

## Staff Report

January 6, 2009

**TO:** City Council

**FROM:** Sue Gedestad, Assistant Public Works Director

**SUBJECT: Draft Wood Burning Ban and Restriction Ordinance**

---

### **Recommendations:**

1. Hold a public hearing.
2. Approve staff recommendation as follows:
  - a) Work with Dr. Cahill and the YSAQMD to establish monitoring to gather specific air quality information, to be used in assessing what further restrictions may be in order;
  - b) Adopt the following wood burning restrictions: Establish burn/no burn days based on Federal air quality standard of PM<sub>2.5</sub> of 35 ug/m<sup>3</sup> and apply the same criteria to open hearth and non-certified appliances. Restrictions do not include the eventual ban on open hearth an non-certified appliances. Further restrictions will be revisited once air quality data is collected and analyzed.
  - c) Work more closely with the YSAQMD to disseminate all manner of information on the wood burning, i.e., health effects, proper burning techniques, etc;
  - d) Pursue programs that would encourage the change out of old appliances and the conversion of open hearth. This can be done through promotion of YSAQMD's Woodstove Change Out Program and pursuing funds to increase the grant amount to further encourage change outs;
  - e) Pursue viability of using resale requirements that may reduce the number of open hearths and non-certified appliances.

If Council approves staff recommendation, an ordinance would be brought back well before November, 2009, the next burn season.

### **Natural Resources Commission Recommendation**

The Natural Resource Commission (NRC) has a different set of recommendations, should Council decide not to adopt staff recommendations. The Natural Resource Commission recommends introducing the attached ordinance, which reflects the following Natural Resource Commission recommendations:

- a) Wood burning will only be allowed on "Allowable Burn Days" defined as a forecasted average regional PM 2.5 of 25 ug/m<sup>3</sup> (particulate matter) or lower and a forecasted average wind speed from 6 PM to midnight of 5 mph or greater.
- b) Wood burning will be allowed a maximum of 6 hours per day per residence and only burning of seasoned dry wood is allowed.
- c) Beginning March 1, 2010, wood burning is only allowed in EPA Phase II-Certified wood and pellet stoves and prohibited in fire places or non-EPA certified appliances.

- d) A one time permit is required (for law enforcement and educational purposes). Permit issuance would start March 1, 2010.
- e) This proposed ordinance does not pertain to any appliances fueled by natural gas or propane and/or designed and exclusively used for cooking purposes.
- f) Exemptions are allowed for temporary breakdowns of other heat sources and power outages.

**Fiscal Impact:**

The complete fiscal impact for either alternative is not yet determined. For either alternative, there will be an undetermined amount of staff time for initial set up of the program. Time would also be required for development of a web page with information on the ordinance and the location burn/no burn day information would be posted. Initial set up time would also be necessary to establish the burn/no burn day process and information dissemination process.

If the NRC recommendation is approved, there are additional costs. Given the dual factors of wind and AQI, for burn/no burn, it may be beneficial to pursue a completely automated process. YSAQMD's cost to automate their process was approximately \$7,500. Also, there are undetermined costs associated with the issuance of permits and enforcement.

Until the process is more fully developed, it is difficult to give estimates of actual time involved.

**Background:**

The subject of wood burning has been discussed by the NRC at numerous meetings.

As part of their process, the NRC established a subcommittee to work through the issue and present to the full commission a recommendation. At the October meeting, the Commission heard considerable public comment. In response to public concern, the commission reconstituted the subcommittee to refine a wood burning ordinance. The subcommittee subsequently provided a set of revised recommendations which provide the basis for the NRC recommendation. The NRC's full study and recommendation to the City Council is included in this report as Attachment 2.

**Wood Burning Ban Versus Restrictions**

The Commission and staff differ on treatment of bans and restrictions. While the subcommittee's recommendation does not ban EPA Phase 2 certified appliances, it does ban open hearth and non-certified appliances. Staff's recommendation is to focus on burn restrictions and not to include any ban at this time.

At the October NRC meeting, Dr. Cahill, a former professor in the UC system and local expert on global climate change, offered to work with the city to gather air quality information. Staff supports Dr. Cahill's measured approach of gathering specific information that will aide in assessing the air quality and the nature of future action. This would be accomplished through a donation of monitoring equipment and Dr. Cahill's expertise and time to evaluate data. Staff has met with Dr. Cahill and a monitoring station has been set up.

The NRC also concurs with the benefit of additional monitoring and recommended that staff develop a monitoring system now and to continue monitoring one year after the implementation of the ordinance to help measure the ordinance's effectiveness. Staff is looking for grant opportunities to help fund monitoring beyond what Dr. Cahill is providing.

Staff is also working with the Yolo Solano Air Quality Management District (YSAQMD) to look for opportunities to increase the number of change out grants being distributed to Davis residents. Change out grants provide residents with funding to convert an older wood burning appliance to a much cleaner burning, EPA Phase II certified appliance. Since the fall of 2006, when the change out program was initiated, YSAQMD has issued 20 grants to Davis residents. There are still dollars available in this year's YSAQMD allotment for grants. At a minimum, the city could be actively advertising and promoting the District's current change out program. At best, maybe there is funding that the city could use to add to the District grants to increase the individual grant value.

The NRC expressed concern about the change out program promoting wood burning. From Staff's perspective, changing out older more polluting appliances to newer cleaner burning appliances, helps to improve air quality.

#### Permitting

The NRC recommendation includes a one time permit as an additional vehicle to educate the public and to help the enforcement element. Along with the educational component, the intent was to simplify enforcement. By way of example, a police officer would verify the resident had a valid permit and that it is a permissible burn day. The permit may offer some assistance on the enforcement side but any efficiency would be taken up on the front end in the issuing process. From an educational aspect, there are other methods that can be utilized that would be more widespread than through a permitting process.

#### Enforcement

The draft ordinance proposed by the NRC includes enforcement as a response to those who burn illegally. While it is simple to suggest that the Police Department enforce the ordinance, the nuances of actually doing so are quite complex. There are several elements that make the draft ordinance difficult to enforce.

1. Because of the inherent difficulties of monitoring actual burning time, the 6 hour maximum burn time is not enforceable.
2. Enforcement is complicated when various appliances are treated differently. Police officers would be required to distinguish between open hearth, non-EPA certified wood burning stoves and inserts and EPA Phase II certified stoves and inserts. Some of this concern is relieved if permits are issued.
3. Police officers would be required to distinguish between seasoned dry wood and unseasoned or wet wood.
4. And lastly, this type of call could be triaged and be a very low priority. It is difficult to estimate what percentage of calls the Police Department would be able to respond to.

Burn/No Burn Criteria

The criteria the NRC recommends uses an air quality threshold that is lower than the Federal standard. To our knowledge, this lower threshold has not been used in any other burn restricting ordinances. The NRC recommendation further adds an additional factor of wind speed which is also unprecedented.

Staff believes a more measured approach and collection of air quality data will assist with the establishment of burn/no burn criteria based on the City's air quality. The data collected will help define the air quality challenges in the City and thus allow for the development of burn/no burn thresholds that target the city's needs. Staff recommends starting with moderate restrictions, the Federal standard, and then stepping towards a more restrictive ordinance as may be deemed necessary by the results of the data collection.

Following is a chart of historical data reflecting burn/no burn days using the criteria in the NRC's draft ordinance. The winter burn season is defined as November 1 through February 28, a total of 120 days.

<b>Threshold</b>	<b>2006/07 No Burn Days</b>	<b>2007/08 No Burn Days</b>	<b>December 1-17, 2008 No Burn Days</b>
25 micrograms/m3	21 <sup>1</sup>	7 <sup>1</sup>	7
25 + wind speed (NRC Recommendation)	N/A <sup>2</sup>	64 <sup>3</sup>	10
35 micrograms/m3 (staff recommendation)	8 <sup>1</sup>	0 <sup>1</sup>	0

<sup>1</sup> YSAQMD

<sup>2</sup> Not available

<sup>3</sup> Subcommittee report

YSAQMD, through a contract vendor, does forecasting for each day of the week. This is done as part of their agricultural burn/no burn and also their voluntary "Don't Light Tonight" program. Currently, Sunday and Monday forecasting involves an employee accessing the vendor information from home and then posting/distributing per their protocol. This process is being refined to become an automated process. The vendor would be automatically posting to a banner on the District's web page. By using the District's same criteria, the City could use the same infrastructure already in place.

By having different criteria, the City would have to establish its own protocol for determining burn/no burn days and for disseminating the information. Adding the wind speed element to the burn/no burn determination also involves a more manual process. With a manual process, Sunday and Monday become difficult days to forecast. With current capabilities, either personnel from YSAQMD or the City would need to research and disseminate the information on those days. There is a possibility that the vendor who is automating YSAQMD forecasting and posting will be able to do the same using the two criteria currently included in the draft ordinance.

**Time Table**

December 18, 2008	Informational add in Enterprise on the draft ordinance. Pertinent information posted on the City's web page and run on Davis cable.
December 24, 2008	Official publication of ordinance in the Davis Enterprise. Must be published 10 days in advance of the public hearing.
January 4, 2009	Informational add in Enterprise on the draft ordinance
January 6, 2009	Public Hearing at City Council meeting
January 27, 2009	Second reading (if NRC Ordinance adopted)
February 27, 2009	Ordinance becomes effective. (Must be approved by City Council 30 days before implementation.)

**Attachment:**

- Draft Ordinance
- NRC Subcommittee's Report on Wood Burning as Presented to NRC 11/24/08

J:\pw\adm\nrc\2008\12 22 08 CC wood burning SR Final.doc

**ORDINANCE XXXX**

**ORDINANCE OF THE CITY COUNCIL OF THE CITY OF DAVIS ADDING  
CHAPTER 13A.02 TO THE MUNICIPAL CODE CONCERNING WOOD BURNING**

WHEREAS, air pollution is a major public health concern in California and the State Air Resources Board (ARB) adopted a particulate matter less than ten microns in size (PM10) Ambient Air Quality Standard (AAQS) in December, 1982, and levels for the PM10 AAQS were selected pursuant to California Code of Regulations Title 17 Section 70200 to protect the health of people who are sensitive to exposure to fine particles; and

WHEREAS, in addition to health impacts, air pollution imposes significant economic costs and negative impacts on our quality of life; and

WHEREAS; research indicates that wood smoke is a contributor to particulate matter levels and poses health risks to the public; and

WHEREAS; the City Council of the City of Davis has the desire to improve air quality and lessen the risk to human health and environment by reducing pollution from wood-burning appliances;

WHEREAS, this ordinance establishes regulations and guidelines for wood burning and on the type and usage of wood burning appliances allowed to be operated.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF DAVIS HEREBY ORDAINS AS FOLLOWS:

Section 1.

Chapter 13A.02 of the Davis Municipal Code, entitled “Wood Burning” is hereby added to read as follows:

**13A.02 Wood Burning**

- 13A.02.010 Purpose**
- 13A.02.020 Definitions**
- 13A.02.030 Applicability**
- 13A.02.040 Exemptions**
- 13A.02.050 General Requirements**
- 13A.02.060 Enforcement**

**13A.02.010 PURPOSE**

This ordinance establishes regulations on Wood-Burning in the City of Davis.

**13A.02.020 DEFINITIONS**

**ALLOWABLE BURN DAYS:** An Allowable Burn Day will extend for a 24 hour period from midnight to midnight and will be determined 1) based on a forecasted average hourly wind speed

of 5 mph or greater for the intervening period of 6 PM to midnight as made by the National Weather Service, and 2) 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. Every effort will be made to determine and post the “Allowable Burn Days” by 12:00 PM on the day prior to the day determined to be or not to be an “Allowable Burn Day”.

**COOKSTOVE:** Any wood-fired appliance primarily for cooking food as described in Code of Federal Regulations 60.531.

**FIREPLACE:** Any permanently installed masonry or factory built device designed to burn wood and/or solid fuels to provide space heating and/or ambiance in a residential or commercial building.

**PELLET-FUELED WOOD-BURNING HEATER:** Any wood-burning heater which operates on pellet-fuel and is either U.S. EPA-certified or is exempted under U.S. EPA requirements set forth in Part 60, Title 40, Subpart AAA Code of Federal Regulations.

**U.S. EPA:** The United States Environmental Protection Agency.

**U.S. EPA PHASE -II CERTIFIED APPLIANCE:** Any appliance certified by the U.S. EPA that the unit meets the performance standards set forth in Part 60, Title 40 Subpart AAA Code of Federal Regulations.

**WOOD-BURNING APPLIANCE:** Any fireplace, wood-burning heater, or pellet-fired wood heater, or any similar enclosed device burning any solid fuel used for aesthetic or space-heating purposes.

**WOOD-BURNING HEATER:** An enclosed, Wood-Burning Appliance capable of and intended for space heating (i.e., a wood stove or fireplace insert).

**WOOD-FIRED OVEN:** Any permanently installed masonry or factory built cookstove designed to cook foods in an enclosed portion of the appliance.

**BARBEQUE GRILL:** Any permanently installed masonry or factory built cookstove designed to cook foods above burning wood or coals derived from burning wood.

**13A.02.030 APPLICABILITY**

All Wood-Burning Appliances installed in buildings.

**13A.02.040 EXEMPTIONS**

This chapter does not apply to the following:

1. Any period when a Wood-Burning Appliance is a residential dwelling unit’s temporary and sole source of heat, providing that such temporary occurrence does not extend for more than a period of time reasonably required to repair or replace any non-wood-burning equipment or appliances whose malfunction resulted in loss of space heating availability in the residential unit.
2. Any appliance exclusively fired with a gaseous fuel, or

3. Any Wood-Burning Appliance specifically designed for and exclusively used for cooking such as a cook stove, wood-fired oven, or barbeque grill.
4. Any period when an emergency has been declared and/or during which electrical power service or natural gas delivery service is not available from the local utility provider.

**13A.02.050 GENERAL REQUIREMENTS**

It shall be unlawful to operate any Wood-Burning Appliance, except during Allowable Burn Days as defined in this ordinance and for not more than six (6) hours in any twenty-four (24) hour period and except when burning wood with a moisture content less than 20% w/w (“seasoned”);

Effective March 1, 2010, it shall be unlawful to operate any Wood-Burning Appliance or fireplace which is not an EPA Phase II-Certified appliance or Pellet-Fueled Wood-Burning Heater. EPA Phase II-Certified appliances and Pellet Fueled Wood-Burning Heaters may be used only during Allowable Burn Days as defined by this ordinance and for not more than six (6) hours in any twenty-four (24) hour period and only when burning wood with a moisture content less than 20% w/w (“seasoned”).

Beginning March 1, 2010, a one time permit will be required to burn on allowable burn days in approved EPA Phase II certified appliances or Pellet-Fueled Wood burning heaters

**13A.02.060 ENFORCEMENT**

(a) Any person violating or permitting violation of any of the provisions of this chapter is guilty of an infraction for each of the first two violations within a period of one year, and upon conviction thereof, shall be punished by a fine not to exceed the fine prescribed in accordance with the provisions of section 36900 (b) of the California Government Code, or successor legislation. Each day such violation is committed or permitted to continue shall constitute a separate offense and shall be punishable as such. Any repetition or continuation of any violation, reasonably capable of immediate correction after receipt of written or verbal notice shall constitute a separate offense and shall be punished as such.

(b) Any person violating or permitting violation of any of the provisions of this chapter for the third time within a one-year period is guilty of a misdemeanor, and shall be punished by a fine or, by imprisonment in the county jail, or by both such fine and imprisonment not to exceed the maximum fine and/or imprisonment established in section 36901 of the California Government Code, or successor legislation.

(c) Upon the third confirmed violation of this chapter within a twenty four-hour period of time beginning on the first notice of violation issued, the police department may take action as necessary to abate the wood-burning violation, including but not limited to instructing the wood-burning appliance user to "extinguish the fire" or physically arresting the wood-burning appliance user.

INTRODUCED on the 6<sup>th</sup> of January, 2009 and PASSED AND ADOPTED by the City Council of the City of Davis on this \_\_\_ day of January, 2009 by the following vote:

**DRAFT**

AYES:

NOES:

Ruth Uy Asmundson, Ph.D.  
Mayor

ATTEST:

Zoe S. Mirabile, CMC  
City Clerk

**DRAFT**

**Wood-Burning in Davis: Recommended Ordinance**

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

November, 2008

---

**Table of Contents**

**1. Recommendation to Approve the Draft Ordinance**

**2. Introduction and Background of the Proposed Ordinance**

**3. Discussion of the Proposed Ordinance**

**Appendix A – Draft of Proposed Ordinance**

**Appendix B – Technical Justification of the Proposed Ordinance**

- a) Calculation of Net Exposure to Wood Smoke PM Pollution
- b) Using Dispersion Modeling Tools To Predicted Downwind Wood Smoke Concentrations under Different Metrological Conditions
- c) Results of Wood Smoke Dispersion Modeling and Calculation of 24-Hour PM Exposures
- d) Proposed Control Strategy and Comparison of Number of Burn: No-Burn Days using Wind speed Compared to Restrictions Based on Regional PM
- e) Discussion of the Use of Wind Speed and Other Atmospheric Parameters as Predictive Tools for Determining Burn: No-Burn Days
- f) Other Studies Demonstrating Local Excessive Concentrations of Wood Smoke
- g) Conclusions

## **1. Recommendation to Approve the Draft Ordinance**

The NRC recommends that the City Council approve the proposed attached ordinance as presented and instruct Staff to implement the technical and legal aspects of the program. We also recommend that Staff be instructed to expeditiously prepare and implement an outreach program including utility bill inserts and notification of local media to inform the public of the ordinance and instruct them on proper fire-starting and fire-burning methods.

## **2. Introduction and Background of the Proposed Ordinance**

On July 29, the Davis City Council directed the City's Natural Resources Commission (NRC) to draft an ordinance to phase-out the use of wood burning in open hearth fireplaces and in other wood-burning appliances consistent with the NRC recommendations to the Council dated June 23, 2008 with the following additional considerations.

- 1) Consider deleting the proposed permitting aspects recommended by the NRC
- 2) Consider the use of other meteorological data in addition to wind speed in predicting Burn / No-Burn Days pursuant to the proposed ordinance.

At the direction of the City Council, the NRC has discussed, received presentations, and heard public comments on the issue of wood burning in Davis on numerous occasions including at NRC meetings held in June 2005, March 2006, January 2008, February 2008, April 2008, May 2008, June 2008, September 2008, and October 2008.

The NRC formed a sub-committee on wood burning in February 2008. The Wood Smoke Subcommittee obtained sample ordinances, considered other technical and medical information submitted to them, consulted with the Yolo-Solano Air Quality Management District (YSAQMD), and considered a broad range of alternatives. The subcommittee prepared an issue paper as an intermediate product to assist the NRC in formulating a recommendation to the City Council. The full commission reviewed the issue paper at its meeting of May 21, 2008, and delivered its recommendation to the City Council. Subsequently, on July 29, direction was given by the Council to the NRC to draft such an ordinance and this policy recommendation and draft ordinance is the outcome of the NRC's work on this issue.

Since then, this issue has been prominently discussed and displayed in the local media. The Davis Enterprise has published 1 feature article and 2 additional stand-alone articles, 2 op-ed pieces (one each by an opponent and proponent of the proposed restrictions), and 11 letters to the editor from local citizens. 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 two different threads on the Davis Vanguard Blog and a radio interview on DCTV. An informational article was also published in the Yolano Flame newsletter of the local Sierra Club.

### **3. Discussion of the Proposed Ordinance**

In response to the Council's directive to the NRC, the NRC formed a new subcommittee in September, 2008 to draft an ordinance and present to the NRC for their consideration and approval for submitting to the Council. The subcommittee used a sample contract developed by City Staff and submitted and recommended to the NRC as a template for the final proposed ordinance. This draft ordinance was considered by the full NRC and their meeting of October 27 at which numerous public comments were received. Although the nature of the comments ranged from pleas for immediate ban of all wood burning to complete opposition to any wood-burning restrictions, the consensus opinion of the NRC regarding the comments was that the public generally accepted the need for wood burning restrictions but that an eventual ban on use of EPA Phase II-Certified stoves was premature and that additional study was warranted before enacting a complete ban. The draft ordinance that resulted following these comments by the full NRC is attached as Appendix A. It incorporates all earlier recommendations of the NRC to the Council except the NRC now recommends that additional studies occur before a complete ban would be considered.

The following policy criteria were established for the ordinance:

- 1) Simple – The ordinance must be short, simple, and easily understood by the average citizen.
- 2) Effective Protection for Susceptible Citizens from Neighborhood Wood Smoke “Hotspots” – The ordinance must address the problem of wood smoke accumulation at ground level in neighborhoods and the effects this has on people with respiratory problems. It specifically must go beyond past efforts to just protect the general population by trying to limit 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.
- 4) Easily Enforced – To the extent possible, the ordinance must be as easily enforceable as possible requiring a minimum of police effort to investigate and determine possible violations.
- 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.
- 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.

We believe the draft ordinance meets these criteria.

The main elements of this draft ordinance are as follows:

#### 1. General

- Effective January 1, 2009, wood\_burning will only be allowed on “Allowable Burn Days”, only for 6 hours duration during any one Allowable Burn Day, and only using seasoned wood with a moisture content less than 20% by weight. 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 be based on a forecasted average hourly

wind speed of 5 mph or greater for the intervening period of 6 PM to midnight on the day in question as made by the National Weather Service, and 2) based on a forecasted average daily regional PM2.5 concentration of 25 ug/m3 or less or less as made by the Yolo Solano Air Quality Management District using its existing methodology. This will allow “one-day before” announcement of “Allowable Burn Days to provide timely notification of media and other means of information dissemination and allow citizens to plan one day ahead with respect to planned wood-burning activities

- If the forecasted average wind speed for the 6 PM to midnight period the following day is greater than or equal to 5 mph or greater AND the forecasted average daily regional PM2.5 concentration of 25 ug/m3 or less, then that following day will be an “Allowable Burn Day” and wood-burning is allowed subject to the other provisions of the ordinance. Conversely, if the forecasted average wind speed for the 6 PM to midnight period the following day is less than 5 mph OR the forecasted average daily regional PM2.5 concentration greater than 25 ug/m3, then that following day will NOT be an “Allowable Burn Day” and all wood-burning is prohibited.
- As further discussed in Appendix B, promulgation of an ordinance with this combination of meteorological control parameters would result in wood burning being prohibited on about half of the 120 days of the wood burning season extending from November 1 through February 28.
- Accessing forecasted wind speeds from the National Weather Service via the internet and forecasting the next day’s PM2.5 levels, will be made by YSAQMD staff that will make the subsequent determination of whether the following day is an “Allowable Burn Day”. This information will be transmitted to City Staff and posted on the City’s website, voice mail system, and/or citizen and media email distribution lists as determined by Staff

2. Open-hearth fireplaces and non EPA Phase II-Certified wood-burning appliances

- Wood burning in open-hearth fireplaces and non EPA Phase II-Certified wood-burning appliances would be prohibited on or after March 1, 2009 (following the upcoming burn season).

3. EPA-certified wood-burning stoves

- Only wood burning in EPA Phase II-Certified wood-burning stoves ~~and~~, inserts and pellet fueled stoves would be allowed on or after March 1, 2009.

4. 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 ordinance will not apply to any appliances using only gaseous fuel. An 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 heater, central furnace, portable, wall-mounted, or window-mounted unit.

5. Enforcement

- Enforcement of these provisions would be on a complaint basis, with the City Police Department being the responders. It would be treated by the police as any other nuisance complaint thus response by the Police Department will only be on an “as available” basis. We recommend that the ordinance not be enforced (i.e. only “warnings” would be given) during the remainder of the 08-09 burn season to allow residents time to become knowledgeable with the provisions of the ordinance through a staff directed outreach program.

6. Permitting (Optional Consideration)

- The Council suggested that the NRC not include permitting in the final proposal to be submitted to Council. The Commission feels that the requirement of a permit would be extremely useful for both educational and law enforcement purposes (see below). We have thus included it as an optional component of this draft ordinance to begin only after the effective phase-out date of non-EPA Phase II-Certified wood-burning appliances. We recommend that the cost of any such permit be not greater than \$50 for any one wood-burning season which should be sufficient to administer the program without additional costs to the city.

a) Enforcement of the wood burning ordinance would be greatly simplified for law enforcement officials if a permit system is used. Upon receipt of a complaint from a neighbor, the police department staff can simply review its records to see if a permit is on file for that residence. If this records search is inconclusive or if an exact address is not known, then the police officer in the field can use a simple infrared viewer to identify if a wood-burning appliance is in use at the suspected residence. Through the use of a simple infrared viewer, a police officer can easily review the address list of approved wood-burning permittees and check the city’s website or voice mail system to see if it was an approved wood-burning period. By doing so, the police officer could then instantly determine if the wood-burning activity is lawful without ever even leaving their patrol vehicles. This could result in substantial time savings to law enforcement officials.

b) A wood-burning permit would be issued upon the condition that the permit holder acknowledge that they have read and understood educational materials made available by the city (as provided by the YSAQMD) and that they agree to commence wood burning only on “Allowable Burn Days”. This could greatly assist in minimizing wood smoke emissions from users of EPA phase II certified wood stoves and among owners of open hearth fireplaces that qualify for the “sole source of heat” exception.

## CHAPTER ( )

### WOOD BURNING

#### Section 1: Purpose

This ordinance establishes regulations on the use of Wood-Burning Appliances in the City of Davis.

#### Section 2: DEFINITIONS

ALLOWABLE BURN DAYS: The 24-hour period of time determined by the Yolo Solano Air Quality Management District during which wood-burning is allowed. An Allowable Burn Day will extend for a 24 hour period from midnight to midnight and will be determined 1) based on a forecasted average hourly wind speed of 5 mph or greater for the intervening period of 6 PM to midnight as made by the National Weather Service, and 2) 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. The determination and posting of the “Allowable Burn Days” will be made by 12:00 PM on the day prior to the day determined to be or not to be an “Allowable Burn Day”.

COOKSTOVE: Any wood-fired appliance primarily for cooking food as described in Code of Federal Regulations 60.531.

FIREPLACE: Any permanently installed masonry or factory built device designed to burn wood and/or solid fuels to provide space heating and/or ambiance in a residential or commercial building.

PELLET-FUELED WOOD-BURNING HEATER: Any wood-burning heater which operates on pellet-fuel and is either U.S. EPA-certified or is exempted under U.S. EPA requirements set forth in Part 60, Title 40, Subpart AAA Code of Federal Regulations.

U.S. EPA: The United States Environmental Protection Agency.

U.S. EPA PHASE -II CERTIFIED APPLIANCE: Any appliance certified by the U.S. EPA that the unit meets the performance standards set forth in Part 60, Title 40 Subpart AAA Code of Federal Regulations.

WOOD-BURNING APPLIANCE: Any fireplace, wood-burning heater, or pellet-fired wood heater, or any similar enclosed device burning any solid fuel used for aesthetic or space-heating purposes.

WOOD-BURNING HEATER: An enclosed, Wood-Burning Appliance capable of and intended for space heating (i.e. a wood stove or fireplace insert)

WOOD-FIRED OVEN: Any permanently installed masonry or factory built cookstove designed to cook foods in an enclosed portion of the appliance.

BARBEQUE GRILL: Any permanently installed masonry or factory built cookstove designed to cook foods above burning wood or coals derived from burning wood.

### **SEC. 3. APPLICABILITY**

| All Wood-Burning Appliances installed in buildings.

### **SEC. 4. EXEMPTIONS**

This chapter does not apply to the following:

- | 1. Any period when a Wood-Burning Appliance is a residential dwelling unit's temporary and sole source of heat, providing that such temporary occurrence does not extend for more than a period of time reasonably required to repair or replace any non-wood-burning equipment or appliances whose malfunction resulted in loss of space heating availability in the residential unit.
- | 2. Any appliance exclusively fired with a gaseous fuel, or
- | 3. Any Wood-Burning Appliance specifically designed for and exclusively used for cooking such as a cook stove, wood-fired oven, or barbecue grill.
- | 4. Any period when an emergency has been declared and/or during which electrical power service or natural gas delivery service is not available from the local utility provider.

### **SEC. 5. GENERAL REQUIREMENTS**

| Effective January 1, 2009, it shall be unlawful to operate any Wood-Burning Appliance, except during Allowable Burn Days as defined in this ordinance and for not more than six (6) hours in any twenty-four (24) hour period and except when burning wood with a moisture content less than 20% w/w ("seasoned");

| Effective March 1, 2009, it shall be unlawful to operate any Wood-Burning Appliance or fireplace which is not an EPA Phase II-Certified appliance or Pellet-Fueled Wood-Burning Heater. EPA Phase II-Certified appliances and Pellet Fueled Wood-Burning Heaters may be used only during Allowable Burn Days as defined by this ordinance and for not more than six (6) hours in any twenty-four (24) hour period and only when burning wood with a moisture content less than 20% w/w ("seasoned") and only after obtaining a wood-burning permit issued by the city;

### **SEC. 6. ENFORCEMENT**

a) Any person violating or permitting violation of any of the provisions of this chapter is guilty of an infraction for each of the first two violations within a period of one year, and upon conviction thereof, shall be punished by a fine not to exceed the fine prescribed in accordance with the provisions of section 36900 (b) of the California Government Code, or successor legislation. Each day such violation is committed or permitted to continue shall constitute a separate offense and shall be punishable as such. Any repetition or continuation of any violation, reasonably capable of immediate correction after receipt of written or verbal notice shall constitute a separate offense and shall be punished as such.

(b) Any person violating or permitting violation of any of the provisions of this chapter for the third time within a one-year period is guilty of a misdemeanor, and shall be punished by a fine or, by imprisonment in the county jail, or by both such fine and imprisonment not to exceed the maximum fine and/or imprisonment established in section 36901 of the California Government Code, or successor legislation.

(c) Upon the third confirmed violation of this chapter within a twenty four-hour period of time beginning on the first notice of violation issued, the police department may take action as necessary to abate the wood-burning violation, including but not limited to instructing the wood-burning appliance user to "extinguish the fire" or physically arresting the wood-burning appliance user.

## Appendix B

### Technical Justification of the Proposed Ordinance

#### 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<sub>2.5</sub> exposure standard from 65 to 35 micrograms/cubic meter (ug/m<sup>3</sup>). 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<sub>2.5</sub> 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<sub>2.5</sub> concentration is projected to exceed 35 ug/m<sup>3</sup> 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 device 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 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 PM2.5 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 PM2.5 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 PM2.5 exposure was for a PM2.5 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.

Given this intent, we recommend that the threshold average daily forecasted PM2.5 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 PM2.5 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 PM2.5 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 net 24-hour PM2.5 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 PM2.5 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.

## **Using Dispersion Modeling Tools To Predicted Downwind Wood-Smoke Concentrations under Different Metrological 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 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 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. These were selected to represent the "worst-case" and "best-case" scenarios in terms of fireplace emissions. 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 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<sub>2.5</sub> 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**

		Background PM		6-Hour Factor =		Run No.		EPA Phase II Certified	Open Hearth	EPA Phase II Certified	Open Hearth
		12 ug/m3		0.8				"- EPA"	\$	"- EPA"	"-Open"
						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.	Wind speed		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					
	meter/s	mph									
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 and above, 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.

- ***Because these open hearth fireplaces can produce PM2.5 at 5 – 10 times the rate of an EPA Phase II-Certified wood stove, we recommend that the use of open hearth fireplaces be prohibited as soon as possible and no later than March 1, 2009 – the end of the current wood-burning season. We also recommend that all wood-burning (even in an EPA Phase II-Certified stove) be prohibited when forecast wind conditions do not equal or exceed 5 mph.***

In addition to wind speed, one variable that has a significant impact on the predicted ground level maximum 1-hour PM2.5 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 PM2.5 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

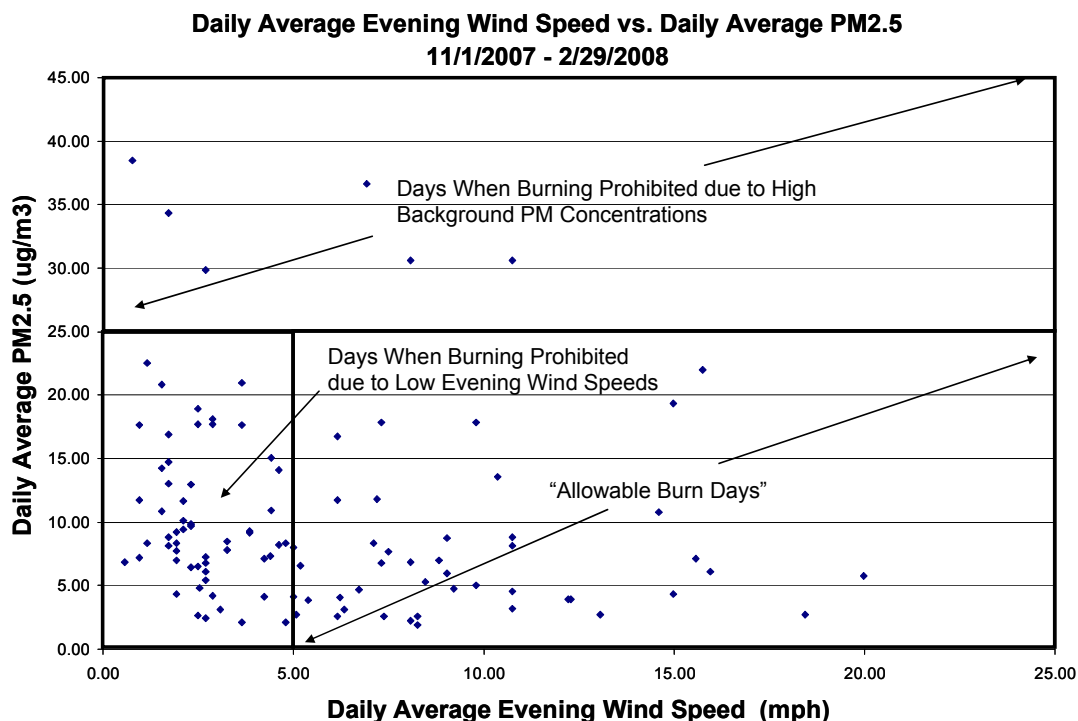
Burn Days” allowing for use of open hearth fire places during this very narrow wind speed “window”

Finally, it is important to note that this predicted net daily PM2.5 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 plume and the degree of exposure to the exposed individual also increases.

- ***For this reason, there will undoubtedly still be some exposure of some people to PM2.5 concentrations of such a duration that their exposure will exceed even the Federal 24-hour PM2.5 standard. The extent of this exposure is subject to disagreement amongst knowledgeable practitioners, however. Thus, we strongly recommend that the UC Air Quality Research Center be contacted and further study be implemented and completed prior to a complete ban on all wood-burning.***

### 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 evening hours wind speed. If these actual average values represented the forecasted average PM2.5 concentrations and wind speeds made the previous day, there would have been a total of 64 days during the 121 days (or about 50%) of the 2007 – 2008 burn season during which wood burning would be prohibited either due to excessive PM concentration or insufficient wind speed. This assumes the actual PM and wind speed values are representative of an average season and the daily forecasts correlate with actual PM2.5 concentrations and wind speed values.



**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