Figure 11. Estimated chloropicrin air concentrations associated with the composite of the estimated chloropicrin mass released from the sprinklers and the drip application made to Block 20 of Daren's Berries, Salinas, California. Chloropicrin air concentration estimates are for the interval 1900hrs to 2000hrs (PDT) October 5, 2005. The red dot shows the location of the first 911 call received at 2015hrs. The yellow dots show locations where after the fact interviews indicate residences might have been affected during 1900-2000hrs.

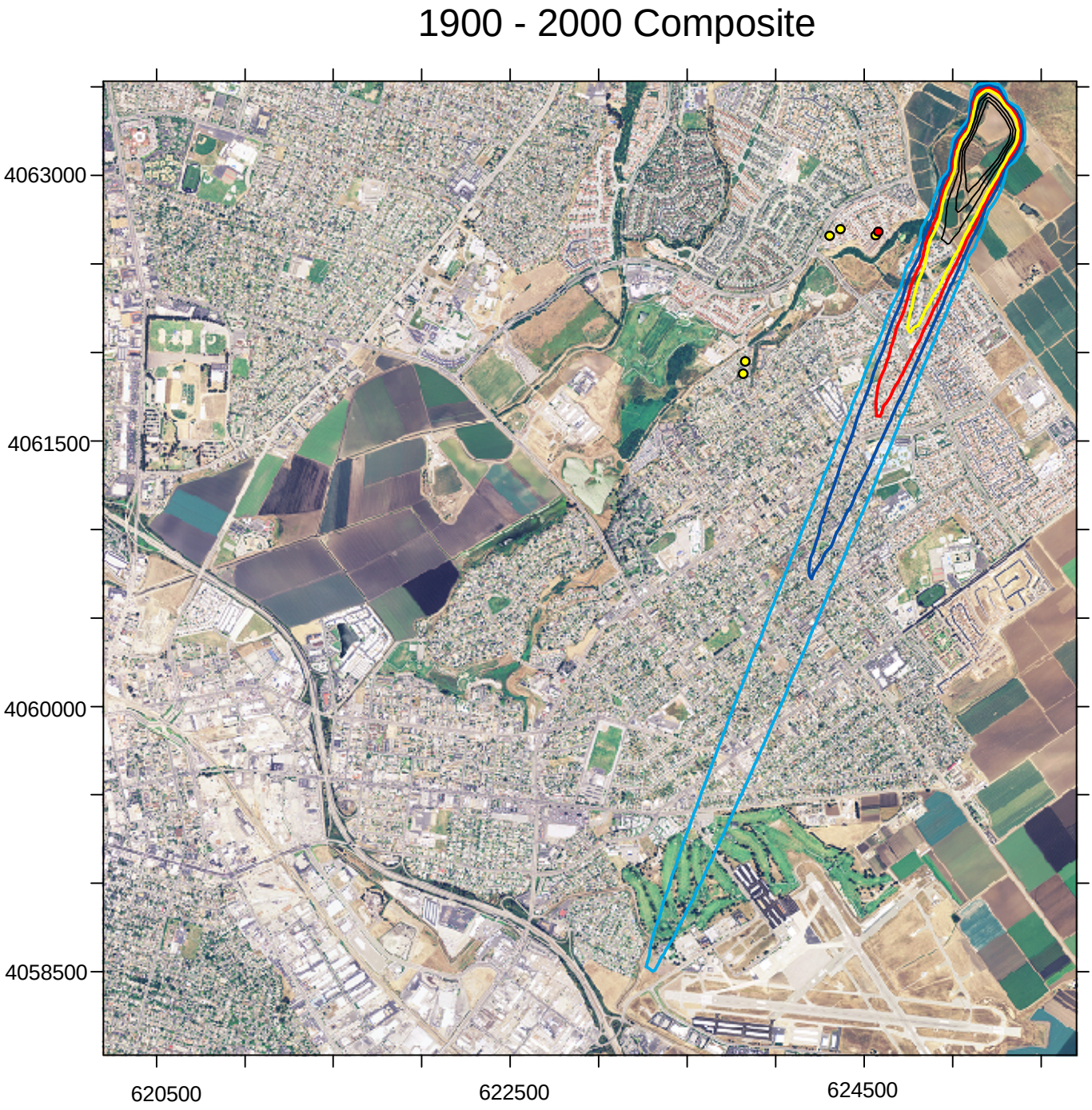


Figure 12. Estimated chloropicrin air concentrations associated with the composite of the estimated chloropicrin mass released from the sprinklers and the drip application made to Block 20 of Daren's Berries, Salinas, California. Chloropicrin air concentration estimates are for the interval 2000hrs to 2100hrs (PDT) October 5, 2005. The yellow dots show locations of 911 calls received during the hour.

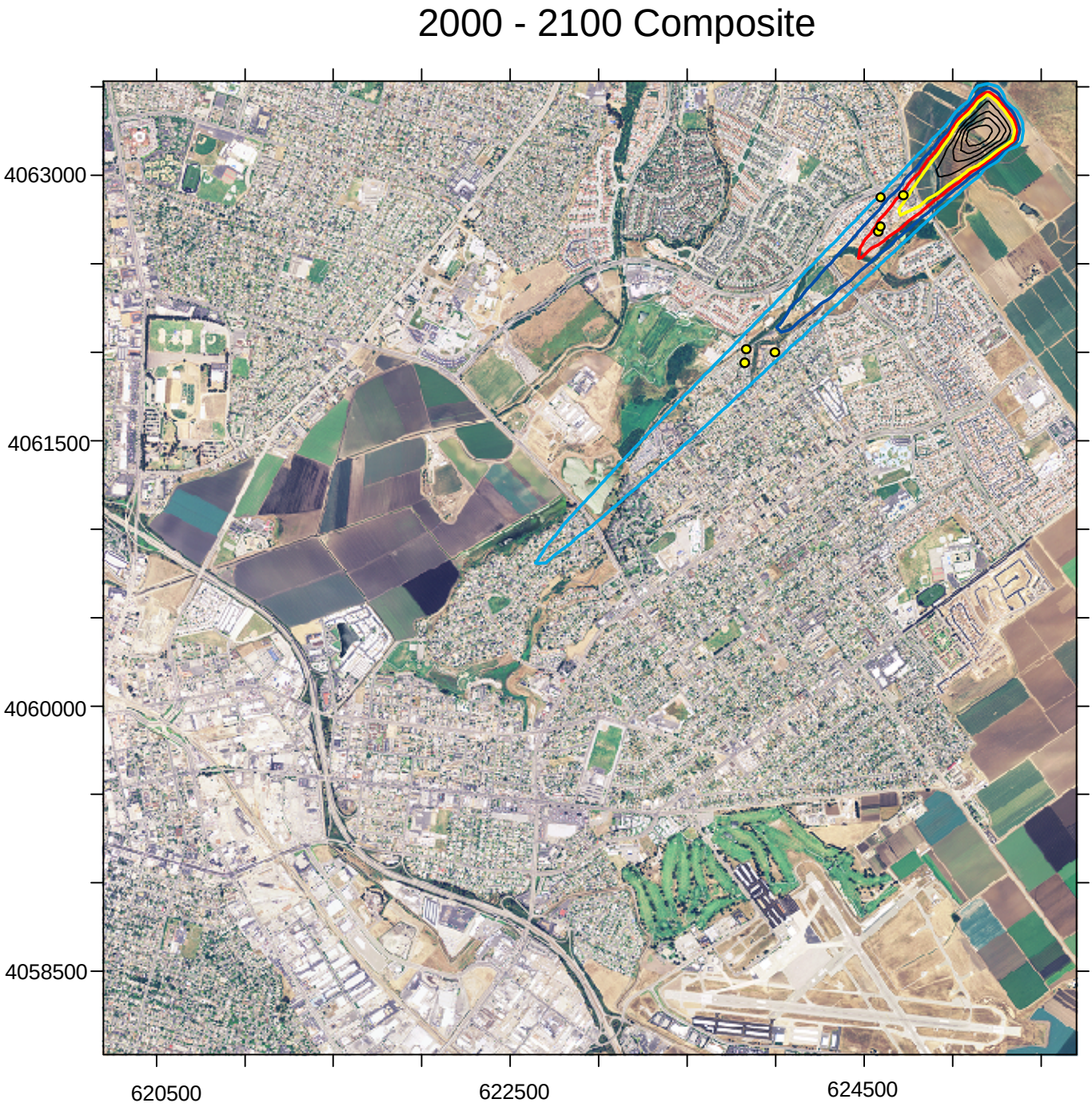
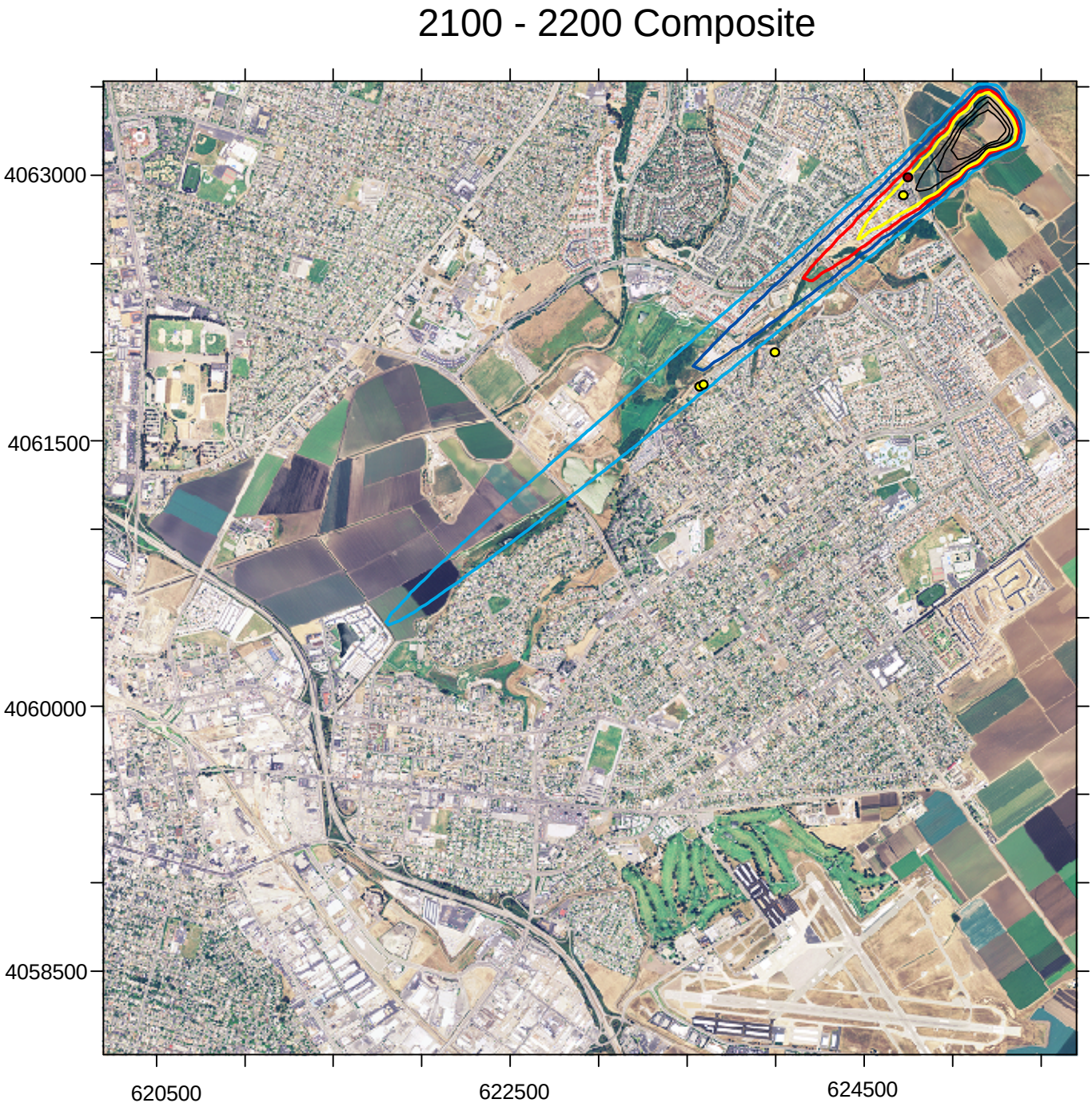


Figure 13. Estimated chloropicrin air concentrations associated with the composite of the estimated chloropicrin mass released from the sprinklers and the drip application made to Block 20 of Daren's Berries, Salinas, California. Chloropicrin air concentration estimates are for the interval 2000hrs to 2100hrs (PDT) October 5, 2005. The red dot shows the location at 2158hrs of the officer at the corner of Boronda and Constitution. The yellow dots show locations of the 911 calls received during the hour.



Appendix A

Generic ISCST3 Input File

```
CO STARTING
CO TITLEONE Salinas chloropicrin incident 10/5/06
CO MODELOPT CONC RURAL NOSTD NOBID NOCALM
CO AVERTIME PERIOD
CO POLLUTID OTHER
CO DCAYCOEF 0.000
CO TERRHGTS FLAT
CO FLAGPOLE 1.2
CO RUNORNOT RUN
CO ERRORFIL E20.err
CO FINISHED

SO STARTING
SO LOCATION blk20 AREApoly 625116 4063260
SO SRCPARAM blk20 0.0001000 0.0 8
so areavert blk20 625116 4063260 625168 4063311 625205 4063404
so areavert blk20 625175 4063450 625217 4063551 625409 4063305
so areavert blk20 625296 4063223 625209 4063170
SO EMISUNIT 0.10000E+7 (GRAMS/SEC) (MICROGRAMS/CUBIC-METER)
SO SRCGROUP ALL
SO FINISHED

RE STARTING
RE gridcart 1 STA
RE gridcart XYINC 620200 56 100 4058031 56 100
re gridcart flag 1 56*1.2
re gridcart flag 2 56*1.2
re gridcart flag 3 56*1.2
re gridcart flag 4 56*1.2
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re gridcart flag 11 56*1.2
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re gridcart flag 52 56*1.2
re gridcart flag 53 56*1.2
re gridcart flag 54 56*1.2
re gridcart flag 55 56*1.2

re gridcart flag 56 56*1.2
RE gridcart end
RE FINISHED

ME STARTING
ME INPUTFIL Salinas1.txt (4I2,2F9.4,F6.1,I2,2F7.1)
ME ANEMHGHT 10.0 METERS
ME SURFDATA 99999 2002 SURFNAME
ME UAIRDATA 99999 2002 UAIRNAME
ME WINDCATS 1.54 3.09 5.14 8.23 10.8
ME FINISHED

OU STARTING
OU PLOTFILE PERIOD ALL Blk20_1.dat
OU FINISHED

Appendix B

Spatial Uncertainty Estimation

The Sajo (2003) technique requires an estimate of the standard deviation of horizontal wind direction (σ_θ). This technique uses the standard deviation of horizontal wind direction (σ_θ) to calculate bounds on the plume centerline location. This method yields a confidence interval on the centerline plume direction using the CIMIS meteorological data. To use this method values must be specified for two measures of uncertainty associated with the dispersion model ensemble mean concentrations. These two measures of uncertainty are the factor of validity, n, and the logarithmic standard deviation of the local concentration (σ_l). The factor of validity is a function of σ_θ, y_0 (crosswind location), and the confidence level (*Ci*) and provides an upper and lower bound on the actual concentration at a location given the model computed ensemble mean (e.g. $\chi(x_0, y_0) = n(Ci)\bar{\chi}(x_0, y_0)$, where $\bar{\chi}\ (x_0, y_0)$ = model ensemble mean predicted concentration at location (x_0, y_0)). In this analysis $y_0 = 0$ because only the uncertainty in the location of the centerline will be estimated. Model uncertainty, and thus the value of n, can vary widely depending upon the conditions under which the predictions are made. Hanna (1982) has placed model uncertainty between 2 and 10. Miller and Hively (1987) report for ground level sources under low wind speed conditions predicted-to-observed ratios of 1 to 100 and σ_l = 1.77 (geometric standard deviation = $\sigma_g \sim 6$). Van der Hoven (1981) has characterized the predicted-to-observed ratio for ground-level releases under low wind speed conditions as about an order of magnitude (a factor of 10). In practice, n and σ_g are often assumed to have the same value (Sajo, per. comm., 2005).

The equations needed to estimate the spatial uncertainty are shown below:

$\Delta\vartheta$ = ½ width of the confidence interval on the plume centerline (radians)

$$\Delta\vartheta = \tan^{-1}(\sigma_\theta \sqrt{G(n, \sigma_l)}) \qquad (1)$$

Where:

$$G(n, \sigma_l) \equiv -\sigma_l^2 \pm \sqrt{4\ln^2(n) + 12\sigma_l^2 \ln(n) + \sigma_l^4} \text{ = scaling parameter} \qquad (2)$$

Only the positive solution for $G(n, \sigma_l)$ has physical meaning (Sajo, 2003).

The confidence interval is:

$$Centerline \pm \Delta\vartheta$$

For this estimate of spatial uncertainty, n = 2 (under the atmospheric conditions present during the incident ISCST3 is assumed to produce concentrations within a factor of 2 of actual) and σ_l = 1.77 (Miller and Hively, 1987). The chosen value of n may be somewhat small for the 1900hr-2000hr because the standard deviation of horizontal wind directions is relatively large (64.2°). However, using a small n will result in a smaller uncertainty bound. If the bound captures the incident locations then a larger bound is not necessary. An n value of 2 is reasonable for 2000hrs–2100hrs and 2100hrs–2200hrs. Thus, a uniform scaling parameter, $G(n,\sigma_l) = G(2,1.77)$ can reasonably be used for all 3 hours of the incident. The spatial uncertainty bounds will have approximately an 80% confidence level. The confidence level is related to the choice of n and σ_l. The values of n and σ_l chosen are relatively small so the bounds are somewhat narrow, thus the confidence level is lower than the conventional 90% or 95%. However, as stated above, if the bound capture the incident locations a larger confidence level in unnecessary.

The estimates are shown below. Calculations are performed in radians, results are shown in degrees. See Sajo (2003) for details and theory regarding derivation of the estimates.

Scaling Parameter:

n = 2
σ_g = 5.87 $\Rightarrow$ σ_l =1.77

$$G(n,\sigma_l) \equiv -\sigma_l^2 \pm \sqrt{4\ln^2(n) + 12\sigma_l^2 \ln(n) + \sigma_l^4}$$

$$G(2,1.77) = -(1.77)^2 \pm \sqrt{4\ln^2(2) + 12(1.77)_l^2 \ln(2) + (1.77)^4} = 3.0149$$

1900hrs–2000hrs

σ_θ = 64.2° = 1.1205 radians
plume centerline direction = 202.2°

$$\Delta\vartheta = \tan^{-1}(1.1205\sqrt{3.0149}) = 1.0958\ radians = 62.8^o$$

Bounds on plume centerline spatial uncertainty = $202.2^o \pm 62.8^o = (139.4^o, 265.0^o)$

Thus, with approximately 80% confidence, the centerline direction for the chloropicrin plume emitting from Block 20 during 1900hrs–2000hrs PDT on October 5, 2005 lies between approximately 140° and 265°.

2000hrs–2100hrs

$\sigma_\theta = 13.9^\circ = 0.2426$ radians
plume centerline direction = 225.9°

$\Delta\vartheta = \tan^{-1}(0.2426\sqrt{3.0149}) = 0.3986\ radians = 22.84^o$

Bounds on the plume centerline spatial uncertainty = $225.9^o \pm 22.8^o = (203.1^o, 248.7^o)$

Thus, with approximately 80% confidence, the centerline direction for the chloropicrin plume emitting from Block 20 during 2000hrs–2100hrs PDT on October 5, 2005 lies between approximately 203°° and 249°.

2100hrs–2200hrs

$\sigma_\theta = 21.2^\circ = 0.3700$ radians
plume centerline direction = 230.3°

$\Delta\vartheta = \tan^{-1}(0.3700\sqrt{3.0149}) = 0.5710\ radians = 32.72^o$

Bounds on the plume centerline spatial uncertainty = $230.3^o \pm 32.7^o = (197.6^o, 263.0^o)$

Thus, with approximately 80% confidence, the mean centerline direction for the chloropicrin plume emitting from Block 20 during 2100hrs–2200hrs PDT on October 5, 2005 lies between approximately 198°° and 263°.