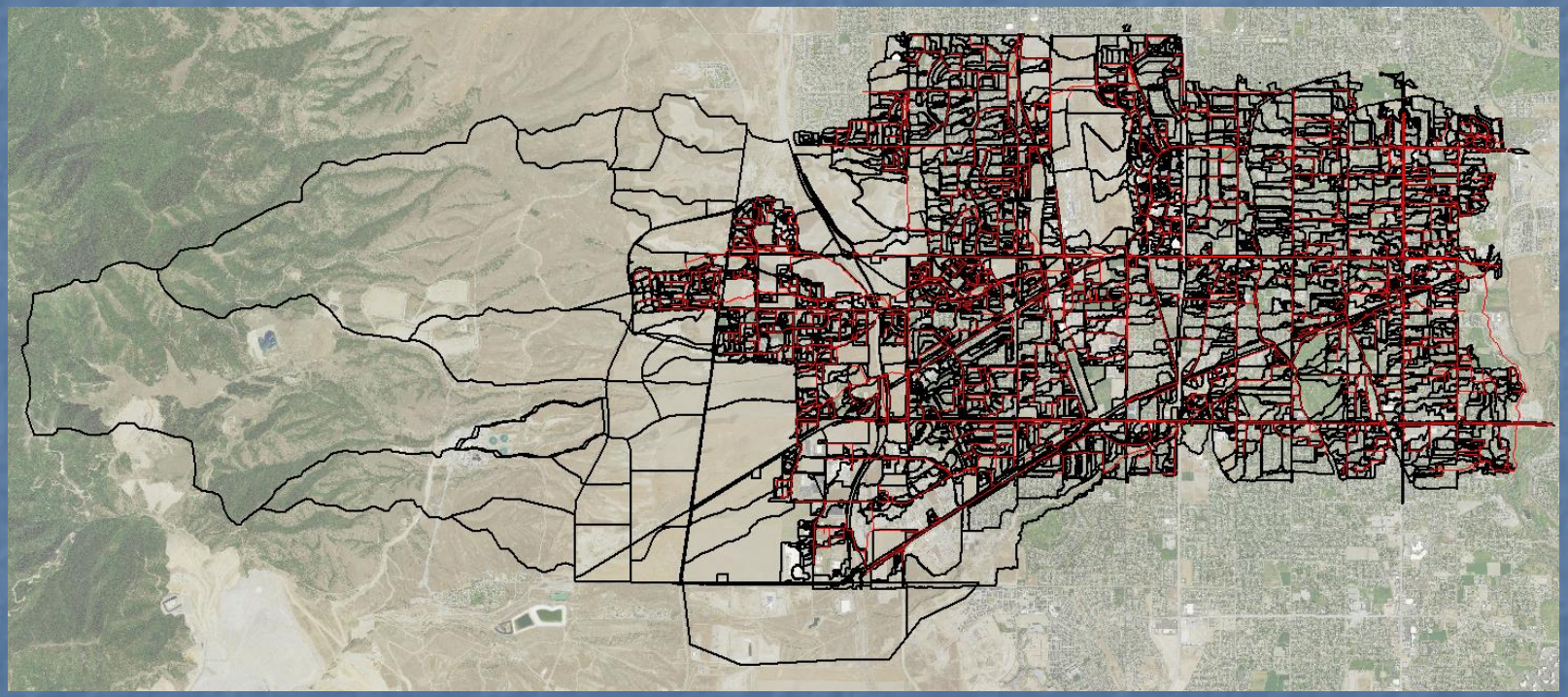
City of West Jordan
Storm Drain Master Plan Dynamic Model



HANSEN ALLEN & LUCE INC
ENGINEERS

October 2015

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Introduction

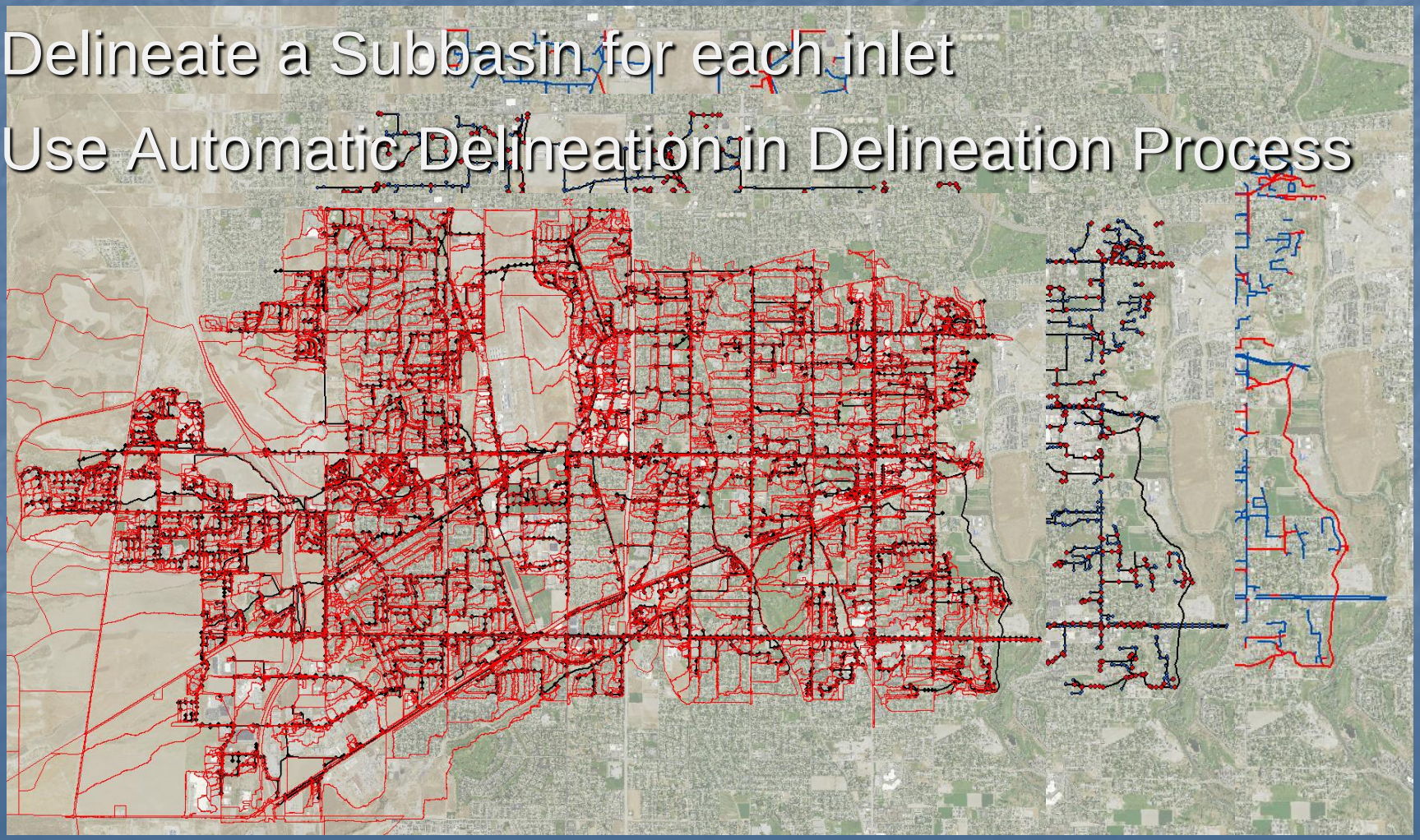
- Presentation Purpose
- Model Requirements
- Data
- Automatic Delineation
- Model Compilation
- Problem Solving with Dynamic Models

Presentation Purpose

- Show the benefits and constraints of dynamic storm drain modeling with automatically delineated subbasins.

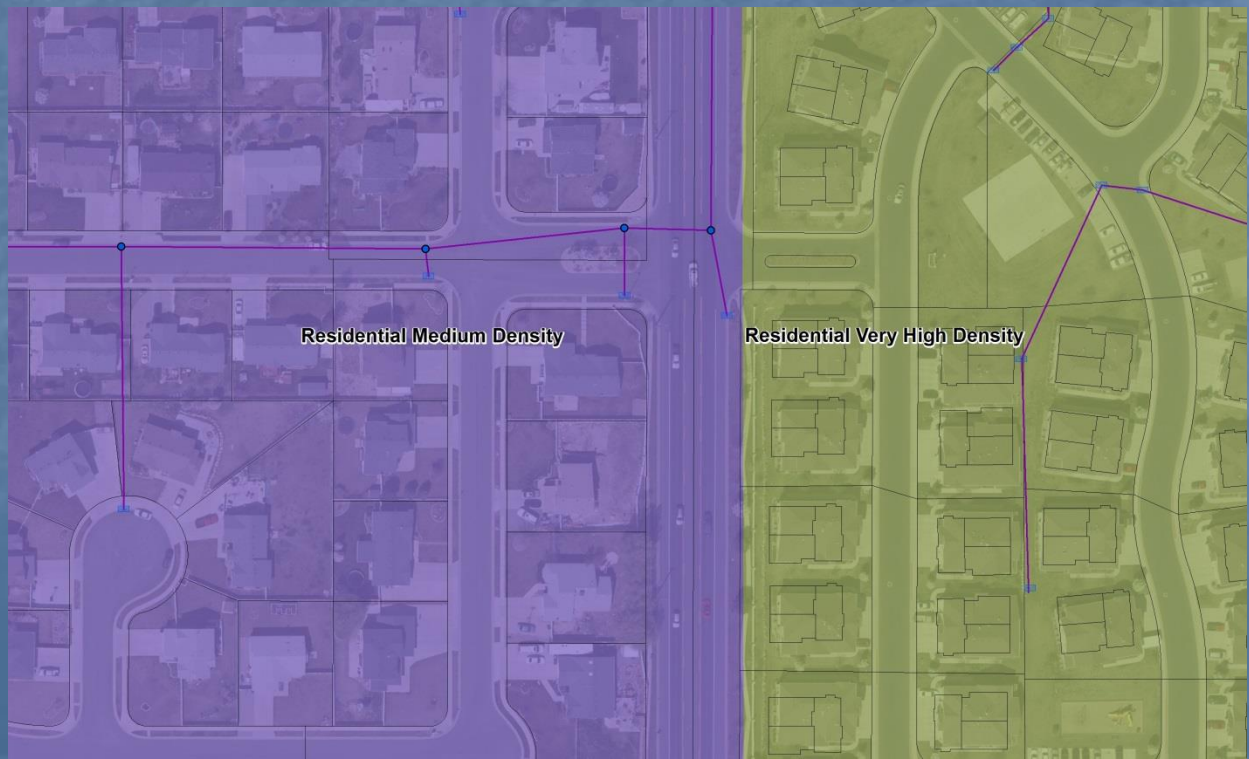
Model Requirements

- Complete a Storm Drain Inventory
- Delineate a Subbasin for each inlet
- Use Automatic Delineation in Delineation Process



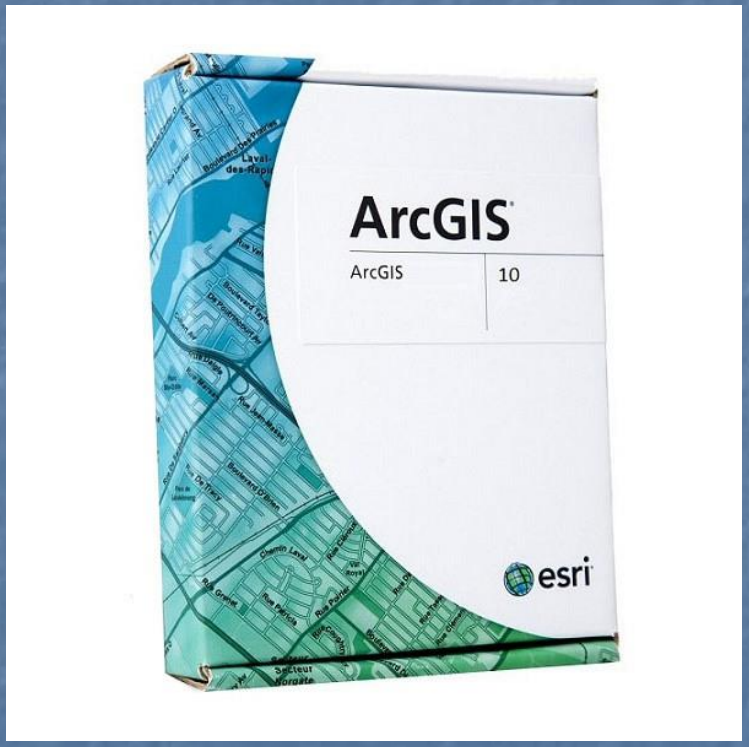
Data

- Inventory of storm drain system completed by Hansen, Allen & Luce (inlets, manholes, pipes)
- SSURGO (Soil Survey Geographic Database)
- AGRC 2013-2014 0.5 meter LiDAR DTM (Automatic Geographic Reference Center)
- Parcel shapefile
- Landuse shapefile



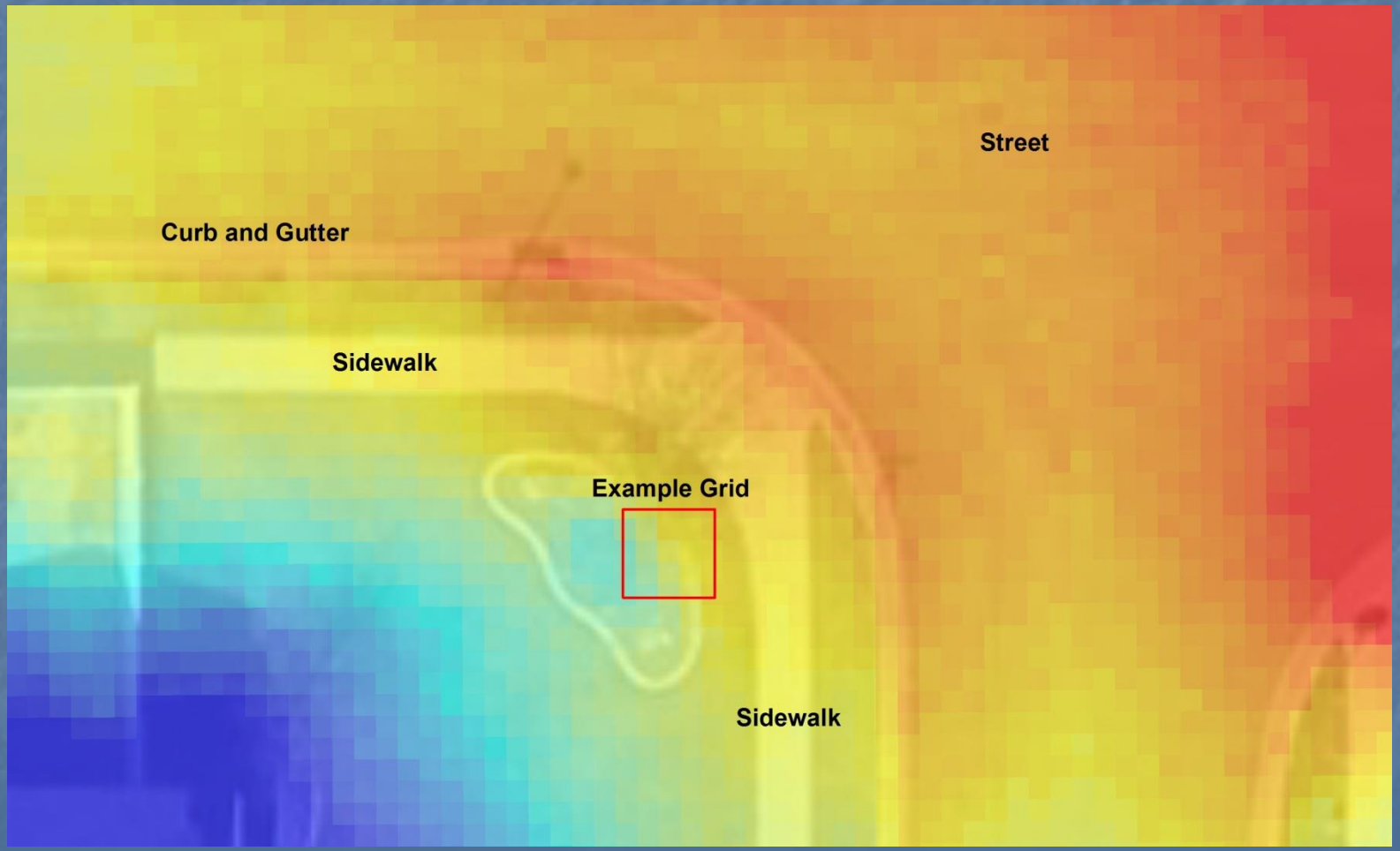
Automatic Subbasin Delineation

- ArcGIS Spatial Analyst with Hydrology Tools (via InfoSWMM)



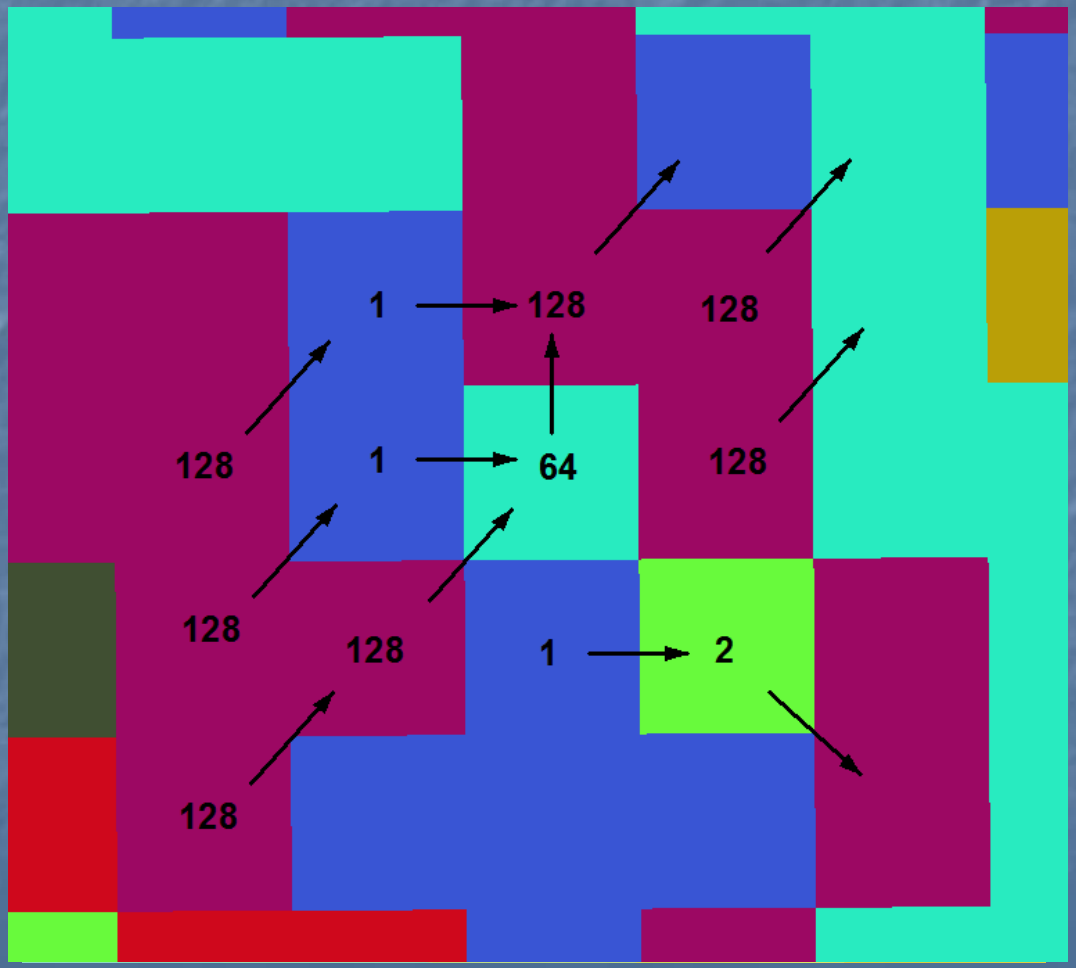
Automatic Subbasin Delineation

- Start with Bare Earth DEM



Automatic Subbasin Delineation

- Determine Flow Direction

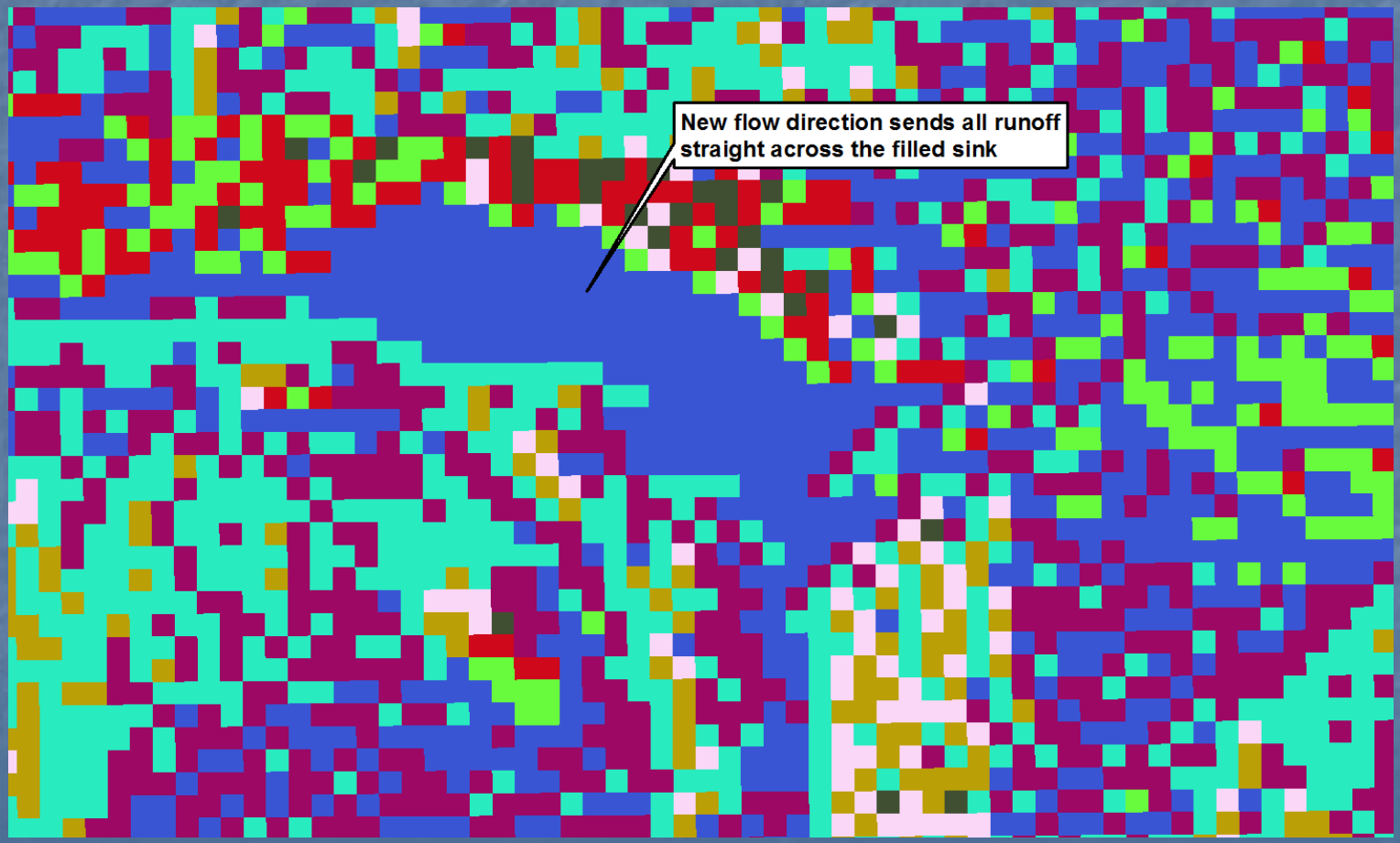


Automatic Subbasin Delineation

- Identify Sinks

Automatic Subbasin Delineation

- Fill Sinks and recreate Flow Direction

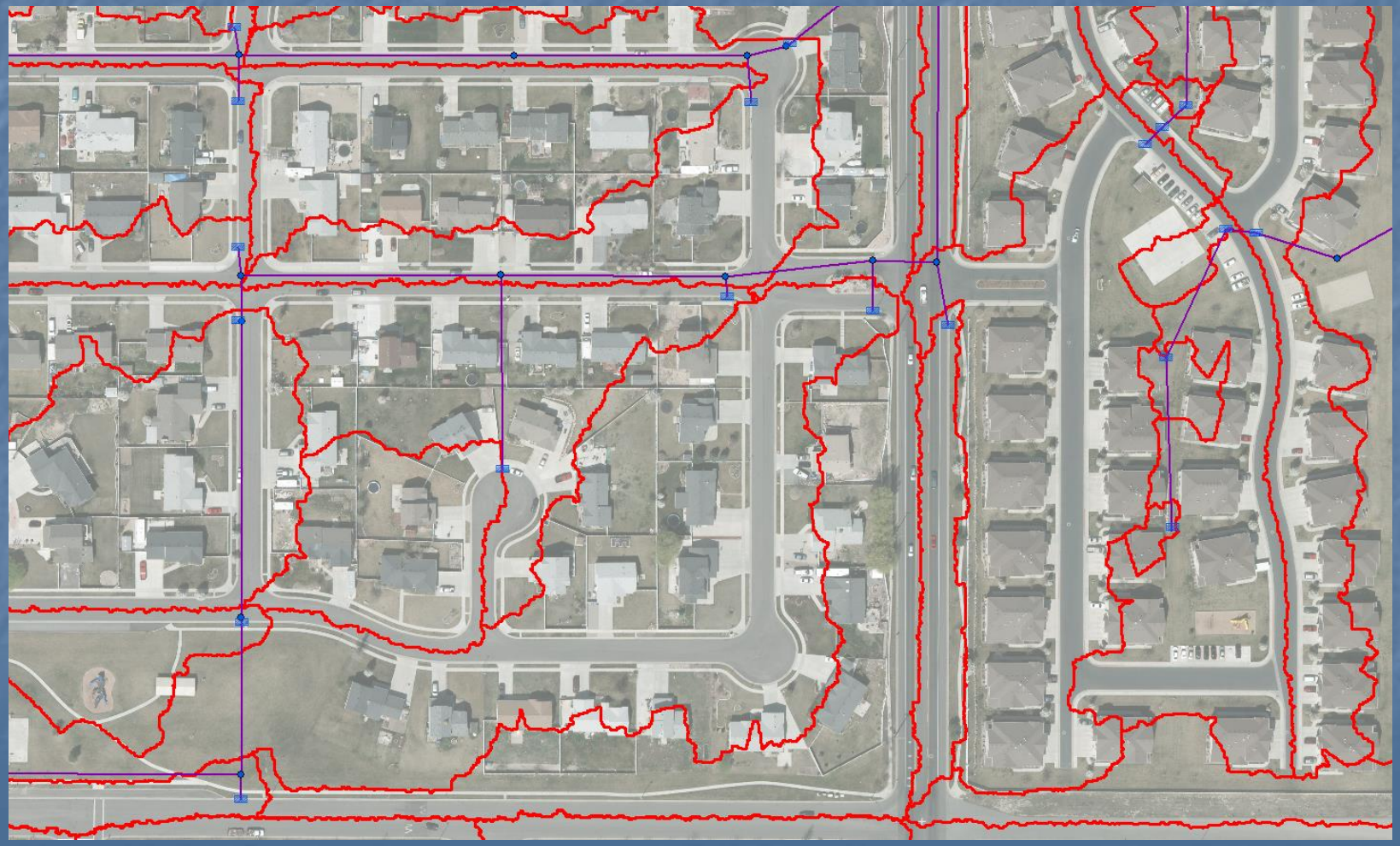


Automatic Subbasin Delineation

- Flow Accumulation

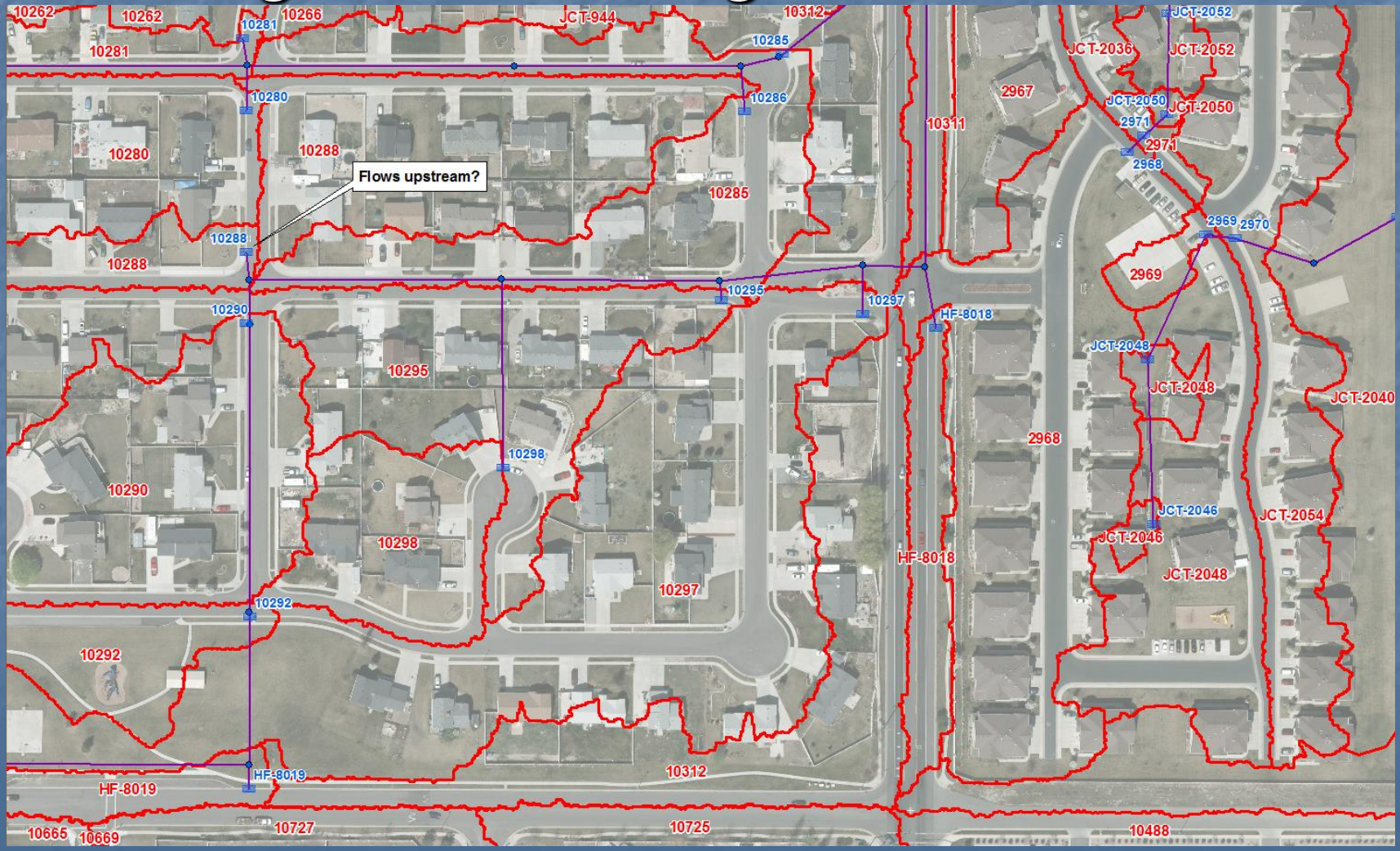
Automatic Subbasin Delineation

- Subbasin Delineation



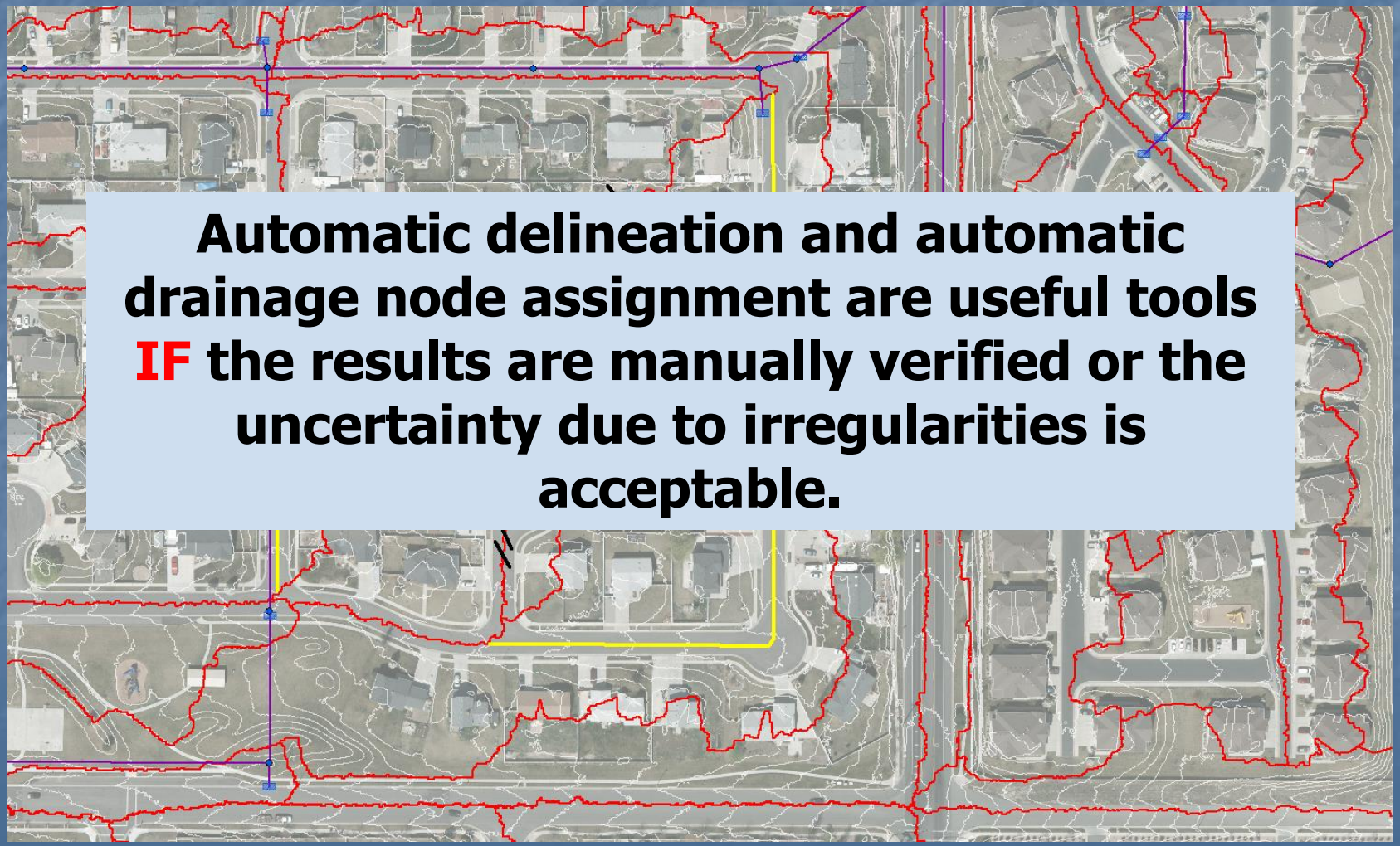
Automatic Subbasin Delineation

- Drainage Node Assignment



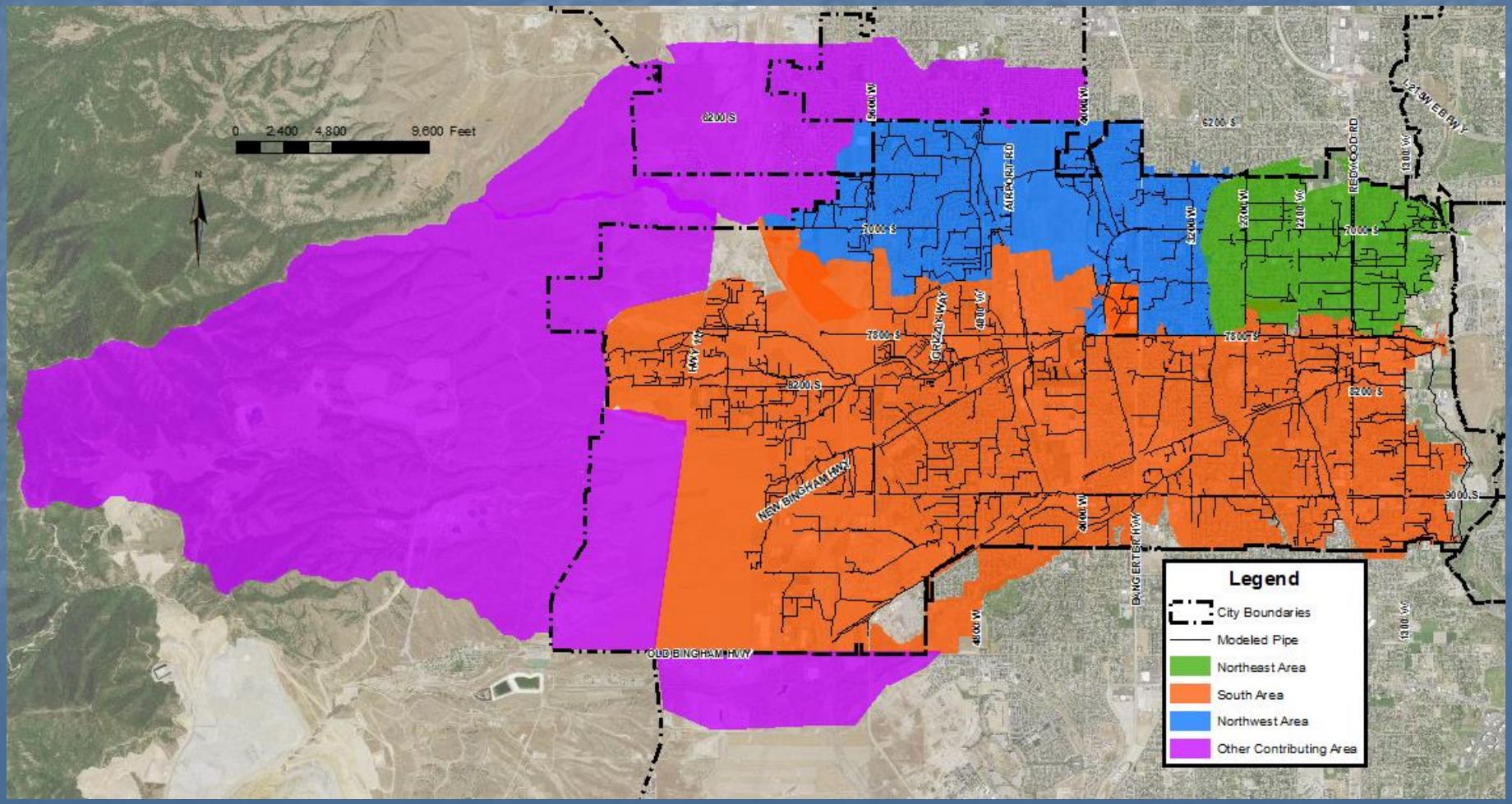
Automatic Subbasin Delineation

- Delineation Constraints



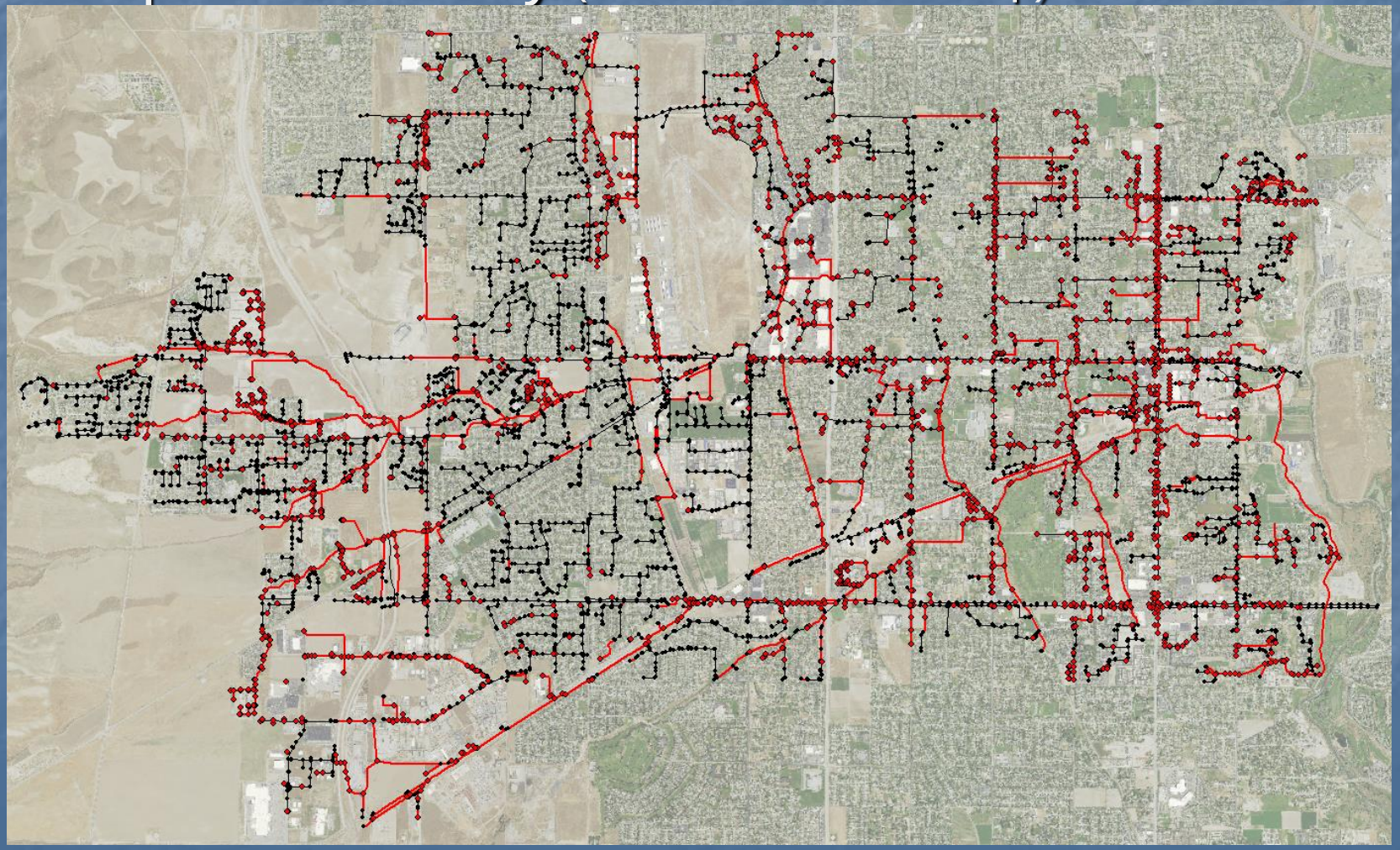
Model Compilation

- Study Area



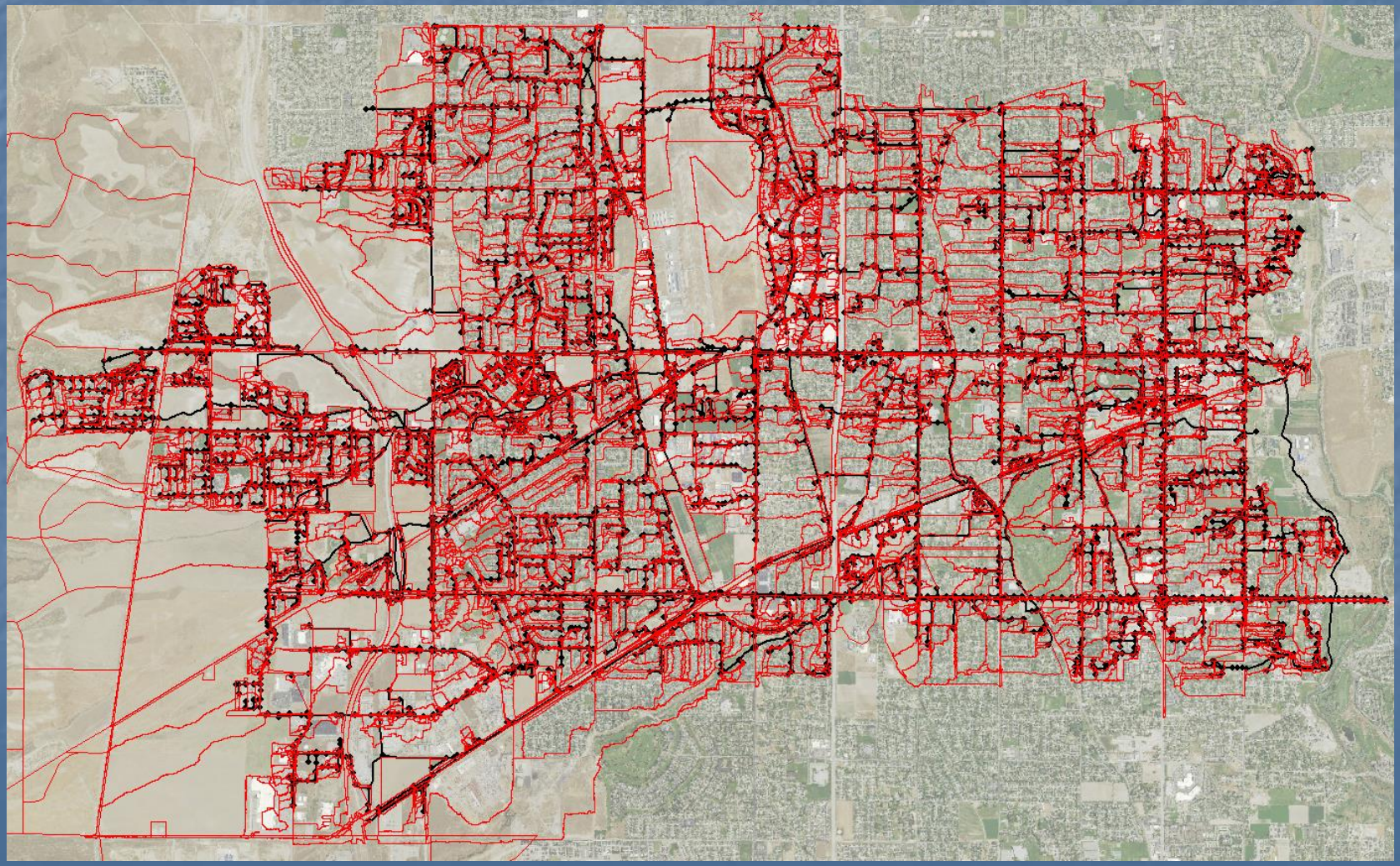
Model Compilation

- Complete Inventory (with West Jordan Help)



Model Compilation

- Perform Delineations

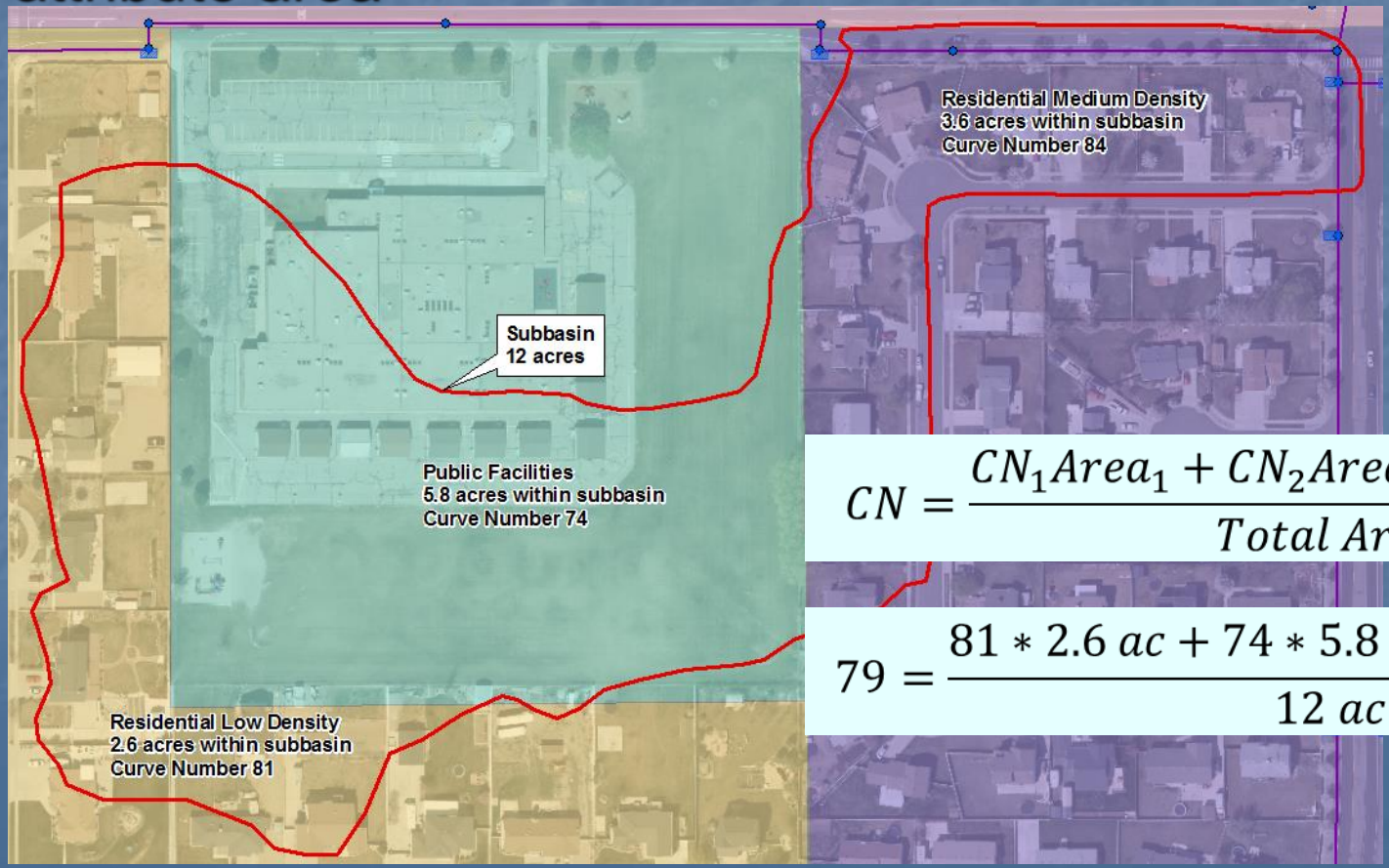


Model Creation

- Composite Subbasin Attributes
  - Width (feet)
    - Width (ft) = Area (ft) / Longest Overland Flow Path (ft)
  - Percent Impervious (Directly Connected)
  - Curve Number
    - USDA Natural Resources Conservation Service

Composite Attributes Calculations

- Use Merge and Union Tools in GIS
- Determine attributes based on weighted average according to attribute area

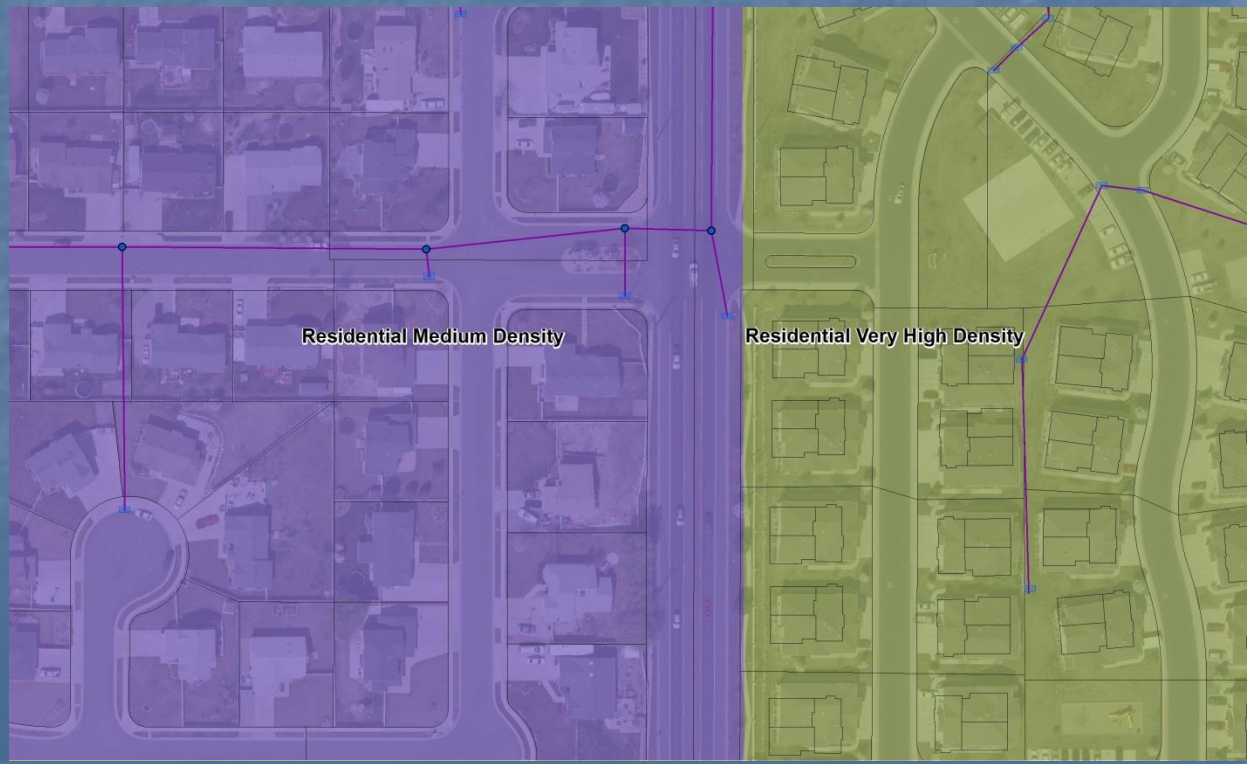


$$CN = \frac{CN_1 Area_1 + CN_2 Area_2 + CN_3 Area_3}{Total\ Area}$$

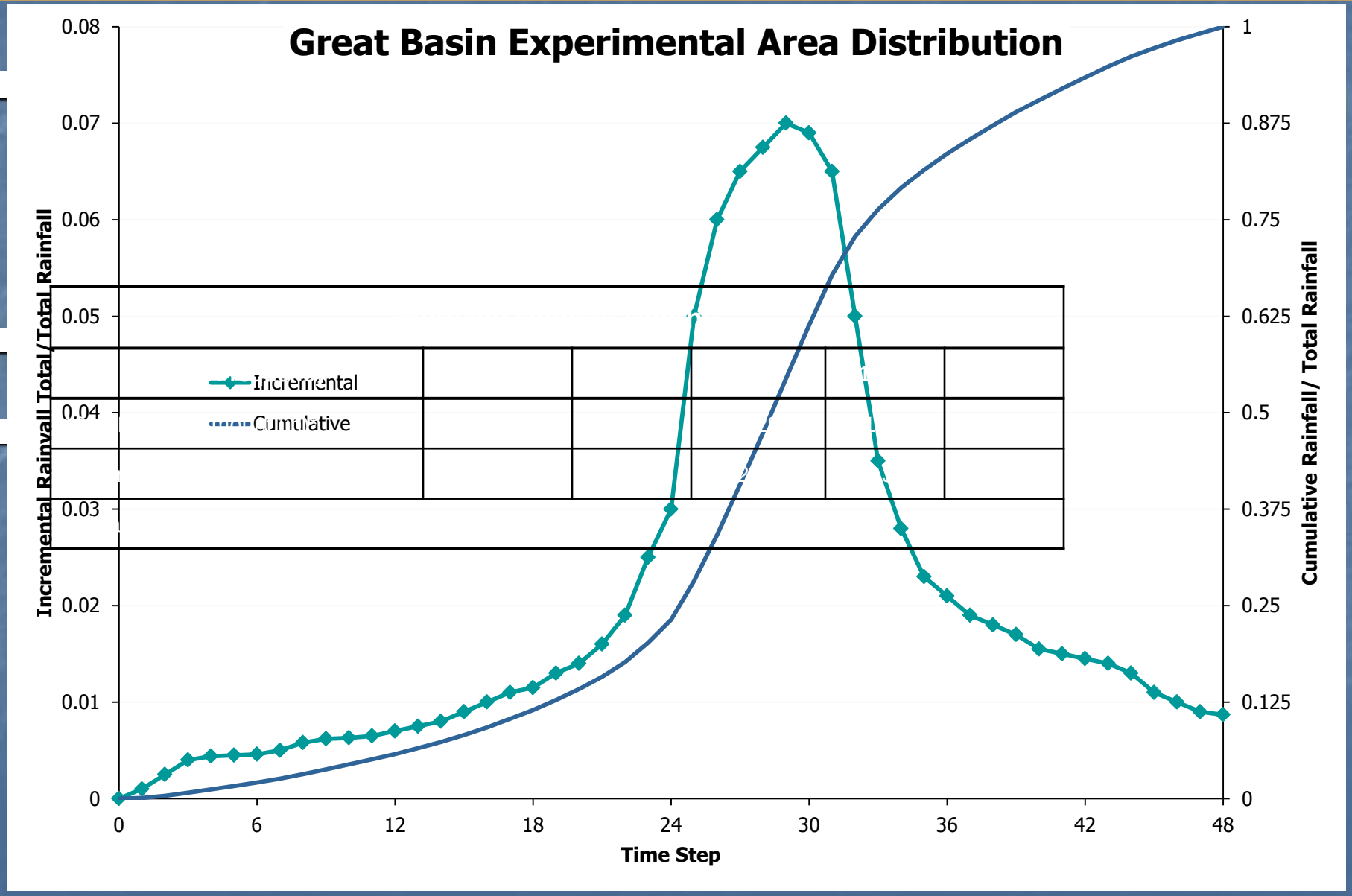
$$79 = \frac{81 * 2.6\ ac + 74 * 5.8\ ac + 84 * 3.6\ ac}{12\ ac}$$

Composite Attributes Calculations

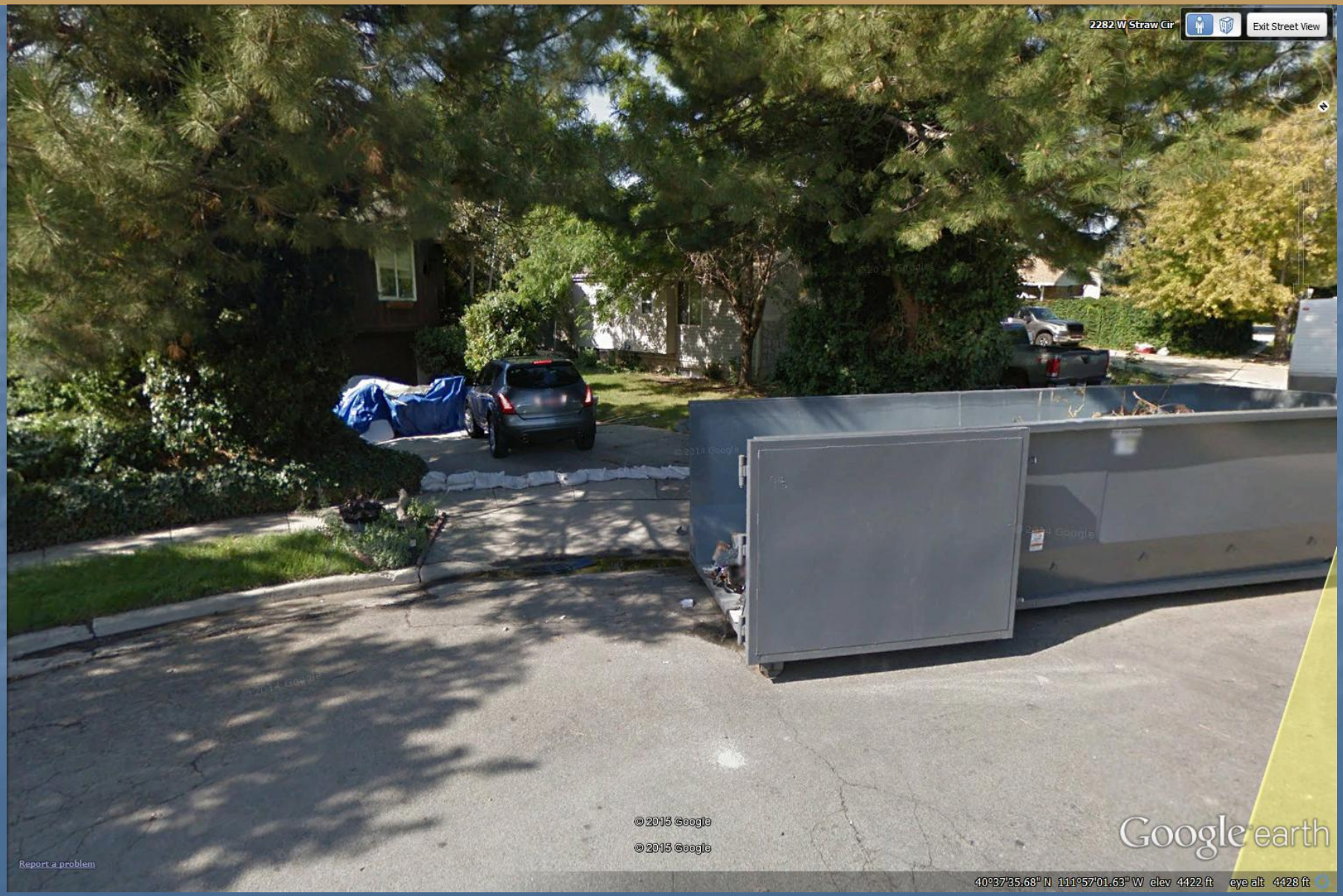
- Calculate Weighted Attributes for Subbasin Width, Percent Impervious, and Curve Number using:
  - SSURGO (Soil Survey Geographic Database)
  - Parcel shapefile
  - Landuse shapefile



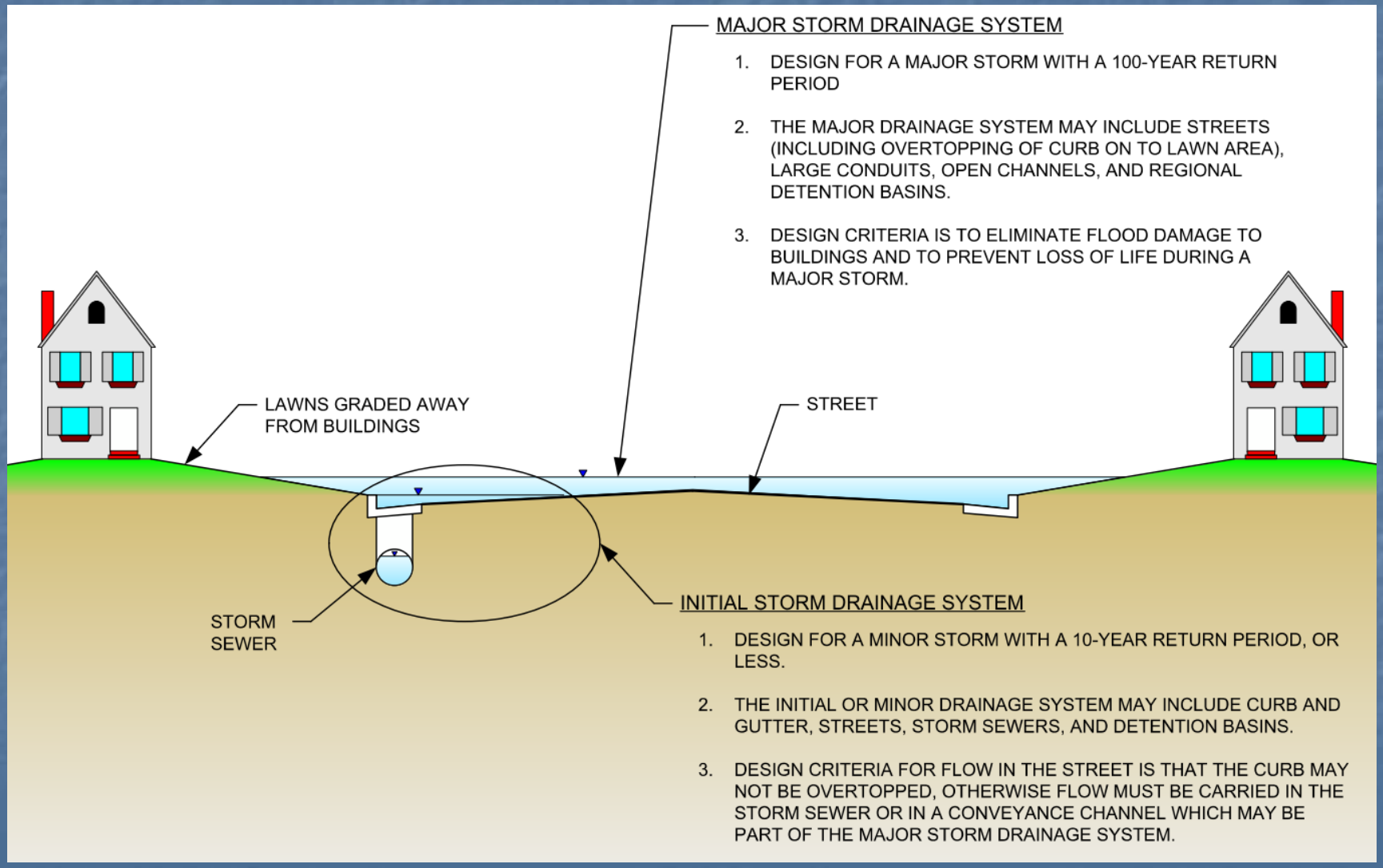
Storm Events



Problem Solving with Dynamic Modeling



Problem Solving with Dynamic Modeling



Problem Solving with Dynamic Modeling

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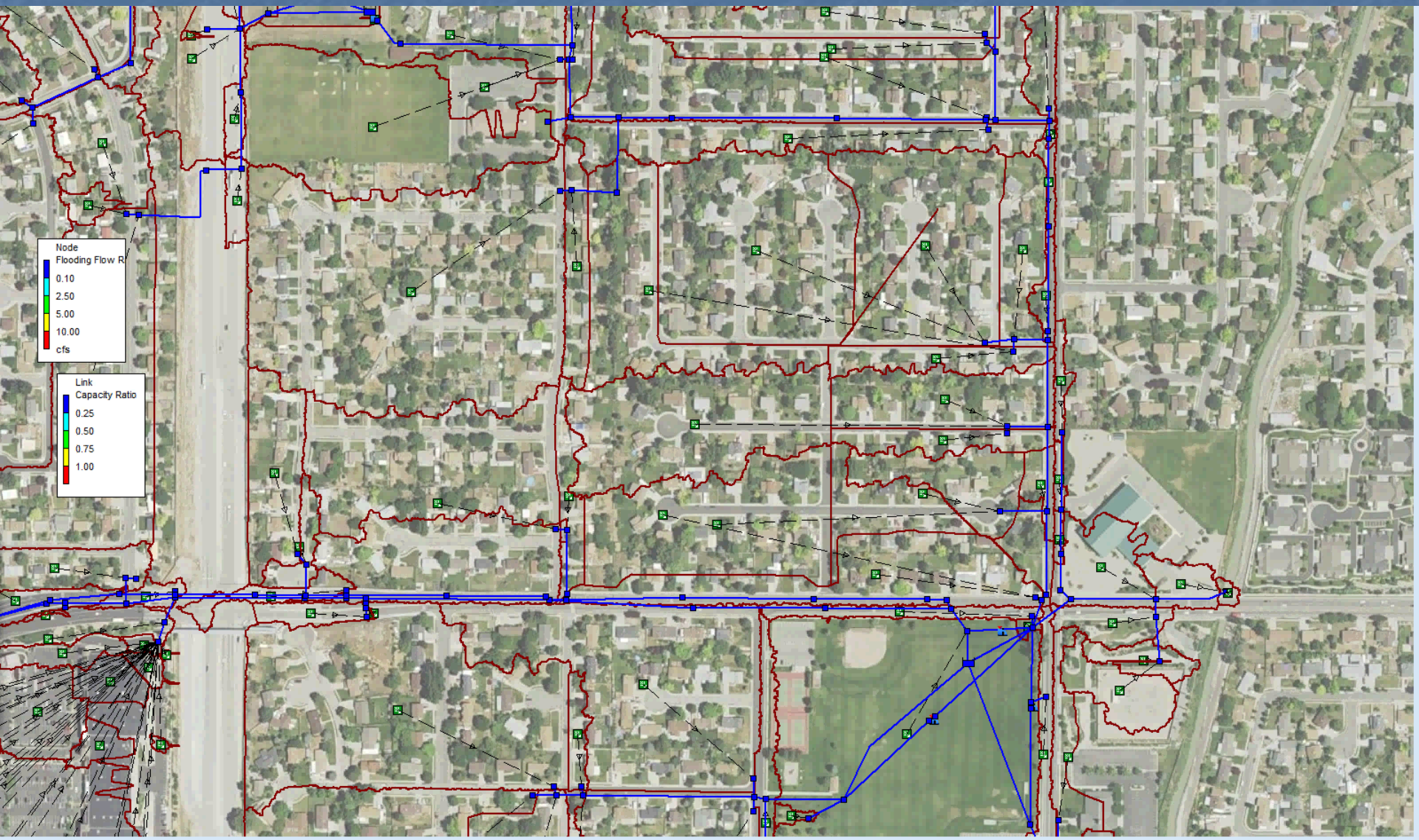
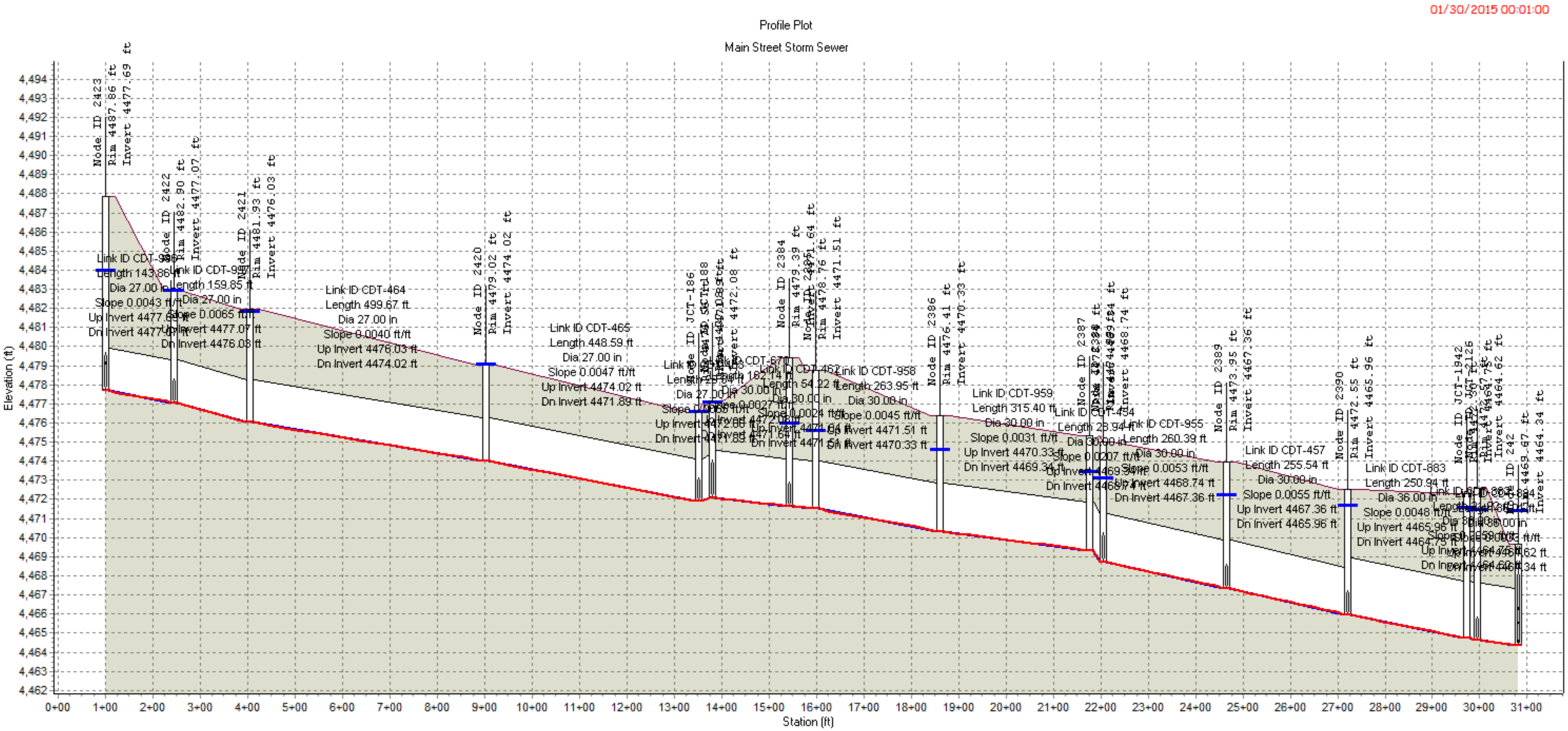


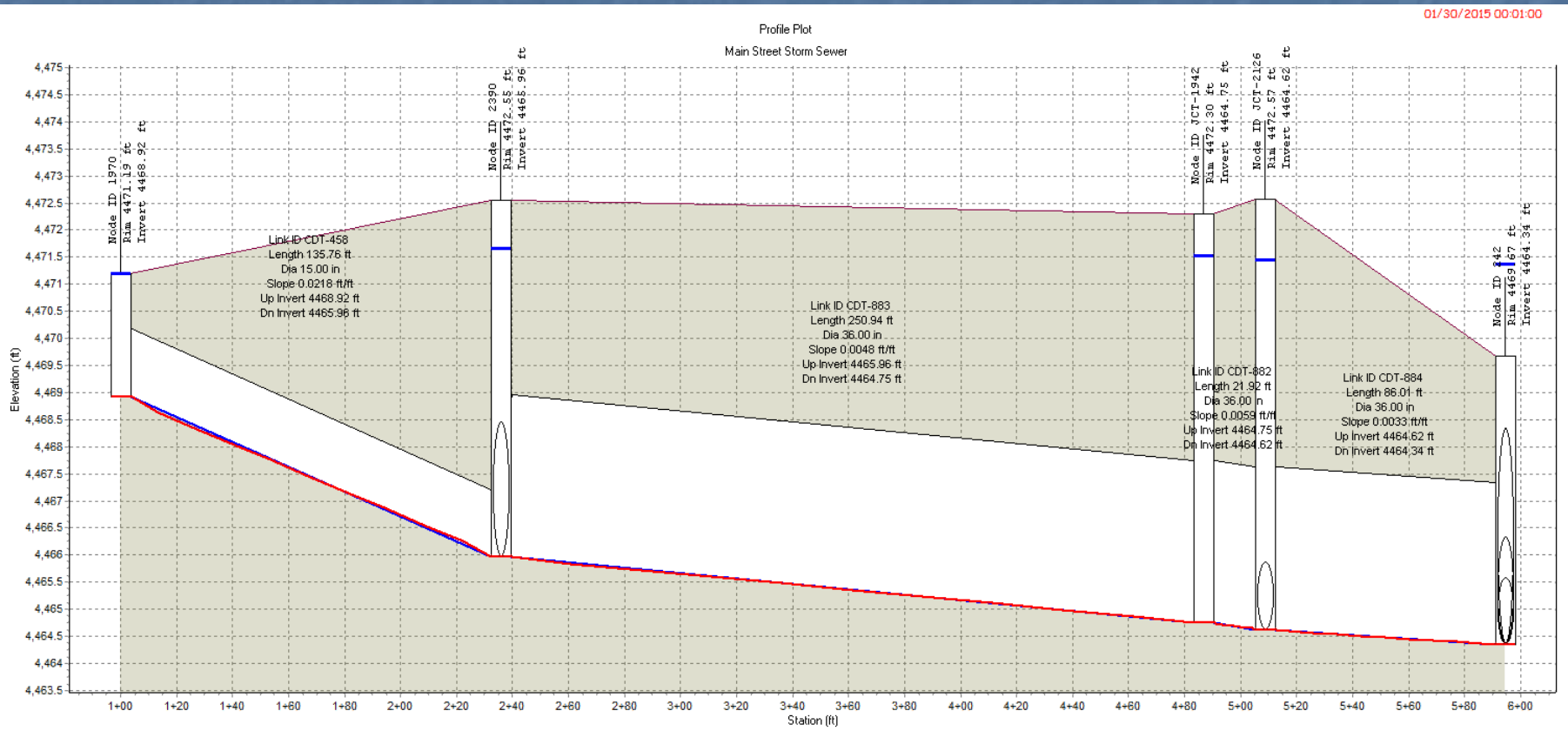
Problem Solving with Dynamic Modeling



Node ID:	2423	2422	2421	2420	[illegible]	[illegible]	2384	2385	2386	[illegible]	[illegible]	2389	2390	[illegible]	[illegible]	242
Rim (ft):	4487.86	4482.90	4481.93	4479.02	[illegible]	[illegible]	[illegible]	4478.76	4476.41	[illegible]	[illegible]	4473.95	4472.55	[illegible]	[illegible]	4469.67
Invert (ft):	4477.69	4477.07	4476.03	4474.02	[illegible]	[illegible]	[illegible]	4471.51	4470.33	[illegible]	[illegible]	4467.36	4465.96	[illegible]	[illegible]	4464.34
Min Pipe Cover (ft):	7.92	3.58	3.65	2.75	[illegible]	[illegible]	5.25	4.75	3.58	[illegible]	[illegible]	4.09	3.59	[illegible]	[illegible]	0.00
Max HGL (ft):	4484.86	4482.90	4481.93	4479.02	[illegible]	[illegible]	[illegible]	4477.49	4476.41	[illegible]	[illegible]	4473.95	4472.55	[illegible]	[illegible]	4472.04

Link ID:	CDT-996	CDT-997	CDT-464	CDT-465	CDT-463	CDT-670	CDT-462	CDT-958	CDT-959	CDT-454	CDT-955	CDT-457	CDT-883	[illegible]	CDT-884
Length (ft):	143.86	159.85	499.67	448.59	29.34	162.14	54.22	263.95	315.40	28.94	260.39	255.54	250.94	[illegible]	86.01
Dia (in):	27.00	27.00	27.00	27.00	27.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	36.00	36.00	36.00
Slope (ft/ft):	0.0043	0.0065	0.0040	0.0047	0.0065	0.0027	0.0024	0.0045	0.0031	0.0207	0.0053	0.0055	0.0048	[illegible]	0.0033
Up Invert (ft):	4477.69	4477.07	4476.03	4474.02	4472.08	4472.08	4471.64	4471.51	4470.33	4469.34	4468.74	4467.36	4465.96	[illegible]	4464.62
Dn Invert (ft):	4477.07	4476.03	4474.02	4471.89	4471.89	4471.64	4471.51	4470.33	4469.34	4468.74	4467.36	4465.96	4464.75	[illegible]	4464.34
Max Q (cfs):	20.86	24.28	23.04	20.85	14.82	27.16	29.21	28.84	23.81	21.70	21.68	21.09	16.28	[illegible]	26.04
Max Vel (ft/s):	5.25	6.16	6.01	5.24	3.73	5.59	6.04	5.94	5.00	4.52	5.13	5.38	3.49	2.10	4.11
Max Depth (ft):	2.25	2.25	2.25	2.25	2.25	2.50	2.50	2.50	2.50	2.50	2.50	2.50	3.00	3.00	3.00

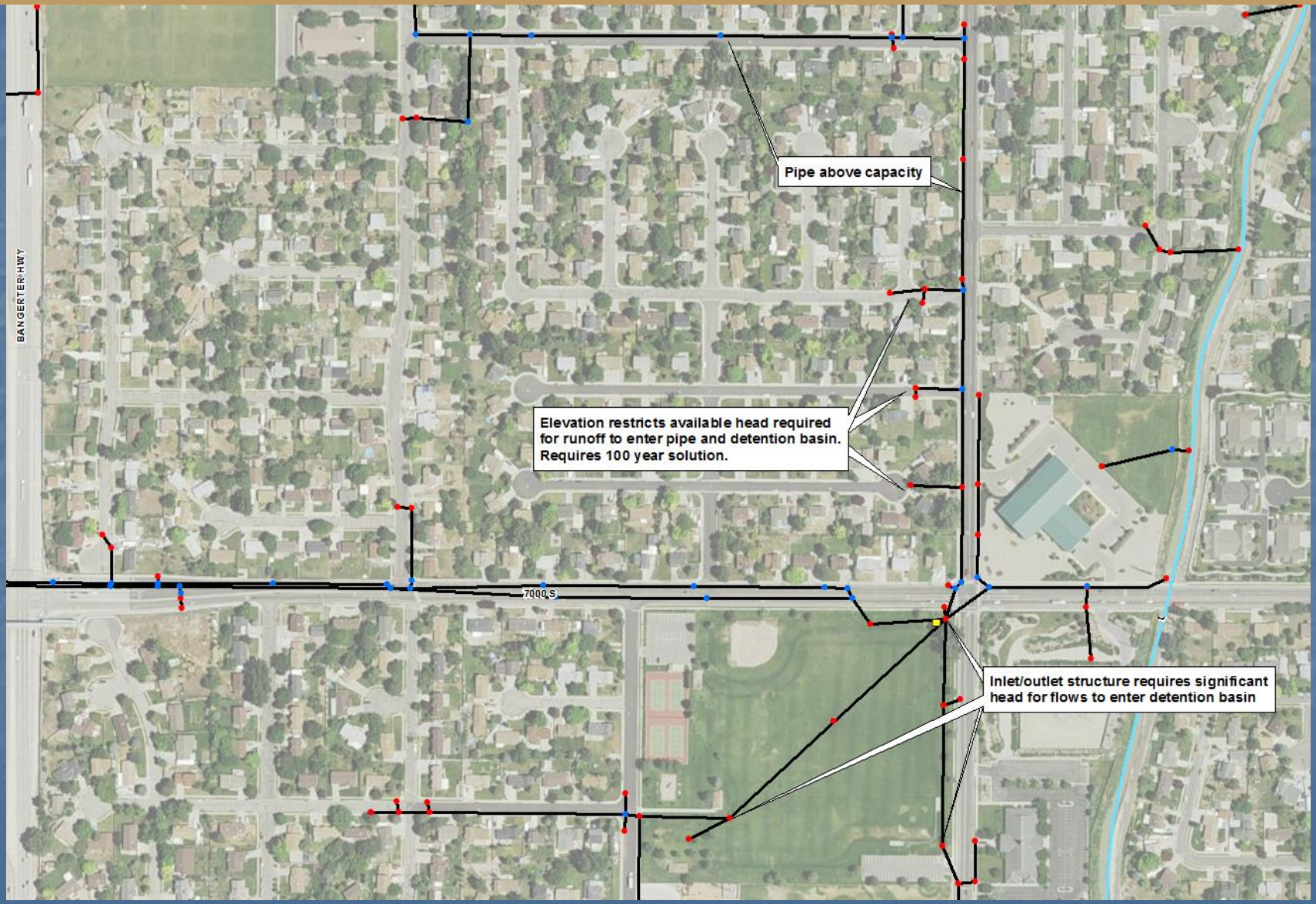
Problem Solving with Dynamic Modeling



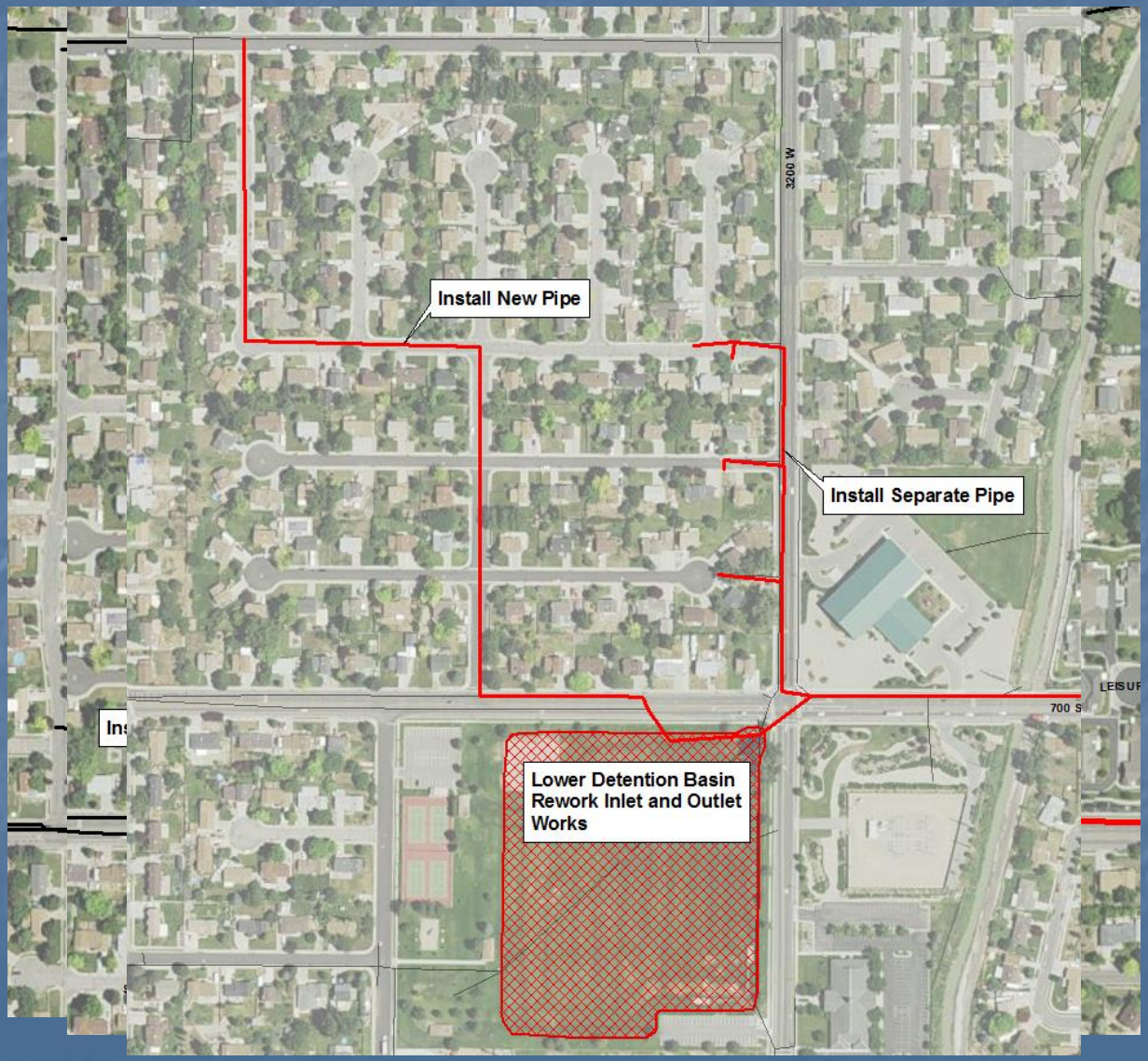
Node ID:	1970	2390	JCT-1942	JCT-2126	242
Rim (ft):	4471.19	4472.55	4472.30	4472.57	4469.67
Invert (ft):	4468.92	4465.96	4464.75	4464.62	4464.34
Min Pipe Cover (ft):	1.02	3.59	4.55	4.95	0.00
Max HGL (ft):	4471.19	4472.55	4472.30	4472.03	4472.04

Link ID:	CDT-458	CDT-883	CDT-882	CDT-884
Length (ft):	135.76	250.94	21.92	86.01
Dia (in):	15.00	36.00	36.00	36.00
Slope (ft/ft):	0.0218	0.0048	0.0059	0.0033
Up Invert (ft):	4468.92	4465.96	4464.75	4464.62
Dn Invert (ft):	4465.96	4464.75	4464.62	4464.34
Max Q (cfs):	5.20	16.28	14.83	26.04
Max Vel (ft/s):	5.55	3.49	2.10	4.11
Max Depth (ft):	1.25	3.00	3.00	3.00

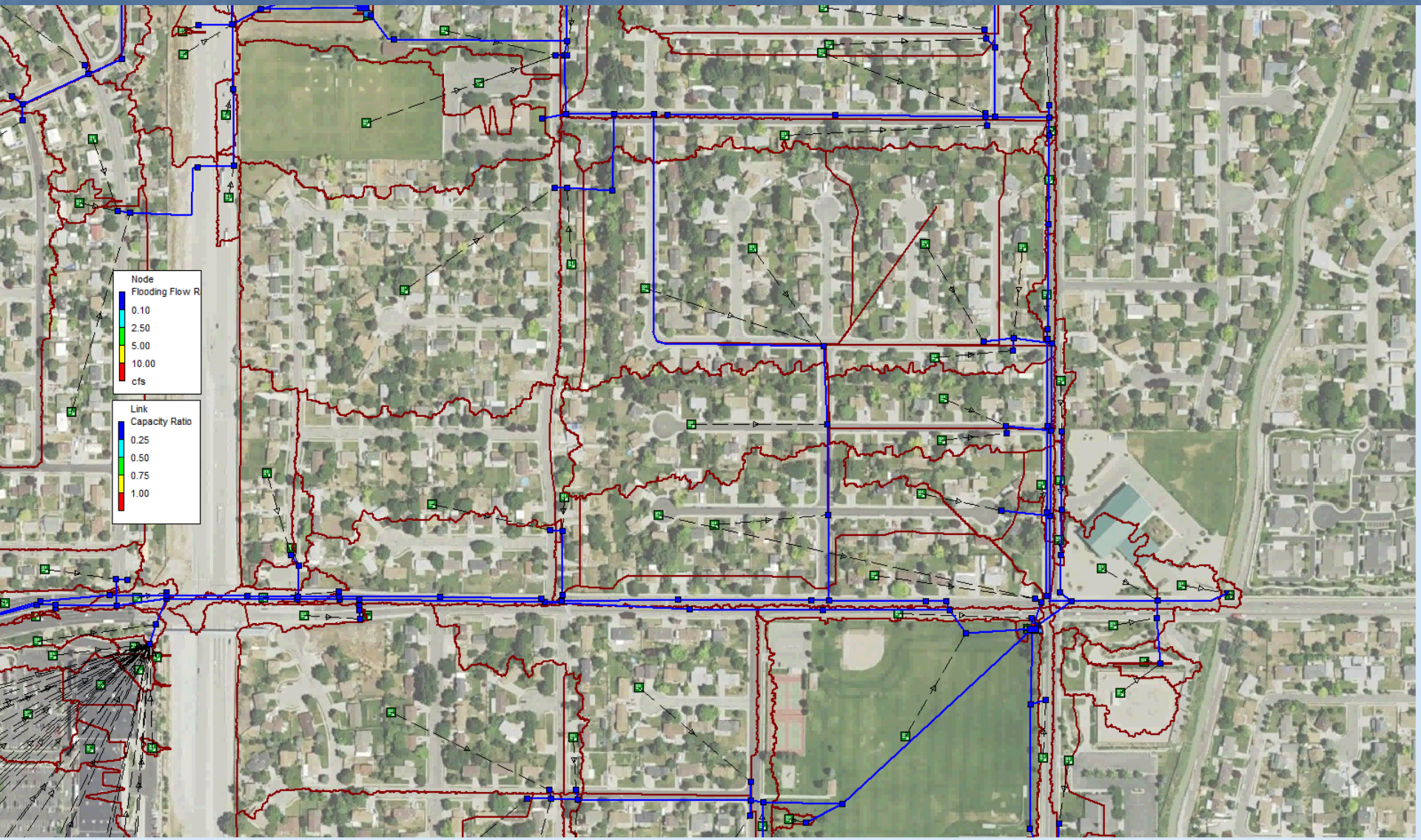
Problem Solving with Dynamic Modeling



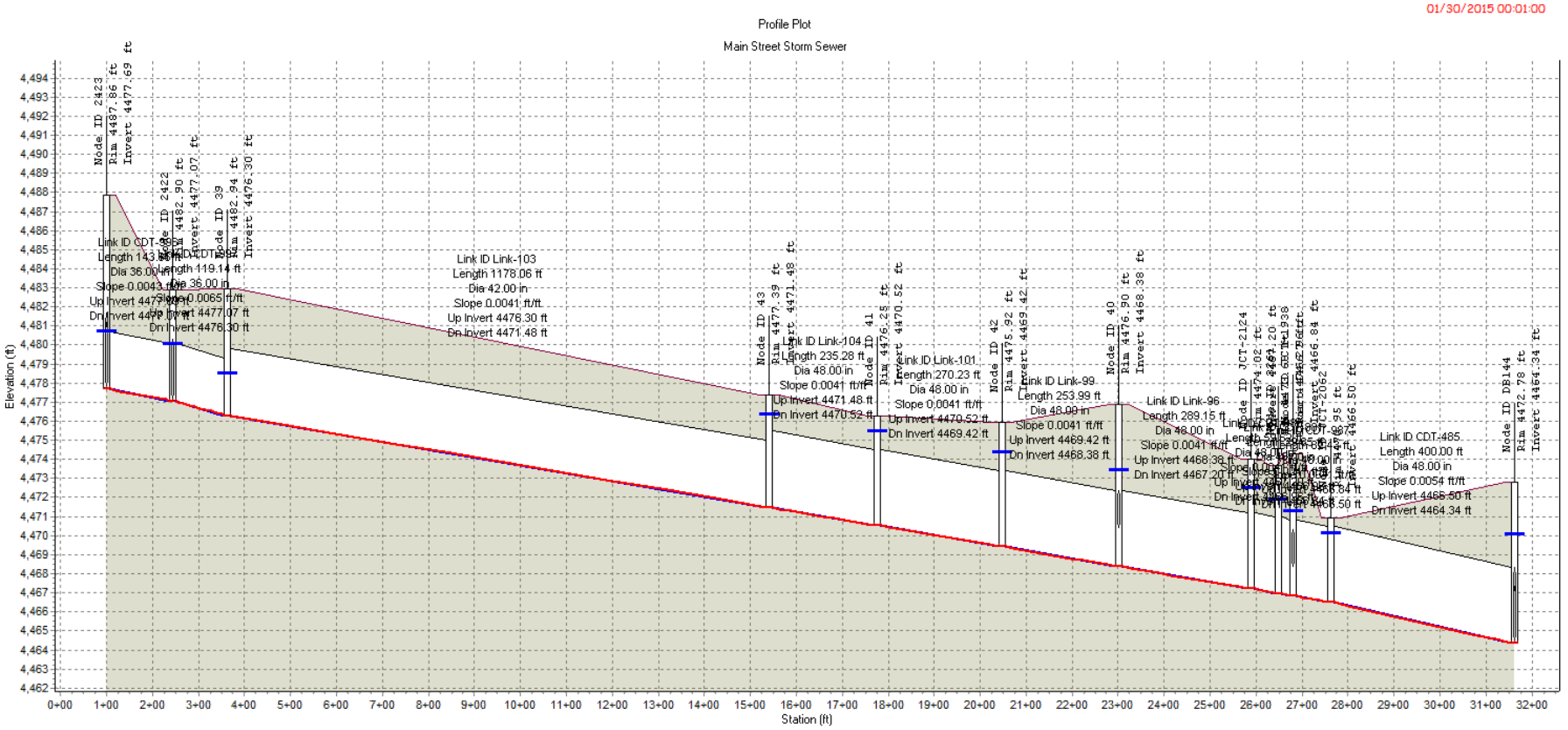
Problem Solving with Dynamic Modeling



Problem Solving with Dynamic Modeling



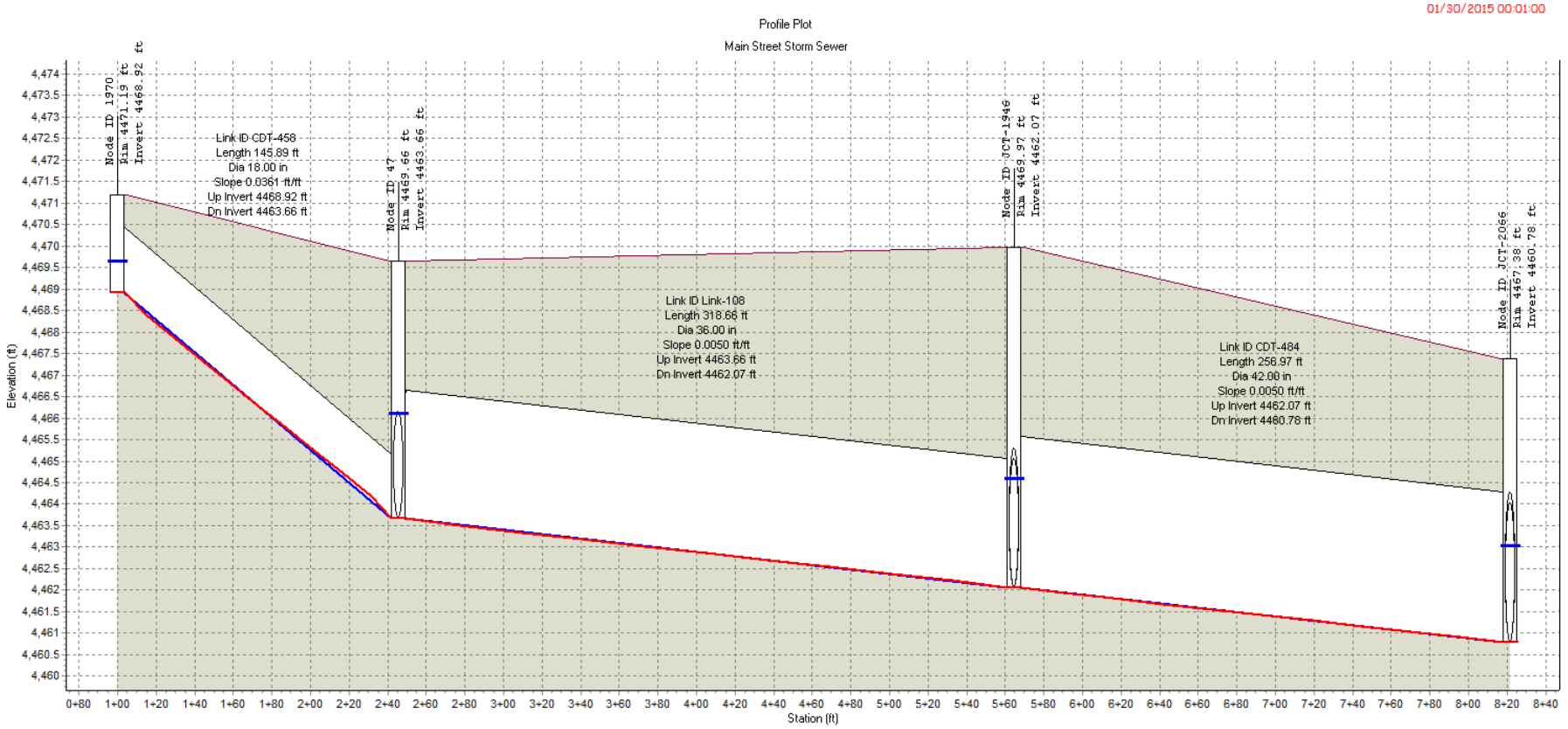
Problem Solving with Dynamic Modeling



Node ID:	2423	2422	39	43	41	42	40	JCT-2124	JCT-2062	DB144
Rim (ft):	4487.86	4482.90	4482.94	4477.39	4476.25	4475.92	4476.90	4474.02	4470.95	4472.78
Invert (ft):	4477.69	4477.07	4476.30	4471.48	4470.52	4469.42	4468.38	4467.20	4466.84	4464.34
Min Pipe Cover (ft):	6.17	2.58	3.14	1.91	1.72	2.50	4.52	2.82	2.43	0.45
Max HGL (ft):	4480.68	4480.05	4478.48	4477.39	4476.25	4475.10	4474.18	4472.69	4470.08	4470.06

Link ID:	CDT-996	CDT-997	Link-103	Link-104	Link-101	Link-99	Link-96	CDT-987	CDT-485
Length (ft):	143.86	119.14	1178.06	235.28	270.23	253.99	289.15	82.43	400.00
Dia (in):	36.00	36.00	42.00	48.00	48.00	48.00	48.00	48.00	48.00
Slope (ft/ft):	0.0043	0.0065	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0054
Up Invert (ft):	4477.69	4477.07	4476.30	4471.48	4470.52	4469.42	4468.38	4466.84	4466.50
Dn Invert (ft):	4477.07	4476.30	4471.48	4470.52	4469.42	4468.38	4467.20	4466.50	4464.34
Max Q (cfs):	31.77	46.54	45.97	63.03	66.64	70.46	74.43	106.59	103.90
Max Vel (ft/s):	4.52	7.33	5.64	5.62	5.73	5.92	5.92	9.27	5.95
Max Depth (ft):	2.98	2.58	2.84	4.00	4.00	4.00	4.00	3.62	3.79

Problem Solving with Dynamic Modeling



Node ID:	1970	47	JCT-1946	JCT-2066
Rim (ft):	4471.19	4469.66	4469.97	4467.38
Invert (ft):	4468.92	4463.66	4462.07	4460.78
Min Pipe Cover (ft):	0.77	3.00	4.40	3.10
Max HGL (ft):	4469.63	4466.10	4464.59	4463.01

Link ID:	CDT-458	Link-108	CDT-484
Length (ft):	145.89	318.66	256.97
Dia (in):	18.00	36.00	42.00
Slope (ft/ft):	0.0361	0.0050	0.0050
Up Invert (ft):	4468.92	4463.66	4462.07
Dn Invert (ft):	4463.66	4462.07	4460.78
Max Q (cfs):	8.07	37.47	47.08
Max Vel (ft/s):	5.79	6.03	6.78
Max Depth (ft):	1.10	2.48	2.37

Conclusion

- Automatic delineation and automatic drainage node assignment are useful tools IF the results are manually verified or the uncertainty due to irregularities is acceptable.
- Dynamic Models can help determine the problems and solutions for complex flooding issues.
- Questions