



Department of Pesticide Regulation



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MEMORANDUM

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SUBJECT: RELATIONSHIP OF YEARLY BROMACIL USE TO BROMACIL
DETECTIONS IN WELLS LOCATED IN FRESNO AND TULARE COUNTIES
OF CALIFORNIA

Background

The Pesticide Contamination Prevention Act (PCPA, AB 2021, Chapter 1298, Statutes of 1985) mandated DPR to detect and regulate ground water contaminants. One aspect of DPR's implementation of the PCPA is the creation of Pesticide Management Zones (PMZs) which are one square mile sections of land where one or more pesticides have been detected in ground water and where the contamination was determined to result from legal agricultural use. Agricultural uses of a subset of detected pesticides are allowed in PMZs, but a permit for use must be obtained from the County Agricultural Commissioner (CAC). Advisories outlining best management practices must accompany the permit. To date, pesticide use is regulated in 489 square miles of land designated as PMZs of which 311 are located in Fresno and Tulare Counties (Figure 1).

The DPR, in cooperation with various universities, local and county agencies, and growers has conducted studies to determine the processes by which pesticides move to ground water. An empirical analysis of spatial vulnerability related pesticide movement to areas where coarse soils were predominant or to areas where soils contained a hardpan (Troiano et al., 2000). In the coarse soil condition, movement was related to leaching of residues from the soil surface. This is the most recognized process associated with movement of pesticides to ground water. In contrast, areas with hardpan soils were vulnerable due to the movement of pesticides in runoff water. One route of rapid movement of runoff water to ground water is through dry wells (Braun and Hawkins, 1991).

Studies have been conducted to test the effectiveness of mitigation measures to reduce the movement of pesticides to ground water under runoff conditions. In a DPR study by Troiano and Garretson (1998), major reductions of pesticide material leaving the site were obtained in a



citrus grove when a pre-emergence herbicide was mechanically incorporated into the top two inches of soil. This resulted in a recommendation to growers located in runoff areas to incorporate their pre-emergence herbicides into the soil before the first heavy rain. Thus, residues would be moved into the soil, preventing movement of residues in runoff water. Other studies conducted by university researchers have indicated that the use of cover crops in row middles or contact herbicides would also mitigate contamination (O'Connell and Liu, 2002a and 2002b).

The mitigation program developed by DPR maintains the use of pesticides but it relies on the adoption of new management practices by growers. Many of the PMZs in Tulare County have intense citrus production with citrus reported in 167 of 202 PMZs (Figure 2). The citrus industry has expressed reluctance to change their current cultural practices. Concerns voiced about the suggested mitigation measures are: (1) mechanical incorporation may have a detrimental effect on the tree roots located near the surface of the soil or there may be potential liability due to a work hazard situation; and (2) growing a cover crop in the row middle or shallow tilling increases the threat of frost damage because mature fruit are present during the winter months.

One potential solution suggested by the citrus industry is to stagger the use of pre-emergence herbicides on a yearly basis. For example, use of bromacil would occur every one or two out of three years with the herbicide applied using the standard practice of broadcasting the application onto the soil surface. The objective of this investigation was to determine patterns of bromacil use in sections that are currently PMZs and in sections adjacent to the PMZs. The pattern of use was then compared to the detection history for bromacil detections in wells located in the PMZs. These combined data were related to the suggestion of staggering pre-emergence use without physical changes in incorporation methods.

Discussion

Bromacil is one of the pre-emergence pesticides currently listed as a ground water contaminant by DPR and has been widely used in Fresno and Tulare Counties by the citrus industry. Bromacil is also registered for use on rights-of-way (ROW). Pesticide Use Report (PUR) data reported between 1990 and 2000 were studied to compare the amounts used on ROW versus citrus (oranges, lemon, citrus, etc.) crops. Bromacil use in citrus in Tulare County represents approximately 90 percent of the total use (Figure 3).

The DPR established a well monitoring network in Fresno and Tulare County during the fall of 1999. The wells were chosen because they had previous detections of pre-emergence herbicide residues and they were located in vulnerable areas. These domestic wells are sampled twice a year, in the spring and fall, for presence of pesticides on the 6800a list. Data from the earliest sampling date and the later monitoring dates through spring of 2002 were combined and a

regression analysis was conducted for each well (SAS Institute Inc. 1988) to determine if any trends in bromacil concentrations could be detected. Six of 32 wells containing bromacil residues were identified as having a significant increase in bromacil concentration (Table 1).

Bromacil use data was obtained from the PUR between 1990 and 2000 for those sections containing wells that indicated a significant increase in bromacil concentration. Bromacil use was calculated for the section in which the well was located and in each of the eight sections adjacent to the well. Specific use patterns for the 11-year period and bromacil concentration from the latest spring sampling in 2002 for each of the six wells were:

Site 32 (Figure 4) was located in Fresno County in the southwest portion of the section. The bromacil concentration observed during April 2002 was 0.067 ppb. Bromacil use was not reported for the section with the well or in the eight adjacent sections. Although there was no reported use of bromacil near the well, potential sources of bromacil include:

- 1) Rights-of-way use because use is only reported at the county level and not for each specific Township/Range/Section.
- 2) A small citrus crop was present in the section as determined by observation of land use data. Bromacil is only registered for use on citrus so bromacil may have been used on the crop but not reported.
- 3) The aquifer may have been contaminated from use located more than 1 mile from the investigated area.

Site 59 (Figure 5) was located in Tulare County in the southeast portion of the section. The bromacil concentration observed during March 2002 was 0.963 ppb. Total bromacil use in the section was low with only 35 pounds reported over the 11 years. Between 3 to 7 pounds were reported each year, except in 1993 and 1995 when no use was reported. Total bromacil use in the eight adjacent sections ranged from 0 to 1006 pounds. Adjacent section A7 had no use reported and six others received 201 pounds or less. Furthermore, three of these six sections had eight consecutive years of no reported use between 1991 and 1998. The longest string of years with consecutive use of 100 pounds or more was in adjacent section A2 for a two-year period between 1994 and 1995. However, bromacil use was reported in A2 during 1993 and 2000.

Site 61 (Figure 6) was located in Tulare County in the southwest portion of the section. The bromacil concentration observed during March 2002 was 0.348 ppb. Bromacil use was reported in the Site 61 section for five of the 11 years. There was consecutive use between 1990 and 1992 totaling 320 pounds but with only 12 pounds reported in 1991. A break in use occurred in 1993, followed by only 22 pounds in 1994, another break in 1995 and again 22 pounds reported in 1996. There was no reported use after 1996 for the adjacent sections; bromacil use was not reported in two of the eight adjacent sections (A1 and A8). Total bromacil use for the 11-year period ranged from 255 to 1111 pounds in the remaining six adjacent sections. Many of the sections had either breaks in use between years or a year with low reported use between years of

much larger use. Section A2 had the highest reported use for years 1990 and 1992 at over 400 pounds for each year but less than 100 pounds of use was reported in 1991.

Site 69 (Figure 7) was located in Tulare County in the northwest portion of the section. The bromacil concentration observed during March 2002 was 1.57 ppb. Bromacil use was reported in the Site 69 section in nine of the 11 years. There was consecutive use between 1991 and 1998 totaling 594 pounds but only one of those years (1993) had reported use over 100 pounds. Total use in the section was less than 60 pounds during four of those years in that period. Use was reported in 1990 and 2000. For the eight adjacent sections, total bromacil use ranged from 66 to 887 pounds. Use in sections A2, A3, A5, A6, A7, and A8 are characterized as low and sporadic between years. More consistent use was noted in sections A1 and A4 but only section A1 had 3 consecutive years where use was greater than 100 pounds on a yearly basis.

Site 75 (Figure 8) was located in Tulare County in the northeast portion of the section. The bromacil concentration observed during March 2002 was 0.219 ppb. Bromacil use was reported in the Site 75 section in eight of the 11 years. Use was not reported in 1990, 1993, and 1999. Total bromacil for the 11 years was 521 pounds and there was only 1 year where use was greater than 100 pounds in 1991. For the adjacent sections, bromacil use was reported in all of the eight adjacent sections ranging from 75 to 1286 pounds. Section A1 only had one year of reported use in 2000 of 75 pounds. Use was fairly consistent in the remaining sections with many years of consecutive use below 100 pounds. Section A2 had relatively higher use with 5 of the years reporting use of greater than 100 pounds but there breaks of years of lower use between the years of higher use.

Site 87 (Figure 9) was located in Tulare County in the northwest portion of the section. This section is only adjacent to seven sections because of a shift at a parallel line in the Township Range Section system. The bromacil concentration observed during March 2002 was 0.615 ppb. Bromacil use in the Site 87 section was reported in each of the 11 years and total 557 pounds. There was only one year when use was greater than 100 pounds in 1999. For the adjacent sections, total use ranged from 134 to 1716 pounds for the 11 years. Use in Section A7 was very low and sporadic with only 3 years of reported use. Very high use was observed in sections A1 and A2 with 1705 and 1716 total pounds, respectively. The pattern in A1 was relatively consistent whereas A2 had years where use was greater than 300 pounds but years with lower use were sandwiched between them.

Conclusions

The suggestion of staggering herbicide use as a mitigation measure is based upon the premise that all growers are currently following the same annual pattern of pre-emergence applications and that departure from the current use pattern will mitigate further contamination. The data for bromacil use varied between years with no use recorded for some years. This pattern indicates that the use of bromacil is already staggered so the benefit of further staggering use is unclear.

In addition, the proposal to have breaks in yearly use would not necessarily mean that a given section would receive no applications of bromacil within any year. It only means that a subset of growers farming in a section of land who used bromacil during a particular year would not use it in the section during the subsequent year. Other growers farming in that section might use it. In this investigation, bromacil use in most of the sections and in many of the surrounding sections was low indicating that a simple reduction in the mass of bromacil applied in runoff areas only staggers the points of ingress of runoff into the subsurface. Furthermore, periods of no use would represent an exaggerated condition of staggered use where none of the growers in a section would report use. Bromacil concentrations in these six wells were increasing even though some of the sections had years with no reported use. Similar patterns in bromacil use were observed in the adjacent sections.

The detections in section 32 were particularly interesting and illustrate potential caveats in relating detections to use data reported in the PUR. The sources could have been due to rights of way use, unreported use, or to contamination of the aquifer by use outside of the investigated area. An in-depth investigation should be conducted to determine the exact sources of residues for this well. On the other hand, data for the other 5 sections indicate that the suggestion of staggered use in runoff areas has a low probability for success in mitigating detection of bromacil in ground water.

References

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PART 2: FIGURES AND TABLES FOR:

**RELATIONSHIP OF YEARLY BROMACIL USE TO
BROMACIL DETECTIONS IN WELLS LOCATED IN
FRESNO AND TULARE COUNTIES OF CALIFORNIA**

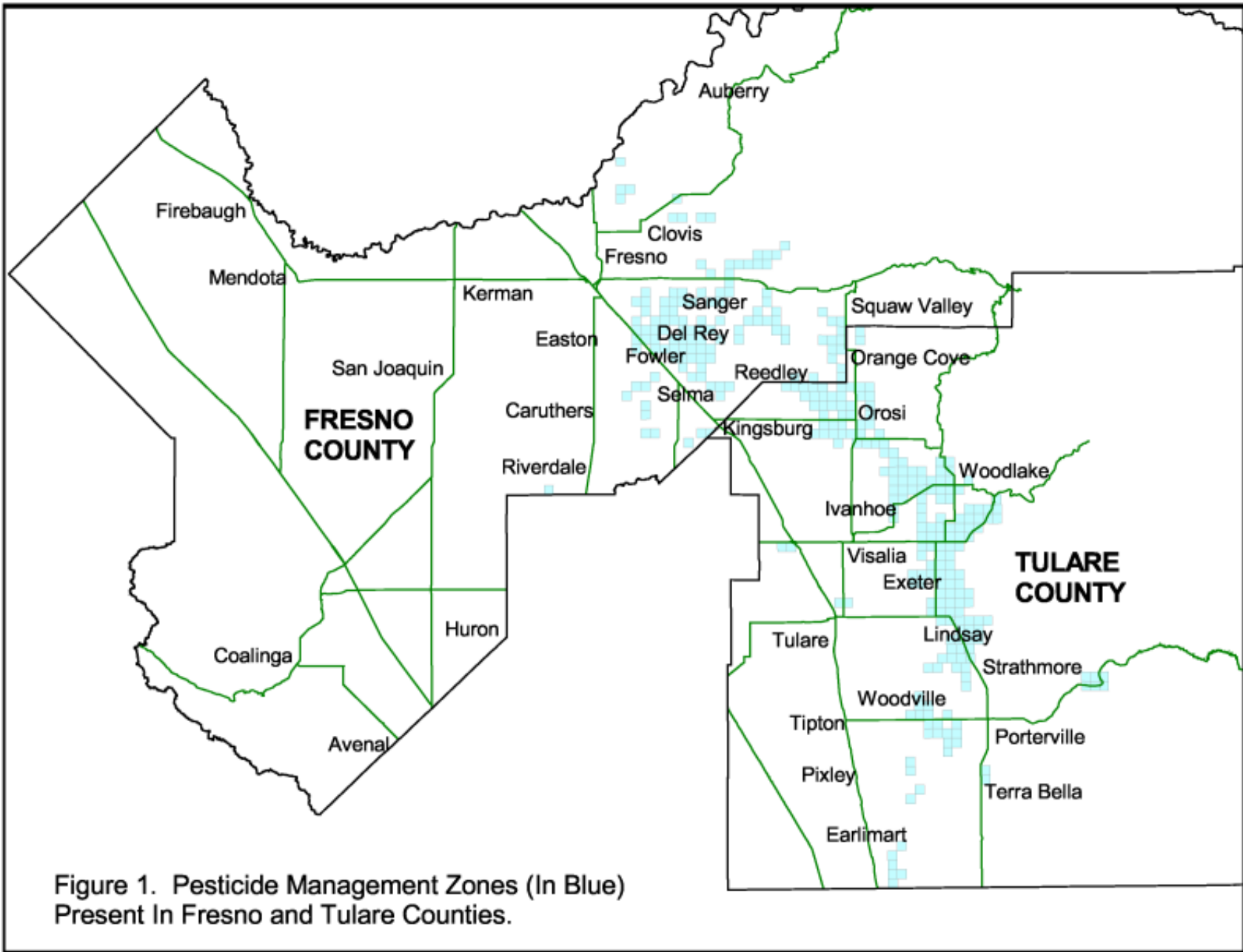


Figure 1. Pesticide Management Zones (In Blue) Present In Fresno and Tulare Counties.

Figure 2 Relationship Between Location of Orange, Lemon, Grapefruit, and Olive Land Use Areas (Orange Pattern) In Tulare County Reported By the 1999 DWR Land Use Survey and Pesticide Management Zones (Red Squares) Established In Tulare County

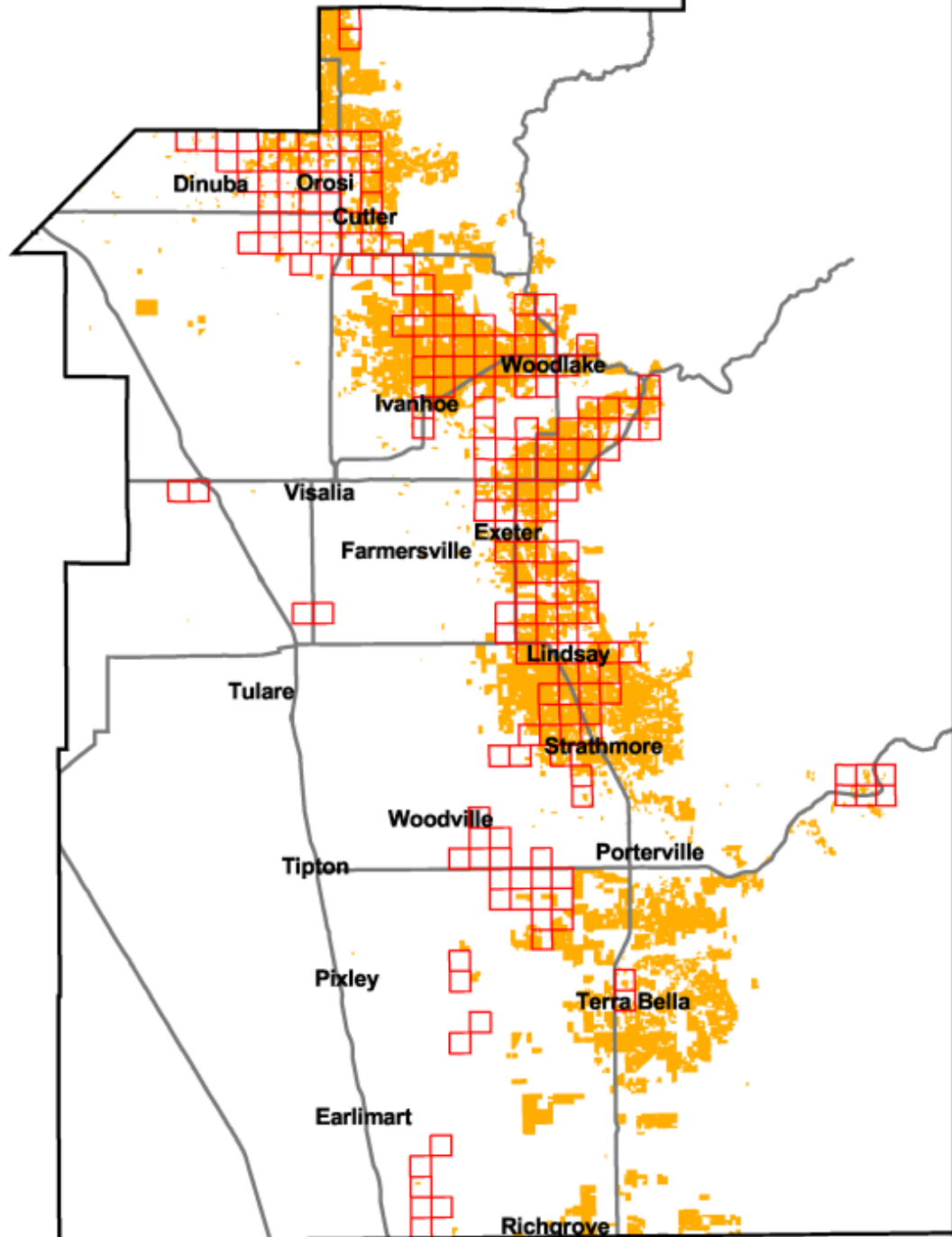


Figure 3. Bromacil Pesticide Use Data Reported From 1990 to 2000 (DPR PUR) in Fresno (Co10) and Tulare Counties (Co54).
 ROW = Rights of Way Cit = Citrus.

Bromacil Use - ROW vs Citrus In Fresno and Tulare Counties

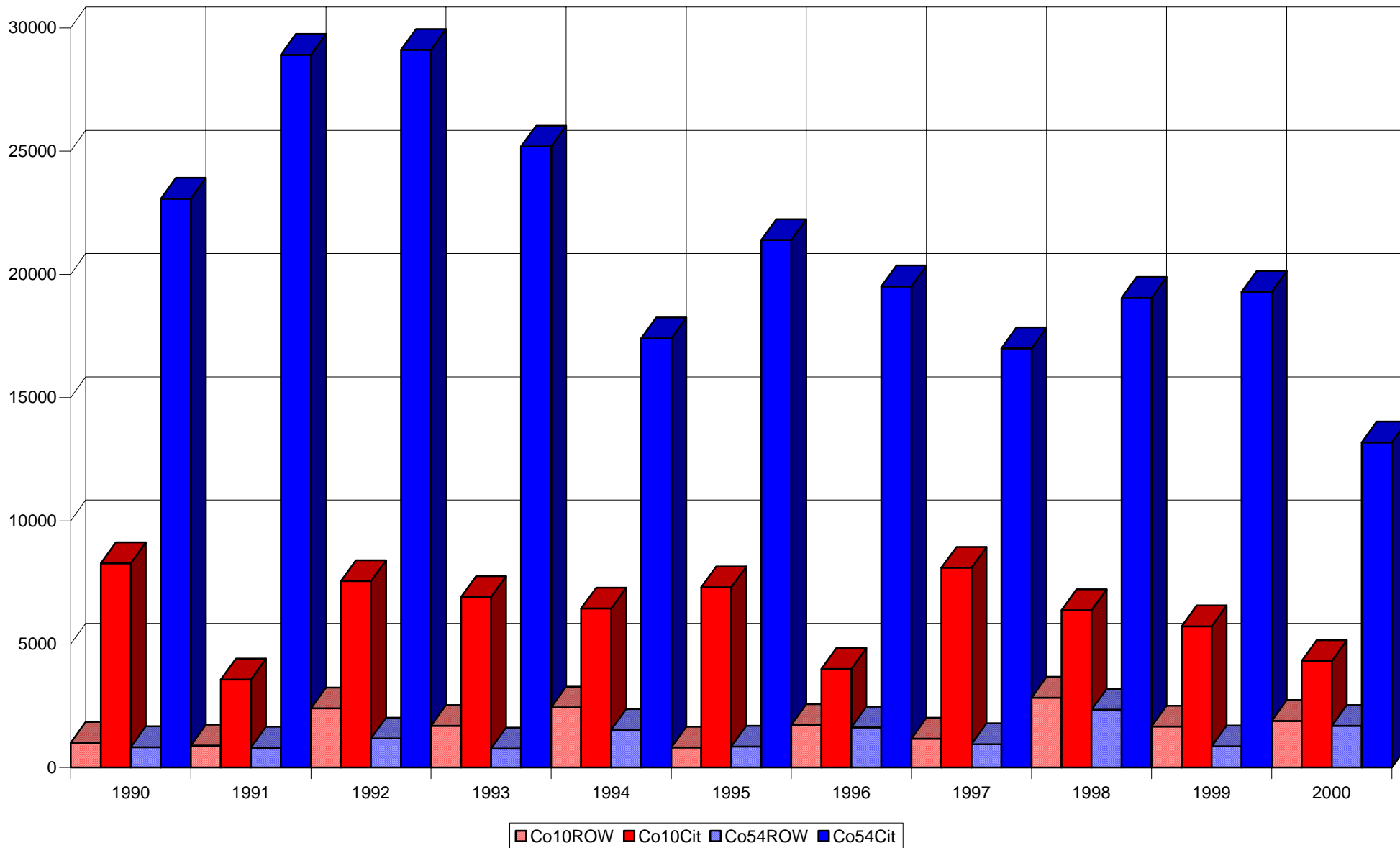


Table 1. Selected analytical data for wells from a monitoring well network in Fresno and Tulare Counties where significant increases were measured in bromacil concentrations.

Site	County	Initial Sample Date	Initial Conc (ppb)	Initial MDL (ppb)	Last Sample Date	Last Conc (ppb)	Last MDL (ppb)
32	Fresno	8/99	0	0.05	4/02	0.067	0.05
59	Tulare	6/91	0	0.1	3/02	0.963	0.05
61	Tulare	9/94	0.2	0.05	3/02	0.348	0.05
69	Tulare	9/94	0.67	0.05	3/02	1.57	0.05
75	Tulare	9/91	0	0.1	3/02	0.219	0.05
87	Tulare	5/93	0	0.1	3/02	0.615	0.05

Figure 4. General location of Site 32. No Bromacil Use (1990 - 2000) Was Reported In the Site 32 Section or in any of the Adjacent Sections.

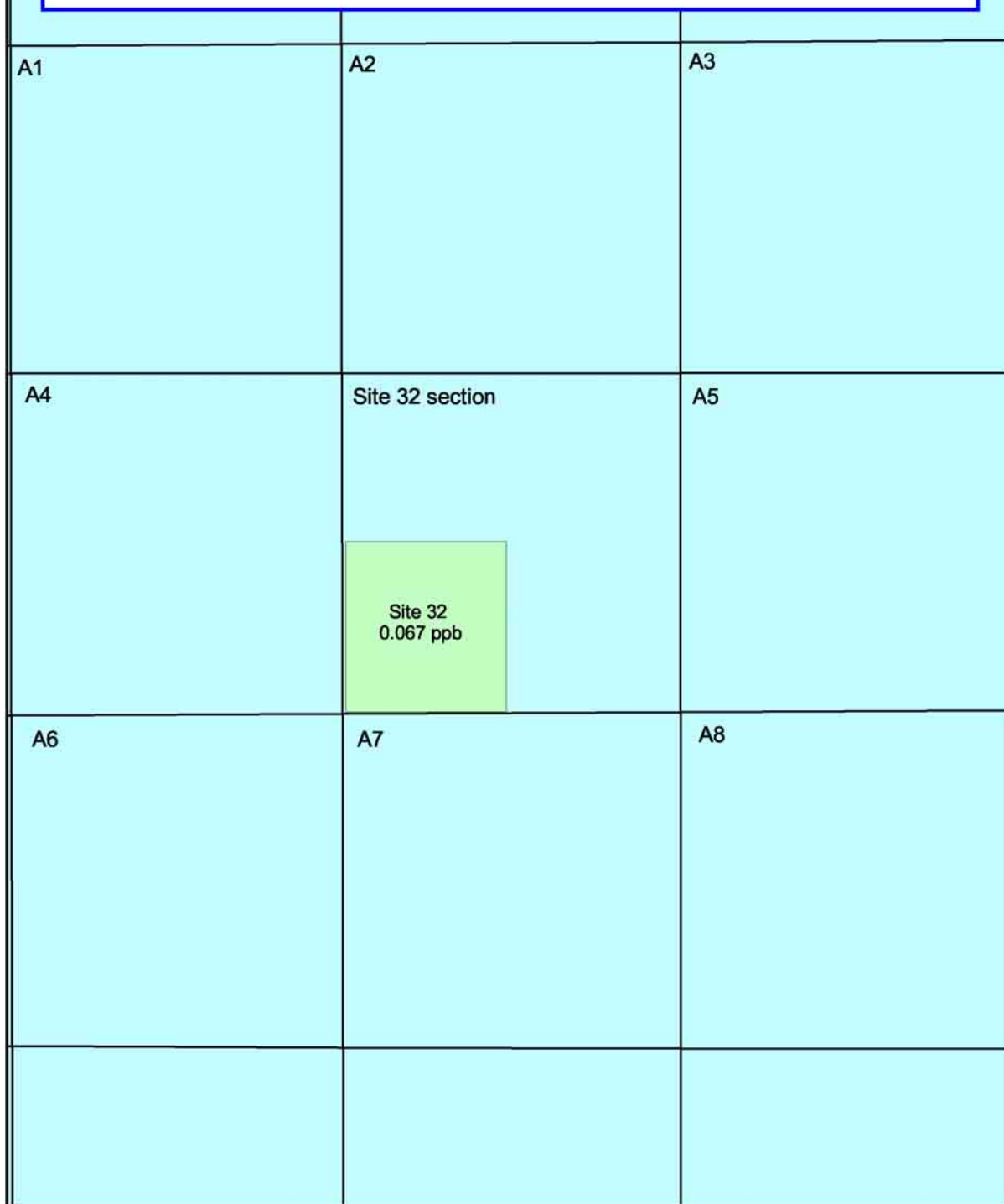
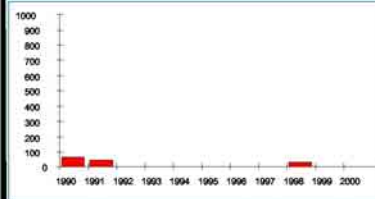
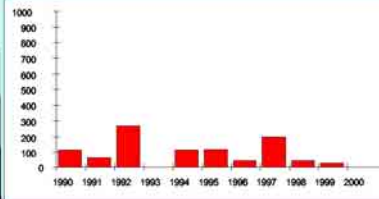


Figure 5. General location of Site 59 and Bromacil Use (1990 - 2000) Reported In Site 59 Section and Adjacent Sections



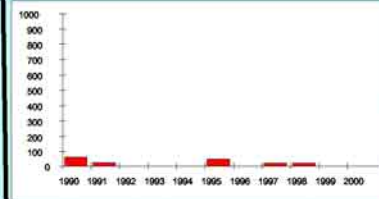
Total Pounds = 149

A1



Total Pounds = 1006

A2



Total Pounds = 194

A3



Total Pounds = 167

A4



Total Pounds = 35

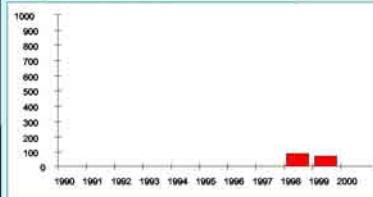
Site 59 Section

Site 59
0.963 ppb
bromacil



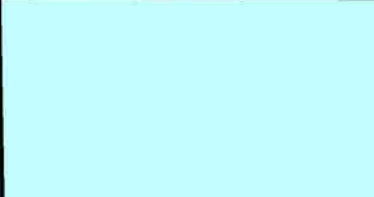
Total Pounds = 76

A5



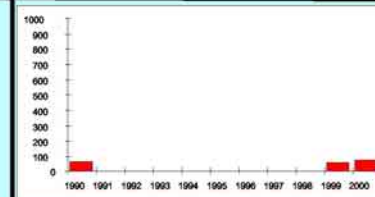
Total Pounds = 163

A6



Total Pounds = 0

A7



Total Pounds = 201

A8

Figure 6. General location of Site 61 and Bromacil Use (1990 - 2000) Reported In Site 61 Section and Adjacent Sections

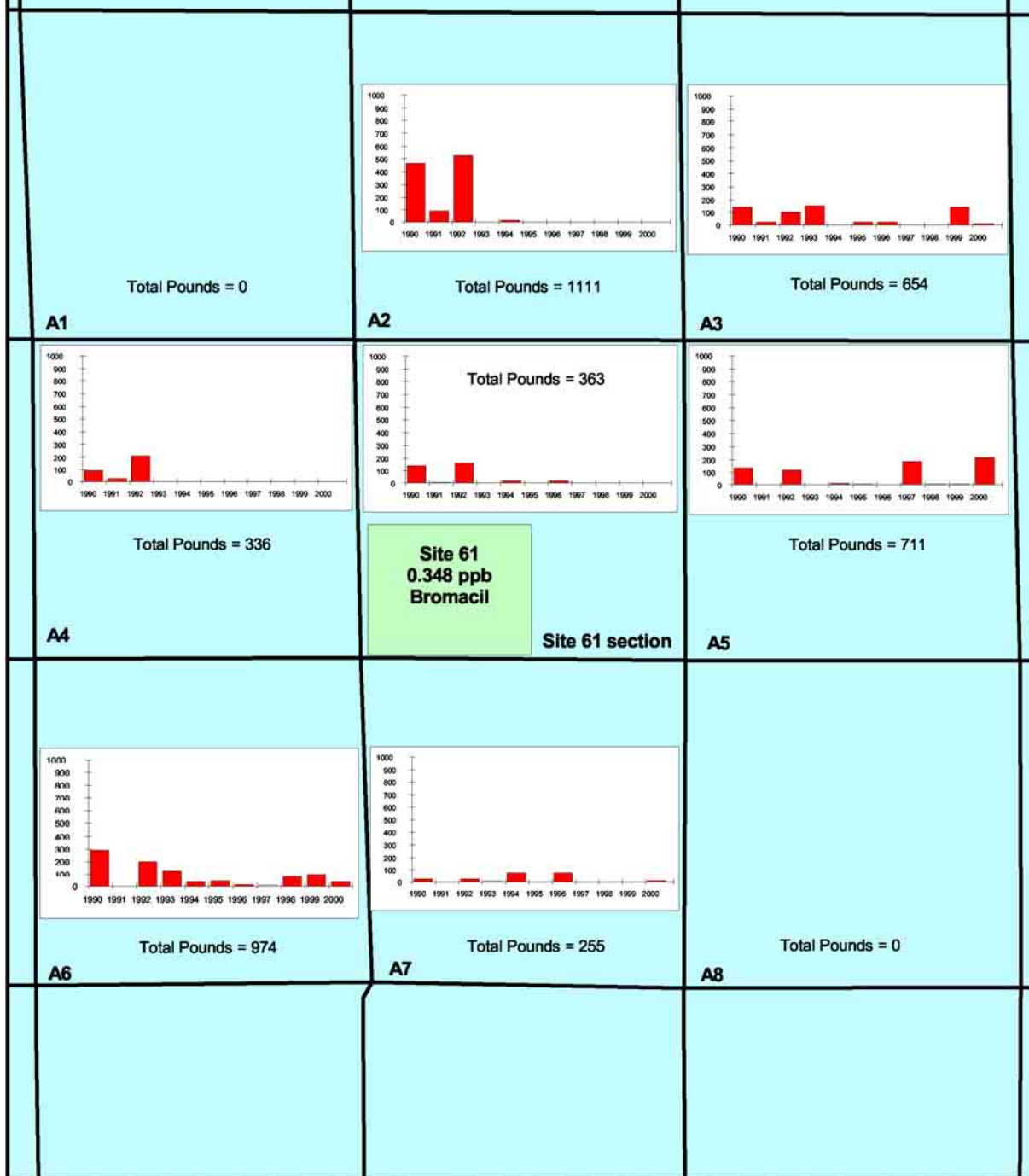


Figure 7. General location of Site 69 and Bromacil Use (1990 - 2000) Reported In Site 69 Section and Adjacent Sections

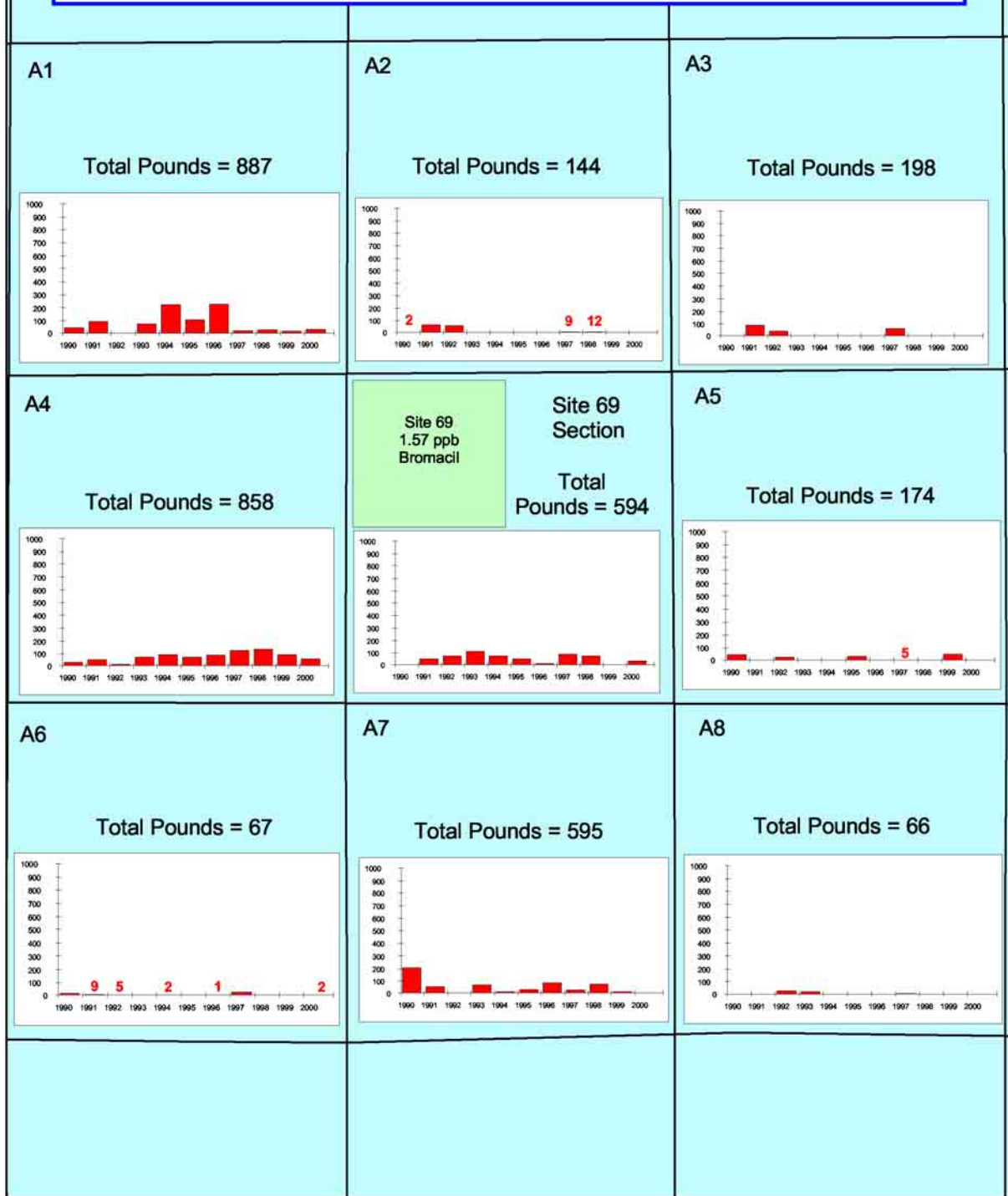


Figure 8. General location of Site 75 and Bromacil Use (1990 - 2000) Reported In Site 75 Section and Adjacent Sections

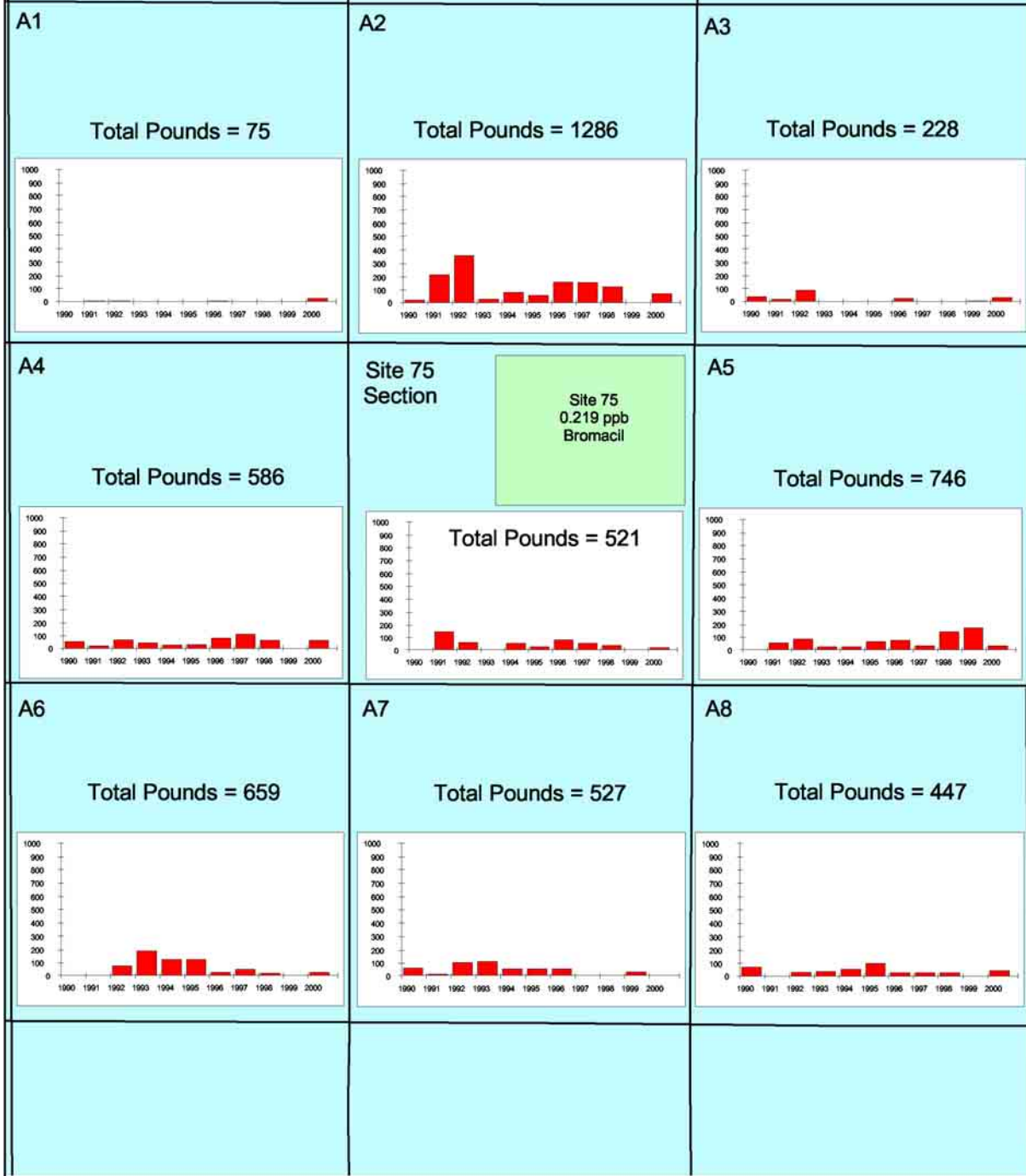


Figure 9. General location of Site 87 and Bromacil Use (1990 - 2000) Reported In Site 87 Section and Adjacent Sections

