



TENNESSEE

SPOTLIGHT

Progressing Towards Stormwater Asset Management

May 16, 2024 / 11:00 a.m. – 12:00 p.m.(Eastern)

www.SESWA.org



Today's Presenters



Karen Ferency, PE
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CDM Smith
ferencyks@cdmsmith.com



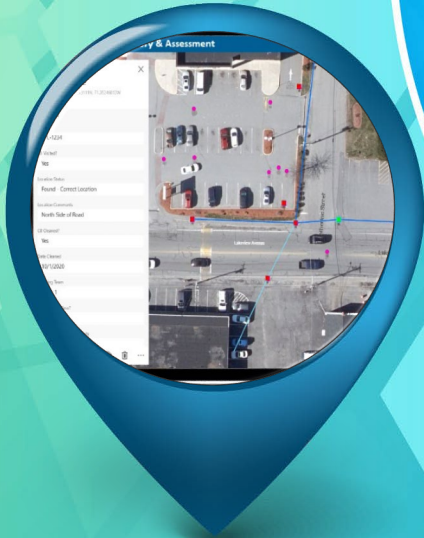
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Stormwater Engineering Manager
City of Knoxville
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VP, Water Resources Engineer
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Progressing Towards Stormwater Asset Management

City of Knoxville, TN



SeSWA
— SPOTLIGHT —

TENNESSEE

Webinar series bringing state-specific content to light.

Randall Whitehead
David Mason
Karen Ferency

May 16, 2024

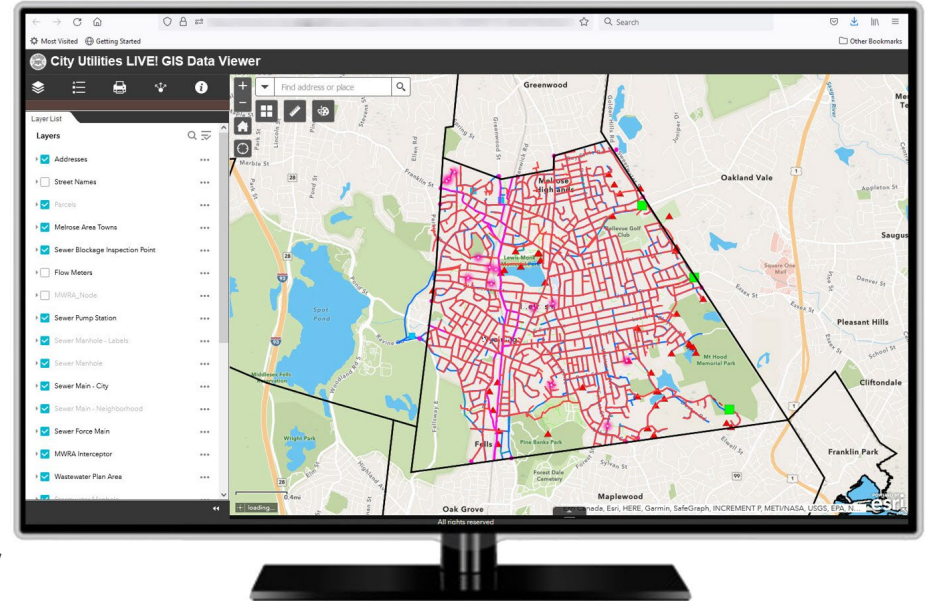


Program History and Project Development

- Original inventory developed in early NPDES MS4 days
- GIS data updated periodically over time using as-built information
- Data lacked attribute or condition information
- ARP funds secured to modernize and update city-wide GIS database

The Rise of the Technology-Driven Organization

- Increasingly **Making Decisions** Based on Data
- Require **Instant Access** to Information, Regardless of Location
- **Leveraging Technology** in Every Facet of Their Organization
- Employing **Asset Management** Principals to Operate More Efficiently



Employing Technology to Support Stormwater

- Stormwater Inventory & Assessment
- Stormwater Asset Management
- Stormwater Compliance
- Modeling & Resiliency
- Maintenance & Operations
- Stormwater Funding



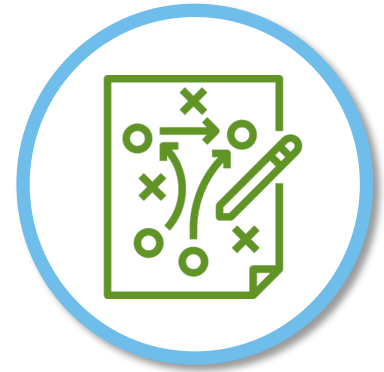
Stormwater Inventory/Asset Management Development Process



Plan



Develop



Implement

KGIS & City GIS Environment Overview

Table Of Contents

- Layers
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 - KGIS.UTIL_swWeirStructure
 - KGIS.UTIL_swDischargeStructures
 - KGIS.UTIL_swWaterQuantityUndgd
 - KGIS.UTIL_swDepression
 - KGIS.UTIL_swManagementPoint
 - KGIS.UTIL_swWaterQualityUnit
 - KGIS.UTIL_swMiscDrain
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 - Roof Drain
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 - KGIS.UTIL_swStructures
 - City Storm Polygon
 - Basemap
 - World Light Gray Canvas Base
 - Basemap
 - World Imagery

Identify

Identify from: City Storm Layers

City Storm Layers

- KGIS.UTIL_swInlet

Location: 2,574,182.814 607,757.514 Feet

| Field | Value |
|--------------------------|--|
| Basin Name | EAST FORK |
| CREATED_DATE | <null> |
| CREATED_USER | <null> |
| Date Attributes Modified | 9/5/2017 9:03:42 AM |
| Date Created | <null> |
| Device ID | PT078691 |
| Easting | <null> |
| OBJECTID | (FACD0A61-E2BA-4E48-A349-F59E047CE63E) |
| Inlet Elevation | <null> |
| LAST_EDITED_DATE | <null> |
| LAST_EDITED_USER | <null> |
| Map X | 2574180.53328 |
| Map Y | 607755.655284 |
| Modified By | rdtaylor |
| Northing | <null> |
| Notes | <null> |
| OBJECTID | 14597 |
| ROTATION_ANGLE | 120.068086 |
| Shape | Point |
| Source | <null> |
| SPAP ID | <null> |
| SWMA ID | <null> |
| Top Elevation | <null> |
| Type | Catch Basin |
| WIDTHINSERT | <null> |
| WITHSLUM | <null> |

Identified 3 features

2574276.13 607238.677 Feet

Knoxville's Priority - Build an Accurate & Complete Inventory of the Stormwater System



Data Development to Accommodate Priorities: NPDES Reporting, Modeling, & CMMS



Prioritization & Maintenance Plan
Risk Reduction
Capital Projects & PM Program

Geodatabase Design

| Name |
|-----------------------------|
| UTIL_swDepression |
| UTIL_swDischargeStructures |
| UTIL_swGreenInfrastructure |
| UTIL_swInlet |
| UTIL_swJunction |
| UTIL_swManagementPoint |
| UTIL_swMiscDrain |
| UTIL_swMiscPolygon |
| UTIL_swOpenDrain |
| UTIL_swPipe |
| UTIL_swPoint |
| UTIL_swRehabilitatedPipe |
| UTIL_swStructures |
| UTIL_swWaterQualityUnit |
| UTIL_swWaterQuantitySurface |
| UTIL_swWaterQuantityUndgd |
| UTIL_swWeirStructure |

- **Project Area** – The project area includes the entire City of Knoxville, minus the University of Tennessee campus. Mapping will only be completed within the City of Knoxville rights-of-way. Stormwater mapping will not be completed on private property.
- **Features to be Mapped** – Features to be mapped include manholes, catch basins, inlets, outfalls, culverts, headwalls, pipes, and other applicable “hard” stormwater system assets. Driveway culverts, streams, and roadside swales will be mapped using existing GIS data and aerial imagery only (for system connectivity).
- **Coordinate System** – All data will be delivered in Tennessee State Plane Coordinate system, Datum NAD 1983 (2011) in US Feet with a sub-foot horizontal accuracy and NAVD 88 (US Feet) vertical sub-foot accuracy.
- **Junctions & Manholes** – Horizontal survey will occur at center of structure. Attributes to be collected include rim, invert, and condition.
- **Inlets and Catch Basins** – Horizontal and vertical survey will occur at center of throat for curbs and center of grate for all other inlets. Attributes to be collected include rim, invert, and condition.
- **Culverts and Headwalls** – Horizontal and vertical survey will be collected at center of each barrel and structure dimensions will be recorded. Ground elevation, top elevation, and invert elevation will be collected for headwall and culvert. Structure material will be identified. Culverts 48-inches and larger are included in Task 3.
- **Outfalls** – Horizontal and vertical survey will occur at structure center. Attributes to be collected include rim, invert, condition, pipe size, and material. Any visible discharge will be documented with an estimate of time since the most recent rainfall event.
- **Pipes** – Pipe information will be captured as part of the field inventory process. Pipe locations, inverts, pipe size, condition, and material will be collected. Pipes will be snapped to structure location (inlet, junctions, outfall, culvert, etc.). Invert, material and diameter will be collected during structure survey. The process of integrating the pipes with the survey will occur in Task 4.
- **Condition Assessment** – A condition assessment, on a scale of 1 to 5 will be assigned to each feature inspected based on criteria established between the City of Knoxville and CDM Smith. Condition assessment will be completed visually. No confined entry will be completed.
- **Photos** – A photo will be collected for each feature inspected/mapped in the field.

Field Data Collection Environment

- ArcGIS Online or Portal
- CDM Smith or KGIS Environment
- Trimble R12 (“Inches” Accuracy)
- Real-Time Collection in AGOL
- Dashboards to Track Progress
- Execution & Quality Control Per Drainage Basin



Database Schema for Data Collection and Storage

- Updated KGIS schema
 - More aligned with ESRI Standard Utility Network
 - Spreadsheet with the new schema - feature classes and attribute fields

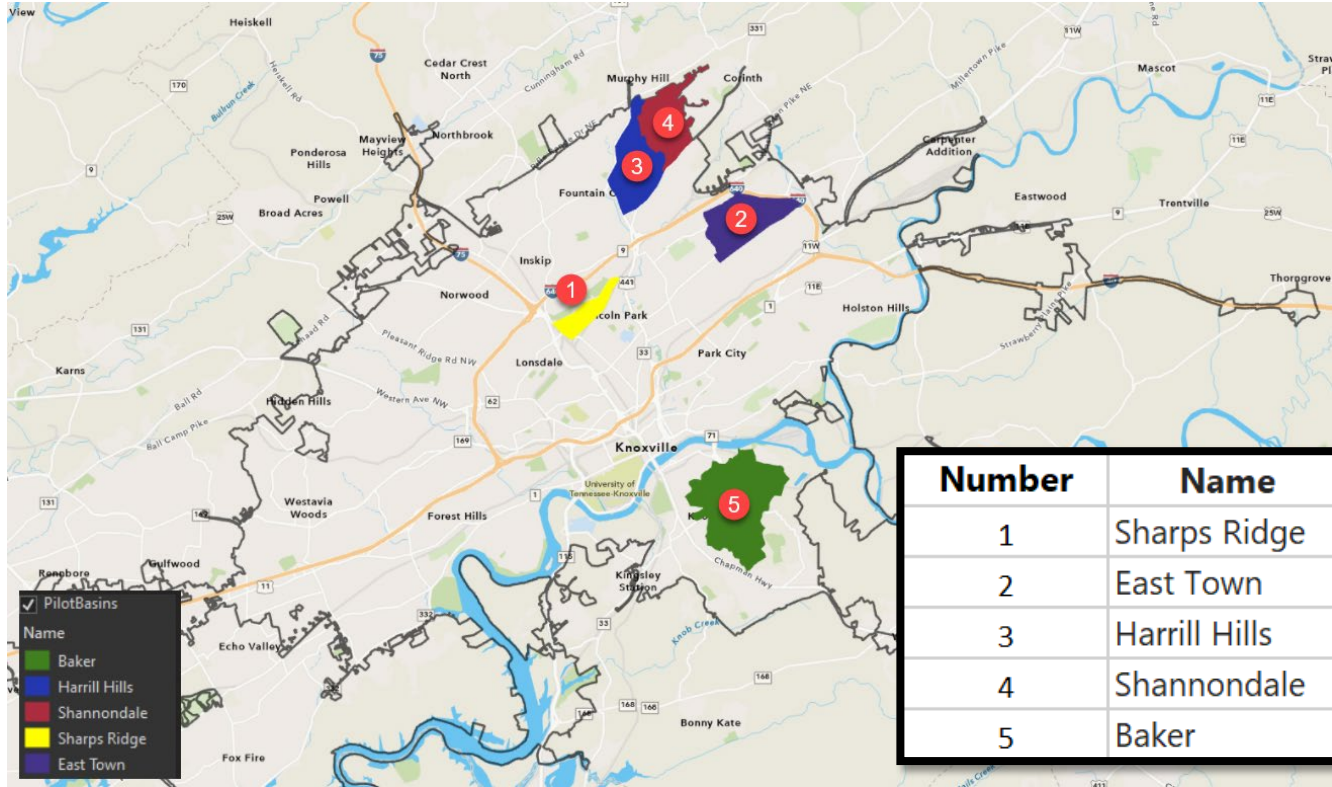
| | A | B | C | D | E | F |
|-----|--------------------------------------|------------------------|-------------------|---|--------------------------|--------------------|
| 1 | Name of Hosted Feature Layer: | Survey_Catch_Basins | | Data entry with Field Maps | | |
| 2 | | | | Desktop Entry for completion or QC | | |
| 3 | Asset Group: | Catch Basin | | Autopopulated Data | | |
| 4 | Asset Type: | Standard or Drop-Inlet | | GNSS data | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | Alias (Field Name) | Example Values | Domain Y N | Code - Description | Scope Requirement | Data Source |
| 88 | Source | | Y | Survey GIS | N | Desktop Entry |
| 89 | | | | Survey Conventional | N | Desktop Entry |
| 90 | | | | Assumed | N | Desktop Entry |
| 91 | | | | TDOT Reference | N | Desktop Entry |
| 92 | | | | City Reference | N | Desktop Entry |
| 93 | | | | County Reference | N | Desktop Entry |
| 94 | | | | DEM | N | Desktop Entry |
| 95 | | | N | Aerial Imagery / Street View | N | Desktop Entry |
| 96 | CreationDate | 2023-01-03 14:58 | N | | N | Autopopulate |
| 97 | Creator | gerrit.dolislager | N | | N | Autopopulate |
| 98 | EditDate | 2023-01-03 15:00 | N | | N | Autopopulate |
| 99 | Editor | gerrit.dolislager | N | | N | Autopopulate |
| 100 | CreationDate | | N | | N | GNSS |
| 101 | Creator | | N | | N | GNSS |
| 102 | EditDate | | N | | N | GNSS |
| 103 | Editor | | N | | N | GNSS |
| 104 | Position source type | 3 | Y | 0 - Unknown | N | GNSS |
| 105 | | | | 1 - User defined | | |
| 106 | | | | 2 - Integrated (SystemP Location Provider | | |
| 107 | | | | 3 - External GNSS Receiver | | |
| 108 | | | | 4 - Network Location Provider | | |
| 109 | Receiver Name | R12 6226F00278 Trimble | N | | N | GNSS |
| 110 | Latitude | 35.97419261 | N | | Y | GNSS |
| 111 | Longitude | -83.92161452 | N | | Y | GNSS |
| 112 | Average Horizontal Accuracy (m) | | N | | N | GNSS |
| 113 | Average Vertical Accuracy (m) | | N | | N | GNSS |
| 114 | Averaged Positions | | N | | N | GNSS |
| 115 | Horizontal Accuracy (m) | 0.020966125 | N | | N | GNSS |
| 116 | Vertical Accuracy (m) | 0.022565398 | N | | N | GNSS |
| 117 | Number of Satellites | 12 | N | | N | GNSS |
| 118 | Altitude | 255.8559097 | N | | N | GNSS |

Baseline Condition Assessment


- 1. New Condition** – Brand New Condition
- 2. Good Condition** – New Condition with Some Minor Signs of Aging
- 3. Fair Condition** – Older Condition But Still Functioning Properly
- 4. Poor Condition** – Failing Condition where Condition Affects the Function of the Asset
- 5. Failing Condition** – Significant Structural Issues that Affect the Function of the Asset




Choosing a Pilot Area to Test Data Model



Notification to the Public Re: Survey Teams








CITY OF KNOXVILLE


Stormwater Asset Management Program

working to serve our City!



**For more info:
Call 311 or scan the code at left.**





Select Language / Print

[Services](#) [Residents](#) [Business](#) [Visitors](#) [Government](#)

Search For Anything

City of Knoxville » Government » City Departments & Offices » Engineering » **Stormwater Engineering Division**

| | | | |
|---|--|---|---|
| <p>Stormwater Engineering Division</p> | <p>Brochures and Links Floodplains Monitoring Stations NPDES Program Rainfall Data</p> | <p>Request for Service (Stormwater Drainage) Sanitary Sewer Overflows (SSOs) Stormwater and Street Ordinance Total Maximum Daily Loads (TMDLs) KGIS Mapping</p> | <p>Engineering Director Thomas V. Clabo, P.E. tclabo@knoxvilletn.gov (865) 215-2148 400 Main St., Suite 475 P.O. Box 1631 Knoxville, TN 37901</p> |
|---|--|---|---|

STORMWATER SURVEY CREWS

The City of Knoxville Engineering Department is conducting an assessment of stormwater infrastructure. Survey crews are working throughout the city, locating and collecting information on the City's stormwater assets, including culverts, manholes, catch basins and drain pipes. Surveyors may need to cross properties to get to a structure that is not located in or next to the street.

The information collected will be used to update the City's existing maps and plans and help City engineers identify and correct system deficiencies. Additionally, the program will help the City with regulatory compliance, routine maintenance, and planning for the future.

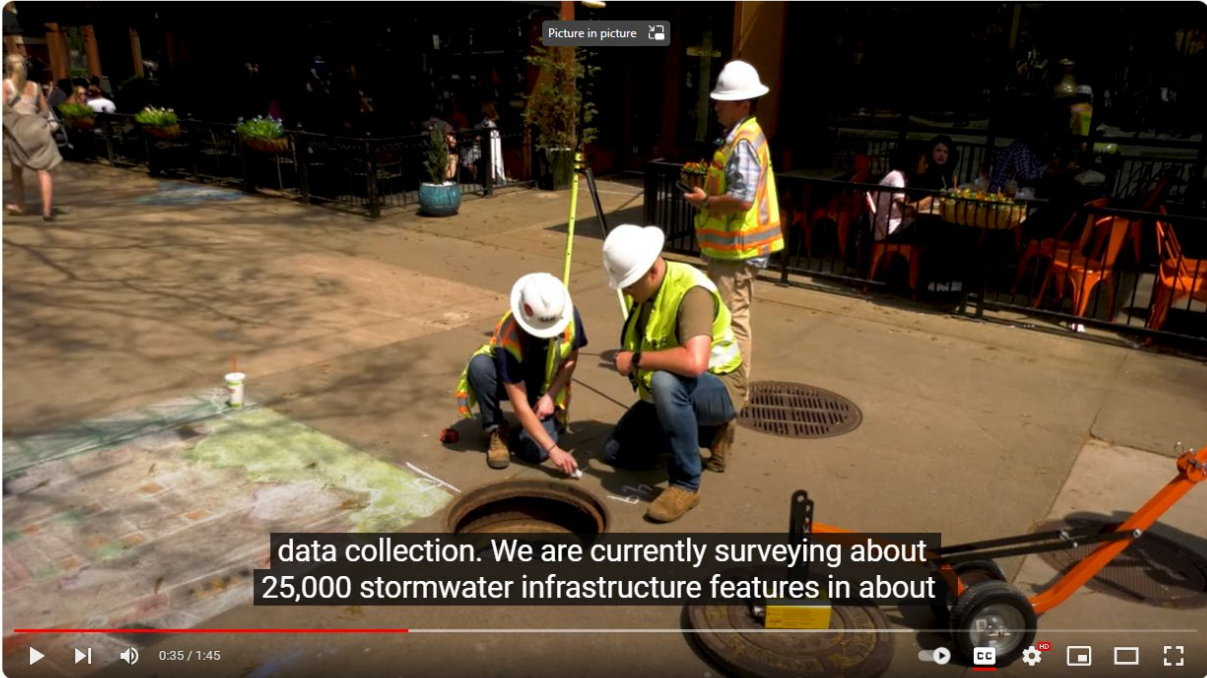
David B. McGinley, P.E.
Stormwater Chief
dmcginley@knoxvilletn.gov
865-215-2148 or 311

For direct requests for City Service:
Call 311 or (865) 215-4311 or send email to
311Office@KnoxvilleTN.gov.

Additional Public Outreach Strategies to Consider

YouTube

Search



Picture in picture

data collection. We are currently surveying about 25,000 stormwater infrastructure features in about

0:35 / 1:45

City of Knoxville Stormwater Engineering Asset Management Program

cityofknox
394 subscribers

Subscribe

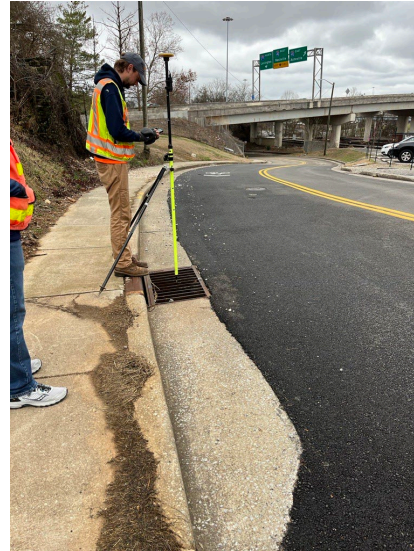
3

Share

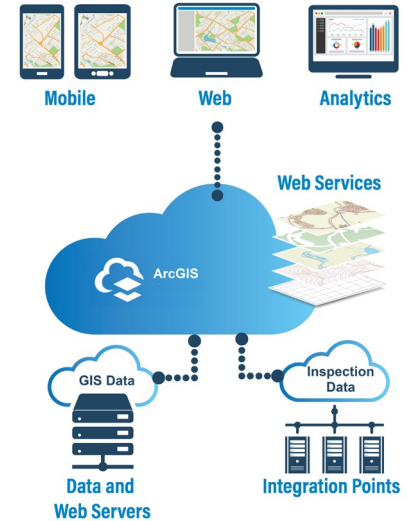
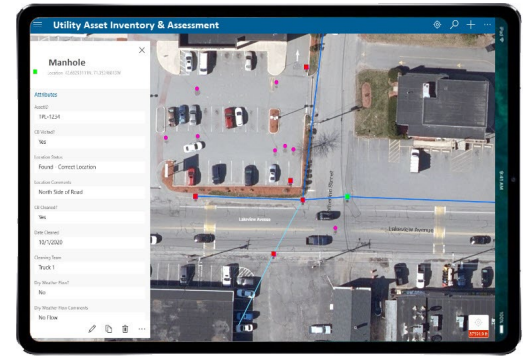
Save

Stormwater Inventory Approach

- Develop field tools
- Leverage existing City GIS layers
- Integrate into Cloud services
- Accommodate QA/QC process
- Maintain visibility on progress with City staff



Configure Field Tools
High-Accuracy GPS
Mobile Devices
Imagery, LiDAR, Cameras



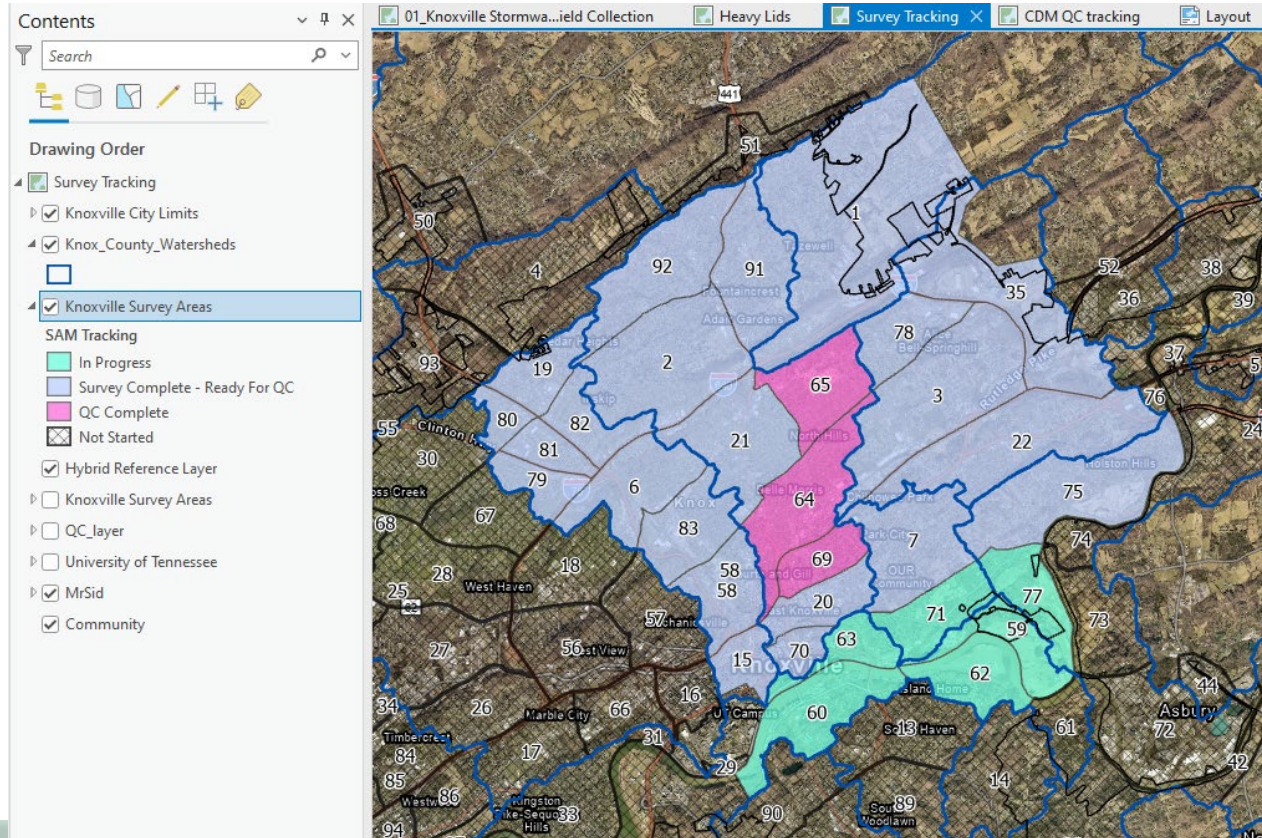
Develop Tools for Data Capture and Editing

- Desktop – ArcGIS Online
- Field – FieldMaps
- All hosted in the Cloud
- Allow for Editing in the Field or the Office



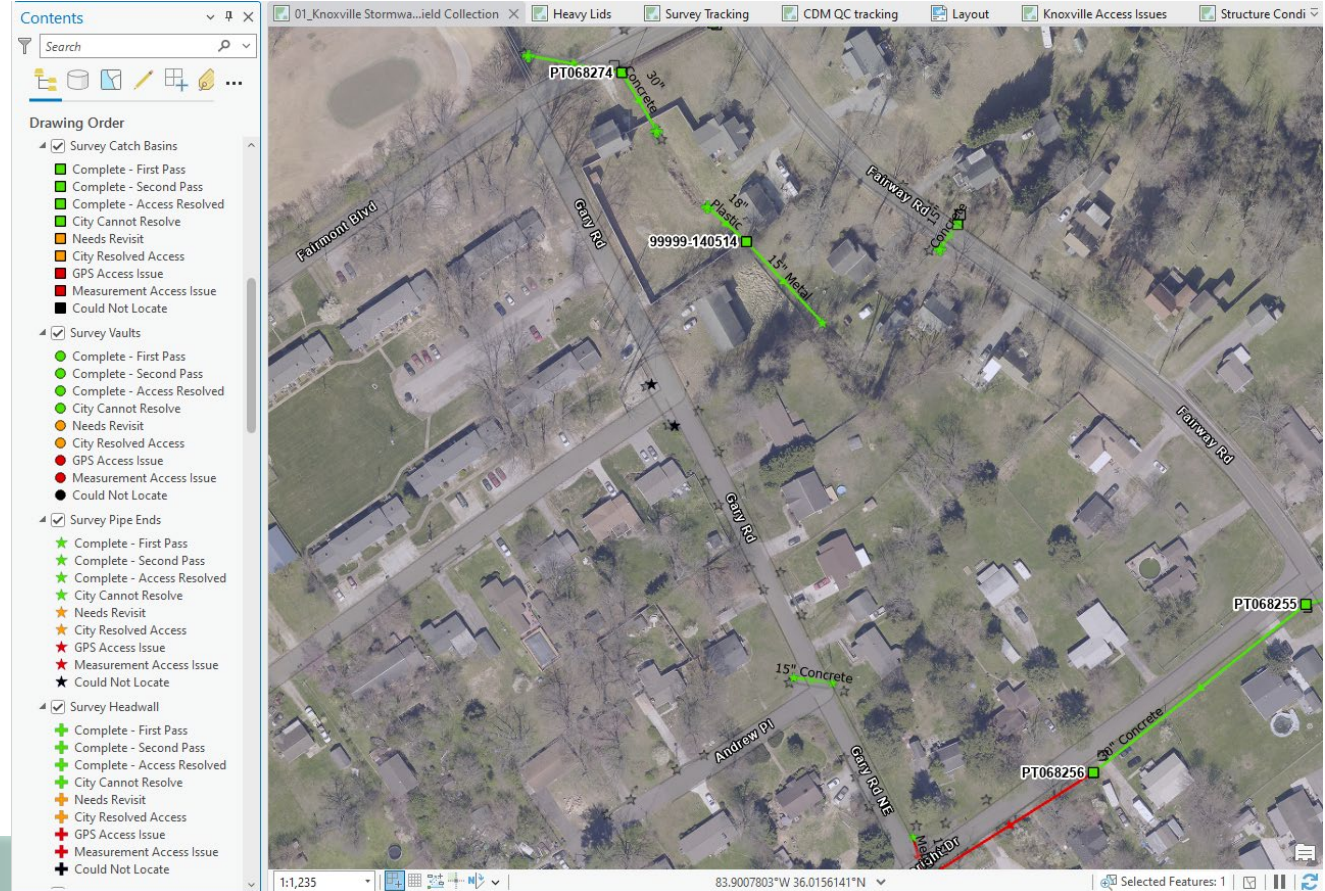
City Subdivided into “Survey Areas”

- Easier to manage survey crews
- Coordination with City
- Public notifications
- Organize QC



Establishing a Complete Network

- Desktop exercise
- Ditch/Channel Connectivity
- Digitizing with available GIS information
- Identifying easily attainable information



Drawing Order

- Knoxville City Limits
- dem_first
- dem_fourth
- Value
- dem_goose
- dem_knob
- dem_third
- dem_wc
- dem_1_2_south
- dem_love
- dem_wc
- MrSid
- 24802E5785N.sid
- 25145E6102N.sid
- 25330E6102N.sid
- 25356E6418N.sid
- 25382E5785N.sid
- 25699E6788N.sid
- 25805E6102N.sid
- 25805E6418N.sid
- 25884E6788N.sid
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- 26280E6102N.sid
- 26280E6418N.sid
- 26280E6788N.sid



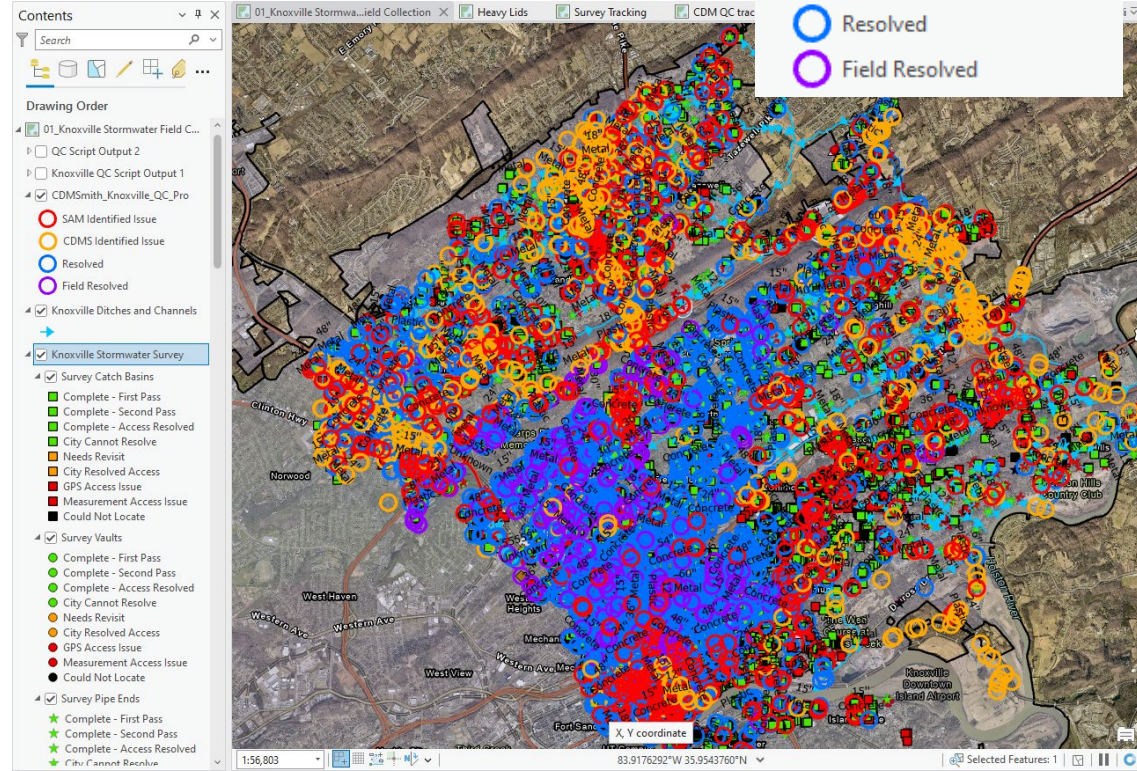
1:976

83.8890281°W 36.0243355°N

Selected Features: 0

Quality Control – CDM Smith and SAM

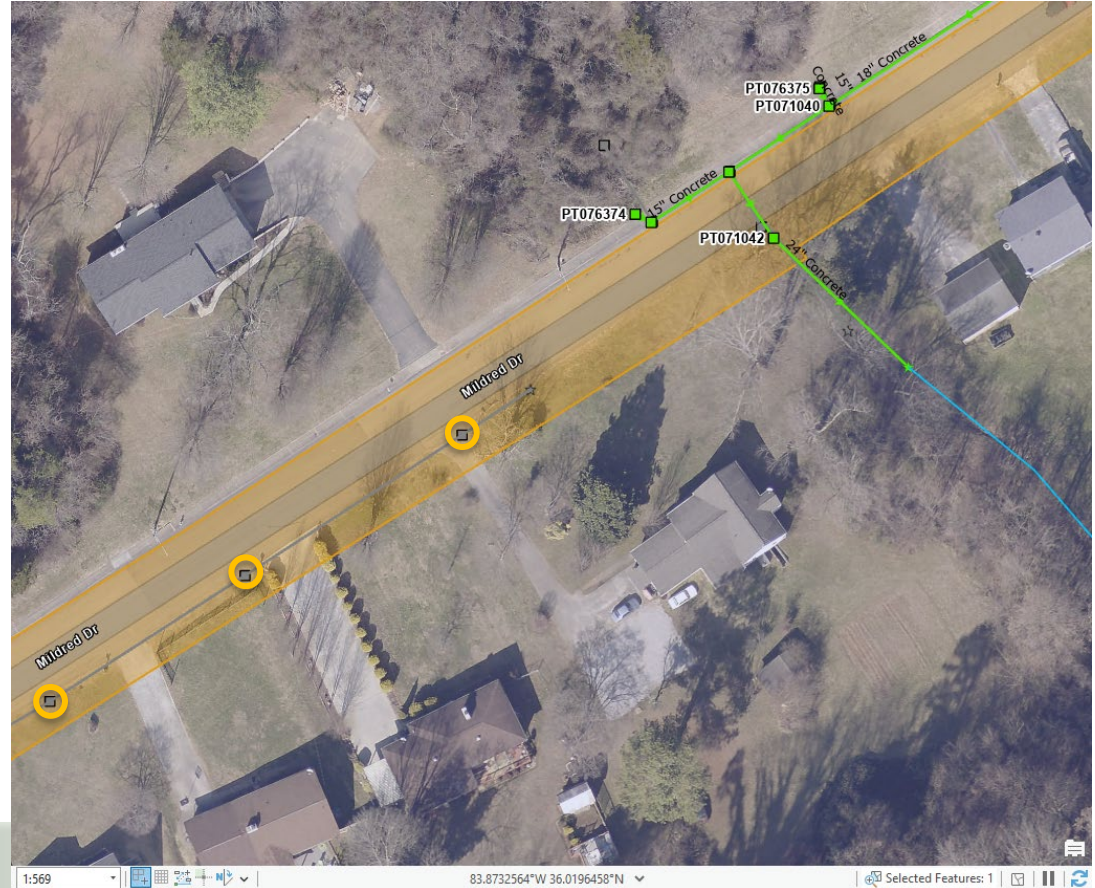
- CDM Smith staff review each flow path
- Check that the information on the photos matches the database
- Use Google Street view for verification
- SAM has their own QC process



Quality Control – CDM Smith and SAM

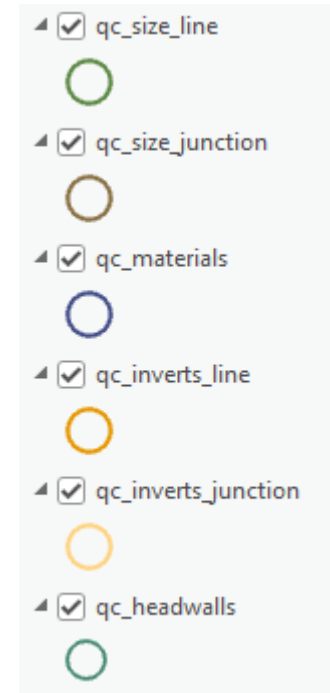
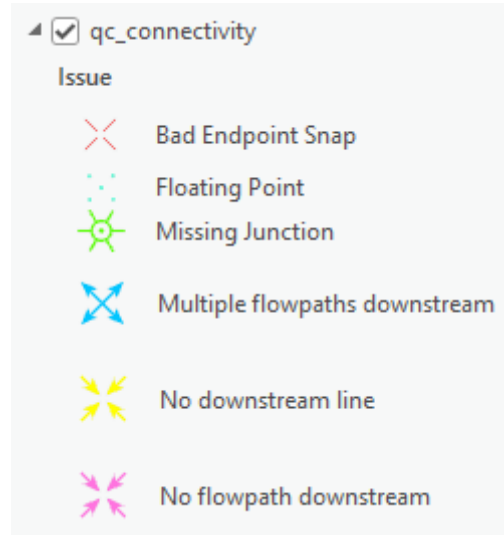
- CDMSmith_Knoxville_QC_Pro
- SAM Identified Issue
- CDMS Identified Issue
- Resolved
- Field Resolved

| Attributes | Geometry | Attachments (0) |
|--------------------|--|-----------------|
| CreationDate | 4/4/2024 7:54:38.378 PM | |
| Creator | feldmanhr_CDMSmith | |
| EditDate | 4/4/2024 7:55:02.772 PM | |
| Editor | feldmanhr_CDMSmith | |
| OBJECTID | 6280 | |
| GlobalID | {91184AFF-093D-41F4-B2B2-56F9C2A48491} | |
| Status | CDMS Identified Issue | |
| Issue Description | CB needs to be surveyed | |
| Issue Type | Missing Survey / Compared to GIS-DEM | |
| Resolution Comment | <Null> | |
| Feature Layer | Catch Basins | |
| CreationDate | <Null> | |
| Creator | <Null> | |
| EditDate | <Null> | |
| Editor | <Null> | |



Scripting Uses to Quickly Identify Common Issues

- Multiple scripts run by the project teams
 - Identify pipe backflow
 - Tolerance accuracy issues
 - Inconsistent pipe size
 - Inconsistent material types
 - Connectivity
 - Missing pics
 - Tracing to outfalls
 - Status used properly



Coordinating on Structure Access Issues

- Conventional Survey
- Submerged
- Parked Car
- Clogged
- Sediment Bag
- Heavy Lid
- Bolted/Welded
- Heavy Traffic
- Vegetation



Conventional Survey

Legend

Survey Structures

Catch Basins

- Complete - Conventional Survey
- Required - Conventional Survey

Vaults

- Complete - Conventional Survey
- Required - Conventional Survey

Pipe Ends

- ★ Complete - Conventional Survey
- ★ Required - Conventional Survey

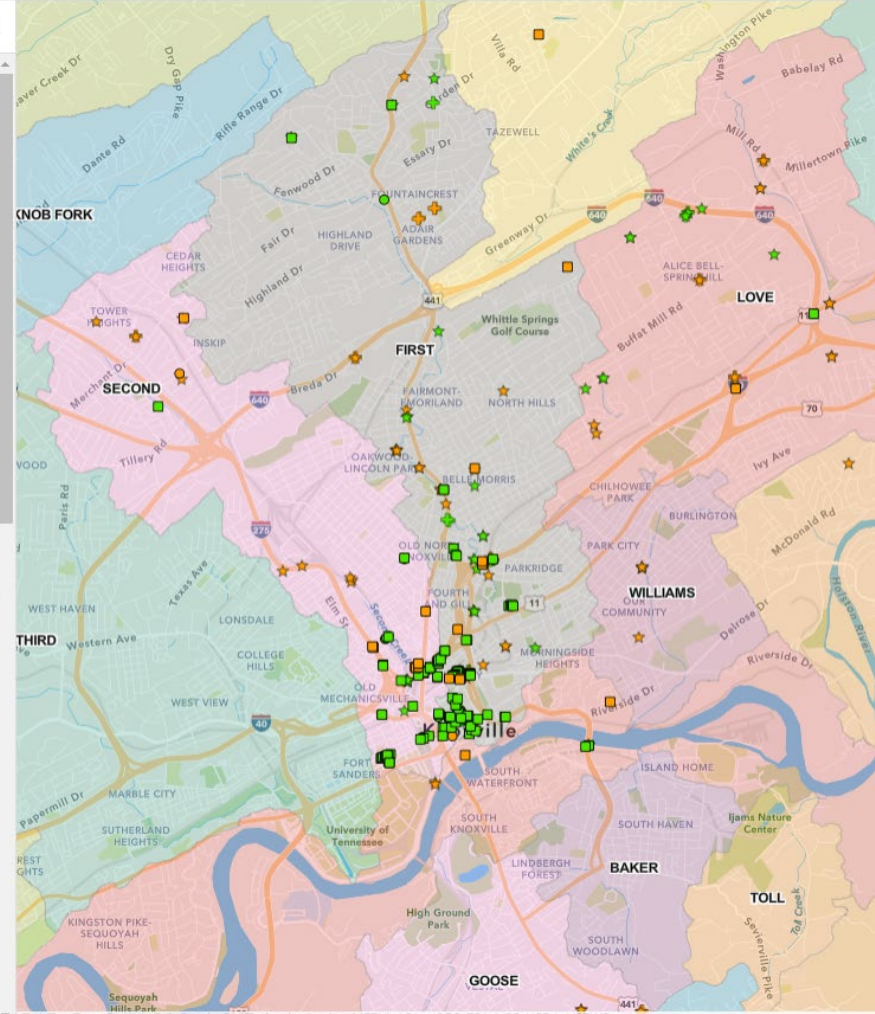
Headwalls

- ✦ Complete - Conventional Survey
- ✦ Required - Conventional Survey

Knoxville Base

Watersheds

- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11



Traffic Control

☰ Knoxville Heavy Traffic

- ⊕ Add
- ☰ Layers
- 📄 Tables
- 🗺️ Basemap
- 📊 Charts
- ☰ Legend
- 🔖 Bookmarks
- 📁 Save and open
- ⚙️ Map properties
- 📄 Share map
- 📄 Create app
- 🖨️ Print

Legend

Survey Structures

Catch Basins

- Measurement Access Issue
- GPS Access Issue
- City Cannot Resolve
- City Resolved Access

Vaults

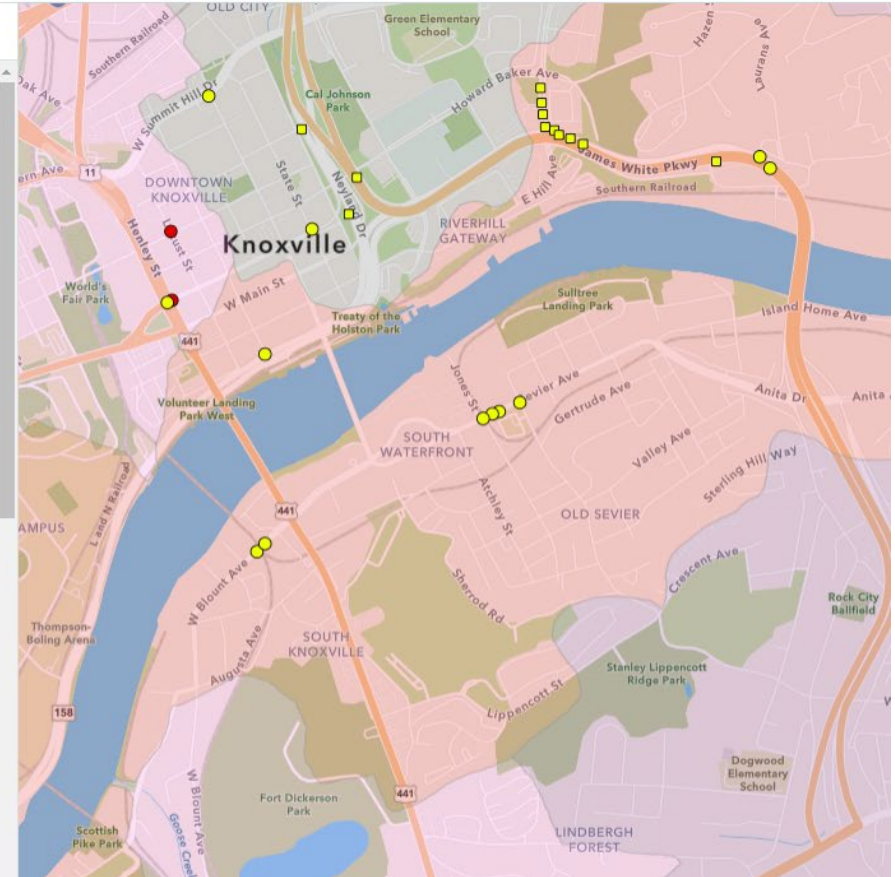
- Measurement Access Issue
- GPS Access Issue
- City Cannot Resolve
- City Resolved Access

Headwalls

- ✚ Measurement Access Issue
- ✚ GPS Access Issue
- ✚ City Cannot Resolve
- ✚ City Resolved Access

Pipe Ends

- ★ Measurement Access Issue
- ★ GPS Access Issue
- ★ City Cannot Resolve
- ★ City Resolved Access



Heavy Lids

- +
- Add
- Layers
- Tables
- Basemap
- Charts
- Legend
- Bookmarks
- Save and open
- Map properties
- Share map
- Create app
- Print
- Information
- << Collapse

Legend

Survey Structures

Catch Basins

- Measurement Access Issue
- GPS Access Issue
- City Cannot Resolve
- City Resolved Access

Vaults

- Measurement Access Issue
- GPS Access Issue
- City Cannot Resolve
- City Resolved Access

Knoxville Base

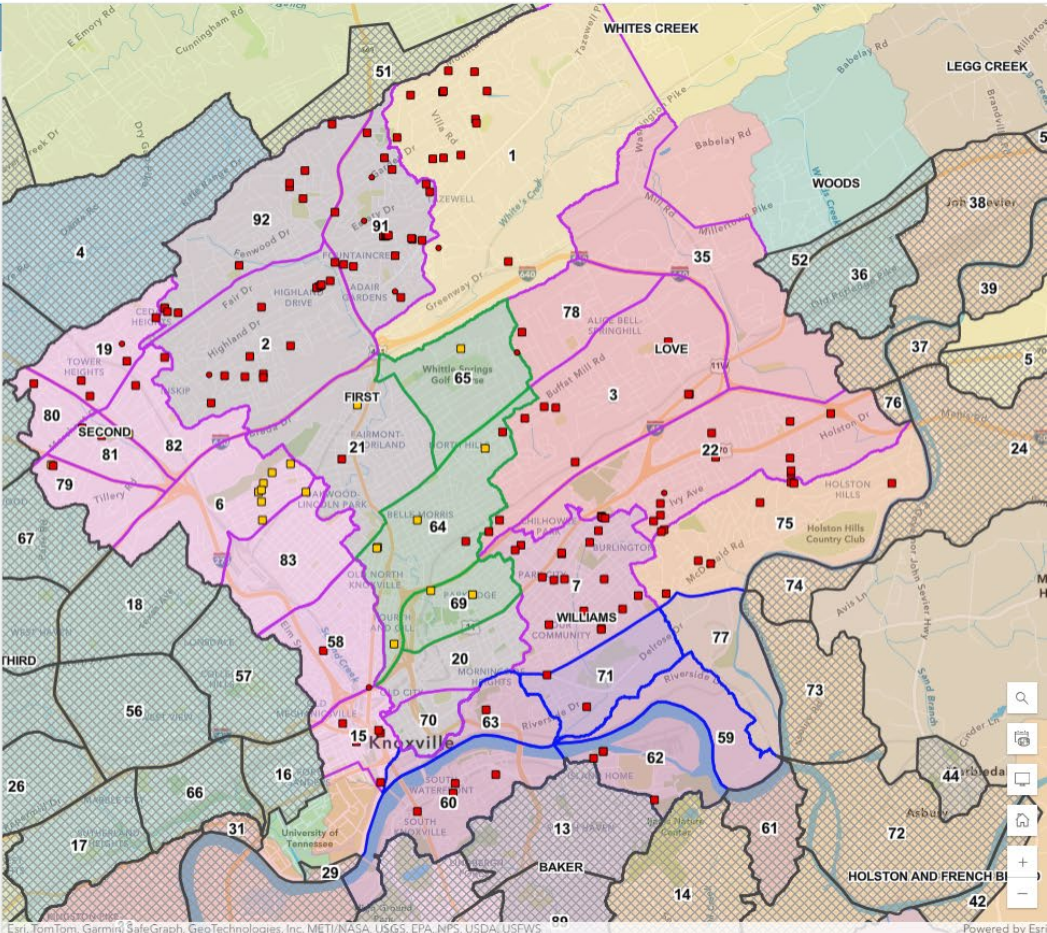
- ▭ In Progress
- ▭ Survey Complete - Ready For QC
- ▭ QC Complete
- ▭ Not Started

SAM Survey Areas

- ▭ In Progress
- ▭ Survey Complete - Ready For QC
- ▭ QC Complete
- ▭ Not Started

Watersheds

- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9



Clogged and Sediment Bags

Layers

Search layers

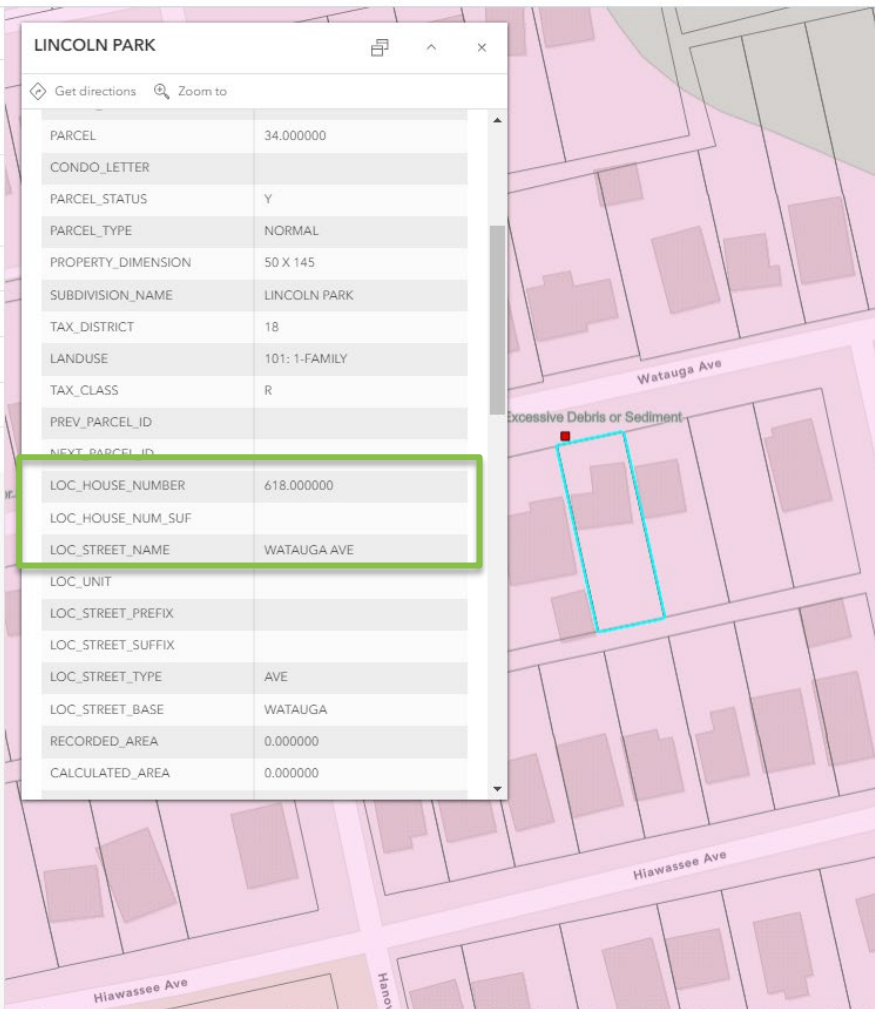
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- ▼ Knoxville Base
 - Knoxville Parcels
 - SAM Survey Areas
 - ROW
 - Watersheds
 - University of Tennessee
 - Knoxville City Limits

Add

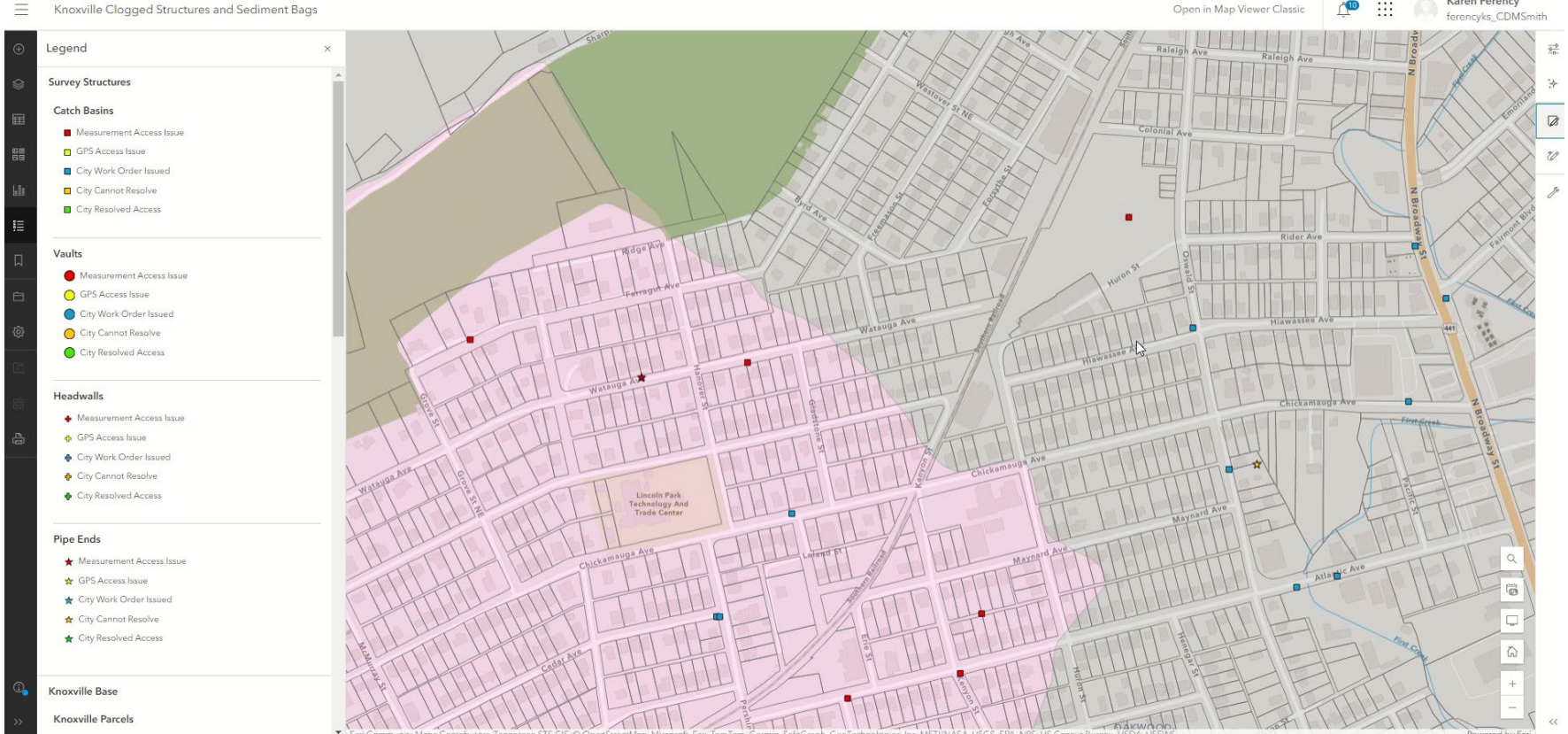
LINCOLN PARK

Get directions Zoom to

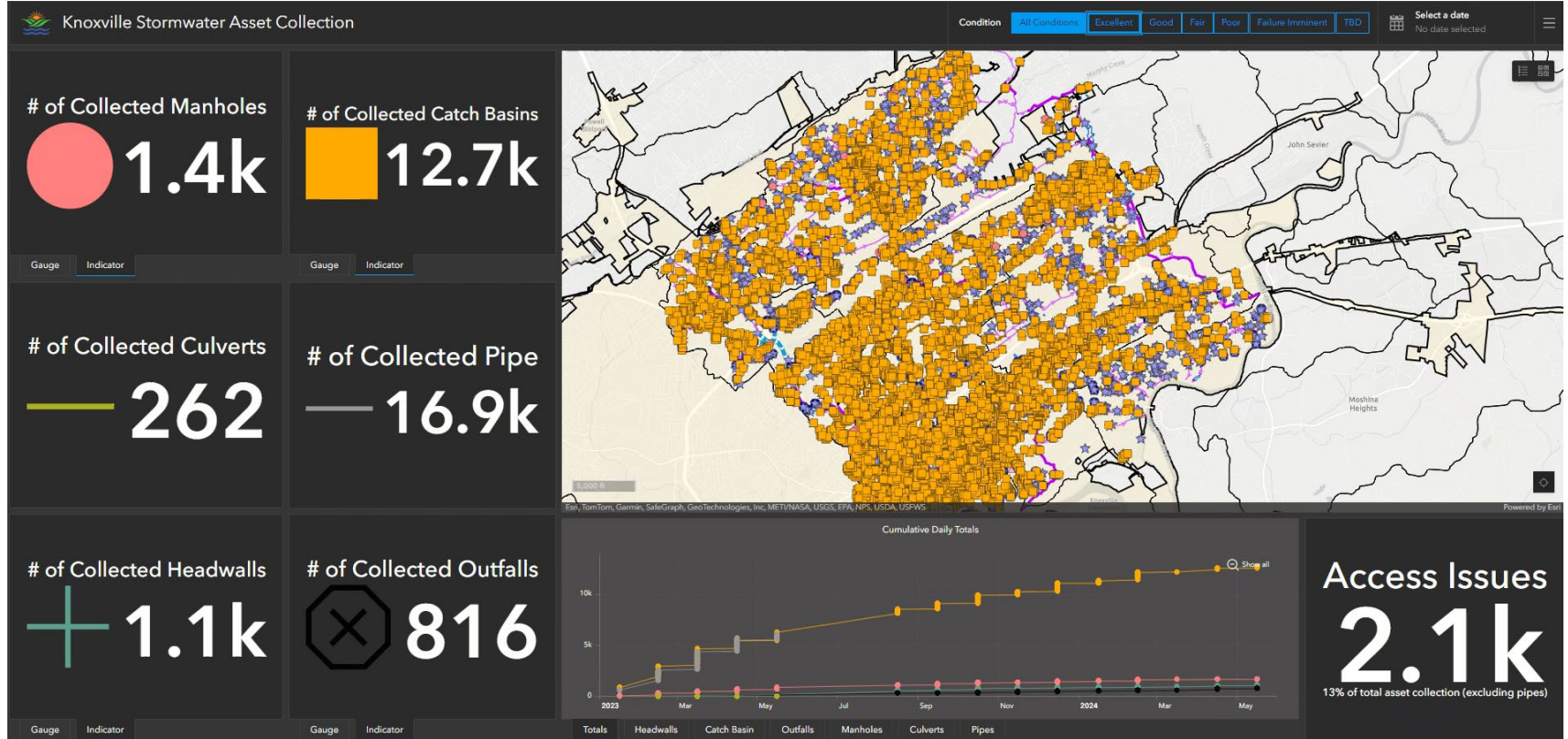
| | |
|--------------------|---------------|
| PARCEL | 34.000000 |
| CONDO_LETTER | |
| PARCEL_STATUS | Y |
| PARCEL_TYPE | NORMAL |
| PROPERTY_DIMENSION | 50 X 145 |
| SUBDIVISION_NAME | LINCOLN PARK |
| TAX_DISTRICT | 18 |
| LANDUSE | 101: 1-FAMILY |
| TAX_CLASS | R |
| PREV_PARCEL_ID | |
| NEXT_PARCEL_ID | |
| LOC_HOUSE_NUMBER | 618.000000 |
| LOC_HOUSE_NUM_SUF | |
| LOC_STREET_NAME | WATAUGA AVE |
| LOC_UNIT | |
| LOC_STREET_PREFIX | |
| LOC_STREET_SUFFIX | |
| LOC_STREET_TYPE | AVE |
| LOC_STREET_BASE | WATAUGA |
| RECORDED_AREA | 0.000000 |
| CALCULATED_AREA | 0.000000 |



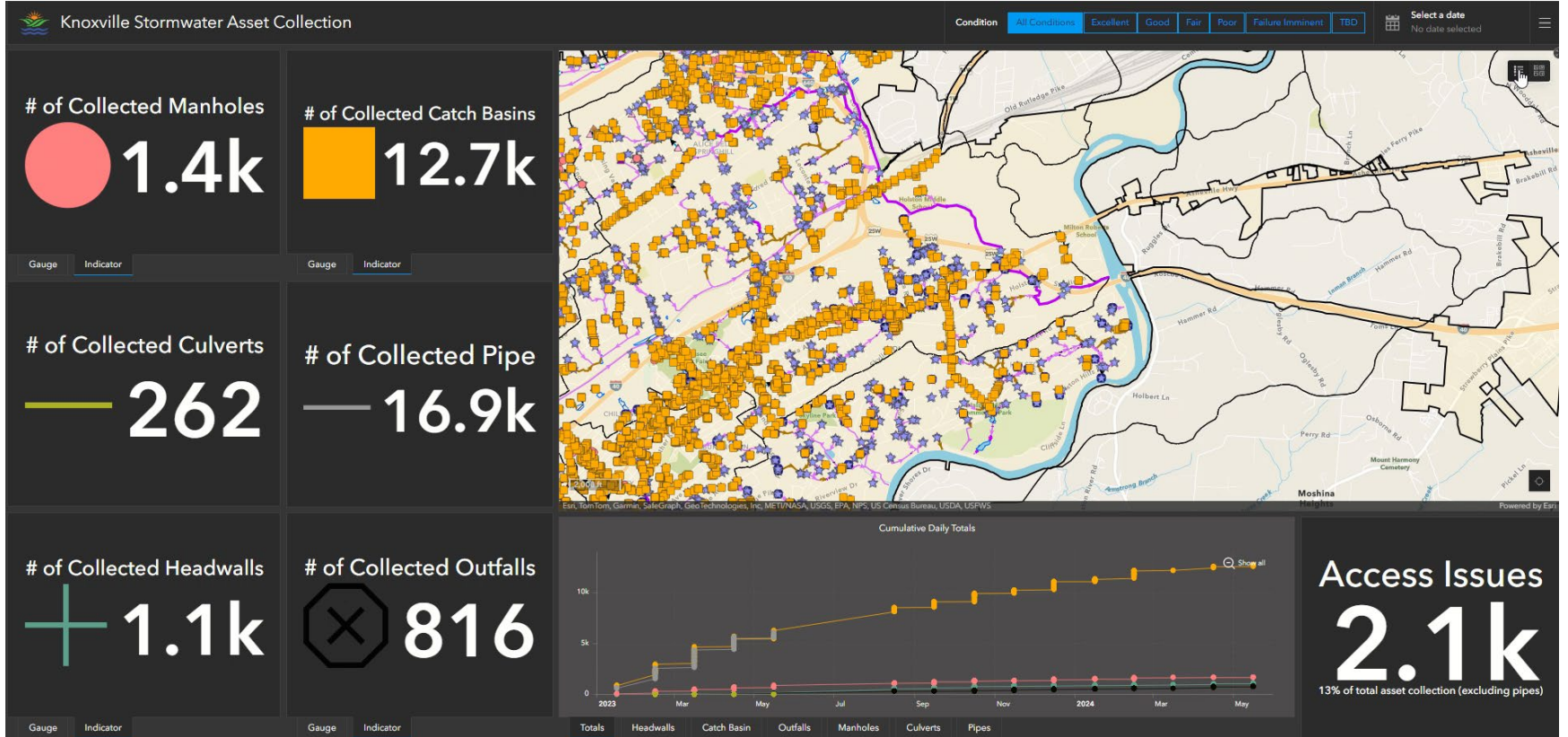
Clogged and Sediment Bags



Progress Dashboard

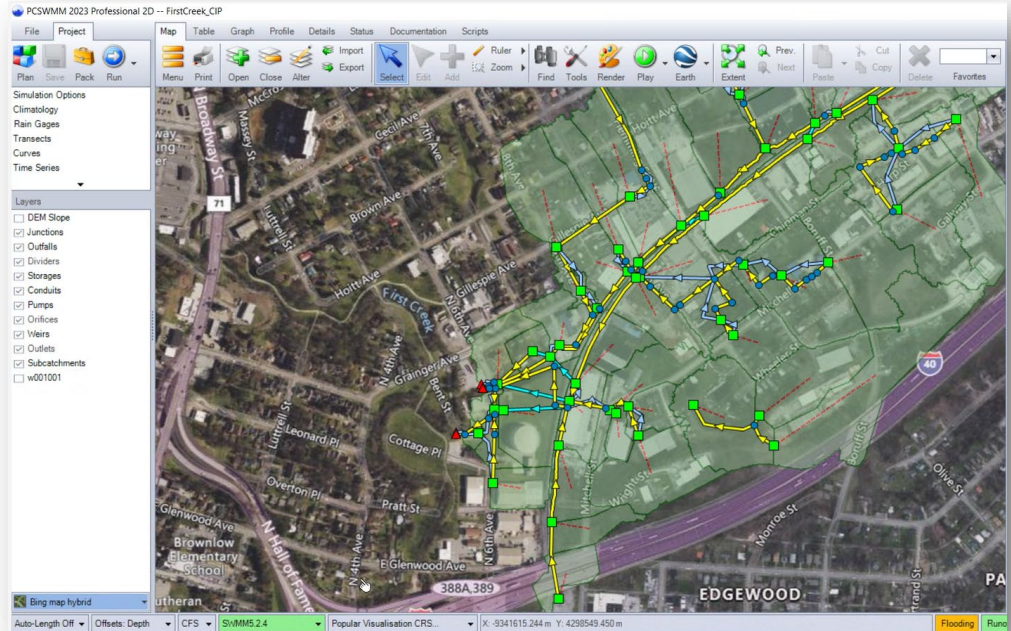


Progress Dashboard



Leveraging Data to Advance SW Program

- Building Flood Models Using GIS Data to Assess Areas of Frequent Flooding (5 locations)
- Developing a Pro-Active Maintenance Plan
 - Inspection Frequency
 - Call Response
 - Preventative vs Reactive Maintenance
 - Metrics and/or KPIs



Summary Thoughts

- Data is Playing a Larger Role in Stormwater Management & an Accurate Asset Inventory is Critical
- Develop An Achievable Plan to Begin Your Asset Management Journey
- Work Closely with Your Field Teams to Establish Expectations
- Use Data to Advance Your Program



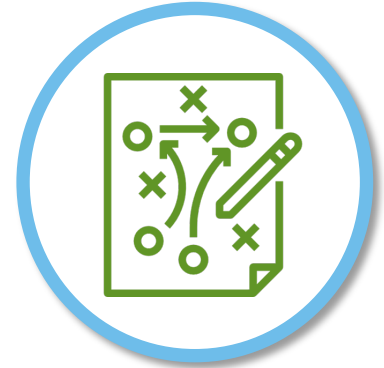
Discussion



Plan



Develop



Implement

■ **Contacts:**

- Randall Whitehead; rwhitehead@knoxvilletn.gov; 865-215-4137
 - Dave Mason; masond@cdmsmith.com; 615-340-6516
 - Karen Ferency; ferencyks@cdmsmith.com; 865-963-4314

