Why you Should be Using Subsurface Utilities and How to Get There

Bentley
Advancing Infrastructure

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Why?

We can sum up why with one word:

BIM

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Why?

- You need to produce a “Building Information Model”
  - Maybe because your client has asked for one
  - You’re already producing a 3D model of the proposed road/rail surface
  - If you can use it for construction, you don’t have to create a ton of drawings

- Then someone asks what you’re doing about drainage and utilities
  - Well intentioned questions, about how to avoid clashes for example
  - So you need to model the drainage and utilities in 3D as well
  - If you’re going to do this, why not design the drainage and utilities in ORD?
  - Single source of truth, no import/export, better collaboration…

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BIM

- How do you get started with BIM for SU?
  - Migrate a legacy project for hydraulic comparison
  - Consider the hydraulic requirements – e.g. ponds, LIDs - and using a CivilStorm licence for them
  - Set up the workspace, including the SU library
  - Set up drawing and reporting standards
  - Think about the data that you want to add
  - Look at how to share the Building Information Model
- The DGN file can store all of this data

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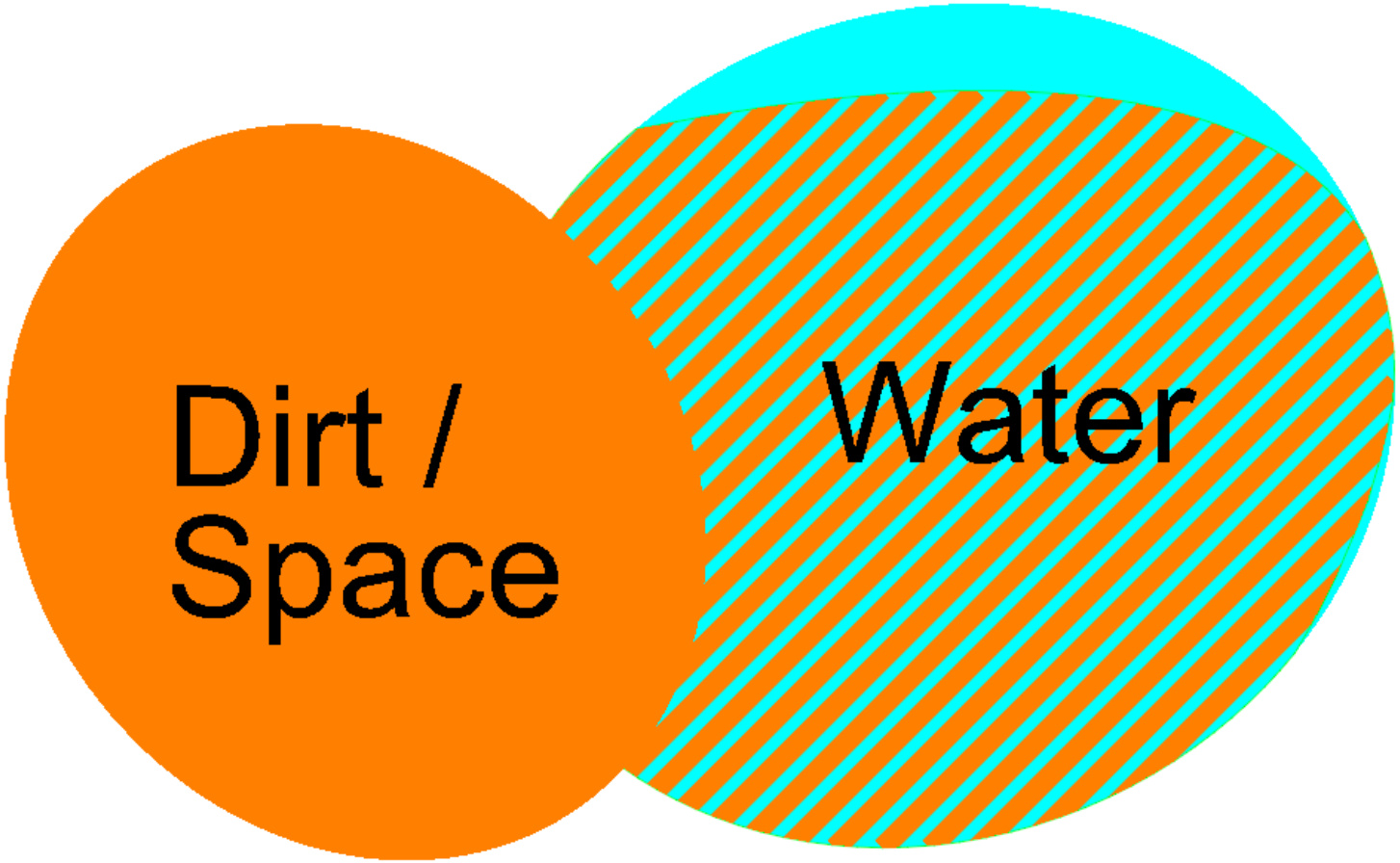
Older Civil Products with Drainage (InRoads, GEOPAK, MX)

Didn’t have full hydraulics and hydrology functionality

Older Civil Products with Drainage (InRoads, GEOPAK, MX)

- The Civil Drainage tools may have done enough hydraulics in the past, particularly for small projects, but they don’t do enough now
- Now you need to consider climate change, larger storm events, attenuation, and low impact developments, in the design process
- You need to “Design for Exceedance” - because the capacity of the system will be exceeded
- What is the volume of flooding? How quickly will flooding occur? Do I need more attenuation? Where does the flood water go?
- You would have needed more advanced drainage tools for this - e.g. MIKE URBAN, MicroDrainage, SWMM etc.

OpenRoads & Subsurface Utilities: Expands the Scope



And uses proven Hydraulics Engines

OpenRoads & Subsurface Utilities: Expands the Scope

- You’re not limited to peak flow hydraulics any more
- Use storm events – model changing rainfall intensity over time
- Then you can…
  - Produce runoff hydrographs (calculates a volume)
  - Model infiltration losses (reduces the volume)
  - Use time-varying analysis (routes the volume)
  - Design attenuation (stores the volume)
  - Find out where the system floods (excess volume)
- The key to all of this is to use a CivilStorm licence in ORD
- This could replace your current advanced drainage tools

Hydraulics!

- Haestad: A Hydraulic Jump in Capability!

WaterGEMS

WaterGEMS is a comprehensive yet easy-to-use decision-support tool for water professionals who design, plan, and operate water distribution systems.

VIEW

SewerGEMS

SewerGEMS streamlines the modeling process to give engineers more time to design, analyze, and operate sanitary or combined conveyance sewer systems.

VIEW

CivilStorm

CivilStorm provides an easy-to-use environment for engineers to analyze, design, and operate stormwater systems.

VIEW

WaterCAD

WaterCAD is an easy-to-use hydraulic modeling application for the analysis, design, and operation of water distribution systems.

VIEW

SewerCAD

Thousands of utilities and engineering firms around the world trust SewerCAD for sanitary sewer modeling and design to minimize capital investments.

VIEW

StormCAD

StormCAD provides stormwater professionals with advanced tools to effectively deliver high-quality storm sewer design with lower capital investment.

VIEW

PondPack

CulvertMaster

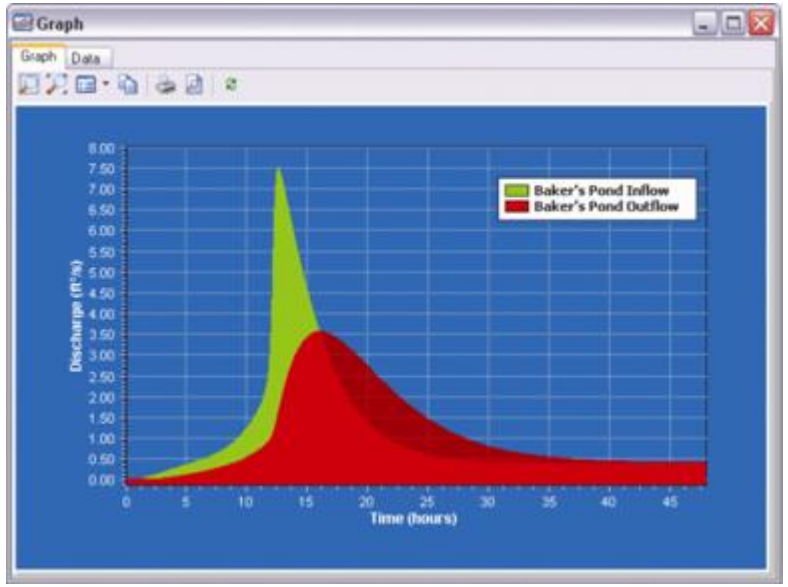
FlowMaster

Hydrograph Methods

- Unit hydrographs
  - SCS
  - RTK
  - Generic
- EPA-SWMM runoff
- Modified Rational
- ILSAX
- Time-Area

Ponds

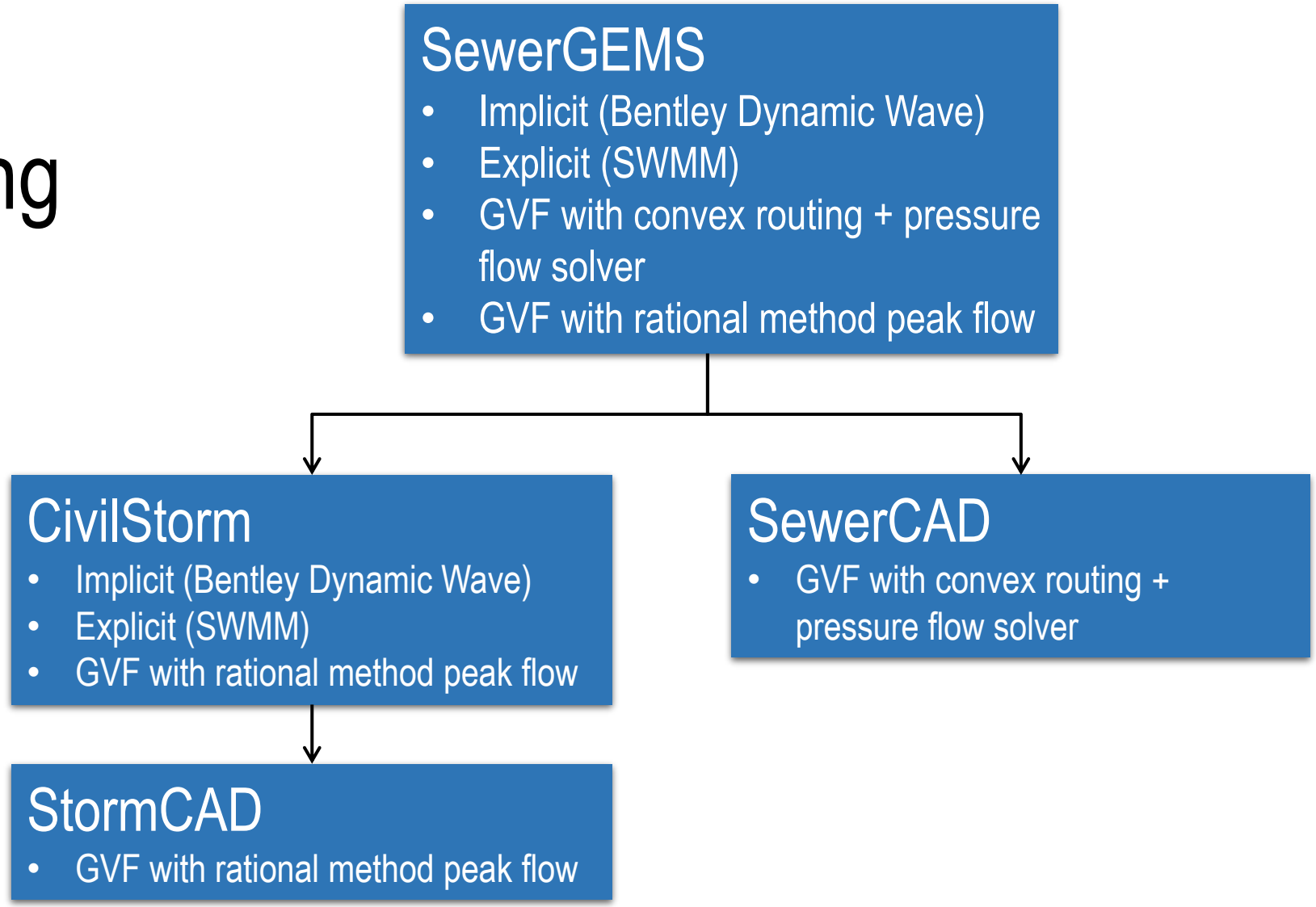
- Inflow – outflow = storage required
- Composite outlet structures
- Multiple inlets and outlets if needed



Low Impact Developments

- Bioretention
- Infiltration trenches
- Porous pavement
- Rain barrels
- Vegetative swales

Licensing



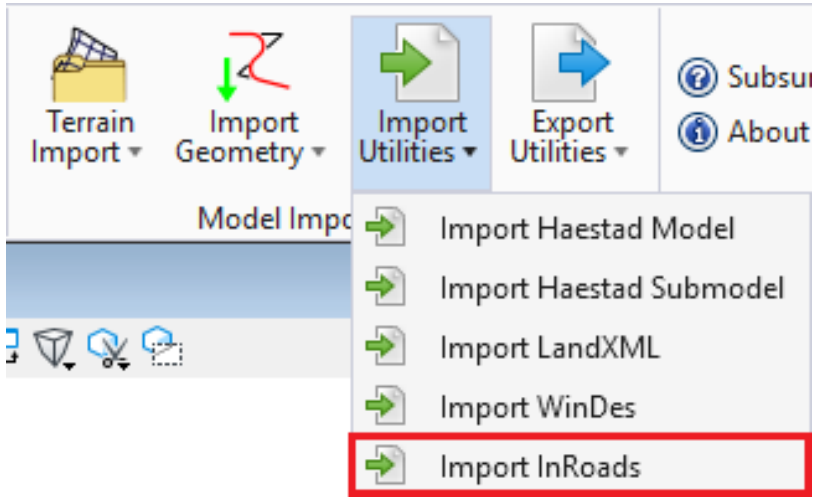
GVF = Gradually Varied Flow

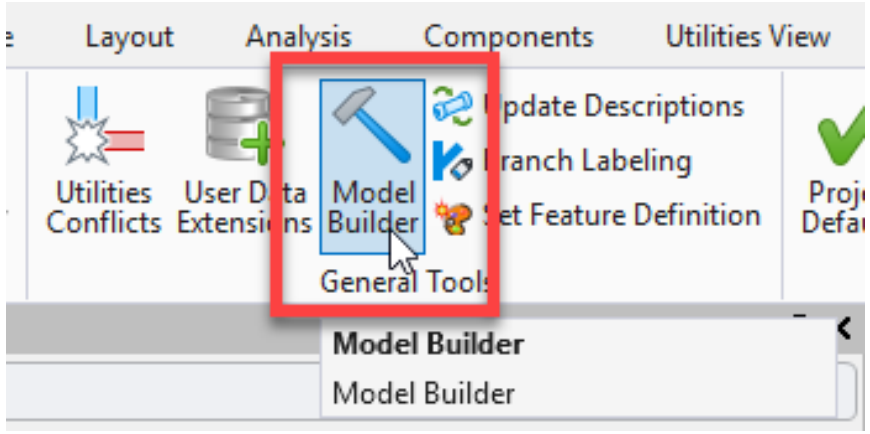
How do I get started?

- Evaluate
  - Does SU meet your Needs? Yes.
  - Are there deltas/deviations? Inevitably.
- Test
  - Do a pilot project
  - Prove H&H and deliverables
- Implement standards
  - Makes everything more efficient
  - Automates drawing layouts, report styles, added data etc
- Train
  - Your designers
  - Other consumers of the data

Evaluate - Importing

- From InRoads
- From GEOPAK/MX
  - Both write a .SWS file
  - MX writes a .XML file
  - C3D writes a .XML file
- From Haestad
  - Import a StormCAD / SewerCAD / CivilStorm / SewerGEMS project
- From Excel, Access, ESRI, and pretty much everything else: use ModelBuilder

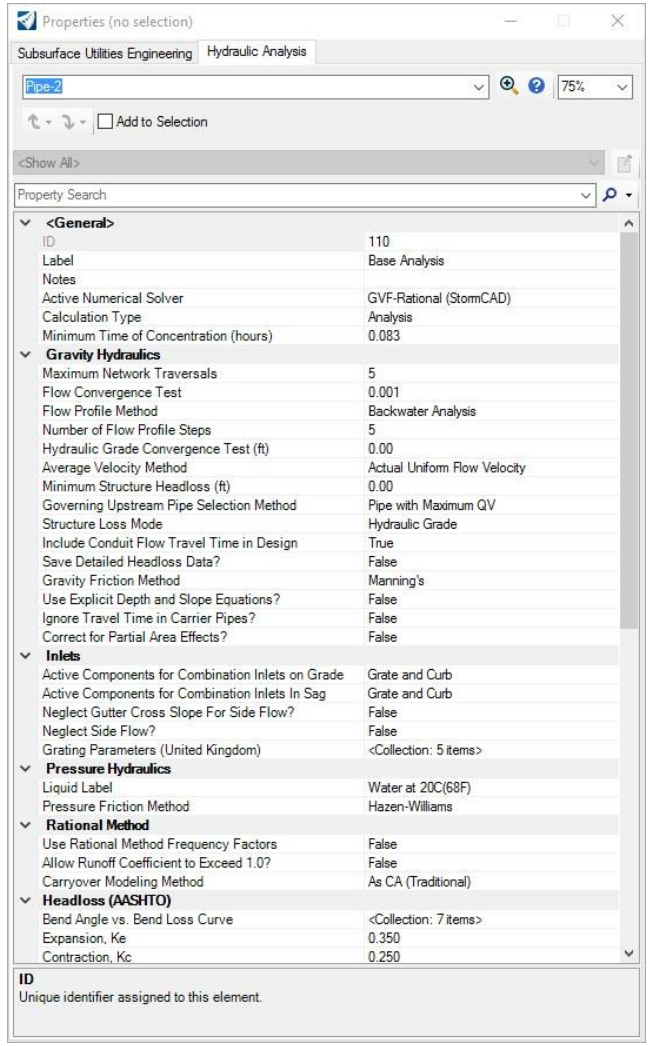




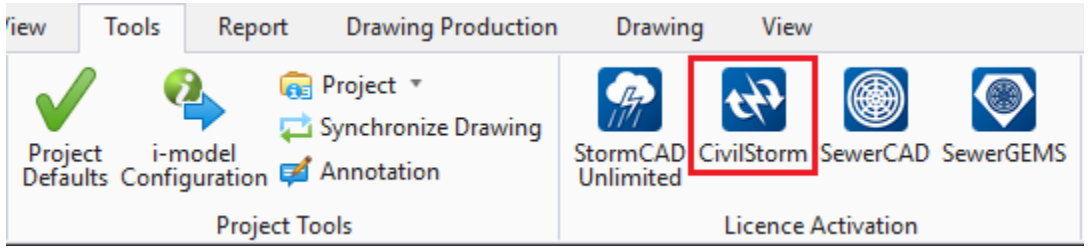
Evaluate - Hydraulic Compatibility

1. Import a project that you know
2. Use a GVF Analysis scenario (doesn't change elevations or sizes)
3. Review the calculation options
4. Compute the scenario
5. Check the results match

- If the results don't match, review the calculation options again – there is probably a setting that you need to change
- These settings can be set up as defaults in your SU DGNLib



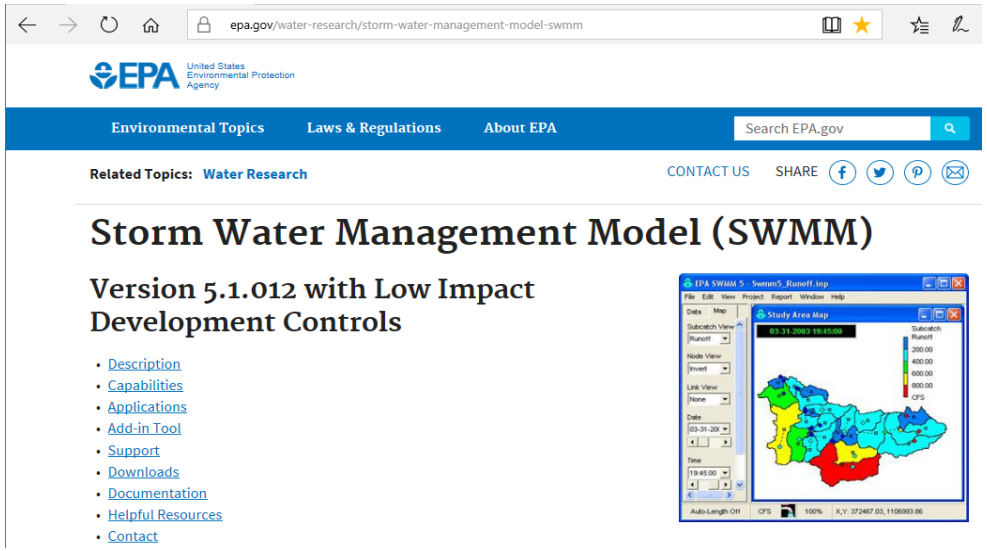
Evaluate – Advanced Hydraulic Compatibility



- CivilStorm highlights:
  1. Dynamic Wave analysis
  2. Uses the same SWMM engine as other products
  3. Bentley extends it, to make it more internationally relevant
  4. Lots of ways to create runoff hydrographs
  5. Lots of ways to model losses
  6. Profiles show results over time (e.g. HGL)
  7. Analytic Symbology varies over time
  8. Design and analyse attenuation, such as ponds
  9. Find out where flooding occurs, and where it goes (one-dimensional)

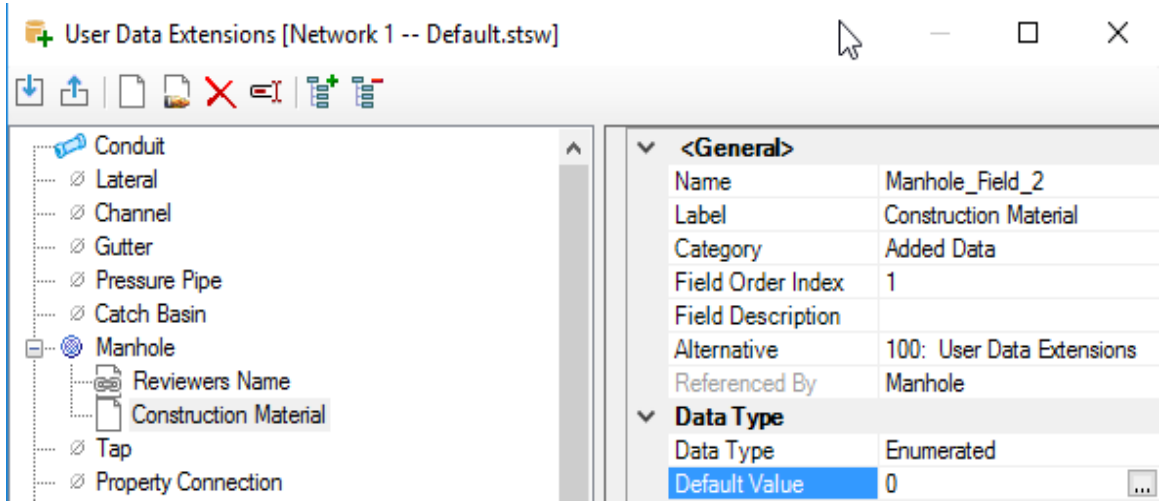
Evaluate - EPA-SWMM

- Written by the Environmental Protection Agency, in the USA
- Probably the best known dynamic hydrology-hydraulic water quality simulation model for urban storm drainage in the world
- CivilStorm uses it
- MIKE URBAN uses it
- Other products use it
- That’s why you might not need them any more



Evaluate - Data

- BIM is more than simply a 3D model – it's the source of data
- Different consumers will need different data
- User Data Extensions let you add your own data
- Not just text – can be enumerated, Boolean, date/time, formula
- These fields appear in properties / FlexTables etc. just like any other field

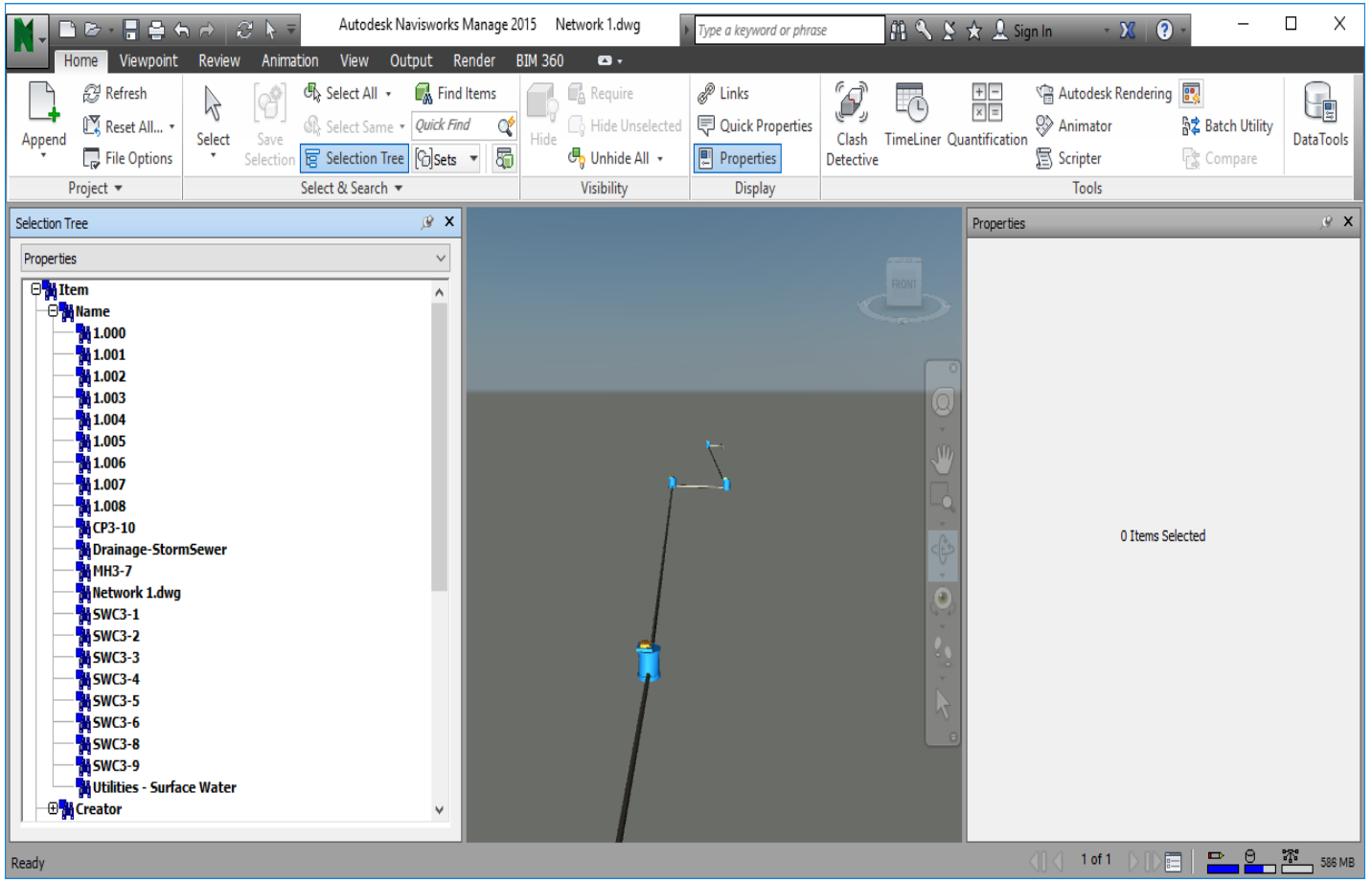


Evaluate - Deliverables

- If you are adopting a BIM philosophy, then the model will be the deliverable
  - You shouldn’t need to create lots of drawings
- Consider how the model will be consumed
  - Navigator?
  - Navisworks?
  - Others?

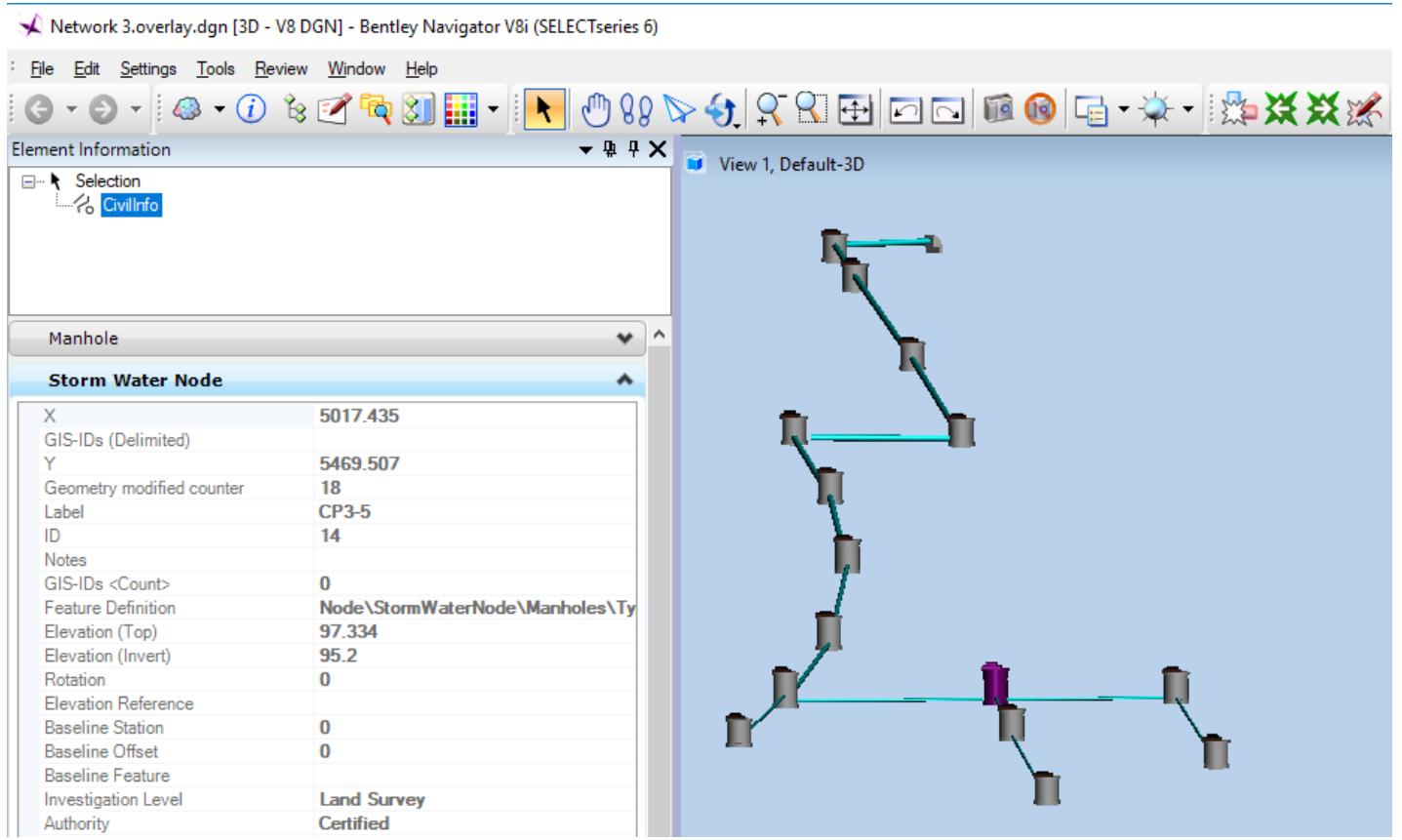
Deliverables - Navisworks

- In ORD, Export the 3D model to DWG
- Use FlexTables or ModelBuilder to export Data to Excel
- Open the DWG in Navisworks
- Use DataTools to import the Excel data
- Links it to the graphics



Deliverables - Navigator

- In ORD, Publish an iModel
- Open the iModel in Navigator
- All data is attached to the graphics
- You can choose what data is attached



Evaluate - Reports

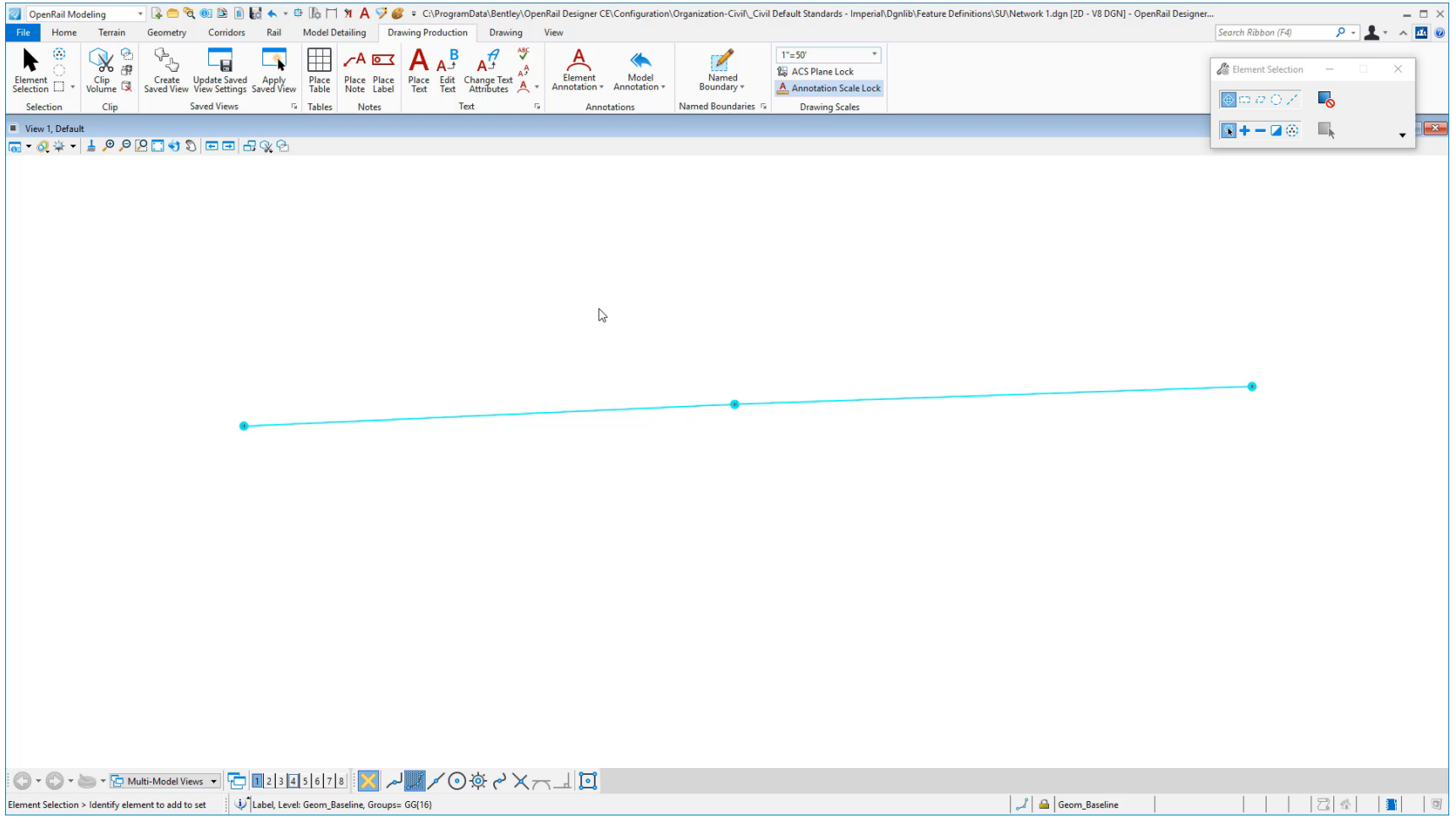
- FlexTables can be set up to include the required data
- The format and position of each column can be controlled
- Can be exported to Excel, or XML (and formatted with a style sheet)

ID	Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Rim) (ft)	Bolted Cover?	Elevation (Invert) (ft)	Headloss Method	Pipe ID	Pipe Label	Pipe Invert	Pipe Diameter (in)
77	MH-2250	124.5	FALSE	125	FALSE	124.5	Absolute				
									Out: P-2250		12.00
									In 1: P-1		12.00
									In 2: P-2		12.00
78	MH-3900	124	TRUE	124	TRUE	104	Absolute				
									Out: P-3900		12.00
79	MH-4700	124	TRUE	124	TRUE	70	Absolute				
									Out: P-4700		12.00
80	MH-7	100	TRUE	100	TRUE	97	Absolute				
									Out: P-7		12.00
81	MH-5300	124	TRUE	124	TRUE	82	Absolute				
									Out: P-5300		12.00
82	MH-4900	124	TRUE	124	TRUE	91	Absolute				
									Out: P-4900		12.00
83	MH-5200	124	TRUE	124	TRUE	89	Absolute				
									Out: P-5200		12.00

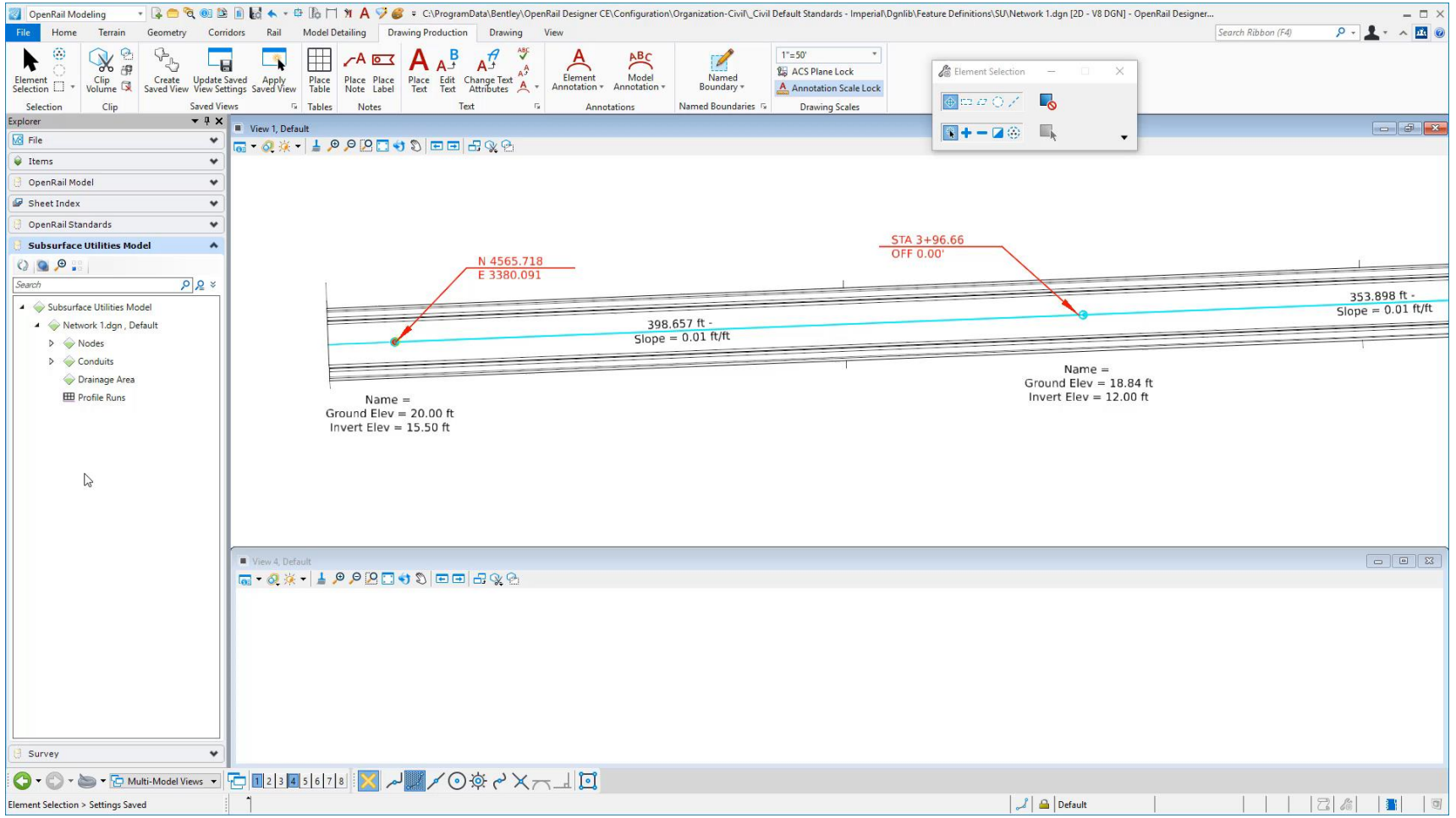
Evaluate – Drawing Production

- Still need to create drawings?
- ORD includes Drawing Production tools
  - Plan, profile, and cross section
  - Now supports SU data
  - Profiles can include tabular SU data
  - Set up Text Favourites to access the SU data
  - Let’s see some examples…

Evaluate – Plan Annotation

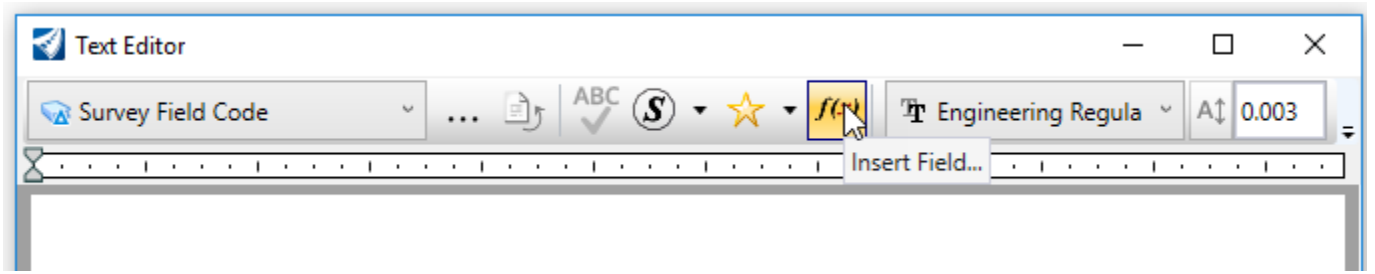


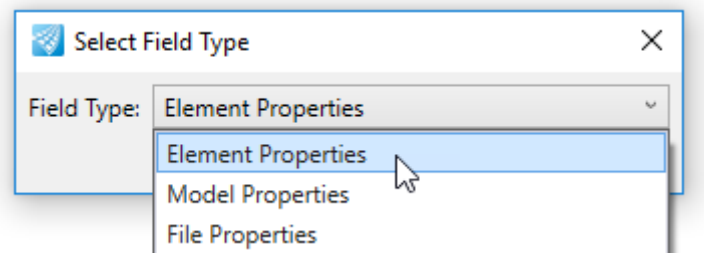
Evaluate - Profile with Frame Annotation



Creating a Text Favorite

- The Insert Field option provides access to “Element Properties”
- Must have a SU node or Link pre-drawn in the file to create the Text Favorite.





Pilot project

Do a pilot project to:

1. Confirm that you can design and analyse your storm drainage system
2. Consider where CivilStorm can add further value
3. Identify your Workspace/Workset requirements
4. Set up for deliverables

Standards / Workspace

The key to doing all of the above efficiently is the workspace

A well-managed workspace facilitates conforming to standards, ease of use, and quality

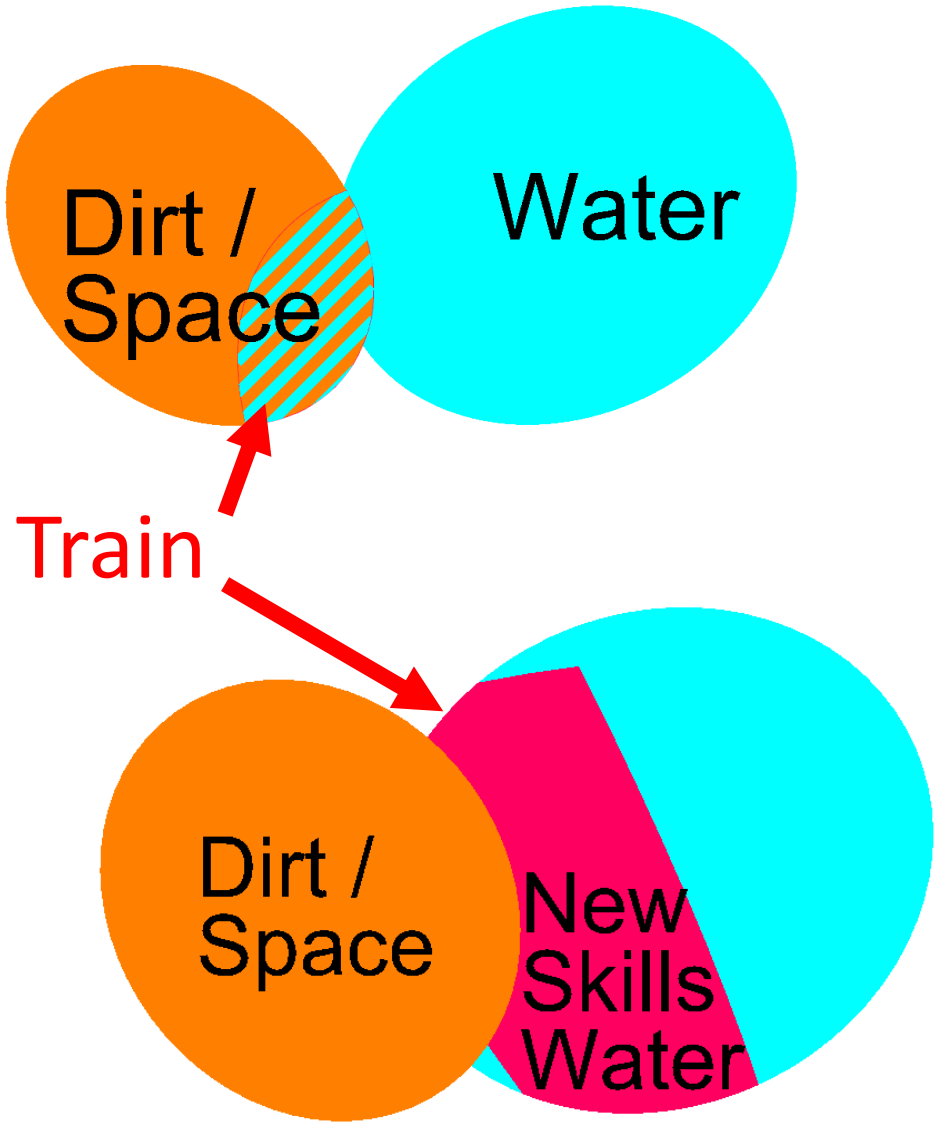
- Hydraulics
- Graphics

You can base SU standards on a DGNLib that ships with the software

Make a copy of it, and adjust to suit

Training

- Train the New Scopes
  - OpenRoads Fundamentals
  - Subsurface Utilities
    - Operational Training (What to click)
      - Subsurface Utilities Fundamentals
    - Deeper Training
      - “What Happens when you…”
    - QC Tools and Techniques
    - Implementation and Standards
- Training as a Process
  - Connect Advisor, Help, Communities



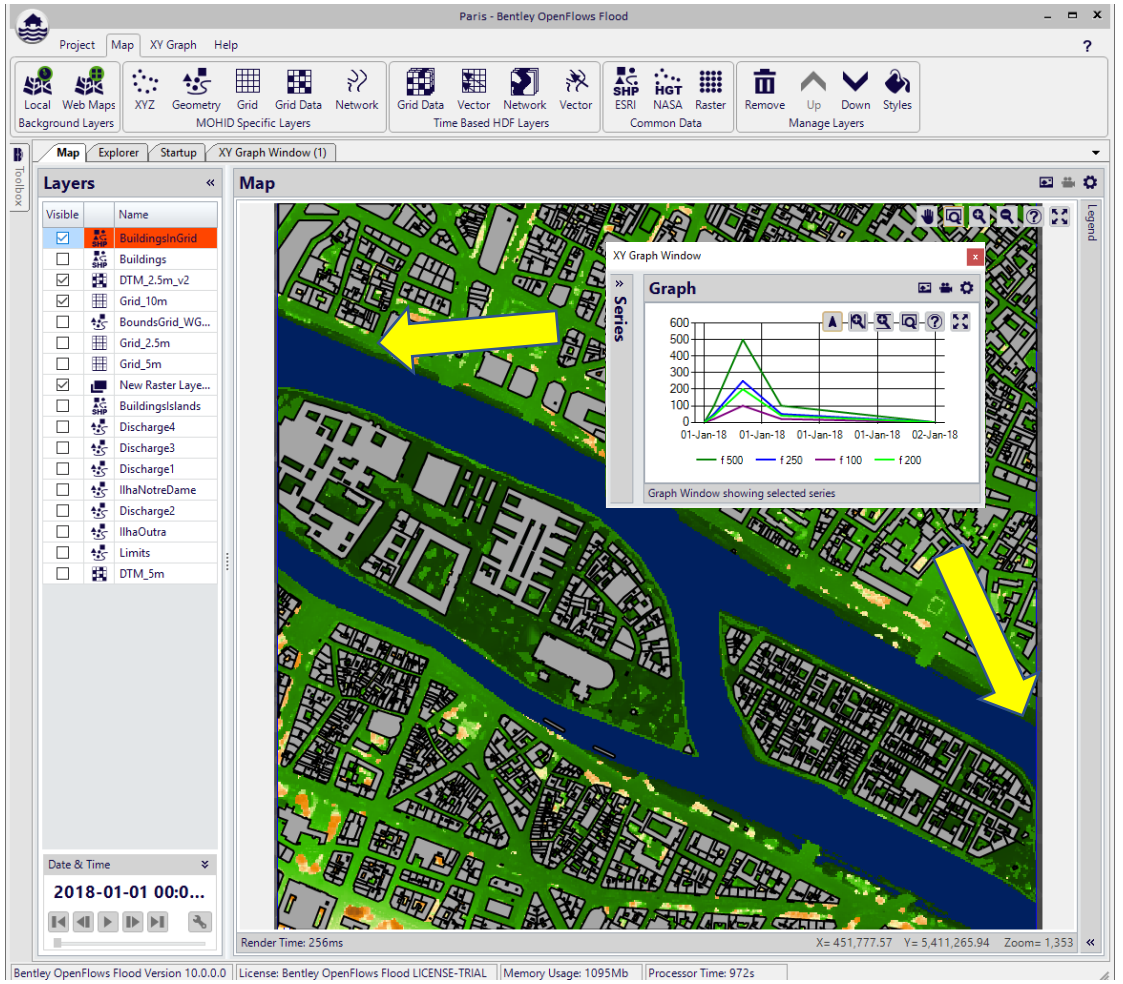
Evaluate – Overland Flow

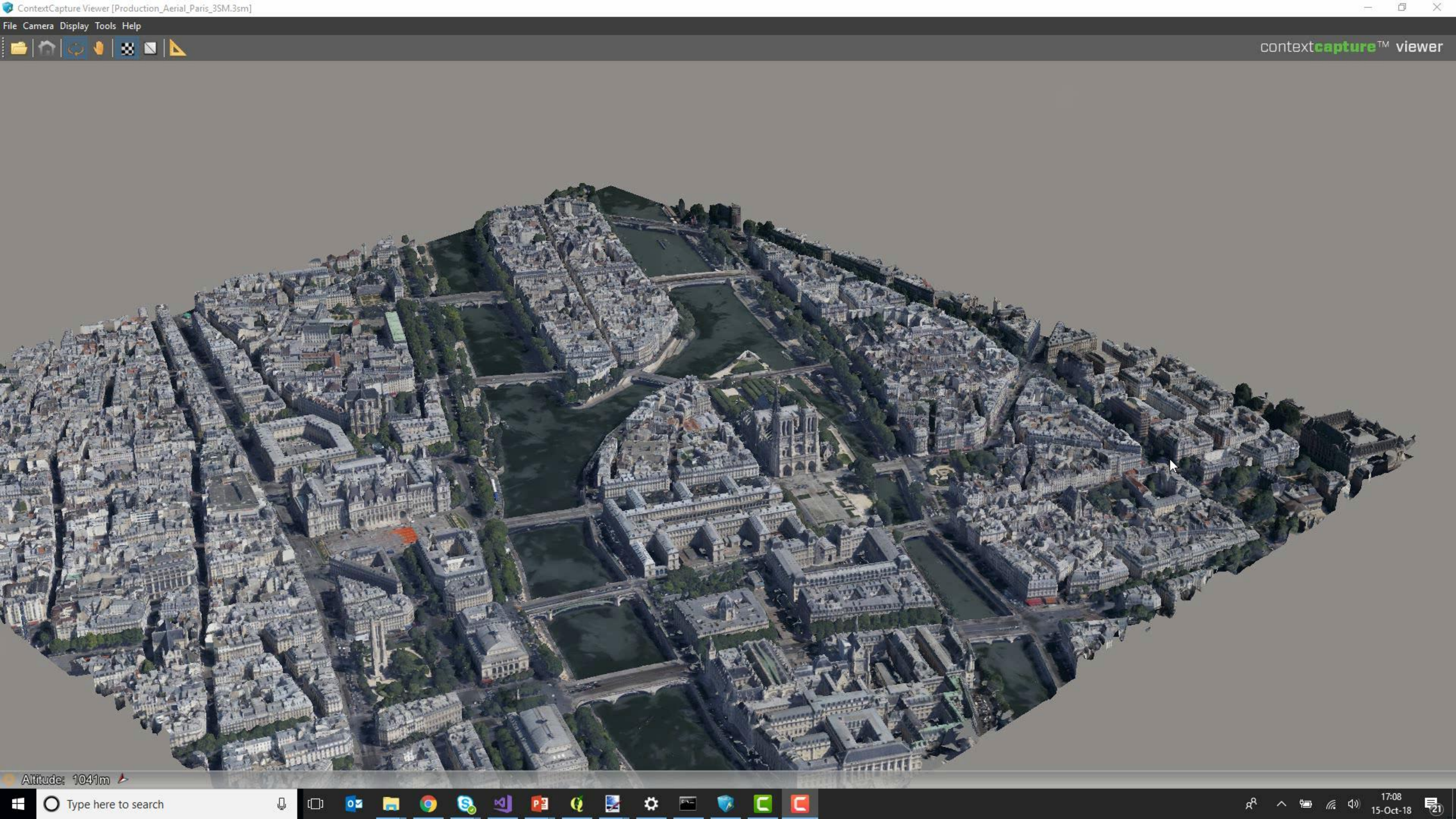
- SU includes 1D overland flow analysis
  - 1D takes account of volume
  - Takes the flood volume from each node, and routes it over a terrain
  - Useful for predicting where problems will occur

- We now have 2D overland flow analysis – OpenFlows Flood
  - 2D takes account of depth and velocity
  - You can see how depths change over time
  - Gives a better approximation of reality than 1D
  - Let’s see…

OpenFlows FLOOD – ContextCapture to Flood Model

- Import Data from ContextCapture
- Create Computational Grid
- Create Digital Terrain Model
- Overlay with Additional Information
- Import SU networks
- Define Boundary Conditions




ContextCapture Viewer [Production_Aerial_Paris_3SM.3sm]
File Camera Display Tools Help
contextcapture™ viewer
Altitude: 1041m
Type here to search
17:08
15-Oct-18

OpenFlows Flood

Demonstration of Capabilities

Extreme Flood Event in the Center of Paris

0 days
00:00:00

Japan Tsunami - Bentley OpenFlows Flood

Project | Map | XY Graph | Help

Local Web Maps — Background Layers
XYZ Geometry Grid Grid Data Network — MOHID Specific Layers
Grid Data Vector Network Vector — Time Based HDF Layers
SHP ESRI HGT NASA Raster — Common Data
Remove Up Down Styles — Manage Layers

Map | Explorer

Toolbox

Layers

Visible		Name
☐		L3 [water level]
☐		L2 [water level]
☑		L1 [water level]
☑		TileLayer - Bing - Aerial

Date & Time

2011-03-11 14:45:00

Map

Legend

Render Time: 1 498ms Lon= 133.3660 Lat= 34.3198 Zoom= 1 839 603

Bentley OpenFlows Flood Version 10.0.0.0 | License: Bentley OpenFlows Flood LICENSE-TRIAL | Memory Usage: 2343Mb | Processor Time: 3 995s

Why you Should be Using Subsurface Utilities and How to Get There

Thank You

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