

SCDOT Specifications and Support Manual for GEOPAK Drainage

Introduction	4
Chapter 1: Data and Organization	6
1. Drives	6
2. Files	
3. Exchange of Information	12
4. Downloading & Organizing	13
5. Hydraulic Engineering Files	14
Chapter 2: Initial Settings	16
1. Start a New Project	16
2. Preferences	17
3. Units	17
4. Project Components	18
5. Rainfall Parameters	19
6. Land Use Options	20
7. Frequency Options	21
8. Intensity Option	22
9. Junction Losses	23
10. Inlet Options	23
11. Node Options	24
12. Link Options	25
13. Profile Options	26
14. Plan Symbology	27
15. Updates	28
16. Save Options	29
17. Drainage Library	30
18. Land Uses	31
19. Links	31
Chapter 3: Nodes	32
1. COGO	32
2. New Nodes	34
3. Properties	36
4. Location	37
5. Spread Criteria	
6. Elevations	41
7. Junction Losses	42
8. Discharge Options	43
9. Computations	44
Chapter 4: Areas	45
1. Definition	45
2. Subareas	46
3. Computation	48
Chapter 5: Links	52
1. Definition	53
2. Conditions	54
3. Constraints	55
4. Computation	55
Chapter 6: Non-Network Pipes	56
1. Add Nodes	56
2. Add Link	58
3. Label Plans	59
Chapter 7: Networks	60
1. The Network Dialog	61
2. Activating Networks	61
3. Designing Networks	62
4. Analyzing Networks	64

SCDOT Specifications and Support Manual for GEOPAK Drainage Last printed: 12/20/2019

5. Outlet Definition	66
Chapter 8: Profiles	69
1. Registration	70
2. Display	71
3. Drainage Information	72
4. Grids & Labels	73
5. Link Profile	73
6. Conflict Finder	75
Chapter 9: Navigator	78
1. Navigating	
2. Updating Graphics	80
3. Identifying Items	81
4. Query Mode	82
5. Global Editor Mode	83
Chapter 10: Reports	
1. Standard Interoffice	86
2. Generate	86
3. AltPipe Spreadsheet	<u></u> 87
4. Standard Interoffice	
5. Final Reports	88
6. Interoffice report	<u></u> 89
7. Roadway Report	<u>91</u>
Chapter 11: Microstation	
1. TIN Files – Draw Contours	<u>92</u>
2. TIN Files – Height/Slope Analysis	<u>93</u>
3. TIN Files – Creating Profiles	<u>95</u>
4. Cross Section Sheets – Side Line Pipes	<u>96</u>
5. Cross Section Sheets – Cross Line Pipes	<u>98</u>
6. Displaying 3-D Networks	100
Chapter 12: Uploading Files	103
Chapter 13: Import/Export	105
1. Shapefiles	105
2. XPSWMM	107
3. HEC-RAS	108
4. Google Earth	115
5. Lidar	117
Appendix A: C Value Table	124
Appendix B: Troubleshooting	125

Introduction

On April 17, 2000, the Hydraulic Engineering Section of the South Carolina Department of Transportation adopted GEOPAK Drainage as our primary storm sewer design package. Due to the many specifications that need to be set to run the program, the best plan was to write a manual to aid everyone using the software. It is not the purpose of this manual to provide you every piece of information needed to run the program. Additional resources are available through online help and training manuals.

Most of our other programs are much simpler to set up, so when misinformation is entered it can be easily found and corrected. GEOPAK has many settings that can cause the program to crash that you could spend several hours looking for that one incorrect specification. This manual was created to help avoid such errors and to set standards for naming conventions, levels, colors, etc. so our information would be easily transferable to the Roadway Designer. Never before has another office worked so closely with output from one of our programs. This is why it is critical that we are consistent with documentation so others can read our information.

This manual *does not* supersede the Requirements for Hydraulic Design Studies of the Department. **Careful** attention should be paid to those requirements and every effort made to adhere to them.

SCDOT still possesses other storm sewer design packages, and there may be a time when one of these methods is the best solution for a particular situation. The Hydraulic Designer will make that determination. If you must use another program, please notify the Roadway Designer immediately to inform them that you will be submitting red lined plans for their use. Some information like riprap pads and outfall improvements will still need to be red lined. We will not be required to forward any MicroStation files with notes.

GEOPAK Drainage, like all other hydraulic programs, gives you the best design and analysis based on the input. Engineering judgment must be used to evaluate the output that the program produces. You must check all data carefully and make determinations on the validity of the answers based on your knowledge of hydrology and hydraulics.

Do not be surprised to find that the program overrides some of your specifications. The program has the ability to change your Preferences and Constraints in order to design the system. The Preferences and Constraints are just guidelines to give the program a starting point to work with; therefore, it is imperative that you check all of your output for validity.

All specifications required to run the program will be added to this manual at the appropriate time. You will also be receiving updates for the storm sewer part as they are published.



NOTE TO CONSULTANTS: Consultants are to follow the standards set forth in this manual and the Requirements for Hydraulic Design Studies. The only procedural change that differs for consultants is discussed under Downloading & Organizing Files and Uploading Files. The consultants will obtain Road Design's files and send their data back to the Hydraulic Engineer, not the Roadway Designer, via electronic means as designated by SCDOT. All other guidelines are to be adhered to as stated.

Chapter 1: Data and Organization

1. Drives

Network Locations and Workspaces Preconstruction Data Folder Structure

P: \\nts\hq\precon

The hydraulic, roadway, geotechnical, and structural project files are consolidated by county on the network drive designated as the **"P"** drive. This drive serves as a central location for hydraulic, roadway, geotechnical, and structural CADD and data files that are project related and are sorted by county and Project ID number. New projects as well as current projects are stored at this location. \\nts\hq\precon

Example of a hydro folder located in Lexington County on the "P" drive:



MicroStation and Geopak Workspaces

MicroStation and Geopak uses a custom workspace that is available to every CADD user. The workspace *automatically* controls access within MicroStation to the most current cell libraries, reference border sheets, drainage files, etc.

Network path

\\nts\hq\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design\

When entering MicroStation, the User and Project should be set to SCDOT_Design with the Interface set to the NTS user name:

Workspace		
User.	SCDOT_Design 📃]
<u>P</u> roject	SCDOT_Design 📃]
I <u>n</u> terface:	McCalVH]

Drainage Library (DLB)

The current version is: SCDOT_english_2018_Alt.dlb

\\nts\hq\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design\Geofiles\Drainage

Cell Library (CEL)

\\nts\hq\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design\MSfiles\cell\RoadV8.cel

GEOPAK (DDB)

\\nts\hq\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design\Geofiles\Database\scdot_engV8.ddb

2. Files

File Type:	GPK	
Туре	Binary	
Acronym	GPK = GeoPaK	
Use	Stationing, Profiling and Reporting	

Through GEOPAK Drainage we will read the *.GPK file that the Roadway Designer produces to obtain the pgl and chain files for placing drainage nodes. The Roadway Designer will provide the names for the centerline profile and chain, all side road profiles and chains, and any curb grade profiles. From these files GEOPAK Drainage will automatically read curb grades and identify the centerline stationing of mainline and side roads. The *.GPK file is extremely valuable. The *.GPK file will usually be named job###.gpk. The ### will be the last 3 digits of the Project ID number.

File Type:	PP.DGN
Туре	Binary
Acronym	DGN = DesiGN
Use	Plan View

The pp.dgn file is the plan view of the project. It is shown exactly as surveyed. The pp.dgn file will usually be named r#####pp.dgn. The ##### is the Project ID number. The .dgn is the designation for all MicroStation design files.

File Type:	PF.DGN
Туре	Binary
Acronym	DGN = D esi GN
Use	Plan & Profile View

The pf.dgn file is the plan and profile view of the project as it appears on the plan sheets. There will be more than one of these files for every project unless the project is very small. You will not need this file for GEOPAK Drainage. You may need to open these files to get tie equalities or look at some of Roadway Designer's notes.

The pf.dgn file can be named many different things. Some squads name them by the Project ID number, i.e. 12345pf.dgn, 1234apf.dgn, 1234bpf.dgn... Some squads name them by the road, i.e. sc100pf.dgn, sc100apf.dgn... The Roadway Designer will provide the names for these files.

File Type:	HY.DGN
Туре	Binary
Acronym	DGN = DesiGN
Use	MicroStation file for Geopak Drainage design

This is the MicroStation file that you will do all of your design in when running GEOPAK Drainage. You will need to create this file. It will be named using the same conventions as the pp.dgn file. Basically we will reference Roadway Designer's pp.dgn file into our created hy.dgn file. This will allow us to view the road, but our design will be in another design file. If the Roadway Designer changes the pp.dgn file, it will not affect our design. This will be discussed in the Downloading & Organizing Files section.

File Type:	*.NEW
Туре	Binary
Acronym	NEW = NEW
Use	Survey shots

The .new file contains a list of all surveyed points. In the past, the Hydraulic Engineer used this file to determine pipe elevations from plans. The .new is usually named a series of numbers with part of those numbers being the Project ID number. Any additional surveys submitted for the same project will follow the same naming convention but will add an A, B, C, etc. to the file name to be sent to the Roadway Designer. You will not need this file for GEOPAK Drainage.

File Type:	*.CEL
Туре	Binary
Acronym	CEL = CELL
Use	Used for placing Node Cells

The Cell Library is used for placing Drainage Nodes into the HY.DGN file.

File Type:	*.DDB	
Туре	Binary	
Acronym	DDB = Design DataBase	
Use	Used for computing quantities	

The Design & Computation Manager database file can be used to compute drainage quantities.

File Type:	*.GOF
Туре	Binary
Acronym	GDF = Geopak Drainage File
Use	Stores the drainage components

The .gdf is short for **G**eopak **D**rainage **F**ile. We will produce this file when we create a design in GEOPAK Drainage. It contains all of our preferences, nodes, links, networks, profiles and output. This file references our Drainage Library, cell library, and the Roadway Designer's GPK File. NOTE: The GDF file is not a MicroStation file, but MicroStation uses this file to plot our basins and pipes. This is a file that you will upload for the Roadway Designer to aid them in labeling the plans. Name your .gdf files according to the naming convention discussed in the New Project section. The naming convention must be followed for consistency. You will only have one .gdf file per project. Even if you have multiple roads on one set of plans and you need to design storm sewers for all of them, you will still have only one .gdf file. Normal in-house projects have one designer assigned to that project, but consultant and large in-house rush projects will have several people working on them. If multiple people work on a project at the same time, then there will be multiple .gdf files. All .gdf files will need to be merged before they are sent to the Roadway Designer for labeling.

File Type:	*.DPF	
Туре	Binary	
Acronym	DPF = Drainage Preference File	
Use	Loading Project Preferences	

The .DPF file references all necessary standard files needed when setting up a .GDF. These files are named according to the rainfall station that the file references. Once settings are loaded, they will be saved in the *.GDF.

File Type:	*.DRF
Туре	Binary
Acronym	DRF = Drainage Report Format
Use	Standard Report format for the output CSV files

The DRF file is the standard Drainage Report Format file created in-house that contains the information format that is required for our standard reports. When you run these files they will automatically generate the CSV files that contain the output data that you will cut and paste into our standard output files. The .drf files that you will need to run have been preset and are on the server. This will be discussed in the Reports section. These files are areastandard.drf, nodestandard.drf, linkstandard.drf, nodestandardroad.drf, linkstandardroad.drf, which need to be run for each storm sewer system, and nodesum.drf and linksum.drf, which are not storm sewer specific. The last two files mentioned are the summation of all the nodes and links, respectively, for the entire project.

File Type:	*.CSV
Туре	ASCII
Acronym	CSV = Comma Separated Values
Use	EXCEL™ file

The CSV file is the output file that you will make through GEOPAK Drainage that is readable inside of EXCEL[™]. It will only contain the information that the DRF file requested to be obtained. There will be multiple files for every network (storm sewer system); three for our records and two to send to the Roadway Designer. This will be discussed in the Output section.

File Type:	*.DLB
Туре	Binary
Acronym	DLB = Drainage LiBrary File
Use	Geopak Drainage Library file

The DLB File is the **D**rainage Library **F**ile. You will download a copy of this file into your project directory. This file is discussed in the Drainage Library section.



This file will not email as is. You must place it into a zip file first. Right-click the file and select Send To->Compressed (zipped) folder

File Type:	*.TIN
Туре	Binary
Acronym	TIN = Triangulated Irregular Network
Use	Stores 3d surfaces

The TIN File is the **T**riangulated **I**rregular **N**etwork file and is used to represent the existing or proposed 3D surface.

3. Exchange of Information

Per Instructional Bulletin No. 2005-8, you should receive the following information from the Roadway Designer to begin a design. The submittals from the Roadway Designer should be checked to ensure that all the information was received by the Hydraulic Engineer. The Hydraulic Engineer should also check to ensure that submittals to the Roadway Designer are complete.

Information to be Obtained from the Roadway Designer for the Hydraulic Engineer

Hard Copy

- 1. Cross Sections to scale on half size sheets
 - a. Mainline
 - b. Side roads
 - c. Outfall ditches
- 2. Plan Sheets <u>to scale</u> on half size sheets
 - a. Centerline final grades for mainline
 - b. Final grades for side roads
 - c. All outfall ditch surveys
 - d. Limits of construction line
 - e. All existing survey pipe recommendations

Electronic Copy

- 1. Project .GPK file
- 2. Project **PP.DGN** file
- 3. Project **PF.DGN** file
- 4. Project **DX.DGN** & **FX.DGN** files
- 5. Project .NEW file
- 6. Excel file containing survey data, including control points
- 7. Centerline and top of curb pgl's.
- 8. Project curb grades

Information to be Provided for the Roadway Designer from the Hydraulic Engineer

Hard Copy

1. Plan sheets stating which existing pipes are to be abandoned or retained.

Electronic Copy

- 1. Project .GDF file
- 2. Project .**DLB** Drainage Library file (if modified for project exceptions)
- 3. Project **HY.DGN** file
- 4. List of file locations and file names of requested information emailed to the Roadway Designer
- 5. Proposed ditch cross sections
- 6. Alternate Pipe spreadsheet
- 7. Erosion Control Data Sheet
- 8. Additional erosion control BMP recommendations as appropriate

Explanation of common plan sheet items -- On the plan sheets, the limits of construction line is the cut/fill line. Also in the plan sheets, you will find the survey recommendations to abandon or retain a pipe.

4. Downloading & Organizing

The Roadway Designer will email you a **Hydraulic Information spreadsheet** containing a list of CADD and survey files that you will need to copy from the project road folder to the hydro folder located on the "P" drive.

A	В	C	D	E	F
	ROADVAY DESIG	IN DATA F	OR HYDRA	ULIC DESIG	N
	DATE:	27672015			
DECICH CROUP		2			
DESIGN GROUP:	BPG-I/R	2			
PRO IECT NO.	20100				
FROVECT NO:	33100				
COUNTY	Jasper				
ROAD/ROUTE NO.:	US 17				
PROJECT DESCRIPTION:	From: Georgia State L	ine To: SC 31	5		
ADDITIONAL NOTES:	Beginning of project ti	ies to a bridge	Georgia is co	instructing and	the end of the project
	ties to project id 00390	603 (US 17 at g	irade HH cros	sing) that will b	e constructed first.
		1			
			DMATION		
		FILE INFO	NMATION		
	SEBVEB	DESIGN	GBOUP	COUNTY	PROJECT NO
FILES LOCATED:	ntsihaiprecon	BPG	-1/B2	Jasper	39168 US17
'.GPK' FILE(S):	job811.GPK			1	2811.TIN
'PP' FILE(S):	r811app.dgn				
PF' FILE(S)	r811pf1.dgn	ofd1p)f.dgn	0	fd5pf.dgn
	r811pf2.dgn	ofd2p	of.dgn		
	r811pf3.dgn	ofd3p	of.dgn		
	r811sc315pł.dgn	0104p	of.dgn		
' NEW' EILE(C).	12011A NEV/				
.NEW FILE[5]:	12811A.INE W				
DYJEY' EILE(S)-	r811adv.dop	r811cf	v dan		
2001111122(0)	r811afx.dgn	sc315r	dx.dan	tunical-3	24sections dan
	r811bdx.dgn	sc315	fx.dan		
	r811bfx.dgn	ofd1 To o	fd5dx.dgn		
	r811cdx.dgn	ofd1 To o)fd5fx.dgn		
CHAIN NAME	ROPOSED PROFI		DE	SCRIPTION	
US17A1	US17A1FP				
US17A2					
2NB24	NBFP				
2SB24	SBFP				
SBIRAN	USI/AIFP				
	COTRAINE				
	SBTRANZ NETRAN2				
CO1E					
0ED1	OED1& OED1E				
	OFD10 OFD1FL				
OFDZ	OF D2 GOF D2FLOW				

Navigate to the project directory on the "P" drive under the **road** subfolder. Highlight the files listed in the index file by using the ctrl + click method to select multiple files at one time. Right click and select copy. Navigate to the **hydro** subfolder under the same project directory and right click and select paste.



Be certain to **copy**, not **cut**, the files from the road folder into the hydro folder. Files should remain intact in the road folder at all times.

For consultants, the Roadway Designer will provide the spreadsheet and deliverables electronically to the consultant.

5. Hydraulic Engineering Files

- You will need to download the english.DLB Drainage Library file from \\nts\hq\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design\Geofiles\Drainage into the project directory on the network.
- You will need to create the hydrology file *#####hy.dgn (refer to pp.dgn for symbol significance). This can be done as follows:
 - 1. Open Microstation.
 - 2. In the File Open screen, click the "New File" button.

File Open - C:\Users\Holtzclajr\Desktop\

Look in: 📃 Desktop

3. Enter the name of the new hydrology file in the File Name box at the bottom of the window.

Ŧ

🌀 🏂 📂 🛄 🔻

S 😣

4. Check the Seed box below File Name. It should be directed to

\\nts\hq\CaddStandards\SCDOT-Bentley\STANDARDS\SCDOT_Design\MSfiles\

seed\seed2d.dgn. If not, enter that address in the box or browse to that directory and select seed2d.dgn.

5. Press Save to return to the File Open menu, then select the new hydrology file and press Open.

- Next, you need to reference in the pp.dgn file as follows:
 - 1. Go to File>Reference.

2. Go to **Tools>Attach...** Choose the pp.dgn file in your project directory. When it asks for a logical name just enter a 1.

3. In the Reference window beside the pp.dgn that you just entered, put a $\sqrt{}$ under the **Snap** column. This will allow you to snap to the reference file, but not delete anything.

It should appear as if you are looking at the plan view of the project. The greatest difference now is that you cannot manipulate anything currently on your screen. It is purely for viewing. Now the hy.dgn file is ready to use through GEOPAK Drainage.

Chapter 2: Initial Settings

1. Start a New Project

To start a new Drainage Project:

- 1. Open your hy.dgn MicroStation file.
- 2. From MicroStation, select Applications>GEOPAK DRAINAGE>Drainage (if GEOPAK is not activated select Applications>GEOPAK>Activate GEOPAK).
- 3. You should now have a new menu item by Applications titled Drainage.
- 4. Selecting Drainage>Project>New... Name the file after the road being improved, i.e. SC100.GDF (this is the GDF file that will contain all of your work and be sent to Roadway Designer).

Drainage	<u>Wi</u> ndow	<u>H</u> elp <u>A</u> xiom
Project	Þ	<u>N</u> ew
<u>C</u> ompone	ent 🕨	Open
<u>N</u> etwork	. 🔸	Save
<u>R</u> eports	+	Save <u>A</u> s
<u>U</u> tilities	•	Preferences
Tool Box	es 🕨	— <u>D</u> rainage Library
E <u>x</u> it		Import Drainage Project
		Export •
	i	E <u>xi</u> t
		J:\Standard Files\V8_drainage_test\s50 test\r28348hy.gdf
		j:\Standard Files\V8_drainage_test\cvtsc121.gdf
	1	J:\Standard Files\V8_drainage_test\testv8.gdf
		J:\Standard Files\V8_drainage_test\testv8.gdf



GEOPAK Drainage always starts in an untitled project; it does not remember or automatically reopen a GDF that was previously worked in. The .GDF file must be reopened manually each time you open the hy.dgn. Select Project > Open each time you start to edit or continue working on a project.

2. Preferences

Set the Preferences as necessary at any time during project design or analysis, from the main menu bar select <u>Project > Preferences</u>:

C	DRAINAGE - Drainage.gdf - [No Active Network]						
	Project	<u>C</u> omponent	<u>N</u> etwork	R <u>e</u> ports	<u>U</u> tilities	Tool Boxes	
_	<u>N</u> ew			H			
	Open.						
	<u>S</u> ave						
	Save <u>A</u>	<u>h</u> s					
ļ	<u>P</u> refer <u>D</u> raina	ences ge Library	k]		

To establish the Preferences of a new project, navigate in Windows Explorer to

\\nts\hq\precon-general\Hydraulics\Standard Files_GEOPAK\DPF Files

Select the appropriate *.DPF corresponding to your project and copy and paste it to your working directory. In Geopak Drainage, go to Preferences, File>Open and open the copied .DPF.

A Preferences - Units				
File				
<u>Open</u> Save	 English 			
Save <u>A</u> s hents Hainrail Parameters	Drainage Area = Acres Length = Feet			

This will load the most up to date versions of all SCDOT preference files and save them to the created GDF when prompted.

3. Units

Set the Project Units to English:



4. Project Components

Set the Project Components:

The DLB, CEL, and DDB can all be loaded from the *.DPF. The .GPK should be obtained from the Roadway group and placed in the same folder as the hy.dgn and .GDF files.

📕 Preferences - Project Components 🛛 📃 🗶						
<u>Fi</u> le						
Options	Drainage Library File (DLB): inage\SCDOT_english_2018_Alt.dlb (1)					
Units	GPK Job Number: 2 User Preferences					
Project Components Rainfall Parameters	Drainage Cell Library: k\GEOPAK cell librarys\BOADV8 Ce 3					
Land Use Options						
Frequency Options						
Junction Losses						
Inlet Options	Water and Sewer Project:					
Link Options	Superelevation Shapes File:					
Profile Options	Site Project:					
Plan Symbology	Original Ground					
Save Options						
	Design Surface					
OK Cancel	TIN File					
L						

1	DLB	Click on the magnifying glass button and select the DLB file which was copied to the hydro project directory.
2	GPK	Click the magnifying glass button and select the GPK Job Number. You need to select your project directory and choose the file job###.gpk; there should only be one .gpk file. When you choose OK only the 3-digit number that was in the file name appears.
3	CEL	Click on the magnifying glass button and select the cell file located in the workspace folder. Select roadv8.cel.
4	DDB	Click on the magnifying glass button and select the DDB file located in the workspace location. Select the scdot_engV8.ddb.

Leave all the other file locations blank.

Under the Road Preferences, be sure that the box for Working Directory is empty. This will ensure that your GEOPAK iterations write to the current working project directory – the hydro folder.

😮 User Pref	ferences			
Unit System: Coordinates: Direction: Station:	English VE VE Bearing V 12+34 V	Output Accuracy Distance: Station: Angle Seconds:	99.1234 9+99(9).12 9*9'9.12	▼ ▼ ▼
Working Dire	ctory:			۹
Eeature	Preferences	🗖 Show this dista	un el alexium	
<u>C</u> 0G0 F	Preferences	1 Show this dialo	ig at startup	
	<u>o</u> k	1	Cancel	

Press the COGO Preferences button and ensure that all three directories are empty also.

8 COGO Preferences	×				
Job (GPK) Open Mode: Query 👻					
Job (GPK) Directory:	Q				
COGO Input File Directory:	Q				
COGO Output File Directory:	Q				
Redefinition of Elements					
Force Redefinition Off Upon COGO Activation					
<u>O</u> K Cancel					
1					

If the Working Directory box is not empty, you risk overwriting the GPK in the roadway folder with the new hydrology GPK.

5. Rainfall Parameters

Set the Rainfall Parameters:



1	Rational	Choose the down arrow under Rational Method and a list of counties from South Carolina appears from the Drainage Library DLB file (choose the county that is closest to your site).
2	SCS	Ignore the SCS Method for now.

6. Land Use Options

Set the Land Use Options:

8 Preferences - Land Us	se Options 📃 🗖 🔁
<u>Fi</u> le	
Options Units Project Components	Rational Method Single Land Use Item: SCDOT SCDOT
Rainfall Parameters Land Use Options Frequency Options Intensity Option	Land Use Item Level Color Weight Style
Junction Losses Inlet Options Node Options Link Options	Sample Land Use Symbology:
Profile Uptions Plan Symbology Updates Save Options	Multiple Land Use Item: Land Use Item Level Color Weight Style
OK Cancel	Sample Land Use Symbology:

1	Rational	The land uses are the "C" values associated with the different land uses and slopes throughout the state. If you have a design exception for a project, you will need to copy the Drainage Library (DLB) to your hydro project directory. You will then be able to input specific "C" values into the Drainage Library. Be sure to include this file in the Electronic Files to the Roadway Designer if you make modifications.
2	SCS	Ignore the SCS Method for now.

For details of the SCDOT Land Use values, see Chapter 2, Section 19 and Appendix A of this manual.

For instructions on using Land Use see Chapter 4, Section 2 & 3 of this manual.

7. Frequency Options

Set the Frequency Options:

🥖 Preferences - Frequency O	ptions	_ 🗆 🗙
File		
Options Units Project Components Rainfall Parameters Land Use Options Frequency Options Intensity Option Junction Losses Inlet Options	Prainage Library (DLB):\Drainage\SCDOT_english_20 1 Rational Frequency Options Computation Frequency: Peaking Factor: 1 1 2 SCS Frequency Options	018_Alt.dlb
Node Options Link Options Profile Options Plan Symbology Updates Save Options OK Cancel	Cumulative Runoff Coefficient Frequency: Peaking Factor: 1.0000	

1	Rational	Our basic storm sewer design is for a 10-year storm, but if cross lines are involved you will need to evaluate the storm sewer for a 25 or 50 year storm event. The Drainage Library has the values listed in it for the 2, 10, 25, 50 and 100-year storms. You can only run one storm at a time, so initially choose the 10-year storm under Rational Frequency Options and input 1.0 as the peaking factor. If you need to run the other storms, simply choose that storm and input the correct peaking factor from the requirements for Hydraulic Studies.
2	SCS	Ignore the SCS Method for now.

8. Intensity Option

Set the Intensity Option:

🕺 Preferences - Intensity Option	X
File	
Options Units Drainage Library (DLB):\Drainage\SCDOT_english_2018_Alt.dlb Project Components 1 Minimum Time of Concentration: 5.0000 Rainfall Parameters 1 Minimum Time of Concentration: 5.0000 Land Use Options 2 Accumulate Pipe Flow Time by: Uniform Flow Velocity Image Library (DLB): Intensity Options 2 Accumulate Pipe Flow Time by: Uniform Flow Velocity Image Library Junction Losses 1 Minimum Time of Concentration: 5.0000 Image Library Image Library Junction Losses 2 Accumulate Pipe Flow Time by: Uniform Flow Velocity Image Library Junction Losses 1 Intensity Options Image Compute Intensity: 0.0000 Junction Losses Intensity Options Image Compute Intensity: 0.0000 Image Compute Intensity: 0.0000 Inke Options Image Computation Only Image Computation Only Image Compute Intensity: 0.0000 Inlet Computation Only Absolute Intensity: 0.0000 Image Compute Intensity: 0.0000	
OK Cancel	

1	Min Tc	Set the "Minimum Time of Concentration" to 5.0 minutes.
2	Accumulate Time by:	Under "Accumulate Pipe Flow Time by" select "Uniform Flow Velocity".
3	Intensity Options:	Always toggle ON the option to "Compute Intensity from Library Rainfall Data Source".

9. Junction Losses

Set the Junction Losses (use the values shown below for the Junction Losses):

Options	🗌 🗖 Disable All J	lunction Loss Computation	ons	
Units Project Components	Loss Velocity	y: Actual 💌		
Rainfall Parameters	D	escription	Loss Coefficient - K	
Land Use Options Frequency Options	11	Pressure Expansion:	0.2000	
Intensity Option	1 III	Free Surface Expansion:	0.2000	
Junction Losses Inlet Options	##	Pressure Contraction:	0.1000	
Node Options Link Options	t‡∰ Fr	ee Surface Contraction:	0.1000	
Profile Options Plan Symbology	\$\$	Bend Loss:	Method 2 💌	
Updates Save Options		Terminal Inlet/Junction:	0.0000	
	1	Simple Junction:	Method 2 🔻	
OK Cancel	¥ <u></u> ∏=	Complex Junction:	Method 2 💌	

10. Inlet Options

Set the Inlet Options (use the values shown below for the Inlet Options):

Options Units Project Components Rainfall Parameters Land Use Options Frequency Options Intensity Option Junction Losses Inlet Options Node Options Link Options Profile Options Plan Symbology Updates Save Options	Inlet By Pass Options: <u>By Pass as Total Discharge</u> Link By Pass Flow Options: <u>Do Not Allow Inlet By Pass in Link Discharges</u> Default Spread n Value: 0.0120 Extend Superelevation Shapes to Inlet at Shape Slope
OK Cancel	

11. Node Options

Set the Node Options:

ptions 🔤 🛄	×
Default Node ID Prefix: CB- Scale Node Cells Scale Factor: 1.0000 Minimum Freeboard: 0.0000	
	Default Node ID Prefix: CB- Scale Node Cells Scale Factor: 1.0000 Minimum Freeboard: 0.0000



The Default Node ID Prefix will be different depending on the type of node being placed. Refer to the Nodes section and input the most commonly used prefix.



We need to be consistent with our naming conventions so we can easily read each other's data and the Roadway Designer will not be confused by different symbology.

12. Link Options

Set the Link Options:

Options	Default Link ID Prefix: NP-
Units	Link Profile Options
Project Components	(1) Design Optimization: <u>Minimize Depth of Cover</u>
Rainfall Parameters Land Use Options	2 Elevation Option:at Actual Link End
Frequency Options	Link Design Options
ntensity Option	O Design for Maximum Capacity
lunction Losses	O Design for Full Canacitu
niet Uptions Viada Optiona	3 Design Partial Capacity (d/D) Batio: 0.9400
unk Ontions	
Profile Options	O Design Partial Lapacity (q/Q) Hatio: 11,0000
Plan Symbology	4 Link Slope Decimal: <u>No Rounding</u> ▼
Updates	Link Criteria File
Save Options	File Name:

1	Design Optimization	Set "Design Optimization" to "Minimize Depth of Cover".
2	Elevation Option	Set "Elevation Option" to "at Actual Link End".
3	Link Design Option	Set "Link Design Options" to "Design Partial Capacity (d/D)" and set to 0.94 (i.e 94% full).
4	Link Slope Decimal	Set "Link Slope Decimal" to "No Rounding".
5	Hydraulic Gradeline	Set "Hydraulic Gradeline Basis" to "Equal Hydraulic Gradeline".



The Default Link ID Prefix will be different depending on the type of link being placed. Refer to the Links section and input the most commonly used prefix.

We need to be consistent with our naming conventions so we can easily read each other's data and the Roadway Designer will not be confused by different symbology.

13. Profile Options

Set the Profile Options:

S Preferences - Profile Options						
Eile						
Options Units Project Components Rainfall Parameters Land Use Options Frequency Options Intensity Option Junction Losses Inlet Options Link Options Profile Options Plan Symbology Updates Save Options	 Default Profile ID Prefix: Create Cogo Chains and Profiles 					



You can choose to have a prefix for all profiles that you create. For now we do not plan to create any COGO chains or profiles.

14. Plan Symbology

Set the Plan Symbology: We need to make sure our design is on levels that the Roadway Designer will not use. This way when they bring in our design there will be no confusion as to whose information is on what level. The labels will share the same attributes as its component. Make sure the following conventions are followed for levels, weight, line style, and colors for consistency:

Options	_	lan View Para	meters	
Units	Component	Linear	Tout	Label
Project Components	Areas:	Linear	Bample	
Hainrail Marameters Land Use Options	Pipes:		Sample	N
Frequency Options Intensity Option	Ditches:		Sample	N
Junction Losses	Culverts:		Sample	ঘ
Inlet Uptions Node Options Link Options	Nodes	Set Node (Cell Symbology	
Profile Options	Inlets:		Sample	1
Plan Symbology Updates	Junctions:		Sample	•
Save Options	Outlets:		Sample	N
) 	Other:		Sample	N
OK Cancel	Headwall:		Sample	2

Use the following symbology:

Attribute	Areas	Nodes	Pipes	Ditches	
Level RD_HY_Area_SS R		RD_PD_DR_Inlet RD_PD_DR_Pipe		RD_PD_DR_FlowCtrl	
Color	3	106	106	106	
Style	0	0	0	0	
Weight	0	0	8	0	



In Plan Symbology, you can copy settings from one black box to another by right-clicking on a box and selecting Copy, then right-clicking on another and selecting Paste.

15. Updates

Set the Updates Options (use the settings below):



16. Save Options

Set the Save Options (use the settings shown below):

8 Preferences - Save Op	tions	
Ele Options Units Project Components Rainfall Parameters Land Use Options Intensity Option Junction Losses Inlet Options Node Options Link Options Profile Options Plan Symbology Updates Save Options	Ptions ✓ Automatically Save Drainage Updates ← Automatic Backup ← Automatic Save: <u>1 Minute</u> ✓	
OK Cancel		

17. Drainage Library

Select Drainage>Project>Drainage Library. Make sure that the Drainage Library DLB File for your active GDF File is open. If not, then go to File and choose the correct one. There are five tabs – Rainfall, Land Use, Nodes, Links, Spread Section. Rainfall, Nodes, Links, and Spread Section have been preset and need not be modified.

3 Drainage Library		<
<u>Fi</u> le <u>E</u> dit		ļ
<u>R</u> ainfall <u>L</u> and Use <u>N</u> odes <u>L</u> inks Sp	read Section	
Element ID	Description	
	5	
	<u> </u>	
1		

18. Land Uses

Use the Land Use Tab to view the land uses on your project. The following are the most commonly used Land Uses.

名 Drainage Library - Land Use (Runoff Coefficient) Item 📃 🔲 🖂					
Item ID: SCDOT		Description: Land Use Item			
Land Use Description	Runoff C	Symbology	▲		
Flat Playgrounds	0.20	Lv:RD_HY_LandUse, Co:20, Lc:ByLv	\sqrt{N}		
Flat Woodlands Fores	0.10	Lv:RD_HY_LandUse, Co:21, Lc:ByLv	/N 🔁		
Flat Meadows Pasture	0.25	Lv:RD_HY_LandUse, Co:22, Lc:ByLv	. N		
Flat Unimproved Area	0.10	Lv:RD_HY_LandUse, Co:23, Lc:ByLv			
Rolling Pavements Ro	0.90	Lv:RD_HY_LandUse, Co:26, Lc:ByLv	. N		
Rolling Earth Should	0.50	Lv:RD_HY_LandUse, Co:27, Lc:ByLv	W 🗙 🕹		
Rolling Gravel Pavem	0.55	Lv:RD_HY_LandUse, Co:29, Lc:ByLv	<i>.</i>		
Rolling Aparment Dwe	0.60	Lv:RD_HY_LandUse, Co:31, Lc:ByLv	/ N 💌		
Flat Pavements Roofs	0.900	ок с	Cancel		

Entering drainage areas will be discussed in the Areas section.

19. Links

Circular Links can be the following material types: Aluminum, Concrete, Plastic (HDPE), or Steel.

In this menu, the "Steel" setting contains the information for all smooth wall (noncorrugated) pipes including Concrete and Plastic. The "Concrete" and "Plastic" settings are not used – pipes of those materials should be set to "Steel". Corrugated Wall pipes are stored in the "Aluminum" material setting.

🔏 Drainage Library\Bentley\GEOPAK\V8.11\bin\default	x
File Edit Rainfall Land Use Nodes Link Aluminum tion Shape: Arch Material: Concrete Type: Standard Element ID Steel tion	
	*

Chapter 3: Nodes

A node represents any new or existing catch basin, drop inlet, junction, open-end pipe or outlet. Each has a cell symbol through GEOPAK that represents that particular node. All nodes appear large in the Drainage Library, but some intentionally plot as a dot and are only visible when you zoom in closely. Outlets, pipe ends, and existing structures do not need a visible mark. Outlets and pipe ends are defined by the line drawn for the pipe. Existing structures are already defined by the Roadway Designer and we want to avoid an overlap of cells. All nodes will have a visible label when placed, and you can always select a node by its label.

Note that GEOPAK Drainage does not automatically space your basins; you must use our spacing charts. To aid in finding low and high points, use the COGO tool.

1. COGO

In December 1998, we were advised to use COGO to locate high and low points on the centerline profile of the road. You can utilize this information to space your basins.

Applications Drainage Window	w <u>H</u> elp <u>A</u> xiom			
GEOPAK F GEOPAK DRAINAGE GEOPAK LANDSCAPE		ર્ચ ા ⊡ ⊞ - ⊚		
GEOPAK ROAD	GEOPAK ROAD Tools			
GEOPAK SITE GEOPAK SURVEY GEOPAK WATER SEWER	Project Manager Acti <u>v</u> e Chain Control GEOPAK Element Attr <u>i</u> butes GEOPAK 3PC AdH <u>o</u> c Attribute Manager			
	User Preferences			
	<u>G</u> eometry >	<u>C</u> oordinate Geometry		
	Design & Computation Manager Quantity Manager	<u>G</u> raphical Coordinate Geometry Layout Alignments <u>H</u> orizontal		
	Plans Preparation DTM Tools 3D Tools	<u>S</u> tore Graphics <u>A</u> uto Store Graphics Subdivision <u>Wi</u> zard		
	Utilities	Layout Profiles (<u>V</u> PI Based) Layout Profiles (Component Based)		
	Help	Legal Description		
	About GEOPAK	<u>n artertenanti (24 Metzika</u> S		

The program is under GEOPAK Road instead of GEOPAK Drainage. To open this go to **Applications>GEOPAK Road>Geometry>Coordinate Geometry**. In the Coordinate Geometry box choose the Magnifying Glass button by **Job Number** and select the GPK file. The **Operator Code** is the county number. Do not fill in the other boxes.

Coordinate Geometry	🥂 Pr 🗕 🗖 🗙
Project Name:	× 🖻
Job: 779 Q	Profile
Operator Code: 01	DOUGWAYNEEX
Subject:	GRAV
OK Cancel	KENTUCKYEX LINEAEX

Open **Element>Profile>Utility**. Obtain the centerline profile and left and right top of curb profiles from the spreadsheet the Roadway Designer emailed, choose one from the list and select the **Print** button. The information will appear in the window. All low and high points for that profile will be marked accordingly. Repeat the process for the two remaining profiles.

📈 Coo	ordinate Ge	cometry Job: 779	Operator: 01					
File	<u>File Edit Element View Tools</u>							
R								
Tempo	orary Visualia	zation 🔻 OFF (Fe	ature) 💌 🖪	rowse OFF (Description)	▼ 99.12	234 🔻 9^9'9.12"	
	>>							
COGO I	Key-in: Prin	nt Profile DOUGWA	YNEFP					-
								A
<*	1	Print Profil	e DOUGWAYNE	FP				
II								
Begi	nning p.	\						
		STATION	RLEV	GRADE	TOTAL L	BACK L	AHRAD T.	
		Dimion	2221	0.0100	1011111 11	Dirott D		
VPI	1	10+35.50	44.8400					
VPC		10+50.00	44.8217	-0.1260	K = 17.8			··· =
Low	Point	10+52.24	44.8203					
VPI	2	10+75.00	44.7902		50.0000	25.0000	25.0000	
VPT		11+00.00	45.4610	2.6829				
		11105 00		0.0000		00D - 400		
VPC	0	11+25.00	46.1317	2.6829	K = 7.3	SSD = 403	.2	
VPI	3	11+35.00	46.4000		20.0000	10.0000	10.0000	
High	Point	11+44.56	46.3940	0.000				
VPT		11+45.00	46.3939	-0.0610				
WDT	4	11+77 09	46 3742	-0.0610				
VPI	4	11+77.09	40.3/43	-0.0610				
Endi	ng profi	le DOUGWAYNEF	P descripti	on				
	ang prote							· · · · · ·

To print, highlight the data, then right click, then choose **Copy**. Paste the information into a text file or word processor so you can remove unnecessary information before printing as normal for text documents.

2. New Nodes

It is best to place all of your nodes for a system before adding links; then if you need to add more nodes you can do so without having to move links.

To add nodes go to **Drainage>Component>Node>Add**. The "Add a New Node" dialog will open for each Node asking for a Node name prefix and number. The nodes number automatically by increasing linearly from 1 to 10000.



Notice in the **Node ID** that it is using the default that you set in Preferences. You may need to change this. The following chart will aid you in the naming conventions:

Node Type	ID Prefix
CB Type 16,17,18,1,9,12,14,15, 25	СВ
DI	DI
Tee Joints	Т
MH, JB	J
Dummy Nodes	DN
Outlet	OP
Water Quality Structure	WQS
Bends (15,30,45,90)	В

Wye	W
Multi-grate	MG
Rebuild Existing Structure	RB

Existing Node:

Node Type	ID Prefix
All CB, DI, Tee Joints, MH, JB, Dummies*, Outlets, Water Quality Structure, Bends, Wye	EX

* A dummy node defines pipe ends. It can also represent existing structures that do not have cells; however, cells do exist for existing manholes, drop inlets, and catch basins.

3. Properties

Set the Properties of the Node (the Description field is optional):

3 Node Configura	tion - Properties	
Node ID	💽 🕨 🗖 Window Center 📷 🙍	🏂 📓 🚳 🛛 Apply
- Details		
Options Properties Location Spread Criteria Elevations Junction Loss Discharge Options	Description: Node Type: Other Profile: On Grade Library Item: C.B. TYPE 16	2
and an experimental states and the	Node Bottom: None Available Solution: None Available Override Library Payitem:	Align

1	Node Type	Choose the appropriate "Node Type", "Profile", and "Library Item" to be placed from the Drainage Library
2	Preview	Ensure the correct cell is shown in the preview window



If placing a Tee or a Bend, initially choose the Tee or Bend that has the description "generic". After the design is finalized go back and reselect the Library Item to the correct size of Tee or Bend. Make sure you adjust the inverts at the Tees if you have a different trunk line pipe size. For Tees, the trunk line is listed first and the stub is second. If you are entering the outlet node, this is where you would define the tailwater.
4. Location

Set the Location of the Node:

Mode Configuration	- Location
Node ID 4 CB-201	🔹 🕨 📄 Window Center 📁 🍺 🏂 🎲 Apply
Details	
Options	Chain: US17A (1) V Profile: TOCRTUS17A (2)
Properties	Coordinates / Stationing
Location 3	Align: Tangent on Element 💌 💉 + Angle: 125.823
Elevations	Station: 250+10.00 🔨 ± X: 2273426.188
Junction Loss	☐ Offset: 49.924
Discharge Options	Mirror Node Offset from Gutter to Inlet: 0.000
Compatations	

1	Chain	Use the pulldown arrow to select the correct chain name. This information comes from the GPK File that you downloaded, and the Roadway Designer will list in the spreadsheet what chain represents which road. If you are placing a node on a side road make sure to use the corresponding side road chain name.
2	Profile	Use the pulldown arrow to choose the correct profile name. Once again this information will come from the GPK File, and the Roadway Designer will list in the spreadsheet the names of the left and right top of curb grades. You will use top of curb grades to define the starting elevation of the catch basin for all basins on curb.
3	Alignment	Set the Align to Tangent on MS Element for all nodes that will be flush with the Face of Curb (FOC). Then click the Select button by Tangent on MS Element and select the FOC line which will also automatically set the offset distance.
4	Placement	Either enter the Station value or click the large PD button to dynamically place the node cell

To be consistent with the Roadway Designer the following picture represents where the cell should actually be placed when on the curb. If you place nodes as instructed previously, the cells will match perfectly with the FOC as shown below:



The image below exhibits how to place a drop inlet against the fill. Offset the inlet approximately one foot from the toe of fill. You don't need to measure the one foot distance, just get close; the important thing is to provide a little space between the inlet and the slope. This avoids cutting into the slope to install the drain and reduces sediment flow into the storm system.



The image below exhibits how to place a cell at a radius. Place the beginning of the throat at the radius point allowing the entire inlet to be constructed along the tangent section outside of the radius.



We need every cell in its proper location because the Roadway Designer cannot move our cells around; this would violate our design and they will have trouble with labeling. Please be conscientious with every cell location. Once you get a feel for it, it will not take but a second to get the cells located correctly.

5. Spread Criteria

N/A for SCDOT Drainage design.



SCDOT does not enter any information in this window. An error message may appear due to spread. This message should be ignored.

6. Elevations

Set the Elevation of the Node:

Node ID	<u>_</u> €	Window Center	<u>`@`}@`@@</u>	Apply
Details	101			
Options	Reference Surface:	TIN File 🔻 🗔	lone>	- a(1
Properties	Elevation Source:	Reference PGL	957.973	
Spread Criteria	Node Elevation Option:	Same as Source	957.973	0
Elevations	Vertical Alignment:	Match Soffit		_ (
Junction Loss Discharge Options	Minimum Depth:	2.000 5		
Computations	Maximum Depth:	10.000 (6)		

1	Reference Surface	If using a TIN file enter it here, otherwise leave blank
2	Elevation Source	Select "Reference PGL"; an elevation will automatically appear (this is the top of curb elevation and it is read from the Profile you entered previously in the Location option). If the cell is not on the curb, you will need to choose "User Supplied" and enter the elevation. For a drop inlet enter the ground elevation. The outlet is discussed in detail under Networks. A stub out or open end pipe elevation will be determined following the same procedure used for the outlet.
3	Node Elev. Option	Set to "Same as Source";
4	Vertical Align	Start with "Match Soffit" but change as needed to represent drop manholes, to match flowlines with other systems, etc.
5	Min. Depth	The Min Depth varies per Node type (see table below)
6	Max. Depth	Enter 10'. If you get a warning message, you have exceeded your maximum depth; in this case special consideration will be required with the road designer.

NODE	Min. Depth		
	From TOC	From Ground	
Water Quality Structure	-	0.0'	
CB 1, CB 15, CB 16, DI 115	2.0'	-	
CB 17, CB 18	3.0'	-	
DI 24x24, DI 24x36, DI 112	-	1.0'	
СВ 9	-	2.0'	
MH, CB 25	-	3.0'	
Outlet, Dummy	0.0'	0.0'	

For a double CB25, the minimum cover should be measured from the lower pavement elevation as shown below. This works for grade separations of up to 18".



For grade separations larger than 18", the designer should only use single CB25s. If drainage is needed on both sides of the barrier/wall,

- Design parallel drainage on both sides of the wall.
- Minimum cover is 3' from lower grade for pipe on lower side.
- Minimum cover is 3' from upper grade for pipe on higher side.
- Stagger Stations of catch basins at least 100' (only box on one side is allowed in any given cross section)
- See Standard Drawings for Concrete Gravity Retaining Walls for additional restrictions (when available).

For walls taller than 6', the hydraulic designer should work with the Structural Engineer to identify maximum box depth on the high side of the wall so the box and pipe do not conflict with the retaining wall footing.

7. Junction Loss

Set the Junction Losses (use the Defined Equations option as shown below):

8 Node Configurati	on - Junction Loss	
Node ID	➡ ➡ ₩indow Center 🙍	n 📷 📷 🏤 🛛 Apply
Details Options Properties Location Spread Criteria Elevations Junction Loss Discharge Options Computations	 Defined Equations Equations x Loss Reduction: Absolute Loss: Supplied K - Outlet Velocity: Supplied K - Change in Velocity: None 	0.000 0.000 0.000 0.000

8. Discharge Options

Set the Discharge into the Node:



Discharge Set to "Use Computed Discharge" for almost all situations so the discharge from the associated area is directed towards the node.



Some drop inlets and cross line pipes require a "Supplied Discharge", in which case enter the discharge value in the key-in field.

9. Computations

Note that the Computations Option is greyed out. Since SCDOT does not let GEOPAK calculate the spread, this option will *not* be available. Otherwise, view the computations.

Node ID 4 CB-1	✓ ✓ ✓
Options Properties Location Spread Criteria Elevations Junction Loss Discharge Options Computations	 Use Computed Discharge Supplied Discharge: 0.000 Disable Inlet Calculations Capacity: 0.0000 Link Drainage Area: None Available 2 20



The Edit Area button (to the left of the Apply button in the above picture) opens the **Drainage Area Definition** window. Use this to create an associated drainage area if your node collects water discharged from one. Junctions, outlets, and water quality structures cannot collect water. When you select this button it will tell you that this area does not yet exist and ask if you want to create it. Answer "yes". The **Add a New Area** box will appear. The **Area ID** is whatever you named the node; do not change this. You can add a description if you desire, but it will only be used to describe the area and not the node.

Alert	
Drainage area [CB-926] not in project. Do you wish to create a new drainage area?	Add a New Area
	Area ID: CB-926
	Description:
Yes No	OK Cancel

Chapter 4: Areas

See the individual Area options below.



SCDOT uses the "Rational Method" only.

1. Definition

Define the Drainage Area:

Contrainage Are	a Definition		
Area ID: 🔳 🛄		Window Center 🔬 🔬	🔏 💧 Apply
Details			
Options	Description:	To Node II	D: CB-1 🏻 🏄
Definition Subareas Computation	Drainage Area: 0.250 1 Base C Value: 0.900 Time of Conc.: 5.000	Area Selection / Creation Select Shape	Create DTM Shape
Hydro. Method Rational SCS	Compute TC	Pick Boundary Elements	DP Create Shape

There are four methods of inputting areas for a basin; use one of the two below, or for more info see the Bentley Geopak Drainage Manual.

1	Drainage Area	Just key-in the acreage in the key-in field
2	Select Shape	Draw a MicroStation closed shape, then click the Select Shape button, identify and accept the shape, and the acreage key-in field will automatically populate with the acreage value.



Enter the **Base C Value**, and the **Time of Concentration**. Disregard the **Compute Tc** button.

2. Subareas

Set the Drainage Area's subareas options. This process assigns new C values to pieces of the overall Drainage Area set in the Definition option and provides a final composite C value for the total area. Any remaining area not explicitly defined in this section is left as the C value set in the Definition option.

名 Drainage Area	Subareas 📃 🗖 🔀
Area ID: (CB-1	✓ Mindow Center → Highlight → Apply
Details	
Options	To Node ID: CB-1 🥠
Definition Subareas Computation	Subarea C Value Description Automatic Delineation
P Hydro, Method ● Rational ● SCS	Display Only

There are three methods of inputting subareas into a basin; use one of the two below, or for more info see the Bentley Geopak Drainage Manual.

1	Manually	Just key-in the subarea acreage into the first key-in field, the "c" values in the second, and any desired description in the third, and use the add/modify/delete buttons to effect the entries in the list
2	Automatically	Click the Automatic Delineation button, which initiates a scanning of the DGN file and reference files within the main drainage area for closed shapes matching the symbology of the Library Land Uses as selected in the Preference Land Use Option, and automatically populates the Subarea Table.

Subareas can be drawn on the appropriate symbology for or have the symbology assigned after drawing. To assign land uses to existing, closed shapes in the design file, select Component > Land Uses:



Ð	MS select the shape	Data point on the drawn shape, and again to accept, which will modify the shape's symbology to that of the designated land use.



Once the closed shapes are designated the correct symbology above, use the **Automatic Delineation** button in the Subareas tab to delineate them.

3. Computation

Check the Computation option, as shown below:

Area ID: 🔳 CB-1	•	☐ Window C □ Highlight	Center 🔬 🙆 👌	🖌 👸 Apply
Details				
Options		Area	C Value	Computer of
Definition Subareas	Total Subareas:	0.000	0.000	Discharge
Computation	Remainder:	0.250	0.900	
Hydro. Method	Composite:	0.250	0.900	
Rational	Computed Intensity:	7.068		
O SCS	Computed Discharge:	1.590 (2)		

1	Compute Discharge	Click the Compute Discharge button to initiate the computations
2	Results	Verify the Drainage Area computation results in the <i>read-only</i> dialog



This is just the discharge value for this individual node, and *not* the discharge in the pipe.

Example:

The image below shows a hypothetical drainage basin divided into sub-areas. The majority of the basin is open land. The basin also contains buildings, paved roadway, and wooded areas. First, the overall basin must be delineated using the MicroStation Place Smartline tool and the primary land-use for the basin determined – in this case, the land use of the majority of the basin is Flat Lawns, Sandy Soil. The sub-areas with different land uses from the primary area must also be delineated and the smartlines set to the appropriate colors and level using the Land Use Boundary Tool as described in Chapter 4, Section 2.



Open the Drainage Areas window (Drainage -> Components -> Areas -> Add) and create a drainage area to represent the basin. In the Definition submenu, click the Select Shape button and choose the shape delineating the overall basin. The Drainage Area, Base C Value, and Time of Concentration forms will be filled in automatically. Change the Base C Value to 0.10, as the majority of the basin is Flat Lawns, Sandy Soil.

Area ID: Image: Window Center Highlight Image: Window	Drainage Area D	efinition		_ _ X
Details Options Description: To Node ID: 1 Image ID: 1 Definition Drainage Area: 56.634 Area Selection / Creation Subareas Drainage Area: 56.634 Select Create Computation Time of Conc.: 5.000 Shape DTM Shape Hydro. Method Compute TC Pick Boundary DP Image SCS SCS Create Shape DP	Area ID: 4	▼ ► □ V	Vindow Center 🐴 🚷	🆄 🖓 🗛 Apply
Options Description: To Node ID: 1 Image Instant Definition Drainage Area: 56.634 Area Selection / Creation Subareas Subareas Computation Select Create Mydro. Method Compute TC Pick Boundary DP Image ScS SCS Create Shape DP	Details			
Definition Drainage Area: 56.634 Area Selection / Creation Subareas Base C Value: 0.100 Select Create Time of Conc.: 5.000 Shape DTM Shape Hydro. Method Compute TC Pick Boundary DP Rational SCS Create Shape DP	Options	Description:	To Node	ID: 1 🦓
Hydro. Method Compute TC Pick Boundary DP Image: Stress st	Definition Subareas Computation	Drainage Area: 56.634 Base C Value: 0.100 Time of Conc.: 5.000	Area Selection / Creat Select Shape	Create DTM Shape
	Hydro. Method Rational SCS	Compute TC	Pick Boundary Elements	DP Create Shape

On the Subareas submenu, click the Automatic Delineation button. The subareas list will be populated with the total area associated with each land use.

🔀 Drainage Area Su	ubareas	and a	Sec.		×
Area ID: 4		• •	Window Center 🐁 🚷	8	Apply
Details					
Options			To Node	ID: 1	<i>4</i> 10
Definition	Subarea	C Value	Description	1	
Subareas	6.3062	0.900	Flat Pavements Roofs	1	Automatic
Computation	18.3230	0.100	Flat Woodlands Forest	2	Demineation
					Display Only
Hydro. Method				X	
Rational					
222					
0.000	18.323	0.100	Flat Woodlands Forest		
<u>[</u>					

The Computations submenu shows the composite area representing the entire basin and its C-value. When the drainage area is linked to a node, Geopak will use these values to calculate the discharge into the storm system.

🗾 Drainage Area C	omputations					
Area ID: 4		Window Center	ක් කි	8	۹	Apply
Details	_					
Options		Area	C Value	ſ	C	mouto
Definition Subareas	Total Subareas:	24.629	0.305		Dis	charge
Computation	Remainder:	32.004	0.100			
Hydro. Method -	Composite:	56.634	0.189			
Rational	Computed Intensity:	0.000				
SCS	Computed Discharge:	0.000				
					_	

Chapter 5: Links

Links can be pipes or ditches. At SCDOT, the Geopak Drainage ditches are used for analyses only and not for auto-designing.

There must be two nodes of any type already placed in order to define a link.

To add a link, go to **Drainage>Component>Link>Add**. Select a link name as stored in the **Preferences** for the prefixes shown below (the numbering will be auto-sequenced):

DRAINAG	E - Drainage	.gdf - [No	Active	Network]	
<u>P</u> roject	<u>C</u> omponent	<u>N</u> etwork	Report	ts <u>U</u> tilities	<u>T</u> ool Boxes
	<u>A</u> rea				
	<u>N</u> ode				
	<u>L</u> ink		•	<u>A</u> dd	
	Profile		•	<u>E</u> dit ID	
	<u>C</u> ulvert		•	Delete	
	<u>R</u> outing		•	— <u>R</u> ename	
	Land <u>U</u> ses		-	Update All	
	<u>M</u> iscellaneo	us Utilities	•	Update wit	h <u>P</u> ay Items

New Pipe	NP
Relay Pipe	RP
Existing Pipe	EP
New Ditch	ND
Existing Ditch	ED

1. Definition

Set the Link Definition option as shown below (Description field is optional):

8 Link Configuration Definition	
Link ID: NP-1 Kindow Center	
Details Options Description: Options From Node: CB-1 1 1 1 To Node: CB-2 2 Conditions 3 Length: 84.5141 Use MS Element 1 <td></td>	
Type 5 Design Size Size: 18" R.C. PIPE Select ● Pipe 6 Design Barrels Number of Barrels: 1 Topic ● Ditch 7 Override Library Payitem: 714EP	:t [0.012

1	From Node	Select the Upstream Node
2	To Node	Select the Downstream Node
3	Length	The length is automatically displayed as the distance between the From and To Nodes
4	Shape/ Material	Set the Shape to "Circular" and the Material to the appropriate type from the Drainage Library.
5	Design Size	Toggle ON for new pipe (NP); or toggle OFF for existing pipe (EP or RP) and click Select to pick the size from the Drainage Library
6	Design Barrels	Toggle OFF. Set to 1 for new pipe (NP), or to the number of existing barrels for existing pipe (EP or RP).
7	Override Library Payltem	If your link is an existing pipe (EP) then check the box beside Override Library Payitem and type 714EP in the space provided. This will prevent the Roadway Designer from overriding the existing pipe line style with the new pipe line style.

***Note**: Refer to SCDOT Standard Drawings for fill height limitations for specified pipe. Where possible, keep pipe between the minimum and maximum fill height appropriate for each material. Keeping cover over pipe between 3' and 10' for most installations will allow one of each alternate pipe available to the contractor.

Work with road designer when establishing pipe depth, particularly when pipe will be very shallow (<3' cover) or very deep (>10' cover). Shallow pipe may also present complications with drainage structures (see section V.D.4). Road designer will determine required class, gage, or type based on fill heights listed in SCDOT Standard Drawings.

Ріре Туре	Standard Drawing #
RCP	714-205-01, 714-205-02
SRAP	714-605-01, 714-605-02
HDPE	714-705-01, 714-705-02
СААР	714-810-01, 714-810-02

2. Conditions

Set the Conditions of the link (for the **initial** design only, *do not* hold any of the conditions. If you use existing pipes, then they will need to be held):

Link ID: 📕 NP-1	<u>•</u>		w Center 🗾 Ż	🎽 📝 🛛 Apply
Details Options Definition Conditions Constraints Computation	- Profile Conditi Min Cover: Soffit: Invert:	ons From Node 1 955.973 955.973 Г 954.473 Г	Slope 2 0.693 0.693 Г	To Node 3 955.360 955.360 953.860
Type Pipe O Ditch	Max Depth:	947.973	0.128	947.860

1	From Node	After the initial design, and only if necessary, toggle ON to set and hold the Invert or Soffit of the pipe. It is better to hold the Soffit and do not hold both.
2	Slope	After the initial design, and only if necessary, toggle ON to set and hold the pipe slope.
3	To Node	After the initial design, and only if necessary, toggle ON to set and hold the Invert or Soffit of the pipe, it is better to hold the Soffit and do not hold both.



The values for **Min Cover** and **Max Depth** come from the Node elevations. You can also make adjustments through the **Profile** window. Use this window to define the downstream outlet pipe elevation; as discussed in **Networks.**

3. Constraints

Set the Link Constraints (use the values shown below for English units):

Details	- Design Constraints		
Definition	Minimum	Maximum	
Conditions	Rise: 1.500	7.000	
Constraints	Slope: 0.300	10.000	
Computation	Velocity: 3.000	20.000	
Г Туре			
Pipe			
O Ditch			

These values should **always** be used for the initial design; you may have to change the minimum slope or min/max pipe sizes later, but *only* for projects with design exceptions.

4. Computation

View the read-only Computations as shown below:

Link ID:	✓ Window Center	🗡 🚀 🛛 Apply
Details Options Definition Conditions Constraints Computation Type	Flow is supercritical Discharge = 1.590 Capacity = 10.187 Rise = 1.500 Roughness = 0.012 Slope = 0.693 Friction Slope = 0.696 Critical Slope = 0.416	

After you add the network, and then perform a design, computations and errors for this individual pipe appear in this window.

Chapter 6: Non-Network Pipes

The following procedures are used to draw, label and report on drive pipes or cross pipes.

1. Add Nodes

To add nodes go to **Drainage>Component>Node>Add**. The "Add a New Node" dialog will open for each Node asking for a Node name prefix and number. The number automatically increases for each node up to 10000. These instructions will place the upstream node for the pipe. Repeat them for the downstream node when you are through.

DRAINAG	iE - Drainage	.gdf - [No	Active	e Network]				
Project	Component	<u>N</u> etwork	Repor	ts <u>U</u> tilities	<u>T</u> ool Boxes			
	Area		+				 	
	<u>N</u> ode		•	<u>A</u> dd	•			
	Link		+	<u>E</u> dit		Ī .		
	Profile		•	ID Delete				
	<u>C</u> ulvert Routina)	<u>R</u> ename				
	Land Uses <u>Miscellaneous Utilities</u>			Update All Update wil	th <u>P</u> ay Items			

Set the Properties Options:

📕 Node Configuratio	n - Properties	
Node ID	💌 🕨 🗌 Window Center 🗽 😹 🔭 🧖 🐔	Apply 3
Details		
Options	Description:	
Properties Location Spread Criteria Elevations Junction Loss Discharge Options	1 Node Type: Other Profile: On Grade 2 Library Item: DUMMY JOINT	
Computations	Node Bottom: None Available Override Library Payitem:	Align

1	Node Type	Set to "Other"
2	Library Item	Set to "DUMMY JOINT"
3	Apply	Click the Apply button to accept the Properties.

Set the Location Option:

Node ID 4 DI-632	🔽 🕨 Window Center 📁 🏂 🏂 🐞 Apply 🌔
Details Options	
Properties Location	Coordinates / Stationing
Spread Criteria Elevations	Align: Tangent to Chain
Junction Loss Discharge Options	V Offset: -36.500 Y: 1093570.076
Computations	

1	Chain	Use the pulldown arrow to select the correct chain name. This information comes from the GPK File . If you are placing a node on a side road make sure to use the corresponding side road chain name. Turn off the curb profile option for dummy nodes.
2	Station DP	Click the Station DP button, move the cursor to place the upstream dummy joint at the upstream entrance of the driveway pipe.
3	Apply	Click the Apply button to accept the Location.

	Node Configuration - Location
FO	Node ID DN-900 Window Center Image: Station Apply Details Image: Station Image: Station
Click here to place the node	<u>C 44</u>



Repeat this **Node>Add** procedure for the downstream pipe location, so you'll have 2 Nodes for each Link.

2. Add Link

To add a link, select **Drainage>Component>Link>Add** and give it a name:



Set the Definition Option:

From Node

Link ID: 4 DP-4	01 🔹 🕨 📔 Window Center 🦅 🏏 💥 🥢 📝
Details	
Options	Description:
Definition	From Node: DN-401 (1) - 🍺 To Node: DN-402 (2)
Conditions	Length: 0.0000 III Use MS Element III
Constraints	Configuration
Computation 3	Shape: Circular 🔻 Material: Concrete 💌
Туре	Design Size Size: 24" R.C. PIPE 4. Select
Pipe	Design Barrels Number of Barrels: 1 Roughness: 0.0
Oitch	Override Library Pavitem:

SCDOT Specifications and Support Manual for GEOPAK Drainage Last printed: 12/20/2019 Page 58

Select the Upstream Node

2	To Node	Select the Downstream Node
3	Shape/ Material	Set the Shape to "Circular" and the Material to the appropriate type from the Drainage Library
4	Design Size	Toggle OFF, and click Select to pick the size from the Drainage Library
5	Apply	Click Apply to accept the Pipe Definition.



Continue adding Nodes and Links for the rest of the driveway or cross pipes.

3. Label Plans

The plans are now ready to be labeled using the Drainage Labeler.



Since only a few Node and Link variables were set, only certain label variables will be available for driveway or cross pipes.

Chapter 7: Networks

The network includes all areas, nodes and links connected to a single outlet node. GEOPAK Drainage can handle any number of networks in one GDF file. To add a network select **Drainage>Network>Add**.

0	G DRAIN	IAGE - S62 50	Oyr 60rev.g	r 60rev.gdf - [No Active Network]						
	Project	<u>C</u> omponent	<u>N</u> etwork	Reports	<u>U</u> tilities	Tool Boxes				
-			<u>A</u> dd							
			<u>E</u> dit							
			<u>D</u> elete							
			<u>R</u> ename Design							
						Add a New Net				
			Analyze			1 Network ID: Network-2				
			Antine	Victoria		2 Description:				
			Active I	Velwork		🗙 Outlet Node: OP-201 🔹 📩				
						OK Cancel				

1	Network ID	Name the network based on the names of its Outlet. A network ending at Outlet OP-201 would be Network-2.	
2	Description	If there are multiple roads on a project put the road name in the description that matches the outfall station.	
3	Outlet Node	Select the Outlet Node connected to the rest of the components contributing flow to this outlet.	
Click OK to add the Network to the GDF File, else Cancel .			



If changes are made to the components the network will need to be redesigned or reanalyzed.

1. The Network Dialog

The Network Configuration dialog is split as shown below; top half for navigating and bottom half (Details) for input of data and computations:

Scroll Back Scroll Forward Add Network	Delete Network Rename Network Set Active Network
Network ID: Net-1	
Details Description: C	Jutlet Node: OUTLET
Validation	Lock Sizes Unlock Sizes Lock Elevations Unlock Elevations
Build Network Highlight Network Design Network Anal	/28

2. Activating Networks

A Network should be activated prior to a Design or Analysis; select <u>Network > Active</u> <u>Network</u>:



3. Designing Networks

Designing a Network computes the hydrologic and hydraulic parameters of the Network, and *automatically sets* any unheld node or link elevations.

There are two (2) methods to Design a Network:

Method 1: From the main menu bar, select <u>Network > Active Network</u>:

DRAINAG	RAINAGE - Drainage.gdf · [No Active Network] 1						
Project	<u>C</u> omponent	<u>N</u> etwork R	Reports	<u>U</u> tilities	Tool Boxes		
		<u>A</u> dd	H				
		<u>E</u> dit					
		<u>D</u> elete					
		<u>R</u> ename					
		De <u>si</u> gn	3				
		Analyze	9				
		Active <u>N</u> el	twork	2			

1	Active Network Indicator	This field will display the Active Network
2	Active Network	Select the Active Network on which to perform the design.
3	Design	Click to Design the activated network.

Method 2: Select Network>Edit:

Use the workflow below:

1

SNetwork Configuration - [Net-1]	
Network ID: 📕 Net-1	🛐 🌋 💓 🚺 🛛 Apply
Details Description: Validation Validation Details Validation Validation Validation Validation Validation Validation Validation Validation Validation	Outlet Node: OUTLET Lock Sizes Unlock Sizes Lock Elevations Unlock Elevations





A "Successfully Built" message should ensue, otherwise see the **errors** section.



2	Highlight Network	<i>(Optional)</i> Click Highlight Network to MicroStation- highlight all the components contributing flow to the Outlet Node.
3	Design Network	Click Design Network to design the components of the GDF project.



A "Successfully Computed" message should ensue, otherwise see the errors section. Drainage Warning/Error messages are reported for all components in the GDF project and are stored in the drgmsg.txt file in the Working Directory.

Active

Active

Network

Analyze

Network

Indicator

(1)

2

4. Analyzing Networks

Analyzing a Network computes the hydrologic and hydraulic parameters of the Network, but does *not* set any unheld node or link elevations and is useful for determining effects of various storm events on existing networks.

There are two (2) methods to Analyze a Network:

DRAINAG	DRAINAGE - Drainage.gdf · [No Active Network] 1				
<u>P</u> roject	<u>C</u> omponent	Network Reports	s <u>U</u> tilities <u>T</u> ool Boxes		
		<u>A</u> dd			
		<u>E</u> dit			
		<u>D</u> elete			
		<u>R</u> ename			
		De <u>si</u> gn (3)			
	_	Analyze 💙			
		Active <u>N</u> etwork	2		

Select the Active Network on which to perform the design.

This field will display the Active Network

Click to Analyze the activated network.

Method 1: From the main menu bar, select <u>Network > Active Network</u>:

	1							
Method 2: Select Network > Edit:								
	DRAINAGE	- Drainage	.gdf - [Net	-1 Activ	/e]			×
	<u>P</u> roject	<u>C</u> omponent	<u>N</u> etwork	R <u>e</u> ports	<u>U</u> tilities	<u>T</u> ool Boxes		
			<u>A</u> dd					
		∕ ∞ [<u>E</u> dit					
			<u>D</u> elete					
	OR		<u>R</u> ename					
			De <u>s</u> ign					
		- N	Analy <u>z</u> e					
			Active N	etwork				

Follow the workflow below:

	8 Netwo	ork Configuration - [Net-1]	
	Network	ID: 📕 Net-1 💌	🕨 💉 🚿 😭 🛛 Apply
	Details D Va	escription: Computation	Outlet Node: OUTLET2 Image: Constraint of the second seco
1	Build Network	Click Build Networ l connectivity contribution	k to build the component uting flow to the Outlet Node
	A "Succes	sfully Built" message sh Information Network Net-1 Succe Total Node in Networ Total Links in Networ	$\begin{tabular}{l}{llllllllllllllllllllllllllllllll$
2	Highlight Network	<i>(Optional)</i> Click highlight all the Node	Highlight Network to MicroStation- components contributing flow to the Outlet
3	Analyze Network	Click Analyze N GDF project	letwork to analyze the components of the



A "Successfully Computed" message should ensue, otherwise see the errors section. Drainage Warning/Error messages are reported for all components in the GDF project and are stored in the drgmsg.txt file in the Working Directory.

5. Outlet Definition

Several references have been made to defining the outlet in this document. The outlet is the only node where you have a set elevation that you must match. You want the pipe invert equal to the outfall invert. Below is the full explanation on how to do this. GEOPAK Drainage wants an envelope defined for every node. This envelope is a vertical range that Drainage can use to place the pipe:



The pipe, regardless of its size, will fit within these limits that you set. Each node has an envelope, but the outlet envelope is much harder to define.

In the node box under **Elevation**, the **Elevation Source** and **Minimum/Maximum Depth** defines the envelope (Figure 2). The program takes the **Elevation Source** and subtracts the **Minimum Depth**. This is the top of the envelope and the highest elevation where the soffit of the pipe can be located.



The program then takes the **Elevation Source** and subtracts the **Maximum Depth**. This is the bottom of the envelope and the lowest elevation where the flow line of the pipe can be located. This process is called building the envelope.

For all nodes but the outlet, the **Elevation Source** is easily defined as either the top of curb or ground elevation. The outlet, however, does not have a set elevation above the soffit. The pipe is out of the ground, and the ground elevation is at the bottom of the pipe. The top of the envelope has to be defined with an assumed elevation.

The following steps will aid you in building the envelope for the Outlet:

1. Open the Node window for the outlet.

2. Put 0.00 as the **Minimum Depth** in the **Node** window under **Elevations**. This means the program will not have to subtract anything to get the top of the envelope.

3. Put what you normally would for the **Maximum Depth**. This will define the bottom of the envelope. This will be below the known flow line elevation, but this will not cause a problem.



4. Assume an **Elevation Source**. Most of the time you have a good idea of the outlet pipe diameter by looking at the area draining to your system. If you have 800' of road drainage, an 18" pipe will probably do. In this case you would add 1.5' to the outfall invert or flow line and enter this as the **Elevation Source**.

5. Open the Links box for the last link of our system.

6. Take the elevation that you calculated for **Elevation Source** and enter that value as the downstream soffit elevation in the **Conditions** window.

Run the Design process for the network and check the invert elevation of your outlet pipe. If you guessed a pipe size too large, then your pipe is not flush with your outfall invert. Go back to Links>Constraints and change the soffit elevation. If you guessed a 24" pipe and it designed 18", subtract 0.5' from your original input.

If you guessed a pipe size too small, then your pipe invert is underground. Go back and change your Elevation Source under Node>Elevations. Use this value under Links>Constraints as your new soffit elevation. If you guessed an 18" pipe and it designed a 24", then add 0.5' to your original input.

It is possible to have the limits of the envelope above and below the pipe with the pipe not coinciding with either limit.

Chapter 8: Profiles

GEOPAK Drainage can draw the entire profile of a storm sewer very quickly and is an easy way to determine if you are surcharging nodes.

Remember this information is used for evaluation purposes of our storm sewers and *is not* the information that the Roadway Designer will be expected to read.

DRAINAGE - Drainage.gdf - [No Active Network] x Project Component Network Reports Utilities Tool Boxes <u>A</u>rea <u>N</u>ode Link Profile Þ <u>A</u>dd Edit List…りく Culvert Þ ĪD <u>R</u>outing ID <u>Li</u>nk Land Uses Delete Miscellaneous Utilities Update All 😤 Add Profile Auto Create Profile ID: PROF-2 2)Description: From Node: CB-1 To Node: OUTLET2 4 ্ৰ ক 5 Apply

To add and draw a profile, select **Drainage>Component>Profile>Add**:

1	Profile ID	Key-in the Profile name (best not to use spaces)		
2	Description	(Optional)		
3	From Node	Leftmost Node on grid and 0+00 station.		
4	To Node	Rightmost Node on grid and last station.		
5	Click Apply to add the Profile.			



A profile is for a single run of pipe in between any two connected nodes. You *cannot* draw a profile for parallel pipes at once; therefore, draw multiple profiles for a storm sewer system with dual trunk lines.

As the profile is drawn to scale, you can measure distances in between lines. These profiles can also be printed through IPLOT.

1. Registration

The Registration Point determines the location, scale and elevation of the profile:

Bedit Drainage Profile - PROF-2	
<u>F</u> ile	
Description:	View Number: 1 🗾 🔤 🔤 Apply 🔿
Registration Display Drainage Informati	on Grid & Labels Link Profile
1 Registration Point4	Projection
X: 440358.295 DP	Project to Chain: Identify Profile Cell
Y: 1018814.636	Chain :
2 Scale 5	Grid Stationing and Elevations
Horizontal: 10.000	Begin Station: 0+00.00
Vertical: 1.000	End Station: 0+97.21
3 Node Information	Max. Elevation: 1760.000
From: CB-1	Min Elevation: 1720.000
	Reference Surface
Rooot Profile	TIN File 🔻 📃 🔍
- Heset Frome	Vertical Offset: 0.000

1	Registration Point	Set the lower left point (X,Y) on the grid. Click DP and click a point in the drawing to place the grid or enter the coordinates manually.
2	Scale	Set the Horizontal & Vertical Scale.
3	Node Information	From Node = left-hand on grid and $0+00$ station; To Node = right-hand on grid and ending station.
4	Projection	n/a
5	Stations& Elevations	Stationing is <i>read-only</i> . Set the Max. and Min. Elevations to encompass all profiles and surfaces.
6	Reference Surface	n/a
7		Click Apply to draw the profile in the DGN file.

2. Display

Set the Profile's display. Make sure they are all on Level RD_HY_Gpkprofile, but choose whatever color and weight you want.

名 Edit Drainage Profile - PR	OF-2\DrainageProfPref.ppf	_ 🗆 🗙
Eile		
Description:	View Number: 1 🗾 💼	Apply
Registration Display Drain	age Information Grid & Labels Link Profile	
Soffit	Water Line Crossings	
	🔽 🕜 💳 🔽 Label:	L2.34
Pipe Center	Drainage Crossings	
		12:34
	Sewer Line Crossings	
Design Surface	🗹 (9) 💻 🗹 Label:	L2.34
	Misc. Utility Crossings	
		12.34
- Ref Surface	ID: GasLines	

1	Soffit	Top of Pipe
2	Pipe Center	Center of Pipe
3	Invert	Bottom of Pipe (flowline)
4	Design Surface	Proposed Finished Grade (TIN or Model) located in the Preferences
5	Original Ground	Existing Ground (TIN or Model) located in the Preferences
6	Ref Surface	(Optional) 3rd surface from the Registration Tab
7	Water Line Crossings	n/a
8	Drainage Crossings	Toggle ON to show the drainage crossings
9	Sewer Line Crossings	n/a
10	Misc. Utility Crossings	n/a
Click to modify the Profile.		

3. Drainage Information

Select the drainage information to be displayed in the profile view. Make sure they are all on Level RD_HY_Gpkprofile but choose whatever color and weight you want.

名 Edit Drainage Profile - PR	ROF-2\DrainageProfPref.ppf 📃 🔲 🗙
Eile	
Description:	View Number: 1 🗾 🖬 Apply
Registration Display Drain	age Information Grid & Labels Link Profile
Hydralic Grade Line	Maximum Soffit Drainage Node
(1) ▼	
Critical Depth	Minimum Invert
② ਯ ──	
Uniform Depth	Minimum Cover
3 🛛	
Energy Grade Line	Maximum Depth
4 F	

1	Hydraulic Grade Line	Auto-generated Hydraulic Grade Line
2	Critical Depth	Auto-generated Critical Depth
3	Uniform Depth	Auto-generated Uniform Depth
4	Energy Grade Line	Auto-generated Energy Grade Line
5	Maximum Soffit	Maximum elevation of top of pipe
6	Minimum Invert	Minimum elevation of bottom of pipe
7	Minimum Cover	Minimum cover on top of pipe
8	Maximum Depth	Maximum depth of bottom of pipe
9	Drainage Node	Node display symbology in profile view
Click to modify the Profile.		
4. Grids & Labels

Set each option on an individual basis.



Pick from the options and choose whatever looks best to you. You can easily clutter the profile when choosing too many options; so make sure the information chosen will look good printed.

5. Link Profile

This is a powerful tool allowing you to modify the pipe invert elevations and slopes. In the top portion you will see all the pipes in the profile. Highlight a pipe and its invert elevations appear under Details>Node. From there you can manually change the invert and hold it or you can click the Edit Invert button and move the invert on the profile. You also have the option to hold and change the pipe slope.

<mark>8</mark> Edit Dra	inage Prol	file - PROF-1				_ 🗆 🗙	
<u>Fi</u> le							
Description	n:		V	iew Number: 1	리 🔳 🗌	Apply 🕜	
Registratio	n 🗎 Display	Drainage Info	rmation Grid	& Labels Link Pr	ofile		
_ Drainage	Profile Poir	nts ———					
Link ID	Node	Elevation	Node	Elevation	Slope		
SS-6	CB-7	1750.722	CB-6	1746.542	4.630	<u> <u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u></u>	
SS-5	CB-6 (1) 1743.542	CB-2	1739.785	5.322		
SS-2	CB-2	1739.785	CB-1	1734.774	6.947	┚╩║	
– Details			h h a da				
M	NodeNodeNodeNodeNode						
2 Mill: Covel: 1740.042 3 Mill: Covel: 1744.203 Hold Invert: 1743.542 ♦ 1 Hold Invert: 1739.785 ♦							
Drainage Library Item 5 Hold Slope: 5.322 54" RCP (CL IV)							
				🗖 Cent	er View: 1	-	

1	Link ID	Highlight the Link ID in the list
2	Node	Use the button to dynamically adjust the vertical invert in profile view; or key-in the "Hold Invert" elevation then toggle ON "Hold Invert".

3	Node	Use the button to dynamically adjust the vertical invert in profile view; or key-in the "Hold Invert" elevation then toggle ON "Hold Invert".
4	Drainage Library Item	n/a
5	Hold Slope	Toggle ON and key-in a slope value.
6	Modify	Click the HModify button to change the Link.
7	Click Apply	to accept the revision, redesign the Network, and redraw the Profile.



If a change is made, the Network should be redesigned or reanalyzed.

6. Conflict Finder

Use Conflict Finder to check for vertical piping conflicts. From the main menu bar, select <u>*Utilities*</u> > <u>*Conflict Finder*</u>:

DRAINAG	DRAINAGE - Drainage.gdf - [No Active Network]					
Project	<u>C</u> omponent	<u>N</u> etwork	Reports	<u>U</u> tilities	<u>T</u> ool Boxes	
				<u>N</u> avigator		
				<u>C</u> onflict Finder		
				<u>L</u> abeler		
				Dis <u>pl</u> ay 3D		
				<u>D</u> TM D	rainage Tools	

To assess conflicts, set the Conflict Finder using the workflow shown below:

	Conflict Finder
	Check Feature
(1)	Select: Drainage Links 🔻
	2 Display Options ————
2.34	🔽 Display Only
12.04	Conflict Elevation
Clearance	Feature Elevation
Depth	Surface Elevation
/Number: 1 💌	🔽 View Center 🔽 Plan V
w Number: 1 💌	🔽 Edit Profile 🔽 Profile
	Conflicts
Check Sewer	🛛 🗹 Check Drainage
	🔽 Check Water 🥥
vailable 🔽	Check Misc: ID: Nor
000	Clearances: Override 💌
	Compute:
All	Previous Next
w Number: <u>1</u> Check Sewer vailable v 000	 ✓ Edit Profile ✓ Profile ✓ Conflicts ✓ Check Drainage ✓ Check Water ✓ Check Misc: ID: Nor Clearances: Override ✓ ✓ Compute: ✓ Previous

1	Check Feature	
	Selecti Single Feature 💌 🔟	Click the ID button and <i>data point on</i> a single Drainage Link to check.
OR	Select Drainage Links 💌	Checks all Drainage Links for all crossings.

2	Display Options (All Optional)							
	12.34 Double- symbolic			click to activate the control and set the gy for the remaining display options.				
	🔽 Display Only	Views t display	he ma	e conflict data information in temporary node.				
	Conflict Elevation	Display profile	s tl vie	s the vertical elevation of the utility crossing in view.				
	✓ Feature Elevation	Display profile	s tl vie	s the vertical elevation of the main crossing in view.				
	Surface Elevation	Display you sto	s tl rec	he vertical elevation of the proposed surface d in the preferences.				
	View Center	Centers view ar	s th nd/o	ne selected MS window on the conflict in plan or profile views.				
	Edit Profile	When t Drainac conflict	ogg ge l re	gled ON, and Conflicts are found, the Profile Edit dialog opens to enable on-the-fly solution.				
	Clearance Displays			the vertical clearance (feet or meters) the crossings.				
	Displays crossing			the vertical depth (feet or meters) at the location.				
	Plan View Number: 1 Centers			ne MS plan view on the crossing.				
	Profile View Number: 2 Centers		s th	ne MS profile view on the crossing.				
3	Conflicts Options							
OR	Check Drainage			Checks for Drainage pipe crossings.				
OR	Check Sewer			Checks for Sewer pipe crossings stored in the Drainage Preferences option.				
OR	Check Water			Checks for Water pipe crossings stored in the Drainage Preferences option.				
OR	Check Misc: ID: Gas Line			Checks for Misc. Utility pipe crossings.				
4	Compute Options							
	Compute: 1 of 2 Conflicts C			ck Compute , the <i>#</i> of Conflicts found will displayed.				
	Clearances: Override 10.000			e Default for Sewer clearance value you ored in the sewer line dialogs or the water e dialog, or use Override and supply a rtical clearance in (feet or meters).				

OR	Previous	Displays the Previous crossing location
OR	Next	Displays the Next crossing location
OR	All	Displays All conflicts



Profiles need to be drawn into the DGN file before using this tool. To remedy conflicts, toggle **ON** "Edit Profile" and use the Link Pipe Profile tab to modify vertical elevations as needed.

Chapter 9: Navigator

The Navigator is a powerful tool to aid you in maneuvering through a project. You can also add, edit, delete and identify all drainage components from the Navigator:

DRAINA	DRAINAGE - Drainage.gdf - [NetworkOne Active]							
Project	<u>C</u> omponent	<u>N</u> etwork	R <u>e</u> ports	<u>U</u> tilities	<u>T</u> ool B	loxes		
				<u>N</u> aviga	itor			
				⊆onflic	t Finde	r "N		
				<u>L</u> abele	r			
				Dis <u>pl</u> ay	/ 3D			
				<u>D</u> TM D	rainage	• Tools		

The Navigator has the following toolsets:

8 Navigator Vie 1 Tools	2 - ×
XXX	
ID CB-1 RATIONAL-1 SCS-1 SCS-2	3 Description
Highlight	🔽 Window Center 🗖 Query 🔮

1	Networks	Choose to navigate through "All Networks" or only the "Active Network".
2	Components	Options include: Areas, Inlets, Nodes, Links, Profiles, Culverts and Routings, displayed left to right.
3	ID List	The list of components available by the selection in bullet #2 above.
4	Action buttons	Click to add / modify / delete / or ID any component for modifications.

1. Navigating

The Navigator window allows you to click through the lists of drainage objects to identify and modify the components you are interested in.



1	Туре	Select the component type of interest – only that type will be shown in the components list.		
2	Toggles	Toggle ON so the MicroStation view will highlight and center on a drainage component when it is selected.		
3	Component	Click any component in the list.		
4	ViewThe Microstation view updates to window center and highlight the selected drainage component.			
5	Repeat as necessary to navigate the components			

2. Updating Graphics

After editing the drainage components, you must update their graphics in the Microstation file.



1	Туре	ype Select the component type of interest.	
2	Selection	election Select all (or any you wish) components in the list for graphical updating.	
3	Tools	Select Tools > Update Graphics to commence the procedure.	
4	View The Microstation view updates with the revised graphics.		
5	Repeat as necessary to update the graphics on the components.		

3. Identifying Items

Navigator can also be used to identify a drainage component from its graphic in the Microstation file.



1	Туре	ype Select the component type of interest.	
2	ID	Click the ID button	
3	Select	Select any component in the DGN file	
4	Navigator	Notice the specific component is located and highlighted in the Navigator window	
5	Repeat as necessary to identify the drainage components.		

4. Query Mode

Query Mode allows you to set several requirements and search the project for any drainage components that meet them. Use the workflow below to utilize the Query Mode:

	View Tools	×
	ID Description	
	CB-2	믝
	Dasin-1	녝
	(5) (2)	\mathbf{X}
		D
	🗖 Highlight 🔲 Window Center 🔽 Query	
3	Query Options	
	Query Type: Values 🔹 📩 🏦	
	Condition: < 💙 🎇 👔	
- 1	Variable: Profile Type 🗾 😰	
	Value: On Grade 🗾 🙀	
	Apply Query	

1	Select the Component Type	
	٩	Use Query Mode to search for Areas
OR	₩	Use Query Mode to search for Inlets
OR	/	Use Query Mode to search for Links

2 Toggle ON "Query" mode

3	Query Options		
1	Query: Values	A Value is usually one of two types: "alpha" (i.e. pipe material) or "numeric" (i.e. pipe slope).	
OR	Query: Constraints	A Constraint is usually one of two types: "min" (i.e. minimum depth) or "maximum" (i.e. maximum depth).	

\$	>	Condition = "greater than"	
OR	=	Condition = "equals"	
OR	<	Condition = "less than"	
1	Variable	If the Query Type is set to 'value', a variable may be available.	
OR	Constraint	If the Query Type is set to 'constraint', a constraint may be available.	
*	Value	Value mode is usually one of two types "alpha" (i.e. curb) or "numeric" (i.e. curb length)	

4	Apply Quer	у
	Apply Query	Click Apply Query to initiate the computations

6	Navigator Window	
	Query Applied	The components <i>remaining</i> in the Main Navigator Window meet the results of the applied Query.



After a Query is applied, the Navigator Window will *continue* to display only the results of the Query, until it is reopened, or another Component Type is selected.

5. Global Editor Mode

The Global Editor mode expands the Navigator to let you edit components directly from the Navigator window. From the Navigator's View pull-down menu, select Global Editor:

B CI	obal Edito	or 🔰
View	Tools	
Na	vigator	
Gk	obal Editor	<u> v z k</u>
U	_	Description
الملامير	Januara	and a state of the

Use the workflow below for Global	ly Editing components:
-----------------------------------	------------------------

궁 Global Editor	
View Tools (1)	
	Current Value: 848.018 🔶 🕘 🔪
ID Description	Variable to Edit
OUT	Node - ID New Value: 848.018
CB-2 (2)	Node - Description
out2	Node - Reference Chain
basin-1	Node - Reference PGL
	Node - Reference TIN
	Node - Elevation 3
	Node - Reference Elevation
🗖 Highlight 🗖 Window Center 🔲 Query	Apply Edit With Confirm 5 Apply Edit No Confirm

Select the Component Type:

Components Only Areas, Inlets, Nodes or Links are available for Global Edits.

2	Select the Component(s):	
	Keyboard Input	Highlight (use keyboard shortcuts) single, multiple, or all components on which to perform the Global Edit(s).

3	Variable to	Edit
	Variable to Edit	Select any one of the available Variables to Edit.

4	Current/New Value	
Current Value	Current Value	Displays the current value of the selected variable in the step above.
New Value	New Value: 849.983	Key-in the new value of the Variable.
Overwrite	O Overwrite Text: New Text: existing.tin	Either "Overwrite Text" with "New Text",
OR	Find and Replace:	OR
Find/Replace	Find Text: existing.tin Replace Text: proposed.tin	Use "Find Text" / "Replace Text" feature.

5	Apply Edits	
	Apply Edit with Confirm	Click to make the changes without any confirmation warning messages.
OR	Apply Edit No Confirm	Click to make the changes with a confirmation warning message for <i>each</i> component selected in bullet #2 above.



Use the same workflow above (for any available variables) for Areas, Inlets, Nodes, or Links.

Chapter 10: Reports

Under the Drainage>Reports menu, the three top options are summary reports that GEOPAK Drainage automatically generates. To print these reports you must open one of the three reports, press Alt-PrtScn, then open Paint and press Ctrl V or open Microsoft Photo Editor and choose Edit>Paste as New Image. You can print directly from either program. To generate a specific report you must open the **Report Builder**. This is where you can generate custom reports for system evaluation.



1. Alternate Pipe

The alternate pipe spreadsheet is used to organize drainage network data for inclusion in plan sets. The spreadsheet itself can be found on the **Preconstruction intranet webpage** under "Design Tools" listed as **Alternate Pipe Editor**. The information for generating the necessary reports is located in the **DrainReport4AltPipe2010.drf** file in **\\nts\hq\precon-general\Hydraulics\Standard_Files_GEOPAK_2009\ GEOPAK_Output\Output_drf_files**.

2. Generate

To export the drainage system data from Geopak, select **Drainage>Reports>Generate**. Make sure you have an active network selected. By **Drainage Report Format File** choose the preset **DrainReport4AltPipe2010.drf**.

By **Output File Name** choose your working directory and name the file whatever you desire, but change the extension to csv. Select **Generate** and you will receive a message stating the file has been generated.

Drainage Report Format File: DrainReport4AltPipe2010.drf	2
Output File Name: Smooth.csv C	۹ ا
Generate View	

3. AltPipe Spreadsheet

Copy the AlternatePipeEditor spreadsheet from the Preconstruction intranet webpage to your working directory and open it. You will need to authorize it to use Macros and possibly to confirm that files from the internet are allowed.

1 Protected View	This file originated from an Internet location and might be unsafe.	Click for more details.	Enable Editing
U Security Warnin	g Some active content has been disabled. Click for more details.	Enable Content	

Fill in the File Number on the Input tab of the spreadsheet. The Joint Pressure cell should be 13 psi for coastal regions and 10 psi for all others unless otherwise indicated for the project in question. Set Smooth Data to Yes and Corrugated Data to No. If Driveway Pipes are to be included in the final report, set that field to Yes. Then enter the name of the .drf file created in the previous section next to the Smooth Data field under File Names.

File Number:	21.038	191B
Date:	Apr-01-15	
Current User:	Holtzclaw, Bobby	
Joint Pressure:	10	psi

Type of Data Files To Import A	File Names	?	
Smooth Data:	Yes	Smooth	
Corrugated Data:	No		
Will Project Include Driveway Pipe:	Yes		

Press the "Import Geopak Data" button to fill in the network data from the .CSV file. The leftmost column of data, System ID, must be filled in manually. For each Link, enter the point number of the outlet of its system. The SPT "N" values must be entered manually by the geotech. Once both columns have been filled out, press the "Generate Hydro Output Tables" button and enter a file name to create the final reports.

4. Standard Interoffice

The information for our standard interoffice reports and Roadway Designer reports has been preset in a set of DRF files found on **\\nts\hq\precon-**

general\Hydraulics\Standard_Files_GEOPAK_2009\GEOPAK_Output\Output_drf_ files: - nodestandard.drf, linkstandard.drf, areastandard.drf, nodestandardroad.drf, linkstandardroad.drf, nodesum.drf, linksum.drf. The .drf files were developed under Report Builder and their contents are listed in section 4.

To create our final standard interoffice reports is no simple task. Basically you must generate a set of CSV files from a set of DRF files, and then paste the information in the .csv files in a .xls file for the final report. In the end, you will only have five .xls files for the whole project regardless of the number of storm sewers you design.

To create the CSV files, follow the same instructions from section II, substituting the appropriate .drf files as needed. Linksum.csv and nodesum.csv will only need to be generated once, and it does not matter which storm sewer is active since these files are not storm sewer specific. You must generate the remaining five CSV files for every network (storm sewer system) you designed. These files are specific to each particular storm sewer.

5. Final Reports

Download our standard output XLS files from\\nts\hq\precon-

general\Hydraulics\Standard_Files_GEOPAK_2009\GEOPAK_Output\ Blank Files to your project directory. The CSV files (linksum.csv and nodesum.csv) will be pasted in the linkstandardroad.xls and nodestandardroad.xls, respectively. We will discuss this in the next section. Now we will discuss the storm sewer specific files. The storm sewer specific files are the CSV files you created from the DRF files (nodestandardroad.drf, linkstandardroad.drf, nodestandard.drf, linkstandard.drf, and areastandard.drf.) You should have five .csv files for each storm sewer. The following is the process for creating our standard output files, for the individual storm sewers, from the CSV files.

1. Open the appropriate .xls file for the .csv file that you already have opennodestandard.xls, linkstandard.xls, areastandard.xls, nodestandardroad.xls, linkstandardroad.xls. You will alter this file to reflect your information.

2. Add headings to the first sheet in rows 1 and 2. View the files under

\\nts\hq\precon-general\Hydraulics\Standard Files\GEOPAK

Output\Sample output to see exactly how the reports should look.

3. Select **Edit>Move or Copy Sheet**... and copy as many sheets as you have networks/storm sewer systems.

4. Change the sheet name to match the network name, i.e. System 12+00. Each sheet within the workbook will represent one system.

5. Highlight the data in the .csv file.

6. Right click and select **Copy**.

7. Go to the standard file (.xls) you just modified. Activate the appropriate sheet for the .csv file you are copying.

8. Click on the first cell under the table heading in the A column.

- 9. Right click and select **Paste Special...**
- 10. Choose Values
- 11. Choose **OK**. The font and alignment should be automatically set.

The files with road at the end (linkstandardroad.xls and nodestandardroad.xls) are to be sent to Roadway Designer. The other files are for your in-house report. Be sure to check that the max Design Capacity of 94% has not been violated. Eventually we will add a line in the report to give you such information.

Summary Report Files

We need to paste the linksum.csv and nodesum.csv files into the linkstandardroad.xls and nodestandardroad.xls files, respectively.

- 1. Open one of the sum.csv files.
- 2. Go to Data>Sort....
- 3. Click the down arrow under **Sort by** and choose **Item**.
- 4. Choose OK.
- 5. Open the appropriate .xls for the appropriate sum.csv file you have open.
- 6. Select the sheet labeled Summary Report.
- 7. Add headings to the first two rows. View the files under

\\nts\hq\precon-general\Hydraulics\Standard Files\GEOPAK

Output\Sample output to see exactly how the reports should look.

- 8. Highlight the data in the .csv file.
- 9. Right Click and select Copy.

10. Go to the standard file (.xls) you just modified. Activate the Summary Report sheet for the .csv file you are copying.

- 12. Click on the first cell under the table heading in the A column.
- 13. Right click and select **Paste Special...**
- 14. Choose Values
- 15. Choose **OK**. The font and alignment should be automatically set.

Lastly, we need to run a macro to sum the pipes and basins. Two summary tables will be generated, one in the nodestandardroad.xls and one in the linkstandardroad.xls.

1. Open either nodstandardroad.xls or linkstandardroad.xls and activate the Summary Report sheet.

2. Open \\nts\hq\precon-general\Hydraulics\Standard

Files\macros\drainage_report.xls. This is the macro file.

3. A message box will appear. Choose **Enable Macros**. It will appear as if nothing has happened.

4. Go to Tools>Macro>Macros....

5. Choose **drainage_report.xls!Link_cal.Link_cal** if you are in linkstandardroad.xls and **drainage_report.xls!Node_cal.Node_cal** if you are in nodestandardroad.xls.

6. Choose Run.

7. You will get two messages. Click **OK** for both. The summary table will appear just below your inputted data.

8. Repeat these steps to generate the other summary table.

6. Interoffice Report

The following information is preset in our DRF files.

Our interoffice report will contain the following information:

- Node Report

File name: nodestandard.drf

Node Information:

- 1. I.D.
- 2. Description
- 3. Туре
- 4. Library Item Name
- 5. Reference PGL
- 6. Station
- 7. Offset
- 8. Reference Elevation
- 9. Elevation
- 10. Depth
- 11. Junction Loss
- 12. Tc Used
- 13. Cumulative Tc
- 14. Cumulative Discharge
- 15. Cumulative Area
- 16. Cumulative C Value

17. Cumulative Intensity

- Area Report

File name: areastandard.drf

Area Information:

- 1. I.D.
- 2. Tc Used
- 3. Discharge
- 4. Intensity
- 5. Composite C Value
- 6. Composite Area
- 7. Total Subarea C Value
- 8. Total Subarea
- 9. Remainder C Value
- 10. Remainder Area

- Link Report

File name: linkstandard.drf

Link Information:

- 1. I.D.
- 2. Upstream Node
- 3. Downstream Node
- 4. Shape
- 5. Material
- 6. Number of Barrels
- 7. Rise
- 8. Actual Length
- 9. Slope
- 10. Discharge
- 11. Capacity
- 12. Uniform Depth
- 13. Uniform Velocity
- 14. Soffit Upstream
- 15. HGL Upstream
- 16. Soffit Downstream
- 17. HGL Downstream
- 18. Invert Upstream
- 19. Invert Downstream
- 20. Actual Velocity Upstream
- 21. Actual Velocity Downstream
- 22. Actual Depth Upstream
- 23. Actual Depth Downstream

7. Roadway Report

The following information is preset in our DRF files.

Road Design's report will contain the following information:

- Link Report

File name: linkstandardroad.drf

Link Information:

- 1. I.D.
- 2. Library Item
- 3. Type
- 4. Material
- 5. Shape
- 6. Upstream Node
- 7. Downstream Node
- 8. Actual Length
- 9. Slope
- . 10. Rise
- 11. Pay Item
- 12. Invert Upstream
- 13. Invert Downstream

- Node Report

File name: nodestandardroad.drf

Node Information:

1. I.D.

- 2. Library Item Name
- 3. Reference PGL
- 4. Station
- 5. Offset
- 6. Elevation
- 7. Depth
- 8. Pay Item

Chapter 11: Microstation Drafting

Add completed networks and surface data to the Microstation plans, profiles, and cross-section sheets.

1. TIN Files – Draw Contours

From DTM Tools->Load->DTM Feature choose your *.TIN file to be loaded.

14	Load DTM F	eatures							
Eil	e								
Lo	ad File: TIN	V lie	dar.tin				9 [Lo	ad
- 0)isplay Preferen	ices					-		
L	oad: Extent	~	Display	Only	G	raphic G	iroup	-	
	Feature	Level		Color	Weight	Style	Display	, ^	
	TIN Hull	Default		1	0	0	OFF		\$ ‡
	Contours	14) 1		-			ON		et
	Major Lines	Default		17	0	0	ON	_	
	Major Label	Default		4	0	0	ON		Y
	Minor Lines	Default		6	0	0	ON		8
	Minor Label	Default		6	0	0	ON	~	
		M	linor Inter	val: 2.	000	Major Ir	nterval:	10.00	00
S	mooth: Three	Point 💌	Registrati	ion: 0.1	000	Minimun	n Area:	0.000)
Г	Range 🔽 Mir	nimum Z:	857,180	Ма	ximum Z:	1047	.880	Re	ad
-				_				_)

From the Load DTM Features dialogue set up the Display preferences. In the Load dropdown, choose whether you would like to load the entire .TIN or just specific locations. If just for reference purposes choose display only. This temporarily loads the DTM but will be removed at any change of the window (i.e. zoom in/out).

Highlight Contours and double click to turn on the display. With Contours highlighted set the values desired for Minor and Major intervals. Also, select read to set the MIN/MAX contour lines inside of the tin to be displayed.

Featur	e	Level		Color	Weight	Style	Display	, ^	
Contou	rs	•		•			ON		\$ ‡
Major	Lines	Default		17	0	0	ON		•t
Major	Label	Default		4	0	0	ON		
Minor	Lines	Default		6	0	0	ON		V
Minor	Label	Default		6	0	0	ON		8
Spots		Default		7	0	0	OFF	~	
		[]	Minor Interv	al: 1	0.000	Major Ir	nterval:	20.0	00
Smooth:	None	~	Registratio	in: 0.	.000	Minimur	n Area:	0.00)
Range	🖌 Mir	nimum Z:	308.510	Ma	aximum Z	: 555.9	950	Re	ad

Select the Major Lines and double click the black box to set up the features of the Major lines.



This opens up the Set Feature dialogue. Set up the Symbology as shown below, changing the Level to correspond to the feature for Major Label, Minor Lines, and Minor Labels.

Symbolog	y	
Level:	RD_DTM_Major1	
Color:	ByLevel	~
Style:	(0) ByLev	~
Weight:	(4) ByLev	~
•		

Once all settings have been established choose Load to display contours.

2. TIN Files – Height/Slope Analysis

From DTM Tools->Analysis->Height/Slope, load your *.TIN file to be analyzed.

🖾 Height / Slope	
TIN File: Lidar_TinMe	erged.tin Q
Mode : Elevation V	Display Only

After a *.tin file has been selected the user should choose the mode for analyzing the the*.tin, choosing from Elevation or Slope from the Mode drop down box.

With Elevation selected, choose the Display Only check box to find spot elevations for reference purposes only. To adjust the text for elevations double click the text box to load the text dialogue box. Within elevation mode the user can choose to show the contour associated with the elevation, show the triangle associated with the slope, or show the arrow denoting the direction of water flow. The colors for each of these can be changed by double clicking the box to the right.



Select Start to begin. Move cursor throughout the *.tin file to display elevations and the other options selected. If display only was checked, any data point will be removed if any change is made to the view (i.e. zoom in/out)



With Slope selected you will have the same option of changing the text and what will be displayed. Two options are available for measuring the slope: using a triangle and the two point method. Triangle slope changes dynamically with the cursor, while point method is found by selecting two points.

3. TIN Files – Creating Profiles

From DTM Tools->Analysis->Profile load your *.TIN file to be analyzed, and select "add list item"





Select the Create Profile button, choose the option of place profile element and place two data points in the area you want the profile. This will display the profile in the dialog for review.



If satisfied with the profile previewed choose the third option to place the profile into the

drawing.

ng. To place the profile data, click anywhere within the *.dgn.

4. Cross Section Files – Draw Side Line Pipes

Open the *dx.dgn design file and select

Applications -> GEOPAK -> ROAD -> Design & Computation Manager from the menu bar.



Select English -> VBA Applications -> XS Pipes and double click to start the macro.

📕 Design and Computation Manager	3
<u>File Edit Settings Favorites H</u> elp	
产 id 🔲 🚧 🧬 💷 🔁 🚮 😭	
\\nts\hq\CaddStandards\SCDOT-Ben\scdot_engV8.ddb	<u>.</u>
B VBA APPLICATIONS	
XSMovie VBA - Review cross sections	
GPK Merge VBA - GPK Merge	=
Draw Patterns VBA - Draw pattern lines	
XS Pipes VBA - Draw pipes in cross sections	
Drainage Patterns VBA - Draw special pattern lines	
XSDrawBuildup VBA - Compute and draw buildup in c	
SOR VBA - S-O-Reprot	
XS Report Settings Test - XS Report Settings	_
S Report Test - XS Report for Ditch Anal	

On the **General** tab, select the Job and Chain, then browse to select the *.gdf file in the project folder. Check on the Honor XS Exaggeration. (This toggle controls the size of the pipe drawn on the cross sections in case they are drawn 10:5 vs. 5:5).

General Side-Line Pipes Cross-Line Pipes
Job: 165 💌 Chain: SC9R 💌
Drainage Project File:
D:\pipes\SC9.gdf Q
Tolerance: 1.0
✓ Honor XS Exaggeration

On the **Side-Line Pipes** tab, accept the defaults and press the **Process Cross Sections** button. (You can change the symbology by clicking the appropriate buttons prior to processing as well.)

General Side-Line Pipes Cross-Line Pipes	
✓ Draw Through Pipes Symbology:	
Draw Front Pipes Symbology:	
Draw Outside of Front Pipes Line Style: ByLevel Draw Back Pipes Symbology: Draw	
Image: Draw Outside of Back Pipes Line Style: ByLevel Side-Line Pipe Label Draw Symbology: Image: Draw Symbology: Image: Draw Symbology:	
Process Cross Sections	-

Press the **Begin** button and wait for the program to finish. Select **Yes** to save a *.csv pipe report file. Pipe drawings in cross sections **should be reviewed by roadway and hydraulic engineers** after processing.

5. Cross Section Files – Draw Cross Line Pipes

Open a plan view .dgn file showing the cross line pipes. Draw drainage pattern lines along each cross line pipe using MicroStation "draw line" command. Pattern lines should be set to one of the RD_PD_PatLn# levels and should extend a minimum of 20 feet beyond each end of the cross line pipe or to the construction limits.



Alternatively, open the D&C Manager (*Applications -> GEOPAK -> ROAD -> Design & Computation Manager* on the menu bar), select *English -> VBA Applications -> Drainage Patterns*, and double click to start the macro.



In the Culvert Pattern Lines window, enter the Job number of the project and select the chain of the road being crossed. Click the magnifying glass next to the "Drainage Project"

space and browse to the .GDF file for the project. Check the box marked "Pattern Lines for Cross-Line Pipes" and enter 0 for the Pattern Line Offsets

Culvert Pattern Lines
Job: 283 🔻 Chain: GARLINGTN 💌 💦
Drainage Project:
C:\Users\Holtzclajr\Desktop\39283_s548_564\road\S-548 SW. Q
✓ Pattern Lines for Cross-Line Pipes □ Pattern Lines for Drainage Nodes □ Pattern Line Offsets
Tolerance: 1
Left: 0 Right: 0 Draw Pattern Lines

Open or create a *xp.dgn file for the project. Cut existing and proposed cross sections using the new drainage pattern lines. Cross sections will be skewed.

Open the D&C Manager, select *English -> VBA Applications -> XS Pipes* and double click to start the macro.

📕 Design and Computation Manager	
<u>Fi</u> le <u>E</u> dit <u>S</u> ettings F <u>a</u> vorites <u>H</u> elp	
产 id 🔲 🚧 🧬 💷 🐂 🟥 🖆	
CaddStandards\SCDOT-Ben\scdot_engV8.ddb	•
ENGLISH	
DESIGN	
C VBA APPLICATIONS	
XSMovie VBA - Review cross sections	
🖹 GPK Merge VBA - GPK Merge 🗉	=
Draw Patterns VBA - Draw pattern lines	
XS Pipes VBA - Draw pipes in cross sections	
Drainage Patterns VBA - Draw special pattern lines	
XSDrawBuildup VBA - Compute and draw buildup in c	

On the **General** tab, select the Job, Chain and browse to select the *.gdf file. Check on the Honor XS Exaggeration. On the Side-Line Pipes tab, turn off all of the checks.

General Side-Line Pipes Cross-Line Pipes	General Side-Line Pipes
Job: 165 💌 Chain: SC9R 💌	Draw Through Pipes
Drainage Project File:	Draw Outside
D:\pipes\SC9.gdf	IM Draw Outside
	🔲 Draw Front Pipes
Tolerance: 1.0	🔽 Draw Outside
Honor XS Exaggeration	🔲 Draw Back Pipes

SCDOT Specifications and Support Manual for GEOPAK Drainage Last printed: 12/20/2019 Page 99 On the **Cross-Line Pipes** tab, check on all of the boxes. You can accept the defaults for symbology or click the appropriate buttons to change them.



Press the **Process Cross Sections** button. Press the **Begin** button and wait for the program to finish. Select **Yes** to save a *.csv pipe report file. Pipe drawings in cross sections **should be reviewed by roadway** and hydraulic engineers after processing.

6. Displaying 3-D Networks

Create a new 3-D .dgn. Start GEOPAK Drainage and open the .gdf containing the network. Open the GEOPAK Drainage Preferences menu and go to the Project Components tab. Ensure that the Drainage Cell Library being used is the most up-to-date RoadV8.cel dated 8/24/2011 or later. If not, load the *.dpf file associated with the project and check again.

Update all Nodes and Links via Navigator.



Activate the 3D display using Utilities -> Display 3D in the Drainage menu. Change the Display Style in View Attributes from "Wireframe" to "Smooth."





A 3-D view can reveal errors in the network design, such as incorrect structure and pipe elevations. Examining this view for pieces that appear out of place or incorrectly shaped can be much quicker than comparing the data associated with each pipe and node in text format using the Navigator tool.

Chapter 12: Uploading Files

After you complete your design, you must put all pertinent information about your project on the server for the Roadway Designer to access. All the information that you must supply to them is listed under Exchange of Information. Below is the form that you will email to the Roadway Designer explaining where the files are located and what you named them.

This will be the only thing that you will send them electronically. They will access everything else electronically from our server. Make sure you send them a hardcopy of the abandon/retain notes.

	ROAD DESIGN DATA DATE:	FOR HYDRAULIC DES 8/18/2008	IGN				
DESIGN GROUP:	RPG 4 - UPSTA	ATE					
PIN NO.:	36298						
COUNTY:	OCONEE						
ROAD/ROUTE NO .:	S-402 / SHEEPFAF	RM RD.					
PROJECT DESCRIPTION:	WIDEN (SHEEPFARM GUTTER WITH BIKE L CONNECT SHEEPFAR NEW LOCATION STAP	RD.) EXISTING 2 LANE ANES AND SIDEWALK XM ROAD TO SC 28 (BL RTING AT S-135 (BOUN	ES TO 5 LANE C S ON BOTH SID UE RIDGE BLV ITYLAND ROAD	CURB & DES. (D.) WITH)).			
ADDITIONAL NOTES:	S-135 WILL BE WIDEN	IED TO 5 LANE CURB	& GUITTER AT 1	THE			
	INTERSECTION WITH THE EXISTING PAVEN GUTTER. ALL OTHER	SHEEPFARM ROAD. IENT. STONEBROOK SIDE ROADS WILL HA	IT WILL THEN T DRIVE WILL HA	TIE BACK TO AVE A VALLEY CTIONS.			
		FILE INFORMATION					
	SERVER	DESIGN GROUP	COUNTY	PIN			
FILES LOCATED:	NTS/HQ/Precon/	RPG 4	OCONEE	36298			
		S					
'.GPK' FILE(S):	JOB298.GPK						
'PP' FILE(\$):	R36298PP.DGN	8					
	Decomposite Dovi		0.400.(01)	TO 0 400			
PF' FILE(S)	R36298PF1.DGN		5-402 (SH	TS. 6 - 13)			
	R30290PF2.DGN	9. 	SIDE ROADS (SHIS. 14 - 23)			
	R30290PF3.DGN	S	SIDE ROADS (5115.24-26)			
'.NEW' FILE(S):	36298 NEW						
	36298A.NEW						
CHAIN NAME	PROPOSED PROFILE	DES	SCRIPTION				
S402REL	S402RFP	CENTER LINE GR	ADE S-402 REL	OCATION			
US76		CENTE	ER LINE US 76				
BROOKLANER	BROOKLANERFP	CENTER LINE G	RADE BROOK	LN. REL.			
STONEBROOKR	STONEBROOKRFP	CENTER LINE GRAD	DE STONEBRO	OK DR. REL.			
S135REL	S135RFP	CENTER LINE GR	ADE S-135 REL	OCATION			
SPRINGWOOD		CENTER LINE E	AST SPRINGW	OOD DR.			
OCONEER1	OCONEER1FP	CL GRADE OCONE	EE ESTATES R	EL. PART 1			
OCONEER2	OCONEER2FP	CL GRADE OCONE	EE ESTATES R	EL. PART 2			
ALBERTSR	ALBERTSRFP CENTER LINE GRADE ALBERT'S RD. REL.						
	ALBERTSREP	CENTER LINE GR	ADE ALBERTS	RD. REL.			
PAULGILLR	PAULGILLRFP	CENTER LINE GRAD	E PAUL GILLIS	ON RD. REL.			

TANGLEWOOD	0	ENTER LINE TANGLEWOOD DR.
STREAM1		CENTER LINE OF STREAM #1
STREAM2		CENTER LINE OF STREAM #2
STREAM3		CENTER LINE OF STREAM #3
STREAM4		CENTER LINE OF STREAM #4
STREAM5		CENTER LINE OF STREAM #5
STREAM6		CENTER LINE OF STREAM #6
CHAIN NAME	CROSS SECTIONS	DESCRIPTION
S402REL	S402REL_DX_SCALED.DGN	STA. 10+00.00 - 114+64.38
US76	US76DX.DGN	STA. 10+50.00 - 20+00.00
BROOKLANER	BROOKLANERDX_SCALED.DGN	STA. 10+35.87 - 16+27.98
STONEBROOKR	STONEBROOKRDX_SCALED.DGN	STA. 10+35.92 - 15+94.48
S135REL	S135RDX_SCALED.DGN	STA. 10+00.00 - 42+79.57
SPRINGWOOD	SPRINGWOODDX.DGN	STA. 10+12.71 - 15+57.93
OCONEER1	OCONEER1DX_SCALED.DGN	STA. 10+30.38 - 16+00.00
OCONEER2	OCONEER2DX_SCALED.DGN	STA. 36+00.00 - 41+26.31
ALBERTSR	ALBERTSRDX_SCALED.DGN	STA. 7+00.00 - 12+22.35
PAULGILLR	PAULGILLRDX_SCALED.DGN	STA. 15+02.15 - 19+01.89
SC28	SC28DX.DGN	STA. 648+00.00 - 660+00.00
TANGLEWOOD		

If you have revisions to your GDF file and must resubmit files to Roadway Designer, resend them the email and state what changes were made. Be specific and name the pipes and nodes that were affected. If a large section of roadway was affected then give road stations that define the limits of those changes.



Consultants will still need to submit all files to the Hydraulic Engineer by a CD or FTP for the Roadway Designer's use and a hard copy of the plans for our review. Labels will still be required for all pipes and basins, but they are to be very basic. The Roadway Designer will do the final labels themselves for both Right-of-Way and Construction plans. Also include the spreadsheet on the previous page in the submittal and the Hydraulic Engineer will forward it to the Roadway Designer.

Chapter 13 - Import/Export

This section covers the import & export of shapefiles, XPSWMM, HEC-RAS, Google Earth, DEM files and LiDAR.

1. Shapefiles

Shapefiles (.SHP) can be opened as a MicroStation file and saved as a .DGN, imported into an existing drawing, or referenced within a drawing.

Opening a shapefile in MicroStation works the same as opening a .DGN file. Go to File->Open in the menu bar. In the Open File screen, change the file type (located at the bottom of the screen) from CAD Files (.DGN) to Shapefiles (.SHP), then select the desired shapefile and press open. The file will be opened as Read-Only, but it can then be saved normally as a .DGN file and edited from there.



To Import a shapefile into an existing document, use the File->Import->CAD Files command in the main menu.

<u>Fi</u> le	<u>E</u> dit	El <u>ement</u>	<u>S</u> ettings	<u>T</u> ools	<u>U</u> tilities	Wor <u>k</u> space	SC <u>D</u> OT Design	SCDOT Interface	Applications	<u>Wi</u> ndow	<u>H</u> elp	Topo <u>D</u> OT
1	<u>N</u> ew								Ctrl+N	1		
B	Open								Ctrl+O			
	Close								Ctrl+W			
	<u>S</u> ave								Ctrl+S			
	Save <u>/</u>	<u>\</u> s										
	Compre	ess							+			
	Sa <u>v</u> e S	Settings							Ctrl+F			
8	Item Br	o <u>w</u> ser										
B	Project	Explorer										
È	Refere	nces										
	Raster	Mana <u>q</u> er										
4	Point C	louds										
٥	Models	;										
	P <u>u</u> blish	i-model										
	<u>Import</u>								•	IGES		
	Export								•	<u>P</u> arasoli	ds	
	InterPle	ot Organize	r							ACIS S	AT	
	IPLOT									<u>C</u> GM		
	Print Pr	review								Step AF	203/A	P214
5	Print								Ctrl+P	ST <u>L</u>		
*	Print O	rgani <u>z</u> er								CAD Fil	es	
										Terrain	Model L	andXML

In the import menu, set the file type to Shapefiles exactly as per the process for opening a shapefile, select the file in question, and press Open.

To attach a Shapefile as a reference, follow the same process as for attaching another Microstation drawing as a reference. When browsing to the desired file, set the file type to Shapefile as per the previous two processes, then select the shapefile and press Open.

2. XPSWMM

To Export any Network of the current Drainage GDF file:



The Network is now available for import into XPSWMM.

3. HEC-RAS

Microstation surfaces can be used to produce cross-section data importable into HEC-RAS models. To do so, you will create a chain representing the stream, cut cross-sections along it from a surface file, and then export those cross-sections as a file readable by HEC-RAS.

Streams may be delineated in the project survey. However, preparing a new chain for the stream based on the FEMA blue-line data will allow closer coordination with FEMA and other state and federal authorities that base their data on FEMA models. The FEMA stream delineation can be found in the S_WTR_LN.shp ShapeFile in the National Flood Hazard Layer (NFHL) data available in SCDOT files and on the FEMA website.

📂 Effect	tive Products (126) 🕜				
Þ	FIRM Panels (122) 🕹 DL ALI				
Þ	FIS Reports (2) 🕹 DL ALL				
	LOMC (0)				
►.	NFHL Data-State (1)				
•	NFHL Data-County (1)				
	Product ID	Latest Study Effective Date	Latest LOMR Effective Date	Size	Download
	NFHL_45063C	02/20/2002	06/06/2014	14MB	₽ DL

Open the r#####hy.dgn file for the project. Open the References menu and Select Attach, then browse to the shapefile containing the stream line. For the Attachment Method, select "Geographic – Relocated", then press Open.

🥂 Attach Referer	nce - C:\Users\Ho	ltzclajr\Desktop\45063C_2014060	9\	6X 200 A	×
Look in:	35063C_2014	40609 👻	G 🤌 📂 🖽 -	S 🗟	
œ	Name	*	Date modified	Туре	
Recent Places	S_BFE.shp	N.shp AR.chn	3/31/2015 11:09 AM 3/31/2015 11:09 AM	AutoCAD Shape S AutoCAD Shape S	
Desktop		LN.shp	3/31/2015 11:09 AM	AutoCAD Shape S	
	S_LOMR.shp	bertship bio	3/31/2015 11:09 AM 3/31/2015 11:09 AM	AutoCAD Shape S AutoCAD Shape S	
Libraries	S_STN_STAR	RT.shp	3/31/2015 11:09 AM	AutoCAD Shape S	
	S_WTR_LN.s	hp	3/31/2015 11:09 AM 3/31/2015 11:09 AM	AutoCAD Shape S AutoCAD Shape S	, Attachment Method
Computer Computer Network					
	•	III		•	
	File name:	S_WTR_LN.shp		 Open 	
	Files of type:	Shapefiles (*.shp)		Cancel	
	•	Save Relative Path		Options	h.
Use the Smartline tool to draw a new line for the stream, beginning at the downstream end, and use *Geopak -> Road -> Geometry -> Store Graphics* to turn it into a chain. Select the GPK file for the project and name the Stream. The Beginning Point and Beginning Station entries can be left as they are. Click ID Element, click on the line drawn for the stream, then click Store.

1	📕 Store Gra
	<u>S</u> ettings
	Job: 999 Q
	Operator Code:
	Chain Stream1
	Beginning Point: 1006
	Beginning Station: 10+00.00
	Mode: Complex Chain 🔻
	ID Element Store

Using Smartlines, draw the pattern lines for the required cross-sections along the stream. The pattern lines should be drawn on one of the RD_PD_PatLn levels. The pattern lines should be perpendicular to the chain within the streambed, then turn to perpendicular with the topographic contours in the overbank areas to either side. Place pattern lines as needed to clearly define the stream bed cross-section and any curves in its flowline, as well as any and all notable features in the overbank area such as steep slopes, ditches, and structures. Features that directly impact the waterway such as bridges or connections with other streams should be clearly defined using as many cross-sections as necessary.

Open Geopak -> Road -> Cross Sections -> Draw Cross Sections From Surfaces.

M Draw Cross Secti	ons	7/		 X
File Edit Update	Options			
Job Number: 984	√2 Chain: U	NNAMEDT	RIB	Draw DP Origin
XS Cells Surfaces	8			
Pattem				
3 By DGN File	•			
4 Design File: r01	8pat.dgn			٩
Levels: RD)_PD_PatLn2	治 [
Colors: By	Level	1 1 1	Line	Line String
Styles: Byl	Level	治 〔	Match	Reset
√ Weights: By	Level	~ (Display	
6 Scale	7 Space	ing		
Horizontal: 10.0	0000	H	Horizontal:	1000.000
Vertical: 10.0	0000		Vertical:	500.0000
	Num	ber of XS b	y Column:	40
L		-		

1	Job Number	Select the .gpk file for the project
2	Chain	Select the chain representing the stream
3	Pattern	Select "By DGN File" to use the pattern lines in the current file.
4	Design File	Select the file for the cross sections to be drawn in. It may be the current file.
5	Pattern Line Symbology	Select the Level, Color, Style, and Weights of the pattern lines for the cross sections.
6	Scale	Set the horizontal and vertical scale for the cross section views
7	Spacing	Set the spacing at which the cross section views with be drawn
8	Surfaces Tab	Go to the Surfaces tab to enter data about the topographic surface.

M Draw Cross Sections	
File Edit Update Options	
Job Number: 984 Chain: UNNAMED	TRIB
XS Cells Surfaces	
Type Name Display Settings	Method
	×
□ Details*	
① Tin File: ▼ ②	٩
3 Method: Triangles	Type: Line 🔻
Display Settings	6 Filter Tolerances
By Level Symbology 💌	Horizontal: 0.3000
Feature:	Variance: 0.1000
5 Text Settings	
Elevation 254	Void

1	File Type	Select the file type of the topographic surface, usually a .Tin file.
2	Surface	Browse to the location of the topographic surface file and select it
3	Method	Select Triangles
4	Display Settings	If desired, set new symbology for the cross-section line work.
5	Text Settings	If desired, set new symbology for the cross-section elevations.
6	Filter Tolerances	Do not change.
7	Add Surface	Click the top icon to add the topographic surface to the system
8	Draw	Click the Draw button to draw the cross sections

Go to the new cross sections you just drew. Open *Geopak -> Road -> Cross Sections -> Reports* and click the **HEC-RAS** button.

X III X		
Blue & Red Top	M HEC RAS Report	
Clearing	(1) Job:	
Closure	Search Criteria	
DTM Input	HEC NAS Elements:	Display
DTM Proposed 3D	HEC RAS Report File:	٩.
HEC-2	Apply	
HEC RAS		

1	dof	Select the .GPK file for the project
2	HEC RAS Elements	Click the image to go to the HEC RAS Select Elements Window – see below.
3	HEC RAS Report File	After completing the HEC RAS Select Elements window, enter or browse to the file location and name of the report to be created
4	Apply	Click Apply to create the export file

MEC RAS Se	elect Elem
V Names	RD_HY_XS_Slope 🛛 🔁
Lv Numbers:	· *
Colors:	ByLevel 🖄
Styles:	: 1
Weights:	· *
Match	Display Reset

Click **Reset** to clear the fields, then make sure that only **Lv Names** and **Colors** are turned on using the check boxes. Click **Display**, then **Match** to begin inputting data. Click on the surface lines in the cross sections. As level names and colors are filled in, any lines matching those combinations of level and color will be highlighted to show they are being included in the report. Make certain that all surface lines in the cross sections are highlighted before continuing. Then close the **Select Elements** window, enter the HEC RAS Report File name and location and click **Apply** in the **HEC RAS Report** window. Open HEC RAS. Create a new project or open an existing one, then open the Geometric Data screen.

HEC-RAS	4.1.0			
File Edit	Run	View	Options	GI
	(<u>1</u>	<u>-v-</u> -	<u>ve</u> 💱	20 C (t)
Project:				
Plan:				
Geometry:				

Select *File -> Import Geometry Data -> GIS Format* and browse to the report created in Microstation.



On the **Import Geometry Data** screen, **Intro** tab, make sure US Customary Units is selected.



SCDOT Specifications and Support Manual for GEOPAK Drainage Last printed: 12/20/2019 Page 113 On the **River Reach Stream Lines** tab, confirm that the data shown is correct, that stream lines are being imported, and that the merge mode is set to "Replace".

Imp	Import Geometry Data								
ſ	Intro River Reach Stream Lines Cross Sections and IB Nodes Storage Areas and Connections								
	The river reach stream lines found in the file or generated while reading it are listed below. Check the reaches you want to import, and modify the import name and way existing stream lines are merged. (A range of reaches can be checked/unchecked with the space bar)								
	Import File Import File Invert Import As Import As Import Import Merge Mode								
		River	Reach	#Points	River	Reach	Status	Stream Lines	
	1	285	CREEK	21	285	CREEK	new	N	Replace 👻

On the **Cross Sections and IB Nodes** tab, confirm that the data shown is correct before pressing the **Finished – Import Data** button.

port Geometry Data												
Intro ⊢ No	Intro River Reach Stream Lines Cross Sections and IB Nodes Storage Areas and Connections											
✓ Cross Sections (XS) ✓ Bridges and Culverts (BR/Culv) ✓ Inline Structures (IS) ✓ Lateral Structures (LS)												
Import River: (All Rivers) Import As: # RS = 21 # New= 21 # Import = 21												
Import Reach: Import As: Check New Check Existing Reset												
	T	he imp	orted RS can be	edited h	ere, change t	he import Rive	er and I	Reach na	ames on	the previo	ous tab	
	Import File		Import File	Impo	rt File	Import As		Import	Import			-
	River		Reach	RS		RS		Status	Data			
11	285		CREEK	1000).000	1000.000		new				
12	285		CREEK	950.	000	950.000		new				
13	285		CREEK	900.	000	900.000		new				
14	285		CREEK	850.	000	850.000		new				
15	285		CREEK	800.	000	800.000		new				
16	285		CREEK	750.	000	750.000		new				
17	285		CREEK	700.	000	700.000		new				
18	285		CREEK	650.	000	650.000		new				
19	285		CREEK	600.	000	600.000		new				
20	285		CREEK	550.0	000	550.000		new				
21	285		CREEK	500.	000	500.000		new				_
	 Select Cross Section Properties to Import Node Names Ineffective Areas Descriptions Blocked Obstructions Picture References XS Lids GIS Cut Lines Ice Data Station Elevation Data Rating Curves Reach Lengths Skew Angle Manning's n Values Fixed Sediment Elevation Bank Stations HT ab Parameters Contraction Expansion Coef Pilot Channel Parameters Levees 											
					P	revious 1	Vext		Finish	ed - Impor	rt Data	Cancel

4. Google Earth

- Exporting DGN Files In SPCS

Exporting to Google Earth from a Microstation .DGN file set to the State Plane Coordinate System is very simple. SCDOT's Microstation seed files are automatically set to the SPCS, as are the majority of new surveys. Older files may use modified or local coordinate systems.



1	Coord. System	Check or set the coordinate system.
2	Export KML	Export the entire Microstation file as a .KML file for Google Earth.

- Exporting DGN Files In Local Coordinates

Exporting to Google Earth from a file set to local or adjusted coordinates requires a 3-step procedure:

- 1. Use Google Earth to add & save a Placemark
- 2. Use MicroStation to Define the Google Earth Placemark Monument
- 3. Use MicroStation to Export the Google Earth File

- Add/Save Placemark

Use Google Earth to add & save the Placemark:

- 1. Zoom to your desired location in Google Earth.
- From Google Earth, select Add > Placemark (enter the name; verify the latitude & longitude are correct).
- 3. Right-click on the Placemark, select "Save Place As" and save as the KML or KMZ (the Z means zipped format and is thus a smaller file) to a folder on your local computer or server.

- Define Placemark

In MicroStation, select Tools>Google Earth:

- 1. Zoom to your desired location in MicroStation (corresponding to step 1 in add placemark).
- 2. In MicroStation's Google Earth toolbar, click "Define Google Earth Placemark Monument", and snap to the location in step #1 above.
- 3. In MicroStation's "Select Monument Placemark File" window, select the saved placemark file (from step 3 in add placemark).

- Export KML

In MicroStation, select Tools>Google Earth (if not already open):

- 1. In MicroStation's Google Earth toolbar, click "Export Google Earth (KML) File" and key-in the name of the (KML or KMZ) file to export to Google Earth.
- 2. After clicking OK, Google Earth should automatically open (if not open already) and the cad elements will be exported into the Google Earth view at the proper location.

5. LiDAR

To create a .tin surface file from SCDOT's LiDAR data records, you will need access to the L: network drive (<u>\\nts\hq\scdot-apps\scdot-lidar</u>).



- Identify Required LiDAR Tiles

In Microstation, select the menu item File > References, then Tools > Attach.



	M Attach Referen	nce - L:\LIDAR\Lexington_2010\
	Look in:	Lexington_2010 -
References (0 of 0 unique, 0 displaye	e	Name
	Recent Places	GIS
Slot 1 P in File Name		🕛 LIDAK
		January Tile_Index
	Desktop	Lexington_Tile_Index_Labeled.dgn 2
-		-
Reference Attachment Set	tings for Lexington	_Tile_Index_Labeled.dgn
Eile Name: Lexingto	n_Tile_Index_Labele	d.dgn
Full Path:\Lexin	gton_2010\Lexington	_Tile_Index_Labeled.dgn
Model: Lexington	n_Tile_IndexAnnotati	on 👻
Logical Name:	(3
Description: Annotati	on Model	

1	Attach	Navigate to L:\LIDAR and choose the appropriate county folder.
2	Tile Index	Select the Tile_Index file for the county.
3	Model	Select the County Annotation model in the Attachment Settings window.

Check the numbered squares that correspond to the project location to determine which LiDAR tiles to import.



- Importing LiDAR Tiles

Activate Data Acquisitions (*Tools > Data Acquisitions*), right-click on Surfaces, and create a new surface by importing the first of the required LiDAR tiles.

Data Acquisition	Ce Empty Surface From Field Book From Field Book Selection Set Import External Surface Import From Point Clouds	Import GEOPAK TIN Import InRoads DTM Import MX Surface Import LandXML Surface Import Lidar XYZ Import Lidar LAS Import Raster
Lidar LAS Accept 8 Select Features: UnClassified Ground 1 LowPoint ModelKeyPoint Others		
Filters Filter Option Tile Filter Tin Filter No Filter Point Features Before Filter: Point Features After Filter: Reduction %: Filter 6	Tolerances Z Tolerance: .25 (3) Coarse Fine (4) Reinsert Points (5) 1335187 344651 74.1870614378361 (7)	

1	Select Features	Import only points listed as "Ground"
2	Filters	Tin Filter
3	Z-Tolerance	0.05 to 0.25, depending on site (see item 7)
4	Points Density	Fine
5	Reinsert Points	Toggle ON to maximize surface detail
6	Filter	Calculates Reduction % for proposed filter settings.
7	Reduction %	Shows reduction in number of points after proposed filtering. Adjust Z-Tolerance to achieve 60%-75% Reduction
8	Accept	Filters and imports the LiDAR surface using these settings.

Repeat these steps for all required LiDAR tiles.

- Merge Tiles and Survey

Locate and copy the project survey to the project directory. Import the survey as a Geopak .TIN file.



Expand the data tree for the project .tin until Features is expanded. Click to turn on the Boundaries. Highlight the surface for the project. Right click and select Create Graphics. (This draws the tin hull into the design file.)



Use the MicroStation selection tool to select the tin hull. Right click on the first Lidar .las tile and select Clip Polygon > Internal. Repeat right clicking on the remaining Lidar .las tiles and select Clip Polygon > Internal for each one.



Expand the data trees for each of the LAS Surfaces and turn on Features -- Triangles to verify that the tin hull has been clipped from each of the tiles. (You can then turn the display back off).



Right click on Surfaces and select Create Surface > Empty Surface.



On the newly created Surface, right click and select Append From > ###### (select your first .las surface in the list). Repeat until all of the las surfaces in the list have been added. (Do not add the project surface in this step).



Pay attention to the # of Triangles in the Details panel. Occasionally it will bomb out and reset to 0 and you will have to delete the surface and start over again.

ø,	Data	a Acquisition D	Details			
	Element List Message Center X Adjustment Results					
Li	ist					
		Name	Dissolve Type	Side Length	Triangles	Breaklines
Þ		978702	None	20	783462	0
		978704	None	20	798644	0
		26849	None	20	3325	156
		Surface 4	None	20	1585257	0

Right click on the new project surface, select Merge From, and select the project surface.

Surface 4 Surface 4 Gompo Gom	Create Graphics Vertical Exaggeration Export to Delete) 		
••••••	Merge From	F	26849	
	Append From	•		_

Right click on the project surface and select Export to > Geopak Tin. Save the file.

Appendix A - C Value Table

The highlighted values are the most commonly used "C" values and are stored in the Drainage Library:

RUNOFF FACTORS FOR RATIONAL METHOD				
	Flat	Rolling	Hilly	
	0% - 2%	2% - 10%	Over 10%	
Devemente & Doofe	0.00	0.00	0.00	
Favements & Roois	0.90	0.90	0.90	
Driver & Weller	0.30	0.30	0.30	
Drives & walks	0.75	0.80	0.85	
Gravel Pavements	0.50	0.55	0.60	
City Business Areas	0.80	0.85	0.85	
Unpaved Road, Sandy Soils	0.34	0.45	0.59	
Unpaved Road, Silty Soils	<u>0.35</u>	<u>0.47</u>	0.61	
Unpaved Road, Clay Soils	<mark>0.40</mark>	<mark>0.53</mark>	0.69	
Apartment Dwelling Areas	0.50	0.60	0.70	
Suburban, Normal Residential	0.45	0.50	0.55	
Dense Residential Sections	0.60	0.65	0.70	
Lawns Sandy Soils	0.00	0.15	0.70	
Lawns, Bandy Soils	0.10	0.13	0.20	
Lawiis, fieavy Solis	0.17	0.22	0.55	
Grass Shoulders	<mark>0.25</mark>	<mark>0.25</mark>	0.25	
Side Slopes, Earth	<mark>0.60</mark>	<mark>0.60</mark>	0.60	
Side Slopes, Turf	<mark>0.30</mark>	0.30	0.30	
Median Areas, Turf	0.25	0.30	0.30	
Cultivated Land, Clay & Loam	<mark>0.50</mark>	0.55	0.60	
Cultivated Land Sand &	0.25	0.20	0.25	
Gravel	0.25	0.50	0.35	
Industrial Areas. Light	0.50	0.70	0.80	
Industrial Areas, Heavy	0.60	0.80	0.90	
Parks & Cemeteries	0.10	0.15	0.25	
Playgrounds	0.20	0.25	0.30	
i laygi ounas	0.20	0120	0.50	
Woodland & Forest	<mark>0.10</mark>	0.15	0.20	
Meadows & Pasture Land	<mark>0.25</mark>	<mark>0.30</mark>	0.35	
Unimproved Areas	<mark>0.10</mark>	<mark>0.20</mark>	0.30	
Rail Yards	0.25	0.30	NA	
Expressways & Freeways * 0.60* 0.70* 0.75*				
* The designer can also calculate weighted 'C' values for expressways and freeways using the				
values in the table for pavement, side slopes and planted medians.				

Appendix B - Troubleshooting

Here are some common problems that are easy to correct. Check here before panicking and thinking that the program has gone haywire.



If your problem is not listed below, call your coordinator for help.

Cannot find Cell Library	Make sure that all of your drives are connected.
	You may have to copy the cell library and put it in
	your project directory. Make sure to update the
	project components.
Cannot find Land Use	Say OK and ignore
No active network selected	Got to Network>Active Network
Basins appear on screen but not in	Make sure that you have the correct project open
program	and pertinent levels on
Discharge is equal to 0 0	Check to be sure that the rainfall data matches the
	frequency option under Preferences
Flow line of downstream pipe is higher	Make sure that you have the correct pipe sizes
than flow line of upstream pipe	listed for all existing pipe or make sure design is
	selected new pipe
The nodes/links that I deleted are still on	Go to Navigator and do a Graphic Update
the screen	
Some nodes/links that I did not want	Go to Navigator and do a Graphic Update
deleted are not on my screen anymore	
but are in the Navigator	
When I hit Graphic Update only one	Be sure to highlight everything that you want
nodes/link changed	changed in the Navigator window
I have input 5 nodes/links - where are	Be sure that you are choosing Add after you enter
they?	all information and choosing Component >
	Node/Link > Add to create a new node/link. Also
	check to see if the level is on
I cannot see my labels	Check Preferences to see if you have labels
	checked. Do a Graphic Update. Check the label
	offset in Preferences.
The program keeps changing my set	Check to see if your envelopes are large enough to
elevations/slopes	accommodate the elevations you chose. Or you
	may need to make one of your nodes a drop box
I referenced my pp.dgn file, but I cannot	Go to File>Reference and make sure that there is
see it on the screen	an X under the Display column
The Macro for running reports didn't ask	In EXCEL go to Tools>Macro>Security. Make
me to enable and it will not let me run	sure the security level is set to medium.
nodesum and linksum reports.	

It keeps changing my held elevations and	You may need to change that node to allow drop
saying that I have exceeded the min deep	half always and the second sec
at the basin	held elevations are making it impossible for your
	inflow and outflow pipes to have matching soffits.
	The program changes the elevations to match the
	specifications that you have set
Design/Analyze is grayed out	Got to Network Active Network and choose the
	network you want to run
When I try to move a piece of text in the	Go to Settings/Locks/Graphic Group
profile the whole profile moves	
It will not update my nodes. It says	Download the cell library to your project directory
cannot find the cell library.	and select it again in Preferences.