



MMSD CAD Standards

Revision History

Name	Date	Reason For Changes	Version
Hackbarth	3/31/2010	Draft for Public Distribution	0.4
Hackbarth	12/22/10	Publication	1.1
Chavez	09/10/12	Revisions	1.2
Chavez	12/19/2012	Revisions	1.3
Chavez	03/20/2013	Revisions	1.4
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Attachment B – ChecklistsError! Bookmark not defined.

1. Introduction

1.1 Objectives

The Milwaukee Metropolitan Sewerage District (MMSD) CAD/Graphics Standards specify standards and procedures for the use of computer-assisted drafting (CAD) by MMSD staff and by consultants to MMSD. These standards have been established to achieve the following objectives:

- Provide consistency in drafting presentation for MMSD facility information.
- Provide consistency in format and content to facilitate review and use of drawings
- Preserve the usefulness and accessibility of drawing deliverables to MMSD in the future

All drawing files created within MMSD or by consultants to MMSD shall conform to the standards and procedures specified by this manual, unless waived by written authorization by the MMSD Project Manager.

1.2 Terminology

For the purposes of this document, required conformance to MMSD CAD/Graphics standards is indicated by use of the word “shall.” Optional conformance to material that is intended to provide guidance to users is indicated by the words “may” or “should.” A glossary of technical terms used in this document can be found in Section 8.

1.3 Distribution

Electronic copies of the current version of these Standards and their supporting documents can be obtained as follows:

Table 1 – Accessing Standards

Users	Method
Internal MMSD users	MMSD IntraSharePoint Site
Consultant/Designer (external) users	CD-ROM distributed at contract pre-proposal meeting.
	http://www.mmsd.com/cadstandards.aspx

1.4 Revisions

The CAD/Graphics Standards will be periodically reviewed and updated. Updates will be made available via the distribution methods mentioned above. Each revision to the Standards will be listed at the beginning of the Standards document in the Revision History table.

Suggestions for revisions to the CAD/Graphics Standards are welcome, and should be submitted to the MMSD contact referenced in section 1.5. All suggestions received will be considered during the periodic MMSD Standards review.

1.5 Contact

Please refer all questions regarding the MMSD CAD/Graphics Standards to:

MMSD Facility Information Department
Emily Champagne
Facilities Information Supervisor
EChampagne@mmsd.com
414.225.2180

MMSD Facility Information Department
Robert Chavez
CAD Coordinator
RChavez@mmsd.com
414.225.2230

2. Submittal Instructions

2.1 Delivery Formats

All drawing files delivered to MMSD shall be produced in accordance with the MMSD CAD Standards version provided to the consultant by MMSD during the bidding process. Files shall be delivered in the formats indicated in the following table:

Table 2 – Delivery Formats

Type	Format	Details
Drawings	Electronic – CAD	Bentley MicroStation V8i SS1 design files (.dgn) AutoCAD 2013 and AutoCAD Civil 3D 2013 (.dwg)
	Hardcopy	Half-size (11"x17") printouts on white paper Full-size (22"x34") printouts on white paper
Rasters	.TIF	Black & White Images TIF Format Group 4 Uncompressed Stripped 300 dpi (minimum) 1,4,8,24 bits/pixel (1 bit/pixel is preferred)
		Grayscale Images (*.tif) TIF Format Group 4 Uncompressed Stripped 300 dpi (minimum) 8,24 bits/pixel (8 bits/pixel is preferred)
	.JPG	Digital photographs
	.PDF	Electronic PDF package

2.2 CAD QA Checklist

A signed copy of the CAD Quality Assurance Checklist must be submitted with the CAD drawings being delivered at any phase. Through this checklist designers verify that the submitted CAD deliverables conform to MMSD standards. Exceptions granted by MMSD should be explained in a supplemental document that references checklist item number. Project shall not be considered complete until all deliverable standards have been confirmed by the MMSD PM and FIS CAD Reviewer. Deliverables that fail to comply with any of the following standards shall be denied and will be corrected and resubmitted at the designer's expense. The MMSD CAD Standards (and this checklist) are subject to change without notice.

2.3 Review

The Designer is responsible for verifying the quality and standards compliance of their electronic and hardcopy deliverables. MMSD will perform visual and automated quality checks on submitted drawings to verify compliance with MMSD CAD/Graphics standards. MMSD will reject submittals that are non-compliant with these standards, and will require corrections to be made by the Designer at no additional cost to MMSD.

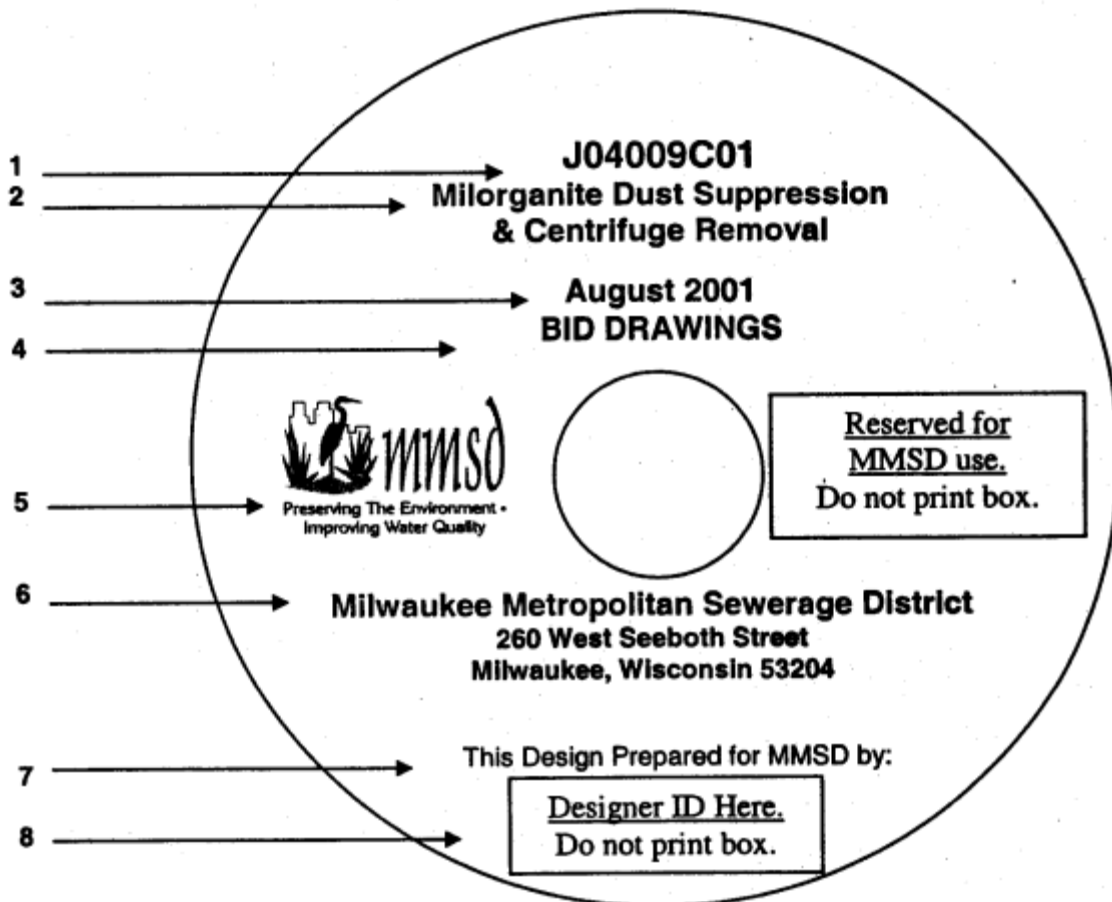
2.4 Submittal media

2.4.1 Electronic File Deliverable

The Consultant shall deliver all electronic files to MMSD on CD-R or DVD-R media, labeled as follows:

- CD/DVD slim-line jewel case, no label required.
- CD/DVD disc label should include:
 1. Contract number
 2. Contract name
 3. Plan date
 4. Plan status
 5. MMSD logo
 6. MMSD name and address
 7. "Design prepared by:" text
 8. Designer logo/identification

Figure 1 – CD/DVD label



2.4.2 Printout Deliverables

- 22"x34" 20# Brite White paper
- 11"x17" 20# Brite White paper

2.4.3 Review Print Deliverables

- 11"x17" Standard 20# paper

3. Directory and File Naming Requirements

The Designer may utilize his/her own directory structure while working on the CAD files, but must submit the data as required for review by MMSD that conforms to these standards.

3.1 Directory Structure

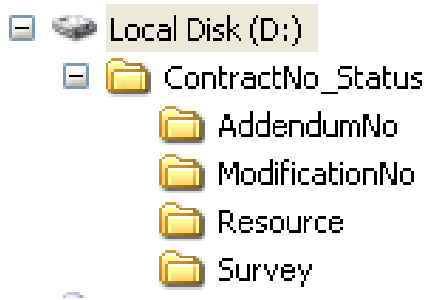
The CD-R/DVD-R title shall be named to match the Contract Number and Drawing Status (defined as “RECORD” or “BID”). All deliverable CAD files shall be located in the root directory of the CD-R/DVD-R. The resource, addendum and modification files shall be located in Resource, Addendum and Modification folders respectively.

Table 3 – CD-R File Directory Structure

Directory Location		Directory Contents	File Type
Root Directory	D:\ContractNo_<Status> <Status> = “RECORD” or “BID”	<ul style="list-style-type: none"> ▪ CAD files for all sheets and reference files ▪ Photos 	<ul style="list-style-type: none"> ▪ MMSDFileNo.dgn ▪ MMSDFileNo.dwg ▪ MMSDFileNo.cit ▪ MMSDFileNo.tif ▪ MMSDFileNo<sequential>.jpeg
Addendum Folder	D:\ContractNo_<Status>\AddendumNo	<ul style="list-style-type: none"> ▪ Folder for each Addendum containing pertinent CAD files 	<ul style="list-style-type: none"> ▪ MMSDFileNo.dgn ▪ MMSDFileNo.dwg
Modification Folder	D:\ContractNo_<Status>\ModificationNo	<ul style="list-style-type: none"> ▪ Folder for each Contract Modification containing pertinent CAD files 	<ul style="list-style-type: none"> ▪ MMSDFileNo.dgn ▪ MMSDFileNo.dwg
Resource Folder	D:\Resource	<ul style="list-style-type: none"> ▪ CAD files for resource type files 	<ul style="list-style-type: none"> ▪ .dll ▪ .rsc
Survey folder	D:\Survey	<ul style="list-style-type: none"> ▪ Survey data, point files, survey notes, etc. 	<ul style="list-style-type: none"> ▪ .xls ▪ .csv ▪ .txt

Note: Directory Location assumes CD drive is “D” drive

Figure 2 – CD-R File Directory Structure



3.2 Drawing Set Organization

3.2.1 Plant Projects

3.2.1.1 Discipline and order of drawings

Drawings will be organized by facility and then by respective disciplines and hierarchy as stated in Table 6. Not all disciplines or discipline drawings will be necessary for each Contract. Combination of multiple disciplines onto one drawing is not allowed without prior MMSD approval.

Note, following the cover sheet, the first drawing for each project shall contain the Index to Drawings, the design engineer’s seal, signature and date, and the Program Management Office (PMO) and the Milwaukee Metropolitan Sewerage District (MMSD) approvals. The first sheet may also contain the detail and section designation stick-on, a vicinity map to locate the project sites, and a detailed location map and other information.

The remaining items are to be presented in the sequence shown above on as few sheets as needed to adequately display the required information without crowding.

Table 4 – Discipline Hierarchy

Discipline Hierarchy	Discipline Designation	Discipline Drawings
General Sheet	G	<ul style="list-style-type: none"> ▪ Cover/Title Sheet ▪ Index to Drawings and approvals ▪ Area Project Vicinity Maps ▪ Project Plant Site Map ▪ Legends ▪ Survey Control (followed by Project Drawing Sheets)
Design Data	K	<ul style="list-style-type: none"> ▪ Design Data
Instrumentation and Control	N	<ul style="list-style-type: none"> ▪ Schedules
	N99Z	<ul style="list-style-type: none"> ▪ P&ID Unit Process (Master P&ID’s only)
	NN	<ul style="list-style-type: none"> ▪ Digital Network

Discipline Hierarchy	Discipline Designation	Discipline Drawings
Site	CJ	▪ Site Demolition or Removal
	C	▪ Site Development
	C_base	▪ Site Base (e.g., 201 <u>CU</u> base18r00.dgn)
	CB	▪ Site Subsurface / GeoTech
	CE	▪ Site Electrical
	CF	▪ Site Fencing
	CG	▪ Site Grading or Paving
	CH	▪ Site HVAC
		▪
	CL	▪ Site Landscaping
	CR	▪ Site Railroad
	CRE	▪ Site Real Estate
	CS	▪ Site Structural
	CT	▪ Site Signage / Traffic Control
CU	▪ Site Yard Piping	
Siphons	Q	▪ Siphons
Architectural	AJ	▪ Architectural Demolition/Removal
	A	<ul style="list-style-type: none"> ▪ Floor/Roof Plan ▪ Exterior Elevations ▪ Interior Elevations ▪ Sections ▪ Schedules ▪ Discipline Details
Structural	SJ	▪ Structural Demolition/Removal
	S	<ul style="list-style-type: none"> ▪ Foundation/Piling Plan ▪ Floor/Roof Framing Plan ▪ Sections ▪ Schedules ▪ Discipline Details
Mechanical	MJ	▪ Mechanical Demolition/Removal
	M	<ul style="list-style-type: none"> ▪ Floor Plan ▪ Sections ▪ Schedules ▪ Discipline Details
	MFP	▪ Mechanical Fire Protection
Building Services	PJ	▪ Building Services Demolition/Removal
	P	<ul style="list-style-type: none"> ▪ Piping Plan ▪ Plumbing Plan ▪ Riser/Waste Diagrams ▪ Sections ▪ Schedules ▪ Discipline Details

Discipline Hierarchy	Discipline Designation	Discipline Drawings
HVAC	HJ	▪ HVAC Demolition/Removal
	H	▪ Plan ▪ Sections ▪ Schedules ▪ Discipline Details
Electrical	EJ	▪ Electrical Demolition/Removal
	E	▪ Electrical
	EFP	▪ Electrical Fire Protection
	ED	▪ Electrical Diagrams
	EP	▪ Electrical Process Power
	EPN	▪ Electrical Process Instrumentation
	EF	▪ Electrical Facility Power
	EL	▪ Electrical Facility Lighting
	ET	▪ Electrical Closed Circuit Television
	EV	▪ Electrical Voice Communication System
Schedules	Z	▪ Schedules
Project Details	D	▪ Project Details
Facility Base	F_base	▪ E.g., 203Abase01r00.dgn (<i>similar to Site Base</i>)
Reference Drawing	RD	▪ Reference Drawing (filenames only)

3.2.2 Conveyance and Watercourse Projects

Plan and Profile	PP	▪ Plan and Profile by Stationing
Real Estate (Watercourse, Conveyance)	RE	▪ Real Estate Acquisition Plats
		▪

3.3 Design Drawing Identification

3.3.1 Design Drawing Numbers

The Designer assigns all drawing numbers, except for the I&C drawing numbers which are pre-assigned by MMSD. The drawing number does not contain leading zeros, contract number, or file extension, as does the actual file name, but includes dashes to separate the fields of code.

Example Drawing Number:

294-S-1 (include dashes)

294 = **Facility Identification**

S = **Discipline Code**

1 = **Drawing Identifier # (sequential)**

3.3.2 Contract Sheet Number (sequential):

Format: Sheet # 1-9999 (line 2 of the MMSD Title Block)

The Designer will assign sequential Contract Sheet Numbers to design drawings. Sheet Numbers establish the order of the drawings and will also be shown on the Index to Drawings.

3.3.3 Deliverable CAD Filenames

Each sheet in the plan set will have a CAD file titled with the MMSD Filename, consisting of the MMSD File Number plus the .dgn MicroStation or .dwg AutoCAD file extension.

MMSD will assign the File Number for each sheet in the plan set during the Design Drawing Review. After the File Numbers have been assigned, if the Designer has removed or added sheets to the drawing set, he/she must get approval from MMSD regarding the change prior to printing the Bid Set.

Example Deliverable MMSD Filename:

294S001.dgn / 294S001.dwg

294 = Facility Identification

S = Plant Discipline Code

001 = 3-character Drawing Identifier #

.dgn = MicroStation File Extension (lower case)

.dwg = AutoCAD File Extension (lower case)

3.3.4 Master Base Files

3.3.4.1 Vector Base

CAD vector base files produced by the Designer as MicroStation or AutoCAD reference attached files to deliverable drawings shall be titled using the following scheme:

Example Master Base Filename:

258Mbase25.dgn / 258Mbase25.dwg

258 = Drawing Group or Facility Identification

M = Plant Discipline Code

base = Master Base File

25 = Drawing Identifier # (Facility Plan floor elevation if complete footprint or sequential number if segmented footprint)

.dgn = MicroStation File Extension (lower case)

.dwg = AutoCAD File Extension (lower case)

3.3.4.2 Raster Base

All CAD raster base files produced by the Designer shall be titled using the source MMSD Filename + "base". For example, the raster file used for background on drawing 258M083baser01.dgn should be titled "258M083baser01.tif".

3.4 Drawing Revision Process

Any drawing revisions made to the drawings after being issued For Bidding and Construction, shall be indicated with a revision number inside a triangle. Also the Revision section of the Title Block shall include the corresponding revision number with the revision date, description and the Designer's initials.

3.5 Border/Title Block

All drawings submitted to MMSD for review must have the title blocks completed using the following guidelines. The MMSD borders can be found in the MMSD Workspace (MMSD_MSW\Workspace\MMSD_Standards\Borders\MMSD-BORDER).

3.5.1 Drawing - Title Format

3.5.1.1 Title Block format (4 lines) - General Discipline Drawings

Line 1:	Plant Location
Line 2:	Project Name (Must match index and specification book covers)
Line 3:	Blank
Line 4:	Drawing Discipline (refer to section 3.2)
Line 5:	Plan Title

3.5.1.2 Title Block format (5 lines) - I&C Discipline Drawings

Line 1:	Plant Location
Line 2:	Project Name (Must match index and specification book covers)
Line 3:	I&C Discipline
Line 4:	Unit Process Name (use MMSD Master Unit Process List)
Line 5:	Unit Sub-Process Name (match Sub-Process name from MMSD Master Unit Process List)

3.5.1.3 Title Block format (5 lines) - Facility Drawings

Line 1:	Plant Location
Line 2:	Project Name (Must match index and specification book covers)
Line 3:	Facility Identification, i.e., FACILITY 291: POWER HOUSE FACILITY (Name must match Site Map \ Facility and Structure Index name)
Line 4:	Drawing Discipline (refer to section 3.2)
Line 5:	Plan Title

3.5.2 Drawing – Design By / Approved By Format

Names in the title blocks shall use the first initial followed by the last name; for example, J.DOE. The checked by and approved by names shall be added after the “Essentially Complete” submittal, and should be left blank on the Preliminary Design submittal documents.

3.5.3 Sheet Numbers

Sheet numbers shall appear on all contract drawing review submittals to MMSD.

4. CAD Requirements

The purpose of providing the CAD Requirements is to standardize the appearance, structure, and content of drawings prepared for MMSD to facilitate review, plotting, and automation of drawings tasks and data extraction.

4.1 CAD Configuration

Designer shall use the custom MicroStation Workspace provided by MMSD to ensure all standards are met. When the Workspace is properly installed on your computers and or server you will be asked upon opening MicroStation using the MMSD Workspace shortcut to use the MMSD project and user name. A base Map and a seed file is provided for the use on new projects to ensure proper coordinates, layers, text styles and plot styles are used among other MMSD standards. Designer shall only provide original MicroStation and or AutoCAD files – files converted from other CAD software are not allowed. AutoCAD files are accepted but they must follow the MMSD standards that are provided in the workspace for MicroStation.

4.1.1 Level Structure

The MMSD standard level scheme shall be adhered to for all CAD drawing files. MMSD levels are based on the CAD Layer Guidelines included in the National CAD Standards. Basing the guidelines on the NCS promotes easier drawing exchange and standardization of drafting tools amongst designers.

In the event that the Designer wants to modify the MMSD standard level scheme, they must obtain MMSD approval to revise the level structures for a particular project, and the new level names should be modeled upon the MMSD level scheme based upon the National CAD Standard.

All level names must follow this format:

X(X)-XXXX-XXXX-XXXX-X

X(X) = Discipline Designation
 XXXX = Minor Group
 XXXX = Minor Group
 XXXX = Minor Group
 X = User Defined, Optional

If the level groups already exist in the MMSD standards, these must be used in hierarchical order to build the level, starting with the discipline designation. (X) denotes an optional character for further defining the discipline. The levels that use the extra character are:

- N – Process Instrumentation
- MN – Mechanical Instrumentation

4.1.2 Graphic Element Configuration

The following configuration settings shall be used in all drawings:

Table 4 – CAD Configuration Requirements

Attribute	General Requirements
Text	All capitalized and sized for full size drawings

Attribute General Requirements				
Font Styles	Font Name	Where Used	Height	Color Name/Number
	Arial	Drawing Text	1/8"	Yellow - 2
		Drawing Titles	1/4"	Yellow - 2
		Drawing Sub-Titles	3/16"	Green - 3
Arial	Cover Sheet	varies	White - 7	
Colors	AutoCAD default color table (acadcolor.tbl)			
Line Weights	Line Weight Name	Where Used	Color Name/Number	
	Grayscale	Existing Facilities	Gray - 252 (118,118,118)	
	Monochrome	New/Proposed Facilities	Yellow - 2	
Line Styles/Types	Default MicroStation/AutoCAD line styles			

4.1.3 Plotting Requirements

The Designer shall use MMSD standard sheet sizes for plotting:

- Full-size - 22"x34"
- Half-size - 11"x17"

The Designer shall use the custom MMSD Printer Driver Configuration files for plotting:

- MMSD-FULL-SCALE.pltcfg – Full size sheets
- MMSD-HALF-SCALE.pltcfg – Half size sheets

The Designer shall use the custom MMSD CTB pen tables for plotting:

- MMSD-PEN TABLE-FULL.CTB – Full Size Sheets
- MMSD-PEN TABLE-HALF.CTB – Half size sheets

The MMSD CTB file is configured for fifteen colors. The MMSD-PEN TABLE.CTB file assigns lineweights to each color so they print with the desired thickness. The table below shows the standard colors and the weights associated with the MMSD standards. These colors should be the only colors used on the plans.

Table 5 – Standard Plot Lineweights

Plot Style	COLOR	FULL SIZE THICKNESS (in)	HALF SIZE THICKNESS (in)
GRAYSCALE	8 - GRAY	0.040"	0.020"
	9 - GRAY	0.062"	0.031"
	250 - GRAY	0.009"	0.006"
	251 - GRAY	0.009"	0.006"
	252 - GRAY	0.009"	0.006"
	253 - GRAY	0.020"	0.010"
	254 - GRAY	0.030"	0.015"
	255 - GRAY	0.009"	0.006"
MONOCHROMATIC	1 - RED	0.009"	0.006"
	2 - YELLOW	0.015"	0.009"
	3 - GREEN	0.020"	0.010"
	4 - CYAN	0.039"	0.020"
	5 - BLUE	0.028"	0.015"
	6 - MAGENTA	0.062"	0.030"
	7 - WHITE	0.009"	0.006"

The following general requirements also apply:

- The use of other pen tables is not allowed.
- MMSD requires ACADCOLOR.TBL color table for all design files.
- MMSD shall be able to print from the CD-R without making any reference or level corrections.
- The printout should exactly match the plan submitted by the Designer.
- Use the MMSD plot border contained in the MicroStation border template files received at the beginning of the project as the plotting fence area.
- Line colors will no longer be overridden to white.

The Designer is responsible for non-conforming drawings and will reconfigure where necessary when copied to CD-R for submittal.

4.1.4 Spatial Reference / Units

4.1.4.1 Horizontal Control

All digital files shall be referenced to the State Plane NAD 1927 Wisconsin South coordinate system, and the MicroStation working units will be Survey Feet with a resolution of 60,000 per Survey Foot. Local plant-specific coordinate systems used in the past will no longer be allowed.

To convert coordinates from the Jones Island plant coordinate system to State Plane NAD27, use the spreadsheet “Jones Island Conversion Formula.xls” available on MMSD.com (see below). To convert coordinates from the South Shore plant coordinate system to State Plane NAD27, use the spreadsheet “South Shore Conversion Formula.xls” available on MMSD.com (see below).

- **Jones Island Conversion Formula**
<http://v3.mmsd.com/assetsclient/documents/procurement/Cad/Jones%20Island%20Conversion%20Formula.xls>
- **South Shore Conversion Formula**
http://v3.mmsd.com/AssetsClient/Documents/Conversion%20Formula_South_Shore.xlsx

4.1.4.2 Vertical Control

The MMSD vertical datum shall be used for all elevation information. To convert MMSD Datum to USC&GS (1929), add 580.6 ft. NOTE: Elevations on pre-PMO drawings are 0.26' higher than the present MMSD Datum. Original drawings should contain an ink stamp indicating the datum change.

4.1.4.3 Drawing Elevations

All piping above grade shall be called out with centerline elevations, and piping below grade will be called out with invert elevations. When calling out centerline and invert elevations, do not include “EL”; e.g., “INVT 786.20” or “CL 786.20”.

All elevations shall be shown using two decimal places except for spot/site elevations in non-paved areas which shall be given to 0.1-foot precision.

4.1.4.4 Elevation Symbol

In plan view, the abbreviation “EL” shall not be used when the elevation symbol is used. In section view, the abbreviation “EL” shall be used; e.g., “EL 1090.10”.

4.1.5 File Configuration for Delivery

- Deliverable MicroStation files shall be saved with the “Fit View” setting toggled ON.
- Designer shall compress all MicroStation files prior to delivery.
- The drawing background should be set to black.
- Deliverable MicroStation files shall be saved with all used levels turned ON for printing as appropriate using the Level Manager (all empty levels should be off).

4.2 Graphic Presentation

Table 6 – Project Appearance Requirements

Attribute	General Requirements	
Drawing Orientation	Drawing Type	Orientation of North
	Site Plan	Drawing oriented with north arrow pointing to top or right
	Plan and Profile	Dictated by the direction of flow
Stationing	Drawing Type	Orientation of Stationing
	Site Plan	Dictated by orientation of north arrow
	Plan and Profile	Increases from left to right travelling upstream
Schedules	??	
Legends	Each discipline has a legend drawing that will be provided by MMSD which shows symbols and styles to be used on construction drawings. These are located in the “Symbols” subdirectory of the Standards directory.	

4.3 Standard Symbols

The Designer will use the symbols as depicted in the discipline-specific MicroStation CAD files included with this Standards package. The MMSD General CAD files provided for the cover sheet, border, index and general legend sheets and will contain the specific symbols, layout, text styles and line styles required.

The Designer shall conform to the symbology depicted on the legend sheets. If the Designer needs to use a symbol that MMSD does not have included in the legend sheets, they must submit a request to the MMSD Project Manager that includes the proposed symbol that the Designer intends to use. The MMSD Project Manager may approve the proposed symbol, or provide an alternate.

4.4 Plant-Specific Requirements

4.4.1 Facility Key Plans

Facility Key Plans are required on all plan drawings where the floor plan is divided into multiple floor segments. The Designer shall only use the pre-determined MMSD Matchline grid for segmented building plans and is not allowed to sub-divide the facility floor plans into custom views without prior approval by the MMSD Project Manager.

Facility Key Plans shall be a simple vector building outline without much detail and located in the lower right corner of the drawing sheet. The building outline is to be shown as Color 7. Key Matchlines are to match building floor plan segments (and shown as Color 7). Grayscale fill or hatching shall be used to identify the Facility Key Plan area shown on the drawing.

4.4.2 Site Key Maps

Site Key Maps are required for all site plans using the site grid, and must show adjacent grid / numbers as related to the master Site Key Grid. *(use same drafting/graphics principals as Facility Key Grid above)*

5. Image Requirements

5.1 Scanned Drawings Used as Base

If a Designer needs to use a historical drawing as a base, the following sections provide guidelines for the rasterization of such drawings.

5.1.1 Format and Resolution

Hardcopy drawings needing to be scanned shall be rasterized into Tagged Image File format (.TIF) format with the following properties:

- Black & white images
 - Resolution – 300 DPI
 - Bit-depth – 1 bit/pixel
- Grayscale images
 - Resolution – 300 DPI
 - Bit-depth - 8 bits/pixel

5.1.2 File Naming

Raster images of scanned drawings should be named according to the rules described in Section 3.3.2.

5.2 Images of Deliverable CAD Drawings

The Designer shall create a raster image of each deliverable CAD drawing, using the following specifications:

5.2.1 Format and Resolution

Deliverable drawings shall be rasterized into Tagged Image File format (.TIF) format with the following properties:

- Black & white images
 - Resolution – 300 DPI
 - Bit-depth – 1 bit/pixel
- Grayscale images
 - Resolution – 300 DPI
 - Bit-depth - 8 bits/pixel

5.2.2 File Naming

Each raster image created from a MicroStation drawing shall be titled with the appropriate MMSD File Number assigned to the CAD file that they represent, plus the raster file extension (.TIF).

5.3 Metadata

To facilitate loading raster images into MMSD's document management system OnBase, a spreadsheet containing raster image filenames and associated attributes (keywords) applicable to each file shall be populated by the Designer. The spreadsheet shall be based upon the template provided by MMSD, and should reference keywords found in the keyword dictionary provided by MMSD.

6. Glossary

The following table provides an explanation for technical terms referenced in this document:

Table 5 – Glossary

Term	Description
Base File	Existing MMSD drawings included as base data
Drawing status	Deliverable stage in Contract lifespan. The typical stages include: Preliminary Design Review Essentially Complete Camera-Ready for Bidding and Construction Record Drawing
Filename	Digital CAD file name; derived from MMSD file number and file extension
File Number	Unique number assigned by MMSD for each drawing
Full-size	22"x34"
Half-size	11"x17"
MMSD	Milwaukee Metropolitan Sewerage District
Plan	
Print	Photocopy reproduction of a drawing
Printout	Hardcopy output of a digital drawing file to a laser printer or ink jet plotter on 20# white paper
Reference Drawing	Drawings attached as reference to contract drawings by the Contractor to be included at the end of the contract document set. Includes CIT and TIF Raster files.
Resource File	MicroStation files used for appearance, not content (i.e. libraries)