MEMORANDUM

To: Tony Federico, Division Director, Water Quality

From: Richard Pfeuffer, Research Environmentalist, Water Quality

Date: January 8, 1986

Subject: Zinc Phosphide Information Sheet

Zinc phosphide (Zn_3P_2) is a restricted use rodenticide registered for sugarcane in field treatment use on rats. The restricted use designation is due to the potential hazard of inhaling phosphine, a highly toxic gas, which is released from the compound when it is exposed to moisture, or if it comes in contact with water or acids. The primary targets of aerially-applied rodent baits are the cotton rat (Sigmodon hispidus) and the roof rat (Rattus rattus). The application of zinc phosphide for rat control occurs after the cane field exceeds the threshold for rat damage (Orsenigo pers. comm). Damage can become appreciable in August with the rate of damage increasing from August through November or December (Holler et al., 1981). A 2 percent zinc phosphide on a carrier bait is applied aerially at 8-10 lb/A (Thomson, 1983). Currently there are two products registered for this use in Florida. A third product is registered for rat control in sugarcane but is not specified for aerial application.

Zinc phosphide is practically insoluble in water. The zinc phosphide reacts with water to yield the hydroxide of the zinc metal and phosphine gas. The gas oxidizes readily to the relatively innocuous oxy-acids of phosphorus (phosphoric, phosphorous, and hypophosphorous). The normal moisture in the soil will react with the zinc phosphide to produce the same end products (FDA, 1983). Hilton and Robison (1972) determined that the rate of zinc phosphide decomposition in Hawaiian soils increased with increasing moisture. However, these authors also determined that zinc phosphide did not decompose in water from streams, domestic source, or the ocean. They concluded that "Zn_3P_2 dropped or carried into streams or ocean water would not readily decompose. Bottom or suspended sediments would likely decompose Zn_3P_2, with the formation of PH_3 or H_3PO_4 in anaerobic or aerobic conditions, respectively." An experiment performed in Belle Glade (Holler et al., 1981) determined that of a total of 192 individual or pooled samples analyzed , only 6, all cane top samples, had greater than the 0.01 ppm tolerance level for zinc phosphide residue in sugarcane. However, the authors suggested that since these sample plots were not burned before samples were taken, the higher residues may have been caused by lodging of bait particles at the leaf-stalk junctions. They concluded that since cane is burned before harvest and the tops are removed during harvest, this does not seem to present a problem. At these same experimental plots, soil residue analysis determined no residues of zinc phosphide 15 days after bait application. No data is available on soil mobility (FDA, 1983).

The EPA has considered any product containing a metal phosphide to be as toxic as phosphine and has therefore placed these products in the highest toxicity category, based on acute and subchronic inhalation studies of phosphine. The usual oral effect studies were determined to be unwarranted and the EPA has waived all of the oral acute toxicity studies. However, the acute oral LD_{50} for Zn_3P_2 of 40 mg/kg has been reported (Sax, 1984). It is possible to calculate the level of a contaminant in

drinking water at which adverse health effects would not be anticipated. Using a EPA developed verified reference dose (this is compatible to an ADI or acceptable daily intake value) of 0.0004 mg/kg/day for aluminum phosphide (AlP), an outdoor fumigant for burrowing rodent control, a 0.014 mg/l contaminant level can be calculated. This value represents the contaminant level in drinking water at which adverse health effects would not be anticipated in the average adult, based on a 70 kg body weight and ingesting 2 liters of water a day.

Hilton, H.W., and William H. Robison. 1972. Fate of Zinc Phosphide in the Soil-Water Environment. J. Agr. Food Chem. 20(6):1209-1213.

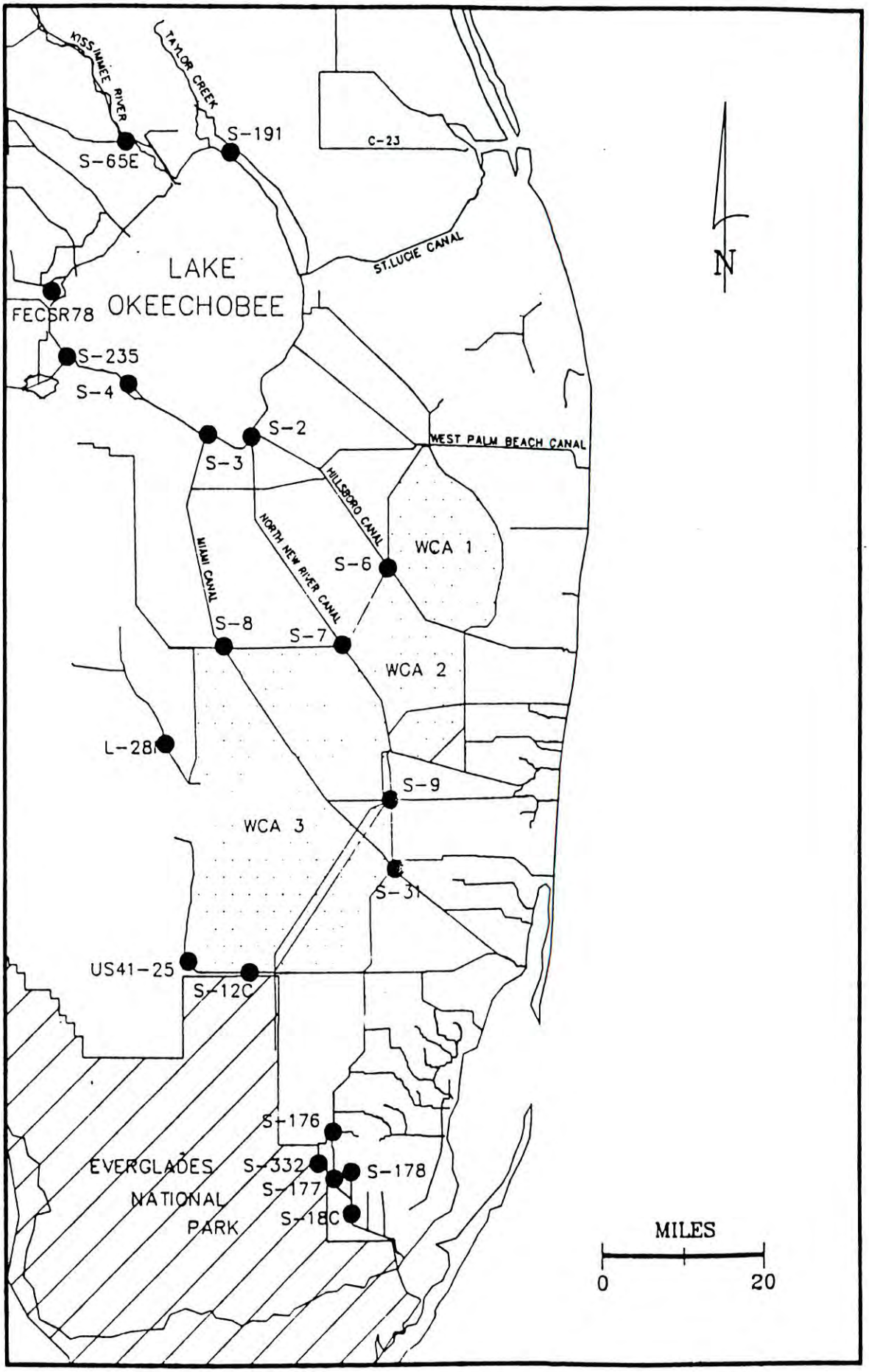
Holler, Nicholas R., Lynn W. Lefebvre, and David G. Decker. 1981. Ecology and Control of Rodent Depredations to Florida Sugarcane. Proc. Second Inter-Amer. Sugar Cane Sem. 183-188.

Orsenigo J.R. Letter of June 16, 1986.

Sax, N. Irving. 1984. Dangerous Properties of Industrial Materials, Sixth Edition. Van Nostrand Reinhold Company, New York. pp.2756.

The FDA Surveillance Index, Supplement No. 5 Sept. 1983. U.S. Food and Drug Administration Washington D.C. NTIS PB83-913204.

Thomson, W.T., 1983. Agricultural Chemicals, Book III, Fumigants, Growth Regulators, Repellents, and Rodenticides, Thomson Publications, Fresno, CA (1983/1984) pp. 152.



ROUTINE PESTICIDE MONITORING STATIONS FY86/87

TABLE 2. COMPARISON OF ZINC PHOSPHIDE ANALYSIS

Station	Sampling Date		
	9/23/86	1/14/87	1/26/87
S-2	0.006	0.004	<0.001
S-3	0.002	0.002	<0.001
S-4	<0.001	0.002	<0.001
S-235	*[1]	*	<0.001
FECSR78	*	*	<0.001
S-65E	*	*	<0.001
S-191	*	*	<0.001
S-6	0.005	0.005	<0.001
S-7	0.005	0.006	<0.001
S-8	0.003	0.002	<0.001
L-28I	*	*	<0.001
S-9	*	*	<0.001
S-31	*	*	<0.001
S-12C	*	*	<0.001
US41-25	*	*	<0.001
S-176	*	*	<0.001
S-177	*	*	<0.001
S-178	*	*	<0.001
S-332	*	*	<0.001
S-18C	*	*	<0.001
Clewiston Water Intake Structure	*	<0.001	*
South Bay Water Intake Structure	*	<0.001	*
South Bay Potable Tap Water	*	<0.001	*

All Values are in Units of mg/L or ppm Phosphine
[1]Station Not Sampled

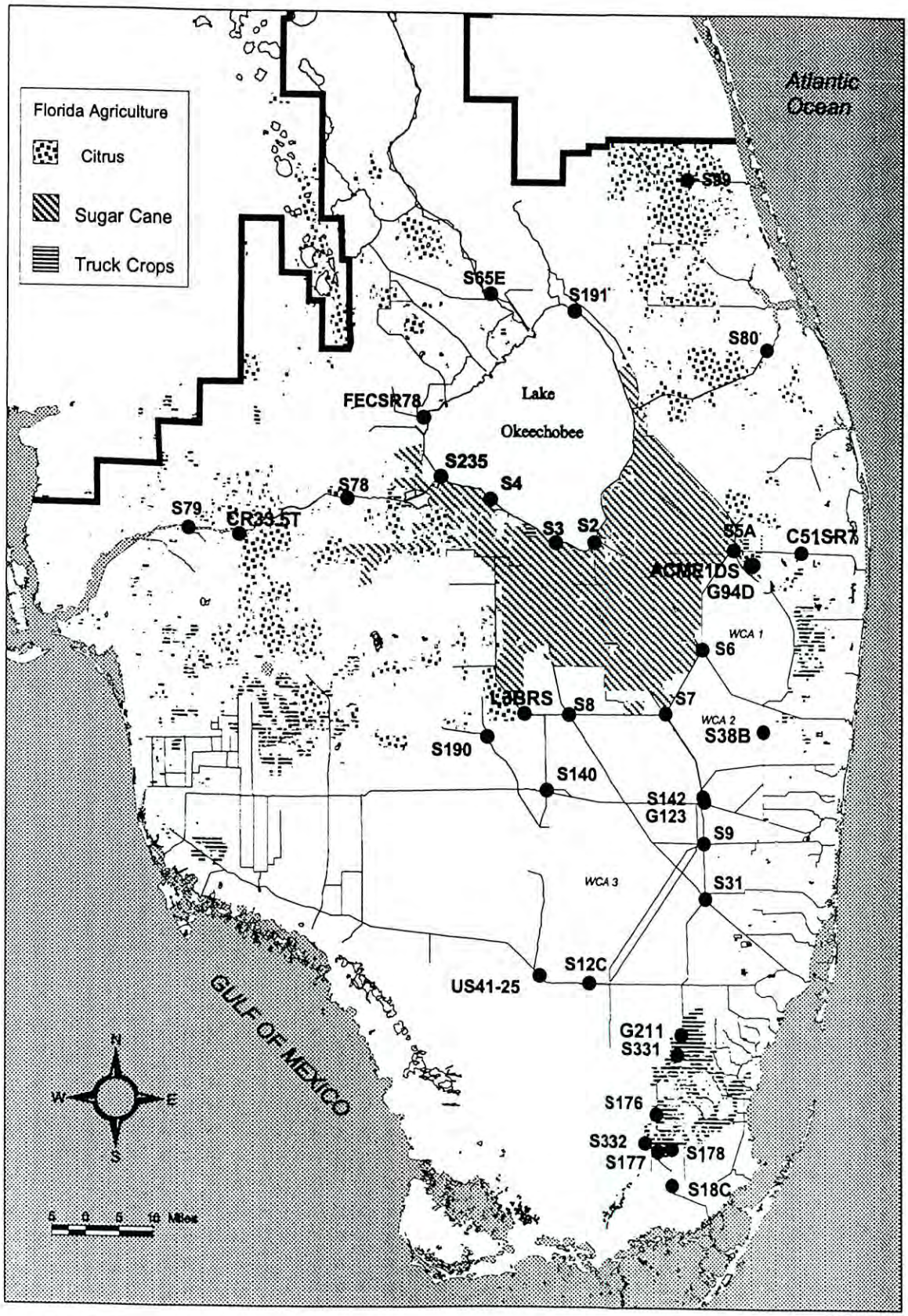
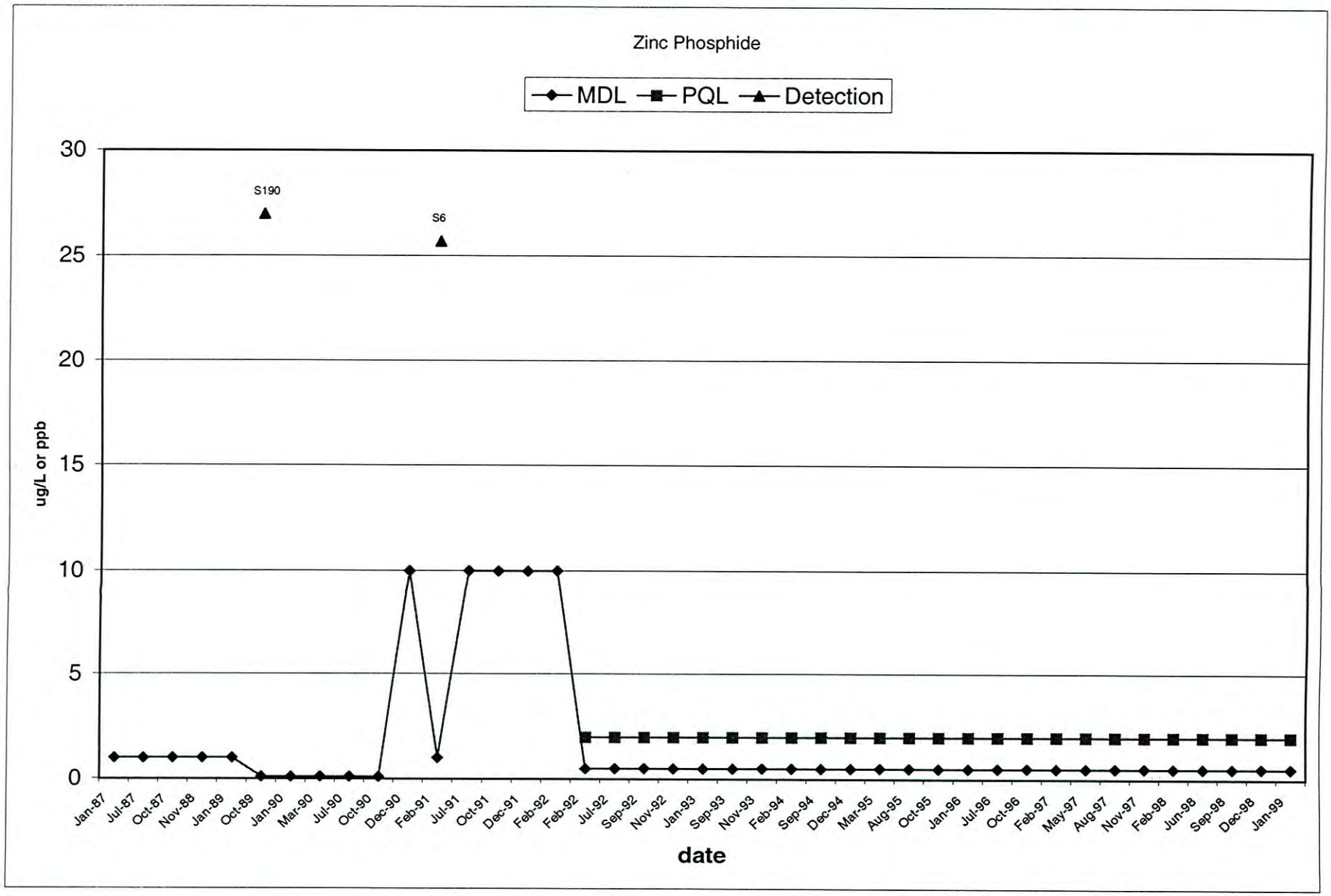


Figure 1. Pesticide Monitoring Network

HAGM 8/17/98 JLW
pest2.apr


Zinc Phosphide
MDL
PQL
Detection
S190
S6
30
25
20
15
10
5
0
ug/L or ppb
Jan-87
Jul-87
Oct-87
Nov-88
Jan-89
Oct-89
Jan-90
Mar-90
Jul-90
Oct-90
Dec-90
Feb-91
Jul-91
Oct-91
Dec-91
Feb-92
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Jul-92
Sep-92
Nov-92
Jan-93
Sep-93
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Dec-94
Mar-95
Aug-95
Oct-95
Jan-96
Jul-96
Oct-96
Feb-97
May-97
Aug-97
Nov-97
Feb-98
Jun-98
Sep-98
Dec-98
Jan-99
date