ATG

Automobile Trips Generated:

CEQA Impact Measure & Mitigation Program

FINAL REPORT

The San Francisco County Transportation Authority proposes a new CEQA transportation impact measure and mitigation program based on the number of automobile trips generated (ATG) by a project. This measure is intended to replace the automobile Level of Service (LOS) impact measures currently in use and provide a new mitigation program. This report summarizes that proposal, focusing on the conceptual basis for the program and the approach to applying the measure in project impact analyses.

PREPARED BY THE SAN FRANCISCO COUNTY TRANSPORTATION AUTHORITY

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1 Introduction

This report summarizes the San Francisco County Transportation Authority's (Authority) proposal for a CEQA transportation impact measure and mitigation program based on the number of automobile[1] trips generated (ATG) by a project. This impact measure is intended to replace the automobile Level of Service (LOS) impact measure currently in use (automobile delay at intersections). Each net new automobile trip added onto San Francisco's transportation system contributes to environmental impacts, especially in terms of pedestrian safety and greenhouse gas emissions. Under the proposed approach, CEQA transportation impact analysis would measure the net new trips generated or induced by proposed projects, rather than changes in automobile delay at intersections.

A Transportation Impact Mitigation Fee (TIMF) program would provide a new, more effective way to mitigate the impacts of these added vehicle trips by funding countywide and local area transportation projects designed to address transportation system development and management needs.

What is CEQA?

The California Environmental Quality Act (CEQA) requires California's public agencies to determine the potential for proposed projects to have significant impacts on the environment, including transportation impacts. CEQA also encourages agencies to develop thresholds of significance – the quantitative point at which an environmental effect may be considered significant – to facilitate these determinations. Although CEQA gives local jurisdictions discretion to adopt impact measures and significance thresholds, California agencies usually measure project effects on transportation using the Highway Capacity Manual's Level of Service (LOS) measure. Typically, that measure is about intersection delay.

1 If other motorized vehicles such as trucks and motorcycles are to be included, then the measure may be more accurately called a "vehicle trips generated" measure (VTG).

Compared with the current LOS measure, the proposed ATG impact measure – in combination with a new TIMF program – would provide several innovations. ATG-based impact analysis would be:

- More consistent with San Francisco's *Transit First* policy and other local policies that seek to reduce automobile traffic in San Francisco while increasing trips by public transit, bicycle, and walking;
- Superior at reflecting and mitigating the impacts of new projects on the transportation environment;
- Effective at increasing certainty and streamlining the transportation impact analysis process for project sponsors; and
- More efficient for the Planning Department to administer.

Moreover, the new measure would be:

- Consistent with California Environmental Quality Act,
- Based on local tools, data and methods, and
- Practical to implement using existing data.

Report Structure

The following sections summarize the ATG threshold and mitigation proposal, focusing on the conceptual basis for the measure and mitigation program and the approach to applying the ATG measure in project impact analyses. Chapter 2 discusses the need to replace the automobile LOS impact measure; Chapter 3 explains why ATG is a superior impact measure relative to LOS; Chapter 4 discusses alternative impact measures and other approaches that the Study Team considered and rejected; Chapter 5 discusses potential thresholds of significance for the ATG measure; Chapter 6 presents the recommended impact measure, a net per-trip ATG impact measure and mitigation fee program; Chapter 7 summarizes the benefits of the proposed approach; and Chapter 8 outlines next steps for implementing the ATG measure and mitigation fee program.

Report History

In December 2003, the Authority adopted a *Strategic Analysis Report on the Transportation System LOS Methodologies* (SAR 02-03), which had been requested by Commissioner McGoldrick. The *SAR* examined alternative methodologies for assessing the transportation impacts of projects pursuant to CEQA, and reported that LOS is not an appropriate measure of the environmental impact of proposed projects in San Francisco.

The *SAR* recommended convening a **Technical Working Group** (TWG) to refine the SAR's recommendations for the Authority Board's approval and action. In July 2005, staff updated the Authority on the LOS TWG recommendations, which included replacing the current LOS measure with a measure based on the net automobile trips generated (ATG) by a project, paired with a transportation impact mitigation fee (TIMF) program designed to mitigate the impacts of added vehicle trips. The Authority assembled a **Study Team** of consultants led by Dowling Associates to conduct a technical assessment.

Based on subsequent technical assessment and input from the LOS TWG, City Attorney, and peer review, this *ATG Final Report* recommends a net per-trip ATG measure and TIMF program. Projects which do not generate new automobile trips would not have an ATG impact. The per-trip ATG threshold is consistent with the conclusion that any added vehicle trip onto San Francisco's transportation system contributes to environmental impact, especially in the areas of pedestrian safety and greenhouse gas emissions.

2 The Need to Replace Automobile LOS as a CEQA Impact Measure

The Authority proposes that the City and County of San Francisco replace automobile Level of Service (LOS), one of the key measures currently used to determine transportation impacts under CEQA, with an impact measure based on the number of automobile trips generated (ATG) or induced by a proposed project.

The Authority's Final *Strategic Analysis Report* (SAR) 02-3 on Transportation System Level of Service (LOS) Methodologies[2] concludes that LOS is not appropriate to measure the environmental impact of proposed projects in San Francisco because it is:

- inconsistent with relevant local policies, including the *Transit First* policy in San Francisco's City Charter, the *Countywide Transportation Plan*, and the *Climate Action Plan*;
- inferior at reflecting negative environmental effects; and
- inefficient for the Planning Department and project sponsors.

The following sections elaborate on these points.

2.1 LOS IS INCONSISTENT WITH LOCAL POLICIES

While the current automobile Level of Service (delay) definition of impact reflected the local transportation policies of decades past, it has become increasingly incongruous with City goals since the adoption of San Francisco's *Transit First* policy in 1973. The *Transit First* policy, Section 16.102 of the City Charter, states in part:

> *The primary objective of the transportation system must be the safe and efficient movement of people and goods.*
> *(emphasis added)*

As noted above, City policy emphasizes the movement of people and goods, rather than vehicles, as the automobile LOS measure does. Moreover, as the City's street network has matured and capacity additions are replaced with vehicle capacity reductions (e.g. Embarcadero and Central Freeway structures), person-capacity increases (e.g. transit only lanes), and demand management efforts, the automobile LOS measure is increasingly

2 Final SAR, December 16, 2003

at odds with the desire to improve the performance and attractiveness of transit, walking, and bicycling.

The Policy also states that:

Decisions regarding the use of limited public street and sidewalk space shall encourage the use of public rights-of-way by pedestrians, bicyclists, and public transit, and shall strive to reduce traffic and improve public health and safety.

Here, the *Transit First* policy recognizes the long-term benefits of prioritizing transit, walking, and bicycling over driving to promote public health and safety. The *Transit First* policy implicitly recognizes that automobile congestion is a likely short term outcome of these efforts to increase use of alternative modes and reduce traffic, due to the fixed supply of road capacity.

The City's use of the automobile LOS impact measure is inconsistent with local *Transit First* policy.

These City goals and policies should be implemented in part through tools such as the measure used to determine whether a proposed project would have a significant impact on the environment. However, the City's use of the automobile LOS impact measure is inconsistent with local *Transit First* policy because it places priority on minimizing automobile delays, often at the expense of transit, bicycle, and pedestrian conditions. The effect is that automobile LOS tends to be maintained at the expense of transit, bicycle and pedestrian LOS when road space (such as a right turn pocket) is required to mitigate a project's traffic impacts.

Another effect of the existing measure is that it hinders the very *Transit First* projects that City policy promotes. San Francisco's next generation of multi-modal transportation improvements will require a system management approach, including re-allocating green time and rights-of-way from mixed flow traffic to pedestrian, bicycle, and transit uses. However, the automobile LOS measure often triggers costly and time-consuming environmental reviews, impeding implementation of these important projects. The City's transportation impact measures can and should be better aligned with local policies and initiatives.

2.2 LOS DOES NOT REFLECT ENVIRONMENTAL EFFECTS

Another important reason for replacing the automobile LOS measure is that it is an imperfect proxy for transportation impacts to the physical environment. CEQA requires a focus on physical environmental effects, not economic or social effects. Research – summarized in Chapter 3 of this report – shows that maintaining and improving automobile LOS may degrade the environment in some instances by orienting mitigation toward congestion rather than the physical impacts associated with increased automobile use.[3]

3 Bhatia R. "Replacing Automobile Level of Service for Better Health and Environmental Quality: A Public Health Perspective." San Francisco Department of Public Health, 2005. Available at: http://www.sfphes.org/publications/Transportation_pubs/Tr_Replacing_Auto_LOSA_CEQA.pdf.

2.3 LOS ANALYSIS IS INEFFICIENT FOR THE PLANNING DEPARTMENT AND PROJECT SPONSORS

Replacing LOS with a new measure provides an opportunity to make the CEQA process more efficient and less resource intensive, both for the City and for project sponsors. The Planning Department's Office of Major Environmental Analysis (MEA) spends significant time and resources to analyze LOS impacts as part of its CEQA review process. To the extent that a new measure can identify impacts and mitigation measures more efficiently, MEA will be able to focus its staff and resources on timely review of other potential environmental impacts.

In addition, potential LOS impacts, and especially mitigation measures, are a significant source of uncertainty in project implementation schedules and budgets. Other ways of quantifying transportation impacts, such as measuring automobile trips generated by a project, are equally effective at identifying environmentally undesirable project effects while also being easier to anticipate, estimate, and mitigate. For project sponsors, reducing the uncertainty associated with environmental impact assessment and mitigation measures can result in significant cost savings.

2.4 LOS APPROACH DOES NOT SPREAD INCREMENTAL IMPACTS EQUITABLY

Another aspect of equity is improved by eliminating the "last-in-pays" syndrome, which means that significant impacts to automobile LOS are generally caused by the traffic resulting from the latest project to be evaluated. This penalizes new projects for contributions made to a problem by earlier generations of projects. In contrast, the one-trip threshold embodied in the ATG measure considers the incremental impact of each additional vehicle trip added to the system. In other words, the one-trip threshold distributes impacts incrementally among all trips.

The ATG approach eliminates the last-in problem: each project contributes fees in proportion to the incremental impact level of each additional vehicle trip.


ONE WAY
DO NOT BLOCK
NO PED CROSSING
USE CROSSWAL

3 Why ATG is a Superior CEQA Transportation Impact Measure

Fortunately, CEQA grants agencies authority to define impact standards consistent with local policy. The Authority recommends replacing automobile LOS with an impact measure that better reflects local policies and physical environmental effects and allows for streamlined administration. An ATG-based impact measure will achieve these objectives.

3.1 ATG IS MORE CONSISTENT WITH LOCAL POLICIES

Local policies call for reduced vehicle trip-making. The *Transit First* policy and the Climate Action Plan call for reductions in automobile tripmaking in order to achieve system efficiency and environmental goals.

Local policies support projects that increase the use of alternatives to the automobile. The *Transit First* policy and the *Climate Action Plan* also recognize that projects that support reduced vehicle trip-making are environmentally beneficial. The *Transit First* policy and *Countywide Transportation Plan* call for improving the performance and attractiveness of transit, walking, and bicycling, to improve overall system efficiency.[4] An ATG-based impact measure supports these policies because it will incentivize projects designed and sited so as to increase the use of transit, biking, and walking.

More significantly, projects that do not generate net new automobile trips will not have an environmental impact on transportation. This is not to propose that traffic delay and circulation should not be studied or considered by the public - on the contrary. Such studies would likely continue to be generated as part of the planning and project design process – in advance of environmental reviews – and would be relevant for public consideration at the point of legislative adoption of roadway changes at the MTA Board. The effect of this change would be twofold: first, to advance traffic studies in the project development process, resulting in more effective and cost-effective public review and design processes; and two, to remove automobile delays from consideration as an environmental impact and instead consider them, more appropriately, as part of legislative circulation changes.

San Francisco's Climate Action Plan calls for a reduction in driving.

4 Countywide Transportation Plan, Transportation Authority, 2004.

3.2 ATG IS A BETTER INDICATOR OF ENVIRONMENTAL EFFECTS

CEQA is concerned with physical environmental effects, including both short-term/direct impacts as well as cumulative and indirect effects. Automobile traffic has negative effects in a number of environmental and associated impact areas, of which the most important are: air quality, climate change, transportation system efficiency, traffic safety, noise, "traffic intrusion," and water quality. Across these impact areas, ATG is a much better indicator than automobile LOS of environmental impacts from automobile traffic.

Air Quality

Key markers of air pollution are reactive organic gases (ROG), nitrogen oxides (NO_x), particulate matter (PM_{10}), and carbon monoxide (CO). The first three of these pollutants are associated much more strongly with region-wide vehicle-miles traveled (VMT),[5] ATG (which is correlated to VMT),[6] and "cold starts" (a direct function of ATG) than with automobile delay (LOS) at individual intersections.

Mitigations to LOS are environmentally harmful: they worsen conditions for pedestrians, transit, and bicycling, while inducing more driving.

Delay (LOS) can be an indicator of high localized concentrations, or "hotspots," of carbon monoxide (CO) caused by idling engines. However, a number of findings indicate that carbon monoxide hotspots are not a key environmental concern for San Francisco, especially relative to ROG, NO_x, and particulates:

- CO hotspots are extremely rare in the Bay Area due to improvements in automotive engines and the introduction of reformulated fuel. The occurrence of hotspots now is primarily limited to areas where heavy-duty vehicles, such as trucks and buses, idle for extended periods of time.[7]
- Air pollution hot spots in San Francisco are primarily associated with automobile traffic intensity rather than LOS.[8]
- Finally, LOS is a poor predictor of potential CO hotspots when compared to the EPA-recommended model CAL3QHCr.[9]

Based on the above, ATG is a very strong indicator of air pollutant emissions from automobiles (keeping in mind that emissions vary depending on factors such as fleet make-up, fuel type and traffic speeds).[10] Comparatively, LOS is a weak indicator of vehicle emissions, with the possible exception of CO hotspots in certain locations and under certain conditions.

5 "Our Built and Natural Environments: A Technical Review of the Interactions between Land Use, Transportation, and Environmental Quality;" U.S. Environmental Protection Agency, 2001.

6 While it would be ideal to estimate VMT rather than ATG to capture the air quality impacts, ATG has the distinct advantage of simplicity. Accurately estimating VMT for transportation impact analysis purposes would likely require the use of expensive and time-consuming travel demand modeling techniques. Our professional opinion is that ATG is a valid and effective proxy measure for the purposes of CEQA analysis and it represents a substantial improvement over current LOS-based methods.

7 From conversations with BAAQMD planning staff in 2007.

8 Bhatia R, Rivard T. "Assessment and Mitigation of Air Pollutant Health Effects from Intra-urban Roadways: Guidance for Land Use Planning and Environmental Review." San Francisco Department of Public Health, 2008. Available at: http://www.sfphes.org/publications/Mitigating_Roadway_AQLU_Conflicts.pdf.

9 Meng & Niemeier, 2000; http://cat.inist.fr/?aModele=afficheN&cpsidt=1256927.

10 FHWA TOPR 29, 2004; http://www.fhwa.dot.gov/environment/conformity/benefits/benefits4.htm.

Climate Change

A key contributor to climate change is emission of carbon dioxide (CO_2), one of the main greenhouse gases. CO_2 emissions are strongly correlated with region-wide ATG and VMT (from cold starts and running engines),[11] but weakly correlated with idling engines and intersection delay (LOS). As such, ATG is a strong indicator of climate change impacts whereas LOS is a very weak indicator. (As with other air pollutant emissions, emissions of greenhouse gases vary depending on a number of factors such as fleet make-up, fuel type, and prevailing traffic speeds).

Transportation System Efficiency

Transportation system efficiency refers to how the transportation network functions as a whole. Measures of system efficiency include person-throughput (on key corridors and on the system overall per unit time) and the trend in mode share of the system. (That is, for San Francisco, an efficient system is indicated by increasing and/or high levels of non-automobile mode shares.) LOS is a reasonable, though indirect, indicator of system efficiency at a corridor level, in that it estimates delay at intersections; these are the traffic "bottlenecks" on surface streets, which are likely to result in reduced person-throughput on a given corridor. On the other hand, LOS – the amount of delay at a particular intersection – is not related to the overall volume of person-trips on the system, especially over time. In fact, traffic delays may be inversely correlated with non-automobile mode share).[12]

In contrast, increases in ATG indicate worsening system efficiency; as automobile trips are added onto the system, person throughput decreases once the vehicle capacity of the system is reached.[13]

Traffic Safety

Collision rates are weakly correlated with automobile delays and LOS. Delay is only predictive of safety for left-turn movements where delay influences signal timing and phasing designs that, in turn, influence safety.[14] ATG, on the other hand, is strongly correlated with the citywide collision rate, since collisions are correlated with ATG and VMT[15] and with fast-moving, rather than idling, traffic. For these reasons, ATG is also a better indicator of minor collisions outside of congested intersections. Numerous models and studies have linked traffic safety with ATG and VMT. In addition, the San Francisco Department of Public Health's *Vehicle-Pedestrian Injury Collision Model* provides evidence that the most important predictive factors of pedestrian collisions are traffic volumes, street type, surrounding land uses, and other socio-demographic conditions.[16]

The most important predictive factors of pedestrian collisions are traffic volumes, street type, surrounding land uses, and other socio-demographic conditions.

11 California Air Resource Board's California Greenhouse Gas Emissions Inventory; http://www.arb.ca.gov/cc/inventory/data/data.htm

12 Dowling et. al., 2005

13 Geroliminis N., Daganzo C.F. (2007a) and 2000(b); also, the SF-CHAMP travel demand forecasting model.

14 Zhang & Prevedouros, 2002

15 Davis (1998); Kenworthy and Laube (2000); meta-study by Litman (2005); Hadayeghi, A., Shalaby, A.S., Persaud, B.N., 2003: "Macrolevel Accident Prediction Models For Evaluating Safety of Urban Transportation Systems," Transportation Research Record 1840, 87-95; Lovegrove, G.R., Sayed, T., 2006: "Macrolevel Collision Prediction Models for Evaluating Neighborhood Traffic Safety," Canadian Journal of Civil Engineering, 33 (5), 609-621; Ladron de Guevara, F., Washington, S.P., Oh, J., 2004: "Forecasting Crashes at the Planning Level: Simultaneous Negative Binomial Crash Model Applied in Tucson, Arizona," Transportation Research Record 1897, 191-199.a.

16 Bhatia et. al., 2007.

Noise

Short term noise impacts associated with transportation include acute site-specific noise from car horns and engine acceleration; important cumulative and long-term impacts include chronic background citywide noise generated by running engines and the friction between tires and pavement. LOS is a strong indicator of short term, acute traffic noise pollution – but only at congested intersections – as some drivers honk their horn or rev their engine while navigating those intersections. However, LOS is not an effective indicator of chronic traffic noise pollution that occurs citywide or for acute traffic noise outside of the immediate area of congested intersections.

On the other hand, the relationship between ATG/VMT and noise pollution has been well documented.[17] ATG is not an effective indicator of acute traffic noise pollution at congested intersections; it is, however, a strong indicator of chronic traffic noise pollution citywide and of acute traffic noise pollution outside of the immediate area of congested intersections. Both of these are more important than acute traffic noise pollution at congested intersections, as they affect larger numbers of people and over longer periods of the day.

17 "Environmental Policies for Cities in the 1990s," OECD (Paris, 1990). Also, Seto EY, Holt A, Rivard T, Bhatia R., "Spatial distribution of traffic induced noise exposures in a US city: an analytic tool for assessing the health impacts of urban planning decisions," International Journal of Health Geography 2007, 6-24 (http://www.ijhealthgeographics.com/content/6/1/24/abstract); FHWA Traffic Noise Model (http://www.fhwa.dot.gov/environment/noise/tnm/tn_ver25lu.htm); Bagby (1980); Hughes and Sirmans (1992); Brown and Lam (1994); Delucchi and Hsu (1998); Delucchi (2000); Gillen (2003); and Litman (2005).

Table 1. Relative Performace of LOS and ATG as Indicators of Environmental Impacts

Environmental Impact	Automobile Level of Service (LOS)	Automobile Trips Generated (ATG)
AIR QUALITY	✚	✚ ✚
CLIMATE CHANGE		✚ ✚ ✚
SYSTEM EFFICIENCY	✚	✚ ✚
TRAFFIC SAFETY	✚	✚ ✚ ✚
NOISE	✚	✚ ✚
TRAFFIC INTRUSION	✚	✚ ✚
WATER QUALITY		✚ ✚

Traffic Intrusion

The term "traffic intrusion" describes the social and psychological impacts of automobile traffic, such as the sense of loss of privacy, reduced social interaction among neighbors and other street users, sleep disturbance, stress, loss of concentration, intimidation resulting from the threat (real or perceived) of injury resulting from collisions with cars, visual blight, and perceptions of neighborhood quality. While there is no research available linking LOS to traffic intrusion, conceivably, LOS would be an effective indicator only at congested intersections, where, by definition, traffic intrusion is high. (Moreover, efforts to improve LOS – such as by increasing capacity for cars – tend to increase traffic intrusion rather than to reduce it.) On the other hand, Donald Appleyard's classic book *Livable Streets* (1981) presents evidence for the positive link between ATG and traffic intrusion impacts, and happened to focus on streets and neighborhoods in San Francisco.

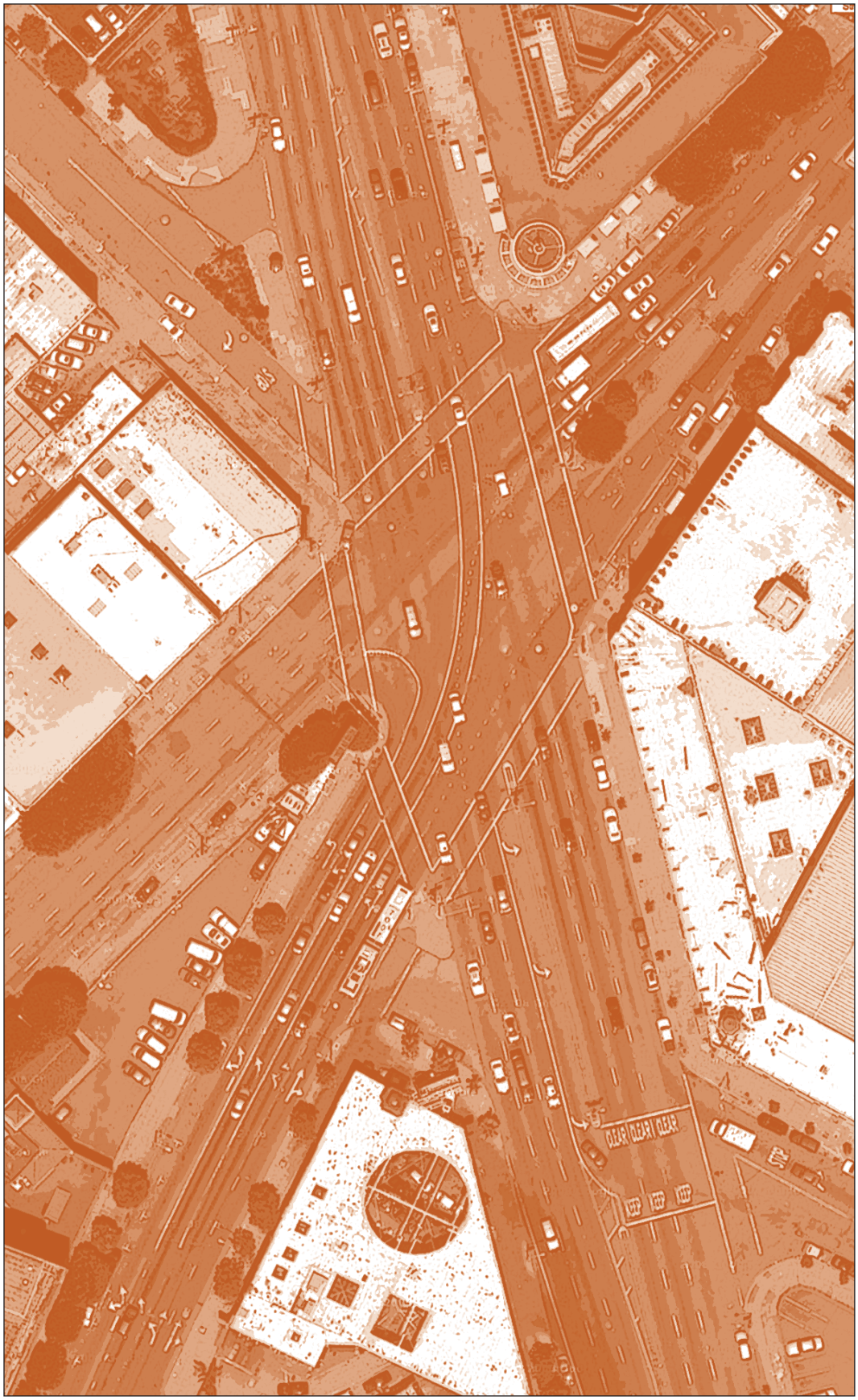
Water Quality

Key environmental impacts to water quality include organic carbons and toxic metals (nitrates, copper, lead, zinc), all largely from brake pad dust and oil and engine drips and leaks and also deposited air pollution. LOS is not an effective indicator of automobile-generated water pollution since such pollution is not correlated with idling traffic at congested intersections. ATG, on the other hand, is a reasonable indicator of traffic-generated water pollution in the form of oil and engine drips and leaks, ground brake pads, and deposited air pollution, especially since ATG and VMT are correlated.[18]

Summary

Table 1, below, summarizes and compares the relative performance of automobile LOS and ATG as indicators of environmental impacts under the seven impact areas discussed above. The table shows why, of the two, ATG is the more appropriate measure of environmental impacts from automobile traffic. ATG is a strong or very strong indicator of impacts (especially when considering long-term, cumulative and citywide effects) under six of the seven areas. Conversely, LOS is an indicator under only five of the impacts area, and is only a weak indicator at that, as its effects are limited to the immediate area of particular intersections and only during times of congestion.

18 "Effects of Transportation on Stormwater Runoff and Receiving Water Quality;" Washington State Department of Ecology (1991). Also, meta-study by Litman (2005).



4 Alternative Approaches Considered but Rejected

In addition to ATG, the Study Team considered and rejected several other measures and approaches. These are described below.

4.1 CHANGES TO CEQA STATUTE OR GUIDELINES: CATEGORICAL OR STATUTORY EXEMPTIONS

The CEQA statute and guidelines provide for "Categorical Exemption" from CEQA requirements for "classes of projects which have been determined not to have a significant effect on the environment" (Section 21084 of the Public Resources Code). Categorically exempt classes, or types, of projects are set forth in the guidelines, and local agencies may adopt additional classes.

One of the options the Study Team considered was pursuing a Categorical Exemption under CEQA for environmentally beneficial types of transportation and land use projects. However, this approach may not solve the problem for many projects, because Categorical Exemption status can be overridden if an agency determines that a particular categorically exempt project may have significant environmental impacts. Therefore, in practice, Categorical Exemptions could not be successfully applied while LOS remains as the definition of impact, since automobile LOS deficiencies are, by definition, currently considered significant environmental impacts.

Another option would be to seek a statutory exemption from CEQA (or from LOS analysis) for certain types of environmentally-beneficial projects from the California State Legislature. A statutory exemption is the Legislature's declaration that it does not want environmental impacts to be analyzed for certain categories of projects. We have not pursued this approach due to the difficulty of defining the category of "exempt" projects – for instance, appropriately defining infill and transit-oriented land use projects. Recently, however, legislative efforts such as Senate Bill 375, recently signed into law by the Governor, do offer a start towards defining such environmentally beneficial projects deserving of streamlined CEQA treatment.

4.2 ADOPT "PROTECTED INTERSECTIONS"

The Study Team also considered the innovative way in which the City of San Jose applies conventional automobile LOS measures under CEQA. As is typical elsewhere, proposed projects that worsen LOS beyond established thresholds are required to mitigate the LOS impacts. However, different requirements apply to intersections that the City has designated as "protected." Such intersections are located in the downtown core, along transit

corridors, and in neighborhood business districts. They are treated differently because the City does not want to continue expanding those intersections, as this would erode its ability to encourage infill and transportation alternatives. Proposed projects causing a significant LOS impact at a protected intersection are not required to mitigate LOS impacts at the affected intersection, but rather make other improvements in the neighborhoods affected by the project traffic and areas in the vicinity of the project site.

San Jose does not consider such improvements to be mitigation measures under CEQA, since they would not reduce or avoid the significance of the impact to intersection LOS. An LOS impact to a protected intersection would still be considered a significant impact under CEQA. However, the project is able to "tier" off an earlier programmatic EIR that cleared protected intersections from LOS impacts through a Statement of Overriding Consideration. The programmatic EIR identified transportation improvements that subsequent projects must implement if they tier off the overriding considerations finding. If a project sponsor chooses not to implement the specified transportation improvements, then the project would be found to have a significant unavoidable impact under CEQA.

San Francisco needs a solution that would apply consistently city-wide.

This approach is appealing conceptually because it acknowledges the drawbacks to urban livability of accommodating automobile LOS. Moreover, and perhaps more importantly, it appears to be strongly defensible legally, because it conforms closely to CEQA's environmental review framework. However, we decided not to pursue San Jose's approach primarily because San Francisco needs a solution that would apply consistently city-wide instead of area by area. San Jose's approach retains automobile LOS at the center of its environmental review process, while carving out exceptions; we sought a solution which would replace automobile LOS as the definition of impact.

4.3 MODE-SPECIFIC LOS MEASURES

The Study Team considered developing a robust set of mode-specific LOS impact measures. The City's current impact measures for transit, bicycles, and pedestrians do not rigorously or consistently reflect all the factors that are most important to the quality of the transit, bicycling, or pedestrian experience in the city such as safety, comfort, reliability, travel time, and connectivity. Instead, they often apply a variant of the automobile LOS measure, generally the number of trips using a particular mode relative to the capacity of the transportation facility serving that mode. For example, the City's pedestrian LOS methodology defines pedestrian LOS as the ratio of sidewalk area to volume of pedestrians; by this measure, a near-empty sidewalk provides a high level of service.

While multi-modal LOS measures would improve the evaluation of project impacts on transit, walking, and bicycling, the Study Team acknowledged that this approach would not accomplish the objectives of replacing the automobile LOS measure and streamlining the environmental review process. Multi-modal LOS measures would supplement rather than replace automobile LOS; as such, they would not resolve the unintended negative consequences of automobile LOS.

5 Potential ATG Significance Thresholds

CEQA encourages public agencies to develop "thresholds of significance" as tools to help assess the significance of potential environmental impacts. A threshold of significance can be defined as a quantitative or qualitative standard or set of criteria that helps to determine the significance of a given environmental effect.

To determine whether an appropriate threshold of significance exists for the ATG measure, the Study Team investigated the quantitative relationships between ATG and a range of physical effects of ATG, listed in ***Figure 1*** and ***Table 2***, namely: collisions, multimodal service impacts, system inefficiency, noise, neighborhood disruption, carbon emissions, and water pollution. (We did not consider air quality impacts other than carbon emissions because the Bay Area Air Quality Management District has already established detailed recommended thresholds of significance for those pollutants.)

Figure 1 on the next page graphically displays the universe of impacts that traffic has on the transportation system and the environment:

- The system users (travelers), especially mass transit and non-motorized travelers, experience negative impacts from each additional automobile trip in terms of their own mobility and accessibility, reliability, and safety;
- The system operator, the entity responsible for maintaining the entire transportation system, faces many challenges as automobile trips increase, in terms of ensuring efficient operations, providing equitable services, and maintaining system assets; and
- External effects on the environment beyond the transportation system, including on air and water quality, noise levels, health and livability, and greenhouse gas levels.

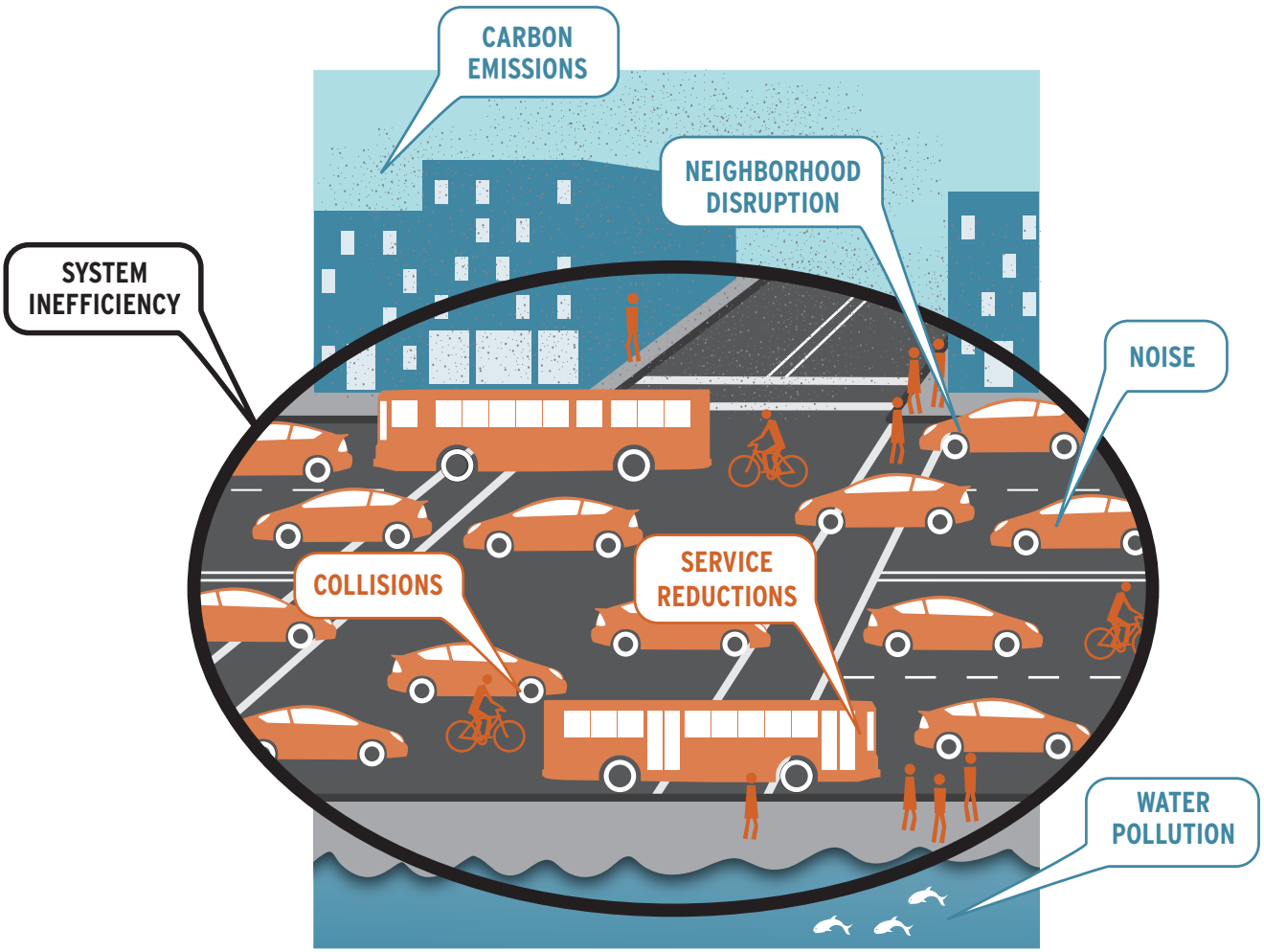
The following sections and ***Table 2*** summarize the results of the research into potential ATG significance thresholds. The research does not indicate a single, obvious threshold of significance for ATG. However, the research does indicate that each net new ATG contributes toward current and cumulative impacts under a number of impact areas: transportation system performance, traffic safety, climate change, livability (traffic intrusion), and air, water, and noise pollution. Of these areas, at least two – pedestrian safety and greenhouse gas emissions (which contribute to climate change) – may reasonably be considered to be deficient already in San Francisco.

Figure 1. Universe of Automobile Trip Impacts on the Transportation Environment

Perspective of the Transportation System User

Perspective of the Transportation System Operator

Perspective of the Environment



5.1 ATG THRESHOLD BASED ON PEDESTRIAN SAFETY

A growing body of research links increased automobile traffic with increased risks of collisions. Balkin and Ord[19] found that the seasonal variations in U.S. highway fatalities correlate with monthly variations in U.S. highway vehicle-miles traveled (VMT). In a study of 300 intersections in Hamilton, Ontario, Leden[20] found that the risks of collisions involving pedestrians decreased with increasing pedestrian flows and increased with increasing vehicular flows. In a similar study of intersections in Florida, Lee & Abdel-Aty[21] found that higher than average vehicular flows increased the risk of pedestrian-involved collisions. Litman (2001) found a strong, positive correlation between VMT and collisions in the Vancouver, B.C. region over time.

In San Francisco, LaScala et al.[22] found that San Francisco neighborhoods with high traffic volumes and population densities also had an increased risk of pedestrian/automobile collisions. Moreover, the San Francisco Department of Public Health[23] has recently developed a predictive model of neighborhood pedestrian injury collisions in the city, using automobile volumes as an independent (i.e., predictive) variable. The study researchers found that automobile traffic volumes have a statistically significant effect on the number of reported vehicle-pedestrian injury collisions.

These studies and the San Francisco model provide substantial evidence that there is a direct, measurable and statistically significant causal relationship between automobile trips and pedestrian injury collisions. In addition, San Francisco already exceeds, by a large margin, the national target standard for pedestrian injuries and deaths established by *Healthy People 2010*. (*Healthy People 2010* is a comprehensive set of disease-prevention and health-promotion objectives for the country to achieve by 2010, created by a panel of governmental and other scientists.[24]) The *Healthy People 2010* target is 20 collisions per 100,000 people (resulting in 19 nonfatal pedestrian injuries and one death). When adjusted for an urban environment, with its higher rates of walking, this rate becomes 34 per 100,000 people/year. By comparison, San Francisco's rate is at 104.

Together, the above indicate that ATG in San Francisco could already support a net-new-trip threshold of significance based on pedestrian safety.

5.2 ATG THRESHOLD BASED ON CARBON EMISSIONS

The *Climate Action Plan* for San Francisco (September 2004) commits the City to reducing its emissions of greenhouse gases by 20 percent below 1990 levels by the year 2012. Since vehicle trip-making is the cause of 50 percent of the city's greenhouse gas emissions, the plan implicitly calls for an absolute reduction in city-wide emissions, implying that the existing level of traffic in the city is environmentally unsustainable — and already significantly impacting the environment.

Development in the San Francisco is subject to smart growth policies and to numerous greenhouse gas reduction measures that have already reduced the City's emissions significantly. Nonetheless, the potential for

Vehicle trip-making is the cause of 50 percent of the city's greenhouse gas emissions.

19 Balkin & Ord, "Assessing the Impact of Speed-Limit Increases on Fatal Interstate Crashes," Journal of Transportation and Statistics, Vol. 4, No. 1 (www.bts.gov), April 2001, pp. 1-26.

20 Leden 2002, "Pedestrian risk decrease with pedestrian flow. A case study based on data from signalized intersections in Hamilton, Ontario", Accident Analysis and Prevention, 34(4): 457-64.

21 Lee & Abdel-Aty, "Comprehensive analysis of vehicle-pedestrian crashes at intersections in Florida.", Accident Analysis and Prevention.

22 LaScala et al., "Demographic and environmental correlates of pedestrian injury collisions: a spatial analysis", Accident Analysis & Prevention, Volume 32, Issue 5 , September 2000, pp. 651-658.

23 Bhatia et al., 2007, "Impacts of Urban Land Use Development on Pedestrian-Motor Vehicle Collisions: An Application of the San Francisco Pedestrian Injury Model to Five Neighborhood Plans," Draft paper for technical review, May 9, 2007.

24 http://www.healthypeople.gov/About/hpfact.htm.

climate change impacts associated with new automobile trips supports an auto-trip related significance threshold to prevent significant environmental impacts.

5.3 ATG THRESHOLD ON OTHER IMPACT AREAS

In addition to the above, the Study Team identified potential ATG thresholds of significance based on transportation system efficiency and livability. Further investigation could likely identify an ATG threshold based on impacts such as air quality and noise, which are directly and quantifiably related to ATG, including sleep disturbance and stress responses.[25]

Regardless, each net new ATG potentially contributes toward environmental impacts associated with pedestrian safety and greenhouse gas emissions. The Study Team thus

25 U.S. Federal Interagency Committee on Noise, Miedema and Oudshoorn, 2001

Table 2. Potential Thresholds of Significance for the ATG Measure

Transportation System User Impacts

ATG ⇧ **COLLISIONS** ⇧ — Risk or rate of collisions, particularly for peds & bikers

DATA SOURCE TO IDENTIFY SIGNIFICANCE THRESHOLDS Published studies correlating automobile volumes / miles with collision rate or risk. Potential threshold: vehicle volumes associated with 34 collisions/year/100 thousand population, based on Healthy Peoples goals. **This threshold is exceeded in much of SF.**

Good Basis for Threshold

DOCUMENTATION SF DPH 2007 Pedestrian Collisions Model. Also see Davis (1998); LaScala et al (1999); Kenworthy and Laube (2000); meta-study by Litman (2005)

ATG ⇧ **MULTIMODAL LOS IMPACTS** ⇧ — Reductions in quality of service for pedestrians & bicyclists

DATA SOURCE Equations for pedestrian and bicycle "Q/LOS" use automobile volumes as a negatively related independent variable

DOCUMENTATION e.g., SCI Bicycle and Pedestrian LOS models (Landis, 1997, and Landis, 2001).

Transportation System Operator Impacts

ATG ⇧ **TRANSPORTATION SYSTEM INEFFICIENCY** ⇧ — Person throughput in cars and on transit

DATA SOURCE Added automobile volumes reduce person throughput (beyond data-based inflection point) as shown by transformations of the standard Bureau of Public Roads (BPR) curve: throughput increases as volumes increase until v/c ratio causes speeds to drop beyond inflection point

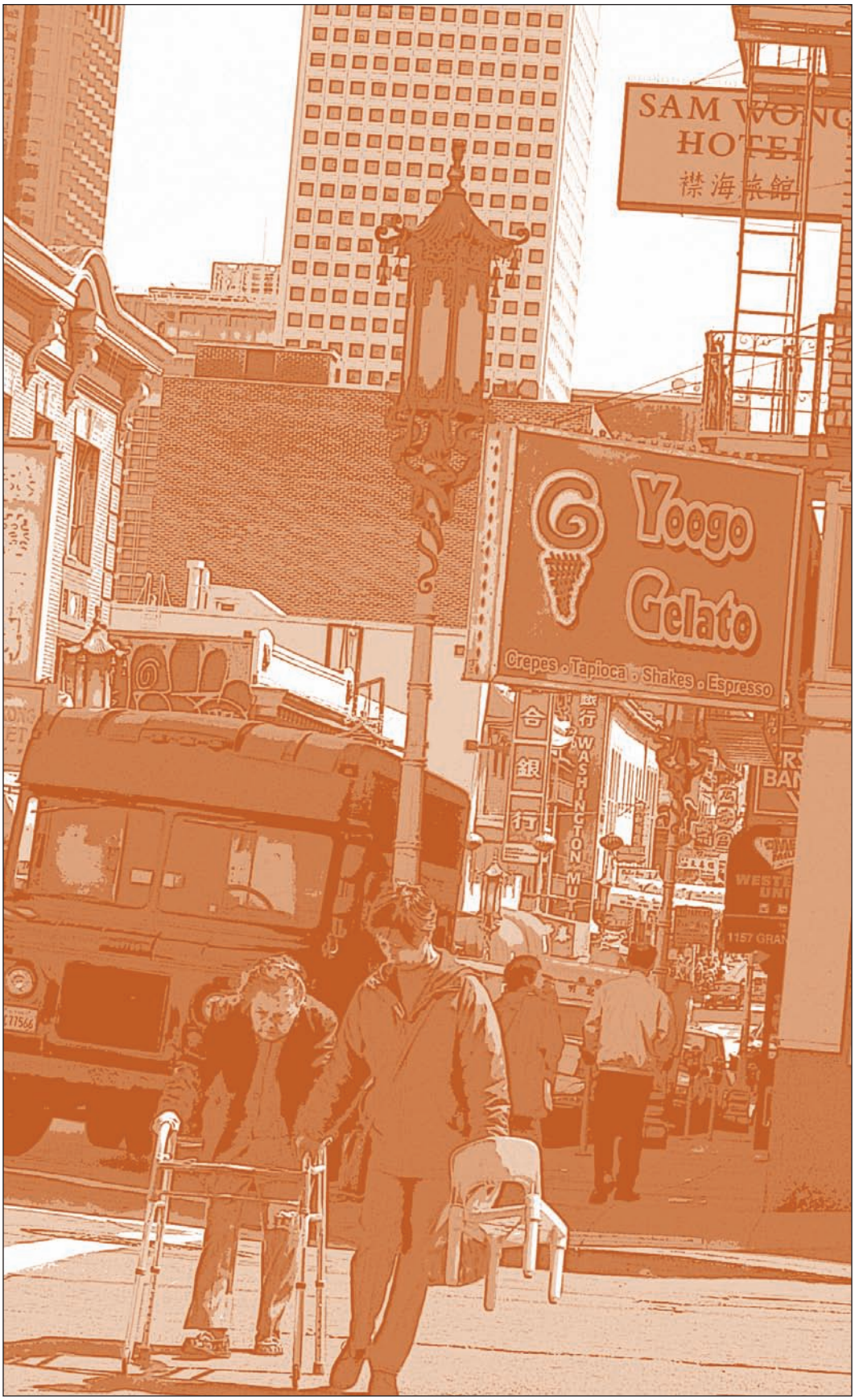
DOCUMENTATION SF CHAMP BPR curves re-validated 2007 for SF. Geroliminis N., Daganzo C.F. (2007a) and 2000(b)

concludes that a conservative and justifiable threshold of significance for the ATG impact measure is based on each net new automobile trip generated by a project.

Table 2 below illustrates the link between increasing ATG and seven different environmental impacts in order to identify potential thresholds of significance for the ATG measure. The table identifies data that quantify the relationship between ATG and each of its effects, and assesses whether the data indicate a useful threshold of significance.

Environmental Externalities

ATG		
↑ ATG	↑ **NOISE**	Acute and chronic noise pollution experienced by sidewalk and adjacent land uses
Possible Basis for Threshold	**DATA SOURCE** Studies identify automobile volumes as an independent variable in understanding noise pollution impacts on residential property values **DOCUMENTATION** e.g., Bagby (1980); Hughes and Sirmans (1992); Brown and Lam (1994); Delucchi and Hsu (1998); Delucchi (2000); Gillen (2003); meta-study by Litman (2005).	
↑ ATG	↑ **NEIGHBORHOOD DISRUPTIONS**	Decline in resident perception of quality of life, street-facing activity, sidewalk interaction, residential property values
	DATA SOURCE Studies identify automobile volumes as an independent variable in understanding resident perceptions of urban and suburban quality of life. TIRE index provides changes in automobile volumes that cause changes in residential environment. **DOCUMENTATION** e.g., Appleyard (1981); Pikoraa et al (2003); Cao et al (2005). Cities of Menlo Park, Los Angeles, and Palo Alto. Quantified in the TIRE Index	
↑ ATG	↑ **CARBON EMISSIONS**	Reduce ability to meet City's Climate Action Plan goals for reduced carbon emissions
Good Basis for Threshold	**DATA SOURCE** Threshold would be set at **1 net ATG, the maximum allowable increase in automobile volumes consistent with the documentation:** City's CAP goal of 20% reduction in 1990 carbon emissions by 2010. **DOCUMENTATION** San Francisco Climate Action Plan (2004)	
↑ ATG	↑ **WATER POLLUTION**	Impacts on water quality (contaminated runoff from leaks of oil & other fluids)
Possible Basis for Threshold	**DATA SOURCE** Studies generally provide national or regional estimates of water pollution costs per VMT. Converting this data into an estimate of pollution cost per automobile trip could provide a threshold. **DOCUMENTATION** e.g., meta-study by Litman (2005)	



6 Recommendation: Per-Trip Impact & Mitigation Program

The Authority proposes to replace the current automobile LOS measure with a per-trip based ATG impact measure and mitigation program.

This new measure would acknowledge the incremental and cumulative environmental damage caused by each project-generated automobile trip to a number of impact areas, including two areas of particular concern in San Francisco: pedestrian safety and greenhouse gas emissions.

This recommended per-trip impact assessment and mitigation approach is consistent with City policy and supported by substantial evidence of environmental effect, as discussed in the previous sections; but importantly, it also provides an opportunity to reduce the administrative burden of CEQA on the Planning Department, fulfilling the last objective of the reform by:

- Eliminating the "last-in pays" problem;
- Reducing analysis requirements and complexity, and increasing predictability;
- Reducing CEQA burdens for *Transit First* projects, which generate few or no automobile trips (many transportation improvement projects, including transit, bicycle, and pedestrian improvements, will reduce rather than generate net new automobile trips); and
- Providing a superior, system-wide approach to mitigation.

An ATG measure implemented with a per-trip impact fee would greatly simplify the environmental review process for both planners and project sponsors. While the automobile LOS measure requires studies of existing and future traffic patterns (traffic assignment), an ATG measure requires only a trip generation estimate. That is a task routinely performed as the first step in the current automobile LOS analysis and it is widely understood by City staff, policy-makers, project sponsors, and the public.

Automobile trip generation methodologies are well-developed and do not necessarily require extensive further development. The ATG measure of impact could be implemented using the Planning Department's existing trip generation estimating methodology. At the same time, the Authority encourages the Planning Department to update and refine its trip generation methodology to allow for a finer grain of variation in trip generation rates. Currently, trip generation rates apply uniformly to one of four Superdistricts. As land uses have evolved over the years, trip generation rates for the same land use may vary significantly within Superdistricts. Additionally, ongoing research indicates that trip generation rates vary based on project site design

ALTERNATIVE METHODOLOGIES FOR DETERMINING A PROJECT'S AUTOMOBILE TRIPS GENERATED (ATG)

As mentioned earlier, the Planning Department routinely estimates the number of automobile trips that a proposed project will generate, using an accepted methodology in its Guidelines for Environmental Review. The Department's methodology is easy to apply, widely accepted and understood and legally defensible. However, because it aggregates vehicle trip rates by transportation Superdistrict, it tends to overstate trip generation around transit centers—particularly outside the downtown—and not consider the effect project-specific conditions within Superdistricts that will likely reduce automobile trips generated by a project.

A number of more fine-grained auto trip generation methodologies have been developed in recent years, such as I-PLAC3S, and INDEX. These tools are basically software packages that use a set of empirically-tested elasticities to relate land use parameters (density, design, diversity, destinations) to automobile trip generation.

Another effort is the Caltrans/ABAG Urban Infill Trip Generation Study, which is developing new trip generation rates that reflect variations in density, land use mix, site design, and multimodal transportation characteristics in "infill" areas throughout California. The study is expected to be complete in 2009. This project is intended to become a supplement to the industry standard, the Institute of Traffic Engineers' trip generation rates, which have been developed largely from suburban, low-density, high auto use environments.

URBEMIS, another example, is an air emissions modeling program which estimates changes in automobile travel resulting from infill and other site-specific development characteristics. This model is already in use by public agencies and professionals in California to estimate air pollution emissions from a wide range of land use projects. Its Trip Generation Adjustment System is one of the most comprehensive and well-researched system for adjusting trip generation and mode share based on project site design and neighborhood factors. In addition, the California Superior Court has upheld the use of URBEMIS as part of its decision supporting the San Joaquin Valley Unified Air Pollution Control District's Indirect Source Rule[2].

Although these models and rates are empirically tested, they may not be immediately applicable to San Francisco's context – which is more urban than the contexts in which they have been validated and applied. While the elasticities are supported by empirical research, it is not clear that their adjustments will produce results that are appropriate for San Francisco's context. However, they do provide evidence that supports more fine grained automobile trip generation methodologies in San Francisco. Existing elasticities should be compared to local, San Francisco data and used to define alternative trip generation rates within existing Superdistricts.

2 California Building Industry Association vs San Joaquin Valley Unified Air Pollution Control District; filed February 21, 2008.

and neighborhood factors; the Planning Department could draw from this research to allow variation in trip generation rates within Superdistricts.

6.1 APPLICATION IN PROJECT IMPACT ANALYSIS

This section describes how impacts would be assessed under the proposed ATG measure and impact fee approach. When evaluating a specific project for potential transportation impacts, each project is first screened for by asking the question: *Will the Project Generate Net New Automobile Trips?* The project impact analysis process is shown in the flowchart in ***Figure 2***.

Project Will Not Generate New Auto Trips

Projects that will not generate new automobile trips – or which reduce ATG – will not have transportation impacts in this area. If the project has no possible impacts in other environmental impact areas, it would be a candidate for a Negative Declaration (or other appropriate document type). Both land use and transportation projects may fit this category, e.g.:

- ***Land use changes from more intense uses to less intense uses.*** These projects would need to be qualified by the Planning Department, for instance setting a minimum time period for basing the comparison on the previous active use in the case where a site is fallow for a short time between uses.
- ***Transportation projects/changes that reduce automobile accessibility.*** The SF-CHAMP model uses automobile "accessibility" to partly determine the level of overall trip generation of automobile trips. Projects that increase automobile accessibility, such as the provision of new roadways, do generate automobile trips. On the other hand, projects that decrease automobile accessibility, such as road pricing or conversion of mixed traffic lanes to bus or bicycle lanes, reduce automobile trip generation.

Project Will Generate New Auto Trips

Projects which either add new or more intense activities (land use activities) or which increase automobile accessibility (by decreasing automobile travel times or reducing automobile delays) will need to undergo the ATG analysis. Again, both land use and transportation projects may fit this category.

While land development project impact analysis focuses on the increases in ATG that result from new activities, the analysis of ATG impacts from transportation projects will focus on the increases in ATG that result from changes in automobile accessibility (also known as the "induced demand" effect).

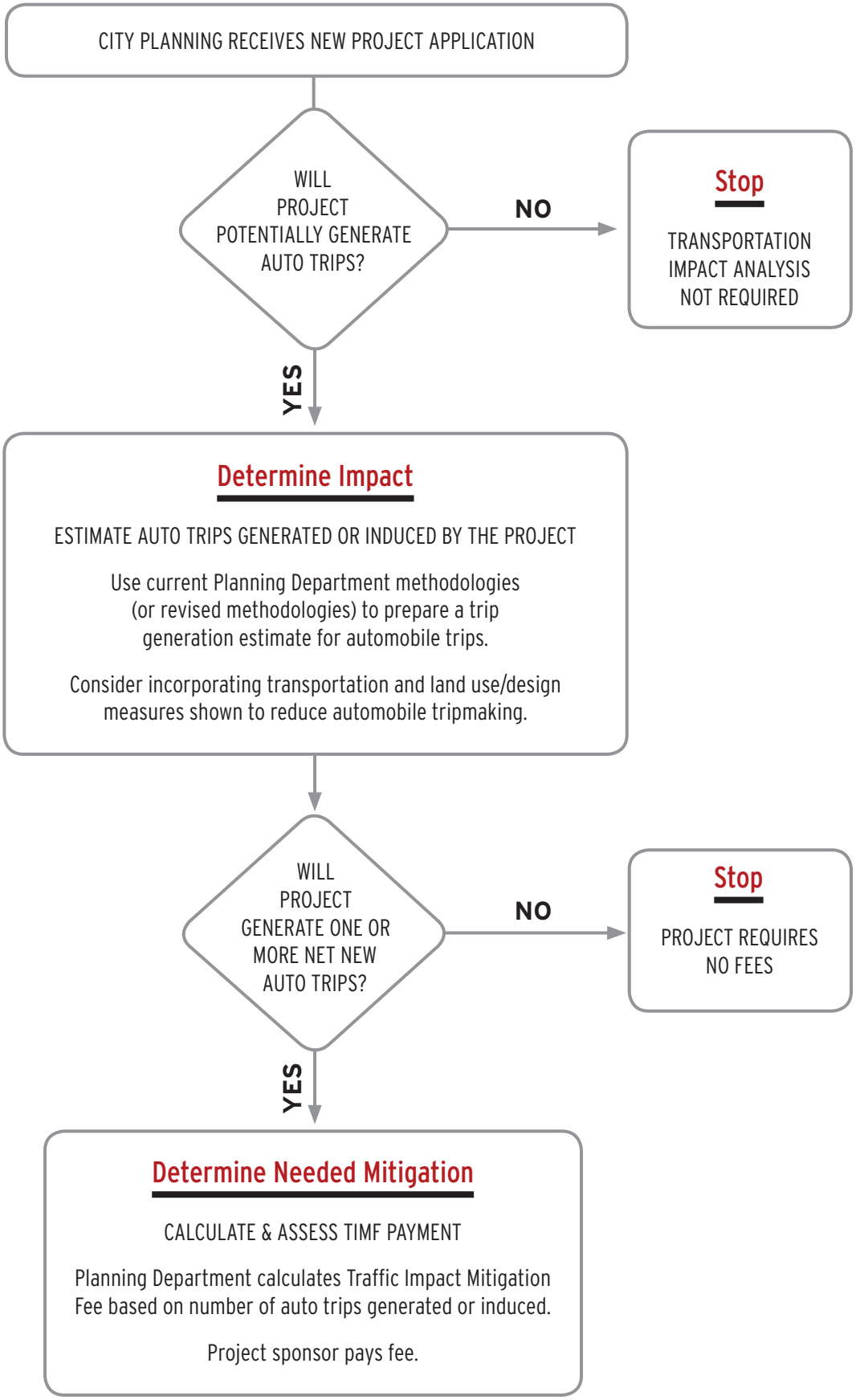
6.2 MITIGATION PROGRAM

Project impacts on ATG will be mitigated by payment of a Transportation Impact Mitigation Fee (TIMF). The fee program will be designed to charge a set fee to a development based on the number of automobile trips it generates. An impact fee will be collected for both land development and transportation projects that add automobile trips to the system.[26]

A *Nexus Study* will establish the monetary impact of each incremental automobile trip based on the cost of a citywide network of transportation improvements that would mitigate the negative effects of future growth in ATG. This per-trip cost would be multiplied by a project's ATG to determine the total mitigation fee required for the proposed development. Under this approach, a project's environmental document would reference

26 Payment of the impact mitigation fee for transportation projects that add road capacity would be based on the number of trips "induced" by the project.

Figure 2. Process for Applying ATG Measure



the TIMF *Nexus Study* and the project sponsor would pay the per-trip fee established through the program to satisfy the project's mitigation requirements.

A proportion of the TIMF revenues would be directed towards site-specific improvements in the project area, all designed to reduce automobile trip generation. In order to ensure that impact mitigation occurs in an appropriate, effective and timely manner, the Planning Department may also wish to set temporal and return-to-source policies for the expenditure of fee revenue.

A per-trip ATG threshold coupled with a per-trip TIMF program provides a superior approach to mitigating the system-wide impacts of traffic growth. One shortcoming of the current EIR process is the localized and sometimes uncoordinated approach to identifying and programming impact mitigations. Each project independently identifies its transportation impacts and associated mitigation measures. This process places a significant and repeated burden on City staff, who must guide the project sponsors through the process of identifying mitigations that will address the impacts identified for the project and that will be consistent with the City's transportation policies and plans.

In contrast, the proposed approach to transportation impact measurement and evaluation is intended to provide a conservative, simple, and more effective approach to mitigating transportation impacts. No further analytical tasks will be required to analyze transportation impacts. Although a greater proportion of proposed projects would be found to have a significant transportation impact, the process for analyzing and mitigating those impacts is greatly streamlined, resulting in overall reduced burden for the Planning Department and project sponsors. Also, a per-trip method provides a built-in incentive for project sponsors to reduce the number of automobile trips their projects are expected to generate since the amount of mitigation fees they must pay is directly proportional to their project's ATG. It may also serve to prevent project-sponsors from breaking their projects up into smaller pieces to avoid triggering significance thresholds. Finally, project sponsors will be able to accurately estimate impact and mitigation levels early on in the project development and environmental review process.

An important consideration is the relationship of the new TIMF to other existing or proposed impact fees (such as the Transit Impact Development Fee and Area Plan Impact Fees), including how the TIMF would be governed. The Mayor's Office of Economic Development, Planning Department, and the Authority plan to coordinate closely on implementing the Transportation Impact Mitigation Fee program of projects in order to maximize technical integration, system performance, and fee leveraging opportunities.

Fee revenues could fund actions that help reduce new automobile tripmaking by improving transit, walking, and bicycling as choices.

7 Benefits of Per-trip ATG Impact Measure and Mitigation Program

As a replacement measure for automobile LOS, the ATG measure provides many benefits for the City's environmental review under CEQA.

ATG is a superior criterion for environmental review for the following reasons.

ATG is a better indicator of environmental effects and impacts on the transportation system. Automobile trips generated are a better indicator than LOS of a range of environmental effects such as carbon emissions, traffic safety, noise levels, and water quality.

ATG is consistent with the Transit First policy. The ATG measure is consistent with the *Transit First* policy, which recognizes that short-term automobile congestion will result from shifts of rights-of-way from automobile to transit, bicycling, and pedestrians. Instead of seeking to preserve system efficiency by expanding capacity for driving, the ATG measure recognizes that constraining the growth in automobile trips on San Francisco streets is critical for maintaining system efficiency on our network of finite automobile capacity. Fittingly, projects which would not generate any new automobile trips would not have transportation impacts under this approach.

ATG results in more effective mitigations. The TIMF program focuses mitigations from project traffic at the system level rather than on isolated intersections. This avoids the uncoordinated mitigations that often result from the current intersection LOS-based analysis method.

ATG is more predictable and simpler for Planning Department and project sponsors. The ATG approach takes a higher-level view of what effects constitute impacts to transportation. The result is a streamlined impact analysis that has fewer data collection and analysis steps than the LOS approach. Linked to a transportation impact fee, the impact analysis process is simpler for project sponsors and the Planning Department to understand and to implement.


ONE WAY

8 Next Steps

The Study Team has done a thorough review of the ATG program. As a next step, the City can lead the LOS replacement effort through adoption.

The next steps in adoption of the ATG impact measure and threshold are:

1. Final report approval

The Authority Board will consider this Final Report for approval; the Planning Department will then take on a more active role as sponsor of the ATG impacts measure effort, with support from the Authority and the Mayor's Office of Economic Development.

2. Nexus Study for ATG Impact Fee

To implement the trips generated impact fee, a *Nexus Study* should be prepared; this effort can be conducted cooperatively by the Planning Department, the Authority, and the Mayor's Office of Economic Development.

3. Planning Commission Hearing

The Planning Commission has the authority to adopt the ATG impact measure as a replacement for automobile LOS. A hearing is the first step in the process.

4. Environmental Review of Action

We recommend an environmental review on the action to adopt ATG as the City's measure and threshold for transportation impact.

5. ATG Ordinance

The Planning Department will prepare an ATG ordinance for adoption by the Planning Commission.

6. Transition Period for Implementation

The new methodology should be phased in through a transition period to be determined by the City Attorney and Planning Department.

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