Chapter 5

Examples

This chapter contains four step-by-step example ALOHA scenarios. You can complete the first three scenarios using only ALOHA. To complete the fourth scenario, you'll need the electronic mapping application, MARPLOT, as well as the sample map of Prince William County supplied with MARPLOT.

Example 1: A Tank Source

In a small industrial park outside Baton Rouge, Louisiana, a 500-gallon, 4-foot-diameter vertical tank contains liquid benzene. On August 20, 2000, at 10:30 p.m. local time, a security guard discovers that liquid is leaking out of the tank through a 6-inch circular hole located 10 inches above the bottom of the tank. He also sees that the liquid is flowing onto a grassy field west of the industrial park. The guard thinks that the tank had just been filled that evening.

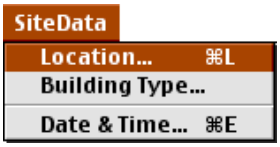
The temperature on scene is 80°F, with the wind from the east at 7 knots (as measured at a height of 10 meters by a fixed meteorological tower at the site). The sky is more than half covered by clouds and the humidity is about 75 percent. There is no inversion.

The local emergency planning committee (LEPC) has indicated that the Level of Concern (LOC) for this product is 10 parts per million (ppm). In this example scenario, we'll determine the downwind distance to this LOC.

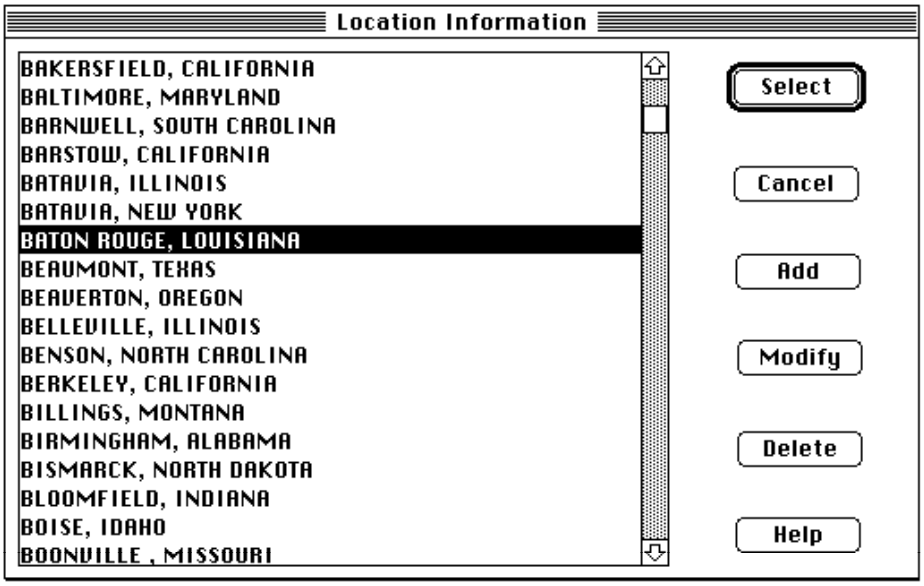
Choosing a location and a chemical

1 Start ALOHA. Read the list of ALOHA's limitations (click Help for more details), then click **OK**.

2 Choose **Location** from the **SiteData** menu.



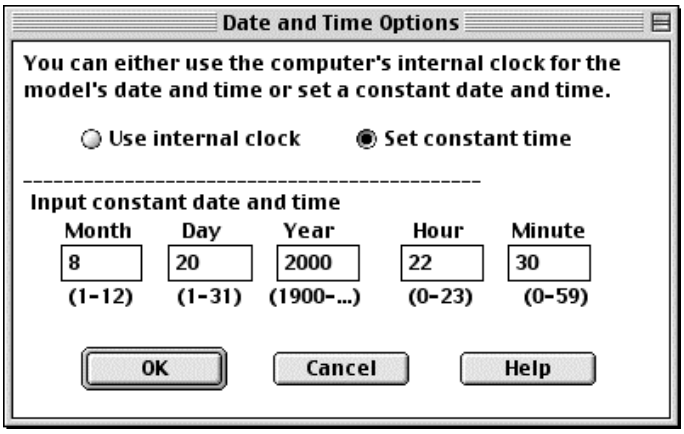
3 Type "b" to quickly move to the section of the list containing names beginning with "b", then scroll down a little farther until you see "BATON ROUGE, LOUISIANA." Click on this name to highlight it, then click **Select**.



In this example, we will not enter building type information because we will not assess concentration at specific locations.

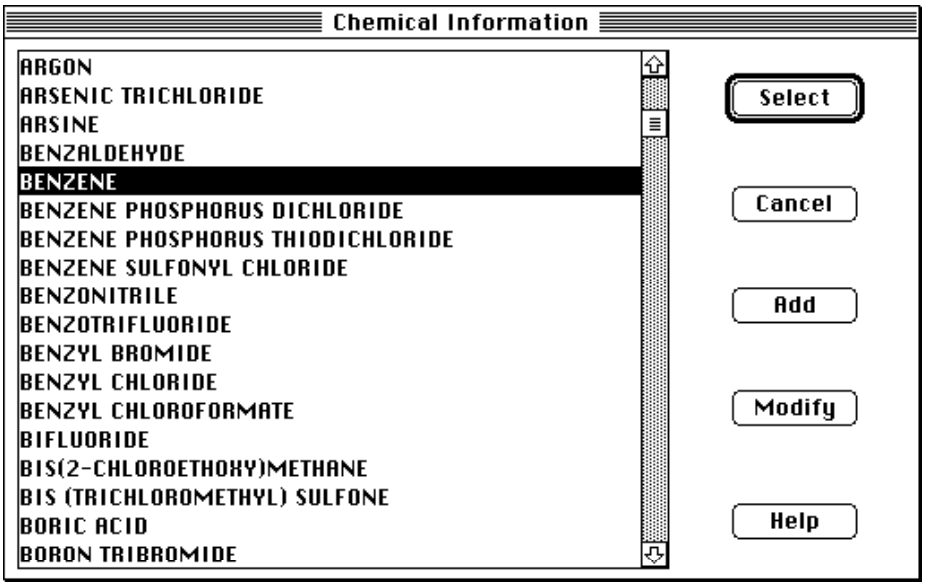
4 Choose **Date & Time** from the **SiteData** menu to enter the date and time of the accident.

5 Click **Set constant time**, then enter the month, day, year, hour and minute for this scenario (press TAB to move from one box to the next), as in the example below. The accident time of 10:30 p.m. equals 22:30 in 24-hour time. Click **OK**.



6 Select **Chemical** from the **SetUp** menu.

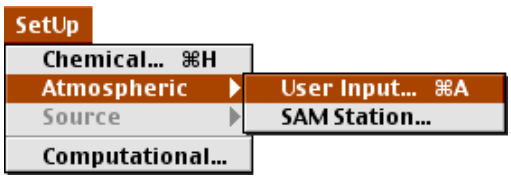
7 Find "BENZENE" in the list (type the character "b" to go to the section of the list containing benzene), click on its name to highlight it, then click **Select**.



Entering weather information

Now that you've selected the location, time, and chemical, you must provide information about weather conditions and ground roughness.

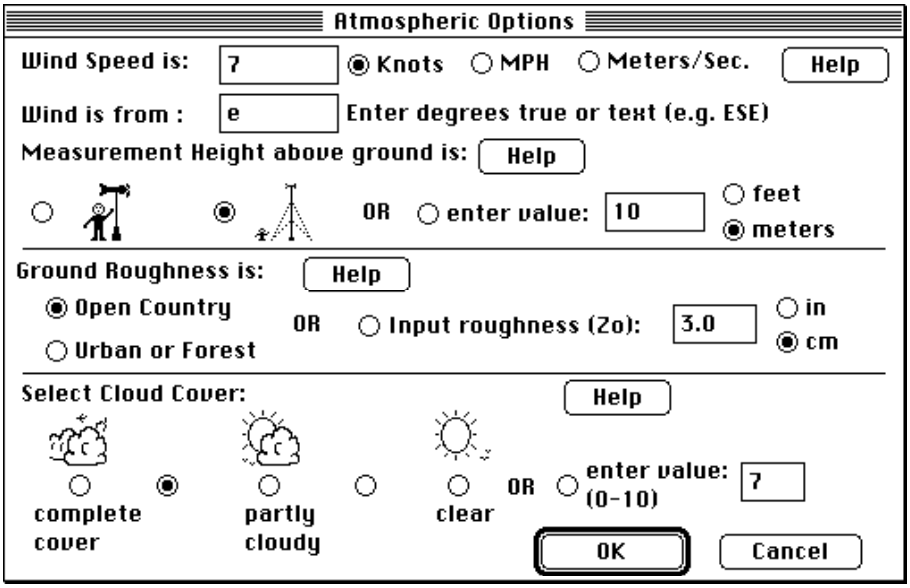
1 In the **SetUp** menu, point to **Atmospheric**, then click **User Input**.



2 On ALOHA's first "Atmospheric Options" dialog box, type "7" into the wind speed box, then click **Knots**. Type "e" into the wind direction box (to indicate that the wind is from the east), then click the right-hand button under the "Measurement height above ground is:" heading. This button represents a wind measurement height of 10 meters.

3 The benzene is flowing onto a grassy field located to the west of the industrial park. Since the wind is blowing from the east, we can expect the cloud of benzene vapor to disperse westward across this field. An open field fits into the category of "Open Country" ground roughness, so click **Open Country**. If the wind was instead blowing from the west, towards the industrial park, **Urban or Forest** would be the most appropriate roughness category.

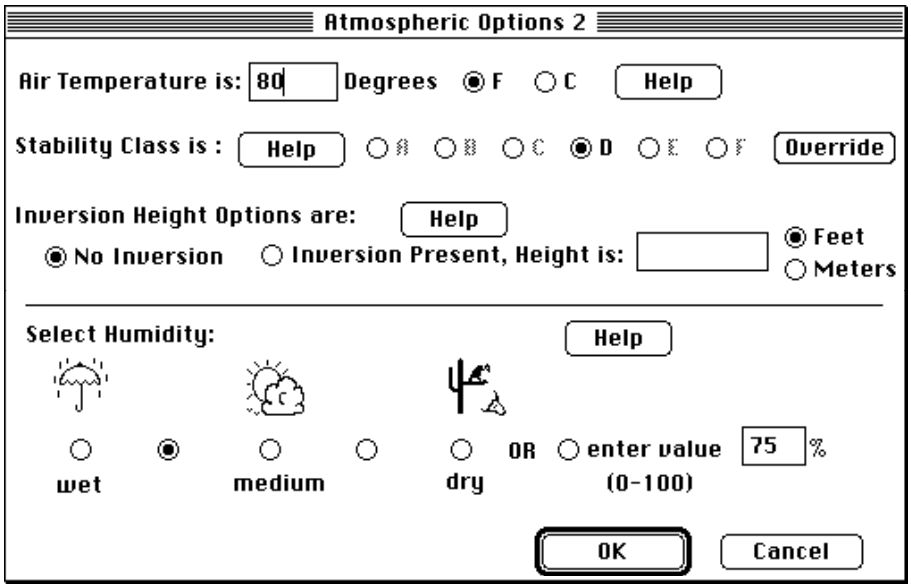
4 Under the "Select cloud cover:" heading, click the second button from the left; this button represents 7/10 cloud cover. Once the dialog box on your screen looks like the one below, click **OK**.



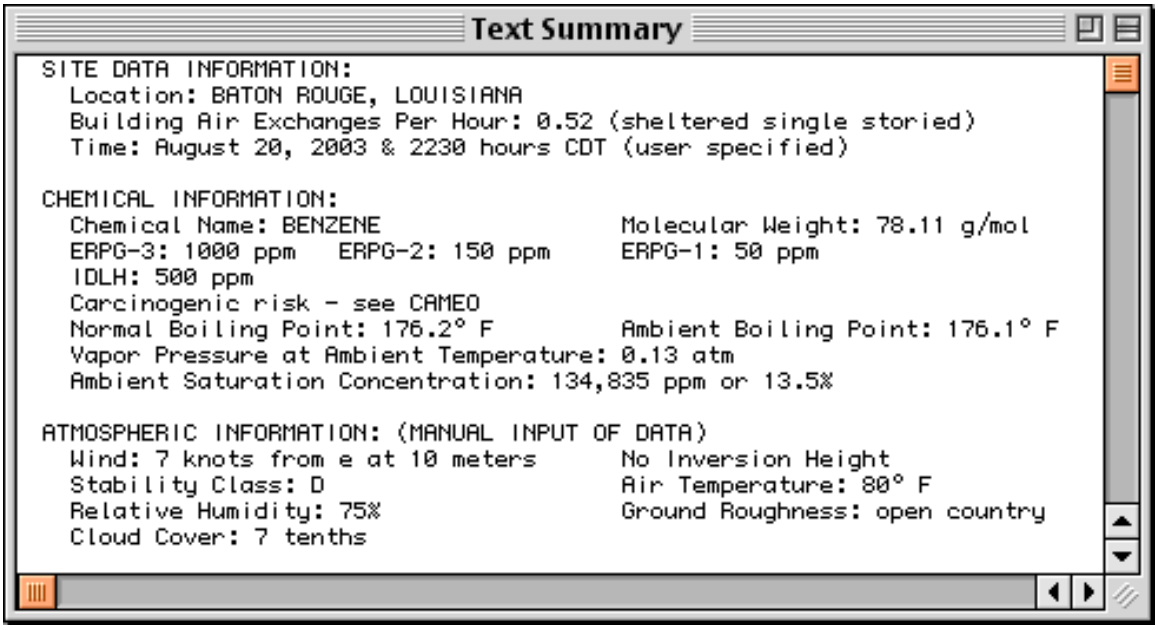
5 On ALOHA's second "Atmospheric Options" dialog box, type "80" into the air temperature box, then click **F** to indicate that this temperature is in degrees Fahrenheit.

6 ALOHA uses the wind speed, cloud cover, and date and time information that you've entered to automatically select atmospheric stability class "D".

7 Check to be sure that **No inversion** is selected, then click the second relative humidity button from the left, which represents 75 percent relative humidity. Once the dialog box on your screen looks like the one below, click **OK**.



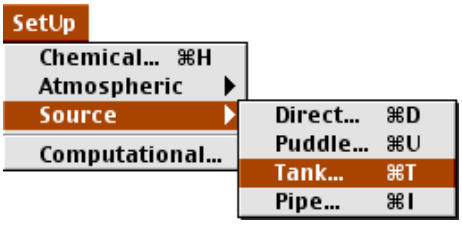
The information that you have entered into ALOHA appears in the Text Summary. Ignore ALOHA's estimate of building exchange rate, since we are not considering infiltration into buildings.



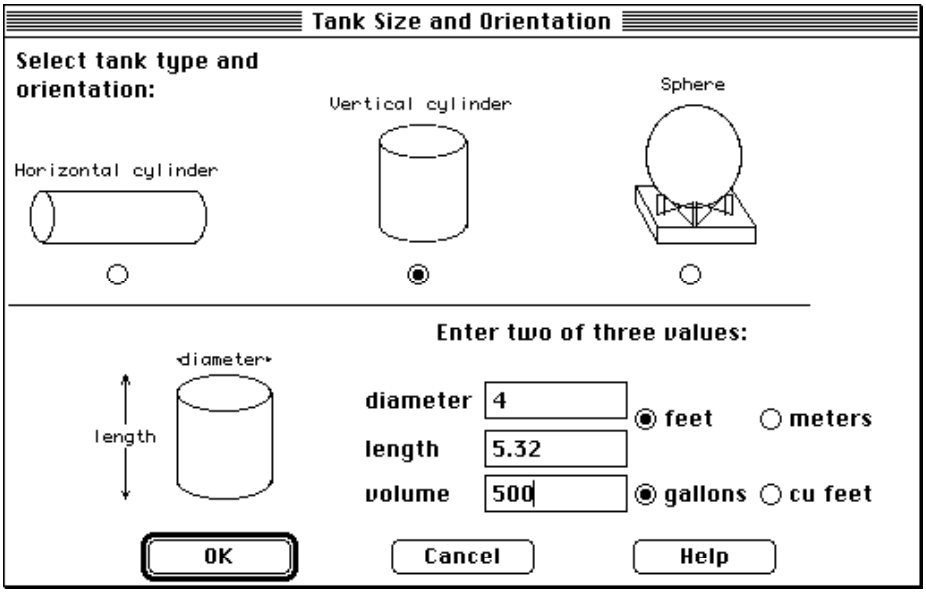
Describing the release

You're now ready to enter information about the release itself.

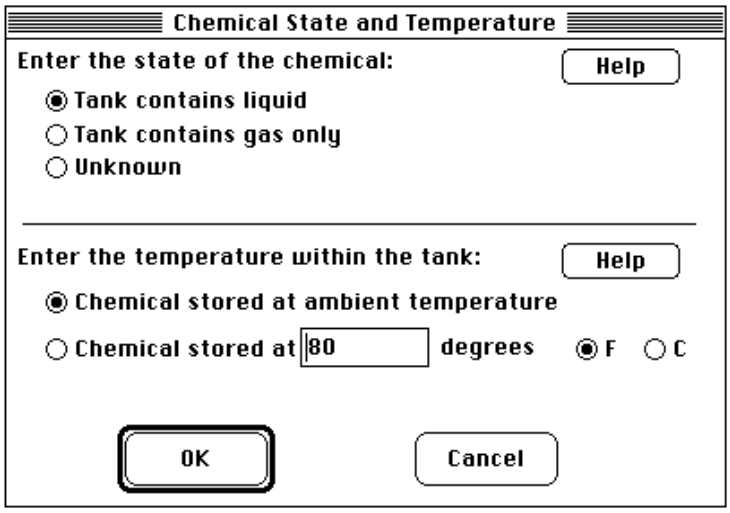
1 Since the benzene is leaking from a tank, this scenario should be modeled as a **Tank** source. In the **SetUp** menu, point to **Source**, then click **Tank**.



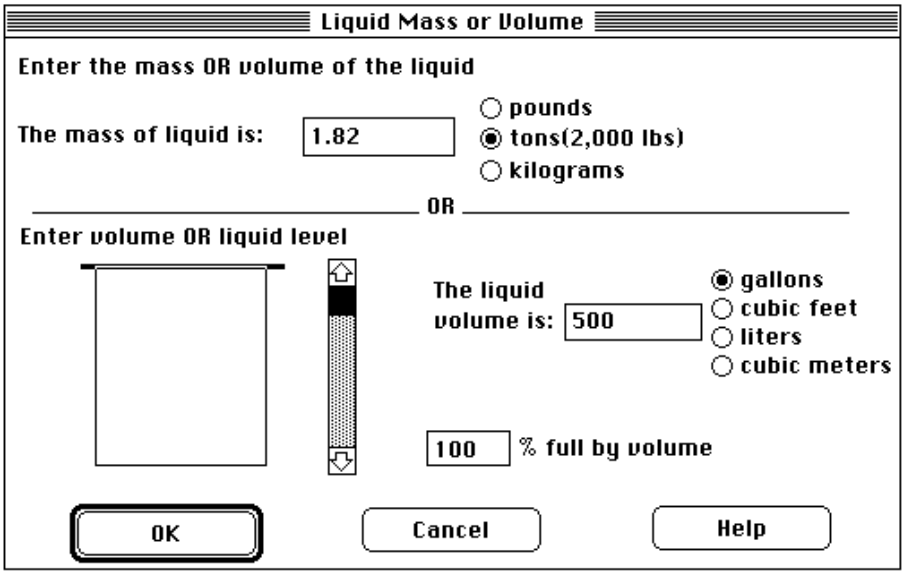
2 Click **Vertical Cylinder**, then enter 500 gallons for the volume and 4 feet for the diameter of the tank. Once you have entered the volume and diameter, ALOHA calculates the correct length. Click **OK**.



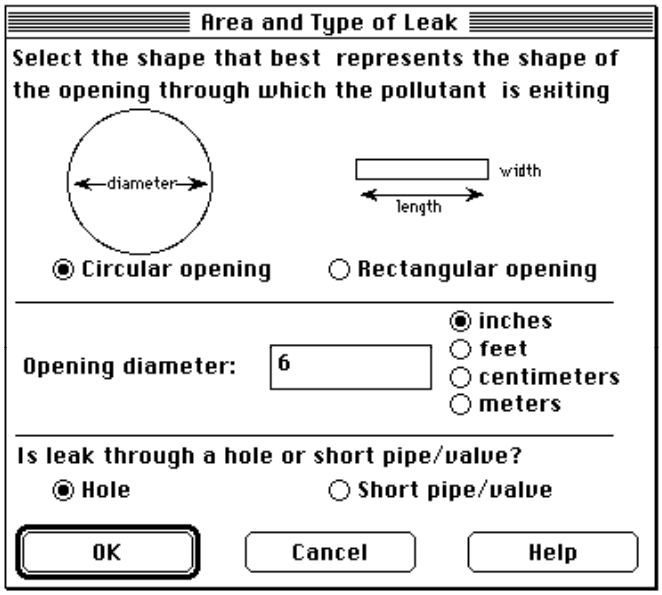
3 The benzene is stored in the tank as a liquid (notice in the Text Summary that it has a boiling point of 176°F, well above the ambient temperature). Check to be sure that **Tank contains liquid** and **Chemical stored at ambient temperature** are selected, then click **OK**.



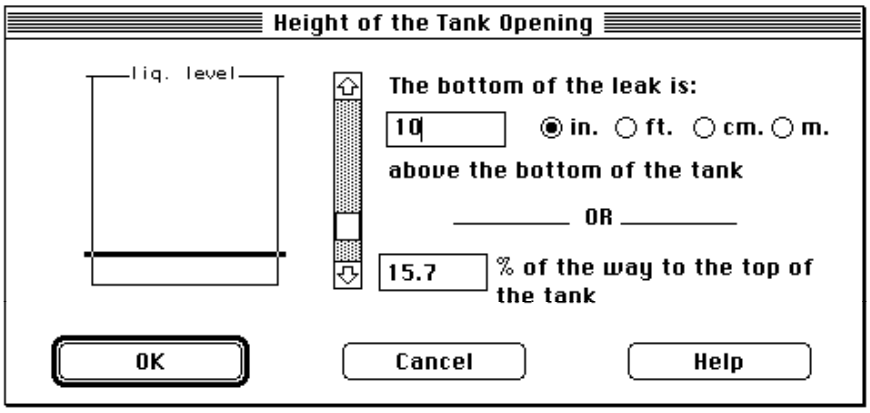
4 The security guard thinks the tank was filled in the evening, so the most conservative estimate we can make is that the tank is 100 percent full. Either (1) type "100" in the "% full by volume" box, (2) type "500" in the liquid volume box, then click **gallons**, or (3) scroll the liquid level bar to the top of the tank diagram. Once you have entered your estimate of the liquid volume, ALOHA estimates the mass of the liquid (1.82 tons). Click **OK**.



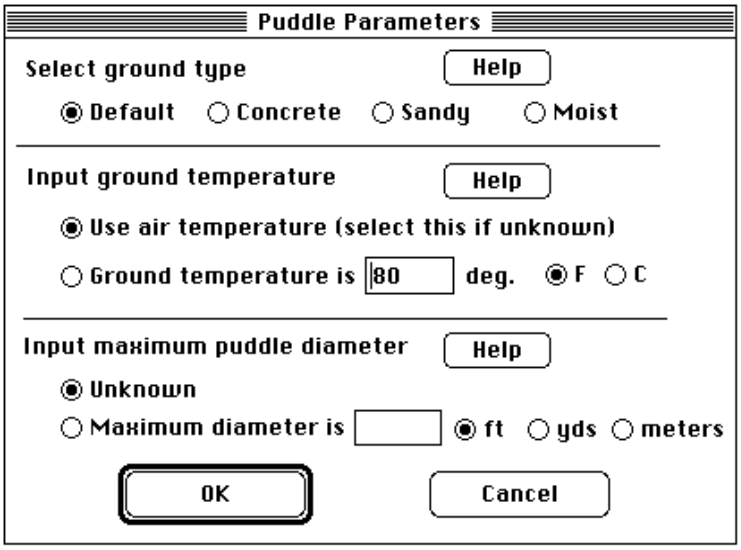
5 Describe how the benzene is escaping from the tank. Click **Circular opening**, enter 6 for the hole diameter, then click **inches**. Click **Hole**, since the benzene is not escaping through a pipe or valve, then click **OK**.



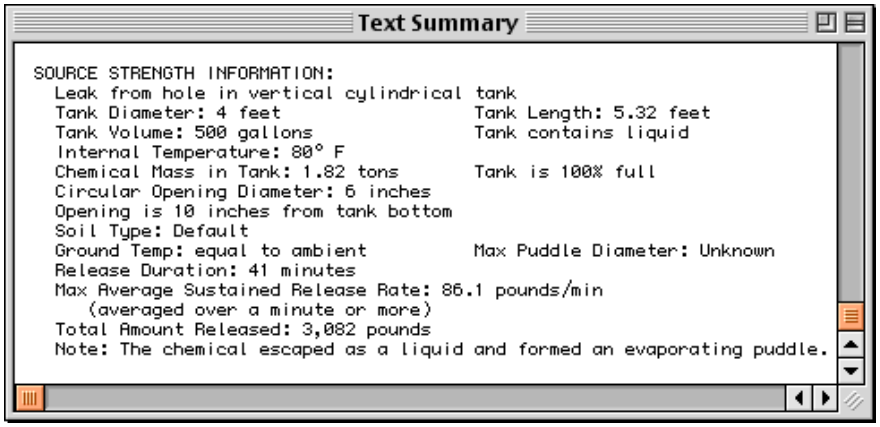
6 Indicate the height of the leak above the tank bottom. Under the "The bottom of the leak is:" heading, type "10" , then click **in.** (inches). Click **OK**.



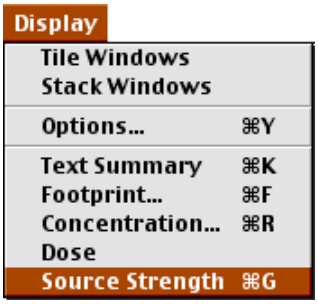
7 The liquid benzene is flowing onto a grassy field. Click **Default** ground type. Since you have no information about the ground temperature, click **Use air temperature**. Because the product is flowing into a field, it is probably not contained by a dike. Under the "Input maximum puddle diameter" heading, click **Unknown**. Click **OK**.

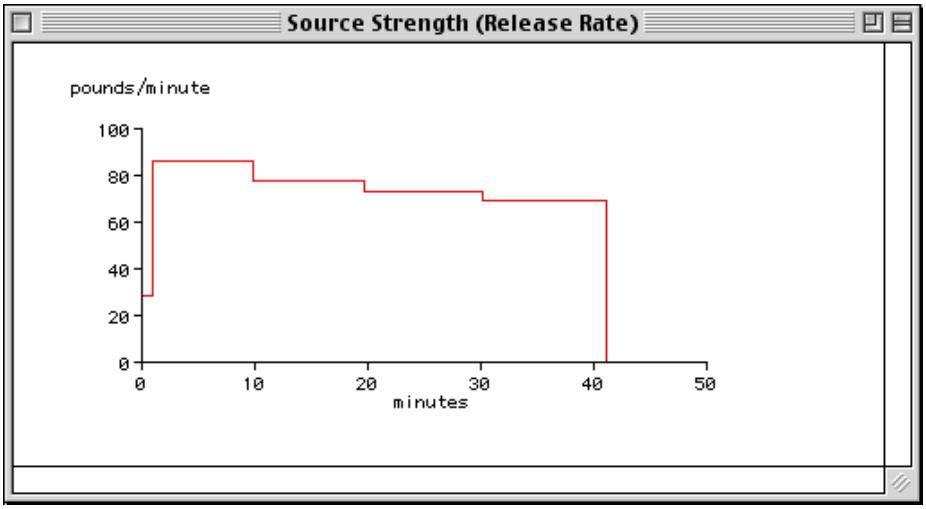


The source strength information that you have entered, and the results of ALOHA's source strength calculations, appear in the Text Summary. ALOHA estimates that the release of vapor into the atmosphere lasts for about 41 minutes, and that the maximum amount of vapor released at any one time is about 86.1 pounds per minute (this is the Maximum Average Sustained Release Rate).



8 To view the source strength graph, select **Source Strength** from the **Display** menu.



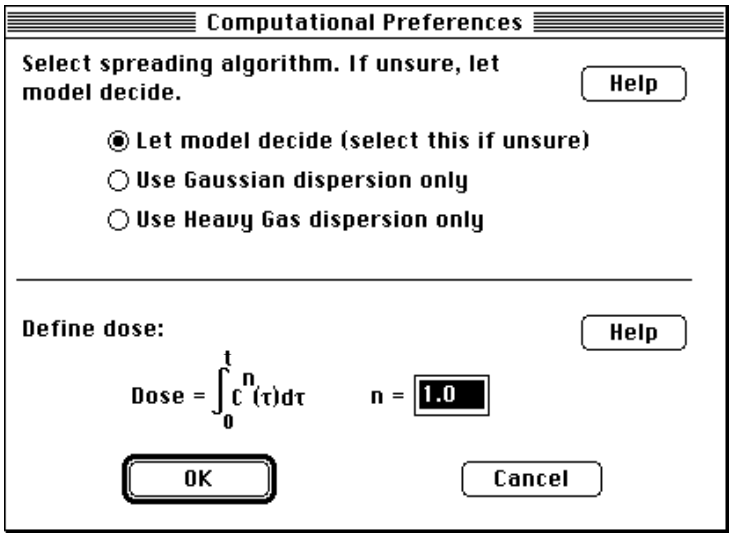


Whenever you run ALOHA, ask yourself: Is ALOHA accurately representing what is actually occurring in this scenario? In this case, liquid benzene leaks from a tank to form a puddle; ALOHA expects that because the puddle is undiked, it spreads out to cover a large area and evaporates at a high rate for a short period of time. What if the puddle were constrained by small depressions in the ground? The puddle would not spread out as far because the liquid flowing away from the tank would fill up the depressions in the grass. The puddle would then be smaller in area and deeper. It would evaporate at a slower rate and it would take longer to completely evaporate.

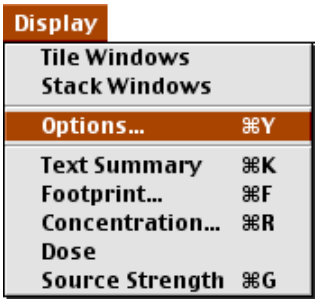
Because ALOHA assumes that the puddle would spread out to cover a maximum area, its release rate estimate may be conservative (more likely to be an overestimate than an underestimate). At a real accident scene, check for terrain features that would constrain the puddle from spreading; use this information to estimate the maximum puddle area.

Choosing a LOC and plotting a footprint

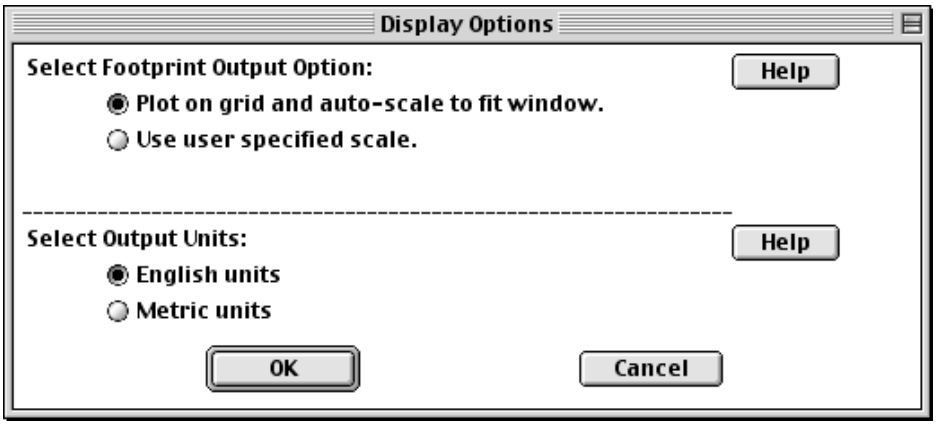
1 First, check the computational setting. Select **Computational** from the **SetUp** menu. Check to be sure that **Let model decide (select this if unsure)** is selected. Click **OK**.



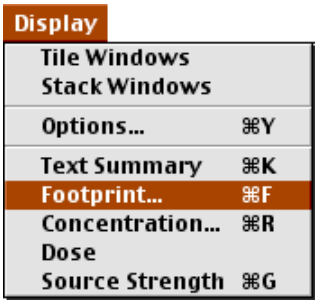
2 Select **Options** from the **Display** menu.



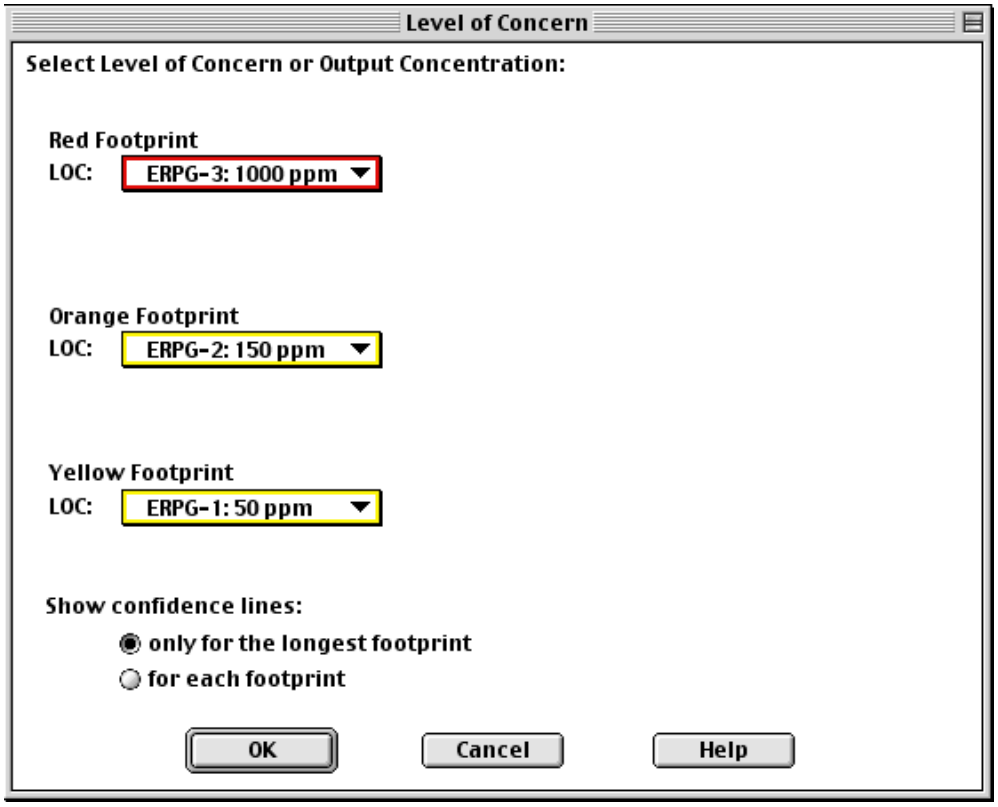
3 Check to be sure that **Plot on grid and auto-scale to fit window** is selected. Select either **English units** or **Metric units**, depending on your preference; ALOHA's computation results will be displayed in the units that you choose. Click **OK**.



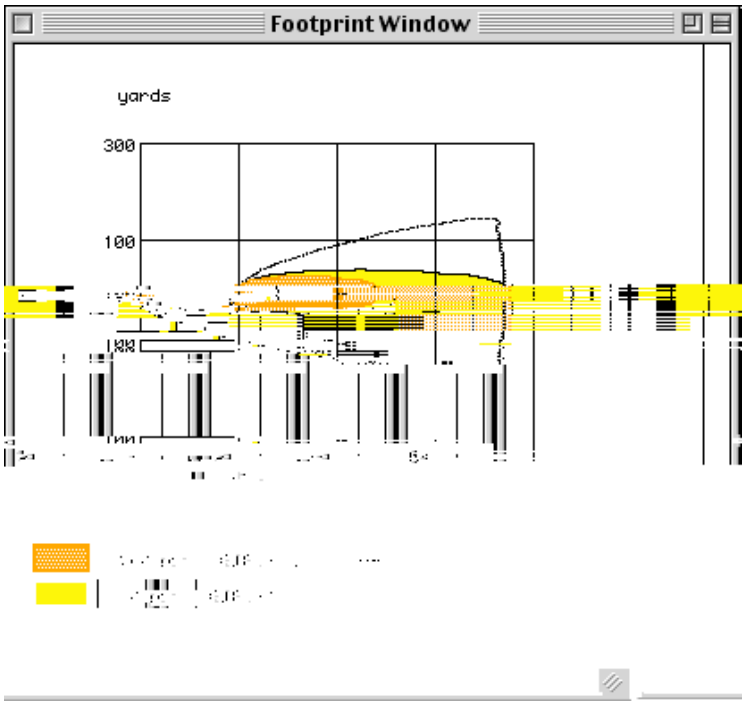
5 Choose **Footprint** from the **Display** menu to obtain a footprint plot.



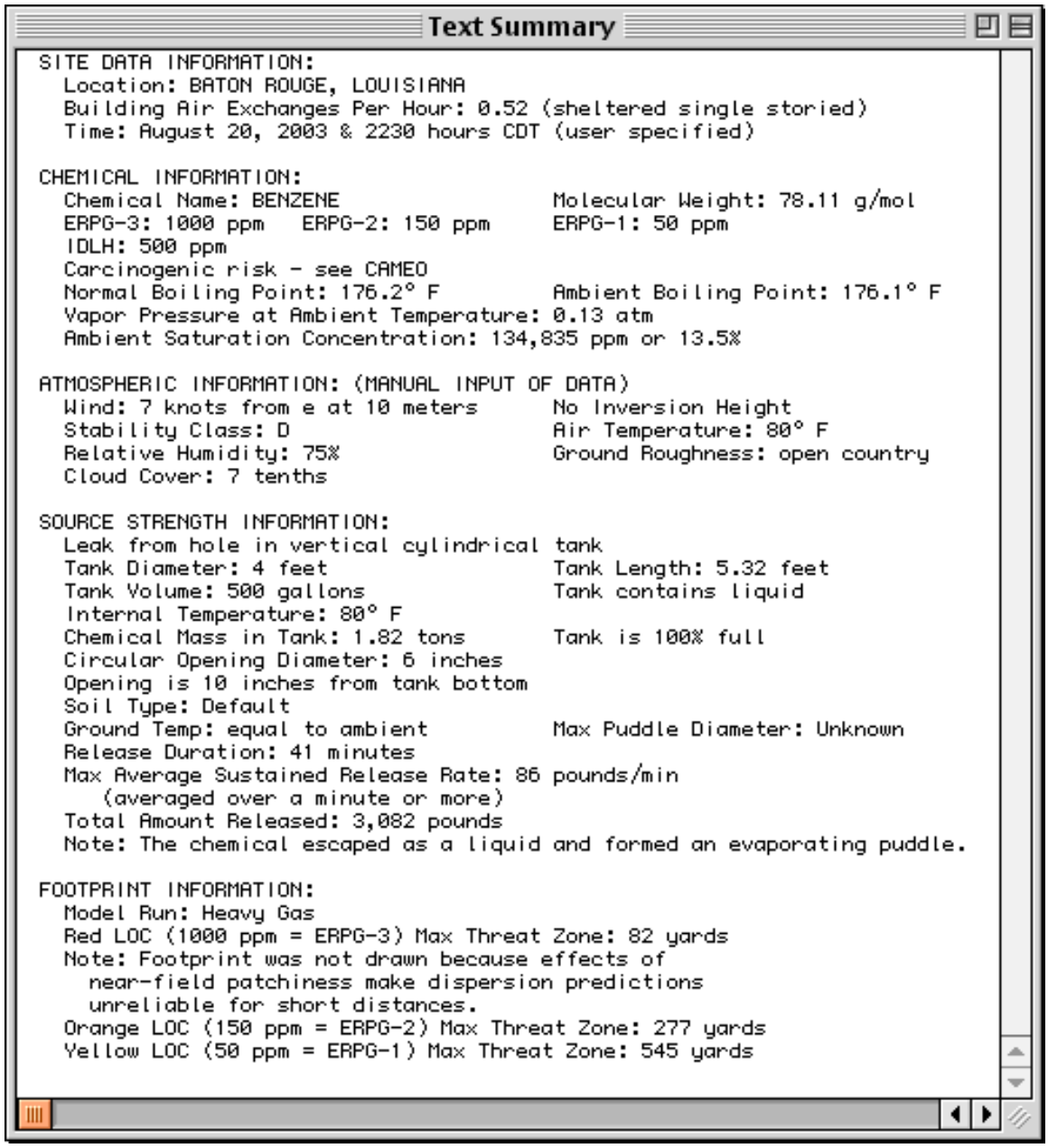
The LOCs for this selected chemical, Benzene, are ERPGs 1through 3. Check to see **Show confidence lines** has **only for the longest footprint** chosen. Click **OK**.



You'll see ALOHA's footprint for this scenario, showing the three different LOC footprints for benzene concentrations. The red footprint, for concentrations that may exceed 1000 ppm (ERPG-3), has a maximum threat zone of 82 yards, and is NOT drawn because of the effects of near-field patchiness. The orange footprint shows benzene concentrations that may exceed the ERPG 2 value of 150 ppm and the yellow footprint shows the benzene concentration that may exceed the ERPG 1 value of 50 ppm. The yellow footprint extends over 500 yards downwind.



Check the Text Summary for this release.



Example 2: Direct Input (Heavy Gas)

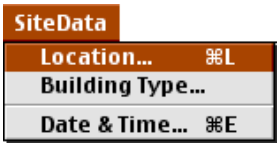
A paper mill located in a highly industrialized section of Columbia, South Carolina, stores large amounts of liquid chlorine. On May 15, 2000 at 13:00, a reckless forklift operator breaks open a pipe. About 500 gallons of liquid chlorine spray out in a fine mist, and evaporate within about 10 minutes. The chlorine is normally stored at a temperature of -30°F. The paper mill's single-storied office building is located about 1,000 yards directly downwind of the accident. The building is surrounded by bushes and trees. Since the weather for the past few days has been cool, most people in the building have kept their windows closed.

At the time of the spill, the sky was completely overcast, the air temperature was 70°F and the wind was from 360° at 10 knots, measured at a height of 10 meters. The relative humidity was 67 percent. The safety officer at the paper mill has recommended chlorine's IDLH of 10 ppm as the LOC for this chemical. We will use ALOHA to predict the indoor concentration of chlorine within the paper mill's office building.

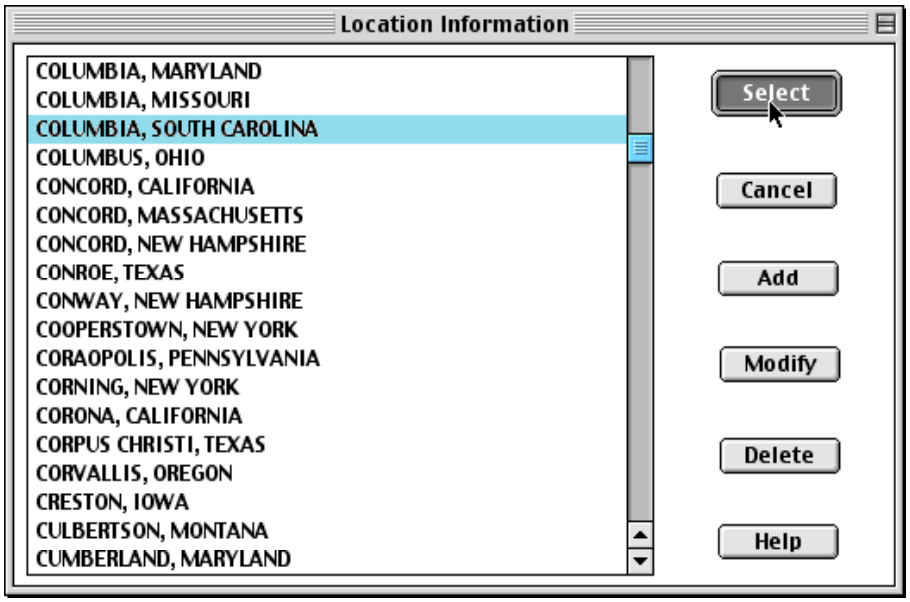
Choosing a location, building type, and chemical

1 Start ALOHA, or, if ALOHA is already running, choose **New** from the **File** menu to begin a new scenario (you will be asked whether you wish to save your previous work as a save file).

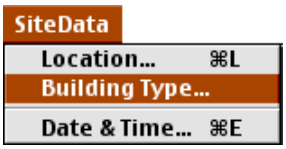
2 Select **Location** from the **SiteData** menu.



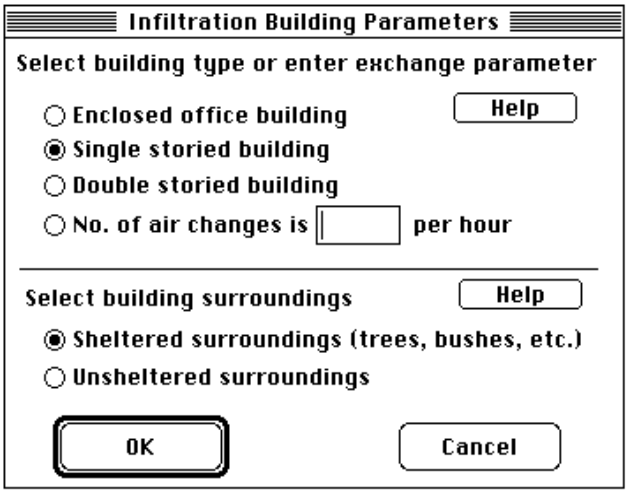
3 Type "c," then scroll down a little farther until you see "COLUMBIA, SOUTH CAROLINA." Click on this name to highlight it, then click **Select**.



4 Choose **Building Type** from the **SiteData** menu.

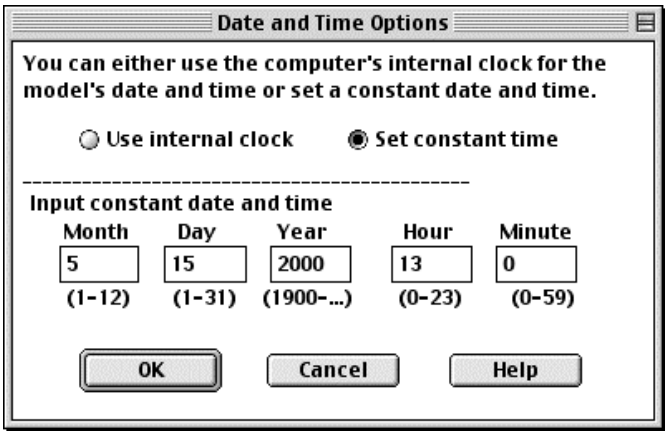


5 The office building is single-storied. Since the building has windows that open, the air exchange rate is probably not controlled, so **Single-storied building** is the most appropriate building type. Because the building is landscaped with trees and bushes that break the wind, click **Sheltered surroundings**. Click **OK**.

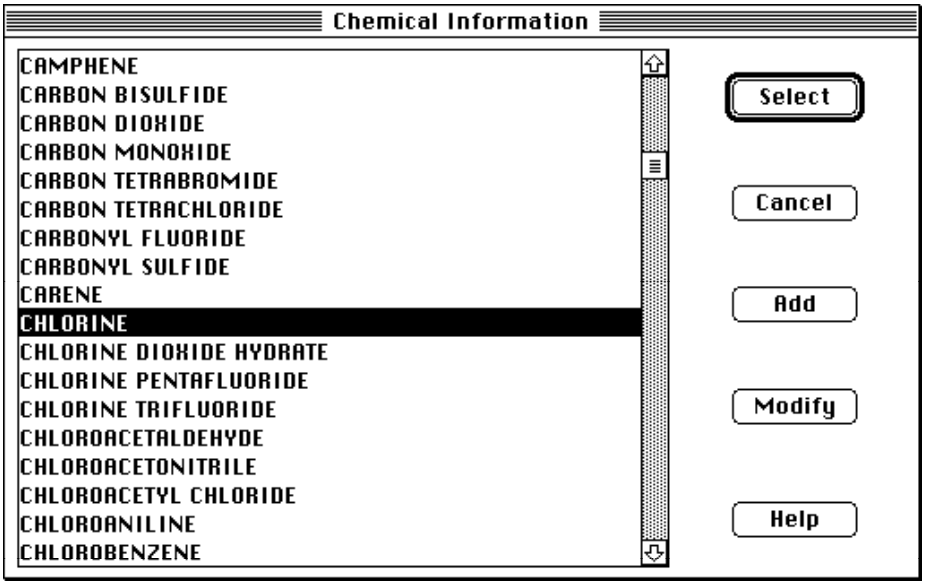


6 Choose **Date & Time** from the **SiteData** menu.

7 Click **Set constant time**, then enter the month, day, year, hour, and minute when this incident begins. Click **OK**.

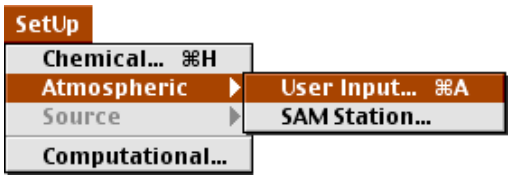


8 Choose "CHLORINE" from ALOHA's chemical library: Select **Chemical** from the **SetUp** menu. Find chlorine in the list (quickly type the characters "ch" to locate chlorine in the list), click on its name to highlight it, then click **Select**.

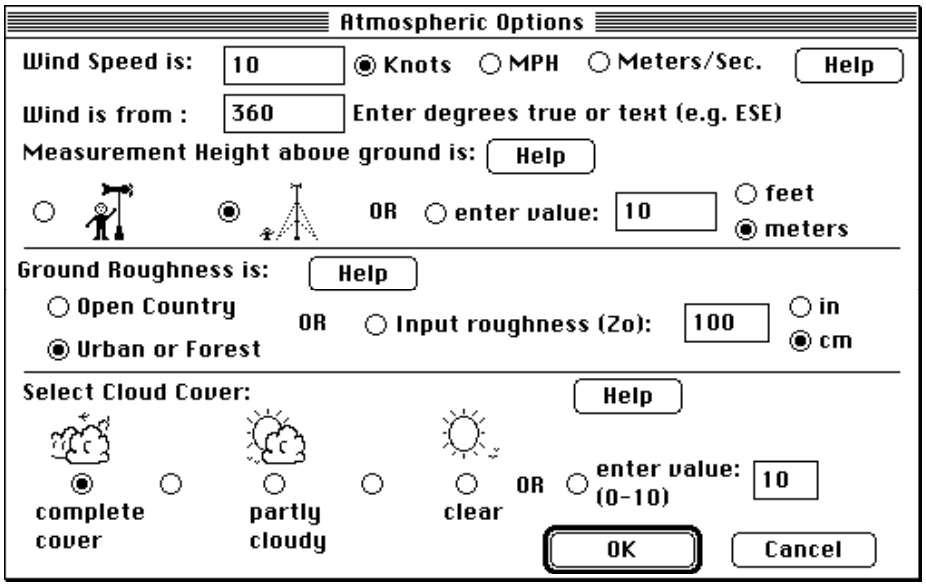


Entering weather information

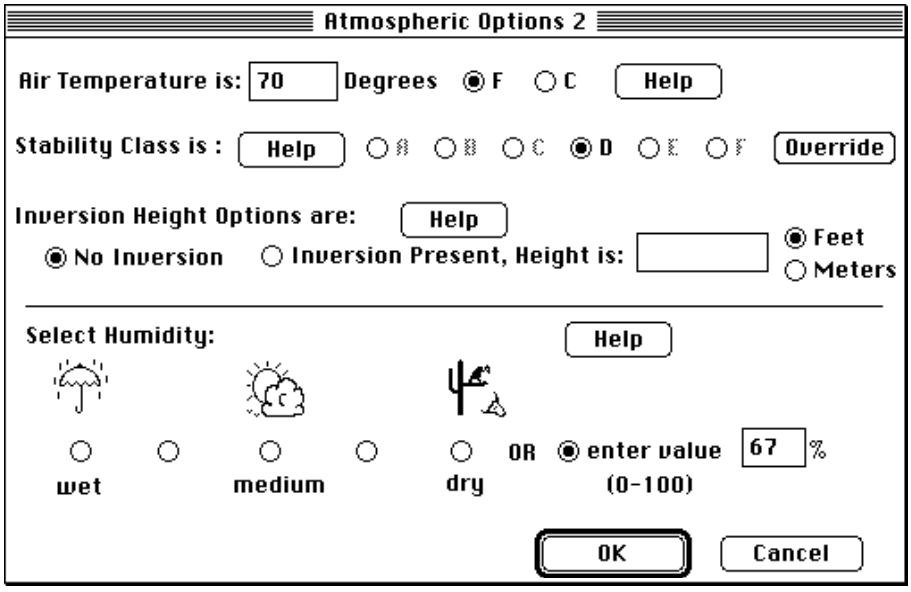
1 In the **SetUp** menu, point to **Atmospheric**, then click **User Input**.



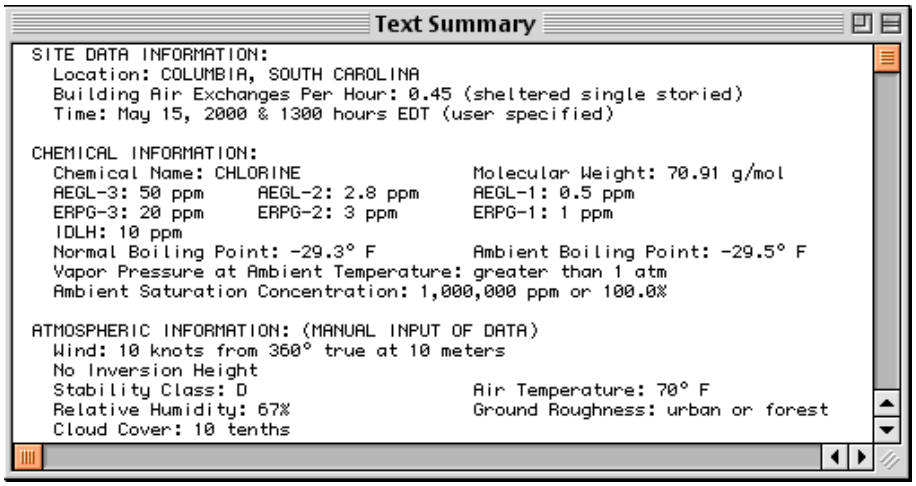
2 Type "10" in the wind speed box, then click **Knots**. Type either "360" or "N" into the wind direction box (to indicate that the wind is from the north), then click the right-hand button under the "Measurement height above ground is:" heading, to indicate a wind measurement height of 10 meters. Since the accident is in an industrialized area, click **Urban or Forest** ground roughness. Under the "Select cloud cover:" heading, click the left-most button; this button represents complete cloud cover. Click **OK**.



3 Type "70" into the air temperature box, then click **F** to indicate that this temperature is in degrees Fahrenheit. ALOHA uses the wind speed, cloud cover, and date and time information that you've entered to automatically select atmospheric stability class "D," representing conditions of neutral atmospheric stability. Check to be sure that **No inversion** is selected, then under the "Select Humidity:" heading, type "67" percent into the relative humidity box. Click **OK**.



The information that you have entered into ALOHA now appears in the Text Summary. Check under the "SITE DATA INFORMATION" heading, to see the air exchange rate ALOHA will use to predict indoor chlorine concentration (0.45 air changes per hour).

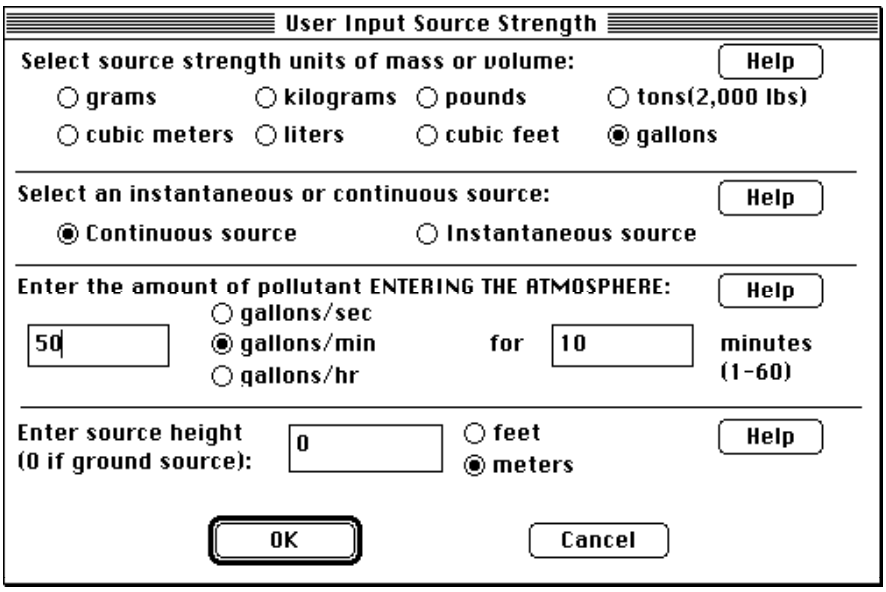


Describing the release

You're now ready to enter information about the release itself.

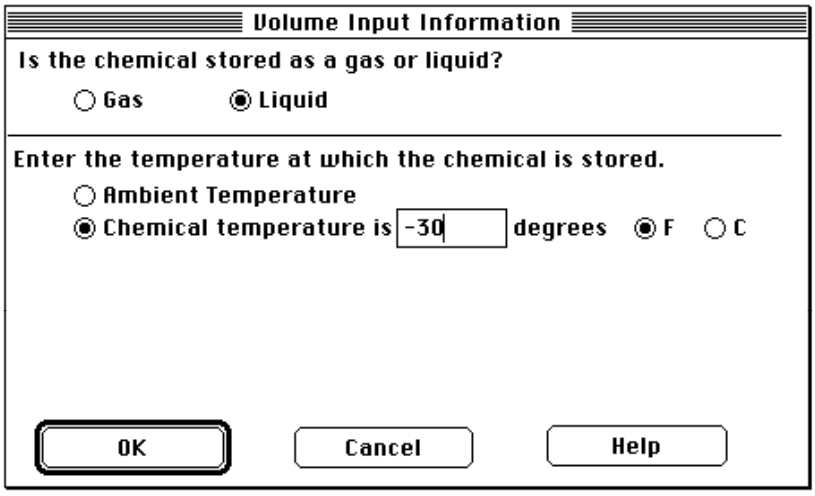
1 In the **SetUp** menu, point to **Source**, then click **Direct**.

2 In this example scenario, about 500 gallons of chlorine spray from a ruptured pipe and evaporate within about 10 minutes. Click **gallons** as your units of source strength. This is a continuous release, because it takes longer than 1 minute for the chlorine to escape into the atmosphere, so click **Continuous source**. Because the release is continuous, you need to enter a rate of release rather than the total amount released. Divide 500 gallons (the total amount of chlorine released) by 10 minutes (the release duration) to obtain a release rate of 50 gallons per minute. Type "50" into the release rate box and "10" into the duration box. Click **OK**.

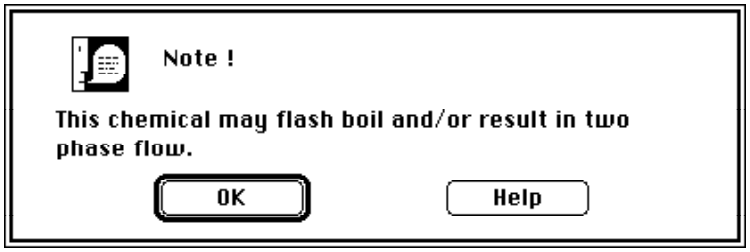


3 When you enter the rate of release in volume units, you need to describe the physical state of the chemical (liquid or gas) and its storage temperature, so that ALOHA can estimate the mass of material released. The chlorine was refrigerated at -30°F. The ambient boiling point for chlorine, displayed in the Text Summary, is -29.5°F, so the chlorine is barely in the liquid phase. Click **Liquid** and **Chemical temperature is**.

Type "-30" into the chemical temperature box, then click **F** to indicate degrees Fahrenheit. Click **OK**.

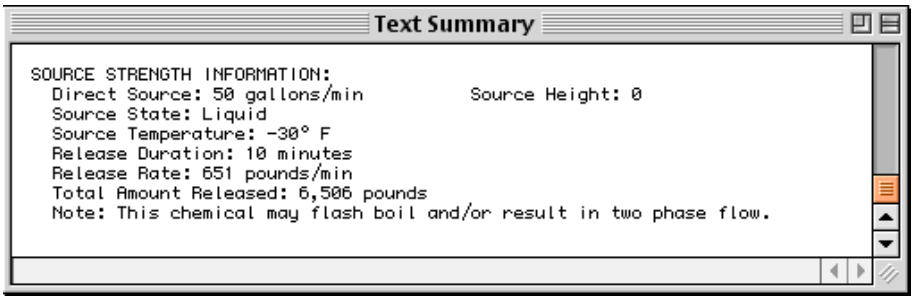


4 ALOHA will alert you that the chemical may flash boil and/or escape as a two-phase flow.



Click **Help** to view background information about flash-boiling and two-phase flow. ALOHA recognizes that because the boiling point of chlorine is well below air temperature, the chlorine may have been stored as a pressurized liquid. If so, it may flash-boil when released. During flash-boiling, much of the stored liquid would turn instantly to vapor, so that a mixture of liquid droplets and vapor (a "two-phase flow") would be released to the atmosphere. ALOHA's Tank release calculations account for these processes, but the Direct Source option does not. Since we don't have the necessary information to run the Tank option, we'll use the Direct Source calculations as the best approximation that we can make, recognizing that ALOHA will treat this release as a steady flow of gas from the tank instead of a two-phase release. Click **OK**.

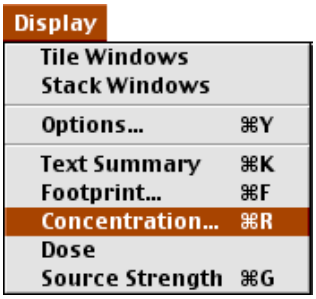
The source strength information that you have entered into ALOHA, and the results of ALOHA's computations of release rate in mass units and total mass released, appear in the Text Summary.



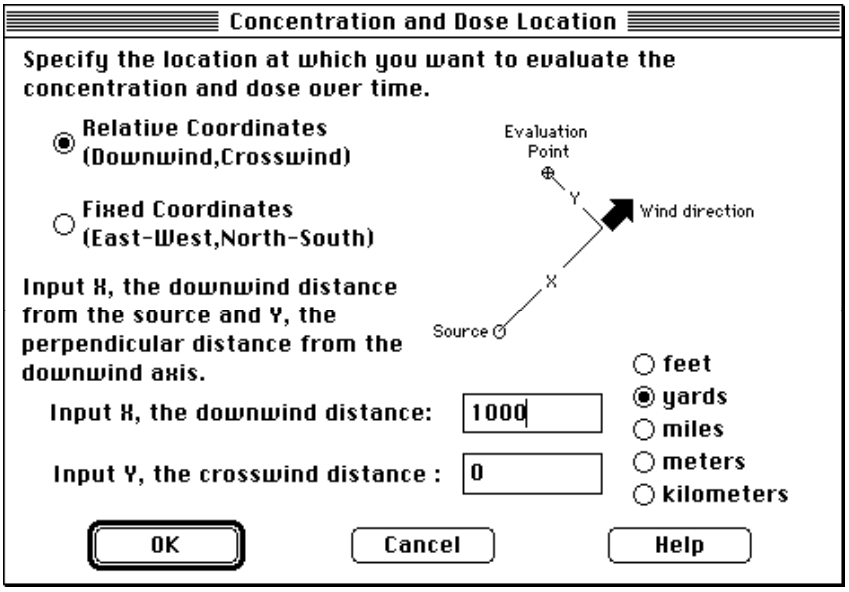
Checking concentration

1 First, check the computational setting. Select **Computational** from the **SetUp** menu. Check to be sure that **Let model decide (select this if unsure)** is selected. Click **OK**.

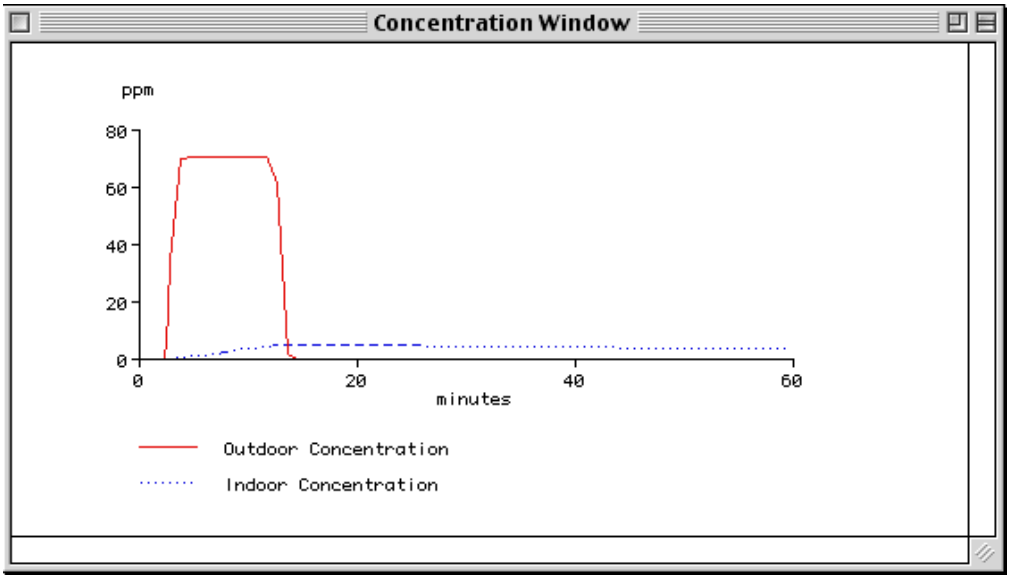
2 Select **Concentration** from the **Display** menu.



3 The paper mill's office building is about 1,000 yards *directly* downwind of the spill. There are two ways—using either fixed or relative coordinates—to describe a concentration location to ALOHA. Click **Help** to view an explanation of both methods. Check to be sure that **Relative Coordinates** is selected; you'll describe the location in terms of downwind and crosswind distances from the release point. Type "1000" into the downwind distance box and "0" into the crosswind distance box. Click **yards**, then click **OK**.

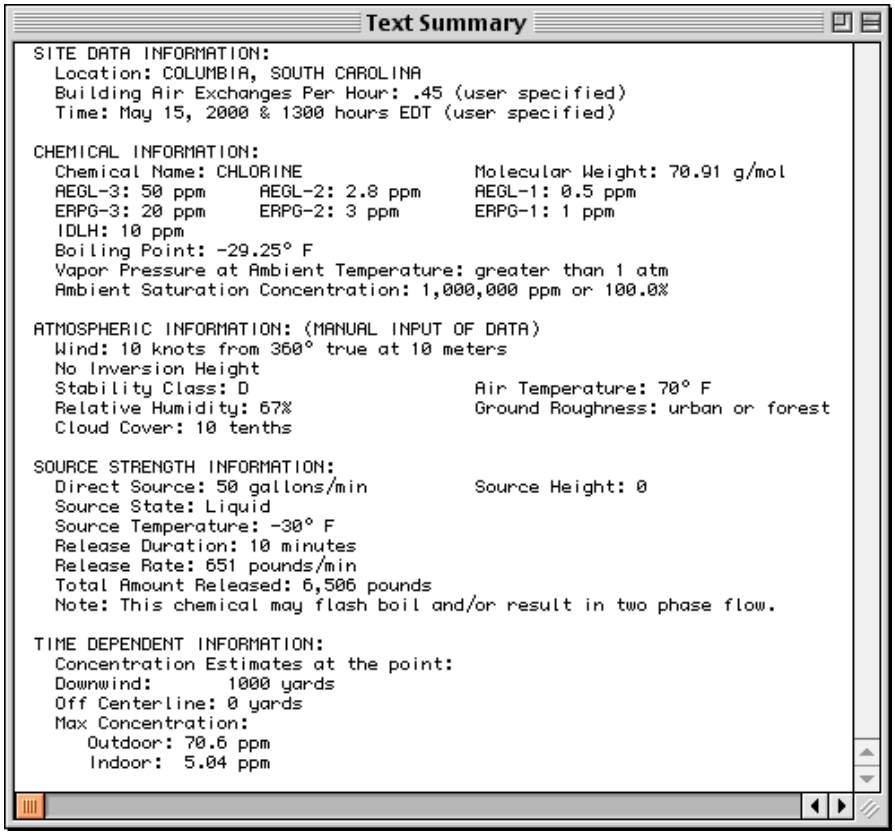


4 ALOHA displays a Concentration by Time graph, showing the indoor and outdoor concentrations predicted at the office building's location during the first hour after the release begins. The solid red line represents the outdoor, ground-level concentration. The dashed blue line represents concentration within the office building, as long as doors and windows are closed. No default LOCs will be present on the concentration window unless the user puts up a footprint window first. In that case, wider horizontal red, yellow and orange lines will represent the AEGL values associated with the selected chemical chlorine.

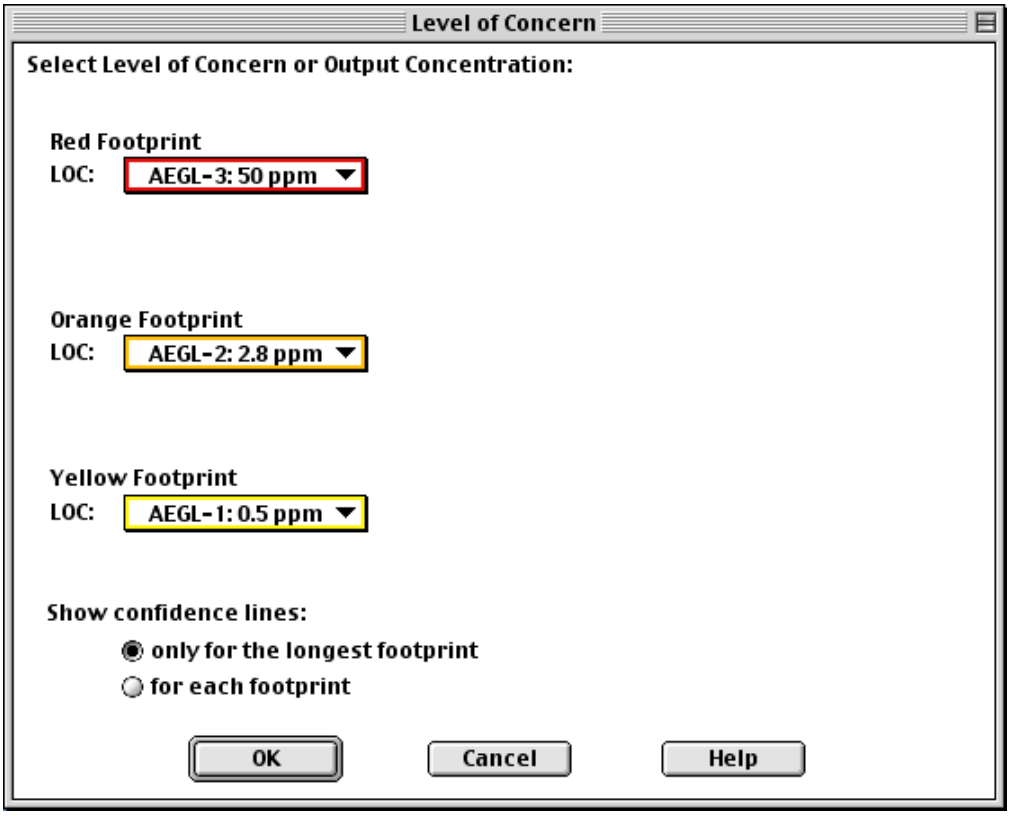


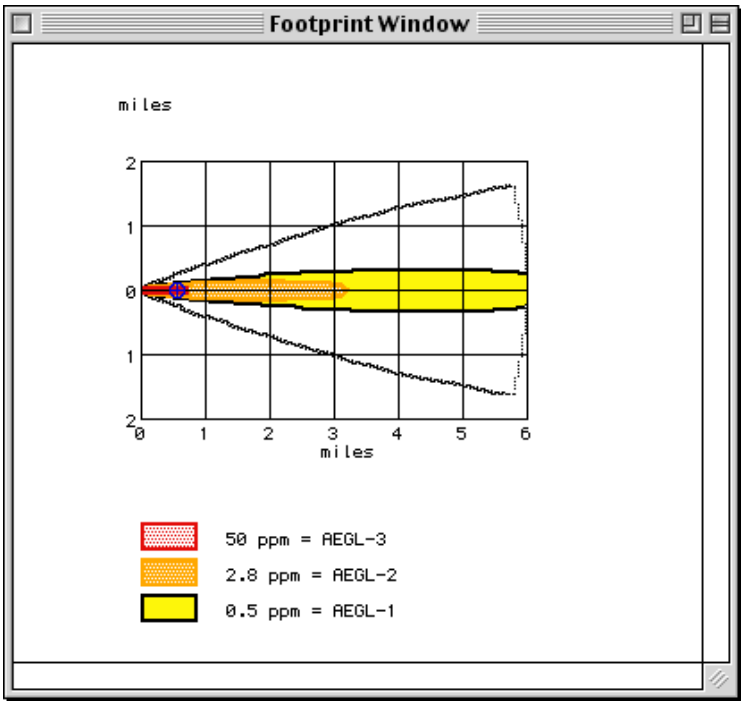
You can see from the graph that the chlorine cloud passes by the office building within the first 15 minutes after the release begins. After that time, the predicted outdoor concentration drops back to zero, while the predicted indoor concentration persists for much longer.

Check the Text Summary to see ALOHA's estimates of maximum indoor and outdoor concentration. You also can see that ALOHA made heavy gas rather than Gaussian calculations for this release (look just under the "FOOTPRINT INFORMATION" heading to see this).



When AEGLs are the LOCs, ALOHA's footprint for this scenario is shown below (choose **Footprint…** from the **Display** menu to see this footprint).





Example 3: A Pipe Source

At a rural road construction site near Portland, Oregon, a heavy equipment operator accidentally cuts open a methane pipe on November 17, 2000 at 14:30. The pipe runs 1,000 feet to the emergency shutoff valve, but the valve has been left open. The inside diameter of the pipe is 8 inches. The inner wall of the pipe is smooth. The methane in the pipe is at ambient temperature and the pressure is 100 pounds per square inch.

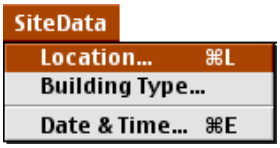
At the accident site, the sky is completely overcast, air temperature is 44°F, and relative humidity is 78 percent. The wind is from the southeast at 15 knots, measured at a height of 3 meters with a portable weather station.

Although methane is relatively non-toxic, the lower explosive limit (LEL) is about 5 percent or 50,000 parts per million (ppm). We will use ALOHA to help determine the downwind distance to 10 percent of the explosive concentration, or 5,000 ppm.

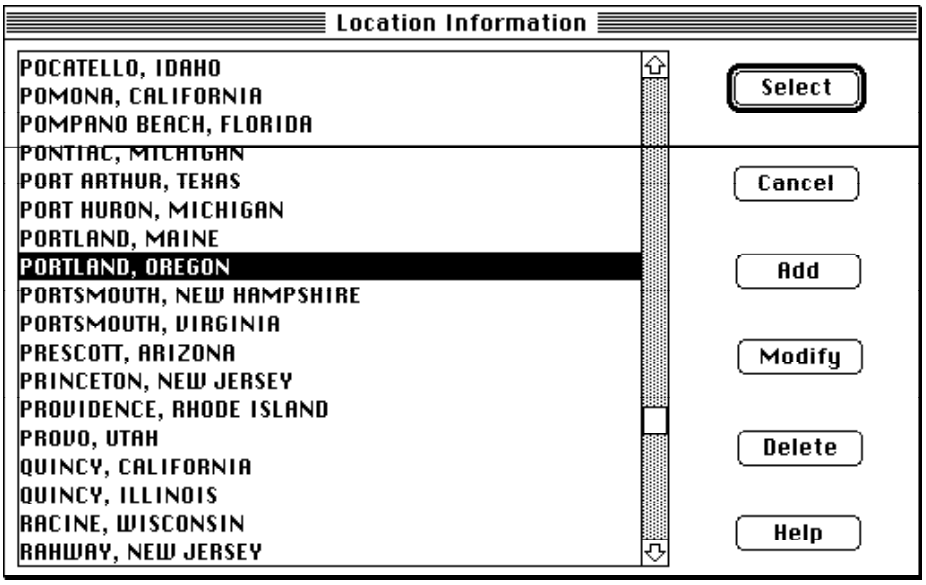
Choosing a location and a chemical

1 Start ALOHA, read the list of ALOHA's limitations, then click **OK**. If ALOHA is already running, choose **New** from the **File** menu to begin a new scenario.

2 Choose **Location** from the **SiteData** menu.

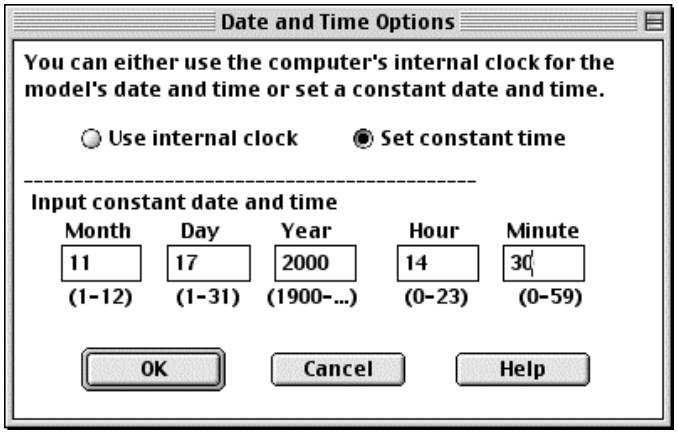


3 Quickly type the characters "po" to move to the part of the city list containing Portland, Oregon. Click to highlight "PORTLAND, OREGON," then click **Select**.

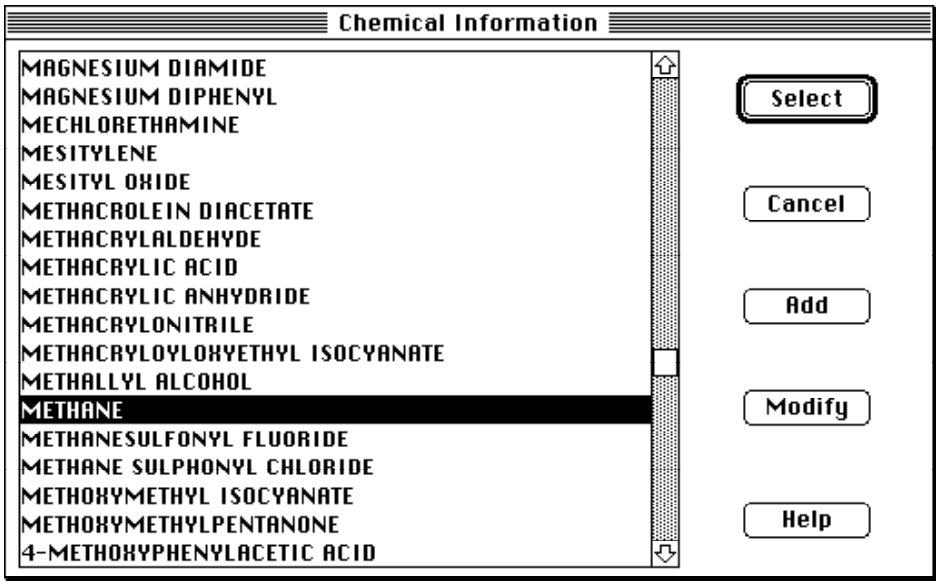


4 Select **Date & Time** from the **SiteData** menu to enter the date and time of the accident.

5 Click **Set constant time**. The scenario date is November 17, 2000, so type "11" in the month box, "17" in the day box, and "2000" in the year box. The accident time is 14:30, so type "14" in the hour box and "30" in the minute box. Click **OK**.



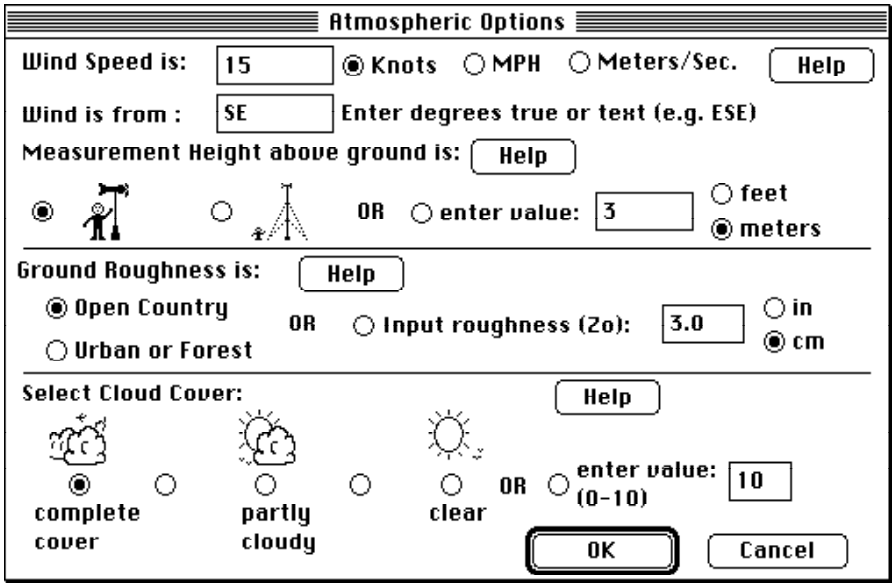
6 Choose methane from ALOHA's chemical library by selecting **Chemical** from the **SetUp** menu. Find "METHANE" in the list (quickly type the characters "me" to go to the section of the list containing methane), highlight the name, then click **Select**.



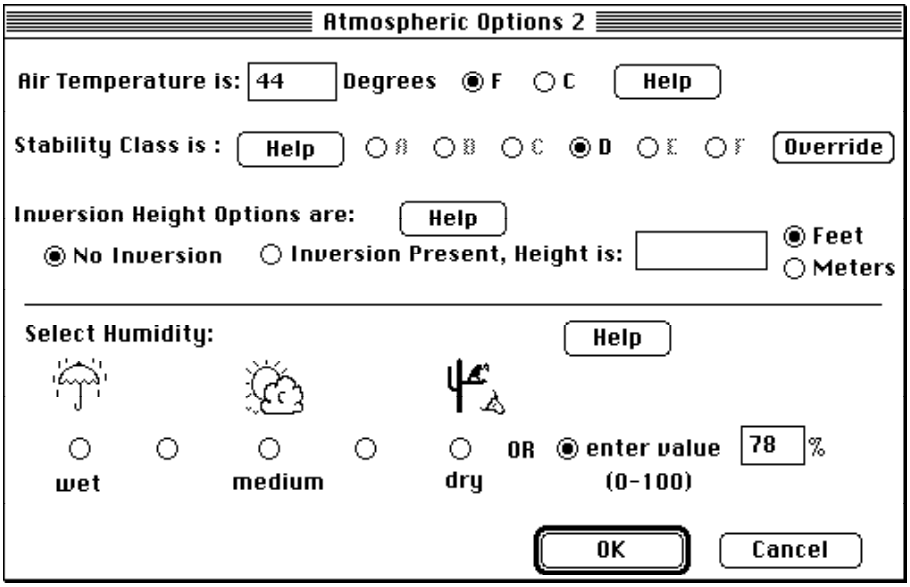
Entering weather information

1

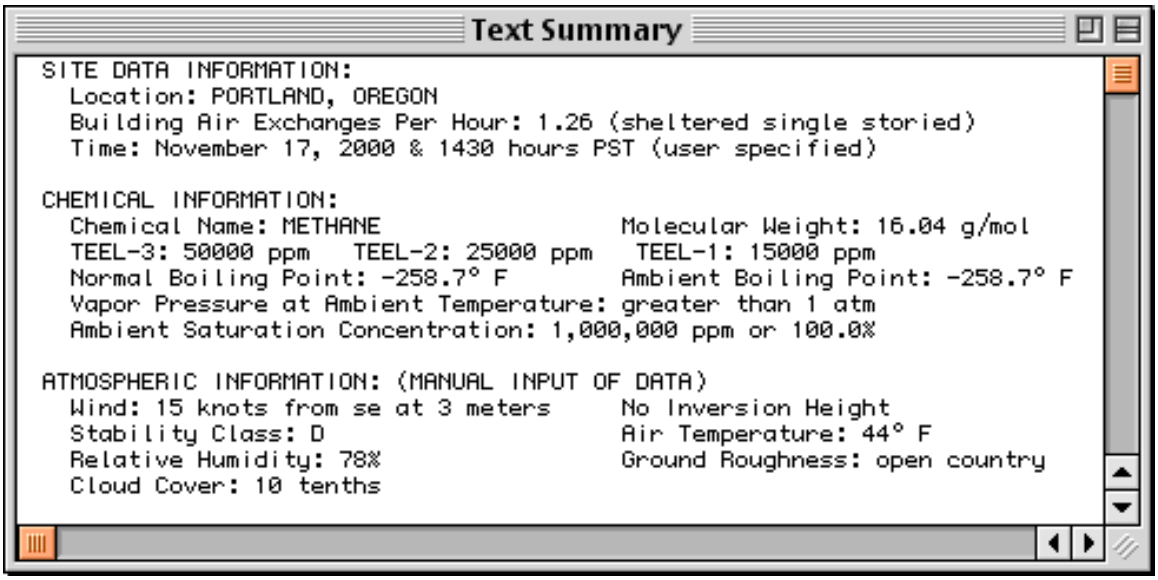
2 Type "15" in the wind speed box, then click **Knots**. Enter "SE" in the wind direction box. Click the left-hand button under the "Measurement height above ground is:" heading to indicate that the wind speed is measured at a height of 3 meters. Because the setting of this scenario is a rural road construction site, click **Open Country** ground roughness. Since you have little information about this site, you may wish to run this scenario a second time, this time with **Urban or Forest** selected. Click the cloud cover button for **complete cover.** Click **OK**



3 Enter "44" for the air temperature, then click **F**. ALOHA selects stability class "D" because when the sky is completely overcast, regardless of the wind speed and the time of day, stability class is always D. Since you were not informed that an inversion exists, check to be sure that **No Inversion** is selected. Type "78" percent into the relative humidity box. Click **OK**.

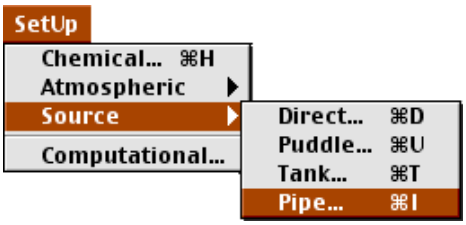


The information that you have entered into ALOHA appears in the Text Summary. Ignore the air exchange rate estimate; you will not estimate indoor methane concentrations in this example.

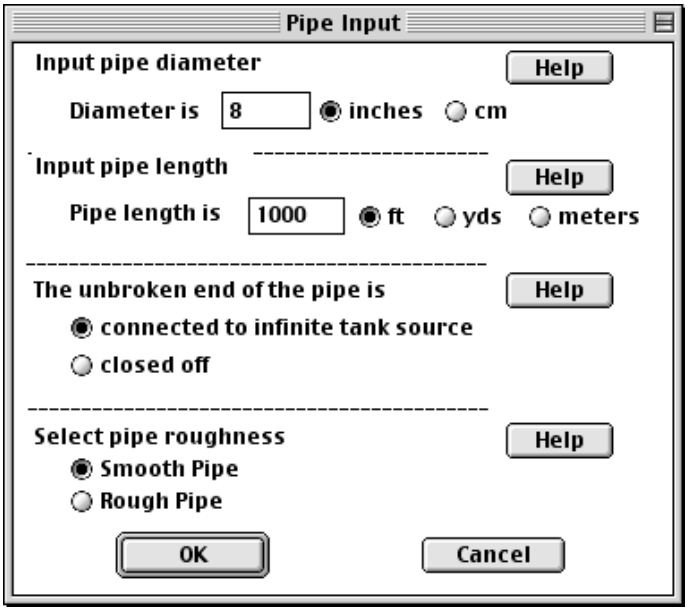


Describing the release

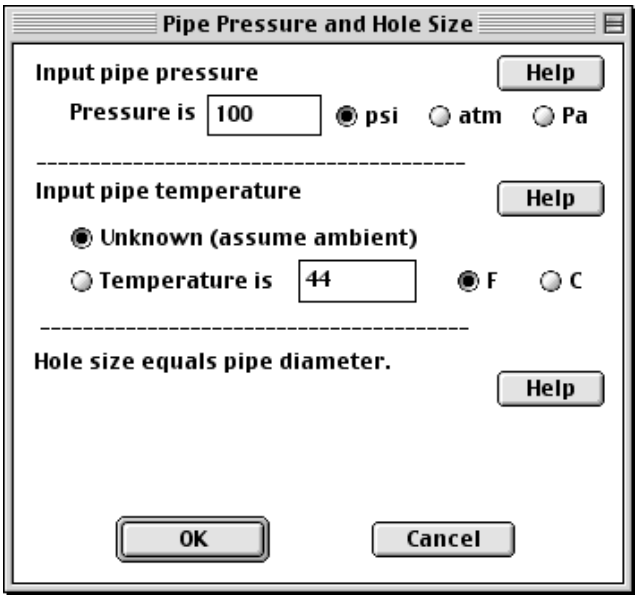
1 In the **SetUp** menu, point to **Source**, then click **Pipe**.



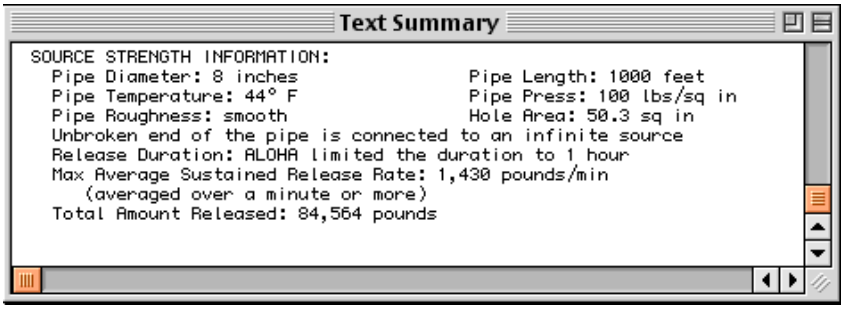
2 Type "8" for the pipe diameter, then click **inches**. Type "1000" for the pipe length, then click **feet**. This pipe is connected to a safety valve, but because the valve has been left open, the pipe is likely to release methane until the valve can be closed. The conservative choice for this example problem is to assume that the pipe is connected to a methane source large enough that methane will continue to flow through the pipe at a constant rate. Therefore, click **connected to infinite tank source.** (If the safety valve for the pipe had been closed, **closed off** would have been a better choice.) The pipe's inner wall is smooth, so click **Smooth Pipe**. Click **OK**.



3 Type "100" for the pipe pressure, then click **psi**. The temperature of the pipe is described as ambient, so click **Unknown (assume ambient)**. Click **OK**.



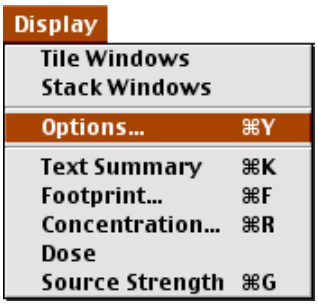
The information that you have entered into ALOHA, as well as ALOHA's estimates for release rate and duration, now appears in the Text Summary. ALOHA predicts that about 1,400 pounds of methane will escape from the pipe each minute until the safety valve can be shut off. ALOHA sets release duration to the maximum possible time of 1 hour.



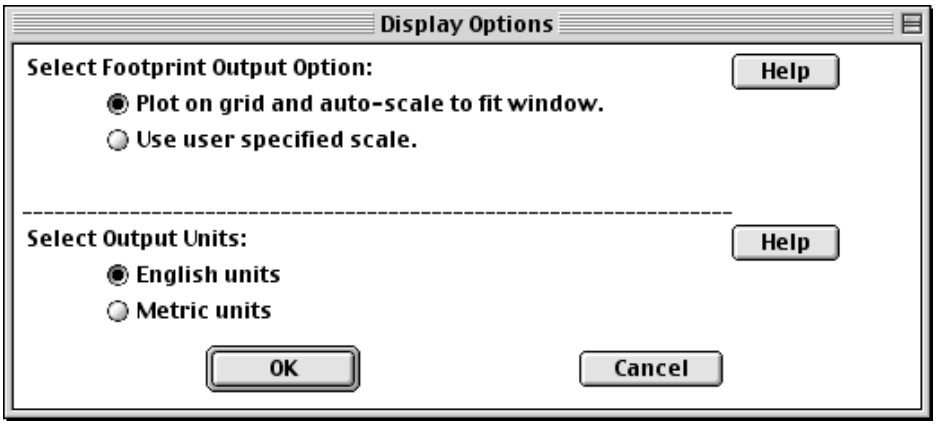
Choosing a LOC and plotting a footprint

1 First, check the computational setting. Select **Computational** from the **SetUp** menu. Check to be sure that **Let model decide (select this if unsure)** is selected. Click **OK**.

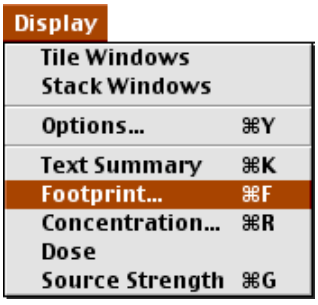
2 Select **Options** from the **Display** menu.



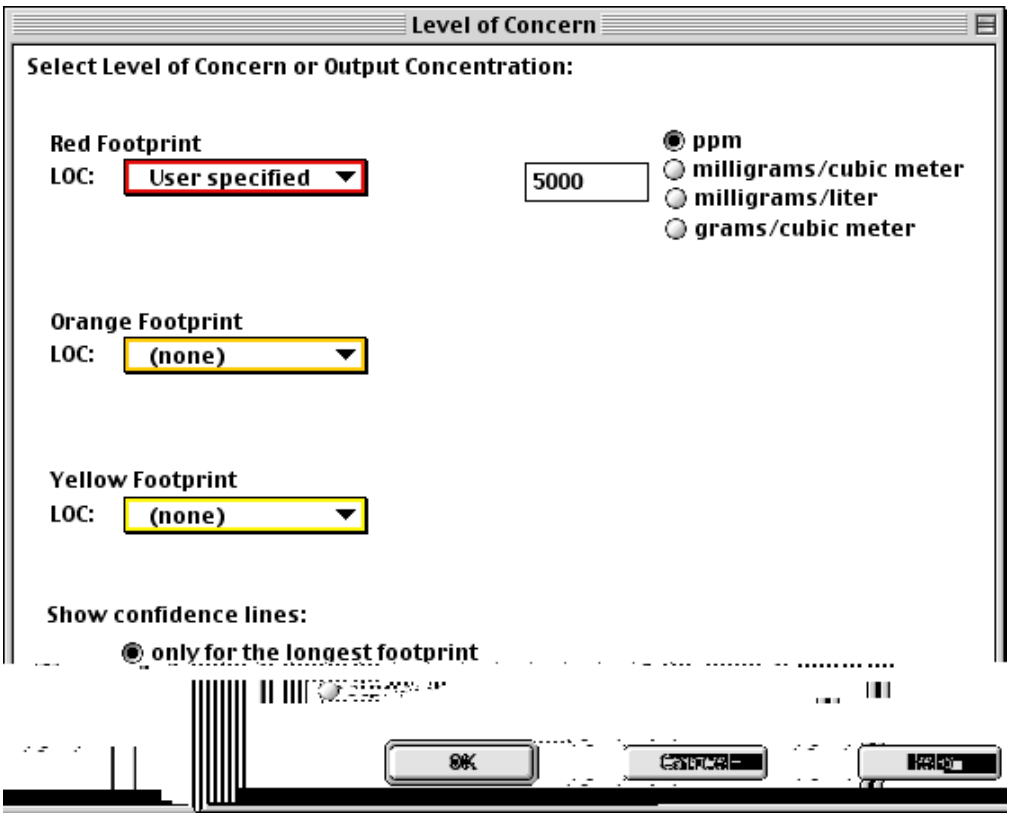
3 Check to be sure that **Plot on grid and auto-scale to fit window** is selected. Select either **English units** or **Metric units**, depending on your preference. Click **OK**.



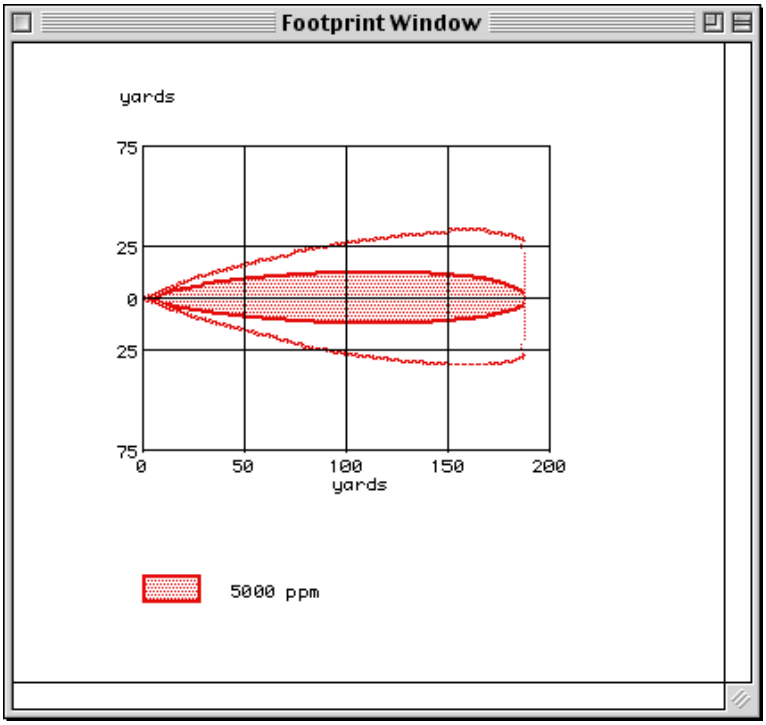
4 Choose **Footprint…** from the **Display** menu.



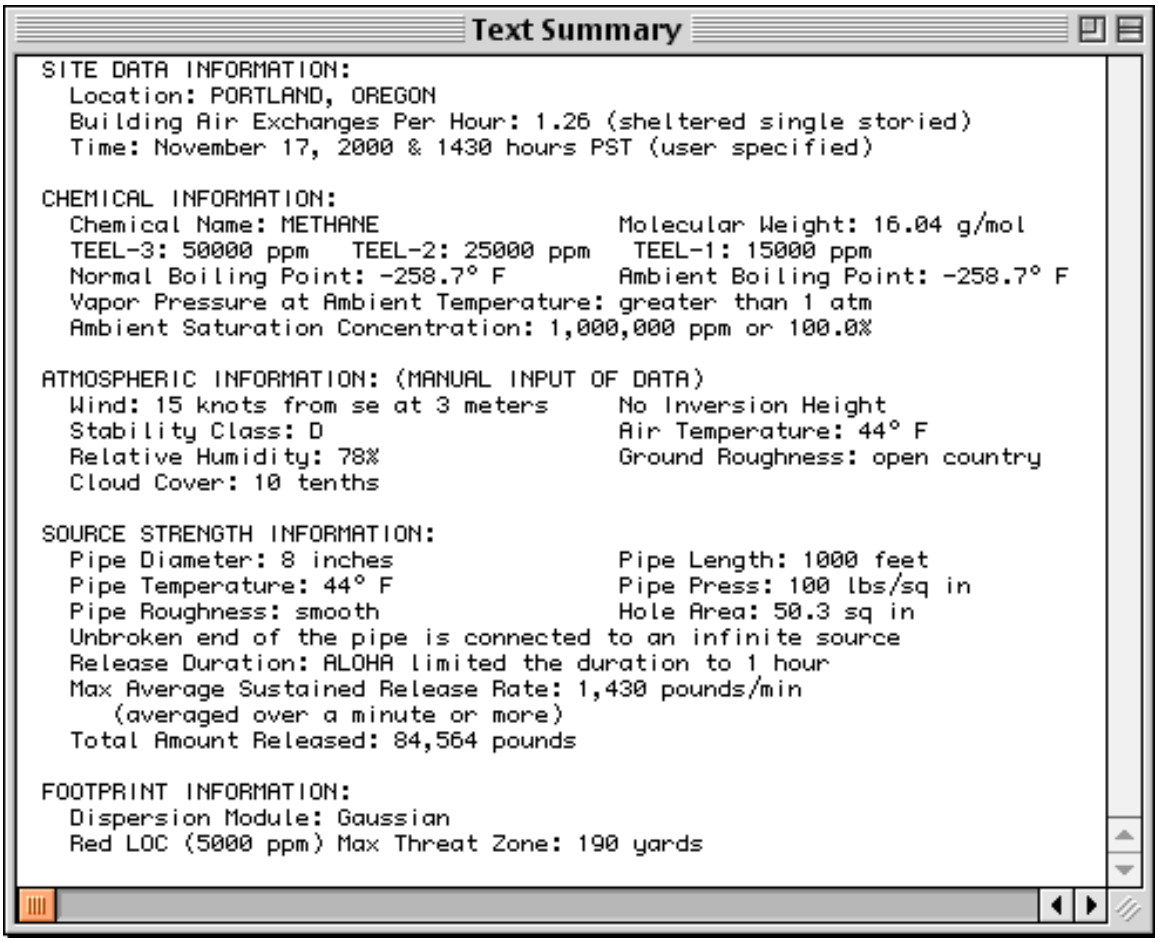
The selected chemical, methane, has TEELs (Temporary Emergency Exposure Limits) as default levels of concern. Click on the **Red Footprint LOC** and choose **User specified**. Put in **5000 ppm** (or 1/10th the Lower Explosive Limit LEL) for the LOC value. Modify the **Orange Footprint** and **Yellow Footprint LOC** values to **(none).** Click **only for the longest footprint** for **Show confidence lines** and click **OK**.



ALOHA predicts that the concentration of methane may exceed 5000 ppm, 1/10th the LEL, for up to about 190 yards downwind of the leaking pipe.



Your Text Summary should now look like the one below.



Example 4: Using ALOHA and a MARPLOT map

On June 4, 2000, a train traveling on the Southern Railway near Manassas, Virginia, collided with a stalled truck at Lee Hwy. During the hour from 15:00 to 16:00, about 4,000 pounds of chlorine gas were released from a derailed tank car. At the time of the release, winds were out of the east-northeast (ENE) at about 5 knots, measured at a height of 3 meters. One-third of the sky was covered by clouds, the humidity was about 80% and the air temperature was 72° F.

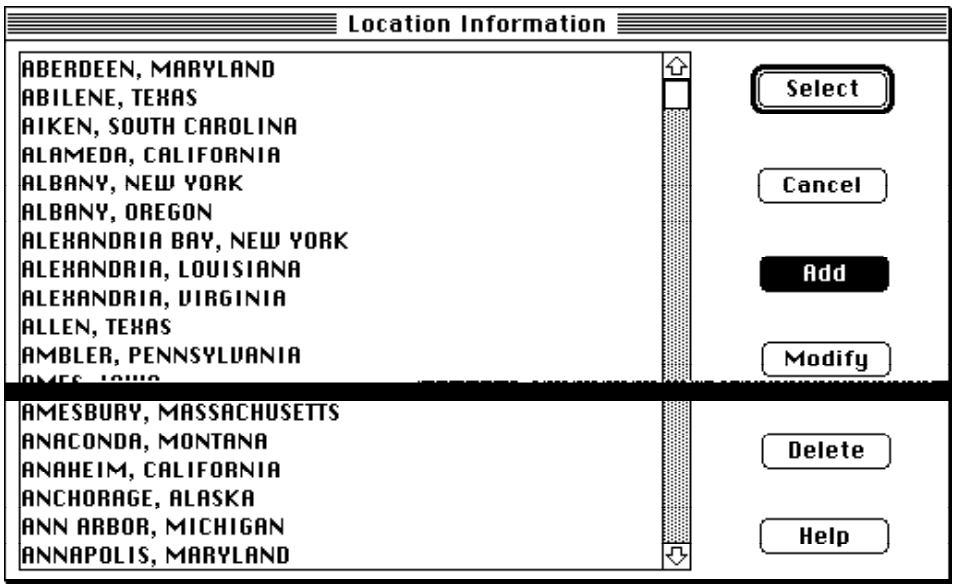
The land between the tank car and the intersection of Gallerher Road with Lee Hwy is flat with no obstructions. Two workmen repairing potholes at this intersection were overcome by fumes and treated at a local hospital for chlorine gas inhalation. To what approximate concentration of chlorine might the workmen have been exposed? You'll evaluate this scenario first by using ALOHA to obtain a source strength estimate and a footprint, then by plotting the footprint on a MARPLOT map in order to obtain a concentration estimate for the location where the workmen were injured.

Choosing a location and a chemical

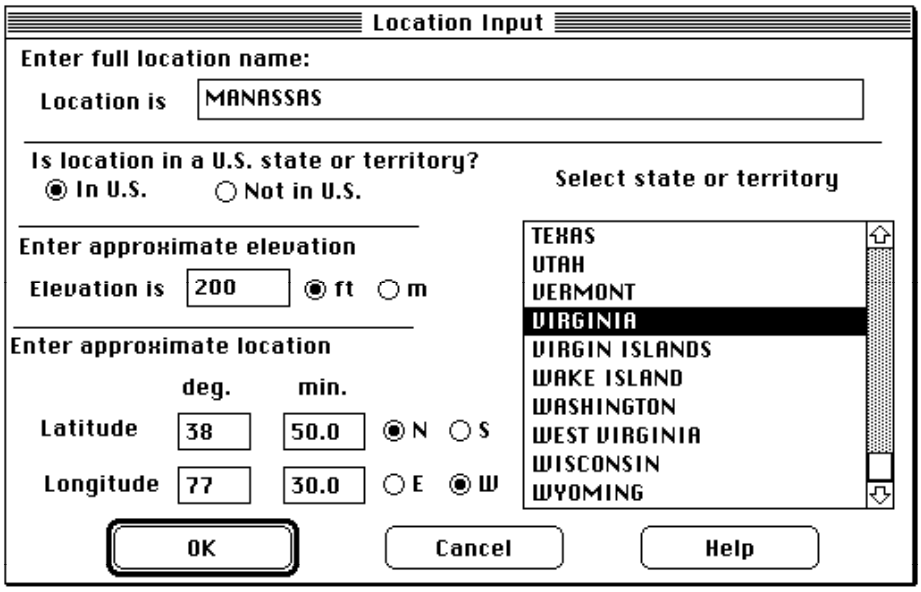
1 Start ALOHA, read the list of ALOHA's limitations, then click **OK**. If ALOHA is already running, choose **New** from the **File** menu to begin a new scenario.

2 You'll ne□jP□by-□H□mO□-□AfmAb□edy running, l□jyCj□mA□-□AfmAb□efmObj'□obtain t□H-□b□-□AfmAb

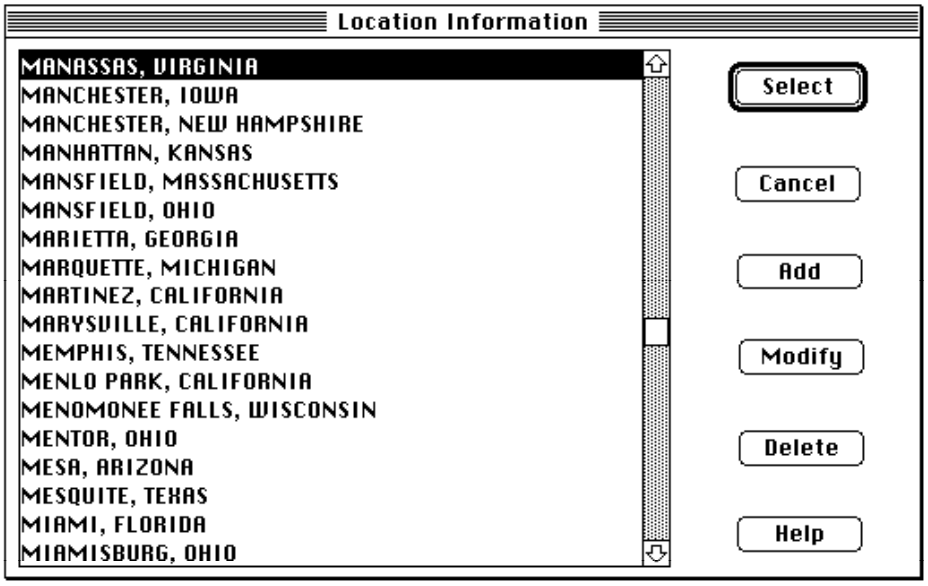
3 Click **Add**.



4 Type "Manassas" in the location name box. Click **In U.S**. Type "200," the approximate elevation of Manassas, then click **feet**. Type the city's latitude and longitude, 38° 50' N and 77° 30' W. Click **N** and **W**. Choose "VIRGINIA" from the scrolling list of state names. Click **OK**.

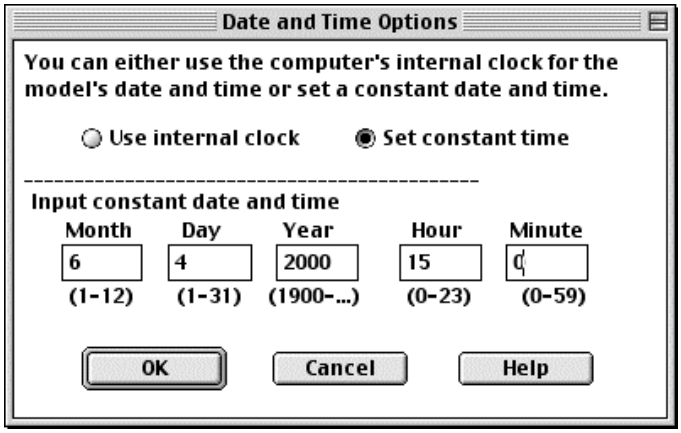


5 The list of locations will be displayed with Manassas, Virginia highlighted. Click **Select**.



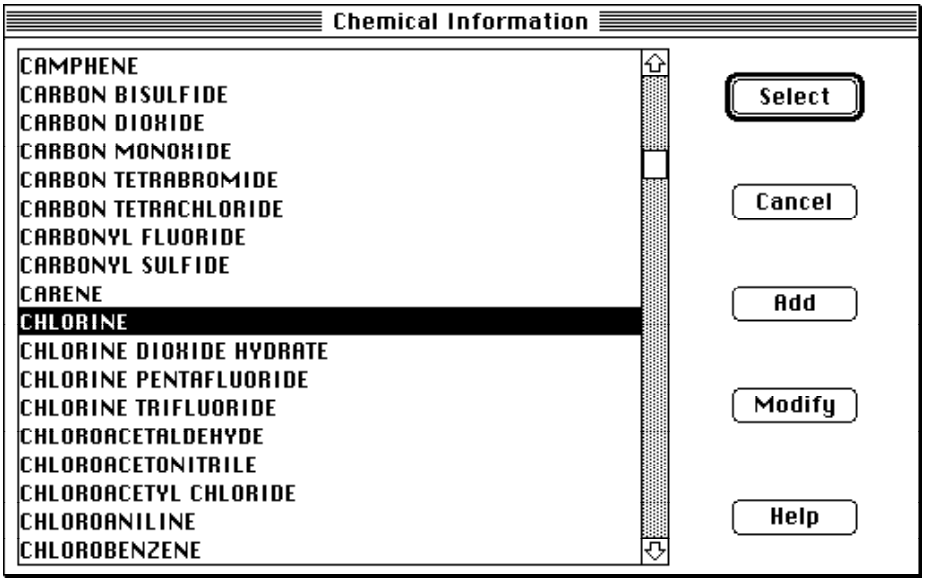
6 We'll ignore **Building Type** during this scenario, since we're interested only in outdoor concentration. Choose **Date & Time** from the **SiteData** menu.

7 Click **Set constant time**, then enter the month, day, year, hour and minute of this accident, as shown below. Click **OK**.



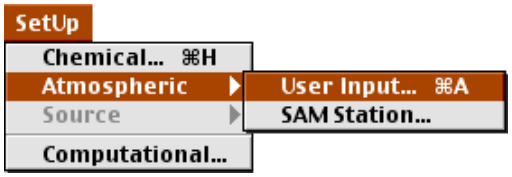
8 Choose **Chemical** from the **SetUp** menu.

9 Use the scroll bar or quickly type the characters "ch" to find "CHLORINE." Double-click on this name or click once on it, then click **Select**.



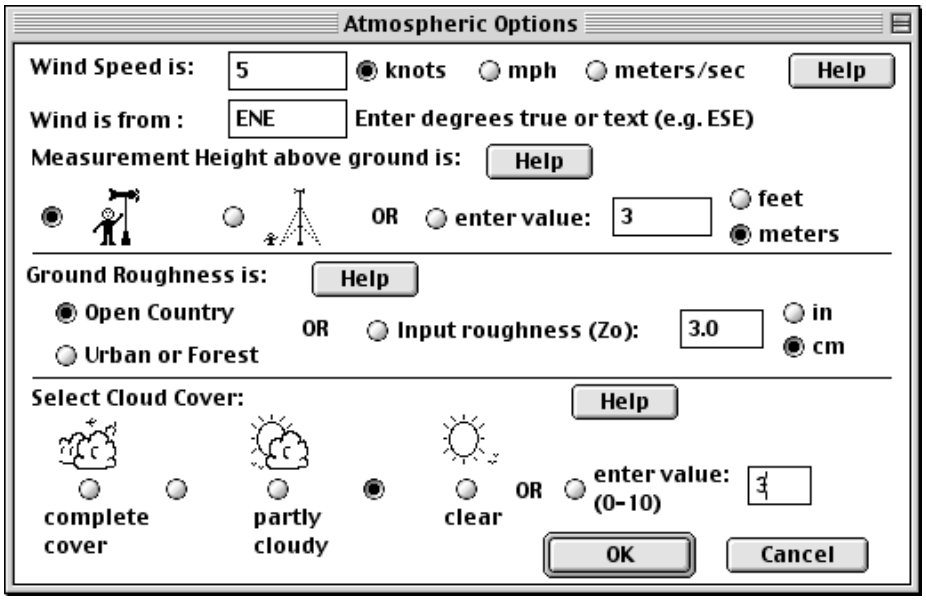
Entering weather information

1 In the **SetUp** menu, point to **Atmospheric**, then click **User Input**.

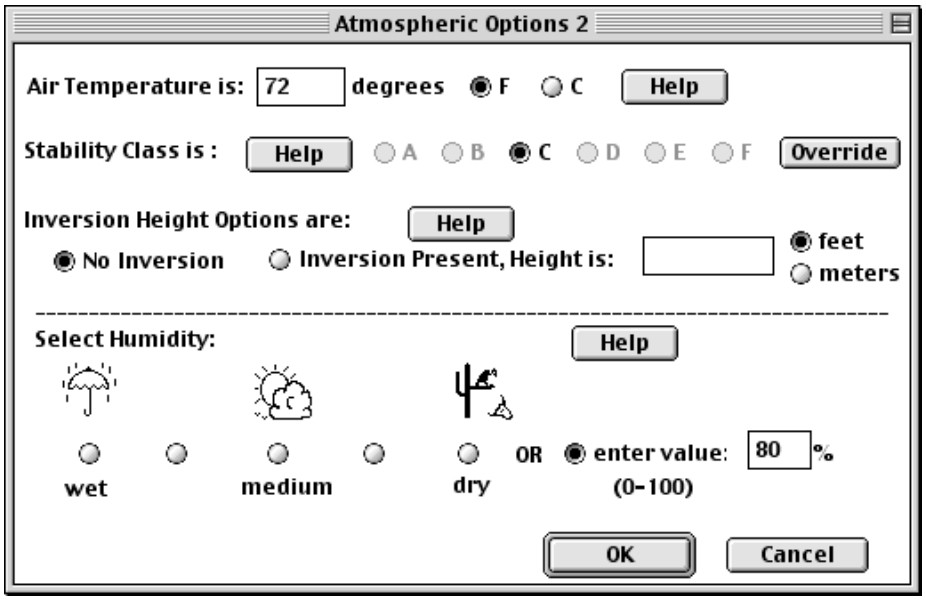


2 Type a wind speed of 5 knots and a wind direction of ENE. Under the "Measurement height above ground is:" heading, click the left-hand button to indicate that the wind speed is measured at a height of 3 meters. The area between the derailed tank car and the injured workmen is flat and free of obstacles, so click **Open Country** ground

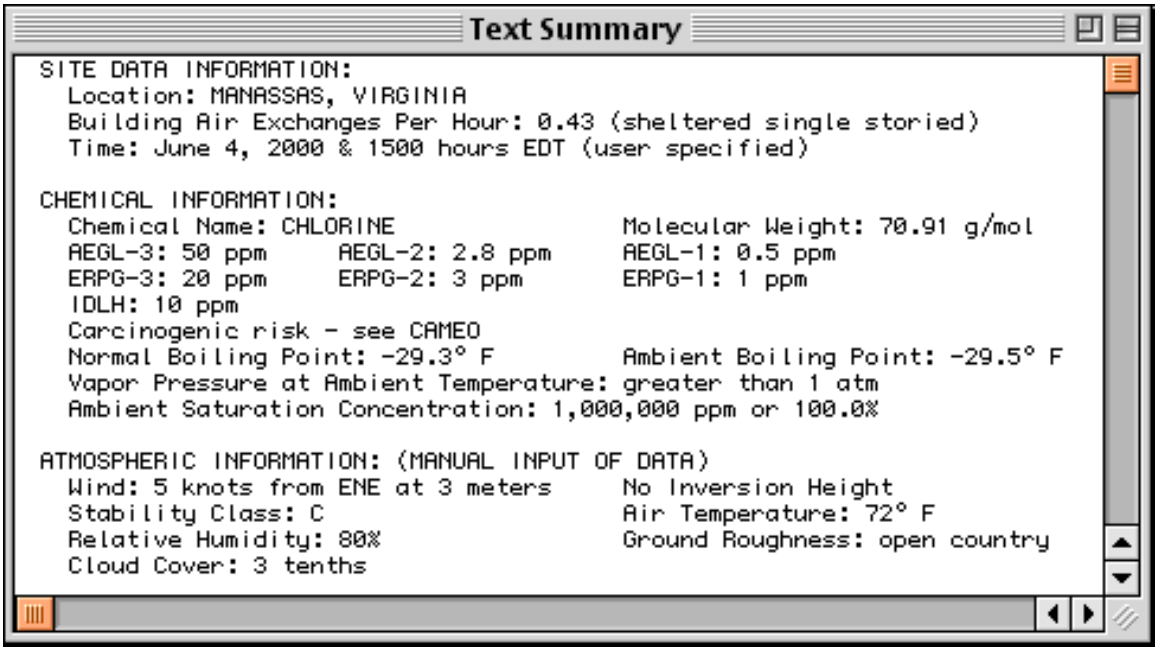
roughness. Click the fourth cloud cover button from the left to indicate that cloud cover is 3 tenths. Click **OK**.



3 Type an air temperature of 72 degrees F. ALOHA has selected stability class "C". Click **No inversion**, since you have no indication that an inversion exists. Type 80 percent into the relative humidity box. Click **OK**.



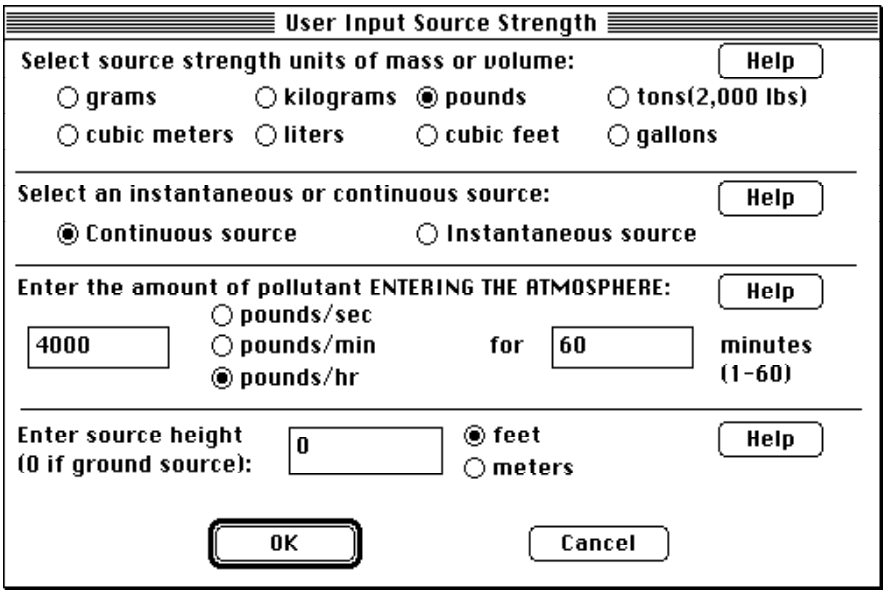
Check the information in the Text Summary to be sure that you have entered all data correctly.



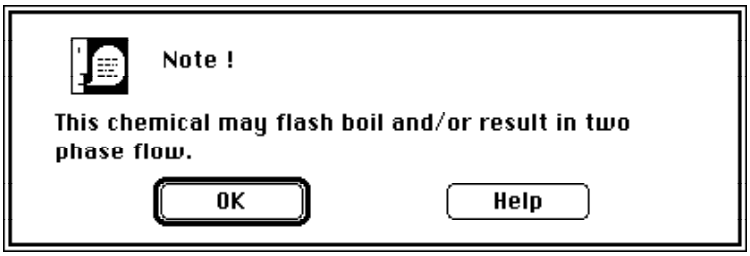
Describing the release

1 This is a release from a tank car, but you don't have all the information that you would need to model the release with ALOHA's Tank source option. You can model this release as a Direct Source, however. In the **SetUp** menu, point to **Source**, then click **Direct**.

2 You know that about 4,000 pounds of chlorine were released, so click **pounds**. The chlorine was released over the course of an hour. Click **Continuous source**, then type "4000" as the release amount. Click **pounds/hour**. Leave the source height as "0," then click **OK**.

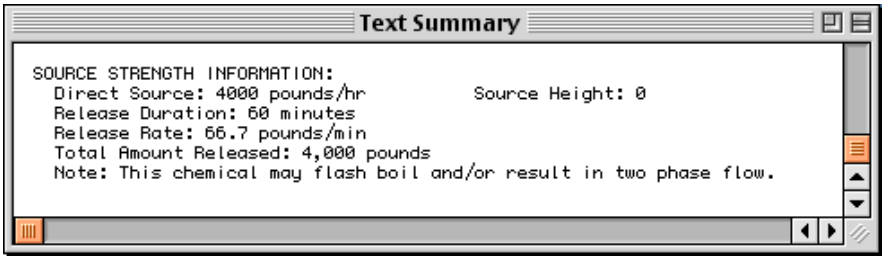


ALOHA will display the warning shown below.



It recognizes that because the boiling point of chlorine is well below air temperature, the chemical may have been stored as a pressurized liquid. If so, it may flash-boil when released through a tank hole. During flash-boiling, much of the stored liquid would turn instantly to vapor, so that a mixture of liquid droplets and vapor (a "two-phase flow") would be released to the atmosphere. ALOHA's Tank release calculations account for these processes, but the Direct Source option does not. Since we don't have the necessary information to run the Tank option, we'll use the Direct Source calculations as the best approximation that we can make, recognizing that the model will treat this release as a steady flow of gas from the tank instead of a two-phase release. Click **OK**.

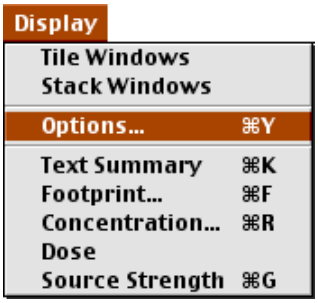
Check the Text Summary to be sure that you correctly entered information about the release.



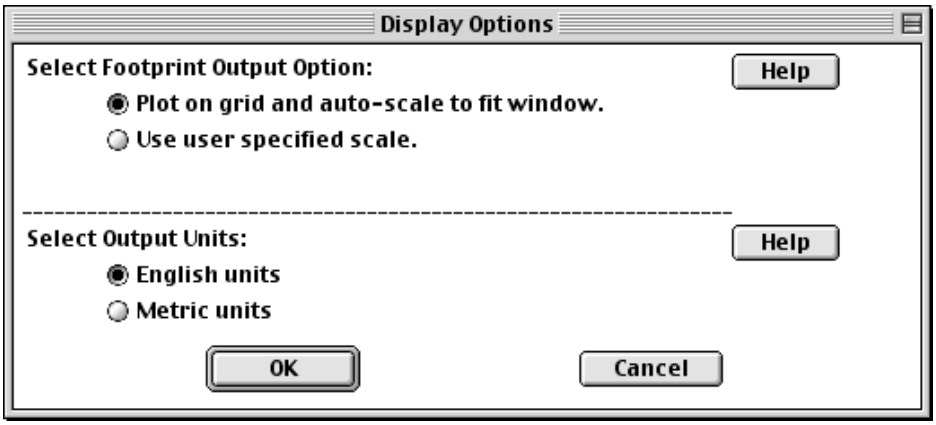
Choosing a LOC and plotting a footprint

1 First, check the computational setting. Select **Computational** from the **SetUp** menu. Check to be sure that **Let model decide (select this if unsure)** is selected. Click **OK**.

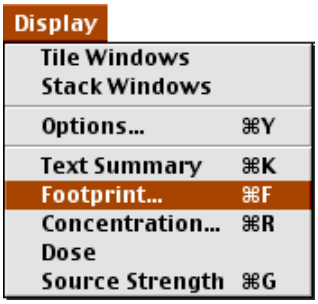
2 Choose **Options…** from the **Display** menu.



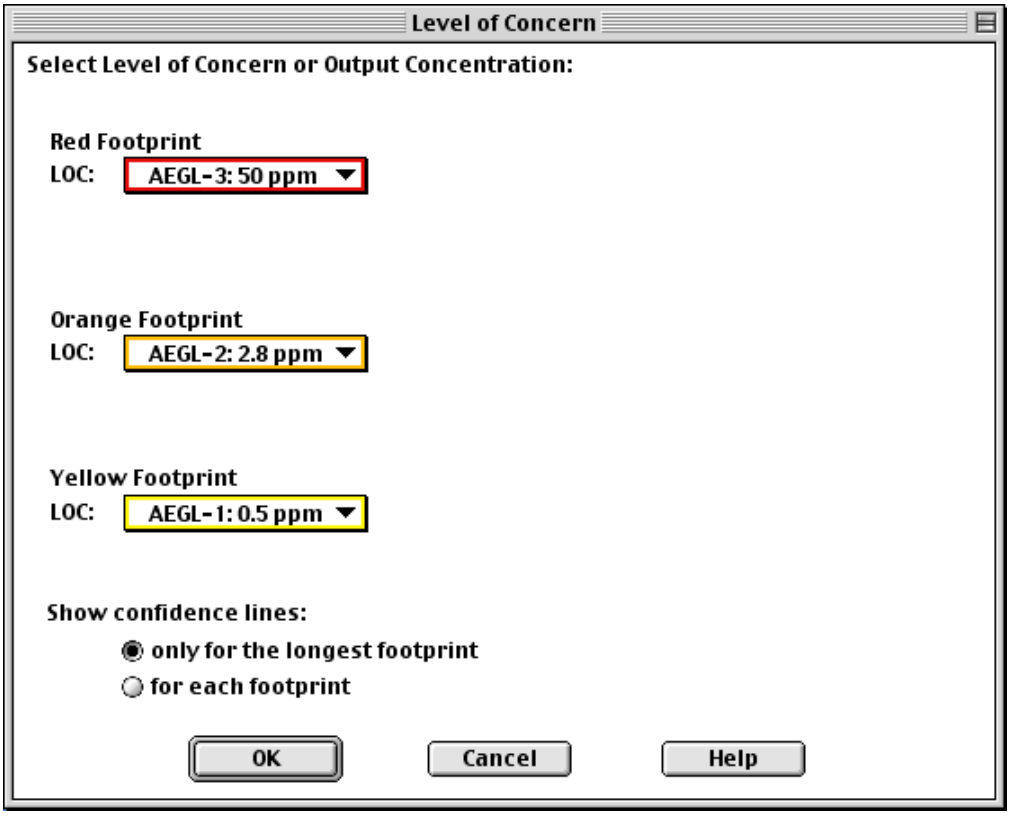
3 Check to be sure that **Plot on grid and auto-scale to fit window** is selected. Select either **English units** or **Metric units**, depending on your preference. Click **OK**.



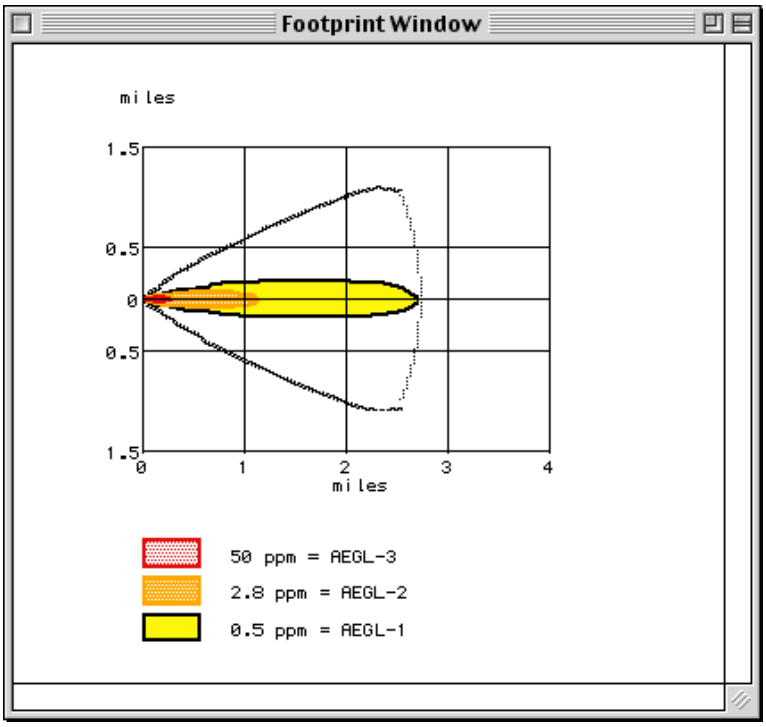
4 Choose **Footprint…** from the **Display** menu.



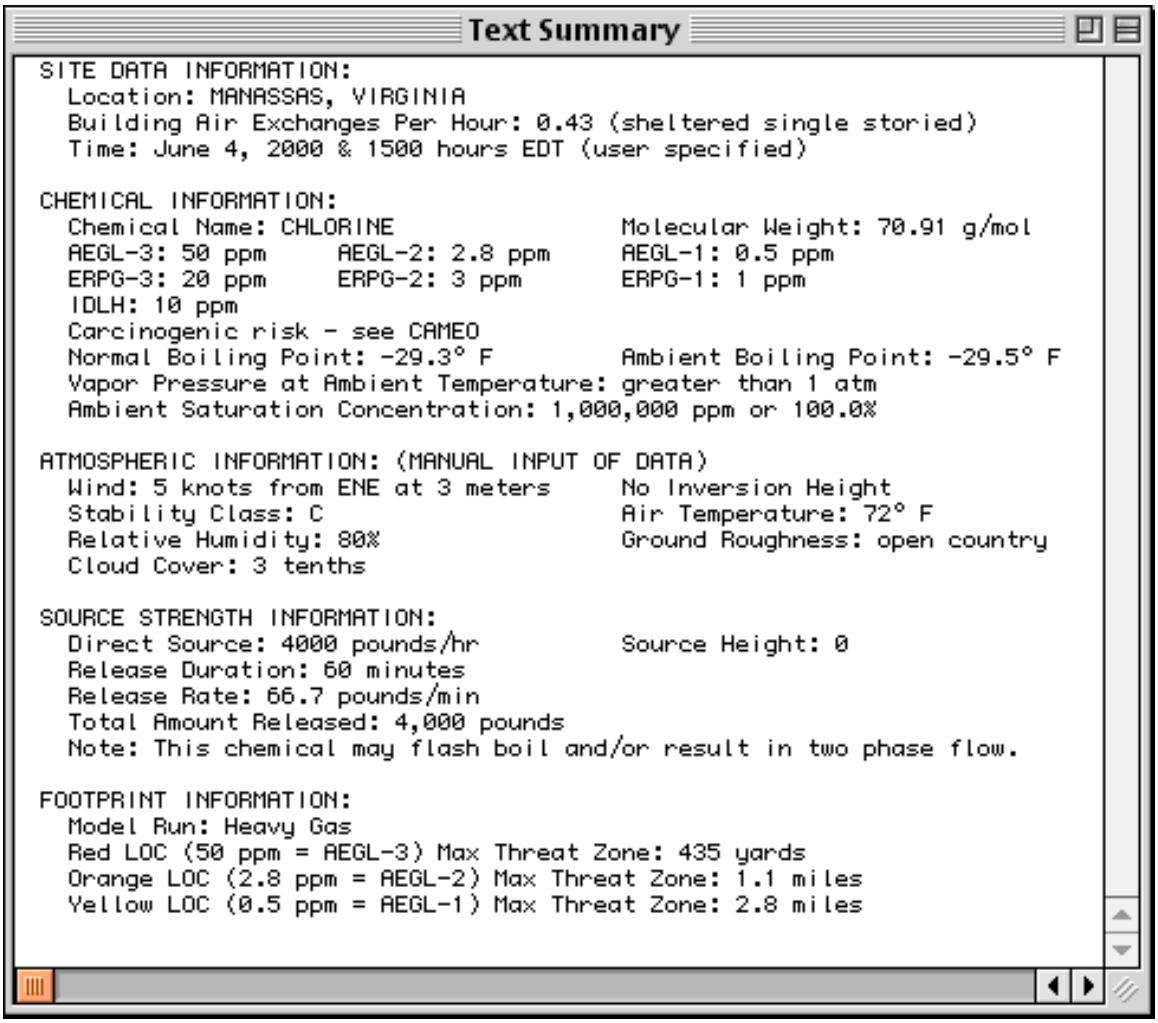
The selected chemical, chlorine, should have AEGLs (Acute Exposure Guideline Levels) as the default LOCs. Choose these AEGLs for the LOC values. Under **Show confidence lines** select **only for the longest footprint**. Click **OK**.



ALOHA will display a footprint for this chlorine release.



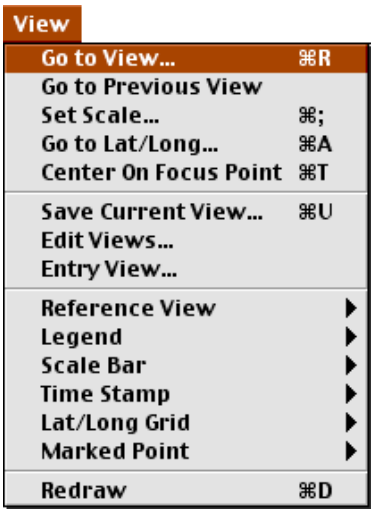
Check the Text Summary to see the length of the footprint that exceeds the AEGL-3 (50 ppm) value (the "Max Threat Zone"). ALOHA expects the footprint to extend at least 436 yards downwind.



Using MARPLOT

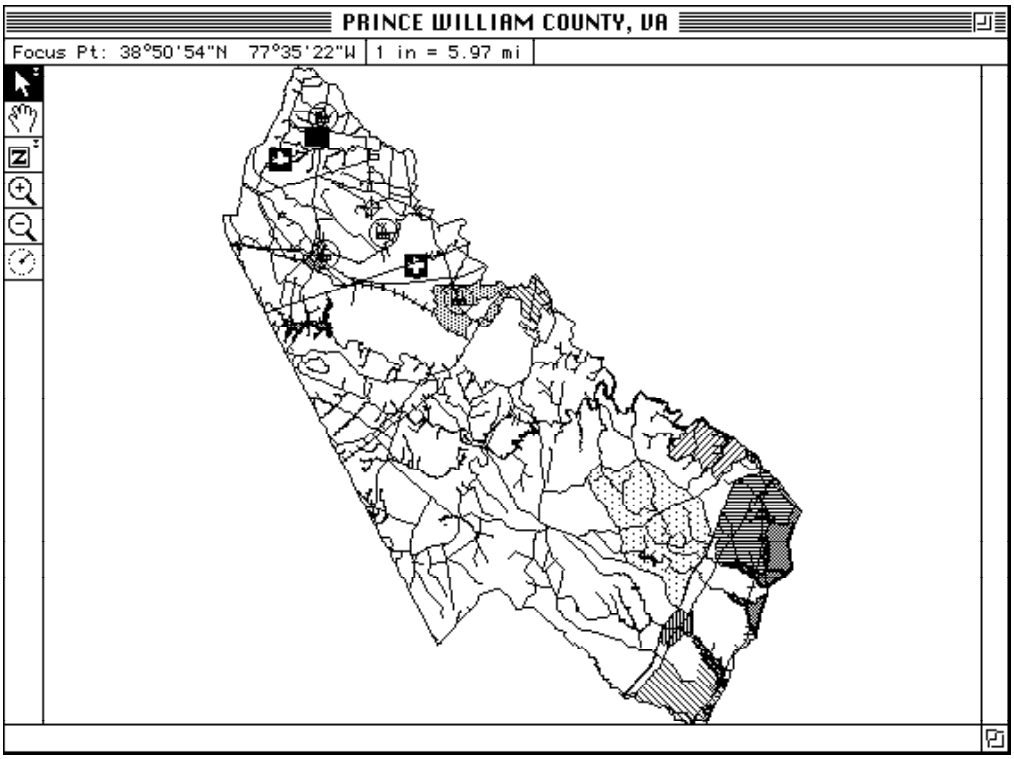
1 You're now ready to plot this footprint on a map of the area in MARPLOT, and to obtain a concentration estimate for the workmen's location. Select **Go to Map** from the **MARPLOT** submenu under ALOHA's **Sharing** menu to bring MARPLOT forward.

2 If this is the first time you've used MARPLOT, the "PRINCE WILLIAM COUNTY, VA" map should automatically be displayed. If it is not, then select **Go to View** from MARPLOT's **View** menu.

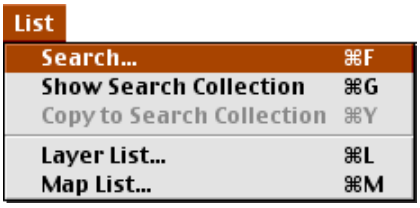


3 Click to highlight "<entire map> PRINCE WILLIAM COUNTY, VA," then click **Go To View**.

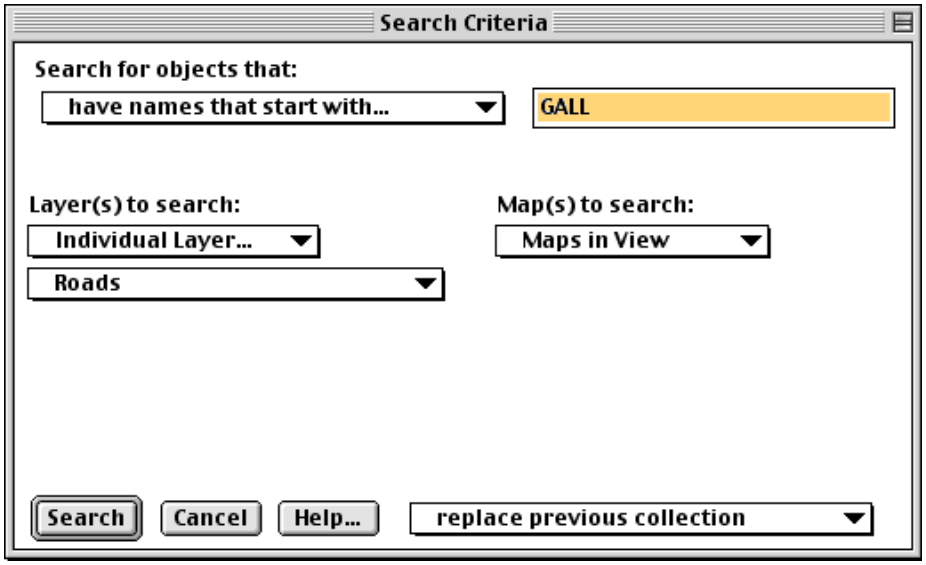
The PRINCE WILLIAM COUNTY, VA map will then be displayed.



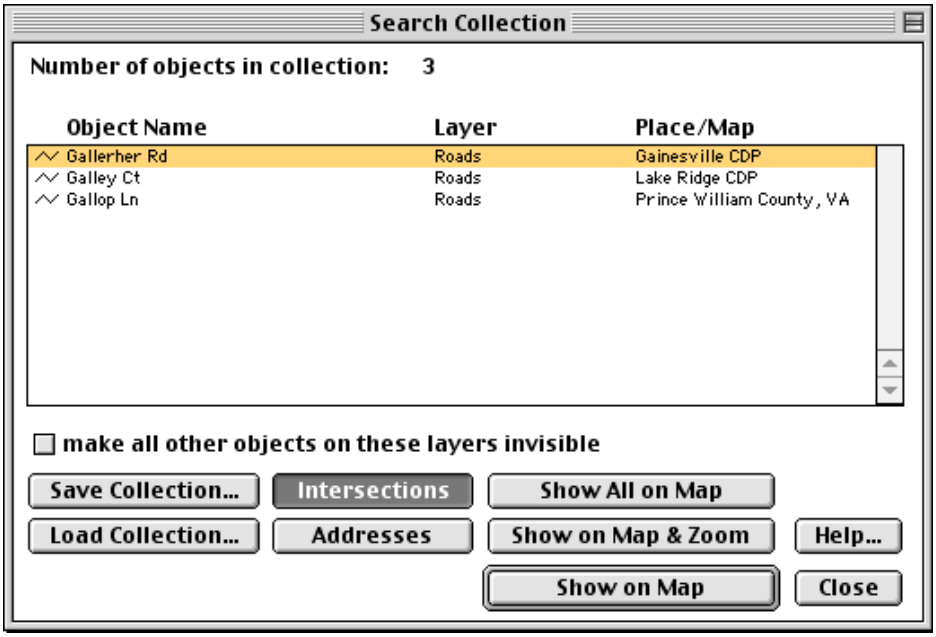
4 Now you'll search on the map for the location where the accident occurred. Choose **Search** from the **List** menu.



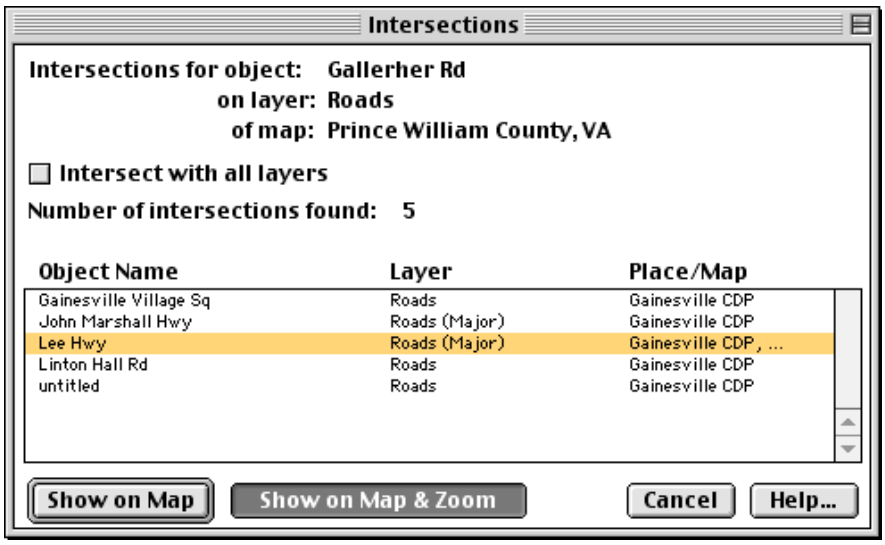
5 To search for Gallerher Road, (1) type "GALL" in the "**have names that start with...**" box. Make sure that (2) **Individual Layer** has been selected in the menu just below the "Layer(s) to search:" heading, then (3) select **Roads** from the menu below that. Check (4) to be sure that Maps in View is selected in the menu below the "Map(s) to search:" heading. When the dialog box on your screen looks like the one below, click **Search.**



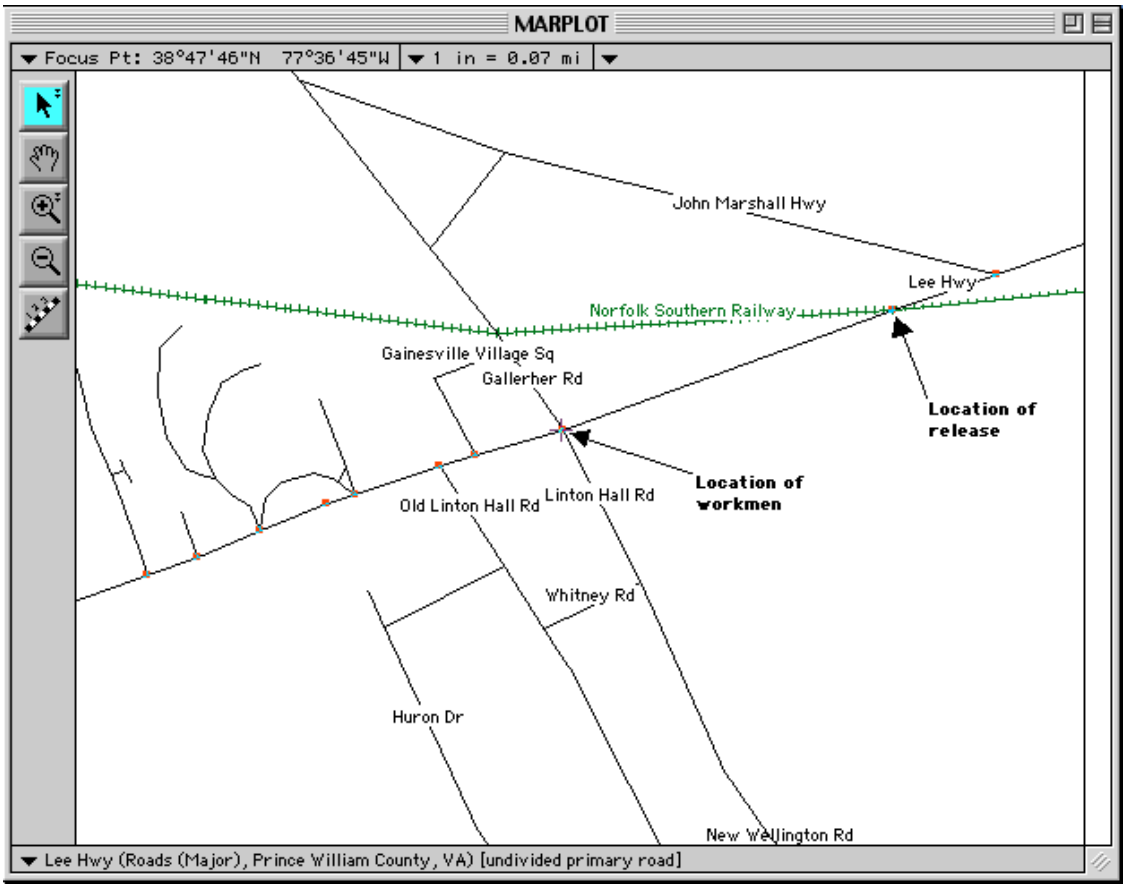
6 The search collection will include three roads. Click once on "Gallerher Road" to highlight it, then click **Intersections**.



7 There are three intersections along Gallerher Road. Click to highlight "Lee Hwy" in the list, then click **Show on Map & Zoom**.

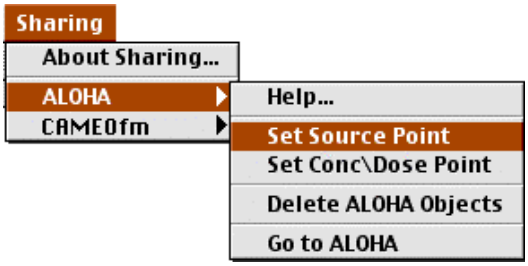


8 Your map should look like the one below. Lee Hwy crosses the map as a straight line from the lower left to the upper right of the map. The Southern Railroad crosses the map horizontally, and intersects with Lee Hwy near the right side of the map.

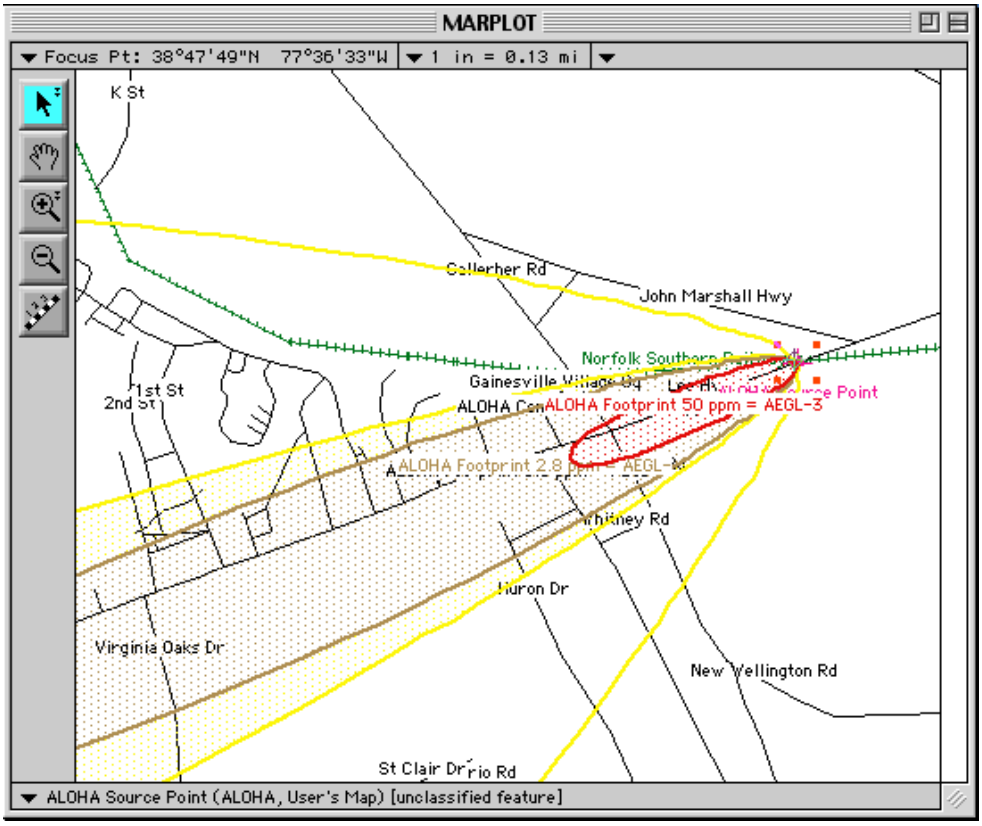


9 In this example, the tank car releases chlorine at the point where the Southern Railway line crosses Lee Hwy. To indicate this location, choose the arrow tool,  , from MARPLOT's tool palette, then click once at this intersection. MARPLOT will place a visible crosshair mark, or "click point" at this location.

10 In MARPLOT's **Sharing** menu, point to **ALOHA**, then click **Set Source Point**.

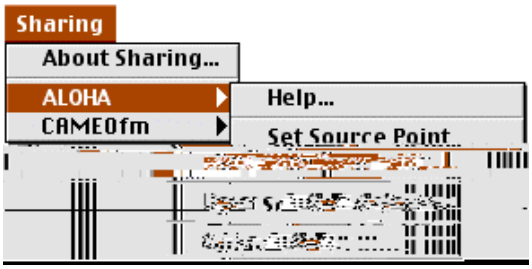


11 An ALOHA footprint will automatically be drawn on the map.



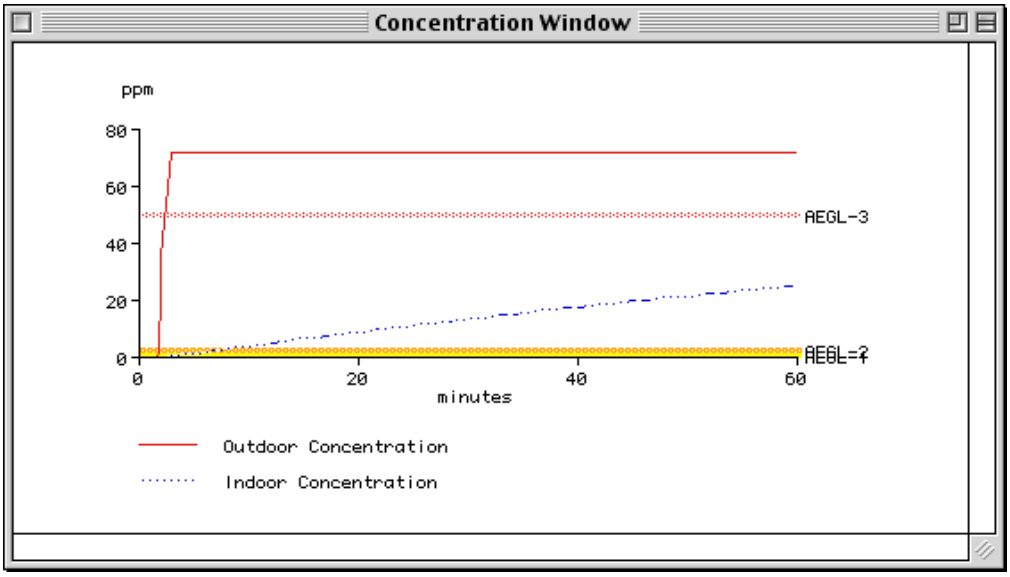
Now you'll choose the location for which you'd like an ALOHA Concentration by Time graph. Find the intersection of Gallerher Road and Lee Hwy (this is close to the end of the red footprint). Be sure that the arrow tool, , remains selected in the tool palette, then click on this location.

12 In MARPLOT's **Sharing** menu, point to **ALOHA**, then click **Set Conc & Dose Point**.

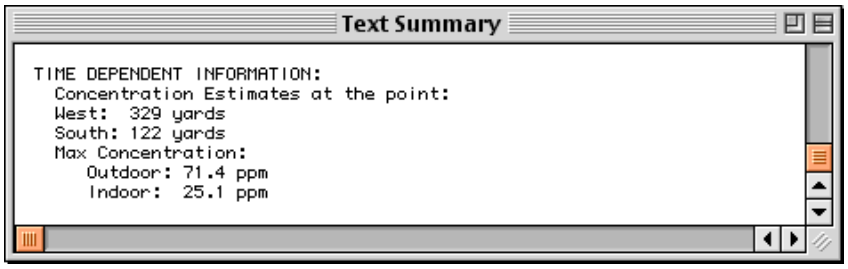


ALOHA will display a Concentration by Time graph for this location. Review the graph and the Text Summary. ALOHA estimated that the workmen were exposed to an outdoor concentration of more than 70 parts per million (well over the AEGL-3

[…individuals could experience life-threatening health effects or death] value for chlorine) for about an hour after the start of the release.



Don't be concerned if the numbers that you see on your screen differ slightly from those shown on the Text Summary. ALOHA's estimates are affected by exactly where on the map you click. The purpose of running this scenario in ALOHA and MARPLOT was to get an estimate of the concentration of chlorine to which the workmen were exposed.



ALOHA was designed to give you "ballpark" estimates of source strength and dispersion. It cannot give you completely accurate predictions for a real release, because no model can account for every uncertainty. For example, ALOHA predicted that the workmen were exposed to a steady concentration of about 70 ppm of chlorine. However, if the wind shifted during the course of the release, the concentration at the workmen's location could have been higher or lower than ALOHA's estimate. If the chlorine was stored as a pressurized liquid, its initial

release rate was probably greater than ALOHA predicted. Downwind concentrations then would have been initially higher, too, but also might have dropped below the LOC much sooner than ALOHA predicted in this example. If you were to respond to a real event similar to this example, you might wish to obtain values for the tank car's dimensions, the amount of chlorine it contained, the size and location of the hole, and other information that you'd need to run ALOHA's more realistic Tank source option.

13 When you've finished this example problem, simply choose **Exit** (in Windows) or **Quit** (on a Macintosh) from MARPLOT's **File** menu. ALOHA's footprint will then be deleted from the map.

Example 5: A Chemical Solution

In Austin, Texas, during a transfer operation from a tank car to a vertical holding container, a collision broke the main transfer hose creating a 25 square foot puddle of a chemical solution of 30 percent aqueous ammonia. The accident occurred on July, 26th, 2003 at 0530.

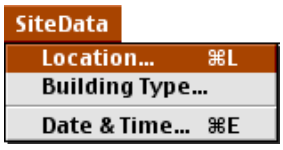
At the accident site, the sky is completely clear, air temperature is 72°F, and relative humidity is 80 percent. The wind is from the south at 7 knots, measured at a height of 3 meters with a portable weather station. An inversion height of 250 feet was noted by the National Weather Service.

The spill occurred on a large concrete walkway and the puddle volume was estimated at 300 gallons. The ground temperature is assumed to be the same as the air temperature.

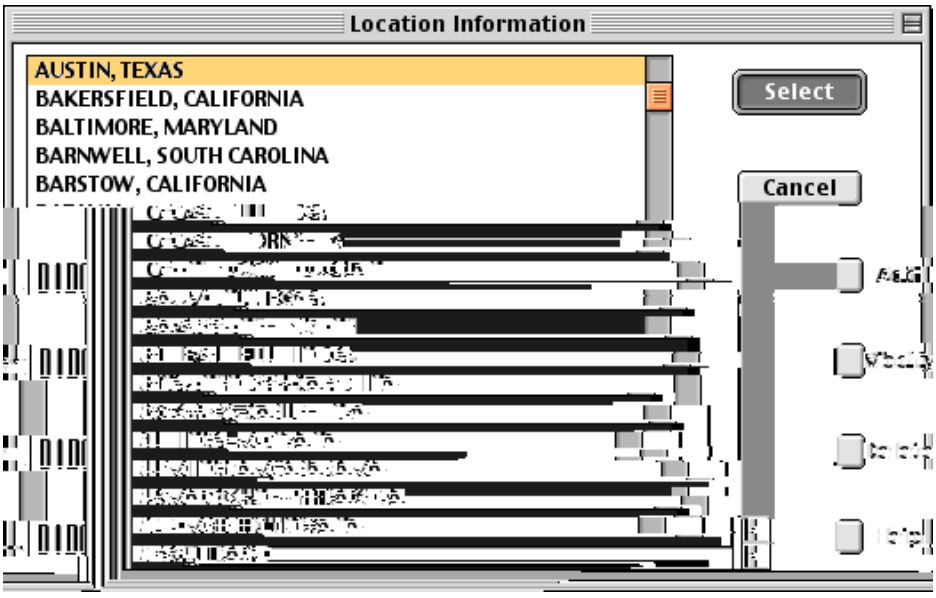
Choosing a location and a chemical solution

1 Start ALOHA, read the list of ALOHA's limitations, then click **OK**. If ALOHA is already running, choose **New** from the **File** menu to begin a new scenario.

2 Choose **Location** from the **SiteData** menu.

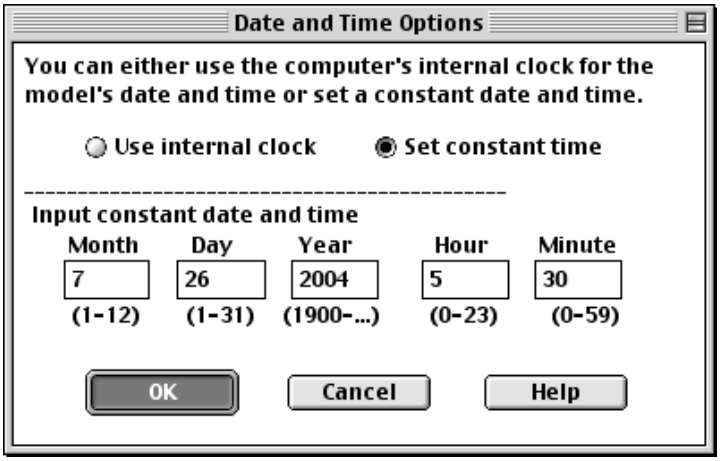


3 Quickly type the characters “aus” to move to the part of the city list containing Austin, Texas. Click to highlight “AUSTIN, Texas,” then click **Select**.

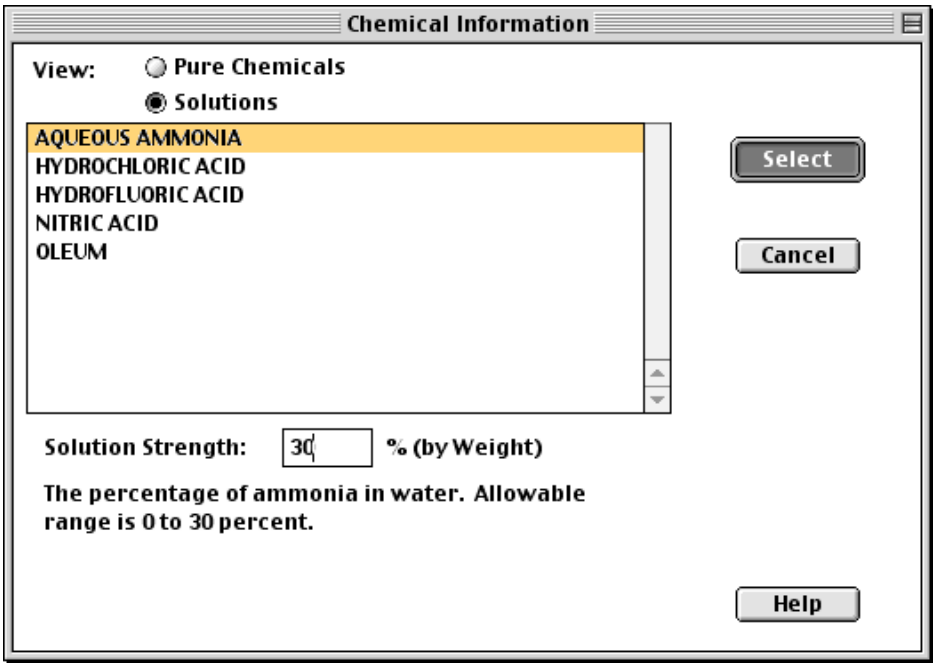


4 Select **Date & Time** from the **SiteData** menu to enter the date and time of the accident.

5 Click **Set constant time**. The scenario date is July 26, 2004, so type "7" in the month box, "26" in the day box, and "2004" in the year box. The accident time is 05:30, so type "5" in the hour box and "30" in the minute box. Click **OK**.

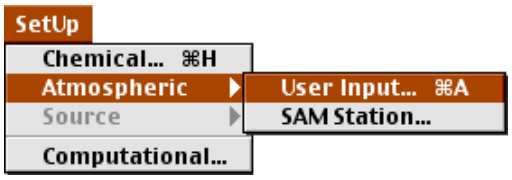


6 Choose aqueous ammonia from ALOHA's chemical library by selecting **Chemical** from the **SetUp** menu. Select **Solutions** near **View:** at the top of the window. Find "AQUEOUS AMMONIA" in the list and highlight the name. Type **30** in for **Solution Strength** percentage (the allowable range of solution strengths will be available at the bottom of this window), then click **Select**.

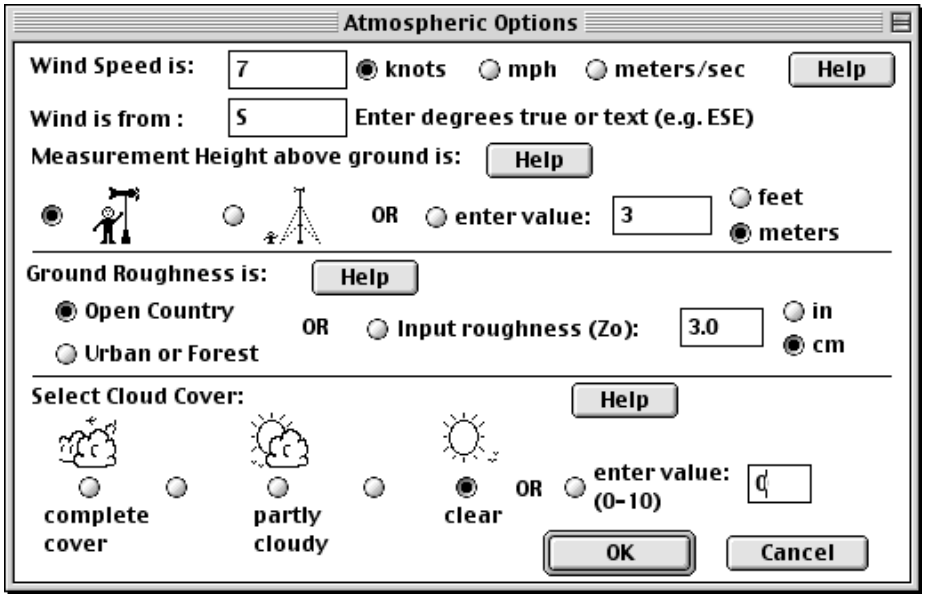


Entering weather information

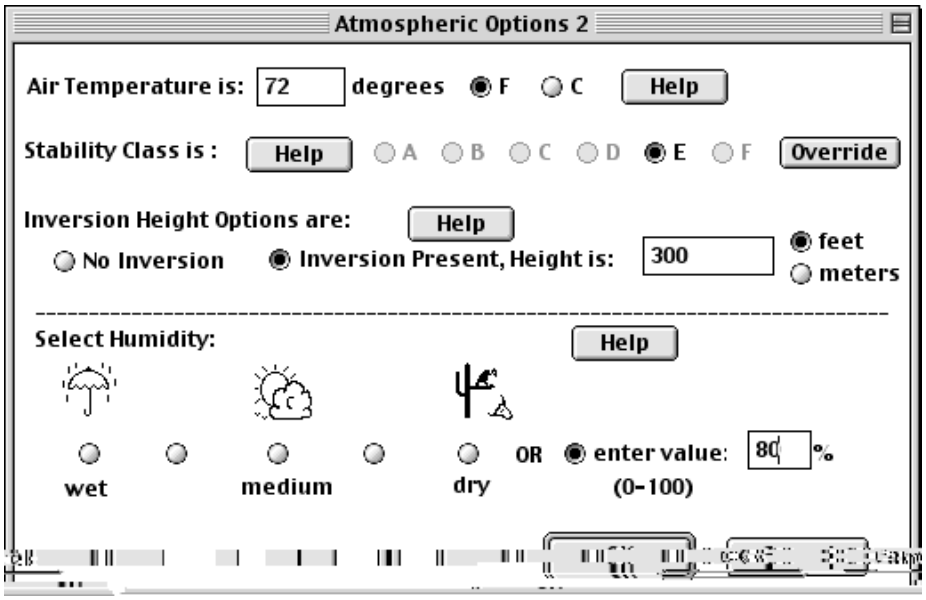
1 In the **SetUp** menu, point to **Atmospheric**, then click **User Input**.



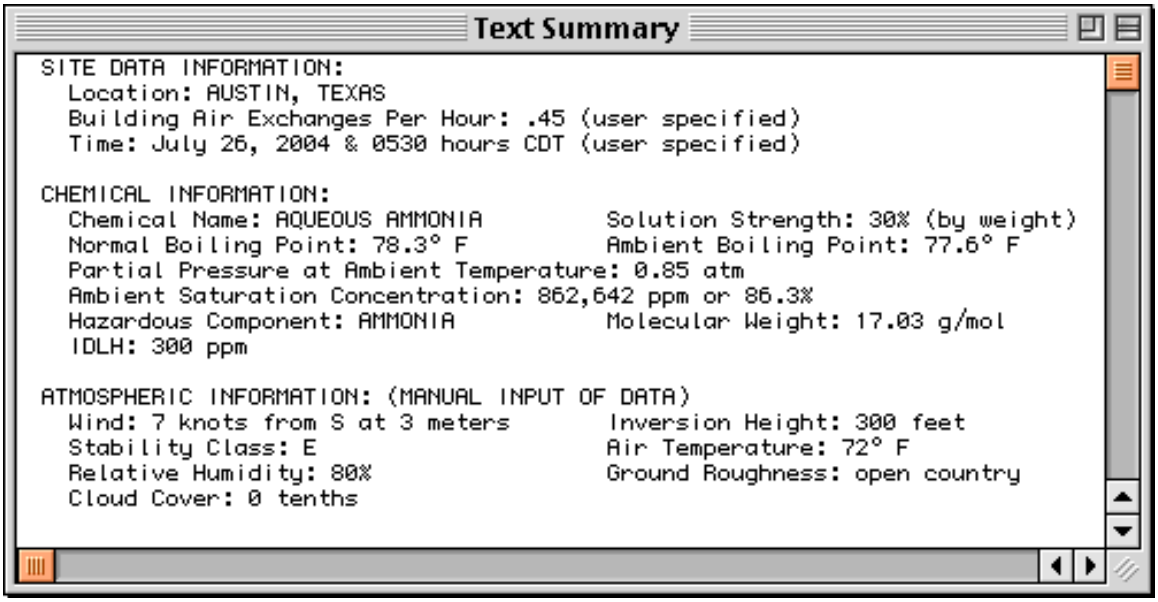
2 Type "7" in the wind speed box, then click **Knots**. Enter "S" in the wind direction box. Click the left-hand button under the "Measurement height above ground is:" heading to indicate that the wind speed is measured at a height of 3 meters. Because the setting of this scenario is a rural road construction site, click **Open Country** ground roughness. Since you have little information about this site, you may wish to run this scenario a second time, this time with **Urban or Forest** selected. Click the cloud cover button for **clear.** Click **OK**



3 Enter “72” for the air temperature, then click **F**. ALOHA selects stability class “E”. Since you were informed that an inversion exists, type "300" in **Inversion Present, Height is:** and make sure "**feet**" is selected. Type “80” percent into the relative humidity box. Click **OK**.

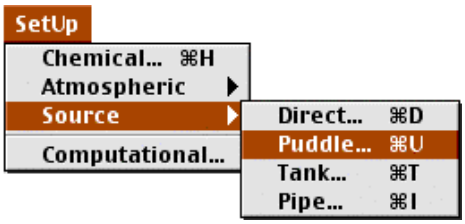


The information that you have entered into ALOHA appears in the Text Summary. Ignore the air exchange rate estimate; you will not estimate indoor aqueous ammonia concentrations in this example.

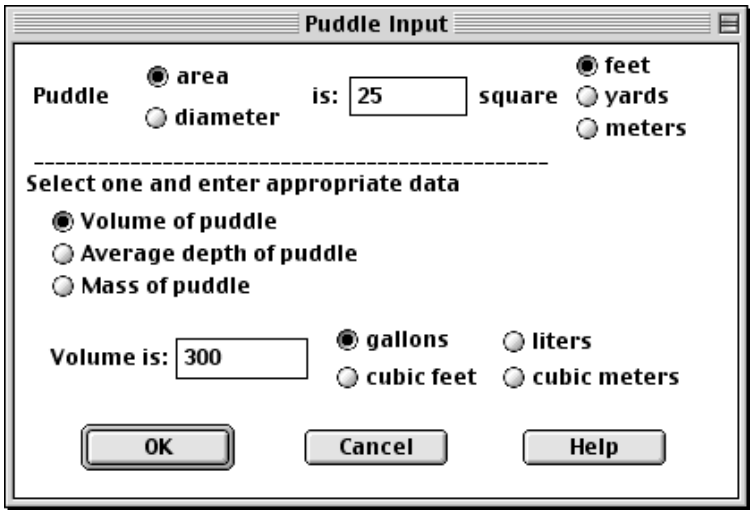


Describing the release

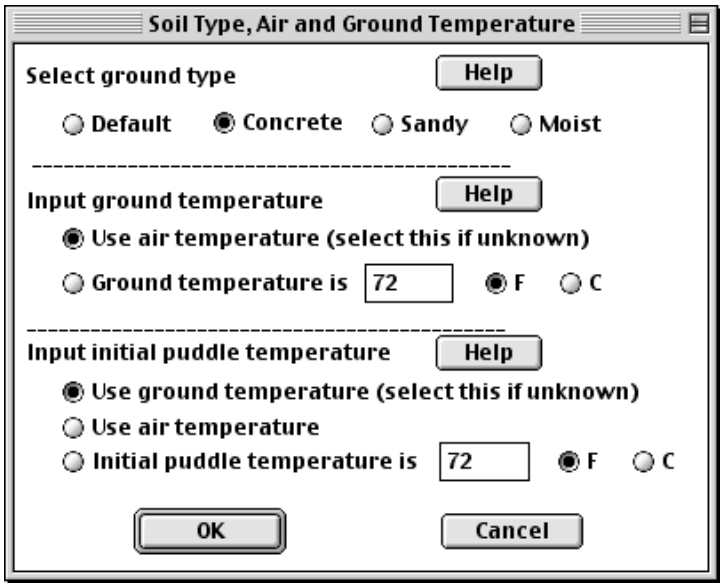
1 In the **SetUp** menu, point to **Source**, then click **Puddle**.



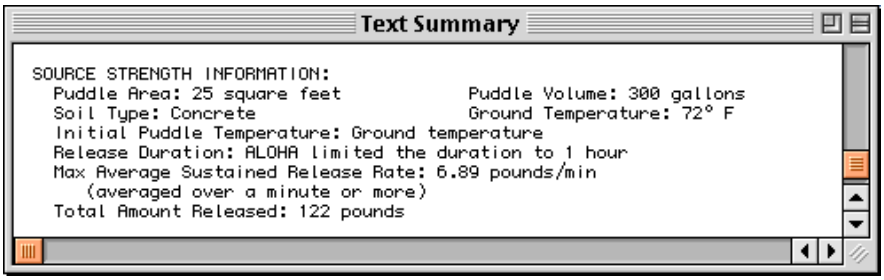
2 Click **area**, type “25” for the puddle area, then click **feet**. Click Volume of puddle and type "300", then click gallons. Click **OK**.



3 Click **concrete** for **ground type**. Click Use **air temperature** for **ground temperature** and click **Use ground temperature** for **initial puddle temperature**. For this example, we will assume that the ground and puddle temperatures are the same as the air temperature of 72 degrees F. Click **OK**.



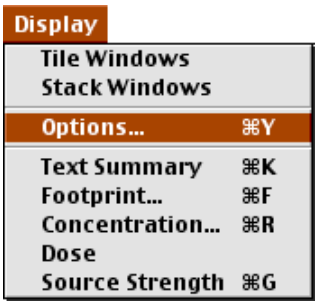
The information that you have entered into ALOHA, as well as ALOHA's estimates for release rate and duration, now appears in the Text Summary. ALOHA predicts that about 122 pounds of ammonia will escape from the puddle at a maximum average sustained release rate of 6.89 pounds each minute. ALOHA sets release duration to the maximum possible time of 1 hour.



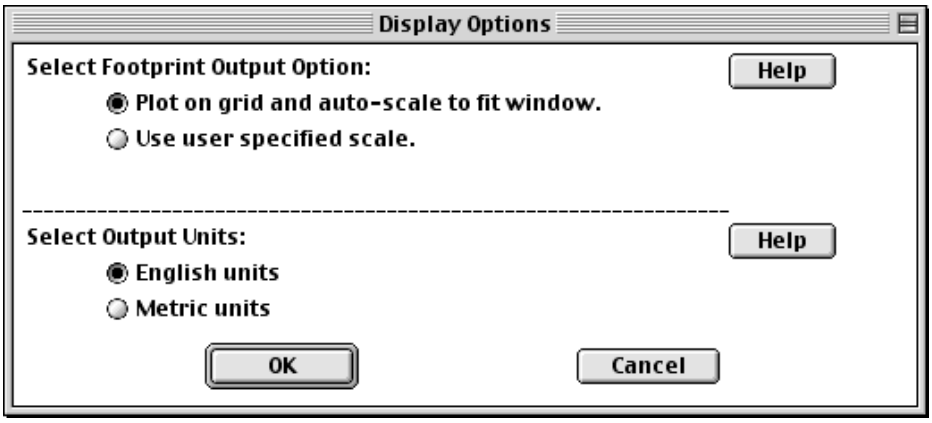
Choosing a LOC and plotting a footprint

1 First, check the computational setting. Select **Computational** from the **SetUp** menu. Check to be sure that **Let model decide (select this if unsure)** is selected. Click **OK**.

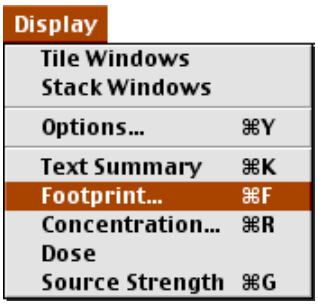
2 Select **Options** from the **Display** menu.



3 Check to be sure that **Plot on grid and auto-scale to fit window** is selected. Select either **English units** or **Metric units**, depending on your preference. Click **OK**.

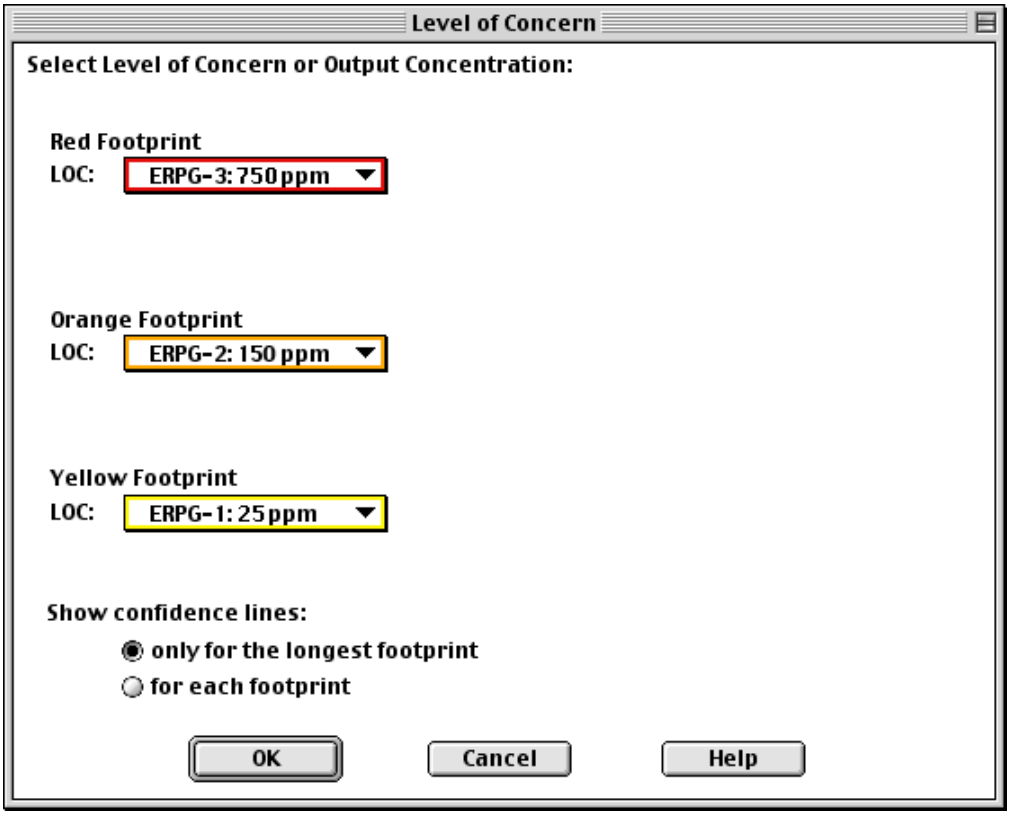


4 Choose **Footprint…** from the **Display** menu.

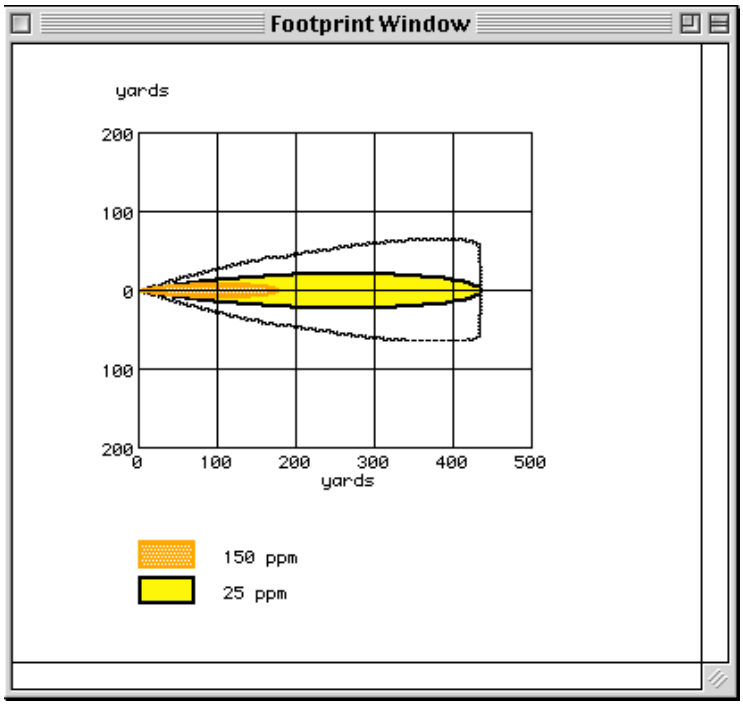


The hazardous component of the selected chemical solution, ammonia, has ERPGs (Emergency Response Planning Guidelines) as default levels of concern. Use these

LOC values**.** Click **only for the longest footprint** for **Show confidence lines** and click **OK**.



ALOHA predicts that the concentration of ammonia from the chemical solution of aqueous ammonia may exceed 25 ppm, ERPG-1 value, for up to about 438 yards downwind of the puddle. Notice that a concentration of ammonia exceeds 750 ppm 76 yards downwind but the red footprint is not drawn because of near field patchyness.



Your Text Summary should now look like the one below.