Keeping Current with Demand Development & Allocation for Hydraulic Models

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Tacoma, WA

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Today's Topics

- Hydraulic Modeling Overview
- Demand Allocation Methods
  - Area-Based Allocation
  - Uniform Allocation
  - Meter-Based Allocation
- Case Studies
- Which Method is Best?

Acknowledgements

- Washington State Department of Health, Office of Drinking Water
  - Paige Igoe, PE

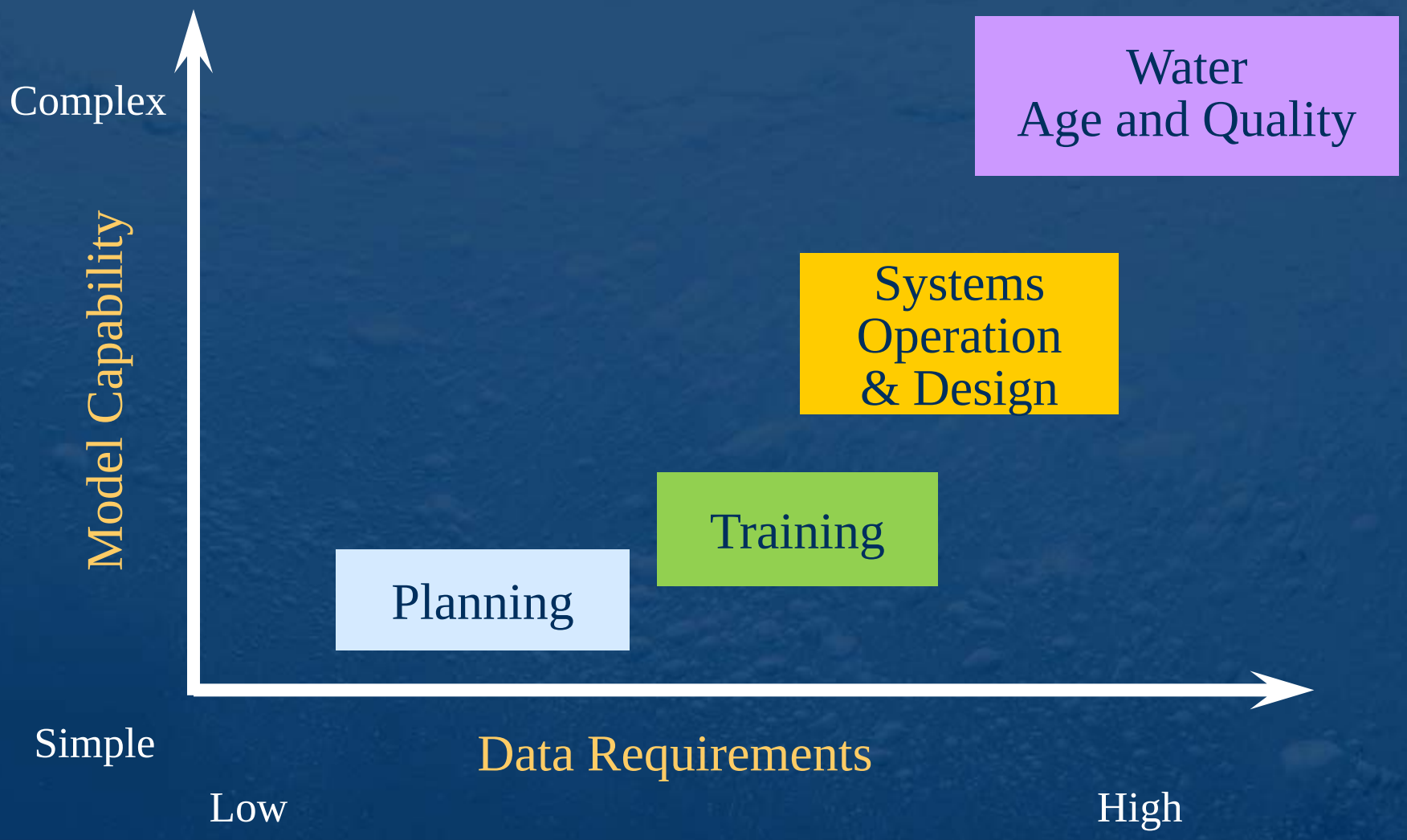
Creating a Hydraulic Model

- Identify the goal of your model
- Identify sources of input data
  - Who has the data and in what format?
  - Base map (roads, water bodies, parcels, etc.)
  - GIS
  - Other data (billing data, controls, curves, etc.)
- Digitizing / Converting Data for Model Construction
- Background Image / GIS Interface
- Balance efforts to maximize results and minimize unnecessary costs
- Project Setup

Modeling Advantages

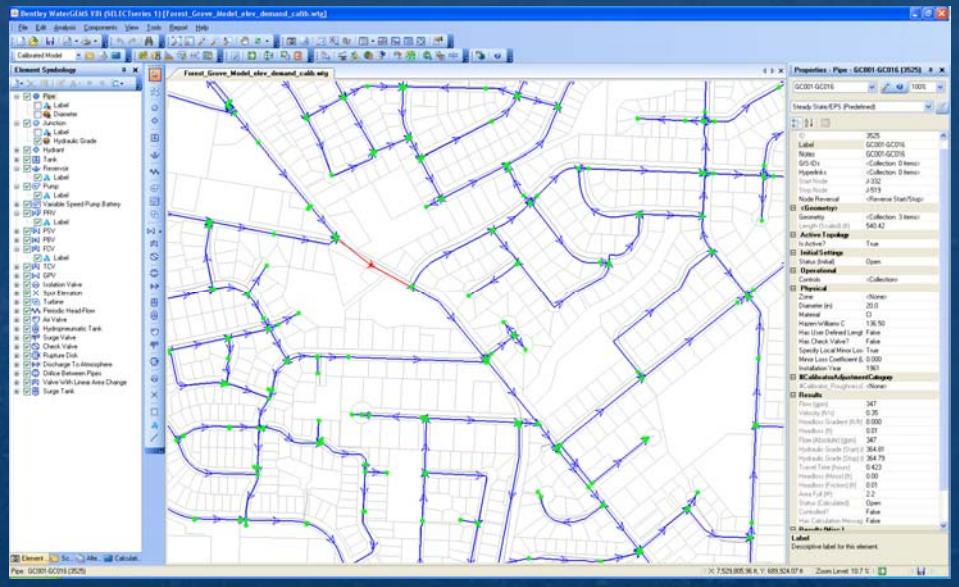
- Modeling provides insight and understanding of distribution system characteristics
- Modeling provides virtual crystal ball
  - Potential problems can be avoided, if used properly
- The Model Database can be used as a complete inventory of the physical assets of the System

Model Complexity



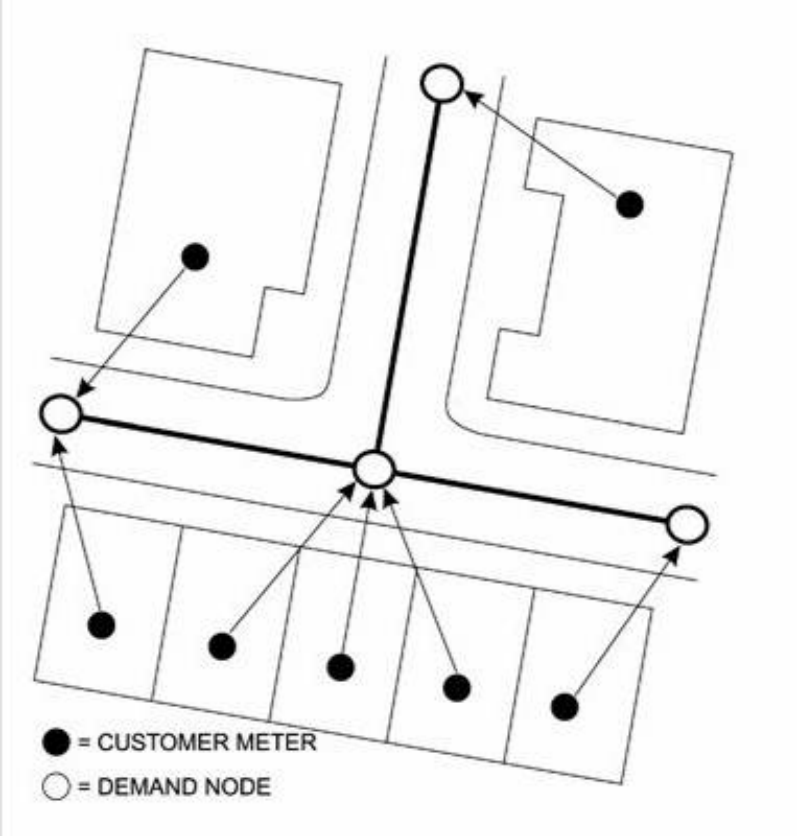
Modeling – Basic Steps

- Build Network
  - Define elements (pipes, pumps, valves, tanks, etc.)
  - Define boundary conditions (i.e., wells, source, interties)
- Develop Demand Forecast
- Allocate Demands in the Model
- Calibrate Model
- Perform System Analysis



What is Demand Allocation?

- How Demands are spatially distributed within a hydraulic model
- All-pipe models require more sophisticated demand allocation
- Technology helps us to automate this process



Three Methods to Allocate Demand

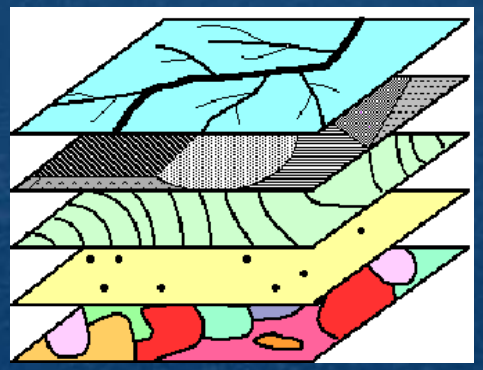
1. Area-based Demand Distribution
2. Uniform Distribution of Demands to Model Junctions
3. Demands Developed from Meter Data

Area Based Demand Distribution

This method has four steps:

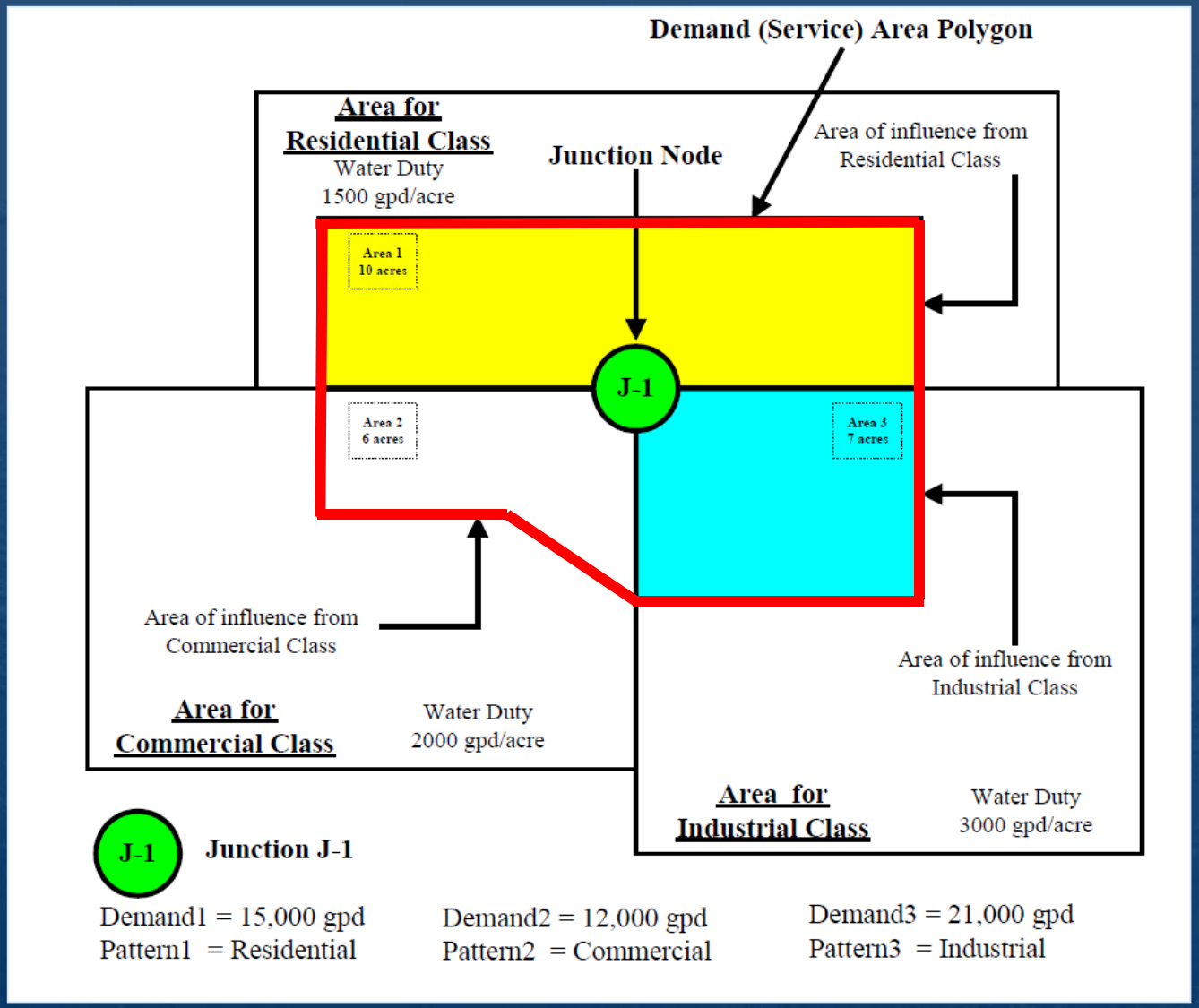
1. Define service area polygons for demand junctions
2. Develop water use factors based on customer class or other classification
3. Multiply the area of each classification by its water use factor within each nodal service area
4. Sum all demand and assign total demand to each junction

GIS Data



Polygon Intersection

Area Based Demand Distribution



Source: H2OMAP Demand Allocator Users Guide, MWH Soft, Inc

Data Needs for Area Based Demand Distribution

- Service Area for each Demand Junction
  - Can use Thiessen polygons
  - Develop system specific nodal service areas
- Polygon layer with land use or population density
  - Transportation Analysis Zones (TAZ), census tracts or other classification
- Data conversion factor to develop demands
  - Water Use Factor for each land use classification
  - Per capita use for population numbers

Uniform Demand Distribution

- Service areas are defined in GIS but distribution of demands within the service area is not known
- Develop lump-sum demand for some known service area
  - Examples: Pressure zones, Traffic Analysis Zones, Meter routes
- Distribution of Demand:
  - Equally amongst demand junctions within the service area
  - Proportionally based on area or population of service area polygon

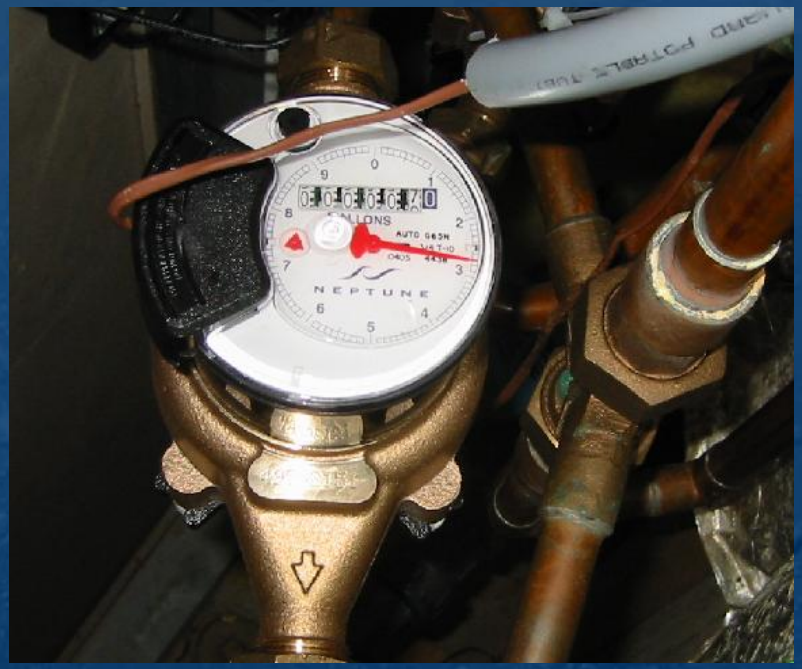
Uniform Demand Distribution

Data Needs

- Service Area polygons defined in GIS
- Total Demand for all areas
- Model Junctions

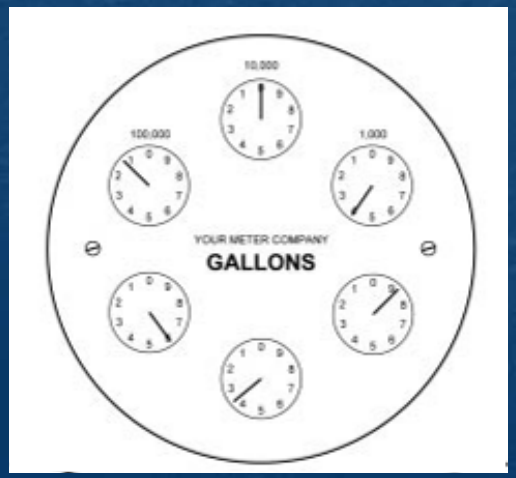
Meter Based Demand Allocation

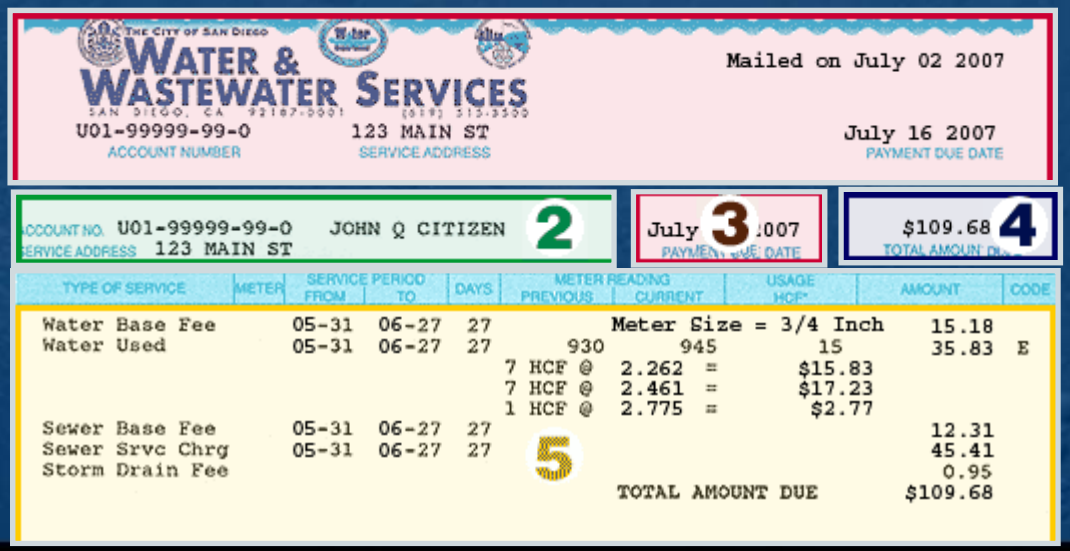
- Develop demand for each customer using billing information
- Assign demands from meters to nearest model demand junction
- Accurate spatial distribution for built out systems
- Must develop method to handle partially developed and vacant land



Data Needs for Meter Based Demand Allocation

- Billing System Data
  - Is it available for each site address?
  - Data manipulation is required to develop average day demands
- Develop peaking factors for system





THE CITY OF SAN DIEGO
WATER & WASTEWATER SERVICES
SAN DIEGO, CA 92187-0001 (619) 515-3500

Mailed on July 02 2007

U01-99999-99-0 — ACCOUNT NUMBER
123 MAIN ST — SERVICE ADDRESS
July 16 2007 — PAYMENT DUE DATE

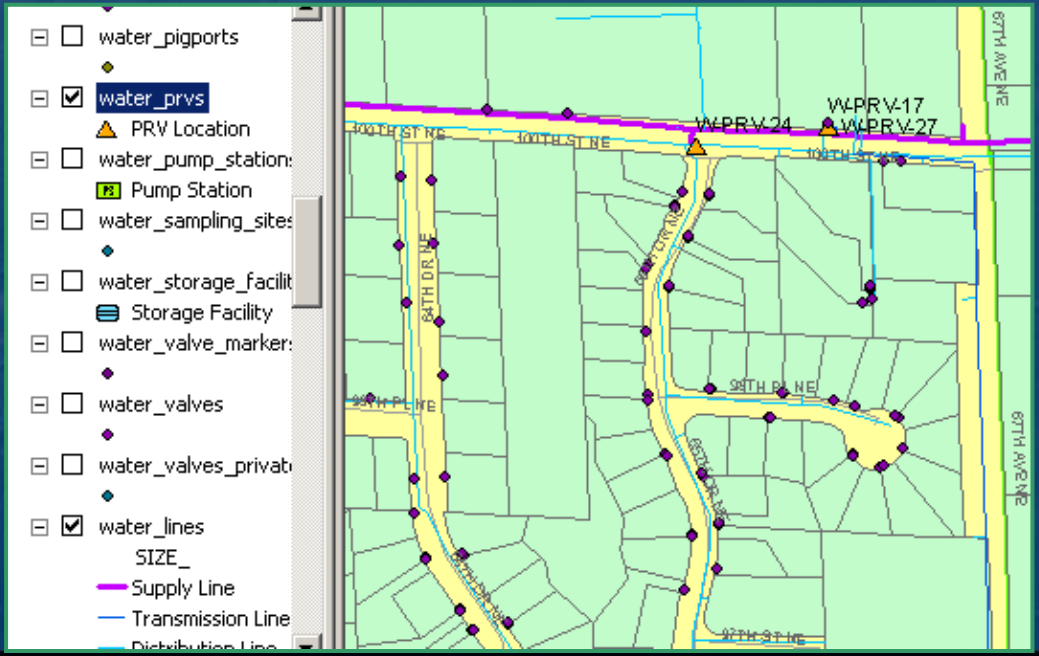
ACCOUNT NO. U01-99999-99-0 JOHN Q CITIZEN 2
SERVICE ADDRESS 123 MAIN ST
July 3 2007 — PAYMENT DUE DATE
$109.68 4 — TOTAL AMOUNT DUE

TYPE OF SERVICE	METER	SERVICE PERIOD FROM	TO	DAYS	METER READING PREVIOUS	CURRENT	USAGE HCF*	AMOUNT	CODE
Water Base Fee		05-31	06-27	27		Meter Size = 3/4 Inch		15.18	
Water Used		05-31	06-27	27	930	945	15	35.83	E
					7 HCF @	2.262 =	$15.83		
					7 HCF @	2.461 =	$17.23		
					1 HCF @	2.775 =	$2.77		
Sewer Base Fee		05-31	06-27	27				12.31	
Sewer Srvc Chrg		05-31	06-27	27				45.41	
Storm Drain Fee								0.95	
						TOTAL AMOUNT DUE		$109.68	

5

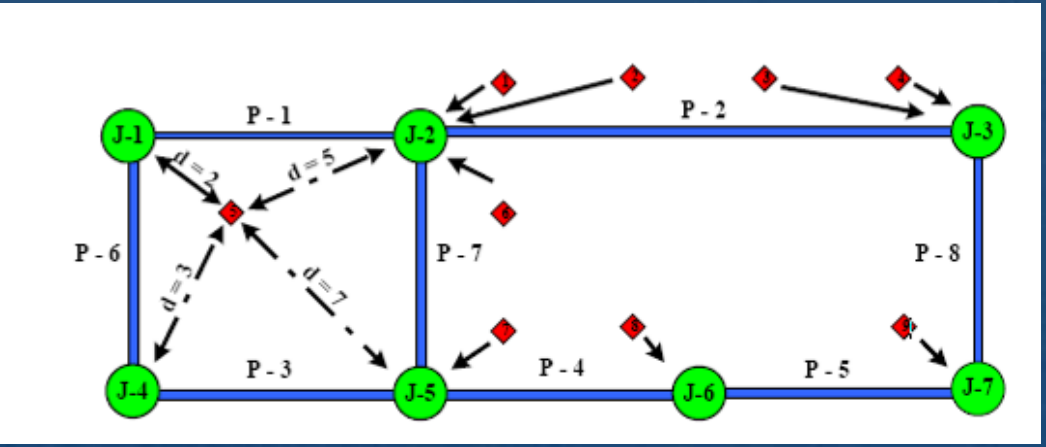
Data Needs for Meter Based Demand Allocation

- Meter Information
  - Have meters have been georeferenced in GIS?
  - Geocoding tool can be used
  - Can assign demands to parcels

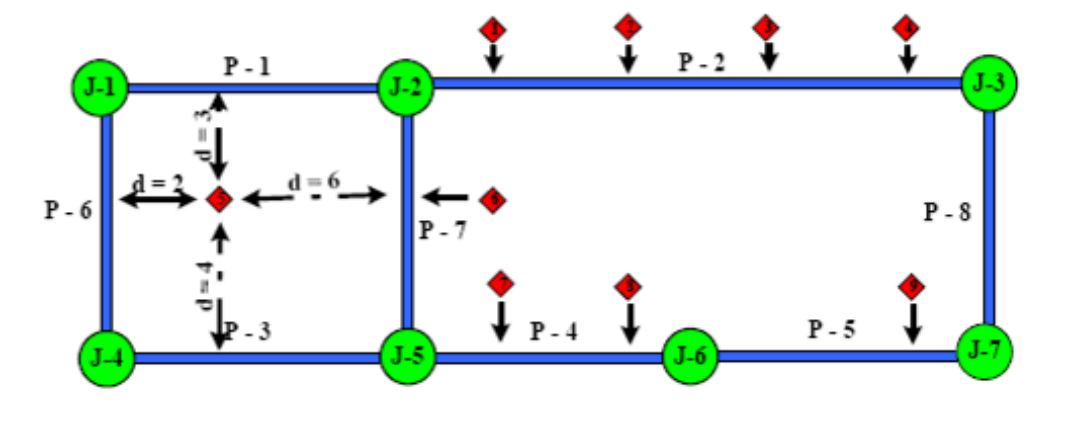


Different Ways to Assign Meter Demands

- Nearest Junction



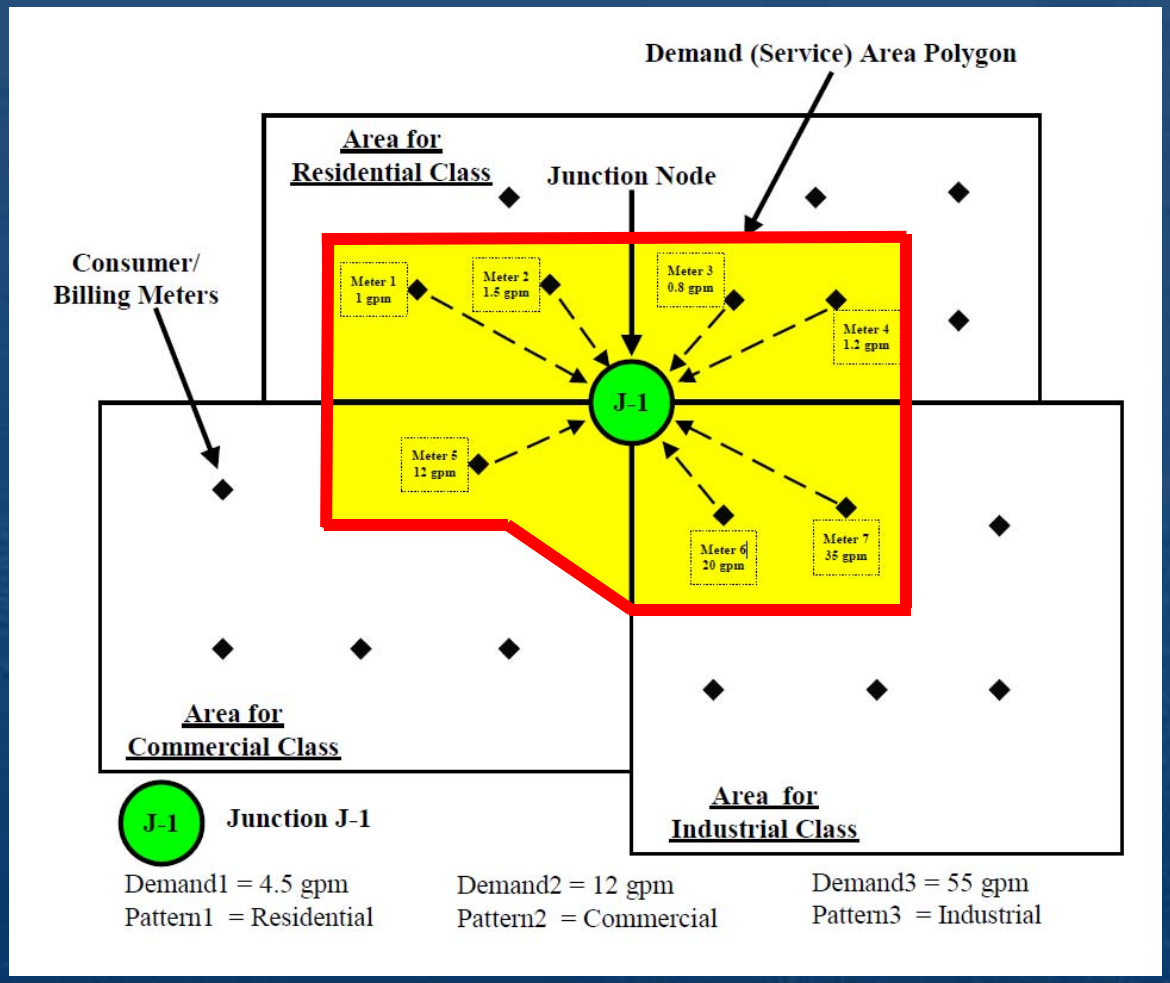
- Nearest Pipe



Source: H2OMAP Demand Allocator Users Guide, MWH Soft, Inc

Different Ways to Assign Meter Demands

- Use of Service Areas for Each Demand Junction



Source: H2OMAP Demand Allocator Users Guide, MWH Soft, Inc

Demand Distribution

CASE STUDIES

- Uniform Demand Allocation
- Meter-Based Demand Allocation

Uniform Demand Distribution

Demand forecast prepared by Land Use

st_helens_demand_forecast_v2.xls [Compatibility Mode] - Microsoft Excel

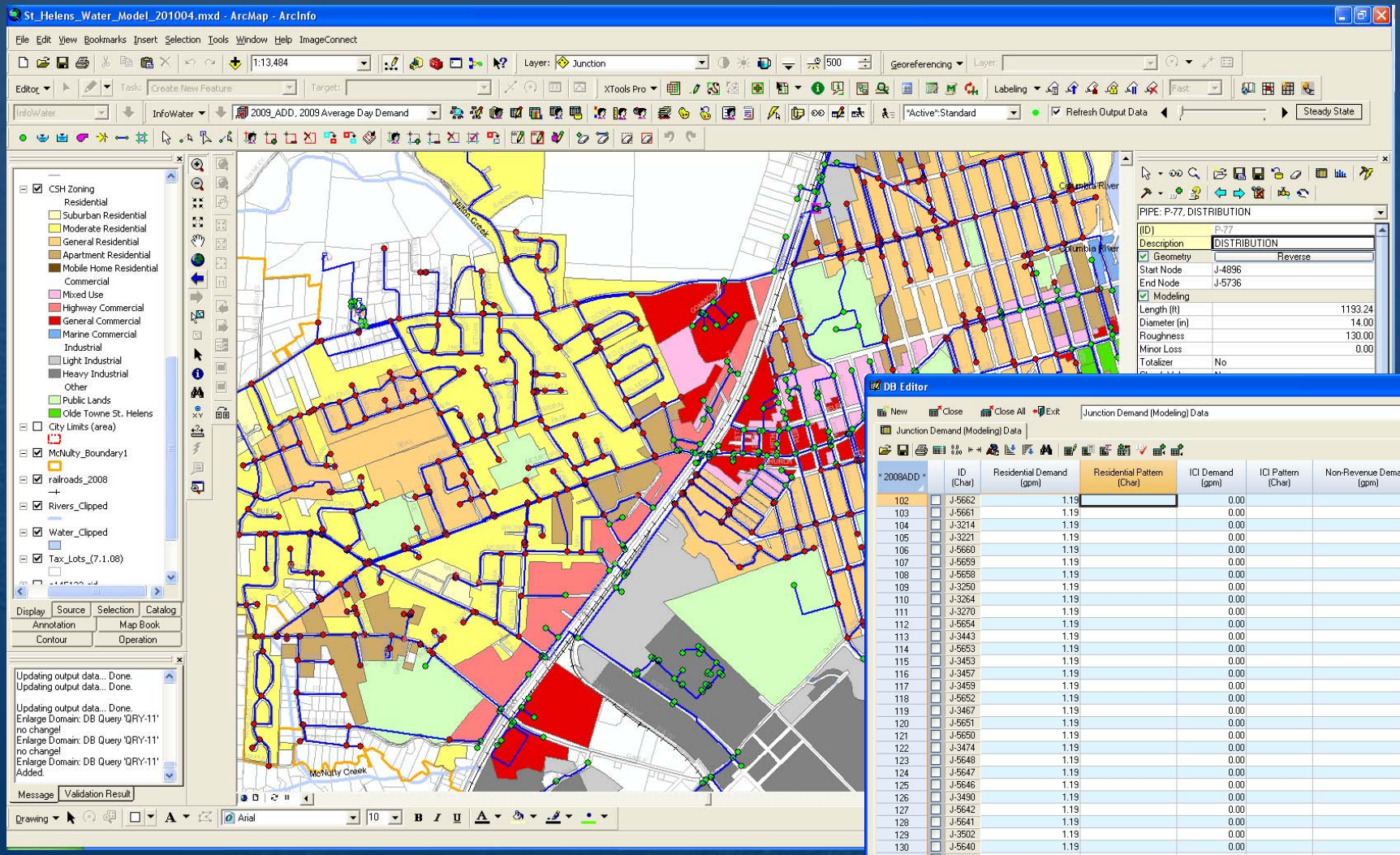
N3 =VLOOKUP($F3,'Demand forecast'!$C$6:$BJ$33,'Demand forecast'!$V$1)

Table 2-5: Demand Forecast Summary (mgd)-Medium Growth Scenario

Year	St. Helens Population	Population in St. Helens Service Area	Employment in St. Helens Service Area	Residential Demand	ICI Demand	Non-Revenue Water	Average Day Demand	Maximum Day Demand
2008	Medium	12,378	3,562	0.89	0.49	0.34	1.74	4.52
2013	Medium	14,005	4,030	0.92	0.55	0.42	2.20	5.16
2018	Medium	15,845	4,560	0.97	0.63	0.45	2.43	5.55
2023	Medium	17,927	5,159	1.02	0.71	0.48	2.70	5.98
2028	Medium	20,283	5,837	1.07	0.80	0.52	3.00	6.48

Demand forecast | pop_emp growth | proj_wtr_dmnds | cons_by_cust_class | Tables_Graphs

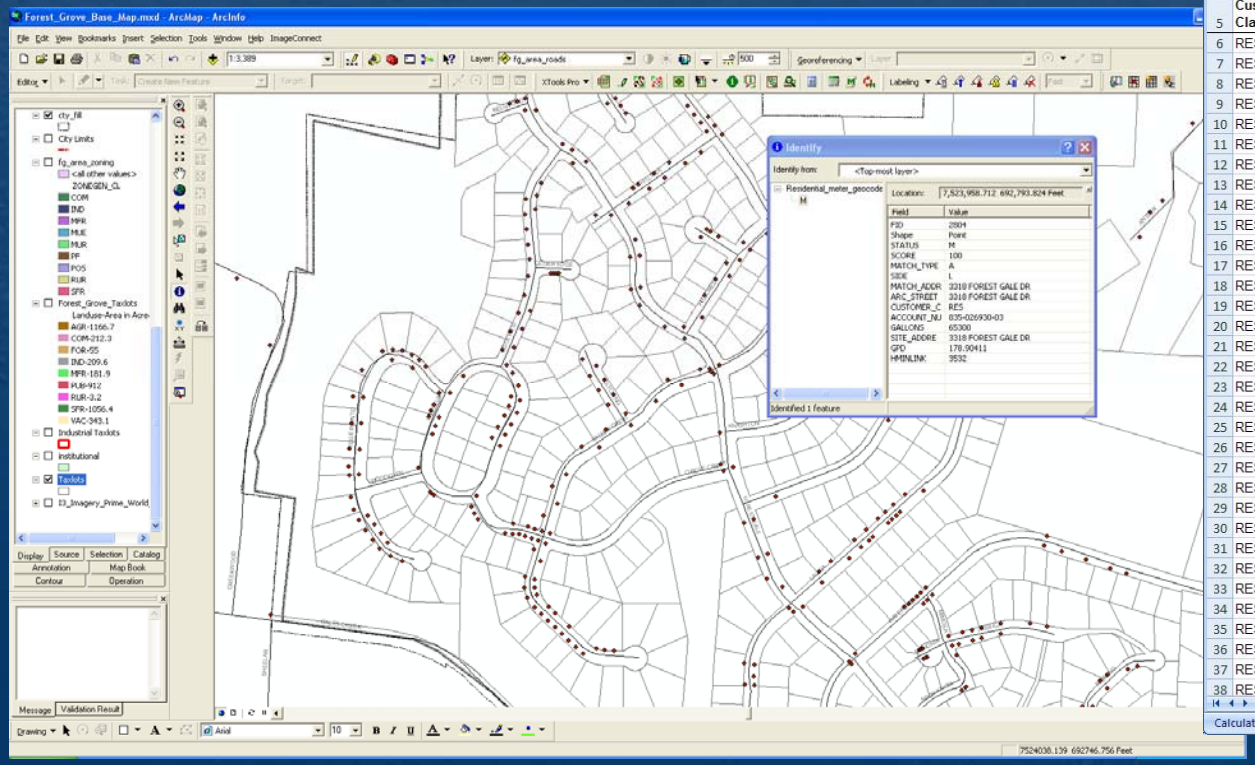
Distribute Demand Uniformly by Land Use

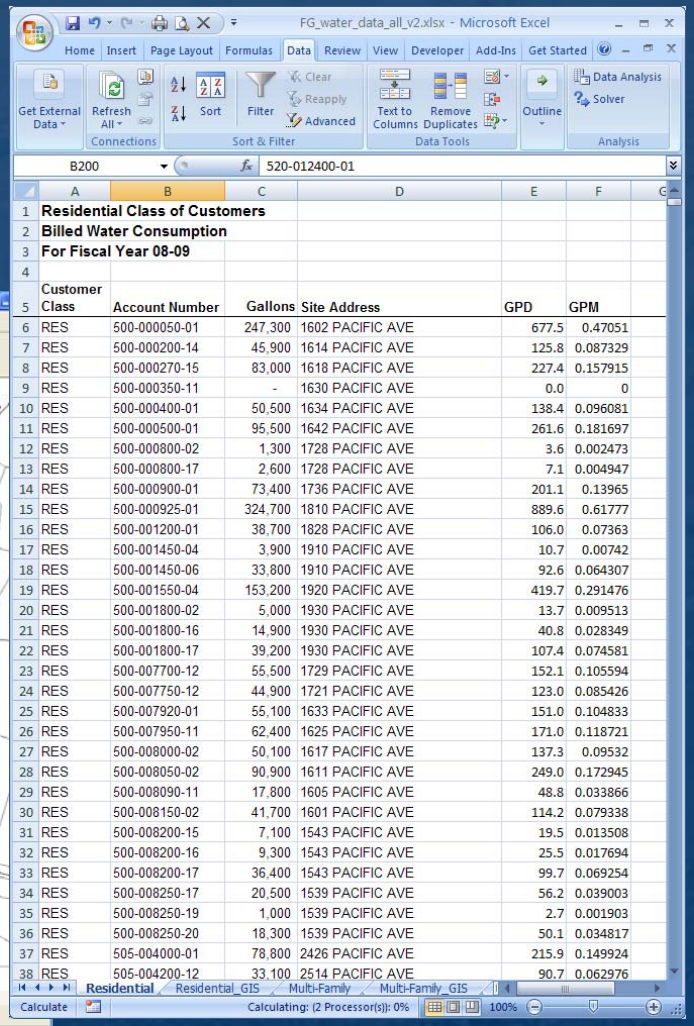


Meter Based Demand Distribution

Billing data used to:

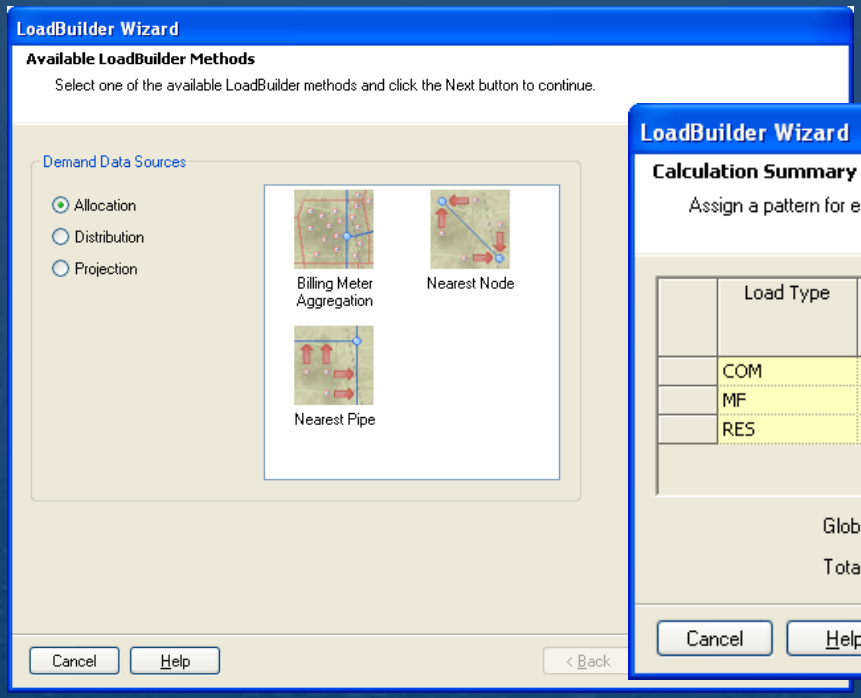
- Calculate average demand
- Locate meters in GIS

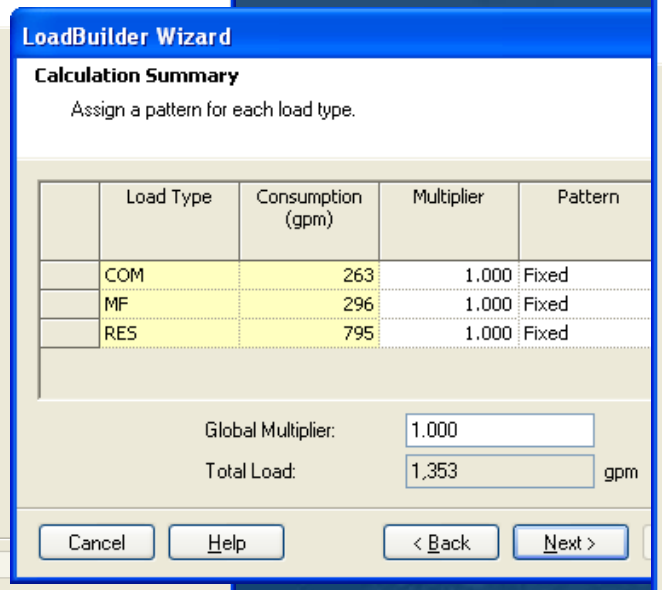


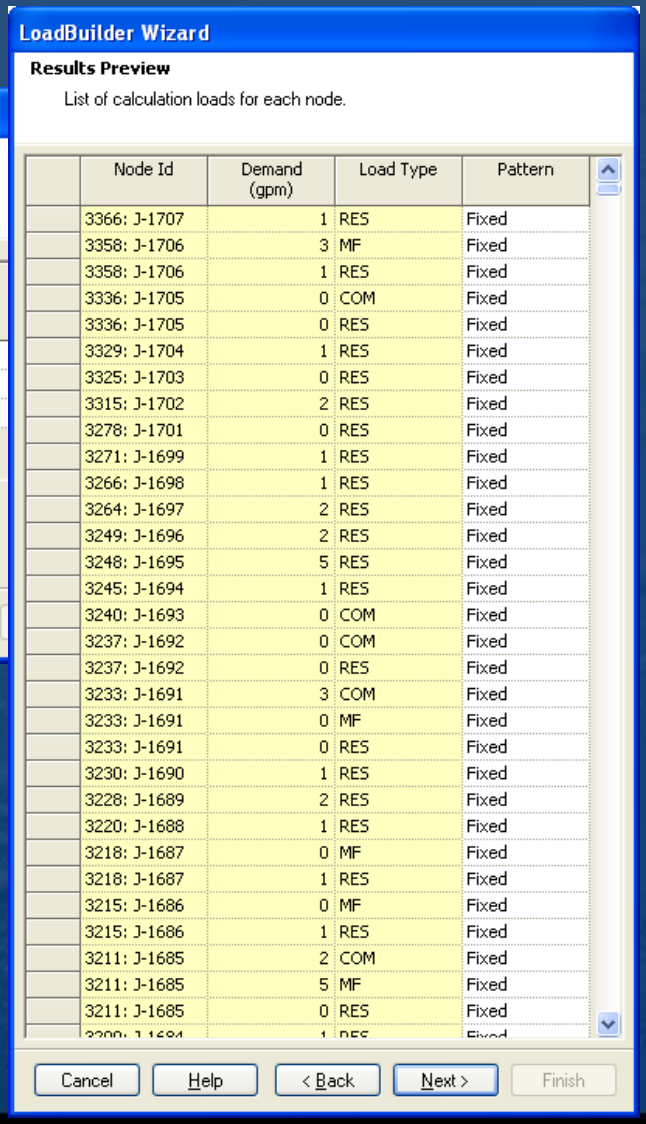


	A	B	C	D	E	F
1	Residential Class of Customers					
2	Billed Water Consumption					
3	For Fiscal Year 08-09					
4						
5	Customer Class	Account Number	Gallons	Site Address	GPD	GPM
6	RES	500-000050-01	247,300	1602 PACIFIC AVE	677.5	0.47051
7	RES	500-000200-14	45,900	1614 PACIFIC AVE	125.8	0.087329
8	RES	500-000270-15	83,000	1618 PACIFIC AVE	227.4	0.157915
9	RES	500-000350-11	-	1630 PACIFIC AVE	0.0	0
10	RES	500-000400-01	50,500	1634 PACIFIC AVE	138.4	0.096081
11	RES	500-000500-01	95,500	1642 PACIFIC AVE	261.6	0.181697
12	RES	500-000800-02	1,300	1728 PACIFIC AVE	3.6	0.002473
13	RES	500-000800-17	2,600	1728 PACIFIC AVE	7.1	0.004947
14	RES	500-000900-01	73,400	1736 PACIFIC AVE	201.1	0.13965
15	RES	500-000925-01	324,700	1810 PACIFIC AVE	889.6	0.61777
16	RES	500-001200-01	38,700	1828 PACIFIC AVE	106.0	0.07363
17	RES	500-001450-04	3,900	1910 PACIFIC AVE	10.7	0.00742
18	RES	500-001450-06	33,800	1910 PACIFIC AVE	92.6	0.064307
19	RES	500-001550-04	153,200	1920 PACIFIC AVE	419.7	0.291476
20	RES	500-001800-02	5,000	1930 PACIFIC AVE	13.7	0.009513
21	RES	500-001800-16	14,900	1930 PACIFIC AVE	40.8	0.028349
22	RES	500-001800-17	39,200	1930 PACIFIC AVE	107.4	0.074581
23	RES	500-007700-12	55,500	1729 PACIFIC AVE	152.1	0.105594
24	RES	500-007750-12	44,900	1721 PACIFIC AVE	123.0	0.085426
25	RES	500-007920-01	55,100	1633 PACIFIC AVE	151.0	0.104833
26	RES	500-007950-11	62,400	1625 PACIFIC AVE	171.0	0.118721
27	RES	500-008000-02	50,100	1617 PACIFIC AVE	137.3	0.09532
28	RES	500-008050-02	90,900	1611 PACIFIC AVE	249.0	0.172945
29	RES	500-008090-11	17,800	1605 PACIFIC AVE	48.8	0.033866
30	RES	500-008150-02	41,700	1601 PACIFIC AVE	114.2	0.079338
31	RES	500-008200-15	7,100	1543 PACIFIC AVE	19.5	0.013508
32	RES	500-008200-16	9,300	1543 PACIFIC AVE	25.5	0.017694
33	RES	500-008200-17	36,400	1543 PACIFIC AVE	99.7	0.069254
34	RES	500-008250-17	20,500	1539 PACIFIC AVE	56.2	0.039003
35	RES	500-008250-19	1,000	1539 PACIFIC AVE	2.7	0.001903
36	RES	500-008250-20	18,300	1539 PACIFIC AVE	50.1	0.034817
37	RES	505-004000-01	78,800	2426 PACIFIC AVE	215.9	0.149924
38	RES	505-004200-12	33,100	2514 PACIFIC AVE	90.7	0.062976

Meter Based Demand Distribution





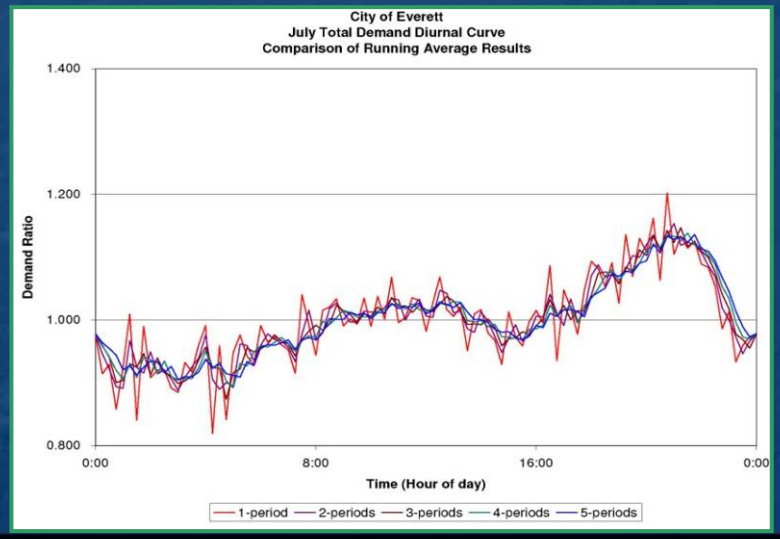


Allocation tools available in model allow:

- For selection of allocation method
- Model tool develops demands at each junction based on location of meters and allocation method selected

Other Items to Consider

- Identify Demand Junctions
- Identify Large Users
- Include non-revenue water and distribution system leakage in demands
- Develop Diurnal Patterns for EPS
  - Residential
  - Commercial
  - Industrial
- How often do you need to update demands?



Which Method is Best?

The method you chose is project specific!

- Available Data
- Software Selection
- Objectives for Modeling Project
- Client Needs and Comfort Level

Which Method is Best?

- Area-Based Allocation
  - Minimal data needed
  - Planning models (steady-state or EPS)
- Uniform Allocation
  - Minimal to moderate data needs
  - Planning models (steady-state or EPS)
- Meter Based Allocation
  - Most data intensive
  - System operations, design and water quality models

Keeping Current with Demand Development & Allocation for Hydraulic Models

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