amendment

Amendment by Pub.L. 101–549 effective Nov. 15, 1990, except as otherwise provided, see section 711(b) of Pub.L. 101–549, set out as a note under section 7401 of this title.

Savings Provisions

Suits, actions or proceedings commenced under this chapter as in effect prior to Nov. 15, 1990, not to abate by reason of the taking effect of amendments by Pub.L. 101-549, except as otherwise provided for, see section 711(a) of Pub.L. 101–549, set out as a note under section 7401 of this title.

Library References

Health and Environment ⇐25.6(1) et seq., 25.
C.J.S. Health and Environment § 91 et seq.

§ 7409. National primary and secondary ambient air quality standards [CAA § 109]

(a) Promulgation

(1) The Administrator—

(A) within 30 days after December 31, 1970, shall publish proposed regulations prescribing a national primary ambient air quality standard and a national secondary ambient air quality standard for each air pollutant for which air quality criteria have been issued prior to such date; and

(B) after a reasonable time for interested persons to submit written comments thereon (but no later than 90 days after the initial publication of such proposed standards) shall by regulation promulgate such proposed national primary and secondary ambient air quality standards with such modifications as he deems appropriate.

(2) With respect to any air pollutant for which air quality criteria are issued after December 31, 1970, the Administrator shall publish, simultaneously with the issuance of such criteria and information, proposed national primary and secondary ambient air quality standards for any such pollutant. The procedure provided for in paragraph (1)(B) of this subsection shall apply to the promulgation of such standards.

(b) Protection of public health and welfare

(1) National primary ambient air quality standards, prescribed under subsection (a) of this section shall be ambient air quality standards the attainment and maintenance of which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health. Such primary standards may be revised in the same manner as promulgated.

(2) Any national secondary ambient air quality standard prescribed under subsection (a) of this section shall specify a level of air quality the attainment and maintenance of which in the judgment of the Administrator, based on such criteria, is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air. Such

CLEAN AIR ACT, AMENDMENTS

P.L. 101-549, see page 104 Stat. 2399

DATES OF CONSIDERATION AND PASSAGE

Senate : April 3, October 27, 1990
House: May 23, October 26, 1990

Senate Report (Environment and Public Works Committee) No. 101-228, Dec. 20, 1989
[To accompany S. 1630]

House Report (Energy and Commerce Committee) No. 101-490(I), May 17, 1990
[To accompany H.R. 3030]

House Report (Ways and Means Committee) No. 101-490(II), May 21, 1990
[To accompany H.R. 3030]

House Report (Public Works and Transportation Committee) No. 101-490(III), May 21, 1990
[To accompany H.R. 3030]

House Conference Report No. 101-952, Oct. 26, 1990
[To accompany S. 1630]

Cong. Record Vol. 136 (1990)

The Senate bill was passed in lieu of the House bill. The Senate Report (this page) is set out below, and the House Conference Report (page 3867) and the President's Signing Statement (page 3887-1) follow.

SENATE REPORT NO. 101-228

[page iii]

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control efficiency information relative to control of PM-10 for many of the control devices and practices that have been used to control total particulate matter. Presently, rough default approximations of PM-10 control efficiencies are being used in estimating PM-10 emissions from controlled sources.

Area source emissions estimating procedures for PM-10 also provide only rough approximations of PM-10 emissions and need improvement that will take several years to achieve. Area source procedures apply, for example, to paved and unpaved road dust reentrainment, storage piles, construction activities, residential wood burning, road salting and sanding.

The bill, in this section and section 109 (pertaining to PM-10), requires the Administrator to publish guidance to address the deficiencies enumerated.

TRANSPORTATION GUIDANCE (SECTION 103)

SUMMARY

The bill amends section 108(e) of the Act and requires the Administrator, in consultation with the Secretary of Transportation and State and local officials, to revise the Transportation-Air Quality Planning Guidelines issued in 1987. The Administrator is also required, by an amendment to section 108(f) of the Act, to publish updated information on a specified list of transportation control measures, including information on the emissions reductions potentials of each measure.

DISCUSSION

The purpose of the amendment to section 108(e) is to provide updated guidance to State and local officials on how best to coordinate air quality and transportation planning in an area.

The purpose of the amendment to section 108(f) is to require the Administrator to take a strong role in providing assistance to State and local agencies regarding transportation control measures. States containing areas classified as severe or extreme for ozone and serious for carbon monoxide will be required to consider these measures as part of their State implementation plan. The intent of revisions of section 108(f) is to give States the information they will need to implement measures that have the potential of decreasing emissions by reducing vehicle miles traveled (VMT) or improving traffic flow.

Transportation control measures are needed because the VMT nationwide is projected to increase by 2 to 3 percent per year from now through 2005, resulting in a cumulative increase of about 40 to 60 percent according to the Congressional Office of Technology Assessment. Average nationwide motor vehicle exhaust emissions are projected to decline through the late 1990s as an increasing percentage of vehicles on the road meet new standards, but to rise after that due to the increase in VMT.

Because of these projected emission trends, in many nonattainment areas it will be necessary to implement transportation control measures which can bring about reductions in future VMT growth, but at the same time provide enhanced mobility to serve

increasing travel demands. The intention of the requirements in the bill related to transportation planning and control measures is to direct air quality and transportation planning toward optimum use of all potential alternatives to the single occupancy vehicle, ranging from highway facilities dedicated to moving high occupancy vehicles, to providing carpool, vanpool services and improved public transit.

The 1977 Amendments to the Act required areas that would not be able to meet the ozone or carbon monoxide standards by 1982 to implement transportation control measures (TCNs) as necessary to attain the standards, and some areas included these measures in their State implementation plans. However, OTA reports that the effect of these measures has not been evaluated at the Federal level because EPA's Office of Transportation and Land Use Policy was eliminated in 1982 and EPA has not required any reporting from the states.

In contrast, the South Coast Air Quality Management District and the Southern California Association of Governments completed in 1987-8 an assessment of the effectiveness of TCMs for the Los Angeles area. The study concluded that implementation of a wide range of TCMs would reduce highway vehicle VOC emissions by a total of 30 percent by 2010, compared to levels projected without TCMs. Total reductions in highway vehicle emissions of NO_x, carbon monoxide and particulate matter based on the TCM measures are also expected to be about 30 percent, compared to emissions levels projected for 2010 without the measures.

These studies indicate that in order to reduce or even avoid increases in vehicle pollution, it is not enought to control the pollution each car emits; the use of the car must be examined as well because growth in VMT threatens to overwhelm what can be achieved through tailpipe standards. These provisions, coupled with others in the bill, give EPA and the States the power to pursue a wide range of transportation demand management efforts.

General Planning Requirements (Section 104)

SUMMARY

This section of the bill makes numerous revisions to section 110 of the Clean Air Act, many of which are technical, to eliminate outdated material. Substantive changes include the following:

States must submit State Department implementation plans (SIPS) within no more than 24 months after the promulgation of a national ambient air quality standard, rather than within nine months as in existing law.

Areas designated attainment or unclassifiable for a pollutant may be required by the Administrator to submit a SIP that shows how the area will maintain compliance with the ambient air quality standard for a 20-year period. States required to submit maintenance plans must update them every ten years. Any attainment or unclassified area that contains all or part of on MSA or CMSA must submit maintenance plans to the Administrator.

Provisions in existing law requiring SIPs to take into account the effect of emissions on other States are strengthened.

to mobile sources in the initial plan unless a comprehensive plan revision is approved by EPA. It is important to continue to implement the mobile source emission targets as part of the overall attainment strategy unless the State can demonstrate that the ambient standard can be obtained with a different mix of strategies.

Any State that fails to submit a timely and complete (including implementation and funding schedules) plan revision under this subparagraph is subject to the sanction provisions for failing to submit an approvable SIP.

Reasonably available control technology (RACT).—Serious and severe areas must require sources emitting twenty-five tons or more of VOCs or one hundred tons or more of NO_x to install RACT.

For an extreme area, VOC and NO_x sources that emit ten or more tons must install RACT. While provisions under current section 172 of the Act require installation of reasonably available control technology, the requirement has not been uniformly implemented. Most nonattainment areas have relied on the issuance of control technique guidelines (CTGs) by EPA to determine what constitutes RACT and have not ventured beyond the sources covered by CTGs or the levels of control in the guidelines in an effort to comply with the "reasonably available control technology" provision of the Act.

The bill makes clear that State and local agencies are not authorized to ignore controls on NO_x and VOC sources for which no CTG has been issued. Sources of the size specified in the bill must be controlled to levels achievable through the use of measures that are technologically and economically feasible for a class or category of sources. RACT is not a "lowest common denominator" standard and does not mean that every source in a category must be economically and technically capable of complying with the requirement. Rather, RACT should be achievable by the majority of sources in a category. With respect to VOC sources, a minimum standard of 80 percent reduction from uncontrolled levels is achievable and requirements that get less than that level should be based on documentation of the technical or economic infeasibility of the presumed minimum 80 percent requirement.

Transportation control measures (TCMs).—Severe and extreme areas are required to offset growth in vehicle miles traveled by implementing the transportation controls listed in revised section 108(f) of the Act in accordance with EPA guidance on means for implementing, and the emissions reductions potentials of, the measures. If a State or local agency can show that the adoption of measures (other than any already required by the Act) other than one or more transportation measures will result in comparable emissions reductions, or that such reductions are not needed to provide for timely attainment, then the agency may choose not to implement that (or those) TCMs.

The provision in the bill allowing the State or local agency to present reasons why a reduction from a particular transportation measure is not necessary to meet the interim emissions reductions requirements of subsection 183(b)(3)(B) of the Act or to attain a national ambient air quality standard is not intended to undermine the bill's requirements that areas must attain the standard as ex-

peditiously as practicable. Pursuant to this requirement, EPA must determine whether such a control measure would permit an area to improve its air quality and attain the primary ambient standard more quickly if it were implemented. For example, for an area to justify not adopting a measure specified in section 108(f), it would have to show that adoption of the measure (or a measure providing comparable reductions) would not reduce the number of exceedances or result in more expeditious attainment of the standard.

Employer vehicle occupany programs.—The bill adds a new provision, to be included in State implementation plans for States containing ozone areas classified as severe or extreme (and also for CO areas classified as serious), requiring certain employers in such areas to implement programs designed to reduce work-related vehicle trips and miles traveled by employees. The purpose of the provision is to require employers of one hundred or more employees in a nonattainment area to provide services, facilities or incentives to encourage employees to share commuting trips. The intent of the provision is to reduce both the number of vehicles on the road during rush hours and the time the remaining cars spend idling or operating at inefficient low speeds, and thereby to reduce emissions of hydrocarbons, carbon monoxide and NO_x.

The bill requires such ares to submit SIP revisions requiring employers of over one hundred employees in the area to achieve no less than a 25 percent improvement in commuting vehicle occupancy above a baseline that is the areawide average for all such trips. The Administrator is required to issue guidance under revised section 108(f) of the Act for implementing this section and may specify baseline occupancy rates that vary depending on portions of nonattainment areas (center city, suburban, etc.) or on differing characteristics among nonattainment areas. Thus, for example, the baseline vehicle occupany rate for center city trips where transit is more readily available might be 1.7 passengers per vehicle while for a suburban area, the baseline rate might be only 1.1 or 1.2.

Each employer is required to submit a plan demonstrating compliance with the provision within two years after the SIP submission.

The bill allows an employer to demonstrate compliance with the requirement even if the 25 percent increase is not achieved if the employer can show that after expenditures have been made on the ridership program equal to or greater than the cost of providing each employee with a parking space at the workplace, the 25 percent increase cannot be achieved.

In determining the cost of providing each employee with a parking space at the workplace, the employer shall either report the actual rental cost of the spaces if provided by a separate entity, or the total of direct and indirect costs incurred by the employer.

The Office of Technology Assessment (OTA) reports that in areas where employer-related programs have been undertaken, some companies have increased the proportion of their employees who do not ride alone to more than 80 percent of their work force. The most far-reaching programs to increase the average ridership during peak periods have been implemented in California. In Los Angeles, a regulation is already in effect to increase average ridership from the current level of 1.13 to a new level of 1.3–1.75 people

ADDITIONAL REQUIREMENTS FOR CARBON MONOXIDE NONATTAINMENT AREAS (SECTION 108)

SUMMARY

Section 108 adds a new subpart 3 to part D of title I of the Clean Air Act. Part D was added to the Act in 1977 and includes specific remedial measures for areas which continue in nonattainment for ozone, carbon monoxide and particulate matter. The new subpart 3 specifically addresses the carbon monoxide (CO) nonattainment problem and includes four new sections: section 187 (classification and deadline extensions); section 188 (requirements for all carbon monoxide nonattainment areas); section 189 (requirements for serious carbon monoxide nonattainment areas only); and section 190 (sanctions for failure to implement the requirements of the Act).

Based on 1987 and 1988 air quality data there are 44 areas which currently fail to attain the national primary ambient air quality standard for carbon monoxide which is 9 parts per million (ppm) averaged over eight hours to be exceeded not more than once per year. Section 187 classifies these areas into two groups: 11 serious carbon monoxide nonattainment areas with design values in each area exceeding 14 ppm CO; and the 33 other areas which have design values between 9 ppm and 14 ppm CO. Attainment deadlines are extended for all areas with five additional years granted to moderate nonattaiment areas and ten additional years granted serious carbon monoxide nonattainment areas.

The new section 188 of the Act establishes requirements which will be applicable to both moderate and serious areas. The requirements are to be satisfied by the implementation of various revisions to the State implementation plan (SIP) for each area. A comprehensive inventory of carbon monoxide emissions must be prepared for each area and updated every three years. All commitments contained in current implementation plans which have not been implemented must be in place within 18 months after enactment of the bill. The States must collect an annual auto registration fee of $2.00 from the owner of each vehicle registered in a corbon monoxide nonattainment area. Major stationary sources located in these 44 areas will be required to pay a fee of $75 for each ton of carbon monoxide emitted. Revenues from these fees will be used by the State or local air pollution control agency to develop and carry out the implementation plan for the area. Major stationary sources (50 tons/year of CO in moderate areas; 25 tons/year of CO in serious areas) are required to obtain an operating permit.

Not later than two years after enactment of the bill, each State containing a carbon monoxide nonattainment area must submit to the Administrator a completely revised State implementation plan for each area which includes the measures necessary to demonstrate that the area will attain the standard by the newly established deadlines. In addition to the attainment demonstration, these revised SIPs must also include interim milestones expressed in quantitative terms and contingency measures (standby emissions reduction regulations), which can be implemented promptly, if an interim milestone is missed. The Administrator is to audit each SIP every three years to assure that the SIP is being fully implemented and that milestones are being met.

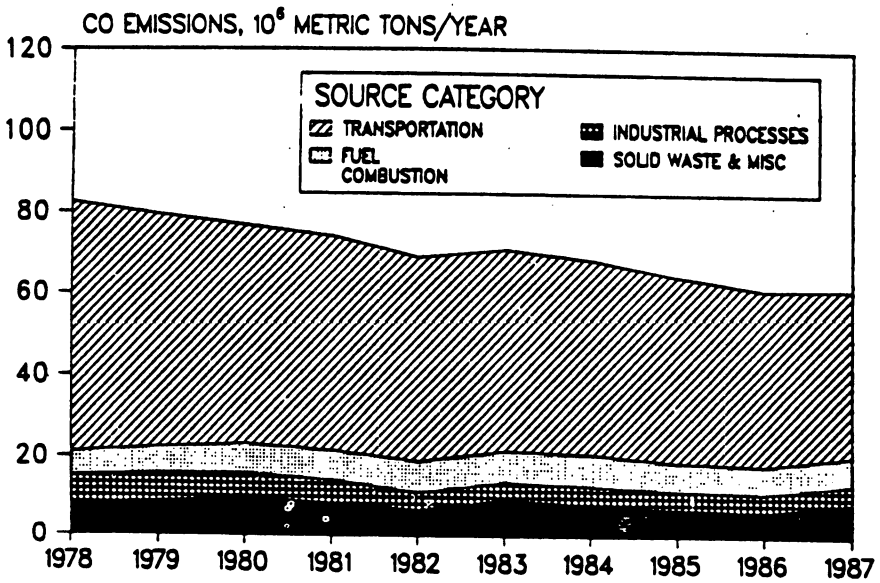
FIGURE I-2.—NATIONAL CARBON MONOXIDE EMISSION ESTIMATES, 1978-87

[Million metric tons/year]

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Source category:										
Transportation	61.6	56.9	53.5	52.5	50.0	49.3	47.6	45.5	42.8	40.7
Fuel combustion	5.8	6.6	7.3	7.5	8.0	7.9	8.1	7.2	7.2	7.2
Industrial processes	7.2	7.1	6.3	5.9	4.4	4.4	4.8	4.6	4.5	4.7
Solid waste	2.5	2.3	2.2	2.1	2.0	1.9	1.9	2.0	1.7	1.7
Miscellaneous	5.7	6.5	7.6	6.4	4.9	7.7	6.3	5.3	5.0	7.1
Total	82.4	79.4	77.0	74.4	69.4	71.3	68.7	64.6	61.1	61.4

Note.—The sums of sub-categories may not equal total due to rounding.

Figure I-3



National trend in emissions of carbon monoxide, 1978-1987.

All carbon monoxide nonattainment areas must also include an enhanced vehicle inspection and maintenance program and an oxygenated fuels program in their revised SIPs.

In addition to the requirements imposed by section 188, the new section 189 also requires the 11 serious carbon monoxide nonattainment areas to implement the transportation control measures specified in section 108(f) of the Act and a program to increase the vehicle occupancy rate in worktrips which is to be implemented by major employers (those employing more than 100 persons) in each of these serious nonattainment areas.

Cambridge Citizens for Liveable Neighborhoods Inc.

P.O. Box 19, Cambridge, MA 02238 / (617) 354-5670

Cambridge Citizens' Plan for Clean Air

Submitted as an Amendment to the State Implementation Plan Under the Policies and Procedures of the Federal Clean Air Act

Executive Summary

The Cambridge/Boston core area has a serious problem with air quality. Sanity and law mutually require that we reduce carbon monoxide and ozone substantially for each of the next several years. These problems come from cars almost entirely. This clean air plan will effectively reduce pollution by changing the role cars play in Cambridge. It uses a combination of regulations and incentives. The eleven key elements of this plan are:

1. No growth in how many cars can or do come into Cambridge
2. Strict limits on commercial parking
3. Earmarked revenue for local transit
4. Important City initiatives on MBTA transit
5. Bicycle and pedestrian facilities
6. Strengthening the residential parking permit program
7. Taxicab related improvements
8. Zoning changes
9. Real traffic policy
10. Economic growth for Cambridge citizens
11. A formal Trip Reduction Ordinance
12. Tailpipe standards enforcement

This plan is real; it contains no half-measures, window-dressing or flim-flam. This plan provides powerful incentives for change. It is self funding. It is quantitatively verifiable. This is a strong, visible local initiative. It will make regional solutions much more likely through its leadership. It attends to the needs of our citizens for clean air and economic opportunity without the big and common lie that one must be bargained against the other.

Cambridge Citizens for Liveable Neighborhoods Inc.

P.O. Box 19, Cambridge, MA 02238 / (617) 354-5670

State Implementation Plan: Cambridge Citizens' Proposed Amendment

Abstract

Under the Federal Clean Air Act as amended, the Boston core area has been given a "serious nonattainment" rating. This rating means that we must reduce the priority pollutants for this area, carbon monoxide (CO) and ozone (O_3), 3% per year for the next several years.[1] Most of these priority pollutants come from mobile sources,[2] mostly cars. This Cambridge Citizens' Proposed Amendment offers a plan to effectively achieve the reductions mandated by regulations, to do so in a quantitatively verifiable manner, and to make the administration of the plan self funding.

Assumptions

1. Mobile pollutant discharge is linearly proportional to vehicle miles travelled (VMT), or trip count times average trip length.

2. Those parts of personal vehicle usage that are regular, daily, and routine are most amenable to reduction or diversion to other transportation modalities.

3. Incentives are preferable to regulations, but incentives, absent regulation, are incapable of effecting the 3% reduction goal.

4. Regional solutions are made more palatable through the leadership of strong, visible local initiatives

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[1] The Boston Basin has a "serious non-attainment" designation, which, under the Clean Air Act, requires these reductions and this schedule.

[2] For CO, 66-76% are from mobile sources (depending on season). For Volatile Organic compounds, 54% are from mobile sources. For Nitrogen Oxides, 43% are from mobile sources. Source: Massachusetts 1987 Base Year Emmission Inventories, Department of Environmental Protection, Division of Air Quality Control, December, 1990.

1. No growth in vehicular flow capacity of the infrastructure

It is the paramount principle of this proposal that traffic volumes not increase as measured by VMT. The history of the past decade shows that tailpipe emission improvements have been more than wiped out by increased VMT (averaging 3% per annum).[3] This plan categorically states that no net traffic capacity growth is the foundation of a purposeful step towards air quality improvements. Capacity enhancements are very expensive, destructive of other urban amenities and ultimately counter-productive.

This means explicitly that no attempt will be made to improve the morning performance of class D and F intersections within Cambridge unless there is a quantitative verification that said improvements will not result in increased VMT due to the apparent capacity increases of diminished bottlenecks. Improved flow in the afternoon, to more speedily flush cars from the city, is likely worth consideration, and this will be studied carefully. Similarly and in addition, no road widening efforts will be made (except for bicycle lanes), nor will there be any effort to improve morning arterial capacity (such as might be accomplished with morning rush hour parking bans).

Cambridge will aggressively use all means at its disposal to contain traffic to arterials and not involve residential and side streets as thoroughfares, *e.g.* addition of new one-way streets with patterns that discourage through traffic; "traffic calming" measures such as woonerfs[4], expanding sidewalks at intersections to neck-down intersection size, *etc.*

These issues have special significance in East Cambridge, the Kendall Square redevelopment district, and the Alewife are, including Alewife Center and Quadrangle and Triangle areas west of Route 2 between Concord Avenue and the Alewife Reservation. Technically, Alewife Brook Parkway, if upgraded at all, would be built to parkway standards, not highway standards.

2. Stable destination capacities

It is widely understood in planning circles that the strongest

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[3] Traffic data from the Massachusetts Department of Public Works.

[4] A Scandanavian commonplace, woonerfs are mid-block "lateral speed bumps" or, putting it differently, jogs in roadways whose purpose is to reduce the practical speed of drivers. Especially popular in residential areas as a safety and liveability measure.

constraint on commuter traffic volumes is the amount of destination capacity available.[5] "Destination capacity" can be thought of as some combination of flow capacity and parking. Point 1 addresses the former; this point addresses the latter. This plan categorically states that no increase in parking capacities will be allowed. Parking capacity may be rearranged in patterns of use or ownership, but no increase will be permitted. As the parking in Cambridge is already at saturation, this will provide a powerful incentive to switch trips from private automobiles to other, less polluting alternatives.[6]

This means explicitly that a parking supply restriction no less strict than that set by the current ordinance (#1112) will be in place permanently. It also means that increases in parking that may be deemed desirable as an incentive City policy goals will only be available from reassignment of the existing pool, not by the creation of new parking. It also means that residential parking, on-street parking, and MBTA park and ride will continue to enjoy the only exemptions from supply restrictions.

To complete the circle, all on-street parking will be regulated via meters or residential-parking-only stickers. Where meters are used, the time period of the meters can be fit to the circumstances, *e.g.* the meters can be 10-hour meters in industrial areas where public transit service is limited or non-existent. For those commercially zoned areas which are nonetheless used for residential purposes (Concord Avenue for example), residents who have a sticker allowing parking on that street would be exempt from the meter fee.

3. Earmarked revenue for paratransit

A fee will be assessed on all "controlled parking"[7] in the City. Such

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[5] Many studies have substantiated this finding (Bhatt, 1990; Higgins, 1990; Pratt, 1990; Shao, 1991; Shoup & Willson, 1990; Valk, 1990; Willson, Shoup & Wachs, 1990). Stable destination capacity is also a feature of many SIPs in other areas, such as Seattle, Washington (where no principal use facilities have been built since 1976) and Portland, Oregon (where there is no required parking for new development and an absolute limit on aggregate downtown capacity, excepting only lodging).

[6] For years, the prevailing rule that limited the number of cars into Manhattan was the reputation of the unavailability of parking and the existence of a comprehensive transit program. The city in the 1950s had the image of a place where people would be crazy to bring a car in. Downtown Boston has generated this image in recent years, so that bringing even a motorcycle inth the city is fraught with parking worries. Only Harvard Square carries this image today for Cambridge.

[7] Controlled parking is defined by the Memorandum of Agreement, dated 10 August 1990, between the City of Cambridge and the Massachusetts Department of Environmental Protection, and subsequently enacted into Cambridge Ordinance No. 1112, enacted 26 November 1990. Basically, it says that all spaces are subject to control except for those that are exclusively residential, on-street, or MBTA park-and-ride. Technically, a controlled parking space is any space in "any lot, garage, building or structure, or combination or portion thereof, on or in which motor vehicles are parked, except (i) a parking facility, the

fees are now common in major metropolitan areas.[8] This fee will average $1 per day per space. Fees will be higher than the average in the vicinity of those City locations that are transit hubs, and be lower than the average in those areas ill served by public transit. Charges at city-owned metered parking will also be increased by an average of $1.00 per day, or approximately 10¢ per hour, depending on the location of the meter. The majority of these funds will be earmarked for a paratransit system that will be support the local trips of citizens of Cambridge and employees of Cambridge businesses. Owners of parking spaces (employers, developers, parking garage operators) will be encouraged, but not required, to pass the fee on to the ultimate user of the space (employees, commercial tenants, garage users).

This means explicitly that all controlled parking in the City will effectively contribute $1/day/space. In areas well served by transit, principally Porter, Harvard, Central and Kendall Squares, that fee will be higher. That fee will be $2/day in the Harvard and Kendall areas, and $1.50/day in the Porter and Central areas. Other areas, *e.g.* industrial areas of southeast Cambridgeport, will be lowered (minimum $.50) so as to make the net yield be $1/day per controlled space. Such a fee structure will tend to favor mercantile uses over commuting uses, but at the going rate of $100 per month per space for low end commuter parking, will add no more than 30% to the price of that parking. These figures will be inflation indexed so as to retain their buying power.

Note that the provision of a fixed fee per space, rather than a percentage of the gross revenue, has an intentionally differential impact on the kinds of parking present in the city. The cheapest parking, by far, is that that is rented monthly in large blocks and provided to employees as "free parking"; second is that which the employee him/herself purchases on a monthly basis. It is those uses that are targeted by this proposal and which will be most affected by it. High turnover parking that is associated with mercantile uses will be much less impacted by such a fixed fee per space scheme.

In round numbers, such a $1/space contribution will amount to some

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use of which is limited exclusively for the benefit of the residents of a specific residential building or group of buildings or, (ii) parking on public streets, and (iii) a parking facility designated as a park-and-ride facility to be operated in conjunction with the Massachusetts Bay Transportation Authority.

[8] New York: 18.25%, San Francisco: 15%, Washington, D.C.: 12%, Los Angeles: 10%. The only novel feature is that we propose a fixed fee per space and not a percentage of the take. Other similar measures are in place in Portland and Eugene, Oregon, Madison, Wisconsin, Hartford, Connecticut, Chicago, Illinois, and Montgomery County, Maryland. On a grander scale, on March 14, 1990, the State of Washington enacted a Parking Tax that applies to all non-residential parking.

$50,000 per day[9], or in excess of $12,500,000 per annum. This figure can abundantly support a local transit system for Cambridge. An illustrative plan and balance sheet for such a "paratransit" system is in Appendix 1.

When technologically feasible, the paratransit and express bus systems will be converted to natural gas fuel, so as to further enhance the impact of the program and to serve as a public demonstration of clean fuel conversions.

4. City initiatives on MBTA transit

Cambridge must do more that merely cooperate with the MBTA; Cambridge needs activism - advocacy and monitoring. The City will prepare a transit plan for Cambridge, in draft form for submission to the MBTA. The City of Cambridge will design programs for MBTA implementation, such as in signing, brochures, signal/bus preemptions, trip sampling, headway monitoring of trains and buses. Components of this coordinated effort follow.

The City commits to establishing standard signage at all MBTA bus stops (and all city paratransit system stops). The City will make the government access (cable) channel carry schedule and general transit information.[10]

The City commits to cooperate with the MBTA in locating bus stops where they will be maximally convenient for riders and for bus operators, and to aggressively clear parking that occurs in bus stops. Where it is appropriate, the City will make street improvements that will improve bus operations, such as changes in signal timing, signals that can be controlled or pre-empted by buses, and changes in curbing or lane striping, so long as these improvements offer an advantage to buses and do not increase road capacity for other vehicles. Bus stops at Harvard (#66 and #86) and at Porter (#77) will be relocated closer to the subway station entrances.

The City will also undertake surveys of residents and employees throughout the City, targeted at understanding barriers to MBTA usage.[11]

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[9] City figures for 1990, total number of non-residential, off-street parking places is 51,829.

[10] As is now being done in Iowa City, Iowa.

[11] In the Report of the Service Committee of the MBTA Advisory Board, January 9, 1991, they write "The MBTA must make a serious commitment to collectin information on existing and potential ridership. Planning should begin now for a broad-based systemwide survey...". Clearly, there is room here for initiative and cooperation on the part of the City of Cambridge.

[11] A similar program is in place in Seattle, Washington.

The City will work with the MBTA to investigate adjustments of existing routes, and to plan new routes where necessary, that will better serve Cambridge employers, merchants, and residents, and that will effectively link with the City's paratransit system. These bus route improvements will be geared both at making it easier to commute within the city, and at making it easier to commute between Cambridge and nearby communities, without degrading the existing connections between buses and the rapid transit system.

Taking a cue from the air travel industry, careful examination of timing issues at transfer points between modes, such as bus to subway, will be made. Schedules will be devised to ensure that intermodal transfer delay is acutely minimised. Monitoring of the performance of these coordinative efforts will be done regularly and scientifically by City staff.[12] So as to ensure the best possible ability to meet these schedules, Cambridge will install traffic signal preemption for the bus fleet.[13]

The City will use the full measure of means at its disposal to cause the MBTA to establish a new commuter rail station at Alewife, with direct and safe access to the (existing) Alewife Garage 1. The City will take all necessary steps to site additional Alewife parking in a new Alewife Garage 2, to be constructed on the east side of Alewife Brook Parkway, across the roadway from the existing parking. Construction there will intercept more cars and simultaneously provide permanent assurance of the usefulness of the East Head House to commuter and North Cambridge resident alike.

If any road improvements are built at Alewife, they will be exclusively geared to improving access into the subway station's parking garages and bus lanes. In sum, these measures substantially enhance the effective interception capability of the Alewife terminus for inbound suburban commuters. (*Noto bene*: The plans proposed by the Mass. DPW are wholly incompatible with these common-sense goals, and the City will continue its vigorous opposition to those plans.)

5. Bicycle and pedestrian facilities

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[12] Such monitored coordination is already being done in Alberta, Canada. "For example, in Washington, a staff of 32 checkers work full-time to monitor WMATA's service delivery, including the on-time performance of its bus fleet." and "Closer to home, the privately provided shuttle system which serves Boston's Longwood Medical Area posts service schedules at its stops, showing intermediate arrival times on each of its routes" - Report of the Service Committee of the MBTA Advisory Board, January 9, 1991.

[13] A similar program is in place in Seattle, Washington.

The City will commit to greater use of bicycles and walking.[14] A Bicycle and Pedestrian Design Engineer will be appointed. The Design Engineer's first responsibility will be the preparation of a Cambridge Bicycle and Pedestrian master plan within six months of his/her appointment. Bicycles will be provided to Police and Department of Transportation personnel for official uses where appropriate so as to both gain air quality advantages and to serve as a public example. Intersections and grade crossings that pose hindrance to pedestrian and bicycle uses will be reworked to favor, rather than disfavor, those uses.[15]

6. Changes in residential parking permit program

The City's residential parking permit program has generally worked well in the past; however, some minor adjustments are needed. The biggest problem with the current system is that residential streets in the vicinity of Harvard, Central, Porter, and Lechmere Squares are used as parking for adjacent commercial areas and subway stations. Users of these parking spaces include both residents of other neighborhoods in Cambridge and non-residents who have illegally acquired Visitor Parking Passes.

To reduce the black market on Visitor Passes, the address of the owner will be written on Passes by city employees when they are issued. The Visitor Pass will be redesigned to feature a calendar appropriate for the year of issue. The Visitor Pass will be valid *only* if the then "today's date" is circled.

The "White Visitor Passes" (city-wide Visitor Passes) will be eliminated. The City of Cambridge will substitute stickers for authorized individuals. These stickers will display the vehicle registration number of the vehicle to which it is assigned and also show an expiration date.

Residential parking zones will be established for streets near MBTA stations. Resident parking permits from other parts of the city will not be valid in these areas. In effect, Cambridge will have 5 exclusive permit zones (Lechmere, Kendall, Central, Harvard and Porter) plus a general zone covering the rest of the city.

To ease the inconvenience that will result from parking meters being installed at now-unregulated spaces on streets that have mixed commercial

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[14] Cities from Chicago, Illinois, to Phoenix, Arizona, to Valencia, California, already reserve important city infrastructure for walking and bicycling.

[15] See the Mayor's Bicycle Commission Study, 1991, for a breadth of details that will form the basis for this Bicycle & Pedestrian Master Plan.

and residential uses (such as Concord Ave., Huron Ave., and Cambridge St.), these meters will require coins only between the hours of 9:00 and 5:00. The rate charged for these meters will be indexed to remain at the maximum level of all meters city-wide.

7. Taxicab improvements

In cooperation with the taxicab industry, the City will undertake measures to promote business and to improve efficiency. Emphasis will be placed on multimodal connections which will allow taxis to supplement both MBTA and paratransit service. One necessary improvement is the establishment of new taxi stands, especially adjacent to the Porter and Lechmere subway stations.

8. Zoning changes

Between January, 1980, and March, 1990, Cambridge constructed over 8 million square feeto of office, retail, and industrial space, 1000 new hotel rooms, and approximately 19,700 non-residential off-street parking spaces. Since March, 1990, an additional 1 million square feet of office and retail space has been constructed or has begun construction. An additional 7 million square feet of non-residential development is proposed or planned. If parking is developed at the same rate as since 1980, an additional 19,700 spaces would be constructed. This figure, large as it is, is less than that allowed under current zoning.[16] Clearly, zoning changes are essential for Clean Air, as well as for liveability concerns.

Present city zoning requires a minimum number of parking spaces per square foot of floor space. For non-residential uses, these regulations will be sharply modified to encourage developers to offer public transit incentives in exchange for a sharply reduced number of parking spaces.[17] For example, an office building which gave free MBTA passes to its employees (if it were near a transit station) or which funded free paratransit service (if it did not already have good transit service) will be allowed to have (potentially substantial) reductions in required parking spaces. Similarly, employers could mandate that a portion of their spaces are for high occupancy vehicles (HOV) only, thereby increasing the net

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[16] Cambridge Systematics, Inc., January, 1991.

[17] These changes would have substantial positive impact on developers and businesses in Cambridge. Anecdotally, at least one major employer has achieved significant savings by buying T passes for its employees rather than continuing to lease reserved parking for them. Similarly, it is reported that a major development expended 40% of its total construction dollars on the parking facility associated with it. Average figures are in the 20-30% range.

employee capacity of their facilities without the requirement of any other steps being taken, administratively or otherwise.[18] In any case, the aim is to use the Zoning Ordinance to keep parking supplies tight.[19]

New site guidelines will be established to promote transit, ridesharing and pedestrian modes for new developments. Criteria will include minimizing walking distances between transit access and the proposed development, bus shelters, bicycling facilities, sidewalks, paratransit loading areas and control of parking.[20]

9. Traffic Policy

The City of Cambridge will formalize its traffic policies. It will identify major highways (such as Fresh Pond Parkway, Memorial Drive, O'Brien Highway) and state the function of each. The traffic function of other arterials (such as Massachusetts Avenue, Hampshire Street, Broadway and Concord Avenue) will also be established. These arterials will not seek to move large volumes of vehicles swiftly but will instead provide service adequate only to avoiding having delays that force vehicles to use adjacent routes through residential neighborhoods.

Finally, several categories of residential streets will be developed. Some will be primarily residential access, with speeds of 25 MPH or above. Pearl Street and Harvard Street are examples. For streets in this category, games in the street are usually impossible because of traffic volumes and speed, but there is no congestion.

Other residential streets will have peak hour traffic specifications in these ranges: 1-25, 25-50 and 50-100 cars per hour. Policies will be adopted by the City (Planning Board and Traffic Department) to prevent all traffic growth on these streets.

10. Economic growth for Cambridge citizens

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[18] The Traffic Mitigation Plan for University Park implicitly implements this idea. It establishes the maximum number of vehicular trips which can be generated from the development during peak hours. It includes a requirement to charge reduced parking fees for carpools and vanpools and reduced fees for designated spaces not available for use on working days until after 9:30 AM. Failure to meet performance standards can result in limitations on the extent of the project;s build-out.

[19] To quote one recent Federal Review: "Localities also should insure parking supplies are kept on the tight side... [Zoning] codes should be revised in support of [transportation systems management] and [parking management] strategies to insure a tight supply. New maximum requirements might be added to codes for this purpose. (USDOT/UMTA, 1989)

[20] Much as is now being pursued in Seattle, Washington.

The City of Cambridge will reverse its policies and practices of recent years[21] and explicitly put forward a plan that encourages employment and business opportunities for Cambridge citizens. The history of the past three decades is that in 1970, 75% of the employees of Cambridge businesses and institutions were from Cambridge or immediately adjacent communities. By 1980, that figure was 67%. Today, it is less than 50%.[22] Expressed differently, only 28%[23] of Cambridge's employees live in Cambridge, compared to 40% in Boston. Increasing the Cambridge percentage to only 33% would decrease Cambridge based VMT by over 1%.[24] It is imperative that a Clean Air SIP amendment recognize that reducing the need for long distance commuting is no quick fix, but is where the ultimate solution lies.

This means explicitly that the City will use is full influence to ensure that economic growth in the City employ Cambridge residents or those from immediately adjacent communities. This includes the full weight of its regulatory influence and the full benefit of its incentive influence. The principle is simple: *Hire those who live here, or house those you hire.*

Goals will be established that reflect an expectation of equal effort on the part of all local employers to improve their performance. Opportunities for sponsoring and coordinating educational partnerships between Cambridge employers and schools in Cambridge will be explored, and a semiannual job fair will be organized. A Local Employment Opportunity Plan will be developed to achieve substantial gains in this direction. Such efforts require serious, new administrative vigor to accomplish meaningful changes, and the City pledges that effort.[25]

To the extent that major new construction of economic enterprises takes place in the City, the builders of these enterprises will be required to contribute to the housing stock of this City in proportion to the numbers of persons these new enterprises will employ. Cambridge will take regional leadership in this area by requiring that each new square foot of commercial construction be accompanied by a square foot of housing. In short, the principal is to *hire those who live here or to house those you*

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[21] To quote the City's documetation of April, 1991, jobs generated by the existing pattern of new development "will tend to focus on white-collar employment and attract workers from higher growth communities further distant from Cambridge".

[22] Figures provided by Cambridge Community Development Department, April, 1991.

[23] Cambridge Community Development and Cambridge Systematics, Inc.

[24] Cambridge Systematics, Inc., analysis, March 1991.

[25] Increasing the share of the City's employment base composed of residents from 28% to 33% will require Cambridge employers to hire at least 5,100 Cambridge residents for existing jobs and to hire 33% Cambridge residents for all new jobs created in the City.

hire. The details of such a coordination of supply and demand be worked out by a public process, again providing a hearing for all before a body of Cambridge citizens who make the final proposal.

11. Trip Reduction Ordinance

Cambridge will craft a Trip Reduction Ordinance (TRO) with an initial emphasis on incentives rather than regulations. TROs are well understood and widely adopted;[26] a good one is no more work to compose and administer than a bad one. The Cambridge TRO will be devised by a *citizen's committee* that will hear from all sectors including persons representing regional concerns, such as MAPC, CLF, CTPS and DEP. If a separate TRO is implemented either for the city of Boston or on a regionwide basis, then the drafting and implementation of the Cambridge TRO will be done in cooperation with these other efforts so long as it does not result in a weakening of the Cambridge effort.[27]

The details of this TRO will be worked out by the citizen's committee, but will include the creation of a mandatory annual survey of all businesses and institutions that employee more than 50 persons[28] and an accompanying Trip Reduction Plan based on the results of that survey and a citywide automobile efficiency rate (AER) target.[29] A citywide AER will be established, but will require employers to adhere to districted AER targets, which will vary based on factors such as proximity to transit and site-specific issues. The TRO will require improvements in each

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[26] See, for example, the before and after case studies of eleven cities in "Evaluation of Travel Demand Management", Federal Highway Administration report FHWA-SA-90-005,.February, 1990, or the paper "Ten Cities' Strategies for Transportation Demand Management", Flynn & Glazer, Transportation Research Record #1212. Many more references exist, all pointing to the contention that TROs are effective.

[27] Regional parking and transportation demand management strategies are already being put in place in Massachusetts. Since May, 1991, the developer of any project generating more than 3000 new behicle trips/day is required to perform an "indirect source analysis" for submission to the Secretary of Environmental Affairs. Transportation demand management and other mitigation measures will be required to ensure zero net growth in hydrocarbon emissions. Under another statewide program, the Department of Public Works has proposed "curb cut" regulations designed to ensure that developments which generate traffic impacting on state highways will be required to reduce vehicle trips as a condition of gaining access to the state highway. Programs such as these will serve to ensure that new suburban development, in cluding employers who attempot to move out of Cambridge or Boston to avoid regulatory restrictions, is adequately regulated.

[28] This is 240 firms, 65,000 employees according to 1990 Community Development Department and Census data.

[29] Automobile Efficiency Rate was defined in "Regulation XV", City of Los Angeles. It is calculated by dividing the number of cemployees who report to the worksite or to a job-related activity between 6:00 AM and 10:00 AM, inclusive Monday to Friday, by the number of vehicles used by these employees. As the AER increases, use of single-occupant vehicles for commuting is reduced. The AER calculation requires that a five consecutive weekday average be used. Vehicles counted exclude bicycles and public transit vehicles. Motorcycles count as automobiles.

employer's AER, designed to achieve the goal of zero net VMT growth and/or 3%/year reductions in emissions This requirement will be imposed even if an employer already has an AER at or above the citywide or district target. Unless a business can show that it is already spending substantially on trip reduction programs, and that a hardship would be required to produce further improvements in the AER, no relief will be granted from the requirement to show annual increases in AER.

This TRO will vigorously advance alternate transportation modes to the private, single passenger automobile[30]. It is imperative that the TRO make a substantial, qualitative distinction between employers that are performing well and those that are not, including historic efforts by employers when public policy was not so well delineated.

Businesses will be encouraged to avail themselves of paratransit in meeting their respective requirements, and could contribute to the paratransit system directly should special circumstances obtain. Similarly, business will be encouraged to substitute transportation allowances[31] for other "free" programs; in particular, it is the goal of this proposal to end the provision of "free parking" as a perquisite of any employment in Cambridge.

The City will also provide expanded Commuter Mobility Assistance to Cambridge businesses and institutions. The amount of assistance currently offered by the City (1 person) will be tripled. The opportunities in this area are untapped by the current program of totally voluntary compliance and one staff member per 100,000 employees. In addition and as a matter of fairness, revenues from Residential Parking Permits will be dedicated exclusively to improving programs that directly benefit residents, rather than the Commuter Mobility Program which is targeted primarily to out-of-town employees of Cambridge businesses. The Commuter Mobility Program will be funded instead from the parking fee revenues.

During the initial two years the ordinance is in effect, attainment of the performance standards will not be mandatory, however it will be rewarded by the establishment of a priority order on obtaining additional

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[30]Based on 1980 census data provided by the Community Development Department, 43% of all employees in Cambridge arrive by private, single passenger automobile.

[31] A transportation allowance is a sum of money that is provided to the employee independently of the transportation mode they use to get to work. It is preferable that it be provided in cash on the same day that T passes are available on site. The employee will then be required to decide between pocketing the money (if he or she bicycles or walks to work), to buy a T pass, or to purchase parking over the course of the month. The travel allowance should be set at a level that strongly encourages the use of transportation other than the private automobile.

parking, access to paratransit, and access to commuter mobility resources as administered by City departments. If this policy proves successful, it will be made permanent; if it does not succeed, mandatory enforcement of the TRO will become the rule instead.

12. Tailpipe standards enforcement

Recognizing the importance of tailpipe emissions, Cambridge will enact an ordinance making it an infraction of City law to tamper with the emissions control system of any vehicle, or to operate in Cambridge any such vehicle. This ordinance will impose fines on the owner of any vehicle found to have had its emissions control system tampered with.

Summary

This proposal will provide powerful incentives for change, will be self funding with surplus for other City programs, and will be quantitatively verifiable. It provides leadership that is consistent and replicable on a regional scale. It attends to the needs of our citizens for clean air and economic opportunity.

Appendix 1
Illustrative balance sheet for paratransit system

Specifically, this plan stipulates a fleet of 50 vans, operating on fixed schedules throughout the City, and the provision of 10 express busses from key suburban locations. The balance sheet for such an operation will be favorable; even without fare subsidies, nearly half the revenue from the fee on parking will be available for other transit purposes.

Keeping a van on the street amounts to some $32/hour of operation. At 60 hours/week of operation, that is $100,000 per annum. The fleet of 50 such vans, then, implies an aggregate cost of $5,000,000. Similarly, allowing for two morning and two evening rush hour trips for an express bus will amount to some $150,000 per annum. Assuming marketing and other ancillary expenses, we allow for an actual expense of $200,000 per annum. This plan stipulates a fleet of 10 such busses, at an aggregate cost of $2,000,000. The expected revenue from the parking fee, net of this paratransit program, is then some $5,500,000 per annum. This transit program will not be encumbered by the administrative expense of fare collection, i.e. their ridership will pay nothing directly to board. Such a paratransit program will serve to lessen the usual diminution of ridership that occurs at each transfer point, and will be a powerful overall stimulus for usage of the system. So as to assure the intent of the express bus program, passcards to the express busses will be issued to Cambridge employers for redistribution to their employees. Businesses will be encouraged to request van routes that helped them comply with trip reduction requirements, *vide supra.*.

The yield on such a program will be substantial. By strategically placing express bus terminations at places of concentration of Cambridge employees, the 10 busses will be fully subscribed. The Community Development Department already has this required information. Ten busses times two loads of 50 individuals per day is a reduction in auto traffic entering Cambridge of 1,000 vehicles per day. This measure alone will supply a 1% reduction in the automobile emissions attributable to trips with a Cambridge end-point (which we estimate at 100,000 per day in round numbers)[32]. Because of the above average length of these trips, we

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[32] Employment in Cambridge was estimated by MAPC at 105,800 in 1990, and in any case is greater than 100,000 - a figure which does not include students and shopping trips from out -of-Cambridge persons.

claim a better than 1% reduction in emissions from this portion of the program alone.

This estimate is conservative; if the true figure is in fact smaller, the effectiveness of this measure is improved.

Cambridge Citizens for Liveable Neighborhoods Inc

MEMORANDUM

Sunday, March 22, 1992

COMPARISON OF PROPOSED STATE IMPLEMENTATION PLAN REVISIONS: THE CITY MANAGER PLAN VERSUS THE CCLN PLAN

Topic	Proposals of the City Manager	Proposals of CCLN	Comments
Expanded Commuter Mobility Program	Paid for by increased Residential Sticker fees. 1 Full time staff.	Paid for by commuter parking fees. 3 Full time staff	Commuters should pay for own program. There are 240 eligible employers, 3 staff is minimum.
Bicycle & Pedestrian Program	Bikes to Police & Traffic. Fund bicycle storage and improved amenities. Recommend regional plan. 1/2 time staff.	Bikes to Police & Traffic. Redesign streets to favor pedestrians and bicycles. 1 full time Bicycle & Pedestrian Design Engineer.	If you want serious changes, you will need to make physical changes to the City.
Parking On Unregulated Streets	Meters or time restrictions on all unregulated, nonresidential streets.	Unregulated streets either converted to residential stickers or meters. Residents of metered streets exempt from meters. Meter prices consistent with policy on use, vary by location.	CCLN plan does not penalize resident parkers living in commercial zones. CCLN plan permits long term meters (10 hours) and other flexibility.
Fees For Municipal Garages	East Cambridge and Green Street garages prices increased by 25%.	(See below on Funding)	City Manager's plan has insignificant revenue and impact.
City-Wide Visitor Passes ("White Passes")	Replace city-wide passes with sticker similar to residential sticker.	Replace city-wide passes with sticker similar to residential sticker.	Similar.
Residential Parking Stickers	Four zones drawn as an X across Harvard Square. Parking in your own zone only except weekends.	Neighborhoods very close to the five subway stops get special stickers, others cannot park in these neighborhoods. The rest of Cambridge remains as it is now.	City Manager's plan makes a even worse mess of Harvard Square, and does not protect any other close-to-transit neighborhood. CCLN plan protects close-to-transit neighborhoods with minimal disruption
Visitor Parking Passes	(No plan)	To prevent continuous or commuter use, calendar printed on pass, "today's date" must be circled to be valid. To prevent sale of visitor passes to commuters, visitor pass will have address to whom issued written on it.	CCLN plan protects legitimate visitor parking while preventing misuse of passes.

Topic	Proposals of the City Manager	Proposals of CCLN	Comments
Fee Schedule For Residential Parking Stickers	1st = $8; 2nd = $12; 3rd = $50; 4th = $100; 5th = $200. Half of this money goes to helping commuters through the Commuter Mobility program.	No increases. No diversion of residents money to commuters.	City Manager's plan requires residents to pay for commuter services. CCLN's plan does not.
Increased Local Employment Opportunities	Annual Job Fair Employment Program (CDD). Partnership between employers & Cambridge schools. Local Employment Opportunity Plan (CDD).	Each square foot of commercial construction must provide a square foot of housing. Partnership between employers and Cambridge schools. Local Employment Opportunity Plan (Schools).	CCLN Plan ensures an increase in the percentage of Cambridge employees who live in Cambridge, without displacing existing residents to achieve this goal. Both plans encourage useful goals in local employment. *Hire those who live here, or house those you hire.*
Employer Based Vehicle Trip Reduction Plan	Applies to employers of 50 or more employees. Processing fees and fines for noncompliance City-wide target for the average number of employees per car (called an Automobile Efficient Rate, or AER). Plans required for those employers with AERs lower than the target AER Employee education.	Applies to employers of 50 or more employees. Individualized AER targets based on location and transit availability. End to "free parking", substitute transportation allowances (i.e. give employee the cost of the free parking, make him/her choose). (See Paratransit System.)	City Manager's plan only involves half the employers because only those worse than average have to do anything. CCLN plan requires everyone to do better, and worst offenders to do especially better. CCLN plan makes the true cost of "free parking" visible to employer and employee alike.
New Development And Its Responsibilities	Developer of 50,000 square feet must develop binding transportation management plan. Traffic analyses required. Must meet city-wide AER. Exempts some major developers	Each square foot of commercial construction must provide a square foot of housing.	City Manager's plan claims savings in pollution from buildings that aren't even built yet, and ignores the pollution that would be generated by additional car trips development would bring. CCLN plan ensures that the percentage of Cambridge employees that are Cambridge residents would climb substantially.
Zoning Changes	Study the problem.	Sharp reduction in both minimum parking required and maximum parking allowed. Requirement to build amenities that favor bicycle, pedestrian and paratransit / public transit.	CCLN plan recognizes that only zoning reform does anything, study does not.
Clean Fuels For Fleets	State should study the problem.	City paratransit fleet will be converted to clean fuels.	While asking the State for assistance is a good idea, to doing something is a better one.

Topic	Proposals of the City Manager	Proposals of CCLN	Comments
Tail Pipe Standards Enforcement	(No plan)	Violation of Cambridge law to tamper with emission control system or operate a tampered vehicle in Cambridge.	
Cost Of This Planning Effort To Date	$750,000 in public funds.	$200 of private funds (copy costs) plus citizen labor contributions.	
Summary	Says more.	Does more.	As Cambridge zoning amply demonstrates, the effectiveness of a regulation is inversely proportional to its length.

Topic	Proposals of the City Manager	Proposals of CCLN	Comments
Traffic Capacity Growth	(No plan)	No traffic capacity growth. No street widening. Improved traffic flow out of Cambridge but not into Cambridge. Keep traffic off residential streets. No expansion of Alewife Brook Parkway.	Solving congestion by increasing roadway capacity is like solving obesity by letting out your belt out. Air quality benefits will only occur if traffic capacity is managed.
Parking Management	(No plan)	No increase in commuter or commercial destination capacity.	CCLN plan complies with State and Federal Clean Air requirements. City Manager's plan does not.
Funding For Alternative Transportation Programs	Divert $148,000 from residential sticker program to services for commuters. Raise the rest through taxes.	Raise $12.5 million from commuter parking fee of $1/day. (See Paratransit)	City Manager's plan doesn't begin to fund itself. CCLN plan is self funding, with substantial benefits for residents, and for those employers and employees that avail themselves of paratransit. CCLN's plan has no additional tax burden.
Paratransit System (A Paratransit System Is A Secondary, Supplemental Transit System Keyed To The Primary Transit System)	(No plan)	Fleet of 50 vans running in all neighborhoods, and coordinated to MBTA schedules. Fleet of 10 express buses from suburban locations for Cambridge employees. Businesses can have paratransit route stops at their locations as part of their Trip Reduction Plan.	CCLN's plan provides the first real alternative to single passenger vehicles. This component of CCLN's plan makes serious trip reduction feasible in a way that no other proposal does, and at no additional expense to the City or its citizens.
MBTA Cooperation	Request MBTA to relocate bus stops, offer fringe parking, increase bus routes, and improve signage.	City staff monitor MBTA performance and publicize Cable channel to carry schedule and transit info. Signs with schedules for MBTA and paratransit at all stops. Additional MBTA routes. New MBTA Alewife Garage to be built on east side of Alewife Brook Parkway.	City Manager's plan relies solely on the MBTA to take responsibility. CCLN's plan requires the City to take additional responsibility
Taxicab Improvements	(No plan)	Increase in taxi stands. Role in paratransit system.	CCLN plan recognizes the contribution that the taxicab industry can make to a complete solution.
Traffic Policy	(No plan)	Classification of streets to enhance and maintain residential character. No traffic growth in residential areas. Manage major streets to prevent spill over to residential neighborhoods.	CCLN's plan protects residential neighborhoods as a matter of policy.

Cambridge Citizens for Liveable Neighborhoods Inc

MEMORANDUM

Thursday, March 26, 1992

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SIMILAR

Topic	Proposals of the City Manager	Proposals of CCLN	Comments
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Comparative Estimates:
Reduction in Vehicle Miles Traveled
Resulting from Regulation of Currently Unregulated
On-Street Parking

Cambridge Systematics Scenario #1 (May 1991):

4,700 unregulated spaces	assumption
4,700 (100%) used by commuters	assumption
4,700 (100%) auto trips foregone due to regulation	assumption
18.7 miles round trip average	no source given

4,700 × 18.7 = 88,000 reduction in daily VMT

Cambridge Systematics Scenario #2 (March 1992):

4,700 unregulated spaces	assumption
2,820 (60%) used by commuters	assumption
1,880 (66⅔%) auto trips foregone due to regulation	assumption
18.7 miles round trip average	no source given

1,880 × 18.7 = 35,000 reduction in daily VMT

C. Bahne Estimate for CCLN (April 1992):

4,267 unregulated spaces	city inventory
1,500 used by commuters	estimate based on actual location of unregulated spaces according to city inventory
750 (50%) auto trips foregone due to regulation	assumption (may be overly generous)
12.7 miles round trip average	Cambridge Systematics report, Technical Appendix 3.2
20% adjustment for park and ride (60% of foregone trips become park-and-ride; these commuters still drive ⅓ of former distance)	assumption

750 × 12.7 = 9,500, less 20% = 7,600 reduction in daily VMT

This more realistic estimate is 8.6% of Cambridge Systematics' original estimate (Scenario #1) and 21.7% of their second estimate (Scenario #2).

Comparative Estimates:
Reduction in Vehicle Miles Traveled
Resulting from Regulation of Currently Unregulated
On-Street Parking

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18.7 miles round trip average	no source given

1,880 × 18.7 = 35,000 reduction in daily VMT

C. Bahne Estimate for CCLN (April 1992):

4,267 unregulated spaces	city inventory
1,500 used by commuters	estimate based on actual location of unregulated spaces according to city inventory
750 (50%) auto trips foregone due to regulation	assumption (may be overly generous)
12.7 miles round trip average	Cambridge Systematics report, Technical Appendix 3.2
20% adjustment for park and ride (60% of foregone trips become park-and-ride; these commuters still drive ⅓ of former distance)	assumption

750 × 12.7 = 9,500, less 20% = 7,600 reduction in daily VMT

This more realistic estimate is 8.6% of Cambridge Systematics' original estimate (Scenario #1) and 21.7% of their second estimate (Scenario #2).

PROPOSED
03/20/92

AN ORDINANCE

In amendment to an Ordinance designated as the "Cambridge Municipal Code."

WHEREAS, the City of Cambridge ("City") and the Massachusetts Department of Environmental Protection ("DEP") have agreed to cooperate in an effort to amend the State Implementation Plan under the Clean Air Act, 42 U.S.C. § 7401, et seq., as amended, regarding the measures to be taken by the City toward attainment and maintenance of the National Primary Ambient Air Quality Standards necessary to protect public health in the Boston Metropolitan Region; and

WHEREAS, the City and DEP were parties in a legal dispute pertaining to the terms and implementation of a parking freeze in Cambridge; and

WHEREAS, the City, as part of a settlement of said dispute, passed Ordinance No. 1112 on November 26, 1990 (the "Interim Ordinance"); and

WHEREAS, the Interim Ordinance requires the City Manager to present to the City Council an Ordinance to implement a proposed amendment of the State Implementation Plan that includes a program of transportation control measures directed toward attainment and maintenance of the National Primary Ambient Air Quality Standards to protect public health in the Boston Metropolitan Region; and

WHEREAS, the 1990 Clean Air Act Amendments specifically prohibit states and localities from implementing transportation control measures which will relocate traffic from one city or one area of a region to another; and

WHEREAS, the elements of this Vehicle Trip Reduction Ordinance are consistent with the policies of the City, the Interim Ordinance, and the federal Clean Air Act to reduce vehicle miles travelled and encourage and develop greater use of public transit, bicycles, walking, and other alternative modes of travel; and

WHEREAS, implementation of this Vehicle Trip Reduction Ordinance will demonstrate the commitment of the City to promote the objective of the Clean Air Act by discouraging automobile traffic within and to the City; and

WHEREAS, enforcement of this Ordinance will achieve a reduction in vehicle miles travelled and promote attainment and maintenance of the National Primary Ambient Air Quality Standards for protection of public health in the Boston Metropolitan Region; and

WHEREAS, the City has authority to enact the provisions of this Ordinance pursuant to G.L. Chapter 111, § 31C, as well as by authority derived from the City's general police power.

NOW, THEREFORE, be it ordained by the City Council of the City of Cambridge as follows:

Title 10 of the Code (Vehicles and Traffic), Chapter 10.16 (Parking Freeze) is hereby superseded and replaced by the following new Chapter 10.16:

Chapter 10.16

Vehicle Trip Reduction Ordinance

Sections:

10.16.010 Time Period of Chapter
10.16.020 Findings
10.16.030 Definitions
10.16.040 General Mobility-Based Measures
10.16.050 Parking Supply-Based Measures
10.16.060 City Of Cambridge-Based Measures
10.16.070 Residential-Based Measures
10.16.080 Employer-Based Measures
10.16.090 New Development-Based Measures
10.16.100 Study of Zoning Revisions
10.16.110 Clean Fuels-Based Measures
10.16.120 Use of Fees
10.16.130 Sunset Clause
10.16.140 Certification of Implementation
10.16.150 Non-Severability

Section 10.16.010 - Time Period of Chapter. This Chapter shall take effect sixty (60) days after final approval by the City Council.

Section 10.16.020 - Findings. The City of Cambridge finds and determines that:

a. High levels of vehicle traffic and congestion add to air pollution, noise, and inconvenience and erode the quality of the living and working environment.

b. An increasing number of automobile registrations and jobs in the City has resulted in growth of traffic in and around Cambridge.

c. While the City has pursued programs to mitigate these conditions, new measures are required involving the participation of all sectors of the community to make more efficient use of mass transit, bicycling, walking, and other alternatives to trips by single-occupancy vehicles.

d. Increasing the use of commuting alternatives and reducing the number of trips by single-occupancy vehicles is beneficial in reducing vehicle miles travelled, traffic and associated air pollution, fuel use, noise, and congestion.

e. Programs offered through employers, institutions, owners of multiple-tenant buildings and complexes and other organizations to encourage the use of mass transit, bicycling, walking, and other alternatives to commuting by single-occupancy vehicles are effective and should be expanded.

f. The approach best suited to accommodate the diverse needs and capabilities of the governmental, business and institutional communities in the City is a flexible approach

which establishes performance goals and permits government and private employers, institutions, and automobile owners to select from among a variety of measures designed to contribute toward reaching the goals.

g. The vehicle trip reduction program contained in this Ordinance should give credit to those employers which have already made substantial progress in encouraging the use of mass transit, bicycling, walking, and alternative means of commuting and in providing such alternatives.

h. Measures to discourage, and provide alternatives to, vehicle trips and trips by single-occupancy vehicles made by residents of and visitors to Cambridge are also necessary to further the City's goals.

i. A large portion of vehicle traffic on Cambridge streets is attributable to trips that neither originate nor end in Cambridge ("throughtrips"). The City of Cambridge has virtually no control over these throughtrips.

j. Throughtrips and other traffic in the Metropolitan Boston Intrastate Air Quality Control Region (the "Region") over which Cambridge has no control contribute significantly to the degradation of air quality in the Region. The degradation of air quality, particularly ozone, is a regional problem which requires global and regional solutions.

k. The Clean Air Act Amendments of 1990 call for the attainment of compliance with the National Ambient Air Quality Standard for Ozone within the Commonwealth and the Region by 1999.

l. Attainment of the Ozone Standard will require increased control of vehicle-related air pollution ("transportation control measures") throughout the Commonwealth and the Region, as well as the Nation.

m. This Ordinance will operate as an interim measure in Cambridge to promote the attainment of air quality objectives until November 1996, by which time the U.S. Environmental Protection Agency should have approved, pursuant to the 1990 Clean Air Act Amendments, a State Implementation Plan for Massachusetts containing transportation control measures of regional applicability.

Section 10.16.030 - Definitions

a. Affected Employer shall mean an employer of fifty (50) or more people at a Worksite located within the City of Cambridge.

b. Annual Employer Survey Response shall consist of (i) a completed, signed, and certified Automobile Efficiency Rate calculation sheet; (ii) payment of the applicable Processing Fee; and (iii) a Vehicle Trip Reduction Plan when required from an Affected Employer pursuant to Section 10.16.080.c and d.

c. Automobile Efficiency Rate ("AER") shall mean the figure calculated by dividing the number of employees who report to a Worksite within the City of Cambridge between 6:00 a.m. and 10:00 a.m. (inclusive Monday through Friday to achieve a five consecutive weekday average) by the number of vehicles used by those employees to reach the Worksite during those hours. Bicycles, public transit vehicles, and approved Clean-Fuel Vehicles shall be excluded from the vehicles counted. Motorcycles and light trucks shall be included in the vehicles counted.

d. Base AER for the City of Cambridge shall be derived from the 1990 census modal share data and travel statistics. The Base AER is subject to recalculation as provided in Section 10.16.080.c.

e. Carpool shall mean a private motor vehicle occupied by two to six employees travelling together for at least 75% of their commute trip distances.

f. City shall mean the City of Cambridge, Massachusetts.

g. Citywide AER Goal shall mean as to the first Annual Employer Survey Response, the Base AER plus 2.5 percent. Thereafter, it shall mean the Citywide AER Goal established pursuant to Section 10.16.080.c, which provides for an annual improvement of 2.5% in the Citywide AER until the earlier of the

attainment of the Ozone Standard within the Region or the expiration of this Chapter by its own terms pursuant to Section 10.16.130.

h. Clean Fuel shall mean any fuel or power source used in a vehicle that complies with the applicable standards for clean fuel vehicles contained in Sections 241-245 of the Clean Air Act, 42 U.S.C. §§ 7581-7585.

i. Clean-Fuel Vehicle shall mean a vehicle in a class or category of vehicles which has been certified to meet the applicable clean-fuel vehicle standards as defined by and pursuant to the federal Clean Air Act Amendments of 1990.

j. Commute Alternatives shall mean carpooling, vanpooling, use of public transit, bicycling and/or walking.

k. Employee shall mean any person hired by a public or private employer, including part-time and seasonal employees, who reports to work at least two (2) days a week during five (5) or more months of the year.

l. Fleet shall mean ten (10) or more vehicles which are (i) owned, leased, controlled or operated by a single person or entity; or (ii) parked at the same location, excluding vehicles held for lease or rental to the general public, vehicles held for sale by dealers, vehicles used for law enforcement or emergency purposes.

m. New Development shall mean any proposed or planned construction for which building permits have not been issued by the Cambridge Building Department as of the effective date of this Chapter and involving construction of (i) 50,000 square feet or more regardless of use or (ii) 50 or more residential units.

n. Ozone Standard shall mean the National Ambient Air Quality Standard for ozone established pursuant to Section 109 of the Clean Air Act, 42 U.S.C. § 7409.

o. Processing Fee shall mean the fee required to be paid to the City annually in connection with the Annual Employer Survey Response pursuant to Section 10.16.080.c, in the following amounts:

For Employers Of	Fee
50-99 employees	$100
100-499 employees	300
Over 500 employees	500

p. Region shall mean the Metropolitan Boston Intrastate Air Quality Control Region as defined at 40 C.F.R. § 81.19.

q. Throughtrips shall mean vehicle traffic on City of Cambridge streets attributable to trips that neither originate nor end in the City of Cambridge.

r. Transportation Control Measures are transportation control strategies aimed at reducing transportation-related emissions of pollutants and controlling the growth of future vehicle trips and vehicle miles travelled.

s. Transportation Management Plan shall mean the plan required under Section 10.16.090 for analyzing and reducing vehicle traffic associated with New Development.

t. VMT is an abbreviation for vehicle miles travelled.

u. Vehicle Trip Reduction Plan ("VTR Plan") shall mean a plan prepared by an Affected Employer and submitted to the City pursuant to Sections 10.16.080.c-d which describes the Affected Employer's program of measures intended to reduce vehicle trips and achieve the Citywide AER Goal at the Affected Employer's Worksite.

v. Worksite shall mean a building or grouping of buildings which are located within the City of Cambridge and are on physically contiguous parcels of land or on parcels separated solely by private or public roadways or rights-of-ways and which are owned, operated, or leased by the same Affected Employer.

Section 10.16.040 - General Mobility-Based Measures

a. **Expanded Commuter Mobility Program.** The Assistant City Manager for Community Development, in consultation with the City Manager, shall have authority to hire additional staff to implement the tasks and programs specified in this Chapter. In addition to continuing activities currently in progress, the Commuter Mobility Coordinator shall develop a schedule for implementing such additional programs as:

* a program to encourage commercial and retail businesses to offer discounts to patrons with MBTA transit passes;

* a residential trip reduction program for apartment and condominium complexes of 50 or more units;

* a bicycle commuter program, in conjunction with the Cambridge Traffic and Parking Department, involving consultation with Cambridge residents and businesses;

* a program to assist employers in establishing bicycle commuting incentives; and

* a feasibility study of the potential use of jitney services or shuttles to transit locations, areas of major employment, and major commercial/retail destinations.

b. **Bicycle Incentive Program.** The position of Bicycle Coordinator is created within the Cambridge Traffic and Parking Department. The City Manager shall, within one month of the effective date of this Ordinance, designate the Bicycle Coordinator. The Bicycle Coordinator shall devote at least 50% of his/her time to carrying out the tasks required by this provision. The Bicycle Coordinator shall, in conjunction with the Commuter Mobility Coordinator, design and implement a program to encourage greater use of bicycles as alternatives to single-occupancy vehicles within the City. The program will include, but is not limited to:

* development of a Cambridge Bicycle Master Plan;

* creation of a Bicycle Advisory Committee;

* development and evaluation of recommendations for a regional network of bicycle paths and bicycle priority streets favoring bicycles and pedestrians;

* consultation with Cambridge residents and businesses;

* funding of bicycle amenities and storage facilities; and

* provision of bicycles for use by police and Traffic and Parking Department staff.

The program shall be funded at an initial level of $25,000 annually; these funds shall be in addition to, and not utilized for, the salary of the Bicycle Coordinator.

Section 10.16.050 - Parking Supply-Based Measures

a. **Expansion of Parking Regulation.** Within six (6) months of the effective date of this Ordinance, the Traffic and Parking Department shall prepare a written inventory of all unregulated on-street parking in the City and submit to the City Manager a written draft recommendation specifying appropriate restrictions to discourage the use of these spaces for long-term commuter parking. These restrictions may include, without limitation, the installation of parking meters, time restrictions, and/or the use of residential permits to restrict long-term parking to residents. The City Manager shall make the draft recommendations available for public review and shall schedule one or more public meetings, as appropriate, for public discussion of the draft recommendations. Within one month of the public meetings, the Traffic and Parking Department shall submit a final recommendation to the City Manager. The City Manager shall promptly review the recommendation, revise it as appropriate, and direct the Parking and Traffic Department to implement it within three months.

b. **Municipal Parking Rates.** The rates for daily and monthly parking at all City-owned off-street parking facilities shall be increased by twenty-five percent (25%) over current rates, to be effective within sixty (60) days of the effective date of this Ordinance.

Section 10.16.060 - City of Cambridge-Based Measures.

The Citywide visitor passes that have been distributed to authorized individuals will be invalid thirty (30) days after the effective date of this Ordinance. The Cambridge Traffic and Parking Department is authorized to issue stickers to individuals who would be authorized to receive a Citywide visitor pass. In order to be effective, a sticker must be affixed to a vehicle and must display the vehicle registration number and an expiration date.

Section 10.16.070 - Residential-Based Measures

a. **Residential Parking Zones.** Four (4) residential parking zones are hereby established as follows:

* Zone 1: Cambridge-Somerville border to north, Cambridge-Arlington-Belmont border to west, Concord Avenue to south, Kirkland Street to east (this zone includes the Cambridge Common);

* Zone 2: Concord Avenue to north to Garden Street along Cambridge Common, JFK Boulevard to east, Charles River/Watertown-Belmont border to south and west;

* Zone 3: Massachusetts Avenue to north; JFK Boulevard to west, Charles River to south and east;

* Zone 4: Massachusetts Avenue to south, Kirkland Street to west, Somerville-Charlestown-Cambridge border to north; Charles River to east.

Residents will be permitted to purchase residential parking stickers which will authorize parking (1) within the designated zone from midnight on Sunday to 7 p.m. on Friday and (2) within any zone at all other times.

The Traffic and Parking Department is directed within six (6) months of the effective date of this Ordinance to modify current signage as necessary to clearly identify each residential parking zone. Beginning immediately thereafter, zoned stickers will be issued at the first annual renewal date for current residential sticker holders and to all new qualified applicants for residential parking. The signs shall clearly demarcate a buffer zone on both sides of each street designated as a zone boundary, which will run the full length of the zone boundary, in order to allow parking by residents of both abutting zones in the buffer zone.

Fines and penalties for parking in unauthorized zones shall be consistent with current parking violation policies.

b. **Fees For Residential Parking Stickers.** The fees for residential parking stickers shall be as follows:

1st Sticker per Household	$ 8.00
2nd Sticker per Household	$ 12.00
3rd Sticker per Household	$ 50.00
4th Sticker per Household	$100.00
5th and additional Stickers per Household	$200.00

For the purpose of this measure, all vehicles registered at the same residential address shall constitute the vehicles registered to a household. Reductions and waivers available under current law to elderly and handicapped residents shall remain in effect.

Section 10.16.080 - Employer-Based Measures

a. **Regional Vehicle Trip Reduction Program.** In order to ensure that the employer-based vehicle trip reduction measures mandated by this Ordinance achieve their intended effect of reducing vehicle miles travelled in the Region and enhancing air quality, the City shall include in its submittal to the Metropolitan Planning Organization ("MPO") recommendations for region-wide amendments to the State Implementation Plan under the federal Clean Air Act and revisions of state taxing policies directed at a minimum toward (1) preventing the diversion of traffic oriented toward Cambridge to other areas with more limited transit availability, (2) assuring that Cambridge is not placed at a competitive disadvantage within the Region, and (3) reducing the growth in volume of throughtrips on Cambridge roadways which is outside the control of the City.

b. **Expansion Of Local Employment Opportunities.** To demonstrate and further its commitment to increase the number of Cambridge residents employed by Cambridge businesses, the annual budget for expansion of local employment opportunities shall be increased to $130,000. That budget shall be applied as follows:

1. To continue and expand the Cambridge Employment Program within the Community Development Department;
2. To sponsor an annual job fair to inform residents of local employment opportunities;
3. To sponsor and coordinate educational partnerships between Cambridge employees and schools in Cambridge; and
4. To develop a Local Employment Opportunity Plan.

These functions shall be coordinated and carried out by the Community Development Department in conjunction with the Department of Human Services and under the supervision of the Assistant City Manager for Community Development. The Local Employment Opportunity Plan shall be developed within one year of enactment of this Chapter.

c. **Annual Survey of Employee Commuting Characteristics.** The City shall develop an Employer Survey Kit which will include an Employee Survey Form, administration plan, and Automobile Efficiency Rate ("AER") calculation sheet, designed to elicit commuting data and actual AER from all Affected Employers. The Employer Survey Kit shall be prepared and distributed to Affected Employers within six (6) months of the effective date of this Ordinance and on an annual basis thereafter. Each Affected Employer shall distribute copies of the standard Employee Survey Form to and collect completed forms from a minimum of seventy-five percent (75%) of its employees.

Each Affected Employer shall no later than six (6) months from the date the Employer Survey Kit is distributed to the Affected Employer and on an annual basis thereafter submit to the Assistant City Manager for Community Development an Annual Employer Survey Response, consisting of:

1. a report of the results of the employee survey on a standard AER calculation sheet, signed and certified as to its accuracy;
2. payment of the applicable Processing Fee (as set forth at Section 10.16.030); and
3. where required by paragraph d below, a completed, signed, and certified VTR Plan.

Copies of the completed Employee Survey Forms, AER calculation sheets, and VTR Plans shall be retained by Affected Employers for a minimum of three (3) years and shall be made available to the Assistant City Manager for Community Development or his designee, upon request. The Assistant City Manager for Community Development or his designee may direct an Affected Employer to use an independent third party to perform or certify the Annual Employee Survey Response.

Failure timely to submit a completed and certified Annual Employer Survey Response or to pay the applicable Processing Fee will be subject to a fine of Two Hundred Dollars ($200). Each day, beyond the due date, that an Affected Employer fails to submit the Response or Processing Fee shall be deemed a separate

violation of this section, subject to an additional fine of Two Hundred Dollars ($200). Knowingly reporting false data shall be punishable by a fine of up to Three Hundred Dollars ($300). Each day that an Affected Employer fails to submit a certified Response correcting such a knowingly false submission shall be deemed a separate violation of this section subject to an additional fine of up to Three Hundred Dollars ($300). Responsibility for collection and review of Annual Employer Survey Responses and levying fines shall be with the Assistant City Manager for Community Development or his designee.

The Assistant City Manager for Community Development shall make arrangements with the Commuter Mobility Coordinator to coordinate: (i) preparation and distribution of the Employer Survey Kits; (ii) calculation of the Base AER; (iii) review and tabulation of the Annual Employer Survey Responses; (iv) recalculation of the Base AER based on review and analysis of the first Annual Employer Survey Responses; and (v) establishment of the Citywide AER Goal for subsequent years, provided, however, that the Goal shall provide for an annual improvement in the Citywide AER Goal of at least 2.5% until the earlier of attainment of the Ozone Standard within the Region or the expiration of this Chapter by its own terms pursuant to Section 10.16.130. The Assistant City Manager for Community Development is authorized to engage technical consultants to assist with these tasks.

d. **Employer-Based Vehicle Trip Reduction Plans.** The VTR Plan component of the Annual Employer Survey Response shall describe the Affected Employer's program of measures intended to reduce vehicle trips and achieve the applicable Citywide AER Goal at the Affected Employer's Worksite(s). The extent and nature of the VTR Plan will depend on the difference between the Citywide AER Goal and the Affected Employer's actual AER, as computed on the annual AER calculation sheets, for a given year. The VTR Plan must be signed by a representative of the Affected Employer who is authorized to approve the expenditures necessary to implement the VTR Plan and who certifies that the VTR Plan will be implemented as written. An Affected Employer whose actual AER meets or exceeds the Citywide AER Goal shall not be required to submit a VTR Plan for that year.

A VTR Plan may include a variety of measures, including, but not limited to:

* dissemination and periodic updating of information on all available transit service to and from the Worksite;

* advertising, promoting and making available for purchase on the Worksite any pass program offered by transit authorities;

* incentives and assistance for bicycle commuting including secure parking facilities, shower/changing facilities, and education and training programs;

* coordinating, facilitating and providing subsidies for employer-sponsored rideshare programs;

* preferential parking for carpools and vanpools;
* transportation allowances;
* expanding opportunities for alternative work schedules including 4-day weeks and flexible schedules to facilitate ridesharing;
* elimination or reduction of parking subsidies for single-occupant vehicles;
* shuttle service to transit stops; and/or
* elimination of employee parking spaces.

In developing these programs, affected employers may propose to implement certain measures jointly with other employers. The Commuter Mobility Coordinator shall be available to provide assistance to employers in developing VTR Plans.

The Assistant City Manager for Community Development or his designee may reject any VTR Plan that is inadequate to demonstrate a good faith effort by an Affected Employer to achieve the Citywide AER Goal at the Worksite. The Assistant City Manager for Community Development or his designee shall notify the Affected Employer in writing of the rejection. The Affected Employer shall have thirty (30) days in which to revise and resubmit the VTR Plan before a penalty will be assessed. An Affected Employer may appeal the rejection of a VTR Plan following the procedures in paragraph e of this Section.

Failure of an Affected Employer to implement any part of a submitted VTR Plan shall result in a penalty of Three Hundred Dollars ($300). Each day that an Affected Employer fails to implement any part of a submitted VTR Plan shall be deemed a

separate violation of this section subject to an additional penalty of Three Hundred Dollars ($300). Enforcement of this section shall be the responsibility of the Assistant City Manager for Community Development or his designee.

e. **Appeals**. An Affected Employer whose VTR Plan has been rejected shall have the right to appeal. Such appeal shall be presented to the Appeals Committee, a body to be appointed by the City Manager. The Appeals Committee shall be comprised of: (i) the Assistant City Manager for Community Development or his designee; (ii) two representatives of the City's residential population; (iii) one representative of an employer of 50-99 employees; and (iv) one representative of an employer of more than 200 employees. The decision of the Appeals Committee regarding appropriate revisions to the subject VTR Plan shall be final and binding. The Appeals Committee shall, in every case, determine whether the appeal is frivolous. In the event the Committee determines an appeal to have been frivolous, the Assistant City Manager for Community Development shall levy a penalty of Three Hundred Dollars ($300). Upon such a determination by the Appeals Committee that an Employer's appeal is frivolous, each day that the VTR Plan was on appeal and each day until an acceptable VTR Plan is submitted shall be deemed a separate violation of this section subject to an additional penalty of Three Hundred Dollars ($300).

Section 10.16.090 - New Development-Based Measures

a. This section shall apply to all New Development, as that term is defined in Section 10.16.030, except as provided in paragraph d below. The Cambridge Building Department shall not issue a building permit for New Development without evidence that the Assistant City Manager for Community Development (or his designee) has approved in writing a Transportation Management Plan for such New Development. To qualify for approval from the Assistant City Manager for Community Development (or his designee), a Transportation Management Plan for New Development must include:

1. A processing fee of $1500; and
2. A traffic analysis that demonstrates that (i) for affected locations with existing traffic level of service ("LOS") of D or worse, reasonable traffic mitigation measures will be implemented to improve traffic operations to the extent feasible, and (ii) for affected locations with existing LOS of C or better, the project will not degrade such location below a LOS of C.

b. In addition to the requirements of paragraph a, to qualify for approval, a Traffic Management Plan for New Development consisting wholly or partially of commercial, industrial, or retail uses must also include the following four components:

1. A description of development design elements and vehicle trip reduction measures to be implemented by the developer in order to assist non-residential tenants in the development, collectively, to achieve the Citywide AER Goal. Measures to be considered for inclusion in the Transportation Management Plan include without limitation the following:

   - Hiring a Transportation Management Coordinator, responsible for distribution of information and coordination of traffic management programs within the new development.
   - Discouraging or restricting use of parking spaces by commuters in single-occupant vehicles.
   - Funding a local or area-wide shuttle van to public transit stations and/or shopping centers.
   - Encouragement of staggered or flexible work hours for employees of all tenants.
   - Promotion of the use of public transportation by providing transit information and participation in the MBTA commuter pass program.
   - Operation of a computer-based ridesharing information bank or coordination of ridesharing promotional programs with the City's Commuter Mobility Coordinator.
   - Reserving spaces at preferential locations for carpool and vanpool parking on the site.
   - Establishing reduced parking fees or providing subsidies for carpool and vanpool parking.
   - Encouragement of employment opportunities for Cambridge residents by tenants of the new development.
   - Providing safe, convenient, sheltered bicycle storage facilities and/or changing or shower facilities for bicycle commuters.

2. A monitoring program to demonstrate on an annual basis compliance with the Transportation Management Plan and to calculate the annual AER associated with non-residential tenants of the New Development. The monitoring program must account for all non-resident site-generated traffic between the hours of 6:00 a.m. and 10:00 a.m. Where tenants include employers of 50 or more employees at the Worksite, the monitoring program may utilize data from a tenant's certified Annual Employer Survey Response.

3. A commitment to update and supplement the Transportation Management Plan if, based on the monitoring program, it is determined that the non-residential tenants of the development, collectively, are not achieving the Citywide AER Goal.

4. A commitment to maintain future compliance with the Transportation Management Plan requirements following transfer of the New Development from the developer to other parties.

c. On an annual basis after receiving approval of a Transportation Management Plan, the developer, subsequent owner or property manager of the New Development covered by such Plan, shall submit to the Assistant City Manager for Community

Development or his designee an annual certification of plan compliance, which shall include information and data collected by the monitoring program pursuant to paragraph b.2.

d. The requirements of this Section shall not apply to any development which has already been issued building permits from the City of Cambridge or which is subject to a City-approved traffic mitigation or trip management plan as of the effective date of this Chapter.

e. The requirements of this Section do not exempt any person or any Affected Employer from compliance with other provisions of this Chapter.

f. Failure to implement an approved Transportation Management Plan or failure to submit the annual compliance certification required under paragraph c of this Section shall subject the developer, subsequent owner, or property management firm, whichever owns or operates the New Development, to a fine of Three Hundred Dollars ($300). Each day that the owner or operator of a New Development fails to implement the approved Transportation Management Plan or to submit the annual compliance certification shall be deemed a separate violation of this section subject to an additional fine of Three Hundred Dollars ($300). The Assistant City Manager for Community Development or his designee shall be responsible for enforcing this Section and levying applicable fines.

Section 10.16.100 - Study Of Zoning Revisions

The Cambridge Planning Board (the "Board") shall consider revising the required parking space ratios specified in the City of Cambridge Zoning Ordinance and shall evaluate the effectiveness of such revisions in reducing VMT and traffic congestion and encouraging the increased use of Commute Alternatives. Consideration shall be given, without limitation, to such potential revisions as reduction of minimum and maximum parking requirements, special provisions for carpools and vanpools, and encouragement of mixed-use developments.

The Board shall publicly report its recommendations within one year of the effective date of this Ordinance.

Section 10.16.110 - Clean Fuels-Based Measures

The Department of Public Works shall commission a study of the means available to promote, encourage, and provide incentives for the use of Clean Fuel in fleets of vehicles operating within the City. The study shall include an evaluation of the use of such fuels as methanol, compressed natural gas, and reformulated gasoline based on characteristics of fleets in Cambridge and implementation costs. The study shall also identify reasonably available incentives which could be offered by the City, such as tax credits, to encourage use of Clean Fuel in fleets of vehicles. The sum of $15,000 shall be appropriated for this study. The results of this study will be publicly reported within one year of the effective date of this Ordinance and will

be distributed to all owners and operators of vehicle fleets in the City. The results of the study shall promptly be made available to members of the public upon request.

10.16.120 - Use of Fees

The fees paid to the City pursuant to Sections 10.16.070, .080, and .090 shall be used as follows:

a. One hundred percent (100%) of the processing fees collected by the City in connection with (i) review of the Annual Employer Survey Response as set forth in Section 10.16.080 and (ii) review of Transportation Management Plans for New Development as set forth in Section 10.16.090, and fifty percent (50%) of the funds raised through the sale of residential parking stickers under Section 10.16.070(b), will be dedicated to the continuation and expansion of the Commuter Mobility Program within the Community Development Department and shall be used for implementing the tasks and programs specified in this Chapter.

b. Fifty percent (50%) of the funds raised through the sale of residential parking stickers under Section 10.16.070(b) shall be used by the Traffic and Parking Department for enforcement and other activities required of it pursuant to this Chapter.

Section 10.16.130 - Sunset Clause

The provisions of this Chapter shall cease to be effective on November 15, 1996 if as of that date (a) the Commonwealth of Massachusetts has failed to submit to the U.S. Environmental

Protection Agency ("EPA") a proposed revision of its State Implementation Plan pursuant to Section 182(b)(1) of the Clean Air Act, 42 U.S.C. § 7511a(b)(1), to provide for reductions in emissions of volatile organic compounds to be achieved in part by means of transportation control measures applicable throughout the Region; or (b) the EPA has either rejected or failed to approve such regional transportation control measures proposed by the Commonwealth to achieve a reduction in volatile organic compound emissions.

Section 10.16.140 - Certification of Implementation

The City shall, on or before May 15, 1996, submit to the Department of Environmental Protection a statement certifying that the City is implementing the terms of this Chapter. If this Chapter has ceased to be effective pursuant to Section 10.16.130, the City shall not be required to submit a certification to the Department of Environmental Protection.

Section 10.16.150 - Non-Severability

If any provision of this Chapter is held invalid, the entire Chapter shall cease to be effective and shall be repealed by the City Council.

CITY OF CAMBRIDGE
CAMBRIDGE, MASSACHUSETTS 02139
TEL. 349-4300
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EXECUTIVE DEPARTMENT
ROBERT W. HEALY
City Manager

RICHARD C. ROSSI
Deputy City Manager

March 20, 1992

To: The Honorable City Council

From: Robert W. Healy, City Manager

Re: Proposed Cambridge Vehicle Trip Reduction Ordinance and SIP Amendment

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Executive Summary:

This memorandum describes the program of transportation control measures contained in the proposed Cambridge Vehicle Trip Reduction Ordinance ("Ordinance"). It also describes the objective, impacts, and schedule for implementation of the proposed Ordinance. Finally, this memorandum contains the elements of a proposal for an amendment of the State Implementation Plan. The proposed Ordinance and this memorandum are supported by the attached Technical Appendix prepared by Cambridge Systematics, Inc.

The objective of the City of Cambridge (the "City") in proposing the Ordinance and proposing an amendment to the State Implementation Plan ("SIP") as described herein is to promote the attainment and maintenance of national ambient air quality standards for protection of human health in the Metropolitan Boston Intrastate Air Quality Control Region (the "Region"). The proposed Ordinance and SIP amendment will accomplish that objective by reducing the number of vehicle trips currently travelled to and within the City and reducing the air emissions associated therewith. The program will also constrain future growth of vehicle trips and associated air emissions. While the City currently has a full-time, City-funded Commuter Mobility Coordinator and program for facilitating and coordinating voluntary measures by employers, more systematic and comprehensive measures involving all segments of the City's government, business, institutional and residential populations would advance this effort.

Specifically, the proposed Ordinance would reduce the vehicle miles travelled ("VMT") in connection with existing jobs in the City, restrict parking which is currently unregulated, discourage cross-town trips during the work week, facilitate opportunities

for residents to find jobs in the City, expand the Commuter Mobility Program, and create a Bicycle Mobility Program. Together, these measures are expected to eliminate between 104,500-170,500 daily VMT. This translates into a reduction of approximately 3 to 5% of Cambridge-based daily VMT. This is a significant achievement in view of the data which indicates an annual growth in VMT of 3% in the Region.

In addition to the reductions of existing VMT quantified above, the Ordinance also contains measures to constrain future growth in VMT associated with new development. Furthermore, the Ordinance would reward businesses and institutions which have already or henceforth achieve significant changes in commuter travel behaviors and encourage fleet owners to convert their fleets to cleaner fuels, thereby encouraging and promoting further improvements in regional air quality.

The scientific literature and data are clear: the degradation of air quality is a regional problem that requires global and regional solutions. This is particularly the case with ozone. Every community within a region must contribute to the solution. In the past, Congress directed the force of the Clean Air Act primarily toward the regulation of emissions of air pollutants from stationary sources. In the 1990 Amendments to the Clean Air Act, Congress is requiring increasingly strict controls on emissions from and the movement of automobiles.

Cambridge is committed to being a leader in this movement. Cambridge cannot, however, singlehandedly improve the Region's air quality. Notably, approximately 33% of all traffic on Cambridge streets is attributable to "throughtrips," trips that neither originate nor end in Cambridge. Cambridge has virtually no control over these trips. The program set forth in the Ordinance must therefore be supplemented, complemented and, in accordance with the amended Clean Air Act, replaced by a transportation control program of regional applicability.

Toward that end, the proposal for a SIP Amendment contained herein identifies regional measures necessary to supplement and complement the Citywide measures in the Ordinance. The City's Ordinance should be replaced by a comprehensive regional program of transportation control measures; otherwise, the City's Ordinance could put the City at a competitive disadvantage in the Region, cause an increase in the number of vehicle miles travelled in the surrounding cities and towns, and/or cause the relocation of businesses or institutions to other areas. Genzyme's choice to locate in Allston rather than in Cambridge is a concrete example of the need for a regional plan. Such a result contravenes the mandates of the Clean Air Act and results in no net gains for air quality. Therefore, this proposed Ordinance and SIP Amendment would operate as an interim transportation control plan until 1996 by which time the Commonwealth is expected to have adopted a comprehensive transportation control plan of regional applicability. This proposed Ordinance and SIP Amendment will be

more effective in promoting the air quality objectives of the 1990 Clean Air Act than and therefore would replace the commercial parking freeze regulation set forth at 40 C.F.R. 52.1135.

Recommended Revisions of State Policy and Programs:

If the state is serious about achieving the objectives set by the Clean Air Act, it cannot rely on transportation control measures alone. It must also change certain taxing and pricing policies. Specific recommendations for inclusion in a SIP and revision of state policy are as follows:

Tax Policy. Given that many transportation control measures depend upon changes (some radical) in driving behaviors, a key first step is to force drivers to recognize and bear the costs of their driving patterns. This can be accomplished in several ways through changes in tax policies. Depending upon the type of policy, the Commonwealth could assume direct responsibility for levying and collecting the tax or it could enact enabling legislation to allow individual municipalities to enact local taxes.

Taxes applied to automobile use are an effective demand management tool which can encourage drivers to switch to alternative modes of travel while at the same time raising new revenues to support these alternative modes. Some approaches to be considered include:

- Increase in the gasoline tax.
- Changes in tax policy to eliminate the favored treatment accorded to subsidies of employee single occupant vehicle parking and to favor increased employer subsidies of other, cleaner travel modes. This could include treating a parking subsidy as income and treating financial incentives for alternative travel modes as a deductible business expense and/or as non-reportable income.
- Provision of tax incentives to encourage conversion of vehicles (fleets and otherwise) to cleaner fuels, such as accelerated depreciation.
- Adjustment of the sales tax applied to automobiles to favor the purchase of clean fuel vehicles and disfavor the purchase of gas guzzlers.

Clean Fuels. To demonstrate a genuine commitment to improvements in air quality, the state should commit to an immediate study of alternative (cleaner) fuels and implement a clean fuels program in connection with public fleets, including MBTA buses.

Improved Mass Transit. Critical to any attempt to shift drivers from their cars to public transit is an improved public transit system. Although Cambridge is currently served by local MBTA buses and the Red Line, review of commuting characteristics of employees in the City reveals that large numbers of commuters (particularly those who live to the west and north of Cambridge) do not have ready access to public transit which would bring them into Cambridge. Accordingly, specific recommendations for improvements to the public transit infrastructure serving Cambridge include:

- Circumferential Transit. This project would provide direct transit service connecting Cambridge to the Orange Line North and Green Line's Riverside Branch to the West. The large number of people commuting to Cambridge from the I-93 corridor and the Mass. Turnpike corridor would then have an excellent transit option to travel to Cambridge. Since construction of the Circumferential Transit Line is probably many years away, express bus service into Cambridge should be provided in the I-93 and Mass. Turnpike corridors in the interim (for example, a bus link between the Green Line at Riverside and points in Cambridge). Such service is currently provided into Boston.

- Express Buses and Other Local Service. The MBTA should rearrange local bus services, both within Cambridge and into Cambridge from nearby communities, to provide through service to Cambridge destinations without a transfer, for the largest number of users, wherever feasible.

- General Operational Improvements. The City and the MBTA should undertake cooperative efforts to actively promote bus ridership within and into the City - including, but not limited to:

  - installation of MBTA-endorsed or recognized bus stop signs

  - relocating bus stops to locations which will facilitate transfers between buses, or between buses and the subway (especially in Harvard and Porter Squares)

  - preferential treatment for buses on City streets, where feasible

  - changes where necessary in street patterns or curb cuts, including possible bus-only lanes, to facilitate bus access to transit stations (such as at Kendall Square)

- community workshops to receive input from transit users on potential bus route improvements and changes

- establishment of new or extended bus routes as necessary

- installation of bus shelters

° Relocated Lechmere Station. By relocating this facility to the north side of Msgr. O'Brien Highway, First Street can be extended to Msgr. O'Brien Highway and the roadway constraining columns supporting the existing Green Line can be eliminated. This will help ease traffic flow in the Lechmere Square area.

° Additional Transit Improvements. Additional transit improvements to facilitate increased transit usage in Cambridge and the Boston Metropolitan area include:

- proposed improvements at North Station Green Line to facilitate transfers between commuter rail and the Green Line to Lechmere

- additional local circumferential bus service

- extension of trackless trolley from Watertown to Newton Corner

- a bus to link North Station to Kendall Square/Kendall Square Station

Fringe Parking. In addition to improving the public transit system within and around Cambridge, it is also imperative that long-distance commuters have ample parking at the fringe of the public transit system. These facilities should be charging prices which encourage and favor high occupancy vehicle travel to and from the parking facility. In addition, fringe parking facilities served by public transit should provide ample, convenient, and safe storage for bicycles to encourage bicyclists to ride from home to the public transit system.

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Contribution of Mobile Sources to Regional Air Quality Problems:

Motor vehicles are the dominant source of several air pollutants which cause significant damage to the environment and human health. As shown in the attached figure, 54.3 percent of the volatile organic compounds (VOCs), 42.6 percent of the Oxides of Nitrogen (NOx), and between 66.1 percent (winter) and 75.8 (summer) percent of the Carbon Monoxide (CO) emitted into the atmosphere in Massachusetts in 1987 were produced by transportation sources. A large share of the total emissions of

these pollutants that are released in the State -- 23 percent of the VOCs, 14 percent of the NOx, and 21 to 22 percent of the CO -- are attributable to Middlesex County. The City of Cambridge, as one of Middlesex County's major centers of population and employment, is a significant generator of vehicle travel and, as a result, is a significant contributor of these pollutants.

Volatile organic compounds (VOCs) are compounds of carbon and hydrogen. VOCs are primarily unburned fuel which escapes through motor vehicle exhaust and fuel evaporation. Oxides of Nitrogen (NOx) represent a number of compounds produced during the combustion process. NOx is a pulmonary irritant and short exposures may increase susceptibility to acute respiratory diseases. NOx in combination with VOCs, through a reaction with sunlight, forms Ozone (O3). Because the chemical process of ozone formation is, in large part, dependent upon available sunlight, ambient ozone levels are highest during warm weather periods. Ozone forms naturally in the stratosphere and helps filter infrared rays of sunlight. However, in the atmosphere, ozone and related "photochemical oxidants," is referred to as "smog." Ozone is a strong pulmonary irritant which can affect lung functions. These effects are not limited to individuals with pre-existing respiratory problems, but also affect people in good health by producing measurable reductions in normal lung functions. Ozone also causes eye irritation, is toxic to plants, and damages non-living materials as well.

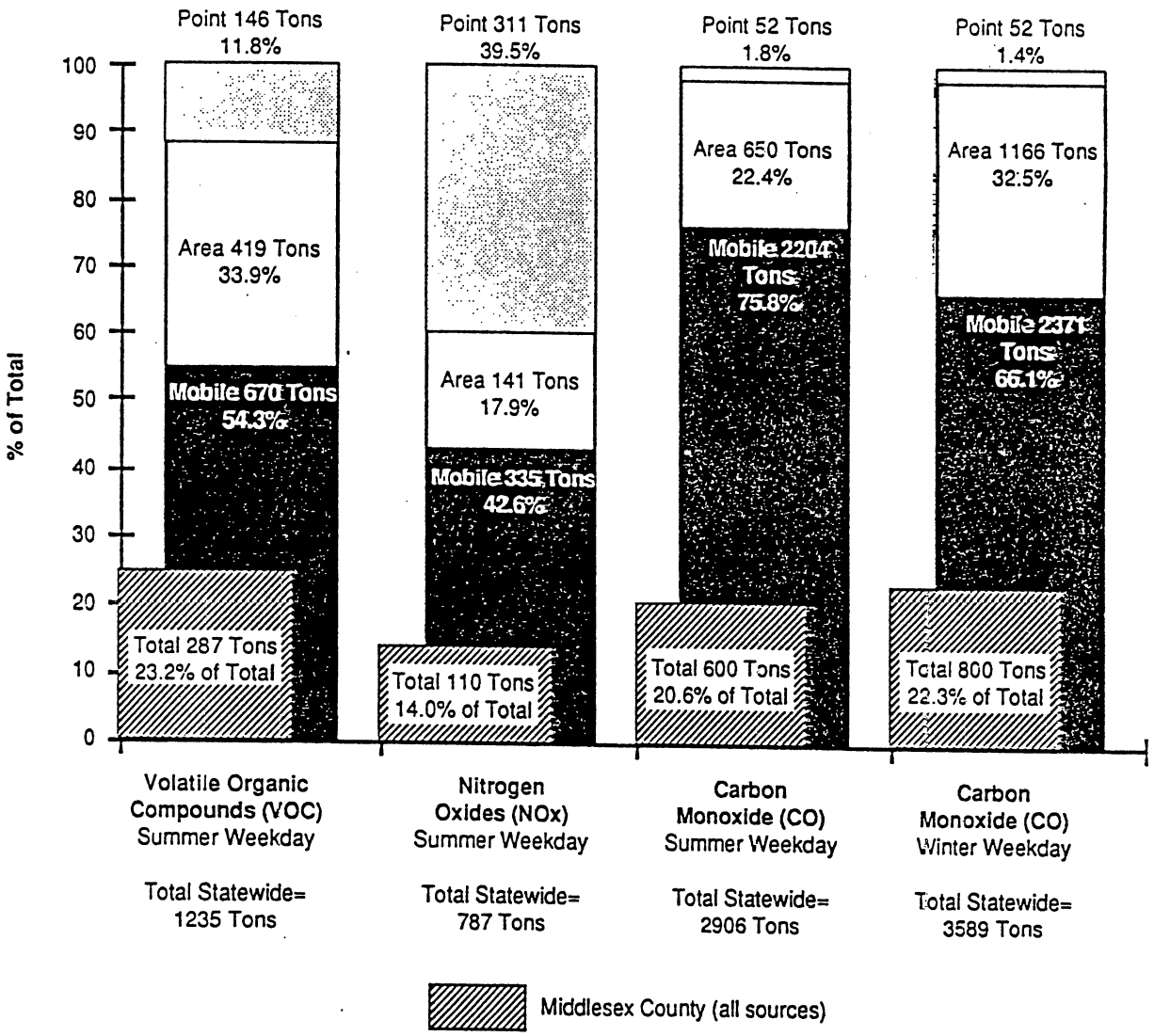
Carbon monoxide (CO) is a colorless, odorless gas produced through the incomplete combustion of organic fuels. Due to the effect of cold weather operating conditions on engine combustion characteristics, CO levels are highest during cold weather. CO combines with the hemoglobin in the blood, reducing the ability of blood to carry oxygen. At high concentrations, CO can be fatal to humans. At lower concentrations, CO can aggravate cardiovascular diseases and impair mental functions.

Vehicle Trips and Miles of Travel:

Passenger cars represent a large fraction of the total motor vehicle fleet, representing over 90 percent of the total vehicle trips made in the Boston metropolitan area. As such, they are also large contributors to ozone precursor and carbon monoxide emissions.

In 1987, Cambridge generated nearly 3.3 million vehicle miles of travel per day, which represented 8.2 percent of the total vehicle miles traveled in the Boston Metropolitan Region. Work-related trips represent the largest share of total travel in Cambridge, comprising over 57 percent of the total travel market. This share includes both Cambridge residents working inside or outside Cambridge and non-Cambridge residents who commute to Cambridge to work. Other non-work related trips that are based from the home represent the next largest travel share at 27 percent. Non-home based related travel represents the other 16 percent share of

Summary of Massachusetts 1987 Base Year Emissions Inventory by Source Category and Middlesex County Share



Source: Massachusetts 1987 Base Year Emissions Inventory, Department of Environmental Protection, Division of Air Quality Control

travel in Cambridge. Cambridge' importance as a major regional employment center is reflected in its relatively high share of work trip based travel as compared to the regional average for work related travel.

Not reflected in any of these totals of vehicle miles of travel are vehicles which pass through the City without stopping. Travel data provided by the Central Transportation Planning Staff for several major and minor arterials in Cambridge indicate that about 33 percent of the total daily traffic on these roadways are throughtrips which have no point of origin or destination in Cambridge.

The vehicle travel in Cambridge includes a large proportion of very short trips as shown on the figure. The overall average trip length for work trips is 6.4 miles and 5.1 miles for non-work related trips. Included in these averages is a large number of vehicle trips of 2 to 4 miles in length.

Overall Trends Affecting Travel:

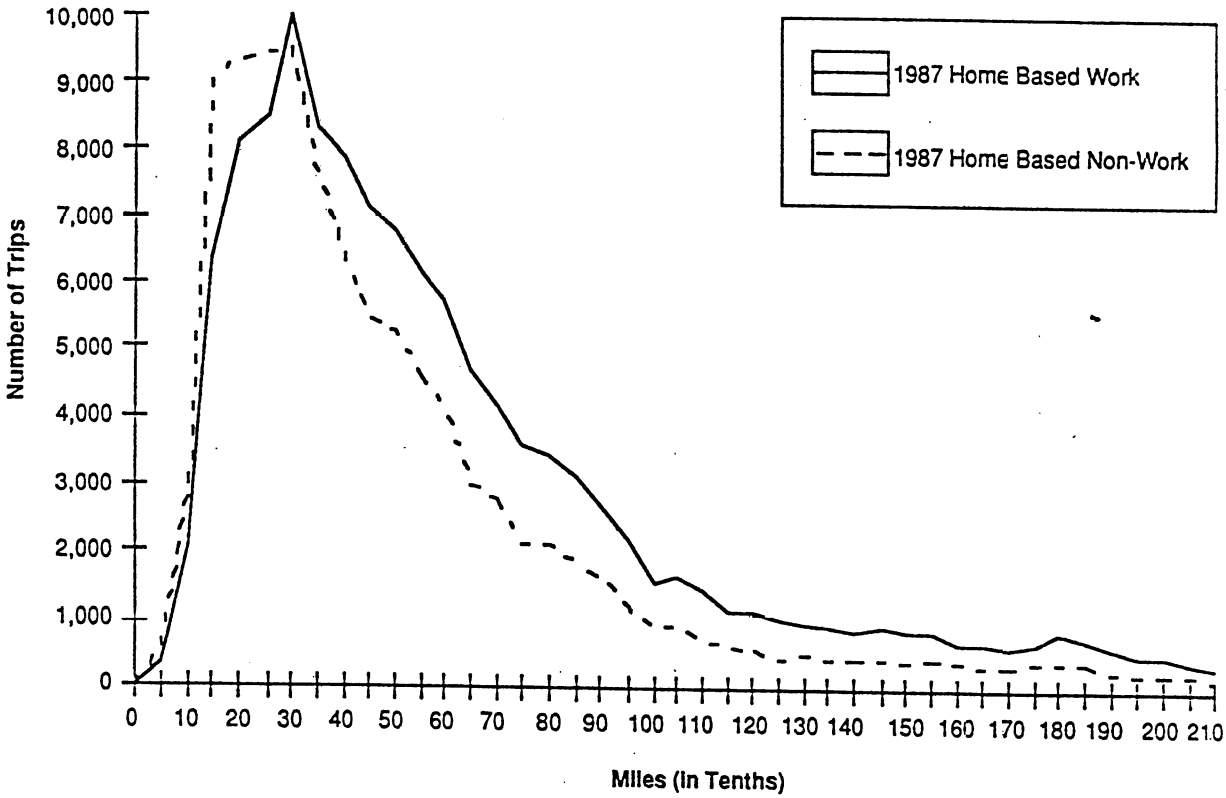
The population of Cambridge has remained relatively stable over the past twenty years, with a 1970 population of 100,000 and 1990 population of 96,000. However, while the City's population has changed little, other factors have contributed to a large increase in vehicle travel. These factors have included higher employment, rapidly increasing household formation and automobile ownership per households. In 1980, Cambridge employed 92,000 people. By 1990 employment had risen to over 102,000 people or 11 percent in 10 years, and had undergone a considerable transformation from an industrial base to a service sector oriented market that attracts employees from throughout the region.

Automobile ownership has also undergone great change in Cambridge and throughout the nation, with a clear pattern of rapidly rising rates of auto ownership per household. From 1980 to 1987, the number of cars registered in Cambridge rose by nearly 40 percent, despite relatively little change in population and a major investment in expanding and improving the region's transit system. Traffic data available from the Massachusetts Department of Public Works (MDPW) indicate that use of the automobile has risen considerably during the 1980's, and that the City and Boston Metropolitan Region have experienced a considerable growth in vehicle miles traveled averaging about 3 percent per year.

The Need for Better Management of Traffic and Vehicle Miles of Travel:

Although significant emission reductions have been achieved in recent years as a result of requirements for emission control equipment on cars, trucks, and other vehicles, it has not been sufficient to eliminate motor vehicle emissions as a problem. Even if existing and potential new emission control devices operate at maximum effectiveness, national trends show that the

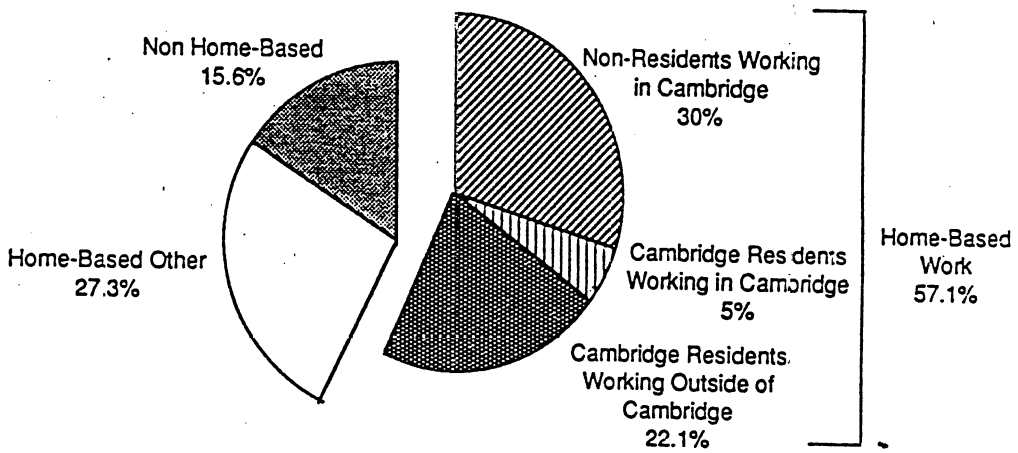
Cambridge Related Vehicle Trip Length by Purpose



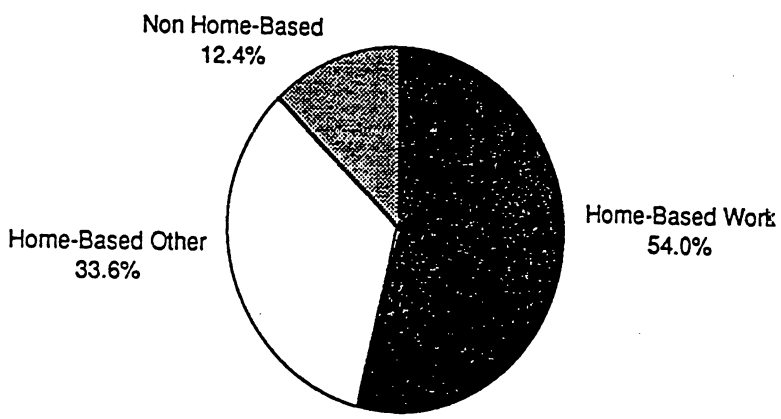
Source: Central Transportation Planning Staff

Vehicle Miles of Travel by Trip Purpose (1987)

Cambridge



Eastern Massachusetts



Trip Purpose	Cambridge VMT	Cambridge % of Total	Eastern Massachusetts VMT	Eastern Massachusetts % of Total
Home-Based Work	1,874,680	57.1%	34,562,384	54.0%
Home-Based Other	896,947	27.3%	21,507,019	33.6%
Non Home-Based	513,447	15.6%	7,912,970	12.4%
Total	3,285,074	100.0%	63,982,373	100.0%

Source: Central Transportation Planning Staff

growing number of vehicles in use and increases in vehicle miles of travel (VMT) will result in a net increase in auto pollutant emissions. In short, growth in VMT and resulting emissions are expected to overtake the benefits of emission control technology and the reductions in emissions it has produced.

Control strategies aimed at transportation-related emissions are intended to reduce the growth of vehicle trips and VMT. These strategies are called transportation control measures or TCMs. The objective of TCMs is to reduce emissions from on-road motor vehicles by reducing the use of motor vehicles, by making the road system operate more efficiently, and by switching to motor fuels that produce comparatively less emissions.

Experience has shown that it is not easy to change automobile travel behavior. Surveys show that most people understand that automobiles significantly contribute to air pollution. Yet automobile use continues to grow. For a program of TCMs to succeed, it must consist of a balance of incentives and disincentives to encourage use of alternative travel modes. To substantially change travel behavior, a TCM program must also include measures to promote alternative means of travel that are improvements or, at a minimum, are comparable in cost and convenience to the single-occupant automobile. It is also imperative that these TCM programs are applied area-wide and have regional applicability. The following program proposed for the City of Cambridge is designed to help meet these criteria until the Commonwealth supplants it with a program of regional applicability.

Cambridge Attributes:

To develop a program of Transportation Control Measures for the City of Cambridge that can be successfully implemented, it is important to identify and take into account the unique characteristics of the City of Cambridge.

These key attributes include:

Land Use:

- High residential densities distributed throughout City.
- Close geographic proximity to downtown Boston which results in a large proportion of trips that pass through Cambridge without stopping.
- Clusters of high density office development concentrated at limited number of locations (East Cambridge/Kendall Square, Alewife, University Park); additional office development dispersed at lower densities primarily along Mass. Ave. corridor between Harvard Sq. and Central Sq.

- Two (2) large educational institutions serving a primarily non-commuter population (Harvard University, Massachusetts Institute of Technology); various other smaller educational institutions; some commuting by faculty and non-resident students.

- Retail/commercial activity dispersed throughout City with few locations of high concentrations (Cambridge Galleria, Harvard Square, Central Square, Porter Square, Fresh Pond Shopping Center, Mass. Ave. corridor).

- Two (2) major hospitals (Mount Auburn and Cambridge) which are located in predominantly residential areas with limited parking availability.

- Cambridge is second to Boston in number of jobs provided in the region. Since 1980, employment has increased by over 10,000 jobs, an increase of 11%.

- Between January 1980 and March 1990, over 8 million square feet of office, retail, and industrial space, nearly 2,000 new housing units, and nearly 1,000 new hotel rooms were constructed in Cambridge. This development has generated about 16,000 additional person trips daily in Cambridge with about 56 percent of the total, or about 9,000 trips, using an automobile to make the trip. Since March 1990, an additional 1 million square feet of office and retail space has been constructed or has begun construction. An additional 7 million square feet of non-residential development has been proposed or planned; although, due to economic conditions and other circumstances, not all this proposed or planned development will necessarily be constructed. However, if all this proposed development were to occur, a similar increase in the number of vehicle trips made daily in Cambridge would be expected.

- Although population has remained constant in Cambridge since 1980, the rate of auto ownership has increased. Data available from 1970 to 1986 show a 40 percent increase in the number of passenger vehicle registrations in Cambridge. From 1982 to 1986, a period of only four years, registrations increased by over 12 percent.

- Given current and projected trends, along with the current downturn in the regional economy, Cambridge employment and development is expected to stabilize for the foreseeable future.

Transportation:

- Served by several major arterials and highways which are not subject to controls by the City of Cambridge (Alewife Parkway, Fresh Pond Parkway, Memorial Drive, and McGrath Highway). These roadways handle a high proportion of through trips to Boston and other communities, as well as work trips to Cambridge employers and non-work trips to Cambridge retail and entertainment facilities.

- Provided transit service by MBTA via local buses and the Red Line and some limited service via the Green Line and commuter rail. The radial nature of the MBTA system, which is oriented to downtown Boston, results in considerably more opportunities to use transit to access Cambridge from the south (downtown Boston) than from the either the north or west.

- Congestion is experienced at various intersections/ roadways and is anticipated to continue at a number of locations into the future; however no measured violations of CO standards currently or projected for future (based on limited available data).

- Extensive supply of primarily privately developed off-street parking serving employees (41% of supply) and commercial (19% of supply).

- Current transit use within the City is relatively high compared with national averages, with nearly 20% of daily home-based work trips to Cambridge destinations being made by transit; use of non-motorized transportation for worktrip travel is much higher than national averages, with nearly 17% of daily home-based work trips made by bicycle or walking (according to Central Transportation Planning Staff data).

Management:

- City has history of action to downzone residential and non-residential areas by reducing the allowable Floor Area Ratio ("FAR"), resulting in a reduction in the potential size of development compared to what would have been allowed under prior zoning regulations.

- One-zone residential permit parking program in place, affecting supply/utilization of on-street parking.

- Citywide commuter mobility program is staffed by a full-time, City-funded, Commuter Mobility Coordinator who provides transportation management services to major employers and developers.

- Many of the City's employers already provide alternative work hour programs as an employee benefit, thereby reducing peak hour traffic.

- The City and several major institutions and private employers historically have implemented a variety of Transportation Control Measure (TCM) programs including parking restrictions, carpool programs, and traffic flow improvements, in addition to supporting programs such as privately-sponsored shuttle bus services and mass transit improvements by the MBTA.

MEASURES IN CAMBRIDGE VEHICLE TRIP REDUCTION ORDINANCE PROPOSED FOR INCLUSION IN REVISION OF STATE IMPLEMENTATION PLAN

A. GENERAL MOBILITY-BASED MEASURES

1. Implement Expanded Commuter Mobility Program

Description:

Various programs/activities would be implemented through the Commuter Mobility Program within the Cambridge Community Development Department, including, but not limited to:

- A program to encourage commercial establishments in Cambridge to offer discounts to patrons who have an MBTA transit pass.

- Establishment of residential-based trip reduction programs at apartment complexes and condominium developments of 50 or more units; such programs could include provision of information about combining trip purposes, available transit and ridesharing services, ridesharing among residents, shopper shuttles, etc.

- A study of potential utilization of jitney services or shuttles to MBTA services, major shopping complexes, and major employment centers where no MBTA service is currently available.

- Creation of a bicycle commuter program, in conjunction with the Cambridge Traffic and Parking Department, including consultation with Cambridge residents and businesses.

- A program to assist employers in identifying and implementing appropriate incentives to encourage employees to commute by bicycle.

Fifty (50) percent of the revenues raised through sale of Residential Parking Stickers and all revenue raised from fees paid by employers with the filing of the Annual Employer Survey and by developers with the filing of Transportation Management Plans would be used to support these and other activities of the Community Development Department in conjunction with the Commuter Mobility Program, as set forth in the Ordinance.

Impact:

Dependent upon program applications and extent of participation. Based on a voluntary and area-wide application of commuter mobility measures, including community education programs on alternative modes of travel and implementation of shuttle services linking the MBTA and major employment centers, Cambridge-based vehicle miles of travel could be reduced by an estimated 0.41 percent or 13,500 daily VMT.

Implementation Responsibility:

Commuter Mobility Coordinator, Cambridge Community Development Department

Schedule:

Upon the effective date of the Ordinance.

2. Implement Citywide Bicycling Incentive Program

Description:

The City of Cambridge would commit an initial annual budget of $25,000 for use by the Cambridge Traffic and Parking Department toward development of a program to encourage greater use of bicycles. As a first step in development of the program, a Bicycle Coordinator will be appointed within the Cambridge Traffic and Parking Department. The Bicycle Coordinator will devote at least 50 percent of his/her time to developing and implementing this program. The budget allocated to this program will be in addition to, and not be applied toward, the salary of the Bicycle Coordinator. The program will include the following:

- Creation of a Bicycle Advisory Committee.
- Development of a Cambridge Bicycle Master Plan.
- Provision of bicycles for use by police and Traffic and Parking Department Staff.
- Funding of improved bicycle amenities and storage facilities.

- Consultation with Cambridge residents and businesses.

- Development and evaluation of recommendations for a regional network of bicycle paths and bicycle priority streets favoring bicycles and pedestrians.

Impact:

Increased bicycle use as an alternative to other travel modes, primarily for short-distance/local trips during the peak ozone season (warmer weather period).

Implementation Responsibility:

Cambridge Traffic and Parking Department, with assistance from the Commuter Mobility Coordinator.

Schedule:

A Bicycle Mobility Coordinator would be appointed within one month of the effective date of the Ordinance.

B. PARKING SUPPLY-BASED MEASURES

1. Implement Parking Restrictions on Currently Unregulated Streets

Description:

The City of Cambridge Traffic and Parking Department would prepare an inventory of all currently unrestricted on-street parking spaces throughout the City and, after consultation with Cambridge residents, businesses, and the City Manager, determine and implement the most appropriate form of regulation, by location, to discourage use of these spaces for long-term parking. Approximately 4,700 on-street parking spaces in Cambridge are currently unrestricted. Regulation can be in the form of parking meters, time restrictions, or residential permit requirements.

Impact:

Reduction in long-term, commuter-related work trips. For the purpose of analysis, it was assumed that this measure would apply to the entire supply of currently unregulated on-street spaces and that restrictions would be applied in the form of residential parking permit requirements. At this time, there is limited information available concerning the usage of these unregulated spaces. Therefore, two scenarios were tested to determine the potential impact of this measure. For the first scenario tested, it was assumed that all available spaces are currently used for long term commuter parking (or would be used for long-term parking as a result of other measures in the Ordinance). In this case, this measure could reduce Cambridge-based vehicle miles of travel

by an estimated 2.67 percent or 88,000 daily VMT. For the second scenario tested, it was assumed that 60 percent of the currently unregulated spaces are used for long-term commuter parking and that, as a result of the new restrictions, 33 percent of these commuters would continue to drive but would find alternative parking. In this case, Cambridge-based vehicle miles of travel would be reduced by 1.07 percent or 35,000 daily VMT.

Implementation Responsibility:

Cambridge Traffic and Parking Department

Schedule:

Cambridge Traffic and Parking Department would be required within six months of the effective date of the Ordinance to inventory all unrestricted on-street parking and submit to the City Manager a written draft recommendation as to appropriate forms of regulation for each inventoried space. The City Manager will make the draft available for public review and discussion prior to finalization.

2. Increase Off-Street Municipal Parking Fees

Description:

In order to discourage the use of City of Cambridge-owned parking facilities for parking by single-occupant vehicle users, the rates for daily and monthly parking at all municipal off-street parking garages would be increased by 25 percent over currently charged rates.

Impact:

The City of Cambridge currently operates two off-street parking garages. The Green Street garage in Central Square provides 290 spaces and the East Cambridge garage (55 First St.) provides 1110 spaces. An analysis of a 25 percent increase in the cost of long-term parking at these facilities was conducted which assumed that the rates at non-municipal facilities in the vicinity of these garages would be unchanged and that any spaces made available at these facilities as a result of the rate increases would not be subsequently filled as a result of latent demand. Based on these assumptions, this strategy would result in an estimated 0.13 percent reduction in the current daily total Cambridge-based vehicle miles of travel, equal to 4,000 daily vehicle miles of travel (VMT).

Implementation Responsibility:

Cambridge Traffic and Parking Department

Schedule:

Within 60 days of the effective day of the Ordinance, the Cambridge Traffic and Parking Department would implement a revised rate structure at municipal off-street parking facilities, consistent with the requirements of the Ordinance.

C. CITY OF CAMBRIDGE-BASED MEASURES

1. Implement Controls on Use of Citywide Visitor Passes

Description:

The City of Cambridge would substitute stickers for the Citywide visitor passes currently used by authorized individuals. The sticker shall display the vehicle registration number of the vehicle to which it is assigned and an expiration date. Stickers will be distinct in appearance from residential parking permit stickers.

Impact:

Unspecified

Implementation Responsibility:

Cambridge Traffic and Parking Department

Schedule:

The Traffic and Parking Department would be authorized to issue stickers immediately upon passage of the Ordinance. Citywide visitor passes will be invalid thirty days after the effective date of the Ordinance.

D. RESIDENTIAL-BASED MEASURES

1. Implement Residential Parking Permit Sticker Zones

Description:

The City of Cambridge currently allows a vehicle with a parking sticker to park in any signed residential parking area throughout the City. A zoned parking program would restrict use of parking stickers to the designated zone where the vehicle is registered. This would ensure that the resident will retain the ability to park a vehicle near the address at which the vehicle is registered, but restrict the ability to park in other residential areas of the City during the work week.

The use of a valid residential parking sticker would be restricted to the zone for which it is designated from midnight Sunday to 7:00 p.m. Friday (5 days of the week). From 7:00 p.m. Friday to midnight Sunday, a valid residential sticker would allow legal parking in all residential parking zones throughout the City of Cambridge.

Four (4) zones would be established for the purpose of implementing this measure and are defined as follows:

- Zone 1: Cambridge-Somerville border to north, Cambridge-Arlington-Belmont border to west, Concord Avenue to south, Kirkland Street to east (includes Cambridge Common)

- Zone 2: Concord Avenue to north to Garden Street along Cambridge Common, JFK Boulevard to east, Charles River/Watertown-Belmont border to south and west

- Zone 3: Massachusetts Avenue to north, JFK Boulevard to west, Charles River to south and east

- Zone 4: Massachusetts Avenue to south, Kirkland Street to west, Somerville-Charlestown-Cambridge border to north, Charles River to east

A special buffer zone would be established within one block on either side of streets designated as zone boundaries, running the full length of the zone boundary, to allow parking by residents of both abutting zones.

Signs designating residential permit parking areas would be modified to clearly identify the zone in which the residential parking is located. Buffer zones will be indicated by signs to allow parking by residents of the appropriate abutting zones. Fines for vehicles which park in zones other than the zone for which a sticker is valid will be administered consistently with current parking violation policies.

Impact:

The strategy would reduce intra-Cambridge home-based work and non-work trips on weekdays. Based on travel and parking characteristics observed throughout the metropolitan area, it is estimated that this measure could reduce internal Cambridge average weekday home-based work and home-based other vehicle miles of travel by 8.7 percent. This would result in an estimated 0.21 percent reduction in the current daily total Cambridge-based vehicle miles of travel, equal to 7,000 daily VMT.

Implementation Responsibility:

City of Cambridge Traffic and Parking Department

Schedule:

Signs designating the four zones would be erected within 6 months of the effective date of the Ordinance. Stickers would be issued according to zone designations beginning with the next-scheduled annual renewal date for current residential sticker holders.

2. Progressive Fee Schedule for Residential Parking Stickers

Description:

The fee charged for residential parking stickers would be adjusted to raise the fees charged to households with multiple vehicle ownership. The proposed fees would conform to the following schedule:

1st Sticker per Household	$ 8.00
2nd Sticker per Household	$ 12.00
3rd Sticker per Household	$ 50.00
4th Sticker per Household	$100.00
5th and additional Stickers per Household	$200.00

For the purpose of this measure, all vehicles registered to the same address shall constitute the vehicles registered to a household.

Fifty (50) percent of all revenues raised through the Residential Parking Sticker program would be made available to the Commuter Mobility Program within the Community Development Department to support programs mandated by the Ordinance. The remaining fifty (50) percent would be used by the Traffic and Parking Department for enforcement and other activities required of it under the Ordinance.

Impact:

The measure would act to discourage marginal vehicle ownership, particularly households with three or more per household. Funding generated by this measure would be used to support other programs under the Vehicle Trip Reduction Ordinance.

Approximately 36,000 parking stickers were issued by the Cambridge Traffic and Parking Department in 1990, generating approximately $152,000 in revenue. Based on data provided by the Cambridge Traffic and Parking Department, derived from a sample of households and used to determine approximate distribution of single versus multi-sticker households, approximately 17 percent of Cambridge households (that have resident parking stickers) have 3 or more vehicles registered to their household. Estimated

revenue from the revised schedule, based on the number of stickers issued in 1990 would increase by approximately $148,000 per year. (Waivers or reductions for handicapped or elderly would reduce this amount somewhat.)

Implementation Responsibility:

City of Cambridge Traffic and Parking Department

Schedule:

Stickers would be issued beginning with the next-scheduled annual renewal date for current residential sticker holders.

E. EMPLOYER-BASED MEASURES

1. Implement Regional Trip Reduction Program

Description:

Given that Cambridge roadways serve as a throughway to other employment centers, employer-based measures are most effective when adopted and enforced on a region-wide basis. The measures proposed herein for Cambridge should be adopted and applied by the Commonwealth on a region-wide basis. Only trip reduction measures that are applied on a region-wide basis (and, in some instances, in other states throughout the Northeast Ozone Transport Region) will enable the Commonwealth to achieve attainment of the Clean Air Act air quality standards. Furthermore, only a regional program will:

- Assure that Cambridge is not placed at a competitive disadvantage with other communities in the region as a result of stricter controls on vehicle trips;
- Prevent the diversion of traffic currently oriented toward Cambridge origins and/or destinations to other areas in the region which have more limited public transit availability, thereby increasing regional vehicle miles of travel, a result that is prohibited by the 1990 Clean Air Act amendments;
- Reduce the high volumes of through traffic on Cambridge roadways which are beyond the ability of this ordinance to control.

Impact:

A regional program would provide for area-wide trip reductions, particularly related to work trips.

Implementation Responsibility:

Various State, regional, and local agencies

Schedule:

A regional program of transportation control measures for the Commonwealth is expected to be prepared and submitted to EPA as an element of the Commonwealth's plan for attaining a 15 percent total reduction in VOC emissions by 1999, as required by the 1990 Clean Air Act Amendments. A regional program of transportation control measures would replace this interim SIP Amendment for the City of Cambridge.

2. Encourage Local Employment Opportunities

Description:

The City of Cambridge would commit to:

- Continuing and expanding the Cambridge Employment Program within the Community Development Department.
- Sponsoring an annual job fair to inform residents of opportunities for local employment.
- Sponsoring and coordinating educational partnerships between Cambridge employers and schools in Cambridge.
- Developing a Local Employment Opportunity Plan intended to achieve these objectives.

To demonstrate and further its commitment to increase the number of Cambridge residents employed by Cambridge businesses, the City would increase its annual budget for this effort to $130,000.

Impact:

Potential increase in share of Cambridge residents employed by Cambridge employers, resulting in reduced work-trip commute distances and reduced vehicle miles of travel. As of 1989, Cambridge employers provided jobs for over 102,000 employees, accounting for nearly 6 percent of the total employment in the Boston SMSA. Approximately 28 percent of Cambridge's employment base is composed of Cambridge residents. The employment base of other major job centers such as Waltham, Bedford, Framingham and Lynn is composed of 35 percent or more local residents. The City of Boston has a 40 percent local resident employee population.

Given unique characteristics of Cambridge, such as its large student population, and uncertainties about expansion of job opportunities due to the current economy, it may not be feasible to increase the residential-employee base to the Boston level.

However, based on local employment rates at other major employment centers (as indicated above), an increase in the rate of local employment in Cambridge appears feasible. An analysis was performed which assumed a growth in Cambridge-based job share to 31 percent of total employment to evaluate the potential effectiveness of this measure. The results of this analysis indicated that Cambridge home-based work vehicle miles of travel could be reduced by an estimated 3.4 percent or 33,000 daily VMT. This would produce an estimated 1.0 percent reduction in total Cambridge-based vehicle miles of travel.

Implementation Responsibility:

Cambridge Community Development Department in conjunction with the Cambridge Department of Human Services.

Schedule:

A plan to encourage local employment opportunities for Cambridge residents would be prepared within one year of passage of the Ordinance.

3. Annual Employer Survey - Developing the Baseline on Employee Commuting Characteristics

Description:

An annual survey would be conducted by all Cambridge employers of 50 or more employees at a single worksite (including institutions and City of Cambridge departments) to determine the number of employees per worksite, their commuting characteristics, modes of travel, places of origin, work schedules, trip volumes, and progress toward meeting the Citywide Auto Efficiency Rate (AER) Goal. This program is estimated to affect approximately 240 employers, including the City, representing nearly two-thirds of the total employment base of Cambridge.

By analyzing employee commuting characteristics the survey will provide the basis for determining if an employer is required to develop a Vehicle Trip Reduction Plan in order to achieve the Citywide Auto Efficiency Rate Goal. Data derived from the survey will provide the basis for preparation and updating of the Vehicle Trip Reduction Plan. An employer who cannot certify achievement of the Citywide AER Goal at its worksite would be required to prepare, implement, and submit to the City a Vehicle Trip Reduction Plan as part of the Annual Employer Survey Response.

The Annual Employer Survey would be based on a survey of employees at each worksite of 50 or more employees. A response rate of at least 75 percent would be required to ensure accuracy of the data. Based on the data obtained through the employee survey, an actual Auto Efficiency Rate will be calculated by each employer for its

worksite and compared to the Citywide Auto Efficiency Rate Goal to determine the need, if any, for an employer to reduce commuter vehicle trips through a Vehicle Trip Reduction Plan.

A processing fee, based on the number of employees at a given worksite, would be submitted to the City each year with the completed Annual Employer Survey Response. Proposed fees are:

$500 for employers with 500 or more employees
$300 for employers with 100 to 499 employees
$100 for employers with 50 to 99 employees

Failure to submit a completed and properly certified Annual Employer Survey Response on the scheduled date would result in a fine of $200.00 per day to be levied until the required Survey Response is submitted. Knowingly submitting false information would result in a fine of $300.00 per day to be levied until a corrected, certified Survey Response is submitted and accepted.

The survey would be performed annually to monitor progress toward meeting the Citywide Auto Efficiency Rate Goal and to provide the basis for amendments to an employer's Vehicle Trip Reduction Plan.

Impact:

Would provide annually updated database on employee commuting characteristics, employer vehicle trip reduction programs, and certification of progress toward achieving the Citywide Auto Efficiency Rate Goal. Revenue generated through the filing fees for the Annual Employer Survey response will be used by the City to carry out the tasks and implement the programs required by the Ordinance.

Implementation Responsibility:

Assistant City Manager for Community Development

Schedule:

An employer survey kit, including employee survey forms, administration plan and AER calculation sheets, would be prepared by the City and distributed to all employers of 50 or more employees at a single worksite no later than 6 months from the effective date of the Ordinance. These employers would then be required to submit a completed Survey Response, which will include the AER calculation sheet, certification, processing fee, and, where required, a Vehicle Trip Reduction Plan, within six months of distribution of the Survey kits by the City. Subsequent and similar surveys will be administered annually.

4. Employer-Based Vehicle Trip Reduction Plan - Citywide Auto Efficiency Rate

Description:

Each Cambridge employer of 50 or more employees at a single worksite (including institutions and City of Cambridge departments) who cannot certify and demonstrate achievement of the Citywide Auto Efficiency Rate Goal would be required to prepare, implement, and submit a Vehicle Trip Reduction Plan as an element of its Annual Employer Survey Response. The Plan will specify a program of measures intended to reduce vehicle trips to achieve the specified Citywide Auto Efficiency Rate Goal. Each year, an employer will certify implementation of the Vehicle Trip Reduction Plan and progress toward meeting the Citywide Auto Efficiency Rate Goal. The Vehicle Trip Reduction Plan will be amended and modified as required through subsequent Annual Employer Survey Responses.

Each employer's Auto Efficiency Rate (AER) will be calculated through the Annual Employer Survey for each worksite and updated annually. The Auto Efficiency Rate is calculated by dividing the number of employees who report to the worksite in Cambridge between 6:00 a.m. and 10:00 a.m. (inclusive Monday through Friday) by the number of vehicles used by these employees. As the AER increases, use of single-occupant vehicles for commuting is reduced. The AER calculation requires that a five consecutive weekday average be used. Vehicles counted shall exclude bicycles, public transit vehicles, and approved clean fuel vehicles. Motorcycles and light trucks would be counted as automobiles. An example form (subject to modification) and sample calculation of Auto Efficiency Rate, is shown in Attachment 1.

The Citywide Auto Efficiency Rate Goal would provide for progressive, annual reductions in vehicle trips and vehicle miles of travel compared to baseline travel characteristics. The current AER for Cambridge ("Base AER") will be derived from 1990 U.S. Census modal share data and travel statistics, which are expected to be available shortly. The Citywide AER Goal for the first year of the Ordinance will be the Base AER plus 2.5 percent. The Base AER for Cambridge may be recalculated after review and analysis of the first Annual Employer Survey Response.

Each employer required to submit an Annual Employer Survey Response would be required to calculate its own Auto Efficiency Rate (on a calculation sheet provided by the City) and compare its rate to the Citywide Auto Efficiency Rate Goal (also to be specified on the calculation sheet). Employers whose AER is below the Citywide AER Goal would be required to develop and implement a Vehicle Trip Reduction Plan which provides strategies and incentives to modify their Auto Efficiency Rate to achieve the Citywide Goal. An employer who demonstrates through the Annual Employer Survey and certifies that the worksite is in compliance

with the AER Goal as of the submittal date of the Survey Response would not be required to submit a Vehicle Trip Reduction Plan for that year.

The Citywide AER Goal is designed to provide for progressive, annual reductions in single occupant vehicle use. Specifically, the AER Goal will be increased annually by 2.5 percent. As a result, employers who may be exempted from a requirement to file a Vehicle Trip Reduction Plan in the first year of this program may be required to do so in subsequent years as the Citywide AER is increased.

The concept of a Citywide Auto Efficiency Rate is consistent with the approach developed in Los Angeles through "Regulation XV" and in Phoenix by federal regulation. These programs require area businesses to "aggressively" encourage ridesharing and transit use by their employees. The goal of these programs is to significantly reduce the number of vehicles on the road, particularly during heavily congested commuting periods.

The strategies and incentives specified in an individual employer's Vehicle Trip Reduction Plan would be based on the difference between the Citywide AER Goal and the employer's AER as computed on the calculation sheets to be provided by the City. Appropriate trip reductions for an individual employer will be determined as a function of the employer's AER in the employer's first Annual Employer Survey Response and Vehicle Trip Reduction Plan. Employers with an AER substantially below the target will be expected to develop a Vehicle Trip Reduction Plan which identifies a more extensive program of strategies and incentives than employers with smaller AER deficits. Subsequent submittals of the Annual Employer Survey Response and Vehicle Trip Reduction Plan will certify progress toward meeting the AER target and also upgrade the Vehicle Trip Reduction Plan as needed to achieve vehicle trip reductions.

A variety of measures and incentives may be implemented to assist in achieving the target AER, including, but not limited to:

- Providing information on available transit service - posting in a conspicuous place or places the schedules, rates, and routes of transit services in the immediate vicinity of the facility.

- Employee transit-pass programs - advertising and making available to all employees any pass program offered by the area transit authority, including but not limited to, making all administrative arrangements for commuters to purchase the pass and encouraging commuters to participate by publicizing the availability and cost advantages of the pass program.

- Incentives to commute by bicycle - including but not limited to, providing secure bicycle storage facilities and shower/changing facilities.

- Employer-sponsored rideshare programs.

- Preferential parking for carpools and vanpools.

- Transportation allowance programs.

- Alternative work schedules - including 4-day work weeks and flexible schedules which would facilitate rideshare arrangements.

- Elimination or reduction of employee parking subsidies.

- Elimination or reduction of employee parking spaces.

- Provision of shuttle vans to public transportation services.

Employers would be responsible for developing their own Vehicle Trip Reduction Plans. The Commuter Mobility Coordinator would be available to assist employers in identifying and developing appropriate trip reduction measures. The Vehicle Trip Reduction Plan is performance based to achieve specified trip reduction objectives. The measures by which trips are reduced are to be determined by the employer based on individual needs and operations.

The adequacy of a Vehicle Trip Reduction Plan to meet the necessary trip reduction goals for a specific worksite will initially be determined by the Commuter Mobility Coordinator. If a Plan is found to be insufficient to achieve the required vehicle trip reductions, the Assistant City Manager for Community Development, in consultation with the Commuter Mobility Coordinator, may disapprove a plan and require its resubmittal within thirty days. If, on resubmittal, the Plan is again rejected, penalties would be assessed. An employer may appeal as provided in the Ordinance.

The Vehicle Trip Reduction Plan is to be submitted as part of the Annual Employer Survey Response. Failure to submit an acceptable Plan (where the Plan is required) will render the Survey Response incomplete and subject the employer to penalties consistent with the penalties for non-submittal of a complete and certified Annual Employer Survey Response. Failure to implement the provisions of a Vehicle Trip Reduction Plan will subject the employer to fines of $300.00 per day until found by the Assistant City Manager for Community Development, or his designee, to be in compliance. Enforcement of this program would be the responsibility of the Assistant City Manager for Community Development.

Impact:

This measure will achieve reductions in single-occupant work-related vehicle trips. It is estimated that there are approximately 240 firms within the City of Cambridge that employ 50 or more employees. As a result, this program is estimated to apply to approximately 65,000 employees based on 1990 employment records.

Based on a 2.5 percent annual improvement in AER compared to current Cambridge travel characteristics (based on available information), total daily Cambridge-based vehicle miles of travel could be reduced by an estimated 0.3 percent or 12,000 daily VMT in the first year and by 0.7 percent or 25,000 by the second year.

(An analysis of program impacts if applied to firms of 25 or more employees was also conducted to determine what the potential for additional effectiveness would be if program coverage was expanded. An additional 270 firms would be covered by the Ordinance if applied to firms with between 25 and 49 employees. However, in Cambridge, these firms employ an estimated total of only 9450 employees. As a result, although the number of firms covered would increase by 112 percent, the number of employees covered would increase by only 15 percent, causing a disproportionate administrative burden and expense.)

Implementation Responsibility:

Assistant City Manager for Community Development

Schedule:

The Vehicle Trip Reduction Plan would be specified in the first Annual Employer Survey Response and updated on an annual basis according to the schedule for submittal of the Annual Employer Survey Response.

F. NEW DEVELOPMENT-BASED MEASURES

1. Development-Based Transportation Management Plan

Description:

For all new development of 50,000 square feet or greater, regardless of use, or 50 or more residential units, a Transportation Management Plan approved in writing by the Assistant City Manager for Community Development would be required. The Cambridge Building Inspector would not be permitted to issue the necessary building permits without evidence of such written approval. The Transportation Management Plan would be required to include:

- a processing fee of $1,500;

- a traffic analysis that demonstrates that for affected locations with existing traffic level of service (LOS) of D or worse, reasonable traffic mitigation measures will be implemented to improve traffic operations to the extent feasible and for affected locations with existing LOS of C or better, the project will not degrade such location below a LOS of C.

For all new mixed-use or non-residential development subject to the requirements of this measure, the Transportation Management Plan must also include:

- a description of development design elements and vehicle trip reduction measures to be implemented by the developer in order to assist non-residential tenants in the development, collectively, to achieve the Citywide AER Goal.

- a monitoring program to demonstrate annual plan compliance and calculate the annual AER associated with non-residential tenants of the development. The monitoring program must account for all non-residential site-generated traffic between the hours of 6:00 a.m. and 10:00 a.m. Where tenants include employers of 50 or more employees at the worksite, the monitoring program may utilize data from a tenant's certified Annual Employer Survey Response.

- a commitment to update and supplement the Transportation Managment Plan if, based on the monitoring program, it is determined that the non-residential tenants of the development, collectively, are not achieving the Citywide AER Goal.

- a commitment to future compliance with Transportation Management Plan requirements following transfer of property from developer to other parties.

Developments which have already been issued building permits from the City of Cambridge or which are subject to City-approved traffic mitigation or trip management plans as of the effective date of the Ordinance would be exempted from these requirements.

The requirements applicable to new developments would not exempt individual employers from compliance with other elements of the Ordinance. Employers of 50 or more employees at a worksite located within a development subject to a required Transportation Management Plan would be required to submit the Annual Employer Survey Response, and, if applicable, a Vehicle Trip Reduction Plan. The Vehicle Trip Reduction Plan will complement and contribute toward attainment of the Citywide AER Goal for the development site.

Measures to be considered for inclusion in the Transportation Management Plan include without limitation the following:

- Hiring a Transportation Management Coordinator, responsible for distribution of information and coordination of traffic management programs within the new development.

- Discouraging or restricting use of parking spaces by commuters in single-occupant vehicles.

- Funding a local or area-wide shuttle van to public transit stations and/or shopping centers.

- Encouragement of staggered or flexible work hours for employees of all tenants.

- Promotion of the use of public transportation by providing transit information and participation in the MBTA commuter pass program.

- Operation of a computer-based ridesharing information bank or coordination of ridesharing promotional programs with the City's Commuter Mobility Coordinator.

- Reserving spaces at preferential locations for carpool and vanpool parking on the site.

- Establishing reduced parking fees or providing subsidies for carpool and vanpool parking.

- Encouragement of employment opportunities by Cambridge residents by tenants of the new development.

- Providing safe, convenient, sheltered bicycle storage facilities and/or shower facilities for bicycle commuters.

The plan would have to receive written approval from the Assistant City Manager for Community Development before the Building Inspector may issue building permits for the project. Annual certification of plan compliance would have to be submitted to the Assistant City Manager for Community Development. Failure to implement provisions of the Transportation Management Plan or to provide the annual certification would subject the developer or subsequent property management firm or owner to fines of $300.00 per day until found by the Assistant City Manager for Community Development to be in compliance.

Impact:

The measure will reduce the growth in vehicle trips and miles of travel generated by new development projects of 50,000 square feet or 50 or more residential units. The measure will also provide reasonable mitigation in an effort to prevent degradation in traffic LOS as a result of new project development.

An analysis was performed to determine the impact of this measure as applied to new non-residential development in Cambridge, based on a potential for 7 million square feet of new non-residential development. For the purpose of this analysis, it was assumed that all 7 million square feet of potential new development would be subject to this measure. The data shows that this measure could reduce Cambridge-based vehicle miles of travel by an estimated 27,000 daily VMT compared to the VMT that would otherwise be generated by this new development in the absence of this measure. This is equivalent to a 10.6 percent reduction in VMT that would otherwise be generated by the new development.

Implementation Responsibility:

Assistant City Manager for Community Development

Schedule:

The measure would go into effect immediately upon passage of the Ordinance.

2. Study of Zoning Revisions

Description:

The Cambridge Planning Board would be directed to consider revisions to required parking space ratios specified in the City of Cambridge Zoning Ordinance and analyze the impacts of these revisions. Possible revisions to be analyzed would include elimination of minimum parking requirements and/or a reduction of maximum parking requirements for all or specific categories of development. Special allowances should be considered to provide for high occupancy vehicle (HOV) parking, in excess of allowable unrestricted spaces. Zoning requirements to encourage mixed-use development should also be considered.

Impact:

Modifications in zoning requirements could reduce rate of new parking development, resulting in change in ratio between vehicle trips and parking availability.

Implementation Responsibility:

Cambridge Planning Board

Schedule:

Consideration of potential revisions to required parking space ratios in the City of Cambridge Zoning Ordinance would commence promptly after the effective date of the Ordinance. The Cambridge Planning Board would publicly report its recommendations within one year of the effective date of the Ordinance.

G. CLEAN FUELS-BASED MEASURES

1. Promote Clean Fuel Use by Fleets of Ten or More Vehicles

Description:

The City of Cambridge would commit $15,000 to fund a study to be conducted one year after enactment of the Ordinance to promote the use and determine the impacts of the use of Clean Fuels as designated by the EPA. The study will include fleets of ten or more vehicles operated and/or maintained within the City of Cambridge. The study will analyze the use of appropriate clean fuels in Cambridge, including but not limited to methanol, compressed natural gas (CNG), and reformulated gasoline, and be based on fleet characteristics, implementation costs, and recommended implementation strategies. The study will also identify reasonably available incentives which could be offered by the City, such as tax credits, to encourage use of clean fuels by fleet operators. Results of the study will be provided to all fleet operators. Results of the study will be available to the public upon request.

Impact:

The study would promote the use of Clean Fuels and provide information to fleet operators concerning potential benefits of Clean Fuels for fleet operations. Air quality improvements will result if and when fleets are converted to Clean Fuel operation.

Implementation Responsibility:

Cambridge Department of Public Works

Schedule:

The results of a study of the advantages and opportunities to utilize Clean Fuels by Cambridge fleet operators would be publicly reported and distributed to owners and operators of vehicle fleets within one year of enactment of the Ordinance.

* * * * *

SUMMARY OF ORDINANCE PROGRAM IMPACTS

The attached table summarizes the various measures included in the Ordinance and lists their potential to reduce vehicle miles of travel and emissions of VOCs, CO, and NOx. As indicated, some measures do not directly result in measurable reductions in VMT or emissions of pollutants. Some of these measures support other strategies which do result in measurable improvements. An example would be the Annual Employer AER calculation (E.3) which is a necessary step in the development of the Vehicle Trip Reduction Plan (E.4). Other measures, such as the Bicycle Incentive Program (A.2), the zoning study (F.2) and the Clean Fuels Study (G.1) involve a commitment to define and implement programs to promote future improvements in air quality. Until the details of these programs and, in particular, the incentives which may be included in the programs are defined, it is not practical to quantify their beneficial impacts.

Based on the programs that are measured, the strategy to encourage local employment opportunities (E.2) has the potential to have a significant impact. The measure assumes a 3 percent change in the resident composition of Cambridge's employee population. This objective could be facilitated and/or achieved through other strategies, such as land-use mixing and housing-jobs balances. Another program shown to have a significant impact, despite varying assumptions for the analysis, is the application of parking restrictions to currently unregulated on-street spaces. The analysis of this measure assumes, through examination of two scenarios, that these spaces are currently used for long-term parking and that this use would be eliminated by the application of resident parking restrictions. If these spaces were controlled by meters or time restrictions, thereby allowing for more frequent turnover per space, impacts would be less.

The Vehicle Trip Reduction Plan measure applied to existing development (E.4) would achieve progressive impacts due to the change in the Auto Efficiency Rate (AER) target from year 1 to year 2 of the program. These reductions are not additive but individually represent a change in VMT and emissions from the baseline 1990 travel characteristics.

The program to require a Transportation Management Plan for new development (F.1) would effectively constrain future growth in VMT. The analysis assumes approximately 7 million square feet of new non-residential development to occur in Cambridge during the analysis period. The reduction shown in VMT represents the reduction which would be possible over the VMT generated by this new development in the absence of this measure. If less than the projected amount of development occurs the extent of the measure's impact would be reduced (the amount of newly generated VMT resulting from new development would also be less).

In summary, the strategies shown to have measurable VMT and emission reduction impacts can reduce total Cambridge-based vehicle miles of travel by approximately 104,500 to 170,500 daily VMT. For the strategies which apply to current VMT (excluding the Transportation Management Plan for New Development), this results in a reduction of 3 to 5 percent in Cambridge-based vehicle miles of travel. This translates into a reduction of approximately .7 tons of per day or 185 tons per year of VOCs, 6.1 tons per day or 1590 tons per year of CO, and .3 tons per day or 73 tons per year of NOx. Based on the extent of Cambridge's contribution to pollutant emissions statewide and the City's ability to affect change in Cambridge-based travel behavior, primarily through reductions in work-trips, these reductions make a substantial contribution to overall improvements in air quality.

* * * * *

SUMMARY OF PROGRAM IMPACTS

MEASURE	VMT REDUCTION	% CHANGE IN VMT(1)	REDUCED VOCs(2) TONS/DAY	REDUCED CO(3) TONS/DAY	REDUCED NOx(4) TONS/DAY
A.1 Expanded Commuter Mob. Program	13,500	0.41	0.06	0.50	0.02
A.2 Bicycle Incentive Program	NA				
B.1 Park Restrictions on Unreg. Streets					
Scenario 1	88,000	2.67	0.38	3.23	0.15
Scenario 2	35,000	1.07	0.15	1.28	0.06
B.2 Municipal Parking Fees	4,000	0.13	0.02	0.15	0.01
C.1 Universal Visitor Passes	NA				
D.1 Resident Parking Zones	7,000	0.21	0.03	0.26	0.01
D.2 Progressive Res. Parking Fees	NA				
E.1 Regional Trip Reduction Prog.	NA				
E.2 Local Employment Opportunities	33,000	1.0	0.14	1.21	0.06
E.3 Annual Employer Survey	NA				
E.4 Vehicle Trip Reduction Plan					
Year 1	12,000	0.3	0.05	0.44	0.02
Year 2	25,000	0.7	0.11	0.92	0.04
E.5 Credits for Excess Trip Reduct.	NA				
F.1 New Devel. Trip Reduction Plan	27,000	(5)	0.12	0.99	0.05
F.2 Modification of Parking Rates	NA				
G.1 Clean Fuel Study	NA				
G.2 Clean Fuel Incentives	NA				

NOTES:
NA: No direct impacts or impacts are unmeasureable
(1): % Change based on current (1987) VMT only
(2): Assumes rate of 3.88 g. of VOCs per mile at 19.6 mph, 78.1 (F)
(3): Assumes rate of 33.27 g. of CO per mile at 19.6 mph, 30.0 (F)
(4): Assumes rate of 1.54 g. of NOx per mile at 19.6 mph, 78.1 (F)
(5): Based on projected new development of 7 mil. sq. ft.

Attachment 1

Sample Auto Efficiency Rate (AER) Calculation Sheets

Los Angeles "Regulation XV"

Sample AVR Calculation, continued.

Weekly Employee/Vehicle Calculation

Section IV must be completed by employers filing both new and updated plans. This is a sample.

	Mode	TOTAL EMPLOYEE TRIPS Column 1		Column 2	TOTAL VEHICLES Column 3
A	Drive alone*	2680	A	divided by 1	2680
B	Motorcycle	25	B	divided by 1	25
C	2 person carpool	150	C	divided by 2	75
D	3 person carpool	60	D	divided by 3	20
E	4+ person carpool	80	E	divided by 4	20
F	Vanpool	120	F	Total vans used	15
G	Buspool	0	G	Total buses used	0
H	Public transit (bus/rail)	10			
I	Walk	10			
J	Bicycle	10			
K	Telecommute	5			
L	Report at another site	10	L	divided by 1	10
L1	No survey response	75	L1	divided by 1	75
			S	Subtotal	2920

Compressed Work Week Credit (days off)

M	3/36 work week	10
N	4/40 work week	5
O	9/80 work week x 0.5	5

W	**Total employee trips**	3255	T	**Total vehicles****	2853

Days Off

P	Vacation	10
Q	Sick	5
R	Other	5

* *Refer to the next page for explanation of how to calculate drive alone trips.*
** *If clean fuel vehicles are used for commuting from home to work, use Appendix B to calculate credit.*

Sample AVR, continued.

Explanation of Drive Alone Calculation

505	Employees drove alone for 5 days	2,525
5	Telecommuters drove alone 4 days	20
5	3/36 Employees drove alone 3 days	15
5	4/40 Employees drove alone 4 days	20
10	9/80 Employees drove alone 9 days	45
5	VAC/ Drove alone 3 days	15
5	Sick Leave/ Drove alone 4 days	20
5	Out of Town/ Drove alone 4 days	20
	Total Drive Alones	2,680

Sample AVR Calculation, continued

AVR Planning Form

Section IV must be completed by employers filing both new and updated plans. This is a sample.

1. Total employee trips generated Monday through Friday between 6:00 am - 10:00 am inclusive (Column 1 (W) Form IV-3). 1. 3255
2. Total vehicles arriving at the worksite Monday through Friday between 6:00 am - 10:00 am. (Column 3 use (T) if claiming clean fuel vehicle credit, otherwise use (S) Form IV-3) 2. 2853
3. Divide line #1 by line #2 for current AVR 3. 1.14
4. Enter AVR target here. 4. 1.5
5. Divide line #1 by line #4 to compute your Regulation XV allowable vehicles. 5. 2170
6. Subtract line #5 from line #2. This is your necessary vehicle reduction to reach your AVR target. 6. 683
7. Divide line #6 by the averaging period of 5 days used to calculate necessary vehicle reduction to reach your target AVR per day. 7. 136
8. Current AVR 1.14 (line 3 above)
9. Target AVR 1.5 (line 4 above)
10. Prior year AVR 1.12 (leave blank if filing for the first time)

After evaluating your survey, adopt incentives which would allow you to reduce the number of excess commute trips in order to attain your target AVR.

All calculations are rounded off to two decimal places.

CITY OF CAMBRIDGE
CAMBRIDGE, MASSACHUSETTS 02139
TEL. 349-4300
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EXECUTIVE DEPARTMENT
ROBERT W. HEALY
City Manager

RICHARD C. ROSSI
Deputy City Manager

March 20, 1992

To The Honorable City Council:

Pursuant to the terms of Ordinance No. 1112, I am hereby presenting to you for your consideration and approval a draft Vehicle Trip Reduction Ordinance. Also enclosed for your review and consideration are (1) a detailed memorandum which describes the comprehensive program of transportation control measures contained in the proposed Vehicle Trip Reduction Ordinance and (2) a Technical Appendix prepared by Cambridge Systematics, Inc. which describes the technical analyses performed and documents the impact of the proposed Crdinance in reducing the number of vehicle miles traveled to and within Cambridge and the associated air quality improvements. I call your attention in particular to the summary of program impacts on pages 30, 31, and 32 of the Memorandum. I also urge you to review sections 4 and 5 and figures 4.1-4.4 of the Technical Appendix.

The proposed Vehicle Trip Reduction Ordinance, together with the Memorandum and Technical Appendix, represent the culmination of a lengthy process and substantial effort. During the past year and a half, the City's technical and legal consultants developed a comprehensive menu of potential transportation control measures and participated in a series of meetings with a community advisory committee comprised of representatives of the City's residential, business, and institutional communities. The advisory committee provided comments on the menu of measures and assisted the City's consultants to develop additional ideas and identify items as to which there was consensus about transportation control measures appropriate for the City. The City's consultants then prepared and circulated a draft Vehicle Trip Reduction Ordinance and supporting Memorandum for comment by both the community advisory committee and the Department of Environmental Protection. The current versions of these documents reflect written and oral comments generated by the community advisory committee as well as comments provided by the Department Environmental Protection during several meetings and telephone conversations.

The proposed Ordinance will effectively reduce by a substantial number the vehicle miles traveled to and within Cambridge and will thereby measurably improve regional air quality. The proposed Ordinance contains a variety of transportation control measures involving all segments of the City's government, business, institutional and residential populations. Specifically, the proposed Ordinance would reduce the vehicle miles travelled ("VMT") in connection with existing jobs in the City, restrict parking which is currently unregulated, discourage cross-town trips during the work week, facilitate opportunities for residents to find jobs in the City, expand the existing Commuter Mobility Program, and create a Bicycle Mobility Program.

Together, these measures are expected to eliminate between 104,500-170,500 daily VMT. This translates into a reduction of approximately 3 to 5% of Cambridge-based daily VMT. This is a significant achievement in view of the data which indicates an annual growth in VMT of 3% in the Region.

In addition to the reductions of existing VMT quantified above, the Ordinance also contains measures to constrain future growth in VMT associated with new development. Furthermore, the Ordinance would reward businesses and institutions which have already or henceforth achieve significant changes in commuter travel behaviors and encourage fleet owners to convert their fleets to cleaner fuels, thereby encouraging and promoting further improvements in regional air quality.

The scientific literature and data are clear: the degradation of air quality is a regional problem that requires global and regional solutions. This is particularly the case with ozone. Every community within a region must contribute to the solution. Cambridge is committed to being a leader in this movement. Cambridge cannot, however, singlehandedly improve the Region's air quality. Notably, approximately 33% of all traffic on Cambridge streets is attributable to "throughtrips," trips that neither originate nor end in Cambridge. Cambridge has virtually no control over these trips. The program set forth in the proposed Ordinance must therefore be supplemented, complemented and, in accordance with the federal Clean Air Act, replaced by a transportation control program of regional applicability.

Toward that end, the enclosed Memorandum identifies regional measures necessary to supplement and complement the Citywide measures proposed in the Ordinance. Upon approval of this proposed Ordinance by the City Council, the Ordinance, supporting Memorandum, and Technical Appendix would serve as the basis for a proposal by the City of Cambridge to amend the State Implementation Plan for achieving air quality in the Commonwealth of Massachusetts.

* * * * *

Very truly yours,

Robert W. Healy
City Manager

RWH/jml
Enclosures

4.

CITY OF CAMBRIDGE
CAMBRIDGE, MASSACHUSETTS 02139
TEL. 349-4300
FAX. 349-4307

EXECUTIVE DEPARTMENT
ROBERT W. HEALY
City Manager

RICHARD C. ROSSI
Deputy City Manager

March 20, 1992

To the Honorable, the City Council:

Shortly after preparing the package of materials for Consent Agenda Item #3, I received the attached letter from Daniel S. Greenbaum, Commissioner of the Department of Environmental Protection (DEP).

I think Commissioner Greenbaum's very positive response to a draft of my proposed Trip Reduction Ordinance is a critical step in the process toward developing a SIP revision. Commissioner Greenbaum indicates that the proposed ordinance would clearly enhance the City's commitment to improving air quality. He also commends the extensive and creative work that has gone into the development of this proposal.

Commissioner Greenbaum also encourages us to formally submit this proposal to DEP so that it might be considered simultaneously with other parking control and trip reduction measures affecting other core communities in the region. I think this reference by the Commissioner emphasizes the need to move toward final action by the City Council as soon as possible.

Very truly yours,

Robert W. Healy
City Manager

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

William F. Weld
Governor
Daniel S. Greenbaum
Commissioner

March 20, 1992

Robert W. Healy
City Manager
Cambridge City Hall
Cambridge, Massachusetts 02139

Dear Mr. Healy:

My staff and I have reviewed a draft Cambridge Trip Reduction Ordinance which you are proposing in accordance with the August, 1990 Memorandum of Agreement between the Department and the City of Cambridge. I appreciate the extensive and creative work effort that has gone into the development of this proposal. The proposed ordinance which includes programs to control vehicle miles of travel to and in Cambridge would clearly enhance the city's commitment to improving air quality.

It is my understanding that the city will be moving quickly to submit the proposal to the Cambridge City Council for enactment as a city ordinance and then will make a formal submittal to the Department for subsequent processing as an amendment to the Massachusetts State Implementation Plan (SIP). I would encourage you to make this submittal at the earliest possible date; we then intend to process this submittal simultaneously with other parking control and trip reduction measures currently before us for other core communities in the region.

The proposal, which would be submitted as a revision to the existing Cambridge Parking Freeze once it is favorably acted on by the city council, must meet certain federal criteria to make it substitutable and enforceable. Any SIP revision must demonstrate that the air quality benefits of the revision are equal to or better than the existing parking freeze. In addition, any such proposal should contain monitoring and tracking provisions which will allow both the state and the U.S. Environmental Protection Agency to determine that the air quality goals of the proposal are continuously being met.

In closing, let me reemphasize that I am very encouraged with the progress the City of Cambridge has made in this difficult task. I look forward to receiving your formal submittal in the near future.

Sincerely,

Daniel S. Greenbaum
Commissioner

Comparative Estimates:
Reduction in Vehicle Miles Traveled
Resulting from Regulation of Currently Unregulated
On-Street Parking

Cambridge Systematics Scenario #1 (May 1991):

4,700 unregulated spaces	assumption
4,700 (100%) used by commuters	assumption
4,700 (100%) auto trips foregone due to regulation	assumption
18.7 miles round trip average	no source given

4,700 × 18.7 = 88,000 reduction in daily VMT

Cambridge Systematics Scenario #2 (March 1992):

4,700 unregulated spaces	assumption
2,820 (60%) used by commuters	assumption
1,880 (66⅔%) auto trips foregone due to regulation	assumption
18.7 miles round trip average	no source given

1,880 × 18.7 = 35,000 reduction in daily VMT

C. Bahne Estimate for CCLN (April 1992):

4,267 unregulated spaces	city inventory
1,500 used by commuters	estimate based on actual location of unregulated spaces according to city inventory
750 (50%) auto trips foregone due to regulation	assumption (may be overly generous)
12.7 miles round trip average	Cambridge Systematics report, Technical Appendix 3.2
20% adjustment for park and ride (60% of foregone trips become park-and-ride; these commuters still drive ⅓ of former distance)	assumption

750 × 12.7 = 9,500, less 20% = 7,600 reduction in daily VMT

This more realistic estimate is 8.6% of Cambridge Systematics' original estimate (Scenario #1) and 21.7% of their second estimate (Scenario #2).

December 3, 1990

EMPLOYER-PAID PARKING: THE INFLUENCE OF PARKING PRICES ON TRAVEL DEMAND

Prepared for:

Commuter Parking Symposium
Association for Commuter Transportation
Seattle, Washington
December 6-7, 1990

by

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Richard W. Willson
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California State Polytechnic University, Pomona

EMPLOYER-PAID PARKING: THE INFLUENCE OF PARKING PRICES ON TRAVEL DEMAND

ABSTRACT

Numerous case studies have shown that employer-paid parking increases solo driving to work. This employer intervention in commuters' travel choices counters public attempts to reduce traffic congestion, gasoline consumption, and air pollution. This paper summarizes previous case studies of the effect of employer parking subsidies on commuters' travel choices, and reports on a new multinomial logit model analysis of employer-paid parking in downtown Los Angeles. Comparing commuters who pay to park versus those who park free, we report on (1) the solo driver mode share, (2) the number of cars driven to work per 100 employees, (3) the price elasticity of demand for parking, and (4) the number of parking spaces demanded per 1,000 square feet of office space. The multinomial logit analysis of downtown Los Angeles commuters estimates a parking price elasticity of demand of -0.18 at the mean market parking price. To illustrate, if a downtown Los Angeles employer eliminated free parking, the model predicts that the solo driving share would decrease from 67 percent to 53 percent. This level of solo driving reduction compares favorably with other much more costly strategies to reduce peak period auto travel. That mode shift reduces the amount of parking "needed" from 2.45 spaces per 1,000 square feet to 2.05 spaces per 1,000 square feet of office space.

The income tax exemption of employer-paid parking subsidies strongly encourages employers to subsidize their employees' parking, and thus indirectly encourages commuters to drive to work alone. To combat the harm caused by the tax-exemption for employer-paid parking, we argue the case that an employer who offers any employee a parking subsidy should be required (either by local ordinance or by the internal revenue code) to offer that employee the *option* to take the fair market value of the parking subsidy as a cash travel allowance instead of as a parking subsidy. No employee would be faced with the loss of any existing parking subsidy as a result of this policy. Instead, employees would receive a new option, the alternative of choosing cash. Employers could continue with any existing parking subsidy arrangement, so long as they broaden the offer to include the *option* of using the cash value of the parking subsidy for any other purpose the employee prefers. Requiring employers to offer employees the *option* of the equivalent cash value of any parking subsidy would reduce traffic congestion, air pollution, and gasoline consumption, and *would do this by aligning commuters' travel choices more closely with their own preferences.*

EMPLOYER-PAID PARKING: THE INFLUENCE OF PARKING PRICES ON TRAVEL DEMAND

I. INTRODUCTION

Although employer-paid parking may appear to be a generous, enlightened, and popular employment policy, it is also a strong incentive to drive to work alone, and it strongly works at cross purposes with public policies designed to reduce traffic congestion, energy consumption, and air pollution. This paper summarizes previous evidence of the effect of employer parking subsidies on mode choice and parking demand, and includes new evidence from a logit analysis of downtown Los Angeles office workers. The paper concludes with a discussion of policies to reduce the level of parking subsidies.

II. EMPLOYERS' INFLUENCE ON COMMUTERS' TRANSPORTATION COSTS

Nine out of every ten American commuters who drive to work park free at work. Three studies have documented this fact. First, Shoup and Pickrell (1980) used National Personal Transportation Study data to estimate that 93 percent of auto commuters parked free. Second, a 1988 survey found that 91 percent of employees in Los Angeles, Riverside, San Bernardino, and Ventura Counties park free (Commuter Transportation Services, Inc. 1988). Finally, a 1989 survey of large SMSAs found that 90 percent of those who drive to work park free (Center for Urban Transportation Research 1989).

Even in downtowns where parking is most expensive, many auto commuters pay nothing for parking. For example, more than half of the 114,000 office workers who drive to downtown Los Angeles receive parking subsidies. Most of those receiving a subsidy pay nothing for parking (47 percent of all drivers), while another 7 percent of all drivers receive partial parking subsidies (Willson and Shoup 1990a).

The difference between receiving free parking and paying for parking greatly affects overall travel costs. The powerful influence of parking subsidies on travel costs can be illustrated in three ways. First, the offer of free parking is often worth more than the offer of free gasoline. For commuters to downtown Los Angeles in 1986, Willson and Shoup (1990a) found that the average round trip length for those who park free is 36 miles. If their gasoline mileage is 20 miles per gallon, the round trip to work consumes 1.8 gallons of gas, and if gas costs $1 per gallon, the cost of gas for the average round trip commute trip is $1.80 (or $2.70 if gas costs $1.50 per gallon). But the average daily equivalent cost of monthly parking in downtown Los Angeles was $4.32, far more than the cost per trip for gasoline. An employer's offer of free gasoline to employees if they drive to work would seem a reckless incentive to drive alone, yet employer-paid parking is a much stronger incentive.

Second, employer-paid parking subsidies dwarf the gasoline tax paid for the average commute trip. A parking subsidy of $4.32 for a trip that consumes 1.8 gallons of gas is equivalent to a subsidy of $2.40 per gallon of gas used. The federal gasoline tax would have to be raised from 14 cents to $2.49 per gallon merely to offset the parking subsidies now given to over 50,000 solo drivers who park free at their employers' expense in downtown Los Angeles. Thus, even very large increases in the gasoline tax would decrease solo driving to work by much less then employer-paid parking already increases it.

A third way to illustrate the effect of employer paid parking is to compare it to a congestion toll. If the average round trip drive to work is 36 miles, and the average parking subsidy is $4.32 per day, the parking subsidy is equivalent to 12 cents per mile travelled. Thus, imposing a congestion toll of 12 cents per mile travelled would do no more to discourage commuters from driving to the Los Angeles CBD than employer-paid parking already encourages it. And employers fully subsidize parking for almost half of all the solo drivers to downtown Los Angeles.

If you subsidize something you get more of it. Because employer-paid parking so heavily subsidizes solo driving to work, it undoubtedly increases the amount of it. The next two sections present empirical evidence on the extent to which employer-paid parking increases solo driving to work.

III. EVIDENCE FROM CASE STUDIES

We first review several previous case studies that examine how employer-paid parking affects commuter mode choice. In each case we use three measures to summarize the effect of employer-paid parking:

1) the *share of commuters who drive to work alone;*
2) the *number of autos driven to work per 100 employees*; and
3) the *price elasticity of demand for parking.*

The first measure is used because many public policies are intended to reduce solo driving to work. The second measure reveals the implications of parking subsidies for trip generation and parking requirements. Finally, the third measure standardizes the parking price changes in the case studies, and can be interpreted as the percent decrease in parking demand that would accompany a one percent increase in parking price.

We assembled all the existing well-documented case studies of how employer-paid parking subsidies affect travel behavior. These case studies have either: (1) examined the commuting behavior of employees *before* and *after* employer-paid parking was eliminated; or (2) compared the commuting behavior of matched samples of employees *with* and *without* employer-paid parking. Willson and Shoup (1990b) summarize these cases, covering a variety of locations, and employer and employee types.

Table 1 shows how ending employer-paid parking reduces the *solo driver share*. The smallest reduction in the number of solo drivers was 18 per cent, and the largest reduction was an impressive 81 per cent (in this case the employer eliminated free parking only for solo drivers).[1]

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1. It should be noted that in the Warner Center and Ottawa cases, some subsidy for solo drivers remained. Also, in the Warner Center and Mid-Wilshire case studies, parking continued to be free for carpools. Therefore, these studies do not show the effect of a *total* elimination of parking subsidies.

Table 1
HOW EMPLOYER PARKING SUBSIDIES AFFECT SOLO DRIVING

Case Study and Type	Solo Driver Mode Share		
	Employer Pays for Parking	Driver Pays for Parking	Decrease in Solo Drivers
Mid Wilshire, Los Angeles (before/after)	42%	8%	-81%
Warner Center, Los Angeles (before/after)	90%	46%	-49%
Century City, Los Angeles (with/without)	92%	75%	-18%
Civic Center, Los Angeles (with/without)	72%	40%	-44%
Downtown Ottawa, Canada (before/after)	35%	28%	-20%
AVERAGE OF CASE STUDIES	66%	39%	-41%

Table 2
HOW EMPLOYER PARKING SUBSIDIES AFFECT AUTOMOBILE TRIPS

Case Study and Type	Autos Driven per 100 Employees			
	Employer Pays for Parking	Driver Pays for Parking	Decrease in Auto Trips	Price Elasticity of Demand for Parking
Mid Wilshire, Los Angeles (before/after)	48	30	-38%	-0.23
Warner Center, Los Angeles (before/after	92	64	-30%	-0.18
Century City, Los Angeles (with/without)	94	80	-15%	-0.08
Civic Center, Los Angeles (with/without)	78	50	-36%	-0.22
Downtown Ottawa, Canada (before/after)	39	32	-18%	-0.10
AVERAGE OF CASE STUDIES	70	51	-27%	-0.16

Table 2 shows two measures of how ending employer-paid parking reduces the number of automobile trips to the site.[2] The first is the number of *cars driven to work per 100 employees*. This measure indicates how trip generation and parking demand would vary under different parking subsidy circumstances. Because some solo drivers shift to carpools when employers eliminated parking subsidies, the number of autos driven to work does not decline by as much as the number of solo drivers, but the decline is still very impressive, ranging from 15 to 38 per cent. The second measure is the *parking price elasticity of demand* for automobiles driven to work, and hence parking. This elasticity allows one to compare the sensitivity of the number of automobiles driven to work for a given standard change in parking cost. The price elasticity ranges from -0.08 to -0.23, and the average change is -0.16.

IV. NEW EVIDENCE FROM A DOWNTOWN LOS ANGELES MODE SURVEY

Willson and Shoup (1990c) report on their progress in developing a logit model analysis of downtown Los Angeles commuters. The work uses a 1986 Los Angeles Community Redevelopment Agency mode choice survey of downtown Los Angeles office workers, entitled *Los Angeles CBD Employee-Employer Baseline Travel Survey*. The survey includes a matched sample of 5,060 employees and 118 employers. The survey collected information on both parking prices and parking subsidies for each employee, so it is possible to determine not only the parking price that drivers paid, but also the parking price that non-drivers would pay if they drove to work. This ability to determine accurately the parking price that non-drivers would pay if they drove is relatively rare in conventional mode choice surveys.

The survey also collected information on a number of other factors (such as distance to work, income, gender, travel time by each mode, vehicle availability) that affect travel mode choices, so an analytic technique which can isolate the effect of parking prices was used. The most widely accepted procedure for modeling mode choice is the multinomial logit model. The mode choices were defined as follows: (1) solo driver; (2) carpool/vanpool; and (3) public transit. The multinomial logit model estimates the probability that a commuter will chose each of the three modes for the journey to work.

The estimated model is shown in Appendix A, based on a sample size of 713 cases. A negative coefficient is estimated on the parking cost variable, which indicates that as parking costs increase, the probability of driving decreases. In order to test the model, the full sample data set was used to make predictions with the estimated model. The mode share in the sample is 64 percent solo driver, 17 percent pool vehicle and 19 percent transit. The model estimated mode share to within a percentage point of each mode when used to predict the baseline mode share.

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2. The number of cars driven to work per 100 commuters incorporates the effect of employer-paid parking subsidies not only on the number of commuters who drive to work solo, but also on the number who carpool, ride public transit, walk, and bike to work. Most of the case studies surveyed do include information on the share of employees who carpool, but not on the average carpool size. In order to estimate the number of cars driven to work by carpoolers, we use the figure of one vehicle per 2.62 carpool/vanpool commuters, which was found in the 1988 *Commuter Survey* of Southern California commuters conducted by Commuter Transportation Services, Inc.

Willson and Shoup use the estimated model to predict mode change under different after-subsidy parking prices by changing the parking cost component of the parking cost/income variable for each case from its actual level to the cost being tested. For example, in testing a parking price of $0, we set the parking price for all individuals in the sample to $0. Table 3 shows the predictions of the model under a range of after-subsidy parking prices. The predictions are shown as mode shares, and are converted to the number of cars driven to work per 100 employees.[3] Mid-point elasticities for $1 increments in parking price also calculated, based on the number of cars driven to work per 100 employees. These are elasticities of the *after-subsidy* parking price, expressed as the daily equivalent of monthly permit parking.

In situations where high parking prices appear not to discourage solo driving to work, this outcome can occur because commuters actually pay nothing to park, no matter how much it costs. Because the model shown in Appendix A is estimated with accurate data on the *after-subsidy* price of parking, the influence of parking prices on travel choices is not masked by employer-paid parking subsidies.

Table 3 shows that commuters are sensitive to the after-subsidy price of parking. If an employer who gave free parking to all employees eliminated parking subsidies, the solo share of that employer's workers is predicted to fall from 66 percent to 53 percent, at the 1986 average downtown parking price of $4.32. Figure 1 shows the sensitivity of mode choice to after-subsidy parking price in a graphic form.

Table 3 also shows the model's prediction that 72 cars per 100 employees would be driven to work by those who park free, while 60 cars per 100 employees would be driven to work by those who pay the 1986 market price of $4.32. Thus, in this case employer-paid parking leads to a 20 percent increase in the number of cars driven to work.

The elasticities shown on Table 3 rise with the price of parking, since a one percent increase on a base of $8 per day parking is more onerous than a one percent increase on a base of $1 per day parking. The elasticity calculated at the $4.32 market parking cost is -.18, indicating that automobile trip generation and parking demand significantly decline as the after-subsidy price of parking increases.

Figure 2 converts the *number of cars driven to work per 100 employees* to the *number of parking spaces per 1,000 square feet* of office space, and plots the new measure as a demand curve for parking.[4] When parking is free, 2.45 spaces per 1,000 square feet are demanded; when parking costs

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3. The mean carpool/vanpool size of 2.92 for commuters to downtown Los Angeles found in the *Baseline Survey* is used to convert mode share into the number of cars per 100 employees.

4. *Cars per 100 employees* is translated to *parking spaces per 1,000 square feet* assuming an office occupancy density of 4.2 employees per 1,000 square feet, an employee absenteeism rate of 14 percent, and a peak parking occupancy factor of 94 percent (all derived from the Baseline Survey and a Wilbur Smith and Associates 1981 study of downtown Los Angeles parking). For example, if there are 4.2 employees per 1,000 square feet, and 0.72 cars driven to work per employee (the figure estimated when parking is free), there are 3.0 cars driven to work per 1,000 square feet. Not all these drivers require parking spaces at the peak accumulation period on a given day. So the 3.0

Table 3
SENSITIVITY OF MODE CHOICE TO PARKING PRICE

After-Subsidy Parking Price	Mode Share			Cars per 100 Employees	Mid-Point Elasticity of Demand
	Solo	Carpool	Transit		
$0	67%	16%	18%	72	
$1	64%	17%	19%	69	-0.02
$2	60%	18%	21%	67	-0.06
$3	57%	19%	23%	64	-0.10
$4	54%	21%	25%	61	-0.15
$5	51%	22%	27%	59	-0.20
$6	48%	22%	29%	56	-0.25
$7	46%	23%	31%	54	-0.30
$8	43%	23%	34%	51	-0.35
$9	41%	24%	36%	49	-0.40

Figure 1
PARKING PRICE AND MODE CHOICE

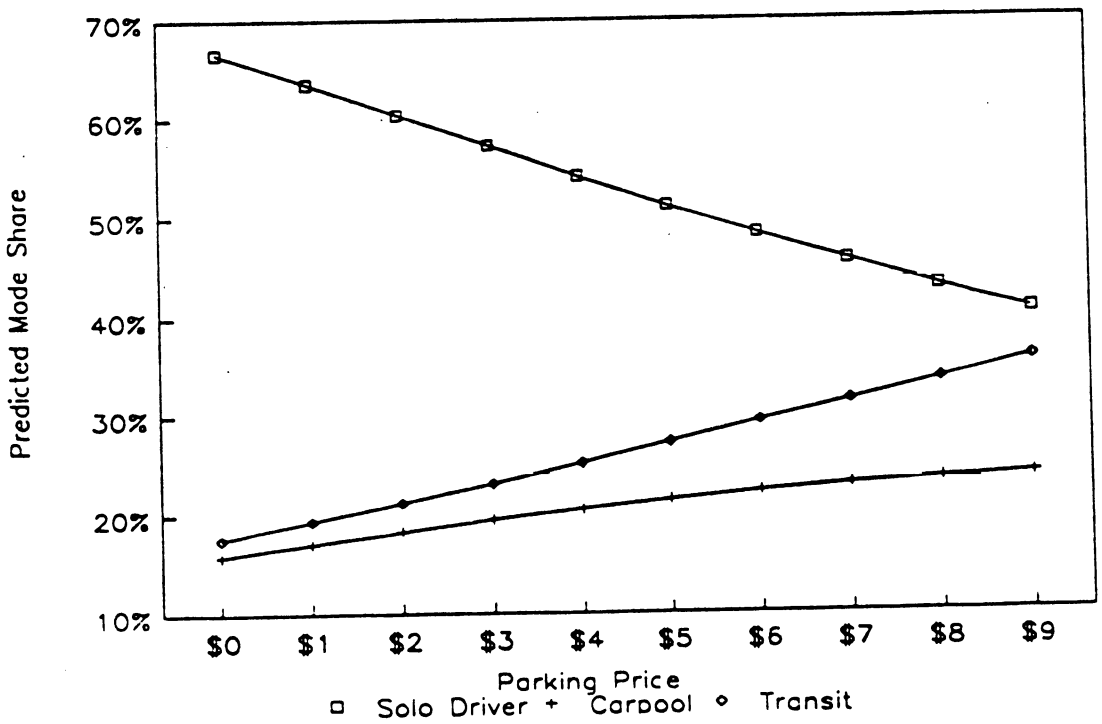
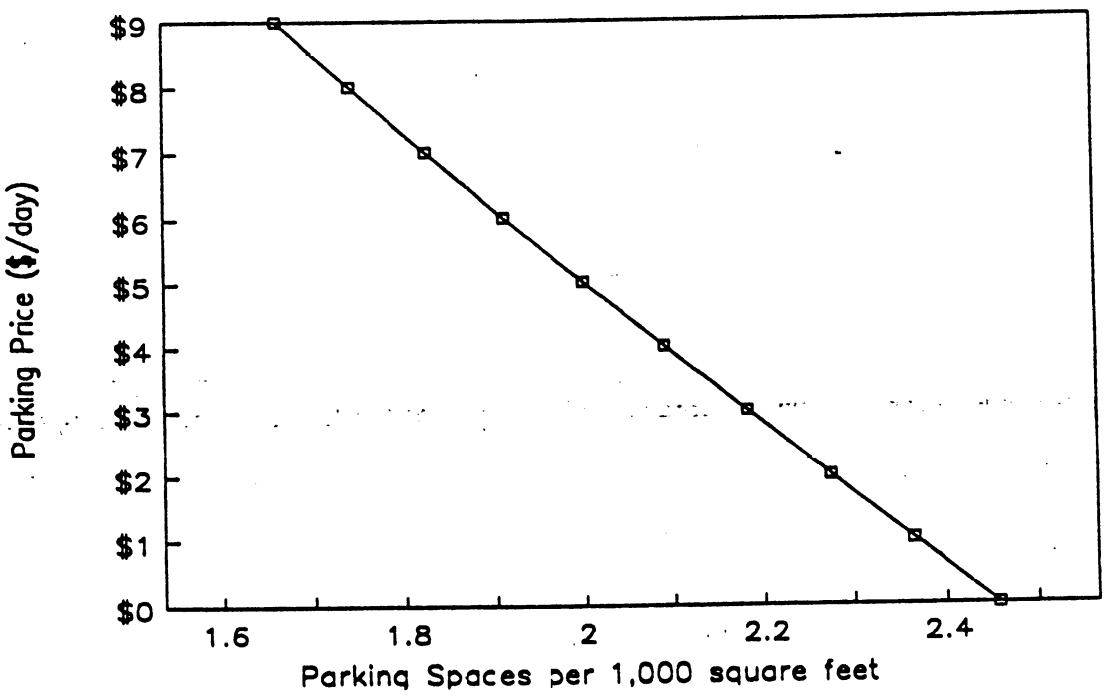


Figure 2
PARKING DEMAND CURVE



$8, only 1.74 spaces per 1,000 square feet are demanded. This finding clearly refutes the notion that the demand for parking can be established (by ordinance or otherwise) *without reference to the price charged for parking.*

V. DISTORTIONS CAUSED BY THE TAX EXEMPTION OF EMPLOYER-PAID PARKING

A. Private Waste and Public Harm

Employer-paid parking is often a take-it-or-leave-it offer. That is, employees are usually not offered any alternative benefit of equivalent value if they do *not* take the parking. Therefore, some employees who value the parking at less than the cost to the employer of providing it will nevertheless take the parking subsidy rather than nothing. For example, suppose the market price of parking at your work site is $50 per month. Suppose also that at any parking price less than $30 per month you would choose to drive to work alone, but if you had to pay anything more than $30 per month to park at work, you would instead choose to commute by bus or bicycle. Thus, if your employer offers you free parking at work (by paying the $50 a month parking charge for you), you would drive to work alone. If, however, your employer offered you the choice between *either* the free parking space *or* the $50 it costs your employer to provide it, you would take the $50 in cash, and then ride the bus or bike to work.

In the situation just described, the offer of employee-paid parking (without the option to choose its cash value instead) has two undesirable consequences. First, it is *privately wasteful,* because you take a parking space that you do not think is worth what it costs. Your employer is paying $50 a month to provide you with something that is worth only $30 a month to you. That represents a net loss of $20 per month in income to you, compared to the alternative of taking the $50 parking subsidy in cash instead.

Of course, if you would choose to drive to work even when parking costs you more than $50 a month, the offer of employer-paid parking does not alter your commute decision, and is therefore not privately wasteful in the sense just argued. The subsidy is worth as much to you as it costs your employer. But all the studies cited earlier clearly demonstrate that many employees do *not* think their parking spaces at work are worth what it costs their employers to provide them, because when commuters have to pay for their own parking, many of them do stop driving to work alone. As one specific example, consider the results found in a Los Angeles case study cited earlier, where an employer ceased offering to pay for parking at work for solo drivers (Surber, Shoup, and Wachs, 1984). Of the 42 solo drivers who had previously been offered free parking, *only one* solo driver chose to pay the market price of $57.50 a month to continue parking in the previously free spaces. That is, 98 percent of all employees who drove to work alone when their employer paid for their parking felt that the parking spaces were *not* worth the $57.50 per month that their employer had been paying for them. This suggests the potential for a considerable amount of private waste involved in offering parking subsidies that are worth less than they cost.

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spaces per 1,000 square feet is multiplied by .86 (to account for employee absenteeism) and .94 (to account for the fact that not all employees who drive park during the peak parking occupancy period), yielding a demand of 2.45 spaces per 1,000 square feet.

parking privileges are intimately related to one's status within an organization, so any proposal to reform parking subsidies must be approached gingerly.

VI. LOCAL ACTION TO REMOVE DISTORTIONS CAUSED BY THE TAX-EXEMPTION OF EMPLOYER-PAID PARKING

Given the extreme sensitivity of the issue, is there any possible public policy that can achieve the benefits of ending employer-paid parking, without encountering the inevitable strong opposition to taking away the substantial subsidies now given to so many commuters? We believe that there is, and that a good example of it exists in the City of Los Angeles' year-old employee transit subsidy ordinance. This ordinance requires that:

> Each employer in the City that offers free or subsidized parking to any employee ... shall offer a $15 (fifteen) per month transit subsidy to each of its employees for their use in commuting to and from the employer's work-site .... (Section 85.05 of the Los Angeles Municipal Code.[5])

This ordinance has aroused no significant opposition, but it has had a limited effect in counteracting the effect of parking subsidies. Because the required transit subsidy is only $15 per month, and because parking subsidies are often far higher than that, the offer of a $15 transit subsidy in lieu of a parking subsidy may have only a slight effect of mode choice.[6] Nevertheless, the required transit subsidy is a sensible, sensitive, and minimally intrusive public policy that is intended to counteract the harmful effects of parking subsidies by expanding the commuter's options beyond the usual choice between a parking subsidy or nothing.

The precedent already successfully set by Los Angeles' transit subsidy requirement suggests the following policy that we recommend as a logical next step to further expand the commuter's options. Building on what the City of Los Angeles has already done, and using the language of its ordinance, any city could require that:

> *Each employer in the City that offers free or subsidized parking to any employee shall offer that employee the choice of taking the market value of the parking subsidy as a cash travel allowance if the employee does not take the parking subsidy.*

This proposed policy of requiring employers who offer parking subsidies also to offer the cash equivalent to employees has, we believe, several important advantages that deserve serious consideration by employers, by employees, and by public policy makers.

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5. The Los Angeles ordinance restricts the transit subsidy requirement to employers who are subject to the South Coast Air Quality Management District's Regulation XV (that is, employers with 100 or more employees at a single work site), but this does not seem to be a necessary feature of the policy. The full text of the ordinance is provided in the Appendix.

6. The figure of $15 per month was chosen for the Los Angeles ordinance because it is the maximum transit subsidy that is exempt from federal income tax. Any transit subsidy greater that $15 per month is taxable, *including the first $15 of the subsidy.*

1. First, and politically very important, no employee would be faced with the loss of any existing parking subsidy as a result of this policy. Instead, employees would receive a new option, the cash alternative. Employers could continue with any existing parking subsidy arrangement, so long as they broaden the offer to include the *option* of using the cash value of the parking subsidy for any other purpose the employee prefers.

2. Any employee who does choose the cash alternative rather than the parking must, by definition, be better off as a result of the choice. If employees do *not* consider themselves better off as a result of choosing the cash alternative, they won't choose it because they can, if they wish, continue to take the parking subsidy. Rather than restricting any employee's options, the proposed requirement *adds* a new option (the cash alternative) for many employees who now face a take-it-or-leave-it choice between a parking subsidy or nothing.

3. Employers are no worse off if an employee chooses the cash alternative rather than a parking subsidy because the cash alternative is no more costly than the parking subsidy. Further, employers might be much more willing to offer the cash alternative if they know that all similarly situated employers are required to make the same offer, so that there can be no question of anyone being put at any competitive disadvantage. Employers should find it difficult to argue publicly that they ought to be allowed to offer parking subsidies alone, without the alternative of taxable cash for an employee who would prefer not to drive to work. Given the serious environmental and traffic problems facing most cities, what valid, persuasive purpose would an employer publicly submit to justify subsidizing *only* employees who drive to work, without offering an equivalent subsidy to those same employees who would voluntarily elect to quit driving to work?

4. The option of taxable cash in lieu of a parking subsidy would most tempt those auto commuters who now receive employer-paid parking in locations where parking prices are highest. Because parking is usually most expensive in the most congested areas, the incentive to stop driving to work alone would automatically be targeted where it is most needed.

5. The proposed cash alternative requirement is minimally intrusive in employers' decisions on how to compensate their employees. The Los Angeles transit subsidy ordinance quoted above requires that the employer offer transit subsidies to *all* employees if a parking subsidy is offered to *any* employee. Our proposed cash alternative policy would require only that an employer who offers an employee a parking subsidy must also offer that same employee the equivalent cash alternative, without imposing any further requirement regarding other employees. An employer could also offer any ridesharing incentives, such as free bus passes or vanpool subsidies.

6. Finally, offering commuters the option to choose between cash and a parking space makes it clear that parking is not free. Therefore, all employees, even those who are offered free parking at work, would begin to consider the cost of parking as an important factor in deciding how to commute to work. Previous research has clearly demonstrated that the cost of parking, previously hidden from many commuters by parking subsidies, profoundly influences commuters' mode choices. The available option of cash in lieu of a parking subsidy would be a strong incentive to rideshare, ride transit, bicycle, or walk to work. By allowing market prices to influence choices, a regulation requiring employers to offer employees the *option* of the equivalent cash value of any parking subsidy would not only reduce traffic congestion, air pollution, and gasoline consumption, but *would do so by bringing commuters' travel choices more in line with their own preferences about how they wish to spend their income.*

In addition to the private waste it entails, employer-paid parking is *publicly harmful,* because it needlessly increases the number of cars driven to work, with all the added external costs that implies. On average, the case studies summarized in Table 2 suggest that ending employer-paid parking decreases the number of cars driven to work by 27 percent. Said the other way around, *offering* employer-paid parking *increases* the number of cars driven to work by 27 percent. In addition, analysis of the 1986 survey data for commuters to the Los Angeles CBD showed that employer-paid parking increased the number of cars driven to work by 20 percent. Thus, employer-paid parking subsidies clearly aggravate the already serious urban problems of traffic congestion and air pollution.

Subsidies are usually justified on the grounds that they encourage desired behavior. When private market prices are, for some reason, believed to deviate from social values, subsidies can be used to correct for this deviation of market prices from social values. But employer-paid parking is an altogether anomalous subsidy, because it strongly encourages the very behavior - solo driving to work - that other subsidies and public policies are trying to discourage. Market parking prices, based on real costs, send a direct signal to commuters to rideshare, but employer-paid parking shields commuters from these market signals and skews commuters' choices toward driving to work alone.

Given the ample and growing body of evidence that employer-paid parking is both privately wasteful and publicly harmful, what explains its ubiquity? Why don't employers instead offer their employees a cash commute allowance that employees could use as they choose? The cash commute allowance would not be privately wasteful, because it would not tempt employees to park in spaces they don't think are worth the cost, and it would not be publicly harmful, because it would not induce commuters to drive to work alone.

B. Effects of Federal and State Income Tax Policy

The strongest explanation for the prevalence of employer-paid parking is that federal and state income tax laws exclude the value of parking subsidies from taxable income. The favored income tax treatment of employer-paid parking subsidies makes it tax-efficient for employers to convert some of their employee compensation from cash into a parking subsidy. Table 4 shows, for each taxable income bracket, how much an employer in California would have to pay an employee in taxable cash income to equal the value of $1 of tax-exempt parking subsidy. For example, for an employee whose taxable income is $45,000 per year, an employer would have to pay the employee $1.51 in taxable cash income to yield, after federal and state income and social security taxes, the after-tax equivalent of a $1 tax-exempt parking subsidy. Thus, the offer of employer-paid parking as a tax-exempt fringe benefit is worth 51% more than a taxable cash commute allowance equal to the cost of a parking space at work. The "tax efficiency" of employer-paid parking is thus a strong incentive to include it as part of an employee's compensation package.

Ridesharing and mass transit advocates have for many years argued that the tax treatment of parking and other transportation benefits should be revised to eliminate the bias in favor of employer-paid parking. But it is very difficult to eliminate a tax exemption that benefits so many workers, at all income levels. Although the tax exemption provides the greatest benefits to those in higher income tax brackets, eliminating it would affect many low-wage employees as well. Thus, no matter how strongly one believes that it is a good idea, it seems unrealistic, even quixotic, to recommend ending the income tax exemption of employer-paid parking. Quite aside from the money involved,

Table 4

TAXABLE CASH EQUIVALENT OF A TAX-EXEMPT PARKING SUBSIDY

Taxable Income	Marginal Tax Rate	Cash Equivalent of $1 Parking Subsidy
$19,056 - $30,070	18% *	$1.23
$30,071 - $32,450	20% *	$1.25
$32,451 - $41,746	32% *	$1.48
$41,747 - $52,760	34% *	$1.51
$52,761 - $78,400	35%	$1.53
$78,401 - $185,730	39%	$1.65
over $185,731	35%	$1.53

The marginal tax rate is the combined federal and California marginal income tax rate for a married couple filing jointly, based on 1990 federal and 1989 state tax brackets and personal exemptions.

* Includes 7.65% Social Security tax rate on incomes up to $51,300 per year.

In making the choice between a parking subsidy or its cash equivalent, employees would, of course, have to consider that the cash is taxable, while the parking subsidy is not. Many employees, however, might still prefer the after-tax value of the cash alternative to an untaxed parking subsidy. For example, an employee who is offered the choice between the free use of a parking space that costs $50 per month, or $50 per month extra in before-tax income, might well prefer to take the taxable cash. For an employee with a taxable income of $45,000 per year and in the 34% marginal tax bracket, the after-tax value of an extra $50 per month in cash income is $33 per month, which might be worth more to the employee than a parking space.

The taxability of a cash payment in lieu of a parking subsidy reduces, but by no means eliminates, the effectiveness of offering the cash alternative as an incentive to rideshare. The problem that cash is taxable but a parking subsidy is tax exempt is *not* an argument against the proposed requirement that employers who offer parking subsidies should also offer the cash alternative. If an employee freely chooses the taxable cash alternative because he or she feels that taxable income is worth more than a tax-exempt parking subsidy, how can anyone else argue that the employee is making the wrong choice? Indeed, if an employee does choose the taxable cash alternative, the choice proves beyond doubt that the parking subsidy is worth considerably less to the employee than it costs the employer, and is thus not only socially harmful but also privately wasteful.

Although any employer can, acting independently, offer employees cash alternatives to parking subsidies, our federal and state income tax laws clearly stack the deck in favor of offering parking subsidies. This explicit tax bias in favor of employer-paid parking is entirely inappropriate, especially in central cities where employer-paid parking most underprices car trips to the very places where public transit is most available, traffic is most congested, and the air is most polluted.

Naturally, the federal and state tax exemption of parking subsidies is a strong motivation for employers to offer their employees free parking, but a local government cannot change that. A local government *can,* however, implement our proposed requirement that employers who offer parking subsidies must also offer the cash equivalent as an alternative, with the Los Angeles transit subsidy requirement as a strong legal and practical precedent.

VII. FEDERAL ACTION TO REMOVE DISTORTIONS CAUSED BY THE TAX-EXEMPTION OF EMPLOYER-PAID PARKING

An important aspect of offering employees taxable cash as an optional alternative to employer-paid parking subsidies is that when anyone voluntarily does choose taxable cash rather than a tax-exempt parking subsidy, *federal and state income tax revenues increase.* This increase in revenue does not result from any increase in tax rates, or from any taxation of previously tax-exempt parking subsidies, but rather it results from voluntary cashing out of inefficient parking subsidies that are worth much less to the employee than they cost the employer. The resulting federal and state income tax revenue bonus thus is funded solely by reducing the private waste initially induced by the parking subsidy tax exemption. Further, the tax revenue bonus is an additional benefit above and beyond any reductions in air pollution, traffic congestion, and energy consumption that result when commuters elect to take taxable cash rather than a tax-exempt parking subsidy.

The potential for federal and state tax revenue increases suggests that federal and state governments also have a strong interest in seeing that employers offer their employees the *option* to take taxable cash in lieu of a parking subsidy. To encourage employers to offer this option, the

federal income tax code could be changed in the following way: employer-paid parking subsidies could remain as a tax-exempt fringe benefit, *but the parking subsidy would be tax-exempt only if the employer offers the employee the option to take the market value of the parking subsidy as a taxable cash travel allowance in lieu of the parking subsidy.*

In addition to the advantages listed above for the municipal variant of the cash alternative proposal, the proposed federal income tax change would eliminate the need for thousands of local governments to enact their own individual ordinances. The federal income tax exemption for parking subsidies is the origin of the inappropriate incentive for employers to offer free parking, and it should not be left to all local governments to design and implement individual policies that are all directed solely toward countering this incentive. Also, the argument for requiring employers to offer their employees the *option* to take taxable cash in lieu of any tax-exempt parking subsidy offered is even stronger at the federal and state level than it is at the local level, because any resulting increase in income tax revenue would accrue to the federal and state governments.

To suggest the revenue potential of the taxable cash alternative requirement, there were 110,000,000 employees on civilian nonagricultural payrolls in the United States at the end of 1989 (*Economic Report of the President, 1990*, p. 342). Eighty-six percent of the American workforce commutes to work by car (Pisarski, 1987), and, as cited earlier, 90 percent of auto commuters park free at work. If the average cost of providing this parking is $30 per month, and if 20 percent of existing auto commuters who get free parking choose the taxable cash alternative, taxable income would increase by $6.1 billion per year. If the effective marginal tax rate on this income is 20 percent, the increase in tax revenue would be $1.2 billion per year. *This revenue increase would occur without increasing any tax rates, and without removing the existing tax exemption of employer-paid parking.* As argued earlier, this revenue increase would result from the voluntary choices of employees who prefer the *taxable* cash value of the *tax-exempt* parking subsidies they now receive.

In this calculation, the assumed market parking price of $30 per month is above the price of many commuter parking spaces, but those who now get the biggest parking subsidies would be the ones most tempted to take the cash alternative. Thus, the taxable cash alternative received by those who do choose to cash out their parking subsidies could well be significantly above the average market price of parking for all workers. The assumption that 20 percent of those who now park free would give up a parking subsidy to choose the cash alternative is less than the average 28 percent reduction in auto trips to work found in the case studies comparing auto use between commuters who do and commuters who do not pay for parking at work. Finally, the assumed 20 percent combined federal and state income tax and social security tax rate is a conservative estimate of the marginal tax rate faced by those employees who would choose the taxable cash alternative to a parking subsidy, because most employees pay a marginal tax rate significantly above 20 percent (see Table 4). For all these reasons, the revenue estimate of $1.2 billion per year is quite conservative.[7]

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7. It might be argued that the additional taxable income paid to employees would be offset by reduced taxable income for the employers who pay the new cash travel allowances. But to the extent that employers fund the cash travel allowances by reducing parking subsidies, the employer's taxable income is unaffected.

VIII. PROBLEMS WITH REQUIRING THE OFFER OF A TAXABLE CASH ALTERNATIVE TO PARKING SUBSIDIES

Three important, interrelated questions regarding any requirement that employers offer their employees the option of taking a parking subsidy in cash are (1) how is the equivalent cash value of a parking subsidy defined, (2) how will employers find the money to pay the cash equivalent, and (3) how will the cash alternative requirement be enforced?

1. What is the Equivalent Cash Value of a Parking Subsidy?

In regard to the first question of how a parking subsidy is defined, consider the situation where there is an active market for off-street parking, as there is in most downtown areas. Then, the cash value of an employer-paid parking subsidy is the difference between (1) the *market price* of the parking spaces offered to employees, and (2) the *price that employees pay* for parking in these spaces. For example, suppose the market price of commuter parking is $50 per month in the vicinity of the work site, and the employer offers free parking to employees. Then the equivalent cash value of the parking subsidy is $50 per month. Similarly, if the market price of parking is $70 per month, and the employer offers the spaces to employees for $20 a month, the equivalent cash value of the parking subsidy is also $50 a month. And in each case the offer of $50 a month in taxable cash costs the employer no more than the offered parking subsidy.

Suppose, however, the work site is in an area where parking is so abundant that the market price is zero. In that case, the required cash alternative would also be zero because there is no market for any parking spaces that employees do not use. However, an employer who buys or constructs *new* parking spaces to offer free to employees would presumably have to offer as the cash alternative of those new spaces the monthly equivalent of the cost of constructing, maintaining, and operating those new spaces; otherwise, the cost of the new spaces would constitute a subsidy to drivers for which no equivalent cash alternative is made available to nondrivers. Thus, before an employer decides to construct new parking spaces, if enough existing auto commuters elect to take the alternative cash value of the proposed spaces, it could eliminate or at least reduce the demand for new spaces.

There is also the problem that, for employees who are subject to Social Security taxes on additional income, the employer would have to pay an extra 7.65 percent Social Security payroll tax, plus any other applicable local payroll tax levied on employers, on any tax-exempt parking subsidy that is converted to a taxable cash allowance. Thus, if an employee opts for the cash equivalent of a parking subsidy, the cost to the employer for the taxable cash allowance would exceed the cost of the parking subsidy. If the burden of payroll taxes levied on employers is considered a serious objection to requiring employers to offer employees the option of a cash allowance in lieu of free parking, the objection can be met by defining the equivalent cash value of a parking subsidy as the cash value that, when the *employer's* payroll taxes on that cash value are added, equals the fair market value of the parking subsidy. For example, if the employer pays an employee a taxable cash allowance equal to 93 percent of the fair market value of a forgone tax-exempt parking subsidy, the employer's 7.65

percent Social Security tax payment on this taxable cash allowance brings the employer's cost of the allowance up to the cost of the parking subsidy.[8]

2. How Will Employers Find the Money to Pay the Cash Value of Parking Subsidies?

In regard to the second question of how employers will find the money to pay employees the cash equivalent of the parking subsidies not taken, the situation is simplest in the case where the employer rents parking spaces from a building landlord, and makes the parking spaces available to employees for free. Then, if an employee who now drives to work when parking is free elects to take the cash value of the parking space instead, the employer saves on parking exactly what is paid in cash.

Even in this simple case, however, the employer faces a problem with employees who are now offered parking subsidies but do not take them. For example, employees who now turn down the offer of a parking subsidy and, say, bicycle to work, cost their employers less than do otherwise similar employees who do take the offer of a parking subsidy. If these employees who now turn down parking subsidies become eligible for the equivalent cash value of the parking subsidies they already don't take, these current nondrivers would begin to cost their employers the same as drivers who do take the parking subsidies. This cost increase would be very limited, however, because, as cited earlier, only 14 percent of all workers now do not drive to work, and many of these nondrivers presumably are not offered a parking subsidy. Naturally, any current driver who now receives an employer-paid parking subsidy and who elects to take the cash value of the subsidy instead would not raise an employer's subsidy cost at all, because the cash offer is entirely funded by the avoided parking subsidies.

Employer-paid parking is, in effect, a form of wage discrimination in favor of employees who drive to work. The economic motivation for this wage discrimination is, presumably, that employees who drive to work can choose among a large number of employers within commuting distance, while those who don't drive to work have a more limited commuting area in which to seek employment. If an employer did *not* offer a parking subsidy to drivers, they would be more likely to work elsewhere, because they can choose among a larger number of potential employers within commuting distance. The employer doesn't have the same incentive to offer nondrivers an equivalent subsidy because the nondrivers have fewer choices among alternative employment options.[9]

This wage discrimination in favor of drivers who have a wider option among employers is a rationale for offering employer-paid parking that is separate from and additional to the tax-efficiency rationale created by the tax exemption of employer-paid parking. But it seems particularly

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8. If p is the employer's applicable payroll tax rate, the percentage of the parking subsidy to offer as the cash equivalent is $1/(1+p)$. Since the *employer's* payroll taxes are not included in Table 4, the figures in Table 4 *underestimate* the tax incentive for employers to offer parking subsidies rather than cash travel allowances.

9. In labor economics terminology, the supply of employees who drive to work is more elastic to the employer than is the supply of employees who walk, bicycle, or ride transit to work. Thus, the employer gains by discriminating among employees according to their elasticity of supply, paying a lower wage to the employees whose labor supply is more inelastic.

inappropriate for federal tax policy to encourage employers to discriminate among their employees in favor of those who are most mobile, by offering employer-paid parking, and against those who are least mobile, by not offering an equivalent benefit. Thus, the proposed requirement to offer employees the option to take the cash equivalent in lieu of a parking subsidy would make it difficult for employers to continue any existing discrimination against employees who don't drive to work. If the employer wanted to keep its parking subsidies tax-exempt, the price would be the elimination of wage discrimination in favor of drivers. To repeat, however, the cash equivalent of a parking subsidy would have to offered only to those who are also offered a parking subsidy. Of course, making a previously hidden parking subsidy visible (by offering the cash alternative) might create further pressure for equal travel subsidies to all employees, and not just to selected employees. The proposed cash alternative requirement would not, however, interfere with any ridesharing subsidy, such as free bus passes, that the employer may continue to offer.[10]

3. How Would the Cash Alternative Requirement be Enforced?

Parking subsidies are unique among tax-exempt fringe benefits in that both their cost to employers and their value to employees are unreported and largely unknown. The employer's cost of other tax-exempt fringe benefits, such as health insurance premiums, are reported both to the employee and to the IRS. Thus, a simple way to implement and enforce the requirement to offer employees the option of taxable cash in lieu of a tax-exempt parking subsidy would be to require employers to report the tax-exempt parking subsidies on their employees payroll forms in the same way they already report other tax-exempt fringe benefits, such as health insurance premiums.

This proposed parking subsidy reporting requirement would not only provide the basis for measuring each employee's cash alternative option, but would also serve to disclose the extent of total employer-paid parking subsidies, which can now only be estimated very roughly. Further, the reporting requirement would make explicit - to employers, to employees, and to policy makers - what parking subsidies go to whom.

To discourage underreporting of tax-exempt parking subsidies, employers who are found to have underreported their parking subsidies - and who are thus found to have offered their employees an insufficient cash alternative to the parking subsidy - could be held liable to make restitution to those employees whose alternative cash payments were smaller than they should have been. This would give employees an incentive to take an interest in the accuracy of their employers' estimates of any parking subsidies offered.

IX. OTHER APPROACHES TO REDUCING DISTORTIONS CAUSED BY THE TAX-EXEMPTION OF EMPLOYER-PAID PARKING

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10. For example, if an employer now offers employees either a parking subsidy *or* a bus pass, the proposed legislation would require the employer to add the option of the parking subsidy's cash equivalent to the menu. And some employees might choose the bus pass in preference to either the parking subsidy or its cash equivalent.

There are several other policies that deserve consideration as ways to deal with the problems created by employer-paid parking. Some of these are alternatives to the required cash alternative offer, and others are complementary.

1. Eliminate the Income Tax Exemption for Employer-Paid Parking Subsidies

Since the tax-exempt status of parking subsidies makes it tax-efficient for employers to subsidize their employees' parking, the income tax code is clearly at the root of the employer-paid parking problem. It seems totally inappropriate for federal tax policy to stimulate solo driving to work when so many other policies are devoted to dealing with the overuse of cars, and on transportation policy grounds it would clearly be a good idea to end the tax-exemption for employer-paid parking subsidies. If ending the tax exemption of employer-paid parking subsidies did lead to ending the practice of employer-paid parking, commuters would face the full market price of parking in their commute decisions, and this would be an even greater incentive to rideshare than offering commuters the after-tax market value of their current parking subsidies.

Although transportation policy analysts have long called for ending the tax-exemption of employer-paid parking subsidies, it is obviously politically difficult to begin taxing a fringe benefit that so many commuters enjoy. As mentioned earlier, 86 percent of the 110,000,000 civilian nonagricultural employees drive to work, and 90 percent of them park free at work, so perhaps as many as 85,000,000 commuters receive some form of parking subsidy. Although small parking subsidies would presumably not be taxed, still it would be hard to deal with the public outcry against taxing a traditional tax-exempt fringe benefit, especially since so many influential decision makers in the highest tax brackets now receive large parking subsidies. In effect, the more pervasive the parking subsidies are, the more damage they do, but the harder they are to end.

In this political context, there is a distinct advantage to the alternative policy of requiring employers who offer employees tax-exempt parking subsidies also to offer employees the option of the taxable cash equivalent: it helps some employees, doesn't harm any others, and causes minimal inconvenience to employers. It increases tax revenues without increasing tax rates, and provides commuters an incentive to rideshare even if they are offered a parking subsidy. Also, local governments cannot change federal tax policy, and if the federal government does not act, local governments can on their own require employers to offer employees the taxable cash equivalent of any offered parking subsidy.

A final question is whether eliminating the tax-exemption of employer-paid parking would in fact lead to the total elimination of employer-paid parking. As mentioned earlier, in addition to the tax-efficiency motive for offering employer-paid parking, there is the additional motive of wage discrimination in favor of employees who drive to work and are thus able to choose among a wider array of employment options. That is, even if employer-paid parking subsidies were taxable, some employers might well continue to offer free parking in order to attract those employees who would drive to work even if they have to pay for their parking, and who thus have choices among employers in a wide area.

2. Increase the Income Tax Exemption for Ridesharing Benefits

To counteract the effect of exempting parking subsidies from income taxation, mass transit and ridesharing advocates have recommended increasing the tax exemption for employer-provided

transit passes and vanpool subsidies. Currently, transit subsidies are tax exempt from federal income tax only up to a value of $15 a month, and if the subsidy exceeds $15 a month the entire value is taxable. An increase in this tax exemption would make it tax-efficient for employers to offer larger mass transit and ridesharing subsidies to counteract the harmful effects of the parking subsidies they also offer. There are, however, two disadvantages to this recommendation: it would reduce federal and state income tax revenue, and, based on previous research, it would do little to counteract the influence of parking subsidies. Several of the case studies cited earlier showed that, as long as parking remains free, it is difficult to outsubsizidize the automobile. Only when parking subsidies were eliminated did significant numbers of solo drivers shift to other modes. Increasing the tax exemption of transit and vanpool subsidies also continues the bias toward *motorized* commuting, and retains, even strengthens, the bias against walking or bicycling to work. Finally, as argued just above, local governments cannot change federal tax policy, but can require employers to offer employees the taxable cash alternative to any offered parking subsidy.

3. A Tax-Exempt Commute Allowance in Lieu of Employer-Paid Parking

This proposal is to modify the federal tax code to allow any employer to pay all of its employees a uniform tax-exempt cash commute allowance *if* the employer doesn't subsidize any of its employees' parking at work. This would, if effect, be a uniform income tax deduction for all employees whose employers don't subsidize any employee parking. Employers would qualify their employees for the new tax exemption by certifying to the Internal Revenue Service that they provide no commuter parking or provide it only at the fair market price.[11] This proposal would not be as unpopular as taxing the value of parking subsidies because any employer could continue to offer employees tax-exempt free parking and not offer them the tax exempt commute allowance. Nondrivers whose employers continue to offer free parking, however, would be motivated to ask "Why give free parking to drivers and nothing to me when you could pay us all a tax-exempt commute allowance?"

Allowing only a small tax-exemption for commute allowances (say $15 per month) would probably induce few employers to convert parking subsidies into cash allowances, so it would mainly reduce tax payments from employees who already work for employers that don't offer parking subsidies. The result is to reduce tax revenues without inducing significant changes in travel choices. A larger tax-exemption for commute allowances (say $50 per month) would probably be required to induce most employers to end employer-paid parking, and thus to induce significant changes in travel choices.[12] Compared to the idea of requiring employers to offer employees the option to choose the taxable cash value of any offered parking subsidy, two advantages of the commute allowance proposal are that (1) it effectively raises the price of parking to the full market price of parking, and (2) it treats all employees equally by allowing all the same tax exempt commute allowance. Two disadvantages are that it would reduce federal income tax revenue, and that it can be implemented only by the federal government.

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11. These certifications could be verified by evidence that: employee parking prices equal nearby market parking prices; parking spaces are available to all employees at the prices charged; and any addition to employer's parking supply is economically justified by the parking prices to be charged.

12. For a more complete discussion of the tax-exemption for commute allowances and its possible revenue consequences, see Shoup (1982)

X. CONCLUSION

The case studies reported here suggest that, on average, employer-paid parking increases the number of cars driven to work by 27 percent. Further, a new multinomial logit analysis of survey data for commuters to downtown Los Angeles suggests that employer-paid parking increases the number of cars driven to work by 20 percent. The logit analysis is an advance in this area of research because it moves beyond case studies to examine a large sample of employees. The logit model controls for other variables affecting mode choice, permitting an accurate assessment of the mode share effect of employer-paid parking. Finally, the model is estimated with accurate data on the *after-subsidy* price of parking, so that the influence of parking prices on travel choices is not masked by employer-paid parking subsidies.

The income tax exemption of employer-paid parking subsidies strongly encourages employers to subsidize their employees' parking, and thus indirectly encourages commuters to drive to work alone. To combat the harm caused by the tax-exemption for employer-paid parking, we have argued the case for the policy of requiring employers to offer their employees the *option* to take the *taxable* cash value of any parking subsidy in lieu of the parking subsidy.

This minimally intrusive, incremental change in the tax code would retain the tax exemption for employer-paid parking subsidies *only if* the employer also offers employees the option to take the market value of the parking subsidy as a taxable cash travel allowance. Even without changes in the federal or state income tax codes, however, local governments can act effectively on their own. Any local government can enact its own ordinance requiring employers to offer their employees the option to take the value of any offered parking subsidy as cash income. Requiring employers to offer employees the *option* to cash out their parking subsidies if they wish will reduce traffic congestion, improve air quality, cut gasoline consumption, enhance employee welfare, and increase tax revenue without increasing tax rates. All these benefits will derive simply from requiring employers to subsidize *people*, not just *cars*.

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Appendix A

Model: Multinomial logit, Fitted by the Maximum Likelihood Method

(Mode 1--Auto (solo driver); Mode 2--Carpool/Vanpool; Mode 3--Transit

Independent Variable (Applicable mode in parentheses)	Estimated Coefficient	t statistic
Parking Cost/Income (1-2)	-57.16	-3.33
Running Cost (w/o parking)/Income (1-3)	-134.47	-4.52
Auto Travel Time (1-2)	-0.0077	-1.56
Transit Travel Time (3)	-0.021	-4.04
Occupation Dummy (1)	0.37	1.93
Employer Rideshare Program Dummy (2)	0.74	3.19
Vehicle Available for the Work Trip Dummy (3)	-3.18	-11.40
Auto Dummy (1)	-2.66	-5.18
Carpool Dummy (2)	-5.02	-8.15

Likelihood ratio index	.33
Log Likelihood at zero	-783.3
Log Likelihood at convergence	-520.4

Notes: The occupational dummy variable is a proxy for factors that would increase the likelihood of driving alone. The dummy is set to one if the respondent is in a professional occupation ("executive, administrative and managerial" and "professional specialty") and zero otherwise. This variable is intended to capture the need for a car at work because of business meetings and variable hours, and status-related attitudes that might affect mode choice. The rideshare dummy measures whether the employer offers significant ridesharing incentives (zero if no incentives, one if incentives). Finally, the vehicle availability dummy measures whether a car was available for that work trip (zero if car not available, one if available).

Paper No. 920923

Predicting The Impact Of Transportation Control Measures On Travel Behavior And Pollutant Emissions

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A Paper Prepared For Presentation At
Transportation Research Board
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INTRODUCTION

Over the past few years, the average annual rate of population growth in California has been roughly two percent. During that same period of time, the average annual rate of growth in vehicle miles of travel (VMT) has been roughly six percent (Caltrans 1989). This growth in travel has led to increasing congestion in urban areas and to a worsening of air quality despite significant improvements in emissions control technology (California Air Resources Board 1990). The seriousness of these problems in California has been recognized by the State Legislature, as is evidenced by the legislatively-mandated Congestion Management Program recently adopted by a statewide referendum (Gosnell 1990). The program requires that each urban county submit a plan for maintaining at least a minimum level of service on key regional roadways. In addition, the California Clean Air Act, passed in 1988 to improve air quality throughout the state, mandates a control of vehicle trips and VMT by local jurisdictions (California Air Resources Board 1990). The following is an excerpt from the California Clean Air Act.

> California Clean Air Act mandates the inclusion of reasonably available transportation control measures (TCMs) in 1991 Air Quality Attainment Plans. Areas which cannot achieve state air quality standards by 1997 are to adopt TCMs to increase vehicle occupancy to 1.5 by 1999 and keep total motor vehicle emissions at or below the 1997 levels after 1997. Areas which can achieve state standards between 1994 and 1997 are to adopt TCMs to substantially reduce the rate of increase in trips and trip length.

This paper reports on the results of a project sponsored by the California Department of Transportation (Caltrans) to develop a consistent methodology for predicting the impact of transportation control measures (TCMs) on travel behavior and pollutant emissions, and to evaluate the cost-effectiveness of the measures. The methodology is designed to be applicable throughout the state and to assist local jurisdictions in screening candidate TCMs. While the primary purpose has been to provide a method for screening TCMs, three secondary objectives have been identified.

1. To provide a consistent methodology for consideration of TCMs that can be used throughout the state.

2. To provide a comprehensive methodology that is realistic and thorough in its prediction of travel and emissions changes.

3. To provide a bridge of knowledge and understanding between the disciplines of air quality analysis and transportation analysis.

The methodology developed can be applied at either a regional level or for a smaller area such as an activity center. To be applied in an activity center, the data entered into the model

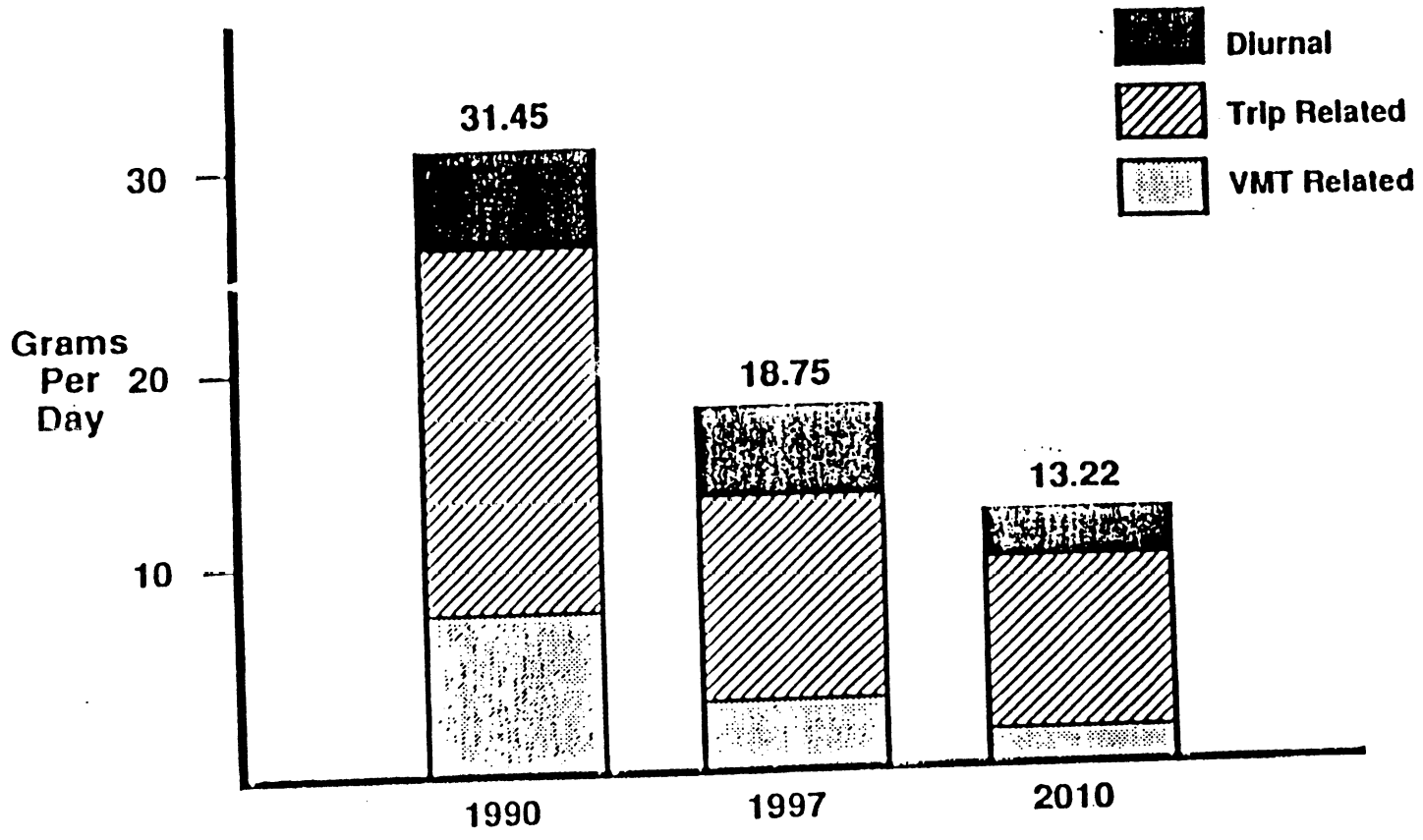
INTERRELATIONSHIP BETWEEN TRANSPORTATION AND AIR QUALITY

Before discussing the specifics of the methodology developed, it is important to understand the interrelationship between transportation and air quality. Transportation-related emissions occur as a result of the vehicle trip, VMT, and the vehicle itself. Each of these factors have different effects on emissions, and, therefore, should be evaluated separately in an analysis.

The importance of separating the travel impacts of TCMs into changes in trips and changes in VMT can be illustrated by a sample calculation using average emission rates from the San Francisco Bay Area for a light duty automobile in 1990 at 75 degrees fahrenheit. This is an estimate of the emissions for a daily round-trip commute twenty miles in length at an average speed of 40 mph. The resulting emissions in grams-per-day for this example trip are illustrated in Figure 1. The trip would produce a total of approximately 31.4 grams of hydrocarbon emissions; however, only about a third of the emissions are associated with the VMT from the trip, illustrated by the running emissions. Fifty percent of the emissions result from the trip being made -- this is a combination of the trip start emissions and the evaporative hot-soak emissions that occur at the end of the trip. A final one-sixth of the emissions, referred to as diurnal emissions, occur as a result of evaporation of fuel from the gasoline tank and occur whether the vehicle is driven or not. Diurnal emissions are not directly affected by TCMs unless there is a long-term impact on vehicle ownership.

Figure 2 illustrates how the emissions for the prototype trip described above will change over time given the changes in California tailpipe emissions standards. By 1997, the total emissions for the prototypical trip will be about sixty percent of the 1990 level, and by the year 2010, will be less than half of the current level. The portion of the emissions that will decrease by the greatest amount is the portion related to VMT, which will decrease from roughly one-third to only about one-eighth of the total hydrocarbon emissions. This further emphasizes the importance of reducing trips as well as VMT to achieve air quality goals.

The importance of recognizing the impact of speed on VMT-related emissions is illustrated in Figure 3. As with the previous two figures, the emissions are calculated for a light duty automobile in the Bay Area in 1990. The figure illustrates how emissions for NOx and HC, the two primary precursors for ozone production, vary with speed as reflected in the EMFAC7E model for a temperature of 75 degrees. (EMFAC7E is California's version of an emission rate model similar to EPA's MOBILE4.) HC emissions decrease on a grams-per-mile basis with increases in speed and are most sensitive to changes in speeds in the range from 0 to 30 mph. NOx emissions decrease slightly with increases in speed at low speeds, but increase dramatically as speeds increase over 50 mph. HC Emissions also increase at speeds over 55 mph. This is an important factor when freeway capacity expansions are being considered, or any other improvements that will lead to speed increases in these upper ranges. For both pollutants, the nonlinearity of the relationship requires some special sensitivity to estimation of changes in speed in responsive transportation control measures. Because of the nonlinearity in the relationships, any averaging of speeds will introduce some inaccuracy in predicting emissions.



Based on a 20-Mile Round Trip for a Light Duty Automobile
In the Bay Area of California

Figure 2
Expected Change in Hydrocarbon Emissions Over Time
for Prototypical Trip

MODEL STRUCTURE

The general structure of the mocel developed in this project is illustrated in Figure 4. The model system has three main modules.

1. A travel impact module that predicts changes in trips, VMT, and speed by time period.

2. An emissions module that takes the travel module output and predicts changes in hydrocarbon (HC), carbon monoxide (CO), and nitrogen oxides (NOx) emissions. Emission rates are provided for input to the module for each county in California.

3. A third module that takes the output from the two previous modules and calculates costs and cost-effectiveness indices that can be used in ranking the TCMs.

The model requires as input a description of the characteristics of the TCMs to be implemented, as well as baseline information on current travel characteristics, current emissions inventory, and local cost parameters.

The model system is designed to evaluate a broad range of candidate TCMs. These include the following:

- Demand Management -- including ridesharing activities such as ridematching, employee transportation coordinators, and other general measures to encourage demand management such as trip reduction ordinances;

- Alternative Work Schedules -- including telecommuting, compressed work weeks, and variable work hours;

- Transit Improvements -- including increases in service frequency and employee pass subsidies;

- Traffic Flow Improvements -- including traffic signal improvements and increases in street capacity;

- Land Use Management -- including growth controls, mixed use development, and jobs/housing balance;

- Bicycle Improvements -- including bicycle paths, signing and other roadway improvements, and support facilities such as bicycle lockers;

- Pricing -- including transit fare subsidy, parking price increase, and VMT gasoline tax;

- Freeway Management -- including HOV lanes and incident response; and
- Goods Movement -- including restricted delivery times and improved loading facilities.

In addition to these specific measures, the model provides a general template that can be used for user-specified TCMs. These templates walk the analyst through the steps important in determining the regional impacts on travel and emissions.

TRAVEL IMPACT PREDICTION

Figure 5 provides a sample of the output of the travel impacts module of the model. As mentioned previously, the three components of the output are changes in trips, changes in VMT, and changes in speed by time period (peak and off-peak). The results are presented in absolute terms as well as a percentage reduction from baseline levels.

Behind the estimation of these changes are a series of spreadsheet calculations designed to walk the analyst through the special considerations necessary for each measure so that the analysts understands the evaluation being performed, rather than the model acting as a "black box." A full description of the methodology developed cannot be provided here, but is detailed in the documentation for the model (User Manuals for Software Developed to Quantify the Emissions Reductions of Transportation Control Measures) and specific questions can be addressed to the authors of this paper. An example of the spreadsheet calculations is provided in Figure 6 and describes the steps followed in the calculation of the impact of an increase in parking price for commuters.

The example for parking cost illustrates one of the many corrections or refinements that are necessary to calculate the travel impact. In this case the percent of employees affected must be specified by the user. For example, the parking charge may only apply to employment in a major activity center or in the downtown rather than being implemented uniformly on a region-wide basis. Elasticities are provided in the model where appropriate, but in all cases an analyst can use elasticities that have been developed for the region.

Some general considerations were taken into account in developing the methodology for each TCM, including those listed below.

- Does the measure affect all trips or just commute trips?
- Are all employees affected?
- Is all traffic affected or just traffic on certain facility types?
- Does the measure affect the number of trips or just VMT?

Figure 6

SAMPLE SPREADSHEET CALCULATIONS
PARKING PRICING

$$T_t = -CT * \frac{PC}{VC} * E_{pd} * EMP$$

$$T_p = T_t * CT_p$$

$$T_o = T_t - T_p$$

$$V_p = T_p * L_c * VMT_{max}$$

$$V_o = T_o * L_c * VMT_{max}$$

$$V_t = V_p + V_o$$

$$S_p = \frac{-V_p}{VMT_p} * E_{sp}$$

$$S_o = \frac{-V_o}{VMT_o} * E_{sp}$$

where:

CT	=	Total commute vehicle trips
CT_p	=	Percent of commute trips in peak period
E_{pd}	=	Elasticity of parking demand with respect to cost for commute trips
E_{sp}	=	Elasticity of speed with respect to volume
EMP	=	Percent of employees affected
L_c	=	Average commute trip length
PC	=	Average daily increase in parking charge
S_o	=	Percentage change in off-peak speeds
S_p	=	Percentage change in peak speeds
T_o	=	Reduction in off-peak trips
T_p	=	Reduction in peak trips
T_t	=	Reduction in total trips
V_o	=	Reduction in off-peak VMT
V_p	=	Reduction in peak VMT
V_t	=	Reduction in total VMT
VC	=	Average daily commute out-of-pocket costs per vehicle
VMT_{max}	=	Percent of maximum VMT reduction realized due to circuity of ridesharing or access to transit
VMT_o	=	Total off-peak VMT
VMT_p	=	Total peak VMT

- Elasticity of speed with respect to volume equals -0.750 in the peak period and -0.375 in the off-peak period. These elasticities were calculated from the predicted change in volumes and speeds in Los Angeles from the 1984 existing condition to the 2010 "No Build" alternative (SCAG 1988). The average elasticity over the day was estimated to be -0.65. From this, the value of -0.75 for the peak period and -0.375 for the off-peak period were subjectively chosen.

- Elasticity of parking demand with respect to cost for commute trips is equal to -0.20. In Free Parking as a Transportation Problem (Shoup 1980), parking elasticities based on empirical evidence were in the range of -0.03 to -0.37. From this, we selected a value of -0.20 for use in the analysis.

- Elasticity of transit use with respect to cost equals -0.510. Barton-Aschman (1981) performed a review of the literature and found a wide range of transit fare elasticities. For fare increases, elasticities ranged from -0.20 to -0.51. The value of -0.51 was chosen because it was estimated for a metropolitan area in California.

- Elasticity of transit use with respect to service equals 0.680. In Barton-Aschman's (1981) literature review, the service elasticity was reported to vary between 0.65 and 0.85. The value 0.68 was chosen as a conservative estimate representative of major California cities.

- The percent of use at park-and-ride lots that is for commute trips equals 92.5 percent. This is based on an examination of park-and-ride lots in Portland (Cambridge Systematics 1989).

- The average commute trip length for a bicycle equals 3.0 miles. This is based on assumptions made for air quality modeling performed for the Maricopa County Nonattainment Area (Maricopa Association of Governments 1987).

- The percent of commute trips less than six miles that would bicycle equals 1.0 percent. This is based on assumptions made for air quality modeling performed for the Maricopa County Nonattainment Area (Maricopa Association of Governments 1987).

- The percent of affected commute trips that shift out of the peak due to a compressed work week program equals 50 percent. This was based on the assumption that, due to the increased length of the work days, either the commute trip to or from work would occur outside the peak period.

- The percent increase in freeway speeds realized due to an incident management program equals 5.0 percent. This is based on a California study to determine the impact of trucks on urban freeway congestion (Cambridge Systematics 1988).

EXAMPLE APPLICATION OF THE MODEL

To provide an example of the results that would be obtained from using this model, it was applied to a major metropolitan area in California. For the purpose of illustration, the results for a selection of the twenty-five TCMs are provided here. The specific TCMs evaluated are:

- Transit Service Expansion - Implementation of a Long Range Transit Plan that includes rail expansion and a doubling of the annual bus miles.
- Parking Management - A minimum parking charge of $3.00 per day for commute trips: a sixty percent increase in the average commute charge.
- Variable Work Hours - Incentives to employees to shift their commute hours that results in a five percent participation by the work force.
- Telecommunications and Compressed Work Weeks - A workforce participation rate of fifteen percent; each participant reduces their trips by ten percent.
- Land Use Management - New zoning controls to achieve a greater jobs/housing balance and, through this, a ten percent average reduction in commute trip length.
- Signalization - Implement an advanced computer-based traffic signal control program for all major arterials in the area.
- Ridesharing - Require employers to establish incentives to increase employee vehicle occupancy levels.
- Gas Tax - Increase the current cost of gasoline per gallon by $1.00, from $1.13 to $2.13.

In Figures 7 to 12, the effect of each of the above individual TCMs on peak period and off-peak period trips, VMT, and speeds is illustrated as a percentage change. The effectiveness of each of the TCMs varies for each of the transportation measures. For example, *signalization* provides a speed improvement, but does not affect the number of trips made. The TCMs that had the most significant affect on the number of peak and off-peak trips made were *parking management* and *gas tax*, which, along with *land use management*, also had the greatest impact on VMT. *Signalization, land use management, and parking management* had the greatest impact on speeds in the peak period, while *gas tax* and *signalization* had the greatest impact in the off-peak period.

Figure 10
The Effect of Individual TCMs On VMT
During the Off-Peak Period

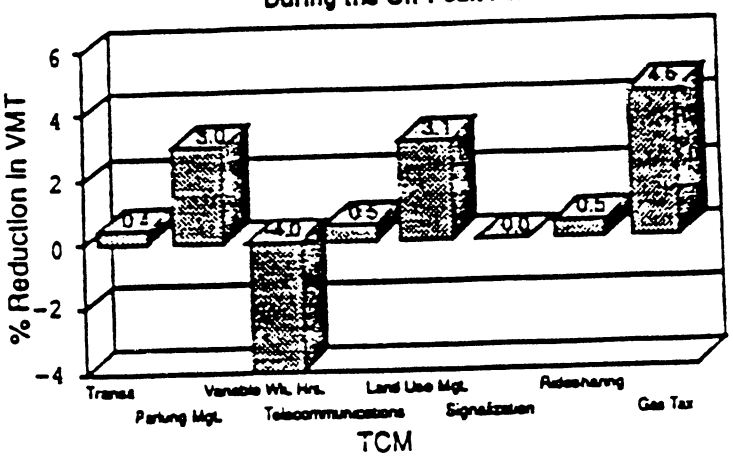


Figure 11
The Effect of Individual TCMs On Speed
During the Peak Period

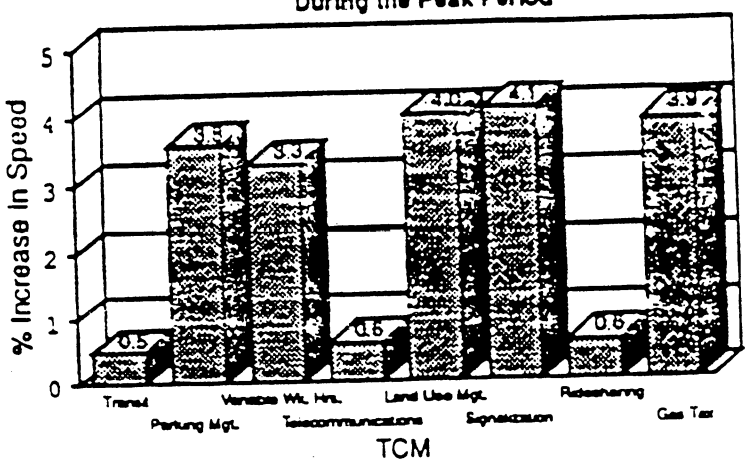


Figure 12
The Effect of Individual TCMs On Speed
During the Off-Peak Period

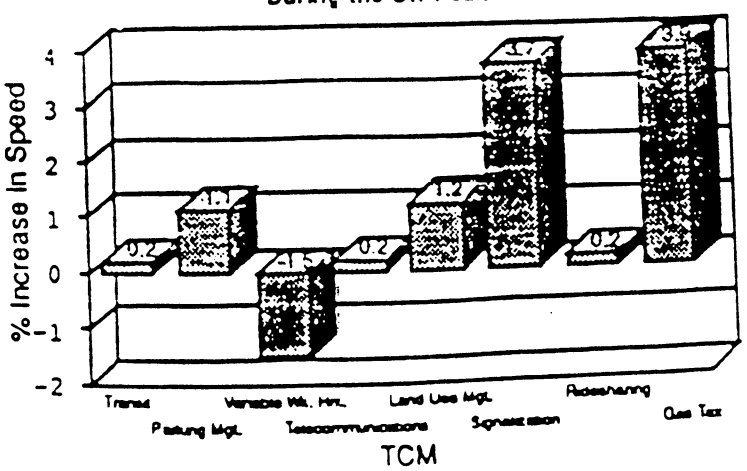


Figure 13
Summary of Daily Motor Vehicle HC Emission Reductions
From Individual TCMs

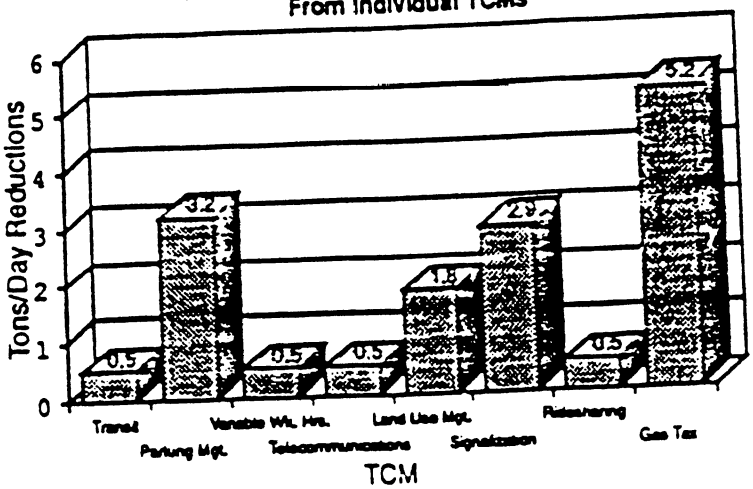


Figure 14
Summary of Daily Motor Vehicle NOx Emission Reductions
From Individual TCMs

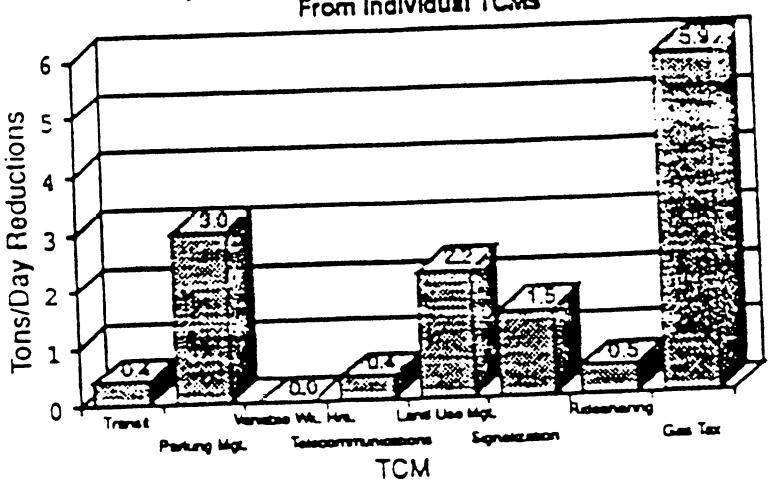
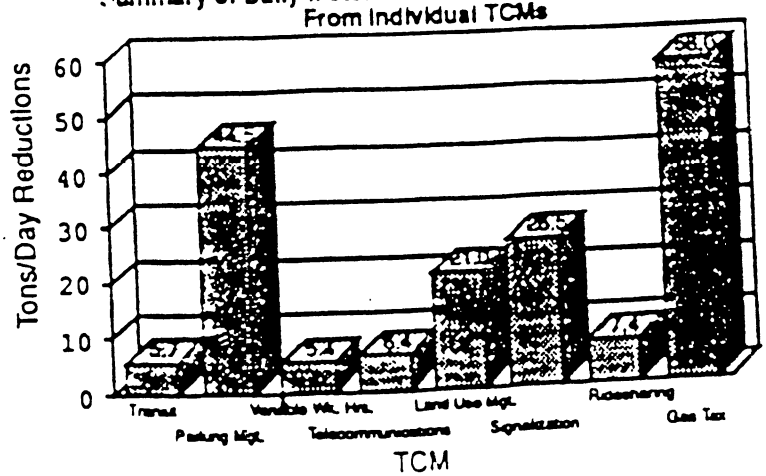


Figure 15
Summary of Daily Motor Vehicle CO Emission Reductions
From Individual TCMs



effectiveness of TCMs, such as the number of children in a household, the number of single adults with children, and the number of two-worker households. Additional research should be performed regarding how to incorporate these issues into the analysis.

Additional research should also be performed to enhance the methodology to reflect activity patterns and constraints. The factors that should be evaluated in greater detail include:

- household structure and constraints;
- midday travel;
- linked trips;
- business-related travel; and
- non-work trips.

CONCLUSIONS

A consistent methodology has been successfully developed to assist local jurisdictions throughout the state in screening candidate TCMs to be included as a part of their efforts to meet the requirements of the California Clean Air Act. The methodology can be applied at either a regional level or for a smaller area such as an activity center and can be used to evaluate a wide range of TCMs. While some additional research needs have been identified, the research presented in this paper goes a long way to providing a better understanding of the impact of transportation measures on air quality.

In evaluating the air quality impacts of TCMs, it is important to first differentiate between the impact on trips, VMT, and speed. Traditionally, most transportation professionals have focused on improving mobility and reducing congestion, which leads to a focus on improving VMT and speed. It is the reduction of trips, however, that has the greatest potential for improving air quality. Measures that are effective in eliminating trips should therefore be a focus of air quality attainment plans.

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1212

TRANSPORTATION RESEARCH RECORD

Ridesharing— Transportation Demand Management

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL
WASHINGTON, D.C. 1989

Cost-Effectiveness of Private Employer Ridesharing Programs: An Employer's Assessment

FREDERICK J. WEGMANN

The benefits derived from ridesharing are varied and accrue to a variety of individuals and groups. The beneficiaries may be classified into three general groups—employees, employers, and the community. The benefits that accrue to employers are not as well understood, but they are essential to the marketing of ridesharing in times of stable or declining energy prices. Although ridesharing can be accepted as good business practice and as an aid in enhancing the corporate image, to achieve employer support frequently a case needs to be established that ridesharing is not just public relations but returns distinct and tangible benefits to the employer. The objective of this paper is to document the costs and benefits available to private-sector employers through the operation of employer ridesharing programs. Special consideration was given to employers having a direct involvement in operating a corporate ridesharing program. An analysis of the responses from 160 private employers indicates a positive assessment of ridesharing's cost-effectiveness. Respondents were requested to provide specific monetary estimates of the benefits derived from their ridesharing programs. Although the employers did recognize and acknowledge the presence of benefits, most could not quantify the benefits. Most of the benefits cited were of an intangible nature—reduced absenteeism, enhanced corporate image, reduced employee tardiness, and so on. Many employers did not have a specific economic criterion on which to initiate corporate rideshare programs but were more concerned with employee and community benefits. Thus, it is clear that the data base necessary to generate cost-benefit analyses does not exist. Even though the benefits cannot be quantified, they are perceived by employers as being real and present.

The benefits derived from ridesharing are varied and accrue to a variety of individuals and groups. The beneficiaries may be classified into three general groups—employees, employers, and the community. Employee and community benefits have been well documented by numerous studies. The benefits that accrue to employers are not as well understood, but they are essential to the marketing of ridesharing in times of stable or declining energy prices. Although ridesharing can be accepted as good business practice and as an aid in enhancing the corporate image, to achieve employer support frequently a case needs to be established that ridesharing is not just public relations but returns distinct and tangible benefits to the employer. In supporting ridesharing, employers usually absorb some organizational and administrative costs. If the ridesharing program involves operating company-owned vans, the employer is assuming a financial risk in laying out the initial investment. Although actions can be taken to limit risk through abort clauses or leasing, the employer has still committed substantial organizational resources on behalf of ridesharing.

McIntyre and Maxwell (*1*), Commuter Transportation Services (*2*), and Dingle Associates (*3*) have identified the reasons why corporations have become involved in ridesharing and have undertaken the risks of vanpooling without any hopes of turning profits. These studies have indicated that some of the most direct advantages are to (a) reduce parking costs, (b) make parking space available for expansion, (c) reduce congestion, or (d) satisfy zoning or air pollution requirements. Some corporations have noted that ridesharing has favorable impacts on reducing employee tardiness, absenteeism, and turnover rates. Likewise, corporations have been able to retain existing employees through ridesharing. These tangible and intangible benefits must then be compared against program costs.

The objective of this paper is to document the costs and benefits available to private-sector employers through the operation of employer ridesharing programs. Special consideration was given to employers having a direct involvement in operating a corporate ridesharing program. The 1985 nationwide canvass of over 897 employers provided useful information from 230 employers (of which 160 were private) concerning

- Status of ridesharing activities at the employment site;
- Characteristics of the employer—size, location, ridesharing services provided, and so on;
- Parking benefits provided by the employer;
- Cost of ridesharing, parking, and transit incentive programs;
- Employer attitude toward ridesharing; and
- Cost-effectiveness of ridesharing.

DATA COLLECTION PROCEDURES AND CHARACTERISTICS OF RESPONDENTS

Ridesharing effectiveness was assessed through a mail survey of firms with current or past experience with ridesharing. Representatives of these firms were requested to identify the costs and benefits derived for operating the ridesharing pro-

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gram. Special emphasis was placed on corporate ridesharing programs because these employers have corporate resources directly at risk. No attempt was made to structure a scientific sample; rather, the survey attempted to gain insight concerning firms with ridesharing experience. Where a corporate representative was able to provide general estimates of benefits, a follow-up telephone call was instituted in an attempt to define the benefits in monetary terms. The results of the follow-up survey are reported in a case study analysis of 20 companies. Of the 160 respondents from the private sector, 19 were judged to have inactive ridesharing programs, whereas 141 were judged to have active ridesharing programs.

Inactive programs were defined as not having current ridesharing participation, participation limited to a rideshare matching service, or a limited employee-owned and operated vanpool program. Active programs were characterized by employers actively financing and supporting an employer-sponsored vanpool program, a large third-party or employee vanpool or carpool program, or a corporate transit incentive program.

Because the conclusions of this report are based on a sample of 160 employers, it is important to identify the characteristics of the employers responding.

Location

Employers were concentrated in three geographical locations—27.3 percent were in central business districts (CBDs); 25.9 percent were within the city limits, but not downtown; and 36.7 percent were in suburbs. Only 10.1 percent of the respondents were located in rural areas or small towns. Thirty-eight percent of the respondents were located in the Mid-Atlantic and Northeast region, followed by 17 percent in the Northwest and West Coast, 16 percent in the Midwest, 16 percent in the Southeast, and 13 percent in the Southwest.

Industry

The firms included in the survey came from a diversity of industry types (finance, 26 percent; manufacturing, 21 percent; engineering services and research technology, 17 percent; energy, 12 percent; and pharmaceutical, health, and hospitals, 9 percent).

Number of Employees

The survey was designed to obtain information on only one employment site, preferably the site with the greatest ridesharing activities. The distribution of private-sector employers (where n = 160) was noted as follows:

Employees	*Private-Sector Employers (%)*
0–500	25.7
501–1,000	12.6
1,001–2,500	31.8
2,501–5,000	20.0
>5,000	6.8
No response	3.1

The average number of employees per site was 3,000 for the urban and suburban locations and 1,350 for the small town and rural locations.

Parking Shortages

Over 33 percent of the employers indicated that they experienced parking shortages at their employment locations. A cross-tally with size of employer indicated that the parking shortage was most critical with the larger employers. Yet for all employment size classes, at least 20 percent of the respondents indicated parking problems. Only in the case of the CBD employers did the majority of respondents indicate parking problems. Interestingly, 32 percent of the employers in urban non-CBD areas and 18 percent of the employers in rural areas indicated experiencing parking shortages.

Mode Shares

Sixty-eight percent of employees arrived at work by driving alone, less than 1 percent used rail transit, 7.4 percent used bus transit, 16.7 percent used carpools, and 7.2 percent used vanpools. Bus and rail transit accounted for 17 percent of the workers in CBDs. In small town and rural locations, carpooling and vanpooling accounted for over 35 percent of the workers' daily trips to work. Carpooling and vanpooling together represented over 25 percent of the work trips made in suburban as well as CBD locations. Little variation was noted for mode split by size of employer. The percent traveling by vanpooling was higher than the national average, indicating the strong interest in ridesharing by the respondents.

EMPLOYER RIDESHARING AND PARKING COSTS

Assessing ridesharing's cost-effectiveness involves identifying program costs as well as benefits. Discussed in this section are the annual direct costs associated with operating a vanpool program, transit incentive program, or ridesharing matching service. Staff time to oversee and administer a ridesharing program is also reviewed. Because the provision of parking at the employment site is a form of employee transportation subsidy, these costs are also documented and will be compared with ridesharing costs.

Parking Costs

Work Site Parking Policies

Traditionally, it is well accepted that commuting is an individual's responsibility, not of concern to the employer. Yet free parking at the employment site is expected and can represent an extensive expenditure on behalf of the employees. Significantly, 78 percent of the employers participating in this survey provided free parking for their employees. An additional 10 percent charged employees for parking but not enough

TABLE 1 ESTIMATED COST TO EXPAND PARKING

Parking Expansion Cost per Space	No. of Responses	Percent of Responses
$0-$500	6	15.8
$501-$1,000	11	28.9
$1,001-$2,000	6	15.8
$2,001-$5,000	6	15.8
$5,001-$10,000	6	15.8
≥$10,000	3	7.9
	38	100.0

Average = $3,920 per space

to cover costs. Parking then is clearly an employee benefit or transportation subsidy provided by the employer.

All responding employers in rural areas and small towns provided parking at no charge or a partial charge to their employees. Correspondingly, fewer than half of the employers located in CBDs assessed no charge for parking. Over 25 percent of the CBD employers expected employees to cover the full costs of parking. Parking charges showed little variation by employer size. A smaller percentage of large firms (more than 2,500 employees) actually charged full costs for parking than did small firms, although the difference was only a few percentages. Over 50 percent of the employers experiencing parking shortages provided for free parking.

Employer Parking Costs

Employer parking costs varied extensively with the geographical location of the employer, type of parking (structure versus surface lot), and the actual cost items allocated to parking. Some employers indicated that estimates of parking costs were not available because parking costs were not segregated from building lease costs or could not be separated from different functions such as security, building maintenance, and so on. It can be expected that some survey respondents were not aware of the full costs of providing employee parking, including items such as lights, security, traffic control, taxes, land, or depreciation. Typical costs that were identified were yearly striping costs, surface cleaning, and pavement resurfacing every 2 to 3 years. In some climates snow removal was noted as a major expense. The average annual parking cost was estimated to be $64 per space. While modest on a per-space measure, parking can become quite expensive when applied to all the spaces provided. The aggregate free parking costs some large employers $150,000 to $200,000/year. Free parking or reduced cost parking can be considered an employee fringe benefit or subsidy.

For the 72 private firms providing complete data on parking costs, the average total annual financial commitment came to $112,000/year or $73.50 per employee. Over 18 percent of the private firms paid in excess of $200,000/year for employee parking and 11 percent paid over $250 per employee.

Cost of Expanding Parking

The cost to expand parking facilities is a major capital commitment borne by the employer. Thirty-eight respondents estimated the cost to increase the existing supply of parking, as noted by Table 1. The higher cost estimates are associated with constructing garages in areas of high land values such as the CBD. The lower costs are related to expanding surface lots where land has already been purchased. Reduction in parking or possibility of avoiding expanding parking are tangible benefits that an employer can receive from ridesharing. The concept of "free parking" is a misnomer, and "free parking" can represent a sizable annual expenditure for the employer.

Ridesharing Costs

Ridesharing costs can be stratified into a number of different cost categories, including carpool and vanpool operating subsidies, costs associated with administering a ridesharing program, and costs for a transit incentive or priority parking program.

Firms were requested to report the cost of staff time devoted to ridesharing activities. Although the ability to track all relevant activities and to provide a reliable cost estimate will vary between firms, expenditures will be influenced by the actual ridesharing activities provided. Ridesharing coordinators can provide assistance in promoting ridesharing, conducting matching surveys, distributing literature, and contacting individuals to help form ridesharing arrangements. In many communities the employer's rideshare activities are

supplemented by the support of a community ridesharing agency. In these cases the employer's costs can be quite minimal.

As the employer undertakes the responsibility of owning and operating vanpools, relieving the employees or a third party of this responsibility, the employer's administrative commitment becomes more extensive. Many employers operating large employer-based ridesharing programs required the retention of a full-time ridesharing coordinator.

Thirty-two firms with employee-owned or leased or third-party vanpool programs provided estimates of the annual costs involved in administering the ridesharing programs. A full 65 percent stated that there was no measurable staff time or that costs were minimal. The average annual cost for all firms reporting an administrative expense was $4.50 per employee or $3,000/year. From the above analysis it is clear ridesharing activities can be supported at the corporate level with little cost to the firm. As the firm assumes direct responsibility for ownership and operation of the vanpool program, the administrative costs become more substantial. Again, firms with just a few vans frequently report negligible administrative costs. When considering the experience of 58 firms operating employer-owned or leased vanpool programs, 33 percent still reported minimal administrative costs. The average cost was $889 per van per year or $23,000 per firm. These costs will be included as part of the costs to operate a vanpool program and will be discussed in more detail in the vanpool cost subsection.

Employer Vanpooling Costs

Vanpooling can become a major rideshare cost commitment for an employer. Because of the size and nature of these ridesharing activities, the cost estimates need to be discussed in more detail.

Firms providing employer vanpool programs have made a strong commitment to ridesharing. Sixty-seven private firms indicated that they were providing vanpool services for employers either by leasing the vehicles or by outright ownership of the vans. Unlike employee-owned and operated vanpools or third-party leases from an organization other than an employer, the employer is directly at risk for the financial success of the vanpool. In addition to assuming risk, the firm also may elect to subsidize the vanpool program as an employee-assistance benefit. The subsidy can be regulated by adjusting the fares. Any cost-effectiveness equation must consider the extent of the vanpool subsidy. However, through the collection of revenue it is possible for an employer to control the amount of subsidy. In fact, if vanpooling is successful, it is possible for the employer to collect adequate revenue to cover all direct costs and even to reimburse the employer for administrative costs associated with operating the ridesharing program. Although there may be free parking, there is no equivalent free vanpooling.

Vanpool costs include direct operating costs (fuel, maintenance, depreciation, insurance) but exclude administrative costs associated with the program. Another factor to consider on the revenue side of the equation is the availability of tax credits generated through ownership of the vehicles. Tax credits are a return to the firm and can be used to defray part of the expenses of operating the vanpool program. Fourteen percent of the respondents include dollar estimates for tax credits.

Employer Vanpooling Subsidy

Break-Even or Positive Return Programs

Of special interest were the 58 corporations included in the survey operating employer vanpool programs. These firms operated a total of 1,236 vans for an average of 23 vans per firm. Without considering administrative cost, 36 percent of the firms operating vanpool programs indicated that they set riders' fares adequate to cover all operating costs. Interestingly, an additional 5 percent used tax credits to cover operating costs. Twenty-one percent set rider fares high enough to provide a net positive return to the firm. Before including administrative costs, 50 percent of the vanpool programs were operating at a financial break-even point or better.

When administrative costs are included, assuming that all administrative costs are allocated against the vanpool program (excluding other program elements such as transit incentives or ridesharing matching), the number of break-even vanpool programs was reduced to 10. Four programs still realized revenues exceeding costs. Almost one-quarter of the programs then had no direct expenditures in operating employer vanpool programs. Any benefits received by these employers for operating the program will provide a very attractive cost-effectiveness ratio.

Subsidized Vanpool Programs

For the programs not able to break even or provide a positive return, the extent of the rideshare subsidy is of interest. Subsidy levels per van, with and without administrative costs, are shown in Table 2. In addition, total program subsidies are noted in Table 3. When administrative costs are not allocated to vanpooling, the average subsidy is $1,283/year per van. Administrative costs increase the subsidy by approximately $70/year per van. Significantly, even with administrative charges, 60 percent of the firms pay from nothing to less than $10,000/year to support ridesharing programs. The average cost per employee, based on total employment at the work site and not just those employees who vanpool, is only $12.35/year per employee. This per-employee expenditure is only one-sixth what employers spend for free parking per employee ($12.25 versus $73.50 per employee). Although not all employees participate in vanpooling, where such programs can substitute for providing additional "free" parking, they can be cost-effective to the employer. Vanpool commitments can be quite extensive, but program costs are a fraction of an employer's commitment to employee parking.

Assessment

Eighty-four percent of the firms believed ridesharing was cost-effective, and all but four acknowledged a benefit being derived

TABLE 2 ANNUAL SUBSIDY PER VAN FOR EMPLOYER VANPOOLS, SAMPLE OF 58 CORPORATIONS

Excluding Ridesharing Administrative Costs		Including All Ridesharing Administrative Costs	
Subsidy/Program (dollars)	Number of Responses	Subsidy/Program (dollars)	Number of Responses
1-99	0	1-99	1
100-499	6	100-499	11
500-999	7	500-999	10
1,000-1,999	6	1,000-1,999	11
2,000-2,999	4	2,000-2,999	7
3,000-3,999	2	3,000-3,999	1
≥4,000	0	≥4,000	3
None	33	None	14
	58		58
Average Subsidy per Van			
All Programs	$521		$973
Only Programs Subsidized	$1,209		$1,283
No. of Subsidized Programs	25		44

from the firm's involvement in ridesharing. The major benefits identified for the vanpools were as follows:

Benefit	*Percent of Respondents Mentioning*
Good public relations	70
Reduced absenteeism	59
Reduced tardiness	53
Retained valued employees	40

The four firms acknowledging no benefits at all had encountered adverse economic conditions or had recently merged, requiring a reduction in employment.

RIDESHARING COST-EFFECTIVENESS AND BENEFITS

Cost-Effectiveness

The bottom-line question asked of the 141 active private employers with active ridesharing programs was, "Do you feel that your ridesharing and/or priority parking programs are cost-effective?" Fifty-seven percent of the private firms operating active ridesharing programs indicated ridesharing was definitely cost-effective, with an additional 17 percent indicating ridesharing was marginally cost-effective. Only 7 percent responded negatively, and 18 percent stated they did not know. By comparison, 57 percent of the private firms not actively engaged in ridesharing did not know, which could be expected as they had no experience with this form of transportation service. It is impressive that firms with active ridesharing programs thought ridesharing was cost-effective at a ratio of almost 3 to 1 over firms with inactive programs, highlighting the need for those experiencing benefits to communicate the positive attributes of ridesharing to other employers. Responses indicated an overwhelming positive attitude toward ridesharing by private firms with active ridesharing programs.

Benefits

Respondents were requested to indicate if their firms experienced benefits associated with ridesharing. Although the extent of benefits was sought as a dollar value estimate, a positive or negative reply was also requested. Sixty-eight of the private firms responded positively to one or more benefit categories.

TABLE 3 ANNUAL SUBSIDY PER RIDESHARE PROGRAM FOR EMPLOYER VANPOOLS, SAMPLE OF 58 CORPORATIONS

Excluding Ridesharing Administrative Costs		Including All Ridesharing Administrative Costs	
Subsidy/Program (dollars)	Number of Responses	Subsidy/Program (dollars)	Number of Responses
1-4,999	11	1-4,999	14
5,000-9,999	6	5,000-9,999	7
10,000-49,999	5	10,000-49,999	19
50,000-99,999	1	50,000-99,999	1
100,000-199,999	2	100,000-199,999	1
≥200,000	0	≥200,000	2
None	33	None	14
	58		58
Average Subsidy per Program			
All Programs	$14,732		$30,095
Only Programs Subsidized	$34,046		$39,671
No. of Subsidized Programs	25		44

Noted in order are positive responses from private employers operating ridesharing programs.

Benefit	*Percent Noting Favorable Response*
Reduces employee tardiness	49.6
Improves public relations	48.9
Reduces absenteeism	36.2
Helps retain valued employees	29.8
Reduces need to construct parking	22.7
Permits other use of previous parking area	14.2

The intangible benefits prevail with emphasis on tardiness, public relations, and absenteeism. Site-specific benefits were valued less than benefits that can be appreciated by a firm regardless of its site location. Although only one benefit category was selected by over 50 percent of the respondents, the diversity of benefits indicates a broad satisfaction with ridesharing.

CASE STUDIES

Although the respondents to the original survey were requested to provide quantitative estimates of the benefits derived from operating corporate ridesharing programs, few were able to comply. Follow-up telephone contacts were made with 20 employers in order to convert general estimates of benefits into annual monetary values. The follow-up contacts concentrated on private employers who were operating employer vanpool programs.

Generally, the individuals contacted felt the estimated benefits derived from vanpooling were real and tangible values, but they had difficulty in converting benefits into monetary values. In many cases, situations and amplifications were cited to demonstrate that the benefits were actually received. One particular problem is defining monetary benefits derived from reduced absenteeism, tardiness, and employee turnovers. Through conversations, attempts were made to estimate these intangible benefits through an analysis of person-hours saved, under the assumption that the employer suffers a negative consequence if a worker is either late or absent. These estimated benefits are clearly separated from the stated benefits in the ensuing sections of this paper. Absenteeism and tardiness were costed at $5/hr in wages and were based on a 2,000-hr work year per employee. The percent reduction attributed to vanpooling was then applied to the yearly person-hours representing the vanpooling segment of the work force. Tardiness was defined to represent 15 min late. Although approximate, these procedures should reflect the general magnitude of benefits received from corporate rideshare programs and allow comparisons with program costs.

TABLE 4 SUMMARY OF BENEFIT-COST RATIOS, LARGE VANPOOL PROGRAMS 1 THROUGH 4

	1	2	3	4
Employees	12,700	2,200	7,000	14,000
Number of Vanpools	115	20	92	54
Number of Employees	990	180	1,120	518
Reason for Initiating Vanpooling	Need to reduce parking to permit expansion	Need to retain trained employees with a relocation	Energy conservation, and relocation to new site and wanted to retain employees	Lack of transit and improve air quality
Is Ridesharing Cost-Effective?	Definitely	Definitely	Definitely	Definitely
Extent of Benefits				
Reduced Absenteeism	NA --	Yes 10% $180,000[a]	Yes 7.5% $840,000[a]	Yes 15%[a] $2,331,000
Reduced Need to Construct New Parking	Yes $900,000/yr[c]	No	Yes $250,000/yr	No NA
Help Retain Valued Employees	No	Yes NA	Yes NA[e]	Yes NA[e]
Reduced Employee Tardiness	Yes 10% $30,937[b]	Yes 5% $2,812[b]	Yes 7.5% $26,250[b]	Yes 20% $338,500
Permitted Utilization of Previous Parking Area for Other Activity	Yes	No NA	No	No $300,000
Improved Public Relations	NA	Yes NA	Yes NA	NA
Other	--	--	Relieves stress on employees	Employees arrive early
Dollar Value of Benefits Stated/Year	$900,000	NA	$250,000	$2,719,500
Dollar Value of Benefits Estimated/Year	$930,937	$182,812	$1,116,250	--
Vanpool Program Costs per Year (Net Cost)	$77,000	$3,179	$55,100[f]	$220,000
Stated Benefit-Cost Ratio	11.7	NA	4.5[f]	12.4
Estimated Benefit-Cost Ratio	12.1	57.1	20.3[f]	12.4
Aggregated Direct Benefits	$920,000	NA	$194,900	$2,499,500

[a]Estimate of absenteeism and tardiness based on 1976 study. Actual hourly salary of $15-$18/hour.

[b]Estimated value based on percent of vanpoolers at $5/hour and 250 work days per year. Absenteeism assumed 8 hours per work day; tardiness assumed 15 minutes per worker.

[c]Allowed construction of new building on property originally designed for added parking.

[d]Estimated cost to train a new employee is $10,000 per year.

[e]Actual cases have been cited where employees have been offered jobs elsewhere, even at increases in salary, but because of vanpool programs they have stayed with the corporation.

[f]Less tax credit; actually there are no costs to employer.

Estimate of Benefits

Tables 4 through 8 provide a summary of the data and resulting benefit-cost ratios calculated for the 20 employers. Direct benefit-cost ratios are separated from estimated benefit-cost ratios where percent reductions in tardiness and absenteeism were converted to monetary values. Most clearly defined as a benefit from ridesharing was the ability of an employer to use vanpooling to avoid constructing additional parking spaces. This benefit is stated with a high degree of accuracy and confidence. Firms that went through a process of relocation found vanpooling to be valuable in retaining employees. Employee training costs were stated to be in the range of $10,000 per employee. It was suggested by a number of employers that retaining employees is a major contribution offered by vanpooling, which is frequently overlooked. Although only one firm had made a formal study of reduced absenteeism and tardiness attributed to vanpooling, most of the 20 employers reported reductions in absenteeism and tardiness in the range of 5 to 10 percent. Although these benefits are intangible, the respondents felt the benefits were real and had confidence in the percent reduction figure based on actual observations. Only a few employers placed an economic value on improved public relations, although many felt the vanpool program reflected favorably on the corporation. The footnotes to Tables 4 through 8 record comments made during the telephone conversations.

The 20 case studies can be separated into large programs—those with more than eight vans per program—and smaller programs. Of the 12 large programs included in the sample, 10 indicated that the vanpool program was definitely cost-effective. One program involving 37 vans initiated because of relocation to a new site was assessed as not being cost-effective. In fact this program did not achieve sufficient stated benefits to cover costs. However, when estimates were included for absenteeism and tardiness, the program did achieve a positive benefit-cost ratio. The one marginal response involved a program receiving a stream of benefits at no cost for operating the vanpool program.

Representatives for four of the smaller programs stated ridesharing was definitely cost-effective, whereas three programs were assessed as being either marginal or not cost-effective. One response was not provided. The representative of a program involving four vans stated that ridesharing was cost-effective but did not achieve a stated or estimated benefit-cost ratio exceeding 1. Similarly, one of the programs involving four vans and initiated as a program for energy conservation was not cost-effective. An analysis of the stated and estimated benefit-cost ratios verified this contention. The other two small programs for which marginal assessments were stated both had positive benefit-cost ratios. The limited sample indicates that large programs have a closer assessment of the role of an employer vanpool program and the returns it provides for the company. Although small programs are seen as less cost-effective than large ones, cost-effectiveness obviously depends on local circumstances surrounding the program.

Benefit-Cost Ratios

As noted in Table 9, out of the 20 case studies, 14 respondents judged their corporate vanpool programs to be definitely cost-effective. Three smaller programs were felt to be marginally cost-effective, whereas one large and one small program (less than six vans) were evaluated as not being cost-effective. The negative assessments reflected corporations in the energy sector, which had suffered major contractions in employment. Three programs were defined as having a benefit-cost ratio of less than 1, while four programs realized a flow of benefits with the vanpools operating at break-even cost. In all cases these benefit-cost ratios were derived from estimates provided directly by the respondents. When estimates of reductions of tardiness and absenteeism are included, the benefit-cost ratios become more favorable. Only in two cases did the benefit-cost ratio not exceed 1. Both of these programs would be characterized as having a strong management commitment to ridesharing with a substantial employer subsidy. However, because of reduced employment, it has been increasingly difficult for the vanpool program to operate.

The 20 case studies indicate that corporate vanpooling programs can generate benefits exceeding costs. Attractive returns are received by many corporations sponsoring vanpooling programs. It is clear that there are a variety of problems and opportunities stimulating interest in corporate vanpooling.

CONCLUSION

An analysis of the responses from 160 private employers indicates a positive assessment of ridesharing's cost-effectiveness. Respondents were requested to provide specific monetary estimates of the benefits derived from their ridesharing programs. Although the employers did recognize and acknowledge the presence of benefits, most could not quantify the benefits. Most of the benefits cited were of an intangible nature—reduced absenteeism, enhanced corporate image, reduced employee tardiness, and so on. Many employers did not have a specific economic criterion on which to initiate corporate rideshare programs but were more concerned with employee and community benefits. Thus it is clear that the data base necessary to generate cost-benefit analyses does not exist. Even though the benefits cannot be quantified, they are perceived by employers as being real and present.

An important finding is that even in cases where employers took on major commitments for operating corporate vanpooling programs and administrative charges were excluded, 56 percent of the firms were able to operate these programs at a financial break-even point or better. Fares and available tax credits were used effectively by private employers to cover all operating expenditures of corporate vanpool programs. Any positive return in the form of benefits can then provide an effective benefit-cost ratio. This finding needs to be communicated to a maximum number of employers. Even with all rideshare administrative costs being applied against the vanpool program, 25 of the programs will still be able to break even or return a profit.

Free parking is accepted as an employee benefit. Unfortunately, free parking can consume extensive corporate resources. Many employers are not aware of the full cost of providing free parking. Ridesharing, especially corporate vanpooling, can be provided at a fraction of the cost of expanding parking. Thus, vanpooling can be used to avoid the capital and operating costs of expanding parking capacity. In general,

TABLE 5 SUMMARY OF BENEFIT-COST RATIOS, LARGE VANPOOL PROGRAMS 5 THROUGH 8

	5	6	7	8
Employees	3,000	3,500	6,000	200
Number of Vanpools	25	70	54	8
Number of Employees	240	525	750	80
Reason for Initiating Vanpooling	Employee benefit	Employee benefit	Energy conservation	Relocation to new site
Is Ridesharing Cost-Effective?	Definitely	Definitely	Definitely	Definitely
Extent of Benefits				
Reduced Absenteeism	NA	NA	Yes 2% $13,650	Yes 5% $40,000[a]
Reduced Need to Construct New Parking	Yes $50,000	Yes $25,000	No	No
Help Retain Valued Employees	NA	NA	Yes	No
Reduced Employee Tardiness	NA	NA	Yes 2% $1,000	Yes 10% $2,500[a]
Permitted Utilization of Previous Parking Area for Other Activity	NA	NA	No	No
Improved Public Relations	NA	NA	Yes	No
Other	---	Rent out vans during day = $20,000		
Dollar Value of Benefits Stated/Year	$50,000	$45,000[b]	$14,650	---
Dollar Value of Benefits Estimated/Year	---	---	---	$42,500
Vanpool Program Costs per Year (Net Cost)	$17,000	$20,000	Breakeven	$ 2,000
Stated Benefit-Cost Ratio	2.9	2.3	Benefits no cost to employer	---
Estimated Benefit-Cost Ratio	2.9[c]	2.3[c]	NA	21.2
Aggregated Direct Benefits	$33,000	$25,000	NA	NA

[a]Estimated value based on percent of vanpoolers at $5/hour and 250 work days per year. Absenteeism assumed 8 hours per work day; tardiness assumed 15 minutes per worker.

[b]Actual corporate study noted a $100,000 profit from vanpooling in 1985.

[c]Same as stated benefit-cost ratio.

TABLE 6 SUMMARY OF BENEFIT-COST RATIOS, LARGE VANPOOL PROGRAMS 9 THROUGH 12

	9	10	11	12
Employees	1,300	2,000	16,000	4,800
Number of Vanpools	8	38	37	24
Number of Employees	70	400	385	240
Reason for Initiating Vanpooling	Energy conservation	Avoid expanding parking	Relocation to new site	Energy conservation
Is Ridesharing Cost-Effective?	Marginal	Definitely	No	Definitely
Extent of Benefits				
Reduced Absenteeism	No --	Yes 5% $280,000	Yes 25% $962,500[a]	Yes 2% $48,000[a]
Reduced Need to Construct New Parking	No	Yes $146,000	No	NA
Help Retain Valued Employees	No	Yes NA	Yes $100,000	NA
Reduced Employee Tardiness	Yes 5% $1.093[a]	Yes 5% $70,000[a]	Yes 22% $26,468[a]	NA 5% $3,750[a]
Permitted Utilization of Previous Parking Area for Other Activity	No	Yes NA	No	Yes $300,000
Improved Public Relations	No	Yes[b]	No	Yes NA
Other	--	Increases labor market for firm; less stress on employees	Expand recruitment after relocation and maintain employees	
Dollar Value of Benefits Stated/Year	--	$426,560	$100,000	$300,000
Dollar Value of Benefits Estimated/Year	$1,093	$496,560	$1,088,968	$351,750
Vanpool Program Costs per Year (Net Cost)	+	$3,300	$150,946	$24,800
Stated Benefit-Cost Ratio	Benefits at no cost to employer	>100	<1	12.1
Estimated Benefit-Cost Ratio		>100	7.2	14.2
Aggregated Direct Benefits	NA	$423,260	Negative	$275,200

[a]Estimated value based on percent of vanpoolers at $5 per hour and 250 work days per year. Absenteeism assumed 8 hours per work day; tardiness assumed 15 minutes per worker.

[b]Positive public relations was felt to be worth millions of dollars to this company over the past four years. The program received extensive coverage in the national press.

TABLE 7 SUMMARY OF BENEFIT-COST RATIOS, SMALL VANPOOL PROGRAMS 13 THROUGH 16

	13	14	15	16
Employees	250	700	1,000	3,100
Number of Vanpools	4	2	5	4
Number of Employees	30	21	50	62
Reason for Initiating Vanpooling	Energy conservation	Employee assistance program	Energy conservation	Legal requirement
Is Ridesharing Cost-Effective?	No	Marginal	Definitely	Definitely
Extent of Benefits				
Reduced Absenteeism	No	Yes 1% $2,100*	Yes 5% $25,100*	Yes 1% $6,200*
Reduced Need to Construct New Parking	No		NA	No
Help Retain Valued Employees	No	Yes	NA	No
Reduced Employee Tardiness	Yes 10% $938*	Yes 4% $262*	Yes 5% $781*	Yes 5% $969*
Permitted Utilization of Previous Parking Area for Other Activity	No	No	NA	No
Improved Public Relations	Yes $2,000	Yes $2,000	NA	Yes
Other				
Dollar Value of Benefits Stated/Year	$2,000	$2,000	--	NA
Dollar Value of Benefits Estimated/Year	$2,937	$4,362	$25,781	$7,169
Vanpool Program Costs per Year (Net Cost)	$11,500	$300	$2,000	Break-even
Stated Benefit-Cost Ratio	<1	6.7	--	--
Estimated Benefit-Cost Ratio	<1	14.5	12.8	<1
Aggregated Direct Benefits	Negative	$1,700	NA	Negative

*Estimated value based on percent of vanpoolers at $5/hour and 250 work days per year. Absenteeism assumed 8 hours per work day; tardiness assumed 15 minutes per worker.

TABLE 8 SUMMARY OF BENEFIT-COST RATIOS, SMALL VANPOOL PROGRAMS 17 THROUGH 20

	17	18	19	20
Employees	70	180	110	165
Number of Vanpools	1	1	2	1
Number of Employees	9	8	25	15
Reason for Initiating Vanpooling	Relocation to new site	Relocation to new site	Relocation to new site	Lack of transit and to improve air quality
Is Ridesharing Cost-Effective?	Marginal	NA	Definitely	Definitely
Extent of Benefits				
Reduced Absenteeism	Yes 3% $2,700[a]	No	No	Yes 20% $30,000[b]
Reduced Need to Construct New Parking	No	No	No	NA
Help Retain Valued Employees	Yes $5,000	Yes $30,000	Yes $3,000	Yes $27,500/yr.[c]
Reduced Employee Tardiness	Yes 5% $141[a]	No	Yes 20% $1,562[a]	Yes 20% $7,500
Permitted Utilization of Previous Parking Area for Other Activity	No	No	No	NA
Improved Public Relations	No	No	Yes	Yes
Other				
Dollar Value of Benefits Stated/Year	$5,000	$30,000	$3,000	$27,500
Dollar Value of Benefits Estimated/Year	$7,841	--	$4,563	$65,000
Vanpool Program Costs per Year (Net Cost)	$4,000	Break-even	Break-even	$300[d]
Stated Benefit-Cost Ratio	1.3	Benefits at no cost to employer	Benefits at no cost to employer	91.6[d] >100[d]
Estimated Benefit-Cost Ratio	2.0			
Aggregated Direct Benefits	$1,000	$30,000	$3,000	$27,250

[a]Estimated value based on percent of vanpoolers at $5/hour and 250 work days per year. Absenteeism assumed 8 hours per work day; tardiness assumed 15 minutes per worker.

[b]A 10 percent absenteeism per shift means 60-62 people would be off; thus the production line could not function.

[c]Retaining one person saves this corporation $11,000-$12,000 in training costs.

[d]Less tax credit; actually no costs to employer.

TABLE 9 SUMMARY OF BENEFIT-COST RATIOS

	Number of Programs	Benefit-Cost Ratios: Based on Monetary Values Stated by Respondents	Benefit-Cost Ratios: Estimated Values
Cost-Effective			
Definitely	14		
Marginal	3		
No	2		
Not Available	1		
Benefit-Cost Ratios			
Less Than or Equal to 1		2	2
Greater Than 1 and Less Than or Equal to 10		5	4
Greater Than 10 and Less Than or Equal to 20		3	6
Greater Than 20		2	4
Benefits Received at No Direct Program Cost to Employer		4	4
Not Applicable		4	0

ridesharing was perceived by private employers as providing a stream of positive returns to the corporation.

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U.S. Department
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Federal Highway
Administration

Evaluation of Travel Demand Management Measures to Relieve Congestion

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February 1990

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16. Abstract

The report summarizes the results of a research study to investigate the effectiveness of Travel Demand Management (TDM) programs. This investigation consisted of the evaluation of a number of existing TDM programs located throughout the United States. The programs, many of which are well known, are primarily employer-sponsored and site specific. These programs are varied in size, setting, motivation, and accomplishments. Some additional programs are featured that present TDM in a central business district environment and in freeway corridors. Together, all the TDM programs presented comprise a fairly representative cross section of contemporary experience with TDM.

The study directly measured the quantitative impact of the TDM programs on reducing low-occupancy vehicles trips. The approach was to evaluate each program as a separate case study, using the same set of evaluations tools and guidelines. Vehicle volumes and mode choice evaluations of the programs were prepared whenever data was available. Comparisons were made and inferences drawn between sites that do have a TDM program and those sites that do not. The report presents these case studies as well as overall conclusions on the impact that TDM has on reducing the number of low-occupancy vehicle trips.

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EVALUATION OF TRAVEL DEMAND MANAGEMENT (TDM) MEASURES TO RELIEVE CONGESTION

Prepared for

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PREFACE

This report was prepared by COMSIS Corporation and Harold Katz and Associates under contract to the Federal Highway Administration, U.S. Department of Transportation. It is a case study review of current Travel Demand Management programs in the United States, with an emphasis on their capability to reduce traffic. Research for the project was sponsored by the FHWA, and occurred during the period October 1988 through July 1989. Results reported were the most current available through this period.

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EVALUATION OF THE EFFECTIVENESS OF TRAVEL DEMAND MANAGEMENT PROGRAMS

1. BACKGROUND

Travel Demand Management (TDM) has become popular terminology to describe a system of actions whose purpose is to alleviate traffic problems through improved management of vehicle trip demand. These actions, which are primarily directed at commuter travel, are structured to either reduce the dependence on and use of single-occupant vehicles, or to alter the timing of travel to other, less congested time periods. Simply stated, the purpose of Travel Demand Management is to maximize the movement of "people," not vehicles, within the transportation system.

Travel Demand Management is a *process*. It is both the transportation actions which affect the travel time, cost and other considerations that shape travel behavior, as well as a specialized way of implementing these actions, through often innovative legal and institutional approaches.

Most of the actions considered to be in the realm of TDM are not new. They may be described according to the following types of strategies:

- **Improved Alternatives** -- TDM offers travelers legitimate alternatives to driving alone. Alternatives include various types of transit service, carpooling and vanpooling, and where appropriate, provisions for walking and bicycling. The emphasis, however, is on providing these alternatives in a manner which makes them competitive with the service levels offered by the private auto.

- **Incentives and Disincentives** -- While opportunities exist to design more competitive alternatives, even the best designs will have difficulty achieving an equal level of competition with the auto, particularly in the suburban environment where employment destinations are widely scattered and parking on-site is generally provided free by the employer. Incentives are necessary to overcome these built-in advantages and equalize the economic competition between auto and the other modes. These incentives can include travel time savings, such as are afforded by High Occupancy Vehicle (HOV) lanes, priority treatment at ramps and entranceways, and preferential parking at the destination. Financial incentives are also important, and can consist of direct subsidies to non-Single Occupancy Vehicle (SOV) users, in-kind subsidies such as discounted transit fares, or "inverted" parking rates which favor HOVs.

- **Work Hours Management** -- The first two types of TDM actions directly affect travel efficiency in terms of choice of mode. Work hours management strategies try to affect vehicle trip demand on highway facilities by shifting that demand to less congested time periods. This includes such strategies as flexible work hours (flextime), staggered work hours, and modified work schedules (4-day work week, work at home options).

Many of these TDM actions were once referred to as Transportation System Management, or "TSM" strategies, and had the same overall objective of trying to "stretch" the capacity of the existing transportation system, and avoid expensive new construction. What distinguishes TDM from TSM is its emphasis on shaping travel demand, as opposed to effecting improvements to the transportation system itself. What is also different is the way that these actions are applied, and the responsibility for their application. The responsibility in TDM programs is shared by both public and private sectors. This is of great importance, because with the participation and support of developers and employers, important incentives which affect individual travel decisions may be controlled at the source.

2. PURPOSE OF REPORT

This report summarizes the results of a research study, sponsored by the Federal Highway Administration, to investigate the effectiveness of existing Travel Demand Management programs. This investigation consisted of the evaluation of a number of existing TDM programs located within the United States. The programs, many of which are well known, are varied in size, setting, motivation and accomplishments. Together, they comprise a fairly representative cross section of contemporary experience with TDM.

The purpose of this study has been to measure directly the quantitative impact of these varied TDM approaches on reducing low-occupancy vehicle trips. Much of was is known and has been reported on TDM has dealt with the legal, institutional and organizational aspects of these programs. While implementation of TDM actions is highly dependent upon such background factors, it has left largely unanswered the basic question: "Is TDM effective in reducing low-occupancy vehicle trips?" The answer to this question will ultimately determine whether TDM will capture the legal and institutional support it needs to be effective in solving highway capacity problems.

While traffic congestion has long been a concern in urban areas, megatrends in the suburbanization of employment are now resulting in some of the country's worst traffic problems occurring in the suburbs. These areas are ill-equipped to cope with large -scale traffic problems. In many cases, residential and commercial development has proceeded far ahead of construction of the necessary infrastructure to accommodate the related traffic. Often, this delay has meant that key segments of the highway system have not been, and now may never be, constructed. Growth projections strongly suggest an ever-widening gap between the demand for travel and physical capacity. In other words, today's traffic problems figure to get much worse.

Attempting to build adequate new highway capacity to satisfy this demand is frustrated by several problems:

- o Limited funds to finance the enormous costs of constructing new highways;

- o Physical space constraints in finding appropriate rights of way for new or expanded highways, matched by citizen resistance to new highways in existing communities;

- o A high rate of growth in vehicle travel relative to increases in person travel, reflecting a continuing decline in the efficiency with which highways are used.

Is TDM a strategy in which confidence can be placed to help deal with this ever-widening gap and the resultant traffic congestion? How much traffic can be reduced by TDM? How can this reduction be measured and validated? What factors contribute to the trip reduction accomplishments of a TDM program? These are all questions which the subject research was designed to address.

3. CASE STUDY FRAMEWORK

The study was structured around a sampling of existing TDM programs. The approach was to evaluate each program as a separate case study, using the same set of evaluation tools and guidelines for each. The report which follows this introduction presents these individual case studies, detailing for each:

- o The setting of the program;

- o The background and motivation for the TDM program;

- o The technical and administrative elements of the TDM program;

- o An estimate of the program's trip reduction impacts.

TDM is normally directed at commute travel, though it need not be restricted to just this market segment. There are several reasons for the focus on commuters. First, the most significant demand placed on the transportation system usually occurs during weekday peak periods. This time period is dominated by commuter travel, which is characterized by the lowest vehicle occupancy rates of all travel purposes. Second, the day-to-day regularity of commuter trips and the comparatively high travel densities make this travel market the most suitable for finding alternatives. Third, conditions at the workplace, in terms of employer practices (such as free parking), are important targets for modification with TDM actions. Therefore, most current TDM programs deal with commuters, and that is reflected in the case studies selected for this report.

Except for a small number of cases, each of the case studies reports on an "areawide" (subarea or corridor level) TDM effort. In other words, traffic conditions have created sufficient concern that there is a collective effort within the community to take action against it. In some instances, the initiative has been provoked by a legal action, such as an

ordinance; in others, it has occurred out of direct self interest of the business community. Where possible with available data, an assessment has been made of the trip reduction impact of this "collective" areawide effort.

Within each areawide program, however, are TDM programs run by individual employers. Typically the number of outstanding individual programs dictates the level of achievement of the areawide effort. Much can be learned from these individual "success stories", because generally the specific TDM elements can be isolated and the data for measuring impacts is more precise. Therefore, each case study includes at least one individual employer example, whose results rank above the average for the areawide effort.

Listed in Table 1 are the various TDM programs selected for evaluation by the study. Each of the major programs is listed in the first column, and described in the second column as to the primary type of setting that it represents:

- Regional CBD
- Corridor
- Suburban Activity Center
- Suburban Business Park

The study has produced TDM trip reduction estimates for each of the programs listed in the first column. Then, within each of these overall programs exist generally one or more individual employer programs which has been documented and evaluated. These are listed in the third column of Table 1.

4. MEASUREMENT TECHNIQUE

The goal of this study was to determine whether particular TDM efforts have had a measurable impact on traffic volumes. Several approaches were considered to accomplish this measurement.

The desired approach was to measure changes in traffic volumes themselves. After considerable thought, this approach was deemed infeasible, for several reasons:

- Lack of available data -- no situations were encountered where traffic counts were available for comparable measurement locations before and after the introduction of a TDM program.

TABLE 1

LISTING AND CATEGORIZATION: TDM PROGRAM SITES

Overall Program	Setting	Individual Employer Sites
Downtown Hartford, Connecticut Transportation Management Program	Regional CBD	Travelers Insurance Hartford Steam Boiler
North Bethesda Montgomery County, Maryland	Suburban Activity Center	Nuclear Regulatory Commission
The 3M Company St. Paul, Minnesota	Suburban Business Park	3M Company
Minnesota Rideshare Downtown Free Parking Program Minneapolis, Minnesota	Regional CBD	
I-394 Interim HOV Lane Minneapolis, Minnesota	Radial Corridor	
Downtown Bellevue TDM Program Bellevue, Washington	Suburban Activity Center	US WEST CH_2M Hill
Bishop Ranch Business Park Contra Costa County, California	Suburban Business Park	AT&T
UCLA/Westwood Los Angeles, California	Suburban Activity Center	University of Calif., at Los Angeles
Downtown Los Angeles	Regional CBD	Atlantic-Richfield Bank of America L.A. Dept. of Water and Power
South Coast Metro Orange County, California	Suburban Activity Center	State Farm

- Intervening Factors -- even if comparable volume data could be found, there was great difficulty separating the effects of external factors on the measured volumes, such as net areawide population/employment growth/decline, or changes in the transportation system.

- High Variability -- high day-to-day or seasonal variability in traffic counts further reduces their usefulness for making valid determination of relatively small changes.

A secondary measure which is frequently used to assess traffic impacts is average vehicle occupancy. Higher levels of average vehicle occupancy are equated with higher levels of efficiency, which may be translated to reduced vehicular demand for highway capacity. This measure was considered but also deemed infeasible because:

- Data Availability -- few if any programs had estimates of vehicle occupancy from comparable sources before and after TDM program introduction.

- Measurement Error -- at least two types of measurement problems limit reliance on vehicle occupancy as a primary indicator: (1) the measure usually does not account for

usage of public transit, walking or bicycle, which makes it misleading as an efficiency measure for some sites; and (2) it becomes difficult to *physically* measure vehicle occupancy at work site locations where there are multiple employers, parking locations or entry points.

Ultimately, the type of data available was used to shape the measure. The most universally available information from TDM programs was employee modal split, measured through employee surveys. Clearly, measures derived from surveys raise the question about response bias from small samples. This potential for response bias cannot be denied, but has been minimized by (1) using information from surveys where the rate of response was at least 35%, and (2) comparing survey results developed from a comparable procedure applied at different points in time.

To estimate vehicle trip reduction impact from modal split, a special index was developed: **Number of Vehicle Trips per 100 Travelers.** This index represents the rate at which vehicle trips are generated by a particular travel population. The population can be the employees in a business park or the total travelers in a corridor or activity center.

The index estimates vehicle trip generation from modal split by assuming the following occupancy levels for each mode:

- Drive Alone -- 1 vehicle trip for every person trip

- Carpool -- 0.4 vehicle trips for every person trip (assumes 2.5 persons per carpool)

- Vanpool -- 0.083 vehicle trips for every person trip (assumes 12 persons per vanpool)

- Transit -- 0.033 vehicle trips for every person trip (assumes 30 persons per vehicle)

- Bicycle/Walking -- no vehicle trips per person trip.

The vehicle occupancy assumptions are made in order to place each of the sites on an equivalent basis. In many cases, the modal split information is known, but the actual vehicle occupancy rates for the various modes is not. The occupancy assumptions were adopted from the work of Bay Area RIDES in San Francisco, which uses this estimating basis to determine compliance with regional trip reduction ordinances.

Understanding the index is quite simple. A reading of 100 vehicle trips per 100 travelers indicates that everyone in the travel base is driving alone. As the index declines, it is an indication of increased efficiency through the use of high occupancy vehicle modes, and in particular, signifies ***vehicle trips not taken*** to support the same level of person movement.

To determine the number of vehicle trips reduced by a TDM program, the TDM program must be compared with a reference base or "control site" that does not include TDM. This comparison is necessary because it is invalid to assume that the starting point for a TDM program is the situation where everyone drives alone. Selection of this reference base is important. The following are candidate bases, in declining order of preference:

1) The organization or area itself before the TDM program.

2) A comparable organization or area that does not have TDM.

3) The behavior of the surrounding region.

Using the trip generation index, the study estimates the number of vehicle trips that are made by the TDM population under the TDM program, and then determines the number of vehicle trips that would have been made in the absence of TDM, as represented by the trip generation index value for the control base. The difference in the number of vehicle trips that would be made by the same population, assuming the different rates of trip generation, is defined as the **net trip reduction** accomplished by the TDM program. These are vehicle trips that would otherwise exert a demand on the highway system if they had not been eliminated through TDM.

This measurement technique offers satisfactory results for programs which have accomplished their effect through changing traveler mode choice. A somewhat different situation is posed by work hours management strategies. With work hours management, the objective is not to reduce vehicle travel, *per se*, but to shift its timing to periods of lower demand.

In principal, measurement of the trip reduction effect of work hours strategies would be similar to mode shifts. A measurement index which measures **peak hour vehicle trip generation** would be a comparable statistic to the former index. The difficulty in performing an assessment of variable work hours trip reduction, however, is in finding suitable control sites for use in gauging net impact. Trip time distribution information is much less frequently obtained than modal split. Therefore, it is difficult to gain a clear measure of reduction for this strategy from existing data.

5. DESCRIPTION OF CASE STUDIES

This section offers brief descriptions of each of the TDM programs which were selected for inclusion as case study examples. The summaries describe the background and setting for each of the examples, identify the principal role players, and list the major elements of the TDM program. Trip reduction impacts are discussed in a later section.

Downtown Hartford, Connecticut Transportation Management Program

The business community in downtown Hartford sensed growing problems with traffic back in the early 1980's, triggered by a development boom in the downtown, and the knowledge that there were no plans to add to the City's limited highway infrastructure. A comprehensive public-private transportation management program was initiated which involved 11 of the largest downtown employers, accounting for about 40% of the approximately 100,000 employees. Most of these employers are insurance companies, which are also land owners with a major stake in the continued viability of the downtown. While parking is restricted in the downtown, many employers compete for employees with parking benefits, which has proved to be a major factor influencing travel patterns. The public-private management organization has attempted to work both with employers to eliminate practices which encourage driving, as well as with the public sector to provide improved transit and other service options for commuters. Two firms, Travelers Insurance and Hartford Steam Boiler, have initiated their own comprehensive TDM programs which have achieved impressive trip reductions.

Nuclear Regulatory Commission, Montgomery County, Maryland

Montgomery County, Maryland, a suburb of Washington, D.C., maintains a program of active measures to control development and traffic in a high-growth environment. Central to this system of controls is the Adequate Public Facilities Ordinance, which restricts new development to the capacity of the transportation system to provide an adequate level of service. Level of service standards have been established for each of 15 planning areas, and development applications are staged to the capacity of the transportation system in the respective subarea. A Transportation Management Association has been formulated in the North Bethesda planning area to search out solutions to a current development moratorium. While the TMA is only in its early stages, there is one individual example, the Nuclear Regulatory Commission (NRC), that serves as an important case study. When planning its relocation of 2,450 employees to a central headquarters in North Bethesda, the Nuclear Regulatory Commission encountered difficulty when it was realized that the full consolidation of its staff would generate a level of vehicle trips that would exceed the limits established by the county ordinance. In order to accomplish its consolidation, the NRC developed a comprehensive TDM plan for its employees including improved alternatives, subsidies and parking management strategies. The trip reduction achieved at the first building so successful that the county granted the NRC permission to proceed with construction on the second building, which will allow NRC to complete its consolidation.

3M Company TDM Program, St. Paul, Minnesota

3M is a major technology/light manufacturing firm located in the suburbs east of St. Paul. About 12,700 employees are employed at the company's 3M Center complex. 3M's pursuit of a TDM program was motivated entirely by internal objectives. Poor access to the site and competing demand for land between parking lots and buildings caused the company to become involved in transportation management back in the early 1970's. Since that time, the company has launched both work hours management programs and development of alternate travel modes. 3M has designed and managed significant subscription bus, carpool and vanpool programs. Its vanpool program has been one of the country's model programs for many years.

I-394 Interim HOV lane, Minneapolis, Minnesota

When Trunk Highway 12 into downtown Minneapolis was scheduled for reconstruction as Interstate 394, one of the conditions placed on the new facility was that it include High Occupancy Vehicle (HOV) lanes. To ease traffic problems during construction and begin to shape behavior toward the eventual opening of the lane, an interim HOV lane was installed on Highway 12 beginning in 1985. Known as the "Sane Lane", the single reversible lane gained significant favor from corridor travelers, and has been credited with both converting a high percentage of drivers over to carpooling, as well as attracting travelers from parallel routes. This case study is of a different character than most of the others, in that it features the application of a single TDM strategy, i.e., an HOV lane, by a public agency in a very specific setting, an urban corridor. Its importance is that it demonstrates the impact of this key TDM strategy on shaping travel behavior.

Downtown Free Parking Program, Minneapolis, Minnesota

Concurrent with the I-394 Interim HOV lane, the Minnesota Department of Transportation, through its Minnesota Rideshare office, devised and implemented a free parking program in downtown Minneapolis. The program makes available free parking at a series of CBD fringe lots to registered pool units of 2 or more travelers. The program conveys savings of $30 to $80 per month to users over parking costs in comparable location. While the program was designed to complement the I-394 program, it is available to and used by all carpoolers to downtown Minneapolis. Like the I-394 case study, the Free Parking Program is a particular example of a single, targeted TDM strategy -- free parking to carpools -- implemented by a public agency.

Downtown Bellevue, Washington TDM Program

Downtown Bellevue, Washington is a suburban center with an employment of about 24,000. The CBD is somewhat atypical of suburban activity centers with its preponderance of high rise buildings, grid-like streets and sidewalks, and restricted parking. These characteristics were influenced by City officials. While there is no formal TDM ordinance in downtown Bellevue, developers are required to minimize building setbacks, restrict parking to a maximum of 2.4 spaces per 1000 square feet, and employ measures to offer employees alternative commuting options to minimize parking spillover to other facilities. A Transportation Management Association (TMA) has been formulated to help businesses

cope with the restrictions and find alternatives for their employees. The city and the TMA have also worked to develop transit and system design elements to encourage use of HOV modes. The Bellevue CBD program has demonstrated significant overall trip reduction relative to regional standards, and there are several individual programs, particularly those of US WEST and CH_2M Hill, which have achieved exemplary trip reductions.

Bishop Ranch Business Park, Contra Costa County, California

Bishop Ranch is a modern business park located at the eastern fringe of the San Francisco metropolitan area, near the town of San Ramon, in Contra Costa County. Bishop Ranch is about 35 miles from San Francisco, and the area in which it is located is of extremely low density. It has become the home of several major organizations with significant employment space requirements, such as Pacific Bell and Chevron, which were formerly located in San Francisco. The park has been in existence since the early 1980s, and its employment, which is predominately white collar professional, numbers 14,000. Bishop Ranch's two primary developers were placed under a requirement by Contra Costa County to reduce their peak hour vehicle trips by 40%. They have satisfied this requirement through a combination of alternative modes and flexible work hours, with a significant role played by flextime. Helping the large number of employees in the relocation to the new office space was an important factor influencing early success of the program. A TMA has been formed in Bishop Ranch to assist with the transportation management program. The TDM program of Pacific Bell is an exemplary individual effort.

City of Pleasanton & Hacienda Business Park, Alameda County, California

Hacienda Business Park is a very similar situation to Bishop Ranch. It is located just south of Bishop Ranch, along I-680 in Alameda County. Hacienda is located near the town of Pleasanton, which effected a TDM ordinance in conjunction with the planning of Hacienda, to limit the traffic impacts of the new development. The ordinance requires a 40% reduction in peak period vehicle trips for all large employers, and it applies to the entire city of Pleasanton as well as Hacienda. The employment at Hacienda is just under 8,000, and the City of Pleasanton, including Hacienda, has an employment of about 22,000. Hacienda has achieved its reduction goal through a combination of alternate mode programs and flexible work hours, with most of the reductions achieved through time shifting. Again, relocation assistance was important to the success the TDM program. Within Hacienda Business Park, the program of AT&T serves as another exemplary individual effort.

University of California at Los Angeles (UCLA)/Westwood Transportation Management Program in Los Angeles

UCLA is located in the Westwood area of Los Angeles. Some 34,000 students attend UCLA, and over 18,000 people work on campus. Westwood is a diversified major activity center, with restaurants, retail and office activity, plus an affluent residential community of about 37,000. Traffic in Westwood is extremely congested, and the community has maintained pressure on the University to manage the traffic generated by its student and employee population. The University has developed a comprehensive management program which includes strategic use of its parking facilities, express and shuttle bus

services, a carpool program and an extensive vanpool program.

Atlantic Richfield Company and Downtown Los Angeles

Downtown Los Angeles, as is all of the L.A. basin, is subject tot the requirements of Regulation XV. This regulation, promulgated by the Air Quality Management District, requires formal trip reduction efforts by all major employers as a means to achieving air quality objectives. Terms of the regulation require evidence of employee commute management programs that will produce near-term achievement of a minimum average vehicle occupancy. One firm which has served as an example for travel management from the time prior to the passage of Regulation XV is Atlantic-Richfield (ARCO). ARCO has a longstanding reputation for aggressive, high impact transportation management programs. The firm's offices in downtown Los Angeles employ about 1500 people. Since relocating to Los Angeles from New York City in 1972, the company has sponsored active carpooling, vanpooling and subscription bus programs for its employees. A large measure of the success of ARCO's program is attributable to the strategic pricing and availability of its employee parking. While it subsidizes employee's parking costs, parking is scaled to the number of vehicle occupants, and the company also offers a Transportation Allowance to employees which further encourages high occupancy vehicle travel. Several other programs in downtown Los Angeles with above-average results are also featured in this case study.

South Coast Metro, Orange County, California

Orange County, located south of Los Angeles, is one of the fastest growing counties in the nation, and features a number of employment centers of major size and regional significance. The spread-out nature of this suburban county has meant an unusually rapid growth of traffic problems. As with the rest of the Los Angeles region, air quality concerns are forcing trip reduction responsibilities on all major employers under Regulation XV. One of the major employment centers addressing itself to this new regulation is South Coast Metro, a 2200-acre mixed-use activity center situated between the cities of Costa Mesa and Santa Ana. At build out, South Coast Metro is expected to contain 13.5 million square feet of office space and employ 45,000 people. Current employment is about 25,000, with over 1100 firms. The transportation management program at South Coast Metro was initiated before the enactment of Regulation XV, but clearly the effectiveness of the program is being greatly influenced by the regional mandate. While initiatives inspired by Regulation XV are still too early to allow measurable trip reduction impacts in the area as a whole, some of the individual employers have interesting programs which are underway and have already achieved impressive results. One of these is State Farm, which improved its vehicle occupancy from 1.21 to 1.55 in a little over one month through a creative carpool subsidy program.

6. REVIEW OF RESULTS

Structure and Content of Summary Tables

Tables 2A through 2H provide a summary level review of the findings from the case study evaluations. Each table presents findings from a particular geographic area. Within each area, the table first reports on the areawide program, if such a program exists. Following the areawide summary are results on any individual projects within the areawide effort that have meaningful impacts.

Each table is comprised of several entries. The feature entries are the TDM examples themselves. The second column of the table indicates whether the example is a **TDM** case or one of the **Control** cases; the controls are used as the base of comparison against which TDM trip reduction is measured.

Each entry in the table is described by several characteristics which define travel conditions at the site. These characteristics include:

o The **Travel Base** to which the TDM measures apply (shown only for TDM examples, for reasons of relevance);

o The **Drive Alone Rate** (current percentage of all travelers who drive alone);

o The **Average Vehicle Occupancy** rate (calculated using same modal occupancy assumptions used in vehicle trip index);

o The vehicle trip generation rate, expressed as **Number of Vehicle Trips per 100 Travelers.** This rate is calculated from modal split information, assuming 2.5 persons per carpool, 12 persons per vanpool, and 30 persons per transit trip.

o The **Total Vehicle Trips** (daily one-way) generated by the travel base, using the Vehicle Trip per 100 Travelers index.

The calculated **Trip Reduction** is then shown in boldface below the respective entry. The calculation of vehicle trip reduction is made by comparing the TDM example with one or more relevant control examples. To calculate the reduction, the number of vehicle trips for the TDM site is first calculated using the Trips per 100 index achieved by the site, and then calculated assuming the travel base were to travel at the rate exhibited by the control, using the control's index. The difference in vehicle trips from these two calculations is the **Net Trip Reduction** credited to the project. It is presented in the table as both a **Total Trip Reduction** and a **Percentage Reduction.**

Sample Table

Table 2-A, which summarizes the results for Hartford, is used as an example to illustrate how the tables are interpreted. The first entry (1) in the table describes the travel conditions measured in downtown Hartford in 1987, following implementation of its

areawide TDM program. The Travel Base to which the TDM program has been applied is 102,000 downtown employees. Characteristics of this travel population after implementation of the TDM program include a Drive Alone Rate of 45%, an Average Vehicle Occupancy of 1.79, and a vehicle trip generation rate of 56.0 Vehicle Trips per 100 travelers. Applying this rate to the travel base yields an estimated 57,120 daily one-way vehicle trips generated by this population.

Clearly, these would be enviable travel statistics in most travel markets, particularly the suburbs, where drive alone rates are closer to 90% and vehicle occupancy rates are only slightly above 1.0. But Hartford was already starting from a significant base, as shown in the control case (2), which is Hartford in 1981 before the TDM program. Even in 1981, the drive alone rate was only 48%, and average vehicle occupancy was 1.74. Comparing the pre and post-TDM situations (1) vs. (2) implies that the TDM program accomplished only a 2.4% reduction in vehicle tripmaking, or 1428 daily one-way vehicle trips. There are important reasons why Hartford's areawide TDM program accomplished only a modest trip reduction, and these are discussed in the case study. But for the purpose of understanding Table 2-A, the Trip Reduction is calculated by assuming that if the 1987 TDM travel population of 102,000 employees were to travel at the vehicle trip generation rate observed in 1981, or 57.4 trips per 100, they would generate 58,548 vehicle trips, vs. the 57,120 generated at the 56.0 per 100 rate observed after the TDM program in 1987. This results in the net reduction of 1,428 trips or 2.4% relative to 1981 levels.

The Hartford TDM program is an "areawide" transportation management effort intended to apply actions across and elicit travel changes from the employment base of a major downtown. All major employers are targeted in this areawide effort, the results of which were described in the comparison above. Within this areawide base are the efforts of numerous individual employers, some of which have achieved outstanding results. Two of these are listed in Table 2-A. They are Travelers Insurance, which is entry (3), and Hartford Steam Boiler, which is entry (5). In the table, each is compared to two standards. Each is first compared to another company within Hartford that is of comparable size and function, but which does not have an active TDM program. For reasons of confidentiality, these comparison companies are referred to as Company "B" and "D", shown as entries (4) and (6), respectively. Comparing Travelers to its non-TDM equal suggests a trip reduction of 47.9%. Comparing Hartford Steam to its equivalent suggests a trip reduction of 26.5%. Both individual TDM programs are also compared to the downtown as a whole before the TDM program (2). This comparison yields a more modest trip reduction of 25.4% and 13.6%, respectively, which would be expected considering that the TDM firms and the non-TDM firms represent the extremes in the downtown, whereas the downtown as a whole represents the average condition.

The other tables are read in virtually the same fashion. The major exceptions to this standard format are Tables 2-C and 2-E. Table 2-C lists three unrelated and somewhat specialized examples from the Twin Cities area, and Table 2-E similarly lists two unrelated examples from the Los Angeles area. All other tables follow the format of Hartford, with an areawide program presented first, followed by one or more individual examples from within the larger program.

TABLE 2-A: SUMMARY OF EFFECTS OF TDM PROGRAMS
Hartford, Connecticut

Location/ Project	Type Site	Travel Base	Drive Alone Rate	Average Vehicle Occupancy	Veh. Trips Per 100 Travelers	Total Vehicle Trips	Vehicle Trip Reduction	Percent Reduction
(1) Downtown Hartford, Post-TDM (1987)	TDM	102,000	45.0%	1.79	56.0	57,120		
(2) Downtown Hartford, Pre-TDM (1981)	Control		48.0%	1.74	57.4			
Trip Reduction, (1) vs. (2)							**1,428**	**2.4%**
(3) Traveler's Insurance	TDM	10,000	33.2%	2.34	42.8	4,280		
(4) Company "B"	Control	9,000	77.6%	1.22	82.1			
Trip Reduction, (3) vs. (4)							**3,930**	**47.9%**
Trip Reduction, (3) vs. (2)							**1,460**	**25.4%**
(5) Hartford Steam Boiler	TDM	1,100	39.9%	2.02	49.6	546		
(6) Company "D"	Control	900	63.0%	1.48	67.5			
Trip Reduction, (5) vs. (6)							**197**	**26.5%**
Trip Reduction, (5) vs. (2)							**86**	**13.6%**

TABLE 2-B: SUMMARY OF EFFECTS OF TDM PROGRAMS
North Bethesda/Montgomery County, Maryland

Location/ Project	Type Site	Travel Base	Drive Alone Rate	Average Vehicle Occupancy	Veh. Trips Per 100 Travelers	Total Vehicle Trips	Vehicle Trip Reduction	Percent Reduction
(1) North Bethesda	Control		89.5%	1.04	91.9			
(2) Nuclear Regulatory Commission, After Consolidation	TDM	1,400	42%	1.59	53.7	752		
Trip Reduction, (2) vs. (1)							**582**	**41.6%**
(3) Nuclear Regulatory Commission, Before Consolidation			54%	1.47	64.4			
Trip Reduction, (2) vs. (3)							**232**	**16.6%**

TABLE 2-C: SUMMARY OF EFFECTS OF TDM PROGRAMS
Minneapolis/St. Paul, Minnesota

Location/ Project	Type Site	Travel Base	Drive Alone Rate	Average Vehicle Occupancy	Veh. Trips Per 100 Travelers	Total Vehicle Trips	Vehicle Trip Reduction	Percent Reduction
(1) Free Parking Program, "Before"	Control	2,752	35.6%	2.05	48.5	1,336		
(2) Free Parking Program, "After"	TDM	2,752	0.0%	2.43	41.2	1,133		
Trip Reduction, (2) vs. (1)							**203**	**15.0%**
(3) I-394 HOV Lane, "Before"	Control	2,680	61.9%	1.17	72.6	1,946		
(4) I-394 HOV Lane, "After"	TDM	3,630	48.7%	1.29	65.8	2,387		
Trip Reduction, (4) vs. (3)							**247**	**10.3%**
(5) 3M Company, Before TDM (1970)	Control	7,723	91.6%	1.09	91.6			
(6) 3M Company, After TDM (1985)	TDM	12,700	82.7%	1.21	82.7	10,503		
Trip Reduction, (6) vs. (5)							**1124**	**9.7%**

TABLE 2-D: SUMMARY OF EFFECTS OF TDM PROGRAMS
Bellevue, Washington

Location/ Project	Type Site	Travel Base	Drive Alone Rate	Average Vehicle Occupancy	Veh. Trips Per 100 Travelers	Total Vehicle Trips	Vehicle Trip Reduction	Percent Reduction
(1) Bellevue CBD, 1988	TDM	24,000	63.2%	1.32	71.0	17,040		
(2) Regional Control Sites, 1988	Control		81.8%	1.12	86.4			
Trip Reduction, (1) vs. (2)							**3,696**	**17.8%**
(3) US WEST	TDM	1,150	25.7%	2.17	45.2	520		
Trip Reduction, (3) vs. (2)							**474**	**47.6%**
(4) Bellevue CBD, less US WEST	Control		79.6%	1.19	83.1			
Trip Reduction, (3) vs. (4)							**436**	**47.1%**
(5) CH_2M Hill, Before Relocation	Control	400	89%	1.07	92.6	370		
(6) CH_2M Hill, After Relocation	TDM	400	54%	1.40	59.4	237		
Trip Reduction, (6) vs. (5)							**133**	**35.7%**
Trip Reduction, (6) vs. (2)							**108**	**31.2%**

TABLE 2-E: SUMMARY OF EFFECTS OF TDM PROGRAMS
Bishop Ranch/Contra Costa County, California

Location/ Project	Type Site	Travel Base	Drive Alone Rate	Average Vehicle Occupancy	Veh. Trips Per 100 Travelers	Total Vehicle Trips	Vehicle Trip Reduction	Percent Reduction
(1) Bishop Ranch Business Park	TDM	14,000	70.2%	1.27	77.6	10,864		
(2) Regional Control Sites	Control		90.6	1.07	93.0			
Trip Reduction, (1) vs. (2)							**2,156**	**16.6%**
(3) Pacific Bell, Bishop Ranch	TDM	6,900	63%	1.35	72.8	5,023		
Trip Reduction, (3) vs. (2)							**1,394**	**27.8%**
(4) Company "B", Bishop Ranch	Control	2,400	73%	1.24	79.1			
Trip Reduction, (3) vs. (4)							**435**	**8.7%**
(5) Bishop Ranch, Less Pac Bell	Control		80%	1.16	85.2			
Trip Reduction, (3) vs. (5)							**856**	**17.0%**

TABLE 2-F: SUMMARY OF EFFECTS OF TDM PROGRAMS
Hacienda Business Park/Pleasanton, California

Location/ Project	Type Site	Travel Base	Drive Alone Rate	Average Vehicle Occupancy	Veh. Trips Per 100 Travelers	Total Vehicle Trips	Vehicle Trip Reduction	Percent Reduction
(1) City of Pleasanton After TDM (1988)	TDM	22,000	84.3%	1.13	88.7	19,521		
(2) Regional Control Sites	Control		90.6%	1.07	93.0			
Trip Reduction, (2) vs. (1)							**946**	**4.8%**
(3) Hacienda Business Park, After TDM	TDM	7,769	78.7%	1.17	85.2	6,623		
Trip Reduction, (3) vs. (2)							**605**	**9.1%**
(4) AT&T, Hacienda Business Park	TDM	3,890	71.3%	1.24	80.5	3,131		
(5) Company "B", Hacienda Business Park	Control		77.2%	1.17	85.2			
Trip Reduction, (4) vs. (2)							**486**	**13.4%**
Trip Reduction, (4) vs. (5)							**183**	**5.5%**

TABLE 2-G: SUMMARY OF EFFECTS OF TDM PROGRAMS
Los Angeles, California

Location/ Project	Type Site	Travel Base	Drive Alone Rate	Average Vehicle Occupancy	Veh. Trips Per 100 Travelers	Total Vehicle Trips	Vehicle Trip Reduction	Percent Reduction
(1) Region, 1988	Control		83%	1.19	83.6			
(2) U.C.L.A.	TDM	18,000	74.4%	1.26	79.0	14,220		
Trip Reduction, (2) vs. (1)							**828**	**5.5%**
(3) ARCO	TDM	2,000	45.3%	1.81	55.3	1,105		
(4) Downtown L.A. Office Workers	Control		60%	1.46	68.3			
Trip Reduction, (3) vs. (4)							**261**	**19.1%**

TABLE 2-H: SUMMARY OF EFFECTS OF TDM PROGRAMS
South Coast Metro/Orange County, California

Location/ Project	Type Site	Travel Base	Drive Alone Rate	Average Vehicle Occupancy	Veh. Trips Per 100 Travelers	Total Vehicle Trips	Vehicle Trip Reduction	Percent Reduction
Orange County, CA								
(1) Countywide Average	Control		90%	1.08	92.4			
(2) South Coast Metro	TDM	25,000	89%	1.08	92.3	23,079		
Trip Reduction, (2) vs. (1)							**none**	**none**
(3) State Farm, South Coast Metro	TDM	980	68%	1.55	64.3	630		
Trip Reduction, (3) vs. (1) or (2)							**276**	**30.4%**

Accomplishments of Subject Programs

The research findings require some interpretation to understand the accomplishments and potential of TDM. Attention is first given to the "areawide" programs.

The areawide approach to TDM is where the measured effects are currently the most modest, but where the greatest potential lies. TDM should be implemented at an areawide level to be most effective. Areawide management programs attempt to encircle the principal functions which contribute to the traffic problem, and to engineer collective action through cooperation of the various stakeholders. This collective action should yield a higher payoff than isolated individual actions.

However, to date, most of the collective, areawide programs have not achieved their potential. In most instances, they have fallen short because major players have not been incorporated into the process, or if they have, their participation is not of the necessary type or level. Listed in Table 3 are the programs which have areawide elements, along with their trip reduction results and other characteristics.

Note from the start that the Minneapolis Free Parking Program and the I-394 HOV Lane are not typical areawide programs. They are examples of single TDM actions applied through the actions of a public agency. They are listed in this table because they are directed to areawide travel markets (Regional CBD and Radial Corridor, respectively) and produce areawide (rather than site specific) impacts.

The other programs are much more typical areawide TDM programs, where a management group has been formulated with significant private sector membership and direction. Table 3 indicates a range of trip reduction achievements from these efforts between 17.8% and 2.4%. What accounts for the difference?

The best areawide efforts were Downtown Bellevue and Bishop Ranch, which achieved 17.8% and 16.6% reductions, respectively. Both are suburban sites, with comparatively limited options to driving. However, in both instances, there are compelling legal reasons for the private sector to become involved. At Bishop Ranch, a county-imposed trip reduction ordinance requires major employers to reduce their peak hour vehicle trip generation by 40%. In the case of Bellevue, the City does not have a trip reduction ordinance, but it imposes development standards on new construction which reduce building setbacks and constrain on-site parking to a maximum of 2.4 spaces per 1000 square feet. In both cases, employers have been inspired to find innovative ways for their employees to reach work without driving alone.

A similar situation to Bishop Ranch exists at Hacienda Business Park, but the response of employers has been somewhat different. Hacienda also must achieve a 40% peak hour vehicle trip reduction, which they have done largely through the use of flexible work hours. Their program has achieved a respectable 9.1%, but the employer programs have been more a response to meeting the requirements of the ordinance, than developing programs which create the best possible options for employees.

The programs in South Coast Metro and North Bethesda are both conceived under rather substantial traffic management ordinances – South Coast Metro under Regulation XV and North Bethesda under Montgomery County's Adequate Public Facilities Ordinance. In the case of South Coast Metro, it is simply too early to tell if the legal pressure will cause proper participation. The Air Quality Management District, which administers Regulation XV, has been seeking more substantial commitments of employers when submitting TDM plans. This pressure has already produced some important individual efforts, and promises to produce more.

In North Bethesda, the effect of the APFO has been more to slow development than to stimulate active TDM programs. The areawide TDM effort only began in 1987 with the formation of a Transportation Management Association, that received its stimulus from an ongoing building moratorium. Unfortunately, the program places most of the stimulus on land owners and developers, whose projects are stymied, and does little to require employers to participate in trip reduction programs. North Bethesda is listed as having no trip reduction impact based on judgment; no data are available to confirm this assumption.

Finally, there is the case of Hartford. Hartford does not have an ordinance that mandates trip reduction. The transportation management program was conceived and developed by the business community, over concern about high growth in the downtown and the lack of public action in enhancing the infrastructure. Because the employers, which are also the major land owners downtown, initiated the program, membership was voluntary and did not involve legal pressure. However, incentive to incorporate key TDM actions like parking management was difficult to achieve in the voluntary environment, particularly when the projected development boom failed to materialize. At the same time, improvements to transit and system level actions required from the public sector did not materialize, with the result that the travel options for most employees did not change significantly under the TDM program. It should also be noted that the TDM program has really focussed on the support of major employers, which means that about 60% of the downtown employment base was unaffected by the program.

In summary, evidence shows that TDM programs conceived under conditions where private sector support is motivated by legal concerns are more likely to gain the type of participation and implement the types of actions which reduce vehicle travel. Locations where parking supply is constrained are better equipped to support comprehensive TDM programs. As yet, the potential of TDM, as seen in a collective, areawide program which is not just a sum of individual efforts, has not yet been demonstrated.

Summary of Individual Employer TDM Program Accomplishments

In marked contrast to the experience with areawide programs, there are numerous examples of successful TDM programs implemented by individual employers or organizations. In many cases, the inclusion of these standout individual programs within an areawide program is the reason for the measured success of the latter.

Much can be learned from the individual programs, because the trip reduction effects can be tied more immediately to the specific TDM actions. By observing this cause-and-effect, valuable insight can be gained as to how areawide programs can be made more successful.

TABLE 3

SUMMARY OF TDM PROGRAM RESULTS AT SUBAREA LEVEL

Program	Setting	Legal Requirement	Percent Reduction
Downtown Bellevue	Suburban Activity Center	Yes	17.8%
Bishop Ranch	Suburban Business Park	Yes	16.6%
Minneapolis Free Parking	Regional CBD	No	15.0%
I-394 Interim HOV Lane	Radial Corridor	No	10.3%
Hacienda Business Park	Suburban Business Park	Yes	9.1%
Downtown Hartford	Regional CBD	No	2.4%
South Coast Metro	Suburban Business Park	Yes	NA*
North Bethesda Montgomery County	Suburban Activity Center	Yes	NA*

* Note: NA indicates that program has been operating for insufficient time or there exists insufficient data to determine subarea level trip reduction.

Table 4 lists eleven exemplary individual programs chosen from the various case studies. the table allows a side-by-side comparison of the results of these programs along with some key TDM elements. Table 4 shows the size of the particular program (employment base), the Vehicle Trip Production Rate (trips per 100 travelers) and the Percent Reduction in vehicle trips. These statistics are abstracted from Tables 2-A through 2-E. The table then indicates important contributing conditions at that site, in particular, the relative density of the area, whether there is a constrained parking situation at the site, and whether there is a prevailing legal requirement. Finally, the table indicates whether particular TDM actions have been applied, such as whether the employer charges for parking, and whether the employer makes strategic use of transportation allowances or subsidies to encourage high-occupancy vehicle use.

Several things are evident in examining the data and results in Table 2. First, it may be seen that trip reductions range from a low of only 5.5% at UCLA to a high of 47.6% at US WEST. But there are a number of programs with major reductions; six of the 11 sites have net reductions of greater than 20%. The average for the sites, in fact, exceeds 20%, which is considerable, remembering that this measure is the ***net*** reduction above ambient rates of non-drive alone use, which in some cases are quite high, e.g. Hartford and Bellevue.

The second thing to notice is that there is not a significant role played by employer size. While there are no examples of employers smaller than 400 employees in the group, there is no obvious correlation between employer size and the trip reduction rate. The largest employer in the list, UCLA, has the smallest reduction percentage, and one of the smallest, CH_2M Hill, has the second highest percentage. In theory, large employers have an edge in employee TDM programs due to the "large number" advantage in trip matching, and also somewhat in resources and corporate ethic. However, what seems to matter more is the specific components which are used in the program, and the enthusiasm with which they are applied.

The third item of interest is that these programs represent areas of all land use types, and density. Three are located in regional CBDs, judged to be high density areas; four are suburban activity centers, judged to be medium density; and the remaining four are located in suburban business parks, which are usually very low density areas. The sample, which is approximately evenly proportioned among these density classes, shows generally lower vehicle trip reduction indices in higher density areas (starting mode split has higher share of HOV use); however, there is no obvious correlation between density and net trip reduction. Again, it appears more important what the program consists of, than the physical environment in which it is implemented. Realistically, it would seem that programs in higher density areas have a greater potential for trip reduction.

What are the elements that separate the outstanding performers from the average ones? As the individual case studies will point out, all the programs listed here have in common the fact that they provide a wide range of alternatives to employees: carpool and vanpool programs, and higher quality transit service. However, the major difference among programs is largely explained by the incentives offered by the employer to encourage use of these improved alternatives in preference to driving alone.

TABLE 4: COMPARISON OF TOP INDIVIDUAL TDM PROGRAMS

Location	Program	Travel Base	Veh. Trip Rate	Pct. Reduc.	Area Density	Legal Req.	Restr. Park.	Parking Charges	HOV Allow./ Subsidy
Hartford	Travelers	10,000	42.8	25.4%	High	No	Yes	Yes	Yes
Hartford	Hartford Steam Boiler	1,100	49.6	13.6%	High	No	Yes	Yes	Yes
St. Paul	3M Company	12,700	82.7	9.7%	Low	No	No	No	No
Bellevue	US WEST	1,150	45.2	47.6%	Med	Yes	Yes	Yes	Yes
Bellevue	CH_2M Hill	400	59.4	31.2%	Med	Yes	Yes	Yes	Yes
Bishop Ranch	Pacific Bell	6,900	72.8	27.8%	Low	Yes	Yes	No	No
Hacienda Business Park	AT&T	3,890	80.5	13.4%	Low	Yes	No	No	No
Los Angeles	UCLA	18,000	79.0	5.5%	Med	Yes	Yes	Yes	No
Los Angeles	ARCO	2,000	55.3	19.1%	High	Yes	Yes	Yes	Yes
Orange County	State Farm	980	64.3	30.4%	Low	Yes	No	No	Yes
Montgomery County	NRC	1,400	53.7	41.6%	Med	Yes	Yes	Yes	Yes

It will be noted, therefore, that 8 of the 11 sites listed have some measure of restricted parking; only 3 do not. And most of these also charge employees for the privilege of parking; 7 of the total 11 sites, and 4 of the top 6 charge for employee parking. Perhaps equally important, the outstanding firms also offer counter pricing incentives as an alternative to driving: these include transit or carpool subsidies, which may be in the form of an allowance (ARCO, CH2M Hill), graduated parking fees (US WEST, ARCO, CH2M Hill, Travelers, Hartford Steam Boiler), or a direct subsidy payment (State Farm). The State Farm example is particularly attention getting because a subsidy payment is offered in lieu of parking charges, and yet they have been as successful as charge-for-parking programs.

It is also important to note that 8 of the 11 programs overall, and 5 of the top 6, were spurred in some manner by a prevailing legal requirement to manage traffic. Only the two Hartford programs, Travelers and Hartford Steam Boiler, and 3M in St. Paul, occurred without pressure from a local trip reduction ordinance or building code requirement. In the Hartford situation, there were major parking constraints which posed an economic burden to the firms, while at 3M, capability to build out at the site was being threatened. Unless this type of self interest is present, legal mechanisms may be credited with eliciting employer participation and implementing key TDM actions.

7. SUMMARY AND CONCLUSIONS

Based on the findings in this research study, it appears reasonable to conclude that Travel Demand Management is capable of having a significant impact on controlling the demand for low-occupancy vehicle travel and thereby reducing or postponing the need to add additional capacity to the highway system. Trip reductions such as those discovered could have a major impact on the demand for future infrastructure construction if TDM programs with the proper elements were implemented at a larger scale.

Important insight into the nature and potential for TDM has been provided by this study. Prior to this time, the actual accomplishments of TDM programs in reducing vehicle trips had been poorly understood. The research enabled by this study has helped substantiate three important points:

1) That TDM can **significantly** reduce low-occupancy vehicle trip demand at a site, in a corridor, or within a subarea;

2) The degree of success is directly determined by the specific components of the TDM program; and

3) To inspire use of the key TDM actions, either some type of legal pressure is necessary, or the individual firm must have a readily apparent, economic self interest in adopting these measures.

What level of trip reduction would be an acceptable expectation from TDM? Many professionals reason that even a 10% reduction in vehicle trip volumes could significantly

aid an area in alleviating current traffic difficulties. A 10% difference in a volume-to-capacity ratio could represent anorder of magnitude difference in Level of Service, which would be felt in terms of traffic congestion.

However, a 10% reduction in vehicle travel will be relatively insignificant if viewed as a strategy to help the nation meet the projected enormous gap between vehicle travel demand and available capacity into the next century. A 10% reduction would be almost insignificant as a strategy to offset capital construction needs.

Placing modest expectations on TDM unfairly diminishes its potential to be a major factor in determining long-term infrastructure needs. This study has shown areawide programs that have achieved reductions approximating 20% (Bellevue at 17.8%), and individual programs with reductions in excess of 40% (US WEST at 47.6% and the Nuclear Regulatory Commission at 41.6%). These need not represent the upper limit of Travel Demand Management, but could help establish the norm.

The accomplishment of a TDM program depends entirely on the actions that are applied. If travelers are presented with no alternative that realistically competes with the private auto, they will not stop driving. And if driving continues to be subsidized in the form of free (or heavily subsidized) on-site parking, alternative modes will represent bad economic choices for travelers. If these factors are confronted by a TDM program, **trip reductions in the range of 20% to 40% can be the norm, rather than the exception.** Where TDM programs have been observed with average or limited trip reductions, it is obvious that these fundamental relationships have not been incorporated in the design.

Great potential exists for areawide TDM programs that has not yet been tapped. By grouping together the myriad interests in a transportation impact area, there should be considerable leverage in affecting travel conditions. If all employers or developers can be implored to implement the same control actions, the sharing of responsibility can have the effect of "leveling the playing field" for all participants, i.e., no small group will be expected to carry the burden for the entire community, and therefore experience an unfair burden. Beyond the sharing of responsibilities is a separate advantage of collective action. If all travelers in an impact area are responding to the same conditions, the opportunities for providing high quality alternatives is greatly enhanced. A larger base translates to greatly improved odds for ridesharing programs and transit service. This also leads to the situation where smaller employers begin to realize matching and service opportunities for their employees.

Thus far, no areawide TDM program has come close to approaching this ideal. Even the best programs are generally comprised of a small number of outstanding individual employer programs, typically large employers who can afford to act autonomously. No legal mechanism has yet been employed to cause this collective action, and voluntary appeals of a transportation management organization have gained only partial support and participation.

To realize the invaluable potential of TDM, conditions must be created that mirror those found in the successful cases in this study, and in particular the individual employer programs. This includes high-level alternatives and complementary economic incentives.

To cause these actions to occur will require legal impetus in most all cases. Such legal pressure need not be heavily prescriptive, and probably should not be, since each employers or subarea is likely to face somewhat unique conditions. However, there are particular actions which must occur if measurable reductions are to occur, such as parking management and incentives, and TDM implementors should be given education and direction in their selection and use. A good example of such guidance is Los Angeles' Regulation XV Air Quality Ordinance. The original transportation management plans required from employers required only a performance goal, namely achievement of an average vehicle occupancy of 1.5. Experience with original plans, evaluated through employee travel surveys, has now caused the Air Quality Management District to increase the requirement for plans to include obvious economic incentives. In turn, the new plans are showing a variety of innovative measures from the employers, with growing evidence that trip reductions are being realized.

In summary, the potential for TDM appears to be limited only by expectation built around conventional experience with many programs that have achieved minimal results. The key to TDM is use of the right strategies. If this can be accomplished, there is ample evidence in this report that significant trip reductions can be realized. Perhaps even more important than the short-run benefit of TDM in reducing current travel, is the longer term potential to shape locational and land use choices: if travelers are faced with finding alternative travel choices today, it may well influence locational patterns of individuals and firms so that tomorrow's travel markets may not be as dispersed and difficult to serve with travel alternatives.

Review of the individual case studies which have been compiled in the study report is encouraged. Only by reading the complete case study can the interested professional get a full understanding of the motivations behind the individual programs and the key elements which have made them a success.

CASE STUDIES

1. CASE STUDY: HARTFORD, CONNECTICUT

1. SITE DESCRIPTION

Location and Character of Site

Hartford, located in central Connecticut, is the state capital and is probably best known as the insurance capital of the U.S. According to the 1980 census, the city's population was 167,000, compared to a regional population of over 1 million. The region, comprised of three counties, has experienced some growth over the past 20 years, but Hartford County has remained relatively stable.

Despite suburban growth trends, downtown Hartford remains the region's commercial, government and finance center, as well as its principal employer. The downtown area includes the central business district, the capitol area and Asylum Hill. Approximately 100,000 employees work in this area, with a large portion of these jobs associated with the seven major insurance companies which are headquartered in Hartford.

The vitality and regional dominance of downtown Hartford is heavily influenced by the insurance industry. The insurance companies are not only the region's major employers, but they are also among the major landowners. So, downtown Hartford has actually been experiencing an economic and development upswing despite a stable region and a period of general decline in the Northeast. Since 1970, over $200 million of private and public funds have been invested in downtown Hartford. More than 3 million square feet of office space were completed in the early 1980's, representing as much space as had been constructed in the past 20 years. While growth slowed somewhat in the mid-1980's, another 4 million square feet of space has been approved for construction and another 2 million have been proposed.

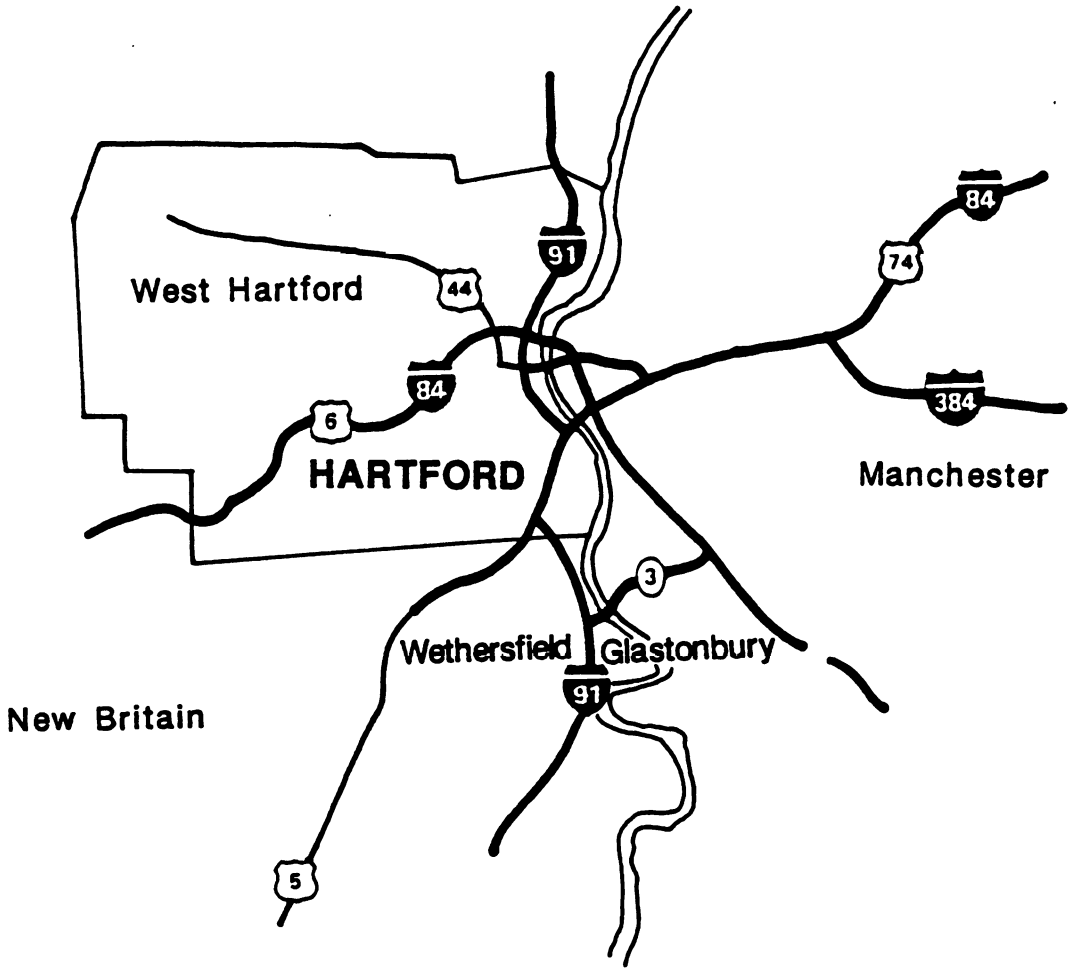
Transportation Facilities

As seen in Figure 1, Hartford is located at the intersection of Interstates 91 and 84. While this location suggests good regional access, connections between these highways are poor. Several connectors require using downtown streets, and this contributes to delay on the freeways and congestion on downtown streets. Plans to construct a beltway around the city in the 1960's were never realized, and as a result, significant numbers of long-distance travelers are channeled through the center of town on the two interstates. This through traffic adds to the already-congested conditions caused by local peak period commutation.

While the auto is still the primary mode of travel to downtown, several alternatives exist. Public transit service is provided by Connecticut Transit, which operates a fixed-route bus network that includes 230 peak period vehicles, and carries over 22 million trips per year. In addition, demand responsive service is provided by the Greater Hartford Transit District, and a segment of commuters make use of Amtrak service between New Haven and

FIGURE 1

MAP OF GREATER HARTFORD



Springfield. The Greater Hartford Ridesharing Corporation provides assistance with ridesharing programs and other commuter assistance to employers.

2. BACKGROUND AND MOTIVATION FOR TDM PROGRAM

As of 1982, when major interest in transportation management began in Hartford, the share of commuters reaching downtown by driving alone was 48%; transit users accounted for 31%, and persons in carpools and vanpools averaged 21%. The projected increase in employment in the downtown alerted local public and private leaders that traffic congestion problems would become severe unless measures were taken to resolve them.

Conventional traffic management techniques seemed limited in their potential relief. With the exception of major reconstruction of the two interstates, the transportation infrastructure in Hartford was mature and reasonably fixed. Transit service also was not in a position to expand, but rather was being stretched increasingly to meet the demands of the growing suburbs.

Local officials judged parking to be a key factor contributing to the downtown's transportation difficulties. Over 80% of the estimated 21,700 parking spaces serving downtown Hartford were found to be privately controlled. Corporate policies governing the location, pricing and utilization of these spaces were seen as a significant encouragement to drive-alone auto commuters, who dominate use of the spaces. Data indicated that about 75% of employee parking was free or heavily subsidized by employers, compared to a national average of 35 to 40% for major downtowns. In turn, demand for these spaces by long-term commuters resulted in a severe shortage of short-term spaces for business or shopping.

The business community's vested interest in the continued economic vitality of the downtown forced it into a proactive role regarding the traffic and mobility problems. The area boasted a strong Chamber of Commerce, with a history of involvement in transportation and other broad reaching local issues. The Downtown Council, formed in 1974, became a forum for such issues and funded several transportation-related studies. Perhaps the most important of these was the Downtown Hartford Transportation Project (DTHP), undertaken in 1981 as a joint public-private effort. The project was designed to investigate management solutions to the areas transportation problems, knowing that efforts to enhance the existing infrastructure would be very limited.

The DTHP project reached strong conclusions about the need to control congestion, manage the parking supply, and improve the street environment. But one of the most important conclusions was that the public and private sectors needed to organize into a body capable of providing the appropriate responsibility "umbrella" necessary to manage the transportation system. This conclusion resulted in the designation of the existing Greater Hartford Ridesharing Corporation (GHRC) and the City's Department of Public Works as the respective private and public nucleus of a new Transportation Management Organization, or TMO.

The DTHP study accelerated the efforts of the TMO with a list of 33 action strategies that it had recommended for implementation. These included transportation facility management (TSM) measures, parking management strategies, transit and rideshare enhancement strategies, and improvements to the street and pedestrian environment.

The only two measures not to appear in the TMO's initial workplan from the list recommended by the DTHP were the phasing-out of employee parking subsidies and the phasing-in of employee transportation allowances. The prevailing sentiment of the business community was to study these issues more carefully and ensure that alternatives were in place before proceeding with actions as stringent as parking management.

Major employers belonging to the TMO, representing about 40% of downtown employment, submitted to a survey which indicated their current modal splits, and served as a basis for setting trip reduction targets as part of the management program. Goals were set that targeted a 20% improvement in rates of use of high occupancy vehicle modes over the three-year period 1984 through 1987. To achieve this goal the employers were encouraged to foster such TDM actions as increasing ridesharing efforts, increasing transit subsidies, implementing flextime, and allowing shared use of corporate vanpools. At the same time the TMO worked with the city to structure a new zoning ordinance providing density bonuses or reduced parking for developers in exchange for TDM measures, and for street improvements to improve flow and circulation. The TMO also worked with the transit agency toward establishment of a downtown shuttle service, and park and ride services.

3. OVERALL EFFECTS OF PROGRAM

Despite strong efforts toward each of the above actions, Hartford's TDM program fell somewhat short of its trip reduction goal. Data compiled by the DTHP study in 1981 indicated a mode split rate of 48% drive alone, 21% ridesharing and 31% transit. As shown in Table 1, a comparative estimate developed by the TMO in 1987 using employee survey data suggested that the drive alone rate had fallen to 45%, while the rate of ridesharing had increased to 25%, and transit had fallen slightly to 30%.

To assess the effectiveness of this trip reduction program, an index is calculated that reflects the number of vehicle trips generated by each 100 employees. The index assumes 30 person trips for each transit vehicle trip and 2.5 persons for each ridesharing vehicle trip. This corresponds to a trip generation rate of 56 vehicle trips per 100 employees in 1987, down 1.4 trips from a rate of 57.4 per 100 in 1981 (Note that the assumption of 2.5 persons per rideshare unit probably understates the average occupancy due to vanpooling; however, no information was available on the percentage of travelers using vanpools). To gauge the impact of this change, if the 102,000 employees in downtown Hartford in 1987 traveled at the mode split rates that existed in 1981, they would have generated an additional (57.4 - 56.0)/100 x 102,000 = 1428 daily one-way vehicle trips. Therefore, the TDM program may be credited with a net trip reduction of (102,000)(.574 - .560)/(102,000 x .574) = 2.4% over 1981 levels.

TABLE 1

VEHICLE TRIP REDUCTIONS IN DOWNTOWN HARTFORD

	Hartford Downtown 1981	Hartford Downtown 1987	TMO Goal
Employment	100,000	102,000	110,000
Travel Mode			
Drive Alone	48%	45%	39%
Carpool	21	25	28
Transit	31	30	33
Vehicle Trips per 100 Employees *	57.4	56.0	51.3
Average Vehicle Occupancy	1.74	1.79	1.95

* assumes 2.5 persons per carpool and 30 persons per transit trip

The ultimate goal of the TDM program to reach a mode split of 39% drive alone, 28% rideshare and 33% transit would have required reaching a trip generation rate of 51.3, a reduction of 6.1/57.4 = 10.6% over the 1981 rate, compared to the 2.4% that was achieved. Failure to reach the trip reduction goal did not have serious implications on the downtown, largely because the projected growth in downtown development and employment did not occur. Only about half of the projected development for this period actually occurred, meaning that only about 2% of the projected 10% increase in jobs was realized. Thus, the 2% increase in employment matched by a 2.4% reduction in vehicle trips satisfied the practical goal of the TMO that traffic conditions not get any worse.

However, the prospect of ultimate traffic congestion continues to threaten the downtown as development activity continues. The TMO is particularly concerned that, without a concerted effort toward parking management, future progress toward trip reduction goals will be severely limited. Strategic data have been obtained through surveys and studies which confirm the high cost to employers of providing parking to employees as well as the incentive role played by parking on employee mode choice. The average Hartford employer surveyed by the TMO was found to subsidize drive alone employees by about $715 per year, compared to only about $50 per year for transit users. The TMO is working actively with employers to try to implement a comprehensive parking management program. As yet, however, most employers have rejected the concept because: (1) they feel the alternatives are still not in place, and (2) they consider free parking an important fringe benefit through which they compete for employees.

4. INDIVIDUAL PROGRAM EFFORTS

A large measure of the credit for existing trip reduction levels in downtown Hartford must be given to two employers and the comprehensive programs they have implemented. These employers are the Travelers Insurance Company and Hartford Steam Boiler. Both are members of the TMO, and have been exemplary in both fostering improved alternatives to employees and providing the appropriate balance of incentives and disincentives to encourage their use. Below are brief summaries of each program.

Travelers Insurance

Travelers is largest insurance company in Hartford, employing about 10,000 people at its downtown site. Through a combination of "natural" locational advantages and company support with some important transportation program measures, Travelers has achieved a modal split among its employees of:

Drive Alone	33.2%
Carpool	19.4
Vanpool	8.0
Transit	36.2

The two locational advantages are (1) a relatively constrained parking situation for its large workforce, and (2) proximity to good transit service, both local and express.

The constrained parking at Travelers is not so much a matter of space ratios or cost as convenient access. Travelers owns or leases facilities which account for about 4700 parking spaces. This is about 1 space for every two employees, or expressed another way, if each employee occupies about 200 square feet of office space, this would be a space ratio of about 2.35 spaces per 1000 sq. ft. These spaces are located in 8 different places. Only about 1500 spaces are located on site, in 2 facilities, most being within a garage owned by Travelers. The waiting list for a space in this garage is 3 to 4 years long.

The company charges employees to park in its spaces, but the charges are very nominal. Travelers pays between $30 and $70 per space per month for its facilities, and charges employees according to vehicle occupancy for their use. Single-occupant commuters are charged $25 per month; carpools with 2 occupants are charged $15 per month; and ridesharing units with 3 or more occupants are allowed to park free. Even with the charge, the company parking is a reasonable fringe benefit to employees, considering that the market rate for parking in the immediate area averages about $200 per month. But the disincentive to driving alone is that the parking off-site requires a considerable walk. Carpools and vanpools are offered priority parking in the on-site facilities.

While Travelers program has resulted in about 19% of its employees taking carpools to work, it also boasts a significant number of people in vanpools and transit. The vanpool program is quite active, with approximately 800 employees traveling in 67 vanpools. The company subsidizes the vans to provide an equivalent benefit to employees who vanpool of about $20 per month.

But above all, Travelers has taken advantage of its location to get maximum usage of transit service. Over 36% of its employees ride transit to work, which is assisted greatly by the location of the company's offices immediately adjacent to the downtown terminus of many local and express services. The company offers a monthly subsidy of $15 to employees who use transit. About 20% of the company's employees reach work by express bus, and the company has been instrumental in establishing many of these services.

The high percentage of employees using either vanpools or transit is significantly responsible for the impressively low vehicle trip generation rate. Assuming 2.5 persons per average carpool, 12 per vanpool and 30 per transit trip as before, Travelers' 10,000 employees generate about 4280 vehicle trips, or about 42.8 per 100 employees.

How significant a *net* trip reduction is this? Before-program data are not available for Travelers, but Travelers' achievements can be compared with two standards: (1) the average of all downtown businesses in 1981 before the TDM program, and (2) a firm of comparable size and function whose TDM efforts are comparatively minimal. The comparative data are listed in the following table:

	Travelers	1981 Downtown Average	Non-TDM Company "B"
Employment	10,000	100,000	9,000
Travel Mode			
Drive Alone	33.2%	48%	77.6%
Rideshare	27.4	21	14.3
Carpool	(19.4)		(9.7)
Vanpool	(8.0)		(4.6)
Transit	36.2	31	6.5
Vehicle Trips per 100 Employees*	42.8	57.4	82.1

* assumes 2.5 persons per carpool and 30 persons per transit trip

If Travelers program is compared with the result for the entire downtown, pre-TDM program, Travelers' program is reducing an additional 57.4 - 42.8 = 14.6 vehicle trips per 100 employees. This means that travelers efforts have taken an additional 1460 daily vehicle trips off the highways than could have occurred in the absence of their program. This corresponds to a (10,000 x .146)/(10,000 x .574) = 25.4% net reduction attributable to the TDM program.

The program at the non-TDM Company offers a good comparison to Travelers. The comparison company is not located in the center of downtown, so it does not have access to the same quality of transit service. However, it does not subsidize its employees transit passes as does Travelers, nor has it worked as diligently with the transit operator to establish effective service arrangements. Neither does Company "B" manage its parking. Its spaces cost the company $45 per month, and employees are charged nothing for their use. The company does provide some preferential parking for HOV users, and a vanpool subsidy roughly equal to Travelers', which values about $20 per month.

The result is that Company "B" does not have nearly as many employees in alternative modes as Travelers. Approximately 82.1 vehicle trips per 100 employees are calculated from the indicated mode split. If Travelers' rate of 42.8 vehicle trips per 100 is compared with Company "B", Travelers' efforts result in an additional 39.3 trips reduced per 100 employees. This means that, for Travelers' 10,000 employees, its efforts are responsible

for an additional 3930 vehicle trips taken off the road than would have occurred under a program with the components of a company of equivalent size and stature, but without an equivalent TDM program.

Hartford Steam Boiler

Hartford Steam Boiler is a second interesting example in Hartford, owing both to its level of trip reduction and its size. Hartford Steam (HSB) is also an insurance company, so it is a professional, white collar employer. And while it is a large employer, with about 1,100 employees, it is not of the same scale as Travelers or many of the other major employers in the downtown.

Like Travelers, Hartford Steam (HSB) has two factors working in its favor, which have contributed heavily to the success of its TDM program: It has relatively constrained parking, which it prices strategically for incentive purposes; and it makes maximum use of nearby transit service.

Largely by design, there are only 233 spaces available through the company for HSB's 1100 employees. This means almost 5 employees for every space, or, if a space ratio of 200 sq. ft. per employee is assumed, only about 1.05 spaces per 1000 sq. ft.-- a very constrained parking ratio. The company makes other spaces available off-site through a lease arrangement which costs employees $30 per month.

The on-site spaces cost HSB $110 per month. They in turn charge single-occupant employees $110 for the space, and offer a sliding scale for HOVs. The rate for 2-person carpools is $75 per month; for 3-person carpools it drops to $40 per month; and for pools with 4 or more occupants the charge is $10 per month. As an added incentive, rideshare employees are given priority use of the on-site facilities.

The constrained parking makes the alternatives to driving alone undoubtedly look better. Almost 36% of all employees use transit to get to work, which the company also subsidizes at rates between $15 and $30 per month. Of those who rideshare, the great majority are in carpools -- 20.9% While the company offers incentives to vanpool, in form of a subsidy that amounts to between $10 to $30 per month, only 1.3% of the company's employees commute in vanpools.

To ascertain the net effectiveness of HSB's demand management program, a comparison is again made with the downtown business community as a whole, pre-TDM program, and also a similar firm with a minimal program. Comparison Company "D" in this case is located near enough to HSB to enjoy the same transit advantages, and they employ about 900 of the same type of workers. Comparative results are listed in the following table:

	HSB	1981 Downtown Average	Non-TDM Company "D"
Employment	1,100	100,000	900
Travel Mode			
Drive Alone	39.9%	48%	63.0%
Carpool	20.9	21	9.1
Vanpool	1.3		0.5
Transit	35.9	31	24.1
Vehicle Trips per 100 Employees*	49.6	57.4	67.5

* assumes 2.5 persons per carpool and 30 persons per transit trip

In review of the data, even though HSB's program has not produced a trip reduction rate that is as low as Traveler's, it is still quite impressive. Compared to the downtown average, the vehicle trip rate at HSB has taken 57.4 - 49.6 = 7.8 daily vehicle trips per 100 more from the roads than would have occurred in the absence of its program. On a base of 1100 employees, this means 86 vehicle trips per day reduced, equating to a (1100 x .078)/(1100 x .574) = 13.6% net reduction due to TDM.

The program at Company "D", as a comparison, involves some TDM incentives. Company "D" also charges its employees for parking, an average of about $50 per month, and also provides a discount to employees who rideshare. They also offer a vanpool subsidy of $15 per month, and a transit pass subsidy of between $12 and $15 per month. This is actually a fairly ambitious program. The major difference is that Company "D" is not particularly active about its program in terms of corporate backing and promotion. Less than half as many people rideshare at Company "D" as at HSB, and about two-thirds as many take transit. The result is a vehicle trip rate of 67.5 per hundred, which is 67.5 - 49.6 = 17.9 more than Company "D". Hartford Steam's program is able to reduce 1100 x 17.9/100 = 197 more vehicle trips than the program at Company "D" or (1100 x .179)/ (1100 x .675) = 26.5%. So the lesson for this example seems to be that the spirit in which a TDM program is offered can be almost as important as the particular transportation components of that program.

2. CASE STUDY: NUCLEAR REGULATORY COMMISSION

MONTGOMERY COUNTY, MARYLAND

1. SITE DESCRIPTION

Location and Character of Site

The Nuclear Regulatory Commission (NRC) is an agency of the Federal Government that has been involved in the consolidation of its staff and operations into Montgomery County, a suburb of Washington, D.C. Growth management controls applied to the consolidation under Montgomery County law have produced some very interesting results regarding the potential of Travel Demand Management actions.

Montgomery County, Maryland is a fast-growing suburban area located just northwest of the District of Columbia. Its location in the capital region is shown in Figure 1. This 500-square-mile county was largely a residential bedroom community for Washington, D.C. commuters prior to 1980. However, since that time, Montgomery County has followed the trend of most "first-ring" suburban counties in the nation's capital area in becoming a major employment center. In 1985, the County was the home for 236,000 households and 371,000 jobs. Comparing these totals with 191,000 households and 247,000 jobs in 1975 indicates the substantial growth that has occurred in the county, particularly as an employment center.

The new headquarters of NRC is located in an area known as North Bethesda, one of 15 planning subareas in the county. The location of North Bethesda and its size in relation to the county is also illustrated in Figure 1. It lies midway between two existing suburban centers, downtown Bethesda and the City of Rockville. This location relative to the transportation system and other activity centers has helped fuel North Bethesda's growth as a job center, producing traffic levels that have brought the area into conflict with the county's growth policy.

In the period prior to its employment surge, North Bethesda was primarily known as the location of Rockville Pike, a major retail strip district that has become increasingly upscale with time. However, as of 1987, employment in North Bethesda had reached 55,000, over 80% of which is office employment centered in four primary locations. One of these centers is the area along Rockville Pike itself, which is where NRC is located, as shown in Figure 2. North Bethesda is also a significant residential community, with approximately 13,000 housing units in 1987.

Transportation Facilities

Much of what has made North Bethesda such an attractive growth location is its excellent location in the region's transportation system. It lies at the base of the Interstate 270 corridor, where I-270 intersects with the Capital Beltway, I-495. I-270 is a six-lane facility which is in the final stages of a major expansion to twelve lanes. The Capital Beltway is

FIGURE 1

MAP ILLUSTRATING LOCATION OF NORTH BETHESDA

IN RELATION TO MONTGOMERY COUNTY AND WASHINGTON, D.C. REGION

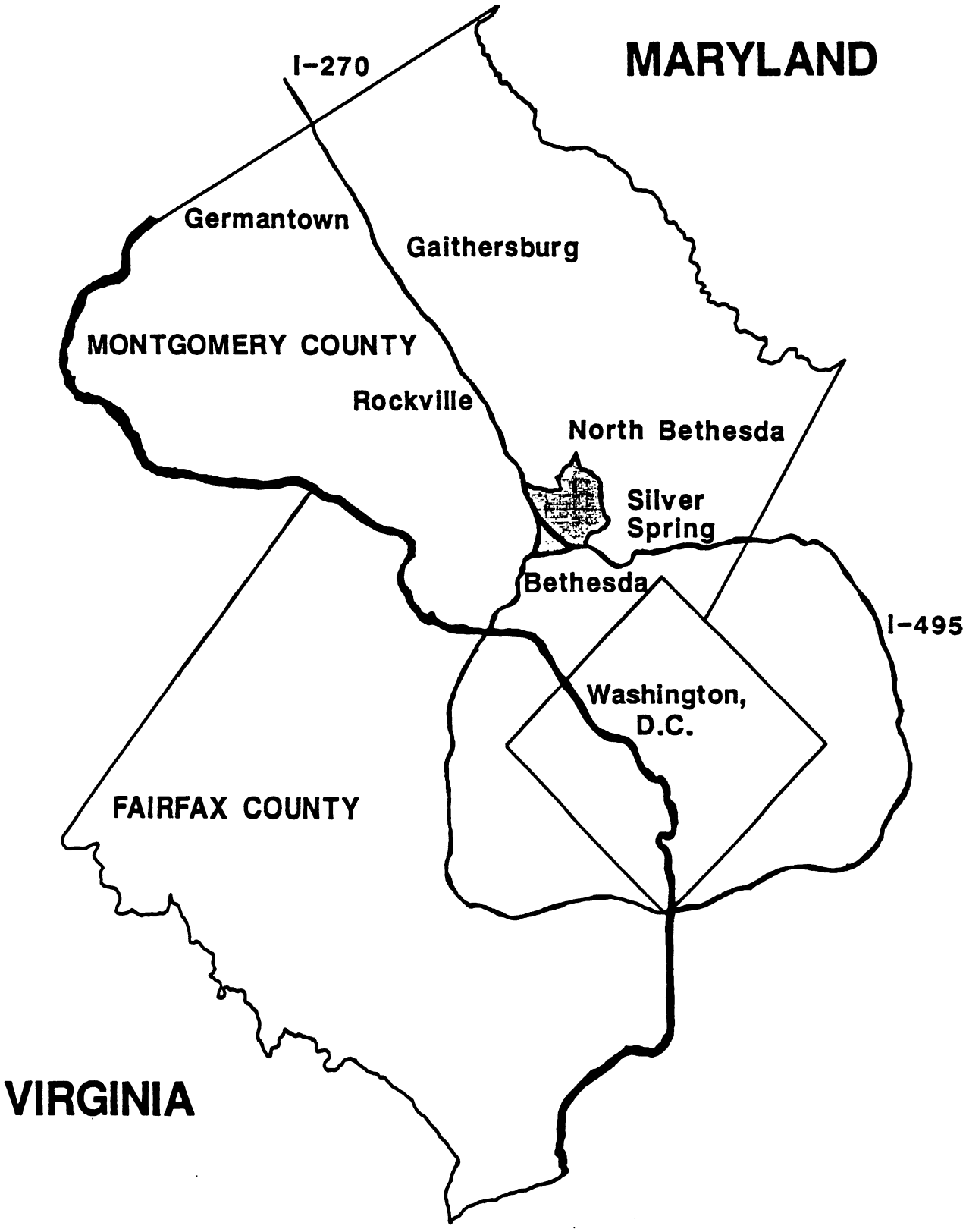
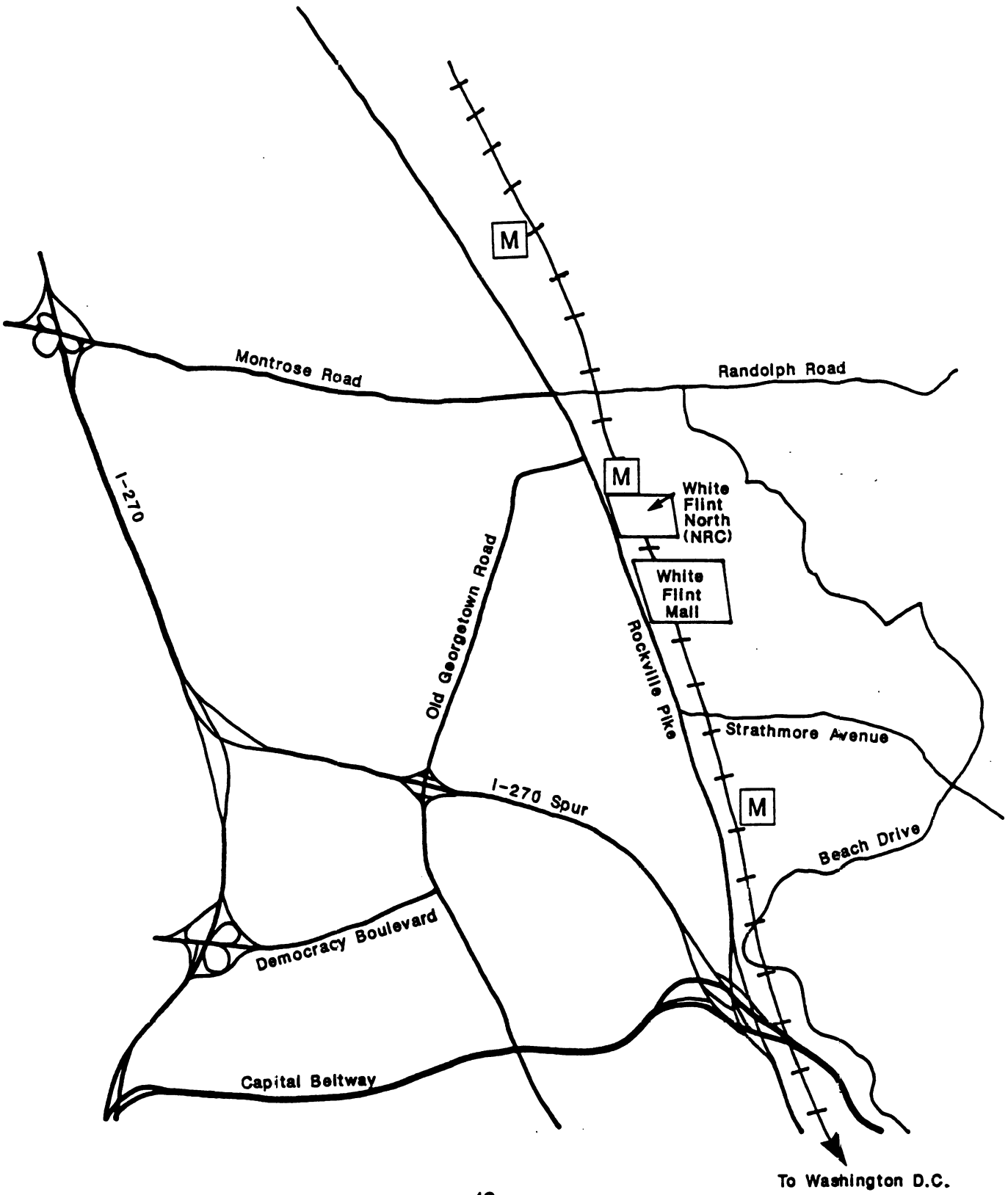


FIGURE 2

MAP OF NORTH BETHESDA

SHOWING LOCATION OF NRC AND MAJOR TRANSPORTATION FACILITIES



similarly undergoing an expansion from six lanes to eight lanes. These freeways make North Bethesda something of a regional gateway, which has proved to be a mixed blessing in terms of traffic. While the area the area is also served by some major six-lane arterials, such as Rockville Pike, Old Georgetown Road, Democracy Boulevard and Montrose/Randolph Roads, there are some key traffic movements that are not well accommodated by the existing network, which produce some serious flow problems.

Public transportation in the area is provided both by the county and the regional transit authority. The regional Metrorail system's Red Line runs north-south through the center of the area, roughly parallel to Rockville Pike, with three stations serving North Bethesda. Both the Washington Metropolitan Area Transit Authority and Montgomery County (Ride-On) provide fixed-route bus service through the area, largely oriented as feeder operations to the Metrorail system.

2. BACKGROUND AND MOTIVATION FOR TDM PROGRAM

Montgomery County is a striking example of a community that has taken major strides to try to balance the forces of economic growth with the interest of maintaining a high quality environment in which to live. Driven by its highly educated and relatively affluent population, County elected officials and planners have developed an advanced system of controls to try to moderate the impacts of growth.

Central to this system of controls is the county's Adequate Public Facilities Ordinance, or APFO. Enacted in 1973, the APFO places stringent tests of capacity on new developments related to the ability of public services to accommodate those developments. Two of the most stringent tests apply to transportation and schools. The County may withhold permits from landowners if the projects violate established capacity standards. In transportation, the APFO prescribes an average Level of Service that is to be maintained in each planning area, with the closer-in, higher density areas allowed a lower level of service (D and up) than the more rural upcounty planning areas (generally C). North Bethesda has been under a development moratorium since 1987 when it was realized that development projects either on line or for which construction permits had been granted, would consume the transportation capacity that is projected to exist through 1995.

Would-be developers can influence the likelihood of acquiring a building permit from the county by offering to establish trip reduction programs as a condition of project approval. In most of these cases, the developer is asked to back the transportation management agreement with a letter of credit, redeemable to the county in the event the proposed trip reduction is not met within a specified time frame. In other instances the county has granted conditional approval to a project, allowing an initial phase to be developed with approval on subsequent phases contingent upon whether trip reduction targets are met on the previous phase.

3. OVERALL EFFECTS OF PROGRAM

The County has been instrumental in initiating areawide management approaches in several locations where there are growth/traffic problems to help the areas resolve those difficulties and comply with the APFO. As examples of the above, the County has established:

- o A Transportation Management Association in North Bethesda that includes both developers and employers and exists as a vehicle to seek resolution of the area's transportation capacity problems through collective action.

- o A Transportation Management District in Silver Spring that has the responsibility of reducing private vehicle tripmaking among all employers, both new and existing;

- o An Urban District in downtown Bethesda which is responsible not only for collective resolution of traffic problems, but for the upkeep and promotion of the area as a place to live and work;

- o A Parking District in Bethesda to manage the parking supply to the best advantage of the area in terms of traffic management goals;

As yet, there is insufficient information at an areawide level on how well these collective efforts are performing. However, there are some important results at the individual project level. NRC is one of those programs.

4. THE NUCLEAR REGULATORY COMMISSION EXAMPLE

The Nuclear Regulatory Commission employs about 2,450 people, which, prior to its proposed move to North Bethesda, were headquartered in eight different locations throughout the metropolitan area. When looking for a consolidation site for the NRC, the General Services Administration (GSA) was attracted to a site at White Flint North, an area of mixed retail and office development lying east of Rockville Pike and just north of White Flint Mall in North Bethesda. The reasons for the attraction were twofold: more than 60% of NRC's staff already lived in Montgomery County, and the site itself adjoined a Metrorail station, which was also a transfer point for feeder buses. GSA purchased the 310,000 sq. ft. One White Flint North building from its developer while it was still under construction. This single building was not enough to meet NRC's entire staff needs, so GSA also executed a lease for a planned second building at the site, that would remain under the developer's ownership.

As a privately-owned building, however, the second facility required approval under normal Montgomery County development review procedures. Viability of the project initially depended on county approval of a revised development plan, since the original plan called for a hotel and conference center at the site. Even if the revised site plan were approved, the project faced the sterner test of the Adequate Public Facilities Ordinance. Heavy commuter traffic along Rockville Pike caused the county to establish strict trip generation limits for the White Flint North site.

NRC's plans were dealt a further blow when a 1986 survey of employee commuting patterns revealed that most staff members intended to drive to the new complex. Based on these reported travel preferences, estimates were made of the probable trip generation rates at the new site. It was evident that the peak-hour trip generation from the first building alone would far exceed the county's limit of 465 trips for the building. Completing NRC's consolidation with the second building would mean exceeding the 640-trip limit assigned to the entire 13-acre site in the approved development plan.

Faced with the certainty that under these circumstances Montgomery County would not approve the revised development plan, it became a critical objective to both the NRC and the developer to find a way to improve the employee travel situation and satisfy the county's regulations. With 18 months remaining before the scheduled initial occupancy, the NRC and GSA, with the help of the developer and its attorney, consultants and the NRC employees' union, launched a major effort to develop a transportation management plan (TMP).

Formulation of the TMP considered the widest possible range of options, including specialized transit services, ridesharing programs, flexible work hours, and a variety of financial incentives and disincentives, featuring parking management strategies. Options were tested out on the employees through another survey, which indicated concern that travel to the new site would be restricted, but also acknowledgement that alternatives to driving alone might be more attractive.

With the help of the Montgomery County Department of Transportation, a TMP was established and put into effect in early 1988 with the beginning of occupancy of the first building. The plan contained the following elements:

- Fee Parking -- All parking space formally available to NRC staff was charged at market rates; rates were $60 per month at the 365-space in-building garage, and $30 per month at a surface lot some blocks away.

- Transit Discounts -- Whereas Montgomery County maintains a program which offers matching discounts to employers who subsidize employees transit use, the NRC as a federal agency was prohibited from furnishing such subsidies; however, the county's transportation director agreed to make a 20 to 25% discount available without a matching subsidy. NRC purchases discounted fare cards, passes and bus tokens from the county and sells them to staff at a central building location, along with schedule information.

- Carpools -- Carpools of two or more riders are guaranteed space in the building's garage, but are offered no discount. NRC's transportation office provides a carpool matching service.

- Early Work Hours -- NRC's standard working hours were changed from 8:15 a.m./5:00 p.m. to 7:30 a.m./4:15 p.m. Moreover, flexible arrangements were offered to allow employees to start and leave even earlier. This element marked the first time that a federal agency had altered it work schedule in response to a local traffic problem.

- Nearby Parking Restrictions -- To backup its parking fee program, NRC informed employees that cars violating parking restrictions in posted areas near the building would be ticketed and towed. In addition, the developer obtained an agreement from owners of nearby shopping centers to tow illegal all-day parkers.

- Transit Shuttle -- The developer has also made an offer to subsidize a commuter shuttle that would supply a link currently missing in the public transportation system. Persons wishing to travel to jobs in North Bethesda from areas to the east (estimated 14,000 travelers) currently have no effective transit option. The developer's proposal would subsidize a bus service that would run between a new county park and ride lot and several job centers in North Bethesda. Since commuters other than NRC employees would use the service, the developer would receive the trip credit toward the White Flint project. A final decision on the shuttle service will be made in 1989.

NRC began its occupancy of White Flint North in early 1989, with the relocation of 1,400 of its 2,450 staff into the first building. According to the pre-consolidation 1986 employee survey, 54% of the NRC staff drove to work most of the time, 25% normally carpooled, and less than 11% used public transit. The modest transit use was particularly striking since all eight former office locations were within walking distance of Metrorail. In June 1988, four months after the initial occupancy, a subsequent survey indicated that only 42% were driving alone, 27% were carpooling and 28% were using public transit. Moreover, traffic monitoring at the building indicated that the majority of those who did drive alone were arriving at work before the start of the morning peak hour (7:30 - 8:30) and most were leaving either before or after the evening peak hour (4:45 - 5:45).

Table 1 presents summary data that provides an assessment of how effective NRC's Transportation Management Program has been. The modal split is indicated for NRC before and after its relocation, with a basis provided for calculation of the trip reduction. To perform the calculation, the measure of Vehicle Trips per 100 Employees is once again employed. This measure assumes a vehicle occupancy rate of 1 person for every drive alone trip, 2.5 persons for every carpool vehicle trip, and 30 persons for every transit vehicle trip. Based on this assumption, the NRC transportation management program for White Flint North has reduced vehicle trip production by 16.6% over its employees previous travel patterns. On a base of 1400 employees, this is an implied reduction of 232 daily one-way vehicle trips.

A much more striking comparison comes when NRC is related to North Bethesda as a whole. As part of the County DOT's North Bethesda Traffic Mitigation Study in 1987, an employee travel survey was conducted in North Bethesda that revealed the modal split shown in the last column of Table 1. Using this profile as a more relevant base of comparison, NRC's employee travel patterns are radically different from the heavily auto-oriented North Bethesda environment; almost 90% of all commuters to North Bethesda regularly drive alone. Against this base, NRC can claim a vehicle trip reduction of 41.6%. Applied to NRC's employee population of 1400, this implies 582 daily one-way vehicle trips averted, a very significant reduction.

TABLE 1

SUMMARY OF EFFECTIVENESS QF TDM PROGRAM

NUCLEAR REGULATORY COMMISSION

	NRC, Post-Relocation	NRC, Pre-Relocation	North Bethesda
Travel Mode			
Drive Alone	42%	54%	89.5%
Carpool	27	25	6.5
Transit	28	11	4.0
Other	3	10	0
Average Vehicle Occupancy	1.59	1.47	1.04
Vehicle Trips per 100 Employees*	53.7	64.4	91.9
Percentage Reduction		16.6%	41.6%

* assumes 2.5 persons per carpool and 30 persons per transit trip

NRC's trip reduction program is working so well that the building's peak hour trip generation is only two-thirds of the level anticipated by Montgomery County planners. The program's success led the Montgomery County Planning Board to unanimously approve the revised site plan proposal for the White Flint North site in April 1988. The revised plan includes a second 364,000 sq. ft. building for NRC, incorporating ground-floor retail, plus 200 apartment units on the site. However, this approval rests on the continued effectiveness of the TMP, which will be periodically monitored.

Although successful, the program is not without problems. The parking fees are not a complete deterrent to solo drivers. Many will pay the price, and other options exist for those willing to accept some inconvenience. Less than 40% of the employees who drive alone to NRC park in the assigned market-rate spaces. Some use the substantial amount of free legal on-street parking in the general vicinity, and others take advantage of a free, practically empty State of Maryland commuter lot a quarter mile away. In contrast, almost 70% of those who carpool park in the building's garage, taking advantage of the cost savings and space incentive. Investigations have shown that the carpool matching services have to be improved, with most current polls having been established through informal arrangements. Survey returns indicate that many auto drivers will not switch modes under any circumstances, based on work hours problems, locational difficulties, or other needs for the vehicle. Nevertheless, the NRC program has emerged as an important model of the potential trip reduction effectiveness of a well-designed and supported transportation management program.

Author's Note: This case study has borrowed extensively from a recent article: "Can Transportation Management Reduce Traffic in the Suburbs? Ask the Nuclear Regulatory Commission," which appeared in the November 1988 issue of Urban Land, published by the Urban Land Institute, Washington, D.C. Thanks are extended to Malcom D. Rivkin, principal of Rivkin Associates, Inc., Bethesda, Maryland, author of the article, and to Urban Land for permission to use major portions of the article to describe the NRC experience.

3. CASE STUDY: I-394 INTERIM HOV LANE

MINNEAPOLIS, MINNESOTA

1. SITE DESCRIPTION AND BACKGROUND

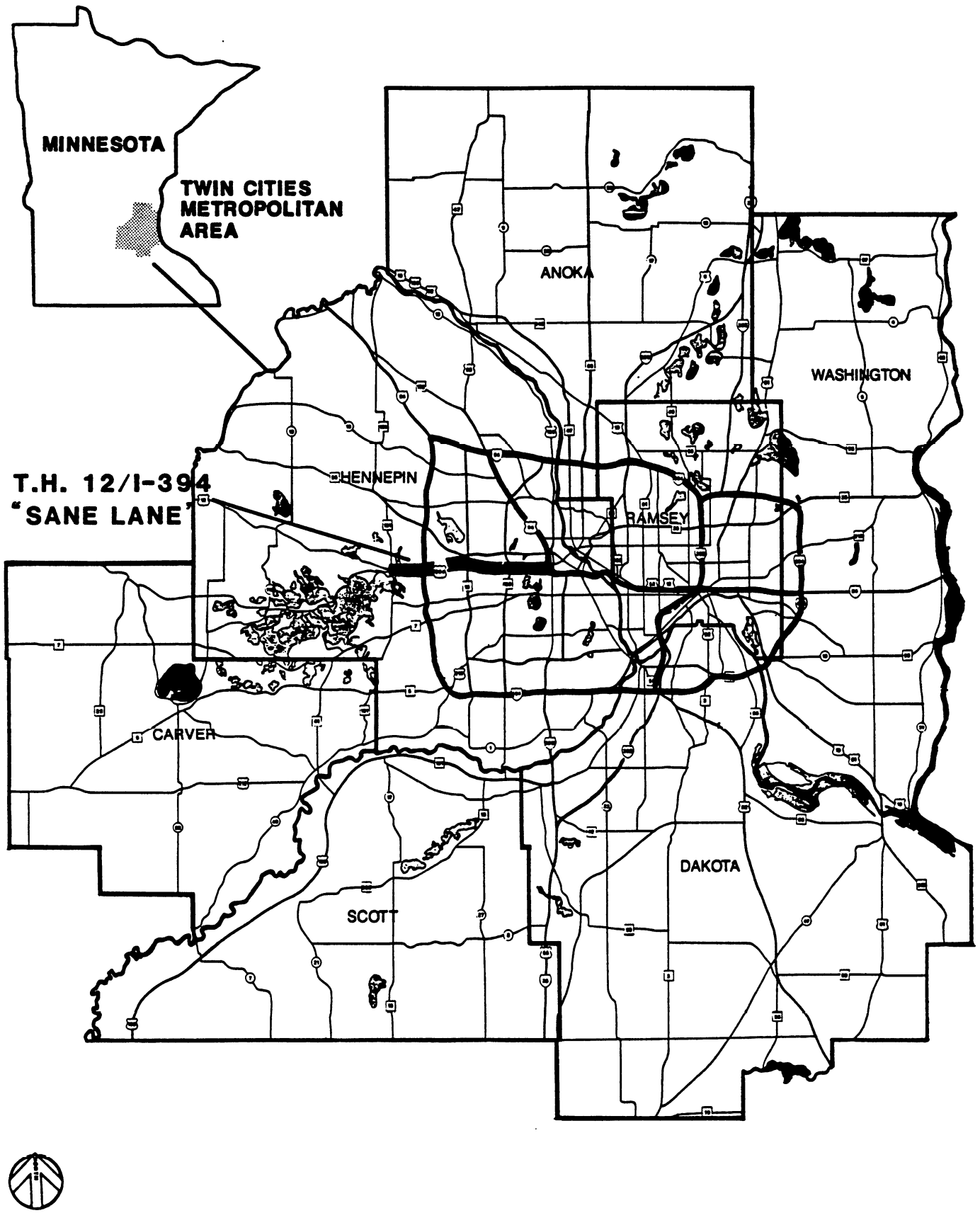
Trunk Highway 12 is a major artery in the Minneapolis-St. Paul highway system, connecting downtown Minneapolis with its western suburbs (see Figure 1). Highway 12 is a major commuting artery, providing an east-west linkage from circumferential highway I-494, and several north-south arterials, including Route 100, with both downtown Minneapolis and I-94 for travel to the eastern and southern parts of the Twin Cities area. Parallel facilities include Route 55, approximately 1 mile to the north, and Route 7, approximately 2 to 3 miles to the south.

As early as 1968, T.H. 12 was designated to be added to the Interstate System as I-394. However, after years of public controversy over the alignment of the proposed highway, the Minnesota State Legislature passed legislation in 1975 requiring that the new highway be built along the existing T.H. 12 alignment and that it have no more than 6 through lanes. After extensive review of design alternatives to accommodate this decision, the Twin Cities Metropolitan Council adopted the design concept of a 6-lane freeway with the two inside lanes reserved for buses, carpools and vanpools. These plans were approved by the state and the FHWA and final design and planning began in 1982.

In 1983, the Minnesota Department of Transportation (MnDOT) decided to prepare a Transportation System Management Plan to coordinate all of the program activities that would be necessary to support the construction and operation of HOV lanes along I-394. At about the same time, Minnesota Rideshare conducted a market research survey to assess the potential for ridesharing in the corridor, and to investigate the types of incentives which might be effective in encouraging HOV travel. One of the strategies recommended by that study was the construction of an "interim" HOV lane along Highway 12 for use before and during construction of I-394. A Corridor Management Team, formed to guide development of the TSM plan, adopted the interim lane concept, as a way of alleviating congestion impacts during construction, and conditioning behavior to ease implementation of the ultimate facility. MnDOT commissioned a design and the lane was built in 1985, with the first day of service on November 19, 1985.

2. CHARACTERISTICS OF PROJECT AND SUPPORTING PROGRAM

The I-394 interim HOV lane operates as a single reversible lane in the median of Highway 12, which is a 4-lane facility. The segment over which the HOV lane treatment extends, from I-494 east into the city, is only about 7 miles long. The HOV lane itself covers only a portion of this stretch of Highway 12, as shown by Figure 2, and is in two segments. The first segment is about 1 mile long, and extends from roughly the intersection with I-494 to Ridgedale Drive, at which point HOV users must merge back into regular traffic. Mixed traffic conditions prevail for approximately 2 miles until the next HOV segment, which

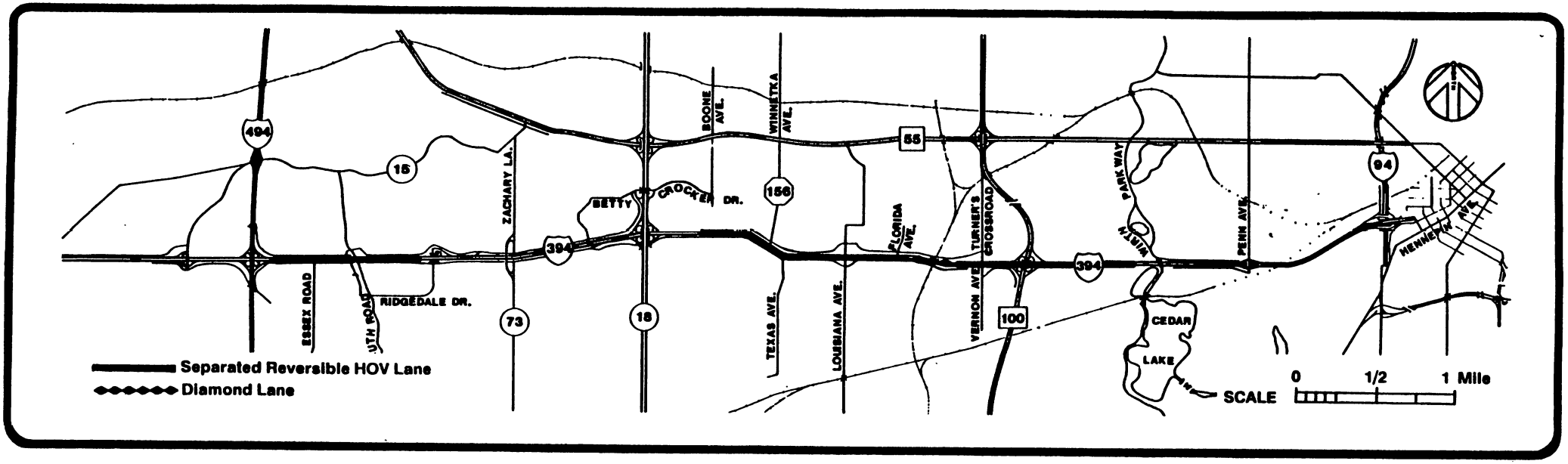


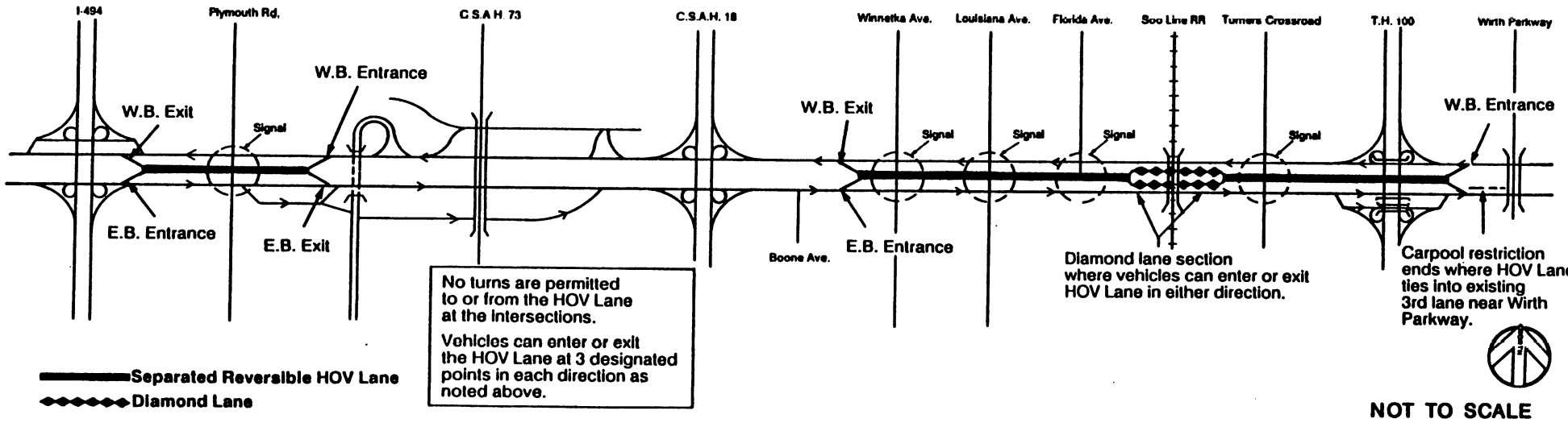
STRGAR-ROSCOE-FAUSCH, INC.

FIGURE 1

LOCATION OF I-394 INTERIM HOV LANE IN TWIN CITIES REGION

I-394 CASE STUDY FIGURE 1





STRGAR-ROSCOE-FAUSCH, INC.

FIGURE 2
LOCATION AND SCHEMATIC DESIGN OF THE T.H. 12/I-394 INTERIM HOV LANE

I-394 CASE STUDY

begins before Winnetka Avenue and runs approximately 3 miles to Wirth Parkway, just east of Highway 100, but still approximately 3 miles from downtown Minneapolis. A short section of this particular segment of the HOV lane splits into two narrow "diamond lanes" to squeeze under an existing railroad bridge. The segmented design of the interim lane is intended to provide continuity between segments of the proposed permanent I-394 HOV lanes as they are constructed. Travel within the two HOV lane segments is not non-stop; there is one signalized intersection within the first segment and four signalized intersections within the second segment.

Use of the lane is open to travelers in carpools or vanpools with at least 2 passengers, and to transit riders. Hours of operation of the lane are between 6:00 to 10:00 A.M., and from 2:00 to 7:00 P.M.

Concurrent with the introduction of the lane, a number of other important supportive activities occurred:

- Minnesota Rideshare opened a 251-space parking lot in downtown Minneapolis in November 1985 in conjunction with the opening of the HOV lane, and offered free parking for registered carpools. In June 1986, another lot with 320 spaces was made available.

- In December 1985, the public bus service along the Highway 12 corridor was reorganized. This included introduction of a new Route 75, which is an express peak period service making only one stop and running every 15 to 30 minutes, as well as provision of a timed-transfer option between the express service and a local service (Route 51).

- The capacity of one of the six existing park/ride lots (C.S.A.H. 73) along Highway 12 was increased by 60 spaces.

- Minnesota Rideshare launched a comprehensive marketing and outreach program within the corridor.

- The State Highway Patrol increased its enforcement activities along the corridor, and instituted a new schedule of fines for violations of the HOV lane, consisting of $44 for a first violation, subsequent fines of up to $100, and, if three violations are committed within two years, a court appearance and license review with possible suspension of license.

- A very aggressive public information/relations effort was undertaken prior to the opening and during the first year of operation of the HOV lane.

3. OVERALL EFFECTS OF PROGRAM

Overall, the HOV lane has apparently worked well and as expected. Despite the discontinuous segmentation of the lane, plus the signalized intersections, measured time savings for carpoolers using the lane average 8 minutes. Survey findings suggests that

carpoolers perceive an average savings of 10 minutes. Bus riders perceive a time savings of about 15 minutes. Bad weather greatly increases the time savings for all users.

Operationally, it was found that signal coordination is critical to maintaining travel time savings in the HOV lane. Signal phasing needs to be checked periodically and has been adjusted several times since the lane was opened. Also, it was initially anticipated that weaving in and out of the mixed traffic lane at the short diamond lane section might be a problem. In practice, this does not occur frequently, perhaps because this section is quite short and visibly connects two separated sections. The standard merges to and from the HOV lane are left merges which can pose operational problems in some situations, particularly when traffic volumes are heavy. Some extension of merge lanes was made to ease merging problems.

How effective has the HOV lane been in achieving its primary purposes, in terms of encouraging travelers to use HOV modes and in managing traffic congestion on T.H. 12 during reconstruction?

A local consultant, Strgar-Roscoe-Fausch, Inc., responsible for the engineering design of I-394, was also charged with monitoring the performance of the interim HOV lane during the first year of its operation. Several data collections were performed to conduct this evaluation. These included: daily traffic counts at three locations; an HOV lane use survey; bus ridership checks; auto occupancy counts; and travel time studies. Several analyses were possible with these data, as described below:

Recognizing that the morning peak hour represents the maximum hourly volume on Highway 12, the consultant's evaluation data were compiled for the AM peak hour only. Data collected in May 1984 have been used to represent pre-lane conditions, and data from October 1986 to reflect conditions approximately 1 year after implementation.

Two important changes occurred simultaneously with the introduction of the HOV lane on T.H. 12. These are illustrated in Table 1. First, travelers did respond to the availability of the lane and the broader program incentives of free parking, etc. to greatly reduce the rate of single-occupant vehicle usage. However, at the same time, the addition of the HOV lane on T.H. 12 as net additional capacity, plus the HOV time savings incentive, combined to attract travelers from other parallel routes and increase overall travel volumes. So there was both a significant change in modal split as well as a considerable increase in vehicular traffic. Overall, the change in modal split was the stronger effect, with the result that person trips on the facility greatly increased.

Prior to the interim HOV lane on T.H. 12, 61.9% of all persons traveled by single occupant vehicle, 20.1% rode in carpools or vanpools, and 17.9% rode transit. After opening of the lane, the percentage of people driving dropped over 13 percentage points, to 48.7%, while the number traveling in carpools or vanpools rose over 12 percentage points, to 32.8%. The percent of people riding transit remained about the same, at 18.5%, but the net increase in people using T.H. 12 also meant an absolute increase in one-way daily bus person trips of 190. Interestingly, the new ridesharing users seem to have come, percentage wise, from single occupant autos, allaying some conventional fears that HOV lanes will shift travelers primarily from high occupancy buses to lower occupancy carpools.

TABLE 1

SUMMARY OF TRAVEL IMPACTS

I-394 INTERIM HOV LANE
(AM PEAK HOUR)

	Before Lane May 1984	After Lane October 1986	Net Change
Travel Mode			
Drive Alone	61.9%	48.7%	-13.2%
Rideshare	20.2	32.8	+12.6%
Transit	17.9	18.4	+0.5%
Total Person Trips	2680	3630	+950 trips (35.4%)
Total Vehicle Trips	1946	2387	+441 trips (22.6%)
Average Vehicle Occupancy	1.17	1.29	+0.12 (10.3%)
Vehicle Trips per 100 Travelers	72.6	65.8	- 6.8 trips (9.4%)

Exactly why this change happened is not clear; the downtown free parking program certainly provided specific new incentives to carpoolers in addition to the HOV time savings. Transit riders also benefited from HOV time savings, and alsc modest improvements were made to transit service on T.H. 12.

The new mode split meant an increase in average vehicle occupancy from 1.17 to 1.29. Using an alternative measure, vehicle trips per 100 travelers, the travelers in the new system are generating 65.8 vehicle trips per 100 employees, compared to 72.6 per 100 before the lane and related programs. This means a reduction of 6.8 vehicle trips per 100 travelers. If the number of persons using T.H. 12 in 1986 traveled at the modal split rate seen in 1984, they would have produced:

3630 person trips x 6.8 veh.tr./100 = 247

additional vehicle trips per hour than the 2387 vehicle trips realized, or about 10.3% less than would have occurred.

The survey data permit exploration of the various shifts in travel among modes and routes that occurred when the Interim HOV lane on T.H. 12 was opened. Table 2 provides a breakdown of the prior mode and route of 1610 peak hour HOV lane users.

What these data illustrate is the high rate of behavioral change that occurred with the offering of the HOV lane. To better understand the display, first segment the HOV users into two primary markets: rideshare and transit. Of the 1610 surveyed HOV users, 64.5% are carpoolers and 31.7% are transit. Looking at the carpooler segment, only 25.3% (16.3% overall) were formerly carpoolers on T.H. 12; the great majority, 74.7% (48.3% overall), previously traveled on other modes and/or other facilities. Specifically, about half of the converted carpoolers, 50.5%, were formerly drive alones (15.9% on other routes); 35.4% were carpoolers on other routes; and 14.1% were transit riders (4.1% on other routes).

Among bus riders, about 38% were riders on non-public transit buses, for which the source survey data have no information on changes. Of the 62% who were public transit riders, only a small fraction were new riders. Only 13% of all public transit riders were new riders, and about two-thirds of these were previously drive-alones, while the remaining one-third were carpoolers. In summary, the significant shifts were from other modes to carpooling, and the most significant shift was from drive alone to carpool. And most new carpools were formed from previous T.H. 12 drivers.

TABLE 2

PRIOR MODE AND ROUTE OF INTERIM HOV LANE USERS

Travel Mode	Number	Percent
Carpoolers	**1039**	**64.5%**
Previous Carpoolers, T.H.12	262	16.3%
Diverted	777	48.3%
Drive Alones	392	24.4%
T.H. 12	*268*	*16.7%*
Other Routes	*124*	*7.7%*
Carpoolers, Other Routes	275	17.1%
Transit Riders	110	6.8%
T.H. 12	*78*	*4.9%*
Other Routes	*32*	*2.0%*
Transit Users	**510**	**31.7%**
Public Transit	319	19.8%
Previous Users	277	17.2%
Diverted Users	42	2.6%
Drive Alones	*27*	*1.7%*
Carpoolers	*15*	*0.9%*
Other Bus	191	11.9%
Total	**1610**	**100.0%**

4. CASE STUDY: MINNESOTA RIDESHARE FREE PARKING PROGRAM

MINNEAPOLIS, MINNESOTA

Commuters to the City of Minneapolis are provided a special incentive to consider ridesharing as their method of travel. Minnesota Rideshare, an agency within the Minnesota Department of Transportation, offers registered carpoolers and vanpoolers free parking privileges at a group of downtown fringe lots. Since its introduction in 1983, the program has drawn an steadily increasing number of users, closely tracking the supply of spaces that the program is able to offer.

The program was initiated primarily as a construction impact mitigation strategy. Plans to convert Highway 12, a major arterial serving downtown Minneapolis from the west, into an interstate highway (I-394) meant that highway capacity in that corridor would be reduced for some time. It was reasoned that increasing HOV usage during the reconstruction period, scheduled to last between 1985 and 1992, might help minimize congestion for commuters. The free lots, which are located on the western fringe of the downtown, were part of a two-fold strategy that also included implementation of an HOV reserved lane on Highway 12/I-394. The free lot/reserved lane program will also be part of the new highway when it is completed. I-394 will feature a permanent HOV express lane, and three parking garages will be constructed at the downtown terminus of I-394 along Third Avenue which will feature priority parking and direct HOV entrance ramps from the freeway.

Figure 1 illustrates the location of the special lots within downtown Minneapolis. There are currently six facilities. Locations numbered 1 through 5 are surface lots located on land owned by the Minnesota Department of Transportation, and parking at these lots is free. Facility 6 is a privately-owned lot which is located in an area where parking is highly desirable. Minnesota Rideshare has struck a deal with the lot owner to offer a reduced rate for pools, charging them $37 per month instead of the standard $47 per month. Facility 7 is the only structure parking facility. It is one of the previously described distributor garages for I-394, and is expected to open in August of 1989. Rates at this garage will be $10 per month for I-394 carpoolers and $80 per month for all others.
All of those facilities which are owned by the Minnesota Department of Transportation are maintained and managed by the City of Minneapolis. While the lots are located at the fringe of the downtown, access is facilitated by MTC Dime Zone bus service from most of the lots and by vanpool loading areas at numerous locations within the center of town. By parking in the free lots, users save between $30 and $80 per month in parking costs relative to comparable locations, and between $100 to $200 for parking in the downtown core.

To be eligible to use the lots, carpoolers must register with Minnesota Rideshare and receive a permit. A sample of the registration form is shown in Figure 2. To qualify as a carpool, the unit must have at least two members, they must carpool at least three days a week, and the destinations of the passengers must be within a three-mile radius of downtown Minneapolis.

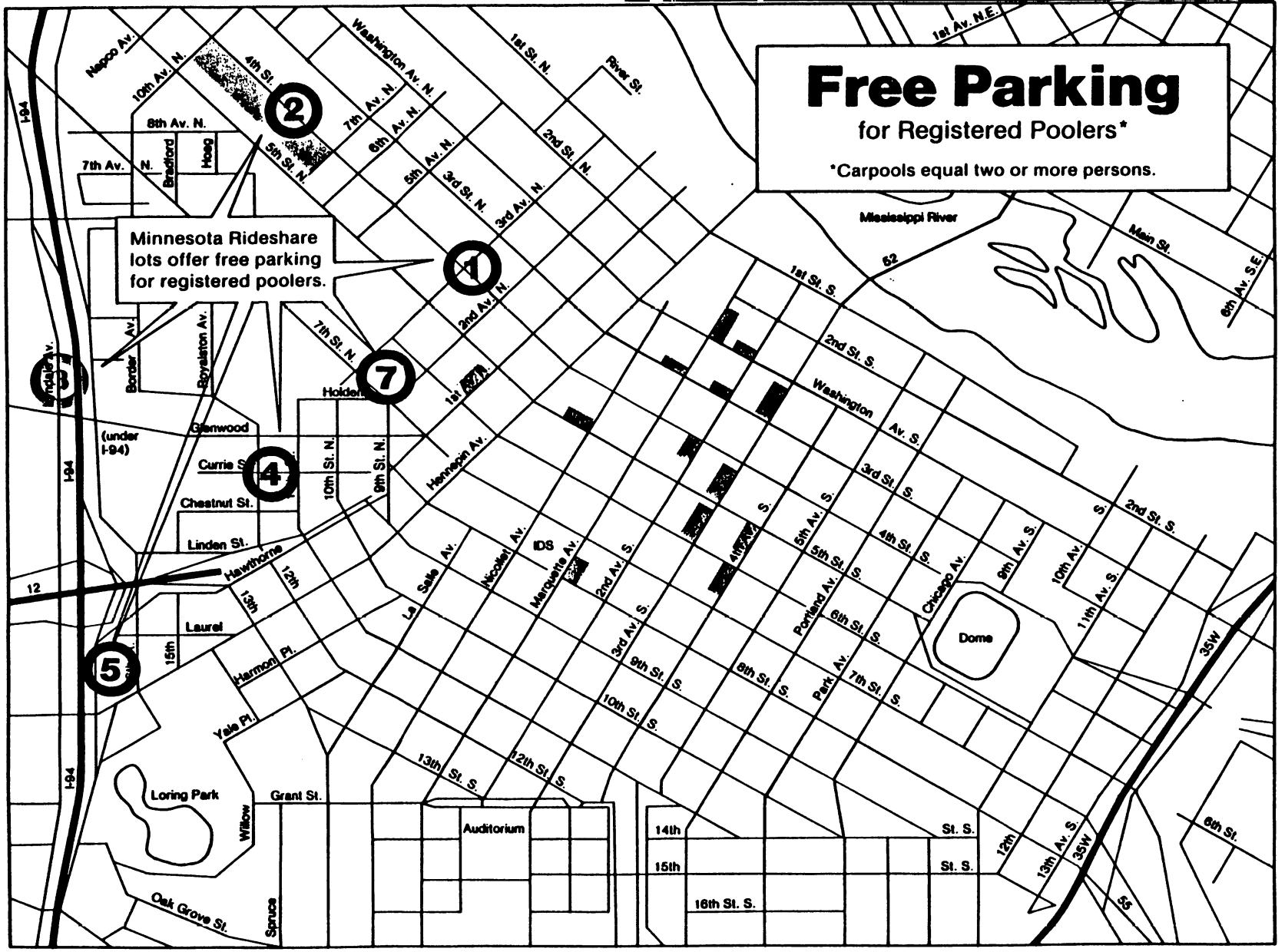


FIGURE 1

LOCATION OF CARPOOL LOTS IN DOWNTOWN MINNEAPOLIS

SAMPLE

MINNESOTA RIDESHARE

METROPOLITAN TRANSIT COMMISSION

560-6th Avenue North, Minneapolis, Minnesota 55411-4398 612/349-RIDE (7433)

MINNEAPOLIS: AFFIDAVIT/REGISTER
PERMIT PARKING PROGRAM

SAMPLE

POOL # CP 1000
(For Office Use Only)

AFFIDAVIT, this 8th day of August, 1988, does hereby state and affirm: I, Joe Smith and Bill Jones and _____ are participants in a 2 or more person car or vanpool, regularly (three or more days per week). PLEASE PRINT THE FOLLOWING INFORMATION FOR EACH POOL MEMBER COMPLETELY.

ID# (OFFICE USE ONLY)	NAME HOME STREET ADDRESS CITY, ZIP CODE	WORK PHONE # HOME PHONE #	COMPANY NAME & WORK HOURS	YEAR, MAKE, MODEL LICENSE PLATE # (TO BE USED IN POOL)
1.	Joe Smith 4000-1st Ave So #1 Mpls. 55400	337-0000 922-0000	Daytons 8:00-4:30	82 Ford ESCORT PPP-111
2.	Bill Jones 3200 Blaisdell Ave So. Mpls. 55400	349-0000 925-0001	1st Banks 8:15-4:45	84 CHEV Monte Carlo BBB-111
3.				

59

Further, we understand that privileges for free parking will be revoked if regular ridership falls below the required 2 persons and/or usage falls below three days per week.

SIGNED Joe Smith DATE 8-8-88
Bill Jones

WITNESS C. Glee DATE 8/8/88

WE REQUIRE THAT ALL POOL PARTICIPANTS SIGN THIS AFFIDAVIT. Please mail the commuter application cards and this affidavit together to our office. You will be required to re-register every 6 months.

FIGURE 2

SAMPLE CARPOOL REGISTRATION FORM

Each pool must reregister every six months. Registered pools are issued a parking permit which hangs from the rear-view mirror. The permit is meant to be transferable, to allow for alternate use of different pool member's vehicles. The program is not heavily enforced, but periodic checks of proper use of permits is made. The principal enforcement is against non-registered use of the lots; towing is actively administered by the City of Minneapolis.

Since inauguration of the program in 1983, the network of lots and the supply of spaces has changed in response to construction activity and other factors. As shown below, the program began with only two lots and 189 spaces, for which registered units quickly reached 144. Lot capacity reached a maximum in 1986/87, with five lots supplying 1699 spaces. Usage reached a maximum in 1987, with 1356 registered pools. Lot capacity fell in 1988 due to some shifting in facilities; the number of spaces has been reduced to 1378, and availability appears to have had an effect on usage, as the number of registered pools has dropped to 1207. When the 5th Street garage is completed in August, capacity will increase again, as presumably will registrations and usage.

Year	Number Lots	Number Spaces	Number Users
1983	2	189	40
1984	2	189	144
1985	5	1389	566
1986	5	1699	1206
1987	5	1699	1356
1988	5	1378	1207

While Minnesota Rideshare has never done a formal occupancy count at the free lots, an informal assessment of the effectiveness of the program can be made by looking at the registration data. The 1207 pools registered in December 1988 claimed 2752 named riders. If each of these named passengers actually rode in the registered pool, this travel would correspond to an average occupancy of 2.28 persons per vehicle. If each of these people formerly drove alone to work downtown, then the program could be credited with saving 2752 - 1207 = 1542 vehicle trips into downtown Minneapolis every peak period, which would be a substantial trip reduction.

In actuality, the gains attributable to the Free Parking program cannot be counted so simply. Not all of these people rideshare 5 days a week, and not all of them were converted to carpooling by the free parking program. Some may have carpooled or taken transit before, while others may have resorted to carpooling for reasons other than the free parking program, in particular the availability of the reserved HOV lane for Highway 12 travelers.

To try to separate these various effects and arrive at an estimate of the net effect of the Free Parking program, Minnesota Ridesharing staff conducted a survey of registrants in January 1989. The survey was mailed to 2752 registrants, and asked questions about current commute method as well as behavior before joining the free parking program. The

survey was also structured to ascertain the location/direction and route of the registrant's trip, plus demographic information. 1172 usable responses to the survey were received. Responses to relevant questions from the survey are displayed in Table 1. It will be noted that the responses are separated into two groups: Persons whose route of travel is Highway 12 (I-394), where the HOV lane provides an added inducement to carpooling; and for the entire sample, which includes Highway 12. Highway 12 users account for about 14% of the total sample.

The data in Table 1 suggest some conflicting results when trying to assess the overall effectiveness of the parking program. Looking first at the change in mode reflected in the listing of previous mode of travel, it is clear that the program had an effect on choice of mode. Before becoming registered carpoolers or vanpoolers, about 35% of all respondents formerly drove alone. All of these people were converted to ridesharing arrangements. However, almost as large a percentage of carpoolers were formerly transit riders; on Highway 12, 27.5% formerly rode the bus (with and without auto access), as did 29.3% of the overall sample.

The change in occupancy can be estimated in the following manner. For current registrants, the survey estimates that the average number of occupants is 2.4 per vehicle on Highway 12 and 2.57 overall. However, not all of these arrangements pool together every day. The average for both cases is about 4.7 days per week. If a "discount" factor of 4.7/5.0 is applied to the reported occupancy, an "effective daily" occupancy of 2.26 for Highway 12 users and 2.43 for the overall sample is calculated.

To estimate the average occupancy of the same group of travelers before joining the program, the percentages in the modal distribution are divided by the following modal occupancy rates:

Drive Alone = 1 occupant
Carpool = 2.26 and 2.43 (assume same as present)
Vanpool = 12 occupants
Bus = 30 occupants
Other = assume no vehicle trip

Under these assumptions, Highway 12 users are judged to make 45.6 vehicle trips per 100 travelers, equating to an average occupancy rate of 2.19. The overall sample would have made about 48 vehicle trips per 100, equating to an occupancy level of 2.06.

Comparing the overall sample before and after participation in the program suggests that a moderate trip reduction can be tied to the program. Assuming 2752 registered users formerly traveled in a combination of modes averaging 2.05 persons per vehicle trip, that implies 1336 vehicle trips. Under the new occupancy of 2.43, vehicle trips are reduced to 1133, suggesting a savings of 203 trips against a base of 1336, or a net trip reduction of about 15%.

In the case of the Highway 12 users, the number of registered users who would use this route is estimated as 14% x 2752 registrants, or 385. The number of vehicle trips that this sample would have formerly generated at an occupancy rate of 2.19 would be 176; under the new occupancy of

TABLE 1

SUMMARY OF RESPONSES TO JANUARY 1989 SURVEY OF PROGRAM REGISTRANTS

	Primary Route of Travel	
	Highway 12	**All**
Previous Mode of Travel		
Drive Alone	35.6%	35.4%
Carpool	31.9	31.1
Vanpool	-	1.5
Bus	20.0	21.2
Drive + Bus	7.5	8.1
Other	5.0	2.7
Estimated Average Occupancy	2.19	2.06
Current Number of Occupants	2.40	2.57
Current Avg. No. Days Carpool	4.70	4.74
Effective Occupancy per Day	2.26	2.43
Monthly Parking Cost Before	$62.60	$55.45
Travel Time After	31.6 min	31.4 min
Did Free Parking Encourage You To Carpool?		
Pct. "Yes"	90.7%	92.1%
Average Age of Current Pool	21.7 mos.	21.5 mos.

TABLE 1 (Continued)

Reasons for Carpooling	
Money Savings	18.4%
Convenience	15.9
Time Savings	13.4
Reliability	12.0
Avoidance of Stress	10.5
Bus Unavailable	8.7
Changed Job Location	7.4
Do Not Drive	7.0
No Car Available	6.9

2.26, 170 vehicle trips are generated, implying a net savings of 6 trips, or 3.5%, among Highway 12 travelers.

The conclusions from this analysis are that (1) the Free Parking certainly caused changes in mode choice behavior, however, (2) without comparable incentives to support other high occupancy modes, i.e. transit in this case, comparative advantages in using carpools may make them the favorite choice and thereby minimize the overall trip reduction potential.

There is no obvious reason why the rate of reduction should be so much less for the Highway 12 contingent of Free Parking users than the other areas, except that there were slightly higher rates of transit use on Highway 12 before the program, and the occupancy levels of carpools formed by highway 12 users are lower than the sample average. Both the carpool and transit users of the HOV lane realized comparable net travel time savings. Demographically, the Highway 12 travelers have some slight differences from the sample as a whole. A somewhat higher percentage of them are Professionals (57% vs 43%), a higher percentage are males (51.2% vs 47.9%), and incomes are slightly higher ($42k vs $39k). However, in terms of household size, number of workers, and vehicle ownership, they are fairly similar.

The cost savings offered by the free parking program seems to have had a direct effect on the decision to carpool. When asked directly whether the free parking program encouraged them to carpool, 92.1% of the sampled users said "yes", as did 90.7% of the Highway 12 users. The average monthly parking savings was about $55 for the average user, and about $63 for the Highway 12 user.

From a list of possible factors suggesting reasons for carpooling, money savings was the most frequently cited reason, followed by convenience, time savings, reliability, avoidance of stress, non-availablity of a bus, change in job location, non-ability to drive, and non-availability of a car. Pools formed under the program have had reasonable longevity. The average age of pools registered into the free parking program is 21.5 months -- almost 2 years. Minnesota Rideshare believes that the rate of attrition of pools out of the program is on the order of 10%.

In conclusion, the concept of offering free parking to carpoolers as an economic incentive to rideshare has shown a demonstrated capability to reduce trips. Important questions to be weighed in considering application of this concept on a larger scale or in other locations are:

- What is the cost for such a program, including the effective cost of the land, the administrative cost, and also the revenue cost of forfeiting the parking or other revenues which could be generated by the land?

- How many vehicle trips will be reduced as a result of the program? If the program runs in competition to existing transit service, the effect of the comparative advantage in diverting travelers from transit to carpools can be counterproductive to trip reduction goals.

5. CASE STUDY: 3M COMPANY

ST. PAUL, MINNESOTA

736-3277
612 733-1110

1. SITE DESCRIPTION

The 3M Center is the international headquarters of the 3M Company, which operates one of the oldest and most successful private Travel Demand Management programs in the United States.

The center is located in the eastern suburban portion of the Minneapolis-St. Paul metropolitan area, and occupies approximately 420 acres in a campus-type setting. Both laboratory and administrative facilities are located on the site, which employs nearly 13,000 people in a complex of 24 buildings, comprising over 10 million square feet. Figure 1 illustrates the location of 3M Center relative to the metropolitan area, while Figure 2 highlights the layout of the Center itself.

The area in which 3M is located is quite low in density, being at the eastern fringe of the urbanized area. Access to the site is primarily by Interstate highway.

I-94 forms the southern boundary for the center. McKnight Road and Highway 120 (Century Avenue) form the eastern and western boundaries, and each has direct access via interchange with the interstate. In addition, there are several slip ramps that allow easy access directly into and out of the center to the interstate. A short distance to the east is I-694, a circumferential freeway that connects with areas north and south of St. Paul.

2. BACKGROUND AND MOTIVATION FOR TDM PROGRAM

3M's first building at the Center was built in the early 1950's. Since that time, the site has experienced steady growth to its current capacity of 24 buildings. From the beginning, as the company's growth trends became evident, 3M conducted studies of its employees' travel behavior to try to forecast future traffic levels and estimate transportation and parking needs.

By 1970, it had become clear that trends in employee travel would eventually limit the company's ability to grow at the 3M Center site. A Home-Work Survey conducted in 1970 showed an average vehicle occupancy of 1.24 persons, confirming a heavy reliance on single-occupant vehicle travel. Only one bus line from downtown St. Paul provided transit service to the Center, and the total bus ridership out of 7700 employees numbered only 43. The company realized that it had to become actively involved in the management of its employees' transportation if it was going to realize its growth potential at the site.

Several employee transportation programs were considered, and with the approval of management in 1971, the company began implementation of the following measures:

FIGURE 1

REGIONAL LOCATION OF 3M CENTER

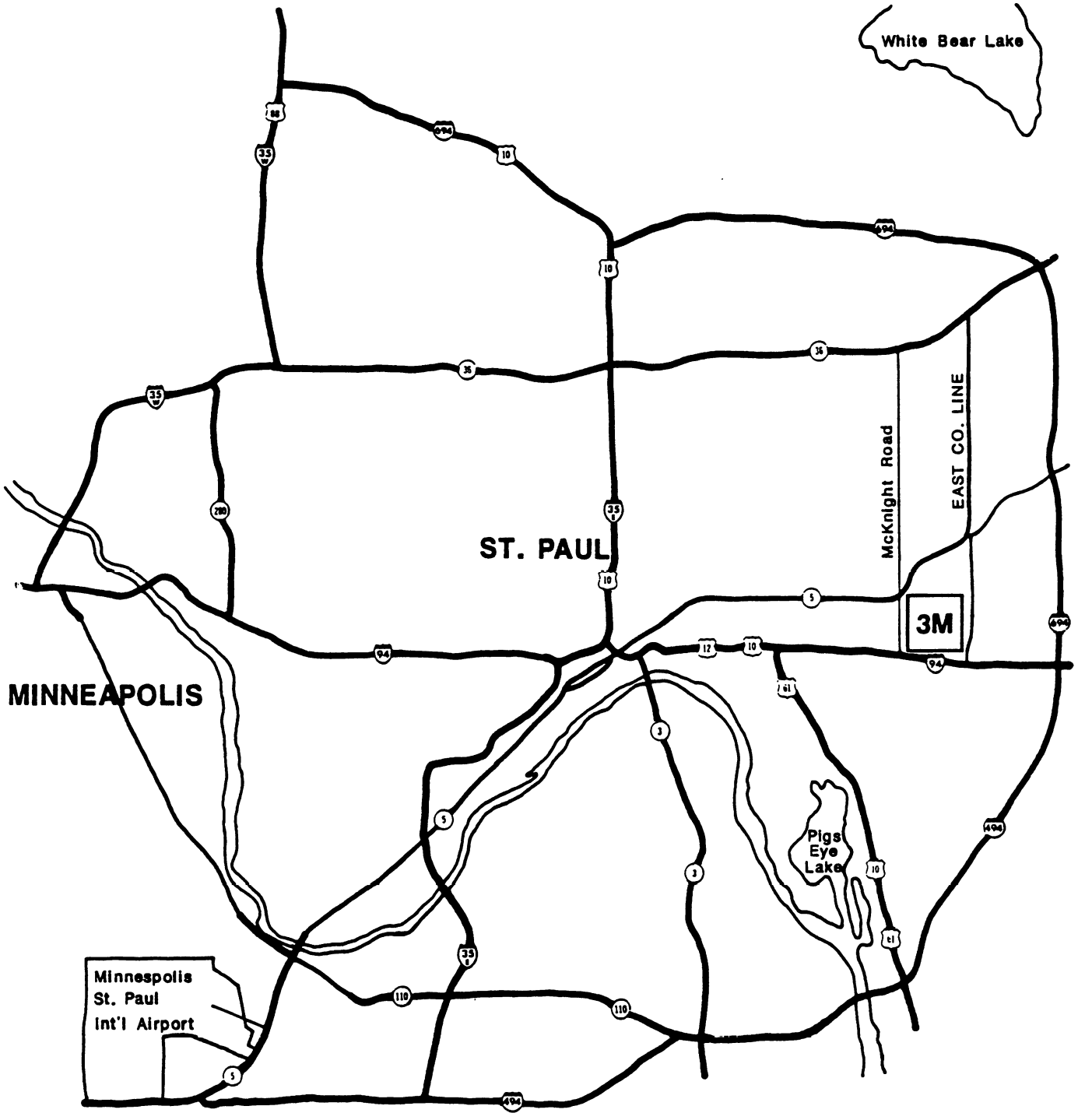
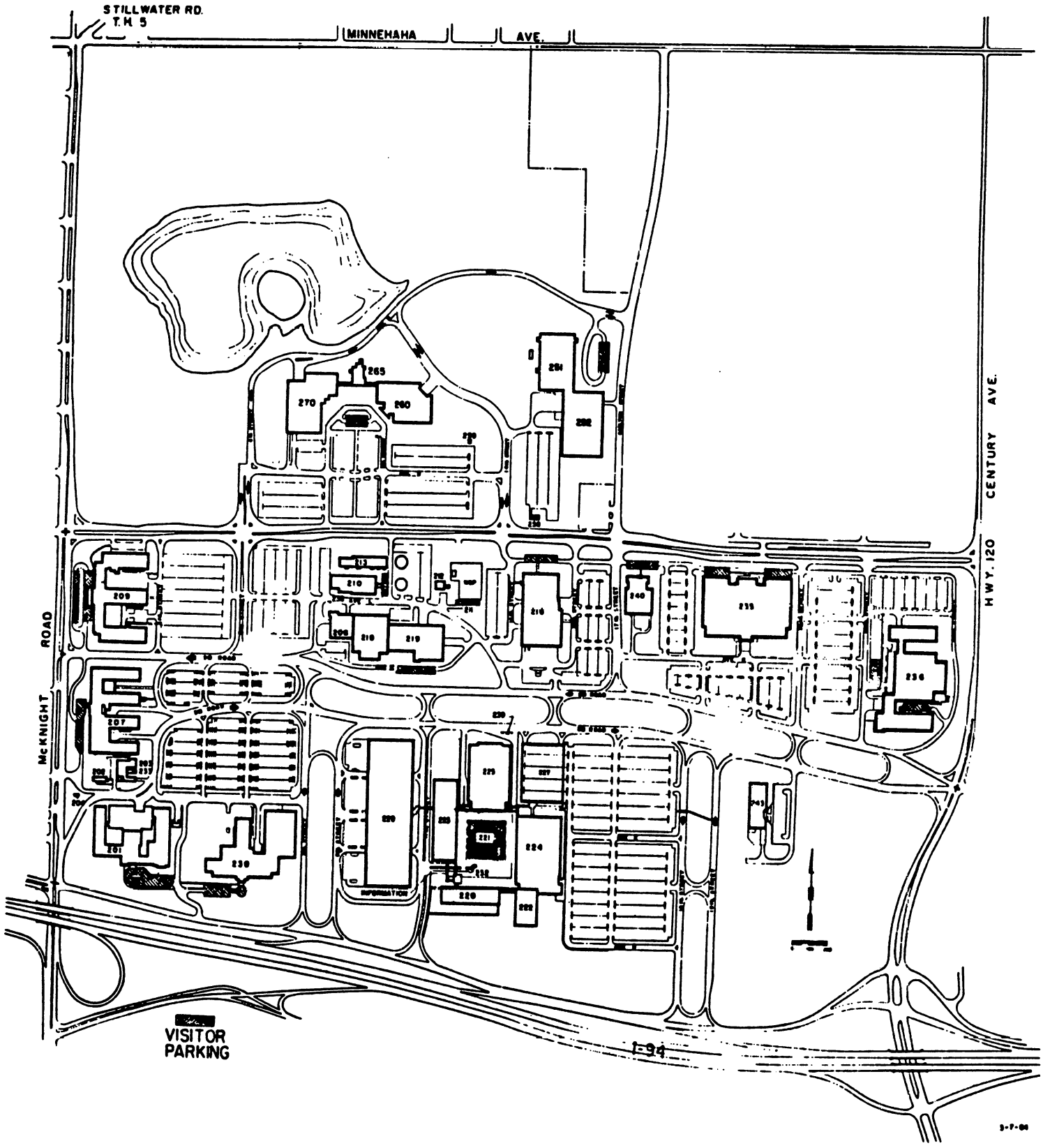


FIGURE 2

SITE MAP OF 3M CENTER



- o Staggered work hours
- o Subscription buses
- o "Ride-Guide" (carpooling program)
- o "Commute-A-Van" (vanpooling program)
- o Safety and capacity improvements

Listed below is a summary of the principal program initiatives.

Staggered Work Hours

One of the first measures instituted by 3M was a staggered work hours policy, designed to provide immediate relief to serious peak hour traffic at the site and on the major transportation facilities leading to the site. Prior to 1971, all activities at the 3M Center site were conducted during an 8 to 5 workday. This meant that over 7000 people were trying to reach the site within the span of an hour. A decision was made to stagger the starting times of the two employee populations with the most separable functions -- the administrative and the lab employees, which each comprised about 50% of the workforce. In 1971, new work hours were instituted for these groups, with the administrative employees asked to work a 7:45 to 4:30 day and the lab employees asked to work an 8:15 to 5:00 day. The effect on reducing peak hour traffic was immediate, and helped win upper management support for future transportation program initiatives.

In November 1988, the company introduced a true flextime policy, which it calls "personalized work schedules". It allows employees to work with their departmental managers to reach a mutually agreeable arrival and departure time. The only requirement is that the employee work a minimum of 8 hours a day, and be on-site between the hours of 9:00 AM and 3:00 PM. Utilization of the new policy has thus far been limited.

Subscription Bus Program

3M recognized that usage of transit service to the site was greatly limited by the nature of its location, and that only one existing bus route provided service. It also realized that if employees were to be expected to use transit, the service would have to be reasonably direct and efficient. This gave way to the idea that special transit services might be designed to serve segments of the employee population that lived in concentrations some distance from the Center.

An experimental service was initiated in January 1982, with a single bus providing subscription service between the Center and a suburban area approximately 12 miles north of the Center. At the time, about 780 employees lived in this particular suburban area and commuted to work at the Center. The design of the "subscription" service was to pick up 3M employees near their homes on an established schedule, and transport them direct, non-stop to the Center.

3M contracted with the Twin Cities Metropolitan Transit Commission (MTC) to provide the service. The contract allowed for equal sharing of any operating losses between MTC and 3M, so in effect 3M was guaranteeing reasonable usage. Three fare options were offered to riders: a 10-ride punch ticket, an unlimited monthly pass, or simple cash fare. Although the service was implicitly subsidized through the 3M contract guarantee, employees were offered no direct fare subsidy to use the service.

The initial service comprised one bus trip each day, and carried only 10 to 12 passengers, but soon grew to an average of 42 passengers and a second bus was added. 3M continued to experiment with subscription services to other areas, reaching an agreement with MTC that the agency would assume full responsibility for the service once ridership reached 75% of the vehicle's seating capacity. Continued development of subscription arrangements lead to a maximum ridership of about 250 employees.

As of the early 1980's, however, with federal spending cutbacks greatly reducing subsidy allowances to public transit agencies, the ability of the MTC to continue to provide such service to 3M was significantly altered. Based on the modest ridership and the conclusion that it was difficult to find sufficient concentrations of employees to provide an adequate base of riders to support a 47- passenger bus, 3M reduced its interest in expanding this program.

"Ride-Guide" Carpooling Program

The carpool program at 3M is somewhat different from many contemporary programs in that it places most of the initiative for identification and formation of pool arrangements in the hands of the employee. The company posts maps in common areas where employees pass in large numbers, such as building entrances, vending machine lobbies and cafeterias. Numbered pins and sign-up sheets are placed beside the maps. Pin colors are used to designate whether a person is willing to function as a driver, passenger or both. Information on the sign-up sheet includes employee residence and 3M Center building address plus the driver/passenger preference, which is used to place the applicant's colored pin on the map. Employees are expected to check the maps and make the appropriate contacts themselves. Computer matching of potential carpool opportunities is done by request, but the number of such requests is said to be quite low, based on the success of the Ride-Guide.

In 1970, prior to introduction of the Ride-Guide system, carpooling at 3M was practiced by about 13% of all employees. In the period following both introduction of the program and the 1973-74 Arab Oil Embargo, the number of employees carpooling virtually doubled, reaching a percentage of over 20%. Since that time, the number of employees carpooling has declined somewhat, while the company itself has grown, causing the share to decline to the level of about 14%. With 1791 persons participating, the carpooling program is still the most successful of all the company's transportation programs in terms of size.

Vanpool Program

Despite the number of 3M employees participating in the carpool program, 3M is most

proud of its vanpool program known as "Commute-A-Van". While a smaller number of employees participate in the vanpool program, the effectiveness of the program in reducing vehicle trips to the 3M Center is the highest of all the company's TDM measures.

When 3M initiated its vanpool idea back in 1972, it was one of the first organizations to consider such a program. The idea grew out of a proposal prepared in May 1972 that lead to a small-scale demonstration of the concept in January 1973. Six pools were formed in the first demonstration, with the units targeted at communities identified through the 1970 employee survey.

The concept of a vanpool program developed by 3M was to provide an employee unit with a 12-passenger van, purchased and supplied by 3M. The operator of the van would be a permanent 3M employee, and would be known as the Pool Coordinator. A minimum of 9 passengers, excluding the driver, would be required to commission a van. The 9 passengers would be required to pay a monthly fare that would be set at such a level as to recover all fixed and operating costs associated with the van. The driver would not be expected to pay a fare, would be allowed personal use of the vehicle, and would be given all passenger fares beyond the 9-passenger threshold set to cover the costs of the van.

In operating the vanpool program, 3M wished to neither make a profit from the program or have it regarded as a subsidy to employees. To determine the fare structure, the purchase cost of the vehicle is depreciated over a 5-year period, with an assumed resale value at the end of the period. The operating costs are then added based on the round-trip miles per day for each pool. Obviously, monthly fares are higher for employees making longer trips.

While 3M does not directly subsidize the vanpool program, several cost advantages accrue to users. First, because 3M is self insured, the cost of insurance to operate the vanpool is quite modest. Second, the vans are maintained in 3M's shops. Third, administrative costs to run the program are not passed on to the vanpool. And finally, in some instances, individual departments have actually purchased the vans and turned them over to the pool as a charitable contribution. At the company level, the company also maintains a number of backup vehicles to cover downtime of the regular vans. 3M does not provide preferential parking for either its vanpool or carpool programs.

There are also other advantages that vanpool users experience. Pool drivers, of course, realize free transportation and potentially a small profit from additional passengers. They also have another vehicle for their personal use, which has allowed some to do with one less family car. Passengers enjoy the exclusive nature of the service: doorstep pickup, reasonable comfort, and no "outside" waiting. Some riders have indicated that they have been able to do without an additional family car. Most riders are particularly taken by the social integrity of their pooling unit, which tends to stay together for many years and maintain its social bonds outside the workplace.

Based on 1985 statistics, the program operates 105 vans; about half of these are 12-passenger vehicles and the remainder are 7-passenger. 991 employees are vanpool riders, which is about 7.8% of the current employment of 12,700. This is down considerably from the 135 vans (1210 passengers, or about 10.3% of total employment) that were in operation at the peak of the program in 1980, but still accounts for a significant number of users and

vehicle trips reduced. The average round trip for a van is 50 miles, and the average monthly user charge is $46. This fee breaks down to approximately 50% capital cost and 50% operating cost recovery.

The vanpool program's two key advantages over time have been net trip reduction and time stability. At 7 to 12 passengers per vehicle trip, the vanpools are 3 to 5 times more efficient in reducing vehicle trips than the average 2.5 passenger carpool. And while a transit vehicle can carry more passengers, it is not able to provide the same quality of door to door service, meaning that it will not be as heavily used. In terms of time stability, while usage of both carpools and vanpools has declined over time, vanpools have declined significantly less.

3. OVERALL EFFECTS OF PROGRAM

The 3M Company's efforts in providing commuting alternatives for its employees appears to have produced an appreciable vehicle trip reduction. The following table illustrates the impact over time of the company's efforts on employee behavior and trip reduction.

	1970	1974	1977	1980	1985
Employment	7723	9476	10,711	11,740	12,700
Method of Travel					
Drive Alone	91.6%	81.3%	82.0%	79.9%	82.7%
Carpool	13.0	20.1	14.0	14.8	14.1
Vanpool	0	6.0	8.7	10.3	7.8
Transit	0.6	1.2	1.7	1.8	1.7
Vehicle Trips per 100 Employees	91.6	81.3	82.0	79.9	82.7
Average Vehicle Occupancy	1.09	1.23	1.22	1.25	1.21

The number of vehicle trips per employee has been calculated using the following assumed occupancy rates: 2.5 persons per carpool unit; 12 persons per vanpool; and 30 persons per transit vehicle trip.

If the 3M situation in 1970 is taken as a measure of travel conditions in the absence of a TDM program, then the effectiveness of 3M's TDM program efforts in reducing trips can be gauged by comparing subsequent years against this 1970 base. The trip reduction attributed to the 3M program based on conditions in 1985 is calculated as follows:

Vehicle trips per 100 employees, 1970 = 91.6

Vehicle trips per 100 employees, 1985 = 82.7

Net trips reduced = 91.6 - 82.7 = 8.9 per 100

Total vehicle trips reduced = 12,700 x .089 = 1124

Percent reduction
due to program = {(12,700 x .916) - (12,700 x .827)/(12,700 x .916)} = 9.7%

Through this calculation, it can be inferred that the 3M program has caused its employees to alter their method of travel, to the extent that at its 1985 employment level of 12,700, 1124 fewer vehicle trips are made by private vehicle than would have been made under modal split conditions that existed in 1970.

Another measure of background conditions has been obtained from the Metropolitan Council, the regional planning agency for the Twin Cities. Data obtained from the Council's comprehensive transportation planning process were analyzed to approximate modal shares of travel to a suburban location, in this case the area along the I-494 corridor south of Minneapolis. The Council's data suggest a modal split to this I-494 area of 86.5% drive alone, 11.5% ridesharing, and 2% transit. Since the ridesharing to this area is predominately carpool, the vehicle trip production rate for this modal split is estimated as:

(86.5% DA/1) + (11.5% RS/2.5) + (2% TR/30) = 91.2 vehicle trips per 100 employees

This rate of vehicle trip generation compares very closely with conditions at 3M before the TDM program, and represents a good check on the background assumptions used to estimate the effectiveness of the 3M program.

Aside from the trip reduction, another finding is clear from the above data: the effectiveness of 3M's TDM program has been declining over time. Utilization rates of HOV modes reached a peak, along with vehicle occupancy, in 1980, and have gradually declined since then. Attrition has occurred in all HOV modes, although the company feels that the vanpool program has been the most stable, perhaps because its passenger unit seems to have its own stability. What the trends imply to the company is that, as economic

conditions improve, people will prefer to drive their own car. Without disincentives to driving at the workplace, commuters who can afford to drive will do so. Similar trends are evident at other sites whose program characteristics are like those at 3M.

Historically, 3M has not used its parking as a device for managing employee travel. There is adequate parking at the Center for anyone who wishes a space, and carpools or vanpools are not given preferential treatment. While the company is concerned about the cost of providing parking, and the competition of parking for other land uses, the economics to alter employee parking conditions have not been compelling. At 12,700 employees, 3M has reached a condition of stability at the St. Paul site; the company's corporate growth is now being directed to other geographic regions of the county. Therefore, the land currently devoted to parking is not presenting a major obstacle to growth of the Center as was once feared. Also, most parking at the Center is provided on surface lots, at a cost of only about $700 per space.

A new development at the Center may test the company's policy on the parking issue. A new central administration building is being planned for the Center that would be located in the Center of the campus where parking is likely to be restricted. The company would have to eliminate some existing parking facilities to construct the building, and addresses the new parking needs through structure parking, which could cost as much as $10,000 per space. 3M is carefully studying its options in this situation, to see what types of TDM strategies would allow it to build the building in light of the parking and cost constraints.

6. CASE STUDY: BELLEVUE, WASHINGTON

1. SITE DESCRIPTION

Bellevue, Washington is a suburban community located in eastern King Country, about 5 miles east of downtown Seattle. The City of Bellevue is the fourth largest city in the State of Washington, with a population of about 83,000. The Bellevue CBD is the second largest employment center in King County, ranking right behind Seattle. Over 24,000 people are employed in the CBD, of which approximately 14,500 are office employees. Figure 1 illustrates the location of Bellevue in the Seattle Metropolitan area.

Its land use patterns make Bellevue somewhat different from other suburban areas in King County, or elsewhere in the U.S., for that matter. The CBD, in particular, features densities and a street network more like a "traditional" downtown. Whereas most suburban employment centers are characterized by low-rise, campus-type office parks, downtown Bellevue presents an expanding skyline of high-rise buildings. Parking facilities are rather limited in the CBD, and most employee parking is priced.

Employment in the CBD is almost exclusively white-collar professional, with supporting retail and service industries. It is estimated that there are more than 300 different employers in downtown Bellevue There are a few large employers, but most are small, located in large, multi-tenant buildings. The larger employers include US WEST Communications (formerly Pacific N.W. Bell, with approximately 1200 employees), Puget Power (approximately 840 employees), and PACCAR (about 450 employees). More characteristic are the small employers located in multi-tenant office buildings and retail businesses.

Residential areas adjoin the CBD, but workers come to Bellevue from throughout the region. As indicated by the map, the study area's location is well defined by the regional highway network. Interstate 405 flanks the area on its eastern boundary, and connections with Route 520 (2 miles to the north) and I-90 (3 miles to the south) link Bellevue with Seattle and the rest of the metropolitan area to the west across Lake Washington. These expressway facilities and the arterial system are congested with commuter traffic during the peak travel period.

2. BACKGROUND AND MOTIVATION FOR TDM PROGRAM

Bellevue's rapid growth and potential for serious traffic problems were recognized by area planners by the late 70's. Significant capital improvements have been and will continue to be a vital part of efforts to accommodate the growing demand for travel in eastern King County. Figure 1 illustrates the proposed Eastside Transportation Program, which if built, would cost over $1 billion, and would not be completed until well after 2000. A more immediate program that is currently underway involves numerous improvements directed specifically at Bellevue, consisting of extensive improvements to the downtown street network in the CBD, as well as the installation of HOV facilities on I-405, complete with special access ramps into the downtown. This near term program, which is illustrated in Figure 2, is projected to cost $188 million.

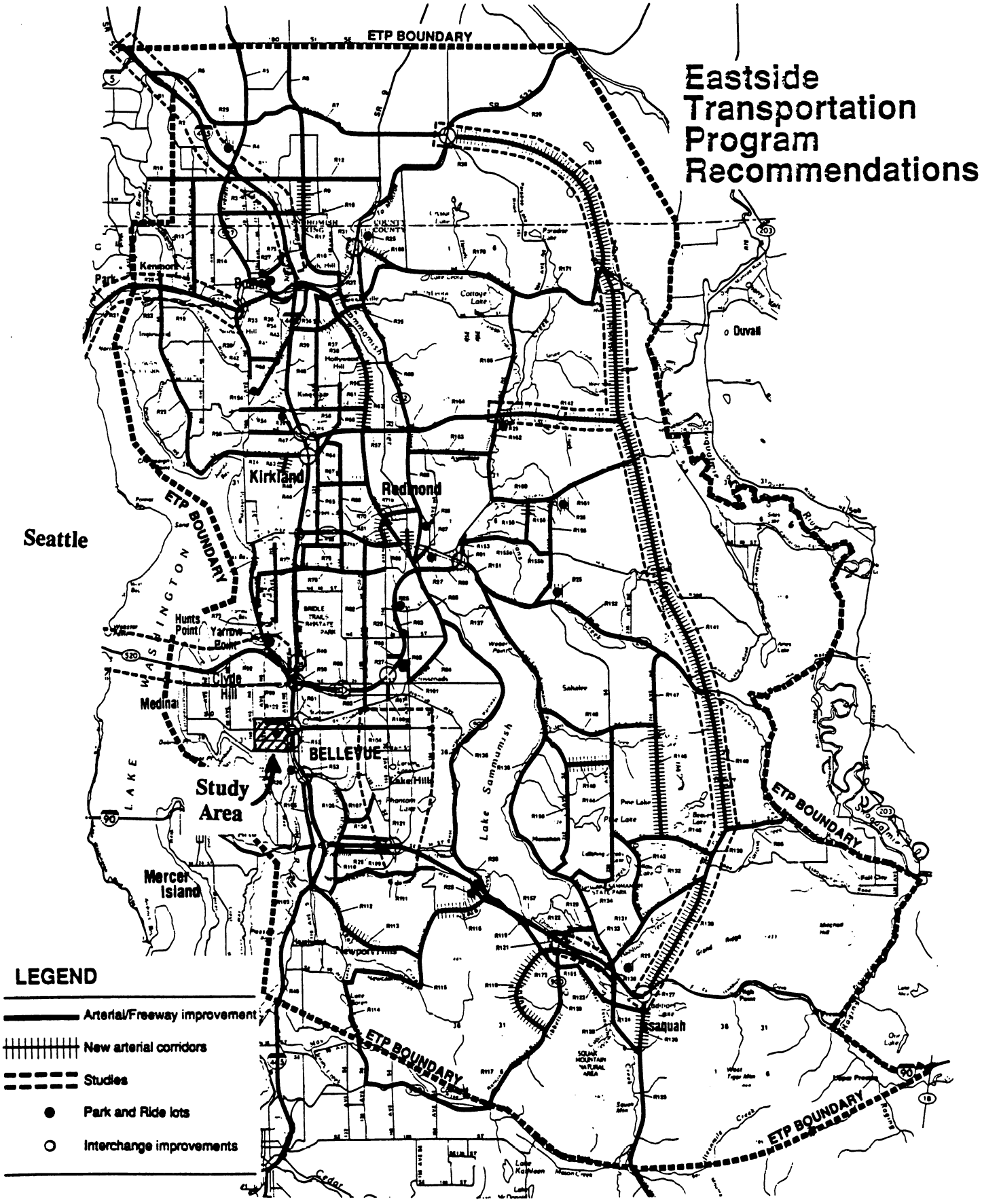


FIGURE 1

MAP OF GREATER BELLEVUE STUDY AREA

FIGURE 2

ONGOING ROAD IMPROVEMENT PROJECTS IN VICINITY OF DOWNTOWN BELLEVUE

Highlights of Non-CBD Improvements, Recommended Plan

DOWNTOWN STREETS

8 - Widen 108th, 110th and 112th Avenues;
9 - Provide NE 10th Street extensions to 106th on the west and to the I-405 interchange on the east;
10 - Operate NE 8th and 10th Streets as a one-way pair with high occupancy vehicle (HOV) lanes connecting to the HOV lanes on I-405;
15 - Complete missing portions of street grid;

OTHER ROADS

11 - Widen 112th Avenue from SE 8th Street to Main Street by providing a turn lane;
12 - Add a fifth lane to 116th Avenue NE from NE 12th Street to Northup;
13 - Widen Northup Way from three to five lanes between 116th Avenue NE and NE 24th Street;
14 - Widen 114th Avenue SE from SE 8th Street to Main Street;
19 - Widen Bellevue Way between I-90 ramp and SE 30th;

TRANSIT

16 - Build a new transit center on NE 6th Street between 112th Avenue and I-405 (contingent on upcoming Metro study) and build 1,300 parking spaces on the site;
17 - Provide access to transit center from I-405 southbound via a grade-separated ramp under NE 8th Street;
18 - Build a transit shuttle system (people mover) along NE 6th Street between the new transit center and Bellevue Way.

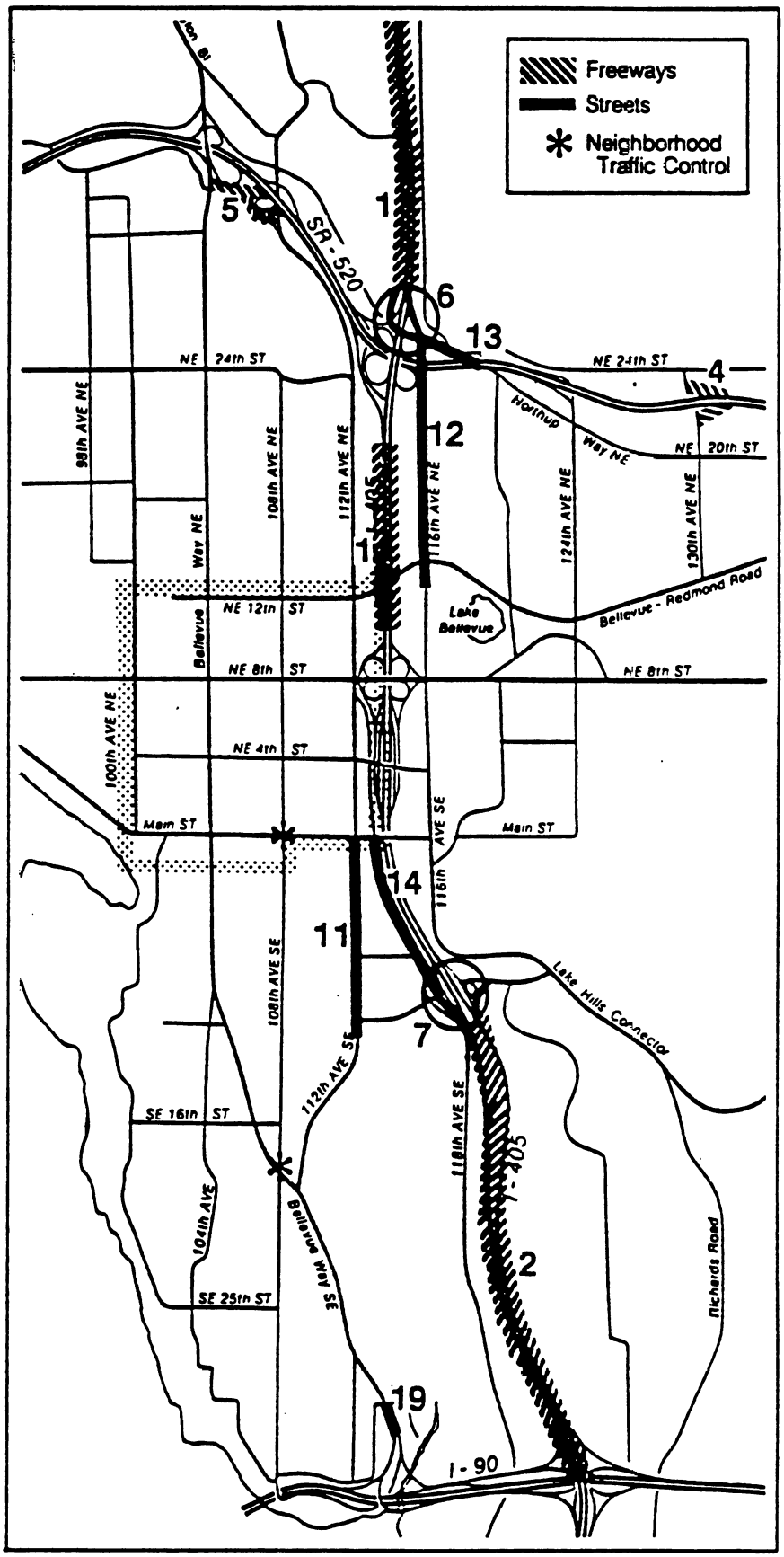


FIGURE 2 (CONTINUED)

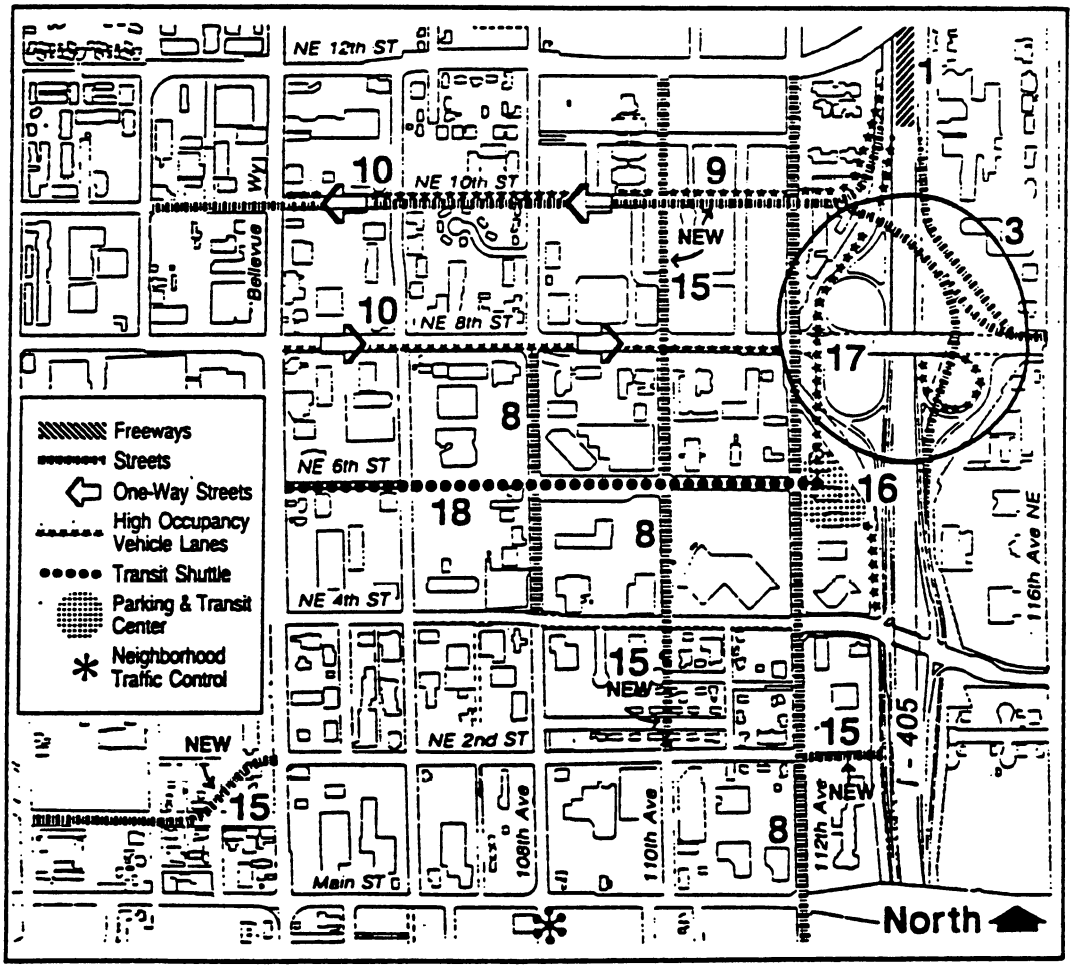
ONGOING ROAD IMPROVEMENT PROJECTS IN VICINITY OF DOWNTOWN BELLEVUE

Legend for Figures 13 and 14

FREEWAYS

1 - Widen I-405 between NE 8th Street and NE 70th Street;
2 - Widen I-405 between SE 8th Street and I-90;
3 - Modify the NE 8th Street/I-405 interchange, including a new westbound bridge over I-405 connecting NE 8th at 116th Avenue NE to NE 10th Street at 112th Avenue;
4 - New interchange on SR 520 at 130th Avenue NE (Part of Bel-Red/Overlake Transportation Plan);
5 - New eastbound on-ramp to SR 520 from Bellevue Way;
6 - New interchange on I-405 at 116th Avenue and Northup Way;
7 - Improved interchange on I-405 at SE 8th Street;

FIGURE 13
Highlights of CBD Improvements, Recommended Plan



Despite these significant capital projects, it has become clear to local officials that infrastructure enhancements alone will not satisfy the projected increase in traffic that will parallel the City's growth. Therefore, efforts have also been initiated to try to curb or manage the growing demand for travel, linked to an employment base that is expected to double by the year 2000.

The trends in development and traffic forced city officials to review and recommend drastic changes to the land use plans. In 1979, two important changes were introduced to project design rules in Downtown Bellevue: first, building setbacks were substantially reduced; second, reduced maximum ratios were placed on site parking. The intention of both measures was to increase the density of the downtown and make it more serviceable to transit. Maximum parking requirements for new buildings were reduced from 5 spaces per 1000 square feet to 2.7 per 1000 (actually 2.4 per 1000 square feet of net usable space); at the same time, the minimum was reduced to 2 per 1000 square feet. These changes helped bring about restrained parking conditions by the mid-1980's, and a basis for introducing viable alternatives to driving alone.

Designers of the parking reduction plan were concerned that, without efforts to provide alternatives for commuters, reduced parking facilities would simply result in spillover to streets and other facilities. To ensure the development and availability of effective alternatives, the city took three actions:

1. Beginning in 1983, the city has required the developers of all new buildings to develop and submit Transportation Demand Management (TDM) plans to indicate actions they would implement to provide alternative commute options. No formal ordinance was enacted to require these programs. Authority was given the city in its existing land use code, though no specific requirements are stated. The existing state Environmental Policy Act provided an important legal basis for requiring the actions. The early programs had minimal performance standards, but have since become more stringent. As a gauge on the effectiveness of the overall program, the city monitors evening peak period vehicle trips, which it regards as a mechanism to reevaluate program requirements. If the current program does not meet the desired trip reduction goals, the city could require imposition of additional actions to help achieve adequate performance.

2. In cooperation with Metro, the regional transit agency, a program of transit services has been evolving for downtown Bellevue. The existing program features a network of 15 bus routes, including regular, express, and park and ride services, that all converge at a Transit Center in downtown Bellevue (located on N.E. Sixth Street between 106th and 108th Avenues).

3. In 1986, the Bellevue Transportation Management Association (TMA) was formed to pool the resources of the City, Metro, and the Bellevue Downtown Association (BDA), which represents the private sector. Its purpose is to address parking and transportation access issues in the downtown. The TMA provides a broad package of transportation alternatives and related services for commuters on a contractual basis to the private sector. Functions performed services provided by the TMA include:

- Promotion of all HOV alternatives at worksites;
- A parking rental/management system for off-site rental spaces for employees;
- Development of pedestrian facilities and amenities in the downtown;
- Personalized transportation assistance (carpool, vanpool and bus information) for employees/employers;
- Carpool certification programs for high-rise buildings;
- Implementation of transportation management programs for developers and employers;
- Promotion of flexible working hour programs;
- A Guaranteed Ride Home Program for HOV users which provides subsidized taxi rides for emergencies and changes in work schedules;
- A park and shuttle service for downtown employees, scheduled for September 1989;
- A downtown circulator to operate during lunch hours, also scheduled to begin in September 1989;

3. OVERALL EFFECTS OF PROGRAM

Assessment of the effectiveness of the TDM program efforts in the Bellevue CBD has been greatly facilitated by data compiled by Seattle Metro under its ongoing HOV/TSM Evaluation Study. This study has been tracking formal TDM program efforts in place in four locations in King County. These locations include downtown Bellevue and three adjacent suburban areas of lower density. The primary mechanism for gauging program impacts has been an annual employee survey, which samples a wide variety of employment sites within the individual areas. The surveys, which obtain data on modal choice and awareness of program features, have been coupled with physical vehicle occupancy counts at each site.

What makes the Metro study data so valuable is that the universe of sites where travel monitoring is being done includes a number of statistical control sites. These are employment locations scattered throughout King County that are similar in most every respect to the TDM project sites, except they feature no ongoing TDM program efforts. They are otherwise identical in terms of type of employment, size of employer, density and other characteristics of the surrounding area, and availability of transportation options.

The baseline surveys for the Metro evaluation study were conducted in 1987. A number of TDM program elements were then implemented and the same organizations resurveyed in 1988. A third survey was scheduled for the summer of 1989, but the data were not available at the time of writing of this report.

The TDM program elements implemented between 1987 and 1988 at all four project sites included assignment of employee transportation coordinators, offering of a vanpool fare subsidy, and a guaranteed ride home program. While these elements were implemented in downtown Bellevue at the same time, they were to follow the significant list of other measures described earlier, which the city began to implement in 1983.

Modal usage rates compiled through the 1988 employee surveys are summarized in Table 1 for downtown Bellevue vs. the regional control sites. The percentage of commuters driving alone to the Bellevue CBD was only 63.2% in 1988, while the comparable rate at the control sites was 81.8% Bellevue makes up for its difference with both higher rates of transit use (10.9% vs. 3.3%) and carpooling (18.5% vs. 11.0%).

To estimate the effectiveness of downtown Bellevue's TDM program in reducing vehicle travel, its travel mode split is converted to a vehicle trip production rate, which is then compared with the regional control sites. The vehicle trip production rate is estimated by assuming that each drive alone commuter generates 1 vehicle trip, carpoolers 1 vehicle trip for every 2.5 riders, vanpoolers generate 1 vehicle trip for every 12 riders, and bus riders travel at the rate of 30 persons per vehicle trip. From this formula, it is estimated that Bellevue CBD commuters are generating 71.0 vehicle trips per 100 employees, compared to 86.4 trips per 100 at the regional control sites, or 15.4 vehicle trips less per 100 employees.

How significant is this trip reduction? If Bellevue's 24,000 employees traveled to work at vehicle trip rates equivalent to the regional control sites, they would generate an additional 24,000 x 15.4/100 = 3696 daily one-way vehicle trips. Thus, Bellevue's TDM program may be credited with a trip reduction of:

$$[(24{,}000 \times .864) - (24{,}000 \times .71)] / (24{,}000 \times .864) = 17.8\%$$

over ambient conditions.

The average vehicle occupancy of these travelers is calculated assuming the same number of persons per vehicle as above, and not including the "other" category in the total. Using this formula, a vehicle occupancy of 1.32 persons per vehicle is estimated for downtown Bellevue, which compares to 1.12 at the control sites.

It is reemphasized in summary that the difference of 15.4 vehicle trips per 100 employees between downtown Bellevue and the regional control sites is due both to the described "TDM program" as well as conditions that existed at the site before the program, such as development controls, restricted parking and focused transit service. The incremental effect of the 1987/88 program features may be inferred from the comparison of 1987 and 1988 conditions in Bellevue shown in Table 1. Following the addition of the transportation coordinator, the vanpool subsidy and the guaranteed ride home program, vehicle trip production dropped from 72.4 to 71.0 per 100 in Bellevue, while it actually increased at the regional control sites during the same period. These additional TDM elements therefore may be credited with at least a 1.9% reduction when first measured in 1988; the 1989 survey may show further reductions as the program becomes better known.

TABLE 1

COMPARATIVE MODAL SPLIT
BELLEVUE CBD vs. REGIONAL CONTROL SITES

	Bellevue CBD		Control Sites	
	1987	1988	1987	1988
Travel Mode				
Drive Alone	64.2%	63.2%	78.8%	81.8%
Bus	7.9	10.9	4.8	3.3
Carpool	19.5	18.5	12.8	11.0
Vanpool	1.2	0.7	0.6	0.8
Other	7.1	6.4	3.0	3.1
Vehicle Trips per 100 Employees*	72.4	71.0	84.1	86.4
Average Vehicle Occupancy	1.28	1.32	1.15	1.12

* assumes 2.5 persons per carpool and 30 persons per transit trip

4. INDIVIDUAL PROGRAM EFFORTS

A closer examination of the composition of the above-average rates of HOV use in Bellevue shows a number of equally above-average individual efforts. In the section below, we detail the efforts of three individual programs:

- o US WEST Communications, located in Bell Terrace
- o Puget Power, located in One Bellevue Center
- o CH_2M Hill, located in Security Pacific Plaza

Below are brief profiles of the history, components and impacts of these programs.

US WEST Communications

US WEST, formerly Pacific Northwest Bell, has the most impressive program in the group. It has achieved a 26% drive alone rate among its employees, which has been attained largely through parking management techniques. This level of trip reduction is unmatched in the Bellevue area. US WEST's rate of high occupancy vehicle use is 30% higher than the second ranking program in the Bellevue CBD, and 40% higher than an average of downtown businesses.

In 1981, developers of the company's new Bellevue office opted for the minimum parking capacity for employee parking. Their primary concern in the action was minimizing their costs, but they also took initiative to ensure that complementary actions were developed, in terms of options and incentives, to ensure that the parking would be adequate.

Only 408 parking spaces are provided at the company's downtown Bellevue site for its 1,150 employees. With the advice of a transportation consultant, the company established a pricing schedule for parking with inverted rates: single-occupant vehicles (SOV's) are charged $60/month for parking, 2-person carpools are charged $45/month, and parking for vehicles with 3 or more occupants is free. Beyond the pricing factor, further restrictions apply to use of the parking. The parking facility is a 4-story garage, with two floors providing reserved spaces for HOVs. A third floor provides spaces for vendors, fleet operators, and short-term occasional users, and only one floor is available for SOV parking. This means that SOV spaces are on a first-come/first-served basis, so that availability of the space, even at a $60/month rate (paid daily) is not reliable. Space is available at other off-site locations at market rates.

The company took an aggressive stance in selling its limited parking program to the city and its employees. The city, which advocates reduced parking with its TDM policy, was nevertheless concerned that the limited capacity proposed by US WEST would produce spillover problems unless adequate efforts were made to provide alternatives. The company took the lead in selling the program, promising carpool incentives, flexible work hours programs, and a full-time transportation coordinator, so the city eventually agreed to the limited parking proposal.

Many employees were initially somewhat bitter about the need to find alternative commuting arrangements at the new location, but soon adapted to the new environment. The situation was helped by the fact that many of the employees, having been transferred in a consolidation from Seattle, were already conditioned to using carpools and transit to get to work.

Most employees rideshare as their alternative to cope with the limited parking situation. As illustrated in Table 2, survey data for June 1988 indicate that only 25.7% of US WEST's employees drive alone, 12.8% ride transit, 44.7% ride in carpools, 1.8% in vanpools, 2.0% other, and 13.0% in multi-modal arrangements typically driving to access some HOV mode. It should be noted that many employees who carpool with co-workers drive to meet their carpools at a park and ride lot within a short distance of downtown (1 mile or so), and then form carpools to reach work.

If US WEST employees are loaded into vehicles at the occupancy rates used for the downtown Bellevue analysis, it is estimated that they are generating 45.2 vehicle trips per 100 employees (this calculation assumes that "Multi-Mode" trips occur at an average occupancy of 12 persons per vehicle). Thus, 1150 employees generate only 520 vehicle trips. Comparing this to the regional control sites, US WEST's employees generate 86.4 - 45.2 = 41.2 vehicle trips per 100 less than conceivably would be made at typical regional rates in the absence of a TDM program. Stated another way, if US WEST's employees travel at regional rates, they would generate 1150 x 41.2/100 = 47 additional daily one-way vehicle trips; this difference credits US WEST with a trip restriction rate of [(1150 x .864) - (1150 x .452)]/(1150 x .864) = 47.6% over and above ambient conditions.

Another impressive comparison is to relate US WEST to the rest of downtown Bellevue without US WEST. This analysis has also been performed in Table 2. Downtown Bellevue without US WEST is estimated to have a trip production rate of 83.1 vehicle trips per 100 employees. The effectiveness of US WEST's program is so great that, without it's inclusion, downtown Bellevue is only 86.4 - 83.1 = 3.3 vehicle trips/100 better than the rest of the region.

PUGET POWER

Puget Power is an example of a large employer with modest initial TDM efforts that is now having to respond to changing conditions with a more aggressive program. In the summer of 1983, Puget Power consolidated its Bellevue-based employment force from six locations into three buildings in downtown Bellevue. The company knew from the start that the City's restrictions on parking would affect their parking capacity, and took steps to make the situation work for employees.

Puget had available roughly 650 spaces for its 830 employees at the time of consolidation, located in several structures and surface lots adjacent to the building sites at One Bellevue Center. To make maximum efficient use of the limited capacity, the company developed a program with the following components:

TABLE 2

COMPARATIVE MODAL SPLIT RATES AND TRIP REDUCTIONS FOR INDIVIDUAL BELLEVUE CBD PROGRAMS

	US WEST	Puget Power	CH2M Hill	Regional Control Sites	Bellevue Without US WEST
Employment	1150	830	400		
CBD Travel Mode					
Drive Alone	25.7%	76.6%	54%	81.8%	79.6%
Bus	12.8	8.4	17	3.3	9.1
Carpool	44.7	12.1	12	11.0	7.7
Vanpool	1.8	2.9	-	0.8	0.3
Other	2.0	NA*	17	3.1	1.0
Multi-Mode	13.0	NA	-	NA	2.3
Vehicle Trips per 100 Employees*	45.2	75.6	59.4	86.4	83.1
Average Vehicle Occupancy	2.17	1.24	1.40	1.12	1.19

* assumes 2.5 persons per carpool and 30 persons per transit trip. Calculation of vehicle trips per 100 employees assumes 6.4% of Drive Alone is "Other", since not broken out.

- Parking was allocated to employees using a lottery system. After reserving a set number of spaces for visitors, handicapped persons, fleet vehicles and executives, the remaining spaces were distributed to employees based on low number drawn in a one-time lottery.

- Persons wishing to carpool or use vanpools were guaranteed a space, albeit not a reserved space.

- A $21 monthly charge was imposed for all employee parking.

- Persons wishing to use transit were offered a $12 monthly discount against a transit pass.

- A transportation coordinator was made available to assist employees in forming commuting alternatives.

With this program, Puget was able to place 5.2% of its employees in carpools, 1.4% in vanpools, and 8.4% in transit, with the remaining 85% primarily driving alone. Using the standard occupancy rates from above, this suggests that Puget was generating about 87.5 vehicle trips per 100 employees, which actually is above both the rate for downtown Bellevue, 70 per 100, and even the control sites, at 86.4 per 100.

As of March 1989, however, Puget learned that in May it would lose one of its surface parking lots to another tenant with lease rights. This means that the company lost 110 spaces, reducing its capacity from 650 to about 540. To cope with the sudden change, the company implemented the following additional measures:

- Carpoolers and vanpoolers are now allowed to park free, and are offered reserved, preferential spaces.

- The number of "free parking days" allowed carpoolers and transit users was doubled from 2 days to 4 days, to take into consideration the occasional need of a car for personal reasons.

- The transit subsidy was raised from $12 to $15 per month.

Concurrent with these new program features, Puget also contracted with the Bellevue TMA for transportation coordination with its employees. As part of the service contract, the TMA worked with Puget to encourage formation of HOV arrangements. Special kick-off promotional incentives of $35 gift certificates were offered to new HOV users who agreed to participate for 3 months, and also $15 certificates were awarded to existing HOV users. Within a month of the presentation of this new program, the number of carpoolers at Puget increased from 43 to 100 and a second 12-passenger vanpool was formed. No additional transit usage occurred, although 7 new persons began using transit and 7 existing riders switched to other modes. As illustrated in Table 2, these additions have changed the mode split to roughly 12.1% carpool, 2.9% vanpool, 8.4% transit (stayed the same), and 76.6% drive alone/other. This new mode split implies that the Puget employees are

currently generating about 82 vehicle trips per 100 employees, down from the 87.5 previously; so the new program has reduced (87.5 - 82) = 5.2 additional vehicle trips per employee, or 43 trips from 830 employees. If it is assumed that 6.4% of employees are found in the "other" category, equivalent to the population norm for the CBD as presented in Table 1, and this is subtracted from the drive alone share, then Puget may be credited with a trip rate of 75.6. Even this optimistic rate is above the average of 7 per 100 for downtown Bellevue, but below the average of 86.4 for the control sites. Applied to the employee population of 830, the reduction rate of the Puget TDM program reduces (86.4 - 75.6)/100 x 830 = 90 more vehicles than would be reduced by the normal forces inherent at the control sites. This corresponds to a [(830 x .864) - (830 x .756)]/(830 x .864) = 12.6% reduction over ambient conditions.

CH2M HILL

CH2M Hill is an architectural/engineering firm of approximately 400 employees that has used a "transportation allowance" program in conjunction with restricted on-site parking to accomplish an exemplary level of trip reduction.

When contemplating its relocation to its new building at Security Pacific Plaza in downtown Bellevue in 1987, the company realized that it was going to experience a limitation in parking capacity. Lease provisions allotted 325 spaces for staff for the first three years, and then a reduced number for subsequent years -- only 210 spaces in years 4 through 8, and then only 195 spaces in years 9 and 10. While it appeared that parking would be adequate for the first two years, the company's growth plans plus the declining allotment meant that they would soon see a parking problem. So it decided to implement a TDM program concurrent with the move to begin to condition employees to the need to seek alternatives to driving to work.

The program centers around a "transportation allowance." Each employee was given a monthly compensation increase of $40 per month beginning with the move to cover the cost of parking at the new site. In actuality, the parking charge at the new site to CH2M Hill was less than $40 per month, but it was decided to charge $40, and commit the overpayment to a parking fund. This fund was then used to finance direct subsidy payments to carpool and transit users. Transit users are provided with a $15 monthly pass discount, and carpoolers are given a free parking space. Additionally, both qualify for the $40 transportation allowance.

The combination of the restricted parking, the transportation allowance, and the HOV subsidies has had an important impact on mode choice. Listed below is the company's modal split before and after the move:

Travel Mode	Before (Dec. 86)	After (Jan. 88)
Drive Alone	89%	54%
Carpool	9%	12%
Bus	1%	17%
Walk/Other	1%	17%

This program has reduced CH2M Hill's vehicle trip generation rate from 92.6 per 100 at the previous location to 59.4 at the new location, which is a vehicle trip reduction of (92.6 - 59.4) = 33.2 vehicle trips per 100 employees, or 133 over the base of 400 employees. This corresponds to a reduction of 370 - 238/370 = 35.7% reduction. If CH2M Hill is compared to the regional control sites, their program reduces 86.4 - 59.4 = 27 vehicle trips per 100 more than would occur in the ambient conditions, or approximately 31.2% less.

7. CASE STUDY: BISHOP RANCH

CONTRA COSTA COUNTY, CALIFORNIA

1. SITE DESCRIPTION

Location and Character of Site

Bishop Ranch is a large suburban office park in Contra Costa County, California. As Figure 1 illustrates, it is located in the northeastern fringe of the San Francisco metropolitan area, adjacent to the town of San Ramon, approximately 35 miles from downtown San Francisco. Opened in 1981, the 585-acre business community currently includes about 5 million square feet of office space, accommodating 12,000 employees. When completed in 1995, the park will include 8 million square feet of office, hotel, shopping and recreational facilities, while providing employment for 25,000 employees.

The area was largely undeveloped before the park was sited in the early 1980's. While there has been complementary residential growth near the business park and the town of San Ramon as Bishop Ranch has grown, land use in this area is still at a very low density.

Employment in the Bishop Ranch business park was approximately 12,500 in 1987, and is projected to reach 25,000 at buildout in 1995. It is primarily a professional, white-collar employment center. The 1987 employment composition was approximately 38% Professional / Technical, 29% Executive / Managerial, 28% Clerical / Administrative, 2% Sales, and 4% Other. The major tenants of the Park are Pacific Bell with 6,900 employees in one location, and Chevron with 2350 employees in a single campus location, Chevron Park, plus others scattered throughout the complex. The remainder of the park consists of small to moderate size employers in multi-tenant buildings or complexes. Figure 2 illustrates the layout of the park and the location of major tenants.

Transportation Facilities

The principal transportation facilities serving the park are highways, chiefly Interstates 680 and 580. I-680 is a six-lane facility, with access ramps at two locations. The location of the park relative to these facilities is illustrated in Figure 1. For persons traveling outward from the San Francisco area, the nearest stations on the BART system are located at Walnut Creek and LaFayette, approximately 11 miles north of Bishop Ranch. Shuttle bus service operates between the stations and the park.

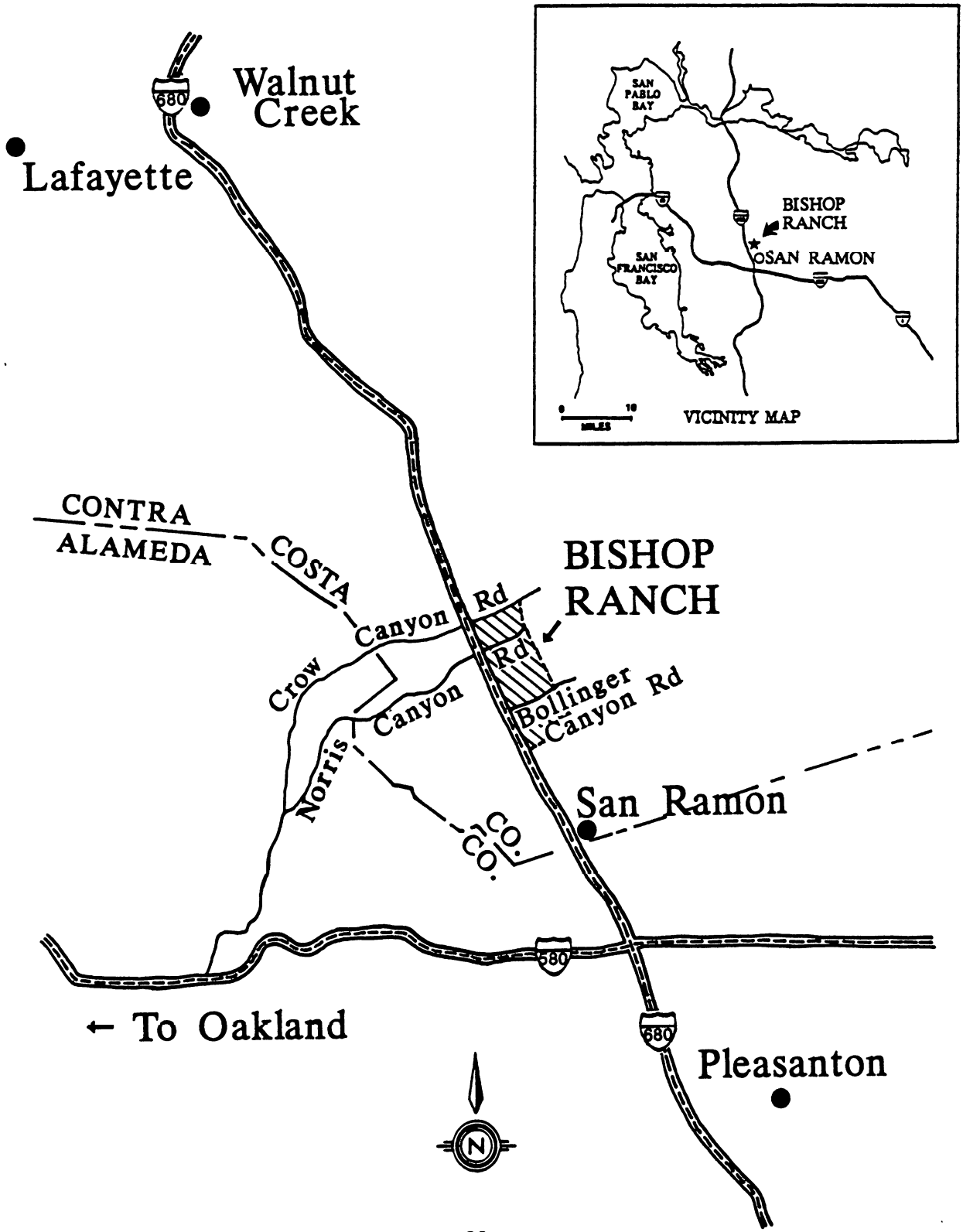
2. BACKGROUND AND MOTIVATION FOR TDM PROGRAM

Two forces combined to foster development of a comprehensive transportation management program at Bishop Ranch. First, as a condition of building permit approval, the two major landowners at the site, Sunset Development and Pacific Bell, were required to find a way to reduce their respective peak hour vehicle trip generation by 40%.

FIGURE 1

LOCATION OF BISHOP RANCH

AND MAJOR TRANSPORTATION FACILITIES



Bishop Ranch 2
2678 Bishop Drive
2680 Bishop Drive
2682 Bishop Drive
2694 Bishop Drive
Lox, Stock & Bagel Deli,
2682 Bishop Drive
Wells Fargo Express Stop,
2694 Bishop Drive

Bishop Ranch 6
2400 Camino Ramon
2410 Camino Ramon
2420 Camino Ramon
2430 Camino Ramon
2440 Camino Ramon
Child Care Assistance Office,
2420 Camino Ramon
Pot Belly Deli,
2420 Camino Ramon
Transportation Centre,
2420 Camino Ramon
Wells Fargo Express Stop,
2420 Camino Ramon

Bishop Ranch 8
3000 Executive Parkway
4000 Executive Parkway
5000 Executive Parkway

Bishop Ranch 11
2301 Camino Ramon
2303 Camino Ramon
2305 Camino Ramon

Bishop Ranch 12
One Annabel Lane
Two Annabel Lane
Center For Higher Education,
One Annabel Lane

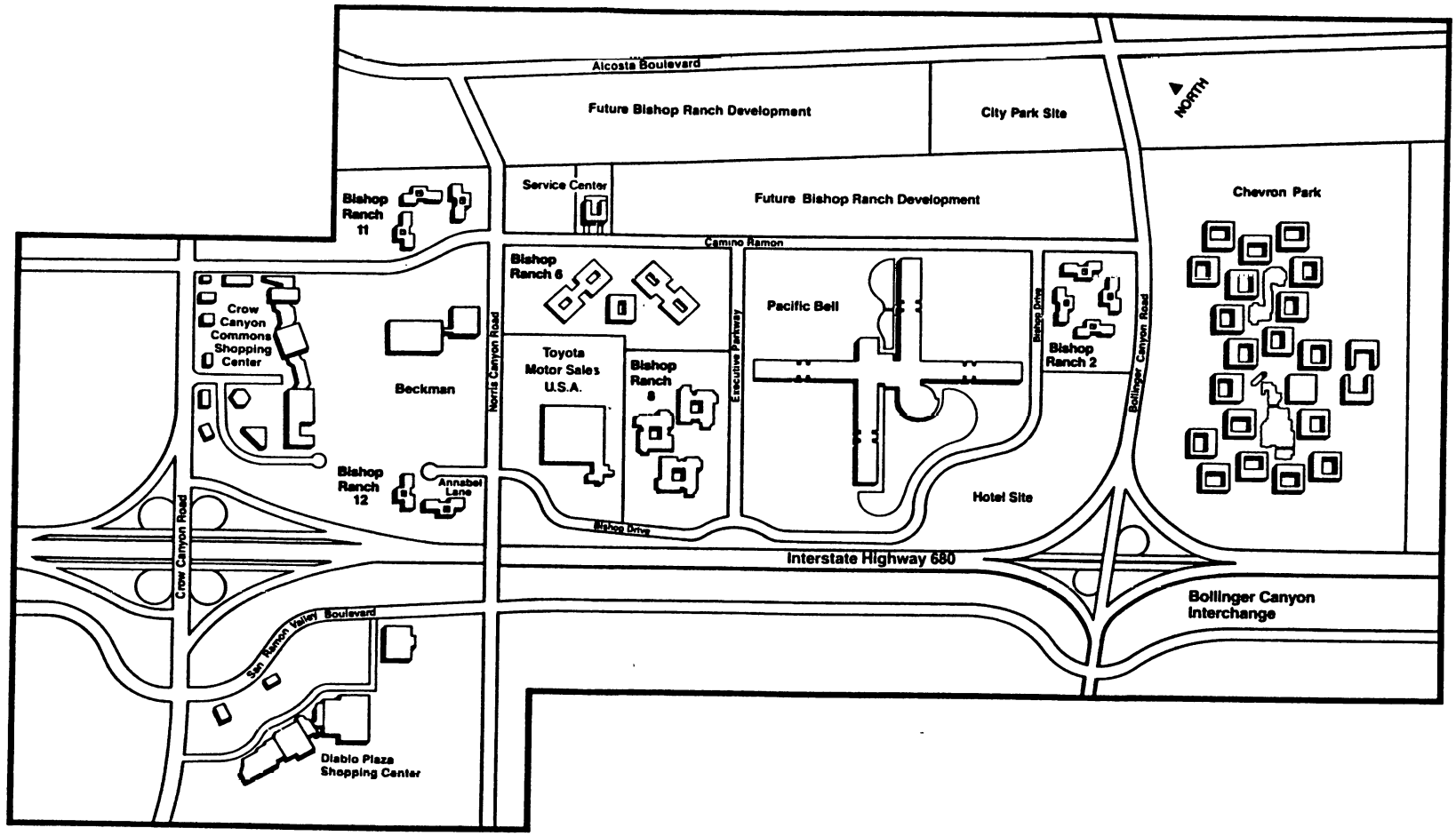


FIGURE 2

MAP OF BISHOP RANCH BUSINESS PARK

Independent of this formal requirement, however, the two organizations had internal motives for wanting to manage the park's potential transportation problems: to keep traffic congestion from diminishing access to the park, and to help employees cope with the relocation of their workplace to Bishop Ranch.

To better understand its management options for the park, Sunset Development, the Park's major developer, contracted with a transportation consultant in early 1983 to review the situation and offer recommendations. The central element of the consultant's plan was to form a transportation management association among the park's members for the purpose of coordinating the proposed ridesharing and parking management programs. In 1984, the Bishop Ranch Transportation Association (BRTA) was formed to implement the proposed program. The by-laws for the BRTA limit voting membership to property owners in the park, which included at the time of formation:

- Sunset Development, which owns five of the major multi-tenant complexes in the park, currently housing about 3500 employees;
- Pacific Bell, which owns a 1.7 million sq.ft. building in the park that houses about 7000 employees;
- Chevron, which owns a 143-acre campus style development in the park that houses about 3500 people;
- Toyota, owner of 30 acres at the site, supporting a warehouse with about 100 employees; and
- Pacific Telesis, whose real estate division had purchased property from one of the parks major tenants and leases it back to them and several other companies engaged in light manufacturing.

Of these, only the first three are participating as voting members of the Association. Costs for the program are negotiated among the three, with some costs wholly paid by one or the other.

The BRTA felt that the essential element to its transportation program was the establishment of an on-site transportation center, which could offer personalized assistance to employees in selecting their best commute and encourage them to use alternatives to driving alone. The Association contracted with RIDES for Bay Area Commuters, the regional ridesharing organization, to provide a full time manager for the Transportation Centre. Services provided by the Centre include:

- Computerized ridematching using the RIDES system;
- Sale of discounted transit tickets and transit scheduling information;
- Special assistance for companies relocating to Bishop Ranch; and
- Vanpool formation assistance and referrals to existing vans.

While the consultant study recommended ridesharing as the principal short to medium-term alternative for commuters to the site, efforts were also directed toward cultivation of several transit services. The two major landowners both provide transit shuttle service connecting the park with the regional BART system. Sunset provides a free luxury bus on a 20-minute headway for its tenants, which operates during commute hours between the park and the Walnut Creek BART station. Pacific Bell contracts with a local transit agency, County Connection, to provide express bus service at a cost to users of $1 each way between the Lafayette BART station and the Pacific Bell building during commute hours. In addition to these services, a BART Express bus now operates through the park all day on 35-minute headways, providing emergency midday transportation back to BART. Also, both Sunset and Pacific Bell shuttles offer a noon shopper shuttle to the nearest shopping/restaurant areas to reduce the perceived need for a car during the day.

Flexible work hours were recommended by the consultant study, and the policy is promoted in the park. However, it is a program prerogative exercised by the individual employer, with no one charged with the responsibility of synchronizing time shifts among the various firms.

Marketing and outreach activities are, of course, important elements of the transportation program. Supplementing these elements are supportive programs in employee relocation assistance and child care. The relocation assistance (in addition to identifying commuting alternatives) is an effort by some employers to help employees in hardship cases who wish to change their residence location to lessen their new commute burden, but realize difficulties in the transfer. In various instances the employers have assisted with the transactional costs in helping the employee move to a closer location. In terms of day care, Bishop Ranch does not maintain a day care center on site, but supports an active care referral service to help workers find the best opportunities in their respective communities.

Within the past year, the Bishop Ranch business park was annexed into the City of San Ramon, and as a result, now is formally subject to the requirements of a TSM ordinance, similar to the relationship between Hacienda Business Park and the city of Pleasanton, just to the south. Under the new conditions, the responsibility for transportation management and trip reduction has been shifted to employers. This has caused a much more proactive effort from some of the park's major employers. As yet, the city has not indicated what if any penalties might be imposed for non-compliance with its ordinance; at the present time the only requirement is a report from each employer by June 1990 on current commute patterns by employees and a management plan for meeting the trip reduction goals.

3. OVERALL EFFECTIVENESS OF PROGRAM

Evaluating the effectiveness of the TDM program at Bishop Ranch has been facilitated by the monitoring activities and data base compiled by Bay Area RIDES. RIDES conducts an annual employee survey in the park that achieves about a 35% response rate. Surveys have been conducted in June 1986, October 1987 and December 1988.

Data complied by the RIDES staff strongly suggests that the combination of elements in the Bishop Ranch TDM program has had a significant impact in reducing employee vehicle travel, and in particular, peak-hour vehicle travel. In 1988, an estimated 70.2% of all Bishop Ranch employees drove alone to work; 16.3% commuted in carpools, 8.7% in vanpools, 3.2% in one of several transit modes, and the remaining 1.7% reached the park by other means. Assuming that each carpool carried 2.5 travelers, each vanpool 12 travelers, and each transit vehicle 30 travelers, it is estimated that Bishop Ranch employees generate 77.6 daily one-way vehicle trips per 100 employees. Stated another way, this corresponds to an average vehicle occupancy rate of 1.27 persons per private vehicle trip.

What this means is that the population of 14,000 employees produces about 10,864 daily vehicle trips. Only 6244 of these vehicle trips are estimated to occur in the AM peak hour, defined as 7:30 to 8:30 AM. Therefore, with the combination of shifting to higher occupancy travel modes and traveling outside the peak hour, the Bishop Ranch program has been credited with a (14,000 - 6244) / 14,000 = 55.4% reduction in peak hour vehicle trips over the situation where every employee would drive alone in the peak hour. Based on the County's 40% peak hour vehicle trip reduction requirement, the park has easily met the primary trip reduction goals.

Of course, even without a formal TDM program, it would be expected that a percentage of employees would find a method of travel to work other than driving alone. It is the difference between this "background" rate of vehicle trip generation and that realized under the formal program which is the net effectiveness attributed to the TDM program. To help identify a basis for comparison, Bay Area RIDES was consulted to furnish an estimate of modal split rates for work travel to suburban locations like Bishop Ranch where no TDM programs were underway. Two locations were identified with similar characteristics to Bishop Ranch, but without TDM. They are Walnut Creek, in Contra Costa County, and Santa Rosa, in Sonoma County. The first is a rapidly commercializing area located near a suburban BART station, while the second is a town developing as a new high growth center north of San Francisco, with no major transit service. The following table lists the comparative travel characteristics at the various sites:

	Bishop Ranch	Walnut Creek	Santa Rosa
Travel Mode			
Drive Alone	70.2%	89.9%	91.3%
Carpool	16.3	6.9	4.7
Vanpool	8.7	0.5	0.1
Transit	3.2	2.6	1.4
Other	1.7	0.1	2.5
Vehicle Trips per 100 Employees*	77.6	92.8	93.2
Average Vehicle Occupancy	1.27	1.08	1.05

* assumes 2.5 persons per carpool and 30 persons per transit trip

If these two other suburban locations can be used as reference points for commuting behavior in the absence of TDM measures, then the program at Bishop Ranch may have reduced the following number of vehicle trips from the roadways:

Vehicle Trip rate, Bishop Ranch = 77.6 per 100

Vehicle Trip rate, control sites = 93 per 100 (average, both control sites)

Rate Difference: 93 - 77.6 = 15.4 per 100

Total Reduction: 14,000 x 15.4/100 = 2156 vehicle trips.

Percent Reduction: 2156/(14,000 x .93) = 16.6%

Unfortunately, it is not possible to estimate the net impact of the TDM program in reducing peak hour vehicle trips, since comparable data are not available regarding the time of day distribution of work trip arrivals elsewhere in the county, or the distribution at the park before the practice was begun.

Tracing the combined effect of program actions that induce changes in modal choice as well as time of day can be quite complicated. Added to this are shifts in residence location, which have an impact on travel patterns and choices. However, thanks to the extensive

data of RIDES, it is possible to trace trends in some of these important factors over a three year time period, offering some important insight into the following issues:

- o What is the ability of the TDM program to maintain its effectiveness over time?
- o Does flextime contribute to a better trip reduction rate than would occur without flextime? Stated another way, does offering employees flexibility in their arrival/departure times encourage or discourage use of high-occupancy vehicle modes?
- o Does relocation of employee residence aid or detract from trip reduction goals?

These are all important research questions that can be broached to varying degrees with the Bishop Ranch survey data.

The first issue probed is the stability of the TDM program over time. Shown below are modal split rates for travel to the park for the three years that data have been obtained:

Travel Mode	1986	1987	1988
Drive Alone	55.1%	67.7%	70.2%
Carpool	26.6	18.5	16.3
Vanpool	7.7	8.3	8.7
Transit	9.0	4.1	3.2
Other	1.3	1.4	1.7

These data show that, despite a respectable usage rate of high occupancy vehicles at the present time, the rate of use has been gradually decreasing over time. Carpool usage has fallen more than 10 percentage points since 1986, and transit usage has fallen almost 6 percentage points. Usage of vanpools has increased slightly, by about 1 percent, but most of the change in travel over the three year period has been a significant increase in the drive alone rate, which has increased by about 15%.

The decline in HOV usage was greatest between 1986 and 1987, and seems to have slowed somewhat over the last year. But the question remains: Why has this decline occurred? Because of the particular survey questions asked, the RIDES data do not permit a true causal analysis of these trends. However, by looking at some parallel trends, it is possible to suggest some contributing factors to the decline.

The data in the following table confirm that, indeed, employees at Bishop Ranch are adjusting their work hours to travel outside the peak hour.

Bishop Ranch
Percent of Employee Arrivals

Morning Arrival Time	1986	1987	1988
Before 6:30	4.1%	2.7%	3.1%
6:30 to 7:00	9.3	5.2	5.3
7:00 to 7:30	31.0	21.6	22.8
7:30 to 8:00	28.9	30.6	29.4
8:00 to 8:30	20.3	27.7	27.4
8:30 to 9:00	5.2	11.2	10.6
After 9:00	1.2	1.0	1.4

What these figures indicate is that the flextime policies as currently operative, have (1) pushed the peak later into the day, and (2) have "flattened" the peak so that the second highest hour is now a higher fraction of the peak than before. In 1986, 44.4% of all workers arrived before the designated 7:30 to 8:30 peak hour, 49.2% during and 6.4% after. In 1987, the distribution had shifted such that only 29.9% traveled before the peak, 53.3% during the peak, and 12.2% after. In 1988, the trend continued, with only 31.2% traveling before the peak, 56.8% during the peak, and 12.0% after. So in effect, travel during the peak hour was actually increased over the measured three year period, with a slight downturn in 1988, but in general there has been a movement toward later arrivals. These same trends are seen in the departure times, which have not been shown here. The second highest hour as a percentage of the peak has also increased during this period. In 1986 the second highest hour had 55% as many trips as the peak; in 1987, the ratio increased to 56.3%, and by 1988 it had reached 58.8%.

These data encourage several conclusions. First, given a choice, these travelers would prefer to travel later in the day, and not both earlier and later, which would provide greater relief to the peaking problem. Interestingly, the tendency at most other sites where flextime has been implemented has been toward earlier arrivals. Second, it does not appear that the flexible hours policies are coordinated among the park's employers, so schedules are not synchronized. Failing such synchronization, the peak hour has actually increased under flextime over 1986 levels, and the second highest hour has grown steadily higher. There has not been any transfer, on a percentage basis, outside the peak 2 hours.

The second issue pursued concerning flextime is whether allowing flexibility in employee work hours aids or detracts from use of alternate modes. Drawing upon the only two years for which data are available, 1987 and 1988, listed below are rates of single occupant vehicle (SOV) use by time period. The data illustrate a strong correlation between travel outside the peak hour and increased rate of use of SOVs.

Percentage of Travelers in Time Period who Drive Alone

Morning Arrival Time	1987	1988
Before 6:30	81.3%	89.3%
6:30 to 7:00	73.2	69.3
7:00 to 7:30	58.3	57.4
7:30 to 8:00	63.0	65.6
8:00 to 8:30	73.5	77.8
8:30 to 9:00	82.3	82.9
After 9:00	92.9	87.0

What these data show is that employees who travel before 7:00 and after 8:00 AM are significantly more likely to drive alone than those arriving during that hour. This suggests that most employees who choose to travel outside the peak do not take advantage of that flexibility to facilitate ridesharing or transit scheduling, but see it as a more relaxed environment in which to drive alone. As the data in the previous table documented a shifting of the employee population toward arrival times of after 8:00, the observation is made that rates of driving alone are highest during these times. In 1986, 26.7% of all employees arrived after 8:00; by 1987 this fraction had reached 39.9%, and remained roughly at that level in 1988, or 39.4%. Using the 1988 data, it is estimated that employees traveling during the 7:00 to 8:00 period generate 70.8 vehicle trips per 100 employees, while those traveling after 8:00 generate 84.9 trips per 100 employees. The impact of the observed shift in time period on the number of vehicle trips that may have been generated can be estimated as follows:

Number 1988 employees = 14,000

Additional percentage traveling after 8:00 AM,
1988 vs 1986 = 39.4 - 26.7 = 12.7%

Additional rate of vehicle trip production, post-
8:00 AM period vs 7:00 to 8:00 = 84.9 - 70.8 = 14.1 per 100

Additional Vehicle Trips:

14,000 x .127 x .141 = 251 vehicle trips

Of course, there are a variety of factors that determine the method of travel that an employee will choose, and it is unreasonable to project that the mere act of traveling later means that the employee is going to drive alone. However, without any policy that promotes flexible work hours as a mechanism to encourage employees to use higher occupancy modes, the tendency as shown in the data would be to drive alone.

Another factor that has the same type of weak but interesting causal relationship is location of the employee's residence. Because virtually all of the tenants at Bishop Ranch relocated their operations from elsewhere in the region (typically from San Francisco area), many employees suddenly found themselves with very long commutes. To a considerable extent, this distance acted as an incentive for relocated employees to seek a ridesharing or transit alternative to a very long drive to work. Over time, two things have happened: some employees have relocated their residence to be closer to work; and there has also been attrition in the staff, as labor pools closer to the park have taken over some of the new jobs. The net effects are that (1) the average commuting distance of employees has decreased, and (2) rates of driving alone have increased as more employees now reside within 5 miles of Bishop Ranch, where carpooling is not presently advantageous nor is transit service generally available.

Listed below are data that describe these trends toward close location.

Distance of Employees from Bishop Ranch
(percent of employees)

Distance	1986	1987	1988
under 5 mi.	18.1%	20.9%	23.1%
6 to 10 mi.	8.5	9.3	7.9
11 to 20 mi.	40.7	40.4	41.5
> than 20 mi.	32.7	29.4	27.6
Avg. Trip Length (in miles)	15.2	14.6	14.3

If nothing else had changed during this measurement period, i.e., persons also changing their mode of travel, these data would suggest a positive trend in reduced trip lengths, translating to fewer vehicle miles of travel (VMT). Weighting the distance groups at the midpoint of their ranges (over 20 miles represented by 25 miles) produces an estimate of an average trip length of 15.2 miles in 1986, falling to 14.6 miles in 1987, and then to 14.3 miles in 1988.

However, this shift in trip length was also accompanied by important changes in mode choice, as illustrated in the following table:

Modal Use by Distance to Work

	0 - 5 miles			6 - 10 miles			11 - 20 miles			21+ miles		
	'86	'87	'88	'86	'87	'88	'86	'87	'88	'86	'87	'88
Drive Alone	77%	84%	86%	70%	84%	81%	57%	69%	74%	36%	44%	48%
Carpool	17	12	9	25	15	16	28	20	16	30	24	23
Vanpool	0	0	0	1	1	1	4	4	5	19	23	23
Transit	0	0	0	0	0	2	9	6	4	15	8	4
Other	4	4	5	4	0	0	2	1	1	1	1	1

These data illustrate that the rate at which employees drive alone increases directly as the distance to work becomes shorter. The tendencies toward all ridesharing modes increases with distance from work, and becomes particularly attractive outside of 10 miles. The data also illustrate that these trends are becoming more pronounced over time, i.e., the closer an employee lives to work, the higher the percentage which drove alone in 1988 than did in 1987 or 1986.

These distributions of mode of travel vs. distance from work correspond to the following rates of vehicle trip production:

Vehicle Trips per 100 Employees

Distance	1986	1987	1988
Under 5 miles	83.8	88.8	89.6
5 to 10 miles	80.1	90.1	87.5
11 to 20 miles	68.8	77.5	80.9
Over 20 miles	50.1	55.8	59.2
Average VMT	9.2	9.9	10.2

If these trip production averages are applied to the distribution of employees in the various distance categories, and the result is weighted by the mean trip length of the category, the average Vehicle Miles of Travel (VMT) per employee in each year can be estimated. This calculation shows that average VMT per employee has increased steadily between 1986 and 1988, despite the fact that closer location has meant that average trip lengths have *declined* steadily through the same period.

Some interesting "what if" challenges can be made to the current vehicle trip rates using the above data.

- If 1988's travelers comprised the same geographic distribution as those in 1986, with the 1988 modal splits, they would generate 75.9 vehicle trips per 100 employees, instead of the 77.6 observed. On a base of 14,000 employees, this means (77.6 - 75.9) x 14,000 = 238 fewer daily vehicle trips made.

- If 1988's travelers comprised the same modal split distribution as those in 1986, but 1988's geographic distribution, they would generate 68.1 vehicle trips per 100. With the 1988 employment base this would mean (77.6 - 68.1) x 14,000 = 1330 fewer vehicle trips.

- If 1988's travelers comprised both the same geographic and modal split distribution as 1986, they would generate 66.9 vehicle trips per 100. With the 1988 employment base, this would mean (77.6 - 66.9) x 14,000 = 1498 fewer vehicle trips.

From this analysis of the link between geographic location, mode choice and trip reduction, several conclusions can be offered. It is ironic that, while having the workforce locate closer to the employment site should result in improved travel conditions, in reality, living closer also seems to be correlated with a greater tendency to drive alone. Therefore, what is seen at Bishop Ranch is a higher percentage of persons driving alone, with a net increase in both vehicle trips and vehicle miles of travel. If these closer locations could be translated to higher densities, potentially the relocations could be used to advantage in terms of offering alternatives such as transit.

In summary, the TDM program at Bishop Ranch has achieved an impressive trip reduction, particularly considering (1) the remote location and low density nature of the development and its surrounding area, and (2) the absence of "hard" incentive and disincentive actions, such as subsidies and parking charges. Restricted parking at some of the major employment sites seems to have an important effect on employee use of high occupancy modes. Also important is the aspect of strong employer concern and support of alternative commute and relocation assistance programs for employees who were inconvenienced by their company's relocation to such an outlying location. The long commute distances facing many employees has acted to encourage high ridesharing rates. However, over time, resettlement and attrition has brought the workforce closer, and whether as a result of the closer distance or readjustment to travel conditions, rates of single occupant commuting have increased. Similarly, employees have been offered flextime privileges, as a means of reducing the number of vehicle trips in the peak hour. Initial evidence suggests a shifting of trip making, but, while there has been some reduction of the peak, the evidence shows

primarily a shifting of the peak by about a half hour later into the day, and higher rates of drive alone usage both outside and within the peak hour.

The results achieved at Bishop Ranch are nevertheless impressive for a modern, low-density office park. The lack of time stability in the trip reduction rates will require continued monitoring to ascertain whether there are program factors that are contributing to the divergence from goals or which can be used to return performance toward the goals.

4. INDIVIDUAL PROGRAM EFFORTS

While each employer in the park can be credited with a vehicle trip reduction, some have achieved a decidedly higher rate of performance than others. Discussed below are the details on one program which has been exemplary in its success in reducing vehicle tripmaking.

Pacific Bell

Pacific Bell has the largest single installation in the park. The facility, known as the San Ramon Valley Administrative Center, is a 1.7 million sq. ft. building located on a 100 acre site in the center of the park. The company employs about 6900 individuals, mostly in service, clerical and administrative functions.

Pac Bell was one of the early tenants at Bishop Ranch, beginning its occupancy in January 1985. Virtually all of its employees were relocated from the company's former offices in San Francisco. The massive relocation occurred within a relatively short 6-month period. The scale, suddenness and the distance of the move meant that the company had to make special efforts to assist its employees make the adjustment to the new site, particularly since many were facing extremely long commutes. It appears that the concentration of the move may have made certain of the TDM program elements even more effective.

The company offered an extensive relocation assistance program to its employees which included retention of a full-time, on-site transportation coordinator to assist in identification of alternatives, a rideshare matching program to assist in the formation of carpools and vanpools, establishment of a vanpool program, and contracting with the County Connection for shuttle service to the BART station at Lafayette. A flextime program was instituted, and Pac Bell also offered special assistance to hardship cases with difficult commutes in relocating their residences closer to the park.

While many of the employees were interested in forming carpools or vanpools simply to reduce the burden of the long commute, the company provided an additional discouragement to driving alone to the site by placing strict limits on its parking supply. When Pac Bell furnished its plans for the new building, those plans included surface parking for only 4600 vehicles. This is only 2.7 spaces per 1000 square feet, which is quite low for this type of development. This is also a ratio of 1.5 employees per space.

The motivation in limiting its parking was primarily cost related, since that was really all the surface parking that could be accommodated at the site. However, the company was also placed under a 40% peak period vehicle trip reduction requirement by Contra Costa County as a condition of its building permit. It believed it could make the space ratio work with the appropriate management program.

Pac Bell has had and continues to have the best trip reduction program in the park, as shown by the modal split rates listed in the following table:

Pacific Bell TDM Program Results
Employee Modal Split and Trip Generation Rates

	1986	1987	1988
Travel Mode			
Drive Alone	48%	59%	63%
Carpool	32	26	22
Vanpool	9	11	11
Transit	6	3	2
Other	5	1	2
Vehicle Trips per 100 Employees*	61.8	70.4	72.8
Avgerage vehicle Occupancy	1.54	1.41	1.35

* assumes 2.5 persons per carpool and 30 persons per transit trip

Pac Bell's initial program efforts in its first year, 1986, resulted in only 48% of its employees coming to work by single-occupant vehicle; the majority came to work by other means, mostly (32%) by carpool. Over the next two years, the drive alone rate has gradually increased, with currently 63% of all employees driving alone. Both carpool and transit use have fallen accordingly, while vanpool usage has increased somewhat.

Exactly why the rate of use of high occupancy modes has fallen is not clear, although even at the present rate of trip reduction, the Pac Bell program has an impressive result. In the table below, the Pac Bell results are compared to three standards: The next largest employer in the park, the rest of the park with these two large employers excluded, and the regional control sites (Walnut Creek and Santa Rosa) presented in the previous section.

Pacific Bell TDM Trip Reduction Comparisons

	Pac Bell	**Company "B"**	**Remaining B.R. Park**	**Region Average**
Travel Mode				
Drive Alone	63%	73%	80%	
Carpool	22	13	12	
Vanpool	11	10	3	
Transit	2	2	4	
Other	2	2	1	
Vehicle Trips per 100 Employees*	72.8	79.1	85.2	93
Average Vehicle Occupancy	1.35	1.24	1.16	1.07
Eff. Vehicle Trips @ Pac Bell	5023	5458	5879	6417
Trips Reduced		435 (8.7%)	856 (17.0%)	1394 (27.8%)

* assumes 2.5 persons per carpool and 30 persons per transit trip

From these comparisons it is concluded that the efforts of Pac Bell's program, compared to the most direct competing company in the park in terms of size and function, reduces 435 more vehicle trips, or 8.7%, than would the comparable efforts of the Company "B". Compared to the rest of the park without the two large employers included, Pac Bell's efforts reduce 856 more trips, or 17%, than the efforts of these organizations. Finally, compared to the average for the region, the Pac Bell program reduces 1394 trips, or 27.8% more than would be expected to occur at other comparable locations in the region.

Why Pac Bell's program has diminished in effectiveness over time is not known. Clearly more employees are deciding to drive alone. This is probably due to residential relocation, time of day changes, and other factors. What is suggested by the above analyses is that the number of vehicle trips now being generated, 5023, exceeds the 4600 spaces that are available at the site. It is believed that these vehicles are parking at other locations in the park. It is also known that statistically, an average of only about 85% of an employment force appear at work on a given day, meaning that the effective demand of these 5023 vehicle travelers would only be 5023 x .85 = 4270.

8. CASE STUDY: HACIENDA BUSINESS PARK

PLEASANTON, CALIFORNIA

1. SITE DESCRIPTION

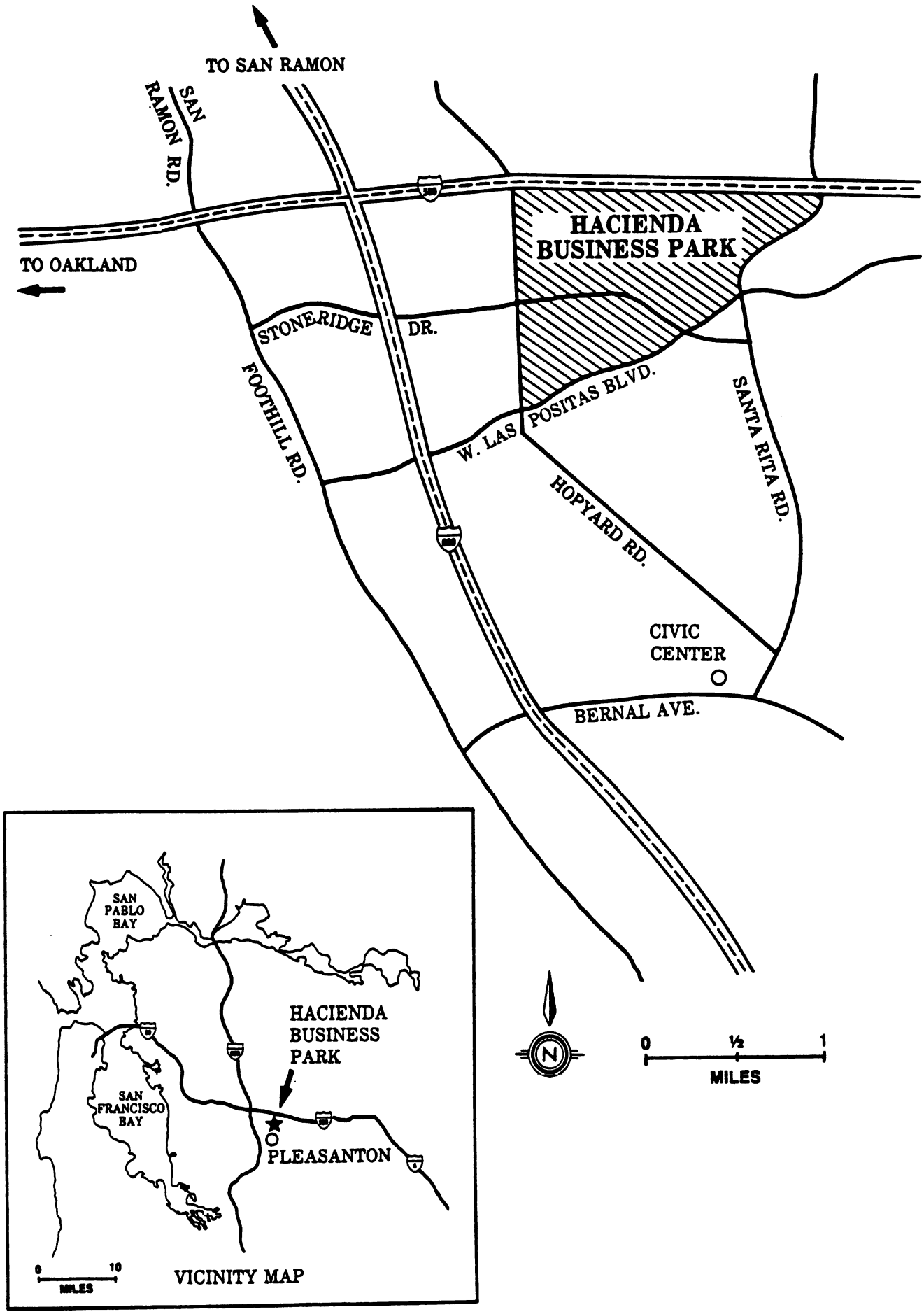
Location and Character of Site

Located 32 miles southeast of downtown San Francisco, in the "Tri-Valley" area, Pleasanton was first an agricultural community and then a "bedroom" suburb of San Francisco. As shown in Figure 1, Pleasanton is located just south of San Ramon and the Bishop Ranch Business Park, at the intersection of two regional freeways, I-580 and I-680.

The current population of Pleasanton is over 40,000 residents. The trend over the past 20 years reveals a steady increase in population, slowing after the advent of Proposition 13 in California and the implementation of a growth management program in Pleasanton for new housing in the early 1970's:

Year	Population
1970	18,328
1975	31,667
1980	35,160
1985	39,924

At about the same time that the City of Pleasanton chose to limit residential growth, which it feared might overburden the city's ability to provide services, the City began pursuing opportunities for commercial development. Such development was viewed as being able to expand the local tax base while not being a drain on the city's services. Thus, as of 1984, almost 14 million square feet of office, light industrial and retail development had been approved in Pleasanton. This translated into significant increases in employment. 1980 employment in Pleasanton was 8,774, while 1987 levels have swelled to approximately 22,289. Thus, while the population is only growing by approximately two percent per year, employment has more than doubled in the past eight years. The Association of Bay Area Governments (ABAG) project that, between 1980 and 2000, four new jobs will be created in Pleasanton for every new household in the city. In fact, the same projections estimate that the jobs-to-housing ratio will shift from 0.81:1 to 1.86:1 from 1980 to 2000.



PLEASANTON, CA

FIGURE 1

Transportation Facilities

Traffic conditions on the two freeways serving Pleasanton (I-580 and I-680) and on local streets are still relatively uncongested, especially as compared to other parts of the Bay Area. These freeways operate at 75 - 80% of capacity during the peak hour and local intersections largely operating at LOS C or better. Between 1987 and 1988, average daily traffic (ADT) volume increased by 10%, from 844,000 vehicles per day to 928,000. Overall, traffic conditions stayed about the same during this period. As measured by Level of Service at 37 major intersections throughout the city, nine intersections improved, six worsened and 22 remained the same during the a.m. peak period. In the evening, 14 intersections improved, seven worsened, and 16 remained the same.

Clearly, however, increases in employment will outpace the ability of the public and private sectors to accommodate all this new demand by improving the local and regional roadway network. Efforts to reduce the overall number of vehicle trips generated by this new development via traffic mitigation programs were foreseen. In 1983, the Tri-Valley Transportation Study concluded that with new development, traffic volumes would increase to unacceptable levels and that peak hour vehicle trips would have to be reduced by as much as 45% to maintain "reasonable" levels at full development.

Since future phases of development were contingent on maintaining certain traffic conditions in the area, and the assessment district would apply to all development, the developers of the Hacienda Business Park pursued the expansion of the TSM requirements city-wide via an ordinance. Concurrently, a citizen's General Plan Review Committee, noting that most transportation studies in the area called for significant use of flex-time and commute alternatives to maintain tolerable traffic levels, also called for a city-wide TSM ordinance. City staff drafted the ordinance with substantial input from area employers and developers.

The TSM ordinance was adopted in October 1984. The ordinance is tied to both peak hour trip reduction and intersection LOS goals. The ordinance applies to new and existing employers and multi-tenant buildings. For employers with 10-49 employees, some informational requirements are called for, but more extensive requirements are placed on employers with 50 or more employees and groups of employers in multi-tenant buildings.

The ordinance calls for the designation of an employee or complex coordinator and the development of a transportation management program to reduce the number of trips arriving in the peak hour by 45% over the hypothetical level defined above. "Any reasonable combination of TSM measures" can be used to achieve the target, including commuter alternatives and changed work hour programs. The ordinance calls for compliance with the 45% target in four years, with a 15% reduction the first year and a 10% reduction in each subsequent year. An annual employee survey, part of the annual reporting requirement, and separate plan are required by the City and are designed to report on progress in the previous year and update plans for the following year.

A transportation coordinator was hired by the City to oversee the provisions of the ordinance and collecting intersection and employee survey data and employer annual reports. The City is ultimately empowered to levy fines for not complying with the

reporting requirements or implementing the measures in a plan. Finally, the City can prescribe mandatory TSM measures on employers and complexes. As a check, however, a peer review group, called the TSM Task Force was formed among area businesses to monitor compliance with traffic and transportation management requirements.

The results of Pleasanton's ordinance after four years reveals some unexpected trends in terms of mode split, while at the same time meeting its peak hour target. For the city as a whole, the drive alone rate has increased from 1985 to 1988. In 1985, the first year of the ordinance, 81% of Pleasanton workers drove alone to work. According to the annual required survey, this had increased to 84% and 86% during the next two years, respectively. Finally, the drive alone rate for 1988 began to fall again, and was 84%. Regional mode split estimates for suburban employment is consistent with these alternative mode splits of 15 - 18%. This five percent shift (as seen in the figure below) in 1985 - 1987 mode share occurred at a time when employment increased by 65%, from 13,549 to 22,289.

It should be noted, however, that most of the 45% reduction in peak hour traffic was expected to come from flex-time and other alternative work hour programs that would shift travel outside the target peak hour (7:30 - 8:30 a.m.). During the same period, the proportion of commuters traveling to work during the a.m. peak hour decreased city-wide from 56% in 1985 to 51% in 1988, even with the increases in employment and the drive alone rate. Therefore, Pleasanton achieved its targeted peak hour trip reduction by moving commuters out of the morning peak hour and not by shifting commuters into high occupancy or non-motorized modes. The city-wide changes in mode split and peak hour commuting are summarized below:

Year	1985	1986	1987	1988
Drive Alone Rate	81%	84%	86%	84%
Commuting During Peak Hour	56%	58%	53%	51%

2. BACKGROUND AND MOTIVATION FOR TDM PROGRAM

Hacienda Business Park

Approximately half of the approved 14 million square feet of development in Pleasanton will occur within the Hacienda Business Park, located in the northern part of Pleasanton, at the intersection of the two freeways. Phase I, with construction beginning in 1981, calls for some eight million square feet of office, light industrial, hotel and retail uses. The master planned development will ultimately consume 763 acres and employ 35,000 employees within 11.7 million square feet. There are currently over three million square feet of development on the ground with some 9,800 employees. The business park's existing major tenants include: AT&T (2,930), Associates National Bank (550), EG&G Energy (212), and many employers with 100-200 employees.

In 1982, in response to plans for this major development, the City of Pleasanton rezoned a parcel of land from an industrial classification to a Planned Unit Development, making way for the Hacienda Business Park. After a challenge to the environmental documents and the passing of a local referendum, the PUD process moved ahead and some 110 requirements were placed on the phased development. The two major traffic-related requirements were the creation and implementation of a transportation management program to reduce the number of vehicle trips and contributions toward roadway improvements through an assessment district. This later requirement lead to the establishment of the North Pleasanton Improvement District. Funds collected ($110 million) through this mechanism will pay for streets, sound walls, freeway interchange improvements, a computerized traffic signalization system, and other needed improvements. These improvements are geared toward a goal of maintaining a peak hour level of service (LOS) "mid-D" at all adjacent intersections on arterials and freeways.

The PUD requirements also called for a TSM program for all owners and lessees. A goal was established of reducing the number of a.m. peak hour trips by 45% over levels that assume all commuters arriving during the peak hour by single occupant vehicles. Subsequent phases of development would be contingent on meeting these traffic goals.

The Hacienda Business Park Owners' Association was established to oversee the operation and maintenance of the park and assure compliance with the PUD requirements. One function of the Owners' Association is to serve as a Transportation Management Association to assist owners and tenants in developing and implementing their transportation management programs and provide services available to all employees in the park. The Owners' Association also reviews new building designs to assure compliance with city guidelines that call for five percent of all parking to be designated as preferential spaces for carpools and vanpools and enough bicycle parking to serve 3.5% of the building's population.

The Hacienda Business Park Owners' Association (HBPOA) initiated a transportation management program in April, 1984. It was designed to implement many of the PUD requirements placed upon the development during project approval. The developers, Callahan-Pentz Properties and Prudential Insurance Company of America had previous experience in transportation management programs, having established a program at Moffett Park in Santa Clara County, CA.

The Hacienda Business Park transportation program originally consisted of two staff members overseeing services to tenants and building managers within the park as well as a shuttle system for peak hour service to a nearby BART station and a noon-time internal circulation system. The HBPOA provided computerized matching for carpools and vanpools and promoted commute alternative through new tenant orientations, promotions and a company coordinators' network.

The program currently provides passes to employees of the business park for the BART Connection, assists employers with their in-house programs, facilitates the company

coordinator network, and promotes the program through the Owner's Association newsletter. Owners pay dues to the association and this funds the transportation management activities.

The TSM Task Force has played an active role in assisting employers and complexes with compliance. The Task Force produced "TSM Made Easy: A Guide for Multi-tenant Managers" which was distributed to all buildings in the city that need to comply. The Task Force also helped mitigate a growing traffic problem at a critical intersection. The intersection had degraded to LOS "E" during the p.m. peak hour. The City determined that 600 trips needed to be reduced to bring the intersection up to LOS "D". A committee of the TSM Task Force was formed of the employers and complexes that used this intersection and developed refined TDM strategies to solve the problem. The City was empowered to create an assessment district to improve the intersection, but first choice to work cooperatively with the business community to find a transportation management solution. The combination of opening a new interchange in the area, and reducing 599 trips through TDM, contributed toward bringing the intersection back to LOS "D".

3. OVERALL EFFECTIVENESS OF PROGRAM

The effectiveness of the Hacienda Business Park TDM program is revealed through two sources. First, the annual surveying requirements of the city reveals that the drive alone rate at Hacienda Business Park has remained fairly static, if not increased slightly. The drive alone rate in 1986 was 77.1%; in 1987 it was 79.8%; and in 1988 it was 78.7%. One explanation for this slight shift back to driving alone was the fact that commute distances were becoming slightly shorter at the same time, as illustrated in the table below. Average trip length decreased from 15.1 miles in 1986 to 14.6 miles in 1988. Since trip distance is often correlated with mode choice, shorter trip distances, partially caused by workers moving closer to their Pleasanton jobs, translated into more commuters choosing to drive alone.

Distance of Employees from Hacienda Business Park
(percent of employees)

Distance	**1986**	**1987**	**1988**
< 5 miles	23.9%	23.9%	25.0%
6 to 10 miles	15.7	16.5	16.6
11 to 20 miles	20.0	20.3	20.0
> 20 miles	40.5	39.3	38.4
Avg. Trip Length (in miles)	15.1	14.9	14.6

The carpool and transit (local bus and BART connection) rates remained fairly constant as well, at around 16% and 2.3% respectively. Indeed, the alternative mode that seemed to garner more interest over time was vanpooling, although the proportion is still small, increasing from 1.2% in 1986 to 1.9% in 1988. However, since 7,700 employees work in Hacienda Business Park, this would correspond to 150 vanpool riders and 10 vans serving the employment center. The following table summarizes the travel mode characteristics of Hacienda Business Park employees for the three years with available data:

Travel Mode	1986	1987	1988
Drive Alone	77.1%	79.8%	78.7%
Carpool	16.2	14.6	15.8
Vanpool	1.2	1.7	1.9
Transit *	3.0	2.5	2.3
Other **	2.5	1.4	1.2

* Local transit, BART connection, club bus

** Bicycle, walk, drop-off, motorcycle, other

Traffic, however, does not seem to be suffering as a resulting of employment growth nor a consistent drive alone levels. Of the seven intersections monitored between 1987 and 1988 in or adjacent to Hacienda Business Park, all but one operate at LOS "A" or "B". In most cases the volume to capacity V/C ratio remained the same or improved. The one intersection (Hopyard/I-580) that was operating at LOS "D" with a V/C ratio of 0.90 was improved to LOS "C" with a V/C ratio of 0.74. A major interchange is being constructed on I-680 near Hacienda Business Park which will further alleviate traffic congestion at the access points from I-580. Vehicle occupancy for the North Pleasanton area is 1.14 during the p.m. peak hour and the 16 sites surveyed through driveway counts revealed a low occupancy of 1.05 to a high of 1.29. The counts also revealed a p.m. trip generation rate of 1.24 vehicle trips per 1,000 square feet of office space. This is well below the standard of 2.0 traditionally used by the city.

What probably accounts for the ability of Hacienda Business Park to hold the line on traffic conditions is the city's emphasis on flexible work hour programs to move trips out of the a.m. peak hour (7:30 - 8:30 a.m.). In 1988, the proportion of Hacienda Business Park bound commuters that arrived in the a.m. peak hour was 63%. Each year this proportion has decreased. The fact that one third of the workers were arriving before and after this peak hour contributed to the ability to maintain uncongested roads.

Referring to data presented in Table 1, Hacienda Business Park's TDM program seems to have met the city's trip reduction requirement. If it is assumed that each carpool carries 2.5 riders, each vanpool 12 riders, and each bus 30 riders, it is estimated that Hacienda Business Park employees generated85.2 daily one-way vehicle trips per 100 employees in 1988. This corresponds to a 1.17 vehicle occupancy average. This means that the employee population of 7,769 produces about 6,623 daily vehicle trips. Of these trips, 63% or 4,172, occur in the a.m. peak hour (7:30 - 8:30 a.m. as defined by the ordinance). Therefore, from the combination of shifting some employees to higher occupancy modes and others to travel outside the peak morning hour, the Hacienda Business Park can be credited with a 46.3% (7,769 - 4,172/7,769 = .463) reduction in peak hour vehicle trips over the situation where every employee would drive alone during the morning peak hour. Based on the city's 45% peak hour trip reduction requirement, Hacienda Business Park has meet the goal within the specified four year period.

This comparison, however, is made against a hypothetical situation whereby every commuter would be driving alone. Indeed, some percentage of commuters would naturally be using alternatives to driving alone even without a formal TDM program. It is the difference between this "background" rate of vehicle trip generation and that induced by the TDM program that constitutes the trip reduction directly attributable to the formalized transportation management effort. As a basis for comparison, three other areas were selected so as to assess the mode split and trip production rates in contrast to those for Hacienda Business Park. The table below compares Hacienda Business Park to Pleasanton as a whole, to Walnut Creek (another suburban growth center) and to Santa Rosa (an existing smaller city developing into a high growth center).

Applying the occupancy factors utilized throughout this report, Hacienda Business Park is estimated to generate 6,623 trips among its 7,769 employees, or 85.2 trips per 100 employees. This is 3.5 trips per 100 less than for the city as a whole, and is considerably lower than for the other suburban activity centers used as comparisons in the table. However, if Hacienda Business Park were to generate vehicle trips at rates equal to that for the city as a whole, the center would generate 6,891 trips, or 268 more than with its TDM program, translating to a 4% trip reduction attributable to the program.

If the two other locations, Walnut Creek and Santa Rosa, are used as reference points for commuting behavior in the absence of a TDM program, then the Hacienda Business Park program may have reduced 606 vehicle trips, for an 8% reduction over "background" levels, calculated as follows:

Hacienda Business Park Vehicle Trip Rate = 85.2/100

Vehicle Trip Rate for Control Sites = 93/100

Rate Differential: 93 - 85.2 = 7.8/100

Total Reduction: 7,769 x 7.8/100 = 606 Vehicle Trips

TABLE 1

COMPARATIVE TRAVEL CHARACTERISTICS
HACIENDA BUSINESS PARK

	HBP	Pleasanton	Walnut Creek	Santa Rosa
Travel Mode				
Drive Alone	78.7%	84.3%	89.9%	91.3%
Carpool	15.8	10.8	6.9	4.7
Vanpool	1.9	0.7	0.5	0.1
Transit	2.3	1.6	2.6	1.4
Other	2.5	1.3	0.1	2.5
Vehicle Trips per 100 Employees *	85.2	88.7	92.8	93.2
Average Vehicle Occupancy	1.13	1.17	1.08	1.07

* Assumes 2.5 persons per carpool,
12 persons per vanpool, and
30 persons per transit trip

4. INDIVIDUAL PROGRAM EFFORTS

As a means to show the variety of employer programs, both within Hacienda Business Park and other parts of the city and to compare firm results with the results for the Business Park and the city as a whole, five employer programs were examined. Each is described below, along with some revealing statistics on the firms' ability to induce commuters to change their travel behavior. Finally, a comprehensive comparison is made, based on mode split and peak hour arrivals, between these programs and comparable statistics for Hacienda Business Park and the city as a whole. The five companies are: AT&T and Sun Diamond Grower's located within the park, and Payco General American Credits, Farmers Insurance, and the Clorox Technical Center located outside the park.

Firms Within Hacienda Business Park

AT&T

In the early 1980's, AT&T moved its West Regional Operating Center to Pleasanton and leased space in a number of buildings throughout Hacienda Business Park. When it consolidated its operation into a single site, parking became a key issue. AT&T's employees in San Francisco had generally paid for parking as a corporate-wide policy precluded sites from leasing spaces outside those provided as part of floor space leases. In suburban settings such as Pleasanton, AT&T knew that abundant surface parking would be provided. They negotiated with the city and the developer to build less than required parking because of their anticipated TDM program. The Covenants, Codes and Restrictions for Hacienda required tenants to implement trip reduction measures. The city's requirement would have meant some 4,000 spaces be built at the new site. AT&T convinced the city that their required TDM program would mean that 25% of AT&T's employees would commute to work by means other than driving alone. Therefore, the city agreed to 2,950 parking spaces for an ultimate employee population of 3,890. The site now employs closer to 3,300 employees, which is still higher than the parking supply. Therefore, AT&T purposely sought reduced parking in the face of the TSM requirement and with the confidence that they could maintain a 25% use of modes other than driving alone.

In 1988, AT&T had 3,890 employees, making it the largest employer in Pleasanton, consolidated in a complex of six buildings that the firm developed with 1.1 million square feet of office space. AT&T's program consists of rideshare promotion and matching. AT&T had used the matching services of the Hacienda Business Park Owners Association, but in the absence of that service has begun doing their own in-house matching next year. Some 280 preferential parking spaces are provided for 300 carpools and 12 owner-operator vanpools. Flex-time allows employee arrival anytime between 5:00 - 9:00 a.m. AT&T was a strong supporter of the citywide ordinance and was instrumental in establishing the TSM Task Force.

AT&T's program meets the city requirements by having high carpooling and vanpooling rates and by shifting a significant proportion of its employee arrivals outside the peak period. The mode split and arrival statistics for 1986 and 1988 are revealed in the table below (data for 1987 are not included because of low response rate):

AT&T MODAL SPLIT

Travel Mode	1986	1988
Drive Alone	70.5%	71.3%
Carpool	21.2	21.8
Vanpool	1.8	3.2
Transit	3.0	2.4
Other	2.3	1.0
Percent in a.m. peak hour	61.8%	55.5%

As the data indicate, AT&T has a strong carpool program, a growing vanpool program (51% of the employees live 16 or more miles from work), and has met the city requirement of moving 45% of the employee arrivals out of the morning peak hour. The average a.m. vehicle occupancy for AT&T is 1.13 (close to the city's average of 1.14), but the a.m. peak hour trip generation per 1,000 square feet of office space is only 1.03, (less than the 1.24 city average) due to the flex-time program. With half of the employment of Hacienda Business Park, AT&T's program has a dramatic impact on the compliance for the entire development.

Table 2 allows a computation and comparison of AT&T's program vs. "background" conditions in the area. AT&T's 3,890 employees generate 3,131 daily one-way vehicle trips, or 80.5 trips per 100 employees. If the mode split for Hacienda Business Park as a whole were considered indicative of typical employer TDM programs, and these proportions were applied to AT&T's employee base, AT&T would generate 3,314 trips, or 183 more than what it accomplishes with its TDM program. This corresponds to a 5.5% trip reduction. Likewise, if AT&T were to generate trips at a rate equal to that of the city of Pleasanton, it would generate 3,450 trips from its 3,890 employees, or 183 more than are presently made under its TDM program; this translates to an effective trip reduction of 9.3%.

Sun Diamond Growers

Located in the Hacienda Lakes complex of Hacienda Business Park, Sun Diamond has 128 employees at the Pleasanton site. Sun Diamond's work schedule for non-exempt employees is 7:45 a.m. - 5:00 p.m. Monday through Thursday and 7:45 a.m. - 12:45 p.m. on Fridays. Sun Diamond provides rideshare matching through the regional commute management organization, RIDES. It also provides preferential parking spaces for poolers, company cars for mid-day business use and a guaranteed ride home program for emergencies. Sun Diamond's drive alone rate has dropped from 82.4% in 1986 to 77.2% in

TABLE 2

SUMMARY OF EFFECTIVENESS OF TDM PROGRAMS

PLEASANTON - HACIENDA BUSINESS PARK

(1988 Commute Statistics)

	City	HBP	AT&T	SD	PC	FI	CL
Travel Mode							
Drive Alone	84.3%	78.7%	71.3%	77.2%	49.5%	79.4%	78.5%
Carpool	10.8	15.8	21.8	19.3	33.0	19.0	19.6
BART/Bus	0.9	1.4	0.9	0	12.0	0.7	0.2
Transit	0.7	0.9	1.5	0	5.5	0.2	0
Vanpool	0.7	1.9	3.2	2.6	0	0	0
Bicycle	0.8	0.4	0.4	0	0	0	0.2
Walk	0.8	0.3	0.3	0.9	0	0.2	0.2
Motorcycle	0.4	0.2	0.2	0	0	0.5	0
Other	0.5	0.2	0.2	0	0	0.5	0
Percent a.m. peak hour	51%	63%	55%	76%	66%	86%	61%
Employees	22,000	7,769	3,890	128	112	705	450
Vehicle Trips Per 100 Employees *	88.7	85.2	80.5	85.2	63.4	87.0	86.2

Employer Code:

HBP = Hacienda Business Park
SD = Sun Diamond Growers
PC = Payco
FI = Farmers Insurance
CL = Clorox Technical Center

* Assumes 2.5 persons per carpool
12 persons per vanpool, &
30 persons per transit trip

1988. Carpooling increased over the same period from 14.7% to 19.3% and vanpooling from 1.0% to 2.6%. Morning peak hour arrivals constitute 76.5% of Sun Diamond's total arrivals, and this is well above the average for Hacienda Business Park of 63% and 51% for the city as a whole. However, the combination of Sun Diamond's and neighbor Spreckels Sugar's high carpooling rates contributes the fact that the Hacienda Lakes complex has a a.m. peak hour vehicle occupancy of 1.29, but generates 1.82 trips per 1,000 square feet during that period.

Firms Outside Hacienda Business Park

While many firms within the Hacienda Business Park,and the HPBOA, have produced impressive results, several firms with very impressive results can be found outside of the business park. This is partially due to the fact that the ordinance applies to all employers within the City of Pleasanton. For example, Farmers Insurance Group of Companies has only achieved 26% of its needed TSM goal of 45% fewer employees driving alone during the morning peak hour. Its carpooling rate (19% in 1988) is higher than that for the city of for Hacienda Business Park, but its set work hours policy means that 85% of its employees arrive between 7:45 and 8:45 a.m.

Clorox

Clorox Technical Center has a similar carpool rate of 19.6% in 1988 and this number is down from 23.8% in 1986. However, in 1988 the firm instituted staggered work shifts beginning at 7:00, 7:30, and 8:00 a.m., which resulted in the number of employees arriving in the city's targeted peak hour dropping from 90% to 61%.

Payco General American Credits

Payco, with 112 employees, is new to Pleasanton, having relocated from some distance, but has achieved impressive results via flex-time and an aggressive TDM program. The company's flex-time program allows employees to work flexible schedules M-F and on half-days Saturday. The firm intends to implement a 4/40 work week next year. Preferential parking for pools and bicycle parking is provided. In 1988, only 49.5% of Payco workers drove alone to work, while 33% carpooled, 12% used BART and its bus connection, and 5.5% used other transit. Only 66% of Payco workers arrived from 7:45 - 8:45 a.m. and the flexible schedule seemed to have no detrimental impact on ridesharing or transit use. One explanation for Payco's success in maintaining high commute alternative rates is the fact that 73.4% of its employees live 16 miles or more from work.

Overall Comparison

Comparing these five employer programs to that for Hacienda Business Park and the city as a whole reveals a considerable amount of information on the city's ability to garner a variety of programs, yet still meet its areawide peak hour reduction.

Even with impressive diversion of commuters to periods outside the critical a.m. peak hour, the trip production rates and overall trip reduction impacts (for all daily commute trips) is indicative of high drive alone rates and low vanpooling and transit usage.

Given the number of commuters who travel to work outside the a.m. peak hour, and the fact that most intersections operate at or above LOS "C", Pleasanton seems to have accomplished its stated objective of reducing a.m. peak hour trips. However, in the meantime, the proportion of drive alone commuters has been increasing and with it a general increase in trips and trip-making rates over 1985 levels.

This raises the question of whether flex-time is a long-term or only a temporary solution to traffic generation. Clearly flex-time can address site access problems by relieving peaking problems, but its ability to address areawide mobility issues is not clear. What is clear is that had Pleasanton employers and developers done nothing, traffic would indeed be worse in the a.m. peak hour. However, if a comprehensive TDM program aimed at shifting commuters out of drive alone modes altogether had been implemented instead, overall trip making levels might have been curtailed, with the result of relieving congestion throughout the day and perhaps on longer-term basis. The choices an area makes concerning congestion relief depend on many factors, and thus flex-time needs to be considered against a number of other strategies for reducing trips in response to particular or potential problems.

9. CASE STUDY: U.C.L.A.

LOS ANGELES, CALIFORNIA

1. SITE DESCRIPTION

Location and Character of Site

The University of California, Los Angeles (UCLA) campus is located immediately adjacent to Westwood Village, a densely developed urban area in West Los Angeles approximately 10 miles west of downtown L.A. Westwood is a major Southern California activity center. In addition to UCLA, Westwood houses several 20 story office towers, numerous high rise residential complexes, and a growing retail/entertainment center which continues to make the area a popular place to live, shop, work and play.

Approximately 37,000 people live in Westwood, which is bounded by the San Diego Freeway to the west, Sunset Blvd. to the north, Beverly Glen Blvd. to the east, and Pico Blvd. to the South (see Figure 1). Westwood Village is the heart of the community and is situated between Wilshire Blvd. and the UCLA campus. In fact, the intersection of Wilshire and Westwood Blvds. reportedly has the highest 24 hour traffic volume in Los Angeles. Based on its location, Westwood would appear to be a suburban center. However, given its density and proximity to downtown (200,000 employees), Century City (60,000 employees), and the rest of the dense Wilshire corridor, Westwood possesses more the character of an urban center, with a diverse mixture of activities and land uses.

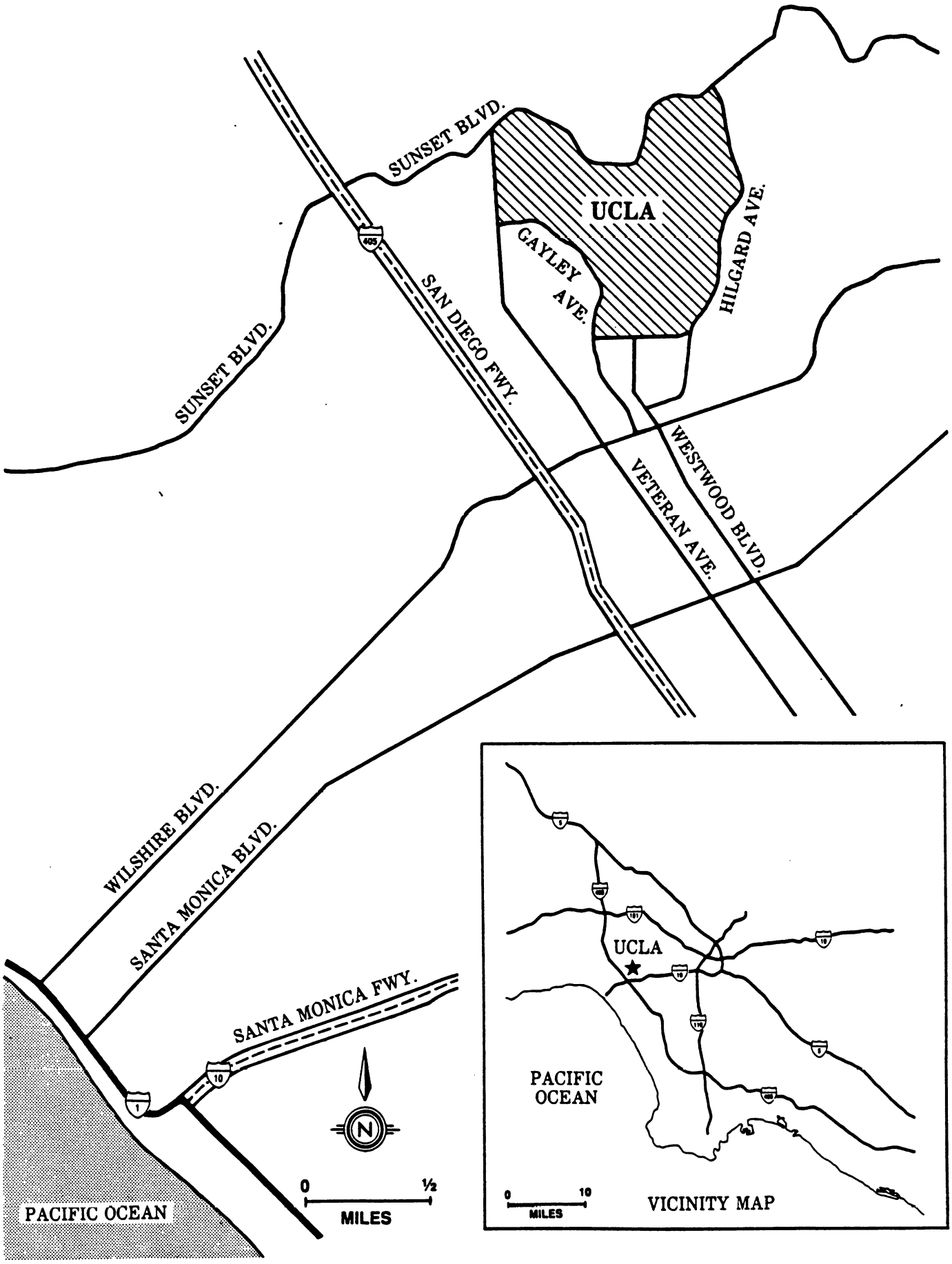
Based on a 1987 environmental impact report for the Westwood Community Plan update, over 21,000 work in Westwood, exclusive of UCLA. Another 18,000 work as faculty and staff at UCLA. Since the Community Plan was updated, two new high-rise office buildings have been completed and another is under construction.

The updated Community Plan (January 1989) has downzoned Westwood, but still allows for considerable growth in employment. At build-out, an estimated 57,000 jobs will be located in Westwood, a 44.5% increase over 1987 levels. The Plan also allows for a population increase of 8,500, a 23% increase.

University of California, Los Angeles

UCLA is the largest campus in the University of California system and the largest university in Los Angeles County. Some 34,000 students attend UCLA and over 18,000 people work on campus. It should be noted that this case study focuses on UCLA faculty and staff, and not on students. Approximately 20,000 university-controlled parking spaces exist on and near campus to serve this total daytime population of over 50,000.

UCLA's employment consists of some 4,000 faculty and 14,000 staff and employees of the Center for Health Sciences (Med Center). This number is not expected to grow significantly in the near term, but even so UCLA is the major employer and influence



WEST LOS ANGELES, CA

FIGURE 1

in Westwood. In fact, the next largest single employer in Westwood is the Federal Building with some 3,000 employees and the largest private employer is Occidental Petroleum with 450 employees. Most of the employment in Westwood is either smaller firms in multi-tenant buildings or smaller retail and other commercial establishments.

UCLA continues to build on campus, even with expectations for stable employment levels. A new housing complex is underway on Northwest Campus, as is a new engineering building. A large medical clinic building is being built in the center of campus and will have a significant impact on traffic, given the expected visitors.

Transportation Facilities

UCLA is located approximately a half mile from the San Diego Freeway (I-405), with access at the southern and northern edges of campus. The Santa Monica Freeway (I-10) is located some three miles south, but the 405 provides the primary freeway access. Several major arterials, providing regional access as well, line the campus, including: Wilshire, Sunset and Sepulveda Blvds. In fact, Wilshire Blvd. is ten lanes wide at Westwood, as wide as the San Diego Freeway at Wilshire.

Transit service to UCLA is among the best in southern California, with 12 lines from three public operators serving Westwood. In fact, UCLA is a major destination for the Southern California Rapid Transit District and a terminus for the Culver City and Santa Monica municipal systems. As will be described below, UCLA also operates its own internal shuttle system (throughout Westwood) and commuter bus service to two areas.

Finally, given the large numbers of students and employees that travel by bicycle, (and other motorized cycles such as mopeds) plans are underway to build an elevated bicycle facility called a Veloway.

Traffic in and around Westwood is severely congested. Westwood streets are overburdened and are expected to worsen. Recent City of Los Angeles Department of Transportation statistics show that within the Westwood Community Plan area, 15 of the 52 intersections operate at LOS "F" during the peak periods. The EIR predicts that by the year 2010, 30 of these intersections will operate at LOS "F", even assuming that a list of eight street widening and improvements will be made. At build-out of the Community Plan area, 38 of these intersections are expected to operate at LOS "F."

A major strategy the City is using to address traffic problems is the collection of traffic mitigation impact fees to pay for, among other physical improvements, the installation of the ATSAC system (Automated Traffic Surveillance and Control system). ATSAC is expected to improve traffic flow by some 15% at intersections and street segments for which it is installed. ATSAC is a computerized traffic control system that will automatically adjust signal timing to compensate for changes in the areawide system of traffic flows. The impact fee system was established as part of the Westwood Specific Plan Ordinance (there are actually several in the area), and calls for a fee of some $5,200 for each p.m. peak trip generated, and has a trip reduction requirement as well.

Traffic entering the UCLA campus has also grown considerably. Based on cordon counts, total daily vehicle volumes had increased by 17% from 1980 to 1985 (95,000 to 111,000). Vehicles entering at the three major entrances increased by 1.5 times more than at other access points. This increase and concentration underscores the traffic congestion situation facing UCLA. Overall, in 1985, the following trip patterns (entering and exiting of students, faculty and staff) were observed:

Vehicles	111,437
Pedestrians	22,129
Two Wheeled	4,386 (12 hours)
Transit	10,878 (12 hours)

Two thirds of the transit riders reaching the campus used one of the three public bus systems, while the remaining third used the UCLA parking shuttles that serve remote lots outside the area's cordon; the shuttle riders, therefore, be better classified as auto users. Inclusive of students, overall vehicle occupancy in 1985 was 1.26 (exclusive of bus passengers, pedestrians, and two wheeled cycles). According to the cordon information, the a.m. peak hour mode split (defined as auto drivers vs. passengers) in 1985 was:

Mode Split of All Persons Entering Campus

Travel Mode	Number	Percent
Auto Driver	7,056	55.4%
Auto Passenger	1,708	13.4
Bicycles	224	1.8
Motorized Cycles	237	1.9
Pedestrians	2,066	16.2
Bus Passengers	997	7.8
Parking Shuttle	435	3.4
Total	12,723	100.0%

Due to student trips, peaking characteristics are slightly later than for the rest of the region. The morning peak hour, based on 1985 cordon data, is 7:45 - 8:45 a.m. (7.2% of the daily total) and the evening peak is 5:00 - 6:00 p.m. (8.4%). Peak hour traffic volumes have grown very little from 1980 to 1985, while other off-peak periods have experienced much greater growth, indicative of a system nearing capacity. In fact, by 1988, the a.m. peak hour seems to have shifted closer to the 7:00 - 8:00 a.m. hour. A comparison of employee arrival times, based on employee surveys in 1985 and 1988, is presented in the figure below. This information confirms the 7:00 - 8:00 a.m. hour as having the largest concentration of arrivals and shows a slight shift to later arrivals between 1985 and 1988.

Time	1985	1988
Before 6:00 a.m. or after 10:00 a.m.	7.7%	6.6%
6:01 - 7:00 a.m.	14.8	14.2
7:01 - 8:00 a.m.	45.9	46.8
8:01 - 9:00 a.m.	25.4	26.2
9:01 - 10:00 a.m.	6.2	6.1

Parking fees are charged to all students, staff, faculty and visitors. The monthly/daily fee is $30/$4 respectively, which is well below the market rate in Westwood of $80-$120/$6-$10. Employees are virtually guaranteed a space, and are generally assigned to a lot near their building. Some parking is provided in three peripheral lots, served by shuttle buses, but primarily serves students. Therefore, most employee parking is distributed through the campus in various sized facilities adjacent to buildings. Some employees are eligible for a "blue" permit allowing access and convenient parking at many locations. This is for employees in positions requiring significant intercampus travel. However, with the implementation of the Campus Express shuttle service, more employees are making these trips without their car.

Students also pay $30 per month ($90 per quarter) to park, but vie for a limited number of spaces. A need-based point system is used and student parking is determined by various factors, including: commute distance, tenure, availability of near-by transit, etc. A waiting list several thousand names long exists each quarter. Student carpool permits are provided for carpools of three or more, at a cost of $22, and these commuters are assigned parking first.

In 1985, there were 19,600 available parking spaces on campus, for a combined student and employee population of some 50,000. The maximum accumulation occurs at 11:00 a.m. when 86% of the spaces are filled. The rate of increase in accumulated vehicles is less than a third of the increase in traffic volumes. Again, this is indicative of the peak spreading that is occurring, as increased volumes are being absorbed outside the morning and evening

peak hour. Parking is constrained in many lots as some 1,000 spaces are stacked parking requiring attendants to park cars.

Traffic is a major issue in Westwood, and a very well organized and vocal network of community and homeowner's groups has emerged to bring the issue to the forefront. Growth within the UCLA campus is not controlled by the City, but rather is under the jurisdiction of the U.C. Regents and the State. While UCLA's transportation management program, and its outreach to the rest of Westwood is designed to serve the commuter needs of the campus and its surroundings, it is also clearly a response to the politicizing of the growth and traffic issue and UCLA's desire to remain a responsible community institution.

2. BACKGROUND AND MOTIVATION FOR TDM Program

Prior to 1984, commuter assistance services were provided through the University's Transportation Services office. These services were mainly comprised of annual registration drives, in conjunction with the regional commute management organization, Commuter Computer. Student workers were used to assist Transportation Services staff with the rideshare registration drive and the program was otherwise relatively passive.

In 1984, in conjunction with UCLA's role in the L.A. Olympics, UCLA committed to developing a comprehensive commute management program for UCLA students, staff and faculty. The Commuter Assistance - Ridesharing Office (CAR) was established as a department within the Business and Transportation Services Administration. The CAR Office currently has a staff of 13 full-time equivalents (plus student assistants) and has won numerous awards as a premier university ridesharing program in the U.S. While vanpooling has become the focus of the CAR program, the variety of services and promoted alternatives includes:

Vanpools

65 UCLA vans are currently serving Westwood and the campus, primarily with 15-passenger deluxe vans and some 6-passenger mini-vans. Seventy percent of the riders are staff, 20% students and 10% faculty and non-UCLA commuters. The vans are owned and maintained by UCLA. The round trip distances that vans travel range from 25 to 200 miles. Fares are based on mileage and average $60-120 per month for full-time riders. Use is also allowed on an occasional, space-available basis. Demand is growing for vanpools and the use of starter vans is an attempt to capture the latent demand for vanpooling without waiting for enough passengers to make a 15-person van viable. Vanpoolers seem to rideshare for the convenience and reduced stress rather than for cost savings. Since the average vanpool fare is twice the parking fees and parking is available to employees, convenience must be the central draw.

Carpools

The CAR program maintains a service contract with Commuter Computer for Remote On-Line Access (ROLA) to the regional ridesharing database. This allows for on-line matching of interested individuals with others in the system. Interested individuals can also

fill out registration forms and receive matchlists in the mail. As mentioned above, three or more students are eligible for a Special Student Carpool Parking Permit which entitles groups to reduced rates and a priority on parking waiting lists. No preferential parking is provided for carpooling employees, since most get parking near their buildings. Recently, however, carpool permits have been instituted which offer a cost savings for three or more employees per vehicle.

Buspools and Transit Services

UCLA operates two commuter bus routes, from the Westchester/LAX area south of Westwood and from Sherman Oaks/Studio City north of campus. Hourly service (three runs) during the peak morning and afternoon periods is provided. The routes were determined by identifying employee/student concentrations that were approximately 8-15 miles from campus and thus not well served by vanpools. They serve existing Caltrans park-and-ride lots and one lot arranged with a private party. The fare is $1.50 each way or $55 for a monthly pass. The runs are currently operating at 50% load factors. UCLA contracts for the service with a private provider. The CAR Office also promotes the services of the three public transit systems and Caltrans park-and-ride lots that serve UCLA.

Motorcycles, Mopeds, and Bicycles

There are 43 parking areas offering 2,300 spaces for motorcycles and mopeds. In addition, 57 areas on campus provide over 2,300 bicycle parking spaces. Given the significant number of students and staff that commute to UCLA and travel within the campus by bicycle, motorcycle and moped, the CAR program has developed an aggressive educational campaign on parking, safety and use of these modes.

Shuttle Service

A broad range of UCLA-operated shuttle services are provided: the Campus Express services, shuttles to off-campus housing areas, an Evening Van service linking housing areas to other key locations, and the Medical Center shuttle. The first three services are operated by Campus Transit and the fourth by the Hospital Transportation Department. The Campus Express utilizes 30 passenger vehicles and provides internal circulator service with the campus and to Westwood Village. It is free and well utilized by students and employees alike. It operates on 5-10 minute headways, serving ten stops through the campus.

Additionally, Campus Transit operates three park-and-ride shuttles to remote lots near the southwest corner of campus. The City's DOT operates a weekend shuttle services from a nearby Federal Building into Westwood Village (which is closed to traffic on weekends).

3. OVERALL EFFECTIVENESS OF PROGRAM

In order to assess the effectiveness of UCLA's evolving commuter assistance program, several data sources are utilized. Since 1970, UCLA has been performing periodic surveys, either Housing and Transportation or special Commuter Surveys. These surveys have been performed approximately every five years (1970-1985), plus a special evaluation was performed in 1988 among faculty and staff. These data, excluding students (see figure below), show the dramatic impact that the vanpool program emphasis has had since 1984. However, they also show the relatively stable relationship of drive alone commuters to users of alternative modes.

Mode Split 1970-1988 for UCLA Staff and Faculty

(Excludes Students)

Year	**1970**	**1975**	**1980**	**1985**	**1988**
Travel Mode					
Drive Alone	76.1%	74.4%	75.0%	75.6%	74.4%
Carpool	11.0	9.7	6.9	11.5	10.1
Vanpool	0.0	0.0	0.1	1.7	5.0
Transit	6.5	9.2	11.4	6.1	6.2
Other *	6.3	6.7	6.6	4.0	3.8
Vehicle Trips per 100 Employees**	80.7	78.6	78.2	86.7	79.0

* includes walking, bicycling, etc.

** Calculation assumes 2.5 persons per vanpool,
12 persons per vanpool trip, and
30 persons per transit trip

A shift of employees, from carpooling to transit, occurred right after two major gas crises (1975 and 1980) and the resurgence back to carpools was probably due to UCLA's rideshare marketing efforts and to a perceived denigration of bus service throughout the region.

Overall, the program seems to have attracted vanpool riders, and solidified carpoolers, but at the expense of transit and walk/cycle modes. Thus, between 1980 and 1985, while the proportion of transit users and carpoolers seems to switch and considerable movement occurred between several alternative modes, traffic volumes increased by 17% and the drive alone rate remained the same. It should be mentioned that the survey and methodology between the two periods was somewhat different; the survey is based on sample, while the traffic volumes are from direct observation. The 1970-80 surveys were performed to gather transportation and housing information. A more detailed survey on transportation behavior and attitudes was used in 1985 with a smaller sample size.

Assessing the overall effectiveness of UCLA's TDm program can be performed by utilizing the method of calculating vehicle trip generation as employed throughout this report (described in table above). Based on this calculation, it can be shown that in 1980, before the TDM program was initiated in earnest, UCLA was generating 10,951 daily vehicle trips from among its approximately 14,000 employees. This translates to 78.2 trips per 100 employees. In 1985, after initiation of the program and its vanpool component, the rate increased to 86.7 trips per 100, translating to 13,867 vehicle trips from a population of then 16,000 employees. The rise in vehicle trip generation was primarily due to a 5% shift away from transit to carpooling (and only 1.7% vanpooling). However, in 1988, when the vanpool program was accounting for a full 5%, 14,231 vehicle trips were generated, translating to 79 trips per 100. There fore, the vanpool program was able to recapture the trip reduction gains that were lost in the general shift from transit.

In any case, there seems to be a stable level of drive alone commuting (about 75%) and considerable movement between alternative modes, although almost 30% of the carpoolers polled in 1988 have been carpooling to UCLA for five years or more. Seven-tenths carpool with household members, indicative of the size and variety of employment on campus. Additionally, 70% of carpoolers share a parking permit, which had a clear benefit to UCLA's already strained parking situation. However, since all employees have access to parking, priced below market rates, the primary motivation among staff and faculty seems to be the convenience of commuting with others and not having to deal with traffic congestion on a daily basis.

Commute patterns are clearly influenced by the distance to work. An interesting analysis is provided through the 1985 survey results, by comparing the average commute distance, duration and speed for each travel mode, as shown in the following table:

Commute Mode	Distance	Time	Speed
Walk/Bicycle	2.5 miles	22.2 min	7 mph
Bus	7.7 miles	41.0 min	11 mph
Motorcycle/Moped	10.0 miles	23.3 min	26 mph
Drive Alone	11.6 miles	31.4 min	22 mph
Carpool	15.3 miles	36.9 min	25 mph
Vanpool	29.4 miles	60.7 min	29 mph
All Employees	12.0 miles	30.8 min	23 mph

These findings confirm the conventional mode/distance relationships recognized in Transportation Demand Management (TDM) planning. Indeed, carpooling, vanpooling and transit serve different markets, partially differentiated by the distance to UCLA. Similarly, in 1988, 17% of the survey respondents who lived over 15 miles from UCLA traveled to work by vanpool, showing the effectiveness of UCLA's vanpooling program to penetrate this longer distance market.

4. OTHER PROGRAM EFFORTS

Another means to evaluate the effectiveness of the UCLA CAR program is to compare it to another major university in the area. Comparing the mode split for UCLA versus another university's program reveals something about the programs at and conditions around UCLA.

California State University, Northridge (CSUN) is one of the largest campuses in the CSU system and is the third largest university in L.A. County (after UCLA and Cal State University, Long Beach). CSUN is located in the San Fernando Valley in a lower density area than Westwood. Some 30,000 students attend CSUN and 4,500 faculty and staff work at the University. Parking is constrained at CSUN, with only 1,500 parking spaces available to employees (although a significant number of employees work during evening classes) and only 5,400 for students. Staff and students pay $12.00 per month for parking and faculty pay $7.50 per month. Unlike UCLA, CSUN's parking permit program is not capacity controlled -- in other words, anyone can purchase a permit but they are not guaranteed a space, as far more permits are sold than spaces are available.

Prior to the passage of the SCAQMD's trip reduction regulation, CSUN's commute management program consisted of a standard, somewhat passive approach. Annual ridesharing registration drives were conducted with Commuter Computer and transit information was provided at the Student Union. Additionally, facilities were installed for a

bus lane and terminal on campus as well as considerable provisions for bicycles. Based on 1988 (UCLA), 1989 (CSUN) survey data (and 1988 regional statistics) the mode split for University employees is as shown in the table below:

COMPARISON OF UNIVERSITY EMPLOYEE TRAVEL

	UCLA	CSUN	REGION
Travel Mode			
Drive Alone	74.4%	85.1%	83.0%
Carpool	10.1	6.6	14.0
Vanpool	5.0	0.1	1.0
Transit	6.2	0.6	2.0
Bicycle/Walk	3.4	6.6	0.0
Other	0.4	1.0	0.0
Vehicle Trips Per 100 Employees *	79.0	88.0	83.6

* Calculation assumes 2.5 persons per vanpool,
12 persons per vanpool trip, and
30 persons per transit trip

The sample for the CSUN sample was not a random sample, but given the self-selection bias among ridesharers, the sample probably does not severely underestimate non-drive alone. The increased walk/bicycle proportion is probably due to the existence of affordable housing within short distance of the campus at Northridge and the low transit patronage related to service levels and coverage. The statistics do, however, point to the ability of the UCLA program, acknowledging the more congested conditions and transit availability, to maintain 10% more employees using commute alternatives with their more comprehensive program. However, it should be noted that CSUN has a more constrained parking situation than UCLA, but its employees seem to respond by adjusting parking times and locations rather than switching modes.

It should be noted that since the passage of AQMD Regulation XV, CSUN and the entire CSU system is taking a hard look at the commute incentives that will need to be offered to affect the necessary trip reductions.

Comparing UCLA's program to that of CSUN and the region as a whole, on a trip reduction basis, permits an assessment of the effectiveness of the UCLA program in reducing vehicle trips. As mentioned above, in 1988 UCLA generated 79 vehicle trips per 100 employees. CSUN generates 3,961 vehicle trips among its 4,500 employees, for 88 trips per 100 employees. If UCLA were to generate trips at the same rate as CSUN, 15,844 vehicle trips would be made by its 18,000 employees. If CSUN is considered typical of university commutation conditions, then UCLA's program has reduced 1,613 trips over this ambient condition, for a 10% trip reduction over levels attainable with a typical programs. Comparing UCLA with CSUN yields a very positive profile for the trip reduction accomplishments of UCLA. However, comparing its results with he region as a whole is perhaps more realistic. If UCLA were to generate vehicle trips at the rate of the LA region, i.e., at the rate of 83.6 trips per 100 employees, its population would produce 15,048 vehicle trips. Based on this comparison, this means that the UCLA is reducing 812 vehicle trips from background levels, constituting a 5.4% trip reduction.

5. FUTURE PLANS FOR THE UCLA TDM PROGRAM

UCLA has a long term budgetary commitment to TDM. The current year budget is over two million dollars for all the commuter programs and services offered. UCLA is in the process of planning and implementing three new components to its program. In the spring of 1989, UCLA was the catalyst in forming a Transportation Management Association for the entire Westwood area. The university contributed $70,000, which was matched by city funds for the formation of the Westwood Transportation Network. UCLA's desire is to expand the CAR program to the entire activity center in order to have a greater impact on area traffic. CAR staff, in conjunction with an area chamber of commerce and several businesses, is currently setting up the TMA and establishing the TMA office.

Second, the CAR program has recently implemented a Guaranteed Ride Home program for ridesharers. Drive alone respondents to the 1988 survey cited such a back-up system as the primary incentive that might encourage them to carpool or vanpool.

Finally, parking rates at UCLA were increased as of July 1, 1989, from $22 per month to $30 per month. While students have been eligible for special carpool parking permits, this will be the first time that faculty and staff will be able to purchase a carpool permit. Thus, employee carpools of three or more can realize a cost savings by purchasing a single carpool permit for $22 rather than individual permits at $30. Finally, a "RIDE" card is available to ridesharers, offering the occasional driver a guarantee to park in their preferred lot for the old daily rate of $3.00. This increase in employee (and student) parking rates, and the availability of carpool permits and the RIDE card for occasional parking may create more of a financial incentive among employees, whereas heretofore, the main motivation seemed to be the convenience of sharing a ride and the potential for reducing commute stress.

10. CASE STUDY: ATLANTIC RICHFIELD COMPANY

DOWNTOWN LOS ANGELES, CALIFORNIA

1. SITE DESCRIPTION

Location and Character of Site

The Los Angeles Central Business District (CBD) is the largest employment center in the L.A region. An estimated 225,000 employees work in downtown L.A. This area is the banking, cultural, and government center of the region, and will likely remain so, due to L.A.'s position as a major international center in the Pacific Rim economy. Major banking reform in California, which will allow the entry of many new banks in 1991, is expected to bring considerably more new employment to downtown L.A. Over a quarter of a million employees are expected to work in the CBD by 1995.

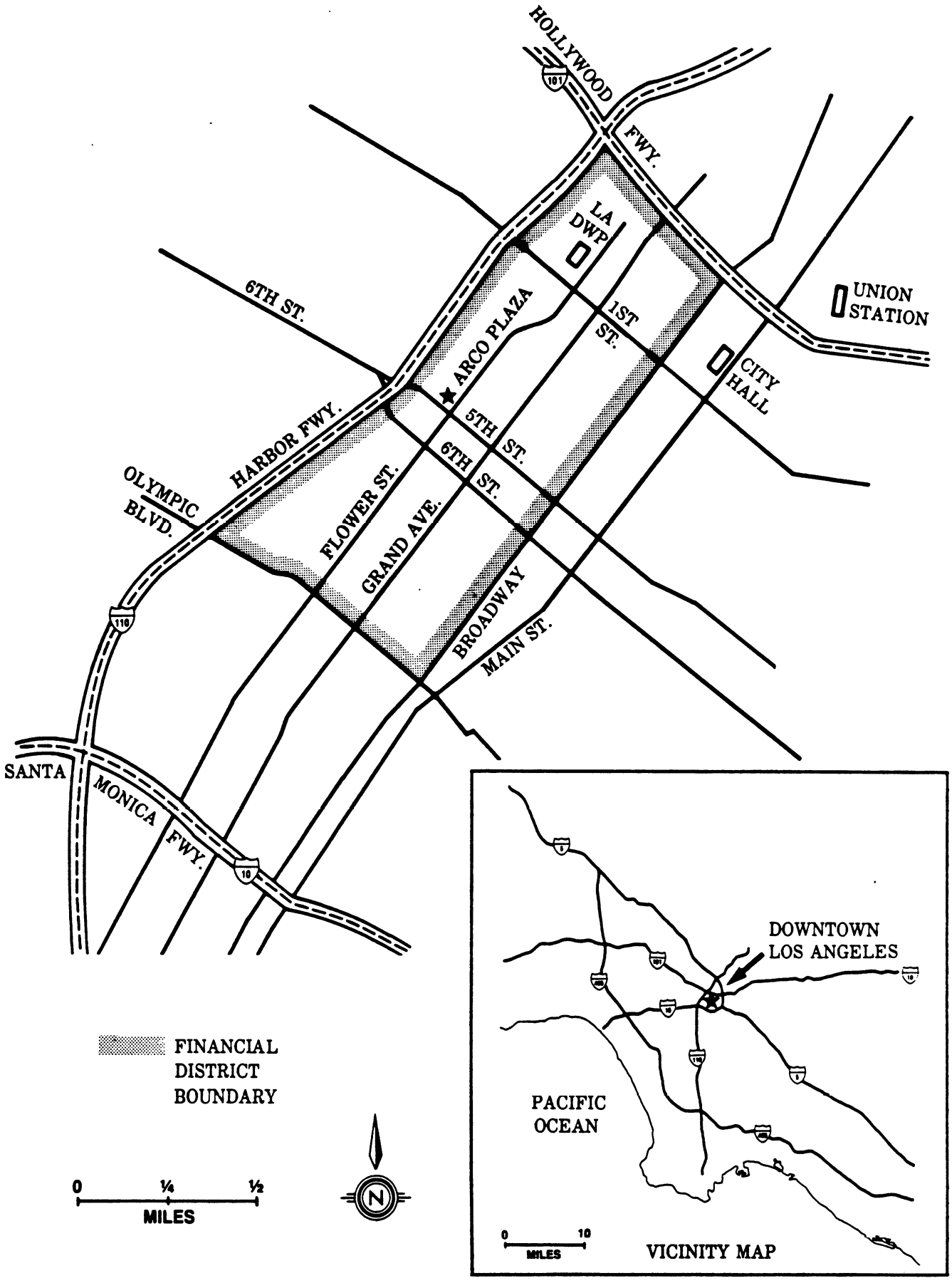
Of the 225,000 employees, 175,000 are classified as "office workers." Since the 1960's, over 23 million square feet of new office development and 5 million of retail/wholesaling space has been added to downtown L.A. As of 1987, the 20 largest (in terms of costs) office developments that were approved or under construction accounted for an additional 14.3 million square feet, including L.A.'s first 70 story building, Library Square.

Transportation Facilities

Much of the regional freeway system (see Figure 1) is radially-oriented, with downtown L.A. as the hub. The CBD is bounded by the Santa Monica Freeway (I-10) to the south, the Harbor Freeway (I-110) to the west, the Hollywood Freeway (U.S. 101) to the north and the Golden State (I-5). In fact, the Harbor Freeway becomes the Pasadena Freeway north of downtown and this was the first freeway in the U.S. when it was opened in the 1930's as the Arroyo Seco Parkway.

L.A.'s transit system is also radially-oriented, especially the peak hour express service. The Southern California Rapid Transit District (RTD) has 51 local and 43 express routes serving downtown L.A. Additionally, the City of L.A. DOT contracts for another eight commuter express routes and the County for four others. The Santa Monica, Montebello, and Torrance municipal systems operate express service to downtown L.A., as does the Orange County Transit District. In all, over 100 local and express routes serve downtown L.A.

Several transit facilities serve downtown L.A. or are in the process of being constructed. The El Monte Busway operates from the San Gabriel Valley to the east and utilizes a separated right-of-way to Union Station. The Busway is open to buses, vanpools, and carpools with three or more occupants. The El Monte Busway is in the median of the San Bernardino Freeway and signs along the route proclaim, "Busway users save 20 minutes during peak periods." Another commuter lane is currently being constructed on the Harbor Freeway, from San Pedro (the Port of L.A.) to downtown and will be operational in 1993.



DOWNTOWN LOS ANGELES, CA

FIGURE 1

The RTD is currently constructing the first operable segment of the Metro Rail Red Line, which will operate from Union Station to Alvarado Street (4.4 miles). Subterranean construction is ongoing and the line is planned to open in 1994. The Los Angeles County Transportation Commission is currently constructing the L.A. - Long Beach Light Rail Line (Blue Line) from downtown L.A. to downtown Long Beach. The Red and Blue lines will have two common transfer stations. The Blue Line is scheduled for operation in 1991.

Finally, Amtrak service to San Diego, Orange, and Ventura Counties operates as commuter rail service during the 4-5 peak hour runs. Caltrans subsidizes the peak hour service and many trains operate at standing-room-only. The City of L.A. operates a downtown shuttle service from Union Station throughout points downtown.

Traffic conditions in and around downtown L.A. are severely congested and getting worse. While 225,000 people work in downtown L.A., it is estimated that over 700,000 people enter the downtown on a typical workday. This quantity of trips, coupled with Metro Rail construction, has created severe congestion on both downtown streets and the freeways serving downtown L.A. Downtown streets often experience near gridlock conditions, prompting the City to enact a gridlock law, imposing stiff fines for getting "caught in the box."

Several solutions have been devised to address traffic congestion. The city, with its Automated Traffic Surveillance and Control (ATSAC) system, and Caltrans' downtown traffic control center are working to improve the efficiency of the roadway system, but it is clearly not enough. Los Angeles' mayor, with the support of the downtown business community and all major government agencies, has developed a transportation management plan that includes a heavy emphasis on Transportation Demand Management (TDM). To show the city's commitment, parking rates for city employees was raised from $5 per month to $25 and transit pass subsidies introduced. The City also passed a landmark ridesharing ordinance in 1986, requiring all employers with 500 or more employees and all buildings with 550,000 square feet or more to develop programs designed to increase peak period vehicle occupancy to 1.75 in the downtown and 1.5 in most other areas. This ordinance was repealed when the regional air quality trip reduction regulation was enacted. The Community Redevelopment Agency (CRA) of Los Angeles also has a comprehensive set of development requirements for trip reductions programs at new developments.

Commuting characteristics of downtown employees reveals a much higher use of alternatives than for the region. Forty percent of downtown L.A. office workers commute to work by means other than driving alone, according to a CRA ridesharing survey conducted in early 1987. The modal split of downtown office workers, as compared to regional statistics compiled by Commuter Computer, is:

	Downtown L.A. (1987)	Region (1988)
Travel Mode		
Drive Alone	60%	83%
Rideshare *	19	15
Transit **	21	2

* includes walk, bicycle, motorcycle, other
** includes commuter rail and private bus

According to the CRA survey, the downtown experiences severe p.m. peak hour peaking problems, as 28% of office workers leave between 4:30 - 5:00 p.m., as compared to 11% for workers throughout the region. In fact, 25% of downtown office workers leave in the 15 minute period, 4:30 - 4:45 p.m., while only eight percent leave in the 15-minute periods before and after this rush "quarter hour." Thus, the CRA study concluded that downtown L.A. possesses significant potential for flex-time, especially given the fact that only 38% of the employers surveyed offer some form of a flex-time programs.

Employer programs vary considerably, but the CRA survey showed that 83% of the employers responding provide free or highly subsidized parking. Only 14% of the private companies surveyed have commute management programs, and 19% retain Employee Transportation Coordinators. This is compared to 83% of the government agencies that offer some form of carpooling program for employees. While 21% of the downtown office employment uses transit to get to work, only 12% of the employers provide subsidized transit passes and four percent offer free transit passes to employees. Interestingly, among private firms, service, finance, insurance and real estate firms are the primary providers of transit incentives. This is likely due to the large proportion of administrative and clerical workers employed at these types of firms.

Therefore, traffic in and approaching downtown L.A. is severely congested and getting worse as the downtown economy flourishes and the transportation systems slowly expands. The proportion of employees using alternatives to driving alone is quite impressive when compared to the region, but this is largely due to the transit orientation of downtown L.A. The proportion of employees ridesharing to work is not significantly higher than the regional average. However, some downtown companies have proven to be exceptions to this, and the Atlantic Richfield Company's program is often touted as an exemplary program nationwide.

2. BACKGROUND AND MOTIVATION FOR TDM PROGRAM

This case study focuses on the TDM program at Atlantic Richfield's downtown Los Angeles site. ARCO's TDM program has been heralded as exemplary since its inception in the early 1970's. Located in the Bunker Hill area of downtown L.A., ARCO Plaza has twin 52-story towers and a retail complex. ARCO's international headquarters were relocated here from New York in 1972, and ARCO has maintained from 3,000 to 1,500 employees at this and nearby sites since that time. The buildings, located on the block bounded by Figueroa, Flower, Fifth and Sixth Streets, are multi-tenant structure with many large and small employers.

At the time that ARCO relocated its headquarters from New York City to Los Angeles in 1972, the firm began a carpooling and subscription bus service. The latter consisted of leasing six buses from the RTD to provide service for employees located in the San Fernando and San Gabriel Valleys to its downtown L.A. office. This commuter assistance program soon evolved into a vanpool program, and ARCO was instrumental in forming one of the first regional ridesharing organizations, Commuter Computer (a.k.a. Commuter Transportation Services, Inc).

ARCO currently has some 700 employees in ARCO Plaza and another 700 employees in the Trans-Pacific Building across the Harbor Freeway. ARCO leases 350 spaces within ARCO Plaza for employee parking, and 300 spaces within the Trans-Pacific Building. While the building allocate slightly more parking spaces based on ARCO's office space leases, their TDM program results in parking demand that is equal to or less than half of the employees in each location. The parking spaces are not included in the floor space leases, so ARCO is faced with leasing spaces at $135 for ARCO Plaza and $125 at the Trans-Pacific Building. The firm passes part of these costs on to employees. Therefore, while ARCO has access to a larger number of spaces in each building, their TDM program and parking subsidy scheme (each described below) has resulted in the firm needing only one space for each two employees. However, ARCO cites the primary motivation for establishing and maintaining the program as contributing toward traffic congestion relief and energy conservation efforts.

Currently, ARCO's transportation management program consists of seven primary alternatives to driving alone, including:

(1) Carpooling

(2) Company Sponsored Vanpooling

(3) Buspooling

(4) Transit Information and Pass Sales

(5) Amtrak Commuter Rail

(6) Telecommuting (working from home)

(7) Compressed Work Weeks

ARCO also encourages walking and bicycling to work, but its location makes these alternatives relatively infeasible. Commute data for all employees is maintained on a computer by the commute management office, staffed by three persons. The manager of that program also serves as a loaned executive to the Central City Association of Los Angeles, in its efforts to form a set of Transportation Management Associations in downtown.

ARCO's vanpool program is at the center of its commute management effort. ARCO leases the vans and in turn charges users an average of $60 per month in fares. The company pays the insurance and allows employees of other firms to ride in its vans. ARCO currently has 55 vans operating and leases the vehicles for five years, assuring that modern, well maintained vans are always in use. ARCO also backs up its ridesharing program with a guaranteed ride home service, utilizing a near-by car rental company. Riders that have important meetings during the day or have an emergency at home can rent a car at a substantially reduced rate.

ARCO's rideshare subsidy program is comprehensive and also allows for the tracking of all ARCO employees' commute habits. Basically, ARCO provides a graduated scale of parking subsidies for employees, depending on auto occupancy and offers all ridesharers and transit users a $15 per month Transportation Allowance (the maximum currently allowed by federal tax law as non-taxable). The subsidy program is effected through the employee payroll program and the employee share is deducted on a monthly basis. The features of the subsidy program as they apply to each travel mode are:

Drive Alone:	ARCO pays one-third of the $125-135 monthly parking fee for each building $41.6 - 45$
2-Person Carpool:	ARCO pays two-thirds of the parking fee for each two-person carpool parking space, plus provides each user a $15 transportation allowance
3-Person Carpools:	ARCO provides a free parking space to carpools of three or more employees, plus provides each user a $15 transportation allowance
Vanpoolers:	Each vanpooler is given a $10 per month parking subsidy (assuming 12-13 in a van would pay for a space), plus provides each user a $15 transportation allowance
Bus, Train and Buspool:	Each transit user is given a $15 transportation allowance

Thus, the per-person subsidy cost to the firm ranges from a low of $15 per month for transit users to $58 per month for two-person carpoolers.

3. OVERALL EFFECTIVENESS OF PROGRAM

ARCO prides itself on having maintained at least a 50% alternative mode split since 1973, even though its workforce size has fluctuated and several external forces, such as gasoline price and transit service changes have occurred. In 1984, a company reorganization reduced the number of employees from approximately 3,000 to 2,000 and in 1988, the relocation of the International Company to Texas further reduced the workforce to around 1,500. The mode split for ARCO for three representative years is indicated in the following table:

	1983	1986	1989
Travel Mode			
Drive Alone	34.4%	45.3%	40.0%
Carpool	22.4	20.2	26.2
Vanpool	12.8	14.3	13.6
Transit/Amtrak	30.4	20.2	20.2
Veh. Trips per 100 Employees *	44.5	55.3	45.6
Vehicle Occupancy	2.25	1.81	2.19
Employees	3,000	2,000	1,500

* Assumes 2.5 persons per carpool
12 persons per vanpool, and
30 persons per transit trip

Thus, while the drive alone rate and vanpooling rate have hovered around 40% and 13%, respectively, ARCO has compensated for decreasing transit usage by strengthening its carpool program. This mode split, with an overall occupancy rate of 1.81, has enabled ARCO to report an a.m. vehicle occupancy rate of 1.96 to the South Coast Air Quality

Management District in response to Regulation XV, which requires all large downtown employers to meet an occupancy target of 1.75. ARCO's vehicle occupancy rate is much higher than the reported regional occupancy rate of 1.13.

The firm reports several perceived benefits from its ridesharing program. First, ARCO feels it is contributing to finding solutions to downtown traffic congestion and regional air quality problems. Its on-going commitment since 1973 to its own program and to regional ridesharing efforts is testimony to this. Second, the firm has reduced its parking needs through the program. As noted above, the TDM program and its transportation subsidy system have contributed to decreasing parking demand to one space for every two employees. Third, employee attendance, morale and productivity are all reported as improving.

4. INDIVIDUAL PROGRAM EFFORTS

Another means to evaluate the relative effectiveness of the ARCO program is to compare it to other large employer programs in downtown L.A. and to areawide statistics.

Bank of America

Bank of America was selected as a comparison site in the downtown to help gauge the effectiveness of ARCO's TDM program. Bank of America (B of A) occupies much of the other twin tower in ARCO Plaza.

In 1986, a UCLA graduate student performed a comparison of the ARCO program to that of B of A. While the samples from the surveys used in this analysis were quite small, the comparison was interesting in its discussion of mode choice.

In 1986, B of A had 2,045 employees and ARCO had a similar amount. At the time, B of A had no organized ridesharing program nor did the firm subsidize any alternative commute mode. It did subsidize 40% of the $100 monthly parking fee (at that time) for ARCO Plaza. It allocated 508 spaces, of a total of 800 available spaces (allocated by its floor lease, as with ARCO) for employees. There was a six month waiting list for subsidized spaces. For those without a subsidized space, their choice was to pay the full cost of a parking space, find a cheaper lot away from Bunker Hill, carpool and share the costs, or use transit.

As seen in the following table and based on the survey data, the mode choice comparison reveals that B of A experienced the same drive alone rate as ARCO, but more employees used transit at B of A, while more ARCO employees used carpools and vanpools.

COMPARATIVE MODAL SPLIT

BANK OF AMERICA VS. ARCO

	B of A	ARCO
Travel Mode		
Drive Alone	49%	48%
Carpool/ Vanpool	20	34
Transit	31	18

B of A's parking policy served to constrain parking on-site for employees and prompt a large proportion of employees to seek alternative commute modes. However, in the absence of a comprehensive TDM program with a range of alternatives, many B of A employees used the transit system. On the other hand, ARCO's vanpool program, carpool promotion, and balanced subsidy program induced more commuters into shared ride modes. These data illustrate that the particular incentives in a company's TDM program can dramatically affect its employees' travel choices.

Department of Water and Power

The Los Angeles Department of Water and Power (DWP) is another large downtown employer (3,850), with a General Office Building site four blocks north of ARCO Plaza. The building is a 17 stories high and contains 600,000 square feet of office space. DWP maintains a Commuter Services Office with a staff of six, plus part-time coordinators at other DWP sites.

The parking situation at DPW is fairly constrained, with only half of the employee capacity located on site. Employee parking is located in a garage under the building, in three levels totaling 1,995 spaces. This is approximately three spaces per 1,000 square feet of office space, or one space for each two employees in the building. Assigned parking spaces are allocated to employees on a seniority basis at $30 per month. Scramble parking (parking wherever an open space exists) is offered for $10 per month. Because the parking supply in the building is always at capacity, additional parking is provided across the street at the

To encourage ridesharing and reduce parking demand, DWP has a graduated parking fee structure for ridesharers, with carpools paying $12 per month and vanpools receiving free parking. Preferential parking for carpools and vanpools is made available in the General Office Building near entrances from the garage to the office building. DPW's ability to reduce parking demand clearly helps it minimize costly dependence on off-site parking leases.

While DWP does not offer a travel allowance, such as ARCO, it does have an aggressive program to market commute alternatives, particularly vanpools. Since December 1986, DWP has established 49 vanpools with waiting lists for more vans. More vans have been ordered, and the total demand for vanpooling is estimated at 77 vans. In fact, the proportion of employees commuting by vanpool has increased from 0.5% in 1986 to 10.2% in 1988. One reason that vanpooling is so successful is that 42% of DWP employees live 20 miles or more from work, as compared to about 25% for ARCO and B of A. Even with these distances, only five percent of DWP employees use transit, which is surprising as compared to the downtown as a whole and since most employees pay from $30-70 per month for parking.

Comparing the mode split of three large employer programs (ARCO, B of A, LADWP), downtown office workers (as surveyed by the CRA), and the region as a whole (as surveyed by Commuter Computer), the effectiveness of these large employer programs is clear from the presentation in Table 1.

Comparing the effectiveness of ARCO's TDM program in reducing vehicle trips, the number of vehicle trips per 100 employees was calculated using the occupancy factors utilized throughout this report. For those programs without separate carpool and vanpool proportions reported (Bank of America), the carpooler rate of 2.5 persons per vehicle was used. This is probably accurate in that B of A has no formal vanpool program and any vanpoolers would be commuting in private vans or those supported by other employers. ARCO generated 1105 vehicle trips for its 2,000 employees in 1986. This trip rate of 55.3 trips per 100 employees is almost three trips per 100 less than Bank of America (even with its high transit usage), 13 trips per 100 less than the Department of Water and Power and the CBD office employment, and 28 trips per 100 less than the regional mode split would dictate (due to the use of transit).

If B of A were seen as a typical employer and ARCO were to generate trips at the same rate as B of A, it would produce 1,148 trips or 42 more than with its existing program, for a four percent trip reduction attributable to the program. Alternatively, if the Department of Water and Power's program, with low transit use, were used as a control, ARCO would generate 1,360 trips among its 2,000 employees, or 255 more trips than with its comprehensive program, for a 19 percent trip reduction attributable to the program. Similarly, if ARCO were to generate trips using the CBD statistics a the norm or background conditions, 1,366 trips would be generated among the 2,000 workers in 1986, or 261 more vehicle trips than generated as a result of ARCO's TDM program, or a 19% trip reduction over ambient conditions.

Much of the success of ARCO's program is due to the large employee base from which to match ridesharers, the strategic use of parking supply and pricing, the overall subsidy scheme, and good downtown transit service. Their program stands out for their ability to induce half of the employees working at the downtown sites to commute to work by means other than driving alone over a 15 year period.

TABLE 1

COMPARATIVE TRAVEL CHARACTERISTICS

FOR SELECTED DOWNTOWN L.A. EMPLOYERS

	ARCO (1986)	B of A (1986)	LADWP (1988)	CBD (1987)	REGION (1988)
Travel Mode					
Drive Alone	46%	49%	55%	60%	83%
Rideshare	34	20	40	19	15
Carpool	(20)	NA	(30)	NA	NA
Vanpool	(14)	NA	(10)	NA	NA
Transit	20	31	5	21	2
Vehicle Trips Per 100 Employees *	55.3	58.0	68.0	68.3	83.6
Vehicle Occupancy	1.81	1.74	1.47	1.46	1.19

* Assumes 2.5 persons per carpool,
12 persons per vanpool, and
30 persons per transit trip

11. CASE STUDY: SOUTH COAST METRO

ORANGE COUNTY, CALIFORNIA

1. SITE DESCRIPTION

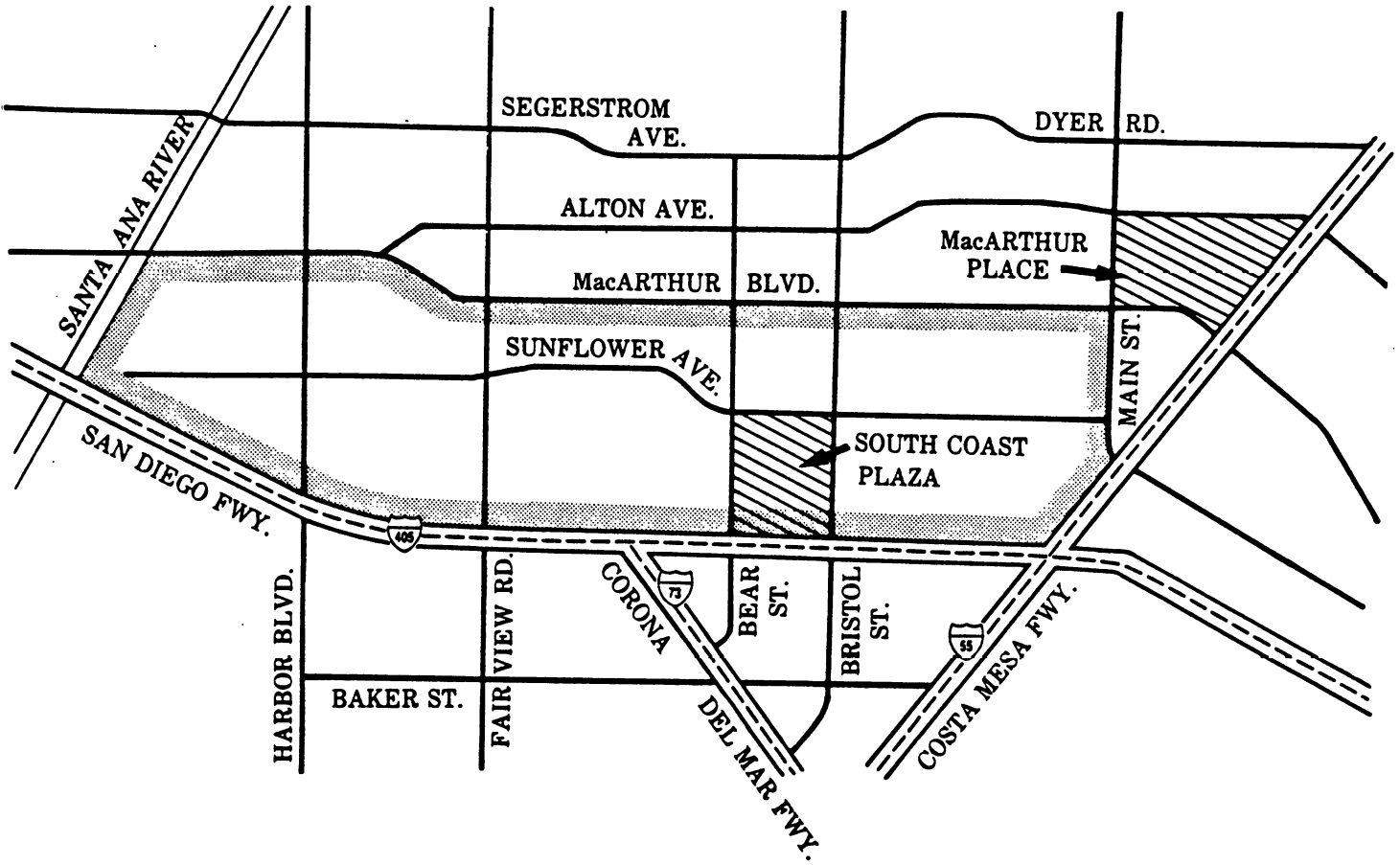
Location and Character of Site

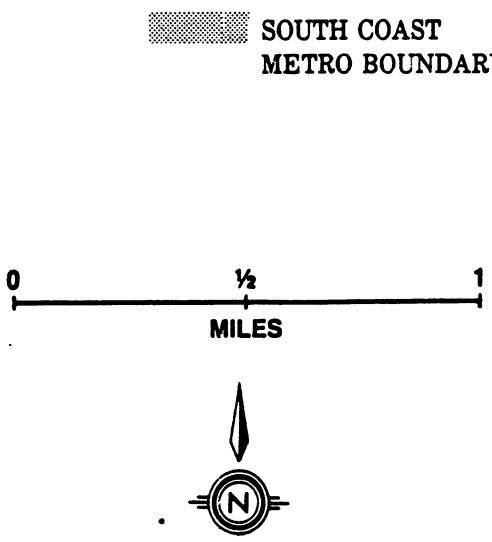
Orange County, located between Los Angeles and San Diego Counties, is the epitome of the multi-centered suburban area (see Figure 1). Orange County remains one of fastest growing counties in the nation (ranked third in rate of growth according to the 1980 census), and is no longer a set of "bedroom" communities for Los Angeles. The county has just over two million residents and almost one million are employed in the county.

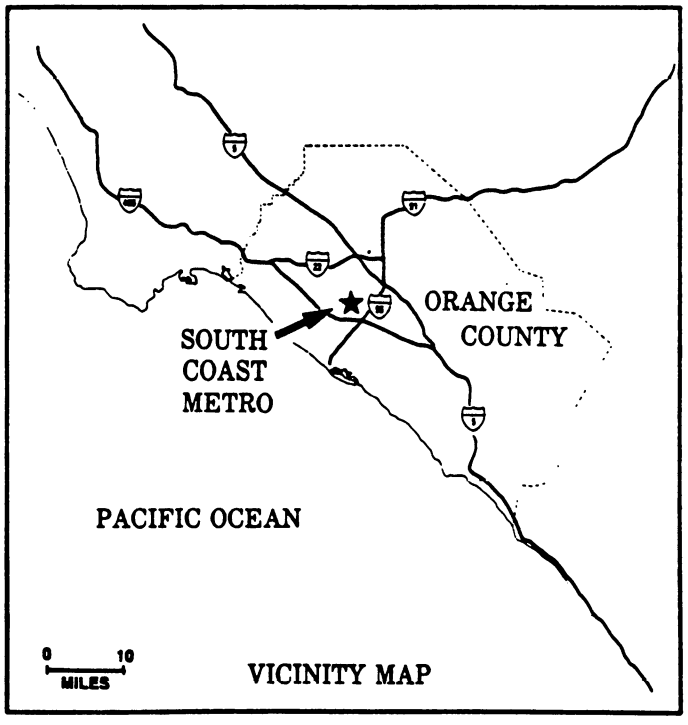
While Santa Ana is the county government center and possesses a downtown core, the largest employment concentration in Orange County is in the vicinity of John Wayne Orange County Airport. Comprised of the Irvine Spectrum, the Irvine Business Complex and South Coast Metro, these activity centers are all situated within the Orange County Airport Area. These centers comprise 24 million of the county's 37 million square feet of existing speculative office space. Employment in the Airport Area is approximately 200,000, which is of a scale similar to downtown Los Angeles and San Francisco. Unlike these downtowns, however, the Orange County Airport Area does not possess a rapid transit system or a radially-oriented highway system. Dispersed residential and employment patterns place a tremendous strain on the transportation system. Congestion levels on Orange County freeways are approaching some of the worst experienced anywhere in the U.S. Given the expected growth in employment and development anticipated for this area, the situation is likely to get worse before it gets better.

South Coast Metro is a mixed-use activity center, comprised of over 2,200 acres, and is situated in portions of the Cities of Costa Mesa and Santa Ana (see Figure 1). The "official" boundaries for South Coast Metro differ somewhat, but figure 1 presents the general area. At the heart of the center is South Coast Plaza, which includes one of the nation's largest retail centers, the Orange County Performing Arts Center, major hotels, a residential complex, and several high-rise office buildings. With several other developments in the area in existence or planned, South Coast Metro is considered by many as Orange County's "downtown." Existing (1987) land uses for the center as a whole include over 6.5 million square feet total of office, and R&D uses. The center has over 3.5 million square feet of retail space and almost 2,000 hotel rooms. Over 5,500 housing units are situated in South Coast Metro, ranging in type and density. Over 25,000 employees work for some 1,100 firms within South Coast Metro. While several large employers exist, most employees work for smaller retail, insurance, banking, and law firms.

At build-out, South Coast Metro is estimated to possess 13.5 million square feet of office space and employ 45,000 persons. Another major project, MacArthur Place will have a significant impact on the area. The parcel is located on the southeastern edge of South Coast Metro and is planned to include 3.8 million square feet of office space and 300 residential units. Over 15,000 workers may ultimately be employed at MacArthur Place.







SOUTH COAST METRO — ORANGE CO., CA

FIGURE 1

Transportation Facilities

As of the summer of 1989, each of two major freeways serving South Coast Metro, the San Diego (I-405) and Newport/Costa Mesa (SR 55), will possess high occupancy vehicle lanes for carpools, vanpools and buses. The other freeway serving the area is the Corona Del Mar freeway (SR 73). There are HOV by-pass lanes on most freeway on-ramps. The Orange County Transit District serves the center, and as a major shopping and employment center, service is relatively good.

Circulation within the center is also quite good, with wide arterials serving South Coast Metro. The problem seems to be of a more regional nature, as chronic congestion on the freeways backs-up onto the arterials during the peak periods. As of 1980, adjacent freeways were operating at about 85% of capacity. It is estimated that by the year 2000, the freeways will be operating at 135% of capacity. The County estimates that daily trip-making will increase by 59% by the year 2000, from 410,000 daily trips to the two cities to 667,000 trips.

2. BACKGROUND AND MOTIVATION FOR TDM PROGRAM

Several factors were responsible for developing a transportation demand management program in South Coast Metro. Each is briefly discussed below:

First, the South Coast Metro Alliance, a developer consortium, promotes Transportation Demand Management as an amenity for tenants, owners and users in its marketing of the center. This brought key commitments from the development community for a transportation management program.

Second, the local land use and transportation policies of the two cities, Costa Mesa and Santa Ana, have set the stage for traffic mitigation. Several key local and regional policies have affected the development of South Coast Metro and it's transportation management program. South Coast Metro was planned as a high-density, mixed-use development. Shared parking arrangements were included to reduce the overall parking supply by shared use of office and retail/entertainment uses. The tremendous growth of the center, however, has placed some strain, albeit in limited cases, on the parking situation in the center and this has contributed to the need for a center-wide TDM program. TDM is viewed as reducing further parking problems in the future as development continues.

The City of Costa Mesa, in addition to its shared parking ordinance, has an innovative housing ordinance, placing requirements on large developments, like South Coast Metro. This ordinance requires housing, either on-site or within city limits, to serve at least 20% of the project's workforce. This has prompted South Coast Metro developers to build over 1,200 multifamily units within the boundaries of the center. A 1981 Costa Mesa ordinance does require developers of South Coast Metro to implement TSM programs prior to issuance of building permits and submit a status report prior to occupancy. However, this statute has not been enforced to date as city staff feel it difficult to monitor such programs after occupancy.

The City of Santa Ana does not have mandatory TDM requirements as part of an ordinance, but is becoming more aggressive in requiring trip reduction measures as part of the development approval process. For example, at build-out, MacArthur Place is required to reduce trips by 30% which will be accomplished through a three-phase TDM program designed to result in 24% of employees commuting to the site traveling by alternative modes.

Third, a survey of employers and employees confirmed that a market existed for commute alternatives and that the formation of a Transportation Management Association was the appropriate means to implement a commute alternatives program. According to the 1986 employee and employer survey conducted in South Coast Metro (see below for more information), 44% of employees felt that local streets were always or usually congested and 63% felt the freeways were similarly congested. Almost two-thirds of employers in South Coast Metro felt that traffic congestion was going to get much worse and that congestion was affecting the delivery of products, employee tardiness and accessibility for clients and customers. Over 90% of these employers agreed that it was in their best interest to get directly involved in reducing traffic congestion.

Finally, a landmark trip reduction ordinance, passed by the regional air quality agency has involved many more employers in the transportation management program. This major regional air quality regulation is providing an additional impetus to TDM programs, above and beyond the need created by the worsening traffic and parking situation. In December 1987 the South Coast Air Quality Management District (AQMD) adopted Regulation XV, the nation's first mandatory trip reduction regulation tied to air quality attainment. While encompassing a four-county area in southern California, Regulation XV will impact all employers with 100 or more employees at any site. This will impact over 1,000 sites in Orange County. These employers are required to develop and implement a trip reduction plan, within 12 months, to achieve an average vehicle occupancy of 1.5 during the morning peak period. The regional auto occupancy is currently about 1.13.

Upon notification, the employers have 90 days to submit a plan, have a designated transportation coordinator trained, and file an application fee. A calculation of baseline vehicle occupancy, termed Average Vehicle Ridership (AVR), is required in the plan along with a listing of the incentives that will be offered to employees to reach the target AVR. Fines of $25,000 per day or incarceration can be levied against employers for not submitting a plan or not offering the incentives promised within the plan, but not for failing to meet the specified trip reduction targets. Regulation XV has provided an increasing demand for the program at South Coast Metro as more employers are notified to comply.

Components of South Coast Metro's TDM Program

Development of a transportation management program for South Coast Metro began as part of the efforts of the Orange County Transit District's Commuter Network. This county-wide commute management organization was reorienting its service policy to better serve major activity centers, rather than solely concentrate on individual commuters and employers. The Commuter Network had been working with Newport Center and the Irvine Spectrum for a year or more.

In 1986, the Commuter Network conducted a Mobility Enhancement Study in South Coast Metro. The purpose of the study was to explore the feasibility of initiating demand management strategies within the center and to determine the appropriate means for implementing these strategies. Supported by the South Coast Metro Alliance (primarily developers) and the Executive Task Force (representing over 80% of the center's major employers), the study involved a survey of commuters, employers, and interviews with chief executive officers. Some 2,600 commuters returned surveys and 144 employer surveys were returned.

The surveys revealed that the mode split for South Coast Metro was typical for the county in that the vast majority of commuters drive alone to work. A comparison of mode split from the 1986 South Coast Metro survey versus a 1988 county-wide survey reveals similar statistics:

	South Coast Metro	Orange County
Travel Mode		
Drive Alone	89%	90%
Carpool	8%	6%
Vanpool	1%	0%
Bus	1%	1%
Motorcycle	<1%	1%
Bicycle/Walk	1%	2%

Some of the reasons cited for driving alone included the fact that 93% of employees receive free parking at their workplace; 90% of all respondents need their car to run errands after work; and 71% would have difficulty in ridesharing with non-coworkers because their schedule is inflexible.

South Coast Metro does not experience severe peaking problems, at least not as compared with the neighboring Irvine Business Complex (IBC). Sixty-five percent of South Coast Metro employees arrive between 7:00 - 9:00 a.m., as compared to 90% of IBC employees. Only 49% arrive between the single peak hour (7:30 - 8:30 a.m.) as compared to 75% at the IBC. This is more in line with the mixed office/retail nature of South Coast Metro. Only 67% of South Coast Metro workers depart between 4:00 - 6:00 p.m., as compared to 86% at the IBC. Sixty percent of IBC employees leave work between 4:30 - 5:00 p.m., whereas only 38% of South Coast Metro employees leave during this half-hour period.

While this seems rather ominous for demand management prospects, some 57% of respondents said they would consider using an alternative 2 days a week. Additionally, three-quarters of the respondents said they would change their work schedule if given an opportunity.

The employer survey portion of the Mobility Enhancement study revealed that a joint public/private effort was needed as the most appropriate mechanism for organizing a transportation management program for South Coast Metro. In response, OCTD coordinated an effort to form the South Coast Metro Transportation Management Association. The TMA was formed in early 1988 as a cooperative effort of the South Coast Metro Alliance, the Employer Task Force, OCTD and the two cities. These groups are currently bound to the TMA effort through a memorandum of understanding. For the first year, the Alliance and OCTD are each contributing $85,000 toward the TMA. The TMA is staffed by a full-time executive director, a planner and an assistant.

The overall goals of the program are to:

- o create a self-sufficient TMA office
- o increase awareness of commute alternatives
- o implement TDM programs at employment sites
- o coordinate these programs to achieve maximum impact on reducing traffic congestion

In addition to providing centralized commute management services, such as carpool matching, vanpool formation, promotion of alternative work hour and telecommuting programs, and provision of tailored marketing materials and events, the South Coast Metro TMA provides the following services:

- o Employee Transportation Coordinator training
- o development of parking management programs
- o assistance in employer preparation of AQMD Regulation XV plans, via data collection, analysis and incentive planning
- o development and promotion of two transit routes for South Coast Metro bound commuters

3. OVERALL EFFECTIVENESS OF PROGRAM

The TMA has just completed its first full year of operation. No resurveying of employees has taken place nor a formal evaluation conducted. Therefore, no data exists to perform a mode shift or trip reduction analysis. The next section, on individual employer programs, does provide some insights into the effectiveness of selected programs and the potential

impact of the air quality trip reduction requirements. However, some preliminary results have been reported by the TMA in terms of achievement of internal objectives.

First, the TMA had a first year objective of increasing the number of South Coast Metro employees in OCTD's database by 7,200 individuals. Over 6,000 names have been added in the first year, which improves the ability of the TMA to match commuters from different firms into ridesharing arrangements. An objective was set to increase the number of OCTD-assisted ridesharers from approximately 375 to 1,500 and the TMA has identified some 416 new ridesharers since formation of the TMA. Additional objectives were set for transit ridership, use of flex-time and new worksite program, but insufficient information precludes any conclusions at this point.

While it is unclear what type of changes in commuter behavior would have occurred in the absence of the South Coast Metro TMA or the impact that the reported results have had on traffic congestion, the TMA has been able to increase the number of employers with TDM programs via a centralized transportation management program located within the center and in response to the air quality regulation.

4. INDIVIDUAL PROGRAM EFFORTS

To understand the types of individual employer programs that have been developed within South Coast Metro and the impact of Regulation XV, two programs are compared below. One program, at State Farm Insurance, exhibits a more effective trip reduction program than most firms in the area and the second, at Company "B" provides comparative statistics on a more typical effort.

State Farm Insurance

Approximately 980 people are employed by State Farm at its Southern California Regional Office in Costa Mesa. The company's TDM program before being subjected to the requirements of Regulation XV was primarily a passive ridesharing program. Prior to the spring of 1989, State Farm operated one vanpool, and encouraged employee ridesharing through preferential parking spaces, free morning coffee, and marketing through posters, memos and brochures. The company's rate of carpoooling was 20% in 1988, and its average vehicle occupancy rate was 1.22.

In order to comply with Regulation XV and increase its average vehicle occupancy to 1.5, State farm increased its TDM program efforts beginning in April 1989. The major change to its program was the introduction of a direct subsidy for those employees using commute alternatives. The subsidies are paid daily through use of a coupon system. Upon arriving at the company's parking lot between 6:15 and 7:45 a.m., coupons are issued to each employee according to the following formula:

Mode	Coupon Value
2-person carpool	$0.50
3-person carpool	$1.00
4-person carpool	$1.50
Bicycle, bus, walk	$1.50

Employees retain the coupons until they complete their time sheets, at which time they attach the coupons to the forms for cash reimbursement. Maximum monthly reimbursement under the system is $30, depending on the mix of modes used by the employee over the course of the month. Flexibility is an important aspect of the system: as employees' daily travel needs change, and they use different modes, they are awarded the appropriate type of coupon and level of subsidy.

The offering of subsidized van service has also become an important part of State Farm's enhanced TDM program. Currently, the company has two vans that are both full, and another van is expected to be added this fall. State Farm subsidizes one third of the costs of these vans. The vans travel between 60 to 80 miles per day, for which the passengers are charged approximately $40.00 per month. The driver receives 100 miles of free travel a month, and does not pay to ride in the van.

The addition of these new program features has had an important effect on mode choice and vehicle occupancy. The program is monitored by counting the number of vehicles n the parking lot during the first week of each month. Monitoring started in March of 1989, just before the new program initiatives, and data are available for each month since implementation.

As shown in the Table 1, the new program initiatives had the effect of raising State Farm's carpooling rate from 20% to 31% in only 1 month. Simultaneously,the average vehicle occupancy rate was increased from 1.21 to 1.55, placing State Farm in compliance with Regulation XV.

The vehicle trip reduction implications of this shift in modal use means that, within in one month following implementation of its revised TDM program with a financial incentive, State Farm was able to reduce its vehicle trip generation rate from 82.4 daily one-way trips per employee to only 63.4, a 22% reduction. This means that 820 - 630 = 190 additional vehicle trips have been removed from the roads.

An even more impressive assessment of State Farm's trip reduction accomplishments is obtained by comparing them with some other standards that are more reflective of "background" conditions. These other standards include:

TABLE 1

STATE FARM BEFORE AND AFTER REVISED TDM PROGRAM

	March 1989	April 1989
Employees	995	980
Travel Mode		
Drive Alone	78%	66%
Carpool	20%	31%
Vanpool	1%	2%
Other	1%	1%
Vehicle Trips Per 100 Employees *	82.4	64.3
Employee Vehicle Trips	820	630
Average Vehicle Occupancy	1.21	1.55

* Assumes 2.5 persons per capool,
12 persons per vanpool, and
30 persons per transit trip

- o A comparable "Company B";
- o The entire South Coast Metro employment area; and
- o Orange County as a commuting region.

The results of these comparisons are shown in Table 2. Compared to the most nearly comparable "company B", a firm of equivalent size and function also located in South Coast Metro, but without a TDM program, State Farm's vehicle trip generation rate is 28% less than Company B. Compared to South Coast Metro's complex level trip rate of 92.3 vehicle trips per 100 employees or Orange County's 92.4, State Farm may be credited with a 30.4% reduction.

TABLE 2

COMPARATIVE MODAL SPLIT RATES AND TRIP REDUCTIONS

SOUTH COAST METRO, STATE FARM AND SELECT CONTROL SITES

	South Coast Metro (1986)	Orange County (1988)	State Farm (1989)	Company "B" (1986)
Travel Mode				
Drive Alone	89%	90%	66%	86%
Carpool	8%	6%	31%	8%
Vanpool	1%	0%	2%	0%
Bus	1%	1%	0%	2%
Motorcycle	<1%	1%	0%	4%
Bicycle/Walk	1%	2%	1%	0%
Vehicle Trips Per 100 Employees *	92.3	92.4	64.3	89.3

* Assumes 2.5 persons per carpool,
12 persons per vanpool, and
30 persons per transit trip

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NAME	ADDRESS

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City of Cambridge

HEARING SCHEDULE

Monday, April 6, 1992	5:30 P. M.	Regular City Council Meeting. (Sullivan Chamber)
Tuesday, April 7, 1992	5:30 P. M.	The Rent Control Committee will conduct a public hearing to continue discussions of the agenda and goals of the committee for the 1992-1993 term. (Sullivan Chamber)
Wednesday, April 8, 1992	5:30 P. M.	The Committee on Ordinances will conduct a public hearing to receive public testimony, recommendations and opinions relative to the SIP. (Sullivan Chamber)
Monday, April 13, 1992	5:30 P. M.	Regular City Council Meeting. (Sullivan Chamber)
Tuesday, April 14, 1992	5:30 P. M.	The Committee on Claims will conduct a pu public hearing to act on any and all claims brought before the city. (Ackermann Room)
	5:30 P. M.	The Committee on Ordinances will conduct a public hearing, if needed, regarding the SIP. (Sullivan Chamber)
Monday, April 27, 1992	5:30 P. M.	Regular City Council Meeting. (Sullivan Chamber)

Corporate Real Estate

Polaroid Corporation
575 Technology Square
Cambridge, Massachusetts 02139

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Polaroid

April 8, 1992

Committee on Ordinances
Cambridge City Council
City Hall
795 Massachusetts Avenue
Cambridge, MA 02139

Dear Members of the Ordinance Committee:

Polaroid Corporation hereby submits written testimony to the Ordinance Committee on the draft Vehicle Trip Reduction Ordinance dated March 20, 1992, which was submitted to the City Council by the City Manager and is currently the subject of public hearings before the Ordinance Committee.

Before making specific comments on the Ordinance, let me state that the Company understands that the 1990 Amendments to the Federal Clean Air Act will require commuting behavior changes by our employees as a contribution toward reduction of emissions from all sources in the region. We remain committed to working with the City on reasonable measures to encourage those behavioral changes.

However, air pollution and traffic congestion are regional problems we all share and we must all contribute to the solutions. For that reason we urge the Council to defer the implementation of the Cambridge Ordinance until the State has adopted equitable measures pertaining to the entire region.

Polaroid's interest in these measures relates to both its current and potential future operations in the City.

Polaroid has maintained its worldwide corporate headquarters in Cambridge for over 50 years and, as it has grown, has established a network of manufacturing and distribution facilities in the suburbs. Over 90% of the company's facilities in the United States are located here in Eastern Massachusetts. This network of facilities in Massachusetts was established by design so that the Company would not economically dominate any one community, so that its traffic was dispersed around the region, and so that its plant sites are kept to an optimum size that would not become impersonal. This network of facilities is not well served by public transportation and there is, of necessity, frequent movement from site to site during the work day. Thus, we are a company that depends on mobility to function.

The measures adopted by the Council should provide flexibility to accommodate the diverse needs of Polaroid and other Cambridge firms and should recognize that diversity may translate into different travel characteristics.

As technology changes rapidly, Polaroid may have needs for new facilities for its core research and engineering functions. Because we are a technology based company, these functions need to be in proximity to marketing, finance, and corporate administration. To maintain our necessary flexibility for future growth, we have assembled a site in Cambridge and, although we have done some conceptual studies, we have no current plans to proceed with new construction on that site. We need to feel confident that when we are ready to proceed, all regulatory measures enacted in the interim will still allow us to meet our needs.

It is impossible, given the changing regulatory climate in Cambridge, to assure our management that we can provide for our requirements in the City.

Attached are a series of initial comments on various portions of the Ordinance and how we assess the potential impact on our existing and potential future operations. We may wish to make further comments on this complex issue as the public discussion continues.

Thank you for considering our comments.

Very truly yours,

POLAROID CORPORATION

Gerald L. Hathorne

Gerald L. Hathorne
Manager
Corporate Real Estate

GLH/jp
cc: Robert W. Healy, City Manager
Joseph E. Connarton, City Clerk
Wendy B. Jacobs, Esquire - Foley, Hoag & Eliot
Donald A. Drisdell, Esquire - Deputy City Solicitor

Polaroid:
E.V. Benson
I.M. Booth
G.M. Brown, Jr.
R.F. deLima
W.J. O'Neill, Jr.

POLAROID CORPORATION April 8, 1992

INITIAL COMMENTS ON PROPOSED
VEHICLE TRIP REDUCTION ORDINANCE AND SIP AMENDMENT
(DRAFT DATED MARCH 20, 1992)

A. Employer-Based Vehicle Trip Reduction Plan and Citywide Auto Efficiency Rate

1. Citywide AER Goal

The calculation of the Citywide AER Goal should be examined in greater detail and a sensitivity analysis performed by the City after the initial survey is done of the affected employers.

The City's two largest institutions (and largest employers) may exhibit quite different travel characteristics from the remaining business and institutional community such that their inclusion in the AER calculation will skew the resulting Citywide rate and cause an arbitrary hardship on the remaining businesses and institutions. Similarly the City's hospitals, as employers, may exhibit further differences.

2. Impact on Polaroid

Using an assumed single Citywide AER Base of 1.95 would result in a requirement that Polaroid reduce 40% of its single passenger automobiles, based on a 1989 survey of Polaroid travel characteristics. (The reduction with a Citywide AER Base of 1.80 would be 35%). This assumes reductions compared to the Citywide goal with further reduction indicated per year as the Citywide goal is increased.

It is unclear over what time period reductions would be expected and, if a full reduction is intended, it raises serious questions as to whether the Company could continue to be able to operate its business effectively from a Cambridge headquarters location.

3. Proposal

a. The Citywide Auto Efficiency Rate Goal should be treated as an average, around which there will be an allowance for variation which recognizes the diversity of various Cambridge firms and institutions and their different travel characteristics.

b. The allowance for variation should also take into account the proximity to public transportation such as employer sites close to T stations versus facilities remote from T stations.

3. Proposal (Cont'd.)

c. The City should provide a reasonable time period for an individual firm, which is cooperating in good faith, to reach its goal. There should be no requirement for a drastic near-term correction by a firm to meet an arbitrarily chosen goal.

B. Parking Restrictions on Currently Unregulated Streets

The proposed measure suggests that unregulated on-street spaces become regulated (resident permit only, metered parking, etc.). Polaroid employees regularly make use of unregulated spaces on streets which are within the Industry B Zone near our buildings, to supplement our off-street parking. If those spaces were lost to us, more of our employees would be forced into our parking lots which are at or near capacity.

C. Study of Zoning Revisions

As discussion continues around management of parking supply through further revision of zoning ordinances, it must not be forgotten that parking is needed by businesses for more than just Cambridge based employees. For Polaroid it is needed for such groups as:

- employee visitors from other suburban sites
- vendors, consultants, and contractors
- business guests and customers

GLH/jp

O-24

Parking Study

6/15/92 - Passed to 1st
Ordained

June 15, 1992