



**US Army Corps  
of Engineers®**  
Engineer Research and  
Development Center



*The CAD/BIM Technology Center for Facilities, Infrastructure, and Environment*

## **Record Package Guidance**

### **Best Practices**

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# Record Package Guidance

## Best Practices

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## Abstract

The CAD/BIM Technology Center receives numerous questions throughout the year regarding the development of a Record Package that shows as-built conditions. While the Center does produce Standards on the look and organization of CAD drawings that are used to show as-built conditions, users wanted guidance on the Record Package development. The Chicago District had undertaken the development of such guidance, but a formal document was never officially released. The CAD/BIM Community of Practice (CoP) Work Structure Committee finished this guidance and their efforts are reflected in this document.

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## Preface

Originally, this document started as a District joint venture, led by Mr. John A. Groboski at the Chicago District. Thanks go to Mr. Groboski and his team for their initial efforts.

This study was updated and revised for the CAD/BIM Community of Practice (CoP). The technical monitor was Mr. Jason C. Fairchild, U.S. Army Corps of Engineers – Headquarters (USACE-HQ).

The work was performed by the CoP Work Structure Committee , which is comprised of: Mr. Roger J. Fujan, U.S. Army Engineer District, Walla Walla; Mr. Carl A. Broyles, U.S. Army Engineer District, Kansas City; Mr. Gerald L. Piotrowski, U.S. Army Engineer District, Louisville; Mr. Justin L. Jameson, U.S. Army Engineer District, Seattle; Mr. Brian M. Baker, U.S. Army Engineer District, Pittsburgh; and Mr. Stephen C. Spangler, U.S. Army Engineer Research and Development Center (ERDC), Information Technology Laboratory (ITL). At the time of publication, Ms. Mariangelica Carrasquillo-Mangual was Chief of the CAD/BIM Technology Center Branch; Dr. Jacqueline S. Pettway was Acting Chief of the Software Engineering and Informatics Division; and Dr. Robert M. Wallace was the Technical Director for the Engineered Resilient Systems Research and Development Area. The Deputy Director of ERDC-ITL was Ms. Patti S. Duett and the Director was Dr. David A. Horner.

COL Teresa A. Schlosser was the Commander of ERDC, and Dr. David W. Pittman was the Director.

# 1 Introduction

The purpose of this document is to provide guidance on the preparation of a high-quality Record Package that conveys as-built conditions at the completion of a construction project. An accurate Record Package is very important for project operation and maintenance and future modifications, particularly for project features which are hidden from view.

The process of utilizing the original As-Designed Package as the basis for the As-Built Package is documented. The As-Built Package is revised to show all additions, deletions or other changes made to the project during construction to create the Record Package.

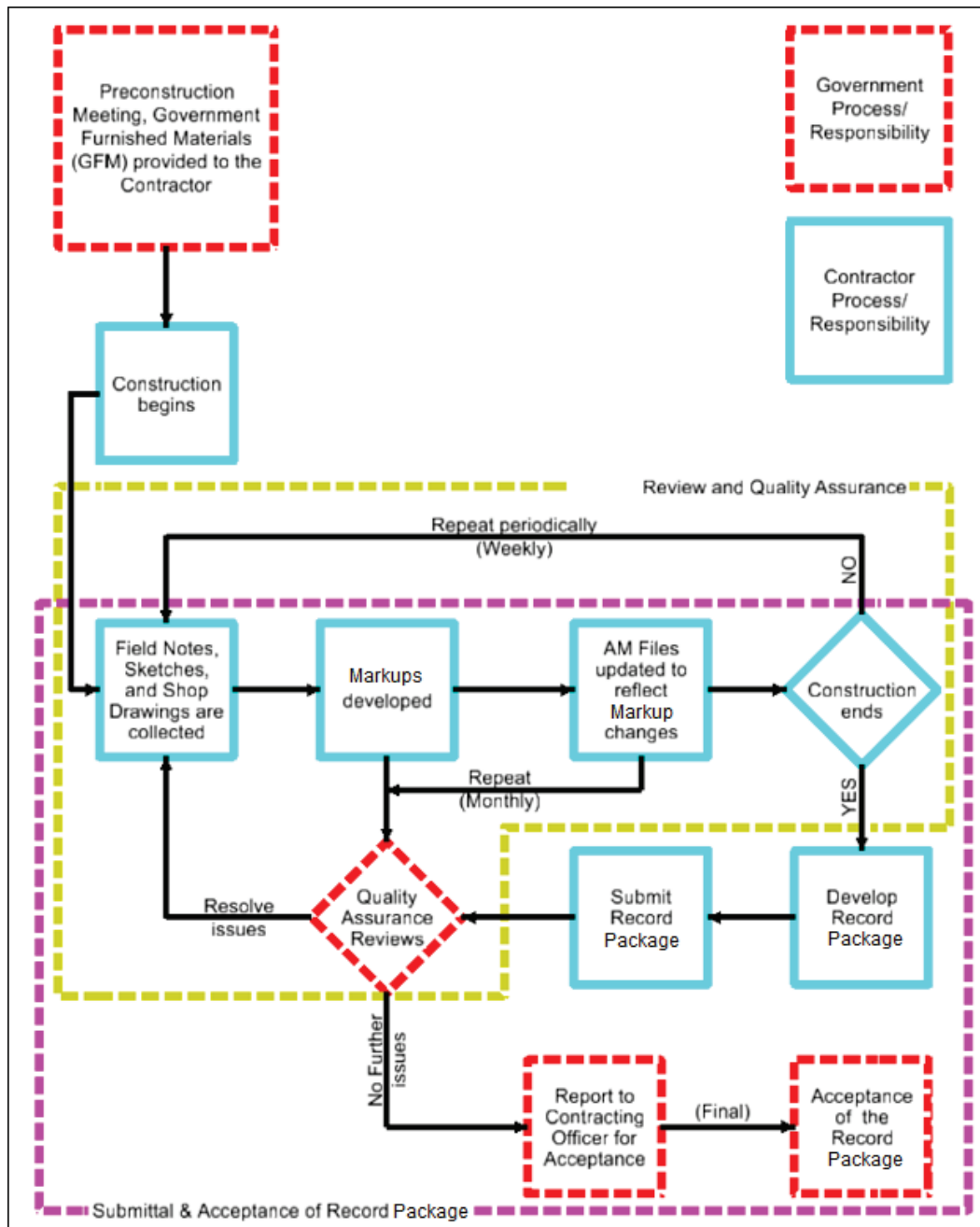
This is not intended to supersede or replace any requirements set forth in the Contract Specifications but is intended to provide guidance on meeting those requirements. For the complete As-Built and Record contract requirements see 'Section 01 78 00 - Closeout Submittals' of the Contract Specifications.

## 2 General Procedure – Development/Delivery of As-Built and Record Packages

1. **Provide Government Furnished Material (GFM)** - The Government will provide the GFM at the preconstruction conference.
2. **Review of GFM** – Contractor will review the GFM utilizing the most current USACE Advanced Modeling Submittal Review Checklist (CHX) and USACE Advanced Modeling Submittal Review Checklist Guide. Any discrepancies shall be reported to USACE immediately for resolution.
3. **Markups** - During construction, the contractor uses the Digital Drawing Files to indicate revisions (changes, additions, or deletions) reflecting as-built conditions.
  - a. The contractor shall Markup the Digital Drawing Files as required by the Contract Specifications.
  - b. Based on the Markups, the contractor shall update the Advanced Modeling (AM) files.
4. **Quality Assurance (QA) of Markups** - The designated government representative(s) performs a QA review of the Markups and the AM files as described in the Contract Specifications.
5. **Submittal of As-Built Package** -The contractor shall submit updates that show the as-built conditions of the project as required by the Contract Specifications (minimum 50% construction milestone and at construction complete).
6. **Quality Assurance of As-Built Package** - The designated government representative(s) performs a QA review of the As-Built Package. From the review, the designated government representative(s) consolidates government comments identifying issues that need to be resolved prior to government acceptance.
7. **Resolve Issues with As-Built Package** – Contractor shall address, resolve, and document all issues identified by the government during review as required by the Contract Specifications.
  - a. **Note:** It is sometimes necessary to perform several iterations of the review, comment, and resolution process prior to acceptance.
8. **Acceptance of As-Built Package** – When the government determines that the As-Built Package accurately represents the changes depicted in the Markups, the As-Built Package may be accepted.

9. **Record Drawings** – As required by the specifications, Record Drawings are derived from the accepted Record Package.
10. **Record Digital Drawing Files** – PDF formatted Record Drawings.
11. **Acceptance of Record Package** - When the Government determines the contractor has met the requirements of the Contract Specifications, the Record Package, consisting of the accepted As-Built Package, Record Drawings, and Record Digital Drawing Files, may be accepted.

Figure 1. Record Package procedure flowchart.



## Government furnished materials

At the Preconstruction Meeting, GFM will be provided to the contractor which includes the As-Designed Package. The delivered GFM may or may not be in the software required for Record Package submittal. The As-Designed Package is provided to enable preparation of the As-Built Package. If discrepancies exist between the As-Designed Model and the Digital Drawing Files, correct the As-Built Package to reflect the contract Digital Drawing Files.

## General guidelines

During construction, the contractor uses the Digital Drawing Files to make revisions (changes, additions, and/or deletions) reflecting as-built conditions. Revisions are to be transcribed to the As-Built Package and are to include, but not be limited to, the following list:

- Correct grade, elevation, cross-section, or alignment of roads, earthwork, structures, or utilities if revised from the Digital Drawing Files.
- The topography, invert elevations, and grades of drainage installed or affected as part of the project construction.
- The actual location of existing and new subsurface utility lines including valves, splice boxes, etc.
- The location of unusual or uncharted obstructions that are encountered in the contract work area during construction.
- Location, extent, thickness, and size of stone protection (particularly where it is normally submerged by water).
- Changes in the design, dimensions, specifications, or locations of project features and/or equipment.
- Actual location of features (e.g., anchors, joints) in concrete.
- Any sketches to be prepared or furnished by the contractor (e.g., fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations).
- Systems designed or enhanced by the contractor (e.g., HVAC controls, fire alarm, fire sprinkler, irrigation systems).
- If borrow material for the project is from sources on government property, or if government property is used as a spoil area, the contractor furnishes a contour map of the final borrow pit/spoil area elevations.
- Actual depths of new subsurface utilities.

- Layout and schematic sketches of electrical circuits and piping.
- Correct dimensions and details transferred from shop drawings.
- Changes or modifications that result from the final inspection.

## **Markups**

An As-Built Package and Markups are part of the permanent record of the contract and will be retained by the government upon acceptance. During the execution of the work, Markups shall be maintained. These will show the current as-built conditions, changes that are made in the work, and additional information uncovered during construction. As changes occur, update the working As-Built Package and make available upon request from the government. Utilize the following colors on Markups:

1. Red – Deleted graphics, including text in notes and leaders.
2. Green – Added items, including text in notes and leaders.
3. Blue – Items requiring clarification, including text in notes and leaders (these items may or may not be incorporated into the As-Built Package).

## **Shop drawings**

All shop drawings are included in the As-Built Package. Refer to the Contract Specifications for complete requirements on shop drawing acceptance. These do not have the same CAD and Graphics Standards requirement as the contract and record drawings.

## **Guidelines**

The number of Markup sets that must be maintained and the frequency at which they must be revised is provided in the Contract Specifications. Typically, revision of the Markups is performed on a weekly basis; at a minimum, at least one Markup set is always on-site as required by the Contract Specifications.

Markups occurs on the current working Digital Drawing Files. If a Contract Modification requires revised sheets during construction, an up-to-date version would be included in the Markups. The Sheet Index would be revised to reflect the addition, deletion, or renaming of any sheets in the set.

Revisions to the Markups include legible, written explanations to assist in the conveyance of the graphical intent and to clarify any ambiguities. The contractor ensures all text is clear and concise. When revisions are made, the contractor ensures that the As-Built Package and all associated views (e.g., sections, details, plans, profiles, elevations, sheets) and data are revised accordingly. In addition, it may be necessary to revise legends, schedules, notes, and call-out designations. When revisions require deletions, ensure that all features and associated data and captions that relate to the revisions are marked accordingly.

It may be necessary to make revisions on Sketches where space is restricted. In this event, developing large scale sketches with leaders to the location where applicable may be necessary. When attached Sketches are included with the Markups, indicate whether:

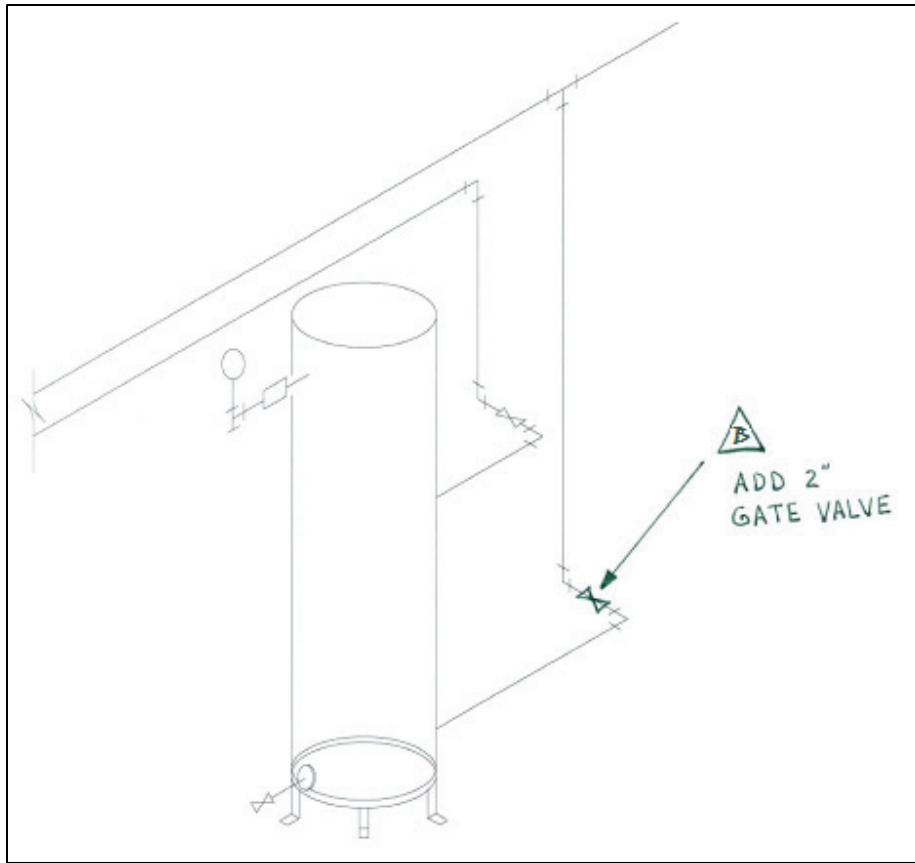
1. The working As-Built Package requires revision,
  2. Additional Sheets should be added to the set, or
  3. The Sketch has been provided for further detail and is for reference only.
- When Sketches are required, ensure that adequate detail is provided to allow for revision of the working As-Built Package or the development of additional Sheets.

**Note:** Refer to the A/E/C Graphics Standard, section 7.2 “Revision graphics” for information on revision symbols and their use.

When several items in a table or view (e.g., sections, details, plans, profiles, elevations, etc.) are changed or completely redrawn, a single revision symbol is placed near the title for the table or view. This same method is used for general revisions to entire sheets when a major portion is changed.

If only a few items are revised, added, and/or deleted, a revision symbol is placed near each item requiring revision (see Figure 2). Each revision symbol contains an identification letter that corresponds to an entry in the Revision (Issue) Block that describes the revision.

Figure 2. Use of revision symbols for additions.



Revision of Markups require entries into the Revision (Issue) Block of the Title Block (see Figure 3). Each entry contains a description of each revision on the sheet and lettered in alphabetical order (going from bottom to top). In the event the Markup already includes lettered revisions, the next alphabetical letter is used.

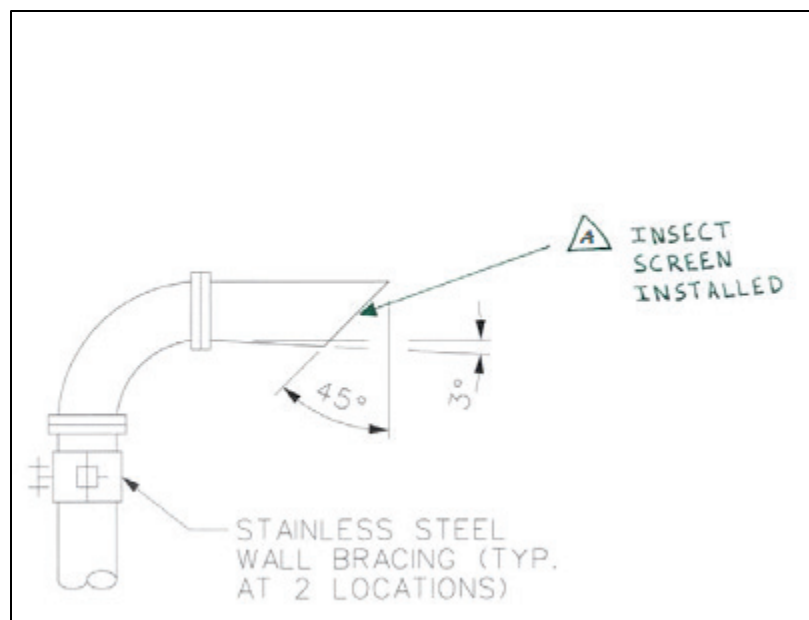
Figure 3. Example of Revision (Issue) Block.

Mark	Description
D	Move Air Relief Valve to STA 8+95
C	DRAIN REMOVED
B	ADD 2" GATE VALVE
A	INSECT SCREEN INSTALLED

### Additions

When revisions require additions to the Markups, the additions are indicated with green graphics and text. The revision is identified with a Revision Symbol and includes graphics, dimensions, and notes describing the addition (see Figure 4). Revisions are documented in the Revision (Issue) Block with a green letter and description of the addition.

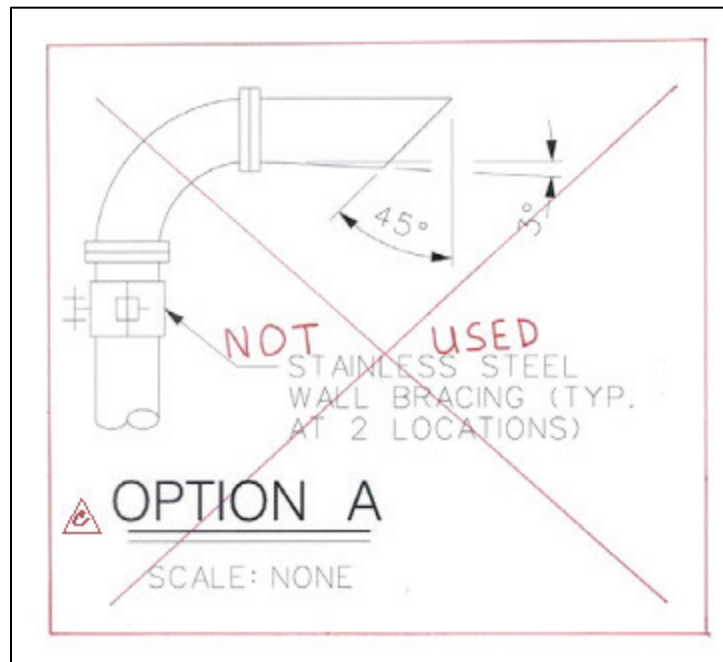
Figure 4. Markup addition.



### Deletions

To indicate a feature was not constructed, installed, or implemented, red Markups are used to identify the associated graphics and text as deleted on the Markups. Graphics and text associated with deleted features are crossed out (X) or marked through. To show a view (e.g., sections, details, plans, profiles, elevations, etc.) or design option is not being used, draw a red box around the view or design option, place an “X” across the box and write “NOT USED” within the box (see Figure 5). In addition, a lettered Revision Symbol is provided inside the box along with notes (if needed) to describe the deletion. Deletions are documented in the Revision (Issue) Block with a red letter and description of the deletion.

Figure 5. Markup deletion.



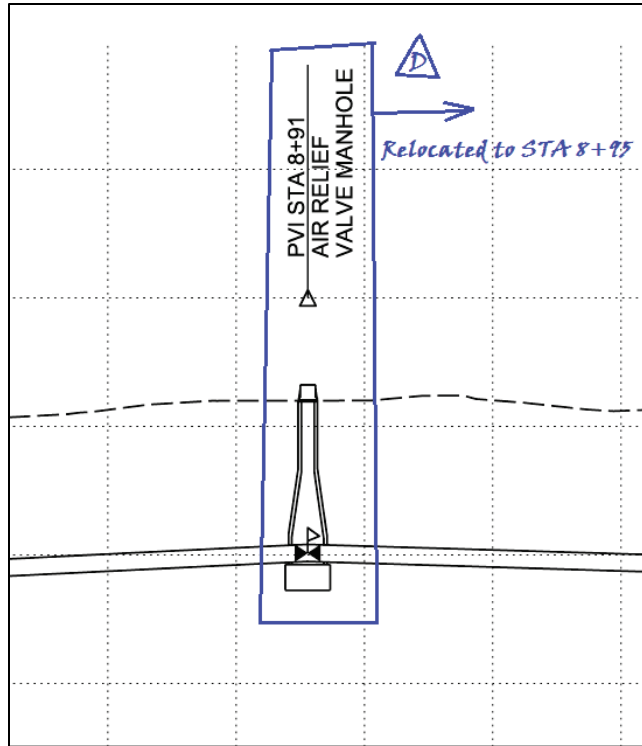
### Relocated features

Relocated features are identified on the Markups and identified by drawing a blue box around the entire feature. A note including specific details to describe the new location will also be needed.

Within the box, the text “RELOCATED” is written and a Revision Symbol is provided in blue. The relocation is documented in the Revision (Issue) Block, also in blue.

If necessary, all connections for the relocated feature (e.g., wiring, piping, duct work, utilities) are revised to accommodate the relocation.

Figure 6. Markup relocation.



### **3 Revision of As-Built Package and Drawing Files**

#### **A/E/C Standards**

All revisions to the As-Built Package and As-Built Drawings, including any additional sheets added, shall conform to all A/E/C Standard requirements outlined in the Contract Specifications.

The A/E/C Standards listed in the Contract Specifications include details on Drawing File Organization, Graphic Concepts, Level/Layer Assignments, and Standard Symbolology.

#### **Guidelines**

The As-Built Package is the GFM that are revised during construction to show current as-built conditions to reflect changes shown on the Markups. Typically, revisions to the As-Built Package Files are performed on a weekly basis.

When revising the As-Built Package Files, care is taken to maintain the same folder structure, file structure, file format, file naming convention, and Standards utilized in the delivered GFM.

In order to revise the As-Built Package, the entire folder structure and files provided with the GFM are copied to the contractor's project network/folder location. The folder structure at this location is then maintained throughout all revisions so they match the original GFM. If a revision requires additional Sheet and/or Model files, the new files are added to the folder structure in the appropriate location. Conversely, if a revision requires the deletion of existing Sheet and/or Model files, these files are permanently removed from the As-Built Package folder structure.

It is very important to ensure that the Sheet and Model reference relationships provided with the GFM are maintained when revising As-Built Package Files. In addition, the contractor ensures there are no broken reference links and only the required Model files are referenced to the Sheet files. If a revision requires the addition of Sheet and/or Model files, the reference relationship for new files remain consistent with the folder structure used in the GFM. If it is necessary to delete Sheet and/or

Model files, reference relationships are updated to reflect these changes (e.g., remove the reference to the Model files from the Sheet Files if they are no longer needed).

The file naming convention used in the GFM is maintained when revising the As-Built Package Files. Use the Project Code portion of the file name provided with the GFM. Examples of the Model and Sheet file naming conventions are in the A/E/C CAD Standard.

Sheet content (including graphics such as line work, dimensions, symbology, and text) shall maintain the same attributes (width/weight, style/type, color) and level/layer assignment as included in the GFM. If a revision requires the addition of a new level/layer, this shall follow the same naming convention and assigned attributes as defined by the A/E/C CAD Standard. If a new level/layer is required that is not covered in the A/E/C CAD Standard, that level/layer is documented in the Standards compliance report.

Revisions to the As-Built Package are performed to the same level of detail or greater than the original GFM. The same level of detail is also applied to new/additional files required for a revision.

When the government issues a modification and provides revised GFM to the contractor, the text and feature changes are made in the appropriate model or sheet file, on the appropriate level based on the A/E/C CAD Standard. The revision symbols are placed on level/layer G-ANNO-REVS and clouds on G-ANNO-REVC.

## 4 Review and Quality Assurance

### Quality assurance of Markups

The designated government representative(s) will review the Markups and the As-Built Package for accuracy and completeness as described in the Contract Specifications. The designated government representative(s) maintains a log of the monthly meetings held between the project office's staff and contractor's staff, which includes any notes of deficiencies.

### Review of Markups

The review of the Markups will ensure that revisions are being performed in accordance with Contract Specifications. This review includes ensuring that all required revisions since the last review have been addressed by Markups. Items to be reviewed include, but are not limited to, the following:

- Proper use and placement of Revision Symbols.
- Adequate details and notes have been provided to convey revision intent.
- Complete and accurate population of the Revision (Issue) Block describing revisions.
- Adherence to Contract Specifications and guidance relating to Markups (e.g., Markup colors, additions, deletions, relocations, etc.).
- Addition or replacement of new or substantially revised sheets due to Contract Modifications into the appropriate location in the Markups.
- Correct dimensions and details transferred from shop drawings.
- Index, Sheet Identification numbers, Detail and View Identification numbers, etc. updated to reflect any changes to the Markups.

### Review of As-Built Package

This review will verify revisions indicated on the Markups have been appropriately transcribed to the As-Built Package in accordance with the Contract Specifications. Items to be reviewed include, but are not limited to, the following:

- Adherence to A/E/C Standards required by the Contract Specifications for new content added to the sheet set (e.g., file naming, level/layer usage, attribute usage, symbology).

- Addition or replacement of new or substantially revised sheets due to Contract Modifications into the appropriate location in the Working Sheet set.
- Correct dimensions and details transferred from shop drawings.
- Index, Sheet Identification numbers, Detail and View Identification numbers, etc. updated to reflect any changes to the Working Sheet set.

### **Criteria for As-Built Package acceptance**

It is the government's intent that the Record Package reflect only the as-built conditions of the project. Therefore, prior to the submittal of the As-Built Package for acceptance by the government, items need to be addressed by the contractor to finalize and complete the Record Package.

- Any text reflecting pre-existing conditions or changes to be made during construction are updated to reflect the Record Set condition. For example, if the GFM included text stating "MODEL TO BE DETERMINED" for a pump, this text is updated to reflect the actual model for the pump. Another example would be if the GFM included text stating "SHALL BE REMOVED," this text is deleted, and the graphics are updated to reflect this removal.
- All bid option words shall be removed and only the graphics and language of the options exercised shall remain.
- Data on the objects should reflect the data required for Facility Data Exchange.

When all revisions have been completed on the As-Built Package, all As-Built Sheets in the set shall be labeled with the text "RECORD DRAWINGS" in the Status field (see Figure 7) or with text as stated in the Contract Specifications.



## **5 Submittal and Acceptance of As-Builts**

### **Interim review submittals**

There may be multiple interim review submittals required for each contract, as defined in the Contract Specifications. Each of these review periods require the Record Model and the Marked-up Digital Drawing Files be submitted to the designated government representative(s). The intent of the intermediate reviews is to assure the Record Model is properly being maintained and to correct deficiencies early in the process. If the Record Model and Marked-up Digital Drawing Files are properly maintained during construction, the As-Built Package should be near completion at project handover.

### **Completed As-Built Package**

Upon completion of the project, the contractor submits the completed As-Built Package that shows the as-built conditions of the project to the designated government representative(s) for review. The completed As-Built Package submittals maintain the original folder structure and utilize the file format as stated in the Contract Specifications. The submittal media is labeled with the Project Name, Project Code, Date it was created, Contract Number, and Contractor's Name.

### **Review of completed As-Built Package**

The designated government representative(s) performs a review of the Completed As-Built Package. From the review, the representative(s) consolidates government comments identifying issues that need to be resolved prior to government acceptance.

### **Resolve issues with completed As-Built Package**

The contractor documents, addresses, and resolves all issues identified by the government during review.

### **Acceptance of completed As-Built Package**

When the government determines the contractor has met the requirements of the Contract Specifications, the completed As-Built Package is accepted. It may be necessary to perform several iterations of the review, comment, and resolution process prior to acceptance.

## **Record package**

### **Record Model**

The Record Model is the final government accepted As-Built Package.

### **Record Drawings**

Record Drawings are the CAD Sheet files derived from the Record Model sheets.

### **Record Digital Drawing Files**

Record Digital Drawing Files are the final government accepted files produced from the Record Drawings.

## References

The following references may be required in the development of the Record Package. Specific versions of the referenced documents are provided in the Contract Specifications.

Engineering and Construction Bulletin (ECB) No. 2017-22, “Electronic Red-lines, As-Builts, and Record Drawings”. <https://www.wbdg.org/ffc/dod/engineering-and-construction-bulletins-ecb/usace-ecb-2017-22>

United States National CAD Standard. <https://www.nationalcadstandard.org/ncs6/>

ERDC/ITL TR-19-6, “A/E/C Graphics Standard”.  
<https://cadbimcenter.erdcdren.mil/default.aspx?p=a&t=1&i=7>

ERDC/ITL TR-19-7, “A/E/C CAD Standard”.  
<https://cadbimcenter.erdcdren.mil/default.aspx?p=a&t=1&i=7>

Local CAD Standard(s) required by the Contract Specifications

## Acronyms and Definitions

### **Government Furnished Material (GFM)**

Government material that may be incorporated into, or attached to, an end item to be delivered under a contract or which may be utilized in the performance of a contract. It includes, but is not limited to, raw and processed material, parts, components, assemblies, and small tools and supplies. For the purpose of this document, GFM is the products developed by Advanced Modeling.

### **Advanced Modeling files**

A subset of geospatial technologies as defined in EM 1110-1-2909 to include BIM, CIM, GIS, and CAD. Advanced Modeling is comprised of models and drawings that form a digital representation of the project, or part thereof, that are comprised of model elements with facility data.

### **Building Information Modeling (BIM)**

Building Information Modeling is a process for creating a digital representation of physical and functional characteristics of a structure to insert, extract, update or modify information to support and reflect the roles of the stakeholder.

### **Civil Information Modeling (CIM)**

Civil Information Modeling is a process for creating a digital representation of physical and functional characteristics of a site to insert, extract, update or modify information to support and reflect the roles of the stakeholder.

### **Geographic Information System (GIS)**

Geographic Information System is a computer system capable of capturing, storing, analyzing, and displaying geographically referenced information, which is information attached to a location, such as latitude and longitude, or street location.

### **Computer Aided Design (CAD)**

Computer Aided Design is a tool for creating 2D/3D digital designs.

### **Drawing Files**

Drawing files (e.g., plans, elevations, sections, schedules, details, etc.) are CAD Sheets derived from the BIM and CIM model(s) or created directly representing project drawings in the design set.

### **Digital Drawing Files**

PDF formatted Drawing Files.

### **Standards/Guide/Checklists:**

### **USACE Advanced Modeling Submittal Review Checklist (CHX)**

This checklist is used to evaluate compliance with Advanced Modeling contract requirements and the Submitter's approved PxP.

### **USACE Advanced Modeling Submittal Review Checklist Guide**

This Guide defines the methodology and criteria for conducting an Advanced Modeling Submittal review (typically performed by a BIM Manager or delegate). It also provides transparency of the CHX and submittal review methods to the Submitter (Contractors or Government In-house Design teams).

### **A/E/C CAD Standard**

ERDC/ITL TR-19-7: This manual provides guidance and procedures for preparing Computer-Aided Design (CAD) products within the Department of Defense (DoD).

### **A/E/C Graphics Standard**

ERDC/ITL TR-19-6: This manual addresses the need for standard BIM, CIM, and CAD drafting practices that were once covered by documents related to hand drafting techniques.

### **GIS Spatial Data Standard**

All non-raster data developed for, by, or in partnership with USACE must comply with the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE). Metadata are required for all geospatial data developed for, by, or in partnership with USACE.

## **The Advanced Modeling Packages**

### **The As-Designed Package**

The Advanced Modeling files and supporting documentation used to communicate design intent for the basis of Construction.

### **The As-Built Package**

The Advanced Modeling files and supporting documentation used to communicate as-built conditions.

### **The Record Package**

The Advanced Modeling files and supporting documentation used to communicate government accepted final as-built conditions.

### **Sketch**

A Sketch is a hand drawing on a piece of paper or portable device used to clarify items in the contract documents.

### **Shop Drawing**

A Shop Drawing is a drawing produced by the contractor, supplier, manufacturer, subcontractor, or fabricator. Shop drawings are typically required for prefabricated components (i.e., elevators, structural steel, trusses, precast/prestressed concrete, air handling units, millwork, etc.). The shop drawing is the manufacturer's or contractor's drawn version of information shown in the Contract Documents. The shop drawing normally shows more detail than the Contract Documents. It is drawn to explain the fabrication and/or installation of the items.

### **Markups (Marked-up PDF files)**

Markups are Drawing Files with annotation (revision symbology) of changes during the construction phase (RFIs, mods, etc.). Digital Markups are primarily .PDF, but may possibly be .dwf, .nws, .imodel, .i.dgn, or another format as defined in the contract language. These may also be scanned images of hand marked-up drawings.

### **As-Built Package**

The As-Built Package is maintained by the Contractor, to depict actual conditions including deviations from the Contract Documents. These deviations and additions may result from coordination required by, but not limited to: contract modifications; official responses to Contractor submitted Requests for Information; direction from the Contracting Officer; designs which are the responsibility of the Contractor; and differing site conditions. The Contractor maintains the working As-Built Package throughout construction to coordinate changes in the marked-up PDF files. As-Built Drawings are to be derived from the As-Built Package. The As-Built Package files serve as the basis for the creation of the Record Model.

### **As-Built Sheets**

As-Built Sheets are the Sheets derived from the As-Built Package.

**Record Model**

The Record Model is the final accepted compilation of verified conditions reflected in the As-Built Package and Marked-up Digital Drawing Files.

**Record Drawings**

Record drawings are the CAD Sheet files derived from the Record Model sheet views.

**Record Digital Drawing Files**

Record Digital Drawing Files are PDF files representing project drawings in the design set.

# REPORT DOCUMENTATION PAGE

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<b>14. ABSTRACT</b>  The CAD/BIM Technology Center receives numerous questions throughout the year regarding the development of a Record Package that shows as-built conditions. While the Center does produce Standards on the look and organization of CAD drawings that are used to show as-built conditions, users wanted guidance on the Record Package development. The Chicago District had undertaken the development of such guidance, but a formal document was never officially released. The CAD/BIM Community of Practice (CoP) Work Structure Committee finished this guidance and their efforts are reflected in this document.					
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