

VDOT CADD MANUAL

CHAPTER 3

CONTENTS

3	CADD Standards.....	3-1
3.1	Software	3-1
3.1.1	ProjectWise	3-1
3.1.2	ProjectWise Deliverables Management.....	3-1
3.1.3	ProjectWise Project Share.....	3-1
3.1.4	MicroStation	3-2
3.1.5	OpenRoads/GEOPAK	3-2
3.1.6	OpenRoads Designer CONNECT Edition (ORD)	3-2
3.1.7	Subsurface Utilities Design and Analysis (SUDA)	3-2
3.1.8	GuideSIGN	3-3
3.1.9	AutoTURN	3-3
3.1.10	AGI 32	3-3
3.1.11	Bluebeam Revu.....	3-3
3.1.12	AASHTOWare Preconstruction	3-3
3.1.13	CADD Training Opportunities	3-4
3.2	Software Versions/Licensing	3-4
3.2.1	Current Software Versions	3-4
3.2.2	Consultant/Contractor Software Licensing Information.....	3-4
3.3	CADD Workspace	3-7
3.3.1	OpenRoads Designer CONNECT Edition (ORD) CADD Workspace.....	3-7
3.3.2	OpenRoads/GEOPAK Cadd Workspace.....	3-8
3.4	Working Units	3-9
3.4.1	VDOT Transition from Feet to US Survey Feet	3-9
3.5	Seed Files	3-10
3.5.1	US Survey Foot Seed Files – (US Survey Feet).....	3-10
3.5.2	“Legacy” International Foot Seed Files – (Feet)	3-11
3.6	Design Libraries.....	3-12
3.7	CADD File Names	3-13

3.7.1	CADD File Names by Discipline	3-13
3.7.2	File Name Format.....	3-13
3.7.3	Plan Sheet Numbering	3-14
3.7.4	Commonly Encountered File Extension Types.....	3-16
3.8	Drawing Scale	3-16
3.9	Levels and Symbology	3-17
3.9.1	Levels	3-18
3.9.2	Colors	3-19
3.9.3	Line Styles.....	3-21
3.9.4	Line Weights.....	3-22
3.9.5	Patterns	3-22
3.10	Text and Dimensions.....	3-23
3.10.1	Annotation Scale Settings	3-24
3.10.2	Text Styles.....	3-24
3.10.3	Dimension Styles.....	3-25
3.11	Cell Libraries	3-25
3.11.1	Cell Library Names by Discipline	3-26

TABLES

Table 3-1:	Bentley ELS Software Titles Available to Consultants and Contractors	3-5
Table 3-2:	US Survey Foot Seed Files	3-11
Table 3-3:	Legacy International Foot Seed Files	3-12
Table 3-4:	Plan Sheet Numbering Standards	3-14

FIGURES

Figure 3-1:	VDOT Current (2014) Color Table.....	3-20
Figure 3-2:	VDOT Legacy (Pre-2014) Color Table	3-20

3 CADD STANDARDS

3.1 SOFTWARE

The primary software packages used by the Department for design/review are listed in the sections below. VDOT employees are to contact the CADD Support Section Helpdesk at CADDsupport@vdot.virginia.gov for installation/licensing and software support. Consulting firms, Contractors, and Utility companies with ACTIVE VDOT PROJECTS may contact the CADD Support Section Helpdesk for licensing and software support for eligible software. Please refer to the CADD Support Section [CADD Software and Application Support](#) webpage for additional information regarding software packages used by VDOT, including software used by specific disciplines not included below.

3.1.1 PROJECTWISE

ProjectWise is the document management system used by VDOT. The software provides full document management functionality and design collaboration between our business partners and VDOT. ProjectWise is marketed and distributed by Bentley Systems Inc. of Exton, Pennsylvania.

- Link to [VDOT's ProjectWise](#) webpage
- Link to [Bentley's ProjectWise](#) webpage

3.1.2 PROJECTWISE DELIVERABLES MANAGEMENT

ProjectWise Deliverables Management (PWDM) is a secure cloud-based service used to manage transmittals, submittals, and Requests for Information (RFIs). The software can be used to manage deliverables during any phase of a project.

- Link to [VDOT's ProjectWise Deliverables Management](#) webpage
- Link to [Bentley's ProjectWise Deliverables Management](#) webpage

3.1.3 PROJECTWISE PROJECT SHARE

ProjectWise Project Share is a secure cloud-based service which allows for the quick and secure exchange of critical project data and files of any size in order to facilitate real-time project collaboration between multiple project participants.

- Link to [Bentley's ProjectWise Project Share](#) webpage
- Link to [VDOT's ProjectWise Project Share Job Aids \(Coming Soon\)](#)

3.1.4 MICROSTATION

MicroStation is a CADD Software package for Drafting, Survey, and Design used by VDOT to develop and prepare plans. MicroStation is marketed and distributed by Bentley Systems Inc. of Exton, Pennsylvania.

- Link to [VDOT's MicroStation](#) webpage
- Link to [VDOT's MicroStation Job Aids](#)
- Link to [Bentley's MicroStation](#) webpage

3.1.5 OPENROADS/GEOPAK

OpenRoads/GEOPAK is a CADD Software package for producing digital terrain model (DTM) surfaces, cross sections, profiles, three dimensional (3D) Models, and visualizations for roadway projects. Bentley is integrating MX Road, GEOPAK, and InRoads into a single product line known as OpenRoads Technology. OpenRoads/GEOPAK is marketed and distributed by Bentley Systems Inc. of Exton, Pennsylvania.

- Link to [VDOT's OpenRoads/GEOPAK](#) webpage
- Link to [VDOT's OpenRoads/GEOPAK Job Aids](#)
- Link to [Bentley's OpenRoads](#) webpage

3.1.6 OPENROADS DESIGNER CONNECT EDITION (ORD)

OpenRoads Designer CONNECT Edition (ORD) is a comprehensive design application for surveying, drainage, subsurface utilities, and roadway design that supersedes all capabilities previously delivered through InRoads, GEOPAK, MX, and PowerCivil. OpenRoads Designer is marketed and distributed by Bentley Systems Inc. of Exton, Pennsylvania.

- Link to [VDOT's OpenRoads Designer](#) webpage
- Link to [VDOT's OpenRoads Designer Job Aids](#)
- Link to [Bentley's OpenRoads Designer](#) webpage

3.1.7 SUBSURFACE UTILITIES DESIGN AND ANALYSIS (SUDA)

SUDA is a module within the Bentley OpenRoads / GEOPAK and OpenRoads Designer CADD Software packages used for modeling and manipulating subsurface storm water and utility networks with the ability to produce storm sewer and utility profiles, identify potential conflicts, and perform related design calculations.

- Link to VDOT's SUDA webpage (*Coming Soon*)
- Link to [VDOT's SUDA Job Aids](#)

3.1.8 GUIDESIGN

GuideSIGN is a CADD based software that automates the process of designing highway and roadway signs. GuideSIGN is marketed and distributed by Transoft Solutions Inc. of Richmond, BC, Canada.

- Link to [Transoft Solutions' GuideSIGN](#) webpage

3.1.9 AUTOTURN

AutoTURN is CADD based software for simulating vehicle turning movements and swept path analysis for highway vehicles. AutoTURN is marketed and distributed by Transoft Solutions Inc. of Richmond, British Columbia, Canada.

- Link to [Transoft Solutions' AutoTURN](#) webpage

3.1.10 AGI 32

AGI 32 is a CADD based software for comprehensive lighting calculations, modeling, and rendering. AGI 32 is marketed and distributed by Lighting Analysts Inc. of Littleton, Colorado.

- Link to [Lighting Analysts' AGI 32](#) webpage

3.1.11 BLUEBEAM REVU

Bluebeam Revu is a software for viewing, editing, and signing and sealing PDF files. Bluebeam Revu is marketed and distributed by Bluebeam, Inc. of Pasadena, California.

- Link to [VDOT's Bluebeam Revu / Sign & Seal](#) webpage
- Link to [VDOT's Bluebeam Job Aids](#)
- Link to the [Bluebeam Revu](#) webpage

3.1.12 AASHTOWARE PRECONSTRUCTION

AASHTOWare Project Preconstruction is a web-based Bid Analysis and Management System. The product is used to produce engineering estimates, create proposals, manage bid lettings, analyze bids, and facilitate award and management of construction activities including payment. AASHTOWare Project Preconstruction is marketed and distributed by AASHTO of Washington, DC.

- Link to [VDOT's AASHTOWare Preconstruction](#) manual

3.1.13 CADD TRAINING OPPORTUNITIES

VDOT provides CADD training for VDOT employees and VDOT's partners through several different venues including VDOT University, training manuals, datasets available for download, and access to the Bentley LEARN Service.

- Link to [VDOT's CADD Training](#) webpage

3.2 SOFTWARE VERSIONS/LICENSING

3.2.1 CURRENT SOFTWARE VERSIONS

The CADD Support Section maintains a webpage which provides the current software versions for the primary Bentley software used on VDOT projects by VDOT employees and consultant staff. The software versions posted on this webpage are subject to periodic changes as VDOT tests, approves, and releases updated software versions for the production environment. The CADD Support Section will install the current software versions and any updates for VDOT employees. VDOT employees must be connected to the VDOT network via LAN or VPN connection in order for CADD Support Section staff to install any software. Consultants and contractors should refer to the webpage for current software version information and download/installation instructions.

- Link to the [VDOT's Current Software Versions](#)

3.2.2 CONSULTANT/CONTRACTOR SOFTWARE LICENSING INFORMATION

3.2.2.1 AVAILABLE SOFTWARE LICENSES

VDOT provides consulting firms, contractors, and utility companies that have ACTIVE VDOT PROJECTS with the necessary software and licenses in order to develop right-of-way and construction plans. Many of these software titles are available to Consultants through VDOT's Enterprise Licensing Subscription (ELS) agreement with Bentley Systems.

- Consultants and contractors should refer to the [VDOT Software and License Program](#) webpage for additional information on obtaining the required licenses through VDOT.
- A list of Bentley Systems ELS software titles available for use by VDOT's partners on VDOT projects is provided in Table 3-1.

Table 3-1: Bentley ELS Software Titles Available to Consultants and Contractors

Software Titles

Bentley Connect Agreement Service	GEOPAK Survey	MicroStation Distributed Processor	OpenFlows StormCAD
Bentley Descartes	gINT AGS Toolkit	MicroStation Extensions	OpenRoads ConceptStation
Bentley GEOPAK Bridge	gINT CLT	MicroStation GeoGraphics	OpenRoads Designer
Bentley GEOPAK Civil Engineering Suite	gINT Logs	MicroStation GeoSELECTools	OpenRoads Navigator
Bentley GEOPAK Road	gINT Professional	MicroStation Geospatial Extension	ProjectWise Edge
Bentley Lumen RT	gINT Professional Plus	MicroStation PDF Composer	ProjectWise Explorer Client
Bentley View V8i	LEAP Bridge Concrete	MicroStation Schematics	ProjectWise Explorer Client V8i
CONNECT Advisor	LEAP Bridge Enterprise Design Code USA	MicroStation TriForma	ProjectWise Explorer CONNECT Plug-in
CONNECTION Client	LEAP Bridge Steel	OpenBridge Modeler	STAAD Advance Concrete Design US
CONNECTIONS Passport	LumenRT Designer	OpenFlows CivilStorm	Subsurface Utilities Design and Analysis
Culvert Master	MicroStation	OpenFlows FlowMaster	
Distributed Rendering Service	MicroStation Civil Extension	OpenFlows PondPack	

3.2.2.2 PROCESS FOR LICENSE REQUESTS

Consultants/Contractors are to follow the process below for license requests.

- Any Prime Consultant/Contractor with an active VDOT project/contract who is requesting software licenses for the Prime Consultant/Contractor and/or their Subconsultant(s)/Subcontractor(s) will need to download, fill out, and submit the [VDOT Software License Request Form](#) (LD-893) to their VDOT Project Manager.
 - All license requests **must** be made only by Prime Consultant/Contractor.

- The Prime Consultant/Contractor is responsible for coordinating with their Subconsultant(s)/Subcontractor(s) regarding their individual licensing needs for the project and gathering the information required on the LD-893 form including the completed spreadsheet(s) with names, email addresses, computer names, and software versions for each license requested.
- Licenses are now based on individual users and computer names and are no longer based on the former process of one license per company or group.
- A separate LD-893 form must be submitted for each project/contract that software licenses are needed for.
- The form includes a section for the Prime Consultant to identify whether new license activation keys are needed or whether existing license activation keys are needed for a new project.
- The VDOT Project Manager will review all information provided on the LD-893 form including the VDOT project information and dates, Prime Consultant information, Subconsultant information (if required), spreadsheet attachments, and required signatures.
- Upon approval, the VDOT Project Manager will sign and email the completed form and attachments to the CADD Support Section at CADDSupport@vdot.virginia.gov.
- The CADD Support Section will review the completed form and create the individual licenses for each email address/computer name listed on the spreadsheet(s) for each Prime Consultant and Subconsultant.
- The CADD Support Section will email the licenses to the Point of Contact listed on the bottom of the spreadsheet(s). Any licenses requested by the Prime Consultant for Subconsultants will be emailed directly to the Subconsultant's Point of Contact.
- The software and licensing is available for the duration of each individual active project/contract.
- Refer to [VDOT's Frequently Asked Questions \(FAQ\) for Bentley Licensing](#) for additional information.

The use of any software with licenses issued by VDOT is limited solely to work on VDOT projects/contracts. Licenses are monitored for exclusive VDOT use and non-compliance with the license agreements may result in revocation of the supplied license(s).

3.2.2.3 REQUIREMENTS FOR JUSTIFICATION FOR ADDITIONAL LICENSE(S)

Consultants are to use [VDOT Software License Request Form](#) (LD-893) to request additional licenses. The same process described above for initial license requests must be followed for

any additional license requests and the requests must be made by the Prime Consultant/Contractor. The following are valid reasons to request additional licenses:

- Need additional license(s) for additional Prime and/or Subconsultant/Subcontractor staff assigned to a project
- Need additional license(s) for additional Subconsultant/Subcontractor added to a project
- Need additional license(s) for additional work/scope added to a project requiring additional software, different software, and/or additional Subconsultants/Subcontractors

3.2.2.4 SOFTWARE LICENSED SEPARATELY

Licenses for software programs used by VDOT other than those listed above are not directly available to consultants/contractors. Please contact the software vendors for purchase of software licensing as required. See the [CADD Software and Application Support](#) webpage for a listing of additional software used by VDOT broken down by discipline.

3.3 CADD WORKSPACE

VDOT has developed a customized CADD Workspace for the MicroStation and ORD CADD platforms which provides all of the required VDOT configuration files, cell libraries, and resource files necessary to automatically configure MicroStation or ORD to generate plans and documents matching the uniform plan appearance requirements established by VDOT. These uniform appearance requirements are key to facilitating efficient plan reviews during the design phase between VDOT employees, consultants, and other outside agencies and for providing design information to the public in a uniform way making it easier to understand. Additionally, plans generated through VDOT's CADD Workspace that meet the uniform appearance requirements established by VDOT provide contractors and inspectors with the expected plan clarity necessary to easily understand the designer's intent, prepare accurate bids and reports, and facilitate the construction of the desired improvements per the plans in a timely manner.

3.3.1 OPENROADS DESIGNER CONNECT EDITION (ORD) CADD WORKSPACE

The CADD Support Section in consultation with Bentley has developed an OpenRoads Designer CONNECT Edition (ORD) CADD Workspace which will be required for use on any projects where the contract or other VDOT guidance specifies that ORD is the required CADD platform for design delivery. This ORD CADD Workspace will be unique to projects designed using ORD and will not be suitable for use on OpenRoads/GEOPAK projects. **The migration of an existing OpenRoads/GEOPAK project to ORD must be completed prior to using the ORD CADD Workspace on project files.** Refer to the webpages at the links below for additional information regarding ORD including Announcements, Rollout, Project Migration, and Training specifics as well as Frequently Asked Questions.

- Link to [VDOT's ORD Connect Edition](#) webpage
- Link to [VDOT's ORD Frequently Asked Questions](#) webpage

3.3.1.1 ORD PROJECTWISE MANAGED WORKSPACE

The CADD Support Section has developed an ORD ProjectWise Managed Workspace which provides one centrally managed secure ORD CADD Workspace which can be applied by VDOT to applicable ORD projects stored within VDOT's ProjectWise Document Management System. The CADD Support Section will apply the ORD Managed Workspace on a per project basis. When files are opened directly from an ORD project on VDOT's ProjectWise with the ORD Managed Workspace applied, the ORD VDOT CADD Workspace is automatically loaded correctly when ORD opens, regardless of whether the user is a VDOT employee, consultant, or contractor.

The CADD Support Section is currently configuring the ORD ProjectWise Managed Workspace and it will be made available when configuration and testing are complete. The CADD Support Section will provide instructions when available.

- Link to [VDOT's ORD Local Workspace](#) zip file folder
- Link to VDOT's ORD ProjectWise Managed Workspace (*Coming Soon*)

3.3.2 OPENROADS/GEOPAK CADD WORKSPACE

The CADD Support Section has previously developed and distributed an OpenRoads/GEOPAK CADD Workspace that will continue to be used on projects that are not required to be migrated into ORD. The CADD Support Section will continue to maintain and update the resources in this OpenRoads/GEOPAK CADD workspace in order to support the timely completion of these projects. **All projects which will be required to be migrated into ORD shall use the ORD CADD Workspace described above after project migration is complete.**

3.3.2.1 VDOT EMPLOYEES OPENROADS/GEOPAK WORKSPACE

The CADD Support Section provides VDOT employees who require access to MicroStation using OpenRoads/GEOPAK with computers which have the OpenRoads/GEOPAK CADD Workspace automatically configured to point to the correct workspace files and folders with no additional configuration required by the user.

3.3.2.2 CONSULTANT/CONTRACTOR OPENROADS/GEOPAK WORKSPACE

VDOT provides an executable file with instructions which should be run by the Consultant or Contractor's IT staff. This executable file creates the OpenRoads/GEOPAK VDOT CADD workspace folder and file structure on the local machine on which it is executed. As noted in

the provided instructions, consultants and contractors have the option of deploying VDOT's Consultant OpenRoads/GEOPAK CADD Workspace on a server or similar means for managing the workspace for multiple users in one location.

- When installed on the local machine, the workspace files can be found at C:\proj\supv8i2015\.
- When installed on a server, the path to the workspace files will be based on the unique server name and folder structure present on the hosting server.
- Consultants and contractors should refer to VDOT's [MicroStation and OpenRoads/GEOPAK Webpage](#) for specific installation and configuration instructions.
- Link to [VDOT's Consultant OpenRoads/GEOPAK CADD Workspace](#) folder

Due to the many potential methods by which consultants and contractors may choose to deploy the VDOT CADD Workspace within their local environments, the CADD Support Section is limited in their ability to troubleshoot and assist with issues that arise from installation methods other than the standard install on the local machine from the provided executable file.

3.4 WORKING UNITS

3.4.1 VDOT TRANSITION FROM FEET TO US SURVEY FEET

In 2014, VDOT began migrating to the Bentley OpenRoads platform. With this migration, VDOT also transitioned MicroStation design file working units from the "legacy" International Foot working units (Feet) to the US Survey Foot working units (US Survey Feet) for new projects as required per Section § 55-290 of the Code of Virginia. Projects with MicroStation design file working units based on the International Foot working units (also referred to as Imperial Foot) are considered "legacy" projects.

Code of Virginia Section 55-290 – Plane coordinates used in systems states "The plane coordinates of a point on the earth's surface, to be used in expressing the position or location of such point in the appropriate zone of these systems, shall be expressed in U.S. survey feet and decimals of a foot. When converting coordinates in the Virginia Coordinate System of 1983 from meters and decimals of a meter to feet and decimals of a foot, the U.S. survey foot factor (one foot equals 1200/3937 meters) shall be used."

The differences between Feet and US Survey Feet working units are as follows:

- 1 US Survey Foot = 1.000002 International Foot
- This is a difference of 2 ten-thousandths in 100 feet. It is generally not significant when measuring distances within our projects. However, the origin of our coordinate system is far enough away that designers will have a significant error if they try to superimpose (reference) graphics drawn in one system over graphics drawn in the other.
- It is critical to **never mix working units**.
- **All design disciplines and consultant staff are responsible for using the same working units as the base survey files, no exceptions.**

3.5 SEED FILES

All MicroStation or ORD design files must be created from a seed file. These seed files have several operating parameters and design file settings which are specific to that design file's purpose. These parameters include the working units, global origin, and color table of the seed file. Separate seed files have been created for different types of design files and for different disciplines.

As noted above, VDOT used (and in some cases still uses) "legacy" International Foot (Imperial) working units based on the International Foot in all MicroStation files. Accordingly, VDOT will continue to use the legacy seed files for the existing projects life cycle (in International Foot units) only.

In 2014, VDOT's survey group started providing projects in the US Survey Foot seed file for new projects in an effort to comply with the code listed above. Except as noted below, new project assignments after June 1, 2015 will use the US Survey Foot seed files. New projects may use the "legacy" International Foot seed file if the new project is tying into an old legacy project. This should be determined prior to commencing survey.

- Files will note the seed file used to begin the project.
- All VDOT employees and consultant staff are responsible for verifying and using the proper seed file when work is assigned.
- Any MicroStation or ORD file that shows or references the survey file will need to utilize the correct seed files with matching working units.
- It is critical to NEVER MIX WORKING UNITS.

3.5.1 US SURVEY FOOT SEED FILES – (US SURVEY FEET)

New 2D and 3D seed files are provided with the US Survey Foot working unit (US Survey Feet) and should be used for all Projects where the Survey files are set to US Survey Foot.

New US Survey Foot seed files are located in the following directories:

- OpenRoads/GEOPAK CADD Workspace: C:\proj\supv8i2015\seed\US Survey Foot\
- ORD CADD Workspace: *(Coming Soon)*

Table 3-2 below lists the VDOT provided seed files by discipline for US Survey Foot units.

Table 3-2: US Survey Foot Seed Files

Seed File Name	Description	Disciplines
rwdatasheet.dgn	Right of Way Data Sheet Seed File with embedded Excel spreadsheet	Roadway, Survey, Right of Way
USFootSeed.dgn	Standard 2D Seed File	Environmental, Hydraulics, Landscape, Materials, Right of Way, Roadway, Survey, Traffic, Utilities
USFootSeed3D.dgn	Standard 3D Seed File	Hydraulics, Roadway, Survey, Traffic
USBRSEED_V8i.dgn	Structures and Bridge 2D Seed File	Structures and Bridge
guidesign.dgn	GuideSign Layout 2D Seed File	Roadway, Traffic

3.5.2 “LEGACY” INTERNATIONAL FOOT SEED FILES – (FEET)

“Legacy” files are MicroStation files started prior to July 2014 that use the legacy International Foot (Feet) as a working unit. All legacy survey and design projects must continue to use the old legacy seed files for the duration of the project for consistency due to working unit settings. Any drawings created in association with legacy project files MUST use the legacy seed files which are set to the International foot (Feet).

Seed files for legacy project files are located in the following directories:

- OpenRoads/GEOPAK CADD Workspace: C:\proj\supv8i2015\seed\Imperial\
- ORD CADD Workspace: *(Coming Soon)*

Table 3-3 below lists the VDOT provided seed files by discipline for International Foot units.

Table 3-3: Legacy International Foot Seed Files

Seed File Name	Description	Disciplines
BRSEED_V8i.dgn	Structures and Bridge 2D Seed File	Structures and Bridge
eng-ser-seed.dgn	Standard Seed File for Insertable Sheet	Hydraulics, Roadway, Traffic, Utilities
geopakdes.dgn	Standard Seed File for creating the Design	Hydraulics, Roadway, Traffic, Utilities
geopakdtm.dgn	GEOPAK Seed File for creating 3D files for design	Roadway
geopakprof.dgn	GEOPAK Seed File for creating Profiles	Roadway
geopakwork.dgn	GEOPAK Seed File for pattern lines, shapes, template separator, etc.	Roadway
geopakxs.dgn	GEOPAK Seed File for Master Cross Section File	Roadway
geopakxsht.dgn	GEOPAK seed file for Cross Section Sheet File	Roadway
guidesign.dgn	GuideSign Layout 2D Seed File	Roadway, Traffic
matseedV8i.dgn	Standard Seed File for Gint	Materials
Public Hearing Seed.dgn	Standard Seed File for Public Hearing Display	Roadway
Survey-Legacy-2D.dgn	Standard Seed File for creating 2D Survey Files	Survey
Survey-Legacy-3D.dgn	Standard Seed File for creating 3D Survey Files	Survey
vdotseed.dgn	Generic Imperial Seed File	Roadway

3.6 DESIGN LIBRARIES

Design Libraries (DGNLIBs) with the .dgnlib extension are MicroStation or ORD files which contain CADD Standard and Library data and easily allow for the propagation of standards across the organization. The information in these design libraries are shared with all VDOT CADD users through VDOT’s workspaces. The type of information stored and shared in DGNLIBs can include: Levels and Symbology, Level Filters, Text Styles, Dimension Styles,

Line Styles, Display Styles, Print Styles, Cells, Civil Cells, Design Standards, Element Templates, Feature Definitions, Project Explorer Linksets, Visualization Settings, and MicroStation or ORD Interfaces and Menu's. VDOT does not currently provide Line Styles in DGNLIB format.

- Link to [VDOT's DGNLIB's for OpenRoads/GEOPAK and ORD CADD Workspaces](#)

3.7 CADD FILE NAMES

VDOT has developed a standard CADD file naming convention for use in plan and model production on VDOT projects. Each discipline has developed specific standard file names which convey to the user the purpose of the design and sheet files and provide information on the type of content of the file. File names must not be duplicated within a project folder structure to avoid issues with reference files and data integrity. Consistency must be used in assigning file names to CADD design files to ensure that future searches for the files is a simpler task.

3.7.1 CADD FILE NAMES BY DISCIPLINE

The document linked below provides tables of VDOT CADD file names broken down by discipline which contain the standard file names and any additional instructions required to correctly name the design and sheet files for a project.

- Link to [VDOT CADD Files Names](#)

3.7.2 FILE NAME FORMAT

The following naming convention depicted in the tables above shall be used on all CADD files:

- Survey Files
 - S + FILE TYPE + UPC # + EXTENSION
- Design Files (including Sheet Files)
 - DIVISION + UPC # + DESIGNATED USE/SHEET NUMBER + EXTENSION
- Structure and Bridge Files
 - Structure and Bridge file names are provided in [VDOT's Manual of the Structure and Bridge Division](#).
- The CADD File Name is NOT limited but it is recommended that file name is no more than Twenty (20) CHARACTERS in length with a three-character extension.
 - Example: d1234508(12).dgn. Special Characters should be limited to (), _, and -.

3.7.3 PLAN SHEET NUMBERING

In accordance with sheet numbering standards as specified in the Road Design Manual (RDM) Section 2E-6 for the Index of Sheets (and shown on the Sample Index of Sheets in RDM Chapter 2H), each type of drawing has a specific sheet number or number range that must be used. Table 3-4 below provides a detailed list of the plan sheet numbering standards used by VDOT in the development of plans.

Table 3-4: Plan Sheet Numbering Standards

Sheet Name	Sheet Number
Title Sheet	01
Location Map Sheet	01A *
Index of Sheets	01B *
Right of Way Data Sheet	01C *
Revision Data Sheet	01D *
Stream Flow Hydrograph Sheet	01E *
Survey and Construction Alignment Data Sheets	01F, 01G *
Underground Utility Test Hole Information Sheet	01H *
Maintenance of Traffic, Sequence of Construction, and Transportation Management Plan Sheets	01J, 01K *
General Notes	02
Typical Sections	02A (1 st Typical Sheet)
Typical Sections	02B * (Additional Typical Sheets)
Details	02 * (Summary Sheets, Environmental Commitments Summary Sheets, Detail Sheets, Special Design Sheets, Hydrologic Data Sheet, SWPPP Sheets, etc.)

Sheet Name	Sheet Number
Plan Sheets	03, 04, 05...
Profile Sheets	03A, 04A, 05A...
Drainage Description Sheets	03B, 04B, 05B...
Phased Erosion and Sediment Control Sheets	03C, 03D, 04C, 04D, 05C, 05D...
Environmental Commitments Plan Sheets	03E, 04E, 05E
Right of Way Plan Sheets	03RW, 04RW, 05RW...
Utility Plan Sheets (for UFI)	03UT, 04UT, 05UT...
Entrance Profile Sheets	06(1) – 06() **
Storm Sewer Profile Sheets	07(1) – 07() **
Signing Plan Sheets (or Signing and Pavement Markings Plan Sheets)***	08(1) – 08() **
Lighting Plan Sheets	09(1) – 09() **
Signal Plan Sheets	10(1) – 10() **
Pavement Markings Plan Sheets***	11(1) – 11() **
Utility Adjustment Plan Sheets (In-Plan Utilities)	12(1) – 12() **
Landscape Plan Sheets	13(1) – 13() **
Cross Section Sheets	1 – xxx ****
Bridge Plans	See Manual of the Structure and Bridge Division

* The Lead Design Engineer assigns the Alpha Letter to sheets. Numbering in the “1” series may need to be adjusted to allow for the exclusion of sheet(s), such as the Project Location Map.

** Ancillary plans (Utility Relocation, Lighting, Signs, Traffic Control Devices, Landscaping, Bridge, etc.), which are to be incorporated into the plan assembly, are to be assigned plan series numbers beginning after the last plan sheet number by the lead design engineer, in coordination with the project manager.

*** The Signing and Pavement Markings plan sheets may be combined into the same sheet file (the preferred method) per the Discipline Specific Plan Production Procedures for the Traffic Division in Chapter 4 of the CADD Manual. When plan clarity cannot be achieved due to project complexity, the Signing and Pavement Marking Plan Sheets should be broken into two different sheet series as noted in the prior table.

**** Main cross section sheets are numbered and placed in accordance with cross section sheet numbering.

Bridge plans have their own plan sheet numbering system. Place the bridge plans after the cross sections in the plan assembly.

3.7.4 COMMONLY ENCOUNTERED FILE EXTENSION TYPES

The document linked below provides a list of the common file extensions which may be encountered by the different disciplines when working on VDOT projects.

- Link to [Common VDOT File Extensions](#)

3.8 DRAWING SCALE

Several of the components in VDOT’s CADD Workspace are placed based on the drawing scale of the plan sheet being produced. VDOT utilizes a standard sheet size of 23”x35” for plan sheets. Other sheet sizes are used for scroll plots, permit sketches, public hearing displays, and other meeting displays. VDOT primarily uses three drawing scales based on the desired scale of the plans being produced. The standards for determining a project appropriate scale are discussed in VDOT’s Road Design Manual Section 2C-5. The selected scale is dependent on the project facility’s roadway classification, whether it is an urban project, and the overall complexity of the project. The plan scale selected should provide neat, legible, and clearly readable plans. The standard drawing scales used on the majority of plans are provided below.

- 25 Scale Plans
 - MicroStation or ORD Drawing Scale: 1" = 25'
 - MicroStation or ORD Plot Scale: 25 Scale
- 50 Scale Plans
 - MicroStation or ORD Drawing Scale: 1" = 50'
 - MicroStation or ORD Plot Scale: 50 Scale
- 100 Scale Plans (**NOTE: LIMITED USE ONLY - NOT A PRIMARY DRAWING SCALE**)
 - MicroStation or ORD Drawing Scale: 1" = 100'
 - MicroStation or ORD Plot Scale: 100 Scale

The drawing scale applied to a drawing is selected from the MicroStation or ORD Settings Menu or the Model Properties dialogue box and is set individually for each model in a file. The drawing scale chosen for the file affects the following MicroStation or ORD file settings.

- Annotation Scale
 - Text Size
 - Dimension Text Size and settings
- Line Style Scale
- Pattern Scale
- Cell Scale

The drawing scale must be established at the beginning of a project prior to acquisition of survey data and should be set correctly in every design file utilized on the project. This drawing scale setting is not able to be automatically taken care of in the CADD Workspace seed files since these default seed files are set up by VDOT for use on multiple project types with varying drawing scales.

3.9 LEVELS AND SYMBOLOGY

Standards have been established for placing data in CADD files in order to maintain uniformity and to facilitate the sharing of the data between the various disciplines. All data placed in CADD files including lines, text, cells, and other graphical elements must follow the appropriate standards for levels (named or numbered) and symbology (color, line style, and line weight) based on either the legacy standards or 2014 standards described in further detail below.

- Legacy Standards – Elements must be placed on the proper level. The correct symbology attributes including line style (where applicable), color, and line weight must be independently assigned.

- 2014 Standards – Elements must be placed on the proper level. The correct symbology attributes including line style (where applicable), color, and line weight will be automatically assigned as long as the individual element attributes are set to ByLevel.

VDOT's current CADD workspace based on the 2014 standards utilizes DGNLIB's in order to maintain the established CADD standards for level names based on the naming conventions and level symbology across the different files and disciplines. The level structure for each Division (section of plans) will be described below.

NOTE: Electronic files are made available to contractors for projects designed in CADD. The need for placing items on proper levels is of utmost importance.

3.9.1 LEVELS

All electronic files are to be developed using the standard level structure as developed by VDOT and described in this manual. MicroStation and ORD have the capability of placing data on unlimited number of levels. These levels work similar to overlays, such that you can turn levels on and off to be able to display only the desired data instead of the entire file. A user can also print only the desired levels to produce layered plans to assist the contractor in constructing the project. In order to maintain design consistency, VDOT has established a level naming convention and created named levels as required for the different disciplines.

3.9.1.1 NUMBERED LEVELS (LEGACY)

Previous versions of MicroStation were limited to only 63 different numbered levels for the placement of graphics. The number of available levels greatly limited the ability to separate and distinguish items within a design file for viewing and printing. In legacy design and survey files with only 63 numbered levels available, element symbology (color, line style, and line weight) settings are critical and must be set and maintained properly in order follow the established CADD standards, and meet the expectations of the various users of the files including those in other Disciplines. VDOT does not intend to revert back to using just the original 63 numbered levels for any project.

3.9.1.2 NAMED LEVELS

In 2014, VDOT began transitioning to named levels in MicroStation and began providing separate named levels for text, line styles, and cell symbology per feature. All levels are preset with color, weight, and line style as shown in the tables below. Color overrides are still available.

3.9.1.3 LEVEL NAMES BY DISCIPLINE / CATEGORY

The document linked below provides VDOT's Level Names used within MicroStation and ORD which are sorted by Discipline / Category along with the corresponding level description and "ByLevel" symbology information (color, line style, and weight) for each level where applicable.

- Link to [VDOT Level Names and Symbology by Discipline/Category](#)

3.9.1.4 LEVEL FILTERS

VDOT's named level library includes over 5,000 levels which cover many different disciplines and types of survey and design items. Level filters can be used to turn on and off groups of levels needed to perform a specific task. Several level filters have been created to assist with the creation of plans. Level filters developed and provided by VDOT are included in the CADD workspace.

- Link to [VDOT Level Filters](#)

3.9.2 COLORS

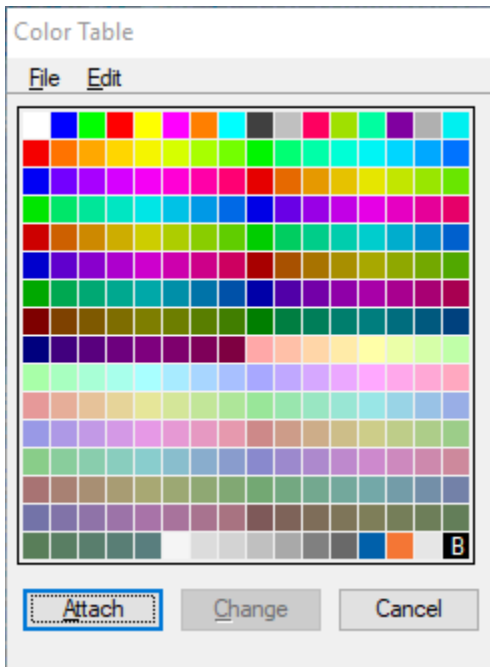
A MicroStation or ORD color table represents an index of 256 available colors with specific RGB values assigned by VDOT for each of the 256 colors. Standard color tables should be used whenever possible in order to visually differentiate MicroStation or ORD elements in files and to maintain uniform color printing across VDOT projects. While VDOT has developed a standard color table with colors assigned to each value, it is still possible for consultants and other VDOT partners to create their own color tables. If one of the VDOT provided seed files noted above is used to create the design file, the correct color table will automatically be attached. If those seed files are not used, then the user will need to attach the correct color table shown below to the design file.

The standard VDOT MicroStation or ORD color tables described below should always be used by VDOT employees and by all others whenever possible.

3.9.2.1 CURRENT STANDARDS (2014) COLOR TABLE

The color table for current project files (vdotcolor2015.tbl) is shown in Figure 3-1:

Figure 3-1: VDOT Current (2014) Color Table



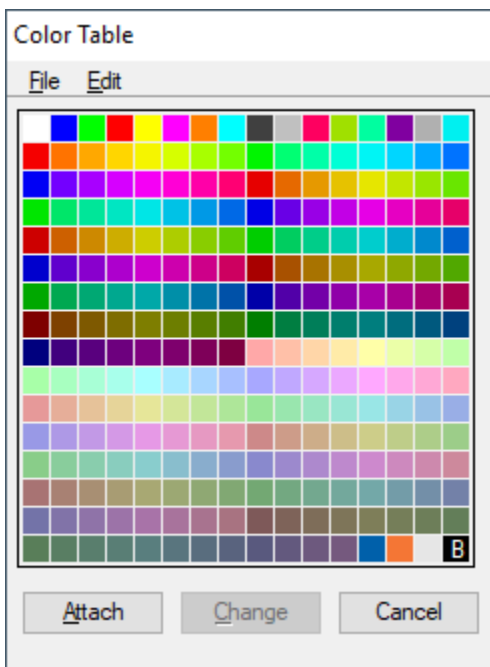
The color table for current project files (vdotcolor2015.tbl) is located in the following directories:

- OpenRoads/GEOPAK CADD Workspace:
C:\proj\supv8i2015\colortbl\
- ORD CADD Workspace: *(Coming Soon)*

3.9.2.2 LEGACY STANDARDS (PRE-2014) COLOR TABLE

The color table for legacy project files (vdotcolor.tbl) is shown in Figure 3-2:

Figure 3-2: VDOT Legacy (Pre-2014) Color Table



The color table for legacy project files (vdotcolor.tbl) is located in the following directories:

- OpenRoads/GEOPAK CADD Workspace:
C:\proj\supv8i2015\colortbl\
- ORD CADD Workspace: *(Coming Soon)*

3.9.2.3 SETTING ELEMENT COLOR

The color for individual MicroStation or ORD elements will be set correctly if the element is placed using any of the following methods:

- Using the predefined named level with the color attribute set to “ByLevel”
- Using GEOPAK’s Design & Computation Manager.
- Using a Feature Definition or Element Template in OpenRoads/GEOPAK or ORD

3.9.3 LINE STYLES

MicroStation and ORD line styles are one of the components of an elements graphical symbology and define the appearance of the line when viewed and printed. Line styles settings are applicable to each individual element and can be selected from a list of Bentley’s default MicroStation or ORD line styles or VDOT’s custom MicroStation or ORD line styles. VDOT has developed an extensive library of custom line styles for use on many different types of projects in order to provide consistency on all projects when displaying linear elements and shapes on plans.

- Legacy Standards – Line styles for legacy projects will need to be selected and applied manually or through GEOPAK’s Design and Computation manager.
- 2014 Standards – Line styles for 2014 standard projects are applied automatically by either using one of the following methods:
 - Manually placing the element on the correct individual level with the line style attribute set to ByLevel (The 2014 standard levels include named levels with preset ByLevel line style settings for each level.)
 - Placing the element through GEOPAK’s Design and Computation manager
 - Placing the element using a Feature Definition in OpenRoads/Geopak or ORD

3.9.3.1 LINE STYLE SCALE

The line style scale is based on the annotation scale set in the DGN file in the model properties dialogue box. Each model can have a different annotation scale. NOTE: Some line styles are set to physical which are true to size and cannot be scaled.

- 25 Scale Plans (1”=25’)
- 50 Scale Plans (1”=50’)
- 100 Scale Plans (1”=100’)

3.9.3.2 LINE STYLE RESOURCE FILES

VDOT’s custom line styles are contained in individual resource files which are provided in the CADD Workspace and are automatically made available in MicroStation and ORD for use in

design and plan preparation. Links have been provided below to tables depicting the available line styles along with any special instructions applicable to particular individual line styles.

- Link to [VDOT MicroStation and ORD Default Line Styles](#)

3.9.4 LINE WEIGHTS

VDOT's MicroStation and ORD line weights range in value from 0 to 16 and represent the element thicknesses used when drawing, viewing, and printing graphical elements. Line weights are applicable to all MicroStation and ORD element types. Printed line weight thicknesses are directly controlled by the discipline (roadway, traffic, bridge, etc.) specific VDOT pen table applied during the printing process. Each discipline's individual pen tables specify different printed line weight thicknesses and several also adjust the printed line weight thicknesses between full size and half size prints. Therefore, line weights depicted on printed PDF output files created from MicroStation or ORD are directly dependent on the plot driver and pen table used to create the print.

Line weights for individual elements are specified in VDOT's detailed level structure tables.

- Legacy Standards – Line weights for legacy projects will need to be selected and applied manually or through GEOPAK's Design and Computation manager.
- 2014 Standards – Line weights for 2014 standard projects are applied automatically using one of the following methods: manually placing the element on the correct individual level with the line weight attribute set to ByLevel, placing the element using GEOPAK's Design and Computation manager, or using a Feature Definition or Element Template in OpenRoads/GEOPAK or ORD. The 2014 standard levels include named levels with preset ByLevel line weight settings for each level.

3.9.5 PATTERNS

MicroStation and ORD patterns which can include hatching, cross-hatching, and various cell-based area patterns including stippling are used by the different VDOT disciplines as noted below on various plan sheets in order to more clearly convey design information.

- Roadway Plans
 - New areas of proposed asphalt pavement are required to be defined by stippling.
 - Existing pavement areas to be demolished are required to be hatched.
 - Existing pavement areas to be resurfaced (including cold planing/milling) are required to be hatched with a dot-dashed line style.
 - New areas of proposed concrete sidewalk or entrances can be patterned with a concrete pattern.

- Cross hatching can be used to delineate areas for other purposes.
- All forms or patterning described above will be placed in a pattern reference file by the roadway plans designer as described in the pattern tables.
- Pattern Reference File Name – Division + UPC# + pat.dgn (e.g. d123456pat.dgn)
- Erosion and Sediment Control Plans
 - MicroStation or ORD patterns can be used to depict area of riprap and erosion control stone.
 - Areas of riprap and erosion control stone patterning will be placed by the hydraulics designer in a hydraulics and/or erosion and sediment control pattern file in the hydraulics folder. The hydraulics staff must coordinate with the roadway staff and any others as necessary to ensure that the hydraulics and/or erosion and sediment control patten file is properly referenced into the plan sheets with the correct logical name.
- Temporary Traffic Control / Sequence of Construction Plans
 - MicroStation or ORD patterns can be used for the purposes of depicting construction phasing including areas of completed construction, areas under construction, and future stages of construction.
- Environmental Division Plans
 - The Environmental Division uses MicroStation or ORD patterns on Natural Resources Section plans including wetland mitigation plans, stream restoration/compensation plans, and stream relocation plans.
- Landscape Division Plans
 - The Landscape Division uses MicroStation or ORD patterns for hardscape items and vegetation where appropriate.

VDOT has developed detailed instructions for VDOT’s patterning standards for the disciplines described above. These instructions provide specific patterning standards based on the drawing scales used to create the plan sheets and details. The instructions also include the lists of corresponding cell libraries with cell names used for patterning.

- Link to [VDOT Pattern Instructions](#)

3.10 TEXT AND DIMENSIONS

VDOT has developed standard text sizes and fonts for use on plans and drawings to ensure consistency across projects. The text sizes, fonts, and line weights selected by VDOT for use with text and dimensions are based on providing clearly legible plans when printed. Text size and dimension settings are based on the drawing scale of the plans being produced. VDOT

has established text sizes based on the three primary drawings scales described previously, which are listed below.

- 25 Scale Plans – Drawing Scale: 1" = 25'
- 50 Scale Plans – Drawing Scale: 1" = 50'
- 100 Scale Plans – Drawing Scale: 1" = 100'

VDOT has developed detailed discipline specific standards for placing text and dimensions in the design files based on these drawing scales.

- Link to [VDOT Text and Dimension Standards](#)

3.10.1 ANNOTATION SCALE SETTINGS

MicroStation and ORD annotation scale settings are used to control the size of the text in a design file based on the selected drawing scale. This allows the size of the text to change if the drawing scale is changed or if the file is referenced into a different design file with a different drawing scale. The drawing scale of the project must be set as described above and the text and dimensions must be set to annotative for these settings to work properly. Refer to the Text and Dimension Standards link above for additional information and settings.

3.10.2 TEXT STYLES

Text Styles allow for the automatic selection of text font, text size (including the application of annotation scale settings), line spacing, justification, and many other detailed text settings. VDOT's CADD Workspace includes a limited selection of Text Styles for use by specific disciplines in the development of plans. Additional Text Styles may be developed by VDOT in the future and incorporated into the CADD Workspace. Text Styles currently available in the CADD Workspace are noted below. These Text Styles are set to use annotation scale and therefore the drawing scale must be set correctly.

- Bridge Plan Text (Text Size=0.01, Font=25)
- Location and Design Border File Text (Text Size=8.0, Font=Arial)
- Survey General Text (Text Size=0.01, Font=23 or Arial)
- Survey Contour Text (Text Size=0.008, Font=23 or Arial)
- Survey Easement Text (Text Size=0.0067, Font=23 or Arial)
- Survey Information Text (Text Size=0.10, Font=23 or Arial)
- Survey Property Owners Text (Text Size=0.0133, Font=23 or Arial)
- Survey Property Owners Deed Book and Page Text (Text Size=0.01, Font=23 or Arial)

The Survey Text Styles shown above list both Font 23 and Arial. Projects developed using the MicroStation and OpenRoads/GEOPAK CADD Workspace will continue to use Font 23 for the Survey Text Styles. Projects developed using ORD will use the Arial Font for the Survey Text Styles in accordance with a recent decision by the VDOT Survey Division and the Survey Text Styles in the ORD CADD Workspace have been updated accordingly.

3.10.3 DIMENSION STYLES

Dimension Styles allow for the automatic selection of dimension settings (including the application of annotation scale settings), text style, formatting, line style, color, and line weight to be applied when using the dimension tools. VDOT's CADD Workspace includes a limited selection of Dimension Styles for use by specific disciplines in the development of plans. Additional Dimension Styles may be developed by VDOT in the future and incorporated into the CADD Workspace. Dimension Styles currently available in the CADD Workspace are noted below. These Dimension Styles are set to use annotation scale and therefore the drawing scale must be set correctly.

- Easement Bearing/Distance
- Easement Bearing (multiple sub-styles)
- Easement Distance/Bearing
- Easement Distance (multiple sub-styles)
- Survey Contour Text
- Survey Bearing/Distance
- Survey Bearing (multiple sub-styles)
- Survey Distance/Bearing
- Survey Distance (multiple sub-styles)

3.11 CELL LIBRARIES

Cell libraries contain individual cells representing existing survey elements and proposed design elements, details, typical sections, and plan sheet elements. Each cell library provides details about the cells within including the cell name, the cell description, and an image of the cell.

Workspace Configurations in MicroStation and ORD have been setup by the CADD Support Section to defined paths to folders where cell libraries are located. When the user opens the cell library dialog box and clicks on "**File**" a list of the cell libraries is displayed. The user can pick the appropriate cell library.

- Legacy Standards
 - All legacy cells are created based on 100 scale plans unless otherwise noted.
 - Legacy cells should be placed in files based on the following active scales.

- Active Scale=0.25 – 25 Scale
- Active Scale=0.50 – 50 Scale
- Active Scale=1.00 – 100 Scale
- 2014 Standards
 - Updated cells are based on the old legacy cells and have been set to annotative.
 - New cells are annotative in nature and if placed manually they should be at 1 scale.
 - If the drawings scale is changed, the scale will adjust accordingly.
 - Some cells in the 2014 Standards are annotative but not all as noted below.
 - Cells that have set values do not scale up or down as these cells are meant to represent true values as they would be built or measured.
 - Cells that are used for labeling or to show an objects location are set to annotative.
 - Most of the Survey cells are annotative as they represent where an object is located.

Cell libraries files are located in the following directories within individual discipline subfolders:

- OpenRoads/GEOPAK CADD Workspace: C:\proj\supv8i2015\cells\
- ORD CADD Workspace: *(Coming Soon)*

3.11.1 CELL LIBRARY NAMES BY DISCIPLINE

A link is provided below to a table of VDOT's MicroStation and ORD cell libraries. These cell libraries are sorted by discipline and include cell library descriptions along with information regarding which standard (Legacy and/or 2014 STD's) and CADD platform (MicroStation and/or ORD) the cell libraries are applicable to.

- Link to [VDOT Cell Library Names, Descriptions, and Usage Information](#)