Sewer Lateral Mapping: An Automated Approach

MSGIC 2016 Fall Quarterly Meeting

David Thaler, GISP

david.thaler@ebaengineering.com

EBA ENGINEERING

EBA Engineering, Inc.
6100 Chevy Chase Drive
Suite 200
Laurel, MD 20707-2917

o 240.547.1124
f 301.725.0394
ebaengineering.com

EBA Engineering, Inc.

- Established in 1981
- 250+ employees
- 5 Mid-Atlantic region offices
- Certified MBE/DBE with various state and local agencies
- 90% of work from repeat clients
- “Where commitment counts”

EBA’s Lancaster, PA, office | 1525 Oregon Pike, Suite 202

EBA ENGINEERING

Office Locations

Headquarters
6100 Chevy Chase Drive, Suite 200
Laurel, MD 20707
p 240.547.1124
f 301.725.0394
Harish Patel, PE, RLS, LEED AP
email

DIRECTIONS

Maryland
4813 Seton Drive
Baltimore, MD 21215
p 410.358.7171
f 410.358.7213
Steve Diggins, PE
email

DIRECTIONS

Pennsylvania
1525 Oregon Pike, Suite 202
Lancaster, PA 17601
p 717.399.7007
f 717.399.7015
Bruce Stauffer
email

DIRECTIONS

Virginia
311 North Madison Road
Orange, VA 22960
p 540.672.4760
f 540.672.4763
Kevin Kreis, PE, CCS, DBIA
email

DIRECTIONS

EBA ENGINEERING

Our services

- Asset management
- Civil/site engineering
- Construction management and inspection
- Environmental engineering
- Geotechnical engineering
- Geospatial services
- Materials testing
- Structural engineering
- Surveying and mapping
- Transportation engineering
- Water resources
- Water systems engineering

EBA ENGINEERING

Geospatial Technologies

ArcIMS Server Troubleshooting and Enterprise GIS Architecture Design, Schuylkill County, PA

EBA ENGINEERING

Geospatial technology services

- Enterprise GIS: needs assessment, planning, architecture
- Custom, desktop, mobile, and web GIS solutions
- Map centric document and database integration
- Data maintenance: workflows, procedures, and tools
- Centerline geodatabase: routable network implementation
- On-call technical support services

Enterprise GIS Needs Assessment and Implementation Plan, Westmoreland County, PA

esri Partner Network Silver

esri ArcGIS Online Specialty

EBA ENGINEERING

Surveying and Mapping

Anacostia River Tunnel, Washington, DC

EBA
ENGINEERING

Surveying and mapping services

- As-built surveys
- Boundary surveys
- GPS surveys
- Ground controls for aerial surveys
- Planimetric surveys
- Right-of-way and easement plats
- Topographic and hydrographic surveys

Cedar Branch Stream Restoration,
Baltimore, MD

EBA ENGINEERING

Transportation Engineering

MD 231 at JW Williams Road Intersections Improvements, Prince Frederick, MD

EBA ENGINEERING

Transportation engineering services

- Transportation/traffic studies
- Multi-modal planning and design, including bicycle/pedestrian facilities
- Geometric and roadside design
- Traffic design including urban MOT
- Intersection/interchange design
- Highway drainage/SWM/E&S
- Low impact development design

Newkirk Street Reconstruction, Baltimore, MD

EBA ENGINEERING

Water Resources

EBA ENGINEERING

Water resources services

- Complex and basic water modeling—1-D and 2-D hydraulics
- Flood hazard analysis and flood risk management
- Funding assistance and CIP development
- MS4 program development, funding, and support
- Site evaluation, feasibility studies, and master planning
- Stormwater best management practices construction documents
- Stormwater utility study and implementation
- Watershed and stream condition assessments

Water Quality Management Retrofits, NASA GSFC, MD

EBA ENGINEERING

Water Systems Engineering

WSSC Asset Management Program Business Case Development, MD

EBA ENGINEERING

Water and wastewater systems design

- Pipeline condition assessment and rehabilitation
- Sewer system evaluation survey (SSES)
- Trenchless pipeline design
- Hydraulic modeling and analysis
- Pumping station design and upgrades
- Utility structures design
- Fat/oil/grease (FOG) management
- Water and wastewater treatment facility designs

EBA ENGINEERING

Feature Project

City Dock Bulkhead Replacement, Phase II, **Annapolis, MD**

EBA ENGINEERING

Sewer Lateral Mapping: An Automated Approach

- Goal: Expand the current GIS Sanitary Sewer Network
  - Current Mapped Assets
    - Gravity Mains
    - Pressure Mains
    - Pump Stations
    - Manholes
- Create a more complete network of the actual system
  - Map Lateral lines from property line to Main line connection
  - Approximately 185,000 lateral connections

Sewer Lateral Mapping

- City Lateral
- Main to Property Line

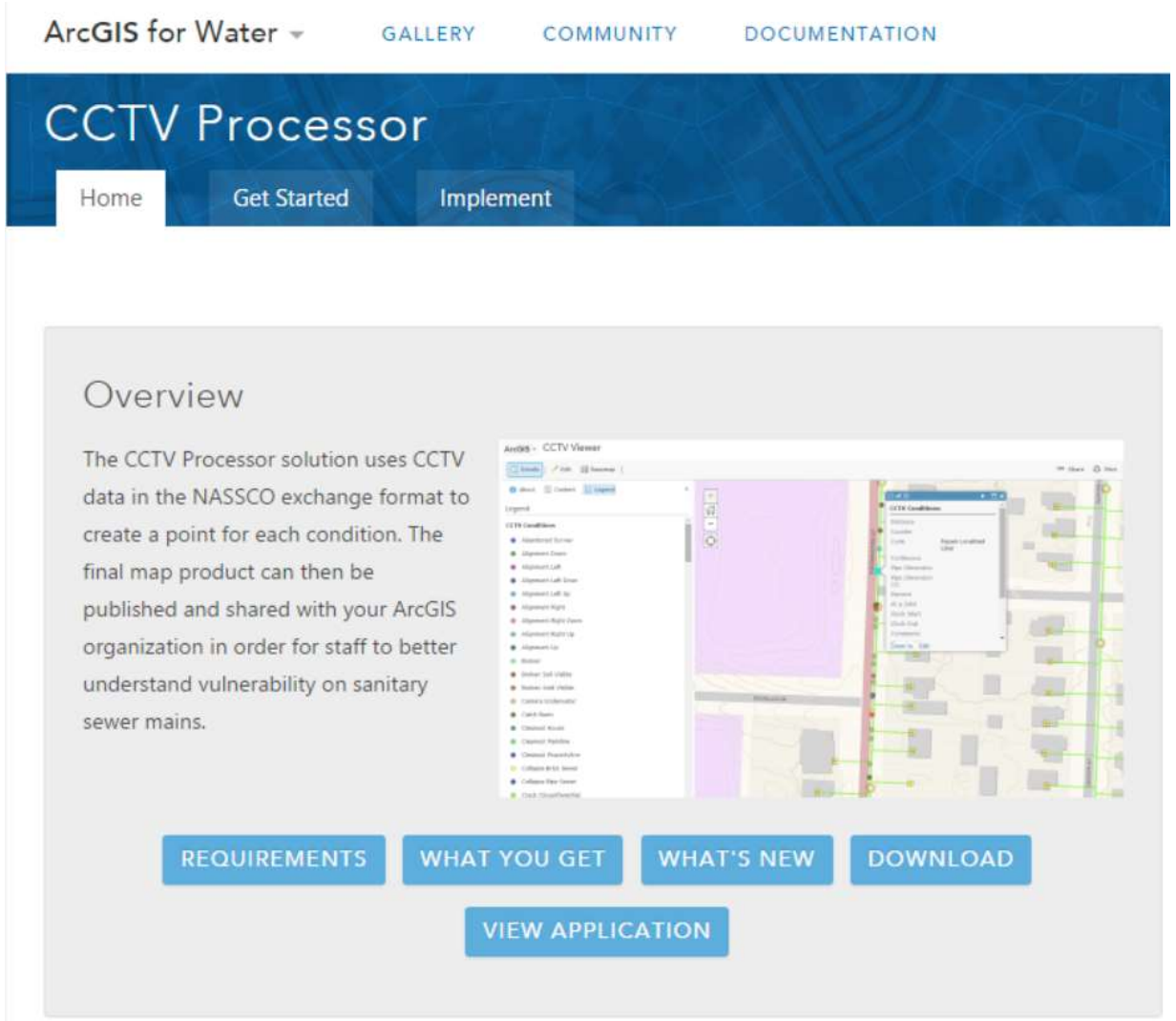
Sewer Lateral Mapping

- Approach:

- CCTV (Closed Circuit Television) Inspection data of Sewer Mains
- Map Lateral Tap Points observed in CCTV data
- Create Laterals extending from Tap Points to Property line
- Eventually Snap Lateral to Cleanout on Property
  - Cleanouts are being mapped with GPS

Sewer Lateral Mapping

- CCTV Processor
- Available from ArcGIS
- Maps observations for each condition found in Pipe
- Model Builder Tool



EBA ENGINEERING

Sewer Lateral Mapping

Data Returned from CCTV Inspection:

- Videos of Inspection
- Database
  - Pipes Inspected
  - Conditions Found, distance along pipe condition found

Inspections

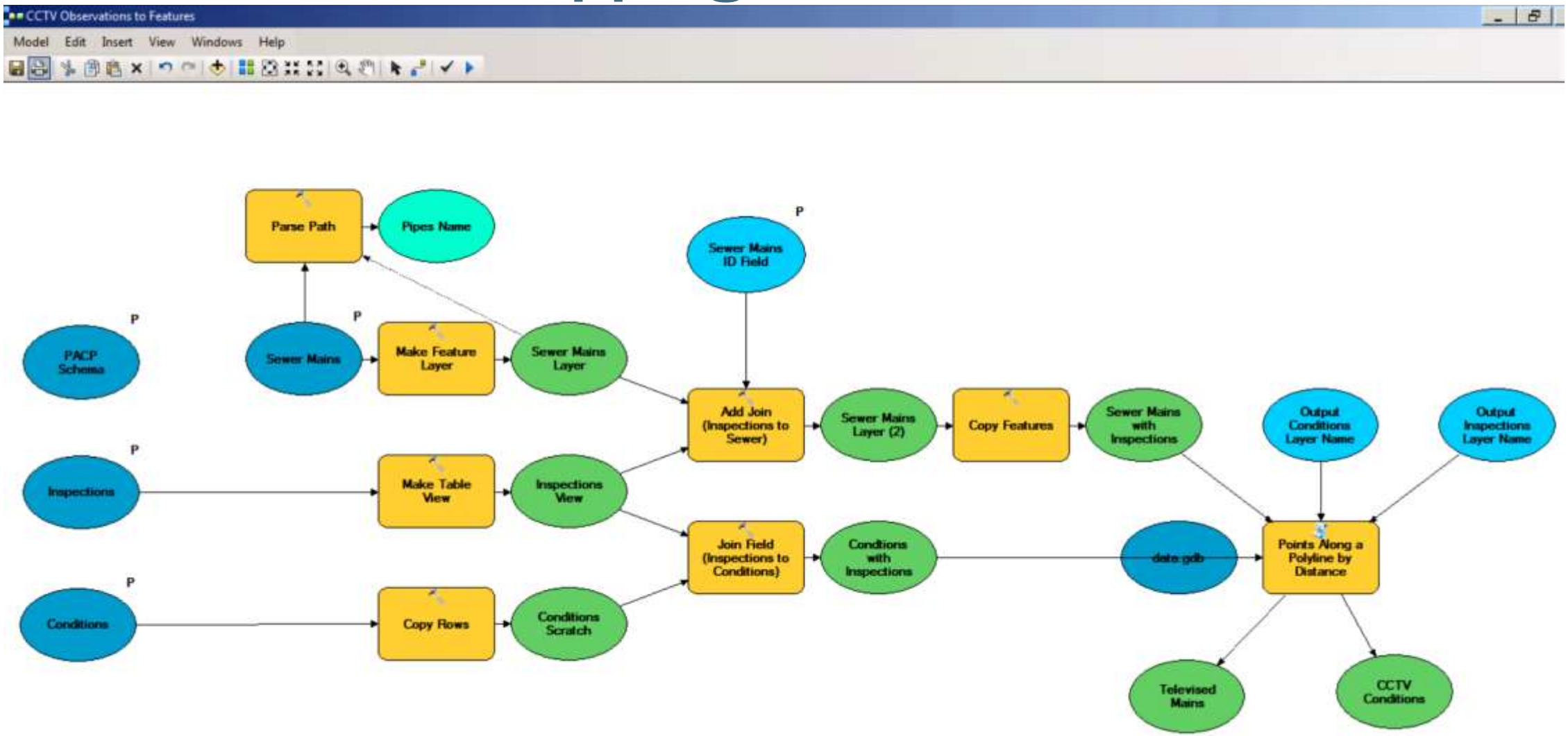
InspectionID *	Pipe_Segment_Reference	Upstream_MH	Downstream_MH	Direction *	Length_Surveyed
1	12470-10751	12470	10751	Downstream	163
2	12471-12470	12471	12470	Downstream	343
3	12472-12471	12472	12471	Downstream	344
4	13003-8458	13003	8458	Downstream	180.1
5	31003-12472	31003	12472	Downstream	325
6	61050-61047	61050	61047	Downstream	146.2
7	8453-8454	8454	8453	Downstream	274
8	8454-8455	8455	8454	Downstream	284
9	8455-8456	8456	8455	Downstream	329
10	8457-8458	8458	8457	Downstream	261
11	C506-12470	C506	12470	Upstream	81

Conditions

ConditionID *	InspectionID *	Distance	PACP_Code *	Clock_To
1	1	0	AMH	<Null>
2	1	0	MWL	<Null>
3	1	10.7	IS	6
4	1	20.5	IS	6
5	1	35.6	MWLS	<Null>
6	1	39.8	TFA	<Null>
7	1	41.1	CM	6
8	1	44.4	MWLS	<Null>
9	1	47.4	IS	6
10	1	50.3	CC	10
11	1	103	TFA	<Null>
12	1	131.9	IR	6
13	1	135	MMC	<Null>
14	1	163	AMH	<Null>

EBA ENGINEERING

Sewer Lateral Mapping



EBA ENGINEERING

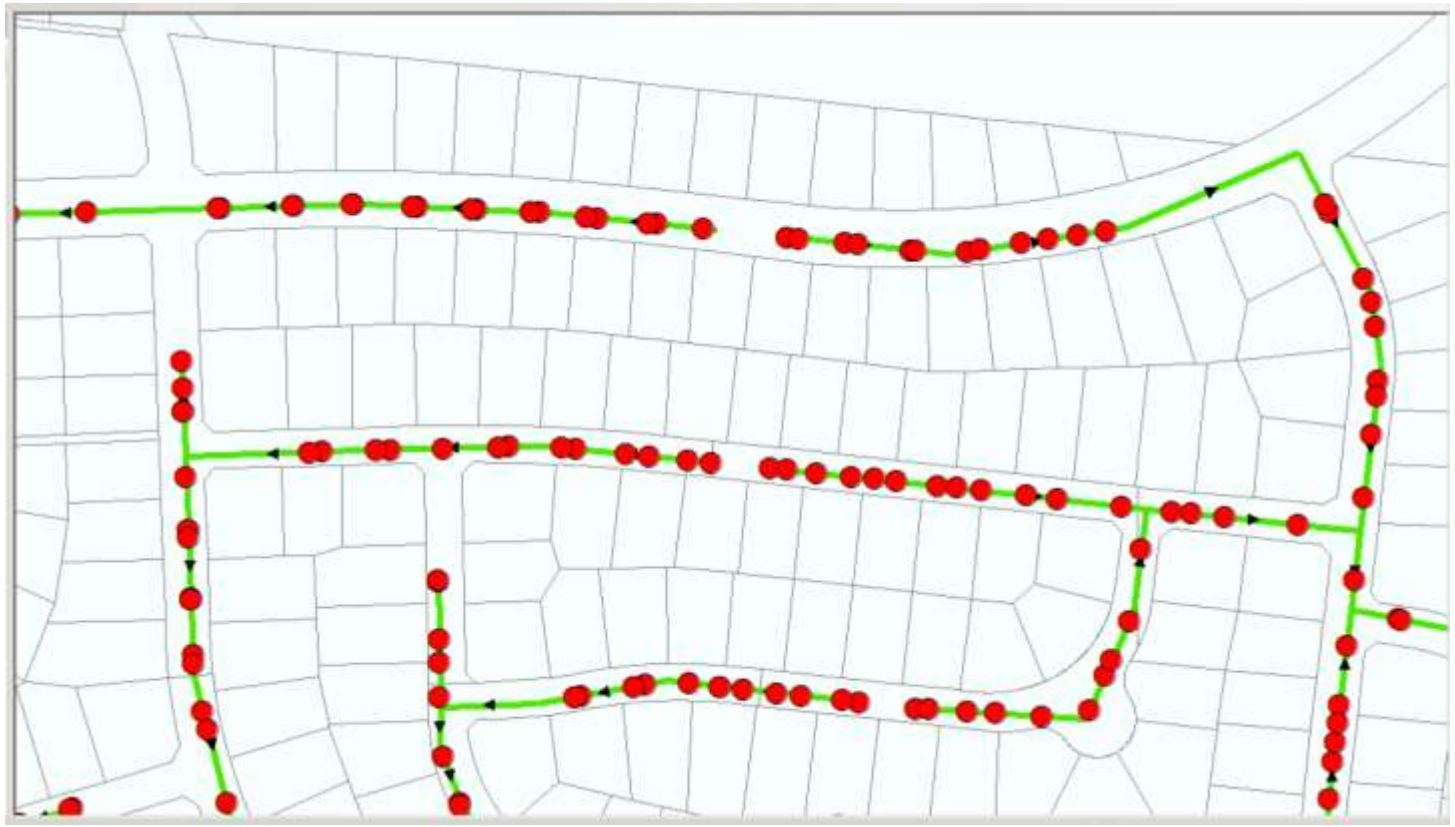
Sewer Lateral Mapping

- All observations mapped
- Query out TAP observations

CCTV Conditions

- Access Points
- Brickwork
- Broken
- Collapse
- Crack
- Deformed
- Deposits
- Fracture
- Grout Test and Seal
- Hole
- Infiltration
- Intruding Sealing Material
- Joint
- Line
- Lining
- Miscellaneous
- Obstacle
- Point Repair
- Roots
- Surface
- Tap
- Vermin
- Weld
- Other

Tap Observations: Point where lateral enters Main Line



EBA ENGINEERING

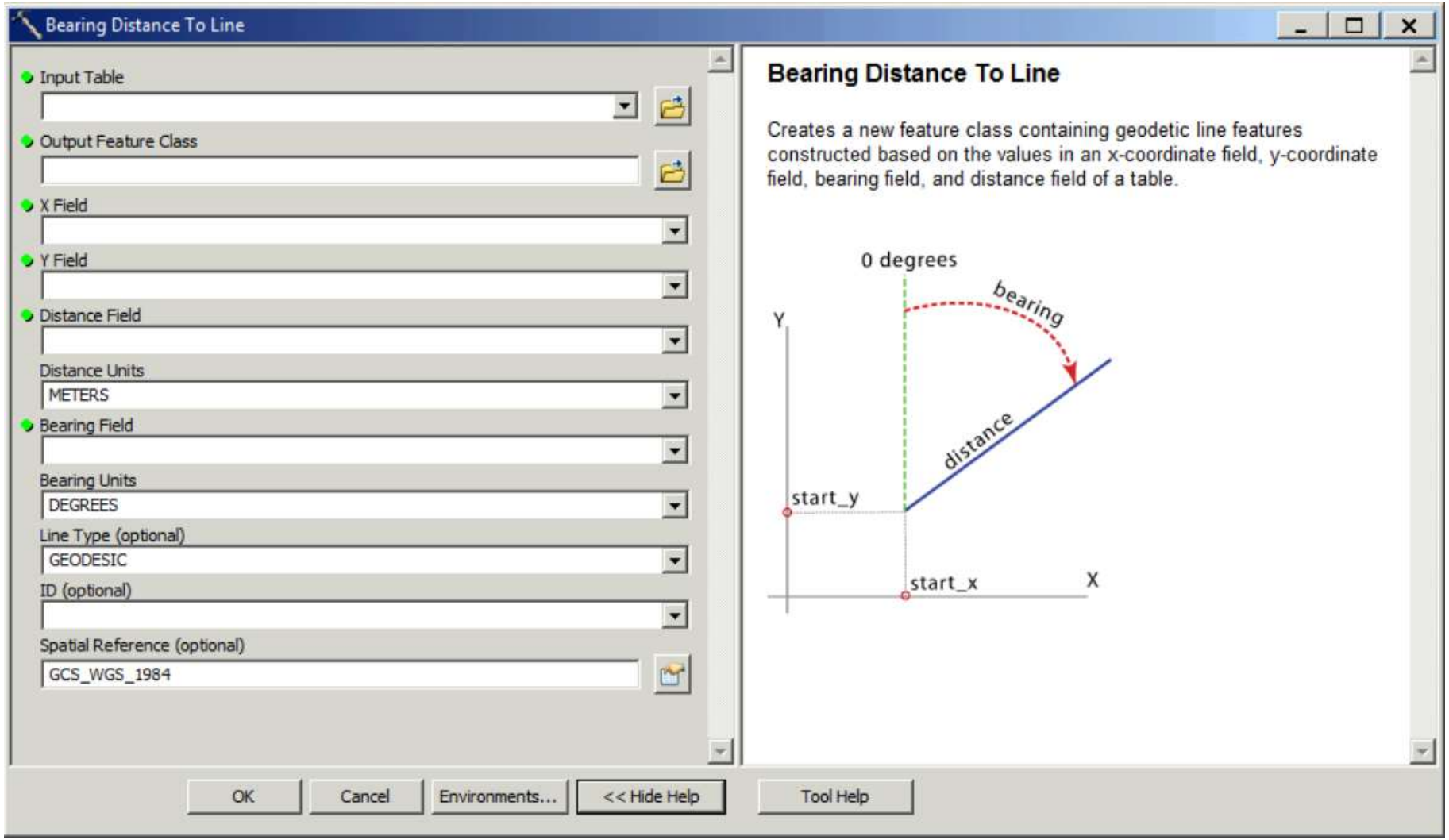
Sewer Lateral Mapping

- How to Create Laterals from TAP Points?

- Assumptions
  - Laterals extend from Main Line at 90 degree angle

Sewer Lateral Mapping

- How to Create Laterals from TAP Points?
- ArcGIS Tool: Bearing Distance to Line



EBA ENGINEERING

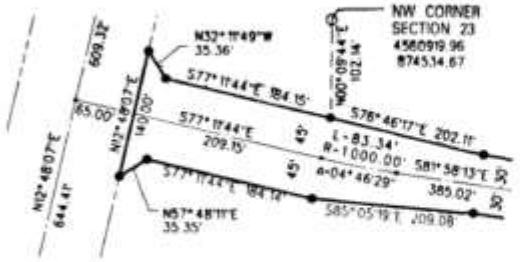
Sewer Lateral Mapping

- Start X, Y: will be calculated from TAP Point
- Distance: 70 feet
- Bearing: Need to calculate
  - Retrieve Bearing of Sewer Main
  - Add 90 Degrees or Subtract 90 Degrees depending on which side of the Main the Lateral is connecting

Sewer Lateral Mapping

- Calculating Lateral Bearing
  - 1st Calculate Main Bearing
    - COGO Tools in ArcGIS
    - Adds and calculates fields that describe the geometry of a line
      - Direction
      - Distance
      - Delta
      - Radius
      - Tangent

When surveyors or civil engineers need to record the location of human-made features, such as land parcels, road centerlines, utility easements containing transmission lines, and oil and gas leases, they typically provide the results on a survey plan that describes the location of features relative to each other. Below is an example survey plan that diagrammatically shows a road centerline and the edge of the land properties adjoining the road. The road centerline and parcel boundaries comprise a number of straight and curved lines.



Each line has measurements that describe it. A straight line has a direction and distance, while a curved line has a radius, angle, arc length, direction, and so on. These measurements are coordinate geometry descriptions. You can use these COGO descriptions to accurately re-create the features the surveyor captured. The survey plan also includes references to existing locations that help you to tie these new features into your GIS database. The reference could be the coordinates for a point or a measurement to a well-known location such as a control point, a road intersection, or an existing parcel corner.

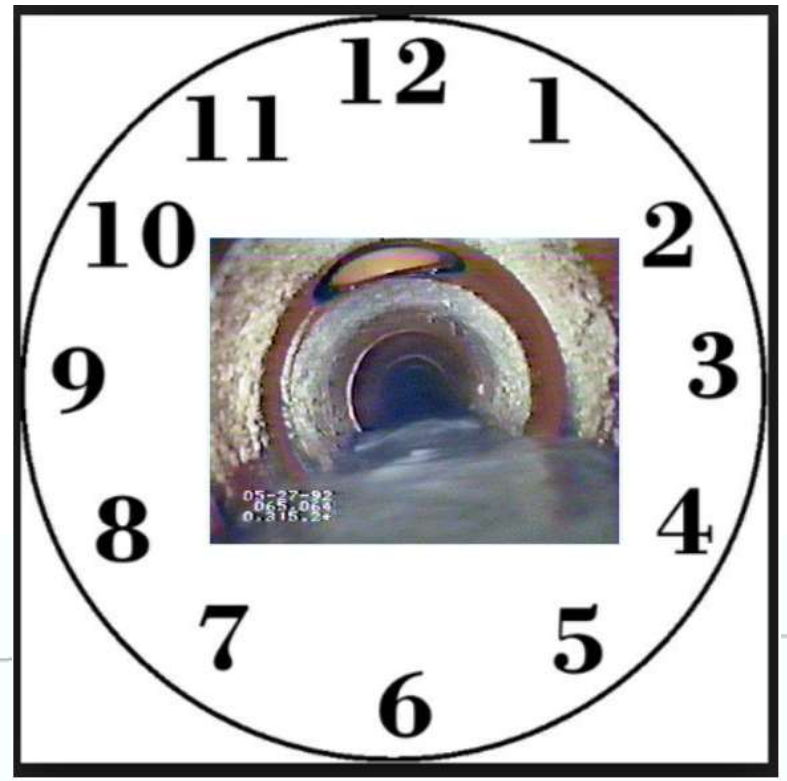
EBA ENGINEERING

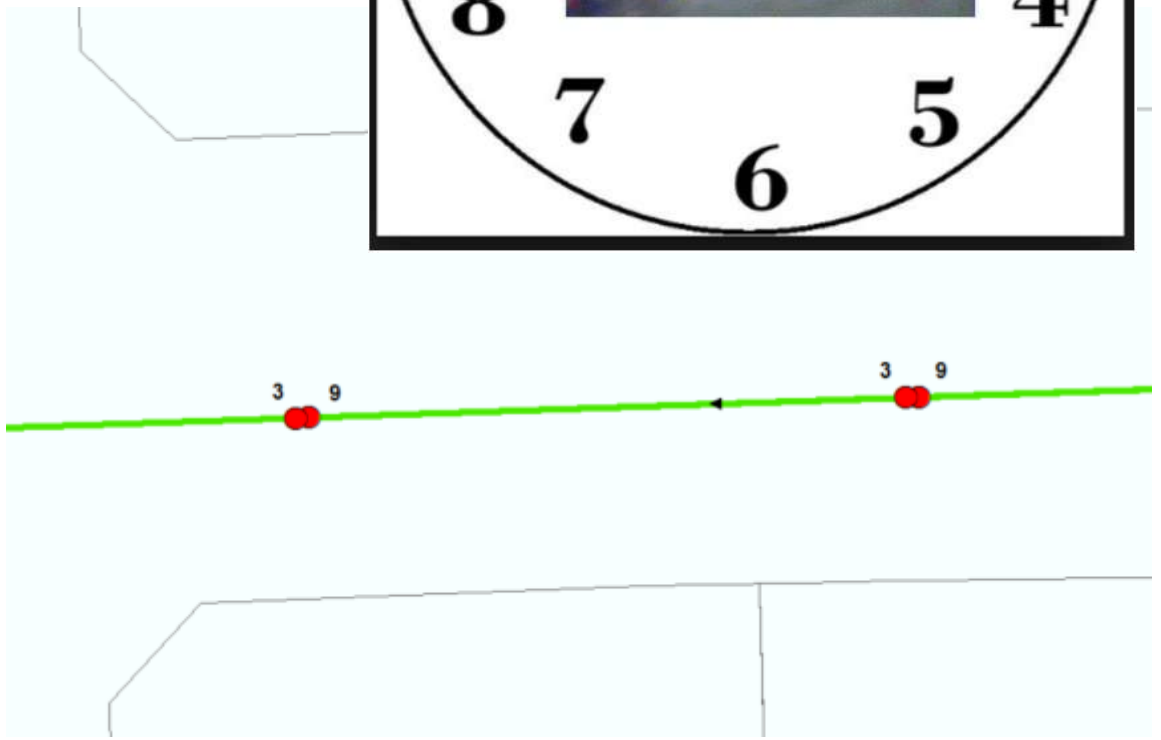
Sewer Lateral Mapping

- Calculating Lateral Bearing
  - 2nd Spatial Join Mains to TAP Points
    - TAP Points get all the attributes of the Main Line that it Intersects
    - TAP points get the Bearing Direction of the Main
  - 3rd Need to generate the Bearing of the Lateral

Sewer Lateral Mapping

- Which Side of Pipe does lateral connect to Main?
  - CCTV data – Clock Position
  - Position of TAP entering pipe
  - Based on Flow direction
  - 1-5: lateral goes to Right Side
  - 7-11: Left Side

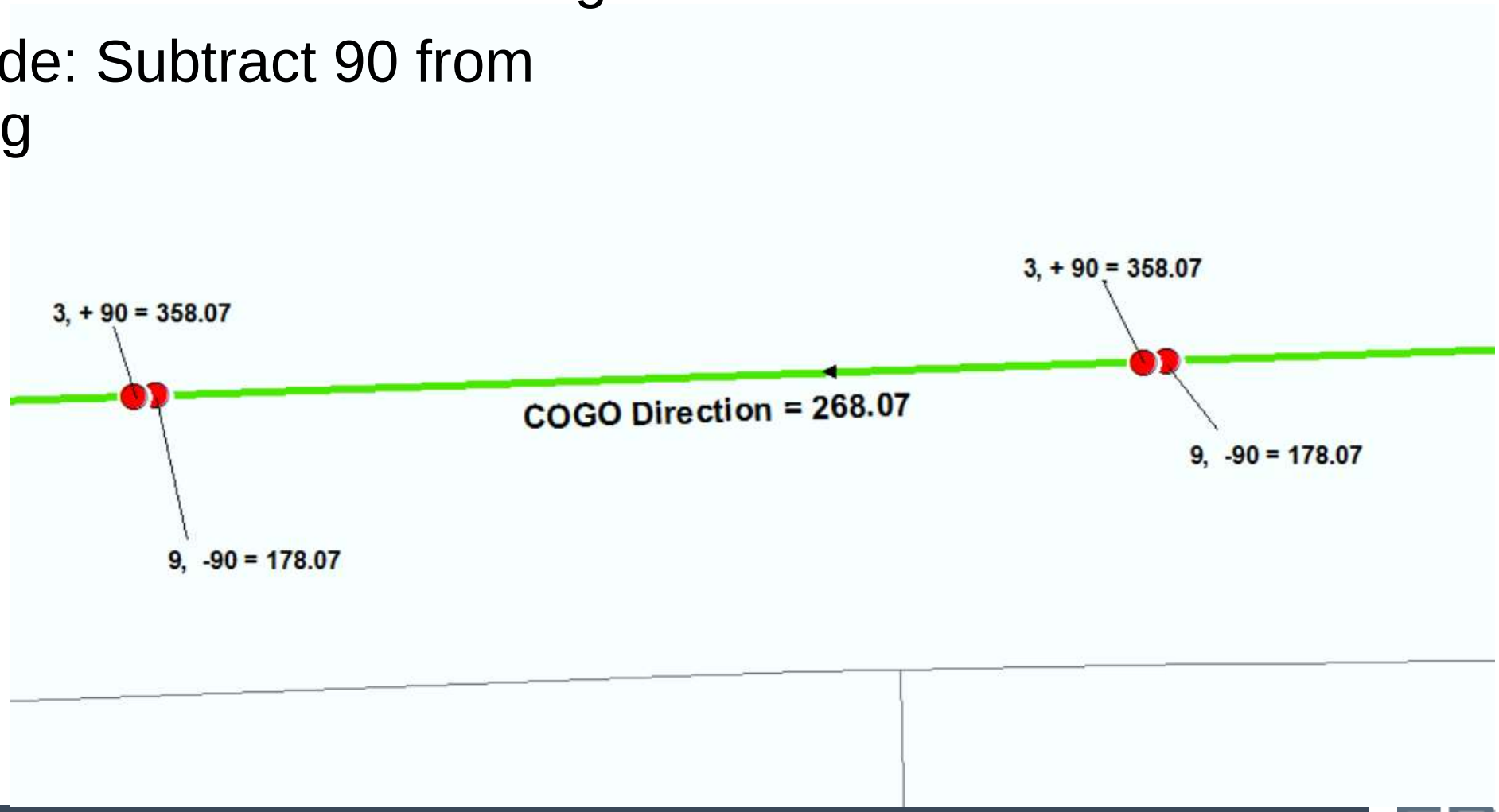




EBA ENGINEERING

Sewer Lateral Mapping

- Right Side: Add 90 to Bearing
- Left Side: Subtract 90 from Bearing



EBA ENGINEERING

Sewer Lateral Mapping

- TAP Point Attributes Needed for Bearing Distance to Line Tool
  - X
  - Y
  - Bearing
  - Distance

- Run Tool: Bearing Distance to Line

POINT_X	POINT_Y	BearingDistance	LateralBearing
1386401.130489	611504.831733	50	205.4136
1386349.284911	611529.464966	50	205.4136
1386347.659095	611530.237435	50	115.4136
1386294.332843	611207.89347	50	293.6868
1386306.264401	611235.091411	50	113.6868
1386328.319705	611285.366392	50	293.6868
1386329.16335	611287.289478	50	113.6868
1386353.347852	611342.417959	50	293.6868
1386355.436878	611347.179885	50	113.6868
1386377.130619	611396.630685	50	293.6868
1386377.974267	611398.553777	50	113.6868
1386399.868875	611448.462455	50	293.6868
1386401.957907	611453.224395	50	113.6868
1386285.575	611187.93	50	293.6868
1386285.575	611187.93	50	113.6868
1386025.096203	610609.140939	50	324.659
1386040.449786	610642.585032	50	114.659
1386054.468276	610673.120943	50	294.659
1386066.442405	610699.203705	50	114.659
1386084.75823	610739.10033	50	294.659
1386092.142969	610755.186209	50	114.659
1386112.795209	610800.172152	50	294.659

Sewer Lateral Mapping

EBA ENGINEERING

Sewer Lateral Mapping

- Why are Laterals important in the GIS?
  - Inflow & Infiltration
    - Rain events cause overflows when runoff enters cracked Laterals
    - Improper Connections to the Sewer System
      - Uncapped Cleanouts
      - Sump Pump Connection
      - Gutter Downspout Connection
      - Driveway Drain Connection
      - Lead to increased Volume

EBA ENGINEERING

Sewer Lateral Mapping

- Generate Work Orders for Laterals
  - Smoke Testing
  - Dye Testing
  - Jetting
  - Root Removal

EBA ENGINEERING

EBA ENGINEERING

where commitment counts

To learn more, visit
www.ebaengineering.com or LinkedIn