SECTION 35 20 23.00

DREDGING QUALITY MANAGEMENT (DQM) SPECIFICATIONS

2026-06-25

PART 1 GENERAL

Where any options or variables are listed in this Specification Section, only the options that are called out for use in this contract are applicable. Any non-indicated options are to be removed from the Scope of Work.

1.1 UNIT PRICE

There will be no separate payment for installation, operation, and maintenance of the DQM-certified system in connection with this contract and are considered covered under the contract unit price for dredging in the bid schedule.

1.2 DESCRIPTION

The work under this contract requires use of the US Army Corps of Engineers (USACE) Dredging Quality Management (DQM) Program to monitor all dredge plants at all times throughout the contract.

This performance-based Specification Section identifies the minimum monitoring, reporting, and compliance requirements. The requirements can be satisfied using equipment and technical procedures selected by the Contractor.

1.3 APPLICABILITY

DQM monitoring is required on all equipment (to be called plants) used on this contract to excavate, transport, or place dredged material. Potential plant types to be monitored include but are not limited to hopper dredges, pipeline dredges, cutter suction dredges, dustpan dredges, mechanical dredges, agitation dredges, water injection dredges, split-hull scows, pocket scows, deck barges, etc. Requirements vary by plant type and/or data profile.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ADMINISTRATIVE AND CERTIFICATION REQUIREMENTS

3.1.1 CERTIFICATION

Current certification from the DQM Center for all dredge plants to be used under this contract is required. See the DQM website (https://dqm.usace.army.mil) for QA check procedures and criteria for certification. Compliance will be verified by onsite quality assurance (QA) checks and by periodic review of the transmitted data. DQM certification is contingent upon the Contractor's system's ability to meet the performance requirements as outlined in SYSTEM TECHNICAL REQUIREMENTS and OPERATIONAL PERFORMANCE, REPORTING AND QA, including all subparagraphs. If performance requirements are not met and maintained, DQM certification may be revoked.

DQM Certification for dredge plants is based on the following:

- The requirements outlined in SYSTEM TECHNICAL REQUIREMENTS, including all subparagraphs.
- Review of the Dredge Plant Instrumentation Plan (DPIP) as described in DREDGE PLANT INSTRUMENTATION PLAN (DPIP).
- Onsite QA checks as outlined on the DQM website (https://dqm.usace.army.mil) and described in ONSITE QUALITY ASSURANCE (QA) CHECK.
- Data transmission and quality maintained throughout the duration of the contract as described in OPERATIONAL PERFORMANCE, REPORTING AND QA, including all subparagraphs.
- Timely communication and corrective action in response to QA notifications as required by QUALITY ASSURANCE COMMENTS.
- Accurate and timely entry of data as described in STATE DATA.

3.1.2 RECERTIFICATION

Contact the DQM Center at dqm-support@usace.army.mil at least three weeks prior to certification expiration, to schedule and coordinate QA checks for certification renewal. This notification is to make the DQM Center aware of a target date for the annual QA checks for the plant(s) in need of recertification. At least one week prior to the target date, the DQM Center must be contacted to verbally coordinate a specific date and location. The Contractor must then follow up this conversation with a written email confirmation.

Recertification is required for changes in sensor type or location as well as any yard work that produces modification to reported values. Any changes must be reported in the

sensor log section of the DPIP. For hoppers and scows, this includes but is not limited to modifications that alter displacement and/or bin volume (change in bin dimensions, addition or subtraction of structure, repositioning of draft marks).

A plant does not have to be transmitting data between jobs; however, to retain its DQM certification, the sensors or hardware must not be disconnected or removed from the plant. If the system is powered down, calibration coefficients must be retained.

3.1.3 ONSITE QUALITY ASSURANCE (QA) CHECK

Contractor/subcontractor personnel who are familiar with the instrumentation and can recalibrate the sensors must be on site during the QA process. The Contractor will coordinate pickup times and locations and provide transportation to and from any vessel with a DQM system to team personnel in a timely manner. Generally, DQM Center personnel will come with personal protective equipment (PPE) consisting of hard-hats, steel toe boots, and life jackets. If additional safety equipment is needed, such as eye protection, safety harnesses, work gloves, or personal location beacons— the Contractor must provide these items to the DQM QA team while on site. It is the Contractor's obligation to inform the DQM QA team if the location designated for the QA checks has any site-specific safety concerns prior to their arrival on site.

3.1.4 DREDGE PLANT INSTRUMENTATION PLAN (DPIP)

A digital copy of the DPIP must be on file with the DQM Center. While working on site, the Contractor will maintain on the plant a copy of the DPIP, which is always easily accessible to Government personnel. This document must accurately describe the sensors used, the configuration of the system, how sensor data will be collected, how quality control on the data will be performed, and how the sensors/data-reporting equipment will be calibrated and repaired if it fails. A description of the computed plant-specific data and how the sensor data will be transmitted to the DQM database must also be included. Prior to the start of work any addendum or modifications made to the plan after its original submission must be submitted to the DQM Center. Any changes to the computation methods must be approved by the DQM Center prior to their implementation.

DQM requirements and a template for the DPIP are available on the DQM website (https://dqm.usace.army.mil).

3.1.4.1 SENSOR LOG

Keep a log of sensor repairs, replacements, installations, modifications, and calibrations in the DPIP. The log must contain a three-year history of sensor maintenance, including the time of the sensor failures (and subsequent repairs, replacements, installations, modifications, and calibrations), the time and results of sensor calibrations, the time of sensor replacements, and the time that backup sensor systems were initiated to provide the required data. It must also contain the name of the person responsible for the sensor work.

3.2 SYSTEM TECHNICAL REQUIREMENTS

3.2.1 DATA COLLECTION

The Contractor must provide, operate, and maintain all hardware and software to meet these specifications for the respective plant types on the contract. The Contractor is responsible for the repairs, replacements, installations, modifications, and calibrations of the sensors and any other equipment needed to collect and transmit the required data. Sensors installed must be capable of collecting and reporting parameters at the specified interval, accuracy, precision, and resolution as described in DATA PARAMETERS BY PLANT TYPE, including all subparagraphs.

Data will be logged and archived locally onboard the plant as a backup to transmitted data as described in DATA BACKUP REQUIREMENTS.

3.2.2 DATA DISPLAY

The Contractor must provide an easily accessible visual display onboard the plant that displays in real time the raw parameters collected by the system in the same units as are used for data submitted to DQM. In the event a reported parameter is calculated based on multiple sensors, the sensor values as used in the equation must be visible in addition to the required parameter.

3.2.3 DATA TRANSMISSION

The Contractor is responsible for acquiring, installing, and maintaining all necessary hardware and software to ensure reliable internet connectivity for data transmission to the DQM web service. The internet connection must support real-time data transmission and provide sufficient bandwidth to clear any queued data when connectivity is restored after an outage.

Data collected must be transmitted to the DQM web service in real-time, in accordance with the standards outlined in DATA PARAMETERS BY PLANT TYPE and all related subparagraphs. If internet connectivity is lost, the web service is unavailable, or data cannot be transmitted for any reason, unsent data should be queued and transmitted immediately upon restoration of connectivity. Transmission should begin with the oldest data in the queue and continue until real-time transmission resumes. Failure to transmit within timeframes may be treated as non-compliance and/or result in revocation of the plant's DQM certification.

Scow data transmission must be fully automated end-to-end. The Contractor may transmit directly from the scow or via a shore-based relay. When a relay is used: (a) the scow must transmit to the relay no less frequently than every 4 hours, and (b) the relay must forward to the DQM web service immediately and automatically upon receipt.

Contact dqm-support@usace.army.mil for transmission details, such as the DQM web service URL, headers, authorization credentials, and communication protocol information.

3.2.4 DATA FORMAT

Collected sensor data will be compiled into correctly formatted data strings for transmission to DQM. Data string format varies by plant type:

Hopper: XML
Scow: XML
Pipeline: JSON
Mechanical: JSON

All data strings contain a minimum of two data parameters, a plant identifier assigned by the DQM Center and a Coordinated Universal Time (UTC) stamp based on a 24-hour format (YYYY-MM-DD HH:MM:SS). Other data parameters vary by plant type or profile and will be enclosed within the appropriate XML or JSON tag. If a parameter is not applicable or otherwise missing, it will be omitted from the data string.

Example data strings for each plant type are available at the DQM website or upon request from the DQM Center at dqm-support@usace.army.mil.

3.2.5 DATA FREQUENCY

Data must be collected and transmitted at set intervals (which vary by plant type and activity state) as outlined in the table below. Raw sensor samples reported in a data string must be acquired no more than 1 second before the timestamp of that string. Averaged or computed parameters must be derived from samples acquired within the reporting interval as outlined in the table below. Any sensor data averaging or calculations performed externally to the sensors must be documented in the DPIP.

Plant Type	**Event Type**	**Reporting Interval**
Hopper	ALL	6-12 seconds
Pipeline	ALL	6-12 seconds
Mechanical	Time Interval	1 minute
Mechanical	Dig/Dump	A data point must be recorded within 1 second of a bucket “dig” or “dump” event occurring.
Scow	Loading/Sailing/ Offloading/Idle	1 minute
Scow	Open Water Placement	A data point must be recorded within 1 second of the hull status going from closed to open and again within 1 second of the hull status going from open to closed. Between these events, report the data at an equal interval from 6 to 12 seconds. This interval must always remain consistent for the dredge plant.

3.2.6 DATA BACKUP REQUIREMENTS

Data will be logged locally onboard the plant as a backup of transmitted data. An archive of all data sent to the DQM Center in the format that it was originally collected and transmitted must be maintained. This archive will be preserved by the Contractor for a minimum of one year past the end of the contract. At the completion of dredging activities all data gaps must be filled or addressed. When data backup includes unresolved data gaps the Contractor must follow the guidance described in DATA GAPS.

3.3 OPERATIONAL PERFORMANCE, REPORTING AND QA

3.3.1 PERFORMANCE REQUIREMENTS

The Contractor's data transmission system must be operational at the start of dredging operations and certified prior to moving dredge material on the contract (see paragraph CERTIFICATION). The plant must maintain DQM certification and remain compliant throughout the duration of the contract.

3.3.2 WORK EVENT MESSAGES

Work event messages are data transmissions generated by the automated data collection system at defined time intervals or in response to specific operational events, as required for each plant type. A work event message includes all required sensor data, computed parameters, and a timestamp corresponding to the event or interval. Work event messages are generated according to the reporting intervals and event triggers as specified in DATA FREQUENCY and the relevant DATA PARAMETERS BY PLANT TYPE. Each work event message is formatted and transmitted in accordance with the requirements outlined in DATA FORMAT and DATA TRANSMISSION.

3.3.3 STATE DATA

In addition to real-time work event messages, submissions of "state data" are also required for hoppers, pipeline, and mechanical plant types. State data provides information about the current state of the dredge equipment or operations. State data entries are submitted daily through the DQM Contractor Management Site from the first day of dredging activity on the contract through the final day. State data entries include, but are not limited to contract information, load or coverage and volume estimates, non-effective event information, as well as plant type-specific parameters such as pipeline length and outfall information for pipeline dredges and dredge advance for pipeline and mechanical dredges. State data must be submitted daily, reporting on all activities for the prior day.

3.3.4 PROJECT START AND END NOTIFICATION

Prior to commencement of project startup and at the completion of work DQM must be notified by emailing dqm-support@usace.army.mil.The notification must include the plants working on the project, estimated project duration, and project personnel who need access to DQM.

3.3.5 DATA GAPS

In the event of a system outage that results in a data gap which cannot be filled with backup data, provide a clear explanation documenting the cause and duration of the gap. Record this explanation using the DQM Contractor Management Site within 48 hours.

3.3.6 QUALITY ASSURANCE COMMENTS

The Contractor will submit a response within 48 hours of receiving any QA notification identifying immediate mitigations and an estimated restoration schedule. All notifications, actions, and supporting records will be entered in DQM Contractor Management Site.

3.3.7 SENSOR QA ISSUES

3.3.7.1 REPAIRS

If hardware problems occur, or if a part of the system is physically damaged, the Contractor is responsible for repairs. Sensor failures must be documented on the DQM Contractor Management Site. Corrective action (repair, replacement, or recalibration) must be completed within 48 hours of discovery. If 48-hour completion is not feasible, the Contractor must notify the DQM Center before the 48-hour deadline with cause and estimated completion date. Upon completion of repairs, replacements, installations, modifications, or calibrations, notify the DQM Center.

3.3.7.2 RECALIBRATION

The DQM Center may request recalibration of the sensors or other hardware components at any time during the contract as deemed necessary.

3.4 CONTRACTOR SUPPLIED ITEMS

3.4.1 LIST OF ITEMS TO BE PROVIDED BY THE CONTRACTOR

DPIP	Paragraph DREDGE PLANT INSTRUMENTATION PLAN (DPIP) and DQM Center website https://dqm.usace.army.mil.
INSTRUMENTATION SYSTEM AND DATA	Paragraph SYSTEM TECHNICAL REQUIREMENTS, including all subparagraphs.
EVENT DOCUMENTATION	Paragraph OPERATIONAL PERFORMANCE, REPORTING AND QA, including all subparagraphs.

3.4.2 HOPPERS

QA EQUIPMENT ON THE DREDGE

Clear and accurate draft marks
Dragarm depth chain or calibrated pressure sensor
Ullage tape
Refractometer
Water-sampling device

3.4.3 PIPELINES

QA EQUIPMENT ON THE DREDGE
Suction mouth depth chain/tape or calibrated pressure sensor

3.4.4 MECHANICAL DREDGES

QA EQUIPMENT ON THE DREDGE
Bucket depth chain/tape or calibrated pressure sensor

3.4.5 SCOWS

QA EQUIPMENT ON THE DREDGE
Clear and accurate draft marks
Ullage tape

3.5 DATA PARAMETERS BY PLANT TYPE

3.5.1 HOPPER SENSOR PARAMETERS

Transmit all data in XML message bundles (see DATA FORMAT).

3.5.1.1 PLANT IDENTIFIER

Plant-specific identifier provided by DQM. If the plant is new to using DQM, please contact the DQM Center for a Plant Identifier.

3.5.1.2 LOAD NUMBER

Load number for each plant will begin at number 1 at the start of the contract and will increment by one at the completion of each placement event. Load number sequence will be unique to each plant on the contract. Whenever possible, calculate the load number using sensors aboard the plant with a mathematically repeatable routine. Make efforts to include logic that avoids false load number increments. If manual increment of the load number is performed, pay extra attention to this value in the quality control process.

3.5.1.3 MESSAGE TIME

Report the date and time to the nearest second and referenced to Coordinated Universal Time (UTC) time based on a 24-hour format (YYYY-MM-DD HH:MM:SS). The reported time must be the time reported by the Global Positioning System (GPS) in the National Marine Electronics Association (NMEA) data string.

3.5.1.4 HORIZONTAL POSITIONING

Obtain location using a positioning system operating with a minimum accuracy level of 3-10 feet horizontal Circular Error Probable (CEP). Report positions as Latitude/Longitude World Geodetic System 1984 (WGS 84) in decimal degrees with South Latitude and West Longitude values reported as negative.

Record vessel horizontal positioning as geographic coordinates of the vessel as indicated by the location of the GPS antenna. Describe any offset calculations from the GPS antenna(s) in the DPIP.

3.5.1.5 DRAGHEAD HORIZONTAL POSITIONING

Obtain location using a positioning system operating with a minimum accuracy level of 3-10 feet horizontal Circular Error Probable (CEP). Report positions as Latitude/Longitude WGS 84 in decimal degrees with South Latitude and West Longitude values reported as negative.

Record draghead horizontal positioning as geographic coordinates of the heel on the centerline of the draghead(s). Horizontal positions must be reported for all dragheads. Describe any offset calculations from the GPS antenna in the DPIP.

3.5.1.6 COURSE

Provide vessel course-over-ground (COG) using industry-standard equipment. The COG must be accurate to within 5 degrees and reported to the nearest whole degree with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

3.5.1.7 SPEED

Provide vessel speed-over-ground in knots using industry-standard equipment with a minimum accuracy of 1 knot and resolution to the nearest 0.1 knot.

3.5.1.8 HEADING

Provide vessel heading using industry-standard equipment. The heading must be accurate to within 5 degrees and reported to the nearest whole degree with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

3.5.1.9 HULL STATUS

Hull status is meant to reflect a condition when the split hull or bottom doors are positioned such that material could be released from the bin. The only permissible values are “open” and “closed”. An “open” status must be reported as the bin starts to open, and a “closed” status must be indicated only once the bin is fully closed. For bins with multiple doors or pockets, the “open”/”closed” status must correspond to the compartment which is first to open and last to close.

3.5.1.10 VERTICAL CORRECTION (TIDE)

Obtain the variation of the water level from the vertical datum for the river stage or tidal gage using appropriate equipment to give the water level with an accuracy of ± 0.1 foot and a resolution of 0.01 foot. Enter vertical correction values above the project datum with a positive sign and those below with a negative sign. Use datum and gage described in the dredging specification and indicate in the state events when changing gages.

3.5.1.11 DRAFT

Report all draft measurements in decimal feet with an accuracy of ± 0.1 ft and a resolution of 0.01 ft relative to observed physical draft readings in calm water. Values for the forward draft and aft draft will be reported. The reported draft values are the averages of the respective port and starboard physical draft mark readings.

3.5.1.12 DISPLACEMENT

Report vessel displacement in long tons to the nearest tenth, based on the most accurate method available for the plant. The minimum standard of accuracy for displacement is interpolation from the displacement table, based on the average draft. For this contract the density of water used to calculate displacement is _____* kg/cubic meter, and it will be used for an additional interpolation between the fresh and salt water tables.

* *The water density used is project-/location-specific. Enter the appropriate water density in the blank:*

- *Fresh Water—1000 kg/m^3 (1 g/cm^3)*
- *Salt Water—1027-1030 kg/m^3 (1.027-1.03 g/cm^3)*

3.5.1.13 EMPTY DISPLACEMENT

Report empty displacement in long tons to the nearest tenth, which is the lightship value of the plant, or the weight of the vessel with no material in the bin, adjusted for fuel and water consumption.

3.5.1.14 BIN ULLAGE

Report forward and aft ullage distances in decimal feet with an accuracy of ± 0.1 ft and a resolution of 0.01 ft relative to the ullage table reference point (typically the top of coaming) at the forward and aft extents of the bin along the centerline.

Mount sensors to avoid discharge flume turbulence, foam, and any structure that could produce sidelobe errors. If sensors must be offset from the centerline of the bin, the sensors should be offset to opposite sides of the vessel. If more than one fore or one aft sensor is used, place the sensors near the corners of the bin, and report the average value of the fore sensors and the average value of the aft sensors.

3.5.1.15 BIN VOLUME

Report bin volume in cubic yards to the nearest tenth, based on the most accurate method available for the dredge. The minimum standard of accuracy for bin volume is interpolation from the certified bin volume table, based on the average fore and aft ullage soundings.

3.5.1.16 DRAGHEAD DEPTHS

Report draghead depths with an accuracy of ± 0.5 foot and a resolution to the nearest 0.1 foot as measured from the surface of the water with no tidal adjustments. Minimum accuracies are conditional to relatively calm water. The depth reported should be the bottom surface of the heel at the centerline of the draghead. Depths must be reported for all dragheads.

3.5.1.17 DRAGARM GIMBAL DEPTHS

Report dragarm gimbal depths with an accuracy of ± 0.5 foot and a resolution to the nearest 0.1 foot as measured from the surface of the water with no tidal adjustments. Minimum accuracies are conditional to relatively calm water. The depth reported should be the center of the gimbal in both vertical and horizontal planes

3.5.1.18 SLURRY DENSITY

Use a density-metering device, calibrated according to the manufacturer's specifications, to record the slurry density from each pump being used to move material in any phase of the dredging process to the nearest 0.001 grams per cubic centimeter (g/cc) with an accuracy of ± 0.01 g/cc. If the manufacturer does not specify a frequency of recalibration, conduct calibration prior to commencement of work. Densities must be reported for each draghead and pumpout path.

3.5.1.19 SLURRY VELOCITY

Use a flow-metering device, calibrated according to the manufacturer's specifications, to record the slurry velocity from each pump being used to move material in any phase of the dredging process to the nearest 0.01 feet per second (fps) with an accuracy of ± 0.5 fps. If the manufacturer does not specify a frequency of recalibration, conduct calibration prior to commencement of work. Measure the slurry velocity in the same pipeline inside diameter as that used for the slurry density measurement. Velocities must be reported for each draghead and pumpout path.

3.5.1.20 PUMP RPM

Measure the revolutions per minute (RPM) of all pump impellers being used to move material in any phase of the dredging process. Dredges with multiple pumps per side must report RPM for the pump that best describes the dredging process. Pump RPM should be recorded to the nearest whole RPM.

3.5.1.21 DRAGHEAD SUCTION

The draghead suction status must be reported if the dredge is equipped with valves designed to bypass the suction (i.e., suction not through the draghead). Contractor must use the status of the valves and the vessel's configuration to determine a "true" value when suction is present at the draghead; and a "false" value when draghead suction is bypassed via the "turtle valves," sea-chest" valves or other methods (with no suction at the draghead). The status must be reported as a Boolean value; The only permissible values are "true" and "false".

3.5.1.22 PUMPOUT STATUS

When the vessel is being pumped out, report a "true" value; when it is not, report a "false" value. The only permissible values are "true" and "false".

3.5.2 PIPELINE DREDGE SENSOR PARAMETERS

Transmit all data in JSON message bundles (see DATA FORMAT). Slurry velocity and slurry density are **not** mandatory fields for the **Pipeline Small Business Profile**; however, if the dredge is outfitted with a velocity or a density meter, then it is required that velocity or density data will be included within the DQM string and will meet the standard DQM requirements outlined in Section 3.5.2.8 and Section 3.5.2.9.

3.5.2.1 PLANT IDENTIFIER

Plant-specific identifier provided by DQM. If the plant is new to using DQM, please contact the DQM Center for a Plant Identifier.

3.5.2.2 MESSAGE TIME

Report the date and time to the nearest second and referenced to Coordinated Universal Time (UTC) time based on a 24-hour format (YYYY-MM-DD HH:MM:SS). The reported time must be the time reported by the Global Positioning System (GPS) in the National Marine Electronics Association (NMEA) data string.

3.5.2.3 COMMENT

Comments concerning the work event messages being transmitted provide descriptive information that relates to the data.

3.5.2.4 VERTICAL CORRECTION (TIDE)

Obtain the variation of the water level from the vertical datum for the river stage or tidal gage using appropriate equipment to give the water level with an accuracy of ± 0.1 foot and a resolution of 0.01 foot. Enter vertical correction values above the project datum with a positive sign and those below with a negative sign. Use datum and gage described in the dredging specification and indicate in the state events when changing gages.

3.5.2.5 CUTTER/SUCTION HEAD HORIZONTAL POSITION

Obtain location using a positioning system operating with a minimum accuracy level of 3-10 feet horizontal Circular Error Probable (CEP). Report positions as Latitude/Longitude WGS 84 in decimal degrees with South Latitude and West Longitude values reported as negative.

Record cutter/suction head horizontal positioning as geographic coordinates of the bottom of the suction mouth. Describe any offset calculations from the GPS antenna in the DPIP.

3.5.2.6 CUTTER/SUCTION DEPTH

Cutter/suction depth is the measurement from the surface of the water to the bottom of the suction mouth. Instrumentation must be capable of reporting to an accuracy of $\pm$ 0.5 foot and a resolution to the nearest 0.1 foot with no tidal adjustments. Minimum accuracies are conditional to relatively calm water.

3.5.2.7 CUTTER/SUCTION HEAD HEADING

The cutter/suction head heading is the angle of the centerline of the cutter/suction head and dredge ladder measured relative to true north. Provide all headings using industry-standard equipment. The heading must be accurate to within 5 degrees and reported to the nearest whole degree with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

3.5.2.8 SLURRY VELOCITY

Use a flow-metering device, calibrated according to the manufacturer's specifications, to record the slurry velocity to the nearest 0.01 feet per second (fps) with an accuracy of $\pm$ 0.5 fps. If the manufacturer does not specify a frequency of recalibration, conduct calibration prior to the commencement of work. Measure the slurry velocity for the same pipeline inside diameter as that used for the slurry density measurement.

3.5.2.9 SLURRY DENSITY

Use a density-metering device, calibrated according to the manufacturer’s specifications, to record the slurry density to the nearest 0.01 grams per cubic centimeter (g/cc). It is understood that the accuracy of this sensor can vary based on several factors, including the type of material, the magnitude of the cut, and the length of time since calibration. If the manufacturer does not specify a frequency of recalibration, conduct calibration prior to the commencement of work. Continuous monitoring of this sensor ensures that drift and other factors inherent in the dredging process can be accounted for in monitoring dredge activity.

3.5.2.10 PUMP RPM

The pump revolutions per minute (RPM) is the number of revolutions per minute measured for the slurry pump impeller of the last onboard pump in use. Pump RPM should be recorded to the nearest whole RPM.

3.5.2.11 PUMP VACUUM

Measure the vacuum pressure of the dredge pump(s) (inches of mercury gauge) recorded to the nearest 0.01 inHg as near to the eye as practicable in the pump's suction pipe for the first onboard pump in use.

3.5.2.12 PUMP OUTLET PRESSURE

Measure the pump outlet pressure in the discharge line after the last onboard pump in use in terms of pounds per square inch (psi) gauge recorded to the nearest 0.01 psi.

3.5.2.13 OUTFALL HORIZONTAL POSITION (OPEN WATER/SPILL BARGE PLACEMENT)

Obtain the horizontal position of the outfall end of the discharge pipe using a positioning system operating with a minimum accuracy level of 3-10 feet horizontal Circular Error Probable (CEP). Report positions as Latitude/Longitude WGS 84 in decimal degrees with South Latitude and West Longitude values reported as negative.

3.5.3 MECHANICAL DREDGE SENSOR PARAMETERS

Transmit all data in JSON message bundles (see DATA FORMAT).

3.5.3.1 PLANT IDENTIFIER

Plant-specific identifier provided by DQM. If the plant is new to using DQM, please contact the DQM Center for a Plant Identifier.

3.5.3.2 MESSAGE TIME

Report the date and time to the nearest second and referenced to Coordinated Universal Time (UTC) time based on a 24-hour format (YYYY-MM-DD HH:MM:SS). The reported time must be the time reported by the Global Positioning System (GPS) in the National Marine Electronics Association (NMEA) data string.

3.5.3.3 WORK EVENT TRIGGER

Work events are triggered by a time interval ("time") or a bucket event ("dig"/"dump"). A "time" event occurs when the time elapsed since the previous data point exceeds the reporting interval defined in DATA FREQUENCY. A "dig" event occurs when the

bucket excavates material, and a “dump” event occurs when the bucket releases the previously excavated material.

3.5.3.4 VERTICAL CORRECTION (TIDE)

Obtain the variation of the water level from the vertical datum for the river stage or tidal gage using appropriate equipment to give the water level with an accuracy of ± 0.1 foot and a resolution of 0.01 foot. Enter vertical correction values above the project datum with a positive sign and those below with a negative sign. Use datum and gage described in the dredging specification and indicate in the state events when changing gages.

3.5.3.5 HORIZONTAL POSITION

The horizontal position of the dredge must be obtained using a positioning system operating with a minimum accuracy level of 3-10 feet horizontal Circular Error Probable (CEP). It must be reported as Latitude/Longitude World Geodetic System 1984 (WGS 84) in decimal degrees with South Latitude and West Longitude values reported as negative. This position will be reported from an unchanging reference point with respect to the dredge’s dimensions.

3.5.3.6 HEADING

Dredge heading is the angle of the centerline of the dredge vessel measured relative to true north. The dredge heading must be accurate to within 5 degrees and reported to the nearest whole degree with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

3.5.3.7 BOOM ANGLE

The boom angle is the angle between the longitudinal centerline of the boom and the horizontal. The boom longitudinal centerline is a straight line between the boom foot pin (heel pin) centerline and boom point sheave pin centerline. The boom angle must be reported from the horizontal and accurate to within 1 degree and reported to the nearest whole degree with values from -90 to 90 degrees. The values will be positive above the horizontal.

3.5.3.8 STICK ANGLE (IF APPLICABLE)

The stick angle is the angle between the longitudinal centerline of the stick and the horizontal. The stick longitudinal centerline is a straight line between the boom point pin centerline and the bucket pin centerline. The stick angle will be reported from the horizontal and accurate to within 1 degree and reported to the nearest whole degree with values from -180 to 180 degrees. The values will be positive above the horizontal. Tag and value should be omitted if not applicable to dredge.

3.5.3.9 BUCKET HORIZONTAL POSITION

The horizontal position of the center of the bucket will be obtained using a positioning system operating with a minimum accuracy level of 3-10 feet horizontal Circular Error Probable (CEP). It must be reported as Latitude/Longitude WGS 84 in decimal degrees with South Latitude and West Longitude values reported as negative.

3.5.3.10 BUCKET DEPTH

The bucket depth will be the distance from the surface of the water to the bottom-most edge of the bucket when closed. An accuracy of $\pm$ 1.0 feet with values recorded to the nearest 0.1 feet is required. The values will be positive below the surface and negative above the surface of the water.

3.5.3.11 BUCKET HEADING

Bucket heading is the angle of the centerline of the bucket measured relative to true north. The bucket heading will be reported away from the crane/excavator and accurate to within 5 degrees and reported to the nearest whole degree with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

3.5.4 SCOW SENSOR PARAMETERS

Transmit all data in XML message bundles (see DATA FORMAT). Bin ullage and bin volume are **not** mandatory fields for the **Scow Monitoring Profile**; however, if the plant is outfitted with bin sensors and can report bin volume, then it is required that bin ullage and bin volume data will be included within the DQM string and will meet the standard DQM requirements outlined in Section 3.5.4.14 and Section 3.5.4.15.

3.5.4.1 SCOW NAME

Assign each scow a unique name that will remain constant from one dredging operation to the next.

3.5.4.2 PLANT IDENTIFIER

Plant-specific identifier provided by DQM. If the plant is new to using DQM, please contact the DQM Center for a Plant Identifier.

3.5.4.3 CONTRACT NUMBER

The USACE-assigned contract number for the project will be reported.

3.5.4.4 LOAD NUMBER

Load number for each plant will begin at number 1 at the start of the contract and will increment by one at the completion of each placement event. Load number sequence will be unique to each plant on the contract. Whenever possible, calculate the load number

using sensors aboard the plant with a mathematically repeatable routine. Make efforts to include logic that avoids false load number increments. If manual increment of the load number is performed, pay extra attention to this value in the quality control process.

3.5.4.5 MESSAGE TIME

Report the date and time to the nearest second and referenced to Coordinated Universal Time (UTC) time based on a 24-hour format (YYYY-MM-DD HH:MM:SS). The reported time must be the time reported by the Global Positioning System (GPS) in the National Marine Electronics Association (NMEA) data string.

3.5.4.6 HORIZONTAL POSITIONING

Obtain location using a positioning system operating with a minimum accuracy level of 3-10 feet horizontal Circular Error Probable (CEP). Report positions as Latitude/Longitude World Geodetic System 1984 (WGS 84) in decimal degrees with South Latitude and West Longitude values reported as negative.

Record the scow's horizontal positioning as geographic coordinates of the barge as indicated by the location of the GPS antenna. Describe any offset calculations from the GPS antenna in the DPIP.

3.5.4.7 HULL STATUS

Hull status is meant to reflect a condition when the split hull or bottom doors are positioned such that material could be-released from the bin. The only permissible values are "open" and "closed". An "open" status must be reported as the bin starts to open, and a "closed" status must be indicated only once the bin is fully closed. For bins with multiple doors or pockets, the "open"/"closed" status must correspond to the compartment which is first to open and last to close.

3.5.4.8 OFFLOADING STATUS

Offloading occurs when the scow is being unloaded, either by hydraulic or mechanical means. When offloading is occurring, report a value of "true"; otherwise, report a "false" value. The only permissible values are "true" and "false".

3.5.4.9 COURSE

Provide scow course-over-ground (COG) using industry-standard equipment. Provide scow COG accurate to within 5 degrees and reported to the nearest whole degree with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

3.5.4.10 SPEED

Provide scow speed-over-ground in knots using industry-standard equipment with a minimum accuracy of 1.0 knot and resolution to the nearest 0.1 knot.

3.5.4.11 HEADING

Provide scow heading using industry-standard equipment. The scow heading must be accurate to within 5 degrees and reported to the nearest whole degree with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

3.5.4.12 DRAFT

Report all draft measurements in decimal feet with an accuracy of ± 0.1 ft and a resolution of 0.01 ft relative to observed physical draft readings in calm water. Values for the forward draft, aft draft and vessel average draft will be reported. The reported draft values are the averages of the respective port and starboard physical draft mark readings.

3.5.4.13 DISPLACEMENT

Report scow displacement in long tons to the nearest tenth based on the most accurate method available for the scow. The minimum standard of accuracy for displacement is interpolation from the displacement table, based on the average draft. For this contract the density of water used to calculate displacement is _____* kg/cubic meter, and is used for an additional interpolation between the fresh and salt water tables.

**The water density used is project-/location-specific. Enter the appropriate water density in the blank:*

- *Fresh Water—1000 kg/m^3 (1 g/cm^3)*
- *Salt Water—1027-1030 kg/m^3 (1.027-1.03 g/cm^3)*

3.5.4.14 BIN ULLAGE

Report forward and aft ullage distances in decimal feet with an accuracy of ± 0.1 ft and a resolution of 0.01 ft relative to the ullage table reference point (typically the top of coaming) at the forward and aft extents of the bin along the centerline. Report average ullage calculated from the forward and aft ullage values.

Mount sensors to avoid foam, and any structure that could produce sidelobe errors. If sensors must be offset from the centerline of the bin, the sensors should be offset to opposite sides of the vessel. If more than one fore or one aft sensor is used, place the sensors near the corners of the bin, and report the average value of the fore sensors and the average value of the aft sensors. Special arrangements for pocket scows may be made in consultation with the DQM Center.

3.5.4.15 BIN VOLUME

Report scow bin volume in cubic yards to the nearest whole number based on the most accurate method available for the scow. The minimum standard of accuracy for bin volume is interpolation from the bin volume table based on the average ullage soundings.