METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI

BIM Standard

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Version 2.2

Record of Revision

Revision No.	Date	Description
1.0	3/19/21	Issued for review
2.0	6/18/21	Final
2.1	9/9/22	Updated logo
2.2	11/6/25	Updated file naming conventions and added sections for Model Federation Strategy & Coordinates. Minor word modifications to match current requirements.

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1 Introduction

This Standard for the use of Building Information Modeling (BIM) system provides advice and direction to Lead Appointed Party & appointed party(s) delivering projects for the Metropolitan Sewer District of Greater Cincinnati (MSD). The goal of this Standard is to take advantage of the (BIM) modeling process for delivery of construction documents, construction phases, and commissioning phases to enhance and feed into existing and future post construction processes. To successfully implement BIM on a project, MSD developed this detailed BIM Standard which incorporates a BIM Execution Plan (BEP) template for use on each project. MSD will define whether a project will be based on BIM or conventional. Some projects may not need BIM (i.e., simple replacement projects and other projects where detail is not required). The BIM Standard defines uses for BIM on a project along with a detailed design of the process for executing BIM throughout the project lifecycle. A BEP shall be prepared for each project by the design team to define the specific details to be adopted and maintained for that project. Additionally, this Standard is to provide all stakeholders with a delineation of roles and responsibilities detailing scope of information to be shared, relevant business processes, and supporting software.

BIM Standard Change Management

This BIM Standard is designed to be a living document that will change throughout the life of the program. Changes requested to this document must be submitted in writing to the MSD Standards Committee. To be accepted into the document, changes must be agreed to by the MSD Standards Committee.

The BIM Standard was developed to document the decisions made by the project team in working through the BIM Process on a project-by-project basis. The CAD/BIM platform templates with supporting border files and content libraries to ensure project consistency with modeling and deliverables in accordance with the MSD BIM and CAD standards are attached to this BIM Standard. Any changes, modifications, or additions to these templates proposed by the Appointed Party must be approved by MSD.

2 Software

2.1 Software Selection

The following Table is the list of approved BIM software and versions. MSD uses Autodesk Application as standard for all CAD/BIM requirements. Versions noted below shall be maintained for the duration of a design project.

It is recommended to use the latest available version of the software at the time of initiating a new project, to ensure compatibility, access to new features, and optimal performance. However, it is subject to approval by MSD.

Table 2-1. Approved BIM Software Versions

Software	Version	Discipline(s)
Revit	20XX	Process Mechanical
Revit	20XX	Building Mechanical (Plumbing, HVAC & Fire Protection)
Revit	20XX	Electrical
Revit	20XX	Structural
Revit	20XX	Architectural
AutoCAD Electrical	20XX	Electrical 2D single lines & schedules
Plant 3D P&ID	20XX	I&C 2D P&ID's and schedules
AutoCAD Civil 3D	20XX	Civil / Survey / GIS / Landscaping (Civil Yard Piping, Civil Grading, Paving, Drainage, Irrigation, & Landscaping)
Navisworks	20XX	All disciplines – Coordination/Clash Detection/Information extraction/Review Models/Visualization
Autodesk Model Coordination		For Clash Detection & ACC issue management
InfraWorks	20XX	All disciplines – Site Planning & Visualization (optional)
Autodesk Construction Cloud (ACC)		All disciplines – Common Data Environment (CDE)
Desktop Connector	Latest available	All Disciplines
ReCap	20XX	For viewing LiDAR Scan data
Tandem		Digital Twin (optional)

2.2 BIM Design Process

The BIM design process shall follow the design stages noted below in accordance with the agreement between the Engineer and MSD. The table below is the typical model development progression starting with the preliminary design stage with expected deliverables.

Table 2-2. Typical Model Development Progression

Preliminary	30%	60%	90%	100% Issued for Construction (IFC)
Originating Model* Basic GA's	Originating Model* PID's Electrical Single Lines	Federated Model PID's Electrical Single Lines GA's, elevations/sections, and standard details for all disciplines	Federated Model PID's Electrical Single Lines GA's, elevations/sections standard details, and special details for all disciplines	Federated Model PID's Electrical Single Lines GA's, elevations/sections standard details, and special details for all disciplines

*The originating model is defined as the first model developed by the primary discipline that determines the facility layout and space plan.

Figure 2-1 on the following page depicts a typical BIM design workflow. It is important to understand that model development coincides with true engineering during the preliminary phase. In order to develop the originating model with accurate sizing and processes, the engineering prerequisites are required. These include PID's, hydraulic profiles (if required), process flow diagrams, hydraulics for pipe sizing and selection. Once the originating model has been agreed upon by MSD, the other disciplines shall proceed with their respective model development referencing the originating model.

Note that any changes required after the other disciplines have been released due to inadequate prerequisite preparation can result in additional cost and delays to the design.

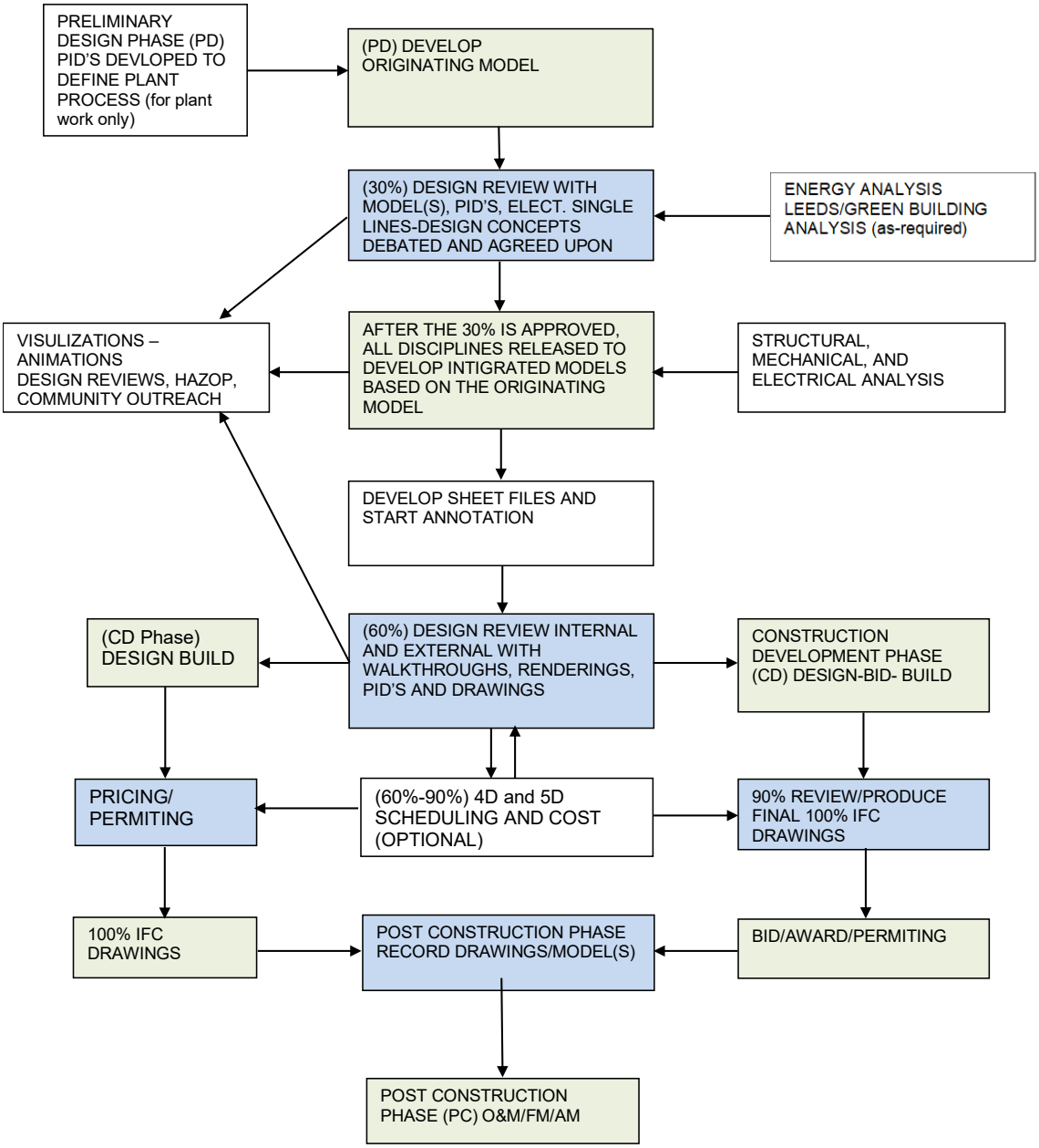

Figure 2-1. BIM/3D Design Process Workflow

3 Building Information Modeling Requirements

3.1 BIM Execution Plan

3.1.1 Definition

The BEP template will be provided to the Lead Appointed Party by MSD and shall be completed by the Lead Appointed Party / Appointed Party(s) and submitted for approval by MSD within 30 days of the notice to proceed.

The BEP identifies the roles and responsibilities of the BIM Participants and the protocol for information exchange between them. Clear requirements are defined for the types of models that will be produced, how the models must be developed including Level of Development (LOD) inclusions and exclusions, and how the models must be relied upon for other analytical processes.

The BEP shall contain the following information at a minimum:

a) Project Information, including name, contract type, process description, schedule milestones.

b) BIM roles – shall include the Project Manager, Project Technical Lead, Engineering/Architectural Discipline Leads, BIM/CAD Leads.

c) BIM uses for each stage of design.

d) BIM software for all disciplines, see 2.1 herein. Any deviation to the approved software list shall be approved by MSD in advance of the use of that software.

e) Discipline Model Requirements shall define all elements to be included and the specific Level of Development (LOD) for each Discipline and Data requirements for the model elements.

f) Collaboration Requirements shall define how model security and coordination between disciplines shall be executed.

g) Quality Control shall define responsible parties for visual checks, interference checks, standards checks, and model integrity checks. The timing of these checks shall be stated.

Please refer to **Appendix A** for the BIM Execution Plan.

3.1.2 Data Requirement

Each model element is assigned a level of detail for the data deliverable as identified and required by the project team. All participants must input required data into their models and associate it to the corresponding elements. The following are the minimum data requirements that each discipline/participant's model shall meet as listed in Table 3-1:

Table 3-1. Minimum Data Requirements

All Disciplines: Room / Space Attribute	**All Disciplines: Element Attribute**	**MEP Disciplines: Element Systems**
Attribute Name/Type:	Attribute Name/Type:	Attribute Name/Type:
Room Number	Category/Subcategory	System Classification
Room Name	Type Name	System Type
Department Name	Level	System Name
Level	Element ID	Tag Number
Area	Material	
Height		

3.1.3 Level of Development (LOD)

The LOD describes the level of development to which a Model Element is developed and is based on BIM Forum 2023 release. MSD has elected to use LOD 350 for all design-bid-build projects which provides sufficient Model detail to create a set of contract documents and establishes a useful base for the addition of other pertinent data.

In LOD 350, the Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, orientation, and interfaces with other systems. Non-graphic information may also be attached to the Model Element.

Table 3-2. Level of Development

Level of Development	Description
LOD 100	The Model Element may be graphically represented in the Model with a symbol or other generic representation but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.
LOD 200	The Model Element is graphically represented within the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.

Level of Development	Description
LOD 300	The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, location, and orientation. LOD300 is suitable for the generation of traditional Construction Documents. Non-graphic information may also be attached to the Model Element.
LOD 350	The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, orientation, and interfaces with other systems. Non-graphic information may also be attached to the Model Element.
LOD 400	The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. This level of development is considered to be suitable for shop drawings. Non-graphic information may also be attached to the Model Element.
LOD 500	The Model Element is a field verified representation in terms of size, shape, location, quantity, and orientation. Non-graphic information may also be attached to the Model Elements.

3.2 Software-specific Settings

3.2.1 Revit

Because of the importance in which hierarchy and direction objects are modeled in Revit, it is critical to follow some standards for creating objects in the model.

Starting a New Model from a Template

Revit models should always be started from the MSD provided template as all project standards and setups are pre-loaded within these files. If you do not use the standard template or start a job based on a different model you are likely to have inconsistent line weights, line types and display settings for the major model objects inside the Revit file. Using the standard template also ensures consistency with the parameters used across the models in the same project.

Revit Families

Use shared parameters contained in the standards (reference location).

For multi-type families, create consistent names for the different types.

Name reference planes for setting up parameters and alignments.

Use By-Category materials for standard objects.

Test all hosted families to see what happens if the host's dimensions change both larger and smaller.

Test all family parameters to ensure that the model behaves correctly as they are modified.

Check all views to ensure that the symbol is displayed appropriately.

All families should have at least one pre-defined type unless a type catalog is used. Where real world examples come in typical sizes, pre-defined types should be generated.

Shared Parameters

Shared parameters are definitions of parameters that you can add to families or projects. Shared parameter definitions are stored in a file independent of any family file or Revit project; this allows you to access the file from different families or projects. The shared parameter is a definition of a container for information that can be used in multiple families or projects. The information defined in one family or project using the shared parameter is not automatically applied to another family or project using the same shared parameter.

In order for information in a parameter to be used in a tag, it must be a family or shared parameter.

3.2.2 AutoCAD-based Applications

All AutoCAD based applications including but not limited to Civil 3D, AutoCAD Electrical, Plant 3D PID, and AutoCAD shall be produced in accordance with the MSD CAD Standards.

3.3 Design Collaboration

3.3.1 Discipline Coordination

To meet the end goal of coordinated building systems amongst the design team, the design authored models generated by the BIM Participants will undergo thorough coordination analyses to determine and resolve major system design conflicts prior to construction. Coordination will undergo the following process for the Design phase only. Once building elements transition from generic volumes to actual product data, a second coordination analysis shall follow.

The coordination analysis for each model for the Design phase will follow a monthly cycle that is aligned with the project schedule for the facilities included in the project. Once a month, on a predetermined date let known to the design team in advance, the design team BIM Manager will create or request the most recent .NWC model per discipline from the Shared folder on the file sharing site. The BIM Manager will then gather these discipline models and aggregate them into a Federated Model. The BIM Manager will analyze the Federated Model for several items. These include, but are not limited to:

- Geometric conflicts (Clashes & Clearances)
- Modeling craft and quality
- Data requirements
- General best practices
- Coordinates (if required)

The BIM Manager will then report back to the design team through one of the following venues:

- Coordination Meetings
- Issue Tracking platform
- Email, depending on the item being studied

- Federated Model including issues as saved views (.nwd)

The BIM Manager and model leads shall attend periodic coordination meetings facilitated by the BIM Manager. On some occasions, other team members will be required to attend in order to lend their expertise dealing with a particular project issue.

3.3.2 Design Reviews

The BIM models shall be used to facilitate design reviews at the MSD defined milestones for a project typically at 30%, 60% and 90%. The BIM models shall be federated (inclusive of all disciplines). The federated model shall be projected during the review meeting and be dynamic to allow walkthroughs and comments. The federated model shall be shared with MSD designated project participants. Participants shall be able to view, navigate, create issues, and markup via the Engineer's common data environment with sufficient privileges that allow for creation of issues and basic comments.

4 Model and Sheet File Management

4.1 Security

As BIM involves a complex interaction between governance, people, process, and technology, it is important that all personnel involved in a BIM project understand the cyber security implications. The common data environment (document management system) requires appropriate security policies to be developed and implemented. It is recommended to have a system delivering a multi-layered approach to document and content security including Windows Active Directory integration for single sign-on and document-level security settings for view and edit access.

4.2 Common Data Environment (CDE)

It is the responsibility of Appointed Party to set up the common data environment (CDE) that allows for design collaboration, access, user permissions, notifications, versioning control, file security, and model exchange. Model exchange will occur based on the schedule described in Chapter 5 – Deliverables section. The CDE system shall allow data to progress through the project lifecycle by having a folder for WIP (Work-In-Progress), Shared, Published, and Archived with all permissions and notifications set up accordingly.

The preferred platform for the above noted model exchange and management is Autodesk Construction Cloud (ACC). The Appointed Party shall host, set up and administer the ACC application.

All CAD/BIM sheet and model development shall be done via the CDE. Models shall be developed and maintained in the Model folder under each discipline and sheet files as noted in the folder structure in the below figure. The Exports folder shall be used for file exports to other formats needed for collaboration. It is required that only project sheet files reside in the discipline root folders and project models reside in the discipline Model folder.

The Appointed Party will host a master Federated model (NWD) that would include all discipline models aligned and positioned. This will be the single source of truth for looking at the model progress updates, pending issues, etc. These models shall be viewed from ACC and made available to MSD as requested.

4.3 PDF Production and Management

Work in Progress PDF Sheet plots shall be posted at agreed intervals on ACC under 01_WIP/PDF's respective discipline folder. Updates shall be posted in the same folder using consistent PDF file naming. It is essential that only a single source of truth is maintained for the PDF. Teams will be able to back track older versions of PDF's form single location. Teams can also utilize the Markup/Issue creation utilities within ACC. Each discipline is responsible for maintaining the latest set of WIP PDFs on ACC.

These PDF's will be made available to all stakeholders associated with design and review responsibilities.

An additional document with ACC, project specific folder structure and guidelines for uploading PDFs shall be provided.

4.4 File Naming Convention

4.4.1 Model File Naming

The electronic file name for model files shall be named as follows:

12345678-##-A-md.ext

12345678	MSD Project ID (PID)
##	Denotes Area Number. See Table 4-1.
A or AA	Denotes Discipline Designator. See Table 4-2.
md	Denotes BIM (3D) Model.

For example, 10172960-20-DQ-md.ext (project 10172960, secondary treatment, process equipment).

4.4.2 Revit Sheet Files

Sheet file names stay within Revit models and shall be named as follows:

##-A-$01 – Sheet Number

##	Denotes Area Number. See Table 4-1.
A or AA	Denotes Discipline Designator. See Table 4-2.
$	Denotes Sheet Type Designator. See Table 4-3.
01	Denotes sequential Sheet Number (NCS requires sheet numbers start with 01, not 00).

For example, 20-DQ-201 -Secondary_Clarifiers (secondary treatment area, process equipment, elevations, sheet 01).

4.4.3 AutoCAD and Civil 3D

4.4.3.1 Sheet Files

The electronic file name for Sheet Files shall be named as follows:

12345678-##-A-$01

12345678	MSD Project ID (PID)
##	Denotes Area Number. See Table 4-1.
A or AA	Denotes Discipline Designator. See Table 4-2.
$	Denotes Sheet Type Designator. See Table 4-3.
01	Denotes sequential Sheet Number (NCS requires sheet numbers start with 01, not 00).

For example, 10172960-20-DQ-201 (project 10172960, secondary treatment, process equipment, elevations, sheet 01).

4.4.3.2 Sheet Number

Sheet Numbers (these are on each sheet on the lower right) shall be named as follows:

##-A-$01

##	Denotes Area Number. See Table 4-1.
A or AA	Denotes Discipline Designator. See Table 4-2.
$	Denotes Sheet Type Designator. See Table 4-3.
01	Denotes sequential Sheet Number (NCS requires sheet numbers start with 01, not 00).

For example, 20-DQ-201 (secondary treatment, process equipment, elevations, sheet 01).

Table 4-1. Wastewater Plant Area Numbers

Wastewater Plant Area No.	Primary Area Description	Sample Sub-Area Descriptors
01 – 05	Civil – Site/Yard	Yard Piping Paving, Grading, and Drainage Location/Layout Reservoirs Erosion and Sediment Control
06 – 09	Raw Sewage	Headworks/Screens/Grit Removal EQ Basins/Tanks Grit Removal Lift Pump Stations
10 – 19	Primary Treatment	Aeration Facilities Primary Clarifiers
20 – 29	Secondary Treatment	Trickling Filters Secondary Clarifiers MBR Facilities
30 – 39	Advanced Treatment	MBR Facilities Ion Exchange MF Facilities RO Facilities Gravity BA Filters Pressure Filters
40 – 49	WW Effluent	Chlorine Contact Basins UV Disinfection UW Pump Station Effluent Pump Stations Injection Well Outfall

Wastewater Plant Area No.	Primary Area Description	Sample Sub-Area Descriptors
50 – 59	Waste Stream and Solids Handling	Plant Drain Neutralization Sludge Clarifiers Sludge Thickeners Anaerobic Digesters Aerobic Digesters Dewatering Facilities Brine Recovery ZLD Process Biogas Recovery
60 – 69	Chemical Storage and Feed	Tank Farms Chemical Feed Facility Dry Chemical Feed Facility
70 – 79	Ancillary Systems	Utility Water System Odor Control Systems
80 – 89	Solids Handling	Sludge Storage Blowers Digesters Gas Burner Gravity Belt Thickener Belt Filter Press Sludge Stabilization and Loading Systems Sludge Dryers
90 – 99	Plant Power	Substations Generators Fuel Storage Cogen Systems Distribution / Switchgear Center

Table 4-2. Discipline Designators

Level 1	Level 2 (Optional)	Description – Content
G		**General** – Cover Sheet, Location and Vicinity Maps, List of Drawings, Symbols, Abbreviations
V		**Survey / Mapping**
	VA	Survey / Mapping Aerial
	VB	Survey / Mapping Boundary
	VU	Survey / Mapping Combined Utilities
C		**Civil**
	CD	Civil Demolition - Structure and utility removal, site clearing, etc.
	CS	Civil Site - Plans, horizontal and vertical control, etc.
	CG	Civil Grading - Excavation, grading, drainage, erosion control, etc.
	CP	Civil Paving - Roads, driveways, parking lots, walks, etc.
	CI	Civil Improvements - Pavers, flagstone, exterior tile, furnishings, retaining walls, and water features

Level 1	Level 2 (Optional)	Description – Content
	CT	Civil Transportation - Traffic control, traffic signage, waterways, wharves, docks, trams, railways, people movers, etc.
	CU	Civil Utilities - Water, sanitary sewer, storm sewer, power, communications, fiber optic, telephone, cable television, natural gas, steam systems, etc.
L		**Landscape**
	LD	Landscape Demolition - Protection and removal of existing landscaping
	LI	Landscape Irrigation - sprinklers, water features, etc.
	LP	Landscape Planting - location of all site landscape elements (trees, shrubs, groundcover, surface treatments, site features (benches, bike racks, etc.)
	LL	Landscape Lighting
S		**Structural**
	SD	Structural Demolition - Protection and removal
	SB	Structural Substructure - Foundations, piers, slabs, retaining walls, etc.
	SF	Structural Framing - Floors, walls, roofs, etc.
A		**Architectural**
	AD	Architectural Demolition - Protection and removal
	AF	Architectural Finishes
	AG	Architectural Graphics
	AI	Architectural Interiors (in lieu of adding Interior Design discipline)
IN*		**Interior Design**
	IND**	Interior Demolition
	IF	Interior Furnishings
	IG	Interior Graphics
I		**Instrumentation and Controls (I&C)**
	ID	I&C Demolition
D		**Process Mechanical**
	DD	Process Demolition - Protection, termination, and removal
	DS	Process Site - Utility tunnels and piping between facilities (where not done as yard piping)
	DP	Process Piping - Piping of all commodities
	DQ	Process Equipment - location, installation, etc. (may be combined with Process Piping)
		Building Mechanical
M		**HVAC** - Ductwork, air devices, equipment, etc.
	MD	HVAC Demolition - Protection, termination, and removal
	MS	HVAC Site - location of equipment sitting on the site along with service connections (if not included in the Civil Site sheets). H sheets sit after if HS sheets are being included in the set.
P		**Plumbing**
	PD	Plumbing Demolition - Protection, termination, and removal
	PP	Plumbing Piping - Chilled and heating water, steam, fixtures, equipment, etc.

Level 1	Level 2 (Optional)	Description – Content
F		**Fire Protection**
	FD	Fire Protection Demolition - Protection, termination, and removal
	FA	Fire Detection and Alarm
	FX	Fire Suppression
E		**Electrical**
	ED	Electrical Demolition - Protection, termination, and removal
	ES	Electrical Site - Duct bank, equipment, site lighting, etc.
	EP	Electrical Power - Control plans, equipment location plans, grounding plan, lightning protection, etc.
	EL	Electrical Lighting - location, receptacle, grounding, etc.
	ET	Electrical Telecommunications - Telephone, network, voice and data cables
	EY	Electrical Auxiliary Systems - Alarms, nurse call, security, CCTV. PA, music, clock, program, etc.

*Where both Interior Design and Instrumentation and Controls disciplines are required for a project, use IN for Interior Design or if preferred use AI as shown above.

**Where both Interior Design and Instrumentation and Controls disciplines are required for a project, use IND for Interior Design Demolition if applicable.

NOTE: According to NCS guidelines, Instrumentation drawings are managed by the discipline that is sharing responsibility for stamping and signing as identified by a Level 2 Discipline Designator.

Instrumentation drawings per their suggestion:

- **DI** – Process & Instrumentation Diagram drawings reside with the process discipline
- **MI** – Mechanical Instrumentation drawings will reside with the mechanical discipline
- **EI** – Electrical Instrumentation drawings will reside with the electrical discipline

For convenience of managing the disciplines, these drawings will be branded as **I - Instrumentation and Controls**.

Table 4-3. Sheet Type Designators

Number	Description
0	General (symbols, legends, notes, Standard Details, project specific standard details [X-9## series for example], etc.)
1	Plans (horizontal views and combination Plan & Profiles)
2	Elevations (vertical views and Profiles)
3	Sections (sectional views, wall sections)
4	Large scale (enlarged plan, section, and details to capture full design intent of small structures such as valve vaults or sheds – where there may be a plan, top plan, sections, and details that fit on one sheet. Not for enlarged plans taken from an overall plan)
5	Details that are discipline and specific to limited location (not Standard Details nor project wide specific details such as X-9## series details)
6	Schedules and diagrams (including P&ID)
7	User defined (for types which do not fall in other categories)
8	User defined (for types which do not fall in other categories)
9	3D Views (isometric, perspectives, photographs)

When the type of drawings on a sheet is mixed, the primary designator on the sheet and title block is used.

4.5 Model Positioning

The purpose of this policy is to define how 3D models are located within the design plane and who creates the originating model.

4.5.1 Originating Model

The originating model is created by the Discipline (i.e. Architecture, Structural, Building Mechanical, Electrical, and Process Mechanical) that governs the model space plan. The type of facility defines which Discipline governs the originating model.

4.5.2 Revit Coordinate System

Every Revit project file has three distinguishable coordinate systems. These coordinates are utilized to define the location of the model objects in relationship to the following:

Project Internal Coordinate System: This is a non-editable static coordinate system and is defined as the true internal Revit (0,0,0) or commonly referred to as the **World Coordinate System (WCS)**. The WCS is utilized by all 3D applications to determine the location of model and/or annotation objects for application driven computations. Because of this, the performance of the Revit file will be impacted if there is a great distance between the (0,0,0) of the WCS and user created geometry.

Project Base Point: Location of the originating model will be at the inside lower left corner of the structure walls at the ground floor elevation or the center of circular structures at the base and shall be located at a common coordinate set at X=0, Y=0, Z=0. **(Note: Z elevation may be defined close to or the actual elevation for existing Structures)**. All originating models in a project shall use the same coordinate. All originating models shall be oriented with up in the north direction unless directed otherwise by the design manager. All other Disciplines shall reference/link to the originating model to develop the respective

Discipline models. **The originating model and the respective Discipline models shall not be moved or rotated for the duration of design/model lifecycle.**

Civil shall be responsible for defining the actual structure location within the site by taking the referenced structure from the common coordinate and moving it into its proper location within site model. For the purposes of MSD Projects, Ohio State Plane Coordinates shall be used.

Survey coordinate system: The survey coordinate system establishes the precise geographic location of your project site. The Model Manager will link the Civil Site layout (DWG) that has the Coordinates defined into the Revit master model, align it to match the Revit model's orientation and footprint, and then acquire the shared coordinates. This master Revit model will serve as the single source of truth for managing any coordinate or elevation adjustments. All other base models will obtain their coordinates from this master model.

4.5.3 Project Coordinate System

A master project origin file will be set-up setting out the plant origin with survey coordinates, plant north and units of measurement. This will set the common coordinate system for all BIM data with consistent adoption for all Design Models. There will be no deviation from the data contained in the master file.

BIM manager to ensure the templates are set correctly based on the project needs. Verify and set consistent (International, US Survey, and Grid) across project.

Table 4-4. Project Coordinate System Parameters

Project Parameter	Details
File Name	*Cad file from Survey or control file used to establish coordinate control to models*
Geocentric Datum	*e.g. Local or State/Providence horizontal datum control*
Height Reference	*e.g. North American Vertical Datum NAVD 88*
Survey Units	*e.g. International Survey Feet or US Survey Feet (Discontinued Dec 2022)*

Table 4-5. Project Base Point

Coordinates	Value
N/S	*Coordinate of the known survey monument on site*
E/W	*Coordinate of the known survey monument on site*
Elevation	*Elevation of the known survey monument on site*
Angle to True North	*(If more than one angle, create a table to define each structure) Angle to True North is the lessor of 90deg and must define the structure on a sheet to point up or to the left.*

Example image shows site orientation to True North. Rotations would be applied to each unique structure depending on their alignment to the overall plant.

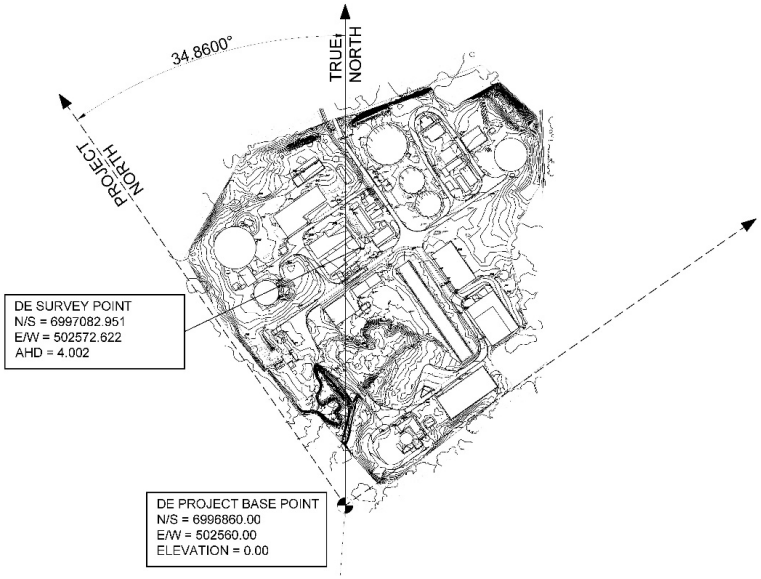

Figure 4-1. Example Site Orientation

4.5.4 Federated model

A Federated Model, which is the integration of multiple discipline-specific or asset-specific models into a single, cohesive framework, shall be used as the primary method for project team coordination and review. Discipline Model Managers will be responsible for publishing their updated design models weekly, at a minimum, or at agreed frequency, so the project BIM Lead can publish the updated federated model and make available to the design team.

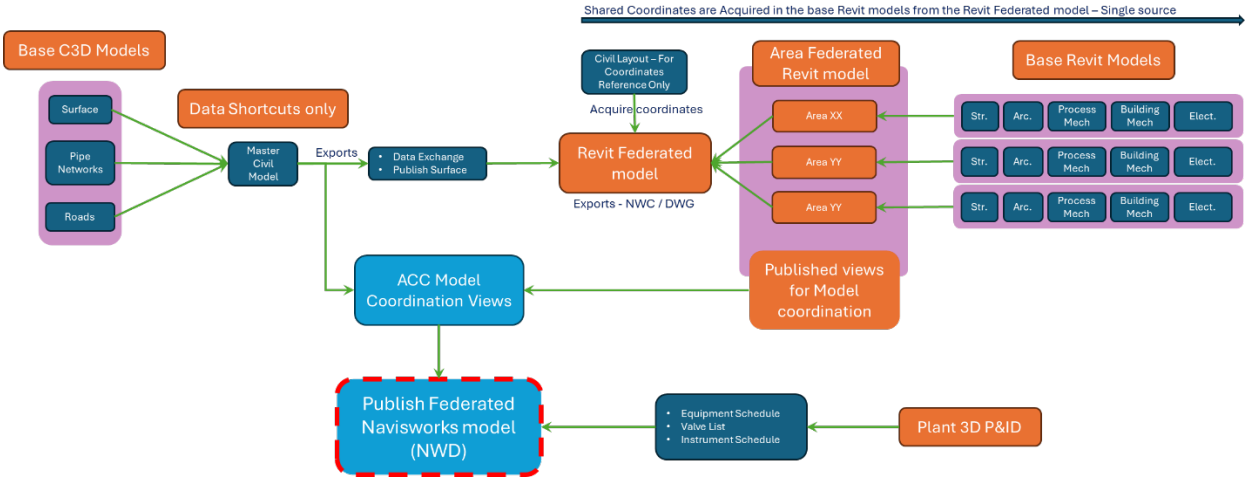

Figure 4-2. Example Federated Model Structure

4.6 QA/QC

To ensure project teams are using best practices in the development and file exchange of models, a quality assurance process is required to be taken by each BIM Participant. This is an ongoing process, which is to be conducted by the project team at both project milestones and at random intervals to ensure that each model is suitably developed for its intended use. The goal is to ensure that there are no unresolved issues during design or any significant loss of data upon transfer of models.

Each BIM Manager and Model Lead will be responsible for running quality assurance checks on their model(s) on a consistent and frequent basis. For issues involving other disciplines, the issue shall be made known to the corresponding BIM Manager. In addition to the internal QA requirement for each BIM Participant, the project BIM Manager is responsible for periodically checking against pre-determined quality control criteria such as naming conventions, general modeling best practices, corrupt or insufficient data/geometry, etc. The following checklist can be used for Quality Assurance. The actual QA checklist developed for each project shall be incorporated into the BEP.

Participant Models

- BIM in agreed version and format
- BIM includes defined levels and grids
- BIM is correctly positioned with project set out and coordinate system
- Building elements, components, and spaces are modeled separately for each level
- BIM includes required building elements at the required LOD for that phase
- Building elements modeled using correct objects
- Building elements include types
- Building elements use human readable names that follow a logic/standard
- No excess building elements (Isolated or place holders)
- No overlapping or doubled building elements
- No significant clashes between building elements
- Rooms/Space areas match space program
- Rooms/Space names and heights are defined
- Rooms/Spaces match the boundary walls
- Rooms/Spaces do not overlap
- Components belong to the correct system type (Building Services)

Federated Models (Merged Models)

- BIM in agreed version and format
- Included participant models are up to date
- Included participant models are located in the correct coordinate system
- The statuses of previous and ongoing coordination issues are up to date

4.6.1 Model Optimization

Model optimization refers to the general practice of maintaining a ‘healthy’ model. These items deal with general best practices of maximum file size, clear use of meta-organizational tools such as worksets and layers, use of formula driven families, family file size, and other items listed below that can

adversely affect the overall health of a model, or set of models. Below is a list of criteria that must be met when sharing models on each project:

- To ensure optimal performance, the goal should be to keep model file sizes under 300 MB. A model should be split into links if it reaches this range.
- Worksets should be clearly identified, and their application should be strict (i.e. do not have random elements in a work set they do not belong to)
- All linked models should have their own workset. The name of the workset should begin with "XLINK_" and the linked model should be appended to create "XLINK_Linked Model Name".
- Worksets should not be used to explore design iterations or hide elements from view.
- Phases should be clearly identified consistently across all Revit models, and their application should be strict.
- Design Options are a great functionality but do require that double the amount of geometry exist in the model. The naming of the Design Options should be clearly identified, and their application should be strict. Old Design Options should be eliminated from the model and the desired options should always be set to 'Primary Option'.
- Parametric families with many formula-driven options tend to be large. Once decisions have been made on which option to use, the heavy family should be made leaner to maintain model health.
- Models should be fully purged and compacted before sharing.
- Family names and Parameter names should follow a system. BIM Manager shall be able to provide a reference for the system's logic.

5 Deliverables

Each Appointed Party is responsible for submitting a Building Information Model that meets the model use requirements at the milestones noted below. The level of development for each BIM deliverable at the project milestones should refer to Section 3.1.3 Level of Development with a minimum sufficiency to fulfill the 2D document submission requirement.

Table 5-1. BIM Deliverables

	Milestones				Final Deliverables			
Model Use	**Weekly**	**30%**	**60%**	**90%**	**100%**	**Bid Phase for Design-Bid-Build**	**Design-Build**	**Post Construction Record**
Model Authoring (Revit)	.RVT	.RVT	.RVT	.RVT	.RVT	.PDF .NWD	.RVT	.RVT
Model Authoring (C3D & Plant 3D)	.DWG	.DWG	.DWG	.DWG	.DWG	.PDF .NWD	.DWG	.DWG
Drawing Production		.PDF	.PDF	.PDF	.PDF	.PDF	.PDF	.PDF
Design Review	3D PDF, .NWD	3D PDF, .NWD	3D PDF, .NWD	3D PDF, .NWD	3D PDF, .NWD	3D PDF, .NWD	3D PDF, .NWD	3D PDF, .NWD
Clash Detection	PDF (ACC issues Report)	PDF (ACC issues Report)	PDF (ACC issues Report)	PDF (ACC issues Report)	PDF (ACC issues Report)			
Engineering Analysis		●	●	●				
Visualization		●	●	●	●	●**	●**	
Construction Simulation (4D, 5D)			●*	●*	●*		●**	

* Optional, must be defined in contract.
** Contractor's option, must be defined in contract for model transmittal with usage disclaimer.

5.1 For Design Reviews

During the design review process, project stakeholders view the 3D models prepared and presented by the Appointed Party(s) and provide their feedback to validate multiple design aspects. ACC Review, Issues, and Bluebeam Revu are suggested for the Design review process. Predefined published views shall be configured in Revit for use in model federation within the ACC Model Coordination module.

NWC exports will also be generated from these published views. ACC Issues shall be used to flag any potential design issue identified.

5.2 100% Deliverables

3D Geometric Deliverables – Design Intent Model

The Design Team is to ensure that the "Design Intent Model" remains current with all approved design for overall scope. The final BIM deliverable is expected as below:

- Native file format(s) of Design Model (version as agreed in BIM Execution Plan)
- Federated Design Model (i.e. Revit model with all associated linked models and Navisworks published model .NWD, version as agreed in BIM Execution Plan)

Data Deliverables

- Provide room/space data according to locational hierarchy as defined by MSD's Facilities Management/Asset Management system.

2D Deliverables

- Produce one printed set of final documents generated from the Design Intent Model in PDF format, each discipline shall be combined in PDF book format.

5.3 Bid Phase for Design-Bid-Build

3D Geometric Deliverables—Design Intent Model

The Design Team is to ensure that the "Design Intent Model" remains current with all approved design for overall scope. It is not expected that product specific information will be added to this model. The final BIM deliverable is required as follows:

- Federated Design Model (i.e. Navisworks published model .NWD - can be opened in Navisworks Freedom)
- Native file format(s) of Design Model (as required and agreed to by MSD and Consultant)
- All Addendums shall be incorporated into the Design Models when conformed documents are prepared.

2D Deliverables

- Produce one printed set of final documents generated from the Design Intent Model
    - PDF format
- All Addendums shall be incorporated into the Design Models when conformed documents are prepared.

5.4 Post Construction Record

3D Geometric Deliverables—Construction Coordination Model

Responsibility for maintaining the construction record model and drawings shall be assigned by MSD and will depend on the construction delivery method. The Lead Appointed Party shall ensure the Model(s) will conform to the actual construction with the final BIM deliverable is expected as below:

- Native file formats of the final consolidated As-Built Model(s) for building systems used in the multi-discipline coordination process (version as agreed in BIM Execution Plan)
- Federated As-Built Model for facility management (i.e. Navisworks published model .NWD, version as agreed in BIM Execution Plan)

Data Deliverables

- Provide room/space/product data according to locational hierarchy and asset parameter requirements as defined by the MSD's Facilities Management/Asset Management software.

2D Deliverables

- Provide Record Drawings in PDF format.
- Sheet files in dwg format for AutoCAD based platforms
- Revit sheet files will be as delivered with the .rvt model file

Appendix A BIM Execution Plan

Refer to the Capital Project Resource Library for content

Appendix B MSD CAD Standards

Refer to the Capital Project Resource Library for content