## Appendix L. Development of a Commercial Industrial Watershed for the Evaluation of Aquatic Exposure from Pesticide Applications

To evaluate the industrial and commercial lawn uses of acephate, a watershed was developed with commercial buildings, parking lots and roads in order to evaluate the potential loading of acephate to aquatic environments from these types of uses. Because information on lot sizes and fractions of impervious surfaces were not available, the water shed was set up so that different lot sizes and impervious fractions could be evaluated, and lot size and number which generated the highest EECs was chosen for use in risk assessment.

The water shed for this assessment was assumed to be the same size as the standard farm pond watershed of 10 ha (100,000 $m^2$) and the water body use was the 1 ha standard pond. A 1000 $m^2$ building was placed on each lot, and it was assumed that half of each lot was parking lot. In addition, a sidewalk was placed around the edge of each lot. Each lot was on its own block with a road grid separating the lots. The watershed was assumed to be square, so the length and width of the water shed was square root of 100,000 $m^2$, or 316 m. Roads bordered the whole watershed. Roads were assumed to be 18 m (~59 ft) wide. The area of each road is 316 m x18 m or 5692 $m^2$. Total area of roads, is the number of roads single road area times the number of roads minus the area of intersections. For example, if there are 3 north-south roads, and 4 east-west roads, there are7 total roads and 12 intersections so the total road area is 5692 x 7 – 12 x $18^2$ = 35,957 $m^2$. The total area in lots was the remainder of the watershed. For the previous example, that would be 100,000 $m^2$ – 35,957 $m^2$ = 64,043 $m^2$.

The area of each lot was figured as the total area of lots divided by the number of lots. If, as in the previous example, if there are 3 north-south roads, and 4 east-west roads, there would be 20 lots, and the area of each lot would be 3,202 $m^2$. All area on each lot that was not impervious surface was assumed to be lawn. There are three kinds of impervious surface on each lot (Figure 1). Parking lot, building, and side walk. Parking lots were assumed to take up half of each lot and the building area was assumed to be 1000 $m^2$. The sidewalk was assumed to border each road on the half of the lot that had lawn. Sidewalks were assumed to be 1 m wide. The length of side walk was calculate by taking the side length of the water shed, subtracting out the total road width along that side, and dividing by number of lots the watershed was divided into along that direction. For example, with a watershed width of 316 m, which is crossed by 3 north south roads, the total road width is 3 x 18 m = 54 m. Therefore the total length of sidewalk is 316 – 54 m = 262 m. There are 4 lots in this direction so the length of side walk along a lot in this direction is 262 m / 4 = 65.5 m. Similarly the length of sidewalk along each lot in the east-west direction is 48.8 m. If the sidewalk went all the way around each lot the total length of side walk would be 2 x (48.8 + 54) – 4 $m^2$ = 224.6 m. The subtraction of 4 $m^2$ accounts for the places where sidewalks intersect. However, since the side walk only borders the half of each lot with lawn, the sidewalk length is half of this or112.3 $m^2$. Since the sidewalks are 1 m wide the total area of sidewalk is 112 m and the area of lawn (for this example is (3,202 $m^2$ – 3,202 $m^2$/2 – $1000^2$ – 112.3 $m^2$) = 488.7 $m^2$. For this example watershed, the total area of lawn is 9.770 $m^2$ or 9.8% of the watershed with balance (90.2%) being impervious surface.

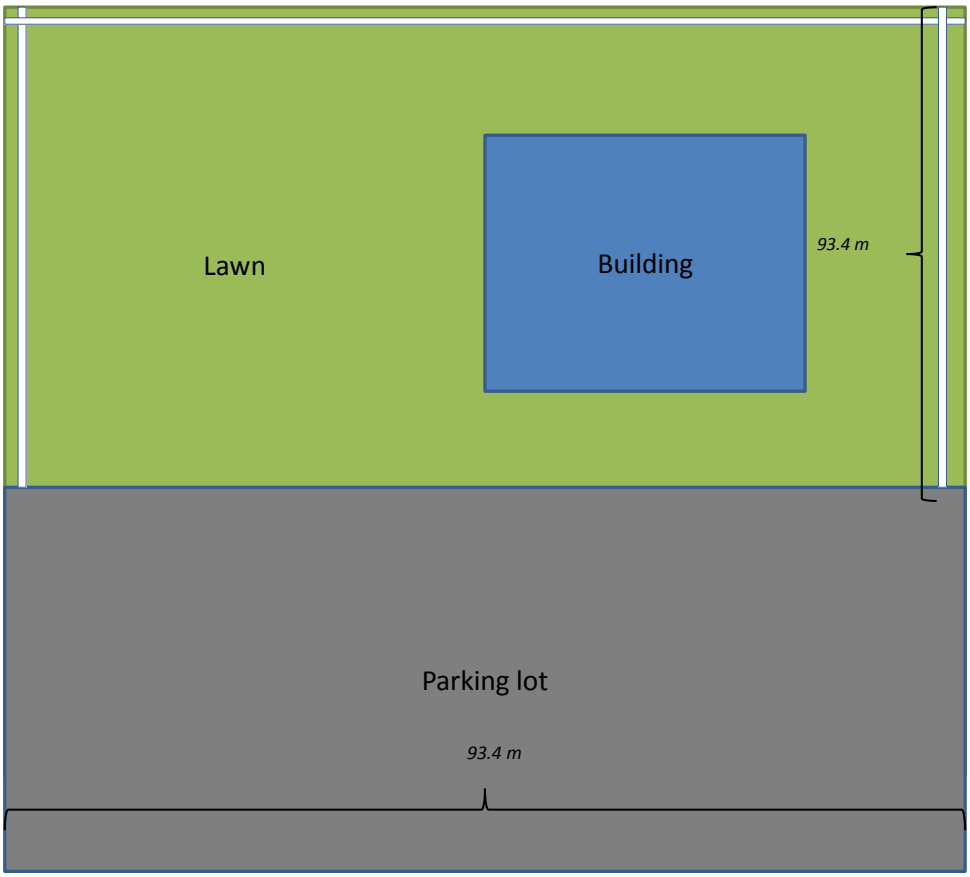


**Figure 1. Lot Design for Commercial Lawn Watershed with 9 lots in the watershed. The lot is 8725 $m^2$. The building is 1000 $m^2$.**

The next step in estimating the EEC is to find the fraction of the total lawn and impervious area that is treated. For the acephate labels for commercial lawns, building perimeter treatments and spot treatments are allowed. For the building perimeter, it was assumed that a 1 m swath around the perimeter of the building each building was treated. The total perimeter length of a square 1000 $m^2$ building is square root of 1000 or 31.6 m x 4 = 126 m, so the treated area for each building is 126 $m^2$. To represent the spot treatment, one half of the remaining lawn on each lot is assumed to be treated. (It is highly likely that spot treatments would be less than this. For the example with 20 lots in the watershed, the spot treatment area is (488.7 $m^2$ – 126 $m^2$) / 2 = 181 $m^2$. With twenty lots the total treated area is 181 x 20 or 3627 $m^2$ or 3.6% of the whole watershed.

In this scenario, impervious area is not treated directly, but incidentally from the spot and perimeter treatments. The incidentally treated areas were assumed to include a 1 m swath along the edge of each parking lot, a 1 m swath along each road frontage, and the whole sidewalk on each lot. This was multiplied by the fraction of the lawn which received a spot treatment of 0.5. The calculation of the road length around each lot is identical to the sidewalk length calculation above. The length of parking lot frontage along the lawn was assumed to be the width of the lot. For the above example, the treatable length of sidewalk and road for each lot is 488.7 $m^2$ for a total of 977.4 $m^2$. The area of treated parking lot is 48.8 m if we assume that the lot is divided across the short direction so the treated parking lot is 48.8 $m^2$ with a total treated impervious

surface per lot of 1026 $m^2$. Since only half of this is being treated, the impervious area treated per lot is 513 $m^2$ in this example. With 20 lots, the total treated area in the watershed is 10, 262 $m^2$ or 10.2% of the watershed.

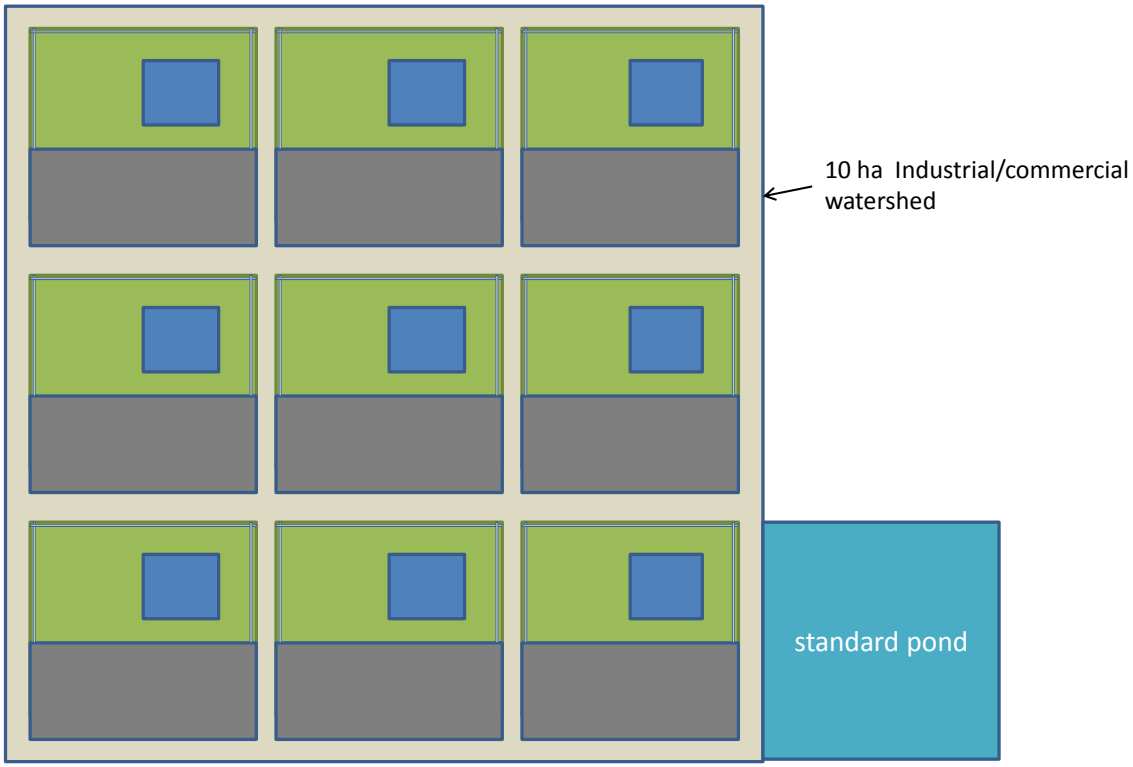


**Figure 2. A standard industrial/commercial watershed for evaluating pesticide exposure from commercial and inudstrial lawns. Total impervious surface is 72%. Lawns area is 28%.**

Based on the calculations described above, the number of lots in the water shed can be varied and the fraction of the watershed which is impervious can be calculated. The typical impervious fraction for industrial watershed is 72% (National Resources Conservation Service, 2004). When the watershed is divided into 9 lots, the impervious fraction is 71.4% and the lawn area is 28.6%. A diagram of this watershed is in Figure 2. Each lot is 3177 $m^2$ and is 56 m on a side. The treated area of lawn for acephate, assuming half is treated is 14.3%. The fraction of treated impervious surface is 2.7%

## References

Natural Resource Conservation Service. 2004. *Part 630. National Engineering Handbook: Hydrology. Chapter 9.* United States Department of Agriculture. Washington, DC