Shaughnessy No: 098301

EAB Log-Out Date: MAY 21 1986

Signature: [signature]

To:

Product Manager # Branagan, PM Team 65
Registration Division (TS-767C)

From:

Steve Noren James J Boland for
Field Studies & Special Projects, Review Section #5
Exposure Assessment Branch
Hazard Evaluation Division (TS-769C)

Attached please find the EAB review of...

Reg./File# :

Chemical : Aldicarb

Type Product: Insecticide

Product Name: Temik

Company Name: numerous organizations

Submission Purpose: rebuttal comments

Date In : 4/21/86

Action Code :

Date Completed: 5/6/86

EAB # 6532

Monitoring Requested:

TAIS (level II) Days

Monitoring Voluntarily Done

10

Deferrals To:

_____ Ecological Effects Branch

_____ Residue Chemistry Branch

_____ Toxicology Branch

NOTE TO: Mike,

The following rebuttal responses are included in this package:

7, 66, 67, 97, 125, 141, 144, 146, 157, 180, 186, 188, 191, 192, 221.

The two Union Carbide rebuttal submissions (242 & 246) will be submitted under separate cover at a later date. The Wisconsin EIS (232) is very extensive and at this time I am not sure a formal review is necessary.

Jim Boland
for Steve Noren 5/20/86
5/20/86

Title: Response to aldicarb comment § 7

Mr. Mason, the Extension Pesticide Coordinator of the Cooperative Extension Service of the Arkansas USDA, comments on the benefits of aldicarb and indicates that the potential to contaminate wells is slight because "...Most of our wells in Arkansas are deep wells with impervious layers between the aquifers and the surface..." This may be true. However, Mr. Mason's assertions are not backed up with any technical information and, if he is technically correct, what is the definition of "Most" - are some wells subject to contamination, and if so, are these drinking water wells? What is the exposed population?

Mr. Mason's desire to retain the use of aldicarb for corn and soybeans in Arkansas is noted. However, he needs to back up his assertions with technical documentation.

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb comment §66

Robert M. Rakich, President of the Arizona Agricultural Chemicals Association, states that the liklihood of well contamination by aldicarb (which is used primarily for cotton in Arizona) is slight for the following reasons: 1) drip irrigation is becoming more prevelant due to rising water costs, and drip irrigation is more effecient than other methods of irrigation, 2) 90 - 95% of all well water used for irrigation is extracted from wells which are 100-450 feet deep, and assuming properly set well casings, and proper back flushing valves, these wells themselves stand little chance of contamination, and 3) the soil is high in pH and high in temperature, both of which are environmental conditions conducive to aldicarb degradation.

Mr. Rakich's comment that drip irrigation is less conducive to leaching is indeed true. However, Mr. Rakich only states that "...Rising water costs are also forcing drip irrigation into Arizona farming..." He makes no statement on what is the prevelant form of irrigation presently, to what extent is drip irrigation (or other forms of effecient irrigation) used in Arizona farming, and what is the future expectation for irrigation trends. His statement on well depth and the unliklihood of contamination of ground water through contaminated wells makes sense, but as he says: "...penetration of those water stratas from irrigation assuming we have properly set well casings, and proper back flushing valves. These are certainly controllable..." Indeed, they are controllable, but are Arizona farmers controlling them? His comments that the soil is high in pH and high in temperature are appropriate in terms of degradation concerns. However, he has simply made the statement and not referenced them or backed them up in any way.

In summary, Mr. Rakich's comments do, in fact, address the appropriate issues concerning ground water contamination. However, he has simply made arguments stating what he believes to be true, without any supporting documentation. His concern is primarily for farmer's economic benefits, which is clear from his statement:

"...we and all of agri-business are very apprehensive over the possible loss of this, or other strategic pesticides."

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb comment § 67

Mr. Edsall, President of Edsall Grove Service, Inc., used aldicarb in only 125 of 2500 of his orange and grapefruit groves in 1984. He did this because of "...publicity concerning the product which has made me cautious and which will keep me from using it anywhere but in problem spots for another year or two." He shows an encouraging concern for drinking water, as well as a knowledge of Union Carbide's present suggestion that aldicarb not be used within 1000 feet of a drinking water well. He suggests that this restriction, plus continual close monitoring of wells "...seems the route to go".

The Exposure Assessment Branch (HED/OPP) does not endorse this strategy. Union Carbide initially suggested 400 ft as the buffer, but increased their suggestion to 1000 ft when aldicarb was found in a well around 400 ft of their own test plot. There is no technical basis for this 1000 feet. As well, this strategy in fact allows for the contamination of potable aquifers, and precludes the possibility of future well construction within 1000 feet of a treated field, as well as the expansion of treated groveland nearer to a drinking water well.

Mr. Edsall's points out the benefits of using aldicarb. His comments are appreciated, but as he points out, "...whether Temik is used or not should be decided by cold logic and not public hysterics."

As for technical content, Mr. Edsall's letter does not contain any factual information concerning the contamination of Florida's aquifers by aldicarb.

Matthew Lorber, Agricultural Engineer

5

Title: Response to aldicarb comment §97

Dr. Boren's comments are well informed. The counties of Hidalgo, Willacy, and Cameron were evaluated for top-soil characteristics for the aldicarb PD-2/3. These counties lie in the Lower Rio Grande Valley of Texas that Dr. Boron refers to. The soil was evaluated as medium to low potential to leach, which concurs with Dr. Boron's contention that, "Permeability of our cropland is classed as slow, moderately slow, or moderate. This means that water moves in saturated soil at rates of 0.06-0.2, 0.2 to 0.6, or 0.6-2.0 inches per hour". Dr. Boron obviously has knowledge of SCS soil definitions and classifications. He also states, "We have a few sandy areas in which permeability is classed as rapid, 6.0-20.0 inches per hour, but these spots are too droughty for cropping and are used only for rangeland." There is, in fact, a "soil association" which dominates Brooks, Kenedy, and a significant portion of Jim Hogg county. These counties lie above the Lower Rio Grande Valley in a resource area of Texas known as the Rio Grande Plain. These soils are very permeable, 6.0-20.0 inches per hour. However, a check on the soil series comprising this association, Sariata, Fulfurrias, and Nueces soil series, show that the soils are not used for cotton, citrus, or grain sorghum. Rather, the "Soils 5" data base, which contains information on most mapped soil series in the nation, states that these soils are suitable for the following crops: Sarita (6.0-20.0 inches/hr permeability): watermelon, peanuts, and pasture; Fulurrias (6.0-20.0 in/hr): pasture; and Nueces (0.6-2.0 in/hr): cotton lint, peanuts, and pasture. Use of the Soils 5 data base for the soils of Hidalgo, Willacy, and Cameron show that the pH is above 7.5, as stated by Dr. Boron.

Further supportive evidence of Dr. Boron's contentions for soils in Texas comes from the publication, "Resources Areas of Texas - Land", bulletin B-1070 by Texas A&M University, Texas Agr. Extension Servise, and Texas Agr. Exp. Sta. in College Station, Texas. The Lower Rio Grande falls in a land resource region kown as "Bottomlands" and the soil of this region is described as: "reddish brown to dark gray, calcerous, loamy to clayey alluvial soils", and soil management considerations include: "Drainage, land shaping, salinity control, water management for irrigation, nitrogen and phosphorus fertilizers.

In summary, Dr. Boron's statements are technically sound and I am in general agreement with his conclusions concerning top-soil and the probability that aldicarb will not contaminate ground water in the Lower Rio Grande Valley. I cannot comment on his statement, "Ground water in this area is too saline for practical use as potable water or for irrigation", except to note that salinity control was mentioned in the extension bulletin above.

Matthew Lorber, Agricultural Engineer

Title: Response on aldicarb comment §125

John Bolduc of the Conservation Law Foundation of New England, Inc. has made three appropriate comments, which will be discussed now:

1) The first comment is well-founded. Planned for the aldicarb PD 2/3 is a brief summary of the fate and transport characteristics of alternative pesticides to aldicarb, as well as a brief summary of toxicity characteristics of alternatives.

2) John Bolduc has hit on a key point, in terms of a generalized label statement on not using aldicarb in, as he puts it, "areas with well-drained soils...". He notes that the difficulty with this generic type of label statement, i.e., prohibition of use if the soil is permeable and overlies a shallow aquifer, is that it is difficult to enforce. There are two other regulatory options (and likely more) that are being considered in the registration of leaching pesticides, including aldicarb. One is the cancellation of registration for specific uses, and the other is the geographically-based cancellation, probably on a county basis similar to the present ban on Suffolk County, Long Island, New York. These latter two are more enforceable than a label statement. However, we are not abandoning the generalized label statement approach for these reasons. If this statement could be followed (somehow), it would be the most equitable and effective. The objective of any regulatory option for aldicarb is that aldicarb not be used where it would contaminate ground water, but could be used elsewhere. The is the only of the three alternatives mentioned that, if followed, would guarantee this objective. Since aldicarb is a restricted use pesticide, it is felt that appropriate training of applicators as to the hydrogeology of the region they plan to apply aldicarb, as well as sources for additional information, would increase the probability that the restriction be followed. Finally, inclusion of quantitative information on the label would make it possible to indict those violating the label. Presently, quantitative criteria being evaluated are: soil permeability greater than 2 inches per hour, and potable ground water less than 30 feet from the soil surface.

3) Attached is a table summarizing information on monitoring results for Rhode Island. Further information on this table can be obtained from Hale Vandermeer, Office of Pesticide Programs (TS-769c), US EPA, Washington, D.C. 20460 phone: (703) 557-7347. Citations and/or supporting documentation for the findings in Connecticut were not present in either the federal register or the standard. Phone calls were made to Paul Marin of the Dept of Env. Protection, Water Compliance, to Greg Piontek of the EPA office in Connecticut, Pesticide Program, and to Jim Murphy, Dept. of Env. Protection, and all are unaware of aldicarb

findings in Connecticut. It would therefore be reasonable to conclude that presently aldicarb has not been found in Connecticut.

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb comment §141

Dr. Wyman has submitted a detailed comment on aldicarb efficacy, followed by a technical paper accepted for publication. The comments on efficacy will not be dealt with here. However, the technical publication dealt with field studies of aldicarb applied to potato crops in Wisconsin, and addressed issues concerning leaching potential of aldicarb in Wisconsin. These field studies will be commented on here.

There were two field sites studied, and several scenarios examined within those two field sites including permutations of application date, rate, and irrigation scheduling. Without going into detail, one major conclusion concerning leaching was that aldicarb would not leach in one site which had sandy loam soil: "...The mean concentration of aldicarb residues at the Cameron location...demonstrated that residues did not leach below 1.2 m throughout the 208 day sampling period..." Conclusions concerning the second site, which had a loamy sand soil, were not as conclusive: "...At Hancock, no aldicarb residues were detected below 2.4 m following the emergence application under either medium or heavy irrigation schedules... Small traces of aldicarb residue were detected at the 2.4-3.0 m level under both irrigation regimes following the 3.36 kg AI/ha planting application...Some leaching of aldicarb residues probably occurred below the 3.0 m level in the plots treated at planting and receiving heavy irrigation while leaching below 2.4 m did not occur in the emergence treatments receiving medium ET based irrigation. No conclusions could be drawn about whether leaching occurred below the 3.0 m level in the planting application with medium irrigation or the emergence application with heavy irrigation..."

Apparently, leaching was indicated for some of the scenarios tested for the loamy sand at Hancock. One way that an estimate of the amount of leaching can be obtained is with the use of computer simulation models. In fact, both these field sites and the leaching data were evaluated with the PRZM model, as part of a technical paper submitted by Mr. Lorber entitled, "A Method for the Assessment of Ground Water Contamination Potential Utilizing PRZM - A Pesticide Root Zone Model for the Unsaturated Zone". In this study, PRZM was calibrated to the field data for the loamy sand and the sandy loam site (calibration in this context refers to "forcing" the model to fit the field data with appropriate choice of aldicarb first-order decay rate and adsorption partition coefficient). Once calibrated, an assessment was made concerning how much aldicarb actually did leach below the depth of sampling for these experimental field sites. Only a minor amount, 0.3% of applied, was found to leach below the depth of sampling for the sandy loam site. However, aldicarb was found to leach below 3 m for all scenarios at the loamy sand site. For the heavy irrigation scenarios, around 25% of applied was found to leach below 3 m.

For the other scenarios, between 3.6 and 8.9% of applied aldicarb was simulated to leach below 3 meters. One can conclude with these results (and with other simulations described in the submitted publication by Mr. Lorber) that aldicarb has the potential to leach in field sites with soil similar to the loamy sand at Hancock, but little potential to leach on soil types similar to the sandy loam soil at Cameron.

Dr. Wyman did not state that his study supported a conclusion that aldicarb would not leach in Wisconsin. Rather, he concluded that, "...The changes in application procedures for Temik, together with effective irrigation management, cultural management techniques and intelligent state regulation and use monitoring, thus significantly reduce the risk portion of any risk/benefit analysis and favor the continued use of this product." The modeling study of Mr. Lorber also supports the conclusion that changes in cultural practice, such as applying aldicarb later in the season, would reduce the amount of aldicarb leaching. However, Mr. Lorber also concludes that aldicarb has the potential to leach in loamy sand soils similar to the loamy sand of the field site reported in Dr. Wyman's publication, even when improved cultural practices are in effect. The appropriate direction one may want to take at this point, with this information, is to determine the extent of loamy sand soils in Wisconsin and the use of aldicarb on these soils.

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb comment §144

Dr. Weingartner of the University of Florida submits a cover letter summarizing the importance of aldicarb to Northeast Florida potato growers, and follows the letter with more detailed summaries and several publications on potato diseases, nematicide options, and related aldicarb issues. He states that, "The reasons for regulating aldicarb use due to contamination of well water in some locations do not appear valid in NEF flatwoods area." He also reports on surficial runoff from NEF potato fields. Only these two issues of fate and transport will be dealt with in this response.

"About 300 NEF shallow (≥150 feet deep) drinking water wells have been analyzed since 1979 for aldicarb contamination by various state agencies and Union Carbide. To date all have been free of detectable concentrations of aldicarb." That is encouraging news, no doubt. However, "≥150 feet deep" is insufficient criteria to be able to claim that the wells were "shallow". If the depth of the wells was ≥100 and ≥150 ft, they might instead be classified as moderately deep. As well, in a literature article in the same package, it was stated that this sampling program represented only 25% of the shallow drinking water wells "near NEF potato fields". Still, Dr. Weingartner presents a strong argument as to why drinking water would never become contaminated with aldicarb in NEF due to potato uses. He claims that, "Cultivated flatwood soils are sublayered by a zone of weakly cemented pan to cemented pan". This results in a situation of lateral, rather than vertical, drainage from potato fields. Furthermore, artesian flow below the clay lenses do not easily allow intrusion by solutes into the ground water. "There is therefore a greater probability in such a system for contamination of surficial run-off water during heavy rains than groundwater beneath the clay." In one study conducted during 1983, samples were taken from the "Deep Creek" drainage system which drains into St. John's River. During "unusually heavy rains" in March and April of that year, 30 samples were taken and 28 were found positive, ranging from a high concentration of 190.2 ppb found in edge-of-field runoff 49 days following application to a low of 1.1 ppb found at the St. Johns River inlet.

Dr. Weingartner does present a convincing argument that aldicarb will not contaminate the drinking water wells located more than 100 feet deep, but only because of the existance of the clay pan. Also in his package is information that the top-soil in these regions is "sandy", an assertion which is backed up by soil maps of Florida. Therefore, any aldicarb which is applied has a high probability of leaching to the cemented clay layer located 3 to 6 ft below the soil surface. The appropriate question is, what is the extent of this clay layer? Does it underlie all potato fields? As the package states, "...presence of an impervious zone of clay sublayering most NEF fields..."

11

What is the extent of this clay layer, precisely? As well, is there any extraction of surficial water from above the clay lenses, for drinking water or otherwise? The only positive aldicarb sample came from a surficial aquifer beneath a potato field.

In summary, Dr. Weingartner presents a strong argument against the possibility of drinking water contamination in Northeast Florida due to aldicarb use on potatoes. He does, however, indicate aldicarb's mobility with evidence of surface run-off into the Deep Creek system, and concentrations of aldicarb (1.1 ppb) at the inlet to the St. John's River in Florida. Since aldicarb is mobile, it will move with water. Dr. Weingartner shows why it is more likely to move with surface runoff rather than ground water recharge.

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb comment §146

Dr. John M. Harkin, a Professor at the Water Resources Center of the University of Wisconsin, sent 2 letters to Michael Branagan of OPP and attached a study entitled, "Aldicarb in Groundwater". Professor Harkin has an obvious bias, and that is in the continued use of aldicarb. This is reflected in both letters, which explain results of field monitoring of aldicarb used on potatoes over the Central Sands Aquifer. Whereas Dr. Harkins acknowledges the inevitability of ground water contamination of the Central Sands Aquifer by aldicarb use, "the contamination of groundwater by aldicarb residues has created some minor localized problems in Wisconsin, but these are neither unsurmountable nor permanent."

The attached report makes clear the following facts:

1) The top soil in this region is sandy and conducive to leaching,

2) The top of the water table is located between 4 and 22 feet from the surface in the Central Sands area,

3) Their conclusions on movement beneath potato fields were based on monitoring from three study fields between December, 1980 and July, 1981 (and also monitoring efforts by Union Carbide). The aldicarb use history in these fields was never clearly stated in the report (which is my major criticism of the report). However, it appears that aldicarb was used on one field, field A, annually from 1978-1980, but not in 1981; field B had split use, with one half receiving an application in 1980 but not in 1981, and the other in 1981 but not in 1980 (no information on use prior to 1980); and "several rows of potatoes in the western half of field C were treated with aldicarb in 1981, in soil where aldicarb had never been used previously", with no further information on Field C. If it can be surmised that 2 of the 3 fields had no use prior to 1980, than the results of these studies cannot be considered typical for fields receiving aldicarb on an annual basis.

Nonetheless, their results are summarized as follows:

- Field A showed average concentrations in wells designated "shallow" (located 15 feet below the land surface and less than 10 feet below the water table) to be 25 and 34 ppb in February and April in 1981, following an application in 1980, and 2.4-3.0 ppb in sampling in June and July; "middle" (35 ft below land surface and 25 ft below water table) wells showed 4.1-21.0 ppb concentrations between February and July; "deep" (60 and 50 ft) wells showed no aldicarb from 6 on-site wells but two irrigation wells showed concentrations averaging 13 ppb.

- Field B, which differed from Field A in that it had applications

15 1981, showed concentrations as follows: "very shallow" (10 ft below land, 2 ft below water table) wells showed average concentrations 61-76 ppb from March-July, "shallow" wells showed average concentrations 6.1-85.0 ppb for the same time period, "middle" wells showed 0.3-1.5 ppb, 5 "deep" well samples showed no aldicarb, although one irrigation well sample showed 2 ppb aldicarb.

- Field C, which had no prior history of aldicarb application until 1981, showed concentrations of 25-46 ppb in the "shallow" wells, 1.4-19.0 in the "middle" wells, and 12 ppb in the "deep" wells.

Maximum concentrations from all fields came from the "very shallow" and "shallow" wells and ranged from 150-210 ppb. Further details of this study can be found in comment §146. In short, this and related data was used to conclude that the primary contamination of aquifer occurs within the top ten feet of the water table.

4) Sampling of 25 private wells are inconclusive. No details on well location and proximity to a field receiving aldicarb is given. Six of the 25 showed measurable concentrations with a high of 17 ppb. Only 5 of 116 wells sampled by Union Carbide showed concentrations, with a high concentration found in two wells of 85 ppb.

5) Dr. Harkin suggests that biological degradation may occur in the ground water based on laboratory studies. However, they surmise that the biological half-life of aldicarb is 1.3 years, which suggests that chemical degradation via hydrolysis probably dominates the loss of aldicarb in the ground water environment. Inclusion of findings of biological degradation in both letters by Harkins indicates his desire to build a strong case for continued use of aldicarb by indicating its degradability in the ground water environment.

In summary, Dr. Harkins presents a strong case indicating that aldicarb will contaminate the Central Sands Aquifer when used on potatoes. However, the primary contamination will occur near the surface of the water table, and degradation of aldicarb in the ground water will prevent it from contaminating deeper portions of the aquifer. It is his opinion that aldicarb use should continue with the following precautions: 1) all wells in construction should be completed to deep portions of the aquifer, 2) selected wells should continually be monitored, 3) contaminated well water could possibly be handled by consumers of the water by baking soda - "A tiny pinch of baking soda can be added to water before boiling to prepare hot beverages...The ease of hydrolysis of aldicarb provides a cheap, convenient method of removing it from drinking water...", 4) careful irrigation practices should be practiced, and 5) studies of aldicarb movement should continue.

This reviewer agrees with 4 of these 5 conclusions, but does not see baking soda as a means to handle contaminated ground water. Dr. Harkins believes that aldicarb should continue to be registered in Wisconsin with proper precautions, recognizing the fact that ground water will become contaminated. This reviewer's opinion is that there are many similarities between the Central Sands of Wisconsin and Long Island, New York which suggests that the same regulatory strategy should be carried out in both places. Some of these similarities include:

1) strong dependence on ground water for drinking water

2) shallow water table

3) sandy soils overlying the shallow water table

4) cool, wet climate which increases the pesticide degradation half-life (cool climate) and the liklihood of transport (wet climate)

5) dependence of aldicarb in an extensive potato growing region

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb comment §157

James Graham, Commissioner of the Department of Agriculture in North Carolina, wrote of concerns in using aldicarb on tobacco and ornamentals in North Carolina. He summarized Union Carbide sampling in North Carolina, which included samples from 23 wells in Northampton and Halifax counties in 1980 and 1981, with one sample showing 1 ppb and another showing 2 ppb (total number of samples not given). The Pesticide Section of North Carolina Department of Agriculture sampled from Cumberland, Edgecombe, Gates, Halifax, Martin, Northampton, Pitt, and Scotland Counties in 1983. In this study, 7 samples from 104 wells showed positive results, with two samples from Scotland County showing 28.2 and 27.6 ppb. Three other samples from Scotland County showed 2 ppb. Three samples from Halifax County showed trace levels of aldicarb estimated at less than 1.5 ppb. All wells sampled by NCDA were verified to be less than 600 feet from fields using aldicarb.

James Graham recommends that, "...future registration of Aldicarb or any other water soluble mobile pesticides be conditioned upon the establishment of a structured monitoring program developed and supervised by EPA. Further, we recommend that at registration EPA establish maximum allowable levels for any pesticide likely to impact groundwater so that such monitoring could have a meaningful impact."

The suggestion that registration of water soluble pesticides be contingent on a continuing monitoring program appears reasonable. However, it is not clear who is to develop and supervise the program. It appears unreasonable to this reviewer that EPA, even the regional offices, should be responsible to bear the financial and management burdens of these programs, although certainly they could offer technical assitance. The registrant or the appropriate state agency might be other candidates to handle monitoring programs. The second suggestion of the establishment of maximum allowable levels for any pesticide is reasonable - if not at registration, than at some time. Aldicarb has a Health Advisory Level of 10 ppb.

Matthew Lorber, Agricultural Engineer

Title: Response to Aldicarb comment § 180

Wisconsin Public Intervenor Thomas J. Dawson has sent an extensive package detailing his efforts on aldicarb dating back to 1981. His package contains 8 appendices and is complete up to September, 1984. The bottom-line conclusion by Thomas is that Section Ag 29.17 Wis. Adm. Code, which governs the present use of aldicarb, is a failure.

Section Ag 29.17 Wis. Adm. Code was adopted in 1982 against the policy position of the Public Intervenor. The rule is based on the assumption that mere restrictions on continuing aldicarb use, rather than a state-wide moratorium, would "prevent aldicarb residues in groundwater from reaching a level exceeding 10 ppb" and "afford an opportunity for groundwater quality recovery". Further, the rule is based on the assumption that "adequate monitoring and testing of groundwater supplies would be done, intensive research would be conducted to refine the regulatory scheme, and that the rule would not be the final word on the aldicarb contamination issue."

Briefly, the regulatory components of Ag.17 are:

1) Aldicarb shall be used at a rate no higher than 2 lb/ac and should be used only in alternate years on a given field site.

2) Aldicarb shall be applied by certified applicators only.

3) Aldicarb shall be applied between 28 and 42 days following application, and fields treated by aldicarb shall be harvested no sooner than 50 days following application.

4) No person may apply aldicarb unless a report of intended application has been filed with the department at least 30 days before the pesticide is applied.

5) The state of Wisconsin has the right to prohibit the intended application of aldicarb with a "summary special order" if "the intended application site is located within a township quarter-quarter section lying wholly or in part within one mile of a sample point at which aldicarb residues have been detected at a level exceeding 10 ppb." Exemptions to a "summary special order" are listed in Ag 29.17.

6) Distributors and retail dealers of aldicarb shall keep records and report sales of aldicarb.

7) All findings of aldicarb in groundwater at levels of 1 ppb or more shall be reported to the proper authorities.

Thomas Dawson believes that, as of September, 1984, "Ag.17 has failed to prevent aldicarb residues in groundwater from

reaching unacceptable levels, that groundwater quality in Wisconsin is not recovering from its aldicarb contamination as hoped, and that there is no credible evidence showing that the label and use-restrictions are adequate to protect Wisconsin's groundwater...The Wisconsin "experiment" has been tried, and it has failed."

The major evidence that Thomas Dawson is basing his contention on is a sampling of 144 drinking water wells for aldicarb in June of 1984 by the Wisconsin Department of Natural Resources and the Portage County Department of Health. The results of this survey are: 82 wells showed positive findings, 33 of which were above the 10 ppb level, with a high reported value of 69 ppb. In addition, "Of wells with previous residue histories, about 22 were seen to decrease, 11 increased and 36 remained near the same." Ron Becker of DNR states, "No distinct overall downward trends were apparent from the June data...Aldicarb is moving with the groundwater and has been seen to contaminate new areas as it moves." Mr. Dawson also believes that other intentions of Ag.17 were not met as of September, 1984: "...although groundwater monitoring has occurred, it has been far from adequate to obtain a fair and complete picture of the extent to which Wisconsin groundwater is contaminated by aldicarb residues. At best, the results of the latest monitoring provide an extremely conservative indication of contaminated areas. Intensive research on which to base a refined regulatory scheme has proceeded at a snail's pace or not at all. Nagging questions about the effect of use-restrictions on aldicarb leaching to groundwater, and how aldicarb residues are acting in already contaminated groundwater, remain unanswered. The assumptions that adequate monitoring and intensive research would be conducted have not been fulfilled." Mr. Dawson further goes on to refute, one by one, contentions of Union Carbide made in 1982 following the adoption of Ag.17. Union Carbide made these contentions in an effort to ward off more protective regulation.

This reviewer agrees with Mr. Dawson that the survey made in June of 1984 would indicate that the intention of Ag.17, stated as: "The purpose of this section is to minimize the quantity of aldicarb and its degradation products in groundwater, in order to prevent aldicarb residues in groundwater from reaching a level exceeding 10 ppb...The general restrictions in this section are based on the judgment that label restrictions implemented in 1982 on timing, amount, and frequency of aldicarb use are adequate measures to prevent further deterioration of groundwater quality", has not been met.

As to other contentions by Mr. Dawson, this reviewer is not in total agreement. It is hard to say what is "adequate" monitoring. Union Carbide, the University of Wisconsin, and the Department of Natural Resources (and possibly others this reviewer is not aware of) have conducted monitoring activities. Indeed, Mr. Dawson's primary evidence is monitoring from DNR.

Mr. Dawson's contention that "intensive research on which to base a refined regulatory scheme has proceeded at a snail's pace or not at all." is questionable. Although perhaps not "enough" research has taken place, Dr. Harkin of the University of Wisconsin has been conducting research in Wisconsin, as has Union Carbide. Several other interested parties, including, for example, EPA research laboratory and the University of Florida, are also conducting research on aldicarb. The implicit assumption in Mr. Dawson's statement is that research should be directed towards development of a refined regulatory scheme. Since his proposal is a cancellation of aldicarb in Wisconsin, it doesn't appear that this regulatory scheme requires much research. Related research such as computer simulation modeling, which is gaining more credibility, has shown that management options, such as delayed timing of application, will reduce the amount of aldicarb leaching. Intuitively, applying aldicarb every other year will also reduce the amounts contaminating ground water. Appropriate questions to ask at this time would be: "Are the restrictions in Ag.17 enough?", "Will the use of aldicarb in the Central Sands result in ground water contamination, regardless of precautions taken?" and "Are all restrictions in Ag.17 being followed?".

This reviewer is in agreement with one contention by Mr. Dawson, that "Nagging questions about...how aldicarb residues are acting in already contaminated groundwater, remain unanswered." A recent study by Dr. Miles of the University of Florida indicates that aldicarb sulfoxide reduces back to aldicarb sulfide under Florida ground water conditions. This would support the contention that aldicarb persists longer in ground water than previously thought, in some conditions.

There is no prior basis for the state-wide cancellation of a pesticide product. Regional cancellations of aldicarb in Suffolk County, New York, and Del Norte County, California support a county-wide ban option, but not a state-wide ban. Pesticides are also cancelled on a crop-by-crop basis. The strategy for regulating aldicarb has not yet been determined by the EPA, but it is doubtful that a state-wide cancellation will be an option that is considered. There is no precedent for this type of restriction. As well, this option is not "equitable" considering that there are, in all liklihood, use sites in Wisconsin aside from the vulnerable Central Sand region, which are not at risk for ground water contamination and loose the benefit of aldicarb use. This is inequitable considering that farmers in other states will still have use of aldicarb.

However, Mr. Dawson's letter does bring into clear focus that Ag.17 may not have fulfilled its primary purpose. His letter is perhaps both long-winded and emotional, and is based solely on the results of one survey done in June of 1984. Nonetheless, there is little doubt that ground water contamination has continued to occur beyond the 1982 restrictions.

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb comment §186

This package is from C.D. Besadny of the Department of Natural Resources. It includes an extensive computer printout summarizing the testing of 840 wells in Wisconsin as of March of 1984, two communications in 1982 between the Department of Natural Resources (DNR) and Department of Health and Social Services (DHSS) to the Department of Agriculture, Trade, and Consumer Protection (DATCP), the first of which expressing concern about the proposed aldicarb rules (Ag.17) and the second recommending adoption of the aldicarb rule with new "purpose" language, and a copy of the resolution adopted by the Wisconsin Pesticide Review Board (PRB) requesting a report on the effectiveness of the aldicarb restrictions from the DATCP to be prepared by January 1, 1984. As of Aug. 20, 1984 (when this comment was submitted), the report was not completed.

Some concerns expressed by DNR and DHSS in their first letter to DATCP dated Aug 10, 1982, were not adequately met in the law governing aldicarb, Ag.17. Both agencies preferred to see a moratorium on aldicarb use when residues are found at some fraction of the Suggested No Adverse Response Level (SNARL; this level is not defined in the letter and it is assumed that SNARL is also 10 ppb), rather than above the SNARL. AG.17 reads:

> Aldicarb applications are subject to prohibition... if the intended application site is located within a township quarter-quarter section lying wholly or in part within one mile of a sample point at which aldicarb residues have been detected in groundwater at a level exceeding 10 parts per billion...

The "purpose" language of Ag.17 regarding "2 to 10" ppb addresses this concern but does not allow for a moratorium.

This letter also addressed a concern that "...The proximity to irrigation wells should not be a basis for disregarding a sample. The only criterion should be whether the sample is indicative of ground water quality. A landowner's rights should be preserved to assure that he may construct a future well which will provide a safe water supply." Ag.17 reads:

> ...Samples shall not be drawn from a high capacity irrigation well, or any well located within 300 feet of a high capacity irrigation well.

Thirdly, they suggested that the proposed rule "...require review after 1 or, at most, 2 years allowing for additional data from research and sampling and input the Legislative Council's Special Committee on Groundwater Management..."

This concern was handled in a general manner in the "purpose" section, which said that the "The department shall evaluate the need for further actions...when groundwater samples are found to contain aldicarb residues at a level from 2 to 10 parts per billion."

Whereas the first letter (Aug 10, 1982) from DNR and DHSS to DATCP expressed concerns about Ag.17, the second letter dated Dec 16, 1982 to DATCP recommended adoption of Ag.17, due mainly to the "purpose" language included in front of the rule:

> Should substantial evidence become available, through research or field monitoring, that, as a result of applications made since 1982, the label restrictions enumerated in this rule or label changes made subsequent to 1982 do not adequately minimize the quantity of aldicarb and its degradation products in groundwater in order to meet the purpose of this section, the rule will be amended. The department shall evaluate the need for further actions, including but not limited to monitoring, research, label restrictions, use restrictions, and moratoria, when groundwater samples are found to contain aldicarb residues at a level from 2 to 10 parts per billion. Based upon that evaluation, prior to each growing season, the department shall implement those actions.

A summary of the monitoring results shows that, of the 840 wells that have been tested, 180 have shown at least a detectable concentration of aldicarb, and 75 have produced at least one sample result with an aldicarb concentration over 10 ppb.

Clearly, the DNR and DHSS are concerned with <u>any</u> contamination of the ground water. They even express concern over the synergistic effect of aldicarb in combination with other pesticides which might leach to ground water. This view represents the opposite extreme from the viewpoint of Dr. Harkins (comment §146) of the University of Wisconsin, who believes that although contamination of the Central Sands Aquifer will occur, it will only be a localized problem, and aldicarb will only penetrate the top of the aquifer where leaching does occur. As such, it is Dr. Harkins view that <u>some</u> contamination of the Central Sands Aquifer is acceptable.

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb Comment §188

J.E. Legates, Dean of the School of Agriculture and Life Science at North Carolina State University, writes on the usefulness of aldicarb on cotton, peanuts, and tobacco in North Carolina. He notes that the concerns of aldicarb are not due to chronic effects, but does acknowledges that it has high acute toxicity. He reports on a survey by the North Carolina Department of Agriculture in 1982 and 1983 in which samples were taken from drinking water wells in or adjacent to treated fields of cotton, peanuts, and tobacco. Aldicarb was found at concentrations of 1-2 ppb in 7 of 104 wells. He notes that the Health Advisory Level is at 10 ppb. In and of itself, this evidence would seem to indicate that the population served by these drinking wells is in no immediate danger. However, it is difficult to extrapolate further without knowledge of: 1) depth of these wells, 2) soil type and geology where the samples were the samples were taken, 3) if these wells were "deep", are there also "shallow" wells used for drinking water, and so on.

Dr. L.E. Legates concerns are noted, but his information is insufficient to draw any conclusions from.

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb comment §191

Lori Johnston, Assistant Director, Pest Management, Environmental Protection and Worker Safety, Department of Food and Agriculture, California, writes that "we believe aldicarb is being used safely in California". She does note that aldicarb was banned in Del Norte, due to a "combination of high rates of use, permeable soils, low pH, cool temperatures and a shallow water table". She notes that other aquifers over which aldicarb is being used have been sampled with no findings, but she does not comment as to whether or not the same environmental conditions which led to contamination in Del Norte County exist elsewhere. She claims that, "If the mechanism of pesticide mobility through soil to groundwater was understood, it might be possible to print restrictions on the label which would be simple but accurate enough to eliminate the possibility of residues in ground water." This is a totally inaccurate statement, as well as being somewhat contradictory to earlier statements in her letter where she explained why aldicarb was leaching to ground water in Del Norte County. Nonetheless, "...after exhaustive reviews of the literature and some research projects of our own, we can say with some confidence that the mechanism is not understood." Soluble aldicarb is transported in water which leaches through the soil and recharges the aquifer.

She is also concerned and misinformed about the use of computer simulation models: "Soil mobility of aldicarb through modeling or any other way cannot be predicted, except in certain very specific locations where residues have already appeared in groundwater." This is also inaccurate. It is true that the validity of model results increases when the model has been applied and compared with field data. However, model results are also useful and valid (up to a point) when the model has not been validated with field data. There have been several published studies of modeling and aldicarb, and this reviewer is aware of three excellent modeling studies utilizing the PRZM model which will be published within a year. However, modeling will never be used as the only evidence in regulatory decision making, although they will probably be used as supportive evidence.

Lori Johnston does offer an opinion which is not often heard from a public official, "Therefore, the control of aldicarb use to prevent groundwater contamination must be addressed at the local level." Typically, the EPA is berated for passing problems onto local officials.

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb comment §192

James P. McKeown, PhD, Consulting Cotton Entomologist in Jackson, Mississippi writes a very short letter supporting the continued use of aldicarb, and does not think there will be a ground water contamination problem "since the ground water in my area is at least 150 feet below the surface".

Dr. McKeown will have to produce documentation on his facts if he wants them to be used as evidence.

Matthew Lorber, Agricultural Engineer

Title: Response to aldicarb comment §221

G. Talmadge Balch, Pesticide Education Specialists of the Alabama Cooperative Extension located at Auburn University, writes mainly of the present use and benefit of aldicarb on peanuts, soybeans, pecans, sweet potatoes, Irish potatoes, and cotton.

He notes that there is little danger due to worker exposure. He also briefly describes a small monitoring program in order to address issues of potential ground water contamination. His paragraph is:

"Well water samples have been taken from four wells and analyzed by the Alabama Pesticide Residue Laboratory. Wells were located in the edge or near cotton fields treated with Temik for the past ten years. Individuals living near and utilizing these water supplies were concerned and made request to have their water analyzed after ground water contamination by Temik began to make National Television News. No Temik was found in water sampled."

This is insufficient evidence to draw conclusions concerning the potential for and/or existance of ground water contamination in Alabama. Other information which would be of help concerning these wells include depth of water extraction, depth to ground water, surface soil type in the neighboring cotton fields, and so on. Soil type and hydrogeologic conditions in all areas of Alabama in which Temik is used would be necessary in determining the potential for contamination of ground water in Alabama in general. It would appear that the individuals using these four wells are in no immediate danger.

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Title: Response to "Temik Aldicarb Pesticide A Scientific Assessment", Part II, Section entitled, "Environmental Studies Movement and Fate of Aldicarb in Soil and Water", p. 58-59

This is a brief summary on the fate and transport of aldicarb in the environment. While there is nothing glaringly incorrect in this two-page summary, there is a clear and obvious bias in the reporting of information which would lead the uninformed reader to conclude that there may be no problem associated with aldicarb fate and transport. Following are several comments on this summary, with a focus on this reporting bias.

1) The summary describes the microbial degradation of aldicarb, including environmental factors which enhance and retard this process. The state that the half-lives of aldicarb and its metabolites range from 4 to 8 weeks. This is consistant with the discussion of aldicarb fate and transport by EAB for the PD 2/3. However, Union Carbide does not clarify that this half-life is associated only with microbial decay which occurs in the root zone of crops. Union Carbide does state that microbial decay predominates near the soil surface, and that hydrolysis decay is the major mode of decay several feet below the surface. However, Union Carbide does not say anything about hydrolysis half-life, which is significantly longer than microbial half-lives. Hydrolysis half-lives range from months to years. This is an example where biased reported can lead the uninformed reader to believe that aldicarb half-life is 4-8 weeks, regardless of the mode of decay which predominates.

2) Union Carbide spends an undue amount of space describing the possibility of upward movement of aldicarb due to evaporating water. Three of the four references used to support the conclusion, "In most agricultural soils, these movements result in little or no net loss of aldicarb from surface soils due to leaching." are unpublished Union Carbide studies unavailble to EAB for review, but obviously were performed with the intention to show that evaporating water plays an important role in retarding the downward movement of aldicarb. To some extent, evaporating water near the soil surface will play a role in retardation. In a recent modeling study by this reviewer (Lorber and Offutt, 1986, "A Method for the Assessment of Ground Water Contamination Potential Utilizing PRZM - A Pesticide Root Zone Model for the Unsaturated Zone", to be published in Fall, 1986, in ACS Symposium Series Publication entitled, "Evaluation of Pesticides in Ground Water"), evaporating water was listed as one of four possibilities as to why aldicarb appeared to be staying near the soil surface longer than would be expected. However, the energy necessary to move water upward against the pull of gravity is high and would negate the possibility of this process being significant, if at all present, lower than a foot below the surface. Since aldicarb is incorporated, residues can very easily move below a depth where

upwardly moving evaporating water can effect its movement. This is another example where Union Carbide wants to leave the reader with the impression that leaching of aldicarb is not significant.

3) On p. 59, Union Carbide twice refers to the possibility of aldicarb reaching the water table in "trace amounts", once in association with the situation on Long Island, New York. EAB disagrees that only in certain special situations will aldicarb reach ground water in trace amounts. The EAB report for the aldicarb special review describes several monitoring efforts and results, and in the executive summary, states that aldicarb has been found in 50 counties in 15 states, and concentrations exceeding 10 ppb have been found in 10 states. A rough estimate of all well monitoring shows that aldicarb has shown up in 15% of over 30,000 samples. The time has well past that aldicarb can be thought of as appearing in "trace amounts" in ground water in situations where it is expected to show up in ground water. It may show up in trace amounts in situations where it would not be expected to show up at all.

4) The section by Union Carbide concludes with a discussion of the possibility of aldicarb runoff. The fact that it is typically incorporated in granular form minimizes the potential for its appearance in surface runoff, since several studies in the literature show that typically only that amount of pesticide in the surface few centimeters of soil are available for loss via runoff. This does not mean that the potential exists for contamination of surface waters. In a Congressionally-mandated study of drinking water wells for aldicarb in Florida, no aldicarb was found in wells, but some was detected in a river supplying drinking water in Lee County, Florida. It could have appeared in the river due to runoff or through groundwater recharge of the river. The one study cited in the Union Carbide summary showed that runoff of aldicarb would not be a problem, although they stated that "total toxic residues in the runoff water did not exceed 1 ppm". Realizing that 1 ppm is two orders of magnitude higher than a toxicological level of concern (10 ppb), the fact that the runoff water had levels approaching 1 ppm is a matter of concern. Still, as Union Carbide pointed out, these levels were the result of broadcast application followed by flooding and as such, were highly atypical of aldicarb use.

In summary, this environmental review by Union Carbide was highly biased towards the safety of aldicarb use. Certain environmental tendencies were exagerated in order to build Union Carbide's case. For example, the influence of upwardly evaporating water was exagerated in order to show that aldicarb would not leach. Certain important factors were omitted. For example, the soil half-life was correctly stated as 4 to 8 weeks, but no mention was made of the much longer half-life of residues which leach to lower sections of the profile and are subject to the slower process of hydrolysis. Aldicarb hydrolysis half-lives range from months to years. For these reasons, this environmental review section should be viewed with skepticism.

Matthew Lorber, Agricultural Engineer 27

Title: Review of "Appendix I Comments on Statements made in EPA's Special Review Notice for Aldicarb"; comments § 2 and 6

Comment §2: Union Carbide questioned EPA's statement that: "...Aldicarb sulfoxide and aldicarb sulfone...persist longer under anaerobic conditions...than under aerobic conditions". They cite two references which show the reverse trend - that persistance is longer in aerobic conditions than in anaerobic conditions. Both references were checked, and were found to be accurately represented by Union Carbide. The current EAB report, "Ground Water Vulnerability Assessment", which is the EAB contribution to the aldicarb PD 2/3, does not state that the aldicarb sulfoxide and sulfone persist longer under anaerobic conditions than aerobic conditions. It does refer to laboratory experiments which show rapid degradation of aldicarb and aldicarb sulfone under anaerobic conditions. However, it also references work done in Florida with Floridan ground water. In these experiments, the persistance of aldicarb and the sulfoxide and sulfone degration products were studied with and without limestone amendments (the Floridan Aquifer is a limestone aquifer). Of six comparisons between half-lives (3 products, 2 comparisons each), five showed longer half-lives under anaerobic conditions by a significant amount.

The statement, as originally made by EPA, was made in recognition that microbial decay, which predominates in the aerobic environment of the root zone of crops, is a more robust degradation process (in that it leads to shorter half-lives) than chemical hydrolysis, which predominates in the anaerobic environment of the ground water. Exceptions to this rule occur (as noted in two references cited by Union Carbide) when anaerobic microorganisms promote rapid degradation of aldicarb products.

Comment §6: Union Carbide rebutted EPA's statement: "Because aldicarb residues have half-lives as long as several years, under conditions typically found in groundwater, the time required for degradation of aldicarb groundwater residues to non-toxic compounds will be long". Similar to comment §2 above, the EAB ground water assessment does not comment on conditions which are typical for ground water. It does state that hydrolysis, which predominates in groundwater, can vary from weeks to years, depending on conditions (primarily pH and temperature). Therefore, Union Carbide was correct in flagging this inaccurate general statement.

However, Union Carbide, in rebutting this statement, also spends time (5 sentances) before concluding themselves that: "Therefore, in most areas where aldicarb is used, residues do not persist from year to year." Suffice it to say that EAB does not agree with this conclusion - in some places it persists, and in some places it degrades rapidly. See the EAB document for details.

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