Water System Modeling

A Unique Way to Use Meter Technology

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Steve Riley, PE – NE MD Client Manager
John Brady, PE – Hydraulic Modeler

Engineering Consultant for NE MD since 2010

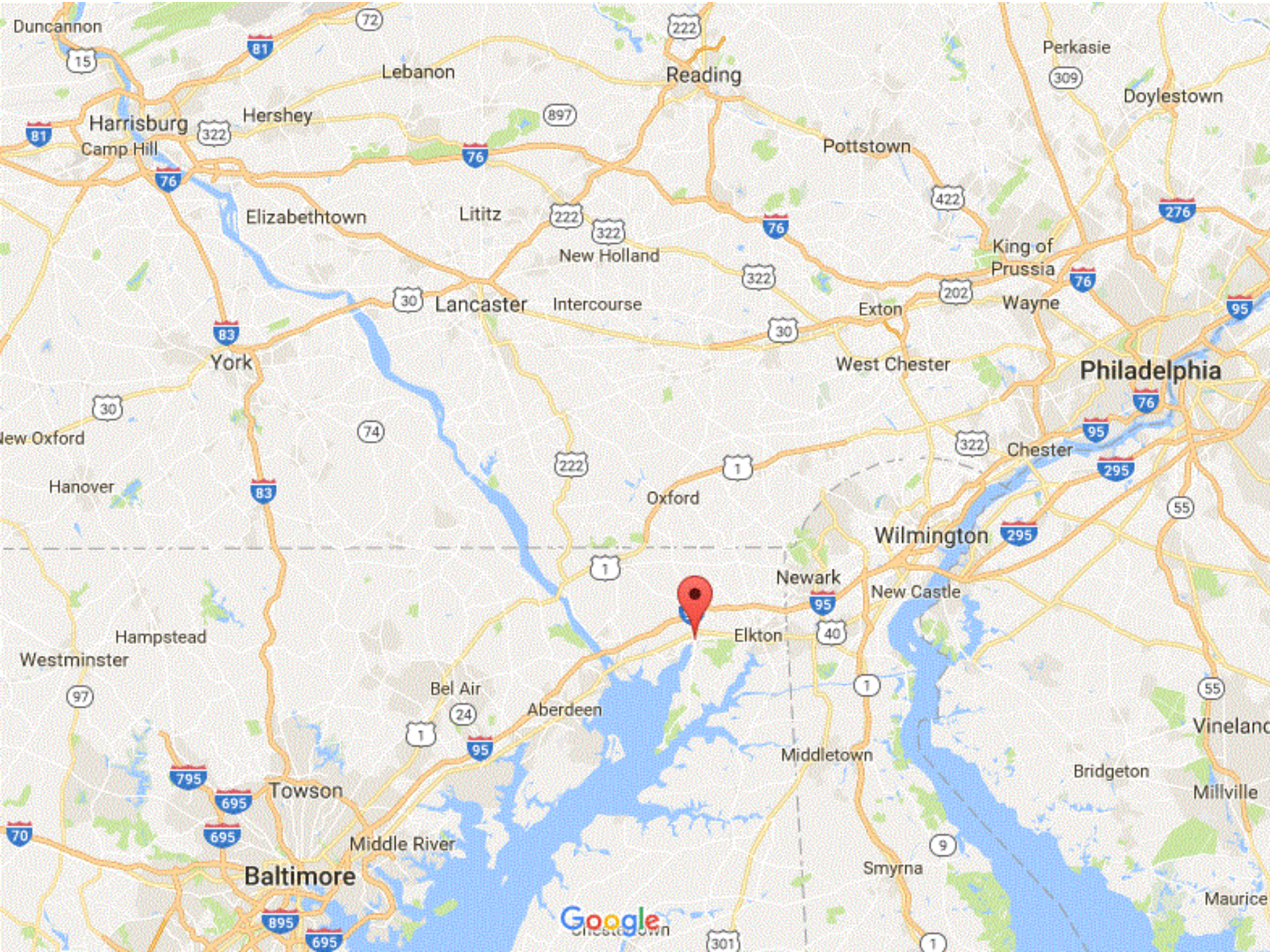
- **Metering Project provides higher level of data**
- **Powerful data that can be used to accurately allocate water demands**

Presentation Topics

- **Meter Replacement Project**
- **Hydraulic Modeling Overview**
- **Manipulating Meter Data**
- **Graphical Information System (GIS)**
- **Customer Meter Units**
- **Conclusion**

North East, MD The Town

- Location: Headwaters of Chesapeake Bay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Lebanon
Reading
Perkasie
Doylestown
Harrisburg
Hershey
Camp Hill
Pottstown
Elizabethtown
Lititz
New Holland
King of Prussia
Lancaster
Intercourse
Exton
Wayne
York
West Chester
Philadelphia
New Oxford
Chester
Hanover
Oxford
Wilmington
Newark
New Castle
Elkton
Hampstead
Westminster
Bel Air
Aberdeen
Middletown
Bridgeton
Millville
Towson
Middle River
Baltimore
Smyrna
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North East, MD The Town

- Location: Headwaters of Chesapeake Bay
- Nearby: Elk Neck State Park, Turkey Point Light House
- Once occupied by Shawnee Indians
- 1658: Settled by English
- 1850: Town of North East incorporated

North East, MD The System

- 2 Surface Water Treatment Plants
- Elevation Range: sea level to 400’+
- 3 Elevated Tanks
- 2 Ground Level Tanks
- 5 Major Pressure Zones
- Production: 650,000 GPD
- Customers: Residential, Commercial, Industrial, Institutional

Meter Project Water Meter Replacements

- Entire system, minus approximately 150 meters
- 2,600 Sensus iPERL AMR/AMI Water Meters
- Primarily in Meter Pits

Meter Project Water Meter Replacements

Project Objectives

- Update old tired water meters
- Improve reading accuracy (reads as low as .1 to .3 gpm)
- Eliminate manual meter reading routes
- Automatically collect and log system and customer data

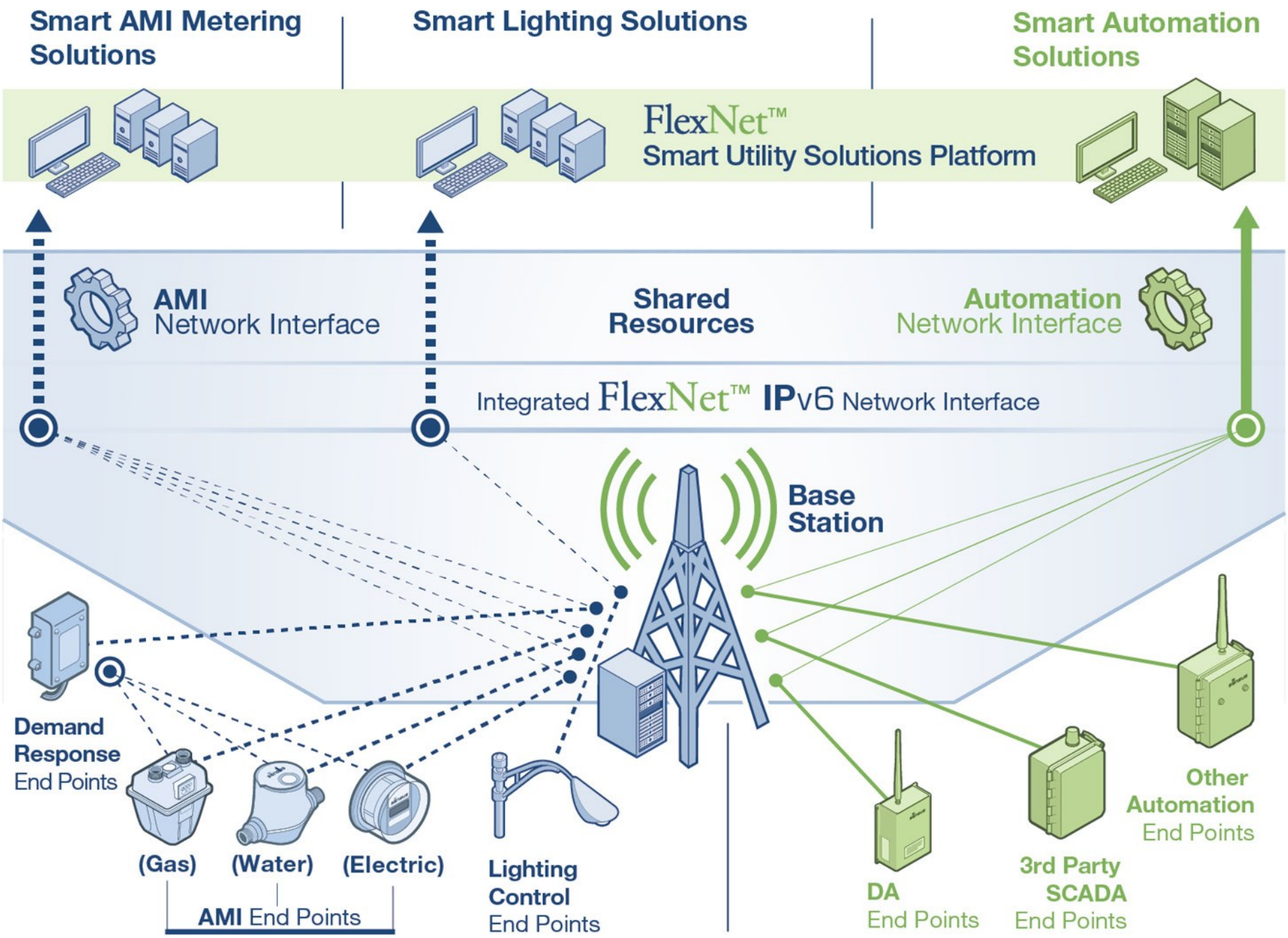
Meter Project Water Meter Replacements

Benefits

- Latitude/Longitude meter locations
- Prevents tampering
- Detects system leaks
- Remote management, monitoring, and diagnosis
- No lead content and no moving parts

Meter Network

- Flex Net Managed Data
- 2 towers required for system
- Approximately 150 meters read manually



source: http://sensusinjapan.com

Hydraulic Model Project Overview

Objectives

- Hydraulic model representative of field conditions
- Update pipe network
- Determine:
  - System operational procedures
  - Pressure zone connectivity
  - Accurate tank and pump information
  - **System Water Demands**

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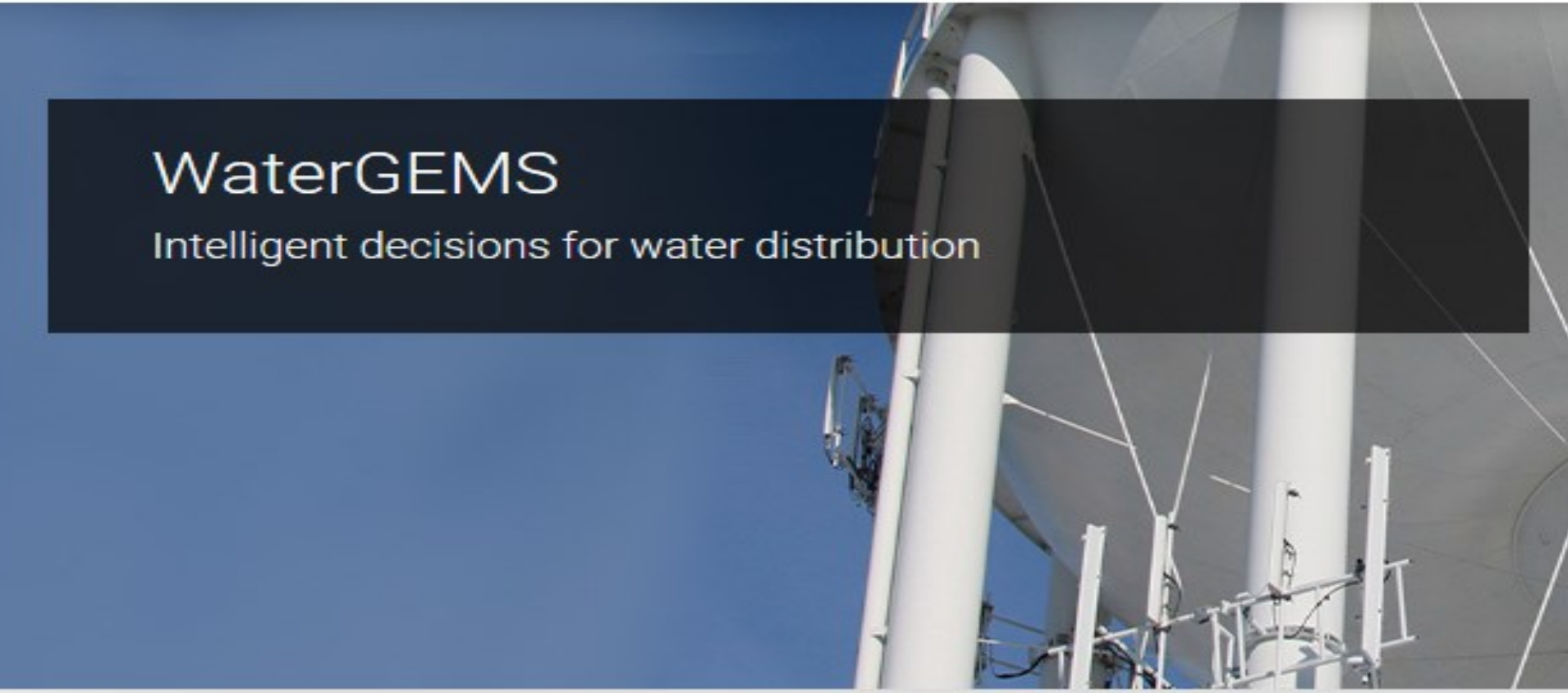
Bentley

Solutions Products S



WaterGEMS

Intelligent decisions for water distribution

Home > Products > Hydraulics and Hydrology > WaterGEMS

Water Distribution Analysis and Design Sof

source: https://www.bentley.com

Hydraulic Model Project Overview

Components

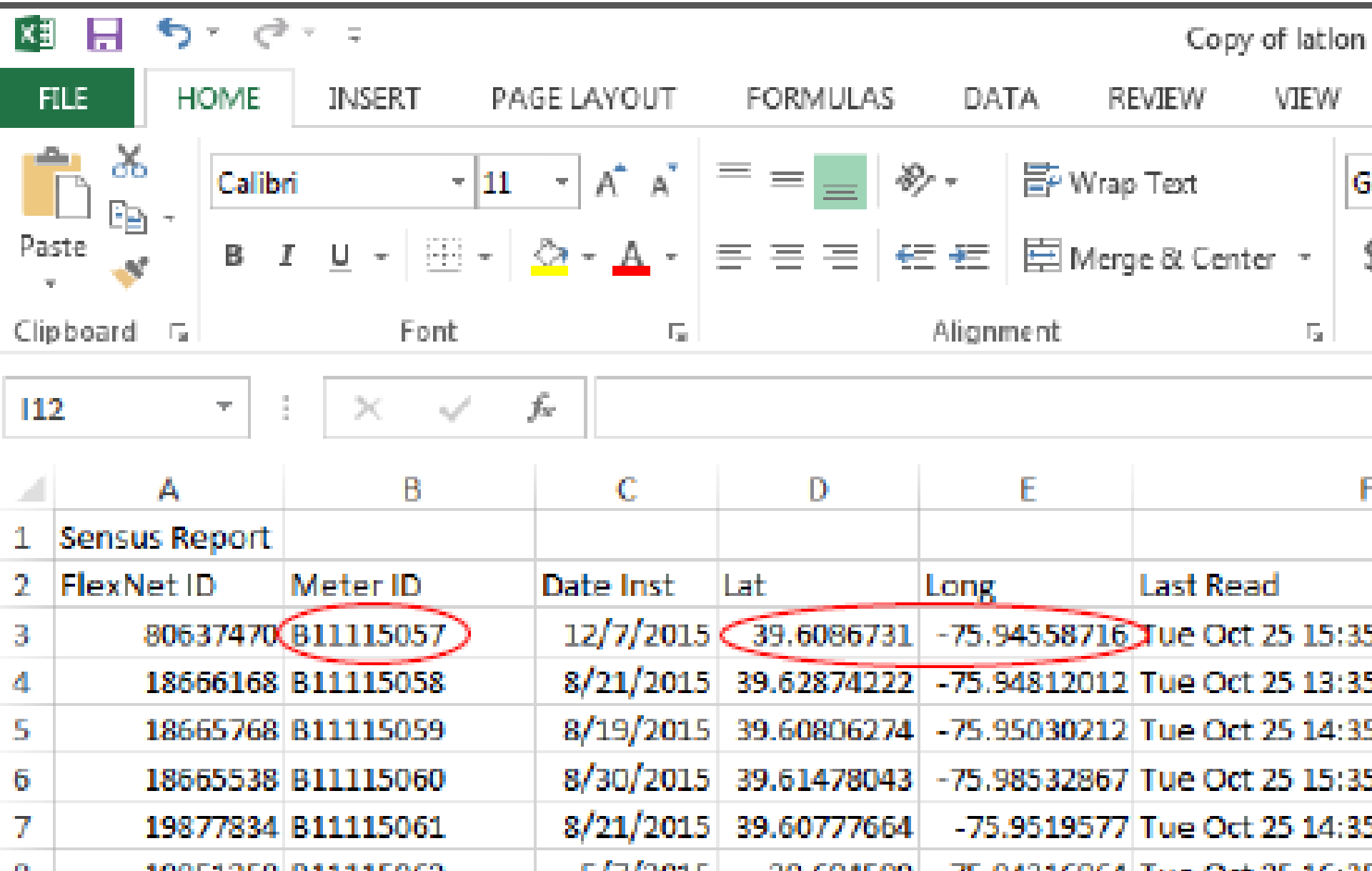
- Junctions or Nodes: elevation, water demand, connectivity, ...
- Pipes: diameter, material, age, C-factor, ...
- Tanks: base, minimum, initial, and overflow elevations, physical attributes, …
- Valves: variety, from check valve to complex flow control valves
- Pumps: pump curves, efficiency information, …

Hydraulic Model Project Overview

Demand Allocation - Methods

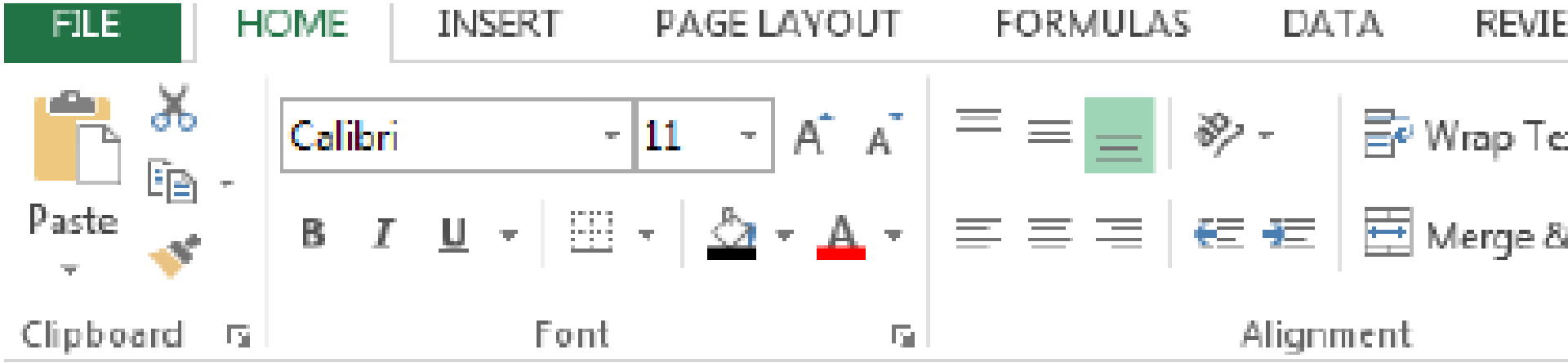
- Split daily demand equally throughout system nodes
- Proportional distribution based on area population
- Determine largest users, enter manually at nearby node, split remaining demand among system nodes
- Use meter routes to split equally in localized node areas
- Determine each customer's usage from recent readings and manually insert meter symbols
- Import water meter data file to locate and assign most recent meter data into the model

Meter Manufacturer Data



	A	B	C	D	E	F
1	Sensus Report					
2	FlexNet ID	Meter ID	Date Inst	Lat	Long	Last Read
3	80637470	B11115057	12/7/2015	39.6086731	-75.94558716	Tue Oct 25 15:35
4	18666168	B11115058	8/21/2015	39.62874222	-75.94812012	Tue Oct 25 13:35
5	18665768	B11115059	8/19/2015	39.60806274	-75.95030212	Tue Oct 25 14:35
6	18665538	B11115060	8/30/2015	39.61478043	-75.98532867	Tue Oct 25 15:35
7	19877834	B11115061	8/21/2015	39.60777664	-75.9519577	Tue Oct 25 14:35

NE MD Billing Data



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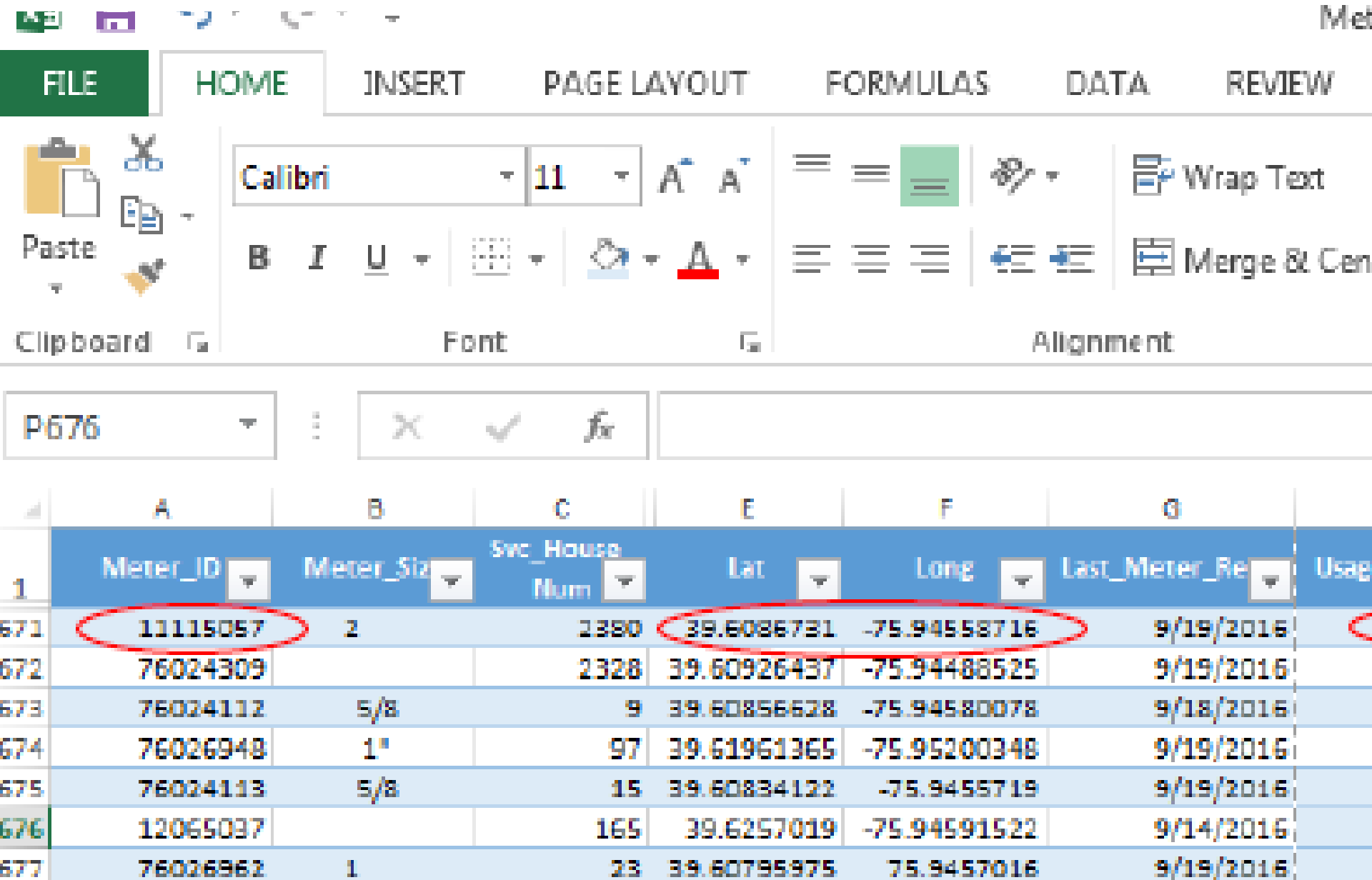
	D	E	I	J	K
1	Meter_Size	Reference_Code	Reading_Date	Sum(hist_sum_0.Usage_Value)	Svc_House_
1939	2	11115057	9/19/2016	15190	
1942	1"	77467678	9/19/2016	10720	
1956	5/8"	664015	9/30/2016	17100	
1957	1"	76024031	9/19/2016	4220	
1958	5/8"	76024491	9/19/2016	9310	
1959	5/8"	76024598	9/19/2016	9270	
1960	5/8"	76024793	9/30/2016	9030	
1961	1"	76026728	9/19/2016	11230	

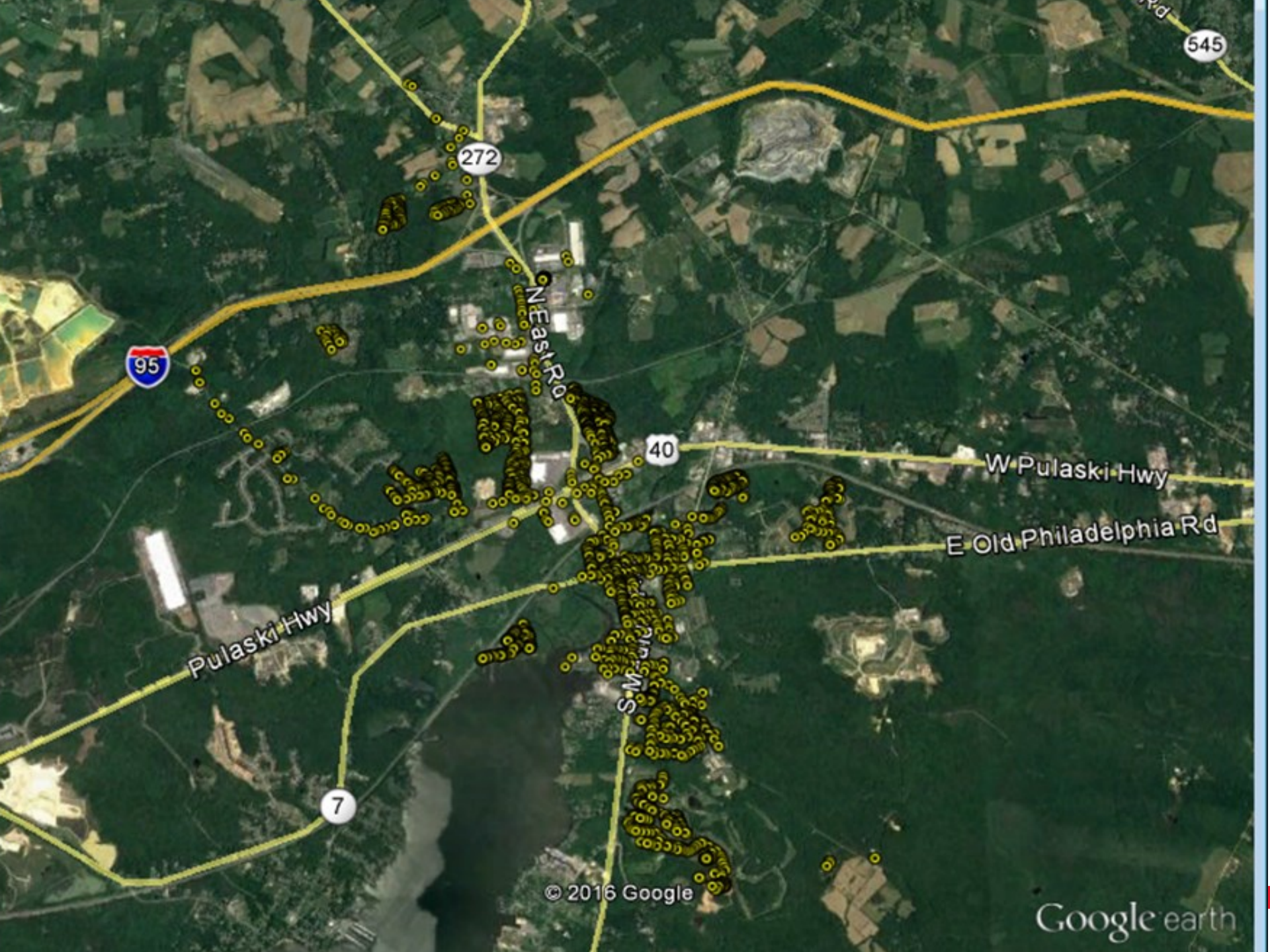
Entech Merged Data



	A	B	C	E	F	G
1	Meter_ID	Meter_Siz	Svc_House Num	Lat	Long	Last_Meter_Re
671	11115057	2	2380	39.6086731	-75.94558716	9/19/2016
672	76024309		2328	39.60926437	-75.94488525	9/19/2016
673	76024112	5/8	9	39.60856628	-75.94580078	9/18/2016
674	76026948	1"	97	39.61961365	-75.95200348	9/19/2016
675	76024113	5/8	15	39.60834122	-75.9455719	9/19/2016
676	12065037		165	39.6257019	-75.94591522	9/14/2016
677	76026962	1	23	39.60795975	75.9457016	9/19/2016

GIS Shape File Preparation

- Meter locations: excel spreadsheet table
- Spreadsheet imported into ESRI ArcGIS software
- Latitude/longitude in decimal degrees to map meter locations
- Mapped locations converted to ESRI shapefile with Maryland State Plane 83 coordinates
- Meter ID ,Customer ID, Customer Name, Customer Address information preserved in GIS Conversion
- Shapefile output from ArcGIS for direct import into WaterGEMS software


545
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N East Rd
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W Pulaski Hwy
E Old Philadelphia Rd
Pulaski Hwy
S Main St
7
© 2016 Google
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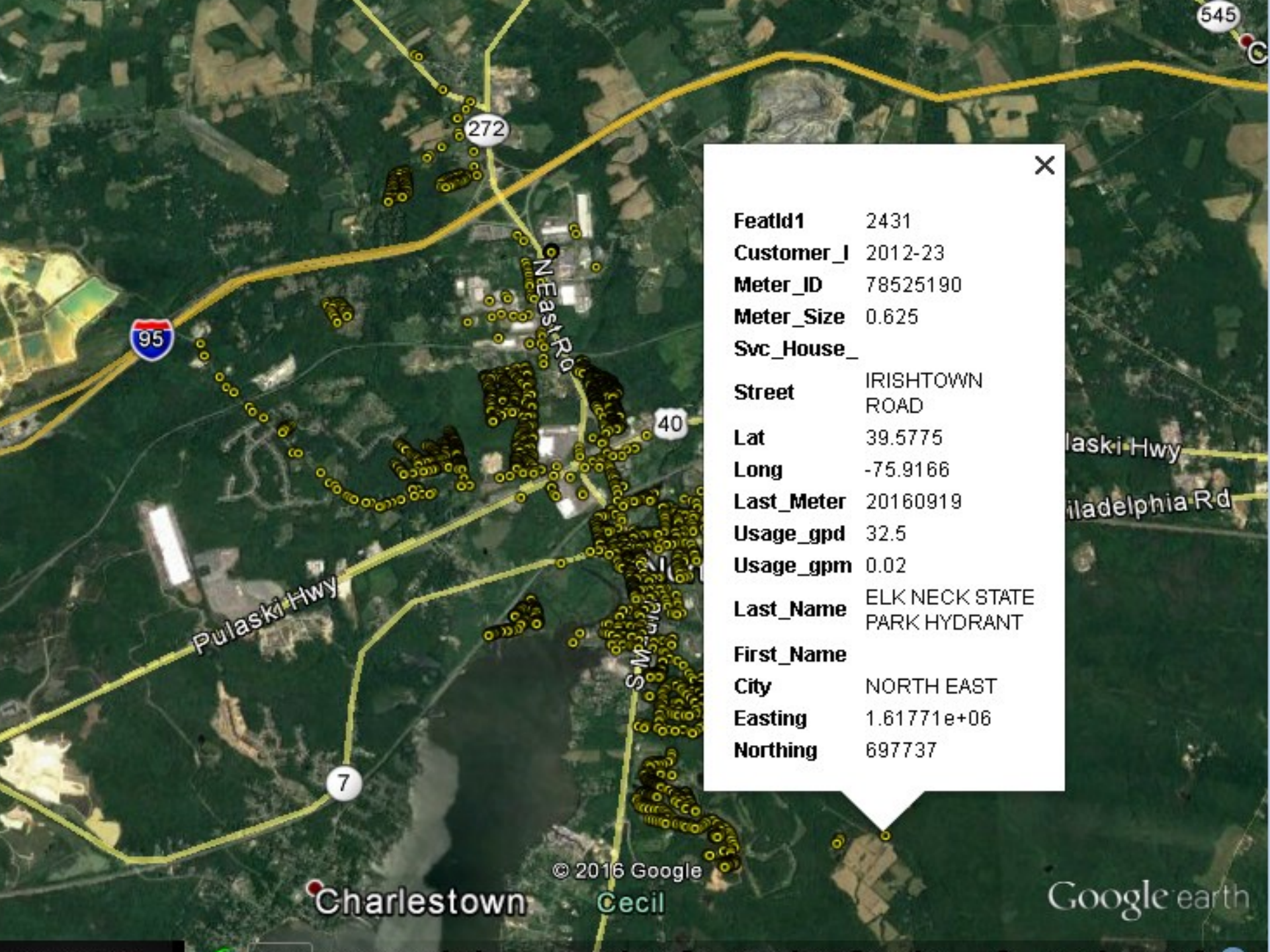
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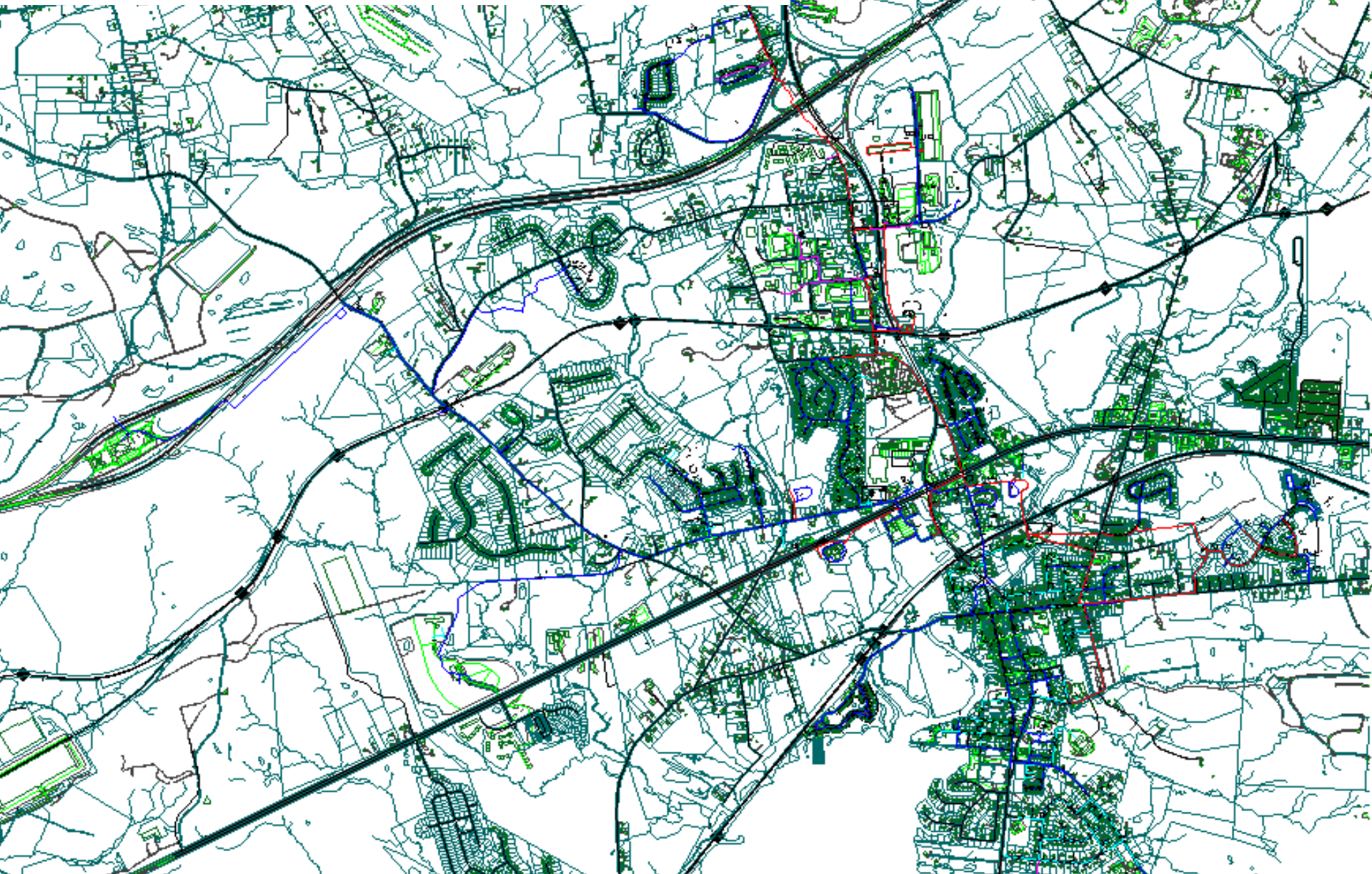
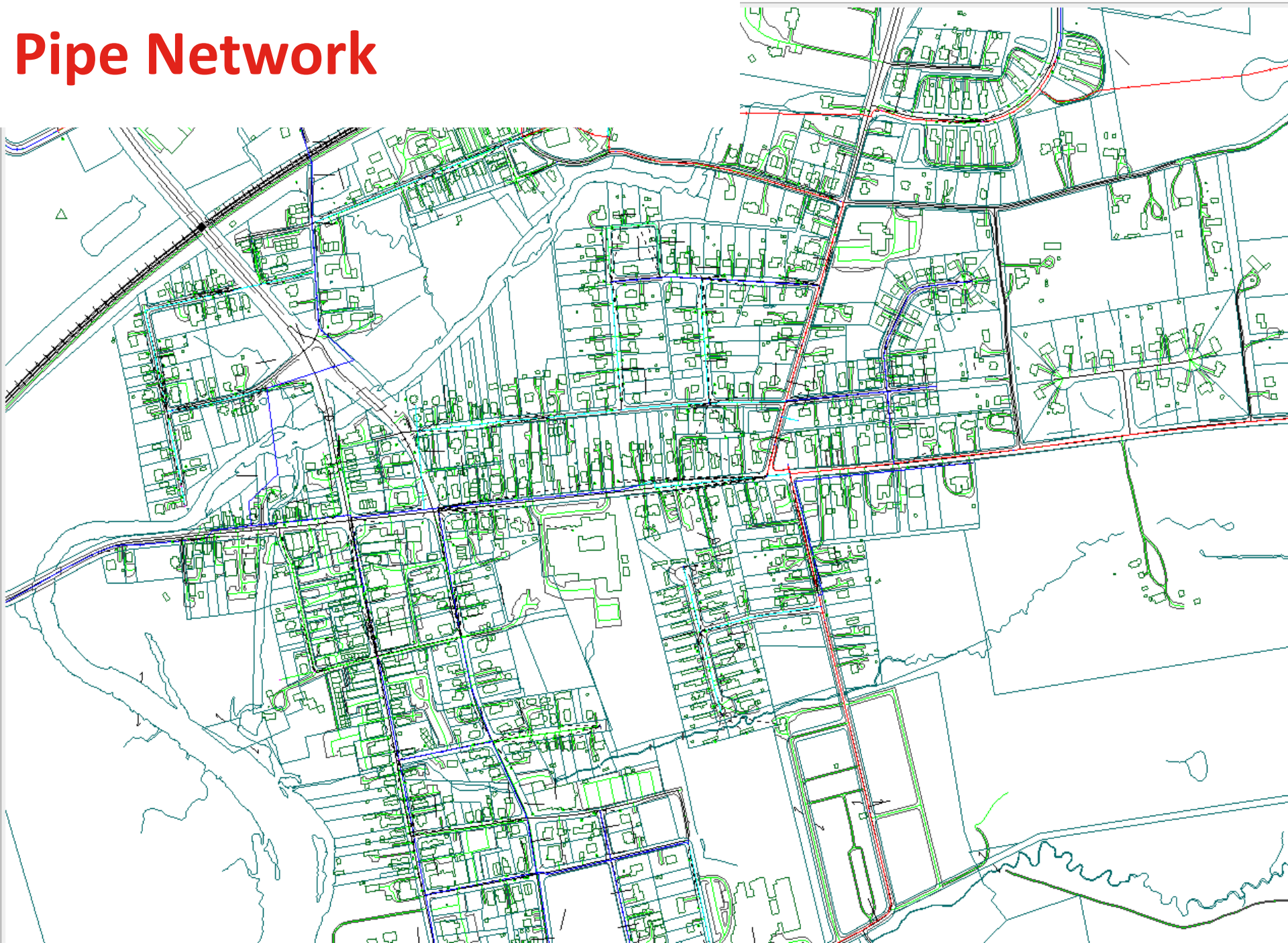
North East Rd
Pulaski Hwy
Charlestown
Cecil
© 2016 Google
Google earth
Featld1 2431
Customer_I 2012-23
Meter_ID 78525190
Meter_Size 0.625
Svc_House_
Street IRISHTOWN ROAD
Lat 39.5775
Long -75.9166
Last_Meter 20160919
Usage_gpd 32.5
Usage_gpm 0.02
Last_Name ELK NECK STATE PARK HYDRANT
First_Name
City NORTH EAST
Easting 1.61771e+06
Northing 697737

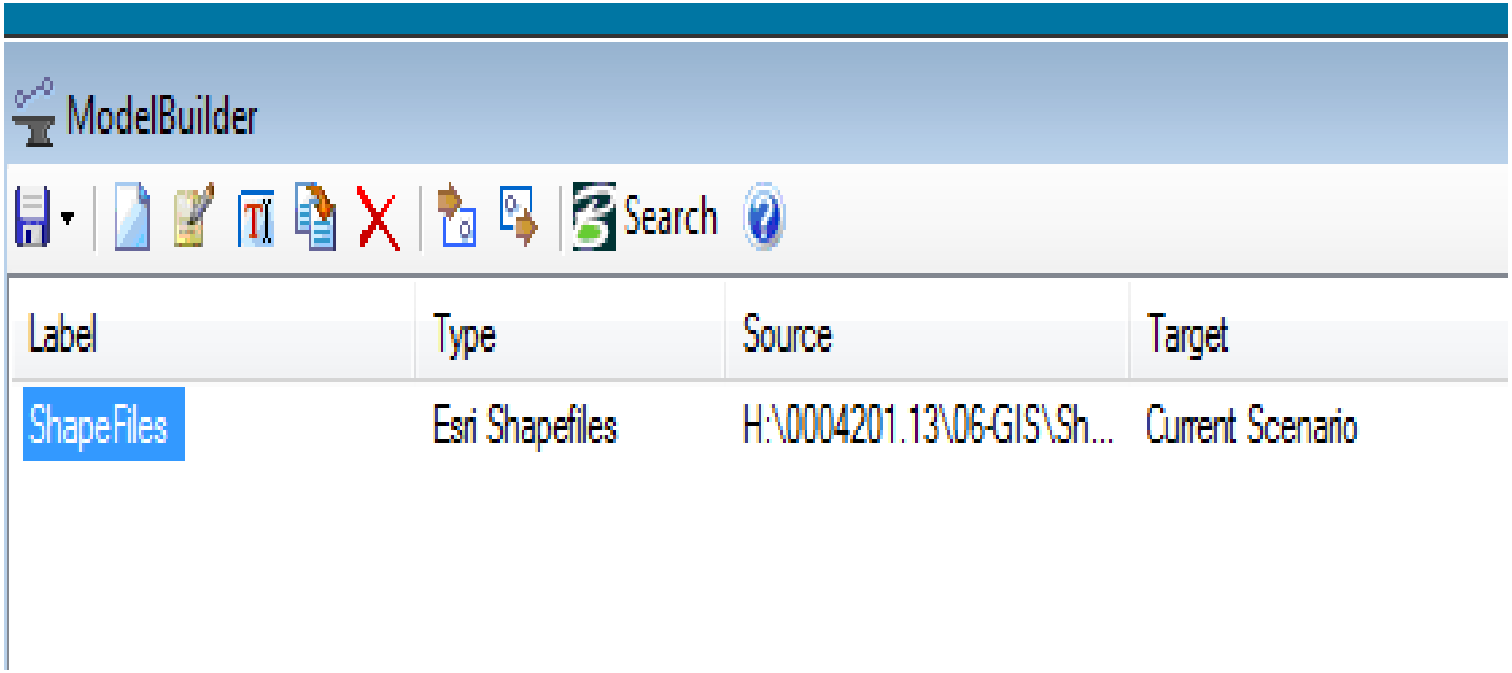
Pipe Network



Pipe Network



Hydraulic Model Model Builder – Customer Meter Units



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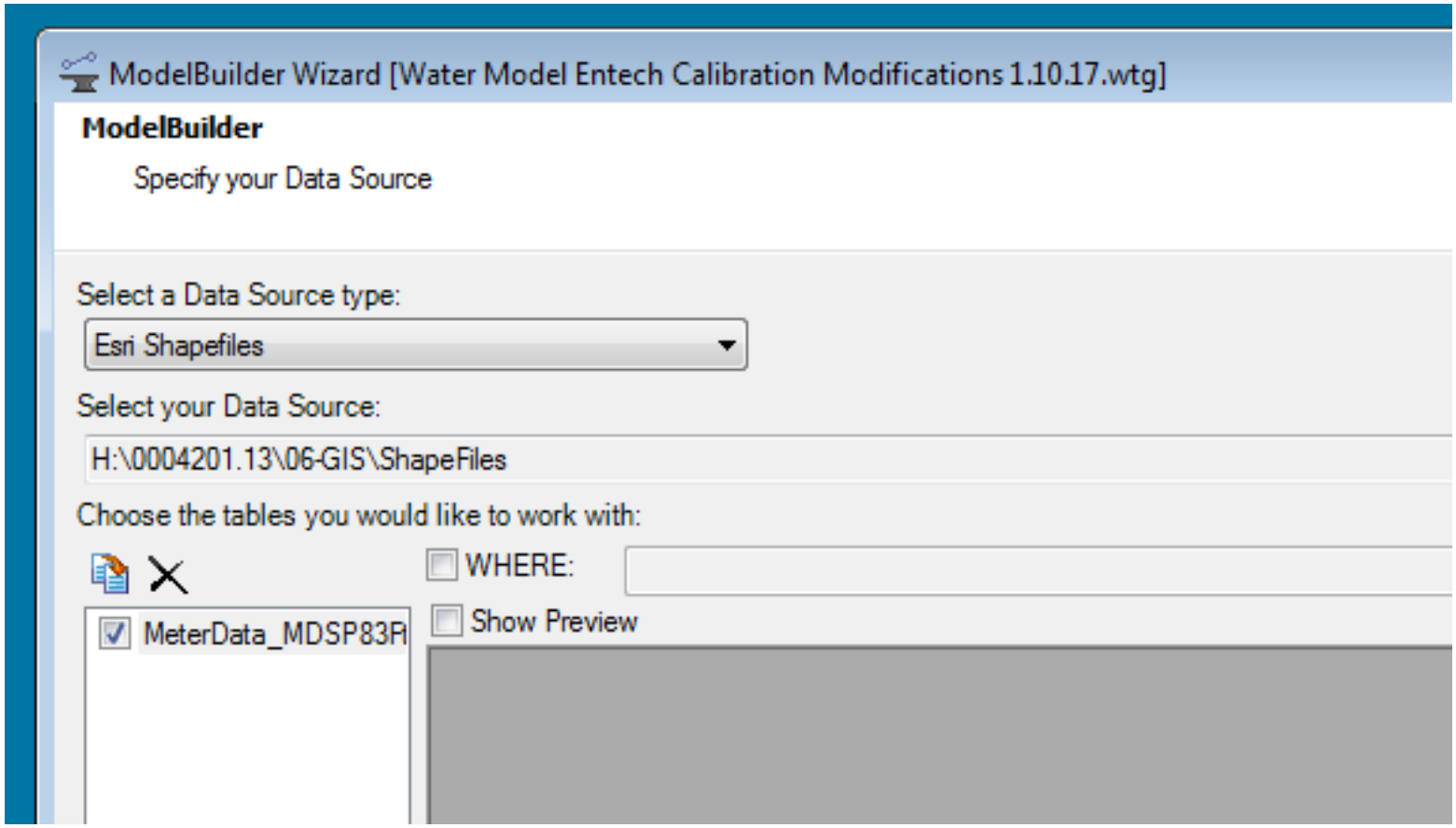

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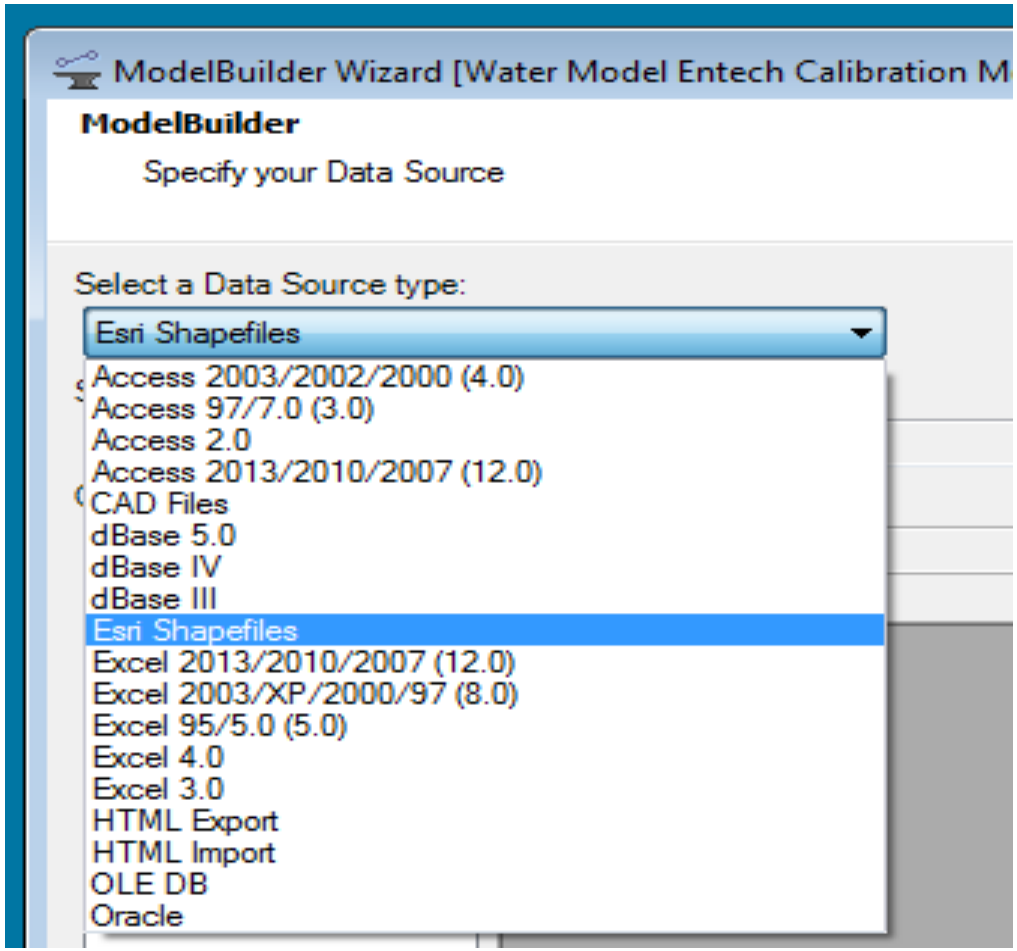

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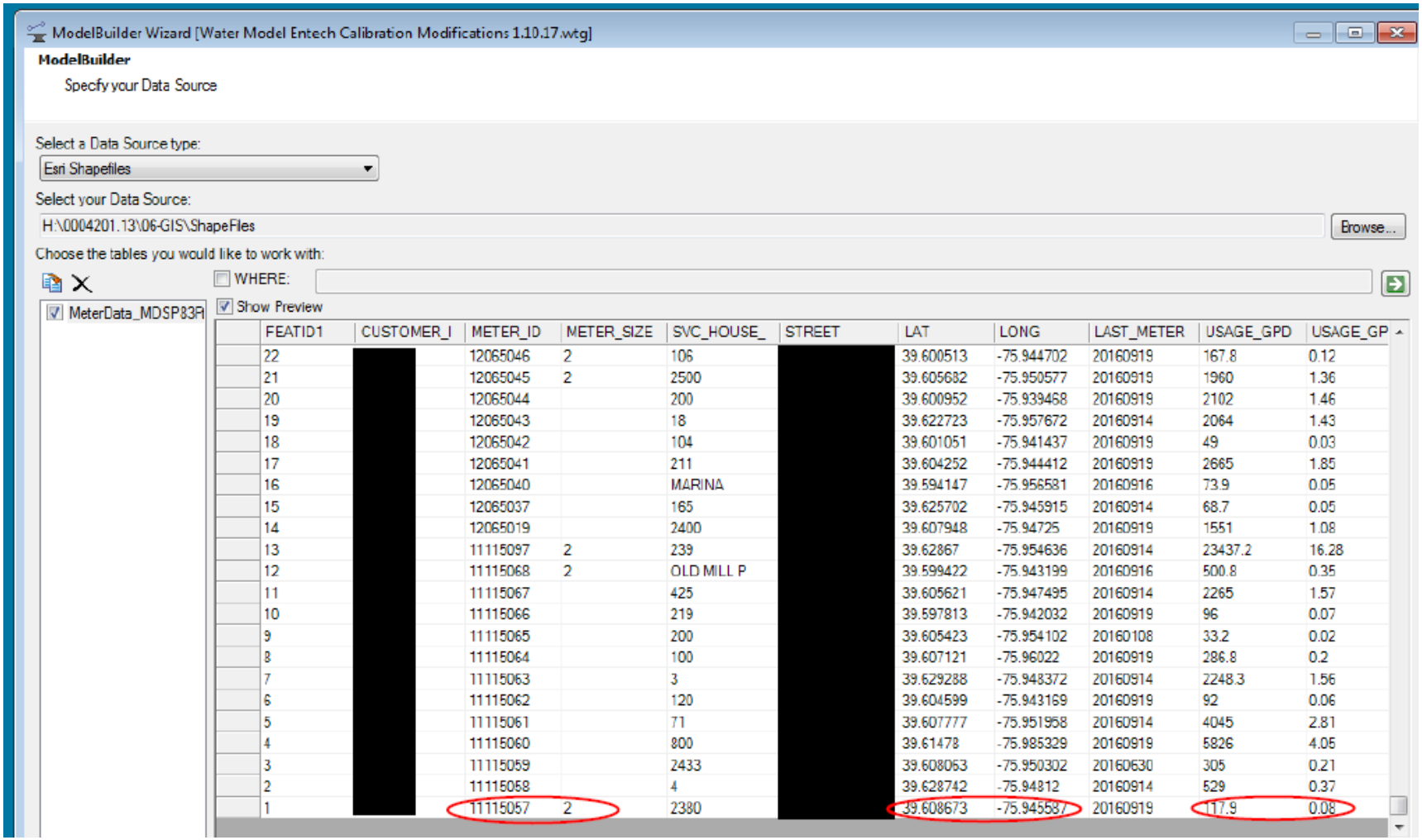
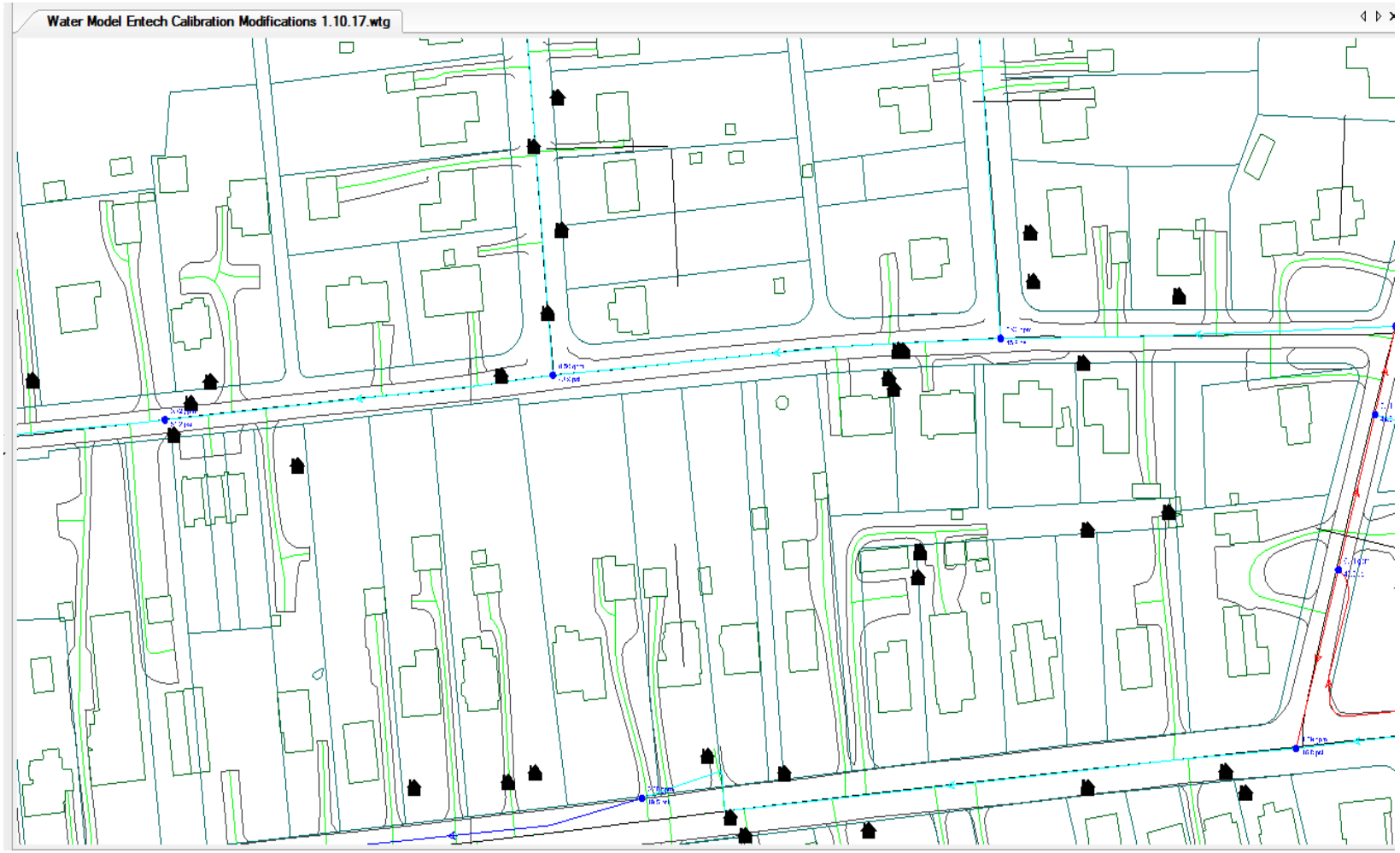
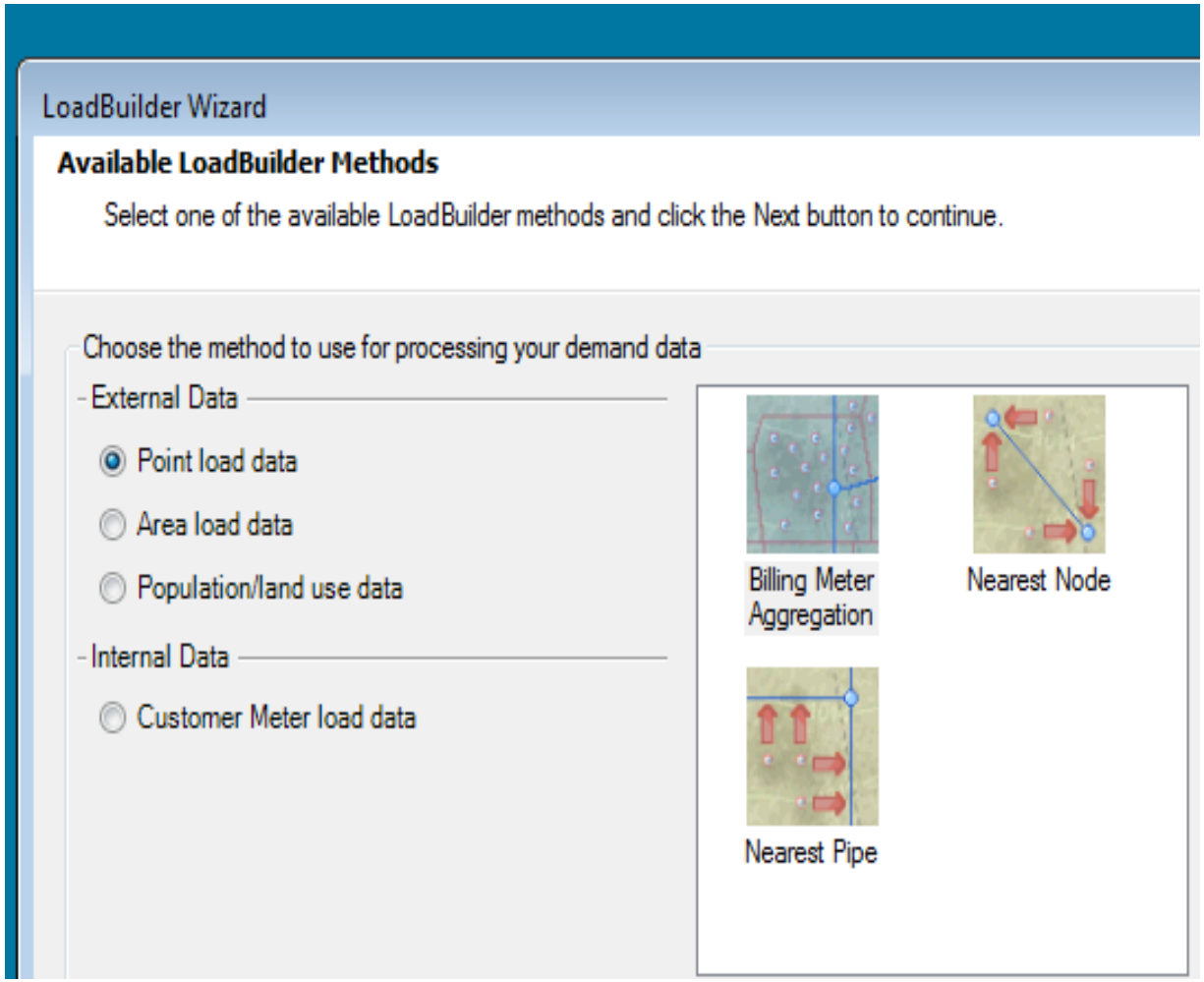


	FEATID1	CUSTOMER_I	METER_ID	METER_SIZE	SVC_HOUSE_	STREET	LAT	LONG	LAST_METER	USAGE_GPD	USAGE_GP
	22	[redacted]	12065046	2	106	[redacted]	39.600513	-75.944702	20160919	167.8	0.12
	21		12065045	2	2500		39.605682	-75.950577	20160919	1960	1.36
	20		12065044		200		39.600952	-75.939458	20160919	2102	1.46
	19		12065043		18		39.622723	-75.957672	20160914	2064	1.43
	18		12065042		104		39.601051	-75.941437	20160919	49	0.03
	17		12065041		211		39.604252	-75.944412	20160919	2665	1.85
	16		12065040		MARINA		39.594147	-75.956581	20160916	73.9	0.05
	15		12065037		165		39.625702	-75.945915	20160914	68.7	0.05
	14		12065019		2400		39.607948	-75.94725	20160919	1551	1.08
	13		11115097	2	239		39.62867	-75.954636	20160914	23437.2	16.28
	12		11115068	2	OLD MILL P		39.599422	-75.943199	20160916	500.8	0.35
	11		11115067		425		39.605621	-75.947495	20160914	2265	1.57
	10		11115066		219		39.597813	-75.942032	20160919	96	0.07
	9		11115065		200		39.605423	-75.954102	20160108	33.2	0.02
	8		11115064		100		39.607121	-75.96022	20160919	286.8	0.2
	7		11115063		3		39.629288	-75.948372	20160914	2248.3	1.56
	6		11115062		120		39.604599	-75.943169	20160919	92	0.06
	5		11115061		71		39.607777	-75.951958	20160914	4045	2.81
	4		11115060		800		39.61478	-75.985329	20160919	5826	4.05
	3		11115059		2433		39.608063	-75.950302	20160630	305	0.21
	2		11115058		4		39.628742	-75.94812	20160914	529	0.37
	1		11115057	2	2380		39.608673	-75.945587	20160919	117.9	0.08

Hydraulic Model Model Builder – Customer Meter Units



Hydraulic Model Load Builder – Customer Meter Units



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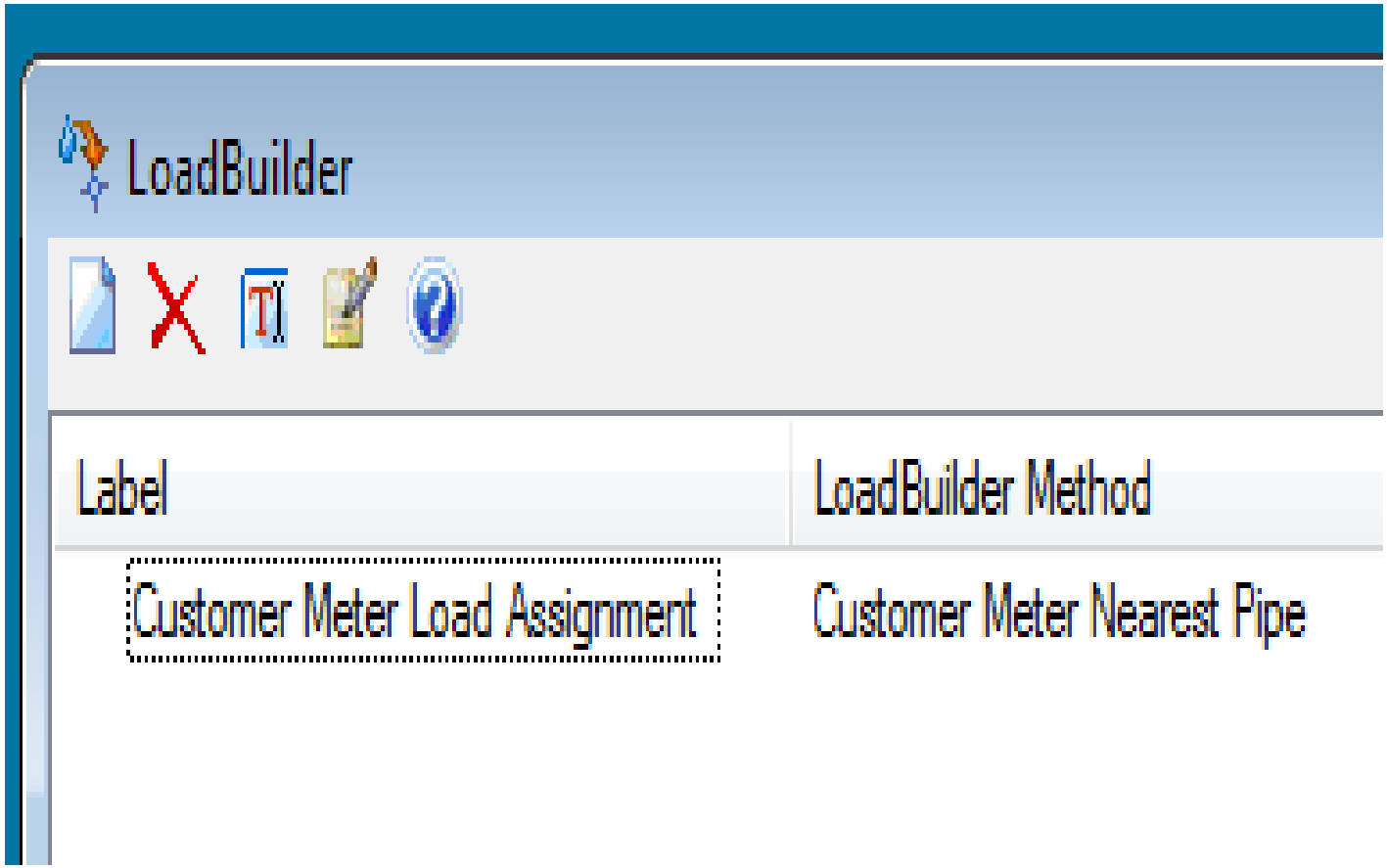

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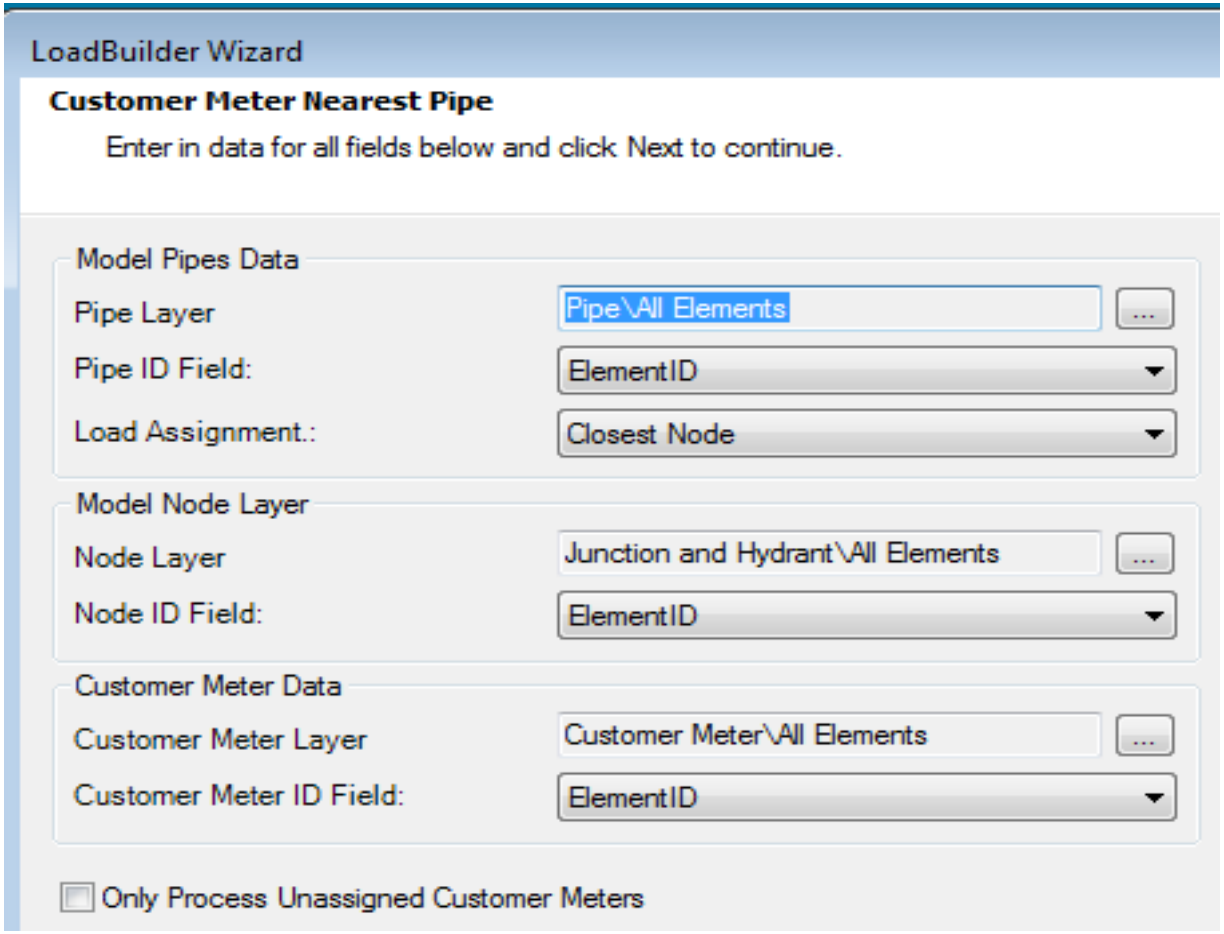

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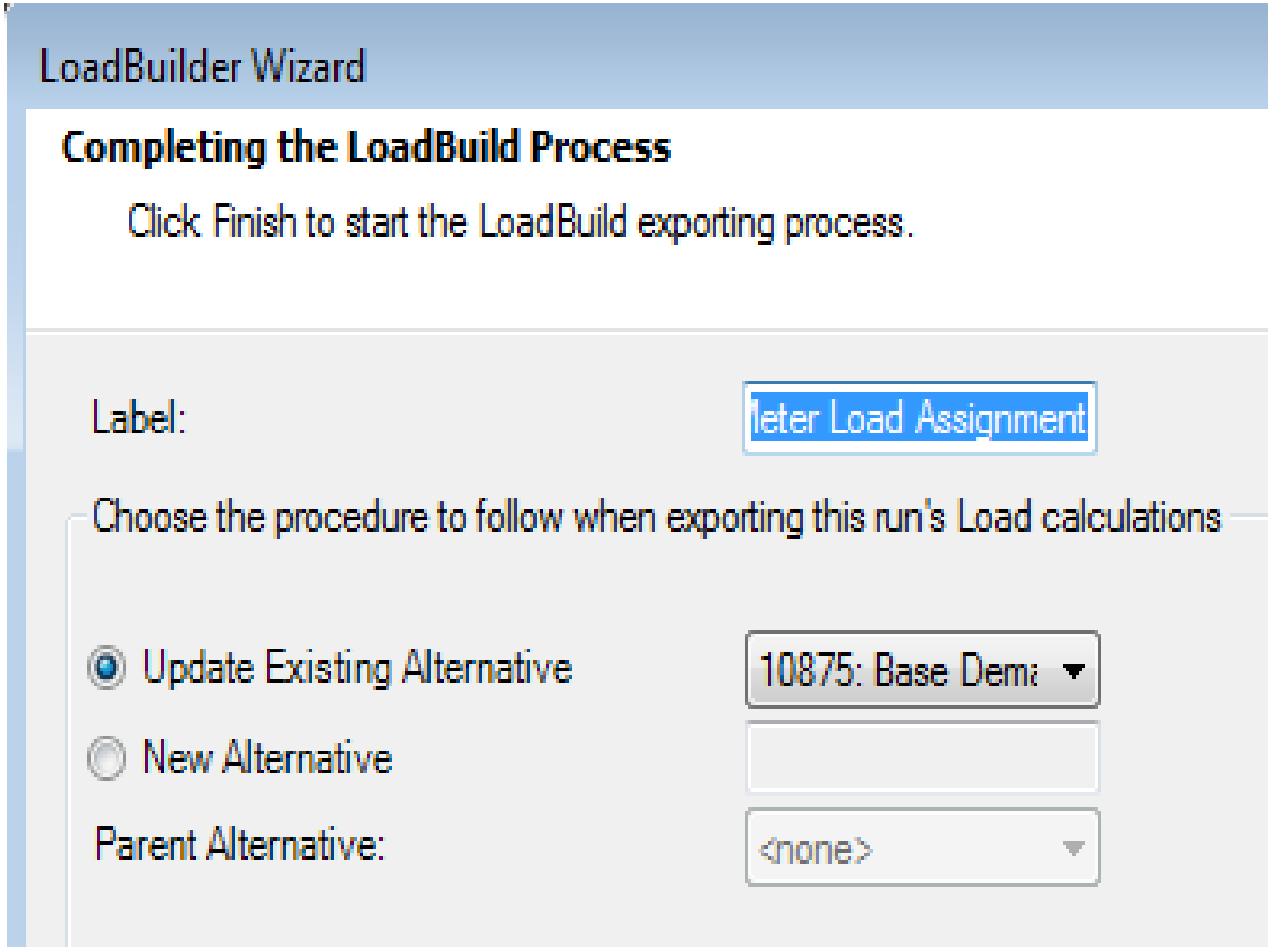

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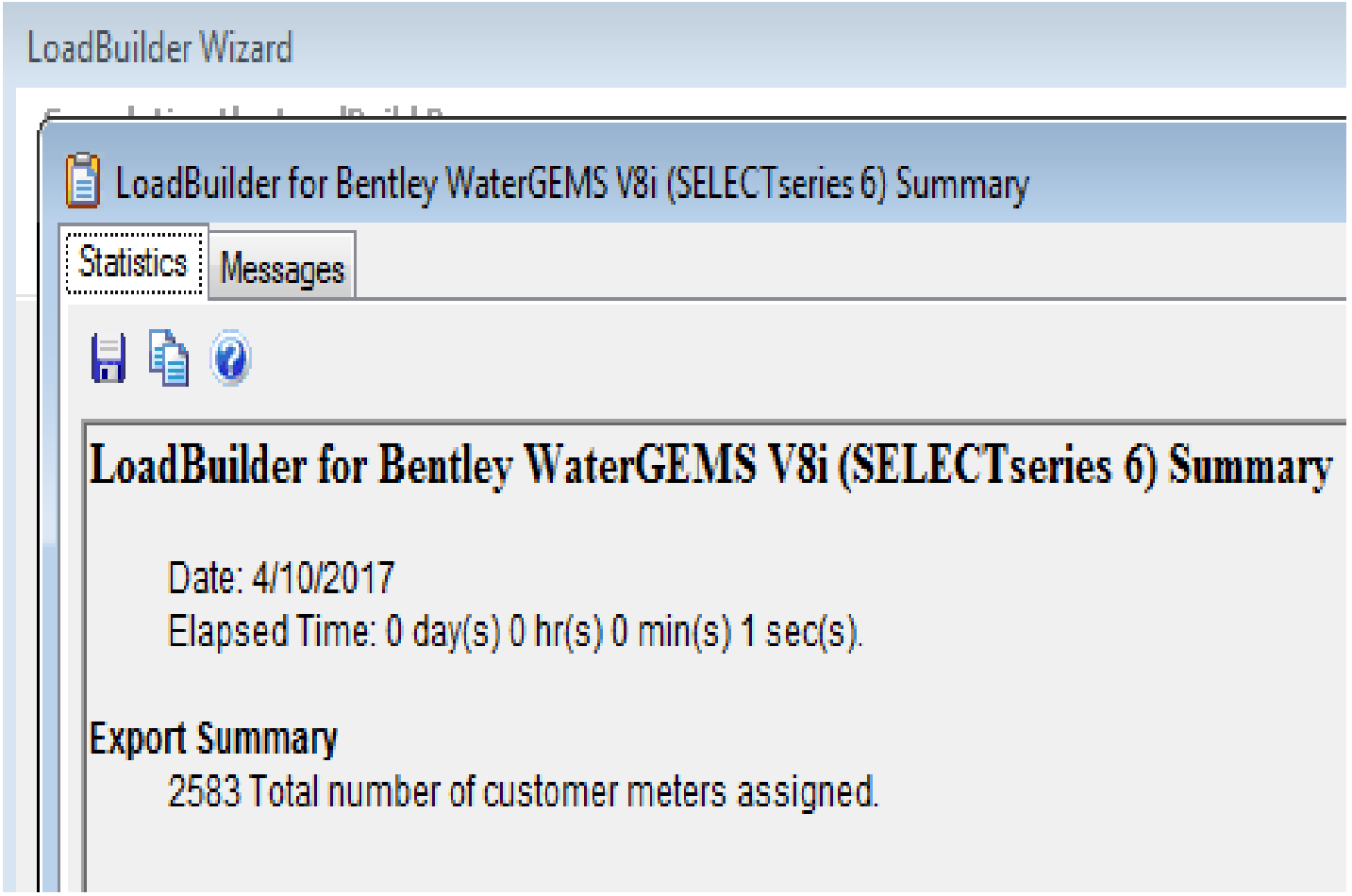

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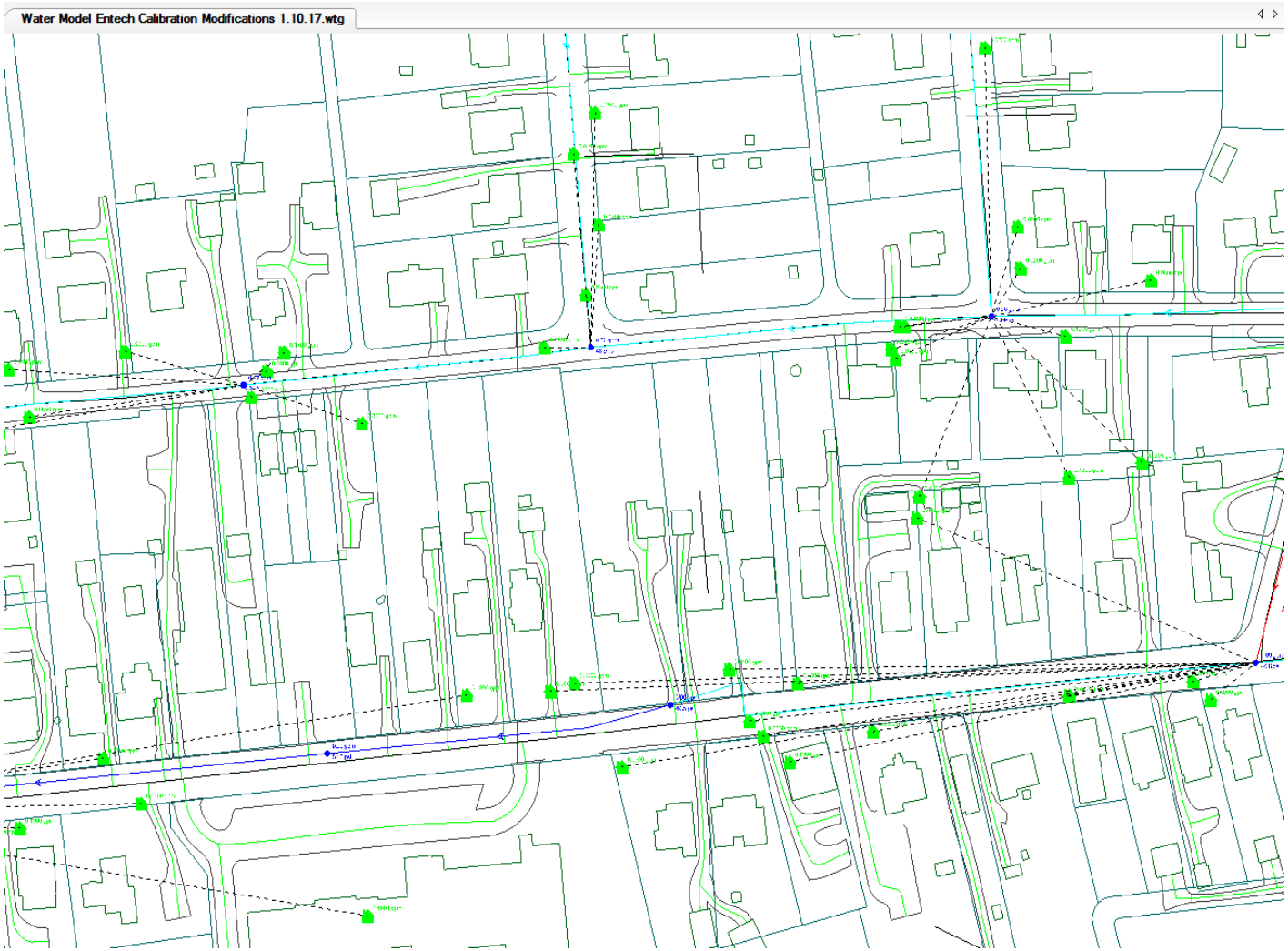

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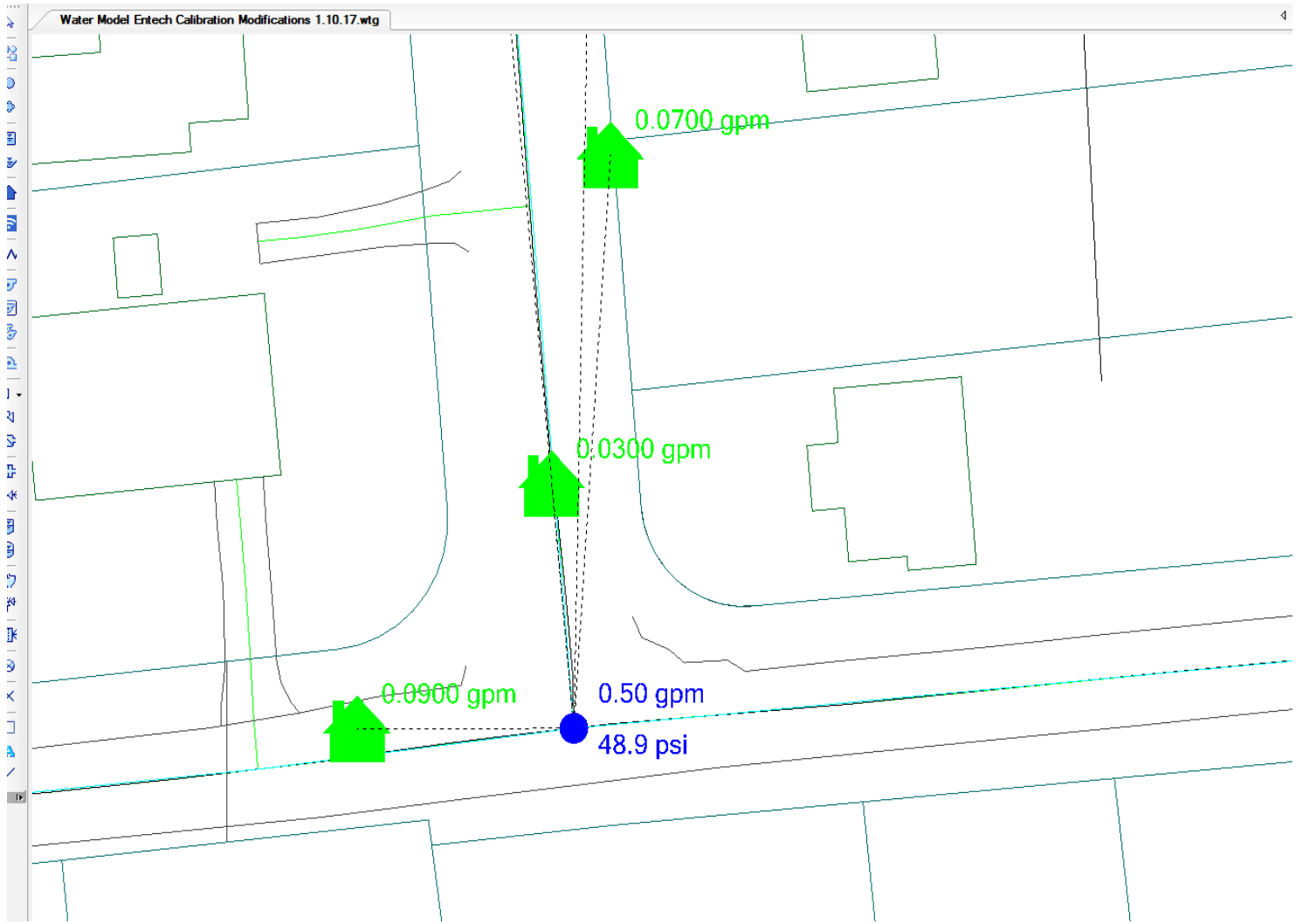

Notable Items

Meters

- About 150 meters are not part of AMR/AMI system, require manual readings
- Non AMR/AMI meters - data manually entered
- Data reviewed/refined to eliminate “bad” and duplicate data

Data

- Time to manipulate into the model in meaningful way
- Now easy to update system demands with model in the future

Notable Items

Unaccounted for Water

- Approximately 20%
- Allocation assigned as even distribution amongst all system nodes

Calibration

- Respectable calibration uses best known or available data
- Using the best available water usage information is one piece
- Calibration: ongoing process & effort, revisit periodically

Global Edits

- Customer Meter Unit demands: globally edited from Model table

Project Summary

- Bentley WaterGEMS Software Customer Meter feature allows for water usage demand allocation of each customer assigned in the Model
- Information from billing software may be exported and manipulated into a usable form to import into a hydraulic model to automate the allocation process
- With the Customer Meter feature in place, the water demand data can be updated at the Owner's desired frequency
- Applying the actual water meter reading data in the model provides a high level of confidence in the Model water demand allocation

Conclusion

- NE MD meter replacement project led to a higher level water allocation capability in their hydraulic model that can be easily updated as often as they desire

- The high level water allocation data will provide improved results for the Town to make informed decisions on system improvements, particularly with water quality issues

- Higher confidence in the model results can guide the Town to efficient problem resolutions, potentially saving them money on unnecessary infrastructure and improvements

Questions?

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