

Preparing Activity: USACE

New

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2022

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PROJECT TECHNICAL DATA MANAGEMENT AND VISUALIZATION
05/22

NOTE: This guide specification covers the requirements for project technical data management and visualization.

Adhere to [UFC 1-300-02](#) Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a [Criteria Change Request \(CCR\)](#).

PART 1 GENERAL

NOTE: This specification has been developed from lessons learned over a decade of DoD mega contracts, and input from the data management industry. What this has taught us is where the Contractor fully understands the activities and efforts associated with the collection and display of data during the bidding process, the more successful they are in providing what the Government requires from its system. It has also taught us that the enforceability of a specification depends on specific measures such as turnover times, government approval submittals, work product expectations, and

dedicated measurement and payment for features.

The data management system's primary function is to ensure quality construction that meets the organization's regulatory requirements, meets time and budget constraints. None of these components have been added frivolously but were thoughtfully developed with the hindsight of lessons learned on other mega contracts which resulted in significant additional cost, or a failure of some or all aspects of the system to meet the Government's needs.

Good data management system design relies heavily on communication and a common understanding of technical designer and construction office during the design process considering the project staff's technologic capabilities and the scope of the project. This communication is required to adequately customize this specification. It is strongly recommended to be as specific as possible about government goals and expectations and design the system and products with the same amount of detail as any other feature of work.

The Government has specific cybersecurity, project documentation, as built drawing specifications and software constraints defined by our security protocols and engineering regulations. Therefore, writing a vague, performance style specification without a thorough description of these needs and constraints - placing the onus entirely on the contractor to premeditate government needs - is not appropriate. A specification that is adequately descriptive but with room for contractor innovation will lead to better biddability, and a better understanding of the Government's goals and desired end products. This will lead to a better overall outcomes and avoid lengthy submittal processes and disagreements with the Contractor to arrive at acceptable workflows and deliverables.

Tailoring options have been added for:

SQL RDBMS EDB (for use of SQL RDBMS - generic database language which must be customized will remain even if this option is removed. Choose this option OR ACCESS ENTERPRISE DATABASE, not both)

ACCESS ENTERPRISE DATABASE (for small projects where Access is more appropriate choose this option - if removed generic database language will remain. Choose this option OR SQL RDBMS EDB, not both)

WEB INTERFACE Utilize this option for all types of web interfaces - spatial and non-spatial. This option contains the general requirements for security, accessibility and QA tools.

WEB-BASED GIS INTERFACE Utilize this option for

web-hosted GIS models such as ESRI ArcGIS on a federated ArcServer platform.

DYNAMIC DATA WEB INTERFACE Utilize this option for web-hosted data visualizations such as Microsoft PowerBI, QLIK, Tableau. to show data plots and analytics on testing or installation QC data.

DESKTOP GIS FILES Utilize this option for the receipt of files for GIS desktop products in the full-scale version of the software. This is different from the GIS web viewer in that you have the source files that can be edited and republished to the Agency web service. The GIS web viewer is limited to viewing only and will no longer be available after the contract ends.

OPENGROUND USACE users should use this option for all boring data. If no rock or soil boring data will be collected, or if a different software format will be used, do not use this option.

SAMPLE DATA DELIVERABLES Intended to give a sample of the types of requirements that need to be detailed for different types of work. In a perfect world, these requirements would be placed in the feature of work section which details the work requirements.

ADDITIONAL DATA COLLECTION PLAN SUBMITTALS Contains sample data collection plans for the collection of automated grouting data and remote sensing data such as LiDAR, imagery, and photogrammetry. This option may become redundant if a grouting and remote sensing guide specification is published.

CAD 3D MODEL Utilize this option if Section 01 78 00 CLOSEOUT SUBMITTALS is not properly descriptive of standards and requirements for a spatially referenced CAD model.

CAD QUALIFICATIONS AND ROLES Utilize this option if Section 01 78 00 CLOSEOUT SUBMITTALS is not properly descriptive of qualifications for CAD personnel.

DATA VISUALIZATION SPECIALIST Utilize this option if this role is desired in addition to a data manager. See PART 1, PERSONNEL for a description of the position and notes about when it should be considered for use.

SDSFIE Utilize this option only if there is SDSFIE schema available for data to be collected on the project.

NETWORK INFRASTRUCTURE Utilize this option only if the project requires the Contractor to provide internet connectivity to the site for themselves or the Government.

If the content in any of these options is not needed, the options can be removed and will remove all language associated with the option. Language in the table in Part 1, DATA TURNOVER TIMEFRAMES must be manually corrected.

ALL TECHNICAL DATA GENERATED AS PART OF THE CONTRACT IS SUBJECT TO FEDERAL ACQUISITION REGULATION (FAR) CLAUSE 52.227-14 AND DEFENSE FEDERAL ACQUISITION REGULATION (DFAR) 227-71. THEY ARE NOT REFERENCED IN THE TECHNICAL SPECIFICATION SECTIONS BUT THIS LANGUAGE IS PART OF THE NON-TECHNICAL SECTIONS OF THE CONTRACT. FOR INFORMATION ON THESE CLAUSES TO ASSIST WITH ENFORCEMENT, GO TO:

https://www.acq.osd.mil/dpap/dars/dfars/pdf/current/20220101/227_71.pdf
<https://www.ecfr.gov/current/title-48/chapter-1/subchapter-H/part-52>

1.1 MEASUREMENT AND PAYMENT

NOTE: Measurement and payment have been handled a variety of ways on data management projects. It has been included as incidental to the Construction as well through separate CLINs. Strongly recommend a separate Data Management CLIN or price breakout item rather than treating this as incidental to construction. It can be done in one lump sum CLIN for the whole job, breakdown CLINs per PRODUCTS below, or a monthly payment. A lump sum payment is strongly recommended for the initial system development as a large effort will be required to design and stand up the system.

Monthly payment in a separate monthly CLIN is strongly recommended to give the Government leverage for timely corrections for elements which aren't being completed within required turnover times. Without the ability to withhold payments, the correction of deficiencies for data that is needed in a timely manner cannot be readily enforced. Alternatively, you must ensure that the Contractor develops the system in a timely manner.

NOTE FAR Subpart 227-71 - Rights in Technical Data (Section 227.7103-14 Conformity, acceptance, and warranty of technical data) details that Government can withhold payment "up to 10 percent of the contract price pending correction or replacement of the nonconforming technical data or negotiation of an equitable reduction in contract price."

1.1.1 Develop The Data Management System

1.1.1.1 Payment

NOTE: Edit bracketed items to ensure the payment is associated with the specific project deliverables. Tailoring options "WEB-BASED GIS INTERFACE" and "DYNAMIC DATA INTERFACE" are present. If the option is removed, all associated language will be removed.

Payment will be made for development and delivery of products to provide a complete and fully functioning data management system, as specified herein and in the Contract documents including [required preconstruction submittals, complete construction and testing of the enterprise database (EDB), all components of the **web-based GIS/dynamic data interface**, a functional SFTP site, data management planning meeting completion, delivery of the initial training session, and approval of the quick reference guide. Related costs include, but are not limited to, uploading of all existing data as provided by the Government into the data management system, **initial design, build, scripting, and populating layers the web interface and desktop GIS products**, and including incidental items per the Contract documents.] All incidental costs associated with the performance of work in this section are included in the Contract price. The Government will make no additional separate payment for items included herein or by reference.

1.1.1.2 Measurement

NOTE: Tailoring options are present for "WEB-BASED GIS INTERFACE" and "DESKTOP GIS FILES"

Measurement for payment of DEVELOP THE DATA MANAGEMENT SYSTEM will be paid in one lump sum. Payment for the data management system will be made after completion of the following work:

- [a. The data management staff have been submitted and approved,
- b. All preconstruction submittals have been submitted and approved,
- c. The data management planning meeting with the Government has been conducted,
- d. The 100 Percent Data Management Plan (and all related addenda) submitted and approved,
- e. The initial training session has been conducted, and the quick reference guide submitted and approved, and
- f. The database, **web interface and GIS** being fully developed to 95 percent including all available design features and historical project data loaded to the system, as submitted/demonstrated by the Contractor and approved by the Government. The five percent will account for any changes needed just prior to the start of work for which various components of the system has been built, or testing required to be conducted once initial data has been received.]

1.1.1.3 Unit of Measurement

Unit of Measurement: Lumps Sum (Ea).

1.1.2 Maintain The Data Management System And Turnover Of Final Products

1.1.2.1 Payment

NOTE: Tailoring options are present for "WEB-BASED GIS INTERFACE", "DESKTOP GIS FILES", "CAD 3D MODEL".

Payment will be made on a monthly basis for the maintenance of the data management system in a fully functional state with 24/7 accessibility by the Government, and up to date as specified in PART 1, "Data Turnover Timeframes". This includes the enterprise database, SFTP site, [Web Interface](#), and [desktop GIS components](#) to be up to date (as defined by the turnover time requirements) at all times, and timely resolution of any issues with data correctness, completeness or other quality control measures identified by the Government as defined in this contract.

These payments include the timely submittal of all required data, [digital CAD and GIS products](#), progress drawings, periodic as-built updates, and reports - as required by this and other sections of the Contract - throughout the Contract duration. This item includes all required support staff. This item also includes all final turnover items detailed in Part Three, FINAL EDB TURNOVER, PART 1, SUBMITTALS, SD-11 CLOSEOUT SUBMITTALS, and throughout this section. An amount not to exceed 10 percent of the total payments may be withheld if the Contractor fails to perform the required work. All incidental costs associated with the performance of work in this section are included in the Contract price. The Government will make no additional separate payment for items included herein or by reference.

1.1.2.2 Measurement

Measurement of payment for MAINTAIN THE DATA MANAGEMENT SYSTEM AND TURNOVER OF FINAL PRODUCTS will be made monthly for work completed and submitted as described above for the duration of the Contract activities for which the data management system applies.

1.1.2.3 Unit of Measure

Monthly (Mo) for the number of months which data management work is ongoing.

1.2 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

- ISO 19110 (2005) Geographic Information Methodology for Feature Cataloging - First Edition
- ISO 19115 (2003; Corr 1 2006) Geographic Information - Metadata - First Edition
- ISO 19115-1 (2014) Geographic Information -- Metadata -- Part 1: Fundamentals
- ISO 19115-2 (2009) Geographic Information - Metadata - Part 2: Extensions for Imagery and Gridded Data - First Edition
- ISO 19119 (2005; AMD 1 2008) Geographic information Services - First Edition
- ISO 19139 (2008) Geographic Information-Metadata-XML Schema Implementation

U.S. ARMY CORPS OF ENGINEERS (USACE)

- ERDC/ITL TR-12-6 (2015) A/E/C CAD Standard - Release 6.0

U.S. DEPARTMENT OF DEFENSE (DOD)

- SDSFIE Standards Spatial Data Standards for Facilities, Infrastructure, and Environment

1.3 DEFINITIONS

NOTE: NOTE: Customize the definitions for the database type, and file transfer products that are actually required. Make sure to add any definitions for other products or processes that are required.

1.3.1 Data

NOTE: Tailoring option for "SQL RDBMS EDB" is present. The definition for a Relational Database Management System will be removed if the tailoring option is removed.

A representation of facts, concepts or instructions in a structured, semi-structured or unstructured format, suitable for processing and interpretation by humans or machines. Records generated by any activities related to features of construction detailed in this Contract or by any instrumentation or monitoring equipment or processes in use on the project. Includes raw data generated by automated collection systems, recorded manually on paper or tablets, and data tables and databases and their constituent records which can be used with custom or off-the-shelf software.

1.3.2 Data Cleaning

The process of preparing data for analysis by correcting or qualifying data that is incorrect, incomplete, irrelevant, duplicated, or improperly formatted.

1.3.3 Data Management

The identification, definition, collection, organization, verification, correction, storage, protection, processing, communication, and transfer of data in order to maintain project records in an organized, complete, and rapidly accessible archive for immediate and future use.

1.3.4 Data Management System (DMS)

The hardware, software and network components, architecture, policies, technical processes, and workflows that efficiently manage data and information for the duration of the contract-required activities.

1.3.5 Data Validation/Verification

The process of checking the accuracy and quality of source data before using, importing or otherwise processing data. The same process as data QA or QC. One form of data cleaning.

1.3.6 Documented Enterprise Database (EDB)

A relational database hosted on a server that is utilized to contain, organize, and relate large collections of data stored in individual tables. Capable of handling a range of 100 or more users at a time, and running queries of multiple users simultaneously. A database that is "documented" has detailed written documentation of the schema, in which all items from DEFINITIONS "Schema" are provided in table format, as well as an accompanying entity relationship diagram supplemented with explanatory text.

1.3.7 Metadata

A set of data that gives information about data. For geospatial data this includes information about the feature or dataset location in space (i.e. datums, projections, resolution, collection resolution and accuracy, and other common requirements), entered into the appropriate form in the GIS software platform; as well as information about the data attributes (units, assumptions, sources, and other common information). File metadata are stored in a text file with the same name as the target file. Database metadata are stored in table descriptions or in appropriately labeled metadata fields.

1.3.8 Relational Database Management System (RDBMS)

Relational Database Management System. A type of database management system (DBMS) that stores data in a row-based table structure which connects related data elements. An RDBMS includes functions that maintain the security, accuracy, integrity, and consistency of the data.

1.3.9 Report

Any data or information in a format designed for human communication, where file format is not tabular but comprised of conceptual narrative, formatted tables, or static visualizations, and the contained data is either static or requires conversion to other file formats or manual cleaning or entry for aggregation, processing and analysis by machines.

1.3.10 Schema

Also referred to as "database schema", it is the logical structure of the of the database. Schema consists of the following database elements:

- (1) Table definitions and names;
- (2) Field names;
- (3) Field definitions;
- (4) Field types (constraints), including precision and units for numeric fields;
- (5) Primary and Foreign Keys (to determine table relationships);
- (6) Field default values;
- (7) Domains;
- (8) Calculated fields and the calculations and equations to produce values that populate them;
- (9) Selected database views required to produce values displayed in the web interface, used to derive reports, for ongoing CAD/GIS feature generation, or as requested by the COR.

1.3.11 Secure File Transfer Protocol (SFTP)

Also SSH File Transfer Protocol, a networked protocol to handle file transfers between computers over the internet. It provides file transfer, access and management over a secure connection communicating on server data port 22. This should not be confused with similarly-named "Simple File Transfer Protocol" which operates on server data port 115, and does not meet the requirements of an SFTP site for the purpose of this contract.

1.3.12 Tabular Data

Any structured or semi-structured numerical or qualitative facts in a character-limited field and record format. Suitable for processing by machines with minimal human interpretation, cleaning or processing, and in a file format suitable for importing into a database software program without any structural changes to the file.

1.3.13 Tag

A keyword or term applied to a computer file that is stored in the file metadata that can aid in searching for that file or document. Most commonly used with files such as imagery to aid in computer-based searching.

1.4 ADMINISTRATIVE REQUIREMENTS

1.4.1 Data Management Planning Meeting

NOTE: This meeting was added as a forum for getting the initial setup of the Contractor's data management system to meet the Government's expectations and goals and give the Government insight into the limiting factors for turnover times and other requirements. The meeting circumvents using the submittal process to accomplish that. It allows the Government to have an immediate feedback about what kind of time requirements for turnover are realistic, and to set expectations, determine workflows, discuss schema changes to the database, and build rapport. Adjust the length of this meeting commensurate with the complexity and intensity of data production of the project.

Covid-19 has changed many elements of how we do business. If both parties are comfortable with in-person meetings based on current transmission and new case trends, it is recommended to have the meetings in person to help build rapport. If in-person meetings do not make sense given infection rates on site or in the area where personnel will be traveling from, this requirement can be relaxed by the government. If the project thinks it might want in-person attendance, leave the more stringent requirement in the specification so that it can be enforced as needed, however it can always be relaxed later.

Tailoring option is available for "DATA VISUALIZATION SPECIALIST" and "WEB-BASED GIS INTERFACE".

Hold a collaborative meeting with the [Contracting Officer (COR)] [Administrative Contracting Officer (ACO)] within 15 days of the approval of all applicable SD-01 submittals. This collaborative effort will consist of a meeting over [_____] [4 full consecutive business] days, where primary Contractor and data management Contractor (if subcontracted) each provide in-person attendance. The data manager, [data visualization specialist](#), and data management QC must physically attend this meeting with [COR][ACO] in order to facilitate the building of rapport and efficient communication. Additionally, personnel from each subcontractor having technical knowledge of data collection and processing for that subcontractor's features of work must also attend this meeting in person during designated days to be decided in the agenda. The meeting must not take place until submittals from paragraph SUBMITTALS - SD-01 are received and approved including:

- (1) 50 Percent Data Management Plan
- (2) Automated and Manual Data Collection Output Examples
- (3) Data Cleaning and Verification Plan
- (4) [QC Data Collection Plan](#)
- (5) Backups, Archiving And Disaster Recovery Plan
- (6) Data Transfer Workflow

(7) Data Management System Demobilization Plan

The goals of this meeting are:

- a. To provide a venue for problem-solving on data requirements and workflows;
- b. Discuss and decide on needed changes to the database schema;
- c. To view, discuss and provide feedback on the web interface displays and functionality as specified;
- d. Discuss and provide feedback on the SFTP file organization structure;
- e. Discuss and resolve any Government questions about Contractor workflows as detailed in submittals;
- f. Presentation and discussion of any Contractor-proposed changes to methods of execution;
- g. Development of field data collection app form formats and associated products (if applicable);
- h. Collaborate to support the Contractor in submittal of a 100 Percent Data Management Plan that meets the Government's expectations - including documentation of all requested or agreed changes to facilitate completion of the 100 Percent Data Management Plan submittal;
- i. To establish a working rapport between all data management personnel;
- j. To communicate and clarify the specific goals and expectations of the Government with respect to any part of the data management system.

NOTE: The following paragraphs are needed on large contracts with multiple features of work where the subcontractor for certain features will not be on site at the time of the initial data management planning meeting. In these cases, the methods and equipment which determine database schema, report formats, turnover times, and others may not be known until years after the NTP. It then becomes necessary to have a special planning meeting for each of these features due to timing.

1.4.2 Additional Planning Meetings

An additional data management planning meeting specifically for the [____][Cutoff Wall][Concrete Placement][Excavation][Grouting] is required no later than 30 days prior to the start of work on that feature. For any feature of work where the data-generating Contractor will not be on site, and specific data-generating equipment will not be detailed until the start of that work which would affect the data management system, hold a specific data management planning meeting no later than 30 days prior to the start of work on that feature. These delayed coordination meetings must be of at least [____][4 hours] duration (or as directed by COR) and must not be combined with other kickoff or coordination meetings. All the same personnel are required to be in attendance as the initial data

management planning meeting.

1.4.3 Coordination and Technical Meetings

The Contractor's Data Manager, or another employee that can act competently on their behalf, must participate in recurring data management technical meetings as needed, scheduled at [COR][ACO] request. These meetings will be critical prior to, and at the start of work for which intensive or voluminous data collection will take place, but are not intended to be ongoing weekly throughout the entire project. For bidding purposes assume monthly meetings for the duration of work. Conduct these meetings in order to ensure the timely and adequate collection, formatting, quality, and flow of data from site to the EDB, SFTP site, and web interface, and to troubleshoot any recurring problems. These meetings are also a venue for collaboration to solve technical problems, make data management progress updates, give feedback, and make technical decisions about data.

Include high level data management updates in the overall weekly coordination meeting for the project.

1.5 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Tailoring options are available for "ADDITIONAL DATA COLLECTION PLAN SUBMITTALS", "DATA VISUALIZATION SPECIALIST", "WEB-BASED GIS INTERFACE", "DESKTOP GIS FILES", "CAD 3D MODEL", "CAD QUALIFICATIONS AND ROLES", and "OPENGROUND".

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

50 Percent Data Management Plan; G[, [_____]]

NOTE: The intent of a Data Management Plan is to ensure that all data processes and policies are fully documented, and that the Contractor fully understands the expectations of the Government. The 50% Data Management Plan is the Contractor's first attempt to document their data management system. The finalization of the plan will be a collaborative effort, with the Government and the Contractor collaborating on the final 100 Percent Data Management Plan, which will be submitted by the Contractor after Government input during the data management planning meeting. For some data, supplied to the Contractor by the Government, these sections may need to be written by the Government and supplied to the Contractor.

Automated and Manual Data Collection Output Examples; G[, [_____]]

NOTE: csv, ASCII - which are common standard open data formats - are readable by MS Excel. Other programs than Excel can be used if the other program is nearly universally available at the home district. This is for ease of data sharing as needed among the construction and design teams. PDF captures the static view of the data but prevents data from easily being added to a database. It is used primarily for data verification purposes, with a static view that is more difficult to change for the purposes of QA/QC. Excel readable files (or database tables) allow the data to be better searched and analyzed and more easily ported into a database without the need for re-typing data that was already generated by a computer.

Data Cleaning and Verification Plan; G[, [_____]]

QC Data Collection Plan; G[, [_____]]

QC Daily Information Collection Plan; G[, [____]]
Backups, Archiving And Disaster Recovery Plan; G[, [____]]
Data Transfer Workflow; G[, [____]]
Data Management System Demobilization Plan; G[, [____]]
100 Percent Data Management Plan; G[, [____]]
Proposed Changes To The Enterprise Database Schema; G[, [____]]
Web Interface; G[, [____]]
Quick Reference Guide; G[, [____]]

NOTE: The following preconstruction submittals are ONLY to be included when the specification section covering the work does not already require one. They become especially important to understand what data will be collected in a performance specification where a methodology is not specified and so the Government will not know the details of the data collection until a proposed method is approved. These plans are samples based on common features of work. Customize the requirements, and add any additional plans as needed.

Automated Grouting And Water Pressure Testing Data Collection Plan; G[, [____]]
Remote Sensing Data Collection Plan; G[, [____]]
System Testing; G[, [____]]

SD-05 Design Data

GIS Files; G[, [____]]

SD-06 Test Reports

Photograph PDF'S; G[, [____]]
Digital Photographs; G[, [____]]
Database Files; G[, [____]]
Digital 3D CAD Model Files; G[, [____]]

SD-07 Certificates

Data Manager; G[, [____]]
Data Visualization Specialist; G[, [____]]
CAD Technician(s); G[, [____]]

CAD Supervisor; G[, [_____]]

SD-10 Operation and Maintenance Data

Data Management Plan Updates; G[, [_____]]

Data Transfer and QC Reports; G[, [_____]]

Ongoing Schema Updates; G[, [_____]]

Web Interface Updates; G[, [_____]]

SD-11 Closeout Submittals

NOTE: Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Data Management System Demobilization Plan Updates; G[, [_____]]

Finalized Enterprise Database; G[, [_____]]

Finalized OpenGround Cloud Borehole Database; G[, [_____]]

Final File Indexes; G[, [_____]]

Data Management Manual; G[, [_____]]

Final GIS Files; G[, [_____]]

1.6 PERSONNEL

1.6.1 Qualifications

NOTE: Extensive thought went into determining these roles, their technical qualifications, and responsibilities. The data manager is an essential role. The number of personnel needed to manage the project data should be scaled based on the breadth of the contract. The full-time Data Manager for the Contractor is needed for mega projects with data-intensive features of work that must meet specific regulations for quality, or have a significant life-safety component. Smaller projects may utilize a part time Contractor Data Manager with scheduled hours commensurate with the data production intensity of the work. The qualifications have been changed from previous versions of this specification to primarily include database skills. The QC data management role outlined in the note preceding section 1.6 under Section 01 45 00.00 10 is intended to assist with interpretation of the work-specific data as needed by the data manager to make any necessary schema changes needed to capture it.

The data visualization specialist is an important role for mega projects that will have a web interface designed by the Contractor that includes any business analytics functions in a dashboard style display. The purpose of this role is to ensure that the necessary data to monitor structural safety and quality management (when required) is displayed in the viewer in such a way that project and engineering staff can rapidly ascertain the "big picture" of the data. If no visualization, web-viewer, or geospatial component will be required, this role is unnecessary. If the project will use only a GIS web map it may make more sense to combine the data management roles into one position.

If the data manager role is combined with the Data Visualization Specialist, it is very important to ensure that the relevant qualifications and responsibilities are captured in the Data Manager requirements below. Do this prior to removing the tailoring option DATA VISUALIZATION SPECIALIST. Tailoring options are available for "DATA VISUALIZATION SPECIALIST", and "CAD QUALIFICATIONS AND ROLES".

1.6.1.1 Data Manager

NOTE: Tailoring options are available for "SQL RDBMS EDB" and "ACCESS ENTERPRISE DATABASE".

The data manager must have the following verifiable credentials:

- a. Have a minimum of [____][5] years of advanced experience occurring in the past [____][8] years overseeing the import, cleaning, verification, processing, storage, backup and scripted transfer of construction data, similar to the type that will be generated by work in the contract.
- b. Have a minimum of [____][5] years' experience occurring in the past [____][5] years designing and editing [SQL][MS Access] enterprise databases *utilizing an RDBMS such as MS SQL Server*.
- c. Have served as the data manager on at least two construction projects of similar complexity, with similar data production volume and data management requirements. Each project should be described in the resume detailing the data management tasks performed.
- d. Be approved by the [COR][ACO] before any data is transferred into the EDB.

Submit the resume for approval within 15 calendar days after notice to proceed.

1.6.1.2 Data Visualization Specialist

The Data Visualization Specialist is responsible for the design, deployment, and maintenance of the spatial (GIS) and dynamic data web interface, and must have the following verifiable credentials:

- a. Have a minimum of [____][3] years of experience in use of [____][ESRI ArcGIS Pro and ArcGIS Online];
- b. A current working knowledge of cartographic design and geoprocessing methods to produce the required visualizations in planimetric, profile and 3D views;
- c. Have a minimum of [____][3] years of experience utilizing data visualization software such as Power BI, Qlik, PowerPivot, Tableau, Python/R data visualization/data science libraries, or equivalent web tools that will be used by the Contractor to meet the specification requirements.
- d. Have performed similar work for one other construction project of similar size and complexity to this contract, and containing similar [geotechnical, civil and structural] engineering work.

Submit the resume for approval within 30 calendar days after the notice to proceed. Provide in the resume samples of the individual's work, including maps, visual analytics and other graphics that demonstrate the individual's analytical and problem-solving skills, and maximization of the tools to meaningfully visualize technical datasets.

1.6.1.3 CAD Supervisor

All CAD work must be completed under the supervision of a CAD supervisor with at least 10 years of CAD experience, [____][5] years of which is in [____][AutoDesk AutoCAD][Bentley MicroStation][Open Roads Designer SS4], and who has produced as-built drawings for a Contract of similar scale and complexity.

Submit resume for approval within 30 days of the notice to proceed including relevant education and experience, and details of previous work on the qualifying Contract as-builts. All CAD personnel must be approved by the [COR][ACO] prior to performing work as part of this contract.

1.6.1.4 CAD Technician(s)

The CAD technician(s) are responsible for the completion of all required prefinal and final as-built drawings and all digital 3D CAD model files in accordance with the requirements specified in Section 01 78 00 CLOSEOUT SUBMITTALS.

All CAD Technicians employed on the project must have at least [____][3] years of experience utilizing [____][AutoDesk AutoCAD][Bentley MicroStation][Open Roads Designer SS4]. In addition, at least one CAD technician must have at least [____][3] years of experience utilizing [____] [Autodesk Revit and Inventor]. Submit resume for approval within 30 days of the notice to proceed including relevant education and experience, and details of previous work on the qualifying Contract as-builts. All CAD personnel must be approved by the [COR][ACO] prior to performing work as part of this contract.

1.6.2 Roles and Responsibilities

1.6.2.1 Data Manager

The Data Manager is responsible for:

- a. Population, maintenance, quality control, and oversight of the Contractor's Data Management System and components;
- b. Coordination with data collection professionals from the primary Contractor and sub-contractors, QC personnel, and other parties performing work on and offsite as necessary to obtain data;
- c. Automated and manual input of data into the enterprise database (EDB);
- d. Ensuring all data generated physically or digitally during construction is captured, converted, cleaned, validated, QC-checked, and organized in the appropriate tabular and non-tabular formats as described in this specification;
- e. Coordination with all other data management personnel to ensure data flows efficiently from site to database to visualizations or other end use;
- f. Scripting of autogenerated reports required in this specification;
- g. Automated and manual transfer of database .csv and backup files, non-tabular files, raw data, and all other documents to the SFTP site within the specified turnover timeframes;
- h. Develop and oversee the processes for QC review of data entered into the EDB as required by this specification;
- i. Develop and oversee the processes for backups of data as required by this specification;
- j. Participate in all data-related technical meetings and report and speak on technical data matters when requests are made by the Government.
- k. Author and compile the data management plans and other data-related submittals.
- l. Provide username and password access to platforms required by this specification including the web interface and SFTP site, and any web applications utilized;
- m. Work with the Data Management QC to develop and incorporate the workflows for integrating QC data into the data management system (via digital collection methods and automated transfer processes as applicable);
- n. Design forms for QA digital data collection and processes to facilitate direct input of data by the Government to the [web interface/](#) database (as applicable).
- o. All other data management tasks not specifically assigned.

If the Data Manager does not know how to execute any part of the technical

processes needed to accomplish any work specified, provide them with the appropriate training. Provide training within 30 days of the data management kickoff meeting.

1.6.2.2 Data Visualization Specialist

The Data Visualization Specialist is responsible for:

- a. Development, deployment, maintenance and updates of the web-based GIS and dynamic data display interfaces. Including all specified visualizations and graphical representations of data to communicate project progress, construction quality, and as applicable dam/life safety monitoring;
- b. Coordination with the Government's data manager to design and edit data displays for maximum comprehension by Government personnel;
- c. Development and maintenance of the desktop ArcGIS Pro projects and source files (.aprx, .gdb, feature classes, rasters, and other GIS products);
- d. Assisting the Contractor's Data Manager in authoring and compiling the Data Management Plan for all visualization duties, GIS metadata and other documentation;
- e. Working with the Contractor's data manager to provide scripted and digital updates to the visualizations whenever possible. Utilizing spatial data collected from the field that is outside of the database;

1.6.2.3 CAD Supervisor

The CAD supervisor is responsible for:

- a. Quality Control of the CAD Technician work.
- b. Ensuring proper use of advanced CAD tools and functions including the use of the [____][eTransmit][Packager] tool and the proper export and transmittal of digital model files so that the full functionality of layers, data files, annotation, and other functions, are retained upon transmittal.
- c. Ensuring the correct use of A/E/C CAD standard [____][R6.1], contained in reference ERDC/ITL TR-12-6, in the creation of the digital CAD model and as-built drawings.
- d. Ensuring the features in the 3D digital CAD model are geospatially referenced to the project survey control and incorporated using the correct horizontal and vertical datums.
- e. Ensuring the inclusion of all required drawing elements and formatting as specified in Section 01 78 00 CLOSEOUT SUBMITTALS, and other feature of work sections of the contract.
- f. Acting as a point of contact (POC) for any needed corrections or changes to either the preliminary as-built submissions or the 3D CAD model, or directly assigning a POC to interface with the Government as needed to address corrections and changes.

1.7 EXISTING DATA

The Government will provide existing data for use by the Government in the data management system including but not limited to [_____] [boring logs, CAD drawings, and GIS feature classes and rasters]. The Government will provide all files via the SFTP site once it has been established.

1.8 DATA REQUIREMENTS

NOTE: This section is comprised of industry and Government standard practices that will remain mostly the same from project to project regardless of the type, size and scope. Only slight customization is intended.

1.8.1 Data Integrity

Maintain integrity of data such that records are accurate and internally consistent, that all data and records reflect the quality of the data gathered on the site, and that all data is preserved and archived for future use.

1.8.2 Data Ownership

NOTE: As stated in the initial note for this section, the entire contract is subject to Federal Acquisition Regulation (FAR) Clause 52.227-14 and Defense Federal Acquisition Regulation (DFAR) 227-71. They are not referenced in the technical specification sections, however this language IS included in the non-technical part of the contract. For complete language of these clauses visit:
https://www.acq.osd.mil/dpap/dars/dfars/pdf/current/20220101/227_71.pdf
<https://www.ecfr.gov/current/title-48/chapter-1/subchapter-H/part-52>

All data generated on-site by [_____] [instrumentation, monitoring, anchorage, excavation, construction equipment, sampling, concrete and soil testing, grouting, blasting, surveying, concrete production, conveyance and placement, tunneling, mapping, cutoff wall construction, equipment calibration, maintenance], and all other data associated with the work performed is the property of the Government. All calculations and formulae and any constants or variables used to produce data, reports, or analytical products are the property of the Government and must be included in any required database fields, and turned over in an editable or otherwise specified format upon request.

NOTE: It is very common for Contractors to claim that data is proprietary. The following paragraph specifically sets up the legal expectation that no data may be withheld without exception - consistent with the FAR and DFAR clauses regarding data.

For any data to be excluded from the system, submit a written request for

a Government determination of whether data can be classified as proprietary, along with a detailed justification. No data source is exempt from these data requirements unless a specific exemption is requested of and granted in writing by the [COR][ACO]. Under no circumstances will "proprietary data" impede the Government's ability to monitor construction, perform analyses, or evaluate the effectiveness of construction.

1.8.2.1 Custom Algorithms

NOTE: The below paragraph is meant to establish the ownership of the data, not the "means and methods" of custom software designed by or for the Contractor where ownership of the software remains with the Contractor. However, there is a need for the Government in many cases to review the process and algorithms of this software to ensure it is providing accurate data.

For example, where a Contractor has set up a custom excel spreadsheet using formulas and/or Visual Basic for Applications code to calculate the cross-sectional area and 3D location of a barrier wall element during a barrier wall construction project and the Government did not specify software development on the part of the Contractor. In this case the Excel spreadsheet and Visual Basic for Applications code belong the Contractor, but the algorithm in the code and the results of that code need to be verified by the Government to ensure that the code is accurately processing the data and providing the correct output. For this example, the cross-sectional area and its location in 3D space will be directly relevant to showing that the barrier wall was placed per the contract requirements.

If software developed by or for the Contractor will be used for processing of data provided to the Government, detail to the Government the algorithms and procedures used to process the data. The Contractor maintains ownership of its computer code, unless otherwise specified, but must allow the Government access to the algorithms (with all values/variables defined) and procedures to verify how the data is processed so that the quality of the final data can be assessed.

1.8.3 Disclosure of Data or Advertisement of Project

Do not disclose any project data to third parties, and do not publish any data without prior written approval of the [COR][ACO]. Request and receive permission in writing prior to publishing or presenting any data from the project to any third parties not associated with this contract, this includes data with project references removed. If the data management system is the subject of any Contractor-produced papers, proper design credit must be explicitly attributed to the Government's data management designers, as well as appropriate Contractor/subcontractor personnel.

NOTE: If there are Governmental or other third-party owners/stakeholders of the project, make sure to provide permission to release the data to them in this section.

1.8.4 Backups, Archiving and Disaster Recovery

Avoid data loss by backup and archival of all digital and paper data records from the time of data generation until final data turnover. This includes having specific policies, workflows, and infrastructure in place to archive and have redundant backups on servers in either a commercial cloud computing platform or multiple locations according to industry standard practice. Address backups, archiving and disaster recovery plans in the appropriate submittal, as specified in paragraph SUBMITTALS, SD-01 Preconstruction Submittals.

If a data loss occurs, the Contractor is responsible for regeneration of the data. Any data which are re-generated from a non-primary source must be clearly noted in the record as shown in the EDB. Backup data within 24 hours of generation. Should a data loss occur, even if is within this 24-hour window, the Contractor is responsible for all steps necessary to recover from this data loss and will receive no additional payment for these data recovery efforts. Notify the [COR][ACO] of any data loss in writing within 12-hours of discovery that it has occurred.

NOTE: This section is needed to establish the expectation of industry-standard data backup routines on projects and assign ownership of all data loss risk to the Contractor. 24 hours is industry standard for backup times and should not be increased.

1.8.5 Contractor Quality Control of Technical Data Including Metadata

Verify and perform cleaning (see definitions provided in paragraph DEFINITIONS) of all tabular data entered into the databases including at a minimum:

- (1) Verification of completeness of records such that all records are completed with all data within required turnover times;
- (2) Correction of entry errors;
- (3) Verification of source field data;
- (4) Data review for verification of entry correctness;
- (5) Consistency and accuracy of naming convention;
- (6) Consistency and accuracy of field formats;
- (7) Standardized character entry of fields and records, for example consistent use of spelling, capitalization, spaces and special characters (where allowed);
- (8) Entry of required QC or correction metadata associated with the records (per paragraph RECORD TRACKING REQUIREMENTS).

Conduct this process in accordance with all procedures and policies outlined in the submitted and approved "Data Cleaning and Verification Plan" in paragraph SUBMITTALS, SD-01 Preconstruction Submittals. See paragraph DATA TURNOVER TIMEFRAMES for turnover time requirements.

1.8.6 Raw Data Requirements

1.8.6.1 Digital Raw Data

Submit raw digital data files for any data gathering system used on the project in accordance with the following:

NOTE: The types of data that will be expected by the design team should be listed above. The list in the example is not all-inclusive for every type of project.

In reference to number 2) - csv, ASCII, which are common standard open data formats, are readable by MS Microsoft Excel. Other programs can be used if it is nearly universally available at the home district. This is for ease of data sharing as needed among the construction and design teams.

- a. Provide these files in a format readable by the current version (at the time of the contract) of Microsoft Excel, such as a tab-delimited ASCII file, a CSV file, or other format readable by MS Excel.
- b. To the extent possible, use data gathering systems that will generate "non-proprietary" or industry standard format data files readable in ASCII, CSV or with Microsoft Excel. Any necessary export or conversion, or software required to perform conversions, will be completed at the Contractor's expense.
- c. Label all data columns so that it is apparent what data they contain, and provide metadata to [COR][ACO] including units, any formulae used to calculate the data, and any criteria used to generate the data. Detail metadata for these files in the Data Management Plan or in addenda to that plan as appropriate.
- d. Where these files as generated are not directly readable by Microsoft Excel, submit raw data to the [COR][ACO] in their raw format and in a second file created in Microsoft Excel with column headings that include units.

NOTE: 1-4 are important to specify so that raw data can be accessed in the case where any disallowed changes such as averaging or fabrication of data may be occurring in the database.

- e. Detect and correct any inconsistencies, mistakes, missing records or fields, or other anomalies in the data that may be generated through use of automated data collection systems - including but not limited to the automated grout monitoring and data collection system, and the instrumentation data collections system. Provide a written explanation of the nature and cause of any anomalies, and any corrected records within 48 hours of the resolution of the anomaly. Paragraph RECORD TRACKING REQUIREMENTS, Items 7-9 apply to corrections made as required in this section.

- f. All data columns must be labeled so that it is apparent what data they contain, and metadata provided to [COR][ACO] including units, any formulae used to calculate the data, and any criteria used to generate the data. Metadata for these files must be detailed in the Data Management Plan or in addenda to that plan as appropriate. For all files with the same structure, metadata may be provided for the set of data documents and is not required for every single file. Data included in the EDB data tables from these raw data sources may be uploaded from the data source to minimize any duplicate data entry of tracking data.

1.8.6.2 Analog Raw Data

Submit clear, complete, readable, center-justified digital scans or photographs of all analog raw data collected for the project in accordance with the following requirements:

- a. All analog reports of raw data must be scanned and transferred to the Government via the Secure File Transfer Protocol (SFTP) site within 24 hours of generation in the field.
- b. Any data collected via manual methods must be entered into the database by the Contractor within 48 hours of field generation. Analog data entered in the database must include a field in the appropriate table of the database with a hyperlink to the scan of the analog file for URL referencing. Ensure coordinate X, Y, and Z of features are included for any data collected by analog methods and entered into the database table for the associated record.
- c. Handwriting and scan quality must be clear and legible, and contain any related information needed to place the data in context, to which the raw data pertains.
- d. Scanned digital files must be named according to the approved naming convention, and stored in the appropriate location of the SFTP according to the file structure organization provided in the attachments.
- e. Adjust data collection forms utilized at any time at [COR][ACO] request.

1.8.7 Data Turnover Timeframes

**NOTE: Tailoring options are available for "DYNAMIC
 DATA INTERFACE" and "DESKTOP GIS FILES"**

Provide all data from any automated data gathering system or manual collection system which is not otherwise described specifically in the feature of work sections, or this section, according to the following requirements:

<u>Data Format</u>	<u>Turnover Time</u>	<u>Turnover Location</u>	<u>Section</u>
Raw Data Files	24 hours	SFTP	a
Converted Raw Data Files	24 hours	SFTP	b
Reports	24 hours	SFTP	c
Generated Data as required by data dictionary	24 hours	EDB/Dynamic Data Interface	c
Appended QC Data	48 hours	EDB/Dynamic Data Interface	d
QC Data collected synchronously to work	24 hours	EDB/Dynamic Data Interface	d
[Instrumentation Readings - Automated]	10 mins	Field Interface/Dynamic Data Interface	e
[Instrumentation Readings - Manual]	1 hour - or as directed by [COR][ACO]	USGS/MIDAS database as directed by [COR][ACO]/Dynamic Data Interface	e
[Cofferdam Piezometer Readings]	collect hourly 24 hours	EDB	f
[Seismograph]	10 mins	Seismic Website	f
[Concrete Thermal]	10 mins	Concrete Thermal Data Website	f
QC Verification of Data	72 hours	EDB	g
Metadata	72 hours	EDB	g
[GIS Project Package (.aprx)]	24 hours when updated	SFTP	h
[ESRI Geodatabase (.gdb)]	24 hours when updated	SFTP	h
Enterprise Database Tables (.csv)	[____][24 hours]	SFTP	
Enterprise Database backup files	[____][Quarterly]	SFTP	

NOTE: All time frames listed in the table above and the text below have been reviewed for feasibility by industry practitioners and are considered appropriate. For small projects without significant

concern for life safety or risk, or time-sensitive construction components, it may be appropriate to use longer time windows based on the amount of project staff, automation, and how often the Government needs to review the data being generated.

Customize the elements in accordance with the scope of this specification. For example if no GIS files are required, delete the associated text.

- a. Submit all raw data within 24 hours of data collection to the [COR][ACO] via the SFTP site.
- b. If conversion of this raw data is necessary in order for it to be readable by Microsoft Excel, submit this converted raw data file within 24 hours of data collection.
- c. Transfer all non-tabular files (as defined in Part One, DEFINITIONS "REPORT") to the SFTP site within 24 hours of submittal to RMS unless otherwise stated elsewhere in the Contract.
- d. Import data records into the Enterprise Database (EDB) within 24 hours of generation.
- e. Enter or append, as applicable, QC data collected after the initial generation of data for a given feature of work to the appropriate records in the EDB within 48 hours of the QC data collection, except where specifically stated otherwise. Enter QC data for features of work being collected synchronously to the work within 24 hours of generation.
- f. Provide near real time access to continuously-recorded automated data. Maintain accessibility to [COR][ACO] using hyperlinks in the secure web interface as described in Part 2 PRODUCTS or other sections of this contract. Make any manually collected data that is part of this system available in the reporting system no later than 24 hours after it has been gathered. Enter all required data into the SQL EDB within 24 hours if applicable.
- g. C verify the data and provide data verification metadata within the appropriate table of the EDB, with appropriate relationships in the database created within 72 hours of initial data appearing in the EDB. For detailed QC requirements see PART 1, "Contractor Quality Control of Data".
- h. 8) Provide the most recent version of the ArcGIS Pro .aprx, .gdb and raster datasets within 24 hours of an update (or nightly when updates are occurring daily), to the SFTP site. See PART 3, DESKTOP GIS FILES for details.
- i. Make data available in the dynamic data interface within 10 minutes for continuously recorded automated data (e.g., all automated instrumentation). Make any manually collected data that is part of this system (e.g., instrumentation data) available in the reporting system no later than 1 hour after it has been entered into the EDB per the timeframes above, unless internet connectivity at the site causes the inability of rapid transmission from the collection device. In this case update the data within 8 hours or as directed by the

[COR][ACO].

1.8.8 Record Tracking Requirements

NOTE: The following record tracking practices are industry standard. The intent is to be able to understand the provenance and quality of data. They track when and how records were created, entered, and altered.

Each record entered into the Enterprise Database (EDB) must document the following if not already specifically defined in the database schema, or allowed by the Government to be non-applicable in the Data Management Plan:

- a. Source of the record (e.g. laboratory information, sample ID, instrument name, name and affiliation of observer/tester/data gatherer);
- b. Organization generating the data (e.g. [COR][ACO], Contractor, Contractor Laboratory);
- c. Date and Time where data was created (e.g. when sample was taken, start and stop time of drilling or grouting, when observation was made);
- d. Name of the data collector (when manually collected);
- e. Date and Time data was entered into the system;
- f. Name of the individual entering the data.

Where a complete record was modified after submission, document the following:

- g. Date/time any data in the system was modified;
- h. Name of personnel who made the edit;
- i. Reasons for the edit (e.g. where laboratory testing data is appended to a sample record, correction was requested by the Government, correction for entry error of analog data, or other edits).

1.8.9 Naming Conventions

NOTE: Naming conventions are important for several reasons.

For certain programs such as MS SQL, Oracle PL/SQL or ArcGIS there are characters that should never be used in certain places because they interfere with the internal programming and cause features not to work. Assuring compatibility with the programs is very important to avoiding future labor to eliminate these errors.

All files must be named according to the same

convention in order to automate the use, movement or querying of files.

Manually searching through hundreds or thousands of raw data records is much easier if the naming convention is meaningful. If the agency has already established a file naming convention that meets these criteria, utilize that one.

For photographs, contractors often have decent naming conventions, and renaming files according to a Government requirement is a large cost-driver. To avoid these costs, allow the Contractor to propose a convention instead of imposing one.

The following standards help to ensure all the above are covered.

Tailoring option in the following entries is available for "DESKTOP GIS FILES".

1.8.9.1 Fields of Database, [ArcGIS Feature Classes](#), or Tables

Naming conventions for all elements must be developed according to the following requirements. Where a precedent exists in the project design or other parts of this contract, use the established precedent, however, change names prior to use in GIS/database to be consistent with the following:

- a. No spaces. If a space is needed an underscore must be used;
- b. 256-character limit;
- c. No special characters;
- d. No characters that are considered reserved in ArcGIS or MS SQL;
- e. Do not start a name with an underscore or a number;
- f. Each record must be named utilizing the same format and character length. For record names containing a numeric ID that could utilize a different number of characters between records, zeroes must be utilized as placeholders at the start of the ID number to ensure consistent character lengths for scripted searches;
- g. Employ a standardized scheme for names that include element-specific information as required in the Contract section where required and eliminates random alphanumeric characters that do not relate to the element.

1.8.9.2 Folder and File Names

All files and report (non-tabular) and raw data files loaded to the SFTP site must be consistently named according to the following conventions (except photographs). Work with the Government to resolve any naming convention issues in the initial data management kickoff meeting, however the [COR][ACO] may direct a change to the naming convention of any files at any time throughout the duration of the Contract if the convention is

not conducive to automation.:

- a. No spaces. If a space is needed an underscore must be used;
- b. 256-character limit;
- c. No special characters;
- d. No characters that are considered reserved in ArcGIS, or common database programs such as MS SQL, Oracle PL/SQL, Postgres, MySQL or other full scale RDBMS's;
- e. Do not start a name with an underscore or a number;
- f. Each group of file types must be named utilizing the same format and character length (where possible).

Propose in the Data Management Plan a file nomenclature for each file classification that should include the project/Contract code, work feature, applicable unit ID, and date data was generated (or began being generated if it spans across multiple dates). See the following examples:

Feature of Work File Type	Unit ID	Date	Sample File Name
Concrete Batch Ticket	Monolith R12 Lift 2	06/02/21	BatchTickets_R12-2_20210622
Grouting CSV - raw data file	Hole R1440P Stage 15-25	08/20/21	R1440P_15-25_20210802
Drilling Log PDF	Hole R32	07/26/21	BoringLog_R32_20220731
Load Cell Installation Log	Load cell 15	09/05/21	LoadCellInstall_15_20210905

1.8.9.3 Site Feature ID's

Propose a consistent naming convention for all features and tests on site in the Data Management Plan and utilize it unless otherwise specified in other locations of the plans and specifications. For features or tests that have failed or been abandoned where another feature or test for the same purpose is conducted, utilize the original ID for that feature or test, but designate a letter R (for "retest" or "redrill") or other letter convention as appropriate to the test.

For all naming conventions, document the convention and define all numbers and letters utilized for each in the associated work plan submittal and the Data Management Plan. Provide a table in the EDB which defines the naming convention components.

Feature	Specification	Sample Name
Grout Hole station 1(plus sign)00, Upstream, Primary hole	Yes, meets spec	0100UXP

Feature	Specification	Sample Name
Grout Hole station 1(+plus sign)00, Upstream, Primary hole	No, does not meet spec	_P100USej1zhfo56

1.8.9.4 Photograph Naming Convention

Propose a naming convention for raw digital photograph files in the 50 Percent Data Management Plan which provides meaningful information about the subject of the photo. Utilize the approved convention for all photographs.

1.8.10 Spatial Data Projections

NOTE: Within the US, CAD and surveys will be done most commonly in State Plane. Using the same projection in GIS as well as in CAD will prevent confusion and errors. Alternative projections can be used (i.e., UTM), however, all metadata required to accurately reproduce data in 3D space must be provided, and for some systems this may require epoch as well as horizontal and vertical datums. All data provided to the Government should be on one consistent spatial system, rather than mixing and matching spatial systems which can lead to significant errors.

Tailoring is available for "DESKTOP GIS FILES"

All spatial data must be projected in modeling products using [_____] coordinates. The Horizontal Datum must be [_____] , [_____] , U.S. Survey Feet. The Vertical Datum is [_____] , U.S. Survey Feet. Clearly describe projections and datums of data collection and display in the Data Management Plan and in all associated metadata forms and tables.

1.8.11 Geospatial Metadata

NOTE: This section should be included if geospatial data will be generated as a part of the contract. Geospatial data generation may also be required by other feature of work sections such as Surface Blasting or Instrumentation. The purpose of this section is to define how we want the contractor to apply the ISO and SDSFIE-M standards including basic general requirements and engineering-specific requirements as listed. The SDSFIE-M standard defines the feature-level metadata that is accessible to the user in ArcCatalog. This section defines the feature metadata that will be included in a metadata table of the database also.

For all geospatial metadata, utilize the ISO 19139 standard template XML for creation of fields in the GIS dataset level metadata. Follow the SDSFIE-M SDSFIE Standards and ISO 19115, ISO 19115-1, and ISO 19115-2 for

the completion of the ISO metadata form. The following list should also be included in the information completed in the ISO metadata form, as applicable. Utilize the following additional standards where applicable ISO 19110, ISO 19119, and ISO 19139.

Include all metadata as records in a metadata table of the EDB:

1.8.11.1 Vector Datasets

- a. Date dataset was created;
- b. Equipment used to collect the data;
- c. Agency, personnel, and contact information for original dataset;
- d. Name, description, and location of survey control the original dataset is referenced to;
- e. Is the geometry and location as designed or as built;
- f. If the data was derived, converted, or imported from another dataset, the source dataset file name, format, date, datum, projection, resolution, and description (as applicable);
- g. Narrative information about the data and what it depicts (from "Summary/Description");
- h. For layer files where the symbology is interpretive of engineering data (for example grout stage permeability, grout stage volumes, barrier wall element overlap/thickness) - describe in the notes section of the application any description needed to understand the symbology and binning applied. If symbology is calculated based on a field value, describe the field values and how they are derived in the field-level metadata;
- i. If it is a derivative product made by geoprocessing from other datasets - document the datasets used to produce it including file name, format, date, and a description of the datasets. Include any information about interpolation methods, geoprocessing tools, and relevant variables (and their definitions) or settings used to create it.

1.8.11.2 Raster Datasets

- a. Date data was collected;
- b. Dataset resolution (raster): (1) Equipment resolution, (2) Accuracy of equipment resolution, (3) Dataset resolution;
- c. Equipment used to collect the data;
- d. Corrections or processing steps applied to the raster;
- e. If the data was derived, converted, or imported from another dataset, the source dataset file name, format, date, datum, projection, resolution, and description (as applicable);
- f. Narrative information about the data and what it depicts (from "Summary/Description");

- g. For layer files where the symbology is interpretive (for example subsidence data from InSAR) - describe in the notes section of the application any description needed to understand the symbology and binning applied. If symbology is calculated based on a field value, describe the field values and how they are derived in the field-level metadata;
- h. If it is a derivative product made by geoprocessing from other datasets - document the datasets used to produce it including file name, format, date, and a description of the datasets. Include any information about interpolation methods, geoprocessing tools, and relevant variables (and their definitions) or settings used to create it.

1.8.12 Photographs

NOTE: The intent of this section is to ensure that all progress and other photos provided to the Government are transmitted in high resolution, and that they are able to be indexed and queried by their subject matter. Having several thousand photos with no data on where photos were taken, without dates and other critical data makes the photographs much less useful.

Submit **Digital Photographs** taken at the project site as specified throughout the contract, including progress photos required in Section [____], with a minimum of **181.11 pixels per cm 300 pixels per in** resolution for all photo files. Provide photos in a lossless compression file format that does not lose any pixels in the compression process (e.g. .TIFF, .PNG and .GIF). Ensure no loss of original resolution from the raw photo if converted to a lossless format. Create digital images and metadata that meet or exceed the specifications of the Exchangeable Image File Format (EXIF) version [____][2.3] or higher.

The enterprise database must contain a populated table which identifies all images taken at the project, and includes fields for the listed captioning items, and fields for the basic metadata encoded in each digital image including resolution, latitude, longitude. Include a field for hyperlinking to the digital images.

1.8.13 SDSFIE

NOTE: Delete this section if SDSFIE schema does not exist for the dataset being collected. Determining a standard SDSFIE schema for construction data is not recommended due to the highly customized nature of the work. The SDSFIE requirement applies to all DoD projects, however each branch has their own version. Information is available at SDSFIE.org.

Tailoring is available for "SDSFIE"

Work with the Government's Data Manager to ensure all applicable spatial

data and spatial metadata are SDSFIE compliant. This is not required for datasets where there is no established SDSFIE standard.

1.8.14 Network Infrastructure

NOTE: This may be covered in other areas of the contract. The purpose of this section is to ensure that if the contractor is maintaining the web interface from the site remotely that they have the required connectivity to push updates to the web interface and other components. Some remote sites also rely on the contractor to provide internet infrastructure for the government. This should be customized based on the project.

Tailoring is available for "NETWORK INFRASTRUCTURE"

Provide the Government with, and utilize network infrastructure that can achieve speeds of at least [____][250] Kbps or the maximum commercially available in the area if [____][250] Kbps cannot be achieved.

1.8.15 COR Access to Data

Provide any data or assistance in accessing the data, as specified in PART 2, SFTP SITE, and at any time as requested by the [COR][ACO]. Provide current database table [____][.csv, backup] files or any other data/report files upon request.

Provide username and password access to any interfaces required by this Contract to any member of the Government or applicable third party at [COR][ACO] request. Provide access within 48 hours of the request.

NOTE: If any components referenced in this section are not required in the contract, remove the associated language (i.e. "SFTP", "interface", "database").

1.8.16 Conflicts of Data Requirements

In the case of a conflict between any data requirements in the Contract, the data requirement must be whichever is more detailed, rigorous, specific, precise, and complete as determined by the [COR][ACO].

1.8.17 Data Collection Prior to Full Approval of the Data Management System Components

If the Contractor is able to mobilize for the start of work prior to all components of the data management system being fully approved, collect all data and input/convert as necessary to integrate it into the final database, SFTP site, and web interface.

NOTE: The process for approving the data management system as laid out in this specification is complex and lengthy on large-scale projects. It is intended

to premeditate and work out all potential issues at the start of construction when it is easy to fix them rather than wait until they occur. However, the cost associated with this strategy is extended time prior to system approval. This language is intended to make sure the contractor is aware that they need to apply the same standards and be able to integrate early data with the main dataset.

1.9 RELATED WORK SPECIFIED ELSEWHERE

NOTE: It is the role of the 01 31 20 section to ensure the timely receipt of the data in a format appropriate for real time verification, and long-term retention and display. To do this, an understanding of what work verifications will be performed, and the data products needed to facilitate this is needed.

Data management design requires rigorous cross-checking of other specification sections for data generation requirements, and conflicts with the 01 31 20 data requirements. In this section of the 01 31 20 specification, list any technical sections where there is a data requirement or a reference back to 01 31 20. It is important to make sure they are cross-referenced, but NOT to restate the requirements in 01 31 20.

For any technical specification that has a data generation requirement, add the following to that section in the part one Requirements. Adapt the sections in 01 31 20, or in the technical specification section for the work if the requirements are different from the general requirements in the 01 31 20 language. This includes items such as file formats and nomenclature, turnover times, special reporting in the form of drawings.

The narrative below each section identifies common data and verification needs of each section. This is not an exhaustive list but a guide for how to think about designing the data specification based on the features of work of the contract.

For more data intensive features of work, the digital data generation should be addressed in that technical section or in the data management specification, and how the Government wants to receive it needs to be specified. See Part 3 "DATA REPORTS AND DISPLAYS" for examples.

General Data Management Requirements Sample Language for other specification sections in the Part 1 requirements:

1.X DATA MANAGEMENT REQUIREMENTS

The Contractor and any Subcontractors performing work specified in this section must provide all generated data. All data generated as part of this specification is subject to the requirements in Section 01 31 20 DATA MANAGEMENT. Conduct a thorough review of the data specifications in this section and in 01 31 20 DATA MANAGEMENT, and ensure proper review and compliance.

Provide data for all of the fields in the EDB for the project pertaining to the work described herein via the appropriate tables as specified by the Section 01 31 20 DATA MANAGEMENT, and the data dictionary.

Provide all analog data related to the specified work via the SFTP in accordance with the requirements specified in Section 01 31 20 DATA MANAGEMENT.

DIVISION 01 SURVEY CONTROL AND REMOTE SENSING

This is not a guide specification yet, however every construction project should include a section which identifies survey control requirements including accuracy and precision. Requirements typically stated in this section include personnel requirements, datums, project survey control points to be used for development of survey baseline and construction of structures, survey accuracy and precision, and types of surveys to be conducted.

For remote sensing (such as LiDAR, orthoimagery, photogrammetry, bathymetry), the requirements include a data collection plan, the specific accuracy and precision of the equipment and the dataset, equipment and dataset resolution, any QC tests on the equipment or data, calibration requirements, and other standards related to geospatial accuracy of the dataset collected, data processing methods and steps, raw data and final data products and reports, and any procedural or security requirements related to the equipment utilized (i.e. UAS). These requirements will be developed in tandem with the technical designer for the data management specification and system, and the technical designer for the feature of work they are required on. For example, if LiDAR is required to be collected for quantities, the land surveyor and the RE may be involved in developing the requirements. If photogrammetry, LiDAR and or Orthoimagery are being collected to document geologic foundations, the lead geologist may also be involved in developing them to ensure the proper resolution is required. The 01 31 20 specification details for instance, what data is to be collected,

the turnover times, the specific dataset requirements as needed for short term verifications or long-term project documentation.

For contractor-proposed methods, it is important to require detailed submittals on the specific accuracy and precision of the equipment and the dataset, equipment and dataset resolution, any QC tests on the equipment or data, calibration requirements, and other standards related to geospatial accuracy of the dataset collected, data processing methods and steps, raw data and final data products and reports. It is also essential to have all of this information reviewed and approved by qualified personnel (such as a licensed land surveyor) prior to approving it's use. It is also important to understand any procedural or security requirements related to the equipment utilized to ensure cybersecurity standards or other applicable federal regulations are followed (for example in UAS use).

Minimum references to be included in this section as applicable to specified work:

EM 1110-1-1005 (2007) Control and Topographic Surveying

EM 1110-1-1000 (2015) Photogrammetric and LiDAR Mapping

EM-1-1002 (2012) Survey Markers and Monumentations

EM 1110-1-1003 (2011) NAVSTAR Global Positioning System Surveying

Section 01 45 00.00 10 QUALITY CONTROL or
01 45 00.00 20 QUALITY CONTROL

It was determined as a major lesson learned that a QC person as part of the QC organization who is not the Contractor's Data Manager or other personnel in the data management spec should be assigned to coordinate the flow of the data from the field to the data management staff (typically remote employees). This role can also help the data management staff understand how the database schema will be set up for the specific data when the Contractor proposes means, methods and equipment. They also have a role in verifying data.

This person's role and responsibilities will be detailed in the quality control program specification section. This person should be an engineer and capable of understanding the work represented by the data. Sample language to be entered into the Experience Matrix table of Part 3 is as follows. Change the work experience requirement to match the project needs. This person is referenced in 01 31 20 under the QC data

collection plan and the Data Management Planning Meeting - both of which they are required to participate in.

Data Management

Graduate Civil Engineer with 5 years' experience in the QC verification of features of work being performed as part of this contract. This requirement is a full time Quality Control staff position performing duties at the job site to support Data Management, facilitating the flow of data and documentation generated during work by all Contractors into the data management system in accordance with the specifications. This position also assists in verifying the validity of provided data as necessary. This position is in addition to the offsite Data Manager requirement in specification Section 01 31 20 and must not be combined with that position. This individual reports directly to the Quality Control Manager and must be not be assigned duties outside of Quality Control or as outlined in the specifications, however the position is expected to work in close collaboration with the Contractor's Data Manager in these and any specified duties. The Contractor must fill this position within 60 days of NTP.

The need for comprehensive digital collection of QC data also needs to be addressed in Section 01 45 00.00 10 so that the Contractor understands what we want and bids it properly. The guide specification emphasis for this section is on QC daily reports submitted via RMS. It is strongly advised to add language in PART 1 that refers to this specification, and at least mentions the types of requirements that will apply to QC data. It is also strongly advised to add a requirement that the Contractor streamline the collection of QC data via digital means in coordination with their Data Manager. If the Contractor is struggling with manual entry of QC data, this will impact their turnover times, and our ability to use that information effectively. It is important to include the language in the QC section, so it is understood that this effort is part of the prime contractor's responsibility. If written in the Data Management section it will be assumed to be the responsibility of the data management subcontractor rather than a dedicated effort of the QC team. Sample language to be entered in PART 1 is as follows:

"1.X QUALITY CONTROL DATA

Section 01 31 20 DATA MANAGEMENT outlines specific requirements for the reporting of QC data and information as fields in the database related to the feature data (for example, concrete fresh properties tests, or the taped depths of blast holes prior to loading is a field in the drilling report tables).

Collect discrete field QC data in such a way that it reduces the effort and time required to incorporate into the database and data management system. This may include utilizing digital data collection devices in the field, utilizing apps with customized forms that directly populate the database, or other methods developed by the Contractor in consultation with their Data Manager. The data management QC personnel in the QC matrix must assist in supporting and streamlining this effort.

Refer to Section 01 31 20 DATA MANAGEMENT for other details about time requirements for this data to be entered into the database, the preconstruction submittal "QC data collection plan", and data management coordination planning meeting. The data management QC personnel must coordinate with the Contractor's Data Manager as needed to create an efficient flow of field and QC data into the data management system. The Contractor must design this effort so that no repetition of effort between the data management system and RMS is required."

In addition to this, it is strongly recommended to add an item to the QC Plan submittal where the Contractor will outline how they plan to integrate data to the data management system. See the following sample language:

"Procedures, workflows and equipment used to collect QC data from the field and facilitate rapid integration into the project database and data management system. Describe how the QC data collection plan from 01 31 20 DATA MANAGEMENT will be integrated into this plan."

Section 01 78 00 CLOSEOUT SUBMITTALS

The CAD standards, as-built drawing, and 3D CAD model requirements are contained in the 01 31 20 section. However, they are specified as a closeout submittal in 01 78 00, meaning the Government doesn't receive them until the end of the contract. This is a problem for more than one reason. The as-built library on a major project is enormous, and the contractor often doesn't apply resources to creating it until the end of a contract. If the Contractor is losing money, they may forego completing the as built at all. This has happened. This also pushes reviews into a very short time period at the end of the contract when the project is likely to be losing staff. Review of the 3D CAD model by skilled CAD technicians should be taking place at milestones throughout the contract to make this more manageable and ensure a thorough review. For data management systems where the Government produces their own GIS or CAD model, the submission of the updated 3D CAD model weekly or however often is needed to utilize features for the construction

of GIS features.

A MAJOR OVERSIGHT OF THE GUIDE SPECIFICATION IS THE LACK OF A REQUIREMENT THAT ALL FEATURES BE GEOSPATIALLY REFERENCED TO REQUIRED PROJECT SURVEY CONTROL POINT(S).

Other issues that should be addressed:

- 1) The requirement of document submission via "optical disk". Change this requirement to submission via the SFTP site, directly to the Government's data exchange platform if other than the SFTP site (i.e. Microsoft Azure, common cloud, ProjectWise - as the Government's methods and data transfer capabilities evolve), or external hard drive.
- 2) The requirement that "The CAD files must be complete in all details and identical in form and function to the CAD drawing files supplied by the Government." Is problematic when the Government's CAD model features are geometrically incorrect, not geospatially referenced, or otherwise incomplete. The Contractor should not be allowed to allow sloppy mistakes to matriculate into the final 3D CAD model.
- 3) The specification does not specifically require the use of the current A/E/C CAD model standard version [R.XX], it only references where to find the government's CAD/BIM standards. The use of correct annotation references and other components of the standard should be a requirement to ensure you can fully understand the model.

DIVISION 02

Section 02 32 13 SUBSURFACE DRILLING AND SAMPLING

Ensure the format for data collection and final data products are consistent between 01 31 20 and any section that covers drilling or subsurface exploration. It is common for the software and format of drill logs to be specified in this section. For example, the USACE has moved to an enterprise subsurface data program called OpenGround. The requirements are stated within Section 01 31 20 and referenced in Section 02 32 13.

DIVISION 03 CONCRETE MATERIALS

There are several separate subsections for concrete, shotcrete, aggregate, and other materials, many of which have a specific and unique requirement for data. Include all subsections which require the generation of data that will be input into the data management system. The main datasets generated by concrete specifications are concrete and aggregate, grout and shotcrete QC testing. This includes tests covered by ASTM standards such as fresh properties (bleed, slump, mix temperature, air content, unit weight), strength development (with data collected

at different time intervals), and thermal monitoring - among others. These tests are critical to ensuring concrete quality and structural integrity over time, and the data should be collected in the project database so that the project can accurately assess the concrete quality and any future variance requests, as well as identify potential areas of future O&M or remediation.

DIVISION 31

Section (TBD) INSTRUMENTATION

Because of the data-intensive nature of automated data acquisition systems, and the need for real time review, this specification is likely to be very data-heavy, and potentially include the use of a web-based user interface, a joint instrumentation monitoring plan (JIMP), data management duties, and a file sharing site. Make sure the two are cross-checked for consistency and ensure all applicable data requirements listed in 01 31 20 are understood to apply to instrumentation data as well.

Section 31 23 00.00 20 EXCAVATION AND FILL

Excavation data is of interest to the government in order to verify quantities submitted for payment, to track the progress of work, to verify the excavation was achieved, and to assess spoils and disposal quantities and waste when the excavated materials must be reused in specific designations. Often the contractor is allowed to survey at stations and produce cross sections for quantity determinations utilizing the "end area method". However, the use of the "composite method" is increasing, where subtraction is calculated between two LiDAR - derived DEM's with a much higher degree of accuracy. Quantities of material excavated and disposed of can also be tracked utilizing truck tickets. If the data management system will be used to track these quantities, it is important to ensure the correct data fields and data products are required within the specification.

Section 31 23 06.00 BLASTING - SURFACE

Blasting is a data-intensive feature of work. The blast design and quality, and whether the contractor followed specified tolerances are evaluated through specific data. Datasets to be collected as a baseline for any blasting program should include:

- 1) All blast design parameters used to include bench, burden, blast hole depth and diameter, stemming, decking, explosive agent and primers types, sizes and weights, holes per delay, pounds per delay, fragmentation index, and other pertinent design parameters.
- 2) Post blast evaluation and misfire information

- 3) Loading logs
- 4) Vibration and airblast predictions and reports (generally delivered realtime via website)
- 5) Drill hole plans and reports including penetration rates
- 6) Blast photos and videos

The blasting specification needs to support the receipt of the data types, and the 01 31 20 specification details what to do with them, entry into the database, if and how they are to be displayed in the web interface, relevant turnover times, file formats and other requirements. This data is valuable for protecting the government against differing site conditions claims or claims that the geology caused blast damage rather than the blast design.

Division 31 [31 32 23] Foundation Drilling and Grouting (no UFGS as of 2022)

Grouting is concrete injected into the subsurface via drill holes to fill in voids in the geology that might allow too much water to move through an area where that is not desirable for structural stability or operational efficiency. On civil works projects subject to engineering regulation ER 1110-2-1156 Safety of Dams, the grouting data requirements are intensive and specific. As of the writing of this specification the guide specification does not exist, however that technical section is where they should be housed. This includes the requirements for the automated grouting control data collection system, grouting data collection plan, and other data and reporting verification requirements of the program needed to assess closure and final permeability. Ensure the receipt of data and the display formats properly capture needed verifications in this section.

Section [31 56 10] CUTOFF WALL (no UFGS as of 2022)

A cutoff wall, or barrier wall, is a specific structure installed into the subsurface of a dam where the geologic foundation is highly karstic and introduces significant risk of seepage and piping or internal erosion to the structure. This structure consists of concrete panels or secants placed along the upstream dam axis directly through the dam and into the rock foundation. This process involves the excavation of embankment material and rock, and replacement with concrete in panels or secants.

USACE has an informal guide specification for cutoff walls that has not yet been published through UFC as of the writing of this specification. Pertinent data for this feature of work will be detailed in the specification section, and generally includes the following:

- 1) Excavation verticality and orientation measurements - including raw data from a sonic measurement tool (i.e. Koden) or other equipment that does the measuring, and then analytical reports that show the verticality for approval prior to concrete placement. Because a section of the dam is sitting open with slurry stabilizing the embankment during this verification, it is very time sensitive;
- 2) Concrete placement including quantities, and all normal QC tests including fresh properties, strength, and other requirements.
- 3) Concrete verification cores including classification of concrete anomalies as specifically defined in the technical section;
- 4) Permeability testing, conducted using some method of falling head testing and converted to permeability values;
- 5) Analysis of panel or secant overlap and thickness in relationship to specification tolerance and geologic conditions (if sub-specification). This work feature has very specific engineering verification needs in the field, and as a part of the post implementation evaluation conducted after the work has been completed. These needs are filled by a combination of static reports (1), numerical analysis (4) and visualizations (1-5).

Section 31 66 10 ROCK FOUNDATION PREPARATION

Foundation preparation is an important part of any project where concrete will contact rock or other concrete. For projects subject to engineering regulation ER 1110-2-1156 Safety of Dams, ER 1110-1-1901 or EM 1110-1-2908 Rock Foundations the Government is required to document the rock foundations of its projects, and any dental treatments completed. As technology advances, USACE is employing remote sensing methods such as photogrammetry, LiDAR, and Orthoimagery to compliment hand-collected data on maps. The requirements in the foundation preparation section will coordinate with the requirements in any remote sensing and survey specification as well as this specification for data. There are no dedicated remote sensing guide specifications yet published, however the data product requirements are presented here for reference.

Section 31 63 26 DRILLED CAISSONS

Section 31 63 29 DRILLED CONCRETE PIERS AND SHAFTS

Drilled shafts and caissons are installed when the geologic foundation of a structure does not have rock of sufficient bearing strength for the weight of the structure that will be built on top of it.

The data generated by the installation of these features is important to verify the design

assumptions have been met for the integrity of the structure. For drilled shafts, some of the data generated will be the pilot hole geologic log, penetration test, proof test, load tests, orientation and dimensions of the final shaft (ex. cross hole sonic logs), plumbness the installed reinforcement structure, groundwater data, concrete fresh properties, and strength data.

Section 31 68 13 SOIL AND ROCK ANCHORS

Where anchors are a technical component of structural stability, the documentation of anchor installation data is very important. Data such as the geologic log of the pilot hole, bond zone, alignment, water tightness test results, installation QC and QA, stressing and lock off, and any installed instrumentation such as load cells will be detailed in this technical section. Often concrete will be placed over anchors, and so anchor approval becomes part of the time sequencing for the construction schedule - the concrete should not be placed prior to the approval of the anchors, though the contractors will often try to negotiate this. In this case, the turnover time for this data in order to effectively assess and approve the anchor installation is very important, and should be considered in the time requirements for the submittal of the data.

Section Number	Section Title
[_____]	WEATHER AND WATER STAGE DATA RESTRICTIONS
[_____]	SURVEY CONTROL
[_____]	REMOTE SENSING
01 33 00	SUBMITTAL PROCEDURES
01 33 16.00 10	DESIGN DATA (DESIGN AFTER AWARD)
01 45 00.00 10	QUALITY CONTROL
[_____]	LABORATORY TESTING FACILITIES
01 78 23	OPERATION AND MAINTENANCE DATA
02 32 13	SUBSURFACE DRILLING AND SAMPLING
03 23 00	STRESSED TENDON REINFORCING
03 30 00	CAST-IN-PLACE CONCRETE

Section Number	Section Title
03 30 53	MISCELLANEOUS CAST-IN-PLACE CONCRETE
03 33 00	CAST-IN-PLACE ARCHITECTURAL CONCRETE
03 37 00	PREPLACED-AGGREGATE CONCRETE
03 37 13	SHOTCRETE
03 37 23	ROLLER-COMPACTED CONCRETE FOR MASS CONCRETE CONSTRUCTION
03 37 29	CONCRETE FOR CONCRETE CUTOFF WALLS
03 70 00	MASS CONCRETE
31 00 00	EARTHWORK
[_____]	INSTRUMENTATION AND MONITORING
[_____]	CONTROL OF WATER AND DEWATERING
31 23 00.00	TUNNEL EXCAVATION - BLASTING
31 23 00.00 20	EXCAVATION AND FILL
31 23 01	UNDERWATER BLASTING
31 23 06.00	BLASTING - SURFACE
31 36 00	GABIONS
31 41 16	METAL SHEET PILING
31 43 13.13	CONCRETE PRESSURE GROUTING
31 56 13.13	SOIL-BENTONITE SLURRY WALLS
31 62 13.13	CAST-IN-PLACE CONCRETE PILES
31 62 23	PILING: COMPOSITE, WOOD AND CAST IN-PLACE CONCRETE
31 62 23.13	CONCRETE-FILLED STEEL PILES
31 63 16	AUGERED CAST-IN-PLACE PILES
31 63 26	DRILLED CAISSONS
31 63 29	DRILLED CONCRETE PIERS AND SHAFTS
31 66 10	ROCK FOUNDATION PREPARATION
[_____]	GROUTING
[_____]	CUTOFF WALL CONSTRUCTION
31 68 13	SOIL AND ROCK ANCHORS

Section Number	Section Title
[_____]	ROCK TUNNELING
31 73 19	TUNNEL AND SHAFT GROUTING
35 20 14	STOPLOGS
35 31 19	STONE, CHANNEL, SHORELINE/COASTAL PROTECTION FOR STRUCTURES
35 41 00	LEVEE CONSTRUCTION
35 73 13	EMBANKMENT FOR EARTH AND ROCKFILL DAMS

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

NOTE: Tailoring options are available for "SQL RDBMS EDB" and "ACCESS ENTERPRISE DATABASE".

The work covered by this section consists of a data management system for engineering and construction technical data. The system encompasses every aspect of how this technical data is handled from generation to turnover, and its constituent components - including specified metadata (e.g. time/date of generation, equipment name for tracking, name of person generating the data). Elements of the data management system include hardware, software, network infrastructure, database architecture, a Data Management Plan, raw and processed tabular data, [a web-based interface](#), and reports and documents incidental to all construction or verification activities, coordination, training, quality checking, and any other associated information deliverables required during the construction contract.

However, this specification does not replace nor supersede the USACE Resident Management System - Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM) used for Contract monitoring, submittals and administration of the contract. It also does not replace nor supersede the Quality Control Specification [01 45 00.00 10 QUALITY CONTROL][01 45 00.00 20 QUALITY CONTROL][01 45 00.00 40 QUALITY CONTROL][01 45 00.10 20 QUALITY CONTROL FOR MINOR CONSTRUCTION] except where the specific data requirements are called out in this specification. The requirements in this specification are in addition to, but do not replace Section 01 78 00 CLOSEOUT SUBMITTALS which details closeout submittals and requirements for CAD as built drawings.

2.1.1.1 Overview of Goals and Components

The goals of the Government are to:

- a. Minimize the cost to the Government required to transform, translate, research, aggregate, query and analyze data.
- b. Consume project data in graphical and spatial displays that allow a rapid assessment of progress, and easy comprehension of dam safety and quality management verification.
- c. Aggregate the project's data record in an organized manner for easy access during construction.
- d. Receive data products in a timely manner that have been subject to thorough QC checking.

To accomplish these goals, an effective data management system ensures the following for data: complete collection, appropriate record formatting, cleaning, verification, timely transmission, complete documentation, and secure and organized storage. An [SQL][MS Access] enterprise database (EDB) using a relational database management system (RDBMS) is required to house all project data. The complete initial data dictionary to be used for the tables transferred to the Government and an entity relationship diagram will be provided by the Government.

The data collected must follow the guidelines as specified in this section. All coordinates for spatially located data must be provided in three dimensions such that the data can be used in 2D or in 3D GIS and other visualization, CAD and mapping software. In any instance where the Contract does not specify, the receipt of clean tabular data in a digital format is the default standard for project data.

NOTE: Depending on the requirements of the contract, the system should utilize some type of tabular database. For very large datasets such as are collected on dam safety modifications and navigation projects, an enterprise SQL language database, maintained using a relational database management system (RDBMS) should be required. This is the only type of database with the functionality and storage capacity to handle very large datasets, power web-based visualization applications, and limit user entry error through the use of database rules and domain tables. For small contracts where data is to be collected and querying capabilities are desirable, use of an MS Access or similar database is acceptable.

The smallest datasets can utilize Microsoft Excel workbooks; however, we would caution against doing so. Excel has the most limited functionality, and there is no way to limit user entry to comply with field types or entry choices, so the dataset will require more manual cleaning, QA/QC, and data validation which would be avoided in true databases. This work will fall to the Government

and is VERY labor-intensive.

If the database is the primary deliverable and the Government will utilize it to power their own web-based visualization applications, consider requesting the specific type of SQL database - e.g., Oracle PL/SQL, MSSQL, or PostgreSQL.

2.2 DOCUMENTED ENTERPRISE [SQL][MS ACCESS] DATABASE

NOTE: The purpose of utilizing an SQL language enterprise database is the greater functionality it has and number of simultaneous users it can accommodate. For any megaproject, an SQL language EDB and RDBMS is the standard.

For projects of smaller scope and complexity, an access database may suffice for the effort. Excel is not a functional database structure and should not be utilized for several reasons unless the Government already has an established database to import excel files into, and provides the contractor with the specific data tables, fields and field types - all formatted for easy import into the Government's database. This is essentially the product the specification is designed to deliver in .csv updates, but for a different reason as explained below. Only a database has the power to query and aggregate data, and to accommodate massive datasets without becoming corrupted.

The nightly updates of .csv files are intended to be used by projects that already have a database and can perform automated updates for rapid reconciliation of new data. This would be the case for projects who are building and hosting their own visualizations (i.e. web model, dashboard). These same .csv files could be used to view the data in Microsoft Excel (by just opening the file with Excel), but would need to be loaded into a database in order for the data to be readily queried. If the Contractor will host the visualizations, nightly .csv updates are not necessary, however the work to produce nightly versus weekly, monthly, or other is the same because the Contractor will be scripting these updates to run automatically - meaning the system updates itself - a person isn't performing this task.

The requirement for closeout backup files to be submitted should apply to all projects, regardless of whether the project or the Contractor is hosting the visualizations. The backup files allow the Government to inspect the Contractor's full work and obtain any required views or scripts in the database. Backup files can also be used by the Government to create the database if the project does not have staff skilled in SQL database construction.

In this case, the Contractor will usually be required to administer the web-based visualizations and database for the duration of the contract. The submitted SQL database backup files can be used by the agency's IT department/contractor to create the database on the Government's servers. For example USACE personnel can submit a service request ticket with G6 to "restore" - or set up a local instance of - the database and grant local user read/write/edit access. This is not an efficient workflow for transferring the database though, and should not be used as a substitute for the nightly .csv update due to the large amount of labor involved in setting up the database from backup files.

The requirement of a database mirror in Part Three DOCUMENTED ENTERPRISE [SQL][MS ACCESS] DATABASE of this specification is designed to provide a way for personnel to interact with the Contractor's SQL database data during a contract if the project does not have qualified personnel to set up an interface. The database mirror will provide the project with a Microsoft Access database updated daily. The benefit of the mirror is being able to directly access and manipulate the tabular data if there isn't a database on the Government's servers.

An ESRI EGDB is not a substitute for an enterprise database. Data is not designed to be easily queried and aggregated outside of the desktop GIS environment, and most project personnel are not usually GIS users. The database requirement and the ESRI products requirements are not redundant and should not be combined.

There are different ways to accomplish data transfer, this is the easiest currently, however that may change in the near future, and when it does this document will be updated accordingly. Having a non-DoD entity connecting to the DoD network through the firewall to transfer data is currently only allowable with specific G6-authorized exceptions. If the project wants to have a shared data space that both the Contractor and the Government can access, Microsoft Azure is currently (2022) an approved cloud platform. Amazon cloud is also approved for DoD data. The transfer system would require different specifications with this method; however, data system developers savvy enough to use Azure or Amazon should have no problem tailoring this specification accordingly.

The use of the SFTP to receive .csv and backup files of the database is the least expensive, and most tried and true method for transfer of data (in files). If the Contractor will build a web interface, daily updates of the database tables are less important, however, it is still strongly recommended that these updates are required

throughout the contract and not just as a closeout submittal so that USACE can examine the data for data QA.

Applicable to USACE projects only: The Contractor may utilize separate subs for instrumentation where applicable, however when the Contractor manages the instrumentation data outside of MIDAS, it absolutely should utilize an SQL EDB due to the massive amount of data it will store. Make sure to have a requirement that covers this need in the instrumentation monitoring specification. If the project will utilize the Contractor for instrumentation, but will also utilize MIDAS, set up a requirement for the Contractor to provide this data directly through API or some other means into MIDAS.

Tailoring options are available for "SQL RDBMS EDB" and "ACCESS ENTERPRISE DATABASE".

Set-up, maintain and update a documented [SQL][MS Access] enterprise database (EDB) in a full-scale RDBMS that is compatible with the Government's [SQL][MS Access] database, as proposed in the 50 Percent Data Management Plan and approved by the COR, for the duration of the contract. Store the EDB on the Contractor's servers or the Contractor's cloud storage account for the duration of the contract. Update Database Files including .csv files of the most current version of the database tables to the SFTP site by midnight daily. Update the [SQL RDBMS][MS Access] database backup file of the complete and most current version of the Government's portion of the database to the SFTP on a quarterly basis, and no later than 60 days after the loading of the last record, and at anytime requested by the [COR][ACO]. Utilize industry best practices in the formatting of .csv files so that text fields containing commas do not interfere with the structure of the .csv (i.e. enclose in double quotes or other industry standard).

Provide the Government with an exported data dictionary of the Contractor's EDB optimized for QA of the database tables and fields (to ensure all field types, names, units, precision, and other field parameters are correct) in the 100 Percent Data Management Plan submittal. Upon completion of the Contract and before final demobilization, deliver to the [COR][ACO] the Finalized Enterprise Database according to PART 1, SUBMITTALS prior to final payment.

2.3 CLOUD-BASED DATABASE SERVICES

If a cloud-based database solution is utilized for the database and file management which offers secure file transfer equivalent to or higher than the SFTP requirement, and third-party database access, this may be utilized in lieu of an additional SFTP or database mirror. Provide the Government username and password access to the project via that cloud environment, and include any instructions for access and use of all database and file transfer tools in the "Quick Reference Guide".

2.4 SFTP SITE

NOTE: Currently (2022) there are not many low cost, IT-security approved methods of transferring database files in real time across the firewall because of security constraints.

There will always be a lag time between data generation, Contractor entry and QC of the data, Contractor entry of related QC data, and incorporation into the database updates - even when the Contractor hosts the web interface. The method in this document outlines the most practiced and inexpensive method to date. Because data is coming in as files on the SFTP site, which is a secure, third-party hosted site, the Government can utilize scripts to download these files without having to perform manual updates. RMS or other systems utilized remain the venue for satisfying legal requirements of submission for payment. If the Contractor becomes able to load data directly into ProjectWise, or the structure of RMS permits it to function in this capacity, this could replace the SFTP use for non-tabular file document storage and transfer. Currently the database structure of RMS does not accommodate structured data from the Contractor.

If the Government needs to have the Contractor database hosted in a common environment that the Government can interact with in real time, and provides real time access to data, the Microsoft Azure specialty software is currently FedRAMP approved. However Azure required for use by the Contractor will add expense as it is not considered a common software for the Contractor to use, and it may also incur a licensing-usage fee for the district. Any cloud-based solution must be FedRAMP approved prior to implementation. The other methods for direct connection between the Contractor database and Government data management system would be through the approval of a firewall exception, a Government DMZ, or a Contractor-hosted DMZ. All of these are governed by G6 policy and permissions which have no standard criteria for application. If you are interested in one of these methods, discuss with your local G6 or IT security professional.

The organizational structure of an SFTP site that is used by the Government to populate their own web-viewer and dashboards should be especially well-thought out because of the automated data transfer that will be designed to pull data from that location. Also consider the ease of access and intuitiveness of navigation for users. Alternatively, the Contractor may be required to propose a structure to be used, but this often only delays the Government having to think about it until the submittal process when it may be less convenient and there may be less time to design it properly. The Contractor prefers to know what the Government

wants in most cases.

Tailoring options are available for "SQL RDBMS EDB"
and "ACCESS ENTERPRISE DATABASE".

Host a SFTP site which serves as a system for file transfer for the duration of the contract. [COR][ACO] personnel must be granted unlimited 24/7 access to the SFTP site. Provide username and password access to this site to COR. Establish the SFTP site and provide [COR][ACO] access to the site no later than 7 days after notice to proceed has been issued. Provide [COR][ACO] personnel access from the list provided by the Government within 48 hours of the SFTP site being created, and for 6 months following the uploading of the last project record. Add new users as requested by the Government within 24 hours of the request. The SFTP site must allow traffic over Port 22 for compliance with US Government security protocols. Other web-based document sharing tools (e.g., OneDrive, Google Drive, DropBox or others) that do not comply with the SFTP requirements may not be used as a substitute for an SFTP site.

Host all reports and non-tabular files, raw data, [SQL][MS Access] database .csv and backup files, and other files as directed by the [COR][ACO], on the SFTP site in the same organizational structure as the template provided by the Government in the Volume [_____] attachments. The SFTP folder structure must be fully functional, accessible, current, easy to navigate, and complete with all specified data available for retrieval by both automated and manual methods. If this criteria is not met, pertinent payments will be withheld until the issue is resolved and acceptable to the [COR][ACO].

2.4.1 SFTP File Indexes

No later than 30 days after the last file transfer has been completed, and prior to demobilization, provide [Final File Indexes](#) of the SFTP site and all data files transferred in accordance with PART 1, SUBMITTALS, SD-11. Include an index of all files according to the specified organizational scheme, utilizing a standard naming convention, detailing all other files transferred to the Government. Account for all listed files on the SFTP site and verify they are within the same organizational structure as the index. Provide a signed accountability checklist showing the verification was conducted.

2.5 DATA TRANSFER AND QC REPORTS

NOTE: Typically, QA of the SFTP, database and GIS model have been problematic on large projects, especially when the Government's Data Manager is not on site and integrated in the construction office. The intent of the reports and automated emails is to ensure the Contractor is keeping the DMS components up to date based on the actual site project as work progresses.

Tailoring options are available for "DESKTOP GIS FILES".

Produce scripted reports of the following [Data Transfer and QC Reports](#):

a. Data Transfer Reports:

- (1) Automate the delivery of a weekly report (Excel-readable attachment) on Mondays before 7 am [_____] [Eastern] time zone to COR-requested email recipients that summarizes all of the changes to the SFTP within the previous week, ending at 2359 hours local project time the previous day. Include the date, filepath, document name, associated submittal section and submittal item number, and other data for each record as requested by the COR. Format the attachment so that it is easy to understand what changes were made.
- (2) Automate the delivery of a daily report (Excel-readable attachment) to COR-requested email recipients that lists all of the changes to the SFTP within the previous 24 hours from 0000 to 2359 local project time. Include the date, filepath, document name, associated submittal section and submittal item number, and other data as requested by the COR. Format the report so that it is easy to understand what changes were made.
- (3) If a list of digital deliverables is provided by the Government, prepare the above reports in one and two to show what items on the list were submitted with a date, and what items are still outstanding.
- (4) Automate the delivery of a daily report (Excel-readable attachment) to COR-requested email recipients that lists all of the changes within the previous 24 hours from 0000 to 2359 local project time to the EDB parent tables for which a feature ID number is associated (for example a Hole ID, Blast ID, Anchor ID, Stage ID, or other ID type). Include in the report the name of the parent table, the feature ID of each record added, and date the work was completed/record generated. If data records were updated - as opposed to newly generated - indicate this for each record. Filter out records in this report that would be generated by routine database maintenance and update processes. The goal of the Government is to track the addition of new records to the database to ensure the Contractor is updating the EDB within the specified turnover times.
- (5) Automate the delivery of a weekly report (Excel-readable attachment) to COR-requested email recipients that lists all of the changes within the previous 24 hours from 0000 to 2359 local project time to the GIS EGDB. Include in the report the GIS model alignment (i.e. 3D, 2D Plan, 2D Profile Cutoff Wall, and any others used) feature class name, the feature ID's added or updated, and date of update. The goal of the Government is to track the addition of new geospatial features and records to the web interface to ensure the Contractor is updating the GIS models within the specified turnover times so the Government can effectively track progress using the viewer.

- b. QC Reports: Provide the contract-required individual QC inspector daily reports and combined QC daily report from RMS - including any attached reports or documentation - to the appropriate location of the SFTP site within 24 hours of upload to RMS.

Store copies of all above reports in the appropriate folder of the SFTP

site. Add new reports to the SFTP synchronously to turnover time requirements for each item. Propose report formats for all elements described in this section as part of the 50 Percent Data Management Plan submittal. The Government will use these reports to QA the SFTP site, the database, and the web viewer to ensure the required data work is up to date. Process any requested changes to the report format or content within 48 hours of the request.

2.6 WEB-BASED SERVICE DELIVERY EXPECTATION

For all web-based services required within this Contract, ensure that service availability is maintained from 6:00 am to 10:00 pm local project time.

2.7 ESRI GIS REST SERVICES

NOTE: This product gives the Government pre-processed and pre-published access to the GIS products that are directly connected to the Contractor's project database and hosted within ESRI's online products on the web. Feature services are generally point, line and polygons, or tabular data you want in a dashboard that contains dummy coordinates (such as concrete QC test results). Imagery Layers or Tile Services are published for raster datasets such as aerial images and other DEM files. The benefit of this requirement is the ability to have full creative control over your visualizations if ESRI Enterprise Portal is used for CAC users on the Government's Portal, while avoiding the scripting and publishing from the database directly, which has not been effectively implemented in DoD to date. This requirement is used in conjunction with database requirements, but replaces the "WEBSITE INTERFACE OF DATA" and "WEB-BASED GIS INTERFACE". Using this method requires that the Government build and maintain their own web maps and dashboards, and to successfully accomplish this it will require providing the Contractor with a starting list of web services desired, including the schema of the attributes and any additional fields needed to filter or classify the data. For example if the dashboard will show passing or failing, that is easiest as a field in the feature service. Additionally, if QC narrative is desired for the feature service, ensure that is included in a comments field of the attribute table schema.

Provide ESRI REST feature services, scene layers, image layers, and tile services hosted on ArcGIS Online (AGOL) or ArcGIS Enterprise Portal with export capability enabled. Deliver links to feature services which are shared with the Government's user group utilizing an ESRI collaboration, or provide username and password access to the Contractor's AGOL or Enterprise Portal account to access the links. Update REST feature services and scene layers within 15 minutes of an update to the database, and update other services within 24 hours of generation of the new dataset.

Specific feature service attribute schema is provided in the attachments to the solicitation. Ensure the attribute data in the feature services follows the schema requirements specified for the documented SQL database. The data within the attribute tables of all feature services must be free from errors, appropriately attributed, and utilize the field type of the corresponding database field. Make any changes to the feature services including the addition of attribute fields, corrections to data errors, numerical field precision, and field type as requested. Make the requested change within 48 hours of the request.

Provide the following web services in 2D and 3D:

- a. [_____] [Lifts of embankment material by zone];
- b. [_____] [Most current top of rock surface and contours];
- c. [_____] [Excavated quantities per billing cycle];
- d. [_____] [Placed quantities per contract billing cycle];
- e. [_____] [Spoils quantities per contract billing cycle];
- f. [_____] [Concrete structures including attributes for concrete materials testing. For concrete testing data without spatial coordinates create dummy coordinates. Include pass/fail for each test performed, retest and retest ID if applicable to the sample, and QC narrative about the test included in a comments field for all tests if failing or resampled];
- g. [_____] [Soils material testing locations including attributes for soil testing with pass/fail for each test performed, retest and retest ID if applicable, and QC narrative about the test included for all failing or retested samples];
- h. [_____] [Blast Plans and Reports including blast holes, polygons, overbreak in final surfaces, final grade survey, and any overexcavation];
- i. [_____] [All processed orthophotographs or aerial photos produced, and DEMs from LiDAR data gathered on site];
- j. [_____] [All grout stages and holes in 2d profile with grout stage summary data including grout volume, mix design, effective pressure]
- k. [_____] [Verification holes including all attribute data of water pressure testing, falling head testing, concrete anomalies]
- l. [_____] [Anchors including all attribute data for testing, and pass/fail for each test performed];
- m. [_____] [Cutoff wall panels and secant piles orientation and location in space, including all attribute data associated with alignment acceptance and materials testing].
- n. Provide [_____] [15] additional feature services not requested in this list or the schema provided as requested throughout the course of construction.

2.8 WEB INTERFACE AND GEOGRAPHIC INFORMATION SYSTEMS (GIS)

NOTE: Tailoring options are available in this section for "WEB-BASED GIS INTERFACE", "DYNAMIC DATA INTERFACE", and "DESKTOP GIS FILES".

Develop a web-based visual user interface to spatial and tabular project data that incorporates the following elements. Host this interface for the entire Contract duration, and for [_____] [6] months following demobilization, or the Contract closeout, whichever comes first.

Within 30 days of the end of the data management planning meeting, provide a presentation of the initial [Web Interface](#) build for preliminary approval

by the [COR][ACO]. Within 30 days after any subsequent Data Management Planning Meetings held for major features of work that weren't covered by the initial planning meeting, or where a change to the web interface is made due to the subject feature of work starting much later in the Contract (for example the [____][cutoff wall]), provide a presentation of the components of the web interface to be added/updated including GIS and dynamic data components for approval by the COR to satisfy the [Web Interface Updates](#) submittal requirement.

NOTE: It is important not to require the web interface to be hosted past the contract end date. Six months has been a typical required time period on a large project.

2.8.1 Web-based GIS Interface

NOTE: ESRI ArcGIS is already a FEDRAMP approved software platform, and as such many agencies are already using it for web-hosted display and desktop products of geospatial data. If the designer wishes to specify a different service/program, remove and replace all bracketed language. If the designer will specify ESRI products, remove all brackets around ESRI language and empty brackets.

Develop [____][ESRI] GIS web viewers in plan, profile and 3D views using web services published with [____][ArcGIS Server or Enterprise]. Grant read-only access to the Government to all GIS services used in the web viewers such that the Government can securely add services to Government web viewers and [____][ArcGIS Enterprise or Portal maps] applications. For details of execution see Part Three, EXECUTION.

2.8.2 Dynamic Data Web Interface

Develop the web interface to have a display component featuring tables, charts, graphs, plots, widgets, and other visualizations in an integrated dashboard style user interface with the GIS views as exemplified in the mockups provided in the Volume [____] attachments. Display data in near real-time from the appropriate enterprise database, even when the data displayed is not real-time from generation (i.e. analog data collection). As the needs of the project evolve, the [COR][ACO] will direct changes or additions to these displays. Make additions and changes to display components as requested by COR.

2.8.3 Desktop GIS Files

NOTE: Verify versions and update the software utilized based on what the project uses prior to finalization of spec. The intent of the last sentence in brackets is to clarify for the Contractor that there is not an existing 3D model of the planned or existing features and that the Contractor is to build it. Delete this language if this is not required.

Develop, update, and maintain the required 2D and 3D models, complete with all existing feature classes and rasters provided by the Government, and all available planned and completed elements of work as directed by this specification and the [COR][ACO] for the project duration. Develop desktop GIS files in ESRI ArcGIS Pro version [____][2.X] or current as directed by the [COR][ACO]. The desktop map packages and associated spatial data (e.g. .aprx, .gdb's, and other appropriate file types) must contain all formatting, symbology, labeling, binning, and other information requested by the Government. The formatting must be such that the user can easily produce a printed map(s) after performing only the most minor formatting or rescaling. Print templates will be provided by the Government. Provide these documents and all source files as specified in PART 3 EXECUTION.

The Government will provide all historical GIS layers, as detailed in the Volume [____] attachments, that are required for display in the 2D web interface.[The Government will not provide a base 3D model or any 3D feature classes, however the Government will provide any data required to be displayed in the 3D GIS by the Contractor (as detailed in the Volume [____] attachments).]

2.9 QUICK REFERENCE GUIDE

**NOTE: Tailoring options are available for
"WEB-BASED GIS INTERFACE" and "WEB INTERFACE"**

Develop a [Quick Reference Guide](#) that meets the following criteria at a minimum:

- a. Describes how to access and view information management system tools and components;
- b. Describes how to download data, reports, drawings and maps;
- c. Describes how to make or change graphical outputs for the project;
- d. Is designed in an indexed, and well-organized manner and written in plain English rather than technical jargon;
- e. Includes web addresses of web-hosted sites in use, and POC information for administrators who can provide user-access to the Government;
- f. Documents and indexes all the views and group layers and available graphical datasets in an intuitive user guide to the web viewer so that the user has an understanding of the full capabilities of each view;
- g. Clearly describes how to view and filter data in the web viewer, as well as the use of all other functionality of the web interface of spatial and graphical data;
- h. Clearly describes how to utilize field forms on digital devices to input data into the web viewer;
- i. Clearly describes how to download and utilize any phone app required to utilize field forms for direct entry of field data;

- j. Documentation of all URL's used and credentials.
- k. Clearly describes the use of the custom web-based QA tool for the database;
- l. Clearly describes how to use the database mirror functions.

Text, recorded videos (not to exceed 3 minutes each) with separate videos for each topic, and other COR-approved format may be provided as the quick reference guide, however it must meet the requirements for organization and indexing by subject. General software manufacturer product literature in whole or in part will not satisfy this requirement. Host the guide to an additional page of the web interface and provide meaningful user search, reference and selection options to find related videos/topical text/pictures. Prepare and submit the guide within 30 days of the approval of the initial web interface. If the guide is part of the web interface, schedule a 1-hour meeting to walk through the tool and functionalities. Record the meeting and submit the recording to RMS and the SFTP site, and make it accessible on the website itself.

2.10 DIGITAL CAD MODEL

NOTE: If these requirements and submittals are already stated in Section 01 78 00 CLOSEOUT SUBMITTALS, remove the "CAD 3D MODEL" tailoring option from this specification.

If the project intends to maintain and update its own web interface in ESRI products, the turnover times and formats of the CAD model are more important to consider so that the 3D CAD model can be used to update the GIS model. Also consider the Interoperability between CAD and GIS programs used when requiring a specific CAD format.

Provide the Digital 3D CAD Model Files files comprising the 3-dimensional CAD model and associated data files in [____][Autodesk AutoCAD][Bentley MicroStation][OpenRoads Designer 3D] format, compatible for use with [____][AutoCAD 2018][Bentley CONNECT V.8]. The CAD files must be complete in all as-constructed details, and identical in form and function to the Contract drawing files supplied by the Government, except to replace design with as-built data, and to correct mistakes in original design files.

Provide the most up to date version of all [.dwg][.dgn] files and associated data files comprising the 3D CAD model in a weekly update to the SFTP site by [____][0600 hours] local time zone every [____][Monday]. All items (polylines, points or others) in [.dwg][.dgn] files must be on correct A/E/C Layers, in accordance with A/E/C CAD standard ERDC/ITL TR-12-6. Utilize the same required templates as are required and used for redline and final as-built drawings as applicable. Utilize [____][e-Transmit][Packager] to export all features and submit all associated files in one zip file when submitting the CAD files. The Government reserves the right to reject any files it deems incompatible with the Government CAD system, files not compliant with the [____][R6.1] A/E/C standard, and files containing features without accurate geospatial

referencing or with geometric inaccuracies.

2.10.1 Spatial Referencing

Spatially reference the features of the 3D CAD model to the verified primary project survey control, utilizing the established project horizontal and vertical datums and projections. Create all applicable features as geometrically correct closed 3D features which can be imported as closed multipatch features in ArcGIS. Ensure all features are true to as-constructed dimensions and locations.

2.11 DATA MANAGEMENT PLANS AND ADDENDA TO 100 PERCENT DATA MANAGEMENT PLAN

2.11.1 50 Percent Data Management Plan

NOTE: Tailoring options are available for WEB-BASED GIS INTERFACE", "SQL RDBMS EDB" and "ACCESS ENTERPRISE DATABASE".

Within 60 days after Notice to Proceed, prior to conducting the data management planning meeting, submit a 50 percent plan for management of all the various data collected throughout this contract. The Plan must be well-organized, and in a digital format where both text and tables can be easily edited during the data management planning meeting. The Plan must include all sections and information detailed in PART 3, DATA MANAGEMENT PLAN to the best of the Contractor's knowledge at the time. Proposed substitutions for any requirements will be approved in the 100 Percent Data Management Plan submittal. Include the following proposals to Contract requirements:

- a. Any proposed substitutions to required visualizations in this document;
- b. Proposed naming conventions per paragraph in PART 1 Naming Conventions;
- c. Proposed Contractor database platform per paragraph in PART 2, DOCUMENTED ENTERPRISE [SQL][MS ACCESS] DATABASE;
- d. Proposed format for required Data Transfer and QC Reports per paragraph Data Transfer and QC Reports in PART 2;
- e. Proposed photograph PDF organization format per paragraph PHOTOGRAPH PDF'S AND RAW DIGITAL PHOTOS in PART 2.

This document serves as the seed document for use in the data management kickoff meeting containing all necessary information about the Contractor's side of the data management system with respect to the Contract requirements and in light of changes that may occur due to the design-build nature of the Contract. The 50 percent plan will be used to record all decisions and information about the joint data management system that are agreed upon in the meeting, and will become the basis for the 100 Percent Data Management Plan. Government approval of this plan indicates it is complete enough for use in the data management planning meeting. Approval does not indicate an approval of any proposed deviations or substitutions.

2.11.2 100 Percent Data Management Plan

Within 30 days after the end of the data management planning meeting, submit the initial comprehensive Data Management Plan for the project. The 100 Percent Data Management Plan must include all sections and information detailed in PART 3, DATA MANAGEMENT PLAN, and must reflect all [COR][ACO] input, and collaborative decisions, products and workflows from the data management planning meeting. It must be updated with the results of any subsequent kickoff meetings for features of work where the data-generating Contractor will not be on site, and specific data-generating equipment will not be detailed until the start of that work.

This document serves as the authoritative data management guide which documents the collection, processing, storage, flow, and visualization of information and data throughout the contract. At the end of construction, the final version will become the Data Management Manual outlined in SD-11 Closeout Submittals. Resubmit this document every 6 months with any updates per PART 1, SUBMITTALS SD-10. A sample Data Management Plan will be provided upon request after award.

2.11.3 Addenda to the 100 Percent Data Management Plan

NOTE: The following plans are intended to make the Contractor detail the workflows utilized to meet the specification requirements, and submit them for review by the Government. The plans are submitted prior to the data management planning meeting to give the Government a chance to review and discuss them with the Contractor during the meeting to help resolve any issues prior to the start of intensive data collection.

The addenda to the data management plans are submitted and approved prior to the data management planning meeting with the exception of the Proposed Changes to the Enterprise Database Schema, which is submitted synchronously to the 100 Percent Data Management Plan. These individual plans may be changed during the data management planning meeting based on the collaboration that occurs and are subject to a second approval as part of the 100 Percent Data Management Plan submittal, of which they are a component.

The addenda to the 100 Percent Data Management Plan must include the following:

2.11.3.1 Automated and Manual Data Collection Output Examples

Within 45 days after Notice to Proceed, before conducting the data management planning meeting, submit digital samples of all raw outputs from automated data collection systems and all manual processes. Submit automated systems outputs in two formats: 1) Excel-readable digital format with field types defined on separate pages or in a separate document as needed. 2) PDF of digital printouts. Submit forms or logs to be completed manually digitally in PDF format. The purpose of this submittal is to have all necessary data output formats available for use in the data management planning meeting and for the Government understanding of proposed changes to the EDB schema.

2.11.3.2 Data Cleaning and Verification Plan

Within 30 days after Notice to Proceed, before conducting the data management planning meeting, submit and have approved a detailed plan for cleaning and verification (see definitions provided in PART 1) of data generated either by an automated or manual process on site. This includes the identification of all procedures and policies related to consistency and accuracy of naming convention, field formats, standardized character entry of fields and records, correcting entry errors, verification of source field data and data review for verification of entry correctness. This plan must include all technical specifications for all hardware and software utilized in this process. This plan must be developed by the data manager and the data management quality control representative identified in Section [01 45 00.00 10 QUALITY CONTROL][01 45 00.00 20 QUALITY CONTROL][01 45 00.00 40 QUALITY CONTROL][01 45 00.10 20 QUALITY CONTROL FOR MINOR CONSTRUCTION] as applicable. Reference PART 1 for record tracking requirements of EDB contents.

2.11.3.3 QC Daily Information Collection Plan

Within 60 days after Notice to Proceed, before conducting the data management planning meeting, submit and have approved a detailed QC daily information collection plan that includes:

- a. How the narrative information about installation procedures and performance of the work that goes into the QC daily reports will be added to the EDB and related to records for the features of work the QC was performed on.
- b. How activity codes will be collected in conjunction with "a" and incorporated into the database and related to relevant fields.
- c. How personnel hours and equipment and hours will be incorporated into the EDB.
- d. Any proposed changes to the EDB that will be required to incorporate items a-c, and how the information will be related to the features of work.

2.11.3.4 Backups, Archiving and Disaster Recovery Plan

Within 30 days after Notice to Proceed, before conducting the data management planning meeting, submit and have approved a detailed plan for the backup, archiving and disaster recovery for data and data systems, sufficient to describe the steps the Contractor will take to protect and store project data of all types from the time of automated or manual generation, through project record turnover to [COR][ACO] and discontinuation of the SFTP site.

2.11.3.5 Data Transfer Workflow

Within 45 days after the Notice to Proceed, before conducting the data management planning meeting, submit and have approved a detailed plan describing the Contractor's data transfer technical workflow in detail. The plan must show in depth how the data transfer system on the Contractor's side will integrate all features specified by the Government in PART 1, Data Turnover Timeframes, how turnover times will be met, and how it will dovetail with the Government's system architecture (if applicable).

2.11.3.6 Proposed Changes to the Enterprise Database Schema

**NOTE: Tailoring options are available for "SQL
RDBMS EDB" and "ACCESS ENTERPRISE DATABASE".**

Within 30 days after conducting the Data Management Planning Meeting, submit proposed changes to the EDB for approval. The Government acknowledges schema changes to the enterprise database will be required as a result of Contractor-specific systems and methods. Provide a detailed description of any proposed changes to the schema of the enterprise database required to make actual data collection for the project consistent with the Government's goals. As one example - adding fields to the table "Concrete_MixDesign" for the specific cementitious materials that will be used in the concrete mixes. As another example, adding fields specific to the type of hardware used to verify cutoff wall panel or secant alignment. This addendum must include written justification for each proposed change, and a draft version with all of the following with proposed changes highlighted:

- (a) Data Dictionary
- (b) Entity Relationship Diagram

Additionally, for each schema change, submit the SQL statement for the change. All changes must be in accordance with paragraphs DOCUMENTED ENTERPRISE [SQL][MS ACCESS] DATABASE in PART 1 and PART 2, and will require [COR][ACO] approval prior to implementation.

2.11.3.7 Data Management System Demobilization Plan

Within 45 days after Notice to Proceed, before conducting the data management planning meeting, submit a step-by-step plan documenting how the data management system will be demobilized including:

- a. Schedule correlated to project schedule milestones and overall project completion for final deliverable completion and transfers and decommissioning of data system components.
- b. Proposed method for transfer of all final datasets, (viewer components, GIS files, algorithms, scripts, and other products) to the Government.
- c. Schedule of preliminary test of final data transfer from item b that includes adequate time to address these issues prior to data system closeout.
- d. The steps of equipment/component demobilization and details of all impacts of these steps on the data management system functionality.

2.11.3.8 Data Management System Demobilization Plan Updates

Within [____][12] months of scheduled project completion, begin submitting updates to the data management system demobilization plan. Provide any updates to the plan required for changes in technology (i.e., hardware, software, applications) and methodology that may have taken place throughout the execution of the contract. Resubmit the entire demobilization plan but clearly denote in the body of the plan what has been removed and what it was replaced by, or what has changed.

Full details of execution of the Data Management Plan are in PART 3, DATA MANAGEMENT PLAN.

2.12 TRAINING

NOTE: The purpose of training is user integration to the web-based tools and the DMS. If the Contractor is not hosting a web interface it may still provide value for familiarization with any other product they are producing such as the database, database mirror. This must be determined by each individual project.

Covid-19 has changed many elements of how we do business. If both parties are comfortable with in-person meetings based on current transmission and new case trends, it is recommended to have the meetings in person to help build rapport. If in-person meetings do not make sense given infection rates on site or in the area where personnel will be traveling from, this requirement can be relaxed by the government. If the project thinks it might want in-person attendance, leave the more stringent requirement in the specification so that it can be enforced as needed, however it can always be relaxed later.

Tailoring options are available for "WEB-BASED GIS INTERFACE"

Provide training sessions, on site or at the Government office - as coordinated with the Government, to familiarize and train Government users on the [GIS and dynamic data web interfaces](#) and use of the database mirror. Provide [____][3] sessions, [____][4] hours in length each.

2.12.1 Initial Training Session

Coordinate the initial session to take place no later than 15 days after the approval of the initial web interface. Contractor's Data Manager, and Data Visualization Specialist must be physically present at the meeting, and any other data management staff who made integral contributions must participate either in person or via webinar hosted by the Contractor.

Record the training session, bookmark the recordings according to topic, [and host to the help section of the web interface \(specified in PART 2, QUICK REFERENCE GUIDE\)](#) within 5 business days of the completion of the session.

2.12.2 Intermediate and Final Sessions

Coordinate the intermediate session to take place during execution of the Contract with date/time to be arranged between the Government and the Contractor. Demonstrate at this meeting that Government feedback from initial meeting has been implemented, and that adequate coordination between the Government and the Data Manager is taking place prior to the start of features of work for which intensive data collection will occur.

Coordinate the final session to take place near Contract completion to aid in transfer of information management system to the Government systems, including but not limited to transfer of databases, web services, and other data system components.

2.13 PHOTOGRAPH PDF'S AND RAW DIGITAL PHOTOS

In addition to the raw digital photo submissions described in Part One, submit PDF documents displaying all Contract required progress or other photos organized into separate documents. Propose document organization in the 50 Percent Data Management Plan for approval by the [COR][ACO] (for example by feature of work, work phase, work location, or other parameters which make navigation intuitive). Render the photos in the PDF with a resolution that represents the original photo resolution to the human eye. Place photos according to their proper orientation (portrait or landscape). Create an index with bookmarks for each PDF organized by submittal section and suborganized by work area (if applicable) and then by date in the sequence which they were taken.

Process all raw photos for inclusion in the PDF submission with a border including a 13 mm 0.5 in caption at the base of each photo for descriptive information. Include the following information for each photographic image in the caption:

- Project Name
- Contract Number
- Contractor Name
- Date
- Station and Offset
- Photo Number
- Orientation View
- Work Element Depicted
- General Project Area

2.13.1 Turnover Times

Submit all raw photographs to the SFTP site within 48 hours of collection and organize in folders on the SFTP site in accordance with the provided file structure in the Volume [_____] attachments. Photos must be updated to the PDF documents within 7 days of collection. PDF documents must be updated and uploaded to the SFTP site weekly.

2.14 OPENGROUND CLOUD DATABASE AND RECORDS

NOTE: This section applies to USACE projects only - USACE uses OpenGround Cloud for drilling data. Delete the tailoring option for OPENGROUND if used by other agencies or OpenGround will not be needed/used.

The Drilling Data Standards Committee in the Geotech, Geology & Materials Community of Practice in USACE developed the fields for boring log entry to streamline the usage of geologic terms and descriptors. These terms have been researched from USACE ER, EM, ATSM, and other standards. References to the standards can be found in the OpenGround

Cloud program. This schema is available for use by any organization, and the software is DoD-approved. For more information, contact the Data Standards Committee Chair via the Geotech, Geology and Materials Community of Practice lead at USACE Headquarters.

In the most recent update to EM 1110-1-1804 Geotechnical Investigations, a National Drilling Manual was compiled from the drilling manuals of several districts. This manual was edited to include the use of the terms utilized in the drilling database fields. The manual is meant to be used in conjunction with the database and is intended to be provided to the Contractor and required for use in hole logging in the applicable subsurface investigations specification. The use of the manual in producing field logs will limit potential translation errors upon data entry. Ensure that sections of the Contract requiring drilling also require the use of the National Drilling Manual for consistency.

Provide all drilling and soil testing data utilizing USACE Bentley OpenGround Cloud configured for the [_____] project. USACE will provide necessary permissions to Contractors entering data. Provide a list of users with name and emails for the Government to grant access. If the Contractor does not already have a license for OpenGround cloud, user-specific "named user" or concurrent licenses must be obtained.

Enter the data for all drill holes on the project, including but not limited to [exploratory drilling, grout holes, pilot holes, verification holes, instrumentation holes, blast holes]. See PART 3, OpenGround Cloud Database and Records for details of execution.

PART 3 EXECUTION

NOTE: The purpose of requiring specific schema elements are to ensure that the Government is provided with values used for critical evaluation of engineering and construction work, and in a format where they can be rapidly queried and visualized without additional cleaning and formatting. Without providing the Contractor with a baseline of data expectations, they are expected to try to figure out what the Government wants. Lessons learned on mega projects from the past decade have shown that it is far more efficient to detail the Government's expectations at the outset of the Contract, and in writing to ensure they are delivered.

3.1 DOCUMENTED ENTERPRISE [SQL][MS ACCESS] DATABASE

NOTE: Tailoring options are available for "SQL RDBMS EDB" and "ACCESS ENTERPRISE DATABASE".

Transfer the digital datasets identified in the data dictionary, and any additional datasets requested by the COR, to the Government via the project enterprise database (EDB). Provide data for all fields of each table, according to the field definitions provided in the data dictionary.

3.1.1 EDB Structure

The documented [SQL][MS Access] enterprise database must utilize the tables, fields and relationships detailed in the data dictionary. **The Contractor must supply all data for all tables and fields of the database for work being conducted within applicable turnover times.** If data is not provided within specified turnover times, funds for both the features of work being completed and for data management may be withheld until the data is provided.

A preliminary data dictionary will be provided with the Volume [_____] attachments. The database is required to convey the data in a way that can be easily researched, understood and ingested by the Government. The Contractor may utilize their own schema structure as needed within the above constraints for the values used by the Government. Populate all fields within each table for every record as applicable. Utilize the same table names, fields, field names, field types, domains, units, precision, and relationships as defined in the data dictionary agreed upon in the 100 Percent Data Management Plan. Tables added to the database exclusively for use by the Contractor for their own internal business processes not related to the verification of work are not required to be transferred to the Government. This exemption does not include QC data.

3.1.2 Schema Changes

Incorporate any additional requested database fields, tables, relationships and database views, either as requested by the [COR][ACO], or as necessary to capture new features of work, throughout the Contract. The Government's data manager will work with the Contractor's data manager to ensure requested new structural changes do not add significant burden.

Propose modifications to the database schema that will impact the Government's ability to ingest the data as needed. Any changes to the schema impacting the tables, fields and relationships ingested by the Government must be approved by [COR][ACO] prior to any change to the EDB and documented in the subsequent update to the Data Management Plan. This requirement does not apply to triggers, tables, and fields, and other elements that are built for the Contractor's use only. Clearly identify the table(s), field(s), and or relationship(s) to be changed, and the specific changes to be made. Repair or populate any records that were collected prior to the schema change that may be affected.

3.1.3 Database Mirror

Allow the Government to view all tables in the EDB using Microsoft Access software. This can be accomplished through upload of a mirror database to the SFTP (database(s) files updated daily which contain copies of the EDB tables but are not directly updated with new project data from sources other than the EDB), or by providing a Microsoft Access file with security-compliant live-linked data tables, and/or through other means proposed by the Contractor in the 50 Percent Data Management Plan, and accepted by the [COR][ACO].

3.1.4 Ongoing Schema Updates

For updates to schema of the Government's tables throughout construction after the initial "Proposed Changes To The Enterprise Database Schema" submittal in PART 1, SUBMITTALS SD-01, update the following documents hosted to the appropriate location of the SFTP site that detail the changes:

- a. An excel document detailing the new field name, field type, associated units, field definition, relationships if any, and any associated calculation used to produce the value.
- b. ER diagram of the database structure that reflects the change.
- c. Any impacts to the existing dataset arising from the change.
- d. Reason for the change.

Submit this spreadsheet weekly with all changes from the week for [COR][ACO] approval. If there are no schema updates, formal submittal is not necessary

3.1.5 Database Views

The construction of database views is required by the Contractor in order to facilitate providing data specified in some of the visualizations. The Government will provide the required calculations, constants and definitions needed to facilitate the construction of these database views.

3.2 DATA DELIVERABLES FOR SPECIFIC FEATURES OF WORK

NOTE: The state of data requirements across UFGS specifications are highly variable from document to document. This section is intended to specifically detail the data deliverables for work already specified in the feature of work sections as the examples in section 1.3 outline. This section is intended to provide a venue for detailing data and report deliverables that are NOT properly detailed in other sections of the contract. For example if there is no remote sensing section, the LiDAR, or photogrammetry deliverables may be stated here. Or if not covered in the grouting section, OPTV deliverables may be stated here. Keep in mind, this opens a can of worms. These types of work have precision, accuracy, equipment, calibration, QC, processing, and other requirements that should be stated somewhere to ensure a quality data product is received. In a perfect world there would be no sections of requirements like this in this specification. Alternatively, this template can also be used for consistency in the appropriate feature of work specification sections if needed.

3.2.1 Data and Reports

NOTE: Insert a description of the data type.

[_____]

3.2.1.1 Raw Data

NOTE: Insert a list of the raw data file types, contents and turnover times and methods if different from what is specified in Part One "Geospatial Metadata". Some datasets may be appropriate for scanned copy of a paper record generated by the equipment, such as Koden raw data, however the majority of data will be received digitally.

[_____]

3.2.1.2 Processed Data

NOTE: Include any final deliverables required to be produced from the raw data including file type, resolution, hosting size.

[_____]

3.2.1.3 Reports

NOTE: Include the contents and requirements for reports associated with data submissions. Some verifications will be satisfied through the submission of a report containing the data rather than the data itself. One example of this is verticality verification for cutoff wall panel excavations - a report submitted showing verticality, alignment, and rotation of each element with plots generated from the Koden data is far more useful for rapid approvals than the raw data where the government would have to generate these products. Remember, these requirements belong in the appropriate work section. Only list them here if they have not been required there.

[_____]

3.2.1.4 Visualizations

NOTE: Include any specific visualizations needed in GIS including symbology and binning, plots, charts, graphs, and tables of data. in this section.

[_____]

3.2.1.5 Drawings

NOTE: If progress drawings are required as part of the delivery, detail here.

[_____]

[3.2.2 Grouting and Water Pressure Testing

NOTE: Below are examples of data sets for specific features of work, including how they will be displayed in GIS and the associated data plots needed. If the contract specifies that the Contractor builds and maintains a dashboard, the visualization information may be better placed within the section pertaining to the dashboard view of the data. It has been presented here for ease of reference. Format the specification according to the organizational structure that makes it the simplest to reference for both the Contractor and the Government.

Adjust this section as necessary to capture specific project needs. Other typical required reports could include anchor installation, drilled shafts/piles, excavation, blasting, earthwork, or other features of work.

These requirements must be developed with heavy input from the technical designer for that feature of work specific to the project. Tailoring options are available here for "WEB-BASED GIS INTERFACE".

ENSURE THESE ARE NOT DUPLICATE REQUIREMENTS IN OTHER SPECIFICATIONS.

3.2.2.1 Raw Data

Provide digital raw and appended raw data files of the automated grouting control and data collection system in .csv format and load to the appropriate location of the SFTP site within 12 hours for raw data and 24 hours for appended raw data. Format raw data files, or appended data files if not an option for raw data, such that the field headers have names that allow the user to understand what date they contain.

3.2.2.2 Processed Data

Provide grouting and water pressure testing data to all required fields of the EDB as detailed in the data dictionary, provided in the Volume [_____] attachments. Differentiate water pressure testing records in the naming convention and in the EDB records in accordance with the provided data dictionary.

3.2.2.3 Reports

Furnish records of pay quantities to the [COR][ACO] within 24 hours for the previous day's activities. Submit daily records in the form of drilling and grouting reports with the daily log of construction.

Include in the drilling report:

- (1) The location and station/offset of each hole drilled;
- (2) The date;
- (3) Drill rig identification;
- (4) Inclination and azimuth;
- (5) Time drilling was started and stopped;
- (6) Rock type and condition if core is logged;
- (7) Any unusual drilling conditions encountered;
- (8) Depth and quantity of drilling fluid loss and gain;
- (9) Total footage drilled.

Include in the water pressure testing report:

- (1) Equipment calibration logs;
- (2) Date;
- (3) Hole ID tested;
- (4) Depth of test;
- (5) Pressures applied;
- (6) Time interval;
- (7) Volume of flow.

Include in the grouting report:

- (1) Hole ID;
- (2) Date;
- (3) Grout mixes used for each zone;
- (4) Time of each grouting effort and pressures attained;
- (5) Maximum, minimum and end injection pressure;
- (6) Maximum injection rate;
- (7) Volume of grout mixture placed;
- (8) Volume of cement solids injected in the hole;
- (9) Itemized total quantities of grout materials placed;
- (10) Quantity of grout wasted;
- (11) Temperature of the grout;
- (12) A plot of the evolving permeability and pressure with time.

3.2.2.4 Visualizations

a. Graphs - Included in PDF documents, may also be included in Raw Data.

- (1) Gauge Pressure, Effective Pressure (and Down hole Pressure if used) vs. Test Duration in minutes
- (2) Flow Rate (gal/min) vs. Test Duration in Minutes
- (3) Apparent Lugeon value vs. Test Duration in Minutes
- (4) Volume of grout, water, or dye vs. Test Duration in Minutes

b. Grouting, Water Pressure Testing or Grout Trend Plots in PDF format for each borehole and for each test type with all stages and graphs shown (e.g., each borehole will have one PDF record of Grout Trends plots for all stages and one PDF record for water pressure test plots for all stages). [Hyperlink grout stages in GIS profile view alignment](#)

to trend plots.

- c. Grout summary symbology in the GIS environment: Symbolize grout stages as a layer(s) in a section view within the simplified and desktop GIS environment. Color stages along a borehole to highlight areas of high grout take. Initial symbology must be gray for 0-5 gallons, yellow for 5-15 gallons, brown for 15-30 gallons and red for over 30 gallons.
- d. Water Pressure summary plots in the GIS Environment: Water (and dye testing) stages must be colored along a borehole to highlight areas of high lugeon values. Initial symbology must be green for 0-3 lugeons, yellow for 3-10 lugeons, brown for 10-50 lugeons and red for greater than 50 lugeons. Final "As-built" grout summary plot(s) must be provided in an Adobe PDF and as per Section 01 78 00 CLOSEOUT SUBMITTALS (as-built drawings).
- e. Create and maintain a georeferenced, three-dimensional CAD file with plan and section views for the development of the as-built drawings outlined in this specification. Represent each hole drilled and grouted in both plan and section views of the model. Display the following information in section view, and submit accompanying plan view drawings for orientation of the profile. This may require more than one view of the same section:

- (1) Hole location by station with applicable orientation or orientation indication and inclination;
- (2) Grout volumes and mixes placed per stage in gallons;
- (3) Symbolized by grout volume;
- (4) Lugeon values from water pressure testing by stage;
- (5) Drilling information (e.g., cavities, rod drops, water losses, and other data as applicable);
- (6) Geologic formations along the profile as a backdrop;
- (7) Location and type of lost tooling;
- (8) Irregular events;
- (9) Hole depths and top and bottom elevations;
- (10) Stationing at regular intervals;
- (11) Grout hole IDs;
- (12) Elevations.

Display the following information in plan view:

- (1) Grout holes with labeled hole ID;
- (2) Instrumentation, exploratory drill holes, or other related structures in the immediate vicinity;
- (3) Final bottom elevation of the holes;
- (4) Northing and easting grid;
- (5) Compass rose and scale;
- (6) Total grout takes for finished holes in **liters gallons**;
- (7) Hole symbolized by status (such as planned, drilled, in-progress, completed, and other symbologies commonly used).

Provide all updated CAD source files for the drawings and all other necessary data to view and edit the drawings in the full CAD program via the SFTP site weekly. Use all applicable projections and datums specified and ensure all features are georeferenced to project survey control. Update records and drawings within [____][48] hours of data collection, or [24] hours of progress status changes, and submit updated digital PDF copies on a weekly basis for the duration of the grouting via the SFTP

site. Provide one full-size, color printed copy submitted to the Contracting Officer weekly. The [COR][ACO] may request changes in format or symbology at any time and should take effect within [____][5] calendar days.

][3.2.3 Cutoff Wall Verticality and Orientation

**NOTE: Tailoring options are available here for
"WEB-BASED GIS INTERFACE".**

3.2.3.1 Raw Data

Provide the digital raw data files of the verticality and orientation measuring device. If the native file format requires proprietary software to read, convert the files into an Excel-readable format. Provide printed hard copy data produced by the [____][Koden] via a clean, legible scan in PDF format.

Load raw data files and scans to the SFTP within 12 hours of the measurement of the excavated element.

3.2.3.2 Processed Data

Provide active data and associated plots of verticality and rotation in Microsoft 365 Excel or another approved software application which clearly demonstrate actual position in space along every axis. Plot this against theoretical location in space and specification tolerances. Label all data, constants, and values with units, and orientation in relation to the project baseline. Provide plots within 24 hours of the excavation via RMS and the appropriate location on the SFTP.

3.2.3.3 Reports

Submit detailed reports of the verticality, alignment, and rotation of each element excavation within 24 hours of measurement of each excavation. Submit reports of verticality, alignment, and rotation for each element and its neighboring elements for signed off by the [COR][ACO] prior to backfilling the element with concrete, as detailed in Section [____][Section 31 56 10 CUTOFF WALL]. Both reports must depict actual versus theoretical alignment as specified in this section. Refer to both the raw and corrected verticality and rotation measurement data with a full list and explanation of all values, constants, formulas, and information used to process this data. Submit to-scale graphical plots for each test per the requirements herein. Submit any diagrams/schematics necessary for interpretation of the data. Use the same reference orientation in all instrument reports.

3.2.3.4 Visualizations

Drawings showing an analysis of barrier wall elements must be completed for each element and each set of adjoining elements showing the verticality, orientation, overlap and continuity of the barrier wall. These drawings must be completed weekly.

Display actual location of these elements in space in the GIS environment, in plan and section views. Display overlap between elements in the GIS environment as a separate layer.

- a. Sections of barrier wall elements taken at [_____] meters (m) [_____] foot (ft) depth intervals of the actual location of all barrier wall elements must be shown in plan view such that they are located correctly in space and the verticality and alignment of each element at each [_____] m [_____] ft depth intervals can be seen.
- b. These plan view section cuts of the elements must also include a section at the top of the wall, at the soil-rock interface and at the bottom of the wall. The element section cuts at depths must be placed in layers by depth that can be turned on and off by the user separately such that user can look at section cuts of all completed barrier wall at some specified depth individually (e.g., 30 feet below work platform, or at bottom of barrier wall elements).
- c. Overlap between adjoining elements must be shown as red when criteria specified in [31 56 10] is not met, yellow when criteria are within 0-5 percent over requirement and green where criteria is more than five percent over requirement. Final overlap analysis and drawings must be completed in CAD format as per Section 01 78 00 CLOSEOUT SUBMITTALS (as-built drawings).
- d. Include all relevant base layers such as stratigraphic units, embankments extent, abutment contacts, instruments, station/elevation grid, location of features that cross-cut the embankment, existing grout curtain, existing post-grouting water permeability data, top-of-rock, and other datasets as requested. Also include the [Koden-]calculated excavation and placement geometry of panels/secants, and [hydromill-]detected top-of-rock if data is collected.
- e. Visualize verification holes in the cutoff wall as line/polyline features, and concrete anomalies as point features with unique symbology for each type of concrete anomaly. See the Volume [_____] attachments for details.
- f. Hyperlink verification hole elements in GIS to Hvorslev plots, CCTV footage files, and OPTV/ATV logs.

][3.2.4 LiDAR Surveys

NOTE: Tailoring options are available here for
"DESKTOP GIS FILES".

3.2.4.1 Raw Data

Provide raw LiDAR data in .LAS format, including acquired LiDAR line strips and the SBET files with all EO information included. Calibrate raw files. [The .LAS files must include all returns, intensity data and RGB values.] Submit all raw data to the SFTP within [_____] [48] hours of generation.

Deliver mass point data utilizing .LAS [_____] [V1.4], containing all .LAS items of point data record format 1. The header file must contain all system-generated .LAS items as defined in the Public Header Block, and at a minimum must contain the "File Creation Year Day" and "File Creation Year" which will represent the final deliverable-generated .LAS date.

Specify the projection information for the point data in the Variable Length Record using the appropriate GeoTIFF tags.

3.2.4.2 Processed Data

- a. Noise-removed LiDAR point cloud (classified points) with return number in .LAS format. Break files up into approved tile scheme. [The .LAS files must include all returns, intensity data and RGB values.]
- b. Create Digital Elevation Model (DEM) using an appropriate interpolation method to produce [____][0.01] m [____][.3937008] in posting DEM for geologic foundations and slope monitoring surveys, and [____][1.0] m [____][3.28084] in -posting DTM for quantity surveys, however this resolution may be adjusted at the direction of the [COR][ACO]. Reference DEMs to the same horizontal and vertical datums as the .LAS files. Produce DEMs in GeoTIFF file format. Tiles must be edge joined and seamless within the project. Document interpolation and other data processing methods and provide in the metadata.
- c. Process geologic foundation datasets to produce vector features in GIS of all discontinuity and other structural rock features and of dental concrete.
- d. A sample symbology and visualization for monitoring survey deliverables showing cumulative displacement is provided in the Volume [____] attachments. Utilize this sample as the basis for showing changes to monitored areas over time.
- e. Provide project-based metadata for all final data products.
- f. Submit processed datasets within [____][7] days of conducting the field survey.

3.2.4.3 Reports

Produce a report for each foundation (horizontal and inclined surfaces or tunnel section), that includes all requisite metadata, quality control, field forms, the field checklist for foundation cleaning signoff showing data collection was not started until the [COR][ACO] confirmed appropriate cleaning had taken place, data collection technician and Government representative sign off that compliance with Section SURVEY CONTROL paragraphs LAWS AND REGULATIONS GOVERNING AERIAL DATA COLLECTION and SECURITY REQUIREMENTS were followed, and any other information as directed by the [COR][ACO].

For monitoring surveys produce a report including survey drawings showing cumulative displacement calculated between initial and most recent DEM datasets, and field notes, within [____] [48] hours of data collection. For displacement drawings, utilize a binning for features that captures [____][0.01] m [____][.3937008] in changes, and a symbology that makes these changes easily identifiable utilizing both raster symbology and contouring lines as necessary to achieve a high-quality visualization. Submit a final report of monitoring surveys at the completion of the project and prior to demobilization. Submit all quantity surveys conducted utilizing LiDAR in accordance with [____] SURVEY CONTROL.

]3.2.5 Orthoimagery

3.2.5.1 Raw Data

Provide the raw imagery exposures acquired (Stereo Pairs), the final aero-triangulation solution (Exterior Orientation EO files) in the format required, or as directed by the [COR][ACO]. Submit raw data to the appropriate folder of the SFTP within [_____] [48] hours of generation.

3.2.5.2 Digital Data

Orthorectify the imagery to create a digital mosaic for the entire project area. Employ software techniques to radiometrically process the orthophotos to ensure maximum tone and contrast balance between adjacent tiles. Document the techniques applied in the Data Management Plan.

Use the same tiling scheme from the LiDAR deliverables for each ortho deliverable, and provide the final 4-band digital orthophotos in uncompressed GeoTIFF format (.TIFF) with world files (.TFW) for each tile. Produce vector polygons in GIS of the dental concrete placed if collected with imagery. Submit all processed data to the appropriate folder of the SFTP site within [_____] [7] calendar days of generation for geologic foundations. Submit monthly site overview imagery within [_____] [48] hours of data collection.

3.2.5.3 Metadata

Project-level Metadata must comply with the current ISO Content Standards for Digital Geospatial Metadata including [ISO 19115-2](#). ESRI ArcCatalog, ArcGIS Pro, or script-based geoprocessing tools may be used to create the metadata records. Construct metadata records with sufficient quality to pass through the USGS Metadata Compiler with less than three errors. All products generated must be identified in the metadata.

3.2.5.4 Reports

Include in the report for each foundation part all applicable information for orthoimagery collection. Submit to the appropriate folder of the SFTP site within [_____] [7] calendar days from data collection.

]3.2.6 Bathymetric Surveys

3.2.6.1 Raw Data

Provide all field verified survey control monuments as digital data in US Survey Feet reduced to the nearest [_____] [0.3048] cm [_____] [.01] foot. Survey control must be provided in PNEZD format and submitted in comma-separated values (.csv) file extensions.

Provide all hydrographic elevation soundings and topographic shots (if applicable) as digital data in US Survey Feet reduced to the nearest [_____] [3.048] cm [_____] [.1] foot referenced to mean lower low water (MLLW). Provide point files in ENZ format and submit with ".xyz" file extensions for all multi-beam hydrographic soundings sorted into [_____] [30.48] cm [_____] [1] foot cell size, mean biased (on cell-center), with z values in elevation mode.

3.2.6.2 Processed Data

Provide [.dgn] graphics files and DEM files with [Bentley OpenRoads Designer; MicroStation SS10; Autodesk]. Create files utilizing a data-reduction and averaging technique submitted and approved in the Bathymetric Survey Plan. Additionally, provide all vector feature classes (in a file geodatabase) for topographic contours or other applicable features loaded to the GIS model and created to produce progress or as-built drawings.

3.2.6.3 Progress Drawings

Provide progress drawings for each survey made, showing the excavated surfaces, and as applicable benches, fractures, any blast damage and whether slopes are in or out of specification tolerance.

Include [____][15.24] cm [____][0.5] foot contours and use a continuous color symbology for the raster surface which clearly shows how the excavated surface is changing over time. Reference surfaces to the digital plan files provided at award. Include all pertinent Contract information in the title block. Include below the notes section all tables for survey limits, survey project control, and excavation limits. Submit one digital PDF of the drawing for each slope verification survey, and the final survey with the digital stamped/signature of the Certified Hydrographer. Submit all required drawings and data files with the submittal for payment.

]3.3 WEBSITE INTERFACE OF DATA

NOTE: The complexity of the web interface should be dependent upon the scale and complexity of the work performed. The requirements in this section should be added to the contract if there is any type of web interface utilized - they include general security, operability and system QA tools. The tailoring option for "WEB INTERFACE" is utilized for this section.

3.3.1 General

Visualize every element for which there are spatial coordinates, and provide construction verification and monitoring data and visualizations in a format constructed to maximize user comprehension of the data. [A mockup and tables of dashboard views, GIS alignments, specified plots, tables and GIS layers and group layers] are available in the Volume [____] attachments. The verification and monitoring goals are specified in this section throughout PART 3 EXECUTION [and in the Volume [____] attachments]. Show planned element layouts and positions for all designed elements within the Contract (such as [____][barrier wall elements, rock reinforcements, or drilling and grouting locations]), in their geospatial location, at their proposed location before construction begins. Show these same elements in their correct geospatial location after construction of each element is complete in separate layers. Symbolize planned, in progress, and as-constructed elements using the COR-provided symbology, or as directed by the COR. Include as many data fields in the feature attributes appearing in the viewer as practical. Append related data to geospatial features at [COR][ACO] request.

Propose any visualization substitutions in the 50 Percent Data Management Plan in accordance with PART 2, DATA MANAGEMENT PLANS AND ADDENDA. Where an alternative will be utilized, incorporate in the 100 Percent Data Management Plan submittal for approval by the [COR][ACO]. Provide a preliminary presentation of the **Web Interface** components in accordance with PART 1, SUBMITTALS, SD-01. Provide **Web Interface Updates** for any features where the interface needs to be updated, changed, or further developed due to major features of work starting later in the contract, in accordance with PART 1, SUBMITTALS, SD-10. Examine these goals and requirements, and where the specified item would increase the cost of the system substantially due to additional software licensing, or where there is a superior or more innovative solution, propose an alternative visualization or process that accomplishes the same goal.

3.3.2 Security Credentials

NOTE: Bracketed language is applicable to USACE personnel only. Verify this for any organizations outside of USACE prior to including in contract language.

Grant 24/7 read access to the Government, the Contractor, and any related subcontractors for this contract. Grant representatives of the Government any necessary username and password or other security credential for access no later than 30 days from the Notice to Proceed. The Government will provide a list of names and email addresses of users. [All Government employees can be assumed to have a ESRI Viewer license suitable for read-only access to ArcGIS Online map tools]. For new personnel requested by the Government throughout the contract, grant access and provide security credentials within 24 hours of the request.

3.3.3 Site Operability and Usability

Ensure the website is fully functional, current, easy to navigate, and complete with all data available for retrieval by both automated and manual methods. If the website does not meet this criteria, pertinent payments will be withheld until the issue is resolved and acceptable to the Contracting Officer.

3.3.4 User QA Feedback and Tracking

Provide graphic user interface forms on a web interface (can be a separate tool from the GIS viewer, but must still be linked/embedded via a tab or other integrated means into the main viewer) for any authorized user to provide direct feedback on the Contractor's database records, web interface, and SFTP site work including the ability to:

- a. Verify, flag for correction or masking, and accept data from the database tables;
- b. Submit corrections or updates needed to the GIS;
- c. Submit corrections or updates needed to the dashboard;
- d. Submit corrections or file updates needed to the SFTP site;
- e. Track the status of submitted requests including relevant related

information in a table which shows the following information:

- (1) Data management system (DMS) component the correction was requested for;
- (2) Date/time the request was submitted by the user;
- (3) The dashboard page, GIS model alignment and feature class, SFTP folder or other element the comment/request pertains to;
- (4) The narrative request entered by the user;
- (5) Requesting user's name or initials;
- (6) The status of the Contractor's response - i.e. "requested", "in progress", "resolved", and "expired resolution window". Script an automatic update of any "in progress" issues to "expired resolution window" when the 48-hour resolution window from the date and time of submission is exceed prior to the issue status being changed to "resolved".
- (7) Date of resolution;
- (8) Any resolution notes;
- (9) Initials of Contractor personnel making the correction.

f. Provide the ability to filter the information shown in the table based on items a, c, and e above. Make any requested corrections or updates to data records or displays within 48 hours of the request. The Government will provide a list of authorized users for accepting and flagging database records, however submission of comments on the rest of the DMS components must be available to all Government project personnel.

3.4 WEB-BASED GIS INTERFACE

NOTE: Tailoring option "WEB-BASED GIS INTERFACE" is employed for this entire section.

Provide a secure GIS interface per PART 2, "Web-based GIS Interface" which meets the following minimum criteria:

- a. Produce dynamic views of data in 2D plan view, profile view, section view and 3D, and integrate CAD and BIM elements to these views as appropriate to depict constructed components in correct geometry and geospatial location. Incorporate alternative alignments and static section views as specified in the Volume [_____] attachments or as requested by the COR;
- b. Symbology of represented data in the GIS must be changeable upon request by the Government, but does not need to be editable inside the web environment. Complete requested symbology, filters, or other display changes within 24 hours of the request. Provide symbology for progress to represent "planned", "in progress" and "as-built" such that specific subcomponents of the structures (i.e. [cutoff wall bites and panels, control tower lifts, outlet works lifts]) can be tracked

for progress with this layer. Additionally for all testing data displayed in the GIS, provide a symbology for passing, failing, and passing re-test (or as directed by COR);

- c. Include a well-organized table of contents for the GIS viewer windows with the capability of turning layers and groups of layers on and off;
- d. Group relevant layers in the GIS table of contents together by features of work as specified in the Volume [_____] attachments (e.g. [instrumentation, geotechnics, designed structures, blasting (plan and report), cutoff wall, tunnel, control tower, excavation, monitoring]);
- e. Apply scaling labels to features so that at an appropriate scale the labels appear, but never overwhelm the view. Include the ability to turn labels off. Apply one feature class in each view with labels that always appear as a reference for the user for orientation such as a station line or other primary project location reference;
- f. Include a self-serve function for downloading the most data associated with a selected feature in the web browser;
- g. Provide a standard, off-the-shelf option to generate a PDF map from the current view in any GIS viewer alignment. The PDF must be of a formatting quality suitable for including in reports, for example the frame must be centered and in an appropriate size on the page, and contain a legend for all elements included. The Government may request any structural changes to the graphical displays of data at any time. Complete any requested changes within 48 hours of the request.
- h. Include links to static documents and plots where documents are associated with a single location or location range - for example: photographs, PDF QA/QC reports, scanned handwritten documents and logs in PDF, PDF checklists, PDF or JPEG sample tickets, PDF test reports, grout plots, water pressure test results, and other important documents as directed), final submittal packets, interactive reports such as concrete breaks or other reports listed in this specification, and As-built or Progress Drawings for construction elements within this system. Set up the links using hyperlinks as specified or other techniques proposed by the Contractor in the 50 Percent Data Management Plan, and approved by [COR][ACO] in the 100 Percent Data Management Plan.

For reports (e.g. pdf's, photos, field form scans, and others) that are approved by the Government's data manager, provide a location on an anonymized external web folder such that the user does not have to provide user credentials to access each hyperlink. Examples of this type of data include [boring logs, verticality reports, or items for pay]. Hyperlink all documents which contain any structural schematics or information about distress in the embankment or structures directly to the SFTP site so that secured access is maintained. The [COR][ACO] will direct which additional datasets may be sensitive. Any document determined by the [COR][ACO] to contain sensitive information must be password protected.

- [i. Provide the option of a storymap/operations dashboard style format with embedded GIS and summary statistics for QC testing data;
-] j. Make new spatial features available in the ArcPortal environment within 24 hours of generation;

- k. Make other data available within 24 hours of generation, or as specified in other sections of the contract.

3.5 SYSTEM TESTING

Provide a test of the data management system within 30 days prior to the start of production data generation. This includes loading dummy records to all fields of the database and feature services, and verifying that the data is correctly appearing in the digital delivery products required by the Contract.

Clearly mark all dummy records as such within a record tracking field of the database. Once the test has been successfully completed, remove the dummy records from the database. Provide documentation of the test conducted including the following:

- a. Date the test was conducted;
- b. Name(s) of person(s) conducting the test;
- c. Specific steps conducted in order to test the system including a brief narrative explanation of the purpose of each step;
- d. The results of each test step;
- e. Any actions that were taken to achieve an acceptable test result which include a final operational system;
- f. Documented support including any screenshots necessary to demonstrate that the system is operational according to the requirements of this specification.
- g. Date and verification all/only dummy records were removed from the database.

3.6 DYNAMIC DATA WEB INTERFACE

NOTE: As with other elements of the data system design, the graphical data visualizations the Government wants need to be communicated clearly to the Contractor. Each specialty subcontractor may know what is expected from their specific work, but only the project personnel know what Government requirements need to be evaluated during construction and for post construction risk assessments (if applicable). If specific web interface visual formatting (e.g. item "i" above- or other specific views of certain data streams, ESRI storymap formats, or integrated data visuals and ESRI maps, the specification will need to be very detailed and prescriptive about what is wanted, and it is good to provide any additional attachments needed to clarify the Government's intent.

The tailoring option for "DYNAMIC DATA INTERFACE" has been employed for this entire section.

Provide functionality within the web interface platform to provide dynamic views of data plots, charts, graphs, tables, widgets, and other formats as directed by the COR. Visualization must meet or exceed requirements, deviations in style and navigation controls are acceptable however must be approved by the Government in the web viewer approval. The initial plots

and other formats will be provided in the Volume attachments. The spatial web interface must meet the following criteria at a minimum, and must add other criteria as directed by the COR:

- a. Build the plots and other data-displays for each feature of work as specified in the Volume attachments. As work progresses the may request additional plots or data displays based on specific issues encountered. Add new data displays within 48 hours of the request;
- b. Provide the ability to adjust scales on the data displays, or update scales as requested by the COR, and complete requested changes within 24 hours;
- c. Provide the ability to select data to be displayed (e.g. by groups of features, location, feature of work, and others as pertinent to the work) and to filter the data by crucial elements such as date range, feature subpart or other elements as directed by the COR.
- d. Symbolic and color components of display, and scales or binning of values (where applicable) must be changed at [COR][ACO] request. Complete any requested changes within 24 hours;
- e. Include an intuitive, well-organized, graphic user interface for navigation between and within the spatial and dynamic data portions of the website, and for hosting the user guide, recorded trainings, and user input forms for system QA;
- f. Provide the ability to view relevant data displays together for ease of access and comparison. Specific requests are listed in the Volume [_____] attachments;
- g. Provide legible symbology and legends for all plots, and label axes, axis points, and data points on displays as appropriate to balance the need for information with the need for comprehensible display. Apply scaling labels to features so that at an appropriate scale the labels appear, but never overwhelm the view - or so that labels appear when the mouse hovers above a plotted point/bar, or other feature. If the option for the user to turn labels on or off is available in the application, employ it. Make changes to symbology, scaling, labeling, and/or erroneous data masking when requested by the [COR][ACO] within 24 hours;
- h. Script the connection of data displays to the Contractor's EDB, so that data is updated to the visualizations within 10 minutes of an update to the EDB;
- i. Provide a method to create printed products with legends.

3.7 DESKTOP GIS FILES

NOTE: For software products such as ESRI ArcGIS, make sure to look up the version that is most currently available to the organization and fill it in. It is advised to have the contractor utilize software that is already FedRAMP approved and widely available to all Government technology users via an enterprise license. Allowing the contractor the

flexibility to use their own choice of software may result in a product that cannot be used by the project.

The tailoring option for "DESKTOP GIS FILES" had been employed for this entire section.

Build the ArcPro GIS project to contain geospatial data such as feature classes in geodatabases, rasters (e.g. DEM, DTM, .GeoTiff, .Tiff), point clouds, and other applicable geospatial file formats. Display all elements associated with the 3-dimensional location in this environment and include all associated attribute data. Build plan and profile views, any special section or other views, and 3D view as detailed in the Volume [_____] attachments. Add all data from EDB tables with associated spatial components, feature classes, rasters, imagery or CAD layers visualized in the simplified GIS as layers within this project package.

Publish updates of element progress or geometry/location changes, to the web-viewer within 48 hours of field generation of the data. Update the .aprx, .gdb(s), and raster datasets to the SFTP within 24 hours of an update (i.e. nightly when daily changes are occurring). Complete metadata fields for each feature class within the feature class and in a separate document according to the metadata standards specified in PART 1, Geospatial Metadata. Upon completion of the contract, complete metadata documentation and deliver to the Government finalized .aprx, .gdb, raster and other applicable files in the closeout submittal **Final GIS Files**.

3.8 FIELD DATA COLLECTION

NOTE: This requirement should be utilized when digital data collection in the field is needed by the Government and the Contractor is administering the database and all visualizations in a web viewer throughout the contract. The Government can develop and use the app forms themselves, however the Contractor needs to provide a method for ingestion and display of this data into the viewer.

The tailoring option for "WEB-BASED GIS INTERFACE" has been employed for this entire section as this work will only be utilized in association with a GIS viewer.

Provide a method for Government input of data into the project database and GIS web interface through the use of custom forms in an off-the-shelf app designed for use Survey123 or Collector, or a similar app accessible by the Government. Work with the Government's data manager to develop any additions to the database schema, spatial and dynamic data layers on the web interface, EGDB, and workflows for the input and visualization of this data not already detailed in this specification and attachments. If the Contractor will build the app forms and provide the ESRI account, the [COR][ACO] will provide the necessary information required for the Contractor to create the app fields and GIS features no later than 30 days prior to the start of data collection.

3.9 DATA MANAGEMENT PLAN

**NOTE: Tailoring options are available for "SQL
RDBMS EDB" and "ACCESS ENTERPRISE DATABASE".**

Submit the 100 Percent Data Management Plan within 30 days of the data management planning meeting, and update at least every six months for the duration of the Contract to include any changes or updates to any part of the data management system. Attach all data submittals or plans required as submittals in PART 1, SUBMITTALS SD-01 as addenda to the 100 Percent Data Management Plan. The Data Management Plan must include:

- a. A data flow diagram describing Contractor's Data Management System including each data source type (e.g. raw data, raw appended data, analog field data, digital field data), and processes for structured and unstructured data collection and aggregation.
- b. A table of all datasets generated during the project that includes: raw data format, data generation method, identifying the data generation system if digital or automated, necessary data transformations, data appending, estimated start date of data collection, and description of the data transfer process to the EDB and/or SFTP site. If data management is subcontracted, the primary Contractor must coordinate with all applicable subcontractors to provide all necessary information for the completion of this table.
- c. Descriptions of components of the data management system including software used to create, store, transfer, process, analyze or visualize data.
- d. Naming conventions utilized as detailed in PART 1, Naming Conventions.
- e. Identify and describe data recording and gathering software and hardware (e.g. make, model, version and manufacturer) and the raw data file formats it produces.
- f. Documentation of any formulae, queries, scripts, and macros used to calculate fields. Present the information in an organized and methodical format.
- g. A realistic estimated (50 percent)/agreed (100 percent) schedule for data collection and upload frequency for each data source if different from what is required in Part 1, Data Turnover Timeframes.
- h. A list with screenshots or written details of the visualizations and verification reports to be utilized as agreed in the data management planning meeting. The Contractor may propose better or more cost-efficient ways to show what is needed than what the Government required in the 50 Percent Data Management Plan submittal. These changes must be reviewed in the data management planning meeting and approved in the final 100 Percent Data Management Plan submittal.
- i. Explain how automated data that is obtained directly from field sensors by various subcontractors will be integrated into the web-viewer. Examples of this data would be automated instrumentation data, seismic data, and concrete thermal data;

- j. Enterprise database documentation including relationship diagrams, data source tables, and database schema including fields, field types, units, precision, views, and other pertinent data as directed. If new tables, fields, relationships or views are added to the EDB (as described in PART 3, Documented Enterprise [SQL][MS Access] Database, the changes must be reflected in the schema, and added to the Data Management Plan in an addendum table titled "Schema Changes". This table must show all information about each change and the date the change was effective in the EDB.
 - k. A table of names, roles and contact information for the data management personnel. Include one person for each feature of work identified from each subcontractor that will serve as the POC for technical data questions and problem-solving. Update when personnel changes.
 - l. Approved data transfer and data QC report format.
 - m. Approved Photograph PDF format.
 - n. All proposed and approved changes to any component of the data management system.
 - o. At no more than 6-month intervals, incorporate all changes into the main document and resubmit to COR. Resubmission is also required when a revision to the Data Management Plan is issued due to design after award components, or other such significant changes or additions to the EDB schema and visualizations. Resubmittal may occur after all additions for each such approved feature of design/work have been completed.
- Ensure all final documentation of the EDB and other components of the data management system have been documented prior to a final closeout submission of the Data Management Plan.
- p. Maintain all data plans listed in PART 2, Addenda to the 100 Percent Data Management Plan and submitted per PART 1, SUBMITTALS SD-01 Preconstruction submittals as addenda to the Data Management Plan. Updates to these plans must be reflected in [Data Management Plan Updates](#).

3.10 FEATURE OF WORK DATA COLLECTION PLANS

NOTE: The following plans are provided in case the specification section associated with the feature of work does not contain the plans. It is more appropriate for these data collection plans to be located within the corresponding feature of work section.

This entire section is part of the tailoring option "ADDITIONAL DATA COLLECTION PLAN SUBMITTALS".

3.10.1 Automated Grouting And Water Pressure Testing Data Collection Plan

No later than [____][90] days prior to the commencement of the work,

submit a detailed description, name, manufacturers name, specifications, sample outputs, and sample MS Excel-compatible data files generated by the Automated Grouting and Data Collection Systems to be used during grouting and water pressure testing. Name and provide product specifications for all software products used to control or process data from the automated grouting system(s). Additionally, name and provide specifications for any proprietary software required for gathering, processing, or viewing the automated data. Specifications for commonly used software such as Microsoft Office, Adobe Acrobat, or other similar programs are not required. Include descriptions of all mathematical operations and formulae contained within the software that are related to output files, such as the method for calculating the effective pressure. Provide calibration certificates for all instruments measuring pressure and flow.

3.10.2 Remote Sensing Data Collection Plan

No later than [____][90] days prior to the start of data collection, propose a methodology and plan for the collection of [____][LiDAR][orthoimagery][photogrammetry] in accordance with the data requirements specified for [____][geologic foundations, routine monitoring, site progress, quantities], or for any other purpose that would impact the resolution and accuracy of the data collection. Organize the plan into separate sections for each method, and only combine sections applicable to both such as ground control and datums. Include the following at a minimum:

- a. Data acquisition methods, workflow onsite, and how the data collection will be coordinated with construction activities and the brief window of time in which data may be collected;
- b. Identify a designated lead in charge of mobilization, planning, and the coordination of activities with other elements of construction (e.g., foundation preparation and concrete placement) and define responsibilities in detail;
- c. Identify roles and responsibilities of all personnel involved in the data collection and processing effort;
- d. Data collection, classification, and other parameters to be employed as applicable (e.g., pulse rate, scanner frequency, point density or other parameters) in order to produce data to specified requirements;
- e. Product delivery formats - list each product;
- f. Metadata fields to be collected and provided and metadata format;
- g. Ground control and accuracy standards;
- h. Calibration testing methodology(s), equipment calibration schedule, and certificates/proof of calibration;
- i. Proposed equipment for the collection of datasets including manufacturers specifications, catalog cuts and any applicable regulatory or calibration certificates/records for the specific equipment used;
- j. Description of internal verification quality control processes;

- k. Data processing workflow and methodologies for converting raw data into post-processed data products;
- l. Data validation processes;
- m. Pre-processing and accuracy check;
- n. Processing quality control;
- o. Product delivery workflow and quality control;
- p. Propose a tile scheme and size for deliverables.
- q. Propose a sample monitoring survey symbology for visualizing cumulative change detected if applicable.

3.11 OPENGROUND CLOUD DATABASE AND RECORDS

NOTE: This section applies to USACE projects only - USACE uses OpenGround Cloud for drilling data. Delete the tailoring option for OPENGROUND if used by other agencies.

This requirement should be used for USACE projects where the technical specification requires drilling and core logging as part of the performance of work, and the submittal of associated boring logs. Some features of work which may require it are geotechnical investigations, blasting, grouting, drilled shafts (pilot holes).

This entire section is part of the tailoring option "OPENGROUND".

3.11.1 Digital Logging

The Contractor is encouraged but not required to utilize tablets in the field for borehole logging, with the software Dataforensics pLog, which is seamlessly integrated with Bentley OpenGround to import data from the field into the database. If a digital data-gathering device is utilized, apply the same record tracking requirements and data loss prevention standards as described in PART 1, Backups, Archiving and Disaster Recovery and Record Tracking Requirements. Load raw data files from the device to the SFTP site in .csv format in accordance with the turnover times stated in PART 1, Data Turnover Timeframes. The Contractor must be able to produce a written or printed backup of field data in case an equipment malfunction causes a data loss. In the event of a data loss, the Contractor is responsible to re-log the hole from the core, and must take all necessary steps to ensure the data has been captured prior to core disposal or storage as applicable. Store legible scans of these logs on the appropriate location of the SFTP site in PDF format within 48 hours of completion of the hole.

For digitally collected logs, the geologist who completed the logs must perform the required verification QC of the data in the database, and the Government-approved digital log format must be used to produce PDF's of the logs for submittal according to the same requirements as manually

completed logs.

3.11.2 Manual Logging

If logs are completed manually, manually, enter the data into the OpenGround cloud database within 48 hours of the hole being drilled. The geologist who logged the hole must perform the data entry for continuity, and a separate geologist must perform the QC verification of the data in OpenGround within 96 hours of the hole being drilled.

3.11.3 Data Entry and PDF Drill Logs

For data entry into OpenGround, utilize fields with dropdown lists where applicable. Only use additional descriptions for text entry of data when a dropdown list for that feature does not exist. Verify there is no applicable field for a feature before using the Comments/Remarks fields in any table to enter data.

Produce PDF logs of each hole from the Cloud, and place on the SFTP site within 24 hours of hole entry into OpenGround, and submit in accordance with requirements in [____][Section 02 32 13 SUBSURFACE DRILLING AND SAMPLING]. Submit a notification to the Government that the **Finalized OpenGround Cloud Borehole Database** is ready for review in the cloud environment within 96 hours of the final hole for the project being drilled.

3.12 DATA MANAGEMENT MANUAL

NOTE: Tailoring options are available in this section for "DESKTOP GIS FILES", and "WEB-BASED GIS INTERFACE".

Within 90 days of the last record update to the EDB and prior to demobilization, submit a final Data Management Manual. Incorporate as part of this manual the following:

- a. All sections and contents of the final Data Management Plan, with the information updated to the end of the contract;
- b. Final documentation of the EDB including all metadata, data dictionary and entity relationship diagrams (including table names, field names, table fields, and relationships between these tables, added field definitions), views/queries, macros, scripts (except those used as interim tools and not applicable for archiving), summary tables, formulae used to calculate values or automatically assign categories (e.g. Pass or Fail based on a number or criteria from another field), data source documentation, units, and file structure for all hyperlinked or referenced documents such that these links and references can be used once the EDB is installed on the [COR][ACO] network;
- c. An index and description of all components of the Desktop GIS model, including all elements contained in the .apr and .gdb(s), and any separate metadata documentation;
- d. A detailed index of the published feature classes organized in the table of contents of the web-hosted GIS model;

- e. The submitted and approved final index of the SFTP site contents by file structure - described in Part 2, SFTP SITE.

3.13 FINAL EDB TURNOVER

NOTE: Tailoring options are available in this section for "SQL RDBMS EDB" and "ACCESS ENTERPRISE DATABASE".

Notify [COR][ACO] when the EDB is considered final with all data being uploaded and finalized. Submittal of the [Finalized Enterprise Database](#) includes complete backup files from the [\[SQL RDBMS\]\[MS Access\]](#) database and separate .csv files of the final, fully documented [\[SQL\]\[MS Access\]](#) EDB tables containing all project data. Transfer must take place via the SFTP site prior to demobilization and within 60 days after the final record has been added to the database. The final database structure and contents are subject to the same QC requirements for final data verification and integrity, and must be approved by the [COR][ACO] prior to the final payment for data management. Host the final EDB for 6 months after transmitting EDB documentation, or until Contract closeout, whichever comes first.

-- End of Section --