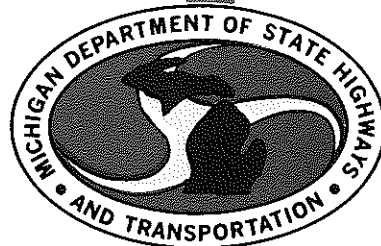


A STUDY TO MONITOR THE DEICING CHEMICAL  
POLLUTION PREVENTION SYSTEM AT  
THE REED CITY MDOT MAINTENANCE GARAGE

Preliminary Report



**TESTING AND RESEARCH DIVISION  
RESEARCH LABORATORY SECTION**

A STUDY TO MONITOR THE DEICING CHEMICAL  
POLLUTION PREVENTION SYSTEM AT  
THE REED CITY MDOT MAINTENANCE GARAGE

Preliminary Report

R. W. Muethel

Research Laboratory Section  
Testing and Research Division  
Research Project 77 G-227  
Research Report No. R-1114

Michigan Department of Transportation  
Hannes Meyers, Jr., Chairman;  
Carl V. Pellonpaa, Weston E. Vivian, Rodger Young,  
Lawrence C. Patrick, Jr., William Marshall  
John P. Woodford, Director  
Lansing, April 1979

The information contained in this report was compiled exclusively for the use of the Michigan Department of Transportation. Recommendations contained herein are based upon the research data obtained and the expertise of the researchers, and are not necessarily to be construed as Department policy. No material contained herein is to be reproduced—wholly or in part—without the expressed permission of the Engineer of Testing and Research.

## Introduction

This study was initiated late in 1977 to gather information for an evaluation of the MDOT Revised Pollution Incident Prevention Plan (PIPP) guidelines for deicing salt and treated sand storage and handling at maintenance facilities. The Reed City garage was selected for this study because it represented a new facility designed to incorporate pollution control features recommended in the PIPP guidelines. The study primarily involves the monitoring of the groundwater for evidence of deicing chemical pollution emanating from the facility. A secondary phase of the study involves the monitoring of deicing chemical leachate from uncovered and asphalt-coated winter maintenance sand stockpiles.

## Groundwater Monitoring System

The groundwater at the Reed City facility is being monitored by taking samples from the following observation wells situated down-gradient from the site:

Test Well No.	Location
1	Southeast corner of property
2	South of salt shed
3	South of retention lagoon

The wells were emplaced with 1-1/4-in. diameter, 4-ft long PVC screens set approximately 5 ft below the water table. The bottom of the screens are approximately 17 ft below ground level. Well Nos. 1 and 3 were completed on November 3, 1977 by MDOT personnel from District 5. Well No. 2 was completed on November 8, 1977 by Testing and Research Laboratory personnel.

In addition to the shallow groundwater observation wells, an artesian well (No. 4) is regularly sampled for information. This flowing well is piped inside the garage at the northwest corner.

Figure 1 presents a general location plan of the Reed City garage site.

## Sand Stockpile Monitoring System

The winter maintenance sand storage area at this facility includes a run-off sampling sump which provides for the retention of sandpile leachate. The sump contains a release valve which permits emptying after samples are obtained. The asphalt-paved sand storage pad and special sampling sump locations are also shown in the figure.

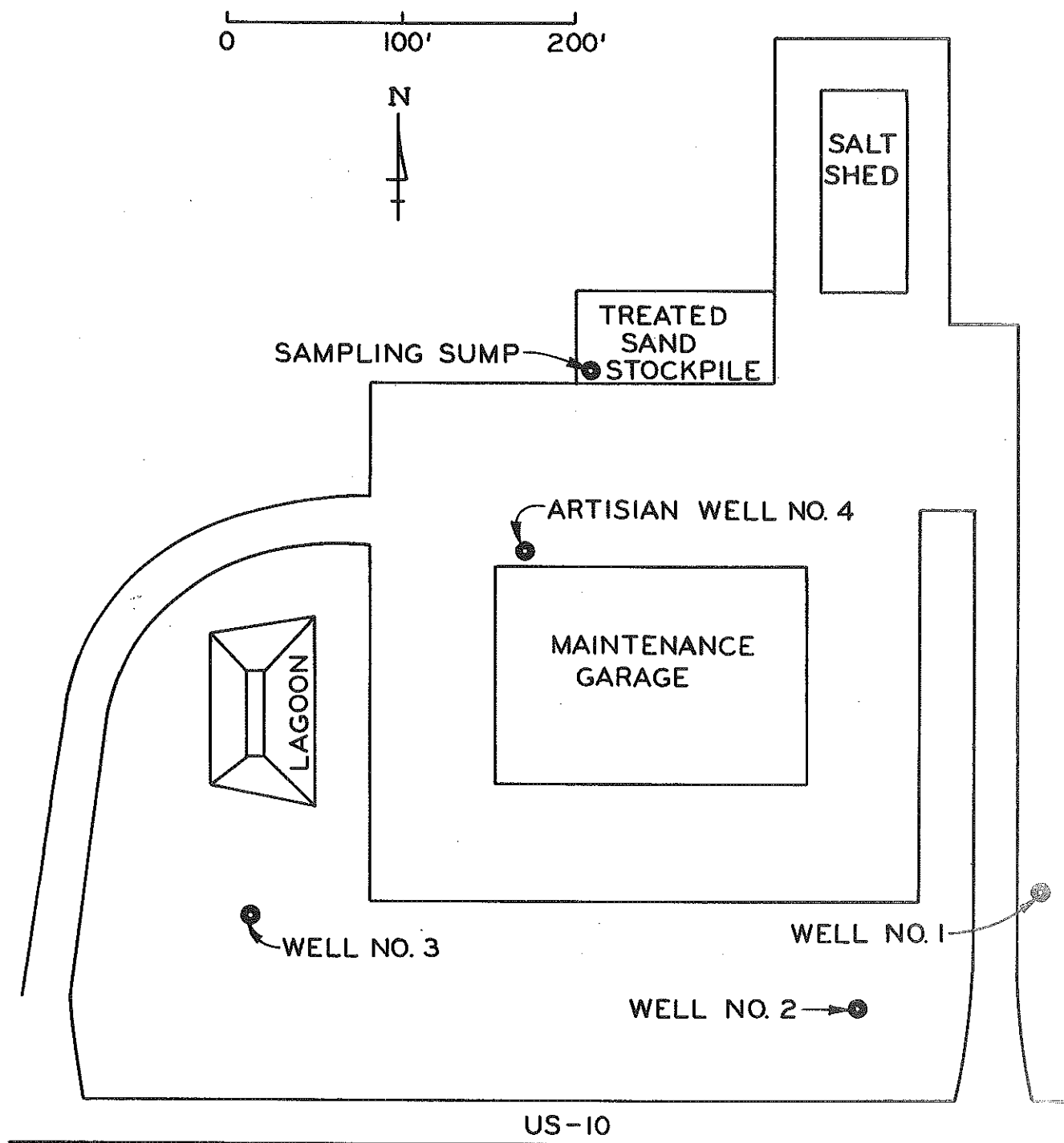


Figure 1. Reed City maintenance garage site.

## Collection and Testing of Samples

Samples of groundwater, sandpile leachate, and retention lagoon water are obtained on a monthly to biweekly schedule in conjunction with the regular Statewide sampling of groundwater for another research project, "Effects of Deicing Salts on the Chloride Levels in Water and Soil Adjacent to Roadways" (71 G-180). The water samples are tested for chloride content at the MDOT Testing and Research Laboratory; chlorides are determined by silver nitrate titrations. The chloride test results are included in Table 1.

## Supplemental Laboratory Leaching Tests

Preliminary salt leaching tests were conducted in the laboratory on a 10-lb quantity of sand containing 2 percent deicing rock salt. Results of the tests indicated that highly saline leachate was formed and released when the sand reached a state of saturation. These preliminary results prompted a repeat experiment with a conical 100-lb stockpile of sand containing 2 percent deicing rock salt. The treated sandpile was exposed to 24 incremental sprinklings of simulated rainfalls equivalent to 1/4-in. of precipitation computed from the base area of the test stockpile. The sprinklings were applied at the rate of approximately one to two per day over a period of four weeks. Samples of leachate were collected from a corner drain in an inclined retention box constructed to hold the test sample. Results of the in-laboratory salt-leaching tests are included in Table 2 for comparison with actual run-off data from the asphalt-coated sand stockpile at the Reed City garage.

TABLE 2  
RESULTS OF LABORATORY LEACHING  
TESTS ON CHLORIDE-TREATED SAND

Accumulated Total Simulated Rainfall, in.	Chlorides in Run-Off, ppm Cl <sup>-</sup>
1/4	103,494
1/2	106,953
3/4	91,657
1	68,652
2	28,226
3	4,613
4	607
5	334
6	106

## Preliminary Findings: Groundwater Monitoring Phase

Water samples obtained from the deep artesian well (No. 4) contain less than 10 parts per million (ppm) Cl<sup>-</sup>. Water samples obtained from the

TABLE 1  
WATER TEST SAMPLE SUMMARY (Cl<sup>-</sup>, ppm)

Date Sampled	Sample Location						Estimated Monthly Precipitation, in.
	Well No. 1	Well No. 2	Well No. 3	Well No. 4	Retention Lagoon	Sandpile Run-off	
11-4-77	11		6	5		no sand	3.64
12-8-77	10	5	7	5	*	**	
12-29-77	7	7	198	6	*	**	3.13
2-3-78	9	8	355	6	*	**	
2-14-78	6	8	213	6	*	**	0.55
3-1-78	15	15	242		*	**	
3-17-78	8	15	91	8	*	9,317	
3-29-78	45	8	152	8	*	**	0.75
4-14-78	8	53	667	8	*	sandpile	
4-21-78			1,121		1,000	gone	2.22
5-4-78	30	128	1,454	15	1,273		2.38
6-12-78	8	8	909		purgings		
6-22-78	8	8	424	8	8		3.21
7-7-78	8	8	120	8	8		
7-18-78	15	15	121		empty		1.83
8-8-78	15	15	53	15	empty		
8-24-78	15	8	45	8	empty		5.27
9-8-78	15	15	45	8	empty		7.59
10-13-78	15	15	23	8	new liner	154,785	
10-24-78					2,850	151,750	3.11
11-20-78	15	15	225	15	1,788	114,116	
11-29-78			37			108,046	
11-30-78			53			**	1.32
12-6-78	8	8	15			96,513	
12-19-78	15	15	30		*	88,622	2.56
1-9-79	15	98	8		*	**	
1-31-79	*	15	23	8	1,882	sandpile	1979 data
2-23-79	*	8	38	8	3,339	gone	not available
3-8-79	*	15	53	8	30		
3-23-79	76	203	53		91		

\*Frozen or covered by deep snow

\*\*No run-off

NOTE: Estimated monthly precipitation is the mean average of total precipitation as recorded at the Big Rapids, Evart, and Baldwin weather stations.

shallow groundwater test well Nos. 1, 2, and 3 were also found to average less than 10 ppm  $\text{Cl}^-$  prior to the storage and handling of deicing salt at the facility.

On December 29, 1977 water samples were obtained from the observation wells. The sample from well No. 3 (the lagoon monitoring well) contained 198 ppm  $\text{Cl}^-$ . As shown in Table 1, subsequent samplings consistently indicated abnormal groundwater chlorides down-gradient from the retention lagoon, strongly suggesting that the liner had developed leaks. During the period from December 29, 1977 through March 29, 1978, six samplings were obtained from the observation wells. The lagoon monitoring well samples ranged from 91 ppm to 355 ppm and averaged 208 ppm  $\text{Cl}^-$  for this period. On April 14, 1978 a water sample was obtained from the lagoon monitoring well. The chloride ion concentration in this sample was 667 ppm, considerably exceeding the U. S. Public Health Service recommended maximum of 250 ppm for human consumption. A further increase in groundwater chloride concentration to 1,121 ppm was indicated by a water sample obtained on April 21, 1978. The two successive water samples containing chlorides considerably higher than the 250 ppm limit prompted an interim letter report (April 28, 1978) to C. P. Seufert, MDOT District Maintenance Engineer regarding the Reed City facility.

During the summer of 1978, a corrective purging procedure was begun to dilute and flush the chlorides from the groundwater in the vicinity of the retention lagoon. The procedure involved filling the lagoon with fresh water from the artesian well and allowing the water to flow through the leaking liner into the groundwater. Table 1 includes chloride values in water samples obtained during the purging period. A steady decline in chloride levels indicated that the groundwater had readily responded to the corrective measures. A water sample obtained from the lagoon monitoring well on October 13, 1978 contained 23 ppm  $\text{Cl}^-$ , indicating a return to low-level conditions.

During sampling of the lagoon monitoring well, periodic visual inspections of the liner were made. The liner material appeared to be composed of nylon-mesh reinforced blue plastic, approximately 4 mils thick. Many sewed seams were evident. The presence of many micro-cracks in the plastic was also noted. This condition suggests a possible deterioration due to exposure to sunlight or an over-stressing due to stretching when the lagoon was filled with water. Since the leakage developed during freezing conditions, the possibility of ice damage is also a consideration.

The lagoon was subsequently repaired by emplacement of an asphalt-impregnated burlap liner over the existing plastic liner. The lagoon has required periodic emptying this past winter to keep the water level below the inlet pipe elevation. This has resulted in considerable variation in chloride content as indicated in Table 1. The District Maintenance Supervisor was contacted regarding disposal of the water. He stated that local



DNR approval was obtained to spread the water along roadway shoulders from a moving tank truck.

Groundwater chlorides in 11 water samples obtained from the lagoon monitoring well from October 1978 through March 1979 ranged from 225 ppm to 8 ppm, averaging 51 ppm. These values suggest a possible small amount of leakage from the lagoon, residual soil chloride, migrant chlorides from an up-gradient source, or a combination of these sources. Groundwater observation wells located due south of the salt storage shed and at the southeast corner of the property have indicated somewhat irregular chloride levels in the groundwater, suggesting possible local minor spillage of deicing salts in the vicinity of the test wells which are situated near the east driveway.

#### Preliminary Findings: Sandpile Monitoring Phase

Due to the leakage of the retention lagoon liner and the usage of stored winter maintenance sand during the 1977-78 and 1978-79 seasons, long-term salt leaching monitoring of the sand stockpile was not possible. Repair of the lagoon has permitted resumption of the collection of leachate from the sand storage area. Several stockpiles of asphalt-coated and uncovered sand containing less than 3 percent salt, to remain undisturbed, have been requested for study purposes to measure the effectiveness of asphalt coverings and to monitor the concentration of chlorides in run-off generated by the stockpiles. If the Reed City facility cannot provide the necessary stockpiles, this phase of the study may require relocation to another site.

Although the leachate-monitoring phase of the study was preempted, a limited number of leachate samples were obtained from the 1978-79 asphalt-coated stockpile. Table 1 includes chloride data from the leachate samples. The test results indicate very high initial chloride concentrations followed by a continual decline. This effect is also indicated by the in-laboratory salt leaching tests conducted on the small experimental salt-treated sandpile.

The salt-treated stockpile at the Reed City garage was inspected on October 13, 1978, shortly after emplacement. The stockpile was observed to be generating a small but continuous trickle of highly saline run-off. The asphalt coating was found to contain a number of cracks due to sagging, requiring a secondary asphalt patching application. A worker at the garage commented that the sand had been saturated by heavy rainfall before it had been combined with salt. The highly saline run-off from the covered Reed City stockpile compares with the in-laboratory leaching experiment which did not exude run-off until the point of saturation was reached. Also, both sandpiles generated highly concentrated leachate immediately after saturation was reached, indicating that stored sand-salt mixtures should be adequately protected from reaching a saturated condition which would produce run-off.

We plan to closely monitor the precipitation run-off from the two smaller treated sandpiles to be placed specifically for this purpose as previously described. As mentioned earlier, one pile is to be covered with an asphaltic coating and the other is to be left uncovered for comparison. We will continue to sample the test wells and retention lagoon at regular intervals, as we have in the past.