US-19 (SR-55) Drainage Improvements

Stormsewer Modeling with ICPR v4

Christopher Thompson, PE, CFM
Tuesday, November 5, 2019

Overview – Practical Application of ICPRv4

- Evaluation of flooding conditions on US-19
- Comparison of a traditional steady state approach to a hydrodynamic modeling approach
- Leveraging GIS in ICPRv4 model development
- Use of ICPRv4 features to increase productivity
- Review of final solution and construction photos

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Flooding complaint US-19 / SR-55 (2013)

- North and southbound lanes flood 3 to 4 times a year
- Flooding would sometimes extend up to the median
- Water would sit for 30 min to an hour after the rain stopped
- Most severe flooding was at a sag in front of “Pouncey’s Restaurant”
- Built in 1958

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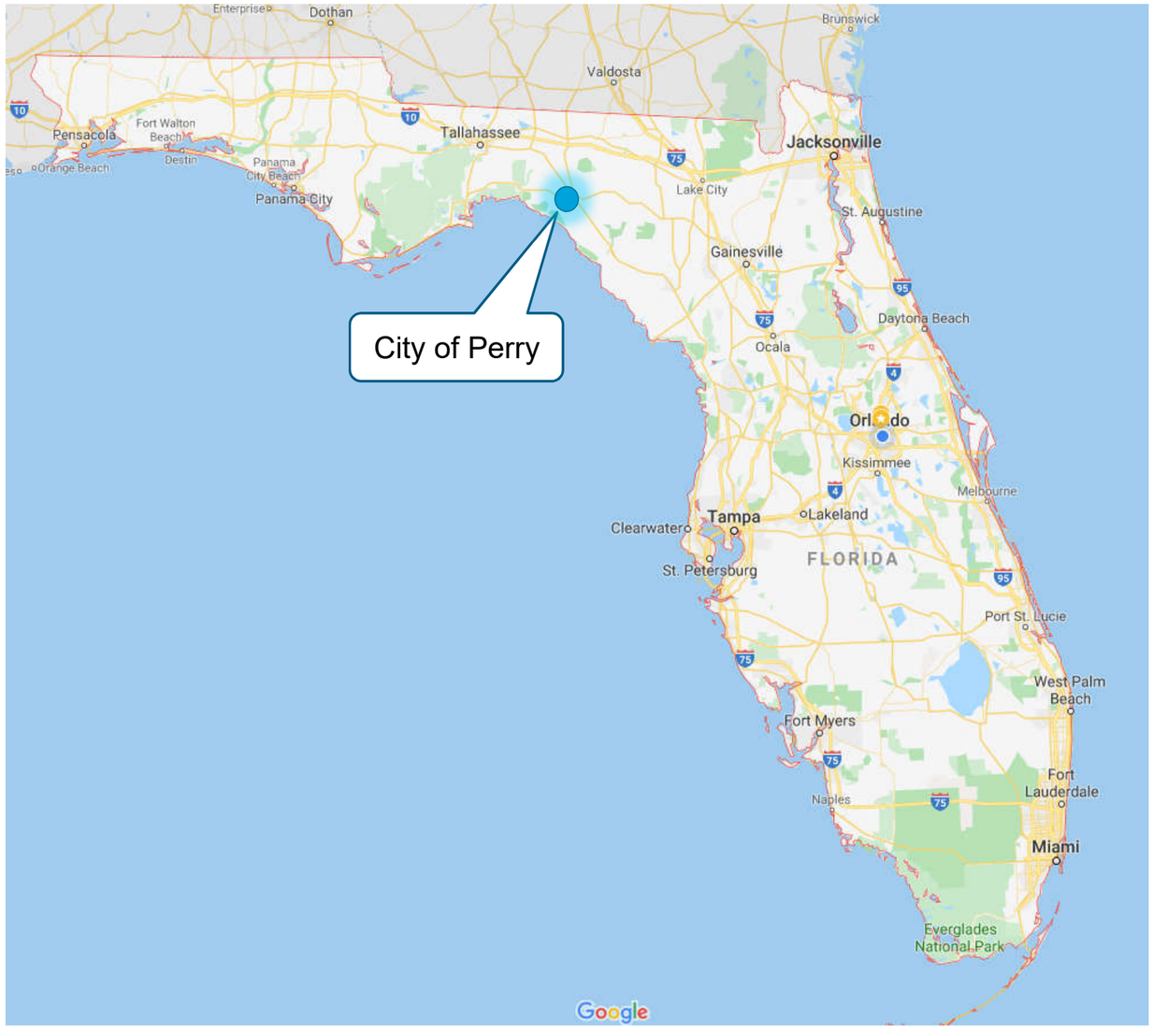
Project Location



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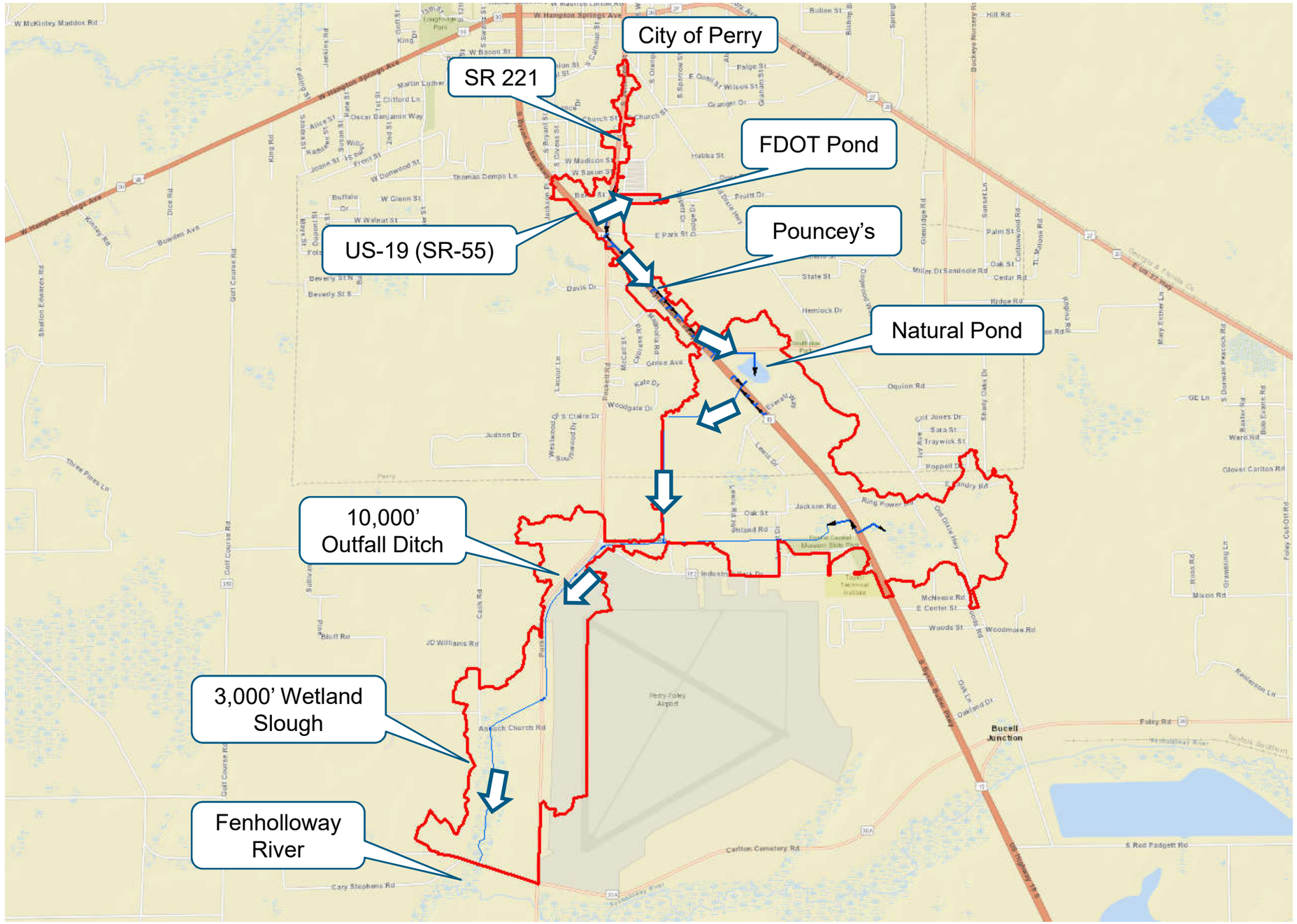
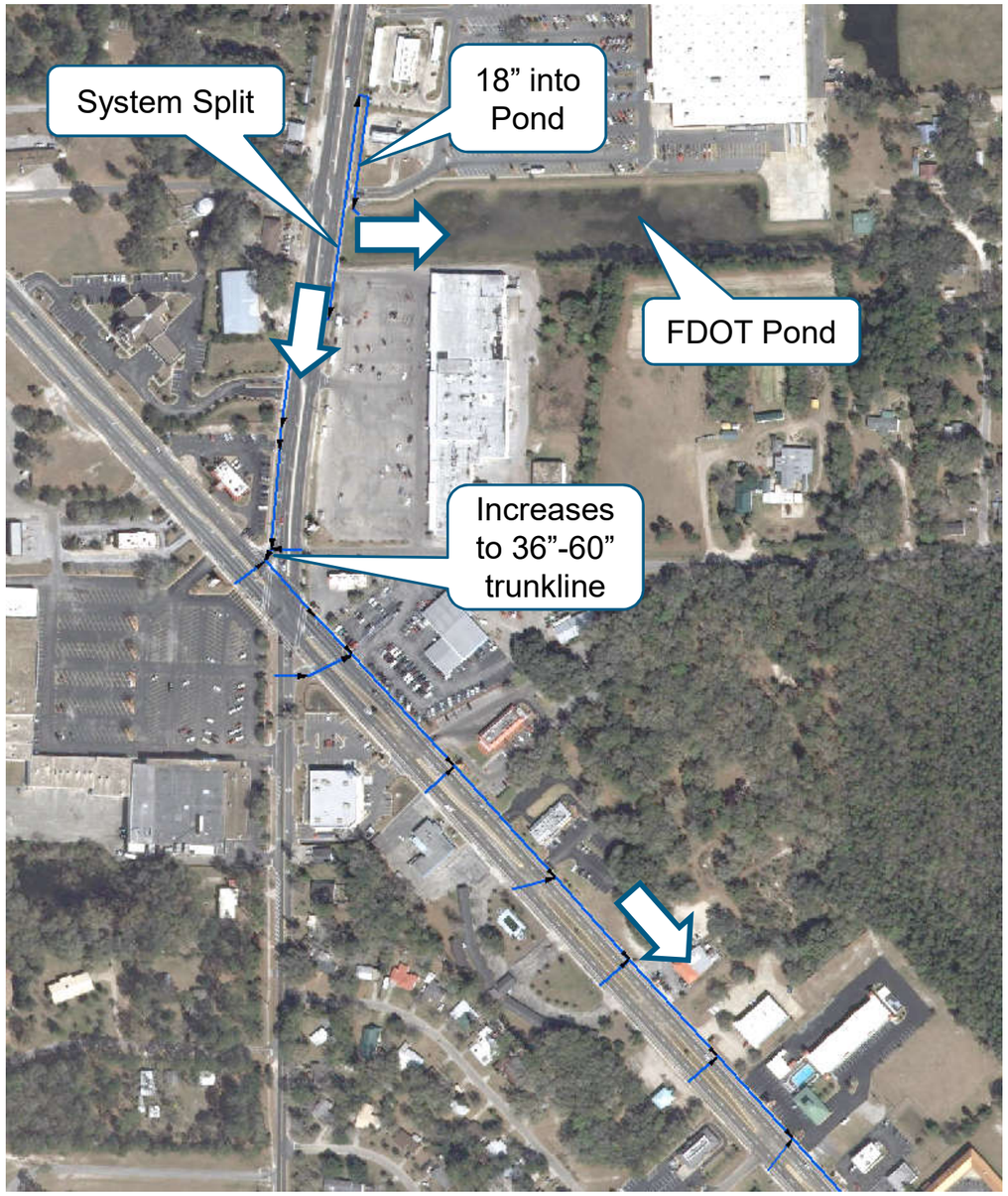
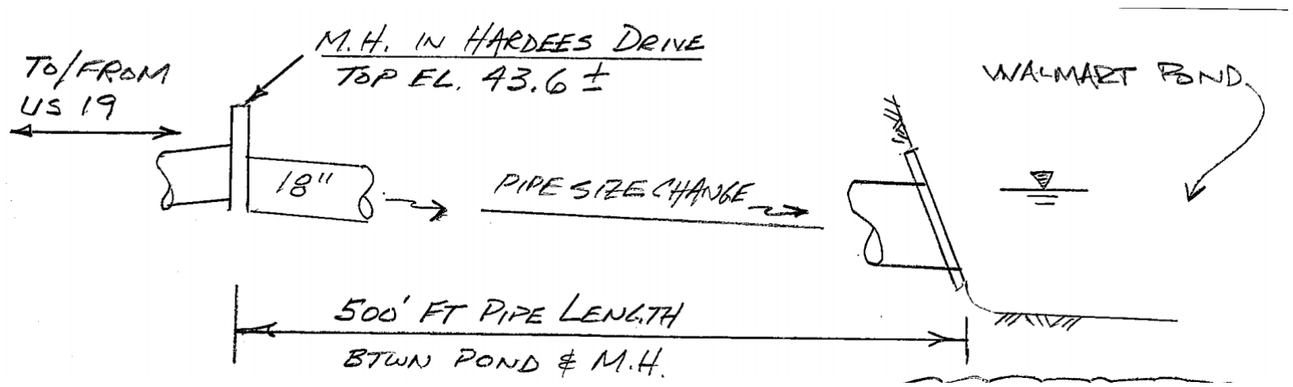

City of Perry
SR 221
FDOT Pond
Pouncey's
US-19 (SR-55)
Natural Pond
10,000' Outfall Ditch
3,000' Wetland Slough
Fenholloway River

Photographs



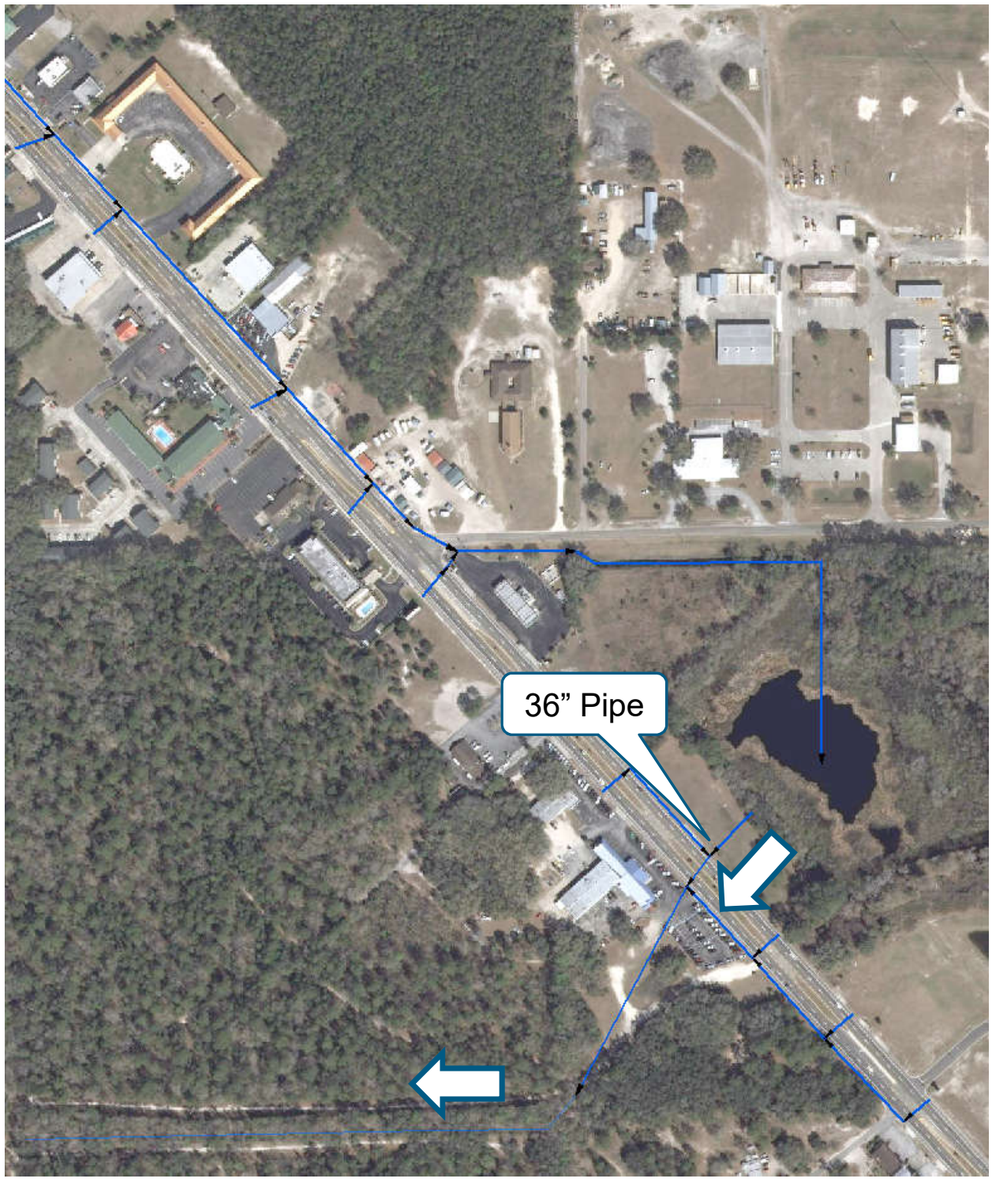
FDOT Pond near US-19 and SR-55



Photographs

Sag inlet at Pouncy's Restaurant

Photographs



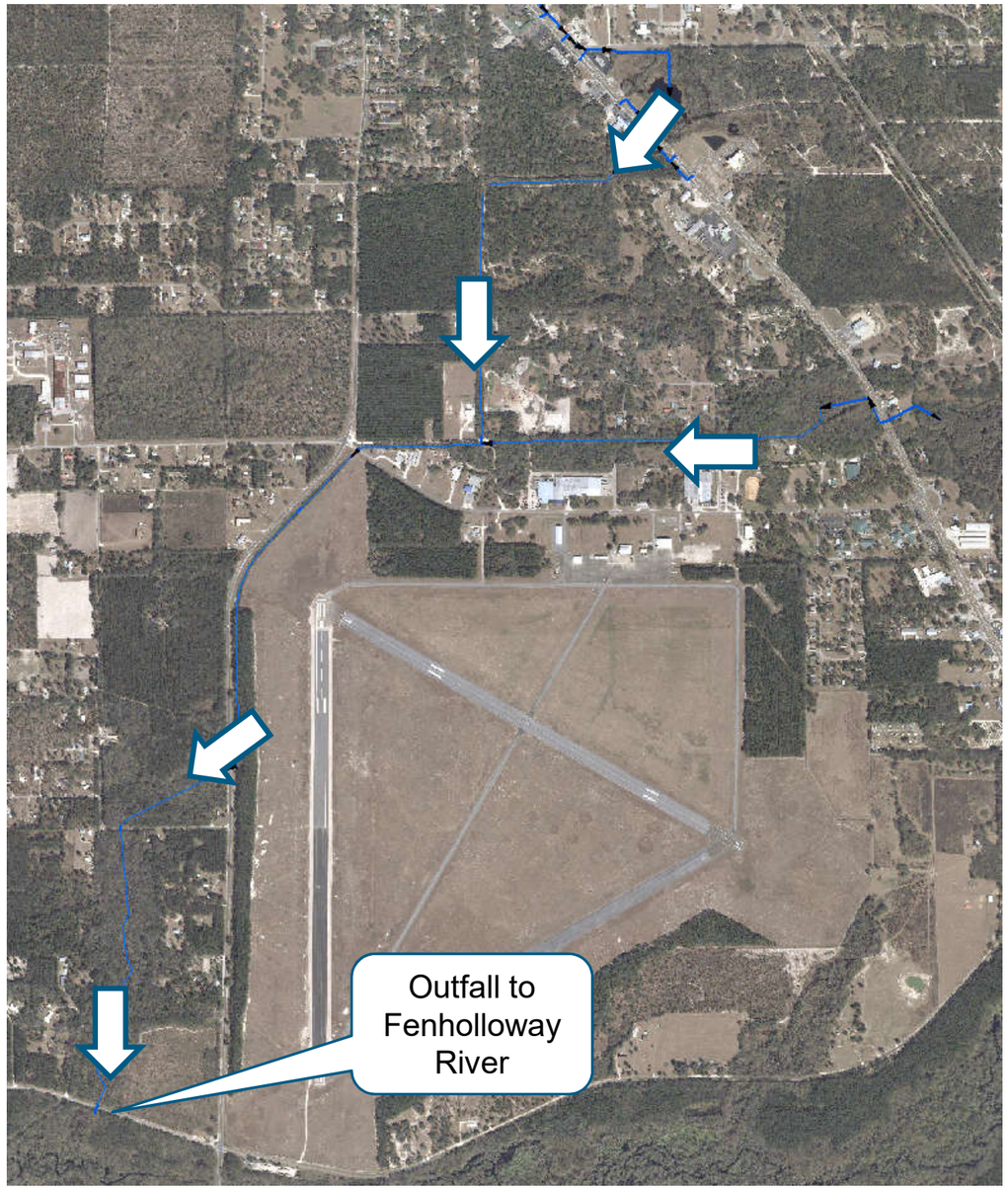
Natural Pond 36” Discharge Pipe (looking into wetland area)

Photographs

Outfall ditch

Outfall ditch CMP culverts

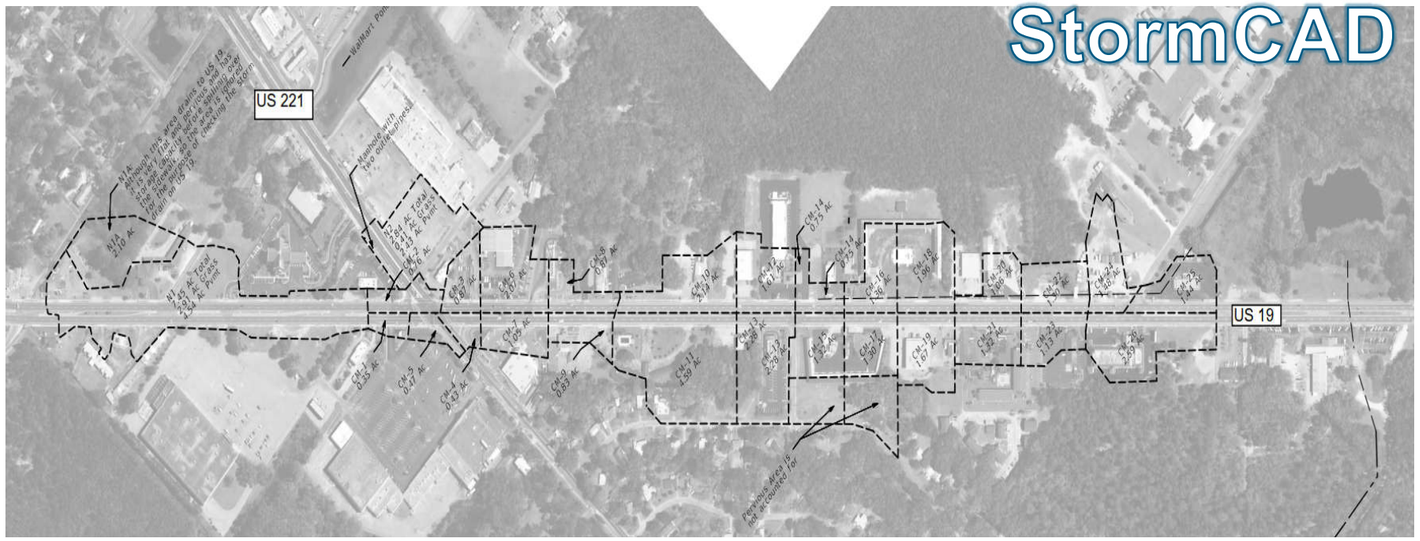
Photographs



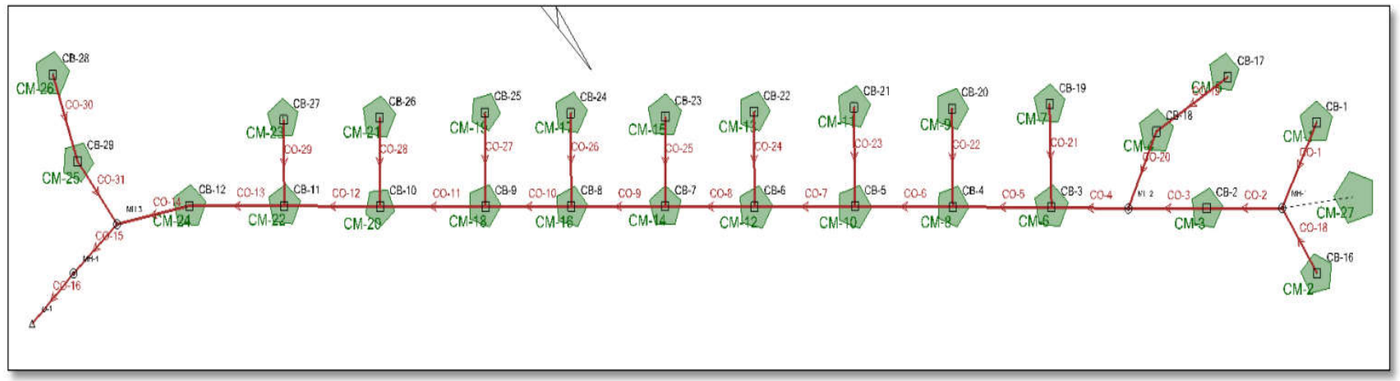
2 - 42” into Fenholloway River

Preliminary Evaluation (2014)

- Utilized historical drainage maps, plans and field reviews
- Discovered FDOT pond – natural pond connection (complicated)
- Conducted using Storm CAD with assumed flow split (steady state)



Storm CAD Schematic Full System



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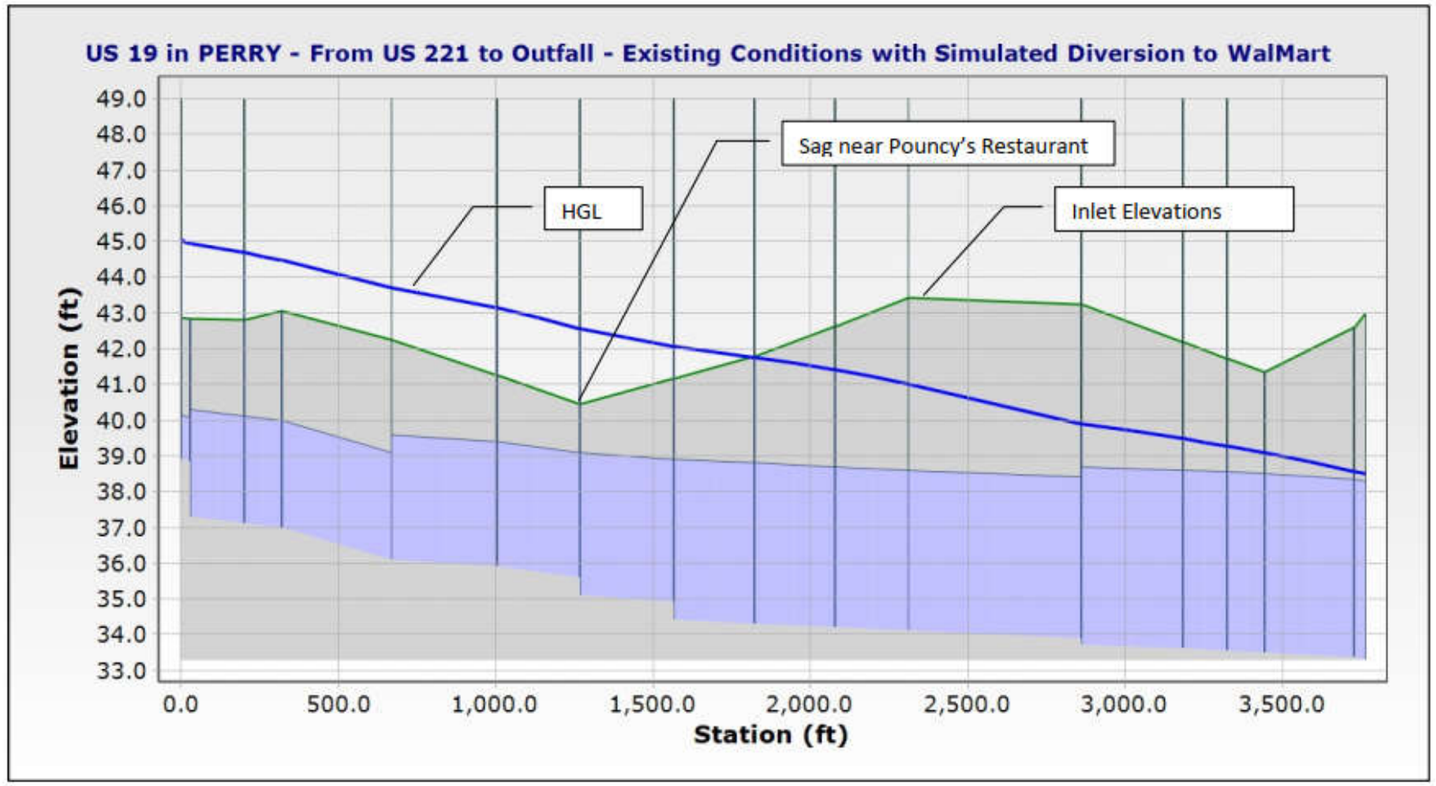
StormCAD Results

- Greater than two feet flooding on the roadway (not realistic)
- Storm sewer capacity the likely culprit
- Tailwater a potential issue (10,000 ft long outfall ditch needing maintenance)

Storm Cad Output – Profile views



Results with simulated diversion to WalMart. This was used as a basis from which solutions were developed.

Full H&H Evaluation (2017)

- Developed a ICPR v4 (non-steady state)
- Allowed modeling of the complex interconnected pond – wetland system
- Ensured realistic accounting of surface storage

- Existing Conditions:
  - Survey of storm sewer, outfall ditch; use of permitted plans
  - Bottom clips to model siltation
  - Storage and cross-sections extracted using ICPR

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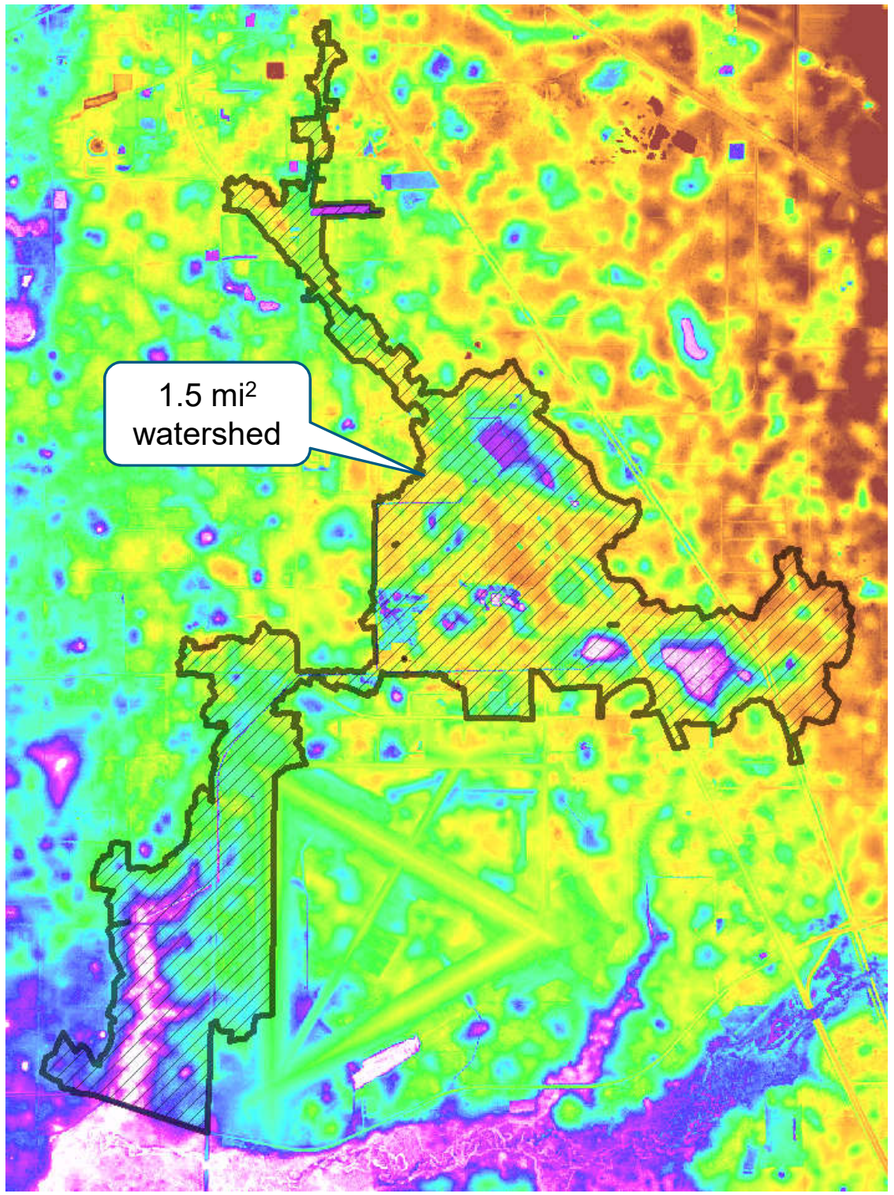
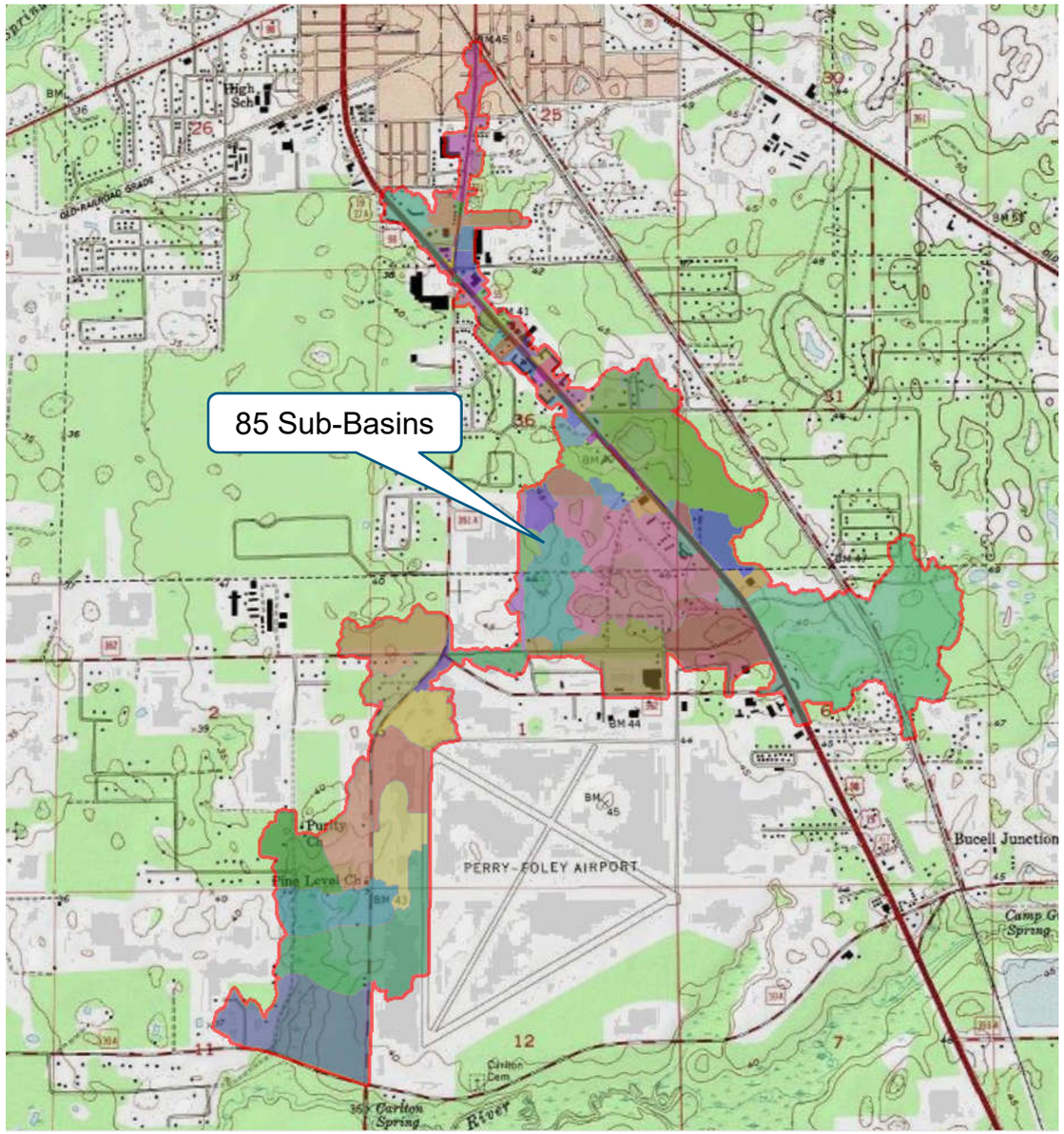
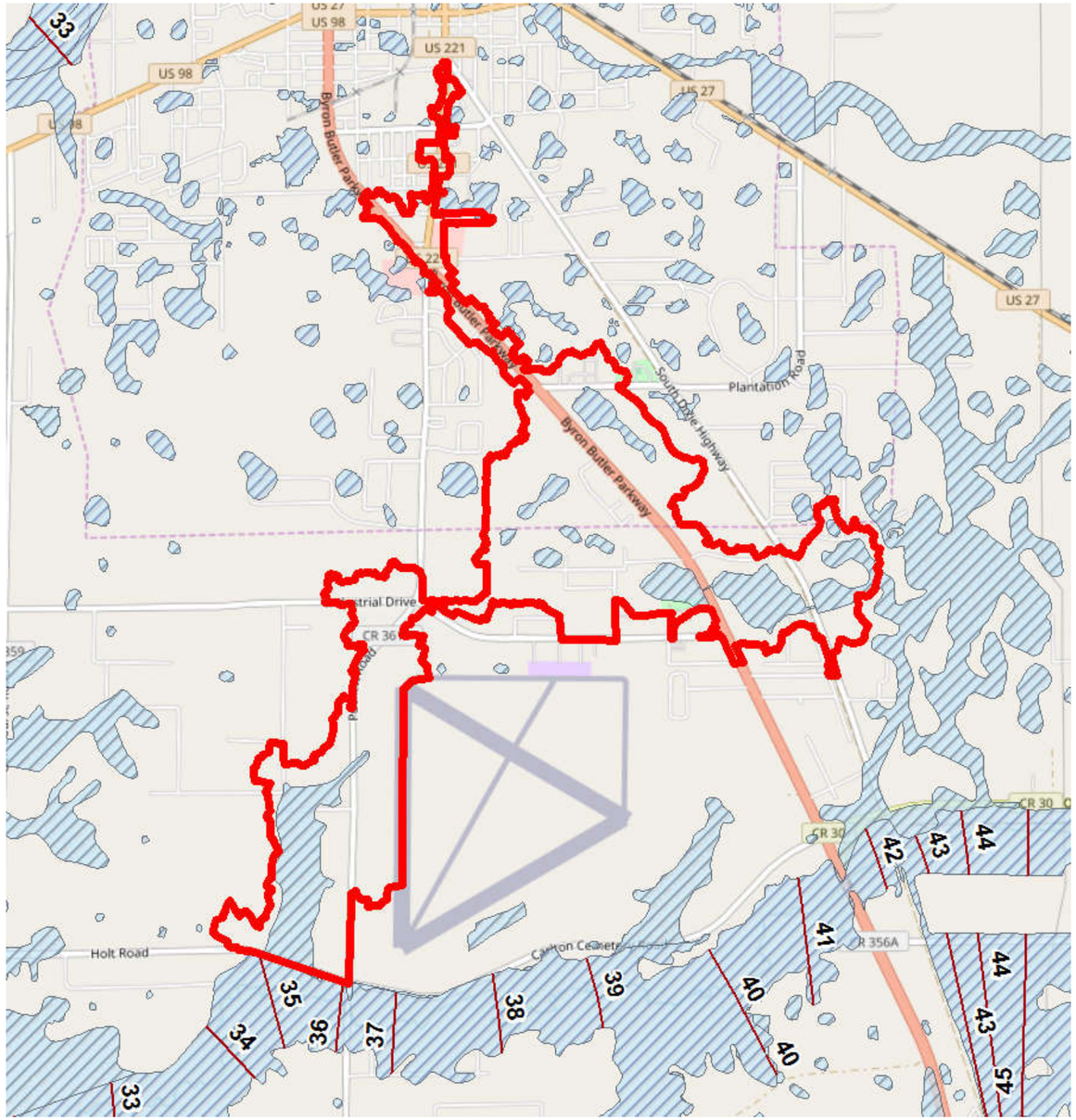
Digital Elevation Map (NOAA 2007)



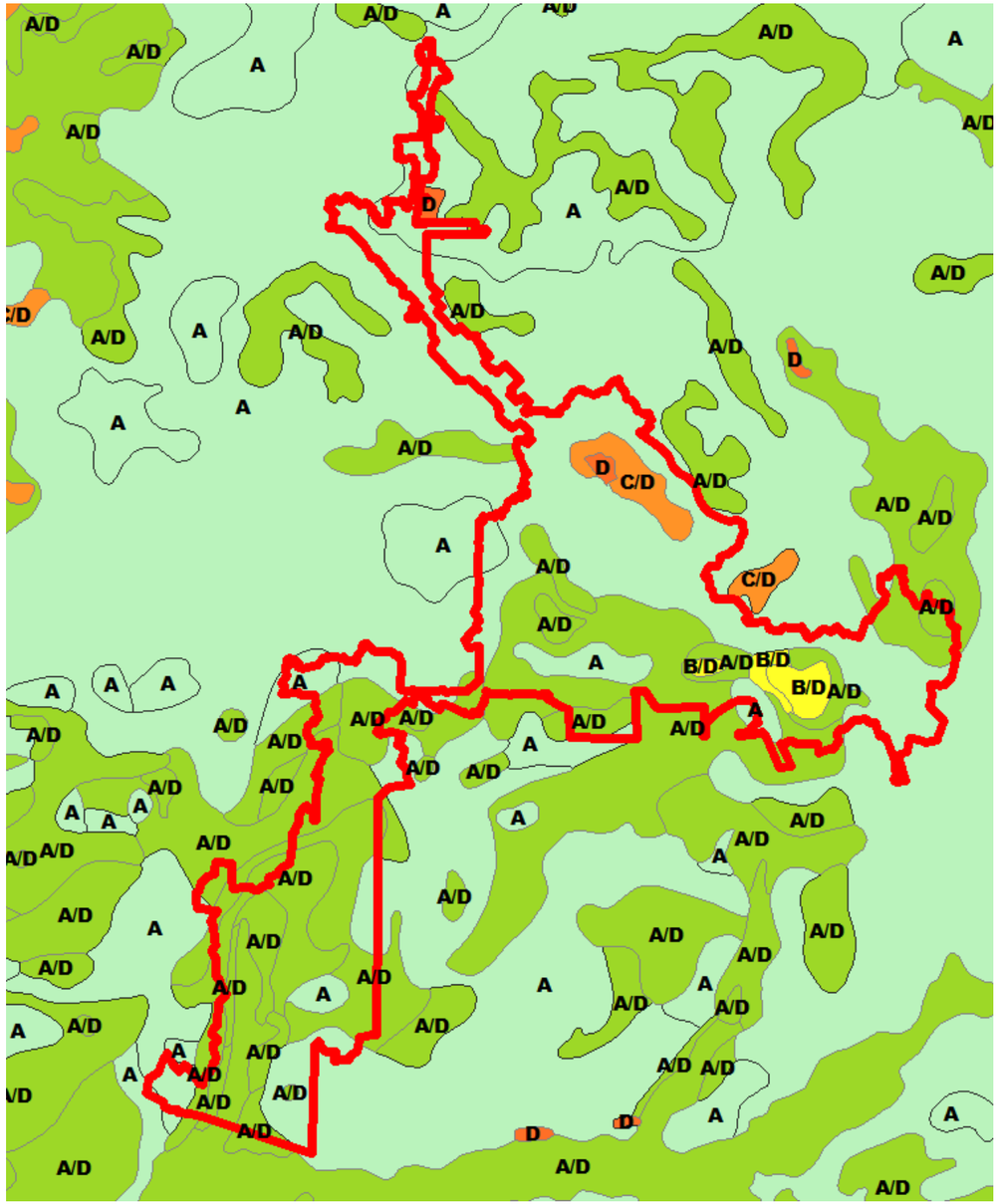
Drainage Basins



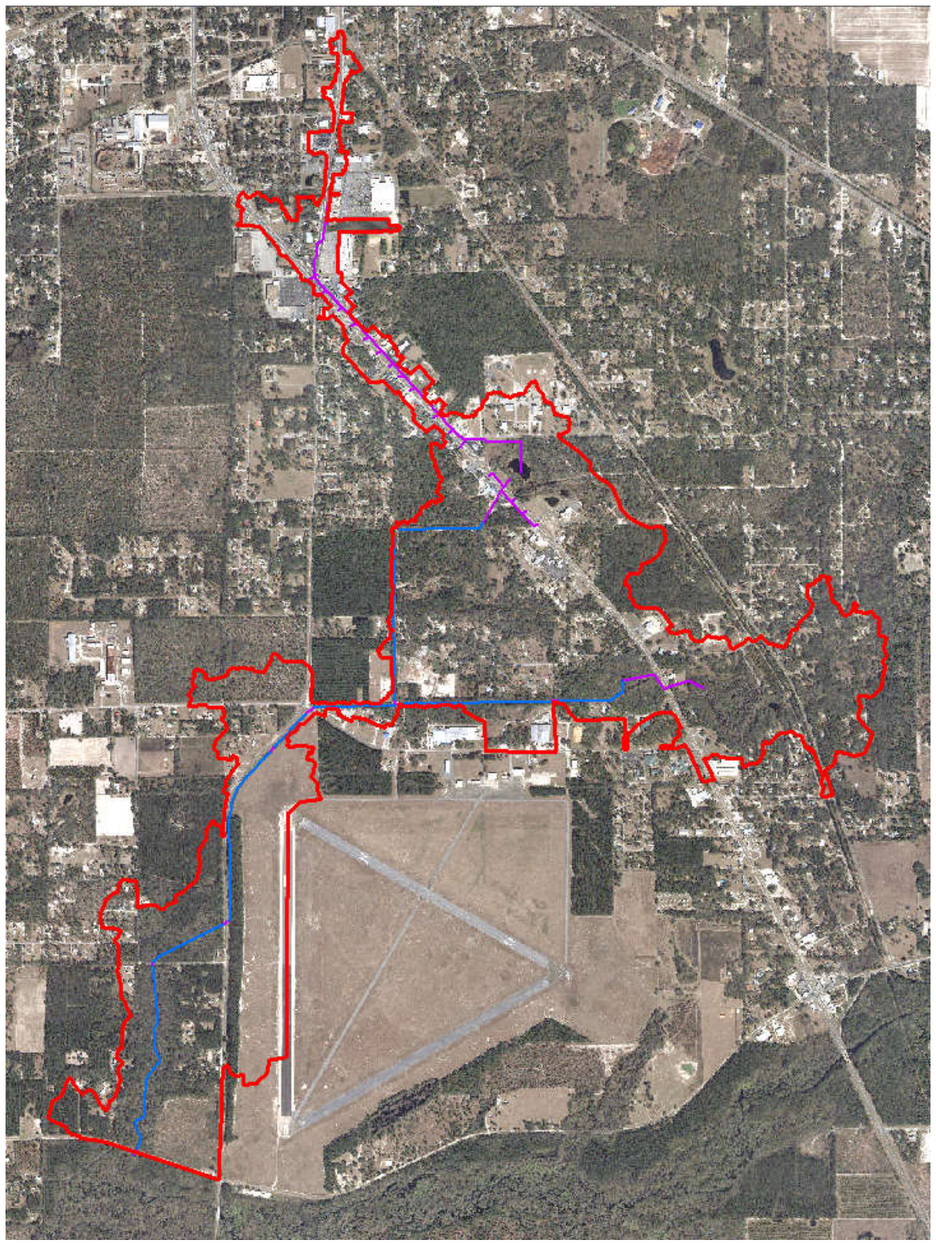
FEMA Flood Map



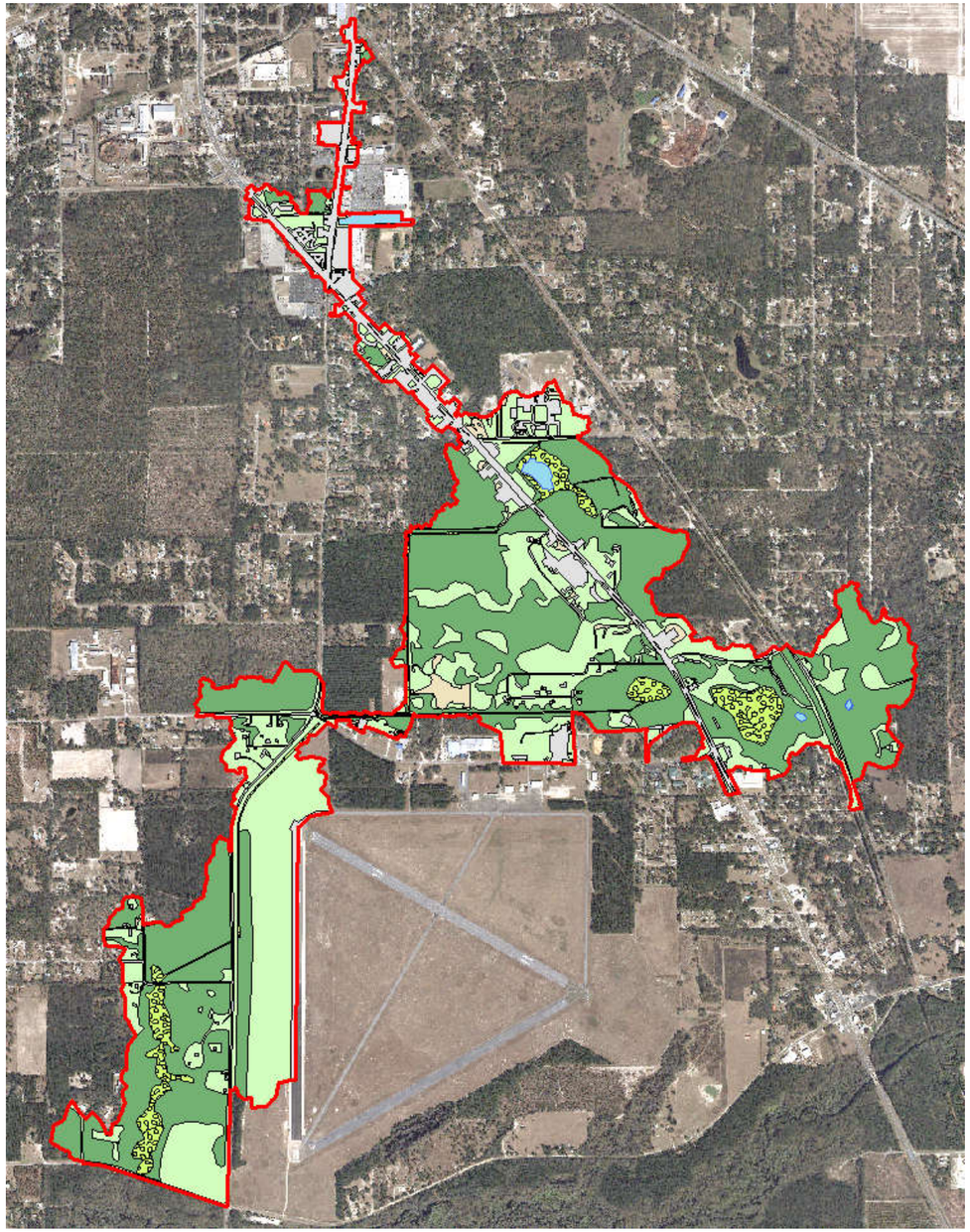
Soils Map

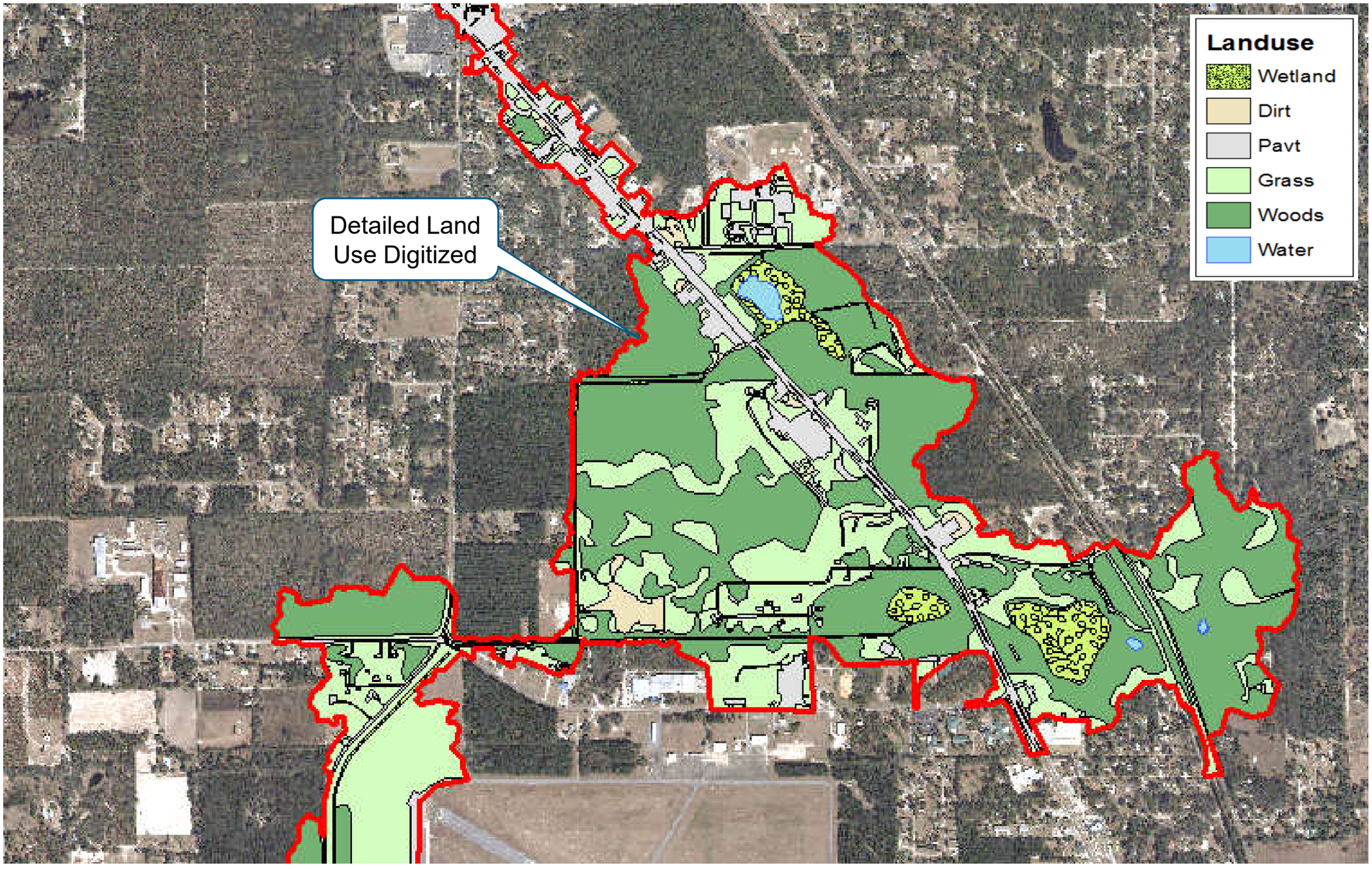


Aerial Imagery

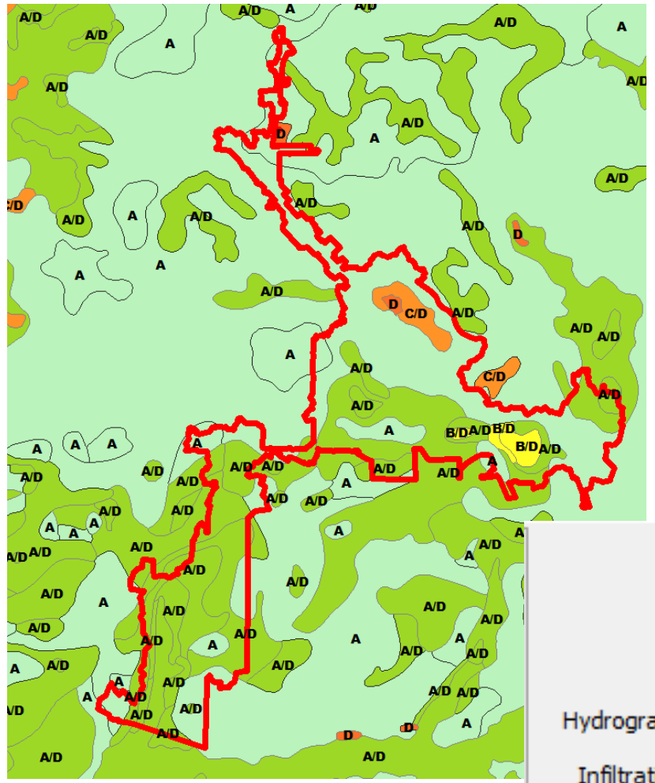


Land Use

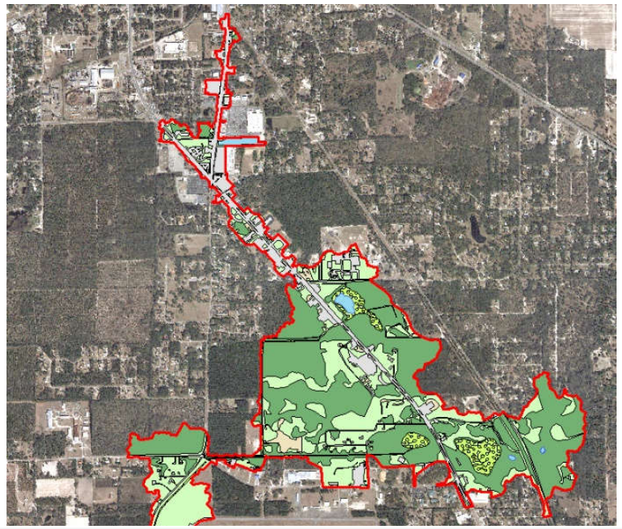



Detailed Land Use Digitized
Landuse
Wetland
Dirt
Pavt
Grass
Woods
Water

Soils



Land Use



CN Look Up

Curve Number Set Data

Menu

Land Cover Zone	Soil Zone	Curve Number
Dirt	A	72
Dirt	A/D	89
Dirt	B/D	89
Dirt	C/D	89
Dirt	D	89
Grass	A	39
Grass	A/D	80
Grass	B/D	80
Grass	C/D	80
Grass	D	80
Pavt	A	98
Pavt	A/D	98
Pavt	B/D	98
Pavt	C/D	98
Pavt	D	98
Water	A	100
Water	A/D	100
Water	B/D	100
Water	C/D	100
Water	D	100
Wetland	A	80
	A/D	80
	B/D	80
	C/D	80
	D	80
	A	36
	A/D	79
	B/D	79
	C/D	79
	D	79

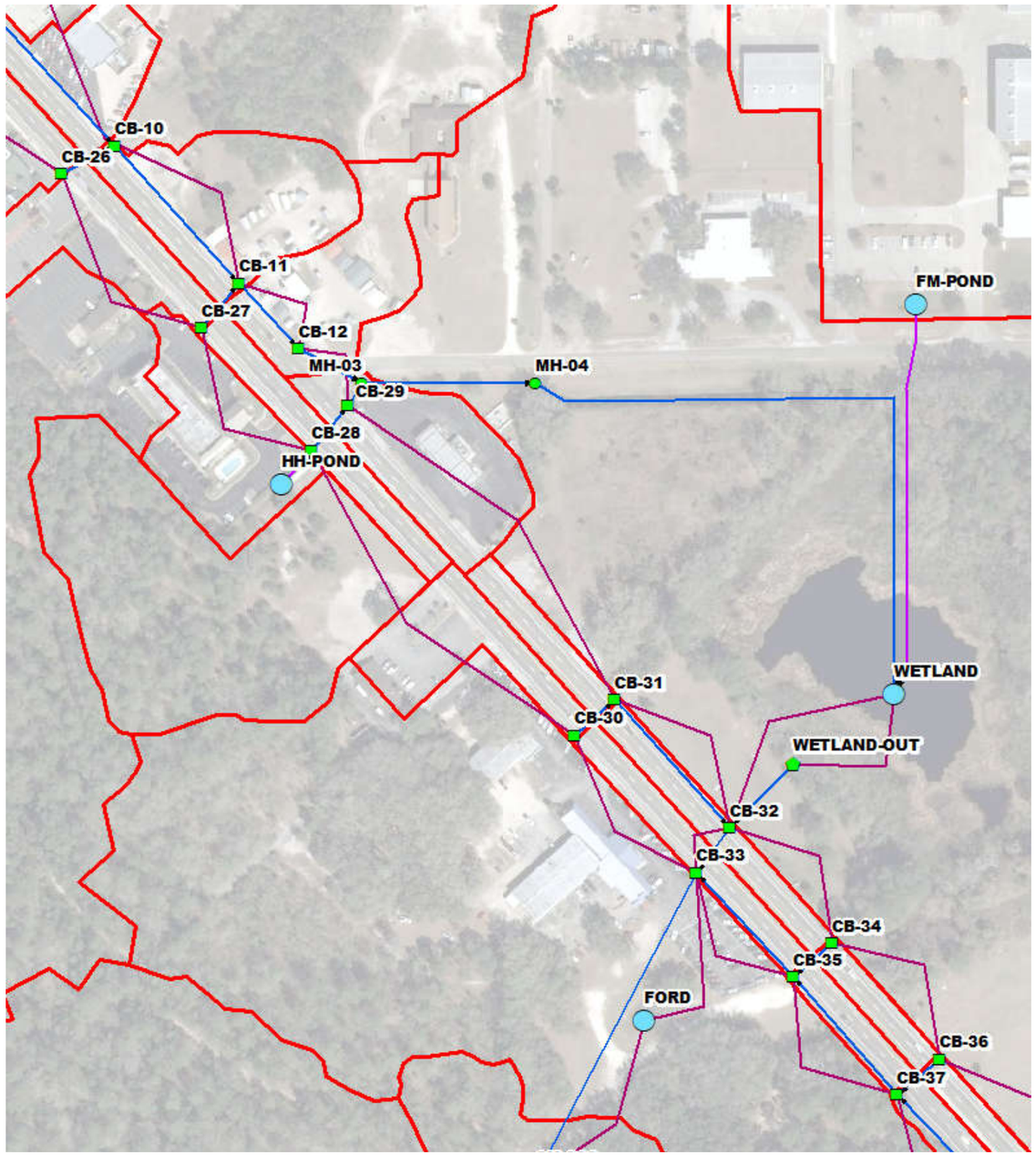
lumber

2 Curve Number Set(s)

Name	WETLAND
Scenario	Scenario1
Node	WETLAND
Hydrograph Method	NRCS Unit Hydrograph
Infiltration Method	Curve Number
Time of Concentration	57
Max Allowable Q	0
Time Shift	0
Unit Hydrograph	UH323
Peaking Factor	323
Comment	

Manual Basin Sub-Basin Edit

Area	Land Cover Zone	Soil Zone
25.954017	Woods	A
15.396763	Woods	C/D
3.449725	Grass	C/D
0.129178	Pavt	C/D
2.388912	Pavt	A
14.515771	Grass	A
0.304086	Dirt	C/D
1.211433	Dirt	A
6.534917	Wetland	C/D
0.073691	Grass	A/D
0.003421	Dirt	A/D
0.509711	Wetland	A
0.869949	Wetland	D
0.107117	Water	C/D
2.647773	Water	D

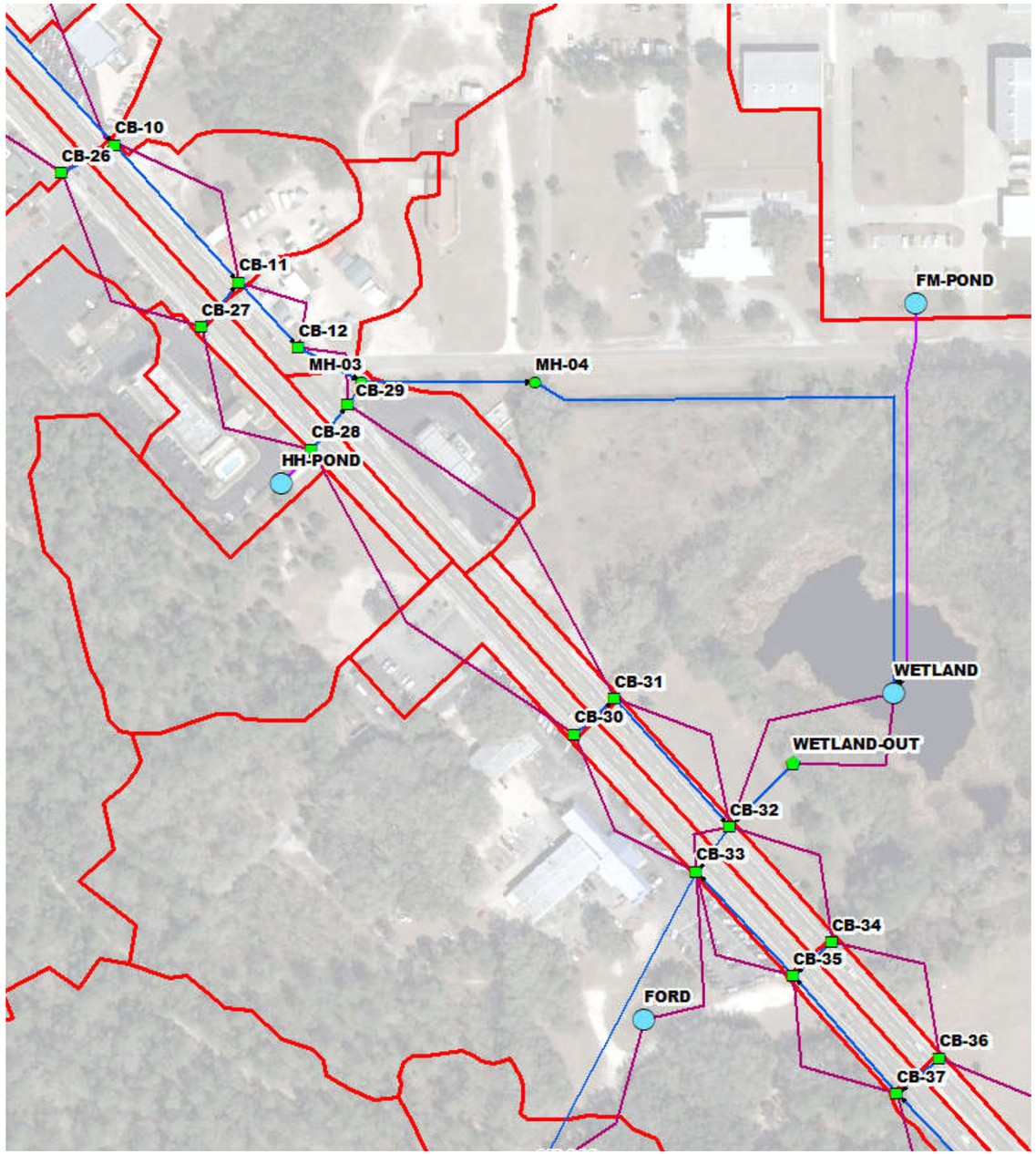


GIS Mapping

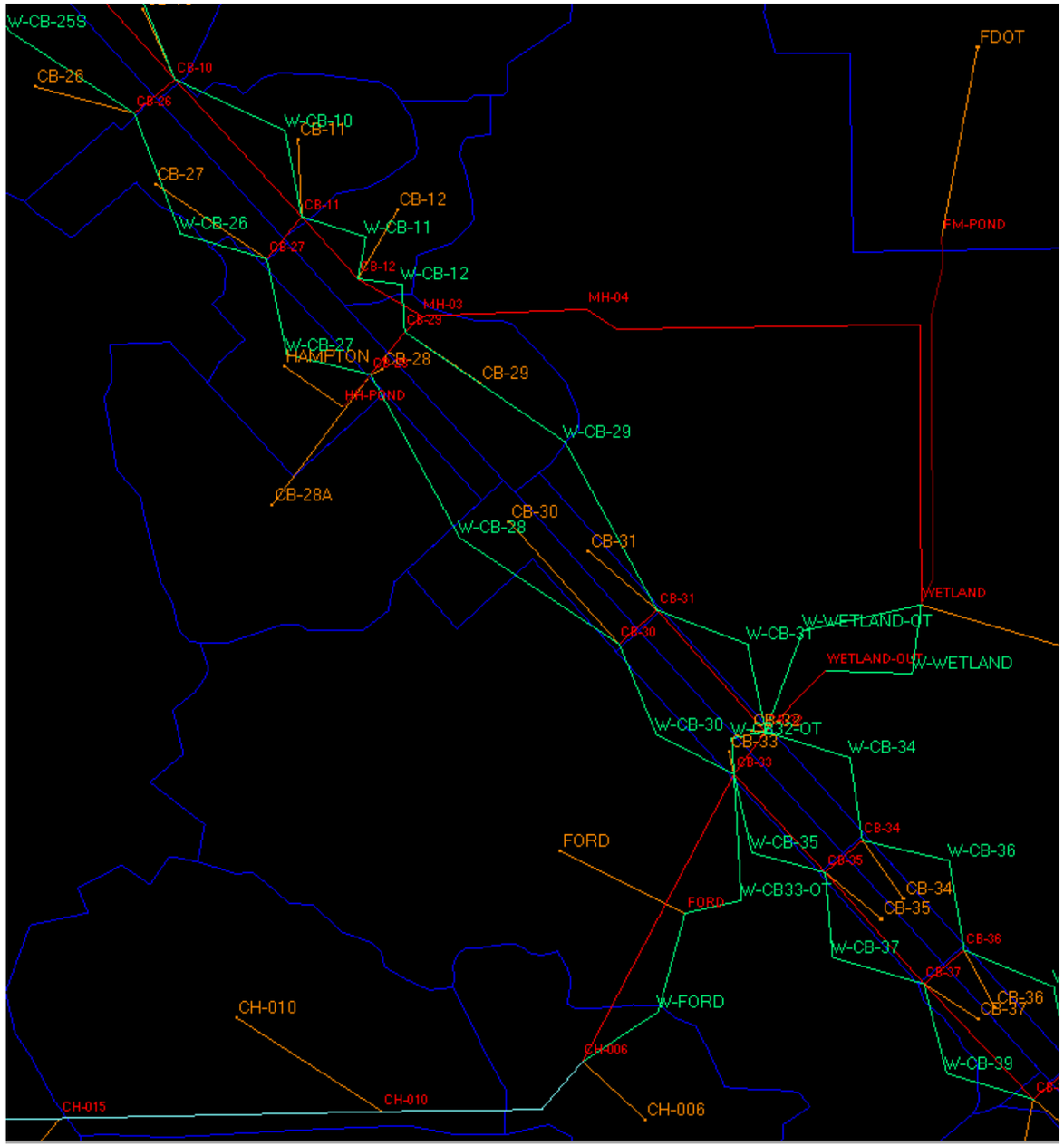
Advantages of building the model in GIS:

- Guided basin delineation using ArcHydro and DEM
- Spatial referencing of aerials, soils, and land use data
- Availability of public reference data
- Georeferencing of plans
- Creation of exhibits

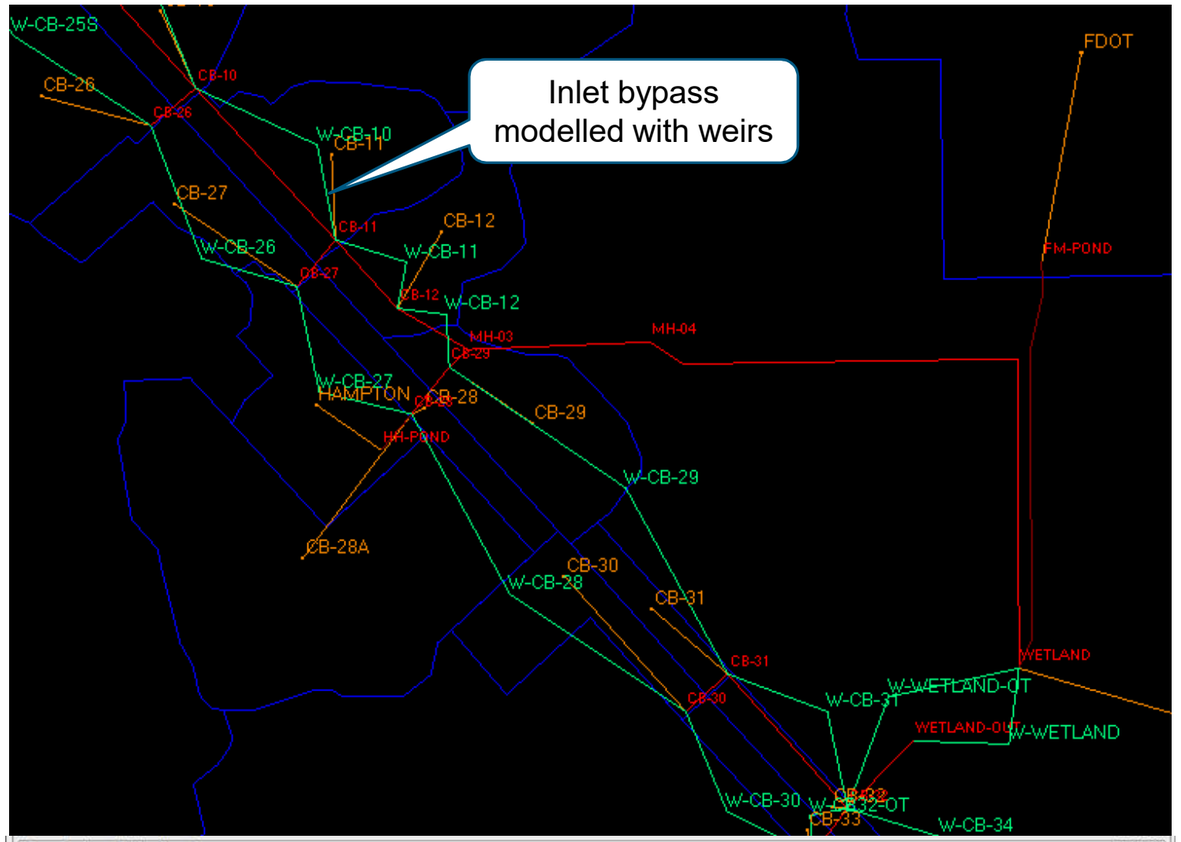
- Usable platform to build a model

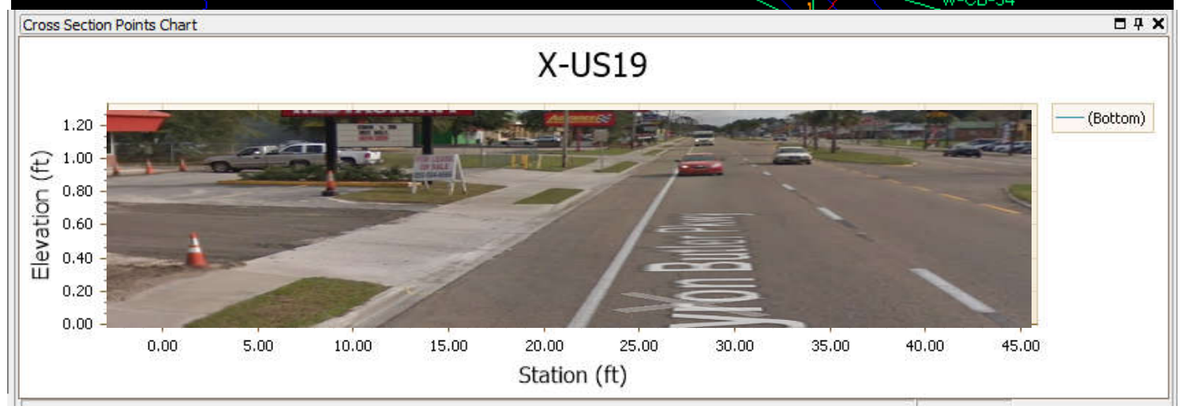


GIS Mapping

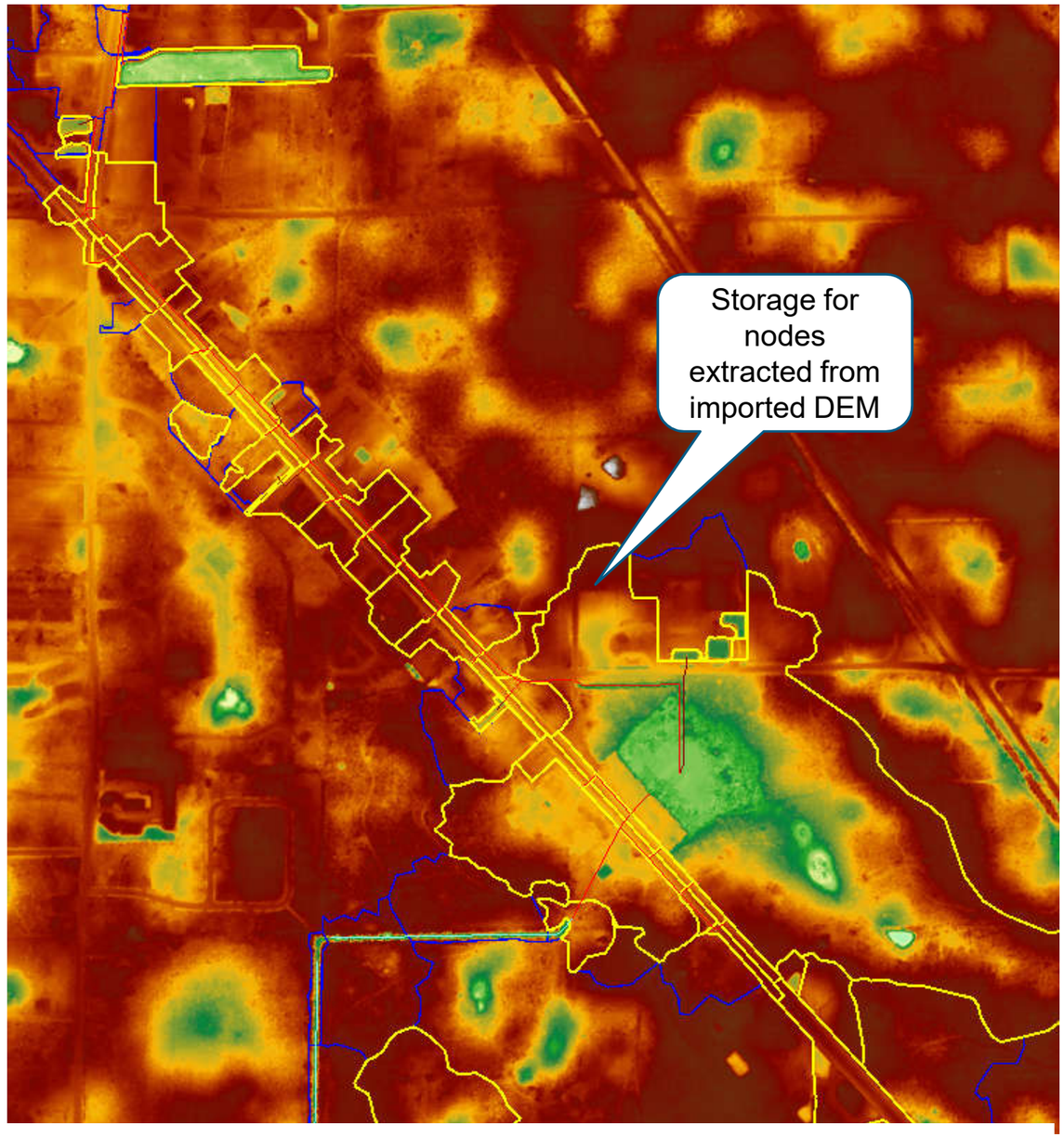


ICPR Model Network



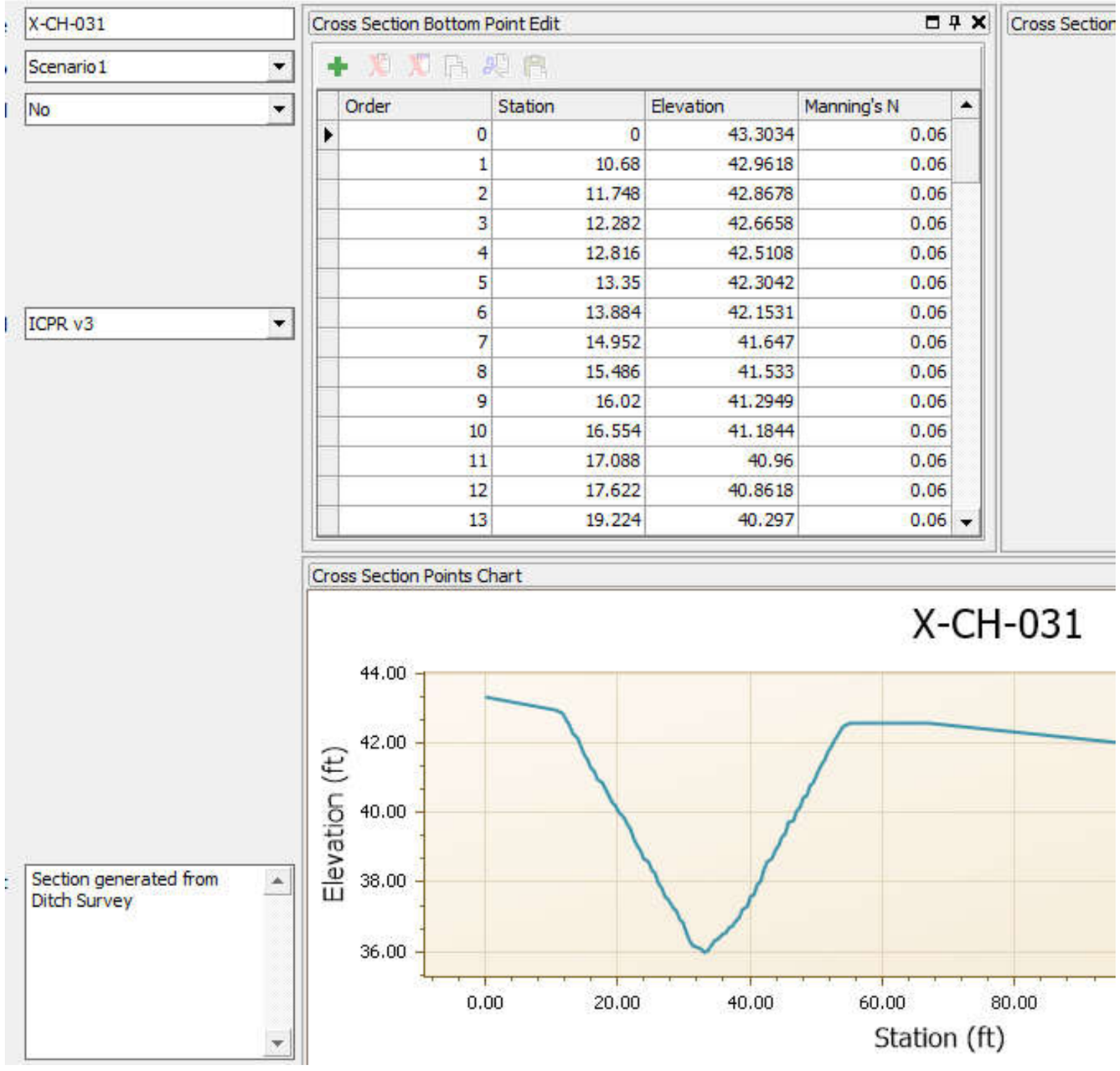


Modelled Weirs



Imported Surface

Imported Ditch Surface



Order	Station	Elevation	Manning's N
0	0	43.3034	0.06
1	10.68	42.9618	0.06
2	11.748	42.8678	0.06
3	12.282	42.6658	0.06
4	12.816	42.5108	0.06
5	13.35	42.3042	0.06
6	13.884	42.1531	0.06
7	14.952	41.647	0.06
8	15.486	41.533	0.06
9	16.02	41.2949	0.06
10	16.554	41.1844	0.06
11	17.088	40.96	0.06
12	17.622	40.8618	0.06
13	19.224	40.297	0.06

Cross-sections cut in program

ICPRv4 Analysis

- Ran multiple EXISTING simulations
    1. Clean system
    2. Replacing cross-drains from natural pond to ditch
    3. Expansion of Natural Pond

Confirmed stormsewer capacity issue

- Ran PROPOSED simulations
    1. Replace existing trunk line
    2. New Median trunk line

Median system chosen

Outfall Ditch Maintenance

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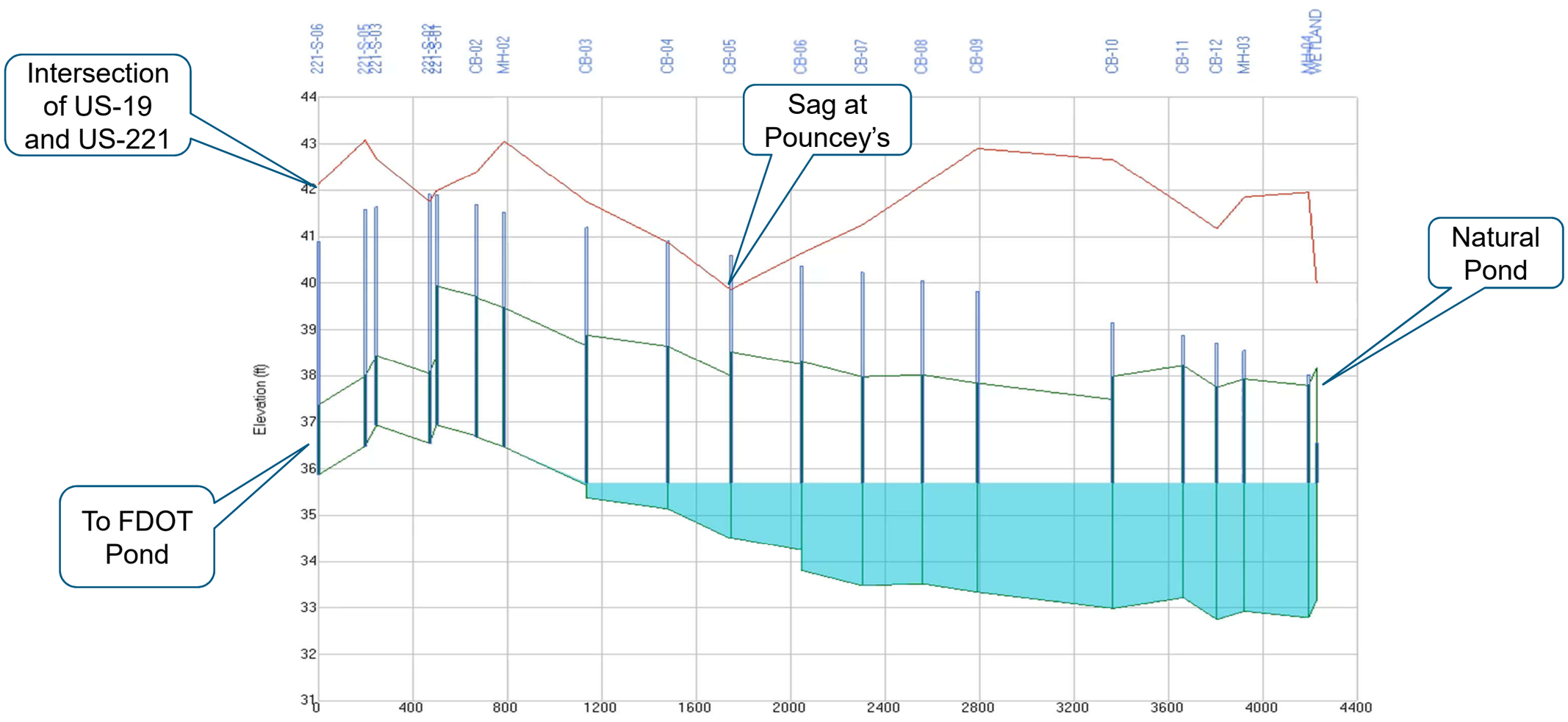
Stormsewer Design with ICPR

- Steady state good for ‘new’ design
  - Ignores storage, timing, bypass
  - Produces conservative design

- ICPR better for retro-fits (or complicated systems)
  - Simulates actual conditions if model setup is detailed
  - Allows demonstration of no adverse impacts

- Design storm choice…
  - What is the risk?
  - Is stage critical or flow?
  - Run multiple storms

Existing Conditions Results



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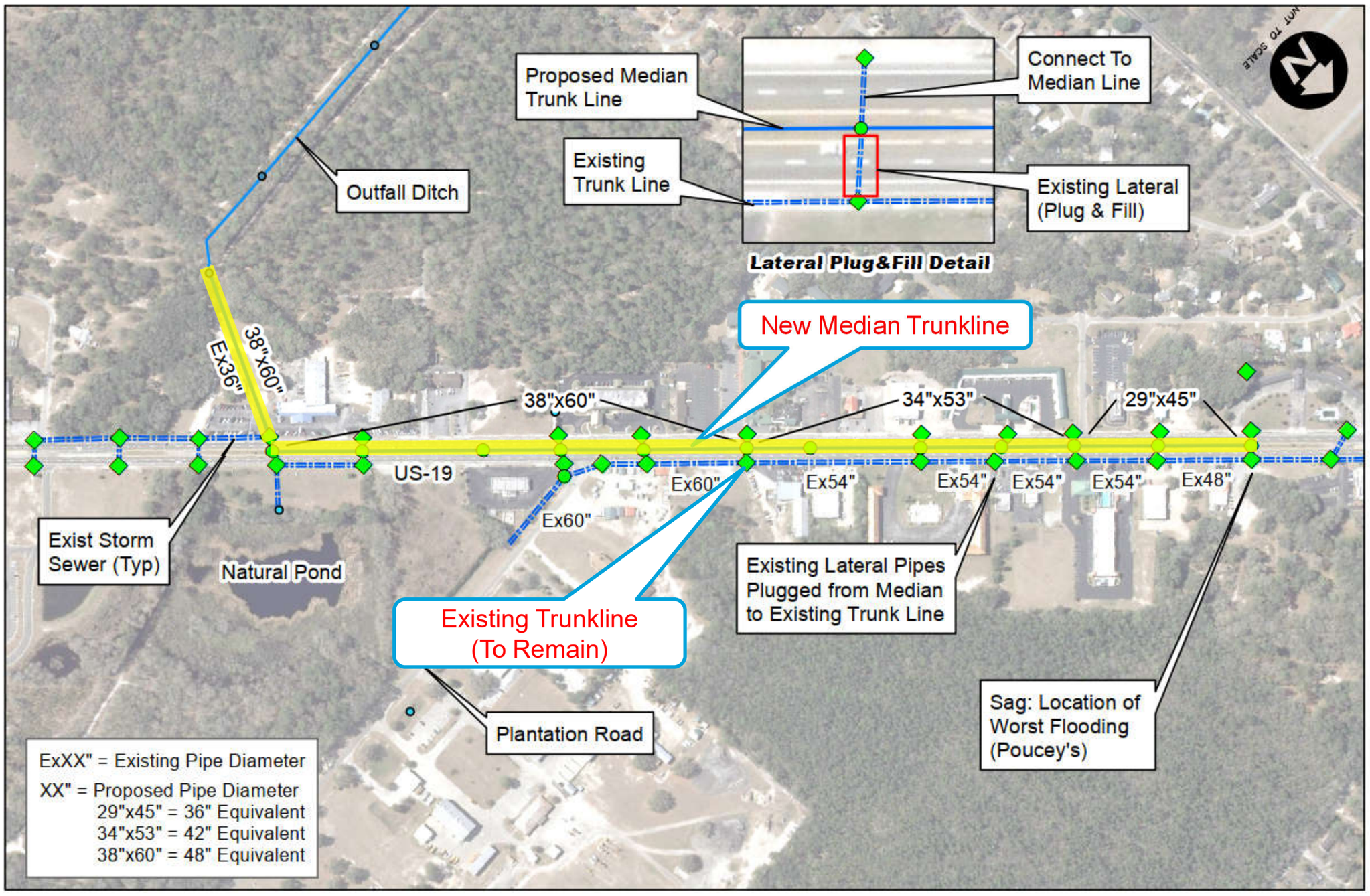
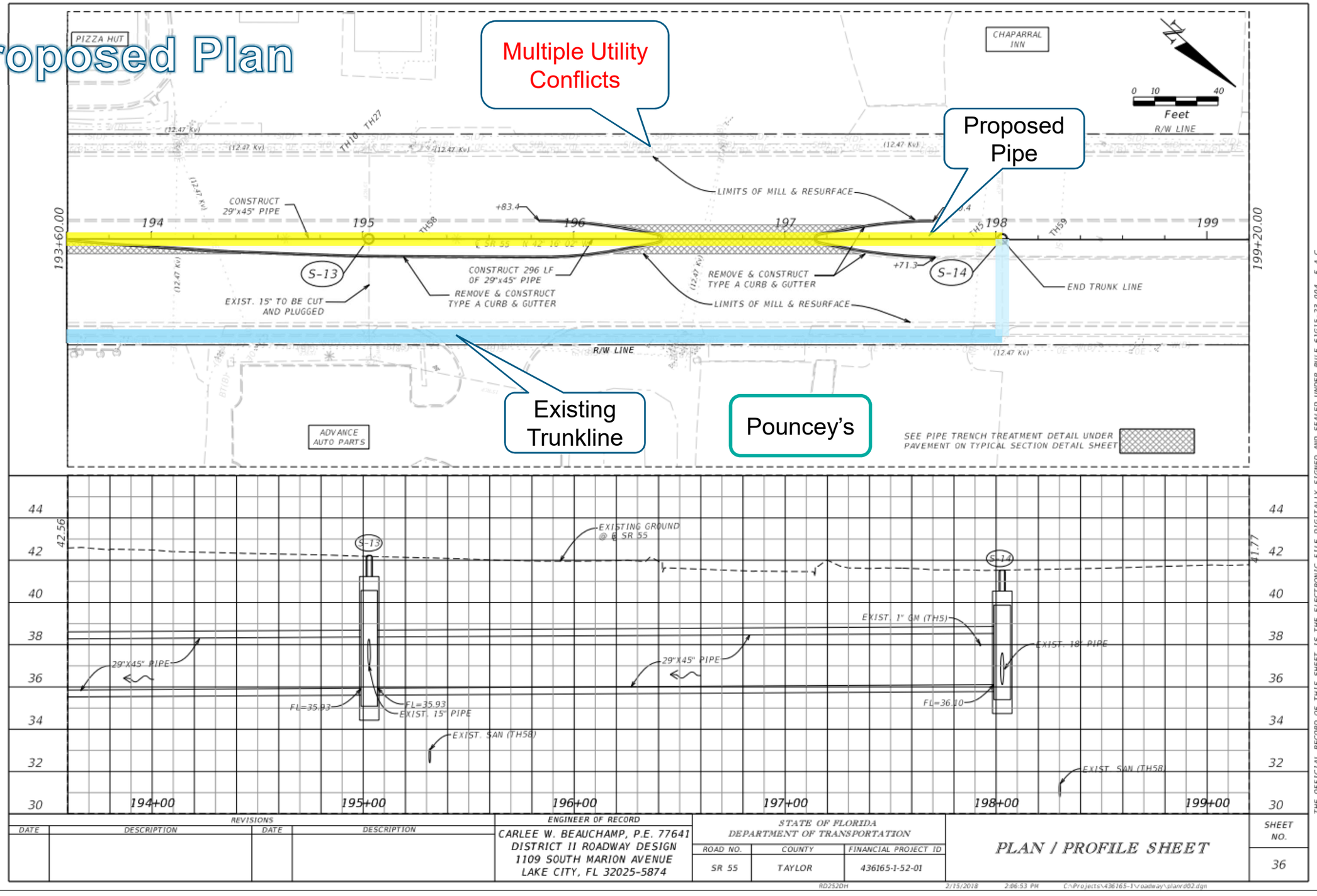


Proposed System Schematic

Proposed Plan



REVISIONS				ENGINEER OF RECORD	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION				SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	CARLEE W. BEAUCHAMP, P.E. 77641 DISTRICT II ROADWAY DESIGN 1109 SOUTH MARION AVENUE LAKE CITY, FL 32025-5874	ROAD NO.	COUNTY	FINANCIAL PROJECT ID	PLAN / PROFILE SHEET	36
					SR 55	TAYLOR	436165-1-52-01		

RD252DH 2/15/2018 2:06:53 PM C:\Projects\436165-1\roadway\plan\rd02.dgn

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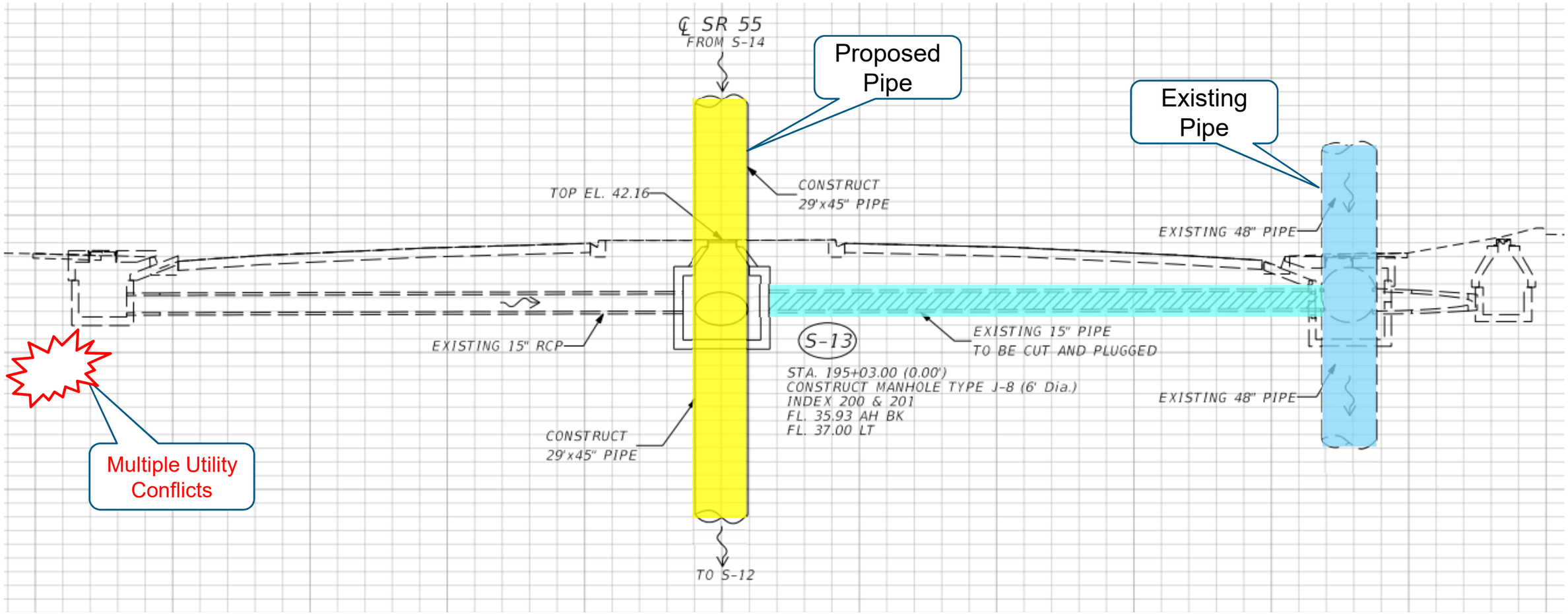
Section of New Trunkline



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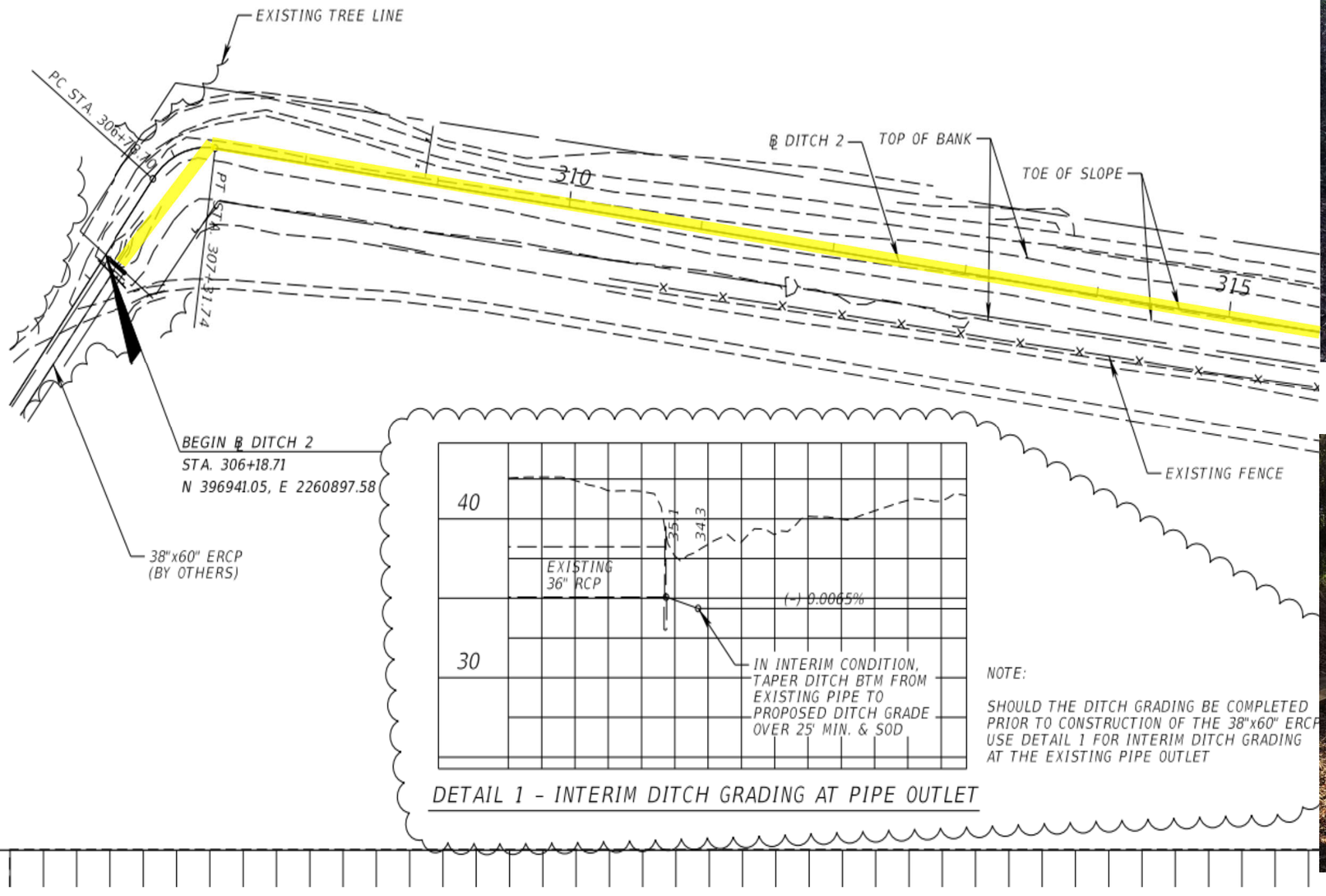
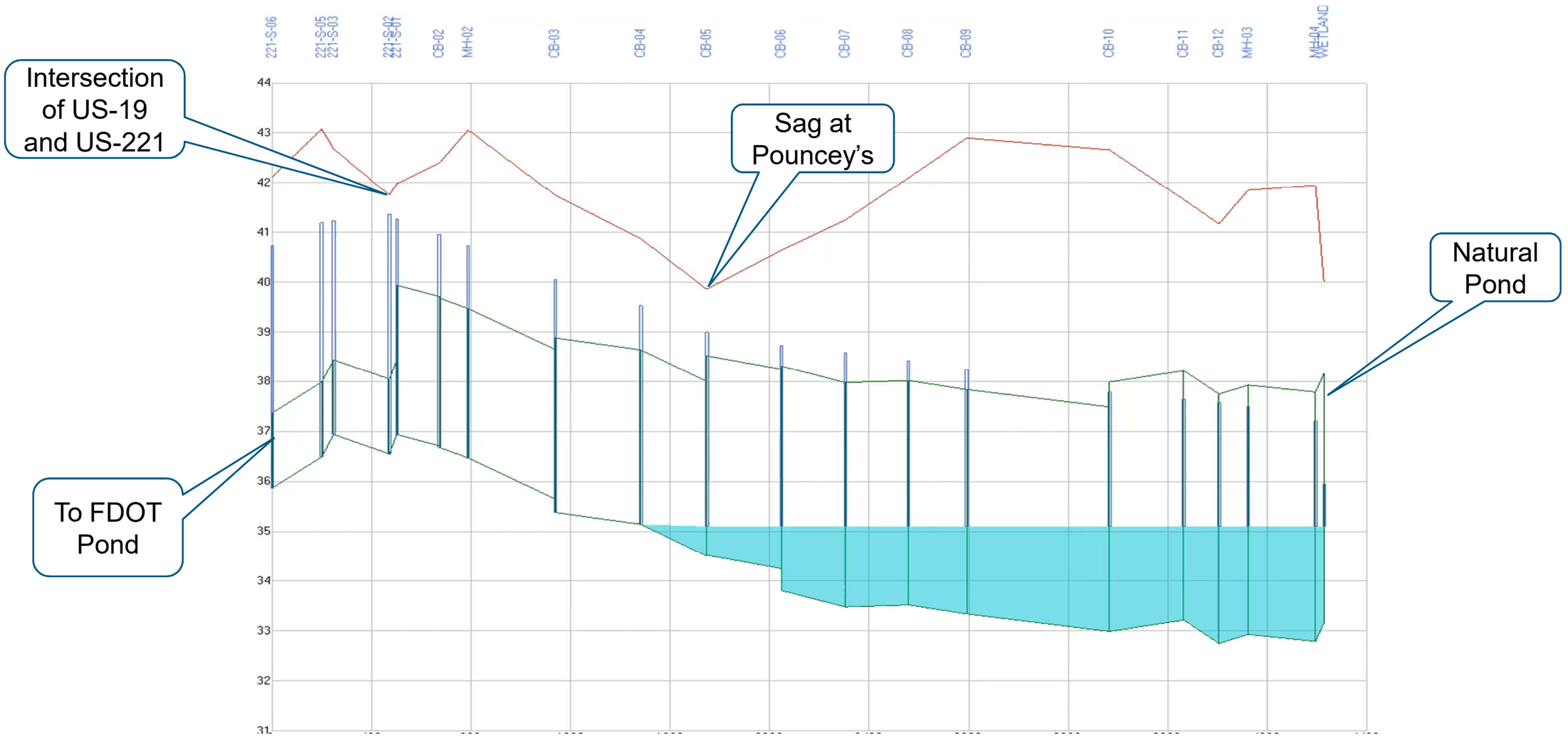
Ditch Regrading (10,000’)



DETAIL 1 – INTERIM DITCH GRADING AT PIPE OUTLET

Outfall Ditch Maintenance

Proposed Results (Existing Trunkline)



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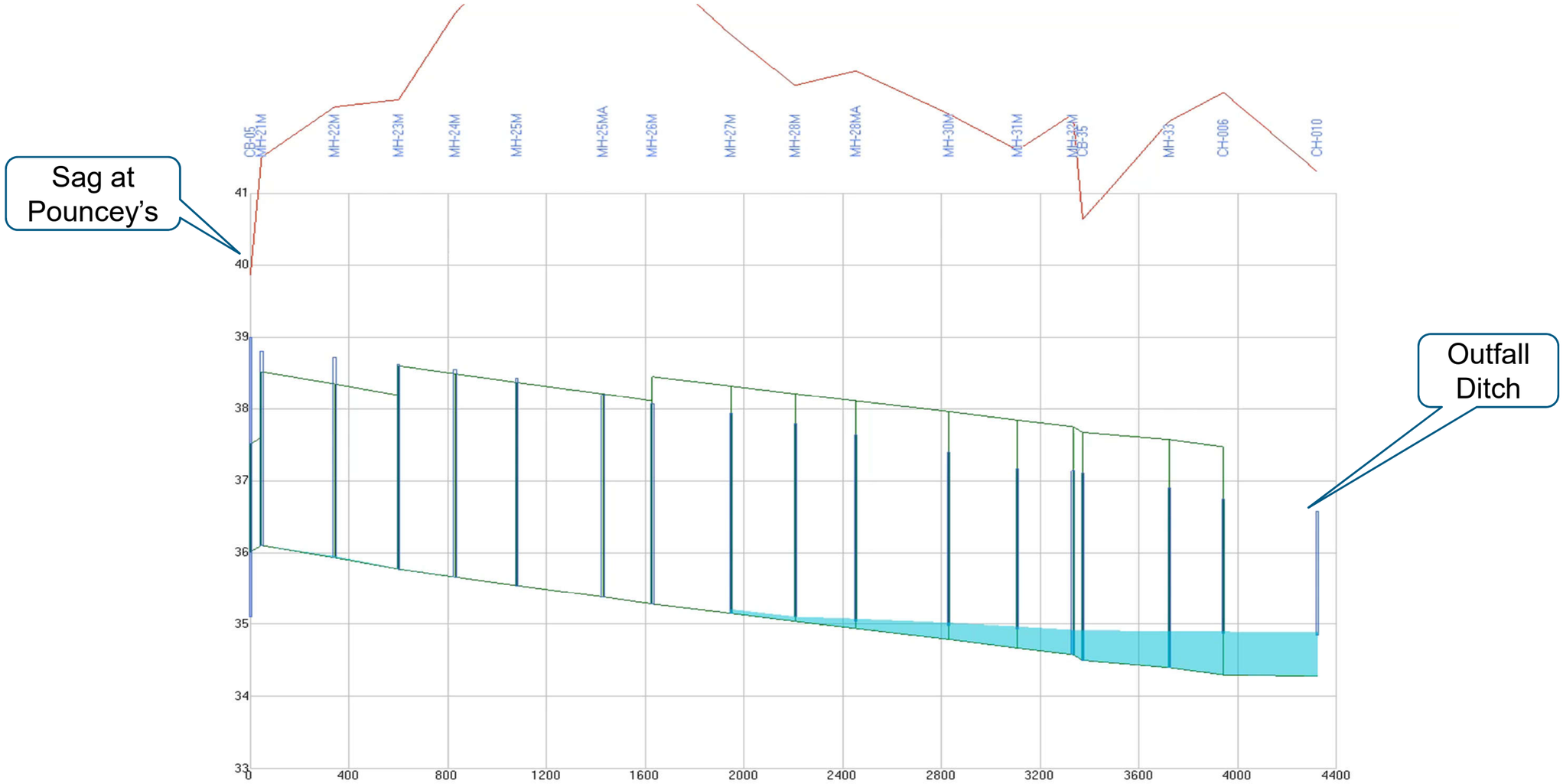
Proposed Results (New Median Trunkline)



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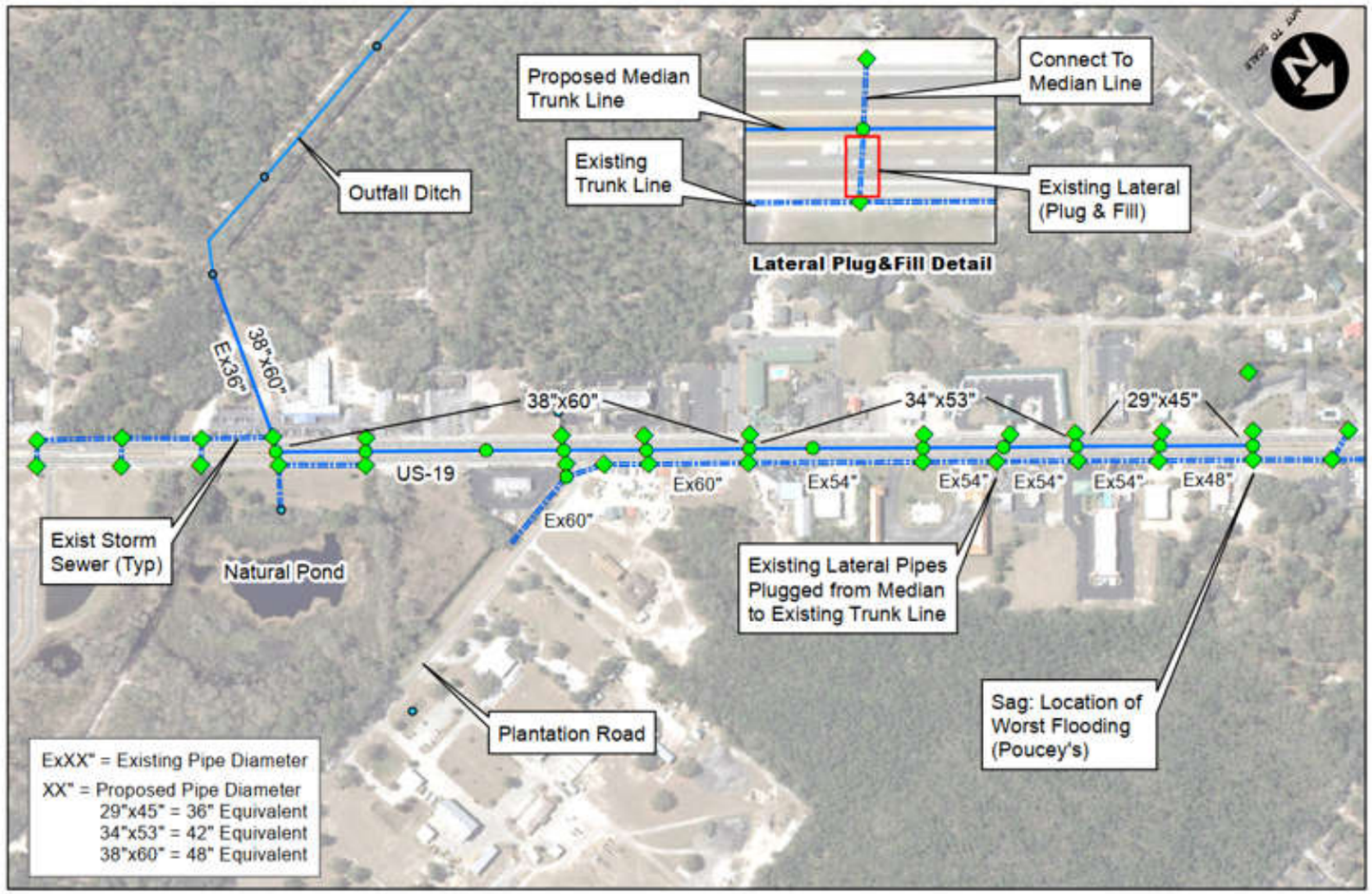
Questions



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