Beyond Runoff Reduction: Thorough Green Infrastructure Design

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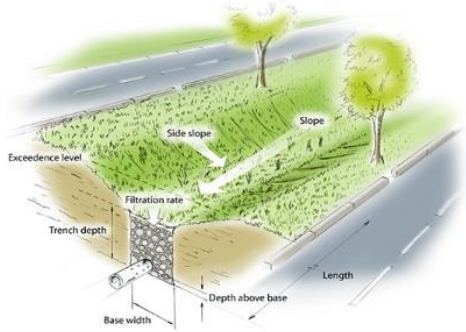
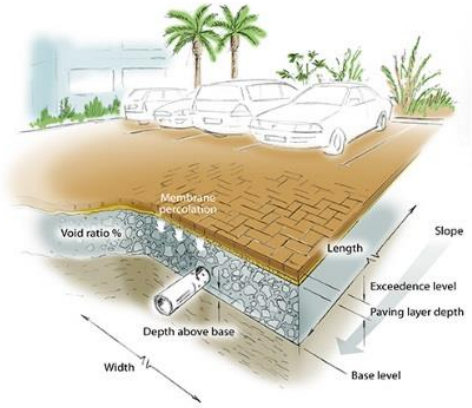
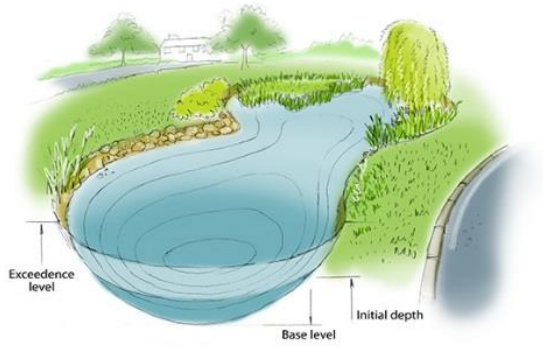
Agenda

- Modern stormwater design (HINT: Runoff Reduction)
- Pros, Cons, Effects
- Solutions by focusing on Clear Visualization of design
- Clear Visualization Solution Case Study with xpdrainage







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Why and How Runoff Reduction (RR) Started

'Traditional' Stormwater Design…

Don't discharge higher flows than you used to:

- Peak flow based, detain flow in single pond
- Pipe Network sizing based on Rational Method and Manning's Equation
- Attenuate 2-100yr ARI storm runoff events
- Inlet-Gutter Spread calculations

We were still impacting our downstream neighbors!

- Significant stream erosion was occurring
- Quality of water (chemicals and solids) was poor
- Groundwater and ecological habitats disappearing

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What is RR… and why it's great!

Runoff Reduction, Water Quality Volume and First Flush capture:

90% of rainfall events are around 1" – retain and infiltrate the **dirtiest** runoff

*RR = P*Rv*A / 12* *WQv = R(P*Cv*(A/12))* *FF = P*Aimp/12*

Could have picked anything – why Runoff Reduction?

- Simple to perform volume calculation (hand calc)
- Pass/Fail review criteria
- RR conservative enough (Hydromodification studies not necessarily better)
- Wide adoption

So.. Things are perfect right?

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RR Shortcomings and Effects

Coarse, Independent facility designs

- Will it fit on proposed site?

Cumbersome to Vet, Review and Approve

- Boxes are checked, but how will system REALLY behave?

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'Designed' systems are not realistic

- Was what will literally be in the ground assessed?

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Clear Visualization Solutions: How to get what we *really* want out of RR

Remember the goal: healthy, long term stormwater systems

RR and Traditional Design: quick, simple, clear starting point for stormwater design

Clear Visualization Solutions:

- Review realistic ‘As Build’ systems
- Must lock calculations to plan/profile/treatment train
- Assess full dynamic hydraulics of stormwater system
- *Integrate with CAD/GIS*

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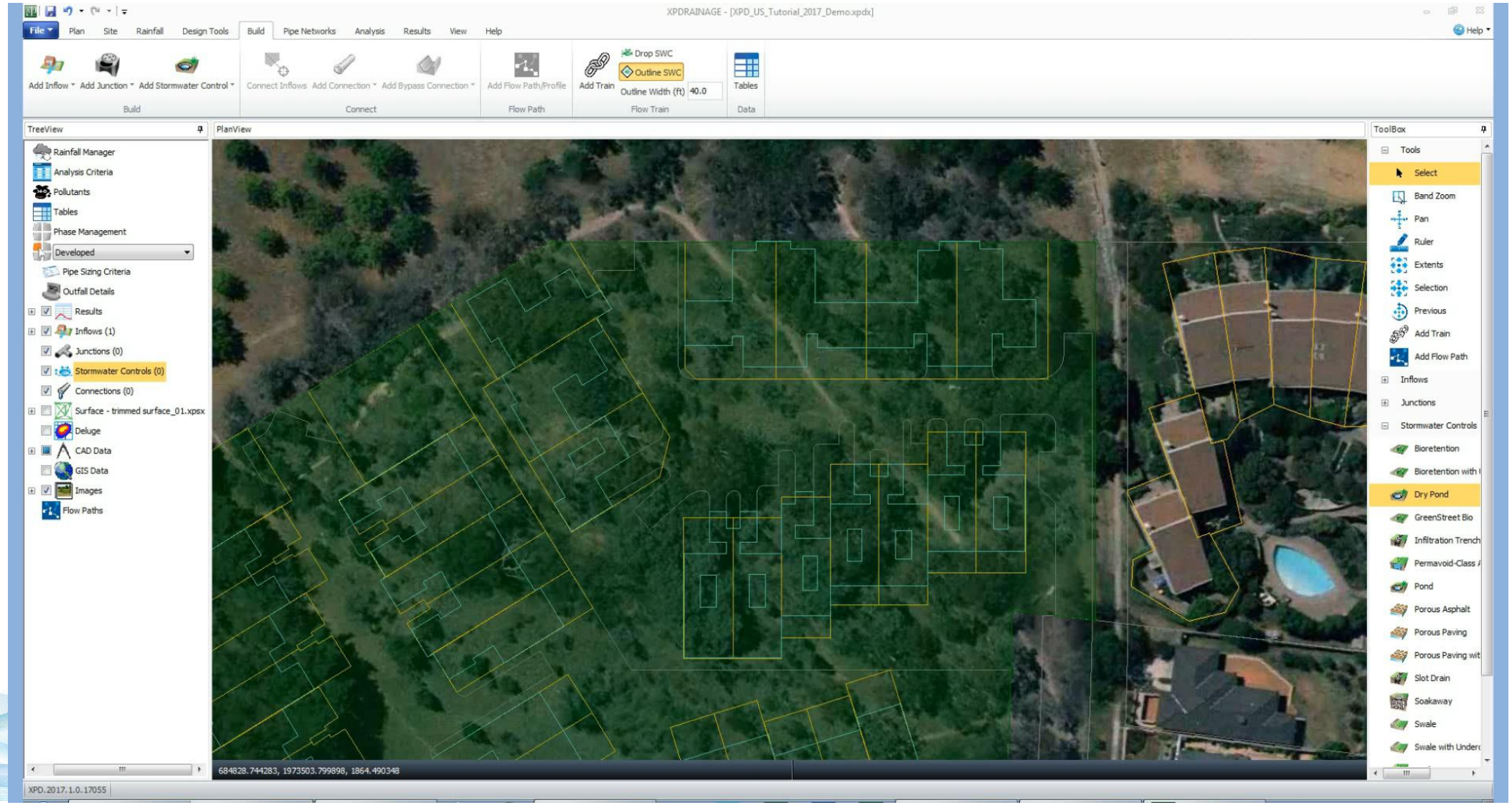
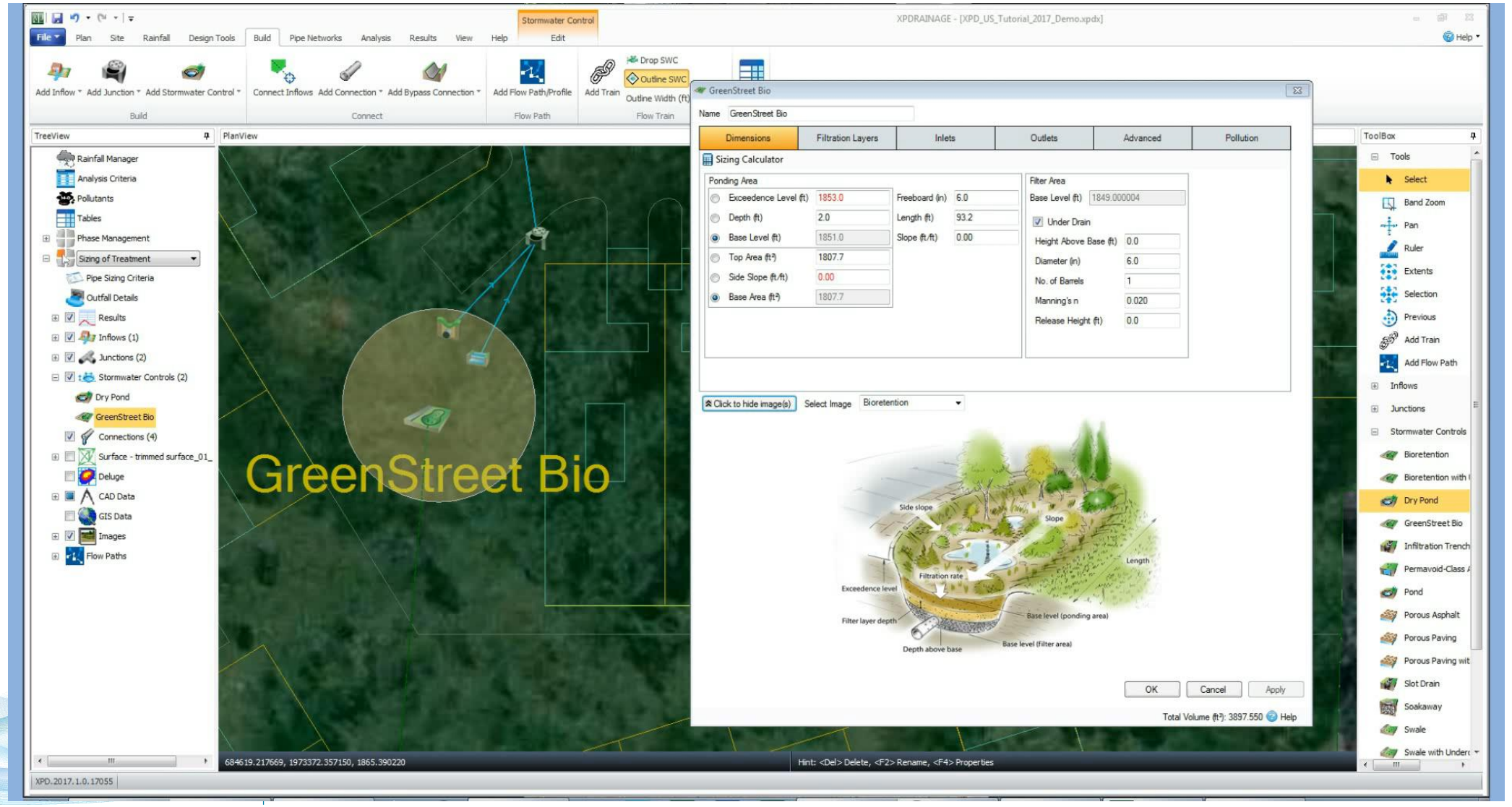
‘As-Build’ Layout



Calculations Locked to Plan



Case Study

Mater Planned Community – Ashley Francis @ LJA Engineering

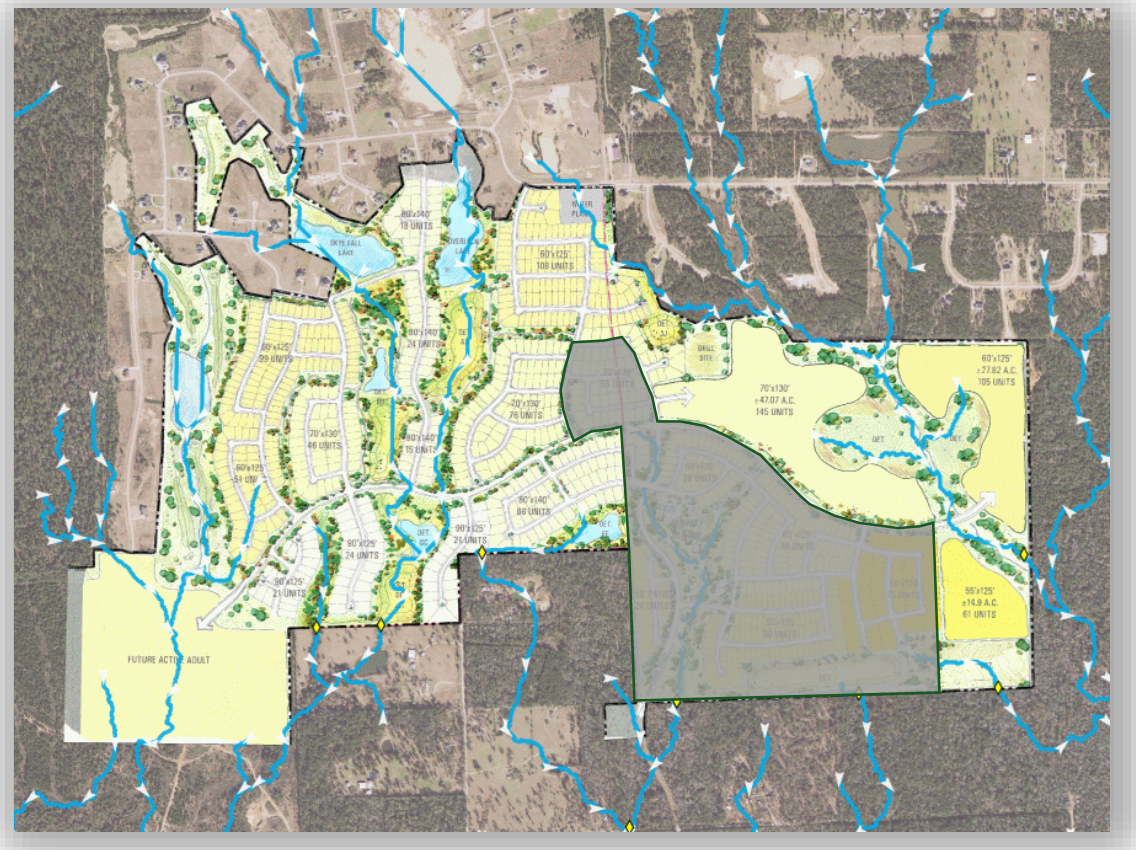
West Central Montgomery, TX

Total Project: (967 acres)

Case study portion of

Phase 1: (157 Acres-***BLUE***)

Masterplan developed along-side existing golf courses



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Visualized Design Case Study

Purpose:

- Develop and improve a residential site with no adverse hydrological impact
- Mitigate to pre-developed 25, 100 year rates
- Reduce pollutant runoff through distributed Green Infrastructure
- Reduce size of detention facility
- Assess viability of Green Infrastructure compared to traditional

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Visualized Design Case Study

Methodology:

- Preliminary flow assessment
  - Rational Method
  - Pipe Sizing estimate
- Existing Runoff Plan
- Typical drainage plan
- LID based plan

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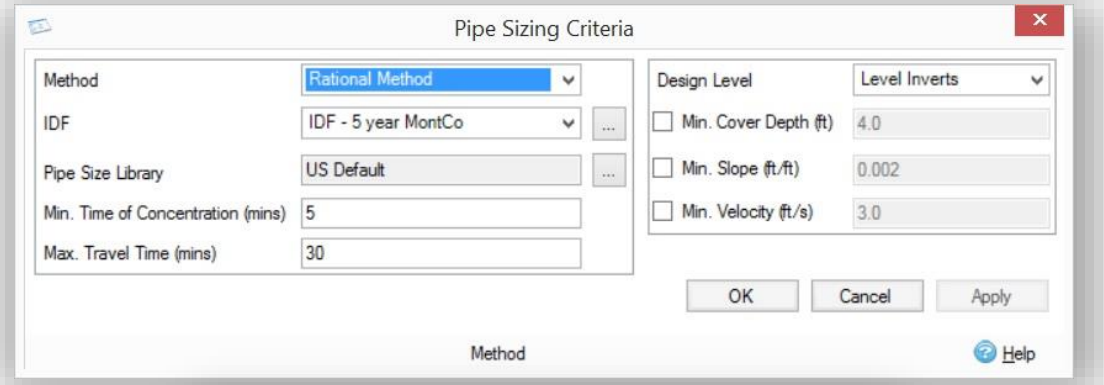
Visualized Design Case Study

Rational Assessment and Pipe Sizing:

- Runoff Coefficient (C) and Tc
  - Developed and ‘effective Green’ scenarios assessed
  - C values decreased and Tc values increased between scenarios
- Pipe Sizing
  - Based on Rational flows and Mannings Eq.
  - Reduction in required pipe sizes shown for the ‘effective Green’ scenario

Visualized Design Case Study

Pipe sizing:



Pipe Full Velocity (ft/s)	Capacity (ft³/s)	Flow (ft³/s)
8.02	56.702	48.645
8.39	80.737	59.764
10.27	98.822	58.869
6.57	471.893	49.175

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Visualized Design Case Study

Existing Runoff Plan:

Based on ‘park’ landuses

‘Deluge’ based catchments

Results

SCS: ARI: WQe: Type III: 3.8 in : Increase Rainfall (%): +0

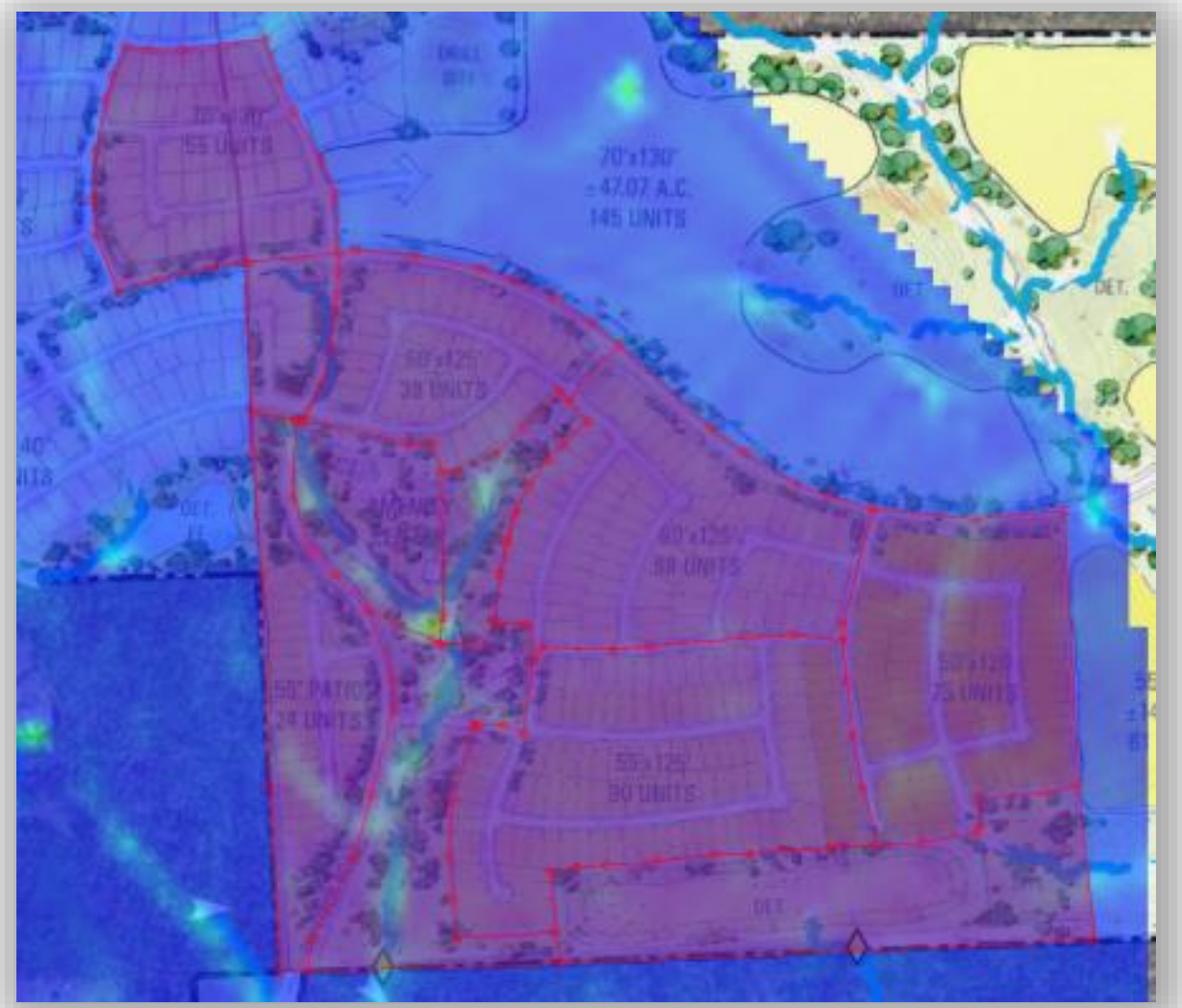
Phase Name	Max Outflow (ft³/s)
Existing	48.70005

SCS: ARI: 20 years: Type III: 9.43 in : Increase Rainfall (%): +0

Phase Name	Max Outflow (ft³/s)
Existing	120.85302

SCS: ARI: 100 years: Type III: 12.17 in : Increase Rainfall (%): +0

Phase Name	Max Outflow (ft³/s)
Existing	155.96832



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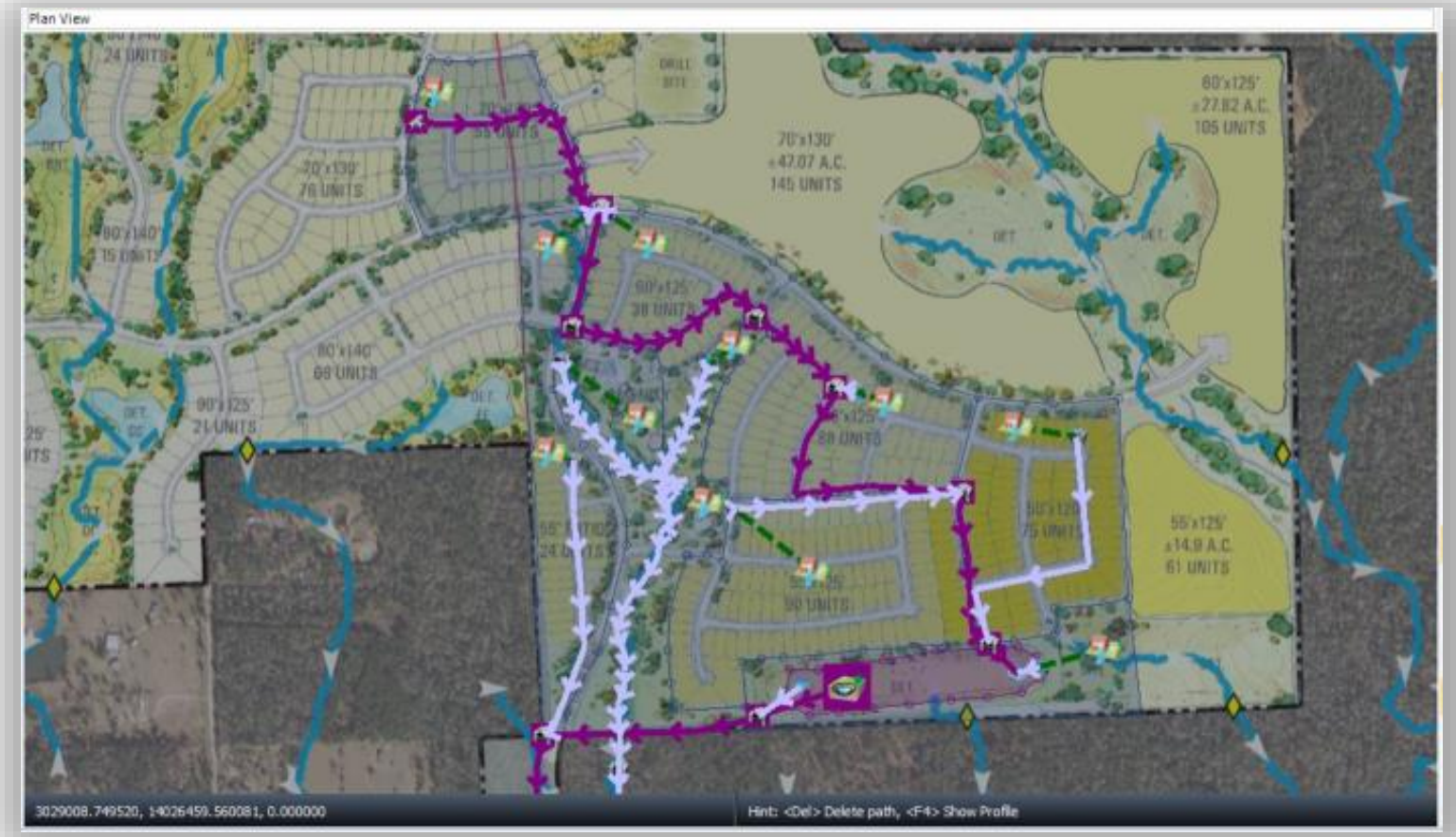
Visualized Design Case Study

Typical Drainage Plan:

- Rational Sized pipe network
- Eastern ‘Trunk’ system to be attenuated by basin
- Western ‘valley’ to leave site untreated



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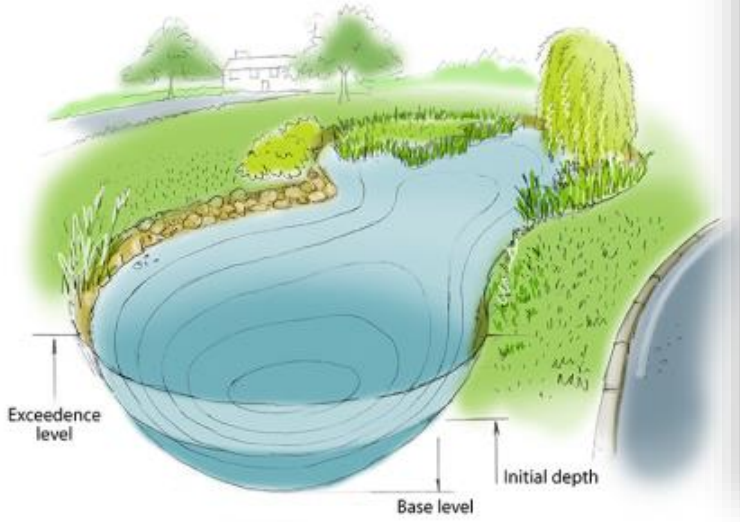
Visualized Design Case Study

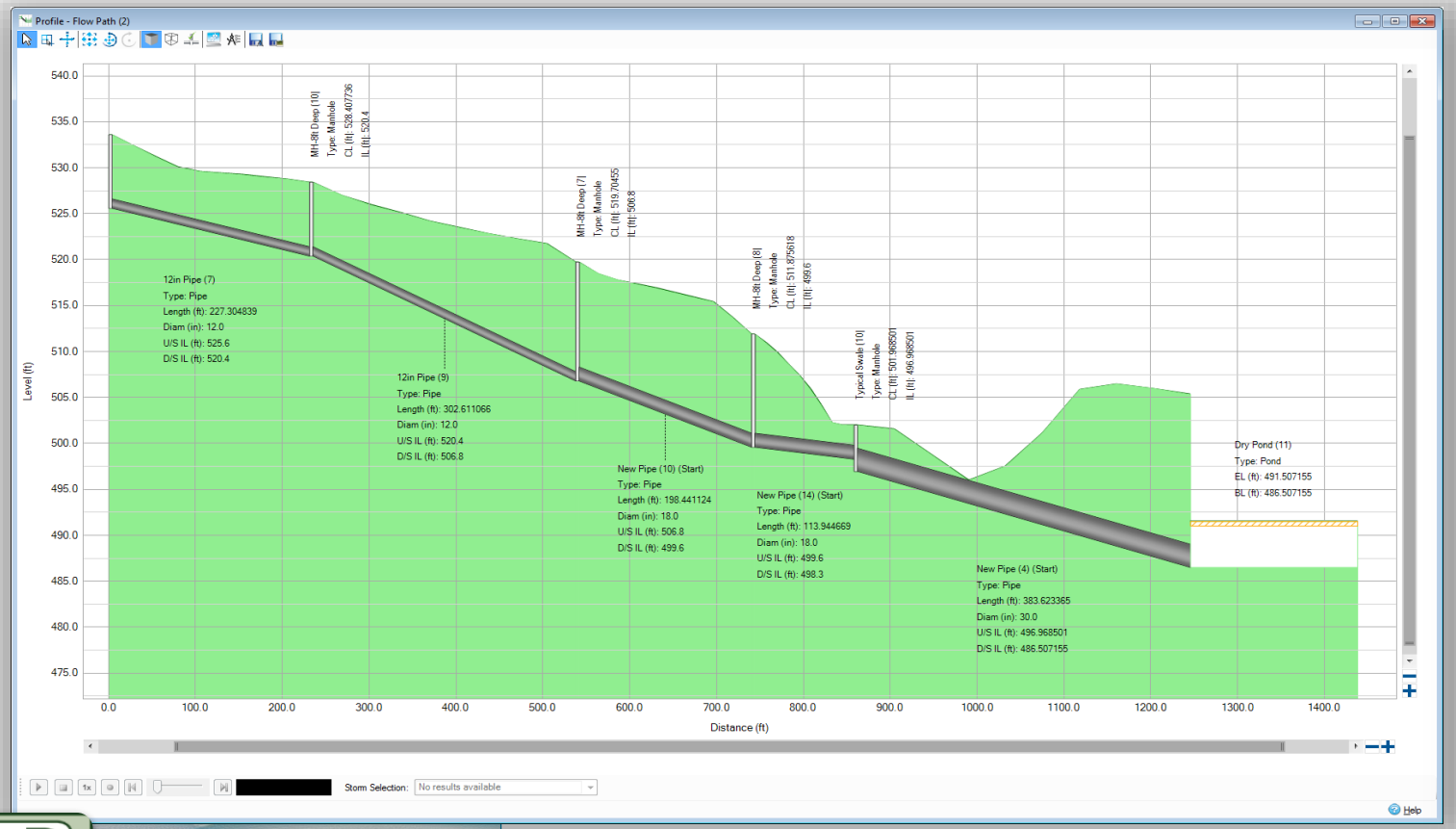
Typical Drainage Plan

- Pond: 6.7 acres
- *Two* outfall pipes
- High flow weir



Visualized Design Case Study

Typical Drainage Plan:



Results

SCS: ARI: WQe: Type III: 3.8 in : Increase Rainfall (%): +0

Phase Name	Max Outflow (ft³/s)
Existing	48.70005
Developed	35.05776

SCS: ARI: 20 years: Type III: 9.43 in : Increase Rainfall (%): +0

Phase Name	Max Outflow (ft³/s)
Existing	120.85302
Developed	89.24629

SCS: ARI: 100 years: Type III: 12.17 in : Increase Rainfall (%): +0

Phase Name	Max Outflow (ft³/s)
Existing	155.96832
Developed	136.91512

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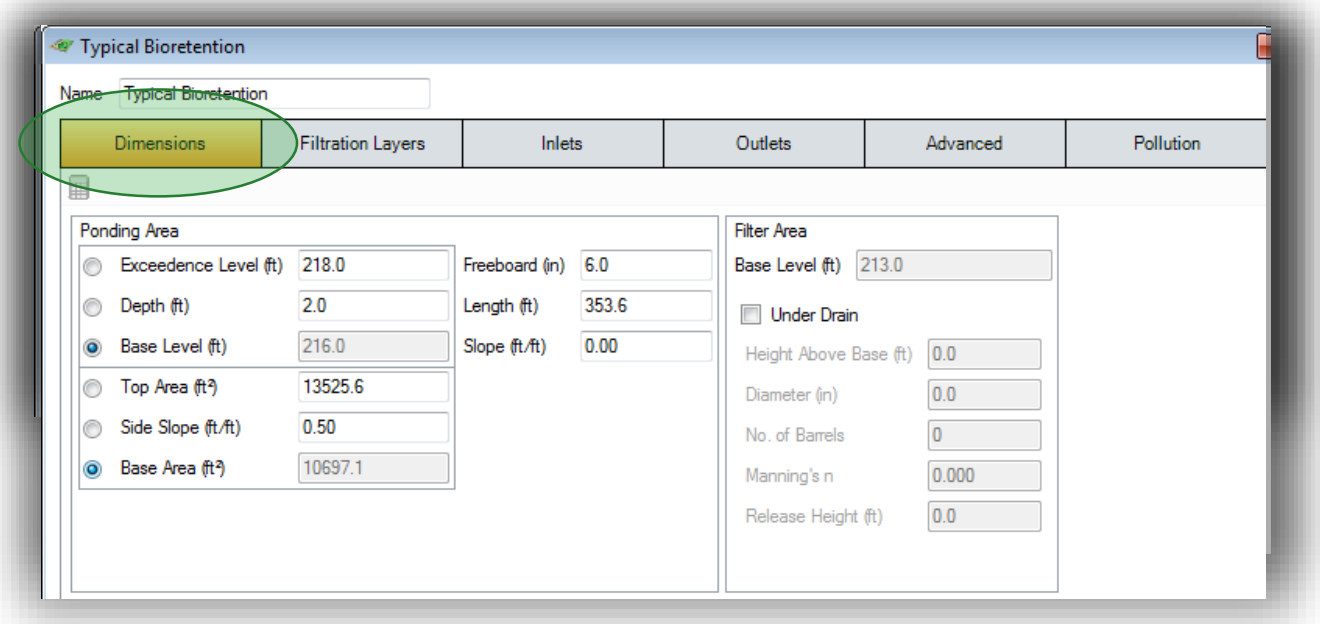
Visualized Design Case Study

Distributed Green Infrastructure Plan:

'lumped' Raingarden for each neighborhood catchment



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Visualized Design Case Study

Distributed Green Infrastructure Plan:

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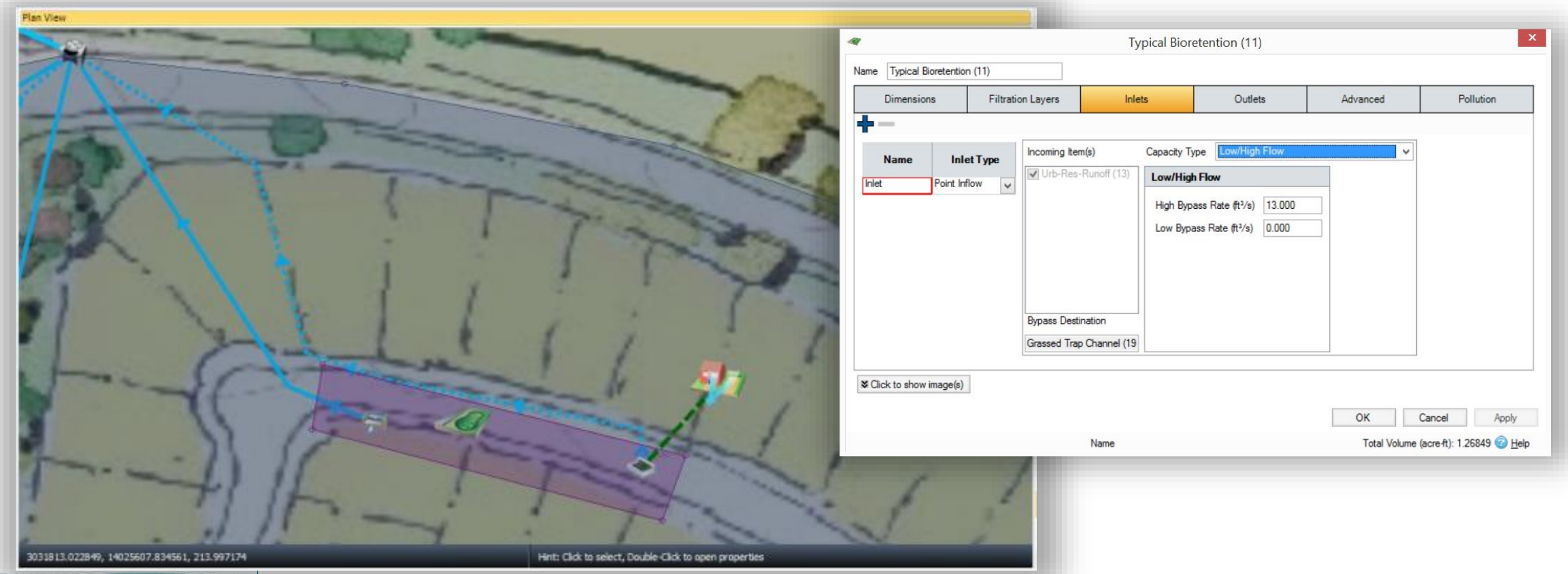
Visualized Design Case Study

Distributed Green Infrastructure Plan:



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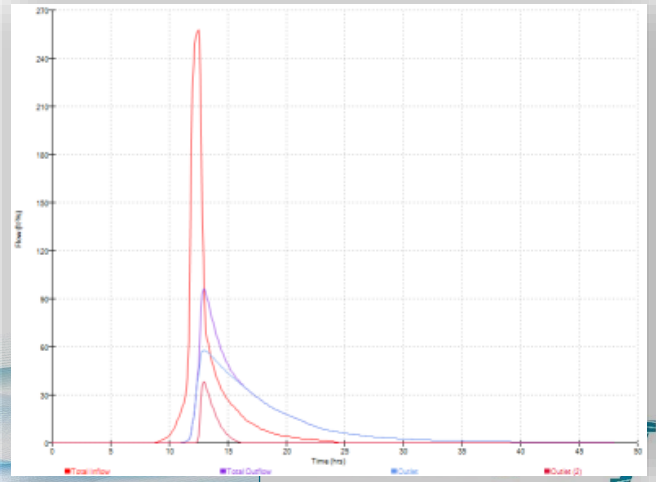
Visualized Design Case Study

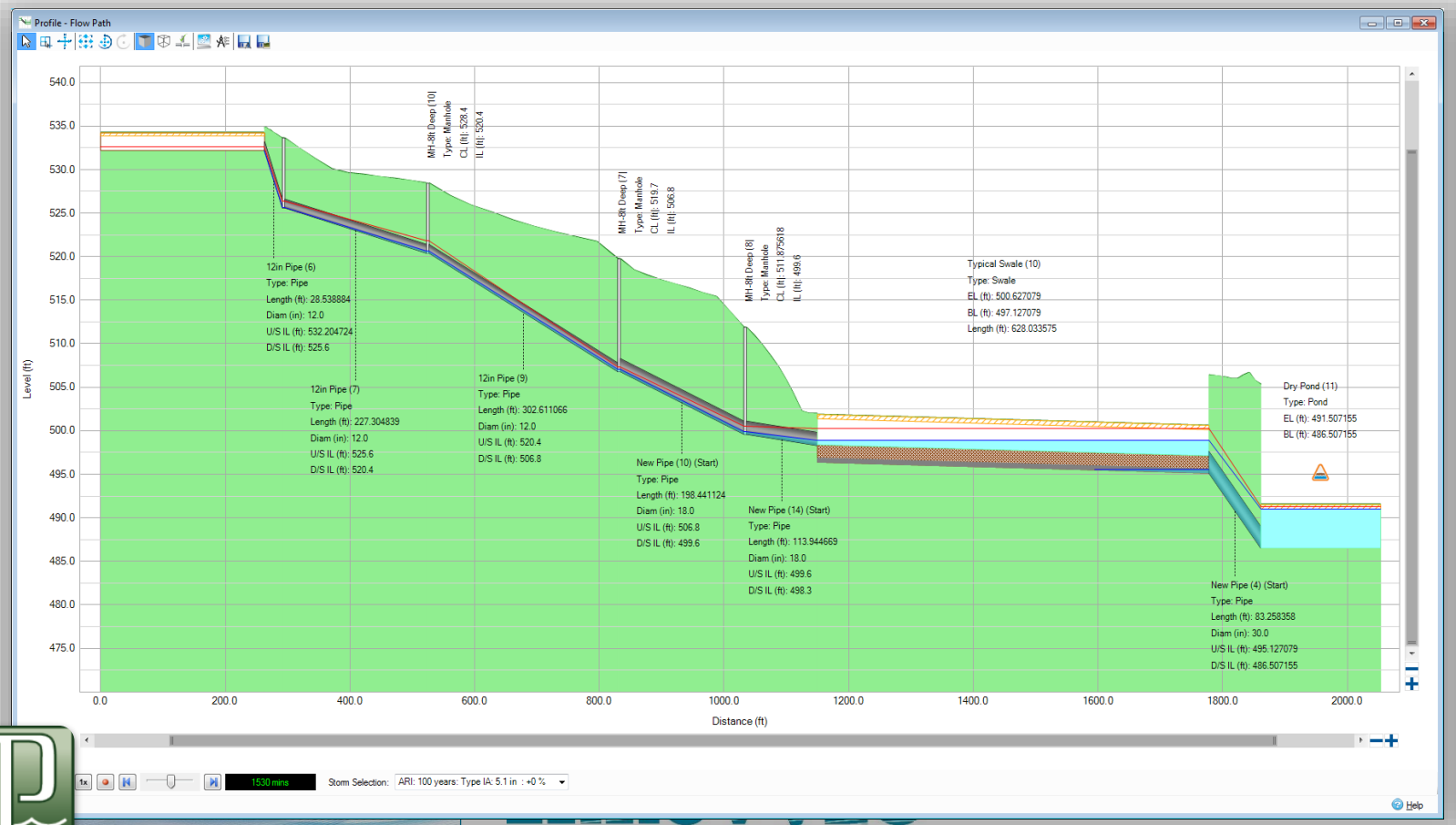
Distributed Green Infrastructure Plan:

- *1.2 acres smaller!*
- *Single* outfall pipe
- *No* Freeboard issues



Visualized Design Case Study

Distributed Green Infrastructure Plan:



Results

SCS: ARI: WQe: Type III: 3.8 in : Increase Rainfall (%): +0

Phase Name	Max Outflow (ft³/s)
Existing	48.70005
Developed	35.05776
LID	5.66699

SCS: ARI: 20 years: Type III: 9.43 in : Increase Rainfall (%): +0

Phase Name	Max Outflow (ft³/s)
Existing	120.85302
Developed	89.24629
LID	71.23745

SCS: ARI: 100 years: Type III: 12.17 in : Increase Rainfall (%): +0

Phase Name	Max Outflow (ft³/s)
Existing	155.96832
Developed	136.91512
LID	113.77116

Visualized Design Case Study

What was learned, next steps..

- Case study - ‘detailed’ schematic design process
- Refinement of Green scenario
- Alternative LID systems possible
- Drag/drop drainage and LID elements (**time saver**)
- Automated elevation data (**time saver**)

One approachable, quick tool replaced workflow using *SIX* other programs to juggle same work

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Thanks for joining us

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