



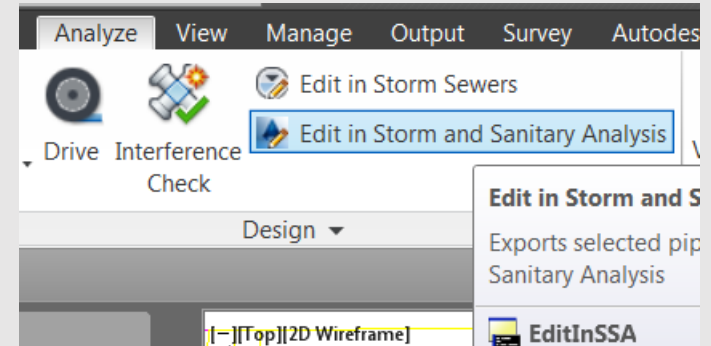
Storm and Sanitary Analysis in Civil 3D

- Presented by Carl Irwin and Brian Morse



Introduction

This example represents the analysis of an existing storm system. We will demonstrate the process of defining basins, nodes, and links using Autodesk Storm and Sanitary Analysis. Then quickly assigning design parameters and running an analysis. Finally we will display some output options for the final results.

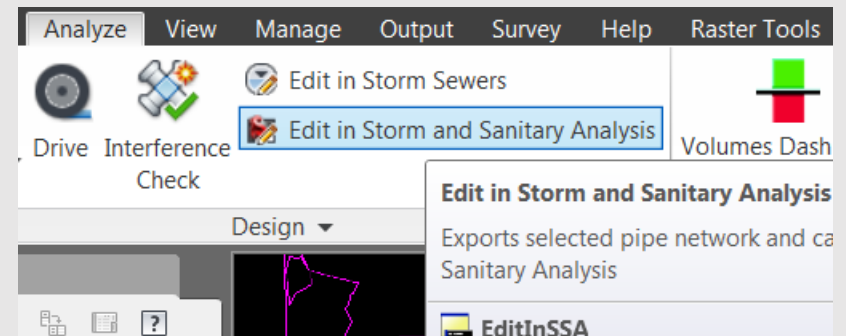


First Step



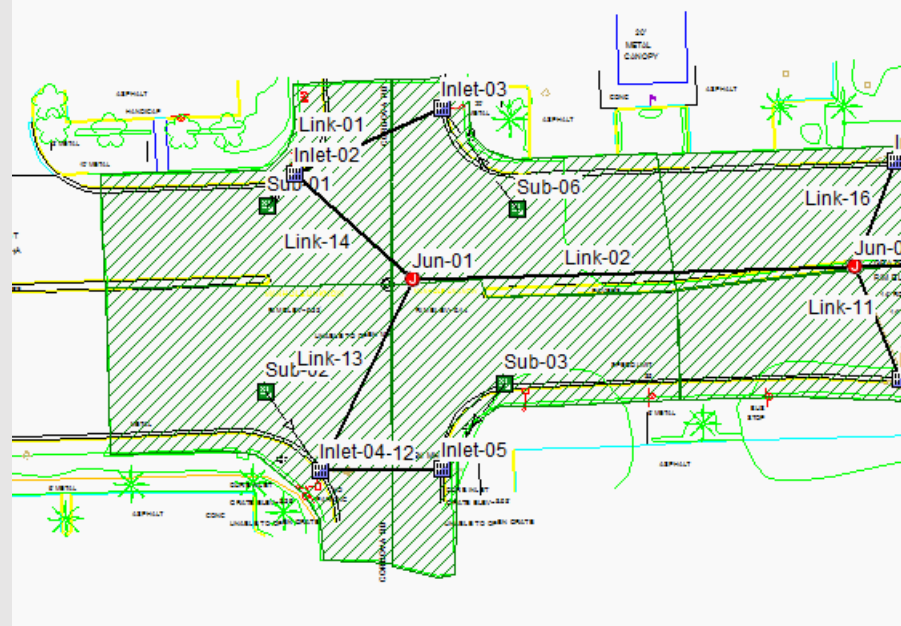
From Civil 3D to SSA

- Edit in SSA exports from Civil 3D
 - Log File Review
 - Plan View Tab
 - View Settings
- Background from Civil 3d
- Catchments from Civil 3d
- Network
 - Nodes
 - Links



Alternate Workflow - Begin in SSA

- Create in SSA
 - Basins
 - Nodes
 - Links



Second Step



Project Options

Project Options

General | ID Labels | Element Prototypes

Units & element specifications

Unit system: US Units

Flow units: CFS

Elevation type: Elevation

☒ Compute lengths and areas while digitizing

Hydrology runoff specifications

Hydrology method: Rational

Time of concentration (TOC) method: SCS TR-55

Minimum allowable TOC: 10 min

Modified rational method storm duration: min

Rational method ascending limb multiplier: 1

Rational method receding limb multiplier: 1

EPA SWMM infiltration method: Horton

HEC-1 unit hydrograph method: Clark

HEC-1 loss method: Uniform

Hydraulic routing specifications

Link routing method: Kinematic Wave

Force main equation: Hazen-Williams

Hydraulic routing specifications

Link routing method:

Force main equation:

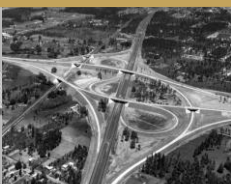
Minimum conduit slope:

Hydrodynamic

Hydrodynamic

Kinematic Wave

Steady Flow



Analysis Options

Setup the Storm duration

Storm Selection

3yr for this example

Analysis Options

General Storm Selection

Time steps

	Days	hh:mm:ss
Runoff (dry weather):	0	01:00:00
Runoff (wet weather):	0	00:05:00
Reporting:	0	00:05:00
Routing:		30 sec

Dates

	mm/dd/yyyy	hh:mm:ss
Start analysis on:	06/07/2015	00:00:00
End analysis on:	06/08/2015	00:00:00
Analysis duration:	1d	
☐ Start reporting on:	06/07/2015	00:00:00
Start sweeping on:	01/01	
End sweeping on:	12/31	
Antecedent dry days:	0	

Analysis computation

- ☐ Hydrology run
- ☐ Hydraulic flow
- ☐ Water quality

Hydrodynamic analysis

Inertial terms:

Lengthening time

Junction surface effects

Supercritical flow

- ☒ Water surface
- ☐ Water surface
- ☐ Froude number

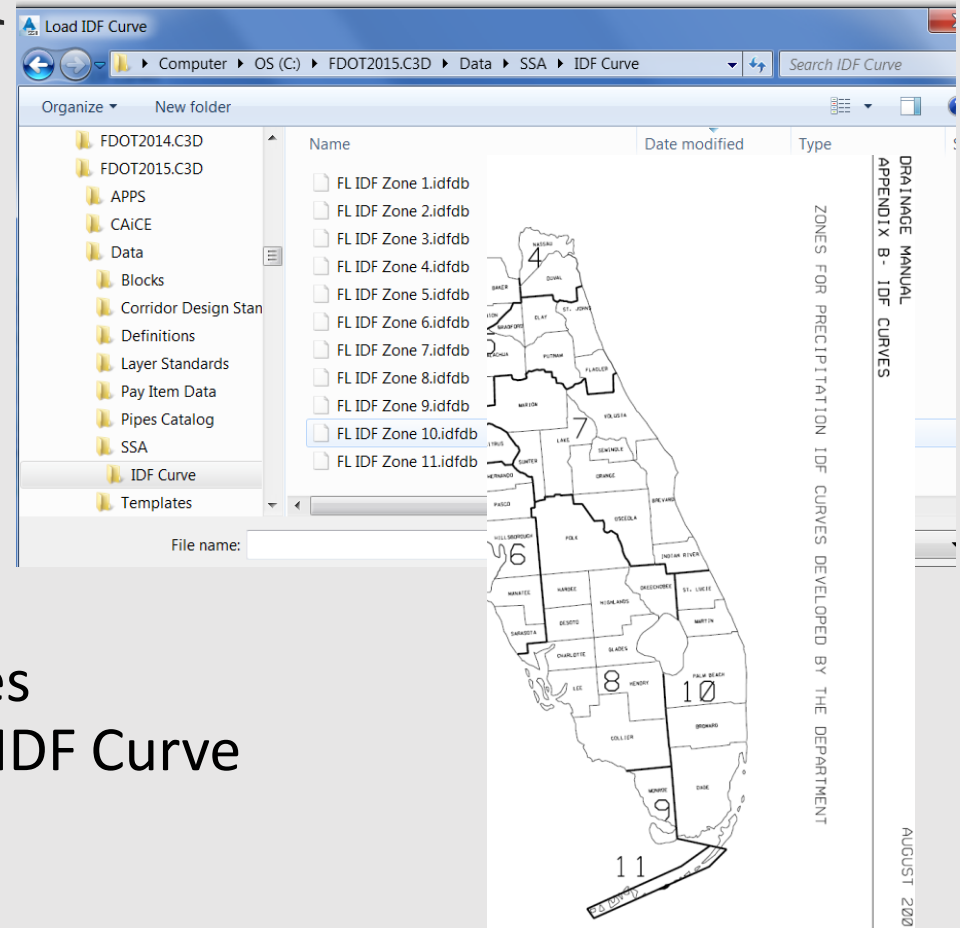
☒ Variable time

Safety factor:



Hydrology Setup

- TR-55
 - Subbasins
 - Weighted Curve Numbers
 - Rain Gauge
 - Rainfall Designer
- Rational Method
 - IDF Curves
 - State Kit location of IDF Curves
C:\FDOT2015.C3D\Data\SSA\IDF Curve
 - drainage manual
 - IDF Curves



Hydraulics

- Nodes
 - Storage Nodes
 - Outfalls
 - Inlets
 - On Sag
 - On Grade
 - Junctions
- Conveyance Links
 - Pipes
 - Channels

The screenshot displays a hydraulic modeling software interface. On the right, a project tree under 'Hydraulics' shows a hierarchy: Nodes (Junctions, Storage Nodes, Inlets, Flow Diversion, Outfalls, External Inflows), Storage Curves, Flow Diversion Curves, and Outfall Tidal Curves. The 'Conveyance Links' dialog box is open, showing the 'General' tab for 'Link-01'. It includes fields for Link ID, Description, Shape (Pipe selected), Physical properties (Length: 66.47 ft, Inlet invert elevation: 0, Outlet invert elevation: 0, Manning's roughness: 0.015), Analysis summary (Constructed slope: 0.0000 ft/ft, Design flow capacity: 0.00 cfs, Peak flow during analysis: N/A cfs, Additional flow capacity: N/A cfs), and Connectivity (From Inlet: Inlet-03, To Outlet: Inlet-02). A table at the bottom lists six links with their respective properties.

ID	From Node	To Node	Shape	Length	Height/Diameter	Inlet Elev.	Outlet Elev.	Manning's Roughness	Entrance Losses	Exit/Bend Losses
1	Link-01	Inlet-0	Circular	66.47	18.000	0	0	0.015	0.5	0.5
2	Link-02	Jun-01	Circular	182.61	18.000	0	0	0.015	0.5	0.5
3	Link-03	Jun-03	Circular	329.15	18.000	0	0	0.015	0.5	0.5
4	Link-04	Jun-02	Circular	638.28	18.000	0	0	0.015	0.5	0.5
5	Link-05	Inlet-1	Circular	26.01	18.000	0	0	0.015	0.5	0.5
6	Link-06	Inlet-1	Circular	12.54	18.000	0	0	0.015	0.5	0.5

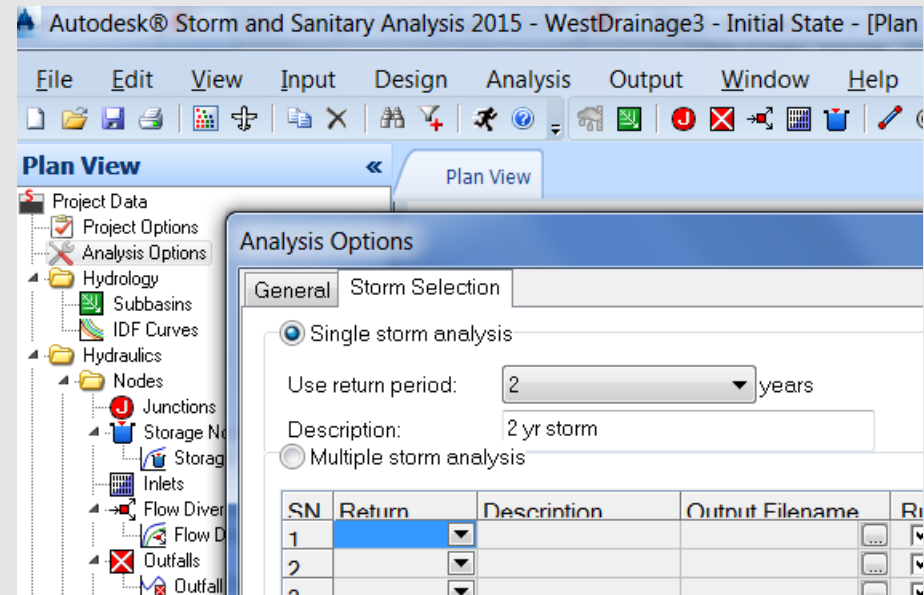
- Bypass Links
- Weirs/Orifices

Open more than one session of SSA to compare Existing and Proposed side by side



Analysis

- Storm Selection
- Messages
 - Bypass Link
- Connectivity Checks



Autodesk® Storm and Sanitary Analysis 2015 - Version 9.1.157 (Build 1)

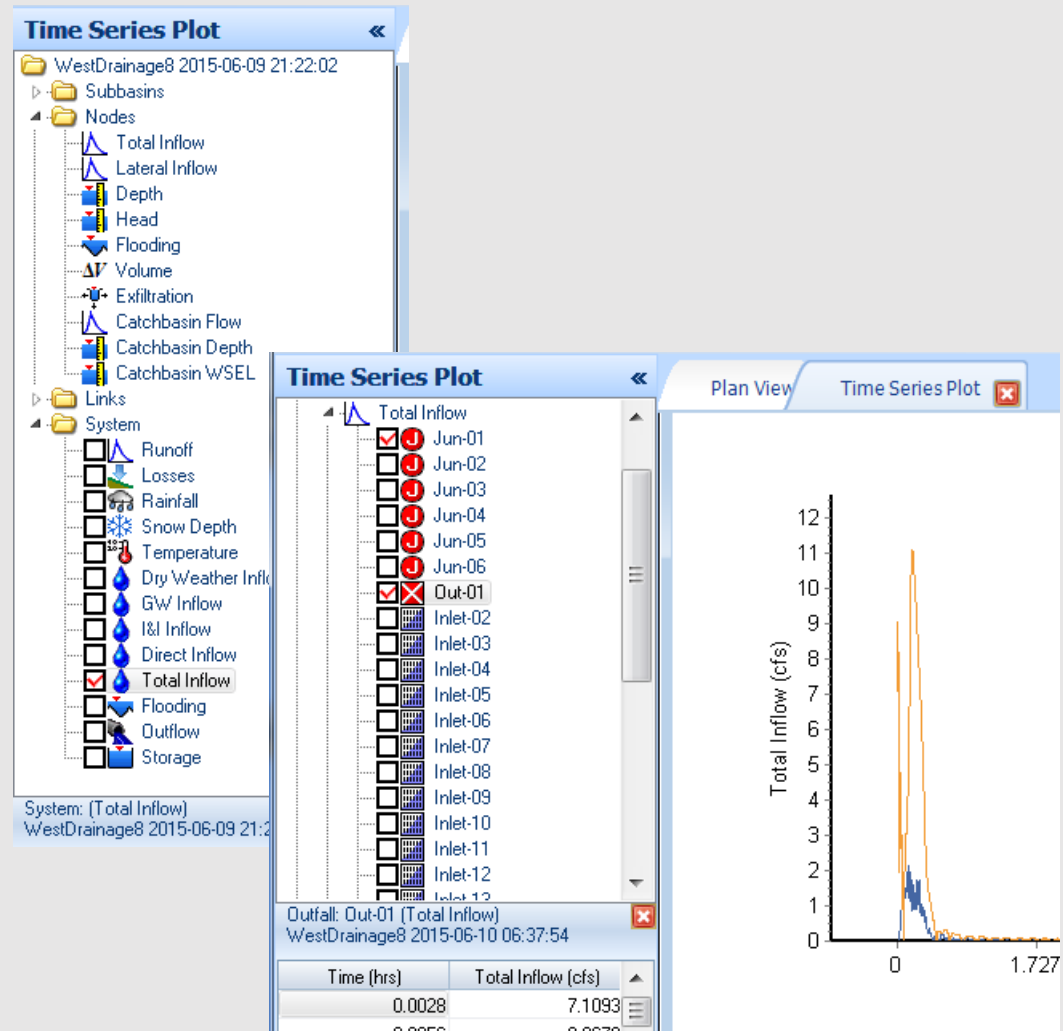
ERROR 601 : Inlet Inlet-02 has invalid by-pass link.at line 111 of [DIV_INL_PROPS] section:
 Inlet-02 0 6 10 0 NO

ERROR 601 : Inlet Inlet-03 has invalid by-pass link.at line 112 of [DIV_INL_PROPS] section:
 Inlet-03 0 6 10 0 NO



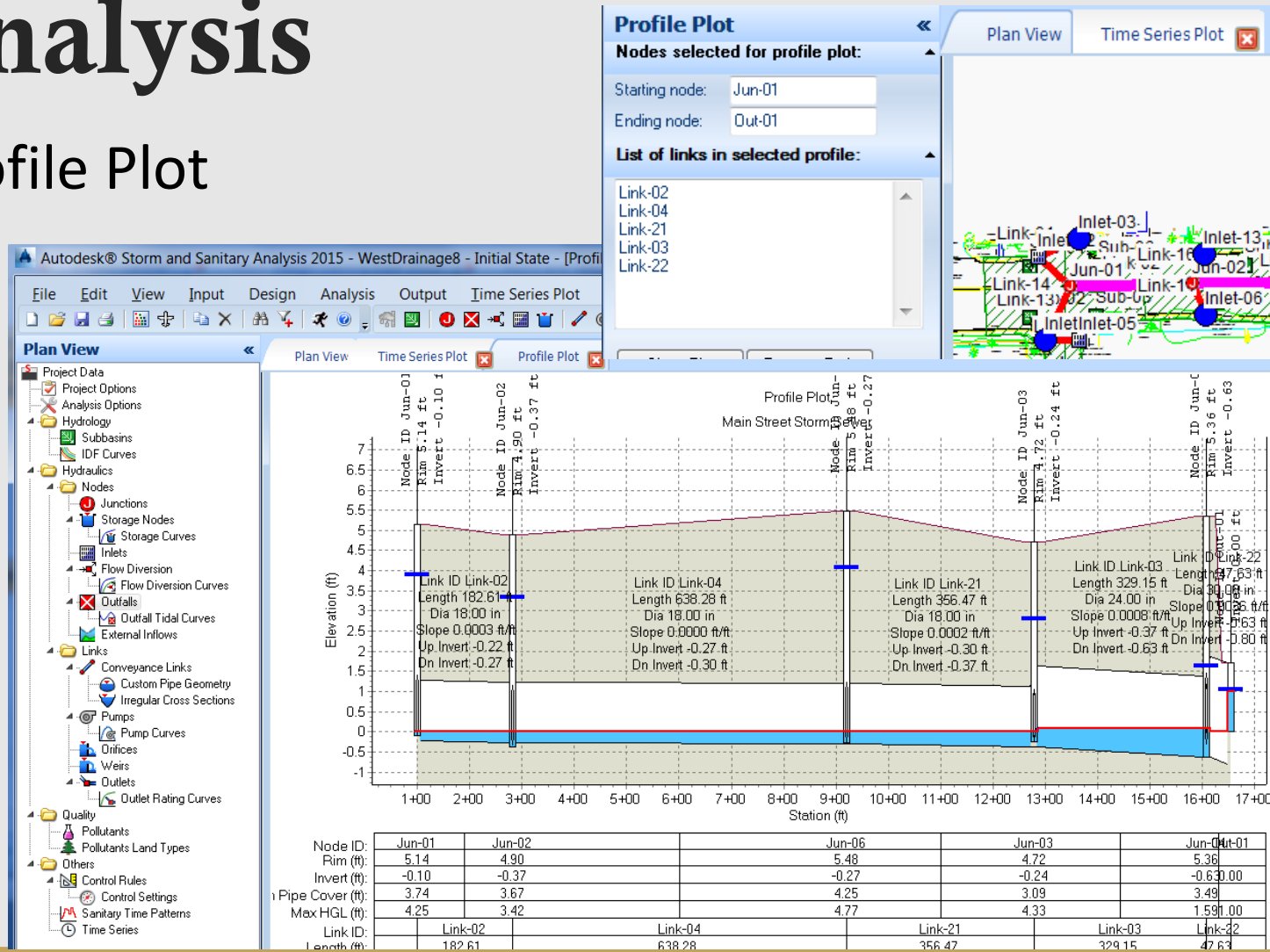
Analysis

- Time Series Plot
 - Nodes
 - System



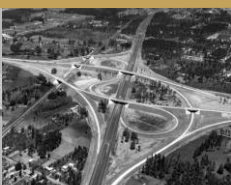
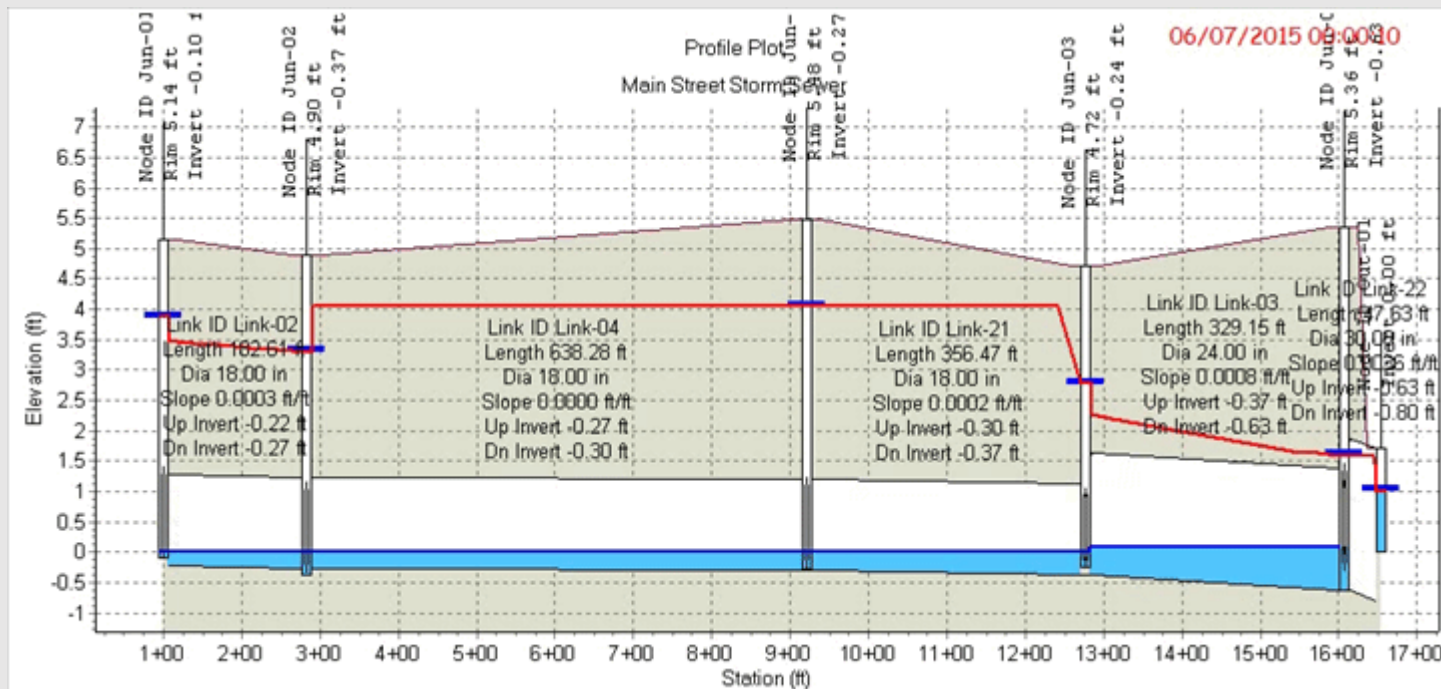
Analysis

- Profile Plot



Analysis

- Profile Plot
 - Profile Animation

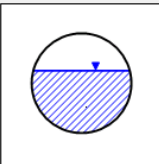


Analysis

- Adjust pipe size
- ReRun Analysis

Conveyance Links

General
Link ID: Link-04
Description:

Shape
 ☐ Open channel ☒ Pipe ☐ Culvert ☐ Direct
Circular

Properties
Number of barrels: 1
Diameter: 18.000 in

Physical properties
Length: 638.28 ft
Inlet invert elevation: -0.27 ft
Outlet invert elevation: -0.3 ft
Manning's roughness: 0.015
☐ Flap gate

Flow properties
Entrance losses: 0.5
Exit/bend losses: 0.5
Additional losses: 0
Initial flow: 0 cfs
Maximum flow: 0 cfs

Analysis summary
Constructed slope: 0.0000 ft/ft
Design flow capacity: 0.00 cfs
Peak flow during analysis: 3.14 cfs
Additional flow capacity: Surcharged cfs
Max velocity attained: 1.78 ft/sec
Max/design flow ratio: 27.56
Max/total depth ratio: 1.00
Total time surcharged: 13 min

Connectivity
From (Inlet): Jun-02
To (Outlet): Jun-06
Invert elevation: -0.37 ft
Invert elevation: -0.27 ft

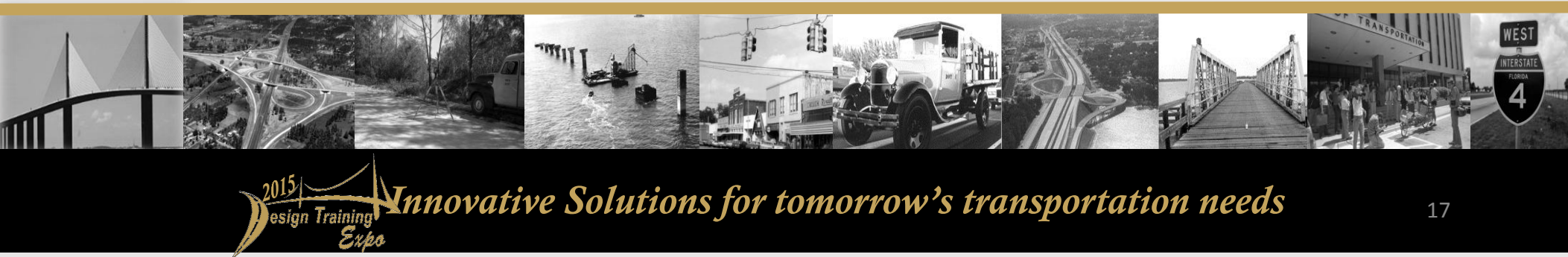
	ID /	From Node	To Node	Shape	Length	Height/ Diameter	Inlet Elev.	Outlet Elev.	Manning's Roughnes	Entrance Losses	Exit/Bend Losses
1	Link-01	Inlet-0	Inlet-0	Circular	66.47	18.000	0.1	0	0.015	0.5	0.5
2	Link-02	Jun-01	Jun-02	Circular	182.61	18.000	-0.22	-0.27	0.015	0.5	0.5
3	Link-03	Jun-03	Jun-04	Circular	329.15	24.000	-0.37	-0.63	0.015	0.5	0.5
4	Link-04	Jun-02	Jun-06	Circular	638.28	18.000	-0.27	-0.3	0.015	0.5	0.5
5	Link-05	Inlet-1	Jun-05	Circular	26.01	18.000	1	0.9	0.015	0.5	0.5
6	Link-06	Inlet-1	Jun-05	Circular	12.54	18.000	1	0.9	0.015	0.5	0.5

Buttons: Add, Delete, Show, Report, Inverts..., Close, Help



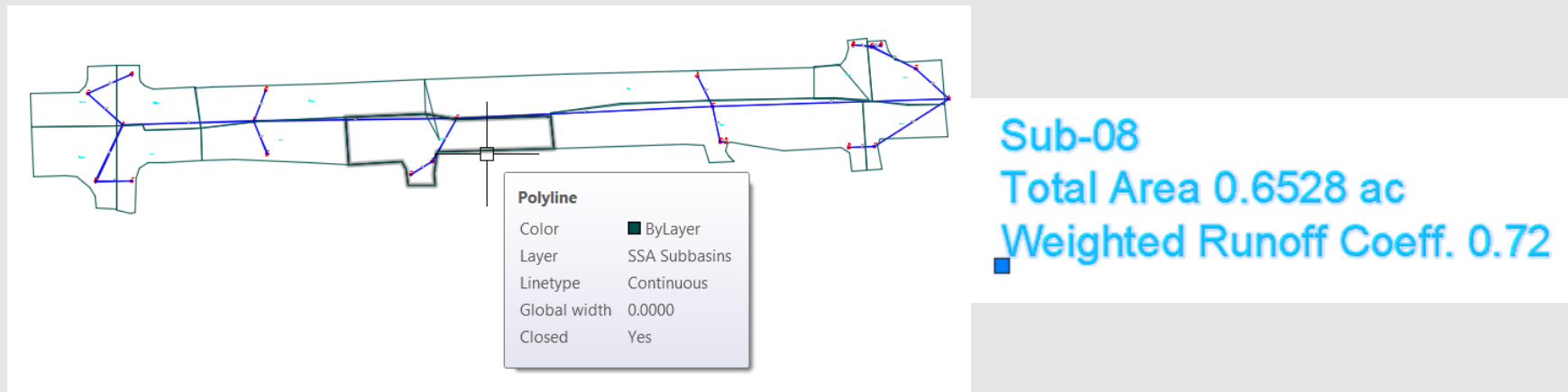
Export formats available

- CAD
 - Nodes and Links with Labels (polylines and text)
 - Basins with Labels (polylines and text)
- GIS
 - Use FDO to Import SHP Files exported from SSA
 - Rich in Tabular Data
 - Setup Tool Tips in Civil 3D



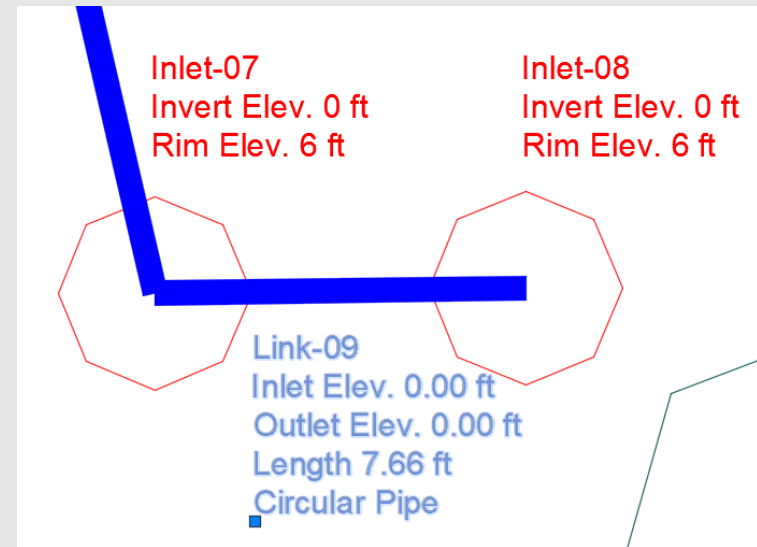
Export to CAD

- Basins are exported as polylines with ID, area, and weighted runoff coefficient labels



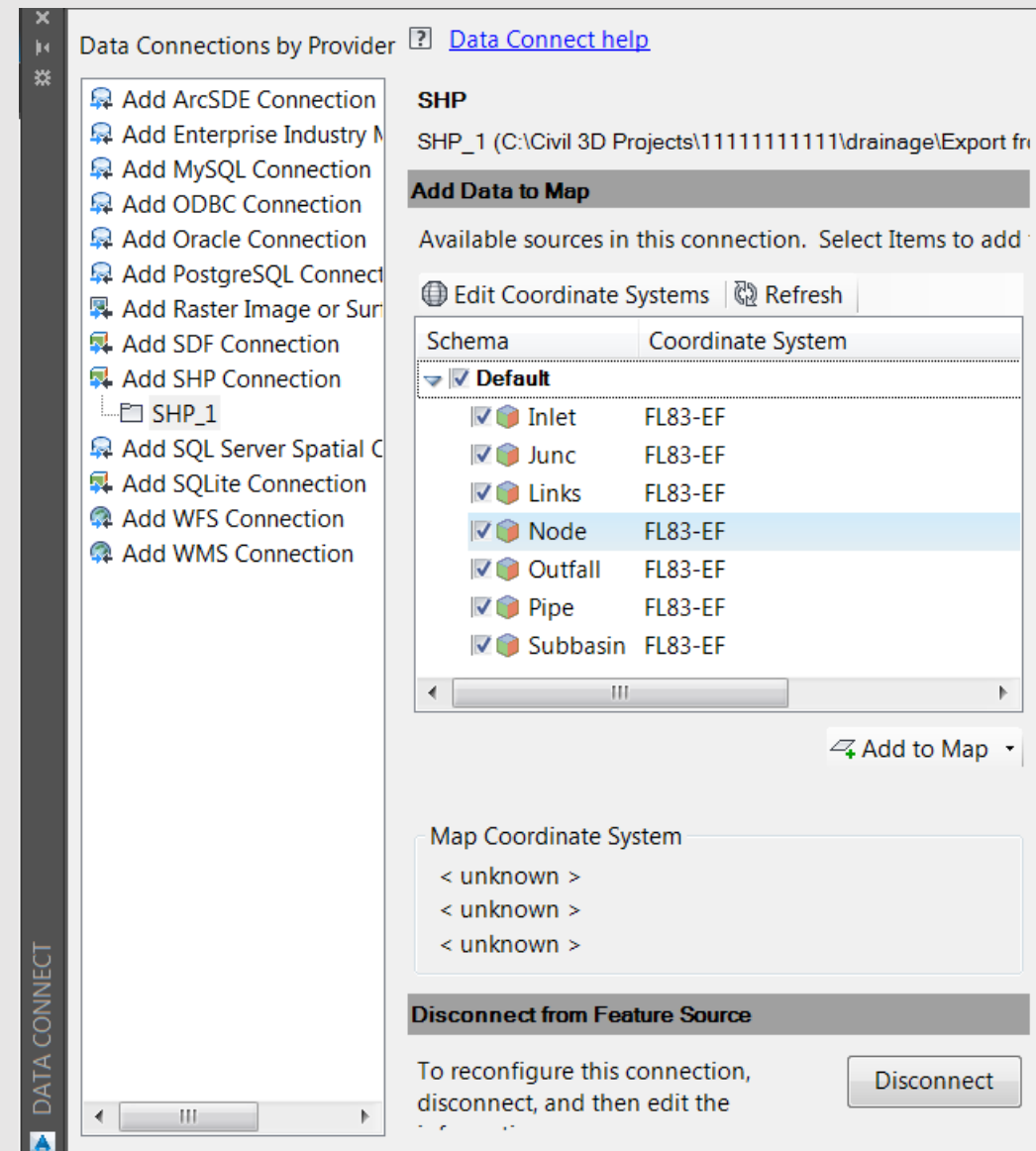
Export to CAD

- Exported entities are MTEXT, circles and polylines in dwg format
- Nodes are exported with ID, Invert elevations, and Rim elevation
- Links are exported with ID, inlet and outlet elevations, length, and pipe type (circular, elliptical, etc)



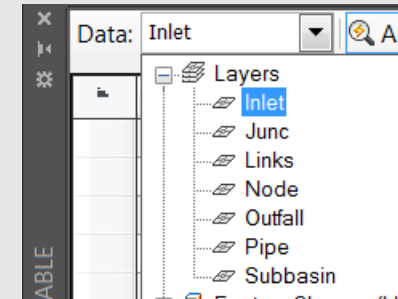
Export to GIS

- Use FDO to Import SHP Files exported from SSA
- Rich in Tabular Data
- Setup Tool Tips in Civil 3D



Export to GIS

- Rich in Tabular Data



Data: Subbasin Auto-Zoom Auto-Scroll

	FeatId	ID	DESCRIPT	AREA	DNAGE_ID	WT_RUNCO	TOC
	1	Sub-01		0.2261	Inlet-02	0.72	0
	2	Sub-02		0.1983	Inlet-04	0.72	0
	3	Sub-03		0.1697	Inlet-05	0.72	0
	4	Sub-04		0.2579	Inlet-06	0.72	0
	5	Sub-05		0.3591	Inlet-13	0.72	0
	6	Sub-06		0.1677	Inlet-03	0.72	0
	7	Sub-07		0.3822	*	0.72	0
	8	Sub-08		0.6528	Inlet-12	0.72	0

Data: Pipe Auto-Zoom Auto-Scroll Filter by:

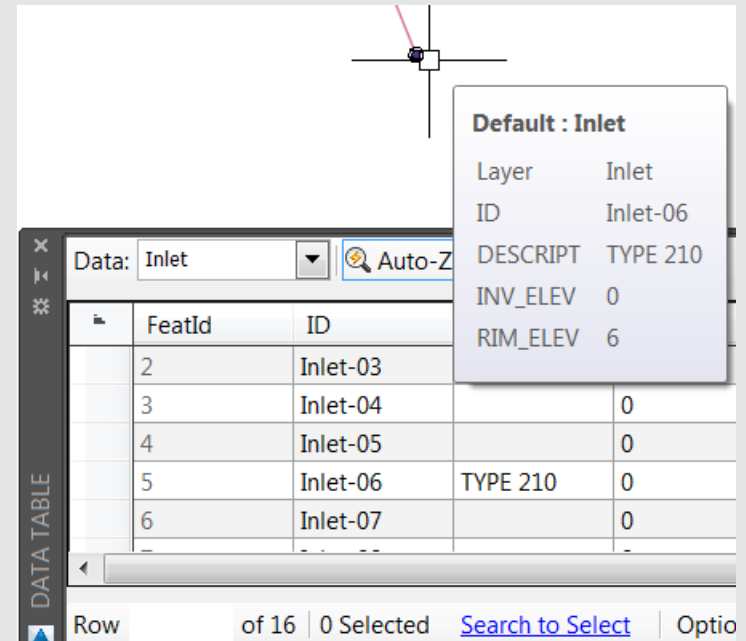
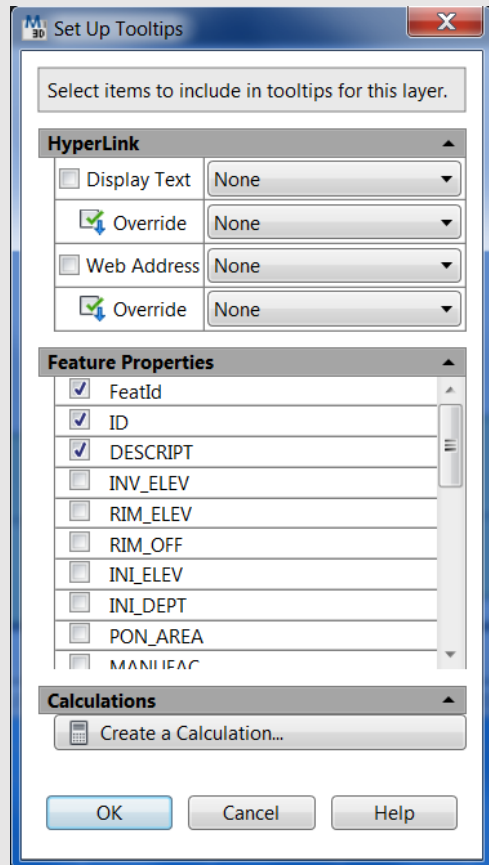
	FeatId	ID	DESCRIPT	UP_NODE	DN_NODE	LENGTH	FLP_GAT	INL_ELEV	INL_OFF	AVG_SLF	OUT_ELEV	OUT_O	MAN_ROUG	ENT_LOSS	EX_LOSS	ADD_LOS	INI_FLOW	PIPE_SHP	DIA_INCH	DIA_FT
▶	1	Link-01		Inlet-03	Inlet-02	66.47	NO	0	0	0	0	0	0.015	0.5	0.5	0	0	CIRCULAR	18	1.5
	2	Link-02		Jun-01	Jun-02	182.61	NO	0	0	0	0	0	0.015	0.5	0.5	0	0	CIRCULAR	18	1.5
	3	Link-03		Jun-03	Jun-04	329.15	NO	0	0	0	0	0	0.015	0.5	0.5	0	0	CIRCULAR	18	1.5
	4	Link-04		Jun-02	Jun-06	638.28	NO	0	0	0	0	0	0.015	0.5	0.5	0	0	CIRCULAR	18	1.5
	5	Link-05		Inlet-10	Jun-05	26.01	NO	0	0	0	0	0	0.015	0.5	0.5	0	0	CIRCULAR	18	1.5
	6	Link-06		Inlet-11	Jun-05	12.54	NO	0	0	0	0	0	0.015	0.5	0.5	0	0	CIRCULAR	18	1.5
	7	Link-07		Jun-05	Inlet-09	68.48	NO	0	0	0	0	0	0.015	0.5	0.5	0	0	CIRCULAR	18	1.5
	8	Link-08		Jun-04	Jun-04	62.02	NO	0	0	0	0	0	0.015	0.5	0.5	0	0	CIRCULAR	18	1.5

Row of 21 | 0 [Search to Select](#) [Options](#)



Export to GIS

- Setup Tool Tips in Civil 3D





The fetch phrase is...

Storm and Sanitary Analysis in Civil 3D

- Carl Irwin - Advantage Engineering
- www.Advantage-Eng.net 813-975-9638
- and Brian Morse bhm@caddesk.com 941-730-4447

