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TO: Iowa State Chemical-Technical Review Board

FROM: Iowa Geological Survey

Subject: Suggested Hydrologic Monitoring System at Winfield Chemical Burial Site

Introduction: Currently society is faced with the necessity of developing hydrologic and geologic criteria for storage of toxic and hazardous wastes. Few sites have been studied. Also, because it is rarely possible to extrapolate the results of research in a distant region to the problems faced locally, the study of a storage site that has existed a sufficient length of time to become hydrologically equilibrated is plainly necessary in Iowa at this time.

I. Objectives and Justifications

A. Scientific--. The hydrology of till and colluvial sedimentary bodies derived from till is not well understood. General hydrologic theory is founded on the assumption that the medium through which water migrates is of uniform permeability and is infinite in extent. Till is material having a wide range of grain size of clastic elements and lacking significant sorting. The manner in which water travels through till is known to deviate from the

generalities defined by flow system hydrologic theory, but the mechanics of water migration in till require intensive study before the generalities of its behavior can be fully identified. Study of the Winfield site would employ the commercial chemicals leaching from the burial as tracers to determine flow characteristics of the site and the surrounding terrain and sediments that inclose it.

It is an especially attractive site to study because it has been in existence long enough to have reached a significant degree of equilibrium with the regional groundwater and surfacewater flow system. Also, the site is producing an unmistakable leachate. Mapping (3-dimensional) of the concentrations of the chemicals will define the direction (spatial) and velocity (temporal) of flow in the sediments. Repetitive analysis will yield a highly refined evaluation of the spatial and temporal aspects of till as a flow system medium. This type of data can be amplified by laboratory studies, but it cannot be duplicated by them.

B. Practical--. The state is now engaged in a program that requires all political subdivisions to establish a plan by which municipal and industrial wastes will be disposed of in sanitary landfills. The criteria by which the construction of these landfill sites will be judged as safe with respect to potential pollution of water resources are erected on fundamental hydrologic assumptions. The most critical of these is the mechanics of water migration in till. The

study proposed here will without question make our evaluations of landfill site plans a more sophisticated and safer procedure.

Of greater importance is the need to erect criteria for the establishment of disposal sites for toxic and hazardous chemical wastes and low-level nuclear wastes. For these wastes a completely impervious site is desirable. The degree to which till can satisfy this requirement is information we need immediately. Even the initial exploration of the Winfield site will produce significant results in this regard.

II. Research Design (Hydrology only)

A. Surface Mapping--. A plane table map of the region must be made before the final research design is completed. This map should include an approximately 500-foot margin around the observation well field.

B. Observation-Well Field--. A field of nine bedrock and seventeen shallow observation wells will be required. Nine of the shallow wells should be dual completion wells that will serve as pieziometers and sample collection points at two levels in unconsolidated materials. Figure 1 is a plan drawing of the distribution of wells in the proposed field.

The required depth of bedrock wells is estimated at 120 ft. These should be cased and grouted into the rock. The shallow wells

will be less than 95 ft in depth, but actual depths should not be determined until initial drilling has precisely defined the stratigraphy of the unconsolidated sediments.

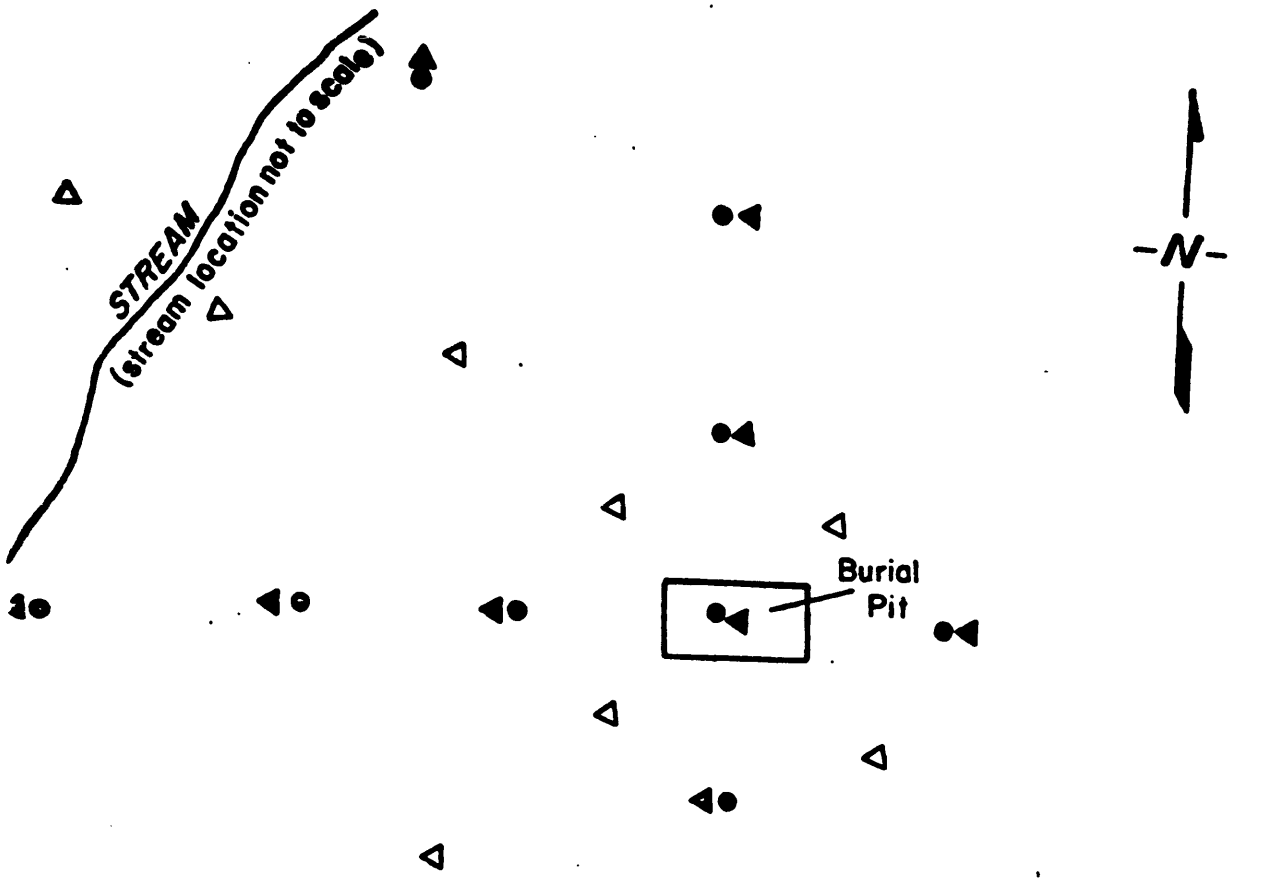
C. Sampling--. Piezometric readings should be collected during the first twelve months of research on a weekly basis. Chemical samples will be collected on a schedule recommended by those responsible for this aspect of the research. For the hydrologic research it would be useful to have a complete analysis at least twice during the first month. Thereafter particularly diagnostic elements or compounds can be selected for analysis as tracers.

III. Projected One-Year Budget (Hydrology only)

Drilling and Casing* 2,695 ft at $4/ft	$10,780.00
Scientific Supervision (including travel) $18/day for 10 days	180.00
Mobilization costs	150.00
Dual completions of 9 wells at $45/completion	405.00
Piezometric Sampling (chemical sample collection can be performed as an adjunct activity without additional operating costs.)	
Field Time	
52 weekly field trips for a student scientist at the B.S.-M.S. level of training	
Costs of plane table mapping	500.00
Travel 40 miles/trip at 10 cents/mi	208.00
Salary at $6.70/hr	2,117.00
Laboratory Time	
52 weeks for 2 days/week at $6.70 (832 hrs)	5,574.00
Employee Benefits at 10 percent	769.00
Computer Time	400.00
Supplies (expendable)	150.00
Subtotal	$21,233.00
Overhead to IGS for project management at 5%	1,062.00
Total	$22,295.00

*Prices based on presumption the IGS does the drilling with its own rig.

Figure 1. Plan for the Establishment of an Observation-Well Field at the Winfield Disposal Site



● Bedrock well

▶ Dual completion drift well

▷ Single completion drift well

0 20 40 60 feet
SCALE

Actual placement of wells will be determined

Winfield

Thimet
Atrazine
Aldrin
Heptachlor
Bux-Ten
Amiben (liquid)
Treflan (liquid)
~~Dinoseb~~ Di-syston
Amaben

approx ~~50 tons~~ of Garbage & Burned material was buried
75-100 Tons

Trench - 40' long x 17' wide 12' deep at the center

Pipe #6	Pipe #7	Surface H_2O		Soil		Soil		Surface Water
Thinct	Thinct	Thinct	Diazin	Thinct	Hep. Ep.	Thinct		Thinct
0.5	0.17							
0.63	0.25							
0.33	0.21							
0.36	0.33	42.		70				
0.14	0.35			130 #37		84 #38		
0.50	0.22							48 #39
0.22	0.22							
0.33	0.28	11 #68		45	8.9 #69	289 #70		
0.29	0			162 #78				
0.44	1.0							
0.63	0.24							
0.36	0.24	Soil # 114		Soil # 115				
0.30	0.30	Middle of Low Spot		Bottom of Low Spot				
0.26	0.28	364	461	Thinct 70	Diazin 237	Hep Ep 8.4		

[illegible] Burial Site H_2O Samples 19[illegible]

Residues P.P.b.

Date	Pipe # 1 Thimet	Pipe # 2 Thimet	Pipe # 3 Thimet	Pipe # 4 Thimet	Pi[illegible] Thime[illegible]
2-12-73	2.0	2.2	1.5	1.6	2.4[illegible]
3-20-73	0.5	0.95	0.58	0.31	0.4[illegible]
4-6-73	0.32	0.84	0.25	0.17	0.18
4-24-73	0.56	0.49	0.38	0.67	0.2[illegible]
5-10-73	0.47	0.50	0.50	0.32	0.2[illegible]
5-24-73	0.65	0.22	0.33	0.00	0.00
6-7-73	0.50	0.33	0.28	0.22	0.56
6-22-73	0.44	0.33	0.73	0.28	0.29
7-16-73	0.30	0.24	0.20	0	0.39
8-1-73	0.47	0.29	0.22	0.21	0.19
8-15-73	0.60	0.46	0.44	0.36	0.48
[illegible]-19-73	0.49	0	0.24	0.18	0.32
8-28-73	0.60	0.40	0.28	0.35	0.88
10-8-73	0.39	0.22	0.19	0.33	0.16

Winfield Disposal Site Evaluation

On April 17, 1965 an explosion and fire destroyed a fertilizer and pesticide warehouse in Winfield, Iowa. The ruins contained an estimated 75-100 tons of Chemicals. This included 40 tons of [illegible] 12 tons of Thimet, and 6 tons each of Sevin and Captafol. Other damaged products [illegible] and Bux-Ten, atrazine, Amiben, Tordon, and Di Syston.

State and local governmental representatives were consulted and it was determined the best method of disposal would be to bury the material buried The area of the burial site had to be far removed from drinking water supplies and have an impervious soil underlying the area. A farm one mile west of Winfield met the requirements and gave permission for the burial of the debris. After a period of rainy weather the debris was finally buried on April 22, 1968 in a trench on the farm. The trench was dug 40 feet long 17 feet wide and 12 feet deep in the center. The trench depth sloped from the sides toward the center. A fairly tight clay soil was found about three feet under the surface. After the debris had been dumped into the trench several sacks of lime were poured over the ruins. It was then compacted and covered. Any field tile that might have been in

the vacinity would have been at the level of the compacted debris. So. there was no fear of ~~the~~ pesticide residues getting into any drainage system.

On ~~O~~ October 25 1968 a water sampling pipe (#5) was installed and six more pipes were installed the middle of September, 1972. The range, location, and depth are as follows:

Pipe #	Pipe Diameter (In.)	Location Burial Site (Ft.)	Depth (F
1	1.25	50 - SE	35
2	1.25	10 - SW	27
3	1.25	50 - W	25
4	5.00	80 - NW	55
5	1.25	100 - NW	17
6	1.25	140 NW	24
7	1.25	140 NW	14

~~Water & Soil~~ Soil samples were taken from the site at intervals when the time and weather permitted. Procedures that should be refered to are as follow~~s~~:

Table 1.

Water Samples at Burial Site

Residues in ppb

Date	DDT	Lindane	Aldrin	Dieldrin	Heptachlor	Hepchlor Epoxide	Location
13-68	0	0	0	0	0	0	Creek ½ mile N of B.S.
15-68	0	0	0	0	0	0	Standpipe
17-69	0	0	0	0	0	0	Standpipe
4-69	0	0	0	0	0	0	Standpipe
4-69	0	0	0	0	0	0	Creek ½ mile N of B.S.
16-69	0	0	0	0	0	0	pipe
27-70	0	0	0	0	0	0	pipe
15-71	0	0	0	0	0	0	pipe
1-71	0	0	0	0	0	0	pipe
30-71	0	0	0	0	0	0	pipe

Soil samples were taken from the time of burial until the completion of this study. During the years 1968 to 1971 Aldrin, Dieldrin, Heptachlor, Heptachlor Epoxide, and Hydroxy Chlordane were found in soils sampled in negligible amounts. (Table 2.) On the other hand, during the same years water samples from the sampling pipe showed only once, trace amounts of dieldrin and heptachlor epoxide. (Table 1.) Several samples were also taken from a creek one quarter mile North of the burial site. These samples were negative for any pesticide reaching the creek from the burial site. A waterway draining the area was also sampled during 1972 and 1973 and only one sample was positive for a pesticide residue. It contained 0.50 pp.b. of Thimet from a point 30 feet North of pipe number 5.

In 1972 until the completion of the study a Flame Photometric Detector and a gas chromatograph was used to detect any organo phosphorous compounds. Only minute amounts of Thimet were found in the seven sampling pipes. (Table 3, 5.) Apparently dangerous quantities of pesticides are not entering the surface or subsurface waters at the sampling points.

Noted during the years of sampling the surface of the burial site has been void of vegetation on the steep hill slope. Samples of surface soil contained a higher resi

level of insecticides than did the water. The highest residue level was 364.0 ppb of Thimet. However, pesticide residues were not found in approximately one-half of the surface soil samples (Tables 2, 4, 6, 8)

Conclusions brought about by this study show that burial of pesticides can be a safe way of disposal. Several considerations are very important though, such as, soil conditions, surface and subsurface water supplies, and the combination of chemicals to be disposed of. There are other ways of disposing of pesticides but most are very costly to operate. This study at Winfield shows burial of pesticidal debris can be both economical and practical as shown by the residues from the water and soil samplings. Although sampling showed minute amounts of Thimet were released from the burial site one has to take into consideration the total tonnage of pesticides involved. When one does realize that from over 100 tons of pesticide debris only a fraction of one ppb can be detected ~~can be~~ in the water sampling pipes and negligible amounts found on the surface soil. The evidence points to the fact the pesticides are being well contained in the burial Trench.

The highest residue level was 364.0 ppb of Thimet. However, pesticide residues were not found in approximately one-half of surface soil samples.

Conclusions brought about by this study, are one, there needs to be more investigation into the ways and methods of disposal of pesticides and related chemicals after the useful life of the wastes for a safe disposal are few in number, and most are very costly expensive. Although this study at Winfield shows burial of pesticides can be economical and practical. Evidence from the [illegible] soil sampling showed minute amounts of Thimet were being released from the burial site, but in consideration of the tonnage involved the pesticide contents of the burial site are being well contained.

Water Samples at Burial Site
standpipe + creek on Webb farm

Residues in ppb

	DDT	Lindane / BHC	aldrin	Hg	Hg Ep	dieldrin	location
9-[illegible]	—	-	-	-	-	-	creek by N. b. site
1-19-68	—	-	-	-	-	—	Standpipe
3-17-69	-	-	-	-		-	Standpipe
8-4-69	—	-	-	-	-	—	Standpipe
8-9-69	—	-	-	-	-	—	creek by N. b. site
11-10-69	-	-	-	-	-	—	pipe
4-27-70	-	-	-	-	-	—	pipe
1-15-71	-	-	-	trace	0 ~~0.094~~	0 ~~0.050~~	pipe
6-1-71	-	-	-	-	-	-	pipe
6-[illegible]-71	—	-	-	-	-	-	pipe

Table 6.

Residues in ppb

Date	Type	Residues		Location
		Thimet	HepEp.	
24-73		70.0		12' N.W. from upper grassline
10-73		130.0		10' N.W. from upper grassline
10-73		84.0		18' N.W. from upper grassline
22-73		45.0	8.9	N.W. from upper grassline 18
22-73		289.0		12' N.W. from upper grassline
16-73		162.0		16' N.W. from upper grassline
8-73		364.0		Middle of Bare Spot
8-73		70.0	8.4	Downhill side of Bare Spot

Surface Water Samples at Burial Site

Residues in ppb

4-73		42.0		30' downhill from upper grassline
4-73		48.0		30' downhill from upper grassline
2-73		11.0		30' downhill from upper grassline

305
12
610
305
3660

305
18
2440
305
5490

305
16
1930
305
4880

Z-202

MEMORANDUM

TO: Dr. Long & Files

SUBJECT: Water from 1 1/4" pipe 100 feet west of pesticide and fertilizer burial site on Harold Wells farm at Winfield

FROM: Victor B. Beat

DATE: 19 November 1968

Ortho-phosphate-0.92 mg/liter

Water from Coralville Reservoir runs from 0.05 to 1.5

Nitrate nitrogen - 0.15 mg/liter

Water from Coralville Reservoir runs from 0.5 to 0.6