CAD/BIM Standards

Sacramento Area Sewer District

Version 2.0

SACRAMENTO AREA SEWER DISTRICT
SERVING YOU 24/7

March 2024

NCS
United States National CAD Standard®

CAD/BIM Compliance Statement

The Sacramento Area Sewer District (SacSewer) has adopted the United States National CAD Standard® (NCS). As such, sections of this document have been reproduced in whole or in part from the United States National CAD Standard® (NCS). SacSewer has modified the United States National CAD Standard® (NCS), as explained in this document.

Additional information or clarification can be obtained from the United States National CAD Standard® (NCS) website at https://www.nationalcadstandard.org/ncs6/

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1.0 Introduction

The purpose of these standards is to provide designers and construction contractors with the information required to ensure that the Sacramento Area Sewer District (District) will receive Computer-Aided Drafting (CAD) documents and Building Information Modeling (BIM) data that will comply with the minimum acceptable standards in use at the District's facilities (CAD/BIM Standards).

District's CAD/BIM standards set the minimum requirements for CAD drawings that are to be used in District construction contracts and apply to all drawings prepared by the individual Project Designer, General Contractor, subcontractors, and vendors.

These CAD/BIM Standards intend to ensure consistency in drawing production and uniformity in file structure for all District drawings.

This CAD/BIM Standards document establishes a format for the preparation of design and construction documents using CAD. District has adopted the National CAD Standard Version 6.0, the latest release, and the U.S. National BIM Standard (NBIMS) along with the amendments included in this CAD/BIM Standards document.

The use of the National CAD Standard (NCS) with these amendments is mandatory for all District projects.

The NCS is a publication of the Facility Information Council of the National Institute of Building Sciences and may be obtained at the following website: https://www.nationalcadstandard.org/ncs6/.

The contract drawings need to convey the information required to construct the project. District's goal is to minimize Requests for Information (RFIs) during construction and change orders. All drawings need to be concise and flow without the need for interpretation. Drawings consist of plans, elevations, sections, large scale views, details, schedules, diagrams, and 3D models.

1.1 Relationship with Other District Design Standards

This document is one component in a suite of District Design Standards. The standards are created and maintained to provide consistency and efficiency among design projects within SacSewer. The standards document requirements, issues, decisions, products, procedures, etc. that have reached a District staff consensus.

Each component of the standards is targeted for a specific purpose. The purpose of this document is as stated above. The additional components of the District Design Standards include:

- **Design Contract Requirements –** Presents the content requirements for contract documents prepared for design projects.

- **Design Guidelines** – Describes discipline-specific District design preferences above and beyond applicable codes and standards.
- **Guide Specifications** – A library of contract requirements and technical specifications available for project use.
- **Standard Drawings and Typical Details** – A library of CAD drawings common across all projects and typically used details available for use by the Designer.
- **Operations Manual Development Guide** – Presents the level of effort required, from the Design Consultant, to develop an Operations Manual for each project. In addition to providing details of the respective project, the Operations Manual also must include details of the interconnections to the existing EchoWater Facilityprojects. The Operations Manual will serve as a teaching and reference tool for the District.

Additional requirements related to design execution, deliverables, and designer coordination with District staff will be contained in the Request for Proposal (RFP) for the specific design project.

A designer library of project-related documents and information is listed in Appendix A - CAD/BIM Designer Library and is available to the design teams. These documents are periodically updated as required.

The District has modeled the existing utilities in the in Civil 3D Pipe networks for each piping system within the EchoWater Facility's boundaries. Please see Appendix B - Civil 3D Model Utility Data Use and Acceptance Agreement for use and application.

2.0 Software

The District has standardized a set of design tools to assure consistency in drawing production and uniformity for all contract documents produced. The standardized software products are the Autodesk AutoCAD and Autodesk Revit suites. These products are design tools that use specifications, data fields, code requirements, BIM, etc. The documents produced with these products shall be smart-object based.

2.1 Software Selection

Listed below is a software matrix required by the District. The current software version is 2021. Products must be maintained throughout the duration of the project unless The District agrees to a newer version.

Table 2-1. 2021 Autodesk Software Matrix

Discipline	Software	Comments
Architectural	Autodesk Revit Architecture	
Fixtures and Equipment	Autodesk Revit Architecture	Stationary items only
Structural	Autodesk Revit Structure	
Process Mechanical	Autodesk Revit MEP	
HVAC	Autodesk Revit MEP	
Plumbing	Autodesk Revit MEP	
Fire Protection	Autodesk Revit MEP	
Electrical	Autodesk Revit MEP Autodesk AutoCAD Electrical	
Civil	Autodesk AutoCAD Civil 3D	
Landscape	Autodesk Revit Architecture	
Process and Instrumentation Diagrams, Plant Flow Diagrams, and Process and Piping Schematics	Autodesk AutoCAD P&ID	
Standard 2D Drawings	Autodesk AutoCAD	
Visualization, Collaboration	Autodesk Navisworks Manage	Clash detection
Contract submittal Documents	Portable Document Format (PDF)	

2.2 Project Software Workflow

The District has standardized on a set of design tools to ensure consistency in drawing content.

The exchange of shared parameters between software products is required on all assets. The BIM standards in this document and the design data management procedures described in District's Design Guidelines outline the use and format of the required database connectivity. An example of database design workflow is shown in Figure 2-1. The Designer shall develop their plan for data management.

In the BIM process, the model carries all the information related to the building or facility, including its physical and functional characteristics and project life cycle information, in a series of “smart objects.” The model provides dynamic information to be viewed in a number of ways. Those can be viewed as 2D drawings, 3D isometrics, or as quantity schedules for estimating.

As described in Section 5.3, the information District is requiring to be exchanged between software products will consist of OmniClass Construction Classification System (OmniClass) data. OmniClass is a reference library system that will serve as the foundation upon which information is transferred between the construction and operation phases.

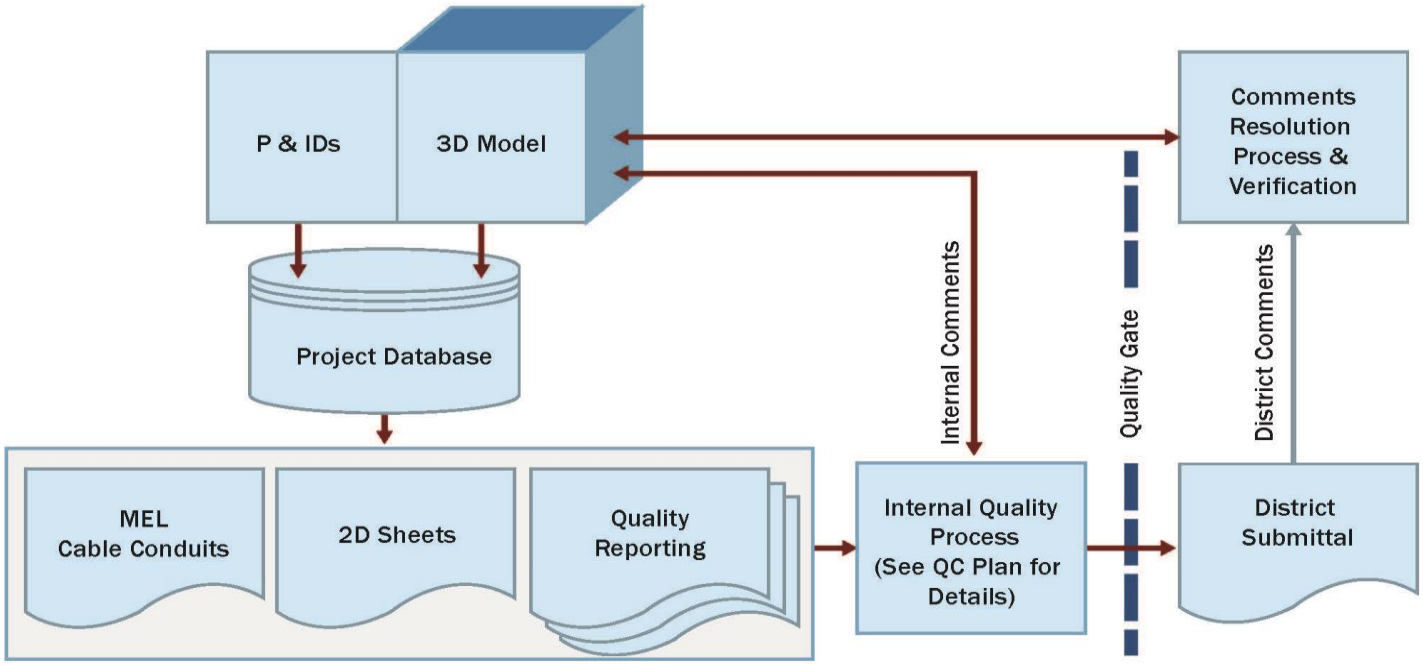


Figure 2-1. Database Design Workflow

3.0 CAD Layering Guidelines

The use of layers is common to all CAD programs. They are used to logically "group" sets of similar elements to be identified quickly and easily by anyone who needs access to the information. The proper use of layers will improve efficiency in document preparation and facilitate the conveyance of information to all consultants, contractors, and owners involved in the project.

District intends to follow the AIA CAD Layer Guidelines as published in the NCS and summarized below. Process and Instrumentation Diagrams (P&IDs) and Civil 3D templates containing predefined layers have been developed and used as seed files for each applicable drawing. However, it is understood that these templates may not include every layer that is needed, and additional layers may need to be added by the user.

3.1 Layer Naming Format

This section defines the use of the NCS as it applies to District's CAD/BIM Standards.

Following the format described in this section allows additional layers to be added, when needed, that will conform to District's CAD/BIM Standard.

3.1.1 Hierarchy of Data Fields

There are four defined layer name data fields in this example:

AI = Discipline Designator

WALL = Major Group

FULL = First of two Minor Groups

DIMS = Second of two Minor Groups

N=Status

Note: The Discipline Designator and Major Group fields are mandatory. The Minor Group and Status fields are optional. Each data field is separated from adjacent fields by a dash ("-") for clarity.

3.1.2 Level 1 Discipline Designator

The Discipline Designator denotes the category of the subject matter contained on the specified layer. Not all Level 1 Discipline Designators may be used in a single project; however, if a Level 1 Designators is used, it shall be applied as shown in Table 3-1 below.

Level 1 Discipline Designators are defined as follows:

Table 3-1. Level 1 Discipline Designators

A	Architectural
B	Geotechnical
C	Civil
D	Process Mechanical
E	Electrical
F	Fire Protection
G	General
H	Hazardous Materials
I	Interiors
L	Landscape
M	Building Mechanical
O	Operations
P	Plumbing
Q	Equipment
R	Resource
S	Structural
T	Telecommunications
V	Survey and Mapping
W	Distributed Energy
X	Instrumentation and Controls (I&C)
Z	Contractor/Shop Drawings

3.1.3 Level 2 Designator

The Level 2 Designator is an optional modifier and can be added to further define a Level 1 Discipline Designator. While it is an option, the use of the Level 2 Designator provides more flexibility in the overall appearance of the model or sheet drawing.

For a complete list of Level 2 Discipline Designators, refer to the NCS.

3.1.4 Major Group

The major group is a four-character field that identifies a major building system. The prescribed Major Group field codes (four-character abbreviations) shown on the Layer List are logically grouped with specific discipline designators. However, any major Group may be combined with any prescribed Discipline Designator, provided that the definition of the Major Group remains unchanged. Therefore, any reasonable combination of the prescribed Discipline Designators and Major Groups is permitted.

For a list of commonly used Major Groups, see Drawing Set Discipline Designators in Appendix C, also refer to the list of Discipline Designators, Major and Minor Groups, and Status Fields, CAD Layer Guidelines in Section 4.2.

NOTE: The NCS recognizes that there will be instances where user-defined Major Group field codes will be required. The NCS set of Major Group field codes is not intended to be all inclusive. There will be instances when project specific Major Groups will need to be created. In these cases Major Group field codes are allowed; however, they must contain four alphabetic and/or numeric characters.

3.1.5 Minor Group

This is an optional, four-character field to further define the Major Groups. For example, A-WALL-FULL denotes Architectural, Wall, Full-Height. A second minor group may be used for still further delineation of the data contained on a layer. For example, A-WALL-FULL -LOWR indicates Architectural, Wall, Full-height, Lower level. The prescribed Minor Group field codes (four-character abbreviations) shown on the Layer List are logically grouped with specific Major Groups. However, any Minor Group may be used to modify any Major Group, provided that the definition of the Minor Group remains unchanged. Therefore, any reasonable combination of the prescribed Major and Minor Groups is permitted.

For a list of commonly used Minor Groups see Drawing Set Discipline Designators in Appendix C.

3.1.6 Status

The status field is an optional single-character field that distinguishes the data contained on the layer according to the status of the work or the construction phase.

A I - W A L L - F U L L - D I M S - N

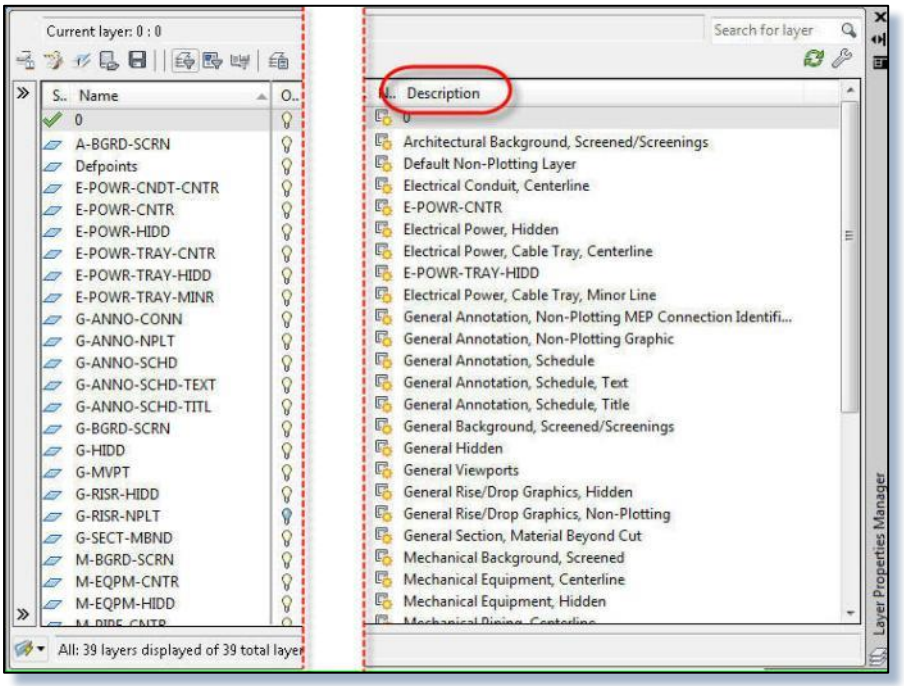
The prescribed field codes for this field are as follows:

Table 3-2. Status of Field Codes

A	Abandon
D	Existing to demolish
E	Existing to remain
F	Future work
M	Items to be moved
N	New work
T	Temporary work
X	Not in contract
1-9	Phase numbers

3.1.7 Layer Descriptions

When additional layers are added, a description of each layer will be required. The description is to be brief and concise and describe the layer usage in as few words as possible. Examples of layer descriptions are given below:



3.2 Drawing View Layer List

3.2.1 Drawing View Field Codes

The Drawing View field codes are specialized codes for layers that are organized primarily by drawing type, rather than by major building system. The field codes DETL, ELEV, and SECT

may also be used as Minor Group field codes to modify a major design system as shown in Table 3-3.

Table 3-3. Example Drawing View Layer Names

Layer Name	Description
□□-**DETL**	Detail
□□-**ELEV**	Elevation
□□-**SECT**	Section
□□-□□□□-**ANNNN**	Drawing View Major Group: optional number (A = letter, NNN = number between 001 and 999)
□□-□□□□-**ANNNN-IDEN**	Drawing View Major Group: optional number: identification tags
□□-□□□□-**ANNNN-MBND**	Drawing View Major Group: optional number: material beyond cut
□□-□□□□-**ANNNN-MCUT**	Drawing View Major Group: optional number: material cut by the view
□□-□□□□-**ANNNN-OTLN**	Drawing View Major Group: optional number: outline
□□-□□□□-**ANNNN-PATT**	Drawing View Major Group: optional number: textures and hatch patterns

For data sets that are organized by drawing type, an optional alphanumeric Minor Group field code, ANNNN, is prescribed to further distinguish drawings within a single CAD file. This Minor Group may be used ONLY to modify the prescribed Drawing View Major Groups; it may ***not*** be used to modify any other Major Group. The format of ANNNN is also prescribed. It must consist of a single alphabetic character followed by a four-digit number between 0001 and 9999.

The Minor Group field codes IDEN, MBND, MCUT, OTLN, and PATT may be used to modify any Major or Minor Group in the Layer List. The definitions of these prescribed field codes cannot be changed. See CAD Layer Guidelines Sections 3.1.4 and 3.1.5 for complete rules and options governing the use of Major and Minor Group field codes, respectively.

3.3 Annotation Layer List

3.3.1 Annotation Field Codes

Annotation consists of text, dimensions, notes, sheet borders, detail references and other elements on CAD drawings that do not represent physical aspects of the design. Use of the Major Group ANNO allows all annotation to be placed in a defined group of layers as shown in Table 3-4.

Table 3-4. Example Annotation Layer Names

Layer Name	Description
□□-ANNO	Annotation
□□-□□□□-BRNG	Bearings and distance labels (survey coordinates)
□□-□□□□-DIMS	Dimensions
□□-□□□□-IDEN	Identification tags
□□-□□□□-KEYN	Keynotes
□□-□□□□-LABL	Labels
□□-□□□□-LEGN	Legends, symbol keys
□□-□□□□-LOGO	Company logo
□□-□□□□-MARK	Markers, break marks, leaders
□□-□□□□-MATC	Match lines
□□-□□□□-NOTE	Notes
□□-□□□□-NPLT	Non-plotting graphic information
□□-□□□□-PROS	Date/Time/File name stamp
□□-□□□□-RDME	Read-me layer (not plotted)
□□-□□□□-REDL	Redlines
□□-□□□□-REFR	Reference, external files
□□-□□□□-REVC	Revision clouds
□□-□□□□-REVS	Revision indicators and text
□□-□□□□-SCHD	Schedules
□□-□□□□-STMP	Professional stamps
□□-□□□□-SYMB	Reference symbols
□□-□□□□-TABL	Data tables
□□-□□□□-TEXT	Text
□□-□□□□-TITL	Drawing or detail titles
□□-□□□□-TTLB	Border and title block

The Layer Names shown in Table 3-4 above provide examples for the use of Minor Group field codes for annotation. These Minor Groups may be used to modify any Major or Minor Group in the Layer List. See CAD Layer Guidelines Sections 3.1.4 and 3.1.5 for complete rules and options governing the use of Major and Minor Group field codes.

4.0 Uniform Drawing System

District has adopted the Construction Specifications Institute's (CSI), Uniform Drawing System (UDS). The UDS applies to all District drawings for all facilities, regardless of how they are produced or by whom. It focuses on the systematic organization and presentation of drawing information. Effective organization facilitates accurate communication between the Designer and those who use that drawing and streamlines information retrieval.

4.1 Drawing Set Organization

Organization standards affect production, delivery, and identification of hardcopy drawings as well as electronic (CAD) drawings. This Drawing Set Organization section provides a consistent, familiar environment for producing and viewing construction drawings.

Following the District cover sheet, sheet drawings will be organized into subsets as shown in Figure 4-1. All of the subsets may not apply, and additional categories may be required.

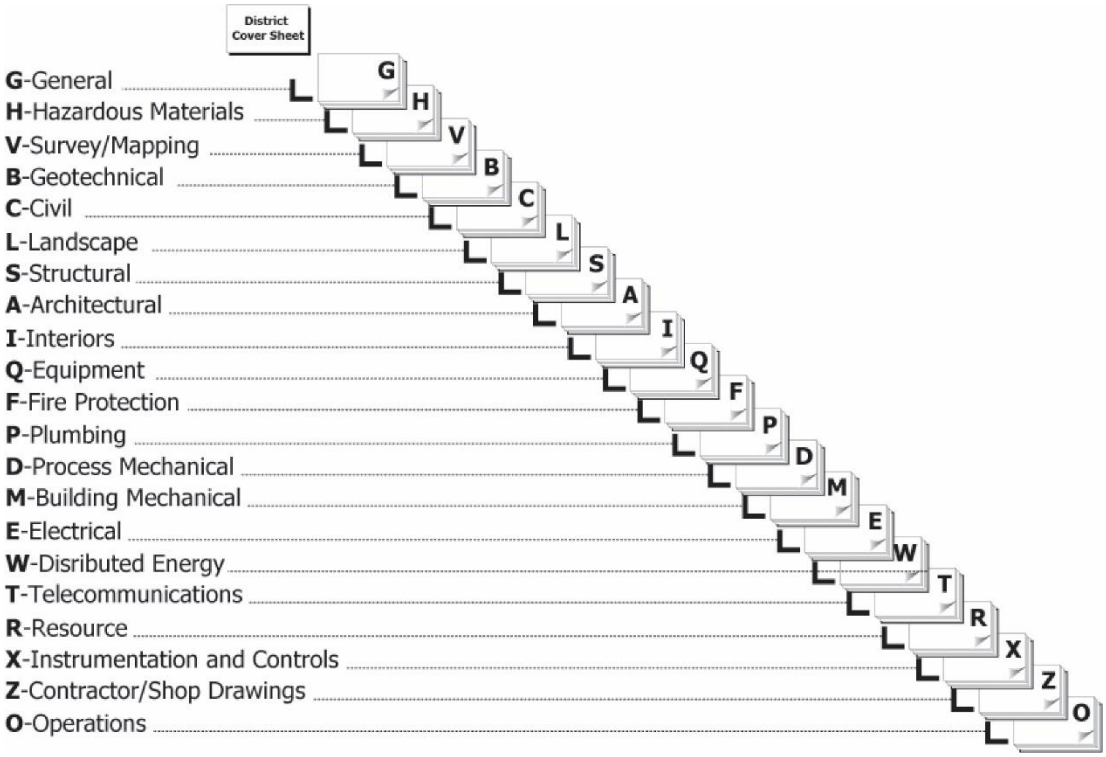


Figure 4-1. Typical Drawing Set

4.1.1 Sheet Identification

District's sheet identification format uses the traditional construction drawing techniques. The sheet identification format depicted here includes the following components:

- The Plant Zone or Equipment Zone ***number***, two numerical characters. If the project is within the EchoWater Facility boundary, the Plant Zone number will be used; if the

project is outside the EchoWater Facility boundary, the Equipment Zone number will be used. The Plant Zone or Equipment Zone number is not required on general sheets, common contract drawings or standard details.

- The ***discipline designator***, one alphabetical character with a hyphen or two alphabetical characters.
- The ***sheet type designator***, one numerical character
- The ***sheet sequence number***, two numerical character (deviation from NCS but two digit numerical character can be used on smaller projects upon request)

Sheet ID Name Format

N N A A N N N
Discipline Designator

N N A A N N N
Sheet Type Designator

N N A A N N N
Sheet Sequence Number

N N A A N N N
Plant Zone Number

A *= alphabetical character*
N *= numerical character*

The one- or two-character Discipline Designator identifies the sheet as a member of a subset. A Sheet Type Designator that identifies the type of information on the sheet is followed by the Sheet Sequence Number.

Level 1 offers the simplest identification format. Level 2 provides guidance for complex projects. See Drawing Set Discipline Designators in Appendix C.

The hyphen in the Level 1 discipline designator is a required place holder in the absence of the second character.

4.1.1.1 Discipline Designator

The first component of the sheet identification format, the discipline designator, is based on the traditional system of alphabetical discipline designators, using either a single alphabetical character with a hyphen (Level 1) or two alphabetical characters (Level 2).

Discipline Designator Name Format

A - N N N N
Level 1 Discipline Designator

A A N N N N
Level 2 Discipline Designator

A
Discipline Character

A
Modifier Character

A *= alphabetical character*
N *= numerical character*

The discipline designator denotes the category of subject matter contained in the file or on the layer designated. A dash always follows the Level 1 discipline designator; a dash is not used when the Level 1 discipline designator is used as shown in Figure 4-1.

Table 4-1 illustrates an example of the use of Level 1 and 2 Designators. For example, the mechanical engineer will be the designer for the HVAC system. The drawings required may be included on the **M** (**M**echanical) sheets along with the rest of the drawings produced by that designer. If the level of detail demands it, the mechanical engineer may decide to segregate the HVAC system information onto sheets with the Level 2 designator **MH** (**M**echanical **H**VAC).

Table 4-1. Level 1 and Level 2 Designators

Designator		Description of Suggested Names	Content
Level 1	Level 2		
M	--	Mechanical	
-	MD	Mechanical Demolition	Protection, termination, and removal
-	MH	Mechanical HVAC	Ductwork, air devices, and equipment
-	MI	Mechanical Instrumentation	Instrumentation and controls
-	MP	Mechanical Piping	Chilled and heating water, steam
-	MS	Mechanical Site	Utility tunnels and piping between facilities
-	MJ	User Defined	
-	MK	User Defined	

For an even more complex project involving instrumentation and controls, chilled and heated water systems, utility tunnels and piping between facilities, separate drawings for each mechanical system may be required, perhaps even produced by an HVAC specialist. In this case the discipline designator **M** (**M**echanical) can be used combined with specific modifier characters to create the Level 2 discipline designators **MI** (**M**echanical **I**nstrumentation), **MP** (**M**echanical **P**iping), or **MS** (**M**echanical **S**ite).

4.1.1.2 Sheet Type Designator

The sheet type designator is a single numerical character that identifies the sheet type as shown in Table 4-2. All sheet types may apply to all discipline designators. It is not necessary to use all the sheet types for a project or within a discipline.

Sheet Type Name Format

A A N N N N

Sheet Type Designator

***A** = alphabetical character*
***N** = numerical character*

Table 4-2. Sheet Type Designators

Sheet Type Number	Sheet Type Description
0	General (symbols legend, notes, etc.)
1	Plans (horizontal views)
2	Elevations (vertical views)
3	Sections (sectional views, wall sections)
4	Large-Scale Views (partial plans, elevations, stair sections, or sections that are not details)
5	Details (plans, elevations or sections that provide more specific information about a portion of a project component or element that are drawn to scale)
6	Schedules and Diagrams (tables or charts that include data about materials, products, and equipment, non-scaled views showing arrangements of special system components and connections not possible to clearly show in scaled views)
7	User Defined (all types that do not fall in other categories)
8	User Defined (for types that do not fall in other categories)
9	3D model Representations (isometrics, perspectives, photographs)

The use of sheet type designators does not preclude combining different types of drawings on the same sheet for simplicity. It is acceptable to:

- Place profile drawings on sanitary sewer or road plan sheets
- Place same scale sections on the same sheet as large-scale plans of stairs or escalators
- Place schedules on a plan sheet when the information is closely associated
- Combine different types of drawings on the same sheet on small projects

4.1.1.3 Sheet Sequence Number

The sheet sequence number is a two-digit number that identifies each sheet in a series of the same discipline and sheet type. Sequence numbering starts with 01**;** sheet number 00 is not permitted. The first sheet of each series is numbered **01**, followed by **02** through **99**. Sequence numbers need not be sequential. For large projects an additional sequence number may be added (3 digits)

Sheet Sequence Name Format

N N A A N N N

Sheet Sequence Number with Plant Zone Number

5 1 C - 1 0 2

C-102 Civil Grading Plan in Plant Zone 51

5 1 C G 1 0 2

CG102 Civil Grading Plan in Plant Zone 51

***A** = alphabetical character*
***N** = numerical character*

4.1.2 File Naming

District will assign a Contract Number to each contract. This 4 digit number will be added as a prefix to all file names.

4.1.2.1 Library Files

Library files are used as sources of information for more than one District project. These files are details, schedules, text, databases, symbols, borders, and title block files. The naming of these files will follow the MasterFormat™ file naming method as adopted by the NCS and the District.

Library files will be named differently from project files because the classification and indexing requirements are different. Library file naming will be grouped by building or structure systems, assemblies, or usage. MasterFormat™ numbers provide a useful method of organization. The library file naming format includes three user-defined characters after the MasterFormat™ numbers, which are followed by a period or dot and the file name extension (rvt, .dwg). Manufacturers and industry associations are developing conventions for library file naming.

Library files are not intended to be edited directly for the project. If a drawing is needed from the library, the library file will always be copied into the project directory and assigned a file name appropriate for the project. The project details are simply a drawing that is specifically indexed and cross-referenced within the project.

4.1.2.2 Project Files

Project files are specific to a project and shall be organized to make it easy to produce contract documents or record documents. Project files are structures, building and site models, details, sheets, schedules, text, database, symbols, borders, title blocks, and other files created for the project.

The project file name shall be consistent. The UDS provides a guideline for the uniform naming of files. An example project uniform naming convention is summarized in Appendix D - File Naming. The format in Appendix D is to be used for Revit models, AutoCAD models, AutoCAD Civil 3D models, sheet files, and 3D pipe networks.

4.1.2.3 Model Files

When naming model files, the first two characters are the discipline designator, consisting of one alphabetical character and a placeholder with hyphen for Level 1 discipline designators, or two alphabetical characters for Level 2 discipline designators. The Level 2 discipline designator is optional.

The District contract number prefix will be assigned for the project. The third and fourth characters are alphabetic characters that define the type of model. The following designations are examples. The fifth through eighth characters are alphanumeric user-defined modifiers for the model types as shown in Table 4-3 below.

Model File Name Format

A - A A U U U U . E X T

Level 1 Discipline Designator and Hyphen

A A A A U U U U . E X T

Level 2 Discipline Designator

A - A A U U U U . E X T

Type of Model

O O O O O A - A A U U U U . E X T

District Contract Number

A - A A U U U U . E X T

User-Defined Model Type Modifiers

A - A A U U U U . E X T

File Name Extension

A *= alphabetical character*
N *= numerical character*
U *= user-defined character*
O *= District Contract Number*
EXT *= file name extension (.rvt or .dwg)*

Table 4-3. Model Types

Type Code	Description
FP	Floor Plan or Plan View
SP	Site Plan
DP	Demolition Plan
QP	Equipment Plan
XP	Existing Plan
EL	Elevation
SC	Section
DT	Detail
SH	Schedules
3D	3D Model
DG	Diagrams and Schematics

4.1.2.4 Detail Files

Detail File Name Format

A - N N N N - A N . E X T
Sheet Identification

A - N N N N - A N . E X T
Placeholder

A - N N N N - A N . E X T
Detail Identification Number

S - 5 0 0 1 - B 3 . D W G
File Name Extension

***A** = alphabetical character*
***N** = numerical character*
***U** = user-defined character*
***EXT** = file name extension (.rvt or .dwg)*

Project detail files are specific type of model files. They include plans, elevations, sections, and details. The project detail files are placed on a drawing sheet file; they will be indexed using sheet grid coordinates. Their file names require close coordination with the sheet file upon which they are placed. The identification of details is part of the system that includes the drawing blocks (drawing area coordinate system), the sheet identification format, and the use of a two-part reference bubble.

When naming detail files, the first five characters are identical to the sheet identification of the sheet file that contains the detail. This coordinates the individual detail file to the specific detail sheet. The sixth character is the hyphen. It serves as a placeholder that makes the name more readable and easier to manage. The seventh and eighth characters are used for the detail identification number.

This is an example of a file name of a specific project detail found on sheet **S-501**. The detail identification number **B3** indicates that it is located on the sheet at grid coordinates **B3**. The two-part reference bubble for this detail would be **B3/S-501**.

4.1.2.5 Sheet Files

The electronic sheet drawing files are comprised of the District sheet border template, text, symbols and views of files, representing appearance on the final sheet.

When naming sheet files, the main purpose of the sheet drawing file is to prepare information for the production of the specific sheet, the format of the file name will be consistent with the format for the sheet identification. The sheet file name categorizes the contents of each electronic sheet drawing files to the same degree as the sheet identification categorizes the physical sheet of drawings.

4.1.2.6 Schedule Files

Schedule Files Name Format

M - 6 0 0 1 - C 1
Example of Schedule Identification

For project schedule file naming, the format is similar to the project detail format. Note that this naming format does not rely on any specific file extension, which makes it valid for all types of software.

The example of a file name of a specific project mechanical schedule found on the sheet labeled **M-601**. The number **C1** indicates that the schedule is located at grid coordinate **C1** on that sheet.

4.1.2.7 Database Files

Database files include tables that predefine and label *fields* or *smart tags* from P&IDs or model data. The applications also let the creator define valid ranges of values for the fields. All databases provide the means to set up formats for both data input and report output and index files to optimize performance.

Examples of database tables include just about any schedule used in construction documents, inventory listings for equipment and furnishings, master keynote listings, discrepancy reports, and numerous other lists or tabulations.

File naming of database files is dependent on how much optimizing and linking information among various software applications is needed within a project. Integration of database tools into CAD varies with the choice of CAD software and is dependent on the degree of customization within the application. ***RDB Link*** is the Revit add-on software used to link the 3D model to the SQL server.

4.1.3 File Management

The preceding file naming system recommendations will obviously create many files with the same name. Operating systems software will not allow two identical file names to exist in the same folder in the system.

The District's project identification name and number shall be used to identify the project folder. The next level of subfolders should consist of names identifying the progression of the project files according to their development phase. The next lower level of subfolders could identify the type of project files described in "Project File Types."

In the format for folder names, a prefix number is included to preserve the sorting of subfolders by development sequence as shown in Table 4-4.

Table 4-4. Proposed Project Folders Name Format

Folder Title	Content
0-PROJECTS	Project administration (project borders, standards, databases, timeline schedules, etc.)
1-SHEETS	Discipline organized sheet file drawings
2-2D MODELS	Discipline organized 2D model file drawings
3-3D MODELS	Discipline organized 3D model file drawings
4-DETAILS	Project Details
5-SECTIONS	Project Sections
6-SCHEDULES	Project schedules
7- NAVISWORKS	Project presentation models
8-X-LIBRARY	District standard models, details, etc.
9-TEMPLATES	Templates (sheet, plotting)
10-STICKFILE	Project PDF's organized by weeks
11-SUBMITTALS	Project submittals organized by submittal type

4.2 Sheet Organization

Sheet organization establishes consistency in the systematic presentation of drawings organized on sheets. The following District standards:

- Provide a consistent sheet format;
- Present examples of sheet formats;
- Provide a location system for drawings on a sheet; and
- Establish guidelines for management, notation, and title block information.

4.2.1 Sheet Sizes

The District standard size sheet drawing is the American National Standards Institute (ANSI) "D" which measures 22-inch by 34-inch sheet size. District requires 11-inch by 17-inch reduced size sheets for most of its submittals.

4.2.2 Sheet Layout

The District sheet drawing is divided into three main areas: *drawing area, title block area, and production data area* as shown on Figure 4-2. These sheet drawing areas are required; each of these areas contains information concerning construction or reference information, project management or presentation information, and project production information.

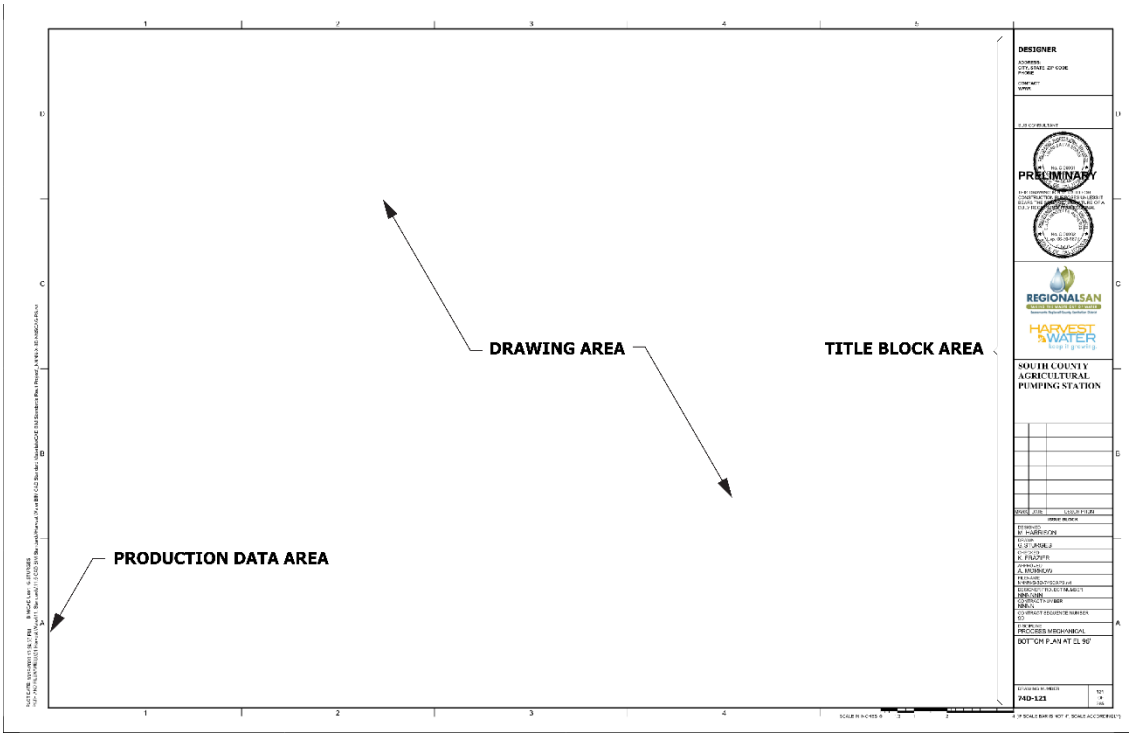


Figure 4-2. Overall Sheet Layout

4.2.2.1 Drawing Area

The drawing area is that portion of the sheet containing drawings, keynotes, key plans, schedules, and other graphic and text data necessary to illustrate the work. The standard drawing module size is 6" x 6". Modules should remain the same throughout the drawing set.

Each drawing block is identified by the drawing area coordinate system.

4.2.2.2 Drawing Area Coordinate System

The drawing modules are arranged in columns and rows. Columns are identified with numerical characters starting with 1 and increasing to the right. Rows are identified with alphabetical characters beginning at the bottom starting with "A" and increasing toward the top of the sheet. Each module is identified by a letter and a number. A drawing block may be composed of one or more drawing area modules and is identified based on the lower left hand location. Therefore, a drawing located in the lower left hand corner of the drawing area, two modules high by two modules wide, would be identified as A1 as shown on Figure 4-3.

Drawing area coordinates are positioned outside the drawing area itself. Coordinates are not required for schematic design drawings.

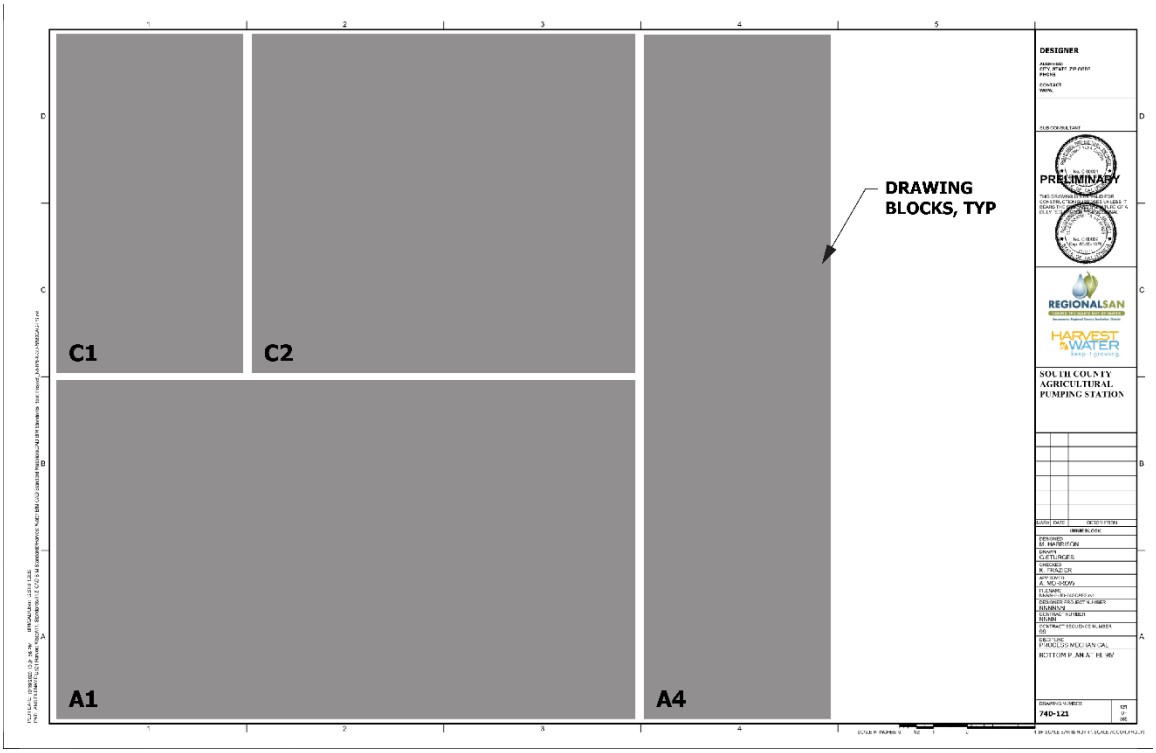


Figure 4-3. Drawing Area Coordinate System

4.2.2.3 Note Block

The note block is the module or modules within the drawing area where keynotes, general notes, and key plans are located. Not all sheets will have a note block. The note block is located in the far right column of the drawing area. A key plan block, when used, should always be located in the lowest module of the note block (see Figure 4-4). If the sheet does not have a note block locate the key plan block in the lowest module next to the title block. When the note block is not required, this area can provide additional drawing space.

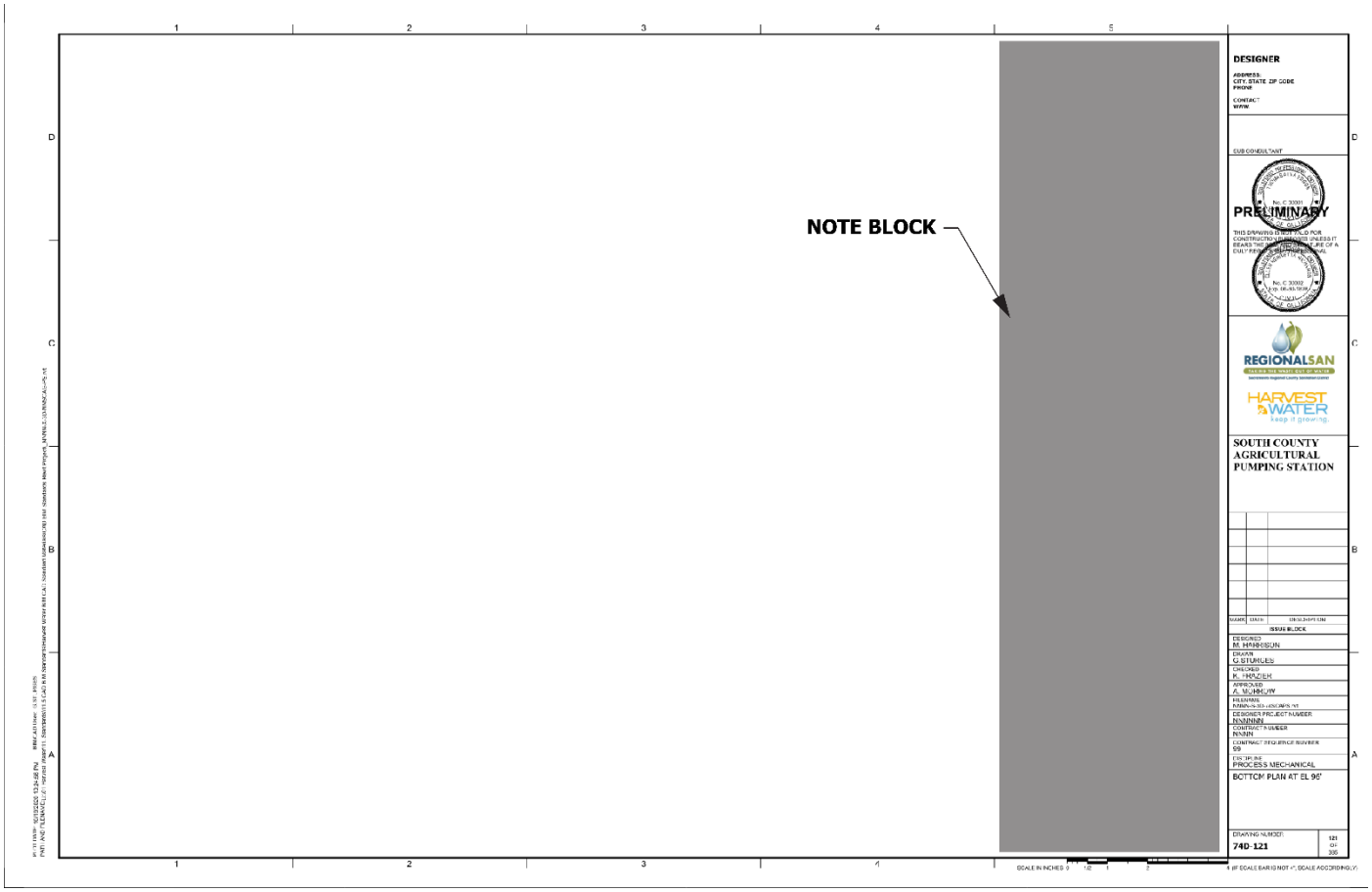


Figure 4-4. Note Block

4.2.2.4 Title Block Area

The title block area is that portion of the sheet containing project, client, designer, sheet identification, and sheet management information needed by the user of the sheet (see Figure 4-5). Data blocks include the following:

- Designer Identification Block
- Project Identification Block
- Issue Block
- Management Block
- Sheet Title Block
- Sheet Identification Block

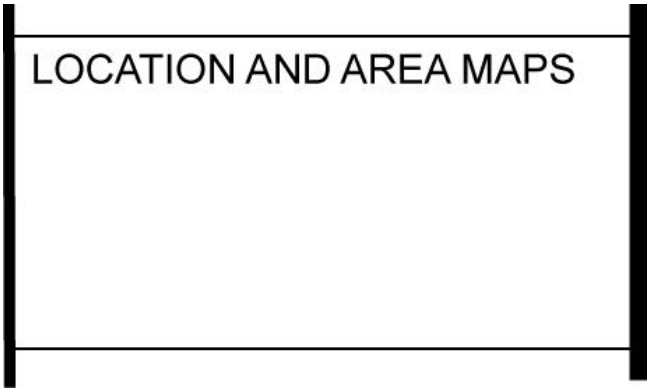


Figure 4-5. Title Block

4.2.2.5 Designer Identification Block

The designer identification block is that portion of the title block area identifying the designer of the sheet (see Figure 4-6). This block should include information about the preparer including:

- Name
- Address
- Telephone and fax numbers
- E-mail address or other means of electronic communication

This block may also include the designer's logo, professional seal(s), certifications, and the names and addresses. A single seal is required by the State of California.

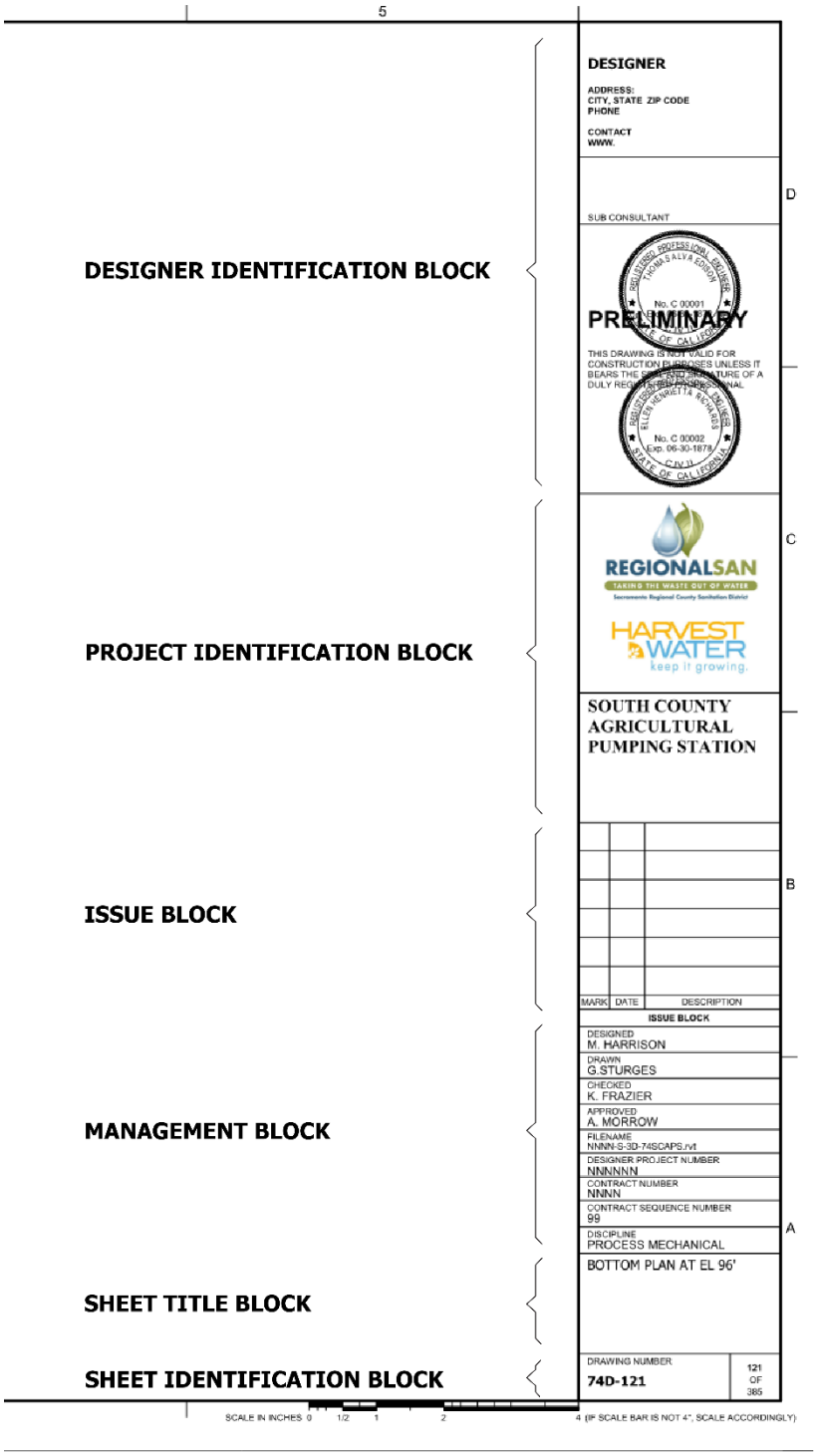


Figure 4-6. Designer Identification Block

4.2.2.6 Project Identification Block

The project identification block is that portion of the title block area that identifies the project (see Figure 4-7). This block may contain information regarding:

- Project name and address
- Building or facility name
- Construction phase sequence
- District Logo

The SacSewer Logo is included in the project identification block.

Figure 4-7. Project Identification Block.

4.2.2.7 Issue Block

The issue block is the portion of the title block area that shows the chronological issue of, and revisions to, the sheet (see Figure 4-8). The issue block has three columns identified as mark, date, and description. See Appendix K for additional drawing revision guidelines.

D	12-22 2014	FINAL DESIGN SUBMITTAL (FD)
C	11-11 2014	DESIGN SUBMITTAL 3 (DS3)
B	9-28 2014	DESIGN SUBMITTAL 2 (DS2)
A	5-21 2014	DESIGN SUBMITTAL 1 (DS1)
MARK	DATE	DESCRIPTION
ISSUE BLOCK		

B

Issue Block during Design

BID DOCUMENTS DECEMBER 22, 2015		
6	2-28 2015	REVISED PER ADDENDUM 11.21
5	2-23 2015	REVISED PER ADDENDUM 8.10
4	1-17 2015	REVISED PER ADDENDUM 7.2
3	1-7 2015	REVISED PER ADDENDUM 4.23
2	12-30 2014	REVISED PER ADDENDUM 3.18
1	12-27 2014	REVISED PER ADDENDUM 1.31
MARK	DATE	DESCRIPTION
ISSUE BLOCK		

B

Issue Block "BID DOCUMENTS"

CONFORM TO INCLUDE ADDENDA DECEMBER 22, 2015		
MARK	DATE	DESCRIPTION

Issue Block "CONFORM TO INCLUDE ADDENDA"

RECORD DOCUMENT DECEMBER 22, 2015		
MARK	DATE	DESCRIPTION
ISSUE BLOCK		

Issue Block "RECORD DOCUMENT"

Figure 4-8. Issue Blocks

The data fields in this block include:

- Phase issue dates
- Addendum issue dates
- Clarification dates
- Revision issue dates

The number of data field lines is user dependent. The initial entry should be placed at the bottom of the issue block, with subsequent entries placed above each previous entry, allowing for expansion into the project identification block if necessary. The Issue Block will be revised at two (2) milestones during Design and Bid period:

1. For Bid Documents, the Issue Block will be revised after DS3. All Design Submittal milestones will be cleared and the "BID DOCUMENTS" will be published with an issue date. These contract documents will be issued to the contractor for bidding. An example of a Bid Documents Issue Block is shown in Figure 4-8b.

2. After the contract is awarded, the Issue Block during the Addendum period will be revised. All Addendum period revisions are not to be cleared and the "CONFORMED TO INCLUDE ADDENDA" will be published with an issue date and will include all bid addendums; these contract documents will be issued to the contractor for information only. An example of a Confromed to Include Addenda Issue Block is shown in Figure 4-8c. The bid documents set that includes the addendums will be the "legal contract".

4.2.2.8 Management Block

The management block is the portion of the title block area that contains the management information generally used for project filing, record keeping, or other project management information (see Figure 4-9). Data fields in this block may include:

- Designers project number
- District's contract number
- SacSewer's project number
- File number
- Design/construction phase number
- CAD drawing file number

- Drawn by
- Checked by
- Discipline

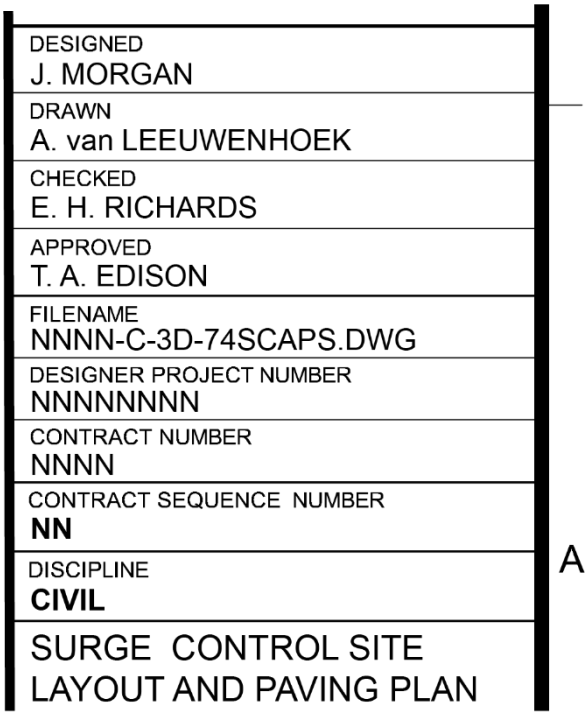


Figure 4-9. Management Block

4.2.2.9 Sheet Title Block

The sheet title block is the portion of the title block area that indicates the type of information presented on the sheet (see Figure 4-10). The sheet can contain one or more types of drawings. The title block will only include the major type of information shown on the sheet, or may indicate multiple types of information (e.g., floor plan, schedules, and details).

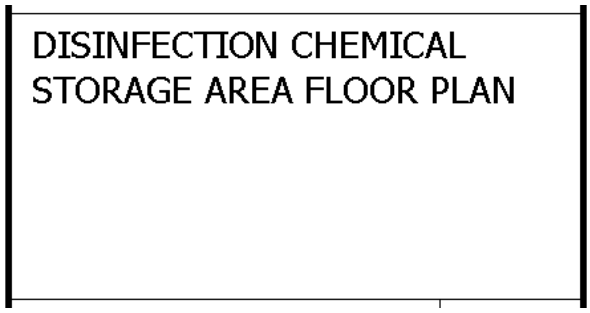


Figure 4-10. Sheet Title Block

4.2.2.10 Sheet Identification Block

The sheet identification block is the portion of the title block area that contains the sheet identifier (see Figure 4-11). The sheet identification block includes the drawing number and the sheet count and total number of sheets in the set. The sheet count will be for all sheets in the drawing set.

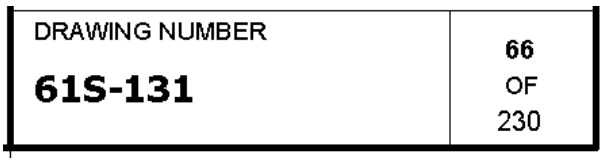


Figure 4-11. Sheet Identification Block.

4.2.2.11 Production Data Area

The production data area is a portion of the sheet that contains information on the production of the sheet. This data is usually covered by the binding strip once the drawing set has been assembled (see Figure 4-12). The production data area may include the following blocks of information.

Plotter Time and Date Block. The plotter time and date block is the portion of the production data area where the time and date of the plot are located. This information is located near the A1 drawing block. The time and date can be automatically inserted by CAD software.

Production Block. The production block is that portion of the production data area that contains management information concerning the production of the sheet. Data that may be assigned to this block includes:

- File path
- Sheet file name
- Default settings
- Pen assignments
- Printer/plotter commands
- Overlay drafting control data
- Reference file(s)
- Layers plotted
- Production hours

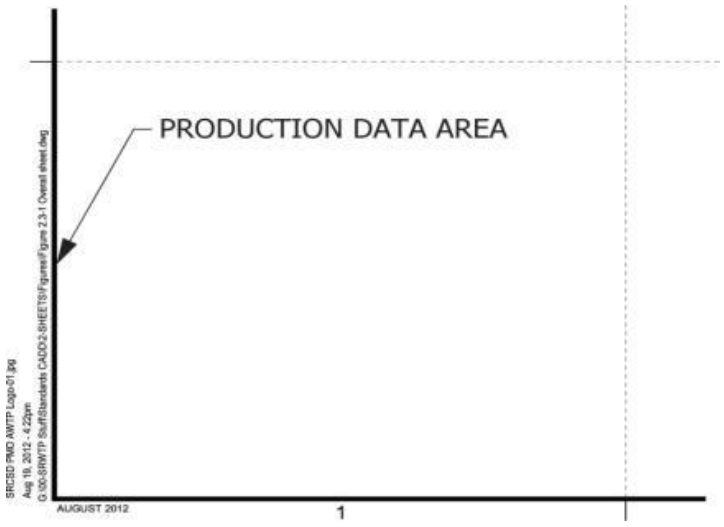


Figure 4-12. Production Data Area

4.2.3 District Cover Sheet

The cover sheet is unique to the sheet organization format. The cover sheet will identify the project, SacSewer logo, the District project number, the volume number of the drawings, and the engineering design firm name. The cover sheet is a standard sheet to be used by all designers.

4.2.4 District Title Page

The Title Page includes the names of the Board of Directors, the SacSewer name and logo, the project name, the contract number, the engineering design firm name, and the signature approvals. The signature approvals include the Designer's Project Engineer, and the District's Project Manager, the Plant Manager, and the District Engineer.

4.3 Drawing Standards

Drawing standards provide uniform guidelines for producing a set of construction drawings of consistent quality that eliminates duplication of information. These standards address the placement of the drawing grid and north arrow, recommended scales, type of lines used to represent different articles in the drawings, and the proper way to represent different materials graphically and the use of notations.

4.3.1 Drawing Orientation and North Arrow

The orientation of a facilities main base plan sets up the orientation of all plans above and below. Plans may be oriented on a sheet in a variety of ways to display the requirements of the project and the intent of the designer. Ideally, the entire plan should be shown on one sheet. If it cannot fit on one sheet, the floor plan should be subdivided into convenient segments with match lines provided to reference where the floor plan is continued. See Match Lines below.

Civil plans may orient the drawing in a manner that will allow the site plan to fit within the sheet boundary when drawn at the most appropriate scale. It is preferable to orient the site plan in the same manner as the plan views whenever possible.

The District's north arrow indicator symbol and the orientation of the plan north arrow should be shown on all plans either as straight up or to the right. This will be consistent throughout the set of drawings. Plan north enables the designer to assign simple names to all elevations. The District's north arrow indicator symbol shall be used for all plan views and placed to the right of the drawing view title.

A sheet containing small scale plans for all levels drawn at 1 inch =200 feet or 1 inch =500 feet (1/16 inch or 1/32 inch = 1 foot) scale or smaller should be included in the set to provide an overview of the project and serve as a quick reference key drawing. This sheet is useful if the plan view is divided into segments to fit in a standard 22 inch by 34 inch size sheet.

Consistency of the display of information throughout the set is important. For example, a pumping station plan detail should be shown in the same orientation as it is shown on the overall plan view.

4.3.2 Grid System Overview

A grid system is used to indicate structural columns, load-bearing walls, shear walls, and other structural elements on the sheet drawings. It is used primarily for reference in schedules of structural data. Grid lines are used as a basis for dimensioning.

Vertical grid lines shall have designators at the top of the grid numbered from left to right. Horizontal grid lines shall have designators at the right side of the grid alphabetized from bottom to top. *To eliminate confusion with the numerals 0 (zero) and 1 (one), do not use letters O or I.*

Where additional intermediate structural support elements occur between grid lines, a fractional designation is used. For example, a column occurring at mid-point between grid lines 2 and 3 would be designated 2.5. In a similar manner, columns occurring between grid lines A and B would be represented as A.1, A.2, A.3, and A.4.

The structural discipline will maintain the grid lines.

4.3.3 Coordinate System Overview

The EchoWater Facility coordinate system can be used with baseline dimensioning to locate various components of the facility about a fixed point horizontally as well as vertically. To locate the building or structure horizontally, fixed points in the building outline (usually two corners and angle of relevance) are dimensioned to the property lines or coordinates are provided for the corners.

Fixed points such as the survey benchmark and adjacent street centerlines may be used to relate the building or structure to the site. Not all the dimensions shown are necessary to locate the building or structure on the site.

For vertical dimensioning, the finish floor elevation is set on the site plan at its true relationship to the benchmark used as a survey datum. The benchmark should be referenced to the EchoWater Facility coordinate system to coordinate grading, drainage, and utility elevations. Elevations are given the 100^{th} of a foot.

For plan views containing arcs, dimensions are determined by the angles radiating from the center of the circle.

4.3.4 Drafting Precision

Ensure that lines join precisely at their ends. Do not allow them to overlap or fall short. Lines that do not meet precisely will end up causing errors when other items that rely on the precision of the intersections are created or inserted.

Always use the actual dimensions or coordinates of a specific point in space or use identifiable points such as the intersection of two lines when drawing, copying, moving, offsetting, or inserting items.

4.3.5 Scale

The selection of the proper scale determines the readability of the drawing. The scale chosen should be large enough to allow the drawing to display its graphic, dimensional, and textual content clearly, without congestion or ambiguity. Clarity should always be considered in selecting a drawing scale. Scale will be expressed numerically. All drawings or views should indicate the numeric scale at which the view is presented. Refer to the title block graphic scale when the sheet drawing has been reduced or enlarged. The use of the word "scale" is required.

Numeric scale can be expressed in architectural or engineering as is appropriate to the project. Table 4-5 shows scales commonly used on construction drawings.

Table 4-5. Common Scales

Architectural Scale	Engineering Scale	Typical Uses
--	1" = 5000'	Site Plans
--	1" = 2500'	Site Plans
--	1" = 1000'	Site Plans
--	1" = 500'	Site Plans
--	1" = 200'	Site Plans
--	1" = 100'	Site Plans
--	1" = 50' (H) 1"= 5' (V)	Site Plans and Profiles
--	1" = 40' (H) 1"=4' (V)	Site Plans and Profiles
1/32" = 1'-0"	1" = 30' (H) 1"=3' (V)	Site Plans and Profiles
1/16" = 1'-0"	1" = 20' (H) 1"=2' (V)	Partial Site Plans, Profiles, Plan Views, Elevations
3/32" = 1'-0"		Plan Views, Elevations
1/8" = 1'-0"	1" = 10'	Plan Views, Elevations, Overall Sections
1/4" = 1'-0"	1" = 5'	Plan Views, Elevations, Overall Sections
3/8" = 1'-0"		Interior Elevations, Sections
1/2" = 1'-0"		Partial Plans, Sections
3/4" = 1'-0"	1" = 2'	Enlarged Partial Plans, Wall Sections, Foundation, Footing, Others
1" = 1'-0"		Details, Sections, Connections, Others
1-1/2" = 1'-0"	1" = 1'	Details, Sections, Connections, Others
3" = 1'-0"		Details, Sections, Connections, Others
Half Full Size		Details, Sections, Connections, Others
Full Size		Details, Sections

It is preferred to keep the same scale for drawings on a single sheet. However, many drawings may require different scaled views on the same sheet to adequately communicate drawing information. In all cases, the scale must be shown for each drawing or view.

4.3.6 Lines

Table 4-6 lists line widths for different applications for CAD-produced drawing

Table 4-6. Lineweights

Width of Line (mm)	Use of Lines
Extra Fine (0.13)	Fine detail which cannot be accomplished using a fine (0.18 mm) line.
Fine (0.18)	Material indications, surface marks, hatch lines, patterns.
Thin (0.25)	Text: 2.5 mm (3/32") to 10 mm (3/8") Dimension lines, leaders, extension lines, break lines, hidden objects, dotted lines, dashed lines, setback lines, center lines, grid lines, schedule grid lines.
Medium (0.35)	Text: 4 mm (5/32") to 10 mm (3/8") Object lines, property lines, text, lettering, terminator marks, door and window elevations, schedule grid accent lines.
Wide (0.50)	Text: 6 mm (7/32") to 10 mm (3/8") Titles, edges of interior and exterior elevations, profiling. Cut lines, property lines, section cutting plane lines, drawing block borders.
Extra Wide (0.70)	Text: 13 mm (1/2") to 25 mm (1") Match lines, large titles, footprints, title block borders, sheet borders, schedule outlines.
XX Wide (1.00)	Major title underlining and separating portions of designs.
XXX Wide (1.40*)	Border sheet outlines and cover sheet line work.
XXXX Wide (2.00)	Border sheet outlines and cover sheet line work.

4.3.6.1 Common Line Types

In addition to object lines, the following lines apply to all disciplines and drawing organization:

- Leaders are lines that connect notes, dimensions, or symbols to a point or item in a drawing. Leaders terminate with 1/8-inch 20-degree filled arrowhead in proximity to the item being described by the notation. Leaders should be drawn in a consistent fashion, at 30 or 60 degree angles. This shall be consistent throughout the set of drawings. They should not be confused with lines in the drawing. They are not allowed to cross dimension lines or each other. Leaders should start at the lower right side or upper left side of the notation.

- Break lines are used to indicate the cut between two parts or levels. Never foreshorten parts of the drawing that require detailing.

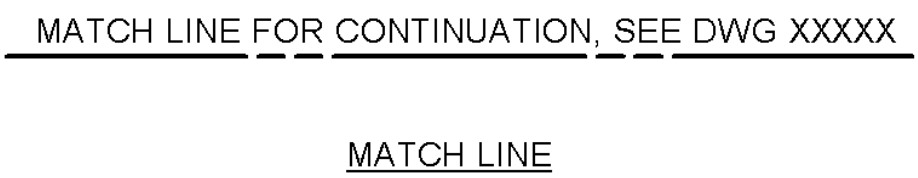
- Centerlines are used to indicate the center of a tank, column, beam, wall, piping, pumps, or opening. A thin line interrupted at intervals by a dot represents centerlines.

- Dimension lines are represented by a thin line connecting between extension lines defining the beginning and end of the object being dimensioned. A 1/8-inch, 20-degree filled arrowhead identifies the intersection between an extension line and a dimension line.

- Limit of construction lines define the area of work beyond which the contractor is not allowed to execute any work.

- Match lines delineate division between two or more areas of a continuous structure that must be shown on separate sheets because of sheet size limitations. Do not locate match lines on column lines, grid lines, or expansion joints. Locate them instead at the

centerline of a wall or corridor. Match lines should be shown at the same location and at the same scale on both sheets containing adjacent segments of the plan at the same location. Match lines should extend beyond the area to be matched. They may jog to avoid important elements of the plan. All match lines should be shown on the Key plan. The line width for match lines is shown in Table 4-6. Match line text should read "MATCH LINE ~~'A'~~ FOR CONTINUATION, SEE DWG XXX". The drawing number reference shall be referenced (fielded).



- Hidden Lines represent items obscured from view by another material. Examples include items above or below a plan view. Thin dashed lines represent hidden lines.
- Property Lines are represented by a line interrupted by double dots. They indicate the boundary of the site.
- • Pipe lines for piping arrangements are shown with single lines and double lines. In single line representation only the center line of the pipeline is drawn using a solid line. In double line representation the actual size of the pipe is drawn to scale with center lines. See Table 4-7 for the correct drawing scales for minimum pipe size representations shown as double lines.

Table 4-7. Double line requirement for Pipe

Drawing Scale	Minimum Pipe Size Drawn as Double Line
1/4"=1'-0" and larger	6"
3/16"=1'-0"	10"
1/8"=1'-0"	12"
3/32"=1'-0" and smaller	Single line
1"=10	12"
1"=20'	24"
1"=40'	48"
1"=50' and smaller	Single line

4.3.7 Dimensions

Each wall or part of a detail must be tied to a fixed point such as a column centerline or an existing or bearing wall. This applies to plan views and the enlargements associated with them. For wall sections and their details, the horizontal reference is the floor elevation.

4.3.7.1 Graphic Conventions and Indications

- Location: Generally, dimensions should be located outside the plan view or other view being dimensioned. Minimize clutter and overlap with other graphics. Dimensions outside the view should be located at the top and/or the right side of the plans whenever possible. Offset dimension lines from object lines a minimum of 9/16-inch and offset dimension lines from each other 3/8-inch. When dimensions must be shown on the interior of a plan view or other view, the dimensions should be arranged in continuous strings for clarity and consistency.

- Types of Terminators: Terminators define the junction between a dimension line and the extension lines leading to the start and finish of the dimension. These terminators are 1/8-inch, 20-degree filled arrowhead.

- Numeral Size and Location: Numeral size shall match the font size (1/8-inch Arial) of the text in the drawing. Where possible, the numeral should be placed at the midpoint and on top of the dimension line.

4.3.7.2 Hierarchy of Dimensions

Arrange dimensions from general to specific. Dimension the overall distances followed by the structural grid or floor-to-floor height. This is followed with more specific information such as opening and pump location, or heights of various structural components.

Extension lines leading from the building or structure to the dimension lines may cross the structural grid. To prevent confusion, interrupt (or break) one of the lines.

4.3.7.3 Plan Dimensions

Steel frame and reinforced concrete buildings are normally dimensioned from column centerline to column centerline. This should include an additional dimension to the face of the finished building.

For concrete structures, perimeter columns may be dimensioned to the face of the column rather than the centerline.

When dimensioning structural and non-structural walls and partitions, three methods of dimensioning are in common use:

- **Face of Concrete or Masonry Unit:** Dimensions should start on the exterior face of the left end or bottom of the plan and proceed continuously to the other side of the plan, ending again on the exterior face. A single dimension in the string may contain a "±" to allow for small variations at the site and to prioritize all other dimensions in the string.

  For masonry construction, dimensions should be the multiple of a masonry module. This minimizes the need for cutting units in the field.

- **Centerline:** This is the most consistent system for some projects when all dimensions (except to exterior face) for pumps, equipment, piping, walls, and openings are shown to

the centerline of that object. This provides flexibility when exact sizes of components may change during the course of production drawings or construction.

- **Face of Finish:** This is most appropriate for modification or renovation work where the face of finish is already known or is highly critical. It can be used in some situations as reviewed above, but should be used only when required by the project.

In some building system types critical dimensions are designated as "clear." This means that after construction, the actual dimension is the clearance between finished surfaces. The actual dimension may never be less than the clear dimension, but may be greater.

Where a dimension cannot be determined in the field, such as a hidden object that will be uncovered after demolition, add VIF (Verify In Field) below the dimension.

4.3.7.4 Vertical Dimensions

Vertical dimensions follow a hierarchy similar to the one described under plans progressing from detailed dimensions close to the wall to overall dimensions farthest from it. Eliminate excessive repetition of dimensions from small scale to large scale.

The EchoWater Facility coordinate system has reference benchmarks available and should be shown on the plans and sections.

When referencing an existing structure level that will be matched or altered, a reference to the elevation of the intended level should be included on the plan. The start point for vertical dimensions is established by criteria appropriate to the project.

- Dimensioning Sections and Elevations: Sections and elevations should be consistently dimensioned within the reference grid and dimension area of the drawing.

- Provide an extension line at each level. Provide a continuous dimension string connecting each extension line. Provide the elevation mark at the critical level only and dimension all other levels and height from the fixed datum. The elevation mark is tied to a fixed datum from the plant site survey.

- Dimensioning Wall Sections and Section Details: Dimension strings for these drawings are usually placed outside the wall within the zone.

- For sections, two main strings of dimensions exist. The one placed closest to the structure defines the rough openings and the top of the slab or level. The second string indicates the level-to-level heights. Avoid dimensioning the overall height of the structure already shown on the overall section.

- For section details provide all the detailed dimensioning not indicated in the drawings described above. This group of sheet drawings should have the same orientation as the sections. Follow the hierarchy of dimensions associated with these drawings.

4.3.7.5 Dimensioning Guidelines

- Structural elevations are +100 feet of datum xxx and shall be shown to the 0.01ft tolerance.
- Dimension fractions should not be less than 1/16". In cases where an opening width is divided into two equal parts and the original width is 5' 2-1/16", write the total width on one string and create another string stating equal (EQ) on both sides rather than label each side as 2' 7-1/32".
- Dimensions on detail drawings shall include fractions of an inch or millimeters to suit the tolerances required of the specific application.
- Where perimeter beams are sloped to accommodate drainage, do not tie the dimensions to the top of steel. Tie them instead to the top of the wall.
- Where the length of dimension lines is too short to accommodate the dimension number, show the number to the side.
- If the drawing is not to scale, note NTS in the drawing title, but try to avoid using NTS whenever possible

4.3.8 Material Indications

Some material indications are used in drawings to help the viewer understand the use and extent of materials; symbols are provided for the identification of material. Detailed information about the indicated graphic material should be placed in the specifications.

Material indications may define general use if the material covers the entire surface, or a specific pattern such as the coursing and placement of bricks. For clarity, notes calling out the material may be used in addition to the graphic symbol. Material patterns and accents indications should be used sparingly on drawings to identify but not to overly describe.

Unless a specific pattern is being illustrated, it is not necessary to fill the drawing area with the material indication. Show the material around the perimeter of the area or at either end to increase the readability of the drawing. The following is a description of material indications for plans, elevations, and sections:

- **Plans:** While plan views drawn at 1/8" or 1/4" = 1'-0" may not require any material indications for exterior walls, plan details drawn at a larger scale should include a hatch or fill showing the exterior material(s). Unique surface materials may not be indicated if the whole area is constructed of the same material and does not include any patterns.
- **Elevations and Sections:** Interior and exterior elevation drawings commonly use material indications to identify the surface materials intended. Section drawings use material indication symbols to define the location of specific materials.

4.3.8.1 Hatching

Hatching refers to the patterns of repetitive lines, dots, or figures used to indicate specific types of materials or designate specific areas. Only use hatching to indicate specific materials such as a concrete block wall or specific areas where work is to be done. For example, drawings shown at 1/8" = 1'-0" or smaller rarely require any hatching to indicate materials. Use a hatch pattern to indicate a specific area of concrete to be removed within a larger area of concrete to remain.

Limit the area to be hatched. In large areas requiring hatching to make the drawings readable, it is not necessary to hatch the entire area. Select small areas to be hatched that will clearly identify the entire area. Indicate hatching where materials change or terminate.

4.3.9 Notations

Notations include standards for different types of notes on different types of drawings. Annotation (callouts) are used in conjunction with leaders in the drawing area. The purpose of notations associated with construction drawings is to perform the following functions:

- Provide information relevant to the entire set of documents, or individual disciplines, or individual sheets.
- Identify products, materials, components, or assemblies using the same terminology used in the specifications.
- Describe the execution requirements of the design: "*Field verify dimensions prior to submitting shop drawings.*"

The following items are additional guidelines:

The annotation (lettering) of a drawing consists of drawing notes, callouts, key notes, general notes, object identification symbols (equipment, instrumentation, pipe, etc.), titles, and dimensions. Guidelines for annotation follow:

- Left justify text on drawings and figures.
- Make lettering readable from the bottom or right of a drawing.
- In any case, reverse the lettering to read from the left when exceeding 15° left of vertical.
- Do not use third-party fonts.

Guidelines for general notes follow:

- Number general notes sequentially.
- Format general notes using proper sentence structure and punctuation.

- Locate general notes in the upper right corner of the sheet.
- Do not repeat information unless absolutely necessary.
- Do not repeat room numbers, door and window numbers, or material identification. Show these on a larger-scale plan or detail.
- Call out items by the same terms used in the specifications.
- Do not call out the number of items on the drawings (e.g., TYP OF 4). Quantities should not be called out on the drawings.
- Avoid using parentheses in notes and callouts unless absolutely necessary.
- Although notes such as "DETAIL 3 SIMILAR" may be a good practice to save detailing, use them only if strictly true or if any differences are clearly noted.
- Avoid the phrase "NOT SHOWN FOR CLARITY."
- Avoid the phrase "BY OTHERS." Instead, use the phrase "OWNER FURNISHED, CONTRACTOR INSTALLED (OFCI)," "OWNER FURNISHED, OWNER INSTALLED (OFOI)," or "NOT IN CONTRACT (NIC)."
- Do not use the word NEW when calling out new items on a drawing. Do not use the word "EXISTING" when calling out existing items that are shown using halftone. Avoid the word "PROPOSED."
- Be careful not to repeat or duplicate dimensional data.
- When possible, call out material requirements in the project specifications and not on the drawings.
- Do not call out manufacturer names on the drawings; rely on specifications for this. Some standard details may break this rule on a limited basis subject to approval.
- Avoid the phrase "CONTRACTOR SHALL…."
- Avoid the terms "FURNISH" and "INSTALL." Instead, use the term "PROVIDE."
- General sheet notes are used to communicate sheet-specific information or instructions.

Drawing callouts are used, in conjunction with leaders, to point to and describe specific features within individual drawings or views. Guidelines for callouts follow:

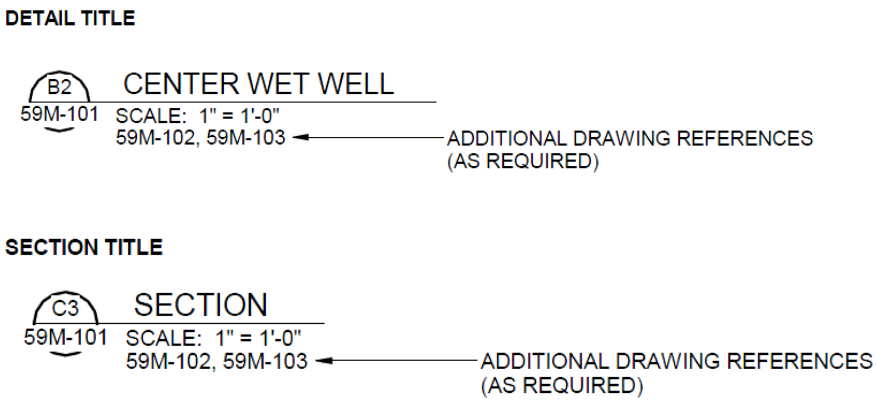
- Make callouts as brief as possible but fully describe the feature the leader line is pointing to.

- Do not abbreviate words in a callout unless there is insufficient space to completely spell the word. There are few exceptions to this rule, such as “typ,” “dwg,” and “inv.”
- Brevity should be a guideline for writing notations.
- Select notes to identify, but not overly describe, the materials, components, and assemblies.
- Use generic terms for products, materials, and components. Refer to MasterFormat™. Minimize use of abbreviations.
- Use consistent terminology between drawings and specifications.
- Do not be specific about the sequence of construction.
- Eliminate repetition of notations on a sheet.
- Eliminate broad references to the specifications such as notes that state "per specs" or "refer to specifications."
- Do not use the term “The Contractor…” or “The Contractor shall…”. Etc.

Notes used in tables, schedules, and diagrams should be brief. Single terms provide a simple, clear, and efficient means of communication.

4.3.10 Back referencing

Back referencing applies to Elevations, Sections and Details. The back reference is a list of the drawing(s) where the Elevation, Section or Details is taken from. The sheets are listed under the View Title as shown below. The drawings are listed in order as they occur in the set.



Cross-referencing provides a system for tracking information from the general to the specific within a drawing set. The master drawing for a cross-referencing system is the plan views. The

plan views shall contain references to the building sections, elevations, interior elevations, plan details, and other information necessary to fully describe the project.

4.4 Sheet Types

Sheet types consist of scaled views and non-scaled views. Scaled views are plans, elevations, sections, large-scale plans, and details. Non-scaled views are diagrams, isometrics, and schedules. Project sheets are grouped into series identified by the alphanumeric numbers listed in Table 4-2 and explained in detail in Section 4.1. The following discussion on sheet types includes general guidelines for information necessary for each series and sheet type, except the X-series drawings (PP&S and P&IDs) are described in Section 4.5.8.

Note: These guidelines are not intended to be comprehensive, but may be used as a basis for establishing a check list for coordination and completeness of the sheets.

4.4.1 Sheet Type 0 - General

General sheets provide information of a general nature that applies to the whole project as well as to each discipline. The first sheet in the set following the cover sheet provides information that includes the index of drawings, District standard materials, District standard graphic symbols, standard abbreviations, a small location and vicinity maps indicating the location of the project, District schedule of existing equipment numbers, and other relevant information of a general nature. A general information drawing is placed at the beginning of the set of drawings for each discipline to show information of a general nature unique to that discipline.

Include Vicinity and Location Maps, Mechanical Equipment Numbering, project specific Hydraulic Profile, Flow Diagram and Design Data as appropriate. As an option include all discipline legends, abbreviations and symbols under General. Refer to District Standard Drawings G-series drawings.

The project structures are documented with screened backgrounds of plan views on which mechanical, HVAC, and electrical layouts are drawn.

4.4.2 Sheet Type 1 – Plans (Horizontal Views)

Typical components of plan views include the following information:

- Drawing Scales
- Column Grid Lines
- North Arrow
- Key Plan

The first drawing shall provide a single drawing showing the overall project limits. Use an appropriate scale to show all areas affected by the project. Use the District Standard Drawings as a basis. Drawing also serves as “site location plan” referencing the specific drawing

numbers. Include a drawing reference table showing drawing number(s), drawing title(s) and drawing scale(s).

4.4.3 Sheet Type 2 – Elevations (Vertical Views)

Architectural and structural elevations and partial elevations are developed from the 3D model plan views from which they are projected. Window types, building section, and wall section symbols may be shown on the plans. All section reference symbols should be shown on the plan views.

A Key plan is used on the plan view drawings. Grid lines should be placed only at corners and where changes in planes occur.

All partial elevations must be shown. Special features must be referenced, detailed, and dimensioned. Hidden items such as steel lintels, shelf angles, and other elements shall be indicated with a partial dashed line to show extent. Movement joints in masonry and joints in panelized systems must be drawn to clarify the designer's intent. Determining these locations will be provided by the structural discipline.

Show materials graphically using hatching at the edges of the area to clarify limits. All hatching or fill must be dark enough to reproduce well even when the sheet is reproduced at half size.

Show all elevations as projected. Provide additional elevations to which the viewer is oriented 90 degrees for material takeoffs. Curves are simply noted as such on the elevations. The same approach applies to partial elevations forming an angle to the main elevation. These should be identified as "unfolded."

Show the relationship between elevations and the surrounding grade taken from the site plan spot elevations around the building footprint. Where a masonry ledge exists below grade, dimension its elevation and show it dashed and stepped to match the grade.

Reference elevations on the plan views by using the appropriate symbol for exterior and interior elevations. Name the elevations as determined by the project north.

4.4.4 Sheet Type 3 – Sections

The District preferred structure and building section scale should be 3/8” =1’-0” or 1/8” scale larger than the plan view. Structure and building sections should be drawn at a minimum the same scale as the plan views.

Show as many sections as are necessary to describe the complexities of the structure. Eliminate section details if they are located at exterior walls because these belong in wall sections. These sections are to be drawn at a larger scale. Eliminate duplication of reference to larger details normally referenced from the roof or top plan. Do not show interior elevations on building sections.

Provide wall sections to clearly indicate different wall conditions. Reference larger-scale details of areas such as openings, window head and sill details, soffit and eave edges, parapets, shelf angles, and areas requiring flashing or fire-prevention insulation. Do not duplicate information shown on large-scale details on wall sections. When more than one wall section is drawn on a sheet, align levels horizontally. Eliminate repetition of dimensions by observing the hierarchies.

Draw sections of all exterior wall types at a scale that allows the section to be drawn without break lines whenever possible.

4.4.5 Sheet Type 4 – Large-Scale Views

Large-scale views are essentially partial plan views reproduced at a larger scale to provide more detailed information that cannot be accommodated at the smaller-scaled drawing.

For partial plan views, place a dashed line around areas or rooms to be enlarged to provide more extensive detailing and dimensions. Stairwells, toilet rooms, elevator shafts, break rooms, laboratories, and mechanical and electrical rooms are examples of plans referenced to the enlarged plan. Do not duplicate information on smaller-scale plans, with the exception of equipment numbers, room names and numbers, partition types, and column grids used for location references.

Enlarged plans for elevator shafts should include a pit access ladder and the size and location of a sump pit, if one is used.

Laboratories are examples of rooms that usually require large-scale views and, in some cases, interior elevations. Enlarged laboratory plans should indicate wall or overhead cabinets with a dashed line. Add elevation symbols and identify each cabinet with a reference shown on the elevation rather than the plan. Where cabinets change direction or abut walls, include filler panels to facilitate installation.

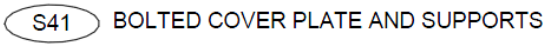
4.4.6 Sheet Type 5 – Details

Manufactured products should be represented by a simplified outline illustrating all the products listed as acceptable in the specifications. Details should take into account tolerances that may be listed in the specifications.

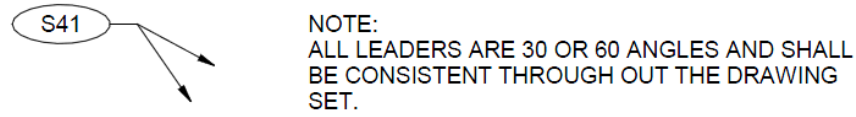
- Use District standard details and provide others where existing details are not available for a particular or unique situation.

- The District standard details shall be titled and referenced as shown. These details are place in the front of each discipline as outlined in Appendix E - Drawing Set Organization.

STANDARD DETAIL TITLE

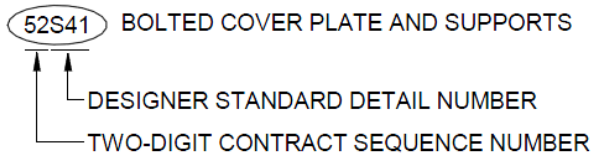


STANDARD DETAIL CALLOUT



- When designer standard details are used within the project. These details shall be titled and referenced as shown. These details are place in the front of each discipline as outlined in Appendix E - Drawing Set Organization.

DESIGNER STANDARD DETAIL TITLE

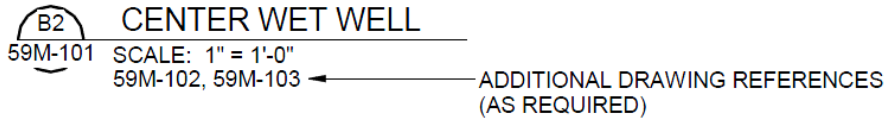


DESIGNER STANDARD DETAIL CALLOUT

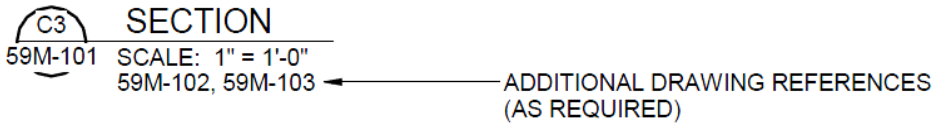
- When a standard detail is provided from within the County of Sacramento Standard Civil Details (as opposed to District's), simply refer to the detail by its 'TITLE' and 'DRAWING NUMBER' (I.E. Commercial Driveway Type A-6, per Sacramento County Standard Dwg No 4-14). It is not required to include the details in the plan set unless it has been modified.

- All project specific details shall be scaled to depict their physical appearance. These details shall be reverse referenced back (back-referenced) to the plans or other drawings.

DETAIL TITLE



SECTION TITLE



- Horizontal details include column furring, partition type, expansion and control joints, fire hose cabinets, and other elements of the plan.

- Vertical details originate either from wall sections, the building or structure section, exterior or interior elevations, and stair or elevator sections.

- 3D details such as isometric drawings are used to help illustrate conditions that cannot be represented fully by 2D details.

4.4.7 Sheet Type 6 – Schedules and Diagrams

Schedules take a tabular form while diagrams are graphic representations. Both provide a large amount of information in a limited space. Schedules may be placed either in the specifications or on the drawings.

Schedules provide a consistent format for representing a related group of items. They are keyed to the drawings and, in addition to the headings, are divided into at least three main columns.

The format, types, and composition of schedules are addressed in detail in Schedule Formats.

Diagrams are graphic representations that are usually not drawn to scale but can be noted with dimensions. They may be schematic in nature such as mechanical and plumbing.

4.4.8 Sheet Type 7 – User Defined

These series of sheets allow the user to accommodate sheet types that do not fall under any of the drawing types.

4.4.9 Sheet Type 8 – User Defined

These series of sheets allow the user to accommodate sheet types that do not fall under any of the drawing types.

4.4.10 Sheet Type 9 – 3D Representations

3D model views consist of axonometric drawings, oblique drawings, perspectives, and photographs. They are used to assist the viewer in comprehending complex 3D relationships of shapes.

- Axonometric drawings can include one of three methods of 3D projection: isometric, diametric, and trimetric. All three methods represent two vertical and one horizontal plane parallel to corresponding established axes at true dimensions. The difference among the three methods is the angles and scales used to execute the drawing. The most commonly used are isometric and dimetric representations. Isometric drawings are drawn with all three axes at 120 degrees relative to each other. Dimetric drawings project the three planes at different angles and scales to simulate a true perspective.

- Oblique Drawings are similar to diametric drawings except that one plane is parallel to the drawing plane.

- Perspectives, unlike axonometric or oblique drawings, are represented by parallel lines that meet at a vanishing point located at the horizon. This gives the structure a true image similar to a photograph.

- Photographs may be used as a means of delineating new work to be performed on existing conditions. A symbol should be indicated on plans and elevations denoting where and at what angle the photographs were taken.

4.5 Sheet Content

The following is a description of sheet content by each discipline placed in the order of the Drawing Set Organization as outlined in Section 4.1. The following subsections describe the District related content. Refer to the USNCS 5.0 for all other descriptions.

4.5.1 General\Civil Drawings

4.5.1.1 Location Map, Vicinity Map, and Project Location Map

Project vicinity map shall include all streets, railroads, freeways, highways (with names), pipe segments, pipe sizes, and all surge control facilities, flow control structures, manholes, etc. Project location map shall identify and include major streets, railroads, freeways, highways (with names), and pipe segments. The location map will identify the region on a California map where the project is located with major cities and surrounding towns and cities.

4.5.1.2 Design Data

Project design data shall be presented on a drawing. Information shall be provided for major process equipment/facilities. The type of information to be provided includes, but not limited to, number, size, capacities, ratings, etc. For modification or upgrade projects, design data on the existing equipment/facilities shall be provided. If applicable, provisions for future expansion shall also be shown in tabulation of design data.

For major pipe alignments inside and outside the District's EchoWater Facility, provide segment alignment line and curve data tables. The line and curve data table shall include the line or curve number, length, bearing/delta, radius, tangent, start, and end information. The line and curve data table shall be done by segment.

Provide private property constraints in a table that includes: location, APN, owner, the drawing location, description of the conflict, minimum depth of agricultural topsoil to be stockpiled, irrigation system, crop or animal coordination, property and/or field access, irrigation across pipe alignment.

Provide a table identifying utility elevations, field inspection, and potholing.

Provide a table with culvert information.

Provide pothole data table.

4.5.1.3 Provide a comprehensive list of all utility contacts consisting of utility agency, contact person, address, email, and phone number.Hydraulic Profile

A hydraulic profile drawing shall be developed or updated (if existing) to reflect the project design. Water surface elevations shall indicate the hydraulic capacity, peak wet weather flow, and average dry weather flow for each process stage. A vertical datum with reference to the mean sea level shall be provided. All physical structures and equipment are to be referenced. All weirs shall include their datum.

4.5.1.4 Coordinate Layout

Coordinates (i.e., Northings and Eastings) of major elements of the project shall be provided in a plan view of the project site. Examples of major elements include: buildings, structures, pipelines, and roadways.

4.5.1.5 Site Work Key Plan

An overview plan of the project site and its relationship to the existing EchoWater Facility shall be provided. This drawing shall provide a key for more detailed outside piping and grading and paving plans. Provide high level segment alignment line and curve data by segment.

4.5.1.6 Standard Civil Details

Civil details typically applied throughout the project shall be presented. The details may come from the applicable SacSewer Typical Details library, or shall be created, as necessary, for the specific project.

4.5.1.7 Outside Piping Plan

The outside piping plans shall highlight underground and above-ground piping located outside of structures. For continuation of piping within structures, see mechanical drawings.

4.5.1.8 Plan and Profiles or Piping Profiles

Unless otherwise mutually agreed to by the Designer and District PM, all piping shown in outside piping plans or along the pipe alignment shall be detailed in full-length piping profiles. The plan and profiles shall identify pipe system, invert elevations, pipe slopes, and stationing of key locations. Additional construction notes may also be provided. Existing underground piping/facilities shall be identified to the greatest possible accuracy.

Plan and profiles sheet drawings shall use the three window format. The top window will utilize a scaled aerial photograph with all easement and property owner information, etc. The middle window will incorporate the aerial survey with the pipe alignment and design features. Show all demolition in this view. The bottom window shall be the profile. The profile will include the pipe alignment, pipe size, pipe material, pipe length, pipe depth, existing and proposed surfaces, and below and above grade design features, etc. All these windows will be to the same scale. The profile will have an exaggerated vertical scale. Additionally, provide a special mitigation sheet using an aerial photograph at the same running scale as the plan views on the plan and profile. The profiles shall use appropriate horizontal and vertical scales.

4.5.1.9 Traffic Control Plans and Details

Unless otherwise mutually agreed to by the Designer and -District PM, all traffic control plans shall provide the necessary information, flag positions, flag type, proper signage, acceleration, deceleration lanes, proper turn lanes, barrier locations, cone locations, and stationing of key locations. Refer to the traffic control sub consultant formal documentation prior to generating the traffic control plans. Take all additional precautions for working dusk to dawn work hours. Additional construction notes may also be provided. Identify all existing obstacles or hazards that will impact the traffic control strategy and plans. All these items mentioned shall be identified to the greatest possible accuracy. The traffic control plans shall use appropriate horizontal scales.

4.5.2 Structural Drawings

4.5.2.1 General Structural Notes

Structural notes shall be provided as a separate drawing. The notes shall address general structural items and materials of construction. They should not duplicate the specifications.

4.5.2.2 Structural Details

Structural details typically applied throughout the project shall be presented. The details may come from the applicable District Typical Details library, or shall be created, as necessary, for the specific project.

4.5.3 Process Flow Drawings

4.5.3.1 Process and Piping Schematics

Process and piping schematics depict simplified schematic layout of process flows, showing equipment, piping, pipe sizes, valves, flowmeters, flow designations, etc. The emphasis is on piping and the relative location of valves in the system. Schematics shall be prepared for all new systems, and for all existing systems which are to be modified or expanded. Modifications or expansions may require the complete system to be depicted, depending on the impact to the existing system. These schematics are to be produced (using Autodesk AutoCAD P&ID) and used in conjunction with the P&IDs.

4.5.4 Mechanical Drawings

4.5.4.1 Mechanical Details

Mechanical details typically applied throughout the project shall be presented. The details may come from the applicable District Typical Details library, or shall be created, as necessary, for the specific project.

4.5.4.2 Mechanical Plans

Plan views of each floor of each structure shall be provided showing the location of each piece of mechanical equipment.

4.5.4.3 Mechanical Sections and Details

Sections and details shall be provided to clearly depict all mechanical features.

4.5.4.4 Fire Sprinkler Riser Plan

A plan view showing the fire sprinkler riser locations, available pressures and point of connection. The Contractor shall provide the design of the fire sprinkler system per National Fire Protection Association requirements.

4.5.5 Heating, Ventilation and Air Conditioning Drawings

4.5.5.1 Standard Designations, Symbols and Schedule

Drawings shall provide heating, ventilation, and air conditioning (HVAC) general notes, symbols, designations, and schedules. Schedules shall be provided for diffusers, registers, and grills.

4.5.5.2 HVAC Details

HVAC details typically applied throughout the project shall be presented. The details may come from the applicable District Typical Details library, or shall be created, as necessary, for the specific project.

4.5.5.3 Airflow Schematics

Airflow schematics shall show air balance for all structures.

4.5.5.4 Temperature Control Diagrams

Air handler schematics showing the following information:

- Fans, coils, control valves, dampers, filters, flow, etc.
- Controller, valve actuators, damper actuators, transducers, instrumentation, etc.
- Calibration information such as setpoint, throttling range, action, input and output signals, spring ranges, air pressures, normally open and normally closed and common ports, etc.
- Performance charts showing input and output signals, valve damper status, pump status, etc. as a function of temperature.

4.5.5.5 HVAC Plans

Plan views of each floor and roof levels of each structure shall be provided showing all HVAC equipment, piping, ductwork, etc.

4.5.5.6 HVAC Sections and Details

Sections and details shall be provided to clearly depict all HVAC features.

4.5.6 Electrical Drawings

4.5.6.1 Symbols and Abbreviations

These drawings shall depict all symbols and abbreviations used on the drawings. Use District's standard drafting symbols. If additional symbols are required, submit a proposed symbol for District review and approval.

4.5.6.2 Electrical Details

Electrical details typically applied throughout the project shall be presented. The details may come from the applicable District Typical Details library, or shall be created by the Designer, as necessary, for the specific project.

4.5.6.3 Elementary Diagrams

If warranted, District's set of elementary diagrams may be supplemented with project-specific elementary diagrams. These drawings show the manufacturer's typical internal wiring diagrams for each power circuit breaker and motor control center (MCC) unit starter. The drawings shall show the internal control logic and external connection terminal blocks.

4.5.6.4 Single-Line Diagram – 12 kV and 4160 V Plant Distribution

As applicable, District's set of 12 kV and 4160 V single-line diagrams shall be modified for project-specific demolition and/or new construction. These drawings depict the major electrical equipment, arrangement, protective relays, transfer control devices, mechanical interlocking, circuit disconnects, interrupting devices, surge protection devices and equipment ratings. The medium voltage distribution drawings show building areas with a drawing reference to the unit substation single line.

4.5.6.5 480V Switchgear Elevations

Equipment elevations shall be shown for all switchgear. Elevations shall be scaled and shall show the physical arrangement of all front panel-mounted devices in their proposed physical location. Include a nameplate schedule for all sections and devices.

4.5.6.6 Electrical Site Location Plan

An overview plan of the project site and its relationship to the existing Plant shall be provided. This drawing shall provide a key for more detailed electrical site and structure plans.

4.5.6.7 Site Plans – Power and Instrumentation

Electrical site plans shall depict the routing of underground conduits and duct banks, locations of handholes, manholes, vaults, major electrical equipment, site lighting, area ground mats and structure grounding systems.

4.5.6.8 Manhole and Handhole Schedule

A drawing shall list a schedule of all electrical manholes, vaults, and handholes.

4.5.6.9 Ductbank Profiles

All medium voltage ductbanks shall be detailed in full length profiles. The profiles shall identify manholes, elevations, slopes, and new and existing underground piping/facilities.

4.5.6.10 Ductbank Sections

Ductbank section drawings shall depict cross sections of all unique ductbank sections, showing the number of conduits.

4.5.6.11 Structure Plans – Power, Control, and Grounding

For complex projects where multiple electrical systems are intermixed, separate structure plans for power, control, and grounding systems shall be provided. Plan views of each floor of each structure shall be provided showing the location of each piece of equipment and control device. Drawings shall show the routing of conduits and elevations at conduit racks and major junction boxes required for a complete electrical installation. The grounding system shall also be shown.

4.5.6.12 Structure Plans – Instrumentation and Communications

For complex projects where multiple electrical systems are intermixed, separate structure plans for instrumentation and communication systems shall be provided. Plan views of each floor of each structure shall be provided showing the location of each instrument, communications device and connecting conduit. Drawings shall show the routing and elevations of cable trays and conduits.

4.5.6.13 Structure Plans – Lighting and Receptacles

For complex projects where multiple electrical systems are intermixed, separate structure plans for lighting and receptacles systems shall be provided. Plan views of each floor of each structure shall depict the location of each lighting fixture, switch, receptacle, exit sign, and emergency light. Fixtures shall be identified by type, panelboard circuit, and switch. Mounting heights shall be indicated.

4.5.6.14 Large Scale Views

Electrical switchgear, MCC and control system rooms shall be drawn to 1/2”=1'-0" or 3/8”=1'-0" scale. Show scaled locations of all power and control equipment and panels accounting for the required clearances between equipment and to the face of wall mounted panels. Show all power and control equipment numbers with connecting conduit numbers. Avoid showing embedded conduits inside building and structures. Exposed power and control conduits shall be shown entering conduit racks with the rack size shown to scale and bottom elevation shown. Underground conduits shall be shown entering duct banks and shall be cross-referenced to drawing(s) showing where the duct bank continues. Refer to District example drawings.

4.5.6.15 Schedules and Diagrams

If required provide a 12kV Distribution System Single Line Diagram, see example digrams provided with the Common Contract Drawings. The drawing should start in the E-601 series drawings. Drawing shall depict existing or not in project equipment with light lines and the project equipment shown with dark lines indicating what is in the contract and the point of connection. If no distribution equipment is being furnished, the drawing is included for information only with a note indicating where the project receives power.

If required, provide sheet drawing E-602 for the process area double-ended Substation Single Line Diagram. Drawing shall identify the 12kV distribution equipment and connections, switchgear voltage, bus amperage, and short circuit rating. Automatic transfer equipment, metering and all feeders (including spares) shall be shown. Show and identify all directly fed motors, MCCs, transfer switches, and panelboards. Switchgear scaled front elevation shall be

shown on this drawing or subsequent drawings along with nameplate schedule and material item list.

E-610 series drawings shall be standardized 480V MCC elementary diagrams for all size starters on the improvement project.

4.5.7 Instrumentation and Control Drawings

4.5.7.1 Symbols and Abbreviations

These drawings depict the more commonly used symbols and abbreviations that appear on the drawings. Standard process and piping related symbols and the mechanical equipment numbering system drawings are included in the instrumentation and control (I&C) drawing set for convenience.

4.5.7.2 Block Diagram – Plant Control System

District maintains a block diagram which shows a simplified version of the Plant's Computer Control System (PCCS) which shows the Plant Control Center (PCC), Area Control Centers (ACCs) and their associated area or building being controlled. New and/or modification work shall be identified.

4.5.7.3 ACC Functional Diagrams -- Existing ACCs

These District template drawings depict the ACC's relationship between field devices, programmable logic controllers (PLCs), MCCs and the PCC in a functional manner. These diagrams show typical analog and discrete control functions. Diagrams show typical signal paths and the relationship of signal conditioners, indicators, controllers and annunciators. The ACC cabinets are identified as housing their specific functions of analog, discrete, PLC, input/output and computer hardware.

4.5.7.4 PLC System Block Diagram

The PLC system block diagram shall show the network topology and major components of the PLC system.

4.5.7.5 PLC Module Block Diagram

The PLC module block diagrams shall show the internal PLC rack modules and I/O link connection wiring for each PLC.

4.5.7.6 Instrumentation Installation Details

Instrumentation installation details typically applied throughout the project shall be presented. The details may come from the applicable District Typical Details library, or shall be created by the Designer, as necessary, for the specific project.

4.5.7.7 Typical Wiring and Loop Diagrams

The Designer shall prepare sample diagrams that depict typical loops applicable to the particular contract being designed. The diagrams shall follow the same level of detail as shown in the SacSewer Example Diagrams.

4.5.7.8 Typical Power Distribution Diagrams

The Designer shall prepare sample diagrams that depict typical power distribution requirements applicable to the particular contract being designed. The diagrams shall follow the same level of detail as shown in the SacSewer Example Diagrams.

4.5.7.9 Control and Logic Diagrams

Control and logic diagrams are composed of two components: field elementary and a PLC logic diagram for each type of equipment.

The field elementary diagrams shall show the interconnection of all 120 V control devices external to the MCC starter, control panels and ACC terminals. Diagrams shall have line numbers and relay coils shall list the line numbers where the control contact appears. Diagrams shall show the MCC starter terminal numbers.

The PLC logic diagrams shall show the interconnection of all external control devices and internal wiring and logic schematics. Diagrams shall have line numbers and relay coil or PLC points that list the line numbers where the control contact appears.

Control and logic diagrams shall also include nameplate schedules for field devices, limit switch development, and all other necessary items for a complete control design.

As part of the development of control and logic diagrams, the Designer shall prepare control block diagrams that show the MCC, ACC, Control Panels and all control devices in block format. Diagrams shall list the equipment, cable and raceway numbers and shall also show the type, number and gauge of all interconnecting control conductors. Control block diagrams are not part of the contract documents. These diagrams shall be submitted as part of the electrical calculations to aid the review of the cable and raceway schedules.

4.5.7.10 Process and Instrumentation Diagrams

Process and instrumentation diagrams (P&IDs) shall symbolically represent the junctions of piping, instrumentation, display, control, logic, PLC and computer interfaces. These diagrams shall depict process lines, valves, actuators, mechanical devices, primary elements, instruments, annunciators, interlocks, programmable controllers, signal paths, field instrument power sources, computer interfaces and all other items required for a complete system representation. Complete P&IDs shall be drawn for all new and modified process and HVAC systems. SacSewer Example P&ID’s are located in Appendix G - Example P&IDs.

4.5.7.11 Cabinets and Panels

Cabinet and panel drawings shall be furnished for ACC cabinets, PLC panels, control panels, and terminal boards. These drawings shall be scaled showing front elevations of the control panels, material list table with specification references.

ACC cabinet drawings shall include a plan view, front view, discrete, analog and computer cabinet layouts, annunciator and signal module arrangements. Also include typical construction details, equipment mounting, ground busses, cable entries, operator station arrangement, engraving and all other items necessary for a complete design.

PLC panel drawings shall include a dimensioned front view, internal arrangement with sections, material list, nameplate schedule, typical mounting details, typical control station details and engravings, references to the applicable control diagrams and all other items necessary for a complete design.

Control panel and terminal board drawings shall include a dimensioned front view, internal arrangement with sections, material list, lamp schedule, nameplate schedule, engraving schedule, references to the electrical plans and control diagrams, and all other items necessary for a complete design.

4.5.7.12 Control Room Layouts

A plan drawing of the control room with outline of control workstations, panels, equipment, and related equipment.

4.5.7.13 Miscellaneous Hardware Details

Various components of the design may require custom hardware to be constructed to match existing components or to interface with existing systems, such as computer I/O cards or discrete control station assemblies (DCSAs). Drawings included in this section shall include detailed descriptions of the required dimensions and functionality of the desired hardware. The Contractor is generally required to do detailed design including detailed submittals to demonstrate that the required custom hardware meets the contract requirements.

4.5.7.14 Miscellaneous Systems

Riser or other drawings necessary to fully describe the required interface to existing systems shall be provided. Examples include:

- Public Address Riser – Schematic diagram depicting the extension of the existing public address system, as well as the components of the new system.
- Fire Alarm Riser -- Schematic diagram depicting the extension of the existing fire alarm system, as well as the components of the new system.
- Telephone System -- Schematic diagram depicting the extension of the existing telephone system, as well as the components of the new system.

4.5.8 Process and Piping Schematics (PP&S) and Process and Instrumentation Diagrams (P&IDs)

4.5.8.1 P&ID Drawing Arrangement

The availability of sufficient space is most important. A general rule-of-thumb is that only equipment associated with a single process be shown on one P&ID. See Appendix G for example P&IDs.

The P&ID drawing for the EchoWater Facility is divided into three horizontal bands:

- Band 1, the bottom 16 percent of the drawing, is reserved for text describing the process equipment.
- Band 2 includes the process equipment and the piping instruments and valves between units. The equipment and interconnecting lines should be arranged logically.
- Band 3, at the top of the drawing, is reserved for instrumentation, including the signal transmission lines which indicate the transfer of a control signal from one P&ID to another.

4.5.8.2 Basic P&ID Rules

Other basic rules to follow in the preparation of P&IDs are summarized as follows:

- Major process flows should generally be shown as moving from left to right across the drawing.
- Large vessels and tanks are best shown in upper portions of Band 2 whereas pumps are generally shown in the lower portions.
- Equipment is always shown schematically in elevation. ISA symbols are used for pumps, blowers, and other liquid movers.
- Lines not connected with the equipment in the drawing, but which pass through the general area of the equipment depicted in the P&ID, need not be shown in the drawing.
- Process flows and/or I&C signals will enter or exit a drawing from right of left edges. No lines will be shown to enter or exit from the top or bottom.
- Align lines from one drawing to the next drawing. Lines shown in one order on a drawing should be shown in the same order on the next.
- Source and destination arrows will be shown only at the far right or left of a P&ID.
- Source or destination drawing to be inside the arrow bubble.
- The arrow bubble should point in the same direction as the direction of flow.
- The major process equipment item which is the source or destination of the flow will be shown below the arrow.
- It is suggested that the lines be alphabetized on a P&ID in a logical fashion and placed beside the arrows in order to allow the reader to readily identify which lines connect in adjacent P&IDs. For the final version, small alphabetical superscripts will have to be placed adjacent to the arrow in compliance with SacSewer convention. At that time, the line symbols can be deleted.

- Pipes are designated by the nominal diameter and the inner diameter. The tags on adjacent, parallel lines should be aligned for ease of understanding.

- The equipment tag should be adjacent to the equipment illustration to ensure a clear association between the equipment and its tag. Full word descriptions are not required beside the equipment. These are indicated in the equipment listing along the bottom of the drawing.

- Motors, and where applicable, motor control units, are shown.

- Where process lines cross, the vertical lines will be broken to allow unbroken horizontal lines. Arrow heads shall be shown at each direction change unless several are close together on the drawing.

- Line labels will be shown in the line. Valve labels will be shown adjacent to the valve, typically just below or to the right.

- Control valves are to be identified with both a process/mechanical tag and with an I&C tag (bubble).

- Reducers will be shown schematically in the pipe runs. Where the reducer is upstream or downstream of pumps, blowers, or compressors, the end nearest the equipment will not be labeled. Where the reducers are indicated elsewhere, there should be a tag on both sides.

Pressure gages need not be shown upstream and downstream of pumps, blowers and compressors unless they perform a process function.

4.5.8.3 Revision Documentation

P&ID drawings form the major process design summary, documentation of their preparation provides a useful chronology of design development. Changes to a P&ID should always be accompanied by a written description of the change and the reasoning. Where existing components (process, mechanical or instrumentation) interact with new or modified equipment, they will be annotated sufficiently to define the interface from a control point of view.

4.5.8.4 Process and Piping Schematics, P&PSs

Piping schematics are prepared to clarify the desired piping layout. Piping schematics illustrate the piping in a manner similar to the P&ID, with the same tags and designations. I&C information is not shown except for in-line elements such as meters and control valves. Illustration of these items gives the piping designer a full description of the piping to be installed. Additionally, Piping Schematics generally show process equipment in plan rather than in elevation. Representing the equipment in this manner allows the piping to be better illustrated. See the District Design Guidelines for purpose and submittal requirements.

4.5.8.5 Additional Guidelines for P&IDs and P&PSs Drawings

P&IDs and P &PSs shall be prepared for all new systems, and for all existing systems which are to be modified or expanded. Below are some common guidelines:

- Equipment and processes will be annotated and show compete instrumentation per Instrument Society of America (ISA) Standards
- The P&IDs and P&PSs shall show all new and existing piping, and all new and existing in-line process, mechanical, and instrumentation and control components.
- The P&IDs shall include all new and existing non-in-line instrumentation and control components for all new systems, and for all existing systems which are to be modified or expanded.
- Certain P&IDs will show existing in-line components that are not affected by new work. All existing non-in-line instrumentation and control components associated with these in-line components shall be shown using a separate CAD drawing layer, and will not be shown on the drawings contained in the Contract Document. At the conclusion of the construction contract, all P&IDs shall be reformatted as single layer drawings.

4.6 Terms and Abbreviations

Consistent terms ensure clear and concise communication among the designers. The purpose of this section is to provide a methodology standard for construction document terms and abbreviations. All abbreviations must be approved by District.

Whenever possible, terms should be spelled out and abbreviations should be used only to reduce time and space or where appropriate to improve clarity. The use of obscure or undefined abbreviations results in a flawed project. Guidelines for terms and abbreviations are as follows:

- Terms and abbreviations are presented in alphabetical order by terms.
- Include trade association acronyms, such as UL, ASTM, and NFPA, if the organization publishes standards likely to be referenced on drawings.
- Do not include common English language terms such as "afternoon" (PM) and "Central Standard Time" (CST).
- For professional licenses, certifications, or memberships associated with a person's name, it is assumed that the professional, whose name is on the documents, will define and control the proper format of his name. American Institute of Architects (AIA), Professional Engineer (PE), and Certified Construction Specifier (CCS) are examples.
- Do not abbreviate terms that conflict with industry-accepted terminology.
- Symbols that contain letters are not abbreviations.

- Do not abbreviate words of five letters or fewer, except in schedules. A schedule column heading may need an abbreviation to reduce the size of the column and the overall size of the schedule.
- Avoid the use of abbreviations with more than one meaning.
- Show the source or a list of abbreviations on the General sheets. Two ways to accomplish this are:
  - ❖ Reference the Terms and Abbreviations Section.
  - ❖ Include a selected list derived from the Terms and Abbreviations Section.
- If any doubt or confusion exists about the meaning of the abbreviation, do not use the abbreviation. Clarity is paramount and must not be sacrificed.

4.7 Symbols

Covered in this section are standard symbols, their graphic representation, and their role in creating, understanding, and fulfilling the intent of construction documents. Standard symbols ensure clear and concise communication among the designers, architects, engineers, contractor, and District. All symbols must be approved by District.

Symbols are organized by the following hierarchy:

- MasterFormat™ Division and Number
- Symbol Type
- Alphabetical order of the symbol description

For example, a pump is listed in MasterFormat™ Division 43, Liquid Handling Equipment, Section 43 21 00, Liquid Pumps. Although the pump may be shown on several floor plans, the pump is listed in Division 43, Liquid Handling Equipment.

The actual layout of the symbols table is:

- MasterFormat™ Division and Number
- Symbol Description (alphabetized)
- Symbol Type (alphabetized)
- Symbol

4.8 Notations

There are five (5) types of notes: *general notes, general [discipline] notes, general sheet notes, reference keynotes, and sheet keynotes*. These five (5) types of notes are placed in Note Blocks.

General notes, general [discipline] notes, and general sheet notes do not directly correspond to a graphic representation and are not directly "linked" by symbol (or other identifier) to other drawings or specifications. When these three types of notes appear on the same sheet, they are listed in the following hierarchical order:

- General Notes
- Discipline General Notes (such as Architectural General Notes)
- General Sheet Notes

4.8.1 General Notes

General notes apply to the entire work and should not be repeated on subsequent sheets or at other locations within the drawing set. These general notes do not repeat specification content on the drawings and are not repeated within the specifications. Carefully coordinate general notes with the contents of the Project Manual and Division 01 specification sections in particular. See Figure 4-13 for a typical layout of the notes block.

Example: ABBREVIATIONS: REFERENCED FROM THE CONSTRUCTION SPECIFICATIONS INSTITUTE'S UNIFORM DRAWING SYSTEM TERMS AND ABBREVIATIONS MODULE

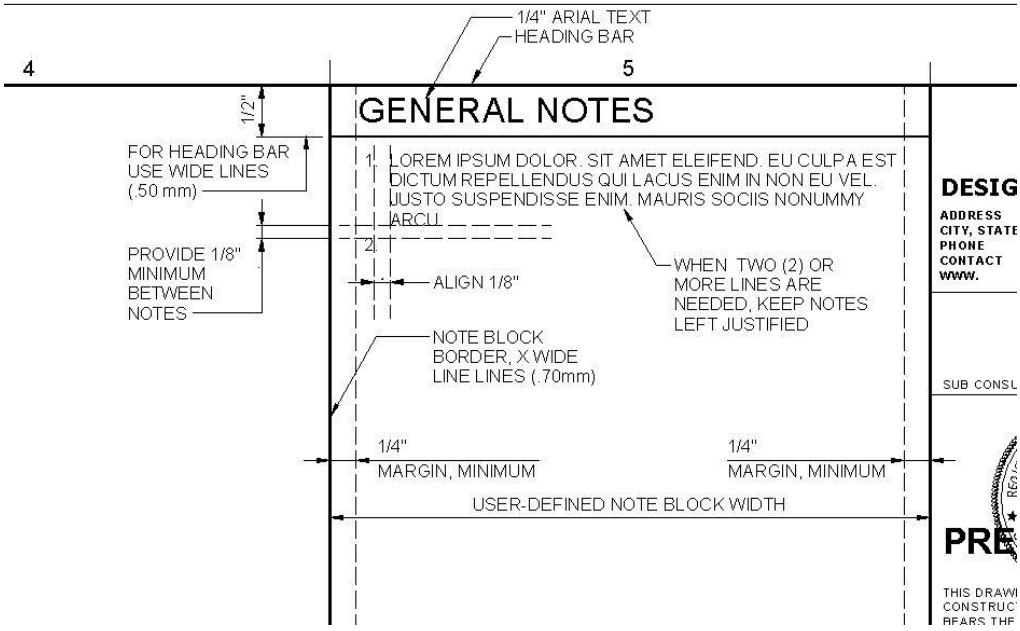


Figure 4-13. General Notes

4.8.2 Discipline General Notes

Discipline general notes appear on the DWG-001 to 099 sheets within a particular design discipline and apply to all subsequent sheets within that discipline. For example, general civil

notes appear on sheet C-007 and apply to all civil sheets within the drawing set. For projects that combine all the discipline general drawings under G-001 to 099 require the discipline heading as in the following examples:

- General Architectural Notes
- General Structural Notes
- General Mechanical Notes
- General Electrical Notes

Discipline general notes apply to drawings of the discipline; they should not be repeated on other sheets within the discipline. Discipline general notes do not replicate general notes. The project requirements and drafting conventions should be established within the general notes and be presented in more detail elsewhere within the drawings or specifications.

Example: TOP OF STEEL ELEVATIONS INDICATED ARE BASED ON A FINISH FLOOR ELEVATION OF 100'-0"—SEE SHEET C-101 FOR ACTUAL DATUM AND BENCHMARK INFORMATION

4.8.3 General Sheet Notes

General sheet notes are used to communicate sheet-specific information. General sheet notes are tabulated sequentially within the note block. General sheet notes follow the other types of general notes and precede any reference keynotes that may appear in the note block. See Figures 4-14 and 4-15.

Example: DIMENSIONS (ON THIS SHEET ONLY) DRAWN TO PARTITION WALLS ARE TO FACE OF STUD UNLESS NOTED OTHERWISE

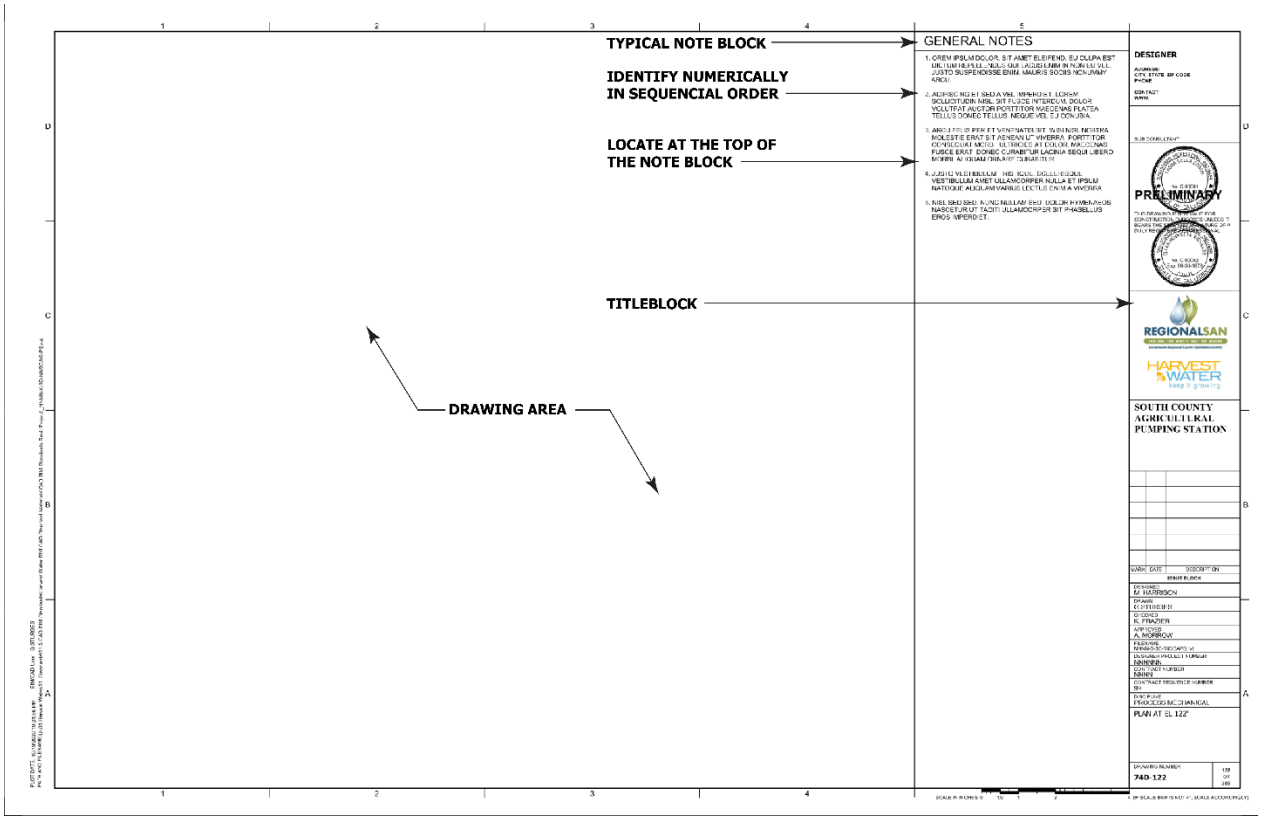


Figure 4-14. Types of General Notes

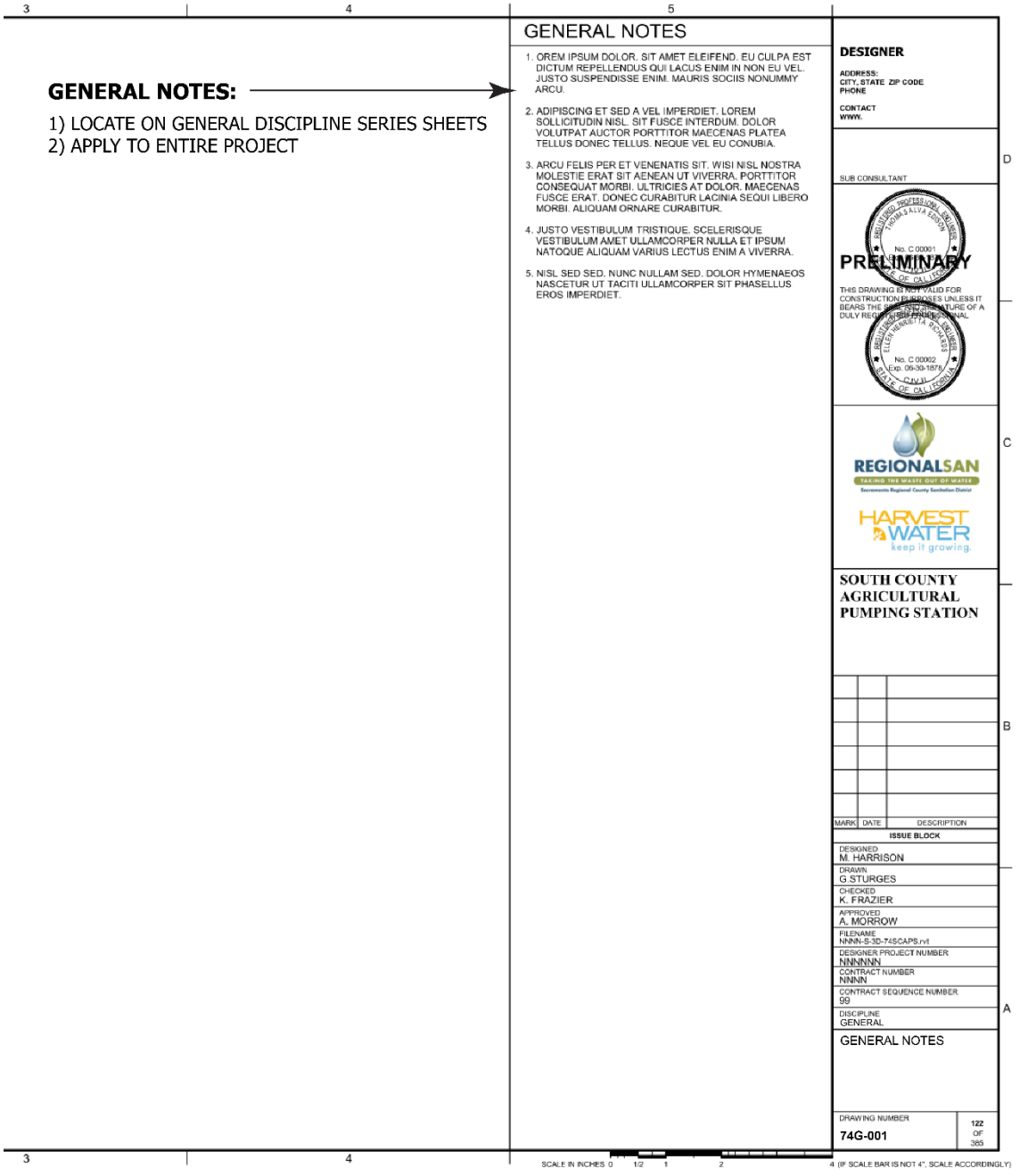


Figure 4-15. General Notes

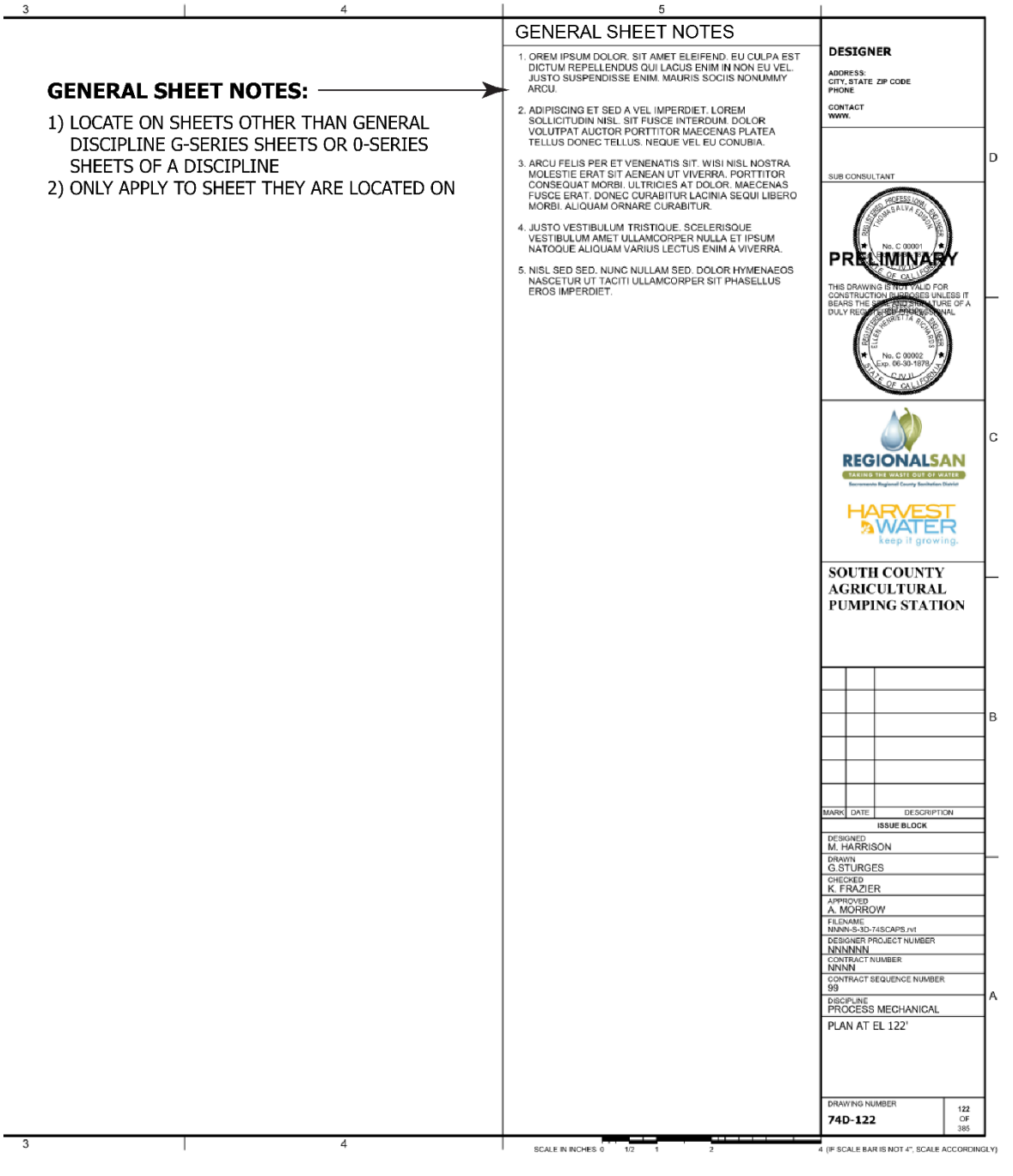


Figure 4-16. General Sheet Notes

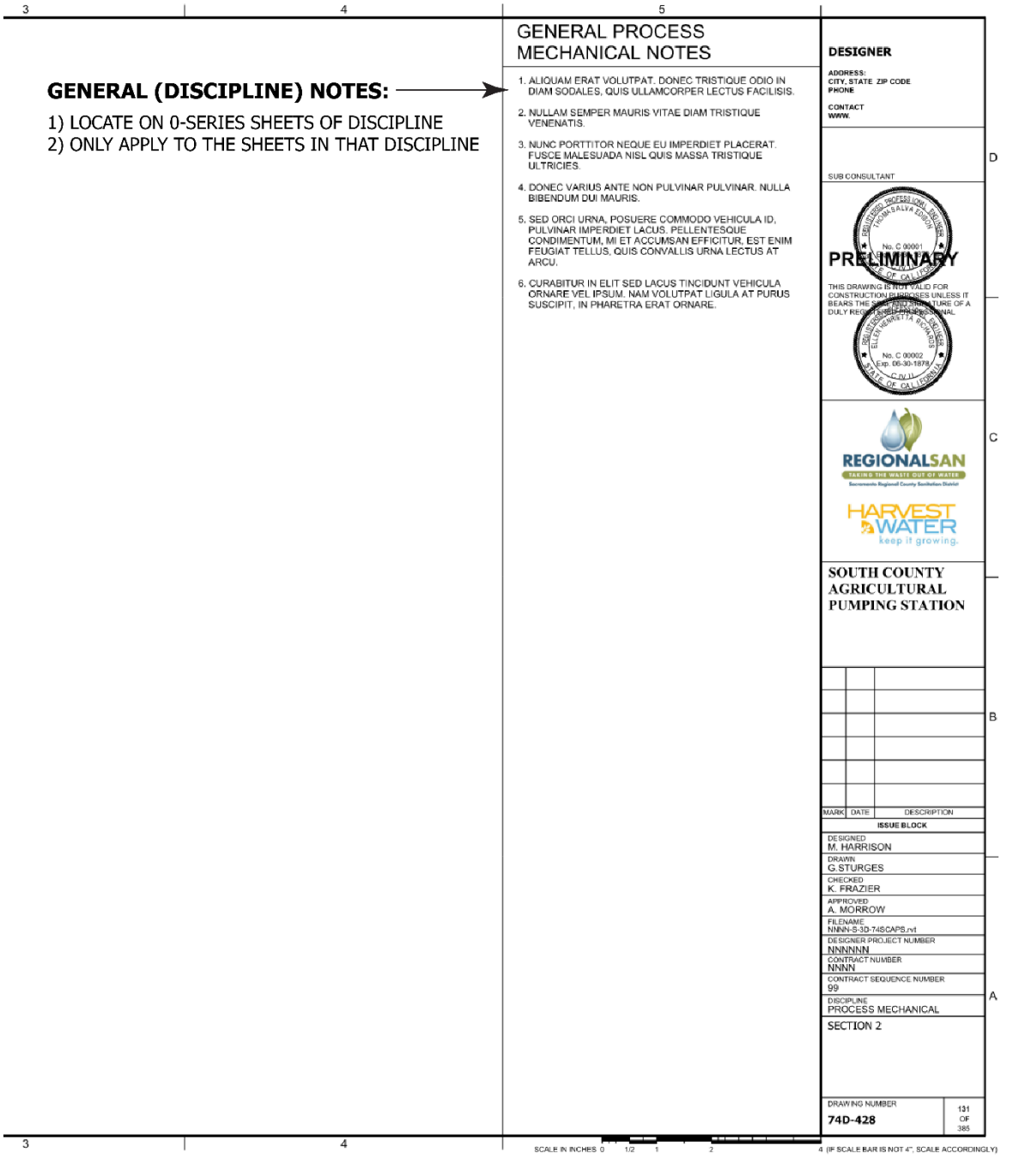


Figure 4-16. General (Discipline) Notes

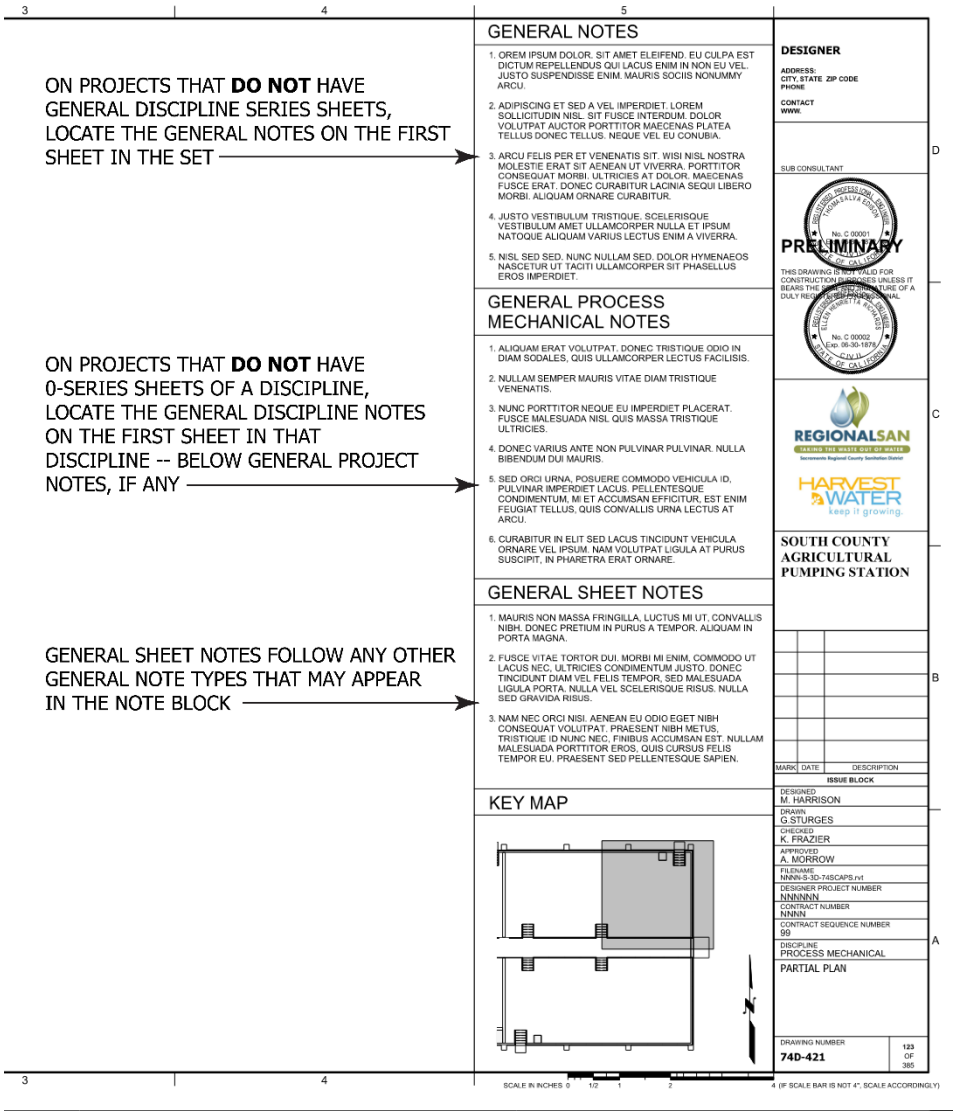


Figure 4-17. Hierarchy of General Note Types

4.8.4 Reference Keynotes

If or when reference keynotes are used in the contract documents, they will be used to identify graphic representations of items and directly reference them to specific sections in the specifications. Reference keynotes identify General or Execution requirements from a specification section and can convey Division 01 requirements.

Example: 01 56 00.A01-TEMPORARY DUST BARRIER TYPE 1

Reference keynote symbols are located within the graphic and notation area of the drawing block. They consist of an identifier and are connected to the graphic by a leader. Each symbol that appears on the sheet is listed in the sheet's note block along with a brief, generic text note that describes the graphic.

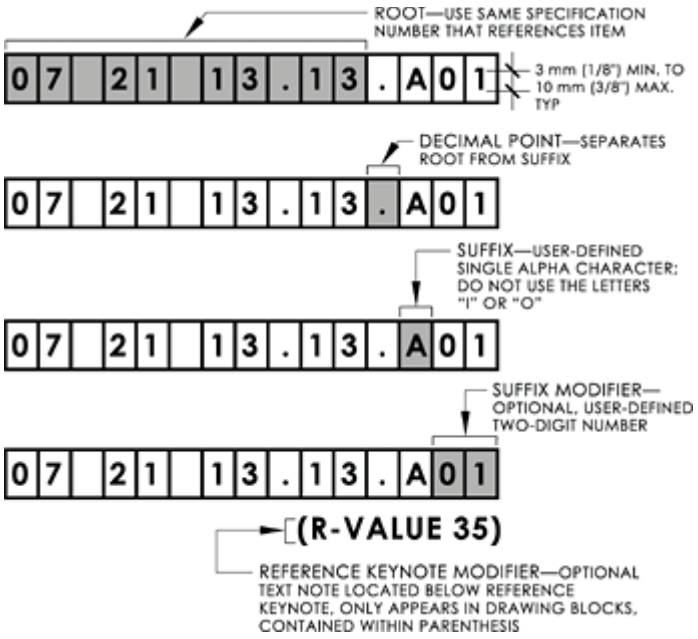


Figure 4-18. Components of Reference Keynotes

Reference keynote symbols consist of the following components, as shown on Figure 4-16:

- **Root:** The specification section number corresponding to the section number location where the object or material is specified.
- **Decimal Point:** A place holder separating the root from the modifying suffix.
- **Suffix:** A capital letter following the decimal point, which allows multiple keynotes to reference the same specification section. The letters I and 0 should not be used as they may be visually confused with the numbers 1 and 0. Reference keynotes always have a suffix.
- **Suffix Modifiers:** Optional numeric characters following the suffix allow creation of numerous unique reference keynotes that would otherwise be limited to the available letters of the alphabet. Suffix modifiers, when used, should always include two numerical characters, e.g., 07 70 00.A01.
- **Reference Keynote Modifiers:** Optional, user-defined descriptive text. These notes, when used, appear underneath the reference keynote symbol only in the drawing block.

Reference keynotes are tabulated sequentially within the note block along with a brief generic text description to identify the item within the specifications. Reference keynotes follow any general notes (general notes, general [discipline] notes, or general sheet notes) that may appear in the note block.

Reference keynotes that appear in the note block are formatted to include:

- The full reference keynote symbol including the root, decimal point, suffix, and any suffix modifiers.

- The brief generic text describing the object or material with the same terminology used within the specifications. Properly coordinate among documents, avoid abbreviations, non-preferred terms, and terms that deviate from the specifications. Do not include any reference keynote modifiers that appear only in the drawing blocks.

- The note block should be formatted with optional headings identifying specification divisions and/or subheadings identifying specification section titles. The text information following the symbol should be concise, consistent with the terminology contained in the specifications, and accurately identify the item. See Figures 4-17 and 4-18.

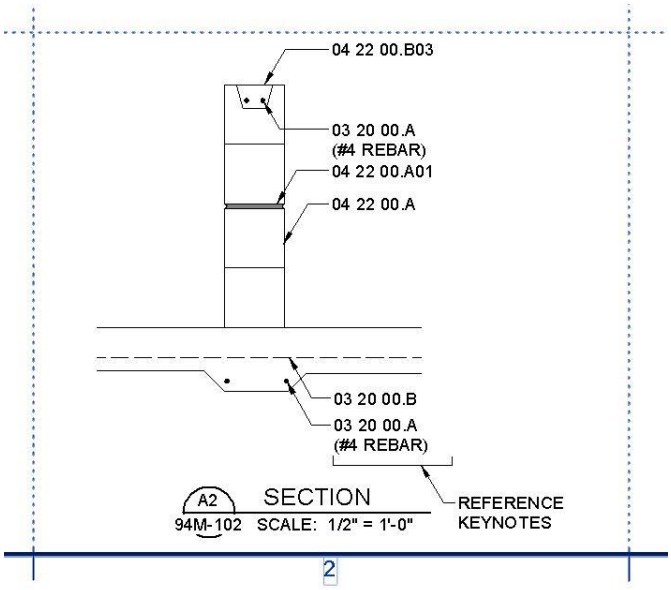


Figure 4-19. Reference Keynotes in a Drawing Block

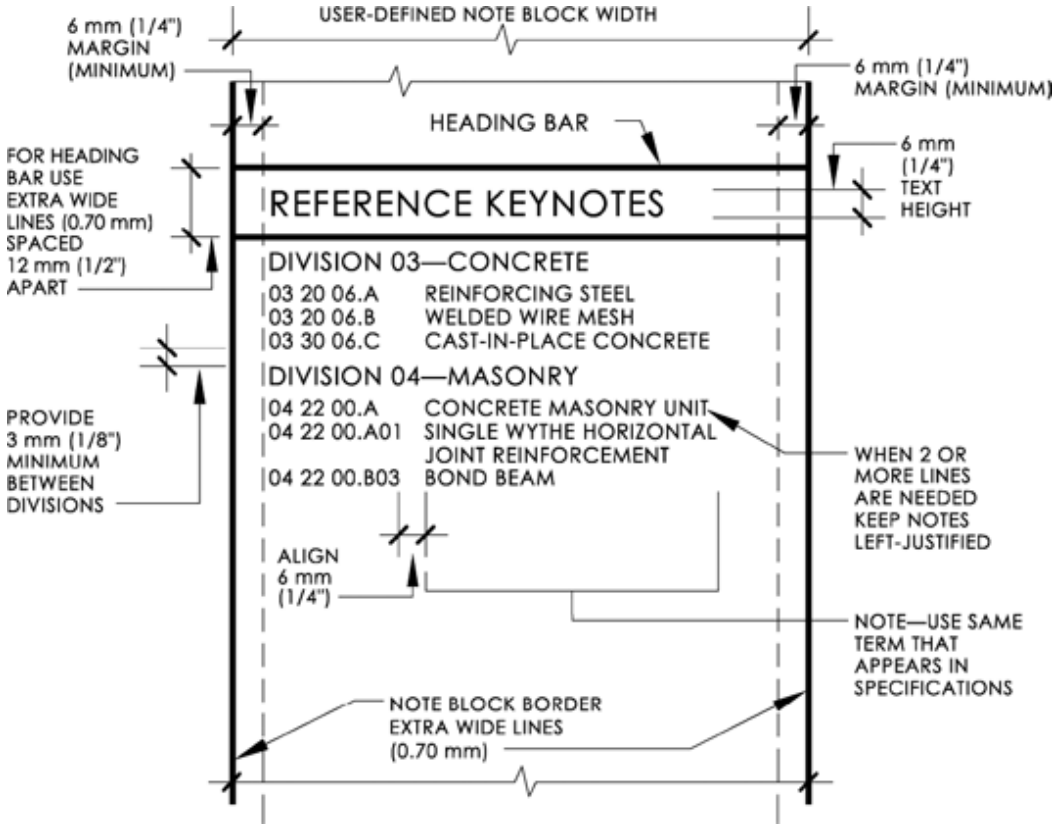


Figure 4-21. Typical Reference Keynotes in a Note Block

4.8.5 Sheet Keynotes

Sheet keynotes are noted within the graphic and notation areas of the drawing block. They are drawn with a hexagonal symbol containing a numeral with leader(s) from the hexagon to the identified item. The bottom of the hexagonal symbol should always be drawn parallel to the bottom of the drawing sheet. The numeral for each symbol that appears on the sheet is listed in the sheet's note block along with a text note that describes the graphic. A unique numeral must be assigned for each identified item, and the keynotes tabulated sequentially within the note block. The numerals should begin with 1, followed by 2, 3, 4, 5, etc., or other sequential orders (i.e., 7 followed by 12, 31, 33, 45, etc.). See Figures 4-19 and 4-20.

Sheet Keynotes can be used to save room and decrease sheet clutter. The decision to use key notes should be based on space availability and clarity of the sheet. In general, the use of key notes should be minimized. Keynotes consist of a standard hex symbol enclosing a number that correlates to a specific note. These types of notes are particularly suited for use on linear projects where identical notation is desirable on each sheet. Keynotes can also be valuable for the notation of piping, mechanical, or equipment assemblies.

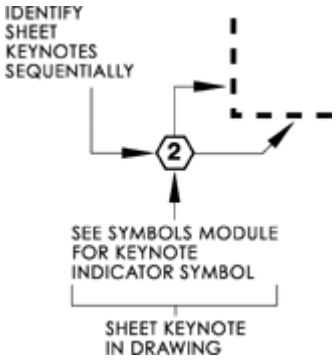


Figure 4-20. Keynote Indicator

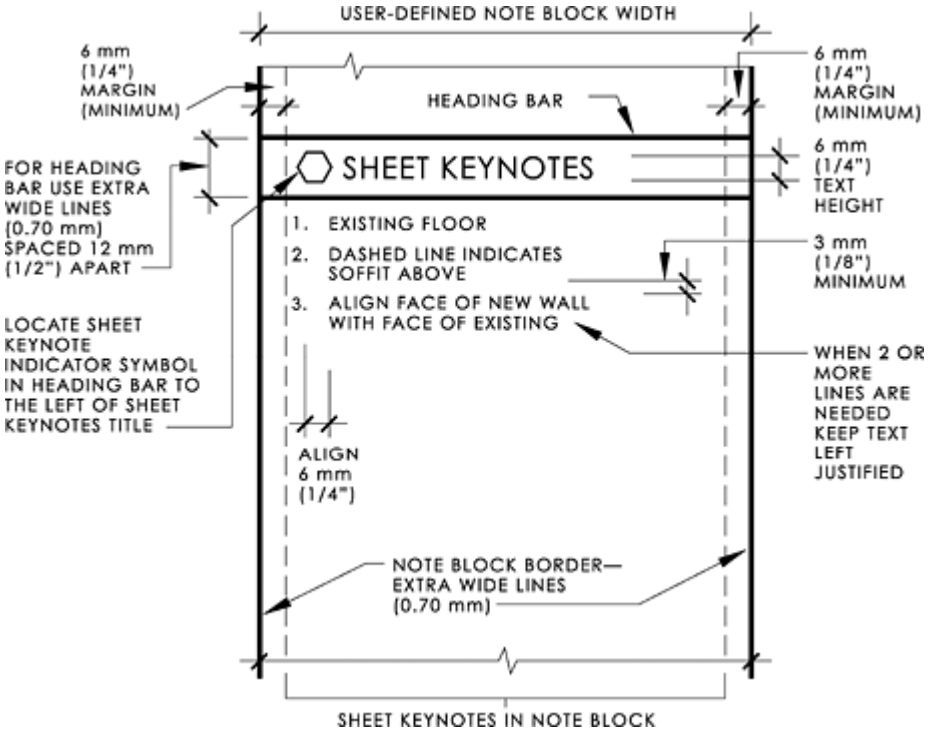


Figure 4-21. Sheet Keynotes

Guidelines for the use of key notes follow:

- Do not overuse sheet keynotes. If there is room to locate the note by the component, place the note there.
- Always align notes horizontally on the sheet and arrange them in a systematic manner.
- Include the keynote legend on each sheet that contains keynote leaders.

- Do not place keynote leaders and legends in crowded areas of the sheet or between views or details.
- Do not arrange the keynote leaders or legends so closely as to confuse the reader or too close to another view or detail as to suggest application to the wrong idea.
- Make keynote leaders as short as possible and cross as few lines as possible. Never run the keynote leaders through specific points of interest or line intersections. Do not place key note leaders as horizontal lines.
- Do not include more than one keynote legend on a sheet. If multiple details have keynotes, combine all keynotes in a simple key note legend.

Sheet keynotes follow the listing of any reference keynotes within the note block. Each numeric identifier is listed in sequential order in the note block with the full text of the note. Sheet keynotes should not be used to identify items referenced in the specifications.

4.8.6 Note Block Hierarchy

The placement of notes within the note block is shown on Figure 4-21. If a certain note type is not required, do not indicate a heading for that note type. Shift the note types upward that would normally be located beneath the unused notes. When laying out note blocks, designers should consider the space required at the bottom of the note block, which is reserved for any applicable key plans. Generally, the note block should be formatted as a single column of notes.

General notes can appear on the first drawing sheet within the set followed by general [discipline] notes, and general sheet notes. As hierarchical information, the general notes always appear as the first notes within their note blocks (see Figure 4-22).

If more notes are required than will fit in a sheet's single-column note block, the note block should expand to the left and be formatted to allow multiple columns of notes (see Figure 4-23).

On the applicable **0-Series** sheets where they appear, the general [discipline] notes are the first notes within the sheet's note block(s).

General sheet notes appear at the top of a sheet's note block(s) except for **G-Series** (e.g., G-001) and **C-Series** (e.g., C-001) sheets where they follow any general notes or general [discipline] notes that may be on those sheets. General sheet notes are numbered sequentially as they are developed.

If general sheet notes are not required for a sheet, locate reference keynotes at the top of the note block. Shift sheet keynotes upward, below reference keynotes (see Figure 4-23).

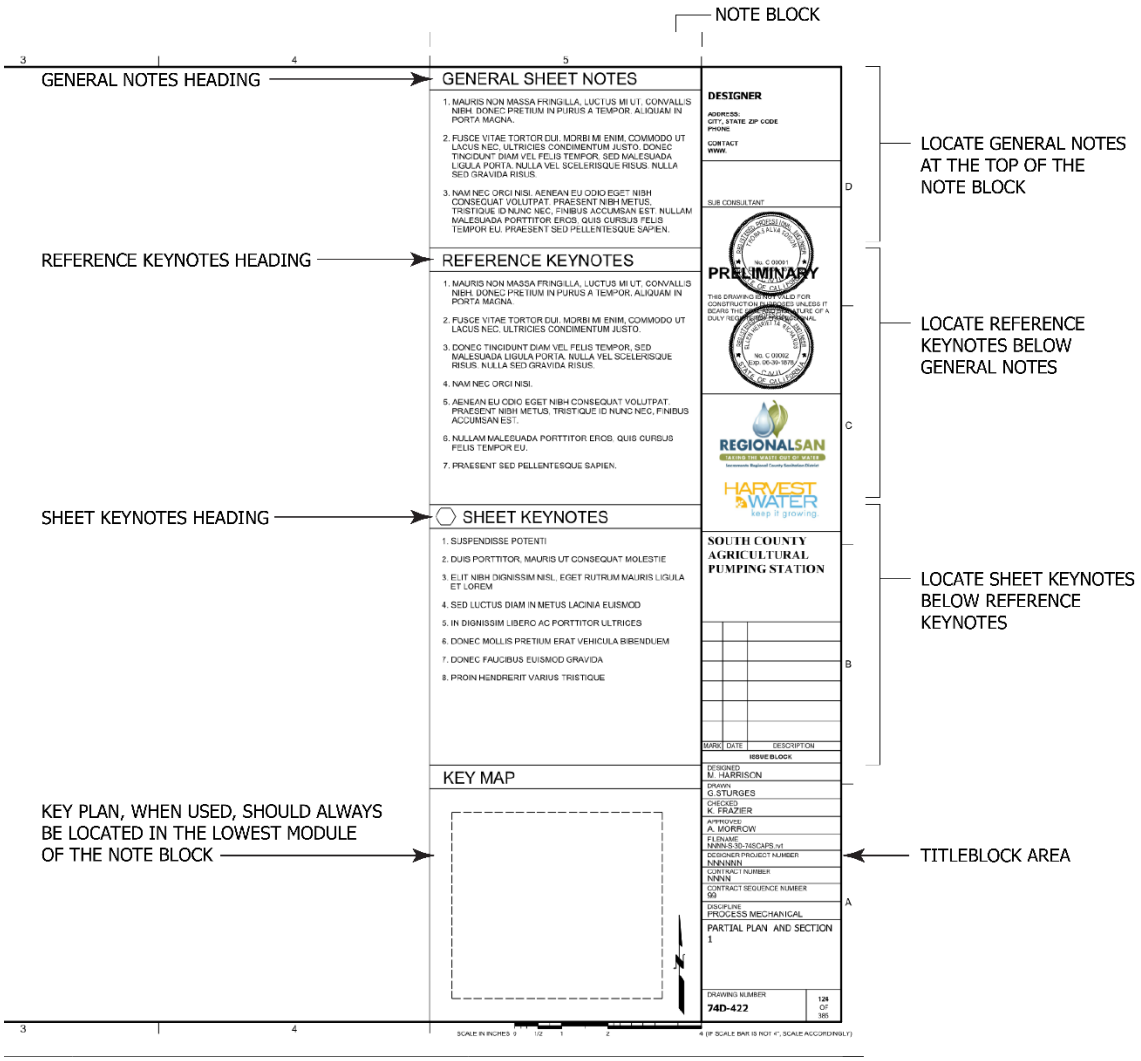


Figure 4-22. Note Block Hierarchy - Order of Notes

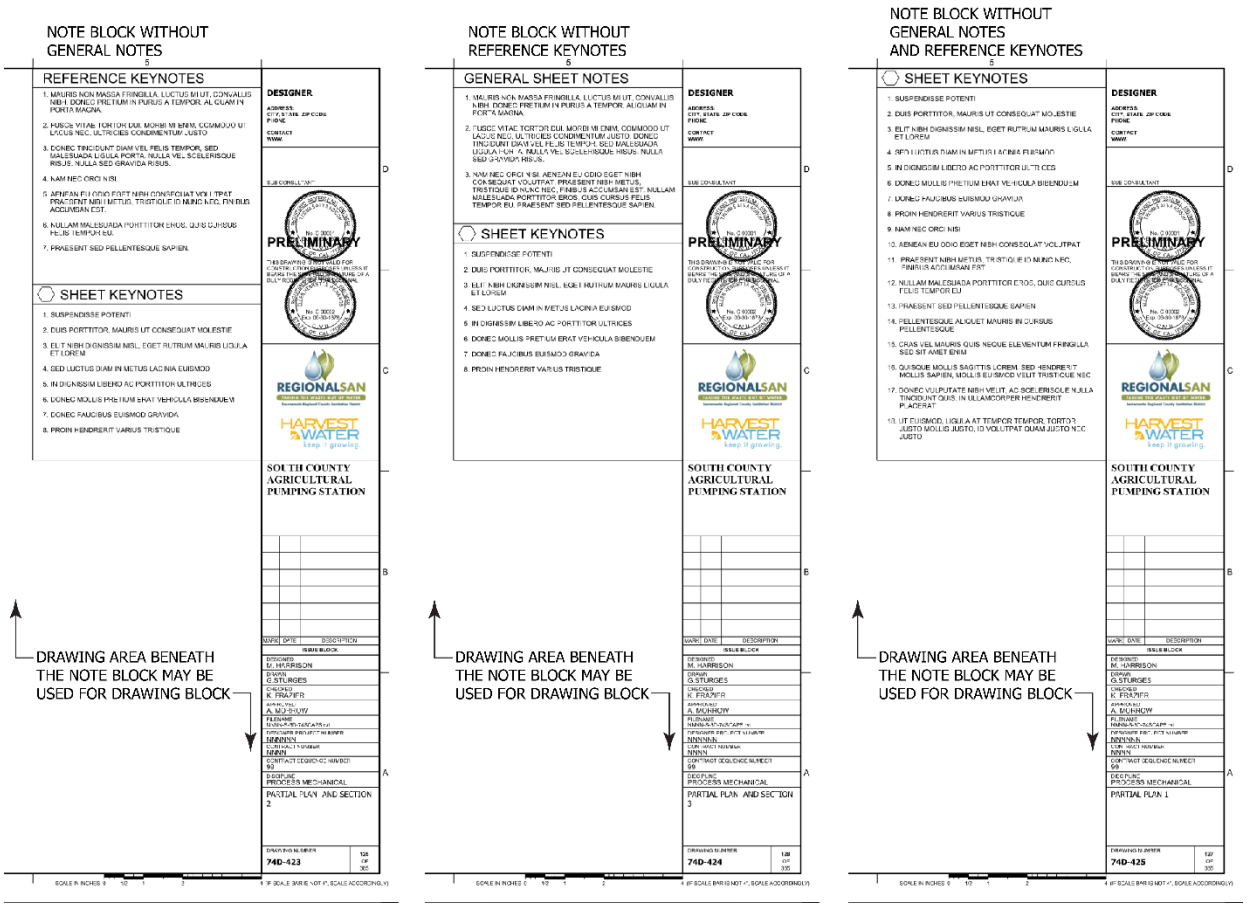


Figure 4-23. Hierarchy of Notes in Note Block

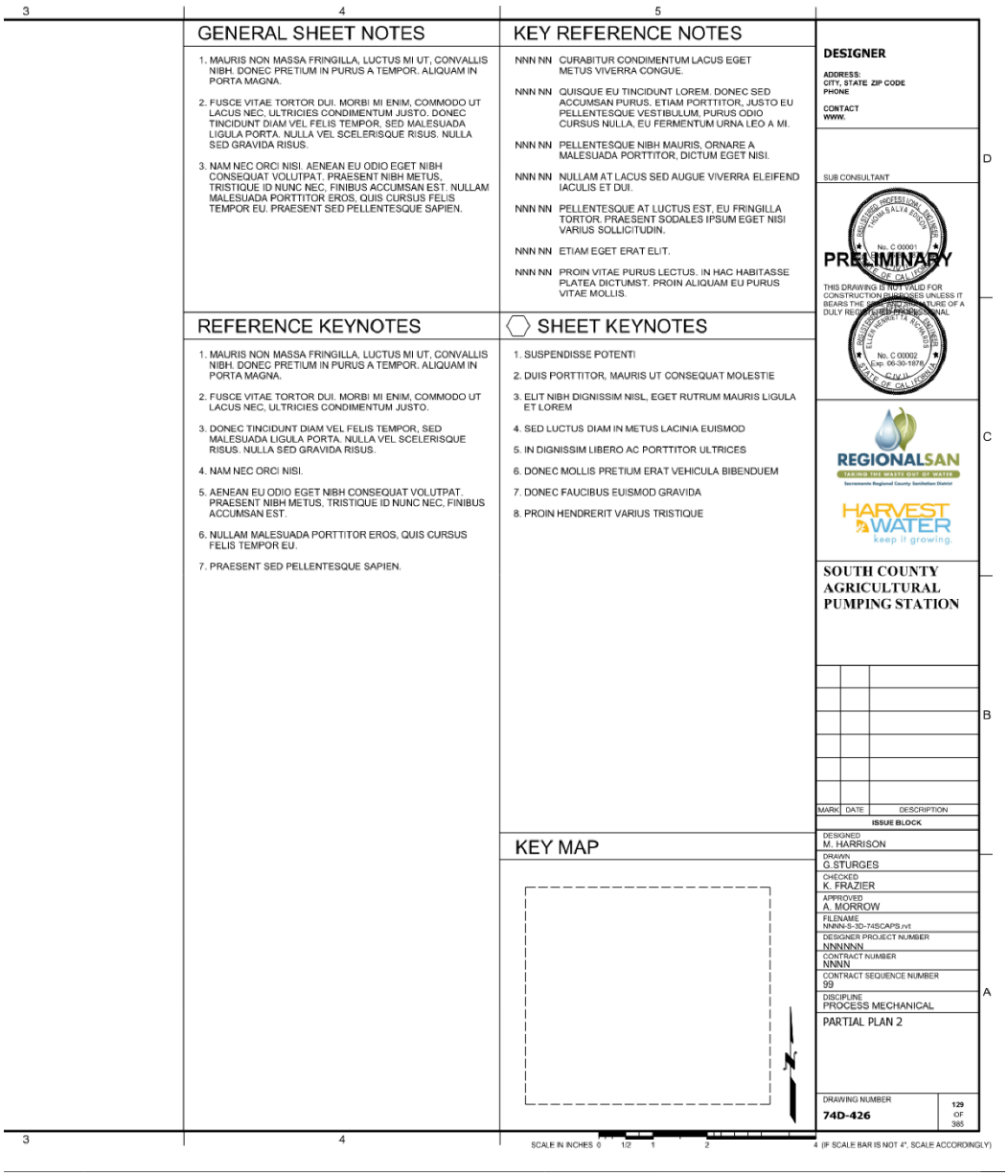


Figure 4-24. Multiple Column Note Blocks

4.8.7 Users' Guide

The development and production of drawings requires discipline, organization, and the management of those elements that make up the drawings. Attention must be paid to managing the notes that become part of the drawings.

The drawings, and their notes, must be complete and accurate. They must also effectively communicate the project to the drawing user. The placement of notes within the drawing block should comply with the drawing block format requirements as described in the UDS (see Figure 4-24).

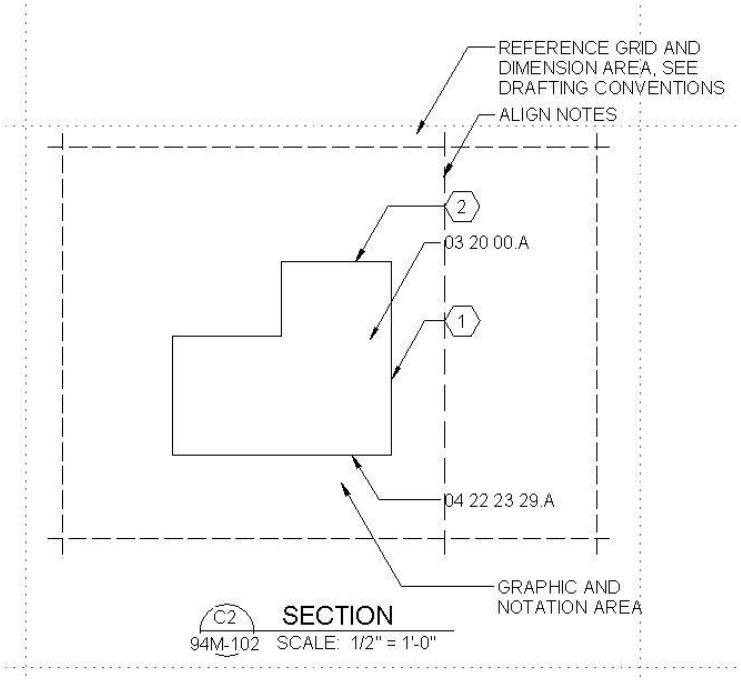


Figure 4-25. Typical UDS Drawing Block Format

Following are some guidelines for proper development of more efficient notes:

- Generic terminology should be based on a well-known, commonly available source(s).
- Drawing notes should match the terminology in the specifications. Names of materials and products appearing on the drawings should be identical to the generic names used to identify those products found within the specifications. Do not to repeat proprietary names, model numbers, or other detailed information within drawing notes. Identify objects and materials on the drawings with generic terminology and a description adequate to distinguish among similar products.
- Text reduction is one of the more obvious benefits of good notes practice. See Figures 4-25 and 4-26 for illustration of benefits.

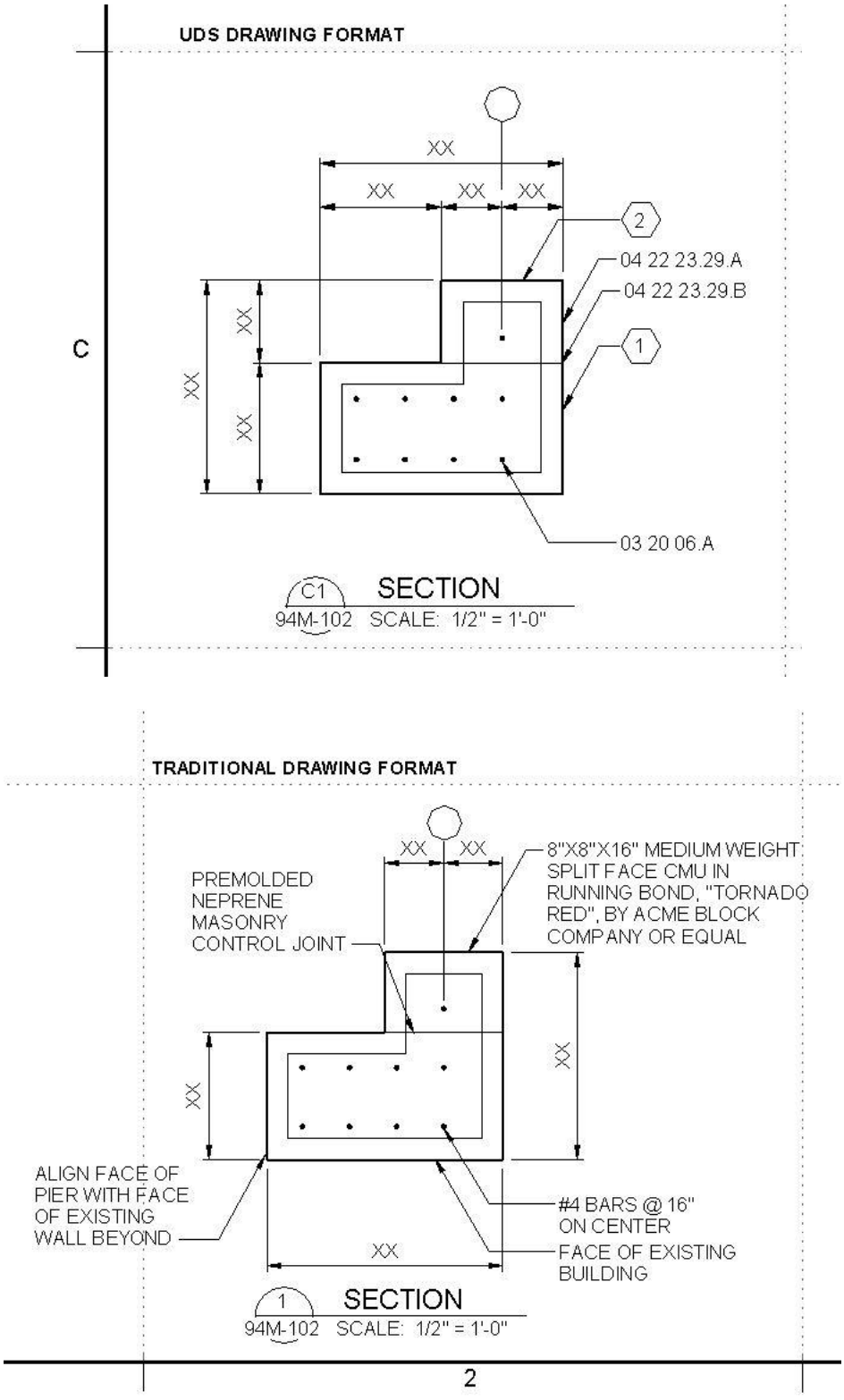
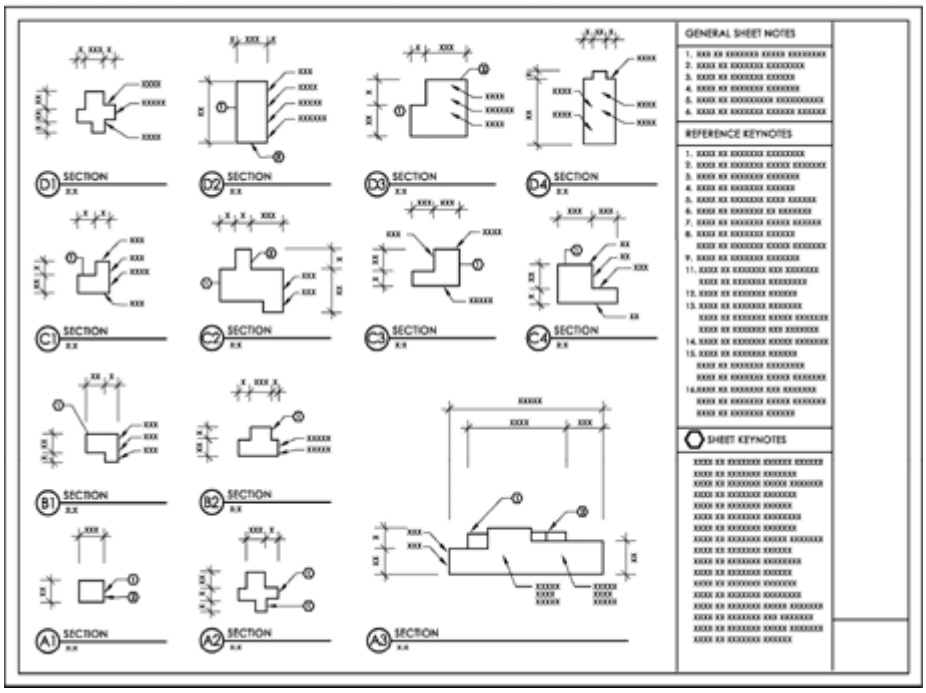


Figure 4-26. Benefits of UDS in Drawing Blocks

UDS SHEET FORMAT



TRADITIONAL SHEET FORMAT

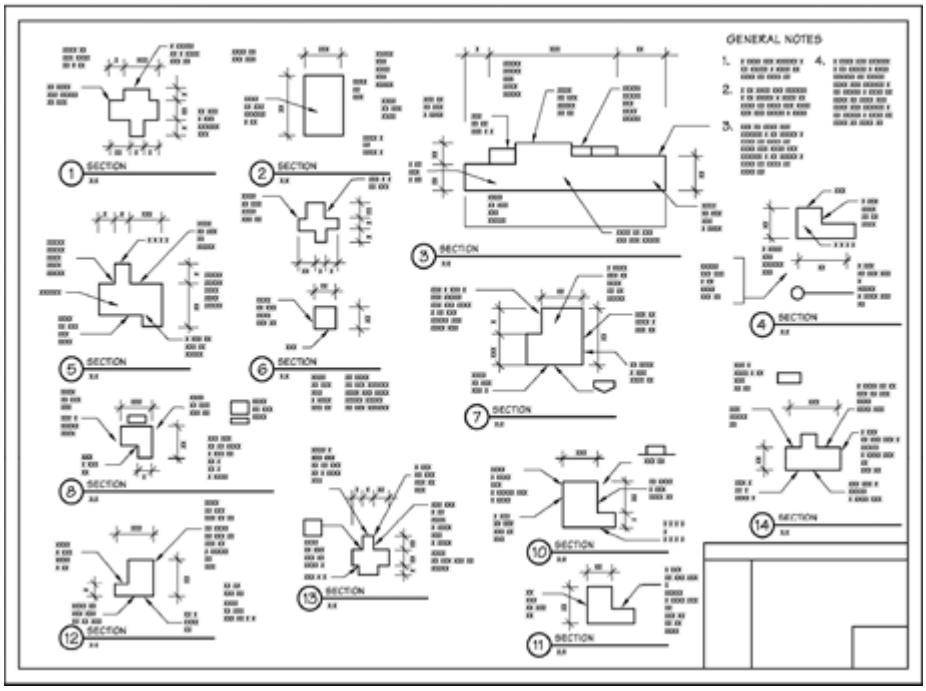


Figure 4-27. Benefits of UDS in Sheets

Reference keynotes or sheet keynotes reduce drawing text by eliminating repetitious text and replacing it with a simple symbol and legend. These same principles apply to drawing notes, as illustrated below:

Indicative note language to be avoided:

- "THE CONTRACTOR SHALL INSTALL…"
- "CONTRACTOR SHALL NOT SCALE DRAWINGS"
- "NEW…"

Preferred streamlined note language: "INSTALL…" and "DRAWINGS: DO NOT SCALE"

- Fonts shall be 1/8" Arial and all capitalized. Do not use italics, underlining, or other highlighting techniques (see Figure 4-27). Bold annotation may only be applied to emphasis important design features, i.e.: Room Names, Structures, Facilities, etc.

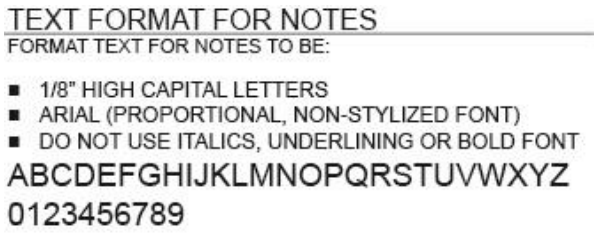


Figure 4-30. Text Format for Notes

- Write notes using complete terminology and avoid the use of abbreviations. Where an abbreviation is essential, the user should coordinate the use of abbreviations throughout the drawings and specifications to ensure consistency and proper use.
- Avoid broad references to the specifications such as PER SPECS or REFER TO SPECIFICATIONS. References to the specifications should provide the reader with an exact reference location within the project manual: SEE SPECIFICATION SECTION 09 25 13.13.
- Avoid broad references to drawings in the drawing set such as REFER TO STRUCTURAL DRAWINGS. References to drawings should provide the reader with a more exact reference location within the drawing set such as: REFER TO STRUCTURAL FOUNDATION PLAN or REFER TO SHEET S-101.

4.8.8 Linking

Link or field project information using reference keynotes. Reference keynotes are a useful organizing tool throughout the design and construction process.

Reference keynotes should be established and shared across all participating disciplines in a uniform format.

4.9 Plotting Guidelines

The purpose of these plotting guidelines is to allow consistent black-and-white and color plotting from various configurations within CAD programs. See Appendix F - Pen Weights.

4.9.1 Black/White/Gray Plotting

Because various screen colors can be assigned to color numbers, only color numbers will be addressed. Table 4-8 uses color numbers and allows the user to select from 255 colors.

Table 4-8. Black and White Plotting with Screening

Color number	Color	RGB Values			Screen	
		Red	Green	Blue	Percent (%)	Output
1-6	Black	0	0	0	100	
7	Background (White)	NA	NA	NA	0	
8-249	Black	0	0	0	100	
250	Gray	102	102	102	60	
251	Gray	128	128	128	50	
252	Gray	153	153	153	40	
253	Gray	179	179	179	30	
254	Gray	204	204	204	20	
255	Background (White)	NA	NA	NA	0	

4.9.2 Color Plotting

This section addresses color printing of non-raster CAD drawings. Red, Green, Blue (RGB) values given are based on default AutoCAD® screen color numbers.

5.0 Building Information Modeling Guidelines

The Building Information Modeling (BIM) guidelines outline the District's expectations for the use of BIM model(s) in executing the Design Project and with collaborating and coordinating with the team and stakeholders.

5.1 BIM Execution Plan

Following the Notice to Proceed (NTP), the Designer must submit a BIM Execution Plan to the District demonstrating how it will meet the requirements of this document. The District will evaluate the BIM Execution Plan and provide feedback to the Designer for revision and resubmittal to the District.

The BIM Execution Plan must include, at a minimum, the following information (the Designer may reference their proposal in lieu of providing duplicate information in the plan):

- Qualifications of BIM leadership staff.
- Software selections, and file format.
- Schedule of BIM activities including milestones and submittals.
- Process proposed to utilize 3-D visualization 'walk-through' video in presentations to the design project stakeholders (both local and remote).
- File folder structure and file naming conventions (nomenclature).
- Plan for file sharing, storage and retrieval, and data security.
- Methodology for ensuring the validation of BIM and CAD files, project-wide.

5.2 Federated Model

The Designer must develop and submit for approval a federated model using BIM as defined by this document. The federated model must be developed for design intent, engineering reference, trade coordination, spatial facilities placement, and for as-built reference and rectification. The federated model must be a reference source for communication and collaboration throughout each phase of the Designer's project. At the completion of the project, the federated model must be turned over to the District. The District will have exclusive rights to the model for their use: (1) as a baseline model for future modifications to the facility, and (2) as a source of data in operating and maintaining the facility. Therefore, the model must be complete and contain all linked files for future use.

The federated model may vary in level of detail for individual elements, but at a minimum must include sufficient data to support use and analysis of:

- Functional and visual representation of spaces.

- Constructability review of Designer's documents.
- Clash detection and correction of all major systems.
- Construction scheduling.
- Cost estimating.
- As-built documentation and modeling.
- Label and identify all major components and equipment.

The construction documents (drawings and specifications) will be derived using information from the federated model. In implementing the BIM requirements, the Designer must:

- Work with the District and the Designer's subcontractors to develop the federated model throughout the work of the design package.
- Submit a Level of Detail (LOD) 300/400 federated model to District representative for review and approval as part of the Designer's submittals prior to start of construction.

Note: During construction the Designer will be responsible for maintaining the federated models unless noted otherwise in the Consultant Agreement..

5.3 OmniClass Construction Classification System

The OmniClass Construction Classification System (OCCS) is a classification system for the construction industry developed by the Construction Specification Institute (CSI). It builds upon MasterFormat for work results, UniFormat for elements and EPCI (Electronic product Information Cooperation) for structuring products. OmniClass is a reference library system that will serve as the foundation upon which information is transferred between the construction and operations phases.

The Designer, upon selection of OmniClass coding, must include, when appropriate, OmniClass classification in the list of property attributes that is assigned to the objects.

5.4 Commissioning and Construction Operations Business Information Exchange (COBie)

If commissioning activities and/or COBie data are required by the contract documents, the Designer must comply with the requirements in addition to the requirements of this CAD/BIM Standard.

Note: During construction and commissioning the Designer will be responsibilities responsible for maintaining the COBie data.

5.5 Level of Development (LOD)

Regardless of the LOD, the model(s) must be capable of being presented in three dimensions, and will be an object-based parametric database system. Each space or area must be identified as a unique area with associated parameters. The LOD is defined as follows:

- LOD 100 (Programming level): Buildings and/or structures must be modeled as 3D solids indicative of area, height, volume, spatial location, and orientation.
- LOD 200 (Planning level): Buildings and/or structures including major architectural, structural, mechanical, electrical, and plumbing objects must be modeled as generalized systems or assemblies with approximate quantities, approximate configuration, spatial location, and orientation.
- LOD 300 (Design level): Buildings and/or structures including all objects must be modeled as specific systems or assemblies with accurate quantities, recognizable configuration, spatial location, and orientation.
- LOD 400 (Construction level): Buildings and/or structures including all objects must be modeled as specific systems or assemblies with accurate quantities, recognizable configuration, spatial location, and orientation, with complete fabrication, assembly, and detailing information.
- LOD 500 (As-built level): Buildings and/or structures including all objects must be modeled as constructed systems or assemblies with accurate quantities, shape, spatial location, and orientation, with complete fabrication, assembly, and detailing information.

5.6 Share Site/File Storage System

The Designer, through its BIM Coordinator, must define a BIM share site (also known as the file storage system) to host all BIM files (reference BIM Execution Plan requirements). Models on this shared site must be fully accessible on line to all members of the Designer's team. The Designer's BIM Manager will assign site users and passwords, must submit updates to the site on agreed schedules, must coordinate and approve the BIM information that is updated into the shared site, monitor usage and ensure capacity and function of this system. The site will contain revision control capabilities and the Designer's BIM Manager must administer read/write rights and hierarchy.

5.7 Data Security

The Designer must establish a data security protocol to prevent any possible data corruption, virus "infections" and data misuse or deliberate damage by users of the BIM share site. The Designer must establish adequate user access rights to prevent data loss or damage.

Submit a narrative description of the data security protocol as part of the BIM Execution Plan.

5.8 Software

5.8.1 Software Requirements

The native model(s) must be developed to include parametric components of major building and site elements. All discipline native models must be linked to the mechanical process native model.

The accuracy of the federated model and each of its native models must be developed to within a dimensional tolerance of a minimum of plus or minus ¼-inch.

BIM application(s) and software(s) for the federated model must:

- Use Autodesk® Navisworks software.
- The native model software must be as listed inTable 2—1. 2015 Autodesk Software Matrix.

The designers will create separate worksets in Autodesk® Revit for the discipline or system corresponding to the 3D model.

The Designer must submit their Autodesk® Revit template and shared parameters files to the District for review and approval.

5.8.2 Nomenclature

5.8.2.1 Object Identification

Every object in the model must have a Unique Identification (UID) parameter and a common name parameter attached to it in the native model.

Designers must assure there is consistency between the level of detail and nomenclature between the Construction Estimate, Construction Schedule and Model. Each item in the model must be distinctly traced to an activity in the schedule and to its corresponding estimate detail. The District uses Synchro software for 4D/5D modeling. It is very important that the links between these three (3) elements can be easily established.

The UID must be readable by the user of the native model software without additional software applications. The UID may be in the form of alpha, numeric, or alphanumeric. Each element has a corresponding UID; a string identifier that is universally unique across separate Revit projects.

If the UID form is alpha-numeric, it must be a consistent string format for all objects, within its discipline, and must be readable by any commonly available database. The UID is an “Instance” parameter.

5.8.2.2 Common Name

In addition to the UID, each object must have a “Common Name” parameter attached to it in the native model. The common name must be approved by the District prior to modeling.

Examples of a common name include such as: door, window, toilet, VAV Box, etc. Typically, the common name will be generated automatically by the software, but if not, it will be input manually in the native model. The common name is an object "Type" parameter.

5.8.2.3 Object Parametric Attributes

The following attributes must be attached to each object. Note: If a required attribute is not automatically generated by Native Model software, it will be manually entered in the native model, or provided in a Microsoft Excel or Access document that includes the UID.

- Unique Identification
- Common Name
- Omni Code Classification
- Native Model Assembly Code
- Manufacturer (where applicable)
- Model Number (where applicable)

The designers of a particular project will identify the new Assets during the design process. The initial asset records will be developed in the design. For each asset, information will be entered in specific fields that were identified by the District. These fields establish the core data needed for each asset record. The District has provided the designers the REVIT family templates containing the common asset Fields. The following are the common fields used for ALL assets:

- Equipment Tag Number /Location ID
- Equipment Name
- Asset Class
- Asset Category
- Maintenance Managed Item (MMI)

5.8.2.4 Area Association

Every object in the model must be associated with either an "Area" or a "Floor" and must have an association "Instance" parameter attached to it in the native model. Any object that will be visible in an area of the completed facility must be associated with that specific Area. This includes all objects regardless of responsible discipline; examples include without limitation: electrical switches and outlets, electrical switch gear and panel boards, plumbing equipment and fixtures, access panels to concealed objects, cabinets, doors and frames, light fixtures, etc.

5.8.2.5 Level Association

Any object that will be concealed in a wall or interstitial space (but would be visible if the finish surface or item was non-existent) must be associated with the specific level that it is within. This includes all objects regardless of responsible discipline; examples include without limitation: electrical conduit, plumbing piping and valves, HVAC supply and return ducts, HVAC equipment, piping and valves, etc.

5.8.2.6 Objects Extending Beyond Area Boundaries

Floors, walls, and/or ceilings are sometimes modeled as objects that extend beyond individual area boundaries. Where this occurs, the native model must be modeled as follows:

- Structural floor objects may extend beyond area boundaries; however, footings must be modeled as objects, with extents contained within the area boundaries, and with appropriate Area association.

- Structural wall and non-structural partition objects may extend beyond area limits; however, the surface material such as coatings, etc., must be modeled as objects, or scheduled, with extents contained within the area boundaries, and with appropriate area association.

- Structural ceiling objects may extend beyond area limits; however, finish surface material such as T-lock liner, etc., must be modeled as objects, with extents contained within the area boundaries, and with appropriate area association.

5.8.3 System Discipline Models

5.8.3.1 Civil Systems Model

The civil systems model must be a sub-system model linked to the structural system model and must serve as the basis for project-shared coordinates through which the position of building elements on the site will be coordinated. Point of connection between civil systems and building/structure systems occur 5 feet from outside the outside perimeter of the building/structure. Provide model objects of:

- Existing natural and/or graded contours, and new grades and finish contours.

- Major landscaped areas, existing trees to remain, new landscaped areas, new trees, and Irrigation lines over 2-inch diameter.

- Pavements, curbs and gutters, retaining walls, exterior non-building structures such as pools, shade structures, pole foundations, etc.

- All facilities within the design project area intended to remain, and structures/facilities intended to be demolished (all existing structures may be modeled exterior surface only; interior elements are not required).

- Existing storm water and sanitary sewer lines (over 3-inch diameter), boxes and structures within design project area, all new lines, boxes and structures, and existing public lines, boxes and structures beyond the design project area but serving as points of connection for the design project.

- Existing domestic and fire water main and branch lines (2-inch and larger diameter) within the design project, all new domestic and fire water lines, existing electrical overhead and underground lines within the design project, all new electrical lines outside buildings, existing telephone and data lines within the design project area, all new telephone and data lines outside buildings, existing gas lines within the design project. All new gas lines outside buildings.

- Individual conduit larger than 1.5-inch diameter. All concrete encasement and conduits.

- All necessary roadways and parking lots or parking structures, including necessary intelligence to produce accurate plans, profiles and cross-sections.

5.8.3.2 Architectural Systems Model

The architectural systems model must provide model objects of:

- Net square footage of all occupied spaces, gross constructed floor area, room names and numbers, and floor, base, wall, and ceiling finishes.

- Exterior walls including type and composition, height, length, and width, and thermal, acoustic, fire, and security ratings.

- Partitions including type and composition, height, length, and width, and thermal, acoustic, fire, and security ratings.

- Floors including type and material, thickness, and finishes. Link floor structure to the structural systems model.

- Ceilings including type and composition, height, length, and width, and thermal, acoustic, fire, and security ratings.

- Roof coverings and openings including configuration, drainage system, and penetrations for modeled building components.

- Exterior doors, windows, and louvers including type and material, height, width, and thickness; thermal, acoustic, fire, and security rating; location, and hardware elements or group.

- Interior doors, windows, and louvers including type and material, height, width, and thickness; thermal, acoustic, fire, and security rating; location, and hardware elements or group.

- Stairs and railings, ramps and railings, and handrails and guardrails.
- Casework and counters including type and material, height, width, and depth, location, and hardware.
- Soffits, Openings and Accessories.
- Plumbing fixtures including type and material, location, trim, and finishes. Link fixtures and trim to the mechanical systems model.
- HVAC grills and registers including type and material, location, trim, and finishes. Link fixtures and trim to the mechanical systems model.
- Electrical fixtures and equipment including type and material, bulb type and wattage, location, trim, and finishes. Link fixtures and trim to the electrical systems model.
- Toilet partitions, toilet room accessories, grab bars, personal storage lockers, display cases, and other surface applied quasi-permanent items such as mirrors etc.

5.8.3.3 Structural Systems Model

The structural systems model must be the sub-primary model to which others are linked. Provide model objects of:

- Foundations and footings including type and configuration, and depth, length, width and areas of influence zones.
- Slab(s) On-Grade: Type and configuration, under-slab base and waterproofing, recesses, curbs, equipment pads, closure pours, and major penetrations.
- Basement Walls: Type and composition, height, length, and width, and thermal, acoustic, fire, and security ratings.
- Elevated Floors: Columns and beams, primary and secondary framing members, bracing, connections, and framed, composite, and/or slab decks.
- Roofs: Columns and beams, primary and secondary framing members, trusses, bracing, connections, and framed, composite, and/or slab decks.
- Lifting Devices: Bridge cranes, monorails, davit cranes, lifting eyes, etc. including the associate travel path and clear space required.
- Joints: Expansion and/or contraction, and seismic.
- Stairs and Ramps: Openings and framing, and railing supports.
- Ladders.

- Shafts and Pits: Openings and framing, and railing supports.
- Penetrations for modeled subsystems.
- Pipe Hangers, Supports and Seismic Bracing designed by the Structural Designer. Refer to Design Guidelines, Chapter 6.
- Area(s) of influence zones under foundations and footings.
- Color code structural steel from other elements.

5.8.3.4 Process Mechanical System Model

The process mechanical system model must be a shared primary model. Provide model objects of:

- Piping (1-1/2-inch and larger) pipe, pipe fittings, and pipe line devices.
- Pipe insulation and containment.
- Valves, valve actuators and operators.
- Flow measurement and monitoring devices.
- Equipment (tag) numbering and coding per District Design Guidelines.
- Limit the model to individual (1) piping service per District Guide Specifications.
- All process equipment, including tanks.
- Miscellaneous mechanical equipment.
- Utility stations.
- Color system per District Guide Specification, Piping Coating Systems.
- All clearances and access to equipment, valves, etc. required by code or for the purposes of operations and maintenance. Maintenance clearance requirements as required by manufacturer.

5.8.3.5 Building Mechanical Systems Model

The building mechanical systems model must be a shared primary model. Provide model objects of:

- Heating, Ventilating, and Air Conditioning: All heating, ventilating, air-conditioning, exhaust fans, and specialty equipment, air supply, return, ventilation and exhaust ducts, including space-consuming elbows and transitions, fire dampers with ratings,

mechanical piping, and registers, diffusers, grills and hydronic baseboards. Coordinate and link fixtures and trim to the Architectural Systems Model.

- Plumbing: All domestic plumbing piping and fixtures, floor and area drains, valves (regardless of pipe size) and related equipment.
- Emergency Eyewash and Shower Stations.
- Piping larger than 1.5-inch diameter must be modeled. Limit Process System Model to individual (1) piping system.
- Equipment (tag) numbering and Coding per District General Design Requirements.
- Transmitters, switches, detectors, motors and thermostats.
- Roof Drainage: All piping and fixtures, and related equipment.
- All clearances and access to equipment, valves, etc. required by code or for the purposes of operations and maintenance. Maintenance clearance requirements as required by manufacturer.
- Color Code: Separate color code for each type element.

5.8.3.6 Electrical Systems Model

The electrical systems model must be a sub-system model. Provide model objects of:

- Interior Electrical Power and Lighting: All interior electrical components, lighting, receptacles, special and general purpose power receptacles, lighting fixtures, panel-boards and control systems, and conduit and cable trays.
- Individual conduit larger than 1.5-inch diameter must be modeled.
- Groups or clusters runs, and cable trays of conduit of all sizes must be modeled.
- Exterior Building Lighting: All exterior electrical components, lighting, receptacles, special and general purpose power receptacles, lighting fixtures, panel-boards and control systems, and transformers, and utility connection and equipment.
- Telephone, Data, Television, and Other Low Voltage: All interior low voltage components, outlets, receptacles, special and controls, fixtures, panelboards, equipment racks, and control systems, and conduit and cable trays.
- Switchgear and MCC elevations and arrangements
- Transformers

- Equipment (tag) numbering and Coding per District's Design Guidelines requirements.
- Clearances and Access. All clearances and access to equipment, valves, etc. required by code or for the purposes of operations and maintenance. Maintenance clearance requirements as required by manufacturer.
- Color Code: Separate color code for each type element.

5.8.3.7 Fire Suppression Systems Model

The fire suppression systems model must be a sub-system model. Provide model objects of:

- Fire Suppression System: (1) valves and risers, (2) all main, branch, and drain lines, (3) sprinkler heads and fittings, and (4) pumps.
- Fire Alarms: (1) alarm and notification devices, and (2) detection systems.
- Smoke detectors and shutoff dampers in ductwork
- Equipment Clearances: Clearances for major equipment as model objects for conflict detection and maintenance access requirements.
- Color Code: Separate color code for each type element.

5.8.3.8 Specialty Equipment Model

The specialty equipment model must be a sub-system model. Specialty equipment includes without limitation such specialties as: conveyance equipment and systems, manufacturing equipment and systems, etc.

5.8.4 Development and Submittal of BIM Models

The Designer must develop the federated model and its discipline systems native models in compliance with the modeling requirements and the following:

- Develop and submit all discipline systems native models concurrently.
- Composite models in Navisworks
- Composite models in 3D DWF (Autodesk design review). 3D DWFs must be created from Native files. Do Not generate DWF/3D DWF files from the Navisworks models.
- Facility data.
- Clash reports and model standards checks. An example clash reporting log will be generated for each project, see Appendix J - Clash Reporting. During each submittal review period, the models, drawings, and sheet files will be reviewed. Health checks will be performed, see Appendix I - Model Health Check Form. These files will be reviewed for standards compliance, see Appendix H – Audit Checklist.

5.8.5 Coordination amongst Design Entities

Designer is responsible to coordinate their respective work with other design teams working on other District projects in design. The District will assist the Designer in coordinating the effort between other design teams.

Submitted models must be accessible to all parties in both native formats and in dwg and/or NWD/NWC/IFC formats as requested.

6.0 Transmittals and Submittals

6.1 Electronic Computer Aided Design (CAD) Drawings and Electronic File Submittal

Electronic documents must be accompanied by a transmittal letter which clearly identifies the firm submitting the electronic documents, the firm's internal project identification and District Project number. The submittal of electronic documents shall take the form of AutoCAD files in .dwg or Revit files in .rvt format.

Electronic submittal (BIM Model and Drawing Exchange) are to using Dropbox or as otherwise directed by District staff.

If Dropbox is used a software account will be setup to support one (1) user from each Design firm. The Design firm's selected user will have read/write access to the entire set of shared folders. The user will publish material into their Dropbox project. Users should not add, change or delete files in project folders other than their own.

For each formal submittal, links will be submitted timely and notifications sent to the standardized group.

Electronic submittals are acceptable on media such as CDs or DVDs.

Electronic documents will not be accepted via email.

Electronic documents shall be delivered to the District on two (2) identical CDs or DVDs. The following file delivery rules apply:

- The two (2) identical CDs or DVDs shall be labeled with the contractor or vendor's name that produced the drawings, District's project contract number, the Submittal number, and the Submittal Transmittal Item identification number(s). All drawing files provided shall be separately listed by electronic file name on the Submittal Transmittal form, under their respective Item number. Drawing electronic file names shall be IDENTICAL to the drawing number shown on the hardcopy drawing submitted. Each electronic drawing file SHALL NOT contain more than one drawing. All files shall be contained in the directory structure as outlined in Section 4.1.3.

- All drawing xrefs, image files, fonts, custom linetype definition files or other supporting files that are required for the parent drawing to open, display and print correctly, shall be provided. The contractor or vendor shall use the AutoCAD eTransmit function to create the Transmittal set to assure that all files required are provided. All drawing files shall be purged to remove extraneous data and reduce the file size. Failure to comply with these requirements is unacceptable and a re-submittal will be required.

Electronic documents shall follow the following guidelines:

- A set of drawings for all applicable disciplines shall be submitted in AutoCAD 2015(.dwg or Revit (.rvt) format or later. DXF and DWF are not acceptable as a substitute for native digital files.
- If converting from a format other than DWG, ensure all graphic elements are preserved.
- External references should not be bound.
- PDF or TIF files may accompany the submittal, but may not be submitted in lieu of DWGs.
- Electronic stamps are allowed on drawings. Electronic signatures are allowed on drawing but electronic signatures shall be not a rubber stamp type.
- The electronic documents must be saved and submitted with the layer state used to plot the hardcopy.
- Drafting guidelines:
  - All lines must be snapped and or closed.
  - Drawings shall not contain multiple overlaid lines or lines with multiple segments unless overlaid lines or adjacent line segments are assigned to different layers.
  - Drawings shall be purged of empty, unused, or non-essential drawing data.
  - PLINES should be used where appropriate instead of LINES.
  - All drawings will be developed in full scale format (one foot = one foot).
  - Entity colors shall be defined “by layer.”
  - Blocks shall be created on layer 0. Use 1:1 scale to create blocks and insert at the appropriate scale.
  - Attributes shall be defined on layer 0 (zero).
  - AIA CAD Layering Guidelines are required.
  - Only native AutoCAD fonts, line types, and hatch pattern shall be used.

The deliverable package shall comply with the following requirements:

- Submitted on CD or DVD labeled with project name, project number, drawings included, date, company name, contact name and telephone number.
- Zipped files are not to be used in any part of the submittal.

- All XREFs shall be included in the submittal package. XREFs shall be inserted on a collection of XREF designated layers and should be included in the same directory as the referencing file or if file folders are used, they shall be constructed with relative paths

  (i.e..\..\XREFname) in lieu of hardcoded letter drives and paths. (Do not use C:\myXREFs\XREFname). Do not bind or insert XREFS into drawings.

- All font files and line types shall be included in the submittal package. The consultant is responsible for transfer of license for any purchased line types or fonts.

- The NCS 5.0.ctb color table is to be used for all plotting.

- Metadata shall also include project information, dates and contact information. Metadata shall be provided to allow District to understand the CAD standards used. The metadata should describe each drawing, how it is referenced by other drawings, the layering standards used, block names and meanings, and any other information which may assist the District in understanding the drawing set composition. If you have questions about electronic submittals, please contact the District CAD Administrator.

6.2 Delivery Media

Digital media shall be delivered according to Table 6-1.

Table 6-1. Delivery Media

Submittal	Media
Preliminary Design Report	DropBox
Design Submittal 1	DropBox
Design Submittal 2	DropBox
Design Submittal 3	DropBox
Final Design Submittal	DropBox
Conformed Drawings	DropBox
Record Drawings	DropBox and DVD or CD-ROM

When digital media are exchanged, an external label must contain, at a minimum, the following information:

- Project number.
- Project title.
- Submittal date.
- Sequence number (for multiple disks, etc.)

- A short description of contents.

In addition, a transmittal sheet must accompany the media containing, at a minimum, the following information:

- Information included on the external label of each DVD or CD-ROM.
- Total number of DVD or CD-ROMs being delivered.
- List of filenames and file descriptions on each DVD or CD-ROM.
- Instructions for restoring/transferring the files from the media.
- Format and version (e.g., Windows 7) of the operating system on which the media was created.
- Utility (command) used for writing the files to the disk.
- Certification that all delivery media is free of known viruses, including the name of the virus scanning software used and the date the virus scan was performed.

6.3 Data Format

All files necessary to produce the drawing set (base maps, project model files, etc.) are to be delivered in both native AutoCAD and/or Revit format and as Autodesk DWF/3D DWF files according the Engineering Design Guidelines and the Scope of Work.

6.3.1 CAD Files and Revit Model Files

All CAD files and Revit files shall be delivered in a format that is directly readable and compatible with the District's CAD environment, as described in Section 2.3, Uniform Drawing System, and without conversion. Before a file is placed on the delivery media, the following procedures must be performed:

- Remove all extraneous graphics outside the border area, and set the active parameters to a standard setting or those in the prototype file.
- Make sure all reference (external reference) files are attached with the appropriate project name variable and do not use device or directory specifications.
- Compress or purge all files using the appropriate utility. A digital media copy of the decompression utility should be provided with the deliverable media, if appropriate.
- Include all files, both graphic and non-graphic, required for the project (e.g., plot styles, color tables, pen tables, font libraries, tables, images, cell/block libraries, user command files, plot files, etc.)
- Make sure that all support files such as those listed above are in the same directory and references to those files do not include device or directory specifications.

- Include all standard sheets (i.e. abbreviation sheets, standard symbol sheets, etc.) necessary for a complete project set.

6.3.2 AutoCAD P&ID Files

All AutoCAD P&ID files shall be delivered in AutoCAD P&ID (current version). A copy of the reference project that the consultant has been using will also be requested as needed.

6.3.3 DWF Files

All DWF/3D DWF files shall be delivered in a format that is directly readable and compatible with the District's CAD environment, as described in Section 2.3, Uniform Drawing System, and without conversion. Before a file is placed on the delivery media, the following procedures must be performed:

- At the Final Design Submittal (BID Documents), verify that the appropriate construction drawings have been stamped and signed by a registered engineer for the respective disciplines in the State of California.
- Export each construction drawing including all standard sheets (i.e. abbreviation sheets, standard symbol sheets, etc.) necessary for a complete project set into individual sheets.
- Save all exported files as individual (*.dwf) files.
- View each (*.dwf) file and verify that the image is clear and readable.

6.4 Documentation

Unless otherwise specified in the project scope of work, the following media types will be submitted with the appropriate submittal as listed in Table 6-2.

Table 6-2. Documentation Submittals

Submittal		Half Size/Media	3D Model Files[(1)]	PDF[(2)]
Preliminary Design Report		Bond (11 X 17)	X	X
Design Submittal 1		Bond	X	X
Design Submittal 2		Bond	X	X
Design Submittal 3		Bond	X	X
Final Design Submittal		Bond	X	X
Conformed Drawings		--	X	X
Record Drawings[(3)]		--	X	X

(1) 3D Models include native files (.RVT) (refer to Table 2-1), Navisworks files (.MWD) (refer to section 5.8.4) and DWF/3D DWF(.dwf) files for construction services

(2) PDF Files shall be 11 x 17 (half size)

(3) The Consultant shall be responsible for preparing the record drawings from the approved field markup set for all drawings except the contractor generated drawings and the shop drawings in accordance with the requirements in this CAD/BIM Standards

Hardcopy media types must meet the following specifications:

- Bond is to be 20 lb. white.

- All record drawings must be reprinted on bond and contain a stamp indicating "Record Drawing." In addition, a note must be placed over the engineer's seal stating that "This drawing was originally approved for construction by [name of engineer] on [date] and sealed by [name of engineer] a licensed professional engineer in the State of California No. [License number]."

The Consultant shall also submit an electronic copy (see Table 6-1) of the record drawings to the District for review and approval. The acceptance of the record drawings shall be deemed a condition for completion of work.

7.0 Dropbox

The Design firm's selected user (designated as a **BIM Lead**) will have read/write access to the entire set of shared folders. The user is expected to publish their CAD/BIM work products into their Dropbox project.

Also required for each formal submittal, links will be properly published and notifications made to a standardized group.

8.0 Glossary

As-Built Model:	A Federated Model incorporating all construction phase modifications to an LOD 400 or better.
As-constructed:	A “record drawing” or a portion thereof provided by the contractor and field verified by Contract Documentation personnel at a given point in time (date shown), unless specified otherwise.
Attribute Value:	The alphanumeric information associated with an attribute tag.
Attribute:	An editable attribute value that is associated with an attribute tag that is embedded in a block.
BIM Execution Plans	The BEP defines the uses for BIM on a project along with a detailed process for executing BIM.
Bid Model:	The Federated Model established by the Designer as part of the Construction Documents.
BIMF:	BIM Files.
BIM:	Building Information Modeling. The process of generating and managing building data (geometry, dimensions, nomenclature, element specifications, material, equipment type, etc.) during a defined life cycle.
BIM Manager:	The individual responsible for managing the Designer’s modeling and coordination process, including managing the Designer’s BIM staff and all other aspects of the Designer’s BIM requirements.
Clash Detection:	Clash detection allows for the effective identification, inspection and reporting of interferences in a 3D project model in Navisworks
COBie:	Construction Operations Building Information Exchange. Collected data throughout the Designer’s project to include equipment lists, product data sheets, warranties, spare part lists, preventive maintenance schedules, and other pertinent information that the owner may require.
COBie Data:	Construction Operations Building Information Exchange
Collaboration Model:	The Federated Model used during the trade coordination phase. The model is comprised of design input from all major designers and integrated according to spatial relationships, design intent, and means and methods.
Co-Location:	The assembling of the entire BIM design and construction team in a single location to enable instant and direct communication and coordination. Co-Location of all team members provides the environment and opportunity to build trust among teammates, while efficiently designing the project. Project issues are transparent and solutions evolve in real time because everyone is working in the same physical space.
Consolidated model:	An assembled model containing all of the project models in one file.
DWG:	DWG ("drawing") is a binary file format used for storing two and three dimensional design data and metadata. It is the native format for several CAD packages.
Facility Model:	The 3D model that incorporates all major equipment and components that require service and maintenance.
Families:	A Revit family is a graphic representation of building objects and symbols
Family Parameters:	Are user-defined fields that you add to families. They are stored in the family file, and cannot be used in any other element or environment apart from the family it was created in.
Federated Model:	The Federated Model combines different modeled elements or assemblies through the process of linking files from their native platforms, maintaining their native properties. It is a virtual representation of the entire Design Project developed to a specified LOD. The Federated Model must consist of the primary disciplines for construction, for example, Civil, Architectural, Structural, Mechanical, Electrical, Fire Protection, and Special Equipment.
Fields:	Fields are “specialized text objects set up to display data that may change during the lifecycle of the drawing. When a Field is updated the latest value of the Field is displayed.

Geo-referencing:	A system that links information to a position on the earth's surface. That is, establishing its location in terms of map projections or coordinate systems.
IFC:	The Industry Foundations Classes is an open, neutral and standardized specification for Building Information Models.
Instance Parameters:	Are settings that control the appearance or behavior of an individual element in a project. The instance parameters and type parameters of an element combine to establish its element properties. Instance parameters can vary with the location of an element in a building or project.
Level 1 Designators:	Discipline Designator in a one letter identifier that defines "Agent Responsible"
Level 2 Designators:	One letter modifier of the Discipline Designator, an optional modifier as needed. These designators vary by discipline.
Level of Development (LOD):	Term, based on the AIA Document E 202 – 2008, used to describe the fullness and definitiveness of the Model; each Model can have a varying LOD depending on the phase of the Designer's life-cycle, and agreed utilization of the Model.
Linking Files:	A process to externally reference a native file into the Federated Model.
MasterFormat:	MasterFormat, a publication of CSI and CSC, is a master list of numbers and titles classified by work results. It is primarily used to organize project manuals and detailed cost information, and to relate drawing notations to specifications.
MEA:	Model Element Author. The primary party who will develop the content of a specific Model Element to the LOD listed for a particular phase of the Design Project.
MEL:	Mechanical Equipment List.
MEP:	Mechanical, Electrical, and Plumbing
MEPF:	Mechanical, Electrical, Plumbing, and Fire Protection systems.
Model:	The 3D virtual representation of the Design Project and its Objects. The Model is generally an assemblage of several Models produced by various disciplines, each of which is comprised of numerous smart Objects.
Model Element:	A portion of the BIM representing a component, system or assembly within a building or building site.
Native Model:	A Model created in a specific CAD platform, i.e., Revit.
NBIMS-US:	The National BIM Standard-United States provides consensus based standards through referencing existing standards, documenting information exchanges and delivering best business practices for the entire built environment.
NWC:	When you open a CAD file in Navisworks, by default, a corresponding cache file (NWC) is created, which contains all of the conversion details required by Navisworks. To open an NWC file, a Navisworks product is required, such as Review, Simulate, or Manage (not Freedom). Certain Applications, like Revit, will export the corresponding model to an NWC file.
NWD:	The published version of a Navisworks file with all loaded models and viewpoints saved to a single (NWD) file. This file type can be opened with any of the Navisworks products including Navisworks Freedom (the free viewer).
NWF:	Navisworks file where only a list with pointers to the files currently loaded is saved, along with the scene's environment, the current view, clash results, if available, and favorite viewpoints (including redlines and comments). To open an NWF file, a Navisworks product is required, such as Review, Simulate, or Manage (not Freedom), as well as access to the original CAD files.
Nomenclature:	A system of principles, procedures and terms related to assignment of a location, object or property.
OLE:	Object Linking and Embedding.
OmniClass:	The OmniClass Construction Classification System (known as OmniClass™ or OCCS) is a classification system for the construction industry. It incorporates other extant systems currently in use as the basis of many of its Tables – MasterFormat™ for work results and UniFormat for elements.
Owner Model:	The final Federated Model integrating the as-built model, collaboration model, and the facility model.

Parameters:	Is a setting that determines the appearance or behavior of an element, type, or view.
Project Parameters:	Are user-defined fields that you add to multiple categories of elements, sheets, or views in a project. These parameters are specific to the project and cannot be shared with other projects.
RDB Link:	Autodesk Revit DB Link allows you to maintain a relationship between a Revit project and a Microsoft Access, Microsoft Excel, or ODBC database. You can use Autodesk Revit DB Link to export Revit project data to the database, make changes to the data, and import it back into the project. The database displays Revit project information in a table view that you can edit before import.
Shared Parameters:	Are user-defined fields that you add to families or projects and then share with other families and projects. They are stored in a file independently of the family file or Revit project; this allows you to access the file from different families or projects. In addition, shared parameters can be used in tags for model elements, and they can display in schedules.
Sheet #:	This refers to text contained in the SHEET NUMBER area of the title block of a drawing, (In the drawing search form, this is a "Contains Field").
Sheet Sequence Number:	The sheet sequence number is a two-digit number that identifies each sheet in a series of the same discipline and sheet type. Sequence numbering starts with 01.
Sheet Set Manager:	Sheet Set Manager organizes your drawing layouts into named sheet sets. The sheets in a sheet set can be transmitted, published, and archived as a unit.
Sheet Type Designators:	The sheet type designator is a single numerical character that identifies the sheet type.
Sheet Files:	A file in which views of the model file(s), including visible edges and sections are attached.
Smart Object:	The term used to describe the 3D virtual representation of separate sub-parts of the Model such as doors, walls, equipment, etc.
SQL Server:	SQL Server is a relational database management system developed by Microsoft. As a database, it is a software product whose primary function is to store and retrieve data as requested by other software applications, be it those on the same computer or those running on another computer across a network (including the Internet).
SacSewer: District:	Sacramento Area Sewer District
EchoWater Facility: Plant:	EchoWater Resource Recovery Facility (916) 875-9000
Type Parameters:	Are settings that control the appearance or behavior of all elements of a particular family type. Type parameters are common to many elements in a family. A type parameter affects all instances (individual elements) of that family in the project and any future instances that you place in the project.
UniFormat:	UniFormat, a publication of CSI and CSC, is a method of arranging construction information based on functional elements, or parts of a facility characterized by their functions, without regard to the materials and methods used to accomplish them. These elements are often referred to as systems or assemblies.
User Coordinate System (UCS):	A user defined coordinate system that defines the orientation of the X,Y, and Z axes in three-dimensional space. The UCS determines the default placement of geometry in a drawing.
Version control:	To ensure that only one copy of any document is available within the system
View:	A graphical representation of a 2D drawing or 3D model from a specific location (viewpoint) in space.

Appendix A

CAD/BIM Designer Files

The Designer files consist of information and templates common to all design projects that available on behalf of the District, as described in the individual project RFPs. The available information will include:

Content developed for projects:

1) AutoCAD and Revit
    a) Revit Family Classes
    b) Revit Project Template
    c) P&ID Project Template
    d) Civil 3D Templates
2) Maximo Asset Metadata and Asset Attributes spreadsheets
3) District CAD/BIM Standards
4) District Standard Drawings
    a) General Common Contract Drawings
    b) P&ID Common Contract Drawings (posted in the P&ID Template)
5) District Typical Details (Revit files and pdfs are posted)

Appendix B

Civil 3D Model Utility Data Use and Acceptance Agreement

AutoCAD Civil 3D MODEL UTILITY DATA USE AND ACCEPTANCE AGREEMENT DISCLAIMER:

Important Note:
Upon receipt and the inclusion of the EchoWater Resource Recovery Facility (EchoWater Facility) master utility pipe networks into a SacSewer project you have implied consent that you have read, understand and acknowledge the information provided herein and that you accept this agreement disclaimer for use of associated data.

No liability, either expressed or implied, for the accuracy of the data delineated herein is assumed by SacSewer or their designated representatives. The EchoWater Facility master utility pipe networks and data available are provided "as is" without any warranty or any representation of accuracy, timeliness, or completeness.

Project Area Utilities

The existing EchoWater Facility master utility pipe networks are provided for use in SacSewer projects. In most instances, it does not represent an on-the-ground survey and represents only the approximate relative location of the utility piping. These utility pipe networks were generated from the most current available record documents. Some utilities will need to be field verified including some form of potholing or field verification for a more accurate location and depth. In instances where no pipe elevations are known, the pipe elevations are set to the elevation 0.0. This will be a "flag" to indicate that additional field verification is required for said utility.

Elevations for the existing EchoWater Facility master utility pipe networks represent mean sea level plus 100 feet in accordance with EchoWater Facility survey coordinate system. The existing EchoWater Facility master utility pipe networks are delineated by using a EchoWater Facility plant wide grid system. The Plantwide Utilities 2D CAD file covers the entire grid.

The EchoWater Faciltiy plant wide grid system is attached to this agreement as a pdf.

The use and care of the existing EchoWater Facility Master Plant-wide 2D utilities:

This is the original utility data provided by SacSewer. Note that dashed lines represent either design or construction document data; solid lines represent areas where SacSewer had or obtained a field survey. Make modifications to the 2D file as follows:

1) Create a new 2D utility drawing by copying and renaming the original drawing and adding a prefix to include the "year" and a suffix to include the "project ID and phase" (Project ID and Phases are listed at the end of this document)

   Example: **2021_SRCSD_SRWTP_Plantwide Utilities_HWPS-PC.dwg**

2) Provide a summary table of ALL revisions including a site map identifying location of the potholes and a brief explanation of pothole findings.

The use and care of the existing EchoWater Facility master utility pipe networks:

SacSewer is providing the plant wide utilities for the projects in AutoCAD Civil 3D. The master utilities files are created by individual utility service. Each utility is created using pipe networks in AutoCAD Civil 3D.

Prior to creating a new pipe network for an existing utility, create a reference to the existing EchoWater Facility Master Utility Pipe Network in a data shortcut.

Utility Pipe Network collaboration workflow between designers

1) Each SacSewer utility network is its own drawing file.
2) Reference in the SacSewer utility network utility drawing that requires modifications or a connection to your project.
3) Create a new network utility drawing. The drawings shall be named as follows:
    a. Utility Name (see List of Pipe Network Utilities - below)
    b. Project Name
4) Copy or Create a new utility pipe network in the new drawing. The pipe network shall be named as follows:
    a. Utility Name (see List of Pipe Network Utilities - below)
    b. Project Name (Project name abbreviations)
    c. Design Submittal(see List of Design Submittal Abbreviations - below)

    Example for the Harvest Water Pump Station Project (HWPS):
    Reclaimed Water Filtered-HWPS-DS2

Utility Pipe Network Update and Submittal Procedures

To better assist the coordination and utility drawing update, the designers will update and submit the Utility Pipe Networks at each design submittal (Unless stated or agreed to otherwise).

If there is an adjustment to the existing EchoWater Facility master utility pipe networks that affects ongoing projects, the designer will receive an update of that service Utility Pipe Network.

List of Pipe Network Utilities

	Pipe Abbreviation	Pipe Network Name
1	CAA	Channel Aeration Air
2	CD	Chemical Drain
3	CLS	Chlorine Solution
4	CSO	Caustic Soda
5	CWR-CWS	Chilled Water Return and Supply
6	DRAIN	Drain
7	Ductbank	Ductbank
8	DS	Digested Sludge
9	ELEC	Electrical
10	FE	Final Effluent
11	HPNG	High Pressure Natural Gas
12	HS	Harvested Sludge
13	IRR	Irrigation
14	MSG	Medium Pressure Sludge Gas
15	NG	Natural Gas
16	OF	Overflow
17	OHP	Oxygen High Pressure
18	PE	Primary Effluent
19	Power	Power
20	RAS	Return Activated Sludge
21	RS	Raw Sewage
22	SD	Sanitary Drain
23	SE	Secondary Effluent
24	SN	Supernatant
25	SOV	Sulfur Dioxide Vacuum
26	STD	Storm Drain
27	TD	Tank Drain
28	WFP	Fire Protection Water
29	WN	Non-Potable Water
30	WNM	Non-Potable Water Monitoring
31	WP	Potable Water
32	WRF	Reclaimed Water Filtered
33	WRH	Reclaimed Water High Pressure
34	WRL	Reclaimed Water Low Pressure

List of Design Submittal Abbreviations

Design Phase:

PC Pothole Confirmation
PDR Preliminary Design Report
DS1 Design Submittal 1
DS2 Design Submittal 2
DS3 Design Submittal 3

Bid and Award Phase:

BID Bid Set

Construction Phase:

CNF Conformed Drawings
REC Record Drawings

Appendix C

Drawing Set Discipline Designators

Module 1 - Drawing Set Organization
1.6 Appendix A - Discipline Designators
The following schedule illustrates discipline designators and the order in which they shall appear when used:

Designator		Description of	Content
Level 1	Level 2	Suggested Names	
G	**-**	**General**	**All or any portion of subjects included in Level 2**
-	GC	General Contract	Phasing, schedules, contractor staging areas, fencing, haul routes, erosion control, temporary and special requirements
-	GI	General Information	List of sheets and symbols, code summary, symbol legend, orientation maps
-	GR	General Resource	Photographs, soil borings
-	GJ		User Defined
-	GK		User Defined
C	**-**	**Civil**	**All or any portion of subjects included in Level 2**
-	CD	Civil Demolition	Structure removal and site clearing
-	CG	Civil Grading	Excavation, grading, drainage, erosion control
-	CI	Civil Improvements	Pavers, flagstone, exterior tile, furnishings, retaining walls, and water features
-	CN	Civil Nodes	
-	CP	Civil Paving	Roads, driveways, parking lots
-	CS	Civil Site	Plats, dimension control
-	CT	Civil Transportation	Waterways, wharves, docks, trams, railways, people movers
-	CU	Civil Utilities	Water, sanitary sewer, storm sewer, power, communications, fiber optic, telephone, cable television, natural gas, and steam systems
-	CJ		User Defined
-	CK		User Defined
L	**-**	**Landscape**	**All or any portion of subjects included in Level 2**
-	LD	Landscape Demolition	Demolition, relocation, and salvage information
-	LG	Landscape Grading	Proposed contours and spot grades
-	LI	Landscape Irrigation	Mainlines, valves, controllers, pumps, etc
-	LL	Landscape Lighting	
-	LP	Landscape Planting	Landscape Planting
-	LR	Landscape Relocation	Vegetation relocation information
-	LS	Landscape Site	All site hardscape and call-outs
-	LJ		User Defined
-	LK		User Defined
S	**-**	**Structural**	**All or any portion of subjects included in Level 2**
-	SB	Structural Substructure	Foundations, piers, slabs, and retaining walls
-	SD	Structural Demolition	Protection and removal
-	SF	Structural Framing	Floors and roofs
-	SS	Structural Site	
-	SJ		User Defined
-	SK		User Defined
A	**-**	**Architectural**	**All or any portion of subjects included in Level 2**
-	AD	Architectural Demolition	Protection and removal
-	AE	Architectural Elements	General Architectural
-	AF	Architectural Finishes	
-	AG	Architectural Graphics	
-	AI	Architectural Interiors	
-	AS	Architectural Site	
-	AJ		User Defined
-	AK		User Defined
F	**-**	**Fire Protection**	**All or any portion of subjects included in Level 2**
-	FA	Fire Protection Detection and Alarm	
-	FX	Fire Protection Suppression	Fire extinguishing systems and equipment
-	FJ		User Defined
-	FK		User Defined
P	**-**	**Plumbing**	**All or any portion of subjects included in Level 2**
-	PD	Plumbing Demolition	Protection, termination, and removal.
-	PL	Plumbing	Domestic water, sanitary and storm drainage, fixtures
-	PP	Plumbing Piping	Piping, valves and insulation
-	PQ	Plumbing Equipment	Pumps and tanks
-	PS	Plumbing Site	Extension and connections to Civil Utilities
-	PJ		User Defined
-	PK		User Defined
D	**-**	**Process**	**All or any portion of subjects included in Level 2**
-	DA	Process Airs	Piping, valves, system components, equipment
-	DC	Process Chemicals	Piping, valves, system components, equipment
-	DD	Process Demolition	Protection, termination and removal
-	DE	Process Electrical	Electrical exclusively associated with a process and not the facility
-	DG	Process Gases	Gaseous process systems
-	***DI***	***NOT USED***	***Instrumentation, measurement, recorders, devices and controllers (electrical and mechanical)***
-	DL	Process Liquids	Liquid process systems
-	DM	Process HPM Gases	Piping, valves, system components, equipment
-	DO	Process Oil	Piping, valves, system components, equipment
-	***DP***	***Process Piping***	***Piping, valves, insulation, tanks, pumps, etc.***
-	DQ	Process Equipment	Systems and equipment for thermal, electrical, materials handling, assembly and manufacturing, nuclear, power generation, chemical, refrigeration, and industrial processes
-	DR	Process Drains and Reclaims	Piping, valves, system components, equipment
-	DS	Process Site	Extension and connection to civil utilities
-	DV	Process Vacuum	Piping, valves, system components, equipment
-	DW	Process Waters	Piping, valves, system components, equipment
-	DX	Process Exhaust	Ducting, piping, valves, system components, equipment
-	DY	Process Slurry	Piping, valves, system components, equipment
-	DJ		User Defined
-	DK		User Defined
M	**-**	**Mechanical**	**All or any portion of subjects included in Level 2**
-	MD	Mechanical Demolition	Protection, termination, and removal
-	MH	Mechanical HVAC	Ductwork, air devices, and equipment
-	MI	Mechanical Instrumentation	Instrumentation and controls
-	MP	Mechanical Piping	Chilled and heating water, steam
-	MS	Mechanical Site	Utility tunnels and piping between facilities
-	MJ		User Defined
-	MK		User Defined
E	**-**	**Electrical**	**All or any portion of subjects included in Level 2**
-	ED	Electrical Demolition	Protection, termination, and removal

Module 1 - Drawing Set Organization
1.6 Appendix A - Discipline Designators
The following schedule illustrates discipline designators and the order in which they shall appear when used:

Designator		Description of	Content
Level 1	Level 2	Suggested Names	
-	EI	Electrical Instrumentation	Controls, relays, instrumentation, and measurement devices
-	EL	Electrical Lighting	
-	EP	Electrical Power	
-	ES	Electrical Site	Utility tunnels, site lighting
-	ET	Electrical Telecommunications	Telephone, network, voice and data cables
-	EY	Electrical Auxiliary Systems	Alarms, nurse call, security, CCTV, PA, music, clock, and program
-	EJ		User Defined
-	EK		User Defined
T	**-**	**Telecommunications**	**All or any portion of subjects included in Level 2**
-	TA	Telecommunications Audio Visual	Cable, music, and CCTV systems
-	TC	Telecommunications Clock and Program	Time generators and bell program systems
-	TI	Telecommunications Intercom	Intercom and public address systems
-	TM	Telecommunications Monitoring	Monitoring and alarm systems
-	TN	Telecommunications Data Networks	Network cabling and equipment
-	TT	Telecommunications Telephone	Telephone systems, wiring, and equipment
-	TY	Telecommunications Security	Access control and alarm systems
-	TJ		User Defined
-	TK		User Defined
R	**-**	**Resource**	**Data furnished without warrant as to accuracy**
-	RA	Resource Architectural	Existing facility architectural drawings
-	RC	Resource Civil	Surveyor's information and existing civil drawings
-	RE	Resource Electrical	Existing facility electrical drawings
-	RM	Resource Mechanical	Existing facility mechanical drawings
-	RR	Resource Real Estate	Real Estate Drawings
-	RS	Resource Structural	Existing facility structural drawings
-	RJ		User Defined
-	RK		User Defined
X	**-**	***Instrumentation and Controls/Process Instrumentation***	**All *Instrumentation, measurement, recorders, devices and controllers (electrical and mechanical)* or any portion of subjects included in Level 2**
-	XJ		User Defined
-	XK		User Defined

Appendix D

File Naming Format

Revit and CAD Model File Naming Format

Contract No	Level 1 Discipline	Level 2 Discipline	Model Type	Plant Zone No	Facility Description	Submittal Type*

EXAMPLE: 4207-MH-3D-61DOB-PDR*.rvt

CAD Sheet File Naming Format

Contract No	Plant Zone No	Level 1 Discipline	Level 2 Discipline	Sheet Type	Facility Code	Sequential No

EXAMPLE: 4207-61MH-121.dwg

Drawing Number Format

	Plant Zone No	Level 1 Discipline	Level 2 Discipline	Sheet Type	Facility Code	Sequential No

EXAMPLE: 61MH121

Level 1 Discipline Codes

G	General
C	Civil
S	Structural
A	Architectural
F	Fire Protection
P	Plumbing
D	Process Mechanical & P&ID
M	Mechanical
E	Electrical
X	Instrumentation & Controls

Level 2 Discipline Codes

M	**Mechanical**	
MD	Mechanical Demolition	Protection, Termination, and Removal
MH	Mechanical HVAC	Ductwork, Air Devices, and Equipment
MP	Mechanical Piping	Chilled and heated water, steam
MS	Mechanical Site	Utility tunnels and Piping Between Facilities

Plant Zone Codes

0	General
61	Disinfection Chemical System
94	Dechlorination Chemical System

Facility Code

0	ALL	Applies to all facilities
1	DOB	Disinfection Operations Building
3	DCSA	Disinfection Chemical Storage Area
1	DCCA	Dechlorination Chemical Storage Area

Model Type Codes

FP	Floor Plan or Plan View
SP	Site Plan
DP	Demolition Plan
QP	Equipment Plan
XP	Existing Plan
EL	Elevation
SC	Section
DT	Detail
SH	Schedules
3D	3D Models
DG	Diagrams and Schematics

Sheet Type Codes

0	General (Symbols, Legends, Notes, etc.)
1	Plans (Horizontal Views)
2	Elevations (Vertical Views)
3	Sections (Sectional Views, Wall Sections)
4	Large-Scale Views (Partial Plans, Elevations, Stair Sections, or Sections That Are Not Details)
5	Details (Plans, Elevations, or Sections)
6	Schedules and Diagrams
7	User Defined
8	User Defined
9	3D Model Views (Orthographic or Perspective Views of Model Elements)

Submittal Type Codes*

	Design Phase
PDR	Preliminary Design Report
DS1	Design Submittal 1
DS2	Design Submittal 2
DS3	Design Submittal 3
	BID and Award Phase
BID	BID Set Drawings
	Construction Phase
CNF	Conformed Drawings
REC	Record Drawings

***Note:** The designer will be responsible for adding the Submittal Type Code to the file name prior to submittal to the district. The project folder should be copied from the Current Design folder to a Design Phase folder before adding the Submittal Code to the file name. The Designer is not responsible for reestablishing broken external references or model links.

Appendix E

Drawing Set Organization

Cover Sheet

Signature Sheet

Index of Drawings Sheets

General

- Location and Area Plans
- Existing Overall Site Plan
- Abbreviations
- Symbols
- Survey Monument Data
- Biological Resources
- Contractor Laydown Areas
- Soil Stockpile Areas
- Access Plans
- Special items
- General Notes
- Process Flow Schematics
- Hydraulic Profiles

Civil

- Symbols
- Abbreviations
- Notes
- Code Analysis
- Standard Details
- Overall Site Plans
- Line and Curve Tables
- Project Tables (Private Property constraints, potholing, utility elevations, field inspections, culvert information, and comprehensive utility contacts, etc.)
- Plans
- Plan and Profiles
- Sections
- Details
- Traffic Control plans
- Erosions Control Plans

Structural

- Symbols
- Abbreviations
- Notes
- Code Analysis
- Standard Details
- Schedules
- Plans
- Sections
- Details

Architectural

- Symbols
- Abbreviations
- Notes
- Code Analysis
- Standard Details
- Schedules
- Plans
- Sections
- Details

Mechanical Process

- Symbols
- Abbreviations
- Standard Details
- Plans
- Sections
- Details
- Corrosion control plans

Plumbing

- Symbols
- Abbreviations
- Standard Details
- Plans
- Sections
- Details

Building Mechanical

- Symbols
- Abbreviations
- Standard Details
- Plans
- Sections
- Details

Electrical

- Symbols
- Abbreviations
- Standard Details
- Standard Elementary Diagrams
- 12Kv Distribution Single Line Diagrams
- Site Plans
- MH/HH Schedules
- Duct Bank Profiles
- Duct Bank, Manhole, Handhole Sections
- 480V Single Line Diagrams
- SWR/MCC Elevations & Schedules
- Penelboard Schedules
- Electrical Building Power and Control Plans
- Grounding Plans
- Instrumentation and Communication Plans
- Lighting and Receptacle Plans

Process and Instrumentation Diagrams

- Symbols
- Abbreviations
- Standard Details
- Diagrams

Control and Instrumentation

- Symbols
- Abbreviations
- Standard Details
- Control and Logic Diagrams
- Process and Instrumentation Diagrams
- Cabinets and Panels
- Miscellaneous Hardware Details

- Miscellaneous Systems
- Example Diagrams

Note:
SacSewer Standard details and Designer standard details follow the Common Symbols and abbreviations for each discipline.

Appendix F

Pen Weights

NCS.CTB -- Pen Table

SOLID LINEWEIGHTS

PEN	LINEWEIGHT
1	0.007 in
2	0.010 in
3	0.014 in
4	0.020 in
5	0.028 in
6	0.039 in
7	By Object
8	0.055 in
9	0.079 in
10	0.007 in
11	0.010 in
12	0.014 in
13	0.020 in
14	0.028 in
15	0.039 in
16	0.055 in
17	0.028 in
18	0.014 in
19	0.079 in
20	0.007 in
21	0.010 in
22	0.014 in
23	0.020 in
24	0.028 in
25	0.039 in
26	0.055 in
27	0.028 in
28	0.014 in
29	0.079 in
30	0.007 in
31	0.010 in
32	0.014 in
33	0.020 in
34	0.028 in
35	0.039 in
36	0.055 in
37	0.028 in
38	0.014 in
39	0.079 in
40	0.007 in
41	0.010 in
42	0.014 in
43	0.020 in
44	0.028 in
45	0.039 in
46	0.055 in
47	0.028 in
48	0.014 in
49	0.079 in
50	0.007 in
51	0.010 in
52	0.014 in
53	0.020 in
54	0.028 in
55	0.039 in
56	0.055 in
57	0.028 in
58	0.014 in
59	0.079 in
60	0.007 in
61	0.010 in
62	0.014 in
63	0.020 in
64	0.028 in
65	0.039 in
66	0.055 in
67	0.028 in
68	0.014 in
69	0.079 in
70	0.007 in
71	0.010 in
72	0.014 in
73	0.020 in
74	0.028 in
75	0.039 in
76	0.055 in
77	0.028 in
78	0.014 in
79	0.079 in
80	0.007 in
81	0.010 in
82	0.014 in
83	0.020 in
84	0.028 in
85	0.039 in
86	0.055 in
87	0.028 in
88	0.014 in
89	0.079 in
90	0.007 in
91	0.010 in
92	0.014 in
93	0.020 in
94	0.028 in
95	0.039 in
96	0.055 in
97	0.028 in
98	0.014 in
99	0.079 in
100	0.007 in
101	0.010 in
102	0.014 in
103	0.020 in
104	0.028 in
105	0.039 in
106	0.055 in
107	0.028 in
108	0.014 in
109	0.079 in
110	0.007 in
111	0.010 in
112	0.014 in
113	0.020 in
114	0.028 in
115	0.039 in
116	0.055 in
117	0.028 in
118	0.014 in
119	0.079 in
120	0.007 in
121	0.010 in
122	0.014 in
123	0.020 in
124	0.028 in
125	0.039 in
126	0.055 in
127	0.028 in
128	0.014 in
129	0.079 in
130	0.007 in
131	0.010 in
132	0.014 in
133	0.020 in
134	0.028 in
135	0.039 in
136	0.055 in
137	0.028 in
138	0.014 in
139	0.079 in
140	0.007 in
141	0.010 in
142	0.014 in
143	0.020 in
144	0.028 in
145	0.039 in
146	0.055 in
147	0.028 in
148	0.014 in
149	0.079 in
150	0.007 in
151	0.010 in
152	0.014 in
153	0.020 in
154	0.028 in
155	0.039 in
156	0.055 in
157	0.028 in
158	0.014 in
159	0.079 in
160	0.007 in
161	0.010 in
162	0.014 in
163	0.020 in
164	0.028 in
165	0.039 in
166	0.055 in
167	0.028 in
168	0.014 in
169	0.079 in
170	0.007 in
171	0.010 in
172	0.014 in
173	0.020 in
174	0.028 in
175	0.039 in
176	0.055 in
177	0.028 in
178	0.014 in
179	0.079 in
180	0.007 in
181	0.010 in
182	0.014 in
183	0.020 in
184	0.028 in
185	0.039 in
186	0.055 in
187	0.028 in
188	0.014 in
189	0.079 in
190	0.007 in
191	0.010 in
192	0.014 in
193	0.020 in
194	0.028 in
195	0.039 in
196	0.055 in
197	0.028 in
198	0.014 in
199	0.079 in
200	0.007 in
201	0.010 in
202	0.014 in
203	0.020 in
204	0.028 in
205	0.039 in
206	0.055 in
207	0.028 in
208	0.014 in
209	0.079 in
210	0.007 in
211	0.010 in
212	0.014 in
213	0.020 in
214	0.028 in
215	0.039 in
216	0.055 in
217	0.028 in
218	0.014 in
219	0.079 in
220	0.007 in
221	0.010 in
222	0.014 in
223	0.020 in
224	0.028 in
225	0.039 in
226	0.055 in
227	0.028 in
228	0.014 in
229	0.079 in
230	0.007 in
231	0.010 in
232	0.014 in
233	0.020 in
234	0.028 in
235	0.039 in
236	0.055 in
237	0.028 in
238	0.014 in
239	0.079 in
240	0.007 in
241	0.010 in
242	0.014 in
243	0.020 in
244	0.028 in
245	0.039 in
246	0.055 in
247	0.028 in
248	0.014 in
249	0.079 in

SCREEN LINEWEIGHTS

PEN	LINEWEIGHT	
250	0.010 in	60%
251	0.014 in	50%
252	0.020 in	40%
253	0.028 in	30%
254	0.039 in	20%
255	0.079 in	non plotting

Filename: PenSettings Date: 2/10/2014 User: Greg
Path: F:_EchoWater\EchoWater Plot Cfgs

SACRAMENTO AREA SEWER DISTRICT
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NCS.CTB -- Pen Table

SOLID LINEWEIGHTS

PEN	LINEWEIGHT
1	0.180 mm
2	0.250 mm
3	0.350 mm
4	0.500 mm
5	0.700 mm
6	1.000 mm
7	By Object
8	1.400 mm
9	2.000 mm
10	0.180 mm
11	0.250 mm
12	0.350 mm
13	0.500 mm
14	0.700 mm
15	1.000 mm
16	1.400 mm
17	0.700 mm
18	0.350 mm
19	2.000 mm
20	0.180 mm
21	0.250 mm
22	0.350 mm
23	0.500 mm
24	0.700 mm
25	1.000 mm
26	1.400 mm
27	0.700 mm
28	0.350 mm
29	2.000 mm
30	0.180 mm
31	0.250 mm
32	0.350 mm
33	0.500 mm
34	0.700 mm
35	1.000 mm
36	1.400 mm
37	0.700 mm
38	0.350 mm
39	2.000 mm
40	0.180 mm
41	0.250 mm
42	0.350 mm
43	0.500 mm
44	0.700 mm
45	1.000 mm
46	1.400 mm
47	0.700 mm
48	0.350 mm
49	2.000 mm
50	0.180 mm
51	0.250 mm
52	0.350 mm
53	0.500 mm
54	0.700 mm
55	1.000 mm
56	1.400 mm
57	0.700 mm
58	0.350 mm
59	2.000 mm
60	0.180 mm
61	0.250 mm
62	0.350 mm
63	0.500 mm
64	0.700 mm
65	1.000 mm
66	1.400 mm
67	0.700 mm
68	0.350 mm
69	2.000 mm
70	0.180 mm
71	0.250 mm
72	0.350 mm
73	0.500 mm
74	0.700 mm
75	1.000 mm
76	1.400 mm
77	0.700 mm
78	0.350 mm
79	2.000 mm
80	0.180 mm
81	0.250 mm
82	0.350 mm
83	0.500 mm
84	0.700 mm
85	1.000 mm
86	1.400 mm
87	0.700 mm
88	0.350 mm
89	2.000 mm
90	0.180 mm
91	0.250 mm
92	0.350 mm
93	0.500 mm
94	0.700 mm
95	1.000 mm
96	1.400 mm
97	0.700 mm
98	0.350 mm
99	2.000 mm
100	0.180 mm
101	0.250 mm
102	0.350 mm
103	0.500 mm
104	0.700 mm
105	1.000 mm
106	1.400 mm
107	0.700 mm
108	0.350 mm
109	2.000 mm
110	0.180 mm
111	0.250 mm
112	0.350 mm
113	0.500 mm
114	0.700 mm
115	1.000 mm
116	1.400 mm
117	0.700 mm
118	0.350 mm
119	2.000 mm
120	0.180 mm
121	0.250 mm
122	0.350 mm
123	0.500 mm
124	0.700 mm
125	1.000 mm
126	1.400 mm
127	0.700 mm
128	0.350 mm
129	2.000 mm
130	0.180 mm
131	0.250 mm
132	0.350 mm
133	0.500 mm
134	0.700 mm
135	1.000 mm
136	1.400 mm
137	0.700 mm
138	0.350 mm
139	2.000 mm
140	0.180 mm
141	0.250 mm
142	0.350 mm
143	0.500 mm
144	0.700 mm
145	1.000 mm
146	1.400 mm
147	0.700 mm
148	0.350 mm
149	2.000 mm
150	0.180 mm
151	0.250 mm
152	0.350 mm
153	0.500 mm
154	0.700 mm
155	1.000 mm
156	1.400 mm
157	0.700 mm
158	0.350 mm
159	2.000 mm
160	0.180 mm
161	0.250 mm
162	0.350 mm
163	0.500 mm
164	0.700 mm
165	1.000 mm
166	1.400 mm
167	0.700 mm
168	0.350 mm
169	2.000 mm
170	0.180 mm
171	0.250 mm
172	0.350 mm
173	0.500 mm
174	0.700 mm
175	1.000 mm
176	1.400 mm
177	0.700 mm
178	0.350 mm
179	2.000 mm
180	0.180 mm
181	0.250 mm
182	0.350 mm
183	0.500 mm
184	0.700 mm
185	1.000 mm
186	1.400 mm
187	0.700 mm
188	0.350 mm
189	2.000 mm
190	0.180 mm
191	0.250 mm
192	0.350 mm
193	0.500 mm
194	0.700 mm
195	1.000 mm
196	1.400 mm
197	0.700 mm
198	0.350 mm
199	2.000 mm
200	0.180 mm
201	0.250 mm
202	0.350 mm
203	0.500 mm
204	0.700 mm
205	1.000 mm
206	1.400 mm
207	0.700 mm
208	0.350 mm
209	2.000 mm
210	0.180 mm
211	0.250 mm
212	0.350 mm
213	0.500 mm
214	0.700 mm
215	1.000 mm
216	1.400 mm
217	0.700 mm
218	0.350 mm
219	2.000 mm
220	0.180 mm
221	0.250 mm
222	0.350 mm
223	0.500 mm
224	0.700 mm
225	1.000 mm
226	1.400 mm
227	0.700 mm
228	0.350 mm
229	2.000 mm
230	0.180 mm
231	0.250 mm
232	0.350 mm
233	0.500 mm
234	0.700 mm
235	1.000 mm
236	1.400 mm
237	0.700 mm
238	0.350 mm
239	2.000 mm
240	0.180 mm
241	0.250 mm
242	0.350 mm
243	0.500 mm
244	0.700 mm
245	1.000 mm
246	1.400 mm
247	0.700 mm
248	0.350 mm
249	2.000 mm

SCREEN LINEWEIGHTS

PEN	LINEWEIGHT	
250	0.250 mm	60%
251	0.350 mm	50%
252	0.500 mm	40%
253	0.700 mm	30%
254	1.000 mm	20%
255	2.000 mm	non plotting

Filename: PenSettings Date: 2/10/2014 User: Greg
Path: F:_EchoWater\EchoWater Plot Cfgs

SACRAMENTO AREA SEWER DISTRICT
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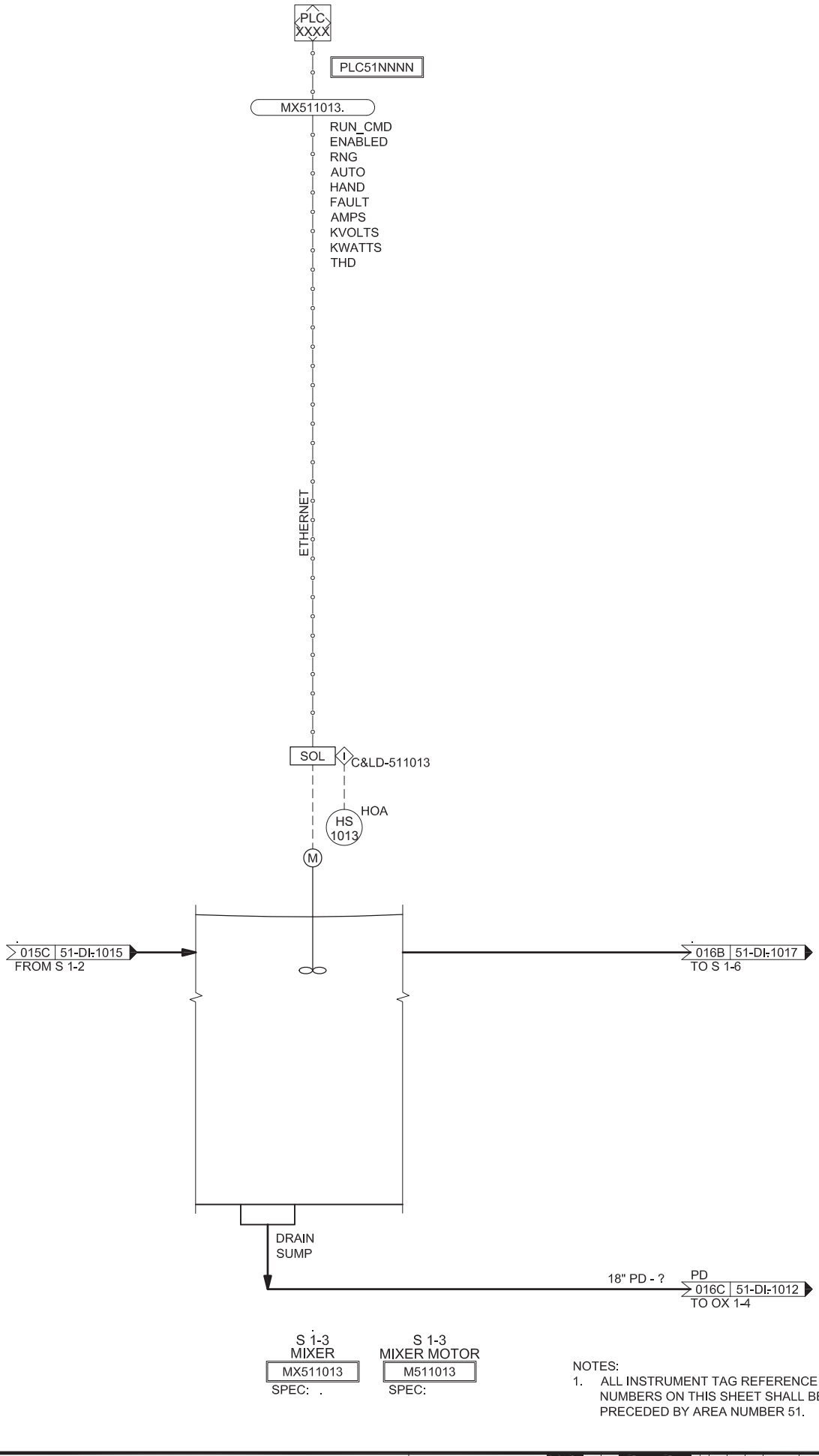
Appendix G

Example P&IDs



NOTES:
1. ALL INSTRUMENT TAG REFERENCE NUMBERS ON THIS SHEET SHALL BE PRECEDED BY AREA NUMBER 51.

DESIGNER NOTES:

SACRAMENTO AREA SEWER DISTRICT
SERVING YOU 24/7

SAMPLE

PROCESS AND INSTRUMENTATION DIAGRAM

MARK	DATE	DESCRIPTION
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.	.	.
.	.	.
.	.	.
.	.	.

ISSUE BLOCK

DESIGNED	D. WHITE
DRAWN	PMO CAD
CHECKED	D. GOTT
APPROVED	D. WHITE
FILENAME	4208-51-DI-1016-PMO.DWG
DESIGNER PROJECT NUMBER	NNNNNNN
CONTRACT NUMBER	NNNN
ZONE NUMBER	NN
DISCIPLINE	PROCESS AND INSTRUMENTATION

EXAMPLE CONSTANT SPEED MOTOR 1

DRAWING NUMBER **X-601**

1 OF 8

SCALE IN INCHES 0 1/2 1 2 4 (IF SCALE BAR IS NOT 4", SCALE ACCORDINGLY)

Sheet Set Manager:
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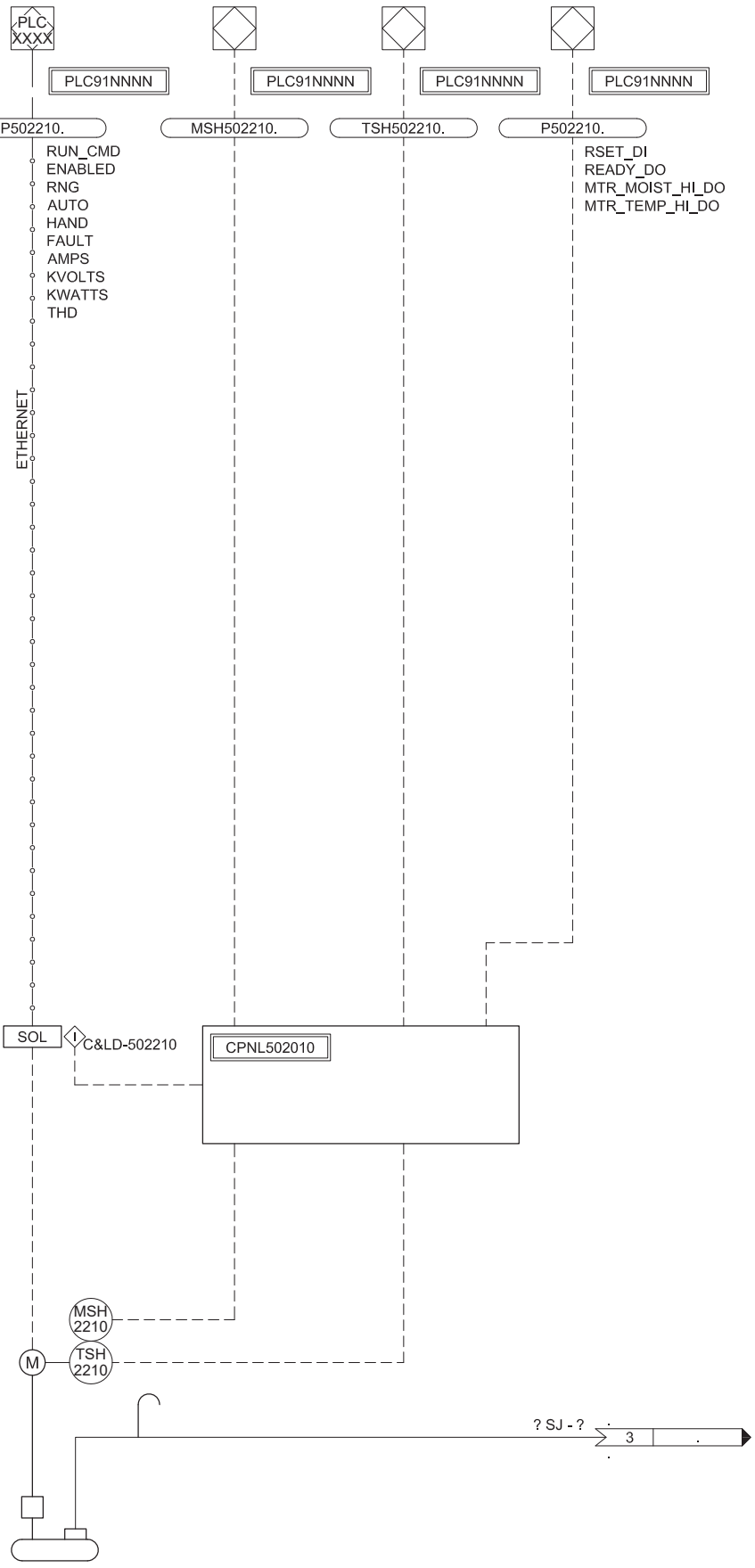

NOTES:
1. ALL INSTRUMENT TAG REFERENCE NUMBERS ON THIS SHEET SHALL BE PRECEDED BY AREA NUMBER 50.

DESIGNER NOTES:

SACRAMENTO AREA SEWER DISTRICT
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SAMPLE

PROCESS AND INSTRUMENTATION DIAGRAM

MARK	DATE	DESCRIPTION

ISSUE BLOCK

DESIGNED	D.WHITE
DRAWN	PMO CAD
CHECKED	D. GOTT
APPROVED	D.WHITE
FILENAME	4208-50D-6011-PMO.DWG
DESIGNER PROJECT NUMBER	NNNNNNN
CONTRACT NUMBER	NNNN
ZONE NUMBER	NN
DISCIPLINE	PROCESS AND INSTRUMENTATION

EXAMPLE CONTANT SPEED MOTOR 2

DRAWING NUMBER **X-602**

2 OF 8

SCALE IN INCHES 0 1/2 1 2

(IF SCALE BAR IS NOT 4", SCALE ACCORDINGLY)

Sheet Set Manager:
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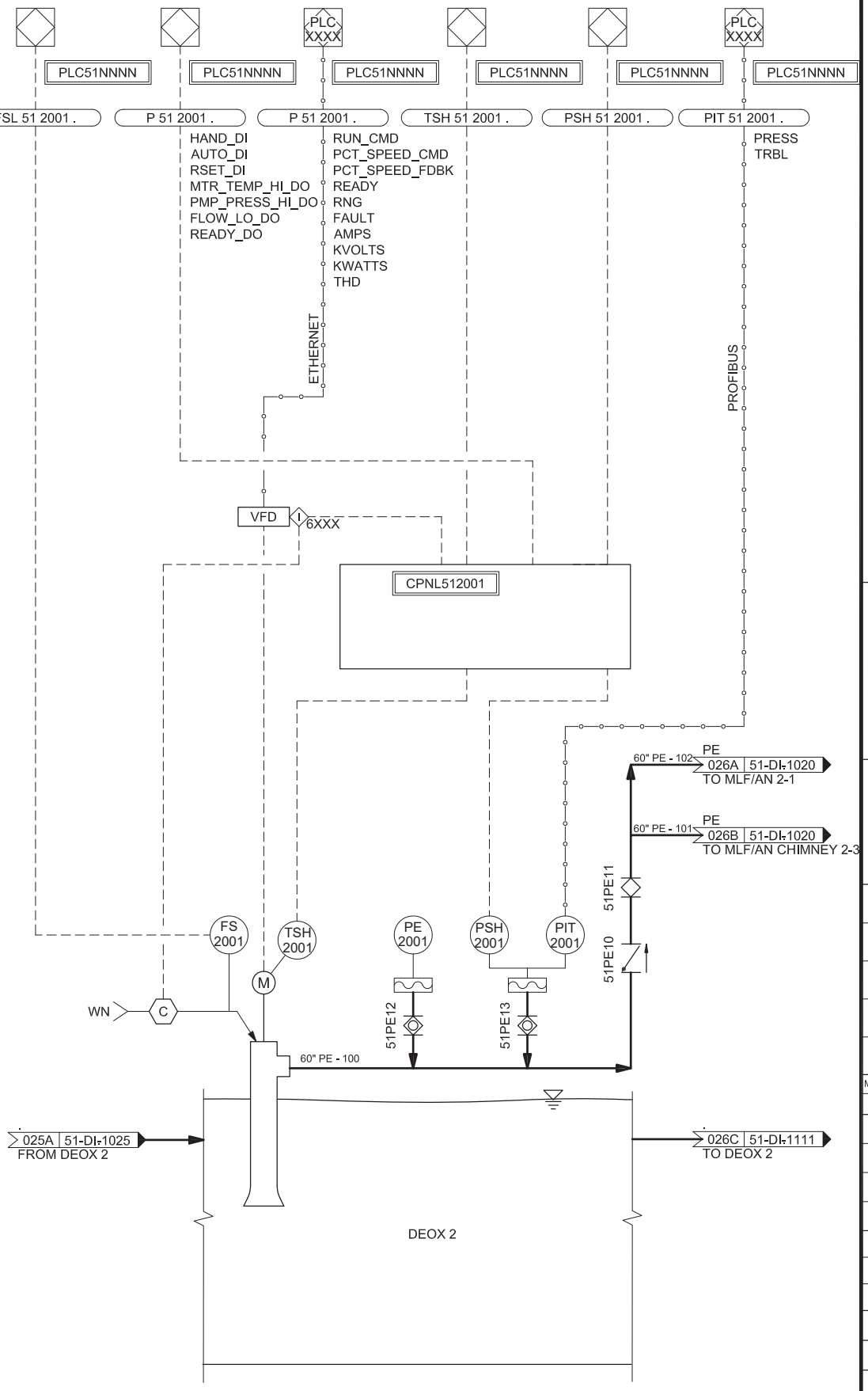

NOTES:
1. ALL INSTRUMENT TAG REFERENCE NUMBERS ON THIS SHEET SHALL BE PRECEDED BY AREA NUMBER 51.

DESIGNER NOTES:

SACRAMENTO AREA SEWER DISTRICT
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SAMPLE

PROCESS AND INSTRUMENTATION DIAGRAM

MARK	DATE	DESCRIPTION

ISSUE BLOCK

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CHECKED	D. GOTT
APPROVED	D. WHITE
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DESIGNER PROJECT NUMBER	NNNNNNN
CONTRACT NUMBER	NNNN
ZONE NUMBER	NN
DISCIPLINE	PROCESS AND INSTRUMENTATION

EXAMPLE MOTOR WITH VFD

DRAWING NUMBER **X-603**

3 OF 8

SCALE IN INCHES 0 1/2 1 2 4 (IF SCALE BAR IS NOT 4", SCALE ACCORDINGLY)

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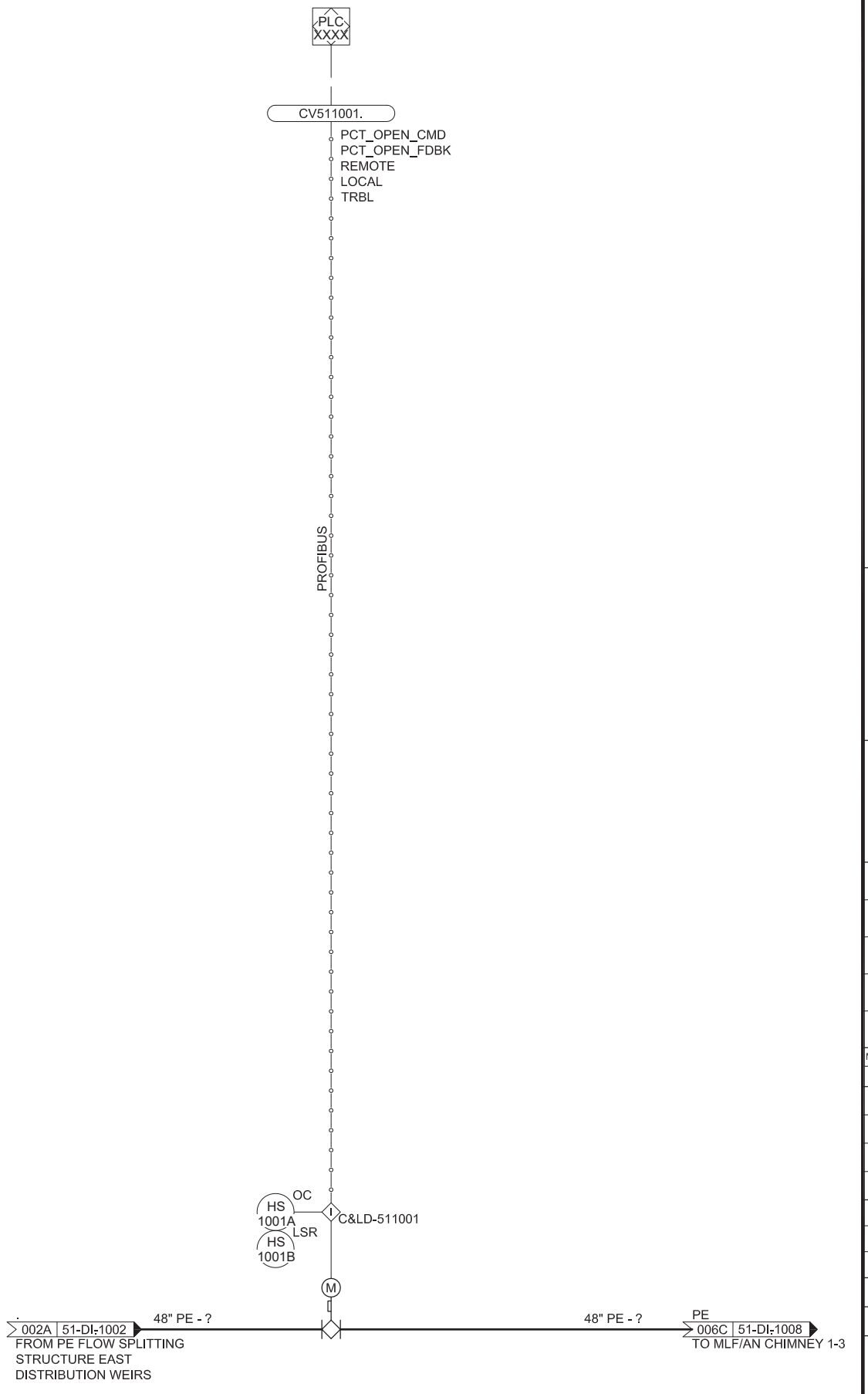

NOTES:
1. ALL INSTRUMENT TAG REFERENCE NUMBERS ON THIS SHEET SHALL BE PRECEDED BY AREA NUMBER 51.

DESIGNER NOTES:

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SAMPLE

PROCESS AND INSTRUMENTATION DIAGRAM

MARK	DATE	DESCRIPTION

ISSUE BLOCK

DESIGNED	D. WHITE
DRAWN	PMO CAD
CHECKED	D. GOTT
APPROVED	D. WHITE
FILENAME	4208-51-DI-1006-A-PMO.DWG
DESIGNER PROJECT NUMBER	NNNNNNN
CONTRACT NUMBER	NNNN
ZONE NUMBER	NN
DISCIPLINE	PROCESS AND INSTRUMENTATION

EXAMPLE MOTORIZED VALVE MODULATING

DRAWING NUMBER **X-604**

4 OF 8

SCALE IN INCHES 0 1/2 1 2 4 (IF SCALE BAR IS NOT 4", SCALE ACCORDINGLY)

Sheet Set Manager:
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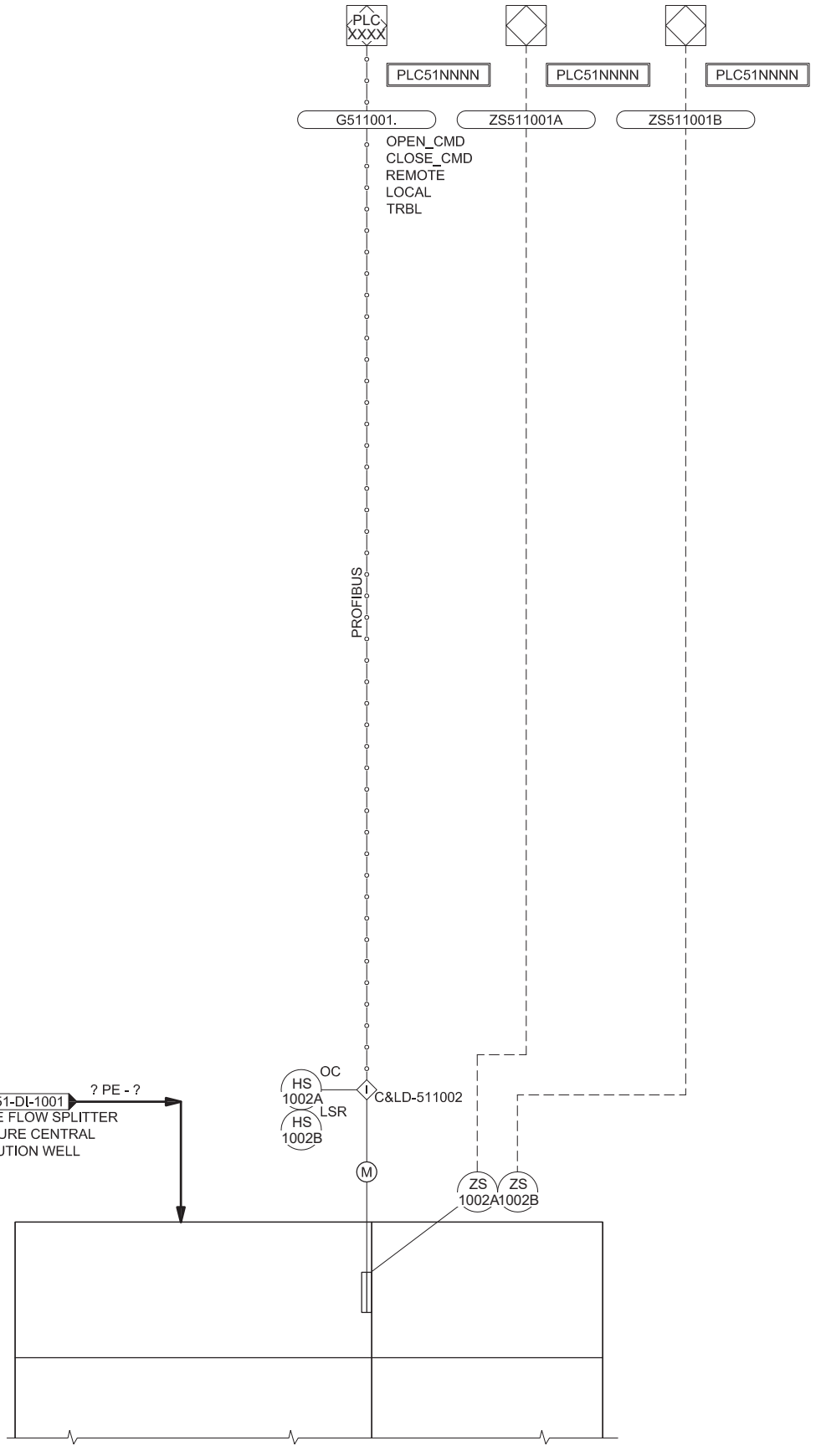

NOTES:
1. ALL INSTRUMENT TAG REFERENCE NUMBERS ON THIS SHEET SHALL BE PRECEDED BY AREA NUMBER 51.

DESIGNER NOTES:

SACRAMENTO AREA SEWER DISTRICT
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SAMPLE

PROCESS AND INSTRUMENTATION DIAGRAM

MARK	DATE	DESCRIPTION

ISSUE BLOCK

DESIGNED	D. WHITE
DRAWN	PMO CAD
CHECKED	D. GOTT
APPROVED	D. WHITE
FILENAME	4208-51-DI-1002-PMO.DWG
DESIGNER PROJECT NUMBER	NNNNNNN
CONTRACT NUMBER	NNNN
ZONE NUMBER	NN
DISCIPLINE	PROCESS AND INSTRUMENTATION

EXAMPLE MOTORIZED GATE OPEN/CLOSE WITH EXTERNAL POSITION SWITCHES

DRAWING NUMBER
X-605

5 OF 8

SCALE IN INCHES 0 1/2 1 2 4 (IF SCALE BAR IS NOT 4", SCALE ACCORDINGLY)

Sheet Set Manager:
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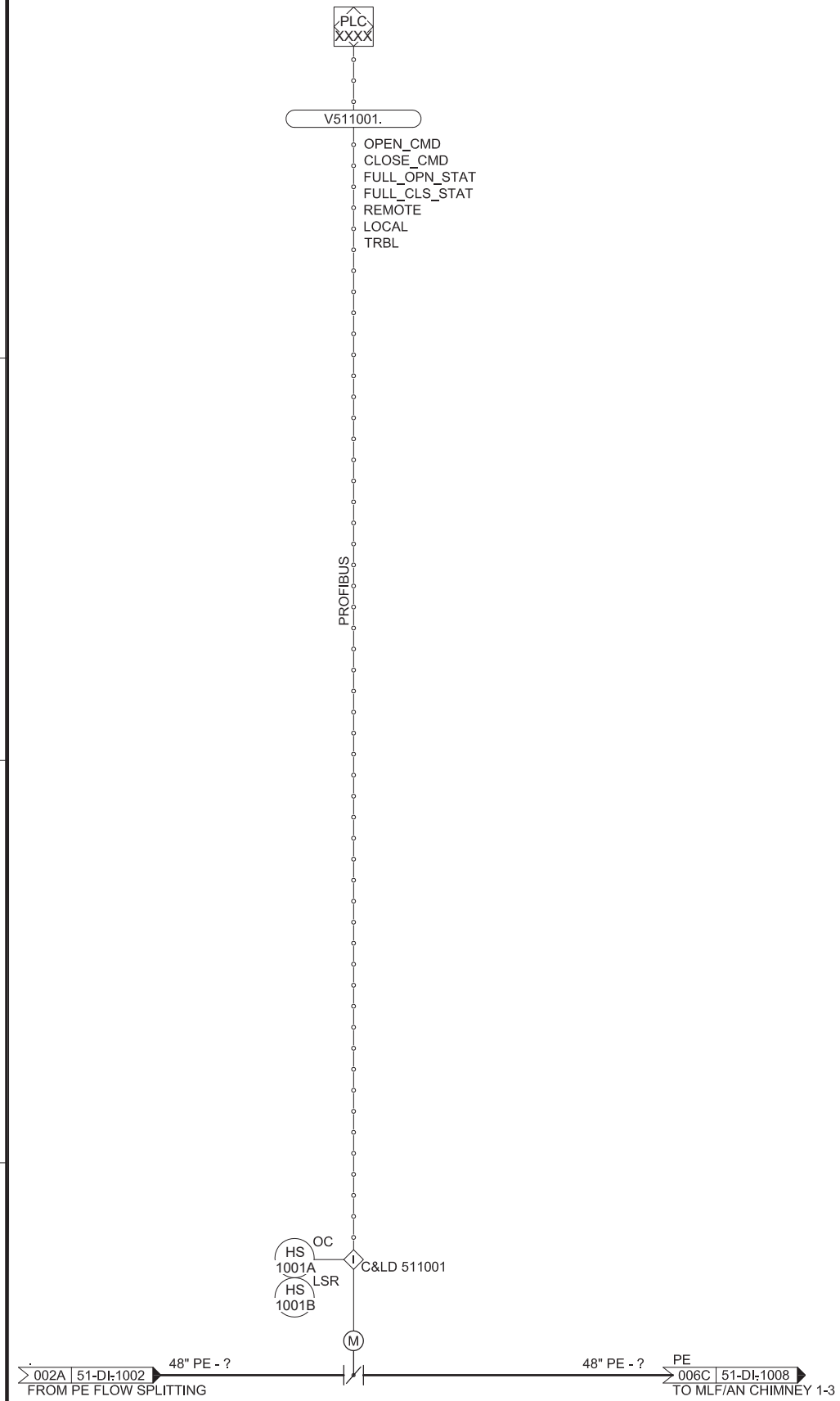

NOTES:
1. ALL INSTRUMENT TAG REFERENCE NUMBERS ON THIS SHEET SHALL BE PRECEDED BY AREA NUMBER 51.

DESIGNER NOTES:

SACRAMENTO AREA SEWER DISTRICT
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SAMPLE

PROCESS AND INSTRUMENTATION DIAGRAM

MARK	DATE	DESCRIPTION

ISSUE BLOCK

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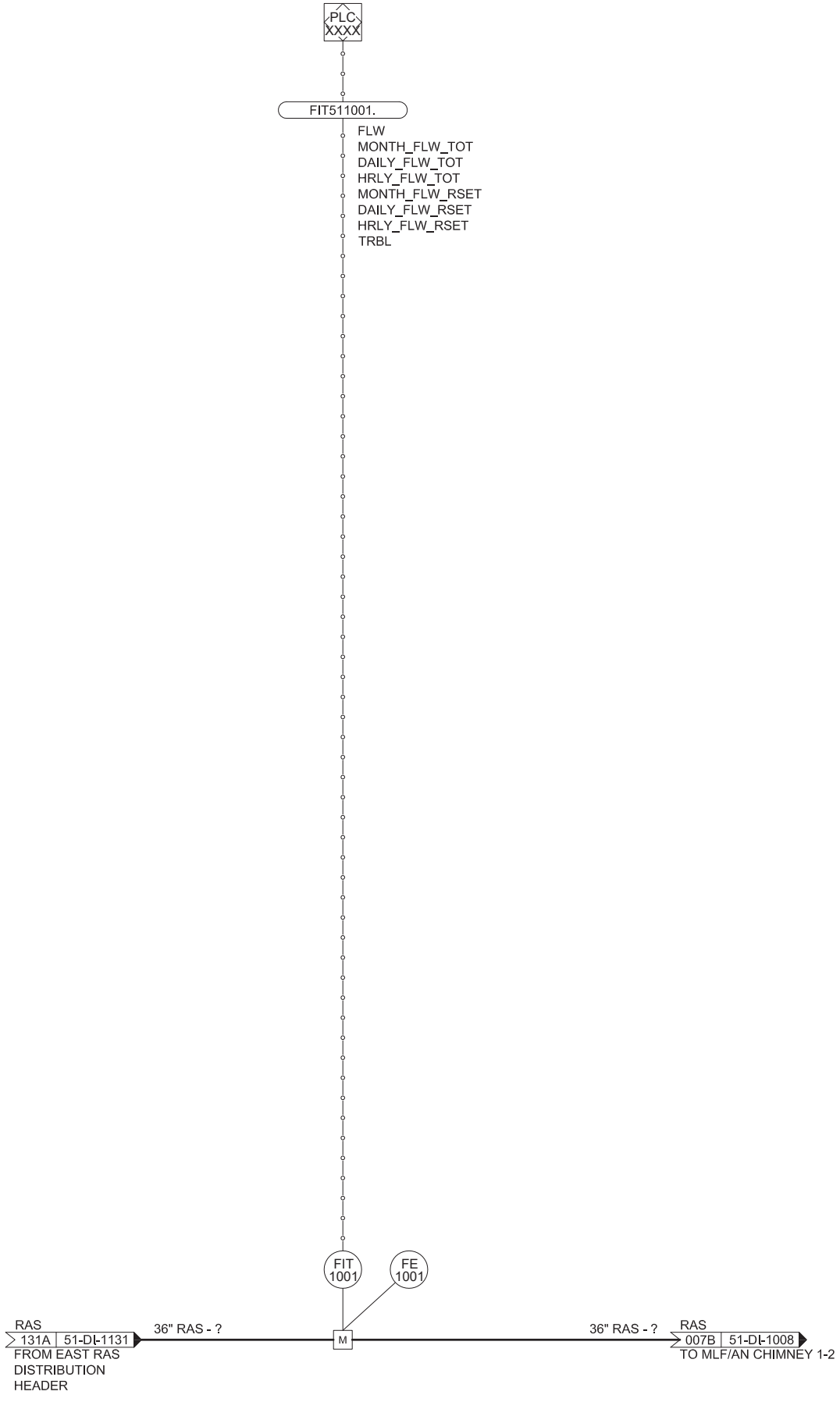
DRAWN	PMO CAD
CHECKED	D. GOTT
APPROVED	D. WHITE
FILENAME	4208-51-DI-1006-PMO.DWG
DESIGNER PROJECT NUMBER	NNNNNNN
CONTRACT NUMBER	NNNN
ZONE NUMBER	NN
DISCIPLINE	PROCESS AND INSTRUMENTATION

EXAMPLE MOTORIZED VALVE - OPEN/CLOSED

DRAWING NUMBER **X-606**

6 OF 8

SCALE IN INCHES 0 1/2 1 2 4 (IF SCALE BAR IS NOT 4", SCALE ACCORDINGLY)



NOTES:
1. ALL INSTRUMENT TAG REFERENCE NUMBERS ON THIS SHEET SHALL BE PRECEDED BY AREA NUMBER 51.

DESIGNER NOTES:

SACRAMENTO AREA SEWER DISTRICT
SERVING YOU 24/7

SAMPLE

PROCESS AND INSTRUMENTATION DIAGRAM

MARK	DATE	DESCRIPTION
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ISSUE BLOCK

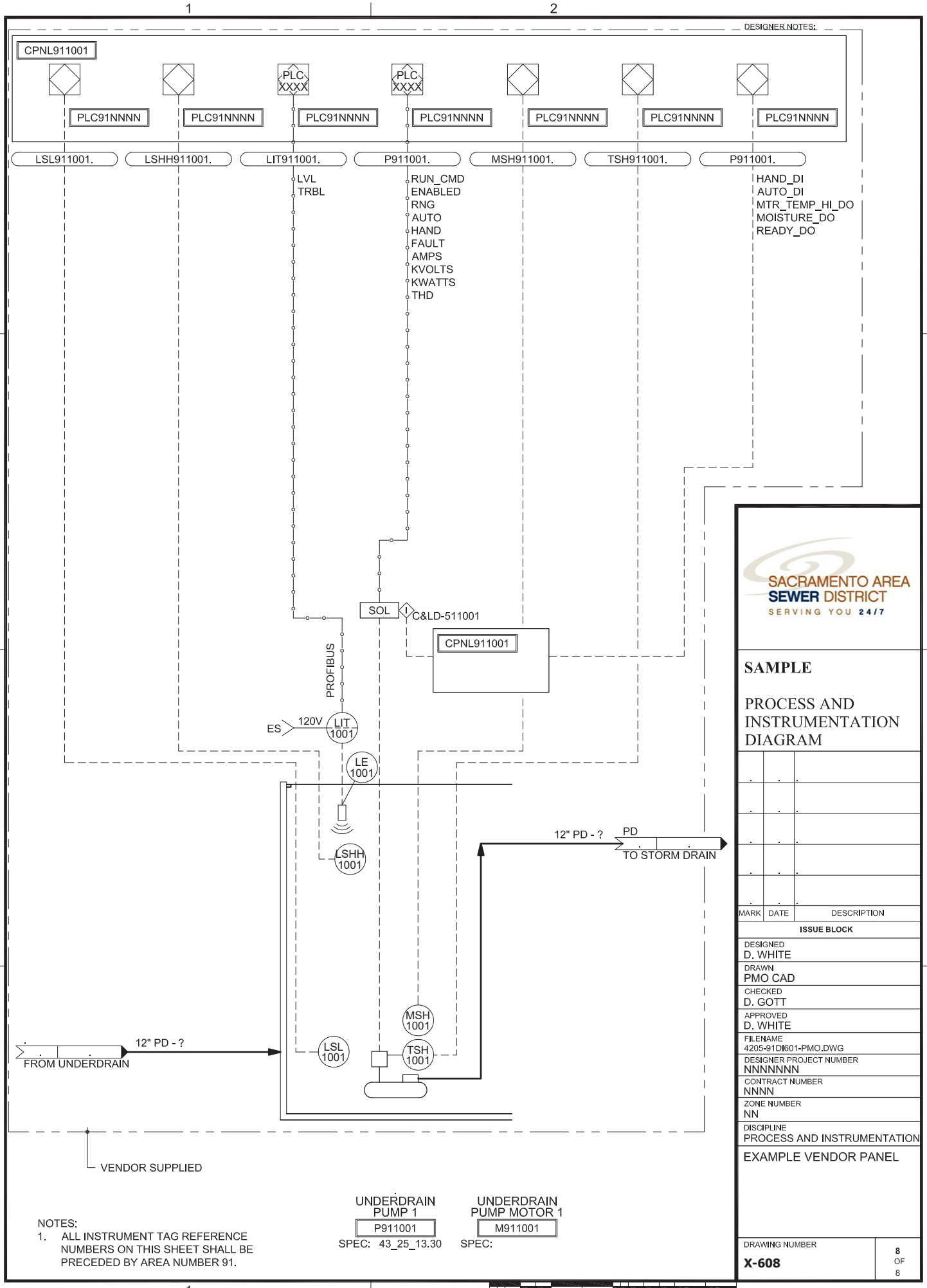
DESIGNED	D. WHITE
DRAWN	PMO CAD
CHECKED	D. GOTT
APPROVED	D. WHITE
FILENAME	4208-51-DI-1007-PMO.DWG
DESIGNER PROJECT NUMBER	NNNNNNN
CONTRACT NUMBER	NNNN
ZONE NUMBER	NN
DISCIPLINE	PROCESS AND INSTRUMENTATION

EXAMPLE MAGNET FLOW METER

DRAWING NUMBER **X-607**

7 OF 8

SCALE IN INCHES 0 1/2 1 2 4 (IF SCALE BAR IS NOT 4", SCALE ACCORDINGLY)



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Appendix H

Audit Checklist

PROJECT TITLE: _____ **AUDITEE:** _____

PROJECT NO: _____ **AUDITOR:** _____

PROJECT ENGINEER: _____ **AUDIT DATE:** _____

FILE NAME: _____ **AUDIT REPORT NO:**_____

SacSewer Revit Audit Checklist

This document contains the Revit Audit checklist protocols to maintain consistency across SacSewer Projects. The SacSewer Revit Audit checklist should be read with Revit Audit Instructions protocols. An audit should be carried out by the Project BIM Leader or BIM Manager.

NO	AUDIT CHECKPOINT	OBJECTIVE EVIDENCE	ITEM			COMMENT
			Y	N	N/A	
1	**PROJECT LEADER**	The person named in PMO Office				
OPEN UP WINDOWS EXPLORER TO START AUDIT						
2	**WINDOWS EXPLORER ORGANIZATION**	Refer to Revit Folder Structure naming protocols				
3	**CONSULTANT INCOMING CAD FILES**	Consultants in folder				
4	**REVIT WORKING FILE NAMING**	Refer to Revit naming protocols				
OPEN UP REVIT TO CONTINUE AUDIT						
5	**DRAWING NAMING**	Refer to Revit naming protocols				
6	**LEGENDS NAMING**	Refer to Revit naming protocols				
7	**SCHEDULE NAMING**	Refer to Revit naming protocols				
8	**SHEET NAMING**	Refer to Revit numbering protocols				
9	**FAMILIES NAMING**	Refer to Revit naming protocols				

10	**SYSTEM FAMILIES - DESCRIPTION & TYPE MARK**	Does all the curtain walls, floors, railings, ramps, roofs, stairs & walls have a description and type mark in the parameters				
11	**SYSTEM FAMILIES - DESCRIPTION & TYPE MARK**	Does all the curtain walls have a description and type mark in the parameters				
12	**SYSTEM FAMILIES - DESCRIPTION & TYPE MARK**	Do all the floors have a description and type mark in the parameters				
13	**SYSTEM FAMILIES - DESCRIPTION & TYPE MARK**	Do all the railings have a description and type mark in the parameters				
14	**SYSTEM FAMILIES - DESCRIPTION & TYPE MARK**	Do all the ramps have a description and type mark in the parameters				
15	**SYSTEM FAMILIES - DESCRIPTION & TYPE MARK**	Do all the stairs have a description and type mark in the parameters				
16	**SYSTEM FAMILIES - DESCRIPTION & TYPE MARK**	Do all the walls have a description and type mark in the parameters				
17	**GROUPS NAMING**	Are there groups in the project? If so, why? And do they follow Refer to Revit naming protocols				
18	**REVIT LINKS NAMING**	Refer to Revit naming protocols				
19	**ASSEMBLIES NAMING**	Are there assemblies in the project, if so? Why? And do they follow Refer to Revit naming protocols				
20	**WORK SET NAMING**	Refer to Revit naming protocols				

21	**MATERIAL NAMING**	Refer to Revit naming protocols				
22	**PROJECT INFORMATION**	Is all the project information correct as well as the energy settings				
23	**PROJECT PARAMETERS**	Are there any rogue project parameters in the file? If so, why?				
24	**FILE PATTERN NAMING**	Refer to Revit naming protocols				
25	**LINE STYLES NAMING**	Refer to Revit line protocols				
26	**LINE WEIGHTS**	Do the line weights match? Refer to Revit line protocols. If not, why?				
27	**LINE PATTERNS**	Are there any rogue project line patterns in the file? If so, why?				
28	**CALLOUT TAG NAMING**	Refer to Revit naming protocols				
29	**ELEVATION TAG NAMING**	Refer to Revit naming protocols				
30	**SECTION TAG NAMING**	Refer to Revit naming protocols				
31	**ARROWHEADS NAMING**	Refer to Revit naming protocols				
32	**LOCATION OF PROJECT**	Is true north & project north set up correctly				
33	**DESIGN OPTIONS**	Have all design options been removed in CD? If not, why?				
34	**MANAGE LINKS REVIT FILE NAMING**	Refer to Revit collaboration protocols				
35	**MANAGE LINKS - AUTOCAD FILES**	Are there any AutoCAD files loaded into the Revit project? Can any be removed?				

36	**MANAGE LINKS - DWF FILES**	Are there any DWF files loaded into the Revit project? Can any be removed?				
37	**MANAGE LINKS - POINT CLOUD FILES**	Are there any Point Cloud files loaded into the Revit project? Can any be removed?				
38	**MANAGE IMAGES**	Are there any rogue images in the file? If so, why?				
39	**DECAL TYPES**	Are there any rogue decal types in the file? If so, why?				
40	**PHASES - PROJECT PHASES**	Refer to Revit naming protocols				
41	**PHASES - PHASE FILTERS**	Refer to Revit naming protocols				
42	**PHASES - GRAPHIC OVERRIDES**	Refer to Revit naming protocols				
43	**REVIEW WARNINGS**	Are the review warning in the project under 50				
		Refer to Revit naming protocols				
45	**GRID SET OUT**	Have the grids been set out correctly				
46	**MODEL LINES**	Are there any rogue model lines in the file? If so, why?				
47	**DETAIL LINES**	Are there any rogue detail lines on any of the floor plans? If so, why?				
48	**REFERENCE PLANES**	Have all unnecessary reference planes be deleted and the rest put on to LINKS, SHARED LEVELS & GRIDS				

49	**IN PLACE FAMILIES**	Are there any in-place families in the file? If there is remove them!				
50	**DIMENSIONS TYPES**	Does the project have any custom dimensions in it? Refer to Revit naming protocols				
51	**TEXT STYLES**	Does the project have any custom dimensions in it? Refer to Revit text protocols				
52	**LINE TYPES**	Does the project have any custom line types in it? Refer to Revit line protocols				
PRINT ALL SHEETS OUT TO COMPLETE THE REST OF THE AUDIT						
53	**NOTES - UPPER CASE**	Are all the text notes in upper case lettering				
54	**NOTES - SPELLING**	Is the spelling correct in the entire job				
55	**TITLEBLOCKS - DRAWING LOCATION**	Have the floor plan drawings been placed in a consistent spot on the title block for every level				
56	**TITLEBLOCKS - MULTIPLE DRAWING LOCATIONS**	Have multiple drawings been placed in the right location with the ground the floor plan on the bottom left-hand side of the title block followed by level 1 above it, then level 2, etc.?				
57	**TITLEBLOCKS - NORTH POINT**	Has the north point been turned off all the elevations, sections & details				

58	**TITLEBLOCKS - VIEWPORTS**	Has the correct viewport markers be placed on the sheets hexagon for floor plans, circle for sections & elevations				
59	**TITLEBLOCKS - INFORMATION**	Has the titleblock information been filled out correctly and is in in CAPS				
60	**TITLEBLOCKS - REVISIONS**	Have all the revisions be clouded and tagged				

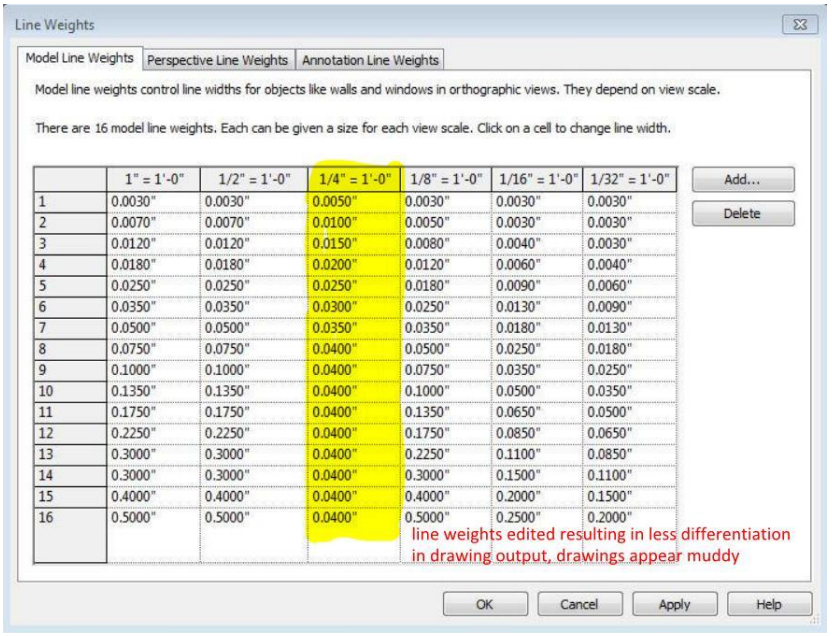
Appendix I

Model Health Check Form

XXXX-D-3D-NNaaaaaaaa.rvt		
Topic	**Details**	**Hours**
Performance	Topic: Worksharing Results: See “Workset Analysis” & “Linked Files not on Worksets” Recommendations: N/A Risk Register: N/A	NA
Performance	Topic: Review Questions Results: Model efficiency and performance is directly related to workflows Recommendations: TBD Risk Register: High	NA
Performance	Topic: Design options Results: Design Options are being used to control graphics or a means of managing links Recommendations: Use Design Options accordingly Risk Register: Low	1
Performance	Topic: Levels and Grids Results: Levels and Grids should be copy/monitored from a verified RVT source. The Levels are not named, only referencing an elevation. Recommendations: Copt Monitor Levels and Grids and name the Levels accordingly Risk Register: Low	2
Workset Analysis	Topic: Worksharing not enabled Results: Worksharing not enabled Recommendations: Regardless of project size, Worksharing plays an important role in file/project management. If the project requires immediate attention during a critical milestone where multiple folks need immediate access, they are unable to do so, which could have a negative impact on the project delivery. (Note: The original SAC Template Health Check suggests enabling Worksharing as one of their top 10 fixes listed as number 5.) Risk Register: High	4.5
Origin & File Linking	Topic: Project Base Point/Survey Point Results: The Shared Site differs from the other RVTs. Would like clarification and workflows that were distributed for the project. The risk here is that federated models are not tied together properly for future use and reference. Causing the client and future consultant’s	2

	timely coordination. Recommendations: A master Civil RVT file should be created referencing a Project Base Point based off of a known State Plane Coordinate, not a future or existing building coordinate. Linking in the Civil 3D DWG would be beneficial for visual reference. Risk Register: High	
Origin & File Linking	Topic: Linked Files Not Pinned Results: The Linked files are not pinned which could cause accidental movement of the links. This could cause a user/designer to model in a location that is not coordinated with the real world location for an extended period of time without knowing. Recommendations: Pin all Linked Models Risk Register: High	1
Origin & File Linking	Topic: Linked Project Task Log file Results: A Task Log has been assembled and referenced in all of the supporting RVT files to communicate project specific design tasks that may or may not be needed for the models. Because this RVT must be managed in another file and linked into supporting files, this may cause unnecessary load times, sync times, slowing down production and overall modeling. In addition to model performance, tasks that reside in an RVT are not accessible outside of the authoring tool, nor does it allow the information to be exchanged easily. Recommendations: Manage tasks outside of RVT. Project management tools and Revit/BIM development processes should be vetted and approved through the BIM Team so that project budgets can be kept on track without charging development time to a project. Risk Register: Low	0
Origin & File Linking	Topic: Linked Files not on Worksets Results: The Linked files are not placed on Worksets. Once Worksharing is enabled and Linked Files (RVT, DWG, PTX, Etc.) are placed on individual Worksets end users have the option of turning them off prior to loading the project. This greatly reduces load times, modeling times, sync times, etc. Recommendations: Enable Worksharing and place each Link on a separate Workset. Risk Register: Medium	1
Families & Content	Topic: Family Naming Conventions Results: Family and Family Type naming conventions are inconsistent, in particular the Equipment naming conventions.	1

	Recommendations: Follow family naming convention per BIM Standard mentioned in BxP. (Note: The original SAC Template Health Check suggests Family Naming Convention.) Risk Register: Low	
Families & Content	Topic: Family Complexity Results: Families should be developed or scrubbed to accommodate the minimum for design. In some cases families have too much information and in others there is not enough. (Example: The Poly-Processing Tanks do not have pipe connectors. This will generate false clashes in both the Revit model as well as the NavisWorks model, causing excessive time deciphering what is a real conflict.) Recommendations: Develop family based off of project needs with the correct information. Risk Register: Low	3
Families & Content	Topic: Shared Parameters/ Project Parameters Results: Several Project Parameters seem unnecessary and unmanageable (Example: Materials, Colors, Louvers, etc.) How were these added? Recommendations: Project parameters should be used sparingly and cleaned up Risk Register: Low	1
Families & Content	Topic: Schedules Results: There are an excessive amount of schedules in the project that are irrelevant to the model. Very confusing when looking for pertinent information. Recommendations: Remove schedules that are unused. Risk Register: Low	1

Deliverable/ Production Output	 Modifying line weights for a preset scale is not recommended as the results will be a drawing with lack of differentiation of modeled elements. The template line weights are not the same as the in-model line weights. Also, importing of families & files from AutoCAD requires a purging of unnecessary line styles which commonly come into the file. Currently there is close to 50 non-standard line styles in the models.	0
Overall File Analysis		17.5

	1" = 1'-0"	1/2" = 1'-0"	1/4" = 1'-0"	1/8" = 1'-0"	1/16" = 1'-0"	1/32" = 1'-0"
1	0.0030"	0.0030"	0.0050"	0.0030"	0.0030"	0.0030"
2	0.0070"	0.0070"	0.0100"	0.0050"	0.0030"	0.0030"
3	0.0120"	0.0120"	0.0150"	0.0080"	0.0040"	0.0030"
4	0.0180"	0.0180"	0.0200"	0.0120"	0.0060"	0.0040"
5	0.0250"	0.0250"	0.0250"	0.0180"	0.0090"	0.0060"
6	0.0350"	0.0350"	0.0300"	0.0250"	0.0130"	0.0090"
7	0.0500"	0.0500"	0.0350"	0.0350"	0.0180"	0.0130"
8	0.0750"	0.0750"	0.0400"	0.0500"	0.0250"	0.0180"
9	0.1000"	0.1000"	0.0400"	0.0750"	0.0350"	0.0250"
10	0.1350"	0.1350"	0.0400"	0.1000"	0.0500"	0.0350"
11	0.1750"	0.1750"	0.0400"	0.1350"	0.0650"	0.0500"
12	0.2250"	0.2250"	0.0400"	0.1750"	0.0850"	0.0650"
13	0.3000"	0.3000"	0.0400"	0.2250"	0.1100"	0.0850"
14	0.3000"	0.3000"	0.0400"	0.3000"	0.1500"	0.1100"
15	0.4000"	0.4000"	0.0400"	0.4000"	0.2000"	0.1500"
16	0.5000"	0.5000"	0.0400"	0.5000"	0.2500"	0.2000"

Appendix J

Clash Reporting

EchoWater Program -- Navisworks Clash Reporting Schedule

PROJECT:

EchoWater Program (PMO)

FILENAME:

4208 BNR_4205 FEQ_4208 PEPS-PDR_5.15.14.nwf

CURRENT DATE:

5/15/2014

Priority Number	
1	Major Priority Prior to DS3
2	Priority Prior to DS3
3	Best Practice Prior to DS3
4	Construction Coordination Priority
5	Construction Coordination Issue

No.	Selection Set Insert Clash WorkSets From the Navisworks File Below	Viewpoint # and Name Insert Viewpoints From the Navisworks File Below	Level	Priority Number from priority list above	Responsible Party Design Discipline or Subcontractor	Date Generated mm/dd/yy	Resolved? Y/N	Date Resolved mm/dd/yy	Days Open	Designer or Design Modeler's Notes and/or Subcontractor's notes	Need EchoWater Input? Y/N	BIM Facilitator Comments	Total Days to Resolve
1	Level 1 PEPS (M-DP) vs BNR (Structural)		1	1	DP-Process Piping	05/09/14			6				
2	Level 2 PEPS (Electrical) vs BNR (Structural)		2	2	E-Electrical	05/09/14			1				
3	Level 1 PEPS (Structural) vs BNR (Structural)		1	1	S-Structural	05/15/14			1				
4	Level 2 PEPS (Structural) vs BNR (Electrical)		2	3	E-Electrical	05/15/14			1				
5	Level 4 PEPS (POC-Point of Connection) vs BNR (POC--Point of Connection)		4	1	DP-Process Piping	05/15/14			1				
6	Level 1 FEQ (M-DP) vs BNR (Structural)		1	1	DP-Process Piping	05/15/14			1				
7	Level 2 FEQ (Electrical) vs BNR (Structural)		2	2	E-Electrical	05/15/14			1				
8	Level 1 FEQ (Structural) vs BNR (Structural)		1	1	S-Structural	05/15/14			1				
9	Level 2 FEQ (Structural) vs BNR (Electrical)		2	3	E-Electrical	05/15/14			1				
10	Level 4 FEQ (POC-Point of Connection) vs BNR (POC--Point of Connection)		4	1	DP-Process Piping	05/15/14			1				
11	Level 1 FEQ (M-DP) vs PEPS (Structural)		1	1	DP-Process Piping	05/15/14			1				
12	Level 2 FEQ (Electrical) vs PEPS (Structural)		2	3	E-Electrical	05/15/14			1				
13	Level 1 FEQ (Structural) vs PEPS (Structural)		1	1	S-Structural	05/15/14			1				
14	Level 2 FEQ (Structural) vs PEPS (Electrical)		2	3	E-Electrical	05/15/14			1				
15	Level 4 FEQ (POC-Point of Connection) vs PEPS (POC--Point of Connection)		4	1	DP-Process Piping	05/15/14			1				
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Appendix K

Drawing Revision Guidelines

Guidelines for Drawing Revisions

Issue Block

The issue block is the portion of the title block area that shows the chronological issue of, and revisions to, the sheet, see **Figure K-1**. The issue block has three columns identified as mark, date, and description. The data fields in this block include:

- Phase issue dates
- Addendum issue dates
- Clarification dates
- Revision issue dates

The number of data field lines is user dependent. The initial entry should be placed at the bottom of the issue block, with subsequent entries placed above each previous entry, allowing for expansion into the project identification block if necessary. See **Figures K-1 and K-2.**The Issue Block will be revised at two (2) milestones during Design and Bid period.

The Issue Block will be revised after the contract is awarded. All revisions are not to be cleared and the "conformed set" will be published to include all bid addendums; these contract documents will be issued to the contractor for information only. The bid set that includes the addendums will be the "legal contract".

Bid Documents Note:

1. *For Bid Documents, the Issue Block will be revised after DS3. All Design Submittal milestones will be cleared and the "BID DOCUMENTS" will be published with an issue date. These contract documents will be issued to the contractor for bidding. An example of a Bid Documents Issue Block is shown in* ***Figure K-2. Issue Block for Bid Documents****.*

2. *After the contract is awarded, the Issue Block during the Addendum period will be revised. All Addendum period revisions are not to be cleared and the "CONFORMED TO INCLUDE ADDENDA" will be published with an issue date and will include all bid addendums; these contract documents will be issued to the contractor for information only. An example of a Conformed to Include Addenda Issue Block is shown in* ***Figure K-3. Issue Block for Conformed to Include Addenda****. The bid documents set that includes the addendums will be the "legal contract".*

3. *In the Issue Block at project close-out, all Addendum period revisions are cleared and the "CONFORMED TO INCLUDE ADDENDA" will be revised to read "RECORD DOCUMENT" with an issue date. These documents will be provided to the District.. An example of a Record Document Issue Block is shown in* ***Figure K-4. Record Document.***

D	12-22 2014	FINAL DESIGN SUBMITTAL (FD)
C	11-11 2014	DESIGN SUBMITTAL 3 (DS3)
B	9-28 2014	DESIGN SUBMITTAL 2 (DS2)
A	5-21 2014	DESIGN SUBMITTAL 1 (DS1)
MARK	DATE	DESCRIPTION
ISSUE BLOCK		

Figure K-1. Issue Block during Design

BID DOCUMENTS DECEMBER 22, 2015		
6	2-28 2015	REVISED PER ADDENDUM 11.21
5	2-23 2015	REVISED PER ADDENDUM 8.10
4	1-17 2015	REVISED PER ADDENDUM 7.2
3	1-7 2015	REVISED PER ADDENDUM 4.23
2	12-30 2014	REVISED PER ADDENDUM 3.18
1	12-27 2014	REVISED PER ADDENDUM 1.31
MARK	DATE	DESCRIPTION
ISSUE BLOCK		

Figure K-2. Issue Block "BID Documents"

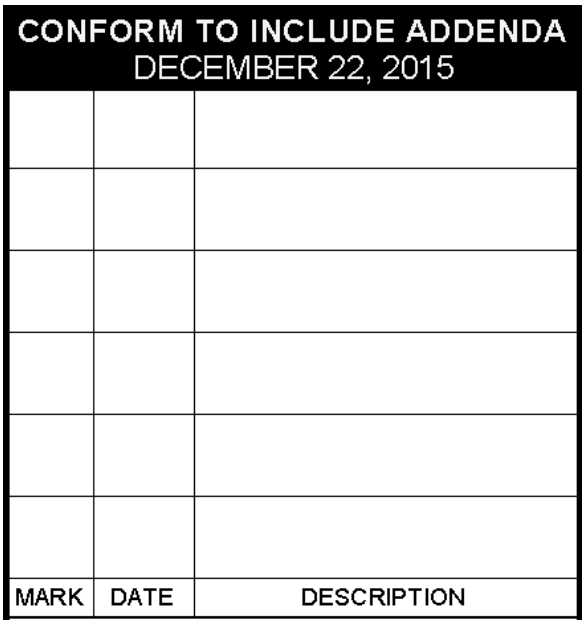

Figure K-3. Issue Block "CONFORM TO INCLUDE ADDENDA"

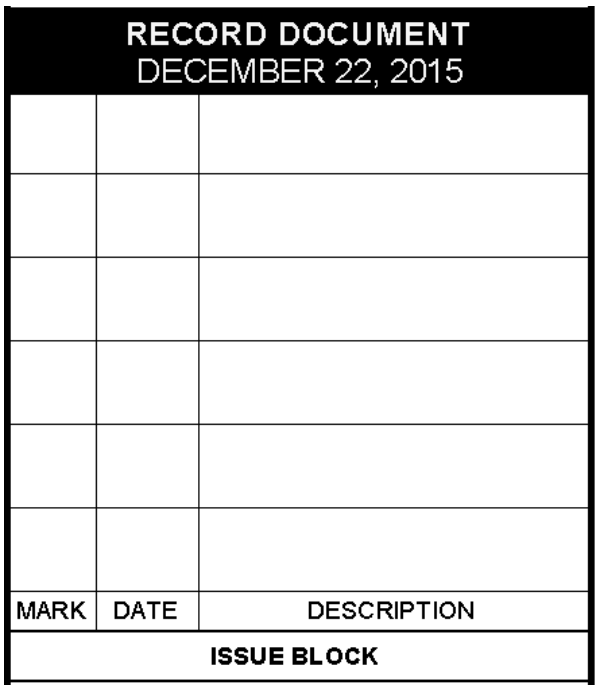

Figure K-4. Issue Block "RECORD DOCUMENT"

At scheduled intervals, the Designer will update the contract drawings. The affected specifications and drawings will be issued for contractor cost estimates and will be referred to as Proposed Contract Modifications (PCMs). If the PCMs are approved by the PM/CM, Change Orders (COs) or Field Instructions (FIs) will be issued to the Contractor as documented on the contract drawing or specification.

Changes are made to individual drawings or in a text format during the bid process. Changes should be made to the original files in their original folder. These changes occur during the Bid Period as a result of clarifications to the design or items not included in the Bid Set.

Changes are to be depicted on drawings by clouding the area that has been modified within the specific view (Plan, Section, Detail, etc) – cloud arc radius should range from 1/4 inch to 3/8 inch – and a revision triangle will be placed inside the cloud.

A notation describing the revision will be added to the revision block (e.g., “REVISED PER ADDENDUM 1.004”, “SHEET REPLACED PER ADDENDUM 3.08”, “SHEET ADDED PER ADDENDUM 4.19”, etc.). Subsequent changes made to the same drawing(s) will also be clouded, and sequential revision number(s) will be shown (“2”, “3”, “4”, etc.).

Do not remove previous changes within the revision block or on the sheet. The clouds, triangles, and notation should remain. The drawing(s) will continue to show the changes from any previous revision(s) made during this addenda phase. The first change to the drawing would be Revision 1, the second change would be Revision 2, and so on. The date applied in the revision block will be the date the addendum will be submitted.

The revision number placed within the triangle represents the numbered change of the drawing, <u>not</u> the addendum number. See **Figures K-5 and K-6.**

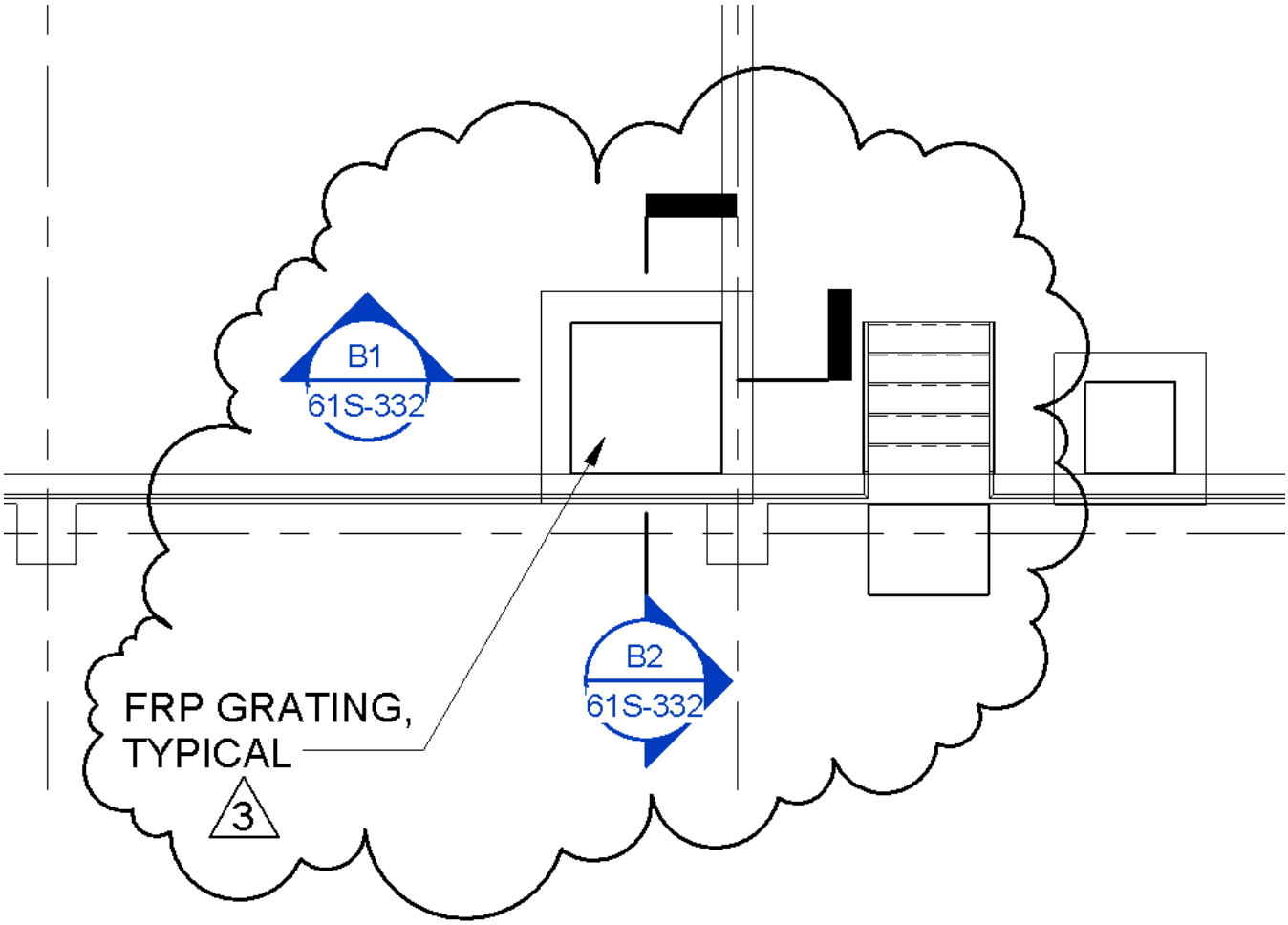

Figure K-5. Revision Cloud

BID DOCUMENTS DECEMBER 22, 2015		
3	1-7 2015	REVISED PER ADDENDUM 4.23
2	12-30 2014	REVISED PER ADDENDUM 3.18
1	12-27 2014	REVISED PER ADDENDUM 1.31
	DATE	DESCRIPTION
ISSUE BLOCK		

Figure K-6. Issue Block

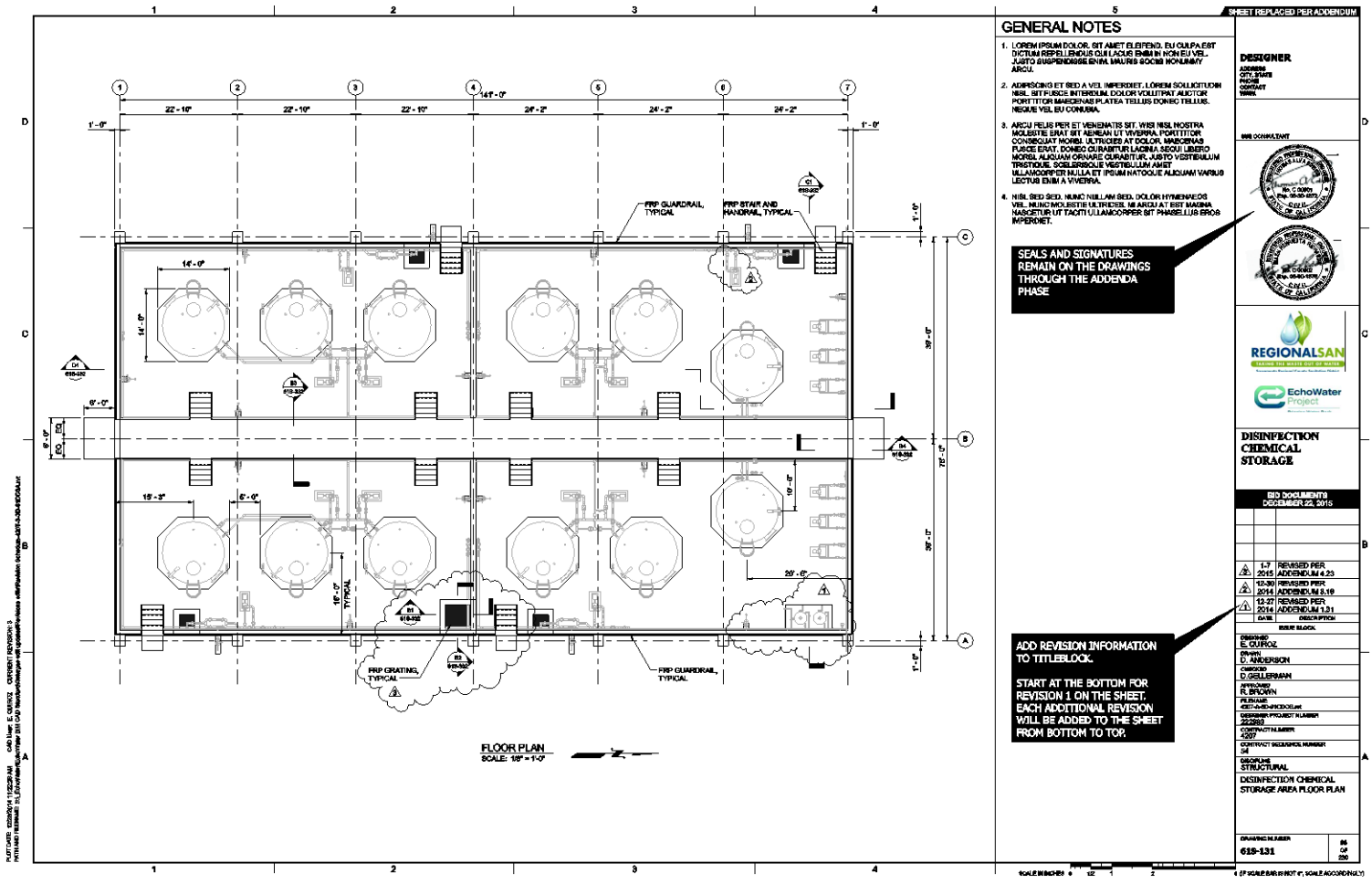

Figure K-7. Issue Block, Signatures and Seals during Addenda Period

If an entire sheet is replaced or added, instead of clouding the entire sheet add notations in the revisions block, per the addendum change, and then display the following at the top of the sheet.

In the Revit environment, **Select** the *22 x 34 NCS* titleblock. **Left mouse click** the Edit Type. **Check** the required display ON/ OFF box for *Sheet Replaced per Addendum* or *Sheet Added per Addendum*.

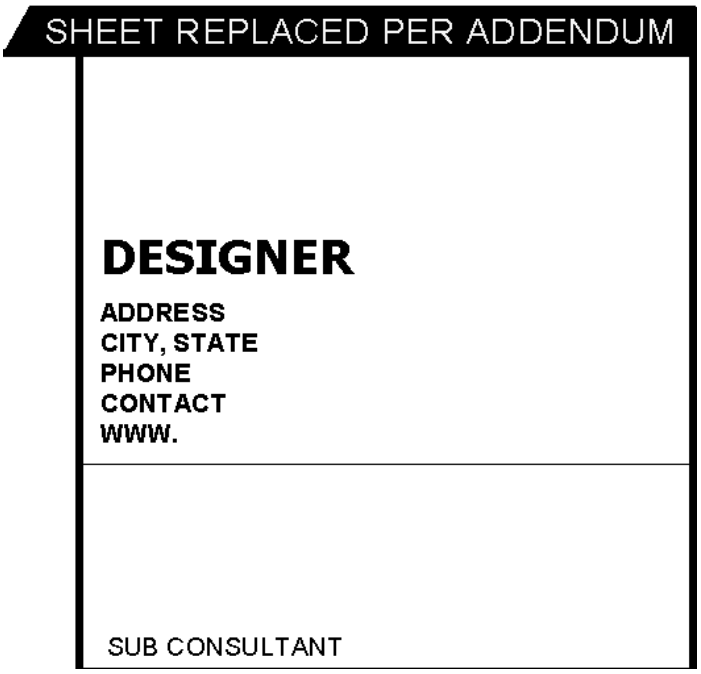

Figure K-8. Sheet Replaced Per Addendum

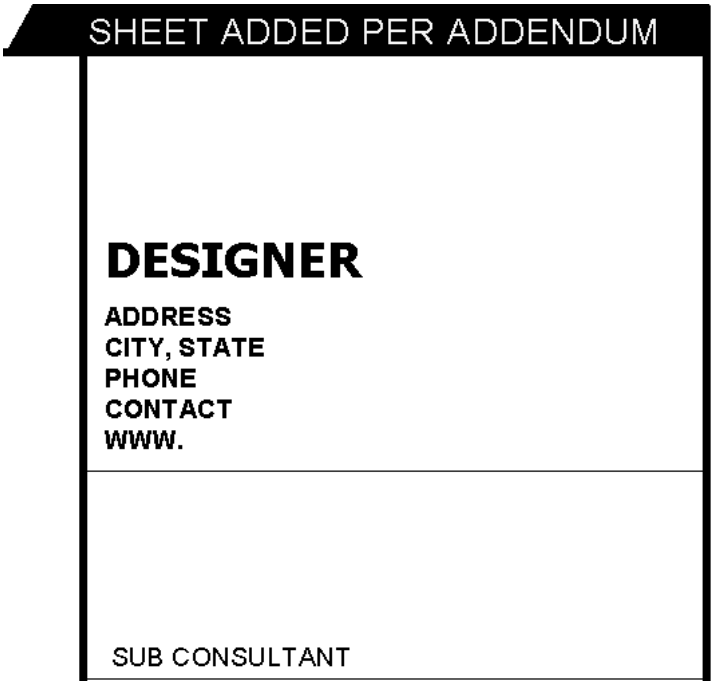

Figure K-9. Sheet Added Per Addendum

Developing a Revision Schedule in Revit

On the *View* tab in the *Sheet Composition* area click the *Revisions* icon, see **Figure K-10**. The Sheet Issues/Revisions dialog box will appear.

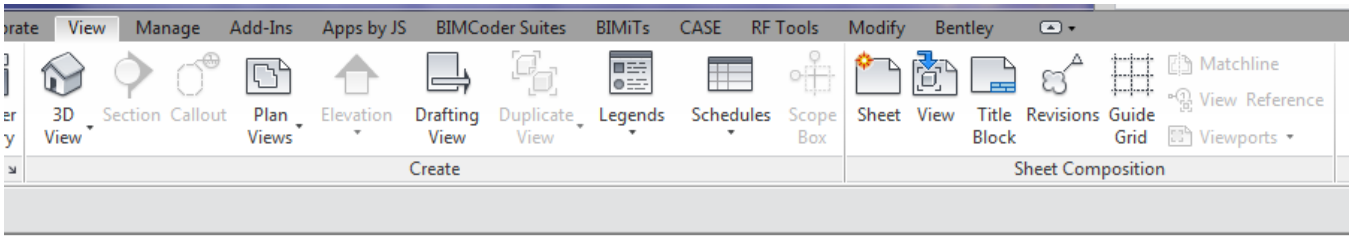

Figure K-10. Revit Revision Schedule

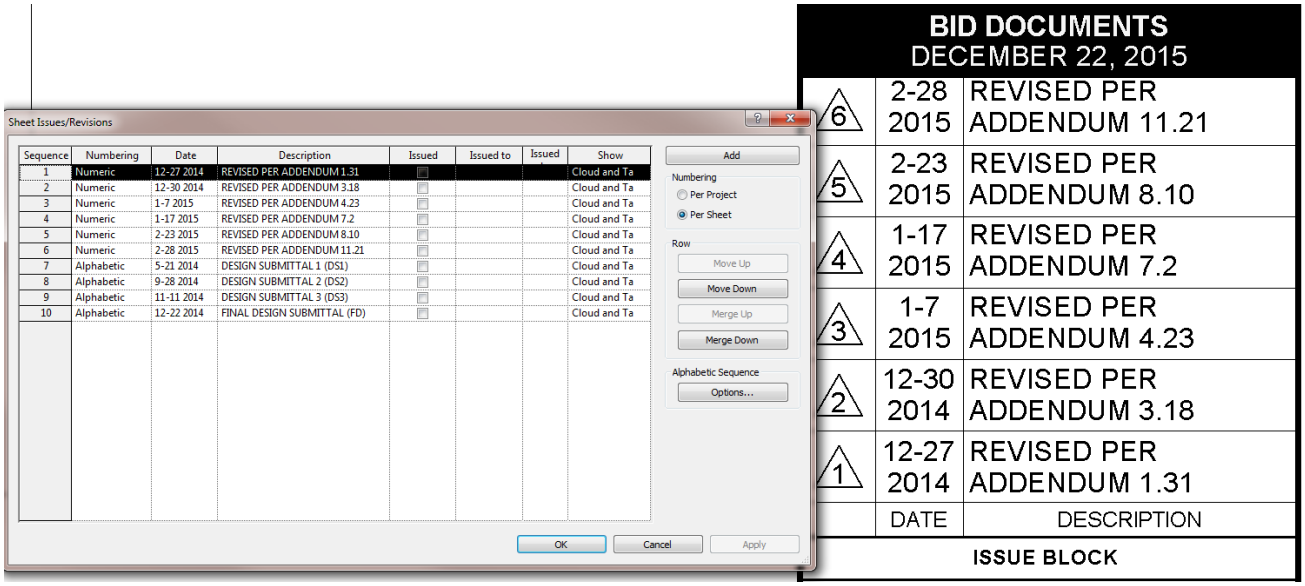

Figure K-11. Generating Revisions for the Issue Block

To view the Titleblock Type Parameters, click on *Edit Type*. The Type Parameters are common to the Titleblock.

To apply the Revision Triangles to the Issue block, *select the titleblock*. Selection of Revit Instance Parameter Values

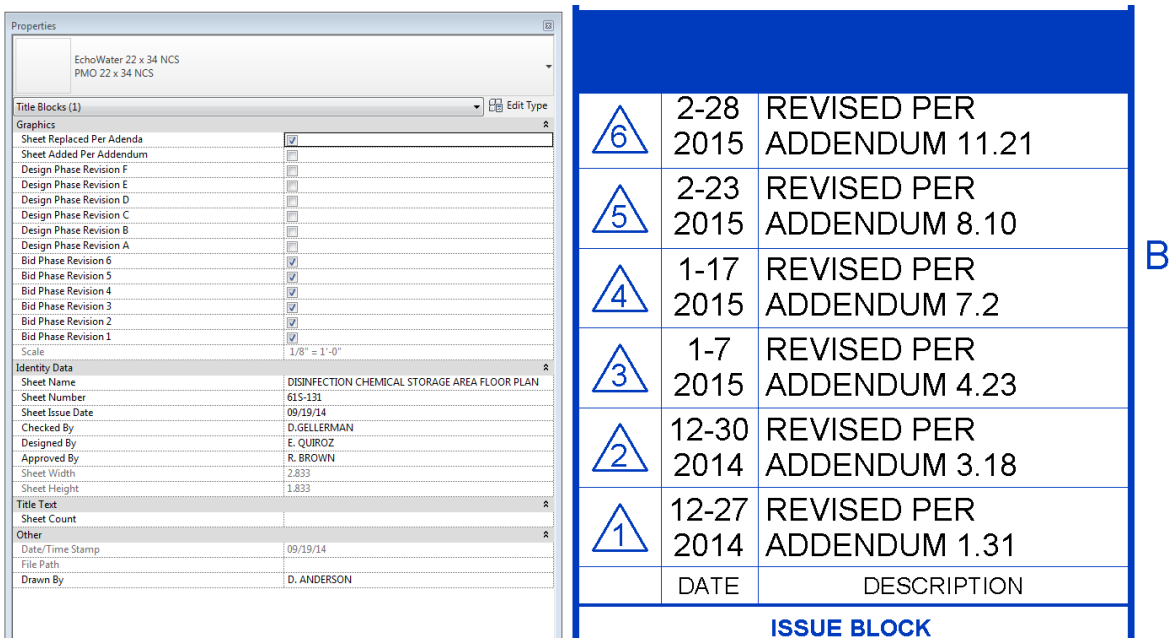

Figure K-12. Adding Revision Triangles to the Issue block

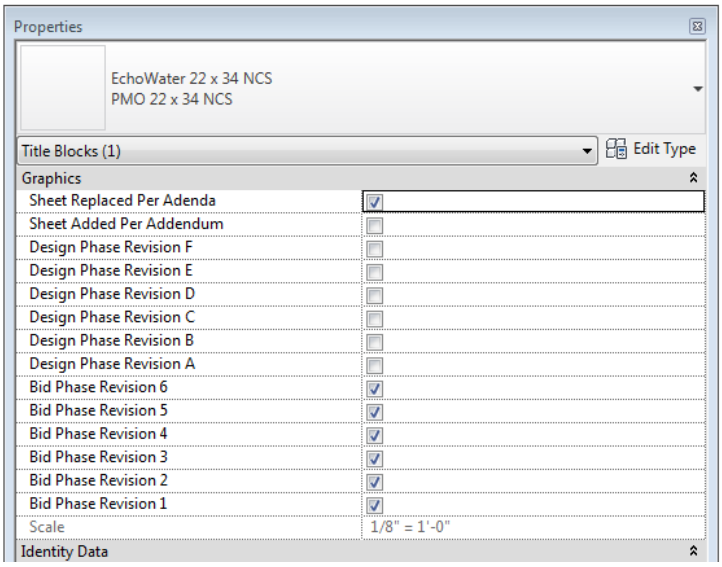

Figure K-13. Selection of Revit Instance Parameter Values

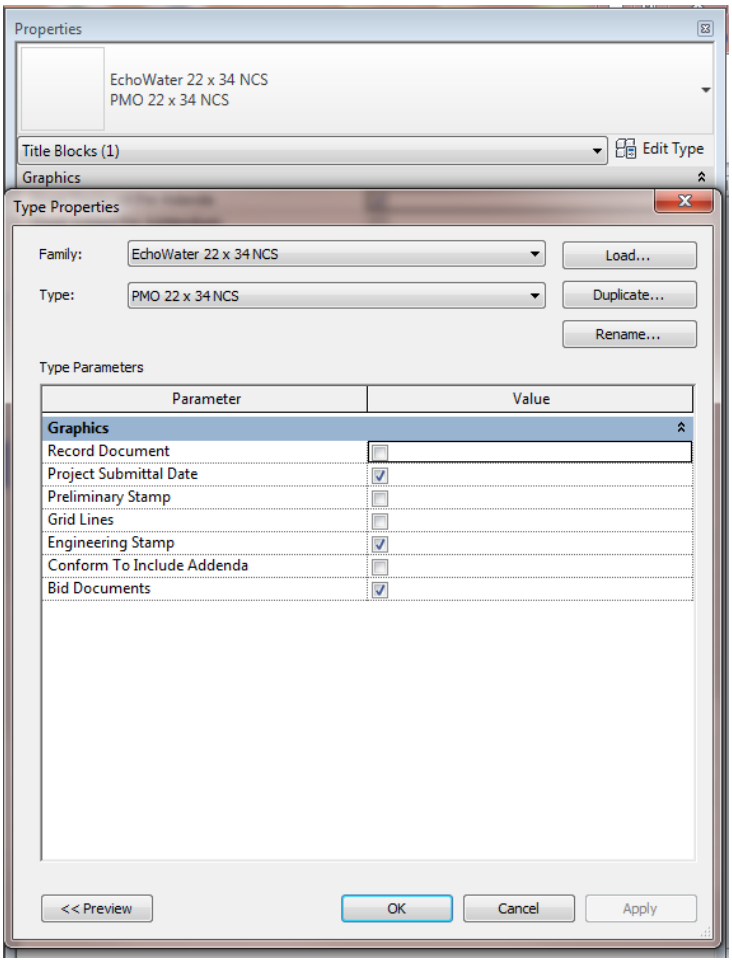

Figure K-14. Selection of Revit Type Parameter Values