FOUNDATION FOR A THRESHOLD

Justification for Air Quality Thresholds of Significance
In the
Sacramento Federal Nonattainment Area

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The environmental review of projects is governed by the California Environmental Quality Act (CEQA). Although CEQA requires agencies to analyze and mitigate potentially significant project impacts, neither the Act nor the Guidelines for implementing the Act establish specific thresholds of significance. Recent amendments to the CEQA Guidelines encourage agencies to adopt thresholds of significance, and require agencies to use a public review process if they opt to adopt thresholds.

The air pollution control districts in the Sacramento federal ozone nonattainment area are joining efforts to update existing thresholds using the public review process anticipated in the CEQA Guideline amendments. We will set thresholds for all of the pollutants of concern in the region, including ozone – which is more commonly known as smog and is our primary air quality problem. Because ozone is not directly emitted from a source, its significance threshold will be based on its precursor emissions, reactive organic gases (ROG) and oxides of nitrogen (NOx). This report explains the basis for selecting each pollutant threshold.

In addition to assisting the environmental review of projects under CEQA, establishing a common threshold for the entire nonattainment area will provide a uniform scale to measure the significance of land use projects in relation to the State Implementation Plan (SIP).

A. Setting a Threshold: The Concept

In setting the threshold, the districts considered both the health-based air quality standards and the attainment strategies developed in conjunction with the Air Resources Board (ARB) and the U.S. Environmental Protection Agency (EPA). These strategies are contained in the 1994 Sacramento Area Regional Ozone Attainment Plan, which was approved by ARB and EPA as part of the State Implementation Plan required under the Federal Clean Air Act.

1. Health-Based Ambient Air Quality Standards

Ambient air quality standards are designed to protect public health, and both the state and federal governments have established health-based ambient concentration standards. The impact of most criteria pollutants can be assessed by determining whether the emissions from the project will cause an exceedance of a standard, or, if the standard is already exceeded, whether the emissions would constitute a significant contribution to the exceedance.

For ozone, however, this approach is impractical because ozone is not directly emitted into the environment. Rather, ozone is formed when emissions of its precursor pollutants, ROG and NOx, react with heat and sunlight. Consequently, to control ozone, it is necessary to set a threshold for these precursor pollutants. This paper explores the basis for the NOx and ROG thresholds, and also discusses the thresholds applied to other criteria pollutants.

2. Attainment Strategy, Threshold Strategy, and the Importance of TCM/Land Use Control Measures

To set a threshold for the ozone precursors, the districts focused on the attainment strategies set forth in the 1994 Sacramento Area Regional Ozone Attainment Plan, which is our regional SIP. The regional SIP sets out a wide range of pollution control strategies designed to ensure that we achieve compliance with the federal ozone standard by 2005. The effectiveness of these measures in achieving this goal was assessed during the preparation of the Plan using the urban airshed model (UAM).

One of the principal elements of the SIP is the requirement to obtain emission reductions of one ton per day each for ROG and NOx through the implementation of transportation control measures (TCMs) and control of land use project emissions. The significance thresholds for NOx and ROG are keyed to this one ton commitment for each pollutant.

Failure to fully implement the TCM/land use control strategy in the ozone attainment plan may cause a significant adverse air quality impact because it will impede on the region's ability to attain the federal ozone standard. Applying a region-wide threshold of significance for ozone designed to successfully implement the land use control strategy will better ensure that we continue to make reasonable progress toward our attainment plan goal and avoid adverse health impacts associated with the failure to meet the standard.

The regional SIP strategies are based on a mix of NOx and ROG reductions that reduces more NOx than ROG. For TCMs and land use controls, however, the Plan calls for an equal reduction of NOx and ROG – one ton each. The districts

in the nonattainment area as well as the Air Resources Board and the U.S. Environmental Protection Agency approved this approach.

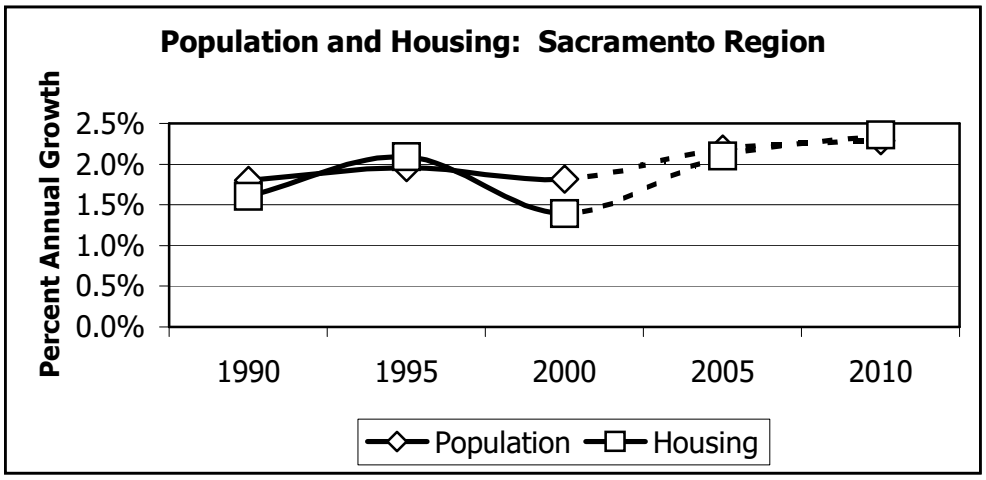
B. Projecting Emissions

To set a threshold, it is first necessary to estimate the level of growth that will occur in the area, and the level of emissions that will be associated with the growth. These estimates can then be compared to the one-ton ROG/one-ton NOx SIP commitments to determine the level of reductions needed in the future, and to set the threshold limit that will most effectively and efficiently achieve that goal. This section focuses on the first two steps – anticipated growth and emissions. Section C focuses on the final steps toward achieving our goal.

1. Regional Growth Trends

The Sacramento Area Council of Governments (SACOG) has estimated that population and housing in the Sacramento region will grow by about two percent of the total population annually over the entire life of the SIP (1990–2005) as we approach our attainment year. The districts relied on this two-percent projection, displayed in the following graph, when preparing and adopting the SIP.

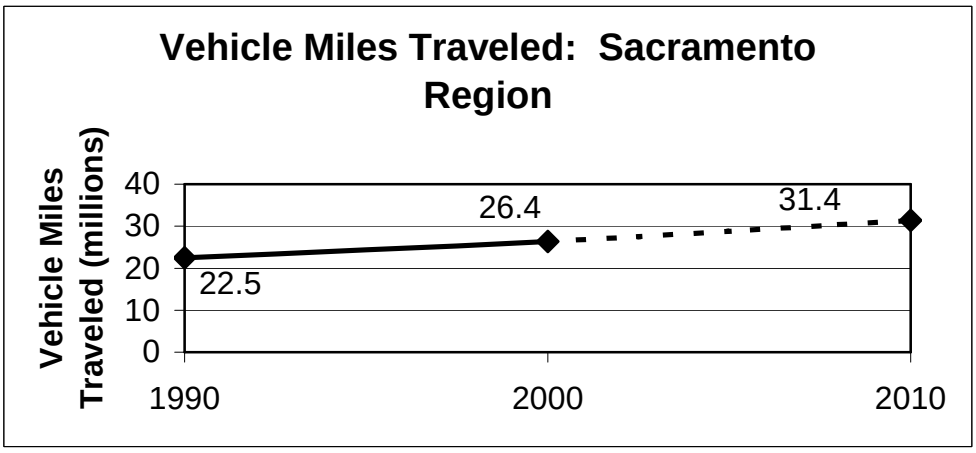
Figure 1 - Total Population and Housing Growth (1990-2010)



Source: SACOG, 2000

SACOG also estimated (as shown in the graph below) that vehicle miles traveled (VMT) will increase by about two percent of the total per year. Increases in VMT will partially offset air quality benefits of cleaner vehicles. The districts considered both these factors – increase in population/housing and VMT – when adopting the SIP.

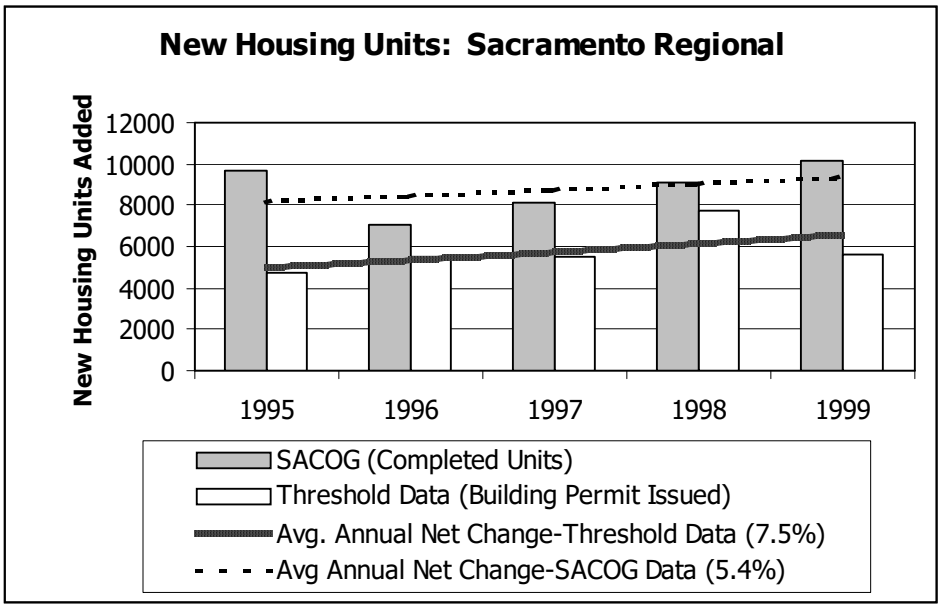
Figure 2 - Total Vehicle Miles Traveled (1990-2010)



The districts also commissioned the development of a database containing building permits issued in the nonattainment area during 1995-1999, and

compared this information to the SACOG projections. The database developed by the districts included housing, commercial, and industrial permits, while SACOG's information included only housing units. The graph below compares new housing units added to the region with housing unit building permits in the threshold database.[1]

Figure 3 - New Housing Units vs. Building Permits (1995-1999)



The difference between SACOG data and the database is because, in part, the SACOG data includes housing units for entire counties whereas the threshold data is limited to the ozone nonattainment area.

[1] SACOG's 2% growth estimate, discussed on page 5, compares the new development to the entire stock of existing housing.. In contrast, the 5.4% change identified in the "New Housing Units: Sacramento Region" graph compares new housing units built or permitted in a given year with the number of new units built or permitted in the prior year.

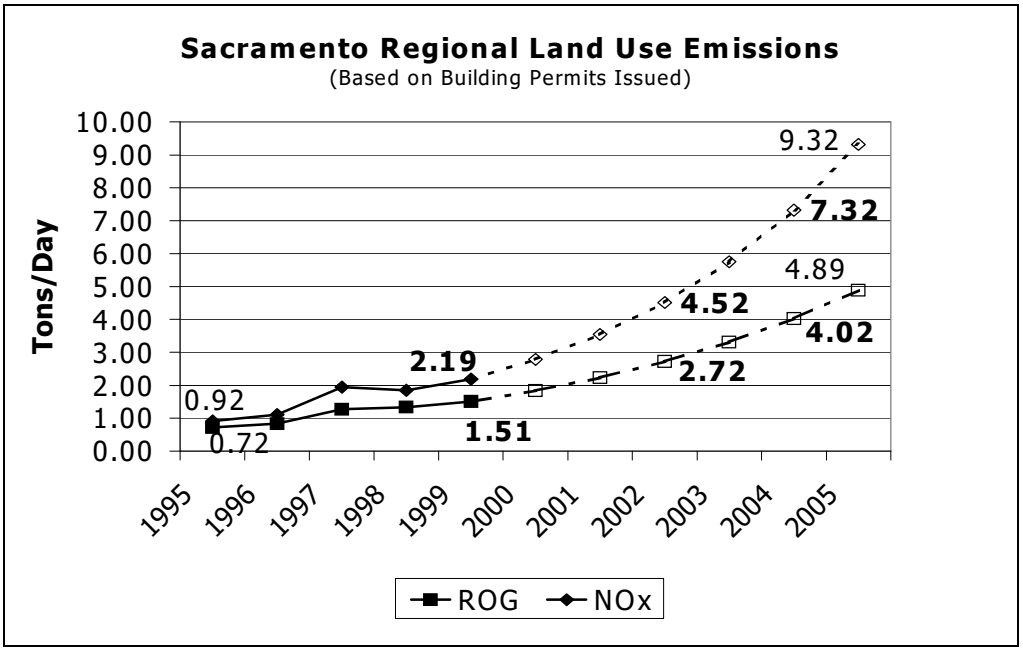
The graph shows that the rate of growth estimated by SACOG is consistent with the rate of growth verified in the database analysis. This provides a crosscheck demonstrating that the database estimates are accurate.

In summary, the comparisons of the database with the various indicators of regional growth shown above demonstrate that projections based on the database should be fairly accurate. These trends also are consistent with the Sacramento Area Regional 1999 Milestone Report on the 1994 Regional Ozone SIP.

2. Projected Land Use Emissions

To estimate land use emissions, the districts looked at the emissions from both past and future projects. The database commissioned by the districts used the URBEMIS model to calculate emission estimates for the projects that obtained a building permit. The districts' emissions estimates for post-1999 are also calculated using the URBEMIS computer model and projected through 2005. These projections are displayed in the following graph:

Figure 4 - Projected Regional Emissions from Land Use



The above projections show an average annual net increase in emissions from new building permits of approximately 22 percent for ROG and 27 percent for NOx based on 1995 – 1999 actual data.

C. Projecting Reductions Needed

Reductions to meet the SIP TCM/land use commitment come from agency TCM efforts and project-oriented land use control programs implemented between 1990 and 2005. The TCMs include measures such as light rail extensions, airport transit services, and bicycle infrastructure incentive programs. The land use measures focus on project specific controls that arise through the CEQA review of projects. Consequently, in order to set the CEQA threshold, the portion of the one ton NOx and one ton ROG commitment attributable to land use must be determined. To do this, the districts looked at:

- TCM and land use reductions achieved from 1990 to 1999.

- Projected TCM reductions to be achieved from 2000 to 2005.
- Projected land use reductions from 2000 to 2002 under the current threshold.
- Any additional land use reductions from 2002 to 2005 needed to achieve the one-ton NOx, one-ton ROG commitment.

The first three steps in this analysis are discussed in sections C.1. – 3., below. The difference between the reductions captured using the TCM measures analyzed in the SIP and the reductions achieved under the existing CEQA threshold will reveal the remaining level of reductions needed to achieve the one ton reduction for each pollutant – ROG and NOx. This latter analysis is discussed in section C.4. below.

1. TCM and Land Use Reductions – 1990-1999

The Sacramento Area Regional Milestone Report (1999) identified emission reductions of 0.21 tons/day NOx and 0.18 tons/day ROG from TCMs and land use mitigation for the years 1990-1999.

2. Projected TCM Reductions – 2000-2005

Emission Reductions anticipated from transportation control measures are:

Table 1 - Projected TCM Reductions – 2000-2005

Project	**NOx** (Tons/Day)	**ROG** (Tons/Day)
South Corridor LRT		

Extension	0.05	0.12
Folsom LRT Extension	0.04	0.13
Total	0.09	0.25

(Source: Mobile Source Division, SMAQMD, 2000)

3. Projected CEQA Land Use Reductions Under Current Threshold

Since the Milestone Report does not assess the anticipated reductions from 2000 to 2002 for projects reviewed under CEQA using the existing 85-pound threshold, staff separately assessed these reductions. As shown in Table 2 below, the total estimated emissions for projects that trigger the 85-pound threshold are 3.15 tons per day NOx and 0.93 tons per day ROG.

Table 2 - Land Use Emissions Above a Threshold

Threshold (Lbs./Day)	**NOx** (Tons/Day)			**ROG** (Tons/Day)		
	'95-'99	'00-'02	'03-'05	'95-'99	'00-'02	'03-'05
35	4.21	5.70	11.75	2.47	2.96	5.33
55	3.25	4.40	9.08	1.40	1.68	3.03
65	2.94	3.98	8.20	0.98	1.18	2.12
75	2.45	3.31	6.82	0.82	0.98	1.76
85	2.32	**3.15**	6.49	0.78	**0.93**	1.68
100	1.97	2.65	5.47	0.68	0.82	1.48
125	1.64	2.21	4.57	0.57	0.69	1.24
150	1.44	1.95	4.02	0.51	0.61	1.09

To estimate the reductions for these projects, staff assumed mitigation requirements for each project would reduce emissions by about eight percent. This level of mitigation effectiveness takes into account differences in regional thresholds and the evolution of mitigation programs. Calculated reductions are 0.08 and 0.25 tons per day for ROG and NOx during the 2000-2002 time period.

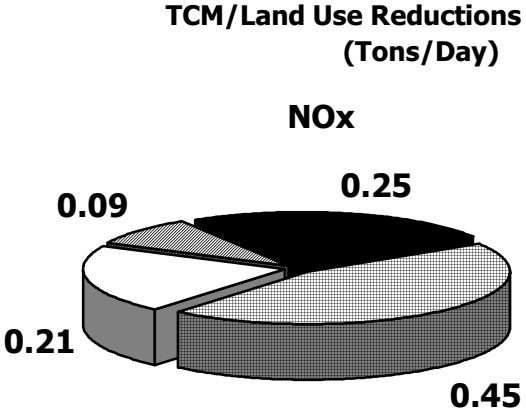
4. Remaining Emission Reductions and Possible Thresholds

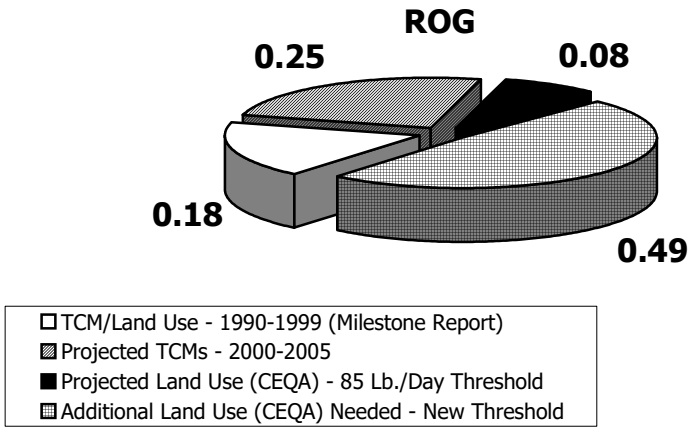
The final steps in the development of a threshold involve estimating the reductions needed, and comparing those reductions to various threshold levels.

a. Total Reductions Needed

After accounting for the emission reductions achieved (*see* Sections C.1. – 3., above), the remaining reductions needed in the 2002-2005 time period are 0.45 tons per day NOx and 0.49 tons per day ROG. Figure 5 below illustrates the contribution of each of the emission reduction categories and the remaining level of reductions required.

Figure 5 - TCM and Land Use Emission Reductions Needed for the SIP





b. Comparison of Reductions Needed to Range of Thresholds

The districts looked at a wide range of potential threshold limits in order to identify an appropriate limit for achieving the 0.45 tons per day NOx and 0.49 tons per day ROG reductions. As should be expected, the lower the limit, the smaller the projects that may trip the limit. The following tables show the approximate residential and commercial land use project size that may exceed each threshold:

Table 3 - NOx Trigger Levels

Threshold (Lbs./Day)	**Residential**	**Commercial**
35	147 du	12,000 sf
55	240 du	18,000 sf
65	285 du	21,000 sf
75	333 du	24,000 sf
85	381 du	28,000 sf
100	452 du	33,000 sf
125	576 du	41,000 sf
150	698 du	49,000 sf

Table 4 - ROG Trigger Levels

Threshold (Lbs/Day)	**Residential**	**Commercial**
35	257 du	22,000 sf
55	418 du	35,000 sf
65	497 du	41,000 sf
75	580 du	47,000 sf
85	663 du	54,000 sf
100	787 du	63,000 sf
125	1,002 du	79,000 sf
150	1,214 du	94,000 sf

* du = dwelling unit; sf = gross square feet.

NOTES: 1. Trigger levels are a guide indicating the approximate project size at a specific threshold and should not be used to determine the impact of a specific project.
2. Trigger levels were estimated using the URBEMIS computer model (EMFAC7F).

The districts developed the following formula to estimate the level of emission reductions that must be achieved to reach the one ton SIP commitment:

$$S = T + E + (L \times M)$$

Where:

S = One ton NOx, one ton ROG SIP Commitment
T = Transportation Control Measure Reductions (*see* Sections C.1-2)
E = Projected Reductions Under Current Threshold (*see* Section C.3)
L = Land Use Emissions Above the Alternative Threshold (*see* below)
M = Assumed Mitigation Program Effectiveness (*see* below)

To calculate "L," – Land Use Emissions Above the Alternative Threshold – the districts used the land use emissions database (*see* Section B.1.), and calculated the level of emissions from anticipated development that would exceed each alternative threshold assessed. The results are presented in Table 5 below.

Table 5 - Land Use Emissions Above Threshold (Tons/Day)

Threshold (Lbs./Day)	**NOx** ('03-'05)	**ROG** ('03-'05)
35	11.75	5.33
55	9.08	3.03

65	8.20	2.12
75	6.82	1.76
85	6.49	1.68
100	5.47	1.48
125	4.57	1.24
150	4.02	1.09

Finally, the districts determined the value of "M" – Assumed Mitigation Program Effectiveness – by calculating the level of mitigation effectiveness required to reduce the land use emissions above the alternative threshold limits to 0.49 tons per day ROG and 0.45 tons per day NOx – the reductions needed to meet our one ton NOx, one ton ROG SIP commitment (*see* Section C.4.a.). So, L x M must always equal 0.49 tons per day.

Table 6 and Table 7 below illustrate the application of the district's formula to the various threshold levels.

Table 6 - ROG Threshold Equation (S = T + E + (L x M))*

Threshold (Lbs/Day)	**S =** (T/D)	**T** (T/D)	**E** (T/D)	**L** (T/D)	M
35	1.00	0.18 + 0.25 = 0.43	0.08	5.33	9%
55	1.00	0.18 + 0.25 = 0.43	0.08	3.03	16%
65	1.00	0.18 + 0.25 = 0.43	0.08	2.12	23%
75	1.00	0.18 + 0.25 = 0.43	0.08	1.76	28%
85	1.00	0.18 + 0.25 = 0.43	0.08	1.68	29%
100	1.00	0.18 + 0.25 = 0.43	0.08	1.48	33%
125	1.00	0.18 + 0.25 = 0.43	0.08	1.24	40%
150	1.00	0.18 + 0.25 = 0.43	0.08	1.09	45%

Table 7 - NOx Threshold Equation (S = T + E + (L x M))*

Threshold (Lbs/Day)	**S =** (T/D)	**T** (T/D)	**E** (T/D)	**L** (T/D)	M
35	1.00	0.21 + 0.09 = 0.30	0.25	11.75	4%
55	1.00	0.21 + 0.09 = 0.30	0.25	9.08	5%
65	1.00	0.21 + 0.09 = 0.30	0.25	8.20	5%
75	1.00	0.21 + 0.09 = 0.30	0.25	6.82	7%
85	1.00	0.21 + 0.09 = 0.30	0.25	6.49	7%
100	1.00	0.21 + 0.09 = 0.30	0.25	5.47	8%
125	1.00	0.21 + 0.09 = 0.30	0.25	4.57	10%

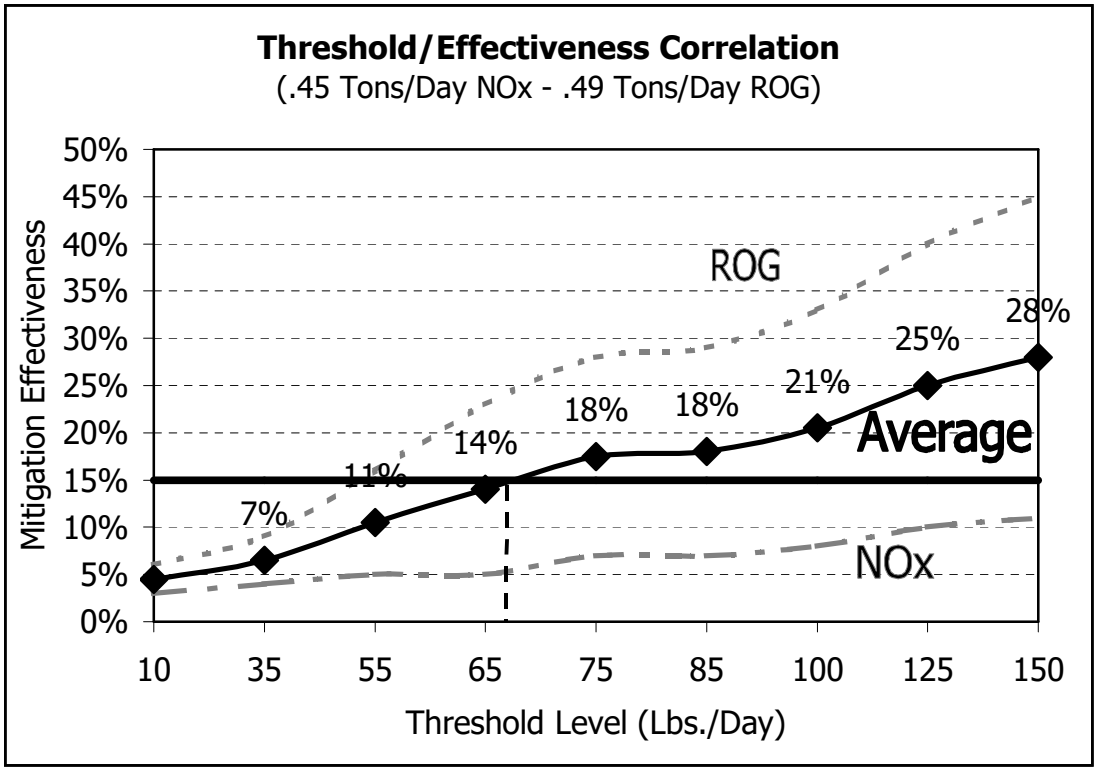
* Calculations may not be exact due to rounding.

For example, if we adopt a relatively low threshold of 35 lbs./day, then to achieve the one ton per year ROG reduction – assuming that we have and will achieve a 0.43 tons per day reduction from past (0.18 tons per day) and future (0.25 tons per day) TCM measures, and have achieved a 0.08 tons per day reduction in emissions under the existing CEQA threshold – then we would capture 5.33 tons per day in emissions over the threshold, and would only need to assure a mitigation program effectiveness of nine percent to achieve the one ton goal. This is because, as discussed above, the low threshold level will result in the application of the threshold to more, and smaller, projects, which will also result in implementing more emission reduction measures for these projects.

Conversely, if we set a high 150 lbs./day threshold for ROG, then to achieve the one ton per year reduction – and still assuming that we have and will achieve a 0.30 tons per day reduction from past (0.21 tons per day) and future (0.09 tons per day) TCM measures, and have achieved a 0.08 tons per day reduction in emissions under the existing CEQA threshold – then we would capture only 1.09 tons per day of ROG emissions, and would need to assure a mitigation program effectiveness for these projects of 45 percent. Under this scenario, far fewer projects will trigger the threshold level, and the required level of mitigation is unrealistically high.

The range of threshold options identified in the above tables is also shown graphically below (Figure 6). The graph is the average of the ROG and NOx mitigation effectiveness required to achieve the .45 tons per day NOx and .49 tons per day ROG needed to meet the CEQA threshold burden of the TCM/land use SIP commitment.

Figure 6 - Threshold and Mitigation Effectiveness Required



As this discussion demonstrates, the mitigation effectiveness is proportional to the threshold level. Low mitigation effectiveness requires a lower threshold that in turn captures more projects for review and mitigation. On the other hand, a higher threshold reduces the number of land use projects subject to CEQA, requiring more mitigation to achieve the same reductions.

D. Recommended Threshold for Ozone Precursors

Staff recommends thresholds for ROG and NOx of:

Table 8 - Recommended Threshold for Ozone Precursors

ROG	65 Lbs./Day
NOx	65 Lbs./Day

As illustrated in Table 6, Table 7 and Figure 6 (Page 16), the 65 pound per day threshold will achieve the one ton SIP goal as long as projects achieve an average mitigation effectiveness rate of 15 percent. Upon implementation of the adopted threshold, the districts will develop a monitoring program that will track mitigation effectiveness to verify that projects are achieving the 15 percent goal and allow the reductions to be credited toward achieving the SIP goal.

E. Recommended Threshold for Other Criteria Pollutants

The districts have determined that the threshold for other criteria pollutants should be based upon the state standard (Table 9) for these pollutants. Consequently, if project-specific modeling shows that the project will cause an exceedance of a state standard for a criteria pollutant, the project would cause a potentially significant air quality impact, and an environmental impact report should be prepared.

In addition, if modeling shows that a particular area is already over the state standard, the project's impact is potentially significant if it will contribute more than five percent of the ambient standard to an existing exceedance. The districts believe this five-percent margin will protect the environment without unnecessarily burdening smaller projects.

Table 9 - Recommended Threshold for Pollutants Other Than Ozone

Pollutant	Averaging Time	Threshold[1]
Carbon Monoxide	8-Hour	9.0 PPM
	1-Hour	20.0 PPM
Nitrogen Dioxide	1-Hour	0.25 PPM
Sulfur Dioxide	24-Hour	0.05 PPM
	1-Hour	0.25 PPM
PM-10	Annual Average[2]	30 $\mu g/m^3$
	24-Hour	50 $\mu g/m^3$
Sulfates	24-Hour	25 $\mu g/m^3$
Lead	30-Day Average	1.5 $\mu g/m^3$
Hydrogen Sulfide	1-Hour	0.03 PPM
Vinyl Chloride	24-Hour	0.01 PPM

1 Threshold is equivalent to California Ambient Air Quality Standard.
2 Annual Average = geometric mean of all measurements. PPM = parts per million. $\mu g/m^3$ micrograms per cubic meter.

F. Conclusion

Staff recommends applying the project-level thresholds established here to land use projects subject to CEQA. The CEQA threshold for air quality impacts serves further progress toward our attainment goals, and helps to keep emission levels below ambient standards.

Bibliography

References Consulted

The following documents were referenced in the preparation of this paper:

1. *Air Quality Thresholds of Significance*, Sacramento Metropolitan Air Quality Management District, 1994

2. *California Environmental Quality Act (CEQA)*, Public Resources Code, Division 13, Section 21000 et seq.

3. *Facts and Figures*, Sacramento Area Council of Governments

4. *Sacramento Area Regional 1999 Milestone Report*, El Dorado County APCD, Feather River AQMD, Placer County APCD, Sacramento Metropolitan Air Quality Management District, Yolo-Solano AQMD, 2000

5. *Sacramento Area Regional Ozone Attainment Plan*, El Dorado County APCD, Feather River AQMD, Placer County APCD, Sacramento Metropolitan Air Quality Management District, Yolo-Solano AQMD, 1994

6. *State CEQA Guidelines*, California Code of Regulations, Title 14, Chapter 3, Section 15000 et seq.

7. *Synergisms Among Land Use, Transit, and Travel Pricing Policies*, Johnston, Robert A. and Rodier, Caroline J. For presentation at the 1999 Annual Meeting of the TRB, Washington, D.C.

8. *Neighborhood Site Design and Pedestrian Travel*, Hess, Paul M., Moudon, Anne Vernez, Snyder, Mary Catherine, and Stanilor, Kiril. For presentation at the 1999 Annual Meeting of the TRB, Washington, D.C.

9. *TODs Importance to Transit; Transit's Importance to TODs: Planning Scenarios for Sacramento*, Thompson, Gregory L. and Audriac, Ivonne, Draft. November 10, 1998 for presentation at the 1999 Annual Meeting of the TRB, Washington, D.C.

10. *The Impacts of Mixed Use and Density on the Utilization of Three Modes of Travel: The Single Occupant Vehicle, Transit, and Walking*, Frank, Lawrence D. Preprint for presentation at the 1997 Meeting of the TRB, Washington, D.C.

11. *If You Build Them, Commuters Will Use Them – The Association Between Bicycle Facilities and Bicycle Commuting*, Nelson, Arthur C. and Allen, Davis. Preprint for presentation at the 1997 Meeting of the TRB, Washington, D.C.

12. *Transit-Oriented Development in the Sun Belt*, Messenger, Todd and Ewing, Reid. Transportation Research Record 1552.

13. *Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience*, Final Report prepared by Comsis Corporation for FHA and FTA, September 1993.

14. *Transportation-Related Land Use Strategies to Minimize Motor Vehicle Emissions: An Indirect Source Research Study*, Final Report prepared by Dagang, Deborah (JHK & Assoc.) in association with Brady and Associates, for California ARB, June 1995.

15. *Testing the Impact of Alternative Land Use Scenarios Using a Travel Forecasting Model*, Steiss, Todd Alan, Baltimore Metropolitan Council. Preprint for presentation at the 1996 Meeting of the TRB.

16. *Assessment of Travel Demand Management Approaches at Suburban Activity Centers*, prepared by K. T. Analytics, Inc., for U.S. DOT, Transportation Systems Center, July 1989.

17. *Simple Methodologies for Quantifying VT and VMT Reductions from Transportation Control and Growth Management Measures for Developing Local Trip Reduction Ordinances*, Evans, V. and Morrow, D., for presentation at the 86th Annual AWMA Meeting, June 1993.

18. *An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies*, conducted by the Center for Transportation Research and the Tellus Institute for the Sustainable Energy Development Council, June 1995.

19. *Analysis of Indirect Source Trip Activity: Regional Shopping Centers*, Final Report prepared by JHK & Assoc. and K. T. Analytics, Inc., for California ARB, November 1993.

20. *Evaluation of Travel Demand Management Measures to Relieve Congestion*, Final Report prepared by COMSIS Corporation for Federal Highway Administration, February, 1990.

21. *Comparative Assessment of Travel Characteristics for Neotraditional Designs*, McNally, Michael and Ryan, Sherry, Institute for Transportation Studies, Transportation Research Record.

22. *Transportation-Related Air Quality and Energy*, Transportation Research Record No. 1520, Transportation Research Board, 1996 (3/11/99 1:58 p.m. nncp-v5.xls 15).

23. *Critical Analysis of Sketch-Planning Tools for Evaluating the Emission Benefits of Transportation Control Measures*. Crawford, Jason and Krammes, Raymond, Research Report 1279-5, Texas Transportation Institute, December 1993.

24. *The Linkage Between Transportation, Land Use and Air Quality: ARB Research*. Parker, Terry, prepared for presentation at the TRB Air Quality and Transportation Committee Summer Conference, July 1996.

25. *Travel Behavior as a Function of Accessibility, Land Use Mixing, and Land Use Balance: Evidence from the San Francisco Bay Area*, Kockelman, Kara, prepared for TRB Annual Meeting, January 1997.

26. *The Effects of Land Use and Travel Demand Management Strategies on Commuting Behavior*, Final Report prepared by Cambridge Systematics, Inc. and Deakin, Harvey, Skabardonis, Inc. for U.S. DOT, U.S. EPA, and U.S. DOE, November 1994.

27. *The Effectiveness of Telecommuting as a Transportation Control Measure*, Sampath, Srikanth et al., Transportation Planning and Air Quality – Proceedings of the National Conference, July 1991, (P34 7-362).

28. *The Travel and Emissions Impacts of Telecommuting for the State of California Telecommuting Pilot Project*, Koenig, et al., Transportation Research C, Volume 4, No. 1, pp 13-32, 1996.

29. *A Micro-Analysis of Land Use and Travel in Five Neighborhoods in the San Francisco Bay Area*, Kitamura, Ryuichi, Mokhtarian, Patricia, and Laura Laidet, November 1994.

30. *An Employer Panel for Evaluating the Effectiveness of Trip Reduction Incentives*, Giuliano, G. and Wachs, M. Chapter 5 in Panels for Transportation Planning Methods and Applications. Golob, T. F., et al. (Editors) 1997.

31. *Framework for Evaluating Transportation Control Measures: Mobility, Air Quality, and Energy Consumption Trade-Offs*, Euritt, Mark, et al., Transportation Research Record 1444 pp. 135-144.

32. *Transportation Control Measure Analysis Procedures*, Final Report prepared by Systems Applications International and K. T. Analytics, Inc., for California ARB, November 1991.

33. *The Effectiveness of Transportation Control Measures in Reducing Congestion and Improving Air Quality*, Loudon, W., Dagang, D. and Dulla, R. for presentation at the AWMA Annual Meeting and Exhibition, 1993.

34. *Travel, Emissions, and Welfare Effects of Travel Demand Management Measures*, Rodier, Caroline and Johnston, Robert. Institute of Transportation Studies, U. S. Davis, for presentation at Transportation Research Board 76th Annual Meeting, 1997.

35. *Energy, Emissions, and Social Consequences of Telecommuting*, Energy Efficiency in the U. S. Economy, Technical Report One, U.S. DOE, Office of Policy, Planning, and Program Evaluation, June.

36. *Quantifying Air Quality and Other Benefits and Costs of Transportation Control Measures, Task 1: Review of Ongoing Research*, Technical Memorandum, Cambridge Systematics, Inc., prepared for National Cooperative Highway Research Program, January 1996.

37. *Quantifying Air Quality and Other Benefits and Costs of Transportation Control Measures, Task 2: Improvements to Current Analysis*, Draft Interim Report, Cambridge Systematics, Inc., prepared for National Cooperative Highway Research Program, March 1996.

38. *Quantifying Air Quality and Other Benefits and Costs of Transportation Control Measures, Task 6: An Analytical Framework*, Working Draft Report, Cambridge Systematics, Inc., prepared for National Cooperative Highway Research Program, April 1997 (3111199 1:58 p.m. nncp-v5.xls 16).

39. *Homemade Money*, Heede, Richard, et al., Rocky Mountain Institute, 1995.

40. *Consumer Guide to Home Energy Savings*, Wilson, Alex and Morrill, John, American Council for an Energy Efficient Economy, Sixth Edition, 1998.

41. *Transit-Oriented Development as a Congestion-Reduction Strategy in the San Francisco Bay Area*, Luscher, Daniel, Berkeley Planning Journal, Huang, William and Weinberger, Rachel, Eds. Volume 10, 1995.

42. *The Great Stove Changeout*, Website http:\\www.woodstove-changeout.org\clean.htm. 311199.37 Sacramento Municipal Utility District Website. http:\\www.smud.org\homeproducts\bia\index.html.2126199.

43. *Home Energy Saver: Energy Advisor*, Website http:\\eetd.lbl.gov. 2122199.

44. *The Electric Appliance Worksheet, PG&E Energy Calculator and Home Energy Survey*, Websites http\\www.pge.com.customer-services\residential. 219199.

45. *The Heat Island Group*, Website http:\\eetb.lbl.goviheatisland\. 318199.

46. *ECO Rule Checklist: Guidance for Estimating Trip Reductions from Commute Options*, Website http:\\www.deq.state.or .uslaqfact\checklst.htm. 318199.

47. *Sacramento Regional Land Use Emissions Database*, Jones & Stokes Assoc., 2000.

48. *Draft Developer's/Builders Guidelines for the Interim Air Quality Program*, Planning and Community Development Department, County of Sacramento, 2000.