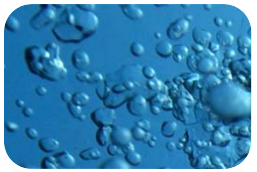
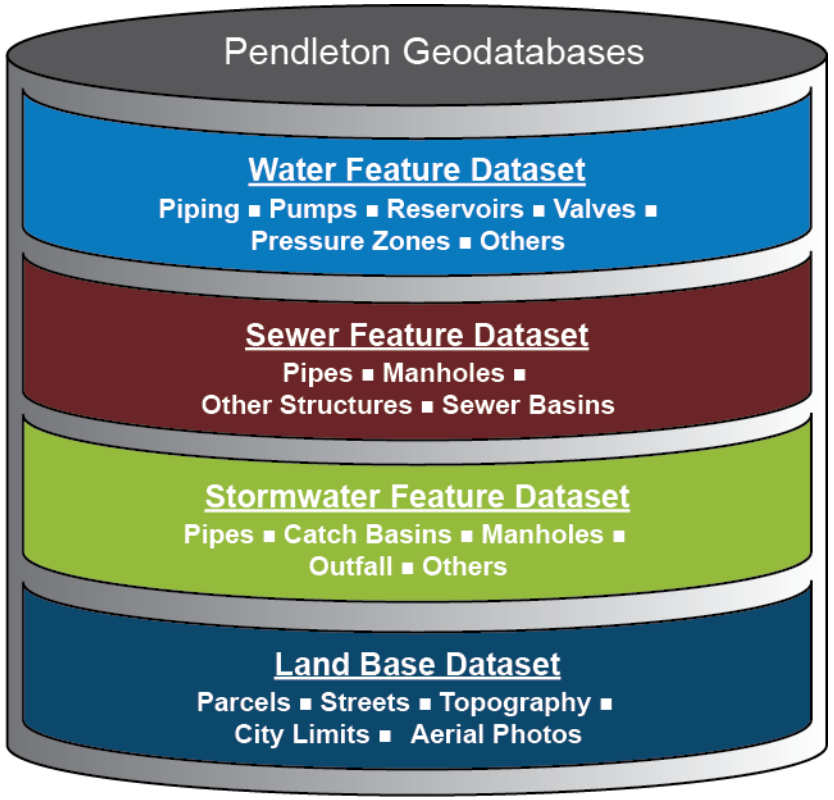
Even Cowboys Need Good Data
City of Pendleton GIS Development

Presenters: Bob Patterson, P.E., City of Pendleton
David Stangel, P.E., Murray, Smith & Assoc. Inc.

Project Overview



- Create GIS Databases for water, sewer and stormwater to support master planning and other public works functions



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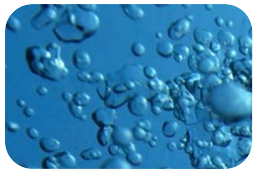
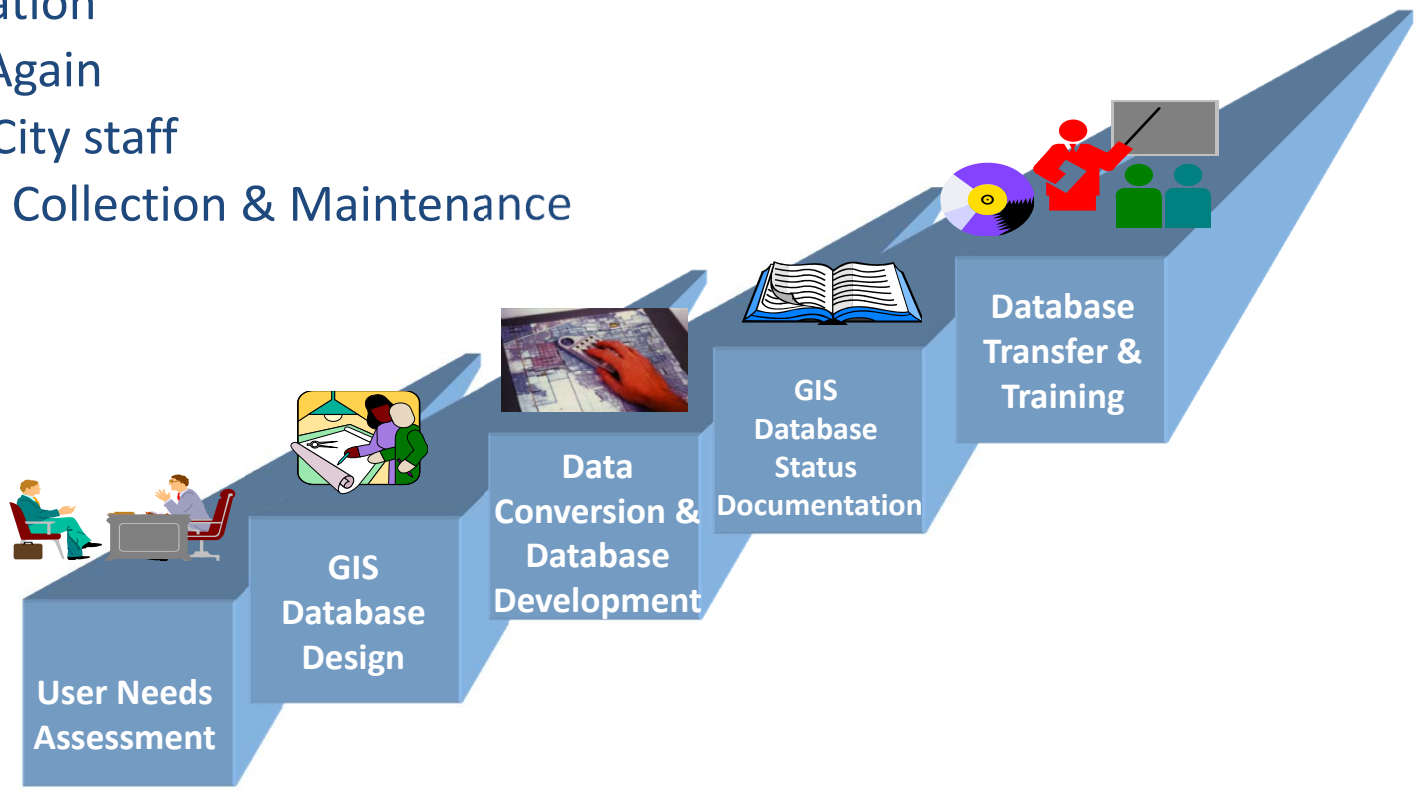
Process Overview



- Assess Needs
- Develop Database Design
- Facility Tours
- Data Conversion into Database
- QA/QC Data
- Model Integration
- QA/QC Data Again
- Transition to City staff
- Ongoing Data Collection & Maintenance



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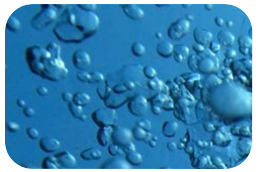
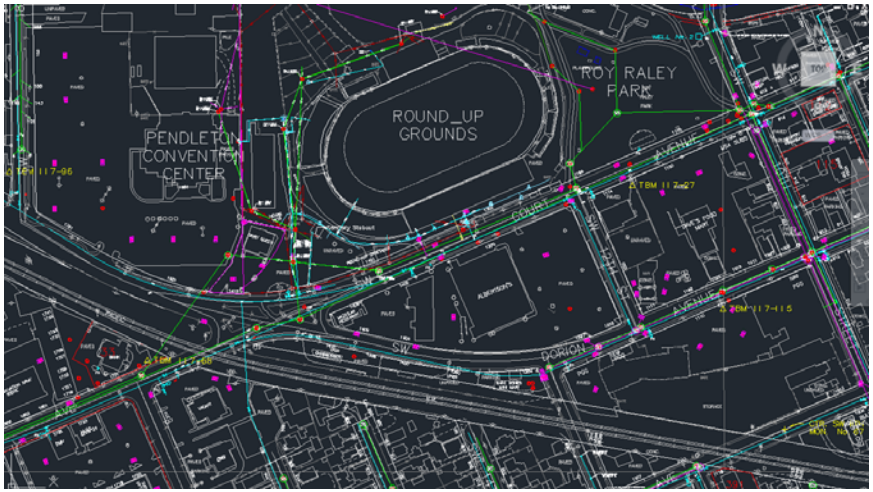
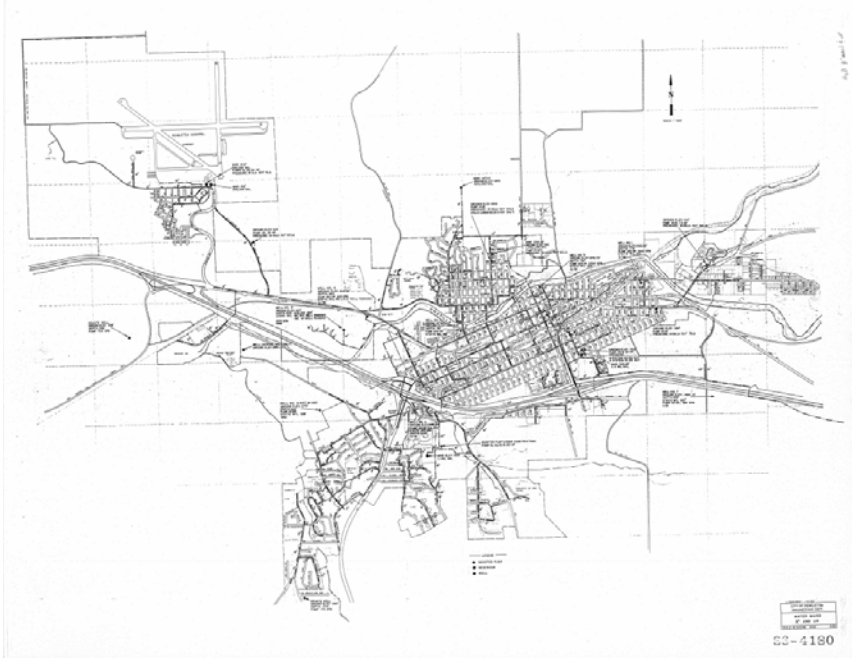
Background



- City serves approximately 17,600 people
- City operates water, sewer and stormwater systems
- Current data in AutoCad, and different hard copy maps/as-builts





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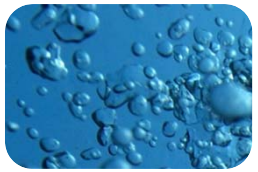
Purpose



- Purpose of Project:
  - Primary data source for Master Planning efforts
  - Transition master data repository to GIS
    - Consolidate information sources
    - Compile base data GIS (e.g. parcels, roads, aerials)
    - Develop consistent mapping tools and products
  - Use GIS as data source for hydraulic models
  - Prepare for transition to new full-time GIS coordinator
  - Ultimately use GIS in the field and for public access
  - Succession planning

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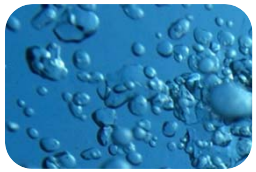
Business Case



Bob Patterson P.E. – Public Works Director

Reasons to Develop a GIS :

- Accurate maps of our systems
  - 2005: Engineering Aide position not refilled
  - 3 sets of different maps with different information
- Accurate inventories and databases of our systems
- A useful tool for maintenance and management of the systems
- A useful tool for system operation
- A useful tool for working with customers, builders, developers and other agencies

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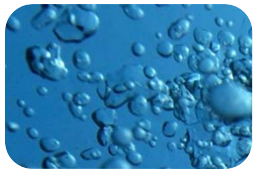
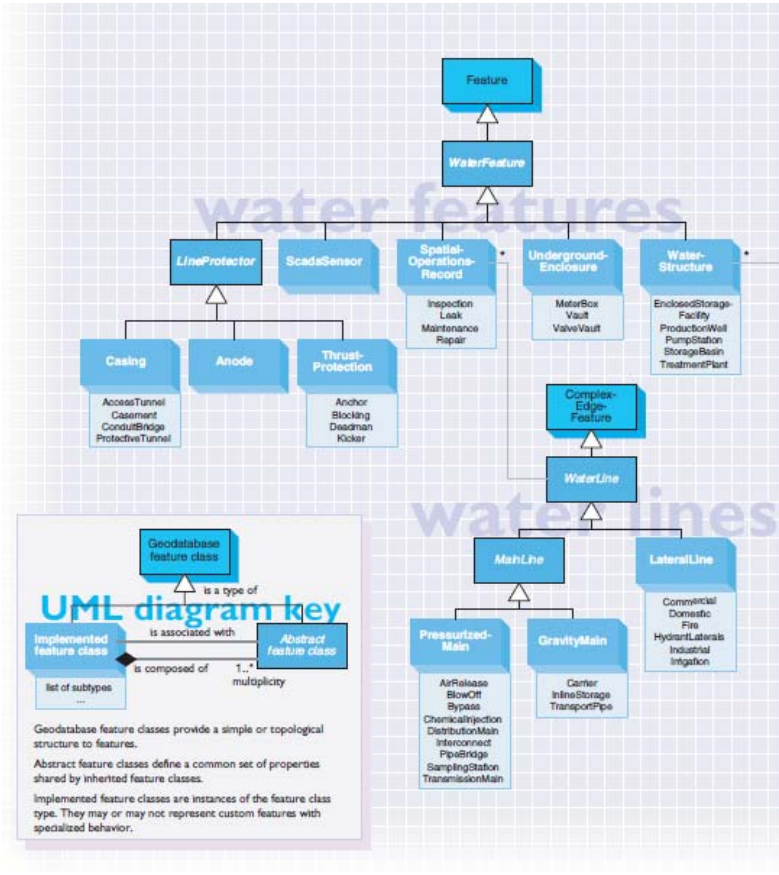
Develop Database Design



- Started with ESRI Standard Utility Templates
- Adapted to City Needs
  - Add/Remove Features
  - Add/Remove Attributes
  - Local terminology
- Considered current and future needs



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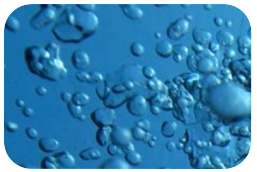
Develop Database Design



- Sample Feature Database Structure (red & blue text indicate use in the model)

ssGravityMain

Number of Records:		**Geometry :** Polyline
Data Origin:	GPS Survey Grade	
Dataset Type	FeatureClass	**Has M:** Yes
FeatureType	Simple	**Has Z:** Yes

Field Name	Alias Name	Type	Length	Null	Description
OBJECTID	OBJECTID	OID	4	No	ArcGIS generated ID
SHAPE	SHAPE	Geometry	0	Yes	ArcGIS generated Element Type
FACILITYID	Facility Identifier	String	20	Yes	Master Unique ID
INSTALLDATE	Install Date	Date	8	Yes	Pipe Installation date
MATERIAL	Material	String	20	Yes	Pipe Material
DIAMETER	Diameter	Double	8	Yes	Pipe Diameter
MAINSHAPE	Main Shape	String	50	Yes	Pipe Shape (geometry)
LINEDYEAR	Year Lined	String	4	Yes	Year Liner Installed
LINERTYPE	Liner Type	String	20	Yes	Liner Type
OWNEDBY	Owned By	String	30	Yes	Owner Agency
LASTUPDATE	Last Update Date	Date	8	Yes	Date Element was updated
LASTEDITOR	Last Editor	String	50	Yes	Editor of last change
NOTES	NOTES	String	255	Yes	General Notes, up to 255 characters
MANNINGS	MANNINGS	Double	8	Yes	Mannings N Value
UPINVELEV	UPINVELEV	Double	8	Yes	Upstream Pipe Invert Elevation
DNINVELEV	DNINVELEV	Double	8	Yes	Downstream Pipe Invert Elevation
UPMHID	UPMHID	String	20	Yes	Upstream Manhole ID
DNMHID	DNMHID	String	20	Yes	Downstream Manhole ID
SLOPE	SLOPE	Double	8	Yes	(Upstream Invert Elev - Downstream Invert Elev)/Pipe Length
CONDITION	CONDITION	String	50	Yes	Condition of Pipe Based on CCTV
LIFECYCLESTATUS	Life Cycle Status	String	10	Yes	Life Cycle Status of asset
SOURCE	Source of Data	String	50	Yes	Typically will be CAD, Model or Other
GPSDATE	GPSDATE	Date	8	Yes	Date that upstream and downstream manholes were GPS'd
ENABLED	Enabled	Small Integer	2	Yes	For use with Geometric Network
SHAPE_Length	SHAPE_Length	Double	8	Yes	ArcGIS Generated Length

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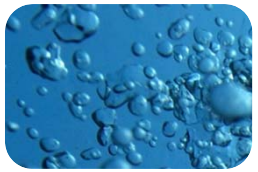
Domains



- Sample Feature Database Structure (red & blue text indicate use in the model)

Coded value domain
ssLineMaterial

Description	Sanitary sewer line materials
Field type	String
Split policy	Duplicate
Merge policy	Default value

Code	Description
AC	Asbestos Concrete
CIP	Cast Iron
CL	Clay
CO	Concrete
DIP	Ductile Iron
GP	Galvanized
HDPE	High-density Polyethelene
PE	Polyethelene
PVC	Polyvinyl Chloride
Wo	Wood
Unk	Unknown
Oth	Other

- Data Domains
  - Limits Attribute Values
  - Maintains Data Consistency
    - Field Data Entry
  - Facilitates Data Searches
  - Standardized Across Feature Classes Where Possible
- Examples
  - Material
  - Diameter
  - Pressure Zone

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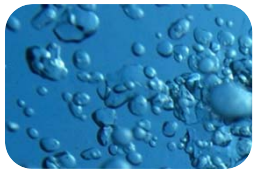
Database Design Changes



- Changes can always be made, but need to consider implications on any other systems that use the data:
  - Hydraulic model
  - Asset/Maintenance Management software
  - Financial/Billing software
    - Existing 1980s DOS based system
    - RFP underway for Integrated Financial System
      - Would link to GIS

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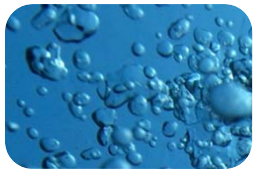
Facility Tours



- Field observation provides reality check for information
- Staff can provide details about systems and facilities that aren't easily captured in tabular formats
- Provides many awkward photo opportunities

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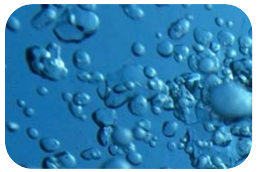
Data Conversion



- Combination of automated & manual processes
  - CAD data imported where available
  - Attribute data (e.g. diameter, material) manually added from hard copy maps
  - Facilities converted from CAD structure to GIS features
- Issues identified
  - Cross connected or unconnected piping
  - Hard copy mapping provided for review
    - Missing infrastructure hand drawn by City staff
  - Several iterations of QA/QC was completed

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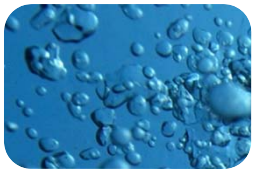
GIS Issues



- Coordinate System differences
- Attributes
- Incorrect topology (connectivity)
- Facilities not represented accurately
- County data challenges (e.g. duplicate, overlapping parcels)
- Staff had little GIS experience
- No software to review initial mapping

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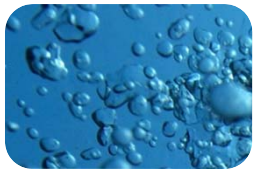
A Foots a Foot Right?



- Coordinate System differences
  - NAD 83_StatePlane_Oregon_North_FIPS_3601_Feet
    - US foot = 0.3048006096 meters
  - NAD 83_StatePlane_Oregon_North_FIPS_3601_Feet_Intl
    - International foot = 0.3048 meters
  - Center of City
    - 8,643,056, 733,371
  - Difference of 5 feet in x coordinate

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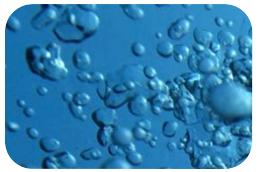
GIS Issues



- Attributes
  - Missing attributes
  - Inconsistent attributes (e.g. rim elevation lower than invert elevation)
  - Contradictory attributes from different sources

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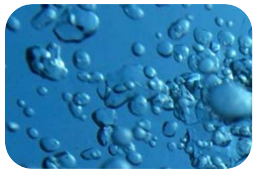
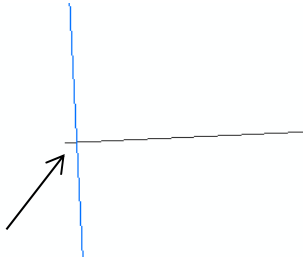
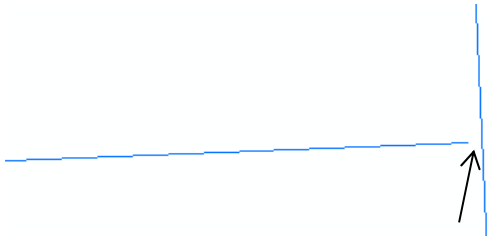
GIS Issues



- Incorrect topology/connectivity



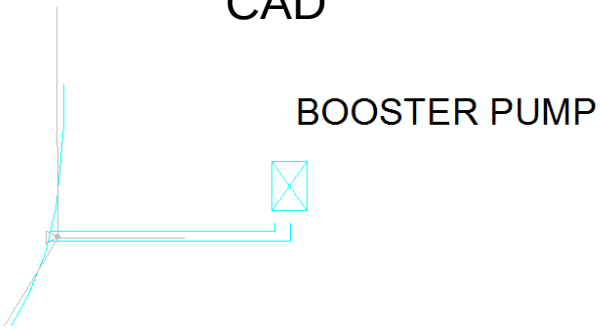
Overlapping Pipe



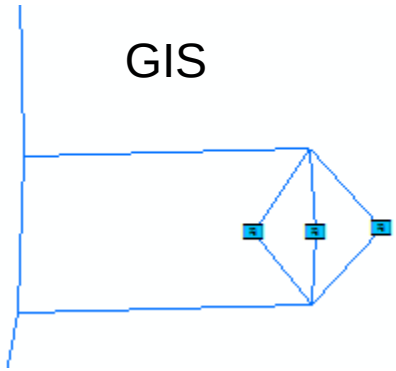
Disconnected Pipe

- Facility Representations

CAD



GIS



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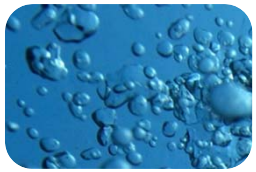
Surveying



- Mix of City & Contracted Staff
- Survey focus on Sewer & Stormwater systems
- No time or budget for entire systems to be surveyed
- Subset of features identified for surveying
- Survey points selected at key elevations for hydraulics otherwise at every 3rd manhole
- Ongoing data collection - all points will be surveyed over time

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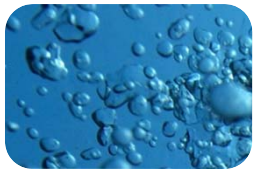
QA/QC



- Again, a combination of automated & manual processes
  - Worked with City to investigate discrepancies
  - Additional survey data collected where needed
  - Geometric Network implemented
- Huge QA/QC value in using the data for modeling
  - Many additional issues were identified and corrected

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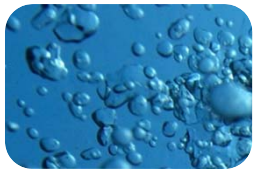
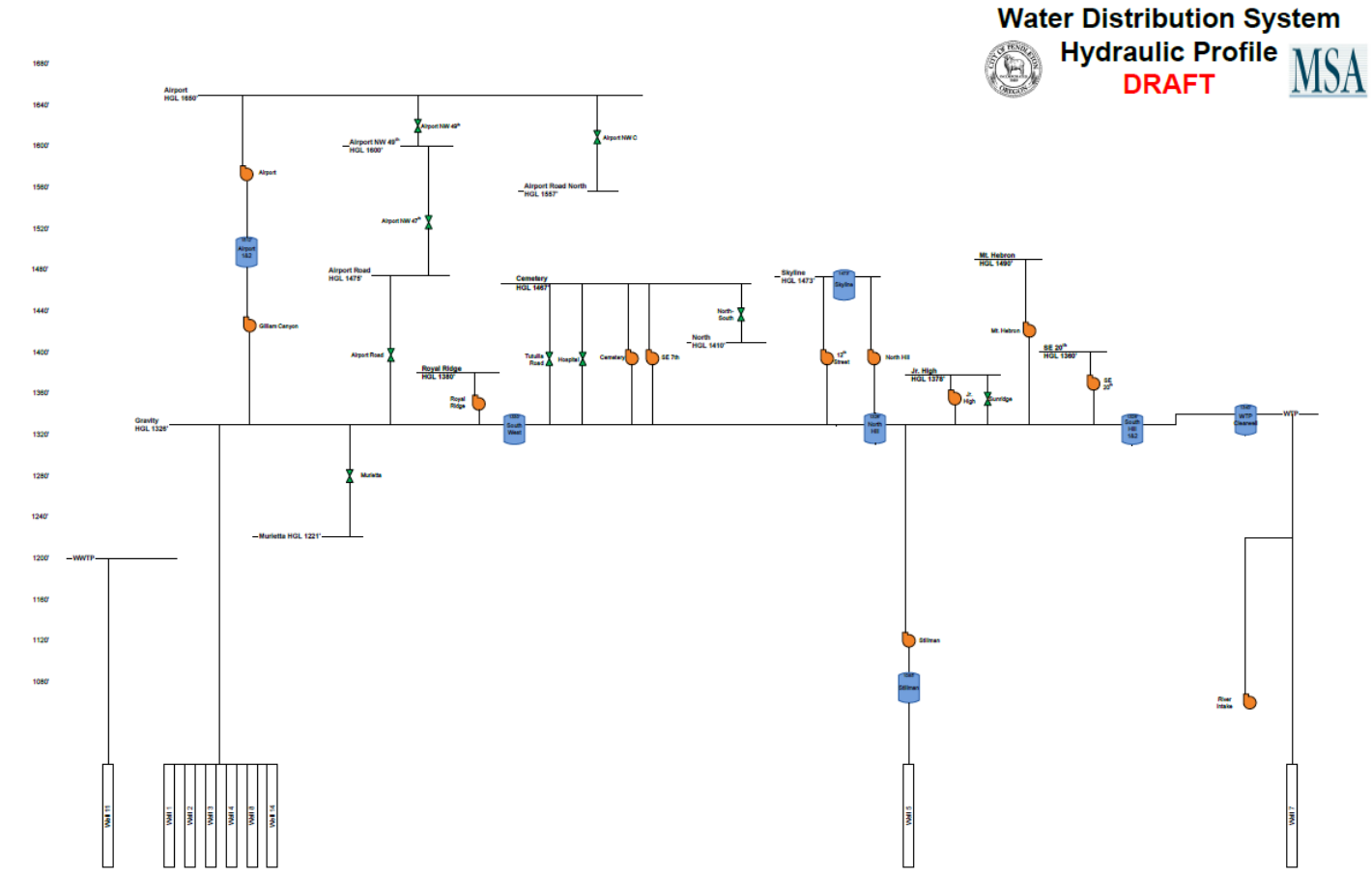
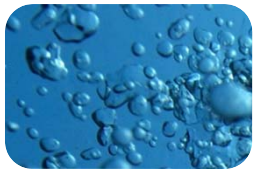
Hydraulic Profile



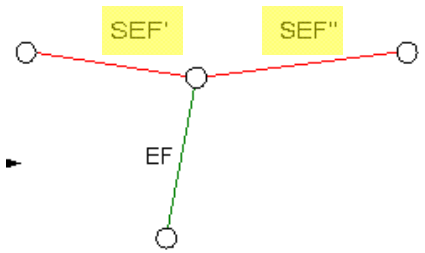
- Can be used to validate assumptions about the system and verify connectivity
  - Review pressure zone boundaries

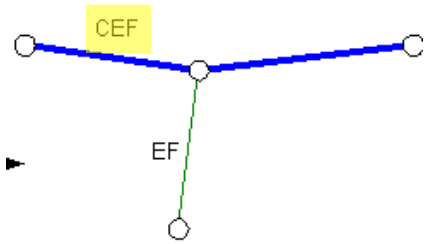


Geometric Network



- Geometric Network
  - Built on ESRI Geodatabase structure
  - Allows connectivity behavior to be dictated and checked (e.g. hydrants can only connect to hydrant laterals)
  - Complex vs. Simple Edges
    - Determines if pipe splits into two features at junctions
    - Determines whether service/hydrant laterals split mains
    - Important consideration for model compatibility





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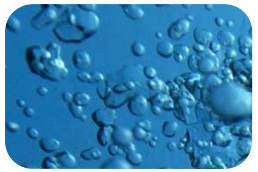
Geometric Network



- Determine which features can connect and how they are connected
- Used to check for existing issues and ensure future edits are implemented consistently

		Line
		wLateralLine
Line	wCasing	
Line	wHydrantLateral	
Line	wLateralLine	
Line	wMain	Fitting (DEFAULT)
Point	wBoosterPump	
Point	wControlValve	
Point	wFitting	X
Point	wFlusher	X
Point	wHydrant	
Point	wLeak	X
Point	wMeter	X
Point	wNetworkStructure	X
Point	wSamplingStation	X
Point	wServicePoint	DEFAULT
Point	wSystemValve	X
Point	wTank	
Point	wTestStation	X
Point	wWellPump	

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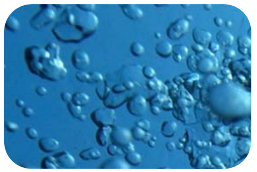
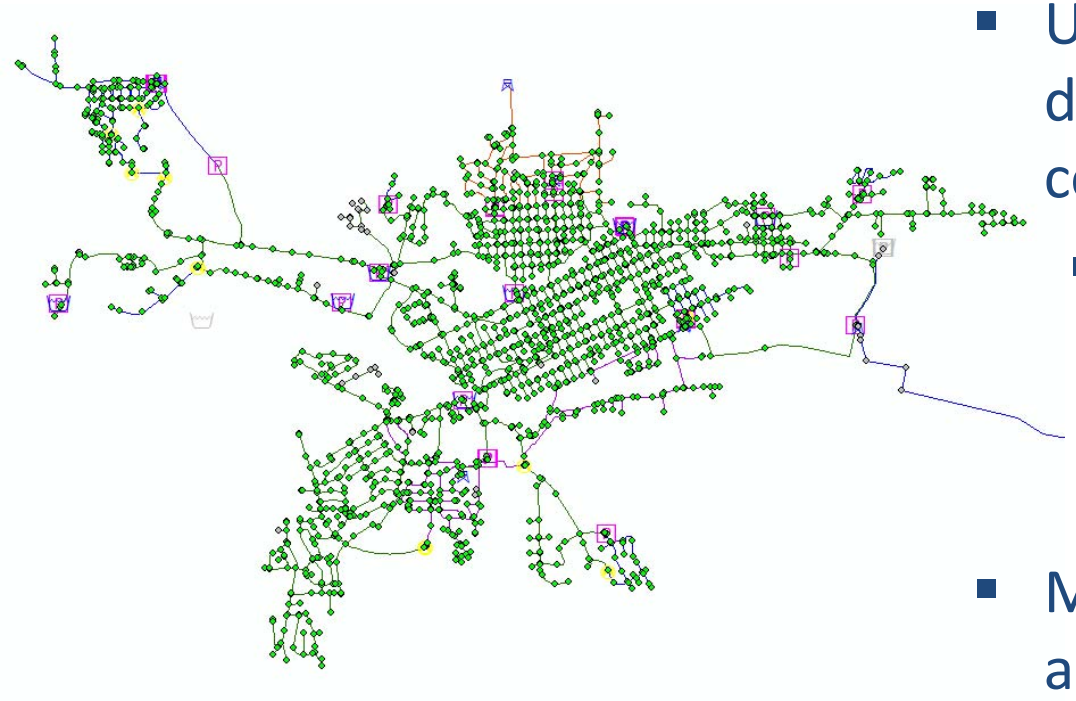
Model Integration





- Unique Opportunity to develop GIS and model concurrently
  - Ensures database design and network structure were compatible with model
- Model provides an additional QA/QC tool

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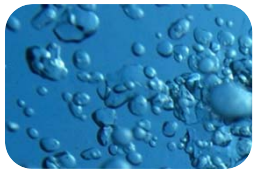
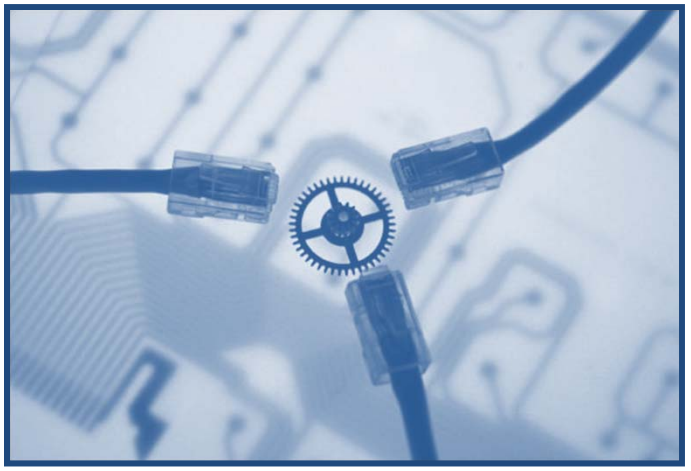
What is Model Integration?



- Software Vendors tout being “fully GIS Integrated”, without clarifying what that means
- Typically there are two primary meanings
  1) Performing hydraulic modeling in a “GIS Environment”
  2) Utilizing a GIS Database as the “source” of model information
- However it **Does Not** mean modeling directly from the GIS database



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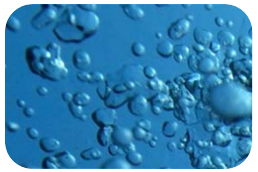
What Does it Take?



- Unique identifiers must be maintained for all elements
- GIS databases should utilize the “geometric network” to enforce connectivity rules
- Typically employ “complex edges” that allow features to be “associated and snapped” without splitting pipes at:
  - Service lines
  - Hydrant laterals
  - Valves
  - Other appurtenances
- Use Hydraulics Based GIS Data Model

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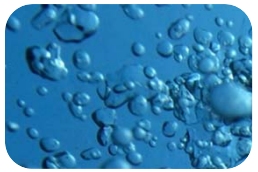
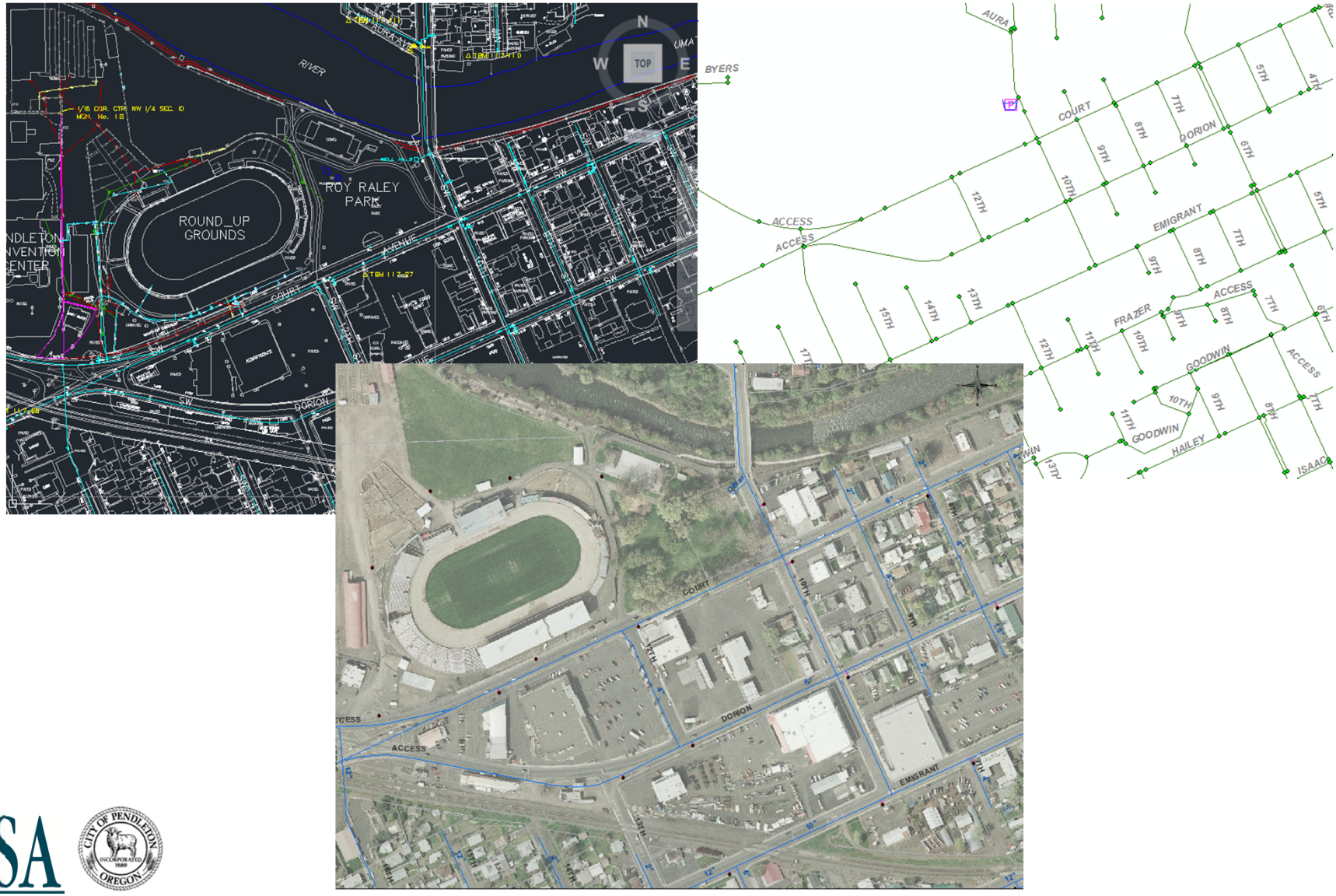
Results | Water System





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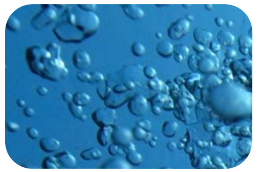
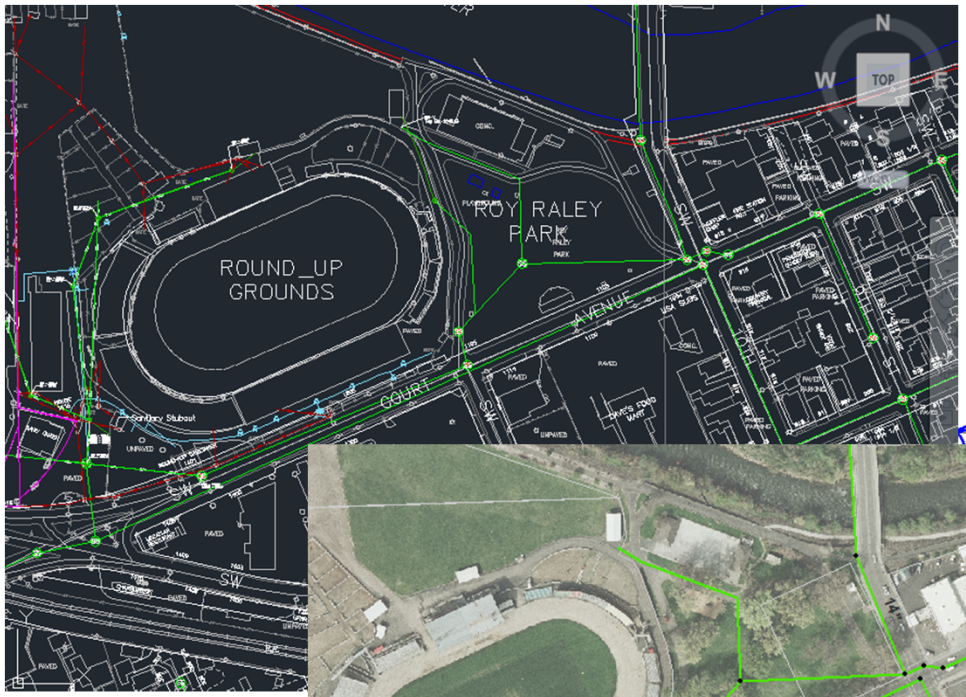
Results | Collection System





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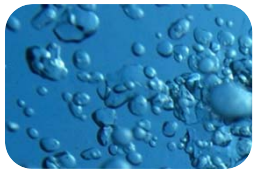
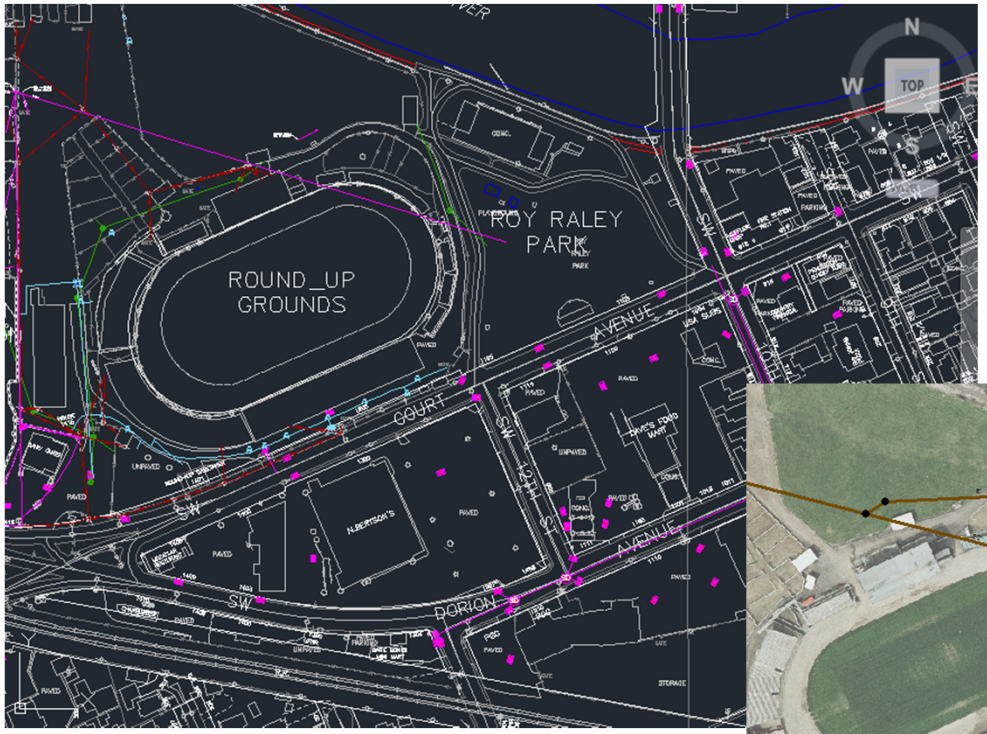
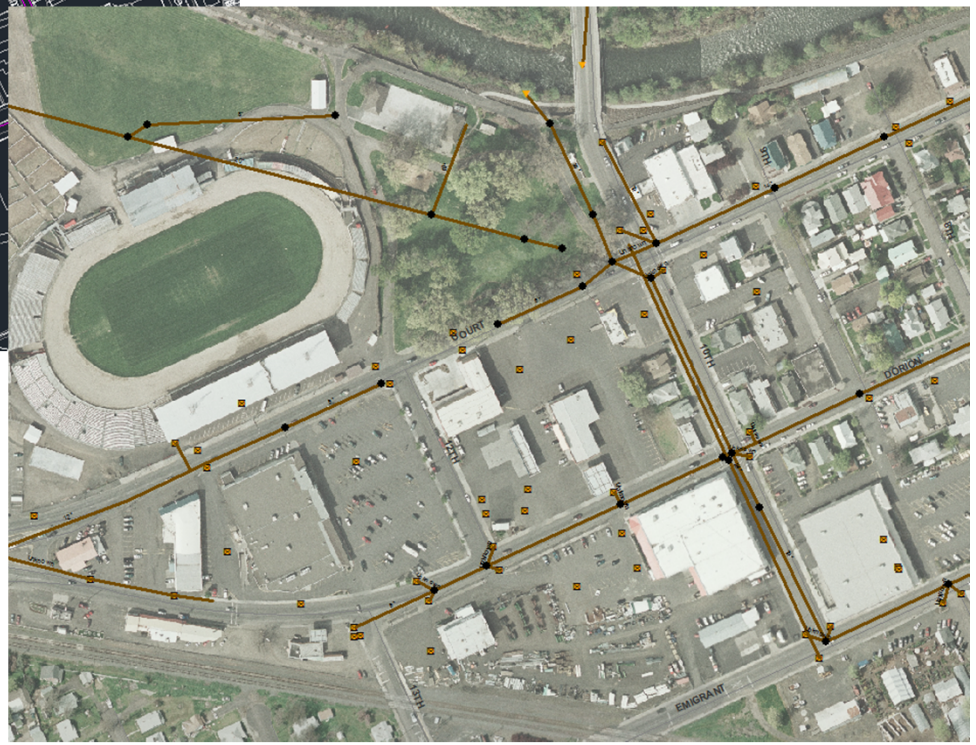
Results | Stormwater System







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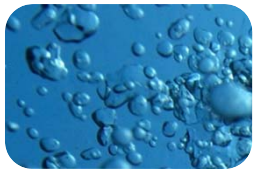
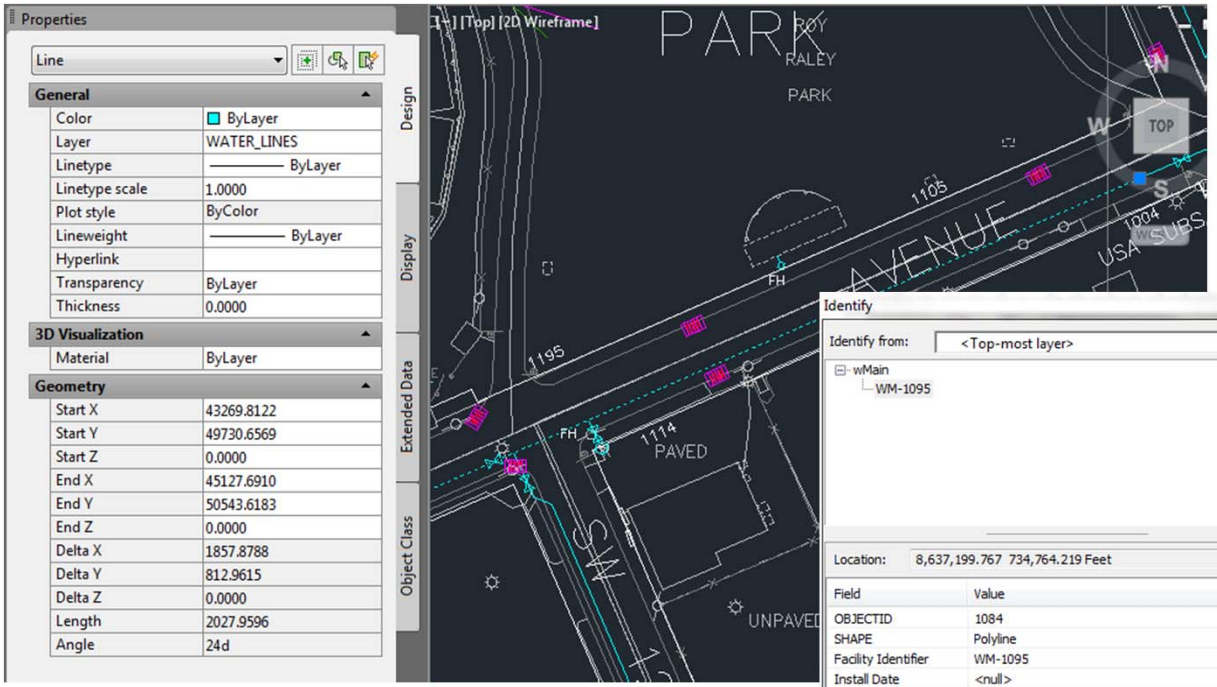
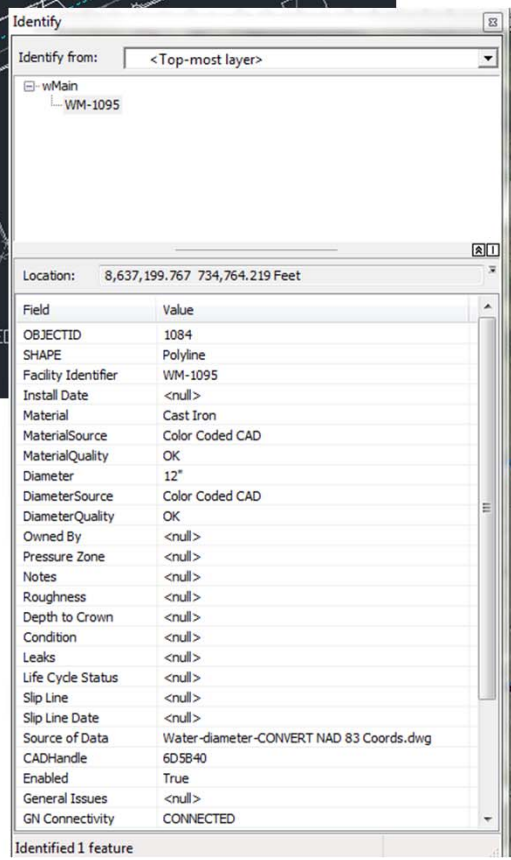
Results | Attributes







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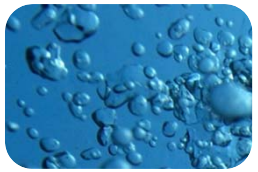
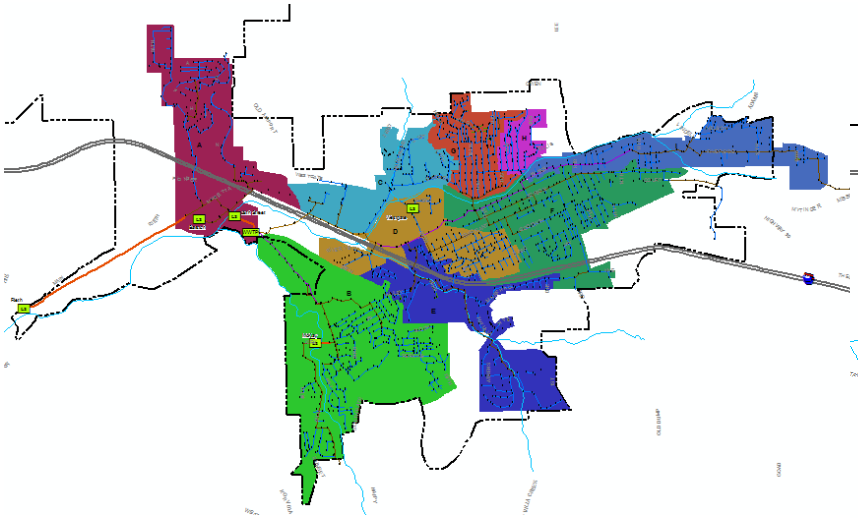
Ongoing Data Collection

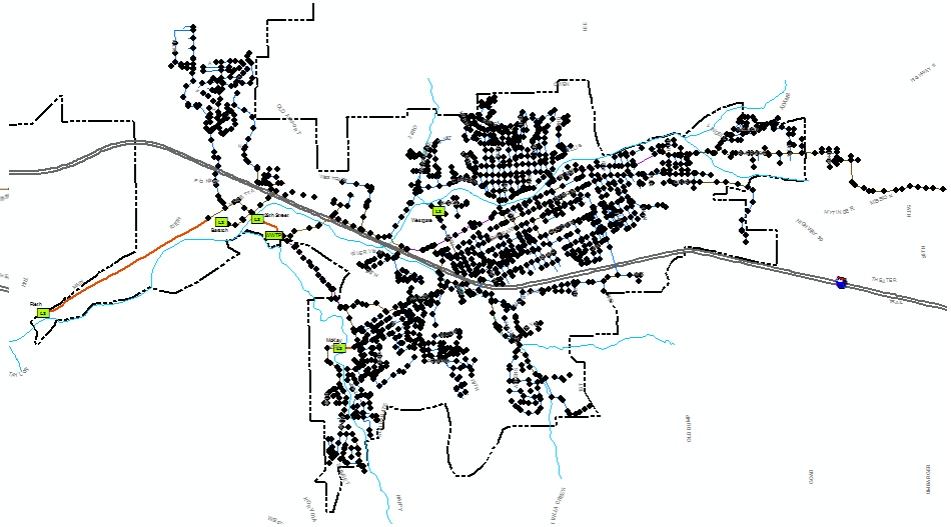


- **Process for Collecting Additional Data**

By Area



By Feature



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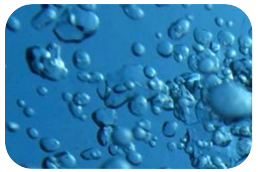
Ongoing Data Collection & Maintenance



- Think holistically about data management & maintenance
  - In other words - Where are we today and where do we want to be? – Succession planning
- Understand the investment required to maintain your GIS and model databases whether you use:
  - In-house specialists
  - Consultants
  - Combinations thereof

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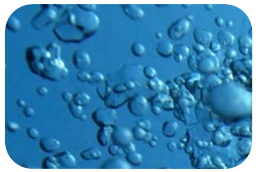
Transition to City Staff



- Critical that everyone knows:
  - Who owns the data
  - How data moves between departments and staff
- GIS Staff typically don't have the hydraulics background to do modeling and Engineers typically aren't the best ones to maintain the GIS
- Ideally have GIS Staff reside in the Engineering Group
- The key, as with almost everything in life, is……
  Effective Communication

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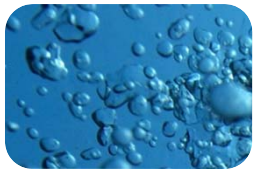
City's View of the Future



- Purchase of software – two phases
- Hire GIS Coordinator: June 30, 2014
- City Goals for this Project and Future Uses
  - Ensure Accuracy of Data
  - Populate Missing Attributes
  - Link GIS with Billing
  - Asset/Maintenance Management
  - Consistent Model Updating Process
  - Increasing Staff GIS Skills
  - Focus on Public Works in Near Term

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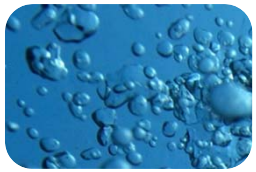
Final Take Away Thoughts



- Almost everything is in a constant state of change:
  - Staff
  - Software
  - Organizational Structures
  - Hairstyles
  - Priorities
  - Budgets
  - Users
- A well structured and maintained GIS can provide consistency and continuity when everything else changes

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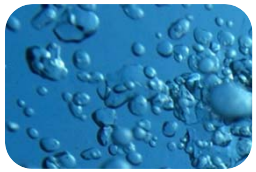
Final Thoughts!

Note: Not from a Pendleton Hotel

Thank You



- Questions

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David.Stangel@msa-ep.com

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