APPENDIX 3

BIM DSM

LIVE LIFE. TRAVEL WELL.

Design Standards Manual

BIM

Denver International Airport

Airport Infrastructure Management

2017

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Table of Contents

Preface

The Denver International Airport (DEN) Design Standards have been developed to ensure a unified and consistent approach to the thematic and technical design for DEN. These standards are for use and strict implementation by all Consultants under contract to DEN, to Tenants, and all other Consultants under contract to any other entity for the design of projects at DEN.

The Standards Manuals are intended to be working documents, which will be revised and updated, as required, to address the general, conceptual, design, and technical standards for all areas of design for the DEN.

This Design Standards Manual for the Denver International Airport have been prepared for use by competent, professionally licensed architectural and engineering Consultants under the direction of DEN Maintenance and Engineering or Tenants of DEN.

The Design Standards shall not be quoted, copied, or referenced in any bidding or construction contract documents. All information contained in these standards must be fully explained and shown in all bidding and contract documents.

The Design Standards Manuals are intended to be used as a whole, as each manual is complimentary to the others. In order to understand the overall thematic and design standards for DEN, the manuals must be utilized together and not separated from the Design Standards Manuals as a whole.

The Consultant shall not reproduce, duplicate in any manner, transmit to other consultants or other entities or use in conjunction with other projects without the express written consent of DEN.

Part I – Electronic Data Collection and Interchange Compliance Policy

Chapter 1 – EDCI Policy

Section 100 - Electronic Data Collection and Interchange Compliance (EDCI) Policy

100.1 Policy

To support diverse DEN initiatives and requirements including FAA Airport GIS (also known as eALP) and DEN maintenance efforts, DEN Airport Infrastructure Management (AIM) Development requires that all airport staff and consultants comply with the Electronic Data Collection and Interchange (EDCI) requirements/standards detailed in the documents listed in Section 103 - FAA Reference Documents.

100.2 Applicability

This policy applies to all personnel responsible for the collection and maintenance of incoming and outgoing spatially referenced vector and raster data. Spatially referenced data includes both collected or produced (derived) data, as well as associated attributes and metadata from the following,

A. Computer Aided Drafting and Design (CADD)

B. Geospatial Information Systems (GIS)

C. Building Information Modeling (BIM)

D. High Definition Scanning (HDS)

Section 101 - EDCI Defined

EDCI is a set of standards for controlling the collection and transfer of electronic spatial data between organizations both inside and outside of DEN. EDCI enables efficient capture and re-use of data generated by airport projects. Currently, design, construction, and maintenance activities that generate airport record data are conducted by multiple organizations both inside and outside of DEN. Each of these data collection efforts are for a single purpose; seldom reused on other projects; thereby, increasing costs and producing disparate data in independent databases, files and storage devices.

Federal Aviation Administration (FAA) NextGen has identified disparate databases as reducing efficiency and safety. The FAA has identified streamlined data systems (Netcentric Information Access) as a transformational solution for NextGen. NextGen is also part of an international effort led by the International Civil Aviation Organization (ICAO) to improve safety critical data at airports and its surrounding environs. Airports GIS (A-GIS) is an FAA-wide initiative to strengthen data quality, improve airport industry efficiencies, reduce data collection and management costs. It is a single, robust web-based system for airport related data. All obligated airports, including Denver International Airport, are required to alter their data collection business practices to support FAA NextGen technological initiatives

To comply with the latest versions of FAA Advisory Circulars AC150-5300-16-17-18, EDCI standards are required for efficient airport owner coordination and collaboration with multiple organizations including federal, state, municipal governments and the private sector.

Section 102 - Background

DEN has developed this Electronic Data Collection and Interchange (EDCI) compliance document to ensure that the FAA mandated Airports GIS (A-GIS) initiative be met. DEN is committed in providing an accurate, systematic, and well-understood process for planning, identifying, controlling, and tracking airport configuration throughout its life-cycle (i.e., development, operation, facility maintenance, renewal, replacement); enabling optimum airport efficiencies.

EDS consists of standards, specifications, procedures, and software components used by airport staff and their consultants. Through EDS, DEN will be better equipped to comply with the new FAA requirements and realize significant benefits and cost saving. EDS takes advantage of Enterprise Geospatial Information System (EGIS), Building Information Modeling (BIM) along with, project control systems such as Enterprise Content Management System (ECMS) and Contract Manager (CM) to enable storage, organization, retrieval, manipulation, analysis, and visualization of various airport drawings/maps and spatially referenced attribute data. A spatial-object-

relational Database Management System (DBMS) integrates the major components on the backend, while a web-enabled GIS Engineering Spatial Viewer (ESV) provides the user with a seamless integrated access to EDS data.

Section 103 - FAA Reference Documents

103.1 AC150/5300-16 Geodetic Control

This FAA Advisory Circular provides the standards for geodetic control required of all airport surveys. Accurate geodetic control is required to tie each airport in the National Airspace System (NAS) to the National Spatial Reference System (NSRS) and is accomplished through a direct tie to the airport's Primary Airport Control Station (PACS) and Secondary Airport Control Station (SACS). To meet Federal Aviation Administration (FAA) spatial data requirement that all Air Operations Area airport data be tied to the NSRS using the following datum: Horizontal Control North American Datum of 1983 (NSRS 2007), Vertical Control North American Vertical Datum of 1988 (GRS 80), and Geoid Model GEOID 09. All surveyed data provided to the FAA must meet accuracy and resolution requirements for airport features at the 95 percent confidence level. DEN Local Coordinate System (DEN LDP) is the current system for all airport spatial data. DEN Low Distortion Projection (LDP) meets FAA criteria for airport spatial standards and conforms to methodology developed by the National Geodetic Survey Advisor.

103.2 AC150/5300-17C Imagery

This FAA Advisory Circular provides specifications for airport imagery acquisition and explains how to submit the imagery for review and approval. Many tasks require imagery to be included in specific airport configuration changes (new construction). These can include a new runway, new or revised approach procedures, and revised airport obstruction charts to include a few examples. Imagery allows safety critical data to be independently verified and is essential for the identification of airport features.

103.3 AC150/5300-18B GIS Standards

Collection of airport data through field and post processing methodologies are specified in this FAA Advisory Circular. The data model specifies the following Geographical Information System (GIS) feature groups: Airfield, Airspace, Cadastral, Environmental, Geospatial, Man Made Structures, Navigational Aids, Seaplane, Security, Surface Transportation, and Utilities. The model incorporates safety critical data including runway thresholds, navigational aids, as well as other airport features including runways, taxiways, aprons, buildings, roadways, cadastral, land-uses, and utilities. The single GIS airport database will serve numerous needs and therefore requires a very robust set of data features and associated attributes. As a result, significant time and effort is required to collect and input the metadata (data about data). The power of an airport GIS database is derived from the metadata. The long-term application of airport GIS data collection methodology will reduce survey costs, errors, and missing data.

103.4 Federal Aviation Administration Regulatory Requirement for Local Compliance

Under the Airport Improvement Program (AIP), The City and County of Denver has an obligation to comply with FAA standards and policies concerning AC150/5300-16, 17 and 18 (current version). In accepting over $711 million in AIP funds since 1988, the City and County of Denver has agreed to specific Federal obligations, including the obligation to "carry out the project in accordance with policies, standards, and specifications approved by the Secretary including but not limited to the Advisory Circulars" (see AIP Grant Assurance No. 34). Under Federal law, this obligation runs in perpetuity since the City and County of Denver acquired land with Federal funds. Failure to comply with Federal grant assurances may result in the FAA issuing an order terminating eligibility for grants pursuant to 49 U.S.C. 47106(e) and 7111(d), an order suspending the payment of grant funds, an order withholding approval of any new application to impose a Passenger Facility Charge pursuant to section 112 of the Federal Aviation Administration Act of 1994, 49 U.S.C. 47111(e), or any other compliance order issued by the Administrator to carry out the provisions of the Acts, including possible repayment of prior Federal grant money.

Section 104 - Document Layout

This document provides staff and consultants with detailed information on how to comply with EDCI.

Part	Title
Part I	Electronic Data Collection and Interchange (EDCI) Compliance Policy
Part II	Subsurface Utilities Data Standards
Part III	CADD Procedures
Part IV	BIM Data Standards

Section 105 - Key Terms and Acronyms

105.1 Key Terms

Term	Definition
3D Models	The digital equivalent of physical objects represented at varying levels of detail
AEC Objects	AEC Objects are custom objects created by Civil 3D for use in Civil 3D only. Object enablers are built into AutoCAD and related verticals beginning in version 2012.
Airport Feature	An airport feature is limited to those aspects of the airport that are outside in the physical space not occupied by a manufactured structure. Anything that can be seen using a satellite image of the airport property falls under airport feature. For example, changes made to the inside of a building cannot be seen by a satellite image and thus do not fall under the definition of an airport feature. Airport features are only those manufactured and natural elements on airport property that are covered by the civil engineering discipline. The only exception to this is subsurface utilities that are also defined by an airport feature.
Airport GIS	The Airports Surveying-GIS Program defines the FAA process for the collection and maintenance of airport and aeronautical data required to meet the demands of the Next Generation National Airspace System. Guided by the program advisory circulars, the airport sponsor/proponent becomes a key link in the airport and aeronautical information chain.
Airport Spatial Data	Any data representing manufactured or natural features that have geometry (size, location, elevation/depth, etc.) and have specific attributes associated with them. The coordinates of a point are the most obvious example of spatial data, but spatial data also incorporates projection systems, line and polygon attributes, and other information. There are two main classes of spatial data: vector and raster.
Attributes	Characteristics of a geographic feature (manufactures or natural) described by numbers, characters, and images, typically stored in a tabular format and linked to a geographic feature by an identifier within some form of database (GIS, MS Access, CADD, BIM). A column in a database table can contain an attribute field covering the same type of data class for a variety of geographically disperse features.
AutoCAD Objects	Objects in a DWG file that are not AEC objects and produced by AutoCAD commands. These objects are often referred to as native AutoCAD objects.
BIM Project Execution Plan (BPXP)	The record document and attachments of the BIM Project Execution Planning process.
BIM Project Execution Planning	A process that allows consensus decisions to be made by all shareholders in the PBIM. Used to identify Model Element Authors (who is creating the model elements) as well as the level of detail and BIM Uses (who is consuming Data from the PBIM, when and what LoD is needed by them).

Term	Definition
Building Information Modeling (BIM)	**(VERB)** An integrated process built around coordinated, reliable information about a project from design through construction and into operations. BIM gives architects, engineers, builders, and owners a clear overall vision of the projects and contributes to the ability to make better decisions faster, helping raise the quality. **(NOUN)** The aggregate of files used to record the building information. Applications and Formats included but not limited to .rvt, .dwg, .pdf, .dwf, .nwc, mdb and sql databases.
Data Shortcuts	A set of tools in Civil 3D that allow a file containing a Civil 3D object to be referenced into another DWG file.
DEN CADD Standard	A manual defining process and content for the production of design documentation, 3D models, and data for BIM
Design Documentation	The traditional set of 2D plans for construction of physical infrastructure or documentation of existing conditions.
Drawing Template File	A DWG file with the file extension .DWT
DREF	Data Reference Files (DREFs) are model files containing the original Civil 3D AEC objects that have been published as data shortcuts.
Horizontal Disciplines	Horizontal Disciplines have their design work located outside of buildings. Horizontal Disciplines produce the following types of drawings. C - Civil Drawings E - Electrical Drawing F - Fueling Drawings G - Signing Drawings L - Lighting Drawings S - Structural Drawings U - Utility Drawings This is not a complete list. Some disciplines listed are limited to that portion of their work positioned 5' or more beyond the outside of a building
Metadata	Information about a data, describing the quality (e.g., accuracy, last revised, originator, etc.) of that data being examined by a user, in order to manage user expectations for proper application of that data. Security level restrictions for the use of a certain data are also part of its metadata.
Model Files	DWG files where drawing content is only created in modelspace.
Modelspace	The drawing editor accessed through the Model tab. Objects are drawn at a 1:1 scale representing real world dimensions.
Object enablers	Object enablers are built into AutoCAD 2012
Paperspace	The drawing editor environment accessed through Layout tabs and scaled for plotted dimensions to fit various paper sizes.
Project BIM Team	The project stakeholders who are either contributing to, or using the PBIM.
Project Building Information Model (PBIM)	Used in this document to specify the aggregate of files used to record the building information for a specific project. It is recognized that a project may have more than a single model to complete the delivery. The term BIM is used in this document to represent all modeling and database files holding data for a specific project.
Sheet Files	DWG files containing XREFs in modelspace and Sheet specific drawing objects in paperspace.
Sheet Set Data File	A file with a .DST file extension used with Sheet Set Manager in AutoCAD. It contains custom properties for managing title block content.
Spatial	Relating to, occupying, or having the character of physical three-dimensional space.

Term	Definition
Spatial Data Standards for Facilities Infrastructure and Environment (SDSFIE)	The SDSFIE is an American National Standard Institute (ANSI) standard detailing the data structure and organization of CADD-GIS graphic features and corresponding attributes constituting a base map.
Team	The terms Design Team, Construction Team, and Design/Construction Team, and Project BIM Team have been used in this document to assist in defining which group the guidance applies to. However, because the project delivery methods can define risk differently, for some projects the responsibility will shift to either the A/E or Contracting entity, or both. The DEN Contract and BPXP should properly define the duties of the parties before BIM modeling begins.
XREF	Externally Referenced File inserted in the current drawing using the ATTACH command in AutoCAD.

105.2 Acronyms

Acronym	Meaning
AC	Advisory Circular
ADO	Airport District Office
AGIS	Airports Geographic information System
AIM	Airport Infrastructure Management Division
AIP	Airport Improvement Program
ALP	Airport Layout Plan
BIM	Building Information Modeling
BPXP	BIM Project Execution Plan
CADD	Computer Aided Design and Drafting
CCD	City and County of Denver
CDOT	Colorado Department of Transportation
CM	Contract Manager
CMC	Configuration Management Committee
DEN	Denver International Airport
DOT	Department of Transportation
eALP	Electronic Airport Layout Plan
EDCI	Electronic Data Collection and Interchange
EDI	Electronic Data Interchange
EDS	Engineering Data Systems
EGIS	Enterprise Geospatial Information System
ESRI	Environmental Systems Research Institute
ESV	Engineering Spatial Viewer
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FIPS	Federal Information Processing Standard
GCS	Geographic Coordinate System
GIS	Geographic Information System
GPS	Global Positioning System
GRS	Geodetic Reference System
LDP	Low Distortion Projection
NAD	North American Datum
NAVD	North American Vertical Datum
NCS	National CAD Standard

Acronym	Meaning
PIMS	Project Information Management System
PM	Project Manager
QA	Quality Assurance
QC	Quality Control
SDSFIE	Spatial Data Standard for Facilities Infrastructure and Environment
SOW	AGIS Statement of Work
SPCS	State Plane Coordinate Systems
SQCP	AGIS Survey Quality Control Plan
TSA	Transportation Security Administration
WGS	World Geodetic System

Section 106 - Policy Updates

This policy will be eligible to be updated and enhanced on an annual basis. Recommended additions and suggested changes are to be directed to:

- Brendan Dillon, Denver International Airport – Brendan.Dillon@flydenver.com
- Jeannette Stoufer, Denver International Airport - Jeannette.Stoufer@flydenver.com

End of Part I

Part II – Subsurface Utilities Data Standards

Chapter 1 - Subsurface Utilities Data Standard

Section 100 - Subsurface Utilities Data Standard

100.1 Overview

Denver International Airport collects subsurface utility engineering surveys for all airport construction projects. Construction projects that expose the location of subsurface utilities must accurately capture the location and provide the data to AIM Development. Construction plans should indicate when subsurface utilities are to be uncovered and/or new utilities installed and coordinate with the DEN Survey Department for the collection of all utility data prior to being covered. The DEN Survey Department is responsible for the collection of utility data including Denver Water and Excel Energy utilities. The contractor must notify the DEN Project Manager and Airport Survey Office three business days before items are uncovered. As-built CADD and GIS data submitted to DEN shall contain all subsurface utility locations and attributes in CADD and GIS format as outlined in this document

100.2 Utility Quality Level Attributes

The American Society of Civil Engineers (ASCE) developed standard guidelines for the collection and depiction of existing subsurface utility information (ASCE/C-I 38-02). The guideline breaks down utility collection into four separate levels of confidence. The initial field collection and mapping for most airports is Quality Level (QL) **D**. The four separate levels of confidence are,

A. Quality Level **D** - Existing Records

Results from review of available records. This quality level provides an overall *feel* for congestion of utilities, but is highly limited in terms of comprehensiveness and accuracy. For projects where route selection is an option, this quality level is useful when combined with cost estimates for utility relocations following applicable *clear zone* and other accommodation policies.

B. Quality Level **C** - Surface Visible Feature Survey

Augments QL D records. QL D records are augmented using surface visible feature survey and then digitizing the data into a CADD drawing. The danger here is that much of the data is *digitized fiction*. There may be as much as a 15-30% error and omission rate in QL **C** information.

C. Quality Level **B** - Designating

Two-dimensional horizontal mapping. This information is obtained through surface geophysical methods. It is highly useful for design basis information for conceptual design and for proceeding prudently to QL **A**. This level should not be used for design basis vertical information or where exacting horizontal tolerances are required.

D. Quality Level **A** - Locating

Three-dimensional points of conflict. This is the highest level of accuracy of subsurface utility engineering data. It provides horizontal and vertical design basis information for engineering, construction, maintenance, remediation, condition assessment, and related efforts.

100.3 Utility Research

Utility research is important before setting out to capture utility data. Prior to beginning the designation work, the contractor should contact both AIM Development and the utility owners within the project limits, e.g., Xcel Energy, Denver Water. The contractor should request all record information within the project limits and specifically ask to speak to the Planning and Development Division to identify utility projects completed but not depicted in the utility owners' records section. The contractor must prepare a utility record log per ASCE standards, and maintain records for future reference. Review the record information for the following,

A. Material type joining procedures that will influence equipment selection.

B. Amount of utilities to be expected, which will influence number and phasing of personnel assigned to the project.

C. Local geology/soil conditions if data is available, which may influence equipment selection.

D. Number and type of access points, such as manholes, etc., which will influence safety procedures.

E. Expected depth of utilities, which will influence equipment selection. Presence of rebar or other paving characteristics, affecting the methods/procedures/equipment.

F. Advise the project owner regarding potential effects that the project may have on existing subsurface utilities.

G. Inform the project owner regarding utility quality levels and reliability of data for each quality level. Such information may include a discussion of costs and benefits associated with obtaining quality levels.

H. Recommend a scope for utility investigations dependent on project needs. This may include a list of the types of utilities for detection and depiction and the desired utility data quality level. It may include certain systems to be investigated and depicted at a lower quality level. It may include geographic sections of the project to have utilities investigated and depicted at various quality levels.

I. Discuss and recommend formatting of deliverables to clearly distinguish quality levels.

J. Discuss the sequence of acquiring appropriate quality level data throughout the planning and design process. This is dependent on project design elements, design timetables, the type of project, the criticality of utility service, and so forth.

K. Prepare a utility composite drawing or file with appropriate supporting documents, in accordance with owner specification, that clearly identifies utilities at their desired quality levels at the appropriate time within project development. The deliverable may contain utilities depicted at quality levels A, B, C, and/or D.

L. Review data with utility owners.

M. Review plans as design develops to analyze the effects of design changes to current utility information.

N. Recommend areas or particular utility systems for a “quality level” upgrade after review. Such an upgrade may be to quality level C, B, or A.

O. Follow applicable one-call statutes or other applicable laws.

P. Place a note on the plans explaining the different utility “quality levels.”

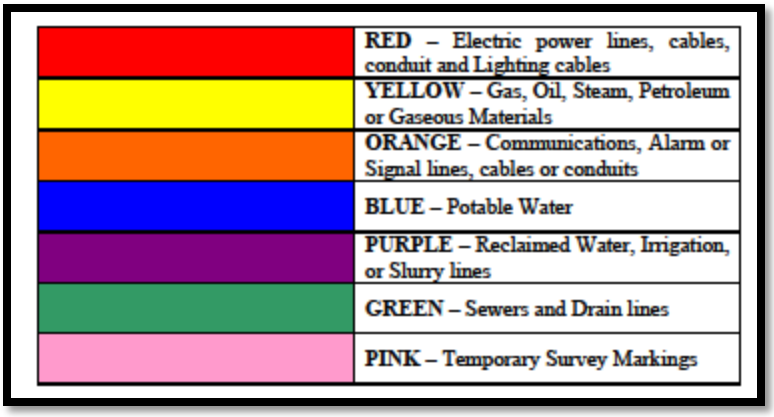
Q. Affix an engineer’s stamp on the plans that depict existing subsurface utility data at the indicated quality levels.

R. Discuss utility accommodation and utility relocation policies.

100.4 Field Utility Locates

Conducting field utility locates require geophysical locating equipment and methods (combined with existing utility records and field observations), the marks that designate the utility on the surface of the ground can be performed. If the utility changes horizontal direction, but has no physical aperture at that point, every standard of care of the subsurface utility engineering profession must be taken to designate the point at which the utility bends or changes direction.

The survey crew collects data for the utility features and marks the location of the utilities using temporary marking paint that follows the Utility Location and Coordination Council Uniform Color Codes, as shown in the following figure.



100.5 Subsurface Utility Engineering Test Holes

Use of subsurface utility engineering test holes are required of certain projects that require detailed high quality data such as vertical depths/elevations and condition assessments, complete Quality Level A test hole services. Digitally photograph the test hole sites before and after the test hole operations. For Quality Level A data, provide a certification form in addition to the plotted position of the utility with additional information. This certification information includes:

A. Horizontal and vertical location of top and/or bottom of utility referenced to project datum,

B. Elevation of existing grade over utility at test hole referenced to project datum,

C. Outside diameter of utility and configuration of non-encased, multi-conduit systems,

D. Utility structure material composition, when reasonably ascertainable,

E. Benchmarks and/or project control used to determine elevations,

F. Paving thickness and type, where applicable,

G. General soil type and site conditions, and other pertinent information as is reasonably ascertainable from each test hole site.

References to the project datum will maintain vertical tolerances to +/-0.05' based on benchmarks used or established with the base mapping deliverables and horizontal tolerances at +/- 0.25’.

Section 101 - Denver Water or Xcel Energy Utilities

If the project involves Denver Water or Xcel Energy utilities, the Contractor is responsible for notifying the Airport Survey Office 48 hours prior to survey so that the Airport Survey Office can be on site to collect as-built utility information. Denver Water and Xcel Energy, in practice, do not furnish the airport with accurate as-built information and it is the airport’s responsibility to obtain this information for those utilities on its property. The Project Inspector on site should ensure that the Airport Survey Department is present when Denver Water or Xcel Energy utilities are exposed or being modified. Project Inspectors should coordinate with Dennis Hamlin for any coordination with the Airport Survey Office.

Dennis Hamlin
Project Manager
(303) 342-4428
Dennis.Hamlin@flydenver.com

End of Part II

Part III – CADD Procedures

Chapter 1 - Overview

Section 100 - Overview

DEN uses AutoCAD® Civil 3D® software, a dynamic, model centric based design software, as the Building Information Modeling (BIM) solution for civil engineering design and documentation. This information is for anyone authoring CADD/Civil 3D® models for Denver International Airport (DEN). This includes both DEN staff, as well as external service providers. The reader is assumed to have a base knowledge of CADD, Civil 3D®, and the workflows and terms common to the industry. This document presents baseline requirements for all BIM projects at DEN.

NOTE: Any of these requirements may be superseded by Project Contract or the project's specific BIM Project Execution Plan (BPXP).

100.1 Purpose

This document establishes the procedures for CADD/Civil 3D® submittals to Denver International Airport (DEN) and organization of CADD/Civil 3D® data within DEN. The procedures are necessary to ensure efficient EDI between DEN and its consultants, contractors, and local, state, and federal government agencies, including the City and County of Denver (CCD), Colorado Department of Transportation (CDOT), Federal Aviation Administration (FAA), Transportation Security Administration (TSA), and law enforcement agencies.

The presented procedures are designed to enforce commonality amongst data required throughout the lifecycle of DEN's airport facilities as well as ensure the compatibility of CADD/Civil 3D® data with the FAA's AGIS database, GIS standards, and metadata standards. CADD/Civil 3D® submittals from consultants are the basis of most Engineering/GIS data referenced by DEN. These procedures assist DEN in receiving and producing data that conforms to FAA Advisory Circular (AC) 150/5300/18b and best practices in planning/design/construction. By organizing data for better accessibility and maintainability, these CADD/Civil 3D® procedures are critical to supporting DEN's infrastructure throughout its life cycle.

100.2 Scope

This document provides procedures for the installation and use of the DIA CADD template as well as management of files, naming conventions, layers, colors, linetypes, and other CADD related properties. The DEN CADD procedures are based on the National CAD Standards (NCS) Version 4, AC 150/5300-18B, and DEN's Design Standards Manual (revised 2012). This document and associated template are intended to provide DEN consultants the baseline for creation of design drawings to be submitted to DEN. The consultant shall follow the procedures provided in this manual and utilize the layering format in the DEN CADD/Civil 3D® template.

A comprehensive set of layers is included in the CADD/Civil 3D® template to represent features typical for Airport projects and include layers provided in the NCS, FAA AC 150/5300-18B, and DEN legacy standards. The layers provided in the CADD/Civil 3D® template will be used to define objects and other data required by the FAA as well as additional layers typically used for design purposes. It is the responsibility of the Consultant/User to choose the appropriate layers and ensure that all data required by the FAA is submitted to the DEN in the proper format.

100.3 Proposing Revisions

This standard is intended to be updated and enhanced as deemed necessary by DEN over time. Recommended additions and suggested changes are to be directed to:

Name	Company	Phone Number	Email
Damon Amato	DEN	(303) 342-2621	Damon.amato@flydenver.com
Mark Hughes	DEN	(303) 214-5620	Mark.hughes@flydenver.com

End of Chapter

Chapter 2 – File Management and Organization

Section 200 - File Management and Organization

DEN uses a standard file format, naming, and directory structure associated with the type of information contained within specific files to ensure consistency in file management, file transfer, and file security.

200.1 File Type Definitions

The file types discussed in this chapter are used for developing project data. Configuration files such as drawing templates are discussed in the Workstation Configuration section.

Section 201 - Model Files

A model file contains the physical components of an existing or proposed site (e.g., roads, drainage structures, terrain models, buildings, etc.). Model files are drawn at full scale and represent plans, profiles, sections, etc. A model file can contain both 2D and 3D objects. Model files can be generated either by adding AutoCAD or Civil 3D objects or from BIM model extractions.

201.1 Design Files

Design files are model files where the majority of design activity takes place.

201.2 Data Reference Files

Data Reference Files (DREFs) are model files containing the original AEC objects produced by Civil 3D for sharing data across multiple design files. Data shortcuts are the Civil 3D mechanisms utilized to share this data. Creating a reference is the action taken to establish the link between the host and the source files for a particular AEC object.

201.3 Reference Files

Reference files are model files. Reference files can be DWG, DGN, PDF, DWF, and all image file formats supported by Civil 3D. Reference files usually provide background information for a model file or design information for a sheet file. DWG files that are referenced into other DWG files are often referred to as Xrefs. Model files can be referenced (Xref'd) into sheet files. Sheet files are never used as Xrefs.

The XREF type should always be "Overlay"

201.4 Sheet Files

A sheet file is synonymous with a plotted CAD drawing file. A sheet file is a selected view or portion of referenced model files within a border sheet introduction.

Section 202 - File Naming Conventions

These conventions standardize the naming and numbering of all project documents. All CADD documents shall contain a numbering system according to the criteria outlined below.

Section 203 - DEN File Naming Components – Project Plan Files

The components used to identify a file depend on the complexity and requirements of the project. The DEN file naming system consists of seven standard components and two optional components, as follows.

_	NNNNNNNN	-	L	N	L	L	-	N	NN	-	LNN
(1)	(2)		(3)	(4)	(5)	(6)		(7)	(8)		(9)

L = alphabetical character
N = numerical character

203.1 FAA Airport Improvement Program (AIP) Number – Used / Not Used

The FAA issues AIP numbers to track projects that have applied for FAA funding. If an AIP number is issued, it shall be entered into the drawing title block for identification and tracking. The two entries used for this identifier include,

- A = AIP Number associated with project
- _ = No AIP Number associated with project

_	95003001	-	F	1	C	G	-	1	01	-	CRDP

203.2 Project Identifier

A project number assigned by DEN Project Manager.

_	95003001	-	F	1	C	G	-	1	01	-	CRDP

203.3 Submittal Level

Single-character DEN submittal level identifier; refer to Table 203.3-1 for a list of identifiers. In this example, the F signifies that the submittal level is Contract Documents – 90%.

_	95003001	-	F	1	C	G	-	1	01	-	CRDP

203.4 Volume Number

The volume number is a single-digit identifier (1 through 9) that denotes individual volumes of a drawing set. The volume number allows for the splitting of individual sub-sets as required to properly detail an area of the project, i.e., Volume 1 for runway, Volume 2 for taxiway, etc.

_	95003001	-	F	1	C	G	-	1	01	-	CRDP

203.5 Level 1 Discipline Designator

This component identifies the subject matter in the file. For example, a civil sheet is denoted with a **C**. Refer to Table 203.3-2 for discipline designators.

_	95003001	-	F	1	C	G	-	1	01	-	CRDP

203.6 Level 2 Discipline Designator

This optional component further identifies the subject matter. For example, a civil grading sheet is denoted with a **G**, while a demolition plan is denoted with a **D**. These designators are not identified in any table included in this document. Refer to Table 203.3-3 for level 2 discipline designators.

_	95003001	-	F	1	C	G	-	1	01	-	CRDP

203.7 Sheet Type Designator

This is a single-digit sheet type designator. The **1** in this example denotes a Plan Sheet (horizontal views). Refer to Table 203.3-4 for a list of sheet type designators.

_	95003001	-	F	1	C	G	-	1	01	-	CRDP

203.8 Sheet Sequence Number

This component identifies sheet sequence in the set. The example denotes the first sheet of the 90% submission for Project 95003001, Volume 1, Civil Grading Plan.

_	95003001	-	F	1	C	G	-	1	01	-	CRDP

203.9 User-Defined Designators

This optional, user-defined component further identifies the project phasing, revisions, or redesign.

R = Revision

X = Redesign

A = Project Phase

The example denotes the first revision to the first sheet of the 90% submission for Project 95003001, Volume 1, Civil Grading Plan. Refer to Table 203.3-6 for user defined model type designators.

_	95003001	-	F	1	C	G	-	1	01	-	CRDP

Section 204 - DEN File Naming Components – External Reference Files (Xrefs)

DEN's file naming system for Xrefs coincides with the NCS Uniform Drawing System (UDS) and DEN legacy standards. The DEN Xref file naming system consists of three standard components and two optional components, as follows.

LLNNNNN	**-**	**L**	**L**	**LL**	**-**	**LNLN**
(1)		(2)	(3)	(4)		(5)

204.1 Project Identifier

The DEN contract number provided by the DEN Project Manager.

ce95003	-	C	G	SC	-	A1R1

204.2 Level 1 Discipline Designator:

This component identifies the discipline. For example, a civil model file is denoted with a **C** after the hyphen. Refer to Table 203.3-2 for discipline designators.

ce95003	-	C	G	SC	-	A1R1

204.3 Level 2 Discipline Designator

This optional, user-defined component further specifies the type of model discipline, as needed. For example, in the civil grading model file a **G** is added to the **C** designation. Use **–** if this option is not needed. Refer to Table 203.3-3 for level 2 discipline designators.

ce95003	-	C	G	SC	-	A1R1

204.4 Model Type Designator:

The example of the 2-character model type designator shows an **SC,** denoting a Section. The example file name denotes the Civil Grading Section for contract ce95003. Refer to Table 203.3-5 for standard model type designators.

ce95003	-	C	G	SC	-	A1R1

204.5 User-Defined Model Type Modifiers:

This optional, user-defined component further identifies the model type for aspects such as project phasing, revisions, or redesign.

R = Revision

X = Redesign

A = Project Phase

In this example, the file name denotes the first revision to the Civil Grading Section, Phase 1 development for Contract ce95003. Refer to Table 203.3-6 for user defined model type designators.

ce95003	-	C	G	SC	-	A1R1

Section 205 - DEN File Naming Components – Identifiers

The following tables provide the identifiers and their descriptions for use in naming project plan files and external reference files.

Table 203.3-1: Submittal Level Identifiers

Identifier	Description	Identifier	Description
P	Preliminary Design	I	Issue for Construction Set
D	Design Development	S	Shop Drawings
A	Design Standards Submittal	V	Record Drawings – Redline Submittal
C	Contract Documents – 30%	W	Record Drawings – Preliminary Submittal
E	Contract Documents – 60%	R	Record Drawings – Final Issue/As-Built
F	Contract Documents – 90%	M	Mapping/Topography
G	Contract Documents – 100%	Y	Planning Documents
B	Bid Documents	Z	Master Plan Documents

Table 203.3-2: Level 1 Discipline Designators

Discipline	Description	Discipline	Description
A	Architectural	M	Mechanical
B	Geotechnical	O	Operations
C	Civil	P	Plumbing
D	Process	Q	Equipment
E	Electrical	R	Resource
F	Fire Protection	S	Structural
G	General	T	Telecommunications
H	Hazardous Materials	V	Survey/Mapping
I	Interiors	X	Other Disciplines
L	Landscape	Z	Shop Drawings

Table 203.3-3: Level 2 Discipline Designators

Identifier	Description	Identifier	Description
AER	Aerial	LID	Lighting Detail
AVD	AVI Details	LIN	Lighting Notes

Identifier	Description	Identifier	Description
AVN	AVI Notes	LIP	Lighting Plan
AVP	AVI Plans	LOP	Sheet Layout Plan
BLD	Boring Log Data	MSC	Miscellaneous Sheets
BLM	Boring Log Map	MSL	Overall Milestone Layout Plan
BMP	Benchmark Plan	PEN	Pavement Elevations Notes
CFG	Conceptual Foundation Grading	PHM	Potholing Map
COV	Cover/Title Sheet	PMN	Pavement Marking Notes
CRS	Cross Sections	PVE	Pavement Elevations Plan/Det
CST	CDOT Standard Plans List	PVM	Pavement Marking Plans/Pvmt Details
DET	Detail Sheets	QTB	Quantity Tabulations
DMN	Demolition Notes	QTY	Summary of Approximate Quantities
DMP	Demolition Plan	RDT	Roadway Details
DPP	Drainage Plan And Profile	RPL	Roadway Plan
DRD	Drainage Details	RPP	Roadway Plan And Profile
DRL	Drainage Profiles	SCD	Structural Caisson Details
DRN	Drainage Notes	SCL	Structural Caisson Layout
DRP	Drainage Plan	SCN	Structural Construction Layout
ECD	Erosion Control Details	SED	Structural Excavation/Backfill Details
ECN	Erosion Control Notes	SEG	Structural Engineering Geology
ECP	Erosion Control Plan	SGL	Structural General Layout
EES	Excavation Earthwork Summary	SGN	Structural General Notes
ELD	Electrical Details	SLD	Structural Slab Reinforcing Details
ELN	Electrical Notes	SMD	Structural Miscellaneous Details
ELP	Electrical Layout Plan	SPD	Structural Panel Details
FCD	Fence Details	SSD	Structural Details
FCP	Fence Plan	STY	Structural Typical Section
FIO	For Information Only	SUR	Survey Control Plan
FSM	Fill Settlement Markers	TDT	Track/Platform Details
GED	Geometry Data	TOP	Topography
GEP	Geometry Plan	TPL	Track/Platform Plans
GNN	General Notes Sheet	TPP	Track/Platform Plan And Profile
GRA	Grading Plan	TTB	Title Block
GRN	Grading Notes	TYP	Typical Sections
GUT	General Utilities	UTD	Utility Details
HRT	Haul Route	UTN	Utility Notes
IMG	Images	UTP	Utility Plans
IND	Index of Drawings	UTX	Utility Text (Base)
INF	Infrastructure/Site	VMS	Vicinity Map Sheet
JTD	Joint Layout Details	WDT	Retaining Wall Details
JTN	Joint Notes	WGL	Retaining Wall General Layout
JTP	Joint Layout Plan	WTY	Retaining Wall Typical Section

Identifier	Description	Identifier	Description
KEY	Key Map		

Table 203.3-4: Sheet Type Designators

Sheet Type	Description	Sheet Type	Description
0	General	5	Details (Misc.)
1	Plans	6	Schedules/Diagrams/Qtys Table
2	Elevations/Profiles	7	3D Representations
3	Sections/Cross Sections	8	User-Defined
4	Large-Scale Views/Vicinity Maps	9	User-Defined

Table 203.3-5: Model Type Designators

Identifier	Description	Identifier	Description
3D	Isometric/3D	GP	Grading Plan
CP	Construction Plan	PP	Phasing Plan
DG	Diagrams	QP	Equipment Plan
DP	Demolition Plan	RP	Roof Plan
DT	Detail	SC	Section
EL	Elevation	SH	Schedules
EP	Enlarged Plan	SP	Site Plan
ER	Erosion and Sediment Control Plan	XP	Existing Plan
FP	Floor Plan	01, 02, 03	Sequence

Table 203.3-6: User Defined Designators (Project Code Example)

Identifier	Description
CRDP	Combine Roadway Design Package
CSPA	Contractor Staging and Parking Area
EARD	Emergency Access Road
ESPR	East Side Parking Plaza Exit Road
EWPA	Excavation Phase I
EWPB	Storm Sewer
EWPC	Utilities Phase I
EXP2	Excavation Phase II
LARD	Limited Access Road
NOX	North of the **X**
T1RD	T-1 Roadway
TL5B	Terminal Level 5 Bridge Extensions
TRRP	Level 4, 5, 6 Traffic Rerouting Package
UTP2	Utilities Phase II

End of Chapter

Chapter 3 – Configuring the Working Environment

Section 300 - Configuring the Working Environment

This chapter describes the folder structure and content for the DEN Standard CADD/Civil 3D® Templates. Files and folders described here are available (shared) to all DEN staff and consultants working on DEN CADD/Civil 3D® projects. **NOTE:** Content is accessed differently by DEN staff than DEN consultants.

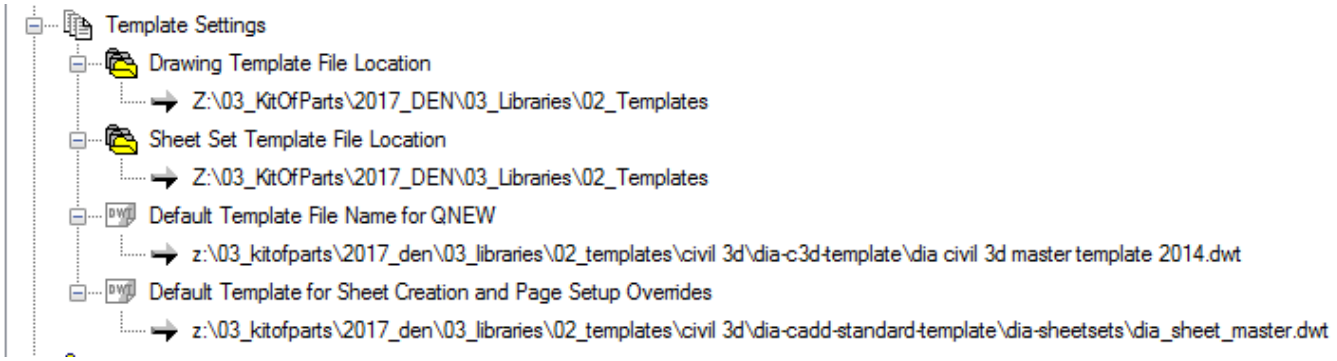
DEN staff has access to an internal "master" content library, a project specific library, and local workstation folders from which to begin projects and maintain related standards material. A current reproduced copy will be provided to DEN consultants from which they can begin their respective projects.

For DEN consultants, this library (DEN Standard CADD Templates) will contain the DEN "Kit of Parts" and will be transferred to their local server/network via FTP, or provided on a disk, after successful request to, and acceptance of, the DEN Project Manager. This folder structure can then be integrated into the consultants' office project folder structure, and made available to all project staff members.

Section 301 - Civil 3D Custom System Configuration

301.1 AutoCAD Options Dialog

1. Substitute your network path in place of the example shown below.



2. Default Template File Name for QNEW should use the example above if you are primarily working in Civil 3D and creating model files.

   (H:\Standards\DEN-CADD-STANDARD\CIVIL 3D 2012\Template\DEN Civil 3D Master Template.dwt)

3. Users working with just AutoCAD will use the DIA_CADD_STANDARD.dwt

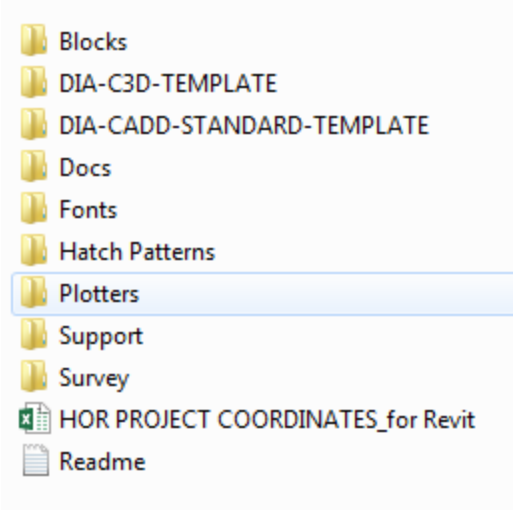
   The DIA_CADD_STANDARD template contains standard border layouts, tool palettes, layers, and is connected to the drawing standards file (.dws) to be used with the CAD Standard command. The drawing standards file helps users check for compliance errors with Layer settings.

301.2 AutoCAD Settings

DIA_CADD_STANDARD.dwg is the defining repository for AutoCAD Settings. The file is separate from the Civil 3D template so it can be kept clean from any content automatically added by vertical applications such as Civil 3D. It is intended to be a starting point for gathering template settings for all AutoCAD based applications including AutoCAD by itself.

301.3 Folder Structures

Within the BIM (\\diagis07) (Z:)\03_KitOfParts\2017_DEN\03_Libraries\02_Templates\Civil 3D\...you will find the following file structure:



The 03_KitOfParts Folders are not project data folders but contain sharable libraries of drawing content and files for configuration purposes. This enables the standardization of AutoCAD applications in a multi-user environment by having this folder structure available in a shared folder on a network accessible by all CAD users who need a DEN-compliant environment. The top levels of folders are described below.

Refer to the Readme.txt file for instructions on configuration.

301.4 Blocks

The Blocks folder contains DWG files with block definitions arranged in logical groups similar to the AutoCAD Sample folder.

301.5 CIVIL 3D 2017

The ..\03_KitOfParts\.. folder contains Civil 3D specific content. When a new version is available, a new folder will be created.

AutoCAD files that are specifically designed to be void of all Civil 3D content are found in the ...\DIA-CADD-STANDARD-TEMPLATE\... branch of the 03_KitOfParts folder structure

301.6 DIA-CADD-STANDARD-TEMPLATE

Drawing templates in this folder are for use with plain AutoCAD versions that are not Civil 3D or Map 3D.

A SheetSets folder is located within the DIA-CADD-STANDARD-TEMPLATE folder. In keeping with the philosophy of organizing AutoCAD specific and Civil 3D specific content in separate folder branches

301.7 DIA-SHEETSETS

The DIA-SHEETSETS folder contains the DEN Sheet Set Master.dst file and the DEN Sheet Set Master.dwt file.

..\DIA-CADD-STANDARD-TEMPLATEDIA-SHEETSETS

301.8 Plotters

The Plotters folder contains shareable plot configuration files (.pc3). Your DEN Civil 3D profile should point to this folder when configured for a shared settings environment.

301.9 Utilities

The Utilities folder is intended to store lisp files and other productivity enhancements made available to assist CAD users.

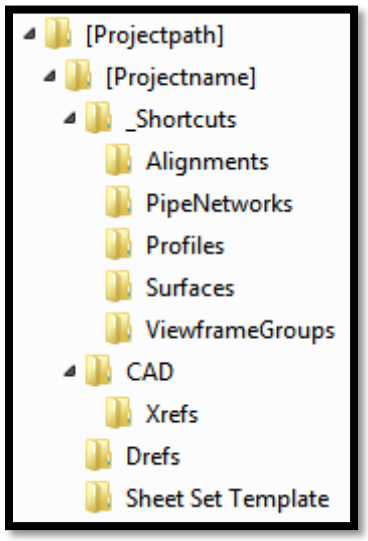
Section 302 - CADD Projects Folder Structure

A Project Folder Template is shown below as the suggested folder structure for all Civil 3D projects.

302.1 Definitions

- [Projectpath] = Substitute your network path down to the root folder for your projects
- [Projectname] = The folder name of the project

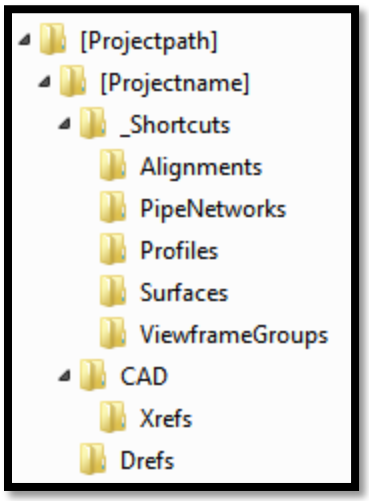
Typical Project Folder Structure



302.2 File Organization within Project Folders is described below.

A. Master Project Folders Template

The Master Project Folders Template is designed as a starting point for organizing files within a Civil 3D Project.



The [Projectpath] illustrates a placeholder for what the user can substitute with the drive letter and folder structure above the Civil 3D Project folder structure.

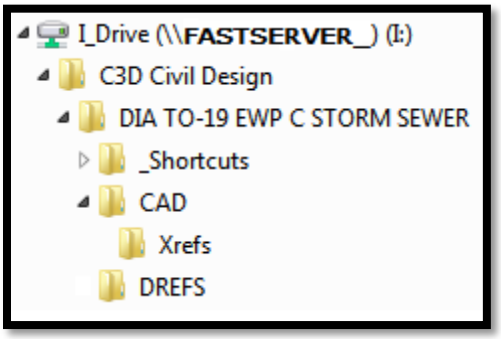
The [Projectname] represents the Civil 3D project root folder.

Example:

Projectpath = I:\C3D Civil Design\

Projectname = 95003001-1 C G-101- CRDP

The resulting folder structure is shown below.



302.3 [Projectname]

- Sheet Files and Sheet Sets (dst) go in the root [Projectname] folder
- Use Sheet Set Manager to create an Index of Drawings

302.4 _Shortcuts

Data shortcuts are automatically populated by Civil 3D. Do not delete anything in here.

302.5 CAD

CAD folder contains model drawings for design that are not data references. These dwg files are Xref'd into Sheet Files

302.6 Xrefs

Background drawings, reference files in other formats (PDF, DGN, DWF, image files) and project specific aerial photos are stored in this folder. GIS files used for background information are stored in this folder.

302.7 Drefs

Contains model drawings for design that are used as data references

302.8 Sheet Set Template

- Contains the typical sheet set files that are specific to this project
- Contains project specific Sheet Set Template file (.DWT) DEN_PROJECT_SHEET_MASTER.dwt
- Contains project specific Title Block drawings (.DWG)
- Contains the project specific Master Sheet Set Definition file (renamed to DEN Project Master.dst)

Section 303 - DEN Standard Symbols Tool Palette Setup

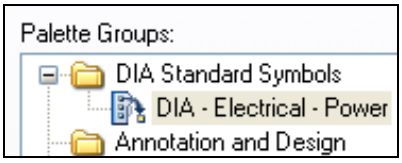
Once the DIA CADD template has been properly setup in AutoCAD, the DIA Standard Symbols Tool Palette can be imported. The DEN Tool Palette includes standard blocks, symbols, linetypes, hatch patterns, etc. according to DEN legacy standards. Where linetypes, hatch patterns, etc. are not specified, use standard AutoCAD linetypes, hatch patterns, etc.

The steps for setting up the DIATool Palette are as follows:

1. Open a new drawing after the DEN template file (DIA_CADD_STANDARD.dwt) has been installed.

2. Type “tp” followed by the enter key into the AutoCAD commandline. The AutoCAD default tool palettes will open.
3. Right mouse click in a blank area on the tool palette. This will open a menu with various selections.
4. Select “Customize Palettes…” on the menu. This will open the Customize dialog box.
5. Right mouse click in a blank area in the “Palettes” column of the Customize dialog box. This will open a menu with various selections. Select “Import…”.
6. Locate the DEN Palette files (*.xtp) in the DIA-TOOL-PALETTES folder located within the DEN production package provided by DEN.
7. For DEN Users see: \\Diagis05_resources\STANDARD-TEMPLATE\DEN-TOOL-PALETTES
8. Select a desired tool palette file and click the “Open” button. Only one file may be selected at a time. Complete the next steps prior to loading all tool palettes. This will expedite the process.
9. Once the DIA .xtp file is imported, right mouse click in a blank area in the “Palette Groups” column of the Customize dialog box. Select the “New Group” option.
10. Name the new group folder “DIA Standard Symbols”. The new group folder will be created in the folder highlighted in the previous step.

11. Select the “DIA Standards Folder” and drag it so that it is not a subfolder within another group as shown here.
12. Drag the previously imported DIA .xtp file over to the newly created folder as shown here.



13. Right click the “DIA Standard Symbols” Palette Group folder that will open a menu with various selections.
14. Click “Set Current” to change the current tool palette to the “DIA Standard Symbols” Palette Group.
15. The “DIA Standard Symbols” Palette Group folder will now be highlighted bold showing that it is the current tool palette. Only the DEN tool palette tabs will be displayed in the tool palette menu.
16. Repeat Step 8 for all remaining DIA tool palettes. The newly imported tool palettes will automatically be placed in the “DIA Standard Symbols” group.
17. Click the “Close” button to exit the Customize dialog box.
18. The images may not be displayed for all tools in the tool palettes. In the event this happens, close AutoCAD and restart the program. The images should load after restarting.

The DIA Standard Symbols Tool Palette is now ready for use. When applicable, the User must use the elements provided in the tool palette in the creation of all drawings.

Section 304 - DEN Standard Symbols Tool Palette

DIA Standard Symbols are provided in the “DEN Standard Symbols” Tool Palette previously installed. The blocks within the DIA Tool Palette are those provided in the “DIA Master Symbols” drawing, included in the DEN CADD Production Package. The “DIA Master Symbols” drawing is not to be modified unless permission is received from the DEN Project Manager.

The intent of the DEN Tool Palette is to improve production by locating all DEN symbols used for design purposes within the AutoCAD workspace. The symbols and blocks provided in the tool palette must be used in the design drawings submitted to the DEN when applicable.

The symbols are arranged by a major discipline (Figure 204.3-1). The individual discipline palettes are arranged into tabs located on the side of the tool palette. By clicking on a specific tab, the selected discipline will move to the top, displaying the symbols within the discipline.

Section 305 - Den Layer Standard

305.1 Abbreviations

The following abbreviations are used in the FAA layer list:

Identifier	Description
1M	1MM
C	Continuous
DS	Dashed Spaced
FT	Feature Type
L	Line
LT	Linetype
LW	Lineweight
P	Point
PG	Polygon

305.2 CADD Standard Layers

The DIA CADD Template contains layers commonly used in the development of design drawings for Aviation/Airport projects. The layers include those identified in the NCS, DEN specific layers, and FAA layers used to satisfy the requirements of AC 150/5300-18B. Airport specific layers were created in accordance with the layer naming guidelines provided in the NCS. A description for each layer is provided to identify what objects/features should be located on the layer.

A full list and description of DEN approved layers is provided in Appendix B, which includes:

- NCS layers relevant to DEN and not provided in the FAA layers
- DEN specific layers created to supplement the NCS layers and FAA layers
- FAA AGIS layers associated with each feature class of each feature group

305.3 Layer Groups

The DIA_CADD_STANDARD.dws file contains layer filter groups.

305.4 DEN Layers

The DEN Layers group includes NCS and DEN specific layers. The group is filtered according to the major discipline groups identified in the NCS to improve layer selection efficiency. The layers within each of the disciplines are further filtered into minor groups according to the type of feature it is intended to represent.

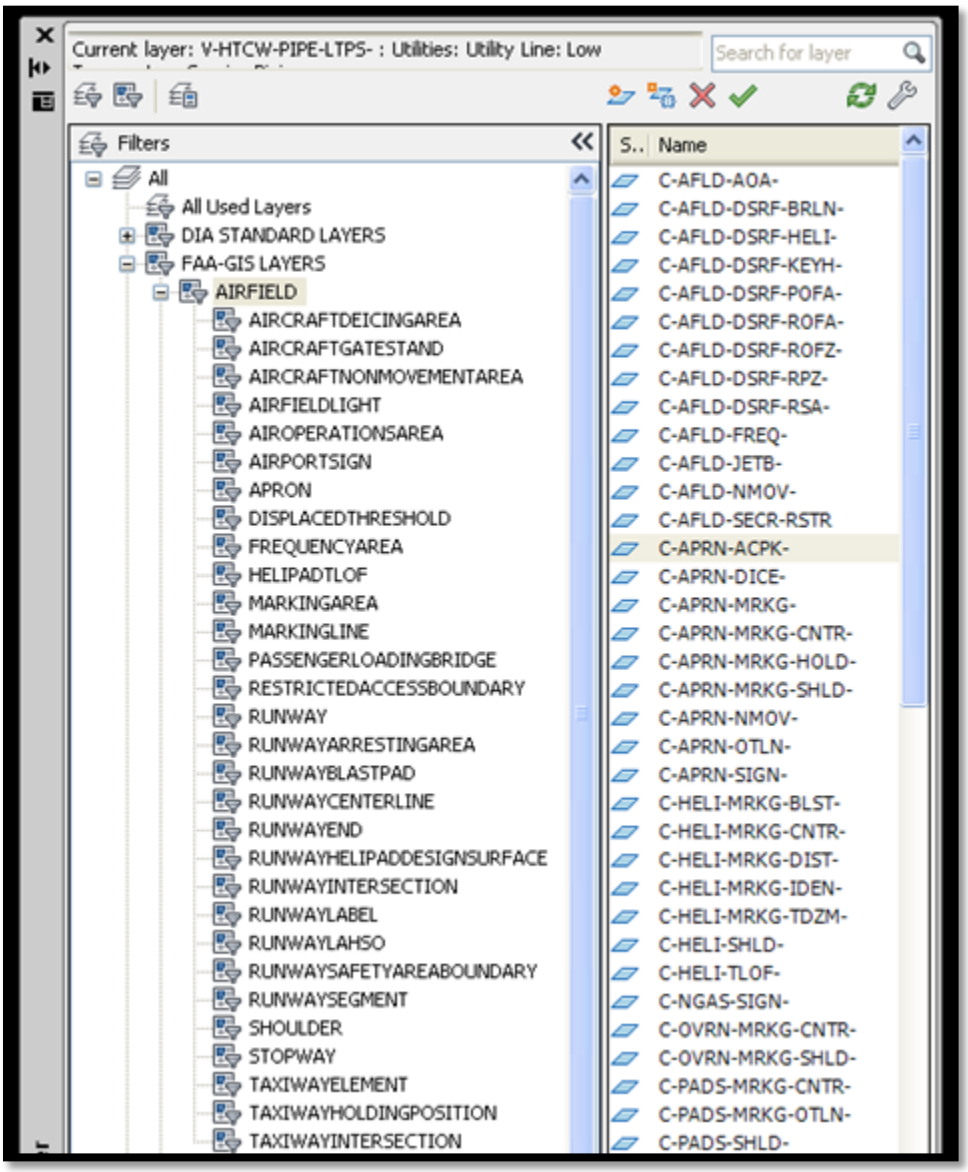
305.5 FAA AGIS Layers

FAA AGIS Layers were created utilizing the samples provided in AC 150/5300-18B. In certain instances, layers were either added or revised to better correspond with NCS guidelines, provide the level of detail typical for design drawings, and/or minimize uncertainty when determining what data is required by the FAA.

The FAA layers are arranged similarly to the NCS Layers in that the layers are filtered according to the FAA feature group. Each feature group filter (e.g., Airfield) contains several additional filters for the appropriate feature class (e.g., Airfield Light) within the group.

As shown in Figure 305.5a, each feature class filter contains the layers used to represent the airport features associated with the class. The intent is to familiarize the User with the new FAA AGIS standards. When preparing a drawing for submittal to the FAA, objects on layers within each feature class will be converted to the FAA AGIS layer for that class, which is typically the feature class name.

Figure 305.5a: FAA AGIS Layers

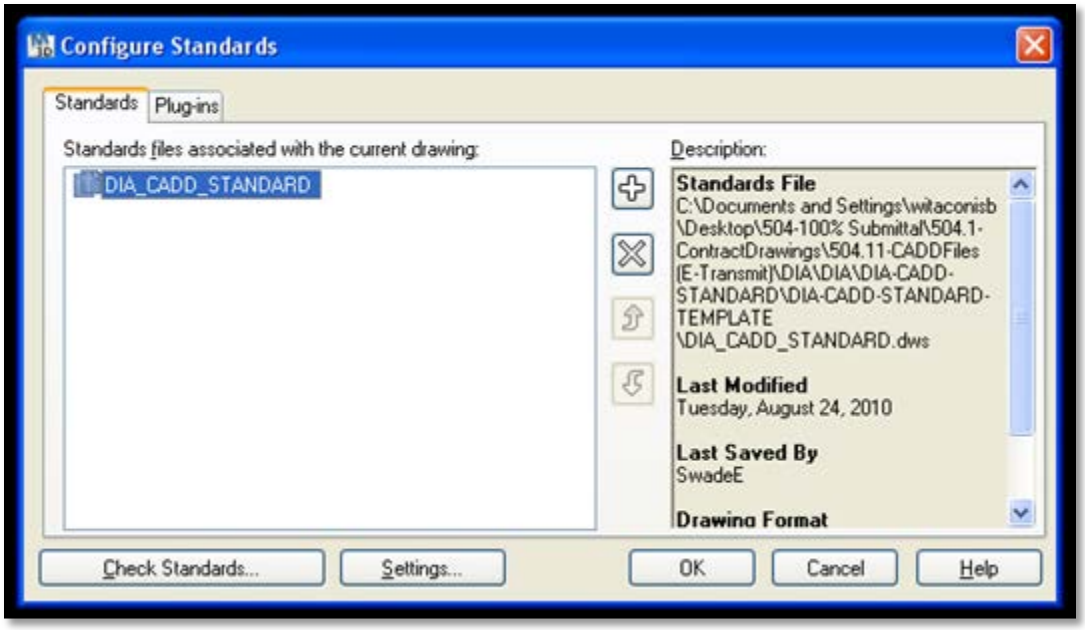


Section 306 - Drawing Standards Check

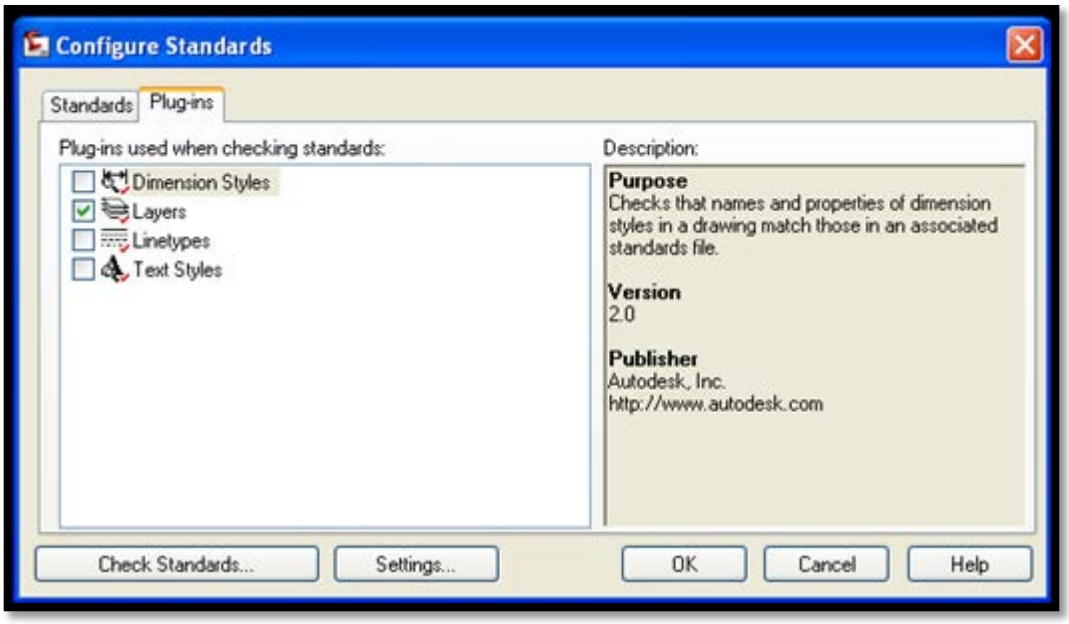
The DIA Drawing Standards file (CADD Check Template) has been included in the DIA CADD Standard to ensure conformance with DEN CADD Procedures. All CADD production drawings must be checked for conformance prior to submission to DEN.

306.1 Configure Standards

Use the Standards Command to open the Configure Standards dialog.



1. Choose the Add (large plus sign) button.
2. Browse to the ..\DIA-CADD-STANDARD\DIA-CADD-STANDARD-TEMPLATE\DIA_CADD_STANDARD.dws file.



3. On the Plug-ins tab, check only Layers.
4. Clear all other check boxes.

306.2 Check Standards

1. Choose the Check Standards button to open the Check Standards dialog. The current drawing is scanned for layer violations.

End of Chapter

Chapter 4 – Drawing Procedures

Section 400 - Drawing Procedures

The following sections discuss the procedures for creating and submitting drawings to DEN.

400.1 Overview

Every drawing should be in the world UCS with the origin at 0,0. Use the same coordinate system as the base map provided by DEN. It is important to maintain an accurate coordinate system in order to allow the exchange of design information among the project team and allow information from different design groups to be displayed together easily. Each design drawing (model file) should be in model space (with nothing in paper space) and should have no other drawing files externally referenced (XREF'd) into it. As you are working on your drawing, you will have the base and other design drawings externally referenced during your drawing session, but when you are complete, it is important to unload but not detach all XREFs. The Basic Drawing Guidelines will cover these topics and other best practices to follow during drawing development.

400.2 Standard Text and Dimension Styles

DEN uses AutoCAD default text and dimension styles. All text shall be UPPERCASE and easily readable on half-size prints. Plotted text heights are provided in table below.

Table 206.1.2-1: DEN Text Heights

Height	Item
3/32"	Normal Text, Notes, Dimensions
1/8"	Sub-Headings
5/32"	Headings

400.3 Standard LineTypes, Colors, Lineweights, and Hatch Styles

DEN uses AutoCAD default line types and hatch styles unless otherwise required and specified by the DEN Project Manager or FAA requirements.

DEN uses the following line weights on drawings unless otherwise required and specified by the DEN Project Manager or FAA requirements.

Table 206.1.3-1: Standard LineTypes, Colors, Lineweights, and Hatch Styles

Color	AutoCAD Number	Pen #	Inches	MM
Red	1	7	0.03	0.7
Yellow	2	7	0.02	0.5
Green	3	7	0.02	0.5
Cyan	4	7	0.015	0.35
Blue	5	7	0.015	0.35
Magenta	6	7	0.01	0.25
Black/White	7	7	0.01	0.25

Color	AutoCAD Number	Pen #	Inches	MM
Peach	11	7	0.05	1.2
Gray	253	253	0.01	0.25
Light Gray	254	254	0.01	0.25
Brown	12	7	0.005	0.127

End of Chapter

Chapter 5 – Plan Production

Section 500 - Plan Production

The Plan Production techniques introduced herein are considered best practices for automating processes for producing nearly complete sheets in very few steps. Training is strongly recommended to acquire skills needed to utilize these tools effectively. DEN submittals are to follow the Plan Production process to minimize large submission packages of multiple files.

500.1 Overview

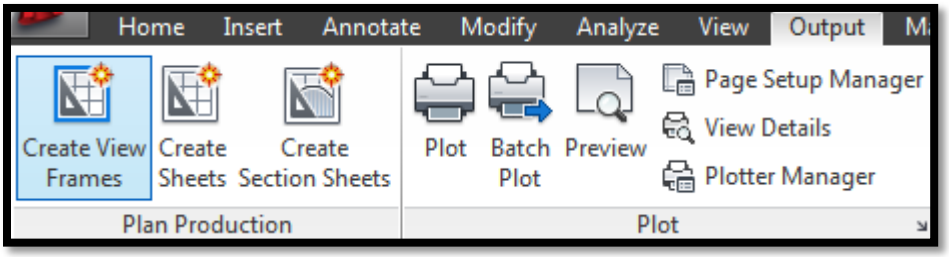
Plan Production is the process of creating individual Sheets for inclusion in a plan set. The result of several possible Plan Production processes is a set of plans either plotted on paper or contained in a pdf file.

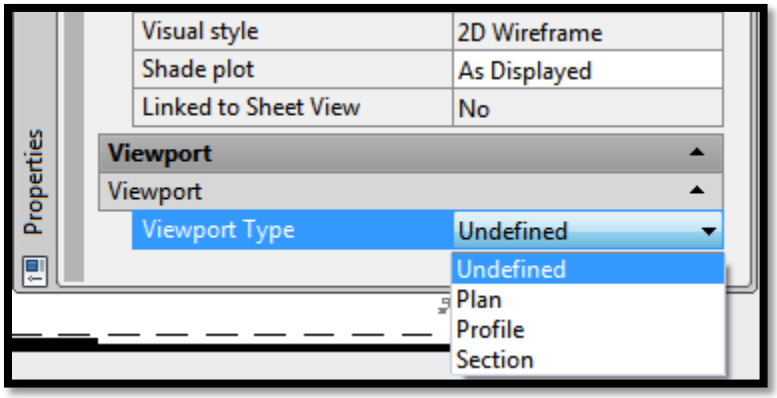
The Plan Production process can be as simple as creating Layouts manually and using the PUBLISH command to plot drawings. Another method employing a little more automation involves creating layouts, creating a Sheet Set and manually adding layouts. Using Sheet Set Manager, you can batch plot drawings. You can use plain AutoCAD for both these techniques.

The most automated technique uses the Plan Production Tools found in Civil 3D. You can create Plan Sheets, Plan and Profile Sheets, or Section Sheets using Civil 3D's Plan Production Tools. The DEN Kit of Parts includes drawing templates (.DWT) and a Sheet Set data file (.DST) ready to use with the Plan Production Tools.

500.2 Plan Only, Plan/Profile, and Profile Only Sheets

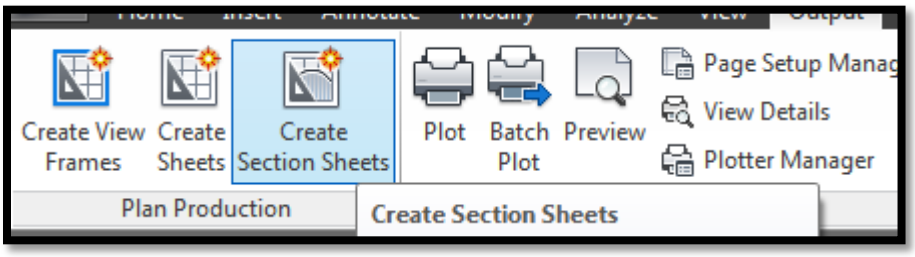
The Plan Production Tools begin by creating View Frames along an Alignment.





The Create View Frames wizard requires you to select a template file that contains a pre-configured layout having a scaled viewport set to Plan as the Viewport Type. A View Frame Group is created when the Create View Frames wizard is completed. The Create Sheets command launches another wizard designed to produce a layout for each View Frame.

500.3 Section Sheets



Similar to the Create Sheets command, the Create Section Sheets command starts a wizard that uses the Section Sample Line Group and other settings to create layouts that place Sections Views in scaled viewports.

500.4 Sheet Set Manager

With the Sheet Set Manager, you can create “links” to drawings (Layout Tabs) called sheets. Sheets can be organized under logical headings called subsets, can display thumbnail images and descriptions, and can be used to open the drawings. There is much more to Sheet Sets that can be learned in a short time by working through some tutorials or enrolling in a training class.

Section 501 - Plotting Configuration

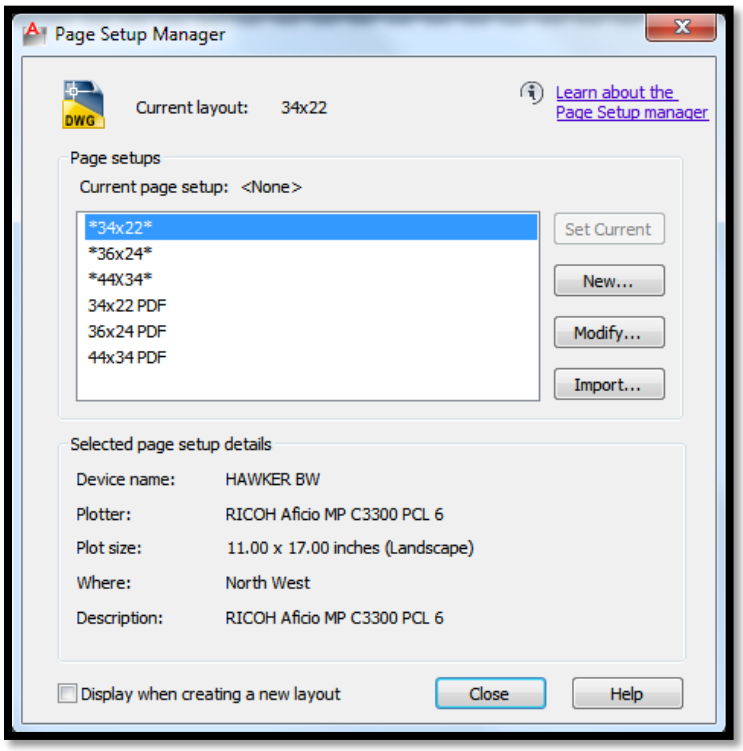
501.1 Plot Styles

Plot Styles are color based .ctb files. Their only purpose is to convert color to black and white or screen a particular color. Lineweights are defined by layer in the drawing. There are no lineweights in the plot style table.

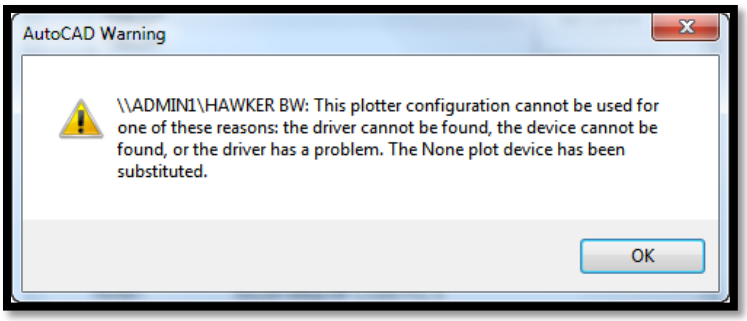
501.2 Plot Configuration Files

Plot configuration files (.pc3) should be shared on a network so named page setups stored within drawing templates can refer to them.

501.3 Plot Device Naming



Agree to use the same name for each specific plot device in your office to avoid warnings such as this one shown below. Using a common name will help you avoid slower AutoCAD performance due to invalid device references.



501.4 Page Setups

Page setups capture a snapshot of all the settings in the Page Setup dialog. Using the Page Setup when plotting allows you to recall the exact same group of settings by choosing the Page Setup name from a list.

Section 502 - Denver International Airport Low Distortion Projection System

All design files submitted in CADD format must be produced and submitted using the DEN Low Distortion Projection (LDP) Coordinate System. This coordinate system is coded into the DEN template. When using the template for the first time on your computer, you will be asked if you want to add the DEN LDP coordinate system to your Library. Please click on the yes button to set up the coordinate system on your machine.

Section 503 - Civil 3D Guidelines

503.1 Civil 3D Best Practices

503.2 Miscellaneous

- In Profile Views, do not use a clipped grid.
- For Pipes in Profiles, use the boundary option rather than the model option.
- Label Styles - create a No Label style to give you the option of turning off labels without deleting the label.
- For Point Label Styles put all text components in a single component instead of separate components.

503.3 Surfaces

- TINs are more memory intensive than DEM.
- Use external ASCII point files rather than point objects in the drawing.
- Create a surface snapshot after sampling the point file. The file size increases but the rebuild times improve.
- Adding contour data - Understand the settings for Minimizing Flat Areas.
- Avoid Surface Editing - filling gaps and adding points is much faster than swapping edges. Plus you have no evidence for what has been altered.
- Minimize points used to create surfaces.
- Surface Simplification is an Editing tool that decimates points without affecting accuracy.
- Create a grid surface if you do not need the precision of a TIN Surface. You can grid a surface by exporting it to a DEM.
- Display of triangles and contours can slow down the display. Minimize displayed data when appropriate.
- Use an outer boundary to reduce data processed in the surface.
- Use Data Clipping instead of Masking the surface.
- Cropped Surfaces are linked to a parent surface but process a smaller portion of the data.
- Query GIS Data to create a surface.

503.4 Corridor Models

- In Subassembly styles, use solid fills instead of hatch patterns.
- Turn off Rebuild Automatic.
- Isolate Regions so you are not processing the entire corridor.
- Reduce Cross Sections in the corridor drawing during preliminary design.
- Xref the corridor into a separate drawing and sample sections in that drawing. Use a data shortcut for the alignment.

503.5 AutoCAD Best Practices

- Layoutregenctl is best set to 1.
- Proxy Graphics should be turned off until you are ready to share your drawing with other non-civil 3D users.
- Turn off Tool Tips and Event Viewer if not needed.

503.6 Data Management Methods

- Using one drawing is best suited for small projects.
- Using Data Shortcuts is best for sharing data across multiple drawings.
- Using Data Management Server applies the same principals as Data Shortcuts but has the requirement of a Server Component that may be undesirable for teams without adequate IT support.

503.7 Civil 3D Labels

Automatic labeling capabilities are found throughout Civil 3D. Label Styles control the behavior and content of these labels. Civil 3D Label Styles and Settings are located under the Settings Tab within the Toolspace palette. The Civil 3D drawing template “DEN Civil 3D Master Template.dwt” contains the Label Styles for use on DEN projects.

To view a list of just label styles choose the drop-down list on the Settings tab of the Toolspace and select Labels Only View.

503.8 Stationing

Stationing shall be indicated in relation to the scale as follows:

Scale	Station at
1" = 50'	Each 100 ft
1" = 100' or greater	Each 500 ft.

The station shall be identified by a tick mark 1/8" long. The numerals shall be 3/32" high. Station equalities shall be shown as a 1/8" open square. The equation shall be shown on a fine line drawn perpendicular to the stationed line.

503.9 Civil 3D Styles and Settings

The Civil 3D drawing template contains the pre-configured command settings and style definitions compliant with the DEN CAD Standard. Begin all model files using this Civil 3D template. Survey Descriptor Codes

The Civil 3D drawing template provided in this Standard contains the Description Key Set defining the Survey Descriptor Codes.

Section 504 - GIS Data Workflow

All drawings submitted for the purpose of satisfying FAA or DEN GIS standards must conform to the general geometric standards for GIS data. The FAA has established a system of feature classes representing the various areas of an airport (Airfield, Airspace, Man Made Structure, etc.) and feature types representing elements within each feature class. Each object for each feature type is represented by a point, line, or polygon. GIS compatible drawings submitted to the DEN must conform to the geometric requirements and topological integrity required for GIS compatibility.

504.1 Terms and Definitions

Term	Definition
Attributes	Tabular data associated with graphical objects such as points, link, or polygons.
Layer	In GIS, a layer refers to a data layer comprised of either points, links, or polygons.
Point	XYZ location with a unique identifier as an attribute.
Link	A linear object defined by points at the beginning coordinate and ending coordinate of the line.
Polygon	A collection of links forming a closed 2D area.
AutoCAD Primitives	Native AutoCAD object including point, line, polyline, circle, block insert, text, mtext.

Term	Definition
AutoCAD Civil 3D AEC Objects	Custom objects created by Civil 3D commands in the form of Points, alignments, Surfaces, Pipe Networks, Corridor Models and more.
Object Data	Object data is attribute data that is attached to individual objects and stored in tables in the drawing.

504.2 AutoCAD Primitives to GIS

Use the FAA Object Data Table as a starting point.

504.3 Creating a New Drawing

The FAA provides the specification for an Airports GIS compliant deliverable. Before you can begin the process of converting AutoCAD objects to fully attributed GIS data you must prepare the proper environment.

504.4 Source Files

The FAA provides a drawing file (AC_150_5300-18B_ACAD2007_TEMPLATE_04012011.dwg) that contains the Object Data Table definitions.

Visit this FAA web site and download the file. Object Data Tables must be completed for all elements within the FAA required feature classes on all projects.

- https://airports-gis.faa.gov/public/data/FeatureClass_Templates/AC_150_5300-18B_ACAD2016_TEMPLATE_10062016.zip

Find information about the FAA Airports GIS here. https://airports-gis.faa.gov/public/surveyorsIntro.html

504.5 Setup

Project data for DEN submittal drawings must use the DEN_LDP coordinate system. If for some reason the DEN template you are using does not have the proper Object Data associated, insert AC_150_5300-18B_ACAD2016_TEMPLATE_10062016.dwg into a drawing created using DEN Civil 3D Master Template.dwt with OD tables. The result gives you the correct coordinate system, the Airports GIS Object Table definitions, plus 100 additional layer definitions used in the process of preparing CAD data for export to GIS.

Section 505 - FAA Object Data Tables

To view the Object Data Table Definition, choose the Define Object Data command on the Map Setup tab in the Planning and Analysis Workspace.

Section 506 - Draw Geometry in AutoCAD Civil 3D using Lines, Arcs, Polylines, and Blocks

Data that represents objects that are normally not modeled as AEC Objects using Civil 3D commands. These objects could be existing utilities, easements, fences, parking spaces, or light poles for example.

506.1 Use Drawing Cleanup Tools to Perfect Geometry

Drawing cleanup helps you improve the accuracy of your maps, correct common map errors (resulting from surveying, digitizing, scanning errors, for example), and remove unnecessary detail from complex maps. This is essential when you need accurate and complete maps suitable for defining topologies or performing map analyses. GIS is very strict on having correct geometry. As a best practice, use the Drawing Cleanup Tools to check and correct drafting errors. Following the rules of geometry for Topologies will give you the best results.

You can perform the following cleanup actions:

- Delete duplicate objects
- Erase short objects
- Break crossing objects
- Extend undershoots

- Extend to apparent intersections
- Snap clustered nodes
- Dissolve pseudo nodes
- Erase dangling objects (overshoots)
- Simplify objects
- Delete zero-length objects
- Weed 3D polyline vertices

Section 507 - Add Object Data to AutoCAD Object in the Drawing

Now that you have near perfect geometry switch to the Planning and Analysis Workspace in Civil 3D. Go to the Create Tab > Drawing Object panel and choose the Attach/Detach Object Data command.

Choose the Attach to Objects to assign the appropriate fields from the appropriate tables to the corresponding drawing objects.

Section 508 - Edit Object Data to Populate Data Fields

After Assigning object data to the drawing objects, you shall enter values in the Properties Palette. Editing data this way works with multiple objects selected to reduce the number of individual edits required

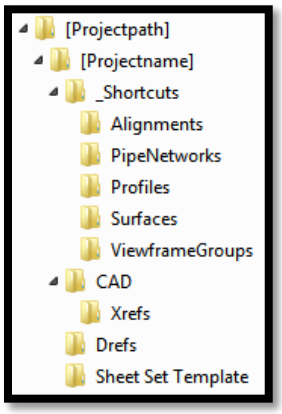
End of Chapter

Chapter 6 – Delivering CADD Data to DEN

Section 600 - Delivering CADD Data to DEN

600.1 Overview

CADD data is mostly in the form of .dwg files. By following the DIA CADD Projects Folder Structure, you will have all the required files in just a few folders beneath the project root folder.



Files within this folder structure can be easily compiled into one zip file. The deliverable is a single zip file with the name following Sheet File naming convention.

Section 601 - Programs to create Zip files

601.1 Metadata

Metadata is required for all submittals from designers, planners or other professional services providers.

601.2 Autocad Map 3D help

601.3 Creation of templates from existing metadata

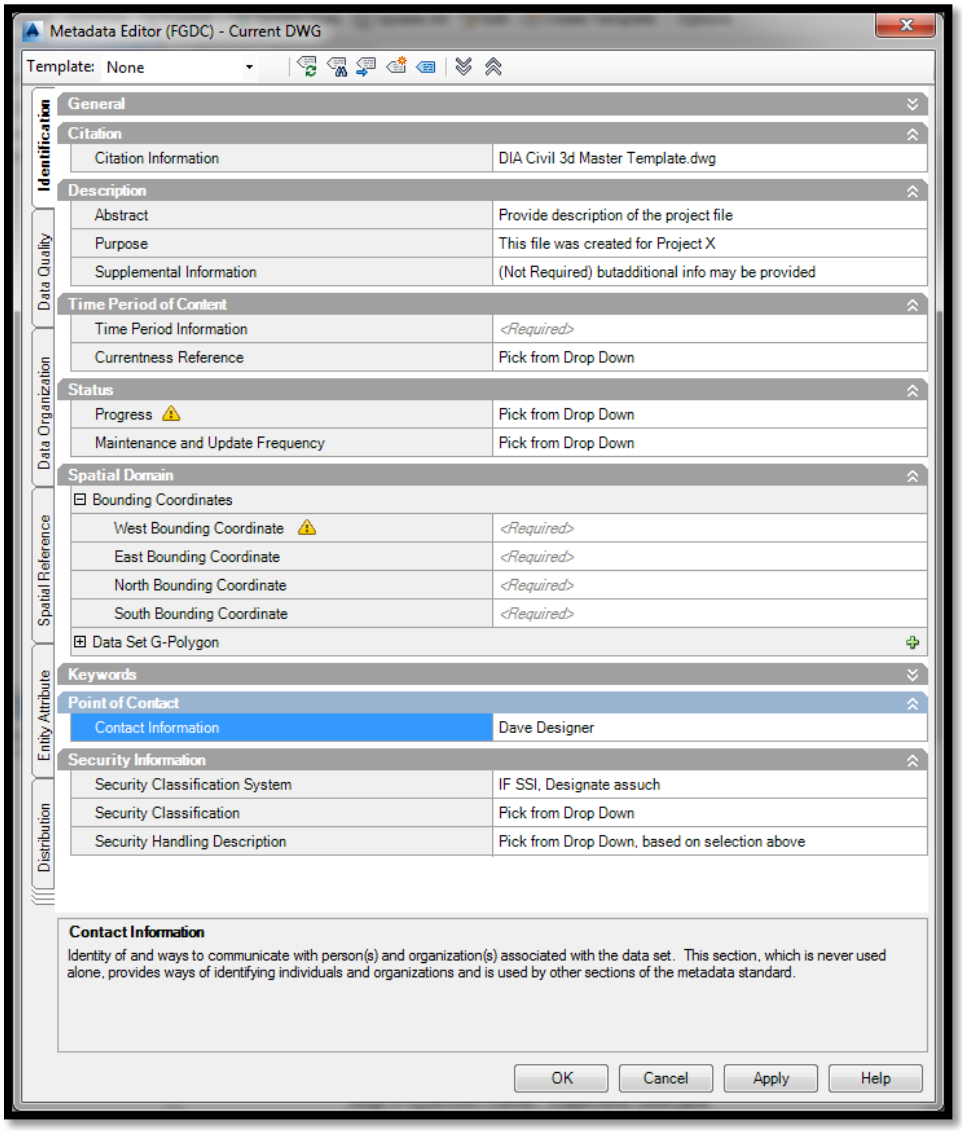
Once you have completed a valid metadata file with all the required fields, you can use it as a starting point for other DWGs.

Metadata is required for all submittals from designers, planners or other professional services providers. Example 2012.4-1 lists the required metadata fields that must be submitted for CADD, GIS and other electronic documents as part of the data submittal process. The table describes each field and lists its functionality and/or how that field will work within the metadata submittal form.

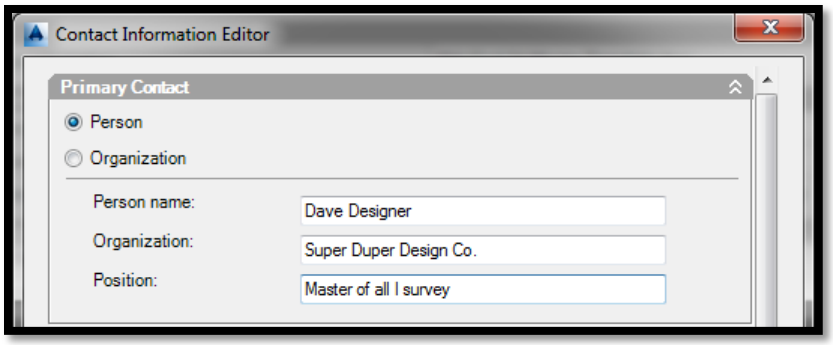
The following example defines the additional metadata that needs to be completed for submitting CADD data.

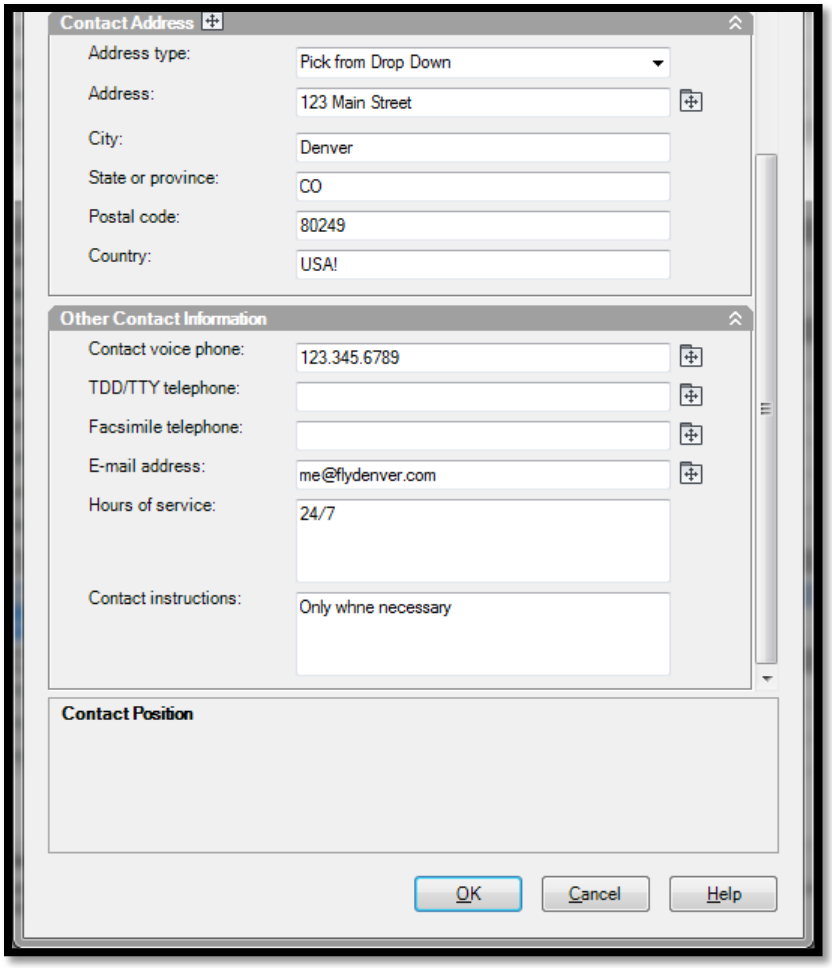
1. In the Command Line type in “MAPMETADATAVIEWER”. This will open the MetaData Viewer

2. Create a project template by filling out all of the highlighted fields below on each of the designated tabs (Some of the data is auto-populated). Use the Edit tab to access the fields to input.

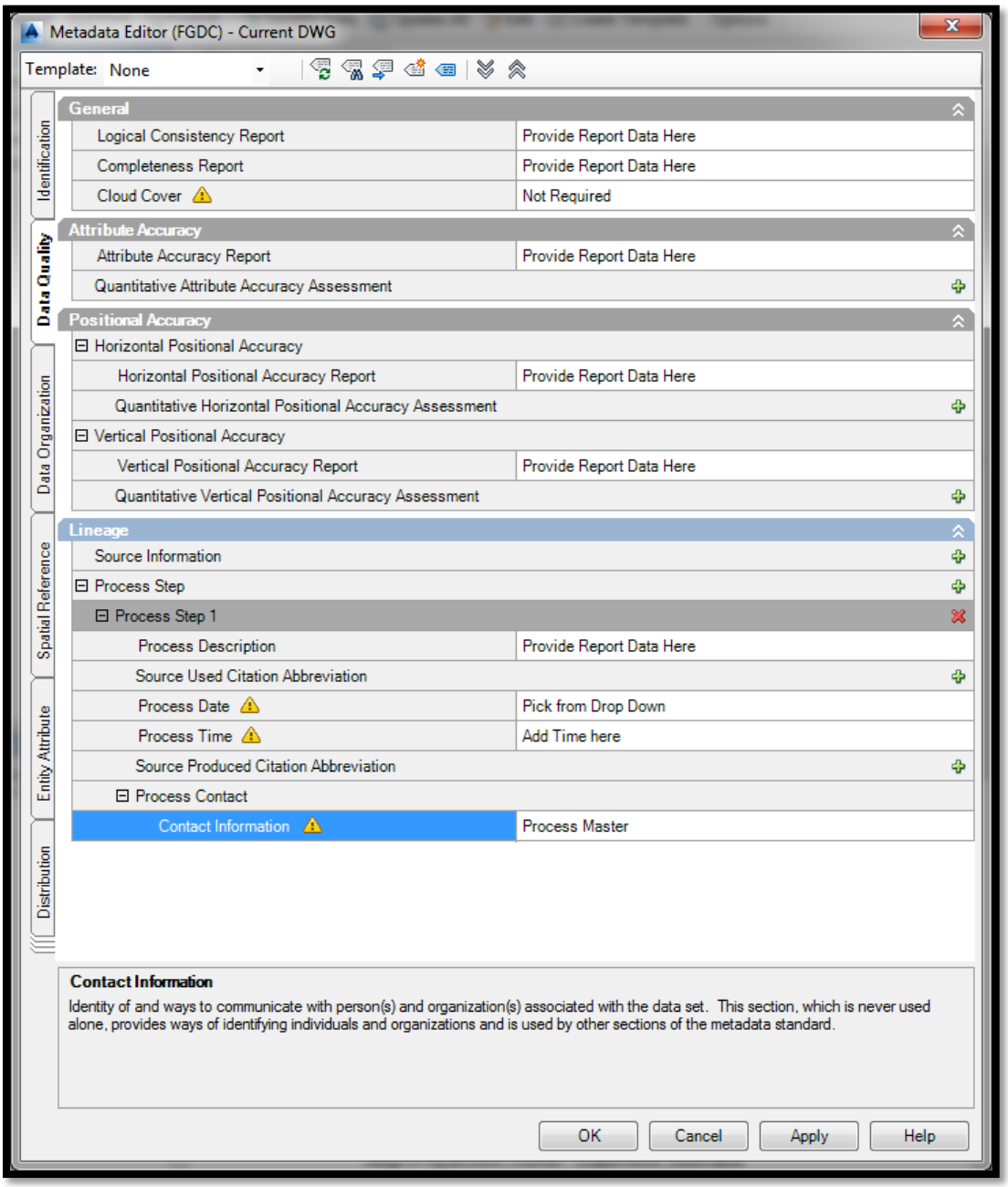


3. Click Contact information to open Contact Information Editor.



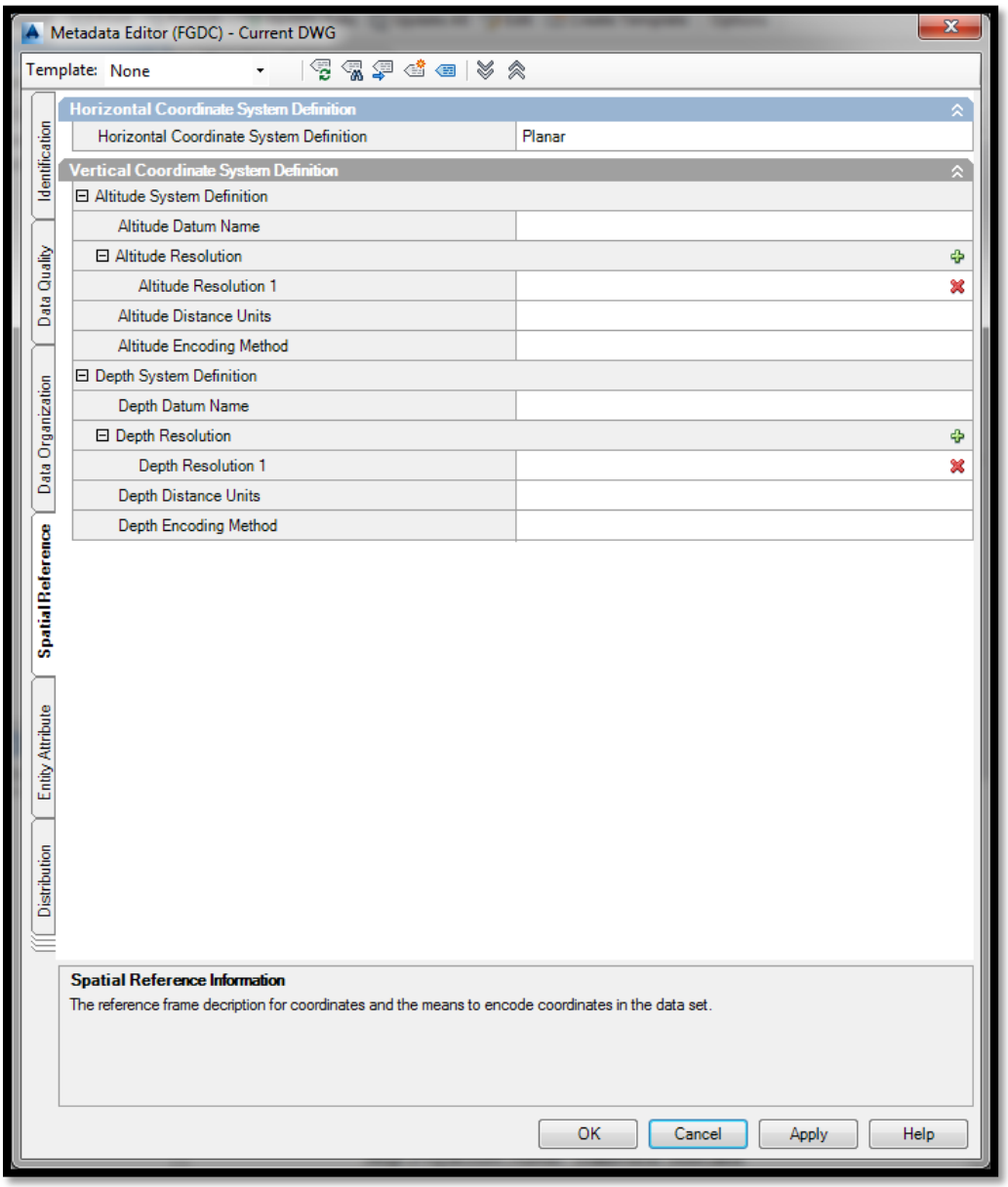

Contact Address
Address type:
Pick from Drop Down
Address:
123 Main Street
City:
Denver
State or province:
CO
Postal code:
80249
Country:
USA!
Other Contact Information
Contact voice phone:
123.345.6789
TDD/TTY telephone:
Facsimile telephone:
E-mail address:
me@flydenver.com
Hours of service:
24/7
Contact instructions:
Only whne necessary
Contact Position
OK
Cancel
Help

4. Fill out the appropriate content.

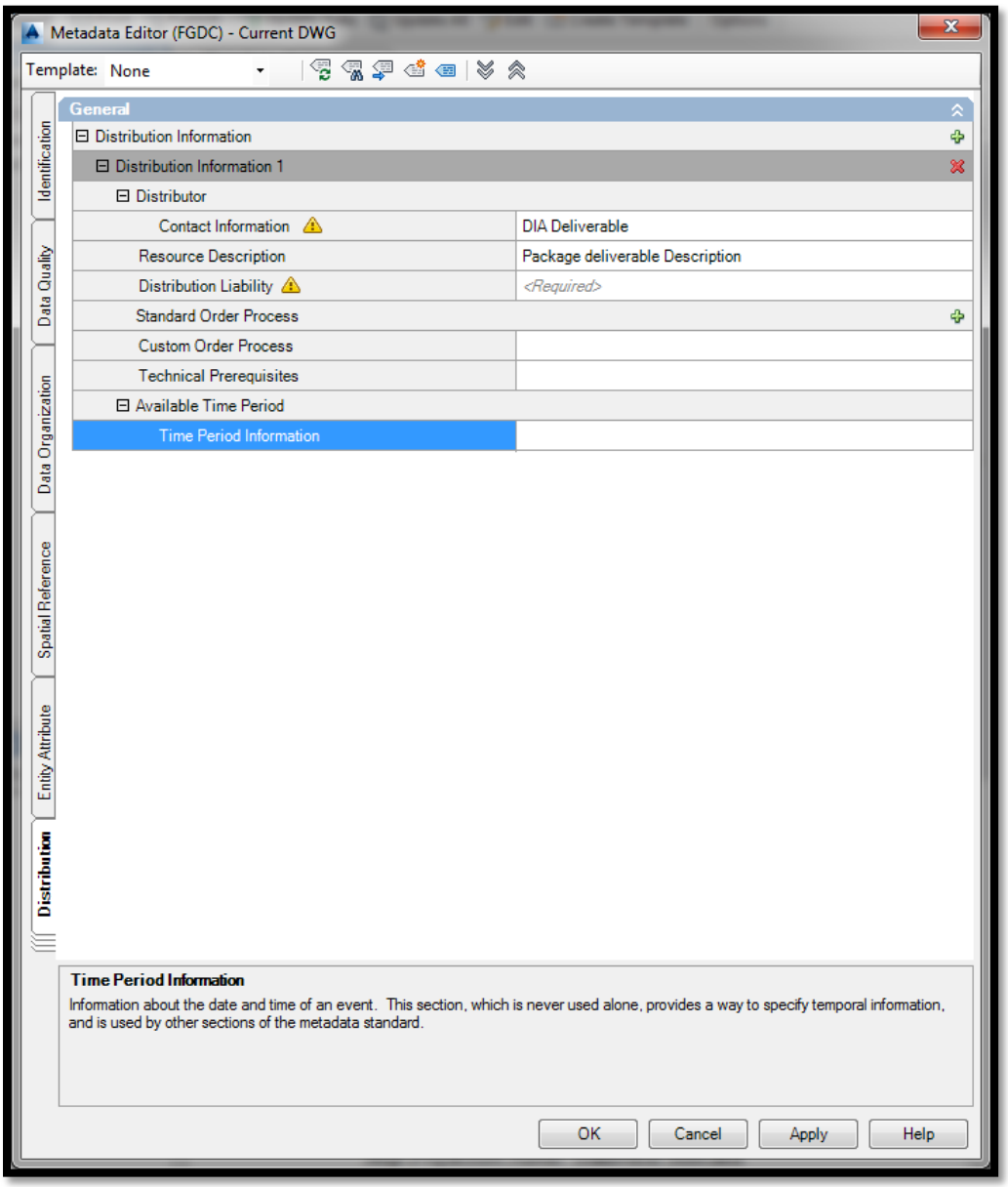


5. Data Quality information is required.

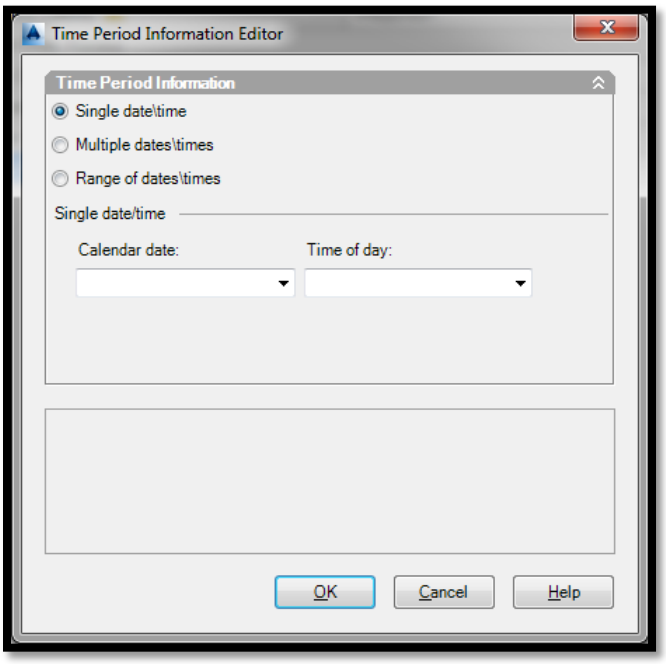
6. Data Organization should be default Vector, unless specifically organized in an alternate fashion.



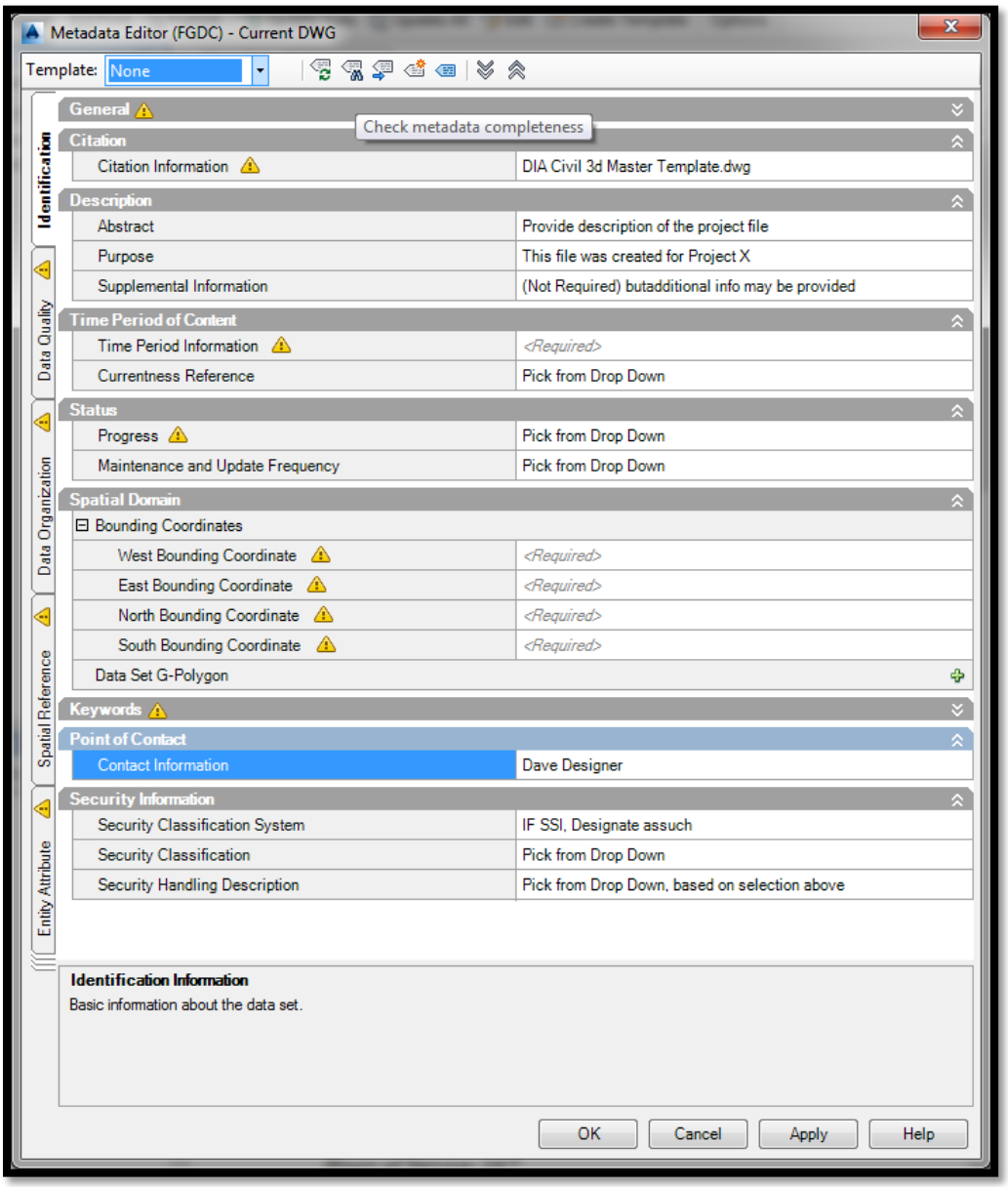
7. Provide additional information for Spatial Reference, as necessary



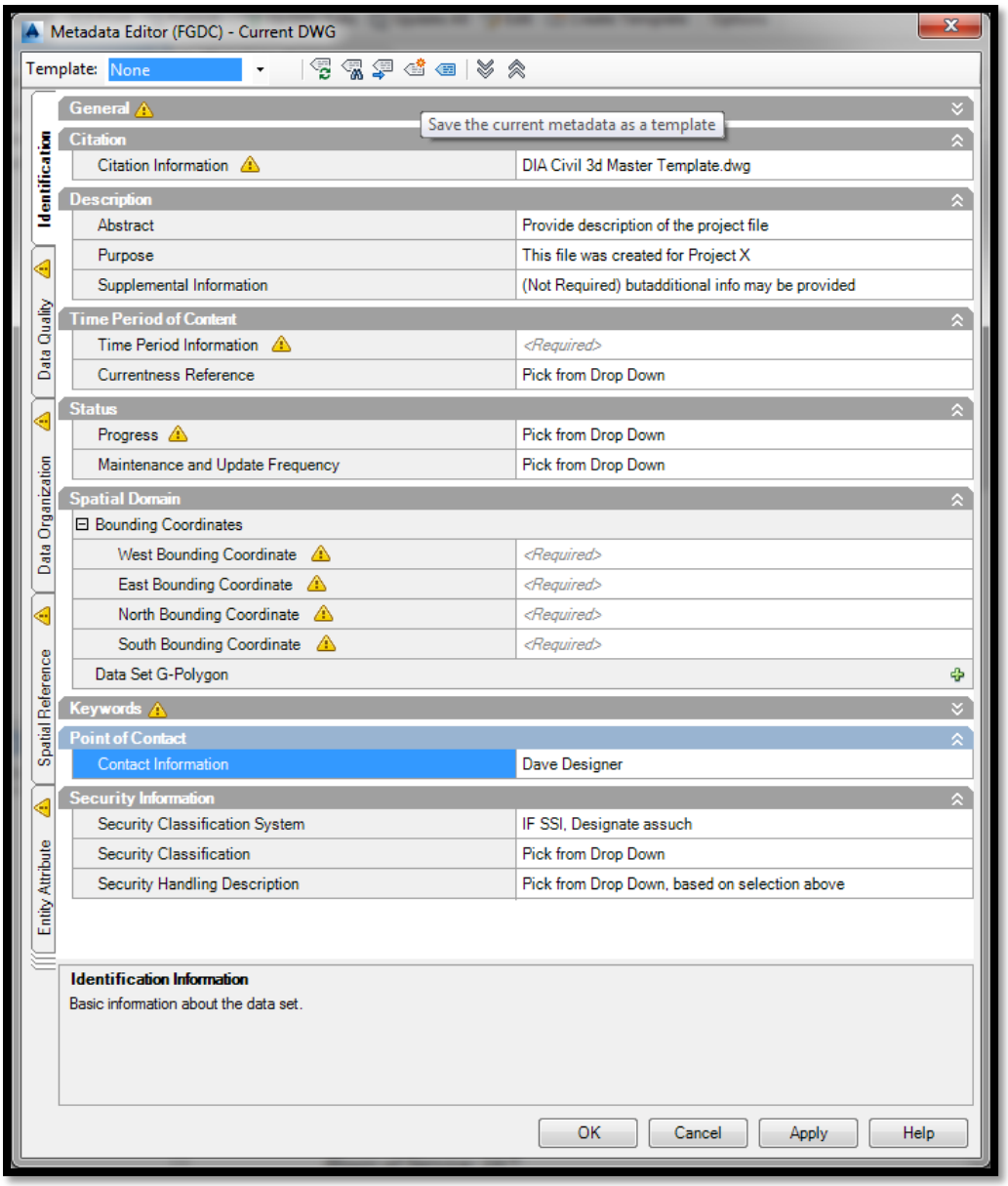
8. Provide Package deliverable information.



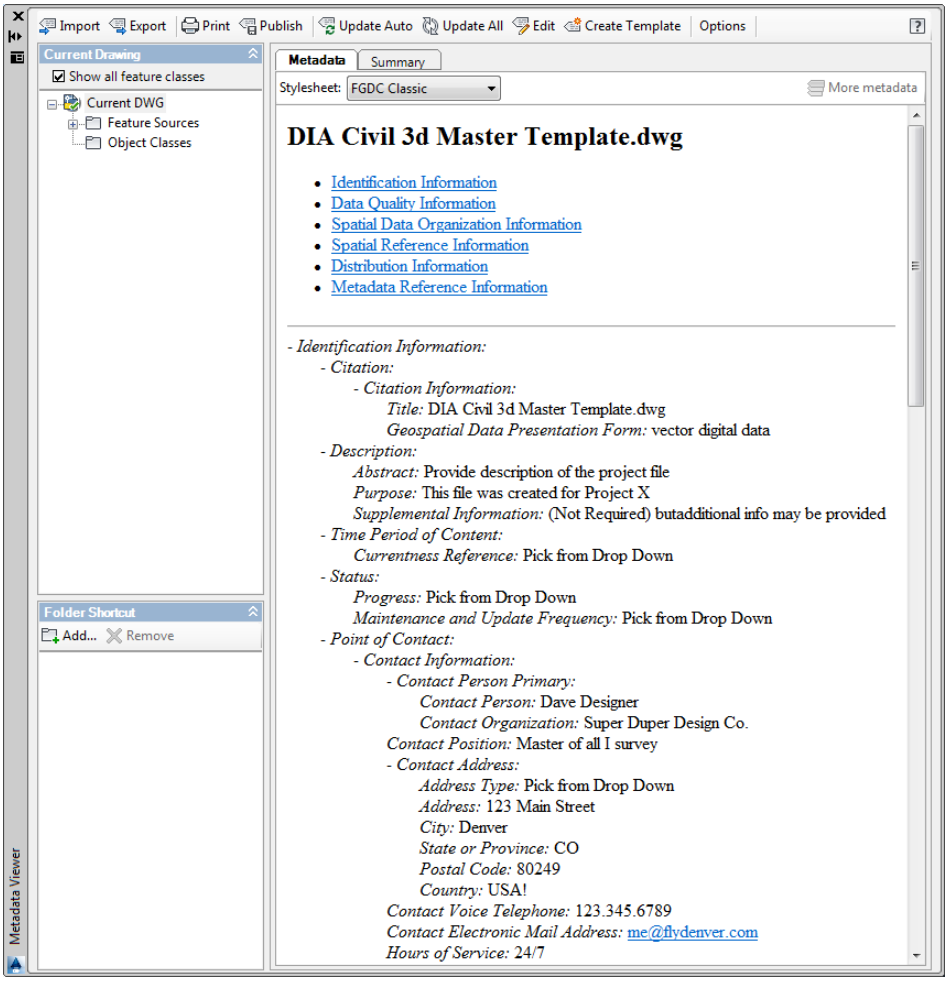
9. Include deliverable date.



10. Once you have filled in the data, run the “Check metadata completeness routine to assure that you have completed the template with as much information as you have. Items left incomplete should be noted with your submission or corrected prior to delivery.



11. Once items are complete, to your satisfaction, you can save the template for your project. It will be internally linked to the template that you will use for your project.



12. You should see the changes you added when you run the “Update All” routine.
13. This incorporated metadata will be reviewed and checked at each deliverable.

Section 602 - Entity Level Metadata

The next level of metadata within DEN will be tracked at the entity level. This provides the required functionality of describing each airport asset independently. A specific water valve, for instance, may have updated data, causing its metadata to be different from that for other valves in the system. Similarly, this flexibility allows a grouping of assets within a given area to be updated to reflect new construction. After the update, the entities within this area would bear different metadata than similar entities in other areas. With flexibility, however, comes a cost. The cost of storing metadata at this level comes in the form of storage space and redundancy. Table 602-1 lists metadata elements to be tracked at the entity level.

Table 602-1 Metadata Elements at the Entity Level

Metadata Element	Note	Description	Comment
ID	Automated Field	Primary Key	Provides a trace back to the original source document or data set from which this data element was derived.

Metadata Element	Note	Description	Comment
GUID	Automated Field	Global ID	
Schema	Automated Field	Schema within the database where the entity is stored	
TableName	Automated Field	The name of the table where the entity is stored	
LastModified	Automated Field	The date when the properties of the entity were last edited	
ModifiedBy	Automated Field	ID of the user who last edited the properties of the entity	
Created	Automated Field	The date the original entity was created	
CreatedBy	Automated Field	The name of the original creator of the entity	
Source		The source data of the entity	
Quality		The quality of the data in reference to accuracy	An example would be +/- units (feet, meters), or A, B, C, D when referring to utilities.
Reference		Any reference material that would be associated with the entity	Description of location of files or a hyperlink to the files

602.1 Attribute Level Metadata

DEN will also track metadata at the individual attribute level. This allows users to make changes to specific attributes contained within a record that describes a specific entity. For example, if a maintenance technician physically examines a feature such as a wastewater line and determines that its status is abandoned, a record of who made this observation and when it was made should be tracked in the metadata. The technician, however, did not make any observation about the depth of the wastewater line, which may need to be measured by a surveyor. Metadata must be tracked at the attribute level to clarify which piece of information was indeed changed based on the technician's observation. Table 602-2 lists metadata elements that will be recorded at the attribute level. At any point in time, the values of each metadata element will relate to the current value of the attribute.

Table 602-2 Metadata Elements at the Attribute Level

Metadata Element	Note	Description	Comment
ID	Automated Field	Primary Key	Provides a trace back to the original source document or data set from which this data element was derived.
GUID	Automated Field	Global ID	
Schema	Automated Field	Schema within the database where the attribute is stored.	
TableName	Automated Field	The name of the table where the attribute is stored.	
LastModified	Automated Field	The date when the properties of the attribute were last edited.	
ModifiedBy	Automated Field	ID of the user who last edited the properties of the attribute.	

Metadata Element	Note	Description	Comment
Source		The source data of the attribute.	
Quality		The quality of the data in reference to accuracy.	An example would be A, B, C, D when referring to utilities.
Reference		Any reference material that would be associated with the attribute.	Description of location of files or a hyperlink to the files.

602.2 Metadata History/Logging

DEN will track the history of each entity as it changes. This includes changes to both an entity's geometry and each of its relevant attributes. This will not be accomplished as a part of the current, valid metadata record itself, but will instead be captured in a log table. This will allow the history of a particular attribute to be captured beyond just the last value, in effect providing an audit trail associated with each modified entity or attribute. This log will track all changes to a given entity or attribute back to when it was first entered into the DEN-EGIS.

As an example of how this log will work, consider a given attribute such as the diameter of a water pipe that is entered into the DEN-EGIS. Later, a maintenance technician in the field may observe that the diameter is in fact different from the value entered into DEN-EGIS. A user authorized to make attribute changes to water pipes should then make this change. Once the change is committed (i.e. saved to the database) the DEN-EGIS system will record a log entry indicating that that particular user made a change to the diameter attribute for that water pipe record in the database. The log entry will capture the former value, but not the new value since it will be stored within the attribute table itself.

Section 603 - How to Create a Data Transmittal

Use one of the Options provided in this section, with Option 3 as the preferred delivery process, to create a zip file for delivery to DEN. Include an etransmit.txt file containing a list of files and any comments you may feel will help the recipient understand what is being delivered and how to use it.

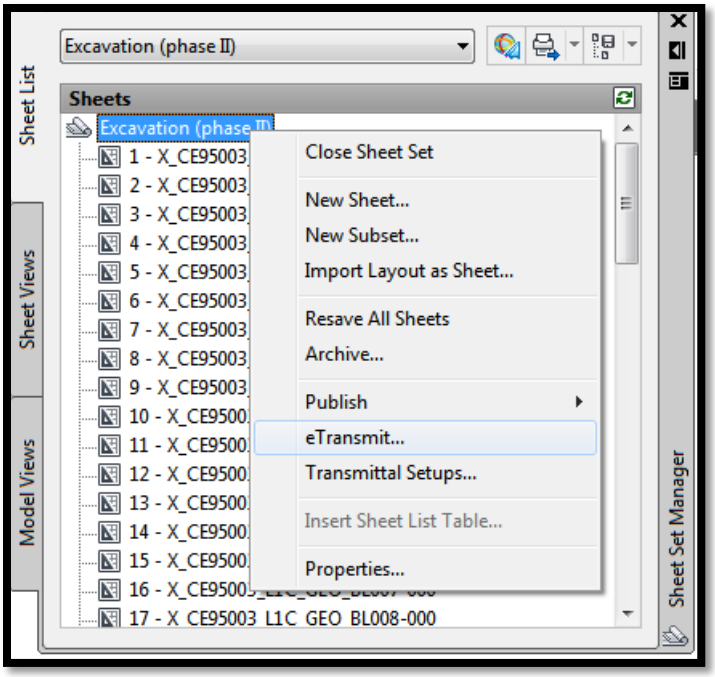
Zip files can contain other zip files. You may wish to use a combination of the eTransmit tools in AutoCAD and/or the zip tools in your zip program to assemble a single zip file with the necessary content to make a complete Data Transmittal.

603.1 Option 1 - Include the entire project folder.

To package file for a submittal Right Click the root folder of a project and create a zip file that includes all the files within the project folder structure and preserves the folder structure within the zip file.

603.2 Option 2 - Use Sheet Set Manager

Use eTransmit from Sheet Set Manager to gather all the sheet files, reference files, and data reference files into a single zip file. Make sure to preserve the original folder structure within the zip file.

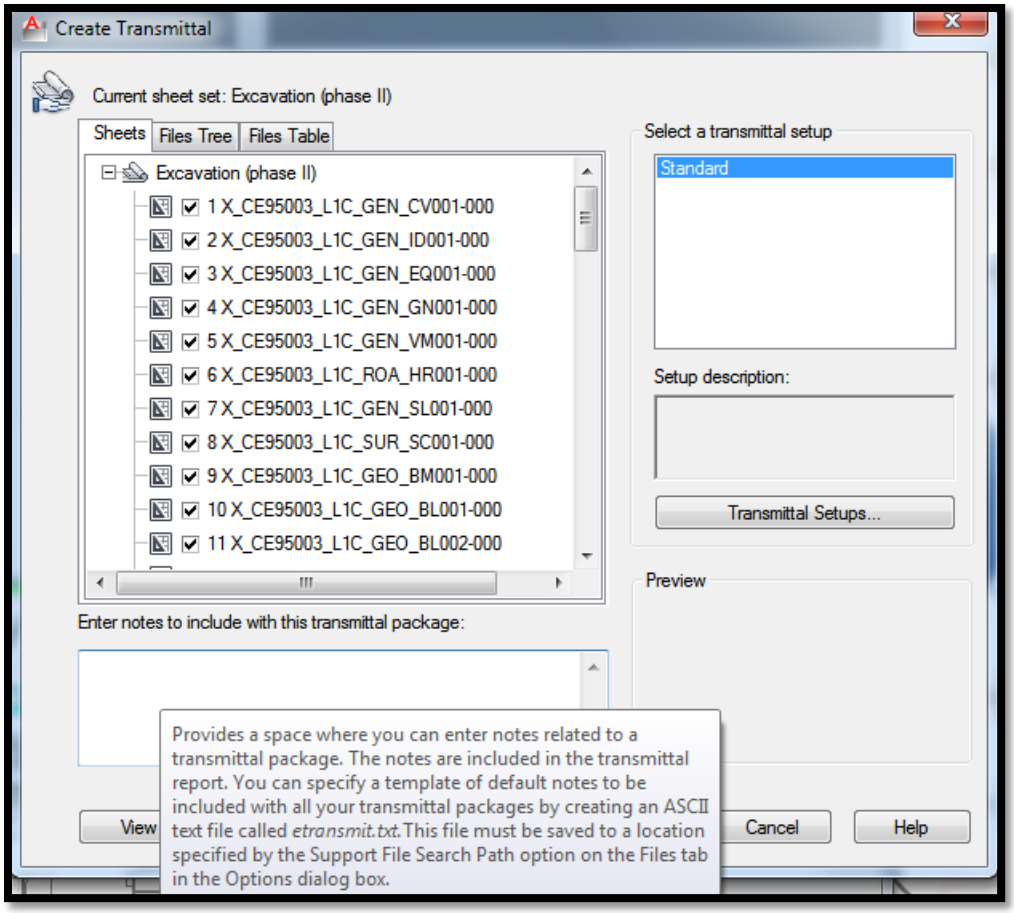


603.3 Option 3 - eTransmit

Use eTransmit command in Civil 3D to create a zip file of the current drawing, its reference files and data reference files.

603.4 etransmit.txt

Include a text file named etransmit.txt in the zip file. The eTransmit command has a transmittal document feature that does this automatically.



End of Part III

Part IV – BIM Data Standards

Chapter 1 - Introduction and Overview

Section 100 - Introduction and Overview

This document lists the BIM requirements for any DEN project whether created in-house or by external consultants, and is both a stand-alone document for staff and consultants to understand DEN's BIM specific requirements for starting projects, as well as a resource used to seed a project execution plan.

Requirements established here are minimum, baseline requirements for all BIM projects at DEN. Any of these requirements may be superseded by Project Contract or the project's specific BIM Project Execution Plan.

100.1 Target Audience

This document is intended for

A. External service providers (design and construction) supplying BIM Data to DEN

B. DEN executives and Project Managers

100.2 Purpose

The goal of Denver International Airport's BIM and Asset Management programs is to integrate BIM from cradle to grave as a process and deliverable into the DEN organizational and planning structure and take advantage of the data information created during design and construction to enhance and feed into existing and future facilities/operations processes.

100.3 Acronyms

The following acronyms are used in this chapter.

Acronym	Definition
BIM	Building Information Model or Building Information Modeling
BPXP / DEN BPXP	BIM Project Execution Plan
DEN	Denver International Airport
LOD	Level of Development is the degree to which the elements geometry and attached information has been thought through – the degree to which project team members may rely on the information when using the model. This base definition is further defined in the attached "Level of Development Specification," 2015 by BIM Forum.

100.4 Proposing Revisions

For any proposed revisions to this document, please contact:

Brendan Dillon

DEN BIM Manager

t: 303.342.2676

e: Brendan.Dillon@flydenver.com

Section 101 - Organizational BIM Strategy for DEN

This overview provides a summary of the overall strategy of BIM integration at DEN. It is to be used as a reference for the BIM Project Execution Plan (BPXP), BIM Manual and as a reference document for the internal departments involved in the use of BIM at DEN.

At DEN, the transition to BIM is not just a change of CAD technology. More importantly, it is a business decision made by the senior executives, knowing the impact on all levels of DEN building projects, from design, documentation, and construction, to operations and maintenance. BIM provides integration and coordination

amongst project stakeholders throughout all aspects of design, construction, and occupation. For DEN, this process is called Full BIM Lifecycle Management.

101.1 BIM Provides Graphical Coordination

The initial Design direction of BIM is to provide a graphical coordinated document set of all trades of a building. BIM provides a three dimensional graphical database that allows the spatial coordination of document sets of multiple Design Disciplines and phasing the project for construction logistics.

Depending on the design discipline, DEN requires all graphical models to be created using either Revit or Civil 3D.

101.2 BIM Provides Data Coordination

The “I” for “Information” in Building Information Modeling is what sets BIM apart; the components within a BIM are more intelligent than 2D CAD elements. For example, a BIM HVAC unit has embedded data fields (called “parameters”) that can control its size, airflow, cost, maintenance schedule, and O&M data. These components are mini databases within the larger graphical database.

101.3 BIM Links Bi-directionally to FM/GIS

The BIM platform and process allows the design and construction data to better coordinate with each other as well as to link bi-directionally to DEN's FM and GIS platforms. The accessibility of the BIM data allows the FM and GIS programs to be more productive with the overall management and preventive maintenance of the facility. This in turn allows exposure to other management benefits including improvement of building sustainability, schedulable maintenance, lifecycle costing, and overall predictive behavior of the facility.

Section 102 - Asset Data

Asset Data delivery and integrity are absolutely essential to DEN’s Asset Management and maintenance programs

102.1 Asset Types

What DEN defines as an Asset is broken down and specified by DEN Asset Type and DEN Functional Area in the attached Appendix C. In general terms, this includes but is not limited to:

- Doors (Power Actuated and/or Overhead)
- Baggage Handling Equipment
- Electrical Equipment
- Life Safety Systems
- Mechanical Equipment
- People Movers
- Plumbing Equipment and Fixtures
- Security Equipment

102.2 Asset Data

Asset data is generated throughout the project process by multiple parties. When a party adds new data, they are also responsible for validating the existing data associated with that Asset. Below are the fields required for the successful population and execution of DEN’s Asset Management program.

By the 60% Deliverable, all DEN assets must be identified using the _Asset Yes/No schedule and _Asset Yes/No - Mass - Fire Alarm Zones.

By the 90% Deliverable, all DEN assets must have the following information entered by the design team in the BIM model using the fields required in the DSM. This information must be maintained as current through the remainder of the project and the data made accessible to the builder via DEN’s Autodesk BIM 360 Field platform.

This data can be checked in the Revit models using DEN's Revit template in the Schedule _Asset Data Checker - 03 DESIGN and _Asset Data Checker - 03 DESIGN-Zone Masses.

Data Type	Revit Attribute	Data Description
Mark	Mark	Asset identifier, e.g., VAV-13, FSD-12
Asset Type	ASSET_TYPE	DEN Asset Type, e.g., Fan Power VAV. Refer to Appendix C.
Location	Room/Space:Number	Associated room/space, e.g., CCA_01_1W_CR101
Functional Area	ASSET_FUNC_AREA	Functional Area group that will maintain the Asset, e.g., HVAC. Refer to Appendix C.
Status	ASSET_STATUS	This value should be set to "Designed" for all Assets at 90% CD
Asset	ASSET	Indicating the element is an asset. If it is a DEN asset, set to Yes; otherwise, No.

As equipment is installed, the installer is responsible for populating the following data for all Assets via the Autodesk BIM 360 Field platform as well as validating existing data, within five days of install of each asset.

Data Type	B360 Field Attribute	Data Description
Manufacturer	MANUFACTURER	Manufacturer of installed asset.
Model	MODEL NUMBER	Model number of installed asset.
Serial Number	Serial Number	Manufacturer serial number of asset.
Purchase Price	PURCHASE PRICE	Asset purchase price, not installation cost.
Install Date	Install Date	Actual installation date of asset (not facility activation date), e.g., 2/2/16.
Status	Status	This value should be updated to "Installed" as the Asset is installed.
Warranty End Date	Warranty End Date	Date Warranty is set to expire, e.g., 3/1/2017.
Vendor	VENDOR	Company that the Asset was purchased from, e.g., HVAC-R-US
BarCode	Barcode	Asset Tag (QR Code) Number; labels provided by DEN.
Expected Life	EXPECTED LIFE	Expected life of the Asset at installation, e.g., 15 years

Section 103 - Implementation

103.1 Project Delivery

The project delivery method must be determined at the initial stage of the project so that BIM can be properly structured and managed to support the delivery strategy. The delivery method defined for a project will have a significant impact on downstream processes and coordination.

103.2 Data Reuse, Ownership, Rights of Data

Denver International Airport shall have title and all intellectual and other property rights, in and to all phased and final project models, and all data used in the development of the same, including the results of any tests, surveys or inspections at the Project site, and all photographs, drawings, drafts, studies, estimates, reports, models, notes and any other materials or work products, whether in electronic or hard copy format, created by the Consultant pursuant to this document, in preliminary and final forms and on any media whatsoever, whether the Project for which the Documents were created is executed or not. The Consultant shall identify and disclose, as requested, all such Documents to the City.

103.3 Project BIM Team Software

The following table lists the BIM team software.

BIM Team Software	Comments
Autodesk Revit 20## -	Required development and deliverable file format for all BIM project models within <5' of the building envelope is to be the latest approved version of the RVT format as determined at project kickoff.
Autodesk AutoCAD Civil 3D	Required development platform outside the building footprint >5'
Autodesk BIM 360 Glue	Spatial Coordination during design, Clash Detection during construction and Model Reconciliation must be done in the Autodesk BIM 360 Glue platform owned by DEN.
Autodesk BIM 360 Field	DEN's BIM 360 Field platform must be populated with all DEN Assets. Asset data (see section 102.2 Asset Data) must be populated during construction. DEN's Field platform is also available for additional project functionality.
Autodesk Collaboration for Revit and Autodesk BIM 360 Team	Team DEN BIM shall be used for non-SSI models for all projects over 5000 square feet.

103.4 BIM Responsibilities

BIM authoring tools, data integration, and collaborative team workflow environments shall be used to develop and produce project information and documentation as required for submittals.

It is the responsibility of all consultants and contractors to have or obtain, at their cost, the trained personnel, hardware, and software needed to successfully use BIM for the project to a level of detail as recorded in the BIM Project Execution Plan.

Equipment used by the subcontractors during the on-site coordination meetings must meet the requirements of the software being implemented so as not to cause delays in modeling and redrawing. All technical disciplines shall be responsible for their data integration and data reliability of their work and coordinated BIMs.

103.5 SSI (Security Sensitive Information) Model

All SSI information will be kept in a separate and distinct model from the Project BIM.

Section 104 - Process Summary, Objectives, and Application

Below is a brief summary of a typical DEN BIM process. These requirements are organized via traditional delivery method. It is not to dictate delivery method, but establish a common vocabulary as a starting point for the DEN BIM Projects.

104.1 General

The following apply to all phases of the project.

All models shall comply to the full DSM standards as laid out here and in other chapters at all phases of work. Modeling shall conform, by project phase, to the LoD Matrix as developed at project kickoff.

To allow the most flexibility in delivery methods the term Project BIM Team has been used in this section to delegate responsibility in general to the Project BIM Team as identified by the BIM Project Execution Plan. Specific roles and responsibilities are determined by that document.

104.2 RFP Process

DEN may make available any existing BIM models, proposed design models, laser scans, surveys, or as-built CAD files of the project area for the RFP process in some cases.

104.3 Contract Negotiation

BIM Project Execution Plan (BPXP) and Level of Development Matrix (LoD) should be developed and finalized as Addenda to the contract. DEN will make available any existing BIM models, proposed design models, laser scans, surveys, or as-built CAD files of the project area available as soon as possible once a proposer is selected.

104.4 Project Kickoff

Once project is awarded and NTP is issued, develop BPXP with DEN and all consultants (and contractor if available). Submit draft of BIM PXP within 30 days of NTP. DEN will respond within 14 days.

Submit project setup model for each planned model with draft BPXP. This is a Project file from DEN's templates with all necessary background files linked and DEN's LDP shared coordinate system integrated.

104.5 Existing Conditions

The Project Team shall model all existing conditions needed to explain the extent of the construction work for alterations, additions projects, and new projects that interface with existing facilities. The extent of modeling beyond the affected areas and the level information to be included will be determined based on project needs. These requirements may be stated in the project program or discussed during the project kickoff meeting. The BIM Project Execution Plan should define the agreed upon scope of the modeling effort.

All project teams should verify with DEN the existence and accuracy of as built models.

Existing models provided by DEN shall be used for reference only.

104.6 Pre-Design (Conceptualization) Phase

Project BIM Team may use any method to begin the process. The Project Team is encouraged to use electronic programming and planning tools that integrate into their BIM Authoring software to capture early cost, schedule, and program information during this phase.

BIM deliverables to be determined by the BIM Project Execution Plan

A. Data

B. Programmatic spaces

Early use of Preliminary Programmatic Spaces is encouraged

C. Energy

A BIM that will provide an accurate volume representation of spaces and a gbXML compliant model is encouraged for lateral and downstream use.

104.7 Schematic Design (Criteria Design)

Project BIM Team may use any method to begin the design process but shall be using a BIM authored models by completion of this phase. All information needed to describe the schematic design shall be graphically or alphanumerically included in and derived from these models. DEN expects the Project BIM Team to use analysis tools, static images, and interactive 3D to describe the design concepts.

A. Data

B. Programmatic spaces

1. All rooms in the architectural and/or MEP BIM model.
2. Programmatic Spaces must be linked to rooms by final submittal of this phase.

C. Sustainability

D. Energy - As called for by BPXP Preliminary Energy modeling data included:

1. Detailed electric and fuel rates as defined by the local service provider
2. Building function and occupancy
3. Preliminary Building operating schedules
4. Preliminary estimates of building construction types

E. Clearance - Clearances will be built into families to allow visual display of:

1. Building code clearances

2. Access clearances
3. Maintenance clearances

F. BIM Rooms / Spaces - Rooms are to be enclosed and bounded by walls or room separation lines, separated by use. Floors shall be room bounding, Ceilings (GWB, ACT, etc.) shall not be room bounding.

104.8 Design Development Phase (Detailed Design)

The Project BIM Team shall continue development of their BIM. Parametric links shall be maintained within the models to enable automatic generation of all plans, sections, elevations, custom details and schedules as well as 3D views. All information needed to describe the “detailed design” shall be graphically or alphanumerically included in and derived from these models only, except for the Specifications. Documentation of the models or design documents shall not happen outside of the BIM Authoring software.

A. Data

B. Programmatic spaces

All rooms in the architectural and/or MEP BIM models

C. Sustainability

D. Energy design - As called for by BPXP Preliminary Energy modeling data included

1. Detailed electric and fuel rates as defined by the local service provider
2. Building function and occupancy
3. Building operating schedules
4. Building construction types

E. Equipment (data) - All equipment in model will be registered in the project equipment library

F. Equipment considerations - MEP equip vs. DEN infrastructure equipment vs. Secure (screening equipment)

G. BIM Rooms / Spaces - Rooms are to be enclosed and bounded by walls or room separation lines, separated by use. Floors shall be room bounding, Ceilings (GWB, ACT, etc.) shall not be room bounding.

104.9 Construction Documents Phase

The Project BIM Team shall continue development of the models created in the Design Development Phase. Maintain parametric links within the respective models to enable automatic generation of all plans, sections, elevations, custom details, schedules, and 3D views. All information needed to describe the “Execution documents” shall be graphically or alphanumerically included in and derived from these models only. Specifications are not required to be linked within the models.

Revit and Civil 3D models shall be submitted at 30%, 60%, 90% and 100% Construction Documents with Level of Development matching those laid out in the LoD Matrix. Include families in use that were not part of DEN library for review. DEN will review models and families within 14 days and schedule meeting with the project team to discuss.

A. Data

B. Programmatic spaces - All rooms in the architectural and/or MEP BIM model shall conform to DEN naming, numbering and categorization requirements

C. Sustainability

D. Energy - As called for by BPXP Preliminary Energy modeling data included:

1. Detailed electric and fuel rates as defined by the local service provider
2. Building function and occupancy

3. Building operating schedules
4. Building construction types

E. Equipment (data) - All equipment in model will be registered in the project equipment library

104.10 Bidding Phase

The Project BIM Team shall update the models with all addendum, accepted alternates and/or value enhancement proposals.

104.11 Contractor Bidding

As delivery method allows, contractors who are bidding on this project are to review the BIM Project Execution Plan, and these DEN BIM Requirements before bidding. Contractor will follow the guidelines and requirements as set forth by the BIM Execution Plan.

DEN will make the project BIM available with appropriate disclaimers to the contractor at bidding.

104.12 Construction Phase (Design Team)

The Project BIM Team is expected to continuously maintain and update the design intent models with changes made from official Construction Change Directives and construction mark-ups maintained on site by the Contractors during construction. At an interval that is decided within the BIM Project Execution plan or at minimum, once a month during construction the updated design intent models will be published in Revit and Civil3D formats (Current Version) and posted to the DEN Project site for the project.

104.13 Construction Models

Contractor shall model conditions, as they will be built in the field. These models could include fabrication models, coordination models, or shop drawing models. These models will now be referred to as the Construction Models. Construction models shall be made available to the Project BIM Team throughout the project process.

104.14 Concurrent Record Model (Design Team)

The Project BIM Team shall submit a plan to the Owner for review, prior to the start of construction that outlines the process for concurrent record documentation. Design Team will incorporate changes from RFIs, Change Orders, Addenda, and other CA revisions into their models as they are issued. Concurrency is mandated. Methods for recording and communicating construction information are left to the discretion of the contractor.

Potential options for concurrency include:

A. Traditional methods

B. Periodic laser scanning of completed or partially completed primary systems coordinated with the sequence of construction.

C. Integration of model changes in RFI, CO approval processes. Responsibility of the modeling updates is determined by the BIM Project Execution Plan.

Primary systems include, but may not be limited to structural framing, primary HVAC duct runs, primary fire protection main runs, primary electrical conduits (2”+ tolerance), ceiling grids layouts, any elements or systems indicated as “Assets” in the LoD Matrix.

Once Contractor model is completely coordinated, Design Team shall reconcile differences between the Contractor and Design models.

104.15 Commissioning Requirements

Commissioning data including but not limited to design intent, performance criteria and operations data shall be recorded and/or linked to the REVIT or Civil3D model as commissioning occurs throughout the project. It shall be the Project Team’s responsibility to coordinate the information sources and integrate this information into the REVIT or Civil3D model for transfer at the completion of the project.

104.16 Project Close-out

The Project BIM Team shall update their respective models with contractor recorded changes (Record Documents). Republish record documents in paper and PDF formats.

In addition to any submissions required per DEN professional services contract (deliverables sections) and the DEN As-Builts Requirement documents, the Project BIM Team will submit:

A. A record model

B. A facilities model

104.17 Record Models

Record models shall be submitted in .RVT and Civil3D .dwg format and shall be cleaned of extraneous “scrap” or “working” views, stories, abandoned designs, object creation and testing places, and other content that is typically produced in BIM production.

104.18 Facilities Models

The Facilities BIM submitted to DEN shall be cleaned of extraneous “scrap” or “working space” views, stories, abandoned designs, object creation, and testing places, and other content that is typically produced in BIM production.

All sheets shall be removed from these models.

All plan, section, elevation, detail and drafting views with the exception of the facilities plan views of each level shall be removed from these models.

All non-DEN Template schedules and legends shall be removed from these models.

End of Chapter

Chapter 2 – BPXP Instructions

Section 200 - BPXP Instructions

This document is a supplemental resource for developing a project execution plan for a DEN project.

The process of engaging in BIM work at DEN requires review of this document, as well as Project Execution Planning Instructions, Templates and Worksheets, and a comprehensive understanding and practice of DEN BIM Standards, all of which combine to define the process of BIM for DEN projects.

Requirements established here are minimum, baseline requirements for all BIM projects at DEN. Any of these requirements may be superseded by Project Contract or the project's specific BIM Project Execution Plan.

200.1 Target Audience

This document is intended for

A. DEN executives and Project Managers

B. External service providers supplying BIM Data to DEN

Section 201 - Supplemental Instructions for DEN BPXP

The DEN BIM Project Execution Plan is based on a template provided by CIC/Penn State. The template word document and each of the worksheets have been modified for use by DEN. This document provides instructions for the modified DEN version of the BIM Project Execution Plan.

201.1 Overview

DEN based its BIM Project Execution Plan Template package on a plan created from the buildingSMART alliance™ (bSa) Project "BIM Project Execution Planning" as developed by The Computer Integrated Construction (CIC) Research Group of The Pennsylvania State University.

The original template package includes several worksheets and a separate guide-instructions document. Like the original, the DEN BPXP includes instructions and worksheets that have been modified from the original CIC/Penn State template. In addition to the worksheets and instructions, DEN has included examples of completed plans and worksheets for illustration purposes.

Section 202 - DEN BIM Project Execution Plan Template Documents

The DEN BIM Project Execution Plan Template is not a single document, but a folder structure containing several documents.

202.1 Worksheet

A separate Level of Development worksheet is provided to aid the project team in completing the BPXP document. The worksheet is a required part of the BIM Project Execution Planning process and becomes an attachment when the planning process is complete.

A. BIM Matrix Worksheet and LoD Defintions.xlsx (Excel file) and provides tools to reconcile conflicts between these two items.

This worksheet further refines the general information established the BPXP and

1. Each building model author provides the Level of Development that they will be creating in the model
2. Each stakeholder requiring a BIM Use records the Level of Development necessary for that use.

Section 203 - BPXP Project Goals / BIM Uses

203.1 Section D: Project Goals / BIM Uses

To complete this section, use the BIM Uses Matrix to:

A. Establish goals for the project

BIM Uses

Stakholders: PMT = PROJECT MANAGEMENT TEAM, AOR = ARCHITECT or ENGINEER OF RECORD, GC = GENERAL CONTRACTOR, OWN = OWNER, DMT = Data Management Team
Function: P = PRIMARY, S = SECONDARY, R = REVIEW, X = REQUIRED CONTENT

Description		Design		Construction		Facilities Management
Existing Conditions Modeling						
2D to BIM (Arch)	X	PMT / P, AOR / R	X	PMT / P, AOR / R, GC / R	X	OWN / P
2D to BIM (Struct)	X	PMT / P, AOR / R	X	PMT / P, AOR / R, GC / R	X	OWN / P
Laser Scanning (Exterior, Interior, Featured MEP)	X	PMT / P, AOR / R	X	GC / P, PMT / S, AOR / R	X	OWN / P

B. Translate the goals to BIM uses

It is important to understand that goals may relate to specific uses while other goals may not. For example, if there is a project goal to increase field labor productivity and quality through large amounts of prefabrication, then the team can consider the '3D Design Coordination' BIM Use which will allow the team to identify and correct potential geometric conflicts prior to construction. On the other hand, if the team's goal was to increase the sustainability of the building project, several uses may assist in accomplishing that goal.

203.2 Organizational Roles / Staffing:

For each BIM Use selected, identify the team within the organization(s) who will staff and perform that Use. The team information is also part of the Key Project Contacts,

The following is a list of lead BIM contacts for each organization on the project.
This is a high level list of contacts; additional contacts can be included later in the document.

Firm	Role	Contact Name	E-Mail	Phone
Denver International Airport (DIA)	BIM Manager	Brendan Dillon	brendan.dillon@flydenver.com	303.342.2676
Denver International Airport (DIA)	BIM Coordinator			
Project Mgmt Team				
Architect				
BIM Consultant				

Section 204 - BIM Information Exchanges

The BIM Matrix combines the worksheets into a single worksheet:

A. 01 – Team Members

B. 02 – BIM Matrix

C. 03 – Level of Development

Model elements by discipline, level of development, and any specific attributes important to the project are documented using information exchange worksheet.

In this method, each of the information exchange flows identified in the BIM Use Process Maps are further expanded, identifying the information required from the BIM model for each exchange.

From this information, the model definition can be established to set the criteria of the development level of the model at each phase to ensure that the model is complete enough to complete all of the required information exchange flows.

A. Define Information exchanges (IE)

B. Establish Model Development list

204.2 Pulling the Information through the Project

Not every element of a project needs to be included for a model to be valuable. Therefore, it is important to only define the model components that are necessary to implement each BIM Use.

Downstream BIM Uses are directly affected by what is produced by the upstream Use. If the model information required for implementing a particular BIM Use is not authored by an upstream team member, then the information needed must be created by the responsible party of that Use. Therefore, it is up to the project team to decide who should be authoring this information and when this information needs to be placed into the BIM. For simplistic purposes, it is only necessary that the team define one information exchange requirement for each BIM Use; although, there may be several exchanges that take place. These exchanges should be clarified in the Level Two process maps.

204.3 Information Exchange Requirement Worksheet

After process map development, information exchanges between project participants are clearly identified. It is important for the team members and, in particular, the author and receiver (for each information exchange transaction) to clearly understand the information content. The procedure for creating the information exchange requirements is detailed below:

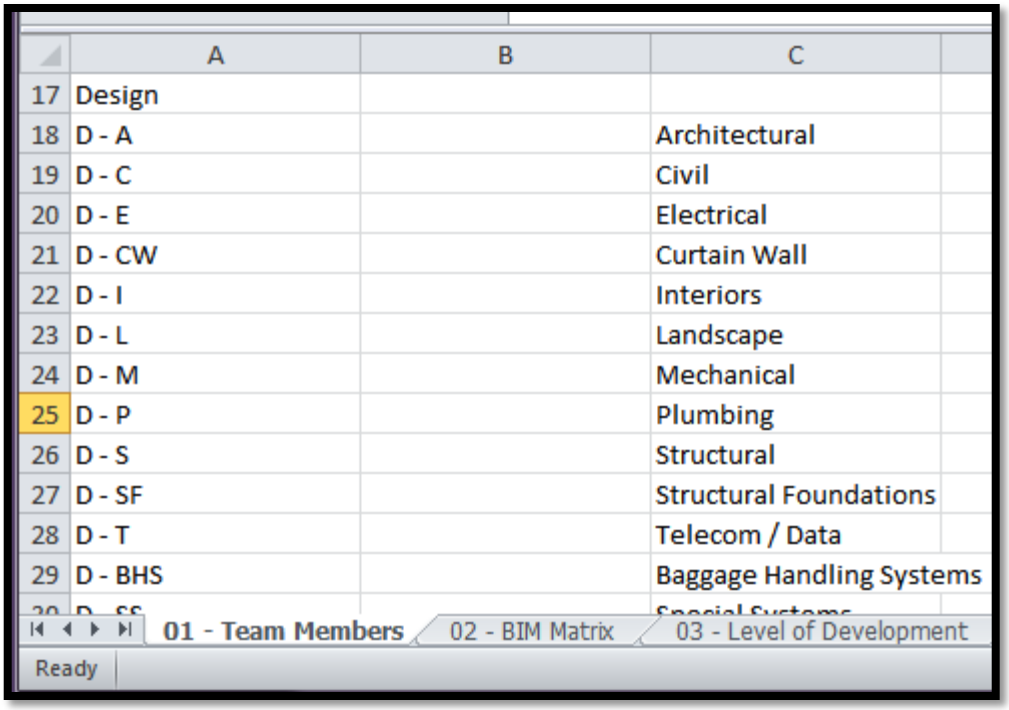
A. Identify Each Potential Information Exchange from Level 1 and Level 2 Process Maps

Information Exchanges that are shared between two parties should be defined. One BIM Use may have multiple exchanges over the life of the project. The time of exchange should be derived from the Level One Map. This ensures that the involved parties know when the BIM deliverables are expected to be completed along the project's schedule. The project phases should also be identified in the project specific contract language. When possible, the BIM Use exchanges should be listed in chronological order to give a visual representation of the progression of the model requirement.

To take an example, the BIM Use Estimating will likely happen at several phases in any BIM project. Concerning the information exchange between the BIM model and the estimating software, the team must decide what a reasonable level of information exchange is at each of the phases.

B. Enter the Team Information in the worksheet

A Separate tab is provided in the DEN excel worksheet BIM Matrix Worksheet and LoD Defintions.xlsx

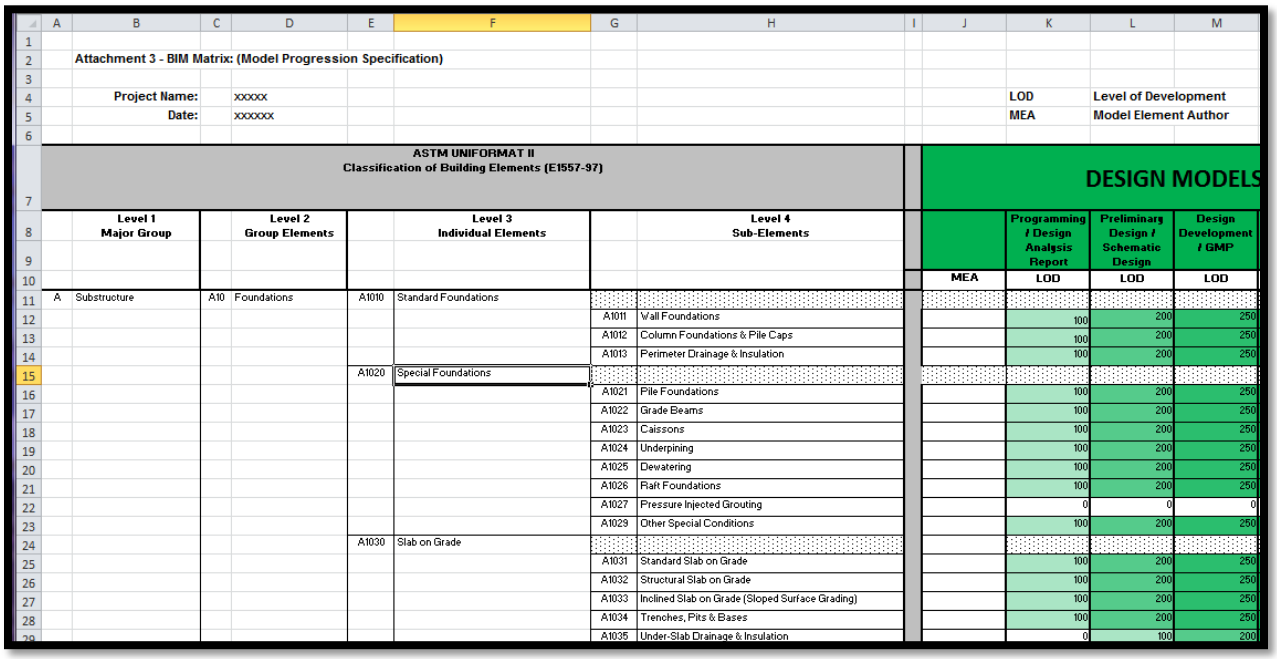


	A	B	C
17	Design		
18	D - A		Architectural
19	D - C		Civil
20	D - E		Electrical
21	D - CW		Curtain Wall
22	D - I		Interiors
23	D - L		Landscape
24	D - M		Mechanical
25	D - P		Plumbing
26	D - S		Structural
27	D - SF		Structural Foundations
28	D - T		Telecom / Data
29	D - BHS		Baggage Handling Systems

C. Record the team member information in this list.

D. Choose a Model Element Breakdown structure for the project

After the project team has established the Information Exchanges (IE), the team should select an element breakdown structure for the project. Currently, The DEN Excel worksheet 2015 Attachment 3 - BIM Matrix Worksheet and LoD Defintions.xlsx spreadsheet uses the CSI Uniformat II structure:



Attachment 3 - BIM Matrix: (Model Progression Specification)

Project Name: xxxxx
Date: xxxxxx

LOD Level of Development
MEA Model Element Author

ASTM UNIFORMAT II Classification of Building Elements (E1557-97)							DESIGN MODELS		
Level 1 Major Group	Level 2 Group Elements	Level 3 Individual Elements		Level 4 Sub-Elements			Programming / Design Analysis Report	Preliminary Design / Schematic Design	Design Development / GMP
						MEA	LOD	LOD	LOD
A Substructure	A10 Foundations	A1010	Standard Foundations						
				A1011	Wall Foundations		100	200	250
				A1012	Column Foundations & Pile Caps		100	200	250
				A1013	Perimeter Drainage & Insulation		100	200	250
		A1020	Special Foundations						
				A1021	Pile Foundations		100	200	250
				A1022	Grade Beams		100	200	250
				A1023	Caissons		100	200	250
				A1024	Underpining		100	200	250
				A1025	Dewatering		100	200	250
				A1026	Raft Foundations		100	200	250
				A1027	Pressure Injected Grouting		0	0	0
				A1029	Other Special Conditions		100	200	250
		A1030	Slab on Grade						
				A1031	Standard Slab on Grade		100	200	250
				A1032	Structural Slab on Grade		100	200	250
				A1033	Inclined Slab on Grade (Sloped Surface Grading)		100	200	250
				A1034	Trenches, Pits & Bases		100	200	250
				A1035	Under-Slab Drainage & Insulation		0	100	200

However, other options are available on the Penn State/CIC BIM Execution project website. While not mandatory, it is recommended that the DEN format be used.

E. 03 - Level of Development

The team should reach consensus on the level of Development system used and document it in this spreadsheet.

On the workbook tab "03 - Level of Development," add in any BIM uses and come to consensus on what the acceptable level of development is for this BIM use for each of the model progression categories 100-500.

	A	B	C	D	E	F	G	H
1	Attachment 4 - Level of Development Worksheet							
2	Level of Development (LOD) Descriptions	Programming / Design Analysis Report	Preliminary Design / Schematic Design	Design Development	Construction Documents	Record Design Model	Construction / Fabrication Model	As-Built Model
3	Design Model	100	200	300	350			
4								
5	Construction Model						200, 300, 350, or 400	500
6	Model Content							
7	Existing Conditions (Architectural)	Geometric data or line work, areas, volumes zones, etc.	From unverified CAD or paper drawings.	Laser surveyed. Exisiting visible conditions verified as complete as possible. On site verified visible elements dimensionally accurate to 2" (hand measured on site).		Laser surveyed. Exisiting visible conditions verified as complete as possible	Laser surveyed. Exisiting Hidden conditions verified as complete as possible	As-built
8	Fundamental LOD Definitions*	The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.	The Model Element is graphically represented within the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.	The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information shall also be attached to the Model Element.	The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, orientation, and interfaces with other building systems.. Non-graphic information shall also be attached to the Model Element.	Reconciled Design Model derived from Model Management During Construction Administration	The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the Model Element.	The Model Element is a field verified representation in terms of size, shape, location, quantity, and orientation. Non-graphic information may also be attached to the Model Element.
9	Buildling Model: Rooms (architectural)		Rooms bounded by walls separated by use (departments)	Individual Rooms bounded. Individual Rooms numbered.		Design model with reconciled Rooms derived from Model Management During Construction Administration		As-Built
						300 Level Design model with reconciled Spaces		

F. Identify the responsible parties and level of development

For each of the building elements, identify who is responsible for authoring the information for that milestone.

	H	J	K	L	M	N	O	Q	R	S
4			LOD	Level of Development						
5			MEA	Model Element Author						
7			DESIGN MODELS					CONSTRUCTION MODELS		
8	Level 4 Sub-Elements		Programming / Design Analysis Report	Preliminary Design / Schematic Design	Design Development / GMP	Construction Documents (Design Model)	Record Design Model		Construction / Fabrication Model	Verified As-Built Model
10		MEA	LOD	LOD	LOD	LOD	LOD	MEA	LOD	LOD
12	Wall Foundations		100	200	250	300	300		400	500
13	Column Foundations & Pile Caps		100	200	250	300	300		400	500
14	Perimeter Drainage & Insulation		100	200	250	300	300		400	500
16	Pile Foundations		100	200	250	300	300		400	400
17	Grade Beams		100	200	250	300	300		400	400
18	Caissons		100	200	250	300	300		400	400
19	Underpining		100	200	250	300	300		400	400
20	Dewatering		100	200	250	300	300		400	400
21	Raft Foundations		100	200	250	300	300		400	400
22	Pressure Injected Grouting		0	0	0	0	0		0	0
23	Other Special Conditions		100	200	250	300	300		400	400

End of Chapter

Chapter 3 – BIM Revit

Section 300 - BIM Revit

This chapter provides a set of graphic and Revit file standards for any Capital Improvement Project at DEN. It has four main sections:

- Introduction
- Project Setup
- Project File Standards

Section 301 - Project Setup

301.1 DEN Kit of Parts (BIM)

The DEN BIM Kit of Parts holds the DEN generated library BIM work. This content is the baseline from which all projects will begin. As project specific content is developed, reviewed, and accepted, this content will be added to the Kit of Parts. The Library structure is defined with Custom folders and folders with a CSI MasterFormat naming convention.

- 01_Archive – Folder for weekly archive of project models
- 02_CentralFiles
    - A – Architecture project BIM files
    - C – Civil project BIM files
    - E – Electrical Project BIM Files
    - Etc.
- 03_Libraries
    - 01_Containers – Revit container files that hold libraries of system familes such as walls, floors, ceilings, roofs, etc.
    - 02_Templates – Project and family templates for Revit and Civil 3D
    - 03_Titleblocks – DEN titleblock for Revit and Civil 3D
    - 04_Hatch Patterns - .pat and .dxf files for Civil 3D
    - 05_e-SPECS – Not currently used
    - Annotations – Annotation families
    - DIV-## – Revit families sorted by Masterformat spec section
    - Etc.
- 04_Support
    - 01_Shared Parameters – DEN Revit Shared Parameter file
    - 02_Keynotes – DEN Revit Keynote file
    - 03_ImportLineweightsDWG – Civil 3D lineweights
    - 04_ExportLayersDWG – Civil 3D layer info
- 05_Reference – Repository for BIM and general reference materials
    - 00_MasterFormat – Contains Masterformat documents for reference
    - 01_UNIFORMAT - Contains UNIFORMAT II documents for reference
    - 02_AutodeskTechPerformanceNote – Hardware recommendations and Autodesk recommended best practices.

- 06_Misc Consult
    - DEN BIM Meetings
    - Misc
    - Navis
    - P6
    - Presentation
    - Revit_temp
    - Synchro
    - Viewpoint Reports
- 07_Scripts – Dynamo tools developed by DEN

Section 302 - Template Files

All projects must use the most current DEN BIM templates. These are project Revit Project files (not Revit template files) for architecture, site files, and MEP files. These are available in the standard content "03 Project Library\02_Templates\Revit 2016" folder.

A. DEN ARCH Template 2016.rvt

B. DEN CONST Template 2016.rvt

C. DEN MEP Template 2016.rvt

D. DEN STRUC Template 2016.rvt

Inherent in the Revit project template files are:

A. Graphic Standards

B. Organization of the Views, Legends, schedules and sheets

The organization established by the DEN Revit templates and documented here is also used by DEN to maintain their facilities models.

Consistency in Worksets, Phases, Design Options, and other built in characteristics of organization and use has a great impact on the ability for diverse teams to be able to effectively utilize the model.

Because the models will become part of the facilities tools, it is essential that the base set of standards established by the DEN templates be maintained through the design and construction process.

Section 303 - Naming: Revit Project Files

This section outlines the DEN naming convention for Revit project (.RVT) file naming. Naming is divided and group formatted into 3 sections as follows,

A. <Building Identifier>_<BIM team/model identifier>_<DEN Project Identifier>_Central_<REVIT Version>.rvt

TML_DEN-A_20110930_Central_2016.rvt

303.2 DEN Revit File Naming Expanded

Fields within the general categories are delimited with a hyphen if needed.

A. Building Identifier (assigned by DEN):

<Bldg ID Abbreviation> e.g. TML (Terminal)

B. BIM Team and Model Identifier

<Office of Origin>< dash ><Discipline> e.g. DEN-A (Denver International Airport, Architecture)

C. DEN Project Identifier

<FAA AIP><DEN Project Number> e.g 20110930

TML_DEN-A_20110930_Central_2016.rvt

Section 304 - Phasing

Phases shall be set up as coordinated with DEN BIM and must be uniform across all models within the project. Standard Phases should be Existing and New for most work. If the project has multiple phases, the model should accurately reflect those phases in phase naming and phased model content.

Section 305 - Worksets

Worksets are Revit's way of allowing multiple people to work on the same project. All DEN project files must have worksharing enabled.

305.1 General Standards

A. The BIM Leader for the project is responsible for creating and maintaining the worksets of the project.

B. Do NOT use worksets like layers.

C. For new content created within an existing DEN base model, the consultant shall create separate Worksets to allow for definition and separation of new content from existing.

305.2 Standard Worksets

All workset enabled projects will have at least the default worksets Shared Levels and Grids and Workset 1 (which should be renamed to the name of the model Discipline, e.g. Architecture, Mechanical, Structural) which should be renamed as appropriate for the primary UNIFORMAT II Level 2 group below. As project complexity increases worksets are added from the following list. This list is not exclusive. Projects may have other worksets, but at the end of the project, the models must be submitted using the workset names and guidelines below.

A. Primary List:

1. A10 Foundations
2. B10 Superstructure
3. B20 Exterior Closure
4. B30 Roofing
5. C10 Interior Construction
6. C20 Staircases
7. C30 Interior Finishes
8. D10 Conveying systems
9. D20 Plumbing
10. D30 HVAC
11. D40 Fire Protection
12. D50 Electrical
13. E10 Equipment
14. E20 Furnishings
15. F10 Special Constructions
16. F20 Selective Building Demo
17. G10 Site
18. L10 Airport Equipment

B. _LINKED CAD

This workset will appear in most workset-enabled files. This workset will be created OFF by default in all views. This is never set as the active workset. Link a DWG to all views, and then change its property to assign it to this workset. Use Visibility Graphics as needed per view to turn this workset on then isolate the individual drawing using the Imported Categories tab.

C. _COORDINATION

This workset should contain elements that are contained in the model solely for Coordination or system connectivity. For instance, if Mechanical equipment is copy/monitored to an electrical model for system connectivity purposes, or light families that exist in architecture for coordination.

D. _LR<DISCIPLINE INITIAL>- For Linked Revit Files.

Create one workset per linked Revit model. These worksets will appear in ALL workset files where another Revit file is linked. This allows users to use Visibility Graphics to turn off a linked Revit model or to use the worksets dialog box to set this to Opened=No

1. Simple

   LR<DISCIPLINE> such as LRA for Architecture, LRS for structure etc.

2. Complex

   LR<DISCIPLINE><FILE NAME> for projects where discipline models are broken into parts. For example, LRA-CCA_DEN-A

Section 306 - CAD and Linked Files

306.1 Use of CAD Files

If CAD files are needed, approval must be sought from the DEN BIM Manager.

When CAD file use is approved, CAD files must be Linked, never Imported. Linked CAD files must always be placed on the correct Workset _LINKED CAD.

CAD files must never be exploded.

306.2 Linked Revit Files

Section 307 - Design Options

Design Options allow the creation of studies of multiple alternates within the Revit file.

307.1 General Standards

Create a null design option where no work is performed and keep it as the Primary design option. Create as many new views as are needed to present the different design options but leave the primary option untouched so work can continue while the decision is under consideration. This practice is least disruptive to the rest of the team working on the project.

Design Options are limited to area specific modifications for wholesale building changes; use Save As. Consider whether options should be preserved long term in separate models that can be linked as needed.

Design Options are meant to be used for short-term decisions that are cleaned from the project by "Accepting Primary" which deletes all the unaccepted option.

Directly from Autodesk: from Autodesk white paper: revit_platform_2009_model_perfomance_technical_note.pdf

Limit the use of rooms in design options to necessities to avoid additional processor time spent on detecting room option conflict.

Unless specifically requested by the DEN BIM Manager, design options should be eliminated from the model file prior to submission.

Section 308 - Shared Parameters

DEN maintains a master shared parameter file for all projects. This is not contained in the shared Revit Content Library, but the parameters are available in the DEN templates. If new shared parameters are required by a project, they must be approved by the DEN BIM manager in advance.

DEN maintains a single master Shared Parameters file; DEN_Shared Parameters.txt. It is located in the 04_Support>02_Shared Parameters folder in the Kit of Parts.

Use of appropriate DEN Shared Parameters is CRITICAL to the Asset Management program. Failure to conform to these standards will result in automatic failure of a submittal review.

Section 309 - Issues and Revisions

Issue and Revisions should be Numbered By Project, not By Sheet to provide consistency throughout a sheet set.

Section 310 - Project Information

Project Information shall be filled out completely from project kickoff.

Section 311 - Shared Coordinates

DEN's current Shared Coordinate system is known as Low Distortion Projection (LDP). All projects must use the LDP coordinate system.

End of Chapter

Chapter 4 – Modeling Standards

Section 400 - Modeling Standards

400.1 Model Accuracy and Tolerances

Models should include all appropriate dimensioning as needed for design intent, analysis, and construction. Level of detail and included model elements are provided in the Information Exchange Worksheet.

Phase	Discipline	Tolerance
Design Documents	Architecture	Accurate to +/- [1/16"] of design size and location*
Shop Drawings	Mechanical contractor	Accurate to +/- [1/16"] of actual size and location*
* Unless otherwise dictated by the element in question needing a higher level of accuracy for design or placement		

Section 401 - Tagging

401.1 Model Content Tagging

All modeled elements must be identified using Revit's built-in tagging functionality. Use of the Text tool to identify rooms, doors, walls, pipes, ducts, equipment, etc., is not permitted.

Tags and Symbols approved by DEN are available in all templates and the Kit of Parts and can be found in the legend: Tags and Symbols

Section 402 - Content and Family Library

402.1 Family Naming

This section outlines the naming format for DEN Revit family files. Naming is divided and formatted into 4 categories as follows:

<CSI Identifier><dash><Type>< dash >< Description>< dash ><Category>.

A. CSI Identifier: 6 Digits (Required)

The CSI 2004/2010 format 6 digit identifier are used, no spaces.

1. 08 13 13 hollow metal doors = 081313

For conditions where conflicts occur, just first two characters are significant. For example, a wood door (08 14 15) in hollow metal frame (08 12 13) leads to just 080000.

B. Type: 6 Characters Max (Optional)

This is a flexible field and is used differently by different family types. The primary use of this is to provide a secondary sorting mechanism in Revit's Project Browser.

MEP can use this to separate out plan vs. other types of symbols. Specific types of annotation families such as title blocks can be separated out by adding this field. Doors and windows can use this to identify with shorthand interior, exterior, single, double.

C. Description: 18 Characters Max (Required)

General description of the family.

Use spaces within the field as necessary for clarity. Do not use hyphens.

Manufacturer or model number is not appropriate in family or type naming.

D. Category: 2 Characters Max (Optional)

This optional field is used to help users identify special types of families. Annotative elements may be created with Generic Annotation (GA), Detail components (DT), or even Generic Models (GM).

Section 403 - Systems and Connectivity

All designed elements shall be included as fully connected and closed systems using the built in System tools and System Browser in the required version of Autodesk Revit.

Section 404 - Rooms, Spaces and Doors

404.1 Room and Space Placement

All areas within the project design scope shall have Rooms in the Architecture and Structure models and Spaces in other discipline models placed in, enclosed, and numbered per DSM requirements. Disciplines other than architecture may forego placing Rooms or Spaces in their model if they meet two conditions. First, rooms or spaces in another project model must be shown, tagged and identified correctly in model views and on sheets (no plain text in place of Room Tags), AND any Assets in that discipline's model must have the ASSET_LOCATION parameter filled out completely and accurately.

404.2 Building Module and Direction Code

These parameters are used by DEN for multiple information systems including the emergency responder systems and must be established in conjunction with the DEN BIM manager. Each of the existing buildings has a building module and direction code system assigned.

404.3 Room Code and Door Room Code

For identification purposes, the Room Code is only a small part of the overall room ID. However, in general the room code can be thought of as the room number.

In the DEN facilities, rooms are numbered clockwise within a single module as established by the Building Module/Direction outlined above. Room Codes will be three digits except as noted below.

Instead of a three-digit room code, stairs, elevators, corridors, mechanical shafts, and gate areas will have a prefix noted below and then a two-digit room number.

Code	Area Type
AP	Apron
CR	Corridor
EL	Elevator
GT	Gate
MS	Mechanical Shaft
R	Roof
ST	Stairs

404.4 Areas and Spaces

Areas and Spaces will use the same naming and numbering convention as Rooms unless created for special purposes such as code/egress diagrams, leasing areas, or take offs of spatial regions per project.

Plenum Spaces will be defined by the inclusion of the prefix "P" before the name. Plenum spaces that cross over multiple rooms will take the name of the room that the space first crosses over in the lower left hand corner.

404.5 Naming: Room, Space and Door Numbering

Room and door identification must be coordinated to assure maximum compatibility with all downstream DEN uses including Maximo, Public Safety, and GIS applications. Each of the Values illustrated below will be a separate parameter that may be modified in Revit.

These parameters are built into the tags available in the DEN Revit Templates.

A. Example Room: ARF_03_5E_EL05

Aircraft Rescue and Firefighting, Level 03, in 5th east module Elevator, room 05 in this building module/grid.

B. Example Door: ARF_03_5E_EL05B

Same room, second door in that room. If more than one door is in a room, the first room will be A.

Section 405 - Modeling Guidelines and Requirements – Design

405.1 Origin Point

All models must be in the correct location in 3D Space (x, y, and z coordinates) using the current approved DEN coordinate system.

405.2 Tolerances

Models and Model Elements must be within 1/8” of theoretical dimensions. Tolerances for specific items and systems will be determined as necessary. Model tolerances are not to be construed as construction tolerances.

405.3 Units

Imperial units: One (1) unit in the model equals 0’-1”

405.4 Best Practices

Contributors to the models shall follow to the best of their ability the best practices listed in the "Autodesk Revit 2014 Technical Note Model Performance". Geometry from CAD applications such as AutoCAD, IFC, or MicroStation shall not be imported or linked into the model. Image files shall not be imported or linked into the model to represent geometry or other documentation. Revit Warnings should be kept to a minimum and model geometry called out in the Model Requirements section of this document shall not be associated with any Warnings.

405.5 Extent of model

The Building Information Model (in plan view) shall typically extend to five feet beyond the exterior walls of the buildings or rooms being modeled. Vertically, the model shall extend from the lowest extent of the rooms or buildings which may include foundations or lowest underground utility up through (and including) the roof of the top most floor, or highest overhead utility or adjacent structure. To the extent that the scope includes building systems, those systems will be included to the full horizontal and vertical extents of the model including underground utilities and rooftop mounted items.

Model scope also includes relevant faces/masses of buildings and encroachment zones (FAA Part 7460) adjacent or across street. Existing conditions will be modeled at level 300 when directly adjacent to new construction. Otherwise, existing conditions shall be modeled as masses.

Section 406 - Existing Conditions

406.1 Existing Model

In the event of a renovation or addition, a base model of the existing facility based on prior record documents may be available on request.

406.2 Laser Scanning

High definition laser scanning and existing conditions surveying may available from DEN’s survey services group on request given sufficient lead time.

Section 407 - Systems Modeled and Level of Detail:

The minimum level of detail defined for elements in the Design models as defined by the 2015 BIMForum Level of Development Specification except as defined otherwise by the Level of Development Matrix attached to the BIM Project Execution Plan for that particular project at each deliverable shall be:

- SD – LOD 100
- DD – LOD 200
- CD – LOD 300
- Record – LOD 300 (Reconciled with Construction Model)

407.1 General – Applicable to All Disciplines

A. All Equipment is to be modeled as solid objects to their overall height, width, and depth and Level of Detail as outlined in “Attachment 3 - BIM Matrix Worksheet and LoD Definitions”

B. All designed elements shall be included as fully connected and closed systems.

C. No-fly and access zones around equipment above control panels shall be modeled as 50% transparent solids for: access issues, code issues, and/or constructability.

D. MEP Spaces will be modeled corresponding/coordinated with Architectural Rooms.

E. Piping and Conduit 2” or greater shall be modeled, smaller piping if in ganged runs may be modeled as a mass.

F. Fire Alarm Zones, Fire Sprinkler Zones, and Communications Speaker zones shall be modeled as solid, transparent Revit Masses with appropriate Asset information assigned.

G. Signage modeling requirements in the BIM Model shall be limited to Way Finding and Room Identification required by Code.

Section 408 - BIM Spatial Coordination Procedure Outline – Design Model

408.1 Design Team

All consultants and subconsultants (architecture, structure, MEP, fire protection, BHS, etc.) will create a BIM model and produce 2D Construction Documents natively using Autodesk Revit (current approved version). The Revit design files shall be 100% Revit and all designed equipment and systems shall be modeled. The Revit file shall not contain any imported or linked AutoCAD, Bentley or other CAD or graphic files. This file shall include the model, families, and 2D documentation. Civil design will be designed and executed in Autodesk Civil 3D.

The Design team will provide a Revit model as a 3D background model or upon request export 2D drawings from the model into an AutoCAD DWG format to be used by Contractor, structural, MEP+FP, FA, and special consultants.

2D and 3D updated backgrounds will be posted regularly as per the BPXP.

408.2 Represented in these assigned colors as a guideline:

Trade colors for Spatial Coordination via Autodesk BIM 360 Glue

A. Fire Protection: red

B. Plumbing: magenta

C. HVAC Duct: blue

D. HVAC Pipe: lime green

E. Electrical: cyan

F. Pneumatic Tube: dark green

G. Concrete: grey

H. Structural Steel: maroon

I. Architectural: white

408.3 Spatial Coordination Procedure

Design Consultants shall be prepared to accommodate bi-weekly coordination meetings. Coordination meetings will begin prior to 60% design deliverable to resolve model conflicts.

A. The Design Team will provide a clash detection report in advance of each coordination meeting. The reports will be generated Autodesk BIM 360 Glue, supplied by DEN.

B. The clash reports will be run for all disciplines. A clash analysis report will be generated by the Design BIM Coordinator that involves looking at each individual clash, and documenting it, by saving the appropriate viewpoints.

C. Design Consultants are required to review the clash detection report generated by the Designer BIM Coordinator before the weekly meeting, and arrive at the meeting prepared to address the unresolved clashes in a constructive manner.

D. Design Consultants are required to run the clash detection analysis for their respective trade systems. The models submitted by the design consultants for overall coordination are required to be checked and coordinated with the architecture, structure and the Design Consultant's own Work prior to submittal. At a minimum, the model shall be precoordinated by the Design Consultant to avoid clashes with architecture, structure, other MEP systems, walls, ceiling systems, and enclosure.

E. Clashes should be kept to a minimum and will be evaluated for acceptable tolerance by DEN.

F. Design Consultants required to post to the Project BIM Server, updated drawings/models at least once per week, prior to the clash detection analysis run by the Designer BIM Coordinator as per the BPXP. This will continue until the project area is completely coordinated.

G. Design Consultants are required to collaborate with each other consultant to resolve basic clashes outside of the weekly Coordination meetings. The weekly Coordination meetings are held to address difficult areas that are not able to be coordinated between the multiple disciplines themselves.

H. Models that are to be used for Clash Detection are to be purged of all non-essential information.

I. Coordinated submittal data is to be distributed on a weekly basis, and prior to coordination meetings.

J. Coordination model shall include, at a minimum: The modeling elements per modeling requirements specified by this document and the LoD.

K. Responses to BIM clashes must be incorporated into the model (when applicable) in less than 10 business days.

L. Implementation of modifications to the project Building Information Models due to Action Item responses will be the responsibility of the Model Element Author in primary control of the effected Model Element at the Action Items initiation.

408.4 Reconciled Model

Once Contractor model is completely coordinated, Design Team shall reconcile differences between the Contractor and Design models as they relate to DEN identified Assets under the guidance of DEN BIM Manager.

408.5 Model Management

Design Consultants shall provide updates/maintenance of Electronic Data/3D Model throughout construction that modify the design intent and/or special coordination to the design model to include but not limited to

A. Incorporation of RFIs

B. Incorporation of ASIs, CDs, CCDs, MODs

C. Submittal comments and revisions on approved shop drawings.

D. Implementation of modifications to the project Building Information Models due to RFI responses will be the responsibility of the Model Element Author in primary control of the affected Model Element at the RFIs initiation.

Section 409 - Modeling Guidelines and Requirements – Construction Team

409.1 Origin Point

All models must be in the correct location in 3D Space (x, y, and z coordinates) using the current approved DEN coordinate system.

409.2 Tolerances

Models and Model Elements must be within 1/8" of theoretical dimensions. Tolerances for specific items and systems will be determined as necessary. Model tolerances are not to be construed as construction tolerances.

409.3 Units

Imperial units: One (1) unit in the model equals 0'-1"

409.4 Model Completeness

Models must be 100% complete for the current building, level, and phase. This includes, but is not limited to:

A. Piping that is larger than 2" diameter.

B. Model all equipment and panels to scale with required clearance zones included.

C. Identify all service and access areas.

D. Show size and thickness of housekeeping pads.

E. Show all sleeved or cored hole penetrations.

F. Model all "no-fly zones" for: access, maintenance clearance, elevator shaft, code issues, constructability with solid objects.

G. Any item which may impact coordination with other disciplines

H. Penetration thru building systems such as cast-in-place concrete and CMU walls shall be identified in the Trade Contractor's model by means of a modeled sleeve (w/ defined tolerance).

I. All model elements (families) are to have identity codes or CSI codes attached as defined in the data normalization requirements.

J. All model elements are to have DEN required parameters and their values included for As-Built submission. CM/GC will ensure collection and data population of DEN required parameters from all subcontractors and vendors.

409.5 Systems Modeled and Level of Detail:

The minimum level of detail defined for elements in the Construction/Fabrication models shall be level 350 as defined by the 2015 BIMForum Level of Development Specification except as defined otherwise by the Level of Development Matrix attached to the BIM Project Execution Plan for that particular project. The Contractor will determine the effect on the Models and scope, and propose the appropriate response to accommodate the noted Model development and/or coordination issue.

Section 410 - Systems Modeled and Level of Detail – Construction Model

The Contractor shall provide modeling to accurately represent the scope of the work contracted for and shall provide separate model iterations to reflect the proposed stages of work for periods no less than one-month duration or "snapshots in time," at significant milestones within the schedule. Project model elements shall, conform, at a minimum, to the requirements established in the *Standards and Criteria Design Standards Manual*, specifically including but not limited to, Chapters 13 – Phasing and Staging Drawings and 28 – Planning Study.

All model elements are to have DEN required parameters and their values included for As-Built submission.

Section 411 - Clash Coordination – Construction Phase

3D Computer coordination as it relates to Mechanical, Electrical, Plumbing, Fire Protection, Fire Alarm, Baggage Handling System, and Special Systems during the construction modeling phase:

411.1 The Trade Contractor

Will deliver a 3D computer model that is complete based upon DEN standards in their native, Revit compatible, file format and in NavisWorks Document Format (.NWD) and Revit .rvt. Any elements not included will become the Trade Contractor's responsibility to coordinate in the field and at no additional cost. All 3D model elements shall include DEN required parameters and their associated values included for deliverable submission.

Trade Contractor shall provide a list of minimum typical clearances for all model components (Clash rule criteria).

411.2 Represented in these assigned colors as a guideline:

Trade colors for Spatial Coordination via Autodesk BIM 360 Glue

A. Fire Protection: red

B. Plumbing: magenta

C. HVAC Duct: blue

D. HVAC Pipe: lime green

E. Electrical: cyan

F. Pneumatic Tube: dark green

G. Concrete: grey

H. Structural Steel: maroon

I. Architectural: white

411.3 Coordination Procedure

A. Design team BIM/3D models: Current Architectural, Structural, MEP, BHS and Security and IT models shall be made available to the Trade Contractor, each trade is required to download and use these files to create their system models by sequence or geographic area (Schedule WBS, Work area, etc.).

B. Trade Contractor shall be prepared to accommodate bi-weekly meetings to resolve model conflicts within the Project Schedule and sign off on a 'Master Model' to be considered the basis for construction on an area and floor by floor basis consistent with the Project Schedule.

C. Contractor will provide clash detection reports to accommodate the above utilizing approved software platforms.

D. Each Trade is required to review the clash detection report generated by the Contractor BIM Coordinator before the weekly meeting, and arrive at the meeting prepared to address the unresolved clashes in a constructive manner. Subcontractors are responsible for coordinating and resolving the majority of the clashes prior to a meeting so that the meeting time can be used efficiently to focus on the issues that require all participants to resolve.

E. Coordination model shall include, at a minimum: The modeling elements, associated parameters, and their data per modeling requirements specified by this document and the LoD and MPS.

F. Models to be purged of all non-essential information, only 3D information should remain in the file.

G. Each Trade is required to run the clash detection analysis for their respective trade systems against the Architectural/Structural design models to ensure that there are no conflicts between the architectural/structural elements and their systems prior to submittal.

H. Each Trade is required to post to the BIM Server, updated drawings/models at least once per week, prior to the clash detection analysis run by the BIM Coordinator. Day and time of the posting is per the BPXP. This will continue until the area is completely coordinated.

411.4 Master Model

Following 100% coordination and agreement on a 'Master Model', the Trade Contractor agrees and signs off to be responsible for locating their respective components within an agreed tolerance based on the 'Master Model'.

A. Any variation beyond the agreed tolerance must be coordinated with Contractor first and approved by Designer and Owner.

B. Items not included in the coordination model will be installed, in the field, after all coordinated elements are in place.

C. Components that are installed in conflict with model layout and create obstacles or additional work for other disciplines shall require one of the following: a) removal and reinstallation per model at no cost to other parties, or b) monetary compensation to the affected party and owner.

411.5 Documentation of Coordination

The following will be included as a zipped file and posted by Contractor for all subs and design team.

A. A record of the Original BIM data used for ‘Sign-off’ Documentation.

B. A NavisWorks (NWD) Published file that includes the final Clash reports and Comments.

C. PDF files of above reports.

D. Each Trade is required to maintain and provide the 3-Dimensional Model with respect to generating As-Built Drawings/Models. It is the responsibility of each trade to update their respective 3-Dimensional Model throughout construction to reflect field conditions to accurately document As-Built conditions.

E. Each Trade is required to submit an electronic copy containing the 3-Dimensional As-Built models, once all issues are addressed from above. This deliverable shall contain As-Built models in Revit .rvt, Postscipt Digital File .pdf, NavisWorks .NWD format and the other original authoring files in the native format of the program that created the models. Owner reserves the right to request additional file formats as the needs of the client or project require.

411.6 Model Management

A. Trade Contractors shall provide updates/maintenance of Electronic Data/3D Model throughout construction to include but not limited to:

B. Incorporation of RFIs, Bulletins and Change Orders, etc.

C. Submittal comments and revisions on approved shop drawings.

D. As-Built field modifications.

E. Trade Contractor to provide Contractor with an updated model on a bi-monthly (2x per month) basis throughout the installation of the Work.

411.7 Utilization of BIM for the RFI / Change Order / Bulletin process

Trades that have work directly affected by RFI, Change Orders, or Bulletins shall submitted updated models no later than 10 business days after execution of the Change Order. Implementation of modifications to the project Building Information Models due to Change Orders will be the responsibility of the Model Element Author in primary control of the effected Model Element at the Change Order’s initiation. Contractor BIM Coordinator will audit and report the clashes that are local to the area affected by the change documents.

End of Chapter

Chapter 5 – Views

Section 500 - Model Views

The following conventions apply to all views in the project regardless of the view type; plan section, legend, or schedule.

500.1 Original Views

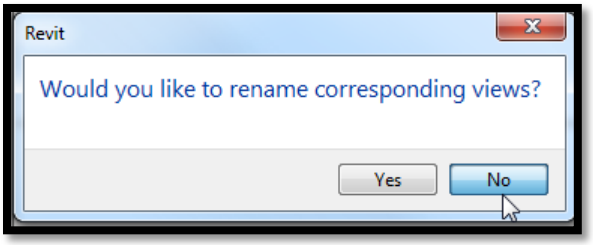
Once section and elevation marks have started to be placed in the project, do not delete the original Level plan views. This is important as DEN utilizes the “Referenced From” parameter. Deleting the original views will create problems with this system.

500.2 Creating New Views

When creating a new view/sheet by duplicating or creating new from scratch, always open the view properties and fill in the element properties that are used by your project for view sorting and organization.

500.3 Level Names

Level Names, once set by the project BIM Lead, may not be changed. This means that the names that appear in elevations/sections should not be changed. Revit attempts to keep the name of a view coordinated with its Associated Level. This message appears when changing a view name that is the same as its Associated Level.



The answer is always NO. Answering with YES will change the Level Name and that is not what is desired.

500.4 Duplication of Section Mark Types

Section -Detail types may not be duplicated.

500.5 Duplication of Drafting View Types

Drafting view TYPES may be duplicated in a project to help organize 2D details in projects. In large projects, the view's browser driving parameters should be used.

A. View Organization Parameters

Most of the view types (Plans, Sections, Elevations, Detail and Drafting views) have two custom parameters, Category and Sub Discipline, which are used with two default Revit view parameters, Discipline and Associated Level, to sort and organize the default views provided in any template.

Discipline refers to the design discipline for the documents being generated, such as Architectural, Structural, Mechanical, Electrical, etc.

Category is used per the National CAD Standard sheet ordering system to group similar view types together, e.g., 100-PLANS, 150-RCP, 200-ELEVATIONS, 300-SECTIONS, 500-DETAILS, 900-3D, etc.

500.6 Plans and RCP

A. Elevations - Two different Exterior elevation types exist in the templates. Design elevations are intended to be used for color presentations. Sheet elevations are for Construction Documents

B. Sections and Detail Views - Sections and Detail Views are added with the same tool, the section tool. The type definition determines the look of the mark as well as where the view appears in the project browser.

C. Drafting views - Drafting views are most commonly used for generating standard 2D details that can be imported across projects. The Synchronize drafting view type is used specifically as the view that models open to when first opened as well as the go to view when synchronizing.

D. Sub-Discipline - Sub Discipline is used by the project browser to organize the plan views into different categories based on how the view will be used in the project. Additional Sub Disciplines may be added for specific project needs.

E. Design views - Design views are intended to be used for Presentation views, which may include colors, shading/shadows, and other Conceptual and/or Schematic Design information.

F. Export views - Export views are set up for exporting to other CAD formats. There may be times when the export does not contain the same information as the construction document set. A Navis works export view shall be set up for each project. The view setting shall be set to “Fine” detail and “Realistic”.

G. Link views are used for:

1. Linking in other CAD formats.

2. A view with the active Revit Links made visible.

H. Sheet views - Sheet views make up the Construction Document set. They contain final annotation and dimensions.

I. Working views - Working views are intended to be used for day-to-day model development. These are views in which you can set the visibility graphics in a way to get your work done, hence "working view". These views are never placed on sheets.

J. Temporary working views

1. Temporary working views are generated to create a view at a different scale or visibility graphic settings when a working view is in use by another member of the team.

2. Name these views t_<your_Initials>_description

3. If you create one of these views, it is your responsibility to delete it when you are through with it.

Section 501 - View Naming

501.1 Legends

The naming convention for legends is the same as for other views. Legends going on sheets are named in ALL CAPS, informational or working legends, which are not placed on sheets, are named in all lowercase.

Legends are broken into two general categories.

A. Notes Legends - Include General Notes and Code Analysis views.

B. Symbol Legends - Includes the list of DEN approved default Fill Patterns and the DEN Symbols reference

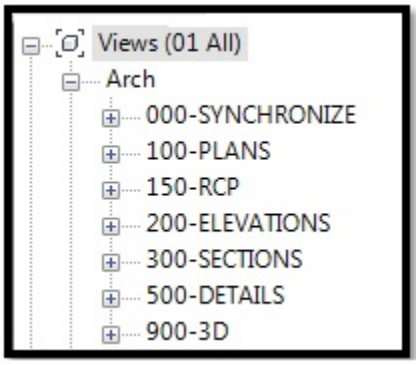
501.2 Schedules

The naming convention for schedules is the same as for other views. Schedules going on sheets are named in ALL CAPS, informational or working schedules, which are not placed on sheets, are named in all lowercase. Additionally, "Key" in a schedule name indicates the scheduling of Revit Keys rather than building components.

Section 502 - Browser Organizations for Views

The DEN templates have six standard view organizations. Each organization definition sorts and/or filter views in the project browser.

For example, in the 01 ALL organization, views are sorted first by Discipline, then Category, Sub discipline, and then by their Associated Level.



All views will be listed and groups of view types are packaged together. A consultant could create a "Sub Discipline" called "Schematic Presentation" and place all the Schematic Design views into that package. Those views will remain with the project but will be separate from the rest of the DD and CD views.

502.1 Template Browser Organizations: DEN Standards (Numbered)

These are standard DEN browser organizations and should not be modified or deleted.

A. 01 All - Views are ordered in a structure similar to the National CAD Standard
   1. Order: Discipline > Category > Sub discipline > Associated Level
   2. Filter: None Applied

B. 02 Design Views -
   1. Order: Discipline > Category > Sub discipline > Associated Level
   2. Filter: Sub Discipline = Design

C. 03 Sheet Views - Only Sheet views are shown in the project browser
   1. Order: Discipline > Category > Sub discipline > Associated Level
   2. Filter: Sub Discipline = Sheet

D. 04 Working Views - Only Working views are shown in the project browser
   1. Order: Discipline > Category > Sub discipline > Associated Level
   2. Filter: Sub Discipline = Working

E. 05 Export Views - Only Export views are shown in the project browser
   1. Order: Discipline > Category > Sub discipline > Associated Level
   2. Filter: Sub Discipline = Export

F. 06 Details Order - Only Detail views are shown in the project browser
   1. Discipline > Category > Sub discipline > Associated Level
   2. Filter: Category = 500-Details

Section 503 - Schedules

503.1 Schedule Creation

Schedules must be created using Revit's built-in scheduling tools. Use of drafting views, CAD, text tools, drafting lines or other workarounds is not permitted.

503.2 Template Schedules

The DEN templates contain many customized schedules. They are designed to be a very efficient way to do data entry in the Revit environment, but must be used in a particular way to be most efficient.

This section outlines the custom schedules available in the DEN templates and container files.

503.3 Schedules: Door and Frame Schedules

The DEN architectural template contains a series of door schedules

Door and Frame Schedule	Schedule intended for plotted set of drawings.
Door and Frame Schedule 01 Materials Key	Key schedule. Holds full information for the materials and finishes assigned to the frame and panel in the DOOR AND FRAME SCHEDULE
Door and Frame Schedule 02 Detail Key	Key schedule. Holds head, Jamb and Sill detail references for specific typical wall conditions to populate DOOR AND FRAME SCHEDULE.
Door and Frame Schedule 03 Hardware Key	Hardware Sets are described in the specifications; edit this Key Schedule to correspond to the specifications to populate DOOR AND FRAME SCHEDULE.

A. _abbreviations

Customized schedules to be used to record or plot the standard abbreviations for the project. This schedule is a key schedule that holds values in the Revit Internal Point Loads parameters.

End of Chapter

Chapter 6 – Sheets

Section 600 - Sheets

Sheets, like views have their own parameters that are used for sorting and organizing the sheets in the project browser. The same parameters used to sort and organize the sheets in the project browser are used to organize the sheets in the Drawing Index schedules. For general Sheet naming, numbering, and layout standards refer to the National CAD Standards v6.0

600.1 Sheet Parameters

Sheet Parameters are used to organize the project browser and the drawing lists for document sets. The following section documents to which elements the parameters are assigned. Similar to the view browser organizations, these are set in the template as a base set of schedules and browser organizations. This base set may be added to for any project.

A. Category - In Project Browser used for browser organization, 01 Architectural Set, similar to view organization described in this document.

B. Sheet Discipline - Used in Browser Organization 03 ByNCS

C. Volume Number - Used for Drawing Index schedule to sort construction document sheets by volume if needed. Volume is also used in the browser organization: 02 Architectural Set By Volume

D. Sheet Sort Order - Allows the Drawing index schedules and Browser Organizations to be organized in a non-alphabetical manner. The sheet sort order number is organized by the National CAD standard sheet set organization.

NCS	NCS	Revit Sheet Sort Order
G	General	0
H	Hazardous Materials	1
V	Survey / Mapping	2
B	Geotechnical	3
C	Civil	4
L	Landscape	5
S	Structural	6
A	Architectural	7
I	Interiors	8
Q	Equipment	9
F	Fire Protection	10
P	Plumbing	11
D	Process	12
M	Mechanical	13
E	Electrical	14
T	Telecommunications	15
R	Resource	16
X	Other Disciplines	17
Z	Contractor / Shop Drawings	18
O	Operations	19
PL	Planning and Urban Design	20
		21

1. Drawing Index – Architecture

A sheet drawing index sorted alphabetically. Delete if not used

SHEET #	DRAWING TITLE
ARCHITECTURAL	
A101	FIRST FLOOR PLAN
A151	FIRST FLOOR REFLECTED CEILING PLAN
A201	EXTERIOR ELEVATIONS
A301	BUILDING SECTIONS
A400	ENLARGED PLANS
A501	DETAILS
A601	SCHEDULES
A700	USER-DEFINED
GENERAL	
G000	COVER SHEET
G001	GENERAL NOTES
G002	ABBREVIATIONS AND SYMBOLS
INTERIOR DESIGN	
I101F	FIRST FLOOR FINISH PLAN
I101U	FIRST FLOOR FURNITURE PLAN
Grand total: 13	

2. Drawing Index – NCS

A drawing list organized using the National CAD Standard set system.

Sheet Sort Order (hide	Volume Number (header and/or hid	Sheet Discipline (hide)	SHEET #	DRAWING TITLE
GENERAL				
0	01	GENERAL	G000	COVER SHEET
0	01	GENERAL	G001	GENERAL NOTES
0	01	GENERAL	G002	ABBREVIATIONS AND SYMBOLS
HAZARDOUS MATERIALS				
1	01	HAZARDOUS MATERIALS	H001	FIRST HAZ-MAT SHEET
SURVEY MAPPING				
2	01	SURVEY MAPPING	V001	FIRST SURVEY MAPPING SHEET
GEOTECHNICAL				
3	01	GEOTECHNICAL	B001	FIRST GEOTECHNICAL SHEET
CIVIL ENGINEERING				
4	01	CIVIL ENGINEERING	C001	FIRST CIVIL SHEET
LANDSCAPE				
5	01	LANDSCAPE	L001	FIRST LANDSCAPE SHEET
ARCHITECTURAL				
7	01	ARCHITECTURAL	A101	FIRST FLOOR PLAN
7	01	ARCHITECTURAL	A151	FIRST FLOOR REFLECTED CEILING PLAN
7	01	ARCHITECTURAL	A201	EXTERIOR ELEVATIONS

Section 601 - Sheet Browser Organization

Like the views, the project browser allows for the organization of sheets. These organization definitions only affect the project browser and not the drawing list schedules. However, the same parameters are used to drive the browser organization as well as the drawing list schedules.

601.1 Template Browser Organizations: DEN Standards (Numbered)

DEN templates have three customized browser organizations built-in. These are standard DEN browser organizations and should not be deleted or changed. Any project may add to this set for project specific organizations. If possible, use parameters already in use by the other browser organizations.

A. 01 Architectural Set - All printed views are shown. Any sheet that is a placeholder (for drawing index) is not shown.

   1. Order: Category > none > none > Sheet Number
   2. Filter: Category Not Equal to 999-PLACE HOLDERS

B. 02 Architectural Set by Volume - All printed views are shown. Any sheet that is a placeholder (for drawing index) is not shown.

   1. Order: Volume Number > Category > none > Sheet Number
   2. Filter: Category Not Equal to 999-PLACE HOLDERS

C. 03 By NCS - All sheet views are shown

   1. Order: Sheet Sort Order > Sheet Discipline > none > Sheet Number
   2. Filter: No Filter applied

End of Chapter

Chapter 7 – Annotation

Section 700 - Standard Text Styles

All Revit text will be in the Arial font. The DEN standard text types as provided in the DEN Revit templates:

A. Redmarks - 3/32” - This text type is red and is used only in working views for coordination between models.

B. Headings - 1/8” - Used for any headings, such as on legends Notes Headings, etc.

C. Sub-Headings - 5/32” - Sub-Headings that need to be hierarchically beneath Headings such as Schedule headings.

D. Notes - 3/32” - This text is used in all use cases in a project not covered specifically by the three preceding types.

Section 701 - Standard Dimensions

DEN templates have three linear dimension types available:

A. Redmarks

Redmarks dimension type is to be used in special working views to exchange information between disciplines with the use of DWF or other export.

B. Standard

Standard dimension type is to be used for all construction document purposes

Section 702 - Sheet Notation

Annotation should follow the National CAD Standards current version (As of this writing current version 6.0) Uniform Drawing System Module 7 Notations. Please refer to that document for complete text on any of the topics in this section.

There are five types of notes: general notes, general [discipline] notes, general sheet notes, reference keynotes, and sheet keynotes. 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. Should these three types of notes appear on the same sheet, they are listed in the following hierarchical order:

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

702.1 General Notes

General notes are located within the G-Series, General Drawing’s sheet types.

702.2 General [Discipline] Notes

General [discipline] notes appear on the first or 0-Series sheets within a particular design discipline and apply to all subsequent sheets within that discipline. For example, general architecture notes appear on sheet A-001 and apply to all architecture sheets within the drawing set.

702.3 Sheet Notes

General sheet notes are used to communicate sheet-specific information or instructions. General sheet notes are tabulated sequentially within the note block. General sheet notes follow the other types of general notes (general notes or general [discipline] notes) and precede any reference keynotes that may appear in the note block. Refer to illustrations that follow. General sheet notes should be written in the imperative mood and in a streamlined

format similar to the preferred specification language presented in The Project Resource Manual—CSI Manual of Practice (PRM).

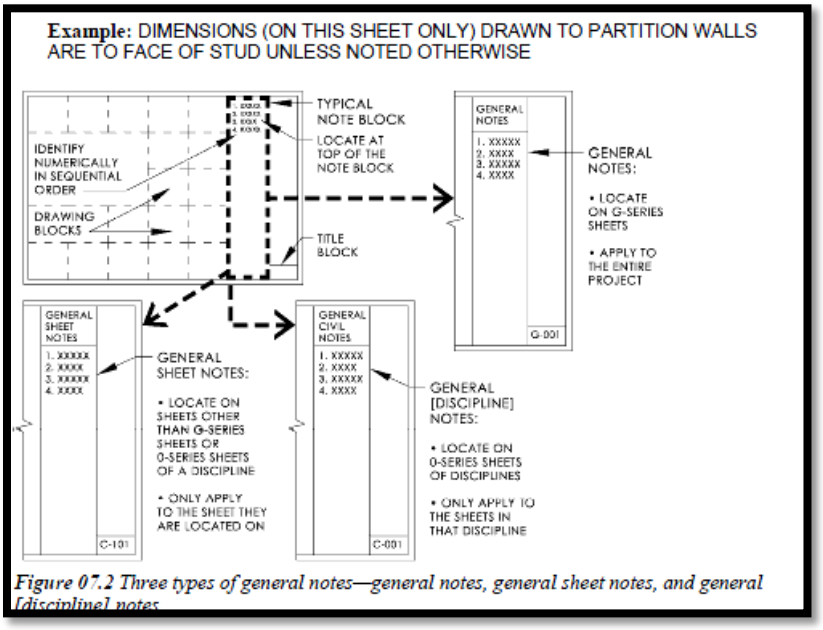


Figure 07.2 Three types of general notes—general notes, general sheet notes, and general [discipline] notes

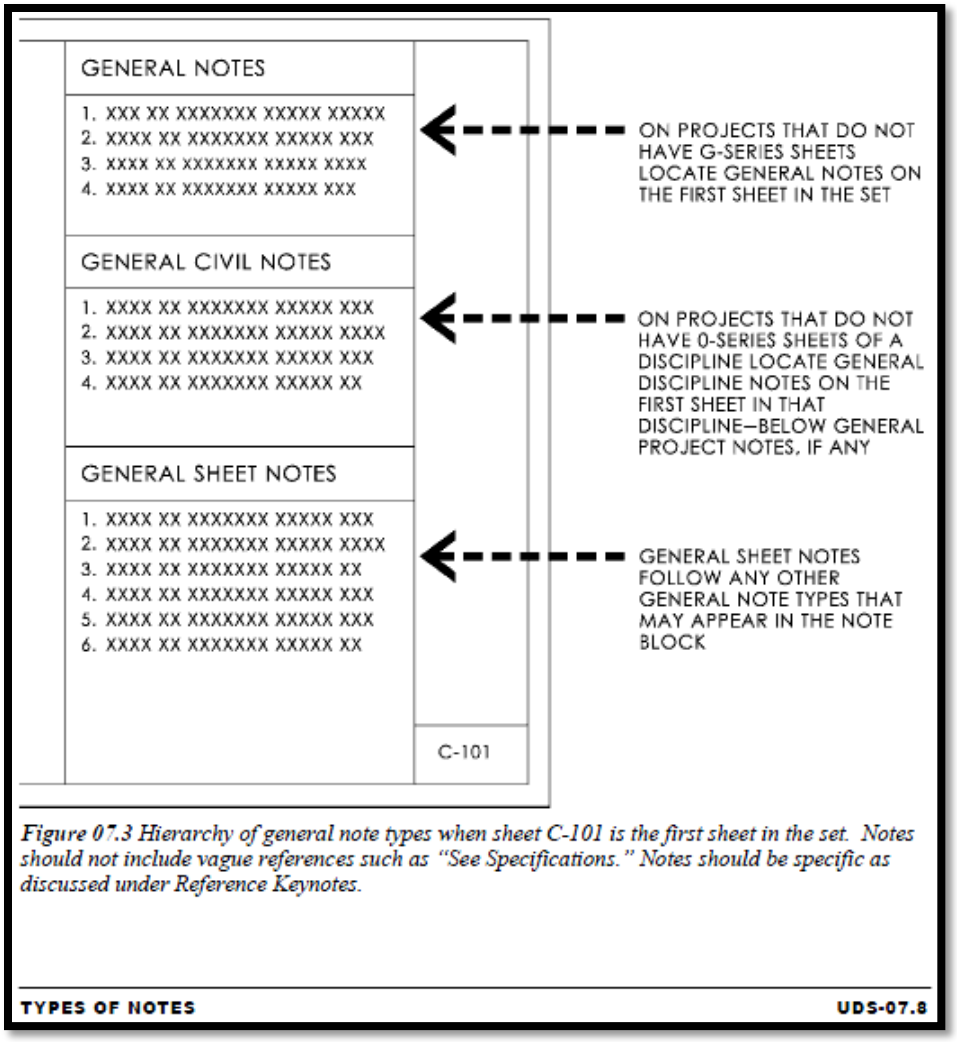


Figure 07.3 Hierarchy of general note types when sheet C-101 is the first sheet in the set. Notes should not include vague references such as "See Specifications." Notes should be specific as discussed under Reference Keynotes.

A. Sheet Notation General Rules:

When placing notes on the drawing, place the note directly next to the noted object, using complete text within the drawing area. Revit Keynote functionality may also be used for sheet notation where possible and appropriate.

If you cannot put the full text of the note within the drawing area, it will become either a Reference Keynote or a Sheet Keynote.

To allow the most flexibility for all firms and disciplines working with DEN, the following Revit components have been identified to fill the roles established by the National CAD Standard for Reference Keynotes and Sheet Keynotes:

1. Sheet Keynotes are more generic and may use the Revit Keynote tools or Generic Annotations and Note block schedules.
2. Reference Keynotes refer to specific specification sections within the project and utilize the Revit Keynote tools.

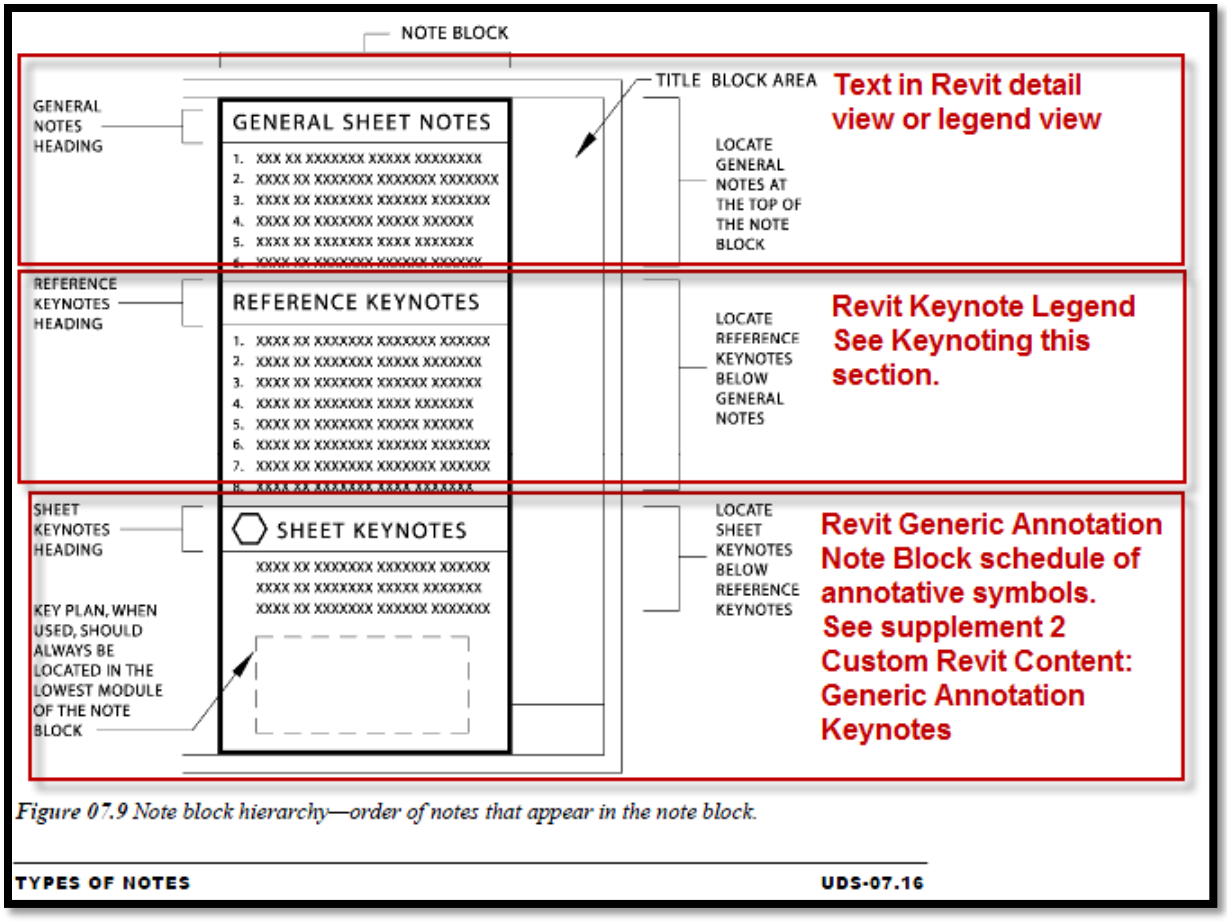


Figure 07.9 Note block hierarchy—order of notes that appear in the note block.

Section 703 - Keynotes

The Revit Keynoting feature links data in a text file to the elements and/or materials within the Revit model. If one material or element type is linked to a keynote, all future keynotes placed on that same material or element within other views will display the same value.

DEN maintains a single master keynote file; DEN_RevitKeynotes_Imperial_2004.txt. It is located in the DEN Kit of parts in the 04_Support>03_Keynoting folder.

Section 704 - Sheet Notes

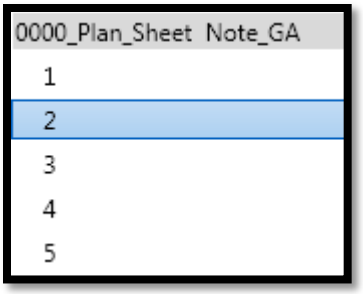
704.1 Family: Annotation: 000000 <Use> SheetNote-GA

Each family is separated by use. Alt notes, Demo notes, Plan Notes and Elev notes, are provided in the base template. If needed save this family from the template for different uses.

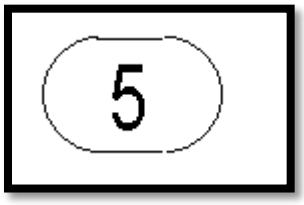
- 000000-PLAN-Sheet Note-GA
- 000000-ELEV-Sheet Note-GA

A. Types

Types are used to designate the number of the sheet note. E.g. Note 2 on A floor plan would use 000000-PLAN-Sheet Note-GA:2



B. Symbol

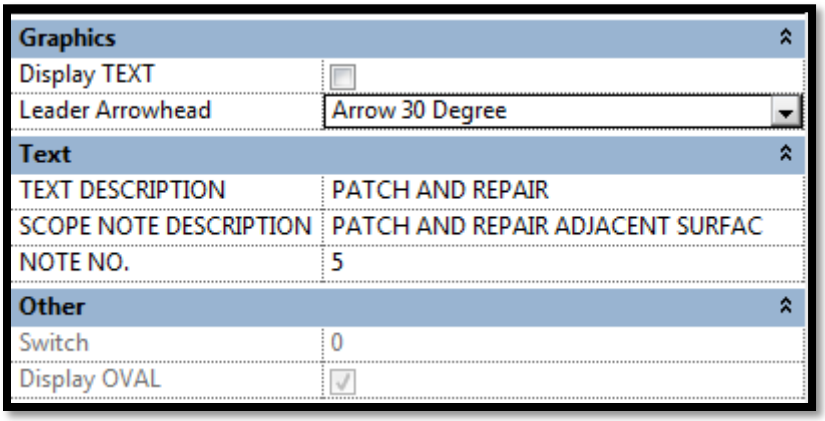


C. Parameters

1. Instance Parameters

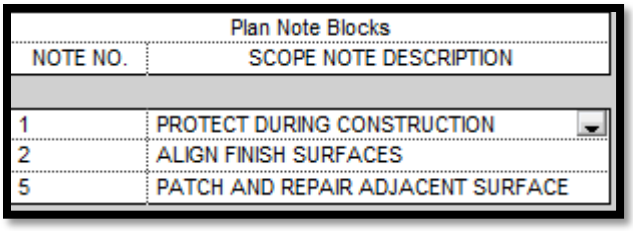
Sheet No is used to filter the note block schedules for placing on individual sheets

2. Type Parameters



a. Scope Note Description

Longer text that appears in note block schedule placed on sheet (Sheet Notes).



Plan Note Blocks	
NOTE NO.	SCOPE NOTE DESCRIPTION
1	PROTECT DURING CONSTRUCTION
2	ALIGN FINISH SURFACES
5	PATCH AND REPAIR ADJACENT SURFACE

The text associated with any number will match the same number used on other sheets.

b. Note No.

Used for note block schedule. Duplicates Type Name.

Section 705 - Line Patterns and Styles

Line styles and patterns approved by DEN will be available in all templates and can be found in the legend: Line Types

The Medium, Wide, and Thin lines should not be used (however they cannot be purged from the templates).

DEN Line Styles should be named according to their thickness and their color and line pattern if they are not Solid Black.

For example:

02	A solid black line with thickness 2
02 Red	A solid red line style with thickness 2
02 Hidden Red	A red line, thickness 2 with the Hidden line pattern

705.1 Line Patterns

Line patterns are documented in the templates in the schedule “Line Patterns for Drafting”

End of Chapter

Chapter 8 – Quality Assurance/Quality Control

Section 800 - QAQC

800.1 General

This section outlines required best use practices that affect the health and/ or organization of the project.

A. Opening Files

1. When opening Revit files: Use the Revit Open dialog box rather than double clicking the file in windows explorer.
2. Open selective worksets for larger files as appropriate.

800.2 Model Reviews

DEN BIM will review all project models at all project deliverables. A detailed model review report will be returned to the project team and DEN PM, a Model Review meeting may be held at the request of the project team or DEN to discuss the results. Interim over-the-shoulder reviews may be requested by the project team or DEN to ensure project model quality.

800.3 Review and Fix Warnings

Warnings should be fixed on a daily or as-created basis. Warnings have a significant adverse effect on model performance. Prioritize warnings for model-based elements (i.e. system connection issues, model elements overlapping, etc.) over annotation or mark type conflicts (line is at a slight angle, door/room/elements share the same mark, etc.)

800.4 Outside Content Sources

Content outside of the DEN Template or DEN Library/Kit of Parts should only be integrated into the DEN Content Libraries by the Project BIM Manager in coordination with the DEN BIM Manager.

Section 801 - References

This part has been inspired and assembled from many sources including

1. IU_BIM_Guidelines_and_Standards.pdf
2. VA-BIM-Guide.pdf
3. State of Wisconsin BIM Guidelines and Standards.pdf
4. BIM_Guidelines_Book_191109_lores.pdf

End of Chapter

Appendix A - BIM Tenant Standards

Chapter 1 - BIM Standards

Section 1100 - Introduction

This appendix provides a set of graphic and Revit file standards for any Tenant Improvement Project at DEN. It has four main sections:

- Introduction
- Project Setup
- Project File Standards
- Content Modeling Standards

1100.1 Denver International Airport's Vision

Denver International Airport (DEN) recognizes that Building Information Modeling (BIM) represents a fundamental change to the industry. This change affects the traditional processes and deliverables for planning, architecture, engineering, construction, and facilities management.

The goal of Denver International Airport is to integrate BIM from cradle to grave in its organizational, planning, and maintenance departments.

To achieve this goal, DEN has adopted these BIM requirements. These requirements apply to all DEN Projects advertised on or after July 1, 2010

Requirements established here are baseline requirements for all BIM tenant projects at DEN. Any of these requirements may be superseded by Project Contract or the project's specific BIM Project Execution Plan.

1100.2 Target Audience

This document is targeted at anyone working on authoring Revit models for DEN. This includes both DEN staff as well as external service providers. The format of this document assumes the reader has a base knowledge of BIM, Revit and the workflows and terms common to the industry, and based upon the design standards committee review.

1100.3 Acronyms

BIM	Building Information Model or Building Information Modeling
BPXP	BIM Project Execution Plan
DEN	Denver International Airport
LoD	Level of Development

Section 1101 - Project Setup

Section 1102 - Folder Structures-2015_DIA (Shared Libraries)

This section describes the folder structure and content for the DIA (shared) BIM libraries. Files and folders described here are available to all DEN staff and consultants working on DEN BIM projects. This content includes Project Content library, a Project specific library, and Local Workstation folders from which to begin projects and maintain related standards material.

For DEN consultants, this library (Project Content) contains the DEN "Kit of Parts" and will be transferred to their local server, or provided on a disk, after successful request to, and acceptance of, the DEN Project Manager. The folder structure is summarized below:

1102.1 2015_DIA

A. 01_Library
   1. 00_Master Format Docs - Contains Master Format Documents for Reference
   2. 01_Containers - Container files hold libraries of DEN approved system families
   3. 02_Templates - approved Project and Family templates
   4. 03_Titleblocks - Approved DEN Specific titleblocks
   5. 04_Hatch Patterns - DEN Standard hatch patterns for Civil 3D
   6. Annotations - Approved DEN symbols and annotation
   7. DIV-## - DEN content organized by Master Format specification section

B. 02_Project ###### - Folder structure for organization of files for your project
   1. 01_Central Files - Discipline specific subfolders by NCS discipline code.
      a. A - Architectural
      b. C - Civil
      c. E – Electrical
      d. F – Fire
      e. I - Interiors
      f. L – Landscape
      g. M – Mechanical
      h. N - Navisworks
      i. P – Plumbing
      j. Q – Equipment
      k. S - Structural
      l. T - Telecom/Data
      m. V – Vertical Transportation
      n. Z - Misc

C. 02_Project Libraries - A duplicate of the Master Format division Library folder structure for project generated content.
   1. Annotations - Approved DEN symbols and annotation
   2. DIV-## - DEN content organized by Master Format specification section

D. 03_Support - This folder includes the standard supporting text files (Keynotes, Shared Parameters, Import/Export lineweights) for Revit as well as customized Batch Files for various uses.
   1. 04_Reference - This folder contains project related reference material, organized in logical file structures, e.g., A copy of the current LoD Matrix, BPXP, product information, cut sheets, program information, etc.

Section 1103 - Naming and Numbering Conventions

1103.1 Name and #: Building ID the Master Grid – Crash Map

Buildings at DEN are identified by many internal systems using a Building ID. The building ID is the combination of the location of the building on the DEN master grid system / Crash Map and the sequence buildings were completed within a given grid segment.

This number is assigned by DEN at project kickoff. The Revit file DEN LDP 2010 Master.rvt contains the crash map grids A-FF and 00-31, for example

R16-1 = Terminal, R17-1 = Airport Office Building, R19-1 = Concourse A

1103.2 Building Abbreviation

A three-character abbreviation for each building is used by Facilities Management. This number is assigned by DEN prior to project kickoff, for example

TML = Terminal, AOB = Airport Office Building, CCA = Concourse A, etc.

Section 1104 - Naming: Revit Project Files

This section outlines the DEN naming convention for Revit project (.RVT) file naming. Naming is divided and group formatted into 3 general categories as follows,

A. <Building Identifier>_<BIM team/model identifier>_<DEN Project Identifier>_Central <YEAR>.rvt

R16-1-TML_DEN-A_20110930_Central 2015.rvt

1104.2 DEN Revit File Naming Expanded

Fields within the general categories are delimited with a hyphen if needed.

A. Building Identifier (assigned by DEN):

<Building ID Grid>< dash ><Bldg ID Sequence>< dash ><Bldg ID Abbreviation>

B. BIM Team and Model Identifier

<Office of Origin>< dash ><Discipline>< dash ><Building Model Split [optional]>

C. DEN Project Identifier

<FAA AIP><DEN Project Number>

R16-1-TML_DEN-A_20110930_Central 2015.rvt

Section 1105 - Naming: Revit Family Files (RFA)

This section outlines the naming format for DEN Revit family files. Naming is divided and formatted into 4 categories as follows:

<CSI Identifier><dash><Type>< dash >< Description>< dash ><Category>.

A. CSI Identifier: 6 Digits (Required)

The CSI 2004/2010 format 6 digit identifier are used, no spaces.

08 13 13 hollow metal doors = 081313

For conditions where conflicts occur, just first two characters are significant. For example, a wood door (08 14 15) in hollow metal frame (08 12 13) leads to just 080000.

B. Type: 6 Characters Max (Optional)

This is a flexible field and is used differently by different family types. The primary use of this is to provide a secondary sorting mechanism in Revit's Project Browser.

MEP can use this to separate out plan vs. other types of symbols. Specific types of annotation families such as title blocks can be separated out by adding this field. Doors and windows can use this to identify with shorthand interior, exterior, single, double.

C. Description: 18 Characters Max (Required)

General description of the family. Use spaces within the field as necessary for clarity, do not use hyphens.

D. Category: 2 Characters Max (Optional)

This optional field is used to help users identify special types of families. Annotative elements may be created with Generic Annotation (GA), Detail components (DT), or even Generic Models (GM).

Section 1106 - Naming: Room and Door Numbering

Room and door identification must be coordinated to assure maximum compatibility with all downstream DEN uses including Maximo, Public Safety, and GIS applications. Each of the Values illustrated below will be a separate parameter that may be modified in Revit.

These parameters are built into the tags available in the DEN Revit Templates.

A. Example Room: ARF_03_5E_EL05

Aircraft Rescue and Firefighting, Level 03, in 5th east module Elevator, room 05 in this building module/grid.

B. Example Door: ARF_03_5E_EL05B

Same room, second door in that room. If more than one door is in a room, the first room will be A.

1106.2 Building Module and Direction Code

These parameters are used by DEN for multiple information systems including the emergency responder systems and must be established in conjunction with the DEN BIM manager. Each of the existing buildings has a building module and direction code system assigned.

1106.3 Room Code and Door Room Code

For identification purposes, the Room Code is only a small part of the overall room ID. However, in general the room code can be thought of as the room number.

In the DEN facilities, rooms are numbered clockwise within a single module as established by the Building Module/Direction outlined above. Room Codes will be three digits except as noted below.

Instead of a three-digit room code, stairs, elevators, corridors, mechanical shafts, and gate areas will have a prefix noted below and then a two-digit room number,

AP	Apron
CR	Corridor
EL	Elevator
GT	Gate
JW	Jetway
MS	Mechanical Shaft
R	Roof
ST	Stairs

1106.4 Areas and Spaces

Areas and Spaces will use the same naming and numbering convention as Rooms unless created for special purposes such as code/egress diagrams, leasing areas, or take offs of spatial regions per project.

Plenum Spaces will be defined by the inclusion of the prefix “P” before the name. Plenum spaces that cross over multiple rooms will take the name of the room that the space first crosses over in the lower left hand corner.

Section 1107 - Naming: Other Revit Element Naming Conventions

Revit Wall Types: DEN will provide wall types in both the template as well as container files. Each of these will be identified by the wall type ID. A separate data file will hold the complete description per wall type of the wall Width, Finish, Fire Rating and Sound Transmission Class rating.

Section 1108 - Shared Coordinates

DEN's current Shared Coordinate system is known as Low Distortion Projection (LDP). All projects must use the LDP coordinate system.

End of Chapter

Chapter 2 – Tenant Project File Standards

Section 1200 - Project File Standards

Section 1201 - Revit Template File Embedded Standards

A Revit file can contain all the elements needed for a construction document set in one file. In the Revit Project File (.RVT) are many aspects of the Building Information Model that in other modalities are standardized in many files or other systems.

Inherent in the Revit project template files are:

A. Graphic Standards

B. Organization of the Views, Legends, schedules and sheets

The organization established by the DEN Revit templates and documented here is also used by DEN to maintain their facilities models.

Consistency in Worksets and Design Options organization and use has a great impact on the ability for diverse teams to be able to effectively utilize the model.

Because the models will become part of the facilities tools, it is essential that the base set of standards established by the DEN templates is maintained through the design and construction process.

Section 1202 - DEN Templates

DEN maintains Revit Project Template files for architecture, site files, and MEP files. These are available in the standard content “03 Project Library\02_Templates\Revit 2015” folder.

A. DEN architecture template 2015.rte

B. DEN construction template 2015.rte

C. DEN mep template 2015.rte

D. DEN structure template 2015.rte

Section 1203 - Browser Organization

Like the views, the project browser allows for the organization of sheets. These organization definitions only affect the project browser and not the drawing list schedules. However, the same parameters are used to drive the browser organization as well as the drawing list schedules.

1203.1 Template Browser Organizations: DEN Standards (Numbered)

DEN templates have several customized browser organizations built-in. These are standard DEN browser organizations and should not be deleted. Any project may add to this set for project specific organizations. If possible, use parameters already in use by the other browser organizations.

The DEN template has three customized sheet organizations. These work in a manner similar to the view browser organization.

A. 01 Architectural Set - All printed views are shown. Any sheet that is a placeholder (for drawing index) is not shown.

   1. Order: Category > none > none > Sheet Number

   2. Filter: Category Not Equal to 999-PLACE HOLDERS

B. 02 Architectural Set by Volume - All printed views are shown. Any sheet that is a placeholder (for drawing index) is not shown.

   1. Order: Volume Number > Category > none > Sheet Number

   2. Filter: Category Not Equal to 999-PLACE HOLDERS

C. 03 By NCS - All sheet views are shown

1. Order: Sheet Sort Order > Sheet Discipline > none > Sheet Number
2. Filter: No Filter applied

Section 1204 - Model Views

Revit organizes what previously would have been many CAD files into one project file as views. Floor plans are views of the entire building model. Sections are just vertical views of the same model. Schedules are also just views of the same building model, but presented in tabular format rather than graphically. While schedules, legend and sheets technically are views to the Revit database, they are given separate sections in this document because their conventions and rules differ from the views listed in this section:

A. Plans

B. Elevations

C. Sections

D. Details

The structure outlined in this chapter is for projects started with the DEN Architecture template file. Other DEN templates may have only subsets of the views, legends schedules, and sheets described here.

The following conventions apply to all views in the project regardless of the view type; plan section, legend, or schedule.

1204.2 Original Views

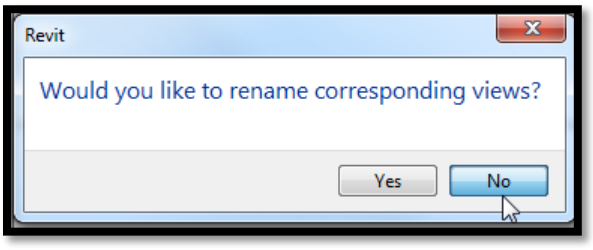
Once section and elevation marks have started to be placed in the project, do not delete the original Level plan views. This is important as DEN utilizes the “Referenced From” parameter. Deleting the original views will create problems with this system.

1204.3 Creating New Views

When creating a new view/sheet by duplicating or creating new from scratch, open the view properties and fill in the element properties that are used by your project for sorting and organization. Do not just create the view and rename it.

1204.4 Level Names

Level Names, once set by the project BIM Lead, are sacred. This means that the names that appear in elevations/sections should not be changed. Revit attempts to keep the name of a view coordinated with its Associated Level. This message appears when changing a view name that is the same as its Associated Level.



The answer is always NO. Answering with YES will change the Level Name and that is usually not what is desired. This message appears when you change a Level name. A Yes response will cause Revit to keep any views that have a matching name coordinated.

Section 1205 - Schedules

Schedules are a powerful tool for accomplishing large amounts of data entry. The naming convention for schedules is the same as for other views. Schedules going on sheets are named in ALL CAPS, informational or

working schedules, which are not placed on sheets, are named in all lowercase. Additionally, "Key" in a schedule name indicates the scheduling of Revit Keys rather than building components. These will likely never be placed on a sheet, if a key schedule needs to go on a sheet, it must be renamed to ALL CAPS.

Section 1206 - DEN Template Schedules

The DEN templates contain many customized schedules. They are designed to be a very efficient way to do data entry in the Revit environment, but must be used in a particular way to be most efficient.

This section outlines the custom schedules available in the DEN templates and container files.

1206.1 Schedules: Door and Frame Schedules

The DEN architectural template contains a series of door schedules

Door and Frame Schedule	Schedule intended for plotted set of drawings.
Door and Frame Schedule 01 Materials Key	Key schedule. Holds full information for the materials and finishes assigned to the frame and panel in the DOOR AND FRAME SCHEDULE
Door and Frame Schedule 02 Detail Key	Key schedule. Holds head, Jamb and Sill detail references for specific typical wall conditions
Door and Frame Schedule 03 Hardware Key	Key Schedule. Holds the hardware set information
Door and Frame Schedule 04 Key Settings	This is a working schedule where you can assign the three previous keys to the doors.
Door and Frame Schedule 05 Hardware Review	A schedule that is sorted by the hardware key giving a total count for each hardware group.

A. _abbreviations

Customized schedules to be used to record or plot the standard abbreviations for the project. This schedule is a key schedule that holds values in the Revit Internal Point Loads parameters.

Section 1207 - Worksets

Worksets are Revit's way of allowing multiple people to work on the same project. All DEN project files should have worksharing enabled.

1207.1 General Standards

A. The BIM Leader for the project is responsible for creating and maintaining the worksets of the project.

B. Do NOT unload a linked Revit file and Synchronize with Central (use visibility graphics or opened=No).

C. Do NOT use worksets like layers.

D. Do NOT create a workset for annotation or notes.

E. For new content created within an existing DEN base model, the consultant shall create separate Worksets to allow for definition and separation of new content from existing.

1207.2 Standard Worksets

All workset enabled projects will have at least the default worksets Shared Levels and Grids and Workset 1 (which should be renamed to the name of the model Discipline, e.g. Architecture, Mechanical, Structural) which should be renamed as appropriate for the primary UNIFORMAT II Level 2 group below. As project complexity increases worksets are added from the following list. This list is not exclusive. Projects may have other worksets, but at the end of the project, the models must be submitted using the workset names and general guidelines below.

A. Primary List:

1. A10 Foundations
2. B10 Superstructure
3. B20 Exterior Closure
4. B30 Roofing
5. C10 Interior Construction
6. C20 Staircases
7. C30 Interior Finishes
8. D10 Conveying systems
9. D20 Plumbing
10. D30 HVAC
11. D40 Fire Protection
12. D50 Electrical
13. E10 Equipment
14. E20 Furnishings
15. F10 Special Constructions
16. F20 Selective Building Demo
17. G10 Site
18. L10 Airport Equipment

B. _LINKED CAD

This workset will appear in most workset-enabled files. This workset will be created OFF by default in all views. This is never set as the active workset. Link a DWG to all views, and then change its property to assign it to this workset. Use Visibility Graphics as needed per view to turn this workset on then isolate the individual drawing using the Imported Categories tab.

C. _COORDINATION

This workset should contain elements that are contained in the model solely for Coordination or system connectivity. For instance, if Mechanical equipment is copy/monitored to an electrical model for system connectivity purposes, or light families that exist in architecture for coordination.

D. _LR<DISCIPLINE INITIAL>- For Linked Revit Files.

Create one workset per linked Revit model. These worksets will appear in ALL workset files where another Revit file is linked. This allows users to use Visibility Graphics to turn off a linked Revit model or to use the worksets dialog box to set this to Opened=No

1. Simple

   LR<DISCIPLINE> such as LRA for Architecture, LRS for structure etc.

2. Complex

   LR<DISCIPLINE><FILE NAME> for projects where discipline models are broken into parts. For example, LRA-CCA_DEN-A

1207.3 Shared Parameters

DEN maintains a master shared parameter file for all projects. This is not contained in the shared Revit Content Library, but the parameters are available in the DEN templates. If new shared parameters are required by a project, they must be approved by the DEN BIM manager in advance.

DEN maintains a single master Shared Parameters file; DEN_Shared Parameters.txt. It is located in the 04_Support>02_Shared Parameters folder in the Kit of Parts.

Use of appropriate DEN Shared Parameters is CRITICAL to the Asset Management program. Failure to conform to these standards will result in automatic failure of a submittal review.

Section 1208 - Quality Control

1208.1 Project File

This section outlines required best use practices that affect the health and/ or organization of the project.

A. Opening Files

1. When opening Revit files: Use the Revit Open dialog box rather than double clicking the file in windows explorer.
2. Open selective worksets for larger files as appropriate.

1208.2 Review and Fix Warnings (Daily Use)

Warnings should be fixed on a daily or as-created basis. Warnings have a significant adverse effect on model performance. Prioritize warnings for model-based elements (i.e. system connection issues, model elements overlapping, etc.) over annotation or mark type conflicts (line is at a slight angle, door/room/elements share the same mark, etc.)

The project BIM lead should review outstanding Warnings weekly and review the list to keep an eye on the progress of the project. Prioritize the list and delegate the resolution of items to the team.

1208.3 Fix Warnings: Select by ID

Often times it is difficult to see what element is causing the warning.

A. Export the warning report then enter a 3D view.

B. Open the report and type or copy/paste the element id in the report into Select by ID

C. Once the item is selected, use temporary isolate to find it in the 3D view

Note, sometimes the warning is in a sketch line that is difficult to track down. This process will allow you to find the item in question.

1208.4 Closing Files

The following process should be followed when closing a workset enabled file:

A. Open and maximize the project's closing view (_Synchronize with Central drafting view)

B. Close hidden windows

C. In the Synchronize with Central dialog box:

1. Verify you are relinquishing all elements
2. Select "Save Local file before and after synchronizing with Central"

D. Close the Revit file.

1208.5 Central File

Only the project BIM Leader should open the central file directly.

1208.6 Outside Content Sources

Content outside of the DEN Template or DEN Library/Kit of Parts should only be integrated into the DEN Content Libraries by the Project BIM Manager in coordination with the DEN BIM Manager.

End of Chapter

Chapter 3 – Tenant Project Maintenance and Quality Assurance

Section 1300 - BIM Manager Project Maintenance and Quality Assurance

Project Maintenance includes items to be completed by the Project BIM Leader or the most experienced Revit user on the project.

1300.1 Families

A. 2D if possible 3D if it makes sense - Develop 3D families only to 1/8” scale unless otherwise identified in the BIM Project Execution Plan

B. Symbolic only in Plan View - All 3D families should use symbolic line representations for Plan or RCP views. All 3D elements should be turned off for plan views.

C. Family before Group - Use families whenever possible, use groups only when absolutely necessary. (e,g, no way to add walls to families, so must be grouped).

D. Keep in Mind Performance - Families that HOST are more memory intensive. Families that cut host are the MOST intensive. Parametric families should be used cautiously. If a family doesn’t need to adjust parametrically, then it should not.

E. No 3D ACAD Blocks - Do not use CAD blocks or elements of any kind in Revit families.

F. No Downloaded content - Content from manufacturer’s libraries or from websites such as Revit City are not allowed. Use the DEN library wherever possible. Where not, create new content from the DEN family templates.

G. Hosted MEP Families - All MEP families will either be hosted or not. Only Face-Based hosting is allowed as hosting method for MEP elements in DEN projects.

1300.2 Constraints

Constraints are memory intensive and are best avoided. Constrain to layout, but then remove the constraint.

Section 1301 - Content Modeling Standards

1301.1 Modeling Guidelines – Design

A. Origin Point

All models must be in the correct location in 3D Space (x, y, and z coordinates) based on the DEN LDP Shared Coordinate system.

B. Tolerances

Models and Model Elements must be within 1/8” of theoretical dimensions. Tolerances for specific items and systems will be determined as necessary. Model tolerances are not to be construed as construction tolerances.

C. Units and Scale

Imperial units: One (1) unit in the model equals 0’-1”.

1301.2 Best Practices

Contributors to the models shall follow to the best of their ability the best practices listed in the "Autodesk Revit 2014 Technical Note Model Performance". Geometry from CAD applications such as AutoCAD, IFC or MicroStation shall not be imported or linked into the model. Image files shall not be imported or linked into the model to represent geometry or other documentation. Revit Warnings should be kept to a minimum and model geometry called out in the Model Requirements section of this document shall not be associated with any Warnings.

Section 1302 - Modeling Requirements – Design Phase

1302.1 Scope

In general, the scope of work is to create a technically accurate and highly detailed BIM/3D computer model of the architectural, structural, building systems, lighting, signage, mechanical, electrical, plumbing, fire protection, fire alarm, passenger-loading bridges (PLBs), and baggage handling system (BHS).

1302.2 Extent of model

The building computer model (in plan view) shall typically extend to five feet beyond the exterior walls of the buildings or rooms being modeled. Vertically, the model shall extend from the lowest extent of the rooms or buildings which may include foundations or lowest underground utility up through (and including) the roof of the top most floor, or highest overhead utility or adjacent structure. To the extent that the scope includes building systems, those systems will be included to the full horizontal and vertical extents of the model including underground utilities and rooftop mounted items.

Model scope also includes relevant faces/masses of buildings and encroachment zones (FAA Part 7460) adjacent or across street. Existing conditions will be modeled at level 300 when directly adjacent to new construction. Otherwise, existing conditions shall be modeled as masses.

Section 1303 - Existing Conditions

1303.1 Laser Scanning

High definition laser scanning and existing conditions surveying are available from DEN's survey services group and are recommended for the buildings and rooms within and adjacent to the project boundary. It will be the responsibility of the Design team to physically survey the existing rooms adjacent to the project boundary to confirm occupancy, use, FFE, and internal service utilities.

Section 1304 - Systems Modeled and Level of Detail – Design Model

The level of detail defined in each section below is the minimum level of detail required in the model. Greater detail than the minimum should be incorporated in the model whenever possible. Any further Model development or scope deemed necessary and not previously defined will be addressed as they are identified. The Designer and Contractor will determine the effect on the Models and scope, and propose the appropriate response to accommodate the noted Model development and/or coordination issue.

1304.1 General – Applicable to All Disciplines

A. All Equipment is to be modeled as solid objects to their overall height, width, and depth and Level of Detail as outlined in "Attachment 3 - BIM Matrix Worksheet and LoD Definitions"

B. All designed elements shall be included as fully connected and closed systems.

C. No-fly and access zones around equipment above control panels shall be modeled as 50% transparent solids for: access issues, code issues, and/or constructability.

D. MEP Spaces will be modeled corresponding/coordinated with Architectural Rooms.

1304.2 Architectural

The following stipulations will be used for architectural model elements.

A. All exterior walls, doors, windows, steps, railings, and roofs will be modeled utilizing modeling best practices for room/space/volume calculations.

B. Risers and sloped floors will be modeled.

C. Interior doors and windows will be modeled to the extent that the walls that they are associated with are included in the model. King studs and headers shall be modeled as part of the window or door family for spatial coordination purposes.

D. Light fixtures will be modeled to the overall height, width, depth, and access through the interstitial space.

E. Elevator shaft clear space will be modeled to the worst-case clear width, depth and height only from preferred possible vendors; elevator cabs, equipment, etc. will not be modeled. Nominal elevator cab size and overrun shall be modeled, including hoist beam.

F. Escalators and moving sidewalks shall be modeled to the worst case clear width, depth and height only from preferred possible vendors

G. Signage shall be limited to Way Finding and Room Identification required by Code.

H. Passenger Boarding Bridges (PBBs) will be modeled at a Level 250 (Section G), and will be representative of either an Apron or Radial bridge type. The PBB length shall be modeled within the design limit for the bridge type (Apron or Radial). PBBs are a standard element in DEN's KoP.

I. Carpet, paint, wall coverings, tile, wall base, and trim carpentry will not be modeled.

1304.3 Structural

The following stipulations will be used for structural model elements.

A. All cast-in-place concrete, including all penetrations and openings identified in the construction documents, will be modeled. Slab camber and chamfers at corners will not be modeled (but will be detailed).

B. Edges of all slabs and penetrations of structural systems will be accurately located in the model.

C. All primary and secondary structural steel members will be modeled, including standard steel member sizes, gusset plates, braces, kickers and equipment supports. Reinforcing steel and imbeds such as rebar and mesh will not be modeled.

D. Metal, wood, and concrete decks will be modeled as the overall thickness of the slab; ribs in metal decks will not be modeled.

E. Bolts, clip angles, etc. will not be modeled.

F. Miscellaneous metals such as elevator hoist beams, rails and intermediate rail support steel for the elevator will be modeled.

G. Identify reinforcing or penetration "no-fly" zones as applicable.

1304.4 HVAC

The following stipulations will be used for HVAC model elements.

A. All ducts and air handling equipment will be modeled. Ducts will be modeled to the outside face dimension of the flanges/insulation. Duct slope shall be modeled.

B. Any piping associated with the mechanical equipment will be modeled. Pipes will be modeled to the outside diameter of the pipe or pipe insulation (whichever is greater).

C. Any electrical associated with HVAC will be modeled per the electrical modeling requirements as outlined in the next section

D. The intent of this model is to show the ductwork and piping, etc. in as true representation of the actual condition at construction completion. Specific dimensional location of ductwork and piping may not be included in the construction documents. To the extent that location can be determined from the construction documents, the model will reflect that location.

E. MEP Spaces will be modeled corresponding to/coordinated with Architectural Rooms.

F. Additional MEP Areas such as above ceiling Plenums will have MEP Spaces created accordingly to provide a full volume within the building/model envelope.

1304.5 Electrical

The following stipulations will be used for electrical model elements.

A. Conduits 4” or greater or, smaller conduits if in ganged runs will be modeled.

B. Ganged runs (4 or more conduits) shall be modeled as a mass.

C. Cable tray, access zones, pull boxes, and equipment must be included in the model.

D. Light fixture locations and space requirements to be included in the model.

E. All power feeds to equipment and all switchgear will be modeled.

F. Consider modeling switches and outlets where coordination with architectural FFE or interior elevations is a concern.

1304.6 Plumbing

The following stipulations will be used for plumbing model elements.

A. Piping 2” or greater or smaller piping if in ganged runs will be modeled.

B. Plumbing piping and gas piping, including specialty gas and equipment will be modeled. Pipes will be modeled to the outside diameter of the pipe or the pipe insulation, whichever is greater.

C. Pipe slope will be incorporated in the model.

D. All valves and clean outs will be modeled along with all access to valves/cleanouts.

1304.7 Fire Protection (Sprinkler and Alarm)

The following stipulations will be used for fire protection model components.

A. All components 2” or greater of the fire protection system will be modeled. This includes all piping, valves, fire pump, and sprinkler heads.

B. Fire alarm modeling requirements shall follow the requirements of the Electrical section.

C. Fire Alarm Zones, Fire Sprinkler Zones, and Communications Speaker zones shall be modeled as solid, transparent Revit Masses with appropriate Asset information assigned.

D. Signage modeling requirements in the BIM Model shall be limited to Way Finding and Room Identification required by Code.

1304.8 Vertical Transportation

A. Elevator clear shaft space requirements are included in the architectural scope.

1304.9 Civil/Site

Site utilities within the project boundary of the project footprint are to be modeled in three dimensions and accurately represented with AEC Object elements as outlined in this document. The Civil / Site model will be delivered in Civil3D including the following:

A. Utility trench excavation surfaces

B. Excavation lift models of proposed daily progress of mass excavation and utility trenches

C. Shored walls/surfaces

D. MSE walls

E. Bridge soffit surfaces – Pre-camber and post-camber

F. Bridge bents

G. Bridge top deck surfaces – Pre-camber and post-camber

H. Bridge hinge keys

I. Electrolier bases on bridges

J. Bridge barriers

K. Piping / Conduit / Duct banks: Model all proposed installations including but not limited too; piping, joints, sump basins, storage tanks, and free draining material wraps or bedding around piping. Pipe networks “part properties” shall be populated with relevant geometric and analytic data pertaining to "Geometry, Resize Behavior, Hydraulic Properties, and Part Data”.

L. Excavation and vertical underground elements: Model all temporary and permanent shoring, and areas of excavation including affected lay back areas, with appropriate sloped surfaces.

M. Horizontal site development: Model all temporary roadways required for potential phasing including but not limited to: perimeter barriers (jersey barriers, k-rails), paving surface relocations, storm drainage requirements, snow storage areas, and first responders site and perimeter access roadways.

N. Site areas of impact: Provide model elements to indicate areas of influence. Sterile area boundaries, AOA boundaries, or stakeholder access zones.

Civil 3D deliverable files should be accompanied by a LandXML 1.2 file of alignments /profiles / surfaces and points, and an IFC if possible.

1304.10 Baggage Handling System (BHS):

A. Baggage Handling System shall be modeled in 3D and provide the clear area and dimensions of equipment. Model equipment to suitable level of detail to ensure the required clear space for the baggage envelope, egress and other right-of-ways are maintained throughout the system.

B. Model the required clear space for the baggage envelope as solid above the bag line surface.

C. Model the preliminary support structure for the BHS; Floor, wall or ceiling mounted supports.

D. Model any catwalks necessary for the BHS.

E. Coordinate clear width and height egress paths.

F. Coordinate all floor and wall openings, concrete curbs, and security/fire doors required for the BHS.

1304.11 Security and IT Systems:

A. Electrical/wiring associated with Security and IT Systems are to be modeled per the electrical modeling requirements as outlined in Section 4.4.

B. At a minimum, device locations are to be designated by installation points in 3D space.

Section 1305 - BIM Coordination Procedure Outline – Design Model

1305.1 Design team

All consultants and subconsultants (architecture, structure, MEP, fire protection, BHS, etc.) will create a BIM model and produce 2D Construction Documents using Autodesk Revit (current approved version). Coordination between team members shall be based on the outline of Attachment 2, e. Design Coordination. The Revit design files shall be 100% Revit. The Revit file shall NOT contain any imported or linked AutoCAD, Bentley or other CAD or graphic files. This file shall include the model, families, and 2D documentation. Civil design will be designed and executed in Autodesk Civil 3D.

The Design team will provide a Revit model as a 3D background model or upon request export 2D drawings from the model into an AutoCAD DWG format to be used by Contractor, structural, MEP+FP, FA, and special consultants.

2D and 3D updated backgrounds will be posted regularly as per the BPXP.

Section 1306 - Spatial Coordination Procedure – Design Phase

3D Computer coordination as it relates to Architecture, Structure, Mechanical, Electrical, Plumbing, Fire Protection, Fire Alarm, Baggage Handling System, and other Special Systems during design model phase:

1306.1 Coordination Procedure

Design Consultants shall be prepared to accommodate bi-weekly coordination meetings. Coordination meetings will begin before the 60% design submittal to resolve model conflicts.

A. The Design Team will provide a clash detection report in advance of each coordination meeting. The reports will be generated using Autodesk NavisWorks, Autodesk Glue, Solibri, or other clash software package chosen by the Design Team and approved by DEN.

B. The clash reports will be run for all disciplines. A clash analysis report will be generated by the Design BIM Coordinator that involves looking at each individual clash, and documenting it, by saving the appropriate viewpoints. The Design BIM Coordinator will create either a Solibri or NavisWorks .NWD file showing the clash viewpoints and corresponding report showing clashes. This Clash report will be posted by the Design BIM Coordinator and a corresponding notice sent by the Coordinator to all parties involved that the report is ready.

C. Design Consultants are required to review the clash detection report generated by the Designer BIM Coordinator before the weekly meeting, and arrive at the meeting prepared to address the unresolved clashes in a constructive manner.

D. Design Consultants are required to run the clash detection analysis for their respective trade systems. The models submitted by the design consultants for overall coordination are required to be checked and coordinated with the architecture, structure and the Design Consultant's own Work prior to submittal. At a minimum, the model shall be precoordinated by the Design Consultant to avoid clashes with architecture, structure, other MEP systems, walls, ceiling systems, and enclosure.

E. Clashes should be kept to a minimum and will be evaluated for acceptable tolerance.

F. Design Consultants required to post to the Project BIM Server, updated drawings/models at least once per week, prior to the clash detection analysis run by the Designer BIM Coordinator as per the BPXP. This will continue until the project area is completely coordinated.

G. Design Consultants are required to collaborate with each other trade through electronic means, email, telephone, and in person to resolve basic clashes outside of the weekly Coordination meetings. The weekly Coordination meetings are held to address difficult areas that are not able to be coordinated between the multiple disciplines themselves. At these meetings, the resolution will be collectively agreed upon, and one or more disciplines will be identified as having to adjust their design. The disciplines will adjust the respective model and repost it for the following week's meeting. All disciplines are responsible to update and post the changes agreed upon at the meeting within 1 week after the coordination meeting.

H. Models that are to be used for Clash Detection are to be purged of all non-essential information. All 2D reference information should be deleted, only 3D information should remain in the file. This includes, but is not limited to the following: Text, Leaders, Symbols, Architectural References, Construction Geometry, etc.

I. Coordinated submittal data is to be distributed on a weekly basis, and prior to coordination meetings.

J. Coordination model shall include, at a minimum: The modeling elements per modeling requirements specified by this document and the LoD.

K. Utilization of BIM for the design coordination process, response protocol and timing, incorporation of responses into any Model.

L. The Action Item template is to provide an input box to confirm whether the response to the Action Item has the potential to require modification to the project Building Information Models.

M. Modification could require geometric model revision or information input.

N. This BIM issues item shall be a searchable item of the projects Action Item log system

O. Responses to BIM Model Action Items must be incorporated into the model (when applicable) in no later than 10 business days.

P. Implementation of modifications to the project Building Information Models due to Action Item responses will be the responsibility of the Model Element Author in primary control of the effected Model Element at the Action Items initiation.

1306.2 Documentation of Coordination:

The following will be included as a zipped file and posted by Designer for Design Consultants.

A. A Solibri or NavisWorks (NWD) Published file that includes the final Clash reports and Comments.

B. PDF files of above reports.

C. 2D print out that includes - Composite floor plan, Text clash report, and clash bubbles in the plan signed by all involved subs.

1306.3 Model Management

Design Consultants shall provide updates/maintenance of Electronic Data/3D Model throughout construction that modify the design intent and/or special coordination to the design model to include but not limited to

A. Incorporation of RFIs

B. Incorporation of ASIs, CDs, CCDs, MODs

C. Submittal comments and revisions on approved shop drawings.

D. Implementation of modifications to the project Building Information Models due to RFI responses will be the responsibility of the Model Element Author in primary control of the affected Model Element at the RFIs initiation.

Section 1307 - Modeling Guidelines – Construction Team

1307.1 Model Ownership

As the model transitions from design to construction there will be some variation on model ownership / authoring. Some disciplines will maintain the model throughout construction (e.g. architecture) while other disciplines will begin creating new models during the shop drawing process (e.g. HVAC). In the case of model authorship by members of the design team, requirements in Section 6 will supersede this section. In the case of models created by the contractor or their subs, requirements in this section will be followed.

1307.2 Origin Point

All models must be in the correct location in 3D Space (x, y, and z coordinates). These coordinates will be set by DEN and distributed to all consultants and trade contractors for their use within the Kit of Parts. This includes correct floor elevations (z coordinates). The correct insertion point is critical and ensures that each model will align properly for the master aggregate Model without modification. General Guidelines for Construction Model authoring process shall follow Attachment 2, m. Construction Modeling.

1307.3 Tolerances

Models and Model Elements must be within 1/8” of theoretical dimensions. Tolerances for specific items and systems will be determined as necessary. Model tolerances are not to be construed as construction tolerances.

1307.4 Units

Imperial units: One (1) unit in the model equals 0’-1”

1307.5 Model Completeness

Models must be 100% complete for the current building, level, and phase. A good rule of thumb is that if you don’t want to move it, it needs to be in the model. This includes, but is not limited to:

A. Piping that is larger than 2” diameter.

B. Model all equipment and panels to scale with required clearance zones included.

C. Identify all service and access areas.

D. Show size and thickness of housekeeping pads.

E. Show all sleeved or cored hole penetrations.

F. Model all “no-fly zones” for: access, maintenance clearance, elevator shaft, code issues, constructability with solid objects.

G. Any item which may impact coordination with other disciplines

H. Penetration thru building systems such as cast-in-place concrete and CMU walls shall be identified in the Trade Contractor’s model by means of a modeled sleeve (w/ defined tolerance).

I. All model elements (families) are to have identity codes or CSI codes attached as defined in the data normalization requirements.

J. All model elements are to have DEN required parameters and their values included for As-Built submission. CM/GC will ensure collection and data population of DEN required parameters from all subcontractors and vendors.

K. Individual Trade Contractors’ 3D model content requirements will be detailed and finalized in conjunction with the final contract agreement.

Section 1308 - Modeling Requirements – Construction Phase

1308.1 Systems Modeled and Level of Detail:

The level of detail defined in each section below is the minimum level of detail required in the model. Greater detail than the minimum should be incorporated in the model whenever possible. Any further Model development or scope deemed necessary and not previously defined will be addressed as they are identified. The Contractor will determine the effect on the Models and scope, and propose the appropriate response to accommodate the noted Model development and/or coordination issue.

Section 1309 - Systems Modeled and Level of Detail – Construction Model

The Contractor shall provide modeling to accurately represent the scope of the work contracted for and shall provide separate model iterations to reflect the proposed stages of work for periods no less than one-month duration or “snapshots in time,” at significant milestones within the schedule. Project model elements shall, at a minimum, conform to the requirements established in the *Standards and Criteria Design Standards Manual*, specifically including but not limited to Chapters 13 – Phasing and Staging Drawings and 28 – Planning Study.

All model elements are to have DEN required parameters and their values included for As-Built submission.

1309.1 Civil / Site (Horizontal BIM)

Proposed Civil / Site elements below are the minimum required and shall be modeled to the “Level of Detail” as represented by the “Model Progression Specification” also including DEN required parameters and their data as indicated in this document.

Piping / Conduit / Duct banks: Model all proposed installations including but not limited to; piping, joints, valves, catch basins, valve boxes, pull boxes, sump basins, tanks, trench bedding, encasements, and free draining material wraps or bedding around installations.

Excavation and vertical underground elements: Model all temporary and permanent shoring, and areas of excavation including affected lay back areas, with appropriate sloped surfaces.

Horizontal BIM site development: Model all temporary roadways required for potential phasing including but not limited to perimeter barriers (jersey barriers, k-rails), paving surface relocations, storm drainage requirements, snow storage areas, and first responders site and perimeter access roadways.

Site areas of impact: Provide model elements to indicate areas of influence. Model all phase revisions for required GSE routes, critical delivery points, Sterile area boundaries, AOA boundaries, or stakeholder access zones.

1309.2 Steel

The fabrication level detailed model shall include, but is not limited to, major structural members, secondary structural members, and miscellaneous steel connections including but not limited to

A. All prefab and cast-in-place concrete, including all penetrations and openings identified in the construction documents, will be modeled. Slab camber and chamfers at corners will not be modeled.

B. Edges of all slabs and penetrations of structural systems will be accurately located in the model.

C. All primary and secondary structural steel members will be modeled, including standard steel member sizes, gusset plates, braces, angles, knife plates, kickers and equipment supports. Reinforcing steel and imbeds such as rebar and mesh will not be modeled.

D. Metal, wood, and concrete decks will be modeled as the overall thickness of the slab; ribs in metal decks will not be modeled.

E. Bolts, clip angles, etc. will not be modeled except as necessary for coordination with other building trades.

F. Miscellaneous metals such as elevator hoist beams, rails and intermediate rail support steel for the elevator will be modeled.

G. Identify reinforcing or penetration “no-fly” zones as applicable.

H. Other elements necessary for the successful coordination of other building trades

1309.3 HVAC

A. Model all ductwork to be shown as actual duct size, in the correct location in 3D space

B. External insulation on piping and ductwork must be modeled to scale, Internal insulated duct is to be noted.

C. Model all grilles, registers, louvers, and diffusers.

D. Model all fire and smoke dampers and indicate service access requirement (i.e. access panel) if not readily accessible.

E. Identify duct balance dampers and model service access requirements as solid objects.

F. Model coil pull areas.

G. Model duct hangers, supports, and seismic bracing carrying 2 or more ducts.

H. Model all Mechanical Equipment: Fans, AHUs, Built-Up AHUs, pumps, tanks, valves, controls, heat exchangers, All Valves (including valve stems and handles), gauges and control valves, High and low point drains, and Starters, etc.

I. The HVAC Contractor shall also include in the 3D model Concrete Equipment pads, inertia pads, and Access Doors.

J. The HVAC Contractor shall identify under separate drawing layer Access doors and Accessibility requirements for above listed items for code and maintenance purposes.

1309.4 Plumbing

A. Model all piping 1” and larger including insulated piping with insulation O.D. at 1” and greater.

B. Model all valves, gauges, and control valves and service access.

C. Model pipe hangers, supports, and seismic bracing carrying 2 or more pipes.

D. External insulation on piping must be modeled to scale.

E. Model all drip legs, drain pipes, blow down valves, and cleanouts

F. Model all underground piping.

G. Model all Plumbing Equipment: Domestic Water, Chilled Water, Steam, Storm/Roof Leaders, pumps, tanks, water heaters, in wall carriers, In wall plumbing equipment, etc.

H. The Plumbing Contractor shall also include in the 3D model Concrete Equipment pads, inertia pads, and Access Doors.

I. The Plumbing Contractor shall identify under separate drawing layer Access doors and Accessibility requirements for above listed items for code and maintenance purposes.

1309.5 Fire Protection

A. Model all Fire Protection Equipment: Preaction System, Dry System, and Main Fire Protection Systems, Hangers and Seismic Bracing, Valve Assemblies, Drain valves, Fire Department Valves,

B. Fire Pump etc.

C. Model all sprinkler head locations and sprinkler head types.

D. Model any tanks not included in the architectural or structural Models.

E. Model all fittings, drains and test connections.

F. Model “No-fly zones” above control panels shall be modeled as solids.

G. The Fire Protection Contractor shall also include in the 3D model Concrete Equipment pads, inertia pads, and Access Doors.

H. The Fire Protection Contractor shall identify under separate drawing layer Access doors and Accessibility requirements for above listed items for code and maintenance purposes.

1309.6 High and Low Voltage Electrical

A. Model all conduit raceways 1” and larger.

B. Model all grouped conduit raceways with 2 or more conduits.

C. Model all junction boxes 6”x6” and larger.

D. Model all cable trays and/or hook locations.

E. Model hangers, supports and seismic bracing.

F. Model all light fixtures (including neon) and switching devices.

G. Model door security J.B.s.

H. Model all Fire Alarm devices

I. Model phone/data ports

J. Model all security devices (cameras, card readers, motion sensors, auto door locks, etc.)

K. Model all audio speakers and equipment.

L. Model all Electrical Equipment: panels, transformers, switch/paralleling gear, ATSs, generators, data racks, starters, VFDs, Exit Signs, AV Equipment, Recessed Electrical devices and Access Doors, etc.

M. The Electrical Contractor shall also include in the 3D model Equipment pads, inertia pads, and Access Doors

N. The Electrical Contractor shall identify under separate drawing layer Access doors and Accessibility requirements for above listed items for code and maintenance purposes.

1309.7 Controls

A. Model all panels

B. Model Individual Conduits 1” and larger, racks carrying more than 2 conduits 1” and smaller.

C. Model hangers, supports, and seismic bracing

D. Model all Controls Equipment: panels, transformers, controls, cable tray, data racks, starters, VFDs, etc.

E. The Facilities Management System Contractor shall also include in the 3D model Concrete Equipment pads, inertia pads and Access Doors.

F. The Controls Contractor shall identify under separate drawing layer Access doors and Accessibility requirements for above listed items for maintenance purposes.

1309.8 General Requirements

Proposed elements below are the minimum required and the content may be revised as required by the project.

A. Model all perimeter site fencing with required security access points and delivery entrances.

B. Model all major SWPPP elements including silt fencing, wash racks, and BMP locations.

C. Model all major material and man lifting equipment (Cranes, Man Lifts, fixed Concrete Pump stations, etc.) and proposed envelope of influence (radius of swing, total height, major picking stations, etc.).

D. Model all temporary and permanent shoring, and areas of excavation including affected lay back areas, with appropriate sloped surfaces.

E. Model all proposed material lay down areas

F. Model all temporary office and trailer locations

G. Model all temporary roadways required for potential phasing including but not limited to: perimeter barriers (jersey barriers, k-rails), paving surface relocations, storm drainage requirements, snow storage areas, and first responders site and perimeter access roadways.

H. Model “no-fly zones surrounding temporary and / or permanent fire hydrant locations.

I. Model proposed “evacuation areas”.

J. Model onsite temporary parking locations.

K. Model all phase revisions to temporary pedestrian covered walkways and / or clearance zones.

L. Model all phase revisions for required GSE routes, critical delivery points, Sterile area boundaries, AOA boundaries, or stakeholder access zones.

1309.9 Special Construction

To Be Determined after Schematic Design Phase.

Baggage Handling system requirements per section 5.6 Baggage Handling Systems (BHS).

Section 1310 - Spatial Coordination Procedure – Construction Phase

3D Computer coordination as it relates to Mechanical, Electrical, Plumbing, Fire Protection, Fire Alarm, Baggage Handling System, and Special Systems during the construction modeling phase:

1310.1 The Trade Contractor

Will deliver a 3D computer model that is complete based upon DEN standards in their native file format and in NavisWorks Document Format (.NWD) and Revit .rvt. Any elements not included will become the Trade Contractor’s responsibility to coordinate in the field and at no additional cost. All 3D model elements shall include DEN required parameters and their associated values included for deliverable submission.

Trade Contractor shall provide a list of minimum typical clearances for all model components (Clash rule criteria).

1310.2 The Model

Shall be developed in a software package compatible with Revit and readily translated to Revit for Design and NavisWorks Manage for coordination purposes.

1310.3 Exchange of 2D CAD files

Shall be in the AutoCAD file format as defined in this document.

1310.4 Represented in these assigned colors as a guideline:

Trade colors for Coordination Software

A. Fire Protection: red

B. Plumbing: magenta

C. HVAC Duct: blue

D. HVAC Pipe: lime green

E. Electrical: cyan

F. Pneumatic Tube: dark green

G. Concrete: grey

H. Structural Steel: maroon

I. Architectural: white

1310.5 Coordination Procedure

A. Trade Contractors shall deliver their scope of Work through the Construction process in general conformance with Attachment 2, k. 3D Coordination. Trade Contractors will take ownership for the construction of the Trade fabrication MEP+FP, BHS and other systems models as defined by the Contractor at Construction Documentation (100%). Design team BIM/3D models: Architectural, Structural, MEP, BHS and Security and IT models shall be posted on the Designer BIM Server, each trade is required to download and use these files to create their system models by sequence or geographic area (Schedule WBS, Work area, etc.). The process is to create and upload system models to the BIM Server as frequently as required by Contractor for other trades to use while modeling their systems. Contractor's BIM coordination process in many respects follows a traditional sequence of drawing / modeling those systems with the most constraints on their routing and then following with those trades that have more flexibility in their placement. Coordination will be expected to start as soon as contracts are awarded and follow the typical sequence:

B. Duct will be laid out in conformance with design documents. If floor size permits, duct layout to flow systematically across a floor allowing other trades to follow behind modeled areas.

C. Thereafter all pitched plumbing systems are to be drawn and coordinated with the ductwork. Once duct/pitched pipe are coordinated, other major constrained trade systems' components including all HVAC, Fire Protection, electrical cable tray, conduit racks, plumbing racks, are to be drawn/modeled and coordinated.

D. Upon completion of drawing/modeling and coordination of major system components of the constrained trades, "minor" components are to follow including branch piping and smaller conduit runs.

E. Trade Contractor shall be prepared to accommodate bi-weekly meetings to resolve model conflicts within the Project Schedule and sign off on a 'Master Model' to be considered the basis for construction on an area and floor by floor basis consistent with the Project Schedule.

F. Contractor will provide clash detection reports to accommodate the above.

G. The clash reports will be run for MEP systems in conflict with other trades and systems. A clash analysis report will be generated by the Contractor's BIM Coordinator that involves looking at each individual clash, and documenting it, by saving the appropriate viewpoints. The Contractor's BIM Coordinator will create a NavisWorks .NWD file showing the clash viewpoints and corresponding Word Document showing clashes. This Clash report and NavisWorks .NWD file will be posted to the BIM Server by the Contractor's BIM Coordinator and a corresponding notice sent by the Coordinator to all parties involved that the report is ready.

H. Each Trade is required to review the clash detection report generated by the Contractor BIM Coordinator before the weekly meeting, and arrive at the meeting prepared to address the unresolved clashes in a constructive manner. Subcontractors are responsible for coordinating and resolving the majority of the clashes prior to a meeting so that the meeting time can be used efficiently to focus on the issues that require all participants to resolve.

I. Coordinated submittal data is to be distributed on a weekly basis, and 2-3 days prior to coordination meetings. Models will be posted a day in advance of coordination meetings so that the contractor has time to review the models.

J. Coordination model shall include, at a minimum: The modeling elements and associated parameters and their data per modeling requirements specified by this document and the LoD and MPS.

K. Models to be purged of all non-essential information. All 2D reference information should be deleted (unless such 2D information is required for model orientation or navigation), only 3D information should remain in the file. This includes, but is not limited to the following: Text, Leaders, Symbols, Architectural References, Construction Geometry, etc.

L. Each Trade is required to run the clash detection analysis for their respective trade systems against the Architectural/Structural design models to ensure that there are no conflicts between the architectural/structural elements and their systems prior to submittal.

M. Each Trade is required to post to the BIM Server, updated drawings/models at least once per week, prior to the clash detection analysis run by the BIM Coordinator. Day and time of the posting is per the BPXP. This will continue until the area is completely coordinated.

N. Each Trade is required to collaborate with each other trade through email, telephone, and in person to resolve basic clashes outside of the weekly Coordination meetings. It is expected that the weekly Coordination meetings be held to address difficult areas that are not able to be coordinated between the multiple trades themselves. At these meetings, the resolution will be collectively agreed upon, and a trade will be identified as having to “move.” This trade will adjust the respective model and repost it for the following weeks meeting. All trades are responsible to update and post the changes agreed upon at the meeting within 1 week after the coordination meeting.

1310.6 Master Model

Following 100% coordination and agreement on a 'Master Model', the Trade Contractor agrees and will sign off to be responsible for locating their respective components within an agreed tolerance based on the 'Master Model'.

A. Any variation beyond the agreed tolerance must be coordinated with Contractor first and approved by Designer and Owner.

B. Items not included in the coordination model will be installed, in the field, after all coordinated elements are in place.

C. Components that are installed in conflict with model layout and create obstacles or additional work for other disciplines shall require one of the following: a) removal and reinstallation per model at no cost to other parties, or b) monetary compensation to the affected party and owner.

1310.7 Documentation of Coordination

The following will be included as a zipped file and posted by Contractor for all subs and design team.

A. A record of the Original BIM data used for ‘Sign-off’ Documentation.

B. A NavisWorks (NWD) Published file that includes the final Clash reports and Comments.

C. PDF files of above reports.

D. 2D print out that includes - Composite floor plan, Text clash report, and clash bubbles in the plan signed by all involved subs.

E. Each Trade is required to submit the number of copies of their respective, coordinated systems in a 2-Dimensional format as required by their contract, for approval through the regular submittal process. This is required for each floor as well as each riser. In addition to the development of 3-

Dimensional coordination models, all Trade Contractors are responsible for producing a traditional 2-Dimensional coordination drawing after cleaning up resolved all clashes and collisions. In the preparation of the final composite 2-Dimensional coordination drawings, large scale details as well as cross and longitudinal sections developed at coordination Meetings shall be made by the Trade Contractor as required to fully delineate all conditions. The final Coordination BIM drawing file will be re-circulated through all trades after a BIM sign-off meeting. This electronic coordination drawing files shall include all coordinated drawing information, fully dimensions (especially elevation dimensions), texts, and tags, etc. Field installation drawings should be submitted in PDF format and corresponding models should be delivered for incorporation into the final As-Built model.

F. The Contractor is required to compile and plot the number of color copies of the 2-Dimensional, multi-trade, coordinated drawings required by the contract documents for approval through the regular submittal process, for each defined Work area. This is required for each floor as well as each riser.

G. Each Effected Trade is required to maintain and provide the 3-Dimensional Model with respect to generating As-Built Drawings/Models. It is the responsibility of each trade to update their respective 3-Dimensional Model throughout construction to reflect field conditions to accurately document As-Built conditions.

H. Each Effected Trade is required to submit the number of color copies of their respective scope, As-Built 2-Dimensional drawings as required by the contract documents, for approval through the regular closeout process. This is required for each Work area, floor, as well as each riser. Submit field installation drawings as PDF file.

I. Each Effected Trade is required to submit an electronic copy containing the 3-Dimensional As-Built models, once all issues are addressed from above. This deliverable shall contain As-Built models in Revit .rvt, Data normalization .dbm, Postscipt Digital File .pdf, NavisWorks .NWD format and the other original authoring files in the native format of the program that created the models. Owner reserves the right to request additional file formats as the needs of the client or project require.

1310.8 Model Management

A. Trade Contractors shall provide updates/maintenance of Electronic Data/3D Model throughout construction to include but not limited to:

B. Incorporation of RFIs, Bulletins and Change Orders, etc.

C. Submittal comments and revisions on approved shop drawings.

D. As-Built field modifications.

E. Trade Contractor to provide Contractor with an updated model on a bi-monthly (2x per month) basis throughout the installation of the Work.

1310.9 Utilization of BIM for the RFI process

Response protocol and timing, incorporation of responses into any Model.

A. Each Trade is required to update and post any changes originating from RFIs, Submittals, and Bulletins that have changed their perspective work. Each Trade making changes shall post onto the BIM Server site and send out a corresponding notice indicating the changes and reasoning behind the change within no later than 10 business days from receipt of changes.

B. The RFI template is to provide an input box to confirm whether the response to the RFI has the potential to require modification to the project Building Information Models. Modification could require geometric model revision or information input.

C. This BIM issues item shall be a searchable item of the projects RFI log system.

D. Implementation of modifications to the project Building Information Models due to RFI responses will be the responsibility of the Model Element Author in primary control of the effected Model Element at the RFIs initiation.

E. The Contractor will Provide an update of the RFI Log to DEN on a bi-monthly (2x per month) basis.

1310.10 Utilization of BIM for the Change Order / Bulletin process

The process for quantifying and correcting clashes caused by a design change to a signed off and in-progress area is as follows:

A. Trades that have work directly affected by the bulletin documents will take the lead in drafting the revised 3-Dimensional layout, minimizing the clashes with other trades as much as possible. Revised layouts are to be drawn in an identifiable layer, labeled to match the respective bulletin.

B. Once the work is drafted by the affected trades, a clash report is to be prepared by the Contractor BIM Coordinator with all latest posts.

C. While running the clash detection feature in NavisWorks, the BIM Coordinator will turn on the 'links view' option and all clashes are labeled while navigating through the model.

D. Contractor BIM Coordinator will audit and report the clashes that are local to the area affected by the change documents, similar to the analysis of detected vs. reported clashes in preparation for weekly clash reports.

E. The Change Order Request template is to provide an input box to confirm whether the Change Order has potential to require modification to the project Building Information Models. Modification could require geometric model revision or information input.

F. This BIM issues item shall be a searchable item of the projects Change Order Request log system.

G. Incorporating approved Change Orders into the BIM Model (when applicable) shall be completed in no later than 10 business days after execution of the Change Order.

H. Implementation of modifications to the project Building Information Models due to Change Orders will be the responsibility of the Model Element Author in primary control of the effected Model Element at the Change Order's initiation.

Section 1311 - Spatial Coordination Procedure: Design/Construction Phase Clash Detection Priorities

1311.1 Architecture and Structural

Will be coordinated first and take precedence over other disciplines, this includes ceiling, walls, soffit framing, and king studs at doors etc. with the following exceptions:

A. Ceilings should only be lowered (RFI) if all other design alternatives have been exhausted and fully and timely articulated to the MEP Team .

B. Architecture should be less significant in mechanical areas (i.e. Special/Main Mech rooms, primary/Main Electrical rooms, etc) look for clear path requirements first!

1311.2 Structure

Takes precedence over MEP in most cases with exception to the following:

A. Fire Protection sleeves are missing.

B. Plumbing Sleeves are in conflict per Design (RFI).

C. All other design alternatives have been exhausted.

1311.3 Baggage Handling System (BHS)

Should have some priority as they are not as flexible (large min. turning radius), with the following notes:

A. The BHS Equipment must be per the design (this is on the ground) all other alternatives should be exhausted before following up with an RFI

B. The BHS Bag Line is slightly more flexible so you can find open areas in the ceiling cavity to elevate any conflicts (they need access panel in hard ceiling, and access to this in general).

1311.4 Plumbing

A. Vent Stack, Storm Drains, Waste and others (large pipes 6" and up) that depend on location of fixture or Minimum slopes typically take precedence over Mech., Elect, and P. Tube

B. Small Water supply lines 1" (cold, hot) and Medical Gas lines routing can be flexible (consider moving if they conflict with Elect. Trays, Large conduit banks).

1311.5 Mechanical

A. Large Ducts (size is relative to the job) should have priority over others and run high in the ceiling cavity if possible (below steel and BHS).

B. Small Ducts (feeders to vents, returns) have priority only as far as the path is not difficult to reach from main duct to return vents per design.

C. If there is conflict with elect. Trays or Conduit Banks you need to make a judgment call.

D. Do not allow Ducts to run parallel to walls (on top of) or crossing Perpendicular to walls at doorframe edge.

1311.6 Electrical

A. Light fixture location/size is not flexible, only changes after all other options are exhausted per RFI.

B. Electrical Trays and Conduit banks should be modified if conflicting with major ducts (or relocated) but take priority over small ducts and other disciplines.

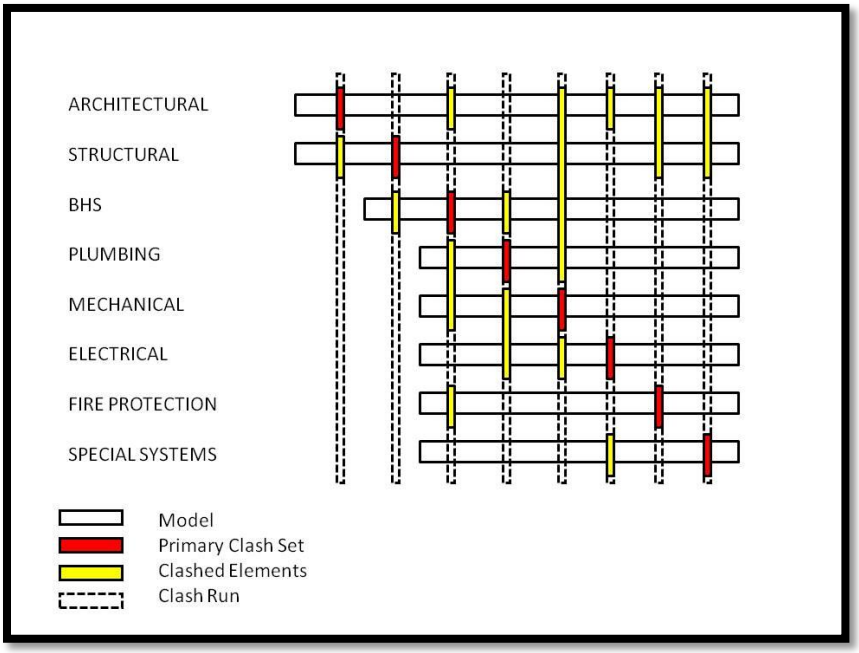
C. Give priority to Electrical at routing from Electrical rooms typically.

1311.7 Fire Protection

A. Sprinkler head is usually required to be centered on ceiling tile and must be spaced to allow sufficient coverage per design.

B. Mains (2" to 6") that are running thru beam sleeves should not be interrupted by any other disciplines if possible (in general run them high).

C. Control Valve locations might be flexible but you or sub need to block out access to this area



1311.8 Quality Control Checks – Design and Construction Process

The following checks should be performed to assure quality.

Checks	Definition	Responsible Party	Software Programs	Frequency
Visual Check	Ensure there are no unintended model components and the design intent has been followed	AoR / CMGC	REVIT / NAVIS	Ongoing
Interference Check	Detect problems in the model where two building components are clashing including soft and hard	CMGC	NAVIS	Bi-weekly
Standards Check	Ensure that the BIM and DEN Standards have been followed (fonts, dimensions, line styles, family naming, shared coordinates, etc)	AoR	REVIT / Data Normalization	Weekly
BIM Content Plan	Create a content list / family list of elements in the respective BIM models.	AoR / CMGC	REVIT / Excel	Weekly
Model Integrity Checks	Describe the QC validation process used to ensure that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements and the reporting process on non-compliant elements and corrective action plans	AoRs / CMGC	REVIT	Ongoing
Data Content Check	Conform to requirements of DEN-EDS-2404	AoR / CMGC / DEN	Data Normalization / Maximo	Weekly then monthly
Error / Warning Check	Conform to requirements of DEN-EDS-2404	AoRs/ CMGC	REVIT	Weekly

1311.9 Model Accuracy and Tolerances

Models should include all appropriate dimensioning as needed for design intent, analysis, and construction. Level of detail and included model elements are provided in the Information Exchange Worksheet.

Phase	Discipline	Tolerance
Design Documents	Arch	Accurate to +/- [1/16”] of actual size and location*
Shop Drawings	Mech contractor	Accurate to +/- [1/16”] of actual size and location*
* Unless otherwise dictated by the element in question needing a higher level of accuracy for design or placement		

Section 1312 - References

This part has been inspired and assembled from many sources including

- IU_BIM_Guidelines_and_Standards.pdf
- VA-BIM-Guide.pdf
- http://www.gsa.gov/BIM
- State of Wisconsin BIM Guidelines and Standards.pdf
- BIM_Guidelines_Book_191109_lores.pdf

End of Appendix

Appendix B - NCS Layers and FAA Feature Classes

The following chapters contain the layers provided in the DIA CADD template, including NCS layers, DEN specific layers, and FAA required layers. The colors, linetypes, and lineweights for the layers assigned in the CADD template are DEN suggested colors, linetypes, and lineweights. These attributes may be modified if agreed upon between the user and the DEN Project Manager.

Chapter 1 - NCS Layers

The NCS Layer Guidelines are to be used on all DEN projects. This section provides the NCS layers included in the DIA CADD Template. Layer names are in accordance with NCS layer naming conventions.

This list is not a complete list of all layers that a User may need. In the event that a layer is needed, which is not provided in the NCS layer, DEN specific layers, or FAA layers the User shall create the layer name in accordance with NCS layer naming guidelines (utilizing the abbreviations provided in the NCS when applicable) and notify the DEN Project Manager of the addition. A complete list of the current standard layers is included on the following pages.

Discipline Group	Layer Name	Old DEN Layer	Description
Architectural			
	A-AREA-	39	Area
	A-AREA-OCCP-	39	Area: occupant or employee names
	A-CLNG-ACCS-	39	Ceiling: access
	A-CLNG-GRID-	39	Ceiling: grid
	A-CLNG-OPNG-	39	Ceiling: openings
	A-CLNG-SUSP-	39	Ceiling: suspended elements
	A-CLNG-TEES-	39	Ceiling: main tees
	A-COLS-	39	Columns
	A-CONV-	39	Conveying system
	A-DOOR-FULL-	39	Doors: full-height (swing and leaf)
	A-DOOR-PRHT-	39	Doors: partial-height (swing and leaf)
	A-EQPM-ACCS-	39	Equipment: access
	A-EQPM-FIXD-	39	Equipment: fixed
	A-EQPM-OVHD-	39	Equipment: overhead
	A-FLOR-CSWK-	39	Floor: casework
	A-FLOR-EVTR-	39	Floor: elevator cars and equipment
	A-FLOR-FIXT-	39	Floor: fixtures (plumbing)
	A-FLOR-HRAL-	39	Floor: handrails / guard rails
	A-FLOR-LEVL-	39	Floor: level changes (ramps, pits, depressions)
	A-FLOR-OTLN-	39	Floor: outline
	A-FLOR-OVHD-	39	Floor: overhead
	A-FLOR-RAIS-	39	Floor: raised
	A-FLOR-RISR-	39	Floor: risers
	A-FLOR-SPCL-	39	Floor: specialties (toilet room accessories, display cases)

Discipline Group	Layer Name	Old DEN Layer	Description
	A-FLOR-STRS-	39	Floor: stair treads (escalators, ladders)
	A-FLOR-TPTN-	39	Floor: toilet partitions
	A-FLOR-WDWK-	39	Floor: architectural woodwork
	A-FURN-FILE-	39	Furnishings: file cabinets
	A-FURN-FIXD-	39	Furnishings: fixed
	A-FURN-FREE-	39	Furnishings: freestanding
	A-FURN-PLNT-	39	Furnishings: plants
	A-FURN-PNLS-	39	Furnishings: system panels
	A-FURN-SEAT-	39	Furnishings: seating
	A-FURN-STOR-	39	Furnishings: storage (component system)
	A-FURN-WKSF-	39	Furnishings: work surface (component system)
	A-GLAZ-FULL-	39	Glazing: full-height
	A-GLAZ-PRHT-	39	Glazing: partial-height
	A-GLAZ-SILL-	39	Glazing: window sills
	A-HVAC-	34	HVAC systems
	A-HVAC-RDFF-	34	HVAC Systems: return air diffusers
	A-HVAC-SDFF-	34	HVAC Systems: supply diffusers
	A-LITE-	87	Lighting
	A-ROOF-	39	Roof
	A-ROOF-HRAL-	39	Roof: handrails / guardrails
	A-ROOF-LEVL-	39	Roof: level changes
	A-ROOF-RISR-	39	Roof: risers
	A-ROOF-STRS-	39	Roof: stair treads (ladders)
	A-WALL-CAVI-	39	Walls: cavity
	A-WALL-CNTR-	39	Walls: center
	A-WALL-FIRE-	39	Walls: fire protection
	A-WALL-FULL-	39	Walls: full-height
	A-WALL-FULL-EXTR-	39	Walls: full-height - exterior
	A-WALL-FULL-INTR-	39	Walls: full-height - interior
	A-WALL-HEAD-	39	Walls: door and window headers
	A-WALL-JAMB-	39	Walls: door and window jambs
	A-WALL-MOVE-	39	Walls: moveable
	A-WALL-PATT-	39	Walls: texture and hatch patterns
	A-WALL-PRHT-	39	Walls: partial-height
Civil			
	C-AFLD-FLNE-	49	Airfield: fire lane
	C-AFLD-FLNE-MRKG-	49	Airfield: Fire Lane: pavement markings
	C-AFLD-FLNE-SIGN-	52/54	Airfield: Fire Lane: signage
	C-BLDG-OVHD-	39	Buildings and Primary Structures: overhead
	C-BLDG-PRCH-	39	Buildings and Primary Structures: porch (attached, roof overhead)

Discipline Group	Layer Name	Old DEN Layer	Description
	C-BLIN-STAN-	56/57	Baseline: stationing
	C-BRDG-CNTJ-	38	Bridge: construction joints
	C-BRDG-CNTR-	38	Bridge: center
	C-BRDG-EXPJ-	38	Bridge: expansion joint
	C-BRDG-FALT-	38	Bridge: fault/break lines
	C-BRDG-HIDD-	38	Bridge: objects or lines hidden from view
	C-BRDG-OBJT-	38	Bridge: objects
	C-BRDG-OBJT-PRIM-	38	Bridge: Objects: primary
	C-BRDG-OBJT-SECD-	38	Bridge: Objects: secondary
	C-BRDG-RBAR-	38	Bridge: reinforcing bar
	C-CATV-OVHD-	69	Cable Television System: overhead
	C-CATV-POLE-	69	Cable Television System: pole
	C-CATV-UGND-	69	Cable Television System: underground
	C-CEME-	25	Cemetery
	C-CHAN-BWTR-	28	Navigable Channels: breakwater
	C-CHAN-CNTR-	45/46	Navigable Channels: center
	C-CHAN-DACL-	28	Navigable Channels: de-authorized channel limits, anchorages, etc.
	C-CHAN-DOCK-	34	Navigable Channels: decks, docks, floats, piers
	C-CHAN-NAID-	34	Navigable Channels: navigation aids
	C-COMM-OVHD-	69	Telephone Communications: overhead
	C-COMM-POLE-	69	Telephone Communications: pole
	C-COMM-UGND-	69	Telephone Communications: underground
	C-CTRL-BMRK-	27	Control Points: benchmarks
	C-CTRL-FLYS-	27	Control Points: fly station
	C-CTRL-GRID-	27	Control Points: grid
	C-CTRL-HORZ-	27	Control Points: horizontal
	C-CTRL-HVPT-	27	Control Points: horizontal / vertical
	C-CTRL-PNPT-	27	Control Points: panel point
	C-CTRL-TRAV-	27	Control Points: traverse
	C-CTRL-VERT-	27	Control Points: vertical
	C-DFLD-OTLN-		Drain Field: outline
	C-DFLD-PROF-	1-7	Drain Field: profile
	C-DRIV-CONC-	47	Driveway Area: Driveway Edge of Pavement (Concrete)
	C-DRIV-CURB-	50	Driveway: curb
	C-DRIV-CURB-BACK-	50	Driveway: Curb: back of curb
	C-DRIV-CURB-FACE-	50	Driveway: Curb: face of curb
	C-DRIV-FLNE-	35	Driveway: fire lane
	C-DRIV-FLNE-MRKG-	49	Driveway: Fire Lane: pavement markings
	C-DRIV-FLNE-SIGN-	52/54	Driveway: Fire Lane: signage

Discipline Group	Layer Name	Old DEN Layer	Description
	C-DRIV-MRKG-	49	Driveway: pavement markings
	C-DRIV-SIGN-	52/54	Driveway: signage
	C-DRIV-WHIT-	49	Driveway: white paint
	C-DRIV-WHIT-TICK-	49	Driveway: White Paint: tick marks
	C-DRIV-YELO-	49	Driveway: yellow paint
	C-DRIV-YELO-TICK-	49	Driveway: Yellow Paint: tick marks
	C-DTCH-BOTM-	78	Ditches or Washes: bottom
	C-DTCH-CNTR-	78	Ditches or Washes: center
	C-DTCH-EWAT-	78	Ditches or Washes: edge of water
	C-DTCH-TOPD-	78	Ditches or Washes: top
	C-EROS-CIPR-	80	Erosion and Sediment Control: culvert inlet protection
	C-EROS-CNTE-	81	Erosion and Sediment Control: construction entrance
	C-EROS-DDIV-	81	Erosion and Sediment Control: drainage divides
	C-EROS-DVDK-	81	Erosion and Sediment Control: diversion dike
	C-EROS-INPR-	81	Erosion and Sediment Control: inlet protection
	C-EROS-SILT-	81	Erosion and Sediment Control: silt fence
	C-EROS-SSLT-	81	Erosion and Sediment Control: super silt fence
	C-FENC-GRAL-	41	Fence: guard rail
	C-FENC-POST-	41	Fence: posts
	C-HYDR-BAFL-	34	Hydraulic Structure: baffle block and splash pad
	C-HYDR-BASN-	34	Hydraulic Structure: stilling and settling basins
	C-HYDR-CNDT-	34	Hydraulic Structure: diversion/bypass conduits/culverts
	C-HYDR-COFF-	34	Hydraulic Structure: coffer dam
	C-HYDR-DAM-	34	Hydraulic Structure: dam
	C-HYDR-FISH-	34	Hydraulic Structure: fish ladder/passage
	C-HYDR-FLUM-	34	Hydraulic Structure: flume
	C-HYDR-INTK-	34	Hydraulic Structure: intake
	C-HYDR-NOVR-	34	Hydraulic Structure: non-overflow structure
	C-HYDR-PENS-	34	Hydraulic Structure: penstock
	C-NGAS-PIPE-CNTR-	71	Natural Gas: Piping: centerline
	C-PERC-	27	Perc testing
	C-PERC-HOLE-	27	Perc Testing: holes
	C-POND-	28	Ponds
	C-POND-EDGE-	28	Ponds: edge
	C-POND-SWAY-	28	Ponds: spillway
	C-POND-TOPB-	28	Ponds: top of bank
	C-POWR-FENC-	41	Power: fence
	C-POWR-INST-	34	Power: instrumentation (meters, transformers)
	C-POWR-MHOL-	34	Power: manhole

Discipline Group	Layer Name	Old DEN Layer	Description
	C-POWR-OVHD-	66	Power: overhead
	C-POWR-POLE-	34	Power: pole
	C-POWR-STRC-	34	Power: structures
	C-POWR-UGND-	67	Power: underground
	C-PRKG-CARS-	35	Parking Lot: cars and other vehicles
	C-PRKG-CURB-	50	Parking Lot: Curbing: curb
	C-PRKG-CURB-BACK-	50	Parking Lot: Curbing: curb back
	C-PRKG-CURB-FACE-	50	Parking Lot: Curbing: curb face
	C-PRKG-DRAN-	77	Parking Lot: drainage slope indications
	C-PRKG-FIXT-	34	Parking Lot: fixtures (wheel stops, parking meters, etc.)
	C-PRKG-FLNE-	35	Parking Lot: fire lane
	C-PRKG-FLNE-MRKG-	49	Parking Lot: Fire Lane: pavement markings
	C-PRKG-FLNE-SIGN-	52/54	Parking Lot: Fire Lane: signage
	C-PRKG-MRKG-	49	Parking Lot: pavement markings
	C-PRKG-SIGN-	52/54	Parking Lot: signage
	C-PRKG-STRP-	49	Parking Lot: striping
	C-PRKG-WHIT-	49	Parking Lot: white paint
	C-PRKG-WHIT-TICK	49	Parking Lot: White Paint: tick marks
	C-PRKG-YELO-	49	Parking Lot: yellow paint
	C-PRKG-YELO-TICK-	49	Parking Lot: Yellow Paint: tick marks
	C-PROP-SBCK-	25	Property Boundary: setback lines
	C-PVMT-ASPH-	47	Pavement: asphalt
	C-PVMT-CONC-	47	Pavement: concrete
	C-PVMT-GRVL-	47	Pavement: gravel
	C-RAIL-EQPM-	34	Railroad: equipment (gates, signals, etc.)
	C-RIVR-BOTM-	28	River: river bottom
	C-RIVR-CNTR-	45/46	River: centerline
	C-RIVR-EDGE-	28	River: edge
	C-RIVR-TOPB-	28	River: top of bank
	C-ROAD-FLNE-	35	Roadway: fire lane
	C-ROAD-FLNE-MRKG-	49	Roadway: Fire Lane: pavement markings
	C-ROAD-FLNE-SIGN-	52/54	Roadway: Fire Lane: signage
	C-ROAD-MRKG-	49	Roadway: pavement markings
	C-ROAD-SIGN-	52/54	Roadway: signage
	C-ROAD-STAN-	56/57	Roadway: stationing
	C-RRAP-	28	Riprap
	C-SGHT-	28	Sight distance
	C-SGHT-PROF-	1	– 7 Sight Distance: profile
	C-SOIL-	33	Soil types
	C-SSWR-DIAG-	59	Sanitary Sewer: diagrams

Discipline Group	Layer Name	Old DEN Layer	Description
	C-SSWR-FORC-	59	Sanitary Sewer: force main
	C-SSWR-LATL-	59	Sanitary Sewer: lateral line
	C-SSWR-PROF-	59	Sanitary Sewer: profile
	C-SSWR-STAN-	59	Sanitary Sewer: stationing
	C-SSWR-STRC-	59	Sanitary Sewer: structures
	C-SSWR-UGND-	59	Sanitary Sewer: underground
	C-STEM-INST-	34	Steam System: instrumentation (meters, valves, etc.)
	C-STEM-MHOL-	34	Steam System: manholes
	C-STEM-PIPE-	34	Steam System: piping
	C-STEM-STRC-	34	Steam System: structures
	C-STEM-UGND-	34	Steam System: underground
	C-STRM-CNTR-	79	Storm Sewer: center
	C-STRM-DIAG-	79	Storm Sewer: diagrams
	C-STRM-PROF-	79	Storm Sewer: profile
	C-STRM-STAN-	79	Storm Sewer: stationing
	C-TINN-BNDY-	28	Triangulated Irregular Network: boundary
	C-TINN-FALT-	28	Triangulated Irregular Network: fault / break lines
	C-TINN-VIEW-	28	Triangulated Irregular Network: triangulation view
	C-TINN-VOID-	28	Triangulated Irregular Network: void regions
	C-TOPO-DEPR-	28	Topographic Feature: depression
	C-TOPO-SPOT-	28	Topographic Feature: spot elevations
	C-TOPO-TPIT-	28	Topographic Feature: test pits
	C-TRAL-MRKG-	58	Trails or Paths: pavement markings
	C-TRAL-SIGN-	58	Trails or Paths: signage
	C-WALL-CTLJ-	143	Walls: control joint
	C-WALL-NSBR-	41	Walls: noise barrier
	C-WALL-RTWL-	41	Walls: retaining wall
	C-WALL-SHEA-	41	Walls: structural bearing or shear walls
	C-WATR-DIAG-	60	Water Supply: diagrams
	C-WATR-INST-	60	Water Supply: instrumentation (meters, valves, etc.)
	C-WATR-PIPE-	60	Water Supply: piping
	C-WATR-PIPE-CNTR-	60	Water Supply: piping centerline
	C-WATR-PROF-	60	Water Supply: profile
	C-WATR-STAN-	60	Water Supply: stationing
	C-WATR-STRC-	60	Water Supply: structures
	C-WATR-UGND-	60	Water Supply: underground
	C-WATR-WELL-	60	Water Supply: well
	C-WWAY-DLPH-	28	Waterway: dolphin
	C-WWAY-FEND-	28	Waterway: fender
	C-WWAY-MOOR-	28	Waterway: mooring

Discipline Group	Layer Name	Old DEN Layer	Description
Electrical			
	E-ALRM-	69	Alarm System
	E-AUXL-	69	Auxiliary Systems
	E-BELL-	69	Bell System
	E-CABL-	69	Cable Systems
	E-CCTV-	69	Closed Circuit Television System
	E-CLOK-CIRC-	34	Clock System: circuits
	E-CLOK-CLNG-	34	Clock System: ceiling
	E-CLOK-CNMB-	34	Clock System: circuit number
	E-CLOK-EQPM-	34	Clock System: equipment
	E-CLOK-FLOR-	34	Clock System: floor
	E-CLOK-WALL-	34	Clock System: wall
	E-COMM-CIRC-	69	Telephone Communications: circuits
	E-COMM-CLNG-	69	Telephone Communications: ceiling
	E-COMM-CNMB-	69	Telephone Communications: circuit number
	E-COMM-WALL-	69	Telephone Communications: wall
	E-CONT-DEVC-	69	Controls and Instrumentation: devices
	E-CONT-WIRE-	69	Controls and Instrumentation: wiring
	E-DATA-CIRC-	69	Data / LAN System: circuits
	E-DATA-CLNG-	69	Data / LAN System: ceiling
	E-DATA-CNMB-	69	Data / LAN System: circuit number
	E-DATA-EQPM-	69	Data / LAN System: equipment
	E-DATA-FLOR-	69	Data / LAN System: floor
	E-DATA-WALL-	69	Data / LAN System: wall
	E-DIAG-BKRS-	69	Diagrams: breakers
	E-DIAG-BUSS-	69	Diagrams: bus duct
	E-DIAG-ENCL-	69	Diagrams: equipment enclosures
	E-DIAG-EQPM-	69	Diagrams: equipment
	E-DIAG-FEED-	69	Diagrams: feeders
	E-DIAG-FLOR-	69	Diagrams: floor
	E-DIAG-GRND-	69	Diagrams: ground
	E-DIAG-SWCH-	69	Diagrams: switches
	E-DIAG-XFMR-	69	Diagrams: transformers
	E-DICT-CIRC-	69	Dictation Systems: circuits
	E-DICT-CLNG-	69	Dictation Systems: ceiling
	E-DICT-CNMB-	69	Dictation Systems: circuit number
	E-DICT-EQPM-	69	Dictation Systems: equipment
	E-DICT-WALL-	69	Dictation Systems: wall
	E-FIRE-CIRC-	69	Fire Protection: circuits
	E-FIRE-CLNG-	69	Fire Protection: ceiling
	E-FIRE-CNMB-	69	Fire Protection: circuit number

Discipline Group	Layer Name	Old DEN Layer	Description
	E-FIRE-EQPM-	69	Fire Protection: equipment
	E-FIRE-WALL-	69	Fire Protection: wall
	E-GRND-CLNG-	69	Ground System: ceiling
	E-GRND-CNMB-	69	Ground System: circuit number
	E-GRND-DIAG-	69	Ground System: diagrams
	E-GRND-EQPM-	69	Ground System: equipment
	E-GRND-WALL-	69	Ground System: wall
	E-INST-CIRC-	69	Instrumentation Systems: circuits
	E-INST-CLNG-	69	Instrumentation Systems: ceiling
	E-INST-CNMB-	69	Instrumentation Systems: circuit number
	E-INST-EQPM-	69	Instrumentation Systems: equipment
	E-INST-WALL-	69	Instrumentation Systems: wall
	E-INTC-	69	Intercom / PA System
	E-LITE-CIRC-CRIT-	69	Lighting: Circuits: critical
	E-LITE-CIRC-EMER-	69	Lighting: Circuits: emergency
	E-LITE-CNMB-	69	Lighting: circuit number
	E-LITE-CNMB-CRIT-	69	Lighting: Circuit Number: critical
	E-LITE-CNMB-EMER-	69	Lighting: Circuit Number: emergency
	E-LITE-EQPM-CRIT-	69	Lighting: Equipment: critical
	E-LITE-FLOR-	69	Lighting: floor
	E-LITE-ROOF-	69	Lighting: roof
	E-LTNG-CIRC-	69	Lighting Protection System: circuits
	E-LTNG-CLNG-	69	Lighting Protection System: ceiling
	E-LTNG-CNMB-	69	Lighting Protection System: circuit number
	E-LTNG-WALL-	69	Lighting Protection System: wall
	E-NURS-CIRC-	69	Nurse Call System: circuits
	E-NURS-CLNG-	69	Nurse Call System: ceiling
	E-NURS-CNMB-	69	Nurse Call System: circuit number
	E-NURS-EQPM-	69	Nurse Call System: equipment
	E-NURS-FLOR-	69	Nurse Call System: floor
	E-NURS-WALL-	69	Nurse Call System: wall
	E-PGNG-	69	Paging System
	E-POWR-CLNG-	34	Power: ceiling
	E-POWR-CLNG-CRIT-	34	Power: Ceiling: critical
	E-POWR-CNMB-	34	Power: circuit number
	E-POWR-CNMB-CRIT-	34	Power: Circuit Number: critical
	E-POWR-DEVC-	34	Power: devices
	E-POWR-EQPM-	34	Power: equipment
	E-POWR-EQPM-CRIT-	34	Power: Equipment: critical
	E-POWR-EXTR-	34	Power: exterior
	E-POWR-FLOR-	34	Power: floor

Discipline Group	Layer Name	Old DEN Layer	Description
	E-POWR-FLOR-CRIT-	34	Power: Floor: critical
	E-POWR-MRKR-	34	Power: marker
	E-POWR-ROOF-	34	Power: roof
	E-POWR-UCPT-	34	Power: under-carpet wiring
	E-POWR-URAC-	34	Power: under floor raceways
	E-POWR-WALL-	34	Power: wall
	E-POWR-WALL-CRIT-	34	Power: Wall: critical
	E-SITE-OVHD-	34	Site Features: overhead
	E-SITE-POLE-	34	Site Features: pole
	E-SITE-UGND-	34	Site Features: underground
	E-SOUN-	69	Sound / PA System
Equipment			
	Q-CMPR-	34	Computer
	Q-CSWK-DVDR-	34	Casework: thin dividers
	Q-CSWK-EDGE-	34	Casework: edge
	Q-CSWK-ELEV-	34	Casework: elevation
	Q-CSWK-FIXT-	34	Casework: fixtures (plumbing / service)
	Q-CSWK-FRMG-	34	Casework: structural framing
	Q-CSWK-FULL-	34	Casework: full-height (cabinets / lockers)
	Q-CSWK-GLAZ-	34	Casework: glazing
	Q-CSWK-GRND-	34	Casework: ground
	Q-CSWK-HRDW-	34	Casework: hardware
	Q-CSWK-LOWR-	34	Casework: lower (cabinets)
	Q-CSWK-PATT-	34	Casework: texture and hatch patterns
	Q-CSWK-SHLF-	34	Casework: wall mounted shelving
	Q-CSWK-SUBA-	34	Casework: cabinet sub-assemblies, drawer boxes
	Q-CSWK-UCTR-	34	Casework: under counter (cabinets - for layout)
	Q-CSWK-UPPR-	34	Casework: upper (cabinets)
	Q-CSWK-WKSF-	34	Casework: work surface
	Q-ELEV-EQPM-	1-7	Elevation: equipment
	Q-ELEV-FIXT-	1-7	Elevation: fixtures (plumbing / service)
	Q-ELEV-GLAZ-	1-7	Elevation: glazing
	Q-ELEV-HRDW-	1-7	Elevation: hardware
	Q-ELEV-OVHD-	1-7	Elevation: overhead
	Q-ELEV-PATT-	1-7	Elevation: texture and hatch patterns
	Q-ELEV-STRC-	1-7	Elevation: structures (support components)
	Q-EXHS-	34	Exhaust system
	Q-MAJQ-ACCS-	34	Major access
	Q-MAJQ-ENGR-	1-7	Major engineering information
	Q-MAJQ-FIXD-	34	Major fixed
	Q-MAJQ-MOVE-	34	Major movable

Discipline Group	Layer Name	Old DEN Layer	Description
	Q-MAJQ-MVNG-	34	Major moving or suspended
	Q-MAJQ-OVHD-	34	Major overhead
	Q-MAJQ-PATT-	1-7	Major texture and hatch patterns
	Q-MAJQ-UCTR-	34	Major under counter
	Q-MINQ-	34	Minor equipment
	Q-POWR-	34	Power
	Q-SPCL-	1-7	Special
	Q-SPCL-ACCS-	34	Special: access
	Q-SPCL-ENGR-	1-7	Special: engineering information
	Q-SPCL-FIXD-	34	Special: fixed
	Q-SPCL-MOVE-	34	Special: movable
	Q-SPCL-MVNG-	34	Special: moving or suspended
	Q-SPCL-OVHD-	34	Special: overhead
	Q-SPCL-PATT-	1-7	Special: texture and hatch patterns
	Q-SPCL-UCTR-	34	Special: under counter
Fire Protection			
	F-PROT-EQPM-	61	Fire protection system: equipment
	F-PROT-EXTI-	61	Fire protection system: extinguishers
	F-PROT-RATE-	61	Fire protection system: ratings
	F-PROT-SMOK-	61	Fire protection system: smoke detector / heat sensors
	F-SPKL-CLHD-	61	Sprinkler: ceiling heads
	F-SPKL-EQPM-	61	Sprinkler: equipment
	F-SPKL-OTHD-	61	Sprinkler: other heads
General			
	G-ACCS-	1-7	Access
	G-CODE-	1-7	Code compliance plan
	G-EVAC-	1-7	Evacuation plan
	G-FIRE-	1-7	Fire protection plan
Geo-Technical			
	B-BORE-FDTA-	1-7	Borings: field data
	B-BORE-HOLE-	1-7	Borings: holes (perc)
	B-BORE-LDTA-	1-7	Borings: laboratory data
	B-DETL-ANNN-	1-7	Detail: optional number (A = letter, NNN = number between 1 and 999)
	B-DETL-ANNN-CONC-	1-7	Detail: optional number: concrete
	B-DETL-ANNN-ERTH-	1-7	Detail: optional number: earth
	B-DETL-ANNN-FDTA-	1-7	Detail: optional number: field data
	B-DETL-ANNN-FILL-	1-7	Detail: optional number: fill and cover material
	B-DETL-ANNN-GENF-	1-7	Detail: optional number: general features

Discipline Group	Layer Name	Old DEN Layer	Description
	B-DETL-ANNN-GNDW-	1-7	Detail: optional number: ground water
	B-DETL-ANNN-LDTA-	1-7	Detail: optional number: laboratory data
	B-DETL-ANNN-PVMT-	1-7	Detail: optional number: pavement
	B-DETL-ANNN-SPCL-	1-7	Detail: optional number: special
	B-DETL-ANNN-STRM-	1-7	Detail: optional number: storm sewer
	B-DETL-ANNN-SUBS-	1-7	Detail: optional number: sub-surface areas
	B-DETL-ANNN-SURF-	1-7	Detail: optional number: surface areas
Hazardous Materials			
	H-PLAN-	1-7	Key plan (floor plan)
	H-SITE-	1-7	Key plan (site features)
Interior			
	I-AREA-OCCP-	Area:	occupant or employee names
	I-CLNG-ACCS-	34	Ceiling: access
	I-CLNG-OPNG-	34	Ceiling: openings
	I-CLNG-SUSP-	34	Ceiling: suspended elements
	I-CLNG-TEES-	34	Ceiling: main tees
	I-COLS-	34	Columns
	I-CSWK-	34	Casework
	I-DOOR-FULL-	1-7	Doors: full-height
	I-DOOR-PRHT-	1-7	Doors: partial-height
	I-EQPM-ACCS-	34	Equipment: access
	I-EQPM-FIXD-	34	Equipment: fixed
	I-EQPM-OVHD-	34	Equipment: overhead
	I-EQPM-STOR-	34	Equipment: storage
	I-FLOR-EVTR-	34	Floor: elevator cars and equipment
	I-FLOR-FIXT-	34	Floor: fixtures (plumbing)
	I-FLOR-HRAL-	34	Floor: handrails / guardrails
	I-FLOR-LEVL-	34	Floor: level changes (ramps, pits, depressions)
	I-FLOR-OTLN-	34	Floor: outline
	I-FLOR-OVHD-	34	Floor: overhead
	I-FLOR-RAIS-	34	Floor: raised
	I-FLOR-RISR-	34	Floor: risers
	I-FLOR-SIGN-	34	Floor: signage
	I-FLOR-SPCL-	34	Floor: architectural specialties (toilet room accessories, display cases)
	I-FLOR-STRS-	34	Floor: stair treads (escalators, ladders)
	I-FLOR-TPTN-	34	Floor: toilet partitions
	I-FLOR-WDWK-	34	Floor: architectural woodwork
	I-FNSH-	34	Finishes
	I-FURN-FILE-	34	Furnishings: file cabinets

Discipline Group	Layer Name	Old DEN Layer	Description
	I-FURN-FREE-	34	Furnishings: free standing
	I-FURN-PLNT-	34	Furnishings: plants
	I-FURN-PNLS-	34	Furnishings: system panels
	I-FURN-SEAT-	34	Furnishings: seating
	I-FURN-STOR-	34	Furnishings: storage (component system)
	I-FURN-WKSF-	34	Furnishings: work surface (component system)
	I-GLAZ-FULL-	34	Glazing: full-height
	I-GLAZ-PRHT-	34	Glazing: partial-height
	I-GLAZ-SILL-	34	Glazing: window sills
	I-HVAC-	34	HVAC systems
	I-HVAC-RDFF-	34	HVAC Systems: return air diffusers
	I-HVAC-SDFF-	34	HVAC Systems: supply diffusers
	I-MILL-	34	Millwork
	I-PRTN-FIRE-	34	Partitions: fire protection
	I-PRTN-FULL-	34	Partitions: full-height
	I-PRTN-HEAD-	1-7	Partitions: door and window headers
	I-PRTN-JAMB-	1-7	Partitions: door and window jambs
	I-PRTN-MOVE-	34	Partitions: movable
	I-PRTN-PRHT-	34	Partitions: partial-height
Landscape			
	L-IRRG-COVR-	81	Irrigation: coverage
	L-IRRG-DRIP-	81	Irrigation: drip irrigation tubing
	L-IRRG-EQPM-	81	Irrigation: equipment (pumps, valves, and controllers)
	L-IRRG-SLVE-	81	Irrigation: pipe sleeve
	L-IRRG-VALV-	81	Irrigation: valves
	L-PLNT-EDGR-	33	Plant and Landscape Material: planting bed edger
	L-PLNT-SEED-	33	Plant and Landscape Material: seeding areas
	L-PLNT-SHAD-	33	Plant and Landscape Material: shadow area
	L-PLNT-VINE-	33	Plant and Landscape Material: vines
	L-PVMT-ASPH-	47	Pavement: asphalt
	L-PVMT-BRCK-	47	Pavement: brick
	L-PVMT-CONC-	47	Pavement: concrete
	L-PVMT-CONC-AGGR-	47	Pavement: Concrete: exposed aggregate
	L-PVMT-GRVL-	47	Pavement: gravel
	L-PVMT-JNTC-	143	Pavement: control joint
	L-PVMT-JNTE-	143	Pavement: expansion joint (for concrete only)
	L-PVMT-PAVR-	47	Pavement: unit pavers
	L-PVMT-RAMP-	47	Pavement: accessible ramp
	L-PVMT-STRS-	47	Pavement: stair treads

Discipline Group	Layer Name	Old DEN Layer	Description
	L-SITE-CURB-	50	Site Features: curb
	L-SITE-CURB-BACK-	50	Site Features: Curb: back
	L-SITE-CURB-FACE-	50	Site Features: Curb: face
	L-SITE-DECK-	34	Site Features: deck (wood, typ.)
	L-SITE-FURN-	34	Site Features: furnishings
	L-SITE-PLAY-	34	Site Features: play structures
	L-SITE-PLAY-EQPM-	34	Site Features: Play Structures: equipment
	L-SITE-PLAY-ZONE-	34	Site Features: Play Structures: zoning
	L-SITE-POOL-	34	Site Features: pools and spas
	L-SITE-POOL-BACK-	34	Site Features: Pools and Spas: back of pool wall
	L-SITE-POOL-FACE-	34	Site Features: Pools and Spas: face of pool wall
	L-SITE-PRKG-	35	Site Features: parking
	L-SITE-PRKG-STRP-	49	Site Features: Parking: striping
	L-SITE-ROAD-	35	Site Features: edge of roadway line
	L-SITE-ROCK-	33	Site Features: large rocks and rock outcroppings
	L-SITE-RRAP-	81	Site Features: riprap
	L-SITE-RTWL-	34	Site Features: retaining wall
	L-SITE-SPRT-	34	Site Features: sports fields
	L-SITE-SPRT-EQPM-	34	Site Features: Sports Fields: equipment
	L-SITE-SPRT-PERI-	34	Site Features: Sports Fields: perimeter
	L-SITE-STEP-	34	Site Features: steps
	L-SITE-WALL-	34	Site Features: walls
	L-SITE-WEIR-	34	Site Features: pool weir
	L-TOPO-	36	Topographic Features
	L-TOPO-LIMI-	17	Topographic Features: limit of earthwork
	L-TOPO-SPOT-	36	Topographic Features: spot elevations
Mechanical			
	M-CHIM-	34	Flues, chimneys, and stacks
	M-DUAL-PIPE-RETN-	63	Dual Temperature Systems: Return Piping (Includes Fittings, Valves)
	M-DUAL-PIPE-SPLY-	63	Dual Temperature Systems: Supply Piping (Includes Fittings, Valves)
	M-DUST-DUCT-CNTR-	34	Dust and Fume Collection Systems: Ductwork: centerline
	M-ELHT-EQPM-	66	Electric Heat: equipment
	M-ENER-EQPM-	34	Energy Management Systems: equipment
	M-ENER-WIRE-	34	Energy Management Systems: wiring
	M-EXHS-CDFF-	34	Exhaust System: ceiling diffusers
	M-EXHS-DUCT-	34	Exhaust System: ductwork
	M-EXHS-DUCT-CNTR-	34	Exhaust System: Ductwork: center
	M-EXHS-EQPM-	34	Exhaust System: equipment

Discipline Group	Layer Name	Old DEN Layer	Description
	M-EXHS-RFEQ-	34	Exhaust System: rooftop equipment
	M-FUEL-GGEP-	72	Fuel Systems: gas general piping
	M-FUEL-GGEP-EQPM-	72	Fuel Systems: Gas General Piping: equipment
	M-FUEL-GGEP-HPIP-	72	Fuel Systems: Gas General Piping: high pressure piping
	M-FUEL-GGEP-LPIP-	72	Fuel Systems: Gas General Piping: low pressure piping
	M-FUEL-GGEP-LQPG-	72	Fuel Systems: Gas General Piping: liquid petroleum gas
	M-FUEL-GGEP-MPIP-	72	Fuel Systems: Gas General Piping: medium pressure piping
	M-FUEL-OGEP-	72	Fuel Systems: oil general piping
	M-FUEL-OGEP-DISC-	72	Fuel Systems: Oil General Piping: discharge
	M-FUEL-OGEP-FLLW-	72	Fuel Systems: Oil General Piping: flow
	M-FUEL-OGEP-GAGE-	72	Fuel Systems: Oil General Piping: gauge
	M-FUEL-OGEP-RETN-	72	Fuel Systems: Oil General Piping: return
	M-FUEL-OGEP-SPLY-	72	Fuel Systems: Oil General Piping: supply
	M-FUEL-OGEP-VENT-	72	Fuel Systems: Oil General Piping: vents
	M-FUEL-OPRP-	72	Fuel Systems: oil process piping
	M-FUME-DUCT-	34	Fume Hood: ductwork
	M-FUME-EQPM-	34	Fume Hood: equipment
	M-GLYC-PIPE-RETN-	75	Glycol Systems: return piping
	M-GLYC-PIPE-SPLY-	75	Glycol Systems: supply piping
	M-HVAC-BOXD-	34	HVAC Systems: mixing box, dual duct
	M-HVAC-BOXS-	34	HVAC Systems: mixing box, single duct
	M-HVAC-CDFF-	34	HVAC Systems: ceiling diffusers
	M-HVAC-DOOR-	34	HVAC Systems: equipment doors
	M-HVAC-EFAN-	34	HVAC Systems: equipment with electric fans
	M-HVAC-EPDU-	34	HVAC Systems: equipment with piping, ductwork, and electricity
	M-HVAC-EPIP-	34	HVAC Systems: equipment with piping and electricity
	M-HVAC-EXHS-	34	HVAC Systems: exhaust air
	M-HVAC-EXHS-DUCT-	34	HVAC Systems: Exhaust Air: ductwork
	M-HVAC-EXHS-GRIL-	34	HVAC Systems: Exhaust Air: grilles
	M-HVAC-EXHS-RSCH-	34	HVAC Systems: Exhaust Air: sketch line round or oval dt
	M-HVAC-EXHS-SECT-	34	HVAC Systems: Exhaust Air: section
	M-HVAC-EXHS-SIZE-	34	HVAC Systems: Exhaust Air: ductwork size
	M-HVAC-ODFF-	34	HVAC Systems: other diffusers
	M-HVAC-PIPE-	34	HVAC Systems: piping
	M-HVAC-RDFF-	34	HVAC Systems: return air diffusers
	M-HVAC-RETN-CNTR-	34	HVAC Systems: Return: centerline

Discipline Group	Layer Name	Old DEN Layer	Description
	M-HVAC-RETN-EQPM-	34	HVAC Systems: return equipment
	M-HVAC-RETN-SECT-	34	HVAC Systems: Return: section
	M-HVAC-RETN-SIZE-	34	HVAC Systems: Return: ductwork size
	M-HVAC-SDFF-	34	HVAC Systems: supply diffusers
	M-HVAC-SPLY-CNTR-	34	HVAC Systems: Supply: center
	M-HVAC-SPLY-SECT-	34	HVAC Systems: Supply: section
	M-HVAC-SPLY-SIZE-	34	HVAC Systems: Supply: ductwork size
	M-MDGS-CAIR-	34	Medical Gas: compressed air
	M-MDGS-EQPM-	34	Medical Gas: equipment
	M-MDGS-NITG-	34	Medical Gas: nitrogen
	M-MDGS-NOXG-	34	Medical Gas: nitrous oxide
	M-MDGS-OXYG-	34	Medical Gas: pure O2
	M-MDGS-PIPE-	34	Medical Gas: piping
	M-MDGS-PIPE-CNTR-	34	Medical Gas: piping centerline
	M-MDGS-SAIR-	34	Medical Gas: scavenge air
	M-MDGS-VACU-	34	Medical Gas: vacuum
	M-MKUP-	34	Make-up air systems
	M-MKUP-CDFF-	34	Make-up Air Systems: ceiling diffusers
	M-MKUP-DUCT-	34	Make-up Air Systems: ductwork
	M-MKUP-EQPM-	34	Make-up Air Systems: equipment
	M-MPIP-PIPE-	34	Miscellaneous Piping Systems: piping
	M-MPIP-PIPE-CNTR-	34	Miscellaneous Piping Systems: piping centerline
	M-NGAS-EQPM-	71	Natural Gas: equipment
	M-NGAS-PIPE-	71	Natural Gas: piping
	M-RAIR-	74	Relief air systems
	M-REFG-DISC-	34	Refrigeration Systems: discharge
	M-SMOK-CDFF-	34	Smoke Extraction Systems: ceiling diffusers
	M-SMOK-DUCT-	34	Smoke Extraction Systems: ductwork
	M-SMOK-EQPM-	34	Smoke Extraction Systems: equipment
	M-SPCL-EQPM-	34	Special: equipment
	M-SPCL-PIPE-	34	Special: piping
	M-TEST-	34	Test equipment
Plumbing			
	P-ACID-EQPM-	34	Acid Waste Systems: equipment
	P-ACID-PIPE-	34	Acid, Alkaline, and Oil Waste Piping
	P-ACID-VENT-	34	Acid, Alkaline, and Oil Waste Vent Piping
	P-DOMW-CPIP-	60	Domestic Water Systems: cold water piping
	P-DOMW-EQPM-	60	Domestic Water Systems: equipment
	P-DOMW-HPIP-	60	Domestic Water Systems: hot water piping
	P-DOMW-RISR-	60	Domestic Water Systems: risers
	P-DOMW-RPIP-	60	Domestic Water Systems: recirculation piping

Discipline Group	Layer Name	Old DEN Layer	Description
	P-MDGS-CAIR-	34	Medical Gas: compressed air
	P-MDGS-NITG-	34	Medical Gas: nitrogen
	P-MDGS-NOXG-	34	Medical Gas: nitrous oxide
	P-MDGS-OXYG-	34	Medical Gas: pure O2
	P-MDGS-SAIR-	34	Medical Gas: scavenge air
	P-MDGS-VACU-	34	Medical Gas: vacuum
	P-SSWR-EQPM-	59	Sanitary Sewer: equipment
	P-SSWR-FIXT-	59	Sanitary Sewer: fixtures
	P-SSWR-FLDR-	59	Sanitary Sewer: floor drains
	P-SSWR-PIPE-	59	Sanitary Sewer: piping
	P-SSWR-RISR-	59	Sanitary Sewer: risers
	P-SSWR-VENT-	59	Sanitary Sewer: vents
	P-STRM-RFDR-	79	Storm Sewer: roof drains
	P-STRM-RISR-	79	Storm Sewer: risers
Process			
	D-AIR~-AA~~	34	Air: agitation air – system
	D-AIR~-BA~~	34	Air: breathable air – system
	D-AIR~-CA~~	34	Air: compressed air – system
	D-AIR~-CDA~	34	Air: clean dry air – system
	D-AIR~-HCDA	34	Air: high pressure clean dry air - system
	D-AIR~-IA~~	34	Air: instrument air – system
	D-AIR~-OA~~	34	Air: outside air – system
	D-AIR~-OFA~~	34	Air: oil free air – system
	D-AIR~-PA~~	34	Air: plant air – system
	D-AIR~-V~~~	34	Air: vent – system
	D-CHEM-ARC~	34	Chemical: regenerative caustic - system
	D-CHEM-C~	34	Chemical: caustic – system
	D-CHEM-DEV~	34	Chemical: developer – system
	D-CHEM-EG~~	34	Chemical: ethylene glycol – system
	D-CHEM-H2O2	34	Chemical: hydrogen peroxide - system
	D-CHEM-HCL~	34	Chemical: hydrochloric acid – system
	D-CHEM-HF~~	34	Chemical: hydrofluoric acid – system
	D-CHEM-IPA~	34	Chemical: isopropyl alcohol – system
	D-CHEM-PHOS	34	Chemical: phosphoric acid – system
	D-CHEM-RER~	34	Chemical: solvent – system
	D-CHEM-SULF	34	Chemical: sulfuric acid – system
	D-CHEM-TMAH	34	Chemical: tmah – system
	D-DETL-BOLD	1-7	Detail: bold lines
	D-DETL-FINE	1-7	Detail: fine lines
	D-DETL-MEDM	1-7	Detail: medium lines
	D-DRAN-AMW~	34	Drains: ammonia waste – system

Discipline Group	Layer Name	Old DEN Layer	Description
	D-DRAN-CD~~	34	Drains: condensate drain – system
	D-DRAN-CLW~	34	Drains: concentrated lead waste - system
	D-DRAN-CMW~	34	Drains: concentrated metals waste - system
	D-DRAN-CUPW	34	Drains: copper plating waste - system
	D-DRAN-CURW	34	Drains: copper rinse waste - system
	D-DRAN-CUSW	34	Drains: copper slurry waste - system
	D-DRAN-DIRC	34	Drains: DI reclaim - system
	D-DRAN-DLW~	34	Drains: dilute waste - system
	D-DRAN-EGW~	34	Drains: ethylene glycol waste - system
	D-DRAN-HFW~	34	Drains: hydrofluoric waste - system
	D-DRAN-IW~~	34	Drains: industrial waste - system
	D-DRAN-MW~~	34	Drains: metals waste - system
	D-DRAN-NPWR	34	Drains: non-potable water reuse - system
	D-DRAN-OIW~	34	Drains: organic industrial waste - system
	D-DRAN-OLW~	34	Drains: organic liquid waste - system
	D-DRAN-OSW~	34	Drains: organic solvent waste - system
	D-DRAN-PHRC	34	Drains: phosphoric acid reclaim - system
	D-DRAN-PSW~	34	Drains: photo solvent waste - system
	D-DRAN-SDD~	34	Drains: scrubber duct drains - system
	D-DRAN-SLW~	34	Drains: slurry waste - system
	D-DRAN-SULF	34	Drains: sulfuric acid - system
	D-DRAN-SULR	34	Drains: sulfuric acid reclaim - system
	D-DRAN-SW~~	34	Drains: solvent waste - system
	D-DRAN-SWF~	34	Drains: solvent waste flammable - system
	D-DRAN-SWNF	34	Drains: solvent waste non-flammable - system
	D-EXHS-AMEX	34	Exhaust: ammonia exhaust - system
	D-EXHS-AREX	34	Exhaust: arsenic exhaust - system
	D-EXHS-HTEX	34	Exhaust: heat exhaust - system
	D-EXHS-SCEX	34	Exhaust: scrubber exhaust - system
	D-EXHS-SVEX	34	Exhaust: solvent exhaust - system
	D-GAS~-AR~~	34	Gas: argon - system
	D-GAS~-ARB~	34	Gas: argon bulk - system
	D-GAS~-BUT~	34	Gas: butane - system
	D-GAS~-CLG~	34	Gas: chlorine gas - system
	D-GAS~-H2~~	34	Gas: hydrogen - system
	D-GAS~-HE~~	34	Gas: helium - system
	D-GAS~-HPN2	34	Gas: high purity nitrogen - system
	D-GAS~-HPO2	34	Gas: high purity oxygen - system
	D-GAS~-LCHE	34	Gas: leak check helium - system
	D-GAS~-N2~~	34	Gas: nitrogen - system
	D-GAS~-N2O~	34	Gas: nitrous oxide - system

Discipline Group	Layer Name	Old DEN Layer	Description
	D-GAS~-NG~~	34	Gas: natural gas - system
	D-GAS~-O2~	34	Gas: oxygen – system
	D-GAS~-PRO~	34	Gas: propane - system
	D-GAS~-SG~~	34	Gas: specialty gas - system
	D-GAS~-UN2~	34	Gas: utility nitrogen - system
	D-GAS~-VN2~	34	Gas: venturi nitrogen - system
	D-GAS~-WAR~	34	Gas: weld argon - system
	D-LIQD-LPG~	34	Gas: liquid petroleum gas - system
	D-OIL~-LO~~	34	Oil: lube oil – system
	D-PIPE-CNTR	34	Piping: center
	D-PIPE-HDLN	34	Piping: hidden line
	D-PIPE-MISC	34	Piping: miscellaneous
	D-PIPE-PATT	34	Piping: texture and hatch patterns
	D-PIPE-UGND	34	Piping: underground
	D-SLUR-SLR~	34	Slurry: slurry return - system
	D-SLUR-SLS~	34	Slurry: slurry supply - system
	D-VACU-CLV~	34	Vacuum: chlorine vacuum - system
	D-VACU-CV~	34	Vacuum: chemical vacuum - system
	D-VACU-EV~	34	Vacuum: equipment vacuum - system
	D-VACU-HV~~	34	Vacuum: house vacuum - system
	D-VACU-HVA~	34	Vacuum: arsenic house vacuum - system
	D-VACU-PV~	34	Vacuum: vacuum - system
	D-WATR-BFW~	60	Water: boiler feed water - system
	D-WATR-DIR~	60	Water: deionized water return - system
	D-WATR-DIS~	60	Water: deionized water supply - system
	D-WATR-DIWP	60	Water: DI polishing loop - system
	D-WATR-FW~~	61	Water: fire water - system
	D-WATR-HDIR	63	Water: hot DI return - system
	D-WATR-HDIS	63	Water: hot DI supply - system
	D-WATR-HDRC	63	Water: hot DI reclaim - system
	D-WATR-HPDR	60	Water: high pH DI return - system
	D-WATR-HPDS	60	Water: high pH DI supply - system
	D-WATR-ICW~	60	Water: industrial city water - system
	D-WATR-NPW~	95	Water: non-potable water - system
	D-WATR-PCWR	60	#NAME?
	D-WATR-PCWS	60	Water: cooling water supply - system
	D-WATR-PW~~	60	Water: potable water - system
	D-WATR-RO~~	60	Water: reverse osmosis water - system
	D-WATR-ROR~	60	Water: reverse osmosis reject water - system
	D-WATR-TDIR	60	Water: tempered DI return - system
	D-WATR-TDIS	60	Water: tempered DI supply - system

Discipline Group	Layer Name	Old DEN Layer	Description
	D-WATR-TW~~	60	Water: tempered water - system
	D-WATR-UPRW	60	Water: ultra pure recycle water - system
	D-WATR-UPW~	60	Water: ultra pure water - system
Resource			
	R-INGR-ESMT-	30	Ingrants: easement
	R-INGR-LEAS-	25	Ingrants: lease
	R-INGR-LICN-	25	Ingrants: license
	R-INGR-PMIT-	25	Ingrants: permit
	R-INGR-RSRV-	25	Ingrants: reservation
	R-OTGR-LEAS-	25	Outgrants: lease
	R-OTGR-LICN-	25	Outgrants: license
	R-OTGR-PMIT-	25	Outgrants: permit
	R-OTGR-RSRV-	25	Outgrants: reservation
	R-PROP-TAKE-	25	Property Boundary: taking lines
	R-PROP-TAKE-ELEV-	25	Property Boundary: Taking Lines: elevations
	R-PROP-TRAC-	25	Property Boundary: tract lines
	R-PROP-TRAC-DFEE-	25	Property Boundary: Tract Lines: disposed fee
	R-PROP-TRAC-FEE~-	25	Property Boundary: Tract Lines: fee
	R-PROP-TRAC-LFEE-	25	Property Boundary: Tract Lines: disposed less than fee
	R-PROP-TRAC-NFEE-	25	Property Boundary: Tract Lines: non-fee
Structural			
	S-ALGN-	34	Alignment
	S-BEAM-ALUM-	34	Beams: aluminum
	S-BEAM-CONC-	34	Beams: concrete
	S-BEAM-STEL-	34	Beams: steel
	S-BEAM-WOOD-	34	Beams: wood
	S-BRCG-ALUM-	34	Bracing: aluminum
	S-BRCG-ALUM-HORZ-	34	Bracing: Aluminum: horizontal
	S-BRCG-METL-	34	Bracing: metal
	S-BRCG-STEL-	34	Bracing: steel
	S-BRCG-STEL-HORZ-	34	Bracing: Steel: horizontal
	S-BRCG-WOOD-	34	Bracing: wood
	S-BRCG-WOOD-HORZ-	34	Bracing: Wood: horizontal
	S-COLS-ABLT-	34	Columns: anchor bolts
	S-COLS-ALUM-	34	Columns: aluminum
	S-COLS-CONC-	34	Columns: concrete
	S-COLS-STEL-	34	Columns: steel
	S-COLS-WOOD-	34	Columns: wood
	S-DECK-FLOR-	34	Deck: floor
	S-DECK-FLOR-OPNG-	34	Deck: Floor: openings

Discipline Group	Layer Name	Old DEN Layer	Description
	S-DECK-ROOF-	34	Deck: roof
	S-DECK-ROOF-OPNG-	34	Deck: Roof: openings
	S-FNDN-FTNG-	135	Foundation: footings
	S-FNDN-GRBM-	135	Foundation: grade beams
	S-FNDN-PCAP-	135	Foundations: pile caps
	S-FNDN-PIER-	135	Foundation: drilled piers
	S-FNDN-PILE-	135	Foundation: piles
	S-FNDN-RBAR-	135	Foundation: reinforcing bar
	S-FNDN-RBAR-BOT1-	135	Foundation: Reinforcing Bar: bottom group 1
	S-FNDN-RBAR-BOT2-	135	Foundation: Reinforcing Bar: bottom group 2
	S-FNDN-RBAR-TOP1-	135	Foundation: Reinforcing Bar: top group 1
	S-FNDN-RBAR-TOP2-	135	Foundation: Reinforcing Bar: top group 2
	S-FSTN-	34	Fasteners and connections
	S-GRID-	26	Column grid
	S-GRLN-	37	Grade line
	S-GRLN-SURF-	37	Grade Line: surface areas
	S-GRTG-OVHD-	34	Grating: overhead
	S-HYDR-	34	Hydraulic structure
	S-JNTS-CNTJ-	143	Joints: construction joint
	S-JNTS-CTLJ-	143	Joints: control joint
	S-JNTS-EXPJ-	143	Joints: expansion joint
	S-JOIS-BRGX-	34	Joists: bridging
	S-PADS-	34	Pads
	S-PADS-EQPM-	34	Pads: equipment
	S-PLAT-FRMG-	34	Platform: framing
	S-PLAT-GRTG-	34	Platform: grating
	S-SIGN-BUOY-	34	Sign: buoy
	S-SIGN-FRMG-	34	Sign: framing
	S-SIGN-GAGE-	34	Sign: gauge (staff)
	S-SIGN-TEXT-	34	Sign: signage text
	S-SIGN-XTRU-	34	Sign: extrusion
	S-SLAB-CONC-	34	Slab: concrete
	S-SLAB-EDGE-	34	Slab: edge
	S-SLAB-OPNG-	34	Slab: openings (and depressions)
	S-SLAB-OPNX-	34	Slab: opening indication ("x")
	S-SLAB-STEL-	34	Slab: steel
	S-SLAB-WOOD-	34	Slab: wood
	S-STIF-LONG-	34	Stiffener: longitudinal
	S-STIF-TRAV-	34	Stiffener: transverse
	S-STRS-LADD-	34	Stairs: ladders and ladder assemblies
	S-TRUS-	34	Trusses

Discipline Group	Layer Name	Old DEN Layer	Description
	S-WALL-CMUW-	34	Walls: concrete masonry unit
	S-WALL-CONC-	34	Walls: concrete
	S-WALL-MSNW-	34	Walls: masonry
	S-WALL-PCST-	34	Walls: pre-cast concrete
	S-WALL-SHEA-	34	Walls: structural bearing or shear walls
	S-WALL-STEL-	34	Walls: steel stud
	S-WALL-WOOD-	34	Walls: wood
Survey/Mapping			
	V-BLDG-DECK-	34	Buildings and Primary Structures: deck (attached, no roof overhead)
	V-BLDG-OVHD-	34	Buildings and Primary Structures: overhead
	V-BLDG-PRCH-	34	Buildings and Primary Structures: porch (attached, roof overhead)
	V-BRDG-BENT-	38	Bridge: top of bent
	V-BRDG-CNTR-	38	Bridge: center
	V-BRDG-CTLJ-	38	Bridge: control joint
	V-BRDG-DECK-	38	Bridge: deck
	V-BRDG-GRAL-	38	Bridge: guard rail
	V-BRKL-BOTB-	36	Break / Fault Lines: bottom of bank
	V-BRKL-FLOW-	36	Break / Fault Lines: flowline (lowest point of ditch)
	V-BRKL-TOPB-	36	Break / Fault Lines: top of bank
	V-BRLN-	Building	restriction line
	V-BZNA-	76	Buffer zone area
	V-CHAN-BWTR-	25	Navigable Channels: breakwater
	V-CHAN-CNTR-	25	Navigable Channels: center
	V-CHAN-DACL-	25	Navigable Channels: de-authorized channel limits, anchorages, etc.
	V-CHAN-DOCK-	25	Navigable Channels: decks, docks, floats, piers
	V-CHAN-NAID-	25	Navigable Channels: navigation aids
	V-COMM-POLE-	69	Telephone Communications: pole
	V-COMM-UGND-	69	Underground Communications/Telephone Lines
	V-CTRL-BMRK-	27	Control Points: benchmarks
	V-CTRL-FLYS-	27	Control Points: fly station
	V-CTRL-HORZ-	27	Control Points: horizontal
	V-CTRL-HVPT-	27	Control Points: horizontal / vertical
	V-CTRL-PNPT-	27	Control Points: panel points
	V-CTRL-TRAV-	27	Control Points: transverse
	V-CTRL-VERT-	27	Control Points: vertical
	V-DRIV-CURB-	50	Driveways: curb
	V-DRIV-FLNE-	35	Driveways: fire lane
	V-DRIV-MRKG-	49	Driveways: pavement markings

Discipline Group	Layer Name	Old DEN Layer	Description
	V-DTCH-BOTM-	78	Ditches or Washes: bottom
	V-DTCH-CNTR-	78	Ditches or Washes: center
	V-DTCH-EWAT-	78	Ditches or Washes: edge of water
	V-DTCH-TOPD-	78	Ditches or Washes: top
	V-FUEL-UGND-	72	Underground Fuel Systems
	V-NGAS-PIPE-	71	Fuel Systems: Natural Gas: piping
	V-NGAS-UGND-	71	Fuel Systems: Natural Gas: underground
	V-NODE-ABUT-	34	Node: abutment
	V-NODE-ACTL-	27	Node: aerial horizontal and vertical control points
	V-NODE-BLDG-	39	Node: building points
	V-NODE-BLIN-	27	Node: baseline
	V-NODE-BRDG-	38	Node: bridge survey points
	V-NODE-BRKL-	1	- 7 Node: break lines, spot elevation
	V-NODE-BROW-	Node:	brush row points
	V-NODE-BRSH-	Node:	brush points
	V-NODE-CABL-	69	Node: underground cable systems
	V-NODE-CURB-	50	Node: curb
	V-NODE-DASP-	1	– 7 Node: description attributes for survey points
	V-NODE-DECK-	34	Node: deck
	V-NODE-DRIV-	47	Node: driveway
	V-NODE-EASP-	1	– 7 Node: elevation attributes for survey points
	V-NODE-EXPJ-	142	Node: expansion joint
	V-NODE-GRND-	36	Node: ground
	V-NODE-MHOL-	Node:	manhole
	V-NODE-MRKG-	49	Node: pavement markings (yellow / white stripes)
	V-NODE-NGAS-	71	Node: natural gas line
	V-NODE-PASP-	1	– 7 Node: point number attributes for survey points
	V-NODE-PIPE-	35	Node: piping (driveway / roadway culverts)
	V-NODE-POLE-	34	Node: pole (power, telephone, etc.)
	V-NODE-PVMT-	47	Node: pavement
	V-NODE-SIGN-	52/54	Node: signage
	V-NODE-SSWR-	59	Node: sanitary sewer
	V-NODE-STRM-	79	Node: storm sewer
	V-NODE-SWLK-	50	Node: sidewalks
	V-NODE-TREE-	33	Node: tree
	V-NODE-TROW-	33	Node: tree row
	V-NODE-WATR-	60	Water supply
	V-POWR-FENC-	66	Power: fences
	V-POWR-INST-	66	Power: instrumentation (meters, transformers)
	V-POWR-MHOL-	67	Power: manhole

Discipline Group	Layer Name	Old DEN Layer	Description
	V-POWR-OVHD-	66	Power: overhead
	V-POWR-POLE-	66	Power: pole
	V-POWR-STRC-	66	Power: structures
	V-POWR-UGND-	67	Power: underground
	V-PRKG-CNTR-	35	Parking Lots: center
	V-PRKG-DRAN-	77	Parking Lots: drainage slope indications
	V-PRKG-FLNE-	35	Parking Lots: fire lane
	V-PRKG-MRKG-	49	Parking Lots: pavement markings
	V-PRKG-STRP-	49	Parking Lots: striping
	V-PROP-RSRV-	25	Property Boundary: reservation
	V-PROP-SBCK	25	Property Boundary: setback lines
	V-PROP-SUBD-	25	Property Boundary: subdivision (interior) lines
	V-PVMT-ASPH-	47	Pavement: Asphalt
	V-PVMT-CONC-	47	Pavement: Concrete
	V-PVMT-GRVL-	47	Pavement: Gravel
	V-RAIL-EQPM-	34	Railroad: equipment (gates, signals, etc.)
	V-RIVR-BOTM-	77	River: bottom
	V-RIVR-CNTR-	77	River: center
	V-RIVR-EDGE-	77	River: edge
	V-RIVR-TOPB-	77	River: top of bank
	V-ROAD-FLNE-	35	Road: fire lane
	V-ROAD-MRKG-	49	Road: pavement markings
	V-RRAP-	81	Road: riprap
	V-RWAY-CNTR-	29	Right-of-Way: center
	V-RWAY-CTLA-	29	Right-of-Way: controlled access
	V-RWAY-LINE-	29	Right-of-Way: lines
	V-RWAY-LMTA-	29	Right-of-Way: limited access
	V-RWAY-MRKR-	29	Right-of-Way: marker
	V-RWAY-STAN-	29	Right-of-Way: stationing
	V-SITE-ROCK-	33	Site Features: large rocks and rock outcroppings
	V-SITE-RTWL-	34	Site Features: retaining wall
	V-SITE-SIGN-	52/54	Site Features: signage
	V-SSWR-STRC-	59	Sanitary Sewer: structures
	V-SSWR-UGND-	59	Sanitary Sewer: underground
	V-STEM-INST-	63	Steam System: instrumentation (meters, valves, pumps)
	V-STEM-MHOL-	63	Steam System: manhole
	V-STEM-PIPE-	63	Steam System: piping
	V-STEM-STRC-	63	Steam System: structures
	V-STEM-UGND-	63	Steam System: underground
	V-STRM-DTCH-	63	Storm Sewer: ditches or washes

Discipline Group	Layer Name	Old DEN Layer	Description
	V-STRM-STRC-	79	Storm Sewer: structures
	V-TOPO-SOUN-	36	Topographic Feature: soundings
	V-TOPO-SPOT-	36	Topographic Feature: spot elevations
	V-UNID-CABL-	Unidentified	Site Objects: cable systems
	V-UNID-PIPE-	Unidentified	Site Objects: piping
	V-UNID-TANK-	Unidentified	Site Objects: storage tanks
	V-UNID-UTIL-	Unidentified	Site Objects: utility lines
	V-UNID-UTIL-OVHD-	Unidentified	Site Objects: overhead
	V-UNID-UTIL-UGND-	Unidentified	Site Objects: underground
	V-WATR-INST-	60	Water Supply: instrumentation (meters, valves, pumps)
	V-WATR-MHOL-	60	Water Supply: manhole
	V-WATR-PIPE-	60	Water Supply: piping
	V-WATR-STRC-	60	Water Supply: structures
	V-WATR-UGND-	60	Water Supply: underground
Telecommunications			
	T-ALRM-	69	Alarm System
	T-BCST-	69	Broadcast-related System (radio or TV)
	T-BELL-	69	Bell System
	T-CLOK-CIRC-	69	Clock System: circuits
	T-CLOK-CLNG-	69	Clock System: ceiling
	T-CLOK-CNMB-	69	Clock System: circuit number
	T-CLOK-EQPM-	69	Clock System: equipment
	T-CLOK-FLOR-	69	Clock System: floor
	T-CLOK-WALL-	69	Clock System: wall
	T-COMM-CIRC-	69	Telephone Communications: circuits
	T-COMM-CLNG-	69	Telephone Communications: ceiling
	T-COMM-CNMB-	69	Telephone Communications: circuit number
	T-COMM-EQPM-	69	Other Telecommunications Equipment
	T-COMM-FLOR-	69	Telephone Communications: floor
	T-COMM-WALL-	69	Telephone Communications: wall
	T-CONT-DEVC-	69	Controls and Instrumentation: devices
	T-CONT-WIRE-	69	Controls and Instrumentation: wiring system
	T-DATA-CIRC-	69	Data / LAN: circuits
	T-DATA-CLNG-	69	Data / LAN: ceiling
	T-DATA-CNMB-	69	Data / LAN: circuit number
	T-DATA-EQPM-	69	Data / LAN: equipment
	T-DATA-FLOR-	69	Data / LAN: floor
	T-DATA-WALL-	69	Data / LAN: wall
	T-DIAG-ENCL-	69	Diagrams: equipment enclosures
	T-DIAG-EQPM-	69	Diagrams: equipment

Discipline Group	Layer Name	Old DEN Layer	Description
	T-DIAG-GRND-	69	Diagrams: ground
	T-DICT-CIRC-	69	Dictation System: circuits
	T-DICT-CLNG-	69	Dictation System: ceiling
	T-DICT-CNMB-	69	Dictation System: circuit number
	T-DICT-EQPM-	69	Dictation System: equipment
	T-DICT-FLOR-	69	Dictation System: floor
	T-DICT-WALL-	69	Dictation System: wall
	T-ELEC-	69	Electrical System, telecom plan
	T-EMCS-	69	Energy Monitoring Control System
	T-FIRE-CIRC-	69	Fire Protection: circuits
	T-FIRE-CLNG-	69	Fire Protection: ceiling
	T-FIRE-CNMB-	69	Fire Protection: circuit number
	T-FIRE-EQPM-	69	Fire Protection: equipment
	T-FIRE-FLOR-	69	Fire Protection: floor
	T-FIRE-WALL-	69	Fire Protection: wall
	T-INTC-	69	Intercom / PA Systems
	T-NURS-CIRC-	69	Nurse Call Systems: circuits
	T-NURS-CLNG-	69	Nurse Call Systems: ceiling
	T-NURS-CNMB-	69	Nurse Call Systems: circuit number
	T-NURS-EQPM-	69	Nurse Call Systems: equipment
	T-NURS-FLOR-	69	Nurse Call Systems: floor
	T-NURS-WALL-	69	Nurse Call Systems: wall
	T-PGNG-	69	Paging System
	T-PROJ-	69	Projector System
	T-SERT-CIRC-	69	Security System: circuits
	T-SERT-CLNG-	69	Security System: ceiling
	T-SERT-CNMB-	69	Security System: circuit number
	T-SERT-EQPM-	69	Security System: equipment
	T-SERT-FLOR-	69	Security System: floor
	T-SERT-WALL-	69	Security System: wall
	T-SOUN-	69	Sound / PA System
	T-TRAN-	69	Transmission System (RF and microwave)
	T-TVAN-CIRC-	69	Television Antenna System: circuits
	T-TVAN-CLNG-	69	Television Antenna System: ceiling
	T-TVAN-CNMB-	69	Television Antenna System: circuit number
	T-TVAN-EQPM-	69	Television Antenna System: equipment
	T-TVAN-FLOR-	69	Television Antenna System: floor
	T-TVAN-WALL-	69	Television Antenna System: wall
	T-TVVS-SAUD-	69	Television and Video System: audio signal
	T-TVVS-SCOM-	69	Television and Video System: communications signal

Discipline Group	Layer Name	Old DEN Layer	Description
	T-TVVS-SCTL-	69	Television and Video System: control signal
	T-TVVS-SDAT-	69	Television and Video System: data signal
	T-TVVS-SDGA-	69	Television and Video System: digital audio signal
	T-TVVS-SDGV-	69	Television and Video System: digital video signal
	T-TVVS-SMIC-	69	Television and Video System: microphone signal
	T-TVVS-SPWR-	69	Television and Video System: power signal
	T-TVVS-SRFI-	69	Television and Video System: RF signal
	T-TVVS-SRGB-	69	Television and Video System: RGB and component video signal
	T-TVVS-SSYN-	69	Television and Video System: sync signal
	T-TVVS-SVID-	69	Television and Video System: video signal

End of Chapter

Chapter 2 - DEN Specific Layers

The following list of layers identifies the DEN specific layers that were added to the NCS layers. The purpose is to ensure all elements of the Airport are identified through a standard layer in the same format used by the NCS. These layers include DEN legacy layers for drawing features not accounted for in the NCS or FAA layers. This list of layers will be modified according to need.

Discipline Group	Layer Name	Old DEN Layer	Description
DEN Specific Layers			
Architectural			
	A-EQPM-BAGG-	34	Baggage Handling System / Text
	A-EQPM-CNVR-CNTR-	45/46	Equipment: Conveyor Centerline
	A-EQPM-CNVR-SITE-	34	Equipment: Conveyor Site
	A-FIXT-REST-	34	Restroom Fixtures
	A-FIXT-WATR-	34	Drinking fountains, floor drains
Civil			
	C-AFLD-REVS-P139-	27	Location of Part 139 repairs on the airport
	C-AFLD-RVZ-	76	Runway Visibility Zone
	C-AIRS-MIL-	76	Airspace: Military: Flight Corridor / Direction Arrow
	C-FUEL-FLOW-	72	Fuel Systems: flow arrow
	C-PEDS-RSTR	58	Pedestrian: foot traffic only areas
	C-POWR-MRKR-	34	Power: marker
	C-PVMT-DSRS-LINE-	47	Pavement: distress location (line)
	C-PVMT-DSRS-PNTS-	47	Pavement: distress location (point)
	C-PVMT-DSRS-POLY-	47	Pavement: distress location (polygon)
	C-PVMT-HIST-	47	Pavement: history
	C-PVMT-JNTS	142	Pavement: Joints
	C-PVMT-JNTS-INSP-	142	Pavement: Joints: inspection area
	C-RAIL-AGTS-BLDG-	34	AGTS Building: Central Control Facility
	C-RAIL-AGTS-BUFF-	34	AGTS Over-travel Buffers
	C-RAIL-AGTS-CCTV-	34	AGTS CCTV
	C-RAIL-AGTS-CNTL-	34	AGTS Automatic Train Controls
	C-RAIL-AGTS-CNTL-CNTR	34	AGTS Automatic Train Controls: Central Control
	C-RAIL-AGTS-COMP-	34	AGTS Guideway Components
	C-RAIL-AGTS-DOOR-	34	AGTS Automatic Doors
	C-RAIL-AGTS-ELEC-	34	AGTS Equipment Room Electronics
	C-RAIL-AGTS-ENVL-	34	AGTS Vehicle Dynamic Envelope
	C-RAIL-AGTS-EQPM-	34	AGTS Equipment Room
	C-RAIL-AGTS-GUID-	34	AGTS Lateral Guidance
	C-RAIL-AGTS-STOR-	34	AGTS Vehicle Maintenance and Storage Facility
	C-RAIL-AGTS-SURF-	34	AGTS Running Surface

Discipline Group	Layer Name	Old DEN Layer	Description
	C-RAIL-AGTS-SWCH-	34	AGTS Switches
	C-RAIL-AGTS-WALL-	41	AGTS Barrier Walls
	C-SSWR-ANOD-	59	Sanitary Sewer: anode
	C-SSWR-ANOD-STAT-	59	Sanitary Sewer: anode test station
	C-SSWR-CONN-	59	Sanitary Sewer: connection
	C-SSWR-DSCH-	59	Sanitary Sewer: discharge
	C-SSWR-DSPL-SITE-	59	Sanitary Sewer: disposal site
	C-SSWR-FLOW-	59	Sanitary Sewer: flow arrow
	C-SSWR-INLT-	59	Sanitary Sewer: inlet
	C-SSWR-MRKR	59	Sanitary Sewer: marker
	C-SSWR-NEUT-	59	Sanitary Sewer: neutralizer
	C-SSWR-PIPE-CNTR-	59	Sanitary Sewer: Sanitary Sewer Piping: pipe centerline
	C-SSWR-RCTF-	59	Sanitary Sewer: rectifier
	C-SSWR-SLDG-	59	Sanitary Sewer: sludge bed
	C-STRM-DA~~-	79	Storm Sewer: drainage area
	C-STRM-DSCH-	79	Storm Sewer: discharge
	C-STRM-FLOW-	79	Storm Sewer: flow arrow
	C-STRM-MRKR	79	Storm Sewer: marker
	C-TOPO-AUAB-	76	Topographic Feature: Noise Abatement Feature
	C-TOPO-AUAB-AREA-	76	Topographic Feature: Noise Abatement Feature: noise abatement area
	C-WATR-AREA-MGMT-	28	Water Supply: management area
Electrical			
	E-COMM-UGND-MRKR-	67	Telephone Communications: Underground Communications: telephone line marker
	E-INST-MRKR-	69	Instrumentation Systems: marker
	E-LTNG-EQPM-	34	Lighting Protection System: equipment
	E-POWR-PDTL-	34	Power: Pedestal Point
	E-POWR-RGLR-	34	Power: Regulator
	E-POWR-RISR-	34	Power: Riser Point
	E-SITE-GUYW-	34	Site Features: guy wire
	E-SITE-TOWR-	34	Site Features: tower
Fire Protection			
	F-AFFF-PIPE-CNTR-	61	Aqueous Film Forming Foam (AFFF) Piping Centerline
	F-PROT-PIPE-	61	Fire Protection: Fire Protection System: piping
	F-PROT-PIPE-CNTR-	61	Fire Protection: Fire Protection System: piping centerline
	F-PROT-UGND-	61	Fire Protection: Fire Protection System: underground piping
	F-SPKL-PIPE-CNTR-	61	Fire Protection: Sprinkler piping centerline

Discipline Group	Layer Name	Old DEN Layer	Description
	F-WATR-PIPE-CNTR-	61	Water piping centerline
General			
	G-ANNO-	1	– 7 General: annotation for features
	G-ANNO-DIMS-	1	– 7 General: Annotation: dimensions for features
	G-ANNO-MATC-	18	General: Annotation: match lines and text
	G-ANNO-NOTE-	21	General: Annotation: notes (call-outs and keynotes)
	G-ANNO-RDME-	21	General: Annotation: readme / notes to drafter (non-plot)
	G-ANNO-REVS-	22	General: Annotation: revisions
	G-ANNO-SCHD-TEXT-	23	General: Annotation: Schedule: text
	G-ANNO-STMP-	19	General: Annotation: architect / engineers seal
	G-ANNO-STMP-TEXT-	19	General: Annotation: Stamp text
	G-ANNO-SYMB-	20	General: Annotation: symbol (north arrows, scales, etc.)
	G-ANNO-TITL-LOGO	19	General: Annotation: Title: company logos
	G-ANNO-TITL-TEXT	19	General: Annotation: Title: titleblock text
	G-ANNO-TITL-VPRT		General: Annotation: Title: viewports
	G-ANNO-TTLB-	9	
	G-ANNO-TTLB-DRFT	19	General: Annotation: Titleblock: draft stamp
	G-ANNO-TTLB-NFCR	19	General: Annotation: Titleblock: not for construction text
	G-LEGN-KMAP-	20	General: Annotation: Legend: keymap
	G-LEGN-KMAP-BLDG-	20	General: Annotation: Legend: building keymap
	G-LEGN-KMAP-CNTR-	20	General: Annotation: Legend: keymap
	G-LEGN-KMAP-ROAD-	20	General: Annotation: Legend: road keymap
Interior			
	I-AREA-SECR-BAGG-	34	Security Baggage Check
	I-EQPM-KIT-	34	Kitchen Equipment (grease ductwork, kitchen hoods, etc.)
	I-FIXT-REST-	34	Restroom Fixtures
	I-FIXT-WATR-	34	Drinking Fountains
Landscape			
	L-AGRA-LCVR-	33	Agriculture: appearance of the earth's surface
	L-AGRA-MGMT-	33	Agriculture: management zone
	L-AGRA-RSTR-	33	Agriculture: restriction area
	L-AGRA-SHED-	33	Agriculture: sheds
	L-AGRA-TRAC-	33	Agriculture: tract areas
	L-IRRG-PIPE-CNTR-	81	Irrigation: piping centerline
Mechanical			
	M-AGTS-BUFF-	34	AGTS Over-travel Buffers

Discipline Group	Layer Name	Old DEN Layer	Description
	M-AGTS-CCTV-	34	AGTS CCTV
	M-AGTS-CNTL-	34	AGTS Automatic Train Controls
	M-AGTS-CNTL-CNTR-	34	AGTS Automatic Train Controls: Central Control
	M-AGTS-COMP-	34	AGTS Guideway Components
	M-AGTS-DOOR-	34	AGTS Automatic Doors
	M-AGTS-ELEC-	34	AGTS Equipment Room Electronics
	M-AGTS-ENVL-	34	AGTS Vehicle Dynamic Envelope
	M-AGTS-EQPM-	34	AGTS Equipment Room
	M-AGTS-GUID-	34	AGTS Lateral Guidance
	M-AGTS-SURF-	34	AGTS Running Surface
	M-AGTS-SWCH-	34	AGTS Switches
	M-AGTS-WALL-	34	AGTS Barrier Walls
	M-BRIN-PIPE-CNTR-	34	Brine System: Piping Centerline
	M-CHEM-PIPE-CNTR-	34	Chemical: Piping Centerline
	M-CMPA-PIPE-CNTR-	34	Compressed / Processed Air Systems: piping centerline
	M-CNDW-PIPE-CNTR-	34	Condenser Water Piping Centerline (Return and Supply)
	M-CWTR-PIPE-CNTR-	62	Chilled Water Systems: piping centerline
	M-DUAL-ANOD-	34	Dual Temperature Systems: anode point
	M-DUAL-CNCT-	34	Dual Temperature Systems: connection (fittings, transitions, etc.)
	M-DUAL-FLOW-	34	Dual Temperature Systems: flow arrow
	M-DUAL-JNCT-	34	Dual Temperature Systems: junction
	M-DUAL-METR-	34	Dual Temperature Systems: meter
	M-DUAL-MRKR-	34	Dual Temperature Systems: marker
	M-DUAL-PIPE-CNTR-	34	Dual Temperature Systems: Dual Temperature Systems: Piping Centerline (supply and return)
	M-DUAL-PLNT-	34	Dual Temperature Systems: plant area
	M-DUAL-PUMP-	34	Dual Temperature Systems: pump
	M-DUAL-RCTF-	34	Dual Temperature Systems: rectifier
	M-DUAL-RGLR-	34	Dual Temperature Systems: regulator
	M-DUAL-TEST-STAT-	34	Dual Temperature Systems: test station
	M-DUAL-VALV-	34	Dual Temperature Systems: valve
	M-FUEL-GGEP-CNTR-	72	Fuel Systems: Gas General Piping: piping centerline
	M-FUEL-GPRP-	72	Fuel Systems: gas process piping
	M-FUEL-GPRP-CNTR	72	Fuel Systems: gas process piping: piping centerline
	M-FUEL-OGEP-CNTR-	72	Fuel Systems: Oil General Piping: piping centerline
	M-FUEL-OGEP-EQPM-	72	Fuel Systems: Oil General Piping: equipment
	M-FUEL-OPRP-CNTR-	72	Fuel Systems: oil process piping centerline

Discipline Group	Layer Name	Old DEN Layer	Description
	M-GLYC-PIPE-CNTR-	75	Glycol Systems: piping centerline (return and supply)
	M-HVAC-CNTR-	27	Center Point
	M-HVAC-EXIT-	34	Exit Point
	M-HVAC-PCAR-DUCT-	74	HVAC Systems: Preconditioned Air: ductwork
	M-HVAC-PCAR-EQPM-	74	HVAC Systems: Preconditioned Air: equipment
	M-HVAC-PCAR-PIPE-	74	HVAC Systems: Preconditioned Air: piping
	M-HVAC-PIPE-CNTR-	45/46	HVAC Systems: piping centerline
	M-HVAC-REFF-	34	Reference Point
	M-HYDR-PIPE-CNTR-	45/46	Hydraulic System: Piping Centerline
	M-KIT~-DUCT-	34	Kitchen ductwork
	M-KIT~-EQPM-	34	Kitchen equipment
	M-KIT~-HOOD-	34	Kitchen exhaust hoods
	M-LUBE-PIPE-CNTR-	34	Lubrication Oil Piping Centerline
	M-NGAS-PIPE-CNTR-	71	Natural Gas: piping centerline
	M-RCOV-PIPE-CNTR-	45/46	Energy Recovery Systems: piping centerline
	M-SPCL-PIPE-CNTR-	45/46	Special: piping centerline
	M-STEM-PIPE-CNTR-	45/46	Steam System: piping centerline
Plumbing			
	P-LGAS-PIPE-CNTR-	45/46	Laboratory Gas Systems: piping centerline
	P-MDGS-PIPE-CNTR-	45/46	Medical Gas: piping centerline
	P-STRM-PIPE-CNTR-	79	Storm Sewer: piping centerline
Process			
	D-IWST-ANOD-	64	Industrial Waste: anode
	D-IWST-ANOD-TEST-	64	Industrial Waste: anode test station point
	D-IWST-CNCT-	64	Industrial Waste: connection (fittings, transitions, junctions, etc.)
	D-IWST-DCHG-	64	Industrial Waste: discharge
	D-IWST-DEVC-	64	Industrial Waste: device (oil-water separators, rectifiers, neutralizers, valves, etc.)
	D-IWST-FLOW-	64	Industrial Waste: flow arrow
	D-IWST-GRIT-CHMB-	64	Industrial Waste: grit chamber
	D-IWST-HWAL-	64	Industrial Waste: headwall
	D-IWST-INLT-	64	Industrial Waste: inlet
	D-IWST-JNCT-	64	Industrial Waste: junction
	D-IWST-LAGN-	64	Industrial Waste: lagoon
	D-IWST-METR-	64	Industrial Waste: meter
	D-IWST-MRKR-	64	Industrial Waste: marker
	D-IWST-NLZR-	64	Industrial Waste: neutralizer
	D-IWST-OWTR-SPTR-	64	Industrial Waste: oil-water separator
	D-IWST-PIPE-	64	Industrial Waste: piping

Discipline Group	Layer Name	Old DEN Layer	Description
	D-IWST-PIPE-CNTR-	64	Industrial Waste: piping centerline
	D-IWST-PLNT-	64	Industrial Waste: treatment plant
	D-IWST-PUMP-	64	Industrial Waste: pump
	D-IWST-PUMP-STAT-	64	Industrial Waste: pump station
	D-IWST-RCTF-	64	Industrial Waste: rectifier
	D-IWST-STOR-	64	Industrial Waste: storage
	D-IWST-TANK-	64	Industrial Waste: tank
	D-IWST-VALV-	64	Industrial Waste: valve
Structural			
	S-CSSN-	34	Caissons/Text
	S-DBLT-	34	Double Ts/Text
	S-TENS-POST-	34	Post Tension Strands/Text
	S-PTRN-	34	Pneumatic Transport System
Survey/Mapping			
	V-AREA-EMER-	28	Emergency Services: medical area
	V-AREA-EMER-MGMT-	28	Emergency Services: management area
	V-NGAS-ANOD-	71	Natural Gas System: anode
	V-NGAS-ANOD-TEST-	71	Natural Gas System: anode test site
	V-NGAS-CNCT-	71	Natural Gas System: connection (fittings, transitions, etc.)
	V-NGAS-FILL-	71	Natural Gas System: fill point
	V-NGAS-FLOW-	71	Natural Gas System: flow arrow
	V-NGAS-JNCT-	71	Natural Gas System: junction point
	V-NGAS-MRKR-	71	Natural Gas System: marker
	V-NGAS-PUMP-SAT-	71	Natural Gas System: pump station
	V-NGAS-RCTF-	71	Natural Gas System: rectifier
	V-NGAS-RGLR-	71	Natural Gas System: regulator
	V-NGAS-SRCE-	71	Natural Gas System: source
	V-NGAS-TANK-	71	Natural Gas System: storage tanks
	V-PROP-FIRE	28	Boundary: fire department area
	V-SSWR-PIPE-CNTR-	59	Sanitary Sewer: piping centerline
	V-STRM-PIPE-CNTR	79	Storm Sewer: piping centerline
	V-TOPO-QRRY-	28	Topographic Feature: quarry
	V-TOPO-RFNY-	28	Topographic Feature: refinery
	V-TOPO-WETL-CNTR-	28	Topographic Feature: Wetlands: centerline

End of Chapter

Chapter 3 - FAA AGIS Features and Associated Layers

The following provides the list of layers for each FAA feature class (e.g., Airfield Light, Flood Zone, etc.) within each feature group (e.g., Airfield, Environmental, etc.). The FAA's database is designed to recognize certain feature types and layer names based on the information required in AC 150/5300-18B. While several feature classes have multiple layers used within the CADD platform, the FAA's AGIS database only recognizes one layer per feature class. Therefore, each layer within a feature class must be converted to a single layer name representing the feature class. For example, all the layers used for an Airfield Light in design drawings to provide the detail necessary (e.g., "E-LITE-APRC", "E-LITE-OBST", etc.) will be converted to a single layer named "AirfieldLight". Refer to AC 150/5300-18B for additional information.

The following abbreviations are used in the FAA layer list:

Abbreviation	Definition
3D	3D Line
FT	Feature Type
L	Line
P	Point
PG	Polygon

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
Airfield				
Aircraft Gate Stand	P	C-APRN-ACPK	93	Aircraft Parking Zone
Aircraft Non-Movement Area	L	C-AFLD-NMOV	76	Airfield Non-Movement Area
	L	C-APRN-NMOV	76	Apron Non-Movement Area
Air Operations Area	PG	C-AFLD-AOA-	76	Air Operations Area (AOA)
Airfield Light	P	E-LITE-APRC	86-91	Approach Lights
	P	E-LITE-DIST-	86-91	Distance/Arresting Gear Markers and Lights
	P	E-LITE-LANE-	86-91	Hoverlane, Taxilane, Helipad Lights
	P	E-LITE-OBST-	86-91	Obstruction Lights
	P	E-LITE-RUNW-CNTR	86-91	Runway Centerline Lights
	P	E-LITE-RUNW-DTGS	86-91	Runway Distance-To-Go Lights
	P	E-LITE-RUNW-EDGE	86-91	Runway Edge Lights
	P	E-LITE-RUNW-GARD	86-91	Runway Guard Lights
	P	E-LITE-RUNW-TDZN	86-91	Runway Touchdown Zone Lights
	P	E-LITE-SIGN-	86-91	Guidance Signs
	P	E-LITE-TAXI-CNTR	86-91	Taxiway Centerline Lights
	P	E-LITE-TAXI-EDGE	86-91	Taxiway Edge Lights
	P	E-LITE-THRS-	86-91	Threshold Lights
	P	V-LITE-APRC-	86-91	Approach Lights

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	V-LITE-LANE-	86-91	Hoverlane, Taxilane, Helipad Lights
	P	V-LITE-OBST-	86-91	Obstruction Lights
	P	V-LITE-RUNW-	86-91	Runway Lighting
	P	V-LITE-RUNW-CNTR	86-91	Runway Centerline Lights
	P	V-LITE-RUNW-TDZN	86-91	Runway Touchdown Zone Lights
	P	V-LITE-TAXI-	86-91	Taxiway Lights
	P	V-LITE-THRS-	86-91	Threshold Lights
Arresting Gear	L	C-RUNW-ARST-GEAR	34	Runway Arresting Gear Cable Locations
Frequency Area	PG	C-AFLD-FREQ-	76	Airfield Frequency Area
Passenger Loading Bridge	P	C-AFLD-JETB-	94	Airport Jetbridge
Runway Centerline	L	C-RUNW-CNTR-	45/46	Runway Centerline
Runway Helipad Design Surface	PG	C-AFLD-DSRF-BLRN-	76	Building Restriction Line
	PG	C-AFLD-DSRF-FATO-	76	Final Approach and Takeoff Clearance
	PG	C-AFLD-DSRF-HELI-	76	Helipad Design Surface
	PG	C-AFLD-DSRF-IOFZ	76	Inner Approach and Transitional Object Free Zones
	PG	C-AFLD-DSRF-KEYH-	76	Key Holes
	PG	C-AFLD-DSRF-POFZ-	76	Precision Object Free Zone
	PG	C-AFLD-DSRF-ROFZ-	76	Object Free Zone
	PG	C-AFLD-DSRF-ROFA-	76	Object Free Area
	PG	C-AFLD-DSRF-RPZ-	76	Runway Protection Zone
	PG	C-AFLD-DSRF-RSA-	76	Runway Safety Area
	PG	C-AFLD-DSRF-TOFA	76	Taxiway Object Free Area
	PG	C-AFLD-DSRF-TSA	76	Taxiway Safety Area
	PG	C-AFLD-DSRF-TSS	76	Threshold Siting Surface
	PG	C-RUNW-CLRW-	76	Runway Clearway
Runway Intersection	PG	C-RUNW-INTS	47/48	Runway Intersection
Runway LAHSO	L	C-RUNW-LHSO-	49	Runway Land And Hold Short Area
Runway Element	PG	C-RUNW-SEGM-	47/48	Runway Segment
Stopway	PG	C-RUNW-MRKG-STWY-	49	Runway Stopway Marking
Taxiway Holding Position	L	C-TAXI-MRKG-HOLD-	49	Taxiway Holding Position Lines
Airport Sign	P	A-BLDG-SIGN-	88	Signage (Other than surface painted)
	P	A-FLOR-SIGN-	88	Signage (Other than surface painted)
	P	C-PVMT-SIGN-	49/88	Other Sign

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	V-SIGN-DIST-	88	Distance and Arresting Gear Markers
	P	V-STRM-SIGN	82-85	Storm Sewer Surface Markers/Signs
	P	C-NGAS-SIGN-	71	Natural Gas Surface Markers/Signs
	P	C-APRN-SIGN-	49	Airfield Signs on the Apron
	P	C-SSWR-SIGN-	82-85	Sanitary Sewer Surface Markers/Signs
	P	C-STRM-SIGN-	82-85	Storm Sewer Surface Markers/Signs
	P	V-TAXI-SIGN-	88	Taxiway Guidance Signs
	P	C-TAXI-SIGN	82-85	Airfield Signs on the Taxiway (Taxiway Designator, Hold Short, Direct Signals, etc…)
	P	V-NGAS-SIGN-	71	Natural Gas Surface Markers/Signs
	P	V-SSWR-SIGN-	82-85	Sanitary Sewer Surface Markers/Signs
	P	E-SPCL-TRAF-	53/55	Traffic Signal System
	P	V-SPCL-TRAF-	53/55	Traffic Signal System
	P	C-RUNW-SIGN-	88	Airfield Signs on the Runway (Distance Remaining Signs, etc…)
Apron	PG	C-APRN-OTLN	47/48	Apron Outline
Deicing Area	PG	C-APRN-DICE	75	Aircraft Deicing Area
Touch Down Lift Off	PG	C-HELI-TLOF	76	Helipad Take Off and Landing Area
Marking Area	PG	C-HELI-MRKG-IDEN-	49	Heliport Numbers and Letters
	PG	C-HELI-MRKG-TDZM-	49	Touchdown Zone Markings
	PG	C-RUNW-MRKG-DIST-	49	Fixed Distance Markings
	PG	C-RUNW-IDEN	49	Runway Numbers and Letters
	PG	C-RUNW-MRKG-TDZM-	49	Touchdown Zone Markers
Marking Line	3D	C-APRN-MRKG-	49	Apron Markings
	3D	C-APRN-MRKG-CNTR-	45/46/49	Apron Centerlines
	3D	C-APRN-MRKG-HOLD-	49	Apron Holding Position Markings
	3D	C-APRN-MRKG-SECR-	49	Security Zone Markings
	3D	C-APRN-MRKG-SHLD-	49	Apron Shoulder Stripes
	3D	C-HELI-MRKG-BLST-	49	Helipad Blast Pad and Stopway Markings
	3D	C-HELI-MRKG-CNTR-	45/46/49	Helipad Centerlines

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	3D	C-HELI-MRKG-DIST-	49	Helipad Fixed Distance Markings
	3D	C-OVRN-MRKG-CNTR-	45/46/49	Overrun Centerlines
	3D	C-OVRN-MRKG-SHLD-	49	Shoulder Markings
	3D	C-PADS-MRKG-CNTR-	49	Pad - Centerline
	3D	C-PADS-MRKG-OTLN-	49	Pad - Outlines
	3D	C-ROAD-MRKG-WHIT	49	Roadway Markings (White)
	3D	C-ROAD-MRKG-YELO	49	Roadway Markings (Yellow)
	3D	C-RUNW-MRKG-CNTR	45/46	Centerline Markings
	3D	C-RUNW-MRKG-SHLD-	49	Runway Shoulder Marking
	3D	C-RUNW-MRKG-SIDE-	49	Side Stripes
	3D	C-TAXI-MRKG-CNTR	45/46	Centerline Markings
	3D	C-TAXI-MRKG-EDGE-	49	Edge Markings
	3D	C-TAXI-MRKG-SHLD-	49	Shoulder Transverse Stripe
	3D	V-PVMT-MRKG-	49	Pavement Markings
Movement Area	L	C-AFLD-SECR-	76	Airfield Security Area
Runway	PG	C-RUNW-EDGE	47/48	Airfield Runway Edges
Restricted Access Boundary	L	C-AFLD-SECR-RSTR	76	Restricted Access Boundary
Runway Arresting Area	PG	C-RUNW-ARST-EMAS	47/48	Runway Arresting Area
Runway Blast Pad	PG	C-RUNW-BLST	47/48	Runway Blast Pad
Runway End	P	C-RUNW-ENDP-	27	Runway Endpoint
Runway Label	PG	C-RUNW-MRKG-IDEN	49	Runway Numbers and Letters
Runway Safety Area Boundary	PG	C-RUNW-RSA-	76	Runway Safety Area
Shoulder	PG	C-HELI-SHLD-	51	Shoulder
	PG	C-PADS-SHLD-	51	Shoulders with Annotation
Taxiway Intersection	PG	C-TAXI-INTS	47/48	Taxiway Intersection
Taxiway Element	PG	C-TAXI-EDGE	47/48	Airfield Taxiway Edges
Airspace				
Landmark Segment	L	C-AIRS-LNDM	34/35/39/58	Landmark Segment
Obstacle	PG	C-AIRS-OBST-LINE	34	Obstacle: Airfield Obstruction (Line)
	PG	C-AIRS-OBST-PPNT	34	Obstacle: Airfield Obstruction (Point)

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
Obstruction Area	PG	C-AIRS-OBST-POLY	34	Obstacle: Airfield Obstruction (Area)
Obstruction Identification Surface	PG	C-AIRS-AAAS-APRC	76	Approach Surface
	PG	C-AIRS-AAAS-CONL	76	Conical Surface
	PG	C-AIRS-AAAS-HORZ	76	Horizontal Surface
	PG	C-AIRS-AAAS-PRIM	76	Primary Surface
	PG	C-AIRS-AAAS-TRNS	76	Transitional Surface
	PG	C-AIRS-AAAS-VERT	76	Vertical Guidance Protection Surface
	PG	C-AIRS-OEIA	76	One Engine Inoperative Analysis
	PG	C-AIRS-OTHR	76	Other Airspace Surfaces
	PG	C-AIRS-PART-APRC	76	14CFR Part77 - Approach Surface
	PG	C-AIRS-PART-CONL	76	14CFR Part77 - Conical Surface
	PG	C-AIRS-PART-HORZ	76	14CFR Part77 - Horizontal Surface
	PG	C-AIRS-PART-PRIM	76	14CFR Part77 - Primary Surface
	PG	C-AIRS-PART-TRNS	76	14CFR Part77 - Transitional Surface
	PG	C-AIRS-TERP	76	TERPS Surfaces
	PG	C-AIRS-TERP-DEPT	76	TERPS Surfaces: Departure Analysis
Runway Protection Area	PG	C-RUNW-CLRW-PROT	76	Runway Protection Area
Cadastral				
Airport Boundary	PG	C-PROP-LINE-	25	Airport Property
Airport Parcel	PG	V-PROP-AFLD-LINE-	25	Property Lines (Existing Recorded Plats)
	PG	V-PROP-QTRS-	25	Quarter Lines
	PG	V-PROP-SECT-	25	Section Lines
	PG	V-PROP-SXTS-	25	Sixteenth Lines (40 Lines)
County	PG	V-PROP-CNTY-	25	County Boundary
Easements And Right Of Ways	PG	V-ESMT-ACCS	29/30	Access (pedestrian only; private access)
	PG	C-ESMT-ACCS	29/30	Access (pedestrian only; private access)
	PG	V-ESMT-CATV	29/30	Cable Television System
	PG	C-ESMT-CATV	29/30	Cable Television System
	PG	V-ESMT-CONS	29/30	Conservation
	PG	C-ESMT-CONS	29/30	Conservation
	PG	V-ESMT-CSTG	29/30	Construction/Grading
	PG	C-ESMT-CSTG	29/30	Construction/Grading
	PG	V-ESMT-ELEC	29/30	Electrical

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	PG	C-ESMT-ELEC	29/30	Electrical
	PG	V-ESMT-FDPL	29/30	Flood Plain
	PG	C-ESMT-FDPL	29/30	Flood Plain
	PG	V-ESMT-INEG	29/30	Ingress / Egress (vehicles; private access)
	PG	C-ESMT-INEG	29/30	Ingress / Egress (vehicles; private access)
	PG	V-ESMT-LSCP	29/30	Landscape
	PG	C-ESMT-LSCP	29/30	Landscape
	PG	V-ESMT-NGAS	29/30	Natural Gas Line
	PG	C-ESMT-NGAS	29/30	Natural Gas Line
	PG	V-ESMT-RWAY	29/30	Right of Way (public access)
	PG	C-ESMT-RWAY	29/30	Right of Way (public access)
	PG	V-ESMT-ROAD	29/30	Roadway
	PG	C-ESMT-ROAD	29/30	Roadway
	PG	V-ESMT-ROAD-PERM	29/30	Roadway: Permanent
	PG	C-ESMT-ROAD-PERM	29/30	Roadway: Permanent
	PG	V-ESMT-ROAD-TEMP	29/30	Roadway: Temporary
	PG	C-ESMT-ROAD-TEMP	29/30	Roadway: Temporary
	PG	V-ESMT-SSWR	29/30	Sanitary Sewer
	PG	C-ESMT-SSWR	29/30	Sanitary Sewer
	PG	V-ESMT-SGHT	29/30	Sight Distance
	PG	C-ESMT-SGHT	29/30	Sight Distance
	PG	V-ESMT-STRM	29/30	Storm Sewer
	PG	C-ESMT-STRM	29/30	Storm Sewer
	PG	V-ESMT-SWMT	29/30	Storm Water Management
	PG	C-ESMT-SWMT	29/30	Storm Water Management
	PG	V-ESMT-PHON	29/30	Telephone Line
	PG	C-ESMT-PHON	29/30	Telephone Line
	PG	V-ESMT-TRAL	29/30	Trail or Path (public access)
	PG	C-ESMT-TRAL	29/30	Trail or Path (public access)
	PG	V-ESMT-UTIL	29/30	Utility Lines
	PG	C-ESMT-UTIL	29/30	Utility Lines
	PG	V-ESMT-WATR	29/30	Water Supply
	PG	C-ESMT-WATR	29/30	Water Supply
FAA Region Area	PG	C-AFLD-FAAR-	76	FAA Region
Land Use	PG	V-PROP-LUSE-	28	Land Use Area
Lease Zone	PG	V-PROP-LEAS-	24	Lease Line (Surveyed)
	PG	A-PROP-LEAS-	24	Lease Line(Exterior / Ground Lease)

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	PG	C-PROP-LEAS-	24	Lease Line (Interior)
Municipality	PG	V-PROP-MUNI-	25	Municipal Boundary
Parcel	PG	V-PROP-LINE-	25	Property Lines (Existing Recorded Plats)
State	PG	V-PROP-STAT-	25	State Boundary
Zoning	PG	V-PROP-ZONE-	25	Zoning Areas
Environmental				
Environmental Contamination Area	PG	H-POLL-CONC-	28	Polluted Area of Concern
	PG	H-POLL-POTN-	28	Potential Spill, Emission, or Release Source
Fauna Hazard Area	PG	V-TOPO-SPEC-	33	Species Site
Flood Zone	PG	C-FLHA	28	Flood Zone
	PG	C-FLHA-100Y	28	Flood Zone: 200 Year Mark
	PG	C-FLHA-200Y	28	Flood Zone: 100 Year Mark
	PG	C-FLHA-025Y	28	Flood Zone: 25 Year Mark
	PG	C-FLHA-050Y	28	Flood Zone: 50 Year Mark
Flora Species Site	P	L-PLNT	33	Planting Plants
	P	L-PLNT-CTNR-	33	Containers or Planters
	P	L-PLNT-TREE-	33	Trees (Evergreen, deciduous, etc…)
Forest Stand Area	PG	L-AREA-GRAS-	33	Grass Sod
	PG	L-PLNT-BEDS-	33	Planting Beds
	PG	L-PLNT-BUSH-	33	Bushes and Shrubs
	PG	L-PLNT-BUSH-LINE	33	Bushes and Shrub Line
	PG	L-PLNT-GCVR-	33	Groundcover and Vines
	PG	L-PLNT-MLCH-	33	Mulches - Organic and Inorganic
	PG	L-PLNT-SPRG-	33	Sprigs
	PG	L-PLNT-TREE-LINE	33	Tree Line
	PG	L-PLNT-TURF-	33	Lawn Areas (Turfing Limits)
	PG	V-AREA-VEGE-	33	Existing Tree Line and Vegetation
HazMat Storage Site	P	H-SITE-STOR-HAZM-	27	Hazardous Materials
	P	H-SITE-STOR-HAZW-	27	Hazardous Waste
Noise Contour	PG	C-TOPO-AUZN-	76	Noise Contour Zone
Noise Incident	P	C-TOPO-AUCO-	27	Noise Complaint
Noise Monitoring Point	P	C-TOPO-AUST-	34	Noise Monitoring Station
Sample Collection Point	P	H-SAMP-AIR~-	27	Air Samples
	P	H-SAMP-BORE-	27	Boring Locations
	P	H-SAMP-BIO~-	27	Biological Samples
	P	H-SAMP-GWTR-	27	Ground Water Samples

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	H-SAMP-SEDI-	27	Sediment Samples
	P	H-SAMP-SOIL-	27	Soil Samples
	P	H-SAMP-SOLI-	27	Solid Material Samples
	P	H-SAMP-SWTR-	27	Surface Water Samples
	P	H-SAMP-WAST-	27	Waste Samples
	P	V-TOPO-BORE-	27	Boring Locations
Shoreline	PG	C-TOPO-OHWM-	28	Ordinary High Water Marks
	PG	C-TOPO-SHOR-	28	Shorelines, Land Features, and References
	PG	H-MNST-WATR-GRND	28	Ground Water
	PG	H-MNST-SWTR-	28	Surface Water
	PG	C-TOPO-WATR-SURF	28	Water Surface
	PG	V-SITE-EWAT-	28	Water Features
	PG	V-SITE-WATR-	28	Water Features
	PG	V-TOPO-SHOR-	28	Shorelines, Land Features, and References
Wetland	PG	V-TOPO-WETL	28	Wetland
Geospatial				
Airport Control Point	P	C-RUNW-ELEV-INTS	27	Runway Centerline Elevation at Intersection
	P	C-RUNW-ELEV-CNTR	27	Airport Elevation
	P	C-RUNW-ELEV-PERP	27	Centerline Perpendicular Points For NAVAIDS
	P	C-RUNW-ELEV-DISP-	27	Runway Centerline Elevation Point At Displaced Threshold
	P	C-RUNW-ELEV-STWY	27	Runway Centerline Elevation Point At Stopway or Blastpad Ends
	P	C-RUNW-ELEV-PROF	27	Runway Centerline Profile Elevation Point
	P	C-RUNW-ELEV-TDZE	27	Runway Centerline Elevation Point At Touchdown Zone
	P	V-SURV-DATA-PACS-	27	Primary Airport Control Stations (PACs)
	P	V-SURV-DATA-SACS-	27	Secondary Airport Control Stations (SACs)
Coordinate Grid Area	L	C-DETL-GRPH-	8/26	Graphics, Gridlines, Non-Text Items
	L	C-GRID-FRAM-	8/26	Frame (Bounding Frame Of An Area Referenced By A Grid)
	L	C-GRID-MAJR-	8/15	Major Grid Lines
	L	C-GRID-MINR-	8/16	Minor Grid Lines
	L	S-GRID-HORZ-	8/26	Primary Grid Lines (Horizontal)
	L	S-GRID-MSC1-	8/26	Miscellaneous Grid Lines (Type 1)

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	L	S-GRID-MSC2-	8/26	Miscellaneous Grid Lines (Type 2)
	L	S-GRID-MSC3-	8/26	Miscellaneous Grid Lines (Type 3)
	L	S-GRID-MSC4-	8/26	Miscellaneous Grid Lines (Type 4)
	L	S-GRID-VERT-	8/26	Primary Grid Lines (Vertical)
	L	V-GRID-FRAM-	8/26	Frame
	L	V-GRID-MAJR-	8/15	Major Grid Lines
	L	V-GRID-MINR-	8/16	Minor Grid Lines
Elevation Contour	L	C-TOPO-MAJR-	32/44	Major Contours
	L	C-TOPO-MINR-	31/44	Minor Contours
	L	V-TOPO-MAJR-	32/44	Major Contours
	L	V-TOPO-MAJR-IDEN	32/44	Major Contours
	L	V-TOPO-MINR-	31/44	Minor Contours
	L	V-TOPO-MINR-IDEN	31/44	Minor Contours
	L	C-TOPO-MINR-ONEF	31/44	1 Foot Minor Contours
	L	C-TOPO-MINR-TWOF	31/44	2 Foot Minor Contours
Image Area	PG	V-AERI-BNDY-	28	Aerial Photograph Boundaries
Man Made Structures				
Building	PG	A-BLDG-OTLN-	39/135	Building Outline
	PG	C-BLDG-OTLN-	39/135	Buildings and Other Structures
	PG	G-PLAN-OTLN-	39/135	Floor Outline/Perimeter/Building Footing
	PG	H-BLDG-OTLN-	39/135	Command Posts, Information Centers
	PG	M-BLDG-OTLN-	39/135	Building Outline
	PG	V-BLDG-OTLN-	39/135	Buildings and Other Structures
Construction Area	PG	A-AREA-BNDY-DEMO	17	Demolition
	PG	A-AREA-BNDY-DEMO-1	17	Demolition Phase 1
	PG	A-AREA-BNDY-DEMO-2	17	Demolition Phase 2
	PG	A-AREA-BNDY-DEMO-3	17	Demolition Phase 3
	PG	A-AREA-BNDY-F	17	Future Work
	PG	A-AREA-BNDY-N	17	New Work
	PG	A-AREA-BNDY-T	17	Temporary Work
	PG	C-LOCN-	17	Construction Limits/Controls, Staging Area
	PG	C-AREA-BNDY-DEMO	17	Demolition
	PG	C-AREA-BNDY-DEMO-1	17	Demolition Phase 1
	PG	C-AREA-BNDY-DEMO-2	17	Demolition Phase 2

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	PG	C-AREA-BNDY-DEMO-3	17	Demolition Phase 3
	PG	C-AREA-BNDY-F	17	Future Work
	PG	C-AREA-BNDY-N	17	New Work
	PG	C-AREA-BNDY-T	17	Temporary Work
	PG	E-AREA-BNDY-DEMO	17	Demolition
	PG	E-AREA-BNDY-DEMO-1	17	Demolition Phase 1
	PG	E-AREA-BNDY-DEMO-2	17	Demolition Phase 2
	PG	E-AREA-BNDY-DEMO-3	17	Demolition Phase 3
	PG	F-AREA-BNDY-DEMO	17	Demolition
	PG	F-AREA-BNDY-DEMO-1	17	Demolition Phase 1
	PG	F-AREA-BNDY-DEMO-2	17	Demolition Phase 2
	PG	F-AREA-BNDY-DEMO-3	17	Demolition Phase 3
	PG	F-AREA-BNDY-F	17	Future Work
	PG	F-AREA-BNDY-N	17	New Work
	PG	F-AREA-BNDY-T	17	Temporary Work
	PG	G-SITE-OTLN-	20	Site Plan - Key Map
	PG	H-AREA-BNDY-DEMO-1	17	Demolition Phase 1
	PG	H-AREA-BNDY-DEMO-2	17	Demolition Phase 2
	PG	H-AREA-BNDY-DEMO-3	17	Demolition Phase 3
	PG	L-AREA-BNDY-DEMO	17	Demolition
	PG	L-AREA-BNDY-DEMO-1	17	Demolition Phase 1
	PG	L-AREA-BNDY-DEMO-2	17	Demolition Phase 2
	PG	L-AREA-BNDY-DEMO-3	17	Demolition Phase 3
	PG	L-AREA-BNDY-F	17	Future Work
	PG	L-AREA-BNDY-N	17	New Work
	PG	L-AREA-BNDY-T	17	Temporary Work
	PG	M-AREA-BNDY-DEMO	17	Demolition
	PG	M-AREA-BNDY-DEMO-1	17	Demolition Phase 1
	PG	M-AREA-BNDY-DEMO-2	17	Demolition Phase 2

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	PG	M-AREA-BNDY-DEMO-3	17	Demolition Phase 3
	PG	M-AREA-BNDY-F	17	Future Work
	PG	M-AREA-BNDY-N	17	New Work
	PG	M-AREA-BNDY-T	17	Temporary Work
	PG	P-AREA-BNDY-NGAS-	71	Natural Gas Piping
	PG	P-AREA-BNDY-DEMO	17	Demolition
	PG	P-AREA-BNDY-DEMO-1	17	Demolition Phase 1
	PG	P-AREA-BNDY-DEMO-2	17	Demolition Phase 2
	PG	P-AREA-BNDY-DEMO-3	17	Demolition Phase 3
	PG	P-AREA-BNDY-F	17	Future Work
	PG	P-AREA-BNDY-N	17	New Work
	PG	P-AREA-BNDY-T	17	Temporary Work
	PG	S-AREA-BNDY-DEMO	17	Demolition
	PG	S-AREA-BNDY-DEMO-1	17	Demolition Phase 1
	PG	S-AREA-BNDY-DEMO-2	17	Demolition Phase 2
	PG	S-AREA-BNDY-DEMO-3	17	Demolition Phase 3
	PG	S-AREA-BNDY-F	17	Future Work
	PG	S-AREA-BNDY-N	17	New Work
	PG	S-AREA-BNDY-T	17	Temporary Work
	PG	T-AREA-BNDY-DEMO-1	17	Demolition Phase 1
	PG	T-AREA-BNDY-DEMO-2	17	Demolition Phase 2
	PG	T-AREA-BNDY-DEMO-3	17	Demolition Phase 3
	PG	V-AREA-BNDY-DEMO	17	Demolition
	PG	V-AREA-BNDY-F	17	Future Work
	PG	V-AREA-BNDY-N	17	New Work
	PG	V-AREA-BNDY-T	17	Temporary Work
Roof	PG	A-ROOF-OTLN	39	Roof Outline
Fence	L	C-FENC-	41	Fencing
	L	C-FENC-SECR	40	Security Fence
	L	C-FENC-HAND	41	Handrails
	L	L-FENC-	41	Fencing
	L	S-FENC-SAFE	41	Fencing
	L	V-FENC-	41	Fences and Handrails

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
Gate	L	L-GATE-	41	Gate
	L	C-SITE-GATE-	41	Gate – Opening in Fence or Other Barrier between Areas
	L	C-FENC-GATE-CTLA	40	Gates Along Fences or Other Barriers Intended to Restrict Access
Tower	P	C-STRC-TOWR-	34	Tower
	P	E-STRC-TOWR-GUYS-	34	Guy Equipment
	P	V-STRC-TOWR-GUYS-	34	Guy Equipment
	P	V-STRC-TOWR-	34	Tower
Navigational Aids				
NAVAID Critical Area	PG	C-AFLD-AIDS-CRIT	76	Airfield Navigational Aid - Critical Area
NAVAID Equipment	P	C-AFLD-AIDS-APBN	91	Airport Beacon
	P	C-AFLD-AIDS-ASR	92	Airport Surveillance Radar
	P	C-AFLD-AIDS-ARSR	92	Air Route Surveillance Radar
	P	C-AFLD-AIDS-ALS	91	Approach Light System
	P	C-AFLD-AIDS-BCM	92	Back Course Marker
	P	C-AFLD-AIDS-DME	92	Distance Measuring Equipment
	P	C-AFLD-AIDS-EFGS	92	End Fire Type Glide Slope
	P	C-AFLD-AIDS-FM	92	Fan Marker
NAVAID Equipment	P	C-AFLD-AIDS-GS	92	Glide Slope
	P	C-AFLD-AIDS-GCA	92	Ground Control Approach - Touchdown Reflectors
	P	C-AFLD-AIDS-IM	92	Inner Marker
	P	C-AFLD-AIDS-LOC	92	Localizer
	P	C-AFLD-AIDS-LDA	92	Localizer Type Directional Aid
	P	C-AFLD-AIDS-MM	92	Middle Marker
	P	C-AFLD-AIDS-MLSA	92	MLS Azimuth Antenna
	P	C-AFLD-AIDS-MLSE	92	MLS Elevation Antenna
	P	C-AFLD-AIDS-NDB	92	Non-Directional Beacon
	P	C-AFLD-AIDS-OM	92	Outer Marker
	P	C-AFLD-AIDS-PAPI	91	Precision Approach Path Indicator System
	P	C-AFLD-AIDS-PAR	92	Precision Approach Radar Touchdown Reflectors
	P	C-AFLD-AIDS-PASI	91	Pulse Light Approach Slope Indicator System
	P	C-AFLD-AIDS-PVAS	91	Pulsating Visual Approach Slope Indicator
	P	C-AFLD-AIDS-REIL	91	Runway End Identifier Lights

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	C-AFLD-AIDS-SDF	92	Simplified Directional Facilities
	P	C-AFLD-AIDS-TACN	92	Tactical Air Navigational
	P	C-AFLD-AIDS-TRCV	91	Tricolor Visual Approach Slope Indicator System
	P	C-AFLD-AIDS-TVAS	91	T Visual Approach Slope Indicator System
	P	C-AFLD-AIDS-VOR	92	VHF Omni Directional Range
	P	C-AFLD-AIDS-VASI	91	Visual Approach Slope Indicator System
	P	C-AFLD-AIDS-VTAC	92	VOR/TACAN
NAVAID Site	PG	C-AFLD-AIDS-SITE	92	Airfield Navigational Aid - Site
Seaplane				
Water Operating Area	PG	C-SEAP-AREA-	78	Water Operating Area
Water Lane End	PG	C-SEAP-LNDA-	78	Seaplane Landing Area
Taxi Channel	PG	C-SEAP-TAXI-	78	Taxi Channel
Turning Basin	PG	C-SEAP-TBSN-	78	Turning Basin
Navigation Buoy	PG	C-SEAP-BUOY-	78	Seaplane Navigational Buoy
Seaplane Ramp Centerline	L	C-SEAP-RAMP-CNTR	45/46	Seaplane Ramp Centerline
Seaplane Ramp Site	PG	C-SEAP-RAMP-	34	Seaplane Ramp Site
Docking Area	PG	C-SEAP-DOCK-	34	Seaplane Dock
Anchorage Area	PG	C-SEAP-ANCH-	34	Seaplane Dock
Security				
Security Area	PG	C-SECR-SECA	76	An Area of the Airport in Which Security Measures Required by 49 CFR 1542.201
Security ID Display Area	PG	C-SECR-SIDA	76	Security Identification Display Area
Security Perimeter Line	PG	C-SECR-FENC	40	Security Fencing
Sterile Area	PG	C-SECR-STER	76	Sterile Area
Surface Transportation				
Bridge	PG	C-BRDG-STRC-	38	Bridges, Piers, Breakwaters, Docks, Floats, etc…
	PG	L-BRDG-PROF	38	Bridges - Profile
	PG	C-BRDG-EQPM	38	Bridge Cranes, Jib Cranes, and Monorails
	PG	V-BRDG-STRC-	38	Structures (Bridge, Sheds, Foundation Pads, Footings, etc…)
Driveway Area	PG	C-DRIV-ASPH	47/48	Driveway Edge of Pavement (Asphalt)

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	PG	V-DRIV-ASPH	47/48	Driveway Edge of Pavement (Asphalt)
	PG	C-DRIV-CONC	47/48	Driveway Edge of Pavement (Concrete)
	PG	V-DRIV-CONC	47/48	Driveway Edge of Pavement (Concrete)
	PG	C-DRIV-GRVL	47/48	Driveway Edge of Pavement (Gravel)
	PG	V-DRIV-GRVL	47/48	Driveway Edge of Pavement (Gravel)
	PG	C-DRIV-UPVD	47/48	Driveway Edge of Pavement (Unpaved)
	PG	V-DRIV-UPVD	47/48	Driveway Edge of Pavement (Unpaved)
Driveway Centerline	L	C-DRIV-CNTR	45/46	Driveway Centerline
	L	V-DRIV-CNTR	45/46	Driveway Centerline
Parking Lot	PG	C-PRKG-ISLD-	47/48	Parking Islands
	PG	C-PRKG-ASPH-	47/48	Parking Lots (Asphalt)
	PG	C-PRKG-CONC-	47/48	Parking Lots (Concrete)
	PG	C-PRKG-GRVL-	47/48	Parking Lots (Gravel)
	PG	C-PRKG-UPVD-	47/48	Parking Lots (Unpaved)
	PG	V-PRKG-ASPH-	47/48	Parking Lots (Asphalt)
	PG	V-PRKG-CONC-	47/48	Parking Lots (Concrete)
	PG	V-PRKG-GRVL-	47/48	Parking Lots (Gravel)
	PG	V-PRKG-UPVD-	47/48	Parking Lots (Unpaved)
Railroad Centerline	L	C-RAIL-CNTR-	45/46	Railroad Centerlines
	L	V-RAIL-CNTR-	45/46	Railroad Centerlines
	L	C-RAIL-TRAK-	34	Railroads
	L	V-RAIL-TRAK-	34	Railroads
Railroad Yard	PG	C-RAIL-YARD-	28	Railroad Yard
Road Centerline	L	C-ROAD-CNTR-	45/46	Roadway Centerlines
	L	V-ROAD-CNTR-	45/46	Roadway Centerlines
Road Point	P	C-ROAD-PNTS-	35	Road Point
Road Segment	PG	C-ROAD-CURB-BACK	50	Back of Curb
	PG	C-ROAD-CURB-FACE	50	Front of Curb
	PG	V-ROAD-CURB-	50	Curbs
	PG	C-ROAD-ASPH-	35	Roads (Asphalt)
	PG	V-ROAD-ASPH-	35	Roads (Asphalt)
	PG	C-ROAD-CONC-	35	Roads (Concrete)
	PG	V-ROAD-CONC-	35	Roads (Concrete)
	PG	C-ROAD-GRVL-	35	Roads (Gravel)
	PG	V-ROAD-GRVL-	35	Roads (Gravel)

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	PG	C-ROAD-UPVD-	35	Roads (Unpaved)
	PG	V-ROAD-UPVD-	35	Roads (Unpaved)
	PG	C-ROAD-PROF-	1-7	Roads Profile
	PG	V-ROAD-PROF-	1-7	Roads Profile
Sidewalk	PG	C-TRAL-ASPH	58	Pedestrian Trails & Bicycle Paths (Asphalt)
	PG	L-TRAL-ASPH	58	Pedestrian Trails & Bicycle Paths (Asphalt)
	PG	V-TRAL-ASPH	58	Pedestrian Trails & Bicycle Paths (Asphalt)
	PG	C-TRAL-CONC	58	Pedestrian Trails & Bicycle Paths (Concrete)
	PG	L-TRAL-CONC	58	Pedestrian Trails & Bicycle Paths (Concrete)
	PG	V-TRAL-CONC	58	Pedestrian Trails & Bicycle Paths (Concrete)
	PG	C-TRAL-GRVL	58	Pedestrian Trails & Bicycle Paths (Gravel)
	PG	L-TRAL-GRVL	58	Pedestrian Trails & Bicycle Paths (Gravel)
	PG	V-TRAL-GRVL	58	Pedestrian Trails & Bicycle Paths (Gravel)
	PG	C-TRAL-UPVD	58	Pedestrian Trails & Bicycle Paths (Unpaved)
	PG	L-TRAL-UPVD	58	Pedestrian Trails & Bicycle Paths (Unpaved)
	PG	V-TRAL-UPVD	58	Pedestrian Trails & Bicycle Paths (Unpaved)
	PG	C-SWLK-	50	Walks and Steps
	PG	L-SWLK-	50	Walks and Steps
	PG	V-SWLK-	50	Walks and Steps
Tunnel	PG	C-STRC-TUNL-	34	Tunnels
Utilities				
Tank Site	PG	C-SITE-TANK	34	Tank Site
Utility Line	L	C-FUEL-PIPE-ABND-	70/72/73	Abandoned Fueling Piping
	L	C-FUEL-PIPE-DEFL-	70/72/73	Defueling Piping
	L	C-FUEL-PIPE-MAIN-	70/72/73	Main Fueling Piping
	L	C-FUEL-PIPE-SVCE-	70/72/73	Service Piping
	L	C-FUEL-UGND-	70/72/73	Fuel Line Trench
	L	C-NGAS-PIPE-ABND-	71	Abandoned Natural Gas Piping
	L	C-NGAS-PIPE-MAIN-	71	Main Natural Gas Piping
	L	C-NGAS-PIPE-SVCE-	71	Natural Gas Service Piping
	L	C-PROF-PIPE-	1	– 7 Piping Profile

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	L	C-SSWR-PIPE-ABND-	59	Abandoned Sanitary Sewer Piping
	L	C-SSWR-PIPE-RCON-	59	Sanitary Sewer Piping (Reinforced Concrete)
	L	C-SSWR-PIPE-STEL-	59	Sanitary Sewer Piping (Steel)
	L	C-SSWR-PIPE-SVCE-	59	Sanitary Sewer Service Piping
	L	C-STRM-PIPE-ABND-	79	Abandoned Storm Sewer Piping
	L	C-STRM-HWAL-	79	Headwalls and End walls
	L	C-STRM-PIPE-CMTL-	79	Storm Sewer Piping (Corrugated Metal)
	L	C-STRM-PIPE-RCON-	79	Storm Sewer Piping (Reinforced Concrete)
	L	C-STRM-PIPE-SVCE-	79	Storm Sewer Service Piping
	L	C-STRM-PIPE-UGND-	79	Subsurface Drain Piping
	L	C-STRM-ROOF-	79	Roof Drain Line
	L	D-PIPE	34	Process Piping
	L	E-AFLD-DUCT-	90	Duct banks
	L	E-CABL-COAX-	69	Coax Cable
	L	E-CABL-FIBR-	69	Fiber Optics Cable
	L	E-CABL-MULT-	69	Multi-Conductor Cable
	L	E-CABL-TRAY-	69	Cable Trays and Wireways
	L	E-CIRC-CTRL-	27	Control and Monitoring Circuits
	L	E-CIRC-MULT-	69	Multiple Circuits
	L	E-CIRC-SERS-	69	Series Circuits
	L	E-COMM-OVHD-	66	Overhead Communications/Telephone Lines
	L	E-COMM-UGND-	67	Underground Communications/Telephone Lines
	L	E-DUCT-MULT-	90	Duct bank
	L	E-GRND-CIRC-	69	Ground System Circuits
	L	E-LITE-CIRC-	89	Lighting Circuits (Including Cross lines and Homeruns)
	L	E-POWR-CIRC-	89	Power Circuits (Including Cross lines and Homeruns)
	L	E-PRIM-OVHD-	66	Primary Overhead Electrical Utility Lines
	L	E-PRIM-UGND-	67	Primary Underground Electrical Utility Lines
	L	E-SECD-OVHD-	66	Secondary Overhead Electrical Utility Lines
	L	E-SECD-UNDR-	67	Secondary Underground Electrical Lines
	L	F-AFFF-PIPE-	61	Aqueous Film Forming Foam (AFFF) Piping

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	L	F-CO2S-PIPE-	61	CO2 Piping or CO2 Discharge Nozzle Piping
	L	F-HALN-PIPE-	61	Halon Piping
	L	F-IGAS-PIPE-	61	Inert Gas Piping
	L	F-PROT-HOSE-	61	Fire Hose
	L	F-SPKL-PIPE-	61	Sprinkler Piping
	L	F-WATR-PIPE-	61	Piping
	L	L-DETL-WIRE-	7-Jan	Wiring
	L	L-IRRG-PIPE-LTRL	81	Irrigation Piping (Lateral)
	L	L-IRRG-PIPE-MAIN	81	Irrigation Piping (Main)
	L	M-AFRZ-PIPE-	34	Anti-Freeze Piping
	L	M-AFRZ-PIPE-WDSP-	34	Anti-Freeze Waste Piping
	L	M-BRIN-PIPE-	34	Brine System Piping
	L	M-CHEM-PIPE-	34	Chemical Piping (Includes Fittings, Valves)
	L	M-CMPA-PIPE-	34	Compressed/Processed Air System Piping
	L	M-CMPA-PIPE-CNTR-	34	Compressed/Processed Air System Piping centerline
	L	M-CNDS-PIPE-	34	Condensate Piping (Includes Fittings, Valves)
	L	M-CNDW-PIPE-RETN	34	Condenser Water Piping (Return)
	L	M-CNDW-PIPE-SPLY	34	Condenser Water Piping (Supply)
	L	M-COND-PIPE-	34	Condensate Piping
	L	M-CONT-WIRE-	34	Low Voltage Wiring
	L	M-CWTR-PIPE-RETN	62	Chilled Water System Return Piping (Includes Fittings, Valves)
	L	M-CWTR-PIPE-SPLY	62	Chilled Water System Supply Piping (Includes Fittings, Valves)
	L	M-DETL-PIPE-	7-Jan	Piping
	L	M-DETL-WIRE-	7-Jan	Electrical Wiring
	L	M-DUAL-PIPE-RETN	34	Duel Temperature Systems Return Piping (Includes Fittings, Valves)
	L	M-DUAL-PIPE-SPLY	34	Duel Temperature Systems Supply Piping (Includes Fittings, Valves)
	L	M-GTHP-PIPE-	34	Piping (Includes Fittings, Valves)
	L	M-HTCW-PIPE-ABND-	62/63	Abandoned Piping
	L	M-HTCW-PIPE-CHLL-	62/63	Hot & Cold Water – Main Chilled Water Piping
	L	M-HTCW-PIPE-CHWS-	62/63	Hot & Cold Water – CW Service Piping
	L	M-HTCW-PIPE-HTPL-	62/63	Main High Temperature Piping

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	L	M-HTCW-PIPE-HTPS-	62/63	High Temperature Service Piping
	L	M-HTCW-PIPE-LTPL-	62/63	Main Low Temperature Piping
	L	M-HTCW-PIPE-LTPS-	62/63	Low Temperature Service Piping
	L	M-HTCW-PIPE-STML-	62/63	Main Steam Piping
	L	M-HTCW-PIPE-STMS-	62/63	Steam Service Piping
	L	M-HVAC-DUCT-RETN-	34	Return Ductwork
	L	M-HVAC-DUCT-SPLY-	34	Supply Ductwork
	L	M-HYDR-PIPE-	34	Hydraulic System Piping
	L	M-INSL-PIPE-	34	Insulating Oil Piping
	L	M-LGAS-EQPM	34	Laboratory Gas Equipment
	L	M-LGAS-PIPE	34	Laboratory Gas Piping
	L	M-LUBE-PIPE-	34	Lubrication Oil Piping
	L	M-RCOV-PIPE-	34	Piping (Includes Fittings, Valves)
	L	M-REFG-PIPE-RETN	34	Refrigeration Return Piping (Includes Fittings, Valves)
	L	M-REFG-PIPE-SPLY	34	Refrigeration Supply Piping (Includes Fittings, Valves)
	L	M-RWTR-PIPE-	65	Raw Water Piping
	L	M-STEM-HPIP-	34	High-Pressure Steam Piping
	L	M-STEM-LPIP-	34	Low-Pressure Steam Piping
	L	M-STEM-MPIP-	34	Medium Pressure Steam Piping
	L	M-STEM-PIPE-BLBD-	34	Boiler Blow Down Piping
	L	M-STEM-PIPE-CNDS-	34	Steam Condensate Piping
	L	P-ACID-PIPE-	34	Acid, Alkaline, and Oil Waste Piping
	L	P-ACID-VENT-	34	Acid, Alkaline, and Oil Waste Vent Piping
	L	M-CMPA-PIPE-	34	Compressed/Processed Air System Piping
	L	V-PROF-PIPE-	34	Piping
	L	M-CMPA-PPIP-	34	Compressed/Processed Air System Process Piping
	L	P-FUEL-PIPE-FGAS-	70/72/73	Fuel Gas Piping
	L	P-FUEL-PIPE-FOIL-	70/72/73	Fuel Oil Piping
	L	P-LGAS-PIPE-	34	Laboratory Gas Piping
	L	P-MDGS-PIPE-	34	Piping
	L	P-SANR-PIPE-	34	Piping
	L	P-SANR-PIPE-CNDS-	34	Condensate Piping
	L	P-SANR-PIPE-VENT-	34	Vent Piping
	L	P-STRM-PIPE-	79	Storm Drain Piping
	L	T-CABL-TRAY-	69	Cable Trays and Wireways

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	L	V-AFLD-DUCT-	90	Duct banks
	L	V-CIRC-CTRL-	89	Control and Monitoring Circuits
	L	V-CIRC-MULT-	89	Multiple Circuits
	L	V-CIRC-SERS-	89	Series Circuits
	L	V-COMM-OVHD-	69	Overhead Communications/Telephone Lines
	L	V-COMM-UGND-	69	Underground Communications/Telephone Lines
	L	V-DUCT-MULT-	90	Duct bank
	L	V-ELEC-PRIM-OVHD	66	Primary Overhead Electrical Utility Lines
	L	V-ELEC-PRIM-UGND	67	Primary Underground Electrical Utility Lines
	L	V-ELEC-SECD-OVHD-	66	Secondary Overhead Electrical Utility Lines
	L	V-ELEC-SECD-UGND-	67	Secondary Underground Electrical Utility Lines
	L	V-ELEC-STRC-	96	Vaults
	L	V-FUEL-PIPE-ABND-	70/72/73	Abandoned Fueling Piping
	L	V-FUEL-PIPE-DEFL-	70/72/73	Defueling Piping
	L	V-FUEL-PIPE-MAIN-	70/72/73	Main Fueling Piping
	L	V-FUEL-PIPE-SVCE-	70/72/73	Service Piping
	L	V-FUEL-UGND-	70/72/73	Underground Fuel Systems
	L	V-GTHP-PIPE-	34	Piping (Includes Fittings, Valves)
	L	V-HTCW-PIPE-ABND-	62/63	Abandoned Piping
	L	V-HTCW-PIPE-CHLL-	62/63	Main Chilled Water Piping
	L	V-HTCW-PIPE-CHWS-	62/63	Chilled Water Service Piping
	L	V-HTCW-PIPE-HTPL-	62/63	Main High Temperature Piping
	L	V-HTCW-PIPE-HTPS-	62/63	High Temperature Service Piping
	L	V-HTCW-PIPE-LTPL-	62/63	Main Low Temperature Piping
	L	V-HTCW-PIPE-LTPS-	62/63	Low Temperature Service Piping
	L	V-HTCW-PIPE-STML-	62/63	Main Steam Piping
	L	V-HTCW-PIPE-STMS-	62/63	Steam Service Piping
	L	V-NGAS-PIPE-ABND-	71	Abandoned Natural Gas Piping
	L	V-SSWR-PIPE-ABND-	59	Abandoned Sanitary Sewer Piping
	L	V-SSWR-PIPE-MAIN-	59	Sanitary Sewer Piping
	L	V-SSWR-PIPE-SVCE	59	Sanitary Sewer Service Piping
	L	V-STRM-PIPE-ABND-	79	Abandoned Storm Sewer Piping
	L	V-STRM-PIPE-MAIN-	79	Storm Sever Piping
	L	V-STRM-PIPE-UGND	79	Subsurface Drain Piping
	L	V-UTIL-ELEC-	66/68/69	Power Lines, Telephone Poles, Communication Lines

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	L	V-UTIL-STEM-	34	Steam Lines
	L	V-UTIL-STRM-	79/80	Storm Sewer Lines, Culverts, Manholes, and Headwalls
	L	V-UTIL-WATR-	60	Water Lines, Hydrants, Tanks
Utility Point	P	C-FUEL-DEVC-	70/72/73	Air Eliminators, Filter Strainers, Hydrant Fill Points, Line Vents, Markers, Oil/Water Separators, Reducers, Regulators, and Valves
	P	C-FUEL-FTTG-	70/72/73	Caps, Crosses, and Tees
	P	C-FUEL-HYDT-	70/72/73	Hydrant Control Pits
	P	C-FUEL-INST-	70/72/73	Instrumentation (Meters, Valves, etc.)
	P	C-FUEL-JBOX-	70/72/73	Junction Box, Handholes, Test Boxes
	P	C-FUEL-MHOL-	70/72/73	Manholes, Hand holes, Test Boxes
	P	C-FUEL-PUMP-	70/72/73	Booster Pump Stations
	P	C-FUEL-TANK-	70/72/73	Fuel Tanks
	P	C-FUEL-VALV-	70/72/73	Valve Pits
	P	C-FUEL-VENT-	70/72/73	Vent Pits
	P	C-NGAS-DEVC-	71	Hydrant Fill Points, Lights, Vents, Markers, Rectifiers, Reducers, Regulators, Sources, Tanks, Drip Pots, Taps, and Valves
	P	C-NGAS-FTTG-	71	Caps, Crosses, and Tees
	P	C-NGAS-INST-	71	Instrumentation (Meters, Valves, etc.)
	P	C-NGAS-MHOL-	71	Manholes and Handholes
	P	C-NGAS-PUMP-	71	Compressor Stations
	P	C-NGAS-REDC-	71	Reducing Stations
	P	C-NGAS-VALV-	71	Valve Pits / Boxes
	P	C-NGAS-VENT-	71	Vent Pits
	P	C-SECR-EQPM	69	CMRA Security Camera Locations Outside of Buildings
	P	C-SSWR-DEVC	59	Grease Traps, Grit Chambers, Flumes, Neutralizers, Oil/Water Separators, Ejectors, and Valves
	P	C-SSWR-FILT	59	Filtration Beds
	P	C-SSWR-FTTG-	59	Caps and Cleanouts
	P	C-SSWR-JBOX-	59	Junction Boxes
	P	C-SSWR-MHOL-	59	Manholes
	P	C-SSWR-PUMP-	59	Booster Pump Stations
	P	C-SSWR-TANK-	59	Septic Tanks
	P	C-STRM-CULV-	80	Culverts

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	C-STRM-DEVC-	81	Downspouts, Flumes, Oil/Water Separators, and Flap Gates
	P	C-STRM-EROS-	81	Erosion Control (riprap)
	P	C-STRM-FMON-	81	Flow Monitoring System
	P	C-STRM-FTTG-	81	Caps and Cleanouts
	P	C-STRM-INLT-	81	Inlets (Curb, Surface, and Catch Basins)
	P	C-STRM-MHOL-	81	Manholes
	P	C-STRM-PUMP-	81	Pump Stations
	P	C-STRM-STRC-	81	Storm Drainage, Headwalls, Inlets Manhole, Culverts, and Drainage Structures
	P	D-PIPE-EQPM	34	Equipment
	P	E-AFLD-DEVC-	89	Capacitors, Voltage Regulators, Motors, Buses, Generators, Meters, Grounds, and Markers
	P	E-AFLD-JBOX-	87	Junction Boxes, Pull Boxes, Pedestals, Splices
	P	E-AFLD-MHOL-	87	Manholes
	P	E-CATH-ANOD-	34	Sacrificial Anode System
	P	E-CATH-CURR-	34	Impress Current System
	P	E-CATH-TEST-	34	Test Stations
	P	E-COMM-EQPM-	69	Other Communications Distribution Equipment
	P	E-COMM-JBOX-	69	Communications Junction Boxes, Pull Boxes, Manholes, Hand holes, Pedestals, and Splices
	P	E-COMM-MHOL-	69	Manholes and Hand holes
	P	E-ELEC-EQPM-	96	Other Substation Equipment
	P	E-ELEC-JBOX-	92	Junction Boxes, Pull Boxes, Pedestals, Splices
	P	E-ELEC-MHOL-	92	Manholes
	P	E-ELEC-STRC-	92	Vaults
	P	E-ELEC-SWCH-	96	Fuse Cutouts, Pole Mounted Switches, Circuit Breakers, Gang Operated Disconnects, Reclosers, Cubicle Switches
	P	E-GRND-EQUI-	34	Equipotential Ground System
	P	E-GRND-REFR-	34	Reference Ground System
	P	E-LITE-CLNG-	34	Ceiling Fixtures
	P	E-LITE-EMER	34	Emergency Fixtures
	P	E-LITE-EXIT	34	Exit Fixtures
	P	E-LITE-EXTR-	34	Exterior Lights
	P	E-LITE-JBOX-	34	Junction Boxes

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	E-LITE-SPCL-	34	Special Fixtures
	P	E-LITE-SWBD-	34	Main Distribution Panels, Switchboards, Lighting Fixtures
	P	E-LITE-SWCH-	34	Lighting Contractors, Photoelectric Controls, Low Voltage Control Systems, etc…
	P	E-LITE-WALL-	34	Wall Mounted Fixtures
	P	E-LTNG-COND-	34	Lighting Protection Conductors
	P	E-LTNG-TERM-	34	Lighting Protection Terminals
	P	E-POLE-UTIL-	34	Pole Utilities
	P	E-POWR-BUSW-	34	Bus ways and Wireways
	P	E-POWR-CABL-	34	Cable Trays
	P	E-POWR-FEED-	34	Feeders
	P	E-POWR-GENR-	34	Generators and Auxiliary Equipment
	P	E-POWR-JBOX-	34	Junction Boxes
	P	E-POWR-SWBD-	34	Panel boards, Switchboards, MCC, Unit Substations
	P	E-POWR-SWCH-	34	Disconnect Switches, Motor Starters, Contractors, etc…
	P	E-SNSR-UGND-	34	Buried Sensors
	P	E-SPCL-JBOX-	34	Junction Boxes
	P	E-SPCL-SNSR-SURF	34	Surface Sensor System
	P	E-SPCL-SWBD-	34	Panel boards, Backing Boards, Patch Panel Racks
	P	E-SPCL-SYST-	34	Special Systems (UMCS, EMCS, CATV, etc…)
	P	E-XFMR-PADM-	34	Pad Mounted Transformers
	P	E-XFMR-POLM-	34	Pole Mounted Transformer
	P	F-AFFF-EQPM-	34	AFFF Equipment
	P	F-ALRM-INDC-	34	Indicating Appliances
	P	F-ALRM-MANL-	34	Manual Fire Alarm Pull Stations
	P	F-ALRM-PHON-	69	Fire Service or Emergency Telephone Stations
	P	F-CO2S-EQPM-	34	Equipment
	P	F-CTRL-PANL-	34	Control Panels
	P	F-HALN-EQPM-	34	Halon Equipment
	P	F-IGAS-EQPM-	34	Inert Gas Equipment
	P	F-LITE-EMER-	34	Emergency Fixtures
	P	F-LITE-EXIT-	34	Exit Fixtures
	P	F-LSFT-EGRE-	34	Egress Requirements Designator
	P	F-LSFT-OCCP-	34	Occupant Load for Egress Capacity

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	F-WATR-CONN-	34	Fire Department Connections
	P	F-PROT-HYDT-	34	Hydrants
	P	F-WATR-PUMP-	34	Fire Pumps
	P	H-DECN-EQPM-	34	Decontamination Equipment
	P	H-DISP-TANK-	34	Spill Containment Tanks
	P	L-DETL-VALV-	7-Jan	Valves, Fittings
	P	L-IRRG-SPKL-	81	Sprinklers
	P	M-ACID-EQPM-	34	Acid, Alkaline, and Oil Waste Equipment
	P	M-BRIN-EQPM-	34	Brine System Equipment
	P	M-CHEM-EQPM-	34	Equipment
	P	M-CMPA-EQPM-	34	Compressed Air Equipment
	P	M-CMPA-PEQP-	34	Compressed/Processed Air Process Equipment
	P	M-CNDW-EQPM-	34	Condenser Water Equipment
	P	M-CONT-THER-	34	Thermostats, Controls, Instrumentation, and Sensors
	P	M-CWTR-EQPM-	62	Equipment
	P	M-DETL-BOIL-	7-Jan	Boilers
	P	M-DETL-COIL-	7-Jan	Coils and Fin Tubes
	P	M-DETL-DUCT-	7-Jan	Ducts
	P	M-DETL-EQPM-	7-Jan	Equipment and Fixtures
	P	M-DETL-FANS-	7-Jan	Fans
	P	M-DETL-PUMP-	7-Jan	Pumps and Compressor
	P	M-DETL-TANK-	7-Jan	Tanks
	P	M-DETL-TRAP-	7-Jan	Traps and Drains
	P	M-DETL-VALV-	7-Jan	Valves and Fittings
	P	M-DETL-VENT-	7-Jan	Vents
	P	M-DUAL-EQPM-	34	Equipment
	P	M-DUST-DUCT-	34	Dust and Fume Ductwork
	P	M-DUST-EQPM-	34	Dust and Fume Collection Equipment
	P	M-HTCW-CHLP-	62/63	Chilled Water Plant
	P	M-HTCW-DEVC-	62/63	Rigid Anchors, Anchor Guides, Rectifiers, Reducers, Markers, Meters, Pumps, Regulators, Tanks, and Valves
	P	M-HTCW-FTTG-	62/63	Caps and Flanges
	P	M-HTCW-HTPP-	62/63	High Temperature Water Plant
	P	M-HTCW-JBOX-	62/63	Junction Boxes, Manholes, Hand holes, Test Boxes

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	M-HTCW-PIPE-CHWS-	62/63	Chilled Water Service Piping
	P	M-HTCW-PITS-	62/63	Valve Pits/Vaults, Steam Pits
	P	M-HTCW-PUMP-	62/63	Pump Stations
	P	M-HTCW-RETN-	62/63	Pump Stations (Return)
	P	M-HVAC-DMPR-	34	Fire and Smoke Dampers
	P	M-HVAC-	EQPM-EXHS-	34 HVAC Exhaust Equipment
	P	M-HVAC-EQPM-PCAR-	34	HVAC Pre-Conditioned Air Equipment
	P	M-HVAC-EQPM-RETN-	34	HVAC Return Equipment
	P	M-HVAC-EQPM-ROOF-	34	Roof Mounted HVAC Equipment
	P	M-HVAC-EQPM-SPLY-	34	HVAC Supply Equipment
	P	M-HWTR-EQPM-	63	Equipment
	P	M-HWTR-PIPE-RETN	63	Return Piping (Including Fittings, Valves)
	P	M-HWTR-PIPE-SPLY	63	Supply Piping (Including Fittings, Valves)
	P	M-HWTR-PUMP	63	Pump Stations
	P	M-HYDR-EQPM-	34	Hydraulic System Equipment
	P	M-INSL-EQPM-	34	Insulating Oil Equipment
	P	M-LUBE-EQPM-	34	Lubricating Oil Equipment
	P	M-MACH-BASE-	34	Machinery Bases
	P	M-MATL-LIFT-	34	Miscellaneous Lifting Equipment
	P	M-RCOV-EQPM-	34	Equipment
	P	M-REFG-EQPM-	34	Equipment
	P	M-RWTR-EQPM-	34	Raw Water Equipment
	P	M-STEM-EQPM-	34	Equipment
	P	P-FUEL-EQPM-	34	Equipment
	P	P-LGAS-EQPM-	34	Equipment
	P	P-MDGS-EQPM-	34	Equipment
	P	P-SANR-EQPM-	34	Equipment (e.g. Sand/Oil/Water Separators)
	P	P-SANR-FLDR-	34	Floor Drains, Sinks, and Cleanouts
	P	S-BRCG-ALUM-VERT-	34	Vertical Bracing (Aluminum)
	P	S-BRCG-STEL-VERT-	34	Vertical Bracing (Steel)
	P	S-BRCG-WOOD-VERT-	34	Vertical Bracing (Wood)
	P	S-GRTG-UGND-	34	Subsurface Grating
	P	S-PIPE-GATE-	34	Gates (Flap, Sluice, and Others)
	P	T-CABL-COAX-	69	Coax Cable

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	T-CABL-FIBR-	69	Fiber Optics Cable
	P	T-CABL-FIBR-EQPM-	69	Distribution Equipment for Fiber Optics
	P	T-CABL-MULT-	69	Multi-Conductor Cable
	P	T-COMM-ANT-	69	Telecommunications Antennae
	P	T-COMM-EQPM-	69	Other Telecommunication Equipment
	P	T-COMM-JBOX-	69	Junction Boxes
	P	T-CUDE-	69	Distribution Equipment for Copper
	P	T-DATA-JACK-	69	Data/LAN Jacks
	P	T-PHON-JACK	69	Telephone Jacks
	P	V-AFLD-DEVC-	89	Capacitors, Voltage Regulators, Motors, Buses, Generators, Meters, Grounds, and Markers
	P	V-AFLD-JBOX-	87	Junction Boxes, Pull Boxes, Manholes, Pedestals, Splices
	P	V-CATH-ANOD-	34	Sacrificial Anode System
	P	V-CATH-CURR-	34	Impress Current System
	P	V-CATH-TEST-	34	Test Stations
	P	V-COMM-EQPM-	69	Other Communications Distribution Equipment
	P	V-COMM-JBOX-	69	Communications Junction Boxes, Pull Boxes, Hand holes, Pedestals, and Splices
	P	V-COMM-MHOL-	69	Communications Manholes
	P	V-ELEC-DEVC-	34	Capacitors, Voltage Regulators, Motors, Buses, Generators, Meters, Grounds, and Markers
	P	V-ELEC-EQPM-	34	Other Substation Equipment
	P	V-ELEC-JBOX-	34	Junction Boxes, Pull Boxes, Manholes, Pedestals, Splices
	P	V-ELEC-SWCH-	34	Fuse Cutouts, Pole Mounted Switches, Circuit Breakers, Gang Operated Disconnects, Reclosers, and Cubicle Switches
	P	V-FUEL-DEVC-	70/72/73	Air Eliminators, Filter Strainers, Hydrant Fill Points, Line Vents, Markers, Oil/Water Separators, Reducers, Regulators, and Valves
	P	V-FUEL-FTTG-	70/72/73	Caps, Crosses, and Tees
	P	V-FUEL-HYDT-	70/72/73	Hydrant Control Pits
	P	V-FUEL-INST-	70/72/73	Meters
	P	V-FUEL-JBOX-	70/72/73	Junction Boxes and Test Boxes
	P	V-FUEL-MHOL-	70/72/73	Manholes and Hand holes
	P	V-FUEL-PUMP-	70/72/73	Booster Pump Stations

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	V-FUEL-TANK-	70/72/73	Fuel Tanks
	P	V-FUEL-VALV-	70/72/73	Valve Pits
	P	V-FUEL-VENT-	70/72/73	Vent Pits
	P	V-GTHP-EQPM-	34	Equipment
	P	V-HTCW-CHLP-	62/63	Chilled Water Plant
	P	V-HTCW-DEVC-	62/63	Rigid Anchors, Anchor Guides, Rectifiers, Reducers, Markers, Meters, Pumps, Regulators, Tanks, and Valves
	P	V-HTCW-FTTG-	62/63	Caps and Flanges
	P	V-HTCW-HTPP-	62/63	High Temperature Water Plant
	P	V-HTCW-JBOX-	62/63	Junction Boxes, Manholes, Hand holes, Test Boxes
	P	V-HTCW-PITS-	62/63	Valve Pits/Vaults, Steam Pits
	P	V-HTCW-PUMP-	62/63	Pump Stations
	P	V-HTCW-RETN-	62/63	Return for all HTCW Lines
	P	V-LITE-FIXT-	62/63	Exterior Lights
	P	V-NGAS-DEVC-	71	Hydrant Fill Points, Lights, Vents, Markers, Rectifiers, Regulators, Reducers, Sources, Tanks, Drip Pots, Taps, and Valves
	P	V-NGAS-FTTG-	71	Caps, Crosses, and Tees
	P	V-NGAS-INST-	71	Meters
	P	V-NGAS-MHOL-	71	Manholes
	P	V-NGAS-PUMP-	71	Compressor Stations
	P	V-NGAS-REDC-	71	Reducing Stations
	P	V-NGAS-VALV-	71	Valve Pits/Boxes
	P	V-NGAS-VENT-	71	Vent Pits
	P	V-POLE-UTIL-	34	Utility Poles
	P	V-PROF-MHOL-	34	Manholes
	P	V-SPCL-SYST-	34	Special Systems (UMCS, EMCS, CATV, etc…)
	P	V-SSWR-DEVC-	59	Grease Traps, Grit Chambers, Flumes, Neutralizers, Oil/Water Separators, Ejectors, and Valves
	P	V-SSWR-FILT-	59	Filtration Beds
	P	V-SSWR-FTTG-	59	Caps and Cleanouts
	P	V-SSWR-JBOX-	59	Junction Boxes
	P	V-SSWR-MHOL-	59	Manholes
	P	V-SSWR-PUMP-	59	Booster Pump Stations
	P	V-SSWR-TANK-	59	Septic Tanks
	P	V-STRM-CHUT-	81	Chutes and Concrete Erosion Control Structures

Feature Group / Feature Class	FT	Layer Name	Old DEN Layer	Description
	P	V-STRM-CULV-	80	Culverts
	P	V-STRM-DEVC-	81	Downspouts, Flumes, Oil/Water Separators, and Flap Gates
	P	V-STRM-EROS-	81	Erosion Control (riprap)
	P	V-STRM-FMON-	81	Flow Monitoring System
	P	V-STRM-FTTG-	81	Caps and Cleanouts
	P	V-STRM-HWAL-	81	Headwalls and End walls
	P	V-STRM-INLT-	81	Inlets (Curb, Surface and Catch Basins)
	P	V-STRM-MHOL-	81	Manholes
	P	V-STRM-PUMP-	81	Pump Stations
	P	V-UTIL-LINE-	34	Utilities
	P	V-UTIL-NGAS-	71	Gas Lines, Features, and Valves
	P	V-UTIL-SSWR-	59	Sanitary Lines and Manholes
	P	V-XFMR-PADM-	34	Pad Mounted Transformers
	P	V-XFMR-POLM-	34	Pole Mounted Transformer
Utility Polygon	PG	C-SSWR-LAGN-	59	Lagoons
	PG	C-SSWR-LEAC-	59	Leach Field
	PG	C-SSWR-NITF-	59	Nitrification Drain Fields
	PG	C-SSWR-PLNT-	34	Treatment Plants
	PG	C-STRM-AFFF-	79	AFFF Lagoon/Detention Pond
	PG	C-STRM-CHUT-	79	Chutes and Concrete Erosion Control Structures
	PG	C-STRM-LAGN-	79	Lagoons, Ponds, Watersheds, and Basins
	PG	E-AFLD-STRC-	96	Airfield Lighting Vaults
	PG	E-COMM-STRC-	96	Communications Vault
	PG	V-COMM-STRC-	96	Communications Vault
	PG	V-SSWR-LAGN-	59	Lagoons
	PG	V-SSWR-LEAC-	59	Leach Field
	PG	V-SSWR-NITF-	59	Nitrification Drain Fields
	PG	V-SSWR-PLNT-	34	Treatment Plants
	PG	V-STRM-AFFF-	79	AFFF Lagoon/Detention Pond
	PG	V-STRM-LAGN-	79	Lagoons, Ponds, Watersheds, and Basins

End of Appendix

Appendix C

Chapter 1 - Asset Types and Functional Areas

ASSET TYPE	FUNC AREA
ACE	AOM
ACTUATOR	HVAC/PLUMBING
AIR COMPRESSOR	HVAC/PLUMBING
AIR CONDITIONING UNIT	HVAC
AIR CURTAIN	HVAC
AIR DRYER	HVAC
AIR HANDLING UNIT	HVAC
AIR SOLID SEPARATOR	HVAC
AIRFIELD LIGHTING CIRCUIT	ELECTRIC
AIRFIELD LIGHTING UNIT	ELECTRIC
AIRPORT WASTE GRINDER	PLUMBING
AUDIO	HI-TECH
AUTO TRANSFER SWITCH	ELECTRIC
AUTOMATIC DOOR	BUILDING
BACKFLOW PREVENTER	LIFESFTY/PLUMBING
BOILER	HVAC
BREAKER	ELECTRIC
CABINET UNIT HEATER	HVAC
CALL BOX	RADIO
CAMERA	HI-TECH
CCTV	HI-TECH
CCTV/CAMERA	HI-TECH
CCTV/ENCODER	HI-TECH
CCTV/KEYBOARD	HI-TECH
CCTV/MONITORS	HI-TECH
CHEMICAL PUMP	PLUMBING/HVAC
CHILLED WATER PUMP	HVAC
CHILLED WATER SAND FILTER	HVAC
CHILLED WATER SAND FILTER PUMP	HVAC
CHILLER	HVAC
CKT SELECTOR SWITCH	ELECTRIC
COMBINATION AIR VENT	PLUMBING
CONDENSOR WATER PUMP	HVAC

ASSET TYPE	FUNC AREA
CONDENSOR WATER SAND FILTER	HVAC
CONDENSOR WATER SAND FILTER P UMP	HVAC
CONSTANT CURRENT REGULATOR	ELECTRIC
CONTROLLER	HI-TECH
COOLING TOWER	HVAC
DEDICATED SMOKE CONTROL FAN	LIFESFTY
DESSICANT FILTER	HVAC
DISCONNECT	ELECTRIC/HVAC
DOMESTIC WATER PUMP	PLUMBING
DOOR INTERNAL ROLLING STEEL	BUILDING
DRINKING FOUNTAIN	PLUMBING
DYNACO	BUILDING
ECOLOGY AIR UNIT	HVAC
ECS/MICROPHONES	HI-TECH
ECS/PAGING	HI-TECH
EGW EAST BOOSTER PUMP	HVAC
EGW RECIRCULATING PUMP	HVAC
EGW WEST BOOSTER PUMP	HVAC
ELECTRIC HOIST	HVAC
ELECTRICAL CONTROLER	ELECTRIC/HVAC
ELECTRICAL DISTRIBUTION BOARD	ELECTRIC
ELECTRICAL EQUIP.	HI-TECH
ELECTRICAL PANEL	ELECTRIC
ELECTRICAL SWITCHBOARD	ELECTRIC
ELEVATOR	CONTRACT
EMERGENCY	ELECTRIC
ENCODER	HI-TECH
ENERGY MANAGEMENT CONTROL S YSTEM	HVAC
ENERGY RECOVERY VENTILATOR	HVAC
ENVIRONMENTAL FAN	HVAC
ESCALATOR	CONTRACT
EXHAUST FAN	HVAC
EXPANSION TANK	HVAC

ASSET TYPE	FUNC AREA
FAN COIL UNIT	HVAC
FAN POWER VAV	HVAC
FIRE	LIFESFTY
FIRE ALARM	LIFESFTY
FIRE DAMPER	LIFESFTY
FIRE PUMP	FLEET/PLUMBING
FIRE SPRINKLER	LIFESFTY
FOOTING DRAIN SUMP PUMP	PLUMBING
FOUNTAIN PUMP	PLUMBING
FUSE DISCONNECT	ELECTRIC
GAS DETECTION SYSTEM	HVAC
GAS HEATER	HVAC
GENERATOR	FLEET
GLYCOL HOT WATER PUMP	HVAC
GROUND POWER UNIT	ELECTRIC
HEAT EXCHANGER	HVAC
HEAT RECOVERY PUMP	HVAC
HEAT RECOVERY UNIT	HVAC
HEATER	HVAC
HOA	HVAC/ELECTRIC
HOA SOFT START	HVAC
HOT WATER PUMP	HVAC
HOT WATER SAND FILTER	HVAC
HOT WATER SAND FILTER PUMP	HVAC
HVAC	HVAC
ICE MACHINE	HVAC
INCINERATOR	HVAC
INDUSTRAIL SUMP PUMP	HVAC
INFARED GAS HEATER	HVAC
INFARED HEATER	HVAC
INFRARED GAS HEATER	PLUMBING
INFRARED HEATER	HVAC
JOCKEY PUMP	PLUMBING
KEYBOARD	HI-TECH
LIGHTED SIGN	ELECTRIC
LIGHTING	ELECTRIC
LIGHTING CONTROL	POWERMGNT
MAKEUP AIR UNIT	HVAC
MANHOLE	PLUMBING
MDX 128	RADIO
MICROPHONE	HI-TECH
MIXING VALVE	PLUMBING/HVAC

ASSET TYPE	FUNC AREA
MONITORS	FID-BIDS
MOTOR CONT CTR	ELECTRIC
MOTOR CONTROL	ELECTRIC
MOTORIZED DAMPERS	HVAC
OVERHEAD FIRE DOOR	BUILDING
OVERHEAD STEEL ROLLUP	BUILDING
OVERHEADDOOR	BUILDING
PAGING	HI-TECH
PASSENGER LOADING BRIDGE	ELECTRIC
PATV	HI-TECH
PCA PLANT	HVAC
PLATE HEAT EXCHANGER PUMP	HVAC
POOL DEHUMIDIFICATION UNIT	HVAC
PORTABLE COOLING UNIT	HVAC
POTABLE H20 CABINET	PLUMBING
POWER WALK	CONTRACT
PRE CONDITIONED AIR	HVAC
PRIMARY CHILLED WATER PUMP	HVAC
PRIMARY HOT WATER PUMP	HVAC
PUMP	FLEET/HVAC/PLUMBING
RADIANT SLAB MANIFOLD	HVAC
READERS	HI-TECH
RECEIVER	HI-TECH
REFRIGERANT DETECTION SYSTEM	HVAC
REFRIGERANT RECOVERY UNIT	HVAC
RELIEF FAN	HVAC
RETURN FAN	HVAC
ROOFTOP UNIT	HVAC
SANITARY PUMP	PLUMBING
SANITARY SUMP PUMP	PLUMBING
SCAN	HI-TECH
SECURITY	HI-TECH
SERVICE H20 PUMP	PLUMBING
SMOKE GENERATOR	LIFESFTY
SOFT START	ELECTRIC
SOLVENT TANK	HVAC
SUPPLY AIR FAN	HVAC
SUPPLY FAN	HVAC
SYSTEM	HI-TECH
T STAT	HVAC
TRANSFORMER	ELECTRIC
TRITURATOR	PLUMBING

ASSET TYPE	FUNC AREA
UNDGND.CONC.VAULT	PLUMBING
UNIT HEATER	HVAC
UPS	ELECTRIC
VALET BAGGAGE LIFT	ELECTRIC
VARIABLE SPEED CENTRIFUGAL FAN	HVAC
VECHICLE CHARGING STATION	ELECTRIC

ASSET TYPE	FUNC AREA
VERTICLE TURBINE PUMP	HVAC
VFD	HVAC/HVAC
VFD/BYPASS SWITCH	ELECTRIC
WATER BOTTLE FILLING STATION	PLUMBING
WATER HEATER	PLUMBING
WATER TREATMENT SYSTEM	HVAC

End of Appendix