

**Natural Resources Commission
Community Chambers
23 Russell Boulevard**

**Monday, October 24, 2011
6:30 p.m.
Agenda**

Commissioners: Herman Boschken, Mary Greaves, Mark Lubell, Dean Newberry (Chair), William Shapiro, Eugene Wilson (Vice Chair), Mark Braly (Planning Commission Liaison)

Staff: Jacques DeBra, Utilities Manager

Council Liaison: Stephen Souza

- 6:30 PM**
- 1. Roll Call**
 - 2. Approval of Agenda**
 - 3. Approval of Minutes of September 26, 2011**
 - 4. Commission and Staff Announcements**
 - 5. Council Liaison Comments**
 - 6. Public Communications:** At this time, any member of the public may address the Natural Resources Commission on items within the commission's jurisdiction which are not listed on this agenda. Public comments will be accepted for items listed on the agenda when that matter is considered by the commission. No formal action may be taken on issues not listed on this agenda. Presentations may be limited depending on time available.

General Notes: The times designated for particular agenda items are approximate and are subject to change. Please be aware that items may be heard earlier depending on the time taken on previous agenda items. The City does not transcribe its proceedings. Persons who wish to obtain a verbatim record should arrange for attendance by a court reporter or for some other acceptable means of recordation. Such arrangements will be at the sole expense of the individual requesting the recordation.

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Consent Calendar

7. A. **Long Range Calendar**

Recommendation: Informational

Regular Calendar

- 6:40 PM** 8. **Introduction and Swearing In of New Commissioners**
New commissioners Jill Baty, Clifton McFarland, Alan Pryor and Steven Westhoff, upon the receipt of the completed and signed 2010/2011 Statement of Economic Interests – Form 700 from each new commissioner, will be sworn in by Staff Liaison Jacques DeBra.
- Recommendation:** Swear in new commissioners.
- 7:10 PM** 9. **Approve 2012 Environmental Recognition Award Program**
Staff memo presents updated information for the 2012 Environmental Recognition Award Program.
- Recommendation:** Motion to support updated materials and schedule.
- 7:40 PM** 10. **Approve 2011-12 Voluntary Wood Burning Program**
Staff memo presents the major features of the 2011-12 voluntary wood burning program that is coordinated between the City of Davis and Yolo-Solano Air Quality Management District (YSAQMD). The recommendations are consistent with commissioner discussions at the September NRC meeting. The YSAQMD is recommending, in conjunction with the voluntary burn program, additional air quality monitoring for PM2.5 emissions during the Winter 2011-12 burn season.
- Recommendation:** Motion to support recommendations.
- 8:05 PM** 11. **NRC Sub-committee Reports**
Energy, Water Conservation and Zero Waste subcommittee updates.
- Recommendation:** Receive subcommittee updates.

Natural Resources Commission
****DRAFT****
Minutes
September 26, 2011

Commissioners:

Present: Herman Boschken, Mary Greaves, Mark Lubell, Dean Newberry (Chair),
William Shapiro, Eugene Wilson (Vice Chair)

Absent: Mark Braly (Planning Commission Liaison)

Staff: Jacques DeBra, NRC Liaison

Council Liaison: Stephen Souza

1. Roll Call

2. Approval of Agenda

SunPower item moved to later in agenda, motion to approve passed unanimously.

3. Approval of Minutes

Motion to approve July 25, 2011 Minutes passed unanimously.

4. Commission and Staff Announcements:

Upon adoption of the City's water, wastewater and sanitation utility rates in September, there is discussion amongst ratepayers to actively pursue a referendum and/or initiative process with the goal of rolling back utility rates to FY10-11 levels and including these measures on a future regular election ballot. The City Council has updated its goals and would like each City Commission to review the updated information and plan their respective work programs to make progress on or implement Council priorities.

5. Council Liaison Comments:

Councilmember Souza highlighted the value of pursuing the regional water supply project at this time due to the value and benefit to the community and timeliness of constructing large capital projects. There was lots of evaluation of the City's capital infrastructure plan and the rate models looked at every possible way to minimize impacts to ratepayers. If the referendum process now being discussed moves forward, it will be a policy decision of the Council as to whether or not to place the referendum on the ballot. A June ballot measure appears to be likely, pending further review of actions and policy choices.

6. Public Communications:

Reiterated the importance of maintaining the IPM position and highlighted that the use of Roundup was up 17% in 2011 vs. 2010 as an example. Re-Use People of America cited the value of having a building destruction policy in place as a means to meet community recycling goals. Mentioned that the donation of old materials was tax deductible, can help with permit assistance, and likes to partner with local contractors to encourage deconstruction activities in the community.

Consent Calendar

7. A. Long Range Calendar

Action: none.

Regular Calendar

8. Review Draft Resource Plan Outline

The NRC reviewed the outline for the City's resource plan focused on future solid waste management activities and priorities. Staff cited 2010 diversion rate of 60-61%, however mentioned that future diversion rate targets are based on a pounds per capita basis. Mentioned certified green business program and the importance of implementing an effective organics recycling effort in order to meet 75% diversion rate by 2020. NRC highlighted importance of community involvement and outreach for the plan, and use of incentives to meet goals over time.

9. SunPower Alliance Program Presentation

SunPower delivered PowerPoint presentation on the merits and elements of an Alliance Program to increase the saturation of solar power generation in a community. SunPower highlighted other communities that have programs and mentioned that other vendors could offer such programs if the City chose to allow more than one vendor to provide a similar program. Mitch Sears discussed overlap with City's Climate Action Plan, and will work with Public Works to bring back a proposal for action in 2012. Motion approved unanimously to direct staff to bring back an Alliance Program the NRC can consider approving at their January 2012 meeting, for Council consideration thereafter.

10. NRC Sub-committee Reports

Energy: The Energy sub-committee recommends that the City continue efforts on the CCA, Alliance, and Net Zero approaches to meeting long term energy sustainability goals. SB790 passed (rules of fairness for CCAs), the public goods charge legislation did not pass, mentioned SACOG Sustainability Community Planning effort, watching SB375 and SB791 (Steinberg – local gasoline tax to fund regional transportation projects). Also, continuing to follow progress on Yolo County Climate Action Plan and CCA efforts. Cool Davis Week (Oct 13-17) with goal of carbon neutrality by 2050 was mentioned, highlighting several events (films, E-car parade, festival, Cool Davis 'day of service', solar cooking, Cool Davis Foundation).

Zero Waste: No report.

Water Conservation: No report.

11. Wood Smoke Update – Review of Draft Policy/Ordinance

Staff provided brief review of policy/ordinance information to the NRC. Staff highlighted lack of resources for enforcement and monitoring during burn season periods for any kind of mandatory approach. YSAQMD reviewed the guidelines and considerations for an ordinance mechanism for regulating wood burning activities. Discussed trade-offs and costs of single vs. multiple stage, voluntary vs. mandatory, and focused vs. broad policy approaches. The YSAQMD currently has a voluntary program and will continue to work with the City to coordinate the programs and design an effective voluntary approach. YSAQMD suggested further dialogue on a future monitoring site in the City limits, willingness to conduct additional air quality monitoring during 2011-12 burn season, and encouraged residents to remove old wood burning stoves that do not burn cleanly from an air emissions perspective. Public comments that proposed policy as recommended would do a better job of protecting public health and that support resources required would be minimal. Also reminded everyone that wood smoke is toxic. The NRC deliberated and recommended that staff return at the October NRC meeting with a voluntary program coordinated with YSAQMD using a single stage approach with focused outreach on those causing wood burning impacts (best those sources could be identified), with support for additional YSAQMD monitoring during the 2011-12 wood burning season.

12. Review Updated City Council Goals

Staff reviewed the updated Council goals with the NRC and requested that NRC members consider how the 2012 NRC work program can be structured to facilitate progress on the Council goals. This item would be brought back to the NRC for additional discussion concurrent with the 2012 long range calendar.

13. Brief Review of Commission Handbook

This item was discussed as means for conducting NRC meetings in a time efficient manner while following the protocol, principles and guidelines of the handbook.

Adjourn: 10:30 p.m.

Natural Resources Commission
2011 Long Range Agenda

NRC Agenda
Date: October 24, 2011
Item: 7A

2011 Meetings	Topics	Other
August	No Meeting	
November 28	NRC Subcommittee Updates Annual Solid Waste Report Bag Ban Policy 2012 Long Range Calendar	Informational State Regulation Discussion Planning/prioritization
December	No Meeting	
Future Items	Wastewater/Storm water Programs WWTP Improvement Project Update Alliance Program Climate Action Plan	Informational CIP Update Approve Update/implementation

Current NRC Subcommittees:

1. Zero Waste;
Mary Greaves, Dean Newberry
2. Water Conservation;
Mark Lubell, William Shapiro
3. Energy;
Dean Newberry, Eugene Wilson

NRC Chair: Dean Newberry
Staff Liaison: Jacques DeBra, Public Works
Admin. Support: Dani Hester, Public Works

STAFF REPORT

NRC Agenda Date: Oct. 24, 2011 Item No. 9

DATE: October 24, 2011

TO: Natural Resources Commission

FROM: Jacques DeBra, Utility Manager

SUBJECT: **2012 Environmental Recognition Award (ERA) Timeline, Flyer, and Nomination form**

Recommendation:

Consider a motion to support updating the 2012 ERA Timeline, Flyer and nomination form.

Background:

This is the eighteenth year we have been selecting Environmental Recognition Award recipients in 3 different categories. Over the years, the mass mailing has included a folded brochure listing past award winners, a list of selection criteria, and a nomination form.

At the close of the event in 2011, staff received feedback regarding the non-profit category and is recommending that nominations in that category have current 501c status. Staff is also recommending that businesses nominated have a current Davis business license. The volunteer or group category has been merged with the individual(s) category.

As in past years, about 200 individuals, businesses and non-profits will receive a mass mailing. This list is updated annually. Outreach channels are as follows: city webpage, government TV channel, and the Davis Enterprise.

Attachments: 2012 ERA Timeline; Draft Flyer; Draft 2012 Nomination Form



City of Davis
Natural Resources Commission
2012 Environmental Recognition Award

Timeline

Approval of Timeline and Brochure	October 24, 2011
Nomination Period	January 02 - February 10
Mass Mailing to Known Environmentalists, City Council, etc.	Week of January 02
1st News Release: --Davis Enterprise --Run on Cable TV --Place on city website --Davis Environmental Column	Week of January 02
2nd News Release	Week of January 16
Select Subcommittee	Monday, January 23
Nominations Due	Friday, February 10
Subcommittee Meets to Screen Applications	Week of February 13
NRC Selects Award Recipients	Monday, February 27
City Council Presentation, Awards & Reception	<i>Tuesday, April 17</i>

Join past recipients and be recognized for your achievements!

Non-Profit Organization Category

- 2001 - R4 Recycling Program - UCD
- 2002 - Yolo Basin Foundation
- 2003 - Assoc. Students of UCD for Unitrans Bus System
- 2004 - Assoc. for Efficient Environmental Energy Systems
- 2005 - Yolo Transportation Management Association
- 2006 - Tree Davis
- 2007 - Unitarian Universalist Church of Davis
- 2008 - Davis AYSO
- 2009 - Solano County Water Agency
- 2010 - Davis Farm To School Connection
- 2011 - Holmes Jr. High Green Team



Individual/Group Category

- 2001 - Joe Krovoza - Pam Nieberg
- 2002 - Max Cadji
- 2003 - Ron & Petra Unger
- 2004 - Dorothy Peterson
- 2005 - Richard Marovich
- 2006 - Dave Feliz
- 2007 - Charlie Rominger
- 2008 - Emily Griswold
- 2009 - John Mott-Smith - Sid England
- 2010 - Marshall B. Hunt
- 2011 - Judy Moores - Lynne Nittler

Business Category

- 2001 - Davis Food Co-Op
- 2003 - Screaming Squeegee Screen Printing & Embroidery
- 2004 - Sunmart, Inc.
- 2005 - Harrington Place
- 2006 - Island Ink Jet
- 2008 - MAK Design+Build, Inc.
- 2009 - Kiwi Tree
- 2010 - Hallmark Inn
- 2011 - Waste Busters



 **Davis**
California

Environmental Recognition Awards
Recognizing the environmental service of citizens,
businesses and non-profit groups for 18 years!



Environmental Recognition Award

Each year the City of Davis recognizes the environmental contributions of an individual/Group, a business, and a non-profit. Do you know of a business, non-profit or individual that has gone above and beyond to improve the environmental quality of life in and around Davis? Someone who is setting an example of how to conduct business, set up a home environment, and/or live life daily in a manner that encourages sustainability and harmony with nature?

Nominate them for the 18th Annual Environmental Recognition Award!

Award recipients are selected by the City's Natural Resources Commission. An awards presentation will be held at the City Council meeting on **April 17, 2012**.

SELECTION CRITERIA

- ☑ Nominee's actions/achievements address a current environmental concern.
- ☑ Nominee has established a record of achievements or actions benefitting the environment.
- ☑ Nominee's actions/achievements show a commitment to continued effort long term.
- ☑ Nominee's creative implementation or development of an innovative project/program.



NOMINATIONS

In order to be considered, all nominations must be submitted electronically (email attachment, CD, DVD or memory stick). Paper nominations will not be accepted. Nominations are limited to 25 pages and must include the following:

- ☑ Nomination category:
 - Business- must possess a current, valid City business license and be located within the City of Davis.
 - Individual/Group- must be current resident(s) of Davis.
 - Non-Profit Organization- must have a current and valid 501(c) or 23701d non-profit certification and must be located within the City of Davis.
- ☑ The name, address, and phone number of the nominee, as well as the name, address, and phone number of the nominator.
- ☑ How the nominee has shown exceptional environmental initiative.
- ☑ How the nominee's actions/achievements have improved our environmental quality of life.
- ☑ Any other information that supports this nominee's application. Samples of award winning nominations are available for viewing.

Supporting documentation may be used verbatim for the award presentation and news article.



SUBMITTING A NOMINATION

Nomination forms are online at CityOfDavis.org. To submit a nomination, you may email your nomination packet to dhester@cityofdavis.org, or hand deliver or mail a CD, DVD or memory stick to:

Dani Hester
City of Davis Public Works Department
1717 5th Street
Davis, CA 95616

Paper nominations will not be accepted.

Nominations are due Friday, February 10, 2012

Questions should be directed to
Dani Hester at 757-5686.

City of Davis
Environmental Recognition Award
Nomination Form

Category

- Individual/Group** – Must be current resident(s) of Davis
- Business** - Must possess a current, valid City business license and be located within the City of Davis
- Non-Profit Organization** – Must have a current and valid 501(c) or 23701d non-profit certification and must be located within the City of Davis.

Nominee

Name: _____

Address: _____

Telephone #: _____ Email Address: _____

Nominator

Name: _____

Address: _____

Telephone #: _____ Email Address: _____

Nomination Requirements:

- **Must be submitted electronically** – you can email your nomination packet to dhester@cityofdavis.org; or deliver a CD, DVD, or memory stick to Dani Hester at City of Davis Public Works Department, 1717 5th Street, Davis, CA 95616. **Paper nominations will not be accepted.**
- **Must be received by Friday, February 10, 2012**
- **Limited to 25 pages**
- **Include the following information:**
 - How the nominee has shown exceptional environmental initiative.
 - How the nominee’s actions/achievements have improved our environmental quality of life.
 - Any other information that supports the nomination.

Please Note: Supporting documentation may be used verbatim as text for the award presentation and news articles.

If you have any questions regarding the nomination process, please contact Dani Hester at dhester@cityofdavis.org or call 530 757-5686.

STAFF REPORT

NRC Agenda Date: Oct. 24, 2011 Item: 10

DATE: October 24, 2011

TO: Natural Resources Commission

FROM: Jacques DeBra, Utilities Manager
Richard Tsai, Senior Utility Resource Specialist

SUBJECT: Voluntary Wood Burning Program in Davis: 2011-12 burn season

Recommendation

1. Consider a motion to approve the attached voluntary wood burning program to reduce unhealthful wood burning in Davis between November 1 and February 28; and
2. Consider motion to approve the Yolo-Solano Air Quality Management District's (YSAQMD) 2011-12 burn season monitoring program.

NRC Function/Purpose

- Reviews and recommends ways to improve aerosol pollutants in the environment.
- Reviews and makes recommendations pertaining to the degradation of air quality in the Yolo-Solano-Sacramento region.

Fiscal Impact

Limited available staff time will be focused and coordinated with YSAQMD efforts during the burn season to identify wood burning sources and provide informational outreach to encourage more healthful burn practices. No City resources are available for additional enforcement or monitoring efforts.

Background

The NRC deliberated on a wood burning policy/ordinance at the September meeting. After much discussion, the NRC directed staff to return in October with a voluntary burn program in coordination with the YSAQMD that could be implemented during the 2011-12 burn season. Enclosed is a summary of the program elements. This includes easy access to burn status information from the City's main website (adjacent to the weather information), additional outreach (December bill message), customer follow-up with source ID, and continued use of YSAQMD tools such "EnviroFlash" (EF) email service that sends out "don't light tonight" (DLT) advisories, air quality forecasts and health advisories during exceptional events and posted "no burn" days on their webpage. This is available to any resident or customer. Residents, The Enterprise newsroom, Channel 10, Daily Democrat, and KUIC and others will be encouraged to sign up for EF notifications. YSAQMD will send out information to the press to encourage all local media to subscribe to the EF automatic notification. The YSAQMD will conduct additional air quality monitoring during the 2011-12 burn season.

Attachments: Wood Burning Program and 2011-12 Monitoring Program

City of Davis
Voluntary Wood Burning Program
Winter 2011-12

Coordinating Parties:

Yolo-Solano Air Quality Management District
City of Davis
Natural Resources Commission

Program Principles: City of Davis and YSAQMD

1. The City of Davis will continue to implement a voluntary wood burning program in coordination with the Yolo Solano Air Quality Management District (YSAQMD) as directed by the City Council in September 2009;
2. The Program will be effective annually between November 1 and February 28 (a.k.a. the burn season);
3. The purpose of the Program is to encourage the reduction in wood burning on certain days of the burn season to minimize health effects caused by wood smoke emissions;
4. The City of Davis and YSAQMD will continue to investigate the need for establishing a monitoring site within Davis to complement the existing regional monitoring site located on UC Davis property west of highway 113;
5. The City of Davis and YSAQMD will base the 'Don't Light Tonight' decision on District wide next day PM2.5 forecasts indexed to a lower trigger level (71% of the national ambient air quality standard) using forecasts provided through STI;
6. The Program will employ a single stage approach;
7. The City of Davis will provide on its main website during the burn season a link to the burn status information on the YSAQMD's website;
8. The City of Davis website will provide a link to the YSAQMD website to consolidate inquiries through the YSAQMD;
9. The City of Davis and YSAQMD will periodically conduct monitoring surveys and studies to help improve the Program over time;
10. The Natural Resources Commission will review the Program annually at their September meeting to assess the effectiveness of the current Program and to recommend changes to improve the Program over time;
11. Both the City of Davis and YSAQMD will continue to receive customer complaints regarding wood burning practices during the burn season, and will evaluate and follow-up on complaints as resources allow;
12. The City of Davis and YSAQMD will continue to attempt to locate resources to incentivize the replacement of older woodstoves within City boundaries.

Wood Burning Information:

<http://www.ysaqmd.org/>
www.cityofdavis.org

Davis Woodsmoke Monitoring Program – 2011/2012

Over the past two wood-burning seasons, the Yolo Solano Air Quality Management District (District) has conducted PM2.5 monitoring in urbanized portions of the City of Davis. The District plans to develop and implement a special PM2.5 monitoring study in urbanized Davis during the upcoming 2011/2012 wood-burning season as well.

During the fall and winter of 2009-2010, the District worked with the Air Resources Board to monitor for PM2.5 at two locations in Davis. One monitor operated in East Davis at Slide Hill Park. The second operated in Central Davis. The monitors at both locations were “continuous” monitors, which recorded PM2.5 concentrations 24 hours a day throughout the study period. While the Central Davis monitor recorded PM2.5 levels that were similar to those seen throughout the rest of the District, the East Davis monitor recorded levels that were significantly higher. Following up on the 2009-2010 study, the District operated a continuous monitor in East Davis at Slide Hill Park during the fall and winter of 2010-2011. Recorded concentrations from this second study were in line with those observed elsewhere in the District. In addition to the continuous monitoring, the UC Davis Delta Group, headed by Dr. Tom Cahill, provided a “filter-based” monitor that collected six samples of PM2.5 at different times during the 2010-2011 study period. The Delta Group offered to analyze the collected PM2.5 to determine whether wood smoke was the primary source of PM2.5 in East Davis.

For the upcoming 2011-2012 season, the District recommends that a District-owned continuous PM2.5 monitor (E-Sampler) again be deployed in urban Davis. The monitor will be operated and maintained by the District. The location of the monitor is an issue that can be discussed between the City and District staff. It should be noted that the EPA has specific criteria for the siting of monitoring equipment. These criteria exist to minimize outside influences that can bias monitoring results. In addition to meeting the EPA criteria, any potential monitoring location must be both accessible, secure, and have a usable power source. District staff has found that very few suitable sites exist in Davis. The results of the PM2.5 analysis by the Delta Group could also influence the choice of a monitoring location. While this analysis has not been completed at this time, District staff will work closely with the Delta Group to obtain data as soon as possible.

Upon completion of the 2011-2012 study, District staff will tabulate the monitoring results and present them to the City. This will include a comparison of the observed PM2.5 concentrations in urban Davis to concentrations observed at the District’s permanent monitoring sites.

DRAFT SUBMITTED TO NRC

Recommended Voluntary Pilot Program to Reduce Unhealthful Wood Burning in Davis

A Recommendation to the Davis City Council from the
Davis Natural Resources Commission

October 24, 2011

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- 1. Recommendation to Approve the Voluntary Pilot Program without Any Provisions for Enforcement**
 - 2. Introduction and Background of the Proposed Voluntary Pilot Program**
 - 3. Development and Discussion of the Current Proposed Voluntary Pilot Program and Changes from the Last NRC Recommendation**
-

Appendix A – Report from the Davis Wood Smoke Scientific Advisory Committee

Appendix B - Letters of Support for Wood Burning Restrictions in Davis from Physicians and Health Organizations

Appendix C – Letter of Support from the Wood Burning Industry Trade Group, Alliance for Green Heat

Appendix D – Technical Justification of the Proposed Voluntary Pilot Program

- Calculation of the Daily Net Exposure of an Individual to Wood Smoke PM Pollution
- Using Dispersion Modeling Tools To Predicted Downwind Wood Smoke Concentrations under Different Metrological Conditions
- Results of Wood Smoke Dispersion Modeling and Calculation of 24-Hour PM Exposures
- Other Studies Demonstrating Local Excessive Concentrations of Wood Smoke
- Review of Modeling Methodology by one independent Atmospheric Scientist

Appendix E – Summary of Results of Past PM_{2.5} Monitoring and Wood Smoke Complaint Studies in Davis

Appendix F - Current Wood Burning Restrictions in Other Jurisdictions

1. Recommendation to Approve the Voluntary Pilot Program without Any Provisions for Enforcement

The NRC recommends that the City Council immediately approve the proposed voluntary program as presented and instruct Staff to implement the public notification aspects of the program as soon as possible only with respect to posting of allowable burn days on the City's website. We also recommend that Staff be instructed to begin additional public outreach informing the public of the voluntary pilot program including flyers while tabling at Farmers Market and notification of local media. At a later date when resources allow, we also recommend that an additional educational program be implemented to instruct the public on proper fire-starting and fire-burning methods. These educational materials can all be obtained without charge from the Yolo Solano Air Quality Management District (YSAQMD).

This proposal is functionally identical to that approved last year by the NRC and submitted to Council with one major exception. The voluntary program is a policy and not an ordinance so there are no enforcement provisions. This makes the implementation and start-up of the proposed voluntary program very easy requiring only posting of allowable burn days on the City's website. It will take another separate and independent action by the Council if they choose to make this a mandatory ordinance at some undetermined time in the future

In as much as the City is already automatically collecting and posting Don't Light Tonight information from the YSAQMD in addition to forecasted weather information from the National Weather Service, only a simple script further automating the reporting of these results is necessary. This proposed policy is recommended in lieu of an ordinance, even one with delayed implementation, specifically to overcome the objections of Staff that implementation of the ordinance would be problematic because of available resources. The Council may or may not choose to make the voluntary policy an ordinance at some time in the future which gives the public sufficient time to be made aware of the forthcoming provisions of the voluntary program.

Further, although many different health professionals and atmospheric scientists had weighed in one way or another in support of some aspects of the previous NRC-recommended wood smoke ordinance, some objections were raised about the adequacy of the science supporting the proposal and that the proposal as a whole had not been properly vetted by an independent scientific advisory committee comprised of leading atmospheric scientists and respiratory toxicologists. To address this concern, such an independent scientific advisory panel was established and convened. The group was charged with reviewing the NRC proposal with respect to the soundness of the underlying methodology used to predict safe wood burning conditions and whether it really would benefit Davis residents - particularly susceptible populations and those with respiratory impairments.

The Davis Wood Smoke Scientific Advisory Committee was comprised of two renowned atmospheric scientists with particular expertise in particulate pollution in addition to two

foremost respiratory toxicologists with extensive understanding of the impact of particulate pollution on developing lungs of small children, seniors, and those with respiratory impairments.

Their full report and their extensive credentials are attached as Appendix A of this document. Their report is unequivocal in its support of the voluntary program stating both that the methodology used to predict safe wood burning conditions utilized herein is sound and that it will be protective of susceptible populations whom can otherwise experience asthma attacks and/or respiratory distress upon exposure to excessive amounts of localized wood smoke.

2. Introduction and Background of the Proposed Voluntary Program

The NRC recognizes that while many Davis residences find fireplaces and wood burning appliances a desirable amenity, wood smoke consists of fine particles which are regarded as a health hazard by both national and state health professionals. Regional air quality standards have been promulgated identifying maximum ambient levels of particulates in the airtolerable to the general population. Unfortunately, use of wood burning appliances under certain local conditions can result in wood smoke concentrations that significantly exceed particulate air quality standards and adversely affect nearby residents. The operation of wood burning appliances therefore needs to be regulated so as not to cause significant health risks, particularly to susceptible residents who live near the local sources of wood smoke.

Currently, Davis residents affected by excessive local wood smoke sources have no available recourse or means to limit or stop the exposure and potential adverse health impacts. The NRC recognizes that it is impracticable for a member of the public to demonstrate by measurements that intermittent operation of a wood-burning appliance has resulted in particulate concentrations that exceed air quality standards or create a health hazard. It is also impracticable for individuals to simulate their local conditions in a computer model to determine whether operation of a wood-burning appliance will create or has created a health hazard. Thus, it is necessary to define conditions under which residents are likely to be unwillingly exposed to wood smoke such that they may suffer adverse health impacts. Accordingly, the NRC recommends this voluntary program to the Davis City Council as a means of defining the meteorological and operational circumstances under which use of different types of wood-burning appliances are likely to create a health hazard, and to prohibit operation of such devices under such circumstances.

Recognizing, however, that the City is facing severe financial difficulties which could impede effective and widespread public education and outreach about the voluntary program and thus limit effective enforcement of any proposed ordinance, the NRC recommends Council implement the proposed voluntary program recommended herein with the explicit limitation that all enforcement of a proposed ordinance be stayed for a 2 year period. During this two year enforcement hiatus, public outreach and education can continue by Staff. During this time, it is recommended that the existing complaint

recording system used by the City for the past two wood burning seasons be retained and improved to measure the effects of the proposed voluntary program on reducing complaints of wood smoke excessive exposures by the public.

The issue of wood burning restrictions has been deliberated at numerous City Council meetings and over a dozen NRC meetings over the past 4 years. During this time this issue has also been prominently discussed and displayed in the local media. The *Davis Enterprise* has published numerous feature and stand-alone articles and literally dozens of Op-Eds and Letters to the Editors from both opponents and supporters of wood-burning restrictions. The opinions of the letters spanned the complete range of options from opposition to any form of wood-burning restrictions at all to support for immediate and total bans on all forms of wood burning and were about evenly matched between opponents and proponents of the proposed ordinance. The issue of wood burning has also been the subject of numerous articles and threads on the *Davis Vanguard Blog*, a radio interview on DCTV, 2 articles in the UC Davis *Aggie*, television coverage on Channel 10 News, and an informational article in the *Flame* newsletter of the local Sierra Club Yolo Group. Thus, the general Davis public is well aware of the potential and specific need for such restrictions.

In November of 2008, the Davis City Council choose not support the then NRC-proposed wood smoke recommendations but instead elected to accept Dr. Cahill's offer to monitor PM2.5 concentrations at City Hall during the then coming winter. (PM2.5 means particulate matter less than 2.5 micrometers in diameter.) Dr. Cahill's subsequent report (pertinent findings are presented below) was analyzed by the NRC which again recommended a series of mandatory restrictions to the Davis City Council. In January of 2010, the City Council again elected to not impose any mandatory restrictions on wood burning but instead passed a resolution supporting the existing Yolo-Solano Air Quality Management District voluntary wood burning restrictions and supporting continued studies on neighborhood air quality and collecting citizen complaints.

Subsequently, a 2nd monitoring program has been completed by the YSAQMD and the results have been presented to Council and the NRC. Additionally, citizen complaints were collected and analyzed and the results discussed by the NRC (pertinent findings are presented below).

The NRC formed a new sub-committee on wood burning in May of 2010 after receiving the reports of the YSAQMD and Dr. Cahill and hearing analysis of the findings. The sub-committee also reviewed other technical and medical information previously submitted to the NRC and considered a broad range of alternative solutions. The subcommittee prepared an initial recommendation to the NRC which was reviewed and approved by the NRC in July, 2010 and subsequently presented to the Council. The Council again declined to implement that recommended ordinance in October, 2010. Instead, the Council directed Staff to continue to monitor citizen complaints and work with the YSAQMD to monitor wood smoke concentrations at the Slide Hill Park site for another

year. Both the results of the 3rd monitoring program and analysis of the complaints received during the winter of 2010-2011 are presented in Appendix F to this document.

Review of these findings by Thomas Cahill of the UC Delta Group and Alan Pryor of Yolo Clean Air produced contradictory conclusions as to the toxicity of wood smoke and the relative dangers of exposure of citizens to nearby sources of wood smoke. To resolve those differences, it was suggested that the matter be evaluated by an independent scientific advisory committee. Such an independent Davis Wood Smoke Scientific Advisory Committee was established in June of this year. It was comprised of 2 leading atmospheric scientists (Drs. Lowell Ashbaugh and Tony Wexler) and respiratory toxicologist (Drs. Kent Pinkerton and Laura Van Winkle) – all from the University of California at Davis. Their report was completed and submitted in August and is attached as Appendix A to this report along with their credentials.

3. Development and Discussion of the Current Proposed Voluntary Program and Changes from the Last NRC Recommendation

Policy Criteria - The NRC believes the currently proposed voluntary program meets the following policy criteria:

- 1) Simple – To the extent possible, the voluntary program must be simple and easily understood by the average citizen.
- 2) Effective Protection for Susceptible Citizens from Neighborhood Wood Smoke “Hotspots” – The proposed voluntary program must address the problem of wood smoke accumulation at ground level in neighborhoods and the effects this can have on nearby neighbors respiratory problems. The NRC has determined that the ordinance specifically must go beyond past efforts to just protect the general population by trying to limit excessive regional levels of wood smoke.
- 3) Science-based – The restrictions must be based on a defensible scientific analysis of the dispersion of wood smoke and the resultant potential exposures to Davis citizens. The Wood Smoke Subcommittee of the NRC has submitted the ordinance previously recommended to Council to the Davis Wood Smoke Scientific Advisory Committee, discussed above, along with a series of questions posed to them. Their report (attached as Appendix B to this document) clearly supports the position taken by the NRC confirming both the toxicity of wood smoke particularly to susceptible populations, the dangers presented by wood smoke accumulating in neighbor “hot spot”, the methodology used by the NRC to identify atmospheric conditions leading to the formation of such hot spots with different wood burning appliances, and the reasonableness of the proposed ordinance in addressing such untoward exposures.
- 4) Easily Enforced – Although the currently proposed voluntary program is mandatory with respect to its wood burning prohibitions, it is recommended that there be no enforcement of this ordinance during the upcoming two wood-burning seasons (with only verbal warnings issued during the 2012-2013 wood-burning season). Thereafter, to the extent possible, the ordinance must be as

- 5) Minimum Staff Time – To the extent possible, the ordinance must be easy to administrate and require a minimum of city staff time to implement and maintain. The entire process determining and posting the status of wood burning for any particular day can be easily programmed for automatic posting to the City’s website and distribution to local media
- 6) Balanced and Fair – To the extent possible, the ordinance must balance the rights of citizens to clean air while recognizing that some people have made substantial investments in improved EPA Phase II-Certified stoves and inserts and other highly efficient pellet-fueled or other equally high-efficiency wood burning appliances. The extent to which this voluntary program balances the need for clean air with advisability of using different wood burning appliances under different conditions is recognized by the Alliance for Clean Heat, a wood-burning industry trade group. Their letter of support for the basic tenets of this proposed voluntary program ordinance is evidenced by their letter of support attached as Appendix C. Other letters by independent health professionals in support of proposed wood burning restrictions are contained in Appendix B to this document..

The main elements of this newly recommended voluntary program are now as follows:

1. Enforcement

- There will be no enforcement provisions in the proposed voluntary program. Any future enforcement of any subsequently proposed ordinance will require a separate and independent action by the City Council.

2. General

- Effective November 1, 2011, wood-burning will only be allowed on “Allowable Burn Days”, only using seasoned wood with a moisture content less than 20% by weight or pellets or manufactured wood products specifically manufactured for use in wood burning or pellet stoves, and only if wood burning produces no visible wood smoke emissions beyond an initial 0.5 hour start-up period .
- Each Allowable Burn Day will extend for a 24 hour period from midnight to midnight the next day. The determination of an “Allowable Burn Day” will, *in part*, be based on a forecasted average daily regional PM2.5 concentration of 25 ug/m3 or less as made by the Yolo Solano Air Quality Management District or their designees.
- The type of wood burning appliance allowed for use on any Allowable Burn Day will be based on a forecasted average hourly wind speed for the intervening period of 6 PM to midnight on the day in question as made by the National Weather Service. This will allow “one-day before” announcement of “Allowable Burn Days” to provide timely notification of media and other means of information

- Stage III Allowable Burn Days - Only Use of High Efficiency Wood Burning Appliances Allowed (i.e. those with hourly PM2.5 emissions of less than 2.0 g/hour) - The forecasted average evening wind speed is less than or equal to 5 mph AND the forecasted average daily regional PM2.5 concentration is 25 ug/m3 or less
- Stage II Allowable Burn Days - Only Use of EPA Phase II-Approved and High Efficiency Wood Burning Appliances Allowed - The forecasted average evening wind speed is greater than 5 mph and less than or equal to 10 mph AND the forecasted average daily regional PM2.5 concentration is 25 ug/m3 or less.
- Stage I Allowable Burn Days - Use of All Wood Burning Appliances Allowed - The forecasted average evening wind speed is greater than 10 mph AND the forecasted average daily regional PM2.5 concentration is less than 25 ug/m3
- Accessing forecasted wind speeds from the National Weather Service can be automated via the internet and forecasting the next day's PM2.5 levels, will be made by YSAQMD or their designee. The subsequent determination of whether the following day is an "Allowable Burn Day" and the appropriate Stage can then quantitatively and automatically determined. This information can be automatically posted on the City's website and a voice mail system if desired. It can also be emailed to Staff, citizens, and local media as determined by Council or Staff.

3. Exceptions

- Exceptions to the general restrictions on wood burning are proposed to allow wood burning for heat during power outages; in hardship cases where wood burning is the sole source of heat for the entire dwelling unit; and in appliances designed and exclusively used for cooking. This voluntary pilot program will not apply to any appliances using only gaseous fuel. Any open hearth fireplace which has been appropriately converted (under building permit) to use gaseous fuel qualifies for this exception. Any residential dwelling equipped with a working, non wood-burning appliance designed to provide space heating does not qualify for an exception. Such space heating appliances include, but are not limited to a natural gas, propane-fired, or hot water driven central furnace or space heater, electrically-powered heat pump or electric resistance space heaters, central furnaces or portable, wall-mounted, or window-mounted units.

Predicted Number of "Allowable Burn Days" Expected under the Proposed Control Strategy - The following graph shows each day during the 2007-2008 burn season as a single point based on the actual daily average PM2.5 concentration and the actual average evening hours wind speed. If these actual average values represented the

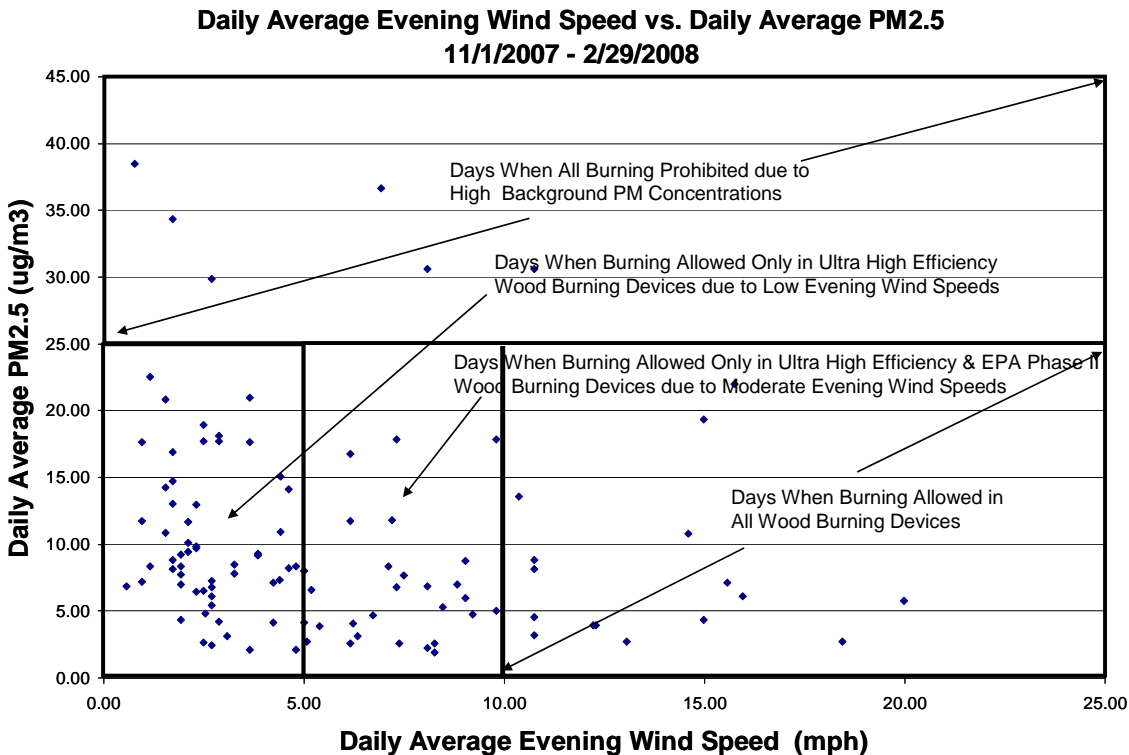
forecasted average PM2.5 concentrations and wind speeds made the previous day, the following number of days would have resulted in which use of various wood burning appliances was allowed or disallowed

No Wood Burning Allowed – 6 Days of the 120 Day Wood Burning Season

Stage III Allowable Burn Days (Only High Efficiency wood burning appliances would be allowed) - 114 of the 120 day wood burning season (95% of the time)

Stage II Allowable Burn Days (Only EPA Phase II-Approved and High Efficiency wood burning appliances would be allowed) - 64 of the 120 day wood burning season (55% of the time)

Stage I Allowable Burn Days (All wood burning appliances would be allowed) - 16 of the 120 day wood burning season (14% of the time)



This assumes the actual PM and wind speed values during 2007-2008 are representative of an average wood-burning season in Davis and that the daily PM2.5 and wind speed forecasts highly correlate with actual PM2.5 concentrations and actual wind speed values.

Concerns Expressed about Prior NRC Wood Burning Recommendations and How they are Remedied in this Voluntary Program

A number of concerns were expressed by both proponents and opponents of previously proposed recommendations by the NRC to the Council. However, it is believed that all of these valid concerns have been substantially addressed by the changes implemented in the 2010 proposed ordinance and this newly proposed voluntary program as more fully discussed below.

Concern No. 1 - It was stated that there was insufficient time to develop a comprehensive outreach program sufficient to inform citizens about the program especially since the previously proposed ordinance carried monetary penalties for inappropriate wood burning.

Remedy No. 1 - The current voluntary program ordinance proposed by the NRC differs from that proposed one-year ago only in that there is no enforcement proposed for the first wood burning season (2011-2012) to enable Staff to arrange for an outreach program. Only warnings will be issued for the 2nd wood burning season (2012-2013) to allow planning for an enforcement program to be developed and implemented for the 2013-2014 wood-burning season.

Concern No. 2 - It was suggested that the penalties for violation of previously proposed ordinance in 2009 were unduly harsh.

Remedy No. 2 - In the 2010 proposal and continued in this proposal, City staff is still given the option of setting fines (only applicable in the 2013-2014 wood burning season) at a lower level of their choosing between 10 and 100% of the limits the State imposes on municipalities. Previously to the 2010 proposed ordinance, fines were specified at inflexible predetermined levels. The current fine limits may change over time, but currently they are: \$100 for first offense, \$200 for a second offense, and \$500 for each additional offense. Thus, beginning only in the 2013-2014 wood burning season, a first offender might pay as little as \$10 or as much as \$100, depending on the percentage level Staff chooses. The Council may prefer to set the level themselves, rather than delegating it to Staff, in which case the few relevant lines of the ordinance should be amended. Fines should be high enough to dissuade illegal burning and cover enforcement costs but should not bankrupt citizens. For this latter reason, the ordinance gives "the Courts" the option of reducing fines for hardship cases.

Concern No. 3 - It was stated that there was no quantitative allowance for use of wood burning devices with efficiencies much greater than existing EPA Phase II-Approved wood burning appliances (e.g. pellet stoves and high efficiency wood stoves). These newer, high efficiency units generally are designed to operate with maximum emissions of 2 g of PM_{2.5} per hour compared to a maximum of 7.5 grams of PM_{2.5} emitted per hour allowed by EPA Phase II-Approved stoves.

Remedy No. 3 - This currently proposed voluntary program, as in the 2010 proposal, specifically recognizes these improved burning efficiencies of newer high efficiency

wood burning appliances and provides for their use about 95% of the times. To accomplish this, a 3rd Allowable burn criteria designation for High Efficiency Wood Burning Appliances was proposed in 2010 and continued in this proposal. The 2009 proposal only allowed wood burning once next-day PM2.5 concentrations were projected to be less than 25 ug/m3 AND projected minimum wind speeds reached 5 mph. This current recommendation proposes that wood burning appliance with efficiencies substantially greater than EPA Phase II-Approved wood burning appliances (i.e. appliances with PM emissions less than or equal to 2.0 g/hr) be allowed only if next-day PM2.5 concentrations were projected to be less than 25 ug/m3 regardless of projected wind speeds. This was suggested by as a reasonable course of action in recognition of the comparably low PM emissions of these appliances and is consistent with the wood dispersion modeling methodology employed in setting minimum wind speeds for less efficient wood burning appliances. We note that the Sacramento AQMD also currently has a 3-tier wood burning ordinance based on forecasted regional PM2.5 concentrations so the addition of a 3rd tier of allowable burn days is not thought to be overly complex..

Concern No. 4 - It was stated that the 6-hour proposed maximum burn time per day, while technically defensible in terms of public health, was unenforceable or too cumbersome or problematic to efficiently enforce.

Remedy No. 4 - The 6-hour burn limitation was been removed from the 2010 proposal and current proposed voluntary program. The 2009 proposed wood burning ordinance submitted by the NRC recommended that there be a six-hour limitation on wood-burning on any one "Allowable Burn Day". This was to prevent excessive build-up of wood smoke over the course of a day if someone was burning 24/7 that could otherwise result in total exposure by a nearby neighbor to the wood burner that would be in excess of federal standards. While the wood smoke subcommittee still believes this criteria is recommended for public safety concerns and to protect neighbors from potential constant exposure to wood smoke, the current proposal eliminates the 6-hour burn limitation requirement because of the expressed concern of enforcement difficulty.

Concern No. 5 - It was stated that if Non-EPA Phase II-Approved wood burning devices (such as open hearths) could be safely operated under certain conditions then that operation should be allowed to continue in the future under those restrictions and therefore their allowable use should NOT be eventually phased-out.

Remedy No. 5 - The 2010 proposed ordinance and the current proposed voluntary program does NOT propose an eventual phase-out of non-EPA Phase II compliant wood stoves but limits their use instead to times when wind speed is sufficiently high to allow for safe operation. No eventual phase-out of Non-EPA Approved appliances is now proposed. In 2009, the NRC proposed that use of open hearth fireplaces and non-EPA Phase II – Approved appliances be phased out after two years. This was consistent with the Sacramento, the Bay Area, and the Yolo-Solano AQMD Model

Wood Smoke ordinance which all similarly proposed such eventual phase-outs. The 2010 and current subcommittee proposal does not recommend such a phase-out but instead recognizes that substantial protections are afforded by the minimum wind speed criteria proposed for use of non EPA Phase II-Approved wood burning appliances.

Concern No. 6 - It was stated that even if fireplaces were operated during allowable burn times, that improper operation of the wood burning device, as represented by the presence of visible smoke, could result in excessive emissions not anticipated under the previously proposed recommendations to the detriment of public health and safety of nearby neighbors and neighborhoods.

Remedy No. 6 - The 2010 proposal and current proposed voluntary program restricts use of fireplaces if they produce any visible emissions except during start-up periods. This is consistent with the regulations of the Bay Area and Sacramento Air Quality Management Districts that have existing mandatory restrictions which similarly prohibit visible wood smoke emissions as a proxy to ensure clean burning methods are employed by the wood burner. These restrictive burning regulations are in place and enforceable regardless of the type of wood burning appliance used or the meteorological conditions during which such wood burning appliances are used.

Concern No. 7 - It was stated that the provisions requiring permitting of wood burning devices would be problematic for Staff to implement.

Remedy No. 7 – In this current proposal, the required permitting of wood burning devices is not recommended. If it is subsequently determined that such permitting is desirable for either educational or enforcement reasons, it can be revisited at that time. It would be no more difficult to implement than the current issuance of dog or bicycle licenses for which the infrastructure currently exist in the City.

Appendix A

Report from the Davis Wood Smoke Scientific Advisory Committee

In June of 2011, four faculty members of the University of California at Davis agreed to participate as members of the Davis Wood Smoke Scientific Advisory Committee. Two are atmospheric scientists (Dr. Tony Wexler and Dr. Lowell Ashbaugh) and two are respiratory toxicologists (Dr. Kent Pinkerton and Dr. Laura Van Winkle). All have extensive experience with particulate matter pollution and the effects of such pollution on human health.

As part of the technology review process, a series of questions were posed to the Advisory Committee. These questions related to the effects of wood smoke on the general and susceptible populations as well as the nature and modeling of wood smoke dispersion and its effect on regional and localized wood smoke concentrations. Their report was completed and submitted to the Davis Natural Resources Commission on August 31, 2011 and follows in its entirety.

Following that report is an abbreviated presentation of the credentials of the individual members of the Advisory Committee. The full list of extensive peer-reviewed publications of each member can be downloaded from their respective UC Davis web pages.

To: Dean Newberry, Chairperson, Davis Natural Resources Commission (NRC) and Chairperson, NRC Wood Smoke Subcommittee

From: Members of the Wood Smoke Scientific Advisory Committee (Lowell Ashbaugh, Kent Pinkerton, Laura Van Winkle, Tony Wexler)

Date: August 29, 2011

Re: Wood Smoke Scientific Advisory Committee Recommendations

Dear Dean and Members of the Davis Natural Resources Commission,

Below are our responses to your questions posed in your memorandum of June 17, 2011. In summary, we support the recommended ordinance because it will protect the health of susceptible individuals in Davis, including the young, the elderly, and those with pre-existing respiratory and cardiovascular conditions. To make the context of our responses clear, we have included the original background and questions here, along with our responses in *italics*.

In your memorandum, you provided contact information for Alan Pryor, Tom Cahill and Mat Ehrhardt as key framers of the debate. We have not consulted them while writing the response to your questions.

Toxicity of Wood Smoke (Respondent: Laura Van Winkle and Kent Pinkerton)

The NRC has received information from a variety of sources including peer-reviewed journals and various publications from the EPA and CARB which indicate that wood smoke is highly toxic and a probable human carcinogen based on the chemicals in the wood smoke. Conversely, Dr. Tom Cahill of the UC Davis Delta Group has stated to the City Council and NRC that wood smoke may not be as harmful as represented by the NRC such that additional measures regulating wood smoke generation are not only unnecessary but would even be counter-productive because it diverts attention and resources from more pressing air quality concerns.

We would appreciate your general opinions on the toxicity and/possible carcinogenicity of wood smoke in addition to your opinions to the specific questions below.

1) *In your opinion, is wood smoke either highly or moderately toxic to humans or carcinogenic or a probable human carcinogen?* *Wood smoke is a complex mixture of chemicals included in a vapor phase and a particulate phase. Wood smoke contains low levels of compounds that are either carcinogenic and or possibly carcinogenic. The dose dictates the level of concern and this is the product of both the duration of exposure and the length of time of exposure. Exposure to high levels of woodsmoke in healthy adults results in increased oxidative stress in the lung and airway mucosal symptoms. Woodsmoke has been shown to aggravate asthma and is associated with increased risk of coronary events. At a minimum, woodsmoke can trigger an abrupt change in breathing pattern, especially in susceptible individuals. This neurological response is thought to serve as an unconscious protective mechanism to minimize particle entry into the respiratory tract. Chronic toxicity of woodsmoke in outdoor air has been little studied. However, the particulate matter portion of woodsmoke is likely to have similar health effects currently attributed to fine and ultrafine ambient particulate matter, since it contains particles in this size range; increased risk of*

cardiovascular events and increased respiratory disease exacerbations. Studies of human populations have shown that exposure to particles in this size range increase morbidity and mortality.

2) If so, in your opinion do human exposures to wood smoke, at either ambient conditions in excess of Federal standards or at elevated concentrations due to proximity to upwind wood burners, present a likelihood of either a near term acute adverse health impact on the general population OR susceptible populations or show longer-term chronic toxicity or increase the probability of a cancer developing as a result of long term exposure to wood smoke? A likely significant adverse effect from woodsmoke exposure in Davis is exacerbation of pre-existing respiratory and/or cardiovascular conditions in susceptible populations. Asthma exacerbations have been linked to exposure to PM_{2.5} from combustion of wood. The level of smoke the person is exposed to, the local concentration, is a determinant of severity of effect. Long-term outcomes of woodsmoke exposure are little studied and the literature on lung cancer is confounded by the heavy influence of smoking tobacco on lung cancer development. Most lung cancer studies of woodsmoke are small and are based on exposure to woodsmoke in women who use wood indoors for cooking with poor ventilation. This level of exposure is unlikely to occur here. Of greater concern may be the existence of sensitivity to woodsmoke that may exacerbate immune-mediated events leading to impaired particle clearance from the lungs, as well as altered cellular functions resulting in increased susceptibility to infection (colds and/or pneumonia) or interstitial lung disease due to impaired particle clearance. In smokers, exposure to wood smoke has been shown to increase risk for developing COPD and reduced lung function.

3) If so, in your opinion is the likelihood of such adverse human health impact sufficiently well-established such that you believe that measures to reduce these ambient or elevated wood smoke concentrations would result in improved respiratory health to the general or susceptible populations? Yes reduced woodsmoke concentrations would improve respiratory and cardiovascular health in susceptible populations.

Sources of Local Wood Smoke in Neighborhoods (Respondent: Anthony Wexler)

The NRC has received verbal complaints from many Davis residents about the levels of wood smoke to which they are locally exposed in their yards or immediate neighborhoods. Other residents have no such complaints in their neighborhoods. Dispersion modeling studies presented to the NRC suggest that this disparity can be explained because some in the community are consistently bathed in a plume of wood smoke downwind from a persistent wood burner. Indeed, some of the complainants have even documented the source of the wood smoke plume through photography or videotaping the smoke emitting from the source chimney. The NRC's recommended Wood Smoke Ordinance attempted to minimize this presumed localized impact by restricting use of those wood burning appliances that produce the greatest amount of smoke to times when dispersion modeling predicts the downwind accumulation of wood smoke would be minimal. The predominate impact on these downwind accumulations of wood smoke was wind speed (i.e. high wind speeds produced the greatest plume dispersion resulting in the lowest predicted downwind wood smoke concentrations). Dr. Cahill has instead suggested that the concentration of wood smoke in any particular neighborhood or yard is primarily a function of regional movement of air introducing particulate matter into Davis. Further, he suggests that the

presence or absence of wood smoke in any particular neighborhood or yard is comparatively independent of the amount of local wood burning thus imposition of wood burning restrictions will have little impact of wood smoke concentrations in Davis or be protective of individual residents.

We would appreciate your general opinions on the sources of the local wood smoke accumulations to which some residents complain in addition to your opinions to the specific questions below.

1) In your opinion, is it reasonable to assume that concentrations of wood smoke throughout Davis might vary appreciably due to the presence or absence of local upwind wood burning?

2) Conversely, in your opinion is it more likely that localized concentrations of wood smoke throughout Davis are more-or-less consistent and influenced more by importation of regionally-derived wood smoke and that local wood burning will have less of an impact on localized concentrations?

Regional wood burning or field burning can also increase the concentrations of wood smoke in Davis but the further away these sources are the more dilute they are. In addition, there are increasing restrictions on such activities. Local woodburning, such as in fireplaces and wood stoves, when the air is stagnant or moving very slowly can produce very high concentrations near the source since minimal air movement does little to dilute the emissions. Also, regional wood burning will affect a larger portion of Davis, while local wood burning under stagnant air conditions will most affect those close to the source.

Usefulness of Modeling Dispersion of Wood Smoke Emissions from Chimneys and Estimating Ground-Level Concentrations of Wood Smoke (Respondent: Anthony Wexler)

The NRC has received several studies (none of which have been fully peer-reviewed sufficient for publication in scientific journals) that purport to model the dispersion of wood smoke from chimneys of different types of wood burning appliances under different meteorological conditions such that ground level concentrations of wood smoke can reasonably be predicted. The conclusions of the authors of these studies indicate that the instantaneous concentrations of wood smoke that can develop are, in many cases, of sufficiently high magnitude to present a health hazard to humans exposed to such concentrations over varying periods of time. The findings presented by these studies served as the underlying basis and justification for the wood burning ordinance recommend by the NRC to the Council as more fully explained in Appendix A (Technical Justification) of the attached NRC document "Wood-Burning in Davis: Recommended Ordinance. Dr. Cahill and Mat Ehrhardt of the YSAQMD otherwise claims that the use of the dispersion modeling tools either are unproven as to their predictive ability when modeling wood smoke dispersions, or are inherently inaccurate compared to making real world measurements of PM2.5. Thus, it is claimed that any recommendations based on the results of these modeling tools are irrelevant and not of particular usefulness.

We would appreciate your general opinions on the usefulness and applicability of using atmospheric dispersion modeling tools that specifically incorporate the Industrial Source Complex Dispersion (ISC) algorithms (with effects of Building Downwash included) to predict downwind wood smoke concentrations in addition to your opinions to the specific questions below.

1) In your opinion, can dispersion modeling of wood smoke from chimneys be done with sufficient confidence such that quantitative or semi-quantitative predictions of downwind, ground-level wood smoke concentrations can be made?

Plume dispersion modeling is a standard technique that has been used and perfected over many decades to predict the concentrations of pollutants downwind from stacks. These methods are state-of-the-art and usually produce quite accurate predictions. For instance, we have used them to examine coal-fired power plant plumes in Ohio affecting Pittsburgh, PA and their predictions were very accurate.

2) If so, in your opinion is Screen3 (an EPA approved dispersion modeling tool using the ISC dispersion algorithms with Building Downwash option included) an appropriate modeling tool for estimating such downwind, ground-level wood smoke concentrations?

Yes. Screen3 is a plume dispersion model used exactly for the purpose of predicting where plumes go when emitted from stacks and chimneys. It is a standard tool used by government, industry and environmental groups.

Estimating Wood Smoke Exposures (Respondent: Anthony Wexler)

The NRC estimated potential daily exposures to wood smoke by residents by first estimating the potential ground-level concentration of wood smoke (using Screen3) to which a resident immediately downwind of a smoke emitting fireplace might encounter. It was conservatively assumed that this exposure would occur over a 6-hour day (recognizing that some residents otherwise do use their fireplaces 24/7 during the winter months).

The product of multiplying the estimated ground-level concentrations times 6 hours was added to the product of multiplying the assumed average ambient PM_{2.5} concentration times 18 hours to obtain a net daily exposure. This was compared to the presumed “safe” level of average exposure of 25 ug/m³ over a 24 hour period (or 600 ug/m³-hours). If the product of the calculated exposure was in excess of the presumed “safe” level of exposure, then it was assumed under the conditions so specified that an adverse wood smoke exposure would occur.

For instance, if Screen 3 predicted average downwind concentrations of PM_{2.5} of 80 ug/m³ for 6 hours of the day, then the downwind resident’s net exposure for that 24-hour period would be 80 ug/m³ x 6 hours plus 15 ug/m³ x 18 hours = 480 ug/m³-hrs plus 270 ug/m³-hours = 750 ug/m³-hours.

Since this is in excess of the presumed “safe” exposure of 600 ug/m³-hours, the set of conditions which produced the high localized concentration of wood smoke were deemed to be insufficiently protective of health and the NRC’s Recommended Wood Burning Ordinance was written such that burning with the type of wood-burning appliance under those atmospheric ordinance would be prohibited. In other words, we compared the concentration of PM_{2.5} to which the downwind resident might be expected to be exposed times the length of exposure (the “CT” value) to a presumed “safe” level and values higher than the presumed “safe” level were deemed to be excessive and prohibited.

This methodology is explained in much greater detail in Appendix 2 (Technical Justification) of the attached NRC document “Wood-Burning in Davis: Recommended Ordinance.

We would appreciate your general opinions on the usefulness and applicability of using this methodology to estimate net daily exposures of residents as a means of determining whether or not a potential excessive exposure exists in addition to your opinions to the specific questions below.

1. In your opinion, is it appropriate to calculate an average daily exposure to wood smoke in the manner described above and compare it to the presumed “safe” level of exposure?

2) In your opinion, is it appropriate to use a value of 25 ug/m³ as the presumed “safe” level of exposure to err on the side of caution compared to using the current Federal 24-hour PM_{2.5} standard of 35 ug/m³ to calculate a “safe” 24-hour exposure maximum?

The safe level of exposure is not known. Currently the EPA is considering lowering the standard yet again since recent research has shown that susceptible individuals die or become critically ill breathing air that meets the current standards. A related issue is that the standards do not address exposures that may be very high compared to the standard but for a shorter period of time than the standard addresses. The EPA sets air quality standards that protect human health but they have to have evidence to establish standards. It is very difficult to obtain human health data for such high, short term exposures, so standards for these have not yet been set. In the absence of more data, the calculation that you have done is reasonable for protecting the health of Davis residents.

Effectiveness of Different Control Strategies (Respondent: Lowell Ashbaugh)

The NRC used the results of dispersion modeling and the resultant exposure calculations to define a meteorological matrix under which wood-burning could be safely employed using a variety of different wood burning devices with different emission factors. This is more fully explained in Appendix 2 (Technical Justification) of the attached NRC document “Wood-Burning in Davis: Recommended Ordinance”. We would appreciate your general opinions on the usefulness and applicability of using this general approach to define safe operating conditions for wood-burning using different wood-burning appliances in addition to your opinions to the specific questions below.

1) In your opinion, are wood burning restrictions that are based on regional air quality sufficient protection from any appreciable toxic effects from wood smoke for the general population?

2) Are wood burning restrictions that are based on regional air quality sufficient protection from any appreciable toxic effects from wood smoke for susceptible portions of the population (e.g. young people with developing lungs, people with asthma, and elderly people both with and without respiratory impairment)?

Air quality regulations are set to provide protection from the adverse effects of air pollutants “with a sufficient margin of safety” to protect the general population. Wood burning restrictions based on not exceeding the regional air quality standards would probably not protect people living close to the burning. Regional air quality monitors are sited to obtain data that is regionally representative, while wood burning impacts are more likely to be close to the wood burning source. This is especially true for sensitive populations, who could experience smoke concentrations far in excess of the health-related standard simply due to their proximity to the source. Such “hot spots” of smoke pollution could exist with no appreciable impact on the measured regional air quality. The approach you have devised to define a meteorological matrix is well thought out and constructed. It acknowledges that the

atmosphere has a capacity to dilute wood smoke that varies with regional air pollution and ventilation (wind speed). When air quality and dilution conditions allow it, more polluting activities (open fireplaces) can be used. As conditions become more restrictive, the allowable wood burning devices shift to those that are more efficient. Under extreme conditions, wood burning is not allowed. This approach is certainly reasonable and protects both those sensitive to the pollution and those who have invested in cleaner burning technology.

Adequacy of Data and Future Research Needs (Respondent: Lowell Ashbaugh)

The NRC acknowledges that more scientific data is probably available that may not have been fully considered by the NRC in the development of the proposed wood burning ordinance. We also understand that much needs to be investigated and many questions need to be answered to more completely understand the nature and health effects of wood smoke exposures in urban environments.

We would appreciate your general opinions on the data considered by the NRC and what future studies might be necessary before an ordinance is introduced or to more carefully refine an ordinance after its implementation in addition to your opinions to the specific questions below.

1) *In your opinion, to what extent has key scientific evidence become available or what additional data would be useful to improve our understanding of the nature and magnitude of wood smoke toxicity or health impacts and the implications of exposure of susceptible populations with respect to the applicability of this recommended ordinance?*

2) *In your opinion, are the current Federal fine particle standards sufficient to provide protection against PM-related health effects for susceptible populations?*

While scientists would always like more data, at some point there is enough accumulated evidence that protective actions are justified. In this case the scientific evidence for the existence of health-related impacts of wood smoke is more than adequate to justify an ordinance to protect people living nearby. Federal fine particle standards are periodically reviewed to accommodate more information as it becomes available. The standards are set now to protect the population based on current knowledge of health effects. Susceptible populations living near sources of pollution, whether wood burning or other sources, can be exposed to much higher concentrations than the standards allow. A useful analogy to consider here is Davis' smoking ordinance. Smoking is not allowed in public buildings or within 20 feet of their entrances. This form of pollution has no effect on regional air quality but certainly affects people who happen to be nearby. A significant difference between smoking and residential wood burning is that wood burning can affect people in their homes and yards where they cannot escape, while we can usually move away from smokers to protect ourselves.

Information on Members of the Davis Wood Smoke Scientific Advisory Committee

September 10, 2011

DR. TONY WEXLER

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CURRENT POSITION

- Director of Crocker Nuclear Laboratory, University of California, Davis
- Director, Air Quality Research Center, University of California, Davis
- Professor - Department of Mechanical and Aerospace Engineering, University of California, Davis
- Professor - Department of Civil and Environmental Engineering, University of California, Davis
- Professor - Department of Land, Air and Water Resources University of California, Davis

EDUCATION

- Ph.D., Mechanical Engineering, California Institute of Technology, December 1990
- M.S., Mechanical Engineering. Massachusetts Institute of Technology, January 1978
- B.S., Engineering Physics, University of California, Berkeley, June 1976

HONORS AND AWARDS

- Appointed to Editorial Advisory Board, Aerosol Science and Technology, 2008
- Outstanding Mid-Career Research Faculty Award, College of Engineering, UC Davis, 2005
- President of the American Association for Aerosol Research, 2005-2006
- Appointed to Editorial Board, Atmospheric Environment, 2004
- Appointed Editor of Aerosol Science and Technology issue on Single Particle Analysis, 2000
- Technical Program Chair for the American Association for Aerosol Research Conference, 1999
- Advisor to the NRC Committee to Review the Department of Energy's Office of Fossil Energy's Research Plan for Fine Particulates, 1998
- Plenary Lecturer, American Association for Aerosol Research Conference, 1998
- Dean's Special Merit Award, U.D., 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998
- Editor's Citation for Excellence in Refereeing for JGR-Atmospheres, American Geophysical Union, 1997
- Dean's Teaching Commendation, U.D., 1993, 1996
- Kenneth T. Whitby Award, American Association for Aerosol Research, October 1995
- Provost's Special Merit Award, U.D., 1993, 1996, 1999

DR. LOWELL L. ASHBAUGH

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CURRENT POSITION

- Associate Research Ecologist – Crocker Nuclear Laboratory, University of California, Davis

EDUCATION

- Ph.D. Ecology, University of California, Davis
- M.S. Environmental Health Sciences, University of California, Berkeley
- B.A. Physics, University of California, Davis

HONORS AND AWARDS

- PM Review Panel, Clean Air Scientific Advisory Committee, U.S. Environmental Protection Agency, 2008-present.
- Session Chair, Air & Waste Management Association Visibility Specialty Conference, Asheville, North Carolina, October 26-29, 2004.
- Member, Ambient Monitoring and Reporting Forum of the Western Regional Air Partnership, 1998-present.
- Associate Editor, Journal of Environmental Quality, 2000-2002.
- Member, Technical Committee of the California Regional Particulate Matter Air Quality Study, 1994-2003.
- Technical Advisor, Air Quality Task Force to the Secretary of Agriculture, U.S. Department of Agriculture, 1999-2001.
- Member, Meteorology Subcommittee of Grand Canyon Visibility Transport Commission Technical Committee, 1992-1996.

RESEARCH INTERESTS

- Visibility/particle relationships in the atmosphere
- Interbasin transport of air pollutants throughout the United States
- Sources and generation mechanisms of PM10 fugitive dust
- Dry deposition of acidic gases and particles
- Source/receptor modeling of particles and gases
- In-use motor vehicle emissions and their effect on air pollution

DR. KENT PINKERTON

Phone: (530) 752-8334

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CURRENT POSITION

- Professor - Department of Pediatrics, School of Medicine, University of California, Davis
- Professor (In-Residence) - Department of Anatomy, Physiology and Cell Biology, School of Veterinary Medicine, University of California, Davis
- Director - Center for Health & the Environment, John Muir Institute of the Environment, University of California, Davis

RESEARCH INTERESTS

- Health effects of environmental air pollutants on lung structure and function
- Interaction of gases and airborne particles within specific sites and cell populations of the lungs in acute and chronic lung injury
- Effects of environmental tobacco smoke on lung growth and development

HONORS AND AWARDS

- PM Review Panel, Clean Air Scientific Advisory Committee, U.S. Environmental Protection Agency
- Chair, Regents' Scholarship Administrative Advisory Committee
- Member, Chemical Safety Advisory Committee
- Member, Long-Range Planning Committee, Assembly for Environmental and Occupational Health, American Thoracic Society

DR. LAURA VAN WINKLE

Phone: (530) 754-7547

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CURRENT POSITION

- Associate Adjunct Professor - School of Veterinary Medicine Department of Anatomy, Physiology and Cell Biology, University of California, Davis
- Associate Research Cell Biologist - Center for Health and the Environment, John Muir Institute of the Environment

HONORS AND AWARDS

- Diplomate, American Board of Toxicology (DABT) 2002-Present
- UC Davis Academic Federation Professional Development Award Fall 2010
- Young Investigator Award, 2008 Inhalation and Respiratory Specialty Section SOT
- American Lung Association Research Fellow 1997-1999

RESEARCH INTERESTS

- Effects of air pollution on childhood health and disease
- Role of sex-differences and xenobiotic metabolism in lung toxicopathology
- Air pollution including tobacco smoke, naphthalenes, particulates and ozone
- Cell proliferation and mechanisms of cytotoxicity
- Airway remodeling in response to air pollutant and during postnatal lung development
- Cell-cell interactions in lung wound healing, in lung disease (lung cancer and asthma) and during lung development
- Imaging methods

Appendix B

Letters of Support for Wood Burning Restrictions from Physicians and Health Organizations

February 21, 2008

Bruce Kemp, Chair
Jennifer Holman, Vice Chair
Members, Natural Resources Commission
City of Davis
23 Russell Blvd
Davis, CA 95616

Re. Regulating Wood Smoke Pollution

Dear Chairman Kemp and Members of the Natural Resources Commission,

Thank you very much for the opportunity to comment on efforts to restrict wood smoke pollution in the City of Davis. Due to health impacts caused by breathing wood smoke pollution, we applaud your interest in reducing wood smoke pollution in Davis to the maximum extent possible.

The science on health impacts of wood smoke pollution has advanced considerably over the last two decades. Wood smoke is comprised of tiny particles which have been associated with adverse health outcomes, including increased mortality. Breathing wood smoke can aggravate a host of illnesses, ranging from asthma and emphysema to heart disease. Last September, after a review of the thousands of studies examining health effects of particle pollution, the United States Environmental Protection Agency set a 24-hour threshold for particle pollution at 35 micrograms per cubic meter, cutting by half the allowable particles in the air.

Every winter, the American Lung Association of California receives phone calls from distraught residents suffering from health problems caused by wood burning from their neighbor's chimneys. Often, they have young children with asthma who are literally unable to breathe in their own homes. Some of these families have had to resort to selling their homes and moving to areas with less wood smoke pollution. The American Lung Association of California has worked closely with air districts throughout the region to educate the public on the harmful effects of wood smoke and to encourage the adoption of measures to reduce exposures. Despite many local air pollution control efforts, the lack of controls on wood smoke pollution in neighborhoods continues to create unhealthy air for many.

Thank you for your leadership in protecting the health of your community and promoting clean, healthy air. Cleaner burning alternatives are available to enjoy the glow without the smoke. Please don't hesitate to contact us if you have any questions, or if we can provide you with any assistance.

Sincerely,

Barbara Beedon
Regional Vice President

Letter to City of Davis City Council

BREATHING SOOT IS DANGEROUS TO YOUR HEALTH

By Anthony Gerber, MD, PhD

The City of Davis has a critical opportunity to improve public health with the proposed wood burning regulation that will help eliminate the harmful effects of breathing wood smoke pollution. The ordinance addresses a common situation in many communities where individuals are exposed to their neighbors' wood burning pollution. The American Lung Association of California and the California Thoracic Society applauds the City of Davis for proposing a strong wood burning ordinance and following in the footsteps of so many other communities that have already taken this important step to protect the public's health.

Wood smoke comprises the largest single source of particle pollution in the wintertime. When inhaled, these tiny particles can lodge deep into the lungs. Breathing even low levels of this pollution increases the risk of premature death. Research has also linked particle pollution to lung cancer, heart attacks, asthma attacks, strokes as well as increased admissions to the hospital for respiratory and heart conditions.

Given the known harmful effects of exposure to wood smoke pollution, the regulations proposed by the City of Davis are long overdue. Despite regional air pollution control efforts, the lack of controls on wood burning and wood smoke pollution has created unhealthy air for everyone in Davis and a situation where neighbors are suffering health effects, becoming prisoners to their neighbors' wood burning pollution.

It may seem hard to believe that something so "natural" as wood could actually be harmful to our health. But forty years ago, we thought smoking was harmless, as well. Today, if an industry emitted as much particulate pollution as some chimneys do, it would be required to have a permit or be shut down.

In the Bay Area, nearly 1 million people have asthma, including 200,000 children. An additional 300,000 have been diagnosed with emphysema, lung cancer and chronic bronchitis. The pervasive problem of respiratory disease is even greater in the Central Valley. Lung disease is the fastest growing cause of death in the United States.

Local and regional government agencies must take leadership on controlling soot pollution from wood smoke.

Data shows that there is public support for wood burning, but there is no public support for wood smoke pollution. Cleaner burning alternatives are available to enjoy the glow without the smoke, such as natural gas stoves, pellet stoves, and electric devices.

Why a regulation? For years, regional voluntary and neighbor-to-neighbor measures have been tried. Once educated about the health effects, many people have turned to cleaner burning alternatives. Most residents are good neighbors and will comply and find ways to stay warm without causing harm to their neighbors. But for those who continue to pollute the air with toxic wood smoke, regulations are needed. Everyone thought restricting smoking in public

places would cause huge problems. It has not. People have adjusted because they know it is a matter of public health. Other air districts such as the San Joaquin Valley, the Sacramento Air Quality Management District, and the Bay Area Air Quality Management District have mandatory restrictions on wood burning when atmospheric conditions favor smoke buildup and local residents have taken it in stride, because they understand it is a critical public health issue.

Some day we will look back on wood smoke pollution as we did smoking. Both are hazardous to our health and should be restricted.

Anthony Gerber, MD, PhD, is Assistant Professor of Medicine at the University of California, San Francisco, specializing in pulmonology and critical care medicine.

To: Davis City Council:

January 1, 2009

From: Bonnie Gieschen, MD

I am writing in support of a marked restriction on, or better yet, complete elimination of the use of wood burning fireplaces. There is more and more information becoming available that their use contributes significantly to the poor air quality in the Sacramento region, especially in the winter months.

I will let the air quality scientists quote particulate size and relative contributions made to air pollution by other sources. The information I have read underscores the danger posed by the fine particles produced and the multiple carcinogens released into the atmosphere by the wood burning. Both of these factors contribute to the health risks faced by all of us as a result of the decrease in air quality. This is especially true of the vulnerable populations I care for, both young children, and the elderly, especially those with preexisting lung disease. It is well known that childhood asthma has been increasing dramatically in the past several years, and air pollution has been one of the factors blamed for this rise. I have also seen for myself numerous cases of environmental factors triggering a flare of Chronic Obstructive Lung Disease or Asthma in my patients. We would have a dramatic increase in “lung cases” in the days (not that long ago) when the rice fields were regularly burned. I have had specific patients who have presented with a flare of their lung disease from indoor wood burning stoves, and as more information becomes available the cumulative contribution of all the individual stoves or fireplaces is apparent.

Especially where wood burning stoves or fireplaces are used “for effect” there needs to be a ban with a transition to the much safer options of natural gas or propane if one desires this luxury. In the relatively few cases where wood burning is a necessity I would support funds to help those in need to transition to a safer (for all) technology.

Sincerely,

Bonnie Gieschen M.D.
Internal Medicine/Pediatrics
2701 Brentwood Pl
Davis, CA 95618

January 5, 2009

Dear Mayor Asmundson and City Council Members:

I understand that you will soon be considering a residential wood smoke ordinance. I've been interested in residential wood smoke for many years, both because it has been repeatedly shown to be a major source of regional particulate matter (PM) concentrations in the winter and because the uneven distribution of smoke generated in neighborhoods can result in very high localized pollution. As a former chairman of the Public Health Committee of the Bay Area Air Quality Management District's Advisory Council, as well as Chairman of the Environmental and Occupational Health Committee of the erstwhile American Lung Association of the East Bay, I am quite familiar with the problems of wood smoke pollution, particularly in inland valleys. Even in areas with good regional air quality, neighbors of someone who burns wood on a regular basis may receive substantial exposures to fine PM as well as gaseous respiratory irritants in wood smoke. When I was still working primarily on air pollution issues, I used to receive phone calls from people throughout California who lived downwind of someone using a wood stove during the fall and winter, asking what recourse they had when their neighbor would not respond to reasonable requests to abate the smoke. Basically there was little that the individual could do other than to bring a private nuisance lawsuit, which would mean spending thousands of dollars to participate in a process with a very uncertain result. There were several instances in which relocation was the only "solution" to this localized air pollution problem.

On a related topic, while the published literature on wood smoke-related health effects is sparse, it is clear that such smoke can exacerbate pre-existing respiratory disease. For instance, in the Santa Clara area, wood stoves and fireplaces have historically been major contributors to winter PM pollution, which has been associated with a greater than 40% increase in the risk of emergency room visits for asthma, especially during episodes of low temperatures (Lipsett M et al. [Air pollution and emergency room visits for asthma in Santa Clara County, California](#). Environmental Health Perspectives, vol 105, pp. 216-222, 1997). Virtually all methodologically sound epidemiological studies of the health impacts of wildfire smoke on populations have clearly documented associations with respiratory illness, as described in a recent wood smoke review article, on which I was a co-author ([Wood smoke health effects: A review](#). Inhalation Toxicology, vol. 19, pp. 67-106, 2007). There have been few studies examining the circulatory effects of exposure to wood smoke, per se, and therefore it is premature to make any pronouncements about cardiovascular effects of smoke mixtures routinely encountered in suburban areas. However, there are both human and animal data linking wood smoke exposures to systemic inflammation, which is thought to be one of the risk factors for precipitating circulatory events. Also, to the extent that wood smoke contributes to combustion particle burdens in a given region, it is likely to contribute to health effects that have been linked with PM exposures.

I hope that these comments are helpful in your deliberations about how best to protect public health. Thank you for your consideration,

Michael Lipsett, M.D. , Chief - Exposure Assessment Section
California Department of Health Services

Appendix C

Letter of Support for Proposed Davis Wood Burning Ordinance from a Wood Burning Industry Trade Group



Sept. 1, 2010

Board of Directors

John Ackerly
Alliance for Green Heat

Nick Salafsky
Foundations of Success

Jon Strimling
Woodpellets.com

Advisory Board

David Ackerly
UC-Berkeley

Gillian Caldwell
ISky

Gary Dodge
*Forest Stewardship
Council—U.S.*

Lily Donge
*Calvert Asset Management
Company, Inc.*

Josh Elmore
Lighthouse Solar

Michael Green
*Center for Environmental
Health*

John Gulland
*The Wood Heat
Organization*

Eric Kessler
*Family Alliance
Foundation*

Steve Nadel
*American Council for an
Energy-Efficient Economy*

Charlie Niebling
New England Wood Pellets

*Organizations for identification
purposes only*

Dear City Council Member,

The Alliance for Green Heat urges you to pass the wood burning ordinance recommended by the Davis Natural Resources Commission. While wood heat is a vital affordable heating source for many low-income families, it must be carefully regulated to ensure a healthy community. We at the Alliance applaud your proactive approach in recognizing the benefits of the clean high efficiency wood stoves while controlling unhealthy burning practices. We would like to offer the following feedback for Davis' proposed ordinance:

We strongly Support:

- **The three stages of restriction- reward & recognize clean burning appliances**
- **Distributing educational material with permits- promote healthy burning**

Recommended additions:

- **Exempting low-income households and funding a change out program**
- **Potential Holiday curtailment waiver**

The Alliance for Green Heat is an independent, national non-profit that supports wood heat as a sustainable, environmentally friendly, affordable heating alternative for low-income families. As supporters of wood heat, we also must push for strict standards and regulations concerning responsible wood burning. Our industry and our neighbors will both profit from clean burning stoves and nuanced public policy about how and when to burn. We have been conducting a study of California's diverse Air District policies on wood burning appliances and considering your proposed ordinance. The Davis Natural Resources Commission Recommendation was quite thorough and we agree with virtually all of their findings. We would like to add our support for some sections of the ordinance in particular and offer a few further suggestions.

The three stages of restriction rewards/recognizes clean burning appliances

We found the nuanced approach of three stages of allowable burn days to be an effective policy that takes technological advances into account and encourages consumers to purchase the cleanest burning stoves. Wood heat is one of the best sustainable heating sources to combat global warming, but this beneficial effect is only felt when the stoves are efficient and clean. By recognizing and rewarding the difference between uncertified appliances, EPA certified and high efficiency stoves, consumers will have an incentive to buy the cleanest stoves they can afford. Simultaneously rewarding high efficiency stove design drives our industry to greater technological advances in clean stoves. Ideally, a total switch to the high-efficiency models would vastly improve air quality, and render these regulations irrelevant in the long run.

Distributing educational material with permits promotes good burning practices

The cleanest wood stove is undermined if poor burning practices are used. The consumer is also hurt by not getting the most heat from their fuel and appliance. Requiring education on safe and clean burning practices before permitting is an excellent measure to ensure positive burning practices.

Exempting low-income households

Wood heat is often the most affordable source of heat to low-income families in rural areas (aside from the dirtier coal in some parts of the country). It also can offset as much greenhouse gasses as a solar PV system for a small fraction of the cost. It is essential that low-income families be able to affordably heat their homes. The adjustment of fines based on potential hardship and exempting wood stoves that are the sole source of heat, are both excellent steps in the right direction. However, for the very poor, running a back up heating system a few days a year might prove too great a burden. Sacramento, South Coast Air Basin and Great Basin Unified all addressed this issue by exempting very low-income families from curtailment days. Respectively low-income was defined as; a city council approved hardship waiver, currently receiving reduced gas or electric bills, or as defined by the Department of Housing and Urban Development. While it is likely that those with the lowest incomes may also have some of the most polluting stoves, it is still important to help families avoid the 'heat or eat' dilemma.

Ideally a low-income exemption would be limited to a year or two and coupled with an incentive program for to upgrade to cleaner stove models. Many low-income families would welcome the improved heat output, air quality and fuel utilization of high-efficiency stoves, but lack the finances to upgrade. In the early 90's the town of Mammoth Lakes enacted a burn ban that had this exact provision. They coupled a low-income exemption with a wood stove change out program for those financially qualified. Wood-stove change out programs such as those enacted in Libby, Montana and the Great Basin Unified Air Pollution District have also been very successful in replacing old stoves, and could be adapted to focus on low-income families. This is perhaps beyond the provisions of the current ordinance, but would be a great future program to consider.

The State of Oregon and several California Air Districts even go so far as to mandate the destruction of non-certified stoves upon sale or transfer of the home, such as the San Joaquin Valley Air Pollution Control District, Glenn County Air Pollution Control District and Great Basin Unified Air Pollution Control District. The wide adoption of some form of this regulation points to its effectiveness as a tool in combating air pollution. We strongly feel that in the long term, the key to reaching healthy air quality lies in the more rapid phasing out of uncertified wood stoves. Ideally, with the phase out of polluting wood stoves, there should be fewer days with unsafe PM2.5 levels.

Potential Holiday curtailment waiver

This provision could prevent public backlash against the regulation and help protect the cultural traditions in our country. In the Bay area, they have met the strongest resistance to their 'Spare the Air' days when these days fell on Thanksgiving and Christmas, days which many residents most wanted to use their fireplace or stove. We propose some flexibility around these traditional wood burning holidays to ease public fears, protect cultural heritage and increase public support for this regulation.

Thank you for your time and interest in the Alliance's input. Our organization is heartened to discover regulations that recognizes the health benefits of clean-burning technology and restricts unhealthy polluting stoves and irresponsible burn practices. The nuanced approach your city is taking to the levels of emissions produced by different stoves is unique and could become a valuable model for other cities. With strict emission standards and

clear guidelines on how and when it's safe to burn we feel your city will best protect the interests of its citizens. We look forward to watching the strides your city is taking for clean air and affordable heat.

Sincerely,

Tatiana Butler
Program Manager
The Alliance for Green Heat

CC: Davis Natural Resources Commission
Mary Nichols, CA Air Resource Board
Paul Hensleigh, Yolo Solano AQMD
Duane Ono, Great Basin Unified APCD

Appendix D

Technical Justification of the Proposed Ordinance

Synopsis

Numerous jurisdictions restrict wood burning when ambient PM_{2.5} concentrations exceed federal thresholds, but this does not address the nearest-neighbor impacts of wood-burning. Citizens near wood burning homes can be exposed to smoke levels well above federal standards while regional air quality remains acceptable. Sensitive receptors like asthmatics are particularly harmed by near neighbor emissions. Since wind can disperse the particulate matter in local hotspots, the NRC proposes an ordinance based on modeling-supported wind speeds and cognizant of the emissions levels of different types of wood burning appliances. This appendix concludes with letters from health experts corroborating the adverse health effects of wood smoke and attesting to the appropriateness of the wind-speed based model proposed.

Introduction

In recognition of the growing body of evidence about the adverse health effects of particulate matter in wood smoke, the US Environmental Protection Agency has recently lowered its 24-hour PM_{2.5} exposure standard from 65 to 35 micrograms/cubic meter (ug/m³). In order to reduce ambient winter time PM pollution and achieve regional compliance with this new standard, every regional air pollution control regulatory body in California that encompasses substantial urban areas have enacted various mandates and restrictions governing wood-burning within the last several years.

In addition to various requirements to have cleaner-burning EPA Phase II-Certified Stoves installed in new construction or on retrofit of wood-burning appliances and restricting sale or use of wet wood, these regulatory efforts have primarily focused on mandatory restrictions on wood-burning when the regional ambient PM_{2.5} concentrations exceed or are predicted to exceed the federal threshold. These restrictions result in varying number of days of wood burning prohibition depending on the degree of PM pollution in the region. In Fresno which has high background levels of PM pollution, it is estimated that newly imposed restrictions will result in 45 “No-Burn Days” in an average 120-day burn season. In Sacramento which has less PM air pollution, it is estimated it will result in from 10-15 days in a burn season in which wood-burning would be prohibited.

Until recently, however, no research has been performed that looks at the concentrations of PM pollution that can actually occur down at the neighborhood level (vs. regional PM concentrations) as a result of local residential wood-burning occurring upwind from exposed citizens. Because wood smoke is produced by single point source emitters and is variably dispersed and diluted downwind, ground-level PM concentrations can be produced that are substantially higher than average regional pollution levels under certain atmospheric conditions. This could lead to exposure by citizens to excessive PM pollution in the air of these neighborhood “hotspots” even though regional particulate matter concentrations may be much lower. Conversely, there are times in which local atmospheric conditions are such that smaller amounts of

ground-level pollution will occur from wood burning (such as with high winds and unstable atmospheric conditions), but that regional PM concentrations are such that no additional burning should occur due to the risk of downwind exposures in excess of the Federal standards.

Recognizing these dual aspects of wood smoke pollution control, the NRC has considered two different methodologies to determine when a day is an “Allowable Burn Day”.

1) The Yolo Solano Air Quality Management District has an existing methodology in which PM concentrations are routinely forecasted for the following day during winter months. Under this program, when the regional average PM_{2.5} concentration is projected to exceed 25 ug/m³ on the following day, a “Don’t Light Tonight” alert is announced in which voluntary curtailment of wood burning is encouraged. This program can be easily modified to meet the specific needs of a mandatory wood-burning restriction program in Davis as further discussed below.

2) A wind based-methodology based on EPA-approved software modeling tools has been considered based on research performed by Yolo Clean Air and a researcher at Lawrence Berkeley Laboratories on behalf of the City of Berkeley. This modeling tool has shown that excessive levels of ground-level wood smoke pollution can occur and persist during night time burning hours when wind speeds are less than 5 mph even when the wood burning appliance is an EPA Phase II-Certified wood stove or insert.

The NRC finds that the of both methodologies have technical merit in the manner in which they address the problem and recommends that BOTH be included in the final determination of whether or not a following day is an “Allowable Burn Day” as more fully described below.

Calculation of the Daily Net Exposure of an Individual to Wood Smoke PM Pollution

The underlying intent of the NRC’s effort is to prevent citizens from being exposed to excessive levels of wood smoke pollution. The calculation of the cumulative exposure of an individual to particulate pollution over a day in which there is no additional local wood-burning contributing to regional pollution levels is very simple.

One simply multiplies the average regional background PM_{2.5} concentration in ug/m³ and multiplies it times 24 hours (e.g. an average concentration of 20 ug/m³ times 24 hours = 480 ug/m³-hours) to yield the cumulative exposure during that 24-hour period. This exposure value so calculated can then be directly compared to the exposure allowed under the existing Federal 24-Hour PM_{2.5} Standard (i.e. 35 ug/m³ x 24 hours = 840 ug/m³-hours) to determine the degree of the exposure to which the citizen was subjected compared to the Federal standard. In the above case where the cumulative exposure over the day equaled 480 ug/m³-hours, it equated to about 57% of the exposure allowed under the Federal standards (480 ug/m³-hours / 840 ug/m³-hours).

However, it is important to note that the Federal exposure standards promulgated by the US EPA are specifically designed to NOT protect ALL people from all ill-effects of

harmful substances. Implicit in the statistical analysis performed when determining the actual levels at which standards are set is the explicit understanding that there is a segment of the population that is simply more sensitive to the pollutant in question than the general population and that the threshold levels established by the Federal standards will almost certainly be harmful to this susceptible population. In the case of wood smoke pollution, the susceptible population is primarily seniors and children with impaired respiratory and/or heart problems. Particularly with respect to children, the NRC understands that the problem of respiratory health is very rapidly becoming a chronic problem in the Valley and that regional PM levels are sometimes harmful to children even if below Federal thresholds. Thus, one intent of the NRC is to establish standards that also protect this innocent and protectionless subset of the general population

Further, there was substantial controversy surrounding the decision to set the new standard at the 35 ug/m³ level. This is because the consensus recommendation for the standard made by the EPA's advisory committee after studying the epidemiology and health effects of PM_{2.5} exposure was for a PM_{2.5} standard in the range of 25 to 35 ug/m³. The decision to use the higher value was subsequently arbitrarily made by the EPA administrator and Bush administration. Thus, in consideration of the intent of the NRC to protect, where possible, those in our community with respiratory impairments, we recommend and have used the conservative lower range value of 25 ug/m³ to establish the maximum exposure to which a citizen should be exposed. Therefore, a "recommended" maximum net 24-hour PM 2.5 exposure was calculated by multiplying 25 ug/m³ times 24 hours = 600 ug/m³-hours instead of the maximum exposure allowed under the Federal Standard of 840 ug/m³-hours. The 25 ug/m³ threshold is the current maximum predicted PM_{2.5} concentration above which voluntary curtailments of wood burning are requested by both the Yolo Solano and Sacramento Air Quality Management Districts.

Given this intent, we recommend that the threshold average daily forecasted PM_{2.5} concentration limit used by the YSAQMD to determine "Allowable Burn Days" in Davis be established at 25 ug/m³ instead of the current value of 35 ug/m³ used in their voluntary "Don't Light Tonight" program.

To predict the levels of PM pollution and exposure that might occur due to wood-burning under mild to moderate wind speeds, EPA-approved software (Screen3) was employed to model particulate pollution dispersion from a chimney stack. The software quantitatively estimates the maximum 1-hour concentrations of PM pollution that would be expected to occur at ground-level downwind from a chimney under different meteorological conditions. Once these maximum predicted concentrations were determined, they were "factored" lower by the recommended 20% (for a 6-hour duration) to account for the fact that wind speeds and direction change over time. (Note: The "factor" for 6 hours was chosen because this is the maximum length of time expected that most fires would operate – e.g. from 6 PM until midnight). This "factoring" has the effect of reducing the average ground level PM concentration that would be expected to occur over a six-hour period given the same emission rate.

The resulting daily PM “exposure” to which a citizen downwind from a fireplace burning for 6 hours is potentially exposed (given the specified fireplace emission rate and atmospheric conditions and background PM) can then be calculated as follows:

Daily PM Exposure = (Maximum predicted 1-hour PM_{2.5} concentration times the 6-hour “factor” plus the Background PM concentration) times 6 hours of exposure plus the Background PM concentration times 18 hours. This will yield a daily 24-hour net exposure in micrograms per cubic meter-hours (ug/m³-hrs) directly compared against the recommended maximum daily exposure threshold of 600 ug/m³-hours which is based on the recommended 24-hour PM_{2.5} standard of 25 ug/m³ as discussed above.

For example, assuming a fire from an EPA Phase II-Certified wood stove is predicted to produce a 1-hour maximum downwind, ground-level concentration of 90 ug/m³ given certain atmospheric conditions. Also assume the fire is burning for 6 hours and the average background PM concentration is 12 ug/m³ (as was actually calculated from a UC Davis monitoring station over the entire 06-07 burn season). The NRC understands that this background PM concentration may be low and thus may underestimate the net exposure to person exposed to wood smoke. That notwithstanding The net 24-hour PM_{2.5} exposure of a citizen so exposed can thus be calculated as follows:

$$[(90 \text{ ug/m}^3 \times 80\% \text{ factored} + 12 \text{ ug/m}^3) \times 6 \text{ hours}] + [12 \text{ ug/m}^3 \times 18 \text{ hours}] = 720 \text{ ug/m}^3\text{-hrs.}$$

The recommended maximum 24-hour PM_{2.5} exposure is 25 ug/m³ x 24-hours = 600 ug/m³-hours.

Thus the predicted exposure of a citizen so exposed is approximately 120% of the recommended standard (predicted exposure of 720 ug/m³-hrs / recommended maximum exposure threshold of 600 ug/m³-hrs) and this would be considered an excessive exposure under which specified meteorological conditions wood-burning should be prohibited for even EPA Phase II-Approved appliances.

Using Dispersion Modeling Tools to Predicted Downwind Wood Smoke Concentrations under Different Meteorological Conditions

Estimates of particulate pollution plumes dispersed from point sources under different wind speeds and atmospheric conditions and the resultant ground level concentrations were then made using EPA-approved dispersion software tool known as Screen 3. Screen 3 uses industry accepted algorithms known as the Industrial Source Complex (ISC3) dispersion model. ISC3 is a steady-state Gaussian air dispersion model which can be used to assess pollutant concentrations from a wide variety of sources. The basic algorithms are available for use in a number of software packages made available through the EPA or other governmental agencies as free downloads. Some commercial vendors also add an overlay and additional statistical or graphical capabilities to the source calculations to allow for increased ease of operation, production of additional information, or graphical representation. The ISC3 algorithms have been widely used to predict dispersion of pollutants for regulatory compliance in California for many years.

The particular software employing the ISC3 algorithms used in this study is called Screen3 which can be freely downloaded from the US EPA. Screen3 also employs the EPA-approved BPIP (Building Profile Input Program) algorithms that calculate the impact of building downwash on downwind concentrations of pollutants. Building downwash is the creation of cavity zones by air moving around or over buildings and can have significant impacts on downwind concentrations of wood smoke pollution.

The Screen3 software was used to predict maximum steady-state downwind PM concentrations at ground level resulting from the use of either a conventional open hearth fireplace or an EPA Phase II-Certified wood stove. The particulate emissions from each of the wood-burning sources were assumed to be discharged from a 15 ft chimney above a single story home approximately 50 ft wide by 50 ft. long. The model was run using 4 different wind speeds (2.5 mph, 5.0 mph, 7.5 mph, and 10 mph) at the 6 different levels of atmospheric stability allowed by the program.

The general methodology employed in predicting these exposures has been presented to Dr. Anthony Wexler of the University of California at Davis. Dr. Wexler is a full professor in 3 departments at the University of California at Davis (Mechanical and Aeronautical Engineering, Civil and Environmental Engineering, Land, Air and Water Resources) and is additionally the Director of 3 different Research Institutes headquartered at UC Davis (Air Quality Research Center, Crocker Nuclear Laboratory, and San Joaquin Valley Aerosol Health Effects Research Center). His analysis is attached as an addendum to this Appendix

The meteorological parameters and other physical values selected for use in the generation of the models are believed to be representative of normal conditions existing in Davis during winter months. Detailed discussion of the selection of the ISC3 algorithms and all Screen 3 program inputs and assumptions used in the preparation of this report are available upon request.

Results of Wood Smoke Dispersion Modeling and Calculation of 24-Hour PM Exposures

The maximum ground-level 1-hour concentrations predicted for each point source type (EPA Phase II-Certified stoves or Open Hearth fireplaces) and for each meteorological combination of wind speed and stability factor is shown in the following table. The resultant percentage of the recommended 24-hour PM_{2.5} exposure threshold that results from exposure to this predicted concentration is also shown for each type of fireplace or wood stove and the different meteorological combinations.

Predicted Maximum 1-Hour Concentrations of Wood Smoke Particulate Matter Dispersed from a Single Fireplace under Different Atmospheric Conditions and the Predicted Percentage of the "Recommended" 24-Hour PM2.5 Threshold that would Result if Burning Occurred 6 Hours per Day

Run No.	Wind speed		Insolation Conditions	Pasquill Stability Factor (K)	EPA Phase II Certified	Open Hearth	EPA Phase II Certified	Open Hearth
	meter/s	mph			"- EPA"	\$	"- EPA"	"-Open"
Background PM	12	ug/m3		Run No.	"- EPA"	\$	"- EPA"	"-Open"
6-Hour Factor =	0.8			Emission Rate (g/s)	0.00228	0.01639	0.00228	0.01639
				Flue Diameter (m)	0.15	0.3	0.15	0.3
				Exhaust Velocity (m/s)	1	4	1	4
				Exhaust Temperature (K)	530	390	530	390

Run No.	meter/s	mph	Insolation Conditions	Pasquill Stability Factor (K)	Maximum Predicted PM Concentration (ug/m3) @ 2 m Height w No Background PM	Predicted % of "Recommended" 24-Hour PM2.5 Exposure Threshold if Operated for 6 Hours		
2.5-6	1.116	2.5	Night w Overcast	6	97.5	44.7	126%	84%
2.5-5	1.116	2.5	Night wo Overcast - Day w Heavy Overcast	5	64.7	29.5	100%	72%
2.5-4	1.116	2.5	Day w Moderate Overcast - Weak Insolation	4	51.5	35.4	89%	76%
2.5-3	1.116	2.5	Day w Slight Overcast - Slight Insolation	3	33.8	32.7	75%	74%
2.5-2	1.116	2.5	Day w Partial Clouds - Moderate Insolation	2	21.3	29.5	65%	72%
2.5-1	1.116	2.5	Day w No Clouds - Strong Insolation	1	14.8	30.1	60%	72%
5-6	2.232	5	Night w Overcast	6	53.2	285.3	91%	276%
5-5	2.232	5	Night wo Overcast - Day w Heavy Overcast	5	35.3	189.4	76%	200%
5-4	2.232	5	Day w Moderate Overcast - Weak Insolation	4	26.5	141.2	69%	161%
5-3	2.232	5	Day w Slight Overcast - Slight Insolation	3	17.4	92.5	62%	122%
5-2	2.232	5	Day w Partial Clouds - Moderate Insolation	2	10.5	58.3	56%	95%
5-1	2.232	5	Day w No Clouds - Strong Insolation	1	7.6	40.6	54%	80%
7.5-6	3.348	7.5	Night w Overcast	6	35.9	230	77%	232%
7.5-5	3.348	7.5	Night wo Overcast - Day w Heavy Overcast	5	23.8	152.7	67%	170%
7.5-4	3.348	7.5	Day w Moderate Overcast - Weak Insolation	4	17.8	113.8	62%	139%
7.5-3	3.348	7.5	Day w Slight Overcast - Slight Insolation	3	11.7	74.6	57%	108%
7.5-2	3.348	7.5	Day w Partial Clouds - Moderate Insolation	2	7.3	47	54%	86%
7.5-1	3.348	7.5	Day w No Clouds - Strong Insolation	1	NA	NA	NA	NA
10-6	4.464	10	Night w Overcast	6	NA	NA	NA	NA
10-5	4.464	10	Night wo Overcast - Day w Heavy Overcast	5	17.92	120.5	62%	144%
10-4	4.464	10	Day w Moderate Overcast - Weak Insolation	4	13.88	89.9	59%	120%
10-3	4.464	10	Day w Slight Overcast - Slight Insolation	3	8.765	58.9	55%	95%
10-2	4.464	10	Day w Partial Clouds - Moderate Insolation	2	5.5	37.1	52%	78%
10-1	4.464	10	Day w No Clouds - Strong Insolation	1	NA	NA	NA	NA

NA = Screen 3 does not allow this combination of Wind speed and Stability Factor

Recommended Maximum 24-Hour Federal PM2.5 Exposure = 25 ug/m3 * 24 Hours = 600 ug/m3-hours

Predicted % of "Recommended" 24-Hour PM2.5 Threshold if Fireplace Operated 6 Hours = [(Predicted Maximum 1-Hour PM Concentration x 6 hr "factor" + Background PM) * 6 Hours of Operation] + (Background PM x 18 Hours) / 600 ug/m3-hours (Note: Includes effects of background PM and the predicted 6-hour PM2.5 concentration "factor")

- Indicates the predicted exposure is greater than the "recommended" 24-Hour PM2.5 exposure threshold

For instance, inspection of the far right-hand column of the above table shows that an open hearth fireplace operated for 6 hours during the night with overcast skies (atmospheric stability class 6) and a wind speed of 5.0 mph would result in approximate maximum downwind PM exposure equal to 276% of the recommended maximum 24-hour PM exposure threshold.

This information indicates that excessive exposures can occur at above 5 mph with EPA Phase II-Certified wood stoves. At 5 mph to 10 mph, an open hearth fireplace produces very high concentrations of PM2.5 that will produce exposures *far in excess* of the recommended 24-hour PM2.5 threshold. Above 10 mph, an open hearth fireplace produces concentrations of PM2.5 that will produce exposures *only marginally in excess* of the recommended 24-hour PM2.5 threshold

In addition to wind speed, one variable that has a significant impact on the predicted ground level maximum 1-hour PM_{2.5} concentration is the degree of atmospheric stability. Atmospheric stability is primarily influenced by the degree of solar insolation that strikes the earth which itself is primarily affected by the time of day and the degree of cloud cover. Since the vast majority of wood burning occurs during the evening/night hours without sunlight, the modeling is simplified because during night hours one only has to look at two atmospheric stability classes – with and without cloud cover. Inspection of the table reveals that there is not an enormous degree of difference between the predicted maximum concentrations produced at night with and without cloud cover thus we have not included atmospheric stability as a recommended parameter to be used each day when forecasting whether the following day should be an “Allowable Burn Day”. A more refined model might be developed that included the forecasted degree of cloud cover predicted to occur the following evening and, in rare instances, it may affect whether or not an “Allowable Burn Day” might or might not be determined.

However, the practical complexities in determining “Allowable Burn Days” introduced using atmospheric stability and the degree of difficulty in explaining the basis for its use to the general public leads us to strongly recommend that the use of forecasted atmospheric stability not be used in the determination of “Allowable Burn Days” in this proposed ordinance.

One surprising aspect of this modeling work was that the predicted maximum concentrations of PM were less with an Open Hearth fireplace at a 2.5 mph wind speed than either the same Open Hearth Fireplace at higher wind speeds or an EPA Phase II-Approved wood stove at the same wind speed. This anomaly is much more pronounced at the more stable atmospheric conditions (i.e. higher Stability Constants) and despite the fact that the PM mass emissions rate of an Open Hearth fireplace is about 7 times greater over time than those from an EPA Phase II-Approved wood stove!

This apparent inconsistency is due to the uplifting dispersion effects of the high exhaust velocity of the Open Hearth fireplace relative to the lower wind speeds seen in this particular combination of meteorological conditions. As the exhaust velocity to wind speed ratio drops by either using an EPA Phase II approved wood stove with reduced exhaust velocity or with increasing wind speeds, the resulting wood smoke plume is forced downward so much higher PM_{2.5} concentrations are predicted with Open Hearth Fireplaces at either higher wind speeds or stagnant air conditions. Thus, it is not practical to suggest a small wind speed “window” to allow burning with open hearth fireplaces because that window is very small from a meteorological point of view - i.e. variable wind speeds would enter and out of the “safe” wind speed window very quickly. This prevents effective practical enforcement of prohibited burning. Further, the degree of neighborhood pollution that otherwise results from burning in an open hearth fireplace when outside the “safe” wind speed “window” is so great that much would be risked to gain little if this wind speed window exemption was implemented for open hearth fireplaces. Thus, we strongly recommend against implementing a two-tiered approach to determination of “Allowable Burn Days” allowing for use of open hearth fire places during this very narrow wind speed “window”

Finally, it is important to note that this predicted net daily PM_{2.5} exposure calculations assumes only one upwind fireplace and ambient background PM of only 12 ug/m³. If the background PM concentration is higher than 12 ug/m³ as often occurs, then this degree of exposure relative to the recommended exposure threshold increases. If one or more additional fireplaces are also being used in close upwind proximity, this will also contribute additional PM to the converged plumes and the degree of exposure to the exposed individual also increases.

Other Modeling Studies Also Demonstrate that Local Excessive Concentrations of Wood Smoke Pollution can Occur

Another study which similarly investigated the localized effects of wood smoke pollution was performed by Dr. Robert Clear of Lawrence Berkeley Laboratories for the City of Berkeley. That study also used Screen3 software to predict maximum 1-hour downwind concentrations of wood smoke from different types of fireplaces under an extensive number different physical, topographical, and atmospheric conditions. As in our own modeling work, Dr. Clear shows in his study that there is a clear potential for excessive PM exposure to some residents to wood smoke pollution during evenings with low wind speed conditions even if the pollution source is a comparatively "low emission" EPA Phase II-Certified wood stove. Dr. Clear draws the following conclusions from his extensive study:

“The first and most important point to make based on the runs shown here is that they confirm our original concern that wood smoke from a chimney is capable of producing a local problem while background levels remain below the level of regulatory concern. The rapid decline of concentration with distance demonstrates that treating wood smoke as a purely regional problem can lead to significant underestimation of its health effects, with a fraction of the population that is adjacent to a wood burning appliance being exposed to particulate levels that can be far in excess of regulatory limits.

A second important point is that it does not appear that making “spare the air nights” mandatory will prevent local problems. Wood smoke can be a problem even under unstable atmospheric conditions if wind speeds are low and can still be a problem under neutral conditions at moderate wind speeds. Bans on wood burning due to meteorological conditions would have to be extended to even fairly moderate conditions to prevent air quality problems. In fact, even this would not be sufficient. The figures show that under some conditions air quality standards can be violated in as little as fifteen minutes.”

The full study is available upon request



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October 25, 2008

Alan Pryor
Yolo Clean Air
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Davis, CA 95618

Alan,

I have reviewed "Appendix B – Technical Justification" of the draft document entitled "NRC WoodBurning Ordinance Recommendation_Draft_10-21-08.pdf"

Wood smoke is known to be a serious source of PM air pollution in this area and many others. We are particularly susceptible in the Valley during winter because cold temperatures and high humidities often occur when we have relatively stagnant air conditions with strong inversions close to the surface trapping air pollutants close to where we breathe.

Generally, the closer you are to a pollution source, the higher the concentration that you are exposed to. This is not always the case, such as when you are very close to a tall stack, but otherwise it is true. Of course, if the wind blows the air pollutants from the stack towards you, then you are going to breathe it, whereas if it blows away from you, then you won't be as exposed. Air currents are not steady due to turbulence in the atmosphere so the plume from an emission may disperse. That is what your calculations illustrate.

These types of dispersion models are widely used for predicting the dispersion patterns and ground level concentrations of pollutants; most often from industrial stacks. When they are otherwise used to predict dispersion from fireplace chimneys in residential neighborhoods, they must also take into account local building heights. This is because the buildings themselves can cause turbulence dispersing and diluting the pollutant more or they may trap pollutants causing even higher concentrations than such models will predict. I understand from you that the EPA-approved Screen3 software you employed in your modeling work incorporated these standard building downdraft calculations. I otherwise have not reviewed all the input parameters you used, and they do matter, but your approach is generally sound for understanding the pattern of dispersion and approximately what is going on.

Your use of these forecasted ground level concentrations to then estimate the potential for excessive time-weighted exposure to wood smoke pollution is also an appropriate methodology for approximately predicting the atmospheric concentrations under which different types of different fireplaces can be safely used.

I was intrigued by your comparison of open hearth fireplaces versus wood stoves, and the conclusion that open hearth fireplaces often lead to lower pollutant exposure. In this era of increasing awareness of climate change, it is worth noting that open hearth fireplaces are beautiful but do not provide much heat to the home. In fact, they generally draw more air out of the home than they heat which may lead residents to using their furnace while using their fireplace, possibly burning more natural gas and emitting more greenhouse gases.

In summary, I think the general conclusions you reached that potentially excessive exposures to neighborhood wood smoke can result from local wood burning under low wind conditions are valid. Further, I believe that your recommendation to prohibit wood burning under those potentially unsafe atmospheric conditions is reasonable and should definitely reduce the potential for excessive exposure to residents downwind from burning fireplaces under these conditions.

I do note that your modeling work assumes that pollution from only a single wood-burning fireplace is produced and dispersed in a neighborhood. To the extent that more than one fireplace is operating upwind from a home, excessive exposures to wood smoke pollution could still occur even under the atmospheric conditions you otherwise believe are considered safe if the separate pollution plumes converge.

Thank you for performing this study and looking out for the health of residents of our community.

Sincerely,

Anthony Wexler
Professor
Mechanical and Aeronautical Engineering
Civil and Environmental Engineering
Land, Air and Water Resources
Director
Air Quality Research Center
San Joaquin Valley Aerosol Health Effects Research
Center

Appendix E

Summary of Results of Past PM2.5 Monitoring and Wood Smoke Complaint Studies in Davis

Winter 2008-2009 –

Monitoring - Downtown Davis PM2.5 air quality as measured by Dr. Tom Cahill outside City Hall was approximately 50% greater than that measured by the more rurally located CARB permanent monitor located west of Hwy 113. The PM2.5 concentrations in downtown Davis were slightly greater than those measured at the CARB downtown Sacramento headquarters indicating for the first time that air quality in downtown Davis was more polluted with respect to PM2.5 than downtown Sacramento. (A complete copy of the report is available upon request).

Winter 2009 – 2010 -

Monitoring - PM2.5 concentrations obtained by the California Air Resources Board (CARB) temporary monitoring site at Slide Hill Park in East Davis were approximately 80-100% greater than concentrations measured west of Hwy 113 by the CARB permanent monitor and in Central Davis by the YSAQMD temporary monitor. This indicates that wood smoke effects can be very localized. As the East Davis monitoring site was not adjacent to any houses, it most likely under-represents the pollution burden borne by nearest neighbors of wood burners. Still, there were 19 days at the East Davis site in which federal air quality standards were exceeded for PM2.5 and deemed to be “Unhealthy for Sensitive Groups”.

This number of days far exceeded (by 50%) the number of poor air quality days recorded at the Del Paso-Sacramento CARB permanent monitor which historically has been considered to have the worst winter PM2.5 air quality in the entire Sacramento Air Quality Management District’s jurisdiction. There were only 2 recorded days in which air quality was similarly deemed to be “Unhealthy for Sensitive Groups” at the other temporary YSAQMD and permanent Davis air quality monitors. (A complete copy of the report is available upon request).

Complaints - The total number of complaints recorded by Davis residents was from 6 to 10 times greater per capita than those recorded in the Sacramento AQMD’s jurisdiction. And the number of individual complainants per capita was minimally from 2 to 2 ½ times greater than the per capita number of complainants in the Sacramento AQMD. This indicates that the wood smoke problem, at least as perceived by the general public, was far greater in Davis (without any wood smoke controls at all) compared to Sacramento (with mandatory wood burning restrictions on forecasted high PM 2.5 days. (A complete copy of the report is available upon request).

Winter 2010 – 2011

Monitoring – A different monitor installed by the YSAQMD recorded concentrations at the Slide Hill Park site last winter that were consistent with concentrations recorded at other CARB monitored sites west of Hwy 113 in Davis and off Gibson Road in

Woodland. It was not determined by the YSAQMD whether the results from 2009-2010 or from 2010-2011 were an anomaly. (A complete copy of the report is available upon request).

Complaints - The number of wood smoke-related complaints and complainants more than doubled in Davis during the most recent wood burning season as shown below. Further, 25 % of the complaints were received on voluntary YSAQMD “Don’t Light Tonight” alert days compared to the 13% of days during the wood burning season on which such alerts were called. The higher percentage of complaints received on No-Burn Days indicates that there was relatively little compliance with the voluntary “Don’t Light Tonight” advisory alerts issued by the YSAQMD in 2010 – 2011. This is even more pronounced than during the 2009 – 2010 season. As further shown in the table below, this indicates that a greater wood smoke problem in Davis existed last winter than the prior wood burning season

	2010-2011	2009-2010	% +/-
Total Complaints on No Burn Days	61	16	+ 294 %
Total Complaints	248	121	+ 105 %
% of Complaints on No-Burn Days	25%	13.3%	
Total Number of No Burn Days	19	15	+ 26 %
Total Number of Days	120	120	0 %
% of No-Burn Days	16%	12.5%	

(A complete copy of the report is available upon request).

Appendix F

Current Wood Burning Restrictions in Other Jurisdictions

Restrictions in California

Currently, mandatory restrictions against wood burning under certain conditions have been promulgated by the San Joaquin Air Pollution Control Board (covering the San Joaquin Valley from Bakersfield through Stockton), the Bay Area Air Quality Management District (covering the greater nine-county San Francisco Bay area), and the Sacramento Air Quality Management District (covering Sacramento Co). This results in mandatory cessation of wood burning in those jurisdictions any where from 10 to 50 days of the 120-day wood burning season. It is estimated that from 90-95% of the entire population between Bakersfield and Sacramento including the entire Bay area are subject to some type of mandatory wood burning restrictions.

These mandatory wood burning restrictions imposed by the major Air Quality Management Districts were implemented for the sole purpose of achieving compliance with EPA regional air quality standards. That is, when regional PM_{2.5} air quality was projected to be in excess of federal air quality standards, wood-burning restrictions were imposed for the following day in an attempt to lower the actual PM_{2.5} during the next day in question. Violators are initially warned and then subjected to increasing fines and/or imprisonment for repeated violations. Each of these Air Quality Management Districts has also imposed additional wood burning restrictions pertaining to the maximum opacity of smoke from wood burning appliances. For instance, both the Sacramento and the Bay Area Air Quality Management Districts prohibits any wood burning that produces any visible smoke beyond an initial start-up period. Each of these Districts also prohibits the sale of firewood as seasoned with moisture content in excess of 20%.

Additionally, each of these Air Quality Management Districts have also promulgated a "Model Wood Burning Ordinance" designed to assist local jurisdictions in imposing additional restrictions over and above those imposed by the regional Air Quality Boards. Almost all of these Model Ordinances are identical and one provision common to all mandates the phase-out of all wood-burning in all non EPA Phase II-Approved wood burning appliances beyond a specified time period. Portions of the Model Wood Burning Ordinance have been adopted by many different municipalities and counties within these jurisdictions. For instance, 41 cities and/or counties in the Bay Area Air Quality Management District have implemented some portion of the Bay Area Air Quality Management District's Model Wood Burning Ordinance. Examples are the County of Marin and a number of municipalities in that County which now ban operation of all non-EPA-Phase II-Approved fireplaces and wood burning appliances in their jurisdictions

The City of Berkeley has gone well beyond these conventional types of restrictions. They recently has passed an ordinance in which a resident has a presumptive exposure to a *'Smoke Health Hazard'* caused by an immediate neighbor whose property *"abuts or confronts a property with a wood burning appliance or a building that has a direct line of sight from the highest residential floor to the source of the smoke, and who resides within 120 feet of a source of wood smoke"*. Such a resident may press a claim in

Superior Court against such an immediate neighbor if the residents cannot otherwise amicably resolve any wood burning dispute through discussions or mediation. The basis for the determination of the 120 ft distance was through the use of computer modeling of wood smoke dispersion from chimneys using an EPA-approved atmospheric dispersion modeling tool called Screen3. This is the same modeling tool upon which the NRC's recommendations were based as presented in Appendix A. The NRC has determined, however, that the Berkeley wood smoke ordinance puts the onus of enforcement of wood smoke exposure on the complaining resident which is felt to be unfair and detrimental to the health and welfare of the citizens of Davis.

Restrictions Outside California

Many municipalities or jurisdictions outside of California have implemented various types of restrictions on wood burning appliances. The majority of these ordinances are "nuisance" ordinances which ban wood burning if excessive wood smoke crosses property lines to the detriment of others. For instance, the State of Washington prohibits all wood smoke of greater than 20% opacity for 6 consecutive minutes. According to the Puget Sound Clean Air Agency, (covering the greater metropolitan Seattle area), "...generating excessive smoke is not only unneighborly, it's illegal...It is always illegal to smoke out your neighbor. Everyone has a right to breathe clean air. If smoke from your fire is affecting your neighbors, it is considered a nuisance and subject to enforcement action.

In Elmira, New York, wood smoke or other deleterious fumes that cross property lines onto the property of another are a municipal violation punishable by fines of \$250 for a second offence or a jail term for subsequent violation.