*VERIDIAN ENGINEERING, INC.*
Ann Arbor Operations

**Technical Report**

for

# SOUTHEAST MICHIGAN SNOW AND ICE MANAGEMENT (SEMSIM)

Contract No. 98-5436

Reporting Period:
**Spring 2001**

Submitted to:

Road Commission for Oakland County
31001 Lahser Rd.
Beverly Hills, MI 48025

Submitted by:

Veridian Engineering, Inc.
1975 Green Rd.
Ann Arbor, MI 48105

# Technical Report Documentation Page

| 1. Report No. | 2. Government Accession No. | 3. Recipient's Catalog No. |
|---|---|---|
| | | |

| 4. Title and Subtitle | 5. Report Date |
|---|---|
| Southeast Michigan Snow and Ice Management (SEMSIM)<br>Interim Report<br>July 2001 | July 2001 |
| | 6. Performing Organizational Code |
| 7. Author(s) | 8. Performing Organizational Report No. |
| E. Anderson | |
| 9. Performing Organization Name and Address | 10. Work Unit No. (TRAIS) |
| Veridian Engineering, Inc.<br>Ann Arbor Operations<br>1975 Green Road<br>Ann Arbor, MI 48105 | 11. Contract or Grant No. |
| 12. Sponsoring Agency Name and Address | 13. Type of Report and Period Covered |
| Road Commission for Oakland County<br>31001 Lahser Rd.<br>Beverly Hills, MI 48025 | Interim<br>December 2000 – June 2001 |
| | 14. Sponsoring Agency Code |

15. Supplementary Notes

16. Abstract

The Southeast Michigan Snow and Ice Management (SEMSIM) partnership includes the Detroit Department of Public Works, the Road Commission of Macomb County, the Road Commission for Oakland County, and the Wayne County Department of Public Services. The purpose of the partnership is to develop an AVL (Automatic Vehicle Location) system that will allow the partners to fight a snowstorm in a cooperative effort. This report provides an interim status of the system prior to upgrades and additional installations that are scheduled to occur in the winter of 2001-2002. The evaluation effort consisted of (1) observations and interviews with drivers and supervisors at the operational terminals and (2) vehicle equipment inspections. The evaluation centered on determining system operational status and what system users with a year of experience would like to see in the system upgrade.

| 17 Key Words | 18. Distribution Statement |
|---|---|
| SEMSIM, AVL, Orbital, SMART, snow, ice, snow and ice management, evaluation | |

| 19 Security Classif. (of this report) | 20. Security Classif. (of this page) | 21. No. of Pages | 22. Price |
|---|---|---|---|
| Unclassified | Unclassified | 10 | |

**Form DOT F 1700.7 (8-72)** **Per FORM PRO/Delrina 04/04/94** **Reproduction of completed page authorized**

## Summary

In the early spring of 1999, the Detroit Department of Public Works, the Road Commission of Macomb Country, the Road Commission for Oakland County, and the Wayne County Department of Public Services formed the Southeast Michigan Snow and Ice Management partnership, naming themselves the SEMSIM Partners. The purpose of the partnership was to develop an AVL (Automatic Vehicle Location) system that would allow the partners to fight a snowstorm in a cooperative effort.

The SEMSIM system is now in its second year and the system users—garage supervisors and drivers—have gained experience that is valuable in determining the direction and improvements that should be addressed as the system is expanded.

The objective of this report is to inform the SEMSIM Partners about the expectations of the people who will be using the system on a day-to-day basis and the readiness of the equipment that makes up the SEMSIM system. The report adds to the experience and observations reported in document number 10032900-3-F, "Final Evaluation at End of Winter Season, Year 2000" (distributed by Veridian-ERIM International in September 2000).

# Contents

## 1.0 Description of Project

In the early spring of 1999, the Detroit Department of Public Works, the Road Commission of Macomb Country, the Road Commission for Oakland County, and the Wayne County Department of Public Services formed the Southeast Michigan Snow and Ice Management partnership, naming themselves the SEMSIM Partners. This partnership was formed to develop an AVL (Automatic Vehicle Location) system that would allow the partnership to fight a snowstorm in a cooperative effort. Orbital Sciences of Germantown, Maryland, was chosen to provide the system. Veridian-ERIM International (now Veridian Engineering) was chosen to evaluate the system.

In 2000, additional funds were made available to expand and improve the system. The original SEMSIM system worked on a standard server-client concept requiring a custom application to be loaded on the client terminal. The SEMSIM Partners felt that a browser-based client would be an improvement in that it would use standard Internet access capabilities and services. Additionally, the database server could be provided and serviced by an Internet service provider making it unnecessary for the partners to provide their own server capabilities. Other improvements, such as a cleaner vehicle installation, improved vehicle-to-server wireless communication, and improved and more accurate vehicle sensors were anticipated.

During the winter of 2001, contract negotiations with Orbital Sciences were conducted to determine the direction of the SEMSIM program in the following years. In the late winter of 2001, Veridian Engineering and their partner, Technology Ventures, visited the four partner terminals where the SEMSIM system was installed. This report covers that activity and provides observations made prior to SEMSIM's contract execution with Orbital.

## 2.0 Base Station Visits and Observations

Veridian Engineering staff members made a scheduled visit to each of the four partner locations. Our purpose was to talk with the supervisors at the base stations to discuss the status of their concerns from last year and note any new experiences and/or recommendations they might have. In addition, we arranged for our Disadvantaged Business Enterprise partner, Technology Ventures, to send a staff member on a scheduled visit to each base station.

We learned that the system, as a concept, continues to be favorably viewed by the majority of supervisory management. However, there is much frustration and disappointment with actual use because of reliability deficiencies. For all partners, there were long segments of days—sometimes weeks—where the system was not operational

on a reliable basis. Other times there were only partial performances of key aspects of the system, such as some trucks showing on the screen but others not indicated and color traces not accurately reflecting what was happening. The lack of system reliability is deterring personnel from getting comfortable with the system as a helpful tool to perform their mission.

All dispatch personnel interviewed felt that if the system were reliable, it would give them helpful and auxiliary information that would be very beneficial in assisting them to accomplish their mission, especially during all-out efforts in major storms. For example, if the police called in a problem area that needed attention, dispatch could immediately know if there was a truck in that area, leading to quicker response time. During our visits, most base station personnel were able to cite at least one example of an emergency situation or accident report for which the SEMSIM AVL system demonstrated its value.

Another view commonly held by dispatch and supervisory employees was that a wider implementation of the system would provide a much better arena to properly assess the benefits of the SEMSIM operations. However, everyone felt that reliability of the basic 40-unit system should be ensured first. There was a general awareness that the system was being redesigned and that added to the concern that present issues weren't being addressed.

## 3.0 On-Vehicle Demonstrations and Observations

In addition to the base station visits, Technology Ventures staff spent from several hours to a full day with a driver at each of the four partner locations. Because the driver is the most visible user of the system and in most cases has had the most difficulty with its operation, particular care was taken to prepare the evaluators so they could gather information in a systematic fashion. In all cases, the drivers were receptive to the evaluation and eager to express their opinions. In all cases, also, the system was not working on the day of the scheduled Technology Ventures visit.

Drivers felt that the AVL concept of the system was invasive and that it represented a way for management to gain more control over them. They felt it wasn't possible to operate the messaging monitor while driving. For the most part, they felt that the vehicle radio transceiver was a superior communication method. A few drivers did like the messaging system as a way to send low-priority messages, thereby freeing the frequency for more urgent priority calls, but they felt the system needed to be more reliable before they could count on it. It was also pointed out that the SEMSIM system only runs when the truck is running. In instances where the battery has failed or the truck is shut off for cab cooling, the messaging system is not enabled.

Drivers felt that the installation of the monitors in the vehicles was not effected in a sturdy and reliable fashion. In some cases, the monitors became unplugged even during evaluation sessions. Drivers liked the temperature- and salt-level readouts and were able to use these features—when the system was up and calibrated—to accomplish their tasks more easily.

For drivers, the primary issue is the need for the equipment to be functioning reliably and accurately. The following section, "Equipment Observations," presents concerns.

# 4.0 Equipment Observations

## 4.1 Temperature Sensor

Many of the temperature sensor readings observed during the Orbital Orbtrac base station training review in Waterford on February 26, 2001, were dramatically incorrect, indicating that either the sensors were not operational or that the temperatures registered did not detect true temperatures. Based on Veridian Engineering experience with the Sprague temperature sensor, we are inclined to believe that at least some of the problems were due to improper sensor operation and suggest that this possibility be investigated.

## 4.2 Salt Flow Sensing

One supervisor observed that lack of proper salt flow is usually not an "on" or "off" situation. It's more likely that the spreader is not disbursing salt at the rate that is being recorded. While an experienced driver often knows the accuracy of salt disbursement, it's not obvious how the Basic Technologies system could address this.

## 4.3 Front Plow Sensor

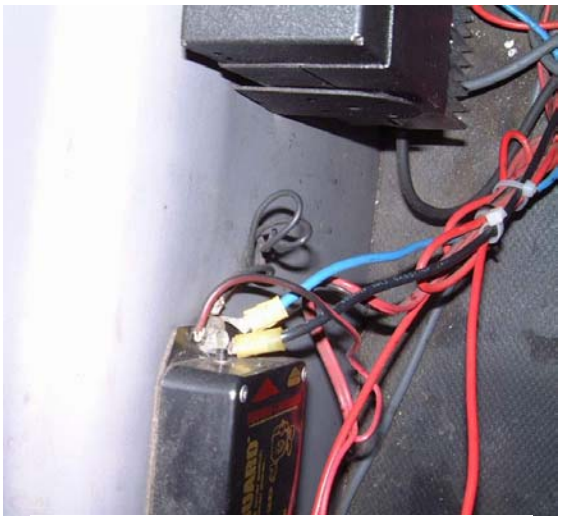
This sensor, also, was addressed in the final report from last year (document 10032900-3-F). The front plow is not used unless there has been a snowfall of more than 6 inches in depth. One supervisor observed that it might be practical to eliminate the front plow sensor entirely since maintenance on the sensor and improper blade position information are strong concerns.

## 4.4 Underbody Blade Sensor

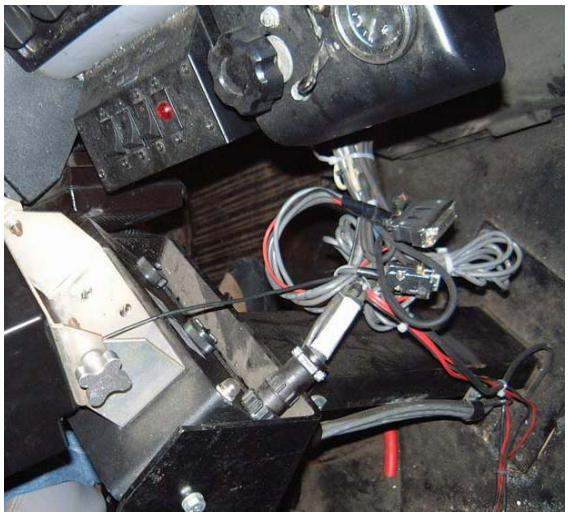
This sensor was addressed in the final report from last year (document 10032900-3-F). As noted in that report, when following the "white shoulder" policy, there is initial sensor switch activation, then switch deactivation, resulting in sensing of the plow up when it is down. It is suggested that a position sensor might be more appropriate.

## 4.5 Equipment Installation

In general, the equipment installation was poor. Many cables were not dressed in a professional way and had a sloppy appearance. Both equipment and cables were in places where they could be damaged during normal use. The photos below demonstrate this problem.



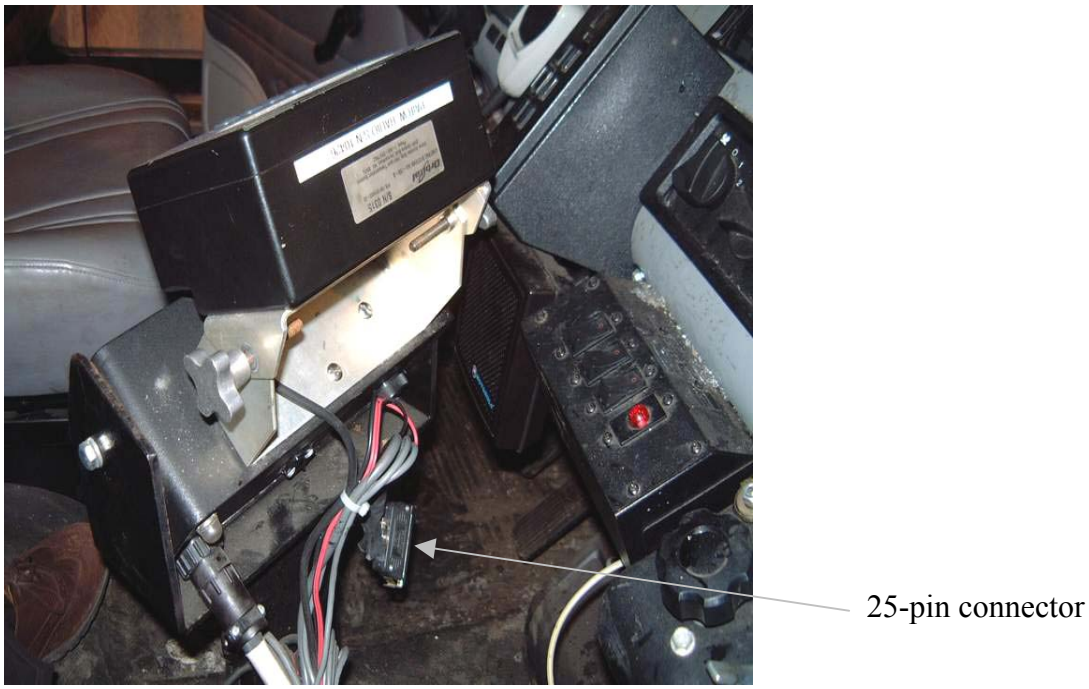
Cabling at rear firewall



Cabling to Orbtrac 100 near dash

Connector to salt rate sensor showing
lack of strain relief

The 25-pin sub-D connector plugged into the rear of the Orbtrac 100 was disconnected on installations at several SEMSIM sites. It was held on by a clip that did not grip securely. The connector can be seen hanging below the Orbtrac 100 in the photo below.



# 5.0 Conclusions and Recommendations

## 5.1 Conclusions

The SEMSIM AVL system shows excellent potential. The first season was a difficult one because of many technical problems, and the second season turned out to be a transition time as SEMSIM and Orbital concentrated on a system redesign. While the lack of progress on system improvement during the second season was frustrating and disappointing for the base station personnel and drivers, it is clear from late season discussions with them that they have maintained their belief in the system's potential.

It is evident to municipal personnel that AVL systems have much to offer with regard to not only snow and ice management operations but also with many other operations and functions, and such systems are expected to greatly facilitate early 21st century services. But just like any of the innovations of the past, it's going to take considerable work, experience, and time to utilize these systems in the most productive ways possible.

First and foremost, overall reliability of the system has to greatly improve for the system to be of practical use. The recommendations in the next section address issues that need to be carefully considered as SEMSIM continues to evolve and moves into the next phase.

## 5.2 Recommendations

In our end of winter season report last year, Veridian presented 17 recommendations to ensure reliability of the system and make it a practical tool. Those recommendations were based not only on the experience of SEMSIM managers, supervisors, and drivers but, just as important, the experience of other states that have used an AVL winter maintenance system for a few seasons. In addition, we included recommendations that resulted from our discussions with SMART personnel.

Now, nearly a year later and after our late winter 2001 discussions with SEMSIM users and observations of the equipment, we would like to re-emphasize the first four of the recommendations listed in the 2000 report (document number 10032900-3-F). We concentrate on these four because we feel that implementation of these will naturally address the other recommendations.

**Empower a SEMSIM program manager with authority over the entire operations.** This had been recommended due to the size and complexity of the program, and we are pleased that the partners have taken a very positive step by giving a program manager this authority. Because the program manager will need to be in close touch with all four municipalities and the system provider and will need to understand exactly the

state of operations at any given time, we suggest that consideration be given to making the program manager a full-time position in the near future.

**Define a period at the beginning of Phase II to resolve outstanding Phase I issues and concerns.** Because the first season of Phase I of the program took longer to achieve installation acceptance than planned and because the second season was primarily spent considering a system redesign, many Phase I operating issues were unresolved. We believe it is important to resolve these issues before increasing the size and complexity of the program.

**Keep the SEMSIM AVL system as simple as possible**. Any AVL system takes a long time to completely learn and understand. If the system were used continuously every day in daily repeatable scenarios, it would take a couple of years to understand and master all of its complexities. In the case of the unpredictable and erratic nature of snow and ice management operations, it will take vastly much longer to fully understand and implement.

**Ensure system operation through preventive maintenance.** By applying the AVL system to non-winter maintenance uses so that it is continuously operated and kept in repair is an important way to make sure that the system is ready for the winter maintenance task. When a system is used only sporadically and seasonally, there are mechanical and electronic failures, such as wires disconnecting and passwords expiring, which will have to be dealt with at the beginning of seasonal use. Ongoing use would also be expected to be cost-effective.