Optimising Design of Retrofit SuDS

12 September 2019, Water Resilient Cities, Retrofitting SuDS from Design to Delivery

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Product Manager, Innovyze

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Innovyze empowers water professionals around the world to create, manage, and maintain water services.

We are the global leader in water infrastructure data analytics software, providing enduring support for customer success.

3240	57	35
clients	countries	years' experience

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Agenda

- How can design software help?
- Where does water flow?
- SuDS representation
- Collaborative retrofit design
- Asset management

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What can design software help us with?

- Assessing existing site conditions
  - Brownfield runoff
  - Greenfield runoff
- Give an insight to natural catchment behaviour & impact of design
- Record, utilise & share data with / from a number of different sources
  - Throughout the whole lifecycle of the system
  - Identify crossings and clashes
- Enable optimised engineering design (sustainability, cost, performance, ease of maintenance...)
- Model for water quality as well as quantity
- Allow faster iteration of the design process and optioneering
- Audit design against regulatory requirements

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Benefits of hydraulic model

Simulation

- Connected objects
- Backwater
- Pollution

- Flooded Volumes
- Flow Paths

Costings

Comparisons

Exceedence

Site Data

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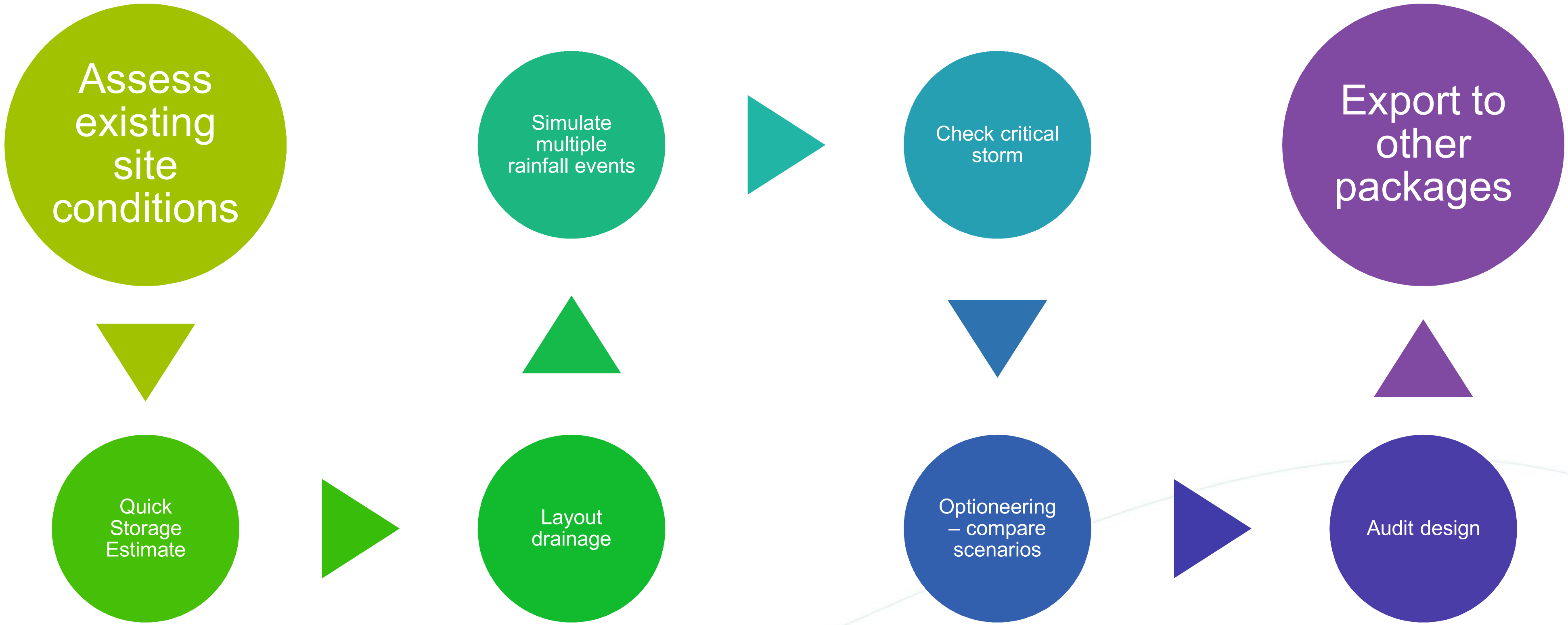

Assess existing site conditions
Quick Storage Estimate
Layout drainage
Simulate multiple rainfall events
Check critical storm
Optioneering – compare scenarios
Audit design
Export to other packages

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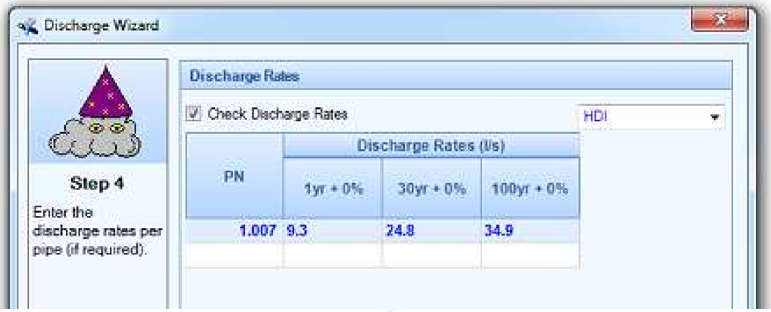
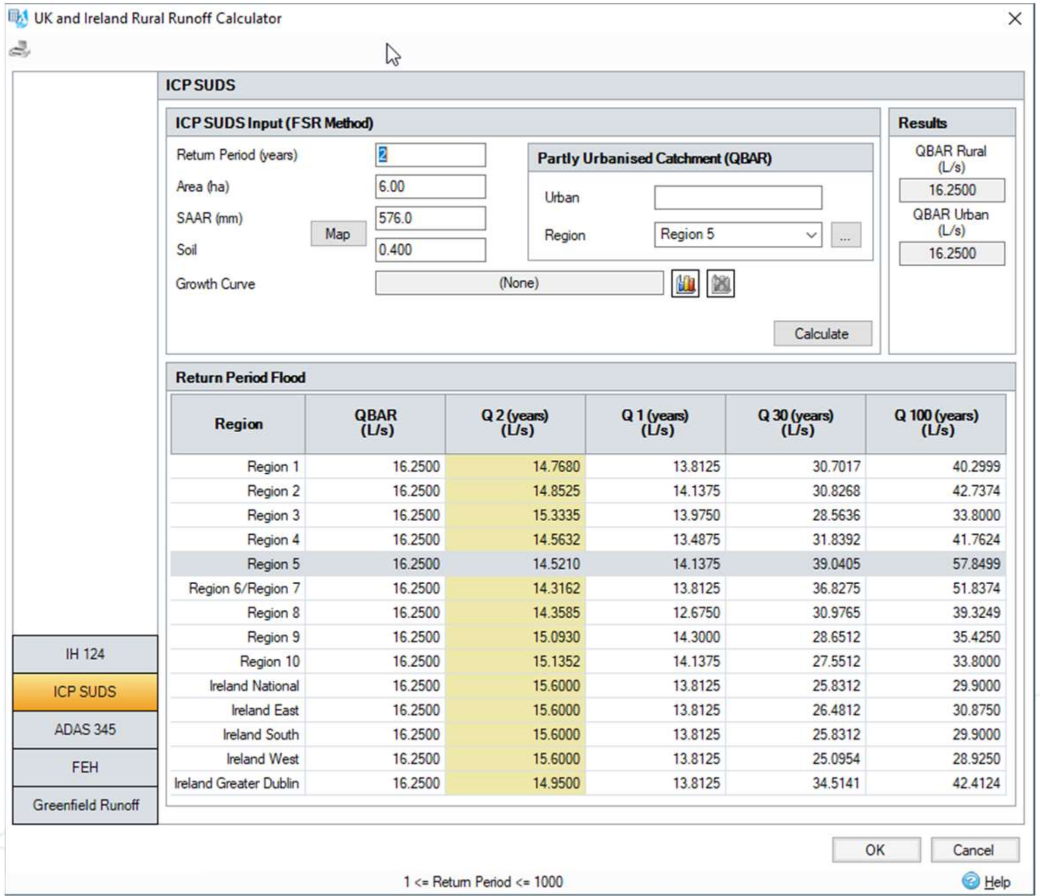
Brownfield Runoff Calculations

OR

Pipe Number	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	15 minute 1 year Winter I	100.000	99.347	-0.178	0.000	0.72		240.0	OK
1.001	2	15 minute 1 year Winter I	99.500	98.828	-0.197	0.000	0.69		230.1	OK



Greenfield Runoff Calculations



UK and Ireland Rural Runoff Calculator

ICP SUDS

ICP SUDS Input (FSR Method)

Return Period (years): 2
Area (ha): 6.00
SAAR (mm): 576.0
Soil: 0.400
Growth Curve: (None)

Partly Urbanised Catchment (QBAR)

Urban:
Region: Region 5

Calculate

Results

QBAR Rural (L/s): 16.2500
QBAR Urban (L/s): 16.2500

Return Period Flood

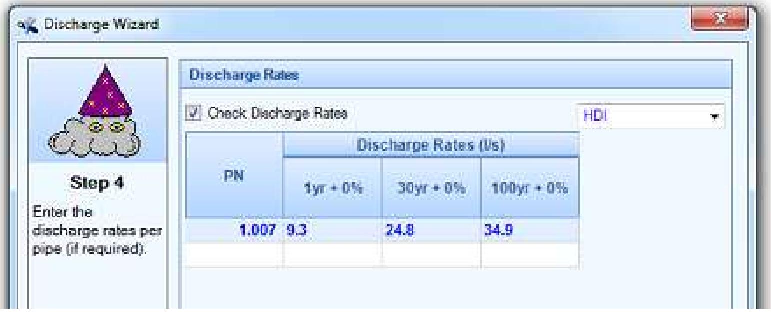
Region	QBAR (L/s)	Q 2 (years) (L/s)	Q 1 (years) (L/s)	Q 30 (years) (L/s)	Q 100 (years) (L/s)
Region 1	16.2500	14.7680	13.8125	30.7017	40.2999
Region 2	16.2500	14.8525	14.1375	30.8268	42.7374
Region 3	16.2500	15.3335	13.9750	28.5636	33.8000
Region 4	16.2500	14.5632	13.4875	31.8392	41.7624
Region 5	16.2500	14.5210	14.1375	39.0405	57.8499
Region 6/Region 7	16.2500	14.3162	13.8125	36.8275	51.8374
Region 8	16.2500	14.3585	12.6750	30.9765	39.3249
Region 9	16.2500	15.0930	14.3000	28.6512	35.4250
Region 10	16.2500	15.1352	14.1375	27.5512	33.8000
Ireland National	16.2500	15.6000	13.8125	25.8312	29.9000
Ireland East	16.2500	15.6000	13.8125	26.4812	30.8750
Ireland South	16.2500	15.6000	13.8125	25.8312	29.9000
Ireland West	16.2500	15.6000	13.8125	25.0954	28.9250
Ireland Greater Dublin	16.2500	14.9500	13.8125	34.5141	42.4124

IH 124
ICP SUDS
ADAS 345
FEH
Greenfield Runoff

OK
Cancel

1 <= Return Period <= 1000

Help



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Understanding where the water wants to flow

Designing with our blue-green corridors in mind

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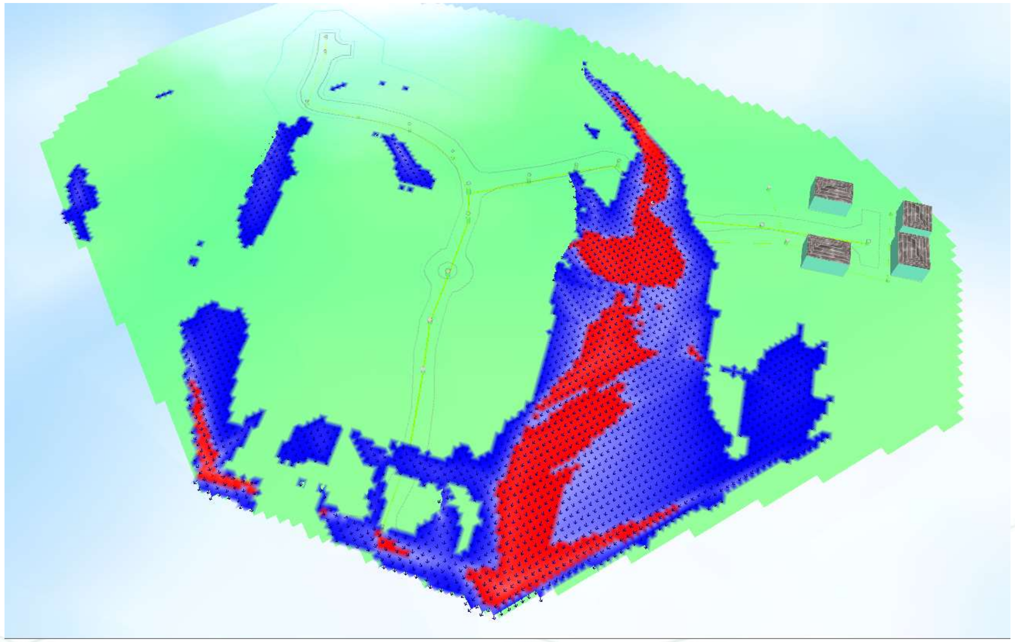
Working with the natural drainage on site

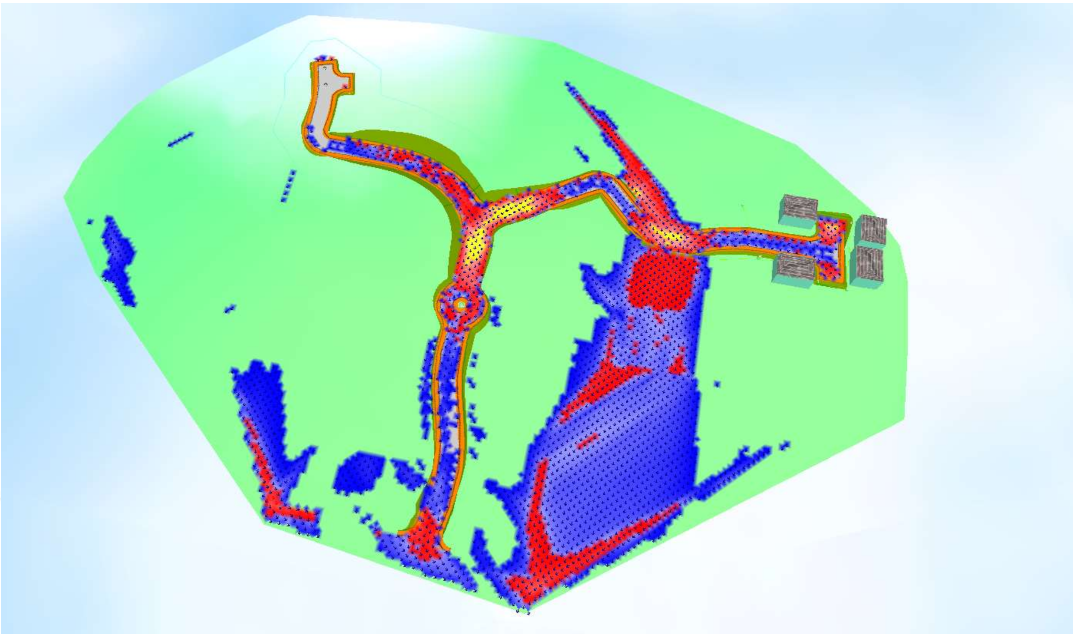
- Deluge site before layout begins
  - Identify natural flow paths to minimize earthworks saving money and maximizing the use of space
- Reduce surface water entering existing drainage systems
- SuDS can be more cost effective than increasing capacity of existing drainage

Deluge Analysis

Existing Ground



Proposed Ground



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Overland Flow Analysis

- 2D Analysis has a growing importance within Drainage Design
- An optimal drainage strategy will account for exceedance routes and look to utilise these to its advantage
- Understanding how the 1D network can interact with the 2D overland flow can lead to identification of flood mechanisms and potential resilience & mitigation measures

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Enabling better SuDS representation

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The Optimum Design Process

In most cases, the SuDS approval process is made up of three stages:

Conceptual design proposals

The developer sets out the conceptual drainage strategy and proposed adoption body or bodies

Outline drainage design proposals

Confirmation of design standards and volumes for principal structures, prescribed exceedance routes and sets out adopting body/partnership

Detailed drainage design

This details the engineering specifications and final design for the SuDS structures

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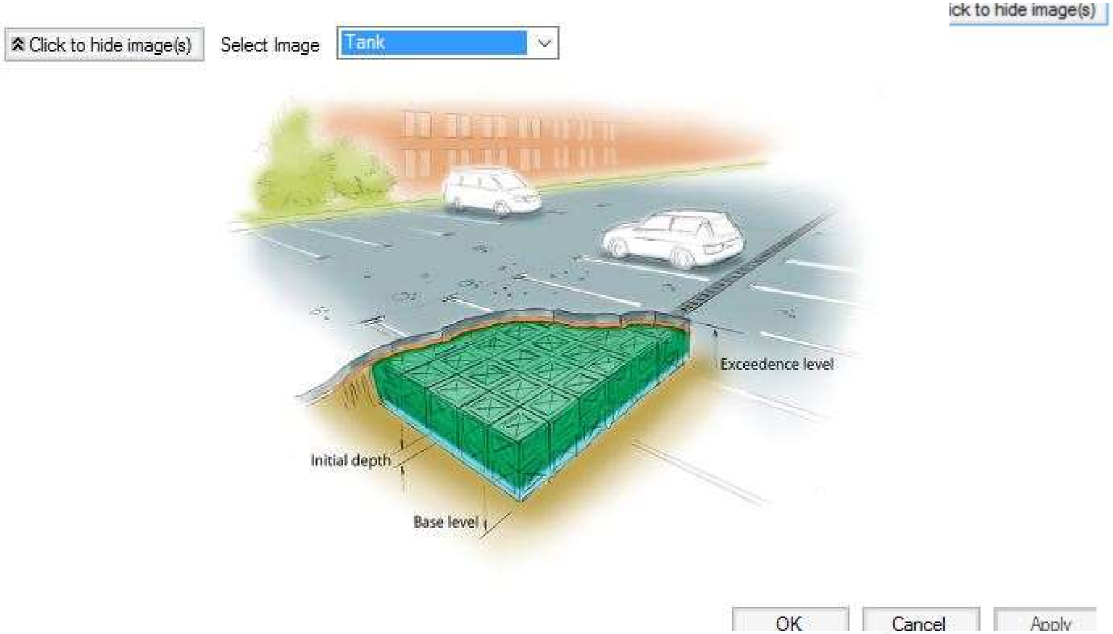
How software can help with planning approvals

- Recognised outputs in easy to digest formats
- Self auditing tools
- Using pro-formas
- MDSuDS or XPDrainage at pre-planning
  - Highly visual
  - Details SuDS analysis
  - Conceptual connections allowed
- MicroDrainage for full detailed design

Traditional – Sustainable Drainage

Simple sizing calculations – complex interactions



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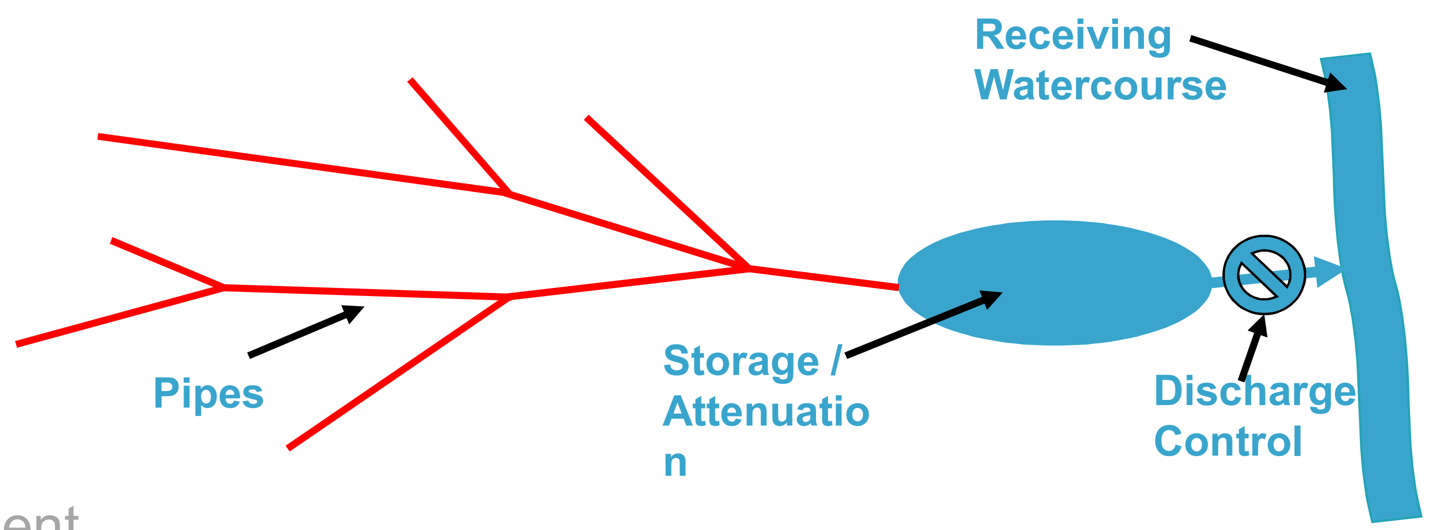
Drainage Networks

- Traditional:
- Large Storage volumes
- Significant control restrictions
- Increased expense
- Poor Water Quality Improvement



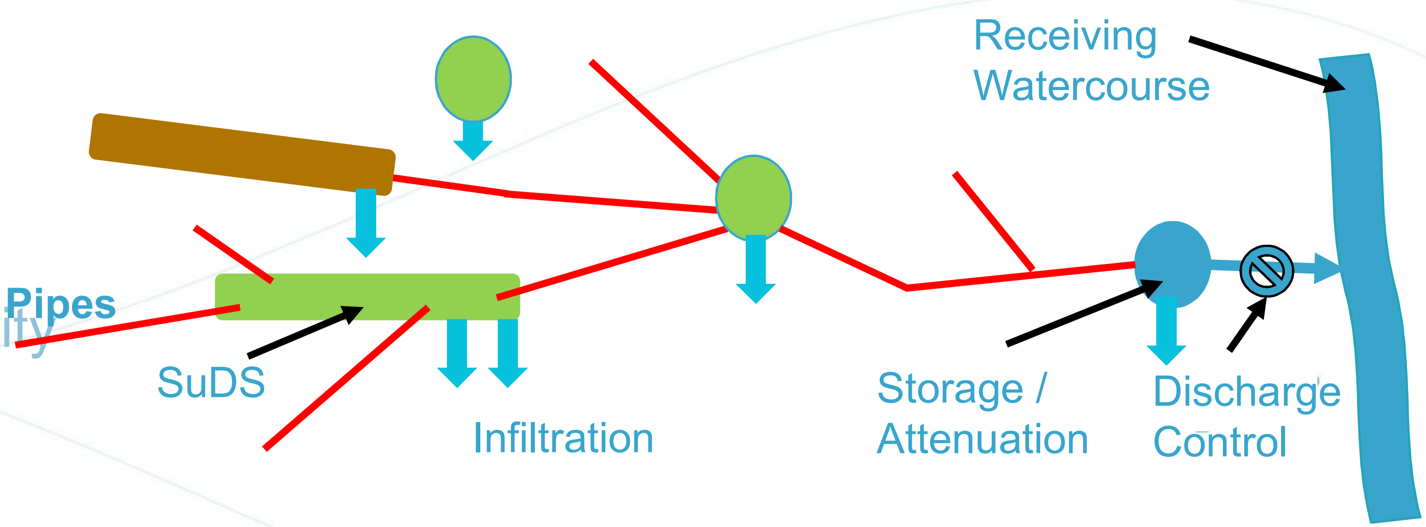
SuDS:

Reduced storage volumes

Utilises natural processes

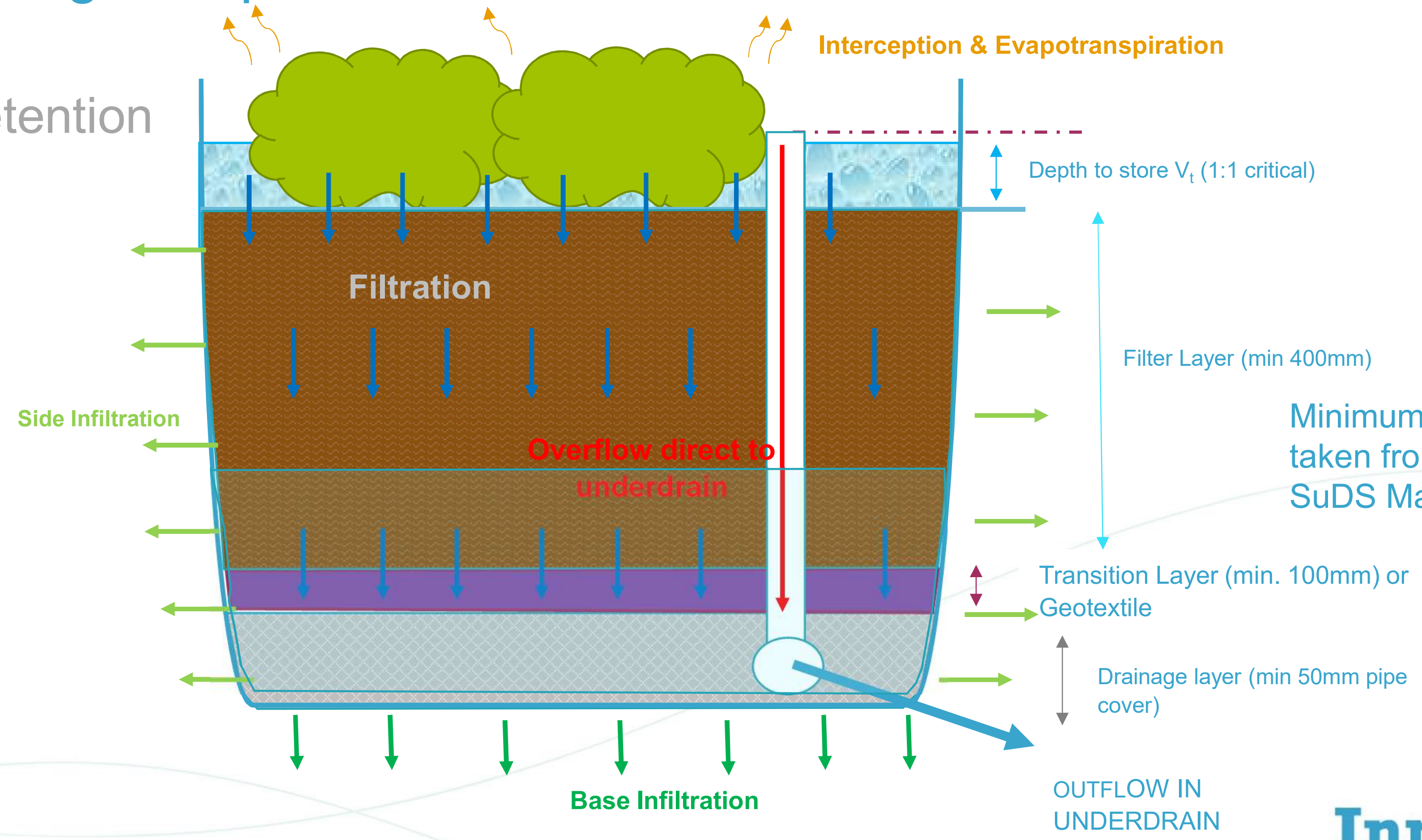
Water Quality Improvement

Increased Biodiversity & Amenity



Modelling Complex Flow Paths & Interactions

- Bioretention



Minimum sizing requirements taken from CIRIA C753 - The SuDS Manual 2015

…and this is before we start to consider water quality

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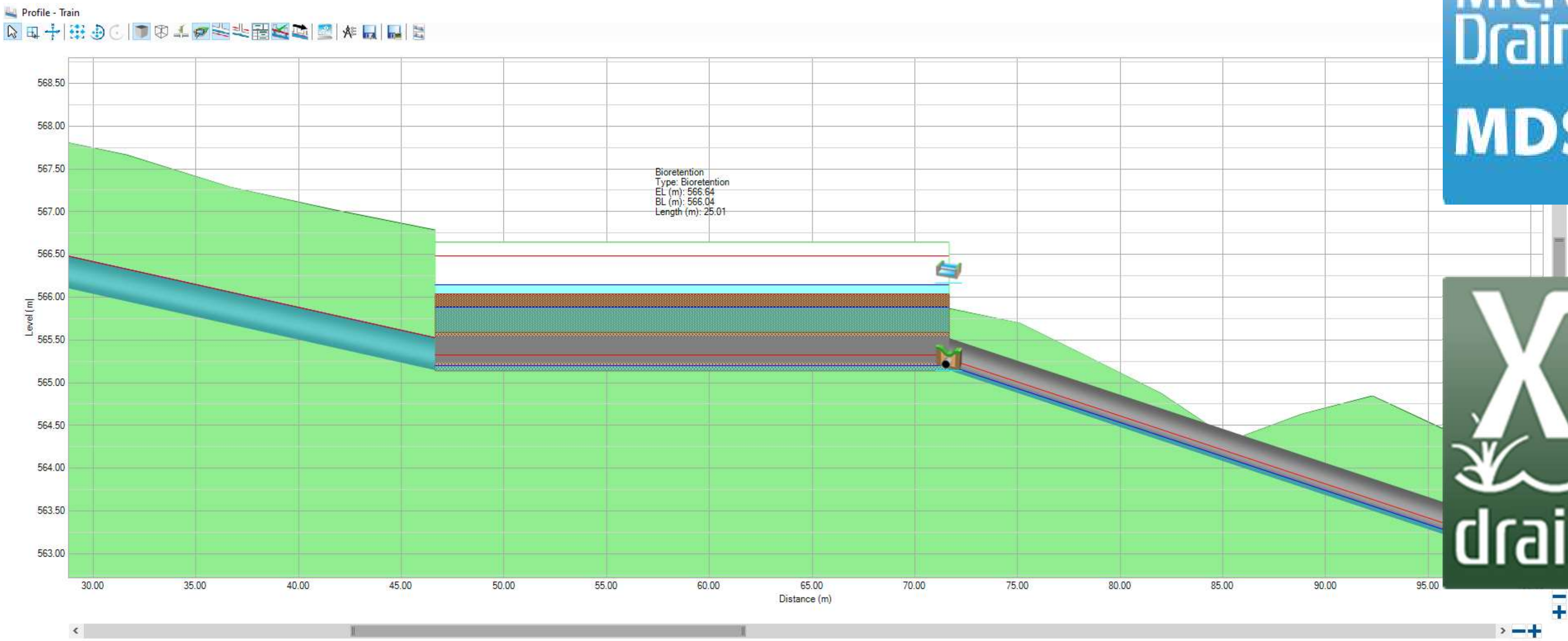
Detailed SuDS Analysis



Micro Drainage

MDSuDS

XP drainage

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Analysing Retrofit Designs

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Multiple rainfall events

Low flow events for water quality

- Low flows capture first flush of pollutants
- Hydraulic models allow pollution analysis
- Improve on existing potential issues

Design events for storage

- Bypass may be needed for raingardens to prevent washout
- Treatments trains help to spread storage across site

Extreme events for exceedence

- Identify overland flow paths
- Ensure properties protected
- Important to ensure no worsening

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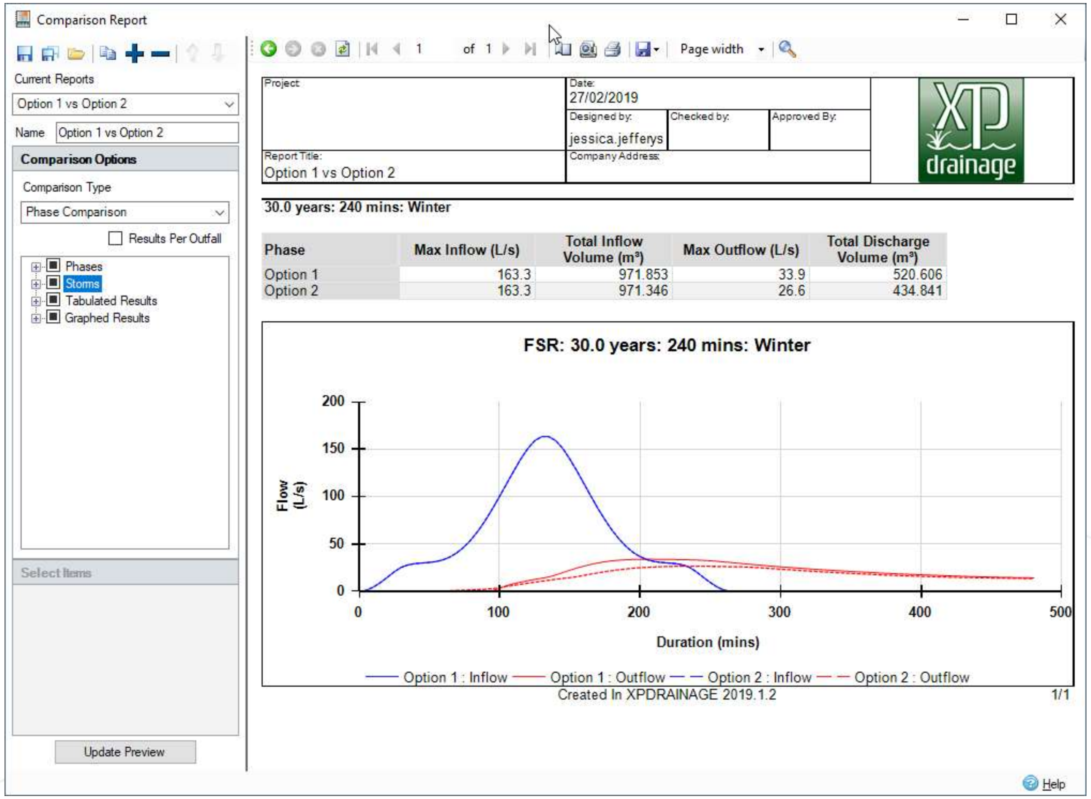
Comparing Scenarios

Comparing results from a mixed SuDS approach including Source Control with an “end of pipe” solution allows us to consider them in the wider context of the multiple benefits.



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Collaborative Retrofit Design

Collaborative Design

- Coordinate drainage design with other activities on retrofit sites
- Clash check with other utilities
- Replicate Drainage Design Data in a wide variety of packages
  - CAD
  - GIS
  - Modelling packages
  - 3D models

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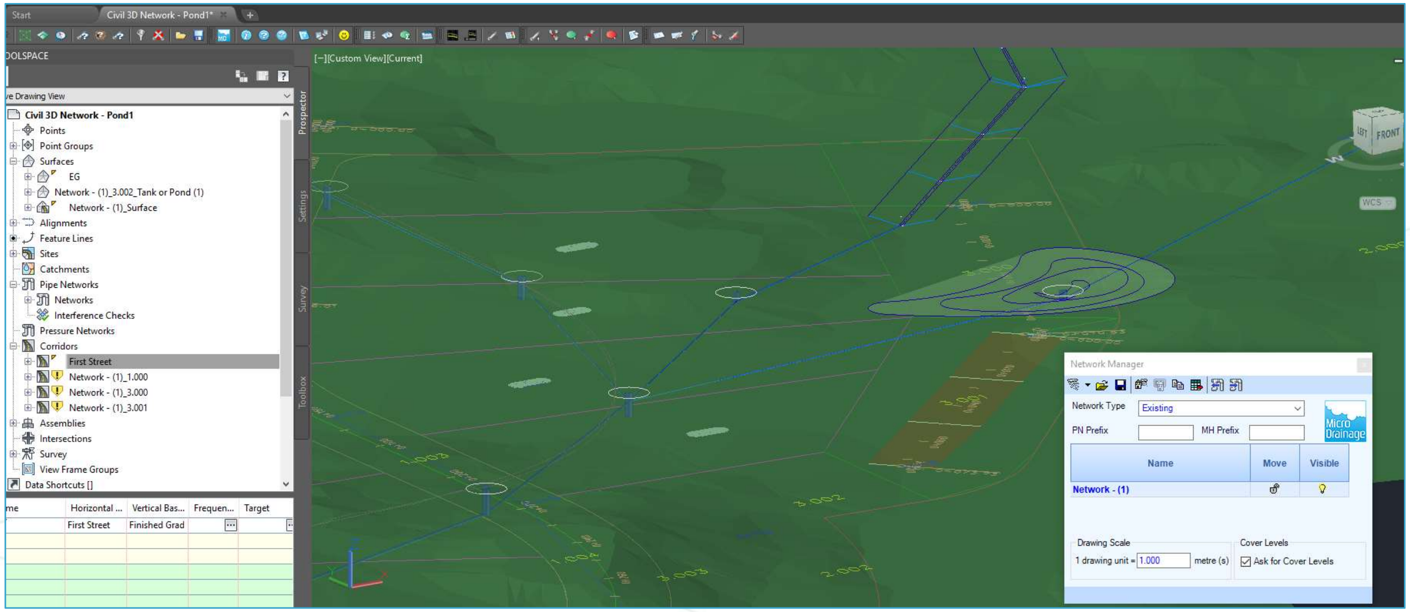
MicroDrainage and Autodesk Civil 3D®

- One-click import / export function!
- Intelligent data structures – MicroDrainage network elements as Pipes, Structures, Corridors, Assemblies, Alignments & Surfaces



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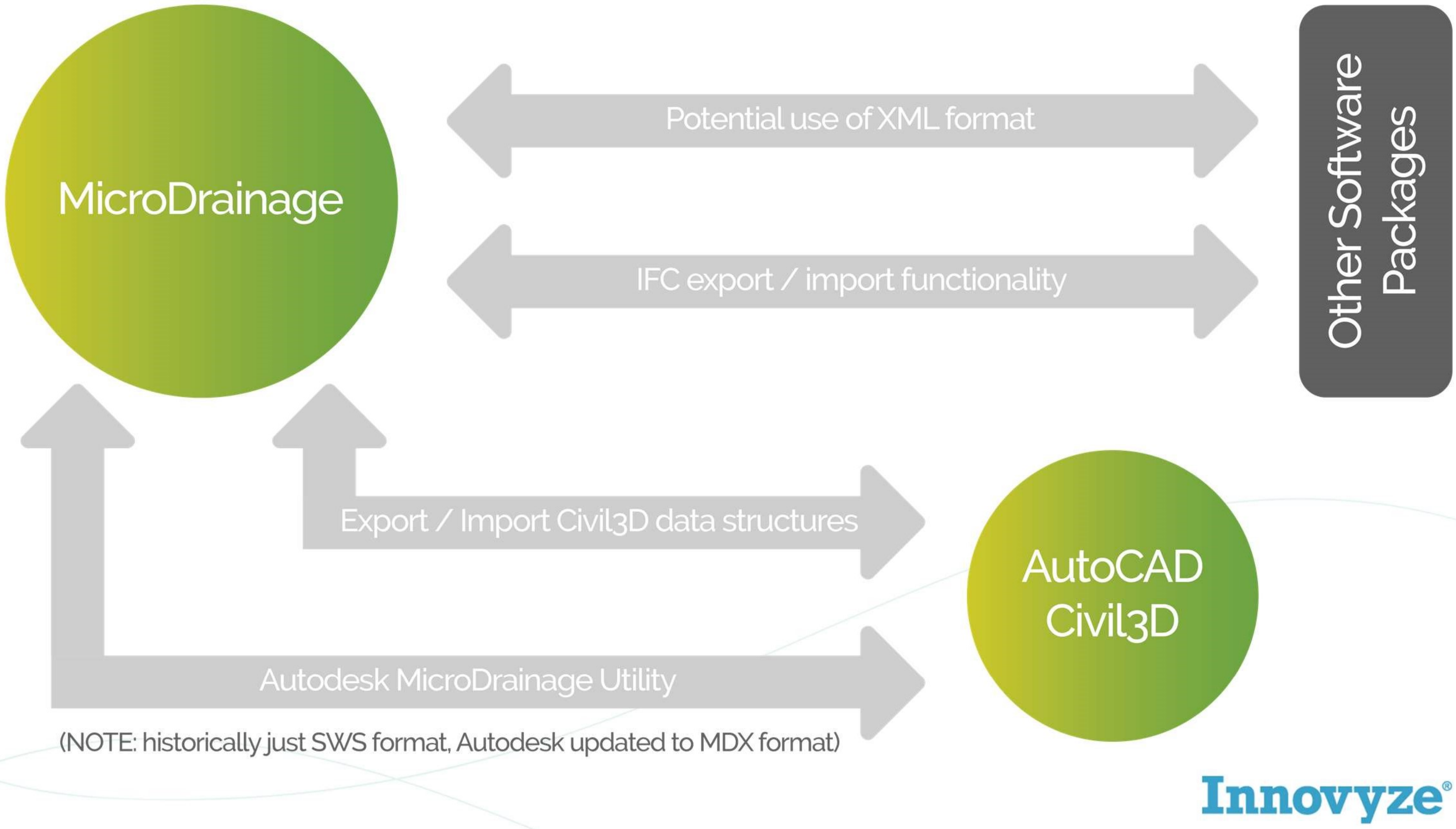
MicroDrainage
Potential use of XML format
IFC export / import functionality
Other Software Packages
Export / Import Civil3D data structures
AutoCAD Civil3D
Autodesk MicroDrainage Utility
(NOTE: historically just SWS format, Autodesk updated to MDX format)
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IFC – an open format for BIM data exchange

- Different software packages exchange information about drainage using non-proprietary file formats

- Industry Foundation Classes (IFC) Standard data format facilitating interoperability between different software systems
    - IFC is an open and publicly available format
    - IFC is already being utilised in a range of products including Bentley Navigator

buildingSMART®
International home of openBIM

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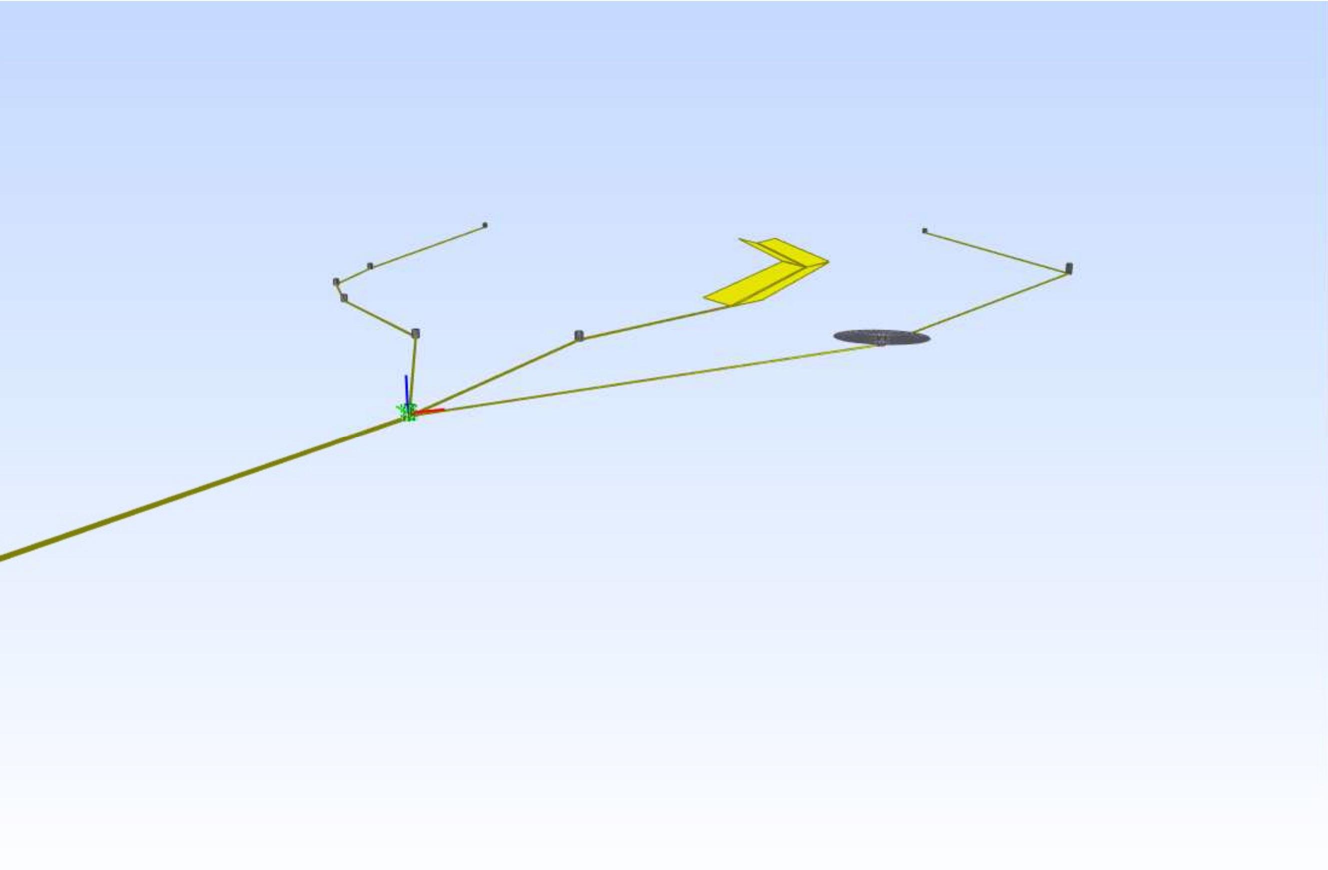
IFC Exports



ve	Type	Name	Description
☑	Building Element Proxy	3.002	PipeConduit
☑	Building Element Proxy	MH9	OpenManhole
☑	Building Element Proxy	3.003	PipeConduit
☑	Building Element Proxy	MH13	OpenManhole
☑	Building Element Proxy	1.005	PipeConduit
	Building	MH14	OpenManhole

Properties | Location

Name	Value	Ur
Element Specific		
Description	OpenManhole	
Guid	294bUpbkT2CQC_zOO_rIqk	
IfcEntity	IfcBuildingElementProxy	
Name	MH13	
Manhole Properties		
C3DHandle	21 350	
CoverLevel	33.803139	m
Diameter	1.2	m
Easting	312 479.720992	m
Headloss	0.5	
Manhole Classifcation	Manhole Classifcation	

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SuDS as Assets

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Good Asset Management Planning

- Assembling information about your assets so you know what you own, where it is, its condition, and its performance
  - As Designed vs As Built?
- Analyzing where there are problems, then identifying and prioritizing solutions (from doing nothing, to rehabilitating, to replacing assets)
- Carrying out repairs and updating the data
- Repeating these steps

Why should SuDS be any different?

InfoAsset Manager

For daily management of your assets

Stores, manages and analyzes information about your assets including surveys and repairs. You can see at a glance on a map where there are problem hotspots and create work orders.

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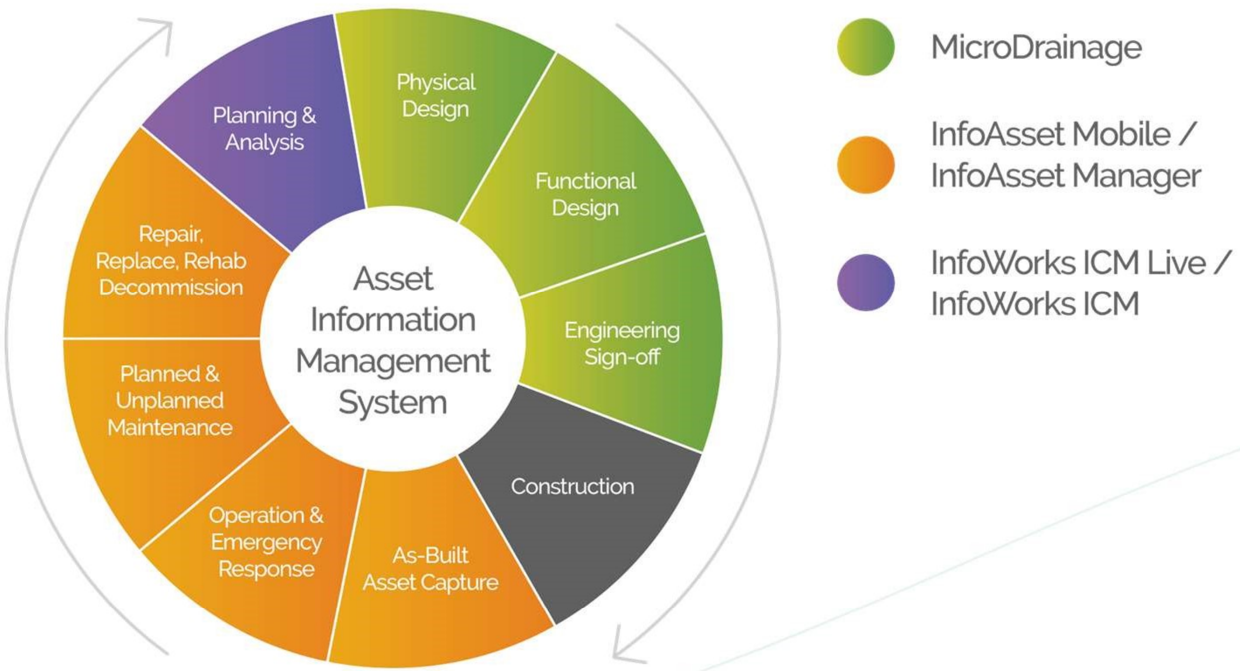
Design – Asset Management – Model



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Conclusions

- Maximising use of existing data
- Work with the site
- Consider different options
- Avoid surprises on site
- Collaborate early
- Plan where design data will live when as built

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