CAMEO Refresher Exercise Set: January, 2011
Using ALOHA with Changing Weather Conditions

Scenario:

A local facility stores Vinyl Chloride in a spherical 50,000 gallon tank. The facility is reporting the tank is releasing product from a 2 inch valve located about 6 feet from the tank bottom. The tank has containment of approximately 50 feet by 40 feet. The amount of product in the tank at the beginning of the incident is unknown; you will assume the tank was 80% full when the leak started.

Current weather conditions are:

Wind: 12 miles/hour from South at 10 meters

Ground Roughness: open country	Cloud Cover: 0 tenths
Air Temperature: 55° F	Stability Class: D
No Inversion Height	Relative Humidity: 25%

However, NWS reports a cold front is expected to move through the area in about 60 minutes. Wind direction will be moving from South to Southwest and then to West. Temperature is expected to remain fairly constant over the next 2 to 3 hours, then drop into the low 40s. Wind speed will be increasing to 35 mph.

CAMEO Chemicals:

Find the following information for Vinyl Chloride using CAMEO Chemicals.

1. ERG-suggested Initial Isolation Zone _____
2. Usual physical state of chemical (solid, liquid, gas) _____
3. NFPA Hazard Codes for chemical _____
4. IDLH _____
5. ERPG 1, 2, and 3 _____
6. Summarize hazards of chemical _____
7. Summarize any Reactive Hazards _____

MARPLOT:

Determine an address in your area where this incident (or an incident similar to this) could occur. On the MARPLOT map, do the following:

1. Mark the "release point" with the MARPLOT Marked Point
2. Draw a circle around the tank to represent the ERG Initial Isolation Zone

ALOHA:

Use ALOHA to predict downwind concentrations of Vinyl Chloride.

1. Select Vinyl Chloride as the ALOHA Chemical
2. Enter the weather conditions as given above
3. Select the ALOHA Tank Source model and enter the tank information as given above.
4. Create the Toxic Threat Zone and display it on MARPLOT

Your initial ALOHA Text Summary will read as follows:

SITE DATA:
Location: OKLAHOMA CITY, OKLAHOMA
Building Air Exchanges Per Hour: 0.93 (unsheltered single storied)
Time: January 26, 2011 1121 hours CST (using computer's clock)

CHEMICAL DATA:
Chemical Name: VINYL CHLORIDE Molecular Weight: 62.50 g/mol
ERPG-1: 500 ppm ERPG-2: 5000 ppm ERPG-3: 20000 ppm
LEL: 36000 ppm UEL: 330000 ppm
Carcinogenic risk - see CAMEO Chemicals
Ambient Boiling Point: 4.9° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

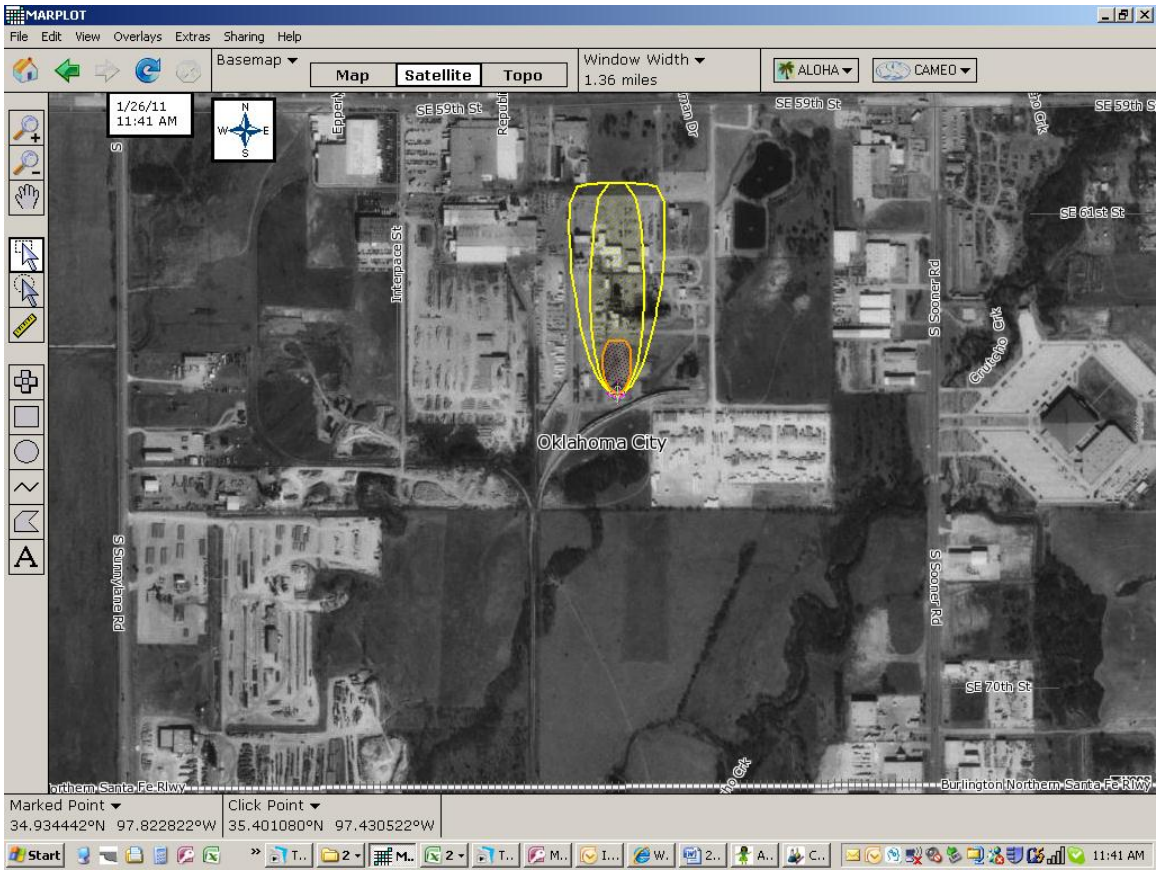
ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 12 miles/hour from s at 10 meters
Ground Roughness: open country Cloud Cover: 0 tenths
Air Temperature: 55° F Stability Class: D
No Inversion Height Relative Humidity: 25%

SOURCE STRENGTH:
Leak from short pipe or valve in spherical tank
Flammable chemical escaping from tank (not burning)
Tank Diameter: 23.4 feet Tank Volume: 50000 gallons
Tank contains liquid Internal Temperature: 55° F
Chemical Mass in Tank: 154 tons Tank is 80% full
Circular Opening Diameter: 2 inches
Opening is 6 feet from tank bottom
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 1,050 pounds/min
(averaged over a minute or more)
Total Amount Released: 62,806 pounds
Note: The chemical escaped as a mixture of gas and aerosol (two phase flow).

THREAT ZONE:
Model Run: Heavy Gas
Red : 53 yards --- (20000 ppm = ERPG-3)
Note: Threat zone was not drawn because effects of near-field patchiness

make dispersion predictions less reliable for short distances.
Orange: 115 yards --- (5000 ppm = ERPG-2)
Yellow: 455 yards --- (500 ppm = ERPG-1)

Your initial Threat Zone on MARPLOT will look something like this:



QUESTION 1: Is this initial ALOHA Threat Zone adequate for this incident?

QUESTION 2: Will the tank stop releasing product before the coming wind direction change occurs? If not, the what is your estimate of the time until the tank stops releasing product?

QUESTION 3: Will a change in the wind direction and the wind speed impact the Threat Zone display on MARPLOT? How will you operate ALOHA to account for the upcoming weather changes?

All HazMat events are different. In this exercise, I present one approach to using ALOHA for this specific Vinyl Chloride release. There are other approaches that could be employed as well.

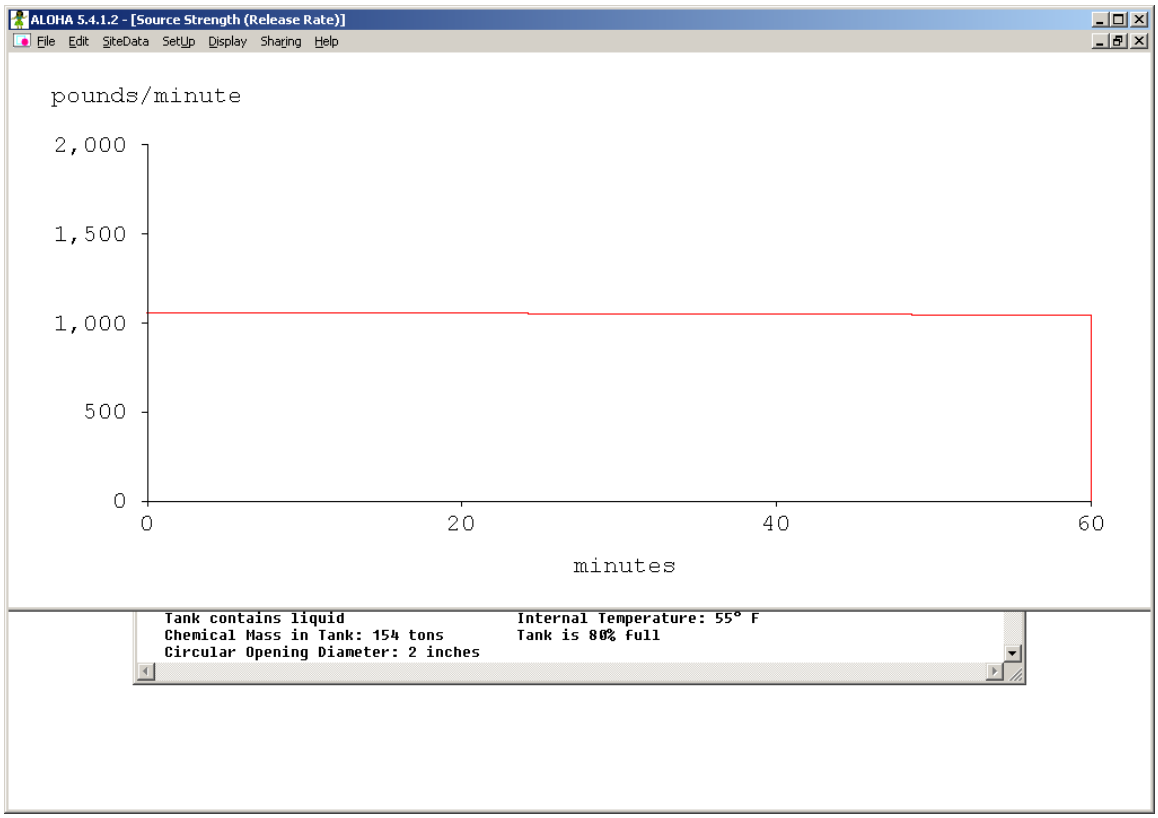
QUESTION 1: Obviously, the initial ALOHA Threat Zone will be adequate for this incident ONLY if the release ends within the 60 minutes before the weather changes. ALOHA predicts that this release will last beyond the 1 hour ALOHA limitation.

However, ALOHA does produce a "Release Rate" as part of the Source Strength Text Summary. In my case, the predicted Release Rate is 1050 pounds per minute. I am going to round that to 1000 pounds per minute to make the upcoming calculation easier.

QUESTION 2: ALOHA has determined that at 80% capacity, the tank contains 154 tons of Vinyl Chloride, or 154 * 2000 = 308,000 pounds. In the first hour of the incident, ALOHA predicts that 68,806 pounds were released into the atmosphere. Using those numbers, we can estimate that 308000 lbs / 68806 lbs per hour = 4.48 hours…or basically we would expect the release to continue for about 4-5 hours, all other things being equal.

Therefore, we cannot depend on the original Threat Zone for accuracy, because the weather conditions will be changing before the release is over.

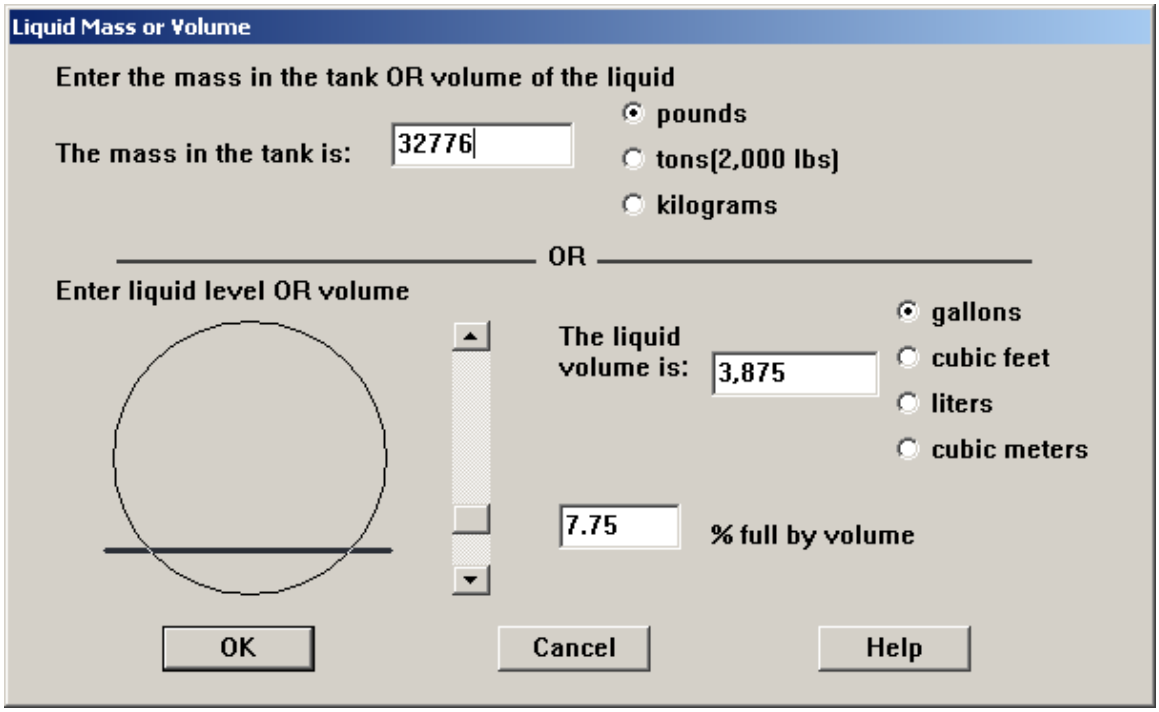
QUESTION 3: Also, we would expect the release rate to lessen somewhat as the amount of material in the tank diminishes. Let's review the ALOHA Source Strength graph to see what ALOHA predicts the release rate to be over the first hour.



In this case, ALOHA predicts the release rate will be constant over the first hour of the release.

Let's look at what the release rate might be at 4 hours into the incident. If the release rate remains constant for the first 4 hours at 68806 lbs/hour, then after 4 hours, 275,224 lbs will have been released, leaving 308,000 lbs minus 275,224 lbs = 32,776 lbs still in the tank.

Return to ALOHA Source/Tank menu and enter the 32,776 lbs for the amount in the tank.



Leaving all other Source inputs as before, ALOHA now predicts the release rate to be 965 pounds per minute, and that the release will cease in 40 minutes.

SOURCE STRENGTH:
Leak from short pipe or valve in spherical tank
Flammable chemical escaping from tank (not burning)
Tank Diameter: 23.4 feet Tank Volume: 50000 gallons
Tank contains liquid Internal Temperature: 55° F
Chemical Mass in Tank: 32776 pounds Tank is 8% full
Circular Opening Diameter: 2 inches
Opening is 6 feet from tank bottom
Release Duration: 40 minutes
Max Average Sustained Release Rate: 965 pounds/min
(averaged over a minute or more)
Total Amount Released: 24,254 pounds
Note: The chemical escaped as a mixture of gas and aerosol (two phase flow).

Note: The point of reviewing the Source Strength information is to determine if the Release Rate will vary significantly over the course of the event. In this particular case, the Release Rate is fairly constant. This will NOT be the case for all incidents and other materials!

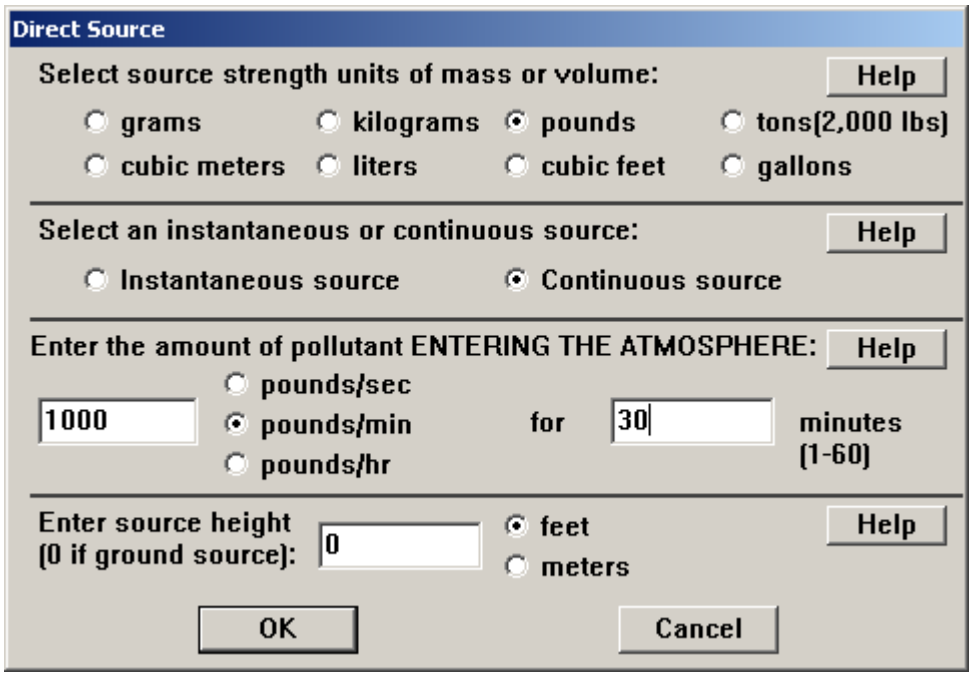
Also note that the Total Amount Released prediction is 24,254 pounds, not the 32,776 pounds that we input as the total amount of vinyl chloride still in the tank. So, we must assume that at 4 hours and 40 minutes after the release began, the active release of vinyl chloride may stop (at least temporarily); however, there are still about 8500 pounds of product still in the tank.

Now that we have established that the Release Rate will be constant over the life of this incident, we can use the ALOHA Direct/Continuous Source model to improve our Threat Zone predictions.

The NWS is predicting a wind change and temperature change in about 60 minutes. ALOHA is a "snapshot" model, and users cannot input upcoming weather or other incident changes. However, ALOHA has provided us with enough information that we can do our own investigation of this release over time.

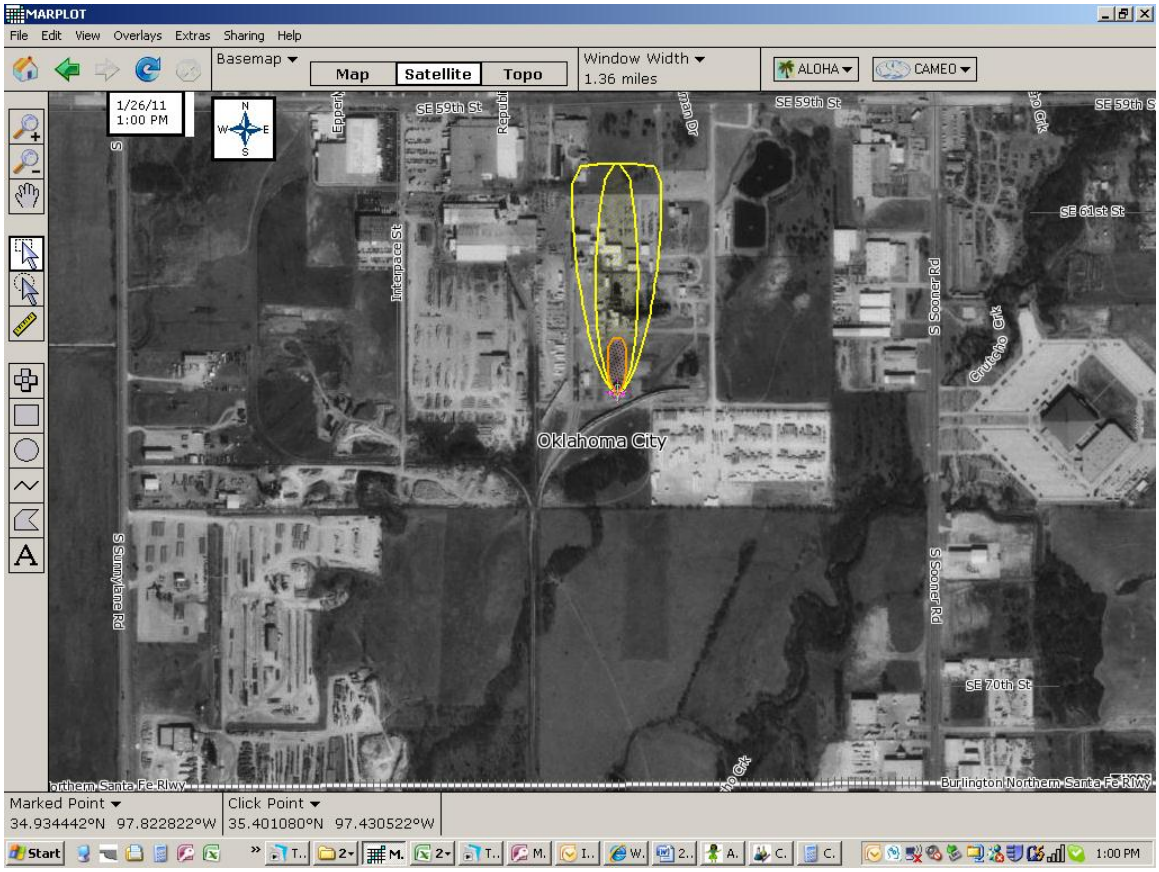
Let's assume the wind change begins in about 30 minutes from the start of the release, and that the complete weather change will be effective at 60 minutes from the start of the incident.

Return to ALOHA Source / Direct model. Choose a "Continuous" release and enter "1000" pounds per minute for "30" minutes.



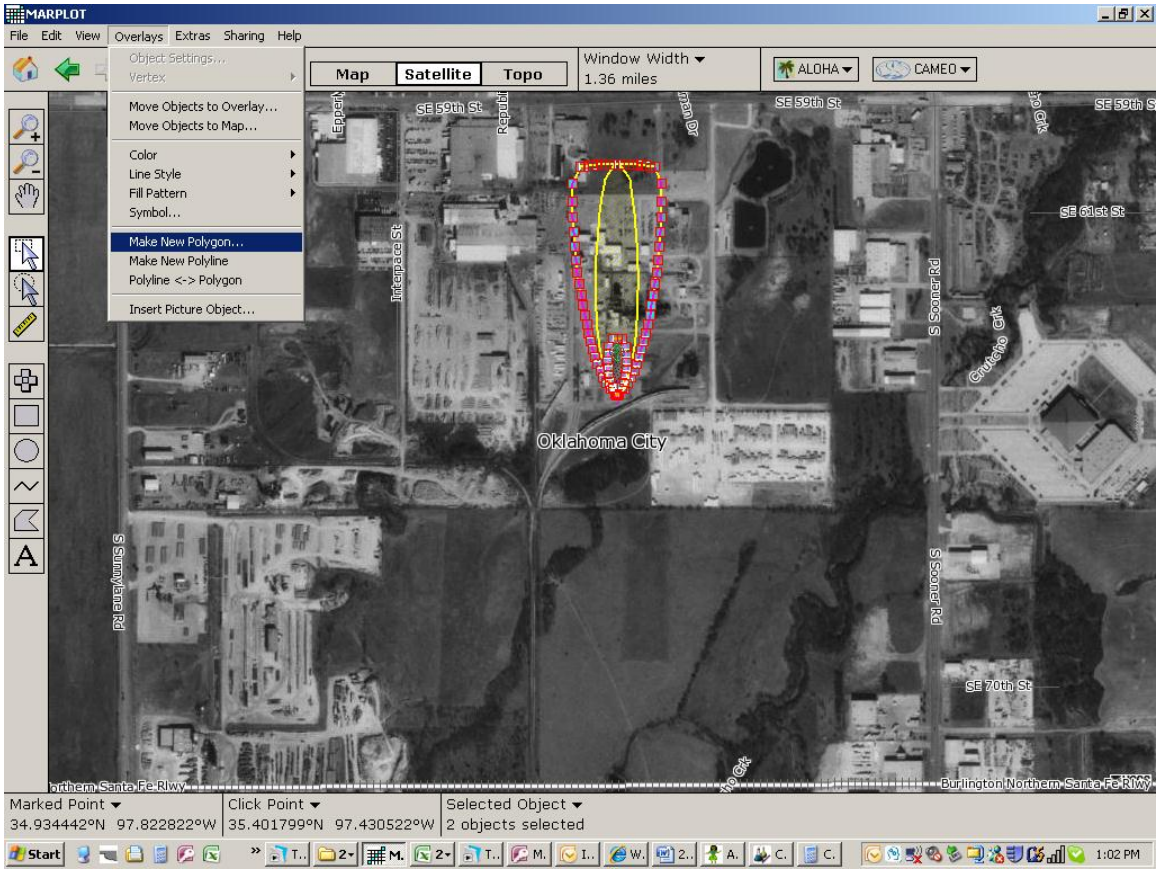
Select OK.

Your MARPLOT screen should look something like this.

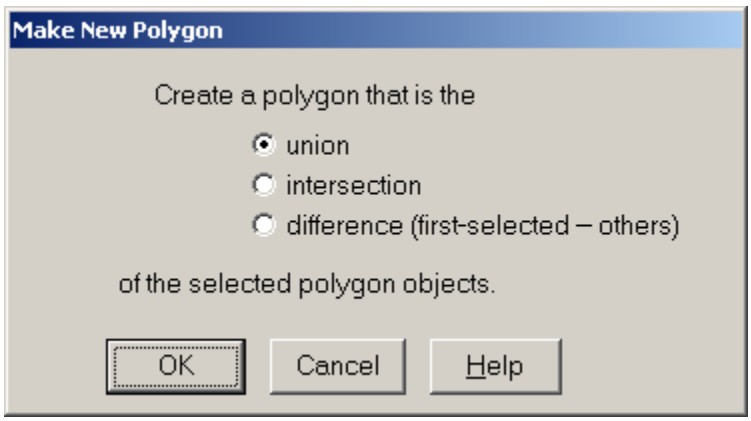


In MARPLOT, use the Pointer Tool to “point and shift-click” to select the Yellow and Orange Threat Zones.

In MARPLOT, select the Overlay / Make New Polygon menu.



Select “union”

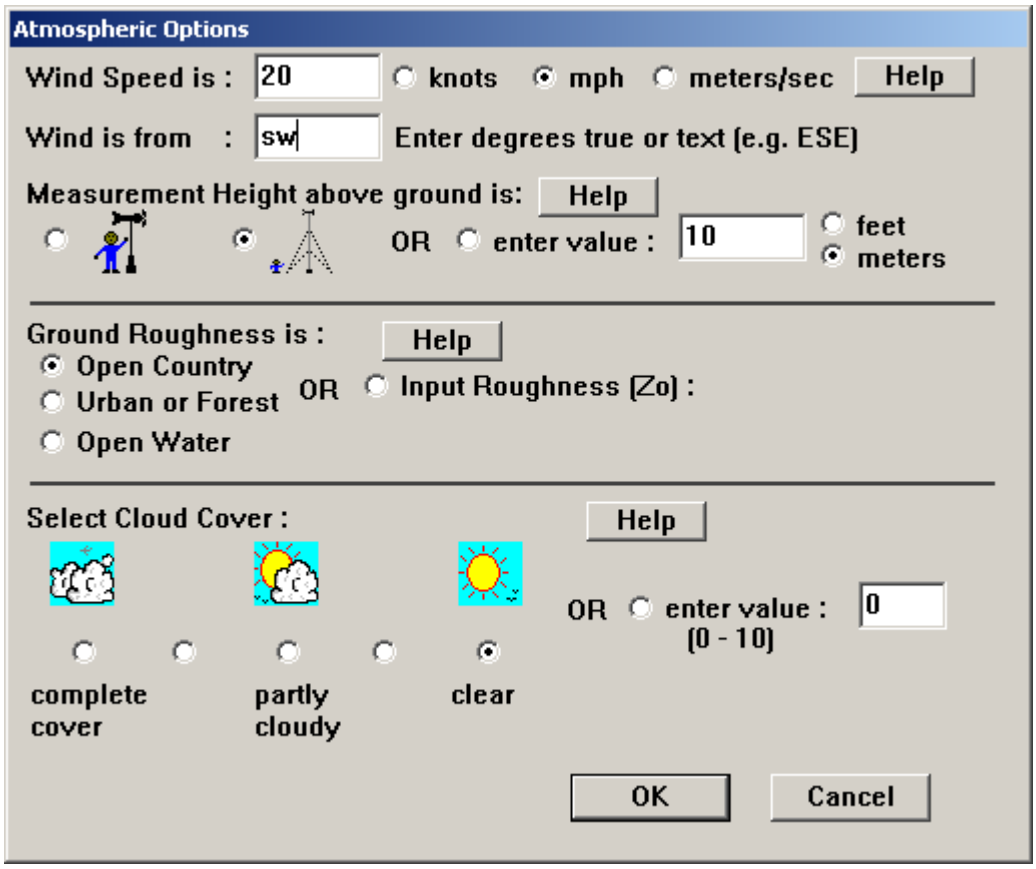


Select “OK”

You may not notice anything different about your MARPLOT screen display, but you have actually made an exact copy of the ALOHA Threat Zones. This will be important after the following steps.

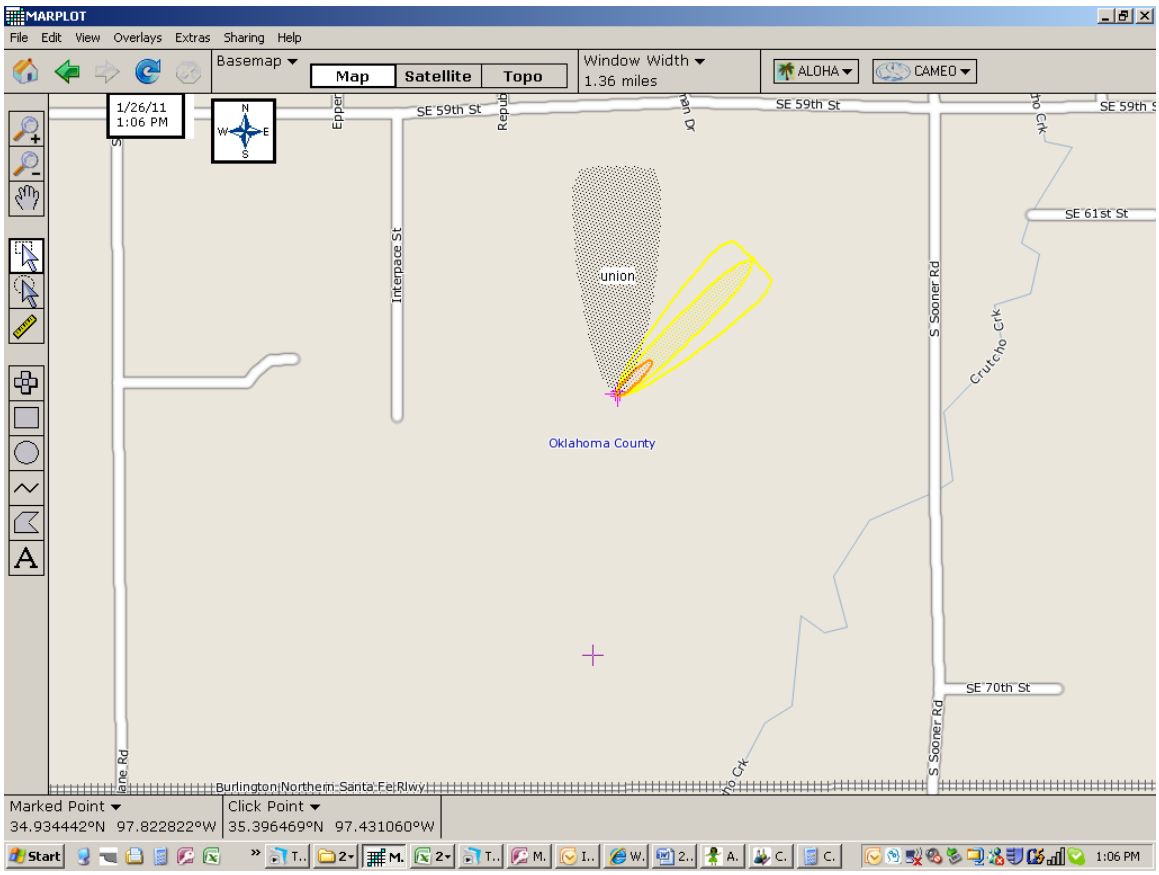
Return to ALOHA. Select the Setup / Atmospheric menu.

Change the Wind Speed to 20 mph and the Wind Direction to SW.



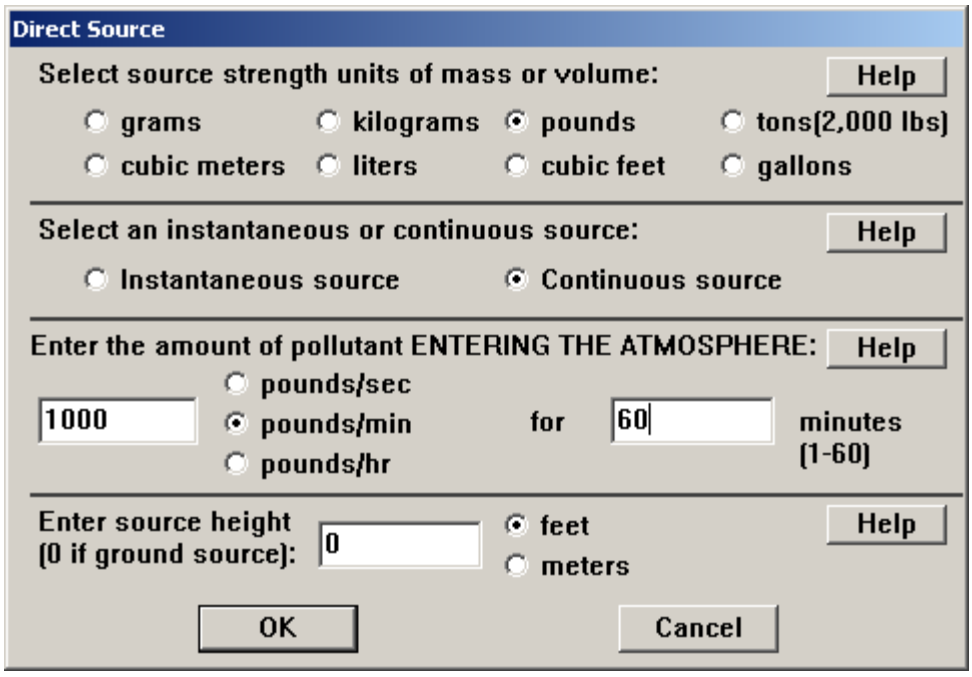
Select “OK”.

Your MARPLOT screen will look something like this.

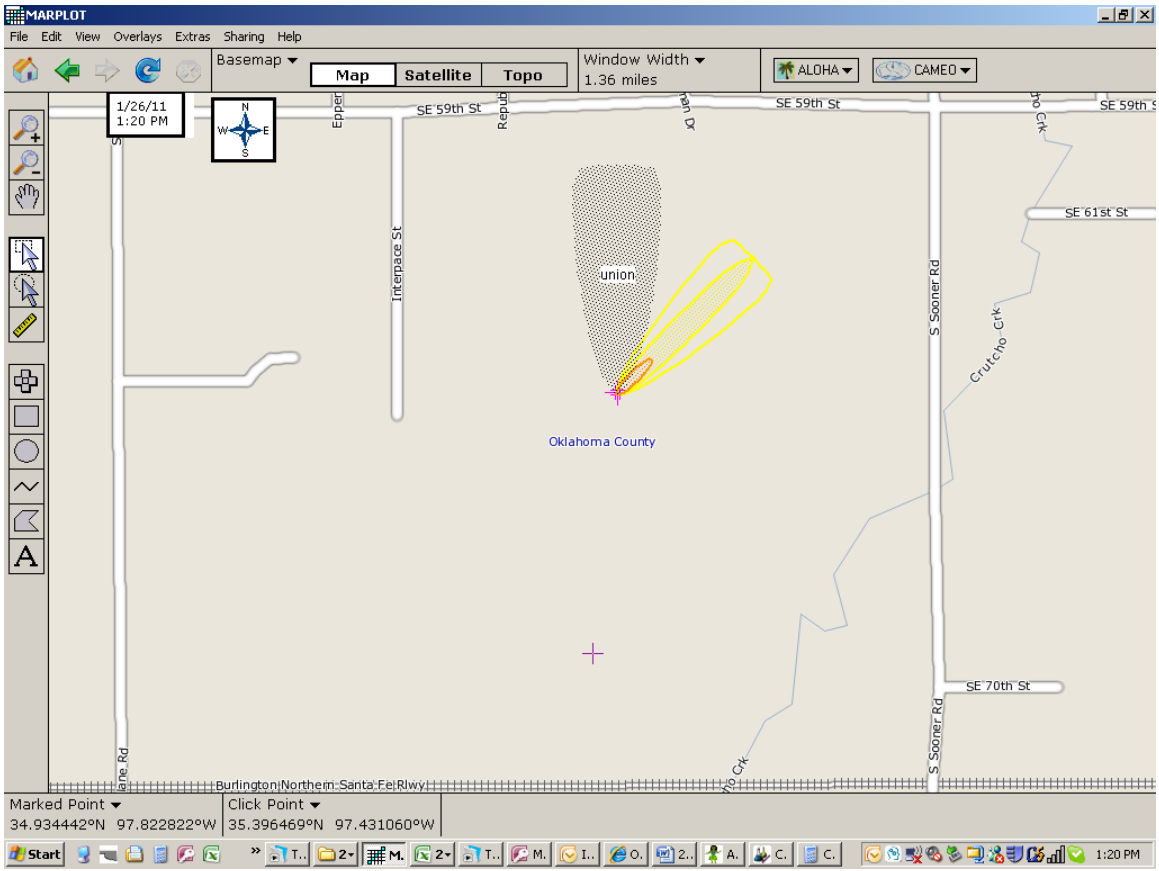


Now, lets suppose the SW Wind at 20 mph will last for about 60 minutes instead of 30 minutes, and that after the 60 minutes, the Wind Speed and Direction will change to 35 mph for 30 minutes.

Return to ALOHA and choose the Setup / Source / Direct menu. Enter “1000” pounds per minute for “60” minutes as the release rate.

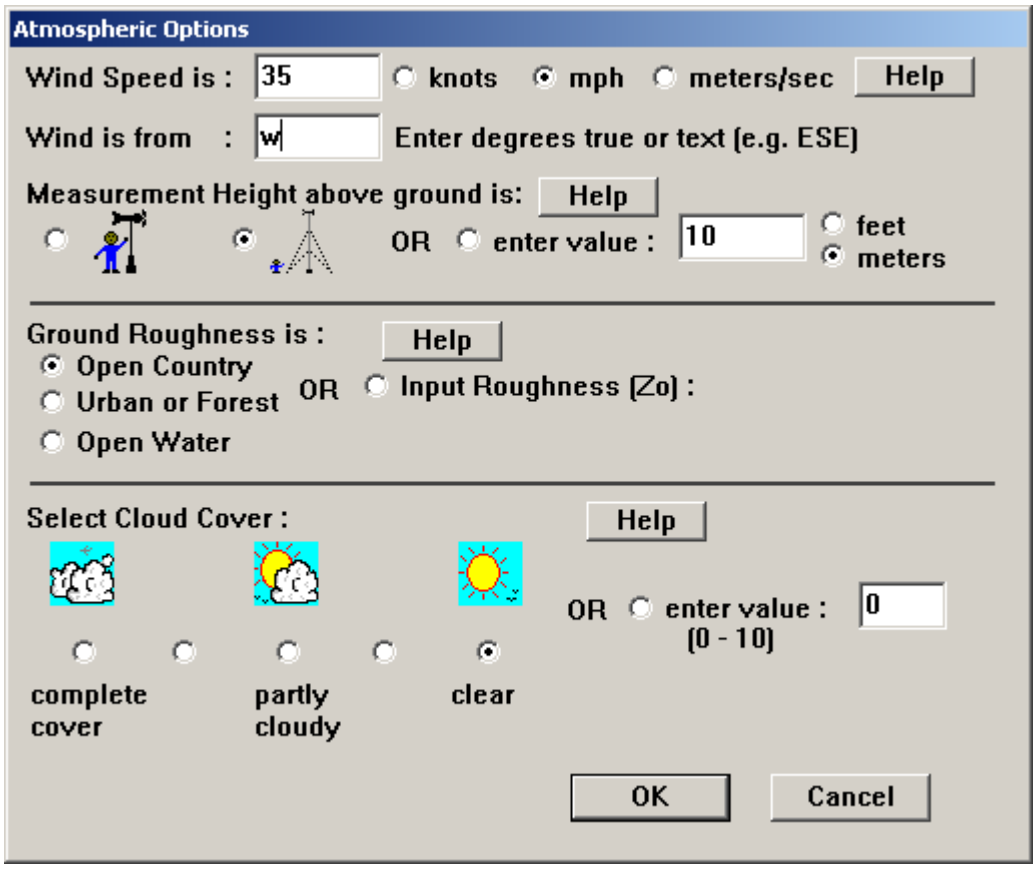


Your MARPLOT screen will look something like this…

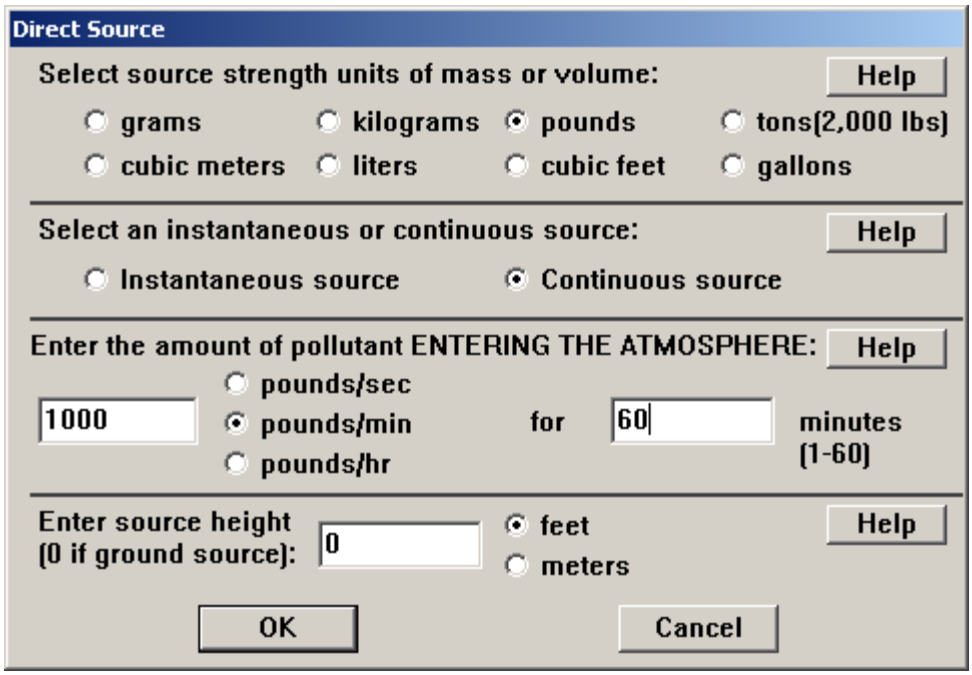


Use the “point&shift click” to select the new ALOHA Threat Zones and use the Overlays / Create New Polygon / Union to make a copy of the new Threat Zones.

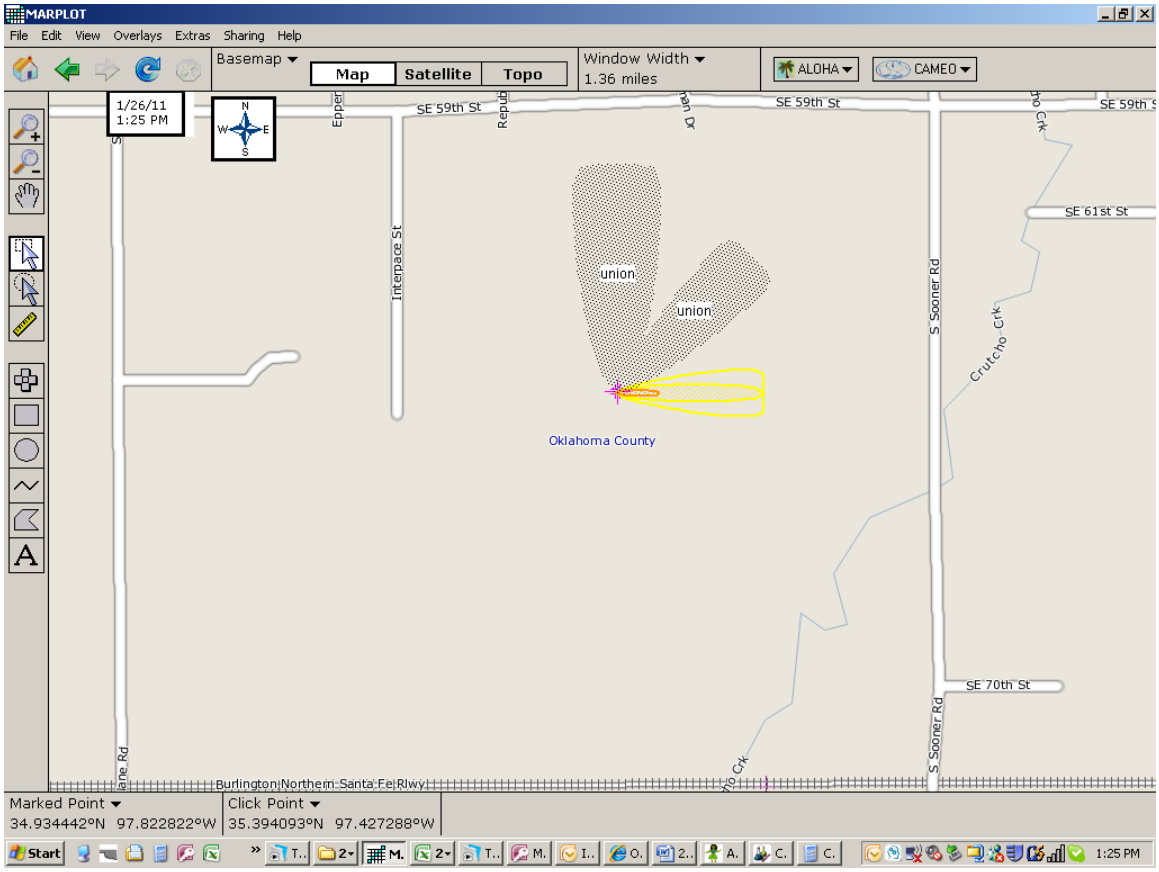
Return to ALOHA. Change the weather conditions to Wind Speed = 35 mph and Wind Direction is west.



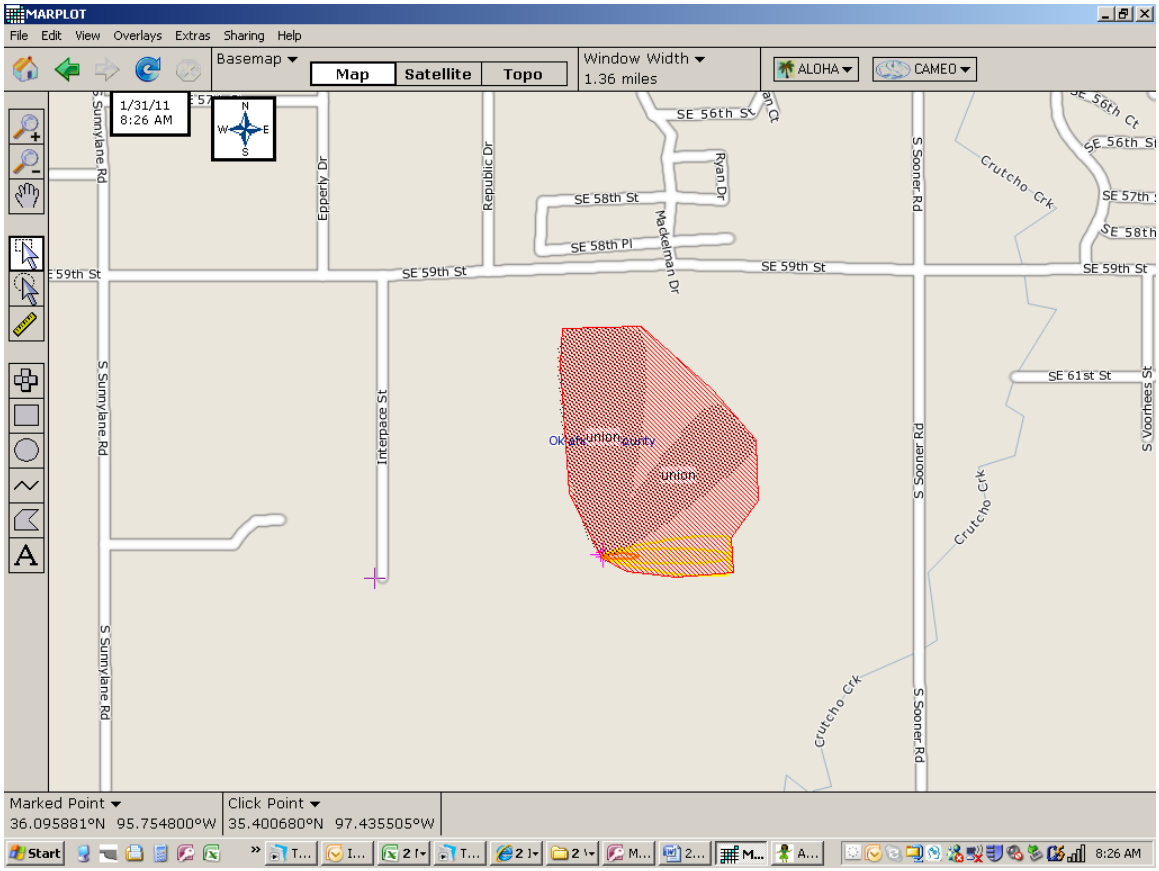
Use the Setup / Source / Direct menu to set the Release Rate to “1000” lbs per minutes for 60 minutes.



Your MARPLOT screen will look something like this…



Use the Polygon Tool to draw your own combination of the 3 Threat Zone areas.



You now have a “composite” of this incident over a 2.5 hour period. You could continue with this process indefinitely. Depending on the substance, you may need to adjust the release rate (usually by decreasing the release rate over time).

Of course, every substance and every release is different. The point of this exercise is to demonstrate a method for using ALOHA when atmospheric conditions are variable, and to use ALOHA beyond the typical “1 hour” time frame.

Please feel free to contact me with any questions you might have concerning this exercise.