3-7-85

080807

Date Out EAB:

To: R. Mountfort
Product Manager 23
Registration Division (TS-767)

From: Stuart Z. Cohen, Ph.D. Stuart
Ground-Water Team Leader
Exposure Assessment Branch
Hazard Evaluation Division (TS-769)

Attached please find the environmental fate review of:

Reg./File No.: 100-541

Chemical: Simazine

Type Product: Herbicide

Product Name

Company Name: Ciba-Geigy

Submission Purpose: Proposed Ciba-Geigy ~~ground-water monitoring~~ site selection plan

ZBB Code: other

ACTION CODE: 400

Date In: 3/7/85

EAB # 5350

Date Completed:

TAIS (level II)	Days
51	4

Deferrals To:

______ Ecological Effects Branch

______ Residue Chemistry Branch

______ Toxicology Branch

/

ROUX ASSOCIATES, INC. ANALYSES OF GROUND-WATER SENSITIVITY

REVIEW AND CRITIQUE:

INTRODUCTION

The report outlines Roux Associates' approach to assessing aquifer vulnerability to the leaching of pesticides. The report focuses on two strategies: locating sensitive aquifers, and then, assessing those soils overlying the sensitive aquifers for permeability and other soil characteristics that may affect leaching. This vulnerability assessment focuses on those states and counties referred to as "listed in Table 1". This is not a ground-water vulnerability assessment for the whole United States.

Two example schematics are given depicting the cross-sectional geologies of a typical coastal plain area and a typical glaciated Mid-Western area similar to areas of Ohio or Michigan. Those portions of high yield aquifers that are overlain by sandy deposits are marked "sensitive". The report points out that "areas where high yield aquifers intersect land surface or are interconnected to land surface by other permeable layers are shown as sensitive". Their focus, on a state by state basis, is on high yield aquifer formations that outcrop at the surface and are overlain by coarse, permeable materials. These are considered "vulnerable areas".

The following points outline the approach taken by Roux Associates in defining sensitive aquifers:

1) define the high yield aquifers state by state;
2) develop schematics of the outcrop areas of those high yield aquifers;
3) map those areas in each state.

Secondly, the soils overlying these "sensitive" areas are considered in the following manner:

1) distinguish between farmed and non-farmed soils;
2) determine the permeability of farmed soils using SCS soil surveys;
3) rank those soils as to their sensitivity based on the permeabilities given for each soil layer making up the total soil profile;
4) map sensitive soil areas to overlie the sensitive aquifer areas.

These two approaches will be discussed individually below.

SOIL SENSITIVITY

Permeabilities were broken down into five categories, 1-5, with 5 indicating the most permeable soil. Roux Associates' soil permeability categories appear to coincide with the SCS' ranking of soil permeabilities, and is in the main reasonable. The report states that although other factors are important, they were not considered in the soil sensitivity analyses, because they are not mappable on a county scale. There is a contradictory statement in that part of the report concerning soil sensitivity. It is stated that after ranking each soil layers' permeability, moisture capacity, clay content, and organic matter content are also considered; however, this consideration is not obvious from the report's examples. From the examples, it is obvious that the authors only considered permeability for the overall soil ranking.

The use of soil layer permeabilities, as given in the soil surveys, is an excellent start. From the individual layer rankings an overall ranking for the soil unit based on permeability is determined. For clear cut cases, where a soil unit has one permeability or where one soil layer and its corresponding permeability dominate the whole soil unit, then soil permeability alone could be used to rank a soil's sensitivity to leaching. However, in cases where several layers have widely differing permeabilities other factors need to be considered. Roux Associates' system would be more defensible if other factors were included in "hazy" cases where permeability is not definitive on its own.

Their method of averaging the sensitivities of different soils composing an association is straightforward and logical. It is based on multiplying a specfic soil unit's rank by its proportion to the total association. The products are added together and divided by the total percentage of the major soils making up the association.

AQUIFER SENSITIVITY

The aquifer sensitivity rating of several states will be discussed. Figures that are mentioned correspond to maps of "vulnerable areas" for those states discussed. All counties referred to as "listed in Table 1" are of specific interest to Ciba-Geigy (Ciba). Ciba supplied those states and counties in Table 1 to Roux Associates for the groundwater sensitivity analysis.

Florida

Figure 1 details sensitive aquifer and soils areas of Florida. The most important hydrogeologic features of the state are considered, the Biscayne and Floridan Aquifers. Figure 1 depicts the western part of the Floridan Aquifer as sensitive. It depicts the eastern part of the Floridan Aquifer as non-sensitive. At the very eastern edge of the state the shallow surficial aquifer located there that overlies the Floridan Aquifer is considered a sensitive aquifer. The question arises as to why the eastern half of the Floridan Aquifer is considered non-sensitive. According to Figure 1 most of Osceola and Orange Counties, located in the eastern part of the Floridan Aquifer (in Table 1), are considered to have sensitive soils, but not to be underlain by a sensitive region of the Floridan Aquifer. No explanation for the basis of this differentiation in different parts of the Floridan Aquifer is given in the text. Why, then, are those parts of the Floridan Aquifer non-sensitive? Is this differentiation based on recharge patterns of the western part of the aquifer versus the eastern part? Maps from the Florida Department of Agriculture and Consumer Review indicate that there are sinkhole areas in Orange and Osceola Counties. This would seem to indicate sensitive aquifer areas, and thus, "vulnerable areas".

South Carolina

Based on information compiled from a survey of ground water in South Carolina for DBCP, the following counties were found to have DBCP in the ground water: Sumter, Richland, Chesterfield, Edgefield, and Barnwell. Sumter and Richland Counties (in Table 1) both have mapped "vulnerable areas" and both have documented ground-water contamination. As a validation exercise, Roux Associates could compare their methodology for selecting "vulnerable areas" with real world contamination findings, as shown above.

North Carolina

In North Carolina, Bertie, Nash, Northhampton, Moore, Harnett, and Johnston Counties encompass sensitive aquifer areas; however, no soils for these counties have been mapped. Although the Soil Conservation Service (SCS) indicates in their list of published surveys that soil surveys for these counties are out of print, they also indicate that reference copies are available at libraries and universities. Is there at least limited soils data from local agricultural commissioners? The methodology for determining a "vulnerable area" falls apart, if there are no more soils data available than that depicted in Figure 3 for North Carolina.

Virginia

Similar problems with limited soils data exist for Virginia as with North Carolina. Again, these surveys are out of print, but available from universities or libraries as reference copies.

In particular, South Hampton Co. in southern Virginia, is mapped with a sensitive aquifer, but no sensitive soil areas were mapped, because the soil survey is out of print. As a result, this county is not mapped with "vulnerable areas". South Hampton Co. is in Table 1. South Hampton Co. encompasses a deep artesian aquifer experiencing draw-down because of a large paper-milling plant in the area. Above this deeper aquifer is a surficial or water table aquifer that is tapped by local residents for domestic use. The deeper aquifer, because of the draw-down effects of the paper plant, is unlikely to be contaminated by pesticide movement (depth to water is now around 225 feet). However, the surficial aquifer is susceptible as it is overlain by sandy soils. The average depth to the water table aquifer is 9-12 feet; the average infiltration rate of water into this surficial aquifer is 0.20-20.0 in./hr. (a moderate to high rate).

This water table aquifer is not a high-yield aquifer, but its possible contamination would pose a threat to that rural population tapping it. The Roux report focuses on high-yield aquifers, only. Is this a good basis on which to base whether or not an aquifer is important enough to be considered sensitive, i.e., high-yield vs low-yield?

Pennsylvania

Known contamination exists in Lancaster and Berks Counties in Pennsylvania, where they meet. Simazine findings have been reported in both counties. Figure 8 depicts the upper portion of Lancaster Co. with a sensitive aquifer; however, there are no "vulnerable areas" mapped in Lancaster Co. The section of Berks Co. where its southwestern border meets Lancaster Co. shows an area of sensitive soils, but no sensitive aquifer, hence, no apparent "vulnerable areas". It is difficult to determine if this portion of Berks Co. is underlain by a sensitive aquifer area.

New Jersey

It would be useful to map out those counties with known ground-water contamination from pesticides and compare them with the "vulnerable areas" mapped. Sussex County is known to have ground-water contamination. For those places in Sussex Co. not considered "vulnerable areas", is there a comparison between areas of actual contamination and those areas mapped as vulnerable?

Indiana

The Mitchell Plain to the East and Crawford Upland to the West are shown to extend up through the central southern portion of the state encompassing more than 9 counties. From West to East, Perry, Crawford, and Harrison are mapped with sensitive aquifer areas on Figure 12. To the North of these three counties, East to West, lie Dubois, Orange, Washington, Martin, Lawrence, Greene, Monroe, Brown, and parts of Owens Counties. These counties were not shown to be evaluated for sensitive soils, nor are they depicted with sensitive aquifer areas, except in the first 3 counties mentioned, Perry, Crawford, and Harrison. (These 3 counties are not listed in Table 1. However, Dubois, Washington, Martin, Lawrence, Greene and Owens counties are listed in Table 1.) As a result, the majority of the Crawford Upland and Mitchell Plain karst areas of south central Indiana are not indicated as "vulnerable areas". For those 6 counties listed in Table 1., why were the soils not evaluated? Is there no soil; is this exposed karst? The text states on p. 56. that, "since the limestones are exposed near to or at the surface south of the glacial front, they are particularly susceptible to contamination from surface sources". The text also refers to a glacial drift cover that terminates in the karst region to the North. It would be helpful to know the extent of this glacial drift as it intersects the Crawford Upland and Mitchell Plain karst areas. How far southward does the glacial drift extend over these karst areas?

To the far southwest of the state, a region of sensitive aquifer and regions of sensitive soil overlap one another and are mapped as a "vulnerable area". This particular area was not discussed clearly in the text.

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California

All counties listed below for California are in Table 1.

The first group of counties has documented ground-water contamination believed to be from non-point sources. They have been mapped with "vulnerable areas" by the Roux methodology. So far so good.

I. Tulare
   Fresno
   Kern
   Stanislaus
   San Joaquin
   Merced
   Madera
   Santa Cruz

Group II counties have no documented ground-water contamination and are not mapped with any "vulnerable areas" by the Roux methodology.

II. Colusa
    Monterey
    Glenn
    Napa
    Solano
    Sacramento
    Kings
    San Benito
    Yuba
    Contra Costa

Group III counties have documented ground-water contamination, but are not mapped with "vulnerable areas" by the Roux methodolgy.

III.	Butte	(1,2-D; Toxaphene)
	Sutter	(1,2-D)
	Sonoma	(Simazine; Atrazine; 1,3-D)
	Yolo	(1,2-D; EDB; Ordram)
	Tehama	(Ordram)
	Santa Clara	(1,3-D)

No sensitive soils were mapped for these counties. The Soil Conservation Service's list of published soil surveys indicates that soil surveys for these counties are out of print, but available at libraries and universities as reference copies. Without this information on soils the Roux methodology is incapable of defining a "vulnerable area".

In Yolo County, there is documented contamination (March 1985 report by the Office of Research for the Committee on Policy Research Management of the California Assembly Legislature --"The Leaching Fields") and there is a present-day soil survey for Yolo County available, yet no "vulnerable areas" were defined.

Group IV consists of counties that were not mapped with "vulnerable areas" in California, but that have documented ground-water contamination. (They are not listed in Table 1.)

IV.

Mendocino	(Simazine)
Lake	(Endosulfan; Simazine)
Siskiyou	(Atrazine; Simazine)
Del Norte	(Aldicarb; 1,2-D)
Humboldt	(2,4-D)
Los Angeles	(Aldrin; DDE; Heptachlor; Lindane; 2,4,5-TP)
San Diego	(Aldrin; Chlordane; DDE; Dicofol; 2,4,5-TP)
San Bernadino	(Chlordane; DDD; DDE)

OTHER FACTORS

Factors other than sensitive soils and aquifers were considered by the Roux methodology. They are discussed below.

Depth to water

The report focuses on high-yield aquifers. This may exclude the importance of certain small-shallow-low-yield aquifers that are susceptible to contamination, and are tapped locally for domestic-use, particularly in rural areas, e.g. South Hampton County, Virginia.

Climate/Irrigation

The Roux methodology points out the need for accurate information on irrigation techniques and amounts of water used during irrigation for determining the vulnerability of an area to pesticide leaching. No specific information on irrigation practices used in those areas mapped as vulnerable was included in the report; however, "Irrigation and Application Data" was a category of information used in the Roux methodology for determining vulnerable ground-water areas.

CONCLUSION

Soil Sensitivity

Roux Associates' approach to the analysis of sensitive ground-water areas is a good start. The use of organic matter and other soil factors to classify a soil as sensitive is advised for those cases where permeability is not definitive.

Aquifer Sensitivity

There are two main criticisms:

1) Areas of known contamination are not always mapped out by the Roux methodology of "vulnerable area" determination for those states and counties of interest. The methodology could be checked by comparing known spots of contamination with theoretical "vulnerable areas".

2) The focus is on high-yield aquifers; this may ignore rural domestic usage of shallow low-yield aquifers vulnerable to contamination.

and a third consideration:

3) Orange and Osceola Counties in Florida were not mapped with "vulnerable areas" in Figure 1. However, Polk Co., Florida is mapped with "vulnerable areas" and is considered to be representative of Orange and Osceola Counties. Why were Orange and Osceola Counties not picked up as having "vulnerable areas" in the mapping exercise, yet they are recognized as being represented by Polk Co., which is mapped with "vulnerable areas"? As mentioned previously, there are documented sinkholes in these two counties. Is this an inconsistency in the method?

ROUX ASSOCIATE'S RECOMMENDED PRIORITY SITES FOR MONITORING SIMAZINE IN GROUND WATER

REVIEW AND CRITIQUE:

INTRODUCTION

Roux Associate's applied their methodology to those states and counties of interest, as listed in Table 1. Based on the Roux Associate's Ground-Water Sensitivity Analysis of 200 counties, 19 were selected as "most sensitive" areas. Soil susceptibility to leaching of Simazine was the focus of this exercise to select sensitive areas for future ground-water monitoring efforts. All counties selected are considered vulnerable to ground-water contamination, some more vulnerable than others, depending on their numerical ranking between 0-20 (low to high). The Leaching Evaluation of Agricultural Chemical's Handbook (LEACH) was used to assess simazine's potential to leach in those 19 counties selected as most sensitive.

The use of the LEACH manual is questionable in some cases. LEACH simulations are only applicable to those areas of the country documented as Site Numbers 1-19 on p. 17 of the manual. These sites are associated with specific pre-set soil types, rainfall patterns, crop types, and crop practices. It is incorrect to apply a LEACH Site to a given area of the country unless that area has the given soil type and rainfall patterns (intensity, duration, and time of year) of that specific Site.

In other words, it is incorrect to apply Site 6 (a loamy sand in Kansas, volumetric water content at field capacity of 0.54 cm^3/cm^3, and annual precipitation of 20-30 inches) to Riverside Co., California. The Soil Survey of Western Riverside Area California lists several representative types of soils, mostly sandy loams, a silty clay and a loamy fine sand. The loamy fine sand has a saturated water content between 0.30-0.55 cm3/cm3 as you move down the soil profile. This is different than the volumetric water content at field capacity that is a required input to the LEACH simulation. Therefore, the volumetric water content used for Site 6 appears too high for Riverside, Ca. Volumetric water content at field capacity, determined at 0.33 bar atmospheric pressure, is expected to be lower than saturated water capacity. The rainfall for the Site 6 area is given as 20-30 inches annually. The annual rainfall given for the Western Riverside area is 11 inches. It is probably higher because of irrigation.

Similarly, Site 11 (a silt loam in Ohio, volumetric water content at field capacity of 0.23 cm^3/cm^3, and annual precipitation - 36.1 inches) is used for Fresno and Tulare Counties. In Eastern Fresno Co., sandy loam to loamy sand soils predominate with volumetric water contents of 0.20 cm^3/cm^3. Rainfall and irrigation for fruit and nut growing areas approximates 47.2 inches annually (sprinkler irrigation).

Water added as irrigation water cannot be included in a LEACH simulation. LEACH simulations operate on pre-set rainfall patterns. The

LEACH manual does not include areas of the Southwest as sites in its simulations, because LEACH has no mechanism for including the effects of irrigation water on pesticide leaching. Irrigation water can be the driving force for pesticide transport in the Southwest.

A final criticism on the use of LEACH in this case is that LEACH simulates 4 crop types: corn, wheat, soybeans, cotton. California grows mostly fruits, nuts and vegetables.

In the overall ranking of counties, Tulare and Fresno Counties in California were given scores of 2 (low contamination potential); however, 7 pesticides have been found in Fresno Co., one of which is simazine. In Tulare Co., 3 pesticides have been found, one of which is simazine. These counties, along with Riverside should figure prominently in any future field monitoring studies, because of documented simazine contamination. A total of 7 counties in California have reported simazine findings in their ground water: Mendocino, Lake, Sonoma, Fresno, Riverside, Tulare, Siskiyou, and a possible finding in Merced Co. The Roux methodology picked up one of these as having a high ground-water contamination potential. The Roux methodology ranked 5 of these counties for "vulnerable areas".

Concerns raised previously that Orange and Osceola Counties in Florida were not mapped with "vulnerable areas" on Figure 1 were addressed in the report on site recommendations for monitoring. Polk Co., Florida was considered to be the best representative county for several central Floridan counties, of which, Orange and Osceola are two.

CONCLUSION

The package submitted is not a final monitoring plan. It is the outline of the methodology used to determine vulnerable ground-water areas of interest to Ciba-Geigy (Ciba). Based on the vulnerability assessment, Roux Associates selected 19 counties as recommended sites for future monitoring activities that may be undertaken by Ciba.

EAB has the following criticisms on the selection of those 19 counties:

1) The Roux methodology for determining vulnerable ground-water areas, though theoretically sensible, should be compared with areas of known contamination to check its practical application.

2) Areas of known simazine contamination in ground water should be the focus of any future monitoring efforts, particularly, those areas in California with documented simazine contamination.

3) LEACH was used incorrectly in assessing simazine leaching potential in certain counties as discussed above.

Based on these criticisms, we expect to see a final list of those counties in which Ciba intends to set-up field sites for monitoring ground-water contamination.

We expect to see a plan for Ciba's actual ground-water monitoring activities. This plan would include the experimental design and procedures involved in executing a field study to monitor ground-water contamination.

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