

# **AIR QUALITY DISPERSION MODELING OF OUTDOOR WOOD BOILERS**

*Prepared for:*

Central Boiler  
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## 1.0 EXECUTIVE SUMMARY

Air dispersion modeling was performed with the U.S. EPA ISC-PRIME model and following EPA guidance to determine the effect of a Central Boiler Outdoor Wood Boilers (OWB) on air quality. Air dispersion modeling assumed the OWB was located 50 feet from either a one-story or a two-story house and had a stack top two feet above the roof peak of the nearest structure, following the chimney height installation instructions supplied by Central Boiler with every new unit. In addition, a short 8-foot stack was also analyzed to quantify the effect on air quality of improper stack installation. Five years of hourly meteorological data for Burlington, Vermont were utilized in the modeling.

The principal air pollutant emitted by OWBs is particulate matter (PM). The Central Boiler Model 6048 was assumed to emit 60 g/hr of PM and operations correspond to a heat input rate of approximately 99,600 Btu/hour. With 55% efficiency, the heat output rate is 54,300 Btu/hour and corresponds to the peak heating-load for January in a northern State for a larger-than-average 2,800 sf home. A second upset condition emission rate of 160 g/hour was also evaluated.

The modeling results demonstrate that maximum predicted air concentrations from operation of a Central Boiler OWB with an emission rate of 60 g/hour are safely in compliance with the new 24-hour National Ambient Air Quality Standards (NAAQS) for fine particulate matter (PM<sub>2.5</sub>) of 35 µg/m<sup>3</sup>. The NAAQS have been established by EPA to protect the most sensitive groups in the population (for PM, these are people with asthma and respiratory disease) from any adverse effects, with a margin of safety. Full compliance with the NAAQS is demonstrated both on the homeowner's property and off-site for all stack heights. The use of a short 8-foot stack next to a one-story house (assumed roof peak 18 feet above grade) doubles the ground-level particulate matter concentrations compared to a properly constructed 20-foot stack. Thus, it is important that all OWBs follow Central Boiler's chimney height installation instructions to minimize ground-level concentrations of PM<sub>2.5</sub>. For the upset condition emission rate of 160 g/hour, predicted PM<sub>2.5</sub> concentrations are in compliance with the NAAQS for the properly tall stacks, but are not in compliance for when a short 8-foot stack is used.

## 2.0 AIR QUALITY STANDARDS

The principal air pollutant emitted by OWBs is particulate matter (PM). EPA has established National Ambient Air Quality Standards (NAAQS) for both coarse (PM<sub>10</sub>) and fine (PM<sub>2.5</sub>) particulate matter. The PM<sub>10</sub> standard applies to particles with a mass-mean diameter of 10 microns or less, while the PM<sub>2.5</sub> standard is keyed to particles 2.5 microns in diameter or less. While both long-term (annual) and short-term (24-hour) standards have been established, the 24-hour standards are the controlling set because of their more stringent limits. Also, the PM<sub>2.5</sub> standard is more stringent than the PM<sub>10</sub> standard. Thus, only the 24-hour PM<sub>2.5</sub> levels are examined in this study.

The 24-hour PM<sub>2.5</sub> standard is 65 µg/m<sup>3</sup>, measured as a 3-year average of 98<sup>th</sup>-percentile concentrations. In a one-year period, the 8th-highest 24-hour value represents the 98<sup>th</sup>-percentile concentration. For compliance purposes, the PM<sub>2.5</sub> design concentration is the 3-year average of the highest, 8<sup>th</sup>-highest (H8H) values in each year at any receptor location. Since EPA is expected to lower the PM<sub>2.5</sub> standard on September 27, 2006 to 35 µg/m<sup>3</sup>, this study assumed the NAAQS is 35 µg/m<sup>3</sup>.

### 3.0 OWB EMISSIONS AND STACK PARAMETERS

Particulate matter from a fuel combustion process contains a wide distribution of particle sizes. For wood combustion, these range from relatively larger carbon particles (soot) down to sub-micron organic compound aerosols. Research studies of OWB emissions have used sampling methods that capture the full size distribution of PM, solid particles and condensible organics. In performing dispersion modeling it is important that the mass fraction appropriate to each NAAQS be used. EPA particle size distribution data for wood boilers reveal that typically 90% of the total PM mass has a diameter of 10 microns or less, and 76% has a diameter of 2.5 microns or less.<sup>1</sup>

Air dispersion modeling results were obtained for four emission rates. First, it was assumed that all 60 g/hour of PM emissions are in the form of PM<sub>2.5</sub>, a conservative but unrealistic assumption. Second, the above-mentioned EPA particle size distribution was used where 76% of PM emissions from a wood boiler are in the form of PM<sub>2.5</sub>. Third, an upset condition PM emission rate of 160 g/hour was used and it was assumed that all of this was in the form of PM<sub>2.5</sub>. Fourth, the EPA size-scaling factor of 76% was applied to the 160 g/hour PM rate. Thus, the four PM<sub>2.5</sub> emission rates studied are:

- Emission Rate 1: 60.0 g/hour
- Emission Rate 2: 45.6 g/hour
- Emission Rate 3: 160.0 g/hour
- Emission Rate 4: 121.6 g/hour

Air dispersion modeling assumed the OWB was located 50 feet from a house with a 30-foot by 50-foot footprint. Three modeling cases were examined:

- Case 1: One-story house, 18-foot roof peak, 8-foot stack.
- Case 2: One-story house, 18-foot roof peak, 20-foot stack
- Case 3: Two-story house, 33-foot roof peak, 35-foot stack

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<sup>1</sup> Since no studies of PM size distribution for OWBs have been done, data for uncontrolled industrial wood boilers from EPA publication AP-42, Section 1.6 are used.

Some existing OWBs have stacks of only 8 to 10 feet above grade, and Case 1 is designed to represent the OWB with an inappropriately short stack. Due to its close proximity to a taller structure (the house), emissions from an 8-foot stack can be caught by the aerodynamic downwash cavity of a house, bringing plume elements close to the ground and negating the benefit of an elevated stack. For this reason, Central Boiler has recommended since 1996 that OWB stacks be installed to a height two feet above the roof line of the nearest structure. These chimney height installation instructions accompany every new Central Boiler OWB that is sold.

The stack gas exit temperature and exit velocity used in this analysis represent typical values measured in Central Boiler's test laboratory for the OWBs. All stack and emission values used in this study are summarized in Table 1.

**TABLE 1**  
**STACK PARAMETERS AND EMISSIONS FOR**  
**AIR DISPERSION MODELING**

<b>Parameter</b>	<b>English Units</b>	<b>Metric Units</b>
Stack Height		
Case 1	8 feet	2.4 m
Case 2	20 feet	6.1 m
Case 3	35 feet	10.7 m
Stack Exit Diameter	8 inches	0.2 m
Stack Exit Velocity	7.2 feet/sec.	2.2 m/s
Stack Exit Temperature	350° F	449.9° K
PM <sub>2.5</sub> Emission Rate		
Emission Rate 1		60.0 g/hr
Emission Rate 2		45.6 g/hr
Emission Rate 3	--	160.0 g/hr
Emission Rate 4	--	121.6 g/hr

#### 4.0 MODELING RESULTS

The air dispersion modeling results are summarized in Table 3 and PM emission rates of 60 and 45.6 g/hr and in Table 4 for PM emissions of 160 and 121.6 g/hr. The ISC-PRIME modeling was done using a PM emission rate of 60 g/hr and the results were scaled for the four emission scenarios. The model output is appended to this report. PM<sub>2.5</sub> contour maps for the emission rates of 60 and 160 g/hr are presented in six figures (two sets of three figures) at the end of this section.

For the emission rate of 60 g/hour, all maximum predicted PM<sub>2.5</sub> concentrations are in compliance with the National Ambient Air Quality Standards (NAAQS) for all stack heights. The use of a short 8-foot stack next to a one-story house (assumed roof peak 18 feet above grade) doubles the ground-level PM concentrations compared to a properly constructed 20-foot stack. Thus, it is important that all OWBs follow Central Boiler's chimney height installation instructions to minimize ground-level concentrations for PM<sub>2.5</sub>.

For the upset condition emission rate of 160 g/hour, predicted PM<sub>2.5</sub> concentrations are in compliance with the NAAQS for Cases 2 and 3 that assume properly tall stacks, but are not in compliance for Case 1 where a short stack below the height of the roof peak is assumed.

**TABLE 3**

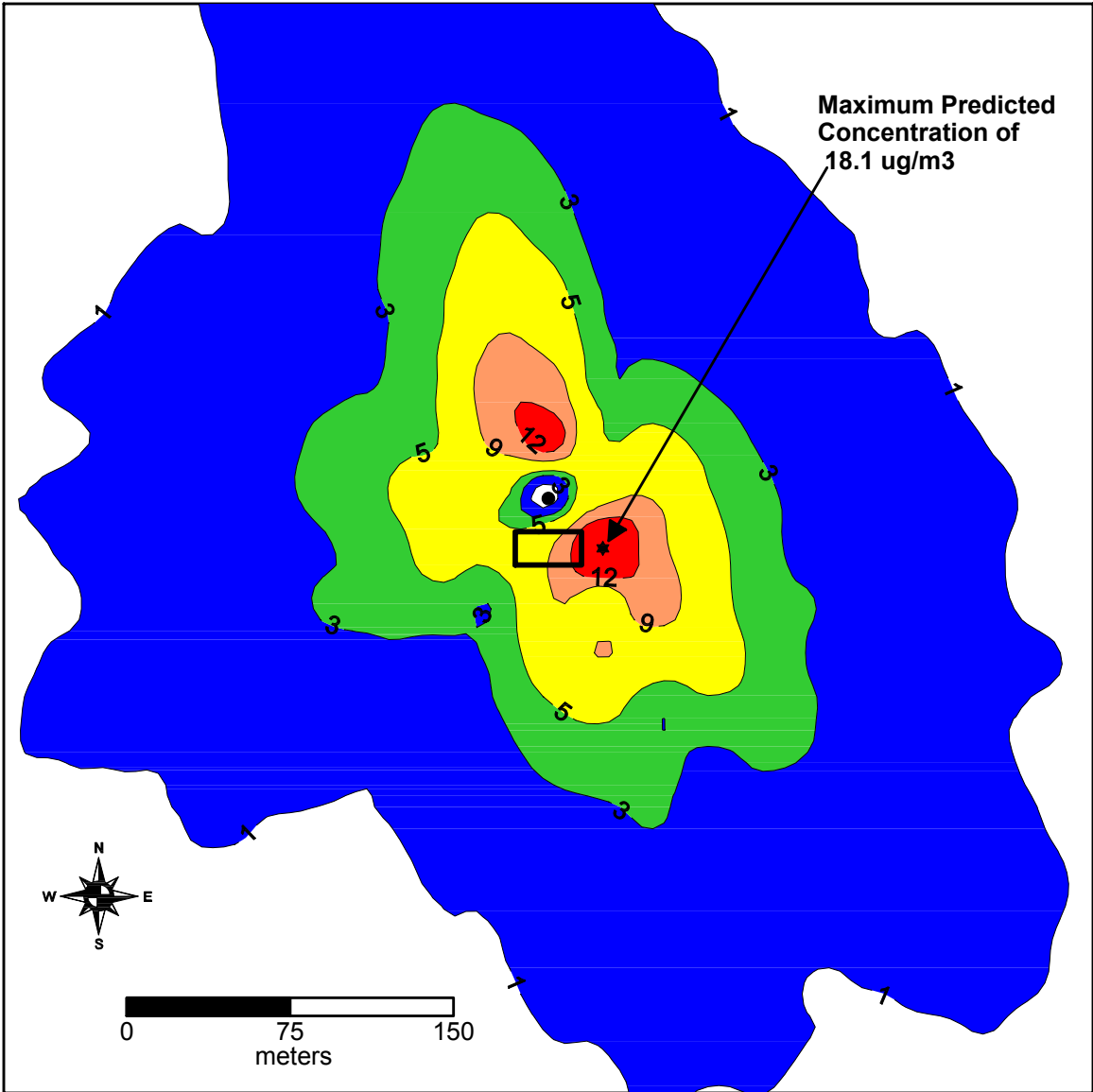
**24-HOUR PM<sub>2.5</sub> AIR MODELING RESULTS FOR  
CENTRAL BOILER MODEL 6048 WITH  
PM EMISSIONS OF 60 G/HR  
( $\mu\text{g}/\text{m}^3$ )**

	<b>Case 1</b>	<b>Case 2</b>	<b>Case 3</b>
Roof Height (ft) Stack Height (ft)	18 8	18 20	33 55
Assume All PM is PM <sub>2.5</sub>			
H8H in One Year	18.1	9.1	5.3
3-Year Average of H8H	16.5	8.6	5.2
NAAQS	35.0	35.0	35.0
Assume 76% of PM is PM <sub>2.5</sub>			
H8H in One Year	13.8	6.9	4.0
3-Year Average of H8H	12.5	6.5	4.0
NAAQS	35.0	35.0	35.0

**TABLE 4**  
**24-HOUR PM<sub>2.5</sub> AIR MODELING RESULTS FOR**  
**CENTRAL BOILER MODEL 6048 WITH**  
**PM EMISSIONS OF 160 G/HR**  
**( $\mu\text{g}/\text{m}^3$ )**

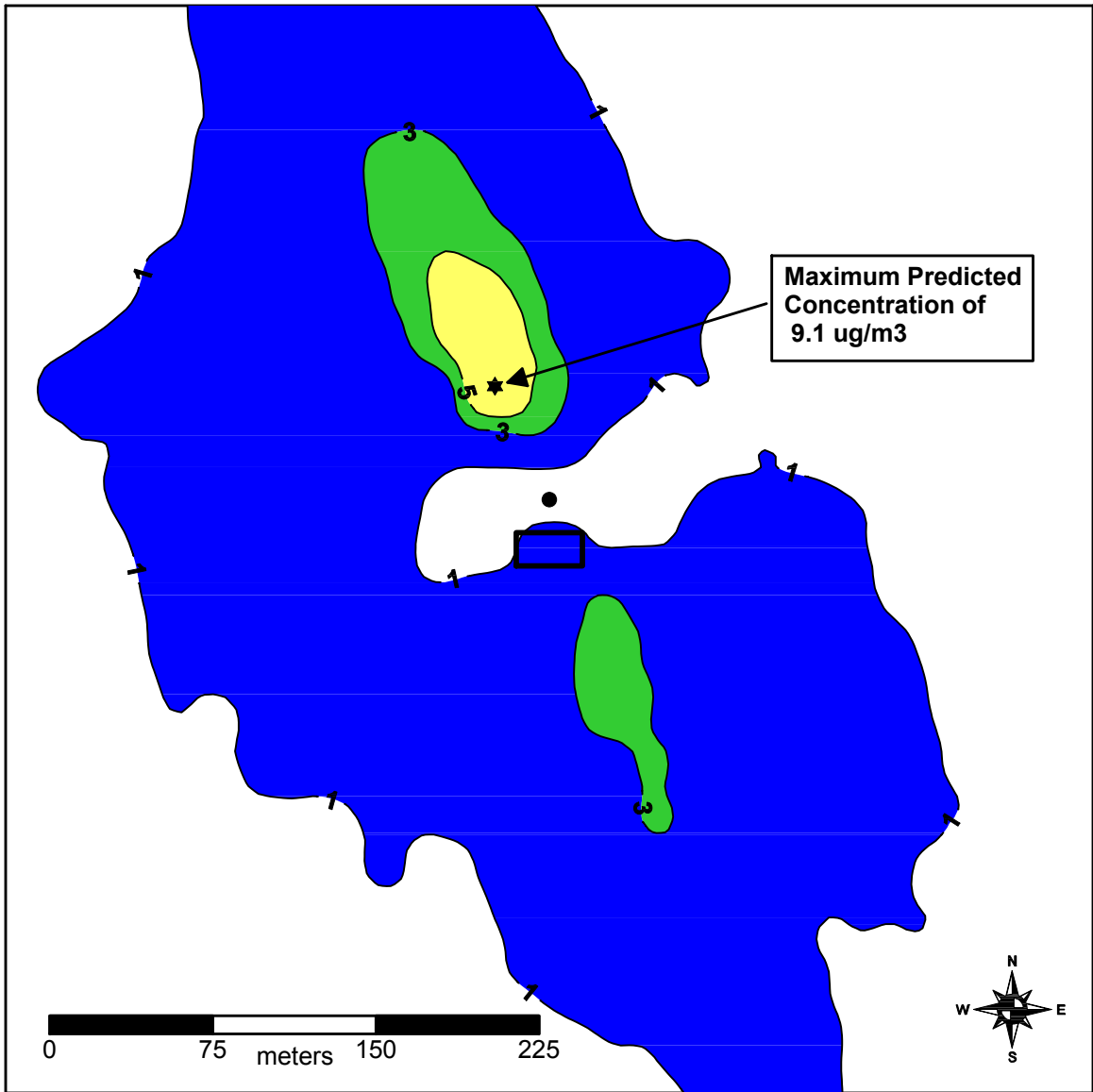
	Case 1	Case 2	Case 3
Roof Height (ft)	18	18	33
Stack Height (ft)	8	20	55
Assume All PM is PM <sub>2.5</sub>			
H8H in One Year	48.3	24.3	14.1
3-Year Average of H8H	44.0	22.9	13.9
NAAQS	35.0	35.0	35.0
Assume 76% of PM is PM <sub>2.5</sub>			
H8H in One Year	34.7	18.4	10.7
3-Year Average of H8H	33.3	17.3	10.7
NAAQS	35.0	35.0	35.0





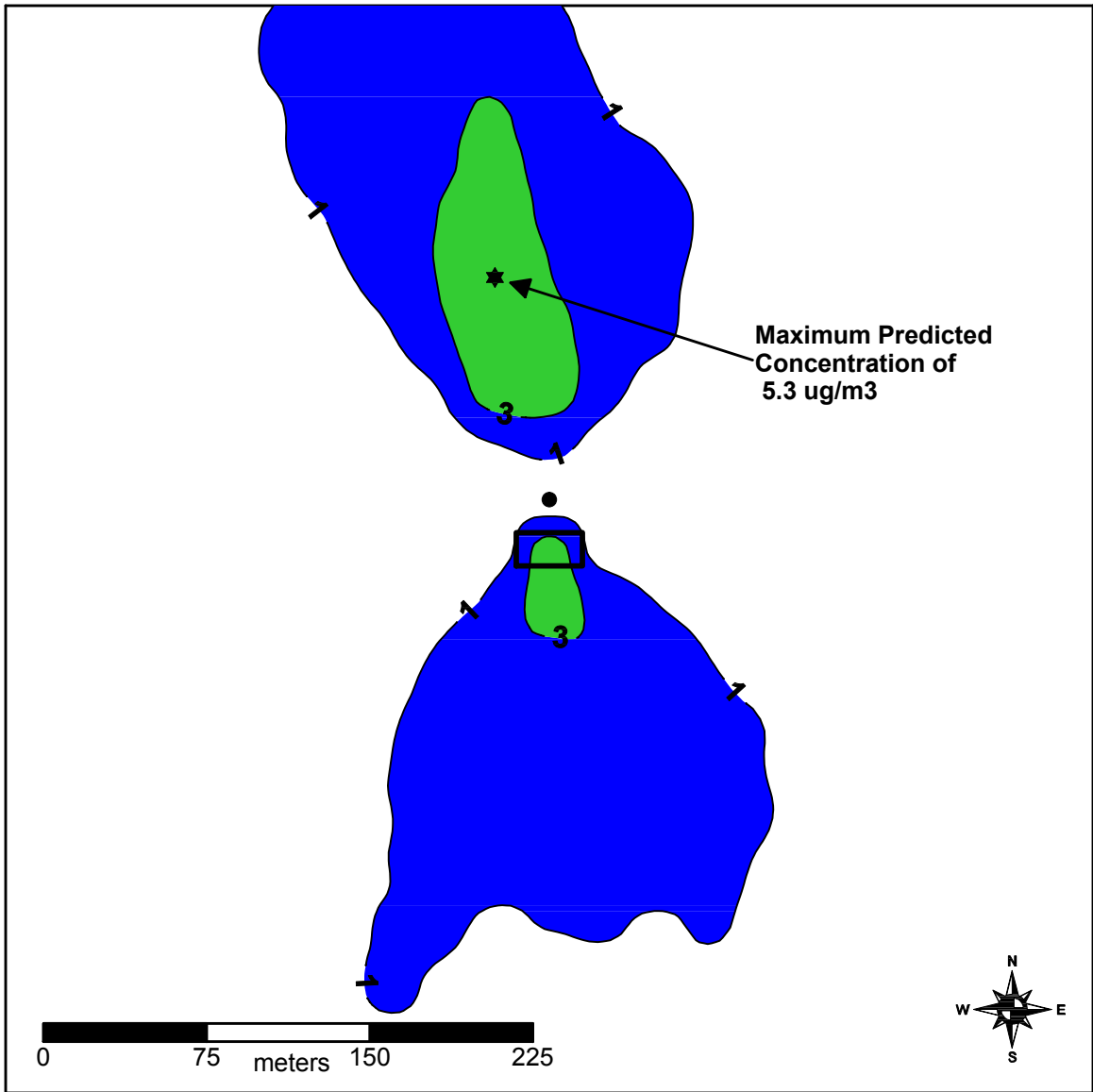
## 8-FOOT WOOD BOILER STACK (CASE 1)

24-Hour H8H Concentrations for 60 grams/hour (ug/m3)



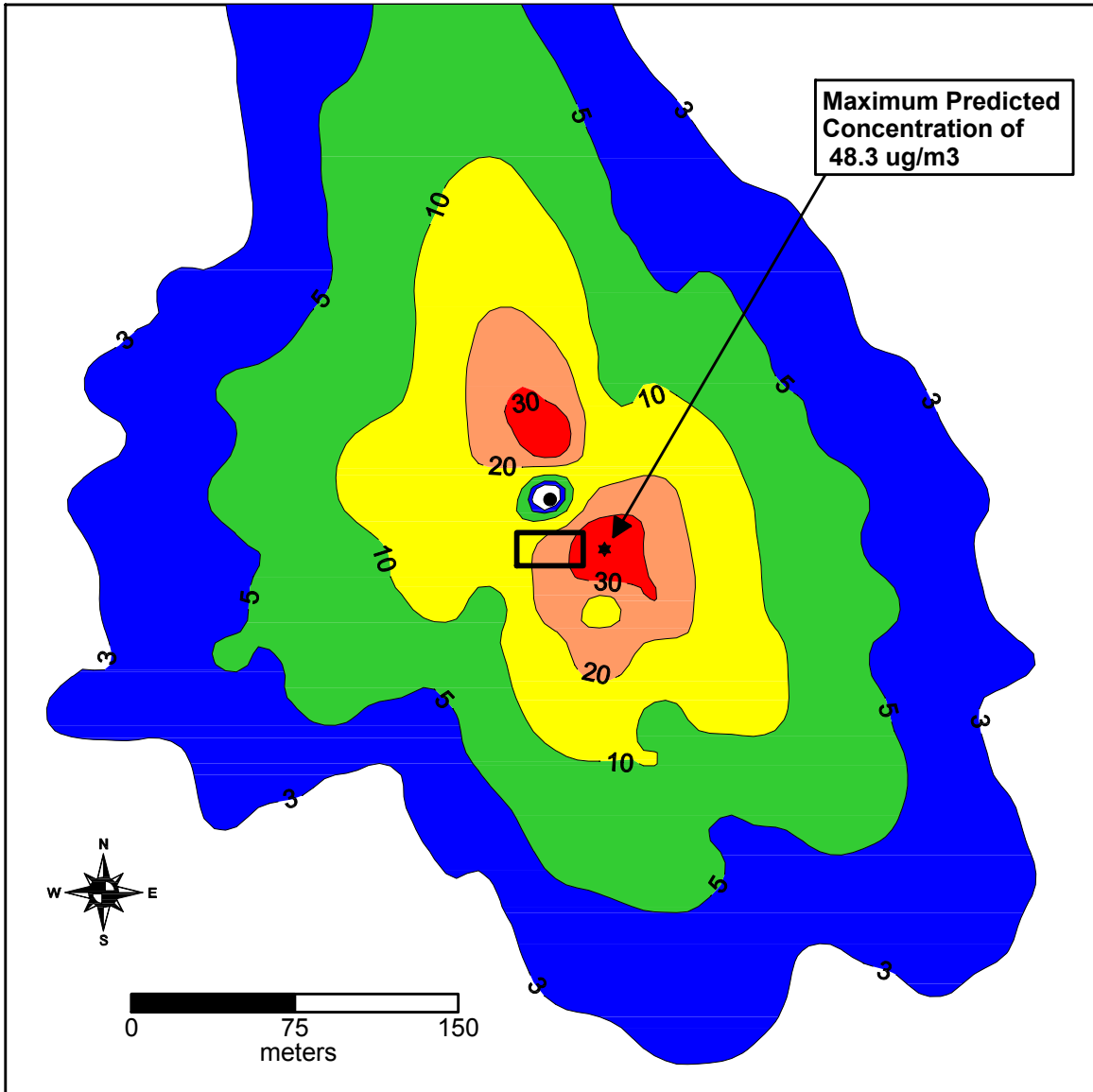
## 20-FOOT WOOD BOILER STACK (CASE 2)

24-Hour H8H Concentrations for 60 grams/hour (ug/m3)



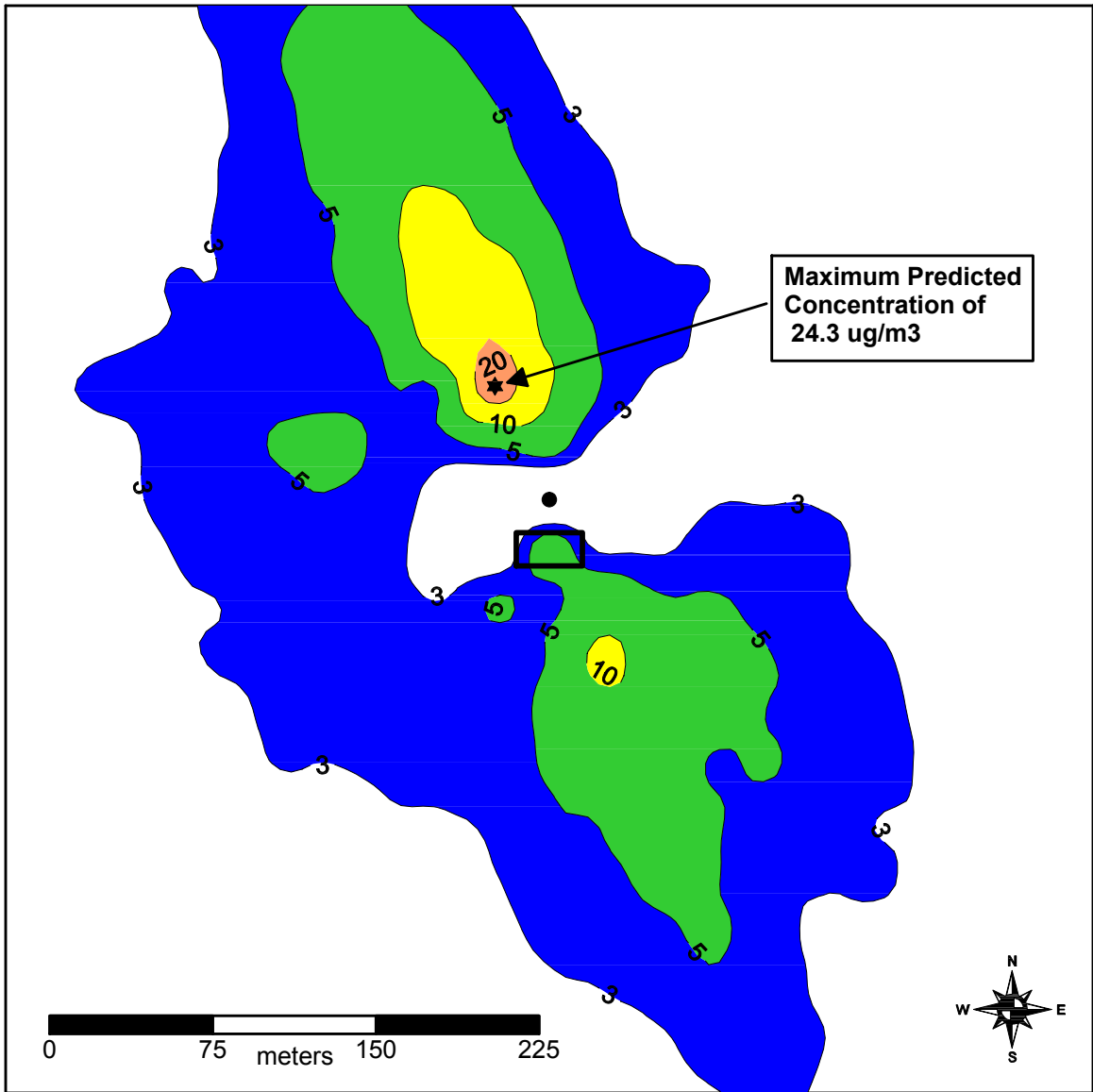
# 35-FOOT WOOD BOILER STACK (CASE 3)

24-Hour H8H Concentrations for 60 grams/hour (ug/m3)



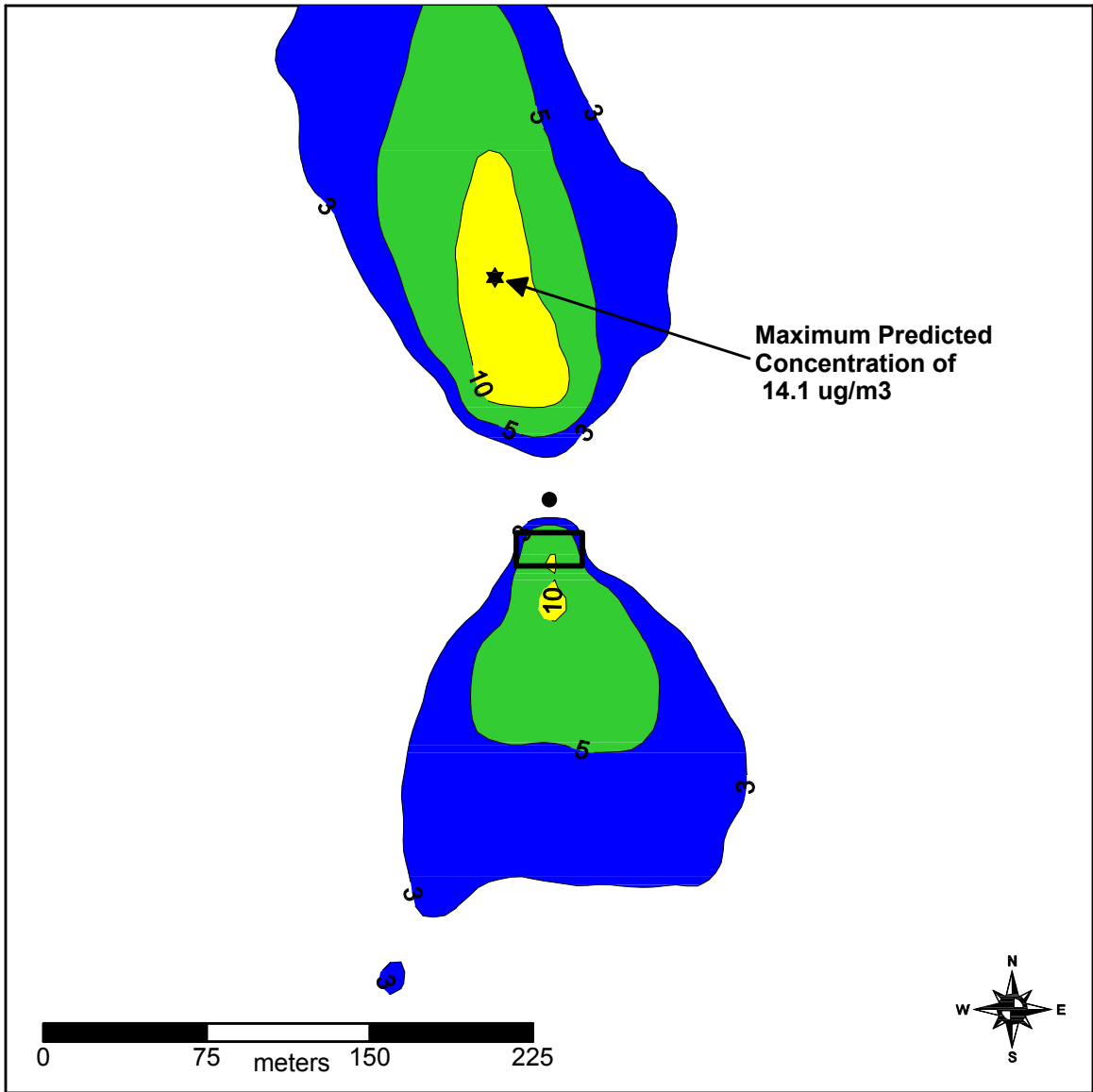
# 8-FOOT WOOD BOILER STACK (CASE 1)

24-Hour H8H Concentrations for 160 grams/hour (ug/m3)



## 20-FOOT WOOD BOILER STACK (CASE 2)

24-Hour H8H Concentrations for 160 grams/hour (ug/m<sup>3</sup>)



# 35-FOOT WOOD BOILER STACK (CASE 3)

24-Hour H8H Concentrations for 160 grams/hour (ug/m3)

# 8-FOOT STACK WITH 18-FOOT BUILDING (CASE 1)

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1987 CASE 1 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:14:22 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 1\1987.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 1\1987.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1987.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE	
		SCALAR	VARY BY										
BOILER	0	0.16700E-01		0.0	19.8	0.0	2.44	449.90	2.20	0.20	YES		

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	CONC OF OTHER IN MICROGRAMS/M**3				OF TYPE	NETWORK GRID-ID
						(XR, YR, ZELEV, ZFLAG)					
ALL	HIGH	2ND HIGH VALUE IS	20.22158	ON 87112624:	AT (	25.00,	0.00,	0.00,	0.00,	GC	GRID
	HIGH	8TH HIGH VALUE IS	14.86892	ON 87042324:	AT (	-25.00,	50.00,	0.00,	0.00,	GC	GRID

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1988 CASE 1 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:13:54 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 1\1988.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 1\1988.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1988.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	2.44	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH	2ND HIGH VALUE IS	18.51985c	ON 88050724:	AT (	25.00, 0.00, 0.00, 0.00)	GC	GRID
	HIGH	8TH HIGH VALUE IS	14.86929	ON 88060624:	AT (	25.00, 0.00, 0.00, 0.00)	GC	GRID



\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1989 CASE 1 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:13:13 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 1\1989.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 1\1989.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1989.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	2.44	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH	2ND HIGH VALUE IS	20.63409	ON 89052824:	AT (	25.00, 0.00, 0.00, 0.00)	GC	GRID
	HIGH	8TH HIGH VALUE IS	14.88189c	ON 89053124:	AT (	25.00, 0.00, 0.00, 0.00)	GC	GRID

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1990 CASE 1 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:12:35 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 1\1990.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 1\1990.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1990.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	2.44	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID SOURCE IDs

ALL BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH	2ND HIGH VALUE IS	22.68898c	ON 90032124:	AT (	25.00, 0.00, 0.00, 0.00)	GC	GRID
	HIGH	8TH HIGH VALUE IS	18.10408	ON 90062024:	AT (	25.00, 0.00, 0.00, 0.00)	GC	GRID

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1991 CASE 1 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 07:49:49 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 1\1991.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 1\1991.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1991.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
BOILER	0	0.16700E-01	0.0	19.8	0.0	2.44	449.90	2.20	0.20	YES		

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK
						GRID-ID
ALL	HIGH 2ND HIGH VALUE IS 21.25855	ON 91111924: AT (	0.00,	50.00,	0.00,	0.00) GC GRID
	HIGH 8TH HIGH VALUE IS 16.53762	ON 91121124: AT (	0.00,	50.00,	0.00,	0.00) GC GRID

## 20-FOOT STACK WITH 18-FOOT BUILDING (CASE 2)

```

*** ISC3PBEE - VERSION 04272 ***
*** RESIDENTIAL WOOD BOILER PM - 1987 CASE 2 ***
*** Model Executed on 04/19/06 at 07:50:39 ***
Input File - W:\Apps\ISCPRIIME\2618\Case 2\1987.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 2\1987.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1987.ASC
    
```

```

Number of sources - 1
Number of source groups - 1
Number of receptors - 441
    
```

### \*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE	
		SCALAR	VARY BY										
BOILER	0	0.16700E-01		0.0	19.8	0.0	6.10	449.90	2.20	0.20	YES		

### \*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

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GROUP ID          SOURCE IDs

ALL      BOILER ,
    
```

### \*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

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** CONC OF OTHER      IN MICROGRAMS/M**3      **

GROUP ID          AVERAGE CONC      DATE      RECEPTOR (XR, YR, ZELEV, ZFLAG)      OF TYPE      NETWORK
-----
ALL      HIGH 2ND HIGH VALUE IS      10.33658      ON 87120924: AT (      -25.00,      75.00,      0.00,      0.00)      GC      GRID
ALL      HIGH 8TH HIGH VALUE IS      9.09559      ON 87090624: AT (      -25.00,      75.00,      0.00,      0.00)      GC      GRID
    
```

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1988 CASE 2 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:15:09 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 2\1988.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 2\1988.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1988.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	6.10	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH	2ND HIGH VALUE IS	10.31844	ON 88011224:	AT (	-25.00, 75.00, 0.00, 0.00)	GC	GRID
	HIGH	8TH HIGH VALUE IS	8.93468	ON 88102624:	AT (	-25.00, 75.00, 0.00, 0.00)	GC	GRID

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1989 CASE 2 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:15:58 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 2\1989.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 2\1989.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1989.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	6.10	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK
						GRID-ID
ALL	HIGH 2ND HIGH VALUE IS	10.14072	ON 89081424: AT (	-25.00, 125.00, 0.00, 0.00)	GC	GRID
	HIGH 8TH HIGH VALUE IS	7.67681	ON 89060324: AT (	-25.00, 75.00, 0.00, 0.00)	GC	GRID

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1990 CASE 2 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:16:50 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 2\1990.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 2\1990.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1990.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	6.10	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH	2ND HIGH VALUE IS	9.04817	ON 90020824: AT (	-25.00,	100.00,	0.00,	0.00) GC GRID
	HIGH	8TH HIGH VALUE IS	7.37965	ON 90100624: AT (	-25.00,	100.00,	0.00,	0.00) GC GRID

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1991 CASE 2 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:17:26 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 2\1991.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 2\1991.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1991.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	6.10	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH	2ND HIGH VALUE IS	9.91220	ON 91082224:	AT (	0.00, 75.00, 0.00, 0.00)	GC	GRID
	HIGH	8TH HIGH VALUE IS	7.48560	ON 91112024:	AT (	0.00, 75.00, 0.00, 0.00)	GC	GRID



# 35-FOOT STACK WITH 33-FOOT BUILDING (CASE 3)

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1987 CASE 3 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:09:33 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 3\1987.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 3\1987.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1987.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE	
		SCALAR	VARY BY										
BOILER	0	0.16700E-01		0.0	19.8	0.0	10.67	449.90	2.20	0.20	YES		

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH	VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK	
									GRID-ID	GRID
ALL	HIGH	2ND	HIGH VALUE IS	6.35215	ON 87120924:	AT (	-25.00, 100.00, 0.00, 0.00)	GC	GRID	GRID
	HIGH	8TH	HIGH VALUE IS	5.19845	ON 87110824:	AT (	-25.00, 75.00, 0.00, 0.00)	GC	GRID	GRID

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1988 CASE 3 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:10:13 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 3\1988.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 3\1988.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1988.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EMISSION RATE	
											EXISTS	SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	10.67	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK
								GRID-ID
ALL	HIGH	2ND HIGH VALUE IS	6.02959	ON 88011224:	AT (	-25.00, 75.00, 0.00, 0.00)	GC	GRID
	HIGH	8TH HIGH VALUE IS	5.13607	ON 88110824:	AT (	-25.00, 75.00, 0.00, 0.00)	GC	GRID

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1989 CASE 3 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 07:51:25 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 3\1989.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 3\1989.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1989.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	10.67	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID SOURCE IDs

ALL BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH	2ND HIGH VALUE IS	6.78076	ON 89082024:	AT (	-25.00, 100.00, 0.00, 0.00)	GC	GRID
	HIGH	8TH HIGH VALUE IS	5.29243	ON 89080224:	AT (	-25.00, 125.00, 0.00, 0.00)	GC	GRID

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1990 CASE 3 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:11:00 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 3\1990.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 3\1990.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1990.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	10.67	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH	2ND HIGH VALUE IS	5.78520	ON 90041924:	AT (	-25.00, 100.00, 0.00, 0.00)	GC	GRID
	HIGH	8TH HIGH VALUE IS	4.64701	ON 90052824:	AT (	-25.00, 100.00, 0.00, 0.00)	GC	GRID

\*\*\* ISC3PBEE - VERSION 04272 \*\*\*  
 \*\*\* RESIDENTIAL WOOD BOILER PM - 1991 CASE 3 \*\*\*  
 \*\*\* Model Executed on 04/19/06 at 08:11:38 \*\*\*  
 Input File - W:\Apps\ISCPRIIME\2618\Case 3\1991.DTA

Output File - W:\Apps\ISCPRIIME\2618\Case 3\1991.LST

Met File - W:\Apps\ISCPRIIME\2618\MetData\1991.ASC

Number of sources - 1  
 Number of source groups - 1  
 Number of receptors - 441

\*\*\* POINT SOURCE DATA \*\*\*

SOURCE ID	PART. CATS.	NUMBER EMISSION RATE (GRAMS/SEC)		X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EMISSION RATE	
											EXISTS	SCALAR VARY BY
BOILER	0	0.16700E-01		0.0	19.8	0.0	10.67	449.90	2.20	0.20	YES	

\*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

GROUP ID	SOURCE IDs
ALL	BOILER ,

\*\*\* THE SUMMARY OF HIGHEST 24-HR RESULTS \*\*\*

\*\* CONC OF OTHER IN MICROGRAMS/M\*\*3 \*\*

GROUP ID	HIGH	2ND HIGH VALUE IS	AVERAGE CONC	DATE	RECEPTOR	(XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK
				(YYMMDDHH)				GRID-ID
ALL	HIGH	2ND HIGH VALUE IS	5.79145c	ON 91122024: AT (	0.00,	75.00,	0.00,	0.00) GC GRID
	HIGH	8TH HIGH VALUE IS	4.59033	ON 91121124: AT (	0.00,	75.00,	0.00,	0.00) GC GRID