## *1.0 Automatic Vehicle Location – Global Positioning System (AVL-GPS) and Sensors*

The Wisconsin Department of Transportation (WisDOT) has implemented new technologies that allow for improved safety to the traveling public and provide effective winter storm management on state maintained highways. The AVL-GPS technology also provides for increased operational and fleet management information for year-round benefits.

The AVL-GPS technology used in conjunction with the Maintenance Decision Support System (MDSS) described in HMM 6-25-10, is installed in trucks used on state maintained highways. The sensors and AVL-GPS feedback collects various real-time information about the vehicle such as location, speed, heading, engine RPM, trip fuel, oil pressure, coolant level, battery voltage, tail gate (up or down), plow (up or down), salt used, liquid used, application rates, weather, etc.

Monitoring of this information is done via a separate website and supports improved storm management based on real time information received. This real-time information includes current road conditions (icy, compact snow and ice, bare and wet, clear). The information is accessed by the Wisconsin Department of Transportation (WisDOT) to populate information in MDSS. These technologies are used by the service provider and WisDOT to improve storm management and management of material usage statewide.

All service provider trucks used on state maintained highways should be equipped with AVL-GPS and corresponding sensors described in section 4.0 of this procedure. Backup trucks, up to 10% of the trucks assigned to state sections by a service provider, should also be equipped with AVL-GPS. State financed AVL-GPS units and sensors shall not be removed from trucks used on state maintained highways unless the units are being repaired, replaced or transferred to another truck used on the state highway system.

## *2.0 Responsibilities*

This state financed program will be managed by the Bureau of Highway Maintenance (BHM). The winter maintenance engineer will act as program manager and will coordinate with regions and service providers on program responsibilities.

Service providers will own, operate, and maintain AVL-GPS systems. They will be responsible for the purchase of equipment, sensors, communications, and installation. All equipment will be operated and maintained according to the manufacturer's recommendations. Minimal equipment requirements are described in section 4.0 of this procedure.

## *3.0 System Operations and Access*

The information provided by the AVL-GPS vendor used by the service provider will be available to WisDOT for its use and operational needs and it will be exported directly from the AVL-GPS vendor system. WisDOT will work with vendor to coordinate access to WisDOT personnel for all equipment financed by state funding. BHM will act as system administrator for access rights to WisDOT staff.

Service providers will act as system administrator for access rights to their personnel and other identified members that need it. Open records requests for data directly from the AVL-GPS vendor source, will be forwarded to the service provider for processing.

## *4.0 System Requirements*

These requirements listed below are minimum specifications for the AVL-GPS unit and sensors.

| | Requirements |
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| **Category 1** | **General** |
| 4.1.1 | Annotated Literature - project literature to identify for the purchaser the location of the supporting information regarding each product specification. |
| 4.1.2 | Software Edition or Version – Unless otherwise specified the software and firmware must be the latest edition or version. If, during the contract period the vendor must hold the bid prices firm, a new edition or version is introduced, the purchaser reserves the sole right to choose to buy the old version at the proposed price; to buy the new version at the proposed price, or, to cancel the item from the bid. |
| 4.1.3 | New Equipment – Equipment offered must be new equipment. New equipment means equipment that is currently in production by the manufacturer or a subcontractor and is the latest model, edition or version generally offered. The equipment must be warranted as new by the manufacturer and may not have been used for any purpose, other than display (not demonstration), prior to its sale to the purchaser. The purchaser will not accept re-manufactured, used, or reconditioned equipment. It is the contractor's responsibility to ensure that each piece of equipment delivered to the purchaser complies with this requirement. A contractor's failure to comply with this requirement will cause the purchaser to seek remedies under breach of contract. |
| 4.1.4 | Installation Schedule – Installation schedule will be negotiated with purchaser within 10 days of purchase order being received. |
| 4.1.5 | AVL-GPS Unit - Features in this specification must be operational and in use by existing clients and may not be developed for the purpose of this order. |
| 4.1.6 | Ownership of information and data - The State and purchaser shall have the unlimited right to publish, duplicate, use and disclose all information and data developed or derived by the contractor pursuant to this contract.<br><br>The contractor must guarantee that it has the full legal right to the materials, supplies, equipment, and other items necessary to execute this contract. The contract price shall, without exception, include compensation for all royalties and costs arising from patents, trademarks and copyrights that are in any way involved in the contract. It shall be the responsibility of the contractor to pay for all royalties and costs, and the State and purchaser must be held harmless from any such claims. |
| 4.1.7 | Cooperation With Other Contractors – The State and purchaser may already have in place or choose to award supplemental contracts for work related to this system, or any portion thereof.<br><br>The contractor shall agree to cooperate with such other contractors and shall not commit or permit any act which may interfere with the performance of work by any other contractor. |
| 4.1.8 | Contractor Responsibility – The contractor is solely responsible for all services offered and products to be delivered. The contractor shall be the sole point of contact regarding all equipment matters.<br><br>If the contractor intends to utilize any subcontractors' services, the subcontractors' level of effort, tasks and time allocation must be clearly defined in the purchaser's work order. |
| 4.1.9 | MDSS Integration |
| a | In vehicle mobile data collection units with integrated maintenance decision support systems, in accordance with the Specifications – The unit purchased shall be of such design and construction as to comply with the requirement hereinafter stated and any parts or attachments necessary to form a complete, functioning unit must be furnished, whether specifically mention herein or not. |
| b | State Roadway System - The AVL-GPS unit shall function properly anywhere on the state's entire roadway system. |
| c | Required NTCIP Compliance – All equipment and software must be compliant with NTCIP standard 1204. |
| d | Compatibility with Existing MDSS Server Hardware – All equipment must be fully able to communicate with existing MDSS servers and processers using protocols specified in NTCIP standard 1204. Vendor must be able to provide proof of compatibility. All costs to enable proper communication between the MDSS and the servers will be borne by |

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| | the contractor. |
| e | MDSS data format requirements – |
| | 1. Vehicle Identifier (required)<br>This should be an identifier that is unique to the organization from which the data is being collected. It can be either textual or numeric. It does not need to be the same as the organization's vehicle identifier system, but a mapping between that AVLGPS identifiers and that system should exist.<br>2. Time (required)<br>This should be a complete description of the date and time of the report to within 1 second of accuracy. It can be in the form of a string (e.g., "1/20/2005 3:43 AM CST" or "1-20-2005 9:43 UTC") or numeric (such as a Unix timestamp, which is a count of seconds since a certain point in history). The form of string representations of the date & time is flexible, but should include at least the year, month, day, hour, minute, second and time zone of the observation. Observations in UTC (Universal Coordinated Time, also known as Greenwich Time) are preferable but not necessary so long as the time zone is described in a standard manner (e.g., MST, CDT, etc.).<br>3. Location (required)<br>Location information should be provided in the form of a GPS latitude and longitude associated with the vehicle's location at the time of the report. Three or more decimals of accuracy are desirable if possible.<br>4. Lane Identifier (required)<br>This should be an identifier that can be used to uniquely determine the lane or lanes that a report applies to. A standard lane identification system across organizations is not necessary. However, an organization's lane identification system should be capable of representing both a single lane as well as combinations of lanes on a roadway. For example, if the digit "1" represented the passing lane and "2" represented the driving lane of a two-lane unidirectional roadway, a report that applied to both lanes might be represented as a "3", a "12", or some other logical identifier. For bidirectional highways it is advisable that an identifier representing both the present lane and oncoming lane be available.<br>5. Maintenance Data<br>a. Plow Position (required)<br>This can be represented as a 0 or 1, or as a string (e.g., "up" or "down"). If the numeric representation is chosen a value of 0 is generally used to indicate that a particular piece of equipment is inactive, so a value of 0 would indicate plow up while a value of 1 would indicate plow down.<br>b. Scraper/Underbody Position (optional)<br>The same explanation as for "Plow Position" applies.<br>c. Wing Position (optional)<br>The same explanation as for "Plow Position" applies.<br>d. Material Applied (required)<br>This field should uniquely describe the freeze-point depressant(s) and/or grit being applied to the roadway. Representation in the form of either a numerical or string identifier is acceptable. In either case, the identifier itself need not fully describe the mixture so long as it is unique and can be associated with a more detailed description of the mixture at the time of processing. For example, if Joe Driver uses a 20/80 mixture of granular NaCl and grit pre-wetted with 10 gallons / ton of $MgCl_2$, the most efficient way to convey this information might be to identify that particular mixture as something like mixture 1 or "Joe's Mix" and place that identifier into the AVLGPS data files. The specific composition of this mixture should be on file with those responsible for processing the data (Meridian at present) so that it can interpreted appropriately. The reason for using an identification system instead of the specifics of the mixture is twofold. First, the complexity of some mixtures would necessitate carrying a large number of fields in the data file in order to accommodate the more complex cases. A second and related issue is that the increased data file size this would necessitate could pose problems for the limited bandwidth that may be available between the trucks and the data collection facility in a real-time |

setting.

e. Material Form (required)
This field, although required, could also be provided through the "Material Applied" field discussed above. However, in some existing systems the choices for "Material Applied" might be limited to something like "NaCl", "$MgCl_2$", etc., and not be descriptive of the form of that salt. In those cases this field should be present and populated with either a numerical or string identifier that indicates whether the material is in brine (liquid), prewet, or dry form.

f. Application Rate (required)
This field should represent the application rate of the material(s) being applied. It can be in the form of either a string or a number, although a number is generally preferable.

g. Application Rate Units (required)
This field should provide the units to associate with the application rate if they are not uniquely identifiable based upon the "Material Applied" field. For example, if a material identification system similar to the "Joe's Mix" discussed above is used no "Material Form" field is needed and it may already be uniquely known (off-line) that the units to associate with reported application rates of that mixture are in lbs per lane mile. However, under the alternative situation also discussed above, if the specifics of the mixture being applied are being described in the AVLGPS data files themselves (such as by supplying "NaCl" at the "Material Applied" and "brine" as the "Material Form") then the specifics of the entire application should be represented within the files, so it would be desirable to include something like "lbs/ln-mi" or "ga/ln-mi" as a string identifier for the application rate within the MDC files.

6. Road Observations
   a. Condition (required)
   This field should represent the road condition to associate with each report from the AVLGPS system. A numerical or string identifier for each condition is acceptable. In the case of a numerical identifier a look-up table will need to be available off-line to convert numbers into conditions.
   b. Road Temperature (required)
   This numeric field could contain infrared pavement temperature measurements to associate with each report.
7. Weather Observations
   a. Precipitation (optional)
   This field should represent precipitation that is observed to be falling (by the driver) at the time and location of the report. A numerical or string identifier for various optional precipitation reports is acceptable. In the case of a numerical identifier a look-up table will need to be available off-line to convert numbers into observations. A preferred set of precipitation reports has not yet been defined.
   b. Visibility & Obstruction (optional)
   Same as for "Precipitation" above.
   c. Air Temperature (optional)
   Same as for "Road Temperature" above.
8. Camera Feed (required)
   Programmed to collect a forward camera images when option is installed.

Notes:

- If maintenance activities data is not collected automatically by the truck but rather through a touch-screen, keyboard, or similar in the truck, it is advisable for the driver to have a way of toggling an indicator of when maintenance is and is not being performed without having to clear the plow & material application entries.
- There are several ways of constructing this information:
  - All data can be logged to a file at regular intervals (from seconds up to no more than every 5 minutes) and distributed back to Meridian when

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| | communications allow. This is the most straightforward way of storing the data but does require more data storage space (and communications bandwidth, if applicable).<br>o Time & location data can be logged at regular intervals and the other data can be logged only when changes occur. For example, if the user enters a road condition of "wet" on a touchscreen, that entry and the time it was made would be logged to the file. The "wet" road condition would be assumed to be valid from that time / location forward until a different condition is entered and would be associated with all locations and times during that period. It is therefore advisable that the "wet" road condition that is being assumed to be valid be visible on the display in the truck so that the driver is conscious of what he or she is reporting. This latter method of data storage is slightly less end-user friendly but is also much less bandwidth and storage space intensive.<br>• Even if data can be streamed back from the trucks to a central collection point in near real-time, it is imperative that the system continue to record data regardless of whether or not it is in communications range. If the truck moves out of range for a period then reenters an area where communications are possible, all data collected during the period it was out of range should be sent back to the central collection point at that time. |
| 4.1.10 | AVL Management and Access – The AVL information collection, storage, and display system shall be designed, owned and operated by the vendor at a location of the vendor's choice, outside of the State or purchaser's network and accessible to the purchaser, the State and other agencies via the internet, using a standard web-browser. |
| 4.1.11 | The server shall receive information from all maintenance vehicles with AVL purchased. |
| 4.1.12 | The system shall be uniform in design and operation across all vehicle types. |
| **Category 2** | **System Website - Data Management – Mapping User Interface** |
| 4.2.1 | User Website - The system must be a web-hosted solution accessible from any web browser with the appropriate User Name and Login credentials. |
| 4.2.2 | User Logins - System must provide unlimited user logins at no additional cost. |
| 4.2.3 | Database – The AVL database system must have the ability to be in continuous operation 24 hours per day, 365 days per year and must be capable of handling year-end changes and daylight savings changes with minimal effort and effect. |
| 4.2.4 | Database Backup/Recovery – The AVL database system must provide for automatic recovery and any interface after any type of network failure. System must allow a means of automatic data archival and backup without system interruption. The system must provide complete reporting and audit trail capabilities for all transactions, as required. |
| 4.2.5 | Database Access – Data can be accessed, stored and archived by State in either SQL or Oracle environments. Database should be designed to preserve the integrity of collected data and facilitate access and integration into other systems and applications. |
| 4.2.6 | Website – Data must be on-line at all times. Vendor must take precautions to prevent downtime. |
| 4.2.7 | Website - Color coded icons for at-a-glance status will be used. |
| 4.2.8 | Archived Data – All data collected on behalf of the purchaser or State shall be stored by the vendor for a minimum duration of 5 years and must be readily accessible within 48 hours of a request. |
| 4.2.9 | System Storage – The system must have capacity to hold collected data and made available for up to 3 years after start up. |
| 4.2.10 | Historical Data – Historical data must be available for playback on a map screen and be downloaded via text file or XML format. |
| 4.2.11 | User Updates - The system must provide user-configurable odometer and hour meter synching to the vehicle's actual odometer and hour meter. System must also include the ability to readjust both odometer and hour meters if a variance occurs. |
| 4.2.12 | System Alerts - System must include email and/or SMS text message notifications when a vehicle is due for preventive maintenance based on engine hour readings, mileage or both. |
| 4.2.13 | System Alerts - System must provide user-configurable notifications for excess speeds, excess idle times, operation after normal operating hours, previous power loss, |

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| | maintenance due and low battery voltage exceptions. |
| 4.2.14 | Data Access - The system must include a web services API to allow read only secured access for raw data retrieval for use in other database applications (such as GIS mapping or other customer uses). |
| 4.2.15 | The system must provide a minimum of the following mapping and reporting information:<br>a. Last known asset location map view – fleet wide view<br>b. Dispatch map (full screen "live" view – "war map")<br>c. Asset last location relative to home (pre-determined address)<br>d. Asset Odometer readings<br>e. Total engine hours<br>f. Last time asset reported in<br>g. Last known location (individual asset map view)<br>h. Historical trip report (individual asset map view)<br>i. Raw data report showing exact data string as it was sent from spreader control (required for analyzing reports)<br>j. Exception reports<br>k. Battery voltage<br>l. Speed<br>m. Idling<br>n. Operating during "off" hours<br>o. Maintenance<br>p. Power<br>q. Geo fence (in/out)<br>r. Temperature (custom attention required)<br>s. View Maintenance History/Update Maintenance Record<br>t. Ping Asset (SMS report)<br>u. Road hazards on fleet-wide live map view<br>v. Distance measurement widget on fleet-wide map view |
| 4.2.16 | Maps – Fully licensed maps included in sale price. |
| 4.2.17 | System administrator for the purchaser will be given at time of purchase. Access to purchaser's information will be given to WisDOT personnel through the Bureau of Highway Maintenance. |
| **Category 3** | **Reports** |
| 4.3.1 | Data Exports – Reports must be exportable to Microsoft Excel and Microsoft Word. |
| 4.3.2 | Vehicle Usage Report - The system must provide Daily, Weekly, Monthly and Custom usage reports to accurately display vehicle utilization as well as hourly usage reports to reflect how many minutes in each hour a vehicle was in use |
| 4.3.3 | Material Usage Report - System must provide material usage reports to accurately track the amount of granular material, pre-wet and/or direct liquid that was applied to a predefined section of roadway, or "zone". (for spreader integrated equipment only) |
| 4.3.4 | Vehicle Mileage Report - System must provide a vehicle mileage report with user selectable date ranges showing miles traveled per day and first start/last stop times for each day in the selected date range. |
| 4.3.5 | Custom Reports - System must provide a custom input usage report with user selectable date ranges showing usage of monitored auxiliary equipment such as plow position, gutter brooms, rear brooms, etc. Report must be able to show all activity or be run on a single auxiliary equipment input such as plow position. |
| 4.3.6 | Zone/Route report |
| 4.3.7 | Engine Data Report (J1939/J1708 integration) |
| 4.3.8 | Fleet Start/Stop Report |
| 4.3.9 | Road Condition Report |
| 4.3.10 | Individual Vehicle Mileage Report |
| 4.3.11 | Daily/Weekly/Monthly Asset Usage Report |
| 4.3.12 | Custom Asset Usage Report |
| 4.3.13 | Custom Input Usage Report (6 discreet inputs) |
| 4.3.14 | Asset Distance Report |
| **Category 4** | **Vendor Support/Training** |

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| 4.4.1 | Installation – A minimum of 1 AVLGPS units and sensors is to be installed by purchaser with the contractor and/or their representative present to provide technical support. |
| 4.4.2 | On-site maintenance training – The contractor shall provide one on-site, in-person training session on preventative maintenance and basic repairs of unit and any furnished sensors. |
| 4.4.3 | Specialty Installation Tools – The contractor shall provide any and all specialty tools required to perform the installations. |
| 4.4.4 | User Training – The contractor shall provide one training session on how to use all furnished software. |
| 4.4.5 | Phone Support – The contractor shall provide support via telephone and email for unusual maintenance problems with the AVL system hardware or software. The vendor shall respond to support requests within 24 hours. |
| 4.4.6 | Single Contact – The contractor shall provide single point of contact technical support for the entire AVL system, with the exception of non-contractor furnished sensors and communications. |
| 4.4.7 | Spares – The contractor shall be able to provide an appropriate percentage of spares within 24 hours based on expected time to failure for purchaser to provide a consistent level of service. |
| **Category 5** | **Documentation** |
| 4.5.1 | Preventative Maintenance – Documentation on preventative maintenance of hardware will be included and be required to occur no more than twice a year. |
| 4.5.2 | User Documentation – The contractor shall provide all manuals for all hardware and software. |
| **Category 6** | **Modem /Wireless Communication** |
| 4.6.1 | Communications – The communications technology to be used for transmitting data must be dual mode – 802.11 b/g and GSM/GPRS. System must include all necessary hardware items, processors, antennas, etc. (This provides the flexibility to use either 802.11 b/g wireless or GPRS to do automatic data downloads if necessary.) |
| 4.6.2 | Data Transfer – Unit shall transmit data using the TCP/IP protocol. All services used shall be RFC compliant. |
| 4.6.3 | Cellular communications – The unit shall be able to operate on multiple major cellular carriers and or private networks, in different parts of the state, with the simple replacement of the communications module. |
| **Category 7** | **AVL-GPS Integrated with Spreader Equipment** |
| 4.7.1 | Spreader Model/Make – All spreader controllers are assumed to be of such a make/model to perform reliable data output via data logging output, single command prompt or such other means as mutually acceptable. All controllers are closed loop. |
| 4.7.2 | Spreader Controller Integration – The system must integrate with Cirus type controller and the AVL modem. Any modification to the system is at the expense of the contractor. |
| 4.7.3 | Spreader Controller Integration – The system must integrate with Component Technology type controller and the AVL modem. Any modification to the system is at the expense of the contractor. |
| 4.7.4 | Spreader Controller Integration – The system must integrate with Dickey John type controller and the AVL modem. Any modification to the system is at the expense of the contractor. |
| 4.7.5 | Spreader Controller Integration – The system must integrate with Force America type controller and the AVL modem. Any modification to the system is at the expense of the contractor. |
| 4.7.8 | Spreader Controller Integration – The system must integrate with Gresen type controller and the AVL modem. Any modification to the system is at the expense of the contractor. |
| 4.7.9 | Spreader Controller Integration – The system must integrate with Monroe type controller and the AVL modem. Any modification to the system is at the expense of the contractor. |
| 4.7.10 | Spreader Controller Integration – The system must integrate with Swenson type controller and the AVL modem. Any modification to the system is at the expense of the |

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| | contractor. |
| 4.7.11 | Spreader Controller Integration – The system must integrate with Tyler type controller and the AVL modem. Any modification to the system is at the expense of the contractor. |
| 4.7.12 | Vehicle Mounted Hardware – All equipment must be all solid state with no moving parts such as fans and all communication hardware shall be fully integrated into the housing with no openings. The unit will be enclosed by a ruggedized case. |
| 4.7.13 | RS-232 Connection – The system must provide RS-232 serial connection, minimum of six (6) discrete inputs, J1939 and J1708 connections. (The variety of connectors provides flexibility in reading spreader controller, plow positions, hoist positions, etc. as needed.) |
| 4.7.14 | System Data Storage - The system must support at least 256MB flash memory for storage of data over extended periods of connectivity loss or 48 hours of observations whichever is greater. (This allows for storing all readings until 802.11 b/g or GPRS coverage is re-established then transmitting the stored data to provide an updated history of the vehicle.) |
| 4.7.15 | Delayed Data Transmission - The system must provide *Store and Forward* capabilities capable of storing over 500 MB of information while out of communications coverage and automatically forwarding the same when back in coverage. (System collects vehicle activity data and geo-stamp data and stores onboard until data can be securely transmitted to provide a detailed historical record of activity while in the field.) |
| 4.7.16 | Power Loss - The system must provide ability to detect and report previous power loss if unit is disconnected then reconnected. (This reports if someone was to disable the system during their shift whether inadvertent or intentional.) |
| 4.7.17 | Power – The unit shall run off the vehicles power system. |
| 4.7.18 | Battery - System must have less than 8mA typical current draw in key-off mode. (Provides minimal battery discharge when not in use.) |
| 4.7.19 | Power Surge/Failure – Unit shall have built in protection from low and high voltages. |
| 4.7.20 | System Operation - System must meet SAE J1455 environmental specifications and provide +/- 25g shock rating (Provides a ruggedized solution in the high abuse environment that system will be used in.) Operating temperature shall be in the range from -40 F to 140 F and operating humidity up to 95%. |
| 4.7.21 | System Operation – The system shall be capable of operating without needing to be reset for a minimum of 24 hours. |
| 4.7.22 | System Operation – The system shall transmit from all integrated sensors simultaneously with the timestamp. |
| 4.7.23 | System Operation – If optional operator input device is used, the system shall transmit simultaneously with timestamp. |
| 4.7.24 | Updates - System must support over-the-air firmware updates. (This allows for updating the system without the need to physically connect to each unit to manually update them.) |
| 4.7.25 | System must support over-the-air configuration updates for the following:<br>a. Start time report intervals<br>b. Reporting transmit intervals<br>c. Reporting power up/down<br>Setting GPS database triggers for distance, time, speed and angle. (This allows for changes in the reporting configuration to customize the data streams to meet changing data requirements for information as well as providing the flexibility to minimize monthly data transfer charges.) |
| 4.7.26 | System Support - Must provide remote assistance within one hour of problem detected. On site assistance within 24 hours. |
| 4.7.27 | The unit will produce low heat and have a low power consuming processer with a minimum processing speed of 1 Ghz. |
| 4.7.28 | Communications – Capable of using and changing carriers by changing carrier connection card or module without changing or replacing unit or other equipment. |
| 4.7.29 | Communications – Capable of migrating to next generation communication technologies with change of connection card or module without changing or replacing unit or other equipment. |
| 4.7.30 | Sensor Input – Capable of 16 or more analog/digital sensor inputs or outputs per port |

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| | with optional module. Multiple ports possible. |
| 4.7.31 | Capable of taking engine codes from heavy vehicles or light vehicle interfaces, with optional module. |
| 4.7.32 | Sensors – Ability to add additional sensors not on the vehicle as it currently exists and/or as provided by truck or controller manufacturer within the parameters of the unit or modules/interfaces provided. |
| 4.7.33 | Sensor Output – Capable of sending sensor data in its original format for data integrity and/or processing controller, camera and/or other data for in vehicle display and other purposes. |
| 4.7.32 | Universal Time – System will synchronize both the unit and database to the universal time clock and time stamp all data collected. |
| 4.7.33 | Additional Software – System will be capable of carrying additional VPN software at the State and purchaser's discretion. |
| 4.7.34 | System Monitor – Internally configured to support a in vehicle monitor, whether monitor used or not. |
| 4.7.35 | 2 way communication capabilities – Provide capability to send messages and images to the vehicle as well as receive data and images from the vehicle when 2-way communication equipment is installed in vehicle. |
| 4.7.36 | Individual vs. Group/Fleet messaging – When 2 way communication is set up with vehicle it will provide messaging capabilities for one, all or groups of trucks, without use or additional cost of "text messaging". |
| 4.7.37 | System Transfer – The system shall be exchangeable between vehicles with minimal reprogramming and downtime. If a memory chip is used, there must be easy access to it should its replacement or reprogramming be necessary. |
| 4.7.38 | GPS - GPS receiver must be accurate to less than 8 meters, for at least 90% of readings. (Provides accurate mapping data for corresponding application rates from spreader controller.) |
| 4.7.39 | GPS - Unit shall be satellite based GPS with WAAS enhanced accuracy. There will be a 12 parallel channel, WAAS enabled GPS receiver. |
| 4.7.40 | GPS - Unit will be modular and can be separated from modem and monitor should either need to be replaced. |
| 4.7.41 | GPS - GPS output interval shall be programmable as determined by WisDOT. |
| 4.7.42 | Troubleshooting – The system shall have self diagnostic capabilities to facilitate troubleshooting and maintenance activities. |
| 4.7.43 | Antenna – The antenna shall be integral to the system or able to be mounted firmly on the vehicle, on the roof of the cab, on the mirror, or similar parts. |
| 4.7.44 | Antenna – The antenna shall be able to withstand extreme cold temperatures, precipitation, and high wind speeds with no loss of function. |
| 4.7.45 | Antenna – The antenna shall be designed to operate without failure for a minimum of five years. |
| 4.7.46 | Warranty – The system shall be warranted for a two year period following installation. |
| 4.7.47 | Data- System will be capable of transmitting all engine diagnostic and fault codes. |
| **Category 8** | **Sensors** |
| 4.8.1 | The AVL system shall be programmable in common full programming language such as JAVA, to accept input from sensors provided by the contractor, or third party. |
| 4.8.2 | The sensors shall be connected to the system through hard-wire ruggedized connections. |
| 4.8.3 | The AVL system shall include sensors able to collect data from the spreader controllers for the following data:<br>a. Plow Sensor (front plow, wing, underbody)<br>b. Pavement Temperature and Ambient Sensor<br>c. Auger Feedback Sensor<br>d. Gate Sensor<br>e. Flow Meter Sensor |